RPS Collaborative Webinar

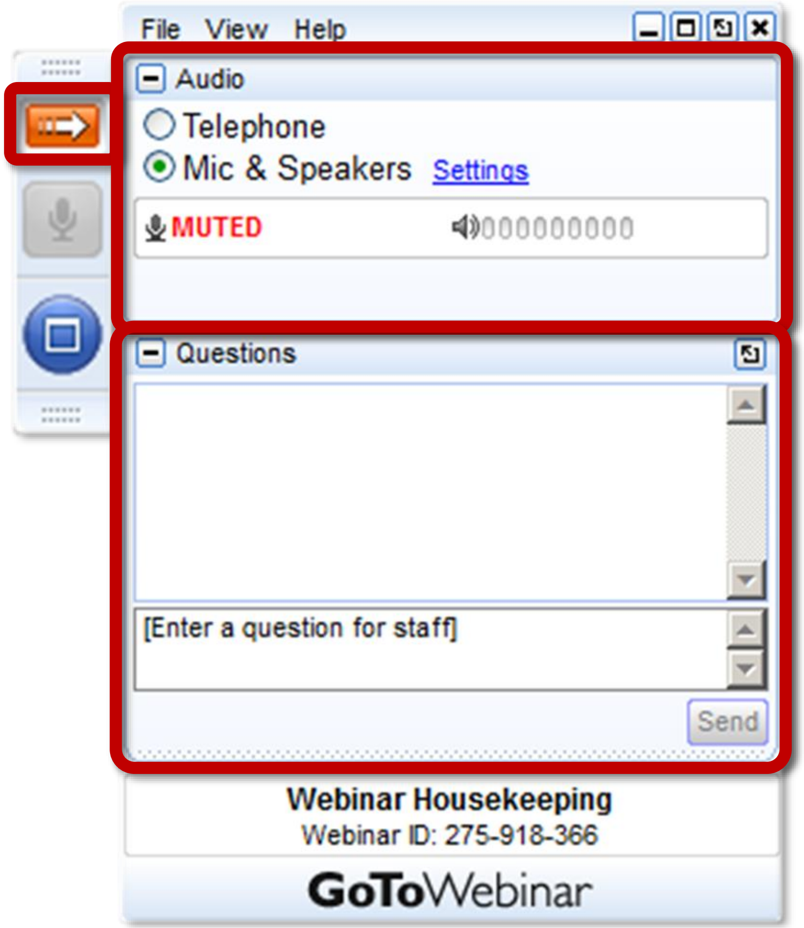
Should There Be a Clean Peak Standard?

Hosted by
Warren Leon, Executive Director, CESA

May 9, 2017

Clean Energy States Alliance

Housekeeping



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RPS Collaborative

- With funding from the Energy Foundation and the US Department of Energy, CESA facilitates the **Collaborative**.
- Includes **state RPS administrators**, **federal agency representatives**, and other stakeholders.
- Advances dialogue and learning about RPS programs by **examining the challenges and potential solutions** for successful implementation of state RPS programs, including **identification of best practices**.
- To sign up for the Collaborative listserv to get the **monthly newsletter** and announcements of **upcoming events**, see: www.cesa.org/projects/state-federal-rps-collaborative

ENERGY FOUNDATION
building a new energy future

U.S. DEPARTMENT OF ENERGY

Clean Energy States Alliance

Today's Guest Speaker

- **Lon Huber**, Senior Director, Strategen Consulting

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Evolving the RPS:

A Clean Peak Standard for a Smarter Renewable Future

Lon Huber

About Strategen

Strategies for clean energy

Strategen provides insight to global corporations, utilities and public sector leaders, helping them to develop impactful and sustainable clean energy strategies

CLIENTS

We work with governments, utilities, research institutions, technology providers, project developers, and large energy users seeking to evaluate and implement next generation grid and clean energy technologies.

MARKETS

Our exclusive focus on clean energy and advanced grid technologies means we bring our clients a sophisticated understanding of industry trends, market drivers and regulatory policy.

SERVICES

Our clients come to us for our expertise in developing business models, commercial strategies, financing tools and regulatory support that empower them to create sustainable value and long-term solutions.

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Our team is comprised of well-respected thought leaders and industry experts who have played instrumental roles in shaping the power sector's transformation in the 21st century.

We are experts in power sector strategy. Our track record and networks are unmatched in the business.

- Cost/benefit analysis
- Market entry
- Public proceeding support
- Regulatory strategy
- Product development
- Grid resource planning and procurement
- Stakeholder engagement and education
- Mergers and acquisitions

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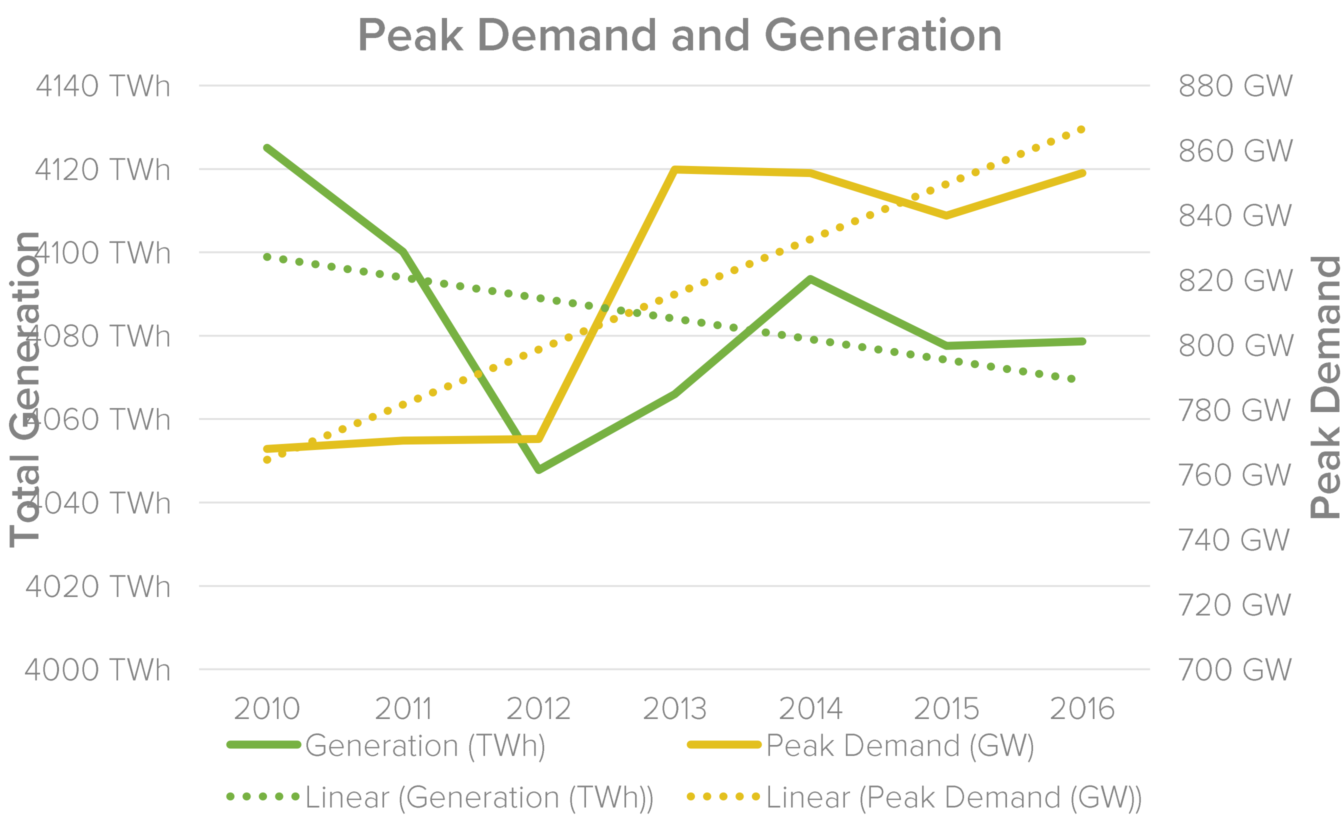
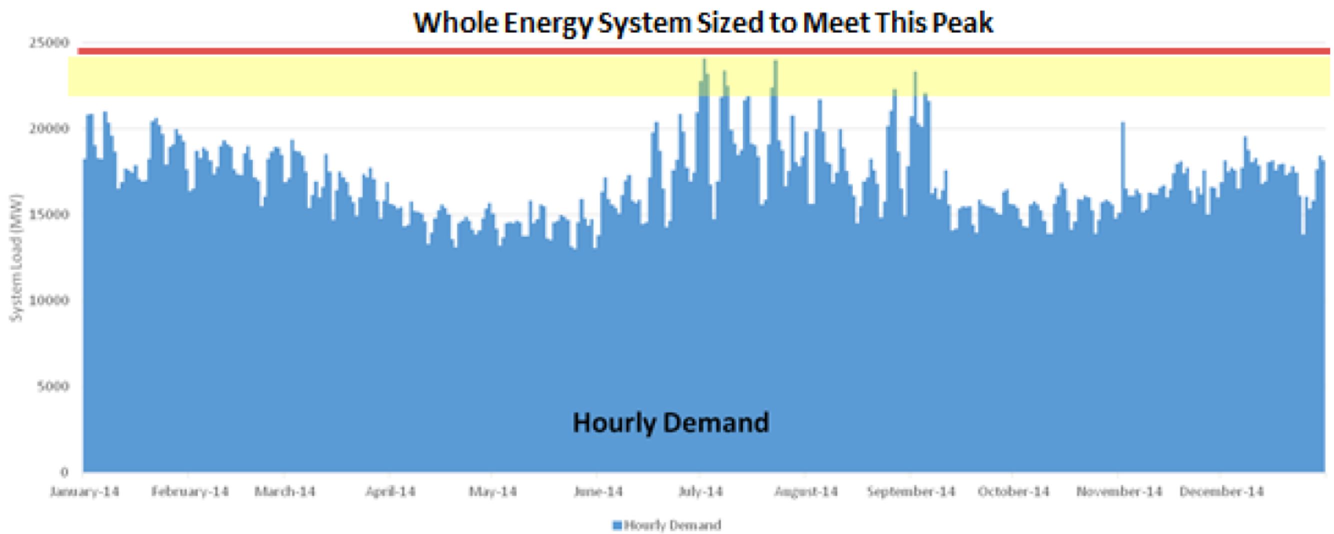
The Dichotomy Between Energy & Capacity



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

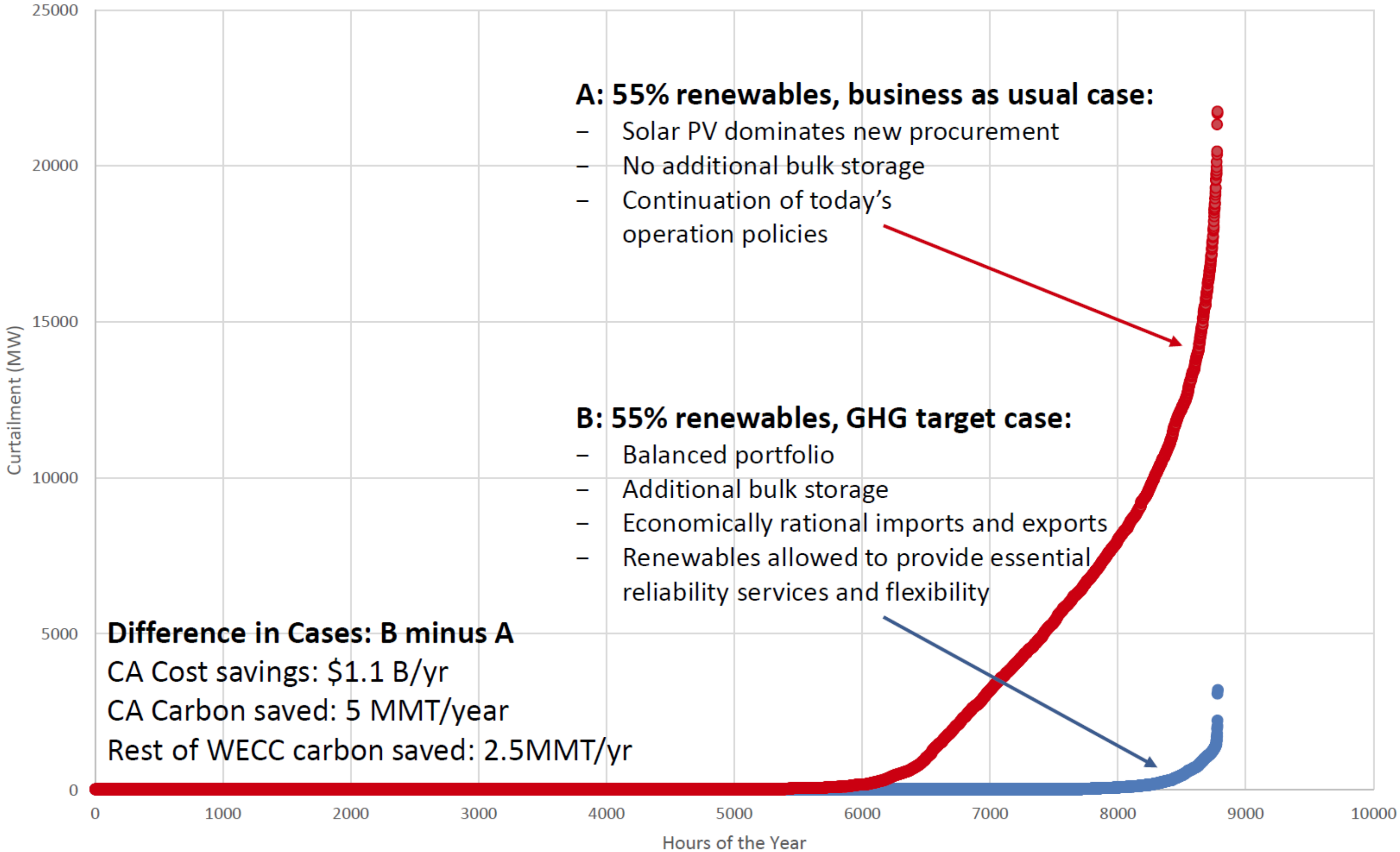
by **Anna Hirtenstein**
May 3, 2016, 9:20 AM PDT

→ 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),

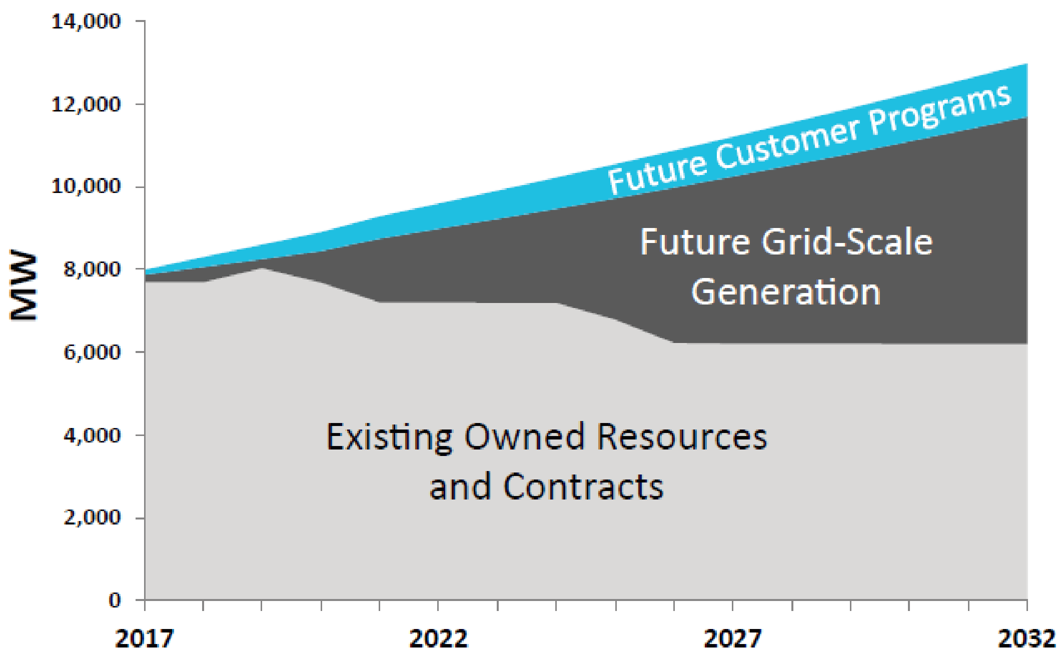
Arizona Context

- CAISO SB 350 Studies: A sizable amount of hours in Arizona balancing areas will be very low or negative pricing by 2030
- APS confirmed they are curtailing for a few hours during a majority of days in February/March
- Already 21% of capacity is being used to serve the top 5% of hours
- If Navajo Generation Station is closed, there will be pressure on reserve margin of the WECC

Arizona Public Service's Load Forecast

- APS is currently projecting 2.3-4.3% average annual peak demand growth over the next 15 years
- Equates to 3,200-7,100 MW growth (prior to customer resources)

FIGURE 2-1. SUPPLY-DEMAND GAP (2017-2032)



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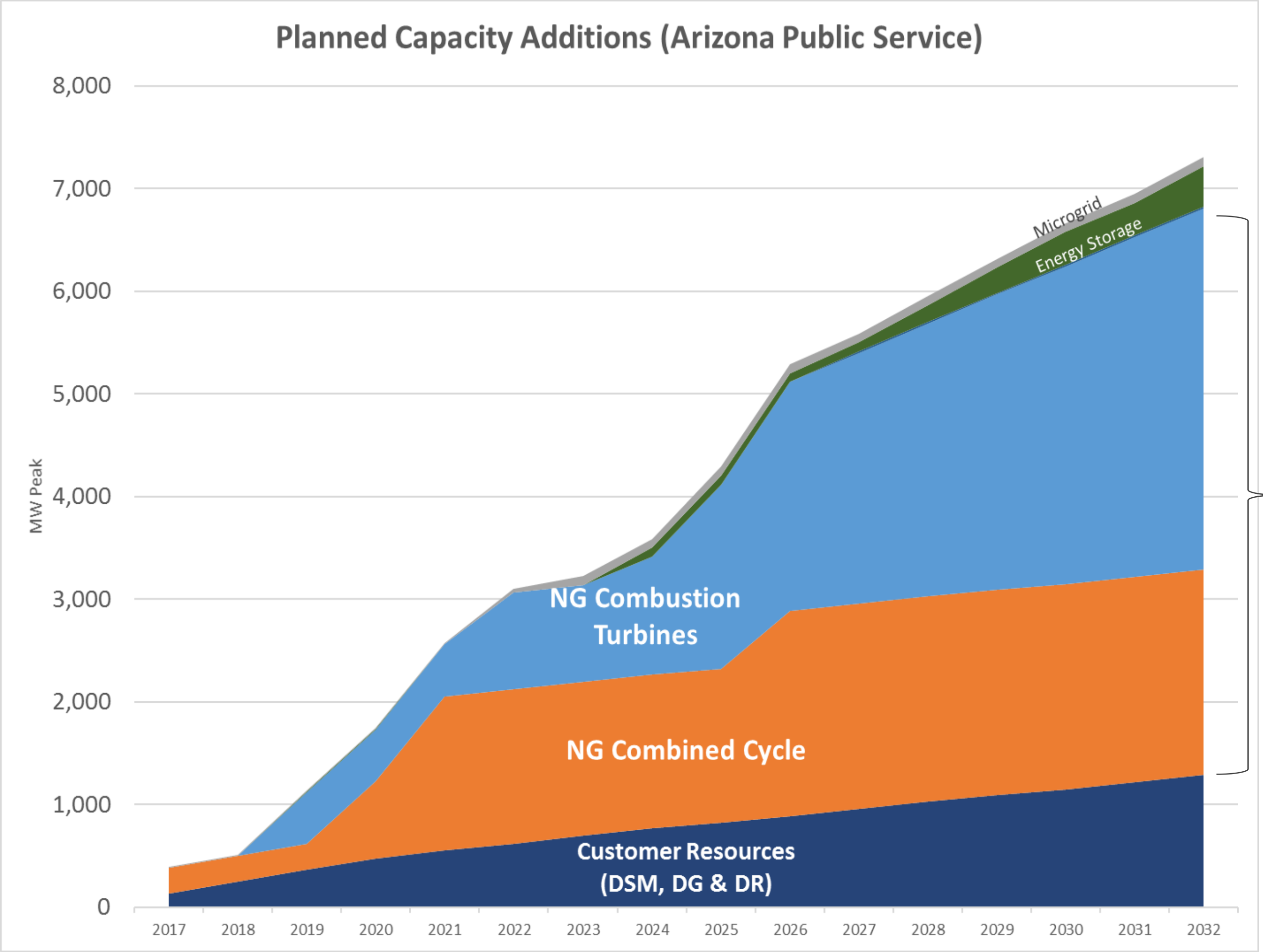
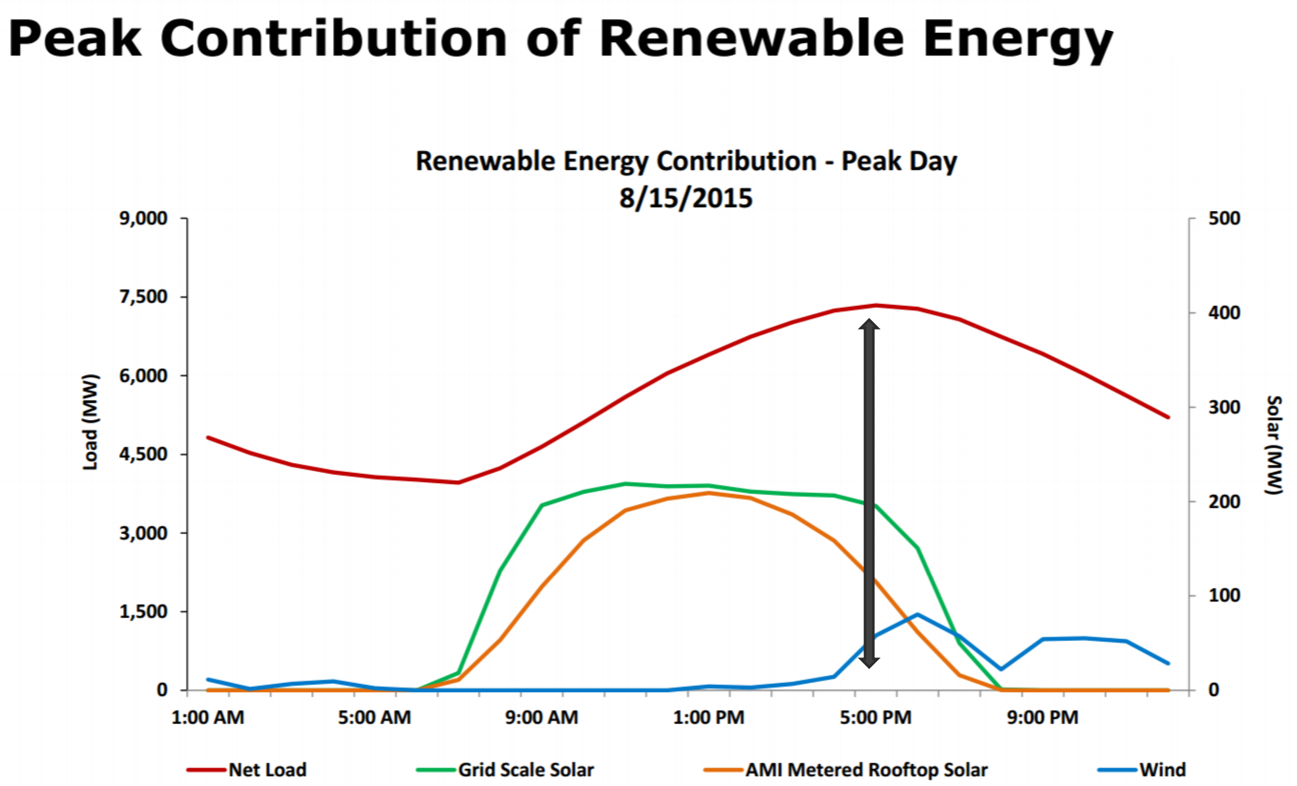
APS' Proposed Resource Plan



- >5,000 MW new natural gas;
- >$7 billion CapEx
- >$600M annual rev. req. increase

The Issue in AZ



- Renewable Energy Standards are based on yearly energy targets and do not consider peak demand
  - ➢ This encourages maximizing renewable production but does not consider dispatchable energy for peak demand during periods of low generation

Arizona Public Service 2016 Summer Preparedness presentation to Arizona Corporation Commission 4/28/16

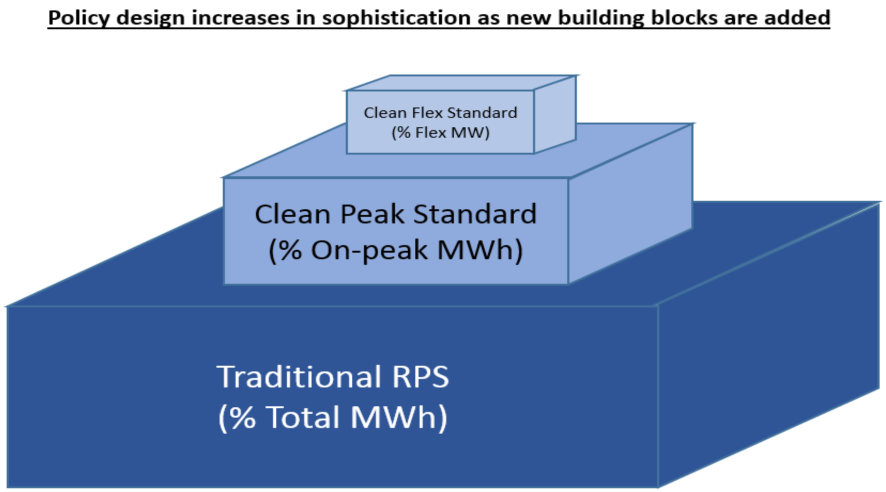
Taking a Step Back: Principles

- 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

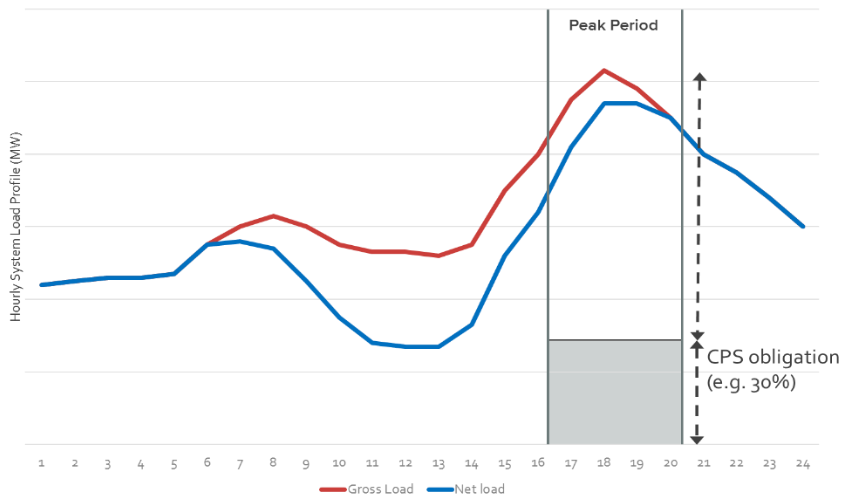


Clean Peak Standard (CPS) - Basic Design

- 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

Illustration of Clean Peak Standard (CPS)



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 not awarded if output not maintained for sufficient duration (i.e. capacity product).

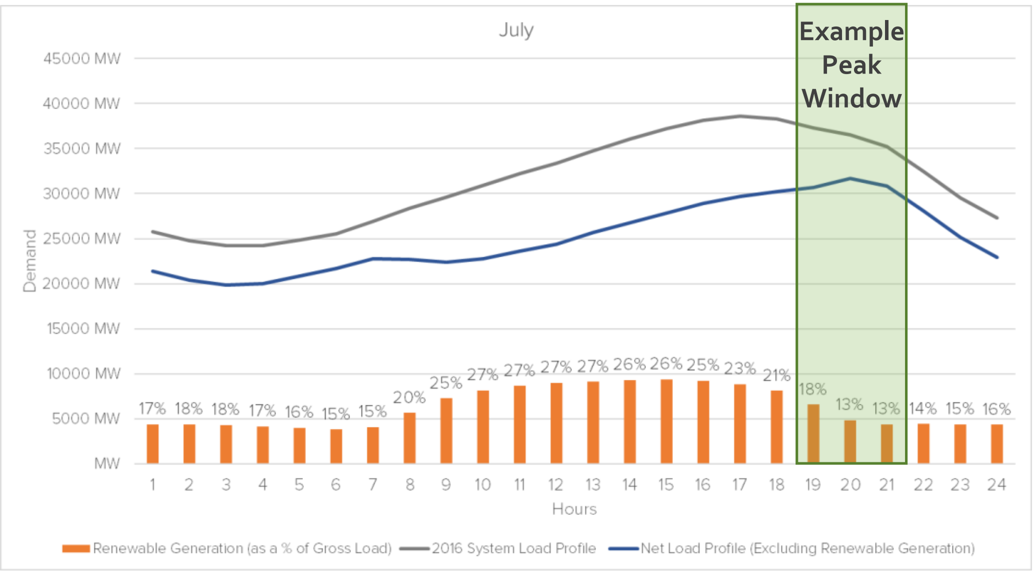
Implementation Considerations

- Time Window
  - Peak summer and high value hours in other months
  - Must get an average amount of RE over specified time period each month
- Potential Qualifying Resources
  - Renewables
  - Demand side resources (may require net vs. gross load calculation)
    - Active demand response
    - Energy efficiency
    - Distributed generation
  - Energy storage
    - Directly charged by RE
    - Grid-charged, full credit *if:*
      - RE on the margin
      - Bundled with incremental RE production that coincides with charging

Setting the Peak Summer Window

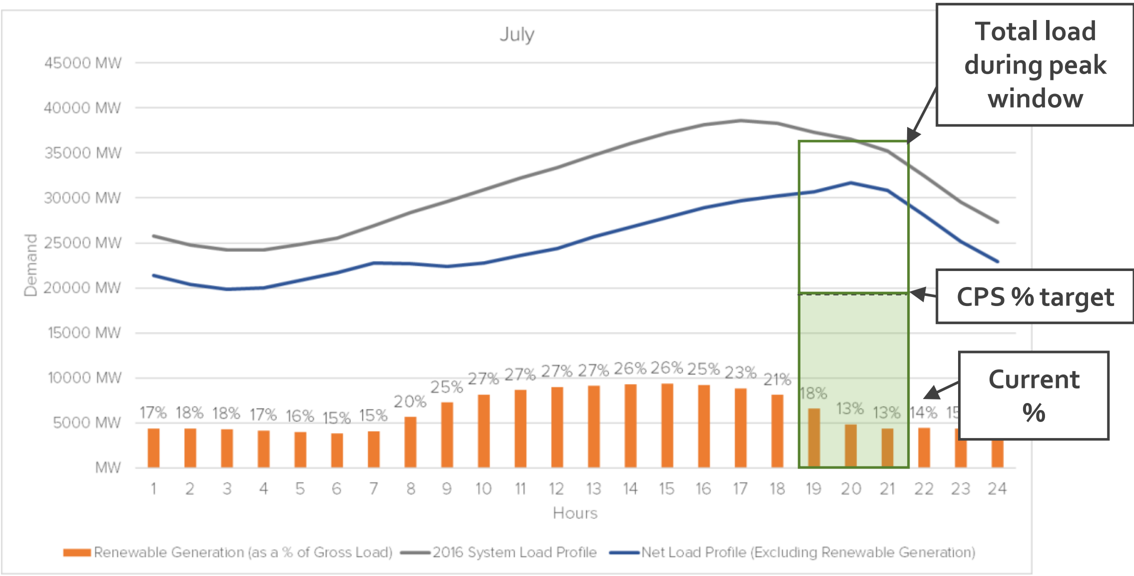
- The clean peak standard is partly intended to help address emerging operational challenges associated with meeting electric power demand, net of renewable resources (i.e. the “duck curve”).

- 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

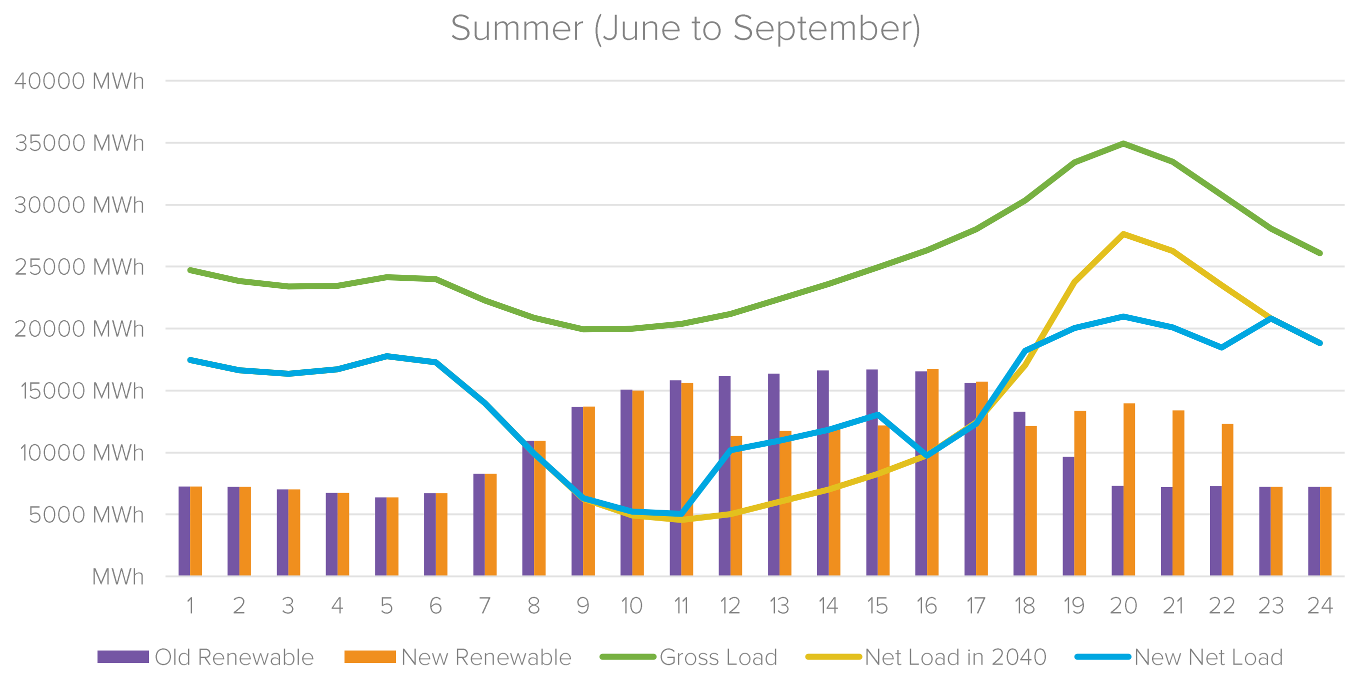
- For compliance purposes, qualifying energy produced during the peak window would be measured against the total or gross load during that “head of the duck" peak window.
- Measuring compliance relative to gross load (rather than net load) is necessary to properly account for existing renewable resources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



Setting the Peak Summer Window

- 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

Summer Load Example: 40% CPS



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

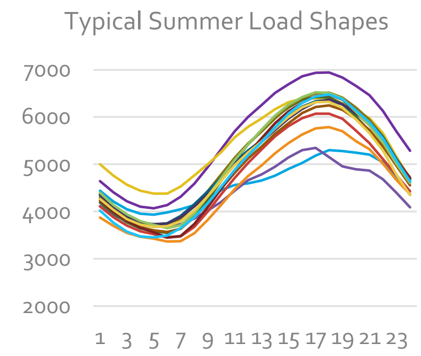
Low Loss of Load Probability

High Loss of Load Probability

Heat Maps Generated to Determine Credit Value

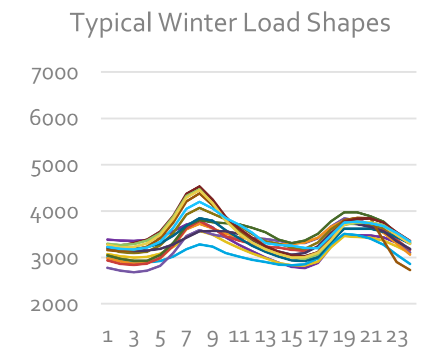
Peak Capacity Heat Map:

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

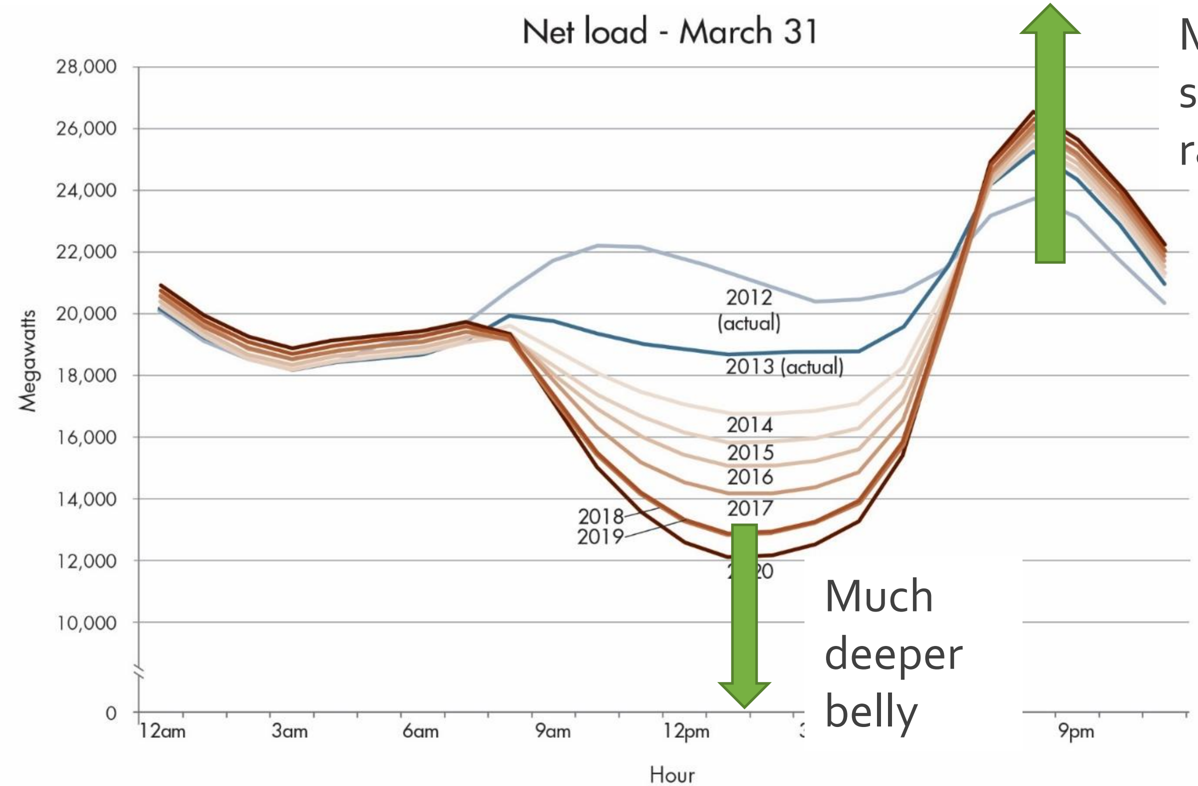


- Based on a rolling average
- Published annually and continuously updated

CPS for California

The most immediate need is for flexible capacity in non-summer months

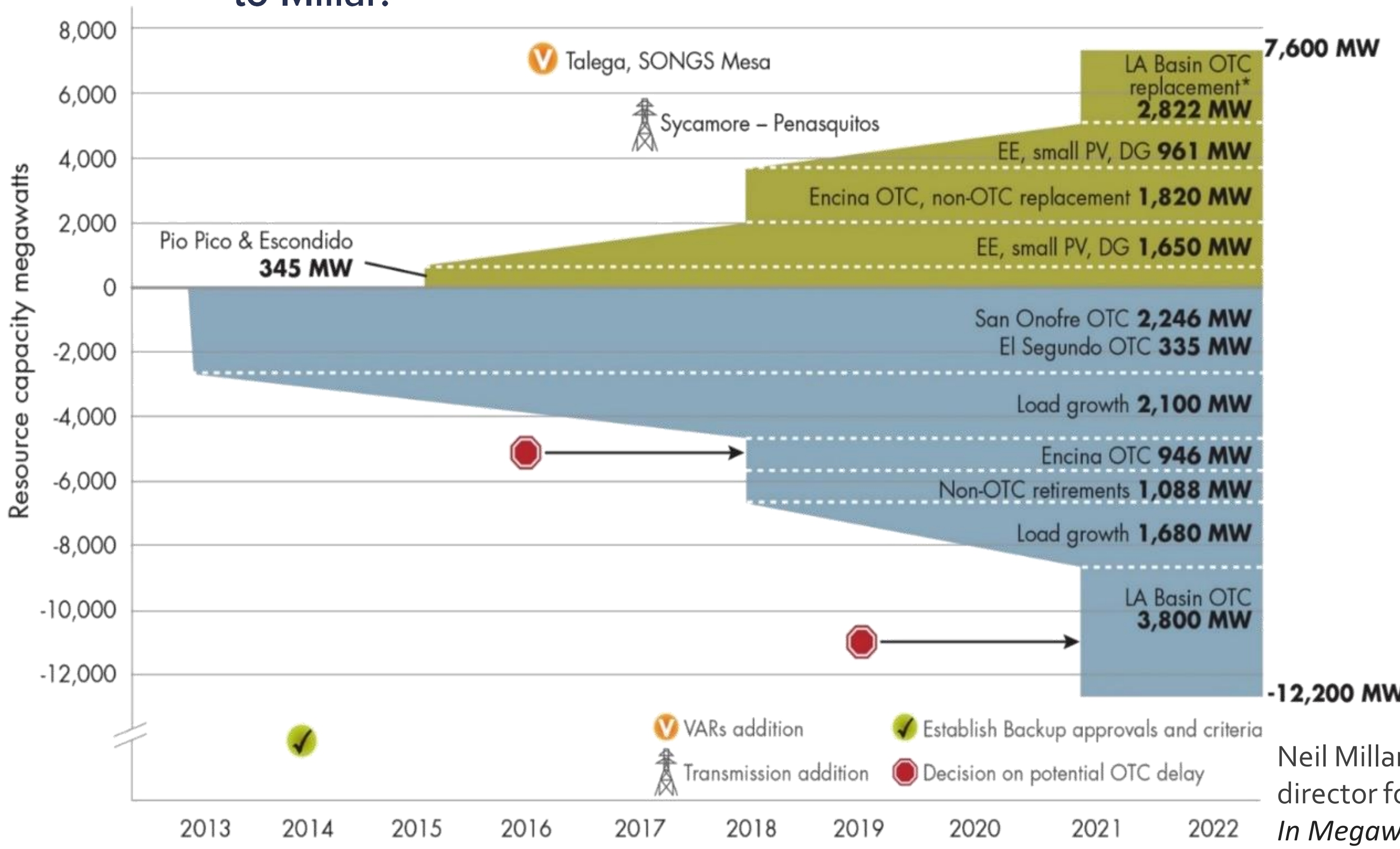
- ISO working on a 50% duck curve:



CAISO

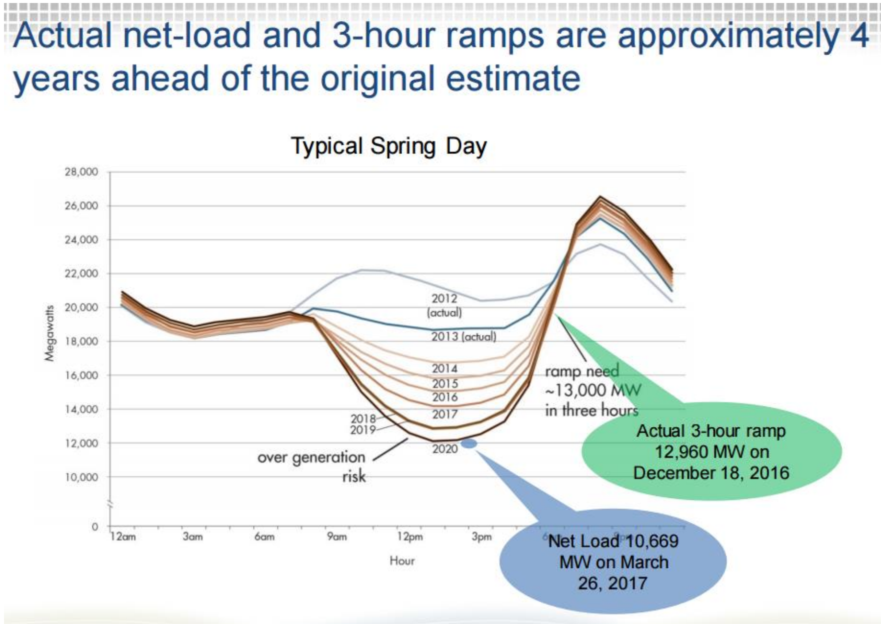
There are Still Peak Supply Challenges

- "Cal-ISO has found that the state faces up to about 9,660 MW of natural gas-fired generation retiring for economic reasons, with load following shortfalls beginning if less than 4,000 MW were to shut down, according to Millar."



Neil Millar, Cal-ISO executive director for infrastructure development.
In Megawatt Daily

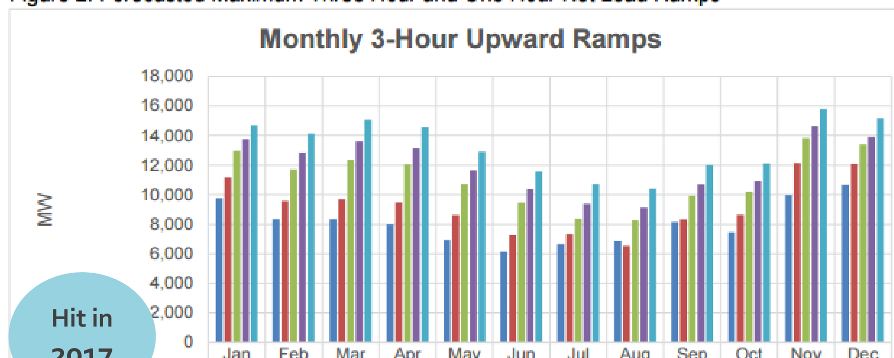
Actual Conditions – Far Worse than Forecasted



http://www.caiso.com/Documents/Presentation_2018DraftFlexibleCapacityNeedsAssessment.pdf

15 GW Ramp surpassed in Feb 2017

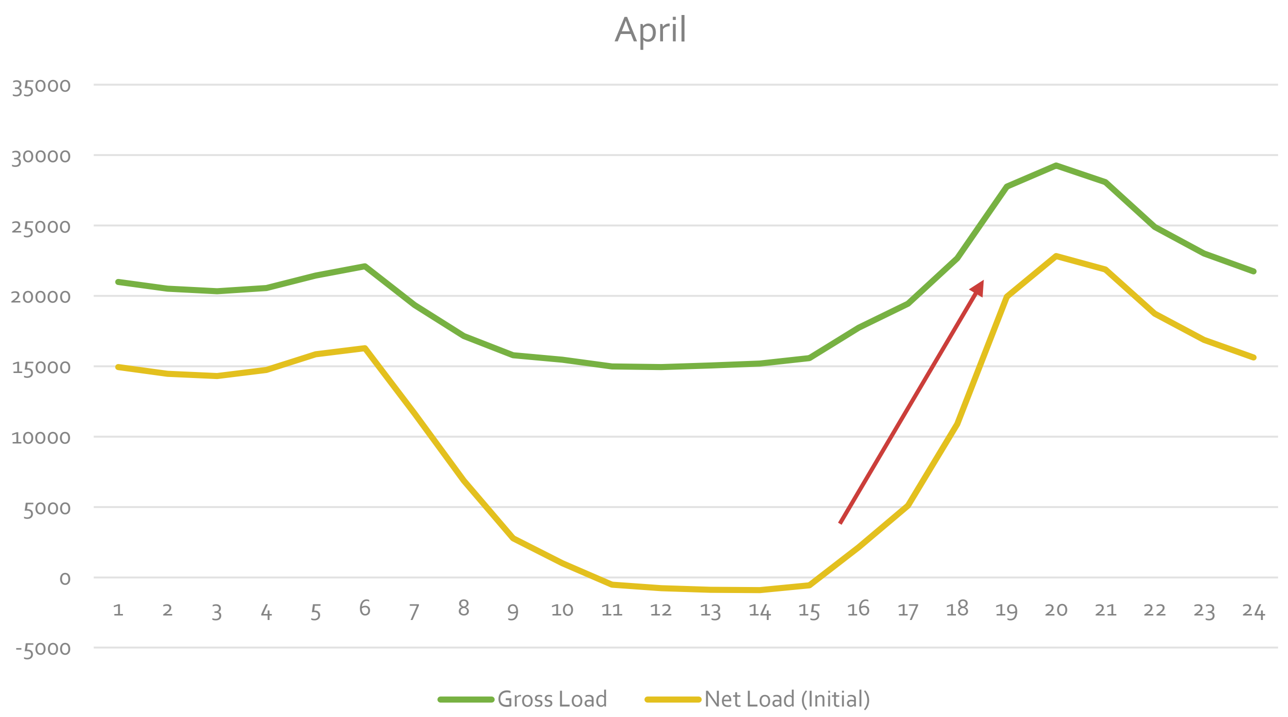
Figure 2: Forecasted Maximum Three Hour and One Hour Net Load Ramps



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
[illegible]_Rmp	9,775	8,366	8,367	8,001	6,962	6,153	6,672	6,882	8,158	7,469	9,987	10,684
2016_3HR_[illegible]p	11,191	9,578	9,700	9,484	8,629	7,262	7,335	6,540	8,353	8,640	12,155	12,096
2017_3HR_Rmp	12,970	11,729	12,364	12,054	10,737	9,464	8,397	8,295	9,918	10,196	13,835	13,399
2018_3HR_Rmp	13,758	12,846	13,596	13,117	11,672	10,383	9,402	9,123	10,728	10,939	14,636	13,896
2019_3HR_Rmp	14,691	14,114	15,067	14,543	12,904	11,571	10,750	10,407	12,003	12,121	15,781	15,186

CAISO

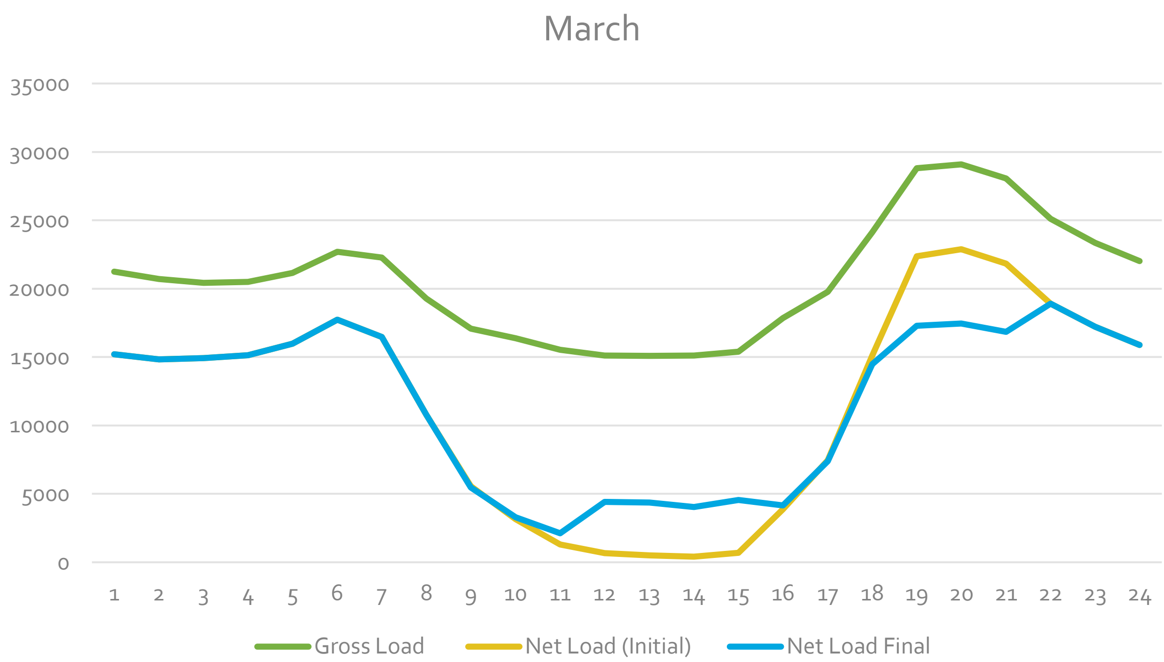
California - April 2030



Strategen Modeling

Ramping after 40% CPS

- **"Dumb charging" still reduces ramp from ~23 GW to ~13 GW**



"Dumb charging" - Assumes charging during times of overgeneration/negative prices and dispatches evenly over peak defined hours. Not optimized for maximum benefit

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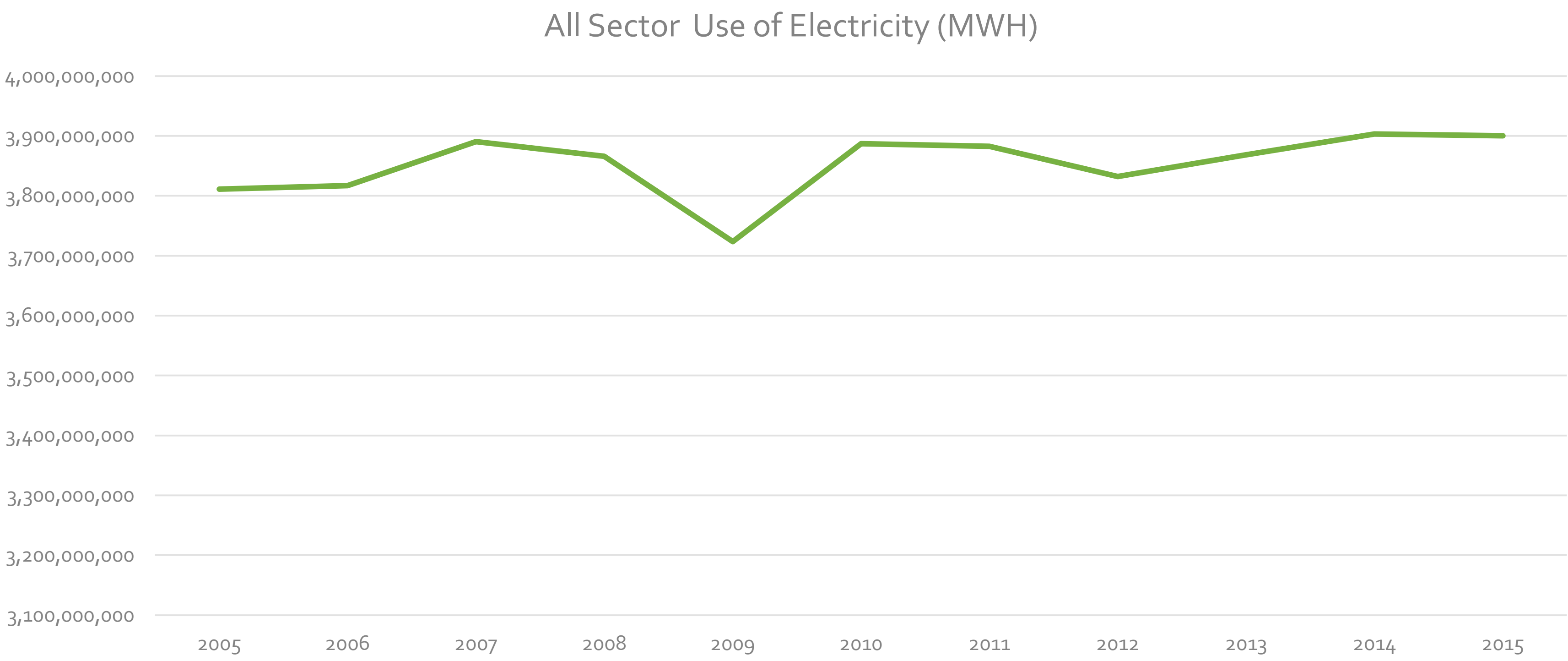
Implementation Considerations

- Locational considerations
  - E.g. load pocket carve-outs
- Cost containment
  - Benchmark CCC procurement to the cost of a new natural gas peaker (adjustments allowed to account for fact that these are clean resources)
- Longer peak windows (e.g. 6-8 hours) can divided
  - E.g. two compliance buckets

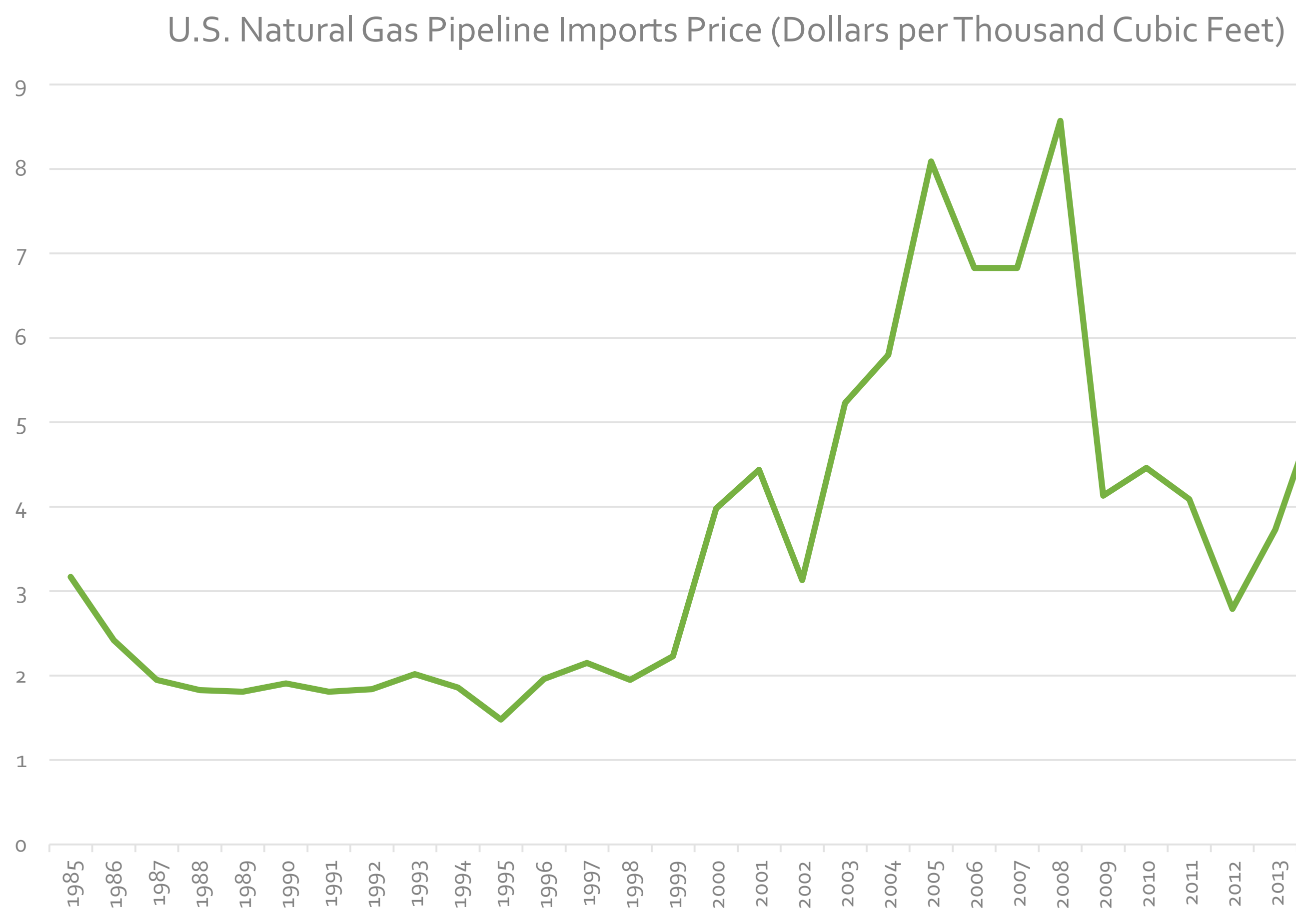
Should There Be a Clean Peak Standard?

‘Load growth can cover a lot of sins’



U.S. Energy Information Administration (EIA)

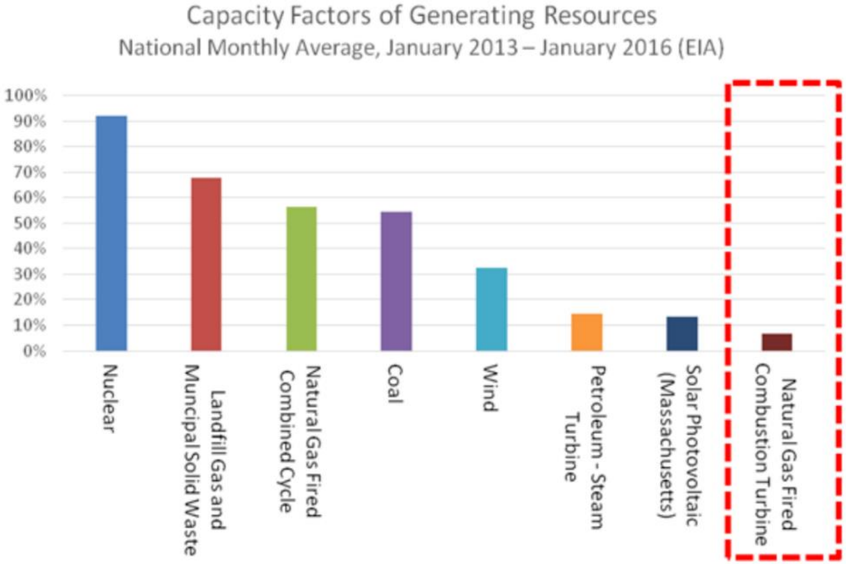
The Temporary Absolver



U.S. Energy Information Administration (EIA)

Peak Demand and Peaker Plants

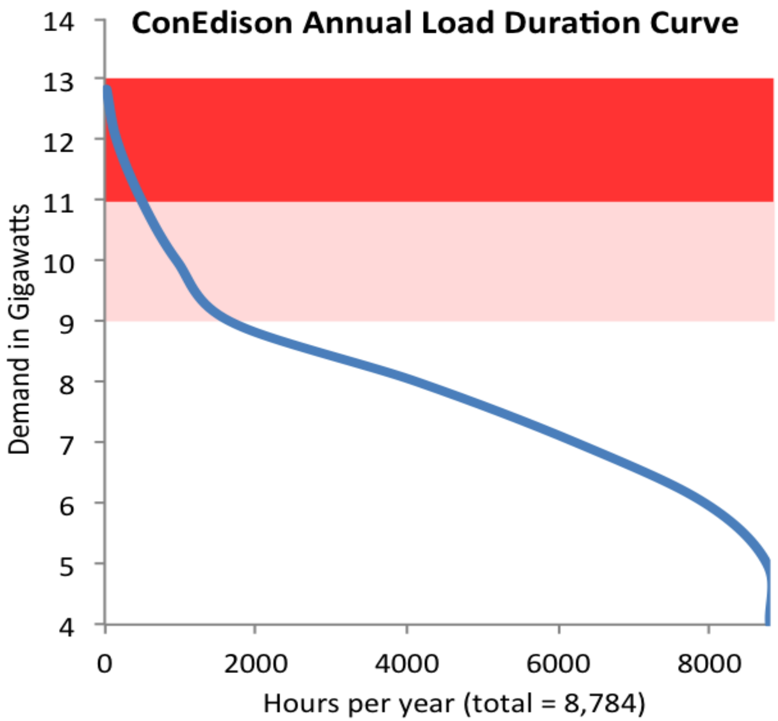
- According to EIA:
  - Average peaker plant runs about 2-7% of the year
  - Over 70 GW of new peaker plants will be built in the U.S. before 2026
- According to ISO-NE's State of the Grid 2016 report:
  - Peak demand continues to grow in the region at a rate of 1.5% per year
  - Peak cost is so high that every $1 spent on reducing peak demand translates into about $3.26 of savings to ratepayers



U.S. Energy Information Administration (EIA)

Peak Demand – ConEdison Example

- While load growth is flattening, peak demand may not be and load shapes are changing
- Problem with peak demand is steepness:
  - 15% of total production assets run less than 7 days per year or less than 2% of that time
  - NYS PCS's REV recently estimated that cutting top 100 hours of peak demand could save New York State up to $1.7 billion per year
  - Idle plants and overbuilt infrastructure handles load levels that only occur a small fraction of time



ConEd: 2012 Load duration data; note CECONY overlaps Westchester City but is mostly New York City

The Rise of DC Coupled Batteries

AC/DC/HYBRID

SYSTEM COMPARISON

	DC-COUPLED	AC-COUPLED	
CAPACITY FIRMING	✓	✓	
ENERGY TIME SHIFTING	✓	✓	
CLIPPING RECAPTURE	✓		
CURTAILMENT RECAPTURE	✓		✓
LOW VOLTAGE HARVEST	✓		
RAMP RATE CONTROL	✓	✓	✓
PV TO GRID EFFICIENCY	HIGH	MEDIUM	MEDIUM
PV TO BATTERY EFFICIENCY	HIGH	LOW	MEDIUM
BATTERY TO GRID EFFICIENCY	MEDIUM	MEDIUM	MEDIUM
EASE OF MICROGRID INTEGRATION	MEDIUM	MEDIUM	HIGH
EASE OF RETROFIT OF EXISTING PV	HIGH	HIGH	LOW

AES' New Kauai Solar-Storage 'Peaker' Shows How Fast Battery Costs Are Falling

Photo Credit: Jo Ann Snover / Shutterstock.com

The Kauai Island Utility Cooperative continues its innovation streak with the solar-plus-storage plant for peak capacity.

by Julian Spector
January 16, 2017

More Information

Thank you!

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Lon Huber
Senior Director
Strategen Consulting, LLC

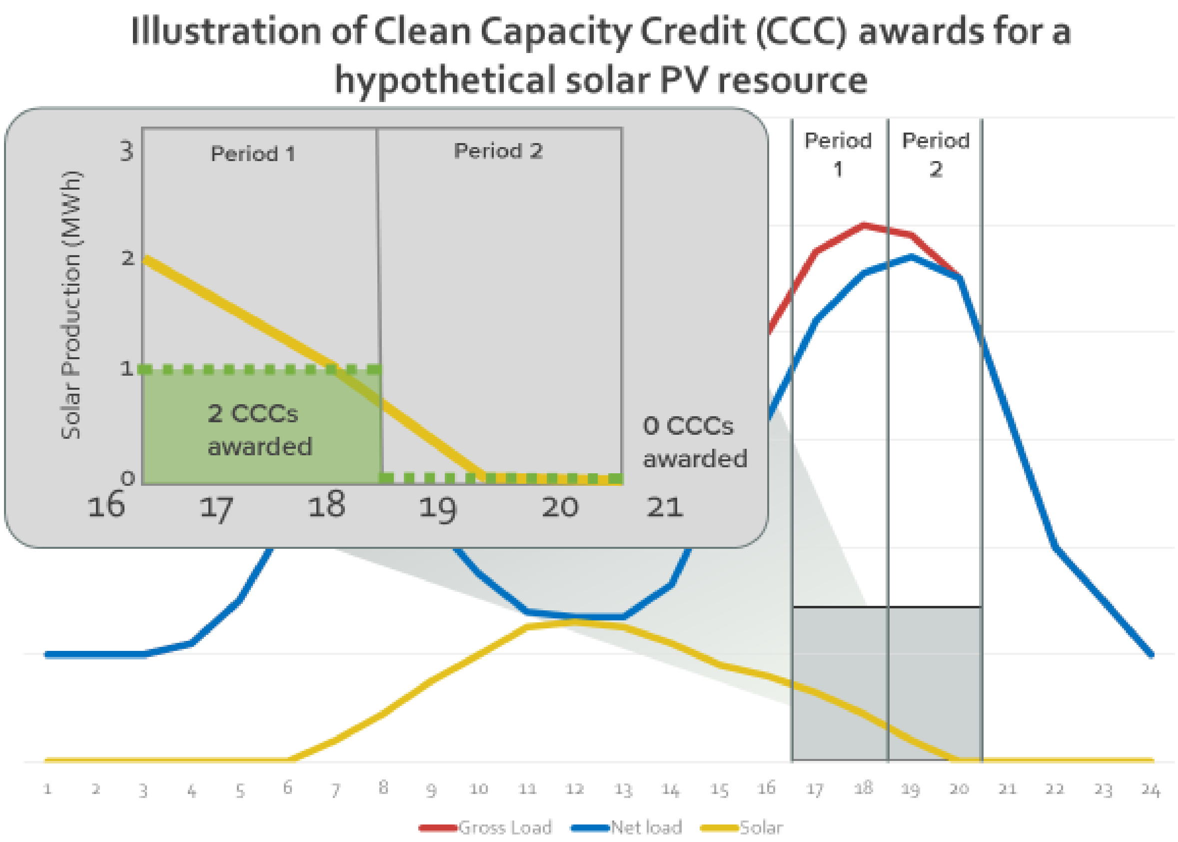
Download white paper:
https://www.strategen.com/s/Evolving-the-RPS-Whitepaper.pdf

Appendix

Assumptions

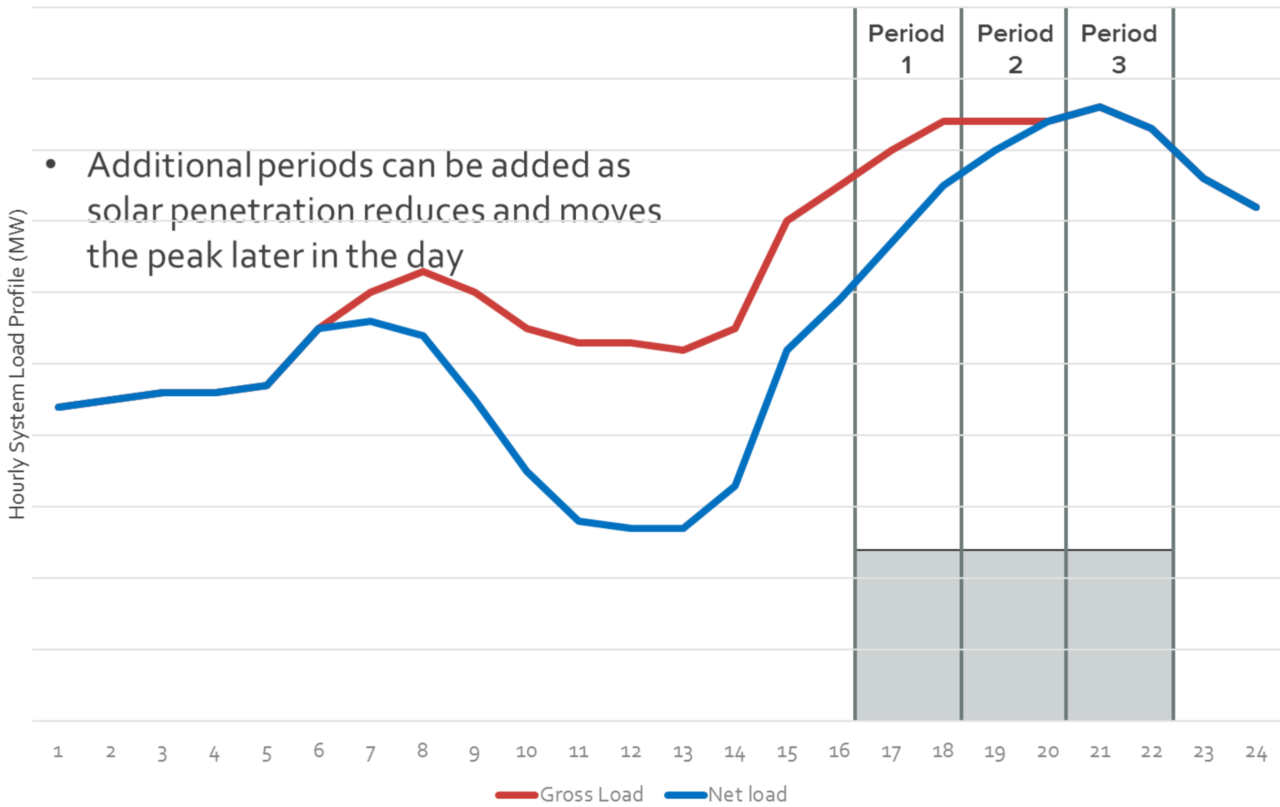
Data	Source	Assumption
Load Data	[2016] 8760 Hourly Data from OASIS	Uses 2016 Load Data; 0.5% yearly peak load growth 2040 Load Data is same as 2016 Load Data
Solar Data	[2016] 8760 Hourly Data from OASIS [2040] E3 SB 350 Study Scenario 1a	Uses 2016 Solar Data; Assumes by 2040, 7601 MW Installed in CA, and 1000 MW Solar delivered from out of state
Wind Data	[2016] 8760 Hourly Data from OASIS [2040] E3 SB 350 Study Scenario 1a	Uses 2016 Wind Data; Assumes by 2040, 3000 MW Installed in CA, and 4551 MW Solar delivered from out of state
Geothermal	[2016] CEC RPS Tracking [2040] E3 SB 350 Study Scenario 1a	Assumes 2016 annual production is evenly distributed among all the 8760 hours Assumes by 2040, 500 MW of Geothermal is added
Biomass/Biogas/ Small Hydro	[2016] CEC RPS Tracking [2040] E3 SB 350 Study Scenario 1a	Assumes 2016 annual production is evenly distributed among all the 8760 hours Assumes by 2040, the Biomass/ Biogas and Small Hydro increases by 1% annually
Distributed Generation	[2040] E3 SB 350 Study Scenario 1a	Assumes 16 GW of Behind the Meter Solar Resources

Implementation Considerations



Implementation Considerations

- **Scalability**



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Thank you for attending our webinar

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