Demand Response and Permanent Load Shift: A Look at Standards and Activities that Impact California

DR13.02

Prepared by
Southern California Edison

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Acknowledgments

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Disclaimer

EXECUTIVE SUMMARY

Increasing demand response (DR) and permanent load shift (PLS) capabilities in California requires an understanding of the actions of international, federal, and state organizations that help define policies, regulations, and mandates for DR and PLS both inside and outside of California. To gain this understanding, this project researched numerous organizations, including North American Electricity Reliability Corporation (NERC), Federal Energy Regulatory Commission (FERC), United States Department of Energy (DOE), California Public Utilities Commission (CPUC), California Energy Commission (CEC), California Independent System Operator (CAISO), regional transmission organizations (RTOs), industry associations, and international organizations.

Based on this research, this report presents an extensive inventory of current policies, plans, initiatives, programs, and mandates that may impact California's implementation of DR and PLS programs. This inventory is followed by a summary of relevant technologies, as well as recommendations for future building and appliance standards, including the Environmental Protection Agency's (EPA's) ENERGY STAR™ specifications. Finally, the report recommends candidate DR and PLS technologies for codification in the 2016 and 2020 CEC Title 24 Building Efficiency Standards, Title 20 Appliance Efficiency Regulations, and ENERGY STAR specifications.

The conclusion and recommendations derived from this report reflect the maturity of DR and PLS as components of broader grid modernization efforts. Interrelated enabling technologies—such as advanced metering; distributed energy resources (DER), including energy storage and intermittent resources such as solar photovoltaic and wind; and distribution automation—continue to evolve and enable broader demand-side management (DSM).

Southern California Edison (SCE) played a key role during the planning and technology development of grid modernization, as illustrated with the industry benchmark SCE 2006 use cases.[1] Subsequent deployment of the technologies described in the use cases at SCE and around the country and world have resulted in systems, processes, rates, and programs designed to achieve the benefits described in the SCE use cases. However, technologies, policies, and business catalysts have also evolved during the multi-year deployment of Edison SmartConnect™ and other related projects. As a result, this report recommends the following additional steps to broaden the adoption and utilization of standardized DR and PLS for the benefit of SCE, its customers, and California:

- Adoption and mandated use of nationally (and internationally) recognized DR messaging protocol standards
- Adoption and evolution of the EPA ENERGY STAR connected designation to include grid interactive concepts and DR messaging protocol standards
- Adjustment of DR and PLS focus from mid-day peak use mitigation to broader demand management that leverage the more dynamic timing of peak period(s) available to DER output

[1] Southern California Edison, Use-Case Series Descriptions; http://on.sce.com/1ajgZjq

ACRONYMS

Acronym	Description
ADS	Association for Demand Response & Smart Grid
AEDG	Advanced Energy Design Guides
AEIC	Association of Edison Illuminating Companies
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AMI	advanced metering infrastructure
ARC	aggregator of retail customers
ARRA	American Recovery and Reinvestment Act
ASHRAE	American Society of Heating, Refrigeration, and Air-Conditioning Engineers
B2B	business-to-business
BACS	building control and automation systems
BCA	Building Codes of Australia
BTMG	behind-the-meter generation
CAISO	California Independent System Operator
CCA	Community Choice Aggregator
CEC	California Energy Commission
CIM	common information model
CoS	Catalog of Standards
CPP	critical peak pricing
CPUC	California Public Utilities Commission

Acronym	Description
CSP	curtailment service providers
DADS	Demand Response Availability Data System
DDR	dispatchable demand resource
DER	distributed energy resources
DOE	U.S. Department of Energy
DR	demand response
DRCC	Demand Response Coordinating Committee
DRM	demand response mechanism
DRMS	demand response management system
DRP	demand response provider
DRPP	Demand Response Partnership Program
DRR	demand response resources
DRRC	Demand Response Research Center
DSM	demand-side management
DSP	demand side participation
E3	Equipment Energy Efficiency Program
EC	European Commission
ECMS	energy control management system
EE	energy efficiency
EERE	Energy Efficiency and Renewable Energy
EIA	Energy Information Administration
EISA	Energy Independence and Security Act
eMIX	Energy Market Information Exchange
EMCS	energy management control system

Acronym	Description
EM&V	evaluation, measurement, and verification
EPA	U.S. Environmental Protection Agency
EPCA	Energy Policy and Conservation Act
EISA 2007	Energy Independence and Security Act of 2007
ESP	electricity service provider
ESPI	energy service provider interface
EU	European Union
FERC	Federal Energy Regulatory Commission
GBI	Green Building Initiative
HAN	home area network
ICC	International Codes Council
IEA	International Energy Agency
IEC	International Electrotechnical Commission
IECC	International Energy Conservation Code
IES	Illuminating Engineering Society of North America
IESNA	Illuminating Engineering Society of North America
IHD	in home device
IOU	investor owned utility
IRM2	Intermittent Resource Management Phase 2
ISO	independent system operator
ISO-NE	Independent System Operator – New England
kW	kilowatt
kWh	Kilowatt-hour
LBNL	Lawrence Berkeley National Laboratory

Acronym	Description
LEED	Leadership in Energy & Environmental Design
LMR	load modifying resource
LSE	load-serving entity
LTPP	Long-Term Procurement Plan
MISO	Midwest Independent System Operator
MTEP	Midwest ISO Transmission Expansion Plan
M&V	measurement and verification
NAESB	North American Energy Standards Board
NAPDR	National Action Plan on Demand Response
NARUC	National Association of Regulatory Utility Commissioners
NASEO	National Association of State Energy Officials
NERC	North American Electric Reliability Corporation
NESHAP	National Emission Standards for Hazardous Air Pollutants
NGR	Non-generating resource
NIST	National Institute of Standards and Technology
OASIS	Organization for the Advancement of Structured Information Standards
OASIS	Organization for the Advancement of Structured Information Standards
OCST	occupant controlled smart thermostat
OE	Office of Electricity Delivery and Energy Reliability
OpenADR	Open Automated Demand Response
ORNL	Oak Ridge National Laboratory
PAP	Priority Action Plan
PDR	proxy demand resource

Acronym	Description
PG&E	Pacific Gas and Electric Company
PJM	Pennsylvania-New Jersey-Maryland
PLS	permanent load shifting
PNNL	Pacific Northwest National Laboratory
PRD	price responsive demand
PRMR	planning reserve margin requirement
PTR	peak time rebate
RDRP	reliability demand response product
RDRR	reliability demand response resource
REP	retail electric provider
REQ	Retail Electric Quadrant
RICE	reciprocating internal combustion engines
RIS	Regulation Impact Statement
RPM	reliability pricing model
RTO	regional transmission organizations
RTP	real time pricing
RXQ	Retail Quadrant
SCE	Southern California Edison
SCED	security-constrained economic dispatch
SDG&E	San Diego Gas & Electric Company
SEDC	Smart Energy Demand Coalition
SEE Action	State and Local Energy Efficiency Action Network
SEP	Smart Energy Profile
SGCC	Smart Grid Consumer Collaborative

Acronym	Description
SGIP	Smart Grid Interoperability Panel
SONGS	San Onofre Nuclear Generation Station
TADS	transmission availability systems
TC	Technical Committee
TDSP	transmission and distribution service provider
Title 20	Appliance Efficiency Regulations
Title 24	Building Efficiency Standards
TOU	time of use
USGBC	United States Green Building Council
USRE	utility-scale renewable energy
WDRCP	Wholesale Demand Response Communication Protocol
WECC	Western Electricity Coordinating Council
WEQ	Wholesale Electric Quadrant

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SECTION 1. INTRODUCTION

CONTEXT

Demand response (DR) and permanent load shifting (PLS) programs benefit Southern California Edison (SCE) and its customers by adjusting load to align with supply, thereby augmenting the primary practice of adjusting supply (generation) to meet demand. Broadly defined, DR is an agreement between an electricity end user and a utility or third party which induces the end user to reduce, or perhaps increase, their use of energy during specific time periods. PLS, a subcategory of DR, is the movement of energy usage from one time period (e.g., peak hours) to another (e.g., off-peak hours). PLS can be realized when customers permanently adjust the time they consume electricity due to a catalyst, such as price, or through use of a technology, such as energy storage. The broader term demand-side management (DSM) encompasses DR and PLS, as well as many other forms of localized energy management, including energy efficiency (EE) and distributed energy resources (DER), as shown in Figure 1.

SCE and many other organizations—including investor-owned utilities (IOUs), such as San Diego Gas & Electric (SDG&E) and Pacific Gas and Electric Company (PG&E), and third-party as DR providers (DRPs), which are also known as DR aggregators and curtailment service providers (CSPs)—have DSM programs and initiatives that address DR, EE, and DER. For example, SCE recently implemented mandatory critical peak pricing (CPP) tariffs for customers with more than 200 kilowatt (kW) of demand and time of use (TOU) tariffs for all other non-residential customers. These and other dynamic pricing rates are designed to incentivize off-peak electricity usage, as customers on dynamic pricing rates may adopt PLS as a form of DR.

Such programs may be affected by, or be obliged to comply with, current policies, plans, initiatives, programs, and mandates promoted or promulgated by multiple organizations. These include the North American Electricity Reliability Corporation (NERC), Federal Energy Regulatory Commission (FERC), United States Department of Energy (DOE), United States Environmental Protection Agency (EPA) California Public Utilities Commission (CPUC), the California Energy Commission (CEC), California Independent System Operator (CAISO), regional transmission organizations (RTOs), industry associations, and international organizations.

In the past, each of these organizations and their associated initiatives has operated somewhat independently. However, grid modernization has introduced a symbiotic relationship between their jurisdictions, policies, and initiatives. For example, integration of DR resources into the CAISO wholesale electricity market as enabled through an advanced metering infrastructure (AMI) is a cross-cutting sample of interactions between multiple agency initiatives and directives from FERC and CPUC leveraging DR functionality mandated or encouraged by the CEC. Figure 2 illustrates the relationship between the U.S. entities that impact DR and PLS programs.[2]

[2] The mapping of these relationships resulted from the research conducted in this project. Some international benchmarking is also described in this report, but for clarity these groups are not included in Figure 2.

The need to navigate overlapping, but not necessarily coordinated, programs and policies complicates DR and PLS program implementation. Moreover, limited interoperability standards and international coordination on DR and PLS has made it difficult for multinational equipment manufacturers to incorporate the features and functionality into their products that would facilitate and enable broad adoption of DR and PLS. Thus, increasing California DR and PLS capabilities requires an understanding of the international, federal, and state organizations that help define policies, regulations, and mandates for DR and PLS both inside and outside of California.

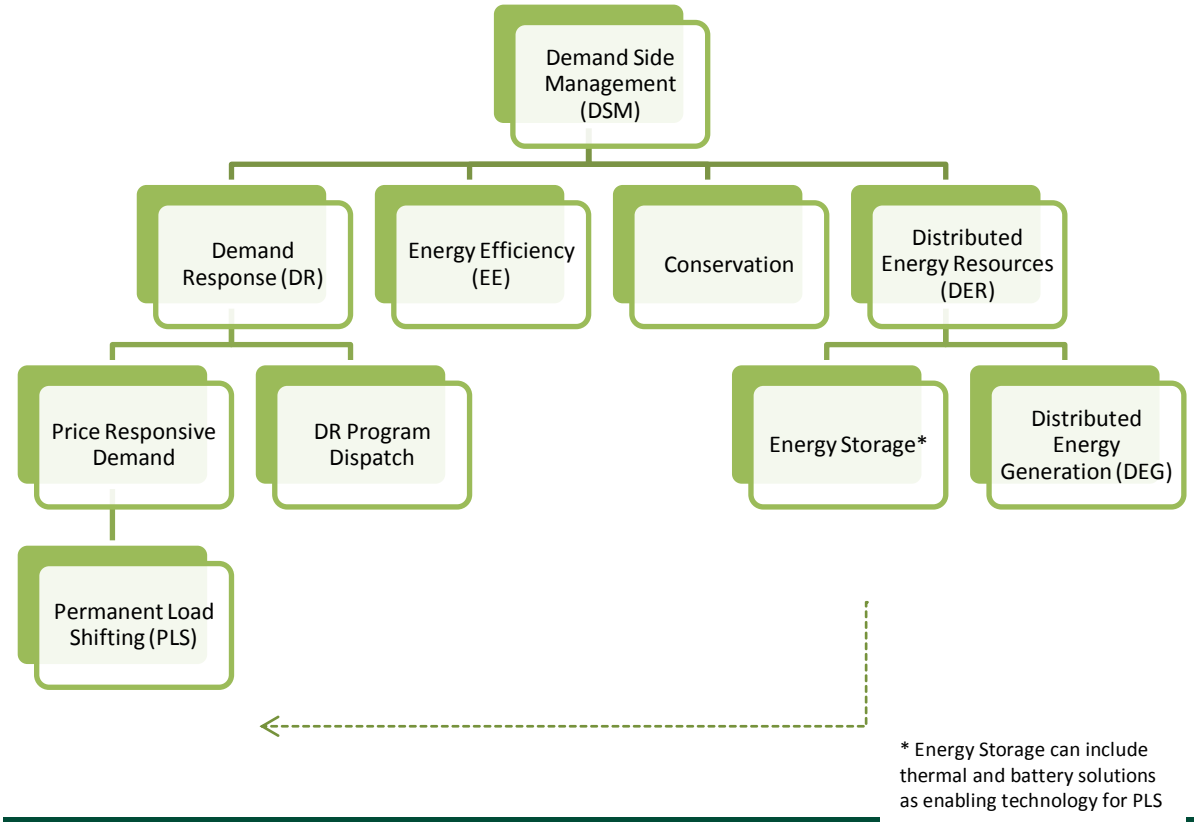

FIGURE 1. DEMAND-SIDE MANAGEMENT SUB-CATEGORIES

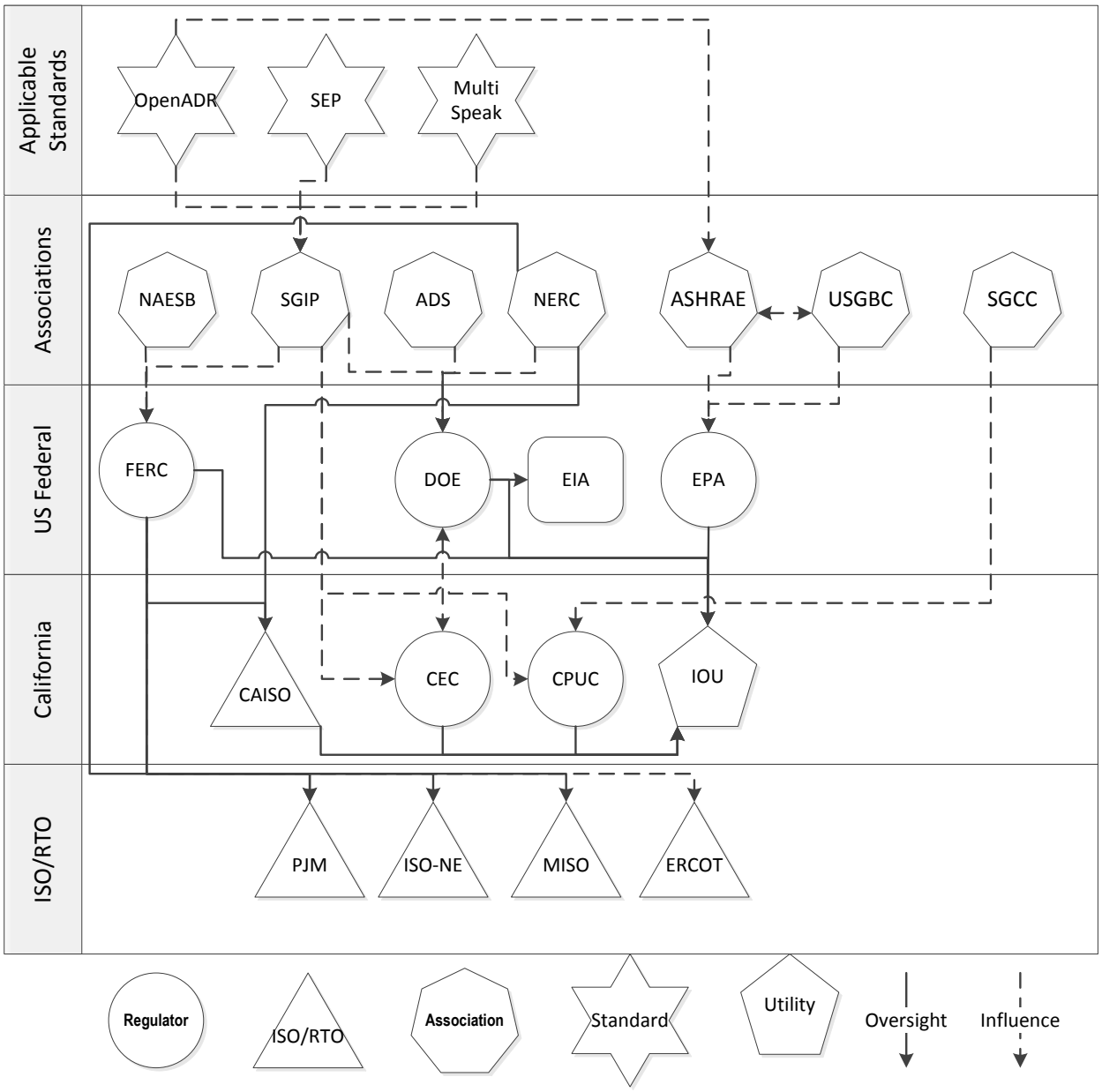

FIGURE 2. RELATIONSHIPS BETWEEN U.S. ENTITIES INCLUDED IN THIS REPORT

OBJECTIVES

To help DR and PLS program providers better coordinate and comply with existing mandates and policies, this project researched numerous organizations to present an extensive inventory of current policies, plans, initiatives, programs, and mandates that may impact California's implementation of DR and PLS programs. Another project goal was to identify candidate DR and PLS approaches or technologies that can be codified in the 2016 and 2020 CEC Building Energy Efficiency Standards (Title

24) and Appliance Efficiency Regulations (Title 20), as well as in the EPA's ENERGY STAR™ specifications and labeling.

APPROACH

To achieve these objectives, SCE's consultant reviewed the body of initiatives, projects, mandates, and programs and compiled an inventory to identify the scope, status, and timeline for each initiative. The team then outlined the trajectory, convergence, and expected outcomes from different agency and organization initiatives in relation to DR and PLS, highlighting areas where both complementary and contradictory actions are being taken, as well as areas with potentially counterproductive outcomes. Finally, the recommended technologies that can be adopted into 2016 and 2020 CEC T24, and Title 20 and ENERGY STAR labeling.

Taken as a whole, the contents of this report reveal gaps between different jurisdictional policies, mandates, and programs that will help DR and PLS program providers identify incremental actions that can build upon current programs to further expand DR and PLS potential.

REPORT STRUCTURE

This report begins with a series of sections that examine a number of organizations that affect DR and PLS program implementation, as follows:

- Section 2. Federal agencies
- Section 3. California agencies
- Section 4. Organizations in other states
- Section 5. Industry organizations
- Section 6. International organizations

The report then describes DR messaging protocols and standards (Section 7) and explores some common themes in DR/PLS programs (Section 8). It concludes with a roadmap and recommendations for expanding DR and PL to benefit California (Section 9).

SECTION 2. FEDERAL AGENCIES

FEDERAL ENERGY REGULATORY COMMISSION

FERC OVERVIEW AND MISSION

FERC is an independent federal agency that regulates the interstate transmission of electricity, oil, and natural gas, as well as the interstate wholesale markets for electricity and natural gas.

FERC's mandate to consider DR resources arises from the Energy Policy Act of 2005[3] (2005 Act) and the Energy Independence and Security Act of 2007 (2007 Act).[4] The sections below discuss the directives to FERC in these acts and describe actions FERC has taken in response.

CURRENT FERC DSM ACTIVITIES

ENERGY POLICY ACT OF 2005

The Energy Policy Act of 2005[5] made multiple amendments to the Public Utility Regulatory Policies Act of 1978, including references to DR and time-based metering. Primarily, these DR references expand the responsibilities of the Secretary of Energy (and DOE) to encourage DR programs and report on DR activities. Sections of note are shown below:

- *Notify the State regulatory authorities, and electric utilities … of technologies, techniques and rate-making methods related to advanced metering and communications and the use of these technologies, techniques and methods in demand response programs.*[6]
- *…shall be responsible for---*

  2. Working with States, utilities, and other energy providers and advanced metering and communications experts to identify and address barriers to the adoption of demand response programs; and

[3] Energy Policy Act of 2005; http://www.gpo.gov/fdsys/pkg/PLAW-109publ58/pdf/PLAW-109publ58.pdf.

[4] Energy Independence and Security Act of 2007; http://www.gpo.gov/fdsys/pkg/BILLS-110hr6enr/pdf/BILLS-110hr6enr.pdf.

[5] Energy Policy Act of 2005; *op. cit.*

[6] *Ibid*., subsection (c), p. 373.

3. … provide Congress with a report that identifies and quantifies the national benefits of demand response …[7]

- *Demand Response and Regional Coordination*

  1. *… It is the policy of the United States to encourage States to coordinate on a regional basis, State energy policies to provide reliable and affordable demand response services to the public.*
  2. *… The Secretary shall provide technical assistance to States and regional organizations formed by two or more States to assist them in—*
     a) *Identifying the areas with the greatest demand response potential;*
     b) *Identifying and resolving problems in transmission and distribution networks, including through the use of demand response;*
     c) *Developing plans and programs to use demand response to respond to peak demand or emergency needs; and*
     d) *Identifying specific measures consumers can take to participate in demand response programs.*
  3. *…the Commission shall prepare and publish an annual report, by appropriate region that assess demand response resources, including those available from all consumer classes, and which identifies and reviews—*
     a) *Saturation and penetration rate of advanced meters…*
     b) *Existing demand response programs and time-based rate programs;*
     c) *The annual resource contribution of demand resources*
     d) *The potential for demand response as a quantifiable, reliable resource for regional planning purposes;*
        - *Steps taken to ensure that in regional transmission planning and operations, demand resources are provided equitable treatment as a quantifiable, reliable resource relative to the resource obligations of any load-serving entity, transmission providers, or transmitting party, and*
        - *Regulatory barriers to improve customer participation in demand response, peak reduction and critical period pricing programs.*[8]

[7] *Ibid.*, Section 1252 Smart Metering, subsection (d), p. 373.

4. *Federal Encouragement of Demand Response Devices—It is the policy of the United States that time-based pricing and other forms of demand response, whereby electricity customers are provided with electricity price signals and the ability to benefit by responding to them, shall be encouraged, the deployment of such technology and devices that enable electricity customers to participate in such pricing and demand response systems shall be facilitated, and unnecessary barriers to demand response participation in energy, capacity and ancillary service markets shall be eliminated. It is further the policy of the United States that the benefits of such demand response that accrue to those not deploying such technology and devices, but who are part of the same regional electricity entity, shall be recognized.*[9]

The language of the 2005 Act indicates the tasks FERC needs to undertake in preparing annual reports on DR and shows the origin for several FERC orders related to DR.

ENERGY INDEPENDENCE AND SECURITY ACT OF 2007

The Energy Independence and Security Act of 2007[10] expands upon the mandates of the 2005 Act by specifying that FERC create a national assessment and report and follow up the assessment with a national action plan on DR. In response, FERC developed the *National Assessment of Demand Response Potential* in 2009,[11] authored the *National Action Plan on Demand Response (NAPDR)*[12] in 2010 and, with DOE, wrote the *Implementation Proposal for the National Action Plan on Demand Response*[13] in 2011. In addition, since 2006, FERC has released annual staff reports that assess DR and advanced metering.[14] Further, FERC uses its regulatory authority to enable DR resources by providing them appropriate consideration in transmission planning and energy markets.

The 2007 Act also requires other actions related to DR. For example, it calls for the Energy Information Administration (EIA) to "enhance the quality and scope of the data collection necessary to ensure … efficient functioning of energy markets..."[15] and includes DR data among the types to consider.

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[8] *Ibid*.

[9] *Ibid*., subsection (f), p. 374.

[10] Energy Independence and Security Act of 2007, *op. cit.*

[11] FERC, *National Assessment of Demand Response Potential*; http://www.ferc.gov/legal/staff-reports/06-09-demand-response.pdf.

[12] FERC, *National Action Plan on Demand Response*, 2010; http://www.ferc.gov/industries/electric/indus-act/demand-response/dr-potential/action-plan.asp

[13] FERC and DOE, *Implementation Proposal for the National Action Plan on Demand Response*; https://www.ferc.gov/legal/staff-reports/07-11-dr-action-plan.pdf

[14] FERC Staff Reports (2006-2013); http://www.ferc.gov/industries/electric/indus-act/demand-response/dem-res-adv-metering.asp

[15] Energy Independence and Security Act of 2007, *op. cit.,* Section 805, subsection (a), p. 230.

The 2007 Act states the policy to "…support the modernization of the Nation's electricity transmission and distribution system…"[16] and describes the characteristics of a "Smart Grid," which include the "development and incorporation of demand response, demand-side resources, and energy-efficiency resources."[17]

Finally, the 2007 Act calls for the National Institute of Standards and Technology (NIST) to coordinate the development of a smart grid interoperability framework and includes references to DR. NIST is a non-regulatory federal agency dedicated to promoting U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve quality of life.

FERC'S NATIONAL ASSESSMENTS

A high level reference, the 2010 NAPDR[18] describes a general vision for DR, discusses communications objectives, provides references to tools for utilities and regulators, and summarizes existing state activities, appropriately recognizing that California is a leader in exploring and expanding DR. The document contains no actionable DR elements for SCE or California.

The plan's strategic vision calls for the formation of a coalition to "coordinate the efforts of state/local governing officials, utilities/load-serving entities, demand response providers, …Regional Transmission Operators (RTOs) / Independent System Operators (ISOs), consumer advocates, commercial/industrial customers, the federal government, existing coalitions, and other stakeholders"[19] to execute the following strategies:

- Provide technical assistance to the states by providing information on DR programs and technologies, sponsoring or conducting research, and sponsoring and participating in national and regional forums
- Create a national communications program, including a national platform designed to support state and local outreach
- Create tools and methods for assessing DR and a web-based clearinghouse to provide stakeholders with the most current information

As noted above, FERC and DOE also wrote the Implementation Proposal[20] for the NAPDR. The proposal expands on information sharing, notes the need for measuring program results with metrics, and provides additional reference materials for estimation and cost-effectiveness tools. As with the NAPDR, the Implementation Plan has no actionable DR elements for SCE or California.

FERC's annual assessments of DR and advanced metering[21] are, however, excellent references to activities that are occurring at the national level, providing up-to-date information in numerous areas:

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[16] *Ibid*., Section 1301, p. 292.

[17] *Ibid*., Section 1301, p. 293.

[18] National Action Plan on DR, 2010; *op. cit.*

[19] *Ibid.,* p. ES-2

[20] Implementation Proposal for the National Action Plan on DR, 2011, *op. cit.*

[21] FERC Staff Reports (2006-2013), *op. cit.*

- State legislative and regulatory activities
- Bi-annual surveys of DR and time-based rate programs (2012 is most current, with another assessment to be conducted for 2014)
- FERC regulatory activities impacting DR
- FERC regulatory activities directly affecting the CAISO market structure, as described in the *California Independent System Operator* section
- Other federal DR activities
- Industry DR initiatives

The 2012 report and survey[22] called out the need for standardized DR information and signals, recognizing the work by the Organization for the Advancement of Structured Information Standards (OASIS) and the North American Energy Standards Board (NAESB) for their contributions and also work by the Open Automated Demand Response (OpenADR) Alliance on OpenADR 2.0 standard development. This report also notes the importance of standardized energy usage information including NAESB's energy usage information standard, the Energy Service Provider Interface (ESPI), which provides a means for controlled and confidential sharing of energy use information, and the Green Button Initiative, an industry-led effort to provide electricity customers with easy access to their energy usage data in a consumer-friendly and computer-friendly format.[23] The report also recognizes the need for wholesale DR communications protocols and facility-level standards. For each of the above areas, the 2012 survey continuously references the work done by the Smart Grid Interoperability Panel (SGIP), and more specifically Priority Action Plan (PAP) groups 09, 10, 17, 18, and 19.[24]

A National Forum on DR

The 2011 Implementation Proposal called for a national forum to spur additional development in the area of DR. The forum was conducted as a virtual project with four working groups:

- Cost-effectiveness
- Measurement and verification (M&V)
- Program design and implementation
- Tools and methods

The working groups each produced reports that act as resources to regulators and utilities for planning DR programs and research.[25] These working groups are described below.

[22] *Ibid*., 2012; http://www.ferc.gov/legal/staff-reports/12-20-12-demand-response.pdf.

[23] *Ibid*., pp. 52–53.

[24] *Ibid*. pp. 53–54.

[25] FERC, National Forum on Demand Response web page including working groups; http://www.ferc.gov/industries/electric/indus-act/demand-response/dr-potential.asp.

Cost-Effectiveness Working Group

This working group published a framework for evaluating the cost-effectiveness of DR.[26] The framework is a high level document that discusses several types of cost-effectiveness tests and benefit types that may be measured using each test. The framework includes references to work done by the CPUC[27] as well as by other entities.

Measurement & Verification Working Group

The M&V working group published a paper[28] which includes several recommendations and heavily relies on the NAESB Business Practice Standards (see section on *North American Electric Standards Board)*. The document differentiates between the wholesale market, which is regulated by FERC and has adopted the NAESB Business Practice Standards (see section on *Order No. 676-G Standards for Business Practices and Communication Protocols for Public Utilities*), and recommendations that are not proposed as standards. The working group's assessment of the NAESB DR M&V business practice standards follows:

> *The NAESB DR M&V Business Practice Standards cover the following aspects of M&V:*
>
> 1. *Provide standard terminology for defining program requirements, measurement methods, and data requirements*
> 2. *Identify elements that System Operators or Governing Documents must specify for each broad type of program and performance evaluation methods*
> 3. *Identify which elements and requirements are applicable to which broad types of methods (unless otherwise specified by the System Operator)*
> 4. *Specify particular requirements for metering accuracy and granularity*
> 5. *Identify five broad types of performance evaluation methodologies and related criteria*
>
> *The standards were not developed to provide specific requirements or guidance on how to specify particular elements of the performance evaluation methodologies. As a result, the NAESB Business Practice Standards do not:*
>
> 1. *Provide guidance on best specifications for particular market/program rules and resource characteristics*
> 2. *Address the relationship between retail and wholesale DR M&V*

[26] FERC/DOE, A Framework for Evaluating the Cost-Effectiveness of Demand Response , 2013; http://www.ferc.gov/industries/electric/indus-act/demand-response/dr-potential/napdr-cost-effectiveness.pdf

[27] *Ibid*., pp. 11–12.

28 FERC/DOE, Measurement and Verification for Demand Response, 2013; http://www.ferc.gov/industries/electric/indus-act/demand-response/dr-potential/napdr-mv.pdf

3. *Address the relationship between M&V for settlement and program evaluation.*[29]

Additionally, the working group's report includes several recommendations:

- *Business or customer type - if baseline methods are to be assigned based on customer type, the assignment is most effective if it is based on observable load characteristics and broad revenue class, rather than on a reported business category or customer segment."*[30]
- *Weather-sensitive loads - to reduce biases for moderately weather-sensitive commercial/industrial loads, include a symmetric day-of-event adjustment. Where anticipatory load changes are considered to be likely for many participants, a weather-based adjustment not affected by the customer's event-day load in pre-event hours should be considered."*[31]
- *Seasonal non-weather-sensitive loads - to reduce biases for seasonal, non-weather-sensitive loads, include a symmetric day-of-event adjustment that is not explicitly related to weather terms."*[32]
- *Highly variable loads – "to ensure that incentive payments are meaningfully aligned with demand reduction actions taken, the following strategies may be considered:"*[33]
    - *Predictability;*
    - *Customized baseline with participant supplied operational information;*
    - *Participant provided scheduled baseline;*
    - *Allow customer participation in other "DR programs that do not require calculation of reduction for program settlement.*
- *Use of baseline adjustment methodologies – "use an additive, symmetric day-of-event adjustment. An additive adjustment shifts the baseline calculated from prior days up or down, so that the adjusted baseline matches the observed load during certain hours prior to the event. A symmetric adjustment allows equally for upward and downward shifts."*[34]

[29] *Ibid*., Section 3.1.2, p. 17.

[30] *Ibid*., p. xiv.

[31] *Ibid.*

[32] *Ibid.,* p. xv.

[33] *Ibid.*

[34] *Ibid.*

- *Program rules to reduce baseline error for weather-sensitive loads"*[35] *– provides program strategies to improve the accuracy of baseline calculations.*
- *Limiting gaming opportunities"*[36]
- *Limiting static baseline opportunities"*[37]
- *Assessment of settlement M&V accuracy - Program design development should include a baseline method assessment based on load simulation. Such assessments should address the accuracy of load reductions and of financial settlements, in addition to assessing the accuracy of the baseline method itself."*[38]
- *Facilitating technology - For load control programs settled in the wholesale market based on the number of units controlled, information from the control system on control over-ride, success, or magnitude should be used as an input to the settlement calculation.*[39]

Program Design & Implementation Working Group

This working group performed interviews with utility personnel and published case studies[40] that provide specific information on the experiences of seven DR program providers: Salt River Project, Consolidated Edison, Gulf Power, Reliant Energy, PJM, Progress Energy, and Southern California Edison.

Tools & Methods Working Group

This working group's *Assessment of Analytical Capabilities, Services, and Tools for Demand Response*[41] has significant overlap with the other working groups in that the tools discussed are generally for cost-effectiveness, measurement, or planning and implementation. The report is a brief, high level document but does include an appendix listing a selection of DR tools identified by the working group. The list provides the tool name, primary function(s) and the vendor/developer. The report does not attempt to rate the suitability of the tools listed.

DR 2.0: A Future of Customer Response

The most recent report published in response to the *Implementation Proposal for DR* has been a paper, *DR 2.0: A Future of Customer Response,*[42] intended as an up-to-date reference on the past, present, and future of DR. This paper was authored by Paul De Martini and provides forward-thinking insights on the

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[35] *Ibid.*, p. xvii.

[36] *Ibid.*

[37] *Ibid.*

[38] *Ibid.*, p. xviii.

[39] *Ibid.,* p. 39.

[40] FERC, National Forum on Demand Response website, including working groups; http://www.ferc.gov/industries/electric/indus-act/demand-response/dr-potential.asp

[41] *FERC/DOE, An Assessment of Analytical Capabilities, Services, and Tools for Demand Response*, 2013; http://www.ferc.gov/industries/electric/indus-act/demand-response/dr-potential/napdr-assessment-analytical-tools.pdf

[42] FERC/DOE, *DR 2.0: A Future of Customer Response*, 2013; http://www.demandresponsesmartgrid.org/Resources/Documents/FINAL_DR%202.0_13.07.08.pdf

direction of DR development with a prediction of market evolution towards *transactive energy*, that is, use of communications or incentives to connect with all the intelligent devices in the power grid to better allocate resources and heighten engagement with customers and demand.

FERC Bearing on California DR Programs

FERC Orders

FERC Orders have a direct impact on CAISO's rules and tariffs determining how the wholesale electricity market works in California. In turn, CAISO's interpretations, rules, and filings directly impact SCE and its plans for DR. FERC Orders with bearing on DR are outlined in Table 1 and are detailed in the subsections below.

Table 1. FERC Order Summary

FERC on DR	Brief Summary of DR-Related Activities	FERC Impacts to CA DR Programs	Future DR Program Considerations for SCE
Order Number 719	Ancillary service using DR should be equitable	CAISO reformed market rules for DR	CAISO market rules apply to SCE
Order Number 745	Market rules for DR and net benefits test	CAISO reformed market rules for DR	CAISO market rules apply to SCE
Order Number 890	Transmission planning must consider DR	See Order 1000 (below)	SCE is a stakeholder in the transmission planning process
Order Number 1000	Transmission planning must consider DR	CAISO has affirmed that DR will be considered in transmission planning	SCE is a stakeholder in the transmission planning process
Order Number 676-G	NAESB business practice standards for DR M&V adopted for wholesale markets	Improves standardization for measurement and verification	No impact for SCE's program consideration

Order No. 719 Wholesale Competition in Regions with Organized Electric Markets

FERC issued Order No. 719[43] in October 2008 to "improve" the operation of organized electric markets for several areas, including DR. The Commission required "RTOs and ISOs to (1) accept bids from DR resources in RTOs' and ISOs' market for certain ancillary services on a basis comparable to other resources; … (3) in certain circumstances, permit an aggregator of retail customers to bid DR on behalf of retail customers directly into the organized energy market; … and (5) study whether further reforms

[43] FERC, Order 719, October 2008; http://www.ferc.gov/whats-new/comm-meet/2008/101608/E-1.pdf

are necessary to eliminate barriers to DR in organized markets." This order and the later Order 745, represent the primary regulatory manifestations of the policies of the Energy Act of 2005.

Order No. 745 Demand Response Compensation in Organized Wholesale Electricity Markets

In March 2011, the FERC issued Order No. 745[44] relating to DR compensation in organized wholesale energy markets. The order requires markets to compensate DR resources participating in the wholesale energy market to balance supply and demand at the market price for energy. The rule includes a net benefits test that should be used. The various affected markets are in different stages of complying with this order. While it may be useful for SCE to be aware of the general nature of how other markets have responded, CAISO is obviously the controlling authority for the California market and SCE's operations. Order No. 745-A[45] denied a rehearing of Order No. 745 requested by CAISO and many entities. CAISO's primary objection was the elimination of the default load adjustment mechanism. During 2011–2012, CAISO attempted to craft market products to satisfy FERC's net benefits test.

In July 2013, in an Order on Compliance and Rehearing,[46] FERC accepted CAISO's proposal and found that "CAISO's cost allocation method is consistent with Order No. 745 because it allocates the cost to those who benefit from DR."[47] Also in July 2013, FERC issued an Order Denying Rehearing[48] that denied CAISO's request for a rehearing of issues related to Order 745 and CAISO's compliance filing. This order is largely unimportant since the July 2013 Order on Compliance and Rehearing finds that CAISO's DR market plan is compliant with Order 745, However, the Order Denying Rehearing does includes references to arguments made by CAISO that seek to align the Commission's rulings from the earlier Order 719.

Order No. 890 Preventing Undue Discrimination and Preference in Transmission Service

Order No. 890,[49] issued in February 2007, recognized limits in the Open Access Transmission Tariff and directs transmission planning to consider DR and other similar resources on equal footing with other resources that contribute to the reliability of the transmission system.

[44] FERC, Order 745, March 2011; http://www.ferc.gov/EventCalendar/Files/20110315105757-RM10-17-000.pdf

[45] FERC, Order 745-A, December 2011; http://www.ferc.gov/whats-new/comm-meet/2011/121511/E-4.pdf

[46] FERC, Order on Compliance and Rehearing, July 2013; http://www.caiso.com/Documents/Jul18_2013Order-Compliance-Rehearing-NetBenefitsTestER11-4100_ER11-3616.pdf

[47] *Ibid*., Item 20, page 7.

[48] FERC, Docket ER11-4100-001, July 2013; http://www.ferc.gov/whats-new/comm-meet/2013/071813/E-28.pdf

[49] FERC, Order 890, February 2007; http://www.ferc.gov/whats-new/comm-meet/2007/021507/E-1.pdf

Order No. 1000 Transmission Planning and Cost Allocation by Transmission Owning and Operating Public Utilities

Order No. 1000,[50] issued in July 2011, reaffirmed Order No. 890's requirement that public utility transmission providers consider all types of resources, including DR and EE, on a comparable basis in transmission planning. In the first half of 2013, the FERC issued 15 orders in response to compliance filings addressing the regional transmission planning and cost allocation requirements of Order No. 1000, addressing each transmission planning region's compliance proposals and directing further compliance filings, including those of CAISO. CAISO complied with the additional compliance filing by providing FERC with an updated filing in August 2013.[51] This second filing confirms that CAISO will consider DR in their Unified Planning Assumptions and Study Plan[52] for the transmission planning process.

Order No. 676-G Standards for Business Practices and Communication Protocols for Public Utilities

In April 2012, FERC issued a Notice of Proposed Rulemaking to amend its regulations to incorporate by reference NAESB's Business Practice Standards on the M&V of DR and EE resources that participate in organized wholesale electricity markets (see section on *REQ.13 – Measurement and Verification of DR Programs Model Business Practices*). The proposed DR M&V standards add specificity to existing standards in several areas, including meter data reporting, advanced notification, telemetry, and meter accuracy. Docket No. RM05-5-020 was accepted in February 2013 as Order 676-G.[53] This order references NAESB's Phase II DR Measurement and Verification and its Wholesale EE Measurement and Verification Standards. NAESB has indicated that its Business Practice Standards will continue to be updated as DR evolves. It can be expected that future updates will be considered by FERC. The FERC summary states:

> *This rule ensures that participants in wholesale energy markets where demand response products are administered receive standardized access to information that will enable them to participate in those markets and addresses performance evaluation methods appropriate to use for demand response products. This rule facilitates the ability of demand response providers to participate in electricity markets, reducing transaction costs and providing an opportunity for more customers to participate in these programs, especially customers that operate in more than one organized market. It also provides a foundation for further business practice standardization efforts, and participants in the NAESB process can use these standards to identify those elements for which standardization would be beneficial. Further, adoption of measurement and verification standards will improve the*

[50] FERC, Order 1000, July 2011; http://www.ferc.gov/whats-new/comm-meet/2011/072111/E-6.pdf

[51] CAISO, FERC Order 1000 Second Compliance Filing, August 2013; http://www.caiso.com/Documents/Aug16_2013Compliance-FERC_Order1000RegionalSecondComplianceER13-103-002.pdf

[52] CAISO unified planning assumptions and 2014–2015 study plan; http://www.caiso.com/Documents/StakeholderInput-2014-2015UnifiedPlanningAssumptionsDec16_2013.htm

[53] FERC, Order 676-G, February 2013; http://www.ferc.gov/whats-new/comm-meet/2013/022113/E-3.pdf

methods and procedures for measuring accurately the performance of demand response resources and assist in monitoring demand response services for potential manipulation.

SUMMARY OF FERC ACTIVITIES, IMPACTS, OPPORTUNITIES, AND RECOMMENDATIONS

Table 2 summarizes the energy policy acts and resulting FERC activities that impact California, as well as opportunities and recommendations that arise from these activities.

TABLE 2 . SUMMARY OF FERC ACTIVITIES, IMPACTS, OPPORTUNITIES, AND RECOMMENDATIONS

Past & Current Activity	Future Activities	Impact on CA	Opportunities	Risks & Barriers	Codes & Standards Recommendation
Energy Independence and Security Act of 2007		Calls for NIST to coordinate the development of a smart grid interoperability framework	A National Assessment of Demand Response Potential, 2009		CEC Title 20 and Title 24 mandated utilization of DR messaging protocols identified in NIST Catalog of Standards (CoS)
			FERC NAPDR, 2010		
Energy Policy Act of 2005	Notify state regulatory authorities, and electric utilities …of technologies, techniques, and rate-making methods for advanced metering and communications and use of these in DR programs	The Secretary shall provide technical assistance to states and regional organizations formed by two or more states to help them:	It is U.S. policy to encourage states to coordinate on a regional basis, state energy policies to provide reliable and affordable DR services to the public	Working with states, utilities, other energy providers, and advanced metering and communications experts to identify and address barriers to the adoption of DR programs	CEC Title 20 and Title 24 mandated utilization of DR messaging protocols identified in NIST CoS
	The Commission shall prepare and publish an annual report, by appropriate region, that assesses DR resources available from all consumer classes	a) Identify areas with the greatest DR potential	U.S. policy encourages time-based pricing and other DR forms that provide customers with electricity price signals and the ability to benefit by responding to them; facilitates deployment of technology and devices that enable customers to participate in pricing and DR systems, and encourages elimination of barriers to DR		
		b) Identify and resolve problems in T&D networks, including through DR use			
	Provide Congress with a report that identifies and quantifies the national benefits of DR	c) Develop plans and programs to use DR to respond to peak demand or emergency needs			

Past & Current Activity	Future Activities	Impact on CA	Opportunities	Risks & Barriers	Codes & Standards Recommendation
		d) Identify measures consumers can take to participate in DR programs	participation in energy, capacity and ancillary service markets		
FERC NAPDR, 2010			Describes a vision for DR, discusses communications objectives, provides references to tools for utilities and regulators		
FERC NAPDR, 2010			Assists states by providing information on DR programs and technologies, sponsoring or conducting research, and sponsoring and participating in national and regional forums		
			Create a national communications program, including a platform to support state and local outreach		
			Coordinate the efforts of state/local governing officials, utilities/load-serving entities, DR providers, RTOs/ ISOs consumer advocates, commercial/industrial customers, the federal government, existing coalitions, and other stakeholders		
			Create tools and methods for the assessment of DR and a web-based clearinghouse to provide the most current information		
Assessment of DR Response & Advanced Metering, 2012			Identified the need for the need for standardized DR information and signals		
A National Forum on DR			A framework for evaluating DR cost-effectiveness, 2013		

Past & Current Activity	Future Activities	Impact on CA	Opportunities	Risks & Barriers	Codes & Standards Recommendation
			M&V for DR, 2013		
Order No. 719 Wholesale Competition in Regions with Organized Electric Markets		CAISO accept bids from DR resources in RTO and ISO markets			
Order No. 745 DR Compensation in Organized Wholesale Electricity Markets		CAISO compensates DR resources participating in the wholesale energy market to balance supply and demand at the market price for energy			
		CAISO's cost allocation method is consistent with Order No. 745			
Order No. 890 Preventing Undue Discrimination and Preference in Transmission Service		Directs transmission planning (CAISO) to consider DR and similar resources on equal footing with other resources contributing to the transmission system reliability			
Order No. 676-G Standards for Business Practices and Communication Protocols for Public Utilities		Incorporate by reference NAESB's 6.1.2.3 Business Practice Standard for M&V			

UNITED STATES DEPARTMENT OF ENERGY

DOE OVERVIEW AND MISSION

The Department of Energy focuses on policy and research regarding all forms of energy and on United States nuclear activities. The Secretary of Energy, currently Dr. Ernest Moniz, is appointed by the President of the United States. DOE's mission is to ensure America's security and prosperity by addressing its energy, environmental, and nuclear challenges through transformative science and technology solutions. To this end, DOE includes a network of national laboratories that conduct a range of basic and applied science, research, and engineering critical to the nation's security, including energy security, and competitiveness. DOE's objective with respect to DR and EE is to assist states in developing policies that include cost-effective demand-side reductions to help ensure a robust and reliable electric power system.

Since its inception in 1973, which consolidated the federal energy and nuclear programs then in existence, DOE has worked to improve energy policies to meet the demands of the changing landscape of U.S. energy usage. DOE's research supports its policy activities to improve the economics, utilization and environmental impacts of all forms of energy.

CURRENT DOE DSM ACTIVITIES

STATE AND LOCAL ENERGY EFFICIENCY ACTION NETWORK (SEE ACTION)

SEE Action is a state- and local-led effort facilitated by DOE and EPA to take EE to scale.[54] It includes eight working groups composed of public and private stakeholders focused in specific areas:

- Building Energy Codes Working Group
- Customer Information and Behavior Working Group
- Driving Ratepayer-Funded Efficiency through Regulatory Policies Working Group
- Evaluation, Measurement, and Verification Working Group
- Existing Commercial Buildings Working Group
- Financing Solutions Working Group
- Industrial EE and Combined Heat and Power Working Group
- Residential Retrofit Working Group

These groups published blueprint documents in 2011 that indicated specific goals. As shown in the example below, some groups' goals were clearly defined or actionable:

- Building Energy Codes Working Group – All buildings will be designed and constructed to the International Energy Conservation Code (IECC) 2012 and American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) and Illuminating Engineering Society of North America (IESNA) standard ASHRAE/IESNA 90.1-2010, and their compliance with those

[54] SEE Action Web Site; http://www1.eere.energy.gov/seeaction/

documents will be readily verifiable on an annual basis. California is considered to already meet this goal.

- Evaluation, Measurement, and Verification Working Group - Transform evaluation, measurement and verification (EM&V) to yield more accurate, credible, and timely results that accelerate deployment and improve management of EE . This goal has synergy with FERC's adoption of the NAESB DR M&V business practice standards (see these sections*: Order No. 676-G Standards for Business Practices and Communication Protocols for Public Utilities* and *REQ.13 – Measurement and Verification of DR Programs Model Business Practices*).

Other goals are generally high level visions that include evaluation of best practices and the sharing of information. While SEE Action has primarily focused on EE in the past, the structure of the eight working groups could be leveraged to expand into a broader DSM scope that includes DR.

Office of Electricity Delivery and Energy Reliability

The mission of DOE's Office of Electricity Delivery and Energy Reliability (OE) includes "assisting states and regions in developing policies that decrease demand on existing energy infrastructure." OE indicates that they are providing support to the New England DR Initiative, the Mid-Atlantic Distributed Resources Initiative, the Midwest DR Initiative, and the Pacific Northwest DR Project. The OE also represents the DOE sponsorship of the combined FERC/DOE NAPDR documents.

Office of Energy Efficiency and Renewable Energy

DOE's Office of Energy Efficiency and Renewable Energy (EERE) publishes and analyses maps and energy data focused on renewable energy and EE. The office also has a technical assistance program for state and local programs focused on EE issues. While EERE has primarily focused on EE in the past, the Building Technologies Office's efforts to create the next generation of energy efficient technology[55] could be leveraged to expand into a broader DSM scope that includes DR.

DOE National Laboratories

Lawrence Berkeley National Lab (LBNL)

LBNL hosts the DR Research Center (DRRC),[56] with the main objective of developing, prioritizing, conducting, and disseminating multi-institutional research that develops broad knowledge to facilitate DR. The DRRC also helped lead the development of the OpenADR standard (now managed by the OpenADR Alliance – see *Open Automated DR* section). LBNL has published numerous papers and reports[57] focused on DR and related smart grid topics.

[55] DOE EERE Building Technologies Office website; http://www1.eere.energy.gov/buildings/index.html

[56] LBNL, Demand Response Research Center website; http://drrc.lbl.gov/

[57] LBNL, DR Publications; http://drrc.lbl.gov/publications

Pacific Northwest National Lab (PNNL)

The PNNL maintains an EE and renewable energy program and has produced software tools to evaluate building retrofits,[58] analyze building HVAC operations[59] and evaluate operations and maintenance for industrial power plants. PNNL has focused on the synergy of EE and DR.[60] Its DR research produced the Grid-Friendly Appliance Controller[61] which is designed to add system frequency monitoring and response to household appliances to support grid resilience through DR. This technology has been licensed to a private company which intends to produce low-cost chips providing this capability to appliance manufacturers. This technology is notable since it does not require communications and is fast acting.

A 2010 PNNL report, *Use of Residential Smart Appliances for Peak-Load Shifting and Spinning Reserves: Cost/Benefit Analysis*,[62] was sponsored by DOE and includes a discussion of their analytical model used for the cost-benefit analysis.

The cost/benefit study analyzed the estimated savings from utilizing residential smart appliances (refrigerator/freezers, clothes washers, clothes dryers, room air conditioners, and dishwashers) for peak load shifting. The report defines benefits as annual savings in power-grid wholesale operating costs as a result of the following:

- *. . . smart appliances shifting their operation from on-peak hours to off-peak hours, thereby reducing the need for peak-power producing generators*
- *smart appliances being able to temporarily curtail their operation (for up to ten minutes) thereby providing an alternative ancillary service equivalent to spinning reserves in the event of a contingency. Note that request for temporary curtailment can be made at any time during the day on those appliances that are running when a contingency occurs. In this sense smart appliances can be "dispatched" in real-time, and are equivalent to dispatched generators providing spinning reserves.*

The benefits are estimated based on historical wholesale electricity market prices for locational marginal prices and spinning reserve from various markets, including CAISO. Based on both "optimistic" and "pessimistic" assumptions, Table 3 summarizes the results for CAISO.

[58] PNNL, Facility Energy Decision System; http://www.pnl.gov/feds/

[59] PNNL, Whole Building Diagnostician; http://www.technet.pnnl.gov/sensors/electronics/projects/ES4Bldg-WBD.stm

[60] PNNL Energy Efficiency and Demand Response; http://eere.pnnl.gov/building-technologies/energyefficiency_demandresponse.stm

[61] PNNL, Grid Friendly Appliance Controller; http://availabletechnologies.pnnl.gov/technology.asp?id=61

[62] PNNL, *Use of Residential Smart Appliances for Peak-Load Shifting and Spinning Reserves: Cost/Benefit Analysis*, 2010; http://www.aham.org/ht/a/GetDocumentAction/i/51596

TABLE 3 BENEFIT-TO-COST RATIOS OF SMART APPLIANCES WITH "OPTIMISTIC" AND "PESSIMISTIC" ASSUMPTIONS

	Dishwasher	Clothes Washer	Room Air Conditioner	Freezer	Refrigerator	Dryer
CAISO 2008 Optimistic	319%	356%	554%	313%	312%	396%
CAISO 2008 Pessimistic	99%	100%	135%	102%	101%	134%

Oak Ridge National Lab (ORNL)

ORNL has completed several assessments related to DR. However, most of the documents are foundational, discussing earlier states of DR, in anticipation of many of the ORNL approaches being piloted or adopted:

- Technical Potential For Peak Load Management Programs in New Jersey,[63] 2002
- Spinning Reserve From Responsive Loads,[64] 2003
- Using Air Conditioning Load Response for Spinning Reserve,[65] 2008
- Making Homes Part of the Climate Solution: Policy Options to Promote Energy Efficiency,[66] 2009

FUTURE DOE DSM ACTIVITIES

GRID INTERACTIVE WATER HEATERS

Water heaters have been an active topic for discussion and highlight the tradeoffs between EE and DR. Many rural electric cooperatives have a significant amount of DR enrolled in electric water heating programs. Some of these coops are able to levelize their load by cycling large-capacity water heaters with a combined PLS and DR approach to avoid significant changes in peak and off-peak usage. This approach enables a more constant generation supply than would a reactive generation supply that must be constantly adjusted to match demand. However, new efficiency standards for water heaters adopted in 2010[67] limited the capacity of electric water heaters to less than 55 gallons. This prompted utilities

[63] ORNL, *Technical Potential For Peak Load Management Programs in New Jersey* , 2002; http://www.ornl.gov/~webworks/cppr/y2002/rpt/115638.pdf

[64] ORNL, *Spinning Reserve From Responsive Loads*, 2003; http://web.ornl.gov/~webworks/cppr/y2001/rpt/116213.pdf

[65] ORNL, *Using Air Conditioning Load Response for Spinning Reserve,* 2008; http://info.ornl.gov/sites/publications/Files/Pub13757.pdf

[66] ORNL, *Making Homes Part of the Climate Solution*: *Policy Options to Promote Energy Efficiency,* 2009; http://info.ornl.gov/sites/publications/Files/Pub15070.pdf

[67] DOE EERE Appliance and Equipment Standards website; http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/27

that utilize larger-capacity water heaters to engage with DOE[68] to discuss alternatives. These discussions resulted in a proposed rule[69] that provides waivers to large-capacity water heaters that have grid interactive capabilities.

DOE Bearing on California DR Programs

At a policy level, DOE is interested in energy activities in all 50 states and looks to the leadership and experience of California as a guide for national energy policy. The research conducted at DOE national laboratories has an ongoing impact on California's DR programs because of California's leadership position among the states. Coordination with the labs has been and continues to be important for demand-side management activities.

Summary of DOE Activities, Impacts, Opportunities, and Recommendations

Table 4 summarizes the energy policy acts and resulting DOE activities that impact California, as well as opportunities and recommendations that arise from these activities.

Table 4. Summary of DOE Activities, Impacts, Opportunities, and Recommendations

Past & Current Activity	Future Activities	Impact on CA	Opportunities	Risks & Barriers	Codes & Standards Recommendation
EERE Building Technologies Office					Stakeholder engagement to expand scope to include DR
SEE Action					
Grid Interactive Water Heaters			Synergy with EPA ENERGY STAR connected		Stakeholder engagement to combine grid interactive approach with EPA ENERGY STAR and incorporate DR/PLS capabilities
National Labs (LBNL, PNNL, ORNL)			Continued partnership on DR initiatives such as OpenADR		

[68] DOE EERE Rulemaking for Residential Water Heater Standards Waiver Process website; http://www1.eere.energy.gov/buildings/appliance_standards/rulemaking.aspx/ruleid/63

[69] Regulations.gov website; http://www.regulations.gov/#!documentDetail;D=EERE-2012-BT-STD-0022-0158

ENERGY INFORMATION ADMINISTRATION

EIA OVERVIEW AND MISSION

The mission of DOE's Energy Information Administration is to collect, analyze, and disseminate an independent and impartial evaluation of relevant U.S. energy information and to be the nation's premier source of energy information. The drivers for this mission are the various federal legislative acts that established EIA and increased its scope to include data on renewable energy sources and DR.

CURRENT EIA DSM ACTIVITIES

EIA produces various publications that include data, analysis, and forecasts for all sectors of the energy industry. The Energy Independence and Security Act of 2007 included a reference to the EIA to improve reporting on DR data. These recent EIA articles in the EIA online news forum *Today in Energy* discuss DR:

- "California's electric power market faces challenges heading into summer,"[70] June 14, 2012
- "Electric grid planners: demand response and energy efficiency to increase,"[71] March 24, 2011
- "Demand response can lower electric power load when needed,"[72] February 15, 2011

Additionally, EIA produces reports related to DSM,[73] including the following:

- Demand-side management program annual effects by program category, by sector
- Incremental effects by program category
- Incremental effects by sector
- Incremental effects by program category
- Direct and indirect costs

EIA RELATIONSHIP TO CALIFORNIA DR PROGRAMS

EIA's reporting activities have no direct impact on California DR programs, but the information it provides and its reports may be useful for benchmarking California against other states.

[70] EIA, *Today in Energy*, "California's electric power market faces challenges heading into summer," June 14 2012; http://www.eia.gov/todayinenergy/detail.cfm?id=6690

[71] EIA, *Today in Energy*, "Electric grid planners: demand response and energy efficiency to increase," March 24, 2011; http://www.eia.gov/todayinenergy/detail.cfm?id=650

[72] EIA, *Today in Energy*, "Demand response can lower electric power load when needed," February 15, 2011; http://www.eia.gov/todayinenergy/detail.cfm?id=130

[73] EIA, Electricity data browser, Demand side management program; http://www.eia.gov/electricity/data.cfm#dsm

ENVIRONMENTAL PROTECTION AGENCY

EPA OVERVIEW AND MISSION

EPA is a federal agency focused on protecting the environment and human health from pollutants to fulfill its mission of ensuring that all Americans are protected from significant risks where they live and work. It enforces laws and develops regulations for that purpose.

The EPA's ENERGY STAR program, a joint program of EPA and DOE, aims to help consumers, businesses, and industry save money and protect the environment through the adoption of energy efficient products and practices. ENERGY STAR marked the beginning of the EPA's involvement in customer end-use energy activities. EPA recognizes that reducing demand for energy has a direct impact on generation requirements and reduces pollution. More recently, it has focused on reducing greenhouse gas emissions by expanding efforts to find methods, including demand-side management activities, to reduce energy usage.

CURRENT EPA DSM ACTIVITIES

DOE/EPA APPLIANCE EFFICIENCY STANDARDS

DOE's EERE appliance and equipment standards website notes the following:

> *The Energy Policy and Conservation Act (EPCA) was enacted in 1975, and established a federal program consisting of test procedures, labeling, and energy targets for consumer products. EPCA was amended in 1979 and directed the DOE to establish energy conservation standards for consumer products.*
>
> *The National Appliance Energy Conservation Act of 1987 established minimum efficiency standards for many common household appliances. Congress set initial federal EE standards and established schedules for DOE to review and update these standards. The Energy Policy Act of 1992 (EPAct) added standards for some fluorescent and incandescent reflector lamps, plumbing products, electric motors, commercial water heaters, and heating, ventilation, and air conditioning (HVAC) systems. EPAct also allowed for the future development of standards for many other products. In 2005, the Energy Policy Act (EPAct 2005) set new standards for 16 products and directed DOE to set standards via rulemaking for another five. In 2007, Congress passed the Energy Independence and Security Act (EISA 2007), enacting new or updated standards for 13 products. EISA 2007 also included a requirement that DOE maintain a schedule to regularly review and update all standards and test procedures.*[74]

74 DOE; History of appliance efficiency standards website; http://energy.gov/eere/buildings/history-and-impacts

The most recent schedule is contained one of the semi-annual report the semi-annual reports[75] that DOE is required to issue to Congress: *Fourteenth Semi-Annual Report to Congress on Appliance Energy Efficiency Rulemakings – Implementation Report: Energy Conservation Standards Activities*, August 2013.[76]

The appliance and equipment rulemaking efforts directed by DOE are primarily focused on EE standards and test procedures, but also include certification, compliance, and enforcement regulations for certain consumer products and commercial and industrial equipment covered under EPCA. DOE is proposing to revise and expand its existing regulations governing the use of particular methods as alternatives to testing for the purposes of certifying compliance with applicable standards.

In general, the efficiency standards set a minimum level of efficiency performance for specific devices. The ENERGY STAR Program was established as a response to language in the 1992 Clean Air Act.[77] In 2005, the Energy Policy Act[78] amended the 1975 EPCA to include additional direction for the ENERGY STAR Program. ENERGY STAR certifications set more stringent efficiency performance requirements and are now beginning to include optional communications criteria which include DR capabilities appropriate to the type of appliance (see below). Devices that meet the connected criteria are permitted to use 5% more energy than non-connected devices and still be ENERGY STAR compliant. The existing statutory language appears to support the inclusion of DR as part of the voluntary ENERGY STAR Program but would not enable mandatory DR requirements as part of DOE's appliance efficiency standards.

ENERGY STAR Climate Controls Specification 1.0

The EPA began work on an ENERGY STAR specification for Climate Controls[79] in 2010. The specification is for HVAC control devices (i.e., thermostats), and states EPA's intention to encourage modular communication options[80] with the intent of "*allow(ing) users to install or upgrade communications at a later date.*" However, the modular approach is only one approach for facilitating this extensibility and upgradability goal.

Several cycles of draft releases and public comments continued into 2012. The California IOUs (including SCE) commented on draft 3 of Version 1.0 in May 2012. Since then, no additional draft versions have been released by the EPA. It's not clear why the work on this specification appears to have stalled or what impact the delay will have on future revisions of the existing draft. There is obvious overlap with

[75] DOE; Reports to Congress web page; http://energy.gov/eere/buildings/reports-and-publications

[76] Fourteenth Semi-Annual Report to Congress on Appliance Energy Efficiency Rulemakings – Implementation Report: Energy Conservation Standards Activities, August 2013;
http://www1.eere.energy.gov/buildings/appliance_standards/pdfs/2013_aug_report_to_congress.pdf

[77] Clean Air Act, 1992, Section 103(g); http://www.law.cornell.edu/uscode/text/42/7403

[78] 42 U.S.C. § 6294a; http://codes.lp.findlaw.com/uscode/42/77/III/A/6294a

[79] EPA, Climate Controls Specification v1.0;
http://www.energystar.gov/products/specs/climate_controls_specification_version_1_0_pd

[80] Reference ANSI/CEA-2045 Modular Communications Interface for Energy Management;
http://www.ce.org/Standards/Standard-Listings/R7-8-Modular-Communication-Interface-for-Energy-Ma/CEA-2045.aspx

California's Title 24 thermostat requirements, but at this time it's difficult to understand how this specification and California's work will align or diverge. Notable elements of draft 3 follow:

- Technical Criteria for Residential Thermostats
    - Schedule periods – Devices must enable a 7-day program schedule with at least 4 periods per day
    - Default schedule – A pre-programmed schedule is required
- Communications Criteria for Residential Thermostats
    - "*Open access - Suitable documentation such as an application programming interface (API) or Interface Specification shall be available to 3rd party developers to enable access to the product's data reporting and remote management capabilities"*
    - "*Connectivity Standards – The following types of standards are recommended for connection outside of the HVAC system, using both built-in connectivity and/or modular connectivity:*
        - *"Standards included in the Smart Grid Interoperability Panel (SGIP) Catalogue of Standards, and/or*
        - *Standards being considered for inclusion in the SGIP Catalogue of Standards, and/or*
        - *Standards adopted by the American National Standards Institute (ANSI) or a well-established international standards organization, such as:*
            - *International Organization for Standardization (ISO)*
            - *International Electrotechnical Commission (IEC)*
            - *International Telecommunication Union (ITU)*
            - *Internet Engineering Task Force (IETF)*

      More robust criteria may be considered in a future revision as relevant standardization 312 efforts mature."
    - Security authentication and authorization
    - Data reporting
    - Remote management (i.e., DR) – devices must respond to remote commands
        - Time synchronization
        - Cooling and heating set points
        - HVAC mode (off, heat, cool, auto)
        - Fan mode
        - Select hold mode
        - Select away mode
        - Remote schedule settings (times and set points)
- Ease of Installation Criteria

Future work on this specification can be expected to have potential impact with the California Title 24 and Title 20 code related to HVAC controls, and should continue to be monitored.

ENERGY STAR CONNECTED CRITERIA

As noted above, ENERGY STAR now includes connected criteria, and products that meet the connected criteria are permitted a 5% greater energy consumption allowance than non-connected devices of the same type. At this time, connected criteria residential refrigerators have been finalized, and criteria for freezers and clothes dryers are under development, as discussed below. Criteria for pool pumps are under consideration.[81]

Connected Criteria for Residential Refrigerators and Freezers Specification Version 5.0

Version 5.0 of this specification, finalized in May 2013 and taking effect in September 2014, contains, in addition to EE updates, a set of optional criteria for connected refrigerators and freezers.[82] Connected devices must meet these criteria:

- Use open standards for communications.
- Feature communications hardware that may be internal or external to the device, manufacturer specific, or open-standards based.
- Enable interconnection, including energy consumption reporting, operational statuses, user settings, communications to delay defrost capability, and some provision for DR. At a minimum, the product must be able to receive a signal and shift its defrost cycle beyond its built in delay period and either shift ice maker cycles or reduce its average power draw during the delay period by 13%.
- Be capable of consumer-authorized remote management requests.

The requirements for delaying the defrost cycle or acting upon a DR signal are subsections under the connected device criteria. Although it would be technically possible for a manufacturer to include a defrost delay without communications, the device would not satisfy the full set of requirements and would not be eligible for the 5% greater energy consumption allowance. Additionally, as written, the defrost delay capability is only required to be active when the device is interconnected via its communication link. As part of the specification update, a separate document providing the test method to validate DR[83] was also published. The test method provides SCE with a description of how manufacturers will calculate power savings for devices with DR capability and may be useful when interpreting the manufacturers' reported results.

[81] EPA, ENERGY STAR Pool Pumps Connected Functionality Discussion Document, August, 30 2012; http://www.energystar.gov/products/specs/sites/products/files/ENERGY_STAR_Pool_Pumps_Connected_Functionality_Discussion_Document.pdf

[82] EPA, Residential Refrigerators and Freezers Specification Version 5.0, May 31, 2013; http://www.energystar.gov/products/specs/residential_refrigerators_and_freezers_specification_version_5_0_pd

[83] EPA, ENERGY STAR Test Method to Validate Demand Response of Refrigerators and Freezers, May 2013; http://www.energystar.gov/products/specs/sites/products/files/ENERGY%20STAR%20Final%20Refrigerators%20and%20Freezers%20Demand%20Response%20Test%20Method.pdf

ENERGY STAR requirements for Clothes Dryers Specification Version 1.0

A new product specification[84] with energy usage standards and optional connected criteria is under development, modeling the work done with refrigerators and freezers. Draft 2 of Version 1.0 was released in September 2013, and California IOUs, including SCE, provided comment in September 2013. Comparing the development of this specification to the work done with refrigerators and freezers, it is reasonable to expect completion of this specification in 2014. As with the refrigeration devices, a device that complies with the connected criteria is allowed to use 5% more energy than a non-connected ENERGY STAR device. The same principles of open standards, open access, energy reporting, and remote management are followed. The remote management (DR) requirements only apply to electric dryers and not gas dryers.

NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS (NESHAP) – RECIPROCATING INTERNAL COMBUSTION ENGINES (RICE)

In January 2013, EPA updated the National Emission Standards for Hazardous Air Pollutants for reciprocating internal combustion engines.[85] Engines used for DR programs have specific clauses in the standard. In September 2013, the EPA re-opened these updates for public comment, requesting input in three areas: ultra-low sulfur diesel fuel requirements for emergency combustion engines, reporting requirements, and the conditions that should permit the use of uncontrolled RICE in DR. The current version (January 2013) allows RICE of 500 HP and smaller to participate in DR for up to 100 hours annually without being subject to the emission rules. Qualifying RICE may spend up to 50 of the 100 hours participating in a non-emergency event. However, if they operate for more than 15 hours per year, additional diesel fuel requirements must then be applied. **These regulations are complex, are undergoing change, and may have interactions with California Air Resources Board regulations. Additional review by an environmental regulatory expert is recommended to determine applicability in California.**

NATIONAL ACTION PLAN FOR ENERGY EFFICIENCY

This National Action Plan for EE [86] was published in July 2006 and updated in November 2008. Similar to other high level national documents, it provides background materials on EE and reviews of state activities. This action plan includes 10 high level goals, 28 key steps to implementing the goals, and tables that indicate the number of states that have completely or partially adopted these policy key steps. There are separate tables for electricity and natural gas efficiency. The ten goals follow:

- Establishing cost-effective energy efficiency as a high-priority resource
- Developing processes to align incentives such that efficiency and supply resources are on a level playing field
- Establishing cost-effectiveness tests

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[84] EPA, Clothes Dryers Specification Version 1.0; http://www.energystar.gov/products/specs/clothes_dryers_specification_version_1_0_pd

[85] EPA, Stationary Internal Combustion Engine web page; http://www.epa.gov/ttn/atw/icengines/

[86] EPA, National Action Plan for EE; http://www.epa.gov/cleanenergy/energy-programs/suca/resources.html

- Establishing evaluation, measurement, and verification mechanisms
- Establishing effective energy efficiency delivery mechanisms
- Developing state policies to ensure robust energy efficiency practices
- Aligning customer pricing and incentives to encourage investment in energy efficiency
- Establishing state-of-the-art billing systems
- Implementing state-of-the-art efficiency information-sharing and delivery systems
- Coordinate demand response and energy efficiency programs to maximize value to customers
- Implementing advanced technologies

The plan highlighted evolving technology, policy, and program practices for EE, including those for DR, advanced metering, and smart grids:

- New technologies, such as advanced meters and smart appliances/controls
- Data collection networks and data analysis to enhance energy efficiency
- New customer interfaces
- Increased interoperability

In addition, a list of related state, regional, and national policies includes reference to policy areas designed to promote load reductions at critical peak times through demand response.

Coordination of Energy Efficiency and Demand Response Report

The *Coordination of Energy Efficiency and Demand Response Report*[87] was created as a resource for the National Action Plan for EE in January 2010 with the following purpose:

- *Summarize existing research on the relationship between energy efficiency and demand response.*
- *Present new information, gathered through interviews with program administrators, customers, and service providers, on the coordination of energy efficiency and demand response, focusing in particular on current practices and opportunities.*
- *Discuss barriers to coordinating energy efficiency and demand response programs.*

This report advocates coordination between EE and DR activities and programs:

- *Combined program offerings.*
- *Coordinated program marketing and education.*
- *Market-driven coordinated services.*
- *Building codes and appliance standards.*

[87] EPA, *Coordination of Energy Efficiency and Demand Response Report*, 2010; http://www.epa.gov/cleanenergy/documents/suca/ee_and_dr.pdf

- *Incorporate preferred energy efficiency and demand response features directly into building design and infrastructure and appliance designs, enabling significant reductions in the costs to customers of integrating energy efficiency and demand response strategies and/or measures (e.g., global temperature setback controls, automated demand response, embedded controls in appliances).*

EPA Bearing on California DR Programs

EPA initiatives have a direct impact on the energy efficiency standards for appliances, vehicles, and other devices manufactured, sold, and utilized in California. CEC Title 20 and Title 24 are complementary to these EPA regulations and often build upon the EPA regulation foundation to go above and beyond the EPA specification.

The EPA connected specification that allows devices to use 5% more energy than non-connected devices and still be ENERGY STAR–compliant is a key consideration for potential DR labeling. The possibility of augmenting ENERGY STAR with an ENERGY STAR connected designation for devices that enable DR is a promising development for the promotion of DR.

Summary of EPA Activities, Impacts, Opportunities, and Recommendations

Table 5 summarizes the energy policy acts and resulting EPA activities that impact California, as well as opportunities and recommendations that arise from these activities.

Table 5. Summary of EPA Activities, Impacts, Opportunities, and Recommendations

Past & Current Activity	Future Activities	Impact on CA	Opportunities	Risks & Barriers	Codes & Standards Recommendation
ENERGY STAR Climate Controls Specification 1.0		Recommending communication standards included in or being considered for the SGIP Catalogue of Standards			
ENERGY STAR connected criteria					Stakeholder engagement to combine grid interactive approach with EPA ENERGY STAR and incorporate DR/PLS capabilities
National Action Plan for EE			Coordinate DR and EE efficiency programs to maximize value to customers		
EPA, Coordination of Energy Efficiency and Demand Response Report, 2010			Incorporate preferred EE and DR features directly into building design and infrastructure and appliance designs		

SECTION 3. CALIFORNIA STATE AGENCIES AND ORGANIZATIONS

CALIFORNIA PUBLIC UTILITIES COMMISSION

CPUC OVERVIEW AND MISSION

The California Public Utilities Commission, headquartered in San Francisco, regulates privately owned electric, natural gas, telecommunications, water, railroad, rail transit, and passenger transportation companies in California, to fulfill the following mission:

> *The California Public Utilities Commission serves the public interest by protecting consumers and ensuring the provision of safe, reliable utility service and infrastructure at reasonable rates, with a commitment to environmental enhancement and a healthy California economy. We regulate utility services, stimulate innovation, and promote competitive markets, where possible, in the communications, energy, transportation, and water industries.*[88]

The CPUC is dedicated to ensuring that consumers have safe, reliable utility service at reasonable rates, protecting consumers from fraud, and promoting the health of California's economy. The CPUC states that it plays a key role in making California a national and international leader on a number of clean energy related initiatives and policies designed to benefit consumers, the environment, and the economy.

The CPUC's five commissioners are appointed by the Governor and serve six-year terms that may be staggered. The governor appoints one of the five commissioners to serve as the Commission President. Michael Peevey, first appointed to the CPCU in 2002, is the current Commission President; the other four commissioners are Michel Florio, Catherine Sandoval, Mark Ferron, and Carla J. Peterman.

The CPUC also employs economists, engineers, administrative law judges, accountants, lawyers, and safety and transportation specialists. The Commission is currently organized into several advisory units, an enforcement division, and a strategic planning group.

The Division of Ratepayer Advocates is an independent arm of the CPUC that represents consumers in Commission proceedings, pursuant to statute. The Commission also has a Public Advisor who assists the public in participating in Commission proceedings and a unit that is charged with informally resolving consumer complaints. See Figure 3 for an overview of CPUC staff.

[88] CPUC mission statement; http://www.cpuc.ca.gov/PUC/aboutus/pucmission.htm

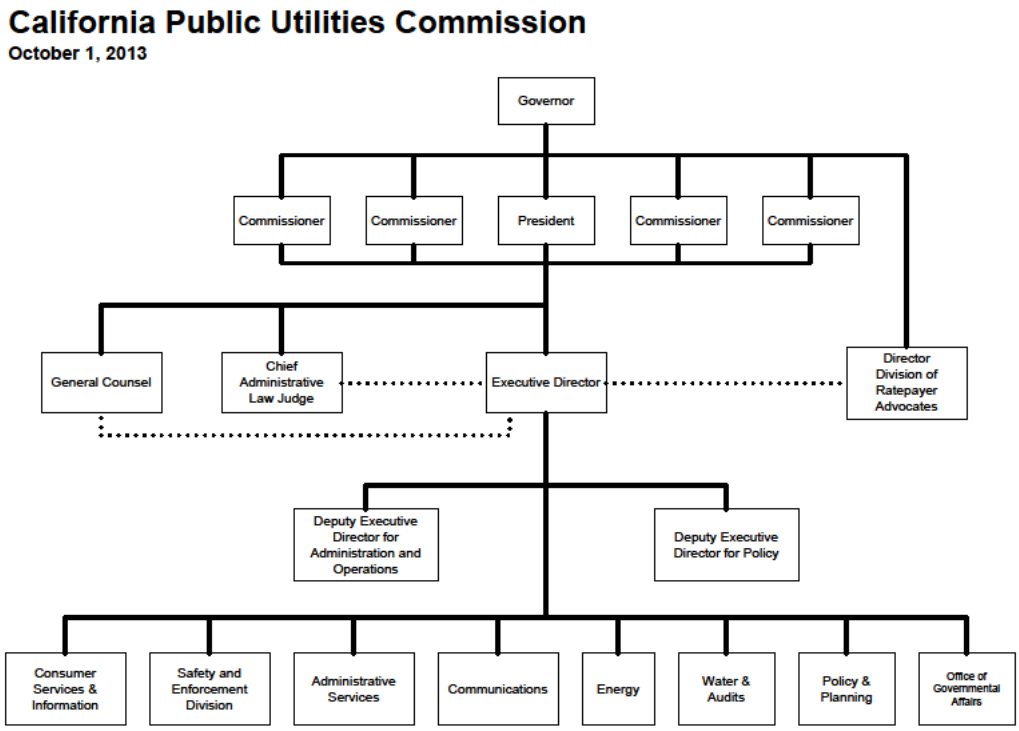

FIGURE 3. CPUC ORGANIZATION CHART[89]

Under the direction of the California Legislature, CPUC regulates investor-owned electric and gas utilities within the state of California, including the implementation of EE, DR, and conservation programs.

The California Public Utilities Code, which contains California state laws relating to utilities, including the authorization of CPUC, is available online.[90] State laws related to EE and DSM are passed as legislative bills, which typically change the California Public Utilities Code.

The CPUC, in its regulatory role, considers and rules on the implementation of legislative laws passed by the California Legislature. Inputs to the CPUC regulatory activities are publically documented in formal proceedings.

[89] CPUC, Organizational Charts; http://www.cpuc.ca.gov/NR/rdonlyres/39DF91EC-E608-4182-8F8D-17F5CF7E7556/0/cpucoverview201310.pdf

[90] California Public Utilities Code; http://www.leginfo.ca.gov/cgi-bin/calawquery?codesection=puc

CURRENT CPUC DSM ACTIVITIES

CURRENT CPUC DR ACTIVITIES

On April 30, 2012, the CPUC issued Decision 12-04-045 *Adopting Demand Response Activities and Budgets for 2012 Through 2014.*[91] This decision focused on the transition of utility DR programs and their DR participating customers to wholesale DR competition following a staged approach that included these actions:

- Consider utilities' readiness to bid DR into wholesale markets[92]
- Encouraged utilities to participate in the CAISO's proxy demand resource (PDR) (to be discussed in the *California Independent System Operator* section below)
- Facilitate direct participation of DR in CAISO whole electricity market
- Update Resource Adequacy program rules to conform to the CAISO's wholesale market and place DR on an equal footing with generation resources[93]

On September 19, 2013, CPUC opened a new proceeding, R.13-09-011,[94] to determine how to separate current utility-administered, ratepayer-funded DR programs into demand-side and supply-side resources. This proceeding will be discussed in greater detail below.

CURRENT CPUC PLS ACTIVITIES

CPUC resolution E-4586 issued on May 13, 2013 adopted the three IOUs' proposal of a standardized statewide PLS program with common design and rules, with some modifications to the rule, budget, and implementation details proposed by the IOUs.[95] Through this resolution proceeding, the CPUC has studied PLS, directed the IOUs to run pilots, approved a PLS budget for 2012-2014, and requested the IOUs to develop a joint PLS program. SCE is now implementing a PLS incentive program for thermal energy storage.

CPUC resolution E-4586 ruling included these revisions to the IOU's proposal:

- Required thermal energy storage technologies to meet existing EE standards for building codes for existing and new construction

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[91] D.12-04-045 *Adopting Demand Response Activities and Budgets for 2012 Through 2014,* April 30, 2012; http://docs.cpuc.ca.gov/PublishedDocs/PUBLISHED/GRAPHICS/165317.PDF

[92] R.07-01-041 *Order Instituting Rulemaking Regarding Policies and Protocols for Demand Response Load Impact Estimates, Cost-Effectiveness Methodologies, Megawatt Goals and Alignment with California Independent System Operator Market Design Protocols,* January 31, 2007; http://docs.cpuc.ca.gov/PublishedDocs/WORD_PDF/FINAL_DECISION/64245.PDF

[93] Proceeding R.09-10-032, Decision D.11-10-003 *Further Refining the Resource Adequacy Program Regarding Demand Response Resources,* October 10, 2010; http://docs.cpuc.ca.gov/PublishedDocs/WORD_PDF/FINAL_DECISION/145022.PDF

[94] R.13-09-011 *Order Instituting Rulemaking to Enhance the Role of Demand Response in Meeting the State's Resource Planning Needs and Operational Requirements*, September 13, 2013; http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M077/K151/77151993.PDF

[95] CPUC Resolution E-4586, https://www.pge.com/regulation/DemandResponse2012-2014-Projects/Final-Decisions/CPUC/2013/DemandResponse2012-2014-Projects_Final-Dec_CPUC_20130509_Res-E-4586_275897.pdf

- Set the PLS incentive level at $875/kW for all three IOUs
- Set the PLS incentive cap for each project at $1.5M for all three IOUs

CPUC Decision 06-11-049 directed the IOUs to develop a process to solicit PLS proposals from third parties to promote system reliability during the summer peak demand periods. The utilities subsequently issued bilateral contracts, and a four-year (2008-2011) pilot program was approved involving various PLS technologies. In 2009, the CPUC issued the Decision 09-08-027 directing the IOUs to jointly conduct a study of the cost-effectiveness and market potential of PLS, as well as of strategies to encourage PLS adoption.

In 2010, the CPU, SCE, PG&E, and SDG&E selected Energy and Environmental Economics (E3) and StrateGen Consulting to conduct the PLS study, *Statewide Joint IOU Study of Permanent Load Shifting,*[96] which was used as a basis for the PLS program detailed in CPUC resolution E-4586. The recommendations from the study included the following:

- Divide PLS programs into two categories based on technology maturity, with one category for mature large-scale PLS deployments of thermal-based solutions that would maximize incentives and the second category for emerging storage technologies which would enable renewable energy integration and EE.
- Address the following three stages of PLS system deployment in PLS program design:
    - System feasibility and design
    - Quality control of construction, including functional performance testing
    - Persistence of PLS operations
- Provide predictable bill savings to encourage long-term customer investment in PLS that encourages capital outlay with a financeable level of long-term rate stability
- Offer a super off-peak rate to encourage energy usage after midnight
- Encourage sustained PLS performance using performance-based incentives and EM&V through incentives based either on TOU rates or payments based on the kilowatt-hour (kWh) shifted
- Incentives consistent with program goals
- Use of simple and transparent performance metrics

In December 2010, the CPUC opened the Rulemaking 10-12-007 to set a policy for utilities to consider the procurement of viable and cost-effective energy storage systems. As part of Rulemaking 10-12-007, the CPUC produced a draft report analyzing energy storage use cases.[97] The document concluded that PLS energy storage technology is commercially available and viable and that the benefits can be monetized. The report listed barriers to energy storage deployment as risk and uncertainty, as well as the lack of clear and consistent compensation and incentives at both the utility and system operator level and.

[96] *Statewide Joint IOU Study of Permanent Load Shifting*, December 1, 2010; http://www3.sce.com/sscc/law/dis/dbattach3e.nsf/0/DEAFA54DABFA3F208825788800746 3B2/$FILE/A.08-06-001_2009-11+DR+App+_Errata+to+11-30-2010+Statewided+Joint+Utility+Study+of+PLS.pdf

[97] *CPUC Energy Storage Use Case Analysis: Permanent Load Shifting (PLS);* http://www.cpuc.ca.gov/NR/rdonlyres/3590C5E8-55A4-4409-8841-948D658CD65D/0/DSMUseCasePermanentLoadShifting.pdf

On April 30, 2012, the CPUC Decision 12-04-045 approved a PLS program budget for 2012–2014 and directed the utilities to revise the cost-effectiveness analysis using incentive levels up to $1,000/kW, and to propose a standardized, statewide PLS program for mature thermal energy storage technologies.

On July 30, 2012, the IOUs submitted a joint PLS program design proposal to the CPUC, and the CPUC then held a workshop to solicit feedback. The CPUC provided program design feedback to the IOUs, and the IOUs submitted their final version of the PLS proposal on January 14, 2013. The IOU PLS proposal included incentive levels, project cost caps, customer and equipment eligibility, summer peak hours, feasibility study requirements, metering and monitoring requirements, and the procedure for program modifications. Included with the PLS proposal were the program budget details and revised PLS cost-effectiveness evaluation, pursuant to CPUC Decision 12-04-045.

SCE is now implementing its PLS incentives program, which runs from July 22, 2013, through the end of 2014 or until funding us depleted. The program pays up to $875 per kW of thermal storage with a project cap of $1.5M. Complete details on the SCE thermal storage incentive program can be found at the SCE website.[98]

FUTURE CPUC DSM ACTIVITIES

FUTURE CPUC DR ACTIVITIES

In collaboration with the CEC and CAISO, CPUC is seeking "a new vision for DR," issuing the Order Instituting Rulemaking R.13-09-011 on September 13, 2013.[99] Some of the DR program issues that CPUC is addressing follow:

- The current DR model is utility-centric and allows only a limited role for third-party aggregators.
- The DR must support evolving needs of the grid.
- DR programs are underused in comparison to the use of power plants, even during extremely hot weather.
- The majority of SCE's and SDG&E's peak time rebate (PTR) programs monies were paid to customers who did not significantly reduce their load.
- DR resources are not bid into the CAISO market, are not subject to CAISO's Must Offer Obligations or to penalties for non-performance, and have very limited visibility and dispatchability to CAISO's grid operations.
- DR resources must meet supply-side requirements.

The CPUC's new vision for DR intends to address these issues by building upon existing work:

- Create a competitive DR procurement process that may require the use of both demand-side and supply-side DR resources

[98] SCE Permanent Load Shifting Program Guidelines, July 2013; https://www.sce.com/wps/wcm/connect/a4e1543d-1cc7-46b3-8cf2-920cf3aa66af/SCE_PLS_ProgramGuides.pdf?MOD=AJPERES

[99] R.13-09-011 *Order Instituting Rulemaking to Enhance the Role of Demand Response in Meeting the State's Resource Planning Needs and Operational Requirements*, September 19, 2013; http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M077/K151/77151993.PDF

- Increase the penetration of DR programs by examining how DR programs are offered and procured and by reducing the barriers to entry for new customers
- Retool DR to align with the grid's needs and enhance the role of DR in the state's energy policy
- Create DR programs that contribute to the efficient use of resources, take advantage of competitive markets, and are simple to administer
- Make it possible for third-party aggregators to play a much larger role in the procurement of supply-side DR
- Consider extending DR funding cycles

The current schedule calls for the CPUC to address 2015 bridge funding in the second quarter of 2014 and then address the potential restructuring of the DR program, DR integration into the CAISO market, and post-2015 funding.

CPUC DR RULEMAKING R.13-09-011

The intent of R.13-09-011 to "prioritize Demand Response as a utility procured resource, competitively bid" into the CAISO wholesale electricity market. A CPUC press release states that the intent of the rulemaking is to:

- Review and analyze current DR programs to determine whether and how to bifurcate them into demand-side (customer-focused programs and rates) and supply-side resources (reliable and flexible DR that meets system resource planning and operational requirements)
- Create an appropriate competitive procurement mechanism for supply-side and DR resources
- Determine program approval and funding cycle
- Provide guidance for transition years
- Develop and adopt a roadmap with the intent to collaborate and coordinate with other CPUC proceedings and state agencies in order to strategize the future of DR in California[100]

The CPUC held workshops to gather stakeholder inputs on R.13-09-011. The October 2013 workshops discussed the possibility of splitting DR into load-modifying DR and supply-side DR.

The CPUC's load-modifying DR corresponds roughly to the CAISO's Load Reshaping path, while the supply-side DR maps roughly to CAISO's Resource Sufficiency Path, as discussed below in the *California Independent System Operator* section. The CPUC states that it "generally agrees" with the CAISO's roadmap.

Following are next steps for R.13-09-011:

- Topic: Phase 1 Bridge Funding
    - Proposed Decision (on one-year vs. two-year bridge funding) expected December 13, 2013

[100] CPUC Press Release, *CPCU to Evaluate Enhancements to Demand Response to Help Meet Energy Needs and Climate Goals*, September 19, 2013, http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M077/K132/77132325.PDF

  - If two-year bridge funding approved, Ruling issued asking for recommended program improvements, expected January 31, 2014
  - If two-year bridge funding approved, Responses to Ruling (recommended program improvements) expected March 1, 2014
  - If two-year bridge funding approved, issuance of Proposed Decision expected April 15, 2014
- Topic: Phase 2 Foundational Questions
  - Responses to Phase 2 Foundational Questions expected December 13, 2013
  - Replies to Responses to Phase 2 Foundational Questions expected January 31, 2014
  - First Proposed Decision expected for Foundational Issues (bifurcation) expected February 11, 2014
  - Ruling issued providing guidance for testimony and hearings on additional issues, expected March 14, 2014
  - Testimony due, expected April 15, 2014
  - Rebuttal testimony due, expected April 30, 2014
  - Evidentiary hearings expected May 13-15, 2014
  - Opening briefs expected June 15, 2014
  - Reply briefs expected June 30, 2014

CPUC Proposed 2015 DR Pilots

In the staff proposal for DR Pilots in 2015, issued as an appendix to R.13-09-011, CPUC listed the following goals:[101]

- Test the participation of DR in the CAISO wholesale energy market through two pilot programs:
  - Further the ongoing Intermittent Resource Management Phase 2 (IRM2) pilot in northern California
  - Implement the IRM2 pilot in southern California
- Test the effectiveness of the following strategies at improving customer response to TOU and CPP rates:
  - Increase customer awareness of peak hours
  - Use feedback and social norms to encourage behavior change
  - Introduce automated technologies that shift or reduce load during peak hours

CPUC Intermittent Resource Management Phase 2 Pilot

The IRM2 pilot is an early-stage method for giving DR providers, also known as third-party aggregators, "experience in the wholesale market." The CEC has proposed extending the IRM2 pilot project to SCE with a proposed budget of $614,300 and to SDG&E with a proposed budget of $519,600. The CEC states that it "considers third party demand response providers to be able to provide additional innovation and

[101] R1309011. *op. cit.,* Attachment A.

services to the market, yielding greater demand response potential in California."[102] Goals for the IRM2 2015 pilot include the following:

- Engage one or more large direct access customers and community choice aggregators that currently have the capability to engage in energy trades in the CAISO day-ahead market
- Enable development of a DR portfolio that can provide flexible capacity to the CAISO
- Build third-party capabilities to directly participate in CAISO proxy demand resource
- Produce a guidebook for direct participation of DR service providers in the CAISO wholesale market
- Develop capabilities to enable bidding of DR by service providers into CAISO ancillary services market

As part of R.13-09-011, the CPUC posed six questions regarding its proposed DR bridge funding[103] and the CEC 2015 staff DR pilot proposal. Stating that the proposed extension of the IRM2 pilot to SCE would "challenge SCE's committed technical resources and constrain the ability to support both the IRM2 pilot" and other existing work, SCE has proposed an alternate of leveraging the following existing efforts to achieve the CEC DR research goals:

- SCE's Vehicle to Grid Pilot
- SCE's Local Capacity Requirement Procurement
- SCE's Preferred Resources Living Pilot
- SCE's Rule 24 Implementation[104]

Rule 24

CPUC is working to establish Rule 24, which would govern the interactions between IOUs and DRPs that directly participate in the CAISO market, mirroring Rule 22 governance of the interactions between IOUs and ESPs and Rule 23 governance of the interactions between IOUs and Community Choice Aggregators (CCAs). This proceeding may include resource adequacy credit for DRPs participating directly in the CAISO market. As such, it would impact whether DRPs continue to act as contractual suppliers to the IOUs or become competitive providers of DR program options for customers.

CPUC Bearing on California DR Programs

The CPUC's role in California DR and PLS programs is to require, regulate, and authorize DR program. Currently, the CPUC is in the process of developing a plan to allow DR participants to be fairly compensated, whether through utility or non-utility programs.

As stated by CPUC President Michael R. Peevey, a CPUC goal is to "create a thriving DR marketplace that fairly rewards participants for their contribution, which will result in a net benefit to ratepayers." He further states, "Our job as regulators is to fix inefficiencies and waste in the marketplace. If a

[102] *Ibid*., p. 15.

[103] *Ibid*., p. 22.

[104] Rule 24 is a rule being considered by CPUC that would enable direct participation of DR in the wholesale market run by CAISO.

commercial customer can dim its lights using new, low-cost control technologies, without affecting its bottom line, while helping the grid, then the market needs to value that. Demand response has incredible potential as a clean resource to maintain grid reliability."[105] Thus the CPUC is seeking to monetize the value of DR to facilitate a DR market which will fairly compensate utilities, third-party aggregators, and consumers for participation in DR programs.

Summary of CPUC Activities, Impacts, Opportunities, and Recommendations

Table 6 summarizes the energy policy acts and resulting CPUC activities that impact California, as well as opportunities and recommendations that arise from these activities.

TABLE 6. SUMMARY OF CPUC ACTIVITIES, IMPACTS, OPPORTUNITIES, AND RECOMMENDATIONS

Past & Current Activity	Future Activities	Impact on CA	Opportunities	Risks & Barriers	Codes & Standards Recommendation
OIR R.13-09-011 Enhance the Role of Demand Response in Meeting the State's Resource Planning Needs and Operational Requirements	Create an appropriate competitive procurement mechanism for supply-side and DR resources				Must be compliant with FERC orders for CAISO, including NAESB *Business Practice Standard for Measurement & Verification* adopted by FERC by reference
D.12-04-045 Adopting Demand Response Activities and Budgets for 2012 through 2014		We approve the utility ADR programs as requested but with the discussed modifications and direct the utilities to fund ADR technologies that interoperate using generally accepted industry open standards or protocols			Update CEC Title 20 and Title 24 to mandate utilization of DR protocols identified in NIST CoS
CPUC resolution E-4586		Joint PLS program rules, budget, and implementation details were adopted			

[105] Restructuring Today website, California PUC votes to get more DR into CAISO markets, September 20, 2013; http://www.restructuringtoday.com/public/12178print.cfm

CALIFORNIA INDEPENDENT SYSTEM OPERATOR

CAISO OVERVIEW AND MISSION

CAISO, created in 1998 following a FERC recommendation, is an independent non-profit organization that coordinates, controls, and monitors California's transmission, generation, and electric energy markets. CAISO operates the California wholesale power system, which balances the need for higher transmission reliability with the need for lower costs.

CAISO is led by a Board of Governors and executive management team. Ashutosh Bhagwat, Robert Foster, Angelina Galiteva, Richard Maullin, and David Olsen are the current members of the Board of Governors. The executive management team is shown below in Figure 4.

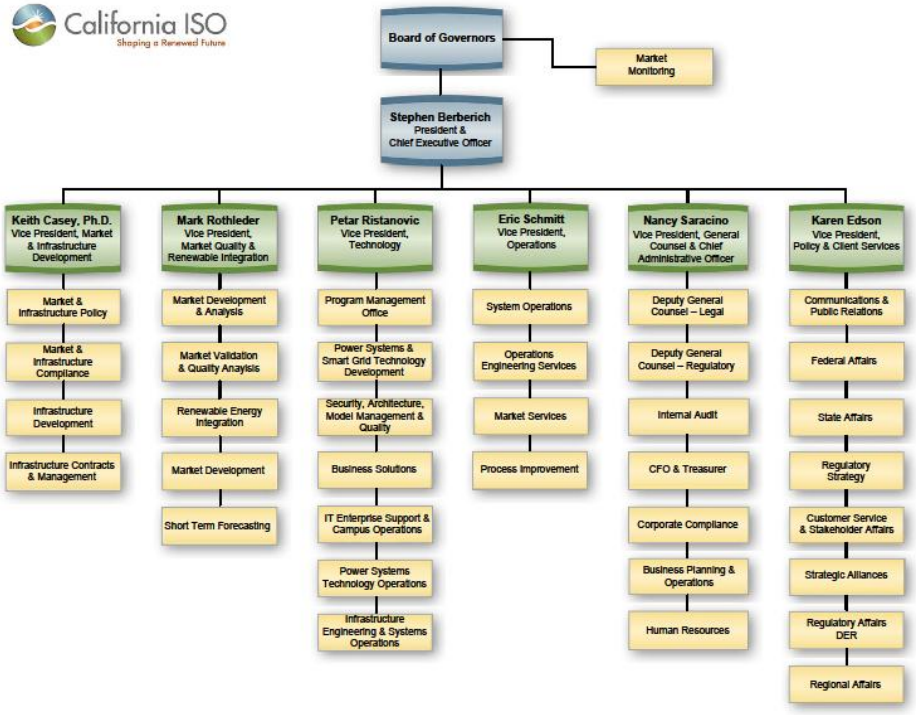

FIGURE 4. CAISO ORGANIZATION CHART[106]

[106] CAISO website; http://www.caiso.com/Documents/ExecutiveStructure.pdf

CAISO Mission, Objectives, and Intentions

CAISO has published the following mission statement:

> *For the benefit of our customers, we:*
>
> - *Operate the grid reliably and efficiently*
> - *Provide fair and open transmission access*
> - *Promote environmental stewardship*
> - *Facilitate effective markets and promote infrastructure development*
>
> *All through the provision of timely and accurate information.*[107]

CAISO states that it also acts as a key platform to achieve California's clean energy goals. CAISO markets offer DR providers the ability to aggregate customer demand reductions and participate in the CAISO day-ahead, real-time, and ancillary services markets. In the CAISO market, demand-side resources can offer bids that reflect their flexibility to adjust their load in response to market schedules and dispatches.

End-use customers can also bid DR services directly into the CAISO wholesale day-ahead and real-time market through a DR provider as proxy demand resources if they meet minimum requirements for market participation. CAISO uses a baseline energy calculation to determine the amount of energy curtailed.

CAISO Drivers for Its Mission, Objectives, and Intentions

CAISO implements policies to meet FERC regulatory requirements (see section on *Federal Energy Regulatory Commission*), which are designed to ensure a reliable transmission system and to encourage competition among wholesale generation entities.

ISOs and RTOs, including CAISO, operate wholesale energy markets that are designed to meet FERC requirements, including the need to provide non-discriminatory access to transmission and to encourage competition in energy markets. The California wholesale market operates as most other commodity exchanges do and is composed of many interrelated processes designed to allow open competition and fair, transparent trading.

Current CAISO DSM Activities

CAISO has three different market products designed to enable DR resources to participate in the wholesale electricity market:

- **Participating Load**: Curtailable demand, including pumping load or aggregated participating load, can bid into the ISO market through a scheduling coordinator who also acts as the load-

[107] CAISO, *Smart Future: Five Year Strategic Plan Update, Planning Horizon 2009-2013*; http://www.caiso.com/23a1/23a1760a411a0.pdf

serving entity (LSE) for the underlying load. These participants can provide non-spinning reserve and demand reduction in the real-time market.

- **Proxy Demand Resource**: End-use customers can bid demand response services directly into the ISO wholesale day-ahead and real-time market through a demand response provider as PDR. The ISO uses a baseline energy calculation to determine the amount of energy curtailed.
- **Reliability Demand Response Resource (RDRR)**: This product enables compatibility with, and integration of, existing retail emergency-triggered DR programs into the CAISO market and operations. This includes newly configured DR resources that have a reliability trigger and desire to be dispatched only under particular system conditions.

CAISO Compliance with FERC DR-Related Orders

On July 18, 2013, FERC issued two orders (an Order on Compliance and Rehearing and an Order Denying Rehearing) that seem to indicate that CAISO has resolved compliance issues with FERC Orders 719 and 745 (see *FERC Orders* section). These issues were noted in FERC's December 15, 2011 Compliance Order[108] that accomplished the following:

- Rejected CAISO's proposal to exclude DR bids from the market that were below the threshold price indicated by the net benefits test
- Directed CAISO to address certain posting and information-sharing requirements and to relocate information regarding the development of the net benefits test threshold price from the business practice manual to the CAISO tariff
- Stated that CAISO failed to demonstrate that its cost allocation methodology, including the default load adjustment, appropriately allocates costs to those that benefit from the demand reduction.
- Stated that CAISO's argument that costs are allocated to the load that benefits from the price reductions, which CAISO characterizes as all loads in the day-ahead market and deviations from day-ahead schedules in the real-time market, ignored the effect of the default load adjustment

FERC's July 18, 2013 Order on Compliance and Rehearing indicated that CAISO will be consistent with FERC Order No. 745 and directs CAISO to file a compliance filing to comply with FERC Order No. 719.[109] The following points from FERC's Order on Compliance and Rehearing summarize CAISO's proposal and FERC's findings:

- For allocating DR costs, CAISO will remove the use of the default load adjustment when the Locational Marginal Price is at or above the threshold price.
- Instead of the default load adjustment, CAISO will allocate DR costs to all loads through the real-time energy offset charge.

[108] 137 FERC 61,217, Order Accepting In Part and Rejecting In Part Compliance Filing and Requiring Compliance Filing, December 15, 2011; http://www.caiso.com/Documents/2011-12-15_ER11-4100_NetBenTestOrder.pdf

[109] 144 FERC 61,047, Order on Compliance and Rehearing, July 18, 2013; http://www.caiso.com/Documents/Jul18_2013Order-Compliance-Rehearing-NetBenefitsTestER11-4100_ER11-3616.pdf

- FERC will accept CAISO's RDRR proposal, which allows DR resources that could otherwise not participate.
- FERC agrees with CAISO that participating load should not be grouped with PDR and RDRR.
- FERC agrees that CAISO has adequately explained its 40-minute ramp time for RDRR.

Thus, CAISO has developed a tariff that FERC agrees meets all requirements of Order No. 719 and Order No. 745. The CAISO proposal[110] was filed on March 14, 2012, and contains responses to FERC's directives for both Compliance Order 745 and the RDRR Order.

In its July 18, 2013 Order Denying Rehearing,[111] FERC partially rejecting CAISO's request for a rehearing, stating that:

- CAISO "*did not comply with Order No. 745 because CAISO did not demonstrate that it appropriately allocated costs to those that benefitted from decreased demand and that only the host load serving entity benefits from the decreased demand.*
- *"CAISO did not demonstrate that the benefits of DR are limited to the host load serving entity, and thus it did not demonstrate that its cost allocation methodology conformed to the Order No. 745 requirement."*

The Order also rejects CAISO's arguments that Order No. 745 is an unexplained departure from Order No. 719 and that Order No. 745 impedes the CPUC's DR efforts.

CAISO Implementation of DR

CAISO's website states that it is engaging stakeholders to develop viable wholesale DR products with direct market participation capabilities that can be used for power system reliability.[112] The website also lists its active initiatives as development of a DR net benefits test and of a reliability DR product. The CAISO demand response net benefits test is meant to establish a price threshold above which DR resource bids are deemed price effective per FERC Order No. 745. The following sections describe major DR implementation initiatives.

CAISO DR and EE Roadmap

CAISO developed a DR and EE roadmap, *California ISO Demand Response and Energy Efficiency Roadmap: Making the Most of Green Grid Resources.* [113] As explained in the roadmap, CAISO is coordinating its DR and EE programs with the proposed regulatory initiatives of CPUC and CEC:

[110] California Independent System Operator Corporation, Fifth Replacement FERC Electric Tariff, Attachment A - Clean Tariff Order 745 and RDRR Compliance Filing; http://www.caiso.com/Documents/2012-03-14_ER11-4100_NetBenefits-DRR_Comp.pdf

[111] 144 FERC 61,046, Order Denying Rehearing, July 18, 2013: http://www.caiso.com/Documents/Jul18_2013OrderDenyingRehearing-DemandResponseProgramER11-4100-001.pdf

[112] CAISO website, http://www.caiso.com/1893/1893e350393b0.html

[113] CAISO, *California ISO Demand Response and EE Roadmap: Making the Most of Green Grid Resources,* Draft, June 12, 2013, http://www.caiso.com/Documents/Draft-ISODemandResponseandEnergyEfficiencyRoadmap.pdf

DR and EE will become integral, dependable and familiar resources that support a reliable transition to an environmentally sustainable electric power system that features increased penetration of new and diverse types of energy resources.

The CAISO roadmap contains four parallel and mostly concurrent paths, described in the subsections below, that run from 2013 to 2020 and are built on inter-agency coordination:

- Load reshaping path
- Resource sufficiency path
- Operations path
- Monitoring path

CAISO Load Reshaping Path

CAISO must ensure that there is adequate electricity supply to meet electricity demand at any given time. The CAISO load reshaping path focuses on the demand side of this supply-demand balance equation with a goal of creating a flatter system load profile through initiatives that change consumer consumption patterns, thereby reducing the need for additional generation and transmission infrastructure. As shown below in Figure 5, CAISO load reshaping strategic activities include advancing EE programs and incentives, evolving demand forecasting, and aligning retail signals with grid conditions. These activities align well with the California Loading Order established by CPUC and CEC as documented in the Energy Action Plan[114] by addressing the top priority in the loading order, "optimize strategies for increasing conservation and energy efficiency."

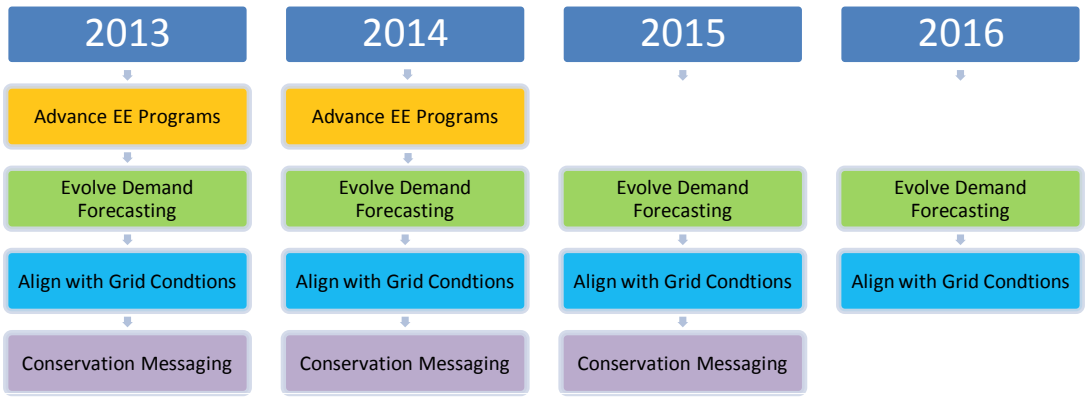

FIGURE 5. CAISO LOAD RESHAPING PATH ACTIVITIES

114 CEC and CPUC, *California Energy Action Plan I*, May 8, 2003; http://www.cpuc.ca.gov/PUBLISHED/REPORT/28715.htm; CEC and CPUC, Energy *Action Plan II - Implementation Roadmap for Energy Policies*, October 2005; http://www.cpuc.ca.gov/PUBLISHED/REPORT/51604.htm

CAISO Resource Sufficiency Path

The CAISO resource sufficiency path focuses on the supply side of the supply-demand balance equation with the goal of ensuring that sufficient resources with the correct operational characteristics are available when and where needed. Actions for the supply side seek to identify a portfolio of resources that can provide the performance capabilities to meet system needs during both normal and emergency conditions. CAISO evaluates resource sufficiency in terms of the physical transmission system capacity and the predicted supply resources expected to be in service over the years of the planning period. As shown below in Figure 6 from the CAISO roadmap, the CAISO resource sufficiency strategic activities include defining resource attributes, coordinating planning and procurement activities, and developing capacity procurement mechanisms.

CAISO is working with SCE on its "define resource attributes" activity within the resource sufficiency path. In the 2011–2012 generation planning process, CAISO studied local capacity needs over a 10-year planning horizon to analyze the impacts of retiring or repowering generators to meet the state's once-through-cooling requirements. Study results were presented in Track 1 of the CPUC's current long-term procurement plan (LTPP) proceeding (R.12-03-014).[115] Parties to the proceeding asked CEC to consider EE, DR, and other resources as alternatives to the local resource needs determined in the CAISO studies. Because CAISO expressed concerns that existing DR programs did not meet the necessary local capacity performance requirements, in D.13-02-015, CEC asked CAISO to work with SCE to further develop preferred resource characteristics for use in its procurement plan. This effort resulted in the inclusion of DR and EE among a variety of resources in SCE's local capacity resource procurement.[116]

Building on the direction of the LTPP Track 1 decision and CAISO's involvement with SCE procurement activities, the CAISO roadmap includes an initiative to develop a catalog of DR resource types, including descriptions of the resource's operational attributes. To this end, and as part of the 2013–2014 transmission planning process, CAISO will study two or three local areas to consider DR or targeted EE as candidate alternatives to a local transmission upgrade or a conventional generator.

CAISO made the first draft of the DR catalog available in late 2013. This draft will include typical and desired DR capabilities and attributes and will offer initial indications of which configurations could effectively offset or defer the need for a transmission upgrade. Comparing the DR capabilities outlined in the CAISO DR catalog with existing DR program attributes will help determine compatibility and potential changes needed to align with the CAISO desired characteristics.

The DR catalog will inform CAISO's 2013–2014 planning cycle and may provide study support for local resource procurement decisions in the 2014 LTPP proceeding. It will also form the basis for further ISO, CPUC, and CEC coordinated efforts to arrive at consistent DR and EE assumptions to be used in future Transmission Planning Process cycles.

[115] CPUC, Decision 13-02-015, Decision Authorizing Long-Term Procurement for Local Capacity Requirements, February 13, 2013; http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M050/K374/50374520.PDF

[116] SCE Local Capacity Requirements ("LCR") Request for Offers (RFO), http://on.sce.com/1mhaExk

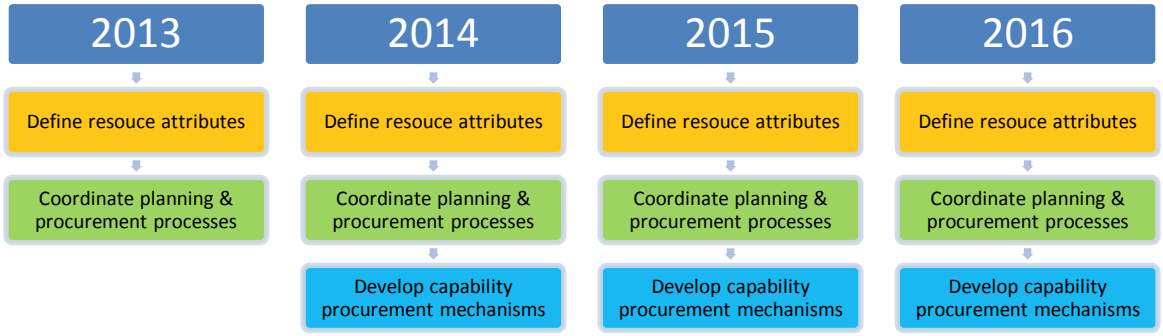

FIGURE 6. CAISO RESOURCE SUFFICIENCY PATH ACTIVITIES

CAISO Operations Path

The CAISO operations path takes the perspective of the grid operator responsible for continuous system balancing and focuses on making the best use of the resources made available from the resource sufficiency path activities. Classifying DR as a supply-side resource can maximize the value of the DR. As CAISO states, " . . . these resources should participate in the ISO market optimization and provide balancing energy or ancillary service capacity." CAISO operations strategic activities include implementing enabling policies, gaining DR operations experience, refining processes, and leveraging technology, as outlined in Figure 7.

The roadmap document explains that when finalized, CPUC Rule 24, which supports direct participation of DR resources in the CAISO wholesale market, will enable existing utility DR programs to fully participate in the ISO wholesale market. CAISO specifically cites SCE's ability to bring DR capacity into the CAISO market as an example of utility DR program market participation. On page 16 of the DR and EE roadmap, CAISO states that under Rule 24 and with the re-filing of FERC's RDRR tariff amendment consistent with FERC's Order 745, SCE should be able to "bring 1,100 MW of DR capacity into the ISO market in the summer of 2014." [117] A caveat is that FERC must approve the re-filing of the FERC's RDRR tariff amendment.

[117] CAISO, *California ISO Demand Response and EE Roadmap, op. cit.,* p. 16; http://www.caiso.com/Documents/Draft-ISODemandResponseandEnergyEfficiencyRoadmap.pdf

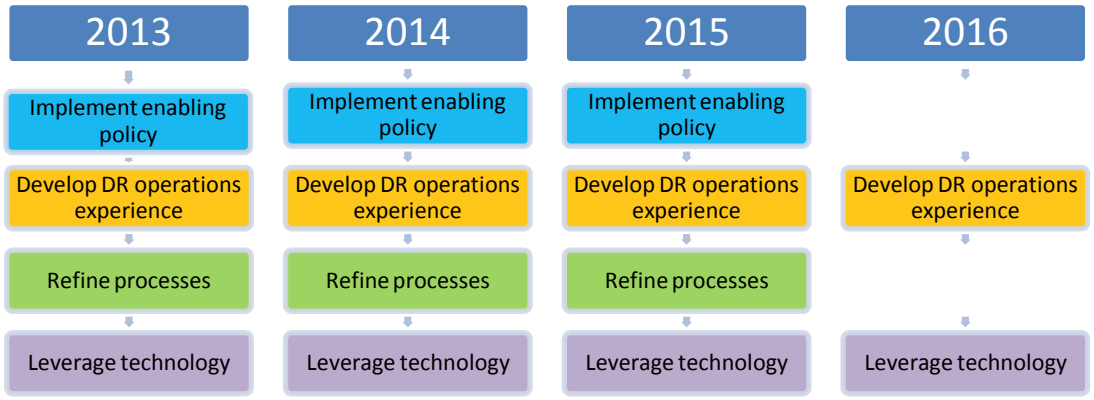

FIGURE 7. CAISO OPERATIONS PATH ACTIVITIES

CAISO Monitoring Path

To ensure that the initiatives in the roadmap are accomplishing their objectives, and enable design of suitable modifications as needed, it is essential to integrate mechanisms for monitoring progress and outcomes and providing feedback to the people and organizations responsible for the initiatives. The CAISO monitoring path provides that essential feedback loop to the other three paths so that experience with each stage of activity will foster a deeper understanding of the operational capabilities of DR resources, the effectiveness of DR and EE procurement programs in aligning with system-wide and locational needs, and the impacts of EE, and DR and other load-modifying programs to reshape the system demand curve. As shown below in Figure 8, CAISO monitoring strategic activities include tracking DR and EE program developments and verifying DR and EE program performances.

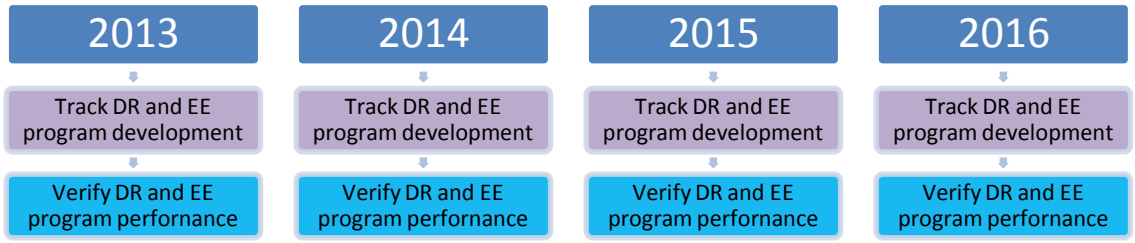

FIGURE 8. CAISO MONITORING PATH ACTIVITIES

CAISO Market Coordination with the CPUC, CEC and FERC

The roadmap states that "The ISO operates a wholesale electricity spot market that clears scheduled supply and demand bids and procures sufficient resources and services to reliably serve the balancing area and satisfy applicable NERC and WECC [Western Electric Coordinating Council] reliability

criteria."[118] CAISO, CPUC, and CEC must establish a clear classification of each of the various DR program types as either a load modifier or a supply resource. FERC has directed CAISO to replace the existing backstop procurement mechanism known as Capacity Payment Mechanism that expires on March 31, 2015 with a market-based mechanism.

The CAISO RDRR model, summarized in Table 7, was designed to incorporate utility reliability programs and enable them to be bid and dispatched through the CAISO wholesale market. If approved by FERC, the CAISO target for implementation is spring 2014.

TABLE 7. CAISO PROPOSED DR MARKET MODELS

Model	Inception	Eligible Market Services	DRP/LSE Relationship
Participating Load	1999	Non-spinning reserves	DRP and LSE must be the same entity
PDR	2010	Day-ahead and real-time energy, non-spinning reserves, and spinning reserves*	DRP can be a separate entity from the LSE
Non-Generator Resource	2012	Day-ahead and real-time energy, non-spinning reserves, spinning reserves, and regulation*	DRP and LSE must be the same entity
RDRR	Pending FERC refiling	Day-ahead and real-time energy	DRP can be a separate entity from the LSE
*Implementation by Western Electric Coordinating Council is expected in 2014			

CAISO's Use of DR to Address SONGS Closure

To address the San Onofre Nuclear Generation Station (SONGS) shutdown, in a July 15, 2013 presentation,[119] CAISO recommended the use of DR for specifically in the San Diego area due to continued load growth. Further the presentation cited "significant uncertainty" in the anticipated deployment and improved responsiveness of DR to help effectively mitigate the SONGS shutdown. Additional detail can be found in the *2013 Local Capacity Technical Analysis, Addendum to the Final Report and Study Results, Absence of San Onofre Nuclear Generating Station (SONGS)*.[120]

[118] *Ibid.*, p. 18.

[119] CAISO, *CEC/CPUC Joint Workshop Electricity Infrastructure Issues Resulting from SONGS Closure*, July 15, 2013; http://www.energy.ca.gov/2013_energypolicy/documents/2013-07-15_workshop/presentations/04A_CAISO_SONGS_Studies_7-15-13.pdf

[120] CAISO, *2013 Local Capacity Technical Analysis, Addendum to the Final Report and Study Results, Absence of San Onofre Nuclear Generating Station (SONGS),* August 20, 2012; http://www.caiso.com/Documents/Addendum-Final2013LocalCapacityTechnicalStudyReportAug20_2012.pdf

CAISO PLS

The CAISO draft DR and EE roadmap discussed above does not mention PLS. From the CAISO perspective, PLS is simply a modification of the load forecast that moves load from one period of time to another. While the end result may reduce the overall peak load and related price in the CAISO market, there is not a market mechanism for bidding and dispatching PLS. However, an earlier draft joint vision statement from the CPUC, CEC and CAISO[121] does indicate that PLS can be used to "reduce the environmental impact caused by electricity usage" and states that:

> *"Demand response via permanent load shifting can help integrate intermittent, non-peak time, renewable resources into the electric grid and benefit the system load factor."*

CAISO Bearing on California DR Programs

Demand response contributes to the CAISO resource adequacy requirement and CAISO operating reserve margin for SCE, which helps negate the need to purchase additional generation resources should load forecasts underestimate demand on any given day. The treatment of DR for resource adequacy has been evolving to align with the CAISO wholesale market inclusion of DR and the potential for DRPs to directly participate in the wholesale market. As a result, DR programs are being modified to participate in the CAISO Participating Load, Reliability Demand Response Product (RDRP), or PDR to continue to qualify for resource adequacy. Going forward, DR programs must take into account:

- CAISO wholesale market product compatibility
- CPUC resource adequacy requirement compliance
- Performance, measurement. and verification for both CAISO and CPUC
- Location attributes for determining both the available DR capacity and targeted dispatch to areas that are capacity- or supply-constrained, where DR is most cost-effective
- The potential for utilizing DR to increase load to balance excess generation (in both the short term as an ancillary service and longer term during off-peak periods to negate the need to shut down excess generation)

Summary of CAISO Activities, Impacts, Opportunities, and Recommendations

Table 8 summarizes the energy policy acts and resulting CAISO activities that impact California, as well as opportunities and recommendations that arise from these activities.

[121] CPUC Draft, *California Demand Response: A Vision for the Future*, http://www.caiso.com/1fe3/1fe3ebb5d860.pdf

TABLE 8. SUMMARY OF CAISO ACTIVITIES, IMPACTS, OPPORTUNITIES, AND RECOMMENDATIONS

Past & Current Activity	Future Activities	Impact on CA	Opportunities	Risks & Barriers	Codes & Standards Recommendation
CAISO DR and EE Roadmap		To qualify for CPUC resource adequacy, DR must participate in the CAISO market as Participating Load, PDR or RDRR	Local capacity resource approach to DR program organization and targeted participation solicitation	RDRR re-filing for compliance with FERC orders	Must be compliant with FERC orders for CAISO, including NAESB *Business Practice Standard for Measurement & Verification* adopted by FERC by reference

CALIFORNIA ENERGY COMMISSION

CEC OVERVIEW AND MISSION

Created by the Legislature in 1974 and located in Sacramento, the California Energy Commission is the state's primary energy policy and planning agency. The governor appoints, with Senate confirmation, five commissioners to staggered five-year terms. The commissioners must come from and represent specific areas of expertise: law, environment, economics, science/engineering, and the public at large. The current commissioners are Chair Robert B. Weisenmiller, Karen Douglas, David Hochschild, Andrew McAllister and Janea A. Scott.[122]

The Commission is responsible for five major areas:

- Forecasting future statewide electricity needs and keeping historical data on energy
- Licensing power plants to meet those needs
- Promoting EE and conservation
- Developing renewable energy resources and alternative energy technologies
- Planning for and directing state response to energy emergencies

Activities in these areas are carried out by six divisions and an administrative arm:

- Electricity Supply Analysis Division
- Efficiency Division
- Renewable Energy Division
- Siting, Transmission and Environmental Protection Division

[122] CEC website, Commissioners at the California Energy Commission; http://www.energy.ca.gov/commissioners/

- Energy Research and Development Division
- Fuels and Transportation Division
- Administrative and Financial Services Division

Six basic responsibilities guide the Energy Commission as it sets state energy policy:

- Promoting EE and conservation by setting the state's appliance and building efficiency standards
- Forecasting future energy needs
- Supporting public interest energy research that advances energy science and technology through research, development, and demonstration programs
- Developing renewable energy resources and alternative renewable energy technologies for buildings, industry and transportation
- Licensing thermal power plants sized 50 megawatts or larger
- Planning for and directing state response to energy emergencies.

The Energy Commission has published the following mission statement:

- It is the California Energy Commission's mission to assess, advocate and act through public/private partnerships to improve energy systems that promote a strong economy and a healthy environment.

The Commission's vision statement is as follows:

> *It is the vision of the California Energy Commission for Californians to have energy choices that are affordable, reliable, diverse, safe and environmentally acceptable.*

The Commission promotes the following values statement:

> *The California Energy Commission's highest responsibility is to the people of California. We will strive to conduct business in a manner that results in maximum public benefit while ensuring fiscal integrity and accountability for the expenditure of public funds.*
>
> *Since the CEC was created shortly after the first OPEC Oil Embargo shock in 1973, many of its responsibilities align with either improving (through mandates) EE for residential and commercial construction and appliances as well as encouraging and incentivizing new forms of generation sources such as renewables.*

CURRENT CEC DSM ACTIVITIES

This subsection provides a broad overview of the CEC's most recent activities in the building energy standards (Title 24) and appliance standards (Title 20), as well as of research programs and objectives that relate to DR and PLS technologies.

CEC Title 20 Appliance Efficiency Regulations

The Title 20 Appliance Efficiency Regulations[123] cover 23 categories of appliances and include mandatory standards for both federally regulated appliances and non-federally regulated appliances. Title 20 applies to appliances that are sold or offered for sale in California, except those sold wholesale in California for final retail sale outside the state and those designed and sold exclusively for use in recreational vehicles or other mobile equipment.

Appliance manufacturers are required to certify to the CEC that their products meet all applicable California and federal regulations pertaining to efficiency before their products can be included in the Energy Commission's database of approved appliances, and for state-regulated appliances, sold or offered for sale in California. To provide manufacturers, retailers, and consumers of appliances with a clear and comprehensive set of requirements, in a single location, pertaining to regulated appliances sold or offered for sale in California, Title 20 contains the efficiency standards and test procedures for both federally regulated and state-regulated appliances.

The 2012 Title 20 contains EE standards, but not yet DR or PLS standards, for the following:

- Home appliances: Refrigerators, dishwashers, clothes washers and clothes dryers
- Home and water heating and home cooling: Air conditioners and dehumidifiers, space heaters, and water heaters
- Pool equipment: Pool heaters, pumps, and pump motors, as well as electric spas
- Plumbing fittings and fixtures, including showerheads, spray valves, faucets, tub spout diverters, water closets, and urinals
- Lighting: Fluorescent lamp ballasts, lamps, general purpose and emergency lighting, self-contained lighting controls, luminaires, torchieres, and portable lighting fixtures, metal halide luminaires, high intensity discharge fixtures, HID fixtures, and under-cabinet luminaires, Ceiling fans and ceiling fan light kits
- Signage: Exit signs and traffic signal modules and signal lamps
- Consumer electronics, consumer audio and video equipment, televisions, compact audio products, digital versatile disc players, digital versatile disc recorders, and digital television adapters
- Cooking products and food service equipment
- Electric motors
- Low-voltage dry-type distribution transformers
- External AC to DC and AC to AC power supplies
- Large and small battery charger systems
- CEC Title 24 Building Energy Efficiency Standards

[123] CEC, 2012 Appliance Efficiency Regulations, (California Code of Regulations, Title 20, Sections 1601 through 1608), October 2012; http://www.energy.ca.gov/2012publications/CEC-400-2012-019/CEC-400-2012-019-CMF.pdf

Currently scheduled to become effective on July 1, 2014 (with implementation delays possible), the 2013 version of Title 24[124] requires commercial buildings to have demand responsive control for HVAC. It also expands the requirement for demand responsive lighting reduction--which currently applies to non-residential buildings larger than 10,000 ft^2—to smaller spaces, those larger than 100 square feet ft^2. This requirement calls for the building to automatically respond to a DR signal, as follows:

- Total energy use for lighting can automatically drop to a level at least 15% below the building's maximum total lighting power
- Lighting is reduced in a manner consistent with the Title 24 requirements for uniform illumination levels.

The demand responsive control can be enabled utilizing an energy management control system (EMCS).[125]

For new residential construction, the new version allows provision of an occupant controlled smart thermostat (OCST) to stand as an alternative to providing a 250 ft^2 solar-ready rooftop zone.[126]

Building designers are responsible for specifying automated controls that are compatible with the local utility's DR protocols.[127] The OpenADR Alliance states that the OpenADR protocol (see *Open Automated DR* section) enables compliance with Title 24.[128]

Future CEC DSM Activities

CEC Coordination with CAISO, FERC, and CPUC

CEC is working with CAISO, FERC, and CPUC to address wind and solar variability. It is envisioned that DR can respond to reduce (or increase) demand when intermittent renewable resources are generating less (or more) electricity than forecast. As shown in Figure 9 from a FERC presentation to the CEC, the demand curve is moving to a "duck" shape due to daytime solar generation.[129] This increase in solar generation will likely will result in longer, steeper demand ramps and potential over-generation. This

[124] CEC website, 2013 Building Energy Efficiency Standards; http://www.energy.ca.gov/title24/2013standards/index.html

[125] *2013 Nonresidential Building Energy Efficiency Standards Measures Summary*, March 6, 2013; http://www.energy.ca.gov/title24/2013standards/2013-03-12_Changes_for_the_2013_Update_to_Building_Energy_Efficiency_Standards.pdf

[126] *2013 Residential Building Energy Efficiency Standards Measures Summary*, March 6, 2013; http://www.energy.ca.gov/title24/2013standards/2013-03-12_Changes_for_the_2013_Update_to_Building_Energy_Efficiency_Standards.pdf

[127] California Lighting Technologies Center, University of California Davis, *What's New in the 2013 Code? Changes to the mandatory Title 24 lighting requirements,* http://cltc.ucdavis.edu/sites/default/files/files/publication/title-24-2013-code-changes.pdf

[128] OpenADR Alliance press release, *OpenADR Helps Building Owners and Operators Meet Title 24 California Compliance Requirements For Connecting Buildings to the Smart Grid,* June 25, 2013; http://www.openadr.org/index.php?option=com_content&view=article&id=81:openadr-and-title-24&catid=21:press-releases&Itemid=121

[129] CEC FERC Keynote, *DR/EE/ES and other Emerging Energy Technologies or How to Learn to Live With and Love the Duck Curve*, , September 9, 2013.

load curve progression greatly alters currently defined DR methods, including dynamic pricing, DR using home area networks (HANs), interruptible loads, and direct load control, which can control from 9% to 20% of the load. The presentation also states that 17% less fuel is consumed by generators when DR is used.[130]

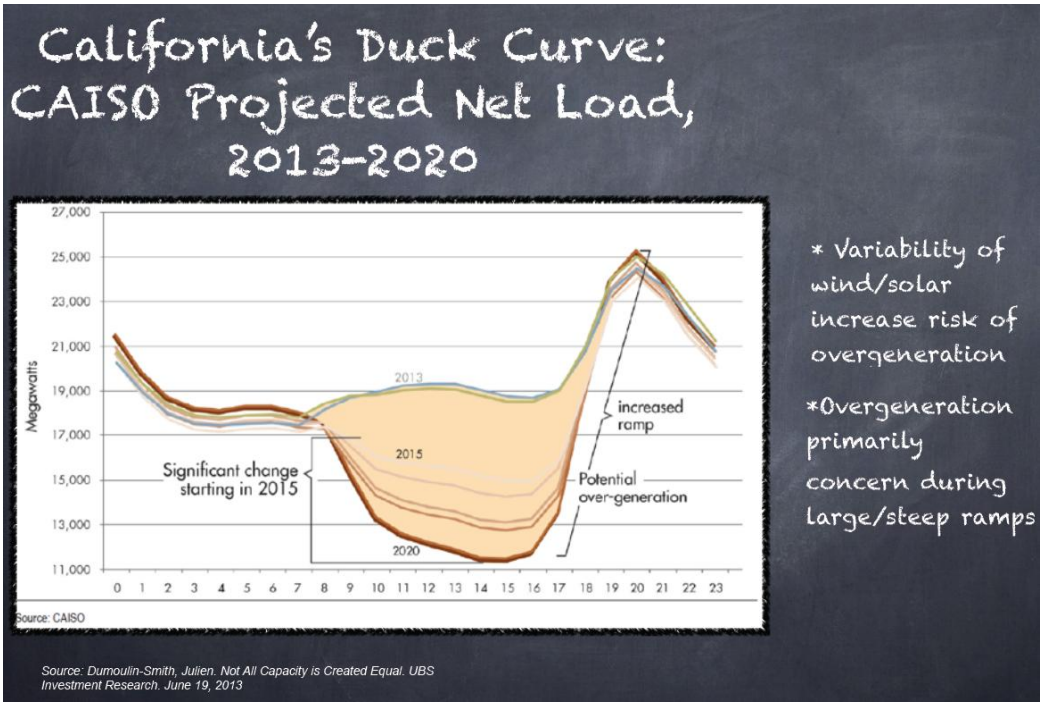

FIGURE 9. CALIFORNIA'S PROJECTED DUCK CURVE FOR NET LOAD

CEC BEARING ON CALIFORNIA DR PROGRAMS

As California's primary energy policy and planning agency, the CEC has a broad range of responsibilities designed to promote EE and conservation by setting the state's appliance and building efficiency standards. The CEC develops and sets DR-related regulations, including those contained in appliance efficiency regulations and building EE standards for existing and new buildings.

The CEC also performs research in DR technologies, policies, programs, strategies and practices. The CEC funds the DRRC at the Lawrence Berkeley National Laboratory, which conducts research in the following areas that advances the near-term adoption of DR technologies, policies, programs, strategies, and practices:

- Energy System Integration and Communication
- Buildings

[130] *Ibid*.

- Industrial, Agriculture, and Water[131]

[131] CEC website, Demand Response Research; http://www.energy.ca.gov/research/integration/demand.html

SUMMARY OF CEC ACTIVITIES, IMPACTS, OPPORTUNITIES, AND RECOMMENDATIONS

Table 9 summarizes the energy policy acts and resulting CEC activities that impact California, as well as opportunities and recommendations that arise from these activities.

TABLE 9. SUMMARY OF CEC ACTIVITIES, IMPACTS, OPPORTUNITIES, AND RECOMMENDATIONS

Past & Current Activity	Future Activities	Impact on CA	Opportunities	Risks & Barriers	Codes & Standards Recommendation
Title 20				Broad adoption of DR-capable devices and participation in DR programs	Update CEC Title 20 and Title 24 to mandate use of DR protocols identified in NIST CoS
					Encourage stakeholder engagement to combine grid interactive approach with EPA ENERGY STAR and incorporate DR/PLS capabilities
Title 24				Broad adoption of DR capable devices and participation in DR programs	Update CEC Title 20 and Title 24 to mandate use of DR protocols identified in NIST CoS
					Encourage stakeholder engagement to combine grid interactive approach with EPA ENERGY STAR and incorporate DR/PLS capabilities
Wind and solar variability			DR to mitigate intermittent renewable generation by reducing (or increasing) demand	Broad adoption of DR capable devices and participation in DR programs	

SECTION 4. ORGANIZATIONS IN OTHER STATES AND BALANCING AUTHORITIES

This section describes the DR approach taken by ISOs and RTOs in different parts of the country. The decision on whether or not to run a capacity market—or a market for bidding to supply future capacity through either generation or DR resources—marks one significant difference in an ISO or RTO's approach to the wholesale electricity market. CAISO has an energy-only market and resource adequacy (which is an alternative method of ensuring adequate capacity to meet electricity demand), which is managed by CPUC (see *California Independent System Operator* section).

TEXAS

ELECTRIC RELIABILITY COUNCIL OF TEXAS (ERCOT)

ERCOT OVERVIEW AND MISSION

The majority of the Texas electric power market is restructured, with the functions of the traditional vertically integrated electric company unbundled into three separate and distinct companies: power generation company; transmission and distribution service provider (TDSP); and retail electric provider (REP). Power generation companies own and operate electric generation plants and sell power in the ERCOT competitive wholesale market. TDSPs own and operate the transmission and distribution system and transport electric power to all electric customers within its defined service area. TDSPs also provide metering services and are responsible for installing smart meters on residential and small business premises. REPs purchase wholesale electric power for resale to retail customers. Customers buy electricity from the REP of their choice, using factors such as price, term, product offerings, and customer service in their decision-making. In addition, third-party service providers may offer customers who have smart meters various EE products, including DR programs.

CURRENT ERCOT DSM ACTIVITIES

ERCOT supports the advanced metering progress made in Texas and is anticipating additional DR activities related to smart meters. ERCOT does not currently have a capacity market, although concerns about declining projected reserve margins are driving public discussion about the need for such a market. The creation of a capacity market could possibly spur additional activity with DR programs. ERCOT has approved the use of aggregated DR,[132] including residential type resources, as valid participants in the ancillary non-spinning reserve market.

[132] ERCOT, Requirements for Aggregate Load Resource Participation in the ERCOT Markets, September 5, 2013; http://www.ercot.com/content/services/programs/load/Requirements_for_Aggregate_Load_Resource_Participation_in_th.doc

FUTURE DSM ACTIVITIES

ERCOT has a demand-side working group that recommends changes to ERCOT rules with the objective of using demand-side resources in an effective manner. A market change[133] approved in September 2013 to become effective in June 2014, will allow dispatch of some DR resources in the real-time market. Initial participation will be limited to certain LSEs and controllable load resources capable of responding to five-minute security-constrained economic dispatch (SCED) base points. Market enhancements are anticipated to further accommodate future participation by DR aggregators and resources with block offers.

BEARING ON CALIFORNIA DR PROGRAMS

As an energy-only wholesale electricity market, ERCOT's approach to integrating DR into the markets as a competitive alternative to generators is relevant to developments with CAISO in California. Additionally, the Texas model with REPs may represent a future state for California, with the gradual reopening of direct access allowing electricity service providers (ESPs) to procure electricity for resale to end-use customers.

SMART METER TEXAS (SMT)

SMT OVERVIEW AND MISSION

SMT is an interoperable smart grid solution that acts as a common interface for access to smart meter data. Specifically, SMT stores electric meter usage data received from participating TDSPs and provides market participants (customers and REPs) access to that data.

CURRENT SMT DSM ACTIVITIES

SMT enables communications with customer HAN devices by providing a common interface, a standard method for connecting devices to the customer HAN , and the ability for third parties to send messages to a customer HAN device. Another key service provided by SMT is a convenient, easy-to-use process whereby customers can authorize third-party access to their electrical usage information and communication with their HAN devices.

FUTURE SMT DSM ACTIVITIES

SMT and the smart meters installed by the TDSPs support the ZigBee Smart Energy Profile (SEP) version 1.0. There are no plans to upgrade to SEP version 1.1 or 2.0, so DR providers wishing to use the SMT to meter to HAN device communications path must support SEP 1.0. The REPs and third parties are free to experiment with various DR and rate options for customers. However because SMT is only recently fully functional, it remains to be seen what types of programs will be popular with customers.

[133] ERCOT, Load Resource Participation in Security-Constrained Economic Dispatch, September 2013; http://www.ercot.com/content/mktrules/issues/nprr/551-575/555/keydocs/555NPRR-01_Load_Resource_Participation_in_Security-Constrain.doc

Bearing on California DR Programs

As California is evaluating the transition from SEP 1.x to SEP 2.0, coordination and collaboration with Texas on SEP programs, upgrade considerations, and optimizing SEP 1.x configurations is advisable.

Summary of Texas Activities, Impacts, Opportunities, and Recommendations

Table 10 summarizes the activities in Texas that may have relevance in California, as well as opportunities and recommendations that arise from these activities.

Table 10. Summary of Texas Activities, Impacts, Opportunities, and Recommendations

Entity	Past & Current Activity	Future Activities	Impact on CA	Opportunities	Risks & Barriers	Codes & Standards Recommendation
ERCOT	Energy-only market			Most analogous to CAISO, which also has an energy-only market	Because ERCOT is self-contained within Texas, it is not under FERC jurisdiction for interstate commerce	
		DR participation in real-time market		Collaboration opportunities on how to best integrate DR into real-time energy-only electricity market		
	Retail electric providers				Approach may be more relevant with gradual reopening of direct access in CA	
SMT	Common interface for access to smart meter data				Centralized repository for meter data and HAN access is a different approach than CA, where IOUs are the data repositories	
	Utilization of ZigBee Smart Energy Profile 1.x			Collaborate with SMT to understand their successful utilization of SEP 1.x	CA had planned to upgrade to SEP 2.0, but that decision is being reassessed	Determine feasibility of utilizing SEP 1.x rather than updating AMI to SEP 2.0 compatibility

PENNSYLVANIA-NEW JERSEY-MARYLAND (PJM) INTERCONNECTION

OVERVIEW AND MISSION

PJM Interconnection[134] is an RTO that serves over 61 million people in all or parts of Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia, and the District of Columbia. PJM performs a similar role as that of CAISO for the states listed above by coordinating the movement of wholesale electricity on the high voltage transmission system and operating a competitive wholesale electricity market. Unlike CAISO, however, PJM operates a capacity market. Electricity consumers within PJM can participate in economic- and emergency-based DR programs. PJM's manual[135] for *Energy & Ancillary Services Market Operations* contains the rules for DR participation.

CURRENT DSM ACTIVITIES

PJM allows end-use customers and CSPs, who act as agents for the customers, to participate in the wholesale market by reducing the demand for electricity. DR participants compete with generation resources in the energy, day-ahead scheduling reserve, capacity, synchronized reserve, and regulation markets.

EMERGENCY DR

Emergency DR in PJM is a mandatory commitment to either reduce load or keep demand below a designated threshold when PJM needs to reduce load to maintain reliability. Emergency DR in PJM is a commitment with penalties assigned for non-compliance. Resources can be designated as follows:

- **Limited DR**: Resources are available from June through September for a maximum of 10 weekdays during that period and a maximum duration of 6 hours per event
- **Extended Summer DR**: Resources are available every day from May through October with a maximum duration of 10 hours per event
- **Annual DR**: Resources are available every day from May through October of the following year with a maximum duration of 10 hours per event

The compensation for participating in emergency DR is largely derived from the capacity market, per the Reliability Pricing Model (RPM)—PJM's model for creating long-term price signals to attract investment in reliability[136]—depending upon the load reduction commitment. These capacity resources are paid to

[134] PJM website, Demand Response; http://www.pjm.com/markets-and-operations/demand-response.aspx

[135] PJM, PJM Manual 11: Energy & Ancillary Services Market Operations, Revision 66, March 7, 2014; http://www.pjm.com/~/media/documents/manuals/m11.ashx

[136] PJM website, Reliability Pricing Model, http://www.pjm.com/markets-and-operations/rpm.aspx

be available per their commitment with monthly compensation and a one-year commitment. PJM currently has 15,064 locations with emergency DR commitments, representing 8,967 MW of capacity.[137]

Alternatively, an emergency DR resource can participate on a voluntary basis in response to PJM emergency events. However, these voluntary resources are only compensated for the energy reduced and do not receive capacity payments for being available.[138]

ECONOMIC DR

Per FERC Order 745, PJM has developed a net benefits test representing the price point at which a reduction of wholesale energy prices is expected to result from DR participation; this savings is deemed sufficient to cover the cost of economic DR resource participation. Economic DR is a voluntary commitment to reduce load when this net benefits test price is exceeded. Currently, 1,575 locations are participating in PJM Economic DR, with 2,357 MW of capacity available.

Economic DR resources can also participate in the ancillary services wholesale market, including synchronized reserve with a 10-minute response requirement; day-ahead scheduling reserves with a 30-minute response requirement; and regulation with the ability to follow regulation and frequency response signals.

FUTURE DSM ACTIVITIES

The PJM Capacity Senior Task Force is considering expanding the emergency DR to categorize resources as pre-emergency and emergency. Under such a strategy, all DR resources would be designated as pre-emergency, except for DR associated with back-up generation for which the generation permit specifically requires system emergencies in order to be dispatched. California went through a similar progression in 2004, when Governor Schwarzenegger signed Executive Order S-12-04[139] with the intent of progressing towards the prevention, rather than the management, of electricity emergencies in the state.

The PJM Operating Committee is considering measures to improve synchronized reserve performance validation. Only 75% of synchronized reserve resources are responding as committed, which results in penalties for resources that do not respond per PJM dispatch. This risk emphasizes the challenge of quantifying DR per measurement and verification standards.

PJM is also addressing the issue of free ridership. To avoid free ridership under economic DR, any customer reduction that would have happened even if a DR event had not occurred (such as the shut down a plant for scheduled maintenance) should not be eligible for economic compensation. Existing processes for verification and remediation are in place, but PJM is considering changes to the enforcement provisions.

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[137] PJM, *2013 Demand Response Operations Markets Activity Report*, December 10, 2013; http://www.pjm.com/~/media/markets-ops/dsr/2013-dsr-activity-report-20131210.ashx

[138] *Ibid.*

[139] http://www.dot.ca.gov/hq/energy/ExecOrderS-12-04.htm

Another challenge is managing DR resources that create curtailment contributions that do not align with peak load time periods. PJM is considering allowing these resources to offer their DR capacity into the Base Residual Auction, which is conducted three years in advance of the operating year to ensure operating capacity and in future years through the Reliability Pricing Model.

Bearing on California DR Programs

As described in the section on the

CAISO Resource Sufficiency Path, CAISO is working to build a DR catalog based on DR resource capabilities. The emergency DR designation utilized by PJM would be a relevant benchmark to reference for the CAISO DR catalog.

Additionally, DRPs in California have typically contracted with the IOUs to provide aggregated DR resources through either DR contracts or the standard offer Capacity Bidding Program. PJM has been successful with DRPs competing directly in their capacity and energy markets. CAISO has worked to facilitate direct participation of DRPs for several years, but the DRPs continue to prefer contracting with the IOUs. This preference stems partially from the fact that capacity in California is ensured through the CPUC regulation, rather than through a capacity market run by CAISO.

CPUC is working to establish Rule 24, which would govern the interactions between IOUs and DRPs that directly participate in the CAISO market, mirroring Rule 22 governance of the interactions between IOUs and ESPs and Rule 23 governance of the interactions between IOUs and Community Choice Aggregators (CCAs). This proceeding may include resource adequacy credit for DRPs participating directly in the CAISO market. As such, it would impact whether DRPs continue to act as contractual suppliers to the IOUs or become competitive providers of DR program options for customers.

Summary of PJM Activities, Impacts, Opportunities, and Recommendations

Table 11 summarizes the activities in PJM that may have relevance in California, as well as opportunities and recommendations that arise from these activities.

Table 11. Summary of PJM Activities, Impacts, Opportunities and Recommendations

Past & Current Activity	Future Activities	Impact on CA	Opportunities	Risks & Barriers	Codes & Standards Recommendation
Emergency DR designations based on capabilities			The emergency DR designation utilized by PJM may be a relevant benchmark for the CAISO DR catalog		
DRP direct participation in PJM market			Review PJM approach for economic DR to determine relevance to DRP direct participation in CAISO energy-only market		

ISO NEW ENGLAND (ISO-NE)

OVERVIEW AND MISSION

ISO-NE is an RTO serving Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont. ISO-NE plays a similar role to that of CAISO and PJM for the states listed above. ISO-NE defines DR as ". . . when market participants reduce their consumption of electric energy from the network when instructed in exchange for compensation."[140] ISO-NE differentiates between active and passive DR, designating active DR as resources that reduce load in response to a DR price or system reliability signal, and passive DR as resources that do not participate in the ISO-NE market.

CURRENT DSM ACTIVITIES

ISO-NE categorizes DR into three programs:

- Price Activated
- Reliability Activated
- On-Peak Consumption Reduction (considered a passive resource)

PRICE RESPONSIVE DEMAND

Market participants can register DR resources to participate in day-ahead and real-time markets. Per FERC Order 745 and similar to PJM, ISO-NE uses a net benefit test to determine a threshold price for DR resource price response participation. Every month, ISO-NE calculates a minimum offer price based on the Forward Reserve Fuel Index multiplied by the Day-Ahead Load Response Price heat rate index. The monthly minimum offer price is posted three business days before the start of the month. As of December 1, 2013, ISO-NE has 277 MW enrolled in its Transitional Price-Responsive Demand program.[141] In 2011, ISO-NE utilized between 26 and 57 price events (depending upon which load zone is reviewed) which translates to 7–17% of the business days utilizing DR price response in 2011.[142]

CAPACITY FOR RELIABILITY

ISO-NE Operating Procedure Number 4[143] outlines the actions taken in the event of a generation capacity shortage. Both generators and demand resources with a capacity supply obligation are notified, and "shortage event" definitions are implemented. The dispatch of real-time demand resources is the second action taken. Other actions, including purchasing available emergency capacity and energy from

[140] ISO-NE website; http://www.iso-ne.com/genrtion_resrcs/dr/dr_gen_info/index.html

[141] ISO-NE presentation, *Demand Resource Asset Enrollments*, December, 2013; http://www.iso-ne.com/genrtion_resrcs/dr/stats/enroll_sum/2013/dr_enrollments_12_01_2013with_dispatch.ppt

[142] ISO-NE, 2011 DR Event Summary; http://www.iso-ne.com/genrtion_resrcs/dr/stats/evntsum_ytd/2011_event_summary.pdf

[143] ISO New England Operating Procedure No. 4 - Action During A Capacity Deficiency, effective October 5, 2013; http://www.iso-ne.com/rules_proceds/operating/isone/op4/op4_rto_final.pdf

market participants, occur later during action Number 5, followed by conservation voltage reduction of 5% as action Number 6.

Market Rule 1 Appendix E1[144] applies to capacity commitment periods for DR resources commencing prior to June 1, 2017. DR resources can register to submit demand reduction offers on a day-ahead and real-time basis if the asset can reduce load by at least 100 kW and meet the metering and communication requirements. The 100-kW commitment can be met with an aggregation of resources.

Requirements and standards for M&V of capacity resources are described in the *ISO New England Manual for Measurement and Verification of Demand Reduction Value from Demand Resources*[145] and reference the NAESB M&V standards described in the section *WEQ-015 – Measurement and Verification of Wholesale Electricity DR.*

Table 12 summarizes the enrolled megawatts enrolled in for each ISO-NE DR program.

TABLE 12. ISO-NE DEMAND RESOURCE ASSET ENROLLMENTS – CAPACITY PROGRAMS[146]

Capacity DR Program Option	MW
Real-time Demand Response Resource	782
Real-time Emergency Generation Resource	263
On-Peak Demand Resource	628
Seasonal Peak Demand Resource	400
TOTAL	**2073**

FUTURE DSM ACTIVITIES

ISO-NE is considering the impact of simultaneous dispatch of DR and emergency generation from the same location. In such a situation, determining the independent contribution of DR and generation resources can be challenging, as the premise meter will record only the net result of both resources. Also challenging is M&V of DR configurations to ensure adherence to performance criteria and accurate financial settlements.

ISO-NE is attempting to address the co-generation challenge as follows:

[144] ISO-NE, Market Rule 1, Appendix E1 – Demand Response; http://www.iso-ne.com/regulatory/tariff/sect_3/mr1_append-e.pdf

[145] ISO-NE, *ISO New England Manual for Measurement and Verification of Demand Reduction Value from Demand Resources Manual M-MVDR*, November 8, 2013; http://www.iso-ne.com/rules_proceds/isone_mnls/m_mvdr_measurement_and_verification_demand_reduction_revision_5_11_08_13.doc

[146] ISO-NE December 2013 Demand Resource Asset Enrollments, op., cit.

- Distinguishing between Facility Metered Load, which is the equivalent of Net Energy Metering, and Total Facility Load, which includes the load satisfied by onsite distributed generation
- Disallowing the coexistence of Total Facility Load and Facility Metered Load metering configurations at a facility

This approach may be relevant as more DR participating customers also deploy distributed generation, such as photovoltaic panels. Additionally, NE-ISO is moving to exclude days with scheduled facility maintenance or an outage from baseline calculations. These steps can be seen as incremental improvements to further refine the accuracy of baselines and performance measurement and verification.

Bearing on California DR Programs

Only 12% of ISO-NE DR resources participate in the market as price responsive demand. Because CAISO does not have a capacity market, a similar proportion of total DR capabilities can be expected to participate in CAISO proxy demand response. The CAISO Reliability Demand Response Product is not exactly analogous to ISO-NE capacity products, but if CPUC requires CAISO market participation in order to qualify for resource adequacy, the remaining dispatchable DR can be expected to participate in the RDRP market product. However, California customers transitioning to dynamic pricing, such as TOU and CPP, may "self-schedule" their DR capabilities to minimize their electricity bill rather than participate in programs that are aggregated for CAISO market participation. Such self-scheduled DR actions would result in modified demand forecasts with load reductions during higher cost periods and load increases during lower cost periods.

ISO-NE efforts to further refine M&V and baseline methodologies based on lessons learned can be coordinated with stakeholders in other control areas, such as CAISO.

Summary of ISO-NE Activities, Impacts, Opportunities, and Recommendations

Table 13 summarizes the activities in ISO-NE that may have relevance in California, as well as opportunities and recommendations that arise from these activities.

Table 13. Summary of ISO-NE Activities, Impacts, Opportunities, and Recommendations

Past & Current Activity	Future Activities	Impact on CA	Opportunities	Risks & Barriers	Codes & Standards Recommendation
Price Activated			Review ISO-NE approach for price activated DR to determine relevance to CAISO PDR	Only 12% of ISO-NE DR resources participate in the market as price responsive demand (similar to CAISO PDR)	
Reliability Activated			Review ISO-NE approach for Price Activated DR to determine relevance to CAISO RDRP	The CAISO RDRP product is not exactly analogous to ISO-NE capacity products	

Past & Current Activity	Future Activities	Impact on CA	Opportunities	Risks & Barriers	Codes & Standards Recommendation
On-Peak Consumption Reduction			Similar to dynamic pricing implementation, which reduces peak demand (and demand forecasts) but does not participate in a wholesale market		

MIDWEST INDEPENDENT SYSTEM OPERATOR (MISO)

OVERVIEW AND MISSION

MISO performs two separate functions within two overlapping regions:

- Manages energy and operating reserves markets for portions of Montana, North Dakota, South Dakota, Minnesota, Iowa, Missouri, Kentucky, Wisconsin, Illinois, Indiana and Michigan
- Manages a reliability coordination area for the above states, plus portions of Arkansas, Mississippi, Louisiana and Texas.

MISO estimates that incorporation of DR resources creates between $112–146 million in benefits[147] to members and their customers.

CURRENT DSM ACTIVITIES

MISO utilizes demand response resources for two types of DR resources:

- DR Resource Type I: Interruptible load in the energy and contingency reserves markets
- DR Resource Type II: Controllable load in the energy, regulation, and contingency reserves markets

Any DR resource that is participating in the energy market and also receiving capacity credit as a capacity resource has a “must offer” obligation to ensure the capacity is available.

In addition, DR, along with behind-the-meter generation, can be used as a load-modifying resource (LMR). LMR can be utilized to meet the LSE Planning Reserve Margin Requirement and must be available for emergency conditions. Penalties are assessed for non-performance.

Emergency DR is not a specific type of DR but instead is a specific use for both DR resources and LMRs.

[147] MISO website, Value Proposition; https://www.misoenergy.org/WhatWeDo/ValueProposition/Pages/ValueProposition.aspx

Future DSM Activities

Aggregators of retail customers (ARCs) aggregate and bid DR from multiple customers into MISO as DR resources. However, regulatory policies in some states within MISO territory, such as Minnesota, do not currently allow utilization of ARCs.

Price responsive demand, such as Real Time Pricing (RTP), that are complementary with the MISO wholesale electricity market have been a challenge. Retail rates do not currently reflect wholesale hourly energy price changes, so consumers are both insulated from, and unaware of, the actual cost of delivering electricity.

MISO is working to incorporate DR in expansion planning (long-term) with the Midwest ISO Transmission Expansion Plan. Additionally, in a near-term (one-year) planning horizon, MISO is working to include DR resources Type I & II that qualify as capacity resources and LMR into their Resource Adequacy Requirements.

Bearing on California DR Programs

MISO's approach for recognizing both DR resources and LMR is pertinent to the California implementation of dynamic pricing. Dynamic pricing encourages LMR with DR capabilities that can be leveraged either separately from the CAISO market or with additional response capabilities to provide load modification in response to dynamic pricing signals, as well as additional DR in response to PDR or RDRP event dispatches.

MISO's work to integrate DR into both Midwest ISO Transmission Expansion Plan and Resource Adequacy Requirements is analogous to CAISO and CPUC efforts to further refine DR as a contribution to resource adequacy requirements with wholesale market integration.

Summary of MISO Activities, Impacts, Opportunities, and Recommendations

Table 14 summarizes the activities in MISO that may have relevance in California, as well as opportunities and recommendations that arise from these activities.

Table 14. Summary of MISO Activities, Impacts, Opportunities, and Recommendations

Past & Current Activity	Future Activities	Impact on CA	Opportunities	Risks & Barriers	Codes & Standards Recommendation
DR Resources (DRR)			Pertinent to the California implementation of dynamic pricing. Encourages capabilities that can be leveraged either separate from the CAISO market or with additional response capabilities to provide load modification.		
Load Modifying Resource (LMR)					

Past & Current Activity	Future Activities	Impact on CA	Opportunities	Risks & Barriers	Codes & Standards Recommendation
Midwest ISO Transmission Expansion Plan			Analogous to CAISO and CPUC efforts to further refine DR as a contribution to resource adequacy requirements with wholesale market integration		
Resource Adequacy Requirements					

SECTION 5. INDUSTRY ASSOCIATIONS

NORTH AMERICAN ELECTRIC STANDARDS BOARD

OVERVIEW AND MISSION

NAESB[148] serves as an industry forum for the development and promotion of business practice standards that lead to a seamless marketplace for wholesale and retail natural gas and electricity, as recognized by its customers, business community, participants, and regulatory entities. NAESB does not set policy but rather develops work products intended to focus on the implementation of state and federal policy decisions by providing roadmap(s) for the interactions between parties.

CURRENT DSM ACTIVITIES

NAESB has several standards and model business practices applicable to both the wholesale and retail electric markets that address DR:

- Wholesale Electric Quadrant (WEQ)
  - WEQ-015 – Measurement and Verification of Wholesale Electricity DR
  - WEQ-018 – Specifications for Wholesale Standard DR Signals
  - WEQ-019 Customer Energy Usage Information Communication
- Retail Electric Quadrant (REQ)
  - REQ.13 – Measurement and Verification of DR Programs Model Business Practices
  - REQ.17 – Specifications for Retail Standard DR Signals Model Business Practices
  - REQ.18 – Retail Customer Energy Usage Information Communication Model Business Practices
  - REQ.21 – Energy Services Provider Interface Model Business Practices
  - REQ.22 – Third Party Access to Smart Meter–based Information Model Business Practices
- Retail Quadrant (RXQ)

[148] NAESB website; http://www.naesb.org/

- RXQ.24 – Enrollment, Drop, and Account Information Change in DR Programs Practices Model Business Practices

These standards are discussed in the subsections below.

WEQ-015 – Measurement and Verification of Wholesale Electricity DR

On February 21, 2013, FERC issued a final rule incorporating updated business practice standards of the NAESB regarding M&V of DR and EE.[149] The final rule revises FERC's regulations (18 Code of Federal Regulations § 38.2) by referencing NAESB's Phase II DR M&V and its wholesale EE M&V standards. These EE standards only apply to wholesale markets administered by ISOs and RTOs. The Phase II DR M&V standards are a more RTO/ISO-specific version. A final set of the retail protocols (parts of the standards) was submitted to National Association of Regulatory Utility Commissioners (NARUC) in late 2012 for possible adoption in regulations related to retail (end-use customer) DR.

FERC intends to elevate M&V practices while safeguarding the need for regional flexibility. Interest is keen in developing demand-side resources—such as direct bid-in dispatchable DR, ancillary services, and price responsive programs—that can compete with fossil fuel–based generation. In addition, FERC intends to allow EE to participate more broadly in wholesale markets and could, in the future, allow bidding of EE portfolios into a forward-capacity market. Adoption by state regulators is also possible.

M&V standards for wholesale DR services[150] address the following:

- Four types of wholesale DR services: energy, capacity, reserve, and regulation
- Categorization of DR products and services
- Provision of support for the M&V of these products and services
- Meter data reporting deadlines
- Advanced notification
- Telemetry intervals
- Meter accuracy for after-the-fact metering
- Meter data reporting intervals
- Adjustment windows

M&V standards for retail DR services address the following:

- Establishment of criteria for the use of equipment, technology, and procedures to quantify the demand reduction value
- General: Advance notification, deployment time, reduction deadlines, release/recall, normal operations, DR availability measurement, aggregation, and transparency of requirements

[149] NAESB website, WEQ-015; http://www.naesb.org/member_login_check.asp?doc=weq015_bklet_073112.pdf (login required)

[150] NAESB presentation, *The North American Energy Standards Board Demand Response and Energy Efficiency Standards*, December 12, 2012;
http://www.neep.org/Assets/uploads/files/emv/Annual-Public-Meeting/NAESB%20DR%20EE%20Presentation.pdf

- Telemetry: Telemetry requirements, accuracy, intervals, measurements, communication protocols, governor control equivalents, and onsite generation requirements
- After-the-fact metering: Requirements, accuracy, equipment details, reporting deadlines, reporting intervals, lock accuracy, VEE methods, and onsite generation requirements
- Performance evaluation: Acceptable baselines and alternative performance measurements for each type of DR product
- Baseline information: Baseline window, calculation types, sampling precision, exclusion rules, baseline adjustments, and adjustment windows
- Event information: Use of real-time telemetry, use of after-the-fact telemetry, performance window, and measurement type
- Special processing: Highly variable load logic and onsite generation requirements

M&V standards for wholesale EE services can be described as follows:

- Designed to create of a standard method for quantifying the energy reductions from EE measures
- Based on services and products administered by PJM and ISO-NE, several state protocols, federal energy management program M&V standards, and the International Performance Measurement and Verification Protocol
- Contain 69 standards and definitions, including EE baseline and demand reduction value
- Include criteria for the use of EE products in organized wholesale electricity markets, general M&V plan requirements, and detailed criteria of acceptable measurement and verification methodologies

M&V standards for retail EE services can be described as follows:

- Designed to create an standard method for quantifying the energy reductions from EE measures
- Applicable to the M&V of electrical energy (kWh) and demand (kW) impacts
- Contain 51 standards and definitions, including definitions of several different M&V methodologies, such as calibrated simulation, partially measured retrofits, retrofits, regression analysis, deemed savings, and large-scale billing analysis
- Contain verification components for projects that verify EE baseline conditions, such as EE baselines, statistical significance, savings calculations, demand reduction calculations, monitoring parameters, and data validation

WEQ-018 – Specifications for Wholesale Standard DR Signals

WEQ-018[151] describes the end-to-end business activity diagrams relating to wholesale market interactions between the system operator and various wholesale market participants. The use cases represent a combination of three aspects of DR participation in wholesale markets: product, deployment, and performance evaluation method.

[151] NAESB website, WEQ-018; http://www.naesb.org/member_login_check.asp?doc=weq018_bklet_073112.pdf (login required)

WEQ-019 – Customer Energy Usage Information Communication

This standard[152] defines an information model of semantics for the definition and exchange of customer energy usage information. The smart grid use of two-way communication between devices, services, and systems enables capabilities such as DR. To ensure effective sharing of customer usage information, WEQ-019 standardized the format for this data from a wholesale electric market perspective.

REQ.13 – Measurement and Verification of DR Programs Model Business Practices

The NAESB Model Business Practice Standard for M&V of DR programs[153] provides a framework for transparency, accountability, and consistency, and attempts to be broad enough to cover all forms of DR. The standards are not intended to address DR program design. The business practices are voluntary and do not address policy issues that are the subject of state legislation or regulatory decisions. Although the standards are voluntary from NAESB's perspective, FERC has adopted them in regulation for the wholesale market.

One specific requirement is replicated below as it references California directly:

> *REQ 13.3.3.1 Statistical Sampling - The method of statistical sampling used should conform to an accepted methodology and should be specified in the Governing Documents. The following list provides examples of currently accepted methodologies:*
>
> - *The Association of Edison Illuminating Companies (AEIC) Load Research Manual*
> - *Chapter 4 – Sample Design and Selection*
> - *Chapter 5 – Sample Implementation*
> - *The Federal Energy Management Program M&V Guidelines: Measurement and Verification for Federal Energy Projects – Appendix B*
> - ***The California EE Evaluation Protocols***
> - ***The California Evaluation Framework – Chapter 13***
> - *The Independent System Operator (ISO)-New England Manual for Measurement and Verification of Demand Reduction Value from Demand Resources, Section 7*

REQ.17 – Specifications for Retail Standard DR Signals Model Business Practices

The purpose of REQ.17[154] is to capture business and data requirements for retail DR signals and messaging between entities that control and manage the DR programs and customers that provide demand response. The business process requirements attempt to align with the following principles:

- Scalability

[152] NAESB website, WEQ-019; http://www.naesb.org/member_login_check.asp?doc=weq019_bklet_073112_mc112812.pdf (login required)

[153] NAESB, website REQ.13; http://www.naesb.org/member_login_check.asp?doc=retail_bk13_083013.pdf (login required)

[154] NAESB website, REQ.17; http://www.naesb.org/member_login_check.asp?doc=retail_bk17_083013.pdf (login required)

- Actionable, testable, and transferable work products
- Platform independence, vendor neutrality
- Cyber secure
- Interoperability
- Automatic DR
- Coverage of all market types

REQ.18 – Retail Customer Energy Usage Information Communication Model Business Practices

This standard[155] defines an information model of semantics for the definition and exchange of customer energy usage information. The smart grid use of two-way communication between devices, services, and systems enables capabilities such as DR. To ensure effective sharing of customer usage information, REQ.18 standardized the format for this data from a retail electric service perspective.

REQ.21 – Energy Services Provider Interface Model Business Practices

The NAESB ESPI[156] standard provides models of business practices, use cases, and system models, as well as an extensible markup language schema, that describe the methods for exchanging energy usage information between retail customers and third parties. The NAESB standard is used for the data payload for the Green Button Initiative (the industry effort to provide electricity customers with easy access to their energy usage data), but the two are not synonymous. The Green Button standard is an implementation of the NAESB ESPI with some additional requirements.

The NAESB ESPI standard is appropriate for any application with the need to exchange a retail customer's energy usage information. The standard considers DR applications and is useful for the exchange of energy usage information prior to, during, and after a DR event. The standard does not include messages that would be used to signal a DR event. The ESPI services model conforms to the SGIP PAP 10 Energy Usage Information Model (described in the section below on *SGIP PAP 10 – Standard Energy Usage Information*) and is working to align with the SEP 2.0 as much as possible.

REQ.22 – Third Party Access to Smart Meter–based Information Model Business Practices

The NAESB REQ.22[157] document "establishes voluntary Model Business Practices for Third Party access to Smart Meter-based information" that are intended only to serve as flexible guidelines for consideration by regulatory authorities or similar bodies that are establishing the actual requirements. In order for customers to effectively utilize smart grid products and services, a customer may grant AMI meter data access to a third party who should also have the responsibility to protect the privacy of the customers' information. NAESB REQ.22 establishes voluntary Model Business Practices in 10 privacy areas for third-party access to smart meter–based Information:

- Management and Accountability
- Notice and Purpose
- Choice and Consent
- Collection and Scope
- Use and Retention
- Individual Access
- Disclosure and Limiting Use
- Security and Safeguards
- Accuracy and Quality
- Openness, Monitoring, and Challenging Compliance

RXQ.24 – Enrollment, Drop, and Account Information Change in DR Programs Practices Model Business Practices

RXQ.24[158]outlines Model Business Practices for enrollment in DR programs by an aggregator. It covers the management of a customer who wants to enroll in a DRP's program while continuing to engage with a separate energy service provider.

Future DSM Activities

NAESB has created a framework for integrated DR and DER models to address the business objectives and context for standardizing control and pricing signals for DR and DER. The framework considers multiple market conditions that will exist in North America and recognizes that pricing models can be complex and varied. The framework attempts to support the various market conditions and seeks to ensure that standardized DR control and pricing signals do not interfere with regulatory and market conditions as they evolve. The document describes the market conditions found in North America and

[158] NAESB website, RXQ.24; http://www.naesb.org/member_login_check.asp?doc=retail_bk24_083013.pdf (login required)

describes various DR programs, DR participants, and business models. The document includes business context diagrams, a framework for DR use cases, a few high level requirements, and a set of guiding principles. The document serves as a starting point for further development of standards, but does not include or document any actionable activities or requirements.

BEARING ON CALIFORNIA DR PROGRAMS

FERC has adopted the NAESB WEQ standards by reference in Order No. 676-G Standards for Business Practices and Communication Protocols for Public Utilities (see section on *Order No. 676-G Standards for Business Practices and Communication Protocols for Public Utilities*), and CAISO must comply with the NAESB WEQ standard approach. FERC does not have jurisdiction to similarly adopt the REQ and RXQ standards described in this section, as retail regulations are under the jurisdiction of CPUC. However, the California IOUs must participate in the CAISO market within FERC regulations, as well as provide retail services within CPUC regulations. Therefore, CPUC consideration of pertinent NAESB REQ and RXQ, in combination with CAISO incorporation of WEQ, will provide a more consistent approach for wholesale and retail treatment of DR.

The California IOUs have already started adopting the Green Button implementation of REQ.21. Further adoption of REQ.21 and REQ.22 for interfacing with third-party ESPs and DRPs would reduce the number of standards utilized by phasing out the Electronic Data Interchange currently utilized to deliver meter read data to ESPs.

SUMMARY OF NAESB ACTIVITIES, IMPACTS, OPPORTUNITIES, AND RECOMMENDATIONS

Table 15 summarizes the activities in NAESB that may have relevance in California, as well as opportunities and recommendations that arise from these activities.

TABLE 15. SUMMARY OF NAESB ACTIVITIES, IMPACTS, OPPORTUNITIES, AND RECOMMENDATIONS

Past & Current Activity	Future Activities	Impact on CA	Opportunities	Risks & Barriers	Codes & Standards Recommendation
WEQ-015 –M&V of Wholesale Electricity DR			Framework for integrated DR and DER models to address the business objectives and context for standardizing control and pricing signals for DR and DER	FERC incorporated by reference in Order No. 676-G Standards for Business Practices and Communication Protocols for Public Utilities	Adopt NAESB WEQ-015
WEQ-018 – Specifications for Wholesale Standard DR Signals					Adopt NAESB WEQ-018
WEQ-019 – Customer Energy Usage Information Communication					Adopt WEQ-019
REQ.13 – M&V of DR Programs Model Business Practices			Synchronize approach for retail and wholesale M&V and communications after FERC adoption of related WEQ standards	Without a consistent approach between the retail and wholesale aspects described in the WEQ and REQ standards, CAISO market products and DR program approaches may not be complementary	Adopt REQ.13
REQ.17 – Specifications for Retail Standard DR Signals Model Business Practices					Adopt REQ.17
REQ.18 – Retail Customer Energy Usage Information Communication Model Business Practices					Adopt REQ.18
REQ.21 – Energy Services Provider Interface Model Business Practices			SCE has committed to utilizing the ESPI enabled Green Button implementation for web-based exchange of energy usage information		Consider transition from Electronic Data Interchange data format to ESPI for communicating meter data to ESPs
REQ.22 – Third Party Access to Smart Meter–based Information Model Business Practices					Adopt REQ.22
RXQ.24 – Enrollment, Drop, and Account Information Change in DR Programs Practices Model Business Practices			Model Business Practices for Enrollment in DR programs by an aggregator		Adopt RXQ.24

NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

OVERVIEW AND MISSION

NERC is a non-profit organization with the mission to ensure the reliability of the North American Bulk-Power System, which serves more than 334 million people in the United States, Canada, and the northern portion of Baja California, Mexico. To help achieve reliability, NERC develops and enforces reliability standards, assesses system reliability, assesses awareness levels, and provides education, training, and certification opportunities for the industry. With oversight from FERC and regulators in Canada, NERC is the electric reliability organization for North America, and owners, operators, and users of the Bulk-Power System are subject to NERC's jurisdiction.

CURRENT DSM ACTIVITIES

The DR Availability Data System (DADS) is a NERC program to receive, assess, and disseminate data on DR programs and services managed by wholesale and retail organizations. DADS is modeled after NERC's transmission and generation availability systems and collects information on both voluntary and mandatory DR programs on a periodic basis. NERC indicates that SCE is a participant in the DADS program.

In early 2013, NERC published[159] the first results from DADS for two time periods: summer 2011 and winter 2011–2012. DADS shows that in the summer of 2011, the reporting entities deployed 527 DR events with an average combined capacity of almost 51 GW and that the average sustained response time for these events was 3 hours and 6 minutes.[160]

FUTURE DSM ACTIVITIES

The DADS system would appear to supplement FERC's annual assessment activities by providing a continuing historical view and quantification of DR programs in North America. There are no planned changes to the data reporting requirements for DADS that would change SCE's current interaction with the system. It's not clear if the lag time in reporting will be reduced as this program continues.

BEARING ON CALIFORNIA DR PROGRAMS

CAISO does not appear to be utilizing DADS. However, FERC is incorporating by reference the business practice standards adopted by the NAESB Wholesale Electric Quadrant for the M&V of DR and EE resources participating in organized wholesale electricity markets. Because NERC utilized the NAESB M&V standards and terminology in the development of DADS, California may want to consider using this tool for DR program assessment rather than building or continuing to augment a customized solution.

[159] NERC, 2011 Demand Response Availability Report, March 2013; http://www.nerc.com/docs/pc/dadswg/2011%20DADS%20Report.pdf

[160] *Ibid.,* p. 12

SUMMARY OF NERC ACTIVITIES, IMPACTS, OPPORTUNITIES, AND RECOMMENDATIONS

Table 16 summarizes the activities in NERC that may have relevance in California, as well as opportunities and recommendations that arise from these activities.

TABLE 16 SUMMARY OF NERC ACTIVITIES, IMPACTS, OPPORTUNITIES, AND RECOMMENDATIONS

Past & Current Activity	Future Activities	Impact on CA	Opportunities	Risks & Barriers	Codes & Standards Recommendation
DR Availability Data System			NERC utilized the NAESB M&V standards and terminology in the development of DADS. Further explore leveraging of DADS for DR program reporting.		

SMART GRID INTEROPERABILITY PANEL

OVERVIEW AND MISSION

SGIP[161] was established to help NIST fulfill its responsibilities pursuant to the EISA 2007. [162] As noted earlier, NIST is a federal agency dedicated to promoting U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology. Initially funded by the American Recovery and Reinvestment Act of 2009, SGIP has worked to provide a framework for coordinating all smart grid stakeholders to accelerate standards harmonization and advance the interoperability of smart grid devices and systems through these actions:

- Facilitating standards development for smart grid interoperability
- Identifying necessary testing and certification requirements
- Overseeing the performance of these activities and continuing momentum
- Informing and educating smart grid industry stakeholders on interoperability
- Conducting outreach to establish global interoperability alignment

In 2013, the SGIP transitioned from a NIST-supported organization to a member-funded organization. While the structure of the new SGIP 2.0 organization continues to evolve, its purpose and goals remain the same.

[161] SGIP website; www.sgip.org

[162] NIST-SGIP, Smart Grid Collaboration Wiki for Smart Grid Interoperability Standards ; http://collaborate.nist.gov/twiki-sggrid/bin/view/SmartGrid/WebHome

Collaborative work was conducted utilizing Priority Action Plans focused on specific gaps in the capabilities of existing interoperability standards. Some PAP output relevant to DR and PLS is described below.

CURRENT DSM ACTIVITIES

SGIP PAP 09 – STANDARD DR AND DER SIGNALS

PAP 09[163] sought to develop or adopt standard DR and DER signals. Initially, NIST intended to organize a meeting with a number of organizations—International Electrotechnical Commission Technical (TC) Committee 57, OASIS, NAESB, and AMI-ENT—to specify a process for developing a common semantic model for standard DR signals. The previous work outputs are available.[164] The work of PAP09 is completed, with the acceptance of the PAP Working Group recommendations to adopt the following into the SGIP Catalog of Standards:[165]

- OASIS Energy Interop (information model)
- OpenADR 2.0a and 2.0b Profiles (see *Open Automated DR* section)
- SEP 2.0 (see Smart *Energy Profile* section)

The CoS[166] is a list of standards that has been reviewed and endorsed via a voting process by SGIP stakeholder categories as being relevant for the foundational development and deployment of a robust, interoperable, and secure smart grid.

SGIP PAP 10 – STANDARD ENERGY USAGE INFORMATION

The informational handoff within and between service providers and customers in the smart grid is fundamental to interactions between the following:

- The distribution provider and the industrial, commercial, and home premise
- The service provider and industrial, commercial, and home premises
- Distributed energy resources and all other domains
- Plug-in electric vehicles (EVs) and the customer or service provider

PAP 10 output was a foundation for the NAESB REQ.18 and WEQ.19 (see section on *NAESB's Current DSM Activities).*

[163] SGIP Workspace, PAP09; http://members.sgip.org/apps/org/workgroup/sgip-pap09wg/ (login required)

[164] NIST-SGIP wiki, PAP09 closeout; http://collaborate.nist.gov/twiki-sggrid/bin/view/SmartGrid/PAP09Closeout

[165] SGIP Catalog of Standards; http://www.sgip.org/catalog-of-standards/#sthash.uW5pdMVd.dpbs

[166] SGIP Catalog of Standards; http://www.sgip.org/catalog-of-standards/#sthash.uW5pdMVd.dpbs

SGIP PAP 17 – Facility Smart Grid Information Standard

PAP 17 activities will lead to the development of a data model standard to enable energy consuming devices and control systems in the customer premises to manage electrical loads and generation sources in response to communication with the smart grid.

SGIP PAP 18 – SEP 1.x to SEP 2 Transition and Coexistence

PAP 18 completed work on the *PAP 18: SEP 1.x to SEP 2.0 Transition and Coexistence Guidelines and Best Practices*[167] (also known as the PAP 18 White Paper), and the Governing Board and plenary membership voted to include the document in the CoS.

SGIP PAP 19 – Wholesale DR

PAP 19[168] built a Wholesale DR Communication Protocol (WDRCP) extension for consideration by IEC TD57 for inclusion in Common Information Model (CIM). The CIM extension was mapped to other relevant profiles, such as OpenADR 2.0b, and MultiSpeak. The work of PAP 19 is completed with the acceptance of the PAP Working Group recommendations to adopt OASIS Energy Interop (information model), OpenADR 2.0b Profile, SEP 2.0, and DR aspects of MultiSpeak into the SGIP Catalog of Standards. This PAP output will be delivered to IEC TC57 for evaluation and potential adoption.

Future DSM Activities

SGIP is still in the process of final consideration for SEP 2.0, OpenADR 2.0 and MultiSpeak for inclusion in the CoS. Inclusion is pending final reviews from the Smart Grid Architecture Committee, Cybersecurity Working Group and review by the Governing Board.

Bearing on California DR Programs

The listing of SEP 2.0, OpenADR 2.0 and MultiSpeak in the Catalog of Standards will give some level of affirmation to manufacturers, utility adopters, and other implementers that these messaging protocols are nationally recognized standards that are foundational to an interoperable smart grid.

Summary of SGIP Activities, Impacts, Opportunities, and Recommendations

Table 17 summarizes the activities in SGIP that may have relevance in California, as well as opportunities and recommendations that arise from these activities.

[167] PAP 18: SEP 1.x to SEP 2.0 Transition and Coexistence Guidelines and Best Practices, December 2011; http://collaborate.nist.gov/twiki-sggrid/pub/SmartGrid/SEPTransitionAndCoexistenceWP/PAP_18_SEP_Migration_Guidelines_and_Best_Practices_ver_1_03.docx

[168] NIST-SGIP wiki, PAP19 closeout; http://collaborate.nist.gov/twiki-sggrid/bin/view/SmartGrid/PAP19Closeout

TABLE 17. SUMMARY OF SGIP ACTIVITIES, IMPACTS, OPPORTUNITIES, AND RECOMMENDATIONS

Past & Current Activity	Future Activities	Impact on CA	Opportunities	Risks & Barriers	Codes & Standards Recommendation
SGIP PAP 09 – Standard DR and DER Signals			Review and insight into DR messaging protocols: OpenADR 2.0a and 2.0b Profiles, and SEP 2.0		Update CEC Title 20 and Title 24 to mandate utilization of DR protocols identified in NIST CoS
SGIP PAP 10 – Standard Energy Usage Information			See Table 15 summarizing NAESB activities		
SGIP PAP 17 – Facility Smart Grid Information Standard					
SGIP PAP 18 – SEP 1.x to SEP 2 Transition and Coexistence			Utilize PAP18 output to consider transition from SEP 1.x to SEP 2.0		
SGIP PAP 19 – Wholesale DR			Utilize IEC CIM mappings to OpenADR		

THE AMERICAN SOCIETY OF HEATING, REFRIGERATION, AND AIR-CONDITIONING ENGINEERS

OVERVIEW AND MISSION

ASHRAE[169] is a society of building technology industry members that focuses on building systems, EE, indoor air quality, refrigeration, and sustainability. ASHRAE operates as both an industry association and a standards development organization, and contributes research, publishing, and industry education. AHSRAE collaborates with the DOE's Building Energy Codes Program and with the International Codes Council (ICC). ASHRAE standards tend to focus on testing standards to quantify compliance or performance of equipment and buildings, and ASHRAE assists its members in developing standards and methods for meeting regulatory and code mandates. Notably, the organization has influence on determining a practical approach to compliance.

[169] ASHRAE website; https://www.ashrae.org/

CURRENT DSM ACTIVITIES

ANSI/ASHRAE/IES STANDARD 90.1-2013 AND 90.2-2007

ASHRAE *90.1-2013 – Energy Standard for Buildings Except Low-Rise Residential Buildings*[170] provides the minimum requirements for energy-efficient design of most buildings, except low-rise residential buildings. It offers, in detail, the minimum energy-efficient requirements for design and construction of new buildings and their systems, new portions of buildings and their systems, and new systems and equipment in existing buildings, as well as criteria for determining compliance with these requirements. This version is an update for 2013 that includes new content, more detailed requirements, and changes resulting from more than 100 addenda. Some of the changes for ASHRAE 90.1-2013 follow:

- Improvements to daylighting controls, space-by-space lighting power density limits, and thresholds for top-lighting
- Revised equipment efficiencies for heat pumps, packaged terminal air conditioners, single package vertical heat pumps and air conditioners, and evaporative condensers
- New provisions for commercial refrigeration equipment and improved controls for heat rejection and boiler equipment
- Improved requirements for expanded use of energy recovery, small-motor efficiencies, and fan power control and credits
- Improved equipment efficiencies for chillers
- Clarifications for the use of prescriptive provisions when performing building energy use modeling, and revisions to enhance capturing daylighting when performing modeling calculations
- A new alternate compliance path to Section 6, “Heating, Ventilating, and Air-Conditioning,” for computer room systems, developed with ASHRAE TC 9.9.

The ASHRAE 90.2-2007 – *Energy-Efficient Design of Low-Rise Residential Buildings* standard similarly provides minimum requirements for the design and construction of energy-efficient design of low-rise residential buildings.

ANSI/ASHRAE/USGBC/IES STANDARD 189.1-2011 – STANDARD FOR THE DESIGN OF HIGH-PERFORMANCE GREEN BUILDINGS

ASHRAE *189.1-2011 – Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings* [171] provides the minimum requirements for the design, construction, and plans for operation of high-performance, green buildings, including new buildings and their systems, new portions of buildings and their systems, and new systems and equipment in existing buildings. Topics include water use efficiency, indoor environmental quality, energy efficiency, site sustainability, and a building’s impact on the atmosphere. The standard presents goals of establishing mandatory criteria in

[170] ASHRAE website; https://www.ashrae.org/resources--publications/bookstore/standard-90-1

[171] ASHRAE website; http://www.ashrae.org/File%20Library/docLib/Public/20100315_1891FAQ.pdf

all topical areas, providing simple compliance options and information on the complement of green building rating programs. The standard also takes into account requirements to ensure that projects can be ready for renewable energy in the future. The optional prescriptive path normally requires that a minimum amount of annual energy be provided by onsite renewable energy sources.

This current 2011 standard is an update to the 2009 version and has industry-wide visibility. It is written with code-intended language and is having a significant impact on the design and construction of buildings and presents a necessary start toward the goal of net-zero-energy buildings as endorsed by ASHRAE. ASHRAE Standing Project Committee 189.1 follows the ASHRAE continuous maintenance process to update this standard.

DOE and the National Renewable Energy Laboratory estimate that applying the minimum set of recommendations in Standard 189.1-2011 will produce energy savings of 27% when compared to Standard 90.1-2007—the standard often utilized by use by states and municipalities for their own buildings, incentive programs and private/public construction. Standard 189.1-2011 has been incorporated as baseline requirements by associations with green building ratings, such as U.S. Green Building Council (USGBC) and Green Building Initiative (GBI).

ASHRAE's Advanced Energy Design Guides (AEDG)

The AEDG[172] series of publications provides recommendations for achieving energy savings over the minimum code requirements of ANSI/ASHRAE/IESNA Standard 90.1. Following these recommendations can be the first step toward achieving a zero-net-energy building—a building that uses onsite renewable energy sources to annually draw from outside resources energy equal to or less than the energy than it provides. The AEDGs were developed in collaboration with several partnering organizations: American Institute of Architects, Illuminating Engineering Society of North America (IES), USGBC, and DOE. The New Building Institute participated in the development of the initial guide.

The original series of AEDGs seek to help users achieve an energy savings target of 30% over Standard 90.1-1999. Six of these 30% saving guides have been published to date. Each 30% saving guide addresses a specific building type. A series of seven guides with an energy savings of 50% over Standard 90.1-2004 are being assembled, with four guides have published to date and three more planned. Each 50% saving guide addresses a specific building type as well. To promote building EE, ASHRAE and its partners are making the guides) for 30% and 50% savings available for free download.[173]

The recommendations in the AEDGs allow those involved in designing or constructing various building types to achieve advanced levels of energy savings without having to resort to detailed calculations or analyses. The prescriptive energy-saving recommendations are contained in a single table for each of the eight U.S. climate zones. Additionally, two guides for existing buildings have been completed and technical support documents for the 30% and 50% AEDGs have been developed. The AEDGs also provide a prescriptive path to achieving Leadership in Energy & Environmental Design (LEED) Compliance with New Construction, and for Energy and Atmosphere points.

[172] ASHRAE website; https://www.ashrae.org/standards-research--technology/advanced-energy-design-guides

[173] ASHRAE website; https://www.ashrae.org/standards-research--technology/advanced-energy-design-guides#completed

A major 2010 survey, *Evaluation of the Market Impact of the ASHRAE Advanced Energy Design Guides*[174] assessed awareness, usefulness, and impact of the 30% saving guides. In response, the majority of the user community reported that they were aware of the guides and that the guides were credible and useful. The estimated impact of AEDG use is a 24–28% reduction in energy use compared with the minimum requirements in ASHRAE Standard 90.1-1999.

SPC 201P – Proposed Facility Smart Grid Information Model Standard

Authorized in June 30, 2010, SPC 201P[175] defines an abstract, object-oriented information model to manage electrical loads and generation sources in response to communication with the smart grid and to communicate information about those electrical loads to a utility and other electrical service providers. The standard is applicable to home, building and industrial appliances and control systems. The intent is to provide "*a comprehensive set of data objects and actions that support a wide range of energy management applications and electrical service provider interactions including but not limited to:*

(a) on-site generation,

(b) DR,

(c) electrical storage,

(d) peak demand management,

(e) forward power usage estimation,

(f) load shedding capability estimation,

(g) end load monitoring (sub metering),

(h) power quality of service monitoring,

(i) utilization of historical energy consumption data, and

(j) direct load control."

The DR aspects in SPC 201P adopt the OASIS Energy Interoperation, Energy Market Information Exchange and Web Services Calendar standards that are further described in the *Open Automated DR* section.

[174] Energy Center of Wisconsin, *Evaluation of the Market Impact of the ASHRAE Advanced Energy Design Guides*, March 2010; https://www.ashrae.org/File%20Library/docLib/Special%20Projects/AEDGPresentations/AEDG-30-percent-finalmarketreport_04_14_10.pdf

[175] ASHRAE, *Facility Smart Grid Information Model*, July 2012; https://osr.ashrae.org/Public%20Review%20Draft%20Standards%20Lib/ASHRAE%20201%20APR%20Draft.pdf

ANSI/ASHRAE STANDARD 135 – BACNET®

BACnet® is a data communication standard for building automation and control. To build upon and leverage a large installation base, BACnet is a key standard for DR and PLS that allows for monitoring and control of devices, systems, and electric loads within buildings. OpenADR was designed to interface with building control and automation systems (BACS) such as BACnet.

FUTURE DSM ACTIVITIES

ASHRAE is recognizing the evolution in technologies and policies enabling and promoting DR.[176] However, initial attempts to incorporate DR into the ASHRAE standards have not progressed. For example, in 2012, two proposals for including DR provisions in ASHRAE Standards 90.1 and 189.1 were returned for further elaboration or redirected to other sub-committees:

- A Research Topic Acceptance Request, *Data-driven Building Models for Smart Meters,*[177] to "Develop a different approach to overall building energy performance than the current Standard 90.1 and 90.2 Energy Cost Budget methods," including DR was submitted, and rejected. While the topic seemed valid, the review committee believed that "This research seems more appropriate for industry funding."
- A Work Statement (1543-WS[178]), *Demand Response Optimization Protocol and Integrated Training*, was returned with comments.

ASHRAE recently published an article*, Thermal Energy Storage for Residential Settings,*[179] that illustrates PLS capabilities and advocates further exploration by ASHRAE, stating that "*electric thermal storage is a mature technology.*"

If ASHRAE were to take a leadership position by integrating DR capabilities within their standards, significant progress could be made with regards to DR-ready devices, such as HVAC thermostatic controls, that consumers purchase every day. The ASHRAE standards can be more prescriptive than CEC Title 20 and Title 24 by including mandated standardized interfaces to ensure interoperability.

ASHRAE 90.1 discussed above has existed for more than 35 years and is updated on a three-year cycle, with the expectation that buildings will become more energy efficient buildings as a result of changes in design and construction practices and in compliance with DOE's Building Energy Codes Program. ASHRAE 90.2 was originally published in 1993 with periodic updates as changing requirements are warranted. Each update results in more stringent requirements, and it is expected that the standard will eventually surpass the energy savings recommended in the 30% Advanced Energy Design Guides.

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[176] *The Key to Energy Efficiency in Buildings: ASHRAE's Response to the McKinsey Report 'Unlocking Energy Efficiency in the U.S. Economy;'* https://www.ashrae.org/File%20Library/docLib/Government%20Affairs/20090811_mckinseyresponse.pdf

[177] ASHRAE memo, July 25, 2012: http://www.ashrae.org/File%20Library/doclib/Research/TW2012ImplementationPlan/1676-RTAR.pdf

[178] AHSRAE memo, April 20, 2012; http://www.ashrae.org/File%20Library/doclib/Research/TW2012ImplementationPlan/1543-WS.pdf

[179] http://bookstore.ashrae.biz/journal/download.php?file=2013aug_092-095_emerging_hastback.pdf

Bearing on California DR Programs

ASHRAE is a stakeholder participant in the CEC Title 20 and Title 24 standards development process. Collaboration with ASHRAE and their members is a vital step towards developing both DR acceptance and DR-ready capabilities. Leveraging interoperability standards like OpenADR to interface with ASHRAE standards like BACnet, which is broadly adopted for BACS, is a practical approach for enabling DR and PLS utilizing capabilities that already exist in many buildings.

Summary of ASHRAE Activities, Impacts, Opportunities, and Recommendations

Table 18 summarizes the activities in ASHRAE that may have relevance in California, as well as opportunities and recommendations that arise from these activities.

Table 18. Summary of ASHRAE Activities, Impacts, Opportunities, and Recommendations

Past & Current Activity	Future Activities	Impact on CA	Opportunities	Risks & Barriers	Codes & Standards Recommendation
ANSI/ASHRAE/IES Standard 90.1 – 2013 Energy Standard for Buildings	Updated on a three-year cycle				Encourage continued synergies with Title 24 to improve building systems efficiencies
ANSI/ASHRAE/IES 90.2 – 2007 Energy-Efficient Design of Low-Rise Residential Buildings	Standard on continuous maintenance				
ANSI/ASHRAE/USGBC/IES Standard 189.1-2011 – Standard for the Design of High-Performance Green Buildings	Standard on continuous maintenance	Incorporated as baseline requirements by associations with green building ratings such as USGBC and GBI	Written with code-intended language; Presents a necessary start toward the goal of net-zero-energy buildings		
Advanced Energy Design Guides (AEDG)		Prescriptive path to achieving LEED Compliance	Collaborate to integrate DR as well as EE measures into AEDG		
SPC 201P Proposed Facility Smart Grid Information Model Standard			Broader industry recognition and adoption of OASIS EnergyInterop , eMIX and WS Calendar, the basis of OpenADR 2.0		Update CEC Title 20 and Title 24 to mandate utilization of DR protocols identified in NIST CoS
ANSI/ASHRAE Standard 135 - BACnet®	Standard on continuous maintenance		Compatibility with OpenADR 2.0		

UNITED STATES GREEN BUILDING COUNCIL

OVERVIEW AND MISSION

The USGBC[180] association administers the LEED certification program, which guides design, construction, operations, and maintenance for buildings, homes and communities. USGBC brings together 13,000 member organizations and 188,000 LEED professionals. USGBC's mission is: "To transform the way buildings and communities are designed, built and operated, enabling an environmentally and socially responsible, healthy, and prosperous environment that improves the quality of life." LEED is the most widely recognized and used green building program globally and is certifying 1.5 million ft^2 of building space each day in 135 countries. More than 54,000 projects are currently participating in LEED, comprising more than 10.1 billion ft^2 of construction space. Studies have shown that LEED-certified buildings cost less to operate by reducing energy and water costs by as much as 40%.[181]

CURRENT DSM ACTIVITIES

The LEED green building program was established in 2000 to provide a framework for identifying and implementing practical and measurable green building design, construction, operations, and maintenance solutions. Third-party verification is a key aspect of the program. Building projects satisfy prerequisites and earn points to achieve different levels of certification. Prerequisites and credits differ for each rating system, which are chosen by the project teams based on such characteristics as construction type and space-usage type. Thus, LEED for schools and LEED for healthcare projects certify under separate rating systems, as do neighborhood development projects.

LEED defines five main credit categories: Sustainable Sites, Water Efficiency, Energy & Atmosphere, Materials & Resources, and Indoor Environmental Quality. Seven additional credit categories are defined for neighborhoods, homes, design or innovation, and regional priorities. In addition, alternative compliance paths have been defined.

USGBC provides reference material for project teams, such as LEED Reference Guides, Minimum Program Requirements, and Supplemental Guidance to the Minimum Program Requirements.

The LEED v4[182] update launched in November 2013 includes new impact categories that serve as drivers for revising the technical requirements of the rating system and are used to assign points to each credit. LEED v4 adds new technical rigor; new market sectors (e.g., data centers); and new support tools, as well as the associated forms, guides and processes.

[180] USGBC website; http://www.usgbc.org/

[181] USGBC website; http://www.usgbc.org/leed/why-leed

[182] USGBC, *LEED v4*; http://www.usgbc.org/leed/v4

LEED Pilot Credit for DR

With the posting in July 2010 of LEED Pilot Credit 8: DR, LEED projects were able to achieve points for participating in DR programs for the first time.[183] Through this testing process, the credit has evolved and is a part of LEED v4.

DR Partnership Program (DRPP)

DRPP[184] is a program started April 2013 by USGBC and the Environmental Defense Fund to bring the building and energy communities together and to increase participation in DR programs. DRPP efforts are divided into two categories: engagement, and research. In the engagement phase, LEED-certified or LEED-registered projects in selected areas are connected with representatives from their local utility to determine if they are good candidates for DR. If so, the projects become participants in the program and share data about their experiences before, during, and after DR events. During the research phase, information gathered from LEED projects is turned into a set of case studies that help the building and energy industries learn more about the possibilities of DR for buildings, the environment, and the electrical grid.

SCE is the official utility host for this program. LEED-registered and LEED-certified projects of existing SCE customers are invited to join as participants. In August of 2013, two more new members joined the DRPP team:

- NV Energy is the DRPP utility host for the state of Nevada. This expands the reach of the program and makes it available to LEED projects (in the applicable rating systems) that are NV Energy customers.
- Enerliance, a technology service provider, will gather data from buildings before, after, and during DR events that will help address DR goals. Enerliance is the company behind LOBOS, an intelligent optimization system for large buildings that offers improved comfort, energy-efficiency, and fully-automated DR capability.

Future DSM Activities

The logical progression is for USGBC to adopt and expand the LEED pilot credit for DR and expand DRPP. The research and collaboration aspects of DRPP will continue to inform and shape the DR pilot credit. Based on the findings, adjustments can be made as needed through the addenda process. Participation and support of stakeholders such as SCE will be required to advance the nascent expansion of LEED into DR.

[183] LEED Pilot Credit Library: Pilot Credit 8: Demand Response, March 1, 2012; http://www.usgbc.org/Docs/Archive/General/Docs7711.pdf

[184] USGBC website: http://www.usgbc.org/leed/tools/pilot-credits/demand-response

BEARING ON CALIFORNIA DR PROGRAMS

The USGBC LEED certification program has become very popular for new construction and retrofit/remodel construction in California. Partnering with USGBC to promote and expand the DR pilot credit is another avenue to educate and engage customers considering LEED building certification.

SUMMARY OF USGBC ACTIVITIES, IMPACTS, OPPORTUNITIES, AND RECOMMENDATIONS

Table 19 summarizes the activities in USGBC that may have relevance in California, as well as opportunities and recommendations that arise from these activities.

TABLE 19. SUMMARY OF USGBC ACTIVITIES, IMPACTS, OPPORTUNITIES, AND RECOMMENDATIONS

Past & Current Activity	Future Activities	Impact on CA	Opportunities	Risks & Barriers	Codes & Standards Recommendation
LEED pilot credit for DR			Collaborate to advocate and expand the LEED pilot credit		
DRPP			Inform and shape the DR pilot credit		

ASSOCIATION FOR DR & SMART GRID (ADS)

OVERVIEW AND MISSION

ADS[185] grew out of the Demand Response Coordinating Committee (DRCC), a 501 c (3) non-profit organization formed in 2004 to increase the U.S. knowledge base on DR and facilitate the exchange of information and expertise among DR practitioners and policymakers. It later adopted the smart grid as part of its charter as it recognized that DR and smart grid were necessarily intertwined and that DR was one of the primary ways that the smart grid would be "put into action." Technology companies, utilities, non-profit organizations, academic institutions, and other entities are welcomed, and ADS is now also a membership association for DR and smart grid professionals.

[185] ADS website; http://www.demandresponsesmartgrid.org/

CURRENT DSM ACTIVITIES

ADS CASE STUDIES

The ADS case studies address the mandate included in the 2010 NAPDR,[186] a report to U.S. Congress issued by FERC in June 2010. This report called for the development of case studies to illustrate lessons learned. In developing its own plan, ADS selected case studies that would be most useful to its target audiences of DR practitioners, smart grid technology providers, service providers, policymakers, and other stakeholders involved in DR and smart grid activities. Consumers and the general public are not the intended audience of the case studies. Case studies to date include the following:

- *San Diego Gas & Electric – Innovation in a Learning Organization*[187] details how SDG&E's AMI meter deployment and customer outreach evolved traditional business processes, products, programs, and systems (published October 2013).
- *Pacific Gas & Electric SmartRate:™ Product Design Converges on Customer Experience*[188] discusses the rollout of a residential critical peak pricing program (published September 2013).
- *Salt River Project – The Persistence of Consumer Choice*[189] examines the role of consumer options related to pricing options (published June 2012).
- *PowerCentsDC – A Model for Stakeholder Collaboration*[190] describes a Smart Meter pilot program with 900 representative customers selected at random (published February 2011).

ADS REPORTS

ADS publishes two kinds of reports to meet primary needs: reports that review DR-related policy activities and reports intended to fulfill part of the implementation proposal for the 2010 NAPDR. Specifically, the 2010 NAPDR called for a national forum on DR, to be directed by DOE and FERC and with working groups to address targeted topics and generate reports. Reports to date include the following:

- *Demand Response 2.0: A Future of Customer Response,*[191] which begins to explore the concept of transactive energy and was authored by Paul De Martini, Newport Consulting, and ADS for

[186] FERC, *National Action Plan on Demand Response,* June 17, 2010; https://www.ferc.gov/legal/staff-reports/06-17-10-demand-response.pdf

[187] ADS, *San Diego Gas & Electric – Innovation in a Learning Organization*, October 2013; http://www.demandresponsesmartgrid.org/Resources/Documents/Case Studies/SDGE_CaseStudy_FINAL.pdf

[188] ADS, Case Study: *Pacific Gas & Electric SmartRate:™ Product Design Converges on Customer Experience*, September 2013; http://www.demandresponsesmartgrid.org/Resources/Documents/Case Studies/PGE-CPP-CaseStudy_Final_13.09.07.pdf

[189] ADS, *Salt River Project - The Persistence of Consumer Choice, June 2012;* http://www.demandresponsesmartgrid.org/Resources/Documents/Case Studies/SRP_CaseStudy_FINAL_061812.pdf

[190] ADS, *PowerCentsDC - A Model for Stakeholder Collaboration*, February 2011; http://www.demandresponsesmartgrid.org/Resources/Documents/NAP Docs/PowerCentsDC_FINAL_11_02_11.pdf

[191] FERC/DOE, *Demand Response 2.0: A Future of Customer Response*, July 2013; http://www.demandresponsesmartgrid.org/Resources/Documents/FINAL_DR%202.0_13.07.08.pdf

LBNL on behalf of the DOE. According to the report, "Transactive energy refers to the use of economic transactions to coordinate distributed energy resources to meet multiple generation, transmission and distribution objectives." DR is one of the DER that would use ". . . information regarding economic value across balancing markets and distributed grid control systems [resulting] in the exchange of value signals among all participants, including customers."

- *Demand Response & Smart Grid—State Legislative and Regulatory Policy Action Review:* July 2011 – May 2012,[192] prepared by Paul Pietsch
- *Demand Response & Smart Grid—State Legislative and Regulatory Policy Action Review:* May 2010 – June 2011,[193] prepared by Paul Pietsch
- *Demand Response & Smart Grid—State Legislative and Regulatory Policy Action Review*: October 2008 – May 2010,[194] prepared by the DRCC
- *Demand Response and Smart Metering Policy Actions Since the Energy Policy Act of 2005*: A Summary for State Officials, prepared by the U.S. Demand Response Coordinating Committee for The National Council on Electricity Policy[195]

FUTURE DSM ACTIVITIES

ADS has begun an initiative to further DSM by collaborating with National Association of State Energy Officials and National Home Performance Council on a National Summit on Integrating EE & Smart Grid.[196] In this context, DR is considered a feature of the smart grid with the focus to achieve synergy with EE initiatives.

ADS is also initiating committees to further explore topics of common concern for DR implementation including:

- Pricing
- Mass market DR
- Technology
- Business case/issues

[192] ADS, *Demand Response & Smart Grid—State Legislative and Regulatory Policy Action Review: July 2011 – May 2012,* June 2012; http://www.demandresponsesmartgrid.org/Resources/Documents/State%20Policy%20Survey/2011%20-%2012%20DR%20_%20SG%20State%20Policy%20Survey_FINAL_12.06.13.pdf

[193] ADS, *Demand Response & Smart Grid—State Legislative and Regulatory Policy Action Review: May 2010 – June 2011,* June 2011; http://www.demandresponsesmartgrid.org/Resources/Documents/State%20Policy%20Survey/2010%20-%2011%20DR%20%20SG%20State%20Policy%20Survey_11%2007%2007_FINAL%20%282%29.pdf

[194] DRCC, *Demand Response & Smart Grid—State Legislative and Regulatory Policy Action Review: October 2008 – May 2010, June 2010;* http://www.demandresponsesmartgrid.org/Resources/Documents/State%20Policy%20Survey/2009_DR-SG_Policy_Survey_FINAL_10.06.17%282%29.pdf

[195] National Council on Electricity Policy, *Demand Response and Smart Metering Policy Actions Since the Energy Policy Act of 2005: A Summary for State Officials,* Fall 2008; http://www.demandresponsesmartgrid.org/Resources/Documents/Final_NCEP_Report_on_DR_and_SM_Policy_Actiona_08.12.pdf

[196] National Summit on Integrating EE & Smart Grid website; http://energyefficiencysmartgrid.org/

BEARING ON CALIFORNIA DR PROGRAMS

Because ADS primarily acts as a federal policy advocate for DR, engaging with ADS can help promote national policies to promote DR. For example, the *Demand Response 2.0: A Future of Customer Response* report articulates a vision for transactive energy that can be leveraged for regulatory advocacy. Approaches that are adopted nationally (and internationally) can be more cost-effective than regional approaches due to the broad implementation and resulting scale of common solutions.

SUMMARY OF ADS ACTIVITIES, IMPACTS, OPPORTUNITIES, AND RECOMMENDATIONS

Table 20 summarizes the activities in ADS that may have relevance in California, as well as opportunities and recommendations that arise from these activities.

TABLE 20. SUMMARY OF ADS ACTIVITIES, IMPACTS, OPPORTUNITIES, AND RECOMMENDATIONS

Past & Current Activity	Future Activities	Impact on CA	Opportunities	Risks & Barriers	Codes & Standards Recommendation
ADS Case Studies			References for DR approaches that are working in other parts of the country		
Demand Response 2.0: A Future of Customer Response			The transactive energy approach described is an economic model to optimize resource utilization	Current electricity market design favors large centralized generation resources rather than interactive DER	

SMART GRID CONSUMER COLLABORATIVE (SGCC)

OVERVIEW AND MISSION

SGCC[197] is a nonprofit organization with the objective to learn the wants and needs of energy consumers in the United States, encourage the collaborative sharing of best practices in consumer engagement among industry stakeholders, and educate the public about the benefits of the smart grid. SGCC's mission is to bring together commercial, utility, and advocacy organizations to work toward a common goal of accelerating the adoption of a smart grid that is consumer-friendly, consumer-safe, and consumer-approved.

[197] SGCC website; http://smartgridcc.org/

CURRENT SGCC ACTIVITIES

In support of the above objectives and mission, the SGCC conducts research, prepares reports, holds webinars, publishes a weekly newsletter and fact sheets, augments a resource library, develops K–12 educational resources, participates in many conferences, and hosts a consumer educational website.

Example reports for 2013 include the following:

- *2013 State of the Consumer Report*
- *Smart Grid Customer Engagement Success Stories*
- *Smart Grid Economic and Environmental Benefits*
- *Low Income Consumers*
- *Wave IV of Consumer Pulse and Market Segmentation Study*
- *Understanding Energy Consumers in their Home*

STATE OF THE CONSUMER REPORT

The SGCC has been publishing an annual *State of the Consumer Report* since 2011. The reports summarize research on customer awareness of, and attitudes toward, the smart grid. In the most recent 2013 Report, the SGCC highlights the importance of knowing one's customers and understanding the various market segments that exist relative to energy management and smart grid products/programs. SGCC considers DR to be an aspect of smart grid, and the success stories and case studies focus on efforts to communicate the benefits of smart grid to customers.

The 2013 report provides the results of consumer surveys on interest in participating in various incentive programs based on the smart grid. Although interest in individual programs can vary significantly among various customer segments, across all segments, SGCC's most recent findings indicate favorable pre-disposition among U.S. consumers toward participating in dynamic pricing programs designed to promote PLS:

- 59 % say they are somewhat likely or very likely to participate in a critical peak rebate program.
- 46% say they are somewhat likely or very likely to participate in time of use pricing.
- 32% say they are somewhat likely or very likely to participate in real-time pricing[198]

BEARING ON CALIFORNIA DR PROGRAMS

SGCC is focused on the communication and outreach aspects of smart grid solutions. Such outreach is especially important to help articulate the benefits that smart grid solutions, including DR, can deliver to customers. Although aware of these benefits, utilities can sometimes fail to communicate about them in ways that resonate with customers. Leveraging the best practices and collaborative efforts of SGCC to promote DR and PLS can help utilities improve their outreach efforts.

[198] SCGG, *2013 State of the Consumer Report*; http://smartgridcc.org/sgccs-2013-state-of-the-consumer-report

SUMMARY OF SGCC ACTIVITIES, IMPACTS, OPPORTUNITIES, AND RECOMMENDATIONS

Table 21 summarizes the activities in SGCC that may have relevance in California, as well as opportunities and recommendations that arise from these activities.

TABLE 21. SUMMARY OF SGCC ACTIVITIES, IMPACTS, OPPORTUNITIES, AND RECOMMENDATIONS

Past & Current Activity	Future Activities	Impact on CA	Opportunities	Risks & Barriers	Codes & Standards Recommendation
SGCC Consumer Research			Customer outreach to communicate the benefits of the smart grid (including DR) to customers		

THE ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

OVERVIEW AND MISSION

Founded by Thomas Edison and his associates, AEIC is one of the oldest associations in the electric energy industry. AEIC members and associate members encourage research and technical information exchange through their committees.

CURRENT DSM ACTIVITIES

The AEIC Load Research & Analytics Committee[199] has developed several white papers related to DR:

- *Demand Response - Measurement & Verification Applications for Load Research*[200] was revised in May of 2013 and attempts to standardize the terminology used when discussing DR M&V. The paper also includes methodologies for M&V processes. Although there are no formal standards, the methodologies and terminology are applicable for DR discussions. The NAESB Business Practice Standard for Measurement & Verification and FERC Order No. 676 that adopted the NAESB standard should be referenced in preference to this white paper.
- *Estimation Errors in DR with Large Customers Applications for Load Research* was produced in November, 2009 but cites challenges that are still prevalent today.

[199] AEIC Load Research Publications; http://aeic.org/committees/load-research/publications/

[200] AEIC, *Demand Response - Measurement & Verification Applications for Load Research*, March 2009.

Bearing on California DR Programs

While reports and research related to DR and PLS are infrequent, monitoring AEIC output for relevant content can provide additional information relevant to DR and PLS.

Summary of AEIC Activities, Impacts, Opportunities, and Recommendations

Table 22 summarizes the activities in AEIC that may have relevance in California, as well as opportunities and recommendations that arise from these activities.

Table 22. Summary of AEIC Activities, Impacts, Opportunities, and Recommendations

Past & Current Activity	Future Activities	Impact on CA	Opportunities	Risks & Barriers	Codes & Standards Recommendation
DR Measurement & Verification Applications for Load Research			Reference for further refinement of M&V		
Estimation Errors in DR with Large Customers Applications for Load Research					

SECTION 6. INTERNATIONAL ORGANIZATIONS

EUROPEAN UNION (EU)

REGULATORY FRAMEWORK/ELECTRICITY MARKET STRUCTURES

In 2012, the European Commission (EC) issued Directive 2012/27/EU (2012 EU Directive). This 2012 EU Directive provides strong support for the growth in DR capability within the European Union, which lags behind DR capability in the United States. Specific language from 2012 EU Directive calls for tariffs and regulations that would support dynamic pricing and DR, equal opportunity for demand-side resources (including aggregators), the removal of tariffs that would detrimental to the participation of DR in energy markets, and the definition of "technical modalities" for participating in these markets, as follows:

> *Taking into account the continuing deployment of smart grids, Member States should therefore ensure that national energy regulatory authorities are able to ensure that network tariffs and regulations incentivize improvements in EE and support dynamic pricing for DR measures by final customers. Market integration and equal market entry opportunities for demand-side resources (supply and consumer loads) alongside generation should be pursued. In addition, Member States should ensure that national energy regulatory authorities take an integrated approach encompassing potential savings in the energy supply and the end-use sectors.*
>
> *Member States shall ensure the removal of those incentives in transmission and distribution tariffs that are detrimental to the overall efficiency (including EE) of the generation, transmission, distribution and supply of electricity or those that might hamper participation of DR, in balancing markets and ancillary services procurement.*
>
> *Member States shall ensure that transmission system operators and distribution system operators, in meeting requirements for balancing and ancillary services, treat DR providers, including aggregators, in a non-discriminatory manner, on the basis of their technical capabilities.*
>
> *Member States shall promote access to and participation of DR in balancing, reserve and other system services markets, inter alia by requiring national energy regulatory authorities or, where their national regulatory systems so require, transmission system operators and distribution system operators in close cooperation with demand service providers and consumers, to define technical modalities for participation in these markets on the basis of the technical requirements of these*

> *markets and the capabilities of DR. Such specifications shall include the participation of aggregators.*[201]

The 2012 EU Directive would appear to address, at least in part, two of the primary barriers to DR in Europe cited in the recent publication, *A Demand Response Action Plan for Europe*, by the Smart Energy Demand Coalition (SEDC).[202] The first major barrier has to do with limited access of demand-side resources to energy markets:

> *[E]lectricity regulation is written assuming generation resources (not demand-side resources) will be providing additional capacity.*
>
> *[W]holesale market tender requirements and documentation are written for power generators, effectively blocking the ability for Demand-side resources to participate through requirements designed around power plant limitations and cost benefit for power plant owners.*[203]

The second major barrier has to do with the absence of capacity markets in most European Union member countries.

> *Most wholesale market structures have been designed to allow generators to receive the maximum value for the energy they produce (kWh) rather than the flexible capacity they may also enable (kW). However, as peaks have grown in severity and as more wind and solar power are added, the value (and the cost) of being able to provide electricity for short periods of time has grown substantially. Currently, due to the focus on energy markets only, the real cost of providing the capacity may not be adequately reflected in hourly electricity prices. The value of demand response lies in its ability to act as a fast, cheap capacity resource. The fact that this value is not reflected in many markets, not only severely slows the development of Demand-side offerings , but is an increasing problem for utilities facing aging generation infrastructure and at the same time increased capacity requirements for the successful integration of intermittent renewables."*[204]

A recent report by the International Energy Agency (IEA) echoes some of the same barriers identified by SEDC, while identifying more:

- *Insufficient exposure to real-time pricing to encourage DR;*
- *Under-developed legal and regulatory frameworks to support demand-response transactions;*

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[201] Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC; http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:315:0001:0056:EN:PDF

[202] SEDC is an industry group primarily dedicated to facilitating demand side program development in the EU by advocating for regulatory reforms.

[203] SEDC, The Demand Response Snap Shot, The Reality For Demand Response Providers Working In Europe Today, September 2011, http://sedc-coalition.eu/wp-content/uploads/2013/03/SEDC-DR-Snap-Shot.-FINAL.pdf

[204] *Ibid*.

- *Under-developed markets, aggregation industry, and products that limit the scope for cost effective DR and customer access, especially for low-volume customer classes;*
- *Lack of access to the detailed real-time information required to develop innovative DR products and services;*
- *Insufficient real-time monitoring, verification and control infrastructure in place to support the development of demand-response products and markets, especially among medium- and low-volume customer classes;*
- *Costly, poorly integrated and time-consuming administrative processes that discourage competition, switching, and effective exercise of customer choice;*
- *Lack of awareness about the potential opportunities and benefits from demand-side participation among customers;*
- *Relatively low financial incentives for some customer classes, especially low-volume customers;*
- *Relatively high cost of advanced metering and related management technologies relative to potential benefits, especially for low-volume customers;*
- *Insufficient scope and coverage of standards governing metering, information and communications functionality;*
- *Regulatory requirements that may restrict regulated entities from developing DR businesses or restrict customers from exercising choice; and*
- *Regulated tariffs that may mute or eliminate the potential for real-time pricing and related price signals needed to induce DR.*[205]

A report prepared for the EC in 2012, *Smart Grid Projects in Europe – Lessons Learned and Current Developments,* identifies a similar set of barriers to the development of DR capability in Europe.

> *Regulatory and market barriers seem to be the main obstacles to the development of commercially viable aggregation applications, e.g., establishing clear rules for the technical validation of flexible supply/demand (demand-response) transactions by system operators; technical/commercial arrangements for the exchange of physical and market data; clear market roles and responsibilities and fair sharing of costs and benefits; new contractual arrangements . . .*[206]

In spite of the actions called for in 2012 EU Directive, progress toward regulatory and market reform is slow. Great Britain and France have largely adopted measures that call for aggregators provide DR services to the market, and several other countries are in the process of regulatory review (Austria, Belgium, Ireland, and Switzerland). However, many other member states have been slow to adopt or

[205] IEA, *Empowering Choice in Electricity Markets*, October 2011;
http://www.iea.org/publications/freepublications/publication/Empower.pdf

[206] EC, *Smart Grid Projects in Europe – Lessons Learned and Current Developments,* 2012;
http://ec.europa.eu/energy/gas_electricity/smartgrids/doc/ld-na-25815-en-n_final_online_version_april_15_smart_grid_projects_in_europe_-_lessons_learned_and_current_developments_-2012_update.pdf

consider reforms. The timing for the creation of a regulatory and market environment conducive to DR remains uncertain.

EU Appliance Labeling and Smart Appliances

The European Union has made significant progress in product and appliance labeling. Beginning with the issuance of EC Directive 92/75/EEC in 1992 "on the indication by labelling and standard product information of the consumption of energy and other resources by household appliances,"[207] the EU embarked on a path toward consistent labeling of electrical appliances, including refrigerators, freezers washing machines, driers, dishwashers, ovens, water heaters and hot water storage appliances, lighting sources, and air-conditioning appliances. Although the EC Directive 92/75/EEC called for adoption of the provisions outlined in the EC Directive 92/75/EEC by January, 1994, actual compliance with the Directive has lagged behind this deadline. As summarized in a 2009 report, a compliance survey initiated by the EC indicated overall (all countries, all appliances) compliance with the Directive at about 61%.[208]

A subsequent EC Directive, 2010/30/EU, issued in 2010, attempted to reinforce and harmonize the labeling requirements set forth in 1992 by calling for a more standardized presentation of EE information.

> *[T]he design and content of the label … shall have uniform design characteristics across product groups and shall in all cases be clearly visible and legible. The format of the label shall retain as a basis the classification using letters from A to G; the steps of the classification shall correspond to significant energy and cost savings from the end-user perspective.*
>
> *Three additional classes may be added to the classification if required by technological progress. Those additional classes will be A+, A++, and A+++ for the most efficient class. In principle the total number of classes will be limited to seven, unless more classes are still populated*
>
> *The colour scale shall consist of no more than seven different colours from dark green to red. The colour code of only the highest class shall always be dark green. If there are more than seven classes, only the red colour can be duplicated.*[209]

The Directive called for compliance by mid-2011, with an evaluation of the Directive's effectiveness conducted by the end of 2014.

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[207] Council Directive 92/75/EEC of 22 September 1992 on the indication by labelling and standard product information of the consumption of energy and other resources by household appliances; http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:1992:297:0016:0019:EN:PDF

[208] EC, Survey of Compliance Directive 92/75/EEC (Energy Labelling), January 4, 2009; http://www.eceee.org/ecodesign/Energy_labelling_directive/Report_energy_labelling

[209] Directive 2010/30/EU of the European Parliament and of the Council of 19 May 2010 on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products; http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:153:0001:0012:en:PDF

In its *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, on Making the Internal Market Work*, the EC defined an Action Plan which calls for the creation of a "framework and market for broad introduction of smart appliances (e.g., via R&D support, standardization, ecodesign, and energy labeling)"[210] by the European Commission and stakeholders (in particular, European standardization organizations) by 2014.

Building Codes

EU Directive 2002/91/EC on the Energy Performance of Buildings, issued in 2002, required its member states to enhance their building regulations and to introduce energy certification schemes for buildings. A subsequent Directive (2010/31/EU) built on the 2002 Directive, calling for a move towards new and retrofitted nearly-zero energy buildings by 2020 (2018 for public buildings), and the application of a cost-optimal methodology for setting minimum requirements for both the envelope and the technical systems.

Although the Directive (2010/31/EU) calls for its member states to "set system requirements in respect of the overall energy performance, the proper installation, and the appropriate dimensioning, adjustment and control of the technical building systems which are installed in existing buildings," and encourages "the introduction of intelligent metering systems" and "the installation of active control systems such as automation, control and monitoring systems that aim to save energy," there is no explicit mention of the need to provide for technologies that would facilitate increased DR capability.[211] No standard for communicating with building automation systems has been promulgated or widely adopted.

Summary of EU Activities, Impacts, Opportunities, and Recommendations

Table 23 summarizes the activities in EU that may have relevance in California, as well as opportunities and recommendations that arise from these activities.

[210] EC, Communication from The Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Making the internal energy market work; http://ec.europa.eu/energy/gas_electricity/doc/20121115_iem_0663_en.pdf

[211] EU, Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings; http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:153:0013:0035:EN:PDF

TABLE 23. SUMMARY OF EU ACTIVITIES, IMPACTS, OPPORTUNITIES, AND RECOMMENDATIONS

Past & Current Activity	Future Activities	Impact on CA	Opportunities	Risks & Barriers	Codes & Standards Recommendation
Directive 2012/27/EU	Member States should ensure that network tariffs and regulations incentivize enhanced EE and support dynamic pricing for DR measures by final customers		Articulates and advocates an integrated DSM approach; Benchmarking the EU approach may be helpful to similar DSM goals in CA	* Insufficient exposure to RTP to encourage DR * Lack of access to detailed real-time information needed to develop innovative DR products and services; * Insufficient real-time M&V and control infrastructure	
	Member States shall promote access to and participation of DR in balancing, reserve, and other system services markets			Electricity regulation assumes generation resources (not demand-side resources) will provide additional capacity	
SEDC - A Demand Response Action Plan for Europe				Wholesale market tender requirements and documentation are written for power generators, blocking participation of demand-side resources	
EC Directive 92/75/EEC in 1992 & EC Directive, 2010/30/EU labeling of electrical appliances	Creation of a framework and market for broad introduction of smart appliances		Alignment with EU appliance labeling will enable a more global market for appliances complying with labeling criteria		Review EU labeling in relation to ENERGY STAR and Title 20
EU Directive 2002/91/EC on the Energy Performance of Buildings					Review building standards in relation to Title 24
Directive (2010/31/EU) nearly-zero energy buildings by 2020	Introduction of intelligent metering systems and installation of active control systems that aim to save energy				

AUSTRALIA

REGULATORY FRAMEWORK/ELECTRICITY MARKET STRUCTURES

In March 2011, the Australian Energy Market Commission (AEMC) was charged with reviewing existing the electricity market and regulations and to develop recommendations that would facilitate the growth of DR capabilities in Australia. The AEMC is the regulatory body in Australia with responsibility for "rule making and market development in regard to the operation of the electricity wholesale market and transmission regulation in the NEM [National Electricity Market]."[212] The AEMC also has authority to make rules for economic regulation of electricity distribution network services in Australia. The AEMC published its review and recommendations in a report, *The Power of Choice Review,* in November of 2012.

A key element in the report was the proposed development of a DR mechanism (DRM) that would fairly reward demand-side participation in the wholesale electricity market.

> *"Under this mechanism demand resources would be treated in a manner analogous to generation and be paid the wholesale electricity spot price for reducing demand. We recommend that AEMO develops the details for a rule change proposal and required procedures, including the baseline consumption methodology."*[213]

Following on from AEMC's report, the Australian Energy Market Operator (AEMO)[214] has now been charged by the Standing Council on Energy and Resources (SCER) with developing specific rule changes that would be required to implement the DRM and for creating an additional market participant category for the aggregation of ancillary services load.

The AEMO has formed a Stakeholder Advisory Working Group to take on this task, dividing the task into five separate activities as described in the Table 24.

[212] AEMC website; http://www.aemc.gov.au/About-Us/Who-we-are.html

[213] AEMC, Final Report. Power of choice review - giving consumers options in the way they use electricity, November 30, 2012; http://www.aemc.gov.au/media/docs/Final-report-1b158644-c634-48bf-bb3a-e3f204beda30-0.pdf

[214] The AEMO operates the bulk electrical transmission system in Australia. Its functions are similar to those of an ISO in the United States; however, the AEMO operates the entire national system rather than just a regional system.

TABLE 24. FIVE DEFINED ACTIVITIES AND OBJECTIVES OF THE AEMO STAKEHOLDER ADVISORY WORKING GROUP[215]

Activity	Objective
Registration	• Assess whether a new category of registered participant is required to implement DRM and for aggregating ancillary services load • Identify necessary registration obligations to impose on a demand response aggregator (can be for one or many loads) • Establish a recommendation on the recovery of project costs from market participants (through participant fees and the proportion)
Metering	• Establish a baseline consumption methodology for DRM customers, must be capable of being reported on • Identify metering requirements, receipt and verification of data, any changes to meter data provider roles, and any further changes necessary to the National Electricity Market and
Settlements	• Identify changes needed to settlements and prudentials to settle DRM provider or participant as a market participant in accordance with settlement billing cycle • Establish a recommendation on the recovery ancillary services, directions, administered price recovery
Performance monitoring and reporting	• Provide a report on the performance and impact of the DRM and aggregated market ancillary services load.
Dispatch	• Identify changes needed to the forecasting and dispatch processes to allow provision of energy from DRM on a scheduled or non-scheduled basis. • Identify changes needed to the forecasting and dispatch processes to allow provision of frequency control ancillary services from DRM on a scheduled basis. • Identify requirements for scheduled or non-scheduled DRM participation.

According to AEMO's schedule, their work on required procedural and rules changes would be completed by the end of 2013, with implementation of the DR mechanism occurring in 2015.

APPLIANCE LABELING AND SMART APPLIANCES

Since the initial efforts of individual Australian states beginning in 1986, Australia has steadily increased its requirements for mandatory energy labeling of appliances. Labeling and EE standards were codified for all of Australia in 2012 through the Greenhouse and Energy Minimum Standards Act. This legislation established a national framework for appliance labeling and regulatory oversight of the Equipment Energy Efficiency Program (E3). E3 established consistent labeling requirements and minimum appliance efficiency standards for the country, replacing the individual requirements of states and territories. The legislation calls for a review of the program effectiveness after five years of operations. The Australian Energy Rating Labelling Scheme applies to refrigerators, freezers, clothes washers, clothes dryers,

[215] AEMO, Implementation of a Demand Response Mechanism and a New Category of Participant for Aggregating Ancillary Services Load; http://www.aemo.com.au/About-the-Industry/Working-Groups/~/media/Files/Other/WorkingGroups/6%20May%202015%20DRM%20%20ASL%20Communication.ashx

dishwashers, air conditioners, and televisions. The scheme adopted uses a 10 star–based labeling requirement (more stars equates to higher efficiency) to assist consumers in making informed purchases. New Zealand has, in large part, adopted the same labeling scheme and requirements.

Australia is also taking a leadership role in promoting smart appliances. A *2012 Regulation Impact Statement (RIS)* prepared by E3[216] calls for the mandatory adoption of a standardized DR interface in air conditioners, pool pumps, water heaters, and electric vehicle chargers.

Standards Australia is the primary non-governmental standards organization in Australia, charged by the national government with meeting Australia's need for current, internationally aligned standards. The group published a standards roadmap for smart grids in June 2012[217] which references the 2007 initial standard, AS/NZS 4755, on *DR capabilities and supporting technologies for electrical products*.

> *Australian Standard AS/NZS 4755 is intended to enable the large scale introduction of smart appliances despite the absence of any single agreed communications protocol, and to ensure that those appliances will be able to operate with any protocol. It is an open rather than a proprietary standard, and specifies minimum physical, functional and electrical requirements for an interface, analogous to the Universal Serial Bus (USB) standard which establishes communications between personal computers and the devices they control.*
>
> *An appliance complying with AS/NZS 4755 'DR capabilities and supporting technologies for electrical products' ('AS/NZS 4755' or 'the Standard') must be capable of entering a limited set of 'DR modes' (DRMs). The DRMs in AS/NZS 4755 include the ability (on receipt of a load control signal) to turn off/change to minimum load settings, limit load to 50 or 75 per cent, and shift load or store energy. If these capabilities are present and connected to a communications pathway via a DR controller ('the controller') or a smart meter, the utility can instruct the appliance to reduce load during peak load events. Alternatively, the consumer can program the controller to enter a DRM when pre-set electricity price or other criteria are met (this behaviour is known as 'price responsive' DR).*[218]

As of December 2012, the status of AS/NZS 4755 and subsequent iterations or revisions was described in Table 25, based on the RIS document.

[216] E3 Consultation Regulation Impact Statement Mandating 'Smart Appliance' Interfaces for Air Conditioners, Water Heaters and other Appliances; http://www.energyrating.gov.au/wp-content/uploads/Energy_Rating_Documents/Library/General/Regulatory_Impact_Statements/Smart-Appliance-Consultation-RIS.docx

[217] Australian Standards for Smart Grids – Standards Roadmap, June 2012; http://www.standards.org.au/Documents/120904%20Smart%20Grids%20Standards%20Road%20Map%20Report.pdf

[218] AEMC, Energy Efficiency and Peak Load Reduction – the work of DCCEE and Equipment Energy Efficiency (E3) Program, August 2011; http://www.aemc.gov.au/Media/docs/Department%20of%20Climate%20Change%20and%20Energy%20Efficiency-6063cf28-84be-4c1b-84a6-b55f04e79d9e-0.pdf

TABLE 25. STATUS OF AS/NZS 4755, DECEMBER 2012[219]

Standard	Part Title	Status
AS4755-2007	Framework for DR capabilities and supporting technologies for electrical products	Published April 2007. Will be superseded by AS/NZS 4755.1 (when published)
AS/NZS 4755.1 (a)	Framework for DR capabilities and supporting technologies for electrical products, and requirements for DR enabling devices	Draft unchanged since last WG meeting. Next draft planned early 2013. Completion expected by mid-2013 (will supersede AS4755). (Responsibility – WG1)
AS/NZS 4755.3.1	Interaction of DR enabling devices and electrical products—Operational instructions and connections for air conditioners (published as AS4755.3.1, 2008)	First published December 2008 as AS4755.3.1. Revision published May 2012.
AS/NZS 4755.3.2	Interaction of DR enabling devices and electrical products—Operational instructions and connections for swimming pool pump-unit controllers	Published May 2012
AS/NZS 4755.3.3	Interaction of DR enabling devices and electrical products—Operational instructions and connections for electric and electric-boosted water heaters	Draft unchanged since last WG meeting. Next draft planned early 2013. Completion expected by mid-2013. (Responsibility – WG3)
AS/NZS 4755.3.4	Interaction of DR enabling devices and electrical products—Operational instructions and connections for charge/discharge controllers for EVs	Draft at advanced stage. Next WG meeting Brisbane 28 November. Completion expected early 2013. (Responsibility – WG4)
AS/NZS 4755.3.5	Interaction of DR enabling devices and electrical products—Operational instructions and connections for inverter energy systems (b)	Same key elements as AS/NZS 4755.3.4. DR rules to be included in AS4777 *Grid connection of energy systems via inverters* (forthcoming – being prepared by EL-42). Possible future publication as a separate standard AS/NZS 4755.3.5 depends on finding a sponsor. (Responsibility – WG4)

Australia has been working through the Asia-Pacific Economic Cooperation and with the IEC to promote broader adoption or harmonization of smart appliance standards. The IEC has established a Working Group on smart appliance standards in which Australia participates.

[219] E3 Consultation Regulation Impact Statement, *op. cit.*

BUILDING CODES

Since 2006, the Building Code of Australia (BCA) has provided EE standards measures for all building classifications covered by the National Construction Code. The National Construction Code for buildings, first issued in Australia in 2011, set forth EE performance requirements and standards for building construction, including the facility to monitor energy use. However, at this time, the codes contain no requirements or initiatives that relate specifically to DR. Further, no standard for communicating with building automation systems has been promulgated or widely adopted.

Figure 10 outlines the historical timeline related to building code EE requirements.

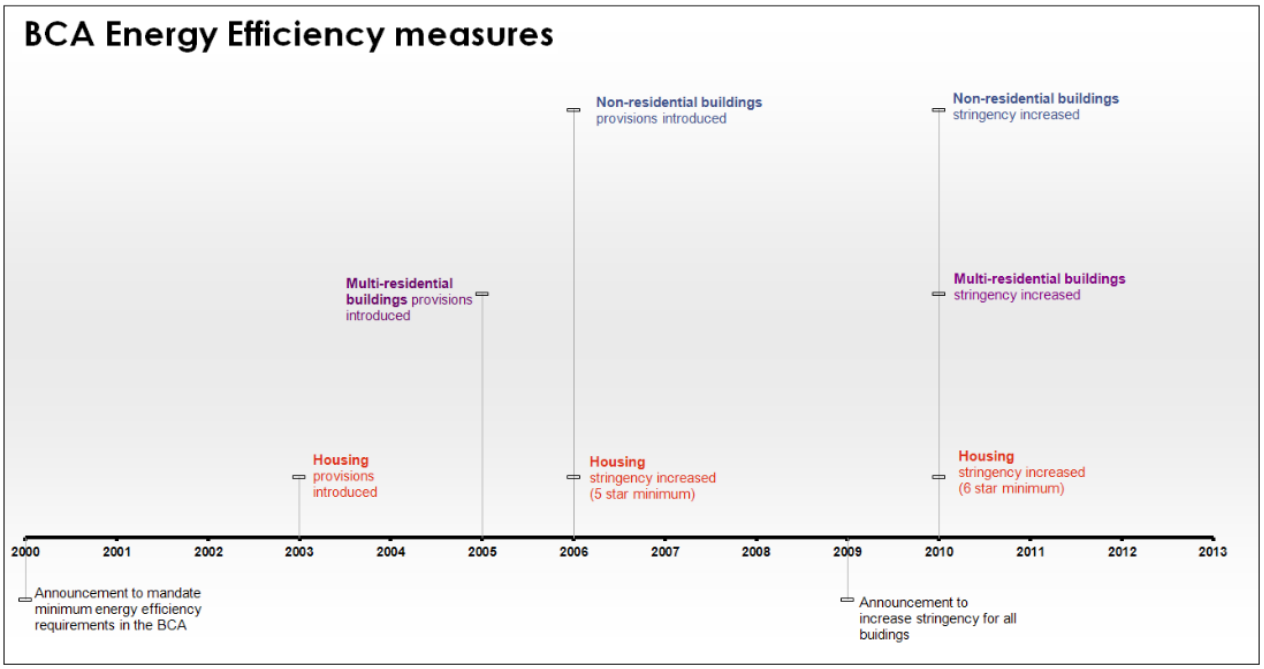

FIGURE 10. TIMELINE OF BCA EE MEASURES[220]

[220] ABCB website; http://www.abcb.gov.au/major-initiatives/energy-efficiency

SUMMARY OF AUSTRALIAN ACTIVITIES, IMPACTS, OPPORTUNITIES, AND RECOMMENDATIONS

Table 26 summarizes the activities in Australia that may have relevance in California, as well as opportunities and recommendations that arise from these activities.

TABLE 26. SUMMARY OF AUSTRALIAN ACTIVITIES, IMPACTS, OPPORTUNITIES, AND RECOMMENDATIONS

Past & Current Activity	Future Activities	Impact on CA	Opportunities	Risks & Barriers	Codes & Standards Recommendation
Australian Energy Market Commission	DMR that would fairly reward Demand-side Participation in the wholesale electricity market		Addressing similar challenges as CAISO in integrating DR into the wholesale market		
Equipment Energy Efficiency Program	RIS calls for the mandatory adoption of a standardized DR interface in air conditioners, pool pumps, water heaters, and electric vehicle chargers		Alignment with Australia appliance labeling will enable a more global market for appliances complying with labeling criteria		Review Australian labeling in relation to ENERGY STAR and Title 20
Standards Australia AS/NZS 4755	Mandatory adoption of a standardized DR interface in air conditioners, pool pumps, water heaters, and electric vehicle chargers		Alignment with Australia appliance standards for DR will enable a more global market for appliances complying with DR criteria		Review EU labeling in relation to ENERGY STAR and Title 20

JAPAN

REGULATORY FRAMEWORK/ELECTRICITY MARKET STRUCTURES

The electricity market in Japan remains dominated by vertically integrated regional electric utilities. Although the market has been "opened" to allow for independent generators to participate in the market, many technical and regulatory barriers remain to the creation of an open market and pricing mechanisms that would facilitate the growth of DR. Although one proposal for reform of the electricity market was recently passed by the national legislature of Japan (the Japanese Diet), the focus of this measure was the creation of an independent body to coordinate supply and demand across all of the

existing regional grids within Japan. The existing regional grids are currently operated independently from one another, with regional grids in the west operating at 60 Hz and grids in the east operating at 50 Hz. The Organization for Cross-regional Coordination of Transmission Operators, expected to be operational in 2016, has been charged with the following key responsibilities:

- Develop a national supply/demand plan and an electrical grid plan
- Promote the development of transmission infrastructure such as frequency converters and interconnection lines between areas
- Coordinate supply and demand during both normal operations and tight supply/demand conditions.

Additional reforms are being advocated by the government that would require legislative action for their realization. These reforms include:

- Full liberalization of entry to electricity retail business by 2016
- Legal separation of the power transmission/distribution sector and full liberalization of retail electricity rates by 2018 to 2020

Depending on the final form of these proposed reforms, the growth of DR capability could be advanced. However, in most of its recent policy statements, Japanese government seems more on stimulating the growth in supply than in managing demand.

However, in response to the Fukushima nuclear accident of 2011, the Japanese government has expressed increased interest in DR. In *Electricity Supply-Demand Outlook & Measures for the Summer of FY2013*, published in April 2013, the Agency for Natural Resources and Energy directed utilities to "promote demand-side efforts, such as expanding supply-demand adjustment contracts and using aggregators [for] negawatt[221] trading, [and] and other demand response measures."[222]

In addition, the Agency for Natural Resources and Energy in its FY2012 Annual Report on Energy (Energy White Paper 2013) Outline" notes:

> *Experiments with demand response systems (which allow consumers to make selections according to supplier conditions) were conducted in four regions in Japan. These systems achieved a reduction of around 20% in the peak demand, demonstrating that peak demand can be controlled with systems and technology and that such control is also beneficial to consumers.*[223]

Still, it would seem that the market and regulatory reforms necessary to promote significant DR capability in Japan are five to seven years away, at the earliest. Smart meters, which could facilitate DR, are still in the early stage of deployment in Japan.

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[221] A "negawatt" is a term that has been coined to designate a delivered reduction in electric demand.

[222] Agency for Natural Resources and Energy, *Electricity Supply-Demand Outlook & Measures for the Summer of FY2013, April 2013;* http://www.meti.go.jp/english/earthquake/electricity/pdf/20130610_01.pdf

[223] Agency for Natural Resources and Energy, *FY2012 Annual Report on Energy (Energy White Paper 2013) Outline*, June 2013, http://www.meti.go.jp/english/report/downloadfiles/2013_outline.pdf

Appliance Labeling and Smart Appliances

In a 1998 amendment to its Energy Conservation Law of 1979, Japan introduced an EE and appliance labeling program called Top Runner. Top Runner established mandatory minimum efficiency standards for most consumer appliances and automobiles. In 2000, a labeling scheme was added to the program. Top Runner differs from other EE programs in that standards for appliances and automobiles are defined by the most efficient energy designs currently on the market or, in some cases, by impending future market designs. This market-based approach differs from programs in the US, EU, and Australia, which are more technology- and analytic-based and consider costs in the setting of standards.

Japan has been active with Asia-Pacific Economic Cooperation and ICE in their ongoing initiatives to promote the harmonization of standards for smart appliances.

Building Codes

Building codes in Japan were first instituted nationwide in 1980 as a result of the Energy Conservation Law (ECL). This legislation, which has been modified numerous times, defines mandatory energy conservation standards for three sectors: Industrial, Consumer (buildings and residential), and Transportation. In the Consumer Sector, this legislation applies to:

- Structures on a large scale with a total floor areas of at least 2,000 m^2
- Small to mid-size structures with a total floor area of at least 300 m^2
- Business operators who build and sell residential buildings (annually supplying at least 150 units)

Commercial building standards relate to thermal insulation performance, HVAC, lighting, hot water supply, and elevators. Residential standards relate to thermal insulation, air tightness, sunlight shielding, and HVAC systems. In addition, with an amendment to the ECL in 2012, the Top Runner program was expanded to include building materials, such as windows, insulation material, and water supply equipment.

In 2001, Japan introduced subsidies for building and home energy management systems through a program administered by the Ministry of Economy, Trade and Industry. The building energy management system market in Japan is dominated (an estimated 50-60% market share) by Azbil, which uses a proprietary protocol for communications with devices within the building. The Japanese government has also established subsidies for the construction of net-zero-energy buildings, and has set a target for newly-constructed public buildings by the year 2020.

Summary of Japanese Activities, Impacts, Opportunities, and Recommendations

Table 27 summarizes the activities in Japan that may have relevance in California, as well as opportunities and recommendations that arise from these activities.

TABLE 27. SUMMARY OF JAPANESE ACTIVITIES, IMPACTS, OPPORTUNITIES, AND RECOMMENDATIONS

Past & Current Activity	Future Activities	Impact on CA	Opportunities	Risks & Barriers	Codes & Standards Recommendation
Electricity Supply-Demand Outlook & Measures for the Summer of FY2013	Promote demand-side efforts, such as expanding supply-demand adjustment contracts and using aggregators, megawatt trading, and other demand response measures				Review Japan appliance standards and labeling in relation to ENERGY STAR and Title 20
Energy Conservation Law "Top Runner."			Alignment with Australia appliance standards and labeling for DR will enable a more global market for appliances complying with DR criteria		
Energy Conservation Law Building Codes			Subsidy based incentive for building energy management systems, home energy management systems, and net-zero-energy buildings		Review Japan building code in relation to Title 24

SECTION 7. DR MESSAGING PROTOCOL STANDARDS

OPEN AUTOMATED DR

OVERVIEW AND MISSION

OpenADR[224] is a messaging protocol standard that enables automated DR in response to DR event or pricing messages to facilitate dynamic pricing and electricity grid reliability. The initial 1.0 version of OpenADR was developed with the LBNL DRRC[225] (see section on *DOE National Laboratories*) before being turned over[226] to OASIS for further development. OpenADR 2.0 leverages portions of the OASIS Energy Interoperation (EnergyInterop),[227] Energy Market Information Exchange,[228] and Web Services Calendar[229] standards. OASIS became an active participant in the NIST SGIP (see *Smart Grid Interoperability Panel* section) and the requirements for EnergyInterop, Energy Market Information Exchange, and Web Services Calendar were based on the output from PAP 04,[230], PAP 03,[231], and PAP 09.[232]

The OpenADR Alliance is a member organization that collaborates on OpenADR promotion, education development, adoption, and compliance. Alliance activities include the following: [233]

- *Develop a conformance, certification, and testing process/program for OpenADR, coordinated with entities such as standard development organizations (SDOs), user groups, and Smart Grid activities.*
- *Collaborate with SDOs and user groups for the continued enhancements of the OpenADR profile specification.*
- *Collaborate with the U.S. Department of Energy (DOE), Federal Energy Regulatory Commission (FERC), National Association of Regulatory Utility Commissioners (NARUC), and other government agencies to expand the adoption of OpenADR.*

[224] OpenADR Alliance website; http://www.openadr.org/

[225] DRRC publications website; http://drrc.lbl.gov/publications/openadr

[226] Oasis website; https://www.oasis-open.org/

[227] Oasis website; https://www.oasis-open.org/committees/tc_home.php?wg_abbrev=energyinterop

[228] Oasis website; https://www.oasis-open.org/committees/tc_home.php?wg_abbrev=emix

[229] Oasis website; https://www.oasis-open.org/committees/tc_home.php?wg_abbrev=ws-calendar

[230] NIST wiki; http://collaborate.nist.gov/twiki-sggrid/bin/view/SmartGrid/PAP04Schedules

[231] NIST wiki; http://collaborate.nist.gov/twiki-sggrid/bin/view/SmartGrid/PAP03PriceProduct

[232] NIST wiki; http://collaborate.nist.gov/twiki-sggrid/bin/view/SmartGrid/PAP09DRDER

[233] OpenADR Alliance website; http://www.openadr.org/overview

- *Collaborate with other alliances and organizations on global partnership opportunities.*
- *Conduct and provide education and training sessions to help facilitate the development and adoption of OpenADR products and programs.*
- *Facilitate OpenADR programs among utilities and system operators through case studies, specifications and industry best practices.*
- *Provide resources to developers to facilitate the development, testing, and demonstration of OpenADR certified products.*

CURRENT DSM ACTIVITIES

The OpenADR 2.0a and b Profiles provide the information needed by implementers to build an OpenADR enabled device or system. The OpenADR Alliance released the 2.0a profile specification on July 8, 2012, and the 2.0b profile specification on July 9, 2013. Profile A is well suited to support standard DR programs. It is designed for resource-constrained, low-end embedded devices that can support basic DR services and markets. Profile B is designed for high-end embedded devices that can support most DR services and markets. It includes a flexible reporting (feedback) mechanism for past, current, and future data reports.

The original OpenADR 1.0 profile specification was designed to interface with BACS, and version 2.0 is more flexible in its application, with Profile A enabling DR messaging and control of simple devices, such as thermostats and pool pumps. However, OpenADR does require a communication path (i.e., internet and WiFi) to enable the communication of the DR message.

FUTURE DSM ACTIVITIES

There is a possibility that an OpenADR 2.0c profile will be developed to enable sophisticated controls and high-end computer systems such as servers to support all services and markets.

The OpenADR alliance continues to enhance testing criteria and certify products as OpenADR compliant.[234] These products should be able to interoperate with other certified products from different manufacturers.

BEARING ON CALIFORNIA DR PROGRAMS

Both SCE and PG&E partnered with LBNL in the development of the OpenADR 1.0 profile specification. As founding members, SCE and PG&S have seats on the OpenADR Alliance board of directors. SCE[235] and PG&E[236] both have a growing DR programs that leverage OpenADR and are in the process of upgrading existing customers from version 1.0 to 2.0.

[234] OpenADR Alliance website; http://www.openadr.org/certified-products

[235] SCE website; http://on.sce.com/1bVRvbw

[236] PG&E website; http://pge-adr.com/

SMART ENERGY PROFILE

OVERVIEW AND MISSION

SEP[237] is a messaging protocol that enables DR with both price and event signals. SEP is intended to enable interoperable products that monitor, control, inform, and automate energy information in a HAN or Premise Area Network. With a HAN communication connection between an AMI meter and consumer devices, a customer has access to the information and automation needed to understand and manage their electricity consumption.

CURRENT DSM ACTIVITIES

SEP gained popularity in the early stages of AMI deployment due to the placement of ZigBee communication chipsets (based on the IEEE 802.14.4 standard) in the AMI meters to enable HAN communication of energy information to the consumer, as well as DR signaling. ZigBee chips are now deployed in millions of meters worldwide and with the major AMI deployments being completed. As has been noted, utilities are developing DR programs and evaluating devices to enable energy information interaction with the consumer.[238] Under SEP, all enrolled/registered devices can respond to DR events. Available DR commands include event start, event end, event override, and event cancel.

SEP version 1.x was installed on most of the AMI meters that were deployed over the past seven years. The ZigBee Alliance, in collaboration with the HomePlug Alliance,[239] released the long awaited SEP version 2.0[240] in 2012 and products were certified to the SEP 2.0 standard starting in 2013.

FUTURE DSM ACTIVITIES

One of the challenges of transitioning from SEP 1.x to SEP 2.0 (see section on *SGIP PAP 18 – SEP 1.x to SEP 2 Transition and Coexistence*) is the fact that many of the early AMI deployments may have lower memory capacity than that required to remotely upgrade the AMI meters to SEP 2.0. However, concerns regarding the security protocols embedded in SEP 1.x are a significant catalyst for utilities explore upgrading their AMI deployments with ZigBee SEP. The SGIP *PAP 18: SEP 1.x to SEP 2.0 Transition and Coexistence Guidelines and Best Practices*[241] document provides a good reference to consider risk mitigation paths and upgrade options.

[237] ZigBee Alliance website; http://zigbee.org/Standards/ZigBeeSmartEnergy/Overview.aspx

[238] *Intelligent Energy Today*, "Does AMI Have What it Takes for Demand Response?," November 20, 2013, http://intelligentenergytoday.com/intelligent-energy-management/does-ami-have-what-it-takes-for-demand-response/

[239] HomePlug Alliance website; https://www.homeplug.org/home/

[240] ZigBee Alliance website; http://zigbee.org/Standards/ZigBeeSmartEnergy/SmartEnergyProfile2.aspx

[241] SGIP, *PAP 18: SEP 1.x to SEP 2.0 Transition and Coexistence Guidelines and Best Practices*; http://collaborate.nist.gov/twiki-sggrid/pub/SmartGrid/SEPTransitionAndCoexistenceWP/PAP_18_SEP_Migration_Guidelines_and_Best_Practices_ver_1_03.docx

BEARING ON CALIFORNIA DR PROGRAMS

All 5.3 million Edison SmartConnect meters, as well as the meters deployed by PG&E and SDG&E, have ZigBee communication chips. Ideas for leveraging this embedded HAN capability has evolved since the first SCE AMI use cases.[242] In some cases, the evolution has been a response to cyber security concerns. In other cases, the expanding ubiquitous access to the internet by WiFi home networks, as well as phones and other mobile devices, provides possible alternative communication paths. However, the ZigBee communication connection to the AMI meter is the one and only source for monitoring near-real-time energy consumption information that can provide customers insight into their electricity usage.

Other than the initial set of field test meters, the AMI that were deployed in California have some level of excess memory beyond what is needed for the current configuration. While it is challenging to coordinate a firmware upgrade to enable the transition from SEP 1.x to SEP 2.0, further exploration of alternative solutions through a pilot program or engineering studies is recommended

NATIONAL RURAL ELECTRIC COOPERATIVE ASSOCIATION (NRECA)

OVERVIEW AND MISSION

NRECA is an association of rural electric cooperatives and public power districts that provides electric service in 47 states to more than 42 million consumers who account for 12% of total U.S. electricity sales. In part because of the coop customer-owner relationship, coop utilities have been leaders in adopting DSM, which now accounts for approximately 20% of actual peak reduction, although the electricity consumption of these coops accounts for approximately 10% of the nation's retail electricity sales.

CURRENT DSM ACTIVITIES

MULTISPEAK

The MultiSpeak specification, developed by a collaboration of NRECA, software and hardware vendors, and utilities, is broader than a DSM messaging protocol. Specifically, it includes aspects of distribution automation and other features to enable enterprise application interoperability. The current specification includes 30 profiles with functionality for the following:

- Meter reading and data management
- Connect/disconnect
- Outage detection
- Load management;

[242] SCE website; http://on.sce.com/JL2uOG

- Supervisory Control and Data Acquisition (SCADA)
- Distribution automation control

MultiSpeak also includes the following DR capabilities:

- Home Area Network (HAN)
- HAN device management
- HAN registration
- In-Home Device (IHD) messaging
- HAN pricing
- HAN notification client
- Demand Response Management System (DRMS)
- CPP event
- DR Event
- DR notification client

The DR aspects of MultiSpeak listed above have been recommended for inclusion in the SGIP Catalog of Standards by PAP 19 (see *SGIP PAP 19 – Wholesale DR* section).

Grid Interactive Water Heaters

NRECA, as well as the Peak Load Management Alliance, has advocated for changing the proposed rules regarding electric water heaters[243] (see *Grid Interactive Water Heaters* section). This advocacy has led to the Rulemaking for Residential Water Heater Standards Waiver Process[244] as well as legislation[245] to address the issue.

Bearing on California DR Programs

The rural electric coops in California are likely already working with NRECA and may utilize MultiSpeak. However, it is unlikely that the MultiSpeak enterprise standard, which is optimized for rural electric cooperative utilities, will be applicable to the larger-scale DR and distribution automation systems being deployed by the California IOUs.

The rural electric cooperative utility utilization of water heater DR for leveling demand is an interesting approach for addressing challenges like the duck curve (see Figure 9). Additionally, the grid interactive concept for appliances and devices may have a broad impact on future standards. This approach may be a key to introducing DR capabilities into codes, standards, and labeling.

[243] NRECA website; http://www.nreca.coop/ect-coop-co-ops-urge-water-heater-rule-change/

[244] DOE website; http://www1.eere.energy.gov/buildings/appliance_standards/rulemaking.aspx/ruleid/63

[245] NRECA website; http://www.nreca.coop/electric-co-ops-welcome-water-heater-legislation/

SUMMARY OF DR MESSAGING PROTOCOL STANDARDS

Table 28 summarizes the DR Messaging Protocol Standards that may have relevance in California, as well as opportunities and recommendations that arise from utilization of these standards.

TABLE 28. SUMMARY OF DR MESSAGING PROTOCOL STANDARDS

Standard	Past & Current Activity	Future Activities	Impact on CA	Opportunities	Risks & Barriers	Codes & Standards Recommendation
OpenADR 2.0	2013 release of OpenADR 2.0 profiles A and B	Possible develop-ment of Profile C. Continued refinement of Profiles A and B.	Existing AutoDR programs in CA utilize OpenADR and are transitioning from v1.0 to v2.0	Interfaces with existing BACS to enable DR		Update CEC Title 20 and Title 24 to mandate use of DR protocols identified in NIST CoS; Update CEC Title 20 and Title 24 to mandate utilization of DR protocols identified in NIST CoS
Smart Energy Profile 2.0	2013 release of SEP 2.0		AMI Smart Meter rollouts totaling over 12 million meters in CA include ZigBee communications. SEP is a messaging protocol for ZigBee communications	Enables HAN communication with AMI smart meters. Pilot program to examine SEP 1.x to 2.0 upgrade.	Challenging to coordinate a firmware upgrade to enable the transition from SEP 1.x to SEP 2.0	
MultiSpeak	2013 incorporation of DR functionality		Likely limited to rural electric utilities			

SECTION 8. COMMON DR/PLS THEMES FOR CONSIDERATION

Common themes emerged from the review of the policies, plans, initiatives, programs, and mandates from the various entities described in this report. Candidate DR/PLS technologies provide a foundation from which to discuss DR and PLS related activities, coverage, desired outcomes, gaps, and trajectories, as well as potential synergies with other programs.

Historically, DR has been utilized to reduce peak period electricity usage and mitigate reliability events in cases when demand exceeds generation or when generation or delivery infrastructure goes offline. As a result, DR has been optimized to address mid-day peak periods and respond quickly to increase reliability.

However, the increase of intermittent renewable generation resources such as wind and solar affects when the peak electricity usage is likely to occur and increases the importance of DR's role in helping to overcome the intermittent nature of these resources to increase reliability. The recommendations below can aid in the evolution of current approaches to address the flexible nature of DER to better manage the realities of the near future.

MANDATED ENERGY STORAGE FOR PLS

The energy storage mandated Assembly Bill (AB) 2514 can be used for load shifting of renewable energy, such as wind and solar PV-generated power, especially for SCE-owned utility-scale renewable energy (USRE). This load shifting so will allow use of wind generated at night to offset load during the day and peak solar output generated at mid-day to reduce the anticipated step evening ramp. The duck-shaped demand curve (see Figure 9) already seen on some spring days will undoubtedly become common as the amount of solar increases.

Using energy storage for PLS would help to maximize its economic benefit by leveraging the multiple benefits possible from stored energy:

- Leveling of variability due to clouds passing over solar arrays and wind intermittency
- Supply of energy produced at lower cost for high cost time periods
- Improved reliability for vulnerable areas, such as those with only a single feeder

California does not have a significant installed base of electric water heaters. Nonetheless, the use of large capacity water heaters as thermal electric storage by coop utilities (see section on FERC rules on *Grid Interactive Water Heaters* and the related NRECA section on *Grid Interactive Water Heaters*) illustrates the potential of DR leverage of energy storage to levelize demand. Additionally, the grid-connected approach utilized by the stakeholder compromise to provide an exception to the limiting of the capacity of electric water heaters can be referenced to potentially further the EPA connected provision (see section on *DOE/EPA Appliance Efficiency Standards*).

DR AND THE CAISO MARKET

Consistent with CPUC Rule 24 and (see *CAISO Implementation of DR* section) and FERC Order 745 (see section on FERC *Order No. 745 Demand Response Compensation in Organized Wholesale Electricity Markets*), SCE's DR programs can be used to bring DR capacity into the CAISO market through resource adequacy. CAISO stated that SCE should be able to "bring 1,100 MW of DR capacity into the ISO market in the summer of 2014."[246] A caveat is that FERC must approve the re-filing of the FERC's RDRR tariff amendment.

As stated by the *DR Action Plan for Europe*[247] ". . . the value of DR lies in its ability to act as a fast, cheap capacity resource." Bringing DR capacity into the CAISO market through the use of DR programs will help leverage SCE existing and future DR technologies.

DR resources can also gain access to CAISO's wholesale market using the participating load model, which allows demand-side resources to participate in CAISO market by increasing and decreasing consumption. Currently, the participating load model only supports bidding into the market on the positive or "generation side," operating region of the resource. In 2012, CAISO implemented a non-generating resource (NGR) model that enables energy storage participation through positive and negative operating ranges. The NGR model can be adapted through a stakeholder process to enable a participating load to be a dispatchable demand resource (DDR).[248]

CAISO also developed proxy demand resource to enable bidding of demand resources directly into the day-ahead and real-time non-spinning reserve market in competition with conventional generation resources. In contrast to participating load, PDR enables DR participation without specifically scheduling the load for the associated DR resource. Implementation and broader adoption of PDR had been pending further FERC clarification, which was provided in July, 2013 (see section on *CAISO Compliance with FERC DR-Related Orders*).

USE DR AND PLS TECHNOLOGIES TO MITIGATE DUCK SHAPED LOAD CURVE

Consistent with CAISO's Load Shaping Path plans (see *CAISO Load Reshaping Path* section), SCE could consider implementing DR and PLS programs that address the predicted duck shaped net load curve (See Figure 9) caused by daytime solar generation.[249] Specifically, CAISO is predicting significant

[246] CAISO, *California ISO Demand Response and EE Roadmap: Making the Most of Green Grid Resources,* Draft, June 12, 2013, p. 16; http://www.caiso.com/Documents/Draft-ISODemandResponseandEnergyEfficiencyRoadmap.pdf

[247] SEDC Demand Response Snap Shot, *op. cit*., http://sedc-coalition.eu/wp-content/uploads/2013/03/SEDC-DR-Snap-Shot.-FINAL.pdf

[248] CAISO, *California ISO Demand Response and EE Roadmap: Making the Most of Green Grid Resources,* op. cit., p. 16.

[249] CEC FERC Keynote, *DR/EE/ES and other Emerging Energy Technologies or How to Learn to Live With and Love the Duck Curve,* September 9, 2013.

potential for daytime over-generation by 2015, resulting in lower daytime demand and a steep ramp in demand in the late afternoon/early evening. The effects of over-generation are already being seen during spring days when solar production is high but demand is relatively low.

Because of the real potential for a drop in demand during the day—as opposed to the current peak—significant effort needs to be devoted to DR/PLS programs that are flexible enough to adjust to the duck curve. Suitable programs include the energy storage mentioned above and DR programs using electric vehicles. Significant savings could be achieved if the duck curve could be smoothed by selling excess day-time energy on the market, but third-party providers might be better able to capitalize on this opportunity.

Building and Home Energy Management Systems for DR and PLS

Building and home energy management systems can be used to help implement DR and PLS programs. DR can be dispatched through internet or ZigBee (AMI-based) communications and/or through the internet utilizing SEP and/or OpenADR messaging protocols. PLS can be enabled through either (grid) communicating or non-communicating systems with energy management systems.

As illustrated in Japan (see section on Japan's *Building Codes*), subsidies can be offered to incentivize the purchase and installation of building and home energy management systems. Over the longer term, California may consider expanding the BACS system mandates in Title 24 to include home EMS systems. A complementary approach is to educate customers on the financial benefits of building and home management systems. In many cases, the cost savings from energy management systems provides a positive return on investment in only a few years. Thus, customers may be willing to pay for and install energy management systems that could then allow them to participate in DR programs.

Flexible EV Charging Programs for DR

Use of variable charging of electric vehicles could help integrate wind and solar PV production. Since solar may eventually produce too much power at noon, communicating charging systems can potentially charge EVs during periods of excess generation (similar to the rural coop grid-connected water heater approach (see *Grid Interactive Water Heaters* section), not just at night using TOU rates. Title 20, which may include mandates for EV charging stations, could mandate this functionality.

Automated Building Pre-chilling for PLS

An automated "pre-chill" DR program for homes, and perhaps businesses, could be used to better utilize solar, which peaks at noon. Such a program would be able to reduce the late afternoon steep ramping caused by solar drop-off. A pre-chill program would work particularly well for homes that are not occupied during the day. However, dynamic pricing would need to be modified for program participants.

PEAK TIME REBATE REGISTRATION FOR DR AND PLS

Peak time rebate incentives (such as SCE's Save Power Day program) can accrue to customers who coincidentally reduced their usage, as well as customers who responded to a PTR notification. As a result, other utilities are considering a requirement for customers to register for the program to prevent customers with unrelated load reductions from receiving the majority of the program benefits.

In addition, SCE should continue developing specific recommendations for residential customers to help them adjust demand during Save Power Days. For example, SCE could recommend that customers run clothes washers, clothes dryers, dishwashers, and pool pumps during non-peak times; reduce the need for air-conditioning by pre-chilling; consider reducing demand for televisions and other entertainment devices by engaging in other activities, such as going to a movie, library, park, or pool, during peak demand hours.

STANDARDIZED INTERFACES FOR DR PROGRAMS

Communication protocols, including the internet, ZigBee, and Wi-Fi, are enablers for DR programs when combined with DR messaging protocol standards such as SEP and OpenADR. OpenADR was initially built to communicate with BACS standards, such as BACnet® which already exist in buildings. SEP was specifically designed to utilize ZigBee communication in AMI meters and can be combined with internet communication to monitor whole-house usage and home energy management.

Standardization to a hybrid of internet and ZigBee through the meter for communications with OpenADR and ZigBee targeted to different customer segments is the broadest path to putting DR-enabling technology in the hands of customers. To the extent possible, the use of open standard, layered, loosely coupled networked communication stacks should be encouraged. In general, the use of widely available application-level and communications protocols will both lower costs and reduce implementation time frames. The NIST SGIP Catalog of Standards lists SEP, OpenADR and MultiSpeak as nationally recognized DR messaging protocol standards that both Title 20 and Title 24 can refer to in their mandates.

COMMUNICATING APPLIANCE PROGRAMS

Many appliance manufacturers would like to sell smart appliances that could participate in DR programs. However, these manufacturers are concerned about the need to interface with more than 3,000 U.S. utilities, multiple federal and regulatory agencies from the fifty U.S. states, and potentially, international entities.

From an appliance manufacturer's point of view, coordination of interfaces on an international level is desirable because it would lower costs for smart appliances across all markets. Lower costs for smart appliances would likely increase sales and therefore indirectly increase the potential use of appliances for DR.

Although Internet, wireless, and ZigBee protocols and DR-specific messaging protocol standards are broadly deployed through AMI, they are still in limited use. Therefore, appliance manufacturers would appreciate further adoption and program implementation. For example, the Association of Home

Appliance Manufacturers (AHAM) lists the following message principles that they would like to see implemented[250]:

- All smart grid message protocol definitions should exist in open standards
- A limited number of standardized messages should be used
- Instructions from the utility should function in one of the following ways:
    - Load shedding for a limited number of levels, e.g., four or five possible power consumption levels
    - Processing of commands from the utility by an in-home managerial control system that interprets or manages the information
    - Presenting the consumer with information that would encourage the consumer to delay use

Smart appliances may not achieve their potential for DR participation unless barriers to appliance-to-utility messaging are resolved. In conjunction with appliance manufacturers, utilities can work to reduce barriers to the development of DR-capable smart appliances. One approach would be to consider adding message protocol definitions to the ENERGY STAR specifications in order to qualify for the 5% connected provision (see *ENERGY STAR Connected Criteria* section). ENERGY STAR specification 5.0 includes requirements for communicating residential refrigerators and freezers. It is expected that similar requirements for clothes dryers will be added in 2014. Title 20 can further mandate this functionality in California.

Message definitions requirements could also be added to future versions of the ENERGY STAR specifications. It might be beneficial to consider supporting an approach similar to Australian Standard AS/NZS 4755 (see section on Australia's *Appliance Labeling and Smart Appliances*), which is intended to enable the large-scale introduction of smart appliances, despite the absence of any single agreed communications protocol, and to ensure that those appliances will be able to operate with any protocol.

TIME OF USE RATES

An effective method of incentivizing PLS, TOU rates provide price signals to consumers to help them decide to shift usage to time periods which have less load. TOU rates better align generation costs and customer rates, thus allowing market forces to induce customers to shift usage. Working with regulators, utilities can set the price differential between time periods to modify the amount of load shifting undertaken by customers; a larger price differential between the time periods will result in more load shifting.

Large commercial and industrial customers in SCE territory are already on CPP rates. SCE is transitioning the remaining non-residential customers to TOU rates beginning in January 2014 and agricultural customers in February 2014.[251] Electric vehicle have optional TOU rates, and the number of EVs is

[250] AHAM website; AHAM States Principles for Smart Grid, August 4, 2009; http://www.aham.org/ht/a/GetDocumentAction/i/42653

[251] SCE website, Transition Schedule; https://www.sce.com/wps/portal/home/business/tools/time-of-use/!ut/p/b1/hZBNc5swEIZ_Sw_olMAKqFE6o-

increasing slowly. In 2014, as non-residential customers' transition to TOU rates, SCE will see load shifting to less costly time periods.

There is also potential for residential customers to transition to TOU rates in order to lower their bills. However, increased solar generation and the resulting duck-shaped demand curve (see Figure 9) may result in TOU rates not aligning with the current rate schedules at least for part of the year.

LEED Credit for DR

The LEED program is the most widely recognized and utilized green building program in the world. The *Pilot Credit 8: DR* program (see *LEED Pilot Credit for DR* section) allowed LEED projects to earn a point for DR-enabled buildings. Further incorporation and support for DR programs within the LEED certification will help increase the number of buildings which are DR-capable.

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SECTION 9. ROADMAP & RECOMMENDATIONS

ROADMAP

The activities described in this report have aligned with the lifecycle status of the general smart grid, as well as the maturity of DR & PLS, as customer programs evolve to utilize newly deployed infrastructure and technologies (such as AMI). Figure 11 illustrates the timeframe associated with CEC Title 20 and Title 24 building and appliance code standards development, as well as the ongoing refinement of EPA ENERGY STAR specifications.

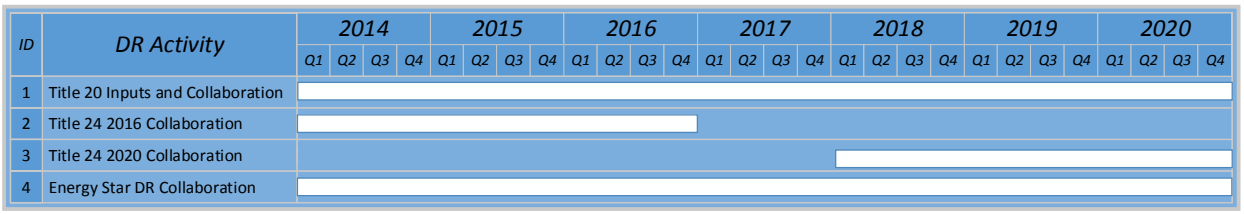

FIGURE 11 CODES, STANDARDS, AND LABELING TIMEFRAME

Figure 12 illustrates the typical lifecycle process for product or technology development and rollout. SCE has been a leader during the decade spent by the industry in moving through the initial steps in the process:

- **Customer Need**: In the face of increasing electricity costs, the customer lacks tools to manage consumption and any insight into usage until after the bill arrives. SCE has moved to address this gap with initiatives such as My Account on sce.com and Save Power Days with related alerts.
- **Requirements Analysis**: These are articulated in SCE's industry benchmark use cases.[252]
- **Project Plan:** This is illustrated in SCE's Application for Approval of Advanced Metering Infrastructure Deployment Strategy and Cost Recovery Mechanism [253] and subsequent Overview of SCE's AMI Deployment Strategy and Objectives.[254]

[252] SCE website; http://on.sce.com/19IMQO1

[253] SCE testimony before the CPUC, *Testimony Supporting Application for Approval of Advanced Metering Infrastructure Deployment Strategy and Cost Recovery Mechanism, Volume 1 – Business Vision, Management Philosophy, and Summary of Business Case Analysis*, March 30, 2005; https://www.sce.com/wps/wcm/connect/8fdfd280-f3f7-40c8-8e4d-851a1b2a4d68/SCEMarch30_2005_Application_Vol1.pdf?MOD=AJPERES

[254] SCE testimony before the CPUC, *Testimony Supporting Application for Approval of Advanced Metering Infrastructure Deployment Activities and Cost Recovery Mechanism, Volume 1 – Overview of SCE's AMI Deployment, Strategy and Objectives*, December 21, 2006; https://www.sce.com/wps/wcm/connect/99f57f4a-db1a-4597-86e8-893d089dd573/Vol1_Testimony_AMIPhaseIIApplication.pdf?MOD=AJPERES

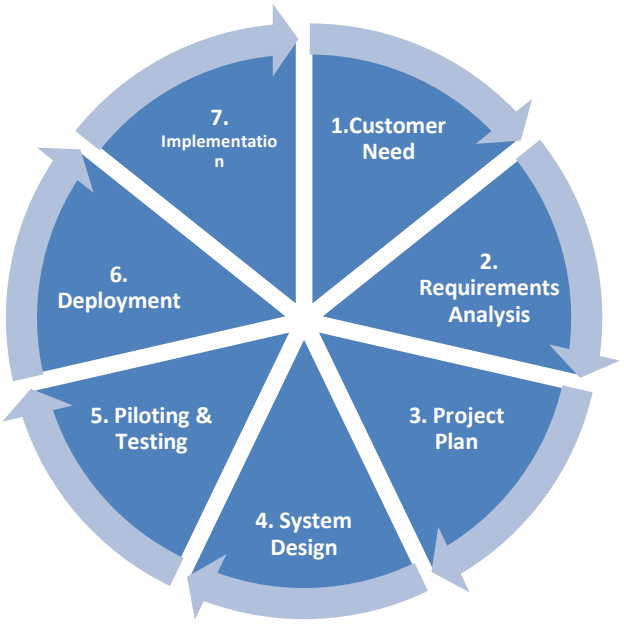

FIGURE 12. TYPICAL LIFECYCLE DEVELOPMENT PROCESS

Common themes emerge from the survey of regulators, collaborations, organizations, and other groups researched in this paper. These themes are highlighted in the descriptions of the remaining lifecycle steps reflecting current and future initiatives and activities:

- **System Design:** Standards are the focus of many activities summarized in this report, including the 2007 mandate from EISA appointing NIST as having ". . . primary responsibility to coordinate development of a framework that includes protocols and model standards for information management to achieve interoperability of smart grid devices and systems. . ." Future codes and labeling for DR & PLS are most likely to be affected by the finalization of standards for DR & PLS, including messaging protocol standards (SEP, OpenADR and MultiSpeak) and M&V Standards (NAESB).
- **DR Messaging Protocols:** Messaging protocol standards provide the language to communicate DR and PLS information that customers or devices programmed by customers can respond to. PLS includes DR that is triggered by dynamic pricing including TOU, CPP, PTR or RTP. The nationally recognized messaging protocol standards for DR are being finalized as Smart Energy Profile, Open ADR, and MultiSpeak.
- **Measurement & Verification:** A common standard for DR M&V is also a common theme within this report. FERC has adopted by reference with NAESB DR M&V standards, which generally represent applied statistic methods for evaluating DR. The challenge will be to align individual customer DR performance incentives with the NAESB approach for aggregated DR participating in the wholesale electricity market (e.g., CAISO).
- **Piloting & Testing:** The summaries for CPUC (see *California Public Utilities Commission* section), CAISO (see *California Independent System Operator* section), and USGBC LEED (see *LEED Pilot Credit for DR* section), emphasize piloting to test approaches prior to full rollout and

implementation. Additionally, the FERC approach applies a net benefits test (see section on *Order No. 745 Demand Response Compensation in Organized Wholesale Electricity Markets*), and DOE has developed Test Method to Validate DR (see section on FERC *Order No. 676-G Standards for Business Practices and Communication Protocols for Public Utilities)*. These activities provide a foundation for establishing common approaches to quantify the participation and performance of DR.

- **Deployment:** In addition to providing initial funding for SGIP, ARRA of 2009 provided funding administered through the DOE[255] for Smart Grid Investment Grants and Smart Grid Demonstration Projects (including SCE's Irvine Smart Grid Demonstration). ARRA funding catalyzed grid modernization projects all over the country and has established an installed base of equipment that can be leveraged to enable both DR and PLS.
- **Implementation:** As deployments catalyzed by ARRA funding are completed simultaneous with the large California IOU AMI deployments, the programs envisioned by the SCE AMI use cases can become reality. While technology has evolved since the use cases were published in 2006, the fundamental approaches outlined are still valid.

The following recommendations for CEC Title 24, Title 20 and ENERGY STAR attempt to align the long-term benefits envisioned for DR with the events, proceedings, and initiatives outlined in this report.

RECOMMENDATIONS

CEC TITLE 24

2016 RECOMMENDATIONS

DR Messaging Protocols

With the 2013 Title 24 California Building EE Standards, the Joint Appendix 5 OCST specification[256] outlined the following for DR messaging protocols:

> *There is no mandated specification for the logical interface, but direction is provided as 'standards based messaging protocols (including but not limited to Smart Energy Profile (SEP), OpenADR or others defined in the Smart Grid Interoperability Panel (SGIP) Catalog of Standards (CoS)' or as defined by the occupant's information update service or DR service provider.*

Not specifying a mandated messaging protocol was intentional for the 2013 version of Title 24, as both SEP and OpenADR had not yet released the 2.0 versions of their respective profile specifications. The DR aspects of MultiSpeak were similarly under development. However, specifically requiring one of these three nationally (and internationally) recognized standards in the 2016 Title 24 language should be feasible. The challenge will be to encourage the multiple third-party providers of DR services, including

[255] Energy.gov website; http://energy.gov/recovery-act

[256] CEC, 2013 Reference Appendices: The Building Energy Efficiency Standards For Residential And Nonresidential Buildings; http://www.energy.ca.gov/2012publications/CEC-400-2012-005/CEC-400-2012-005-CMF-REV2.pdf

DRPs and internet energy management "cloud" solution vendors, to transition to these standards rather than continue with proprietary approaches that are not interoperable.

Occupant Controlled Smart Thermostat

An OCST is required in Title 24 for certain commercial building types and is an option for the solar-ready area of residential construction. For 2016 Title 24, the unknown aspects related to standards, HAN interfaces, and other items that were not quite commercially available will be resolved. Therefore, mandatory OCST for all construction is viable in the absence of an energy management control system.

Automated Pre-Chilling

To help reduce impact of the expected daytime over-generation of solar (e.g., the duck shape load curve), mandated default set-points for HVAC and BACS can be updated to incorporate automated pre-chilling for new residential buildings. An automated "pre chill" DR program for homes would be able to better utilize solar energy, which peaks at noon, and reduce the late afternoon steep ramping caused by the afternoon drop in solar generation. An automated pre-chill program would work particularly well for homes that are not occupied during the day, as occupants in the space could be uncomfortable during pre-chilling, whereas occupants returning later in the afternoon would likely enjoy the temperature created by the pre-chill. Table 29 shows an example pre-cooling strategy. Note that this strategy is not optimized to offset mid-day solar over-generation.

TABLE 29. EXAMPLE PRE-COOLING STRATEGY[257] (NOT OPTIMIZED FOR SOLAR OFFSET)

Strategy (°F)	Time of Day											
	12-2am	2-7am	7am-12pm	12pm	1pm	2pm	3pm	4pm	5pm	6pm	7-9pm	10pm-12am
Typical Set Point	off	70	70	70	70	70	70	70	70	70	70	off
Morning pre-cooling + Peak 2 step reset	off	70	70	74	74	74	78	78	78	76	74	off
Morning pre-cooling + Peak exponential reset	off	68	70	74	76	77	77	78	78	76	74	off
Morning pre-cooling + Peak reset	off	68	70	74	74	74	78	78	78	76	74	off

Flexible Automated EV Charging Program

Building and home energy systems capable of automating charging of EVs when excessive solar/wind production is available would help integrate wind and solar PV production. TOU rates are relatively effective for wind power, which often peaks at night when EV TOU rates are low. However solar generation produces maximum power at noon.

[257] *2009 SCE Participating Load Pilot Feasibility Report;* http://www3.sce.com/sscc/law/dis/dbattach3e.nsf/0/8CEDA19110F726598825769B00817D3C/$FILE/A.08-06-001+et+al.+-++2009-11+DR+App+-+SCE+PLP+Feasibility+Report.pdf

Title 24 and LEED Certification Coordination

To increase the number of buildings with DR capabilities, the 2016 Title 24 standard can seek alignment with the USGBC LEED program. Facilitating the installation of DR systems by coordinating the Title 24 DR requirements with the LEED's allocation of points for DR programs would provide additional incentives for builders to include DR systems in new buildings.

2020 Recommendations

Energy Management Control Systems

Energy management control systems are already included for certain building types in Title 24. These systems increase EE and make it possible for building/residential owners to participate in DR programs. The cost savings from these systems will likely provide positive return on investment in only a few years, given the technical evolution and capabilities of these types of systems over the next six years. Thus, to support both EE and DR programs, new commercial and residential buildings should be required to have energy management control systems capable of reducing energy usage and of receiving and responding to DR signals.

Title 20 Recommendations

To support and align with the connected concept from ENERGY STAR, appliances with networking interfaces that support DR can be allowed to consume 5% more energy in exchange for DR capabilities. As noted in the *ENERGY STAR Recommendations* section below, the ENERGY STAR approach can evolve to incorporate the grid interactive concept and provisions utilized for large capacity water heaters (see section on FERC rules on *Grid Interactive Water Heaters* and the related NRECA section on *Grid Interactive Water Heaters*). Likewise, Title 20 can mandate this capability with the additional caveat of nationally recognized DR messaging protocol utilization. The following is an initial list of devices to consider in Title 20 mandates for grid interactive or grid connected capabilities:

- Refrigerators and freezers
- Pool Pumps & Pool Heaters
- Electric Clothes Dryers
- Automatic Commercial Ice Makers
- Walk-In Coolers and Walk-In Freezers
- Portable Room Air Conditioners

ENERGY STAR Recommendations

The EPA connected designation that allows devices to use 5% more energy than non-connected devices and still be ENERGY STAR compliant is a key consideration for potential DR labeling. The possibility of augmenting ENERGY STAR with an ENERGY STAR connected designation for devices that enable DR is a promising development for the promotion of DR.

Further evolution of the ENERGY STAR connected specification and designation can be derived from the large capacity water heater recommendations based on a stakeholder compromise (see section on FERC rules on *Grid Interactive Water Heaters* and the related NRECA section on *Grid Interactive Water Heaters*) with DOE.

In addition, to enable broader adoption of DR with ENERGY STAR connected devices, the EPA should consider mandating DR capability to receive and respond to DR signals, including the utilization of one of the nationally and internationally recognized DR messaging protocols (SEP, OpenADR and MultiSpeak) in order to qualify for the connected provision.

Summary of Codes & Standards Recommendations

Table 30 summarizes the codes and standards recommendations that were articulated in the summary tables for each of the organizations included in this report.

Table 30. Summary of Codes & Standards Recommendations

Organization	Past & Current Activity	Codes & Standards Recommendation
FERC	Energy Independence and Security Act of 2007	Update CEC Title 20 and Title 24 to mandate utilization of DR protocols identified in NIST CoS
	Order No. 676-G Standards for Business Practices and Communication Protocols for Public Utilities	Adopt NAESB WEQ-015 Measurement and Verification of Wholesale Electricity DR
DOE	Grid Interactive Water Heaters	Stakeholder engagement to combine grid interactive approach with EPA ENERGY STAR and incorporate DR/PLS capabilities
EPA	ENERGY STAR Climate Controls Specification 1.0	Update CEC Title 20 and Title 24 to mandate utilization of DR protocols identified in NIST CoS
EPA	ENERGY STAR connected criteria	Stakeholder engagement to combine grid interactive approach with EPA ENERGY STAR and incorporate DR/PLS capabilities
CPUC	OIR R1309011 Enhance the Role of Demand Response in Meeting the State's Resource Planning Needs and Operational Requirements	Must be compliant with FERC orders for CAISO including NAESB *Business Practice Standard for Measurement & Verification* adopted by FERC by reference
CPUC	D.12-04-045 Adopting Demand Response Activities and Budgets for 2012 through 2014	Update CEC Title 20 and Title 24 to mandate utilization of DR protocols identified in NIST CoS
CAISO	CAISO DR and EE Roadmap	Must be compliant with FERC orders for CAISO including NAESB *Business Practice Standard for Measurement & Verification* adopted by FERC by reference

Organization	Past & Current Activity	Codes & Standards Recommendation
CEC	Title 20	Update CEC Title 20 and Title 24 to mandate utilization of DR protocols identified in NIST CoS
		Stakeholder engagement to combine grid interactive approach with EPA ENERGY STAR and incorporate DR/PLS capabilities
	Title 24	Update CEC Title 20 and Title 24 to mandate utilization of DR protocols identified in NIST CoS
		Stakeholder engagement to combine grid interactive approach with EPA ENERGY STAR and incorporate DR/PLS capabilities
NAESB	WEQ-015 Measurement and Verification of Wholesale Electricity DR	Adopt NAESB WEQ-015 Measurement and Verification of Wholesale Electricity DR
	WEQ-018 Specifications for Wholesale Standard DR Signals	Adopt NAESB WEQ-018 Specifications for Wholesale Standard DR Signals
	WEQ-019 Customer Energy Usage Information Communication	Adopt WEQ-019 Customer Energy Usage Information Communication
	REQ.13 - Measurement and Verification (M&V) of DR Programs Model Business Practices	Adopt REQ.13 - Measurement and Verification of DR Programs Model Business Practices
	REQ.17 - Specifications for Retail Standard DR Signals Model Business Practices	Adopt REQ.17 - Specifications for Retail Standard DR Signals Model Business Practices
	REQ.18 - Retail Customer Energy Usage Information Communication Model Business Practices	Adopt REQ.18 - Retail Customer Energy Usage Information Communication Model Business Practices
	REQ.21 - Energy Services Provider Interface Model Business Practices	Consider transitioning from Electronic Data Interchange (EDI) data format for meter data communication ESP to ESPI
	REQ.22 - Third Party Access to Smart Meter-based Information Model Business Practices	Adopt REQ.18 - Retail Customer Energy Usage Information Communication Model Business Practices
	RXQ.24 - Enrollment, Drop, and Account Information Change in DR Programs Practices Model Business Practices	Adopt RXQ.24 - Enrollment, Drop, and Account Information Change in DR Programs Practices Model Business Practices

Organization	Past & Current Activity	Codes & Standards Recommendation
SGIP	SGIP PAP09 – Standard DR and DER Signals	Update CEC Title 20 and Title 24 to mandate utilization of DR protocols identified in NIST Catalog of Standards
	SGIP PAP10 - Standard Energy Usage Information	
	SGIP PAP17 – Facility Smart Grid Information Standard	
	SGIP PAP18 - SEP 1.x to SEP 2 Transition and Coexistence	
	SGIP PAP19 – Wholesale DR	
ASHRAE	ANSI/ASHRAE/IES Standard 90.1 – 2013 Energy Standard for Buildings	Continued synergies with Title 24 to improve building systems efficiencies
	ANSI/ASHRAE/IES 90.2 – 2007 Energy-Efficient Design of Low-Rise Residential Buildings	
	ANSI/ASHRAE/USGBC/IES Standard 189.1-2011 – Standard for the Design of High-Performance Green Buildings	
	SPC 201P Proposed Facility Smart Grid Information Model Standard	Update CEC Title 20 and Title 24 to mandate utilization of DR protocols identified in NIST Catalog of Standards
	ANSI/ASHRAE Standard 135 - BACnet®	
OpenADR 2.0	2013 release of OpenADR 2.0 profiles A and B	Update CEC Title 20 and Title 24 to mandate utilization of DR protocols identified in NIST Catalog of Standards
Smart Energy Profile 2.0	2013 release of SEP 2.0	
MultiSpeak	2013 incorporation of DR functionality	
EU	EC Directive 92/75/EEC in 1992 & EC Directive, 2010/30/EU labeling of electrical appliances	Review EU labeling in relation to ENERGY STAR and Title 20
	EU Directive 2002/91/EC on the Energy Performance of Buildings	Review building standards in relation to Title 24
	Directive (2010/31/EU) nearly-zero energy buildings by 2020	
Australia	Equipment Energy Efficiency Program (E3)	Review Australian labeling in relation to ENERGY STAR and Title 20
	Standards Australia AS/NZS 4755	Review DR appliance standards for possible DR labeling in ENERGY STAR and mandates in Title 24
Japan	Electricity Supply-Demand Outlook & Measures for the Summer of FY2013	Review Japan appliance standards and labeling in relation to ENERGY STAR and Title 20
	Energy Conservation Law Top Runner	