PREPARED BY GDS ASSOCIATES, INC.

STATE OF RHODE ISLAND
ENERGY EFFICIENCY & RESOURCE MANAGEMENT COUNCIL

# EERMC

## THE RHODE ISLAND ENERGY EFFICIENCY AND RESOURCES MANAGEMENT COUNCIL

## TECHNICAL PROPOSAL

*RFP Number EERMC-2020-03*

## *Policy & Program Planning Consultant Services*

**October 28, 2020**

GDS Associates, Inc.
ENGINEERS & CONSULTANTS

Johnson
CONSULTING GROUP

Demand Side Analytics

GDS Associates, Inc.
ENGINEERS & CONSULTANTS

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October 28, 2020

Ms. Becca Trietch
Rhode Island Office of Energy Resources
One Capitol Hill 4th Floor
Providence, Rhode Island 02908

**RE: *EERMC-2020-03 Policy & Program Planning Consultant Services – Technical Proposal***

Dear Ms. Trietch:

GDS Associates, Inc. ("GDS") in partnership with Demand Side Analytics and Johnson Consulting Group (herein referred to as the "GDS Team") is pleased to submit the enclosed technical proposal to the Rhode Island Energy Efficiency and Resources Management Council ("EERMC") to support the EERMC in its review and oversight of energy efficiency and system reliability programs and initiatives proposed and administered by the electric and gas distribution company.

The GDS Team consultants for this project are senior staff and possess extensive experience conducting primary and secondary research as well as designing, implementing, and evaluating energy efficiency, electric rate, and other types of utility programs. All three firms are experts in stakeholder management, regulatory testimony, and communication of technical issues to audiences of all types. GDS Associates, having worked in Rhode Island since 2005, will serve as the prime contractor and has sub-contracted with industry experts Demand Side Analytics and Rhode Island certified Women-owned business, the Johnson Consulting Group. This team combination will provide the expertise needed in order to provide high value to the EERMC.

I am authorized to make representations on GDS' behalf with EERMC. Rich Hasselman and Josh Duckwall will serve as the points of contact regarding any questions concerning our proposed scope of work or qualifications. Mr. Hasselman can be reached at (608) 354-0192 or via email at rich.hasselman@gdsassociates.com. You may also contact Josh Duckwall at (770) 799-2437 or josh.duckwall@gdsasssociates.com. We are excited about the prospect of working with EERMC and look forward to answering any questions you might have regarding our proposed approach and our team's qualifications and experience.

Sincerely,

Matt Siska
Principal

## TABLE OF CONTENTS

# RFP Cover Sheet

| **Offeror's Name:** | GDS Associates, Inc. |
|---|---|

| **RFP Information** | |
|---|---|
| Title of RFP: | Policy & Program Planning Consultant Services |
| RFP Number: | EERMC-2020-03 |

| **Offeror Information** | |
|---|---|
| Legal Name of Offeror: | GDS Associates, Inc. |
| Type of Entity (i.e. corporation, partnership, sole proprietorship): | C Corporation |
| Mailing Address of Primary Place of Business | 1850 Parkway Place SE Suite 800 Marietta, Georgia 30067 |
| Phone Number: | 770-425-8100 |
| Website: | https://www.gdsassociates.com |

| **Contact Person for the Offeror** | |
|---|---|
| Name: | Rich Hasselman |
| Title: | Managing Director |
| Mailing Address: | 1850 Parkway Place SE Suite 800 Marietta, Georgia 30067 |
| Phone Number: | 608-273-0182 office / 608-354-0192 direct |
| Email Address: | rich.hasselman@gdsassociates.com |

Signature of Authorized Person

October 28, 2020
Date

Matt Siska, Principal
Printed Name, Title

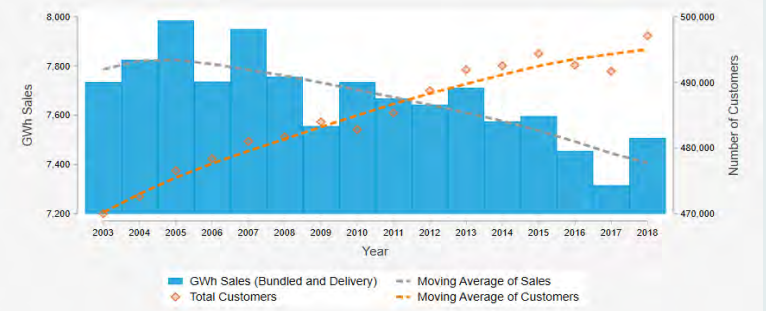
# II Technical Proposal

## II.A **OVERVIEW**

The GDS Team fully understands the complexities and duties of a council like the EERMC. From our experience in both statewide energy efficiency and regional engagements of a similar nature, the skillsets of our consultants are a distinct advantage to the EERMC and its current efforts. One thing that separates the GDS Team is that we have decades of experience in all aspects of energy, from generation design and transmission planning to statewide efficiency consulting, advanced cost effectiveness testing, and expert testimony, all in one shop. We are also very familiar with the utility and regulatory atmosphere in Rhode Island, having held contracts at the state level since 2005. The GDS Team is familiar with Rhode Island's Least Cost Procurement Standards (LCP), LCP core principles, the role of the EERMC, and by extension, the EERMC's consultants.

In 2021, the EERMC faces a new decade, new leadership, and new opportunities to promote energy efficiency across the state. A new EERMC consulting team will bring a fresh perspective to the EERMC as it begins a new chapter. Our team members bring a national perspective informed by the work we complete in other jurisdictions from coast to coast, providing a different vantage point. We will use this background to assist the EERMC in moving forward by identifying new and emerging opportunities in promoting EE throughout the state. Our immediate goal is to build on the success that the Council has already achieved. For example, Figure II-1 highlights the achievements of Rhode Island's conservation efforts since passage of the Comprehensive Energy Conservation, Efficiency, & Affordability Act of 2006. The data comes directly from FERC form 861 and are not weather-normalized or otherwise adjusted. Despite an increasing number of electric accounts, National Grid Rhode Island has shown a downward trajectory in consumption due in part to the collective efforts of the EERMC, OER, National Grid, and other stakeholders.

**FIGURE II-1. NATIONAL GRID (RI) ELECTRIC SALES & CUSTOMERS 2003-2018**




## II.B **WORK PLAN**

This section of the proposal provides a detailed, proposed project work plan and how the GDS Team will provide the required services to meet and exceed all responsibilities defined in the scope of work.

### II.B.1 Responsibility 1. Related to EERMC Oversight

EERMC members play a critical role in setting the course for Rhode Island's energy efficiency programs. Our consultants will work proactively with the EERMC members to ensure they have thorough understanding of the key issues such as: the Least Cost Procurement (LCP) Standards and requirements, EERMC's unique responsibilities, proven and emerging approaches to promote

energy efficient technologies and the key energy policies that will influence Rhode Island's energy future. To ensure that there is a smooth and efficient transition to the GDS Team, we will establish ongoing procedures to support EERMC members and facilitate EERMC oversight:

- Establish efficient, ***two-way communication processes*** to schedule both regular meetings and ad hoc meetings. Using Doodle Polls, for example, will streamline the scheduling process, reduce unnecessary email traffic, and ensure that these meetings are held at a time that works best for all stakeholders.
- ***Prepare member briefings*** on relevant topics including preparing issue-specific reports and summary presentations.
- ***Organize and facilitate the Annual Retreat***, which will provide an opportunity to identify and discuss emerging EE issues.
- ***Establish an EERMC password-protected SharePoint-style site*** which will house all relevant documents, meeting minutes and materials, presentations, and background reports. The password will be provided to each EERMC member and staff.
- ***Manage EERMC website*** maintenance, updates, and monthly meeting materials uploads.
- ***Supervise and coordinate all activities completed by outside consultants*** to conduct task-specific projects, such as the recently completed Potential Study.
- ***Offer workshops for EERMC members*** on a variety of important topics including evaluation, measurement, and verification (EM&V) best practices and LCP Standards. This has been a successful approach we have used in other collaborative settings as it provides a "level playing field" for all council members and ensures everyone has a thorough understanding of these complex issues, for technical and non-technical audiences alike.

The GDS Team routinely incorporates these management tools in all of our stakeholder collaboratives—with positive results. This approach ensures that all EERMC members and interested parties will have access to the specific information they need in a timely manner. Our team members have also managed multiple online meeting platforms that will be utilized for the EERMC meetings including Zoom, GoToMeeting, WebEx, MS Teams, and Adobe Connect. Our utilization of these platforms and all meeting needs are backed by a full-service IT department based out of the GDS headquarters.

The GDS Team will actively participate and provide expertise in EERMC meetings through a combination of in-person representation and virtual attendance by our subject matter experts. At least one senior GDS Team member will attend all in-person meetings with the EERMC, EERMC Executive Council, OER, PUC and Demand Collaborative as requested by the EERMC. Besides preparing meeting materials and presentations, we will provide ongoing support in developing and distributing meeting agendas, preparing meeting minutes, and cataloguing these on our project SharePoint-style site. We will implement the same successful strategy that we use to prepare and organize meeting materials to ensure productive outcomes. We anticipate attending at least 50 in-person meeting days annually, or an average of four (4) days per month, subject to COVID operating procedures. ***Senior staff, including Dr. Johnson, will attend these meetings in-person***, accompanied by additional support staff from the GDS Team as needed. Other GDS subject matter experts will participate in these meetings either in-person or "virtually" as appropriate. With the close proximity of the GDS office in Manchester, New Hampshire office and minimal travel cost for

other team members, we can assure the EERMC that we will have a substantial in-person presence for scheduled and impromptu meetings. The GDS Team's experience in organizing and facilitating stakeholder meetings and collaborative discussions is a distinguishing characteristic of the Team, an example being Dr. Johnson's mention in SEEA's Action Report[1].

As directed by the EERMC, the GDS Team will develop, review, and summarize the critical findings that will inform energy planning and implementation, system reliability standards, and progress towards achieving energy efficiency savings targets relative to program budgets and in alignment with LCP Standards. The GDS Team members already prepare annual EM&V reports summarizing program achievement relative to goals in several jurisdictions. We will leverage our experiences in other collaborative settings to refine financing program offerings, expand programs to low-income or vulnerable populations and assess the effectiveness of utility performance incentives.

The GDS Team will leverage its deep bench of senior-level technical expertise and experience to develop actionable recommendations for stakeholders on variety of EE topics. We will provide the following types of reports or analyses, as directed by EERMC's priorities:

- Policy summaries of past of potential legislative or PUC directives, including describing the impacts regarding EE and system reliability.
- White paper analyses of emerging technologies and impacts; and
- Technical analyses and inputs to ensure utility plans conform to the LCP standards.

Johnson Consulting Group will establish a local office in Warwick, Rhode Island for all GDS Team members to utilize for this effort. This space, which also can host conference meetings for up to 20 members, will be available as needed for EERMC use. This facility will also serve as a central and ideal location for any "impromptu" meetings that may require extended discussions on urgent topics. Dr. Johnson will also use this office for any pre- or post-EERMC meeting activities that may be required. Dr. Johnson has committed to spending at least two days per month in Rhode Island, to ensure she has ready access to the materials required to facilitate the monthly meetings, monitor the website updates, and also provide opportunities to meet with EERMC members, National Grid staff, and other stakeholders, as needed. Since Johnson Consulting Group has recently been engaged to assist in implementing and evaluating Block Island Utility District (BIUD)'s new energy efficiency rebate program, maintaining a local Rhode Island office will benefit both organizations.

### II.B.2 Responsibility 2. Related to Development of Work Products & Representations of the EERMC

Our Team will provide the EERMC with the essential work products needed for each relevant PUC docket. GDS Team member Dr. Katherine Johnson, who provides ongoing support for several

[1] SEEA Action Energy Efficiency Collaboratives- Driving Ratepayer-Funded Efficiency through Regulatory Polices Working Groups, September 2015; attachment in the February 16, 2018 EESE Meeting Minutes.

commissions regarding the development and implementation annual electric and natural gas efficiency programs, will provide key direction for this task. Dr. Johnson is highly skilled in this area, and currently prepares annual testimony summarizing the findings and recommendations from the seven EM&V reports prepared for the electric and natural gas utilities in Arkansas. She also provides recommendations on strategies to improve program reporting, delivery, and energy effectiveness in these filings. Other GDS Team members will bring experience born from advising commission staff or utilities in multiple states throughout the country, including Rhode Island.

The GDS Team is actively engaged with ISO-New England's Forward Capacity Market (FCM) and understands the importance this market and RGGI play in funding Rhode Island's EE programs – approximately 20% of EE funds come from these sources. Additionally, EE puts downward pressure on energy prices by reducing demand (i.e. DRIPE benefits). GDS Team members have completed the required M&V compliance reviews in Maine, New Hampshire, and Massachusetts and provided consulting services to several PJM utilities on FCM bidding strategy. There are currently several changes under consideration at ISO-NE about EE participation in FCM with non-trivial implications for this important revenue stream. Our team has the applied experience and understanding of market operations to inform and support the EERMC's position in these technical discussions.

As part of our ongoing and proactive approach, we will work with the EERMC to prepare the required annual reports for the General Assembly. Given the April deadline, preparing the materials for this report will be one of our highest priorities during the first quarter of each year.

Our team members are already actively engaged with many stakeholder forums, either as contributors, authors or participants. For example, GDS is currently working on a three year plan as part of the EERS committee in New Hampshire, and is active in multiple Massachusetts technical working groups focused on utility program implementation and evaluation. We will leverage these contacts and provide ongoing representation at a variety of stakeholder forums including:

- Codes and Standards Initiatives (LEED, ASHRAE, Green Buildings)
- Alliance for Healthy Homes and Green and Healthy Homes Initiative
- Power Sector Transformation Initiative
- Forums sponsored by industry partnerships such as NEEP (i.e. EM&V Forum, CEE forums)
- Participation and attendance in weatherization-specific conferences and organizations such as the Home Performance Coalition
- Identification of new and emerging organizations that are seeking input to ensure energy efficiency programs address social justice issues, like energy inequity

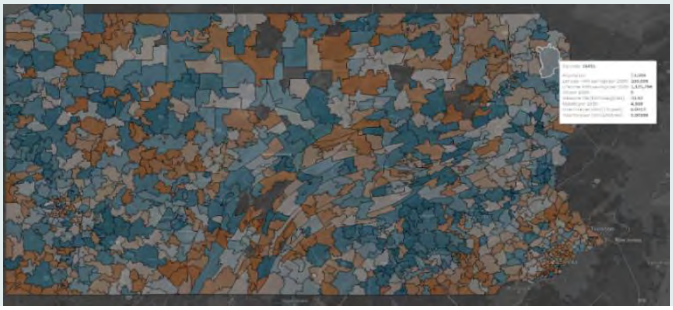
The GDS Team will coordinate and manage monthly strategy meetings with National Grid staff concerning its residential, C&I, and EM&V issues. Our team will be led by subject matter experts and will include close monitoring of program activities and results. We will provide monthly updates of National Grid's progress and immediately share with the EERMC any areas that are underperforming. We will also engage with other key stakeholders involved in National Grid's programs, inviting members from OER, consultant staff and other subject-matter experts to participate in these meetings as appropriate. We will provide quarterly written reports to the EERMC and include regular updates in EERMC meetings.

As a way to ensure that the diverse activities are properly identified and tracked throughout the year, our team will develop a strawman schedule of deliverables, activities, and events in late January 2021.

### II.B.3 Responsibility 3. Related to Energy Efficiency & System Reliability Program Design and Delivery

The GDS Team understands the importance of its support for the EERMC to ensure utility-administered energy efficiency and system reliability programs exhibit transparency, service excellence that maximizes energy efficiency benefits, are in alignment with other Rhode Island clean energy programs, and follow the LCP Standard. The GDS Team will provide oversight services related to program design and delivery in coordination with other EERMC support task areas. The GDS Team will leverage its expertise across the full program lifecycle (potential, planning and design, implementation, and evaluation) and maintain a constant presence to drive optimized program outcomes for Rhode Island ratepayers in alignment with Rhode Island's policies and other programs.

**FIGURE II-2. PENNSYLVANIA EE DASHBOARD – ZIP CODE METRICS**

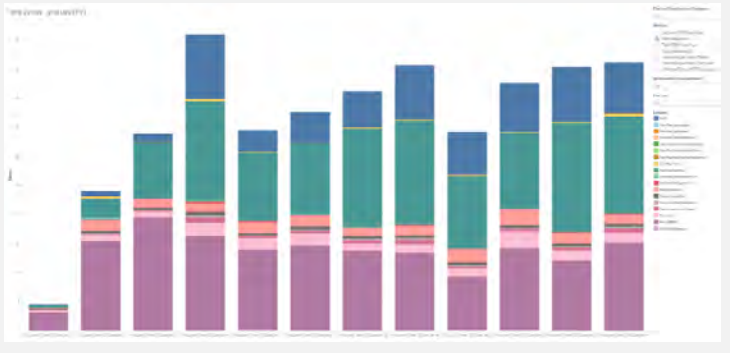


To do so, the GDS Team will engage with the EERMC, National Grid, and other Rhode Island programs. The GDS Team will utilize standing EERMC meetings and ad hoc discussions to ensure that the EERMC's priorities are incorporated into the GDS Team's work and engagement with other stakeholders. Topics will include policy issues, current and future program designs, evaluation results, program data, and progress towards goals. In developing meeting agendas, the GDS Team will gather input from the EERMC to ensure that meeting topics and materials cover the priorities of the EERMC.

In addition to engaging with the EERMC, the GDS Team will engage with National Grid to participate in regular meetings. Doing so will ensure that the GDS Team can provide up to date information to the EERMC but also support an oversight function. By having a steady presence and working in a collegial manner, the GDS Team can be viewed as a resource by National Grid while also maintaining an arm's length distance to maintain independence. The regular engagement with National Grid will also enable the GDS Team to develop a more complete understanding of issues, opportunities, and challenges for energy efficiency and system reliability programs, increasing the value of information and perspectives provided to the EERMC. The LCP Standard will help shape many of the perspectives the GDS Team will bring in its engagement with National Grid. Critical principles of the LCP Standard include: cost-effectiveness, alignment with the previously approved plans, innovation, comprehensiveness, equity, building from prior plans and programs, integration with other clean energy programs, and effective uses of funding sources. The GDS Team is familiar with the Rhode Island Benefit-Cost Test and the approach to addressing the social cost of carbon, DRIPE, avoided costs, and other elements. The principles of the LCP Standard, if followed, justify the Performance Incentive Plan payment, and mitigate risk to ratepayers and ensure broad benefits are achieved across Rhode Island's electricity marketplace. Additionally, the GDS Team understands that the EERMC expects its consultants to leverage their experience to enhance information flowing to

National Grid. This includes providing technical support and recommendations on program design and implementation, providing oversight of third-party analyses and studies commissioned by the EERMC. The GDS Team has expertise across the entire spectrum of energy efficiency and system reliability programs, with direct program, evaluation, market research, program design and experience. This experience will enable the GDS Team to also leverage information and perspectives from other jurisdictions.

**FIGURE II-3. TIME-SERIES METRICS BY END USE**



In addition to coordinating with National Grid, the GDS Team will also continue its working relationship with OER. Subcontractor Demand Side Analytics recently completed a project with the Rhode Island OER (RFP# 7597562 Energy Efficiency Programs Evaluation Study) that required extensive collaboration with OER staff, National Grid, and other Rhode Island stakeholders, one element that will drive seamless engagement. This relationship will help ensure that a holistic perspective of Rhode Island's clean energy programs across the diverse subject areas. Doing so will help ensure that energy efficiency and system stability programs are being delivered in a coordinated manner, and in alignment with policies and other programs. The GDS Team envisions that with shared information exchanges and support, the EERMC and other stakeholders will have a full perspective on how the energy efficiency and system stability programs fit into the larger set of clean energy programs and work to meet State and stakeholder clean energy goals.

The GDS Team is well equipped to deliver all aspects of the work to support the EERMC's interests in the design and delivery of energy efficiency and system reliability. At its core, our method is one of collaboration and information exchange across the wide range of stakeholders, including the EERMC, OER, National Grid, and others. To facilitate this outcome, we will engage in standing periodic meetings, ensure the GDS Team is part of the information flow from the diverse stakeholders, share information, provide support, and ensure that the EERMC's priorities are maintained front-and-center. In advocating for program improvements or the EERMC's priorities, the GDS Team will work in a collegial and collaborative manner to help ensure positive outcomes that lead to the realization of the EERMC's priorities and positive outcomes for all stakeholders.

The GDS Team believes that data transfers in an agreed-upon format and regular cadence are critical for this type of project. In Pennsylvania, we receive complete tracking data extracts every quarter from the seven electric distribution companies. This data is stored in a statewide tracking database and is the foundation for a wide range of audit activities. The data are also used to populate a Tableau dashboard, which provides stakeholders visibility into program activity. The GDS Team will seek to develop a similar approach to drive transparency and establish a steady engagement with National Grid to help ensure the EERMC is able to make decisions with as up-to-date program information as possible.

The GDS Team understands that the core deliverables for this responsibility include the following:

- Represent the EERMC priorities in program planning
- Provide technical support and recommendations to the utility and other stakeholders
- Advocate for program design and delivery improvements, particularly for traditionally underserved sectors (e.g. income limited or small businesses)
- Independently review and assess utility data reports and information (and suggest improvements)
- Review and conduct the cost-effectiveness of triennial energy efficiency plans
- Provide oversight of EERMC third-party analyses and studies, including market potential studies, and advocate for to ensure results are incorporated into program plans
- Inform the EERMC of what other jurisdictions are doing that may improve the quality and delivery of energy efficiency and system reliability programs.
- Monitor and facilitate, and report on the implementation and progress toward goals of annual energy efficiency program plans
- Meet regularly with National Grid program managers and other stakeholders to facilitate all of the above activities, including working with National Grid to enhance the comprehensiveness and timely exchanges of data for the EERMC or OER.

### II.B.4 Responsibility 4. Related to Advancing Integrated Approaches & Addressing Emerging Issues

As a leader in energy and conservation policy, Rhode Island is on the forefront of emerging issues. It will be critical to retain an EERMC technical consultant with the relevant skill sets and experience to navigate these issues in a measured way. Several issues that will become increasingly important over the contract period, that we believe the GDS Team is exceptionally qualified on are:

- ***Strategic Electrification:*** Conversion of fossil fuel space heating, water heating, and other end uses to electricity will be a key component of Rhode Island's aggressive climate goals. Accurately measuring and valuing electrification initiatives are quite complex and require accurate accounting of the type and quantity of fossil fuel resources avoided as well as the timing of incremental electric loads. The timing and diversity of these loads is important for quantifying capacity impacts. In the same way that traditional EE measures reduce capacity costs through peak demand reduction, electrification can increase capacity costs by adding peak loads. With sufficient penetration, whole networks may switch from summer-peaking to winter-peaking. Strategic electrification introduces a whole new dynamic to electric/gas integration and performance incentives that will need to be considered carefully, even for a dual fuel utility like National Grid.
- ***Non-Wire and Non-Pipe Alternatives:*** Rhode Island's current benefit-cost approach relies on system-wide avoided cost of distribution capacity assumptions. In any system, there are circuits and feeders that can accommodate significant growth where the avoided cost is zero and there are locations where peak demand reductions can avoid or defer capital projects and generate millions in benefits. The traditional system-wide approach masks the true distribution of locational value on the system. Accurately quantifying locational value is critical to understanding the true economics of storage, electrification, demand response, and renewables offerings. Our review of the Commission's Docket 4600, Rhode Island's Power Sector Transformation Report, and National Grid's System Reliability Procurement Plan Reports

indicate that this methodology is gaining traction in Rhode Island. Subcontractor Demand Side Analytics has recently completed electric and gas locational value studies for multiple New York utilities. GDS Associates has an entire division of transmission of distribution engineers and planners. In short, we believe the GDS Team is uniquely positioned to help move Rhode Island forward in this area.

- ***Increased Penetration of Connected Devices:*** Connected devices are a key opportunity as EE programs move beyond LED lighting. Optimization of the savings opportunities from connected devices requires the correct program design signals. Subcontractor Demand Side Analytics has been an industry leader in leveraging the wealth of granular end-use data connected devices offer for different planning, evaluation, and valuation applications.
- ***Infrastructure Investments and AMI Business Case:*** One area that Rhode Island has lagged the nation rather than lead is AMI deployment. Advanced metering infrastructure is foundational to several ambitious program offerings and energy policies such as time-varying pricing. We anticipate this issue will continue to arise and receive attention to the magnitude of the investment required. Our team has worked on AMI business cases in California, Vermont, and New York and can help the EERMC navigate this key policy issue.

**FIGURE II-4. PROCESS OVERVIEW FOR ADDRESSING EMERGING ISSUES**


As emerging issues arise that warrant involvement from the EERMC consultant team, we propose a process like the one shown in Figure II-4. After identifying the core research or policy questions at hand and the anticipated role of the consultant team, we will share an estimated budget and timeline to ensure that all parties have a clear understanding of the GDS Team's roles and responsibilities to the issue up front. This will help manage expectations and budgets for emerging issues where prior templates often may not exist.

A key advantage of the GDS Team is our national experience. Many of the approaches and improvements listed in the RFP are currently being considered or tested in other jurisdictions where GDS Team members are actively involved. Knowing where to find relevant regulatory proceedings and studies and summarizing them in a concise format can be an extremely valuable as Rhode Island looks to consider the advantages and disadvantage of different approaches.

### II.B.5 Illustrative Annual Timeline

The GDS Team has proposed a hypothetical schedule based on historical activities by the EERMC, as well as the key requests in the RFP, understanding that this is a tentative outline and subject to modification. See Figure II-5 on page 10 for an illustrative annual timeline.

## II.C COMPANY PROFILES

Since its inception in 1986, ***GDS Associates, Inc.*** ("GDS") has enjoyed considerable growth and now employs a staff of more than 180 persons, of which more than 50 consultants work on energy efficiency and demand response program planning, implementation, and evaluation projects. Our firm operates as a for-profit corporation with headquarters located in Marietta, Georgia and offices in Washington, Oregon, New Hampshire, Maine, Wisconsin, Alabama, Texas, and Florida.

Our consultants are recognized leaders in their respective fields, dedicated to their clients, innovative in their approach to meeting unique challenges, and known for consistently being available when needed. Our broad range of expertise focuses on clients associated with, or affected by, electric, natural gas, water and wastewater utilities. Beyond our conventional client work, we are also invested as volunteers on multiple energy efficiency working groups, such as the New Hampshire Energy Efficiency and Sustainable Energy (EESE) (board member) and the Energy Efficiency Resource Committee (EERS) as a committee member.

Our staff of highly qualified consultants and analysists assist clients with the complexities of multi-faceted energy efficiency, demand response, and renewable energy program planning, implementation, and evaluation. GDS has completed numerous energy projects for utility commissions, regional planning organizations, and utilities themselves. Beyond energy efficiency planning, GDS offers information technology, market research and statistical services to a diverse client base. For more information on the services that GDS provides please visit our website at gdsassociates.com.

***Johnson Consulting Group*** focuses on providing program design and evaluation services for energy efficiency organizations across North America. This woman-owned consulting firm was the logical extension of Dr. Katherine Johnson's successful career in EM&V, having completed more than 200 evaluations during the past 30 years. Founded in 2008, Dr. Johnson has directed program evaluations investigating the effectiveness of energy efficiency programs and policies across residential and C&I market sectors.

***Demand Side Analytics*** (DSA) was formed in 2016 to help utilities and regulatory agencies navigate the technical, economic, and policy challenges of building a smarter and cleaner energy future. DSA's core services include:

- *Energy Efficiency evaluations*
- *Demand Response evaluations*
- *Behavioral program evaluations*
- *Process and outcome evaluations*
- *Market potential studies*
- *End-Use saturation and baseline studies*
- *Time varying pricing analysis and planning*
- *End-use/load profile studies and research*
- *Design and implementation of pilots and controlled deployments*
- *Expert testimony*
- *Distributed energy resource integration into planning and operations*
- *Location specific, probabilistic forecasting for system, transmission and distribution planning (electric and gas)*
- *Granular analysis (8760) and forecasting of distributed energy resource adoption and impacts on the grid*
- *Non-wire alternative and non-pipe alternative project assessments*

**FIGURE II-5 ILLUSTRATIVE ANNUAL TIMELINE**

| Task | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COUNCIL BUSINESS** | | | | | | | | | | | | |
| EERMC Annual Report | | | | 15 | | | | | | | | |
| EERMC Annual Retreat | | | | | | | * | | | | | |
| EERMC Annual Public Engagement Event | | | | | | | | | | | * | |
| **NATIONAL GRID MEETINGS** | | | | | | | | | | | | |
| Residential Program Updates | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| C&I Program Updates | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| EM&V Updates | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| **AD HOC STUDIES (EXAMPLE)** | | | | | | | | | | | | |
| Research Drafts | | | | ✓ | | | | ✓ | | | | |
| Research Final Reports | | | | | | ✓ | | | | ✓ | | |
| Technical Analysis/Policy Briefings | | | | | ✓ | | | | ✓ | | | |
| Briefings | | | ✓ | | | | | | | | ✓ | |
| **EE AND SRP STANDARDS REPORTING** | | | | | | | | | | | | |
| Annual Planning Process | | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| Annual Plan Completed | | | | | | | | | | ✓ | | |
| **ON GOING MANAGEMENT TASKS** | | | | | | | | | | | | |
| Website Maintenance and Updates | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Status Reports | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Reports on Emerging Issues | | | TBD | | | | TBD | | | TBD | | |

** event*

## II.D **RELEVANT EXPERIENCE**

The GDS Team has provided a snapshot of some of our relevant projects by concentration, in alignment with the focus of the RFP. Additional project information can be found in ***Appendix A*** and our Team would be happy to provide additional project qualifications.

### II.D.1 Relevant Experience of GDS Associates, Inc.

The GDS consultants assigned to this project are senior personnel that thoroughly understand the quantitative and qualitative issues associated with the design, implementation, and evaluation of successful energy efficiency programs. GDS has provided energy efficiency consulting services to utilities, public utility commissions, government agencies and other regulatory agencies in states across the country and Canada. Our energy consulting services include:

- Development and evaluation of energy efficiency frameworks, demand response and renewable energy potential studies, including cost-effectiveness model development
- Program design for energy efficiency, solar+storage, demand response, and pilot programs
- Management of multi-faceted stakeholder groups, collection, and synthesis of input
- Technical Reference Manual (TRM) document and savings measure development
- Measure, program, and portfolio-level benefit cost analysis
- Administration of energy efficiency programs in multiple states (i.e. ME, WI, MA, NY, NH)
- Market characterization, assessment, and baseline studies
- Formal program evaluations, filings with regulatory commissions, and expert testimony

GDS has also been overseeing and implementing energy efficiency programs across the country, including some program design responsibilities (see Figure II-6).

GDS has performed over 75 market potential studies over the past 20 years, for clients of all types, some of which are referenced in ***Appendix A*** and Table . In addition to traditional potential assessments, GDS has been involved in innovative versions of this cost-effectiveness work as the energy delivery market and common business models have evolved. In Minnesota, GDS led a first of its kind market potential study analyzing the characteristics of electric utility infrastructure improvements as energy efficiency measures on both the generation side (heat rate improvement), as well as the Transmission and Distribution side, in partnership with Demand Side Analytics. Further, GDS has been providing support to Avangrid related to the planning and benefit-cost screening of energy efficiency programs in Connecticut.

GDS' highly successful existing and ongoing energy efficiency work with MassSave, NHSaves, Ameren Illinois, Wisconsin

**FIGURE II-6 IMPLEMENTATION & PROGRAM DESIGN EXAMPLES**

**ComEd** *Lit Signage Program*

**Wisconsin Focus on Energy** *Agribusiness and Small Business Programs*

**Ameren Illinois** *ActOnEnergy Small Business, Direct Install*

**Westfield Gas & Elec (MA)** *Comprehensive Programs*

**ComEd Northern Illinois** *Agricultural Energy Efficiency Program*

**NYSERDA** *Small Commercial Program*

**Efficiency Maine's** *Commercial & Industrial Prescriptive, New Construction & Small Business Incentive Program*

**HUD** *Energy Audits and Technical Assistance*

Focus on Energy, Efficiency Maine, Efficiency Vermont, NYSERDA, Colorado Energy Office, Massachusetts Municipal Wholesale Electric Company (MMWEC), Alectra and other government agencies and utilities in North America allows the GDS Team to provide this project with program implementation best practices and significant direct knowledge and detailed information on hundreds of energy efficiency measures suitable for Rhode Island. For example, GDS has been providing program planning, benefit cost modeling, and regulatory reporting support to multiple Massachusetts Program Administrators (Liberty Utilities, Berkshire Gas (Avangrid), Unitil Corporation, Columbia Gas of Massachusetts) for their entire portfolios of gas energy efficiency programs since 2011. GDS also serves as subject-matter expert and witness at regulatory hearings and technical work sessions; and other related ad-hoc support/analyses.

GDS also has decades of program oversight experience, including the administration of the Efficiency Maine programs since 2003 that began with Residential service offerings and evolved through the Commercial and Industrial programs that we oversee today. Our efforts include savings and rebate administration, incentive measure design, and marketing that include a focus on **underserved** and hard to reach participants. The engineers and consultants work directly for and interact substantially with the Efficiency Maine Trust, a quasi-state agency governed by a Board of Trustees with oversight from the Maine Public Utilities Commission. GDS is also responsible for management of the public facing **websites** for the program[2] including trade ally/partner training and education[3], including monthly Google Analytics meetings to analyze click through and success ratings of the websites. These websites were preceded by our web-based data reporting and incentive application processing system, showcasing the reduced emissions and energy savings of the programs. Multiple staff at GDS are experienced in WordPress and provide support to these sites in addition to the primary GDS Associates website, all supported by the GDS IT department and its cybersecurity personnel.

GDS has provided non-conventional energy analytical services to several utilities, government agencies, and private clients including:

- ***Federal Housing and Urban Development*** (HUD) multi-state comprehensive energy and water audits including project financing, performance contracting, and solid waste analysis
- ***Orlando Utilities Commission*** Smart City Pilot Project Design and Implementation
- ***Lansing Board of Water & Light*** Solar, CHP and Electric Vehicle Potential Studies
- ***Pennsylvania Public Utility Commission*** Behavioral Persistence of Savings Study
- ***Rhode Island Public Utilities Commission*** Rhode Island Renewable Energy Expert Project Reviews and Commission Technical Support

[2] https://qualifiedpartner.me/small-business-initiative/
[3] https://training.qualifiedpartner.me/

## II.D.2 Relevant Experience of Johnson Consulting Group

For the past 11 years, Dr. Johnson has been leading collaborative forums to help guide decision-making regarding the evaluation and cost-effectiveness of current and emerging energy efficiency tools and policy initiatives. Dr. Johnson served in the Utility Advisory Board (UAB) for the City of Winter Park (FL). For six years, she served as the chair of the board and was instrumental in developing and implementing an energy and water efficiency rebate program targeting low-income seniors. Johnson Consulting Group's primary business focus is providing technical expertise in program design and evaluation across all market sectors. They also serve as subject matter experts supporting public service commissions, quantifying Non Energy Benefits, and developing specific program initiatives in response to specific policy goals. Our services include:

- Technical advice and guidance for EM&V program planning and execution
- Evaluations for energy efficiency and demand response pilot and programs
- Developing EM&V Frameworks and Decision Guidance for NTG approaches for EE programs
- Quantifying Non Energy Benefits (NEBs) for cost-effectiveness testing
- Expert testimony regarding program evaluation results and recommendations
- Conducting primary and secondary market research and analysis, focus groups, and in-depth interviews
- Organizing and facilitating successful stakeholder collaborations on a variety of topics including low-income, financing, and EM&V approaches. Providing expert testimony on low-income "best practices" in program design and delivery.
- Preparing and maintaining password protected electronic dashboards for collaborative regulatory groups. These updates are also then emailed to all committee members and appropriate staff.

Recent Johnson Consulting Group projects include:

- ***Arkansas Public Service Commission:*** Weatherization Collaborative Facilitation: Dr. Johnson led the facilitation and development a new unified statewide approach to weatherization programs at the request of the Arkansas Public Service Commission. Dr. Johnson led a literature review and analysis of current NEBs policies and estimates at the request of the Commission. She also **facilitated the stakeholder process** that led to the establishment of quantifying four NEBs in annual EM&V studies beginning in PY2017. Dr. Johnson led the facilitation and development a new unified statewide approach to weatherization programs at the request of the Arkansas Public Service Commission. She also co-authored the NSPM Case Study documenting Arkansas' progress relative to this new cost-effectiveness framework.
- ***California Public Utilities Commission - EM&V Advisor:*** Dr. Johnson provided technical advice and support to the Energy Division of the CPUC specifically regarding the effectiveness of energy efficiency programs targeting Regional Energy Networks, Local Government Partnerships, Disadvantaged Communities, and multifamily strategies.
- ***Maine Public Utilities Commission - EM&V Technical Advisor:*** Working with Mesa Point Energy, Dr. Johnson completed a fast-turnaround project designed to assess the effectiveness of Maine's triennial plan. Her work included reviewing current EM&V reports, identifying gaps and preparing supporting materials for the Public Utility Commission staff. Her contract was extended to assist the PSC in identifying best practices for TRM updates.

- ***Missouri Public Service Commission - EM&V Auditor:*** Dr. Johnson led the team of EM&V Auditors to review EM&V plans and reports prepared by third-party evaluation firms to ensure that these reports reflect industry best practices and are consistent with industry approved protocols such as the IPMVP for the past four years.

### II.D.3 Relevant Experience of Demand Side Analytics

DSA offers extensive expertise in EM&V, distributed energy resource integration, transmission, and distribution system planning, targeting analytics, and benefit cost analysis. The team assigned to this project includes data scientists, applied statisticians, economists, and public policy experts. DSA has a proven record for conducting high-quality, accurate, and unbiased analysis and is meticulous about ensuring that research is useful for policy decisions, operations, and implementation.

The DSA staff assigned to this project have:

- Conducted over 100 large scale EE, DR, and TOU evaluation studies across North America and dozens of pilots.
- Completed market potential studies and supported integrated resource plans in California, Texas, New Mexico, Pennsylvania, Michigan, South Carolina, Indiana, New York, and Ohio. Several of these studies included significant primary data collection (e.g. appliance saturation or baseline studies)
- Performed ISO-New England Forward Capacity Market M&V certifications for passive resources in Maine, New Hampshire, and Massachusetts and a portfolio of active resources that spans the ISO-New England footprint.
- Developed many of the probabilistic forecasting methods that New York utilities are required to implement as a part of the Distributed System Implementation Plans. Led the DSIP filings for Central Hudson Gas and Electric in 2018 and 2020.
- Developed avoided costs and performed benefit-cost modeling for numerous program administrators.
- Served as the statewide evaluator in Pennsylvania and New Mexico providing review of utility plans and evaluations along with technical and policy support to regulators on a wide range of energy and conservation issues. In Pennsylvania, developed a statewide tracking database and online dashboard of all DSM activity across the seven investor-owned utilities.

## II.E EXAMPLES OF PRIOR WORK

***Appendix A*** of our Team's proposal provides examples of prior work as well as references that best display our Team's ability and experience with work of a similar nature.

***Appendix B*** presents previously written memos describing a technical energy issue and client recommendation.

## II.F REFERENCE INFORMATION

***Appendix C*** presents two former or current client references for which the GDS Team members have performed work in the last three years.

## II.G IDENTIFICATION OF STAFF & SUBCONTRACTORS

The identification of staff and subcontractors is provided in ***Appendix D***, We have listed all staff, including subcontractors, that are proposed members of the GDS Team.

## II.H STAFF RESPONSIBILITIES

***Appendix E***, in response to RFP *Section II H Staff Responsibilities*, presents the duties, responsibilities, and areas of concentration for this engagement for each member of the GDS Team.

## II.I STAFF EXPERIENCE

***Appendix F*** comprises biographies of the GDS Team, resumes detailing germane experience and credentials (see ***Appendix F-1***) and an organizational chart.

## II.J CONFLICTS OF INTEREST

Conflict of Interest statements are provided in ***Appendix G***.

## II.K LITIGATION

Litigation statements from each member of the GDS Team have been provided in ***Appendix H***, in response to RFP *Section II K Litigation*.

## II.L INVESTIGATION

Statements from each member of the GDS Team addressing RFP *Section II L Investigation* have been provided in ***Appendix I.***

# **APPENDIX A.** RFP Section II E Examples of Prior Work

***Appendix A*** of our Team's proposal provides examples of prior work as well as references that best display our Team's ability and experience with work of a similar nature. Additionally, ***Appendix B*** presents previously written memos or short reports from each firm describing a technical energy issue and client recommendation. Some material or pages from the memos/reports may be reduced or omitted for space and client privacy.

Provided below are examples of prior work as well as references that best display our Team's ability and experience with work of a similar nature. These examples address RFP *Section II E Examples of Prior Work*.

## A.1 GDS ASSOCIATES, INC. EXAMPLES OF PRIOR WORK

GDS was retained by the ***Georgia Public Service Commission*** to provide technical support for the 2019 to 2021 time-period, which has included the review of Georgia Power Company's 2019 Integrated Resource Plan Filing, assistance with discovery, preparation, and presentation of testimony on IRP technical and policy issues. The bulk of this work involves analyzing the demand side management programs and the associated costs for legitimacy, including those targeted to underserved communities. GDS has also provided technical support for supply-side and demand-side resource certification hearings held before the Commission and continues to provide technical support for monitoring the implementation of energy efficiency and demand response resources that have received certificates from the Commission. The DSM monitoring portion of this work will extend through December 2021. This includes providing technical support for review of Georgia Power Company program evaluation plans, sampling plans, survey instruments and EM&V reports. GDS held a similar contract with the GPSC from 2016 to 2019 to advise on the 2016 Georgia Power IRP filing. GDS has been supporting the PSC with ***testimony*** and other energy issues since 1988.

From 2009 to 2017 GDS served under contract to the ***Pennsylvania Public Utility Commission*** to lead as the prime contractor for the Pennsylvania ***Statewide Evaluation Team (SWE)*** for the Act 129 EE&C programs being implemented by seven investor-owned utilities. As the SWE, GDS provided a review of utility process and impact evaluations and verified the accuracy of kWh and kW savings reported by the seven EDCs in Pennsylvania subject to the requirements of Act 129. GDS also provided an assessment of the methodologies being used by each EDC, a review of cost-effectiveness calculations, participated in public meetings, quarterly process updates, and biannual improvement workshops with the EDCs. Further, GDS managed multiple rounds of ***stakeholder feedback*** on regulatory issues, delivering condensed input to the PUC and assisting in the creation of regulatory Orders and dockets. Our semi-annual, quarterly, and annual reports provided the Commission with recommendations for improving the EE&C programs with a focus on the cost-effectiveness of program delivery through the lens of dollars spent per kWh saved. GDS managed multiple sub-contractors throughout the project and led numerous technical working groups with utility personnel, evaluation consultants, and state government staff. A key part of this work involved analysis of ***low-income programs*** and consultation to the PUC of the design of the Utilities' low-income programs and savings estimates in comparison with their mandated goals. GDS also produced an accurate assessment of the future potential for energy savings through market

potential studies and baselines studies. GDS prepared many of the deliverables for public consumption (memos, reports) and can be found HERE on the PUC's website.

Since 2006, GDS has served under contract to the ***Rhode Island Public Utilities Commission*** as a ***Renewable Energy Consultant*** in support of the Rhode Island Renewable Energy Standard Act (RES), under the direction of Todd Bianco and formerly under the direction of Nick Ucci. Our staff leads a team of experts responsible for reviewing applications for eligibility and reporting to the Commission. We are also monitoring ongoing eligibility of renewable energy generators and the production of such generating units, reviewing demonstrations of compliance including compliance reports from obligated entities for compliance with the Rules and Regulations of Rhode Island's Renewable Energy Standard Act and for accuracy and reporting to the Commission on findings and recommendations. Our work requires intimate familiarity with the regulatory framework of Rhode Island, in particular the general laws of section 810-RICR-40-05-2 and the legislative process for updating these guidelines. Further, we must remain conversant with the current NEPOOL GIS rules, having a general knowledge of RPS programs in other New England States, and maintain expertise in drafting applications and compliance forms as needed. A significant portion of this work requires regular interaction with National Grid and tracking of their Renewable Energy Growth program and compliance towards targets. GDS develops monthly status reports for posting on the PUC website, tracking progress towards regulatory targets, and holds regular meetings with the Commission staff.

## A.2 JOHNSON CONSULTING GROUP EXAMPLES OF PRIOR WORK

Since 2011, Johnson Consulting Group remains the lead contractor and serves as the Independent Evaluation Monitor (IEM) on behalf of the ***Arkansas Public Service Commission.*** As part of this effort, the Johnson Consulting Group team developed the first set of EM&V protocols and facilitated the streamlining of the Technical Reference Manual for the Parties Working Collaboratively (PWC), which include utilities, third-party implementers, and intervener groups. For the second phase of this project, Johnson Consulting Group is leading all tasks to review all current and planned EM&V activities to ensure compliance with the EM&V protocols, provide annual updates to the TRM, and provide ongoing guidance and direction to EM&V contractors. The IEM prepares annual reports documenting progress towards stated energy efficiency goals and objectives that are presented to the Arkansas Public Service Commission. The IEM also facilitates and assists in on-going program planning for the entire program portfolio in Arkansas, establishes energy efficiency goals and develops new program designs including those targeting ***low-income*** and hard to reach customer segments at the Commission's request. She has also provided examples of the memos she has created with specific program design recommendations on deploying a consistent, cost-effective statewide low-income program.

Johnson Consulting Group is the lead EM&V contractor for ***Spire Energy***, the largest natural gas utility in Missouri in 2017 and is currently conducting the process and impact evaluation for the 2018-2020 program cycle. Dr. Johnson served as the project manager and lead for the program evaluations of its Residential Heating and Water Heating Program and the Commercial & Industrial Prescriptive and Custom Programs for its two operating companies. This evaluation included conducting process, impact, and cost-effectiveness evaluations of these utility programs. Dr. Johnson directed the process evaluation tasks including completing in-depth interviews with

programs' staff, designing and analyzing the participant and non-participant surveys and preparing summary reports filed with the Missouri Public Service Commission.

For the ***Delaware Sustainable Energy Utility,*** Dr. Johnson led the process evaluation of DE SEU's Home Performance with Energy Star statewide program. In this capacity, she is directing the analysis of customer surveys, conducting in-depth interviews with staff, implementers, and contractors and reviewed critical program databases and materials.

## A.3 DEMAND SIDE ANALYTICS EXAMPLES OF PRIOR WORK

***Pennsylvania Statewide Evaluator*** (2016 – Present). Since 2016 Demand Side Analytics has been part of the Statewide Evaluation Team for Pennsylvania's energy efficiency and demand response programs for Phase III of Act 129 DSM programs (2016-2021). DSA partner Jesse Smith has been a key member of the team since 2011. The Statewide Evaluator's role is to provide guidance and oversight to each of the seven electric distribution companies (EDCs) in the state and to audit the energy and peak demand savings values reported to the PA PUC. As a member of the Statewide Evaluation Team, DSA has performed numerous studies and evaluations to support Pennsylvania's Public Utilities Commission. Some examples of these projects are included below:

- ***Demand Response Evaluation Protocol.*** In 2016, DSA developed a detailed evaluation protocol for demand response programs which is included as Section 6.2 of the Pennsylvania Evaluation Framework. This protocol details the procedures that each of the EDCs in the state are required to follow when evaluating C&I demand response programs. It details the selection of baseline methods for different types of loads, calculation of uncertainty, and reporting of impacts to the PUC. Following each summer demand response season, DSA is responsible for auditing the DR savings methods and calculations and assessing EDC progress toward performance targets.
- ***Behavioral Evaluation Protocol.*** In 2016, DSA developed a detailed evaluation protocol for behavioral conservation programs which is included as Section 6.1 of the Pennsylvania Evaluation Framework. This protocol details the procedures that each of the EDCs in the state are required to follow when evaluating Home Energy Report and Business Energy Report programs.
- ***Incremental Cost Database Update.*** In 2017 and 2020, Demand Side Analytics completed updates to the statewide incremental cost database including a detailed analysis non-residential lighting equipment costs.
- ***Statewide C&I Baseline Study.*** In 2018, DSA lead the Evaluation Team to conduct the 2018 statewide C&I baseline study. DSA developed an online data collection tool that was used in the field to inspect 500 non-residential businesses across Pennsylvania. DSA also performed quality control throughout the process by performing weekly data cleaning processes and holding follow-up meetings with site inspectors. The rich data set enabled detailed, bottom up analysis of end use, energy use intensity, and efficiency purchase behaviors across several end uses. In addition, results were provided by sector (large versus small), EDC (seven total), and about a dozen industry segments. Results of the C&I baseline study served as key inputs to the 2019 TRM update and market potential study.
- ***Demand Response Potential Study.*** In 2020, DSA, as a member of the Pennsylvania Public Utility Commission, completed the Phase IV Demand Response Potential Study in 2020 which

evaluated seven electric distribution companies. The study included EDC specific estimates for DR Potential and examined the costs and benefits of statewide policies to encourage the development and deployment of DR resources.

- ***Pennsylvania TRM Update.*** In 2019, DSA led updates to the Pennsylvania Technical Reference Manual, which standardizes the algorithm and assumptions used to calculate energy and peak demand savings.
- ***Pennsylvania Phase IV Implementation Order and Total Resource Cost Test Orders.*** DSA staff have been the primary authors of several PUC orders. The Implementation Order prescribes consumption savings targets for each of the seven EDCs to achieve in Phase IV of the state's Energy Efficiency and Conservation program and outlines the requirements for reporting and evaluating each EDCs' performance. The TRC Test Order provides detailed guidance on all matters related to benefit-cost analysis, including the development of avoided costs.

***Rhode Island Office of Energy Resources – National Grid Energy Efficiency Programs Evaluation*** (2019 – Present). Demand Side Analytics was part of the team selected by OER to complete a legislatively mandated review of National Grid's energy efficiency program evaluations (gas and electric). DSA performed a billing analysis for any non-residential premise that installed an incented retrofit measure between 2015 and 2019. Example retrofit measures offered by the program include lighting measures, steam traps, and VSDs on HVAC systems. Because a billing analysis is not the best way to measure savings for all premises/measures, several premises were filtered out of the analysis. The final billing analysis included over 250 electric customers and approximately 40 gas customers. For each customer, estimates of weather-normalized savings and avoided energy use were produced. Billing analysis savings estimates were then compared to gross savings estimates stored in the tracking data, as well as adjusted gross savings estimates that accounted for in-service rates and realization rates. Throughout the project, DSA collaborated with members of the EERMC and the current consultant team.

***DC Sustainable Energy Utility – Portfolio Evaluation and Benefit-Cost Lead*** (2017 – Present). Demand Side Analytics is a member of the evaluation team for the District of Columbia's Sustainable Energy Unit (DC SEU). As part of the evaluation team, DSA performed a cost-effectiveness evaluation and developed a detailed, flexible benefit cost model for assessing the project, program, portfolio level cost-effectiveness of DC SEU's energy efficiency and renewable energy programs. The model included functionality for dynamically assessing all four cost effectiveness tests (TRC/SCT, PACT, UCT, and RIM) and a variety of cost effectiveness scenarios, including a base scenario replicating DC SEU cost-effectiveness and scenarios for layering in updated avoided cost assumptions, realization rates, net to gross yield, and environmental benefits. The underlying modeling and assessment performed by DSA incorporated key cost-effectiveness considerations, such as adjusted baselines. Since developing the benefit-cost model, DSA has managed and guided DC SEU analysts in rapid updating of cost-effectiveness calculations for several years, facilitated by the flexible model architecture.

DSA also evaluated the impacts of the Nest Seasonal Savings program. Seasonal Savings is a thermostat optimization algorithm that uses incremental adjustments to a participant's heating or cooling schedules. DC SEU implemented a randomized encouragement design covering cooling seasons in 2017 and 2018. There were 12,000 participants in the intent to treat group and 7,000

participants actively engaged in the program. Impact analysis required a difference in difference regression structure and estimated combined verified savings over the two years of 380,000 kWh and 245 kW. In 2020, DSA evaluated the impacts of a winter Seasonal Savings deployment in the District. The winter analysis is more complex because participants have a mix of electric and fossil fuel heating systems. The winter runtime analysis was conducted separately for furnaces, heat pump compressors, and heat pump auxiliary resistance. Connected load assumptions were developed and applied to the different heating system components to convert runtime impacts to energy savings.

### A.3.1 Multiple Clients – Website Management & Online Systems (2016 – Present)

In addition to designing and maintaining the company website in WordPress (seen HERE), DSA hosts and maintains a variety of online systems for clients or internal data collection. These online systems, as well as the company website, are hosted on a dedicate Linux server leased from one of the data centers we lease Windows servers from. As a consulting company, we are frequently tasked with solving complex problems for our clients that they wish to repeat. Sometimes this lends itself well to building online tools that automate the analysis and reporting procedures so that utility staff can update the analysis as needed without incurring additional consulting fees. DSA's currently inventory of active web systems includes:

- A ***DER Management System*** for Central Electric Power Cooperative in South Carolina. CEPC uses this system to dispatch connected thermostats, Wi-Fi water heater switches, and two Tesla grid-scale batteries. The system includes a variety of automated M&V and reporting features including:
  - *Automated post-event M&V reports that are emailed out the morning after a DR event and stored in the system*
  - *Automated monthly program management reports for each of the 20 distribution cooperatives*
  - *Data visualization feature that allows users to chart operating data for a single asset and troubleshoot participant inquiries*
  - *A targeting algorithm that identifies homes that would benefit from weatherization based on the temperature change in the home during DR events.*
- A similar ***DER Management System*** for Old Dominion Electric Cooperative in Virginia.
- ConEdison has highly weather sensitive demand but also experiences substantial variability in year-to-year weather patterns. To assist in monitoring peak conditions, DSA developed a ***monitoring system*** to alert users of the conditions and provide recommendations for when to call demand response events. The user specifies the target numbers of evets for the summer and the system monitors loads and weather conditions, dynamically adjusting the event thresholds based on the event called to date, the target numbers of events, and probabilistic analysis of the likelihood of extreme loads or weather in the remainder of the summer. The tool is designed to be able to address dispatch needs for multiple programs and locations within ConEdison's territory. By design, it:
  - *Uploads weather and location specific forecasts from ConEdison on a daily basis*
  - *Predicts loads and pulls NOAA weather data automatically as a backup, each day*
  - *Runs probabilistic analysis to assess the likelihood of events in the remainder of the summer*
  - *Recommends adjustments to the trigger thresholds*

  - *Automatically sends out a daily report to users via email and also makes it available on the website.*
- ***Online data collection systems*** for residential and non-residential baseline studies. These systems include screens for field technicians to enter data and the data is stored in a MySQL relational database that feeds some analytical reporting processes.
- An ***online system for natural gas distribution planners*** at Central Hudson Gas and Electric to visualize the demand and gas pressure drops for a selected gas system and will implement custom analysis of distribution deferral value for individual gas system. The tool allows for uploads of pressure data or billing data as well as a variety of customizable settings to produce customized, end-to-end analysis and reports and track historical jobs.
- A ***Quals Database***. This is an internal tool DSA uses to manage and search qualifications for proposal development.

The online systems in the bullet list are all protected systems that require logon credentials, but we are happy to provide the EERMC a demonstration of one or more of the tools upon request.

The GDS Team has provided a snapshot of some of our relevant projects by concentration, in alignment with the focus of the RFP (see Table A-1 on the following page).

**TABLE A-1 GDS TEAM SUMMARY OF RELEVANT EXPERIENCE**

| Project Name | Project Year(s) | Oversight & Planning | Regulatory Policy & Legislative | Potential Studies & Economic Analysis | Program Design/ Innovation |
|---|---|---|---|---|---|
| Massachusetts Utilities (CLUB) Program Planning, Evaluation, Regulatory Support | 2011-present | ▲ | ▲ | ▲ | ▲ |
| Efficiency Maine Trust: Administration and Oversight of Efficiency Maine Programs | 2003-present | ▲ | ▲ | ▲ | ▲ |
| Central Electric Power Cooperative: DR Pilot Evaluations & DR Management System | 2017-present | | | ▲ | ▲ |
| Rhode Island PUC: Renewable Energy Standards (RES) Act Administration Support | 2006-present | ▲ | ▲ | | ▲ |
| Vermont Department of Public Service: Statewide Market Potential Study | 2016-2017 | | | ▲ | ▲ |
| PA PUC: Oversight of Statewide Evaluation Team | 2009-2016 | ▲ | ▲ | ▲ | ▲ |
| Colorado Energy Office: Beneficial Electrification Study | 2019-present | | ▲ | ▲ | ▲ |
| Georgia Public Service Commission: IRP Review Technical Support | 2016-present | | ▲ | ▲ | |
| Central Hudson: Distributed System Implementation Plan Support | 2014-present | ▲ | ▲ | ▲ | ▲ |
| CPUC: Integrated Resource Plan - Electric Vehicle Forecast | 2019-present | ▲ | | | |
| Efficiency Maine, ISO-NE: Forward Capacity Market Compliance Review | 2018-2019 | ▲ | ▲ | | |
| PA PUC: C&I Baseline Study | 2016-2021 | ▲ | ▲ | | |

| Project Name | Project Year(s) | Oversight & Planning | Regulatory Policy & Legislative | Potential Studies & Economic Analysis | Program Design/ Innovation |
|---|---|---|---|---|---|
| PA PUC: Total Resource Cost Test Order and Avoided Cost Calculator | 2019-2020 | ▲ | ▲ | ▲ | |
| PA PUC: Phase IV Demand Response and Distributed Generation Potential Studies | 2014-2021 | ▲ | ▲ | ▲ | ▲ |
| PA PUC: Statewide Evaluator Behavioral Evaluation | 2016-2021 | ▲ | ▲ | ▲ | |
| PG&E: T&D Pilot: Integration of Load Management into Distribution Operations and Planning | 2014-2017 | ▲ | | | ▲ |
| PSEG LI: Locational Avoided T&D Cost Study | 2019-present | ▲ | | | ▲ |
| SDG&E: Small Commercial TOU, CPP, & Smart Thermostat Evaluation | 2016-present | ▲ | | ▲ | |
| WA UTC: Assessment of Utility T&D Planning Capabilities and DER integration Practices | 2017 | ▲ | ▲ | ▲ | |
| Lansing Board of Water and Light: Integrated Market Potential Study | 2016, 2019 | | ▲ | ▲ | |
| Arkansas Public Utilities Commission- Independent Evaluation Monitor | 2011-present | ▲ | ▲ | ▲ | ▲ |
| Maine Public Utilities Commission- TRM Review | 2017-2018 | ▲ | ▲ | ▲ | |
| British Columbia Public Utilities Commission | 2016-2018 | ▲ | ▲ | ▲ | |
| Spire Energy Natural Gas Utility | 2017-present | ▲ | | ▲ | |
| ComEdison- NEI Review | 2018-present | ▲ | ▲ | ▲ | ▲ |

# **APPENDIX B.** RFP Section II E Technical Energy Issue Memos & Client Recommendation

In reference to RFP *Section II E Technical Energy Issue Memos and Client Recommendation*, ***Appendix B*** presents previously written memos describing a technical energy issue and client recommendation.

# BENEFICIAL ELECTRIFICATION IN COLORADO MARKET BARRIERS & POLICY RECOMMENDATIONS

## *Colorado Energy Office*

*Final Report July 2020*

prepared by **GDS Associates, Inc.**

# BENEFICIAL ELECTRIFICATION IN COLORADO

*Market Barriers and Policy Recommendations*

**FINAL REPORT**

*prepared for*

**COLORADO ENERGY OFFICE**

July 2020

*prepared by*

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# 1 Executive Summary

## 1.1 OVERVIEW

This report summarizes the findings and recommendations GDS Associates, Inc. (GDS) for a beneficial electrification market barrier and policy analysis study commissioned by the Colorado Energy Office (CEO). This report is a companion to a beneficial electrification modeling report.[1] The modeling report estimated the potential for residential, commercial, and industrial building electrification from 2021-2030 to help Colorado meet its greenhouse gas emissions reduction goals. This market barriers and policy report presents additional information on the current market challenges to beneficial electrification in Colorado and presents recommendations for policy options to help overcome those barriers or other challenges to beneficial electrification, laying the foundation for achieving the potential over the next decade and beyond.

The key findings and recommendations that emerged from this study reflect the combination of two primary sources of data: in-depth interviews with a range of stakeholders in Colorado and literature reviews identifying the status of electrification policies in Colorado and other states. GDS wants to thank the interviewed stakeholders for their time and contribution to the research, which shed invaluable light on the many perspectives related to Colorado's electrification market and policies.

As a note to the reader – although beneficial electrification is a general term, it has a specific definition in Colorado statute, which was added in 2019 in Senate Bill 236.[2] The statute defines beneficial electrification as changing the "energy source powering an end use from a nonelectric source to an electric source, including transportation, water heating, space heating, or industrial processes, if the change:

- Reduces system costs for the utility's customers;
- Reduces net carbon dioxide emissions; or
- Provides for a more efficient utilization of grid resources."

In other states, different terms are also used to convey the same core concept. When using the term "beneficial electrification" this report refers to the Colorado statute definition (described in the Introduction section). Other terms – electrification, strategic electrification, and energy optimization, are used to reflect a jurisdiction's perspective or otherwise used to convey the general concept of electrification in which energy-using technologies are converted from fossil fuels to electricity in a goal to reduce greenhouse gas emissions.

The following key findings and recommendations summarize the results of GDS' research into the current state of the market for beneficial electrification in Colorado and key policy recommendations for the State to consider.

[1] GDS Associates, Inc. *Beneficial Electrification in Colorado, Market Potential 2021-2030.* Prepared for the Colorado Energy Office, June 2020.
[2] C.R.S. 40-3.2-106(6)(a), https://leg.colorado.gov/sites/default/files/2019a_236_signed.pdf

## 1.2 FINDINGS AND RECOMMENDATIONS

Below we summarize the key findings and recommendations that emerged from interviews with Colorado stakeholders and our literature reviews. The findings include a summary of market barriers which may impede beneficial electrification in the building sector and policy recommendations that the State of Colorado should consider implementing to overcome these barriers. The policy recommendations are intended to lay a foundation from which the beneficial electrification markets and programs can grow. As the market for beneficial electrification grows, new or evolving opportunities may warrant the development of additional policies and programs. We discuss these additional themes and policy considerations in Section 3, Interview Results.

### Market Barriers Summary

Throughout our stakeholder interviews, GDS found many common themes and observations regarding market barriers to beneficial electrification in Colorado buildings. Market barriers represent conditions in a marketplace that prevent or limit outcomes from what may be optimal or are otherwise reflected in policy goals. For beneficial electrification the barriers cover aspects related to current market conditions and behaviors that limit market development and growth. The market barriers are interrelated and create challenges for rapidly expanding beneficial electrification for residential and commercial buildings absent policy and programmatic support. Below we provide a short summary, with more detail provided for each in the body of the report.

**Market Barrier #1: Limited consumer awareness and demand**

Interviews revealed a view that Colorado's residential and commercial building owners are not familiar with heat pumps for space heating and water heating. The lack of awareness leads to low interest or demand for products. Additionally, poor experience with prior electric technologies or myths about heat pumps may also hinder demand. Finally, the high upfront cost of heat pumps and other electrification technologies compared to traditional gas or propane equipment can hinder demand regardless of the potential long-term financial and health benefits.

**Market Barrier #2: Limited product availability**

Heat pumps are not common in Colorado. Interview respondents repeatedly relayed challenges for consumers who seek to have heat pumps installed, only to learn at the time of purchase, interview respondents indicated that the available stock of heat pumps was limited or unavailable. The lack of readily available supply creates lost opportunities to grow the heat pump market, particularly when homeowners or businesses must make a quick decision when faced with the need to replace failing existing equipment.

**Market Barrier #3: Marketplace reluctance to promote or sell heat pumps**

Interview respondents reported that many HVAC or plumbing contractors actively discourage or simply do not sell heat pump technologies. This reluctance may be due to outdated perspectives on heat pump performance, a lack of expertise on how to design and install systems or concerns over installing and servicing unfamiliar technology. For new construction, home builders may be reluctant to consider all-electric options since consumers desire features such as gas ranges and gas log fireplaces.

**Market Barrier #4: Workforce limitations**

Several interview respondents raised the issue of contractor shortages for both skilled and unskilled workers in Colorado's HVAC and plumbing workforce. High turnover in the trades as well as the fact that the available workforce is focused on traditional fossil fuel space heating and water heating technologies

exacerbates this challenge. When combined with limited equipment supply and unfamiliar technologies, workforce limitations may also increase prices of electrification retrofits relative to what a more mature market would offer.

**Market Barrier #5: Uncertainty with the Regulatory Framework Related to Fuel Switching**
In our interviews, respondents regularly brought up a perception that utility promotion of fuel switching is prohibited or otherwise discouraged. One clear example is Colorado Public Utilities Commission (PUC) rule, 4 CCR 723-4-4756(b), which prohibits natural gas utilities from incorporating fuel switching away from natural gas in their energy efficiency programs. There is a perception that utilities regulated by the PUC cannot promote fuel switching and, by extension, beneficial electrification. However, our research did not identify any other specific limitations or prohibitions.

**Market Barrier #6: Energy Efficiency Program Focus and Messaging**
Colorado's investor-owned and other utilities have primarily focused energy efficiency messaging on "like for like" energy savings; the fuel switching messaging is uncommon. The success of energy-efficiency programs and messaging has been to reinforce traditional space heating and water heating technologies.

**Market Barrier #7: Some of the existing residential and commercial building stock may not be able to easily integrate heat pumps.**
Interview respondents noted that many of Colorado's buildings, particularly homes, may not have adequate electrical infrastructure (e.g. service panels or wiring) or may need duct work or other improvements to integrate heat pumps. In some cases, heat pump water heaters may be too large to install in the location of existing water heating equipment. Without adequate electricity infrastructure in a home or business or a need to address air distribution or other infrastructure limits, the additional complexities can increase installation costs or may require additional skillsets that are not typically required when addressing retrofits would otherwise use a system similar to the one already in place.

**Market Barrier #8: Electricity market price signals or programs at the wholesale or retail level may not adequately capture the potential value of heat pump technologies or other electrification technologies.**
Some of our interview respondents expressed that electricity markets in Colorado may not have pricing structures that capture or enable the value of beneficial electrification technologies. Many electrification technologies have the ability to enable load control, load shifting or otherwise adjusting use patterns in response to utility demand or price signals. Respondents noted that this can include long term wholesale contracts that may not value short-term shifts in demand (e.g. hourly or narrow peaks) as well as retail rates with demand charge structures that do not link to utility controllable loads.

**Market Barrier #9: Uncertainty in rules related to HB 19-1261[3], a driver of statewide decarbonization efforts, creates risk for electric utilities to utilize beneficial electrification to meet greenhouse gas reduction goals.**
While HB 19-1261 set targets for reducing statewide greenhouse gas (GHG) emissions relative to a 2005 baseline, the rules for allocating baseline emissions to different portions of Colorado's economy are not settled. With beneficial electrification being a potential means of reducing economy-wide GHG emissions, electric utilities may be reluctant to promote beneficial electrification due to the risk that it would increase their emissions beyond what they would otherwise need to reduce relative to their share of the 2005 baseline. Even without utility-sponsored programs, beneficial electrification creates risk to electric utilities unless there is a mechanism to account for their emissions targets while crediting others with emissions

[3] https://leg.colorado.gov/sites/default/files/2019a_1261_signed.pdf

reductions. Additionally, rules related to accounting and tracking emissions reduction that involve two parties (e.g. a gas utility and an electric utility) are needed to track compliance and allocate GHG emissions reductions. With rules in place, electric utilities or others can plan for and promote beneficial electrification as appropriate.

**Market Barrier #10: Electricity rate structures may not envision or allocate costs in a manner that reflects a high penetration of beneficial electrification technologies.**
Current electricity rate designs may not reflect the opportunities that beneficial electrification technologies can bring to utilities' or customers' load management or control options. Additionally, the structure and approach to demand charges may not reflect how heat pumps or other electrification technologies impact the utility system. For example, demand charges set without regard to time of use potentially penalize winter or nighttime energy demand. As a result, current electricity pricing may limit load management program opportunities and the ability of utilities or customers to fully capture the value that beneficial electrification technologies can bring, potentially inflating operating costs from what may otherwise be possible. Current rates and wholesale contracts may also not reflect the resource mix and penetration of electrification technologies in the future, limiting adoption in the present.

## Policy Recommendations

GDS developed the following policy recommendations based on interviews with stakeholders, research into other States' electrification policies, and current policies that affect electrification in Colorado. The policies reflect opportunities to not only overcome the market barriers, summarized above, but also to expand beneficial electrification and reduce Colorado's greenhouse gas emissions. These policies are presented as a general order of priority and selected to address near-term needs to expand the market for beneficial electrification in Colorado.

**Policy Recommendation #1: Either through legislation and subsequent rulemaking, or directly through rulemaking, the PUC should establish clear rules for regulated utilities to promote beneficial electrification.**
Beneficial electrification cannot become a substantial portion of electricity demand-side management programs without a clear regulatory framework. To the degree the PUC requires legislation to take action, the Legislature should build from SB 19-236 and HB 19-1261 and establish a foundation for the PUC to act. The existing legislative definition of beneficial electrification should be used as the cornerstone, with a clear framework for related to quantifying net greenhouse gas emissions impacts a key consideration. Additionally, the PUC should consider programmatic features that allow for program participation equity across ratepayers, including low- or moderate-income homeowners or renters, and hard to reach businesses.

**Policy Recommendation #2: Colorado should establish clear greenhouse gas emissions baselines and accounting practices to support rules associated with HB 19-1261 and incorporate beneficial electrification into those rules.**
Utilities will need a standard practice for quantifying greenhouse gas emissions reductions to track the long-term carbon reduction effects of electrification. The State should establish rules with simplified emissions reductions metrics for the myriad small electrification measures that may be installed via utility programs. For example, attempting to quantify each individual heat pump installation's impacts would be burdensome. These rules and metrics will enable electric utilities to plan and track their performance relative to their responsibilities under HB 19-1261. General principles and metrics will facilitate electrification and can be updated periodically based on electricity grid emissions factors or updates to

the impacts of electrification equipment. This process would be similar to how energy efficiency goals are tracked and credited today. Doing so will enable Colorado's electric utilities to plan for beneficial electrification, contribute to reductions in statewide greenhouse gas emissions, and equitably track the reductions in greenhouse gas emissions associated with beneficial electrification.

**Recommendation #3: The PUC should update cost-effectiveness calculation approaches used by utilities in their energy efficiency programs, integrated resource plans, and other decision making.**
The current formulation of the modified Total Resource Cost (mTRC) test was designed to support energy efficiency programs and follows standard industry practice. Even with utility integrated resource plans filed with the PUC incorporating a social cost of carbon, the formulation does not fully address beneficial electrification. Updating the role of non-energy benefits in the formulation of the costs and benefits will help address the trade-offs of shifting from fossil fuels to electricity. For example, health and safety considerations for fuel switching, such as improvements to indoor air quality, are not explicitly addressed in the current formulation. Factors to ensure that low- or moderate-income customers receive no-cost electrification measures should also ensure that program outcomes do not lead to increased operating costs for these customers. The PUC may want to consider whether the avoided costs used in the current formulation of the mTRC test reflect the avoided costs associated with reductions in greenhouse gas emissions. For natural gas, this might include the cost of alternatives to fossil fuel natural gas, such as renewable natural gas, as one component of the avoided natural gas cost. Finally, the PUC should consider the treatment of net savings for beneficial electrification and whether the current immature state of the market and future growth should receive a net to gross ratio of 1.0.

**Policy Recommendation #4: The State should coordinate with a broader set of stakeholders interested in advancing beneficial electrification.**
Coordination with utilities, advocates, market actors, and others will help drive consistency in how the many stakeholders in beneficial electrification work together to develop the market. Coordination can take many forms. One that may be needed in the near term includes establishing a long-term market tracking mechanism so that utilities and the State can monitor electrification progress across diverse utilities and industries. A second opportunity in the near-term is to support Colorado organizations seeking to address the market barriers above – there is risk of many small and disparate efforts not achieving a scale that will enable beneficial electrification to meet Colorado's greenhouse gas emissions reduction goals. These organizations could include trade associations, utilities, local governments, clean energy advocates, product manufacturers, distributors, developers, workforce representation, or organizations that bring them all together. Supporting existing organizations and coordinating efforts will help facilitate the sharing of lessons learned, reduce potential redundancy, and develop consistent messaging that will create a resilient network to promote beneficial electrification into the future.

**Policy Recommendation #5: The State of Colorado should develop workforce development initiatives focused on beneficial electrification.**
Colorado has a high demand and possible shortage of heating, ventilation, and air conditioning (HVAC) and plumbing industry workers. Beneficial electrification will require workers with new skill sets and an understanding of technology. Leveraging the existing workforce education infrastructure and trades, the State should ensure that electrification becomes a part of technical training apprenticeships, and professional licensure. The State should also support the integration of electrification and energy concepts into school curriculums and utility trade partnership programs. Training efforts to develop knowledge and skills for architects, engineers, builders, and associated trades are particularly important to promote beneficial electrification in the new construction market and to ensure quality design and installation practices and high efficiency electrified buildings.

**Policy Recommendation #6: The Colorado Energy Office (CEO) should promote advanced building energy codes and support local jurisdictions with crafting energy codes to address electrification readiness in new construction or otherwise.**

As a home-rule state, Colorado's local jurisdictions adopt building codes. While HB 19-1260[4] requires local jurisdictions to adopt one of the latest three editions of the International Energy Conservation Code (IECC) upon updating or adopting any other building code, those codes do not directly address electrification. Further, whereas some Colorado jurisdictions are leaders in adopting more advanced energy codes, many others need guidance and consistency in developing their own codes. The CEO can build from its current Energy Code Adoption Toolkit[5] to address building electrification opportunities, similar to the guidance provided for electric vehicle (EV) ready ordinances.

**Policy Recommendation #7: The State should prioritize electrification in its own buildings, leading by example and helping develop the marketplace.**

The State has considerable purchasing power and can demonstrate its leadership and help develop the marketplace by electrifying its own buildings. Incorporating beneficial electrification into its High-Performance Certification Program and updating purchasing policies to favor the appropriate installation of heat pumps or heat pump water heaters into its own buildings will create demand that can have effects into the broader marketplace. Influencing stocking practices at distributors and creating successful examples for others to learn from will help create awareness and experience in the marketplace. As a consideration, the State could incorporate the social cost of carbon into its own purchasing economic criteria.

**Recommendation #8: The Colorado Legislature should consider implementing legislation to develop beneficial electrification funds or goals for electric utilities and funding for State-sponsored programming. Electric utilities should participate at an equivalent level with programmatic expenditures used to facilitate program participation by low- and moderate-income households and small businesses.**

Beneficial electrification in buildings is unlikely to substantially increase its market share over the coming decade without considerable programmatic support. Other states have developed utility-sponsored programs to support the market with incentives, technical support, and related market development activities. In our research, the establishment of goals to support electrification predominated, with utility program funding emerging from the goals. In our interviews with utilities, concern over a system benefits charge primarily focused on issues of equivalency and consistency across the multiple utilities in Colorado. While investor-owned utilities may be able to develop programs via PUC rulemaking, unregulated utilities have no such mechanism. But even for regulated utilities, the lack of legislated goals leads to uncertainty and the possibility for inconsistency. Whether via goals or funding, a legislated system benefits charge ensures that all Colorado ratepayers contribute to and have access to beneficial electrification programs, while equivalent goals create consistency in outcome expectations. To ensure equity across the diversity of the residential and nonresidential customer base, a requirement that a percentage of funds be spent on low- or moderate-income and hard-to-reach small businesses will enable a broad range of program participation and avoid customers with particular demographic or firmographic challenges from being left behind. The legislature may want to consider a "ramp-in" to either funding or goals, with early expectations reflecting the reality that the current market requires preparation, with higher levels of

[4] https://leg.colorado.gov/sites/default/files/2019a_1260_signed.pdf

[5] https://energyoffice.colorado.gov/climate-energy/energy-policy/building-energy-codes/energy-code-adoption-toolkit

spending or goal expectations supporting a more robust market later in the decade. A system benefits charge or goal could be structured as a percent of retail revenue or sales, similar to Vermont. Vermont uses goals, with an increasing expectation for achievements over time, ramping from two percent of retail electricity sales in 2017 to 12 percent in 2032. Any goals or funding should also be treated as separate from energy efficiency programs in order to retain the value those programs offer.

In the next section we provide an introduction to this study and a background on Colorado's current policies that relate to beneficial electrification.

# 2 Introduction

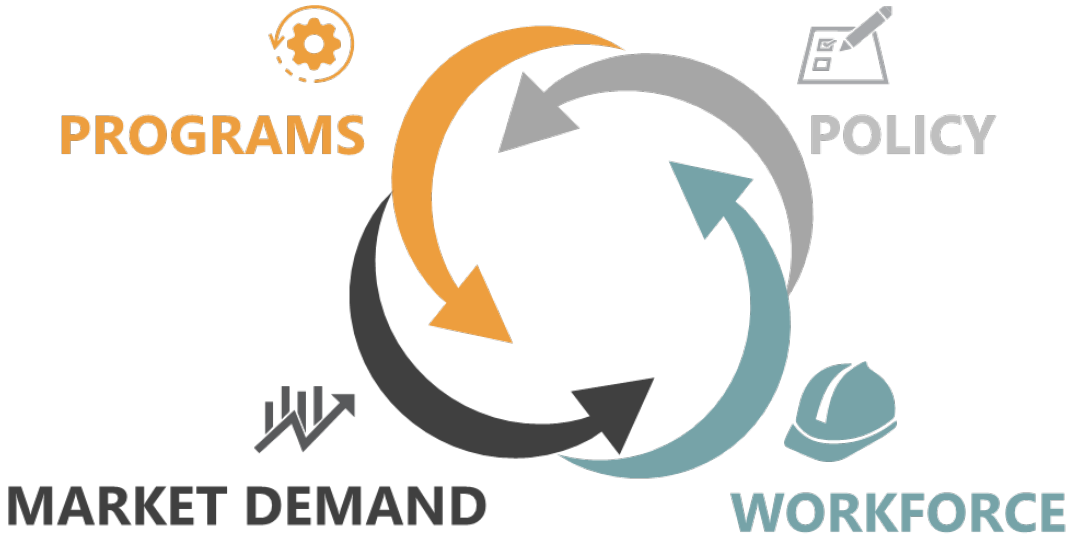
This report presents the results of research into beneficial electrification market barriers and policy related to Colorado's residential and commercial buildings. The purpose of the report is to present the key market barriers for Colorado that were identified through our research and policy recommendations that the State should consider implementing. The study builds from a market assessment in which GDS modeled the potential for and adoption impacts of beneficial electrification that could occur over the next decade (2021-2030). Both the modeling study and this report take into account legislation passed in 2019 and publicly announced utility plans that will result in a substantial reduction in greenhouse gas emissions in the electricity sector over the next ten years and beyond.[6]

To complete the study GDS relied on two major sources of information.

1) Interviews with Colorado representatives from investor-owned, municipal, and cooperative utilities, a power supplier, clean energy advocacy organizations, income-qualified energy efficiency service providers, an efficiency trade association, and sustainability staff from two cities
2) A literature review of current policies in states with the most advanced beneficial electrification policies and programs

In order to drive beneficial electrification in Colorado, GDS identified four major factors that interact to affect the market for beneficial electrification. As shown in Figure 2-1, Colorado will need to tackle the combination of market demand with workforce development, beneficial electrification policies, and programs.

**Figure 2-1 Interrelated Drivers of Beneficial Electrification**




[6] The modeling report developed a base case that assumed an 80 percent reduction in greenhouse gas emissions from electric utilities in 2030 from a 2005 baseline, and achieving a 100 percent emissions reduction in 2050, aligning with SB 19-236 and Xcel Energy's carbon-reduction commitment.

The set of market barriers, program ideas, and policy recommendations presented in this report are meant to provide a set of issues and next steps for Colorado to consider in its development of the beneficial electrification market. There is no one solution, but a mix of solutions that will be necessary to meet the challenge. No single government or market actor action will resolve the challenges. Indeed, even for states with advanced electrification policies, those policies are evolving over time. Colorado can also expect its own markets and policies to evolve over the coming decade, too.

Below we present a summary of Colorado's recent legislative background and policy context for beneficial electrification. Discussions related to Colorado's marketplace for beneficial electrification are presented in our summary of interview results. Lastly, we provide summaries of beneficial electrification policies in four other states. The combination of interview results and policy research led to the development of the key market barriers and policy recommendations presented in the Executive Summary.

## 2.1 BACKGROUND AND COLORADO'S POLICY CONTEXT

Colorado is making substantial progress in decarbonizing its electricity sector. In 2019, Governor Polis signed landmark legislation (SB 19-236) to address avoiding the worst impacts of climate change.[7] This legislation mandated that electric utilities with over 500,000 customers reduce emissions by 80 percent of 2005 levels by 2030, with a target of providing customers with 100 percent clean energy by 2050. Additionally, the legislation codified the concept of beneficial electrification as electrification of an end-use if that electrification:

- Reduces system costs for the utility's customers;
- Reduces net carbon dioxide emissions; or
- Provides for a more efficient utilization of grid resources.

The legislation also directed the Colorado Public Utilities Commission (PUC) to apply a social cost of carbon (SCC) in the benefit-cost calculation of beneficial electrification programs and required public utilities to include SCC as a cost-effectiveness factor in electric resource planning.

As the state decarbonizes its electricity grid, Colorado has the opportunity to further reduce its carbon footprint by shifting other energy uses from fossil fuels to the cleaner grid. Quite simply, with a low-carbon electricity supply, converting end-uses of carbon emitting fuels to electricity provides a pathway for further carbon reductions. Beneficial electrification solves a major challenge of reducing the carbon footprint from the use of fossil fuels since it is difficult with current technologies to cost-effectively scale renewable forms of combustion fuels. Renewable natural gas and hydrogen could theoretically provide a renewable source of combustion fuels but are currently in a nascent market position or still in the research stage of development. Electricity, however, is widely available, has an existing distribution system, and in Colorado, is expected to substantially reduce its carbon footprint by 2030. Hence, electrification can offer a pathway to reducing the use of fossil fuels and their resulting carbon emissions.

Colorado has a complex energy landscape. A majority of its residents are served by two investor-owned utilities – Xcel Energy and Black Hills Energy, with each providing both electricity and natural gas service. Colorado also has a large land area served by 22 rural electric cooperatives that purchase electricity from wholesale power suppliers. There are also more than 25 public power utilities, some of which also provide

[7] https://leg.colorado.gov/sites/default/files/2019a_236_signed.pdf

multiple commodity services including electricity, natural gas, or water. Only investor-owned utilities are regulated by the Colorado Public Utilities Commission. Across the patchwork of energy utilities, electricity and natural gas service territories do not consistently overlap, resulting in two utilities serving a single customer in many cases. Outside of utilities, propane marketers sell and deliver propane to consumers and businesses for space heating, water heating, and other end uses.

Against this backdrop, Colorado utilities have administered demand-side management programs for many years. While investor-owned utilities are mandated to provide these programs, both municipal and cooperative utilities offer programs to their customers. Further, Colorado utilities, and its homes and businesses have made substantial investments in renewable energy, doubling net renewable energy generation to 25 percent between 2010 and 2019.[8] Much more is expected over the next ten years and beyond. The combination of utility- and customer-owned renewable generation and Colorado's experience in delivering energy efficiency services provides a strong foundation for beneficial electrification.

In addition to SB 19-236, Colorado has two recent legislative drivers that influence rules and other policies that can affect beneficial electrification. House Bill 19-1261, signed in May of 2019, commits Colorado to achieve a 50 percent reduction in statewide greenhouse gas pollution by 2030 and 90 percent reduction by 2050, relative to a 2005 baseline.[9] The rules for implementing this economy-wide goal are under development. Unlike SB-19-236 and the mandate for utilities with over 500,000 customers to reduce carbon emission by 80 percent by 2030, this legislation covers all utilities whether regulated by the PUC or not and irrespective of size or energy supply services.

In 2019, Colorado also strengthened its building energy code requirements for local jurisdictions. While local governments still retain jurisdiction over how and when to adopt building codes, HB 19-1260 requires that local jurisdictions adopt one of the three most recent versions of the International Energy Conservation Code (IECC) published by the International Code Council when they make any other building code changes.[10] Local jurisdictions can amend or strengthen the selected IECC code version so long as it does not reduce the energy efficiency outcomes of the code. Additionally, for State funded or owned buildings using 25 percent or more of State funds, the buildings must conform to the State's High-Performance Certification Program.[11] This program also requires that for such buildings undergoing renovations exceeding 25 percent of the building's value, the building must achieve the highest possible Leadership in Energy and Environmental Design (LEED) certification.

Current PUC rules may limit the ability for investor-owned utilities to promote fuel switching, and therefore beneficial electrification, within their energy efficiency and other demand side management programs. In our interviews with utilities and other stakeholders, GDS regularly heard about a "prohibition to fuel switching." These programs impact both natural gas and electricity consumption, but our interviews indicated limited fuel switching measures being offered. Rule 4 CCR 723-4-4756(b) prohibits natural gas utilities regulated by the PUC from promoting fuel switching to other fossil fuel derived energy sources as part of demand side energy programs. Interview respondents were unaware of any other rule, settlement, or regulatory barrier to fuel switching. This uncertainty regarding investor-owned utility prohibitions against fuel switching is an area for regulatory clarification or for new rules to ensure that

[8] https://www.eia.gov/state/?sid=CO
[9] https://leg.colorado.gov/sites/default/files/2019a_1261_signed.pdf
[10] https://energyoffice.colorado.gov/climate-energy/energy-policy/building-energy-codes
[11] https://www.energycodes.gov/adoption/states/colorado

beneficial electrification can be promoted in demand-side management programs. No such limitation exists for cooperative or municipal utilities, which are not regulated by the PUC.

Notwithstanding Rule 4 CCR 723-4-4756(b), these major energy laws, regulations, and policies serve as the foundation that can drive beneficial electrification in Colorado.

In the next section of the report we present the results of interviews with Colorado stakeholders regarding beneficial electrification, the state of the market, and barriers to electrification, as well as policy and programmatic actions that the State should consider supporting.

# 3 Stakeholder Interview Results

To understand Colorado's market barriers to beneficial electrification and gain perspectives on possible policy solutions or future program considerations, GDS interviewed stakeholders from March through May of 2020. These stakeholders came from a wide range of backgrounds and professions, totaling 24 individuals representing their organizations or as representatives of associations. The range of perspectives included:

- Clean energy advocates
- Colorado cities
- Investor-owned utilities
- Cooperative utilities
- Municipal utilities
- Trade associations
- Low-income energy service providers

All respondents had experience with beneficial electrification bringing experience and perspectives ranging from market or program engagement, utilities and policy. The focus of the discussions was on beneficial electrification related to residential and commercial buildings and the challenges or opportunities to drive greenhouse gas emissions reductions via beneficial electrification. The following interview summaries combine the results, retain anonymity for respondents, and are organized by major topic area. Starting with marketplace challenges, the results move to utility considerations, with policy and program considerations included throughout.

## 3.1 COLORADO MARKETPLACE CHALLENGES TO BENEFICIAL ELECTRIFICATION

A major topic for the interviews was to explore how respondents viewed the current Colorado marketplace for beneficial electrification and challenges for expansion. GDS identified several universal themes, plus a few other commonly mentioned topics. We discuss each below.

### 3.1.1 Limited Consumer Awareness and Demand

Every interview resulted in discussion around the current state of Colorado's residential and commercial consumers and their perceptions or awareness of beneficial electrification technology or concepts. Respondents indicated that there is a very low market penetration and awareness of beneficial electrification technologies for buildings –particularly heat pumps, heat pump water heaters, and induction cooktops. While most respondents indicated that *some* electrification was happening in residential and commercial buildings, demand was tepid.

One interview respondent noted that building electrification technologies suffer from an issue similar to electric vehicles – customers do not have a sense of how much energy a product may use and cannot easily convert from more familiar fossil-fuel ratings (e.g. miles per gallon) to make a comparison of what an electrified technology would consume. The absence of an intuitive understanding or at least familiarity with modern beneficial electrification technology is a substantial market barrier to overcome.

Our interview respondents noted that most people simply do not know about the available technology and associated benefits. Additionally, market messages from the past may dampen enthusiasm. For example, our respondents made the following general comments:

- People may think of heat pumps as only working in warmer climates; they are unaware of modern cold-climate technology
- Gas cooking is popular and viewed as superior to traditional electric stoves, with induction cooktops being associated with stoves using electric resistance technology, rather than as a distinct cooking experience
- Consumers may not be aware of the negative health impacts gas cooking can have on their indoor air quality

Perhaps the largest barrier identified by respondents related to consumer habits. Quite simply, people will tend to stick with what they are familiar with, particularly if there is no additional social attribute to drive value. Respondents indicated that space heating and water heating equipment is often not at the top of people's minds. When equipment breaks down, they certainly become aware. However, furnaces, heat pumps, and water heaters otherwise tend to be ignored.

Additionally, the initial cost of equipment is a major barrier. Heat pumps and heat pump water heaters are expensive items for a household or business. Moreover, the availability of capital to invest in a new technology can be an impediment to consumer demand. In general, it will be cheaper to replace a natural gas furnace with another furnace rather than install a heat pump. Household budgets, particularly for low- and moderate-income consumers may not allow for purchasing a heat pump, even if the operating costs of the system decrease. While upfront cost is a traditional barrier to energy efficiency, it may be magnified for beneficial electrification due to consumer or contractor uncertainty regarding operating costs or performance.

As a specific challenge, all our respondents touched on the market for new construction, particularly for new homes. While some noted that there are builders expressing interest in "all-electric" construction, most were viewed as preferring to focus on traditional fossil fuel space heating, water heating, and cooking. Even for buildings willing to the install heat pumps for space heating and water heating, the perceived desirability of natural gas for cooking can overcome cost considerations for extending gas service to new homes. Interview respondents viewed the new construction market as being cautious.

Finally, current and historical market messages may work against driving consumer interest and demand. Respondents spoke of a reluctance by contractors to offer beneficial electrification technologies, or to actively recommend against them. Explored further below, contractors are a key delivery channel for space heating and water heating technologies. Without endorsement by contractors and supported by other positive messaging, homes and businesses may be reluctant to make a change. The view was that, without obvious demand by homebuyers or a desire to differentiate their homes, builders would be cautious about adopting electrification technologies.

Respondents indicated that any future programs will need to develop broad public awareness campaigns with consistent messaging regarding the benefits of beneficial electrification technologies in order to build familiarity and to overcome consumer reluctance. Additionally, programs will likely need to provide significant incentives and/or financing to overcome limitations to -capital availability. Overcoming electrification reluctance by builders was viewed as a crucial program element in avoiding the need for future electrification retrofits and capturing the benefits of designing a home for beneficial electrification from the start.

### 3.1.2 Marketplace Barriers

Interview respondents spoke to the current marketplace for beneficial electrification technologies, noting several key barriers related to the available supply of equipment or contractor practices.

Space conditioning (heating or cooling) and water heating equipment are usually installed by contractors. These contractors typically get their products from distributors, who keep stock on-hand, ready for contractors to make sales. The distributors purchase equipment from manufacturers. For space heating and water heating, this supply chain is crucial to delivering beneficial electrification technologies for Colorado's residential and commercial buildings. Indeed, the most successful energy efficiency programs leverage this supply chain to achieve savings. They key to the supply chain is to ensure that product is available when a consumer is ready to purchase it.

Nearly all our respondents touched on concerns that beneficial electrification technologies may be poorly stocked or stocked with less desirable equipment. Distributors will stock the volume and type of equipment they think will sell. With Colorado's market dominated by natural gas and propane consuming furnaces and water heaters, electrification technologies have limited available shelf-space.

Further compounding the challenge is the nature of purchase decisions. Typically, one will replace a water heater or furnace when it fails. While some consumers will plan ahead and anticipate replacements, "replace on failure" opportunities require quick action to ensure a home is kept warm or cool, and hot water is available. Energy efficiency programs can drive some early replacement sales if energy savings or other value propositions are significant enough to warrant changes. However, equipment must be available at the time a consumer is ready to make a purchase. Even for a consumer ready to install a heat pump or water heater, absent the right equipment being available, the consumer will make an alternative purchase and create a lost opportunity for beneficial electrification. A cycle emerges in which the lack of equipment leads to a lack of sales which leads to a lack of perceived demand which returns to a lack of equipment.

Our respondents also commonly referenced concerns about how contractors may be reluctant to promote or install heat pumps for space conditioning or water heating. Several common themes emerged:

- Contractors may be faced with an unfamiliar technology and be reluctant to learn or risk customer satisfaction. Their lack of confidence leads to a lack of promotion or direct discouragement of beneficial electrification technologies
- Contractors are comfortable with selling and installing fossil fuel technologies and have a natural tendency to take a simpler sales pathway compared to the risk of losing a sale by promoting a different technology that a competitor may not
- Prices may be inflated for heat pump technology due to the lack of familiarity and need to manage risk in the event the installed equipment fails to perform. Higher than necessary prices may also drive their customers to favor less expensive fossil fuel technology.
- Retrofitting a heat pump into a home or business may add complexity and time to a job or require a skill set their firm does not possess or practice. For example, adding a wire run to serve a heat pump with electricity adds time, cost, specific skills, and complexity to a job that can be easily resolved with a fossil fuel system, simply replacing what was already installed.

These issues are all very natural marketplace behaviors but combine to create a supply chain for building owners interested in beneficial electrification technologies that limits the ability for Colorado to scale up

the market without programmatic assistance. Challenges related to contractors are also explored in the next topic related to Colorado's workforce.

### 3.1.3 Workforce Challenges

In every interview we conducted, respondents raised the issue of workforce challenges. These challenges were described in two primary forms:

- a high demand and short supply of HVAC, plumbing, and other associated trades across Colorado's economy, and
- a shortage of workers skilled in heat pump and other beneficial electrification technology installation

These two workforce challenges describe a bottleneck in the supply chain for beneficial electrification, though also for any market relying on workers in the building trades. Respondents described a tight marketplace for labor, with contracting firms competing to attract talent. The effect of this limited labor pool is to drive up the cost of having equipment installed (beneficial electrification or otherwise). It also has the effect of limiting the ability for contractors to develop new product lines and services, including beneficial electrification.

In addition to a tight labor market, our respondents indicated that the skill and knowledge base within the existing labor market directly limits the ability to ramp-up beneficial electrification market share. Quite simply, there is a gap in Colorado's workforce when it comes to awareness, knowledge, and skills associated with specifying, selling, installing, and servicing heat pumps and other beneficial electrification technologies. The effect is that firms that may consider offering beneficial electrification cannot do so or must take on risk with selling and installing equipment their labor force is unfamiliar with.

Our respondents indicated that this issue is an essential concern and should be a part of any program or set of programs. Existing energy efficiency programs have worked with the trades and may be a channel to promote awareness, training, and best practices to build the workforce. However, some respondents indicated that a much broader effort is needed, incorporating Colorado's technical schools, education policies, and approach to developing the next generation of Colorado's HVAC, plumbing, construction, and related industries' workforce.

### 3.1.4 Past Energy Efficiency Program Messaging

Colorado has a history of strong utility energy efficiency programs. Investor-owned utilities, cooperative utilities, and municipal utilities have offered energy efficiency programs for many years. These programs have worked with customers and supply chains to develop products, services, and marketing to promote energy savings. Many of our interview respondents indicated that the messages coming from these programs was positive but may have created a general concern over fuel switching or electrification.

A primary example relates to heating fuels. As noted above, gas utilities regulated by the PUC are prohibited from promoting fuel switching away from natural gas. Historically, electrification options were not viewed as desirable due to cost and performance compared to natural gas. Cold-climate heat pumps and heat pump water heaters are relatively new technologies compared to the options for energy efficiency. Our respondents indicated that the traditional messages related to heat pumps or other electrical heating have created an understanding within the marketplace that using electricity for space heating or water heating is less desirable than high efficiency fossil fuel equipment.

The messaging to customers, contractors, and others in the marketplace have shaped perceptions of electrification equipment. Additionally, incentives for programs have generally been structured as a "like for like" option, with fuel switching not being incentivized. For some technologies, incentives are available, but based on the assumption that a customer was already going to use electrical technology, potentially limiting the incentive by only incentivizing the incremental difference to a more efficient technology.

Our interview respondents all spoke of a need to shift messaging. One challenge is balancing the need to promote efficiency messaging while adding the beneficial electrification message. Effectively communicating the concept of beneficial electrification will add a level of complexity to consumer and trade ally communications. Additionally, some respondents expressed apprehension over how aggressively beneficial electrification should be promoted due to uncertainty regarding customer economics or possible experiences in an immature market.

While some of our utility respondents indicated offering incentives for electrification technologies and promoting them to customers, all indicated limited uptake. Utilities and other respondents spoke of a need to develop consistent messaging related to beneficial electrification, suggesting a need to coordinate across utilities and markets to avoid creating confusion.

### 3.1.5 Uncertainty Related to Electrification in Regulations

During the interviews, two areas of regulatory uncertainty emerged. These areas are:

- Prohibitions against fuel switching for investor-owned utilities
- Uncertainty regarding appropriate funding levels
- Uncertainty regarding the treatment of beneficial electrification in response to HB 19-1261.

These points of uncertainty have an important market barrier component. Utility demand-side management programs are a part of the marketplace. Absent certainty, energy efficiency programs may continue, but beneficial electrification programs may be limited.

As part of the interviews, GDS requested information related to prohibitions to fuel switching in legislation or rules. Municipal utilities and cooperative utilities indicated no legislative or regulatory hurdles to promoting fuel switching or beneficial electrification. Indeed, some of these utilities actively promoted heat pumps and other electrification technologies. For investor-owned utilities, Rule 4 CCR 723-4-4756(b) prohibits a natural gas utility from claiming savings in its demand-side management programs by having customers switch from natural gas to another energy source. However, there was a collective view that promoting fuel switching was generally prohibited for investor-owned utilities, a view shared by multiple interview respondents, including non-utility representative respondents. When asked to provide the rules, settlements, legislation, or other descriptions of fuel switching prohibition, only Rule 4 CCR 723-4-4756(b) was provided.

Regardless of the details related to fuel switching prohibitions, there appears to be a general view that investor-owned utilities may not be able to promote beneficial electrification within their demand-side management programs. Utility energy efficiency programs are an important element in markets for building HVAC and plumbing services and technologies, as well as helping shape the market for new building construction. Our respondents indicated that the PUC should clarify the status of fuel switching or beneficial electrification. Absent the PUC having the authority to do so (a point of uncertainty), respondents suggested that the Colorado legislature should establish the clarity or explicitly authorize the PUC to do so.

A second issue associated with regulatory uncertainty ties to potential program funding levels or goals. Whether a utility is regulated by the PUC or not, beneficial electrification programs will require adequate funding to grow the market and capture the benefits that beneficial electrification can bring. Our interview respondents all made this general observation but offered different perspectives on the issues associated with program funding. These perspectives included:

- A need to develop financing or rebate-style programs to overcome capital availability limitations by customers or to address other market barriers
- The need to ensure that income-limited households and small businesses can participate
- An interest to consider equity *among utilities* to ensure comparative funding levels (e.g. percent of retail revenue) such that all Colorado ratepayers can participate and would experience similar rate effects of funding
- Considerations for an electric utility's natural market incentive to increase electricity sales, suggesting a difference from current energy efficiency programs which create a reduction in revenue
- The ability to link energy efficiency to beneficial electrification efforts in order to continue progress with energy efficiency and leverage it for beneficial electrification, as appropriate, with beneficial electrification operating as a parallel effort to energy efficiency

The lack of certainty regarding funding levels or goals that drive funding limits the electric utility market's ability to move forward in a consistent and assertive manner. Some of our interview respondents suggested this uncertainty could be addressed through establishing statewide funding or goals, while others indicated it could be addressed in the regulatory context of HB 19-1261.

A third area of regulatory uncertainty stems from yet unsettled rules related to HB 19-1261, which developed statewide targets for greenhouse gas emissions reductions, seeking a 50 percent reduction in 2030 from 2005 levels. All our electric utility respondents indicated that without rules addressing electrification, they faced risks that beneficial electrification could create a penalty due to increased emissions driven by increased electricity consumption. While electrification may reduce emissions associated with fossil fuels, there was no mechanism or accounting system to "hold harmless" an electric utility whose emissions would otherwise increase even though net greenhouse gas emissions would decrease.

HB 19-1261 requires the Colorado Air Quality Control Commission (AQCC) to promulgate rules to achieve the reductions targeted in the law.[12] Our respondents suggested a need for the rules to allow for crediting electric utilities with emissions reductions achieved through beneficial electrification or at least be held harmless as more fossil fuel consumption shifts to electricity sources. While Colorado's electric utilities are on a path to substantially reduce carbon emissions, increasing loads through electrification has the potential to increase their own emissions. Despite a net emissions reduction within Colorado as a whole, without an emissions crediting or accounting system, an electric utility and its ratepayers will need to make additional investments due to the choices of others and risk not meeting its GHG emissions targets.

In discussing how these rules might address the challenge that beneficial electrification poses to electric utilities under HB 19-1261, several key recommendations emerged:

- A need for a standardized and simple accounting system to address emissions impacts associated with beneficial electrification measures. Beneficial electrification will result in hundreds of

[12] https://www.denverlawreview.org/dlr-online-article/implementation-of-hb-1261

thousands of small purchases. An efficient accounting system that credits the energy and emissions impacts similar to how energy efficiency programs claim savings will be needed. Respondents viewed it as essential to avoid measure or premise-level accounting for these small transactions.

- Electric utilities will need to know their specific emissions reduction targets from the 2005 baseline in order to take action and track progress to meeting targets.
- The AQCC HB 19-1261 rules should be incorporated into utility integrated resource plans, along with the expected changes in energy loads associated with beneficial electrification.

### 3.1.6 Many Buildings May Not Be Able to Easily Integrate Electrification Technologies

Nearly all our interview respondents indicated that many residential and commercial buildings may have challenges integrating heat pumps and other beneficial electrification technologies. The primary concern related to having an adequately sized electric service panel within the building. This affects both existing buildings and new buildings. In many cases, homes or businesses may need to upgrade electric infrastructure to accommodate the additional electricity demand, adding cost and complexity to potential electrification projects. For new construction, this issue was linked to current building codes and the creation of lost opportunities that could exist for decades to come.

For existing buildings, the state of whole-building energy efficiency was viewed as a challenge. Poorly insulated buildings or buildings with high rates of air leakage mean that heat pumps will need to be larger than otherwise needed, adding cost to the project. Additionally, buildings with inefficient shells may create peak conditions that could lead to suboptimal customer experiences – at very cold temperatures even cold-climate heat pumps may have a challenge responding to rapid swings in the demand for heat. Respondents linked this issue to the ongoing need for energy efficiency programs to help improve whole-building performance. Effectively, a well-designed building or one that has had its shell improved will be better able to integrate a heat pump for space heating while also minimizing the additional electric load on the building.

Respondents that touched on challenges for larger buildings indicated that in some cases heat pumps were very difficult to integrate. For example, buildings designed with large centralized heating systems would require large centralized heat pumps, an expensive and non-typical retrofit option. Others mentioned that water heaters designed for small utility closets may only be able to use electric resistance technology due to space constraints hindering heat pump water heaters. While certainly not a universal issue, the respondents pointed out that in some cases and with current technology and building designs, overcoming technical challenges could be technically accomplished, but only at substantial cost. In cases faced with such a challenge, early adoption of beneficial electrification may not be realistic.

Solutions suggested by the respondents included a mix of possible program options:

1) Using advanced building codes to promote building designs that improve the performance of or ease the integration of beneficial electrification technologies,
2) Promoting whole building energy efficiency and "electrification ready" designs and upgrades. Respondents indicated a possible mix of utility demand-side management programs as well as financing programs through on-bill financing or property assessed clean energy (PACE) style financing
3) Leveraging local programs to incentivize electrified or electric-ready building designs.

### 3.1.7 Electricity Contracts and Rate Designs Do Not Capture Electrification Opportunities

Interview respondents familiar with electricity utility wholesale contracts and customer rate designs indicated that current approaches did not always align with widespread beneficial electrification. Respondents identified a need to develop new approaches or considerations in wholesale contracts and retail rates to optimize the marketplace for beneficial electrification.

The specific issues and concerns varied across respondents. The collective set of concerns point a need for a review of Colorado's electricity markets and how wholesale contracts and retail rates may need to evolve to reflect the changes beneficial electrification may bring. These changes include when and how utility or customer peak loads occur, the structure of demand charges, or the value of having controllable electric loads. The issues overlap and create risks or uncertainty for electric customers and limit utility tariff benefits. The challenges and opportunities include:

- Utilities with low thresholds for triggering demand charge tariffs create a risk for substantially higher electricity bills if customers electrify their loads. This is primarily a risk for smaller commercial customers whose peak winter loads could increase through the use of heat pumps for space heating.
- Setting demand-ratchet tariffs based on 15-minute intervals creates a risk that a single 15-minute period of high demand can increase costs for a month or year. Transient start-up loads may also trigger a higher demand charge than if demand charges were set over a longer time period. Ideally these would align with solar and storage time periods to facilitate customer optimization across several clean energy technologies.
- A lack of critical peak pricing spreads out the peak-demand window for time-of-use rates and reduces the value of short-term load management options available to customers or utilities.
- Long-term bi-lateral wholesale contracts may not have adequate pricing variability or time sensitivity to facilitate load management programs. The wholesale price signal may not be adequate to justify robust and comprehensive load management programs that would help mitigate peak load management.
- A lack of "all electric" rate categories and load management programs reduce the value proposition for customers to consider all-electric buildings and provide their beneficial electrification technologies as a load management asset.

In general, respondents who discussed wholesale contracts and rates indicated that the current electricity marketplace was not adequately capturing the value that electrification technologies could offer, thereby creating risk to those customers who do electrify and dampening demand by reducing the possible benefits of those who might consider electrifying or promoting electrification.

### 3.1.8 Low- and Moderate-Income Households May Not Be Able to Participate in the Beneficial Electrification Market

All interviews touched on the subject of low- and moderate-income Colorado residents, with many touching on challenges serving rural residences. To varying degrees, they raised concerns about the ability of these households to capture benefits associated with beneficial electrification. Further, respondents were concerned that over time, low- and moderate-income households may end up burdened with covering a disproportionate share of stranded costs for a natural gas system that others have exited. While

stranded costs are a long-term issue, the more pressing concern relates to enabling customers with limited incomes to participate in the market. For propane customers, the economic benefits can be substantial, reducing customers' energy burden. However, without access to capital or programs providing substantial cost coverage, many respondents felt that these households would be unable to afford the up-front costs. This issue may also extend to hard-to-reach small businesses.

Under the assumption that ratepayers from electric utilities would fund a beneficial electrification program, our respondents felt that households with limited income should be able to participate as a simple point of equity. Two respondents intimately familiar with low-income energy efficiency programs also pointed out challenges to watch if programs supporting customers emerges. First, energy efficiency technologies should ensure lower operating costs for a household – this may require a careful consideration of total energy cost savings, including air-conditioning and overall efficiency than may be considered now in programs focused on only energy efficiency. However, for homes without air conditioning the savings that modern heat pumps can bring to the total project economics are unavailable. In our modeling report, air-conditioner efficiency improvements were an important part of making a measure cost effective. Additionally, the limited funds available to each household from Colorado's Weatherization Assistance Program (WAP) may not be able to cover the full range of electrical system, building shell upgrades *and* heat pumps or water heating systems. Carefully balancing available utility funding with WAP funding can optimize opportunities for low-income households but may require an expansion in available funding. On-bill financing, which leverages utility capital, may be another option for improving access to energy efficiency and beneficial electrification for any household, but especially those with a limited income.

Second, there was a view that the program infrastructure and staff may not be well versed and familiar with the details of installing a heat pump or making a home "electrification ready." Some respondents felt it might be better to focus on building shell improvements and incrementally work toward getting homes ready for electrification as a programmatic stepping-stone, though some service providers are well versed in the technologies and challenges, and have completed installations of heat pumps in low-income households in the recent past.

All respondents indicated the need to not leave limited-income households or hard-to-reach small businesses behind as beneficial electrification moves forward. Most suggested that current income-qualified energy efficiency programs could be leveraged to include beneficial electrification. However, the issues of electrification will require new creativity in program designs, coordination across funding and delivery services, and care to not increase energy burdens on low-income households over what energy efficiency alone would provide.

In the case of rural residents, particularly limited-income rural residents, respondents expressed concerns that the market barriers to beneficial electrification were magnified, other than perhaps for customers who could reap the cost savings associated with electrifying propane end uses. Programs should work to ensure broad coverage of households (and businesses) in rural areas of Colorado.

In the next section of this report we discuss policy solutions that other states have pursued in supporting electrification efforts as a means to mitigate climate change.

## 3.2 POLICIES IN OTHER STATES

GDS investigated electrification policies in several states that have taken a lead on promoting electrification. California, Vermont, Massachusetts, and New York have each crafted policy directions to help move their energy markets forward to utilize electrification as a means of reducing future greenhouse gas emissions. Each state is unique in its marketplace, history, approach to regulations, and the policy options. Together they provide useful frameworks and examples of opportunities for Colorado to consider.

One theme that GDS identified across several of the states is coordination between state and local governments, utilities, demand-side management programs, and market actors. In particular, coordination appears to play a key role in shifting utility programs from focusing largely on the efficient use of energy to one that considers the overall use efficiency and carbon impact across energy sources. In some cases the coordination extends to linking state-enacted building codes with a larger effort to increase efficiency and drive electrification. Additionally, in California and New York, state facilities are being viewed as an important component to drive markets and emissions reductions.

Below we summarize electrification-related policies from each of the four states to serve as possible examples for Colorado to consider. GDS used the policy experiences of these states to inform our recommendations for Colorado.

### 3.2.1 California

California has long been a leader in clean energy development, including renewable energy, energy efficiency, and fuel economy standards. 2018 legislation requires that 60 percent of California's electricity be generated from clean energy sources by 2030 and 100 percent by 2045 (SB 100).[13] The California Energy Commission is tasked with assessing how the State's facilities can reduce carbon emissions by 40 percent from 1990 levels by 2030. Fuel substitution rules have recently been updated to reflect the benefits that electrification can have for ratepayers and to reduce carbon emissions.

Fuel substitution – the substitution of either electricity for natural gas or natural gas for electricity (regulated fuels) has been allowed as part of California's utility energy efficiency programs. In 2019, the California Public Utilities Commission (CPUC) updated its three-pronged test in response to petitioner concerns that the rule in place at the time did not address changes in the electricity production fuel mix or broader greenhouse gas emissions, as well as needing clarity in terms of application of the rule.[14] The rule was updated to address many of the petitioners' concerns and provides a framework for regulated fuel substitutions. The three-pronged test was modified to:

- No longer require that fuel substitution measures pass cost-effectiveness at the measure level, with cost-effectiveness reflected in a program administrator's overall energy efficiency portfolio
- A net-to-gross ratio of 1.0 is assumed until a net-to-gross evaluation is conducted, thereafter applying the net-to-gross ratio within the overall energy efficiency portfolio
- Require that for utility programs driving fuel substitution, the ratepayers of the fuel being substituted to (e.g. electricity in the case of beneficial electrification) fund the fuel substitution. The ratepayers funding the fuel substitution then have the energy savings accrue to them. The original fuel's energy savings goals are then reduced by the amount of fuel savings

[13] https://www.sacbee.com/news/politics-government/capitol-alert/article218128485.html
[14] https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M310/K053/310053527.PDF

- Clarified that the baseline condition of the measure would follow the same logic as used for the original fuel's baseline – that could be a code baseline, industry standard practice, or existing conditions.

The approach taken in California helps to clarify rules associated with utility-funded electrification efforts for natural gas fuel substitution by electricity consuming measures. It clearly indicates that an electric utility and its ratepayers pay for the fuel substitution, but also gain the benefits, establishes standard baseline and net-to-gross practices, and indicates how fuel substitution fits within the cost-effectiveness framework. The fuel substitution rule has additional provisions that were retained. These include:

- The program must not increase source-BTU consumption[15] (the California Energy Commission establishes the heat rates used for this comparison)
- The program must not adversely impact the environment, with the rule referencing residual emissions factors established in the avoided cost rule.

The fuel substitution rule did not directly address fuel switching from non-regulated fuels (e.g. propane or fuel oil), but referenced a separate proceeding related to building decarbonization (R. 19-01-011).[16] As of this report, the proceedings are still underway but have led to a proposal of several building decarbonization pilot programs.

### 3.2.2 Vermont

In 2015, Vermont enacted a renewable energy standard (RES) that integrated a renewable energy performance standard with distributed renewable energy resources and options for compliance based on "Energy Transformation."[17] The legislation requires electric distribution utilities to retire renewable energy credits (RECS) and associated attributes equal to 55 percent of annual retail electricity sales starting in 2017 (Tier 1). The percentage rises to 75 percent of retail sales in 2032. Distribution utilities are also required to retire RECs associated with distributed generation technologies (nameplate capacity less than 5 MW) equal to one percent of their retail sales (Tier 2). Eligible systems must have been commissioned after June 30, 2015. Finally, under "Energy Transformation," electric distribution utilities are required to either achieve fossil fuel savings or retire distributed renewable energy system credits equal to two percent of retail sales in 2017, rising to 12 percent by 2032 (Tier 3). For all three tiers, utilities have an option to pay an Alternative Compliance Charge. Small municipal utilities (less than 6,000 retail customers) had a two-year delay, to 2019, to meet the requirements.[18]

The Tier 3 Energy Transformation requirements affect electrification. Electric distribution utilities can meet their obligations in several ways, including weatherizing buildings, installing air-source or geothermal heat pumps, biomass heating systems, and other high efficiency heating systems, switching industrial processes from fossil fuel to electric, increasing the use of biofuels, or deploying electric vehicles and charging infrastructure. In this set of options for utilities to consider, electrification of fossil fuel resources enables crediting toward RES obligations. Utilities can earn credits toward Tier 3 obligations via MWh credits derived from a conversion from fossil fuel savings to electricity equivalency. Electric utilities

[15] Source BTU consumption refers to consumption at the point the energy source is produced, not consumed. For example, the energy source for natural gas is typically the point of combustion, while for electricity is the power system.
[16] https://www.cpuc.ca.gov/BuildingDecarb/
[17] https://publicservice.vermont.gov/renewable_energy/state_goals
[18] https://legislature.vermont.gov/statutes/section/30/089/08005

can meet a given year's goal by booking the lifetime of energy savings of Tier 3 projects in the year they were installed. The achievements toward Tier 3 goals then resets each year. Utilities have an option to pay $0.06 per kWh to meet their Tier 3 obligations as an alternative to implementing projects.

Vermont's implementation of programs and initiatives related to electrification are conducted by several types of entities. This includes Efficiency Vermont, the statewide energy efficiency program, the Clean Energy Development Fund[19], focused on wood heating and overseen by the Department of Public Service, and programs offered by utilities themselves. The three groups coordinate incentives and programs that can be used to help meet overall state clean energy goals and reduce greenhouse gas emissions from fossil fuels. Incentives are available for heat pumps and other electrification technologies.

### 3.2.3 Massachusetts

In 2018 the State of Massachusetts enacted Chapter 227 of its 2018 bills, stemming from its House of Representatives bill 4857.[20] Among the bill's provisions included language related to strategic electrification. The law expanded what was allowed within utility energy efficiency and load management plans and programs to include strategic electrification. Along with energy storage and other active demand management strategies, strategic electrification is described as "measures that are designed to result in cost-effective reductions in greenhouse gas emissions through the use of expanded electricity consumption while minimizing ratepayer cost."[21] The law clearly defined strategic electrification in the context of reducing greenhouse gas emissions via increasing electricity consumption. When combined with managing ratepayer cost, this legislation is similar to Colorado's current definition of beneficial electrification.

In late 2018, the State of Massachusetts published its Comprehensive Energy Plan (CEP).[22] The CEP identified a number of policy directions leveraging "investments made in the clean energy sector through electrification," with a key goal to "increase electrification of the thermal sector by providing program incentives for air source heat pumps for heating through Mass Save." Mass Save is Massachusetts's statewide energy efficiency collaborative in which all investor-owned utilities participate. Secondly, the CEP seeks to "drive market/consumer demand for energy efficiency measures and fuel switching." This policy notes that "buildings are long-term assets and choices made in building construction today" have long-term impacts that last decades.

Since that time, Massachusetts's investor-owned electric utilities have introduced measures into their demand-side management programs to incentivize heat pumps for space heating and water heating. The programs have been limited to consumers who would otherwise have used fuel oil or propane as an energy source. In various analyses of cost effectiveness, switching from natural gas to electricity has not been found to be cost effective. As such different incentive offers are available to customers based on their existing equipment and energy uses. Higher incentives are available for customers under "energy

[19] https://publicservice.vermont.gov/sites/dps/files/documents/Renewable_Energy/CEDF/Reports/FY20_Program%20Plan%20and%20Program%20Allocations%20FINAL.pdf
[20] https://malegislature.gov/Laws/SessionLaws/Acts/2018/Chapter227
[21] Accessed from https://malegislature.gov/Bills/190/H4857
[22] https://www.mass.gov/service-details/massachusetts-comprehensive-energy-plan-cep

optimization" incentives targeting electric resistance, fuel oil, and propane using customers, reflecting greater cost effectiveness and a different baseline condition than natural gas users.[23]

Massachusetts also addresses the market for new construction via utility programs (Mass Save) and energy codes. Under Mass Save, new homes receive incentives based on their expected energy performance as determined by a home energy rater. Homes with electricity, natural gas, propane, and fuel oil are all eligible for incentives. Market-based baselines are used to estimate the level of savings, which are all above energy code requirements. Natural gas homes receive their own baseline, while customers choosing other energy sources use a blended baseline assuming a mix of electric, propane, and fuel oil site-based energy consumption efficiencies.[24]

Massachusetts offers two options for energy code adoption by local jurisdictions – a base code and a more stringent stretch code. Local jurisdictions must at least adopt the base code, typically the latest version of the IECC codes or ASHRAE 90.1. The Department of Energy Resources develops a companion stretch code that local jurisdictions can choose to adopt in order to facilitate higher levels of energy efficiency in new construction. Increasing the base code and stretch code is one tool being used to encourage electrification within the new construction market. With increasing building performance standards, the stretch code can drive builders to consider high efficiency cold-climate heat pumps or heat pump water heaters as the efficiency gains over baseline equipment can typically lower a HERS-based performance easier with a heat pump than with a high efficiency furnace. Hence, codes and code policy to promote more stringent building designs are seen as a tool to drive the new construction market toward electrification technologies.

### 3.2.4 New York

The State of New York has been a leader in energy efficiency, setting aggressive reductions in greenhouse gas emissions, and leveraging beneficial electrification. Recently passed greenhouse gas emissions targets envision a 40 percent reduction in statewide emissions by 2030 and 85 percent by 2050, relative to a 1990 baseline.[25] In 2018, the New York State Research and Development Authority (NYSERDA) and the Department of Public Service issued a report outlining broad policy approaches that link energy efficiency programs with energy resource planning, building codes, and electrification, titled New Efficiency: New York.[26] An overall Btu reduction goal was set as a means of moving all markets toward increasing efficiency and greenhouse gas emissions reductions. From these goals, utilities proposed their own programs and targets.

The New Efficiency: New York plan identifies the following key drivers that relate either directly or indirectly to electrification:

- Lead by example and leverage the State's purchasing and decision making in its own facilities to catalyze market development and adoption, while generating cost savings

[23] https://www.masssave.com/rebates
[24] http://ma-eeac.org/wordpress/wp-content/uploads/MA19X02-B-RNCBL_ResBaselineOverallReport_Final_2020.04.01_v2.pdf
[25] https://www.nytimes.com/2019/06/18/nyregion/greenhouse-gases-ny.html
[26] https://www.nyserda.ny.gov/About/Publications/New-Efficiency

- Build a skilled workforce and promoting training for New York workers to accelerate energy efficiency [and by extension, electrification] investments
- Drive energy efficiency and carbon reduction through energy codes and appliance standards
- Improve access for low- to moderate-income consumers
- Develop fuel neutral programs to drive deep energy retrofits and manage challenges in fuel and energy supplies during winter months.[27] The Commission is recommended to address issues associated with the potential scale of cost-effective cross-fuel programs as well as the criteria for determining cost-effectiveness relative to carbon reductions and the benefit cost analysis framework.

The plan also outlines several crucial elements related specifically to beneficial electrification. These include:

- Developing "separate accounting of goals and progress outside of an electricity efficiency sub-target" within the larger Btu reduction goal
- Supporting heat pump adoption to decarbonize heating and cooling
- Utilizing codes and technology to deliver efficient electrification

In January 2020, the Department of Public Service published rules to implement the targets outlined by the carbon reduction legislation and the New Efficiency: New York plan.[28] The Department's rules acknowledged the overlapping roles of the State and utilities in achieving the outcomes. The ruling set targets for utilities, with separate gas and electric targets for each utility (gas and electric, respectively). The utility plans that were approved in the ruling note the prior and expected ongoing collaboration between the utilities and NYSERDA on efficiency and electrification.

[27] Some areas of New York experience gas supply constraints
[28] http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7b06B0FDEC-62EC-4A97-A7D7-7082F71B68B8%7d

# 4 Conclusions

Colorado is well positioned to leverage beneficial electrification for residential and commercial buildings to mitigate GHG emissions. Two foundational laws – SB 19-236 and HB 19-1261 – ensure an electricity grid that will continue to reduce emissions and set targets for GHG pollution reductions across Colorado's economy. Rules and plans emerging from this legislation will chart a course for beneficial electrification efforts over the next decade and beyond. The legislation alone, however, does not ensure that beneficial electrification will be a major contributor to Colorado's efforts to reduce GHG emissions. To realize the full potential that beneficial electrification offers will require additional policies, leadership, and coordinated approaches to stimulate the market and overcome barriers.

GDS Associates' research identified key market barriers that policy or programmatic efforts need to overcome in order to drive beneficial electrification in residential and commercial buildings. These include:

- Limited market awareness by consumers and contractors
- Potential lack of capital to cover upfront costs
- Workforce labor availability and knowledge/skills
- Limited product availability and sales efforts by market actors
- A lack of clarity or consensus on regulated utilities to offer beneficial electrification fuel switching programs or measures
- Challenges related to current building infrastructure that increase the cost or complexity of installing beneficial electrification technology
- An electricity market that does not send price signals that encourage rate design or load control techniques, reducing the value of electrification technologies
- Uncertainty regarding the rules related to HB 19-1261
- A lack of consistent marketing messages to promote and educate the marketplace regarding beneficial electrification

These market barriers can be addressed with policies and programs. The policy recommendations presented in this report will aid the transition to an economy with no net carbon emissions. These include:

- Clarifying fuel switching rules related to beneficial electrification
- Implementing rules related to HB 19-1261 that consider how to manage increased electricity loads and net carbon metrics for electric utilities or others promoting beneficial electrification
- Developing workforce development policies and programs that expand consumer options for implementing beneficial electrification
- State support for localities seeking to implement advanced building codes
- The State leading by example in its own purchasing policies
- Updates to the PUC's cost-effectiveness tests to account for beneficial electrification
- Developing a statewide approach to ensure consistent, equitable, and adequate utility program funding
- The State coordinating and supporting the set of stakeholders engaged in beneficial electrification to develop a network of resilient market actors, long-term market tracking and consistent messaging

Taken together, these policies will help advance Colorado's beneficial electrification marketplace over the next ten years. Colorado should expect that policies and initiatives may need updating based on market responses or unanticipated challenges. If implemented, this initial set of recommendations will help move the market forward and enable Colorado to identify the next evolution of beneficial electrification policies and programs.

# BENEFICIAL ELECTRIFICATION IN COLORADO

*Market Barriers and Policy Recommendations*

**FINAL REPORT**

*prepared for*

**COLORADO ENERGY OFFICE**

July 2020

*prepared by*

GDS Associates, Inc.
ENGINEERS & CONSULTANTS
gdsassociates.com

# ENERGY EFFICIENCY CONSULTING IN LEASED COMMERCIAL BUILDINGS

## *Commonwealth of Pennsylvania*

*Final Report September 2020*

prepared by **GDS Associates, Inc.**

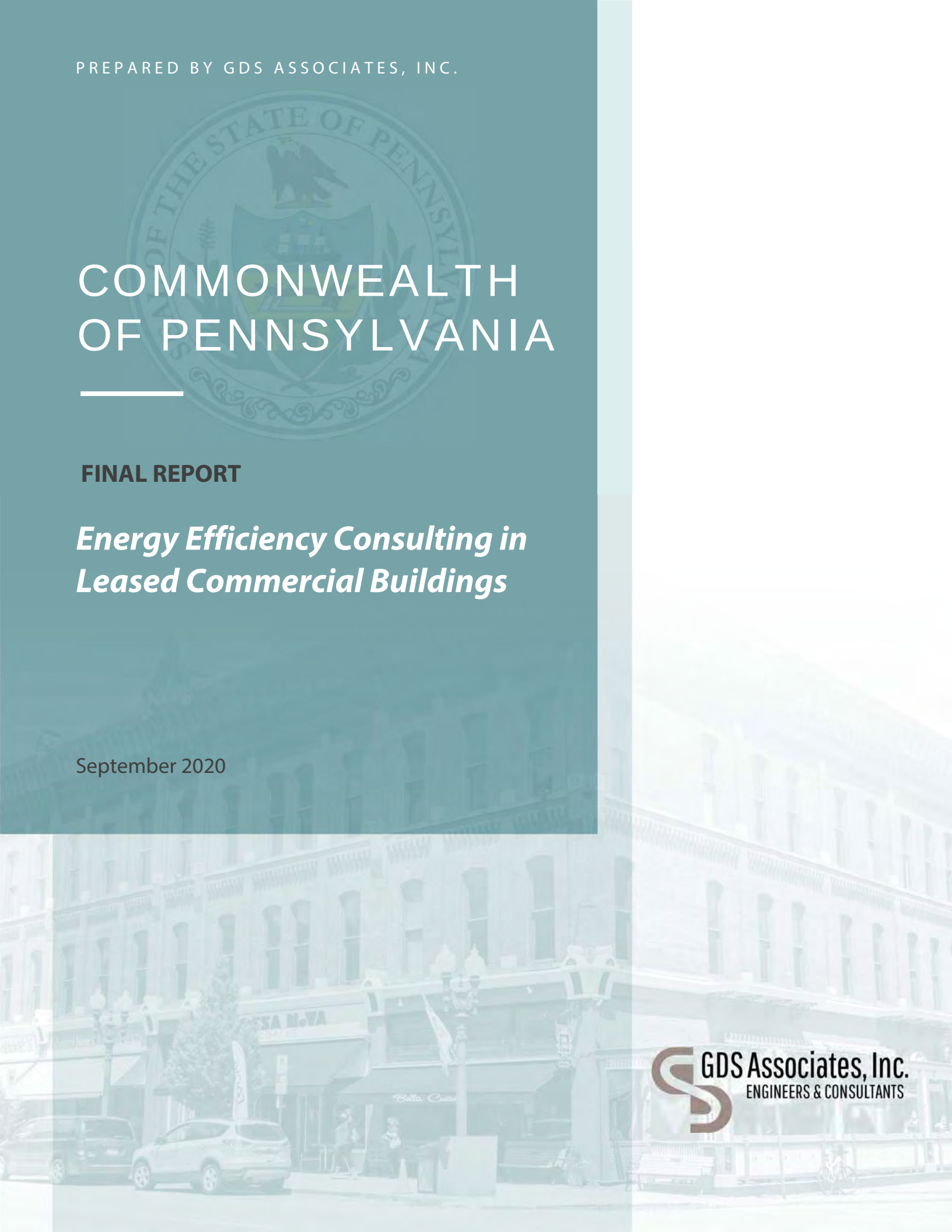
PREPARED BY GDS ASSOCIATES, INC.

# COMMONWEALTH OF PENNSYLVANIA

**FINAL REPORT**

## *Energy Efficiency Consulting in Leased Commercial Buildings*

September 2020



GDS Associates, Inc.
ENGINEERS & CONSULTANTS

# 1 Executive Summary

## 1.1 INTRODUCTION

GDS Associates, Inc. ("GDS") is pleased to submit the final report to the Green Government Council (GGC) of the Commonwealth of Pennsylvania to provide ***Energy Efficiency Consulting in Leased Commercial Buildings*** as part of the implementation of Executive Order (EO): 2019-01 – Commonwealth Leadership in Addressing Climate Change and Promoting Energy Conservation and Sustainable Governance (EO 2019-01). We have a fully executed Contract Number: 4400021468 with the Commonwealth of Pennsylvania available to all using Agencies of the Commonwealth, Participating Political Subdivision, Authorities, Private Colleges and Universities with SAP Vendor Number: 208702.

## 1.2 CORE PROJECT TEAM

GDS extends its gratitude to the members of the project core team, which includes GGC Director Mark Hand, GGC Deputy Director Matthew Reis, Department of Environmental Protection (DEP) Contract Manager Heidi Kunka, and Tracy Surfield, Assistant Director of the Department of General Services (DGS) Bureau of Real Estate (BRE). Their availability and team effort made this project possible.

## 1.3 KEY FINDINGS

The following bullets present the key findings of this six month project:

- Eighty percent of the facilities leased by the Commonwealth fall outside (below) the 20,000 square-foot (SF) threshold in the EO. Therefore, agencies are not required to pursue energy efficiency or carbon savings in these facilities.
- The remaining twenty percent consist of seventy-four (74) buildings. Sixty-five (65) are office buildings. These are the highest priority facilities to examine, subject to the lease renewal timeframe.
- On the cost side, priority should be placed in examining facilities with a cost to lease of $20/SF and above, regardless of size, and $15/SF and above should be prioritized in the 65 office buildings above.
- Interviews with lessors demonstrated little understanding of EO 2019-01, but great willingness to participate.
- Research on available public information on energy efficiency and green leases confirmed that plenty of resources exist. GDS produced a library of publications and websites relevant to the scope of work and recognizes there are many more resources beyond the ones cited.
- Interviews with the core team confirmed that there is generally no data on benchmark scores or building energy intensities among leased facilities, and no such requirement has been made in leases.
- Lessor attitudes toward high performing buildings was directly tied with their experience leasing award winning buildings such as ENERGY STAR® or LEED® buildings. Those with experience saw it as a non-issue. Those without experience expressed some worry and requested some level of handholding.
- Lessors spoke about their interest in leasing to PA, and welcomed a higher level of interaction with the Commonwealth and expressed high regard with the centralized lease operations at BRE.
- Lessors generally recognized that they do some level of internal energy and cost accounting, particularly when they pay the energy cost. A requirement for disclosing energy metrics was generally found to be acceptable.
- Lessors generally welcomed communications and outreach from the Commonwealth and expressed interest in receiving training and technical support to accelerate a shift to high performing buildings.

- Lessors were keen to indicate that a higher level of communication would help balance meeting all the agency requirements with finding a price point that was mutually beneficial. Most worry new requirements will cost more, and PA won't want to pay the improved facility.
- The ENERGY STAR platform provides the most cost-effective platform from which to grow a program for Commonwealth leased space.

# 2 Final Technical Approach & Scope

To accommodate the needs of the parties, particularly related to adjustments due to COVID-19, GDS and the client adjusted the scope to fit the needs. As a memory aide, this section presents the final agreed-upon scope along with the work outcomes.

GDS understands that the Commonwealth of Pennsylvania owns about 8 million square feet (SF) of space and leases another 8 million SF. The purpose of this work is to develop a roadmap for the Department of Environmental Protection (DEP) and its Green Government Council (GGC), and the Bureau of Real Estate (BRE) at the Department of General Services (DGS) so leased space may reflect energy use patterns consistent with Executive Order: 2019-01 – Commonwealth Leadership in Addressing Climate Change and Promoting Energy Conservation and Sustainable Governance. A known hurdle to reach the Executive Order goals is that energy cost is frequently rolled into the lease. We are also aware that the Commonwealth is investing in software-based building asset tools that require agencies to backfill information but recognize that this is work in progress and not available at this time.

Each task is explained below.

## 2.1 TASK 1. KICKOFF MEETING & BUILDING CHARACTERIZATION

For Task 1, the GDS Team organized and lead a virtual kick-off meeting with GGC, DEP and DGS staff, and other stakeholders, as determined by DGS, to discuss the overall scope of work, project outcome, intermediate deliverables, task assignments and the overall project schedule. The initial teleconference included opening remarks, framework and a PowerPoint presentation, with a duration of 1.5 hours. Separately, amore detailed conversations will be held with GSA and BRE staff and are anticipated to last approximately one hour.

GDS made a presentation with available information from the DGS BRE data. The data consisted of information on current leased facilities**.** The goal of this presentation is to verify a common understanding of the nature of the leased building portfolio as follows:

1. ***Market Characterization.*** The GDS Team will coordinate with GGC, DEP and DGS to receive any available studies, reports, databases or tables with building information to identify the market segments, vintages, sizes for all facilities, and total utility bill for owned facilities. GDS and the client agree that GDS will work with existing information to make this characterization. Wherever there is insufficient or incomplete information, GDS will endeavor to make reasonable engineering assumptions which will be disclosed to the client.
2. ***Market Segmentation.*** The GDS Team examined building attributes and compared to published energy saving in existing owned facilities in the market. This information was projected to comparable leased buildings. This segmentation will be reviewed along with the client to ensure buy-in.

### 2.1.1 Task 1 Outcome

GDS received the database of facilities leased by the Bureau of Real Estate which included a characterizaton of space type, size in square feet (SF), and cost to lease per SF. This characterization

allowed GDS to identify buildings above and below the 20,000 SF threshold mentioned in the EO 2019-01. Unfortunately, no energy intensity information is publicly available. Table 2-1 provides the market characterization of facilities leased by the Commonwealth. We identified 379 facilities out of which 305 (or 80 percent) of the leased space corresponds to buildings that are smaller than 20,000 SF. Only 74 buildings are larger than 20,000 SF and only 27 buildings are larger than 40,000 SF. Out of the 27, 23 are office buildings. The other four are one police station, one lab and two driver's license facilities.

The database also demonstrates the predominant building type leased by the Commonwealth is office buildings with 248 leases, police stations at 55, and state health centers at 51. Most of the police stations and health centers occupy less than 20,000 SF.

From this analysis, we observe that most of the leased buildings fall below the 20,000 SF threshold of the EO. The size of facilities to consider for EO compliance are primarily offices with 20,000 SF or larger with a focus on office buildings. In a subsequent effort, should the Commonwealth wish to expand its emission reduction goals to smaller office buildings, and to a lesser extent, police stations and state health centers are the likely places for energy saving opportunities.

**TABLE 2-1.CHARACTERIZATION OF FACILITIES**

| Space Type | Size Characterization | Number of Buildings | Cost / SF | Number of buildings in that bracket |
|---|---|---|---|---|
| **Office General** | <20,000 sq ft | 183 | <$10/sqft | 7 |
| | 20,000-40,000 | 42 | $10-14.99 | 21 |
| | 40,001-60,000 | 10 | $15-19.99 | 109 |
| | 60,001+ | 13 | $20-24.99 | 84 |
| | | | $25+ | 27 |
| **Aircraft Hangar** | <20,000 sq ft | 8 | <$10/sqft | 2 |
| | 20,000-40,000 | 0 | $10-14.99 | 4 |
| | 40,001-60,000 | 0 | $15-19.99 | 1 |
| | 60,001+ | 0 | $20-24.99 | 1 |
| **Driver License** | <20,000 sq ft | 0 | <$10/sqft | 2 |
| | 20,000-40,000 | 0 | $10-14.99 | 0 |
| | 40,001-60,000 | 2 | $15-19.99 | 0 |
| | 60,001+ | 0 | $20-24.99 | 0 |
| **Garage** | <20,000 sq ft | 1 | <$10/sqft | 0 |
| | 20,000-40,000 | 0 | $10-14.99 | 0 |
| | 40,001-60,000 | 0 | $15-19.99 | 0 |
| | 60,001+ | 0 | $20-24.99 | 1 |
| **Labs** | <20,000 sq ft | 0 | <$10/sqft | 0 |
| | 20,000-40,000 | 0 | $10-14.99 | 0 |
| | 40,001-60,000 | 1 | $15-19.99 | 0 |
| | 60,001+ | 0 | $20-24.99 | 0 |
| | | | $25+ | 1 |
| **Police Station** | <20,000 sq ft | 54 | <$10/sqft | 0 |
| | 20,000-40,000 | 1 | $10-14.99 | 23 |
| | 40,001-60,000 | 0 | $15-19.99 | 16 |

[1] EO 2019-01 Section 6. Responsibilities of Commonwealth Agencies, Section (a).4

| Space Type | Size Characterization | Number of Buildings | Cost / SF | Number of buildings in that bracket |
|---|---|---|---|---|
| | 60,001+ | 0 | $20-24.99 | 12 |
| | | | $25+ | 4 |
| **Residential** | <20,000 sq ft | 6 | <$10/sqft | 0 |
| | 20,000-40,000 | 1 | $10-14.99 | 5 |
| | 40,001-60,000 | 0 | $15-19.99 | 1 |
| | 60,001+ | 0 | $20-24.99 | 1 |
| **St Health Ctr** | <20,000 sq ft | 50 | <$10/sqft | 0 |
| | 20,000-40,000 | 1 | $10-14.99 | 9 |
| | 40,001-60,000 | 0 | $15-19.99 | 26 |
| | 60,001+ | 0 | $20-24.99 | 15 |
| | | | $25+ | 1 |
| **Storage** | <20,000 sq ft | 3 | <$10/sqft | 6 |
| | 20,000-40,000 | 2 | $10-14.99 | 0 |
| | 40,001-60,000 | 1 | $15-19.99 | 0 |
| | 60,001+ | 0 | $20-24.99 | 0 |
| **Total** | <20,000 sq ft | 305 | <$10/sqft | 17 |
| | 20,000-40,000 | 47 | $10-14.99 | 62 |
| | 40,001-60,000 | 14 | $15-19.99 | 153 |
| | 60,001+ | 13 | $20-24.99 | 114 |
| | | | $25+ | 33 |

In Table 2-2, the same database is organized by size instead of building type to confirm the earlier conclusion: ***most buildings fall below the threshold of the EO, therefore the universe of actionable faciliteis is small***. Those that do are primarily office buildings. What is new is the consideration of cost to lease per SF. While all facilities should be considered, the 8.7 percent of facilities where the cost to lease is $25/SF or more are the logical starting point. From that point downward, those that cost $15/SF or more.

The team also noted that DEP has a leadership role in demonstrating the merits of energy efficiency in buildings. Table 2-2 has a section for DEP, and for all PA buildings. A total of nine buildings are required to meet the EO goals, but for a strong lead-by-example role perhaps DEP may want to consider extending the energy efficiency parameters to all its leased space.

**TABLE 2-2. COSTS, COUNTS AND PERCENTAGES OF BUILDINGS (ONLY DEP OFFICE, ALL OFFICE, ALL BUILDINGS, BY SIZE**

| COUNTS | | | | PERCENTAGES | | |
|---|---|---|---|---|---|---|
| Square Footage Range | DEP Office Buildings | All Department Office Buildings | All Buildings | DEP Office Buildings | All Department Office Buildings | All Buildings |
| **<20,000** | 13 | 183 | 305 | 59.1% | 73.8% | 80.5% |
| **20,000-40,000** | 2 | 42 | 47 | 9.1% | 16.9% | 12.4% |
| **40,001-60,000** | 3 | 10 | 14 | 13.6% | 4.0% | 3.7% |
| **>60,000** | 4 | 13 | 13 | 18.2% | 5.2% | 3.4% |
| Cost to Lease/Square Foot Range | DEP Office Buildings | All Department Office Buildings | All Buildings | DEP Office Buildings | All Department Office Buildings | All Buildings |
| **<$10** | 2 | 7 | 17 | 9.1% | 2.8% | 4.5% |
| **$10-14.99** | 0 | 21 | 62 | 0.0% | 8.5% | 16.4% |
| **$15-19.99** | 9 | 109 | 153 | 40.9% | 44.0% | 40.4% |
| **$20-25** | 9 | 84 | 114 | 40.9% | 33.9% | 30.1% |
| **>$25** | 2 | 27 | 33 | 9.1% | 10.9% | 8.7% |

Another characterization relates to the cost per square foot that the Commonwealth pays for its leased facilities. Notice that there is a wide range of rates, and seven buildings are larger than 40,000 SF.

The first target facilities that should be engaged in energy efficiency are 23 office buildings that are 40,000 SF or larger, with a possible extension to the other 4 large buildings which are a lab, a police station and two driver's license facilities. The secondary target are the 42 office buildings in the range of 20,000-40,000 SF. This, however, is subject to agency-level desire to participate.

***Task 1 Validation.*** Task 1 validated the work plan and project schedule to meet the needs of GGC, DEP and DGS in consultation with BRE. The GDS team familiarized themselves with DGS leasing operations, the latest information on building leased space and any other relevant issues. At the project kick-off meeting, GGC provided background on the Pennsylvania 2019-01 Executive Order. GDS facilitated the rest of the meeting.

The proposed agenda for the initial virtual call was:

**1** Introductions and reminder of the Executive Order
**2** Review agenda, program goals and deliverables, and revise if necessary
**3** Discussion on the current program and barriers to implementation

The subsequent call with BRE will discuss:

**4** GDS understanding of the baseline data of existing leased buildings
**5** Obtain input on methods to overcome barriers
**6** Next steps

***Deliverable.*** Following the kick-off meeting, the GDS Team submitted summary minutes of the meeting with action items. As needed, GDS submitted an updated work plan that documents any revisions to the initial project scope as well as an updated detailed schedule for completion of interim deliverables and final report products. Task 1 Deliverable is included in *Appendix A.1, Task 1 Kickoff Meeting Minutes.*

## 2.2 TASK 2. INDUSTRY 'GREEN' BEST PRACTICES FOR LEASED FACILITIES

The purpose of this task was to compile and summarize the best practices in the industry, so they are applicable to the facilities in the Commonwealth. GDS utilized publications from US EPA ENERGY STAR, particularly materials devoted to office space benchmarking and participation from the property management industry, similarly, GDS engaged resources from the US Department of Energy Better Buildings Program and the Institute for Market Transformation *Green Lease Leaders* in search for examples suitable for the Commonwealth. Finally, reviewed publications from the Building Owners and Managers Association International (BOMA) *Best Practices*, ACEEE, NAESCO, The National Labs and other published information available online.

***Deliverable.*** A summary report including best practices for leasing specifications. The summary report is included *Appendix A.2, Task 2 Industry Green Best Practices for Leased Facilities Report*. This report contains links to the publications or the websites.

### 2.2.1 Task 2 Outcome

GDS identified a library of 23 documents which are included in Apendix A.2. Perhaps the most relevant to this project is also presented as *Appendix A.2, Task 2 Industry Green Best Practices for Leased Facilities Report*. The library was submitted and accepted by the GGC. Note that after submitting the Task 2 deliverables, GDS identified additional resources to address financing considerations.

#### *2.2.1.1 Introduction to Green Leasing*

***Institute for Market Transformation.*** *(2019).* Green Lease Leaders: Green Leasing Spurs Efficiency Improvements in Cleveland Business and City Buildings, a short report that includes green lease case studies, benefits of partnerships, and advantages of green leases for small businesses.

***Institute for Market Transformation.*** *(2017).* Building a Successful Green Lease with Useful infographic & quick facts.

***Institute for Market Transformation.*** *(2015).* What's in a Green Lease? A report on a study conducted by the Institute for Market Transformation. Provides a good summary on what a green lease is, benefits and energy savings from green clauses, and financial value of energy savings.

***Northwest Energy Efficiency Alliance.*** *(n.d.).* Leverage Leasing Practices to Reduce Energy and Utility Costs. This is a Toolkit with actionable steps for landlords and tenants to learn about the benefits of green leasing, explore the opportunities for green leasing at their building, and begin the process to create a green lease.

***ABC: A Better City.*** *(2014).* Green Leasing: An Effective Tenant/Landlord Strategy for Energy Efficiency. Detailed report that provides a background and introduction to green leasing. It also includes model language from guidance documents and case studies and best practices from around the US.

***BOMA International.*** *(2018).* Green Lease Guide. Detailed green lease guide that covers all aspects of a standard lease agreement, such as models for prime lease agreements, guaranty of lease, and form subleases.

***Green Building Alliance.*** *(n.d.).* Green Leasing. Another webpage that describes how green leases work, factors that affect the applicability of using a green lease, and advantages of green leases.

#### *2.2.1.2 Green Lease Language*

***Environmental Protection Agency and U.S. Department of Energy.*** Specification Language for Pursuing Energy Efficiency Goals with ENERGY STAR.

Also related to lease language modification is the ***Retail Industry Leaders Association, Institute for Market Transformation. (n.d.).*** Retail Green Lease Primer. It is a table that includes potential lease modifications, example lease provisions, and costs and benefits.

***Green Lease Library, Guidance & Case Studies.*** This is not a publication, but instead it is a webpage with resources on: (a) How to develop, negotiate and implement green leases, (b) Public sector green leasing resources; (c) Landlord-Tenant Energy Partnership-- Get help unlocking energy savings in leased space

#### *2.2.1.3 The Business of Green Leases*

***Northwest Energy Efficiency Alliance.*** *(n.d.).* Selling Efficient Spaces: Brokers Bring Green Into the Equation. This is a Toolkit that provides brokers with the actionable resources they need to ensure that they capture the full value of efficiency when a building is sold or leased. It also provides owners and managers with insights into brokers' priorities in facilitating the sale of a commercial property.

***Rocky Mountain Institute. (****2018).* Best Practices for Leasing Net-Zero Energy Buildings. An actionable guide explaining the business case and process for developers and landlords to pursue net-zero energy leased buildings.

#### *2.2.1.4 Green Lease Negotiations*

***Natural Resources Defense Council.*** *(2013).* Selecting High-Performance Tenant Space: A Pre-Lease Guide. Fact sheet that includes key steps for choosing a high-performance space and NYSERDA case study.

***Natural Resources Defense Council.*** *(2011).* Energy Efficiency Lease Guidance. A document that provides direction for negotiating commercial leases that enable resource efficiency. Provides accurate explanation of incentives so the landlord and tenant have sufficient information and economic motivation to make the most energy efficient choices.

***Rocky Mountain Institute, Urban Land Institute, BOMA International.*** *(2020).* Unlocking Hidden Value in Class B/C Office Buildings. A report intending to simplify and streamline energy efficiency and green leasing opportunities for Class B/C office owners and provide strategies that are appropriately tailored to the reality of the market.

#### *2.2.1.5 Innovation*

***American Council for an Energy-Efficient Economy (ACEEE).*** *(2012).* Guiding the Invisible Hand: Policies to Address Market Barriers to Energy Efficiency. This paper considers a few innovative policies designed to address specific barriers to efficiency.

***Rocky Mountain Institute, BOMA International.*** *(2012).* Working Together for Sustainability: The RMI-Boma Guide for Landlords and Tenants. A Guide that outlines 5 actionable steps: Make energy use and costs more transparent; Engage building occupants in saving energy; Incorporate energy efficiency in corporate fit-outs; Plan for deep energy retrofits; Structure agreements to benefit both parties; Includes resources for each step

#### *2.2.1.6 Outreach and Recognition to Property Owners*

***iPropertyManagement. (n.d.).*** Going Green: A Landlord's Guide for Fun & Profit. Guide that covers ways to conserve energy and water as a landlord. Most methods in this guide will pay back incentive in just a few years.

***The Balance Small Business.*** *(2019).* How Landlords Can Reduce Utility Bills. Webpage that lists benefits of reducing utility bills for landlord paid utilities and tenant paid utilities and tips for reducing gas, electricity, and water bills.

***US Department of Energy, Institute for Market Transformation, Lawrence Berkeley National Laboratory.*** *(2018).* Reference Guide for Landlords. A reference guide for landlords. Provides prerequisites and credits needed to qualify for Silver and Gold level recognition.

#### *2.2.1.7 Continuing Education for Commonwealth Staff*

***National Renewable Energy Laboratory.*** *(n.d.).* Assessing and Reducing Plug and Process Loads in Office Buildings. Document provides “quick start” for office buildings looking to reduce plug and process loads Interface. (n.d.). MaterialsCAN Carbon Action Network. Webpage that describes operational and embodied carbon along with several useful resources and case studies.

***US Agency for International Development.*** *(2015).* Guide to Promoting an Energy Efficient Public Sector. Guide that provides strategies and success stories for government action on energy efficiency. Discusses the benefits of public sector energy conservation, program start-up advice, and energy management in existing buildings.

#### *2.2.1.8 Financing*

***US Department of Energy.*** Federal Financing Programs for Clean Energy. Download at the federal site.

***American Council for an Energy-Efficient Economy (ACEEE).*** State and Local Policy Database on Financial Incentives. A webiste with examples by state.

***US Department of Energy. Property Assessed Clean Energy Programs.*** Webpage on local government resources that explains PACE as The property assessed clean energy (PACE) model is an innovative mechanism for financing energy efficiency and renewable energy improvements on private property. PACE programs exist for: Commercial properties (commonly referred to as Commercial PACE or C-PACE), Residential properties (commonly referred to as Residential PACE or R-PACE).

***Investopedia, Property Assessed Clean Energy (PACE) Loan, By Troy Segal.*** This is a webpage that was updated Jun 25, 2019, verified September 2020. What Is a Property Assessed Clean Energy (PACE) Loan?

## 2.3 TASK 3. INTERVIEWS WITH LESSORS TO SEEK WIN-WIN OPPORTUNITIES

In this task, GDS explored opportunities with seven (7) existing property owners and managers of buildings with existing leases or where leases were up for negotiation. GDS coordinated with DGS BRE to perform telephone interviews with a selection of existing lessors as determined by DGS BRE. GDS used a script of questions as agreed upon by DEP, GGC and DGS in consultation with BRE. GDS interviewed seven lessors, (up from the minimum target of four lessors) with the largest SF or other criteria decided by BRE. The team gauged their interest in pursuing cost effective energy retrofits or other best practices identified in Task 2. The emphasis was placed on buildings that are (a) large and (b) have upcoming lease negotiations. GDS met with DGS BRE to discuss agency requirements for upcoming or pending lease negotiations prior to interviews taking place. GDS will reach out to the ENERGY STAR® to seek ways to leverage their program among commercial building owners, tenants and managers. GDS drafted an interview guide and send it to the core team at DGS, GGC and BRE staff as necessary for review and comment. Members of the core team participated in each interview.

***Deliverable.*** A summary report including Interview questions and an organized summary of responses received. The summary report is included as *Appendix A.3, Task 3 Lessor Interview Summary,* with a supplemental attachment that included the guide for the interviews. This guide is provided *as Appendix A.4, Task 3 Supplement-Interview Questions.*

### 2.3.1 Task 3 Outcome

The desired outcome of this project is for GSA, DEP and GGC to have a roadmap that contains the actions that are most likely going to yield measurable results tied to the goals of EO 2019-01. This is provided in this report. We also sought to peak the interest of lessors. The following ideas are guidance to disrupt the market.

- ***No. 1.*** Lessors are mostly unaware of the EO 2019-01. The few that knew the order learned about it during lease negotiations led by BRE over the last year, or because they were interviewed as part of this project. And yet, they all identified with the purpose and goals of the EO.
- ***No. 2.*** The team found connections between what the Commonwealth and vendors want in a lease relationship, beyond SF and $. These are: better communications and opportunities to improve business. The interviewees were very excited that they were individually recognized to be a part of this project. Also, they either agreed that it was time to improve environmental performance or at least have an open conversation about it.
- ***No. 3.*** Outreach and training were identified as promising paths to be developed. Lessors welcomed opportunities for training to discover the value of energy efficiency and other performance measures. They want engagament to put those ideas to the test. An updated lease language could be one such idea, but not the only one. Public recognition may be another. A newsletter may be another. Technical support may be another.
- ***No. 4.*** With some guidance and clear messaging from the Commonwealth, ideas and processes may originate from the vendors. If it's their idea, maybe they will want to lead it!
- ***No. 5.*** Not all agencies are equal. Agencies that ask for performance, get it. The lessors respond to what is requested of them.

## 2.4 TASK 4. OUTREACH ENGAGEMENT MEETING

For this task, GDS made a presentation of the project and the roadmap to the Executive team. This included invitations to Secretary Topper and McDonnell, among others.

This invitation-only workshop was led by Julio Rovi. DGS DEP, GGC and BRE representatives were present for the meeting. GDS will produced the draft invitation and monitored RSVPs. Due to restrictions due to COVID-19, task 4 was conducted virtually.

**UPDATED *Deliverable.*** The roadmap/project PPT presentation as a deliverable, which can be modified for use by BRE, so that the BRE team can conduct outreach to the Lessor community after the contract period. This file was sent and accepted by Director Mark Hand.

### 2.4.1 Task 4. Outcome

Led by Julio Rovi, the GDS team provided a presentation to Commonwealth Directors and Senior staff. The summary notes of the roadmap presentation is included as *Appendix A.4, Task 4 Outreach Engagement with Directors.* The PowerPoint slides were provided to Director Mark Hand for subsequent use by the GGC. The PDF version of the deck is provided in *Appendix A.6 Roadmap Presentation*.

## 2.5 TASK 5. ROADMAP TARGETING THE LESSOR COMMUNITY & BUREAU OF REAL ESTATE

This final task is devoted to generating the final report that will help the Commonwealth accelerate the adoption of energy efficiency in leased space. It will include all recommendations that GDS and GGC, DEP and DGS see as viable among the ideas generated from the kickoff-meeting to the lessor workshop.

The overall deliverable is a roadmap to assist the Bureau of Real Estate (BRE) in future lease negotiations. It will include information such as:

- "Industry 'Green' Best Practices for Leased Facilities", resources for lease negotiations.
- Available financing information such as Commercial Property Assessed Clean Energy or other financing information.
- DEP-specific lease specs (using the Commonwealth's formatted standard template)
- Menu of resources for use by BRE and that can also be provided to Lessors
- Toolkits for all stakeholders
- Additional resources outside of the State to work with GGC, DEP DGS-BRE on best practices
- Identification of opportunities for leasing coordinators to be more knowledgeable when negotiating lease contracts
- Identification of additional resources available to assist with identifying potential cost savings.

***Deliverables.*** GDS prepared a draft report, sent and reviewed it with the core team for review and comment. Then GDS prepared this final report.

### 2.5.1 Task 5 Outcome

This report is the outcome of Task 5. Section 3 (page 13) provides the description of the methodology and recommendation from GDS to the Commonwealth.

Besides the roadmap, the project requested the following materials:

| Request | Section Reference |
|---|---|
| "Industry 'Green' Best Practices for Leased Facilities", resources for lease negotiations. | 2.2.1.1 Introduction to Green Leasing |
| Available financing information such as Commercial Property Assessed Clean Energy or other financing information | 2.2.1.8 Financing |
| DEP-specific lease specs (using the Commonwealth's formatted standard template) | 2.2.1.2 Green Lease Language<br>2.2.1.4 Green Lease Negotiations |
| Menu of resources for use by BRE and that can also be provided to Lessors | 2.2.1.3 The Business of Green Leases<br>2.2.1.4 Green Lease Negotiations |
| Toolkits for all stakeholders | Everything in Section 2.2.1 Task 2 Outcome |
| Additional resources outside of the State to work with GGC, DEP DGS-BRE on best practices | 2.2.1.6 Outreach and Recognition to Property Owners |
| Identification of opportunities for leasing coordinators to be more knowledgeable when negotiating lease contracts | 2.2.1.3 The Business of Green Leases |
| Identification of additional resources available to assist with identifying potential cost savings | |

# 3 The Roadmap

## 3.1 ROADMAP CHOICES

The core team focused on two performance goals for State Agencies in the EO 2019-01. First, Collectively reduce overall energy consumption by 3 percent per year, and 21 percent by 2025 from 2017 levels. Second, replace 25 percent of the state passenger car fleet with battery electric and plug-in electric hybrid cars by 2025 and evaluate opportunities for the reduction of vehicle miles traveled and incorporation of new technology where appropriate. For the purposes of this roadmap, we simply acknowledge the need to make install EV charging stations in leased facilities. The calculation of amount, analisys of type or other design aspects are outside the scope of this project. Therefore, the focus is on reducing energy consumption.

In our methodology, we established five variables of interest, which we call the dimensions, and establish three scenarios from which we explore the creation of a roadmap for the Commonwealth.

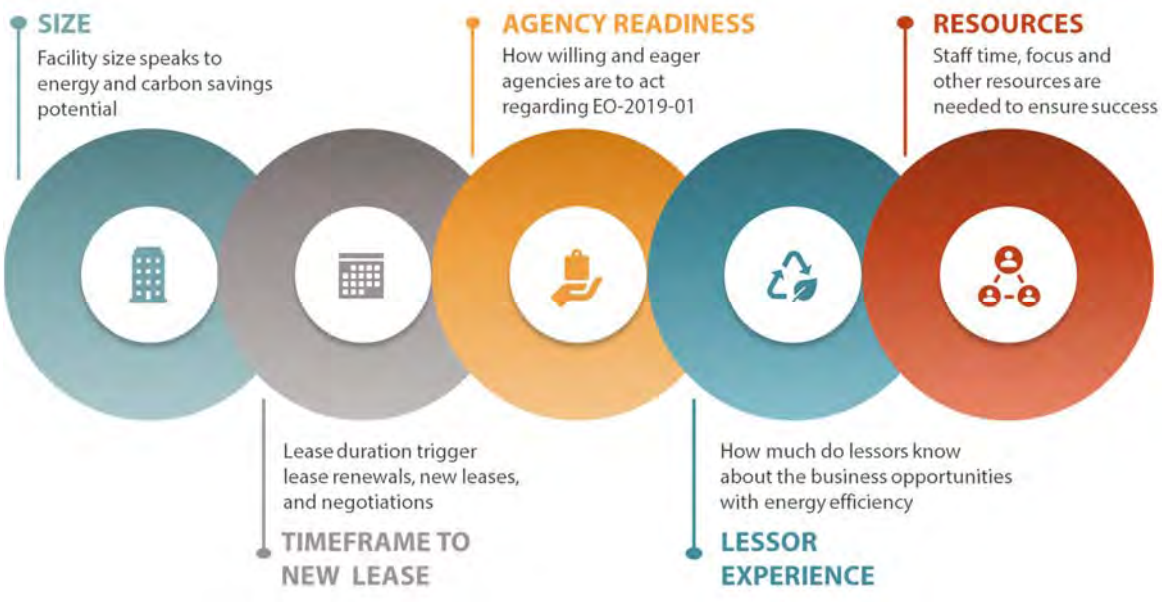
The GDS team will focus on reducing energy waste as a the primary strategy for energy efficiency and carbon savings. Monetary savings from rate restructuring, cost of service auditing, or other accounting mechanisms, while possibly desirable for the Commonwealth, are not considered for the roadmap.

**DISCLAIMERS:**
*The GDS Team acknowledges that due to COVID-19 leased facilities have a lower occupany. Any energy saving that are the result of the pandemic should not be counted as true savings toward the EO-2019-01 goal. However, if this condition remains over a period greater than two years, the baseline should be reset to whatever the new normal is.*

## 3.2 DIMENSIONS: FIVE DEGREES OF FREEDOM

While there are many ways of starting a program to improve energy efficiency in leased facilities, the GDS team identified five topics that are essential in the Commonwealth, which are shown in Figure 3-1. The five dimensions are: (1) size of the facility, (2) time to lease renewal and content of the lease, (3) agency readiness, (4) lessor experience, and (5) resources allocated to project.

**FIGURE 3-1. DIMENSIONS, FIVE DEGREES OF FREEDOM**



## 3.3 SCENARIOS

To facilitate the creation of the roadmap, GDS created three conceptual scenarios.

1. ***Base Scenario:*** this scenario can also be considered as business as usual, maintaining current policies and staff focus. This scenario is not likely to measurably contribute to the EO-2019-01 goals.
2. ***Moderate Scenario:*** In this scenario GGD and BRE make a concerted effort toward building performance improvement to make sure there are some measurable contributions to meet the EO 2019-01 goals somewhat.
3. ***Proactive Scenario:*** In the Proactive scenario there is a more active pursuit of policy, program and investment to change toward a green lease operation which will contribute measurably towards the goal.

### 3.3.1 Base Scenario

***Size:*** No distinction by facility size, no new policies to supplement EO 2019-01, and no acceleration of policies to reduce total SF.

***Timeframe & Contracts:*** There is no significant distinction in timeframe of lease renewal or renegotiation. GGC and BRE introduce minimal new changes to lease contract language such as annual calculated energy use intensity (EUI) and ENERGY STAR performance rating. Yet, no maximum energy EUI will be required or minimum ENERGY STAR score.

***Agency Readiness:*** Basic outreach to agencies to increase compliance, but no quotas set.

***Lessor Experience:*** A modest communications and outreach program will provide opportunities for lessors to learn about best practices in the leasing business.

***Resources:*** No change in funding, staffing or training oriented towards transitioning into a green lease operation.

### 3.3.2 Moderate Scenario

***Size:*** Size matters. a) large>=40,000 SF; (b) medium are 20,000 to 40,000 SF; (c) are below 20,000 SF. New policies and lease terms apply for medium and large buildings. See detail.

***Timeframe & Contracts:*** Renewal dates matter. Attention to tracking and accelerating dates for no less than 4 agencies. New policies on equipment in buildings provided by lessor for all agencies inserted into lease starting 2021.

1. Quarterly benchmarking required and max EUI <= 5% below average EUI for state-owned buildings, and ENERGY STAR rating 5% higher than state-owned buildings.
2. Starting in 2021, DEP will use ENERGY STAR qualified products for all products owned and operated by the lessor on behalf of the lessee, including lighting products, rooftop products, office equipment, vending machines, and water coolers.
3. There will be a mandatory adoption of specific measures tracked in the annual review checklist (such as EV charging stations).
4. BRE wil require an ASHRAE walk through audit be performed to gauge the performance of the building during the renegotiation walk-through.

Additional policies start in 2024.

1. New and renewal leases require ENERGY STAR label, or LEED certification, or other recognition adopted by the Commonwealth.
2. ENERGY STAR label in all lessor provided products, such as commercial boilers, Laboratory Grade Refrigerators and Freezers, Pool Pumps, qualified HVAC equipment and commercial food service equipment, where the designers specify equipment in the range of ENERGY STAR qualified products.
3. A benchmarking reporting requirement for buildings where all or part of the building is leased. Monthly tracking is required with maximum EUI and minimum ENERGY STAR performance rating specified. AGENCY READINESS: DEP will lead the adoption of green policies in all/most its leased facilities. GGC will identify no less than 4 other agencies to match DEP policies.

***Agency Readiness:*** DEP will lead the adoption of green policies in all/most its leased facilities. GGC will identify no less than 4 other agencies to match DEP policies.

***Lessor Experience:*** GGC and ally departments will maintain a targeted communications and outreach program. GGC will lead efforts in training and outreach to promote competition, best-practices, business exchanges, and leverage federal programs such as:

1. Schedule training opportunities to learn about ENERGY STAR, LEED, the federal GSA green building specification, and other high-performance building programs.
2. Training opportunities to learn about best practices related to energy efficiency, energy assurance, resiliency and low carbon in the leasing business.
3. Look-ahead calendar up upcoming leasing opportunities (to encourage competition).
4. News and best practices to improve business while reducing the carbon footprint.
5. Participation on Commonwealth sponsored business exchange programs for engineers and vendors to exchange information on reaching high performing buildings.
6. Leverage national behavioral programs to engage agency staff participation in energy efficiency best practices, such at the EPA Energy Treasure Hunt.
7. Participate in national recognition programs to receive building labels such as LEED or ENERGY STAR.
8. Explain advantages to lessors embedded in lease renewals.

***Resources***: Staff receives training oriented towards transitioning into a green lease operation. Modest staff additions help increase the throughput of lease renewals with new requirements.

### 3.3.3 Proactive Scenario

The Proactive scenario has everything in the moderate scenario, plus the following:

***Size:*** Expands policies to all facilities above 1,000 SF for opportunities to save energy by 2022, 20,000 and higher by 2021.

***Timeframe & Contracts:*** Adopt the policies for all lease renewals starting 2021 as described in SIZE, accelerating dates for all agencies.

***Agency Readiness:*** GGC will identify no less than 20 other agencies to match its policies.

***Lessor Experience:*** In addition to items in moderate, GGC will deploy technical assistance program for lessors. Help lessors discover the benefits of high performing buildings and remove perceived risks.

1. Schedule customized versions of training opportunities to learn about ENERGY STAR, LEED, the federal GSA green building specification, and any other high-performance building program of interest to the Commonwealth.
2. Also offer customized training opportunities to learn about best practices related to energy efficiency, energy assurance, resiliency and low carbon in the leasing business.
3. Provide engineering technical assistance to help lessors estimate potential savings from comprehensive energy efficiency retrofit projects, and to learn about energy saving performance contracts without pressure from vendors.
4. Provide consultant-led technical assistance to assist lessors in learning about financial analysis of the value of energy efficiency, or high performing buildings, or property valuation, or the financial merits of off-balance sheet energy saving performance contracts.

***Resources:*** Add staff to increase the throughput of lease renewals so leases on all 20 agencies are processed promptly. Also provide staff or external support to monitor EUI and ratings, plus increased outreach & communications.

### 3.3.4 Recommended Path

While this is not a feasibility study that estimated the potential economic or environmental benefits to the Commonwealth, or the implementation cost, the GDS team recognizes that a framework to implementation is needed in order to succeed with EO 2019-01. From the core team conversation, we are prepared to offer Figure 3-2. For a presentatio on this roadmap, please see *Appendix A.6, Task 5 Roadmap Power Presentation.*

**FIGURE 3-2. RECOMMENDED ROADMAP**


In a nutshell, this means:

***Size:*** Expands policies to all facilities above 20,000 SF for opportunities to save energy by 2021.

***Timeframe & Contracts:*** Renewal dates matter. Attention to tracking and accelerating dates for no less than 4 agencies starting 2021. New policies on equipment in buildings provided by lessor for all agencies inserted into lease starting 2021.

**1** Quarterly benchmarking required and max EUI <= 5% below average EUI for state-owned buildings, and ENERGY STAR rating 5% higher than state-owned buildings.
**2** Starting in 2021, DEP will use ENERGY STAR qualified products for all products owned and operated by the lessor on behalf of the lessee, including lighting products, rooftop products, office equipment, vending machines, and water coolers.
**3** There will be a mandatory adoption of specific measures tracked in the annual review checklist (such as EV charging stations).
**4** BRE wil require an ASHRAE walk through audit be performed to gauge the performance of the building during the renegotiation walk-through.

Additional policies start in 2024.
New and renewal leases require ENERGY STAR label, or LEED certification, or other recognition adopted by the Commonwealth. For guidance on ENERGY STAR see Appendix A.7.
.

**5** ENERGY STAR label in all lessor provided products, such as commercial boilers, Laboratory Grade Refrigerators and Freezers, Pool Pumps, qualified HVAC equipment and commercial food service equipment, where the designers specify equipment in the range of ENERGY STAR qualified products.
**6** A benchmarking reporting requirement for buildings where all or part of the building is leased. Monthly tracking is required with maximum EUI and minimum ENERGY STAR performance rating specified. AGENCY READINESS: DEP will lead the adoption of green policies in all/most its leased facilities. GGC will identify no less than 4 other agencies to match DEP policies.

***Agency Readiness:*** GGC will identify no less than 20 other agencies to match its policies no later than 2024.

***Lessor Experience:*** In addition to items in moderate, GGC will deploy technical assistance program for lessors. Help lessors discover the benefits of high performing buildings and remove perceived risks.

Schedule customized versions of training opportunities to learn about ENERGY STAR, LEED, the federal GSA green building specification, and any other high-performance building program of interest to the Commonwealth. See Appendix A.8.

**1** Also offer customized training opportunities to learn about best practices related to energy efficiency, energy assurance, resiliency and low carbon in the leasing business.
**2** Provide engineering technical assistance to help lessors estimate potential savings from comprehensive energy efficiency retrofit projects, and to learn about energy saving performance contracts without pressure from vendors.
**3** Provide consultant-led technical assistance to assist lessors in learning about financial analysis of the value of energy efficiency, or high performing buildings, or property valuation, or the financial merits of off-balance sheet energy saving performance contracts.

***Resources:*** Staff receives training oriented towards transitioning into a green lease operation. Modest staff additions help increase the throughput of lease renewals with new requirements. External support attained to leverage internal resources.

# 4 Overview of GDS Associates, Inc.

GDS consultants are recognized leaders in their respective fields, dedicated to their clients, innovative in their approach to meeting unique challenges and known for consistently being available when needed. Our comprehensive range of expertise focuses on clients associated with, or affected by, electric, natural gas, water and wastewater utilities.

The **GDS MISSION** is to *"help our clients succeed by anticipating and understanding their needs and by efficiently delivering quality services with confidence and integrity"*

GDS is a multi-service consulting and engineering firm formed in **1986** as a **C-Corporation** and now employs a staff of more than 180. Headquartered in Georgia, GDS also has offices in Alabama, Florida, Maine, New Hampshire, Oregon, Texas, Washington, and Wisconsin. GDS' annual revenues in 2019 were $40 million.

The firm's largest department is the Energy Efficiency and Renewables Department (EERD) and consists of approximately 50 consultants working on energy performance, energy efficiency planning, market research, implementation and evaluation projects across the US and Canada.

Our consulting services include energy strategic planning, technology feasibility studies, policy development and analysis, data analytics, energy project engineering, and all aspects of energy efficiency and demand response program planning, implementation and evaluation. In addition, GDS also offers information technology, market research, statistical and social media marketing services to a diverse client base. GDS' clients include state regulatory commissions and energy offices, electric and natural gas utilities, for-profit corporations, non-profit organizations, and homebuilders. GDS also has expertise with the development, modeling and planning for electric generation, transmission and distribution infrastructure projects. Table 4-1 below describes four categories of services that GDS provides to State Energy Offices.

**TABLE 4-1. GDS SERVICES FOR STATE ENERGY OFFICES**

| |
|---|
| ***Specialized Studies:*** Market research, energy efficiency market assessment and baseline studies, potential studies, market penetration forecasting, DSM plans, technology studies, program evaluation. |
| ***Program Implementation:*** Program marketing, recruitment, training, incentive application review and processing, certification of qualified partners, call center services, data tracking, reporting, and technical assistance to support comprehensive state government and utility programs. |
| ***Advisory Services:*** Regulatory oversight support to regulatory agencies, regulatory support for corporations and utilities, development of testimony, expert witness testimony, and similar services. |
| ***Project Support:*** Job-specific technical services such as ASHRAE energy audits, energy and water baseline studies, building retro-commissioning, code compliance auditing or training, Commissioning / Retro-Cx, Contractor training, modeling and more. |

# 5 GDS Consultants

This section of our report acknowledges the members of the GDS Project Team, including the Principal or Lead contact who was responsible for ensuring that the project is timely and meets the State's expectations. Full resumes for the GDS Team are available upon request. Key team members assigned to this project are summarized in Table 5-1 which describes relevant education, responsibilities and expertise of each consultant. Biographies for key staff have been provided beginning in Section 5.1.

**TABLE 5-1. GDS TEAM PERSONNEL ROLES & RESPONSIBILITIES**

| Staff Name & Title | Education & Certification(s) | Relevant Expertise |
|---|---|---|
| **Julio Rovi,** *CEM, CSDP*<br>*Managing Director*<br>*Principal Investigator* | B.S. / M.S. / M.S. | Subject matter expert (SME) in energy policy, and program implementation. Served 30 state energy offices, including PA to support their EE programs. |
| **Richard Spellman,** *CMVP*<br>*Senior Vice President* | B.A./ MBA | SME energy efficiency and demand response planning, market research, Manager of PA Statewide Evaluator team from 2009 to 2017. |
| **Kaytie Harrah**<br>*Project Consultant* | B.A | Communications executive, responsible for quality assurance in product deliverables. |
| **Jeffrey Huber,** *CEM, CMVP, BESA, Managing Director* | B.A./ M.A. | Pennsylvania Residential Baseline study in 2011-12 and developed the residential Market Potential Study for Pennsylvania in 2012 |
| **Josh Duckwall,** *CEM, LEED AP, GC, Project Manager* | B.S.A. | Projects focused on statewide efficiency and incentive programs, as well as servicing large clients looking to uncover the viability of current and future DSM programs. |
| **Melissa Young**, EIT, EMIT,<br>*Engineer* | B.S. | Worked on an EE study for the Pennsylvania PUC, using engineering algorithms and models to calculate energy and demand savings. |

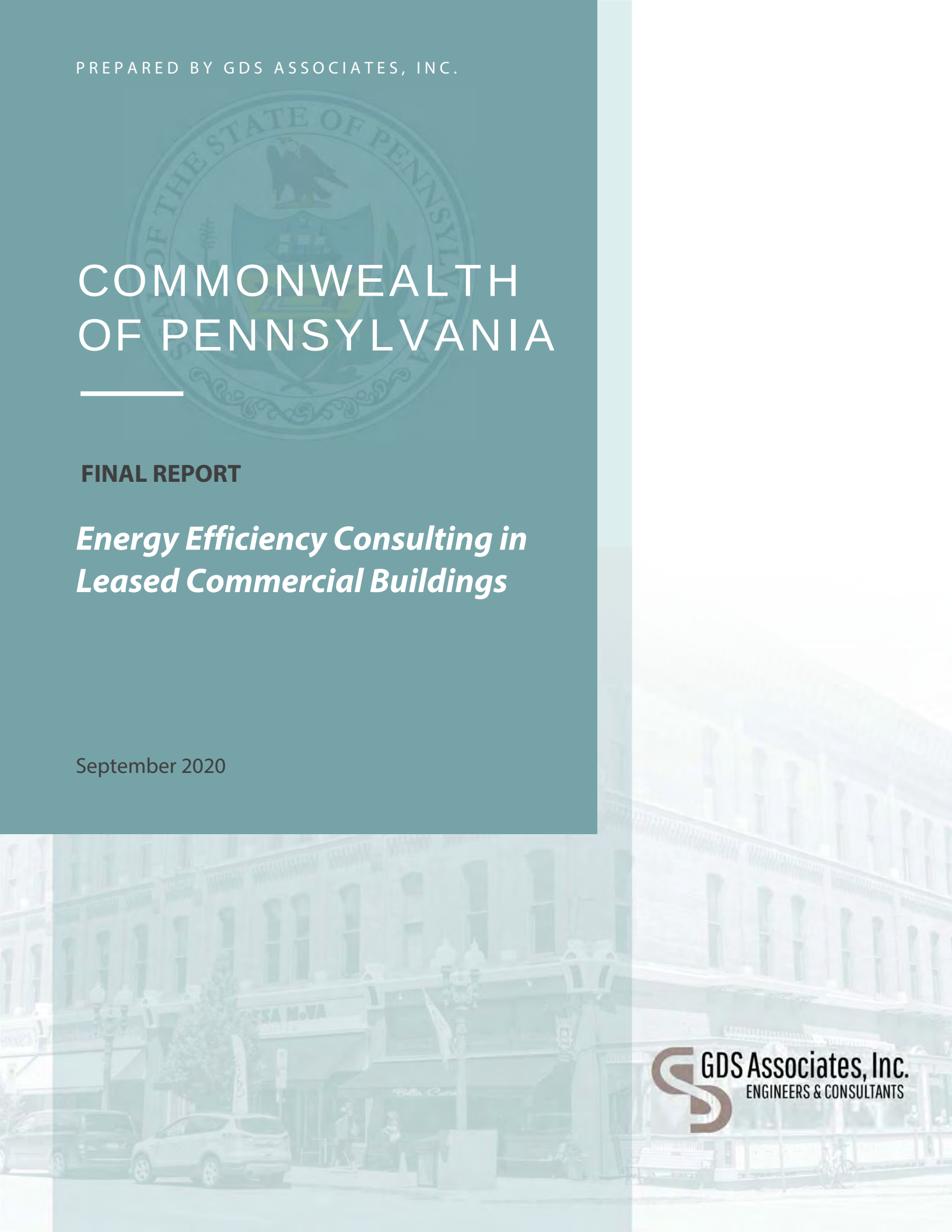
PREPARED BY GDS ASSOCIATES, INC.

# COMMONWEALTH OF PENNSYLVANIA

**FINAL REPORT**

## *Energy Efficiency Consulting in Leased Commercial Buildings*

September 2020



GDS Associates, Inc.
ENGINEERS & CONSULTANTS

# A REVIEW OF LOW-INCOME PROGRAM POLICIES ACROSS THE UNITED STATES

***The Parties Working Collaboratively (PWC) Act 1102 Working Group***

*Draft Report November 11, 2019*

prepared by **Johnson Consulting Group**

# A Review of Low-Income Program Policies Across the United States

*Prepared for:* The Parties Working Collaboratively (PWC)
Act 1102 Working Group

*Prepared by:*
Dr. Katherine Johnson,
Johnson Consulting Group
Independent Evaluation Monitor

*Draft Report*

November 11, 2019

# Executive Summary

As part of the on-going work with the Parties Working Collaboratively (PWC), the Act 1102 Working Group wanted to identify the current types of policies currently in place regarding low-income programs. Specifically, this research focused on two specific areas:

- Current cost-effectiveness requirements for low-income programs; and
- Current state policies regarding low-income funding or carve-outs.

The findings from this research were drawn from two program policy databases developed and updated by the American Council for an Energy Efficient Economy (ACEEE). Additional findings regarding specific low-income programs were also summarized from a 2016 report written by the Southeast Energy Efficiency Alliance (SEEA).

The key takeaways from this research are as follows:

- Low-income cost-effectiveness testing policies fall across a continuum.
- Some states have no policies in place, while other provide one or more exceptions for low-income programs. These exceptions include allowing low-income programs to be not cost-effective, including Non Energy Benefits (NEBs) to improve overall cost effectiveness; or requiring the portfolio to be cost-effective but not individual programs.
- However, 21 states have not established any types of cost-effectiveness policies. Of these, 11 are in the Southeast, including Arkansas.
- Only five states currently have developed any type of low-income carve-outs or set aside. But there is no uniformity among these policies either.

The key recommendation from this research assessment is that Arkansas should develop its own policy based on its specific cost-effectiveness rules and policy objectives.

# Introduction

As part of the on-going work with the Parties Working Collaboratively (PWC), the Act 1102 Working Group wanted to identify the current cost-effectiveness program requirements for low-income programs across the United States. At the request of the Act 1102 Working Group, the Independent Evaluation Monitor (IEM) reviewed two comprehensive low-income databases produced by the American Council for an Energy Efficiency Economy (ACEEE) (ACEEE Guidelines for Low-Income Energy Efficiency Programs and ACEEE Policy Toolkit-Supporting Low-Income Programs.

# Key Findings

This review identified several different strategies that are currently used by one or more states regarding low-income cost-effectiveness testing. However, each state views this requirement slightly differently, but this analysis identified several overall trends which are summarized in the following map.

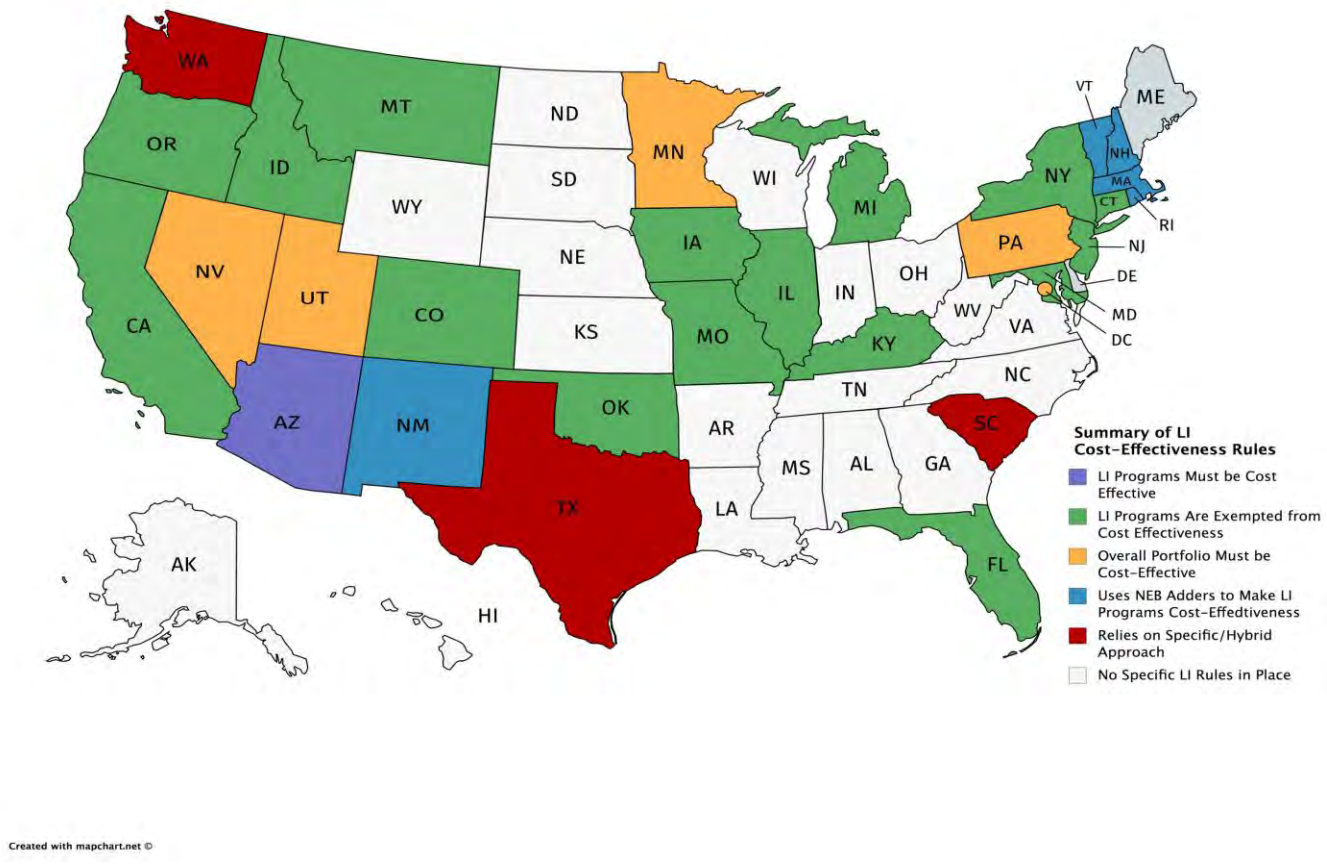



**Figure 1: Summary of Low-Income Cost-Effectiveness Testing in the United States**

- *No guidance for Low-Income Programs*: Currently, 21 states including Arkansas, have not established any specific low-income cost-effectiveness requirements. A few states recognize that low-income programs should be treated differently compared to other energy efficiency program designs, but these states have not yet established any specific cost-effectiveness requirements.

- *Low income programs must be cost-effective:* Currently, only Arizona specifies that low-income programs must be cost-effective; however, it does allow exemptions for health and safety measures (Arizona Administrative Code Title 14, Chapter 2, Article 24 (R14-2-2412

- *Low income programs are exempt from traditional cost-effectiveness requirements.* However, even this guidance differs by state. For example, three states, in practice, do not require low-income programs to be cost-effective, this approach has not been codified in the statutes, as summarized next:

    - Connecticut relies on the Total Resource Cost test as its primary test for the HES-Income Eligible program. Connecticut regulators have repeatedly approved non-cost-effective low-income programs; however, *no explicit adjustments or exceptions to general cost-effectiveness rules are in place for the HES-Income Eligible program*. (Connecticut)

    - No explicit adjustments or exceptions to general cost-effectiveness rules are in place for low-income programs *though they are exempted in practice*. (Georgia)

    - The PUC encourages utilities to include non-energy benefits of LIWAPs when calculating cost effectiveness *but currently declines to construct a specific cost-effectiveness test for low-income programs*. (Idaho)

Several states established that low-income programs are *exempting low-income* programs from cost-effectiveness testing including: California, Colorado, Illinois, Maryland, New York and Kentucky.

But there are differences within these policies. For example, California exempts low-income programs from meeting specific cost-effectiveness rules, but does require that this testing occurs for informational purposes only in applying its own state test: The Energy Savings Assistance Program Cost Effectiveness test (ESACET) and the Resource Total Resource Cost test.

The Colorado Public Service Commission directs all utilities to pursue "all cost-effective low-income DSM programs, but ""but to not forego DSM programs simply because they do not pass a 1.0 TRC test." (Decision Decision No. C18-0417.) Colorado also allows the inclusion of a Non-Energy Benefits (NEBs) adder of 20 percent.

Illinois takes a more straightforward approach and simply excludes low-income programs from any cost-effectiveness testing (Section 8-103B (Energy Efficiency and Demand-Response Measures)

- *The overall portfolio must be cost-effective; but low-income programs do not.* This is another approach used in several jurisdictions that require the overall energy efficiency program to pass the required cost-benefit tests with a ratio of 1.0 or higher. These rules are in effect for Washington D.C., Minnesota (MN Statutes 261B.241 and Rule 7690.0550) and Nevada (2017 Legislation)

- *Include Non-Energy Benefits (NEBs) in low-income programs to make them cost-effective*. These states specify a specific NEBS adder to be included when conducting cost-benefit testing for low-income programs. These adders may be as high as 20 percent (Colorado, Massachusetts and New Mexico), Rhode Island, and Vermont (10% adder).

- *Use a hybrid approach to determine low-income program cost-effectiveness testing.* For example, New Hampshire uses a combination of approaches that include both cost-effectiveness testing, a NEBs adder of 10 percent, and a requirement that the programs are "well designed."

  South Carolina developed a regulatory framework for low-income programs, but is not yet in use.

  Texas took a slightly different approach by requiring that low-income programs are based on the Savings-to-Investment Ratio (SIR) rather than cost-effectiveness testing, as summarized next:

  - In an Order adopted September 28, 2012, the commission directed that low-income programs would not be required to meet the cost-effectiveness standard in Substantive Rule § 25.181 but rather would only need to meet standards required by the Savings-to-Investment ratio (SIR) methodology. All measures with a SIR of 1.0 or greater qualifies for installation. The SIR is the ratio of the present value of a customer's estimated lifetime electricity cost savings from energy efficiency measures to the present value of the installation costs, inclusive of any incidental repairs, of those energy efficiency measures. (Texas)

Washington State also developed specific guidance for low-income energy efficiency programs that blended several approaches:

- The benefit-cost tests are required for overall portfolio and program-level screening. Per WAC 480-109-100, low-income weatherization is not included in the portfolio or sector-level cost effectiveness analysis. Companies may implement low-income programs that have a TRC ratio of 0.67 or above. The rules, codified in Chapter 194-37

WAC, specifies that the TRC test include all non-energy impacts that a resource or measure may provide that can be quantified and monetized. Washington also applies an additional 10% benefit, consistent with the Northwest Power Act.

### Specific Policies in the Southeast

These findings were further corroborated by an comprehensive review of low-income program performance in the Southeast, completed by the Southeast Energy Efficiency Alliance (SEEA).

**Table 8. Cost-Effectiveness Requirements for Low-Income Programs in Southeastern States**

| State | Program-Level Cost-Effectiveness Required? |
|---|---|
| Alabama | N/A[12] |
| Arkansas | No |
| Florida | No[13] |
| Georgia | N/A[14] |
| Kentucky | No |
| Louisiana | Yes |
| Mississippi | No[15] |
| North Carolina | No |
| South Carolina | No |
| Tennessee | N/A[16] |
| Virginia | No |

*Source: SEEA Analysis*

## Low-Income Program Carve-outs

Many low-income program carve-outs are specifically tied to community solar subscribership. However, a few states have developed specific policies to set-aside funds for low-income programs. These funding mechanisms are summarized next and additional details are available at the ACEEE link: ACEEE Policy Toolkit-Supporting Low-Income Programs. Highlights from these findings are summarized next.

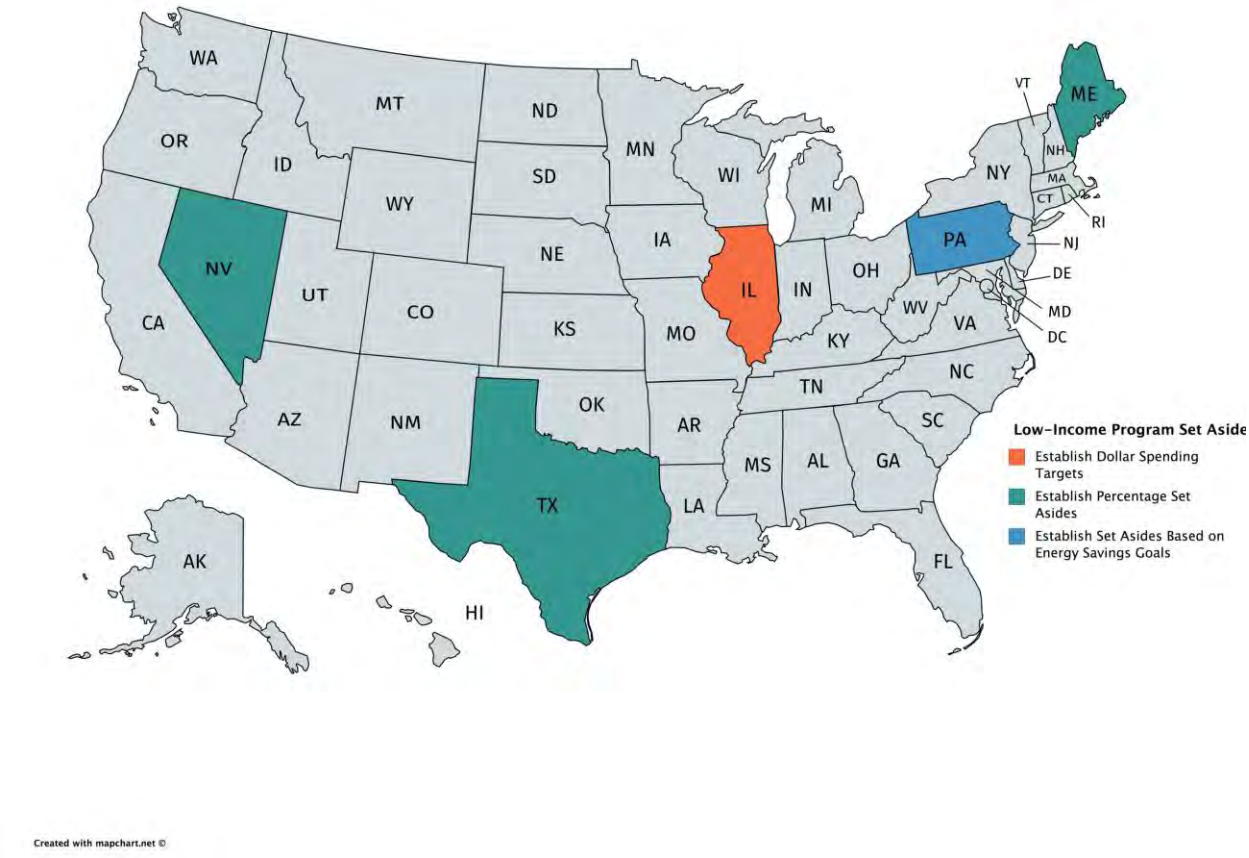



Figure 2: States with Low-Income Program Set Asides

- *Establish specific funding set-asides for low-income programs*. The Future Energy Jobs Bill (SB 2814) in Illinois establishes specific spending targets to implement low-income programs. Depending upon the utility size, electric utilities are to spend between $8.35 and $25 million annually on low-income programs.

- *Establish a set-aside based on the total percentage of utility spending.* Another strategy is to require that a percentage of the overall utility spending for energy conservation be set aside for low-income programs. These set-aside targets range from 10 percent (or $2.6 million in Maine; Texas) and 25 percent in Nevada.

- *Establish a set-aside based on overall energy savings goals.* Pennsylvania's requirements are based on long-term energy efficiency savings goals. Specifically, the current implementation phase, 5.5% of the total savings target must be met through low-income programs.

## Key Findings and Recommendation

Low-income programs occupy a special place within the energy efficiency program portfolio. Each state has developed its own strategy to account for low-income programs during cost-effectiveness testing. The range of current options are:

- Establish no guidance
- Require low-income programs to be cost-effective
- Allow low-income programs to have specific exceptions:
    - Exempt them from cost-effectiveness testing entirely;
    - Require that the overall portfolio is cost-effective rather than individual programs;
    - Allow a NEBs adder for low-income programs, which improves overall cost-effectiveness; or
    - Create specific requirements for low-income programs blending several approaches.

Currently only five states have developed a specific low-income program set-aside. However, each current policy is specific and unique.

The key recommendation from this research assessment is that Arkansas should develop its own policy based on its specific cost-effectiveness rules and policy objectives.

## References

American Council for an Energy Efficient Economy (ACEEE) State Policy Program Database, ACEEE Guidelines for Low-Income Energy Efficiency Programs <Accessed November 8-10, 2019>

American Council for an Energy Efficient Economy (ACEEE) State Policy Program Database, ACEEE Policy Toolkit-Supporting Low-Income Programs. <Accessed November 10, 2019>

Fox, Abby 2016. "Utility- Administered Low-Income Programs in the Southeast," Southeast Energy Efficiency Alliance, Atlanta, GA.

# NATIONAL STANDARD PRACTICE MANUAL CASE STUDY: ARKANSAS' CURRENT PRACTICES

## *Arkansas Public Service Commission*

*Final Report October 10, 2018*

prepared by **Johnson Consulting Group**

# National Standard Practice Manual Case Study: Arkansas' Current Practices

**Prepared for:**

Arkansas Public Service Commission

**Prepared by:**

The Parties Working Collaboratively (PWC),
the Independent Evaluation Monitor (IEM) and
E4TheFuture

*FINAL REPORT*

October 10, 2018

# Glossary

**APSC or Commission:** Arkansas Public Service Commission

**Avoided costs:** An estimation of the future value of avoided market purchases of electric and gas energy resources that is applied to the amount of energy that did not need to be generated or purchased due to an installed energy efficiency (EE) measure that reduced the energy need. The energy efficiency resources are evaluated for cost-effectiveness. The avoided costs are what make up the utility system benefits of EE resources.

**AOG:** Arkansas Oklahoma Gas Company

**BHEA:** Black Hills Energy Arkansas, Inc.

**C&EE Rules:** Rules for Conservation and Energy Efficiency Programs

**CNP:** CenterPoint Energy Arkansas Gas

**EAI:** Entergy Arkansas Inc.

**Energy efficiency resource:** Energy efficient technologies, services, measures, or programs funded by, and promoted on behalf of, electric and gas utility customers.

**E4TheFuture**: E4TheFuture promotes residential clean energy and sustainable resource solutions to help build a resilient and vibrant energy efficiency and clean energy sector.

**Free Riders:** Customers who received a rebate or incentive to participate in a program, but would have participated in the program without the rebate or incentive.

**IEM:** Independent Evaluation Monitor

**NEBs**: Non-Energy Benefits

**NSPM:** National Standard Practice Manual

**Price Suppression:** Price suppression refers to a potential decrease in the wholesale price of energy or capacity resulting from an aggregate reduction in demand.

**PWC:** Parties Working Collaboratively

**OG&E**: Oklahoma Gas & Electric Company

**SARP:** Standard Annualized Reporting Packet

**SWEPCO**: Southwestern Electric Power Company

# Executive Summary

On November 2, 2017, the Arkansas Public Service Commission directed the Parties Working Collaboratively (PWC) to consider the findings and recommendations of the National Standard Practice Manual (NSPM).[1] The PWC formed an NSPM Working Group which has been meeting on a regular basis. The PWC NSPM Working Group collaborated with E4TheFuture to develop a Case Study regarding the NSPM in Arkansas.[2]

The overall goal of this case study was to document Arkansas' progress in adhering to the six NSPM underlying principles. Specifically, this case study:

- Summarizes the status of six of the seven Arkansas Investor-Owned Utilities (IOUs) [3] regarding incorporating the NSPM principles into their current energy efficiency policies and programs' cost-effectiveness analysis*; and*
- Identifies specific areas in which additional review, discussion, and consideration may be needed to fully meet these underlying principles.

This case study provides a snapshot of current IOU cost-effectiveness practices during Program Year 2017 and Program Year 2018. However, the energy efficiency landscape in Arkansas is constantly evolving. Where possible, we have also identified those areas that are undergoing current review as well as areas that may require additional guidance from the Commission. It is important to note that there are several areas of overlap between the various NSPM principles which are identified in this case study as appropriate.

## *Conclusions*

Arkansas has demonstrated ongoing leadership and commitment to sound energy efficiency programs and policies for a number of years. This is evident in its long history of establishing policies that promote energy efficiency programs and its commitment to measuring the overall effectiveness in both program planning and implementation through annual EM&V and transparent reporting.

With respect to assessing cost-effectiveness of ratepayer funded efficiency program, review and consideration of the NSPM suggests that there are both many aspects of Arkansas' current approach that are consistent with NSPM principles and some areas where refinement may be warranted.

The case study documented that the APSC's current guidance on cost-effectiveness analyses addresses all of the biggest utility system impacts (avoided energy, avoided capacity, avoided T&D and marginal line losses); it also addresses most of the state's key policy objectives.

---

[1] Order No. 27, Docket No. 10-100-R and Order No. 40, Docket No. 13-002-U.

[2] *See* General Staff's Status Report Concerning the National Standard Practice Manual Case Study filing on May 30, 2018, in Docket Nos. 10-100-R and 13-002-U.

[3] Due to its uniquely small and rural service territory and corresponding waiver of certain C&EE Rules and requirements as recognized by the Commission in Docket No. 07-076-TF, Order No. 62, The Empire District Electric Company was not used in the NSPM study group.

However, the NSPM case study uncovered both some inconsistencies in application of the APSC's guidance on application of the Total Resource Cost Test (TRC) and several additional areas in which Arkansas' cost-effectiveness analyses are inconsistent with NSPM principles:

- Some utilities are using different approaches to quantify utility system impacts (e.g., not accounting for avoided T&D costs and using average rather than marginal line loss rates) than the APSC directed them to use.
- There are also inconsistencies in the treatment of incentives paid to free riders in the TRC test, the choice of discount rates, and the incorporation of assumptions regarding carbon costs.
- Several categories of utility system impacts have not been addressed by APSC guidance on cost-effectiveness and are not being included in cost-effectiveness analyses by the six IOUs (e.g. avoided ancillary service costs, avoided credit and collection costs and the risk mitigating value of efficiency resources);
- Asymmetrical application of participant impacts – specifically inclusion of all participant costs, but exclusion of some participant non-energy benefits (NEBs).
- Impacts associated with some state policy objectives for efficiency programs are not currently included in the current definition of the Arkansas cost-effectiveness test. Specifically, Environmental, Economic Development, and Energy Security impacts are not quantified as part of the cost-effectiveness testing. However, these NEBs were only noted in the initial energy conservation orders in 2007 and have not been addressed in subsequent orders.

The following table summarizes these findings.

**Table E- 1 : Summary of Arkansas' Consistency with the NSPM Principles**

| | NSPM Principles | | | | | |
|---|---|---|---|---|---|---|
| **Utility Status** | **#1: Treat Efficiency as a Resource** | **# 2: Policy Goals** | **#3: Hard-to-Quantify Impacts** | **# 4: Symmetry** | **#5: Forward-Looking Analysis** | **# 6: Transparency** |
| **Overall Portfolio** | ◕ | ● | ◑ | ◑ | ◕ | ● |
| AOG | ◕ | ● | ◑ | ◑ | ● | ● |
| BHEA | ◕ | ● | ◑ | ◑ | ● | ● |
| CenterPoint | ◕ | ◕ | ◑ | ◑ | ● | ● |
| EAI | ◕ | ● | ◑ | ◑ | ◑ | ◑ |
| OG&E | ◕ | ● | ◑ | ◑ | ◕ | ● |
| SWEPCO | ◕ | ● | ◑ | ◑ | ◕ | ● |
| Fully Met = ● Mostly Met = ◕ Partially Met = ◑ Did Not Meet = ○ | | | | | | |

## *Recommendations*

This case study has also identified several areas that merit further consideration by the Commission with input from the PWC.

- The Commission may want to review the areas of inconsistency identified in the case study (e.g., in the development of utility system impacts such as avoided T&D costs and the use of marginal line losses, the selected discount rates, and the handling of incentives to free riders) and develop more clarity regarding the inputs and calculations for the cost-effectiveness calculations in Arkansas.
- The Commission may want to seek additional guidance regarding carbon cost pricing as the NSPM does not provide specific guidance on this topic. Appendix B summarizes the additional resources and approaches for addressing the issue.
- The Commission may want to consider expanding the current approved NEBs to include those specific to low-income programs that are consistent with the criteria set forth by the Commission in its order approving the inclusion of NEBs in the TRC test of cost-effectiveness, if a Low-Income Pilot Program is launched.
- The Commission may want to consider requiring the six Arkansas utilities to document which other utility system and non-utility impacts are being included in cost-effectiveness analysis (e.g., wholesale price suppression effects; avoided other regulatory costs) in the SARP workbooks in order to reveal any areas of inconsistency.
- Besides participant NEBs directly attributable to low-income programs, there is a long list of potential participant impacts that the Arkansas PSC could consider adding to the cost-effectiveness testing to address current asymmetry in treatment of participant costs and benefits (i.e. current inclusion of all participant costs, but only some participant benefits).[4] The current Commission approach has been to focus on those NEBs that are quantifiable, material, and relevant to the analysis of a specific utility program or program portfolio." [5] Analysis of some NEBs actually produced by the state's efficiency programs would address the current inconsistencies used in Arkansas as well as affirm Arkansas' commitment to focus on quantifiable, Arkansas-specific NEBs going forward.
- The Commission may want to consider whether previously stated policy interest in the environmental, energy security and economic development impacts of efficiency programs is of sufficient magnitude to warrant future inclusion of these impacts in the state's cost-effectiveness test and if so, provide appropriate guidance.

[4] C&EE Rules, Section 2, as amended by Orders 15 and 18 of APSC Docket No. 06-004-R, effective April 12, 2007 and May 25, 2007, respectively.

[5] APSC Docket No. 13-002-U, Order No. 30, p. 16; Order No. 7, p. 88.

# Table of Contents

**List of Figures**



**List of Tables**

# 1. Introduction

On November 2, 2017, the Arkansas Public Service Commission directed the Parties Working Collaboratively (PWC) to consider the findings and recommendations of the National Standard Practice Manual (NSPM).[6] The PWC formed an NSPM Working Group which has been meeting on a regular basis. The PWC NSPM Working Group collaborated with E4TheFuture to develop a Case Study regarding the NSPM in Arkansas.

The NSPM provides a comprehensive framework to determine cost-effectiveness of energy efficiency resources. This approach presents an objective and neutral Resource Value Framework that can be used to define a jurisdiction's *primary* cost-effectiveness test (e.g. the Resource Value Test). The Resource Value Framework is based on six underlying principles that embody the perspective of a jurisdiction's applicable policy objectives, and it includes and assigns value to all relevant impacts (costs and benefits) related to those objectives (NSPM 2017, p. 1). These six principles are the focus of this case study.

**Table 1: Summary of the Universal Principles Articulated in the NSPM**

| | |
|---|---|
| **Efficiency as a Resource** | Energy efficiency is one of many resources that can be deployed to meet customers' needs, and therefore should be compared with other energy resources (both supply-side and demand-side) in a consistent and comprehensive manner. |
| **Policy Goals** | A jurisdiction's primary cost-effectiveness test should account for its energy and other applicable policy goals and objectives. These goals and objectives may be articulated in legislation, commission orders, regulations, advisory board decisions, guidelines, etc., and are often dynamic and evolving. |
| **Hard-to-Quantify Impacts** | Cost-effectiveness practices should account for all relevant, substantive impacts (as identified based on policy goals,) even those that are difficult to quantify and monetize. Using best-available information, proxies, alternative thresholds, or qualitative considerations to approximate hard-to-monetize impacts is preferable to assuming those costs and benefits do not exist or have no value. |
| **Symmetry** | Cost-effectiveness practices should be symmetrical, where both costs and benefits are included for each relevant type of impact. |
| **Forward-Looking Analysis** | Analysis of the impacts of resource investments should be forward-looking, capturing the difference between costs and benefits that would occur over the life of the subject resources as compared to the costs and benefits that would occur absent the resource investments. |
| **Transparency** | Cost-effectiveness practices should be completely transparent, and should fully document all relevant inputs, assumptions, methodologies, and results. |

(Source: NSPM 2017, p. viii)

[6] The Commission issued the directive as part of its Findings and Rulings on Issue B - Inclusion of a Common Annual Forecasted Value of Carbon Costs of the Planning Period in Future Analyses (Docket No. 10-100-R, Order No. 27; Docket No. 13-002-U, Order No. 40) p. 3 of 4).

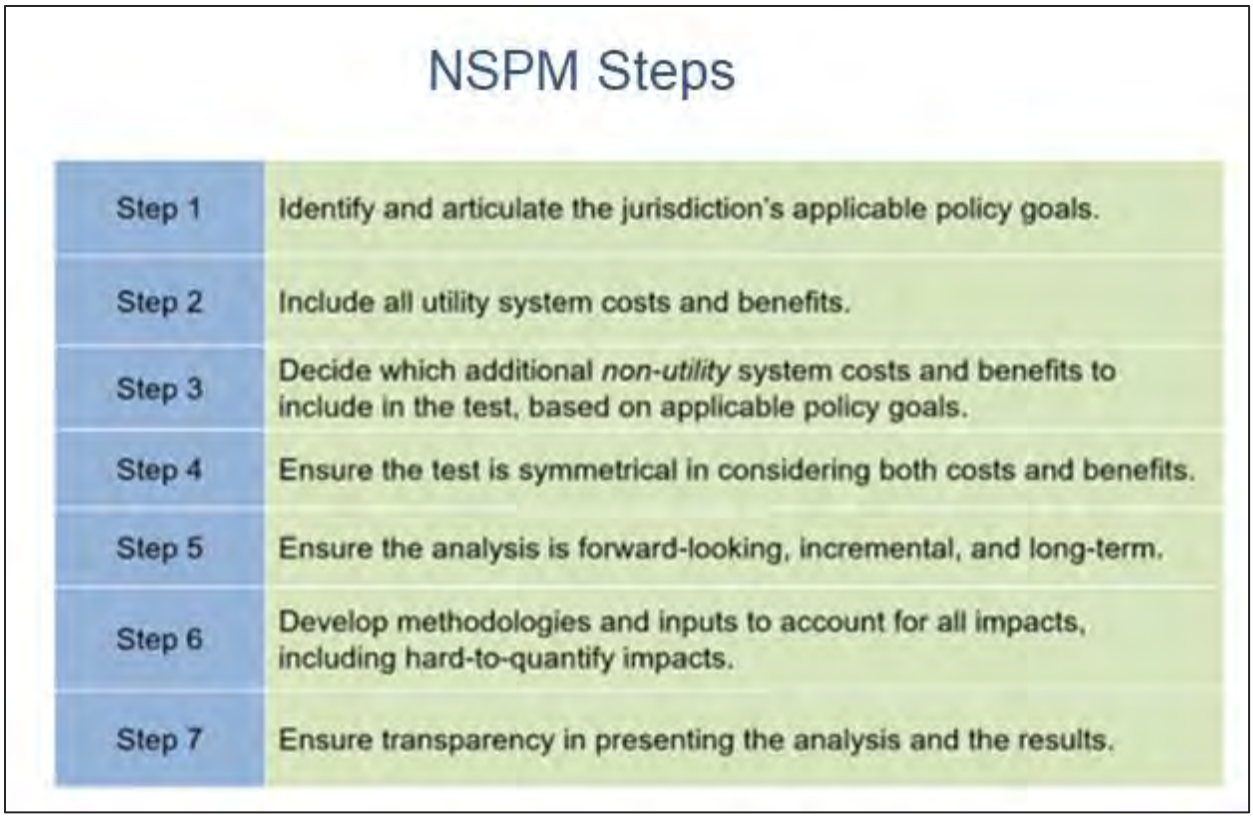
The overall goal of this case study was to assess and document the consistency of current practice in Arkansas with the six NSPM principles. Specifically, this case study:

- Provides an assessment of the current cost-effectiveness testing procedures used by six of the Investor-Owned Utilities (IOUs) with the NSPM principles*; and*
- Identifies specific areas in which additional review, discussion, and consideration may be warranted to determine potential revisions to current cost-effectiveness practice pertaining to energy efficiency program planning and implementation.

This case study provides a snapshot of current IOU cost-effectiveness practices during Program Year 2017 and Program Year 2018. However, the energy efficiency landscape in Arkansas is constantly evolving. Where possible, we have also identified those areas that are undergoing current review as well as areas that may require additional guidance from the APSC in the future.

# 2. Methodology

The Arkansas Public Service Commission directed that the PWC. with assistance from Staff, the Independent Evaluation Monitor (IEM), and E4theFuture, develop a case study assessing the current status of Arkansas' energy efficiency policies and cost-effectiveness testing relative to the best practices described in the NSPM. The seven steps used to conduct the study are summarized in the following figure.




(Source: NSPM 2017, p. ix)

**Figure 1: NSPM Steps**

The next section summarizes the ways in which this information was collected, reviewed, and documented to prepare this case study.

## *A. PWC Working Group Discussions*

The PWC formed a specific Working Group to assist in providing and assessing the information required to complete the requested case study. This Working Group was comprised of representatives from the Arkansas electric and gas utilities, Staff, Intervenors (Audubon), and IEM team members. From March through September 2018, the Working Group members met monthly to discuss the development of the Arkansas Case Study, gather the information required from the Arkansas utilities, and reviewed progress on developing the case study. The Working Group discussed this Case Study in person during the July 2018 PWC meeting and a follow-up meeting on September 18, 2018.

## B. Review of Arkansas' Current Practices

Commission Staff provided invaluable assistance in developing this case study. They conducted a thorough review of the Arkansas Commission Dockets and summarized all of the relevant information regarding the Commission's historical polices on energy conservation and related topics since 1977.

This comprehensive review identified additional impacts that could be quantified and included in future cost-effectiveness testing for the Arkansas utilities. There was a total of 31 instances in which the Commission Orders matched specific impacts described in the NSPM. Table 2 summarizes these findings.[7]

**Table 2: Summary of Occurrences of NSPM Impacts in the Docket Review**

| Policy | Number of Orders Referenced | Currently in TRC? | Notes |
|---|---|---|---|
| **Utility System** | | | |
| Utility System Impacts | 9 | Y | Captured in utility EE portfolio costs and in the system avoided costs reported by the utilities |
| Reliability Impacts | 1 | N | Not quantified in current cost-effectiveness tests |
| **Participants** | | | |
| Other Fuels | 5 | Y | Part of NEBs |
| Water Impacts | 2 | Y | Part of NEBs |
| Low-Income Impacts | 2 | TBD | Will be addressed in the Low-Income Pilot Program currently in development by the PWC if approved |
| Other Participant Impacts | 4 | Limited | Besides other fuels and water, the only participant NEB currently in cost-effectiveness tests is reduced O&M costs |
| **Society** | | | |
| Equitable Access Impacts | 2 | NA | Not quantified in current cost-effectiveness tests |
| Carbon Impacts | 3 | Partially, in some cases | Some utilities include value for avoided carbon emissions; others do not. Those that do base the value on estimate of avoided future carbon regulation costs (utility system impact) rather than societal value. |
| Other Environmental Impacts | 1 | N | Not quantified in current cost-effectiveness tests |
| Economic Development Impacts | 1 | N | Not quantified in current cost-effectiveness tests |
| Energy Security Impacts | 1 | N | Not quantified in current cost-effectiveness tests |

(Source: Summary from Energy Efficiency Policy Docket Review 2018)

The summary of the Commission's Energy Efficiency Policies is provided in Appendix A.

[7] Section 3 of this case study explores more fully Arkansas' policy approach of viewing energy efficiency "as a resource."

## C. Cost-Effectiveness[8] Review by Utility Staff

All of the Arkansas IOUs are also required to provide detailed information each year in the Standard Annual Reporting Packet (SARP) workbooks. These workbooks record the current assumptions used to determine each utility's costs and benefits by program and across the portfolio.

As part of this review, each utility provided details regarding which costs are included in its avoided cost assumptions. Reviewing the individual utility responses identified a few discrepancies regarding the utilities' assumptions for several Utility System Impacts which are related directly to Principles 1 and 4 of the NSPM. These discrepancies focused on the ways in which the electric utilities currently report the following system impact costs:

- Avoided Transmission & Distribution (T&D) Capacity Costs;
- Transmission and distribution (T&D) Line Losses for both energy and peak KW;
- Wholesale Price Suppression Effects; and
- Environmental Regulatory Costs, particularly avoided future carbon regulation costs.

These findings are discussed more fully as this issue also relates to Principle 4: Symmetry in Section 3 of this case study.

[8] The C&EE Rules, Section 3, defines "cost-effective" to mean [a] standard used to describe a 'net beneficial' result for programs to be implemented, determined through a process that includes a review of relevant benefit/cost tests. A 'cost-effective' program would be one that has a high probability of providing aggregate ratepayer benefits to the majority of utility customers."

# 3. Comparison of NSPM Principles to Arkansas Current Practices

This section summarizes the current status of Arkansas' energy efficiency program policies relative to the six NSPM principles. It is important to note that there are several areas of overlap between the various NSPM principles which are identified in this case study as appropriate.

## *Principle #1: Treat Efficiency as a Resource*

NSPM's first guiding principle is that efficiency should be considered a resource. As the NSPM explains,

> "*Energy Efficiency (EE) is one of the resources that can be deployed to meet customers' needs, and therefore should be compared with other energy resources (both supply-side and demand-side) in a consistent and comprehensive manner."* (NSPM 2017, p. 9)

The key research question for this principle is:

- Are all utility system impacts – costs and benefits – included in cost-effectiveness test?

### Background

Arkansas has clearly demonstrated its intention to treat efficiency as a resource through a variety of policies including its energy savings goals and the rigor through which it evaluates performance to ensure claimed savings are verifiable. Indeed, the state is widely regarded as an energy efficiency leader in the Southeast. According to the Program Year (PY) 2017 evaluations, all but one of the six reporting Arkansas utilities exceeded its energy savings goals with the exception of CenterPoint Energy Arkansas Gas, which achieved 97 percent of its goal, as summarized in the following table.

**Table 3: Summary of Total 2017 Gas and Electricity Primary Savings**

| Utility | Planned Therm Savings | Net Evaluated Therm Savings | Planned kWh Savings | Net Evaluated kWh Savings | Percent of Planned Savings Achieved |
|---|---|---|---|---|---|
| AOG | 444,944 | 536,208 | - | - | 121% |
| BHEA | 1,180,976 | 1,261,851 | - | - | 107% |
| CenterPoint | 3,536,126 | 3,423,918 | - | - | 97% |
| EAI | - | - | 238,130,000 | 264,991,920 | 111% |
| OG&E | - | - | 18,062,811 | 21,130,663 | 117% |
| SWEPCO | - | - | 32,381,870 | 33,666,826 | 104% |
| **Total Gas** | **5,162,550** | **5,221,977** | **-** | **-** | **101%** |
| **Total Electric** | **-** | **-** | **288,574,681** | **319,812,165** | **111%** |

Source: 2017 EM&V Reports and Evaluator-provided summary workbooks

The APSC has articulated benefits and objectives for energy efficiency initiatives to pursue in Section 2 of the Commission's C&EE Rules. "*When providing information on these objectives, utilities are directed to describe, in quantitative terms, the benefits and costs of these different aspects of the program, standard, or code, and to comment on the barriers that impede accomplishment of these energy efficiency objectives and how to overcome these barriers."*

Arkansas' commitment to "Efficiency as a Resource" is also evident in Order No. 43 of Docket 13-002-U, establishing energy savings targets for achieving performance incentives during the next program cycle.

> *"For PY 2020-2022, the utility energy savings targets shall be 1.20% of 2018 baseline sales as adjusted for Self-Direct customers for electric utilities and 0.50% of 20l8 baseline sales as adjusted for Self-Direct customers for natural gas utilities.*" (Docket No. 13-002-U, Order No. 43, page 11 of 12)

The Commission noted that the establishment of these savings targets *"is consistent with the policy goal of capturing all cost-effective, achievable savings; promotes the policy objective of program comprehensiveness; provides ratepayers with increased opportunity to achieve substantial economic benefits that will be forgone if targets are set to maintain lower levels of savings; and provides for the payment of shareholder incentives that are commensurate with the level of achievement of potential economic benefits returned to ratepayers."( Id*. at 10)

These are just a few examples of how Arkansas is fostering "*Efficiency as a Resource"* and providing concrete guidance to ensure that energy efficiency initiatives will achieve specific energy savings goals and cost-effective energy efficiency programs for its ratepayers, while promoting the state's policy objectives.

### Efficiency as a Resource in Cost-Effectiveness Analyses

The APSC has also endeavored to treat efficiency as a resource in its guidance on cost-effectiveness analyses. For example, it requires the state's utilities to include the biggest categories of utility system benefits in their analyses, including avoided energy, avoided capacity, avoided Transmission & Distribution (T&D) and line losses. In the case of line losses, the APSC has instructed the utilities to use marginal line loss rates, which is a national best practice.

However, this case study has revealed that not all utilities are uniformly following the APSC's guidance on cost-effectiveness analyses. Further, there are several categories of utility system impacts on which the APSC has not yet issued guidance and which are not included in any utility's cost-effectiveness analyses (e.g. avoided ancillary services costs, the value of risk mitigation, and avoided credit and collection costs). The inconsistencies and omissions in the utility system impacts are discussed more fully in Principle 4.

## *Principle #2: Policy Goals*

Principle #2 is closely aligned with Principle #1 in that the commitment to *"efficiency as a resource"* is articulated through the policy goals in a specific jurisdiction. The NSPM provides the following explanation of this principle:

> "***Applicable Policy Goals**. A jurisdiction's primary cost-effectiveness test should account for its energy and other applicable policy goals. These goals may be articulated in legislation, commission orders, regulations, advisory board decisions, guidelines, etc., and are often dynamic and evolving."* (NSPM 2017, p. 9)

For the purposes of this analysis, Principle #2 focuses on examining the following two questions:

- What does the state's policy goals suggest about the categories of non-utility system impacts that should be included in its test? Are all of those categories of impacts included?
- Is the discount rate consistent with the policy objectives of the state?

### Implications of Policy Goals for Categories of Impacts Included in Arkansas Cost-Effectiveness Test

The review of Arkansas' policy objectives, as shown in Table 2 and Appendix A, indicate that most of the policy goals are currently intended to be reflected in the cost-effectiveness testing conducted by the six IOUs under guidance from the APSC. This issue is discussed more fully in Principles #3 and #4.

In addition, there are some potential state policy objectives for efficiency programs for which impacts are not currently included in the current definition of the Arkansas cost-effectiveness test. Specifically, Environmental, Economic Development, and Energy Security impacts are not yet quantified as part of the cost-effectiveness testing. However, these societal NEBs were only noted in the initial energy conservation orders in 2007 and have not been addressed in subsequent orders. Clarity on the importance of these objectives is necessary to determine whether they should be reflected in the state's cost-effectiveness test in the future.

### Implications of Policy Goals for Discount Rates Used in Arkansas Cost-Effectiveness Test

The NSPM has an entire chapter devoted to discount rates (Chapter 9), noting that:

> *"The discount rate reflects a particular pattern of 'time preference,' which is the relative importance of short- versus long-term impacts. A higher discount rate gives more weight to short-term impacts, while a lower discount rate gives more weight to long-term impacts. The choice of discount rate is a policy decision that should be informed by the jurisdiction's energy and other applicable policies—and thus should reflect the regulatory perspective."* (p. 73)

As Table 4 shows there is substantial inconsistency in the selected discount rates that the utilities currently use as part of their TRC tests: four of the utilities use weighted average cost of capital (WACC), one utility (CNP) uses a societal discount rate (based on long-term treasury bond yields), while another

utility (AOG) uses a blend of WACC and societal discount rates. In addition, the assumed rate of inflation differs between the utilities.[9]

**Table 4: Discount Rates Used in the Benefit Cost Tests**

| | Electric Utilities | | | Gas Utilities | | |
|---|---|---|---|---|---|---|
| **Utility** | EAI | SWEPCO | OG&E | AOG | BHEA | CNP |
| **Rate for BC Tests** | 6.36% | 6.1% | 5.4% | 5.0% | 5.3% | 2.6% |
| **Basis for the Rate** | WACC | After-tax WACC | WACC | Blend of WACC and Societal | WACCC approved in last rate case | U.S. Department of the Treasury's 20-year Constant Maturity Rate (CMT) Rate, averaged from January 2, 2015 to December 31, 2015 |
| **Real or Nominal Rate** | Nominal | Nominal | Nominal | Nominal | N/A | Nominal |

These differences suggest that there is a need for guidance from the APSC on discount rates. As shown in Table 2 and discussed above, statutes and APSCs order suggest efficiency programs are intended to address a wide range of policy objectives.

## *Principle #3: Hard-to-Quantify Impacts*

This principle is defined in the NSPM as follows:

> ***"Hard-to-Quantify Impacts**. Cost-effectiveness practices should account for all relevant, substantive impacts (as identified based on policy goals,) even those that are difficult to quantify and monetize. Using best-available information, proxies, alternative thresholds, or qualitative considerations to approximate hard to-monetize impacts is preferable to assuming those costs and benefits do not exist or have no value."* (NSPM 2017, p. 9)[10]

The key research question for Principle #3 is:

- Does the difficulty in quantifying some impacts prevent the state from including all relevant utility and non-utility impacts?

The APSC has identified several hard-to-quantify benefits associated with energy efficiency programs. Commission Order No. 30 of Docket 13-002-U reflects a thorough analysis of how Non-Energy Benefits (NEBs) should be treated in Arkansas, including the following information submitted by the PWC:

[9] While the use of real vs. nominal discount rates vary between the utilities, the varying rates are not an issue as long as the avoided costs are also in similar real or nominal dollars

[10] While the NSPM promotes the use of hard-to-quantify NEBs, it provides no specific guidance in this regard on the carbon pricing issue and therefore the PWC requests additional guidance from the Commission concerning how to address the carbon cost issue.

"The PWC indicate that it researched and analyzed the quantification of NEBs in cost-effectiveness testing for the next three-year EE planning cycle, with the facilitation and technical assistance of the Independent Evaluation Monitor (IEM). The PWC submit a report developed by the IEM, Dr. Katherine Johnson: *An Examination of Non-Energy Benefits: Definitions, Approaches and Values Used in Other Jurisdictions* (June 17, 2014) at 3 (IEM Report), which includes a review of the literature on NEBs. Joint Comments at 3, Appendix A to Attachment A, Document 204 in Docket No. 13-002-U. The PWC report that, while some jurisdictions rely on adders of 10 to 15 percent to the value of EE programs to account for the additional value of NEBs, rather than trying to quantify specific values for a variety of NEBs, many PWC participants agreed that such an adder does not fit the Commission's definition of well-defined NEBs. *Id.* at 4. The PWC state that they agreed to focus on a few of the most important and most quantifiable NEBs, including:

- Avoided "other fuels" consumption;
- Avoided water/sewerage consumption;
- Avoided and deferred equipment replacement; and
- Avoided utility cost of service.

*Id.* at 4-5. The PWC indicate that they decided early on not to further investigate methods of quantifying avoided utility cost of service because it would require significant research and would be difficult to quantify and because such avoided costs are comprehended in cost of service updates in general rate proceedings.[11] *Id.* at 5. Regarding savings of 'other' fuels," the PWC indicate that for programs that save both natural gas and electricity, most Arkansas utilities already account for the benefit of saving both of these fuels, but not propane, if the benefit is not accounted for by another utility. *Id.*"[12]

After noting difficulties in quantifying avoided utility cost of service items and equipment, the Commission directed that the following three NEBs should be used in the TRC cost-effectiveness tests provided they meet the Order No. 7 standards:[13]

- Benefits of electricity, natural gas, and liquid propane energy savings;
- Benefits of public water and wastewater savings; and
- Benefits of avoided and deferred equipment replacement costs.[14]

At the Commission's direction, the IEM has provided guidance on calculating the value of these NEBs in the EM&V Protocols-which were reported in annual reports starting in PY2017. Protocol L in Volume 1

[11] During the course of the NSPM case study, it was suggested that the fact that some avoided costs are included in cost of service upgrades in general rate proceedings may not be relevant to the question of whether such avoided costs should be included in cost-effectiveness analyses. Due to time limitations, this issue did not get resolved as part of the work on this case study.

[12] Docket 13-002-U, Order No. 30, pp. 2-3.

[13] Docket 13-002-U, Order No. 7, p. 88, stating "that the TRC test shall include well-defined NEBs which (a) measurably reduce scarce resources, add significant value or reduce costs; (b) have a quantifiable economic value; and (c) are clearly applicable to the specific program or measure at: issue."

[14] Docket 13-002-U, Order No. 30, pp. 20-21.

of Arkansas' Technical Reference Manual (TRM) provides detailed information, examples, and reporting templates for each of the approved NEBs.

## Low-Income NEBs

More recently, the Arkansas General Assembly passed Act 1102 of 2017 which provided guidance to the Commission regarding energy efficiency programs for utility customers who are sixty-five (65) years of age or older or who meet the income eligibility qualifications of the Low Income Home Energy Assistance Program (LIHEAP) administered by the Department of Human Services.[15]

Currently, the six IOUs are working to develop pilot programs that will specifically target the LIHEAP-eligible population for the next program cycle.

Offering dedicated low-income programs also expands the potential NEBs that could result from this program design. As identified in the NEB Literature Review (Johnson & Eisenberg 2014, p. 10), low-income programs also provide a variety of Non-Energy Benefits specific for low-income customers. These include helping utilities reduce the effects of termination of service (i.e., reduced "uncollectibles," reduced termination of service costs, other administrative cost savings) (Johnson & Eisenberg 2014, pp. 6-7).

In addition, low-income participants receive many additional NEBs through the installation of weatherization including improved overall health, comfort, and safety.

States have taken different approaches to quantify the NEBs related to low-income programs. One approach is to use an adder designed to capture all of the benefits associated with a low-income program. Another strategy has been to gather specific data from the utilities, weatherization agencies, and other institutions to quantify these improvements in health, comfort, and safety. These NEBs can be broken down further into specific quantifiable metrics such as: reductions in the number of asthma cases, length of hospital stays, number of missed school or work days, etc.

Quantifying the NEBs associated with Arkansas' low-income pilot program is an emerging area that has not yet been addressed in any Commission Orders.

## Carbon Impacts

Another goal of this case study, in response to PSC Order No. 40, was to determine whether the NSPM can provide guidance concerning the inclusion of a common annual forecasted value of carbon costs in program cost-effectiveness testing. Currently, the electric utilities assign different values of carbon ranging from zero to $15/ton; the gas utilities do not include carbon costs in their cost-effectiveness testing.[16]

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[15] The applicable parts of Act 1102, sections 1 and 2, are codified at Arkansas Code § 23-2-304(a) (11) and § 23-3-405(a).

[16] *See generally* APSC Docket No. 13-002-U, Order No. 7, September 9, 2013, pp. 31-39 and 87-88, and Docket No. 13-002-U, Order No. 40, November 2, 2017, pp. 3-4.

The NSPM views carbon as one part of a jurisdiction's overall policy goals, along with other policy goals such as those related to low-income programs or reducing price volatility (NSPM 2017 p. 77). The NSPM does not provide specific guidance on the best approaches to quantify the cost of carbon across a specific jurisdiction. Therefore the question of the use of a common annual forecasted value of carbon costs in program cost-effectiveness testing remains unresolved among the members of the PWC. Appendix B provides a summary of recent carbon pricing trends used in other states as a way to provide additional information to the Arkansas Commission.

## Other Hard-to-Quantify Impacts

This review also identified several areas in which the current avoided cost benefits reported by the utilities that are not consistent with the Commission guidance provided by the C&EE Rules, Section 2. Specifically, this analysis identified several impacts associated with energy efficiency programs that are not currently included in the cost-effectiveness testing uniformly across the six IOUs:

- **Avoided other environmental regulatory costs**: Only EAI[17] includes a cost assumption for this impact while the other two electric utilities and none of the gas utilities currently quantify this system impact.
- **Energy Security Impacts and Benefits:** This category is not included in any of the utility cost-effectiveness testing. This is likely due to its difficulty in quantifying these costs and benefits.
- **Economic Development Impacts and Benefits**: This category is not included in any of the utility cost-effectiveness testing. This is likely due the challenge of quantifying these costs and benefits. However, several states have taken an incremental approach to begin quantifying specific economic impacts such as direct and indirect job creation and increased tax revenues.[18]
- **Costs and Benefits of Low-Income Energy Efficiency Programs:** As mentioned earlier, the launch of a Low-Income Pilot Program could expand the list of potential NEBs to include health, safety, and comfort impacts as well as reduced administrative costs associated with improved payment rates and lower overall energy bills for program participants.[19]

## Summary

Arkansas currently includes a number of costs and benefits in its cost-effectiveness test that are hard to quantify. Others – such as low income NEBs and the avoided cost of future carbon emission regulation – are currently under discussion. The current Arkansas cost-effectiveness test does not fully adhere to the NSPM principle of assigning some value to hard-to-quantify impacts, which are discussed more fully in NSPM Principle #4 – Symmetry.

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[17]EAI adds the following clarification: *The cost for Seasonal NOx is included as an adder to fuel cost which is avoided as a result of the implementation of energy efficiency. Fuel cost is a component of the avoided energy value in the TRC test. This is the same as CO2 cost."*

[18] This is the approach used in Illinois under the Stipulation and Future Energy Jobs Act (FEJA) legislation.

[19] Note, the Arkansas IOUs are currently capturing these administrative costs through rate cases. However, this system impact could be explored more fully to be sure it is capturing all of the costs and benefits associated with low-income programs, once the pilot program has been launched.

## *Principle #4: Symmetry*

Symmetry means that the cost-effectiveness analysis should capture both costs and benefits in a balanced way. As the NSPM explains, this assures that the cost-benefit test is not skewed or misleading (NSPM 2017, p. 12). Specifically, the NSPM defines symmetry as:

> ***"Symmetry.*** *Efficiency assessment practices should be symmetrical, for example by including both costs and benefits for each relevant type of impact."* (NSPM 2017, p. 9)[20]

This need for symmetry applies to all type of impacts, including both utility system impacts and non-utility system impacts deemed important by state policies (as discussed in NSPM Principle #2). In this case study, we have identified two areas where there is asymmetry in Arkansas' application of cost-effectiveness analyses:

- Utility system impacts
- Participant impacts

Each of these is discussed further below.

### Asymmetry in Treatment of Utility System Impacts

As described previously, Principle #1 shows Arkansas utilities are including all of the utility system costs, and most of the larger utility benefits in most cases, but not all utility system benefits. The result is some asymmetry in the treatment of utility system impacts.

As part of this case study, all six utilities provided a summary of the current avoided cost benefit assumptions they use in developing their cost-effectiveness tests. The case study also revealed a number of areas in which the utilities use differing assumptions regarding utility system benefits, or do not claim several categories of utility system benefits at all. Figure 2 summarizes these findings by utility and system impacts.

| | Electric Utilities | | | Gas Utilities | | |
|---|---|---|---|---|---|---|
| **Catetory of Utility System Impacts** | **EAI** | **SWEPCO** | **OG&E** | **AOG** | **BHEA** | **CNP** |
| Avoided Energy Costs | Yes | Yes | Yes | Yes | Yes | Yes |
| Avoided Generating Capacity Costs | Yes | Yes | Yes | N/A | N/A | N/A |
| Avoided T&D Capacity Costs | Yes | No | No | N/A | N/A | N/A |
| Avoided T&D Line Losses | | | | | | |
| energy kWh | Yes (Marginal) | Yes (Average) | Yes (Average) | Yes | Yes | Yes |
| peak kW | Yes (Marginal) | No | Yes (Average) | N/A | N/A | N/A |
| Avoided Ancillary Services | No | No | No | N/A | N/A | N/A |
| Wholesale price suppression effects | | | | | | |
| energy kWh | Yes | No | No | N/A | N/A | N/A |
| peak kW | Yes | No | No | N/A | N/A | N/A |
| Avoided carbon emission regulatory costs | Yes | Yes | No | No | No | No |
| Avoided other environmental regulatory costs | Yes | No | No | No | No | No |
| Avoided credit & collection costs | No | No | No | No | No | No |
| Changes to Risk Profile (e.g. fuel diversity) | No | No | No | N/A | N/A | N/A |

**Figure 2: Summary of Utility System Impacts Reported by Utility and Category**

[20] We also note that symmetry overlaps with Principle #2: Policy Goals regarding cost and benefit analysis. See Principle #2 for a discussion of Arkansas' cost-effectiveness policy goals.

## Inconsistent Reporting of Utility System Impacts[21]

- **Avoided Transmission & Distribution Capacity Costs:** This cost category is treated differently by each Arkansas electric utility. For example, EAI includes this information based on an internal study which has been classified as "Highly Sensitive Protected Information (HSPI). In contrast, SWEPCO does not include these costs, noting that, "*AEP does not believe that energy efficiency alone creates a measurable level of avoided T&D costs.*" OG&E also does not include these avoided costs.

  Commission Order No. 7 of Docket No. 13-002-U described two recommended approaches for calculating these system impacts. The electric utility could base its avoided capacity cost on the cost of a combustion turbine (CT) as modified to account for market conditions and as applied to the year in which the utility or relevant market do not have surplus capacity. Alternatively, the Commission suggested that this cost be based on available market data and account for any "significant, foreseeable changes to marginal capacity costs."[22]None of the gas utilities includes avoided T&D costs in their cost-effectiveness analyses. Though such benefits tend to be smaller for gas utilities, their omission from gas cost-effectiveness analyses also constitutes a lack of alignment with the NSPM symmetry principle.

- **Avoided Transmission & Distribution Line Losses**: The three electric IOUs also have different approaches to quantifying the T&D peak kW line losses. EAI and OG&E use assumptions based on external (EAI) and internal (OE&E) studies, while SWEPCO excludes avoided peak kW T&D line losses in its cost-benefit calculations. Furthermore, SWEPCO and OG&E use average line loss rates – rather than more accurate marginal loss rates – for both energy and peak T&D line losses. Note the use of average line loss rates is inconsistent with APSC Docket No. 13-002-U, Order No. 7, p. 39, which states "*The Commission adopts the use of marginal, rather than average line losses, to quantify EE's incremental effects, which is unopposed by any party, to quantify EE's incremental effects."* which is inconsistent with the NSPM recommendations.[23] The NSPM states:

  > *"A portion of all electricity produced at electric generating facilities is lost as it travels from the generating facilities to the homes and businesses that ultimately use the power… Another key characteristic of line losses is that they expand exponentially as the system experiences higher volumes. For this reason, it is important that calculations account for marginal loss rates for energy savings and peak savings.*" (NSPM 2017, p. 52).

- **Wholesale Price Suppression Effects**: Both SWEPCO and OG&E do not include these system impacts. However, EAI assumes effects are built into its AURORA model through a reduction in usage from energy efficiency, but it is not calculated separately.[24]

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[21] The six utilities completed individual worksheets regarding utility system impacts using a template developed by E4theFuture. The information in this section is summarized from the individual utility responses.

[22] Order No. 7, Docket No. 13-002-U, p. 38.

[23] National Standard Practice Manual, p. 13.

[24] EAI does include wholesale price suppression effects. The EAI load is reduced by the energy efficiency which lowers the LMPs for energy in the market.

- **Avoided Carbon Emission Regulatory Costs**: The three electric utilities have differing cost assumptions regarding carbon. EAI assumes a cost of $2.73/ton beginning in 2028, while SWEPCO assumes a cost of $15.08/ton for carbon beginning in 2022. OG&E sets its carbon price to zero. Currently, none of the gas utilities provide a cost for carbon.[25]
- **Other Environmental Regulatory Costs**: EAI assumes a cost of $528/ton for nitrogen oxide (NOx) beginning in 2018 and then decreasing annually, while the other utilities (electric and gas) do not include Other Environmental Regulatory Costs.[26]

### Omitted Utility System Impacts

Several categories of utility system benefits were not included by any utilities, including:

- Value of risk mitigation (e.g. reduced exposure to future fuel price volatility);
- Avoided ancillary services costs; and
- Avoided credit and collection costs.[27]

### Asymmetry in Treatment of Participant Impacts

As described more fully in Principles #2 and #3, the six Arkansas utilities include all participant costs, but only a portion of participant NEBs. The result is that there is asymmetry in the way participant impacts are treated in cost-effectiveness analyses.

## *Principle #5: Forward-Looking Analysis*

The fifth NSPM principle focuses on ensuring that the cost-benefits analysis remain dynamic and reflect changing market conditions. As defined in the NSPM,

> ***"Forward-Looking**. Analysis of the impacts of efficiency investments should be forward-looking, capturing the difference between costs and benefits that would occur over the life of efficiency measures and those that would occur absent the efficiency investment."* (NSPM 2017, p. 9)

Principle #5 focuses on the following key research questions:

- Key question #1: does the analysis include only future costs and benefits (i.e., excluding sunk costs)?
- Key question #2: does the analysis cover a period sufficiently long to capture all EE impacts?
- Key question #3: does the analysis treat free rider costs as "baseline" (and therefore not an incremental cost) if it includes participant impacts?
- Key question #4: does the analysis value marginal utility system impacts?

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[25] Links to the individual utility SARP workbooks can be located at the following website: http://www.apscservices.info/eeAnnualReports.aspx

[26] EAI further explains, "*The cost for Seasonal NOx is included as an adder to fuel cost which is avoided as a result of the implementation of energy efficiency."*

[27] Note that while Cost of Service rate structures may capture reduced credit and collection costs, they are not currently being captured as part of the benefit cost test screening (i.e., while the benefits may be realized through reduced customer collection costs and thus passed on as reduced rates, they are not being assigned to measure and program screening as a benefit).

Ultimately, this principle recommends that the cost-benefit analyses for energy efficiency portfolios should focus on "what would have happened in the absence of the program" and capture the full lifecycle cost for the installed measures.

Arkansas meets the first two criteria by:

- Appropriately including only future costs and benefits (i.e., excluding sunk costs); and
- Appropriately including the full lifecycle costs and benefits of its approved energy efficiency measures in its Technical Reference Manual (i.e., there is no truncation of the lifetime benefits, as is done in some states).

However, the analysis did identify an area of inconsistency regarding capturing free ridership costs.

- **Incentives to Free Riders**: Only EAI[28] includes incentives to free riders as an administrative cost in its TRC calculation, which is consistent with the current guidance from the Commission. The other five utilities do not include this incentive as an administrative cost. The NSPM notes "*Financial incentives paid to free riders are a cost only if the cost-effectiveness test excludes participant impacts; otherwise the value of the financial incentive to the participant offsets the cost of the financial incentive to the utility system. In other words, the net cost of free riders is zero under any test that includes participant impacts."* (NSPM 2017, p. 99)
- **Average vs. Marginal Costs:** In addition, there is inconsistency in the use of average vs. marginal costs, with EAI using marginal rates for the avoided line losses, SWEPCO using average rates, and OG&E using a blend. The NSPM notes that, "*Cost-effectiveness analyses should consider only marginal impacts. These are defined as the incremental changes that will occur because of the EE resource, relative to a scenario where the resource is not in place*." (NSPM 2017, p. 13)

This analysis suggests that additional Commission guidance may be required to ensure that the cost-benefit analysis across all the utilities is fully forward-looking and properly assessing what would happen in absence of energy efficiency programs.

## *Principle #6: Transparency*

The NSPM definition of transparency is:

> ***"Transparency.*** *Efficiency assessment practices should be completely transparent and should fully document all relevant inputs, assumptions, methodologies, and results.*" (NSPM 2017, p.9)

Principle #6 focuses on the following key research questions:

- Key question #1: Is the rationale for what impacts are included in the Arkansas test clear?
- Key question #2: Is it clear what impacts the Arkansas utilities are including in their tests?

[28] EAI Staff reported that they are following the previous guidance regarding the California Standard Practice Manual, which has since been updated by the five other utilities. However, this update has not yet been reflected in any Commission orders.

- Key question #3: Is the methodology used to estimate values for efficiency costs and benefits clear and publicly reviewable (except for cases where confidentiality is absolutely necessary)?

Basically, the NSPM wants to ensure that all stakeholders understand the "rules of the road" regarding cost-effectiveness testing. The second premise is to ensure that the assumptions used and the results are clearly defined.

Arkansas has developed a transparent energy efficiency reporting process in both documenting the cost-effectiveness analysis and reporting the energy savings across all the entire energy efficiency program portfolio. For example, the development of Arkansas' energy efficiency program portfolio has been conducted in a straightforward and transparent manner.

The PWC was initially designed to only focus on launching energy efficiency programs through the IOUs. However, the PWC has evolved into a highly effective group that now discusses energy efficiency program planning, policy issues, and evaluation matters. The Commission has repeatedly looked to the PWC to sort out various policy options and make recommendations for future programs (Li & Bryson 2015, p. 14). A large measure of the PWC's success is due to the fact that each stakeholder is given ample opportunity to provide input and feedback, decisions are made in a fully transparent manner, and participants are able to "disagree without being disagreeable." (Li & Bryson 2015, p. 14)

The PWC has contributed to the significant progress made in Arkansas' energy efficiency portfolio from developing a leading TRM to establishing criteria for quantifying non-energy benefits and requiring annual EM&V activities to track program success and document program progress towards energy savings goals.

One example of this transparency that directly benefits the cost-effectiveness testing is the updating process for the TRM. The steps are fully described in Volume 1 of the TRM. The annual updating process includes opportunities for input from all the parties and prescribed paths to discuss or escalate concerns, as appropriate (Li & Bryson 2015, p. 18).

Arkansas also has embedded EM&V into the architecture of its program planning and design process. Annual impact evaluations must be conducted by independent third-party evaluators and annual process evaluations must include progress reports regarding the status of previous recommendations.

The IEM provides another layer of review and oversight to ensure that the findings from these individual evaluations are accurate, appropriate, and comply with the established EM&V protocols. The IEM summarizes the progress of Arkansas' overall energy efficiency portfolio in an annual report submitted to the Commission each year.

**Table 5: Description of Arkansas' Comprehensiveness Checklist Factors**

| Commission Checklist Factor | Criteria |
|---|---|
| ***Factor One: Adequate Education, Training and Marketing*** | Whether the programs or portfolio provide, directly or through identification and coordination, the education, training, marketing, or outreach needed to address market barriers to the adoption of cost-effective energy-efficiency measures. |
| ***Factor Two: Adequate Budgetary, Management, and Program Delivery Resources*** | Whether the program and/or portfolio have adequate budgetary, management, and program delivery resources to plan, design, implement, oversee, and evaluate energy-efficiency programs. |
| ***Factor Three: Reasonably Addresses All Major End-Uses*** | Whether the programs and/or portfolio reasonably address all major end-uses of electricity or natural gas, or electricity and natural gas, as appropriate. |
| ***Factor Four: Addresses the Needs of Customers Comprehensively*** | Whether the programs and/or portfolio, to the maximum extent reasonable, comprehensively address the needs of customers at one time, in order to avoid cream-skimming and lost opportunities. |
| ***Factor Five: Addresses Comprehensive Needs of Targeted Customer Sectors*** | Whether such programs take advantage of opportunities to address the comprehensive needs of targeted customer sectors or to leverage non-utility program resources. |
| ***Factor Six: Enables the Delivery of All Achievable, Cost-Effective Energy Efficiency*** | Whether the programs and/or portfolio enable the delivery of all achievable, cost-effective energy efficiency within a reasonable period of time and maximize net benefits to customers and the utility system. |
| ***Factor Seven: Evaluation, Measurement, and Verification*** | Whether the programs and/or portfolio have EM&V procedures adequate to support program management and improvement, calculation of energy, demand, and revenue impacts, and resource planning decisions. |

(Source: IEM PY2017 Annual Approach, pp. 47-52)

These evaluations must also include a progress report for each utility's performance based on seven criteria established by the Commission. The "Commission's Comprehensiveness Checklist" Factors are summarized next.

Each EM&V contractor reports on the progress each energy efficiency program portfolio has made compared to the seven comprehensiveness factors identified by the APSC. Table 5 summarizes these findings from the comprehensive checklist as reported in the individual EM&V reports. Using the following legend, energy organizations have been evaluated as having either fully met, partially met, or failed to meet the criteria associated with each factor as set forth in the Commission's Comprehensiveness Checklist (IEM PY2017 Annual Report, p. 48).

| | |
|---|---|
| Fully Met Criteria = ● | Utilities or third–party administrators are fully meeting the criteria established by the Commission Comprehensive Checklist. |
| Partially Met Criteria = ◑ | Utilities or third party administrators are partially meeting the criteria established by the Commission Comprehensive Checklist. |
| Did Not Meet Criteria = ○ | Utilities or third–party administrators did not meet the criteria established by the Commission Comprehensive Checklist. |
| Not Applicable = ■ | Identifies those cases where the Commission Comprehensive Checklist cannot be assessed. |

**Table 6: Summary of the Commission's Comprehensiveness Checklist Factors by Utility**

| Utility | Factor 1: Education/ Training/ Outreach | Factor 2: Provide Adequate Resources | Factor 3: Address Major End Uses | Factor 4: Comprehensively Address Customer Needs to Avoid "Cream Skimming" | Factor 5: Target All Customer Sectors | Factor 6: Are Cost-Effective | Factor 7: Have Appropriate EM&V Procedures in Place |
|---|---|---|---|---|---|---|---|
| AOG | ● | ● | ● | ● | ● | ● | ● |
| BHEA | ● | ● | ● | ● | ● | ● | ● |
| CenterPoint | ● | ◑ | ● | ◑ | ● | ● | ● |
| EAI | ● | ● | ● | ● | ● | ● | ● |
| OG&E | ● | ● | ● | ◑ | ◑ | ● | ● |
| SWEPCO | ● | ● | ● | ● | ● | ● | ● |
| Fully Met = ● Partially Met = ◑ Did Not Meet = ○ Not Applicable = ■ | | | | | | | |

(Source: Analysis of PY2017 EM&V Reports, IEM PY2017 Annual Report, p. ix)

This case study has further illuminated the ways in which the six Arkansas utilities conduct their cost-effectiveness testing, serving as an exercise to both document what impacts should be included in the Arkansas cost-effectiveness tests, as well as which impacts the utilities are currently including. This transparency has also extended to the specific assumptions and rationale for the impacts that are captured in the utility cost-effectiveness analysis testing. Furthermore, five of the six utilities include details of their avoided cost assumptions for public review.

# 4. Conclusions and Recommendations

## *Conclusions*

The Case Study for Arkansas has documented the consistency of the current cost-effectiveness practices in Arkansas relative to the six underlying principles of the NSPM. However, the case study uncovered a number of inconsistencies in application of the APSC's guidance on the application of the Total Resource Cost Test (TRC):

- Some utilities are using different approaches to quantify utility system impacts (e.g., not accounting for avoided T&D costs and using average rather than marginal line loss rates) than the APSC directed them to use.
- There are also inconsistencies in the treatment of incentives paid to free riders, the choice of discount rates, and the incorporation of assumptions regarding carbon costs.
- Several categories of utility system impacts have not been addressed by APSC guidance on cost-effectiveness and are not being included in cost-effectiveness analyses by the six IOUs (e.g. avoided ancillary service costs, avoided credit and collection costs and the risk mitigating value of efficiency resources);
- Asymmetrical application of participant impacts – specifically inclusion of all participant costs, but exclusion of some participant non-energy benefits (NEBs);
- Impacts associated with some state policy objectives for efficiency programs are not currently included in the current definition of the Arkansas cost-effectiveness test. Specifically, Environmental, Economic Development, and Energy Security impacts are not quantified as part of the cost-effectiveness testing. However, these NEBs were only noted in the initial energy conservation orders in 2007 and have not been addressed in subsequent orders.

The following table summarizes these findings.

**Table 7: Summary of Arkansas' Consistency with the NSPM Principles**

| | NSPM Principles | | | | | |
|---|---|---|---|---|---|---|
| **Utility Status** | **#1: Treat Efficiency as a Resource** | **# 2: Policy Goals** | **#3: Hard-to-Quantify Impacts** | **# 4: Symmetry** | **#5: Forward-Looking Analysis** | **# 6: Transparency** |
| **Overall Portfolio** | ◕ | ● | ◑ | ◑ | ◕ | ● |
| AOG | ◕ | ● | ◑ | ◑ | ● | ● |
| BHEA | ◕ | ● | ◑ | ◑ | ● | ● |
| CenterPoint | ◕ | ◕ | ◑ | ◑ | ● | ● |
| EAI | ◕ | ● | ◑ | ◑ | ◑ | ◑ |
| OG&E | ◕ | ● | ◑ | ◑ | ◕ | ● |
| SWEPCO | ◕ | ● | ◑ | ◑ | ◕ | ● |
| Fully Met = ● Mostly Met = ◕ Partially Met = ◑ Did Not Meet = ○ | | | | | | |

*Overall, Arkansas continues to demonstrate ongoing leadership and commitment to sound energy efficiency programs and policies.* This is evident in its long history of establishing policies that promote energy efficiency programs and its commitment to measuring the overall effectiveness in both program planning and implementation through annual EM&V and transparent reporting.

## *Recommendations*

This case study has also identified several areas that merit further consideration by the Commission with input from the PWC.

- The Commission may want to review the areas of inconsistency identified in the case study, specifically:
    a. Avoided T&D costs;
    b. Use of marginal line losses:
    c. The selected discount rates; and
    d. The handling of incentives to free riders.

The Commission may want to consider providing clarity regarding the inputs and calculations for the cost-effectiveness calculations in Arkansas.

- The Commission may want to seek additional guidance regarding carbon cost pricing as the NSPM does not provide specific guidance on this topic. Appendix B summarizes the additional resources and approaches for addressing the issue.
- The Commission may want to consider expanding the current approved NEBs to include those specific to low-income programs that are consistent with the criteria set forth by the Commission in its order approving the inclusion of NEBs in the TRC test of cost-effectiveness, if a Low-Income Pilot Program is launched.

- The Commission may want to consider requiring the six Arkansas utilities to document which other utility system and non-utility impacts are being included in cost-effectiveness analysis (e.g., wholesale price suppression effects; avoided other regulatory costs) in the SARP workbooks in order to reveal any areas of inconsistency.
- Besides participant NEBs directly attributable to low-income programs, there is a long list of potential participant impacts that the Arkansas PSC could consider adding to the cost-effectiveness testing to address current asymmetry in treatment of participant costs and benefits (i.e. current inclusion of all participant costs, but only some participant benefits).[29] The current Commission approach has been to focus on those NEBs that are quantifiable, material, and relevant to the analysis of a specific utility program or program portfolio." [30] Analysis of some NEBs actually produced by the state's efficiency programs would address the current inconsistencies used in Arkansas as well as affirm Arkansas' commitment to focus on quantifiable, Arkansas-specific NEBs going forward.
- The Commission may want to consider whether previously stated policy interest in the environmental, energy security and economic development impacts of efficiency programs is of sufficient magnitude to warrant future inclusion of these impacts in the state's cost-effectiveness test and if so, provide appropriate guidance.

[29] C&EE Rules, Section 2, as amended by Orders 15 and 18 of APSC Docket No. 06-004-R, effective April 12, 2007 and May 25, 2007, respectively.

[30] APSC Docket No. 13-002-U, Order No. 30, p. 16; Order No. 7, p. 88.

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# SUMMER PEAK SHAVING ADJUSTMENT RESOURCES IN PJM

## *Consumer Advocates of the PJM States*

*Final Report March 2019*

prepared by **Demand Side Analytics**

Demand Side Analytics
DATA DRIVEN RESEARCH AND INSIGHTS

REPORT

# Summer Peak Shaving Adjustment Resources in PJM


Prepared for CAPS

By Demand Side Analytics, LLC

March 2019

## *PREPARED BY*


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# TABLE OF CONTENTS



### Figures

## Tables

# 1 PJM SUMMER ONLY DEMAND RESPONSE TASK FORCE OUTCOMES

At its October 25, 2018 meeting, the Markets and Reliability Committee of PJM voted in favor of a motion to adopt PJM's proposal for creation of a Peak Shaving Adjustment mechanism. The proposal was the result of work by the Summer Only Demand Response Task Force (SODRSTF) which sought to explore mechanisms to include summer only DR resources in PJM's forward capacity market (Reliability Pricing Model, or RPM). Historically demand resources such as demand response and energy efficiency have entered the market as supply and been eligible to compete alongside traditional supply side resources (power plants) in a competitive auction to fulfill the resource requirements for the region.

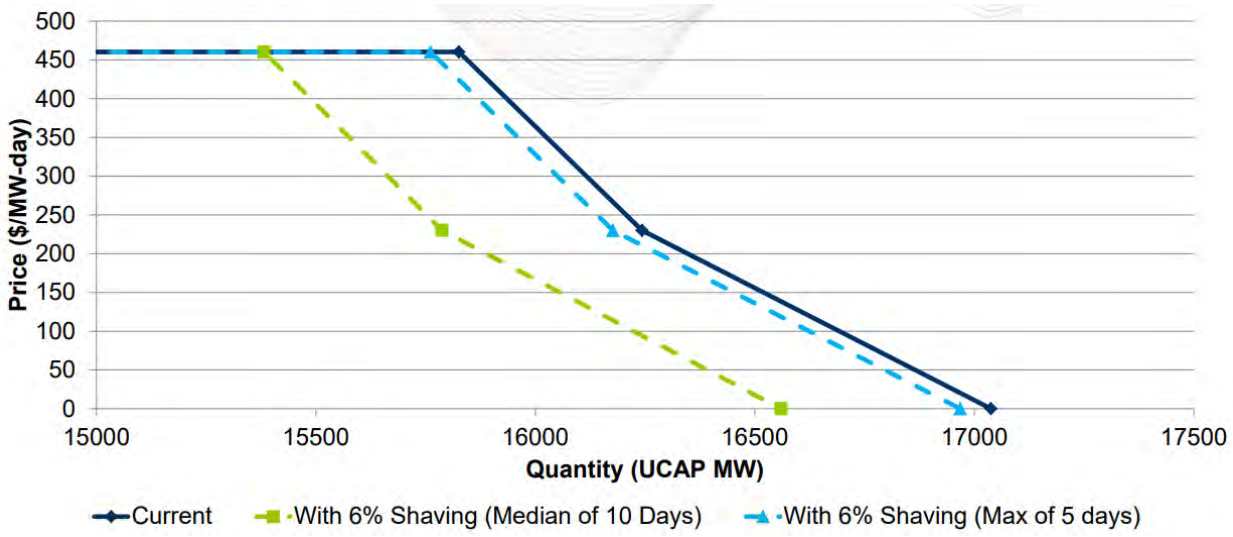
Demand response resources such as utility direct load control of central air conditioners have recently encountered difficulty participating in the market due to PJM's "capacity performance" definition of generation capacity. Capacity Performance, or CP resources, must be able to perform 16 hours per day for consecutive days on any operating day regardless of season, weekends, or holidays. While summer only resources could theoretically pair with a winter only resource to form a bid, EDCs and LSEs with existing summer only DR resources perceived the move to Capacity Performance would lead to stranded summer assets in a summer-peaking system. The SODRSTF charter directed the task force to explore mechanisms to value demand response for those resources that may not be able to clear in the capacity market.

Over the course of nine months, SODRSTF members brought forth various proposal packages with different design components. Through a collaborative process, PJM adjusted its proposal to include key elements of other packages and ultimately received 65% support from the task force.

## 1.1 LOAD FORECAST ADJUSTMENT

A Peak Shaving Adjustment (PSA) is fundamentally different from the way demand response has participated in RPM historically. Instead of being treated as supply that is capable of fulfilling resource requirements, a Peak Shaving Adjustment enters the market on the demand side. In PJM's capacity market, demand is represented by the Variable Resource Requirement (VRR) curve. As shown in Figure 1, the VRR curve is downward sloping. The resource clearing price is ultimately the coordinates on the y-axis (price), where the supply curve – which is upward sloping – intersects the demand curve. Figure 1 also shows the underlying mechanism by which Peak Shaving Adjustments will be recognized in the market. Once recognized by PJM, Peak Shaving Adjustments will lower the peak load forecast for a zone and move the VRR curve to the left.

Figure 1: VRR Curve with Peak Shaving Adjustment




The amount a Peak Shaving resource will lower the summer peak load forecast and move the VRR curve the left is a function of several factors.

- The amount of load reduced when active (MW)
- The frequency of shaving (number of days per summer)
- The duration of shaving (number of hours per day)

Zonal load characteristics also affect the magnitude of the load forecast adjustment and are discussed in more detail in Section 2.1. The load forecast adjustment itself is calculated by PJM using the difference in two forecast models.

1. Traditional econometric load forecast using historic loads, weather, and other factors
2. The same model with a modified load history. Using the attributes provided by the program administrator, PJM will subtract the expected shaving from historic loads back to 1998 and re-run.

## 1.2 DESIGN COMPONENTS AS ADOPTED

Table 1 summarizes the key design components of the Peak Shaving Adjustment mechanism. The table is adapted from a proposal matrix compiled by PJM to compare packages in the SODRSTF.

Table 1: Peak Shaving Adjustment Program Design Components

| Design Component | Description |
|---|---|
| **Mechanism to recognize summer only DR** | Forecast Adjustment based on load forecast run for BRA with modified load history that assumes anticipated curtailment behavior occurred in the past. VRR curve is reflective of the reliability requirement, which depends on the load forecast and the monthly load profile. |
| **Measurement and Verification (M&V)** | Economic DR rules, which use a customer baseline (CBL). CBLs use average load data from recent non-event days to estimate what load would have been absent curtailment. The default CBL is a "high 4 of 5" with SAA. PJM Manual 11 provides a full list of potential CBLs. |
| **Non-Performance Penalties** | Modification to forecast adjustment based on most recent performance. If a resource under-performs relative to its commitment, subsequent commitments will be de-rated. |
| **Curtailment Trigger** | Temperature Humidity Index (THI) as determined by the program administrator. This is different from traditional DR in that there is no event "call". The program administrator must monitor weather conditions and determine whether to shave or not based on the weather forecast. The THI trigger is a daily maximum – actual, not forecasted. Section 2.1 includes addition discussion of weather considerations. |
| **Capacity Market Valuation** | Function of the lower forecast and shifting the VRR curve left. No compensation is provided. The zone only lowers the amount of capacity they are obligated to purchase (an avoided payment). All benefits accrue to the zone in the form of a reduced capacity obligation. |
| **Supervisory Control** | Program Administrator (EDC, LSE, CSP, State or Other) is fully responsible to fulfill the load forecast adjustment requirements. Program Administrator manages a portfolio of customers under an approved Relevant Electric Retail Regulatory Authority (RERRA) tariff or Order. |
| **Performance Months** | Pre-determined. Program administrators can select any active months they wish and communicate that to PJM. Affects the valuation. |
| **Interruption Days** | Unlimited. Any non-holiday weekday in the performance months |
| **Interruption Hours** | Pre-determined. Program administrator decides which hours they will shave load on days the THI trigger is met and communicates that to PJM. Affects valuation. |
| **Eligibility** | Load reduction programs governed by tariffs/orders. Dual participation in supply-side DR (Economic or Load Management) or PRD is not allowed. |
| **Timeline for reporting program components to PJM** | 10 business days prior to September 30th. Timeline is adjusted for transition period (see Section 1.3) |
| **Applicable Auctions** | Base Residual Auction and Incremental Auctions |

The design components listed in Table 1 were not unanimous and alternate structures will likely be proposed until all rulemaking is final at PJM and FERC. The two areas that received the most attention during the SODRSTF meetings were:

1) **Eligibility** – several package sponsors sought alternatives to the PJM package design that disallows participation as both supply and demand in the market.
2) **Supervisory Control** – some package sponsors felt that specifying Program Administrators must manage customers under RERRA tariff or Order was too restrictive and would limit access to Peak Shaving Adjustment market opportunities.

All of the components in Table 1 are important for states and program administrators to understand and consider when nominating a Peak Shaving Adjustment. The prohibition of dual participation may prove especially important for some states. While residential customers do not participate in supply-side DR absent aggregation by EDCs or program administrators, large C&I customers do. For example, Pennsylvania's Act 129 demand response programs deliver 450-500 MW of peak shaving on hot summer afternoons. However, many of the large industrial customers that participate in this state program also have commitments in PJM DR programs (as supply). Regulators and EDCs in Pennsylvania would have to carefully consider the amount of *eligible* peak shaving capability in existing programs before nominating a Peak Shaving Adjustment.

One issue we expect will require additional clarification moving forward is the eligibility of peak demand reductions associated time-varying pricing (TVR). Peak time rebates (PTR) are a dispatchable type of rate and were discussed in the SODRSTF as eligible. We believe event-based price signals such as critical peak pricing (CPP) would also be eligible. The case for new 'everyday' time-of-use rates or residential demand charges is less clear. Certainly these strategies provide a price signal to shave peak demand, but they are not dispatchable. A downward adjustment in the peak demand forecast seems like a logical place to reflect the expected effects of TVR, but PJM will need to determine how long such deployments are considered a load forecast adjustment and at what point they become embedded in the default load forecast.

## 1.3 TIMELINE

The commitment cycle for Peak Shaving Adjustments (PSAs) will precede the Base Residual Auction for generation capacity. The BRA for a delivery year is held in the spring, three years prior to the delivery year. For example, the BRA for the 2021/2022 delivery year (June 1, 2021 to May 31, 2022) was held in May 2018. The BRA for the 2022/2023 delivery is delayed until August 2019 because of FERC filings so the Peak Shaving Adjustment timeline is different as it is phased into place. Once the transition period is complete, PSAs will need to commit by the September prior to the BRA – or almost four years before the delivery year. Key dates for the 2022/2023 delivery year are:

- **December 2018** – PJM releases it's 2019 Peak Load Forecast. This forecast will not reflect any adjustments for Peak Shaving
- **February 1, 2019** – PSA program parameters must be submitted to PJM

- **March 15, 2019** – PJM publishes a new Peak Load Forecast inclusive of Peak Shaving Adjustments
- **May 1, 2019** – Planning parameters for the 2022/2023 BRA are posted online
- **August 2019** – Base Residual Auction of the 2022/2023 delivery year occurs
- **June 1, 2022** – Beginning of the 2022/2023 delivery year. PSAs nominated in February 2019 are expected to perform when the THI trigger is met.

The timeline listed above may ultimately be delayed as FERC approval of the PJM proposal has not been finalized. In February 2019, FERC issued a letter of deficiency to PJM citing the need for additional clarity on several topics. This development has timeline implications because it reopens the filing for member comments and also allows for time periods for PJM to address the topics and for FERC to review.

Specifics aside, a key aspect of this timeline is that PSAs commit in advance of the auction which sets the resource clearing price (RCP). This means a PSA must commit to peak shaving activity without knowing what the value of that shaving will be. Program administrators will have to look at historic clearing prices and base decisions to commit on estimate values. There is no mechanism to withdraw a commitment based on price, other than non-performance.

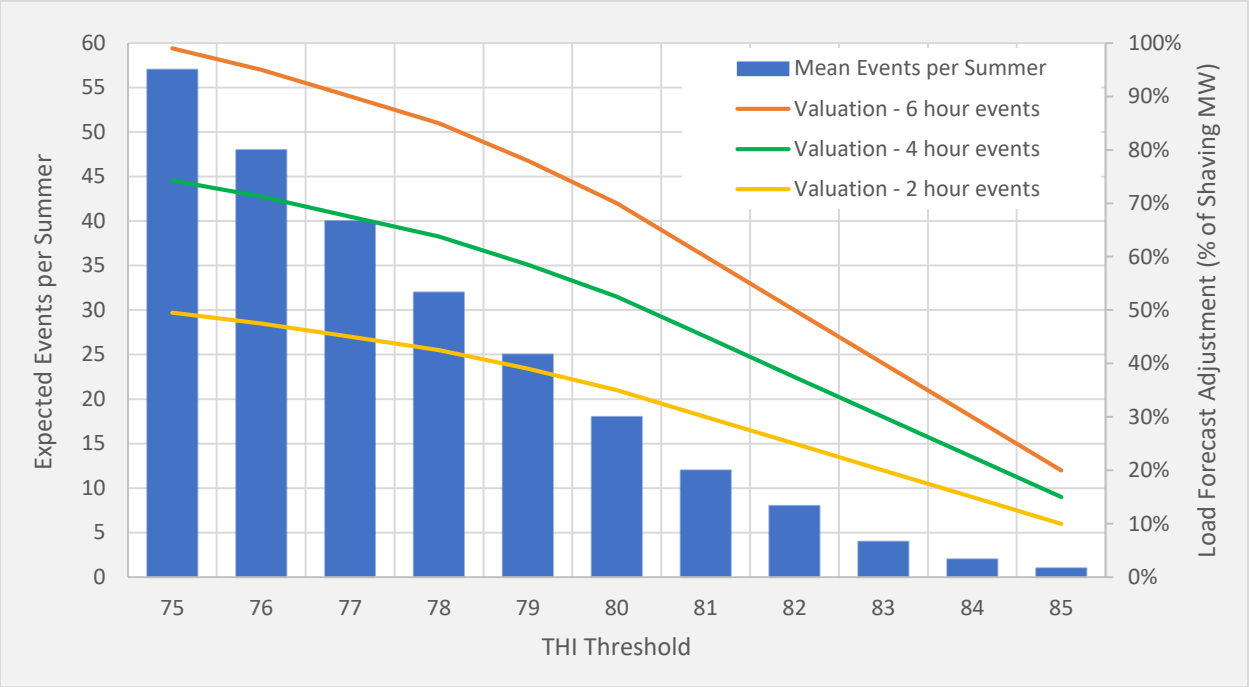
Another key takeaway from the timeline shown above is that PSAs must commit well in advance of delivery. This can create challenges for utility or state planning cycles which sometimes set program plans, budgets and goals in 3-5 year cycles, but only plan 1-2 years in advance. As shown in Table 1, PSAs can also commit in Incremental Auctions, but clearing prices in Incremental Auctions have been lower than BRAs historically.

# 2 PEAK SHAVING RESOURCE OFFER STRATEGY

The valuation of a Peak Shaving Adjustments will be dependent on the magnitude, frequency, and duration of peak shaving. A program administrator that commits to shave 100 MW for two hours per day on summer weekdays with a maximum THI of 84 might receive a 20 MW reduction in their summer peak load forecast and reliability requirement. If the same program administrator were to commit to shave 100 MW for six hours per day each weekday the maximum THI exceeded 78, the zone might receive an 80 MW load forecast adjustment.

Figure 2 illustrates the fundamental decision a program administrator must make when nominating a PSA resource. Along the x-axis is THI. The blue bars show the expected number of peak shaving days per summer at each THI trigger and are based on 20-year averages for a hypothetical zone. Of course not every year exhibits average weather. The orange, green, and yellow lines represent the valuation of a PSA for given event duration. The valuation percentages can be thought of as the percentage of a resource clearing price the PSA earns. Consider a 100 MW PSA that is allocated a 60 MW reduction in resource requirement (60%) for a delivery year where the resource clearing price is $100/MW-day. That 100 MW peak shaving program is valued at 60% of the clearing price, or $60/MW-day.

Figure 2: Sample Program Decision Chart




The height of the blue bars is a function of weather conditions which have to be estimated based on historic data. Section 2.1 explores the risks and decision criteria associated with weather. The shape of the orange, green, and yellow lines illustrated in Figure 2 for a given zone is also a function of zonal load characteristics. This is explored in more detail in Section 2.2.

## 2.1 WEATHER

Peak Shaving days will be identified based on the maximum Temperature-Humidity Index (THI) that a system reaches on any given summer weekday. Program administrators must select a THI threshold for their Peak Shaving program and must dispatch the program whenever that THI threshold is met. This design has uncertainty associated with it, and administrators should understand how weather variability affects program operations. There are two main types of uncertainty related to weather that should be considered:

- Weather forecasts are not error-free. For example, during summer months in the Mid-Atlantic region, afternoon thunderstorms can lead to lower observed THI values compared to forecasts.

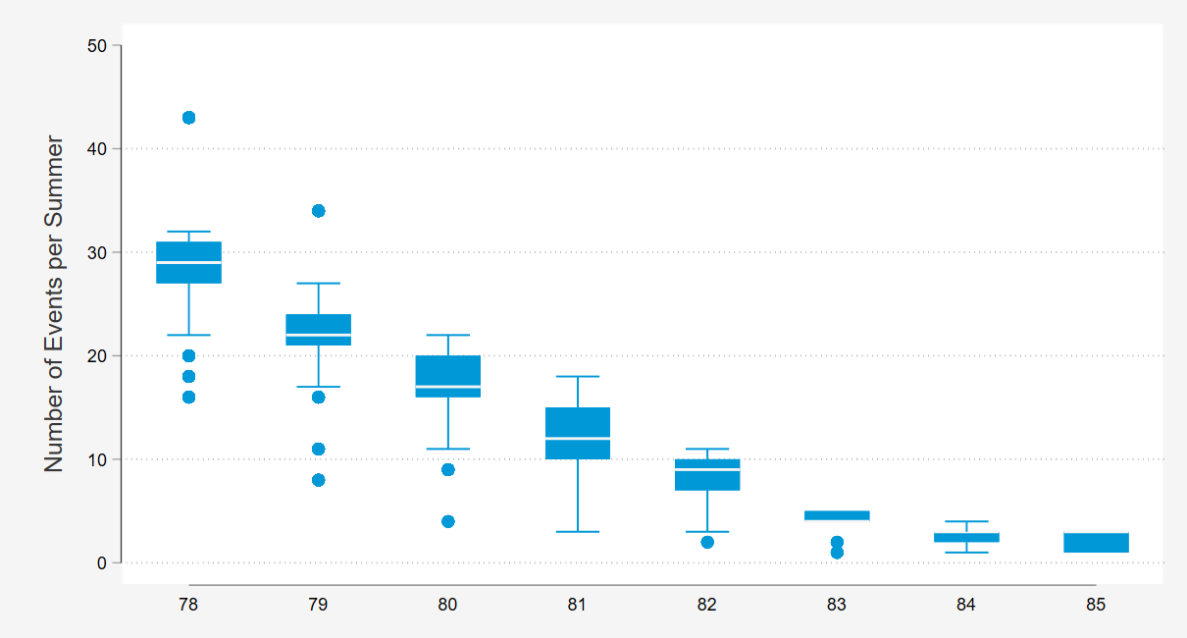
- Observed weather varies from year to year. Whether a summer will be a hot or mild summer cannot be known in advance.

Without a detailed study of weather forecast accuracy, it is difficult to say what the impact of forecast error would be on program dispatch. Program administrators should consider if setting an internal THI trigger lower than the committed trigger to avoid missing a shaving day if the observed THI is higher

than forecasted. Since a lower THI threshold would mean more events, which can have customer incentive and participation implications, program administrators should weigh these costs against any penalties for underperformance. Program administrators will also need to consider when to make "go/no-go" decisions regarding peak shaving. Waiting as close as possible to the committed shaving hours will reduce uncertainty, but also limits the opportunity for "pre-cooling" of homes for programs that shave via control of central air conditioning loads.

Year-to-year variations in weather are easy to understand using historic data. Figure 3 shows the distribution of events per summer for the JCPL (Jersey City Power & Light) system across a range of THI triggers. This graph is a box-and-whiskers plot that illustrates the distribution of a given metric – in this case the number of event days per summer (based on weather data from 2006 to 2017). The height of the blue rectangle (box) illustrates the range of the 25$^{th}$ through 75$^{th}$ percentile of event days per summer, so for example we can see that 50% of summers would have between about 10 and 15 events per summer if the THI trigger had been set to 81. The median outcome in that example is where the line in the middle of the blue rectangle is, or about 12 shaving days per summer. The more salient values from the chart, however, are the minimum and maximum observations that are shown either as the minimum and maximum range of the whiskers, or as the points outside the whiskers, which are classified as outliers. So while, with a THI of 79, the JCPL system experiences a median of 22 events per summer, the lowest number of peak shaving days per summer that would have been observed in this twelve-year period was 8 peak shaving events. Perhaps most importantly for program planners, the highest year would have had 35 shaving events.

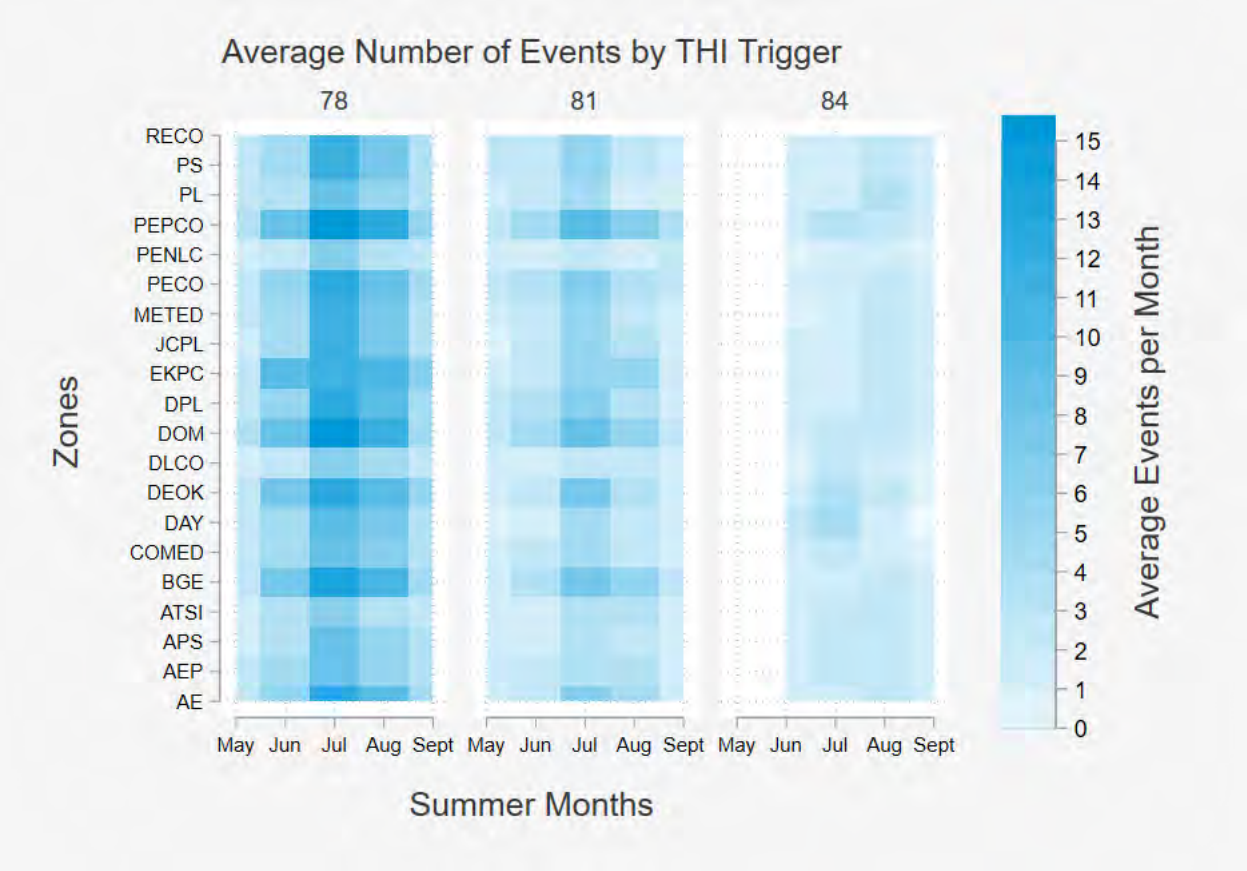
Figure 3: Distribution of Average Number of Summer Events by THI Trigger



What this means for program administrators is that, while a program may be designed at a particular THI trigger to yield an average or median number of events in a summer, the intrinsic variability in year-to-year weather variability will result in unpredictable numbers of events.

Complicating these decision points further, this variability is not necessarily evenly distributed throughout the summer. Figure 4 shows the average number of events per month across all PJM zones and summer months. Naturally, the hotter and more humid months of July and August trigger more shaving events at any THI threshold, and the higher the threshold, the fewer events there are overall. However, such intra-seasonal variability may have effects on participation. It is one thing to enroll in a program that is expected to deliver 20 events per summer, however it may be another to have half of them triggered in a single month.

Figure 4: Distribution of Events by Month and Zone

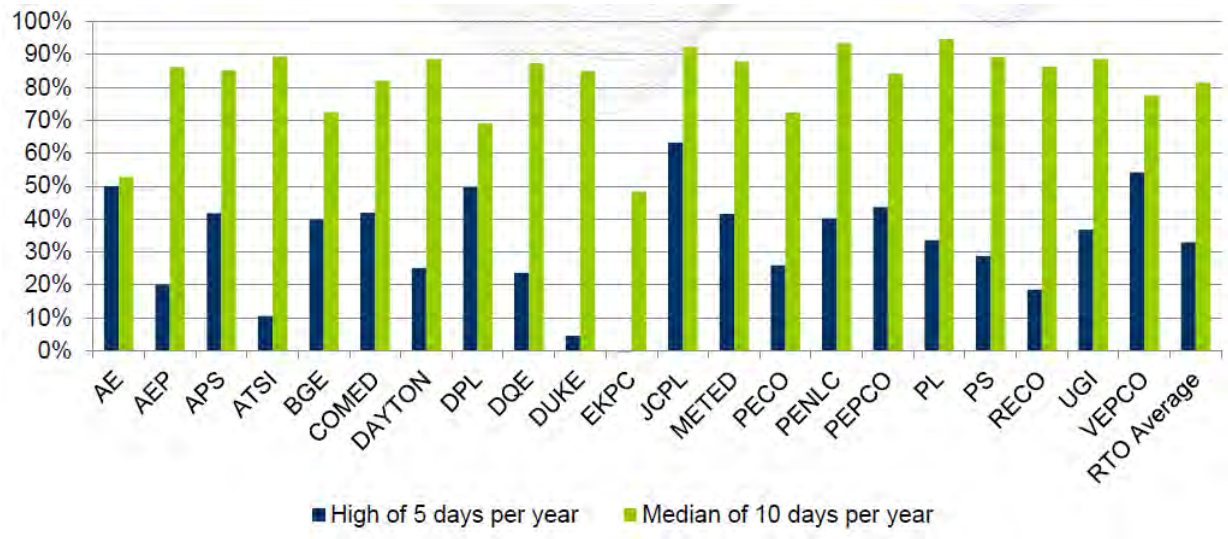



## 2.2 SYSTEM LOAD CHARACTERISTICS

Not every system will have the same peak load forecast impact given the same program design. Due to unique characteristics for each zone, a program that shaves for 5 days a summer in JCP&L will have a higher impact on the peak load forecast than nearly any other system in PJM, as shown in Figure 5. Similarly, the difference in forecast impact between a program that shaves for a maximum of 5 days per summer compared to one that shaves a median of 10 days per summer can vary by system. These

differences are motivated by system load characteristics that make each territory unique. In this section, we examine the key drivers of peak load forecast impact, and what design features of a peak shaving program affect impacts.

Figure 5: Peak Forecast Impact as a Share of Shaving Amount by Zone

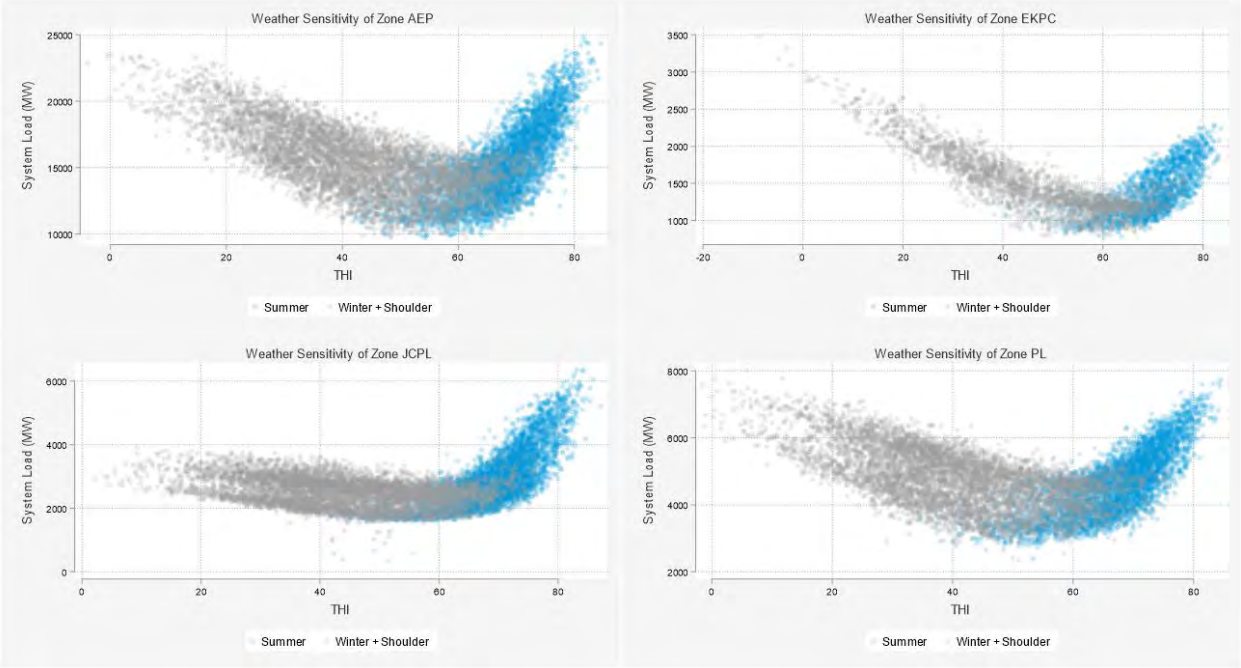



Every system in PJM has slightly different characteristics, due to its size, weather, diversity of industry and residential composition. These differences have meaningful implications for the ability of a summer peak shaving program to lower the reliability requirement for the zone. To assess the value of such a peak shaving program, we should first consider two important interactions between the system and the program:

1) Does the system typically peak when summer peak shaving events would be called?
2) Will the peak shaving activity create a new peak or broaden the peak substantially and spread risk across other days and hours when shaving does not occur?

The first question can be considered in two ways. First, does the system even peak in the summer, when the peak shaving program is operational? Is the zone a summer-peaking, winter-peaking, or dual peaking system? Second, for a given THI trigger, is the system at its peak demand? That is, if an event is called, what is the likelihood that the system is at its peak? Figure 6 shows how these characteristics can change by zone. On the y-axis is an hourly system load for one of four systems for calendar year 2017. The x-axis shows the THI in that interval. Finally, the markers are color coded for summer/non-summer months. For some systems, the maximum system load occurred in the summer, such as AEP (American Electric Power) and JCPL (Jersey City Power & Light). EKPC (East Kentucky Power Cooperation) clearly peaks strictly in the winter, while PL (PPL) is relatively balanced in peaking between summer and winter and the season the peak occurs may vary from year to year based on weather.

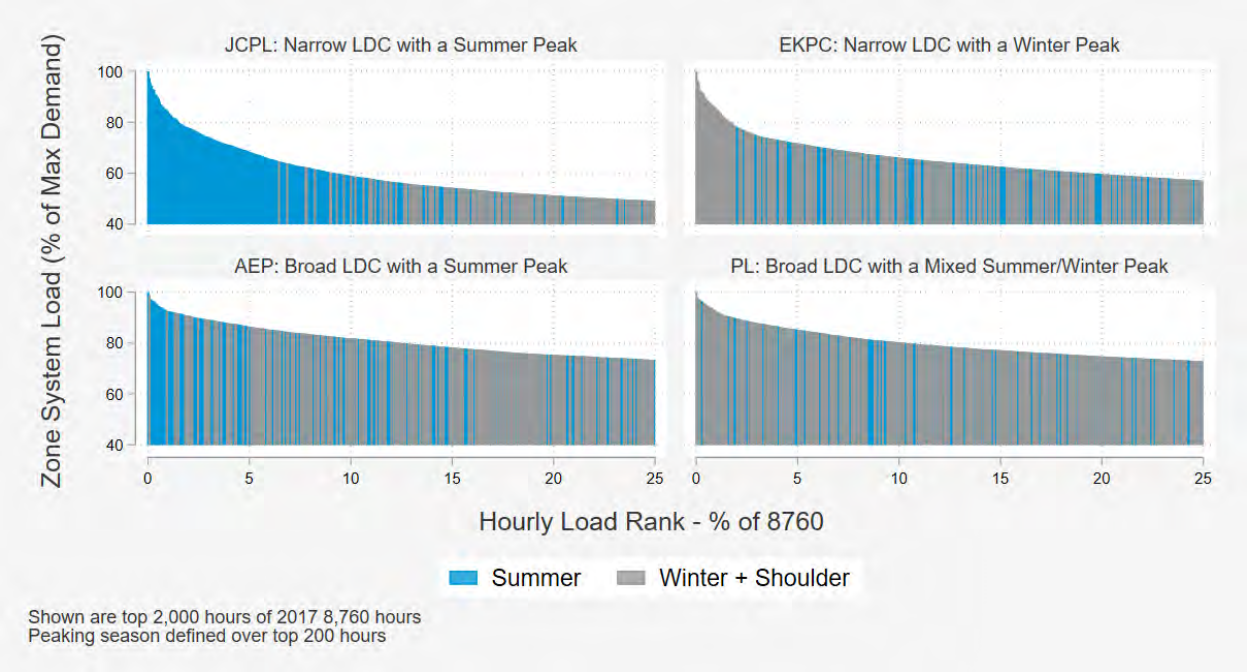
## Figure 6: Weather Sensitivity of Select PJM Zones




Systems that peak in the summer will be allocated more value from a summer-only DR program, as demand reductions will reduce the overall system peaking risk and generation capacity requirement for the zone. Figure 6 also shows differing levels of variability in system load at a given THI. AEP and JCPL are both summer-peaking systems, however at a given THI, AEP has a much broader range of observed system load than JCPL. Similarly, we see AEP loads at or near the maximum system load for the year at several degrees lower than the observed maximum THI. Based on these characteristics, we'd expect the same amount of peak shaving based on a THI threshold to yield a smaller reduction in the peak load forecast than for JCP&L.

To assess the second question, it is also helpful to look at a system's load duration curve (LDC). The LDC ranks system load in descending order, and in some cases normalizes it to be compared to other systems. Shown below in Figure 7 are normalized load duration curves for four illustrative PJM systems. The y-axis is defined as the % of the maximum demand in that year and the x-axis is the rank of each hour-long interval as a percent of the 8,760 hours in a year. Each interval is color-coded in either blue or grey to indicate which season that interval comes from – either Summer (May – September) or Winter & Shoulder (all others). As discussed above, both Jersey City Power & Light and American Electric Power peak in the summer months, while East Kentucky Power Cooperative peaks in the winter and PPL peaks in both summer and winter. This has important considerations for peak shaving program design and valuation, since a program designed to shave summer peak load will be less impactful on resource requirements in a system where significant peaking risk occurs outside of the summer months.

Figure 7: System Load Characterization




Another load characteristic to consider is whether a peak shaving program would simply shift the peak to earlier or later hours during an event day. That is, if the event window is short, there still may be high demand before the event or after the event is over. This is one of the key consideration with event duration and why the three lines in Figure 2 exhibit different valuation trends. The idea of secondary peak creation is best illustrated by the breadth of the load duration curve over the top 5% of hours: the broader the peak, the smaller the difference in demand is between the system peak hour and the 95$^{th}$ percentile. Said another way – if demand is shaved during the top 1% of hours but the load duration curve is broad, the hours in the top 2%-5% of intervals may be close enough to peak that the peaking risk has effectively been shifted to them rather than eliminated. On the other hand, a narrow peak, like at JCP&L or EKPC in the figure above will reap benefits from a peak shaving program since peak load is not likely to be shifted to near-peak hours. Of course, since East Kentucky Power Cooperative peaks in the winter, this second consideration is moot for that system.

To address this issue, programs could be designed with long durations that essentially capture the entire peak on a given day. Program administrators must consider the effect on customer incentives, satisfaction, and participation that such a long event window would have in conjunction with system characteristics.

## 2.3 CUSTOMER ROTATION

Another important consideration for program administrators will be whether to use customer rotation to shave load on more days or for a greater number of hours per day. Consider an air conditioning cycling program that has 100,000 residential participant households that achieve an average load reduction of 1.0 kW (100 MW resource). Historic utilization of the program has been fairly infrequent

with 4-6 events per summer lasting 3-4 hours per event. Is it more advantageous from a valuation perspective for the EDC to commit on of the following designs?

- 100 MW of peak shaving at THI = 83 during hours ending 16, 17, and 18
- 50 MW of peak shaving at THI = 81 during hours ending 15, 16, 17, 18, and 19
    - And during any given peak shaving hour only dispatch half of the program participants

These two designs would likely result in a similar number of interruption hours per participant. The second design would clearly receive a higher valuation *per MW* from PJM because of the greater number of hours and lower THI threshold. However, the EDC can only commit to shaving half as many MW. How would the total valuation compare? We believe the answer to this question will be a function of how broad/narrow peaks are for zonal load. For a peaky system, it may be advantageous to shave more MW at extreme THI conditions for a small number of hours. For a system, with a flatter peak it may be advantageous to sacrifice the amount of shaving in any given hour to peak shave on more days and hours. PJM may be willing to run a small number of permutations during the transition period as program administrators try to optimize their offer strategy.

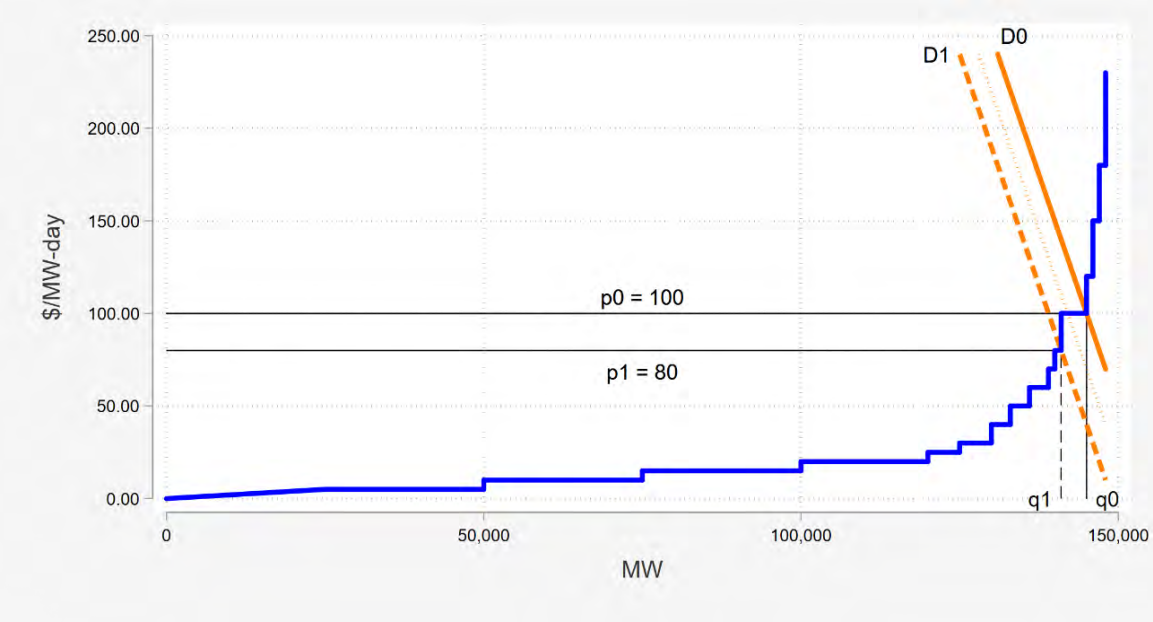
# 3 VALUATION OF PEAK SHAVING ADJUSTMENTS

## 3.1 THE ECONOMIC THEORY OF CAPACITY PRICE SUPPRESSION

The resource clearing prices in the PJM BRA are a function of zonal demand and the cost of resources available to meet those demands. The capacity auction clears resources by ascending price until sufficient resources are procured to meet the resource requirements. The result is a supply curve which is flat over a large portion of the resource requirement and then increases sharply. Section 2 demonstrated how PSAs reduce the amount of generation capacity required for a zone. Reducing peak capacity requirements generates value both by avoiding the costs associated with the load being shaved, and potentially by lowering the price for the remaining capacity that still must be procured. This second component is the price suppression effect.

Figure 8 demonstrates the theoretical concept. The demand curve without peak shaving is shown by the orange line $D_0$, which results in price of $P_0$ and a quantity load $Q_0$. With peak shaving factored into the peak demand forecast and resource requirement, the demand curve shifts left from $D_0$ to $D_1$ which reduces the resource requirement to point $Q_1$. This puts downward pressure on prices, in the example reducing the RCP to $P_1$. While a PSA will always put downward pressure on price, quantifying that price suppression effect is challenging and subject to significant year to year variation. If the demand curve shift were smaller, or the intersection between supply and demand occurred at a flatter portion of the supply curve, the change in resource clearing price might be close to zero.

Figure 8: Price Suppression Example




The value of peak shaving in the capacity market will vary based on the state of the market (specifically in which region of the supply curve the VRR curve intersects) and the amount of capacity reduced. A peak shaving adjustment guarantees the resource contributor will not need to purchase capacity associated with the reduction in resource requirement, but the value of that reduction depends on the RCP. The price suppression effect is even more uncertain. Because the supply curve is composed of discrete steps, it is possible a PSA does not clear a price block in which case the price suppression effect is negligible as illustrated by the faint dashed line between Do and D1 in Figure 8. Generally speaking, higher clearing prices result when the VRR curve intersects a steeper portion of the supply function and are associated with larger price suppression effects because the same change in demand will result in a larger change in price.

That said, the substantial uncertainty in the RCP and price suppression effect are problematic because PSAs must commit in advance of the auction which sets the resource clearing price. This means a program administrator must commit to peak shaving activity without knowing what the value of that shaving will be. This makes conducting prospective benefit cost tests of peak shaving programs difficult since the benefit stream is hard to quantify. Program administrators will have to think about how to set program incentive levels without knowing exactly what the benefits stream will be for a delivery year, and will have to look at historic clearing prices and base decisions to commit on estimated values. Section 3.2 illustrates the variation in benefit valuation based on RCP changes and estimated price suppression differences from year to year.

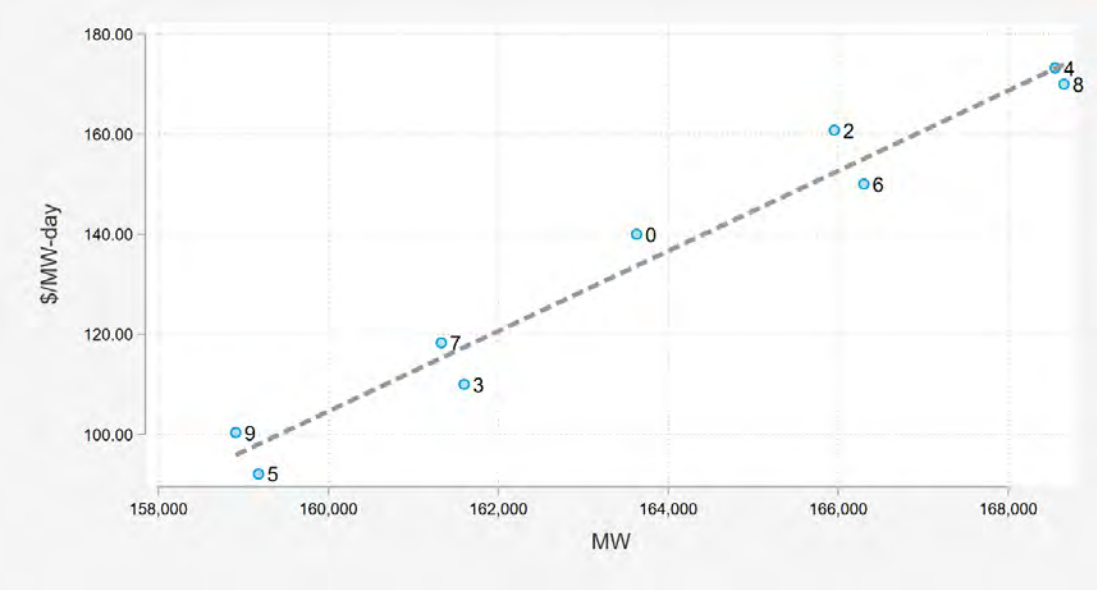
## 3.2 MODELING OF PJM BRA SENSITIVITY ANALYSES

Peak shaving programs should always reduce the load forecast and as a result, the zonal unforced capacity obligation. A conservative approach to reasonably estimate the PSA benefit is to take the

expected reduction in unforced capacity obligation, and multiply it by the historic average clearing price for the zone. Including estimates of the price suppression effect is more challenging, but by estimating the slope of the supply curve around the RCP and using that predict the clearing price with and without the inclusion of the PSA, we can produce a rough approximation.

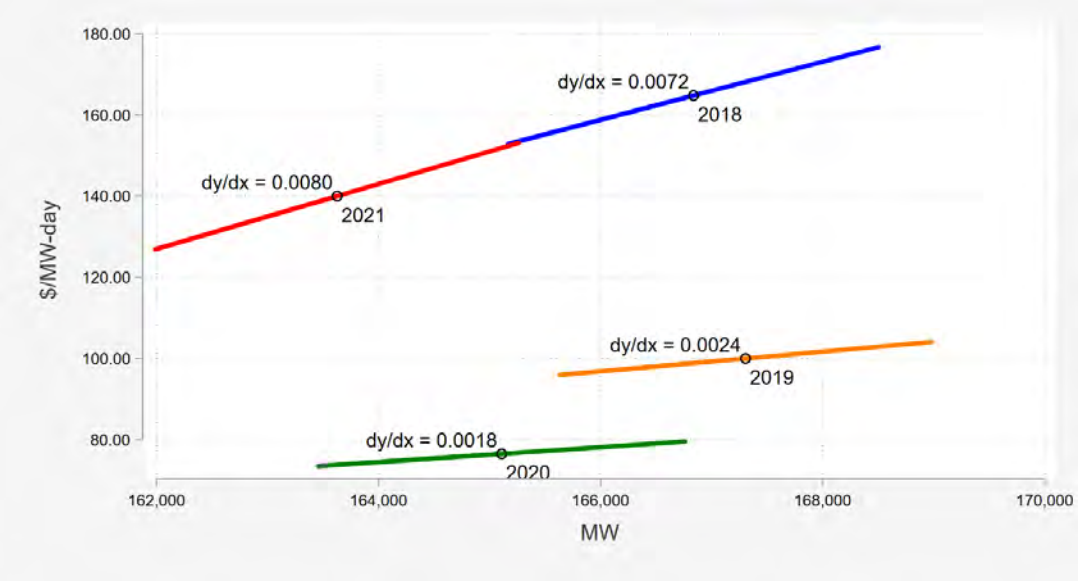
Following each BRA, PJM produces a sensitivity analysis on the auction results. The PJM BRA sensitivity analyses provide the capacity obligations and RCPs under a number of scenarios in which supply is either added to or removed from the bottom of the supply curve. Adding supply to the bottom of the stack is theoretically similar to removing demand (and vice-versa) so we use these scenarios to generate an approximation of the supply curve slope in the narrow band examined in the sensitives. Each scenario represents a point and a simple regression of price on capacity can estimate the slope of the curve as show in Figure 9. In this case, the slope of the curve in the region of interest is roughly 0.008 which means that a 100 MW peak shaving adjustment would lower the clearing price by roughly 80 cents per MW-day.

Figure 9: RTO Capacity Supply Curve Slope Estimation from BRA Scenario Analysis 2021/2022



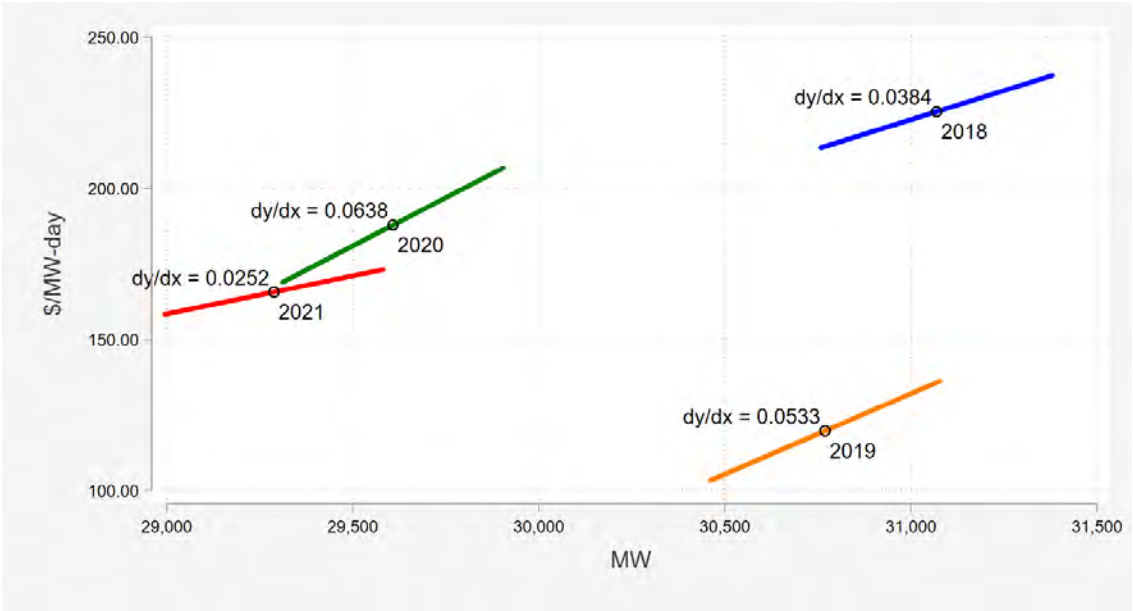

However, the capacity supply curve is not a static entity, it's construction varies from year to year based on a variety of factors – including market rules. It is possible to estimate the general order of magnitude of the slope around the clearing price but there is a significant variation year-to-year. Thus having a several years' worth of BRA scenarios to examine is key in illustrating the uncertainty of the value associated with Peak Shaving Adjustments. Figure 10 shows the estimated slope of the supply curve based on the last four Base Residual Auctions. Based on these calculations the value of the price suppression effect in the 2021/2022 delivery year (labeled 2021) would have been more than four times greater than the 2020/2021 delivery year. The avoided costs associated with the reduced capacity obligation would have also been greater in 2020/2021 due to the higher clearing price.

Figure 10: Supply Curve Slope Approximations from RTO Base Residual Auction Scenarios by Year




The value of a PSA will also vary based on whether or not the supply of the peak shaving resource is located in a constrained Locational Deliverability Area (LDA) or a zone that clears with the rest of the RTO. As shown in Figure 11, the slope estimates in the EMAAC LDA are an order of magnitude larger. This matches intuition as we would expect a peak shaving resource to be more valuable in a constrained area of the system.

Figure 11: Supply Curve Slope Approximations from EMAAC Base Residual Auction Scenarios by Year




To further illustrate the wide range of values for PSAs that may occur from year to year and across LDAs, Table 2 presents the results from a set of sample calculations. ***Each row of the table assumes the***

***hypothetical zone has a capacity obligation of 10,000 MW and is offering an PSA that yields a 100 MW reduction in the resource requirement***. Using data from the BRA scenario analyses, the capacity obligation is multiplied by the RCP to find the initial cost of generation capacity for the zone. Using the estimated slope, the clearing price after a PSA can be estimated and used to calculate reduced clearing price (-100*slope). The total savings per year is the difference between the annual costs with and without the PSA.

It is composed of two parts. For the first row in Table 2 (RTO for 2021/2022 delivery year), these components are:

- Capacity purchase avoided by lower resource requirement
  - 100 MW * $140/MW-day * 365 days = $5,110,000
- Reduced cost for the remaining capacity purchase (price suppression)
  - 9,900 MW *($140.00 - $139.20) * 365 days = $2,895,387

Table 2: Hypothetical PSA Value Calculation

| LDA | Delivery Year | Base Clearing Price | Slope | New Clearing Price | Annual Cost w/out PSA | Annual Cost with PSA | PSA Savings |
|---|---|---|---|---|---|---|---|
| RTO | 2021 | $140.00 | 0.0080 | $139.20 | $511,000,000 | $502,994,613 | $8,005,387 |
| RTO | 2020 | $76.53 | 0.0018 | $76.35 | $279,334,500 | $275,880,705 | $3,453,795 |
| RTO | 2019 | $100.00 | 0.0024 | $99.76 | $365,000,000 | $360,473,759 | $4,526,241 |
| RTO | 2018 | $164.77 | 0.0072 | $164.05 | $601,410,500 | $592,812,465 | $8,598,035 |
| EMAAC | 2021 | $165.73 | 0.0252 | $163.21 | $604,914,500 | $589,745,845 | $15,168,655 |
| EMAAC | 2020 | $187.87 | 0.0638 | $181.49 | $685,725,500 | $655,806,859 | $29,918,641 |
| EMAAC | 2019 | $119.77 | 0.0533 | $114.44 | $437,160,500 | $413,524,181 | $23,636,319 |
| EMAAC | 2018 | $225.42 | 0.0384 | $221.58 | $822,783,000 | $800,665,177 | $22,117,823 |

It is worth noting that while only the zone contributing the PSA will capture the value associated with the avoided capacity purchase, all zones that clear together will receive the value associated with price suppression. Thus the sponsoring zone is not exclusively capturing the price suppression benefits they create. However, the sponsoring zone will also benefit from any PSAs offered by other entities in their LDA.

A key takeaway from Table 2 is that there is large variation in the value of the same PSA from year to year and across LDAs. In this hypothetical example, values range from $3.4 million to almost $30 million annually for an identically sized PSA, depending on year and LDA. While the value is generally higher in

constrained LDAs and when RCPs are higher, anticipating these parameters, particularly over a multi-year period is inherently challenging. As such, program administrators will need to consider the uncertainty in benefits when structuring peak shaving programs and participant incentive levels. Program administrators considering sponsoring PSAs must also decide how reliable they believe estimates of price suppression effects are and decide whether to count on this benefit stream for planning purposes. The more conservative perspective is to only assume the avoided costs associated with a reduced capacity obligation.

In addition to the historic variation discussed above, there are changes to market architecture at PJM that could affect resource clearing prices, and in turn the value of peak shaving. There is currently an Energy Price Formation Task Force[1] at PJM working through issues around the way locational marginal prices are set and other energy market issues. PJM is also undertaking its required periodic review of net cost of new entry (CONE), which is a determinant of the VRR curve. Both of these developments are complex, but the likely outcomes might place additional downward pressure on wholesale capacity prices. At minimum these market changes increase the challenge associated with predicting the future value for PSAs.

## 3.3 AVOIDED COST OF TRANSMISSION AND DISTRIBUTION CAPACITY

PJM's forward capacity market and the Peak Shaving Adjustment program opportunity deal with generation capacity. The need for transmission and distribution capacity is also driven by peak loads. Peak shaving programs may also be able to avoid or defer capital investment to build or upgrade transmission and distribution networks. The value of peak shaving on the distribution system is inherently location-specific. In 90% of an EDC service territory, there may be no deferral value from peak shaving whatsoever. However, if a large capital project can be deferred or avoided in a specific area of the system, avoided costs can be substantial for program participants on that feeder or substation.

The timing of peaks for individual networks can vary substantially. A mostly residential circuit may peak late into the evening – several hours after the system-wide peak. Program administrators considering a PSA nomination should understand the avoided T&D valuation perspective in their jurisdiction when considering the costs and benefits of peak shaving. It is often useful to work with system planners to understand where load growth related investments are being considered on the system and the extent to which peak shaving activity can potentially defer those capital projects.

[1] https://www.pjm.com/committees-and-groups/task-forces/epfstf.aspx

# 4 CONCLUSIONS AND RECOMMENDATIONS

**Conclusion 1:** By setting the shaving duration and THI threshold, program administrators can effectively choose how often peak shaving will occur *on average*. Weather conditions will vary from year to year so long-run averages or medians need to be used when selecting program design options. Existing programs also need to take into account agreements with participants and tariff details regarding event timing, frequency, and duration.

> **Recommendation 1:** *Consider the total number of expected curtailment hours per summer. For AC cycling and other residential mass market programs, 20-30 hours per summer is a reasonable goal. There is a tradeoff between number of events and event duration. For example, twelve 2-hour events are the same number of curtailment hours as three 8-hour events (n=24 hours). Program designs that seek to shave on fewer days, but for longer durations call for a higher THI threshold. Of course, weather varies across the PJM region so long-run weather should be assessed at the zonal level. Table 3 shows the THI thresholds that correspond to different expected shaving days per summer.*

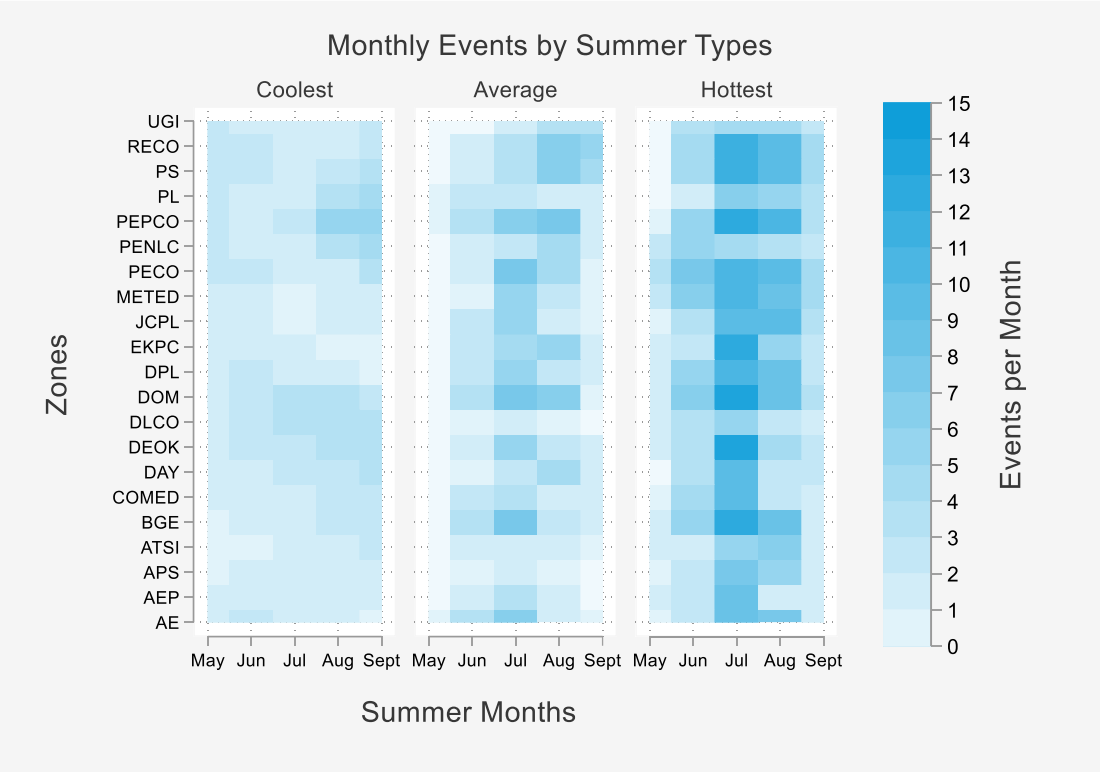
Table 3: THI Thresholds for a Mean of 24 Shaving Hours per Summer

| Zone | Twelve 2-Hour Events | Eight 3-Hour Events | Six 4-Hour Events | Four 6-Hour Events |
|---|---|---|---|---|
| AE | 81 | 82 | 82.5 | 83 |
| AEP | 79 | 80 | 80.5 | 81 |
| APS | 79 | 79.5 | 80 | 80.5 |
| ATSI | 78.5 | 79.5 | 80 | 80.5 |
| BGE | 81.5 | 82 | 82.5 | 83.5 |
| COMED | 80 | 81 | 81.5 | 82 |
| DAY | 79.5 | 80.5 | 81 | 81.5 |
| DEOK | 80.5 | 81.5 | 82 | 82.5 |
| DLCO | 78.5 | 79 | 79.5 | 80.5 |
| DOM | 82 | 82.5 | 83 | 83.5 |
| DPL | 81 | 81.5 | 82 | 82.5 |
| EKPC | 81 | 81.5 | 82 | 82.5 |
| JCPL | 80.5 | 81.5 | 82 | 82.5 |
| METED | 80.5 | 81.5 | 81.5 | 82.5 |
| PECO | 81 | 82 | 82.5 | 83 |
| PENLC | 78 | 79 | 79.5 | 80 |
| PEPCO | 82 | 83 | 83.5 | 84 |
| PL | 79 | 80 | 80.5 | 81.5 |
| PS | 80.5 | 81.5 | 82 | 83 |
| RECO | 80.5 | 81.5 | 82 | 83 |
| UGI | 78.5 | 79.5 | 80 | 80.5 |

**Conclusion 2:** Not every year is average; there are hot summers and mild summers. Program administrators will need to plan based on long run averages or medians, but be also be mindful of the impact of extreme weather. This is not really a concern for mild summers, but extremely hot summers could strain the relationship with participants.

> **Recommendation 2:** *Review the most extreme summer in recent history and make sure the program design characteristics would result in an acceptable number and distribution of events if a similar summer happened. For example, at a threshold of 81 THI for the BGE zone would result in 14 shaving days, on average. However, as illustrated in Figure 12, in an extreme summer, the same THI threshold would have led to 27 events – with 12 of those events occurring in July.*

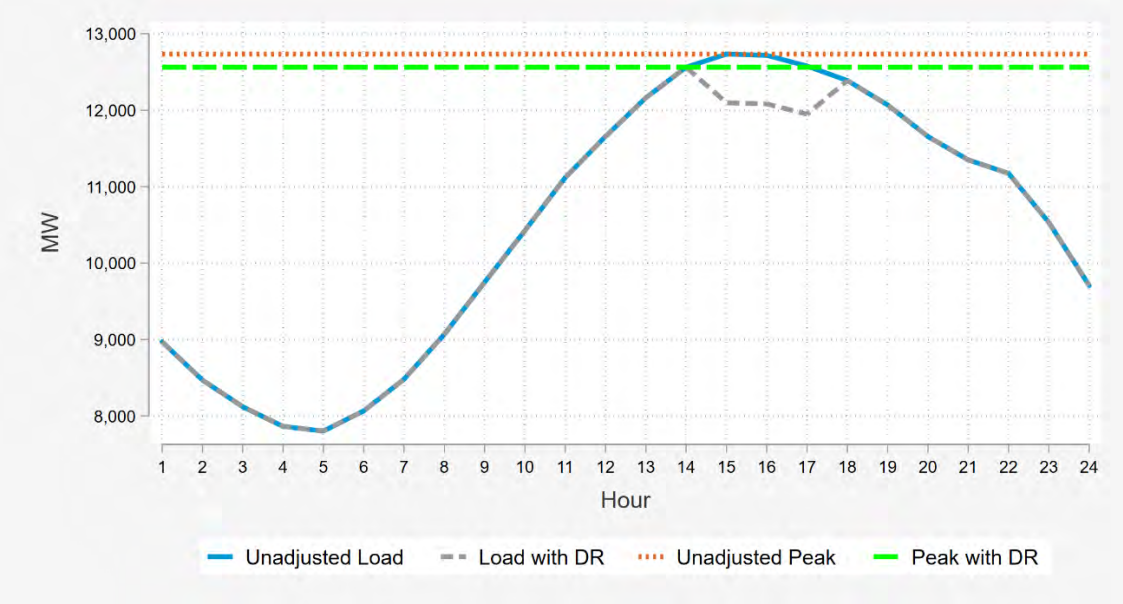
Figure 12: Distribution of Events for Cool, Average, and Hot Summers – 81 THI Threshold




**Conclusion 3:** The optimal number of shaving hours per day will vary by zone based on the load reduction strategy employed and the amount of shaving being nominated.

**Recommendation 3:** *Use historical zonal load data to assess the degree to which shaving activity will shift peaks to other hours of peak days when the peak shaving program is not active. The larger the peak shaving program is relative to total zonal load, the greater the risk of intra-day shifting. Figure 13 provides an extreme example of the risk associated with shaving durations that are too short. This simulation creates a hypothetical peak shaving of approximately 600 MW and applies it to days above 81 THI on a hot summer (2011). Although the load is reduced by 600 MW during the three shaving hours, the difference in peak load is only 175 MW. This is because the peak shifts to Hour 14 when the peak shaving program is not active.*

Figure 13: 600 MW Shaving Program with Three Hour Events – ATSI Zone




*If the simulated peak shaving program were 60 MW instead of 600 MW, there would be no intra-day shifting of peak. Hour 15 would still set the peak – even with 60 MW of peak shaving applied to the loads.*

**Conclusion 4:** The value of a PSA program will not be determined until after it is nominated and the RPM clearing price is known for the delivery year. This makes benefit-cost modeling and decisions about customer incentives challenging.

**Recommendation 4:** *Historical averages of RPM clearing prices can inform an order of magnitude estimate of the value of a peak shaving adjustment, but EDC's must be prepared to handle significant year to year variation. Program administrators should consider the uncertainty in benefits when structuring peak shaving programs and participant incentive levels. That said, a lower value for peak shaving is a net positive for ratepayers because it is associated with lower capacity prices overall. The RPM clearing price drives overall capacity expenditure, so while a higher clearing price makes peak shaving more valuable, it increases annual capacity costs. In other words, the value of the peak shaving adjustment is inversely related to the overall annual capacity cost.*

**Conclusion 5:** The policy perspective on both capacity price suppression and the ability of peak shaving to avoid/defer transmission and distribution investments varies across PJM states.

**Recommendation 5:** *Be mindful of state/utility/commission perspectives on which peak shaving benefit streams can be incorporated in the benefit-cost analysis. If the program is not cost-effective without the additional benefits of price suppression, EDCs will need to evaluate how strongly they feel about their inclusion and how reliably they can estimate the associated value. There is no*

*question that peak shaving will place downward pressure on the capacity clearing price, but there is a high degree of uncertainty in quantifying the effect. The more conservative perspective is to only assume the avoided costs associated with a reduced capacity obligation.*

# **APPENDIX C.** RFP Section II F Reference Information

In reference to RFP *Section II F Reference Information*, ***Appendix C*** presents two former or current client references for which the GDS Team members have performed work in the last three years. Members of the GDS Team give the EERMC permission to contact the references.

## C.1 REFERENCES FOR GDS ASSOCIATES, INC.

| REFERENCE NO. 1 | RHODE ISLAND PUBLIC UTILITIES COMMISSION | | |
|---|---|---|---|
| **Contact Name & Title** | Todd Bianco, Principal Policy Associate | | |
| **Phone** | 401-780-2016 | **Email** | Todd.Bianco@puc.ri.gov |
| *GDS grants EERMC permission to contact this reference.* | | | |

| REFERENCE NO. 2 | GEORGIA PUBLIC SERVICE COMMISSION | | |
|---|---|---|---|
| **Contact Name & Title** | Jamie Barber, Director – Energy Efficiency and Renewable Unit | | |
| **Phone** | 404-651-5958 | **Email** | Jamieb@psc.state.ga.us |
| *GDS grants EERMC permission to contact this reference.* | | | |

## C.2 REFERENCES FOR JOHNSON CONSULTING GROUP

| REFERENCE NO. 1 | ARKANSAS PUBLIC SERVICE COMMISSION | | |
|---|---|---|---|
| **Contact Name & Title** | Mr. Robert Swaim, Sr. Rate Case Analyst- Cost Allocation and Rate Design | | |
| **Phone** | 501-683-4060 | **Email** | Robert.swaim@psc.state.ar.us |
| *Johnson Consulting grants EERMC permission to contact this reference.* | | | |

| REFERENCE NO. 2 | SPIRE ENERGY | | |
|---|---|---|---|
| **Contact Name & Title** | Mr. Shaylyn Dean, Manager, Energy Efficiency Program | | |
| **Phone** | 816-360-5759 | **Email** | Shaylyn.Dean@spireenergy.com |
| *Johnson Consulting grants EERMC permission to contact this reference.* | | | |

## C.3 REFERENCES FOR DEMAND SIDE ANALYTICS

| REFERENCE NO. 1 | CENTRAL ELECTRIC POWER COOPERATIVE, INC. | | |
|---|---|---|---|
| **Contact Name & Title** | Scott Hammond, Director of Member Services | | |
| **Phone** | 803-255-2796 | **Email** | shammond@cepci.org |
| *Demand Side Analytics grants EERMC permission to contact this reference.* | | | |

| REFERENCE NO. 2 | PENNSYLVANIA PUBLIC UTILITY COMMISSION | | |
|---|---|---|---|
| **Contact Name & Title** | Darren Gill, Deputy Director | | |
| **Phone** | 717-783-5244 | **Email** | DGILL@state.pa.us |
| *Demand Side Analytics grants EERMC permission to contact this reference.* | | | |

# **APPENDIX D.** RFP Section II G Identification of Staff & Subcontractors

Table D-1 identifies the staff and subcontractors for this engagement. *Section D.1* provides an overview of the subcontractors, Johnson Consulting Group and Demand Side Analytics, that GDS will utilize for this project. Detailed information regarding our team's experience and qualifications, as well as the assigned roles for each consultant can be found in Section II.H and II.I respectively.

**TABLE D-1 IDENTIFICATION OF STAFF**

| | |
|---|---|
| ***GDS Associates, Inc. (Prime Contractor)*** | |
| Rich Hasselman *Managing Director* | Kaytie Harrah *Project Consultant* |
| Matt Siska *Principal* | Melissa Young *Engineer* |
| Jeffrey Huber *Managing Director* | Michael Coty *Analyst* |
| Josh Duckwall *Project Manager* | Alyssa Gianotti *Associate Engineer* |
| Warren Hirons *Project Manager* | |
| ***Johnson Consulting Group (Subcontractor)*** | |
| Katherine Johnson *President* | Diane Mahon *Project Coordinator* |
| Corine Mahon *Project Manager* | |
| ***Demand Side Analytics (Subcontractor)*** | |
| Jesse Smith *Partner* | Josh Bode *Partner* |
| Alana Lemarchand *Partner* | Adriana Ciccone *Principal Consultant* |
| Steve Morris *Senior Quantitative Analyst* | Mark Noll *Senior Quantitative Analyst* |
| Katherine Burley *Quantitative Analyst* | |

## D.1 **SUBCONTRACTORS**

### D.1.1 Johnson Consulting Group

**Johnson Consulting Group,** founded by Dr. Katherine Johnson in 2008, is a woman-owned strategic consulting firm specializing in the energy efficiency field. Headquartered in metro Washington D.C., we also have an administrative office in Portland, Oregon and satellite offices in Winter Park, Florida, Braintree, Massachusetts and Ouray, Colorado. The firm, which operates a Limited Liability Corporation (LLC), has three employees: one based in Frederick, Maryland and two based in Portland, Oregon and has been certified as a Woman-Owned Business (see ***Appendix D-1*** for WBE certification). To learn more about Johnson Consulting Group, please visit www.johnsonconsults.com.

### D.1.2 Demand Side Analytics

Demand Side Analytics was formed in 2016 to help utilities and regulatory agencies navigate the technical, economic, and policy challenges of building a smarter and cleaner energy future. Through cutting edge research design and analysis methods DSA provides DSM program administrators with data-driven insights into how various technologies and interventions affect the way homes and businesses use energy.

# ***Appendix D-1.*** *Johnson Consulting Group WBE Certification*

STATE OF RHODE ISLAND

Department of Administration
OFFICE OF DIVERSITY, EQUITY AND OPPORTUNITY
**Minority Business Enterprise Compliance Office**
One Capitol Hill
Providence, RI 02908-5860
Office: (401) 574-8670
RI Relay: 711
www.odeo.ri.gov

July 23, 2020

Ms. Katherine Johnson
Johnson Consulting Group, LLC
1033 Lindfield Drive
Frederick, MD 21702

Dear Ms. Johnson:

Based on the annual review package provided by you, a determination has been made that your firm remains eligible for certification as a WBE for the State of Rhode Island Minority Business Enterprise Program. Your "Minority Business Certification Number" which you can utilize as proof of your status is MBCN 2005. Your company has been approved as a **WBE** for the following scope: **"energy consulting services and management consulting services**" firm under primary NAICS Code 541611 and additional NAICS Codes 541618, 541690, 541990.

In order to maintain your certification during the certification period, you must submit your annual review package thirty (30) days prior to your annual review date which is **7/31/2021**. Your annual review package must include: a) a completed No Change Affidavit (b) current corporate federal tax returns, including all federal schedules and attachments, for the applicant firm and any affiliate firms as applicable; (c) copy of your current certification letter from your home state UCP if firm is not based in Rhode Island, and (d) copy of pertinent Rhode Island licenses if business is operating in a licensed industry. Failure to submit your annual review package will result in an administrative removal of your certification. Further, please be advised that it is your responsibility to notify the Minority Business Enterprise Compliance Office of any changes in the ownership or control of your business within thirty (30) days of such changes.

In addition, please be advised that all certified firms undergo a more substantive review, including a new site visit, as well as a review of personal financial information and economic disadvantage status, every five (5) years. Our records indicate that your firm is due for such a review on or about **7/31/2024**.

We wish you success in the State of Rhode Island's Minority Business Enterprise Program; and if we can be of further assistance to you, please contact this office.

Sincerely,

Dorinda L. Keene
Assistant Administrator – MBE Compliance

# **APPENDIX E.** RFP Section II H Staff Responsibilities

***Appendix E***, in response to RFP *Section II H Staff Responsibilities*, presents the duties, responsibilities, and areas of concentration for this engagement for each member of the GDS Team. Table E-1 on the following page describes the duties, responsibilities, and areas of concentration for the GDS Team consultants. The GDS Team has been arranged specifically to address the needs of EERMC, bringing together the most relevant experience and ideas to provide exceptional service in oversight, technical work products, program design, evaluation, and stakeholder management. All staff listed below are confirmed to have the workload capacity and committed availability to work at least the number of hours assigned in the Cost Proposal for each year. Further, our table below shows a workload availability percentage to indicate the estimated amount of annual availability for this project. Rich Hasselman, Managing Director for GDS, will be the chief point of contact with the EERMC and will also serve as the overall project manager.

**TABLE E-1 GDS TEAM DUTIES, RESPONSIBILITIES, & AREAS OF CONCENTRATION**

| Name & Title | Duties & Responsibilities | Areas of Concentration | Workload Availability |
|---|---|---|---|
| ***GDS Associates, Inc. (Prime Contractor)*** | | | |
| **Rich Hasselman** *Managing Director* | Overall GDS project manager, development of work plans, delegation of work assignments, liaison with EERMC staff, regular progress reporting, quality assurance | Oversight, working group facilitation, utility plan analysis, program evaluation | 50% |
| **Matt Siska** *Principal* | Senior technical advisor to the GDS Team | Utility program plans, technical evaluation | 15% |
| **Jeffrey Huber** *Managing Director* | Lead for review of energy efficiency program design analysis | Cost-effectiveness of program plans, evaluation | 25% |
| **Josh Duckwall** *Project Manager* | Deputy project manager, EERMC oversight and liaison | Technical working groups, EERMC education, stakeholder management | 40% |
| **Warren Hirons** *Project Manager* | Support for energy efficiency program and system reliability | Program cost-effectiveness, legislative analysis | 25% |
| **Kaytie Harrah** *Project Consultant* | Meeting facilitation, website maintenance, public presentations | EERMC meetings and technical editor | 35% |
| **Melissa Young** *Engineer* | Technical support for all tasks | Cost-effectiveness, evaluation, program design technical analysis | 35% |
| **Michael Coty** *Analyst* | Technical support for all tasks | Cost-effectiveness, evaluation, program design technical analysis | 15% |

| Name & Title | Duties & Responsibilities | Areas of Concentration | Workload Availability |
|---|---|---|---|
| **Alyssa Gianotti**<br>***Associate Engineer*** | Technical support for all tasks | Program implementation, technical analysis | 20% |
| ***Johnson Consulting Group (Subcontractor)*** | | | |
| **Katherine Johnson**<br>***President*** | JCG senior staff assigned to EERMC oversight, coordination, development of technical and ad-hoc reports and participating in all related EERMC meetings as appropriate. | EM&V, Program Planning, Management, and Policy Reviews | 30% |
| **Corine Mahon**<br>***Project Manager*** | JCG support staff for preparing and deploying meeting deliverables, including meeting minutes, agendas and related materials. | Administrative Support | 20% |
| **Diane Mahon**<br>***Project Coordinator*** | JCG lead for data analysis and tracking of key EE issues, stakeholder follow up and review of EM&V findings | EM&V, data tracking and analysis | 25% |
| ***Demand Side Analytics (Subcontractor)*** | | | |
| **Jesse Smith**<br>***Partner*** | DSA project lead responsible for coordinating staff assignments and participating in EERMC proceedings as needed | EM&V, Program Planning, and Policy | 20% |
| **Josh Bode**<br>***Partner*** | DSA technical lead for specific areas | Non-Wire Alternatives, Load Forecasting, AMI Business Cases, Time-Varying Pricing | 10% |
| **Alana Lemarchand**<br>***Partner*** | DSA lead for benefit-cost modeling and avoided cost development | Benefit-cost modeling, electric vehicles | 10% |

| Name & Title | Duties & Responsibilities | Areas of Concentration | Workload Availability |
|---|---|---|---|
| **Adriana Ciccone** *Principal* | DSA lead for topics related to demand response programs | Demand Response | 10% |
| **Steve Morris** *Senior Quantitative Analyst* | DSA lead for tracking system review and billing analysis | Tracking data, billing analysis | 20% |
| **Mark Noll** *Senior Quantitative Analyst* | Integrated resource planning and emissions impacts | System planning, integration of renewables | 20% |
| **Katherine Burley** *Quantitative Analyst* | Statistical analysis of energy efficiency and demand response offerings | Connected devices, econometrics | 25% |

# **APPENDIX F.** RFP Section II I Staff Experience

***Appendix F*** is composed of the following information to demonstrate staff experience, addressing the RFP requirements provided in *Section II I Staff Experience*.

- Biographies for each member of the project team detailing prior experience and qualifications
- Resumes for all members of the GDS Team that further detail germane experience and credentials (see ***Appendix F-1***)
- Organizational Chart depicting the organizational overview for this engagement, including identification of key staff and the roles/responsibilities on this project

## F.1 BIOGRAPHIES OF GDS ASSOCIATES, INC. STAFF

***Rich Hasselman, CEM, CRM, Managing Director*** is responsible for project management of technology and market research projects, feasibility studies, and evaluation projects at GDS. Prior to rejoining GDS in 2019, he worked in evaluation, developing extensive experience evaluating energy efficiency and demand response programs. He currently leads GDS services to support a consortium of Massachusetts program administrators (Columbia Gas, Liberty Utilities, Unitil, and Berkshire Gas) with their engagements with MassSave© evaluators. As part of this work he participates in evaluation planning and results reviews related to residential and cross-cutting evaluation studies. Rich is also engaged on the electrification front, currently completing a statewide beneficial electrification market study for the State of Colorado. This study is forecasting the ten-year potential for beneficial electrification to help meet Colorado's greenhouse gas reduction goals. As part of this work Rich is leading GDS's team to analyze building electrification for the residential and commercial sectors. Rich has experience working with building energy simulations, with direct experience evaluating whole-building new construction programs using a variety of software, including REM Design BEopt, and related software tools.

***Josh Duckwall, CEM, LEED AP, Project Manager*** at GDS, specializes in residential, commercial, and industrial energy efficiency. He is a licensed residential and commercial general contractor, certified Renewable Energy Professional (REP), and a former Home Energy Rating System (HERS) trainer with more than 17 years of experience managing energy efficiency programs and projects. Mr. Duckwall focuses on projects with regional or statewide efficiency programs, emerging technology and renewable integration, as well as pilot program design. Some of his recent projects include consultation to the Rhode Island PUC on administration of the Renewable Energy Standard (RES) program, a beneficial electrification potential study for the state of Colorado, evaluation of Maryland's low-income Multifamily Energy Efficiency and Housing Affordability (MEEHA) Program, development of expert witness testimony for Metro Atlanta's Transit Authority (MARTA) before the Georgia Public Service Commission and involvement in public meetings, and serving on the statewide evaluation team (SWE) for Pennsylvania where he managed working groups and organized stakeholder feedback exercises. Mr. Duckwall joined GDS in November 2013 and prior to joining GDS, spent many years managing new and existing home energy certifications for the non-profit Southface Energy Institute before joining a small group of consultants to provide LEED certifications for commercial and industrial customers, and most recently served as a project

manager for a commercial and industrial design-build firm. Mr. Duckwall holds a Bachelor's Degree from the University of Georgia.

***Matt Siska, PE, CEM, CWEP, TSP, Principal*** for GDS, manages the commercial, industrial, and agricultural services group for GDS' Manchester NH office. In this capacity, Matt oversees the engineering services group responsible for conducting engineering peer reviews, developing energy analyses, site inspections, TA studies, M&V studies, and program implementation throughout Massachusetts and the region. Matt also oversees a planning department that provides benefit cost modeling, evaluation monitoring, and reporting support to Program Administrators throughout the Northeast. Matt has testified in multiple proceedings in Massachusetts related to iterations of the Mass Save three-year plans, supporting various clients with the detailed planning and cost-effectiveness screening that underpinned these filings. Currently, Matt is supporting multiple Massachusetts program administrators with monitoring on-going evaluation activity, advocating on behalf of PA issues, and providing a bridge between evaluation findings and implementation activities. Matt has also been recently responsible for supporting Avangrid in Connecticut with a fundamental redesign of their portfolio planning process.

Matt is a member of the New Hampshire Energy Efficiency and Sustainable Energy Board and has a strong understanding of New England energy policy gained through twelve years' experience working in the energy sector. Matt understands regional energy economics and the impact of peak periods on pricing and carbon emissions having been responsible for designing and managing multiple smart grid pilot programs. Matt has led renewable energy feasibility studies, supported on battery storage related topics, and has expertise in energy code as the current lead instructor of the commercial energy code trainings in the State of New Hampshire. Matt was intimately involved in the last three-year planning process in Massachusetts (2019-2021) and is actively involved with planning for the next triennium in Massachusetts. Matt is a Certified Energy Manager (CEM) through the Association of Energy Engineers and holds a Professional Engineering license in five states.

***Jeffrey Huber, CEM, CMVP, BESA, Managing Director*** at GDS, is responsible for project management of energy efficiency and demand response planning studies and market and policy research projects for GDS clients. He has completed over 30 DSM potential studies, including electric and natural gas studies and has also led the completion of the market baseline studies in several states and jurisdictions. Jeffrey has provided support to several utilities and/or regulatory agencies with Integrated Resource Planning and has led stakeholder engagement efforts related to DSM inputs during the IRP process. He has previously provided expert witness testimony in Indiana and made presentations to numerous other state regulatory commission staff on DSM topics. Jeffrey also provides technical support to GDS clients on energy efficiency program design and implementation projects, benefit/cost analyses for energy efficiency programs, regulatory policy and other market research studies. Jeffrey is experienced in conducting statistical analyses (frequency distributions, cross tabulations, multivariate analyses) and he is proficient in MS Office (Word, Excel, PowerPoint). Jeffrey has a BA degree (2001) from the University of Florida and a MA degree (2004) in Anthropology with a minor in Statistics from the University of Tennessee.

***Warren Hirons, P.E., CEM, Project Manager*** at GDS, has assisted with the development of energy efficiency potential studies and benefit/cost analysis of energy efficiency and demand response measures and programs. He has been the lead consultant for GDS on a six-year project with the North Carolina Utilities Commission to provide oversight of the EM&V reporting done by regulated utilities in North Carolina. As part of this project he has conducted analyses to compare the energy efficiency cost recovery methods used by the utilities to cost recovery methods used in other states and his examined the advantages and disadvantages of various cost recovery methods. Mr. Hirons has developed designs and plans as well as economic feasibility studies for energy efficiency and demand response programs. He is experienced in conducting residential and commercial energy audits and assisted with the analysis of energy data for these sites. Mr. Hirons has managed energy efficiency projects and has provided impact and process evaluations of energy efficiency and demand response programs. Mr. Hirons has a Bachelor's degree in Environmental Engineering from North Carolina State University and a BS Degree in Environmental Economics and Management from the University of Georgia.

***Kaytie Harrah, Project Consultant*** for GDS, holds an MBA and Bachelor's Degree in Management from Shorter University. Kaytie has more than 17 years of experience in the administrative and consulting fields. At GDS, she provides data collection, data analysis and administrative support to engineers, consultants, and executives of GDS. Ms. Harrah assists with the preparation, formatting, and technical editing of various reports. She has been responsible for the development and formatting of numerous program impact and process evaluations, energy efficiency and demand response potential studies, as well as monthly progress reports for program evaluation projects. Ms. Harrah is responsible for the reporting requirements essential to delivering technically sound and clearly prepared reports to reach a multitude of audiences. She performs in-depth reviews and formatting of client reports and proposals to achieve these results. She has been involved in the development, compilation, comprehensive editing, and formatting of a variety of client studies. Additionally, Ms. Harrah possesses WordPress experience assisting with frequent updates, altering content, or updating parts of an existing website.

***Melissa Young, EIT, Engineer*** for GDS, is a graduate from the Georgia Institute of Technology in Atlanta, Georgia and received her BS in Mechanical Engineering in May 2015. She worked as an Engineering Assistant / cooperative student in the Energy Efficiency / Renewable Energy Department at GDS since 2012 and has worked five years full-time since she graduated. Ms. Young has completed demand response potential studies for Ameren Missouri, Indianapolis Power and Light, Vectren Indiana, East Kentucky Power Cooperative, NIPSCO, Austin Energy, Consumers Energy, DTE Energy, and Lansing, Michigan Board of Water and Light. Melissa has further developed the GDS Demand Response Model (DR Model) to assist in the completion of these potential studies. The DR Model assesses the benefit-cost analysis, while also evaluating the total demand savings potential in each territory for each sector. The residential results are also broken out by low-income and non-low income. Melissa has been responsible for presenting these results to the clients and their Stakeholders. In addition to demand response potential studies, Ms. Young has completed renewable energy potential studies for Efficiency Maine Trust, the District of Columbia Department

of Energy, and Ameren Missouri during her time at GDS. Ms. Young worked on a Residential Low-Income Household Energy Efficiency Baseline Study in Maine to coordinate efforts to conduct 68 on-site energy surveys of low-income homes in Maine. She traveled to Maine to conduct some of the surveys and organized and analyzed data to develop findings and recommendations relating to remaining energy savings opportunities and potential programs for low-income households in Maine. She has worked on several energy efficiency studies, including a natural gas study for DTE Energy, electric study for the Pennsylvania Public Utilities Commission. Melissa is currently working on an electric potential study for 38 utilities in the California Municipal Utilities Association. She has primarily been working on the residential sector to find potential of low-income and non-low-income homes. She has been responsible for using engineering algorithms and models to calculate energy and demand savings and technical potential data on various demand response, energy efficiency and renewable energy programs.

***Michael Coty, EMIT, Analyst*** with GDS provides energy efficiency consulting services for commercial, municipal, and agricultural customers. He conducts energy audits, works with clients to identify savings opportunities, reviews proposed retrofit and new construction projects for cost-effectiveness and financial incentives, and manages day to day operations for several NH business lines. In his role, Michael manages Massachusetts municipal utility Westfield Gas and Electric's Commercial and Industrial energy efficiency program. He is the lead contact between GDS and the utility, conducts scoping audits for customers, reviews projects for energy and cost savings as well as utility incentives, and prepares scoping audit reports and incentive letters. Michael also leads other ad-hoc initiatives for the utility as needed, including development of their recent Commercial Electric Vehicle Charger Program.

Michael manages the agricultural business line for GDS' NH office and conducts energy audits and Agricultural Energy Management Plans for producers in NH and MA. He has been active in conducting energy audits through the Massachusetts Farm Energy Program since 2015. Michael also conducts energy audits and Green Physical Needs Assessments for Public Housing Authorities across the Northeast and manages projects for the NH office. He has experience reviewing draft reports for the Massachusetts Program Administrators and Energy Efficiency Advisory Council Consultants on behalf of electric and gas utilities, managed NYSERDA's Small Commercial and Energy Efficiency Assessment Program and has provided support for GDS' Maine office working on several initiatives for Efficiency Maine. Michael earned a Bachelor of Science in Resource Economics from the University of New Hampshire and a Master's in Urban Environmental Policy and Planning from Tufts University. He is a Certified Energy Manager (CEM) through the Association of Energy Engineers.

***Alyssa Gianotti, Associate Engineer*** began working for GDS in April of 2018 as an Associate Engineer. In her time with GDS, Alyssa has been working on technical analyses for electric and gas conservation measures as well as savings verifications for commercial and industrial facilities. Alyssa is part of a planning department that provides benefit cost modeling, evaluation monitoring, and reporting support to Program Administrators throughout the Northeast. Currently, Alyssa is supporting multiple Massachusetts program administrators with monitoring on-going evaluation activity, advocating on behalf of PA issues, and providing a bridge between evaluation findings

and implementation activities. Alyssa has also recently been responsible for supporting Avangrid in Connecticut with a fundamental redesign of their portfolio planning process. Prior to joining the GDS Team, Alyssa was working as a risk engineer for a global insurance company focusing on partnering with customers to develop cost effective risk improvement actions in order to help the customer limit their loss potentials and protect the business's bottom line. Alyssa graduated from the University of New Haven with a Bachelor of Engineering degree in Mechanical Engineering. In her senior year, Alyssa researched and designed a three-dimensional test apparatus for force generators used on helicopters as her capstone project.

## F.2 BIOGRAPHIES OF JOHNSON CONSULTING GROUP STAFF

***Dr. Katherine Johnson, President*** of Johnson Consulting Group[4] She has provided EM&V advice and technical support to the following public service commissions in the following jurisdictions:

- Independent Evaluation Monitor for the Arkansas Public Service Commission
- EM&V Auditor for the Missouri Public Service Commission
- EM&V Advisor for the California Public Service
- TRM Advisor for the Public Service Commission in Texas
- Developing a comprehensive program targeting low-income/hard-to-reach customer segments
- Preparing expert testimony on program best practices, with a focus on EM&V, low-income, Technical Reference Manual updates, and cost-effectiveness testing for both energy and non-energy benefits.

Dr. Johnson has also provided guidance in assisting two jurisdictions in quantifying Non Energy Impacts (NEIs). Her responsibilities included conducting extensive literature reviews on current quantification practices, developing recommendations to quantify Non Energy Impacts and avoid double counting. She is also a well-regarded industry thought leader, having served for nine years on the Board of the Association of Energy Services Professionals (AESP), and presented findings from her work in both energy evaluation and stakeholder collaboration at national and international conferences

***Corine Mahon, Project Manager*** for Johnson Consulting Group, provides administrative support for Johnson Consulting Group's clients posting meeting agendas and presentation materials on our dedicated project dashboard, preparing and finalizing meeting materials, and summarizing and posting meeting minutes. She also assists in preparing the final reports and presentations. She will assist Dr. Johnson throughout this engagement in meeting facilitation and administrative support.

[4] SEEA Action Energy Efficiency Collaboratives- Driving Ratepayer-Funded Efficiency through Regulatory Polices Working Groups, September 2015; attachment in the February 16, 2018 EESE Meeting Minutes.

***Diane Mahon, Project Coordinator*** for Johnson Consulting Group, assists in areas of project coordination. Ms. Mahon is being mentored in the EM&V field by Dr. Katherine Johnson. She has a Bachelor of Science degree in Criminology and Criminal Justice from Portland State University. Through studies at Portland State she learned how to study and analyze data for programs that are aimed at changing behavior and improve communities.

## F.3 BIOGRAPHIES OF DEMAND SIDE ANALYTICS STAFF

***Jesse Smith, Partner*** at DSA will be the project lead responsible for coordinating staff assignments and participating in EERMC proceedings as needed. Mr. Smith is an experienced utility analyst and consultant whose work is focused on estimating the impacts and economics of demand side interventions to alter the way homes and businesses use energy and helping clients improve those offerings. Over the last decade in the energy industry Jesse has been involved in the evaluation of a wide variety of energy efficiency, demand response, and dynamic pricing programs implemented by electric and gas utilities across North America. Mr. Smith specializes in statistical analysis of energy usage data, sampling, matching, experimental design, and benefit cost modeling. Mr. Smith has been a core member of the Pennsylvania Statewide Evaluation Team since 2011 where he has managed numerous stakeholder processes including utility goal-setting, TRM updates, several TRC Test Orders, and a cross-cutting review of low-income weatherization contractor performance. Jesse also maintains Demand Side Analytics' company website using WordPress. He holds a Master's in Applied Statistics from Kennesaw State University and B.S. in Psychology from the University of North Carolina at Chapel Hill.

***Josh Bode, Partner*** at DSA, will serve as the technical lead for the project in various topic areas, including non-wires alternatives, load forecasting, AMI business cases, and time-varying pricing. Mr. Bode specializes in advanced applications of data analytics using large volumes of hourly and sub-hourly data for evaluation, valuation, planning and forecasting in the energy sector. He has led over 50 studies including some of the first innovations and largest applications of smart meter and SCADA data analytics in energy efficiency, time varying pricing, behavioral programs, and demand response. Mr. Bode has analyzed smart meter data for tens of millions of residential and small and medium business and with the full population of large customers from numerous utilities. Most recently, he has worked on projects designed to align distributed energy resources with grid value and in developing location specific, probabilistic forecasts and T&D marginal costs. Josh has developed several different online systems for client utilities so that analytical processes he developed could be repeated and performed on-demand. He holds a Master's in Public Policy Analysis from University of California, Berkeley and has worked continuously conducting policy and data analysis in the energy sector since 2004.

***Alana Lemarchand, Partner*** at DSA, will serve as the team lead for benefit-cost modeling and avoided cost development. Ms. Lemarchand's professional experience has been focused on strategy, quantitative customer research, and program design optimization. She has worked on engagements ranging from program impact and process evaluations to strategic support helping large utilities

identify frameworks for valuing the impacts of distributed energy resources. She has also managed and advised market research projects for California utilities assessing the accuracy of electric vehicle sub-metering and customer enrollment in demand response programs. Her areas of expertise include program evaluation, market research, and distributed energy resources. She holds a B.S. in Environmental Economics from University of California, Berkeley.

***Adriana Ciccone, Principal Consultant*** at DSA, will be the team lead for topics related to demand response programs. Ms. Ciccone leverages large-scale data to answer meaningful questions about demand response and customer energy consumption. Her work has focused on program evaluation for both residential and commercial populations as well as analytics applications that use machine learning techniques to support utility operations and customer engagement activities. As a member of California's ISO Baseline Accuracy Working Group, Ms. Ciccone analyzed tens of thousands of residential, commercial and industrial baseline methods for accuracy and worked with the group to provide a recommendation of new settlement baselines to be adopted statewide. She holds a Master's in Environmental Science and Policy from the University of Chicago, and a B.S. from MIT, where she doubled majored in Operations Research and Materials Science & Engineering. She is also a two-time Jeopardy champion.

***Steve Morris, Senior Quantitative Analyst*** at DSA, will be the team lead for tracking system review and billing analysis. Mr. Morris is an applied statistician with wide exposure to residential program evaluations using smart meter and billing data. He brings a strong background in mathematics to Demand Side Analytics. He was the lead analyst on DSA's 2019-2020 contract with Rhode Island OER to perform a billing analysis of National Grid commercial retrofit projects. Since 2016, Steve has been a key member of the impact evaluation team for IESO's Energy Manager and has been responsible for developing ex-post savings estimates for 10-15 embedded energy managers from industries such as mining, paper processing, breweries, universities, and hospitals. Steve also designed and maintains the Pennsylvania statewide tracking database which archives measure-level tracking records from the state's seven electric distribution companies and offers a variety of reports and visualizations in Tableau. He is versed in the most prominent statistical packages (R, SAS, and Stata) and has experience translating code from one language to another. He holds a Master's in Statistics and Bachelor's in Statistics and Sociology from the University of Georgia.

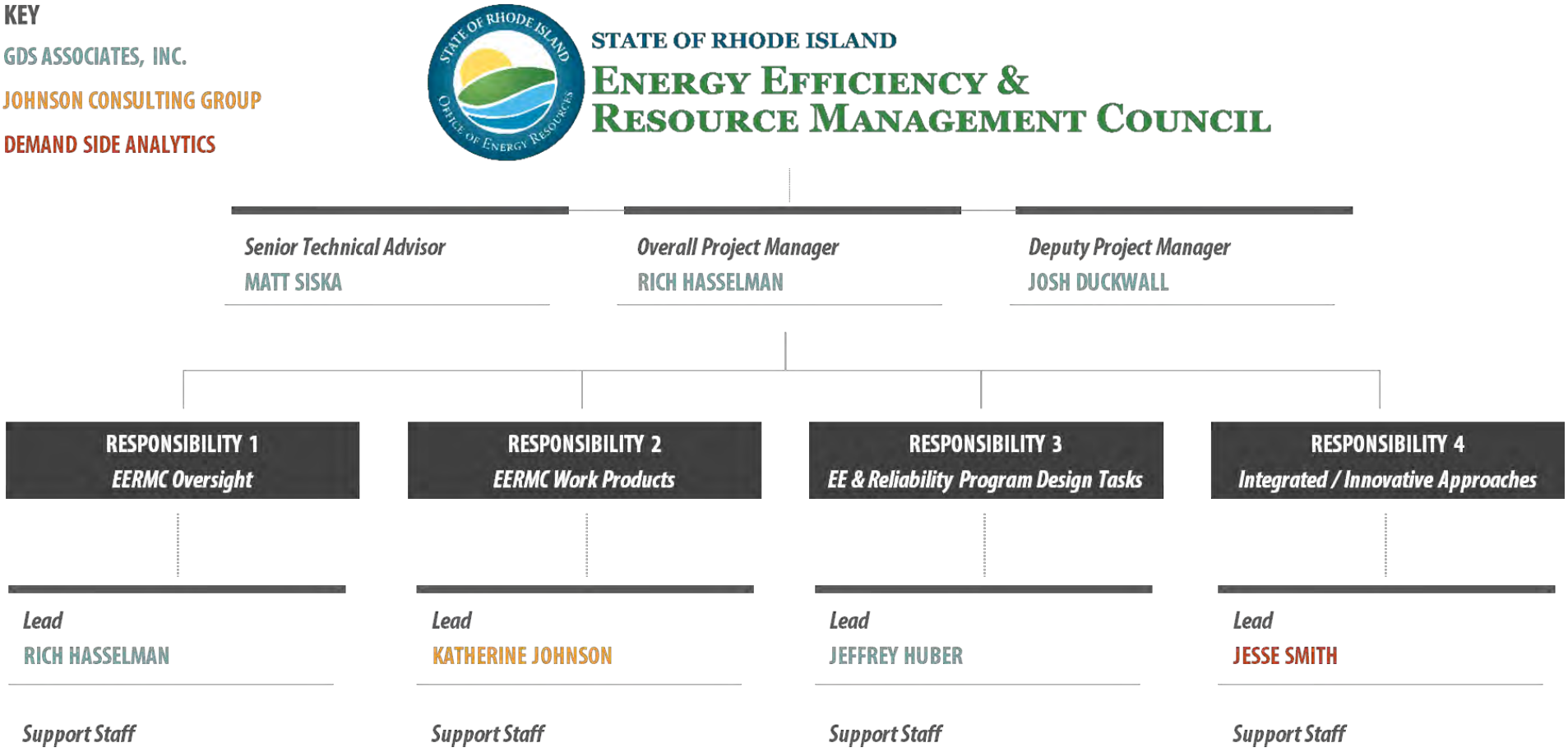
***Mark Noll, Senior Quantitative Analyst*** at DSA, will provide analytical support for the project, concentrating on integrated resource planning and emissions impacts. Mr. Noll's primary experience is in electricity market modeling for applications including asset valuation, transaction work, and integrated resource planning for government, utility, and private sector clients. He has also worked on technology cost projections, capacity market design, and market concentration indices in the natural gas market. He is experienced with statistical computing and visualization languages including Stata, R, and Excel, as well as the Aurora electricity market forecasting software. He holds a B.A. in Economics from Georgetown University.

***Katherine Burley, Quantitative Analyst*** at DSA, will provide analytical support for the project, concentrating on connected devices and econometrics. Ms. Burley's primary interests include program impact evaluation, energy efficiency policy analysis, and benefit-cost analysis. During her time at Demand Side Analytics, she has performed energy efficiency and demand response evaluations, including the winter energy efficiency analysis of ecobee's connected thermostat pilot on over 250,000 homes across North America. She is experienced in several statistical programming languages including Stata, R, and Python. She holds a Master's in Economics from the University of Texas at Austin and a B.S. in Economics from Louisiana State University.

## F.4 ORGANIZATIONAL CHART

A chart depicting the organizational overview for this engagement, including identification of key staff and the roles/responsibilities on this project is included as Figure F-1.

**FIGURE F-1 GDS TEAM ORGANIZATIONAL CHART**



# ***Appendix F-1.*** *Resumes of Key Personnel*

*GDS Associates, Inc.*

# RESUMES OF KEY PERSONNEL

GDS Associates, Inc.
ENGINEERS & CONSULTANTS

Rich Hasselman, CEM, CRM
Managing Director

## EDUCATION

MBA, University of Wisconsin, 2008

MS, Land Resources, University of Wisconsin, 1998; certificate in Energy Analysis and Policy

BA, Geography, Radford University – Radford, Virginia, 1994

## PROFESSIONAL HIGHLIGHTS

Rich has over 20 years of experience in the energy sector for clients in private sector companies and utilities, as well as governments and regulators. His experience includes managing market research projects; and conducting impact and process evaluations of energy efficiency, demand response, and renewable energy programs. He has implemented energy efficiency and renewable energy programs and conducted specialized analyses related to market and economic development. In this experience, Rich has developed an understanding of customer and utility perspectives and cost considerations for energy investments, including non-energy impacts. Additionally, Rich has led stakeholder workshops and trainings on wind energy, biogas, solar energy, and energy efficiency in a variety of settings, including to university, professional development, and general population audiences.

## PROFESSIONAL EXPERIENCE

**Evaluation, Market Research, Measurement and Verification**

Rich has been involved with evaluation, market research, and measurement and verification since the beginning of his career. He currently supports a consortium of natural gas and electric PAs in their engagement with evaluation studies in Massachusetts, leading the GDS team and providing input and review of evaluation strategy, planning, practices, and results. He recently completed an evaluation study in Vermont related to income qualified rate discount and arrearage forgiveness, identifying opportunities for program expansion and the utilization of best practices. He has led evaluations across multiple jurisdictions in the U.S. covering all aspects of residential, commercial and industrial, renewable, and demand response programs. Rich has worked in nearly major impact EM&V method areas, including TRM development and use, custom calculations, behavior programs, billing analysis, and simulations. He has led and supported both net to gross and process evaluations as well, with substantial experience conducting in-depth interviews for evaluation and market research purposes.

**Potential Studies**

Rich has led and supported GDS potential studies. These include traditional potential studies investigating the potential for energy efficiency and demand response programs, as well as a statewide potential and market adoption potential study for beneficial electrification in Colorado. His experience covers measure-level development and estimating current market penetration and future market adoptions. He has developed benefit cost modeling using the traditional benefit-cost tests as well as incorporating non-energy impacts, including the social cost of carbon. He has developed techniques for incorporating the changes in electricity grid carbon emissions rates to model portfolio carbon emissions impacts across forecast periods.

**Program Planning, Design, and Operations**

Rich been involved with program planning, design, and operations. In the early 2000s, Rich helped plan and design programs focused on agribusiness and community-based outreach. Working as part of a large team of implementers, Rich coordinated efforts to meet energy goals, leverage cross-program customer engagement, develop community energy plans, and implement programs. Rich led a wind energy program, overseeing a network of site assessors and specialized trade allies, developing incentives and marketing materials, and conducting internal program M&V to improve realization rates. Rich has led the development of trade ally networks, managed a staff of energy advisors, and tracked KPIs to manage programs toward meeting goals. As an evaluator, Rich has also engaged with program implementation to understand evaluation needs and discussing solutions to challenges that align with program designs and practices.

**Stakeholder Engagement, and Workshops, and Presentations**
Throughout his career, Rich has led efforts to engage with stakeholders in committee formats, workshops, and educational presentations to a variety of audiences. These engagements have included professional conference presentations on energy efficiency and renewable energy, leading groups of diverse stakeholders to set strategic directions, and conveying complex technical issues to lay audiences.

**IRP and Regulatory Support**
Rich has supported GDS clients with IRP reviews and regulatory support for renewable energy and energy efficiency topics. Support includes investigations of analyses and assumptions as well as compliance and ratemaking assumptions related to utility achievement of renewable energy standards.

**Policy Research, Recommendations, and Modeling**
Rich has supported clients in researching potential policy options, translating the experience of other jurisdictions into meaningful considerations for his clients' jurisdictions. Topics include low-income discount and arrearage programs, renewable energy policies, and beneficial electrification policies. Rich has also modeled policy scenarios for both energy and economic impacts. For example, he developed an offshore wind energy and economic impact analysis for the State of Maryland related to legislation being considered by the State, incorporating job and non-energy benefits into the overall economic modeling.

**Survey and Interview Guide Development**
Rich has extensive experience developing structured surveys and in-depth interviews to support market research and program evaluations. Topics have ranged from energy efficiency to renewable energy and demand response. Respondents have included both participant, non-participants, trade allies, program managers, and policy makers. The results are often combined to present a holistic look at a particular subject to drive program, technology, or policy recommendations.

## EMPLOYMENT HISTORY●

**Energy Center of Wisconsin (1996 to 2001)**
**GDS Associates (2001 to 2013)**
**Tetra Tech (2013 to 2019)**
**GDS Associates (2019-present)**

GDS Associates, Inc.
ENGINEERS & CONSULTANTS

# Matthew Siska, P.E., CEM
Principal

## EDUCATION

M.S., Fire Protection Engineering, Worcester Polytechnic Institute (WPI), 2005 B.S., Civil Engineering, Worcester Polytechnic Institute (WPI), 2002

## PROFESSIONAL CERTIFICATIONS & MEMBERSHIPS

- Association of Energy Engineers (AEE)
- Society of Fire Protection Engineers (SFPE), National and New England Chapters
- National Fire Protection Association (NFPA)
- Licensed Professional Engineer (Architectural/Fire Protection) in the states of CA, NH, MA, IL
- Certified Energy Manager (CEM)
- Registered Technical Service Provider (TSP)
- Certified Water Efficiency Professional, Association of Energy Engineers (CWEP)

## PROFESSIONAL EXPERIENCE

Matt has over 18 years' experience in the building science industry, beginning his professional career as a code consultant for complex commercial facilities and working with GDS since 2008 on a range of energy efficiency related engagements. Since joining GDS, Matt has led hundreds of energy audits and assessments from small businesses to large industrial facilities and educational campuses. Matt oversees the day-to-day administration of multiple utility-sponsored energy efficiency programs in the State of Massachusetts and is responsible for coordinating a team of engineers and field staff, identifying energy conservation measures, working with trade allies to develop cost-effective projects, preparing energy analyses, and ensuring all work is completed to the highest standards.

In his capacity managing various energy efficiency program implementation engagements, Matt is responsible for technical oversight of energy audits and project reviews, end use customer outreach and relationship management, budget management, and ensuring all projects are properly documented to the utility standards. This includes benefit-cost screening of measures, identifying and justifying appropriate baselines for end of life replacement and new construction projects, and applying best engineering practices to custom energy analyses.

Apart from energy audits and Commercial/Industrial efficiency program implementation, Matt is actively involved in EE program planning and benefit cost modeling and has completed multiple projects related to renewable energy systems and smart grid pilot programs. Matt has led renewable energy feasibility studies which were used to support REAP grant applications and included consideration of technical, economic, financial, and management feasibility. Matt is an experienced project manager with abilities to clearly communicate responsibilities to team members to deliver projects on schedule and on budget.

Prior to joining GDS in 2008, Matt worked in the building construction industry for over 6 years as a professional Fire Protection Engineer and building code consultant. Matt has been involved in the design, construction and commissioning of numerous commercial and residential facilities.

***Specific Experience Includes***

- Led or conducted over 300 energy audits and technical assessments of commercial, industrial, and agricultural facilities producing actionable and transparent measure recommendations across HVAC, building envelope, refrigeration, process, hot water, compressed air, and lighting end uses.
- Managed GDS' engagement with multiple Massachusetts Investor Owned Utilities providing technical support, customer outreach, QA/QC analysis, and energy modeling. Services included thorough energy analysis and documentation, measure identification and development, and measurement and verification activities. (2013-current)

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- Designed a residential energy optimization pilot program for Eversource in Connecticut focused on displacing oil or propane heating fuel with cold climate air source heat pumps with integrated controls (2019).
- Led impact and process evaluations of demand response programs for residential and commercial users in Connecticut. The residential program consisted of aggregated wi-fi enabled thermostats using either cycling or setback strategies, while the C&I initiative used real time data and enabling controls to limit peak demand below pre-determine thresholds (2018)
- Managed the implementation of commercial and industrial energy efficiency programs for multiple municipal utilities in Massachusetts, including energy audits, budget management, savings analysis, data tracking and reporting, and measurement and verification (2010-2016)
- Designed and managed the implementation of a smart grid pilot program in New Hampshire, including the development of an evaluation plan, customer surveys, sampling plan, and M&V approach, along with coordination of the utilities internal billing, customer service, information systems and metering departments (2009)
- Participated in the process to develop three-year gas and electric efficiency plans in Massachusetts including participation in working groups, budget and savings analysis, analysis of prior year program performance, and evaluation of implementation issues
- Preparation of feasibility studies for large scale biomass, solar photovoltaics, and anaerobic digestion
- Commercial, industrial and agricultural audits including write-ups of existing conditions, identification of efficiency opportunities, energy savings quantification, grant preparation, and implementation support
- Specialized expertise in the hospitality industry; energy audits and consulting, end of life replacement planning, life cycle cost analysis, energy procurement.

## EMPLOYMENT HISTORY ●

- **GDS Associates, Inc.,** ***Principal***, 2019 to Present / *Senior Project Manager*, 2017 to 2018 / *Project Manager*, 2011-2017 / *Project Engineer*, 2008 to 2011
- **Schirmer Engineering Corporation,** ***Associate Consultant***, 2002 to 2008

GDS Associates, Inc.
ENGINEERS & CONSULTANTS

Jeffrey Huber, CEM, CMVP, BESA
Managing Director

## EDUCATION

MA in Anthropology, Minor in Statistics, University of Tennessee, 2004

BA in Criminology & Anthropology, University of Florida, 2001

## PROFESSIONAL CERTIFICATIONS & QUALIFICATIONS

Mr. Huber is a Certified Energy Manager (CEM), Certified Measurement & Verification Professional (CMVP) and Building Energy Simulation Analyst (BESA). He is experienced in conducting statistical analyses (frequency distributions, cross tabulations, regression, and multivariate analyses) and he is proficient in MS Office. Mr. Huber is also familiar with the REM/Rate, BEopt, and Wright Soft building modeling software.

## EXPERIENCE

**GDS Associates, Inc.,** Marietta, Georgia, October 2005 to Present
***Managing Director***
Mr. Huber performs project management and conducts quantitative and qualitative data analysis for a broad range of projects, including DSM potentials assessment, program planning, cost-effectiveness, and market research. He is also experienced in the areas of codes and standards, technical reference manuals (TRM), evaluation, and measurement and verification (M&V).

### RELATED POTENTIAL STUDY EXPERIENCE

***Potential Studies.*** Mr. Huber has managed assessments of electric and natural gas DSM potential across all customer sectors. He has contributed to more than 35 potential studies electric and natural gas utilities across the country. Mr. Huber is currently leading a potential assessment for several public-power utilities in California, and over the last 5 years has contributed or led studies in Missouri, Colorado, Vermont, Kentucky, Indiana, Michigan, Pennsylvania, and Massachusetts. Collectively, these studies have addressed electric, natural gas, and electrification potential across numerous jurisdictions.

Mr. Huber has also had the lead responsibility for completing residential and/or low-income sector energy efficiency potential studies for utilities in Alabama, Arkansas, District of Columbia, Maine, Maryland, North Carolina, and South Carolina. This involves overseeing and coordinating all project activities, including data collection, measure characterization, modeling, and developing estimates of technical, economic, and achievable potential.

***Cost-Effectiveness Analysis.*** Mr. Huber has assessed the cost-effectiveness of many DSM resources for a wide variety of clients. This includes assessment of measures, programs, and DSM portfolios for the planning, reporting, and evaluation purposes. He assisted in the re-design of GDS Benefit-Cost Screening model, as well as many other Excel-based calculators for specialized analysis.

***IRP Support.*** Based on estimates of future potential, Mr. Huber has supported the development of DSM-related inputs into utility integrated resource plans. Mr. Huber has developed 8,760 annual inputs, participated in IRP stakeholder meetings, and submitted written testimony supporting the development of future potential estimates for future resource planning needs.

### RELATED MARKET RESEARCH

***Baseline Assessments.*** Mr. Huber has developed mail, online, and on-site survey instruments and conducted on-site assessments for residential sector baseline studies in several states, including Maine, Indiana, Pennsylvania and Mississippi. He has also led online/onsite assessments in the commercial sector for across several utilities in Indiana. These baseline study efforts also included sampling design, data cleansing, data analysis, and drafting the final market assessment reports.

***Market Barriers and Market Adoption Research.*** Jeffrey has led several surveys to understand residential and nonresidential consumers perceptions of energy efficiency technologies and their likelihood to adopt energy efficiency measures in the future. This research has been utilized to better estimate future potential as part of DSM potential study research and IRP planning.

***Focus Groups and Client Interviews.*** Mr. Huber has conducted focus group research to under customer attitudes and perceptions regarding the effectiveness of DSM program offerings. This research assessed the effectiveness of program marketing strategies, program education and outreach, and general concerns regarding the program administrator. In addition, Jeffrey has conducted internal client interviews to better under program processes and make recommendations for future improvement.

## OTHER RELATED EXPERIENCE

***Program Planning & Design.*** Much of the analysis Mr. Huber performs feeds directly into utility planning efforts. This includes information on DSM resource costs, savings, and potential program participants. In addition to the work noted above, Mr. Huber has assisted utilities in developing estimates of program potential and DSM program portfolio plans. This included drafting recommended program designs, assisting product managers determine appropriate measures and rebate levels, performing cost-effectiveness analysis, and working with utility program managers. He has also provided quality assurance, technical support, and/or developed measures for technical reference manuals (TRMs) for Maine and Pennsylvania, and provided deemed measure savings databases for electric cooperatives in Indiana, Kentucky, and North Carolina.

***Program Evaluation.*** Mr. Huber has worked on multiple evaluations and/or evaluation reviews of utilities' energy efficiency programs. He has conducted impact evaluations of low-income weatherization programs and behavioral programs and has conducted evaluation oversight of residential and commercial programs in Pennsylvania, North Carolina, and Georgia. Mr. Huber has also developed focus group interview guides for Efficiency Maine to assess successful practices, market barriers, and identify program recommendations.

GDS Associates, Inc.
ENGINEERS & CONSULTANTS

# Josh H. Duckwall, CEM, LEED AP

Project Manager

## EDUCATION

B.S.A in Biological Science, University of Georgia, 2002

## PROFESSIONAL REGISTRATIONS

Certified Energy Manager (CEM), LEED Accredited Professional (LEED AP), Certified Renewable Energy Professional, (REP), EPA Universal Refrigerant License

## EXPERIENCE

Experienced energy professional with more than 16 years of effective leadership in all aspects of sustainability management, energy efficiency, and project oversight.

**GDS Associates, Inc**., 2013-Present

***Project Manager for Energy Efficiency Department***

- Serves as a project manager in the EERD department (Energy Efficiency, Renewables, Distributed Generation), a special focus on deemed savings measure development, utility incentive design, renewable integration, and program evaluation.
- Currently serves on a contract as administrator of the Rhode Island Public Utilities Commission Renewable Energy Standards Act reviewing applications for eligibility; reviewing demonstrations of compliance including compliance reports from obligated entities for compliance with the Rules and Regulations of RI's Renewable Energy Standard Act and for accuracy and reporting to the Commission on findings and recommendations;
- Served on the Pennsylvania Statewide Evaluator (SWE) Team from 2013-2017 performing impact evaluations and managing TRM (savings technical reference manual) delivery and savings measure development.
- Performed market potential studies with a focus on renewables (PV), combined heat and power (CHP), and electric utility infrastructure (EUI) for clients including Ameren Missouri, Minnesota Department of Commerce, and DTE in Michigan.
- In 2018, completed a substantial water/energy efficiency analysis and energy management plan for the City of Columbus, GA / Columbus Water Works.
- In 2017, completed Evaluation of Non-Road Electrification Technology program for JEA in Jacksonville, as well a rebate program design and implementation plan for residential and commercial battery storage incentives.
- Currently serves as the evaluation consultant to the Delaware Electric Cooperative, utility consultant and ESCO evaluator for the Metropolitan Atlanta Rapid Transit Authority (MARTA), Smart City consultant to the City of Orlando/OUC, and ESCO (energy services) project evaluator for the State of Louisiana.

**E4E Solutions,** Atlanta, GA, 2010 – 2013

***Senior Project Manager***

- Managed design-build energy and water projects for commercial and industrial clients ranging from $10k to $5M.
- Conducted energy and water audits on numerous building types to gauge client use of HVAC, water, refrigeration, lighting, and building automation with a focus on implementing turnkey projects.
- Served as the property owner's representative on multiple projects, advising the design team on energy efficiency and sustainability in new construction and retrofit applications.
- Procured significant financial incentives from a broad range of large utility programs, ranging from prescriptive rebates to highly customized submittals averaging $250k-$300k per project.
- Increased company visibility, brand identity, and client interest through development and launch of the company website, marketing literature, and case studies.
- Managed support of senior and junior engineering staff needed to service demanding project requirements.

**H2 Ecodesign**, Atlanta, GA, 2008 – 2010

***Senior Project Manager***

- Managed LEED certification initiatives for commercial and industrial customers while directing operations of the firm's independent consultant network.

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- Served as a full-service consultant for domestic and international clients seeking to incorporate water efficiency, energy efficiency, and sustainability into their building projects.
- Delivered high-impact presentations to clients that effectively outlined the measures needed to satisfy LEED requirements for the targeted goal, addressing concerns by multiple stakeholders.
- Managed the junior support staff, adjusting the auxiliary support for each project based on client priorities and project needs.
- Designed, implemented, and deployed a project collaboration and management software platform via Microsoft SharePoint, which served as a company standard across other departments.

**Southface Energy Institute**, Atlanta, GA, 2004 – 2008

***Operations Manager***

- Managed multiple energy and water efficiency and sustainable building programs, including EarthCraft House, ENERGY STAR, and Jackson EMC's RightChoice Program, providing comfort and energy guarantees and rebates.
- Served as the primary decision maker and risk mitigation manager for comfort and energy use policies with a client base of over 800 properties and 400 builders, overseeing a staff of 12 technicians and analysts.
- Led instructional training throughout Georgia and Alabama on energy efficiency, advanced construction, energy certification programs, HERS ratings, IECC energy code, and ENERGY STAR.
- Designed and implemented a company-wide project tracking database via Ruby on Rails (SQL type) that allows real-time carbon and energy savings data to be queried instantaneously.
- Trained in the energy modeling and design programs REMRate, ComCheck, and eQUEST, as well as experienced in AutoCAD; obtained EPA Universal certification.
- Served on the Georgia Energy Code task force as commissioned by the Department of Community Affairs, promoting energy efficiency within the Georgia energy code legislation.
- Acted as a liaison to the Home Builders Association, Jackson EMC, Georgia Power, Georgia Department of Community Affairs, and other partners to provide coordination of critical Southface initiatives and program standards.

GDS Associates, Inc.
ENGINEERS & CONSULTANTS

# Warren Hirons, P.E., CEM, CMVP
Project Manager

## EDUCATION

Murdoch University, *coursework in Renewable Energy*

B.S. Environmental Engineering, N.C. State University, May 2009

B.S.E.S. Environmental Economics & Management, University of Georgia, May 2006

## PROFESSIONAL CERTIFICATIONS & QUALIFICATIONS

Licensed Professional Engineer (PE) ***in the state of Georgia***

Certified Energy Manager (CEM)

Certified Measurement & Verification Professional (CMVP)

Experienced user of REM/Rate and BEopt building energy simulation modeling software.

## EXPERIENCE

**GDS Associates, Inc.,** Marietta, Georgia, 2012 to Present

***Project Manager***

Mr. Hirons performs project management and conducts quantitative and qualitative data collection and analysis, engineering feasibility studies, modeling of energy systems and program evaluation for GDS clients (e.g. utilities, government agencies, and regulatory agencies). He is also experienced in the areas of codes and standards, technical reference manuals (TRM), evaluation, and measurement and verification (M&V).

### PROGRAM EVALUATION

Mr. Hirons has worked on impact and process program evaluation projects for state utility commissions and other GDS clients. He is a Certified Measurement and Verification Professional (CMVP) as well as a licensed professional engineer. He worked on the Pennsylvania Statewide Evaluator Team from 2012 to 2017 and assisted with preparing reports to the Pennsylvania PUC on gross and verified savings from the energy efficiency programs of seven investor-owned utilities in Pennsylvania. He has served as the program evaluation consultant for the North Carolina Utilities Commission (NCUC) since 2012 and is responsible for reviewing the evaluation, measurement and verification (EM&V) reports submitted by the North Carolina electric utilities to the NCUC as part of their application for cost recovery in various electric rate case proceedings. He has submitted testimony and helped prepare affidavits and data requests on behalf of the NCUC in these proceedings. Other evaluation projects include the following:

- Developed program evaluation plans for a utility in Canada.
- Reviewed utility EM&V reports and prepared data requests to collect information in order to examine the basis for reported kWh, kW and therm savings filed in utility cost recovery proceedings. Reviews included impact, process, market effects (net-to-gross), educational, and marketing programs evaluations.
- Provided regulatory support and testimony in cost recovery proceedings
- Developed program theory models
- Reviewed EM&V plans for future programs to advise clients on the adequacy of the plans

### MARKET RESEARCH

Mr. Hirons has assisted with the development of telephone, web-based and on-site survey instruments and conducted on-site assessments for energy efficiency studies in several states, including Maine, Indiana, Pennsylvania and Mississippi. These market research projects also included data cleansing, data analysis, and drafting the final market assessment and baseline reports.

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## COST-EFFECTIVENESS ANALYSIS

Mr. Hirons has assessed the cost-effectiveness of many energy efficiency and demand response resources for a wide variety of GDS clients. This includes assessment of measures, programs, and DSM portfolios for planning, reporting, and evaluation purposes.

## DSM POTENTIAL ASSESSMENT

Mr. Hirons has completed assessments of electric and natural gas DSM potential across all customer sectors. He specializes in developing estimates of residential sector energy efficiency potential in utility service areas or states. He has completed numerous residential sector energy efficiency potential assessments for GDS clients, including the following studies:

- Indianapolis Power and Light (2019)
- Vectren Indiana (2019)
- Vermont Department of Public Service: electric and natural gas service territories (2017 & 2019)
- DTE Energy: electric (2018) and natural gas service (2016) territories
- Consumers Energy: electric service territory (2016); natural gas service territory (2019)
- Ameren Missouri: electric service territory (2016);
- Efficiency Maine Trust: electric and natural gas service territories (2015 and 2014);
- Pennsylvania PUC: electric service territories of seven electric distribution companies (2015).

He performs the following tasks as they relate to performing energy efficiency and demand response potential studies:

- Collects data on the costs, savings, useful lives and saturation of energy efficiency and demand response measures
- Estimates energy efficiency and demand response potential in various regions of North America
- Conducts building energy simulation models and billing and metering data analysis to support energy and demand savings estimates developed for energy efficiency potential studies and evaluation analysis
- Conducts benefit/cost analysis of energy efficiency and demand response measures and programs
- Conducts statistical and uncertainty/sensitivity analysis of data
- Develops and reviews engineering estimates of energy use and savings for energy efficiency and demand response measures and programs using simple and complex engineering models and formulas

## REGULATORY SUPPORT

Mr. Hirons has provided regulatory support services to GDS government and utility clients:

- Served on a team of advisors to help the Connecticut (CT) Office of Consumer Counsel represent the state's utility customers in energy efficiency proceedings.
- Provided analysis to utility and government clients regarding proposed utility shareholder incentive mechanisms
- Provided analysis of utility DSM plans in several states
- Performed research into best practices for providing DSM program
- Served as a consultant in natural gas rate case proceedings for municipalities in Texas
- Reviews utility EM&V reports and prepares data requests in an effort to require the utilities show sufficient evidence of reported savings in cost recovery proceedings. Reviews include impact, process, market effects (net-to-gross), educational, and marketing programs evaluations.
- Provides regulatory support and testimony in cost recovery proceedings
- Develops program theory models
- Reviews EM&V plans for future programs to advise clients on the adequacy of the plans

### PROGRAM PLANNING AND DESIGN

Much of the work performed by Mr. Hirons feeds directly into utility planning efforts. This includes information on DSM resource costs, savings, and potential program participants. In addition to the work noted above, Mr. Hirons has assisted utilities in developing estimates of program potential and DSM program portfolio plans. This included drafting recommended program designs, assisting program managers to determine appropriate measures and rebate levels, and performing cost-effectiveness analyses.

He has also provided quality assurance, technical support, and/or developed measures for technical reference manuals (TRMs) for Maine and Pennsylvania and provided deemed measure savings databases for several electric cooperative clients.

## WORK EXPERIENCE PRIOR TO JOINGING GDS●

**Brown and Caldwell,** Virginia Beach, VA
***Engineer II*** *– Business Consulting Practice*
Mr. Hirons worked with multiple contractors and the City of Virginia Beach Department of Public Utilities (DPU) to complete an investigation of the City's sanitary sewer infrastructure. The job required supervising contractor fieldwork activities, analyzing fieldwork data, compiling data and generating condition assessment reports. He also worked on a project to re-write the City's DPU design standards manual, and led an investigation into the stormwater infrastructure serving a portion of the Ft. Eustis military base in Newport News, VA.

**Southern Energy Management,** Morrisville, NC
***Building Science Plan Review Analyst***
Mr. Hirons worked on residential energy savings efforts by helping builders construct homes that earned Energy Star certification. His duties included conducting plan reviews by analyzing construction design drawings and entering the results of the analysis along with builder supplied specifications into the REM/*Rate* software program to estimate the energy efficiency of new homes. Mr. Hirons consulted with builders to help them make decisions regarding cost effective upgrades in energy efficiency.

**United States Department of Agriculture-Agricultural Research Service,** Raleigh, NC
***Biological Science Aide***
Mr. Hirons provided support to the plant physiologist in charge of completing tasks associated with conducting air quality experiments designed to investigate the effects of carbon dioxide and ozone on crop yield.

GDS Associates, Inc.
ENGINEERS & CONSULTANTS

Kaytie D. Harrah
Project Consultant

## EDUCATION

Master of Business Administration, Shorter University, Rome, Georgia 2016

Bachelor of Science in Management, Shorter University, Rome, Georgia, December 2006

## PROFESSIONAL MEMBERSHIPS

Association of Energy Services Professionals, *member since 2008*

Association of Proposal Management Professionals (APMP), *member since 2017*

## EXPERIENCE

Ms. Harrah has an MBA and Bachelor's Degree in Management from Shorter University and has more than 16 years of experience in the administrative and consulting fields. At GDS, Ms. Harrah provides data collection, data analysis and administrative support to engineers, consultants and executives of GDS. She assists with report preparation, formatting and technical editing of various reports. She has been responsible for the development and formatting of numerous program impact and process evaluations, energy efficiency and demand response potential studies as well as monthly progress reports for program evaluation projects. Ms. Harrah is responsible for the reporting requirements essential to delivering technically sound and clearly prepared reports to reach a multitude of audiences. She performs in-depth reviews and formatting of client reports and proposals to achieve these results. She has been involved in the development, compilation, comprehensive editing, and formatting of the following client potential studies:

- *Pennsylvania Public Utility Commission*
- *Ameren Missouri*
- *Vermont Department of Public Service*
- *Big Rivers Electric Corporation*
- *GreenCo Solutions*
- *Michigan Public Service Commission*
- *Efficiency Maine Trust*
- *Maryland Energy Administration*
- *Maryland Department of Housing & Community Development*
- *District of Columbia Energy Office*

**GDS Associates, Inc.**, Marietta, GA, 2008-Present
***Executive Assistant (2008 – 2014)***
***Project Consultant (2015)***

- Responsible for assisting with design and implementation of energy efficiency programs.
- Responsible for assisting company executives with various projects and reports.
- Responsible for composing and editing text for various projects.
- Assists engineers, consultants and executives with administrative functions.
- Conducts technical reviews and formatting of proposals and client reports.
- Prepares necessary and appropriate graphics for clients reports and proposals.

**Moore Investment Group, Inc.**, Atlanta, GA, 2003-2007
***Office Manager/Executive Assistant***

- Responsible for assisting company executives with various projects and reports.
- Responsible for all administrative duties.
- Managed accounts with duties including general ledger reconciliations, bank reconciliations and accounts payable.
- Managed office staff and office operations.

**Chattahoochee National Bank**, Alpharetta, GA, 1999-2003
***Operations Specialist***

- Responsible for assisting company executives with various projects and reports.
- Managed accounts with duties including general ledger reconciliations, bank reconciliations and accounts payable.
- Trained new staff on accounting software and bank operations.

## SKILLS ●

- Microsoft Office Suite: Excel, Word, PowerPoint
- Adobe: Illustrator, Photoshop, InDesign, Advanced Acrobat XI

GDS Associates, Inc.
ENGINEERS & CONSULTANTS

Melissa Young, EIT, CEM
Engineer

## EDUCATION

BS, Mechanical Engineering, Georgia Institute of Technology, Atlanta, Georgia, 2015

## PROFESSIONAL CERTIFICATIONS & QUALIFICATIONS

- Engineer in Training (EIT) ***in Georgia***
- Certified Energy Manager (CEM)
- Association of Energy Services Professionals (AESP)

## EXPERIENCE

**GDS Associates, Inc.**, Marietta, GA, 2012 to Present
***Engineer***
Ms. Young started at GDS as a coop student in 2012 and began full-time employment in 2015 after she graduated from Georgia Institute of Technology. Some of her responsibilities have included:

- Responsible for using tables and models to generate savings data on various energy efficiency and demand response programs.
- Responsible for research and reporting of energy efficiency and demand response programs.
- Responsible for writing technical sections of proposals.
- Currently working on electric energy efficiency potential study for 38 utilities in the California Municipal Utilities Association. Will be providing technical, economic, and achievable potential for the low-income and non-low-income homes in the residential sector.
- Worked on natural gas potential study for DTE Energy for the commercial sector. Provided technical, economic, and achievable potential for natural gas energy efficiency measures in the DTE service territory.
- Assisted in research and analytics for a project for The Green Government Council of the Commonwealth of Pennsylvania to provide consulting in Leased Commercial Buildings as a part of a new Executive Order that promotes energy conservation. The product was a roadmap that helped the Commonwealth engage their property vendors in a process whereby they invest in energy efficiency retrofits in their owned facilities.
- Evaluated demand response potential for Ameren Missouri in two studies (2016 and 2019). Analyzed demand response programs, including direct load control and rate programs for the residential (broken out by low-income and non-low income) and non-residential sectors. Conducted research to determine appropriate market penetration rates for demand response programs. Presented results to Ameren Missouri and Stakeholders.
- Evaluated demand response potential for Vectren and IPL utilities in Indiana. Analyzed several direct load control and rate programs. Determined cost-effectiveness and potential savings for all programs.
- Worked on update to NIPSCO's 2019-2021 DSM plan, extending it for a 30-year planning period. This project determined demand response updates, as well as the addition of many energy efficiency measures.
- Evaluated demand response potential for East Kentucky Power Cooperative. Analyzed several direct load control and rate programs.
- Worked on the Maine Residential Low-Income Household Energy Efficiency Baseline Study put together for the Maine Office of the Public Advocate. Coordinated efforts to conduct 68 on-site energy surveys of low-income homes in Maine. Traveled to Maine to conduct some of the surveys. Organized and analyzed data to develop findings and recommendations relating to remaining energy savings opportunities for low-income households in Maine.
- Worked on project for Austin Energy to determine the value of demand response in its service territory. A benefit-cost analysis was conducted, along with a review of how Austin Energy's current programs at the time interacted in the ERCOT market. GDS identified the most applicable end uses and customer types for demand response and evaluated the potential savings.

- Researched and collected program administrative and incentive costs information for electric energy efficiency and demand response programs around the country and reported them to Ameren Missouri. Information provided in this report was used to compare Ameren's administrative and incentive costs to many other utilities and determine if these costs fell within a reasonable range.
- Worked on Demand Response Potential Studies for three utilities in Michigan. Analyzed demand response programs, including direct load control and rate programs. Traveled to Michigan to present results to utilities, Michigan Public Service Commission, and other Stakeholders.
- Worked on Distributed Generation Potential Study for Efficiency Maine. Calculated technical and economic potential energy for renewable energy and CHP technologies, using several types of "clean" fuels. Analyzed cost-effectiveness of same technologies.
- Worked on Renewable Energy Potential Study for the Washington, D.C. Department of the Environment (DOE). Calculated potential energy for six forms of renewable energy.
- Worked on Statewide Evaluator Residential Potential Study for the state of Pennsylvania. Calculated energy efficiency saturation figures for each utility by extracting data from individual surveys and analyzing those numbers to calculate statistics for individual measure saturations.

## SKILLS ●

- Microsoft Office Suite- Excel, Word, PowerPoint, Publisher, Access
- SolidWorks
- SAS (Statistical Analysis Software)
- Autodesk Inventor
- AutoCAD
- MATLAB

GDS Associates, Inc.
ENGINEERS & CONSULTANTS

# Michael Coty, EMIT
Analyst

## EDUCATION

M.A., Urban Environmental Policy and Planning, Tufts University, 2015

Graduate Certificate, Water: Systems, Science and Society, Tufts University, 2014

B.S., Resource Economics, University of New Hampshire, 1996

## PROFESSIONAL CERTIFICATIONS & MEMBERSHIPS

- AEE Energy Manager in Training (EMIT)
- MA Wastewater Treatment Plant Operator – Grade 2, Industrial
- U.S. Green Building Council – NH Chapter Board Member
- Association of Energy Engineers (AEE)
- Association of Energy Services Professionals (AESP)

## PROFESSIONAL EXPERIENCE

Mr. Coty provides technical analysis and research for GDS' Energy Efficiency and Renewables Department in Manchester, NH with a focus on commercial and industrial projects. Recent projects have included analysis for HVAC measures, refrigeration, lighting retrofits, variable frequency drives (VFDs), and snowmaking equipment. Additionally, Mr. Coty manages day-to-day operations for the NYSERDA Region 1 Small Commercial and Energy Efficiency Assessment Program which provides free energy audits to small businesses and non-profits. His is other work includes conducting energy and cost savings analysis for utility rebate programs, performing scoping audits for commercial and industrial properties, and reviewing technical reports for various clients. Mr. Coty also has experience conducting research and analysis for a recent NYSERDA Technical Potential Study and utility Market Characterization Study. He is familiar with verification analysis, and was recently involved in the review of multiple Efficiency Vermont projects. Prior to joining GDS, Mr. Coty worked for over 12 years as an environmental project manager and consultant. In 2012, he was accepted to the Urban Environmental Policy and Planning Master's Program at Tufts University with a core concentration in environmental management, energy policy, and watershed planning. Mr. Coty recently completed an intensive energy manager course and passed the Certified Energy Manager exam.

## EMPLOYMENT HISTORY

**GDS Associates, Inc.,** Analyst, 2014 to Present
**ENPRO Services, Inc.,** Environmental Consultant, 2012 to 2014
**Sustainability Intern,** IDEXX Laboratories, Inc., June – November 2013
**ENPRO Services, Inc.,** Project Manager, 2001 to 2012

GDS ASSOCIATES INC
440 Science Drive Suite 400 • Madison, WI 53711
608-273-0182 • Fax 866-611-3791 • michael.coty@gdsassociates.com

GDS Associates, Inc.
ENGINEERS & CONSULTANTS

Alyssa M. Gianotti, EiT
Associate Engineer

## EDUCATION

B.E. Mechanical Engineering, University of New Haven, May 2016

## PROFESSIONAL CERTIFICATIONS & MEMBERSHIPS

- Association of Energy Engineers (AEE)
- Engineer in Training (EiT) - National Council of Examiners for Engineering and Surveying (NCEES)

## PROFESSIONAL EXPERIENCE

Alyssa began at GDS Associates, Inc. in April of 2018 as an Associate Engineer. Since her arrival, Alyssa has been working on technical analysis for electric and gas conservation measures in the industrial and commercial department. Apart from energy audits and Commercial/Industrial efficiency program implementation she is actively involved in EE program planning, evaluation and benefit cost modeling in support of various clients in New England states. Currently, Alyssa is supporting multiple Massachusetts program administrators (PAs) with monitoring on-going evaluation activity, advocating on behalf of PA issues, and providing a bridge between evaluation findings and implementation activities. Alyssa brings experience in large property risk assessment in the industrial realm, and has extensive experience working with customers' management teams. Alyssa's analytic capabilities and technical writing abilities will be an asset for any commercial or industrial application.

***Specific Experience Includes***

- Member of a consulting team in Massachusetts supporting multiple Massachusetts Investor Owned Utility Program Administrators. Support has included monitoring and summarizing all on-going evaluation activities, synthesizing evaluation findings into improved implementation practices and benefit-cost modeling and advocating on behalf of the Program Administrators. (2019 – Current)
- Participant in the Common Assumptions Meeting (CAM) group in Massachusetts responsible for establishing consistent benefit-cost screening practices throughout the state. In 2019, Alyssa provided support to the interim manager of the statewide gas benefit-cost model and incorporated several process refinements that are still being utilized. As part of this team, Alyssa gained keen insight into the drivers of cost effectiveness and PA processes for planning, screening, and reporting program activity (2019 – Current)
- Since 2019, Alyssa has been supporting Avangrid in Connecticut with a fundamental redesign of their energy efficiency program planning efforts including the development of a new planning tool that incorporates historical data for reference and is linked automatically to the Connecticut statewide screening model. Alyssa has supported Avangrid through their most recent regulatory process of semiannual plan updates (2019 – Current)
- Supported GDS' engagement with multiple Massachusetts Investor Owned Utilities providing technical support, QA/QC analysis, and energy modeling. Services included thorough energy analysis and documentation, measure identification and development, and measurement and verification activities. (2018-current)

## EMPLOYMENT HISTORY

- **GDS Associates, Inc.**, ***Associate Engineer***, April 2018-present
- **Zurich North America,** ***Risk Engineering Representative***, June 2016 – April 2018
- **Whiting-Turner,** ***Project Engineering Intern***, December 2015 – January 2016
- **Frontier Communications,** ***Engineering College Summer Inter***, June 2015 – August 2015

*Johnson Consulting Group*

# RESUMES OF KEY PERSONNEL

Katherine Johnson | President
Email: mailto:kjohnson@johnsonconsults.com
Office: 301-461-4865
Website: www.johnsonconsults.com

## *Professional Highlights*

Dr. Katherine Johnson is President of Johnson Consulting Group, a woman-owned consulting firm specializing in the energy efficiency field. For nearly 30 years, she has directed program evaluations investigating the effectiveness of energy efficiency programs and policies across residential and C&I market sectors. For the past eleven years, she has been leading collaborative forums to help guide decision-making regarding the evaluation and cost-effectiveness of current and emerging energy efficiency programs, topics, and policy initiatives.

## *Recent Project Experience*

### Statewide EM&V Guidance Projects

- **Arkansas Public Service Commission: Independent Evaluation Monitor (IEM):** Since 2011, Dr. Johnson has been working with the Parties Working Collaboratively (PWC) to help Arkansas inform, direct, and work towards consensus in achieving consistent reporting standards that conform to EM&V "Best Practices" for both the EM&V Protocols and the Technical Reference Manual (TRM). She also has supervised the annual updating of Arkansas Technical Reference Manual, developed the current EM&V Protocols incorporated into Arkansas TRM V.6. Her responsibilities include reviewing the third-party implementation plans and reports, and preparing an Annual Report to the Arkansas Public Service Commission each June. She has testified before the Arkansas Public Service Commission as an expert in EM&V issues.
    - **Arkansas Public Service Commission: Weatherization Collaborative Facilitation:** Dr. Johnson led the facilitation and development a new unified statewide approach to weatherization programs at the request of the Arkansas Public Service Commission.
    - **Arkansas Public Service Commission: NEBs Quantification:** Dr. Johnson led a literature review and analysis of current NEBs policies and estimates at the request of the Commission. She also facilitated the stakeholder process that led to the establishment of quantifying four NEBs in annual EM&V studies beginning in PY2017.
- **British Columbia Utilities Commission: Energy Efficiency Consultant**: Dr. Johnson provided ongoing technical and expert guidance regarding the practicality and feasibility of proposed energy efficiency plans, filings, and cost-effectiveness calculations.
- **California Public Utilities Commission: EM&V Advisor**: Dr. Johnson provided technical advice and support to the Energy Division of the CPUC specifically regarding the effectiveness of energy efficiency programs targeting Regional Energy Networks, Local Government Partnerships, Disadvantaged Communities, and multifamily strategies.
- **Maine Public Utilities Commission**: **EM&V Technical Advisor**: Working with Mesa Point Energy, Dr. Johnson completed a fast-turnaround project designed to assess the effectiveness of Maine's triennial plan. Her work included reviewing current EM&V reports, identifying gaps and preparing supporting materials for the Public Utility Commission staff. Her contract was extended to assist the PSC in identifying best practices for TRM updates.
- **Missouri Public Service Commission: EM&V Auditor:** Dr. Johnson led the team of EM&V Auditors to review EM&V plans and reports prepared by third-party evaluation firms to ensure that these reports reflect industry best practices and are consistent with industry approved protocols such as the IPMVP for the past four years.
- **New York State Energy Research and Development Authority (NYSERDA):** Dr. Johnson conducted extensive research on current "Best Practices" in EM&V activities nationwide which led to the development of the first set of EM&V Protocols for the Arkansas Public Service Commission and the first ever set of Process Evaluation Protocols for New York State.

### Selected EM&V Experience

- **Commonwealth Edison:** As a subcontractor to Navigant Consulting, Dr. Johnson has been serving as a technical advisor to quantify NEIs for ComEd's entire energy efficiency portfolio. She has developed specialized surveys and conducted independent analysis into NEI quantification strategies and estimates in other jurisdictions and approaches to avoid NEI double counting.
- **Delaware Sustainable Energy Utility:** Dr. Johnson led the process evaluation of DE SEU's Home Performance with Energy Star statewide program. In this capacity, she is directing the analysis of customer surveys, conducting in-depth interviews with staff, implementers, and contractors and reviewed critical program databases and materials.
- **MASS Save:** Completed an independent review and analysis of the major HP software packages currently being used or under consideration in Massachusetts for its MASS Save program. Provided recommendations on the best ways the state could develop a common software approach which would both meet the needs of the Program Administrators (PAs) and the HP contractors looking to expand their business opportunities.
- **Spire Energy:** Led the comprehensive program evaluations for the residential and C&I space and water heating programs for the largest gas utility in Missouri. Her responsibilities included conducting the process evaluations, supervising the impact and cost-effectiveness evaluations, determining NTG and preparing summary reports and presentations to key stakeholders (2017-Present)

**Principal, KJ Consulting**, Frederick, MD (1997-2006): A woman-owned marketing and management firm headquartered in Metropolitan Washington, D.C.

**Marketing and Finance Manager**, **Geothermal Heat Pump Consortium, Inc., Washington, D.C.** (1995-1996)

**Associate, Barakat & Chamberlin, Washington D.C.** (1993-1995**)**

**Research Director, The Corps Group, St. Louis, MO**. (1992-1993)

**Project Manager, Aragon Consulting Group, St. Louis, MO** (1991-1992)

## *Education*

Doctor of Business Administration (July 2010)
University of Southern Queensland, Toowoomba, Australia

Master of Business Administration (Dean's List: 1990)
Rollins College, Roy E. Crummer Graduate School of Business, Winter Park, FL

Bachelor of Science in Business and Journalism (Dean's List: 1983)
Indiana University School of Business, Bloomington, IN

## *SELECTED PUBLICATIONS AND CONFERENCE PAPERS*

Johnson, K. Eisenberg, G., Reeves, S. & Lee, H. 2019, "**Keeping Programs on Track: Monitoring Program Recommendations,"** International Evaluators Professional Evaluation Conference (IEPEC) Denver, CO August.

Johnson, K. & Klucher, M. 2015, "*Getting Our Ducts in a Row: Using Evaluation Results to Create a Statewide Weatherization Program,"* IEPEC Conference, Long Beach, CA. August

Johnson, K. 2014, "**A Modern Twist on an Old Classic: New Program Designs for Low and Middle Income Residential Weatherization Programs,**" ACEEE Summer Study, 2014 (presentation) ( link to **abstract**)

Johnson, K. & Klucher, M. 2015, "**All Together Now: How Collaboration Works in Arkansas**," IEPPEC, Berlin, 2014

Johnson, K. Spector, M. Griffin, C. & Smith, P. 2011,"*Getting out of the Starting Blocks: Challenges with PY1 Portfolio Evaluations,"* IEPEC, Boston.

Johnson, K. Archer, B. & Griffin, C. "*Soup to Nuts: Building EM&V into Program Design,"* 2011, Interactive Conference Session with Griffin, C & Archer, B. 21st Association of Energy Services

_____ 2010. *Geo Heat Pumps: Leading Energy Utility Marketing Programs. Fifth Edition,* Johnson Consulting Group, Frederick, MD.

_____, Willoughby, G., Shimoda, W. & Volker, 2010. *Lessons Learned from the Field: Key Strategies for Implementing Successful On-the-bill Financing Programs,* IEPEC Conference, Paris, France. June.

Johnson, K., Hendershot, D., Naleway, R., Pope, M., Willoughby, G. & Webster, E. 2010. *Staying Out of Hot Water*, ACEEE Summer Study, Pacific Grove, CA

Reynolds, D, Johnson, K. & Cullen,G. 2009. *E, M &V Best Practices: Lessons Learned from California Municipal Utilities,* Association of Energy Services Professionals Annual Conference, San Diego, CA. 2009

Reed, J. & Johnson, K. 2004, *"Who Plays and Who Decides: The Structure and Operation of the Commercial Building Market*, A Report Prepared for the U. S. Department of Energy, Office of Building Technology, State and Community Programs, Washington, D.C. March

Corine Mahon | Project Manager
Johnson Consulting Group
Phone: 503-807-0646; Email: cmahon@johnsonconsults.com; http://www.johnsonconsults.com

## *Professional Highlights*

**Corine Mahon** is Project Manager with Johnson Consulting Group responsible for editorial review, online material support, and logistical support for Johnson Consulting Group. She has a Bachelor of Arts degree with a major in Communications from California State University, Fullerton, CA.

## *Experience*

More than 15 years of experience in various phases of marketing both print and Internet, website creation and maintenance, and technical support for small to medium-sized companies.

**Johnson Consulting Group, MD** (2008 – present) Provides logistical support to JCG, maintains the website and sites for events and organizations controlled by the Johnson Consulting Group. Duties include online event coordination and meeting summaries; production of corporate communications and publications; and maintenance of certifications as required by states plus MBE certifications.

**Market Development Group, CO** (2006-2008) Joined Katherine Johnson and Ed Thomas as Project Coordinator. Handled four websites, created marketing pieces for print or Internet, online event registration, support of webinars/workshops, and coordination of various publications.

**Freelance work, CA** (2000-2006) Provided website support for Association of Energy Service Professionals, Utility Communicators International, Peak Load Management Alliance, Delta-Montrose Electric Association, and Intermountain Energy before joining Market Development Group. Supported the creation and publication of the "Leading Energy Utility Marketing Programs" and its Reports: Home Energy Audits, Home Energy Loans, and Geo Heat Pumps.

**Volt VIEWtech, Anaheim, CA** (1993-2000) Promoted from Executive Assistant to Technical Support Specialist responsible for assisting in the launch of one of the first on-line Home Energy Audits.

**Carter Hawley Hale, Anaheim, CA** (1990-1992) Executive Assistant to the Vice President of Security in charge of employee identification/security in a database of 500 employees.

**Southern California Training Council, Newport Beach, CA** (1988-1989) Associate Project Manager for government subsidized training. Responsible for computer tracking of trainee progress, course scheduling, and brochure creation.

**Docutel-Olivetti, Newport Beach, CA** (1983-1985) Account Consultant for automated teller machine manufacturer. Responsible for technical training of client bank staff, coordination of physical construction of ATMs, and coordination of promotional campaigns.

## *Education*

Bachelor of Arts with a major in Communications, 1988, California State University, Fullerton, CA Associate in Arts Degree, Banking and Finance, (Dean's List honors: 1986), Fullerton Community College, Fullerton, CA

## *Affiliation*

Member of Association of Energy Service Professions since 2008.

Diane Mahon | Project Manager
Johnson Consulting Group
Phone: 503-807-0646; Email: dmahon@johnsonconsults.com; http://www.johnsonconsults.com

## *Professional Highlights*

Diane Mahon is Project Coordinator with Johnson Consulting Group. She assists in areas of project coordination. She is being mentored in the EM&V field by Dr. Katherine Johnson. She has a Bachelor of Science degree in Criminology and Criminal Justice from Portland State University. Through studies at Portland State she learned how to study and analyze data using Microsoft Excel for programs that are aimed at changing behavior and improve communities.

## *Experience*

More than 6 years of experience in survey analysis plus proposal and report coordination for client companies in several states.

Johnson Consulting Group, MD (2011-present) She is responsible for customer and trade alley surveys/interviews analysis and online preparation. She assists in statistical analysis, creation of charts and graphs from evaluation data and databases and assists in other areas of project coordination. She has been heavily involved in the production of reports for clients including Columbia Gas of Virginia (VA), City Utilities of Springfield (MO), Energy Trust of Oregon (OR), Parties Working Collaboratively (AR), Partners in Energy Services (CO), PECO (PA), PSNC Energy (NC). She also assists in proposal preparation and meeting summaries.

Management at Taco Bell (2003-2007) Worked in various Locations: Yorba Linda and Anaheim, CA; Tigard and Oregon City, OR. Responsibilities included management of time, employees, food safety, high cash values, bank deposits, opening/closing the store and customer service.

Internship with Portland State University Student Legal and Mediation Services (2009) Handled a variety of cases in criminal and family law. Worked closely with lawyers, police, court houses, international students and appropriate databases. Also maintained the website for the Student Legal and Mediation Services through Drupal internet website building program.

## *Education*

Bachelor of Science in Criminology and Criminal Justice, 2009, Portland State University, Portland, OR

Internship with the Student Legal and Mediation Services, Portland State University, Portland, OR

## *Additional Certifications/Training*

Currently enrolled in software certification classes for Dashboard reporting, Data Analysis and Big Data using Microsoft Excel and Tableau.

STP Certified in food service management

GIS Mapping Program

Crime Analysis (analysis with MS Excel)

Senior Capstone in Impact of Community Gardens

## *Affiliation*

Member of Association of Energy Service Professionals since 2011

*Demand Side Analytics*

# RESUMES OF KEY PERSONNEL

Demand Side Analytics
DATA DRIVEN RESEARCH AND INSIGHTS

# JESSE SMITH – PARTNER

## DSM Potential Studies

- **Consumers Energy** – Demand response potential study and Integrated Resource Plan support (2020).
- **NIPSCO –** Demand response market potential study and IRP Support (2020-2021).
- **Pennsylvania Public Utility Commission –** Demand response potential study lead (2019). Used to establish goals for the state's seven electric distribution companies.
- **Indianapolis Power and Light –** Demand response potential study lead. Support measured energy efficiency and behavioral measure characterizations (2019).
- **Pennsylvania Public Utility Commission –** Demand response potential study lead (2014-2015). Extensive research on program design and PJM integration.
- **Central Electric Power Cooperative –** DSM potential study and IRP support (2020). Includes energy efficiency, demand response, beneficial electrification, and renewables.
- **Central Hudson Gas and Electric –** Non-residential baseline study (2019). Primary data collection designed to inform a DSM potential study.
- **Pennsylvania Public Utility Commission –** Non-Residential baseline study (2013-2014 and 2018-2019). Each study included approximately 500 on-site audits.
- **Advanced Energy Economy –** Demand response and battery potential in Indiana (2017-2018)

## Energy Efficiency Evaluations

- **Central Hudson Gas and Electric** – Portfolio Impact Evaluation and C&I Baseline Study (2019-2021)
- **Pennsylvania Statewide Evaluation Team** – TRM Development (2011-2019)
- **ecobee eco+** – Connected thermostat optimization evaluation (2019-Present)
- **Independent Electricity System Operator (IESO) of Ontario** - Industrial Energy Manager Program Evaluation (2016-2019)
- **CREED Light Tracker** – National Lighting Analysis for NTG (2016-2019)
- **Columbia Gas of Virginia** – Impact Evaluation of CARE Portfolio of Natural Gas DSM Programs (2016-2019)
- **Efficiency Maine** – Large Customer and Business Incentive program evaluations (2014-2016)
- **Efficiency Maine** – LED Lighting and Heat Pump Water Heater Pricing Trials (2017-2018)

## Demand Response Evaluations

- **Pennsylvania Public Utility Commission** – Statewide Audit of demand response program evaluations (2017-2021) Responsible for the review and all demand response EM&V plans, baseline selections, and load impact calculations for states 500 MW demand response portfolio. Program types include C&I load curtailment, AC load control and behavioral DR.

## Education

Master of Science, Applied Statistics 2010
Kennesaw State University

Bachelor of Science in Psychology 2001
University of North Carolina, Chapel Hill

## Work History

Demand Side Analytics, LLC - Atlanta, GA
Partner and Principal Consultant 2016-now

Nexant – Malvern, PA
Managing Consultant 2015-2016
Project Manager 2013-2015
Senior Analyst 2011-2013

GoodCents Solutions, Inc. – Atlanta, GA
Load Research Analyst 2010-2011

- **Public Service New Mexico** – Power Saver residential AC Cycling and Peak Saver C&I curtailment evaluations (2017-present). Annual load impact evaluation of PNM's 60 MW demand response portfolio.
- **Southern California Edison** – Smart Energy Program (2019-2020) – Annual load impact evaluation of 35 MW residential demand response program for 52,000 participants
- **Central Electric Power Cooperative** – Beat the Peak behavioral demand response pilot evaluation (2018-2019). Includes both winter and summer DR. Impact evaluation uses AMI data and is based on an alternating treatment design developed by Mr. Smith following a detailed power analysis.
- **Georgia Power** – Power Credit AC cycling switch operability assessment (2017) Field study of a random sample of 140 participating households to estimate the operability rate of the programs 50,000 load control switches.
- **CPS Energy** – Home Manager evaluation (2012-2014) – Annual impact evaluation of the DR impacts from air conditioners, water heaters, and pool pumps.

## Behavioral Evaluations

- **Union Gas** – Home Energy Report Program (2017-2018) Impact and process evaluation of a large randomized control trial implemented by Oracle. Included a dual participation and cost-effectiveness analysis.
- **Pennsylvania Public Utility Commission** – Home Energy Report Persistence Study (2015 and 2018) Analysis of the persistence of savings in households that stopped receiving HERs. Study results were synthesized into a TRM protocol to account for measure life, decay, and savings accounting in a more accurate fashion.
- **Avista Utilities** – Evaluation of Opower program impacts (2016) Natural gas and electric billing analysis of a large HER deployment.
- **Duke Energy** – MyHER Program Impact Evaluation (2014-2016) Impact evaluation of the largest HER program in the country with over two million treatment group homes.
- **Seattle City Light** – Home Energy Report Program Impact Evaluation (2016) Evaluation of HER impact for two implementers (Opower and Tendril) using bi-monthly billing data. The process evaluation included a comparison of the customer experience across the two vendors.

## Connected Thermostat Research

- **Tendril** – Orchestrated Energy Pilot Evaluation. Energy efficiency & demand response. (2017 & 2018) Orchestrated Energy is a thermostat optimization algorithm implemented by Tendril for several investor-owned utilities including Indiana Michigan Power. In 2017 and 2018, Mr. Smith performed an 'internal evaluation' of program impacts for Tendril.
- **DC Sustainable Energy Utility** – Nest Seasonal Savings evaluation (2019-2020). Analysis of summer and winter thermostat optimization deployments.
- **Central Electric Power Cooperative** – Smart Thermostat program evaluation. Energy efficiency and demand response. Includes both winter and summer DR (2017-2018) DSA also developed the demand response management system that CEPC uses to manage and evaluate this program.
- **Energy Trust of Oregon** – Nest Seasonal Savings Pilot Evaluation. Energy efficiency only (2017) The pilot was delivered as a randomized encouragement design (RED) and included an impact evaluation using both thermostat runtime and utility gas and electric billing data.
- **Columbia Gas of Virginia** – Smart Thermostat Rebate Impact Evaluation. Energy efficiency only (2017) Regression based billing analysis of natural gas and electric savings from smart thermostats.
- **Avista Utilities** – Smart Thermostat Analysis. Energy efficiency only (2016) Regression based billing analysis of natural gas and electric savings from smart thermostats.

Demand Side Analytics
DATA DRIVEN RESEARCH AND INSIGHTS

# JOSH BODE – PARTNER

## T&D Planning, Forecasting, and Marginal Costs

- **PSEG Long Island Locational Value Study (2019-2020)** – Analysis of T&D loads and valuation of the DERs.
- **Central Hudson Distributed System Implementation Plan Support (2018, 2020)**
  - Development of probabilistic forecasting and planning methodology
  - Produce five years of historical and five years of hourly (8760) forecasted demand for all substations
  - Develop probabilistic 10-year 8760 load forecasts for all substations, transmission areas, and planning areas in service territory
  - Forecast adoption of DERs and their dispersion for each individual circuit feeder, including EE, solar, and EV's.
  - Produce 8760 load shapes with and without DERs for all substations and feeder in service territory
  - Identifying locations beneficial locations for DERs
  - Advanced metering infrastructure analysis and business case
- **Central Hudson Probabilistic T&D Planning (2017)**: Development of distribution planning tools and training for planners.
- **Central Hudson Same Day and Day Ahead Transmission and Distribution Forecasting Model (2018)**: Location specific same day and day ahead forecasting models for all substations, transmission areas, and non-wire alternative projects.
- **Central Hudson EV Adoption and Load Impact Forecasting and NWA Assessment (2015-2018)**: Analyzed and provided expertise regarding 5 non-wire alternative project proposals designed to avoid or defer distribution and transmission investments.
- **PG&E (2014)** - Development of tools for modeling 8760 customer and end use load, including solar and EV's, for all PG&E's 2900 circuits and 800 substations.

## Distributed Energy Resource Valuation and Cost-Effectiveness

- **SDG&E (2019 – present)**: Analysis of Impact of rates, solar, battery storage, and DR for all non-residential customers, targeting analysis, and development of online tools.
- **AEEI Valuing DERs in ERCOT (2019)**.
- **State of Washington** – Distributed Energy Resource Planning Assessment (2017).

## Education

| | |
|---|---|
| Master of Public Policy<br>University of California, Berkeley | 2005 |
| Bachelor of Science in Economics<br>Willamette University | 1999 |

## Work History

Demand Side Analytics, LLC

| | |
|---|---|
| Partner and Principal Consultant | 2017-now |

Nexant – San Francisco, CA

| | |
|---|---|
| Vice President, Strategy & Planning | 2016-2017 |
| Principal Consultant | 2014-2015 |

Freeman, Sullivan & Co – San Francisco, CA

| | |
|---|---|
| Principal Consultant | 2013 |
| Senior Consultant | 2010–2012 |
| Consultant | 2008–2009 |
| Senior Analyst | 2005–2007 |

U.S. Federal Energy Regulatory Commission – Washington D.C.

| | |
|---|---|
| Energy Industry Analyst | 2005 |

California Public Utilities Commission - San Francisco, CA

| | |
|---|---|
| Office of Commissioner Kennedy | 2004–2005 |

- **Dominion Energy West (Questar Gas) –** Development of Peak Moment Valuation Framework (2017).
- **Consolidated Edison** – Brooklyn Queen Demand Management Project (2014): Framework and model for assessing bids and from demand and supply side resources with different operating characteristics.
- **Consolidated Edison** – REV Market Design Support – Designing and Unlocking Markets for Distributed Energy Resources (2015).
- **Central Hudson –** Non-Wire Alternatives (NWA) Assessments (2015 to Present): Analysis of load patterns, modeling of DERs, optimization of resource mix, and benefit costs analysis
  - NW Corridor transmission project – 10 MW of load relief (2015-ongoing)
  - Fishkill/Shenandoah distribution deferral – 5 MW of load relief (2015 – ongoing)
  - Merritt Park feeder circuit project – 1 MW of load relief (2015 – ongoing)
  - Ohioville substation project – 4 MW of load relief planned. Project aborted because Nexant analysis showed overages too large to successfully mitigate given timeline.
  - Coldenham feeder circuit project – 2 MW of load relief initially projected. Project was postponed because Nexant analysis showed natural adoption of solar and a load transfer deferred need for project
- **PG&E** – Demand Response for T&D Pilot Phase II (2017): Report on 10 demonstration projects for integration of demand response into T&D planning and operations.
- **PG&E** – Demand Response for T&D Pilot Phase I (2014): Study of PG&E Needs for Integration of Load Management into Distribution Operations and Planning.

## Energy Efficiency and Behavioral Studies

- **Central Hudson DSM Portfolio** (2019-present) - Josh is the impact lead for multiple programs including Home Energy Reports, Retail Lighting, C&I Prescriptive, and Small Business Direct Install.
- **Fortis BC** Smart Learning Thermostats Pilot (2017-present).
- **Duke Energy Indiana and Carolinas** Education Kit Program (2017).
- **Duke Energy Carolinas and Duke Energy Progress** Business Energy Report Pilot (2015-2017).
- **Tendril** – Orchestrated Energy Randomized Control Trial (2017).
- **Energy Trust of Oregon** – Smart Learning Thermostat Seasonal Savings Randomized Control Trial (2017).
- **Questar Gas** – Home Energy Report Multi-Year Effects, Persistence, and Frequency: A Meta-analysis of Randomized Control Trials (2016).
- **PG&E** – Business Energy Reports Emerging Technology Evaluation (2014-2015).
- **PG&E** – Small Commercial EMS Pilot (2015): Analysis using whole building data.
- **SDG&E** – Smart Energy Solutions Pilot (2012): Small business direct install pilot.
- **Pennsylvania** Low Income Programs Evaluation on Contractor Performance (2014).
- **Southern California Edison**: Demand Response Summer Discount Plan (2019-2020).

## Time Varying Pricing Evaluations and Rate Design

- **ComEd –** PTR Evaluation and Baseline Assessments (2013-2015)
- **PG&E –** Load Impact Evaluation of Residential TOU Tariffs (2009, 2010 and 2011)
- **PG&E –** Load Impact Evaluation for PG&E's Residential SmartRate™ Tariff (2008-2010)
- **SMUD** - Smart Options Pilot (2014)

Demand Side Analytics
DATA DRIVEN RESEARCH AND INSIGHTS

# ALANA LEMARCHAND – PARTNER

## EDUCATION

B.S. in Environmental Economics 2010
University of California, Berkeley

## WORK HISTORY

Demand Side Analytics, LLC
Partner and Principal Consultant 2018-now
Principal Consultant 2017-2018

Nexant
Senior Consultant 2014-2017

Simon-Kucher and Partners
Senior Consultant 2010-2014

## Overview

- **PSEG Long Island –** Locational Avoided T&D Cost Study (2019-Present): Managed and conducted evaluation of locational T&D avoided T&D cost study based on an analysis of 5 years of 8760 hourly SCADA data for about 1500 distribution assets. The study quantified the value associated with an increase or decrease of kW coincident with location specific peaks. It employed methodologies that have been applied and approved by other New York utilities, namely granular, probabilistic load forecasting and deferral value estimation which quantifies the option value of reducing peak demand in specific locations in the PSEG-LI system.
- **DC SEU Portfolio Cost-effectiveness –** Built detailed, flexible benefit cost model for assessing project, program, portfolio level cost-effectiveness for DC SEU energy efficiency and renewable energy programs. (2018-2020)
- **Central Hudson Gas & Electric –** Non-Pipes Alternative Evaluation Study (2018): Conducted gas load disaggregation analysis to support determination of gas peak load drivers and NPA opportunities
- **Central Hudson Gas & Electric –** Distribution System Implementation Plan (2016-2020): Supported preparation of Distribution System Implementation Plan (DSIP) filing in 2016, in compliance with Renewing the Energy Vision (REV) proceeding. Included development of granular (circuit level) forecasts of penetration and system and local peak impacts of various distributed energy resources (DERs) and incorporated granular, stochastic load forecasts. Also included development of AMI business case. Currently supporting 2018 DSIP filing including updates to incorporate probabilistic approach to DER forecasting.
- **Consolidated Edison:** Led design and implementation support for a "prices-to-devices" demonstration of more dynamic, cost reflective rates with a research cell focused on evaluating the impact on bills and. Investigation of innovative pricing designs including time varying and demand based rates for residential and small business customers. (2016-2019)
- **SDG&E –** Evaluation of TOU & TOU-CPP Rates, Smart Thermostat DR Programs (2017-2020): Since 2017, led evaluations of SDG&E's small commercial CPP and smart thermostat DR programs. Evaluated both TOU and CPP impacts for over 120 thousand commercial customers, 18 thousand devices, 5 commercial programs, and since 2019, 18 thousand residential customers, devices, and dozens of events. Granular impact modeling for bottom up segments, and production of ex ante and time temperature matrix weather normalized impact forecasts.

## Distributed Energy Resources

- **Joint California IOUs –** EV Submetering Pilot Accuracy Assessment and Process Evaluation and Conjoint Market Study (2015-2017): Advised, designed, and led implementation and analysis of conjoint survey of EV

owners across all three IOUs to assess their preferences for different submetering features including bill savings and data access and how those preferences affect the likelihood of enrolling in a submetering plan.

- **Large Investor Owned Utility –** Value of Solar Literature Review and Renewable Generation Regulatory Support (2014-2016): Provided overall regulatory and technical support for this utility during their proceedings for their 2016 Integrated Resource Plan
- **SMUD –** Grid 3.0 Strategy Support – Grid Modernization and DER Strategy Harmonization (2015-2016): Coordinate and developed a long-term vision and strategy for operating in an environment in which distributed energy resources (DERs) play a much larger role than in meeting consumer demand for electricity
- **Con Edison** – Designing and Unlocking Markets for Distributed Energy Resources (REV Market Design) (2015): Provided analytic services in conjunction with market design effort as part of the Reforming the Energy Vision (REV) proceeding
- **Con Edison** – Brooklyn-Queens Demand Management Project: Valuation framework and prototype for assessing bids and DER options (2014): Assisted with the development of a comprehensive valuation framework and model for assessing various DER options for specific demand management project.

## Locational Value and Time-Varying Rates

- **Central Hudson Gas & Electric –** Targeted Demand Management Demonstration Project and Distribution System Implementation Plan Support (2016, 2018)
- **Con Edison Smart Home Rate –** Research Design, Rate Design, and Implementation Support (2016-2018)
- **PECO –** TOU Rate Impact Analysis and Participant Survey (2014-2015): Analyzed participant surveys and peak load impact analysis for residential and small business TOU opt-in pilot using AMI data. Required dynamic matched control group approach to address rate coordination with AMI rollout. Augmented process and impact results but combining the two to combing actual versus reported bill savings.
- **SDG&E –** Evaluation of TOU and TOU-CPP Rates (2015), Small Non-Residential TOU & TOU-CPP Evaluation (2018)

## Market Research

- **SDG&E –** Non-Residential Smart Thermostat Evaluation (2018, 2020), and Residential Smart Thermostat Evaluation (2020): Lead the evaluation for multiple years and multiple aspects of smart thermostat and demand response programs.
- **Efficiency Maine** – LED and Heat Pump Water Heater Pricing Trials (2016-2018): Developed practical experimental design, analyzed sales data for a series of discount levels, and provided estimates of free ridership to support program design, budgets, and savings goals for Triennial Plans.
- **Central Hudson –** Non-Residential Baseline Study (2019): Lead and managed the survey design and data collection. Facilitated analysis and reporting of all end uses, energy use intensity, and willingness to pay components of study. Provided necessary parameters used for Central Hudson Potential Study.
- **Pennsylvania Public Utilities Commission –** C&I Baseline Study (2018): Lead and managed the survey design and data collection. Facilitated analysis and reporting of all end uses, energy use intensity, and willingness to pay components of study. Provided necessary parameters used for Pennsylvania Potential Study.
- **SMUD** – Residential Demand Response Conjoint Market Research Study and Program Design Optimization (2015): Led and conducted a market research study of hundreds of SMUD customers to assess drivers of customer enrollment in demand response programs.

Demand Side Analytics
DATA DRIVEN RESEARCH AND INSIGHTS

# ADRIANA CICCONE – PRINCIPAL CONSULTANT

## Education

M.S., Environmental Science and Public Policy
University of Chicago 2015

B.S., Materials Science
B.S., Management Science/Operations Research
Massachusetts Institute of Technology 2009

## Work History

Demand Side Analytics, LLC
Senior Consultant 2018-now

Nexant
Senior Consultant 2015-2018

Proctor & Gamble
Competitive Intelligence Analyst 2009-2013

## Overview

- **Southern California Edison –** Portfolio (2019-2022). Project Manager and Analyst for portfolio of DR programs which included 300MW of savings.
- **Pennsylvania PUC –** DR Potential Study (2020). Lead analyst of residential modeling for DR Potential Study covering 7 EDCs
- **PSEG Long Island –** Non-wire alternative tool design (2020).
- **California –** Statewide Baseline Interruptible Program (2016). Performed three demand response evaluations of large industrial customers (at PG&E, SCE and SDG&E) using individual customer regressions. This analysis had extensive focus on model specification development and out-of-sample testing
- **Southern California Edison** – Agricultural Pump Interruptible Evaluation (2015, 2017). Performed the impact evaluation of an emergency demand response program for agricultural pumping loads.

## Assessments of Accuracy of Evaluation and Settlement Methods

- **Central Hudson Gas & Electric** – Residential Thermostat and DLC Study of Baseline Accuracy (2019). Assessed accuracy for over 10,000 baseline settlement alternatives for a residential and small commercial thermostat and DLC demand response program.
- **ComEd** – Peak Time Rebate Winter Baseline Accuracy Assessment (2018). Performed an assessment comparing ComEd's existing customer baseline performance for the expansion of the program to winter months, relying on interval data and placebo event days to determine whether the accuracy and precision of the existing baseline was similar for both summer and winter events.
- **CAISO** – Study of baseline accuracy for market settlement, including weather sensitive, agricultural, and industrial loads (2017). Assessed accuracy for over 6,000 baseline settlement alternatives for each of ten DR programs at SDG&E, PG&E, and SCE using smart meter data from 580,000customers, including all large C&I customers. Presented results in an iterative, consensus-building process to a variety of stakeholders at IOUs, the CAISO, and aggregators.

## Thermostat, Plug Load, and Load Control Evaluations

- **Power New Mexico** – Power Saver DLC Program (2018-2019). Evaluated the performance of a DLC program across residential, small and medium commercial customers in New Mexico. Relied on baselines, alternating treatment designs, and individual customer regressions to identify accurate and precise program impacts. Developed ex ante impacts under specific program peaking conditions.

- **Tendril** – Orchestrated Energy Evaluation of demand response (2018). Orchestrated Energy is a thermostat optimization algorithm implemented by Tendril for several investor-owned utilities including Xcel Energy. The algorithm includes both an EE and DR component. Ms. Ciccone evaluated the demand response component for four utilities in the program.
- **Georgia Power** – Residential Thermostat Energy Savings Evaluation (2018). Performed an assessment of energy savings associated with a thermostat rebate program and exploration of the incremental benefits of using large scale AMI data (over 1 billion rows) for energy efficiency program evaluation compared to traditional billing data methods.
- **SDG&E** – Small Commercial Technology Deployment (2016). Performed an analysis of demand response capabilities for small commercial customers with programmable communicating thermostats. This evaluation used a triple-differences method to develop ex post and ex ante impacts.

## Time Varying Pricing Evaluations and Rate Design

- **Con Edison** – Innovate Pricing Pilot Design, implementation support, and evaluation (2017-2018). The pilot is focused of assessing innovative delivery rates and assessing customer acceptance, load impacts, and bill impacts of rates with time-of-use demand charges and demand subscription rates. Both opt-in and default enrollment were being tested for residential and non-residential customers. Ms. Ciccone analyzed hundreds of potential revenue-neutral rates for customer bill volatility and revenue stability.
- **Con Edison and O&R** – SmartHome Pilot Design, implementation Support, and evaluation (2016 to present). A prices-to-devices pilot designed to assess the ability of customers to respond through technology (battery storage, thermostats, EV's and home energy management systems) to location specific and time varying prices that better reflect all costs components. Ms. Ciccone analyzed hundreds of potential revenue-neutral rates for customer bill volatility and revenue stability.
- **California** – Statewide Demand Response Potential Study Support (LNBL- 2016). Ms. Ciccone quantified the DR impacts of default or opt-in TOU rates in California as part of the statewide DR potential study conducted by LBNL.
- **California** – Statewide Critical Peak Pricing Evaluation (2015-2016). Assessed impacts associated with a voluntary critical peak pricing rate for California C&I customers. Methods used for evaluation included propensity score matching, out of sample testing, and a difference-in-differences framework.
- **SDG&E** – Evaluation of TOU and TOU-CPP Rates for Small Commercial & Agricultural Customers (2015-2016). Performed an evaluation assessing the impact of a voluntary (2015) and default (2016) rollout of TOU rates to SDG&E's small and medium business population

## Behavioral Studies

- **Union Gas & Enbridge Gas** – Cost Effectiveness of Behavioral Program Persistence (2019). Performed a cost-benefit analysis using TRC+ methodology to assess program cost-effectiveness under four distinct persistence scenarios.
- **Pennsylvania Public Utility Commission** – Home Energy Report Persistence Study (2018). Analyzed the persistence of savings in residential households that stopped receiving HERs.
- **Seattle City Light** – Home Energy Reports Evaluation (2016-2018). Performed an evaluation of behavioral conservation program, including measuring differences in savings between vendors, report delivery frequency, and sub-population treatment arms. Analyzed customer satisfaction and conservation perception surveys to assess the effects of report delivery on qualitative measures.

Demand Side Analytics
DATA DRIVEN RESEARCH AND INSIGHTS

# STEVE MORRIS – SENIOR QUANTITATIVE ANALYST

## Billing Analysis

- **Rhode Island Office of Energy Resources** – National Grid Energy Efficiency Programs Evaluation (2019-present). National Grid's energy efficiency programs (gas and electric) were evaluated by performing a billing analysis for any premise that installed an incented retrofit measure between 2015 and 2019. Example retrofit measures offered by the program include lighting measures, steam traps, and VSDs on HVAC systems.
- **Pennsylvania Public Utility Commission** – Audit Home Energy Report Impact Evaluations (2017-2018): Audited impact evaluations of several HER programs in the state. Key audit steps included cleaning and calendaring large volumes of billing data and running a variety of regression models on the prepared data.
- **Energy Trust of Oregon** – Nest Seasonal Savings Pilot Evaluation (2017): Contributed to the cooling analysis, which leveraged thermostat runtime data, interval meter data, and fixed effects regression models. Also worked on the heating analysis, which leveraged gas billing data.
- **Columbia Gas of Virginia** – Smart Thermostat Rebate Impact Evaluation (2017): Regression based billing analysis of natural gas billing data to determine the impacts of smart thermostat installation on daily gas consumption. Produced weather-normalized impacts.

## EDUCATION

| | |
|---|---|
| Master of Science, Statistics<br>University of Georgia, Athens | 2014 |
| Bachelor of Science in Statistics<br>University of Georgia, Athens | 2010 |
| Bachelor of Science in Sociology<br>University of Georgia, Athens | 2010 |

## WORK HISTORY

Demand Side Analytics, LLC – Atlanta, GA

| | |
|---|---|
| Senior Quantitative Analyst | 2019-now |
| Quantitative Analyst | 2016-2019 |

Kennesaw State University – Kennesaw, GA

| | |
|---|---|
| Part-Time Faculty | 2016-now |

University of Georgia – Athens, GA

| | |
|---|---|
| Instructor | 2014-2016 |
| Graduate Teaching Assistant | 2012-2014 |

## Energy Efficiency

- **Pennsylvania Public Utility Commission** – Statewide Evaluation Team (2016-2021). Developed and maintain a statewide tracking database that tracks program activity and savings. Perform audits of claimed savings using said database. Assisted in updating the C&I and Agriculture sections of the state's TRM. Regularly assist in the reviewing of EM&V plans.
- **Efficiency Maine** – ISO-NE Forward Capacity Market Review (2018-2020). For the last three years led the bottom-up component of the M&V compliance review for FCM resources.
- **Independent Electricity System Operator (IESO) of Ontario:** EM&V of Industrial Programs (2017-2019) Impact evaluation lead for strategic energy management program for Industrial customers. Develop 8760 savings estimates for complex measures in diverse industries. Work closely with facility energy managers to develop data collection plans and refine savings methodologies.
- **Central Hudson – Retail Lighting Evaluation (2019-2020):** Lead analyst for the gross impact evaluation of Central Hudson's point-of-sale LED lighting program. Developed cross-sector sales factors to supplement the lighting protocol in the New York TRM.

- **Efficiency Maine – Retail and Distributor Lighting Evaluation (2019-2020):** Lead analyst for concurrent impact evaluations, which includes a socket saturation study, lighting loggers deployed in 170 homes and businesses.
- **CREED – National Lighting Analysis of LED Costs (2017-2020):** Processed and cleaned large volumes of light bulb point-of-sale data purchased through Nielsen. Helped develop an incremental cost report, which compared the average price of different light bulb types and styles across the U.S. Helped develop a regression model that was used to predict the market share of LED light bulbs in each state. This model was the basis for NTG research in several states.
- **Independent Electricity System Operator of Ontario – Industrial Energy Manager Program Evaluation (2017-2018):** Audited ex-ante energy and demand savings values for a variety of projects, including LED lighting upgrades, facility-wide operational changes, HVAC schedule optimization, and the reconfiguration of heat pump systems.
- **BPA:** M&V Protocols Revisions and Update (2017-2019) This project consisted of updating BPA's measurement and verification protocols. These M&V protocols provide BPA engineers, staff at BPA partner utilities, and 3rd party implementation contractors comprehensive guidance for developing ex-ante savings estimates for custom non-residential energy efficiency projects.
- **IMVP:** Uncertainty Assessment- Option C: Whole Building (2017-2019) Option C is an M&V approach that utilizes whole facility utility meter or sub-meter data, as opposed to engineering calculations or energy use simulations, to estimate the energy savings associated with the installation of energy conservation measures.
- **ISO-NE:** Baseline Accuracy Study (2017) On behalf of ISO New England, DSA led a study into the baseline accuracy and performance accuracy for its 557 large commercial and industrial assets. Baseline accuracy focuses on the magnitude of errors of the baseline estimates while performance accuracy recognizes that baselines are simply a tool to estimate demand reductions and instead focuses on the accuracy of the magnitude of demand reduction estimated using baselines.

## Demand Response Evaluations

- **Central Electric Power Cooperative** – Smart Thermostat Pilot (2017) and DR Management System (2018-2020): Used thermostat runtime data to assess group equivalency and estimate summer and winter demand response impacts. Helped develop an automated reporting tool that provides the client with rapid feedback concerning DR performance and participation levels.
- **Southern California Edison** — Demand Response Summer Discount Plan (2019-2020): Implemented matched control group and difference in difference analysis to estimate residential DR impacts of 197 MW and commercial DR impacts of 23 MW
- **Public Service New Mexico** – Power Saver residential AC Cycling and Peak Saver C&I curtailment evaluations (2017-2020): Annual load impact evaluation of PNM's 60 MW demand response portfolio. Also performed a weather sensitivity analysis to determine which sites are candidates for a day-of baseline adjustment and managed a field study to estimate operability rate of Power Saver devices.

Demand Side Analytics
DATA DRIVEN RESEARCH AND INSIGHTS

# MARK NOLL – SENIOR QUANTITATIVE ANALYST

## EDUCATION

B.A. in Economics 2017
Georgetown University

## WORK HISTORY

**Demand Side Analytics, LLC – Atlanta, GA**
Quantitative Analyst 2019-present

**Charles River Associates – Washington, DC**
Associate 2018-2019
Analyst 2017-2018

**Georgetown University – Washington, DC**
Research Assistant 2015-2017
Teaching Assistant 2016

## Integrated Resource Planning

- **Consumer's Energy** – Demand Response Potential Study (2020). Analyzed AMI data for a sample of 20,000 customers to isolate cooling and heating load and estimate peak coincident loads. Analyze the marketing data to develop adoption propensity model. Estimated levelized costs for 100 customer segments and produced the supply curves.
- **Utility 1** – For a mid-sized Midwest utility, helped lead a forecasting effort to evaluate coal unit retirement and replacement resource options. This consisted of setting up the utility portfolio and calibrating power plant dispatch; developing capital cost assumptions and generation profiles for new renewable and battery technologies; developing a base case forecast and alternative scenarios; and summarizing results for combinations of scenarios and retirement options.
- **Empire District Electric Company** – For a mid-sized Midwest utility as part of an integrated resource plan filing, formulated a strategy to evaluate the locational benefits of distributed solar and storage solutions as alternatives to utility-scale supply-side options.

## Distributed Energy Resources

- **Central Hudson Gas & Electric** – Distribution System Implementation Plan (2020). Analyzed substation (62), feeder (270+), and transmission load pocket loads (10) to develop estimate growth, weather normalize loads, and produce hourly (8760) forecasts for 10 years. Analyzed distributed solar and battery storage adoption. Produced substation level 10-year forecast of DER adoption and DER loads (8760) for residential, non-residential and community distributed solar, and for battery storage.
- **Central Hudson Gas & Electric** – Battery Storage Simulation Model (2020). Supported the development of a model to simulate battery storage operations and market revenues from capacity, energy arbitrage, and ancillary services. The model was designed to assess battery storage bids.
- **PG&E** – WattSaver Pilot (2020). PG&E implemented a pilot to assess the ability to use two new smart water heater technologies to provide thermal storage and shift the energy use profile to lower energy costs and avoid congestion on the grid. The analysis was implement using 5-minute end-use interval data and reporting was automated to produce updates on request for the program or individual sites.

## Energy Efficiency & Demand Response Evaluations

- **Southern California Gas Company** – Central Water Heater Multifamily Building Solution (2019-present) Lead analyst for DSA's contract to provide advanced M&V for the SoCal Gas' Central Water Heater Multifamily Building Solution (CWHMBS) program. Processed hourly billing data to predict pre- and post-period usage for TMY year based on weather data for buildings with natural gas water heater upgrades; and automated the process for analysis and reporting.

- **Central Hudson Gas & Electric** – Small Business Direct Install Impact Analysis (2019-2020)– Assessed the realization rates and verified gross savings of SBDI program via billing analysis with a matched control group of non-participants. (2019)
- **ecobee** – eco+ Pilot (2019). Implemented the demand response and energy efficiency analysis portions of a nation-wide Randomized Encouragement Design pilot including 250,000 homes. The analysis was implemented using 5-minute end-use data for all sites.
- **Central Electric Power Cooperative** – Generac Pilot (2019). The goal of the pilot was to assess the ability of the utility to dispatch distributed generators in a coordinated manner to control peak loads.

## Electricity Market Design

- **Alberta Department of Energy / Market Surveillance** Administrator – Advised on several aspects of the province of Alberta's transition to a capacity market with comparisons to US markets, including on market governance and revision and on specific proposed market design elements.
- **Dominion Energy** – Helped to draft written testimony concerning rule changes to the PJM capacity market across several regulatory proceedings before the Federal Energy Regulatory Commission (FERC).
- **Dominion Energy** – Measured market concentration for natural gas pipeline availability in support of a merger between Dominion and SCANA before the North Carolina Utilities Commission.

## Market Forecasting and Asset Valuation Experience

- **Utility 3** – Contributed to a valuation of a large electric and gas utility in the Pacific Northwest on behalf of a potential investor group, by helping to produce a load forecast, capital and operational expenditures forecast for generation, transmission, and distribution facilities, and financial model.
- **Various engagements** – For a variety of clients, provided forecasts for market prices and/or unit dispatch and associated reports and testimony across multiple electricity markets in the United States (ISO-NE, NYISO, PJM, MISO, CAISO, ERCOT), using the Aurora software and Excel-based dispatch models and capacity price forecasting tools.

Demand Side Analytics
DATA DRIVEN RESEARCH AND INSIGHTS

# KATHERINE BURLEY – QUANTITATIVE ANALYST

## Demand Side Analytics

- **ecobee** – eco+ Evaluation (2020). Analysis of eco+ energy efficiency features during Winter 2019-2020 using a nationwide randomized encouragement design of 250,000 thermostats.
- **SDG&E** – DR & DER Analysis (2020). Performed a demand response propensity analysis for non-residential customers
- **Pennsylvania Statewide Evaluation Team** – Demand Response Program Evaluation (2020). Verification of reported savings from a summer demand response program for one Pennsylvania utility.
- **CEPC** – Generac Pilot Evaluation (2020). Estimated demand impacts for pilot customers during winter demand response events.

## Mather Economics

- Managed subscription pricing strategy for 28 newspaper markets nationwide
- Performed applied econometric analysis to track pricing program success and produce regular and ad hoc reporting for clients in Stata and Excel

## TXP, Inc

- Researched and collected five years of renewable energy data to generate a database of taxable assets and taxes paid by wind and solar projects in Texas
- Analyzed tax data to identify the impact of the renewable energy industry on local government revenues

## Capitol Market Research

- Collaborated with a team of five to prepare market feasibility reports for Austin area development projects
- Collected and cleaned data to maintain a central Texas real estate data base for client reports and bi-annual market updates
- Analyzed occupational employment statistics for the Austin area to generate an office demand forecast using various data sources, including US Census Bureau, BLS, Texas Workforce Commission, etc.

## LSU AgCenter

- Organized and compiled local government financial statements for analysis by researchers in the LSU Agricultural Economics department
- Conducted research project investigating the impact of the Great Recession on local government finances in Louisiana's 64 parishes (counties) with shift share, diversity, and peak/trough analytical methods

## EDUCATION

Master of Arts, Economics — 2019
University of Texas - Austin

Bachelor of Science, Economics — 2017
Louisiana State University

## WORK HISTORY

Demand Side Analytics, LLC - Atlanta, GA
Quantitative Analyst — 2020-present

Mather Economics – Atlanta, GA
Associate Consultant — 2019-2020

TXP, Inc – Austin, TX
Research Analyst — 2018

Capitol Market Research – Austin, TX
Market Analysis Intern — 2017-2018

LSU AgCenter
Research Assistant — 2016-2017

# **APPENDIX G.** RFP Section II J Conflicts of Interest Statement

Conflict of Interest statements from each member of the GDS Team have been provided below in response to RFP *Section II J Conflicts of Interest*.

## G.1 CONFLICTS OF INTEREST STATEMENT FOR GDS ASSOCIATES, INC.

GDS has no known conflicts of interest between EERMC, an affiliate of EERMC and any distribution company, or any affiliates of the foregoing. Further, GDS has no known conflicts of interest between an affiliate of GDS and any member of the EERMC.

## G.2 CONFLICTS OF INTEREST STATEMENT FOR JOHNSON CONSULTING GROUP

Johnson Consulting Group has no known conflicts of interest between EERMC, an affiliate of EERMC and any distribution company, or any affiliates of the foregoing. Further, GDS has no known conflicts of interest between an affiliate of GDS and any member of the EERMC.

## G.3 CONFLICTS OF INTEREST STATEMENT FOR DEMAND SIDE ANALYTICS

One of DSA's core strengths is our familiarity with New England utilities, and the policy and market frameworks they operate in. However, we have no past or current contracts with National Grid in Rhode Island, Massachusetts, or New York. In 2010, at a previous employer, DSA partner Josh Bode worked with National Grid Rhode Island to develop a tool for assessing non-wires alternatives to transmission and distribution investments. DSA recently completed a project with the Rhode Island Office of Energy Resources (RFP# 7597562 Energy Efficiency Programs Evaluation Study) as a subcontractor to Brightline Group, LLC. We do not believe these projects creates a conflict of interest with the EERMC consultant role on a forward-looking basis. The OER project required DSA to have access to significant amounts of National Grid EE tracking and billing data so several DSA staff members have completed the necessary National Grid background check process. In addition, DSA has no prior relationships with any member of the EERMC or Rhode Island Public Utilities Commission that could create a real or perceived conflict of interest.

# **APPENDIX H.** RFP Section II K Litigation

In response to RFP *Section II K Litigation,* litigation statements from each member of the GDS Team have been provided below.

## H.1 LITIGATION STATEMENT FOR GDS ASSOCIATES, INC.

In the past five years, three lawsuits without merit have been filed against GDS.

***Hampton***. Currently GDS is one of two named parties in an electrical worker injury case which occurred in Joaquin, Texas. The injured employee was working for a high voltage electric contractor and has filed suit against the electric utility and GDS Associates. GDS Associates believes this lawsuit is entirely without merit. GDS was not responsible for the design of the project and GDS had no responsibility for site safety.

***Greaff.*** Currently, GDS is one of two named parties in a landowner lawsuit filed in Texas associated with an East Texas Electric Cooperative generation project in Woodville, Texas. GDS believes this lawsuit is entirely without merit. GDS did not design or construct and does not operate the aforementioned generation project.

***Hibler.*** GDS was one of several named parties in a landowner lawsuit filed in Texas associated with an East Texas Electric Cooperative combustion turbine generation project in San Jacinto County, Texas. GDS did not design or construct the aforementioned generation project. All claims were settled by the parties out of court.

## H.2 LITIGATION STATEMENT FOR JOHNSON CONSULTING GROUP

Johnson Consulting Group has no pending legal cases nor lawsuits.

## H.3 LITIGATION STATEMENT FOR DEMAND SIDE ANALYTICS

DSA has not been involved in any litigation, bankruptcy, arbitration, or other preceding since its inception. DSA has no former or current disputes, claims or complaints, events of default, or failures to satisfy contractual obligations or to deliver products. DSA is registered in Georgia and California and is in good standing with the Secretary of State, Revenue, and Labor departments in both states.

# **APPENDIX I.** RFP Section II L Investigation

Statements from each member of the GDS Team addressing RFP *Section II L Investigation* have been provided below.

## I.1 INVESTIGATION STATEMENT FOR GDS ASSOCIATES, INC.

This statement confirms that GDS, nor any directors, employees, agents or any affiliate of GDS, are not currently under investigation by any governmental agency and have not in the last four years been convicted or found liable for any act prohibited by state or federal law in any jurisdiction.

## I.2 INVESTIGATION STATEMENT FOR JOHNSON CONSULTING GROUP

This statement confirms that Johnson Consulting, nor any directors, employees, agents or any affiliate of Johnson Consulting, are not currently under investigation by any governmental agency and have not in the last four years been convicted or found liable for any act prohibited by state or federal law in any jurisdiction.

## I.3 INVESTIGATION STATEMENT FOR DEMAND SIDE ANALYTICS

This statement confirms that DSA, nor any directors, employees, agents or any affiliate of DSA, are not currently under investigation by any governmental agency and have not in the last four years been convicted or found liable for any act prohibited by state or federal law in any jurisdiction.

PREPARED BY GDS ASSOCIATES, INC.

STATE OF RHODE ISLAND
ENERGY EFFICIENCY & RESOURCE MANAGEMENT COUNCIL

# EERMC

## THE RHODE ISLAND ENERGY EFFICIENCY AND RESOURCES MANAGEMENT COUNCIL

## TECHNICAL PROPOSAL

*RFP Number EERMC-2020-03*

## *Policy & Program Planning Consultant Services*

**October 28, 2020**

GDS Associates, Inc.
ENGINEERS & CONSULTANTS

Johnson
CONSULTING GROUP

Demand Side Analytics