Creating A Cleaner Energy Future For the Commonwealth

DOER
Massachusetts Department of Energy Resources

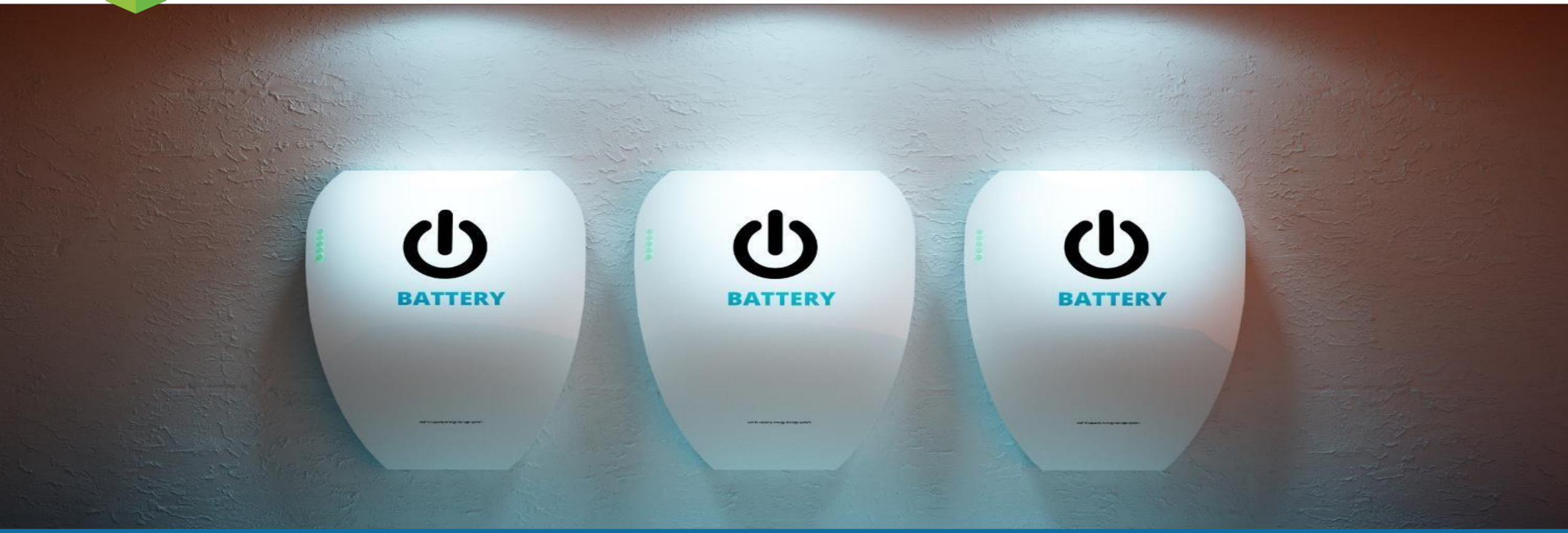
Panel 3: Considerations for a Clean Peak Standard or New Portfolio

Energy Storage Public Stakeholder Forum

May 30, 2018

Boston, MA

STRATEGEN CONSULTING

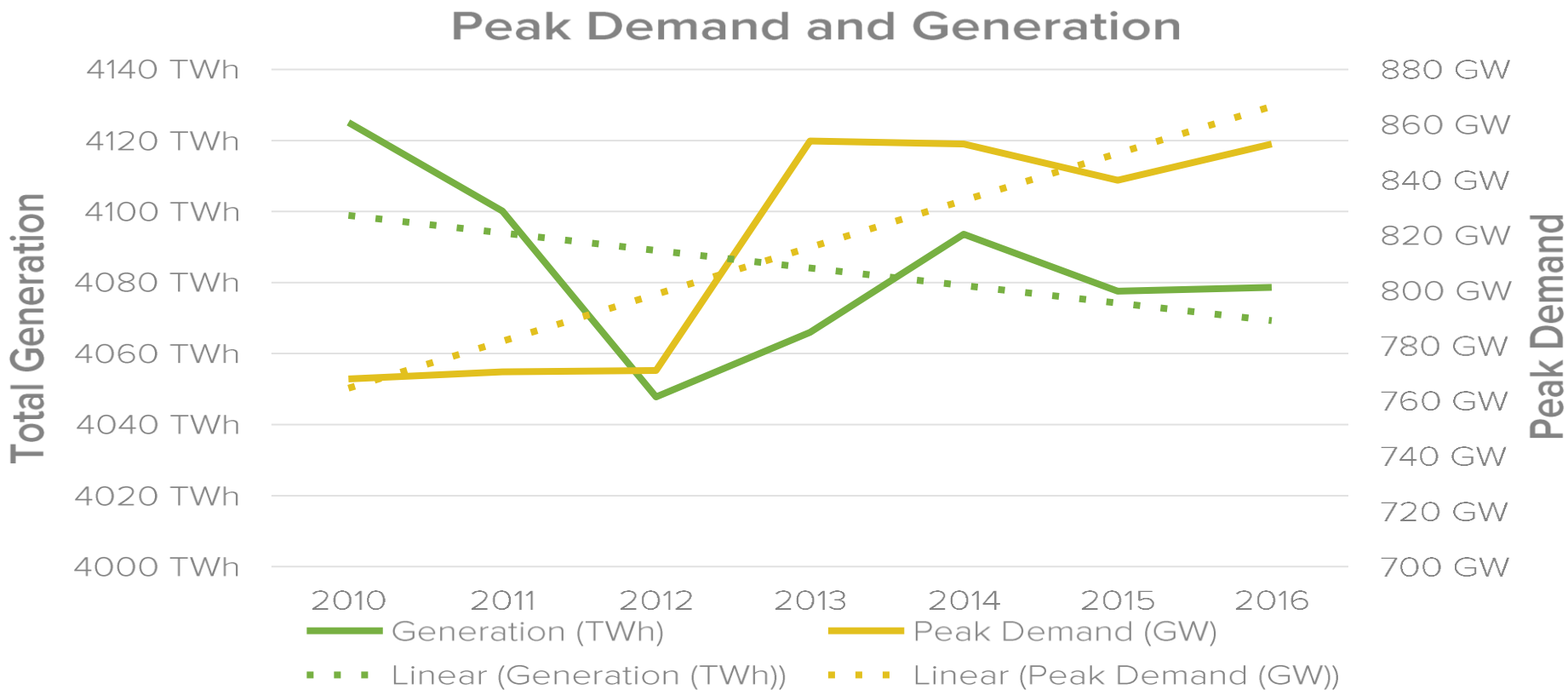


Evolving the RPS:

A Clean Peak Standard for a Smarter Renewable Future

Lon Huber

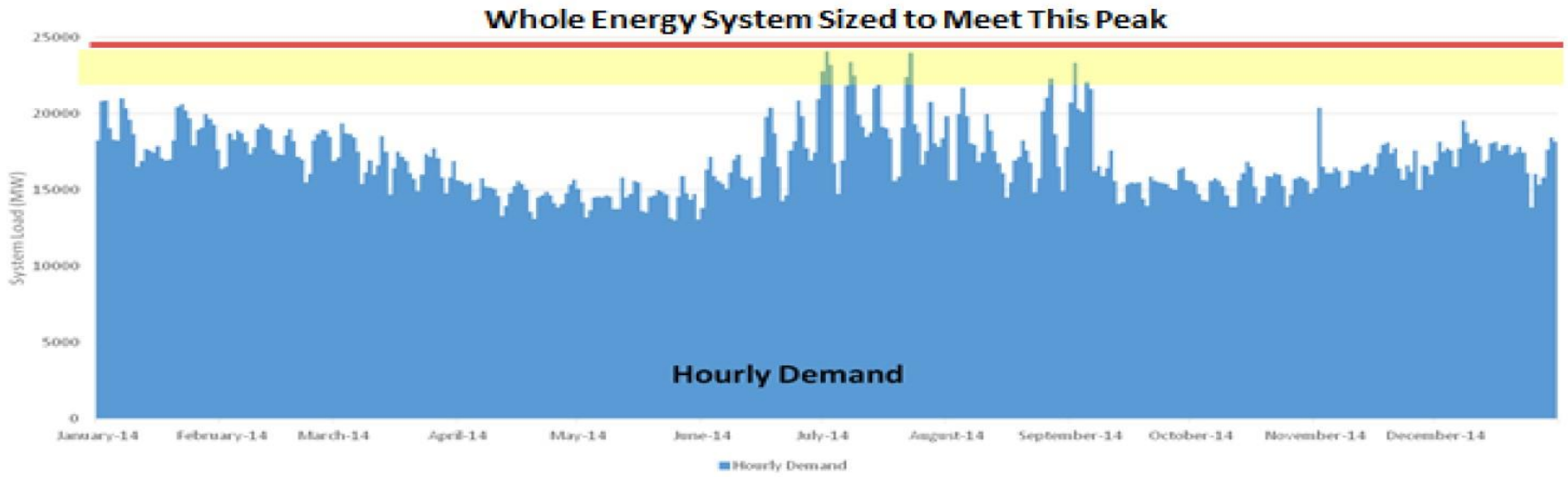
The Dichotomy Between Energy & Capacity



U.S. Energy Information Administration (EIA), NERC Annual Report

Why Pay Attention to Peak Demand?

Electric Grid is Sized for Highest Hour of Demand



Top 1% of Hours accounts for 8% of Massachusetts Spend on Electricity
Top 10% of Hours accounts for 40% of Electricity Spend

MA DOER slide: Commissioner Judson presentation at Restructuring Roundtable, May 2016

WIND MARKETS & POLICY

Price of US Wind Power at 'All-Time Low' of 2.5 Cents per Kilowatt-Hour

New Record Set for World's Cheapest Solar, Now Undercutting Coal

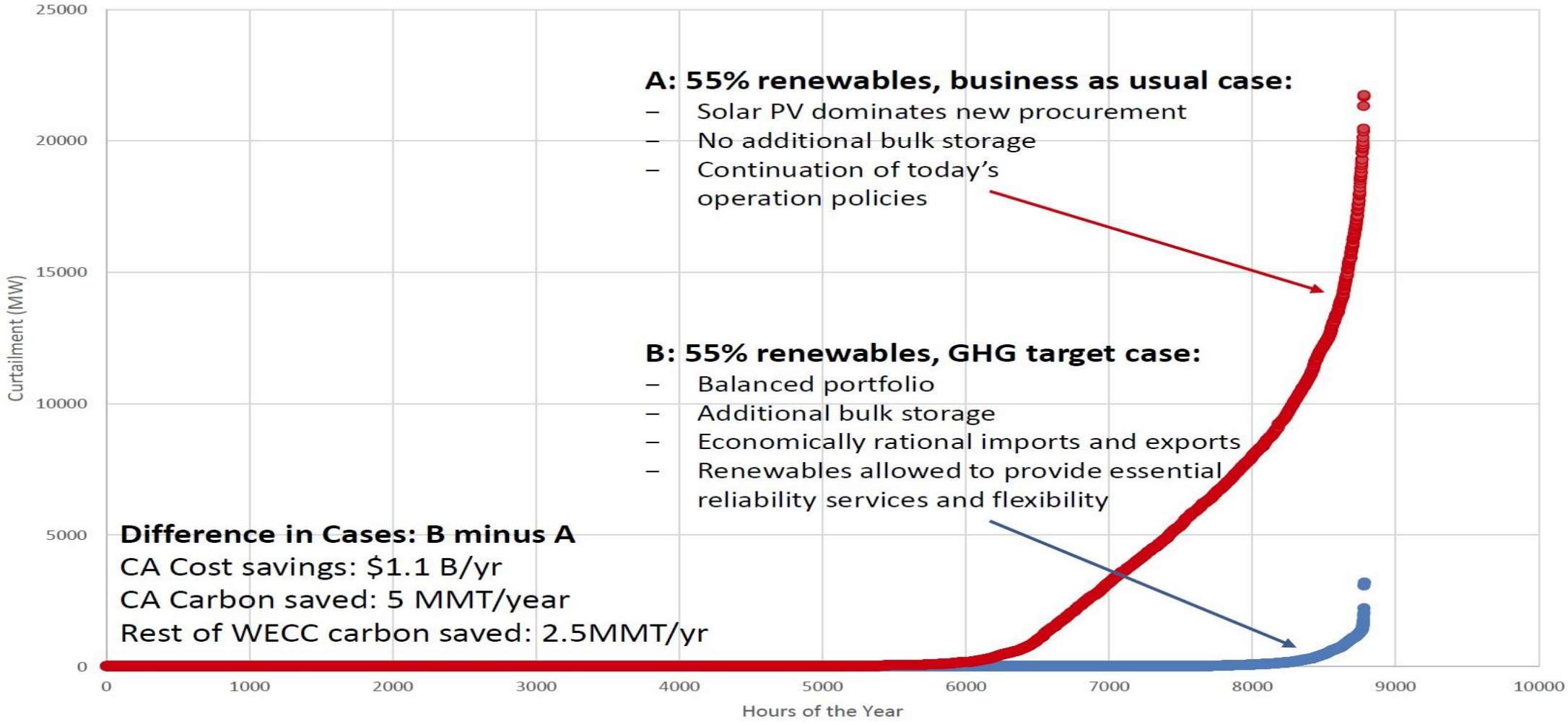
by **Anna Hirtenstein**
May 3, 2016, 9:20 AM PDT

→ 2.99 U.S. cents per kilowatt-hour is 15% lower than old record

BRIEF

NV Energy buys utility-scale solar at record low price under 4 cents/kWh

Low Carbon Grid Study
Curtailment of Renewable Energy



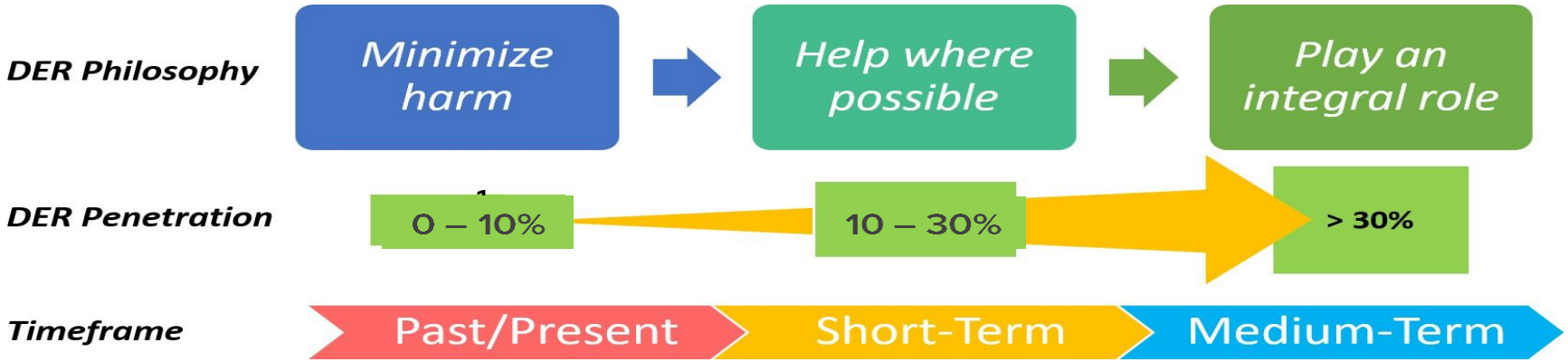
Low Carbon Grid Study (February 2016): http://lowcarbongrid2030.org/wp-content/uploads/2016/PDFs/160307_PhaseIIResults.pdf

Diminishing Returns with High RPS

- E3 50% RPS Study:
  - Over $1 billion in unnecessary costs to ratepayers
  - Alternate case (RE procurement better matched to grid needs): rate impacts of achieving the RPS were reduced by 10-39%.
  - As RE added, marginal fossil generator displaced is increasingly efficient (i.e. fewer GHG reductions per MWh RE).

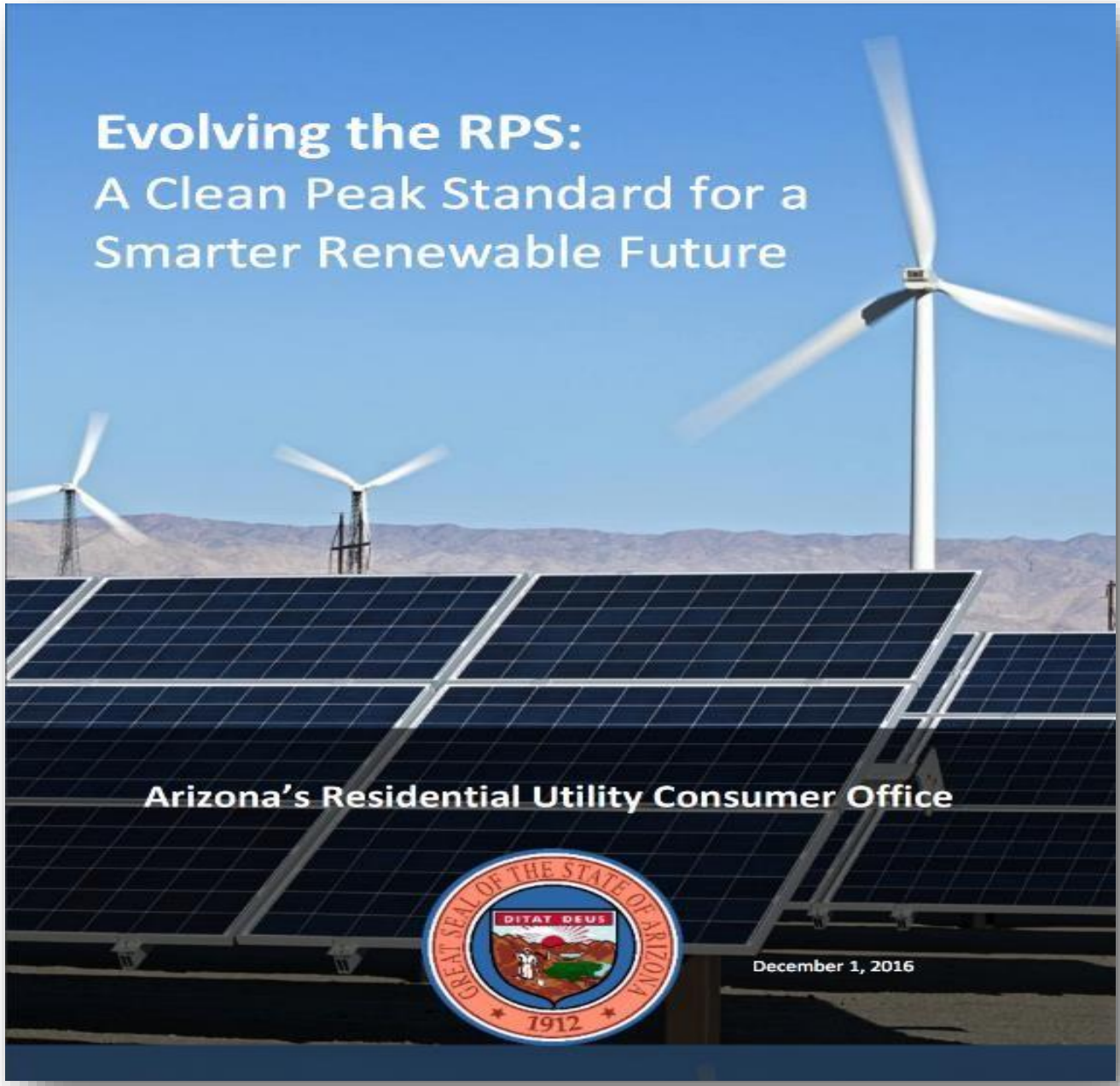
Energy and Environmental Economics, Investigating a Higher Renewables Portfolio Standard in California (PDF) (January 2014),

Renewable energy philosophy progression



Strategen

This philosophy progression provides guidance for how all aspects related to RE need to evolve including planning & operation, interconnection, markets & price signals and valuation.


Evolving the RPS:
A Clean Peak Standard for a Smarter Renewable Future
Arizona's Residential Utility Consumer Office
GREAT SEAL OF THE STATE OF ARIZONA
DITAT DEUS
1912
December 1, 2016

Taking a Step Back: Principles

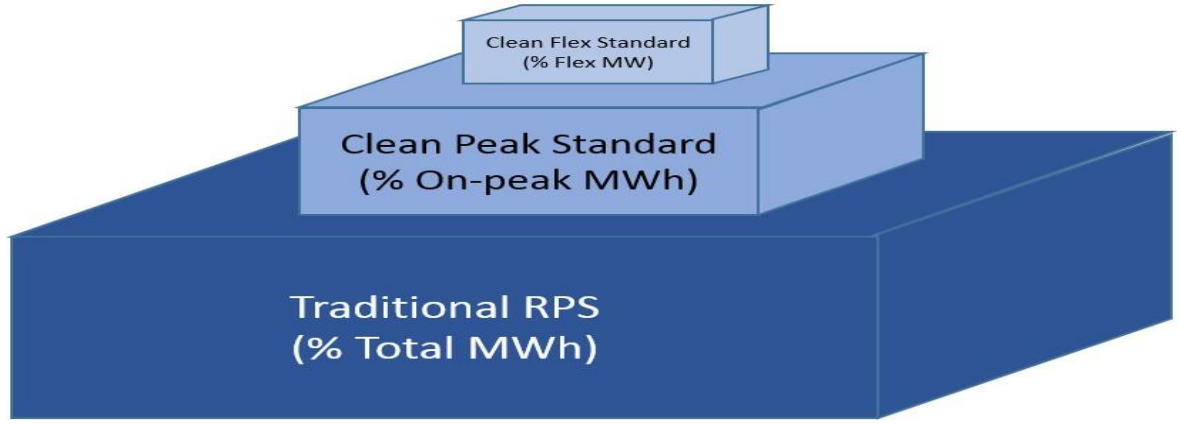
- Design a simple policy mechanism to focus clean energy deployment on resources that maximize value to the grid
- Encourage RE deployment *that also provides* essential reliability services.
  - Start simple: capacity = one of many possible essential reliability services to be provided (i.e. “head of duck”)
- Include some consideration of compliance and implementation details upfront (critical to successful market adoption)
- DO NOT replace existing, successful policies.
  - Intended to be a complement to other successful policies (e.g. RPS, EERS, etc.)

Clean Peak Standard (CPS)

From Clean Energy to Clean Energy AND Capacity:

- Add a carve-out, multiplier, or new target to existing state RPSs
- Target the top peak value hours each month with a focus on system peak
  - Transforms RECs to Clean Capacity Credits or Flexible Capacity Credits

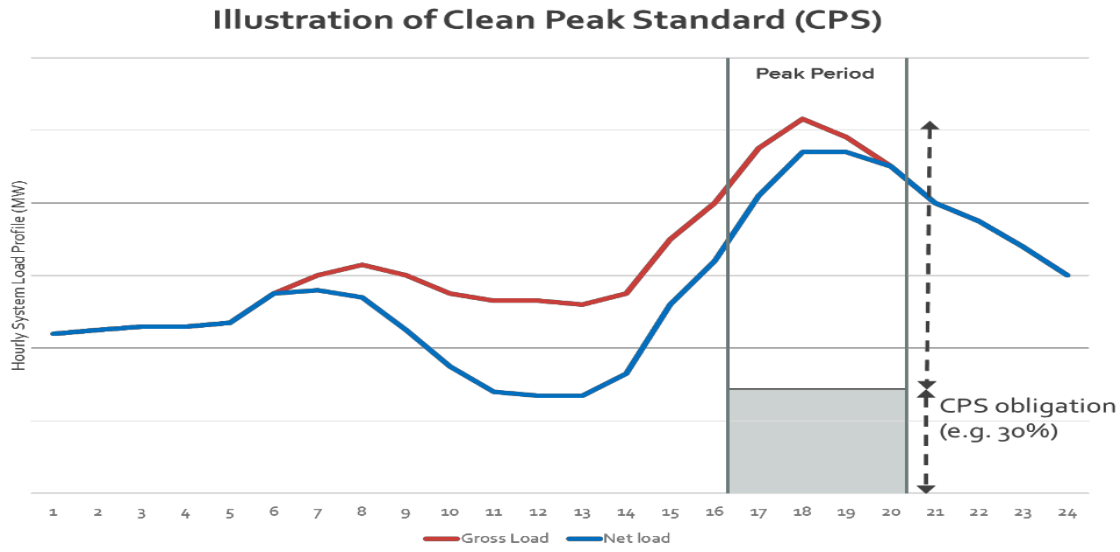
Policy design increases in sophistication as new building blocks are added



Clean Peak Standard (CPS) - Basic Design

- Renewable Portfolio Standards (RPS): X Percentage of retail sales must be met by eligible renewable energy sources by X date.
  - Example – 30% of retail sales (MWh) by 2030

- Clean Peak Standard: X Percentage of peak hours must be met by eligible clean energy sources by X date.
  - Example – 30% of peak energy (on-peak MWh) by 2030



How can a CPS work?

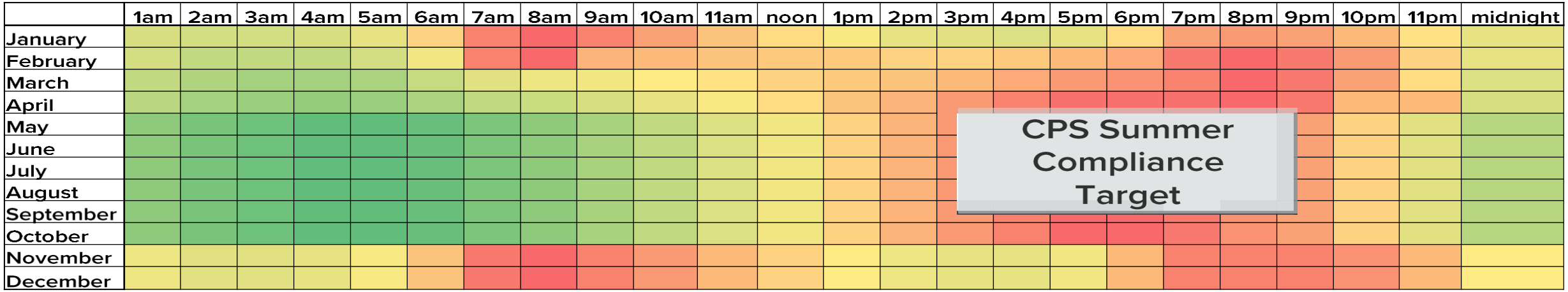
- RPS framework: compliance based on (e.g.) MWhs from a production meter.
  - Renewable energy credits (RECs) awarded for every MWh produced for a renewable resource
- CPS framework: compliance based on monthly MWhs from a production meter *within a peak time window*.
  - RECs, or new version of a REC, such as a Clean capacity credit (CCC) can be awarded for production during peak time.
  - CCCs may not be awarded if output not maintained for sufficient duration (i.e. capacity product).

Implementation Considerations

- Time Window
  - Summer peak and high value hours in other months
  - The LSE would need to obtain an average amount of RE over specified time period each season
- Potential Qualifying Resources
  - Renewables
  - Demand side resources
    - Active demand response
    - Distributed generation
  - Energy storage
    - Directly charged by newly enabled RE
    - Grid-charged, full credit *if:*
      - RE on the margin
      - Bundled with incremental RE production that coincides with charging

Setting Non-Summer Months Targets

- Peak hours for non-summer months change based on a regularly updated schedule to allow for flexibility.
  - Heat map with target capacity factor is one possibility



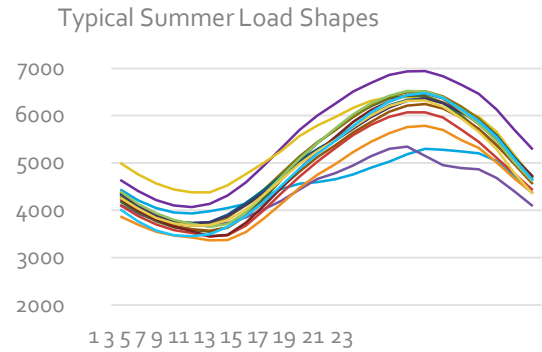
Low Loss of Load Probability

High Loss of Load Probability

Heat Maps Generated to Determine Credit Value

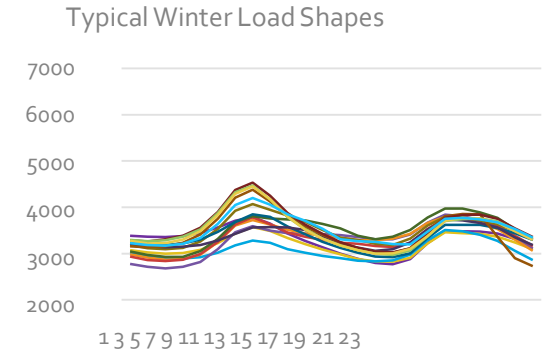
Peak Capacity Heat Map:

Hour ->	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Month																								
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.8	1.4	1.8	1.8	1.1	0.4	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.6	1.7	2.7	3.2	2.7	1.5	0.4	0.1	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.2	2.4	3.4	3.7	3.4	2.1	1.1	0.1	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.6	0.7	0.5	0.1	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0



Flexible Capacity Heat Map:

Hour ->	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Month																								
1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.6	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.1	0.3	0.4	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.3	0.1	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.4	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.5	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0



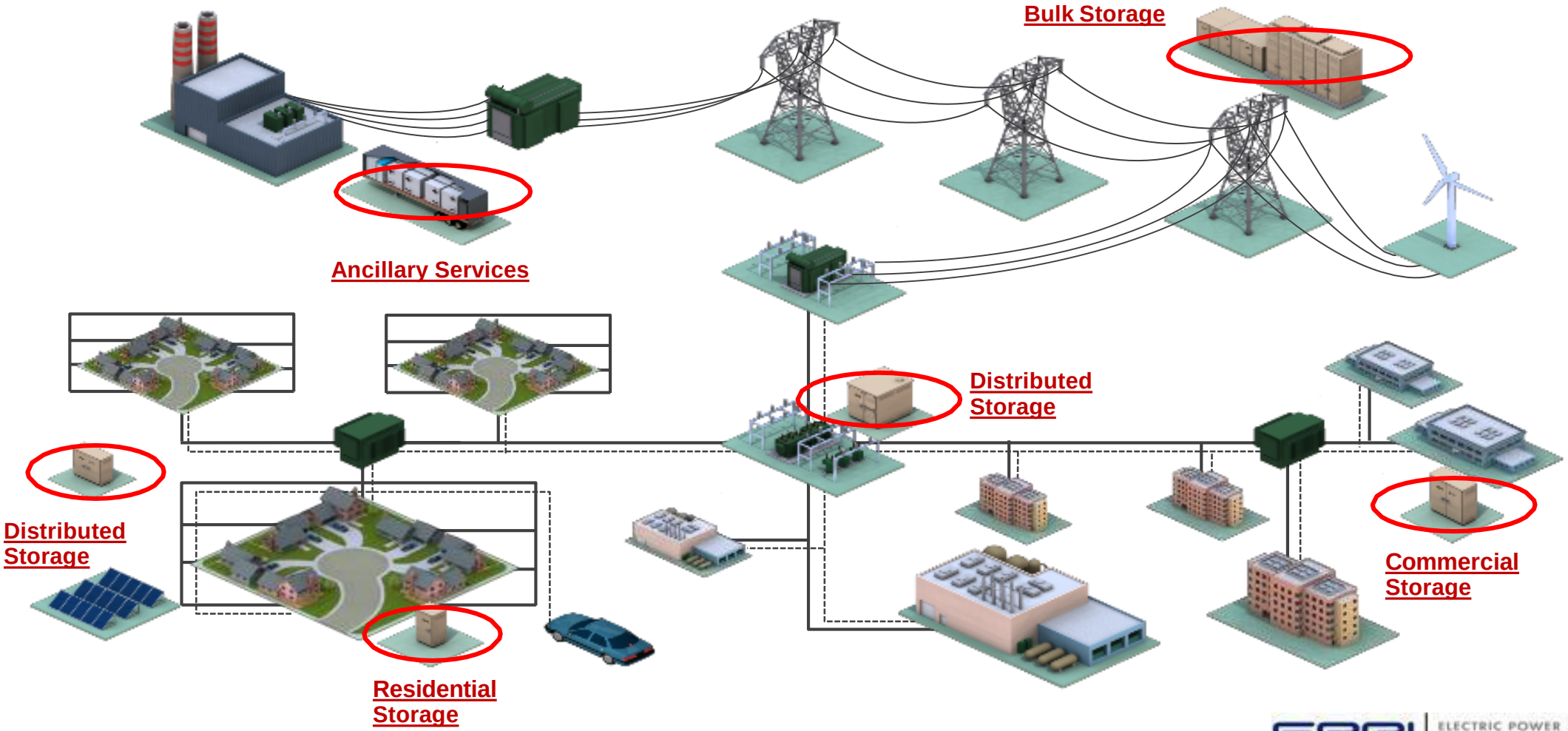
- Based on a rolling average
- Published annually and continuously updated

Implementation Considerations

- Locational considerations
  - E.g. load pocket carve-outs

- As net load peak moves, obligation on original hours still stands to avoid snap back
  - Initial 4-hour peak summer window remains
  - Additional windows can be added as needed
  - Brings scalability to the standard

Broad electric power system applicability



EPRI ELECTRIC POWER RESEARCH INSTITUTE

Are your state policies ready?

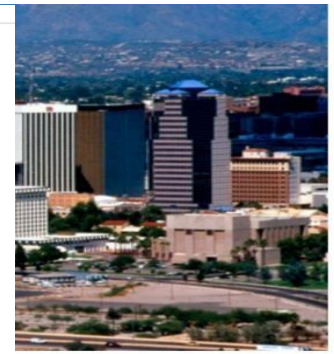
gtm:
A Wood Mackenzie Business

SOLAR
GRID EDGE
ENERGY STORAGE

SOLAR-PLUS-STORAGE

Xcel Attracts 'Unprecedented' Low Prices for Solar and Wind Paired With Storage

Bid attracts median PV-plus-battery price of $36 per megawatt-hour. Median wind-plus-storage bids came in even lower, at $21 per megawatt-hour.



BRIEF

Updated: Tucson Electric signs solar + storage PPA for 'less than 4.5¢/kWh'

First Solar Made Good on Its Promise to Beat Out Gas Peakers With Solar and Batteries

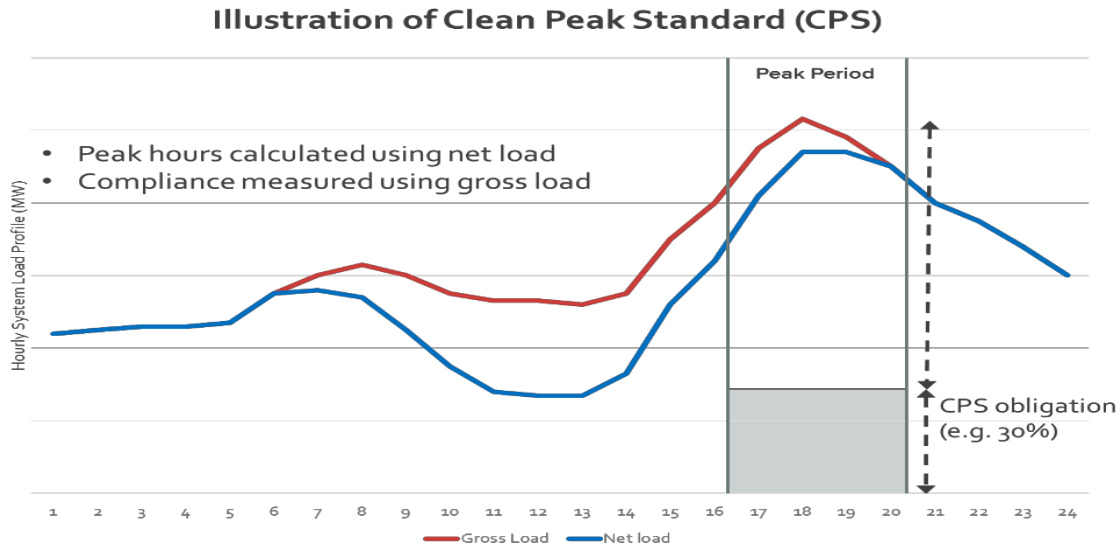
A 50-megawatt battery will give Arizona peak power from the sun.

JULIAN SPECTOR | FEBRUARY 13, 2018

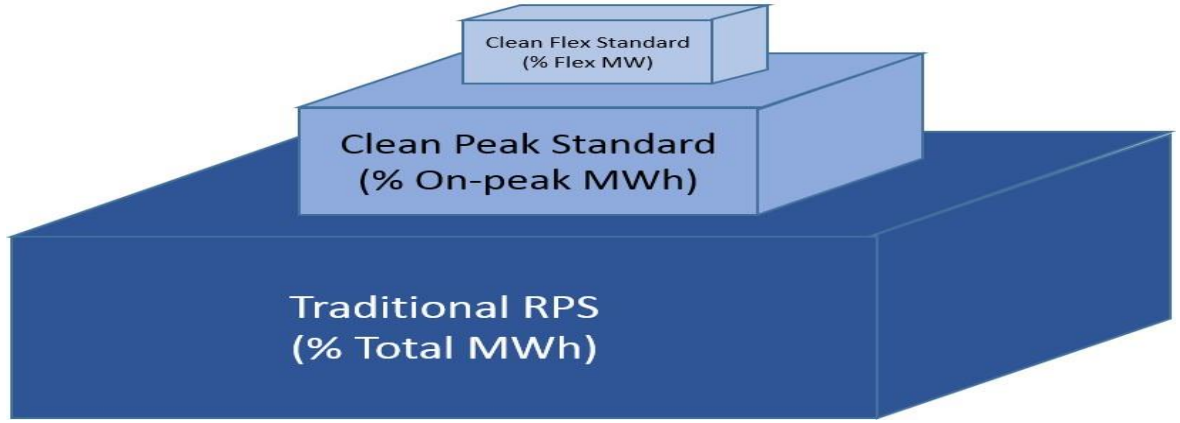
bids in

Xcel Colorado solicitation could set low-price benchmark

The RPS 2.0



Policy design increases in sophistication as new building blocks are added



https://www.strategen.com/reports-1/2018/3/28/evolving-the-rps-implementing-a-clean-peak-standard

Thank you!

Lon Huber
Vice President
Strategen Consulting, LLC

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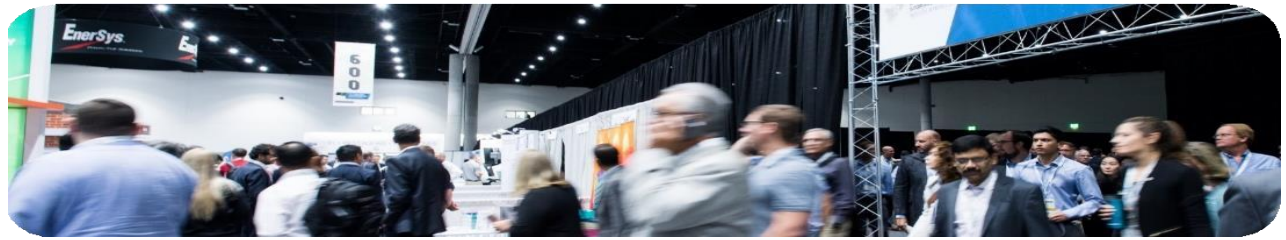


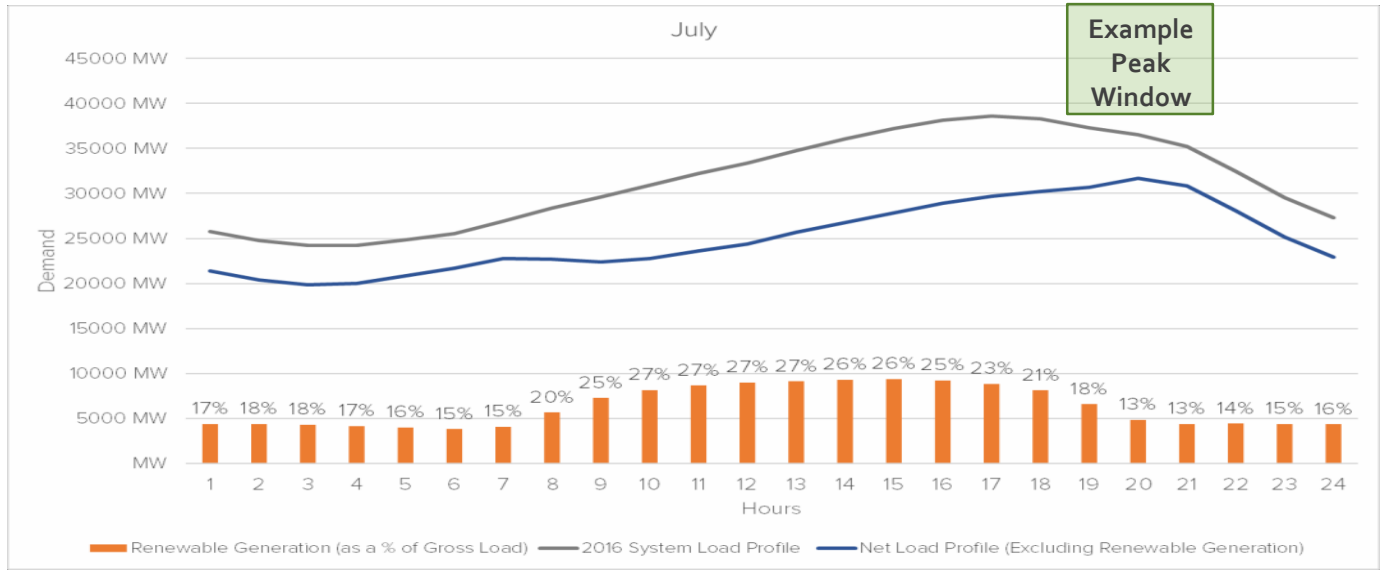
6th Energy Storage North America (ESNA) Conference + Expo: November 6-8, Pasadena, CA
Largest grid-connected energy storage conference in North America, covering all applications including EV charging (www.esnaexpo.com)

Clean Peak Paper
https://www.strategen.com/new-blog/2016/12/1/evolving-the-rps-a-clean-peak- standard-for-a-smarter-renewable-future

Appendix

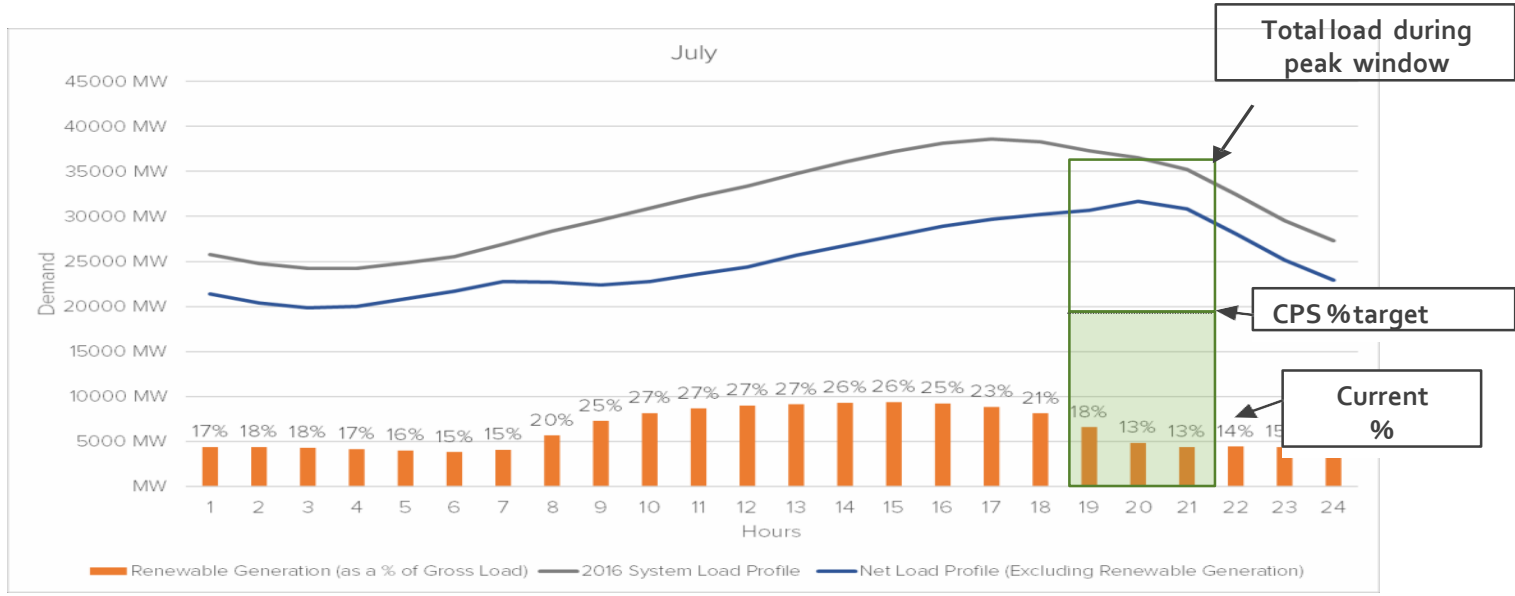
Setting the Peak Summer Window

- The clean peak standard is partly intended to help address emerging operational challenges associated with meeting electric power demand, net of renewable resources (i.e. the “duck curve”).
- Thus, the net load curve (duck curve) is used as the basis for establishing the peak window, which is aligned with the “head of the duck.”

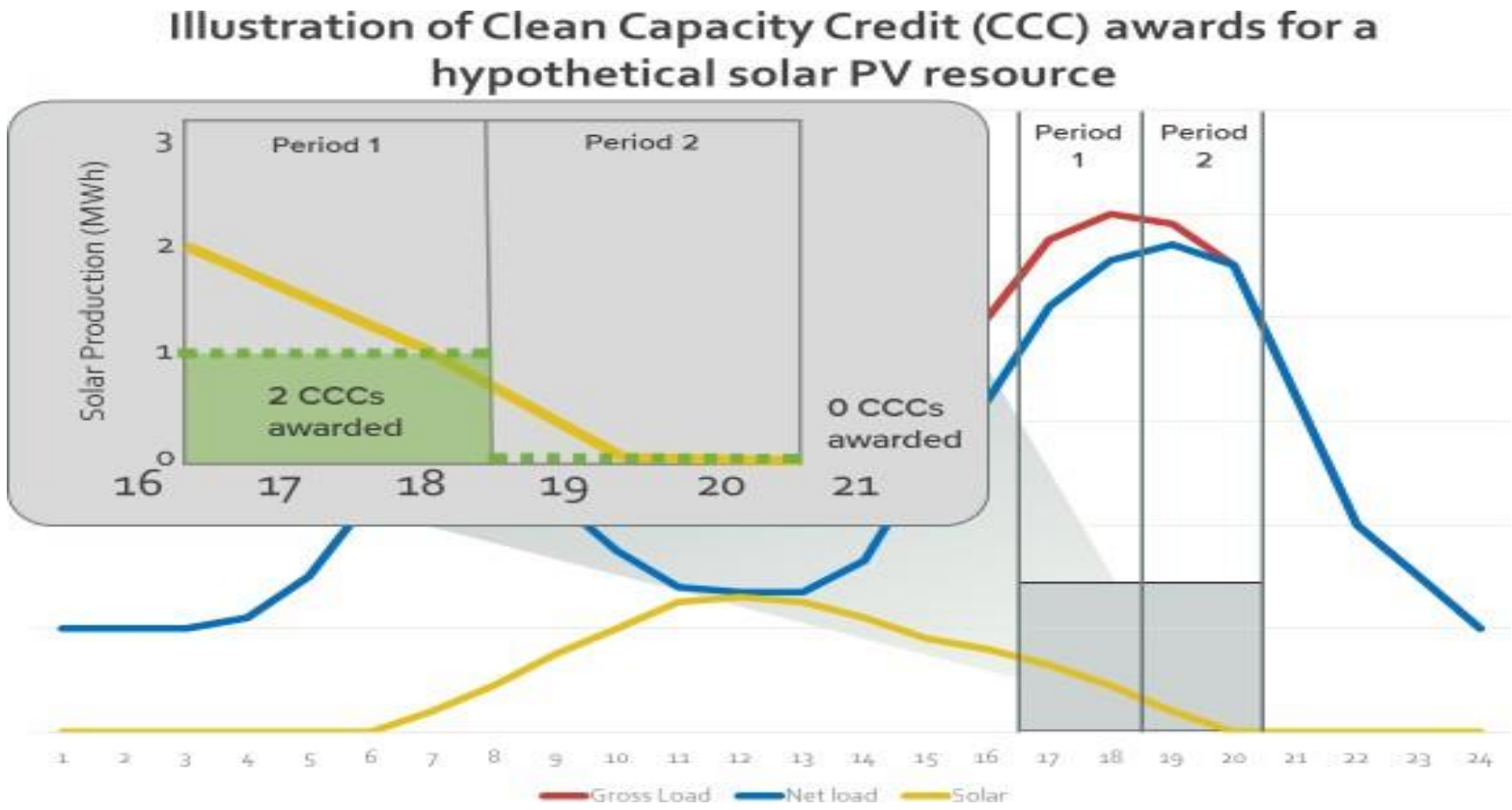


Setting the Summer Compliance Target

- For compliance purposes, qualifying energy produced during the peak window would be measured against the total or gross load during that “head of the duck" peak window.
- Measuring compliance relative to gross load (rather than net load) is necessary to properly account for existing renewable resources and avoid double counting.

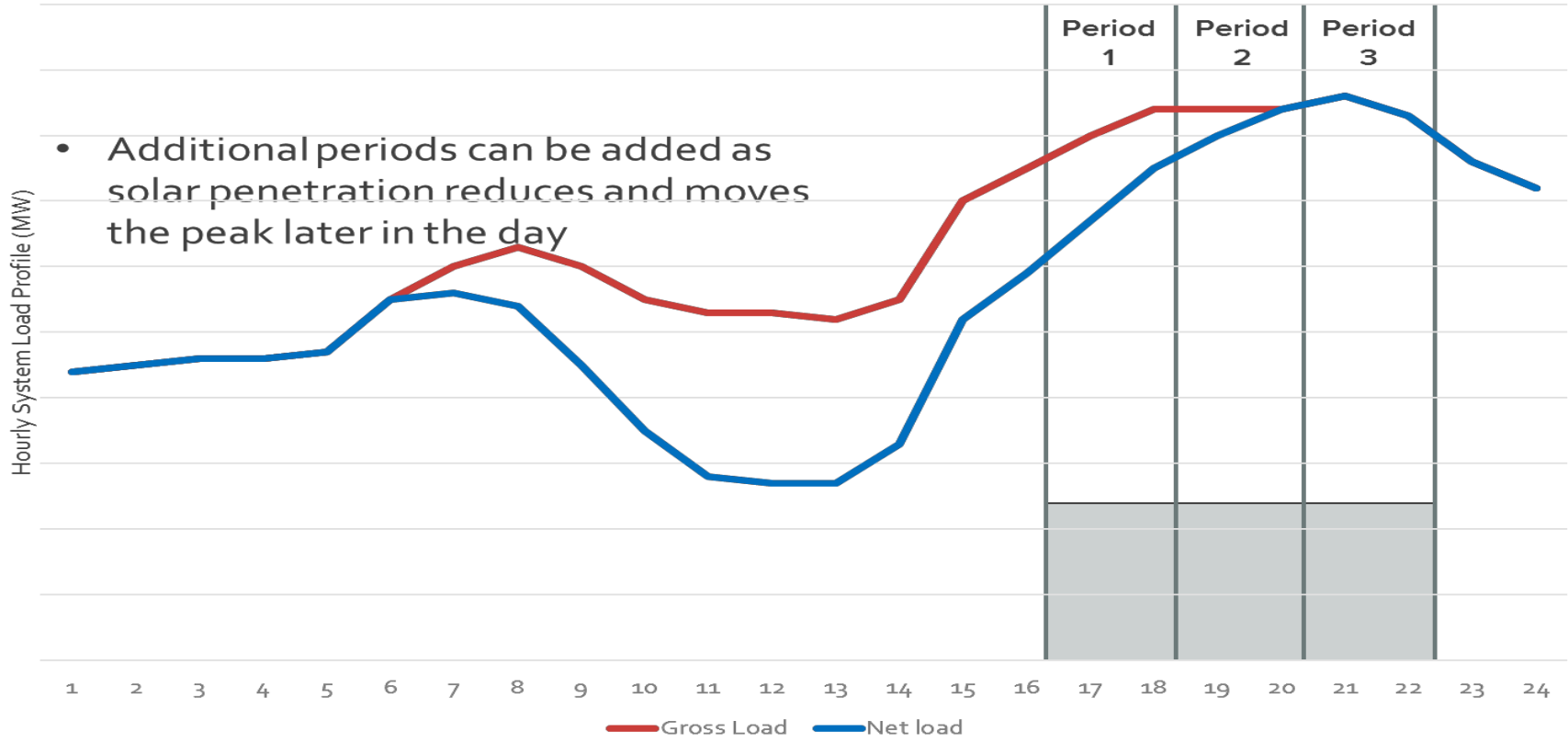


Implementation Considerations

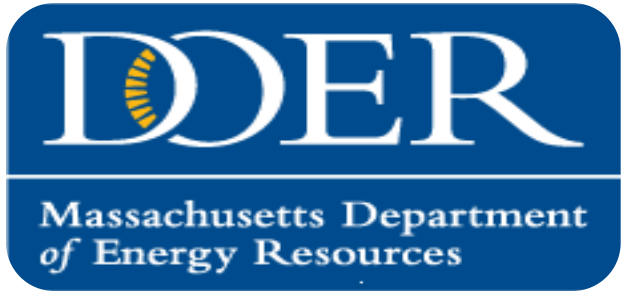


Implementation Considerations

- **Scalability**



Creating A Cleaner Energy Future For the Commonwealth



COMMONWEALTH OF MASSACHUSETTS

Charles D. Baker, Governor
Karyn E. Polito, Lt. Governor
Matthew A. Beaton, Secretary
Judith Judson, Commissioner

Energy Storage Public Stakeholder Forum

May 30, 2018

Boston, MA

Promulgating Regulations in Massachusetts

Michael Judge
Director, Renewable & Alternative Energy Division

Background on Regulations

- State agencies can only promulgate regulations pursuant to authority granted to them by the state legislature
- DOER currently administers nine regulations, including three portfolio standards (RPS Class I, RPS Class II, and APS) and the SMART regulation
- All agencies are required to follow the procedures outlined in M.G.L. Chapter 30A in order to promulgate new regulations or make changes to existing ones
- Agencies are also required to follow any additional administrative established by the legislature outside of the 30A process
- The complete set of regulations promulgated by state agencies is the Code of Massachusetts Regulations and is maintained by the Secretary of the Commonwealth

Steps Required Before Filing a Draft Regulation

- Prior to filing a draft regulation with the Secretary of the Commonwealth to officially begin the 30A process, DOER must first complete several steps:

1. Draft the regulation, review internally, and prepare all filing forms
2. Provide the regulation and filing forms to the Executive Office of Energy and Environmental Affairs (EEA) for review
3. Provide the regulation and filing forms to the Executive Office of Administration and Finance (ANF) for legal and fiscal review
4. Once these steps are complete, the regulation and all required forms may be filed with the Secretary of the Commonwealth (SOC)

DOER Rulemaking Process

Step	Notes
File the draft regulation and accompanying forms with the SOC and provide copies of filing to Department of Housing and Community Development (DHCD) and Massachusetts Municipal Association (MMA)	Regulation cannot be made publicly available until at least 14 days after copies have been provided to DHCD and MMA
Regulation made available for public comment; notice published in newspaper(s)	Occurs at least 14 days after filing; written comment period usually remains open for at least 30 days
Hold at least one public hearing	Must occur at least 21 days after public notice is published
Review public comments; make amendments to draft	No timeline to complete step
Obtain approval to file amended draft from EEA and ANF	No timeline to complete step
File amended draft with Joint Committee on Telecommunications, Utilities, and Energy (TUE)	Unlike most agencies, DOER must file its regulations with the legislature for review and comment
Receive TUE comments on amended draft	The TUE Committee has up to 30 days to provide DOER with written comments
Re-file final regulation with TUE	DOER is required to consider TUE's comments before re-filing with the committee. No timeline to complete step
File final regulation with SOC	DOER must wait at least 30 days after re-filing with the TUE Committee before it may file the final regulation
Final regulation promulgated in Code of Massachusetts Regulations	Occurs at least 14 days after final filing with SOC

Notes on Timing and Process

- While there are certain steps in the Chapter 30A process that have timelines, there are no requirements for promulgating a regulation within a specific timeframe unless the legislature explicitly establishes one
- Agencies must hold at least one public hearing, but can hold as many as they wish
- Agencies can solicit comments multiple times, particularly if substantive changes are made in response to public comments on an earlier draft
- The TUE filing process that DOER is required to follow pursuant to Chapter 25A adds a minimum of 60 days to any rulemaking that it conducts
- The SOC publishes the Code of Massachusetts Regulations every other Friday, so depending on the timing of an initial filing or final filing, an additional 2-4 weeks can be added to the process

Emergency Regulations

- Emergency regulations take effect immediately upon being filed with the SOC
- Can only be issued if:

  "[an] agency finds that immediate adoption, amendment or repeal of a regulation is necessary for the preservation of the public health, safety or general welfare, and that the observance of the requirements of notice and a public hearing would be contrary to the public interest"
- Emergency regulations can only remain in effect for three months unless an agency solicits comments and holds a public hearing as required by Chapter 30A for all other regulations
- There is a high bar for issuing an emergency regulation and it is not likely that a rulemaking incorporating energy storage will be an emergency rulemaking

Timing of Recent DOER Rulemakings

- SMART Regulation (225 CMR 20.00)
  - New emergency regulation filed on June 5, 2017
  - Promulgated on August 25, 2017 (81 days)
- APS Regulation (225 CMR 16.00)
  - Non-emergency regulation originally filed on May 19, 2016
  - Re-filed for second round of comments on June 2, 2017
  - Promulgated on December 29, 2017 (19 months)
- RPS Class I (225 CMR 14.00)
  - SREC II extension
  - Emergency regulation filed on April 8, 2016
  - Promulgated on July 8, 2016 (91 days)
- RPS Class II (225 CMR 15.00)
  - Non-emergency regulation filed on February 28, 2014
  - Promulgated on June 20, 2014 (4 months)
- Note that none of these timelines include stakeholder outreach, drafting, and the process of obtaining approvals prior to the beginning of the rulemaking
  - In particular, APS regulations began stakeholder discussions 1.5 years before initial filing, and SREC II and SMART Programs began discussions over 1 year before filing

Timing of Including Energy Storage in the APS or a Clean Peak Standard

- Timing is dependent on a number of factors, but will involve careful consideration by DOER and more input from stakeholders before any draft regulation can be filed
- Among other things, DOER still needs to:
  - Define objectives and goals;
  - Determine what types and use cases of storage will be eligible;
  - Determine necessary incentive levels; and
  - Understand how storage will interact with other technologies under the portfolio standard
- Whether the vehicle for including storage in a portfolio standard is the APS or a new Clean Peak Standard established by legislation will also likely have an impact on timing
- Today represents the first step in what will likely be an extended process with ample opportunity for public input

Legislative Proposals for a Clean Peak Standard

- Governor Baker filed legislation to establish a Clean Peak Standard in March of 2018
- The Clean Peak Standard was part of the larger environmental bond bill and would give DOER the authority to promulgate regulations establishing a new portfolio standard
- Would allow Class I renewables, energy storage, and demand response to qualify provided they deliver energy during peak periods as defined by DOER
- The Clean Peak Standard language was ultimately removed from the bill when it was moved out of the ENRA committee
- However, H. 1747 moved out of the TUE committee last week and seeks to provide:

  1) DOER the authority to establish a Clean Peak Standard, and 2) to expand the growth rate of the Commonwealth's RPS Class I Minimum Standard beyond 1% per year
- Legislative session is scheduled to end on July 31st

System Peaks

Considerations for a Clean Peak Standard or New Portfolio

ENERGY STORAGE PUBLIC STAKEHOLDER FORUM

by The Massachusetts Department of Energy Resources

PREPARED BY: DAYMARK ENERGY ADVISORS, INC.
PREPARED FOR: MASSACHUSETTS DEPARTMENT OF ENERGY RESOURCES
DATE: MAY 30, 2018

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Understanding System Peaks

- When are the electricity peaks in New England?
- What drives these peaks?
- What resources serve load during these peaks?
- What costs are caused by these peaks?
- What costs might we avoid if we modify the peak?
- What if we change how we serve the peak?

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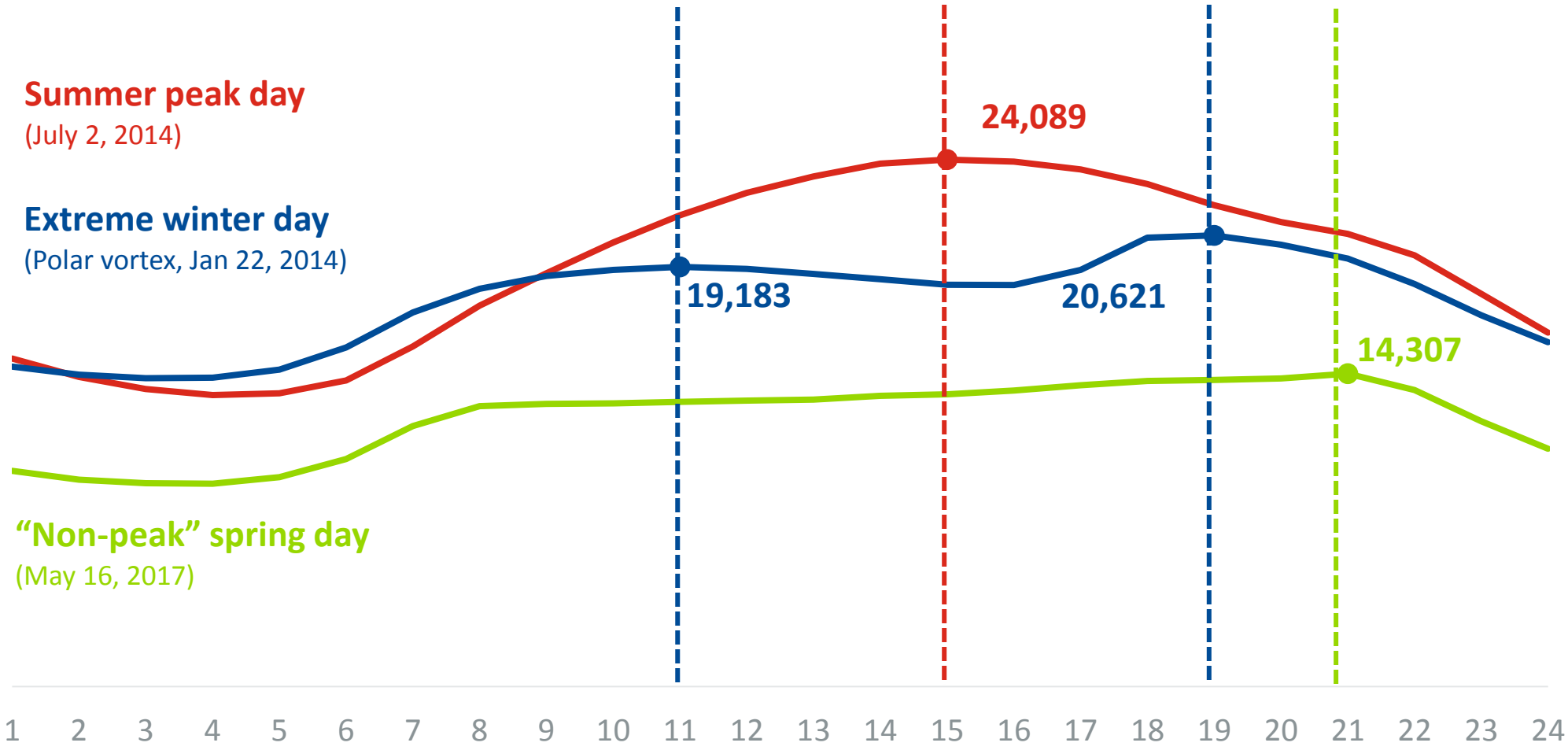
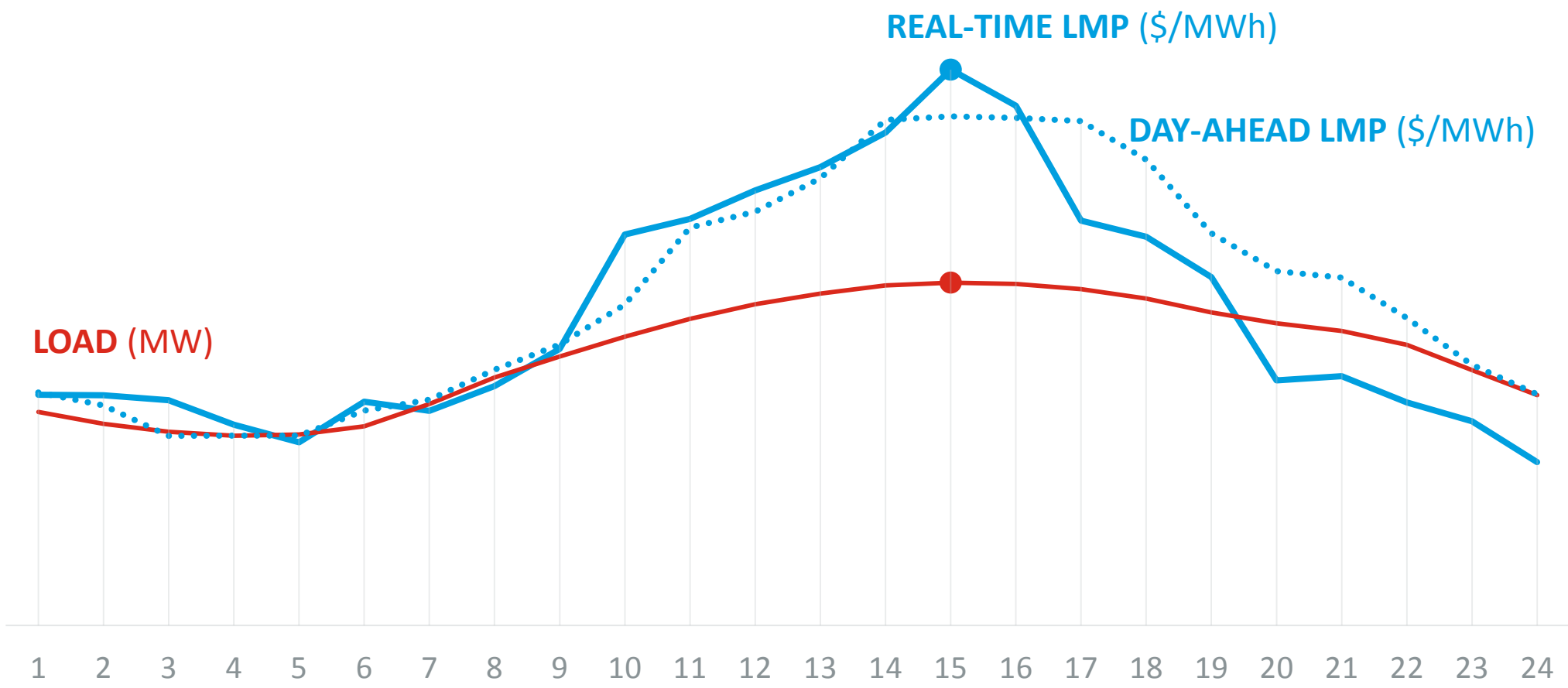
Overview of New England's Electricity Peaks

Real-time load, in MW



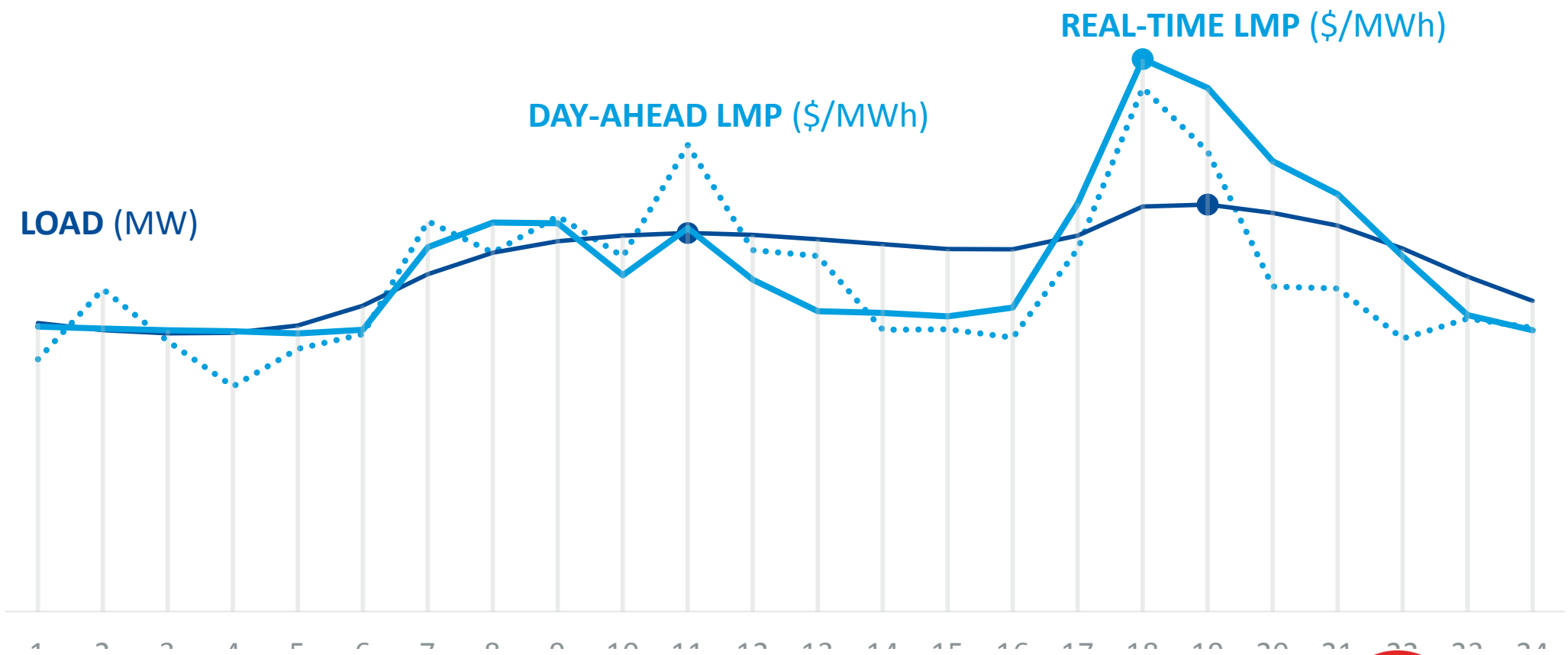
Summer Peak Day (July 2, 2014)

Prices vs Load



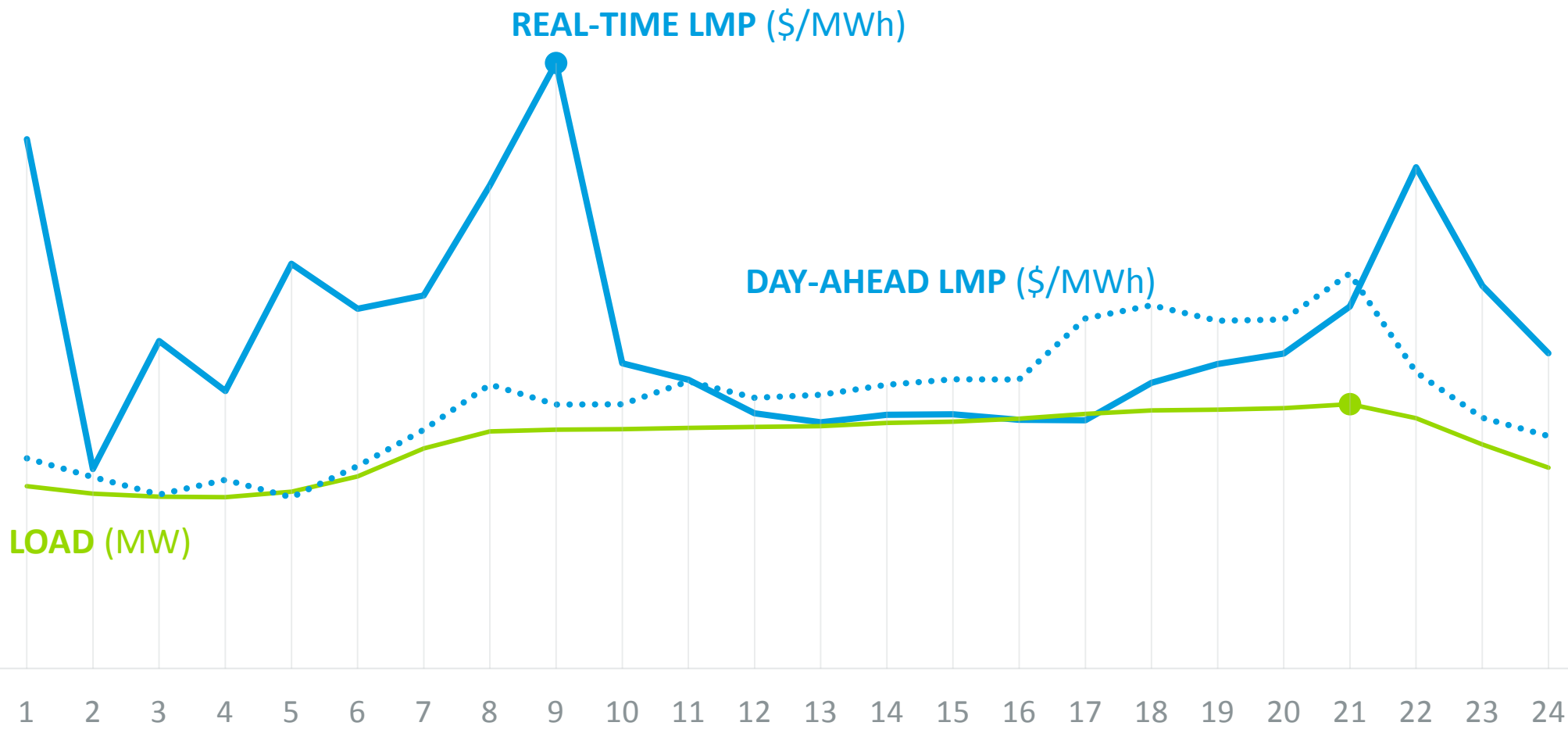
Extreme Winter Day (Polar vortex, Jan 22, 2014)

Prices vs Load

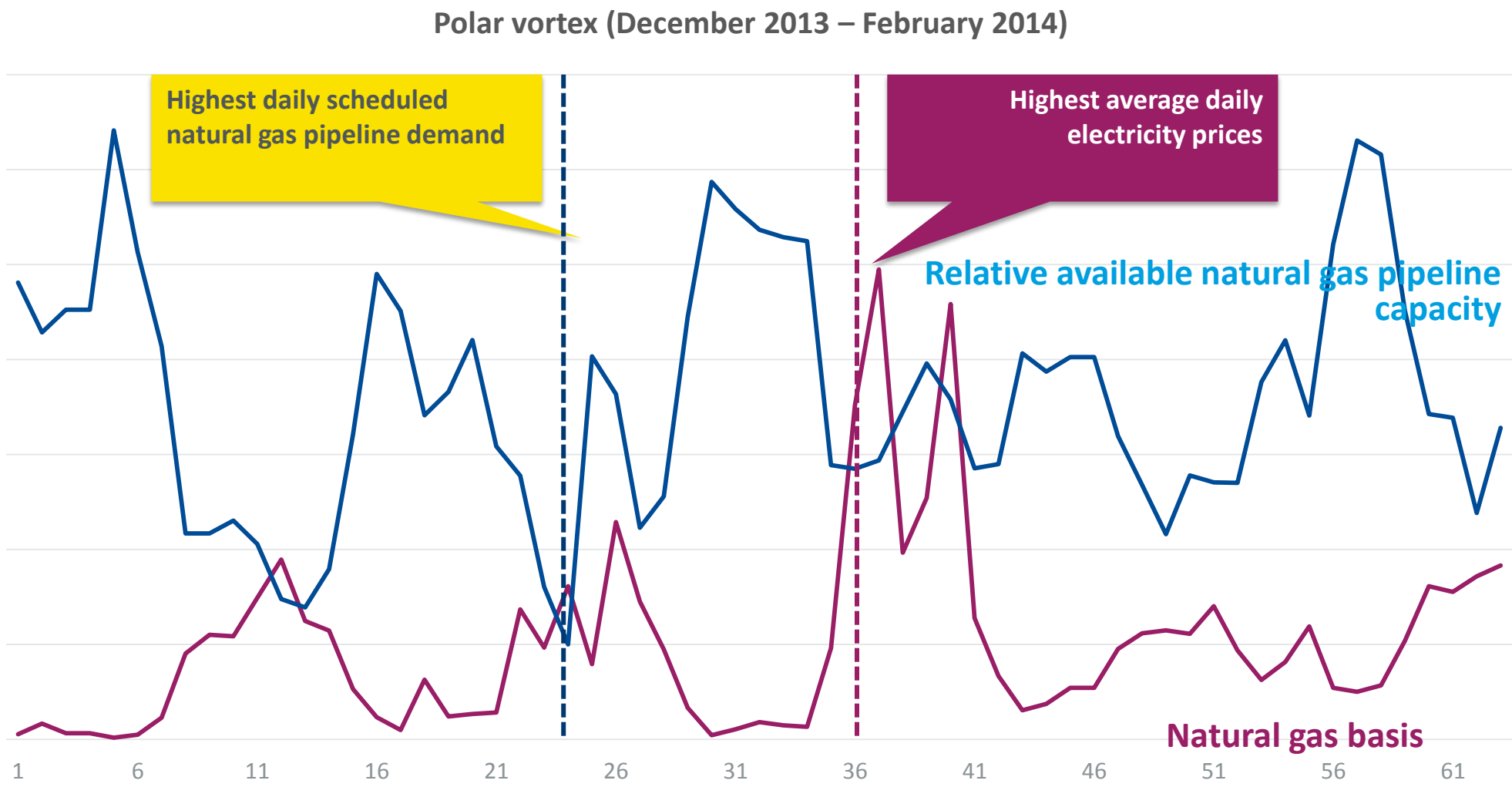


“Non-peak” Spring Day (May 16, 2017)

Prices vs Load

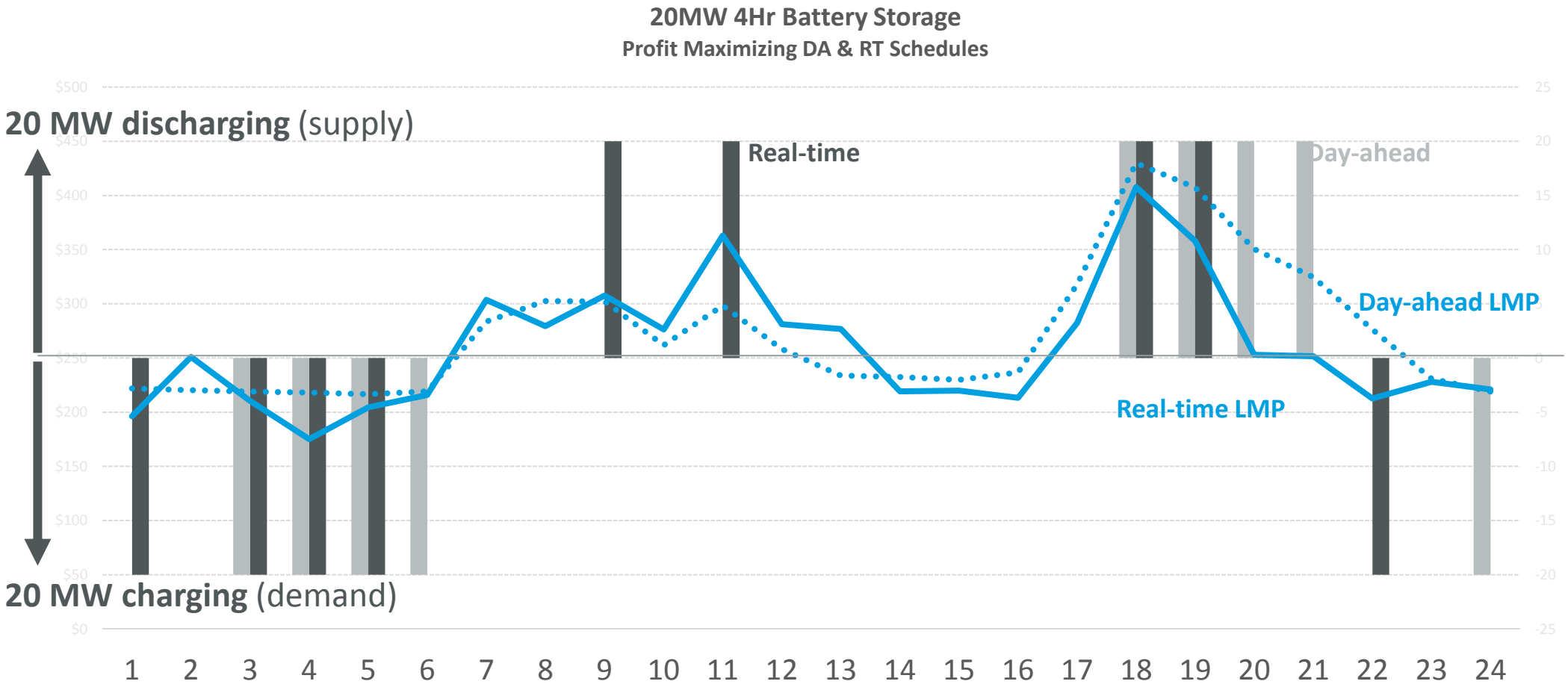


Peak Pipeline Demand, Electricity Demand, Electricity Prices, and Gas Prices Non-Coincident



Hypothetical Battery Storage Schedule *
Extreme Winter Day (Polar Vortex - Jan 22, 2014)

* Produced with Daymark's Energy Storage Scheduling Model - TideMarker



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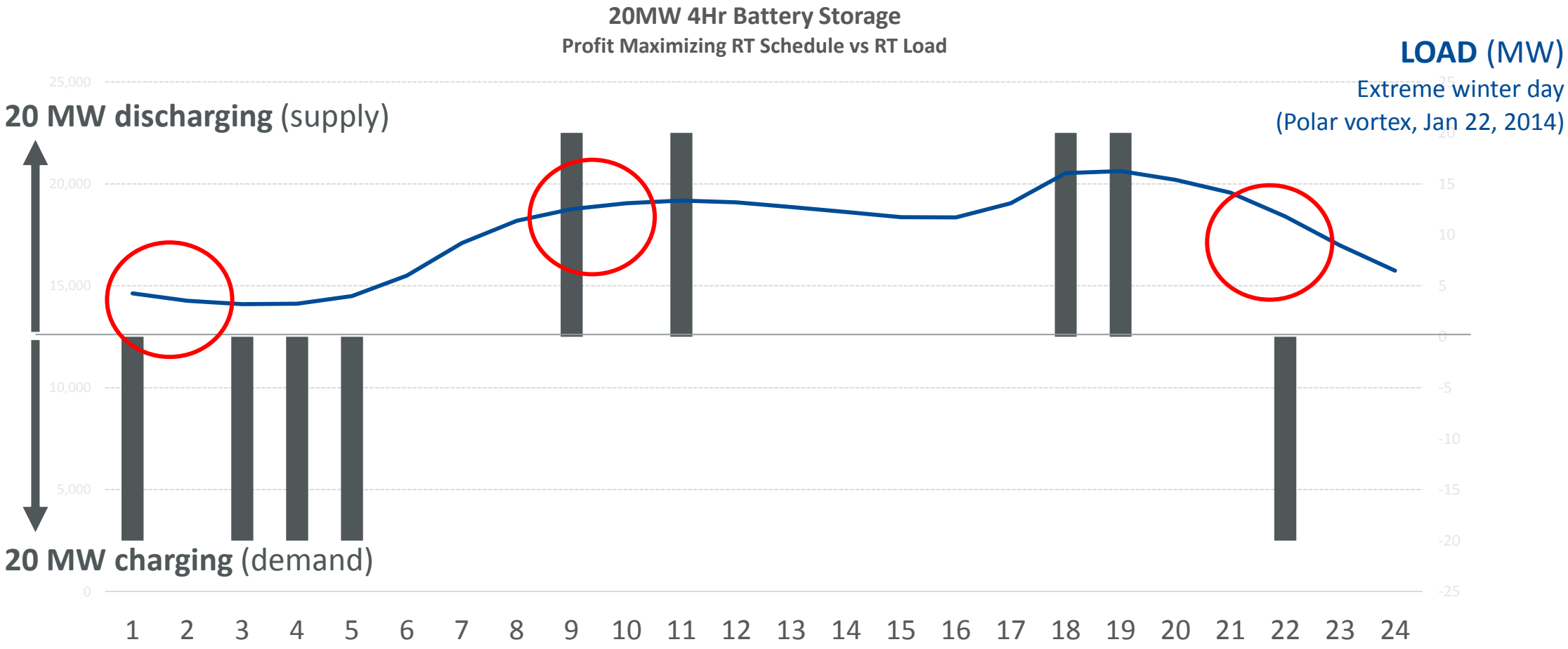
Profit Maximizing Schedule vs Load Leveling Schedule



Hypothetical Battery Storage Schedule *
Summer Peak Day (July 2, 2014)

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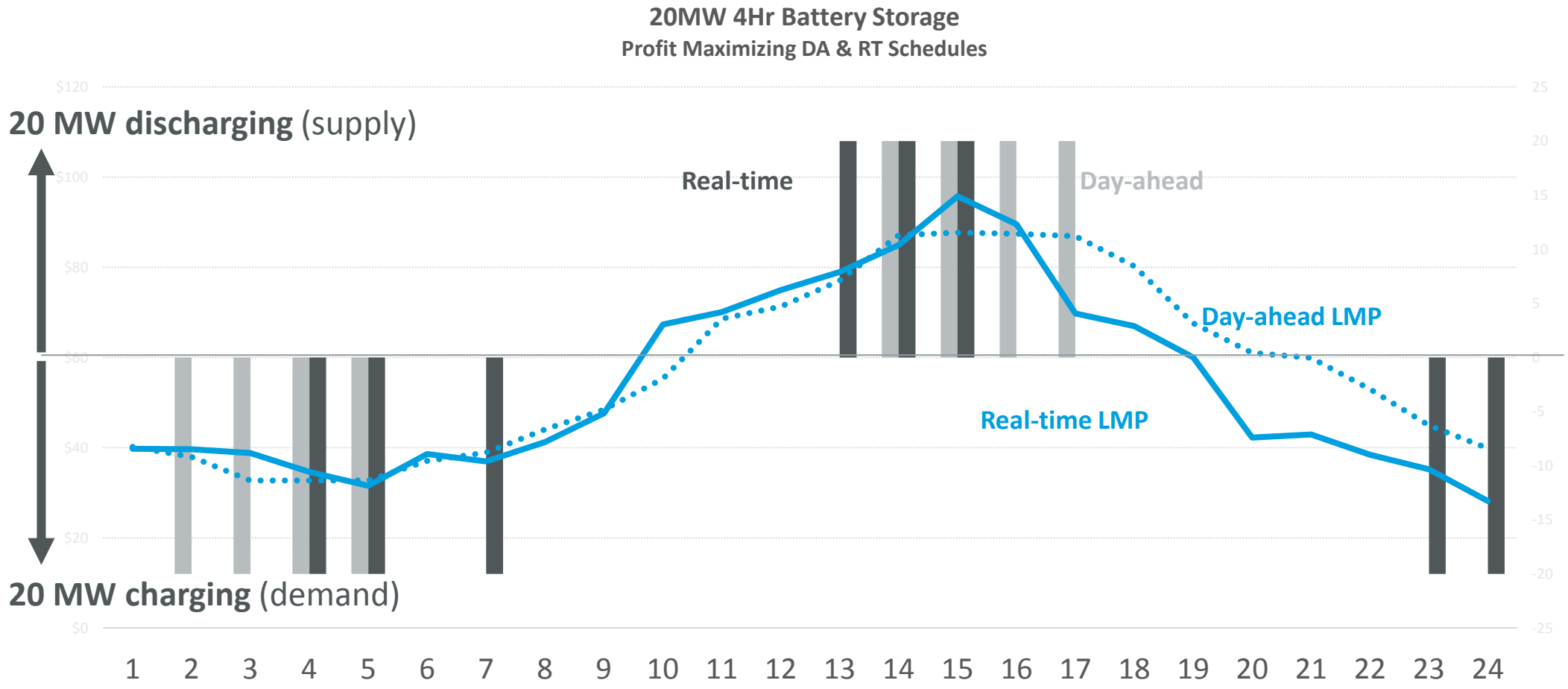

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Hypothetical Battery Storage Schedule *
"Non-peak" Spring Day (May 16, 2017)

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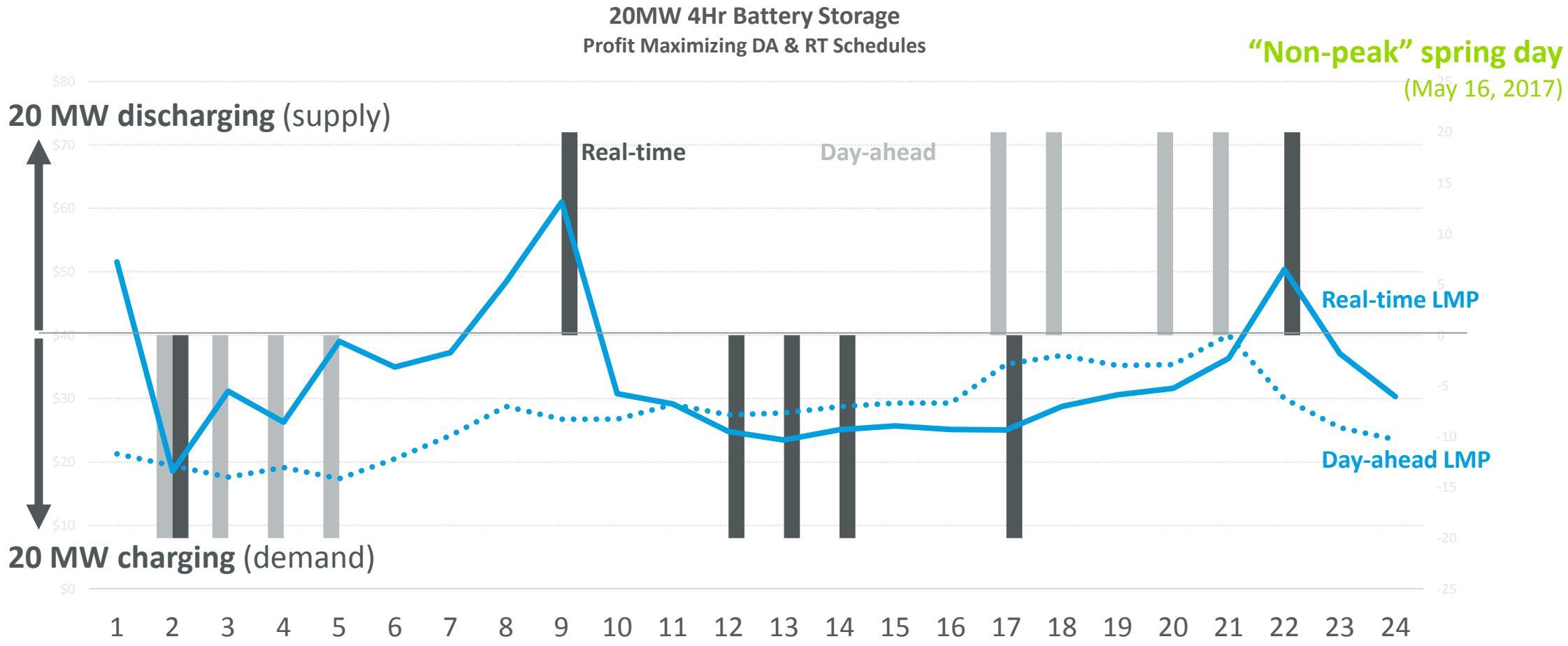

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Thank you

Let’s continue the conversation

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DAYMARK ENERGY ADVISORS

Our team helps business leaders and policymakers navigate the connected and changing energy landscape.

We provide a comprehensive set of integrated economic planning and strategic advisory services.

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ENERNOC

An Enel Group Company

Clean Peak Standard

May 30, 2018

Agenda

- Why do we need a clean peak?
- Clean Peak Standard proposals from Governor Baker and Rep. Haddad
- Benefits of a CPS

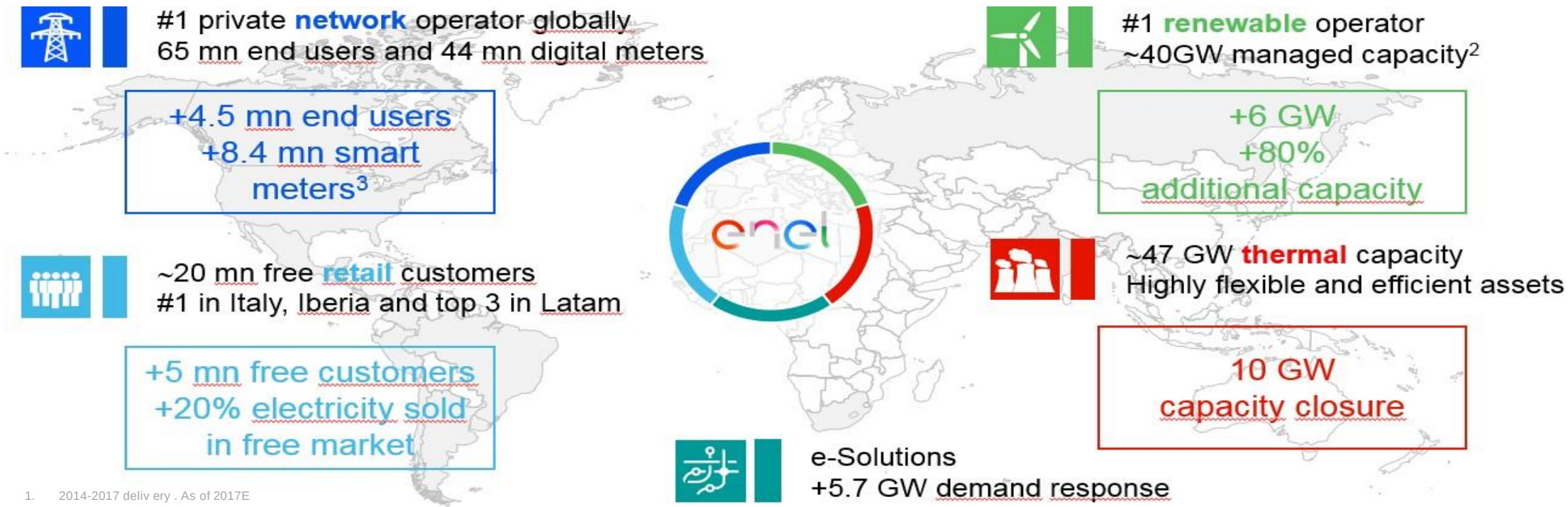
The Enel Group Worldwide

A multinational power company and leading integrated player in the world's power and gas markets

- #74 on Fortune 500 with $84B in annual revenue; nearly 70,000 employees across five continents
- Ranked 20th on Fortune's 2017 "Companies that are Changing the World" list; only utility on the list
- Acquired Demand Energy, EnerNOC and eMotorWerks in 2017 to serve as the foundation for EnelX
- Boston HQ – Global Center of Excellence; BBJ ranked Enel/ENOC 2nd largest Greentech in Mass

The Enel Group Worldwide

Evolution since 2014[1]



1. 2014-2017 deliv ery . As of 2017E
2. Consolidated capacity equal to 37 GW (including 25 GW of large hy dro)
3. Including replacement of smart meters 2.0 in Italy equal to 1.4 mn. Enel global market share equal to 24% (BNEF 3Q17 Energy Smart technologies market Outlook)
4. Presence with operating assets

A Complete Suite of Energy Management Solutions

Flexibility Solutions

C&I Demand Response

EV Charging

Energy Storage

Advisory Solutions

Energy Procurement Solutions

Energy Management Software

Utility Bill Management

EnerNOC's Presence in the Commonwealth

Advisory Services

- Commonwealth Building Energy Intelligence (formerly DOER EEMS starting in 2009)
- Gas and Electricity Procurement for MA Operational Services Division
- Administrate RGGI and MA SREC Auctions

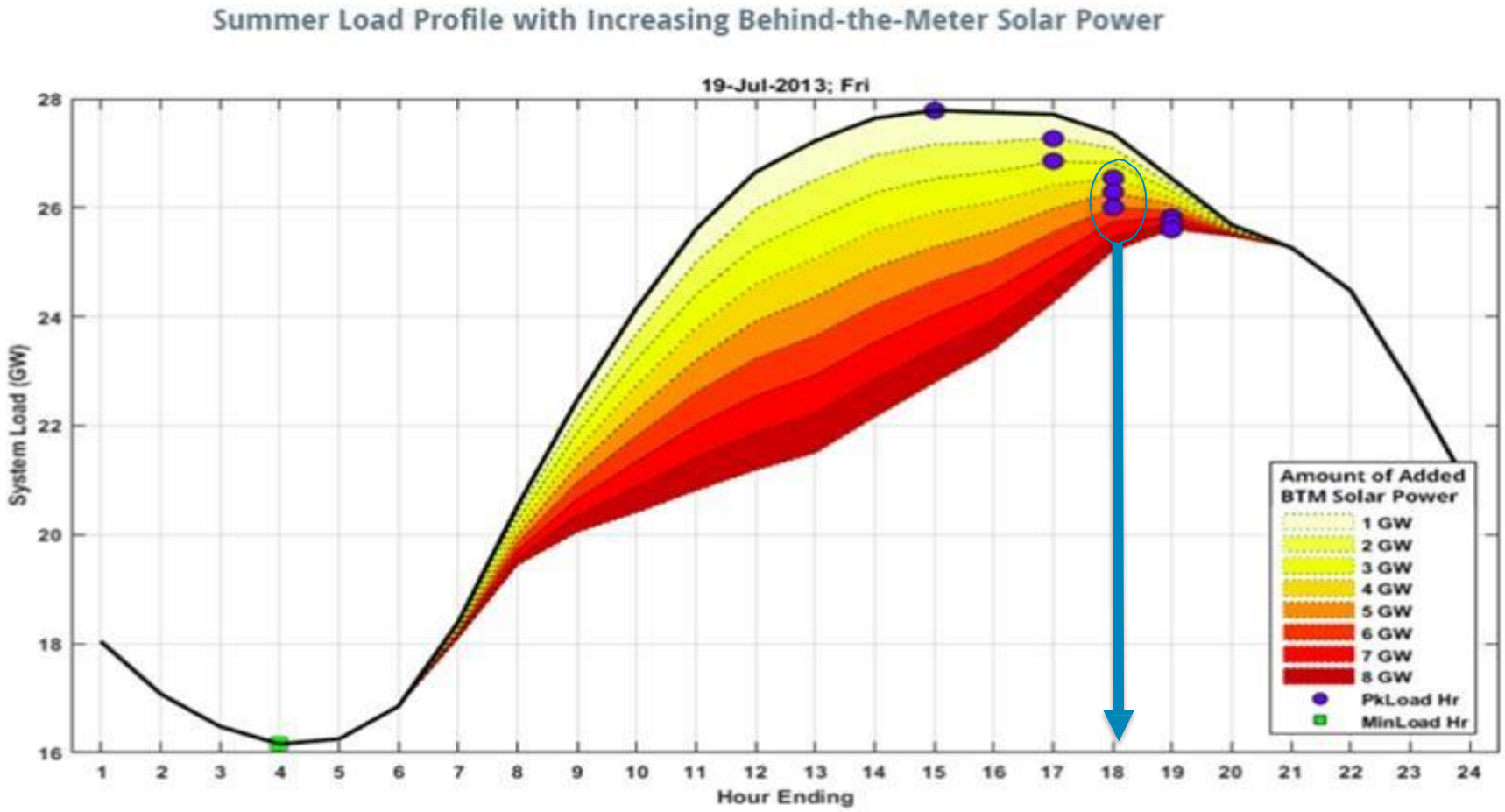
Flexibility Services

- Recipient of two ACES grants at Acton-Boxborough Regional School District (EnerNOC) and UMass-Boston (Enel Green Power North America)
- Participating in ISO-NE Forward Capacity Market and National Grid and Eversource peak-shaving demand response programs

Why do we need a clean peak?

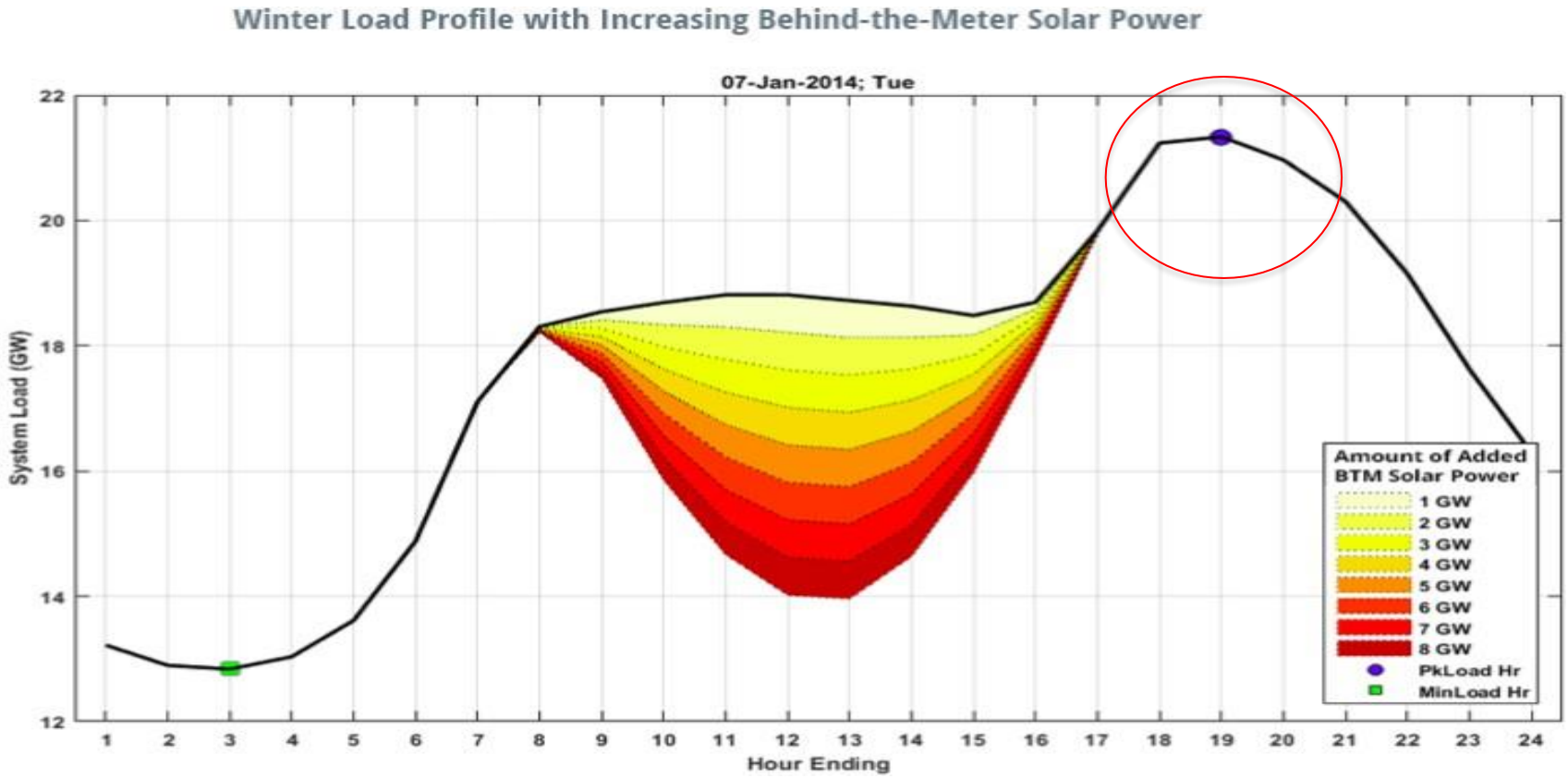
Summer

Summer comprises the highest electricity use in New England, largely because of air conditioning. PV clearly helps "shave the peak" when the peak falls during daylight hours. Because greater amounts of PV will shift the timing of peak demand for grid electricity to later in the afternoon or evening, PV's ability to reduce peak demand will diminish over time.



Why do we need a clean peak?

Winter has the second highest electricity use in New England. Load reductions from PV can be significant during midday hours on sunny winter days, which, as more PV is installed, will increase the need for power resources with the operational flexibility to quickly ramp their output up or down to match the steeper curves of changing demand. Importantly, PV doesn't reduce the winter peak at all due to the timing of sunset.



Why do we need a clean peak?

Table 5-3
2016 LMU Marginal Emission Rates—All LMUs (lb/MWh)[a, b]

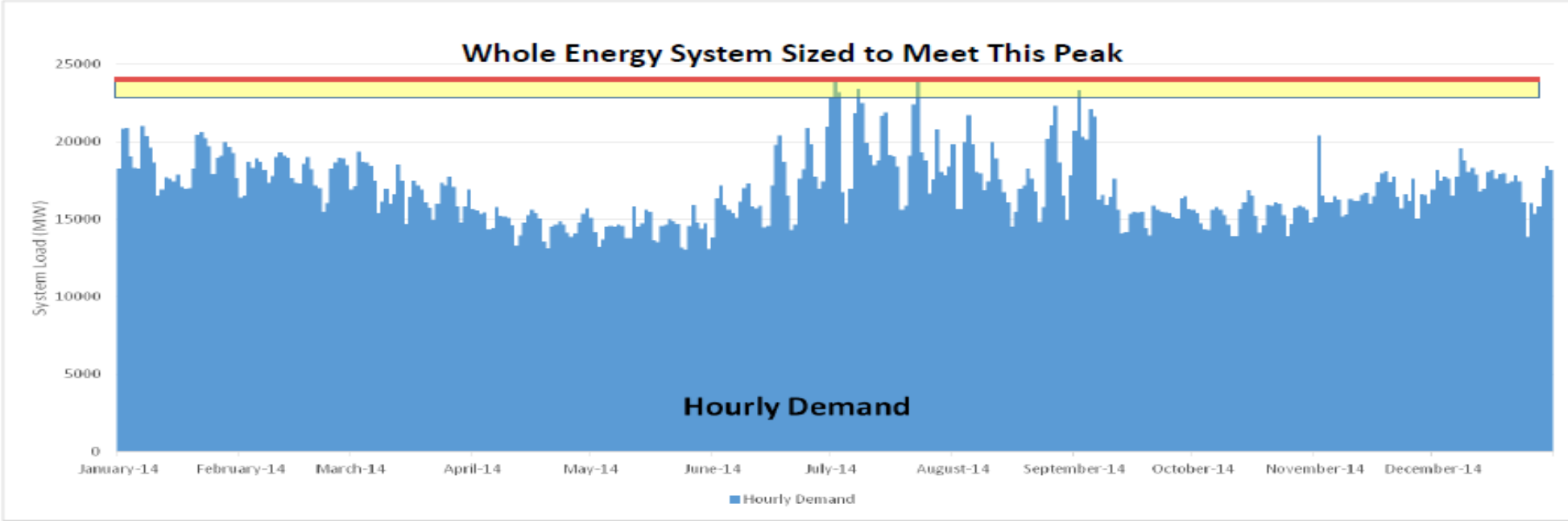
Ozone / Non-Ozone Season Emissions (NOx)					
Air Emission	Ozone Season		Non-Ozone Season		Annual Average (All Hours)
	On-Peak	Off-Peak	On-Peak	Off-Peak	
NO_X	0.26	0.14	0.25	0.19	0.21
Annual Emissions (SO_2 and CO_2)					
Air Emission		Annual			Annual Average (All Hours)
		On-Peak	Off-Peak		
SO_2		0.22	0.11		0.16
CO_2		892	807		842

- "In 2016, the on-peak marginal rates for SO2 and CO2, as well as for NOX during both the ozone and non-ozone seasons, were higher than the off-peak rates. **This is likely due to the operation of older, less-efficient jets or combustion turbines dispatched to meet peak load."**

- 2016 ISO New England Electric Generator Air Emissions Report

Why do we need a clean peak?

Electric Grid is Sized for Highest Hour of Demand



Top 1% of Hours accounts for 8% of Massachusetts Spend on Electricity
Top 10% of Hours accounts for 40% of Electricity Spend

* MA State of Charge Report. Siide 16. https://www.mass.gov/files/2017-07/9-27-16-storage-presentation.pdf

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Clean Peak Standard proposals

- Legislation introduced from the Baker Administration and Rep. Haddad and passed by House TUE

- **Baker Administration legislation**
  - Directs DOER to create a new clean peak standard (no specific target); purpose is "to increase the usage of clean energy during periods of high, carbon intensive, and expensive electricity demand, with the long-term goal of reducing ratepayer costs while lowering greenhouse gas emissions"

- **Rep. Haddad legislation**
  - Directs DOER to develop a benchmark for clean peak resources, and then a standard that increases .75% annually from benchmark; annual competitive procurement for Clean Capacity Credits with 10-20 year terms; DOER can set and adjust seasonal peak load hours
  - Stimulates behavior change; existing RPS resources not eligible unless they install storage
  - Standalone storage qualifies but needs to charge during lower emitting hours

Benefits of Clean Peak Standard

- Sends a stable price signal to developers and customers to “build” resources and invest in technologies that are available when the system needs them the most; not every MWh is the same
- Reducing peaks should lower wholesaleand distribution-level costs (e.g. storage and DR should reduce T&D expenses), as well as emissions
- Increases the firmness of renewable generation and helps avoid curtailing renewable output
- Annual competitive procurement process for CCCs allows costs to naturally decrease over time as technologies become more competitive; DOER can adjust seasonal peak hours over time