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The 16th Annual Conference on

Electric Power in the Southwest

Critical updates on resource development, regulatory changes, legislative actions, market operations, and the transition to clean energy

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July 15 & 16, 2019

Santa Fe, New Mexico

La Fonda Santa Fe Hotel

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8:00 Registration Opens

8:30 Introduction & Overview

Steve Michel, Esq., *Program Co-Chair*
Deputy Director, Clean Energy Program
Western Resource Advocates ~ Santa Fe, NM

Thorvald A. Nelson, Esq., *Program Co-Chair*
Holland & Hart ~ Greenwood Village, CO

Marc L. Spitzer, Esq., *Program Co-Chair*
Steptoe & Johnson ~ Washington, DC

8:45 Federal Energy Update: FERC, Politics, and the Courts

How is commissioner turnover affecting FERC? What is the policy agenda? Is partisan politics creeping into the FERC? What are the practical impacts of recent and pending court cases?

Douglas W. Smith, Esq.
Van Ness Feldman ~ Washington, DC

9:30 Renewable Energy Development and the Economics for Customers

In the end, it's about the customers: Customer preferences and cost recovery issues

Judy Chang, Esq., *Principal*
The Brattle Group ~ Cambridge, MA

10:00 Break

10:15 Wholesale Market Operations in the West

Expansion of ISO's, RTO's, and EIMs

Don Fuller, *Director, Strategic Alliances*
California ISO ~ Folsom, CA

Paul Suskie, Esq.
Executive VP, Regulatory and General Counsel
Southwest Power Pool ~ Little Rock, AR

Todd Fridley, *Vice President of New Mexico Operations*
Public Service Company of New Mexico ~ Albuquerque, NM

11:45 Special Address: Transmission Development from a Federal Policy Perspective

The Hon. Douglas Little, *Senior Advisor, Office of Electricity*
US Department of Energy ~ Washington, DC

12:15 Lunch (on your own)

1:30 Practicalities for New Transmission Development in the Southwest

A regional look at where it is needed and what is likely to find financing and get built

Alan J. Statman, Esq., *Moderator*
Al Statman LLC ~ Santa Fe, NM

Robert E. Busch, *Chairman*
New Mexico Renewable Energy Transmission Authority
Santa Fe, NM

Joseph C. Taylor, *Manager, Transmission Access*
Public Service Company of Colorado ~ Denver, CO

3:00 Break

3:15 Tribal Policy Developments

Trends including the Navajo Nation's proposed shift from receiving revenue from coal production to renewable energy sources

Pilar Thomas, Esq.
Lewis Roca Rothgerber Christie ~ Tucson, AZ

3:15 Case Studies of State Policy Transitions to Clean Energy

New Mexico's Energy Transition Act (SB 489) and the PRC's implementation plans

The Hon. Stephen Fischmann, *Commissioner, District 5*
New Mexico Public Regulation Commission ~ Santa Fe, NM

Quick takes from other states in the region and an interactive discussion on crafting an effective path forward for effectively implementing state policy goals in light of local market conditions

Steve Michel, Esq., *Program Co-Chair*

Thorvald A. Nelson, Esq., *Program Co-Chair*

Marc L. Spitzer, Esq., *Program Co-Chair*

5:00 Continue the Exchange of Ideas: Reception for Faculty and Attendees

Sponsored by Holland & Hart and Steptoe & Johnson

About the Conference

LAW SEMINARS INTERNATIONAL

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Energy News Network,
a nationally recognized news publication featuring original state-based reporting, dedicated to keeping stakeholders, policymakers, and citizens informed about the important changes taking place within the transition to a clean energy economy.

This year has seen increased momentum for a transition to clean power in the West. The New Mexico legislature has passed, and the governor has signed, the Energy Transition Act mandating 100 percent carbon-free electricity by 2040. Commissioner Stephen Fischmann will be on hand to talk about implementation plans at the PRC.

Consumers are driving the demand for a transition to clean power and Idaho Power has responded by announcing a bold new goal to operate its grid entirely with clean energy by 2045. Tess Park, Idaho Power's Vice President of Power Supply, will join us to talk about how the company came to this decision and how it plans to reach the goal.

We are pleased to feature a special address from Doug Little, now a Senior Advisor in the Office of Electricity at the Department of Energy. Former FERC GC, Doug Smith now at Van Ness Feldman, will provide an update on other federal policy developments.

Take a detailed look at the practical topics we'll be covering and the speakers you'll be able to hear and ask to address your specific questions. This year's program is a great opportunity to pick up insights to help you map out the most effective adaptation strategy for your organization. We hope you'll be able to join us for both the program and the reception at the end of the first day.

~ Program Co-Chairs: Steve Michel, Esq. of Western Resource Advocates
Thorvald A. Nelson, Esq. of Holland & Hart and Marc L. Spitzer, Esq. of Steptoe & Johnson

8:30 Energy Storage: Major New Developments Creating New Opportunities

Federal policy update: FERC Order 841 implementation and other developments in Congress, at the FERC, and at the DOE

William M. Keyser, Esq.
K&L Gates ~ Washington, DC

The Duck Curve and hydrogen from electrolysis: How pricing drops from at-scale deployments in Europe are making it a viable solution to avoid negative pricing and the need to curtail variable wind and solar

Rao Konidena, *Principal*
Rakon Energy LLC ~ Roseville, MN

Closed loop hydrogen clean energy production and management

Karl Rudisill, *CEO and Founder*
Element One Technologies, Inc. ~ Salt Lake City, UT

Integration of new technologies into grid operations: What Southwestern states can learn from California's Energy Storage market

Arthur J. O'Donnell
The Energy Overseer ~ Albuquerque, NM

10:30 Break

10:45 Changes in the Generating Mix from the Continuing Phase-Out of Fossil Generating Plants

To what extent can we expect distributed renewables to replace centralized coal plants? What's the anticipated impact on the need for new transmission or other grid resources?

Noah B. Long, Esq., *Legal Director, Western Energy Project*
Natural Resources Defense Council ~ Santa Fe, NM

11:30 PURPA Developments

PURPA and intermittent renewables: What recent developments mean for transmission and the power mix in the West as states transition to cleaner power

Sharon White, Esq.
Van Ness Feldman ~ Washington, DC

12:15 Lunch (on your own)

1:30 Case Studies for Getting from A to B on the Path to a Clean Energy Future

Goal setting: The thinking behind Idaho Power's bold decision to operate its grid entirely on clean energy by 2045

Tess R. Park, *Vice President of Power Supply*
Idaho Power Company ~ Boise, ID

Project optimization: Storage co-locating with gas, solar, and wind facilities and how siting affects investment and production tax credits; other financing considerations

Amanda L. Rosenberg, Esq.
Norton Rose Fulbright US ~ Los Angeles, CA

Reducing transaction costs: Use of Blockchain technologies for advanced energy trading platforms, emissions tracking and carbon registries, managing distributed energy resources and energy efficiency devices

Jeanette Pablo, Esq., *General Counsel and Senior Associate*
Energy Futures Initiative ~ Washington, DC

3:30 Evaluations and Adjourn

Related Seminars & Replays:

Tribal Consultations	June 6-7, 2019	Seattle
Energy Storage	June 13-14, 2019	Seattle
2019: Carbon-Free Energy in California	September 23-24, 2019	San Francisco
Renewable Energy in the Midwest	October 3-4, 2019	Minneapolis

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Faculty: Electric Power in the Southwest Conference

Steve Michel, *Program Co-Chair*, is Deputy Director of the Clean Energy Program at Western Resource Advocates.

Thorvald A. Nelson, *Program Co-Chair*, is a partner at Holland & Hart. A former economist and testifying expert, he represents utility consumers and utilities in regulatory matters.

Marc L. Spitzer, *Program Co-Chair*, is a partner at Steptoe & Johnson. He formerly served as a FERC commissioner and as Chairman of the Arizona Corporation Commission.

The Hon. Douglas Little, *Special Address*, is a Senior Advisor in the Office of Electricity at the US Department of Energy. He previously served as an Arizona Corporation Commissioner.

Alan J. Statman, *Moderator*, founded Al Statman LLC after practicing energy law and founding TransElect, Inc., North America's first independent transmission company.

Robert E. Busch is Chairman of the New Mexico Renewable Energy Transmission Authority.

Judy Chang, Principal at The Brattle Group, is an energy economist and policy expert with a background in electrical engineering.

The Hon. Stephen Fischmann is the Commissioner for District 5 at the New Mexico Public Regulation Commission.

Todd Fridley is Vice President of New Mexico Operations for the Public Service Company of New Mexico (PNM).

Don Fuller is Director, Strategic Alliances for the California ISO. He leads the effort to develop the successful Western Energy Imbalance Market for utilities and customers in the west.

William M. Keyser is a partner at K&L Gates. He focuses his practice on regulatory litigation and transactions involving the nation's electricity and capacity markets.

Rao Konidena is a Principal at Rakon Energy LLC. He specializes in energy storage, distributed energy resources, demand response and energy efficiency.

Noah B. Long is the Legal Director, Western Energy Project for the Natural Resources Defense Council. He manages NRDC's clean-energy initiatives in the interior West and Northwest.

Arthur J. O'Donnell, The Energy Overseer, is an independent energy writer and analyst, monitoring utility and regulatory activities in California and the Southwest.

Jeanette Pablo is General Counsel and Senior Associate at the Energy Futures Initiative.

Tess R. Park is Vice President of Power Supply at Idaho Power Company. She currently serves on the NuScale Power advisory board and an electric energy imbalance market advisory committee.

Amanda L. Rosenberg is a partner at Norton Rose Fulbright US. She focuses on federal income tax law.

Karl Rudisill is CEO and Founder of Element One Technologies, Inc. Over the past two years he has been developing an industrial scale hydrogen project on the Navajo Reservation.

Douglas W. Smith is a partner at Van Ness Feldman. He clients before the FERC and the Department of Energy. He also provides counsel on climate change, energy technology, and renewable energy policy.

Paul Suskie is Executive VP, Regulatory, and General Counsel for Southwest Power Pool (SPP). Prior to joining SPP, he served as Chairman of the Arkansas Public Service Commission.

Joseph C. Taylor is Manager for Transmission Access at Public Service Company of Colorado.

Pilar Thomas is of counsel in the Tribal Lands and Natural Resources, Alternative Energy and Utilities, and Tribal Affairs practice groups at Lewis Roca Rothgerber Christie. Prior to returning to the firm, she was the Deputy Director for the Office of Indian Energy Policy and Programs at the U.S. Department of Energy.

Sharon White is Of Counsel to Van Ness Feldman. She assists electric industry clients on issues relating to the development and acquisition of power projects, market-based rate authorizations, and related regulatory compliance.

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July 15 & 16, 2019

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100 E. San Francisco Street

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Who Should Attend:

Attorneys, industry executives, governmental officials, customer representatives and anyone else involved with energy development in the Southwest

You Will Learn About:

- *Transmission Development from a Federal Policy Perspective in a Special Address by The Hon. Douglas Little of DOE*
- *Federal energy policy and litigation update*
- *State-level policy priorities and implementation strategies*
- *Renewable energy development and the economics for customers*
- *Wholesale market operations in the West*
- *Changes in the generating mix from the continuing phase-out of fossil generating plants*
- *Practicalities for transmission development in the Southwest*
- *Energy storage solutions including hydrogen for power generation and transportation*
- *PURPA developments for intermittent renewables*
- *Case studies of paths forward*

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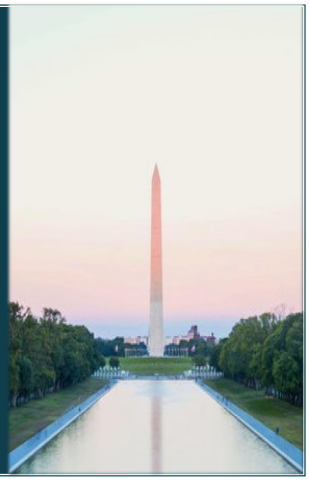
Federal Electricity Policy Update

Electric Power in the Southwest
Santa Fe, NM
July 15, 2019



Doug Smith
Van Ness Feldman, LLP

1050 Thomas Jefferson Street, NW
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Federal Electricity Policy – Big Picture

- FERC
  - Shifting composition of Commission
  - Current priorities
- Courts
  - Reach of Federal preemption? Permissible State actions?
  - Roles in bankruptcy
- EPA
  - Affordable Clean Energy (ACE) rule
- Congress
  - Discrete FPA amendments
  - Oversight

Washington Context

- Midterm elections
  - Democratic majority in House
  - Larger Republican majority (53-47) in Senate
- Green New Deal
  - Broad resolution; not a legislative program
  - Lightening rod
- Trump White House not focused on energy issues
- Resilient resources
  - 2017 DOE proposal to support existing coal and nuclear plants
  - Rejected 5-0 by FERC
  - Issue has faded (it seems)

Composition of FERC

- FERC is composed of 5 commissioners
  - No more than 3 commissioners from one party
  - Serve for staggered 5-year terms
  - Appointments require Senate confirmation
  - Quorum is 3 commissioners
- Chairman
  - Designated by the President from among sitting commissioners
  - Sets agenda

Composition of FERC

- Significant turnover since start of Trump Administration
  - 2 Republican commissioners
    - Chairman Neil Chatterjee (confirmed Aug. 2017; term expires June 2021)
    - Bernard McNamee (confirmed Dec. 2018; term expires June 2020)
  - 2 Democrat commissioners
    - Cheryl LaFleur (confirmed June 2010; term expired 6/30/19)
      - "holding over" until the end of August 2019
    - Rich Glick (confirmed Nov. 2017; term expires June 2022)
  - Will soon have 2 vacancies (for terms ending in 2023 and 2024)
  - No "intent to nominate" announcements yet

FERC Agenda under Trump Administration?

- Larger Trump Administration themes
  - Promote domestic energy production
  - Promote infrastructure investment
  - Deference to States
  - Less concern about climate change, clean energy
  - Skeptical of regulation
  - Pro-competition/pro-markets?
- Translation to FERC agenda - Areas to watch
    - Return on equity
    - Transmission rate incentives
    - Order No. 1000?
    - Grid resilience/grid security
    - PURPA reform
    - Pipeline certificate policy

Transmission Investment - Issues on FERC's Plate

- Return on equity policy
  - Post-*Coakley* DCF policy drove down base ROEs
  - Proposed policy in *Emera Maine* remand order reframes the approach
    - Implications?
- Transmission incentives
  - Notice of Inquiry invites input on reforms to incentive policy
- Implementation of Order No. 1000
  - Designed to support rationalized transmission infrastructure development
  - Growing pains for competitive developers

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Electric ROE Policy under Opinion No. 531 and *Emera Maine* Remand

- *Coakley* – Opinion No. 531 (2014)
  - FERC announced policy change requiring use of 2-step Discounted Cash Flow (DCF) methodology for electricity rates
  - Relying on "anomalous" financial conditions, FERC selected base ROE that was halfway between the midpoint and the top of the range
  - Capped total ROE (base + incentive) at top of range of reasonableness
  - Set base ROE for New England TOs at 10.57% (lowered from 11.14%)
- *Emera Maine v. FERC* (D.C. Cir. 2017)
  - Vacated and remanded Opinion No. 531
  - FERC must make an explicit finding that an existing rate is unjust and unreasonable *before* proceeding to set a new rate
  - FERC provided inadequate support for its decision to set base ROE at the midpoint of the upper end of the "zone of reasonableness"

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Emera Maine Remand Order

- FERC addressed remand in October 2018
- Held that Discounted Cash Flow (DCF) methodology alone is not a reliable metric
- Proposed new methodology under FPA § 206 for determination of ROE for public utilities:
  - Instead of relying solely on the DCF analysis, FERC will meld four financial analyses – the DCF analysis, the Capital Asset Pricing model (CAPM), the Expected Earnings Model, and the Risk Premium model
  - FERC will no longer make adjustments based on anomalous financial market conditions
  - FERC will presume that existing ROE is just and reasonable if it is within the quartile centered on the midpoint (for a group of utilities) of the zone of reasonableness

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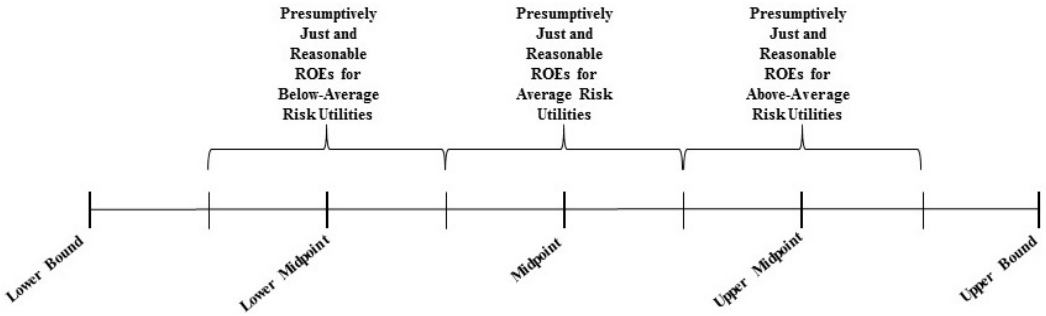
Emera Maine Remand Order

- <u>Step One - Evaluating an Existing ROE</u>
  - Establish composite zone of reasonableness based on DCF, Capital Asset Pricing Model (CAPM), and Expected Earnings model
  - Zone of presumptively just and reasonable ROEs for average risk utilities - one quarter of the zone of reasonableness, centered on the midpoint/median



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Emera Maine Remand Order

- Step Two - Determining a New Just and Reasonable ROE
  - Rely on DCF, CAPM, Expected Earnings, and Risk Premium analysis
    - Use average of the midpoints (for a group of utilities)
  - No adjustments for anomalous market conditions
  - May adjust based on risk profile of utility

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Emera Maine Remand Order

- FERC preliminarily found that the ROE for the NETOs should be set at 10.41%
- Invited briefing on the proposed methodology and its application to the periods covered by the sequential complaints

I. ZONE OF REASONABLENESS

Method	Range	Lower Midpoint	Midpoint	Upper Midpoint
DCF	7.03% -- 11.74%			
CAPM	7.40% -- 13.30%			
Expected Earnings	8.10% -- 14.20%			
Average	7.51% -- 13.08%	8.90%	10.30%	11.69%

9.60% -- 10.99%

Middle Quartile

II. POINT ESTIMATE ROE

Method	Midpoint
DCF	9.39%
CAPM	10.35%
Expected Earnings	11.15%
Risk Premium	10.74%
Average	10.41%

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Remand Order – Math for New England TOs

- Applying the new methodology to the record in the original NE TO complaint case
  - DCF zone of reasonableness: 7.03-11.74
  - CAPM zone of reasonableness: 7.4-13.3
  - Expected earnings zone of reasonableness: 8.1-14.2
  - Risk premium produces a point estimate (10.75), not a range.
  - Composite zone of reasonableness, based on average of the tops and bottoms: 7.51-13.08
  - Midpoint of the zone: 10.3
  - TOs in NE are of average risk
  - The quartile in which existing ROE is presumed to be just and reasonable, centered around 10.3: 9.6-10.99
  - Therefore, prior ROE of 11.14 is not just and reasonable.
  - Average of the midpoints of the DCF, CAPM and Expected Earnings and the Risk Premium value: 10.41
- Thus, FERC proposed to reduce ROE from 11.14 to 10.41 for the period covered by the first complaint
  - This is a little lower than the ROE of 10.57 established in Opinion No. 531
  - But does not depend on an "upward adjustment"

Emera Maine Remand Order

- Remand order addresses *Emera Maine* holdings
  - Distinct process for evaluating existing ROEs
  - Eliminates adjustment for anomalous conditions
- Outcome-driven ROE policy?
  - New methodology but roughly the same ROE outcome
- Arguments on Proposed Methodology
  - Trial Staff urged Commission to:
    - remove Expected Earnings from analysis
    - make adjustments to Risk Premium and CAPM analysis
  - Trial Staff's proposed adjusted methodology produced ROE of ~9.3%
  - Complainant-Aligned Parties proposed additional adjustments to the CAPM, Risk Premium and Expected Earnings methodologies

ROE Policy – Where do we go from here?

- Policy proposed in *Emera Maine* remand order not yet finalized
- Notice of Inquiry on ROE policy for public utilities
  - Comments filed in June
  - Reply comments due July 26
- Open issues on remand order proposal:
  - Impact of "step one" on frequency of complaint proceedings?
  - What factors determine whether a utility is low or high risk?
  - Application of new ROE methodology to § 205 proceedings?
- Open issues on ROE Policy:
  - Reasonable for ROEs to vary widely based on *when* formula rate was sought?
  - Time for regionally (or nationally) uniform ROEs?
  - Time for a formulaically updated ROE?
  - Logic of treating single utilities and groups of utilities differently (median v. midpoint)?

Incentive Rate Treatments

- In 2005, Congress directed FERC to develop incentive rate policy to promote transmission investment
- Order No. 679 set FERC policy in 2006
- 2012 Policy Statement announced tougher criteria for getting incentive rate treatments
  - Must tie incentives to project-specific risks
  - Seek risk mitigating incentives (e.g., pre-commercial cost recovery, ability to recover costs of abandoned projects, inclusion of CWIP in rate base) before seeking incentive ROE adders
- Applications for incentive ROE adders is now rare
  - FERC has granted only two risk-based ROE adders since 2012 Policy Statement

Incentive Policy – Current Issues

- Notice of Inquiry on Incentive Transmission Rate Policy
  - Comments filed in June
  - Reply comment due 8/26
  - Incentives were also topic for the 3/28 FERC/DOE technical conference on Security Investments for Energy Infrastructure
- Can incentive request process and Order No. 1000 competitive bidding process work together?
  - Bid windows leave little time to apply for incentives after project is known but before bid is due
  - Is risk-based ROE adder supported by "risk" of competitive bid concessions (e.g., cost caps)?
- Regulatory asset and hypothetical capital structure
  - FERC willingness to grant incentives for new entrant competitive developers, on "level playing field" grounds
  - Acting under § 205; doesn't require Order No. 679 prerequisites
- Abandoned plant incentive rationale
  - Any policy rationale for denying 100% abandoned plant cost recovery where region, not utility, chose to undertake project?
  - San Diego Gas & Electric decision on costs covered by abandonment incentive
- 50 basis point ROE adder for RTO/ISO participation following 9th Circuit's decision in PG&E proceeding?

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Revisiting Order No. 1000?

- Competitive developer selection
  - Nature of competition
    - Competing solutions for identified problem (PJM)
    - Competing bids for a given project (CAISO, SPP, MISO)
  - Challenges for region, bidders and FERC
    - When are FERC decisions on developer ROE and incentives made, and how are they factored into selections?
    - Are incentive ROEs appropriate where developer has accepted project risk in a competitive process?
  - Projects chosen to avoid competition?
  - State ROFR policies
- Interregional transmission project planning

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Organized Market Issues

- Generator resource resilience and fuel security
  - DOE staff report (2017)
  - DOE-initiated NOPR at FERC (Sept. 2017)
    - Used § 403 of the DOE Organization Act
    - FERC declined to adopt proposal (Jan. 2018)
  - Possible use of DOE authorities
    - FPA § 202(c)
    - Defense Production Act
- ISO-NE fuel security issues
- Capacity markets generally
  - Are mandatory capacity markets in the Northeast RTOs cost-effectively serving the intended functions?
- Storage and DER participation in organized markets

Growing State Role in Generation Choices?

- What can States do post-*Hughes*?
  - *Hughes* was 2016 Supreme Court case holding that Maryland program to support construction of in-state natural gas plant was preempted by the Federal Power Act
  - Subsequent cases have held that States have latitude as long as State policy not "tethered" to FERC-regulated wholesale markets
    - *Allco Finance Ltd. v. Klee* – 2nd Circuit held that CT renewable energy procurement policies were not preempted
    - *EPSA v. Star* – 7th Circuit held that IL zero emission credit (ZEC) policies were not preempted
    - *Coalition for Competitive Electricity v. Zibelman* – 2nd Circuit held that NY ZEC policies were not preempted

Accommodation of State Carbon Policies?

- FERC authority to accept "carbon adders" in RTO tariffs under FPA § 205?
- Attitude of current Commission toward such a 205 filing?
- NEPA questions

Legal Obstacles to Infrastructure Development

- In *Sierra Club v. FERC*, the D.C. Circuit vacated and remanded a FERC-issued certificate for a natural gas pipeline in the Southeast because it found inadequate consideration of greenhouse gas emissions from downstream combustion of the gas to be delivered
  - Similar NEPA challenges can be expected with respect to other certificate orders
- Tensions between Federal and State governments on infrastructure projects
  - NYS denials of CWA § 401 certifications for natural gas pipeline projects
  - State denials of permits for multi-state transmission lines

PG&E Bankruptcy

- Responding to petitions for declaratory order from Exelon and NextEra, FERC found that it had concurrent jurisdiction with the bankruptcy court over rejection of executory PPAs where PG&E is the buyer
  - Petitions for review filed in the 9th Circuit
- The bankruptcy court held that it has exclusive jurisdiction over the discharge of PPAs as executory contracts in a bankruptcy proceeding
  - Found that FERC's attempt to "second-guess -- no overrule -- decisions of the bankruptcy court" would "undermin[e] the function of the bankruptcy court in its role of ensuring that the goals and purposes of bankruptcy law and policy are properly served and executed."
  - Declared that debtor was not obligated to seek any approval for rejection of PPAs from FERC
  - Certified decision for direct appeal to the 9th Circuit

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Affordable Clean Energy Rule

- In June, EPA issued 3 final rules as part of its Affordable Clean Energy (ACE) rulemaking package
  - EPA finalized the repeal of the Obama administration's Clean Power Plan
  - EPA issued a final ACE rule, imposing requirements on existing coal-fired steam power plants, based on "inside the fence" technologies
  - EPA issued regulations on implementation of this and future rules under CAA § 111(d)
- EPA found that the approach taken in the CPP was beyond EPA's authority, relying on a *Chevron* step 1 analysis
- EPA's ACE rule:
  - Finds that the Best System of Emission Reductions (BSER) is limited to heat rate improvements at each unit
  - Clarifies that States have role of determining unit-specific standards based on application of BSER at each unit
  - Does not allow use of trading or averaging to achieve compliance
- Impacts on emissions and costs are expected to be small compared to market-driven changes in the sector
- Alert on the rules is available at: https://www.vnf.com/epa-finalizes-affordable-clean-energy-rule

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Congressional Activity

- Limited-scope FPA amendments in 2018
  - Change to section 203 to apply $10M threshold to purchases of transmission assets
  - Change to allow parties to seek rehearing and judicial review where public utility rate goes into effect without a FERC order
  - Discrete hydropower licensing reforms
- Oversight expected for 2019 and 2020
  - Significant legislation unlikely

Federal Electricity Policy – Big Picture

- FERC
  - Shifting composition of Commission
  - Current priorities
- Courts
  - Reach of Federal preemption? Permissible State actions?
  - Roles in bankruptcy
- EPA
  - Affordable Clean Energy (ACE) rule
- Congress
  - Discrete FPA amendments
  - Oversight

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Questions?

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Electric Power in the Southwest

Santa Fe, NM
July 15, 2019

STATUS OF KEY FERC POLICY PROCEEDINGS
(Updated 7/3/19)

Initiative	Docket No.	Description	Key Developments	Status/Upcoming Deadlines
Electricity – Transmission				
Return on Equity – Notice of Inquiry	PL19-4	The Commission is examining whether, and if so how, to revise its policies concerning the determination of the ROE used in setting rates for electric utilities. FERC is also seeking comment on whether it should revise its policies for determining ROEs for interstate natural gas and oil pipelines.	Mar. 21, 2019 – Notice of Inquiry issued. June 2019 – Initial comments submitted.	July 26, 2019 – Deadline for submitting reply comments.
Return on Equity for Transmission Assets – New England cases	EL11-66 EL13-33 and EL14-86 EL16-64	A number of complaints have been filed seeking to lower the return on equity specified in formula rates for transmission owners. The lead case is *Coakley v. Bangor Hydro-Electric Co.*, in which New England attorneys general and others sought to reduce the ROEs in the rates of New England transmission owners from 11.14% to 9.2%. That case resulted in Opinion No. 531, in which the Commission required the use of a two-step Discounted Cash Flow (DCF) analysis for electric rate matters. Further complaints challenging the ROEs of the New England transmission owners, covering later time periods, have been filed and litigated. In April 2017, the D.C. Circuit issued its opinion in *Emera Maine v. FERC*, vacating and remanding Opinion No. 531. The court found that the Commission did not adequately justify its finding that the New England TOs' existing return on equity was unjust and unreasonable. The court also found inadequate support for the Commission's decision to use the midpoint of the upper end of the DCF zone of reasonableness as the adjusted base ROE. On remand, the Commission announced proposed changes to its ROE methodology for evaluating ROEs. The new approach considers the DCF analysis, the Capital Asset Pricing Model (CAPM), and the Expected Earnings Model to establish a composite zone of reasonableness to evaluate existing ROEs, and additionally considers the Risk Premium Model in setting a new ROE.	June 19, 2014 – The Commission issued Opinion No. 531 revising its policy for determining ROE for public utilities. The Commission decided to use the two-step DCF methodology — the same approach that it uses for natural gas and oil pipelines — to set electric utility ROEs. For the New England transmission owners, FERC chose an ROE that was above the midpoint of the "range of reasonableness," citing anomalous capital market conditions. FERC tentatively adopted an ROE of 10.57%, subject to a paper hearing on the long-term growth projection. Oct. 16, 2014 – The Commission issued Opinion No. 531-A, finding that the projected long-term growth in GDP is the appropriate long-term growth projection to be used in the two-step DCF methodology. The Commission confirmed its decision to set the base ROE at 10.57% and the top of the zone of reasonableness at 11.74%. Apr. 14, 2017 – D.C. Circuit, in *Emera Maine v. FERC*, No.15-1118, vacates and remands Opinion No. 531. Oct. 16, 2018 – Order on remand directs parties to submit briefs on new proposed ROE methodology taking into account DCF analysis, CAPM, Expected Earnings Model and Risk Premium Model, and on how the proposed new methodology should be applied in the four complaint proceedings pending before the Commission involving the New England transmission owners' ROE. The remand order would set base ROE at 10.41% for the initial period using the new methodology. Jan. - Mar. 2019 – Initial and reply briefs filed by participants in the New England ROE complaint proceedings.	

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STATUS OF KEY FERC POLICY PROCEEDINGS
(Updated 7/3/19)

Initiative	Docket No.	Description	Key Developments	Status/Upcoming Deadlines
Return on Equity for Transmission Assets – MISO	EL14-12 EL15-45	Opinion No. 551, addressing a complaint concerning the ROE of transmission owners in MISO, used the same analysis as Opinion No. 531. In light of the Commission's proposal in the *Coakley* remand order to adopt a new methodology for evaluating ROEs, FERC directed participants in the complaint proceedings involving the MISO transmission owners' ROE to submit briefs regarding whether and how this proposed new methodology should apply to these proceedings.	Sept. 28, 2016 – The Commission issued Opinion No. 551, affirming the presiding judge's finding that the appropriate base ROE for the MISO transmission owners is 10.32%. The Commission also affirmed the presiding judge's determination that there were anomalous capital market conditions during the study period (Jan. '15 – June '15) and, therefore, the ROE should be set at a point above the midpoint of the DCF zone of reasonableness. June 30, 2016 – The presiding judge in EL15-45 issued an initial decision, ruling that the MISO TOs should be permitted to collect a base ROE of 9.70% (based on a July 1, 2015 – Dec. 31, 2015 study period). Nov. 15, 2018 – Order directing briefs in MISO complaint proceedings to address the applicability of the Commission's revised ROE methodology proposed in the *Coakley* remand order. Feb. - Apr. 2019 – Initial and reply briefs submitted by participants in the MISO complaint proceedings.	
Return on Equity for Transmission Assets – Single Utility	ER16-2320 (PG&E)	The most recent litigated example of the Commission's ROE analysis as applied to a single utility is in a recently issued PG&E transmission rate case. This predated the remand order in *Coakley*.	Oct. 1, 2018 – The presiding judge issued an initial decision in the hearing concerning Pacific Gas and Electric Company's proposed rate increase — including the proposed base ROE of 10.25% — for service under PG&E's Transmission Owner Tariff. The judge ruled that anomalous financial market conditions persist, and so an upward adjustment was appropriate. After review of alternative methodologies and a survey of state-authorized ROEs, the presiding judge ruled that the company's base ROE should be set at the top of the zone of reasonableness – 9.13%. Oct. - Nov. 2018 – Briefs on exceptions and opposing exceptions to initial decision filed.	
Transmission Rate Incentives – Notice of Inquiry	PL19-3	The Commission initiated a broad review on the scope and implementation of its transmission incentive rate policy. FERC is seeking comments on possible improvements to ensure that it appropriately encourages the development of the electric transmission facilities needed to ensure grid reliability and reduce congestion. Among other issues, the Commission will examine whether incentives should continue to be granted based on a project's risks and challenges or should be based on the benefits that a project provides.	Mar. 21, 2019 – Notice of Inquiry issued. June 2019 – Initial comments filed.	Aug. 26, 2019 – Deadline for submitting reply comments.

STATUS OF KEY FERC POLICY PROCEEDINGS
(Updated 7/3/19)

Initiative	Docket No.	Description	Key Developments	Status/Upcoming Deadlines
Transmission Rate Incentives – RTO Adder	ER14-2529 ER15-2294	The Ninth Circuit Court of Appeals remanded to FERC the Commission's orders granting PG&E's request for a 50 basis point return on equity transmission rate incentive for its continuing membership in the CAISO. The court directed the Commission to inquire into whether PG&E could unilaterally leave CAISO and thus whether an incentive adder could induce it to remain in CAISO.	Jan. 8, 2018 – Ninth Circuit opinion in *CPUC v. FERC*, No. 16-70481. Aug. 20, 2018 – Order on remand establishes a briefing schedule to supplement the record on the specific questions presented on remand, including whether California law requires PG&E to participate in CAISO. Sept. - Oct. 2018 – Initial and reply briefs filed.	Issues on remand remain pending before the Commission.
Transmission Rate Incentives - Abandonment Incentive	EL15-103	The Commission granted San Diego Gas & Electric Company's requested abandonment rate incentive in connection with a transmission project, but limited costs eligible for recovery to those costs incurred after the order. The Commission ruled that SDG&E could only charge ratepayers for half of any abandoned plant costs incurred before the Commission issued its incentive order. The Commission ruled that allowing full recovery of pre-order investments would be contrary to the rationale that incentives are designed to encourage future transmission investments.	Mar. 2, 2016 – Order on petition for declaratory order. Oct. 26, 2016 – Order denying rehearing. Jan. 15, 2019 – D.C. Circuit opinion denied SDG&E's petition for review challenging the Commission's rulings. *San Diego Gas & Elec. Co. v. FERC*, No. 16-1433 (D.C. Cir.).	
Changes in Corporate Income Tax Rates	RM18-12 (NOI) EL18-72 (show cause) EL18-62 (show cause)	The Commission issued a suite of orders to address the impacts of the Tax Cuts and Jobs Act of 2017 on electric utilities' rates.	Mar. 15, 2018 – In light of the reduction of the corporate tax rate from 35% to 21%, the Commission issued two show cause orders to 48 companies that have (1) stated transmission rates, or (2) formula transmission rates with a stated Federal tax rate value of 35%. The orders direct the companies to propose revisions to their transmission rates or show cause why they should not do so. Mar. 15, 2018 – Notice of Inquiry (RM18-12) seeks comments on the topic of rate treatment of accumulated deferred income taxes — the dollar amounts of taxes that public utilities, interstate natural gas pipelines, and oil pipelines collected from customers in anticipation of later tax liability. The NOI also seeks comments on the effect of bonus depreciation restrictions included in the Tax Cuts and Jobs Act. May 2018 – Responses to show cause orders submitted. May - June 2018 – Comments on the NOI submitted. Nov. 2018 - Feb. 2018 – The Commission issued orders terminating the vast majority of the show cause proceedings related to the reduction in the corporate tax rate. A handful of these proceedings are being held in abeyance pending the outcome of related rate proceedings or commitments to submit future rate filings.	Awaiting Commission action on the NOI.

STATUS OF KEY FERC POLICY PROCEEDINGS
(Updated 7/3/19)

Initiative	Docket No.	Description	Key Developments	Status/Upcoming Deadlines
Security of Energy Infrastructure	AD19-12	The Commission and the Department of Energy held a joint technical conference to discuss current cyber and physical security practices used to protect energy infrastructure and to examine how federal and state authorities can provide incentives and cost recovery for security investments in energy infrastructure, particularly the electric and natural gas sectors.	Mar. 28, 2019 – Technical conference held. May 2019 – Post-technical conference comments submitted.	
Interconnection Policy	RM17-8	Final Rule (Order No. 845) revises provisions of the *pro forma* Large Generator (20 MW or greater) Interconnection Procedures and *pro forma* Large Generator Interconnection Agreement adopted by the Commission in Order No. 2003. The Final Rule adopts reforms that: (1) remove a limitation on an interconnection customer's ability to construct interconnection facilities and stand-alone network upgrades; and (2) require that all transmission providers establish more-accessible interconnection dispute resolution procedures. In addition, transmission providers must develop a method for determining contingent facilities and publicly disclose the specific study processes and modeling assumptions they use for interconnection studies.	Dec. 15, 2016 – Notice of Proposed Rulemaking issued. Apr. 19, 2018 – Final Rule issued. Feb. 21, 2019 – Order No. 845-A issued. The Commission's rehearing order adopted certain technical changes but did not reverse any major aspects of Order No. 845. Apr. - June 2019 – Transmission providers submitted Order No. 845 compliance filings.	

STATUS OF KEY FERC POLICY PROCEEDINGS
(Updated 7/3/19)

Initiative	Docket No.	Description	Key Developments	Status/Upcoming Deadlines
Selected Reliability Standards				
Cybersecurity Standards	RM17-11	Final Rule (Order No. 843) approves a Critical Infrastructure Protection reliability standard submitted by NERC, which clarifies the obligations pertaining to electronic access control for low impact bulk electric cyber systems. The rule requires mandatory security controls for transient electronic devices (e.g., thumb drives, laptop computers, and other portable devices frequently connected to and disconnected from systems) used at low impact bulk electric cyber systems. NERC was also directed to develop modifications to address the need to mitigate the risk of malicious code that could result from third-party transient electronic devices.	Oct. 19, 2017 – Notice of Proposed Rulemaking issued. Apr. 19, 2018 – Final Rule issued. May 21, 2019 – NERC submitted a proposed revised reliability standard to address the Commission's directive from Order No. 843 to develop modifications to mitigate the risk of malicious code that could result from third-party transient electronic devices (Docket No. RD19-5).	
	RM18-2 RD19-3	Final Rule (Order No. 848) directs NERC to develop modifications to the Critical Infrastructure Protection reliability standards to include the mandatory reporting of cyber security incidents that compromise, or attempt to compromise, the reliable operation of the Nation's bulk electric system. Pursuant to the Commission's directive, the security incident reports will include certain minimum information to improve the quality of reporting and will allow for ease of comparison by ensuring that each report includes specified fields of information.	Dec. 21, 2017 – Notice of Proposed Rulemaking issued. July 19, 2018 – Final Rule issued. Mar. 7, 2019 – NERC filing submitting proposed cybersecurity incident reliability standard per the Commission's directive in Order No. 848. June 20, 2019 – Order approving reliability standard.	
	RM15-14 RM-17-13	Standards on supply chain risk management.	July 21, 2016 – Final Rule (Order No. 829) directs NERC to develop a new reliability standard on supply chain risk management for industrial control system hardware, software, and computing and networking services associated with bulk electric system operations. Jan. 18, 2018 – FERC issued a Notice of Proposed Rulemaking that would approve NERC's proposed revisions to the current Critical Infrastructure Protection standards to mitigate cybersecurity risks associated with the supply chain for the grid-related cyber systems. FERC also proposed to require NERC to address security risks associated with Electronic Access Control and Monitoring Systems, Physical Access Controls and Protected Cyber Assets. Oct. 18, 2018 – Final Rule (Order No. 850) generally approves the supply chain risk management standards outlined in the NOPR. The Commission approved NERC's request for an 18-month implementation period. The Final Rule excludes Electronic Access Control and Monitoring Systems, but directs NERC to develop modifications within 24 months that will include EACMS associated with medium and high impact cyber systems.	

STATUS OF KEY FERC POLICY PROCEEDINGS
(Updated 7/3/19)

Initiative	Docket No.	Description	Key Developments	Status/Upcoming Deadlines
Electricity – Wholesale Sales				
Grid Resilience in RTO and ISO Markets	RM18-1 AD18-7	The Commission declined to adopt the Department of Energy's proposal to FERC to develop cost recovery mechanisms for grid resiliency resources with 90-day on-site fuel supplies. Instead, the Commission initiated a new proceeding to review the resilience of the bulk power system in markets overseen by regional transmission organizations and independent system operators.	Aug. 23, 2017 – The Department of Energy released a report that studied changes in the Nation's electricity markets and the impact on the reliability and resilience of energy markets. The report found the abundance of cheap natural gas to be the primary driver behind the increase in coal and nuclear plant retirements. The report included several policy recommendations for FERC, DOE, and others to take to improve the reliability and resiliency of the power grid in the wake of market changes. Sept. 29, 2017 – Secretary of Energy Perry initiated a rulemaking at FERC under section 403 of the DOE Organization Act, proposing to require FERC-jurisdictional ISOs and RTOs to develop tariff mechanisms to provide for full cost recovery by generation resources that meet specified criteria, including a 90-day supply of fuel on-site. Jan. 8. 2018 – FERC order terminating rulemaking and initiating new proceeding on grid resilience issues. Mar. 9, 2018 – RTOs/ISOs submitted responses to issues raised in the Jan. 8th grid resilience order. May - July 2018 – Comments filed in response to the RTO/ISO submissions and on related grid resilience issues.	Awaiting further Commission action.

STATUS OF KEY FERC POLICY PROCEEDINGS
(Updated 7/3/19)

Initiative	Docket No.	Description	Key Developments	Status/Upcoming Deadlines
ISO New England Capacity Market Reforms	ER14-1050	The Commission conditionally approved ISO New England's Pay-for-Performance proposal, which beginning in 2018 implemented a two-settlement market design intended to incent generator performance. Under that mechanism, a resource that produces energy or provides reserves during capacity scarcity conditions in excess of a pro rata share of its capacity supply obligation receives additional revenue, while a resource that produces less than its pro rata share faces penalties.	May 30, 2014 – Order conditionally approving ISO New England's Pay-for-Performance proposal. Jan. 19, 2018 – Petitions for review were denied by the D.C. Circuit in *New England Power Generators Ass'n v. FERC*, No. 16-1023. June 1, 2018 – ISO New England implemented its Pay-for-Performance capacity market changes.	
	EL18-182 ER18-1509 ER18-2364	The Commission initiated a section 206 proceeding directing ISO New England to develop a new form of cost-based contracts designed to protect "fuel security" in the region in connection with generators participating in the region's forward capacity market. The Commission initiated this action in an order denying a request for waiver of several tariff provisions that would permit ISO New England to retain two retiring generating units, Mystic 8 and 9, for fuel security purposes. The Commission directed ISO New England to submit changes to address short-term fuel security issues by August 31, 2018 and to submit long-term changes by July 1, 2019. (An extension of time was granted to Oct. 15, 2019.)	July 2, 2018 – Order initiating section 206 proceeding to address fuel security issues in New England. Aug. 1, 2018 – Indicated New England EDCs filed a request for clarification of the July 2 order, asking the Commission to clarify that ISO New England has the authority to adopt tariff provisions to procure, and recover the cost of, natural gas pipeline capacity. Aug. 31, 2018 – ISO New England submitted a compliance filing to establish a fuel security study methodology, a short-term cost-of-service mechanism to ensure fuel security, and related provisions governing the allocation of costs for such out-of-market compensation. Dec. 3, 2018 – Order accepting ISO New England's compliance filing.	Oct. 15, 2019 – Deadline for ISO New England's submission of a proposal on long-term market solutions to address fuel security issues.
PJM Interconnection Capacity Market Reforms	EL18-178, et al.	The Commission rejected two alternate proposals submitted by PJM Interconnection designed to address the price suppressing effects of state out-of-market subsidies for certain generation resources. The Commission established a paper hearing to address alternatives aimed at mitigating the effects of state-subsidized energy resources on the region's capacity market.	June 29, 2018 – Order rejecting PJM's proposals and establishing a paper hearing on a FERC-proposed alternative approach. The FERC-proposed approach would (i) modify PJM's Minimum Offer Price Rule (MOPR) such that it would apply to new and existing resources that receive out-of-market payments, regardless of resource type, and would include very limited exemptions; and (ii) in order to accommodate state policy decisions and allow resources that receive out-of-market support to remain online, establish an option in the tariff that would allow, on a resource-specific basis, resources receiving out-of-market support to choose to be removed from the PJM capacity market, along with a commensurate amount of load, for some period of time. (This option is similar in concept to the Fixed Resource Requirement (FRR) that currently exists in the PJM Tariff.) Oct. - Nov. 2018 – Initial and reply paper hearing submissions filed to address supply-side state subsidies and their impact on the determination of just and reasonable prices in the PJM capacity market.	Awaiting Commission action.

STATUS OF KEY FERC POLICY PROCEEDINGS
(Updated 7/3/19)

Initiative	Docket No.	Description	Key Developments	Status/Upcoming Deadlines
Electric Storage and Distributed Energy Resources – Participation in RTO/ISO Markets	RM16-23	The Commission adopted reforms to remove barriers to the participation of electric storage resources in the capacity, energy, and ancillary service markets operated by RTOs and ISOs. The Final Rule (Order No. 841) requires each RTO/ISO to establish a participation model consisting of market rules that, recognizing the physical and operational characteristics of electric storage resources, accommodates their participation in electricity markets.	Nov. 17, 2016 – Notice of Proposed Rulemaking issued. Feb. 15, 2018 – Final Rule issued. Dec. 2018 – RTOs and ISOs submitted compliance filings to implement Order No. 841 requirements. Those filings remain pending before the Commission.	
	RM18-9	The Commission established a separate proceeding (RM18-9) to consider reforms to accommodate the participation of distributed energy resource aggregations in RTO/ISO markets.	Apr. 10-11, 2018 – FERC held a technical conference to discuss the participation of distributed energy resource aggregations in RTO and ISO markets and to more broadly discuss the potential effects of DERs on the bulk power system. June 2018 – Post-technical conference comments filed.	
PURPA Review	AD16-16	The Commission held a technical conference on implementation issues under the Public Utility Regulatory Policies Act of 1978 (PURPA). The conference focused on the mandatory purchase obligation under PURPA and the determination of avoided costs for those purchases.	June, 29, 2016 – Technical conference held. Sept. 9, 2016 – The Commission requested comments on: (1) use of the "one-mile rule" to determine the size of an entity seeking certification as a small power production qualifying facility and (2) minimum standards for PURPA-purchase contracts. Nov. 2016 – Comments filed. May 17, 2018 – Chairman McIntyre announced that the Commission is re-opening its PURPA review initiative, which will build on the record that was developed in 2016. Oct. 2018 – June 2019 – Chairman Chatterjee has stated that the Commission continues to review its existing PURPA regulations.	Awaiting further Commission action on PURPA reforms.
	EL18-205 (Sunrun)	The Commission issued a declaratory order waiving the one-mile rule and qualifying facility certification filing requirement for separately-interconnected, individual residential solar photovoltaic generating systems owned by Sunrun, Inc.	Apr. 18, 2019 – Declaratory order issued.	

STATUS OF KEY FERC POLICY PROCEEDINGS
(Updated 7/3/19)

Initiative	Docket No.	Description	Key Developments	Status/Upcoming Deadlines
Bankruptcy Jurisdiction	EL19-35 EL19-36	In response to filings by NextEra and Exelon related to Pacific Gas and Electric Company's bankruptcy, the Commission ruled that it has concurrent jurisdiction with bankruptcy courts to review and address the disposition of wholesale power contracts sought to be rejected by the purchaser through bankruptcy.	Jan. 18, 2019 – NextEra Energy petition for declaratory order and complaint. Jan. 23, 2019 – Exelon petition for declaratory order and complaint. Jan. 25, 2019 – Order on NextEra's petition for declaratory order and complaint. Jan. 28, 2019 – Order on Exelon's petition for declaratory order and complaint. May 1, 2019 – Order denying rehearing. June 26, 2019 – PG&E filed a petition for review in the Ninth Circuit. *PG&E v. FERC*, No. 19-71615.	
Congressional Activities				
Section 203 Merger Review		President Trump signed into law legislation (H.R. 1109) that amends section 203(a)(1)(B) of the Federal Power Act to eliminate the need for prior FERC approval of transactions involving the merger or consolidation of FERC-jurisdictional facilities with a value under $10 million. The bill also requires FERC to establish a 30-day post-closing notification requirement for transactions involving facilities with value of more than $1 million.	Sept. 28, 2018 – The bill was signed into law. Feb. 21, 2019 – The Commission issued a Final Rule (Order No. 855) to implement the amended provisions to section 203(a)(1)(B) of the FPA.	
Appeals of Section 205 Rate Filings		The America's Water Infrastructure Act of 2018 (S. 3021) includes provisions amending the Federal Power Act to permit a party to seek rehearing and subsequent judicial review of any rate change filed by a public utility that takes effect without FERC issuing an order. This covers any section 205 rate filing that takes effect automatically because FERC fails to either accept or deny it due to a 2-2 split resulting from a vacancy, recusal, or incapacity, or due to a lack of a quorum.	Oct. 23, 2018 – The bill was signed into law.	
FERC Personnel				
FERC Commissioners		The Commission currently has four sitting commissioners, and Commissioner LaFleur has announced her intent to resign at the end of August.	Commissioner Chatterjee designated as Chairman on October 24, 2018. Commissioner McNamee was confirmed by the Senate December 6, 2018, filling the seat vacated by Commissioner Powelson. Commissioner LaFleur has announced that she will leave the Commission at the end of August. The White House has not made intent to nominate announcements for either of the vacancies left by Commissioner McIntyre's death or Commissioner LaFleur's resignation.	

Renewable Energy Development and IT Sector Load Growth

PRESENTED TO
Law Seminars International
Electric Power in the Southwest

PRESENTED BY
Judy Chang and John Tsoukalis

July 15, 2019

THE Brattle GROUP

Agenda

Load from the Information Technology Sector

What is Attracting Data Centers

Renewable Energy Consumption by Large IT Companies and Data Centers

Transformative Changes of the Electricity Industry

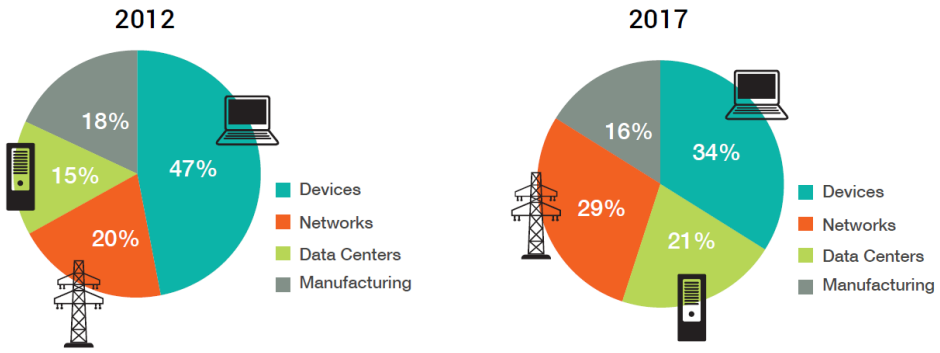
- **Declining costs of solar and wind resources** increasingly dominate the power grid with **low marginal cost** generation
- **Low natural gas prices** place continued downward pressure on coal and nuclear plants
- **Reduced growth in traditional electricity consumption**
- **Growing electricity demand from IT Systems and Data Centers**
- **Increased customer preferences for conservation and clean energy**
- **Technological advances** that allow customers and electric utilities to better monitor and control electricity usage
- **Restrictions on environmental impact** of power generation on air emissions, water usage, waste disposal, and land use
- **Increasing electrification** of transportation and heating

These are significant changes that utilities, grid operators, generators, and regulators have to manage

Four Components of Electricity Consumption for IT Sector

Total electricity consumption from the IT sector is growing at a fast pace, estimated to already consume over 12% of electric production in 2017, and continue to grow at least 7% annually through 2030, double the average rate of electricity growth globally

Main components of electricity consumption for the IT sector

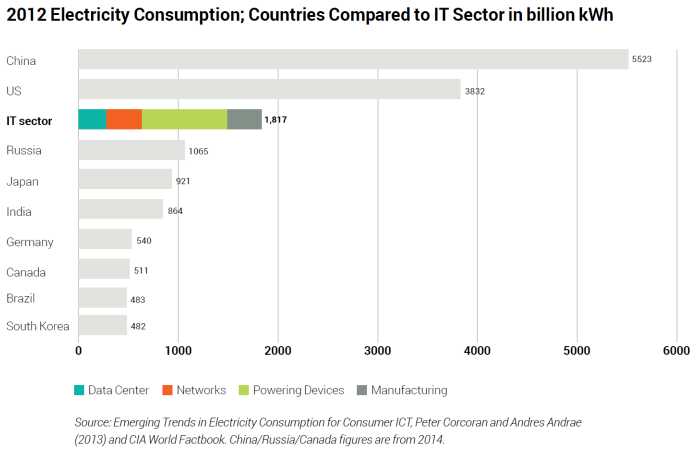


Main components of electricity consumption for the IT sector, 2012. From "Emerging Trends in Electricity Consumption for Consumer ICT"

Source: "Clicking Clean: Who is Winning the Race to Build a Green Internet," 2017, Greenpeace

Internet of Things Driving Electricity Usage

- According to Greenpeace, data centers are the factories of the digital age
- The global electricity consumption is equivalent to a large country's energy need
- Traditionally, devices drove most of the consumption
- Now personal computers and electronic devices have become smaller and more energy efficient, the broadband and internet-based computing platforms that compute and store data are driving the electricity need

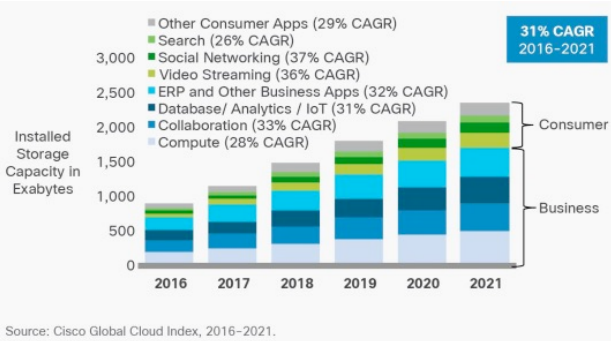


Source: Emerging Trends in Electricity Consumption for Consumer ICT, Peter Corcoran and Andres Andrae (2013) and CIA World Factbook. China/Russia/Canada figures are from 2014.

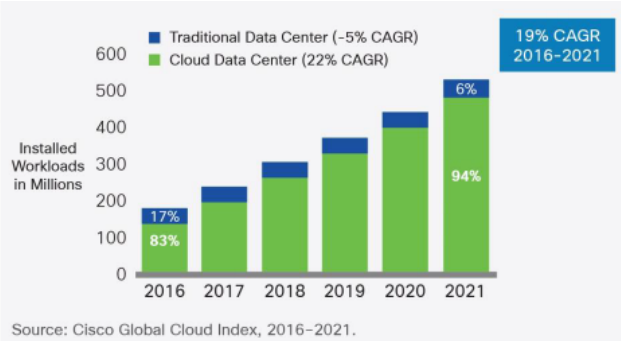
Source: "Clicking Clean: Who is Winning the Race to Build a Green Internet," 2017, Greenpeace

Global Growing Need for Data Storage and Cloud Computing

- With the Internet of Things, abundance of sensor-based automation, cloud computing needs growing, the demand for data center-based workloads is increasing rapidly
- Consumer applications such as video streaming and social networks are the fastest growing applications of data center capacity



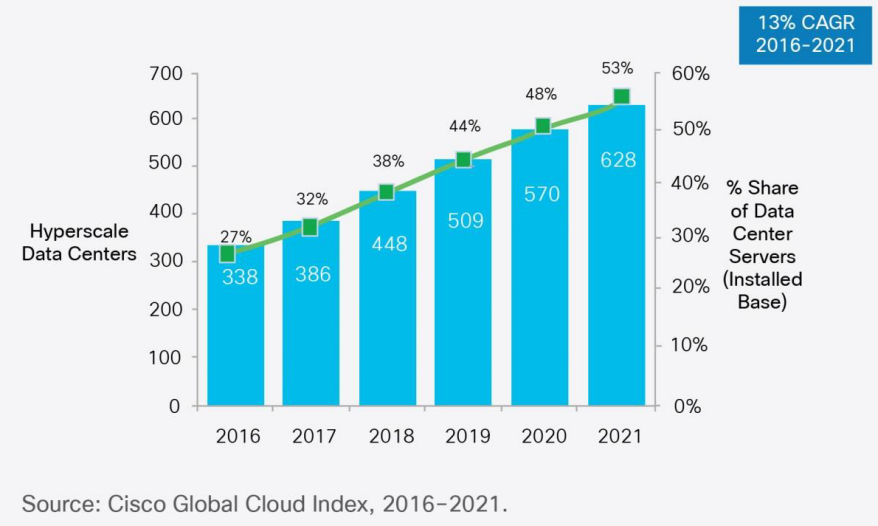
Source: Cisco Global Cloud Index, 2016–2021.



Source: Cisco Global Cloud Index, 2016–2021.

Hyper Data Centers Growth

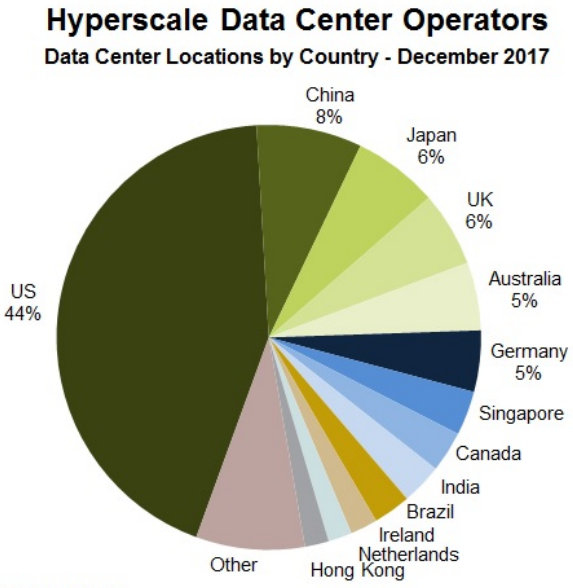
- The shift to cloud computing is driving the need for large-scale data centers
  - Mega data centers are data centers with at least 1M square feet of data center space
  - "Hyperscale" data centers refers architecture that can scale up quickly and in large increments to respond to increasing demand



Source: Cisco Global Cloud Index: Forecast and Methodology, 2016–2021

Hyperscale Data Centers in the U.S.

- U.S. accounts for close to half of the global of hyperscale data centers
- The electricity consumption of a single data center for a large enterprise can be similar to that of a small to medium town



Source: Synergy Research Group

Source: https://srgresearch.s3.amazonaws.com/uploads/hyperscale_Dec_2017.jpg?Signature=qeQZn4er1NUcSnkRhywFAdwln5s%3D&Expires=1563112774&AWSAccessKeyId=AKIAJ5V27TDV4ZXYJ4KQ downloaded on July 14, 2019

Data Center Owners and Users are Committed to Renewable Energy

All major data center owners have pledged to achieve 100% renewable energy supply

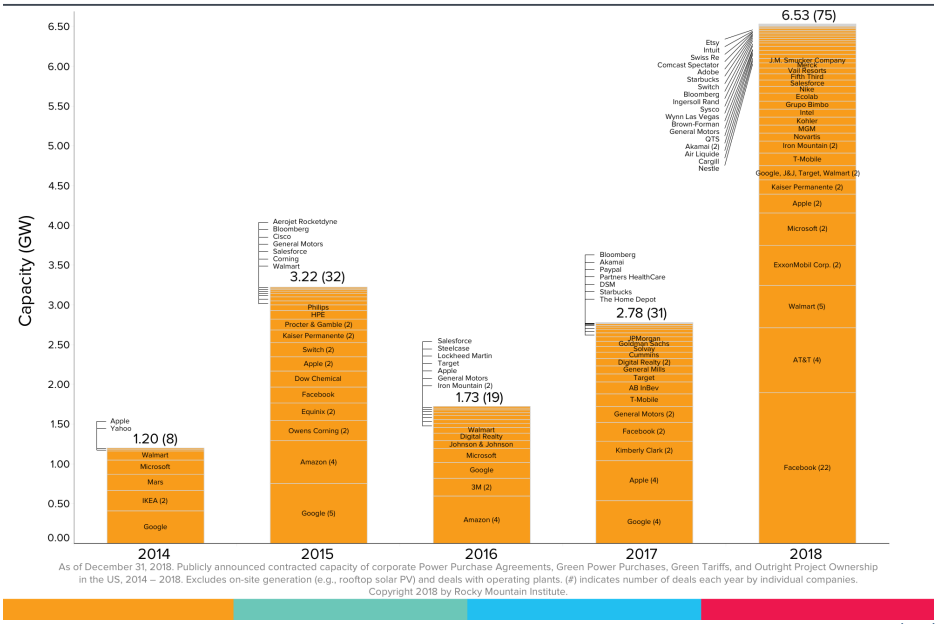
- Driven by evolving customer preferences for clean power

100% Renewable Energy Commitments

C&I Customers Increasingly Drive of Renewable Generation Investments

BUSINESS RENEWABLES CENTER

Corporate Renewable Deals
2014 – 2018

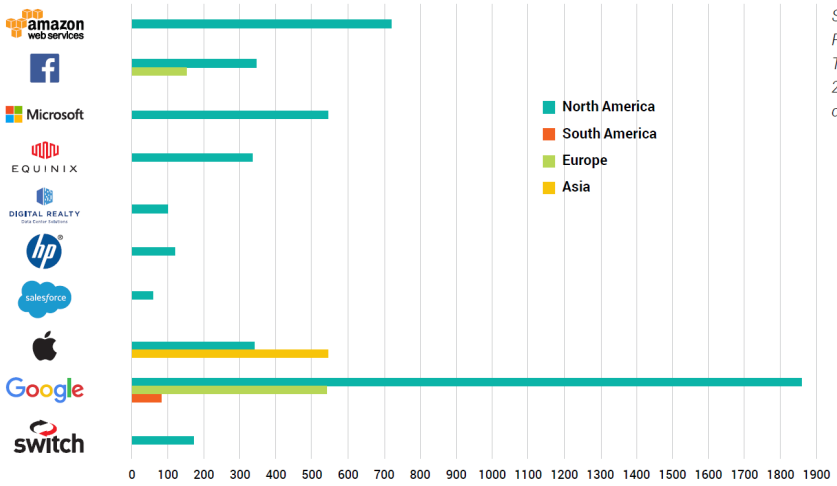


As of December 31, 2018. Publicly announced contracted capacity of corporate Power Purchase Agreements, Green Power Purchases, Green Tariffs, and Outright Project Ownership in the US, 2014 – 2018. Excludes on-site generation (e.g., rooftop solar PV) and deals with operating plants. (#) indicates number of deals each year by individual companies.

Growing Renewable Contracts from the IT Sector

- More and more technology companies are committing to using renewable energy to power their facilities and systems
- Virtual PPAs are one way to accomplish that

IT Sector Renewable Contracts 2010-16 (MW)



Source: Click Clean Renewable Energy Tracker (January 2017) www.clickclean.org

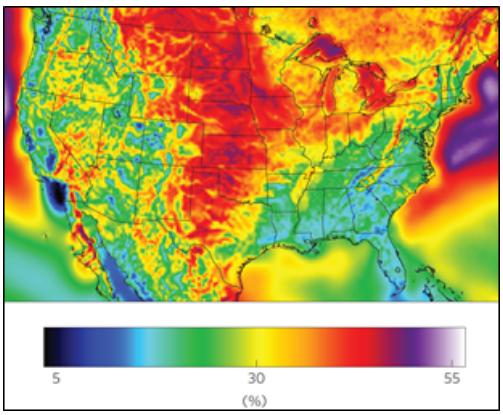
Example of Switch in Las Vegas

- Data center provider, Switch, has contracted 180MW of new solar power in Nevada: 100% powered by renewable energy
  - This is a part of its participation in American Business Act on Climate Pledge.
  - NV Energy built and owns the Switch Station 1 & 2 solar farms
  - NV Energy provides a "Green Rider" Tariff for this and other customers
- Switch is planning and building several other giant facilities
- Switch prides itself in providing colocation data center service has telecommunications connection to "**5 millisecond to Los Angeles**"

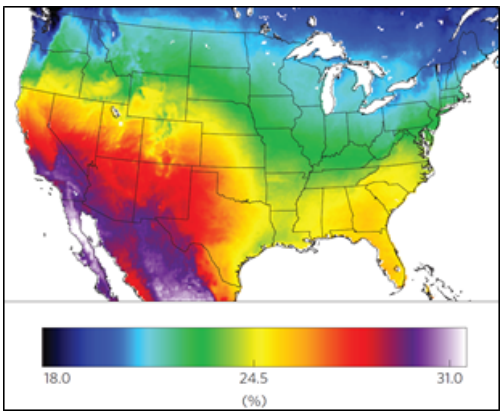
Abundance of Solar Resources in the Southwest

Continued cost reductions and technology improvements will likely create renewable opportunities in regions with (1) access to high-quality solar areas; (2) utilities or ISO/RTO markets able to fairly compensate and cost-effectively balance renewable energy output

Wind Capacity Factor



Solar PV Capacity Factor



Source: MacDonald, Alexander E, Christopher T.M. Clack, et al., "Future cost-competitive electricity systems and their impact on US CO2 emissions," Nature Climate Change (Jan 2016): DOI: 10.1038/NCLIMATE2921. (Reproduced with permission from Earth System Research Laboratory, NOAA.

Renewable Development in ISO/RTO Markets

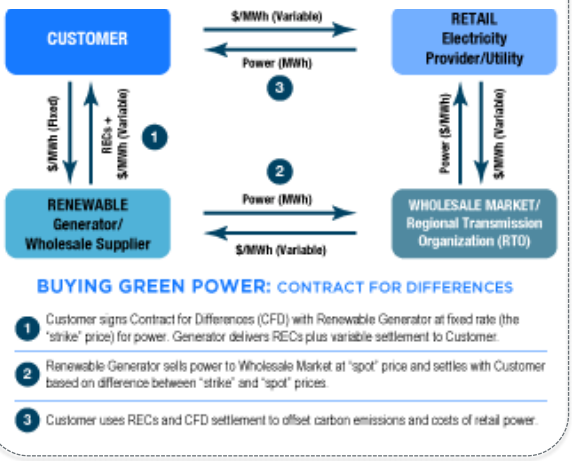
- The renewable generation investments have occurred in regions that:
  - Have organized regional RTO/ISO markets that provide transparent and liquid trading for both the "energy" and "green" attributes generated by the resources
  - Enjoy access to areas with low-cost renewable resource potential
- RTO/ISO markets offer:
  - Ready-made market for real-time energy
  - Geographic and load diversity
  - Lower-cost integration, balancing, and congestion management
  - Improved regional transmission access and generation interconnection processes

These benefits will accrue to the Southwest as it considers participating in regional markets.

Example of Virtual PPA in ISO/RTO Markets

- Example of a 100% renewable power goal: Buyer signs power purchase agreements (PPAs) with suppliers of renewable energy
- All contracts must create new sources of green power on the grid
- Purchased renewable energy is located on the same grid as data center load
- All "bundled" energy and RECs
- Contracts for Differences (CfDs) as financial hedge for physical deliveries to the electric grid (see chart)
  - Almost exclusively in RTO/ISO markets
  - Does not require retail choice

"Virtual PPAs" Using Contracts for Differences
(Reproduced from renewablepowerdirect.com)



Sources: http://renewablepowerdirect.com/a-new-way-for-companies-to-go-green
https://www.google.com/green/energy/use/#purchasing
http://www.wri.org/news/2016/05/release-renewable-energy-buyers-alliance-forms-power-corporate-movement-renewable

Observations

- With the growing need to power our digital age, utilities have an opportunity to serve new customers
- Many questions are being raised regarding these "new loads"
  - How do we price the service for this new large customers?
  - Should we charge the new load incremental cost?
  - What is meant by incremental costs?
  - Should the charges separate the costs associated with generation or should transmission and distribution rates be reconsidered?

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- International Arbitration
- International Trade
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California ISO

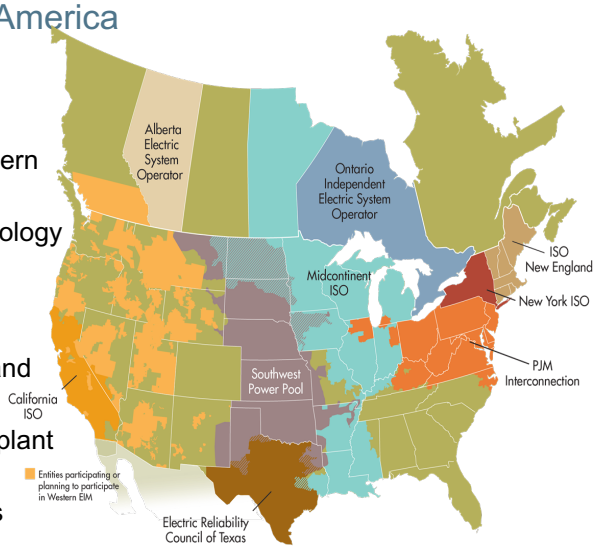
Western Energy Imbalance Market

Law Seminars International
Electric Power in the Southwest

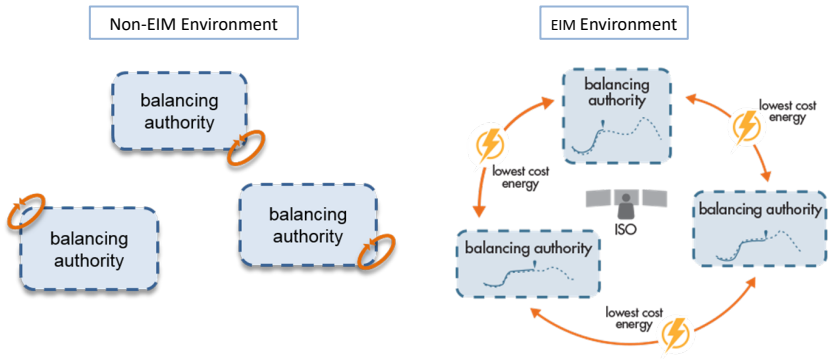
Andrew Ulmer
Director, Federal Regulatory Affairs
July 15, 2019

The California ISO is one of nine independent grid operators in North America

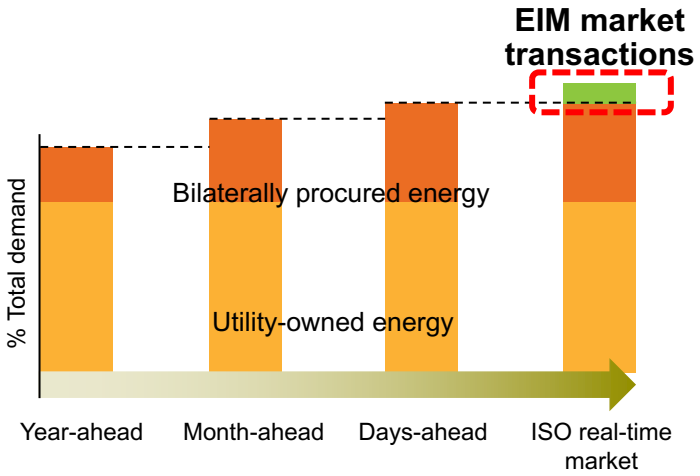
- One of 38 balancing authorities in the western interconnection
- Uses advanced technology to balance supply and demand
- Operates markets for wholesale electricity and reserves
- Manages new power plant interconnections
- Plans grid expansions



Western EIM provides an easily-scalable extension of real-time market to the broader region

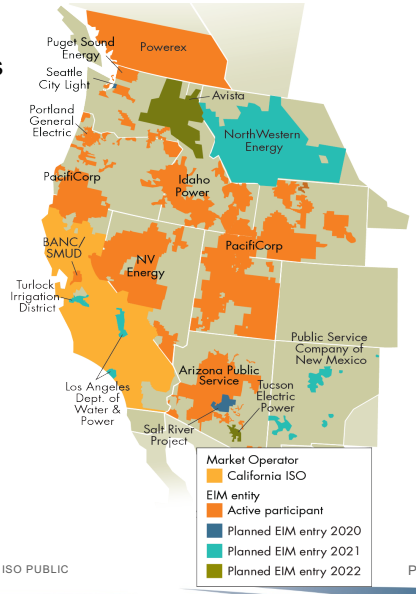


Most demand is met in advance of the market through utility-owned or bilaterally procured resources



Western Energy Imbalance Market

- Automated dispatch minimizes cost, facilitates renewables, resolves imbalance & avoids congestion
- Greater operational visibility which enhances reliability
- Low-cost, no exit fees, voluntary
- Preserves Balancing Authority autonomy, including compliance, balancing, and reserve obligations



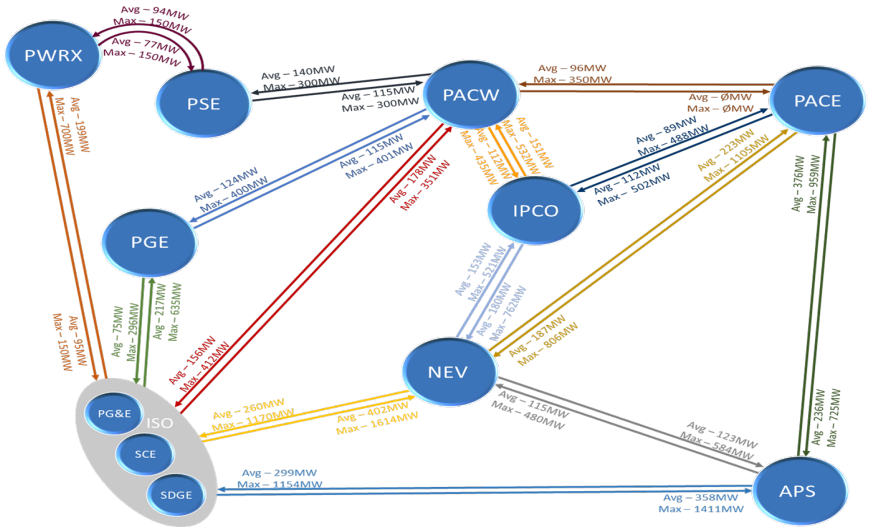
The Western EIM has accrued over $650 Million in gross benefits since November 2014

(millions $)

EIM PARTICIPANTS	2014	2015	2016	2017	2018	2019	TOTAL
Arizona Public Service Entered 10/2016			$5.98	$34.56	$45.30	$8.20	$94.04
California ISO Entered 11/2014	$1.24	$12.66	$28.34	$36.96	$67.94	$13.08	$160.22
Idaho Power Company Entered 04/2018					$26.88	$8.45	$35.33
NV Energy Entered 12/2015		$0.84	$15.57	$24.20	$25.55	$5.71	$71.87
PacifiCorp Entered 11/2014	$4.73	$26.23	$45.47	$37.41	$61.68	$23.76	$199.28
Portland General Electric Entered 10/2017				$2.83	$27.57	$11.74	$42.14
Powerex Entered 04/2018					$7.84	$7.23	$15.07
Puget Sound Energy Entered 10/2016			$1.56	$9.86	$13.68	$7.21	$32.31
TOTAL	$5.97	$39.73	$96.92	$145.82	$276.44	$85.38	**$650.26**

Reduction in flexibility reserves across EIM footprint

Robust energy transfers in Q1 2019



Western EIM governance structure

EIM Governing Body (GB)	• 5 independent, non-stakeholder members • Delegated authority over EIM-related market rules • Selected by stakeholder nominating committee, confirmed by EIM Governing Body • Provides western entities a decision-making voice
EIM Body of State Regulators (BOSR)	• Advises the EIM Governing Body and ISO Board of Governors on matters of interest • Currently eight state officials from EIM states • Provides a state regulatory perspective
Regional Issues Forum (RIF)	• Public vehicle for discussion of EIM-related issues, including impacts to neighboring balancing authority areas • Organized by ten self-selected sector liaisons • May produce opinions for EIM governing body or ISO Board of Governors

Western EIM governance leadership

EIM Governing Body
Chair Valerie Fong
Vice-Chair Carl Linvill
Travis Kavulla
John Prescott
Next meeting is August 28 in Portland, OR.

Regional Issues Forum
Next meeting is August 27 in Portland, OR

Body of State Regulators *self-governed*	
Utah	Chair Jordan White
Washington	Ann Rendahl*
Arizona	Bob Burns
California	Cliff Rechtschaffen
Idaho	Vice-Chair Kristine Raper
Nevada	Ann Pongracz
Oregon	Letha Tawney
Wyoming	Kara Fornstrom
** Member of the EIM GB nominating committee*	
Next meeting is October 7 in San Diego, CA	

Extended Day Ahead Market

- Key regional benefits:
  - Would allow EIM participants to take advantage of day-ahead market enhancements, such as new imbalance reserve product targeted for release in Fall 2021
  - Day-ahead unit commitment and scheduling across larger footprint improves market efficiency and better integrates renewables
- Key principles:
  - Voluntary participation, easy entry, no exit fees
  - Each balancing authority retains reliability responsibilities
  - States maintain control over integrated resource planning
    - Resource adequacy procurement decisions remain with local regulatory authority
    - Transmission planning and investment decisions remain with each balancing authority and local regulatory authority

Resources

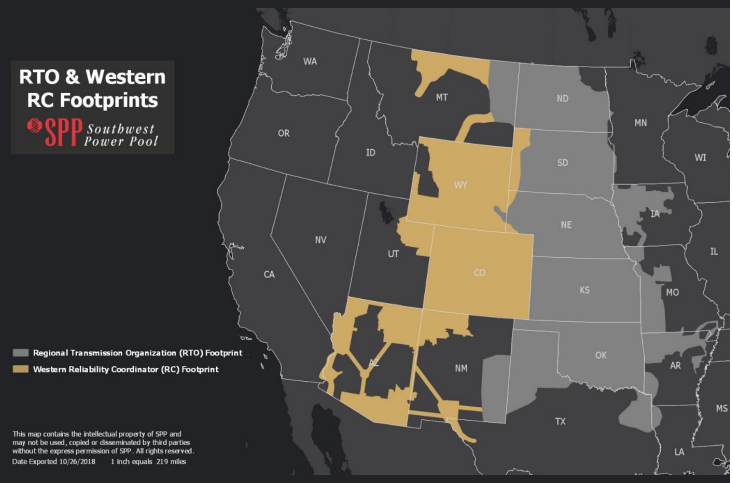
- EIM Computer-based training at: https://www.westerneim.com/Pages/Resources.aspx
- EIM Quarterly benefits reports at: https://www.westerneim.com/Pages/About/QuarterlyBenefits.aspx

WESTERN RELIABILITY COORDINATION SERVICES

SPP-provided RC services will go live in December 2019

Customers

- Arizona Electric Power Cooperative, Inc.
- Black Hills Energy's three electric utilities: Black Hills Power, Inc., Cheyenne Light, Fuel and Power Company, and Black Hills Colorado Electric, Inc.
- City of Farmington, NM
- Colorado Springs Utilities
- El Paso Electric Company
- Intermountain Rural Electric Association
- Platte River Power Authority
- Public Service Company of Colorado (Xcel Energy)
- Tri-State Generation and Transmission Association
- Tucson Electric Power
- Western Area Power Administration (WAPA) Desert Southwest Region, WAPA Rocky Mountain Region, and WAPA Upper Great Plains – West



SPP Southwest Power Pool WESTERN ENERGY SERVICES

1

WESTERN ENERGY SERVICES

- **Western Energy Services is a family of contract-based products offered to new customers in the Western Interconnection**
  - Western Energy Imbalance Service Market (WEIS)
  - Western Reliability Coordination Services
  - Planning coordination
  - Unscheduled Flow Mitigation

WEIS OVERVIEW

- **Contract-based energy imbalance service market that will:**
  - Balance generation and load regionally and in real time
  - Centrally dispatch energy from participating resources every five minutes
  - Respect existing resource-adequacy and transmission service constructs
  - Enhance reliability and affordability of electricity delivery
  - Provide price transparency of wholesale energy
  - Allow parties to trade bilaterally and hedge against transmission congestion
  - Take advantage of synergies by leveraging existing SPP systems and processes
- **Separate and distinct from SPP's role as a Regional Transmission Organization (RTO) and operating under separately filed WEIS Tariff**
- **Design leverages best practices from SPP's administration of an EIS market 2007-2014 and foundational constructs already in place in the west**

KEY WEIS MARKET FEATURES

PRODUCTS, PRICING AND DISPATCH	
Design Component	DESCRIPTION
Market Product	Energy imbalance (five-minute)
Supply Adequacy	Supply adequacy checked day-ahead and before each operating hour
Pricing Mechanism	Locational Marginal Prices (LMP)
Dispatch	SPP sends resources real-time security constrained dispatch signals calculated by its market clearing engine (MCE).
Unit Commitment	Each entity is responsible for commitment of generation to meet its real-time obligation.

KEY WEIS MARKET FEATURES

SETTLEMENTS	
Design Component	DESCRIPTION
Settlement Responsibilities	SPP provides centralized calculation, collection and distribution of market settlements.
Settlement Granularity	Five-minute
Settlement Timeline	Daily settlements statements

KEY WEIS MARKET FEATURES

TRANSMISSION	
Design Component	DESCRIPTION
Transmission Service	Regional JDTS used as non-firm, "as-available" service with lowest priority offered at zero cost.
PARTICIPATION	
Design Component	DESCRIPTION
Participation	Participation open to entities with load or generation in or pseudo-tied into a participating BA.

WEIS ADMINISTRATION

- **Operated under Western Joint Dispatch Agreement (WJDA) that defines the terms of the market administration**
  - Unaffiliated with SPP's role as an RTO and membership in SPP RTO not required for participation in WEIS
- **Implementation and ongoing costs to be paid by WEIS participants based on proportional share of Net Energy for Load (NEL)**
- **SPP expects initial four-year commitment from WEIS participants with no long-term commitments after its first four years**
- **WJDA guarantees participants a say in the market's ongoing evolution through representation on the Western Markets Executive Committee (WMEC)**
- **Market Monitoring provided by SPP's Market Monitoring Unit**

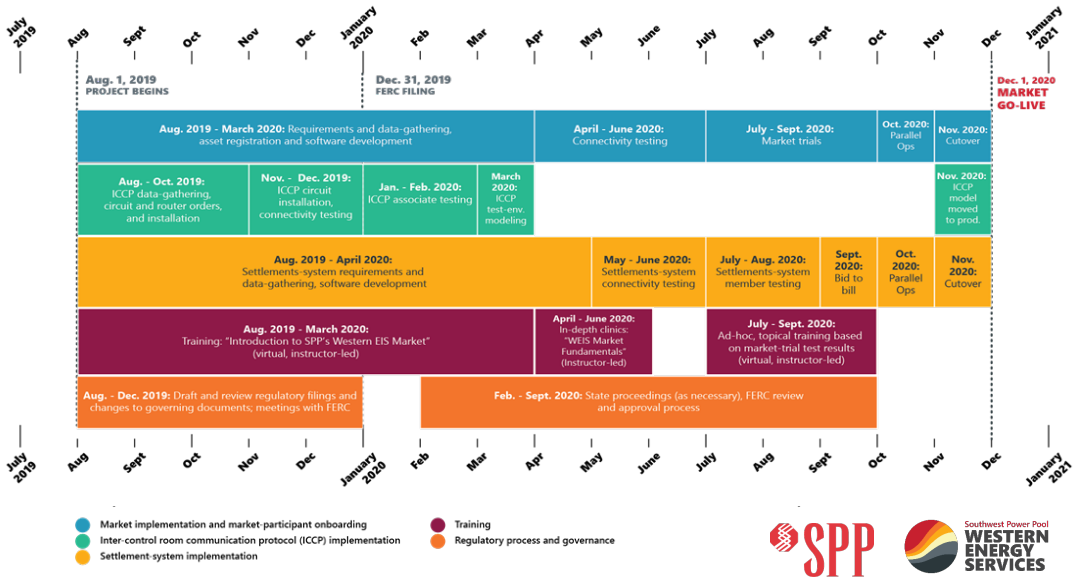
THE WESTERN MARKETS EXECUTIVE COMMITTEE

- **WMEC comprises representatives of each non-affiliated signatory to the WJDA**
- **Provides a forum in which SPP and WEIS participants can collaborate to finalize market rules**
- **After go-live, WMEC will have authority to:**
  - Approve/reject tariff amendments
  - Establish market protocols
  - Recommend proposed amendments to the WJDA
- **Ultimate WEIS oversight lies with SPP board with significant recognition given to WMEC**

WEIS IMPLEMENTATION

- **Initial commitments expected by July 26, 2019, followed by 16-month implementation leading to December 2020 launch**
- **Entertaining all customers interested in participating in the WEIS**
- **Post-launch, SPP will onboard additional market participants according to normal onboarding timelines (approx. every six months)**

IMPLEMENTATION TIMELINE



SPP

Southwest Power Pool WESTERN ENERGY SERVICES

PNM Participation in Western EIM

16th Annual Conference on Electric Power in the Southwest

TODD FRIDLEY – PNM VP NEW MEXICO OPERATIONS

July 15, 2019

ABOUT PNM

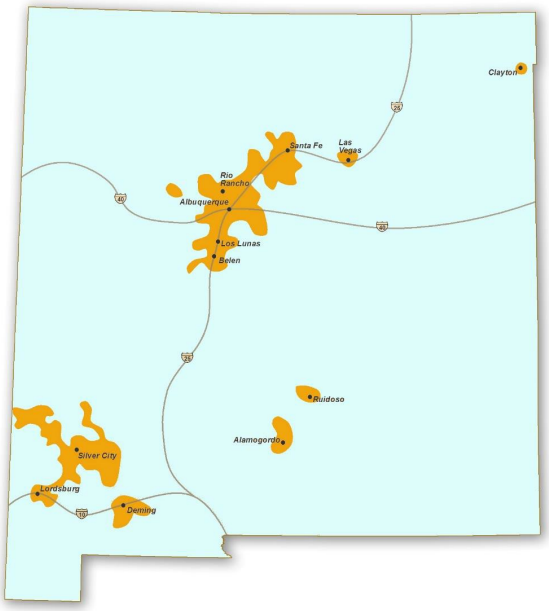
GENERATION

TRANSMISSION

DISTRIBUTION

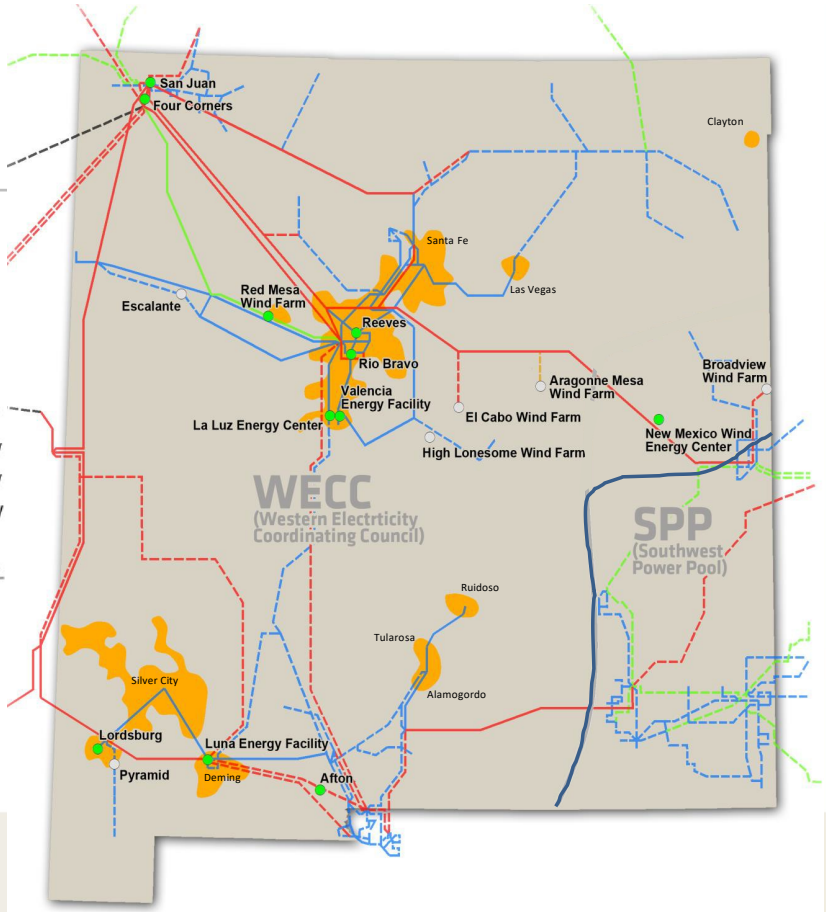
ABOUT PNM

- FOUNDED 1917
- $1.1B REVENUES[1]
- 1,327 EMPLOYEES[2]
- 528,400 CUSTOMERS[1]
- 2,661 MW GENERATION[3]
- 15,158 MILES OF TRANSMISSION AND DISTRIBUTION LINES[1]
- 255 SUBSTATIONS[1]



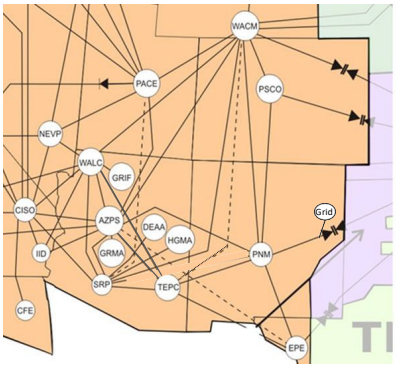
1. PNM Resources 10K for PNM fiscal Year Ended 12/31/18
2. Includes 389 PNM Corporate Employees
3. MW PNM generation , including PPA's

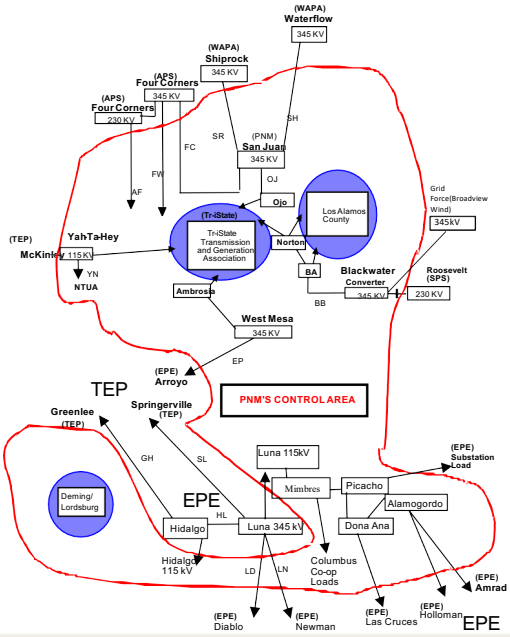
SYSTEM OVERVIEW



PNM INTERCONNECTIONS

(for General Discussion Purposes-Some Approximations and Omissions of Ties May Exist)

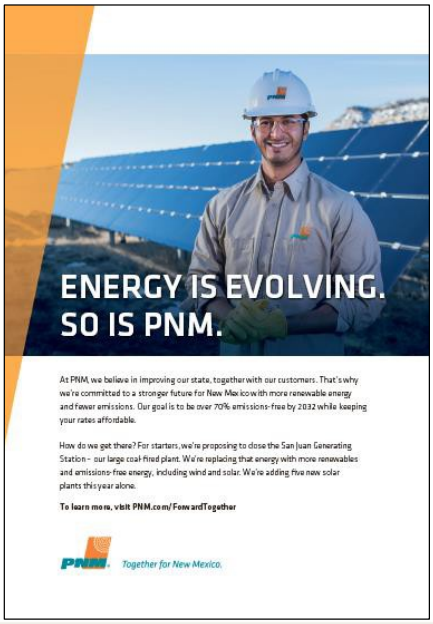




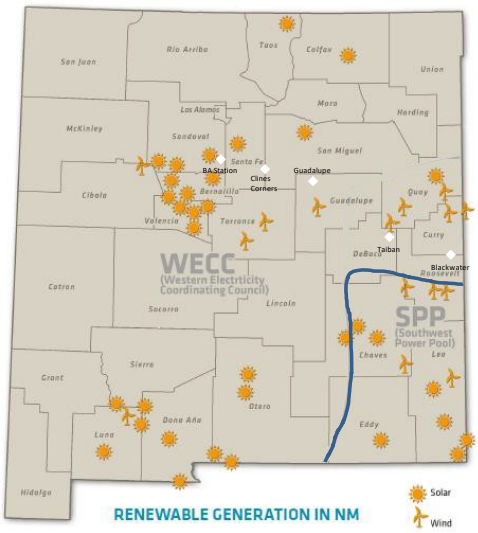
BA Interconnections
Arizona Public Service (APS)
Western Area Power-Loveland, CO (WACM)
Tucson Electric Power (TEP)
El Paso Electric (EPE)
Public Service Co of Colorado (PSCO)
Southwest Public Service (SPS)
GridForce (Grid)

MAJOR INITIATIVES

- Energy Transition Act
  - •100% Carbon Free by 2045 (PNM committed to 2040)
  - •80% Renewables by 2040
  - •50% Renewables by 2030
  - •40% Renewables by 2025
  - •Securitization financing for Closure of San Juan Generating Station
  - •$20M San Juan County economic development
  - •$20M severance payments and retraining

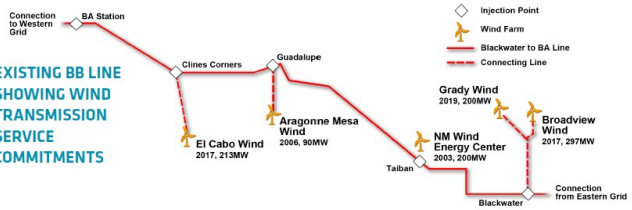


RENEWABLES IN NEW MEXICO

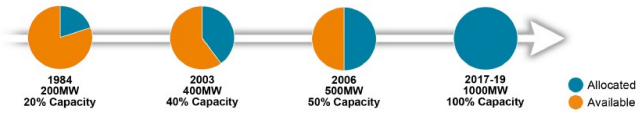


RENEWABLE GENERATION IN NM

EXISTING BB LINE SHOWING WIND TRANSMISSION SERVICE COMMITMENTS

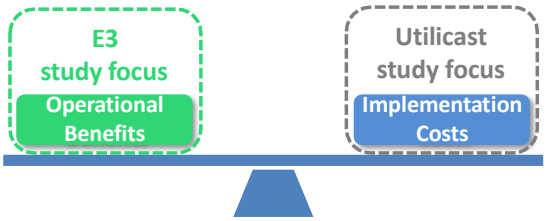


The timeline below illustrates transmission commitments on the existing BB Line and how it has become completely allotted over time.

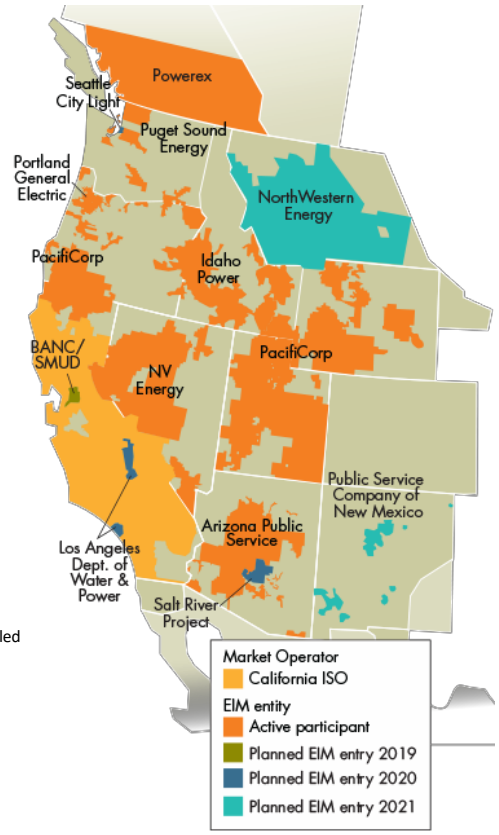


MAJOR INITIATIVES

PNM ENERGY IMBALANCE MARKET STUDIES

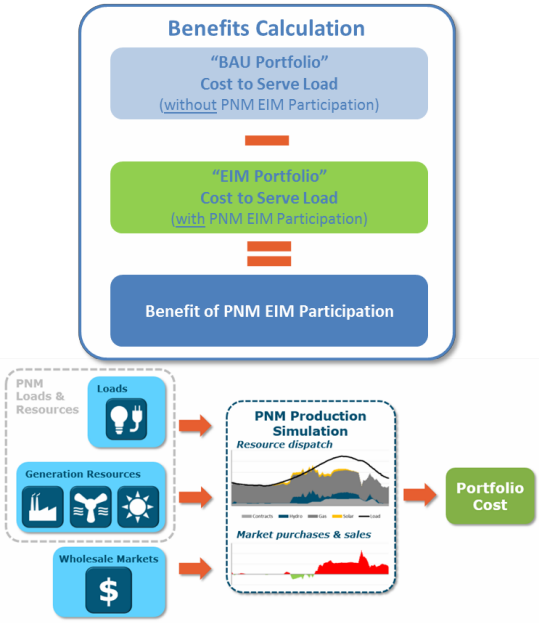


- BANC/SMUD is scheduled for activation in April of 2019
- Seattle City Light, LA Dept. Water and Power, and Salt River Project are scheduled for activation in April of 2020
- PNM and North Western Energy are scheduled for activation in April 2021



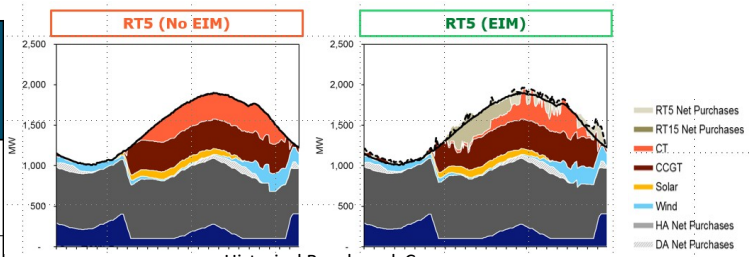
BENEFITS STUDY APPROACH

- E3 developed a model to estimate the cost to serve load within PNM's territory
  - Includes variable cost of all owned or contracted resources + net market purchases
  - Assumed that PNM is a price taker when participating in CAISO markets
- EIM Portfolio provides incremental market access in the real-time in addition to PNM's existing portfolio of resources and trading
  - Benefit of PNM's EIM participation is the reduction in production cost relative to the benchmarked portfolio

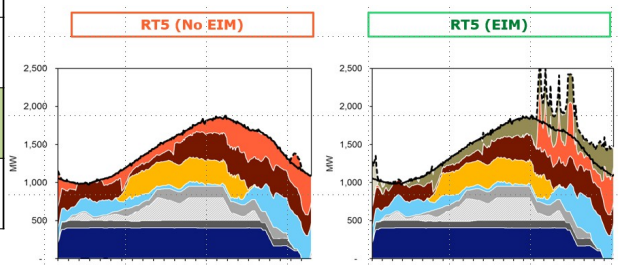


EIM BENEFITS IN THE RANGE OF $17 TO $21 MILLION/YEAR

Scenario(s)	Incremental Annual EIM Benefit ($MM)
Historical Benchmark (2016/2017)	$10.6*
Future Base Portfolio (2024)	$17.4
Future Base w Solar Curtailment	$18.5
Future Flexible Units Portfolio	$19.4
Future High Gas Forecast	$21.4



Historical Benchmark Case



Future High Gas Forecast

*EIM value comes from more volatile RT prices, providing more sales revenues and reducing purchasing costs.

PROJECT FORECASTED COST

Capital:

- System Integrator
- EIM Software
  - Merchant
    - Bids and Generation Schedules
  - Balancing Authority
    - Intertie base schedules,
    - 3rd party generator schedules
    - EMS Changes for Dispatch signals
  - Settlements
    - Meter data warehouse
  - Internal software interfaces
- Metering
  - Upgrades
  - Interval changes
- $20.9M total capital

O&M:

Implementation and one-time

- Change Management PM recommended
- Enterprise Training Development & execution
- Project Support from existing Staff
- O&M onetime relocation expenses

On-Going

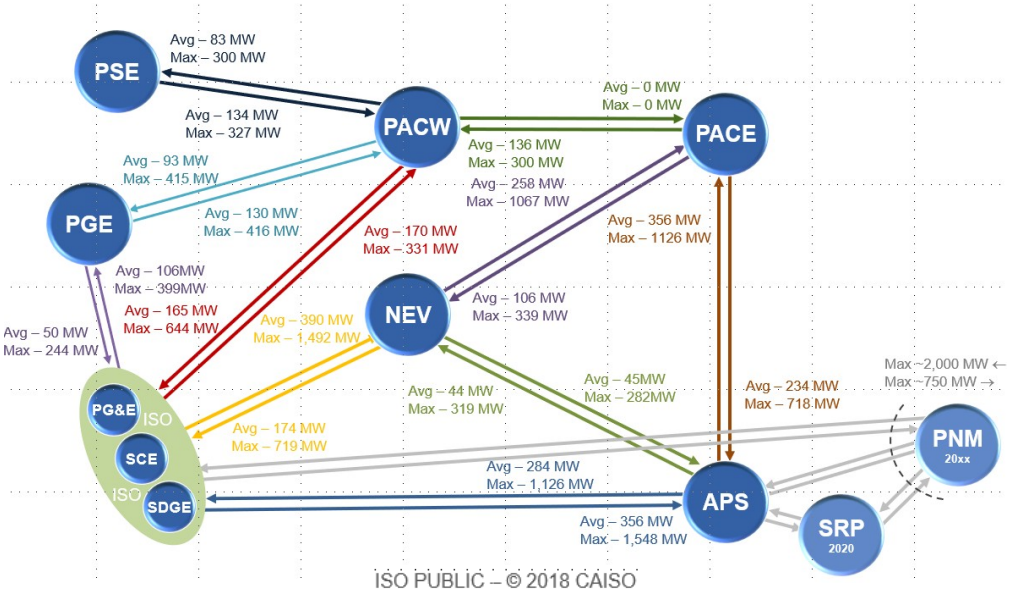
- Onboarding BTS/Operators/WPM Staff (19)
- Software maintenance

Capital: $20.9M

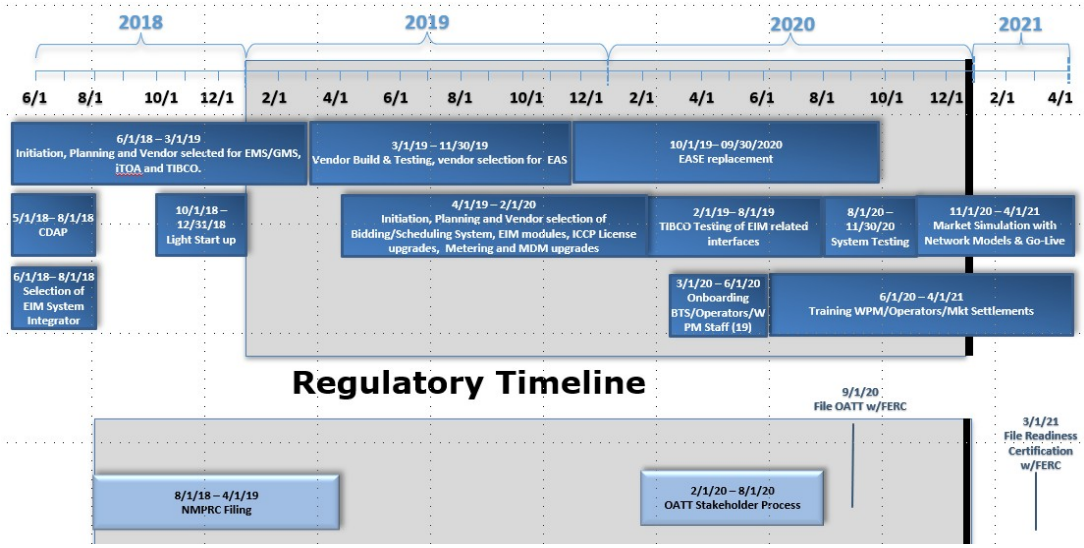
O&M: $7.4M (one time) w/$2.9-3.9M/yr (on-going)

Note: Projected costs between 2021 and 2025 as stated in PNM NMPRC filing

TRANSFER CAPABILITY WOULD BE ENHANCED WITH PNM



TIMELINE FOR IMPLEMENTATION



PNM Talk to us. PNM.com

LAW SEMINARS INTERNATIONAL

Electric Power in the Southwest

Santa Fe, New Mexico
July 15, 2019

Practicalities for New Transmission Development In the Southwest

Some Thoughts on Building Transmission In the Coming Age of Renewables, Electrification, and DERs

Al Statman, President & CEO
Al Statman LLC
Santa Fe, New Mexico

1

Overview

1. Status update on Southwest Transmission Projects
2. RPS Standards in the Southwest
3. Integrating Renewables and Protecting the Grid
4. Cyber, EMP and GMD an Increasing Threat
5. Weather Impacts Increasing and Causing Damage to the Grid
6. Changing the Resource Balance: Electrification/Distributed Energy Resources
7. Technology Improvements: Can the promise be realized?

2

1. Status Update on Southwest Transmission Projects

Delaney Colorado River Transmission Ten West Link (CO, CA)

a. Delaney Colorado River Transmission LLC (Starwood Energy/Iberdrola)
b. Western AZ and Eastern CA, 500-kV transmission line, increases transmission capacity by 3200 MW
c. $280 million projected cost
d. To facilitate California utilities compliance with RPS

Far West Texas Project (TX-ERCOT)

a. AEP/Oncor
b. $336-501 million projected cost, two 345-kV transmission lines
c. Solar development and increased oil and gas exploration in Permian Basin

3

1. Status Update on Southwest Transmission Projects

Harry Allen to Eldorado Transmission Project (NV)

a. DesertLink, LLC (LS Power)
b. Clark County, NV connects to CAISO, 500-kV transmission line
c. $145-159 million projected cost
d. Integration of Nevada's renewable energy resources

TransWest Express Transmission Project (WY to LV, NV through Utah)

a. TransWest Express, LLC
b. 730 mi. 500-kV, consisting of two systems, AC and DC lines, $3 billion projected cost
c. From 1,500 MW to 3,000 MW of transmission capacity
d. Wind and other renewables

4

1. Status Update on Southwest Transmission Projects

Southline Transmission Project (AZ & NM)

a. Southline Transmission, L.L.C.
b. 240 miles of 345-kV double circuit transmission lines
c. 1,000 MW capacity
d. Access to renewable energy resources

SunZia Southwest Transmission Project (AZ & NM)

a. Southwestern Power Group (MMR)
b. 520 mi. of two single-circuit 500-kV transmission lines, $2 billion projected cost
c. Wind

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1. Status Update on Southwest Transmission Projects

Western Spirit (NM)

a. NMRETA to sell to PNM at close, developed with Pattern Energy (who acquired it from Clean Line Energy Partners)
b. 165 miles, 345-kV line, $285 million sale price
c. 800 MW of wind finished 2020-21 in stages to be shipped to California
d. Costs directly assigned to Pattern as wind producer

Lucky Corridor Transmission Project (NM)

a. Lucky Corridor, LLC
b. Northern NM
c. $131.1 million projected cost
d. 345-kV transmission line, 62 miles, 850 MWs
e. Wind/solar energy

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1. Status Update on Southwest Transmission Projects

TUCO-Yoakum-Hobbs Transmission Line (TX, NM)

a. Xcel Energy

b. $242 million projected cost, 168 miles, 345-kV transmission line

c. Wind

PNM BB2 Project (NM)

a. 345-kV line, 45 miles from Eastern NM to PNM, projected cost $85 million, 362 MW of additional wind energy

b. To serve Facebook data center in Albuquerque and Avangrid Renewables

c. CCN granted but the PRC directly assigned $39 million to Facebook (subject to potential review in future rate case)

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2. State RPS	Year	RPS Goal	Detail
Arizona	2025	15%	Renewables
	2030	30%	Includes new technology
California	2024	44%	Renewables
	2027	52%	Renewables
	2030	60%	Renewables
	2045	100%	Carbon-free
New Mexico	2020	20%	Renewables for IOUs
	2030	50%	Renewables
	2040	80%	Renewables
	2045	100%	Carbon-free
Nevada	2025	25%	Renewables
	2030	50%	Renewables
Texas	2025	10,000 MWs	Achieved

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3. Integrating Renewables & Protecting the Grid

Plant Retirements and the Shift to Renewables

a. Retirement of base load power units and the shift to variable resources potentially impacts grid reliability. (NERC 2018, 2019 Reports)

b. Large base load coal generation plants have retired or will retire in the next few years.

c. These retired fossil fuel base load units have and will be replaced in part by renewables, but natural gas will still be prevalent in the near term.

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3. Integrating Renewables & Protecting the Grid

And it Impacts the Grid

d. However, with one notable exception, Libertad Power Project, LLC in Northwest New Mexico, new natural gas generation is not being proposed in the WECC. This shift away from base load fossil fuel plants has a potential future impact on grid reliability as noted previously.

e. Developers tend to locate renewable energy resources in remote areas to meet these RPS goals. Load Centers are generally in urban areas, so transmission is even more critical.

f. MWs do not have equal effect across the bulk power transmission system.

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3. Integrating Renewables & Protecting the Grid

Increased Risk?

g. Synchronous inertia is declining due to variable resources, i.e., renewables, which increases frequency deviation. There have been reported reliability incidents in Ontario, ERCOT and WECC related to frequency response.

h. The frequency response issue has been studied in the Eastern Interconnect by EIPC, but only though 2022. No such study has been made in the WECC. That study is inconclusive as most renewables will added post 2022.

i. These potential problems may be cured in large part by transmission upgrades but much work is needed to be done to eliminate the risk.

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4. Cyber, EMP and GMD an increasing threat

The Cyber Threat

a. No loss of load in North America due to cyber in 2018, but the risk is increasing according to NERC in its June 2019 report reviewing 2018 data.

b. Cyber presents a number of unique security issues. The magnitude and extent of the threat is unknown, the number of cyber systems and the amount of equipment is vast, the details are highly sensitive, and if exposed could lead to other vulnerabilities.

c. Attacks on the grid both here and overseas are continual by foreign actors, notably Russia, China, Iran and North Korea. These attacks involve both software (ICS) and hardware. Vendors have been successfully attacked by bad actors to gain access to utility systems.

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4. Cyber, EMP and GMD an increasing threat

The Cyber Threat

d. There are numerous instances of cyber incursions that are financially motivated to steal information or to attempt to blackmail companies and individuals and these are usually IT in nature.

e. Experts have noted a lack of uniformity on a regional basis in cyber protection procedures. FERC has increased reporting requirements both in 2018 and 2019.

f. Duke, DTE, PG&E and City Utilities of Springfield Mo have been identified as violating cyber rules and being subject to sanctions by FERC.

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4. Cyber, EMP and GMD an increasing threat

The EMP Threat

a. An EMP incident could be catastrophic as up to 90 percent of the population could be adversely affected according to a Congressional study.

b. The Executive Order on EMP issued in March 2019 and EPRI's recent studies show the government considers the threat serious.

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4. Cyber, EMP and GMD an increasing threat

The EMP Threat

c. The Executive Order on EMP was issued to facilitate collaboration and research across federal agencies and to encourage companies to harden systems against potential EMP events. Incentives could include rate recovery, financing, reduced insurance rates and other costs.

d. EPRI is studying the potential impacts of an EMP event and ways to mitigate those impacts. The focus is on ways to retrofit substations against two of three types of pulses. The third pulse has already been mitigated because it is similar to lightning which has occurred in prior GMD events.

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4. Cyber, EMP and GMD an increasing threat

The EMP Threat

e. Additional hardening of the grid system would help with all of these scenarios, but it is not the exclusive fix. In its 2018 and 2019 reports NERC has recommended an "enhanced security posture (regarding cyber and physical threats) through technological hardening."

f. DHS Report, October 9, 2018, addresses the risk of EMP (and GMD) incidents and makes a series of recommendations to deal with these threats including infrastructure enhancement.

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4. Cyber, EMP and GMD an increasing threat

The GMD Threat

a. Geomagnetic Disturbances (GMD) are the result of space weather characterized by solar flares or sunspots. Space weather includes solar wind and coronal mass ejections (CME), the latter which emits radiation particles. These phenomena interact with the upper atmosphere. During a geomagnetic storm this disturbs Earth's magnetic field.

b. While there have been detrimental impacts to the grid internationally from GMD, only the March and September 1989 storms caused damage in the US. Four transformers at one power plant were affected in that incident with no loss of service. In contrast, the March storm caused a nine hour outage on the Hydro-Quebec transmission system.

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4. Cyber, EMP and GMD an increasing threat

The GMD Threat

c. Studies are inconclusive as to the risk but it is recognized technological improvements are needed (GAO Report Dec 2018). FERC issued a Reliability Standard in 2016 on GMD. NERC continues to study the issue.

d. The 1859 Carrington Event. This was a powerful solar flare which caused a CME to hit the magnetosphere with the energy of 10 billion atomic bombs which induced the largest geomagnetic storm in recorded history. The telegraph system went down and equipment caught fire and telegraph operators received electric shocks. There were stunning visual effects in the sky throughout the world. What would happened if such an incident happened today in our technologically advanced society and what would be the Impact on the electric grid?

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5. Weather Impacts are Increasing and Causing Damage to the Grid

The Weather Threat

a. Most major outages are weather related. Most affect distribution (90%), but transmission impacts are more damaging. Responsible for most category 1 and 2 events, and all (2) category 3 events on grid in 2018 according to NERC.

b. Risks appear to be increasing from more frequent and intense storms and the migration of population to higher risk areas.

c. Catastrophic fires have increased in intensity in the West, due in part to the drought, leading to the PG&E filing for bankruptcy protection and causing substantial economic loss throughout the region. PG&E has cut off service in selected counties to minimize wildfire risk with CPUC approval.

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5. Weather Impacts are Increasing and Causing Damage to the Grid

The Weather Threat

d. Hurricane Irma example: FPL spent $1.5 billion on hardening after Hurricane Wilma in 2005 and improved resiliency dramatically, reducing the outage to victims of Hurricane Irma in 2017 from 18 to 10 days.

e. "Money well spent" according to NERC, there is a lesson here for other regions.

f. Further legislation in Florida for grid hardening to protect against major storms was signed in May which requires utilities to submit 10 years plans to FPSC.

g. Utilities such as Con Ed, PSE&G, Duke, Entergy and others have made substantial "hardening" investments.

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6. Changing the Resource Balance: Electrification / Distributed Energy Resources

Potential for Future Increased Load and the Impact on the Grid

a. Studies expect increased transmission utilization due to electrification of transportation and heating of household items such as heat pumps, electric water heaters, electric ranges, and land based transport.

b. NREL estimates the full adoption of electric vehicles may result in a 58% increase in peak residential usage.

c. EPRI predicts a total increase of between 25 to 52% of electric load by 2050 in its "U.S. National Electrification Assessment."

d. A recent AGA/ICF study estimates $100 million of additional transmission investment as a result of a 60% conversion of residual gas furnaces to air source heat pumps by 2035.

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6. Changing the Resource Balance: Electrification/Distributed Energy Resources

Potential for Future Increased Load and the Impact on the Grid

e. Wires Report estimates the need for transmission investment to rise from $15 billion a year to $40 billion from 2031-2050 to meet the electrification challenge.

f. Deployment of distributed storage, batteries and improved technology will not eliminate the need for enhanced transmission. The amount generated by DERs will be insufficient for all power uses. Transmission will be critical to allow DERs access to regional markets. No direct study on the effect of DERs on the grid has been conducted.

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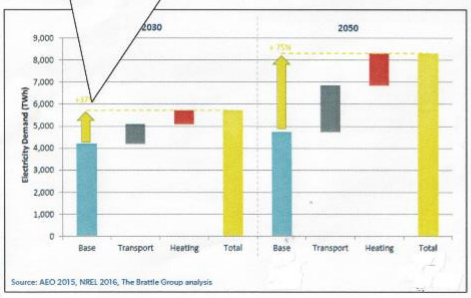
6. Changing the Resource Balance: Electrification/Distributed Energy Resources

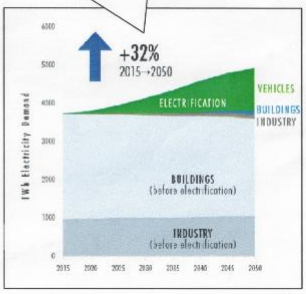
Multiple Studies Point to Increased Electricity Usage Due to EVs and Electric Heating

Brattle: 37% increase nationally by 2030



Note the projected 75% increase in demand

EPRI: 32% increase nationally by 2050



EPRI, U.S. National Electrification Assessment, 2018

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7. Technology Improvements

Can the Promise be Realized?

a. Deployment of improved transmission technology has been slow developing in the United States.

b. Utilities are reluctant to use advanced technology as appropriate incentives do not exist to take risks on deploying such technology.

c. Most commentators see the energy industry of the future as dependent on advanced technology as it affects renewables, DERs, electrification and other elements.

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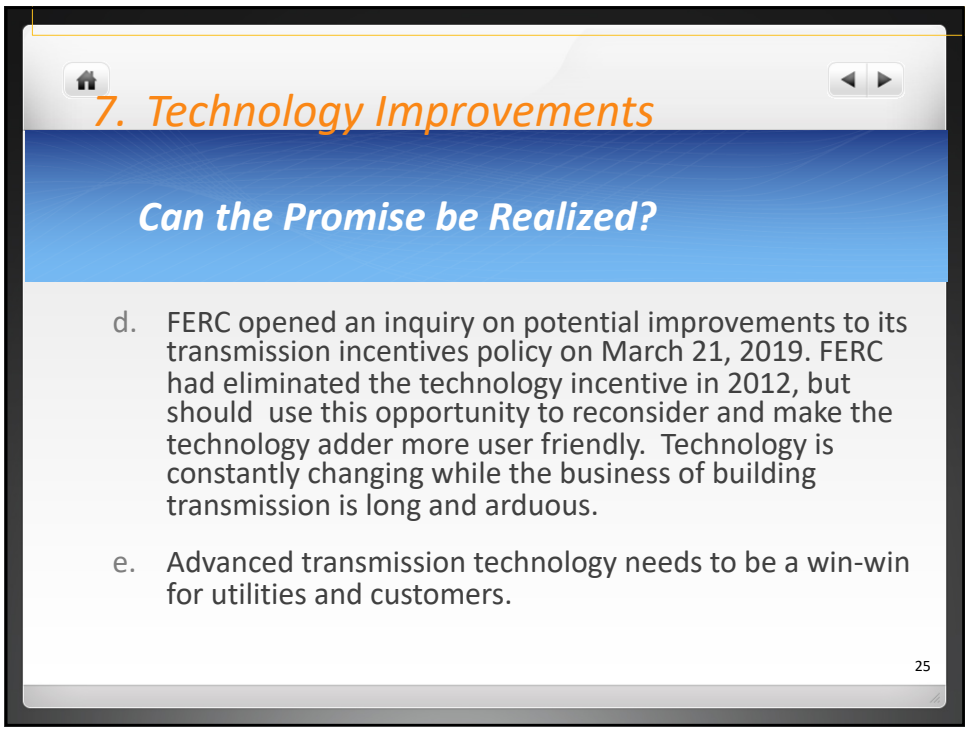
7. Technology Improvements
Can the Promise be Realized?
d. FERC opened an inquiry on potential improvements to its transmission incentives policy on March 21, 2019. FERC had eliminated the technology incentive in 2012, but should use this opportunity to reconsider and make the technology adder more user friendly. Technology is constantly changing while the business of building transmission is long and arduous.
e. Advanced transmission technology needs to be a win-win for utilities and customers.
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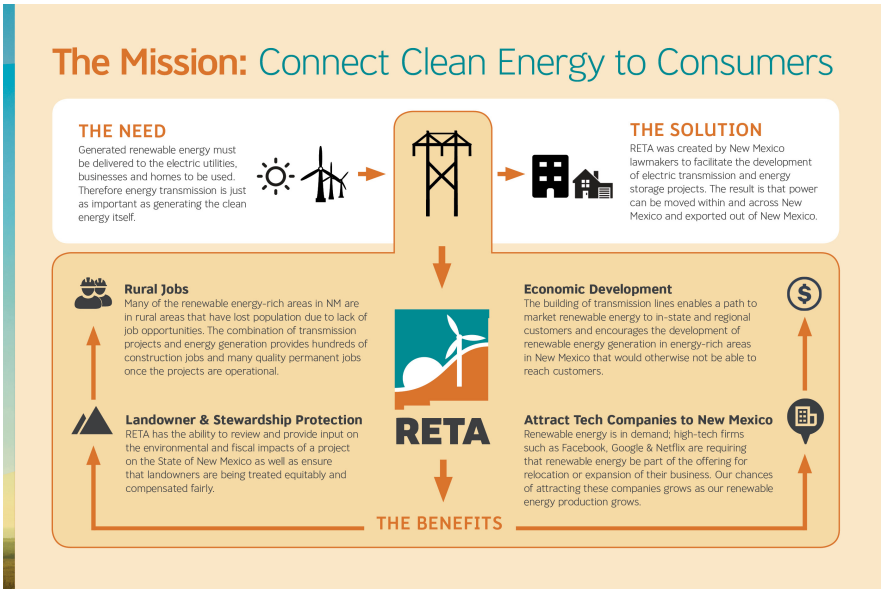
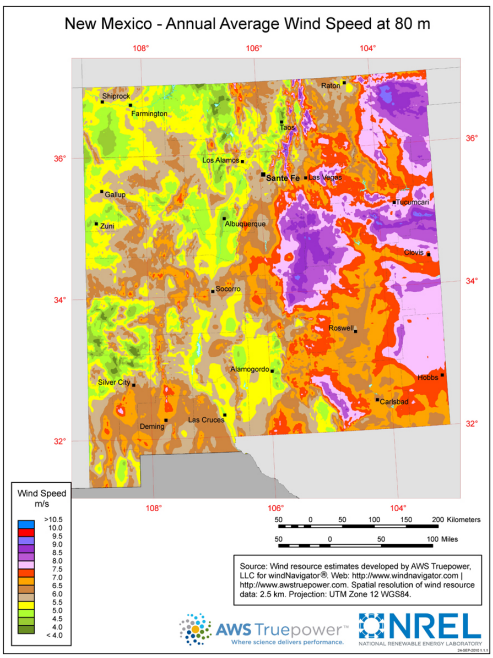
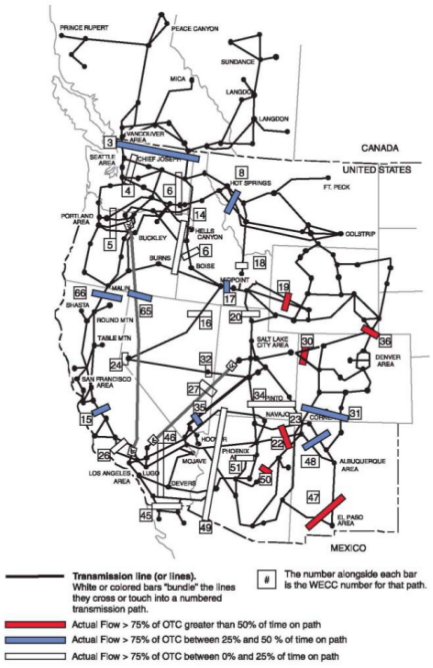
Practicalities for Transmission Development in the Southwest

Robert E. Busch
Chairman of the Board
The Renewable Energy Transmission Authority
Santa Fe, New Mexico
July 15, 2019

Electric Power in the Southwest
Law Seminars International


The Mission: Connect Clean Energy to Consumers
THE NEED
Generated renewable energy must be delivered to the electric utilities, businesses and homes to be used. Therefore energy transmission is just as important as generating the clean energy itself.
THE SOLUTION
RETA was created by New Mexico lawmakers to facilitate the development of electric transmission and energy storage projects. The result is that power can be moved within and across New Mexico and exported out of New Mexico.
Rural Jobs
Many of the renewable energy-rich areas in NM are in rural areas that have lost population due to lack of job opportunities. The combination of transmission projects and energy generation provides hundreds of construction jobs and many quality permanent jobs once the projects are operational.
Economic Development
The building of transmission lines enables a path to market renewable energy to in-state and regional customers and encourages the development of renewable energy generation in energy-rich areas in New Mexico that would otherwise not be able to reach customers.
RETA
Landowner & Stewardship Protection
RETA has the ability to review and provide input on the environmental and fiscal impacts of a project on the State of New Mexico as well as ensure that landowners are being treated equitably and compensated fairly.
Attract Tech Companies to New Mexico
Renewable energy is in demand; high-tech firms such as Facebook, Google & Netflix are requiring that renewable energy be part of the offering for relocation or expansion of their business. Our chances of attracting these companies grows as our renewable energy production grows.
THE BENEFITS


New Mexico - Annual Average Wind Speed at 80 m
108°
106°
104°
36°
34°
32°
Shiprock
Farmington
Raton
Taos
Los Alamos
Santa Fe
Las Vegas
Gallup
Zuni
Albuquerque
Tucumcari
Clovis
Socorro
Roswell
Alamogordo
Hobbs
Silver City
Carlsbad
Deming
Las Cruces
Wind Speed m/s
>10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
< 4.0
50 0 50 100 150 200 Kilometers
50 0 50 100 Miles
Source: Wind resource estimates developed by AWS Truepower, LLC for windNavigator®. Web: http://www.windnavigator.com | http://www.awstruepower.com. Spatial resolution of wind resource data: 2.5 km. Projection: UTM Zone 12 WGS84.
AWS Truepower
Where science delivers performance.
NREL
NATIONAL RENEWABLE ENERGY LABORATORY


CANADA
UNITED STATES
MEXICO
Transmission line (or lines). White or colored bars "bundle" the lines they cross or touch into a numbered transmission path.
The number alongside each bar is the WECC number for that path.
Actual Flow > 75% of OTC greater than 50% of time on path
Actual Flow > 75% of OTC between 25% and 50 % of time on path
Actual Flow > 75% of OTC between 0% and 25% of time on path


Our Goal: Creating a Highway for Clean Energy
SUNZIA
Transmission Line, 500 kV
HIGH LONESOME MESA
Transmission Line, 115 kV
Wind Farm, 100 MW
WESTERN SPIRIT
Transmission Line, 345 kV
Corona Wind Center
Various wind turbine projects in development
Just as a car takes you to work, the gym, a shopping mall and your house, transmission lines do the same for renewable energy. Transmission lines are the highways needed to transport and deliver solar and wind generated energy to the same everyday places that you visit. They enable renewable energy that is generated in New Mexico to be used around the state and around the country.

CURRENTLY OPERATIONAL

HIGH LONESOME MESA

Project Scope: Transmission upgrade and 100 MW wind farm. 32 miles, 115 kV

Capacity: 100 MW, enough to power 30,000 homes

Investment: RETA issued $50 million in revenue bonds for transmission upgrades

Economic Benefit: $14 million in property taxes to Torrance County & Estancia Schools over 30 years. $19 million in lease payments to local landowners

Operational Date: 2010

PROPOSED

SUNZIA

Project scope: Transmission Line: 520 miles (315 miles in New Mexico), 500 kV

Capacity: 1,500 MW enough to power 885,000 homes

Investment: RETA is a partner through a memorandum of understanding (MOU) with SunZia

Financial Benefit: $33.4 million property taxes during a 2 ½ year construction period and $4.7 million during the first year of operation of the transmission line

Anticipated Operational Date: 2020/2021

PROPOSED

WESTERN SPIRIT

Project scope: Transmission Line: 140 miles, 345 kV

Capacity: 1,000 MW, enough to power 590,000 homes

Investment: RETA and Pattern Energy are co-developers of the $150 million project

Financial Benefit: $28 million property taxes to NM counties over first 40 years

Anticipated Operational Date: End of 2020

Now for the Practicalities

Physically Building an AC-HV Transmission Line is Usually not Difficult

- A large number of transmissions lines at 500,000 volts or below have been constructed in the US
- The physical equipment needed is widely available
- Engineer/Construction firms have significant experience in building lines
- While HVDC is much less common, this no longer presents serious technical problems
- Even river crossings can be engineered fairly easily, if aerial lines can be utilized
- Line loses are frequently overstated, and generally not a problem
- Past EMF concerns have been debunked dozens of times with highly reputable epidemiology
- While FERC regulated returns are modest, finding financing is not a major hurdle if schedules are credible

So why is so hard to build transmission in the US?

Practicalities of HV Transmission

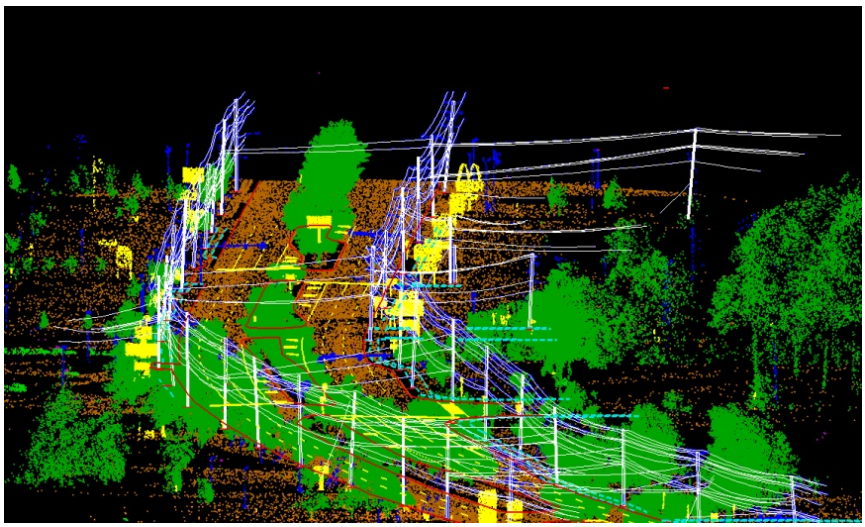
- The three primary issues associated with the construction of transmission are:

Siting, siting, and siting

- Developing the route for a transmission line can be a NIMBY challenge of the first order
- The elaborate permitting required can take years and millions of dollars to prepare with little assurance of success
- Populist politics and 24/7 media can polarize communities that might otherwise be supportive
- Time is the enemy, investors cannot deal with years of planning and litigation, and even worse, changing administrations and politics

The popular view

Todays reality



Eminent Domain-a Painful Choice

- High Capacity transmission lines often cover several hundred miles
- Even in the western desert, hundreds of private properties become involved in the process of obtaining right-of-ways
- Ownership can be virtually impossible to determine
- These are the simple cases
- Developers have a modest amount of flexibility with respect to routing but eventually economics can make major route changes impossible
- If all else fails, however, a condemnation proceeding is a last resort
- Fair treatment of land owners is built into the process. They have access to multiple assessments and an impartial hearing
- Historically, however, both public and private entities with eminent domain have prevailed
- Ultimately, few landowners choose to reject equitable easement compensation

Are there solutions?

- Wind and to a lesser degree solar need scale for the most attractive economics
- Large scale renewable facilities typically require remote siting
- Without new transmission technologies that can replace aerial lines, the need for large long high lines remains
- Undergrounding, while becoming technically feasible is economically impossible
- Economic storage could increase micro-siting of generation but utility scale storage has a ways to go
- Micro-grid solutions could reduce the need for unattractive distribution, but back-up/standby generation feeds can be problematic
- Streamlined regulatory approvals would help immeasurably

The bottom line is that without the careful use of eminent domain the tremendous value represented by new renewable energy will be lost

RETA's 2019 renewable energy study

- Over the next year RETA will be conducting a comprehensive study of how to best utilize the renewable energy resources in New Mexico by 2030
  - ❖ This will represent a material update to a 2010 study done by Los Alamos National Labs
  - ❖ The project manager will be selected by a public RFP
  - ❖ A diverse expert Advisory Panel will guide the work
  - ❖ The study will attempt to address the use of various forms of transmission, micro-grids, and storage
  - ❖ The study will evaluate the regional demand for renewable energy and the potential delivery options
  - ❖ The study will attempt to identify how regulatory requirements could be streamlined without materially reducing public oversight

The study will be designed to be ***actionable, credible, and readable***


Empowering New Mexico
to Power The West.
LEADING THE RENEWABLE ENERGY MOVEMENT FOR YEARS TO COME
nmreta.com
Primary Contact: Gloria Castillo
E-Mail: gloria@nmreta.net
Phone: 505-699-0599
RETA
New Mexico
Renewable Energy
Transmission Authority

Power for the Plains

Southwestern Public Service Transmission Expansion

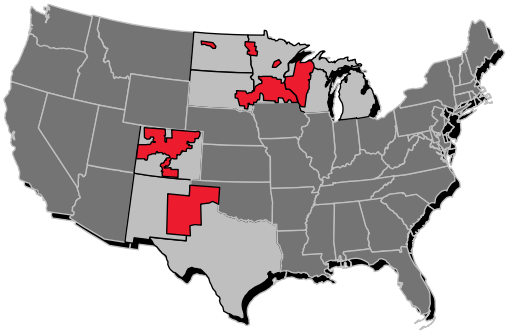
July 15, 2019

Agenda

1. Xcel Energy Overview
2. SPS and Power for the Plains
3. SPP Cost Allocation

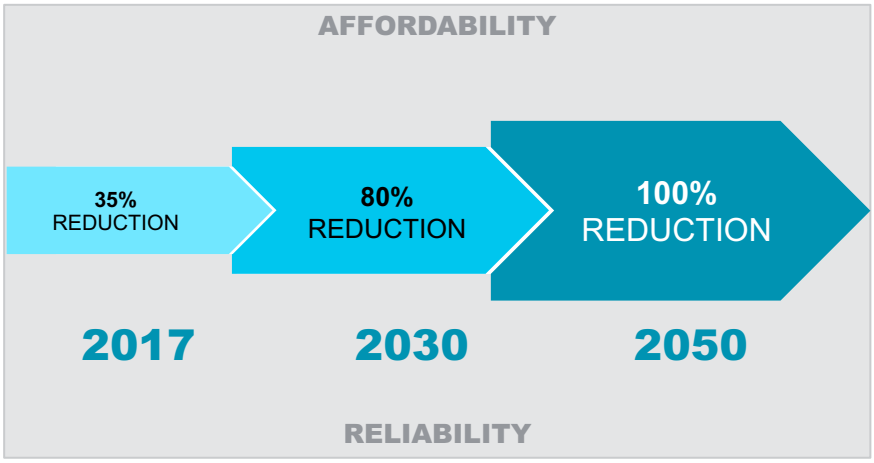
Company Profile – Xcel Energy

Xcel Energy is an electric and natural gas company, with annual revenues of $11.4 billion. Based in Minneapolis, Minn., we have regulated operations in eight Midwestern and Western states, and provide a comprehensive portfolio of energy-related products through four operating companies.



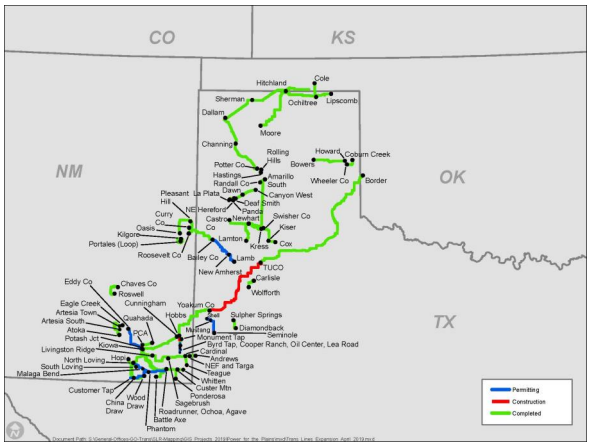
- **Employees**: 11,865
- **Natural gas operations**
- Customers: 2.0 million
- Transmission: 2,209 miles
- Distribution: 35,112 miles
- **Electricity operations**
- Customers: 3.6 million
- Transmission and Distribution: 219,841 miles

Industry-Leading Carbon Reductions



Power for the Plains

- $3 billion investment by SPS in Texas and New Mexico
- 1,300 miles of new transmission since 2011, another 200 miles through 2021
- Improving reliability, meeting demand, providing renewable energy outlets



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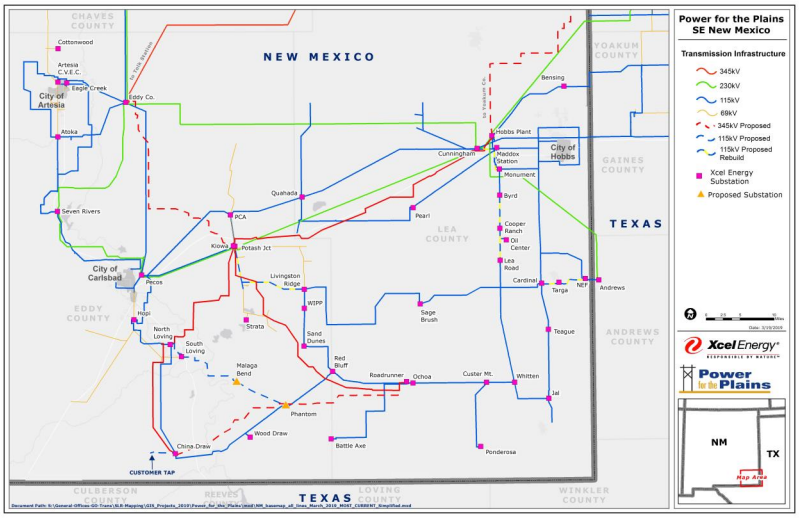
Southeast New Mexico



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TUCO-Yoakum-Hobbs

- 170-mile, 345-kV line
- $242 million investment
- About 150 employees and contractors
- Yoakum-Hobbs completed in 2018
- TUCO-Yoakum completion in 2020

7

Hale Wind Project

- Hale County, Texas
- 478 MW, enough to power about 184,000 homes
- 239 turbines
- COD June 28

8

We even have a You Tube Video

- https://www.youtube.com/watch?v=DoB72Pp3Odg&feature=youtu.be
- For more information about Power For the Plains
  - www.powerfortheplains.com

9

SPP Cost Allocation

- SPS is a member of the Southwest Power Pool (SPP)
- SPP performs the transmission planning function for SPS and all other SPP Transmission Owners on a single system basis
- Soon after becoming an RTO in 2004 SPP began a stakeholder process to determine whether new transmission facilities built in SPP should be regionally allocated among all members
- Fast forward to 2009 a Task Force achieved consensus around a "highway-byway" cost sharing methodology
  - This consensus was confirmed by the SPP Markets and Operations Committee, Regional State Committee and Board of Directors

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SPP Cost Allocation

- Goals
  - Integrate west to east portions of the SPP grid (renewable resources primarily in the west and loads in the east)
  - Provide support for the Aggregate Study process for Transmission Service – more on this later
  - Provide relief to the Generation Interconnection Queue
  - Relieve known congestion

11

Highway-Byway Cost Allocation

Voltage	Regional	Zonal
300 kV and above	100%	0%
100 kV – 299 kV	1/3	2/3
Below 100 kV	0%	100%

12

Exceptions

- Safe Harbor Limits for Firm Transmission Service
  - ✓ < 125% of Network Load
  - ✓ < 20% wind/peak load
  - ✓ Up to $180,000/MW of upgrades eligible
  - – Different rules apply when the upgrades are for a wind project that is located in a zone other than the customer's zone
- Generator Interconnection:
  - – All upgrades are fully funded by generator
  - – Some costs are reimbursable with Incremental transmission congestion rights or service credit payments by firm transmission service customers

13

SPP Statistics Since 2010

- $9.8 Billion of new transmission build (8,100 miles)
  - – $5.8 Billion of this was Highway/Byway funded
  - – $0.8 Billion was direct assigned to generators
  - – $3.0 Billion was sponsored by transmission owners, lower voltage not applicable to highway/byway and direct assigned to transmission service customers
- ~5,000 MW of wind in 2010
- ~21,500 MW of wind today

14


Xcel Energy®

Lewis Roca
ROTHGERBER CHRISTIE

Tribal Policy Developments

Prepared by

Pilar M. Thomas, Esq.
Of Counsel
Tribal Lands and Resources

LSI Electric Power in the Southwest
July 15, 2019

Agenda

- Overview of Tribal Energy Development Opportunities in the Southwest
- Market/Technologies Trends
- Legal/Regulatory Considerations
- Tribal Approaches
  - Navajo Energy Development Opportunities
  - Jicarilla Apache Project
  - Hopi Tribe Project

Introduction to Indian Country in the Southwest

- 102 in California
- 38 in OK, 22 in AZ, 21 in NM, 19 in NV
- Indian Tribes are sovereign entities, with inherent sovereign authorities over resources, land, people
- Indian Tribes, tribal members, and tribal entities are not subject to state law ON TRIBAL LANDS
- Indian Tribes have limited authority over non-Indians on tribal lands

Tribal Energy Sovereignty

- Tribal utilities: water, electricity, gas, telephone
- Tribal energy and climate change adaptation planning
- Tribal distributed energy projects
- Tribal hosted commercial scale projects

Key Opportunities for Tribes

- Partnerships with direct customers – entities with own renewable energy goals
- Distributed energy / energy efficiency projects for energy savings
- Micro grid projects for energy resiliency

DER/Microgrids – Why Do Them?

- Energy Sovereignty
  - Control of energy supply
  - Increased reliability
  - Control of electricity costs (lower)
- Economic Development
  - Jobs
  - Sustainable business development / competitive advantage
  - Stable energy costs
- Climate Adaptation
  - Diversity of energy supply
  - System adequacy and reliability (resiliency)
  - Reduced risk exposure to “centralized power” and transmission

Legal / Regulatory Considerations

- Federal jurisdiction – explicitly disclaimed over "retail" regulations and distribution grid
- Tribal Jurisdiction – control over own development, use
  - Self-determination development authorities – HEARTH Act, TERAs
  - Unresolved authorities – state vs. tribal regulation of state regulated utilities
  - *Montana* or *Merrion/Water Wheel*?

Tribal Approaches

- Energy Policy/Planning
  - Energy sources (i.e., renewable, local)
  - Tribal utility authority (virtual or operational)
  - Economic development link
    - Attract "sustainable businesses" to locate on reservation
  - Land Use
    - HEARTH, TERA
- Tribal Utility Codes, Regulations
  - Rates, tariffs
  - RPS
  - Net metering
- Public-Private Partnerships (3Ps)

Example of Tribal Approaches

- Navajo Nation
  - NTUA solar energy development
  - Private solar energy development
- Jicarilla Apache
  - Partnership with PNM and City of ABQ
- Pechanga Band of Luiseno Indians
  - Utility formation

Navajo Nation

- NTUA – Solar Development
  - 55 MW of solar
  - Self-developed, owned and operated
  - Third party EPCs
  - 500 MW MOU with SRP
- Navajo Power – solar development
  - Private owned company, Navajo member owned
  - Typical third party development on tribal lands
    - Lease land from Navajo Nation
    - Enter into PPA with utilities for power
- Key issues and considerations
  - Navajo Energy Policy Act of 2013
  - Access to transmission
  - Off-takers

Jicarilla Apache

- On-reservation solar project
- City of ABQ is off-taker
- PNM facilitates transmission and sale to ABQ
- Third-party developer also a partner

Pechanga Band of Luiseno Indians (CA)

- Utility Formation
- Negotiation with incumbent utility
  - Purchase distribution assets
  - Negotiate “exit” fee
- Government to government meetings with Calif Energy Commission and Calif Public Utility Commission
  - Received jurisdictional disclaimers
- Interactions with CAISO for power purchases, scheduling and capacity
- Bill crediting agreements with tribes to buy and use WAPA power

New Mexico's Energy Transition Act

Electric Power in the Southwest
Law Seminars International

July 15-16. 2019

What is the Energy Transition Act?

The ETA provides a path for NM utilities, coops and communities to transition from fossil generation to clean and renewable resources.

The ETA has four major components

1) Financing (securitization) to exit coal
2) Economic relief for impacted communities
3) Requirements for clean and renewable energy
4) Coal plant emission standard

FINANCING

Securitization:

- low interest AAA-rated bonds
- applied to undepreciated investment (“stranded costs”)
- reclamation + decommissioning
- severance and worker training
- economic relief

ECONOMIC RELIEF

- Worker training and severance
- Apprenticeship requirements for new projects (25% by 2026)
- Tribal outreach + funding
- New resource locational directives
- Economic development funds

- Paid for by “over-securitizing”

CLEAN + RENEWABLE ENERGY

- Applies to all IOUs and Coops
- 30% RE by 2025 ($60/MWh at busbar cap)
- 50% RE by 2030 ($60/MWh at busbar cap)
- 80% RE by 2040 (subject to affordability + reliability)

- 100% zero-CO_2 emission electricity by 2045 (2050 for Coops)

COAL PLANT EMISSION LIMIT

- Applies to 300MW+ coal plants after 2022
- 1100 lb CO_2/MWh limit for coal plants after 2022
- 2022 variance available for in-progress retrofits

ETA IMPLEMENTATION

- PNM filed application July 1, 2019
- Abandonment of SJGS
- Securitization ($361M); includes
  - Undepreciated investment ($283M)
  - Worker relief ($20M)
  - Economic development ($20M)
  - Decommissioning and reclamation ($30M)
- Replacement
  - 140 MW wind
  - 320MW solar (20MW at SJGS)
  - 130 MW storage
  - 280 MW fast-start gas

WHAT'S NEXT?

- PRC proceedings bifurcated:
  - 19-00018-UT (abandonment/financing – up to 9 months)
  - 19-00195-UT (replacement – up to 15 months)
- Litigation of ETA applicability
  - Likely to go to NM Supreme Court (again)
- Farmington/Enchant Energy CCS effort

QUESTIONS?

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Clean Energy Program – Deputy Director
505-690-8733
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THE FUTURE FOR COAL

ELECTRIC POWER IN THE SOUTHWEST

LAW SEMINARS INTERNATIONAL

SANTA FE, NEW MEXICO

JULY 15-16, 2019

THERE'S BEEN A LOT OF DISCUSSION RECENTLY ABOUT THE FUTURE OF COAL.

MANY ARE FOCUSED ON CARBON CAPTURE AND SEQUESTRATION AS A LIFE-LINE FOR AGING COAL PLANTS

BUT THERE ARE SOME OTHER PROMISING DEVELOPMENTS FOR THE COAL INDUSTRY.

FOR EXAMPLE, THERE IS AN EMERGING MARKET FOR COAL-BASED JEWELRY AND COSMETICS

AND OF COURSE – THERE'S COOKING AND FOOD PRODUCTS

WHICH IS GAINING QUITE A FOOTHOLD AMONG PIZZA MAKERS

BUT THIS OPPORTUNITY IS NOT JUST LIMITED TO PIZZA – YOU CAN GET COAL-FIRED CHICKEN WINGS, TOO

EMBER
COAL FIRED PIZZA & WINGS

WITH A COAL STOUT ...

OLDE KING COAL STOUT

BREAKER BREWING COMPANY

PLAINS PENNSYLVANIA

FOLLOWED BY A FINE WINE...

AND A GOOD CIGAR.

AND THEN THERE'S A NEW COAL-TAR BASED SHAMPOO – FOR THAT REALLY UNRULY HAIR

BUT, THERE ARE STILL SOME

CHALLENGES FOR COAL…

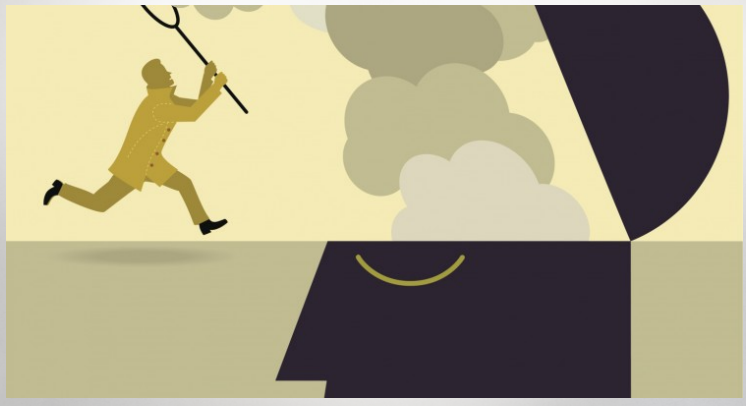
FOR EXAMPLE, COAL IS LOSING MARKET SHARE TO OTHER NEW PRODUCTS – LIKE SOLAR POWERED BIKINIS

SOLAR SWIMSUITS ARE GAINING POPULARITY WITH MEN, TOO... DESPITE THE TOUGH-GUY IMAGE OF THE TRADITIONAL COAL-FIRED SWIMSUIT

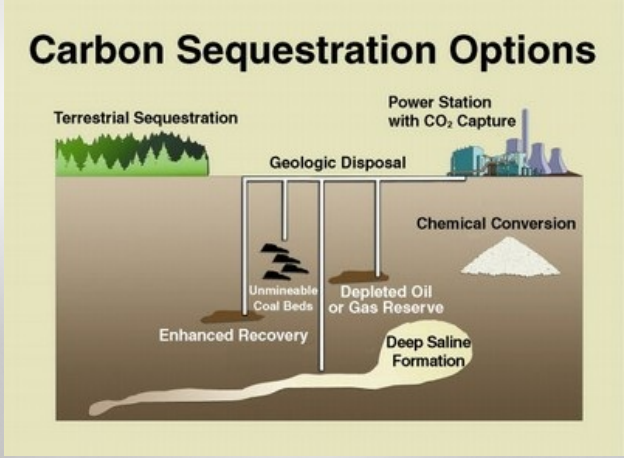
BUT COAL HASN'T GIVEN UP...
EVEN ON THE FASHION FRONT

AND THERE WILL ALWAYS BE
CHRISTMAS PRESENTS

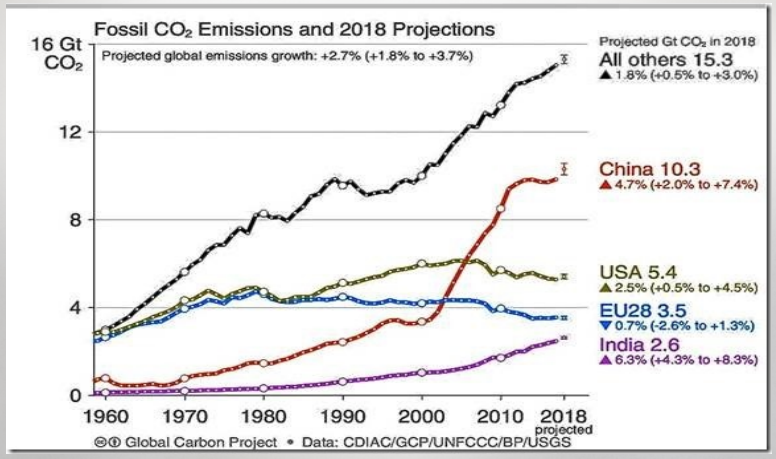
SO, LET'S TALK ABOUT CCS

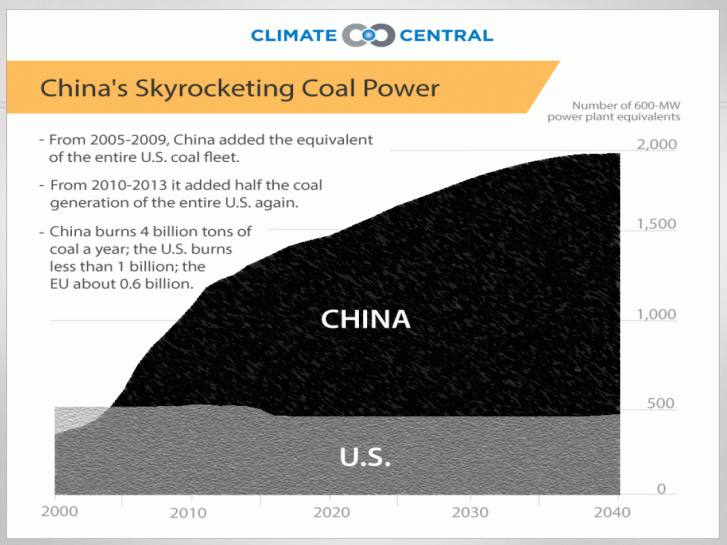


CAPTURE & SEQUESTRATION



WHY CCS?





DIFFICULT TRACK RECORD

- Southern Company – Kemper coal gasification; Miss.; lost $6.5B
- Duke Energy – Edwardsport coal gasification; $3.5B; $141/MWh
- Petra Nova CCS – TX; $1B 240 MW
- Navajo Generating Station – to close 12/19

ENERGY TRANSITION ACT

- Modified the air regulations in New Mexico
- Requires large (+300 MW) coal-fired generators to attain an emission rate no greater than 1100 lbs CO_2/MWh after 2022
- A time variance is available if a retrofit project is underway
- 1100 lbs CO_2/MWh is a standard NM has used in the past

SAN JUAN GENERATING STATION

ENCHANT ENERGY CORP.

ORIGINALLY "ACME EQUITIES"

WHAT'S THE PROPOSAL?

- Partner with City of Farmington to raise $1.2B
- Retrofit the SJGS coal plants to CCS
- Emission reductions of 90% (to 250 lbs CO_2/MWh)
- Recent Sargent & Lundy study shows potential feasibility

  (S&L gets $2M of any federal grant money)
- Applied to DOE for $5.8M feasibility study grant
- Use CO_2 sales for EOR, and 45Q tax credit to make economics work

WHO IS ENCHANT ENERGY?

- New York address shared with hedge fund that specializes in flipping distressed properties
- Asset value unknown
- No electricity-business experience
- Only two employees

WHAT ARE THE OBSTACLES?

- Unproven and unaffordable with coal plants
- At 850 MW, 3X the size of the $1B Petra Nova TX CCS plant
- Must compete with cheap renewables + gas
- Numerous regulatory approvals required
- 20 miles to connect with Cortez CO_2 pipeline to Permian
- No electricity buyer; very limited transmission
- $40/MWh parasitic load
- Tax credits only upon operation

WHAT DOES ENCHANT SAY?

Enchant Energy's website says:

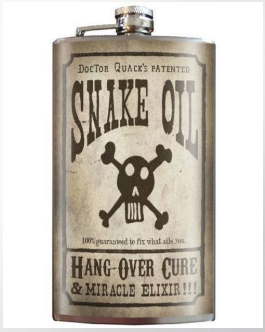
"Tax Equity financing over $1 billion has never been done."

"45Q tax credits are new and Treasury has not written the regulations"

"Project sponsor does not have an investment grade rating"

COAL CCS BOTTOM LINE

OR



"Novice Company's Carbon Capture Pitch Offers False Hope…" July 2019,
Cates and Wamsted; Institute for Energy Economics and Financial Analysis; IEEFA.org;

WHETHER COSMETICS, CULINARY, FASHION OR CCS, WE'LL JUST HAVE TO WAIT AND SEE WHAT THE FUTURE HOLDS FOR OLD KING COAL

The Duck Curve and hydrogen from electrolysis: How pricing drops from at-scale deployments in Europe are making it a viable solution to avoid negative pricing and the need to curtail variable wind and solar

Rao Konidena
Rakon Energy LLC

Key Takeaways

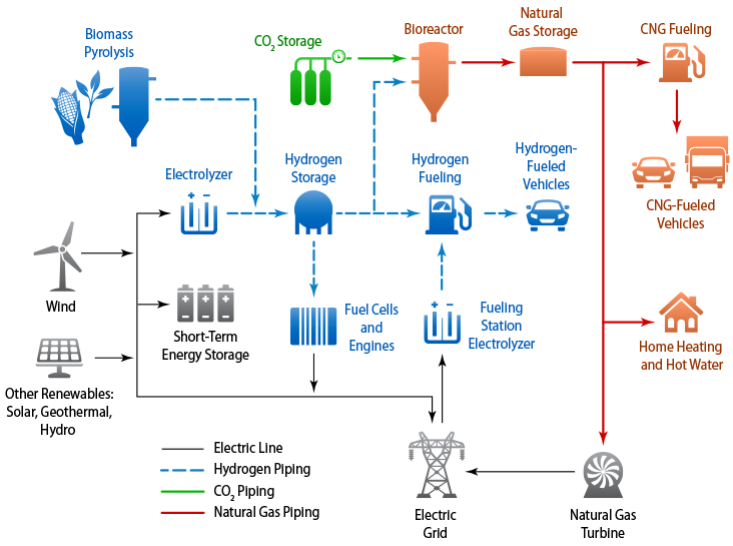
- Can our economy think about hydrogen?
- Does everyone know that renewables are curtailed?
- Negative pricing

Newly opened hydrogen at Citrus Heights, California

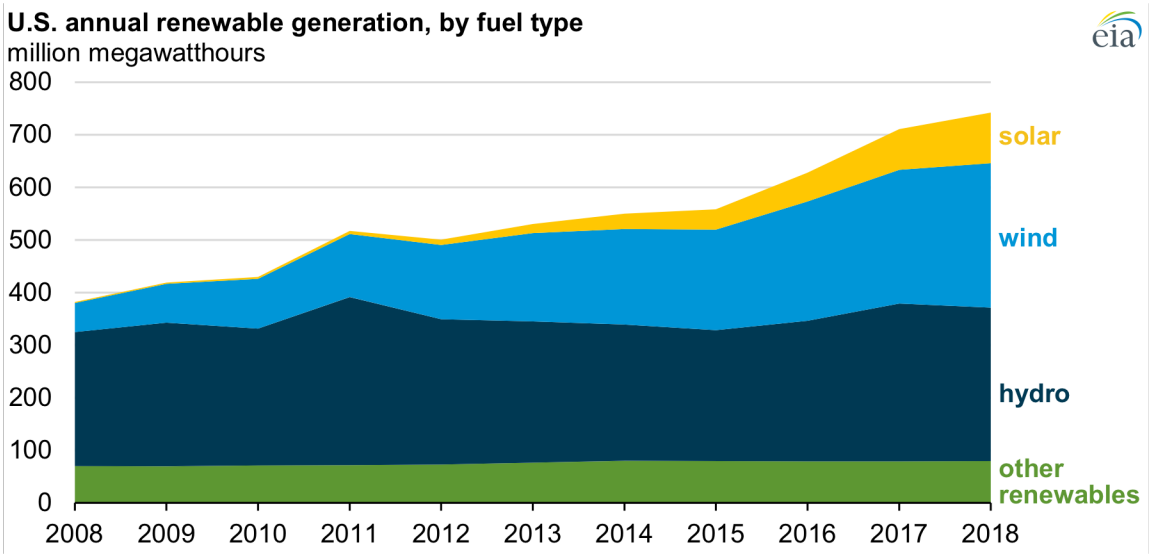
Basics – "It's Elementary, My Dear Watson!" – Sherlock Holmes

How is Hydrogen generated and where is it used?

- Splitting water by direct current (this is sourced from renewables) is called electrolysis
- Generated by splitting Water (H_2O) – "The cleanest way to produce hydrogen is by using sunlight to directly split water into hydrogen and oxygen" – NREL website
- Hydrogen can be stored as fuel for Fuel Cell Vehicles ("FCVs")
- Source: https://www.nrel.gov/hydrogen/hydrogen-production-delivery.html



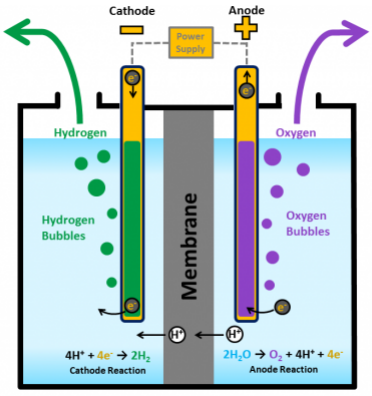
EIA says "U.S. renewable electricity generation has doubled since 2008



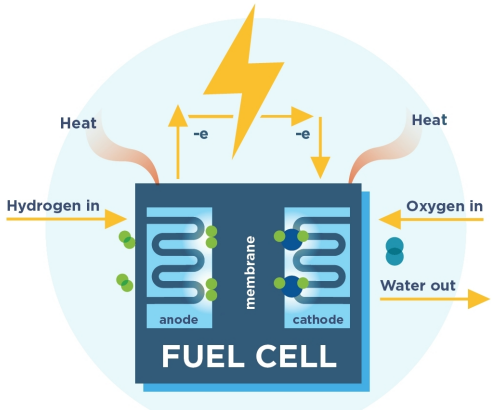
Context

- "FCHEA members Toyota and Fuel Cell Energy announced the installation of a multi-megawatt fuel cell power plant at the Port of Long Beach in California that will generate not only electricity but 100% renewable hydrogen fuel onsite via biogas from dairy cattle waste. Toyota will purchase the hydrogen for its fuel cell-powered cars and heavy-duty trucks that are deployed at the port." - Morry Markowitz, President, Fuel Cell and Hydrogen Energy Association
- "On March 11, 2017, the CAISO observed solar curtailment exceeding 30 percent of the solar production for an hour" Source: https://www.caiso.com/documents/curtailmentfastfacts.pdf

How does an Electrolyzer work?

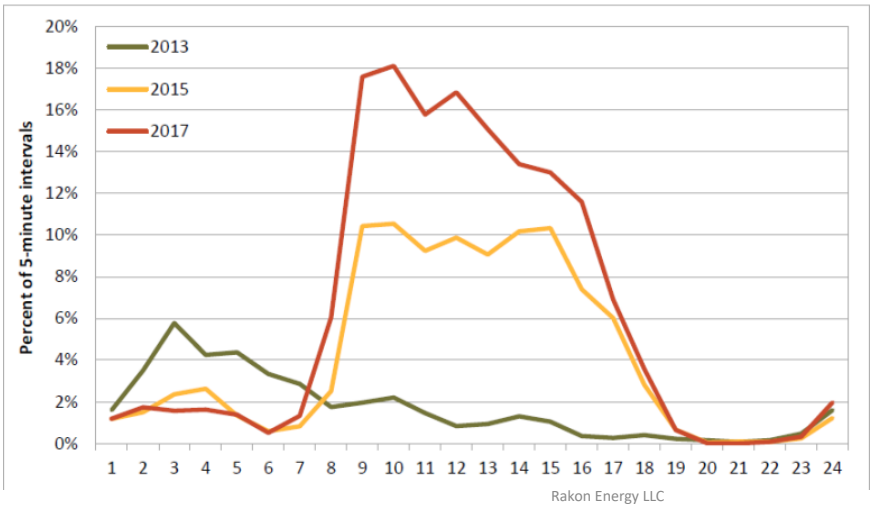


How does a Fuel Cell work?



CAISO Negative Pricing Data (2013-17)

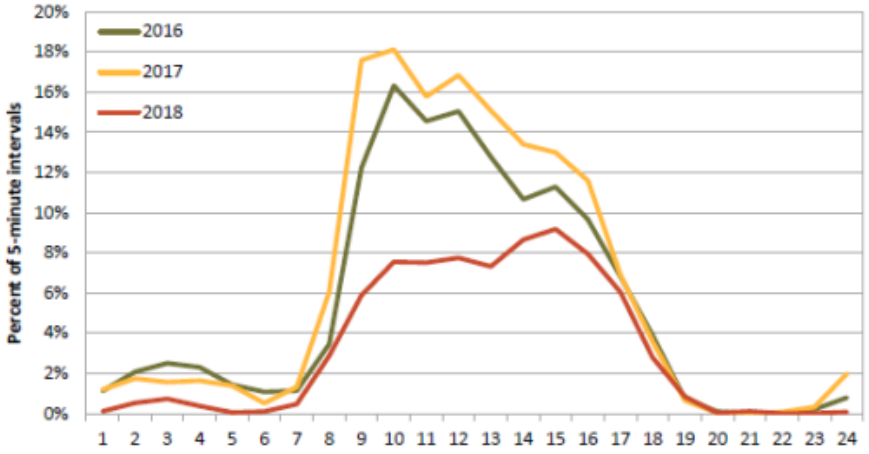
Figure 3.6 Hourly frequency of negative 5-minute prices by year (ISO LAP areas)



"The increase in negative prices largely reflects a growth in installed renewable generation, particularly from solar resources, and increased hydro generation" - Department of Market Monitoring, CAISO. June 2018

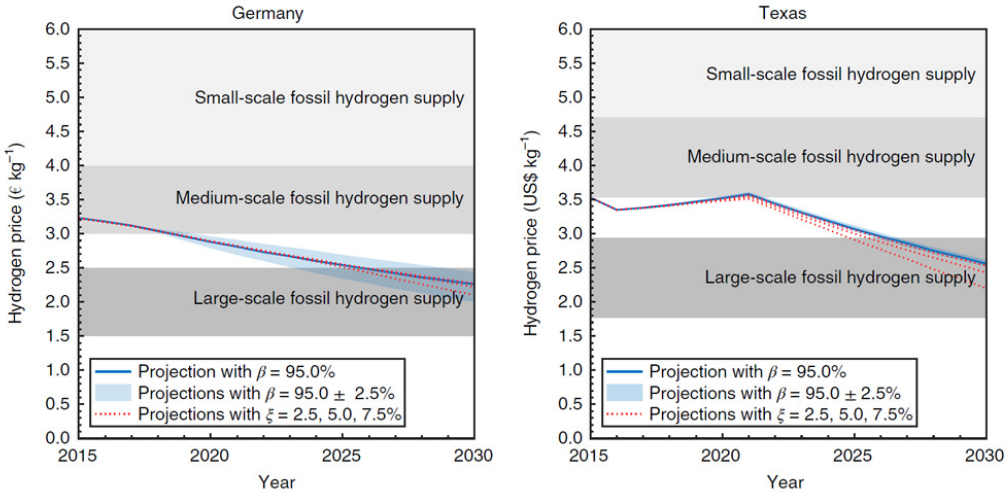
CAISO Negative Pricing Data (2018 Report)

Figure 3.6 Hourly frequency of negative 5-minute prices by year (ISO LAP areas)



"The lower frequency of negative prices this year is likely a result of decreased hydroelectric generation. Negative prices during 2018 were most frequent in the midday hours when renewable generation is highest with many renewable resources (primarily participating solar resources) bidding negative. Most negative prices occurred between February and June when hydroelectric generation was greatest " - Department of Market Monitoring, CAISO. May 2019

Texas Comparison with Germany



Source: https://www.carbonbrief.org/renewable-hydrogen-already-cost-competative-say-researchers

Denmark – From NEL Q4 2018 Financial

- Awarded a USD 6 million contract with Shell Oil Products US for the delivery of a H2Station® solution for fueling of heavy-duty vehicles in California, USA
- Received notice on bid winner for two hydrogen fueling stations in South Korea. The value of the proposed station solution is around EUR 2.8 million
- Awarded purchase order for a 2 MW PEM electrolyzer, and entered into a 30 MW framework contract agreement in Switzerland

Tying it back to US context/MISO markets

- Structured wholesale energy markets are only going to see an increase in renewables in future
- What's happening in CAISO, will become a norm in other ISO/RTO markets
- Headwinds will be distributed energy resources, policy barriers
- Are we ready to think hydrogen?

References

- https://nelhydrogen.com/solutions/ - Danish company with US presence
- http://www.fchea.org/member-nel - Fuel Cell and Hydrogen Energy Association
- FERC Docket # ER11-3140 – Hydrogen Energy California LLC - Petition for a Temporary Waiver of California Independent System Operator (CAISO) Tariff Provisions Regarding Interconnection Financial Security and Request for Expedited Ruling
- http://www.caiso.com/market/Pages/MarketMonitoring/AnnualQuarterlyReports/Default.aspx - Source for CAISO negative pricing reports

References

- https://es.catapult.org.uk/?s=hydrogen+storage
- https://www.carbonbrief.org/renewable-hydrogen-already-cost-competative-say-researchers - compares TX and Germany markets
- http://www.ukhfca.co.uk/wp-content/uploads/UK-HFCA-Energy-storage-final.pdf
- https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2018/Sep/IRENA_Hydrogen_from_renewable_power_2018.pdf

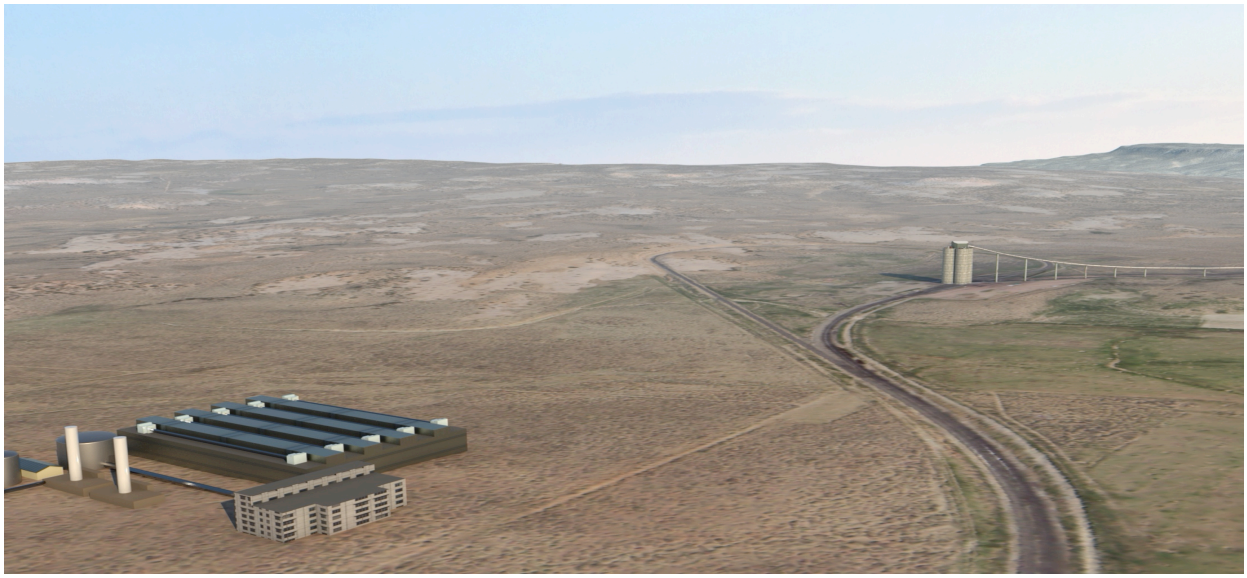
Rakon Energy LLC

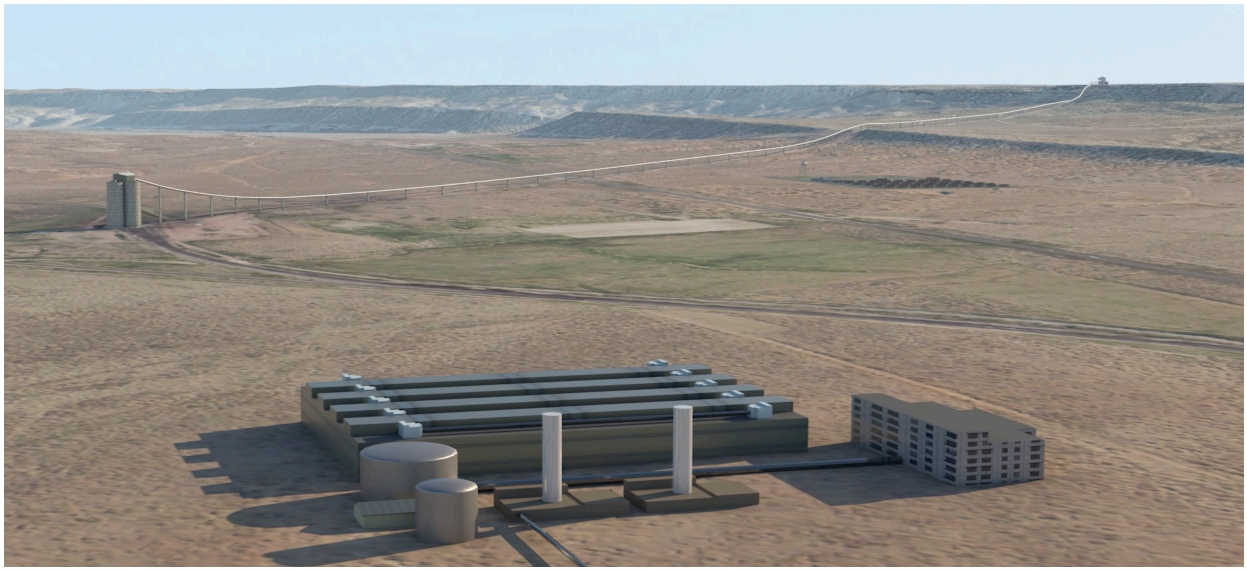
- Approx. 15 years at MISO, two decades experience in manufacturing, consulting and ISO/RTO markets.
- Business Segments
  - Testimony Support - Affidavit Support for DC based Law firm, Environmental Law & Policy Center (ELPC)
  - Policy Support - Energy Storage Association/Order 841 Compliance @ MISO
  - Business Development - Danish Wind and Solar Production Forecasting, MN Solar Installer
  - Training – Grid operators and regulators in Mexico City, Bogota, and Hanoi
- Board member – Finnish American Chamber of Commerce – MN, and Xperitas (language immersion and community partnership)
- MSEE (UT Arlington, Thesis on PV and Fuel Cells) and MBA
- Volunteer work with FutureCity competition, Solar PPA at Faith Based Org in MN
- rkonidena76@gmail.com

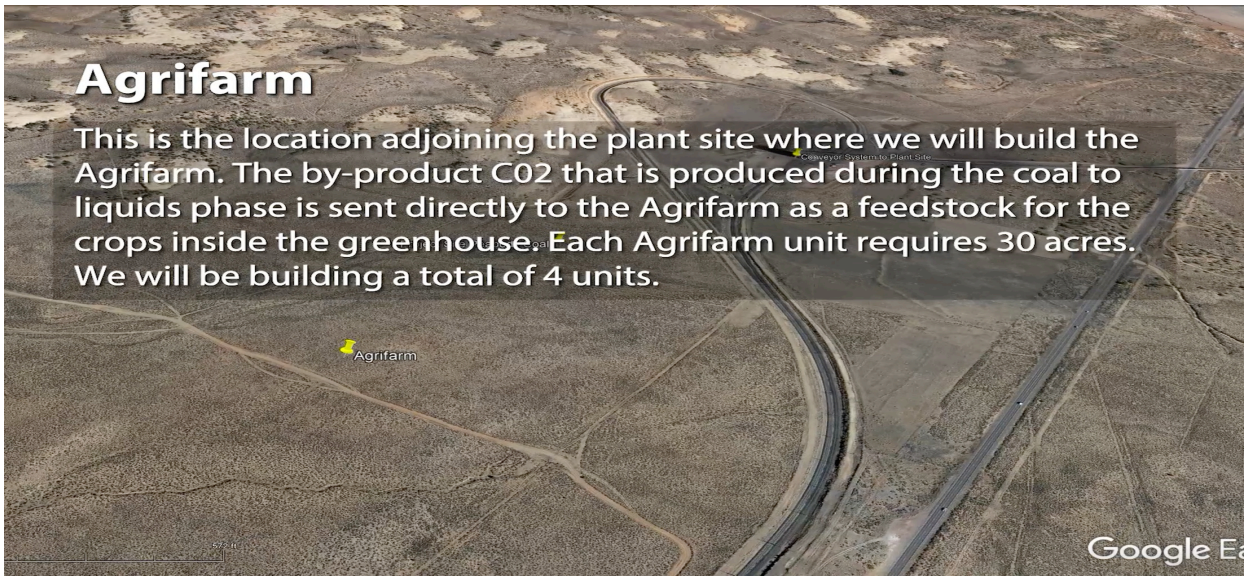
The Utah Hydrogen Initiative and Navajo Transitional Clean Energy Project

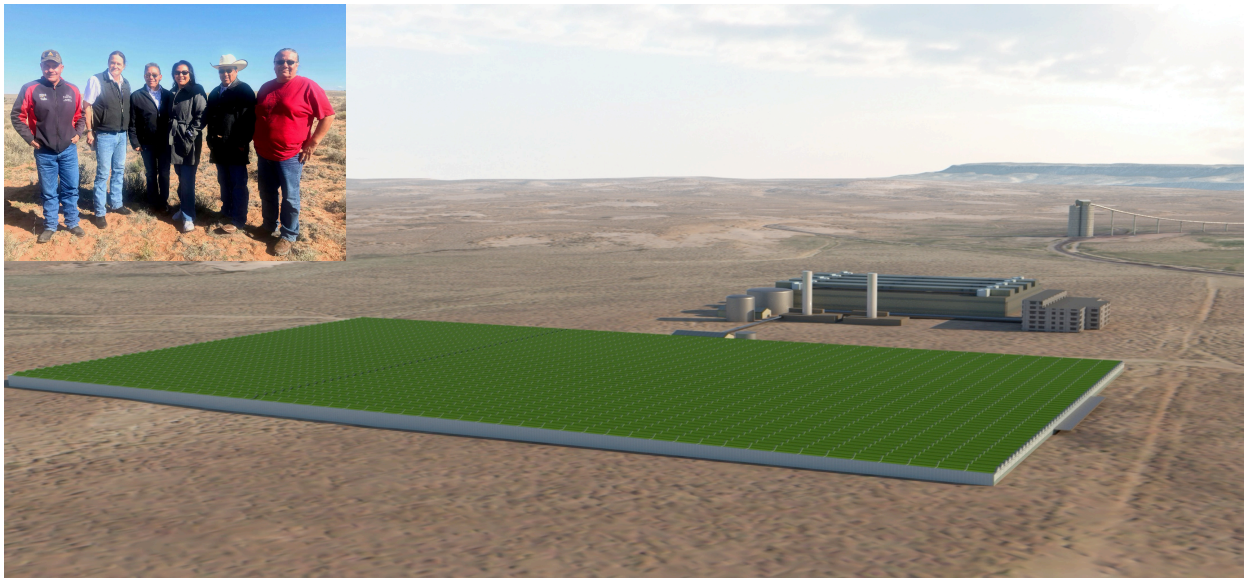
Project Overview
Requirements and Supply

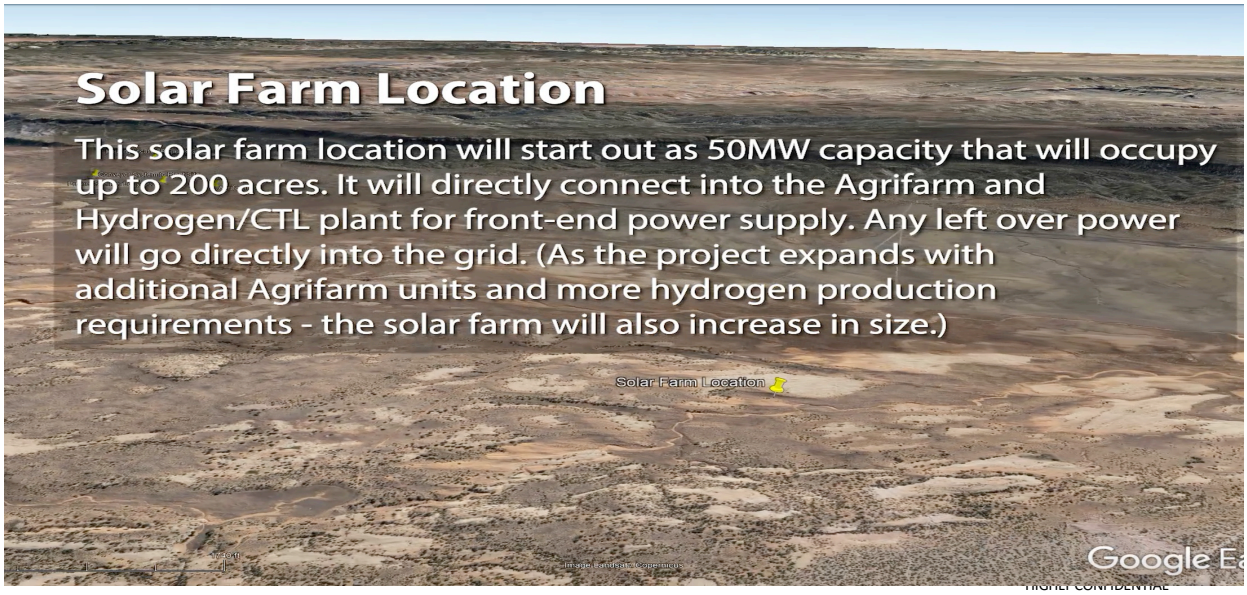
- Land: 250 acres
- Water: available from local reservoir
- Coal: Emery and Carbon County mines
- Electricity: available from dedicated renewable resources
  - Solar
    - Engaged DEPCON on project
    - 50 MW
    - Site has been identified and surveyed
  - Wind
    - Engaged GE on project
    - 72 MW
    - Site has been identified
  - Geothermal
    - Engaged ENEL on project
    - 25 MW
    - Geothermal resource study has been performed
  - Supplemental Baseload Power
    - Huntington/Hunter Plant
    - Black Carbon to Carbon Fiber will be sent to University of Utah for carbon fiber processing or build local plant
    - CO2 consumed at on-site Agrifarm for growing organic tomatoes, peppers, cucumbers, melons and other agricultural food stocks
- Hydrogen Production
  - Renewable Electrolysis combined with fossil fuel gasification
    - Engaged Electrolysis company for the project
    - First Phase - 200 MW yielding ~80,000 kg H2/day
    - Highly scalable equipment based on demand of project






Agrifarm
This is the location adjoining the plant site where we will build the Agrifarm. The by-product C02 that is produced during the coal to liquids phase is sent directly to the Agrifarm as a feedstock for the crops inside the greenhouse. Each Agrifarm unit requires 30 acres. We will be building a total of 4 units.
Agrifarm
Google Ea





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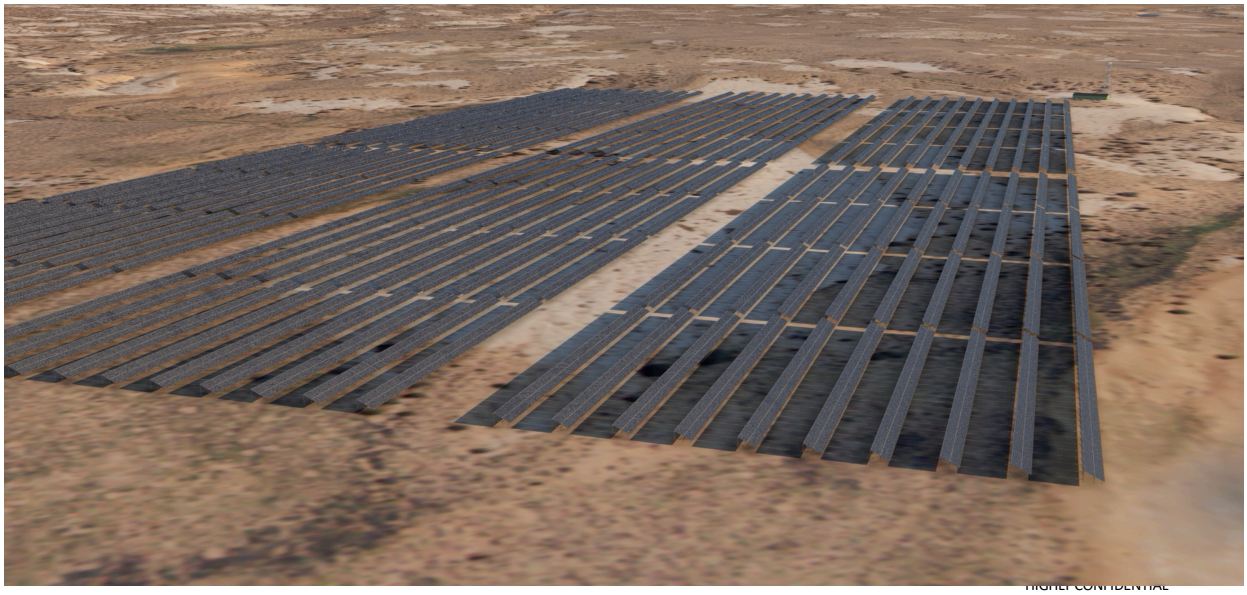

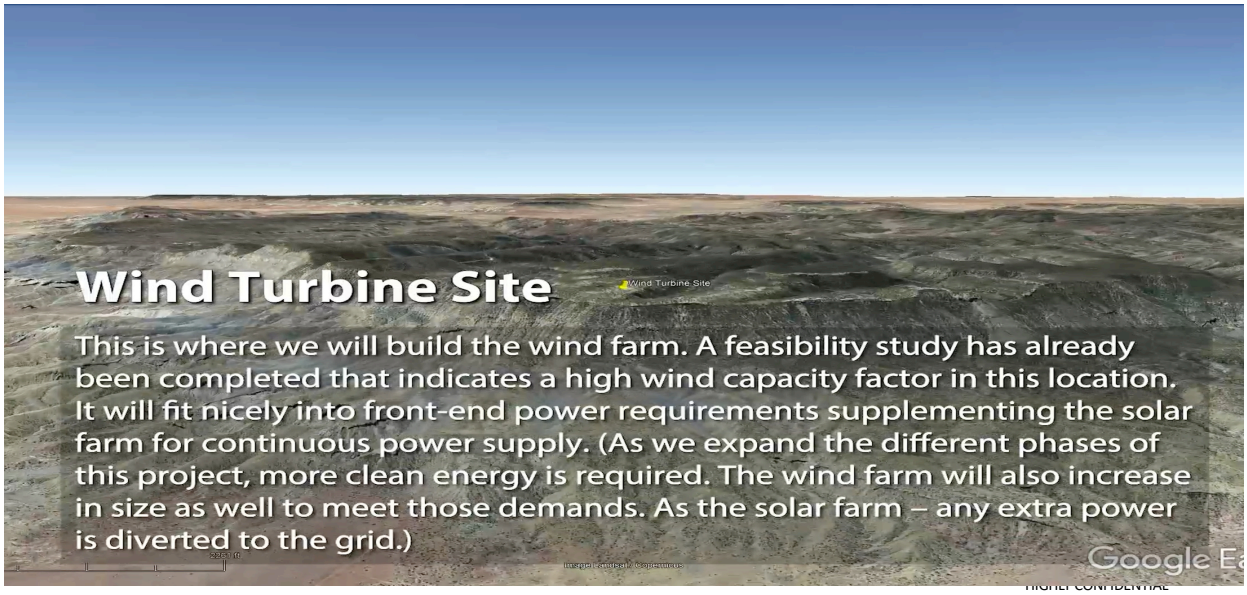

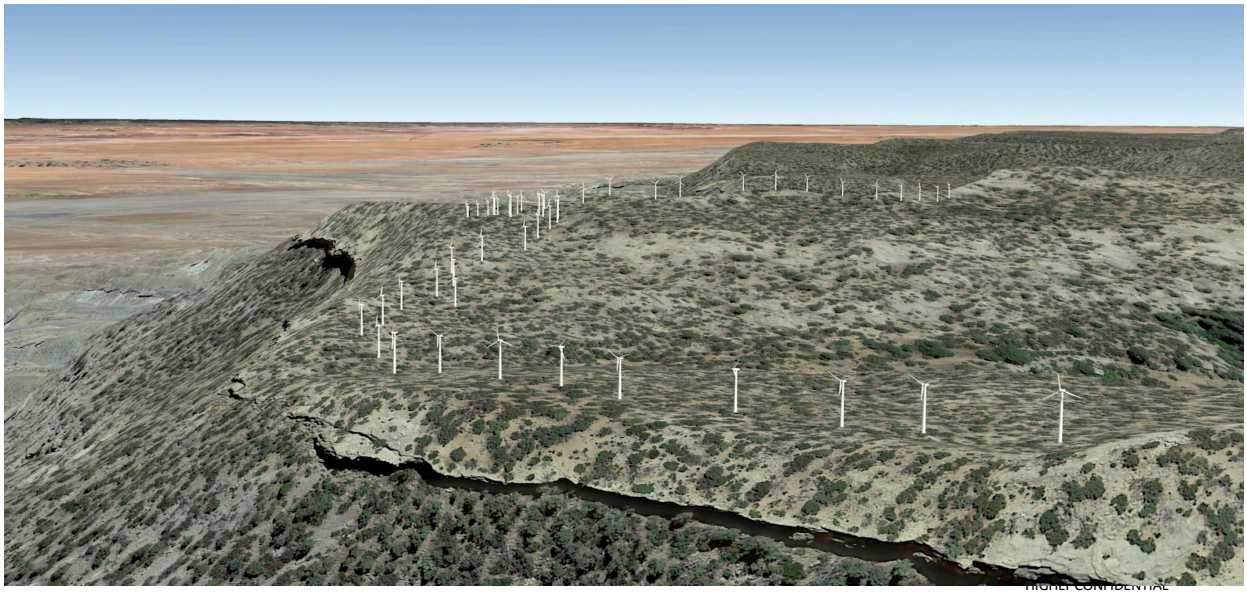

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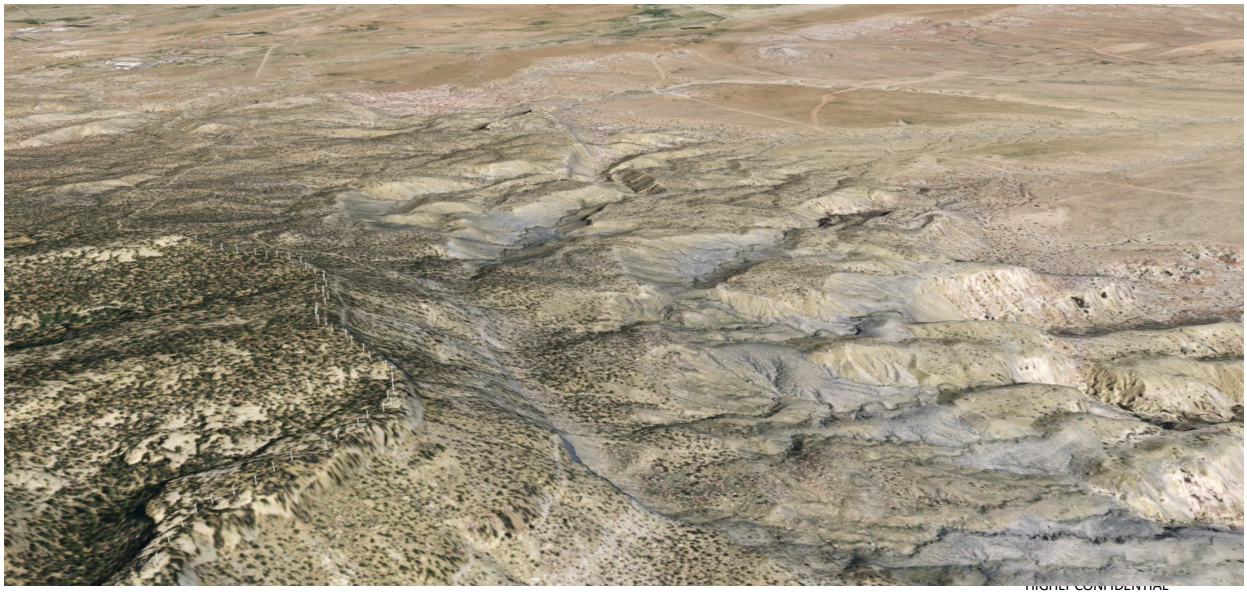

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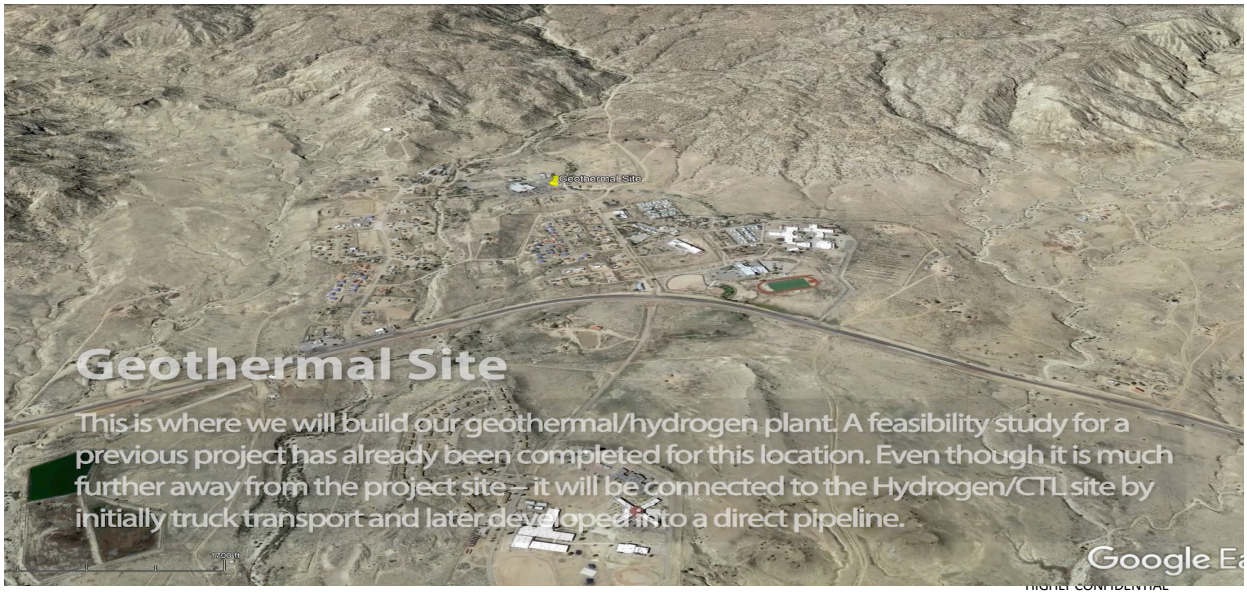
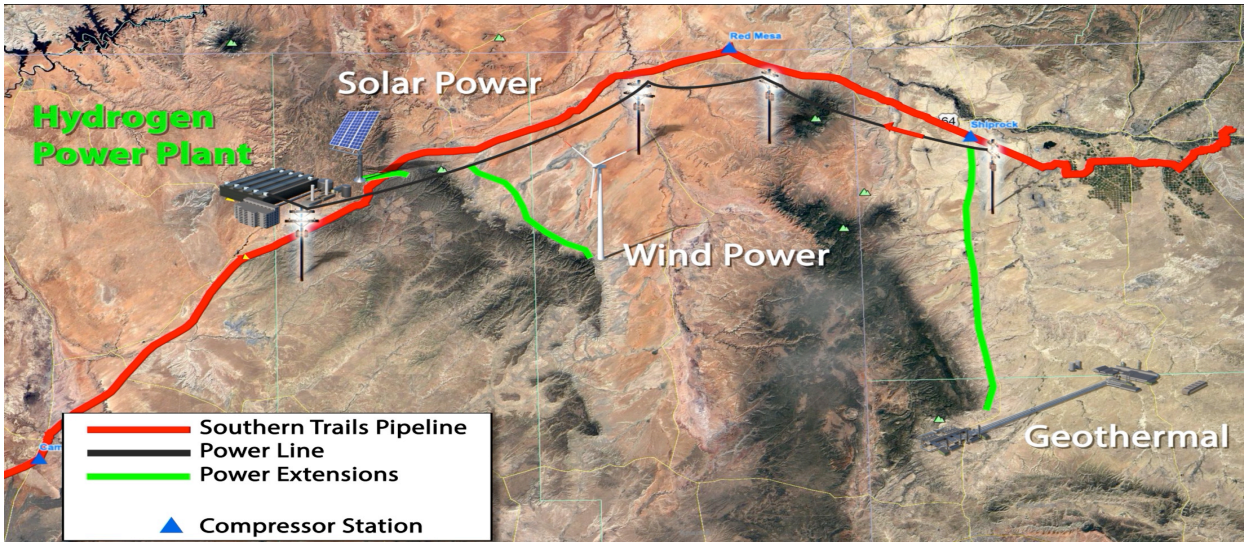
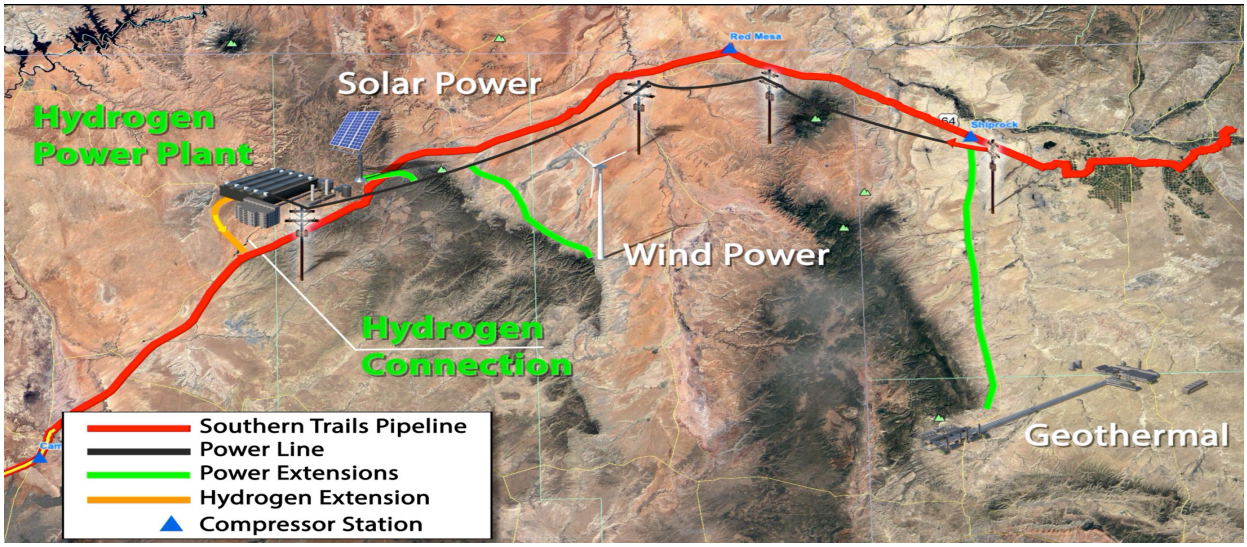
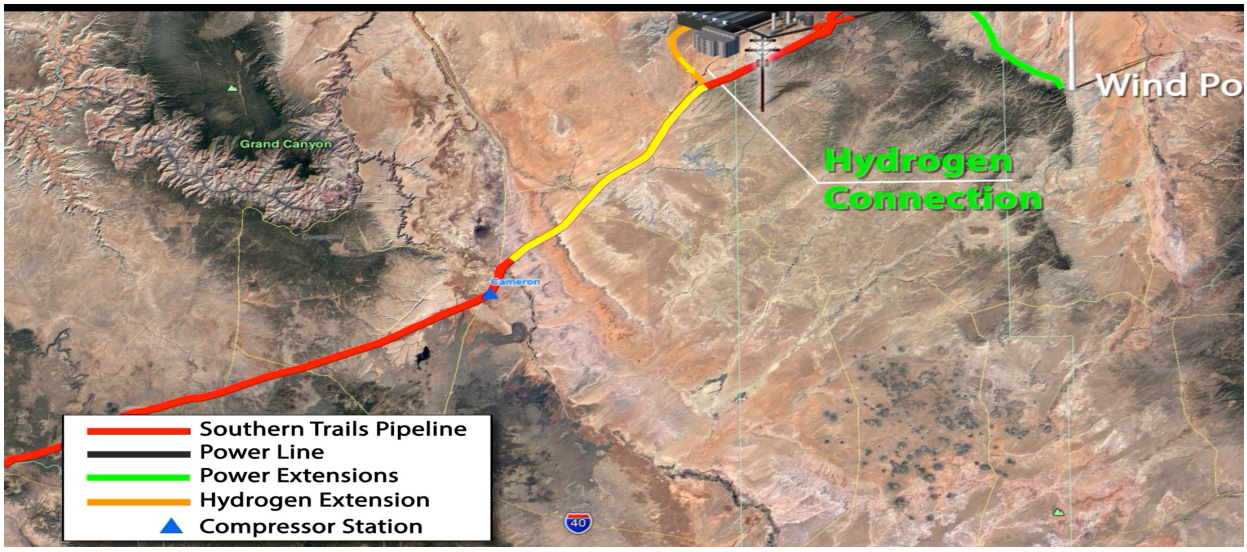
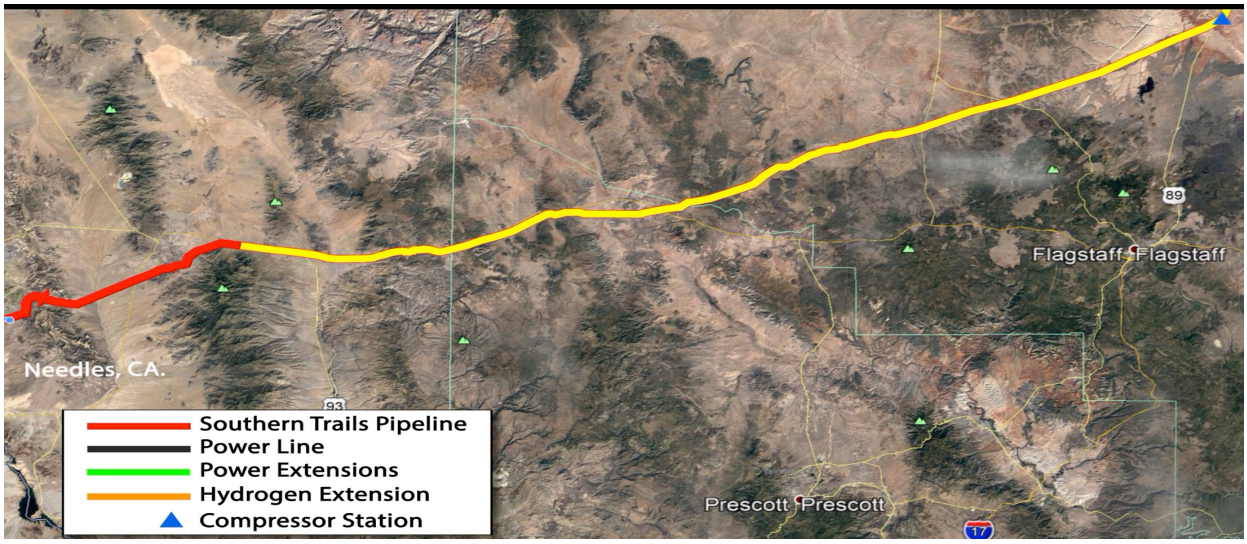







Wind Po
Grand Canyon
Hydrogen
Connection
Cameron
Southern Trails Pipeline
Power Line
Power Extensions
Hydrogen Extension
Compressor Station
40


Needles, CA.
93
Flagstaff
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Prescott
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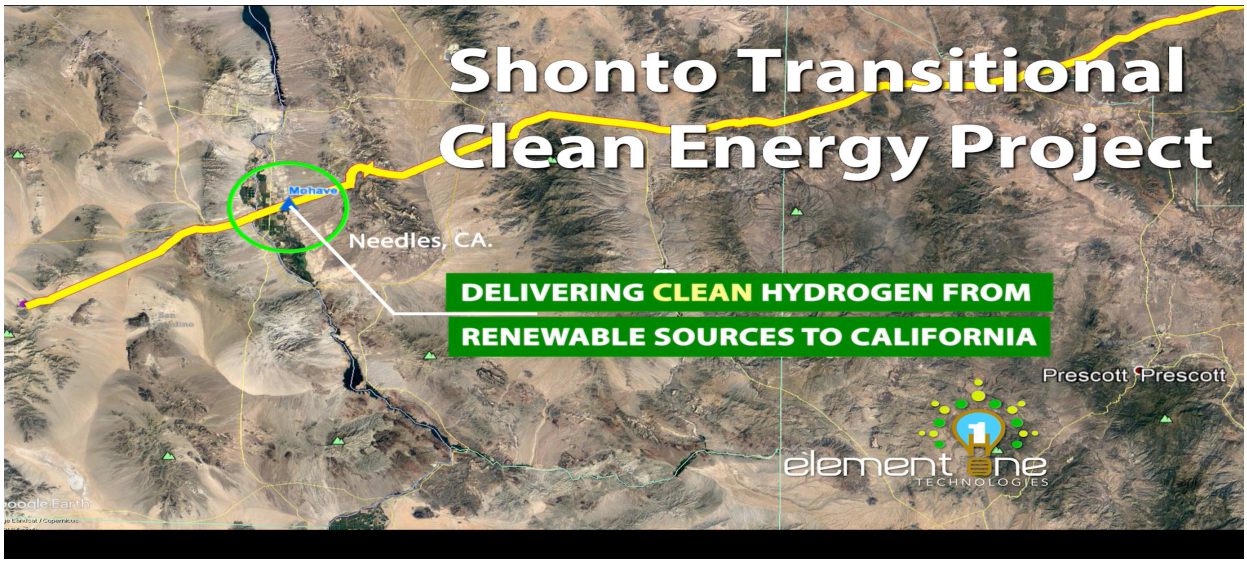
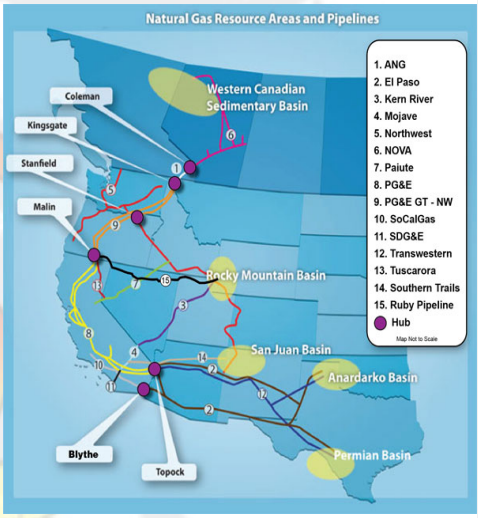
Southern Trails Pipeline
Power Line
Power Extensions
Hydrogen Extension
Compressor Station



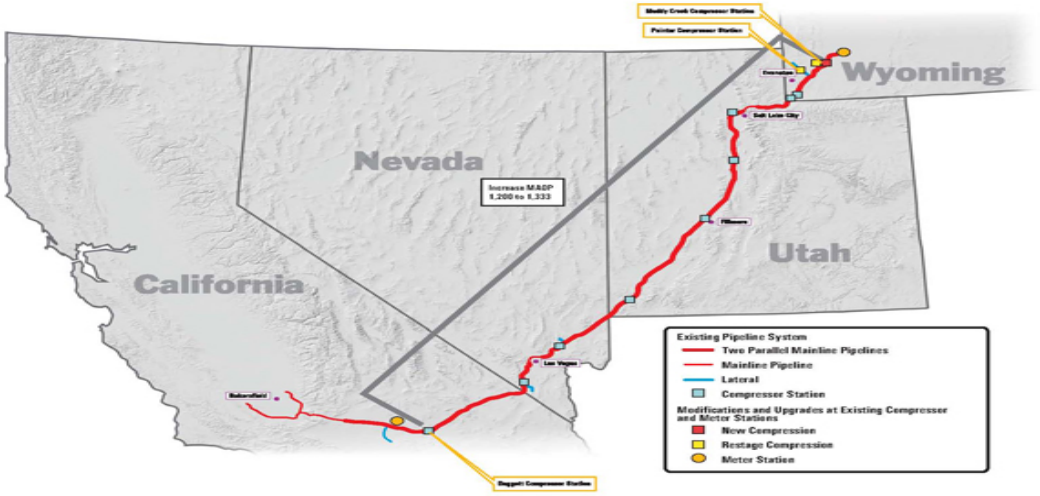
Project Overview

Transport – Southern Trails Pipeline/Transwestern, El Paso to California

- Southern Trails Owned and operated by Dominion Energy
  - Inactive/idle pipe for several years
  - Currently performing a scoping study on re-purposing pipeline
- 220 miles
- 16” outer diameter
- X-52 material (Smart-Pipe)
- 110 Miles addition to Las Vegas from Needles, CA
- GE and Siemens hybrid Gas Turbines
- New Navajo Project Site at Legislative Level
  - Interstate 40 Right of Way to California Border
  - 30” Transwestern and El Paso Line to California
  - Arizona State Rail System
  - Refrigerated Tanker Cars
  - Smart-Pipe Technology
  - Nearby Salt Cavern Storage and Helium resources



Kerns River Pipeline



Project Overview

Demand – California, Nevada and Utah Markets

- **Fueling Stations**
  - Current hydrogen demand from 37 fueling stations and refineries being met almost entirely by Air Products and new stations coming to California via First Element
    - Price hovering around $16 per kilo – projected price 2020: Nikola Motors - $8 per kilo
    - Auto industry is looking for reliable centralized hydrogen supply for expansion now California market is proven
- **Utah has announced big plunge into hydrogen production and storage**
- **The Utah Hydrogen Initiative (production, pipeline, CCU on Hunter and Huntington plants) in Emery County - introduced to the Utah Energy Office May 2019**
  - Gasification, Electrolysis and CCU
  - Pipeline from Utah through Nevada to border of California
  - Hydrogen Research Center and Gasification Plant - Orangeville, Utah
  - New Utah Airport construction Ferron, Utah – Federal qualifications for state and Federal Funding
- **Long-Term Energy Storage**
  - Gas Utilities: Power-to-Hydrogen is perfect "marriage" between electric grid and gas grid allowing for utility-scale, seasonal and daily energy storage to shift from peak periods to off-peak periods
  - Salt Cavern Owners: mass storage of hydrogen potential exists in Utah and Arizona; already validated and performed in Texas and Leeds, England – newly announced Magnum energy Salt Cavern Storage for Hydrogen
- **Local in state Refineries – clean hydrogen gas for heat and power**
- **Power Generation Plants: Huntington and Hunter, Utah and Nevada – support California clean energy demand and Clean Energy Mandate 100% Renewable 2045 pipeline construction to begin for new western region transport infrastructure**
- **Texas will be the new comer for next clean energy wave**
- **International Export Markets**
  - Asia
  - Japan
  - Mexico
  - Taiwan

Next Steps

Technology Providers, Off-Takers, Funding Sources

- **Potential Off-takers:**
  - **California for Clean Energy Mandate and growing Hydrogen Car industry**
  - **Nevada – Hydrogen Generating Plant for California energy Market – First Hydrogen Station major casino downtown LV**
  - **industrial gas providers for liquid hydrogen transport**
  - **hydrogen transporters – tube trucks and refrigerated tanker wagons and newly developed ocean going hydrogen tankers**
  - **fueling stations owners/operators – CAFCP Model – Shell Hydrogen will engage with markets outside California**
  - **gas/electric utilities – hydrogen commercial supplies**
  - **refineries – retrofit hydrogen for clean and low emissions**
  - **petrochemical, etc.**
- **Finalize EPC agreements with partners/collaborators**
- **Continue to permit/survey renewable generation & hydrogen production sites on Navajo Reservation, Utah, Nevada**
- **Finalize LOI's/MOU's with Navajo Leadership, Utah partners and participators; Technology Providers and Government agencies**
- **Finalize available funding for project**
  - **Offshore Investment Group - $4 Billion**
  - **Federal – DOE, DOI, DOC: Loan Guarantees Grants and Money Matching programs**
  - **State Clean Energy and Hydrogen Tax Incentive Programs**
  - **Industry Investors – International Finance Bank and newcomers**
  - **Public-Private Partnerships**

Government, Industry Leaders, Collaborators and Off Takers

- **Federal Government**
  - **DOE - $2Billion loan Guarantee**
  - **DOC – grants, loan guarantees and money matching programs for project**
- **Pipeline construction UT to CA via Nevada and H2 transport, US and Canada, financial engagement, EPC**
- **Agrifarmuse – project integration, gasification CO2 emissions,**
- **Gasification Engineering final work through and agreements**
- **Electrolysis Engineering design and engineering agreements**
- **CaFCP – California Fuel Cell Partnership**
  - **Toyota**
  - **Honda**
  - **Mercedes Benz**
  - **Nikola Motors**
  - **Shell Hydrogen**
  - **BMW**
  - **Air Liquide**
  - **NEL**
- **State Governors, Energy Offices, Senators, Economic Directors:**
  - **Arizona**
  - **Utah**
  - **California**
  - **Idaho**
  - **Nevada**
  - **Canada/US Pipeline**
- **State of California**
  - **Governors Energy office and advisors for 100% renewable mandate – H2 from Utah to California**
  - **California Hydrogen Council – cars and commercial transport**
- **Utah Governors Energy Office**
- **7 State County Coalition – project presentation July 3rdth**
- **DOE and DOC Washington DC – May 2019**
- **Nevada Legislative and Energy Office**
  - **May 15, 2019 Carson City, Nevada**
  - **Hydrogen Road Day – California to Nevada**
  - **Honda and Toyota**
- **Element One Technologies, Inc relocated to Salt Lake City**
- **Solar Power International – presentation in Salt Lake City**
- **Fuel Cell Seminar and Energy Expo – November – presentation**
- **July, 2019 – Asia trip for $4 Billion Investors final presentation**

For Stanford Hydrogen Economy Workshop

Kawasaki
Powering your potential

Kawasaki

Hydrogen Road

Delivering Large Quantities of Hydrogen Affordably, Stably and Safely.

International Liquefied Hydrogen Supply Chain and Related Cryogenic Technologies

March 25, 20

ISHIKAWA, Kats
Kawasaki Heavy Industries, L

Ocean Transportation of LH2

Large Scale LH2 Carrier (Commercial)

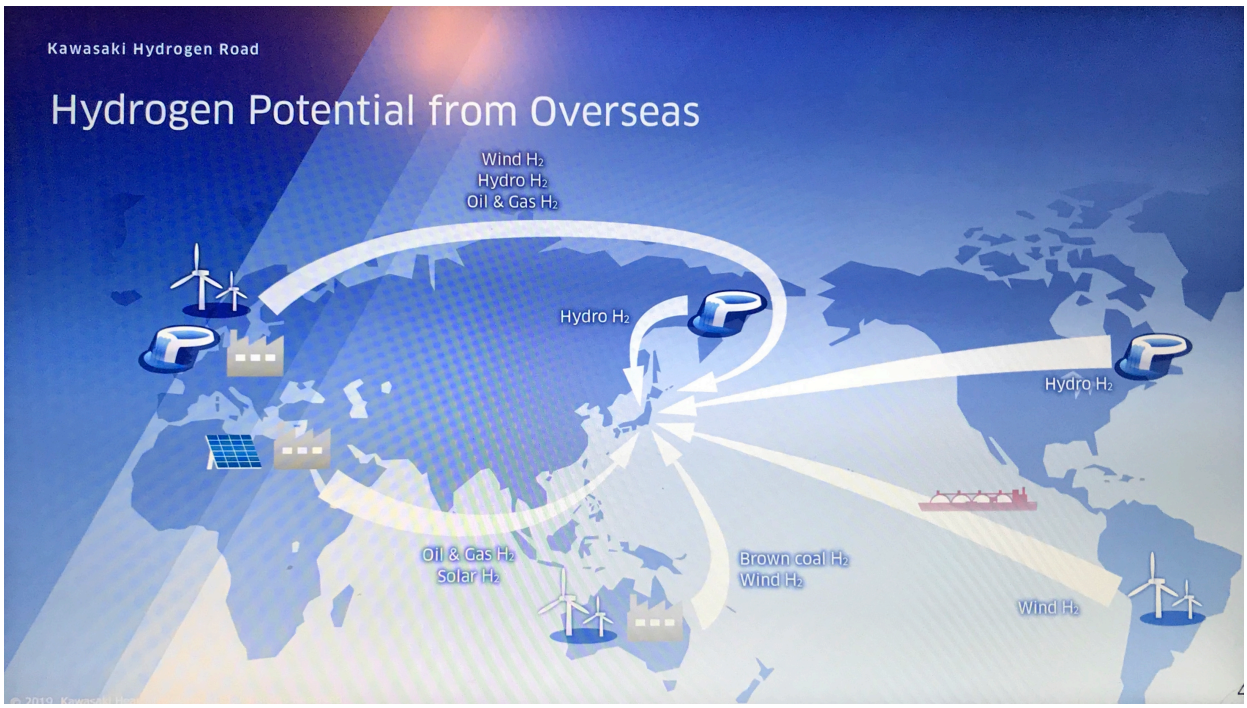
- Tank capacity : 160,000m³
  (40,000 m3 x 4 unit)
- Tank type : Spherical tank, Type- B
- Thermal insulation : vacuum panel
- Propulsion system :Hydrogen gas engine

Small Scale LH2 Carrier (Pilot)

- Tank capacity : 1,250m³
  (1,250 m³ x 1 unit)
- Tank type : Cylindrical , Type- c
- Thermal insulation : High vacuum multilayer
- Propulsion system : Diesel engine

Kawasaki Hydrogen Road

Hydrogen Potential from Overseas



Renewable Energy to Hydrogen by the Numbers

- Power Plant – 1.3 GW Name Plate: 1,300,000,000 Watts
- Hours running per year potential: 8760
- Capacity Factor: 85%
- 1.3 X 8760 = 11,388 GWhs
- 11,388 X .85 = 9,679.80 GWhs annual production
- 9,679,800,000,000 watt hours
- 9,679,800,000 kWhs X 40 years = 387,192,000,000 kWhs X $.10 = $38,719,200,000

Coal to Hydrogen Factor

4,000,000 tons per year X 40 years X 0.05 hydrogen content per ton = 8,000,000 tons of H2 X 907 kilos per ton = 7,257,477,920 kilos X $16 per kilo = $116,119,646,720 retail value X 0.12% net profit from coal gasification: $13,934,357,606 just from the hydrogen production. This does not even include the higher efficiency of 44.5% IGCC power generation sales of a gasification plant compare to the 36% of a conventional coal fired plant.

If we consider the capacity factors of Wind and Solar combined that has replaced a coal fired plant – average them out to 850 MW total considering worse case scenario of 60 kwhs of electricity per kilo of H2 using the same formula above:

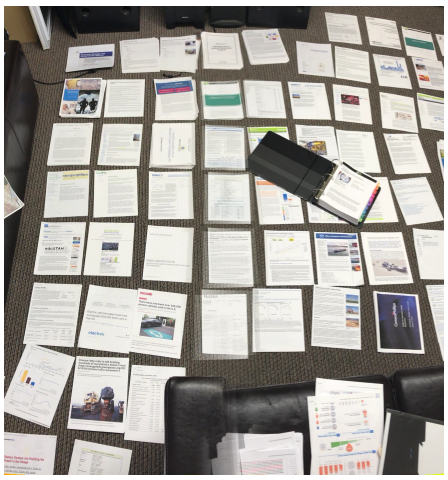
850 MW X 8760 hrs per year operation = 7,446,000 MWhs per year X 1000 (kilowatt conversion) = 7,446,000,000 kWhs X a Low Electrolysis Efficiency of 75% (as high as 95%) = 5,584,500,000 /60 kWhs per kilo = 93,075,000 X $8 = $744,600,000 in Renewable Hydrogen from electrolysis at 50% the going retail rate. Even if we cut that number in half - **$372,300,000**

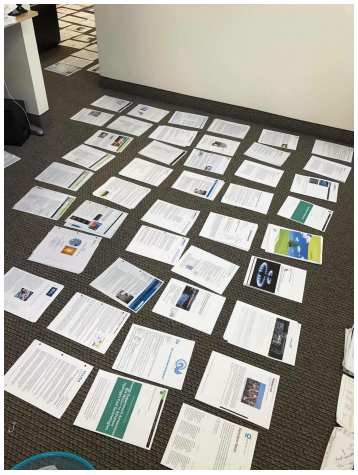
That same equation in power sales alone:

850 MW X 8760 hrs per year operation = 7,446,000 MWhs per year X 1000 (kilowatt conversion) = 7,446,000,000 kWhs X 0.025 = **$186,150,000**

Emery County Utah Power Plants

Hydrogen Research





element one
TECHNOLOGIES

ENERGY STORAGE: NEW DEVELOPMENTS NEW OPPORTUNITIES

LAW SEMINARS INTERNATIONAL: ELECTRIC POWER IN SW JULY 16, 2019

ARTHUR O'DONNELL, THE ENERGY OVERSEER

ENERGY STORAGE: DEVELOPMENTS & OPPORTUNITIES

Some Lessons from the California Experience:

- Define What You Need and Why
- Be Bold – Go BIG or Go Home 1,325 MW by 2024 + 500 MW by 2020
- Be Flexible – Set Expectations and Timelines but Allow for Changes
- Believe in the Market – Capture First Mover Benefits, then Capture New Benefits from Market Scale Transformation

ENERGY STORAGE: DEVELOPMENTS & OPPORTUNITIES

Legislative Driver for California Storage Policy:

AB 2514 (2010) Public Utilities Code Section 2836 directed CPUC to explore policies for utility-connected energy storage.

CPUC launched R.10-12-007 even before bill was signed. Established guiding principles for "viable, cost-effective" energy storage projects to be owned/procured by electric utilities:

- Grid Optimization, including peak reduction, reliability, T&D deferral
- Renewable Energy integration
- Greenhouse Gas emissions reductions in line with AB 32 goals (2006).

ENERGY STORAGE: DEVELOPMENTS & OPPORTUNITIES

Storage Grid Domains (Grid Interconnection Point)	Regulatory Function	Use-Case Examples
Transmission-Connected	Generation/Market	Concentrated Solar Power, Wind + Energy Storage, Gas Fired Generation + Thermal Energy Storage
		Ancillary Services, Peaker, Load Following
	Transmission Reliability (FERC)	Voltage Support
Distribution-Connected	Distribution Reliability	Substation Energy Storage (Deferral)
	Generation/Market	Distributed Generation + Energy Storage
	Dual-Use (Reliability & Market)	Distributed Peaker
Behind-the-Meter	Customer-Sited Storage	Bill Mgt/Permanent Load Shifting, Power Quality, Electric Vehicle Charging

Source: CPUC D.13-10-040

ENERGY STORAGE: DEVELOPMENTS & OPPORTUNITIES

Built in Flexibility in storage mandate D. 13-10-040:

- Based on preliminary studies finding that in most use cases storage could be cost-effective, utilizes had to make a case that bids were not cost-effective, otherwise least-cost/best fit;
- Utilities could propose certain existing storage projects to meet requirement;
- Storage procured outside of biennial RFPs may also count (i.e. LTPP/SGIP);
- Utilities could own up to 50 percent of projects, except behind the meter;
- If more is acquired in one solicitation, utilities can "bank" capacity for future;
- Except for customer-side goals, utilities could substitute between T&D capacity;
- To prevent overwhelming the market, large-scale hydro pumped storage not eligible (except for a previously approved 50 MW project in San Diego territory).

ENERGY STORAGE: DEVELOPMENTS & OPPORTUNITIES

Storage Grid Domain D.13-10-040 Point of Interconnection	2014	2016	2018	2020	Total
Southern California Edison					
Transmission	50	65	85	110	310
Distribution	30	40	50	65	185
Customer	10	15	25	35	85
Subtotal SCE	90	120	160	210	**580**
Pacific Gas and Electric					
Transmission	50	65	85	110	310
Distribution	30	40	50	65	185
Customer	10	15	25	35	85
Subtotal PG&E	90	120	160	210	**580**
San Diego Gas & Electric					
Transmission	10	15	22	33	80
Distribution	7	10	15	23	55
Customer	3	5	8	14	30
Subtotal SDG&E	20	30	45	70	**165**
Total - all 3 utilities Source: CPUC D.13-10-040	200	270	365	490	**1,325**

ENERGY STORAGE: DEVELOPMENTS & OPPORTUNITIES

Storage Grid Domain Point of Interconnection	AB 2514 Targets	AB 2514 Procurements	Adjusted Total from All Procurements	Excess/Deficiency
Southern California Edison				
Transmission	310	0	171	-139
Distribution	185	27	185	0
Customer	85	100	221	136
Subtotal SCE	**580**	127	577	-3
Pacific Gas and Electric				
Transmission	310	135	544	234
Distribution	185	36	185	0
Customer	85	36	46	-39
Subtotal PG&E	**580**	207	775	195
San Diego Gas & Electric				
Transmission	80	0	80	0
Distribution	55	0	56	1
Customer	30	0	39	0
Subtotal SDG&E	**165**	0	166	1
Total - all 3 utilities Source: CPUC Smart Grid 2019	**1,325**	**334**	**1,518**	**193**

ENERGY STORAGE: DEVELOPMENTS & OPPORTUNITIES

Major Lessons from the AB 2514 experience:

- Flexibility in setting cost-effectiveness requirements helped spur the market, utilities had to prove that bid projects were NOT cost-effective (compared to gas-peaker). First RFP in LTPP and subsequent "local capacity" RFOs resulted in many cost-effective bids.
- Over 5 years, bid prices have fallen 40% - 50% according to CPUC staff analysis, and are expected to fall further.
- Flexibility in meeting goals (banking, use of existing facilities and alternate solicitations) allows for meeting the AB 2514 goals well ahead of schedule and opens the doors to more innovative/refined proposals.
- **Downsides:** As of Jan. 1, 2019, online storage from new solicitations was 410 MW (26%);
- PG&E bankruptcy caused uncertainty for small developers some dropped contracts.

ENERGY STORAGE: DEVELOPMENTS & OPPORTUNITIES

AB 2868 (2016) added a 500 MW storage requirement, divided equally among the 3 IOUs (@166.66 MW) to achieve these goals:

- Accelerate widespread deployment of distributed energy storage systems to achieve ratepayer benefits;
- Reduce dependence on petroleum;
- Meet air quality standards;
- Reduce emissions of greenhouse gases.

ENERGY STORAGE: DEVELOPMENTS & OPPORTUNITIES

In their applications, utilities proposed various storage projects, largely utility-owned to provide a variety of storage-related services and functions:

- Microgrids for public sector facilities
- Behind the meter applications for low-income customers (third-party/customer owned)
- Incentives for storage installed at multifamily affordable housing projects
- Behind the meter thermal storage
- Possible resiliency projects in wildfire rebuild areas
- Storage at utility substations for renewable energy integration

ENERGY STORAGE: DEVELOPMENTS & OPPORTUNITIES

SDG&E proposed procuring 100 MW for 7 utility-owned circuit-level microgrid projects at a cost of about $285 million. It had already conducted an RFO in 2018 for such projects.

PG&E did not propose anything specific, either projects or cost, but a "framework" to allow it to conduct an RFO for utility-owned projects and file an advice letter with results. But its "community resiliency" proposal would prioritize distribution-connected projects at military bases, correctional institutions or public transportation facilities. Projects mainly to be located at substations.

Also a $3.6 million behind-the-meter thermal storage program using heat-pump water heaters..

SCE proposed a 40 MW RFO for utility-owned "local energy storage and management systems" on low-load circuits, and rebate for low-income multi-family to purchase storage paired with PV.

ENERGY STORAGE: DEVELOPMENTS & OPPORTUNITIES

On June 27, 2019, the Commission issued D.19-06-032, representing a mixed bag of results:

" The front of the meter investment proposals of the three Applicants are not granted as proposed. Additionally, the behind the meter programs proposed by San Diego Gas & Electric Company and Southern California Edison Company are not granted as proposed. This decision allows and encourages the three Applicants to hold requests for offers for front of the meter energy storage resources that conform to the direction included in Appendix A of this Decision."

ENERGY STORAGE: DEVELOPMENTS & OPPORTUNITIES

- Procurement should not be limited to utility owned projects. PG&E proposal rejected/SDG&E told to hold a supplemental RFO. PG&E may proceed with thermal storage plan.
- Utilities need to show that projects will reduce GHG emissions.
- All IOUs need to provide "rigorous cost-effectiveness showings" including net present value, net market value and least-cost/best fit calculations.
- IOUs must reflect adopted principles for storage "multi-use application rules" previously adopted in D. 18-01-003. "Utilities shall identify all market revenues" and CPUC reserves right to conduct retroactive reasonableness review based on wholesale market revenues generated.
- Projects should provide safety plans, but utilities continue to hold ultimate responsibility for safety regardless of ownership of the projects.

ENERGY STORAGE: DEVELOPMENTS & OPPORTUNITIES

Activities and Proceedings in the Upcoming 12-Months (May 1, 2019 – April 30, 2020)

IOU distribution deferral solicitations underway or imminent in the Distributed Resource Planning (DRP) and (Integrated Distributed Energy Resource (IDER) proceedings. If storage is procured as "non-wires alternatives" the cost is expected to be the same or less then the tradition infrastructure projects being deferred.

SCE application for approval of 200 MW of energy storage contracts to meet the local capacity requirement (LCR) needs in the Moorpark Sub Area, and to satisfy the requirements of SB 801 which directed SCE to deploy energy storage to address Aliso Canyon gas facility operation limitations.

ENERGY STORAGE: DEVELOPMENTS & OPPORTUNITIES

PG&E application for approval of energy storage contracts in the Oakland Clean Energy Initiative (OCEI) to replace retired gas generation and avoid the construction of new transmission lines needed for reliability. (see below)

PG&E and SCE are each evaluating large energy storage procurement opportunities as environmentally preferred alternatives to planned distribution substation and transmission upgrade projects for reliability.

In a recent report to the state Legislature, the CPUC stated:

"We are seeing evidence that in some instances, storage provides net savings to ratepayers when it is:

- Procured as a transmission or distribution infrastructure alternative;
- Procured as an alternative to high priced and/or replacement for aging/retired gas plants;
- Procured as a Local Capacity Resource."

ENERGY STORAGE: DEVELOPMENTS & OPPORTUNITIES

Every day, there are new market announcements for energy storage projects. Some rather astonishing announcements:

- The East Bay Community Energy (a Community Choice Aggregator) on June 24 signed four contracts for 213.5 MW of wind and solar energy and battery storage projects. One is a 10-year agreement for 20 MW of energy storage to provide resource adequacy and partially replace the 40-year-old 165 MW Oakland power plant owned by Vistra. Also signed a 20-year agreement for 100 MW of solar power and 30 MW of energy storage with the Sonrisa Solar Park in Fresno County, which is owned by EDP Renewables North America.

ENERGY STORAGE: DEVELOPMENTS & OPPORTUNITIES

- LA Board of Water and Power Commissioners is set to approve a 25-year contract for about 400 MW of PV solar and up to 350 MW storage capacity at 1.997¢/kwh for solar energy and 1.3¢/kwh for power from batteries.

Colin Smith of consultant Wood MacKenzie stated: "These are close to price points being set by recent projects announced in Nevada and Arizona by utilities seeking to meet gigawatt-scale energy storage targets. A sub-$20 solar-storage PPA in California is exceedingly low," Smith said. "Now we are seeing solar-plus-storage together as providing greater capacity and still competitive with new-build natural gas and other sources of electricity." (GreenTech Media, July 1, 2019).

ENERGY STORAGE: DEVELOPMENTS & OPPORTUNITIES

Thank You!

Arthur O'Donnell, The Energy Overseer

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Changes in the generation mix: clean energy rising

Noah Long, Natural Resources Defense Council

May 2, 2019

Overview

In 2018, NRDC, GridLab, NextGen commissioned the energy consultancy firm ICF to analyze the impact of strengthened renewable portfolio standards (RPS) across Southwest, including New Mexico.

1. Model used
2. Methodology and assumptions
3. Results in Western States: new renewable energy (RE) capacity
4. Results for New Mexico: capacity, generation, exports, and transmission
5. Conclusions for New Mexico

Integrated Planning Model (IPM)

- Model of electric power system used by regulators (e.g., U.S. EPA) and industry to assess impact of environmental policies and regulations
- Simulates the least-cost way to meet projected demand by building new power plants, retiring existing plants, or ramping them up and down
- Constraints on the system include reliability requirements and transmission limits, among others

Methodology & Assumptions

We modeled three cases

Reference Case aka "business-as-usual" (BAU): Existing policies and already approved builds, retirements

Clean Energy Case aka RPS: ~50% by 2030 RPS in NM, AZ, NV, and CO

Utility Plans Case: existing policies plus new fossil builds from utilities' integrated resource plans for NM

NM Clean Energy Case Assumptions

- Investor-owned utilities (IOUs): 50% by 2030 RPS with 2% carve-out for distributed generation (e.g. rooftop solar)
- Co-ops and municipal utilities (munis): 40% by 2030 RPS
- Renewables definition matches existing state policies
- RPS works as percentage of in-state sales
- States required to meet RPS policies with in-state generation
- IOUs, co-ops, and munis increase energy efficiency to 1.8% annual savings by 2025

Methodology & Assumptions: RE Constraints

Model assumes limits on variable renewable generation to approximate the amount of solar and wind the grid could accommodate without significant additional transmission capacity or reliability issues

Constraint Name	2018	2020	2025	2030
Solar	25%	30%	35%	40%
Wind and Solar	**40%**	**50%**	**55%**	**60%**
Wind	30%	40%	40%	40%

Methodology & Assumptions: Transmission

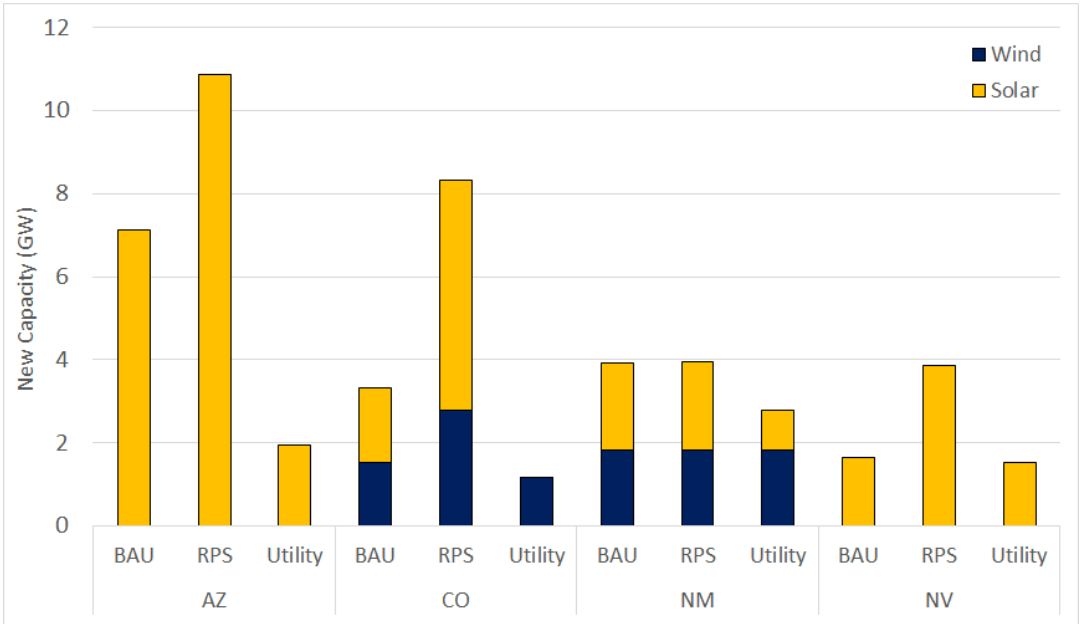
- Model includes a representation of the energy and capacity constraints of existing transmission lines
- The model does not simulate new transmission as an option
- We assumed the SunZia line would allow for up to 3 GW of renewable energy in New Mexico to be used in Arizona

Modeling Results for Western States

Multi-State Results: Conclusions

- Comparison of BAU and Clean Energy Cases shows what RE resources are most cost-effective in each state (e.g. solar in AZ and NV, wind and solar in NM) and what resources a stronger RPS would encourage (e.g. solar in CO)
- In AZ and NM, shows cost-effective achievability of higher RE levels than what utilities were planning for at time of study
- Overall, modeling shows relative cost-effectiveness and feasibility of ~50% by 2030 RPS in Western states

Multi-State Results: New RE Capacity



New Wind and Solar Capacity through 2030

Multi-State Results: New RE Capacity

New capacity through 2030 (GW)						
Source	AZ			CO		
	Reference	Clean Energy	Utility	Reference	Clean Energy	Utility
Wind	0.00	0.00	0.00	1.54	2.80	1.18
Solar	7.13	10.86	1.93	1.77	5.53	0.00
	NM			NV		
	Reference	Clean Energy	Utility	Reference	Clean Energy	Utility
Wind	1.82	1.83	1.82	0.01	0.01	0.01
Solar	2.11	2.13	0.97	1.64	3.85	1.53

Closer Look at New Mexico Results

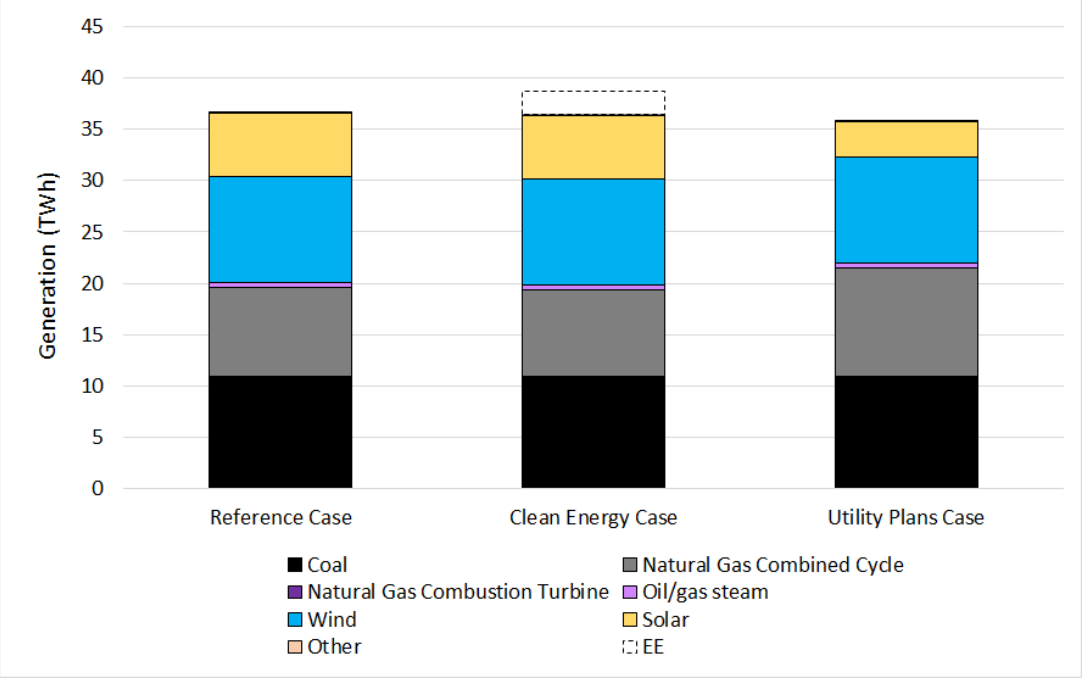
NM Capacity: BAU, Clean Energy, and Utility Cases

New Mexico Capacity (GW)							
Source	Historic	BAU Case		RPS Case		Utility Case	
	2017	2020	2030	2020	2030	2020	2030
Coal	2.63	1.49	1.49	1.49	1.49	1.49	1.49
Natural Gas	3.29	2.51	2.51	2.51	2.51	2.57	3.22
Solar	0.63	1.23	2.63	1.23	2.64	1.23	1.49
Wind	1.76	3.09	3.09	3.10	3.10	3.09	3.09
Total Capacity	**8.32**	**8.32**	**9.72**	**8.68**	**10.26**	**8.75**	**9.35**

NM Capacity Results

- 1.06 GW of coal capacity retires in all cases (planned)
- Only Utility Plans Case adds any new gas-fired plants to the grid, based on IRPs
- **New wind** is essentially same across BAU and Clean Energy Cases
  - 1.8 GW built in Model Year 2020 (2019-2022) to take advantage of federal tax credits
- **New solar** is very similar across BAU and Clean Energy Cases
  - Distributed generation carve-out in the modeled RPS leads to fewer utility-scale GWs, compensated by distributed solar
  - Build out occurs slightly differently in 2020-2030 period

NM Generation in 2030



NM Renewable Generation and Exports

- In RPS Case, 3.96 GW of new wind and solar generate enough electricity to power over 1.5 million homes in NM in 2030
- RE generation in 2030 equals 65 percent of NM demand, so NM ends up exporting significant amounts of clean electricity to other states
- NM exports more power with the RPS policy (net exports are 21% higher than in Reference Case and 36% higher than in Utility Plans Case)
- CA imports more power with stronger RPS policies in the four states

Note on Transmission

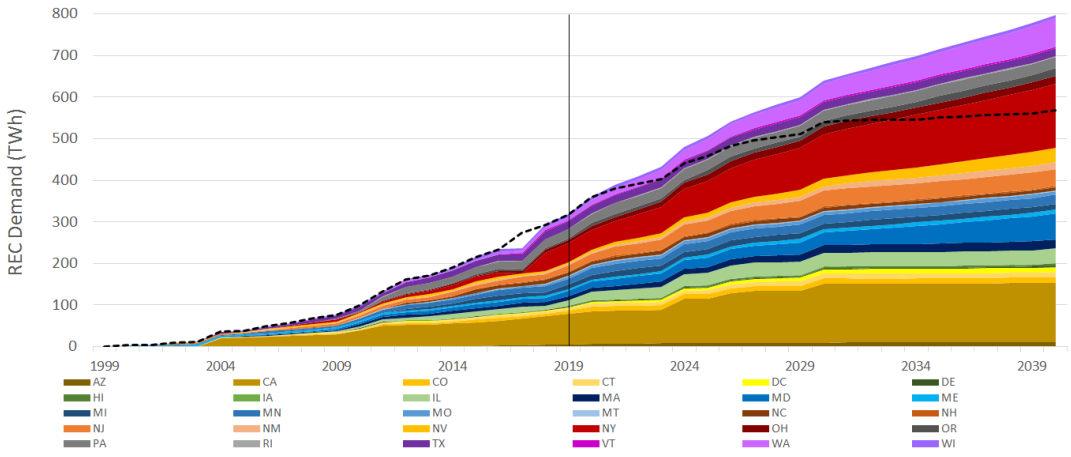
- ICF conducted a post-hoc transmission congestion analysis to determine the costs of adjusting the generation mix to meet transmission constraints
- Congestion costs were 14 percent higher (an increase of $431 million) across the four states in the RPS case than in the Reference Case
- This is one indicator of the value of transmission upgrades in the region

Conclusions for NM

- Similarity in new wind and solar build-out across BAU and Clean Energy case means wind and solar are most cost-effective new energy resources for the state (given our inputs)
- RPS still serves a different purpose
- With existing transmission constraints, NM can still export clean power, but improved transmission would be valuable to the region

UPDATE: Renewable Energy Growth After 2019 Legislation

Clean Energy Supply from RE standards



Impact of New RPS increases

New state renewable and clean energy bills passed since November 2018 will result in demand for another ~229 TWh of clean electricity annually by 2040.

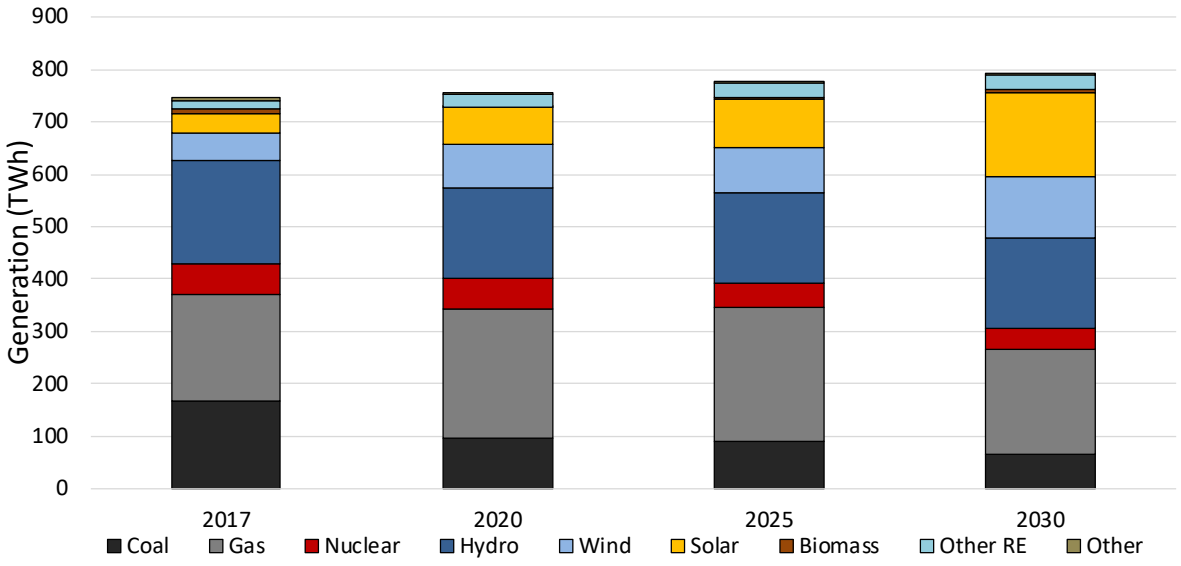
That's **equal to the electricity currently produced from every wind farm west of the Mississippi**.

This is a 40% jump from LBNL's Fall 2018 expected RPS-driven demand projection (i.e. based on policies as of Nov. 2018).

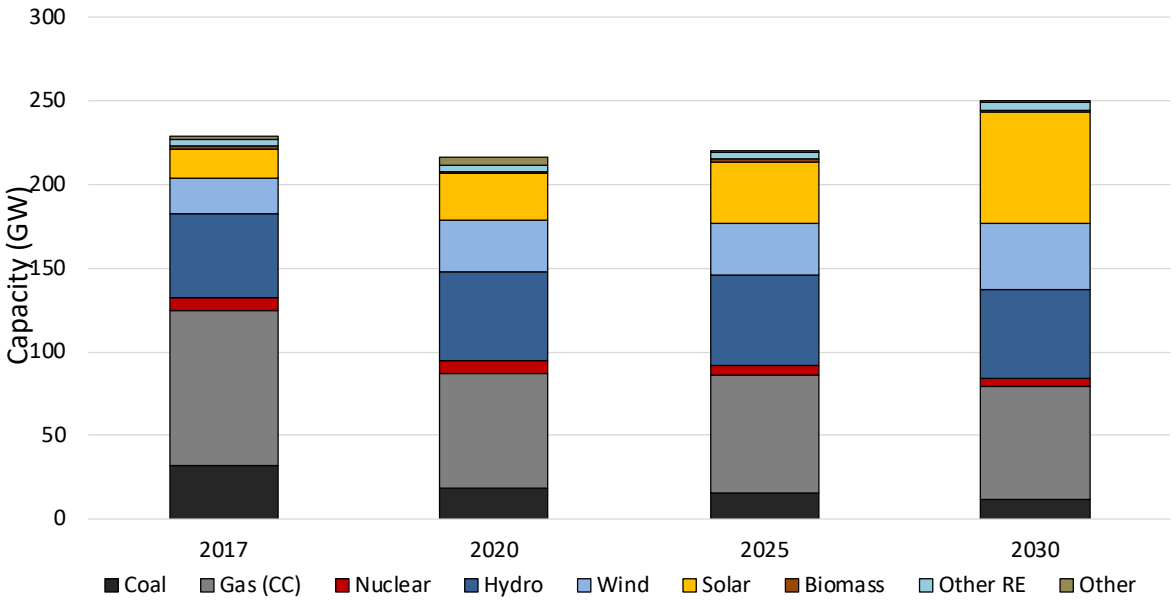
By 2040, **state renewable and clean energy standards will require utilities to procure around 800 TWh of clean electricity each year**.

In 2018, utility-scale wind and solar farms generated just 300 TWh of electricity in the U.S. (meaning we will **need to increase wind and solar capacity by at least 166% over the next two decades just to meet state policy requirements**).

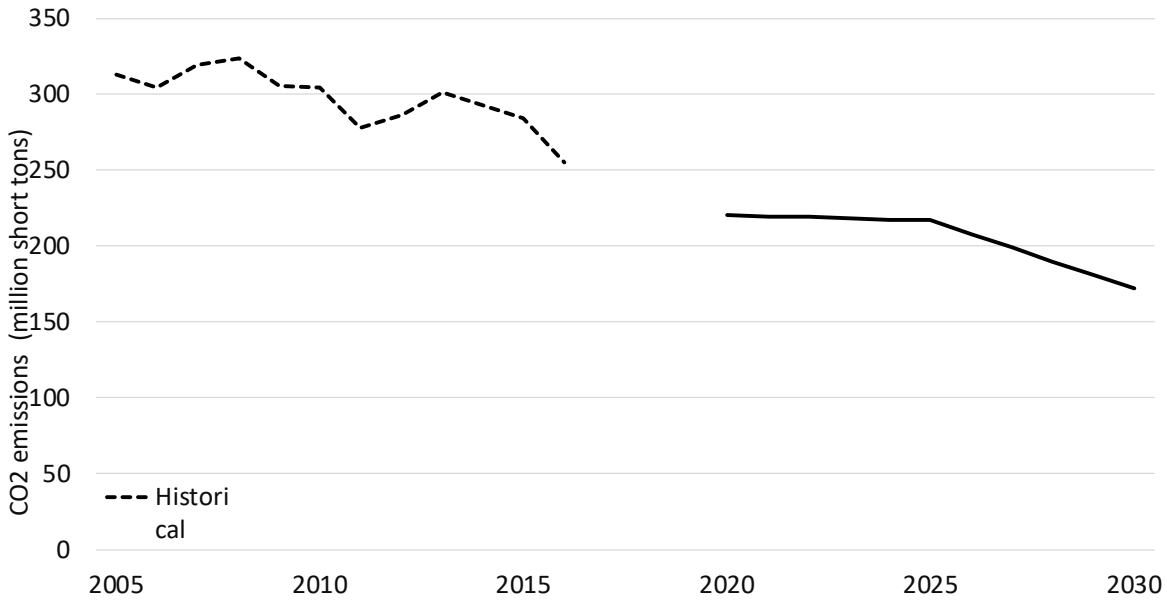
Business-as-usual results from IPM – Western Interconnect States



Business-as-usual results from IPM – Western Interconnect States



Business-as-usual results from IPM – Western Interconnect States



Summary

- Generation mix becomes cleaner.
  - Low-emitting generation (wind, utility-scale solar, hydro, nuclear, geothermal) grows from 48% of the mix in 2017 to 65% in 2030.
  - Generation from wind and utility-scale solar increases by ~3X, from 12% of the generation mix to 35%.
  - Coal generation declines from 23% of the mix in 2017 to 8% in 2030.
  - However, gas maintains a solid share of the generating mix, making up 25% of total generation in 2030.
- Coal capacity declines to 12 GW in 2030 (down from 32 GW in 2017).
- CO2 emissions fall to 45% below 2005 levels.

Thank you

NRDC

ENERGY TRANSITION ACT
SENATE BILL 489

The **Energy Transition Act** (ETA) establishes new renewable and zero-carbon emission portfolio standards for both utilities and rural electric cooperatives. The ETA renewable and clean energy requirements are:

20% renewable energy by **2020**
40% renewable energy by **2025**
50% renewable energy by **2030**

For investor-owned utilities	For rural electric cooperatives
80% renewable energy by **2040** **100%** zero carbon resources by **2045** as long as safety, reliability and impacts to customer bills are considered. **PNM** has already stated publicly that it will meet the zero-carbon requirement by **2040**.	**100%** zero-carbon resources by **2050**, composed of at least **80%** renewable energy as long as it is technically feasible, the system is reliable and is not unaffordable.

The law also eliminates two critical loopholes that had reduced actual renewables utilization in the state under the previous renewable energy standard: 1) All customers, regardless of size, will be provided renewable energy at least equal to these requirements; 2) The cost cap was amended to ensure renewable energy continues to be procured to meet the standard so long as the average price remains equal to or less than expected fossil prices ($60/megawatt-hour).

These renewable and zero-carbon portfolio standards (RPS) are among the strongest in the country, making New Mexico a leader in addressing climate change and renewable energy development. The RPS will provide jobs and training programs for New Mexico workers in expanding renewable and energy markets.

The ETA provides four tools to move towards these renewable energy and zero-carbon requirements, discussed in more detail below:

1. A process is created for private bonding authority for an entity closing a coal plant. This is effectively refinancing the coal plant debt through Triple-A rated bonds.

2. Three funds (one at Indian Affairs Department, one at Economic Development Department, and one at Department of Workforce Solutions) are created to provide transition assistance to tribal communities, displaced workers, and the broader affected community (100 miles from the plant) to promote economic development and job training. In addition to these funds for assisting the community in general, the legislation allows a company using a bond to provide severance to plant and mine workers along with direct training opportunities for these workers.

3. Reinvestment in clean energy and property tax base replacement.

4. Creation of apprenticeship opportunities in all types of energy development areas.

A page key is included at the end of this document that identifies the exact pages for the major component parts of the legislation.

It is important to note that this legislation does NOT force a coal plant to close prior to the zero-carbon target dates (2045 for utilities and 2050 for cooperatives). Economic factors are pushing companies to stop coal production now. As early as July 2017, economic forces caused Public Service Company of New Mexico (PNM) and other owners at the San Juan Generating Station to indicate that they would not continue to operate the plant. PNM later indicated that it would abandon the San Juan Generating plant in 2022. The community has been impacted, not only by the closure of the coal plant in the area, but also because oil and gas production is down in the area as of first quarter 2019. Economic development is needed in the area overall. The legislation supports the communities impacted and assists in the transition to less expensive, cleaner resources.

The legislation does contain an emission standard that will require all larger coal plants to meet a clean-gas standard after 2023. This will mean that a larger coal plant can operate (or in the case of San Juan Generating Station, reopen) as a coal plant only if it can meet this standard. This could only be met through a carbon recapture program at the plant that has only been done a few times world-wide. The plant could be used for any other purpose that meets a clean-gas standard.

Details of the Legislation

The legislation establishes forward-looking goals in the RPS standard through the creation of new renewable and zero carbon emission portfolio standards and then provides assistance to transition away from coal-fired generation and to develop new resources. To say it another way, the RPS goals are where state energy policy is headed; the remainder of the legislation provides tools to get out of coal and move to the state standard.

A decade ago, renewable resources were environmentally sound, but the costs were high. That is no longer true. Renewable energy is not only competitive but is often the **lowest cost** resource. For the next few years, federal tax credits further amplify this opportunity: recent wind contracts in the west have been below $20/MWh and solar contracts (with storage) have come in below $30/MWh.

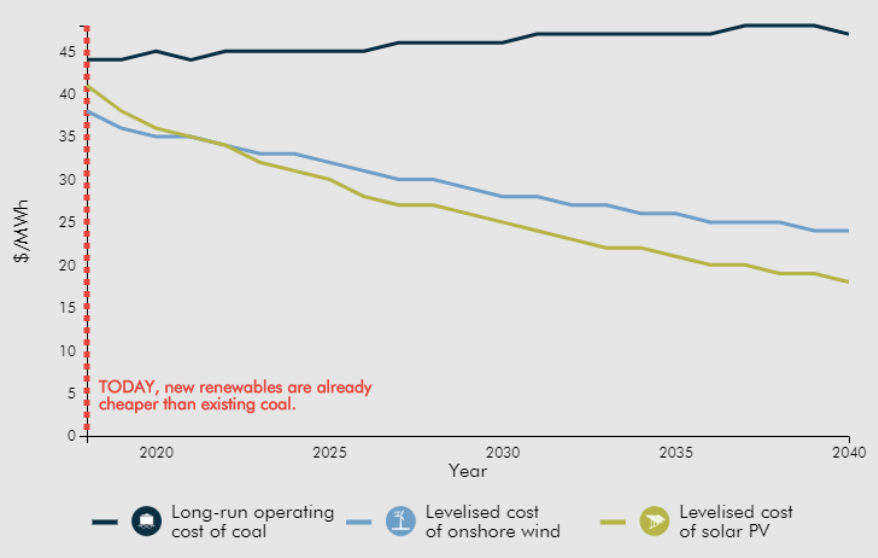
Cost of Electricity in 2019. Across the United States, electricity from coal now has a higher levelized cost of energy than natural gas, wind, and utility-scale solar (even without subsidies):

- Wind power costs between **$29-$59**/MWh or less[1];
- Utility-scale solar[2] power costs **$40-$46**/MWh or even less[3];
- Natural gas power costs **$41-$74**/MWh for combined cycle plants
- Power from coal costs **$60-$143**/MWh. (Lazard 2018)

[1] Deign, J. *Xcel attracts 'unprecedented' low prices for solar and wind paired with storage*. Green Tech Media. January 8, 2018. https://www.greentechmedia.com/articles/read/record-low-solar-plus-storage-price-in-xcel-solicitation#gs.nTvSyFQ

[2] Utility-scale, crystalline, solar photovoltaic.

[3] In Arizona, solar plus storage costs are being bid in the high $30s and mid $40s/MWh. In Colorado, Xcel Energy saw solar plus storage bids at $36/MWh; and wind plus storage was down to $21/MWh.



Cost of Coal, Wind, and Solar Power over Time

It is cost-effective for utilities, cooperatives and companies to move away from coal towards renewables. For example, each PNM customer is presently paying $13.25 per month for the San Juan Generating Station. PNM anticipates that this charge will be reduced by $3.00 - $4.00 per bill per month once the lower financing is in place and renewable energy replaces more expensive coal.

The following describes the major policy tools in the legislation.

<u>Tool 1.</u> A process for private bonding authority for an entity closing a coal plant.

Some utilities, such as PNM, have substantial coal plant costs – approved for recovery but still on their books – to be paid off over decades. The legislation uses a tool not currently available to the Public Regulation Commission (PRC) to better protect customers, while requiring the utility to have shared responsibility: a low-cost financing mechanism to pay off coal plant costs early and close the facilities. This is often referred to as "**securitization**." Securitization, the use of secured, customer-backed bonds, is a tool to advance coal-plant retirements and renewable development and assist workers in affected areas.

Securitization is like refinancing a mortgage at a lower rate. The lower interest, AAA-rated bonds will reduce the overall cost of closing coal plants by as much as 40%. Securitization allows the utility to issue debt with collateral, so it ends up being less expensive financing. The ETA permits utilities that are transitioning out of coal-fired generation to use customer payments as collateral to finance their transition away from coal. With low-cost AAA bonds secured by a surcharge on customer's bills, the effective interest rates charged to customers will change from 8-9% to 3-4%. When millions of dollars of debt is effectively refinanced at a low rate, the cost savings are substantial.

Integral in this process is the rating agency criteria that are the guidelines for achieving a Triple-A rating on the bonds. Key elements of the criteria include the following:

- Creation of a non-bypassable customer charge on every customer's bill that uses the energy;
- Issuance of an irrevocable financing order by the Public Regulation Commission;
- Pledge by the state to not change the law in a manner that affects the bond repayment; and
- An adjustment mechanism that allows the customer payments that are collected over time to be trued-up to match the bond payments going out.
- The bonds are sold privately and NOT backed or guaranteed by the State in any way.

The combination of these elements results in confidence that the bonds will be repaid, and therefore the rating agencies issue a Triple-A rating. It is important that this was accomplished through legislation, as the Public Regulation Commission does not have the authority to make these commitments without the legislation.

By the utility removing the abandoned coal plant from its books, the profit that the utility's shareholders earn (and that the utility's customers are presently paying for) is also given up. That is a key element of what makes this affordable for customers. The utility then takes the money it receives as early repayment of debt and uses those dollars to invest in new resources to continue serving their customers, subject to Commission over-sight and approval. Thus, the energy transition is funded affordably.

The legislation is also specific about what the bond will repay in addition to existing approved capital costs. While coal plant capital costs will take up about 85% of the bond proceeds, the legislation identifies other specific **"energy transition charges"** which are also authorized. These charges include the severance fund for workers, the cost of issuing the bond, and a specific amount for reclamation in addition to other amounts already collected for this purpose. It is important to note that the energy transition charges are only items that can be financed through the bond at the lower interest rate. It does NOT limit the PRC authority to address any of these issues in full through additional cost recovery. For example, the PRC retains full authority to address all reclamation cost recovery issues.

The bond associated with the San Juan Generating Station is authorized for up to $375M plus miscella-neous other costs. These $375 M in are allocated as follows:

$320M (85% of the proceeds)	Undepreciated capital investments previously ap-proved by the commission - early debt repayment
$20M	Severance and job training for plant and mine work-ers
$30M	Decommissioning and mine reclamation costs
$5M	Financing costs and other approved costs including bond counsel for the PRC
$20M	Worker assistance and economic development

PNM is currently planning on submitting abandonment paperwork to the PRC in a process set to begin at the end of June 2019 which will result in the closure of the plant by 2022. A preliminary description of the energy transition charges will be included for the PRC to conditionally approve.

Tool 2. Three funds (one at Indian Affairs, one at Economic Development and one at Workforce Solutions) are created to assist tribal communities, the broader affected community (100 miles from the plant) and promote economic development in the affected community and displaced workers. In addition to these funds for assisting the community in general, the legislation allows a company using a bond to provide severance to plant and mine workers along with direct training opportunities for these workers.

New Mexico communities impacted by the San Juan Generating Station coal plant closure will receive **$40 million in economic relief** - $20 million for direct severance and training for plant and mine workers and ~$20 million to assist the affected community.

The bill provides for a percentage of the bond to be put into the three community relief funds each time the bonding mechanism is used. It is anticipated that a bond could also be used if the Four Corners Generating Station closes.

The community benefits funding (~$20 million from the bond for the San Juan Generating Station) will go into three funds overseen by Indian Affairs, Economic Development, and Workforce Solutions. Through tribal consultation and with public input from community stakeholders, the funds will assist the Four Corners' economy to transition away from its dependence on fossil fuel extraction. As of June 2019, the three state agencies were already in the planning process to develop the community input process in the Four Corners area to assist in developing the plans for the use of these funds. It is anticipated that these funds can be leveraged to obtain federal and other funds to further assist the community.

Tool 3. Reinvestment in clean energy and property tax base replacement

The bill directs hundreds of millions of dollars of replacement power, to be determined by the PRC, to be developed. The development can help to restore the tax base for the community and its schools after SJGS closes and will provide substantial economic activity for many years to come. The higher RPS goals will also provide substantial opportunities throughout the state for the development of renewable resources and energy storage. The bill requires the PRC to approve storage projects that reduce costs for customers and facilitate the integration of renewable energy, where they are the lowest cost option among feasible alternatives.

PNM has issued a request for proposals for the replacement power (450 MW) presently authorized to be generated at the San Juan Generating Station. They have received hundreds of bids responsive to the RFP and will present a series of options to the PRC in its filing at the end of June 2019. The PRC will make the final determination regarding the approval of a replacement power plan. It is anticipated that these options will include at a minimum

1) A lowest-cost option,
2) An option to put all resources in the Four Corners, which is authorized in the legislation,
3) An option to utilize all renewable resources located throughout the state, and
4) A hybrid option.

The local taxes paid on the San Juan Generating Station provide most of the tax base in the Central Consolidated School District. It is unknown what the ultimate impact to the tax base will be because of the closure of the plant until the replacement power package is approved. Senator Mimi Stewart sponsored a memorial (SM 124) directing a group to look at the tax impact to Central Consolidated School District during the 2020 fiscal year to better allow the legislature and executive branch to assist the school district through the transition.

Tool 4. Creation of apprenticeship opportunities in all types of energy development areas.

New Mexico's economy will be bolstered by a large renewable energy build-out, with a local workforce trained to supply the needed labor. There will be a great deal of new construction in the state – renewable energy and storage projects – starting now through at least 2050 in order for utilities and cooperatives to meet the RPS standards. The bill requires a minimum apprenticeship requirement (10% on project beginning before 2024, 17.5% for projects beginning prior to 2026, and 25% for projects beginning after 2026) for all electric generation projects to train New Mexico worker to participate fully in the energy markets in New Mexico.

Outline of Bill Sections:

Due to bill drafting constraints, the legislation is not in an order that is easy to follow. Here are where key sections and provisions can be found:

Topic	Bill page
Rural electric cooperative RPS	55-64
Rural electric cooperatives may count all of their hydro resources as renewable energy to meet their RPS standard	60
Public utility RPS	64-82
For the 80% renewable target, up to 2047, a public utility does not need to displace a zero-carbon resource to reach this standard. This will mean that existing nuclear resources, which are zero-carbon resources, can be used up through that date (2047 is when the current licenses at Palo Verde expire.)	65
Private bonding authorization process for a coal plant that is being abandoned	1-50
Costs authorized from bond, including severance and training for plant and mine workers and previously authorized, but unrecovered, capital costs	4-5
Location of replacement resources after abandonment required that must be in same school district as abandoned facility up to 450MW	9-11
Bond is secure, and therefore anticipated to be AAA rated, because the repayment of the bond becomes a non-bypassable charge on customer bills	8, 13
Indian Affairs, Economic Development and Displaced Worker Funds	40-47
Apprenticeships in construction projects for electricity generating facilities	50-51
Authorization to develop renewable energy storage	51-55
Air quality standard for coal plants in service prior to 1984, effective in 2023	78-82

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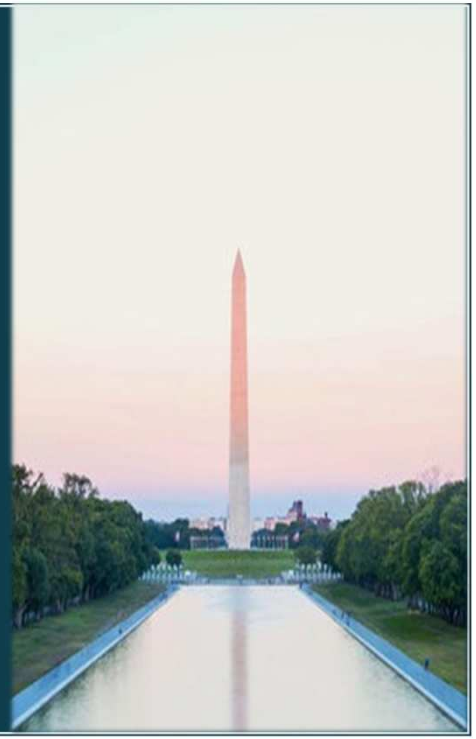
PURPA Developments

Electric Power in the Southwest
Santa Fe, NM
July 16, 2019



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Public Utility Regulatory Policies Act of 1978

- National Energy Act, a response to the Arab oil embargo, included:
  - PURPA
  - Fuel Use Act
  - Natural Gas Policy Act
  - National Energy Conservation Policy Act (energy efficiency)
- PURPA's electricity-related provisions address:
  - Retail electric rate design policies
  - Renewable generation and cogeneration (§ 210)
- PURPA § 210 was early step toward competitive power markets
  - Non-utility generators
  - Non-cost-of-service rates

PURPA Section 210

- Section 210 creates rules regarding “Qualifying Facilities” (QFs):
  - cogenerators - generating units that simultaneously produce electricity and other forms of useful energy (typically steam)
    - Must meet minimum efficiency standards
  - “small power producers” – renewable energy facilities with a maximum size of 80 MW
- Utilities must purchase electric energy from QFs at “avoided cost” rates, which reflect the cost that the utility would otherwise have incurred to generate or purchase the energy supplied by the QF.
- QFs are largely exempt from regulation under the FPA and PUHCA, and from state regulation

Roles of Federal and State Regulators Under Section 210

- FERC prescribes rules on:
  - QF criteria and qualification process
    - E.g., facilities within one mile of each other considered part of same facility
  - Required purchases from QFs at avoided cost
  - Interconnection and back-up power
  - Exemptions from FPA, PUHCA, and state rate regulation
- State Commission implementation
  - Establish “avoided cost” rates for state-regulated utilities
  - Set other terms and conditions of must-buy contracts
  - Utilities not regulated by PUCs (i.e., munis and coops) establish their own avoided cost
  - Approach sustained by Supreme Court against 10th Amendment challenge. FERC v. Mississippi, 456 U.S. 742 (1982).
- State implementation of PURPA varies widely

EPAct/05 Narrowed Must Buy Obligation

- Mandatory purchase obligation may be terminated if FERC determines that a QF has access to competitive wholesale markets
- FERC Order No. 688 – Rebuttable presumption that a QF has access to competitive market if it is in an RTO/ISO and QF is larger than 20 MW

PURPA in Context – the World has Changed

- 1978
  - Virtually no renewable energy (other than hydro)
  - Vertically integrated utilities owned nearly all generation
  - No open transmission access
  - No electricity markets
  - Wholesale power sales at cost-of-service rates
- 2019
  - Renewable energy accounts for 17% of electricity generation (10% without hydro); technology costs continue to fall
  - Independent power producers abound
  - OATTs
  - Organized electricity markets in much of the country
  - Nearly all power sold at market-based rates
  - Federal tax credit support for RE (being phased out)
  - Widespread state renewable portfolio standards
  - Strong end-use customer demand for renewable energy
  - Strong end-use customer interest in distributed solar

Drivers for Possible Reform

- Utility concerns
  - Long-term contracts put price risks on utility customers
  - State-determined avoided costs
- Developer concerns

Current Issues with PURPA – QF Definition

- Should FERC's "one-mile rule" for determining whether facilities are part of the same QF be modified?
  - Wind farms
  - Recent Sunrun order waiving QF certification requirements for residential rooftop solar
- Battery storage as part of QF
  - FERC has stated that storage is not a QF by itself, but can be part of a QF if paired with QF-eligible generator

Current Issues with PURPA – Mandatory Purchase Obligation

- Should Section 210 mandatory purchase obligation be eliminated altogether?
- Changes to EPAct/05 exemption from must-buy obligation
  - For QFs in RTOs/ISOs, should the 20 MW threshold be dropped, so exemption applicable to all QFs?
  - Should exemption apply in the Western EIM?
  - Should IOUs be exempt if state regulators have determined that IOU does not have a need for additional energy or capacity, or if IOU conducts RFP process?

Current Issues with PURPA Reform – Terms Governing Mandatory Purchase

- Avoided cost determinations
  - Should avoided cost pricing reflect RTO wholesale energy prices where applicable (including negative pricing)?
  - Should avoided cost reflect the value of:
    - Capacity if utility IRP shows that no capacity needed?
    - For intermittent resources, cost of backup generation?
    - QF environmental attributes?
    - Diversity, reliability, or other benefits?
  - Should FERC exercise more oversight over state avoided cost determinations?
- Length of purchase contracts
- Relationship to net metering

Congressional and FERC Activity

- Some reforms could be accomplished by FERC; some require Congressional action
- Bills introduced in this Congress to narrow PURPA (changes to, eg, 1 mile rule; 20 MW presumption; give PUC authority to waive must-buy) include:
  - S. 1760 (Barrasso, R-WY)
  - H.R. 1502 (Walberg, R-MI)
- Bills introduced in this Congress to broaden PURPA (eg, into a Federal RPS):
  - S. 1974 (Udall, D-NM)
  - H.R. 2597 (Lujan, D-NM) and S. 1359 (Smith, D-MN)
- House Committee hearings held in Sept. 2017 and Jan. 2018
- Nov. 2015 Hill letter to FERC on need for PURPA reform
  - FERC held technical conference in June 2016
- Chairman Chatterjee has stated recently that FERC continues to review its PURPA regulations
- Legislation quite unlikely in the foreseeable future

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Questions?

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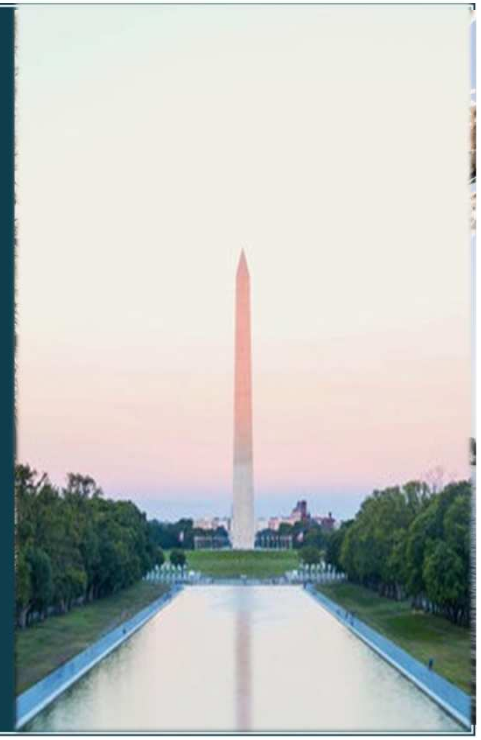


Electric Power in the Southwest

Santa Fe, NM
July 16, 2019

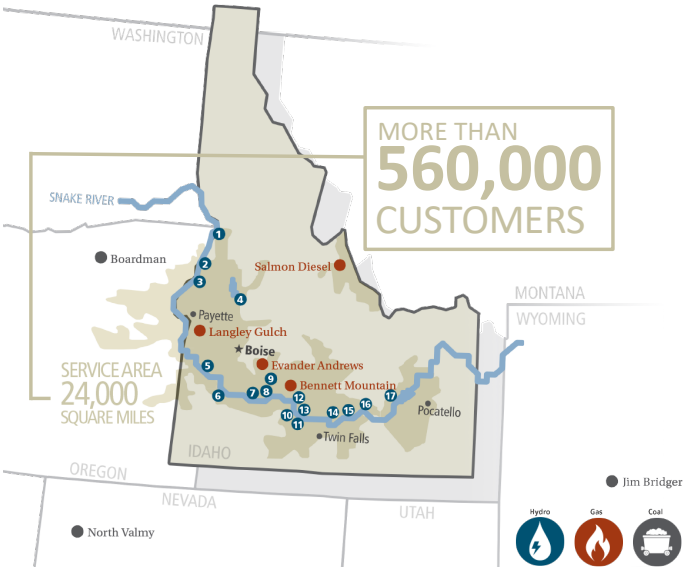
Our Clean-Energy Goal

As Idaho Power continues serving customers and communities with **reliable**, **affordable** energy, we look to do so with a new and exciting goal:

Providing 100% clean energy by 2045

Clean Today. Cleaner Tomorrow.™

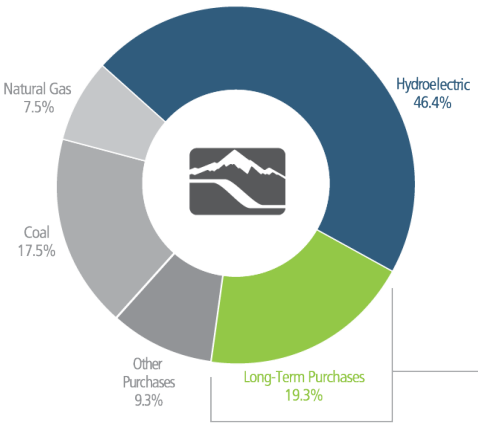
Communities We Serve



1	Hells Canyon	391,500 kW
2	Oxbow	190,000 kW
3	Brownlee	654,100 kW
4	Cascade	12,420 kW
5	Swan Falls	27,170 kW
6	C.J. Strike	82,800 kW
7	Bliss	75,000 kW
8	Lower Malad	13,500 kW
9	Upper Malad	8,270 kW
10	Lower Salmon	60,000 kW
11	Upper Salmon	34,500 kW
12	Thousand Springs	6,800 kW
13	Clear Lake	2,500 kW
14	Shoshone Falls	11,500 kW
15	Twin Falls	52,897 kW
16	Milner	59,448 kW
17	American Falls	92,340 kW

We're Well On Our Way

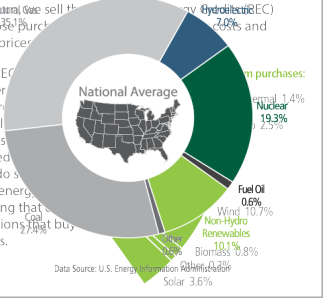
Energy Mix



About our Long-Term Purchases

Idaho Power is committed to supporting renewable energy sources, such as wind and solar, and we buy them as part of our energy mix. In [illegible] we sell th[illegible] (REC) we get from those purch[illegible]s and keep customer price[illegible]

The buyer of a REC claim that power energy. Therefor represent that el produced by this is being delivered customers. We do s these alternate ener and we pass along that to the organization that buy the RECs from us.



Clean and Reliable

WE KEEP THE LIGHTS ON

99.975%

OF THE TIME

Clean and Affordable

OUR PRICES ARE MORE THAN

20% BELOW

THE NATIONAL AVERAGE

Clean Today. **Cleaner Tomorrow.**

Today

Nearly 50 percent of our energy already comes from clean hydroelectricity.

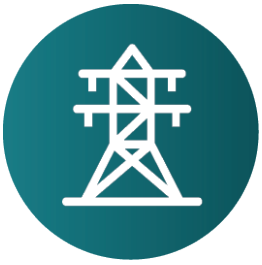
Our carbon emissions intensity is 46 percent less than it was in 2005.

We recently reached a deal to buy 120 megawatts of low-priced solar power.

Clean Today. **Cleaner Tomorrow.**

Tomorrow

We are continuing our path away from coal.

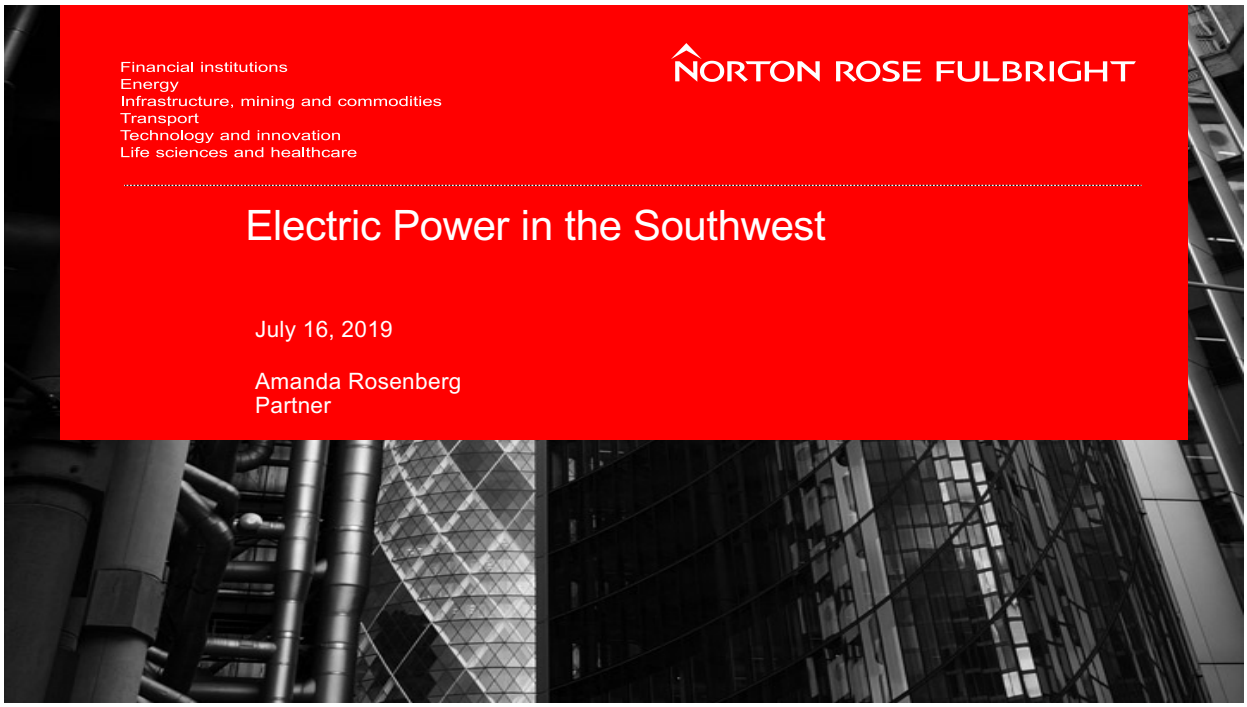


The proposed Boardman to Hemingway transmission line should help move clean energy.

We carefully plan for the future and keep an eye on technology.

Clean Today. **Cleaner Tomorrow.**

cleantoday.com



Financial institutions
Energy
Infrastructure, mining and commodities
Transport
Technology and innovation
Life sciences and healthcare

NORTON ROSE FULBRIGHT

Electric Power in the Southwest

July 16, 2019

Amanda Rosenberg
Partner

There are two ways to look at project finance. One is that borrowing a large amount of money to build a project requires locking down costs and locking in a revenue stream so that the bank can determine how much money you will have to pay debt service.

The other is that project finance is an exercise in risk allocation. Nothing gets financed until all the risks have been identified and allocated among the parties.

The first challenge with storage projects is to find a fixed revenue stream. Debt service coverage ratios for standalone storage are probably around 1.35x. There are many different business models.

The challenge for storage is the only revenue that banks will credit in deciding how much to lend is a fixed capacity payment that is locked in for a specific contract term. Merchant power plants that sell electricity into the spot market can be financed, but only with a hedge that sets a floor under the electricity price. Storage needs the equivalent of such a hedge.

Most of the risks in energy storage projects are not dissimilar from any other project financing. Lenders focus first on anything that might interrupt the revenue stream.

-site and permits
-counterparty credit

However, there are also regulatory, technology and operating risks that are unique to storage. FERC and RTOs are struggling with whether to classify storage as generation, transmission or a hybrid. Projects are more likely to get financed the clearer the regulatory framework.

Most lenders consider lithium-ion technology bankable and require an extended warranty from a supplier with a strong credit rating. Lenders are less comfortable with other emerging technologies and may not be ready to lend against them without an additional performance guarantee.

The role of the asset manager is extremely important. The asset manager optimizes dispatch. Lenders will insist on an asset manager with a good track record, although this is difficult given the nascent nature of the industry.

There are two tax benefits for a which storage project qualifies potentially: an investment tax credit and depreciation.

Batteries qualify for a 30% investment tax credit at the federal level if they are considered part of the generating equipment at a project. The battery should be on the project side of the step-up transformer or customer side of the inverter. It should be owned by the same legal entity that owns the project. It should be physically adjacent.

The IRS issued two private rulings confirming that batteries added to large wind farms qualify. It issued one ruling to a rooftop solar company. It said in the rooftop ruling that a "75% cliff" applies.

The IRS is rewriting its regulations on when investment tax credits can be claimed. The issues are complicated. It is unclear when they will be resolved.

Solar projects must be under construction by the end of 2019 to qualify for a 30% investment tax credit. There is a 26% credit if construction starts in 2020 and a 22% credit if construction starts in 2021.

Projects must be in service by the end of 2023.

The solar credit drops to 10% for projects that start construction after 2021.

Wind projects had to be under construction by December 31, 2016 to qualify for 100% production tax credits. Wind projects qualify for 80% PTCs if they began construction in 2017, 60% if construction started last year and 40% if construction starts this year.

Projects generally have four years to be placed in service to avoid having to show continuous construction. More on that later.

Wind developers will have the option to claim a 30% investment tax credit instead of PTCs during the same period and with the same phase down. Thus, for example, a developer who started construction of a wind farm in 2018 could claim an 18% investment tax credit (30% x 60%).

-offshore wind

There are two ways to start construction.

PTC notices: 2013-29, 2013-40, 2014-46, 2015-25, 2016-31 and 2017-4

ITC notice: 2018-59

5% Test

One is to "incur" at least 5% of the eligible project cost. Costs are not incurred merely by spending money, with one exception. The developer must ordinarily take delivery or title to services or equipment to count costs. The exception is that a payment at year end counts in the year payment is made as long as the equipment or services are delivered within 3 ½ months after payment.

-method of accounting

-7%

A note about services: the cost of services is not incurred until the services are fully performed.

If the vendor charged for future transportation to the project site as part of the equipment price, back it out of the costs considered incurred before the construction-start deadline. The same principle applies to a prepaid storage fee that is built into the price of the equipment.

-mixed contracts

Physical work test

The other way is to start "physical work of a significant nature" at the project site or on equipment for the project at a factory.

The IRS said it focuses on the nature of the work and not the quantity or cost. It said there is no fixed minimum amount of work or monetary or percentage threshold required.

For wind projects, examples of significant physical work are work at the site on turbine foundations or on string roads that run between the turbines or work at a factory on the step-up transformer.

For solar projects, examples include installation of "racks or other structures" to which solar panels will be affixed at the site, manufacture at a factory of "components, mounting equipment, support structures such as racks and rails, inverters, transformers…and other power conditioning equipment" qualifies.

Work at a factory on components does not count if the components are a type that the manufacturer normally keeps in inventory

Preliminary activity, such as clearing a site or removing existing equipment, does not count.

The physical work must be on equipment that is "integral" to generating electricity.

Binding contracts

It is not enough merely to start construction in time. There must also be continuous work on the project after the year construction starts. A developer does not have to prove continuous work on any project that is placed in service within four years.

-wind v. solar

-construction too early?

-document

GETTING FROM A TO B ON THE PATH TO A CLEAN ENERGY FUTURE

Clean Energy Innovation Pathways: Existing And Emerging Clean Energy Technologies Paving A Way For An Affordable, Clean, Low Carbon Future

ENERGY FUTURES INITIATIVE

Jeanette Pablo
General Counsel

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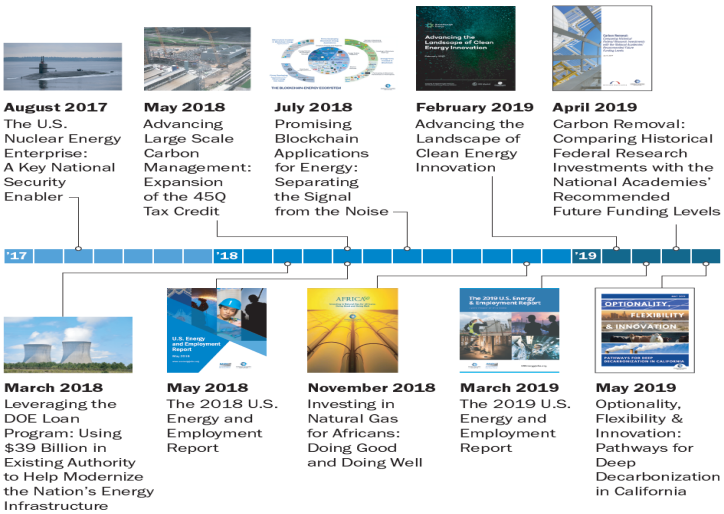
ENERGY FUTURES INITIATIVE

Energy Futures Initiative Reports



August 2017
The U.S. Nuclear Energy Enterprise: A Key National Security Enabler

May 2018
Advancing Large Scale Carbon Management: Expansion of the 45Q Tax Credit

July 2018
Promising Blockchain Applications for Energy: Separating the Signal from the Noise

February 2019
Advancing the Landscape of Clean Energy Innovation

April 2019
Carbon Removal: Comparing Historical Federal Research Investments with the National Academies' Recommended Future Funding Levels

March 2018
Leveraging the DOE Loan Program: Using $39 Billion in Existing Authority to Help Modernize the Nation's Energy Infrastructure

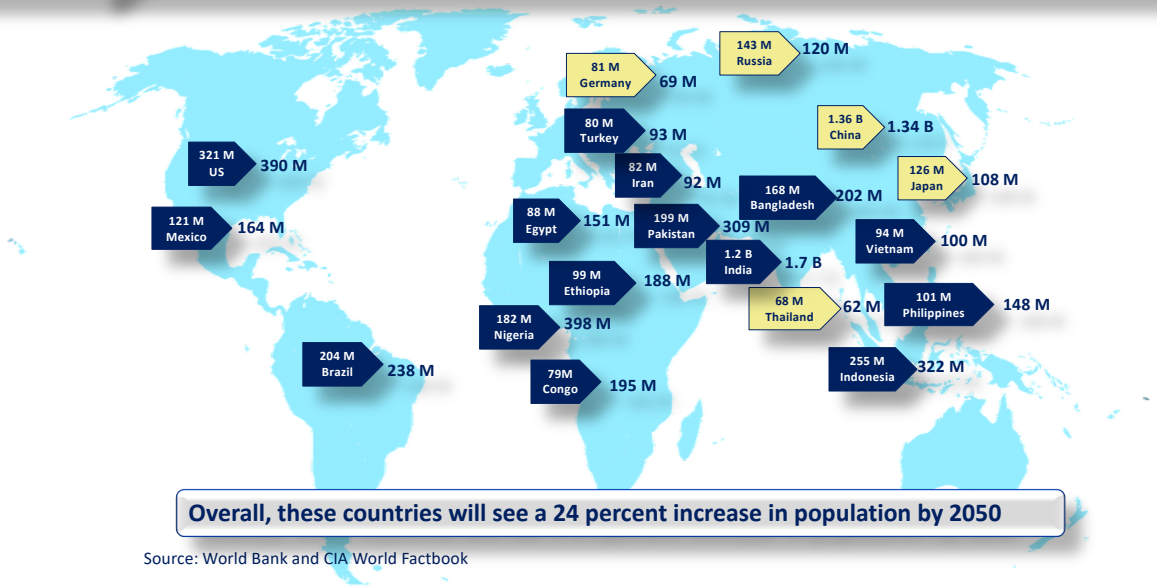
May 2018
The 2018 U.S. Energy and Employment Report

November 2018
Investing in Natural Gas for Africans: Doing Good and Doing Well

March 2019
The 2019 U.S. Energy and Employment Report

May 2019
Optionality, Flexibility & Innovation: Pathways for Deep Decarbonization in California

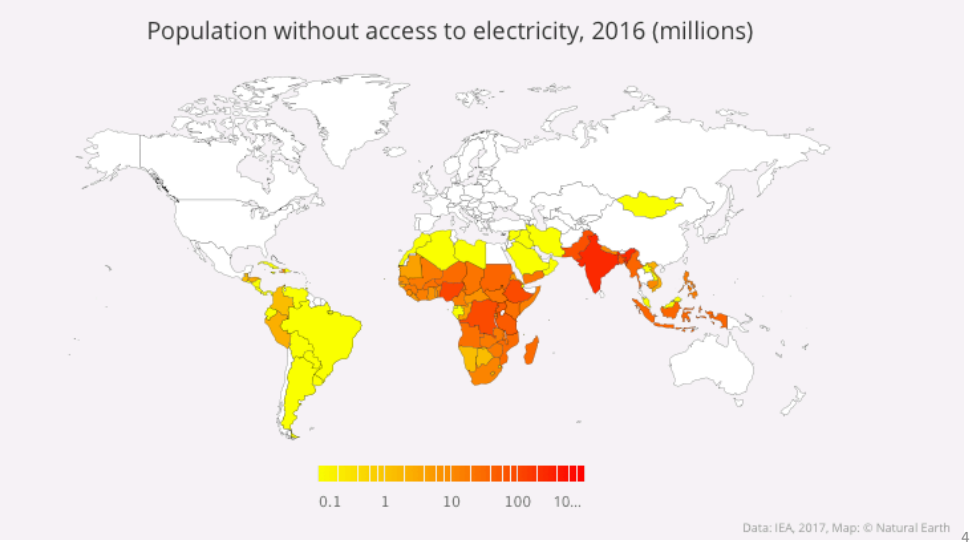
Top 20 Most Populous Countries, 2015/2050



Overall, these countries will see a 24 percent increase in population by 2050

Source: World Bank and CIA World Factbook

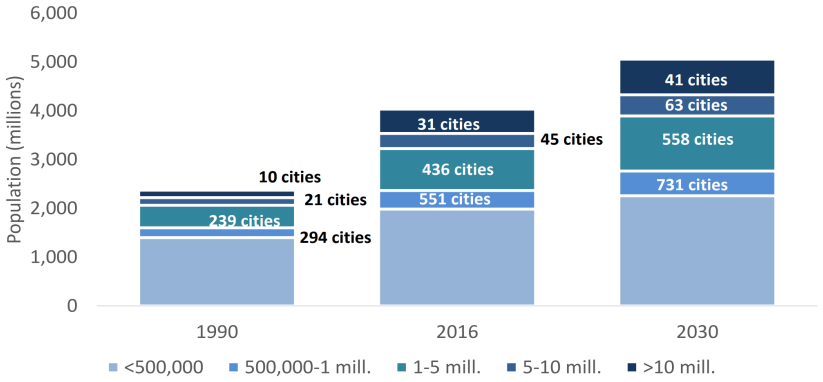
Population without Access to Electricity in 2016



Global Urbanization Trends

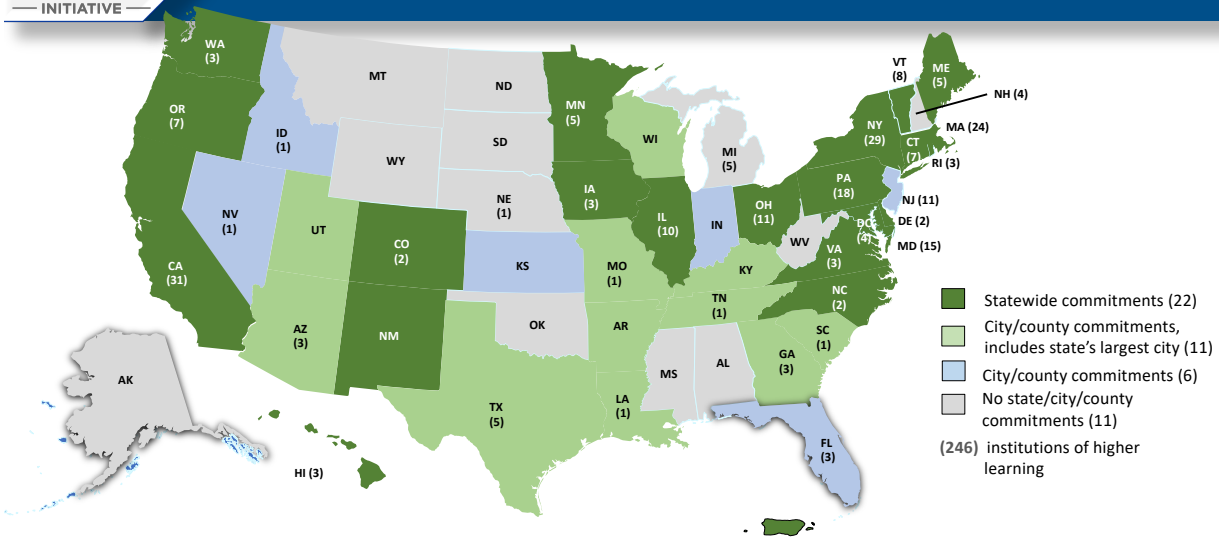
Between 2016 and 2030, the population in all city size classes is projected to increase, while the rural population is projected to decline slightly. Between 1990, cities with more than 10 million individuals will increase from 10 to 41. Cities with 5-10 million individuals will increase from 21 to 63. In 2017, Boston's population was 617,594. New York's population was 8,622,698 and LA was 3,99,759 (2018).

Global urban population by size class of settlement, 1990-2030



Source: United Nations, Department of Economic and Social Affairs, Population Division (2014): World Urbanization Prospects: The 2014 Revision.

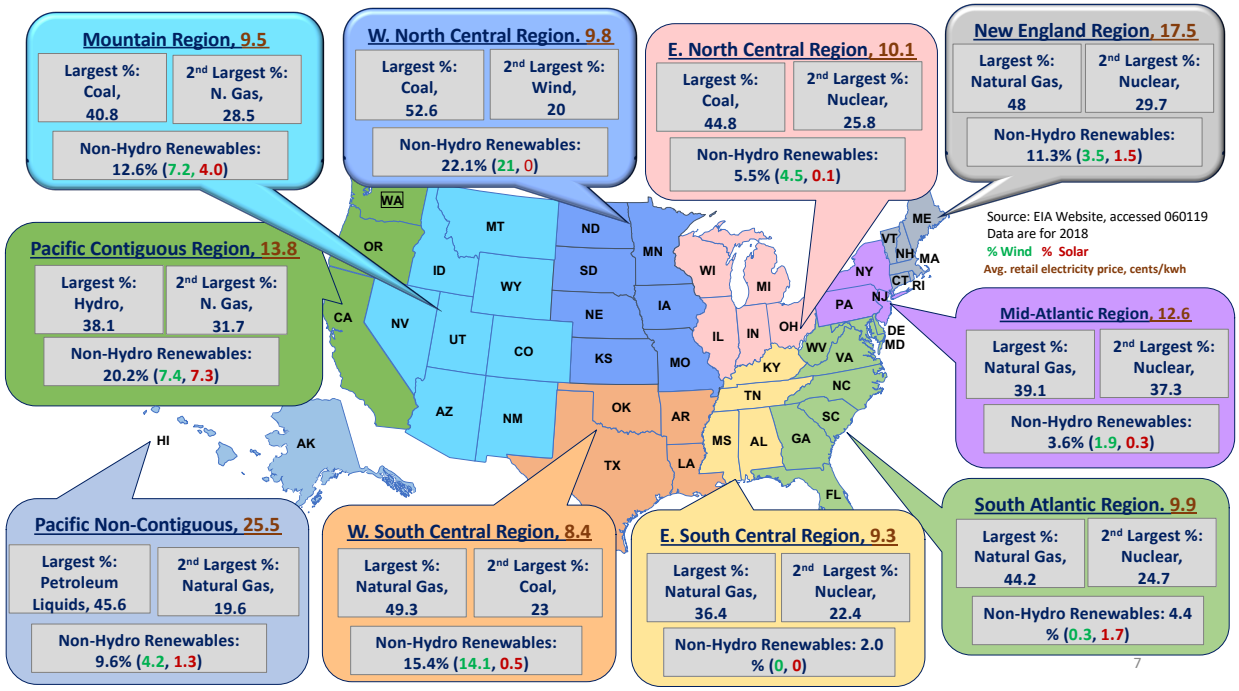
Sub-national Players Committed to Paris Accord



* From lists in formation

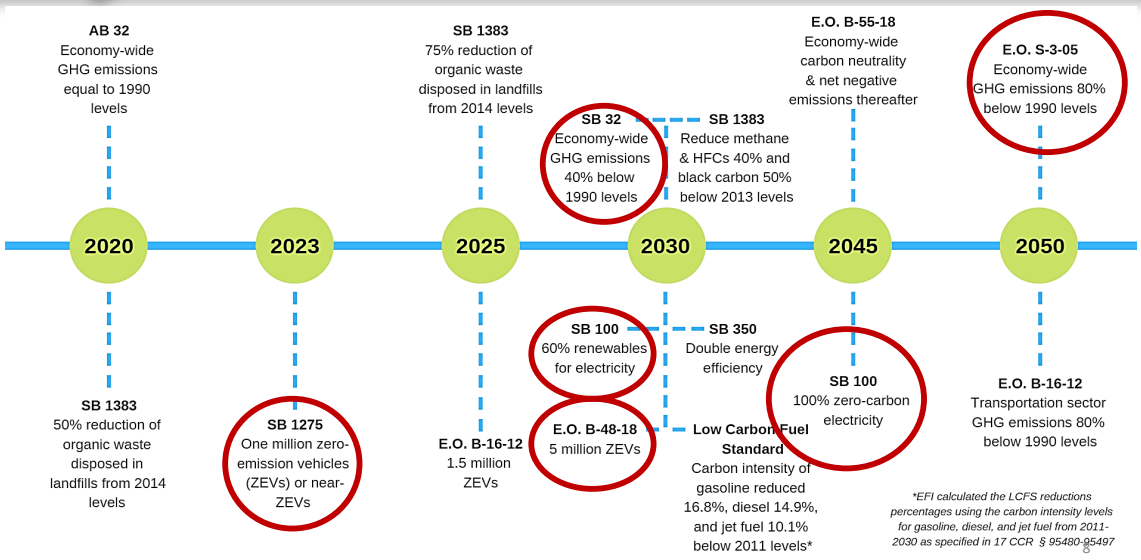
Puerto Rico

Source: Energy Futures Initiative (EFI), 2018. Compiled using data from U.S. Climate Alliance, Climate Mayors, and Office of the Attorney General for the District of Columbia.



ENERGY FUTURES INITIATIVE

Timeline of Key California Policies for GHG Reductions

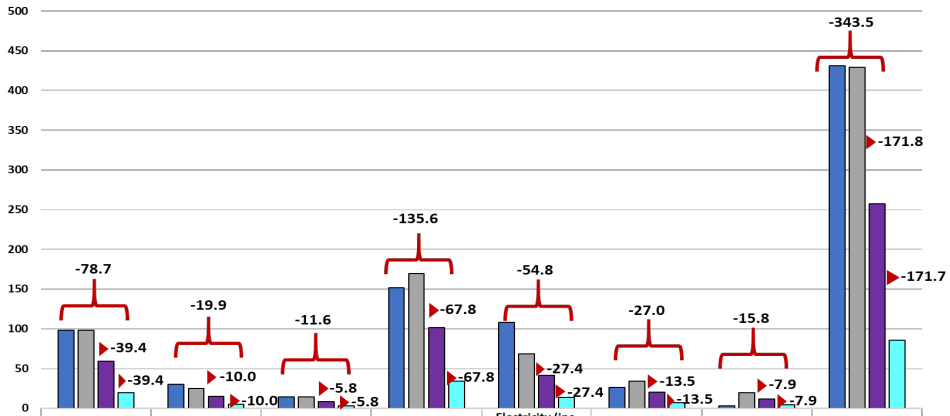


Emissions-Reduction Baseline

MMT CO2e reductions needed by 2030 from 2016 actual

MMT CO2e reductions needed by 2050 from 2040 target

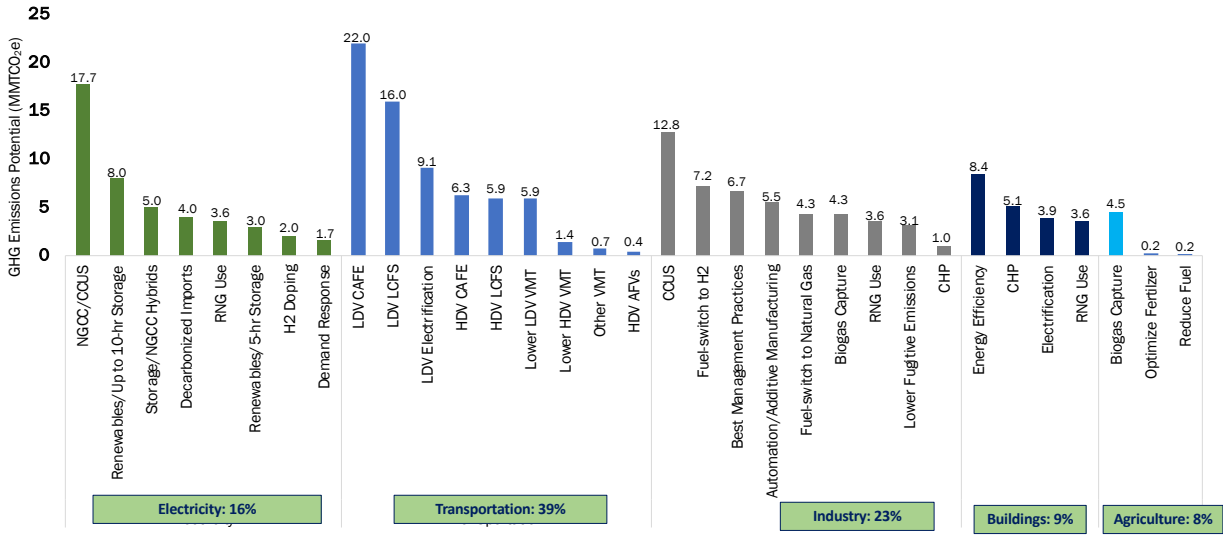
Total MMT CO2e reductions needed by 2050 from 2016 actual



	Industry	Residential	Commercial	Transportation	Electricity (inc. imports)	Agriculture	High GWP	TOTAL
1990 Actual	98	30	14	152	108	26	3	431
2016 Actual	98.4	24.9	14.4	169.38	68.58	33.84	19.78	429.28
40% Reduction from 2016 Actual	59	14.9	8.6	101.6	41.1	20.3	11.9	257.6
80% reduction from 2016 Actual	19.7	5	2.9	33.9	13.7	6.8	4	85.9

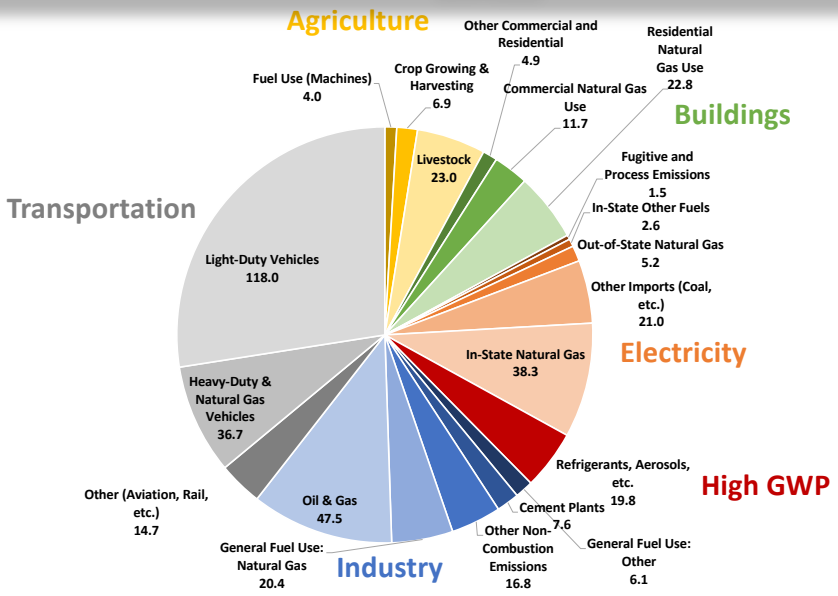
California: 33 Pathways were identified as options for meeting 40% emissions reduction by 2030

Identified Emissions Reduction Potential By Pathway



2016 CA GHG Emissions by Sector, Subsector & Source

(MMTCo2e)



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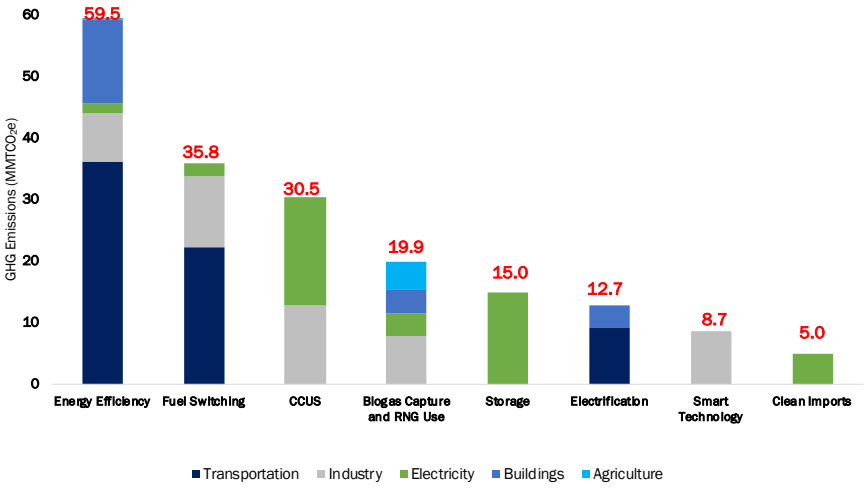


Tech Analysis

Analyzing Technologies for Meeting the 2030 Targets

With 2030 just over a decade away, it would be risky for California to depend on technology innovation to meet the emissions-reduction targets.

As such, our analysis relied heavily on existing clean energy technologies deployed at-scale to meet 2030 goals.

This analysis considered a range of relevant variables to determine the total value of each technology pathway, including:

- the current and expected performance of each technology in the 2030 timeframe;
- the relative costs, including associated infrastructure costs and the potential costs of stranded assets ;
- the net impacts of each technology on carbon emissions in California; and
- potential positive, and negative, feedbacks of each pathway on the State's social and environmental well-being.

2030 Emissions Reduction Pathways		Major Energy End Uses																													
			Industry						Electricity				Transportation			Buildings				Agriculture				Other	
			Mining, O&G Prod.	O&G Ref., Cement, Chem.	Manufacturing	T+D	Recycling, Waste	Baseload	Peaking	Load-following	Vrbl. & Freq. Reg.	HDV, MDV	LDV	Water, Rail	Off- Road	Space Heat	Space Cooling	Water Heat.	Cooling	Machines	Soil Mgmt.	Livestock Mgmt.	ODS*	All Others
	2016 Emissions ($MMTCO_2e$)	429.4	21.6	58.2		5.1	10.7	68.6		0	N/A	35.6	117.9	3.2	2.6	39.4				3.2	6.8	23.1	19.2	13.2
	Emissions (%)		5.0	13.6		1.2	2.5	16		0	N/A	8.30	27.5	0.75	0.6	9.2				0.8	1.6	5.34	4.5	3.08
Diffusion	EE Programs		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Smart End-Use Devices		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	End-Use Electrification				✓	✓			✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓
	Biogas		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	
	Liquid Biofuels											✓	✓		✓					✓			✓	
	Demand Response Programs			✓	✓			✓	✓	✓	✓					✓	✓	✓	✓	✓			✓	✓
	Combined Heat and Power (CHP)		✓	✓	✓			✓	✓	✓	✓					✓		✓						
	Variable Renewable Energy (Wind/Solar)				✓			✓	✓		✓					✓	✓	✓		✓			✓	✓
	Expanded WEIM							✓	✓	✓	✓													
	Fuel Switch to Natural Gas		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓					✓	✓		✓	✓
	NGCC/Battery Hybrids								✓	✓	✓													
	Pumped Hydro								✓	✓	✓												✓	✓
	H2 Doping		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓			✓	✓
	Grid-scale Storage: 5-hr								✓	✓	✓												✓	✓
	CCUS/Industry		✓	✓	✓																		✓	✓
	Automation/Additive Manufacturing		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓
	NGCC/CCUS							✓	✓		✓												✓	✓
Adoption	Fuel Switch to H2		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓									
	Increased Clean Electricity Imports							✓	✓	✓	✓													
	Grid-scale Storage: 10-hr								✓	✓	✓													

Analyzing Technologies for Meeting the 2050 Targets

Meeting the long-term targets, including 80% reduction by 2050 (from 1990) and carbon neutrality by 2045 is much more challenging and will require technology innovation.

This is in part due to the energy technology innovation is relatively slow due to the system's long cycles of adoption, its role as a highly capitalized commodity business, complex supply chains, and established customer bases.

Also, as California achieves higher levels of emissions reduction, the marginal cost of abatement increases. The operational characteristics of a deeply decarbonized energy system are unknown. Realistic technology options do not exist for certain sectors, including aviation, heavy-duty transport, high-temperature industrial process heat, and aspects of electricity.

Meeting the long-term goals requires actions today.

2050 Emissions Reduction Pathways		Major Energy End Uses																													
			Industry					Electricity				Transportation				Buildings				Agriculture					Other	
			Mining, O&G Prod.	O&G Ref., Cement, Chem.	Mfg.	T+D	Waste	Baseload	Peaking	Load-following	Vrbl. & Freq. Reg.	HDV, MDV	LDV	Water	Off- Road	Space Heat	Space Cooling	Water Heat.	Cooling	Machines	Soil Mgmt.	Crop Prod.	Livestock Mgmt.	ODS*	All Others
	2016 Emissions ($MMTCO_2e$)	429.4	21.6	58.2		5.1	10.7	68.6		0	N/A	35.6	117.9	3.2	2.6	39.4				3.2	6.8	0.7	23.1	19.2	13.2	
	Emissions (%)		5.0	13.6		1.2	2.5	16		0	N/A	8.30	27.5	0.75	0.6	9.2				0.8	1.6	0.2	5.34	4.5	3.08	
Adoption	Negative Emissions Technology		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
	Adv. Renewables: Offshore Wind							✓	✓	✓	✓															
	Adv. Renewables: Concentrated Solar PV							✓	✓	✓	✓															
	Smart Systems: SG		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	
	High Performance Computing		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	
	Advanced Nuclear Energy							✓	✓	✓	✓													✓	✓	
	Long Duration Storage (10-hr.+)							✓	✓	✓	✓															
Translation	Smart Systems: Smart Cities		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
	Smart Systems: Artificial Intelligence		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	
	Advanced Biofuels		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	

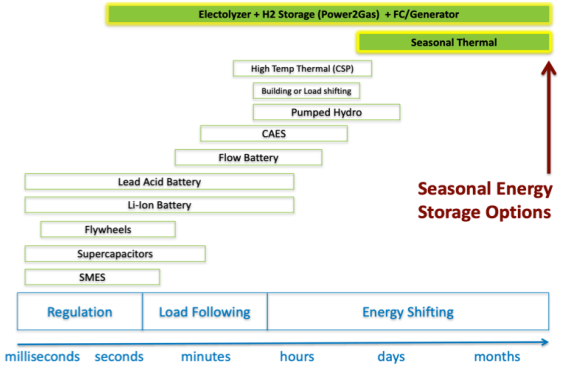
Cross-Cuts for Near- and Long-Term Decarbonization

Major Technology Cross Cuts	Electricity	Transportation	Industry	Buildings	Agriculture
Large Scale Carbon Management	Creates emissions reduction buffer for extremely hard to decarbonize processes	Reduces carbon from atmosphere and oceans, from diffuse and concentrated sources		Creates potential market for carbon-based products in Buildings (materials), Transport (fuels), and Agriculture (greenhouses)	
Hydrogen	Grid Balancing; End Use for Excess Renewables	Clean fuel for all vehicle classes	Meet high-grade heat requirements; used as clean feedstock	Blended with natural gas for all end use needs	Fuel for farming systems
Leveraging Carbon Infrastructure/ Expertise	Co-fire cleaner fuels (RNG, biofuels, H2) with natural gas	Existing networks can carry and store clean fuel alternatives	Refineries and terminals can blend, store, and consume clean alternatives	Existing distribution pipes can carry natural gas doped with H2, RNG	Can access markets with biomass-based products
Smart/Platform Technologies	Smart sensors and controls improve efficiency and resilience	Autonomous vehicles, on-road and -vehicle sensors improve safety and lower fuel use	Automation and additive manufacturing decrease fuel use and other costs	Improved building management can cut cost and connectivity improves livability	Data analytics can improve yields, lower costs

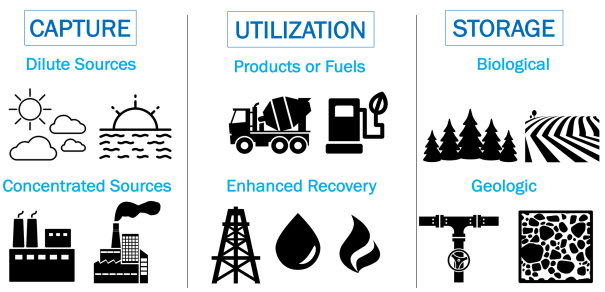
CA Breakthrough Technology Portfolio, Post-2030

Smart Cities
Hydrogen from Electrolysis
Seasonal Storage
Building Performance Technology
Bioenergy
Floating Offshore Wind
Advanced Nuclear
Clean Cement
Li-ion Battery Recycling
Advanced Photovoltaics
Direct Air Capture

Seasonal Storage



Direct Air Capture, Large Scale Carbon Management

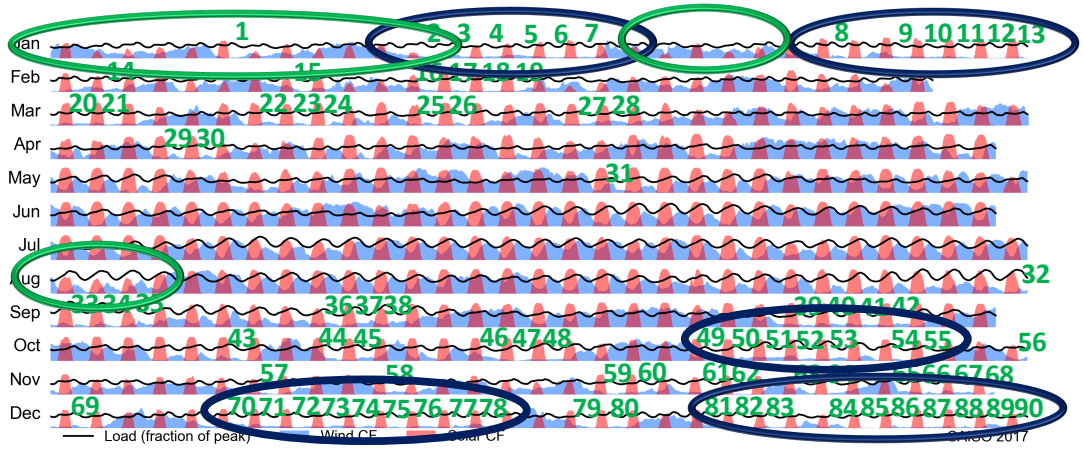


Source: EFI Analysis, NREL

ENERGY FUTURES INITIATIVE

Challenges with Integrating Intermittent Renewables

Over the course of a year large-scale dependence on both wind and solar will result in significant periods requiring very large-scale back-up options



Source: CAISO data, EFI analysis

Hourly trends in solar and wind capacity factors in CA for 2017 aligned to normalized variation in hourly load relative to peak daily load

ENERGY FUTURES INITIATIVE

Advancing the Landscape of Clean Energy Innovation

Global/US: Technologies with Breakthrough Potential

- Storage and battery technologies
- Advanced nuclear reactors
- Technology applications for industry and buildings as sectors that are difficult to decarbonize
  - Hydrogen
  - Advanced manufacturing technologies
  - Building energy technologies
- Systems: electric grid modernization and smart cities
- Deep decarbonization/large-scale carbon management
  - Carbon capture, use, and storage at scale
  - Sunlight to fuels
  - Biological sequestration

Energy Innovation Initiatives

VATTENFALL

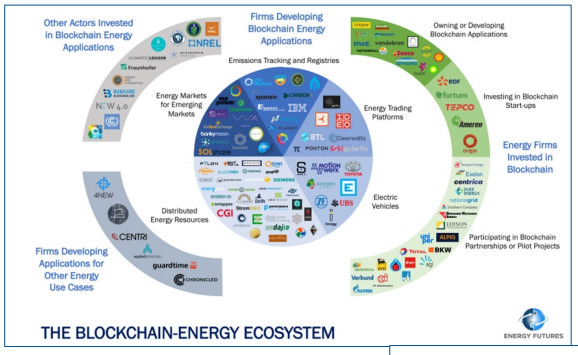
Carbon Engineering

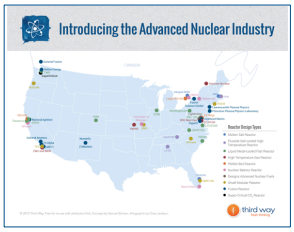
HYDROGENICS
SHIFT POWER | ENERGIZE YOUR WORLD

NETPOWER

Global Thermostat

CLIMEWORKS
Capturing CO_2 from air





Equinor—the world's leading floating offshore wind developer

Zhangjiakou HyPower New Energy Technology Co, a hydrogen energy technologies developer and related service provider in Zhangjiakou, invested about 10 million yuan ($1.5 million) on the city's first hydrogen refueling station for its 74 hydrogen fuel cell buses.

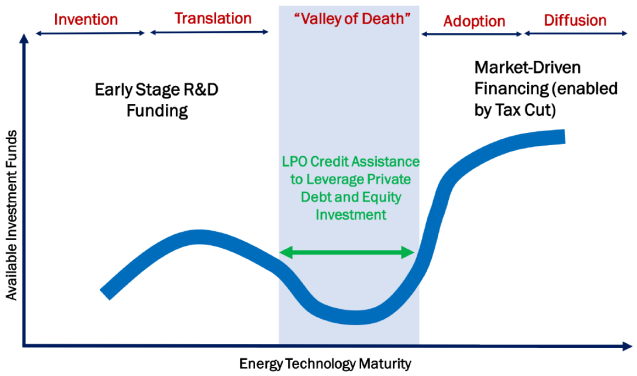
A hydrogen fueling station already built in Tokyo's Shiba Park. The metropolitan government plans to have 35 such stations in operation by 2020. And by 2025 it aims to have 80 hydrogen stations in operation and 100,000 fuel cell cars on the roads.

Topics We Didn't Have a Chance To Cover

Appendix

Leveraging The Doe Loan Program: Using $39 Billion In Existing Authority To Help Modernize The Nation's Energy Infrastructure

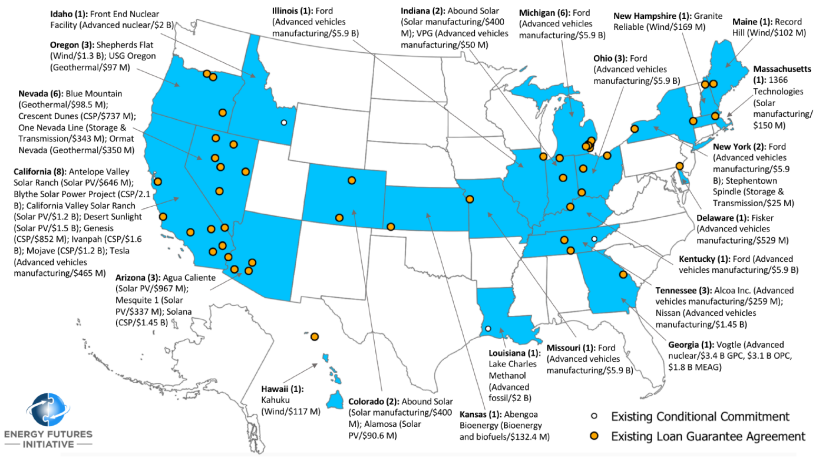
Figure 1.
LPO Bridges the Financing Gap in the Technology Innovation Process



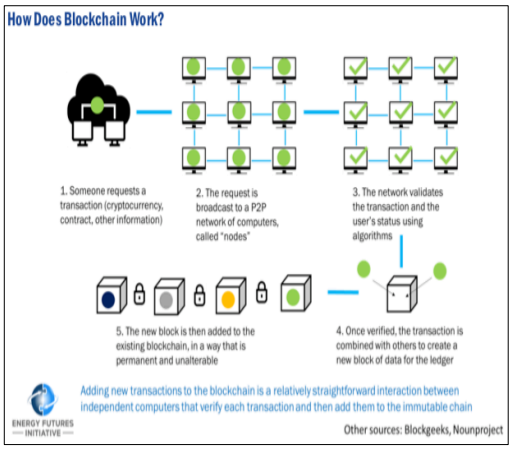
Moving from R&D, to demonstration to deployment to diffusion requires the alignment of many players, processes and programs. The LPO provides critical "de-risking" to initial commercial deployment.

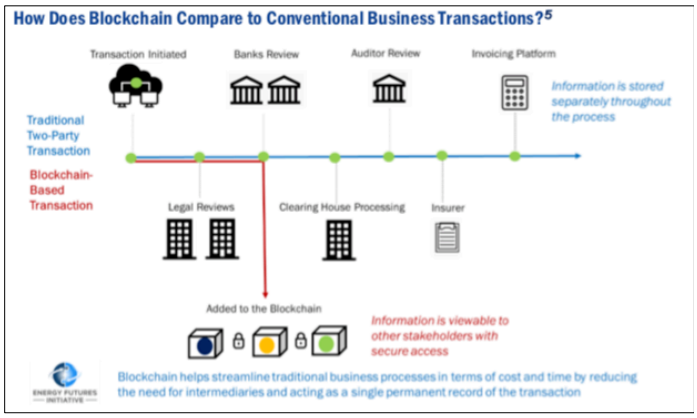
Leveraging The Doe Loan Program: Using $39 Billion In Existing Authority To Help Modernize The Nation's Energy Infrastructure

Figure 4.
DOE's LPO Project Portfolio: Diverse, Regional, High Impact



Promising Blockchain Applications for Energy: Separating the Signal from the Noise





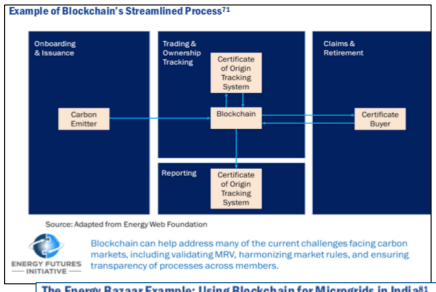
Promising Blockchain Applications for Energy: Separating the Signal from the Noise

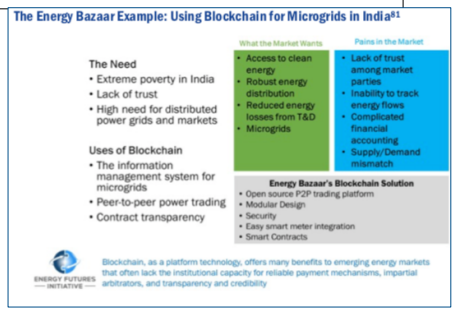
Alignment of Emerging Energy Issues and Core Blockchain Capabilities Result in Promising Energy Sector Applications of Blockchain

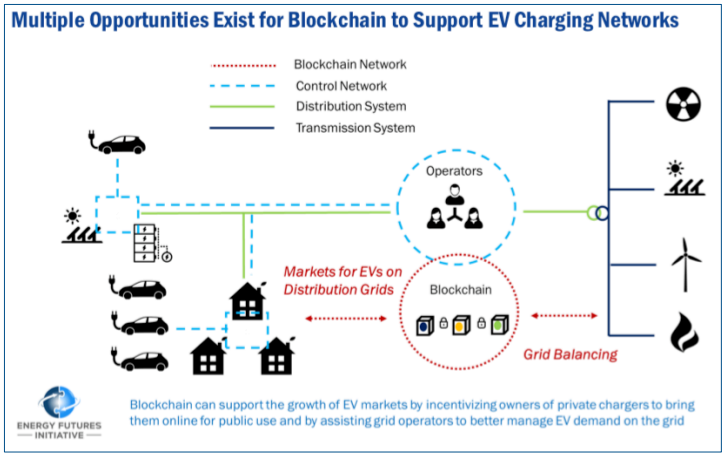
Emerging Energy Sector Issues	Core Blockchain Capabilities	Promising Energy Sector Applications
Falling Technology Costs; Decentralization; Changing U.S. Energy Supply System; Evolving Grid Control Capabilities	Decentralized Systems can be Self-Administered; Architecture Sets Permissions, Regulated by Rules-based System	**Distributed Energy Resources**
Vehicle Electrification; Falling Battery Costs; Decentralization; Decarbonization	Enables "Smart" Contracts for Streamlining and Automating Contract Terms (i.e. Deposits, Payments, Proof of Performance Actions); Removes Need for Trusted Third-Parties; Regulators and Governments Can Observe or Record Details;	**Electric Vehicle Deployment**
Decentralization; Digitalization; Changing U.S. Supply System; Emerging Global Natural Gas Markets	Businesses Partners can Access Records; Removes Need for Trusted Third-Parties; Regulators and Governments Can Observe or Record Details;	**Energy Trading**
Decarbonization; Digitalization; Changing U.S. Supply System; Evolving Carbon Markets	Removes Need for Trusted Third-Parties; Regulators and Governments Can Observe or Record Details; High Process Transparency and Enforceability, Opening Access to Emerging Markets	**Carbon Tracking and Registries**
Global Population Growth; Shifting Global Markets; Decarbonization; Electrification	Supports Digital Payments; High Process Transparency and Enforceability, Opening Access to Emerging Markets	**Energy Transactions for Emerging Markets**

Source: Energy Futures Initiative

Promising Blockchain Applications for Energy: Separating the Signal from the Noise







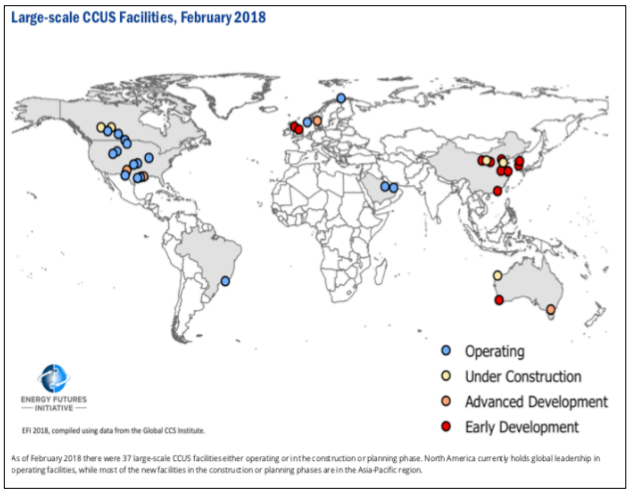
Advancing Large Scale Carbon Management: Expansion Of The 45Q Tax Credit

Tax Credit Value Available for Different Sources and Uses of CO_2

	Minimum Size of Eligible Carbon Capture Plant by Type ($ktCO_2$/yr)			Relevant Level of Tax Credit in a Given Operational Year ($USD/$tCO_2$)									
	Type of CO_2 Storage/Use	Power Plant	Other Industrial Facility	Direct Air Capture	2018	2019	2020	2021	2022	2023	2024	2025	2026	Beyond 2026
	Dedicated Geological Storage	500	100	100	28	31	34	36	39	42	45	47	50	Indexed to Inflation
	Storage via EOR	500	100	100	17	19	22	24	26	28	31	33	35	
	Other Utilization Processes[1]	25	25	25	17[2]	19	22	24	26	28	31	33	35	

[1] Each CO_2 source cannot be greater than 500 $ktCO_2$/yr
[2] Any credit will only apply to the portion of the converted CO_2 that can be shown to reduce overall emissions

Source: Closely adapted from Simon Bennett and Tristan Stanley, Commentary: US budget bill may help carbon capture get back on track, International Energy Agency.



CARBON REMOVAL: COMPARING HISTORICAL FEDERAL RESEARCH INVESTMENTS WITH THE NATIONAL ACADEMIES' RECOMMENDED FUTURE FUNDING LEVELS

Historical Investments in Carbon Removal-related RD&D and Comparison with NASEM-recommended Future Funding Levels
(in millions of dollars, rounded to the nearest whole number)