Committee on Gas

NARUC Summer Policy Summit

Committee on Gas and Committee on Energy Resources and the Environment

How Clear is the Crystal Ball? Planning for the Future of Natural Gas

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How Clear is the Crystal Ball?

Planning for the Future of Natural Gas

NARUC Summer Policy Summit
Joint Session with Committee on Energy Resources and the Environment and Committee on Gas

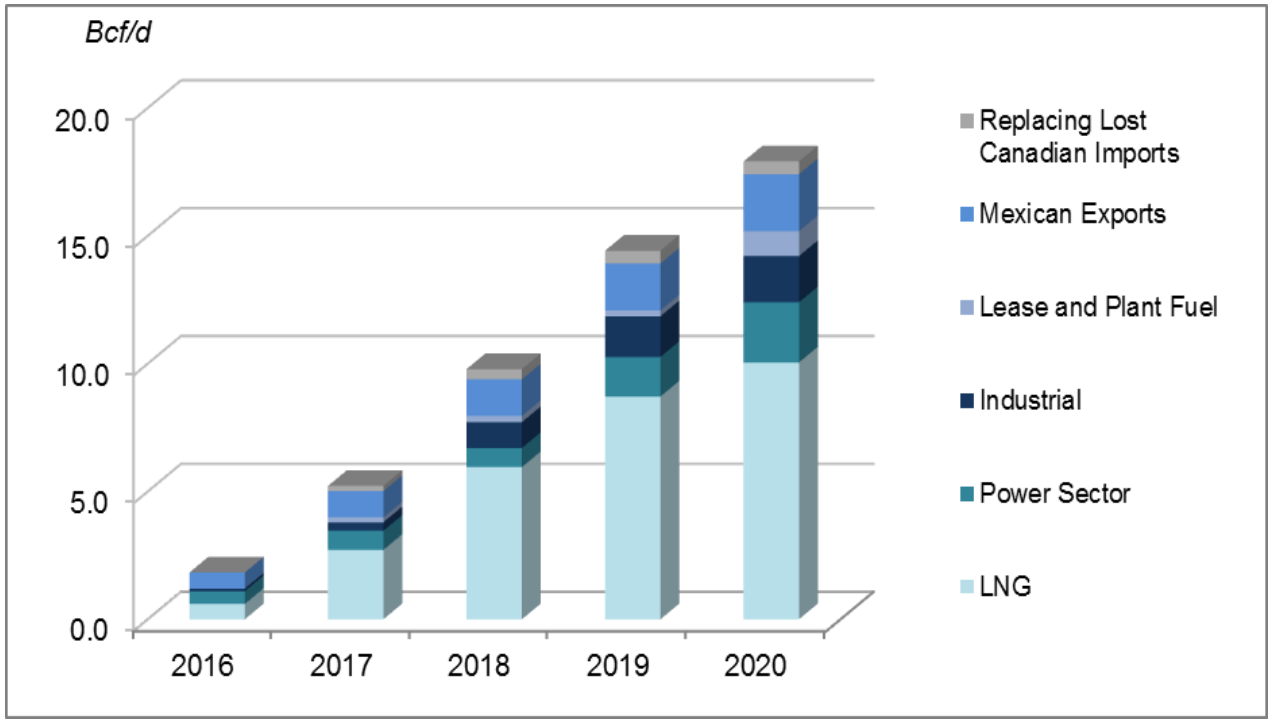
San Diego, California | July 17, 2017

Andrew D. Weissman

Senior Counsel, Pillsbury Winthrop Shaw Pittman LP
CEO, EBW AnalyticsGroup

Early Stages of Explosive Growth in U.S. Demand for Natural Gas

Potential Demand Increase in Demand for U.S. Production, 2017–2020 (Bcf/d)



Source: EBW Analytics

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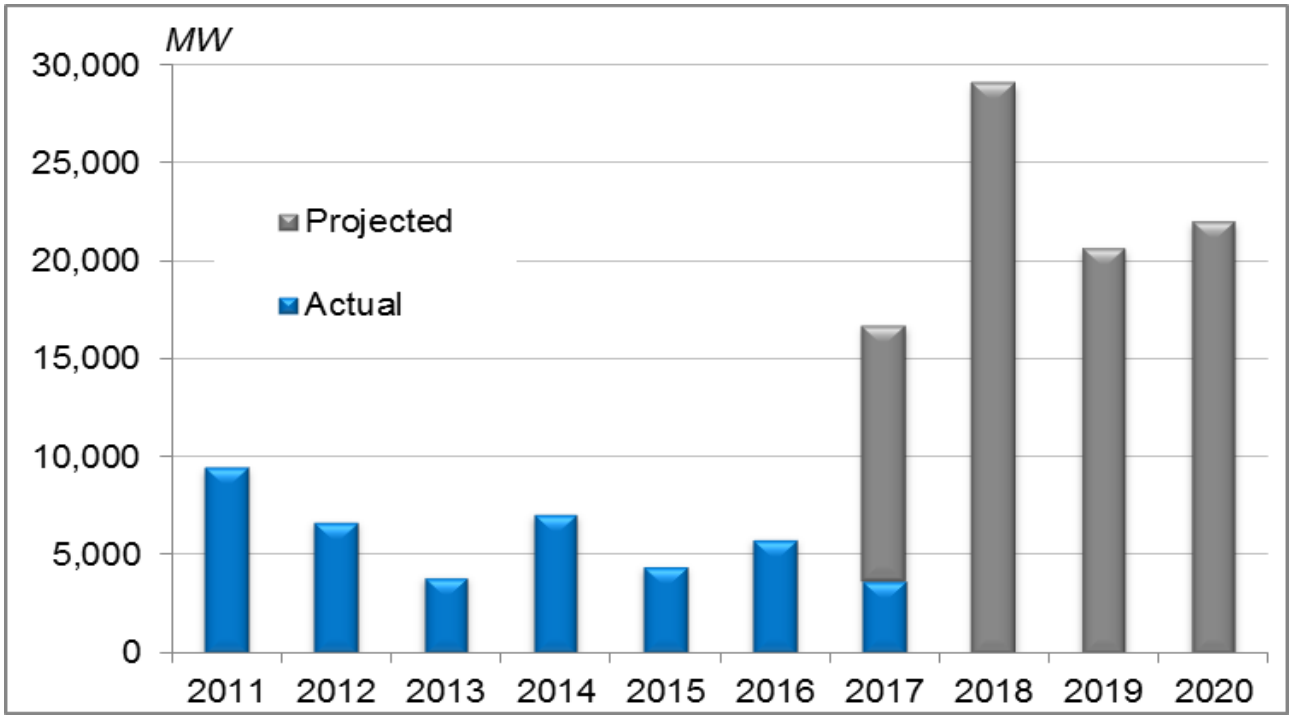
Power Sector Consumption Growing Rapidly

Combined-Cycle Generating Capacity Additions by Year, 2011–2020 (MW)



Source: EBW Analytics, Ventyx

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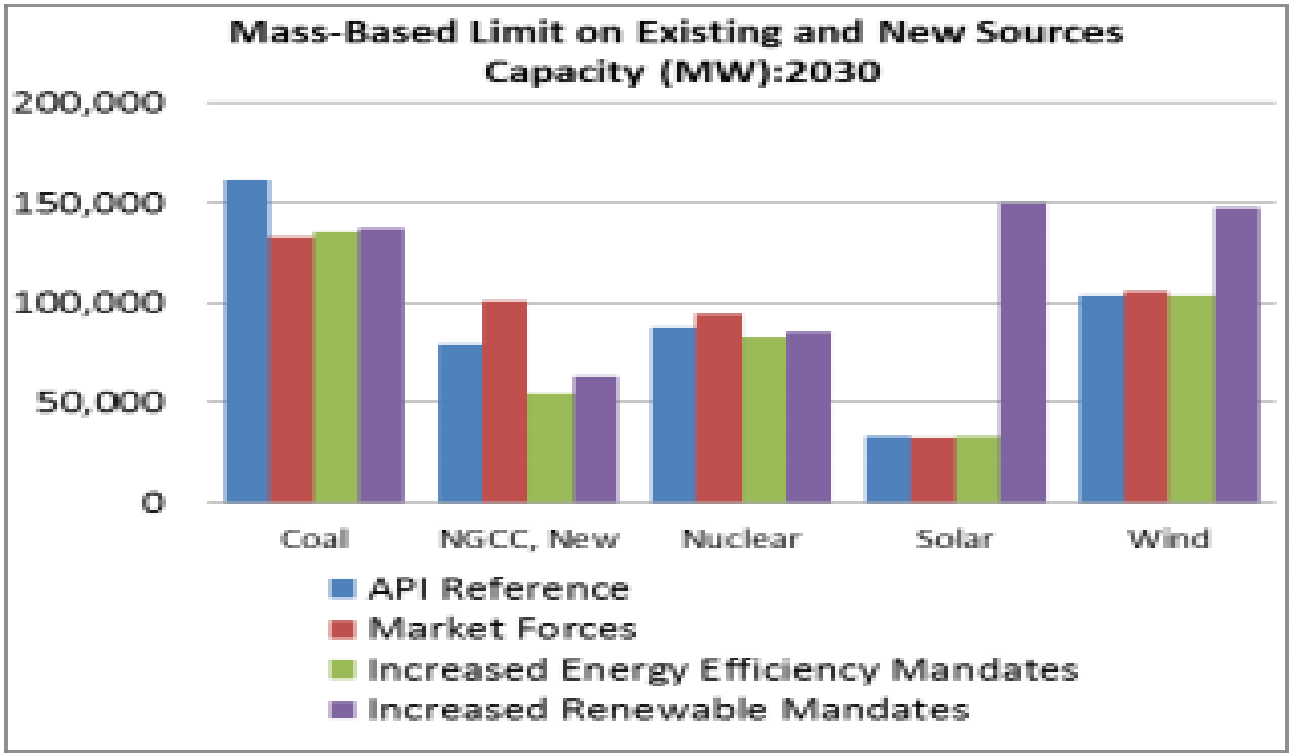
Could Continue Even Without Clean Power Plan

Scenarios for Natural Gas Combined-Cycle Capacity Growth, 2016–2030 (MW)



Source: API

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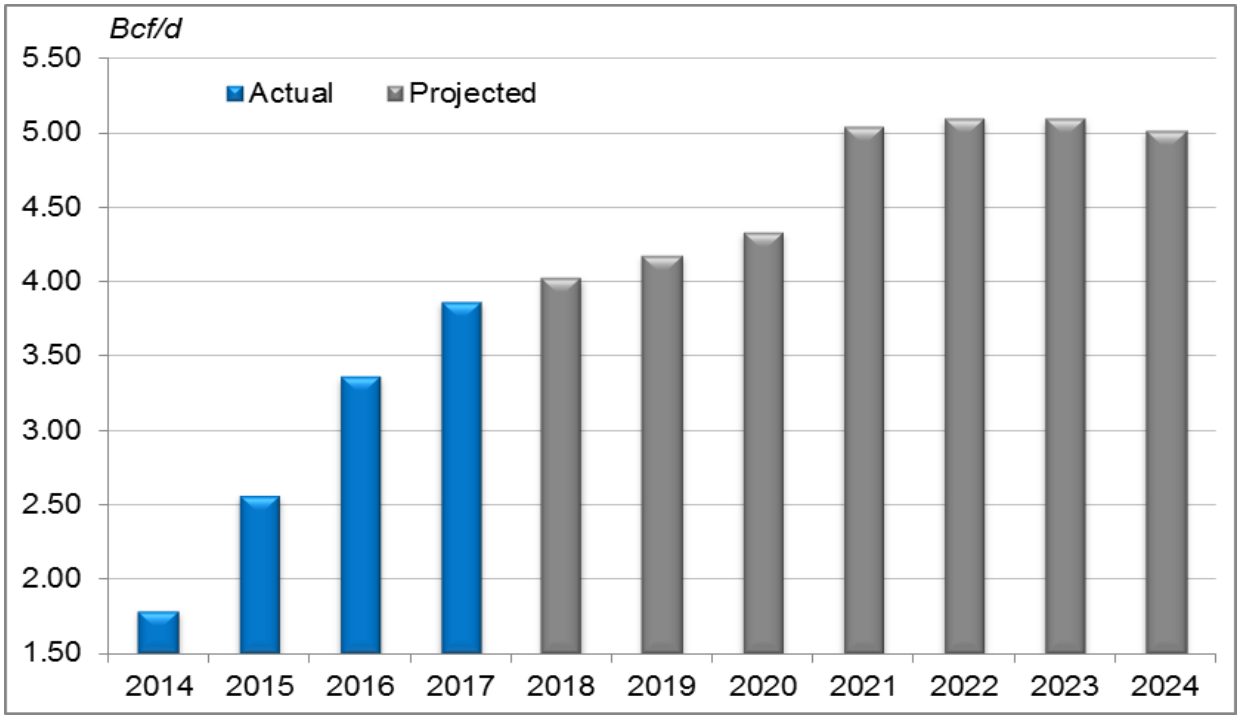
Mexican Exports Growing Rapidly

U.S. Natural Gas Pipeline Exports to Mexico, 2014–2024 (Bcf/d)



Source: EBW Analytics, EIA Annual Energy Outlook

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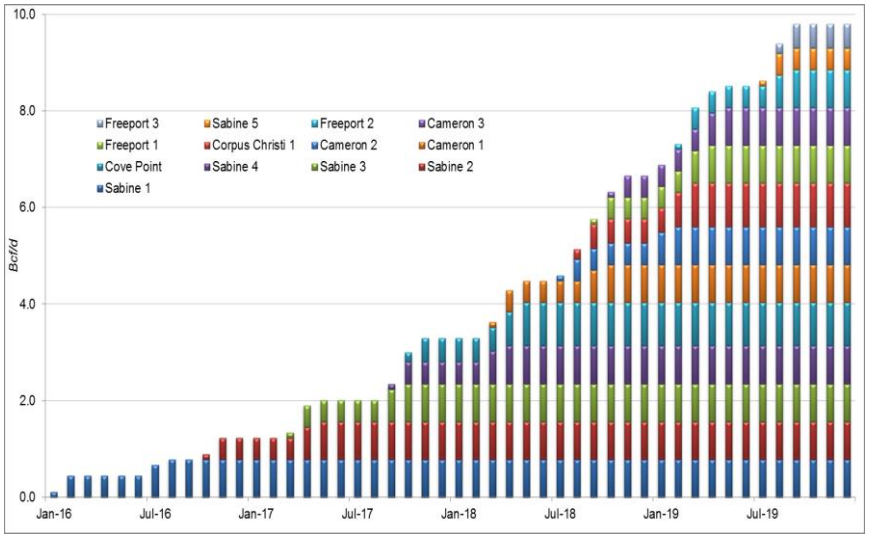
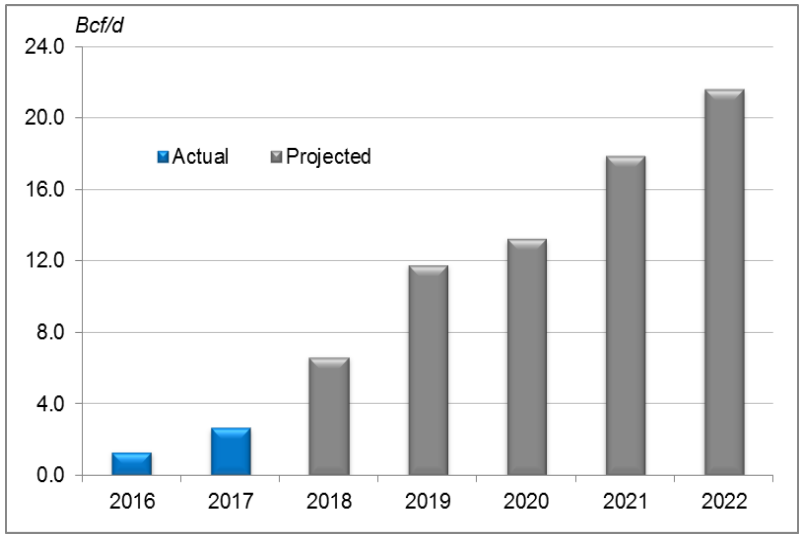
LNG Exports Most Important Driver

Projected Cumulative Growth in Natural Gas Demand Attributed to LNG, 2016–2019 (Bcf/d)



Source: Simmons, EBW AnalyticsGroup

Cumulative Natural Gas Demand for LNG Operations Including Potential Projects, 2016–2022 (Bcf/d)



Source: EBW Analytics

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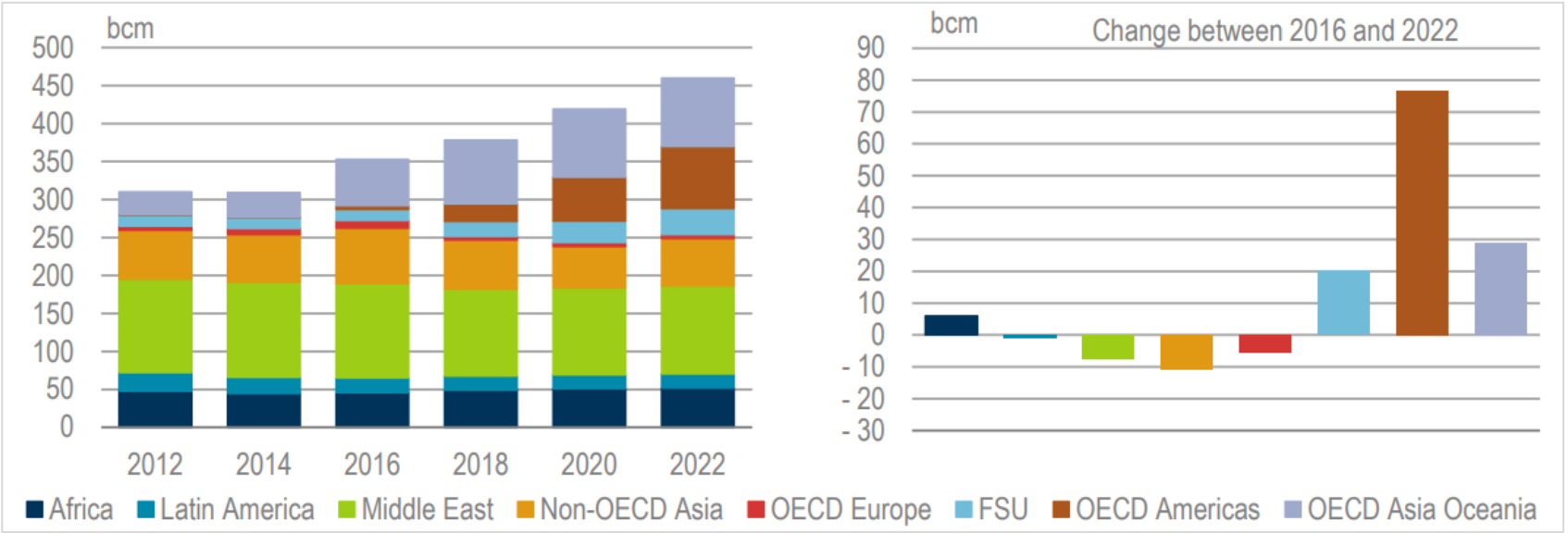
U.S. Now Linked to Global Market

World LNG Exports by Region, 2012–2022



Source: IEA

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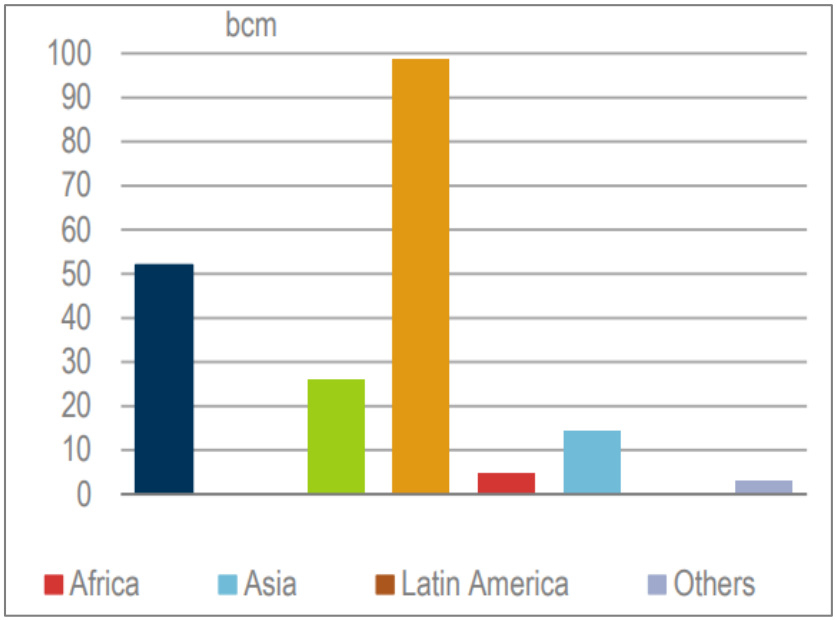
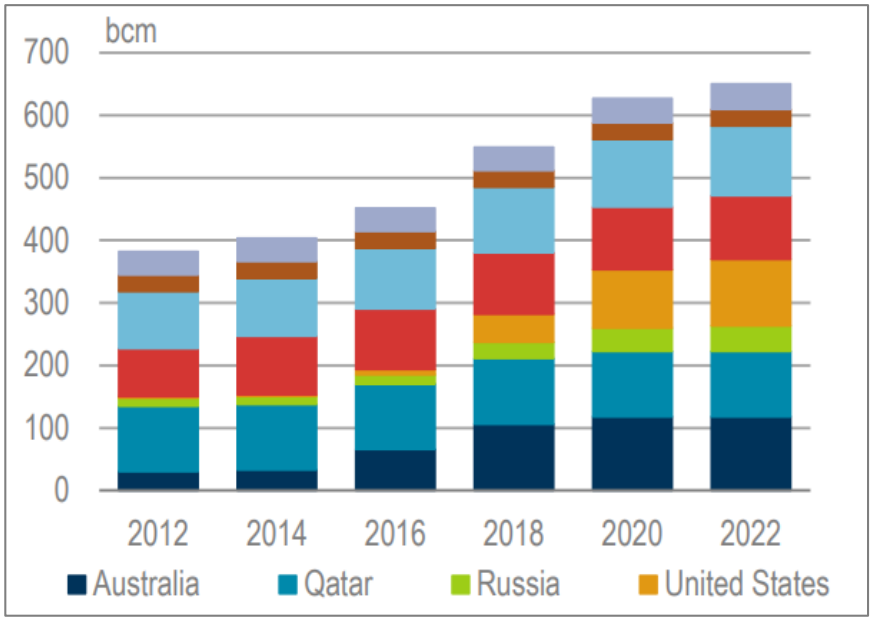
Supply Surging

Global LNG Export Capacity, 2012–2022





Source: IEA

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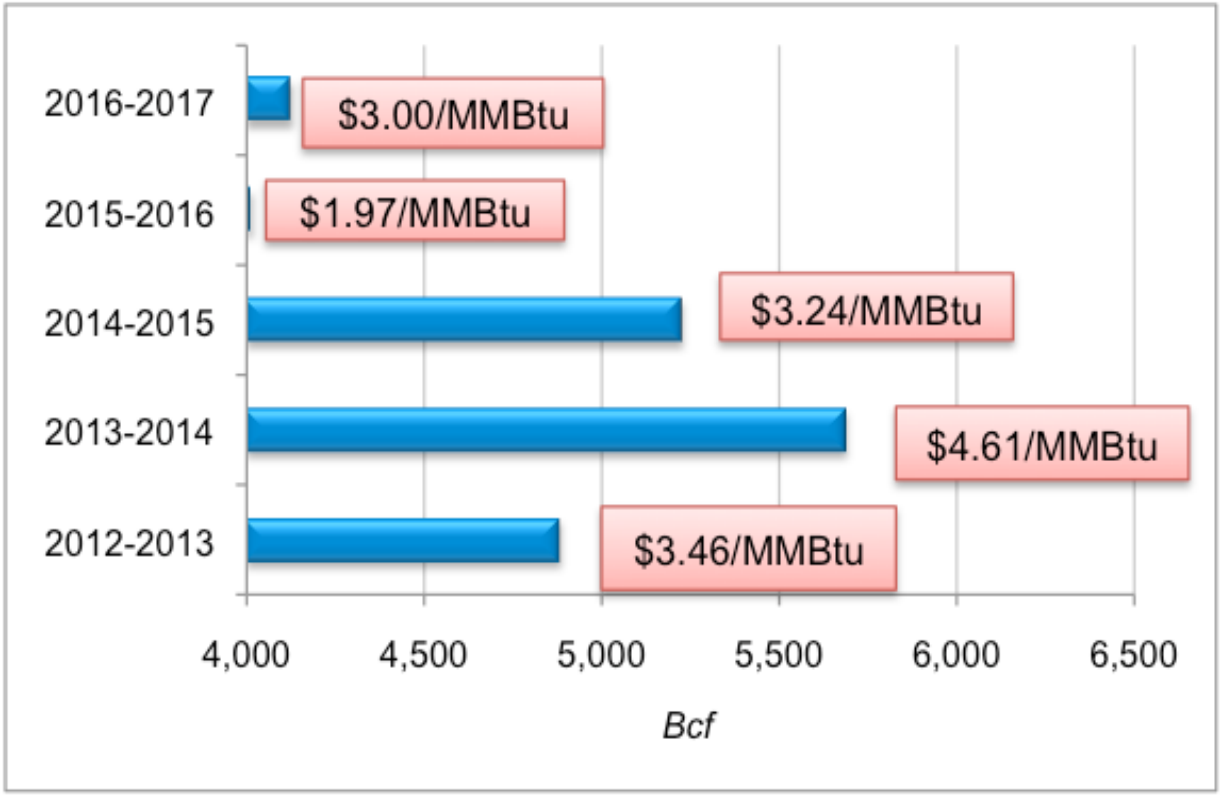
Space Heating Demand (Bcf) and Average Henry Hub Price ($/MMBtu), Last Five Winters



Source: EBW AnalyticsGroup

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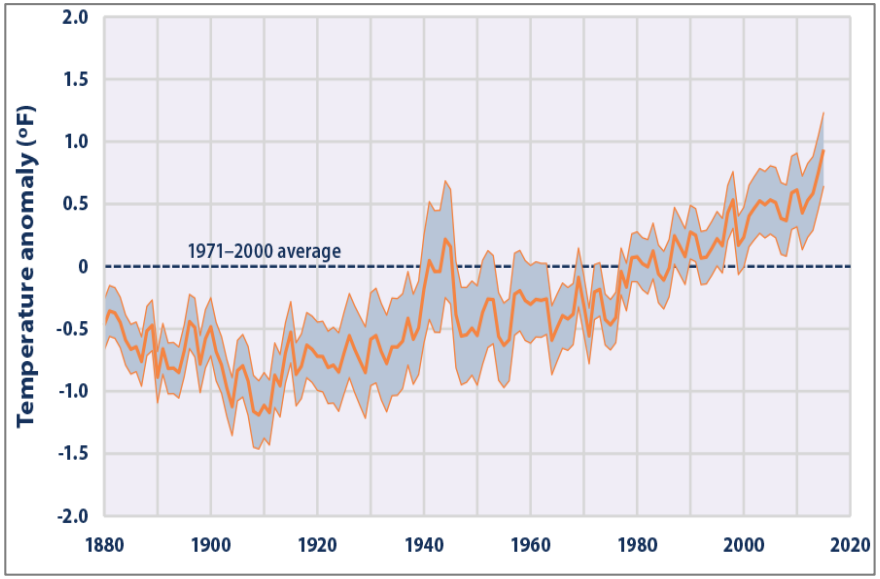
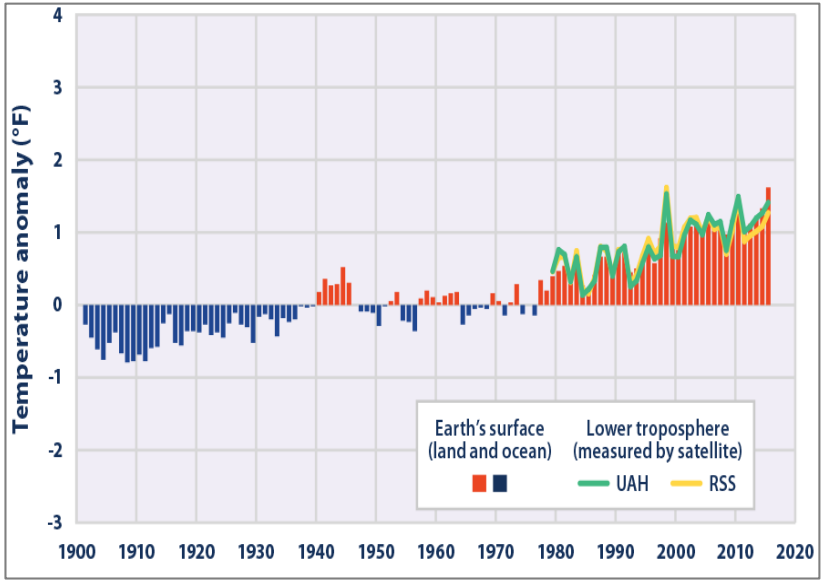
Climate Crisis

Average Global Sea Surface Temperature, 1880-2015



Source: NOAA

Temperatures Worldwide, 1901-2015



Source: NOAA

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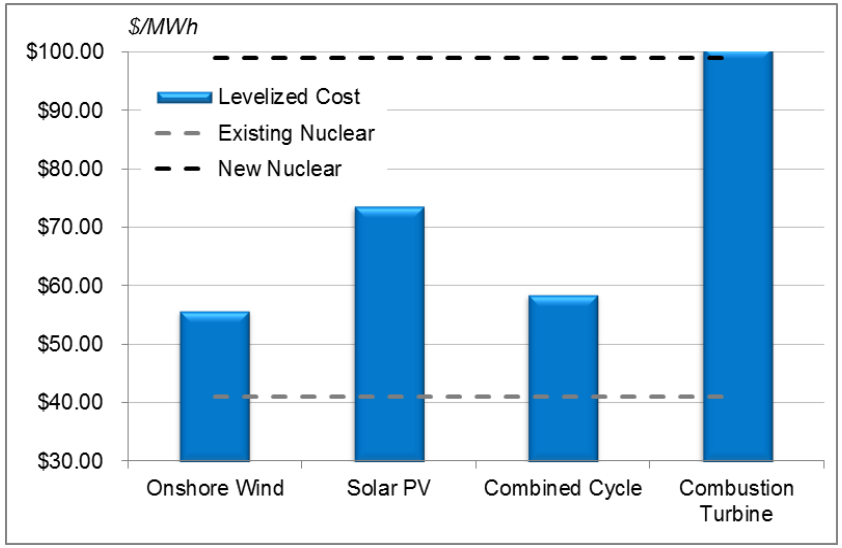
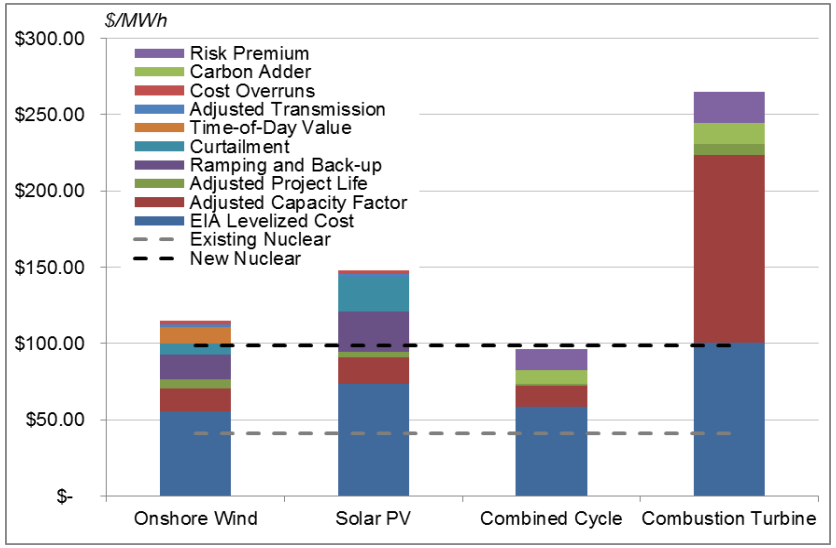
EIA Least Cost of Energy (LCOE) Comparisons Misleading

EIA LCOE Calculations for Onshore Wind, Solar PV, NGCC and NGCT ($/MWh)



Source: EIA

Adjusted Levelized Cost of Energy Metrics



Source: EBW AnalyticsGroup

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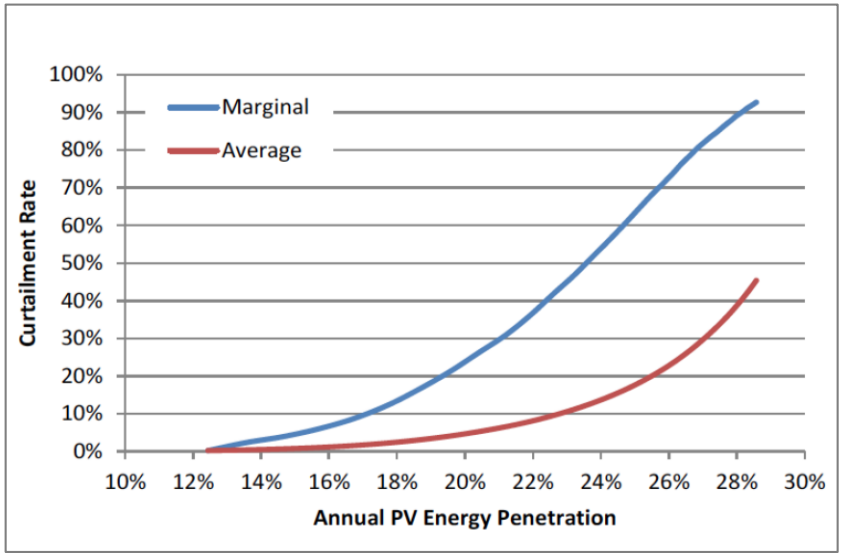
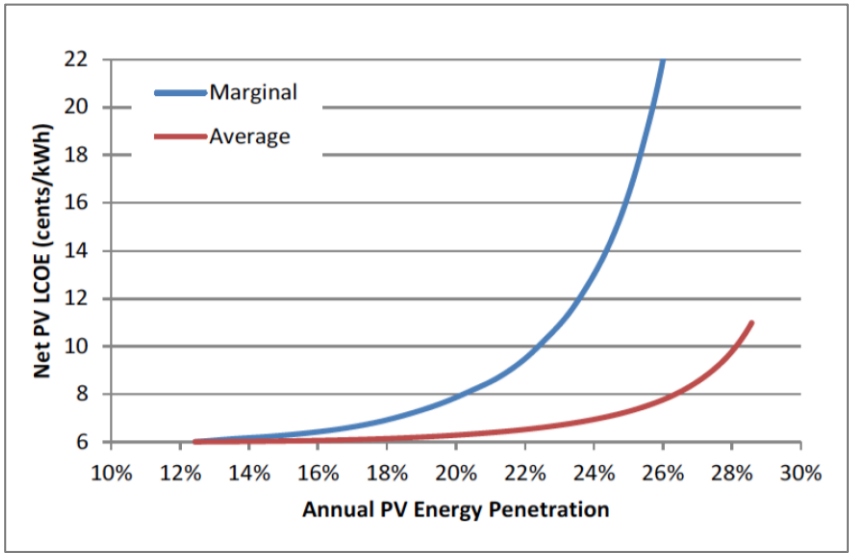
Average and Marginal PV Curtailment and Net LCOE in Base Scenario





Source: "Energy Storage Requirements for Achieving 50% Solar Photovoltaic Energy Penetration in California," Paul Denholm and Robert Margolis, National Renewable Energy Laboratory (August 2016)

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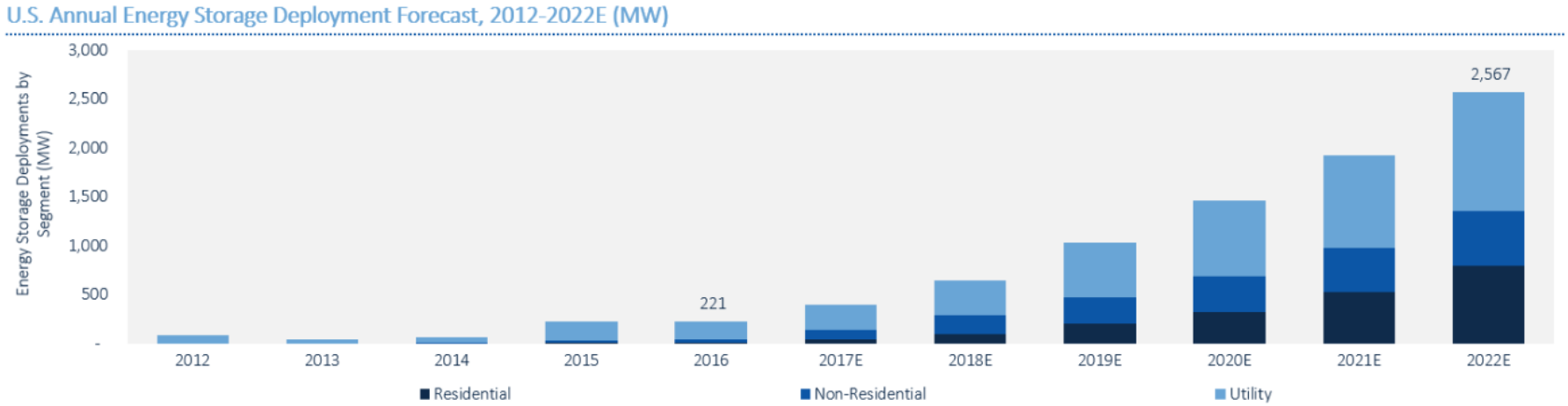
Growth in Electricity Storage

U.S. Energy Storage Annual Deployments Will Reach 2.6 GW by 2022



Source: GTM

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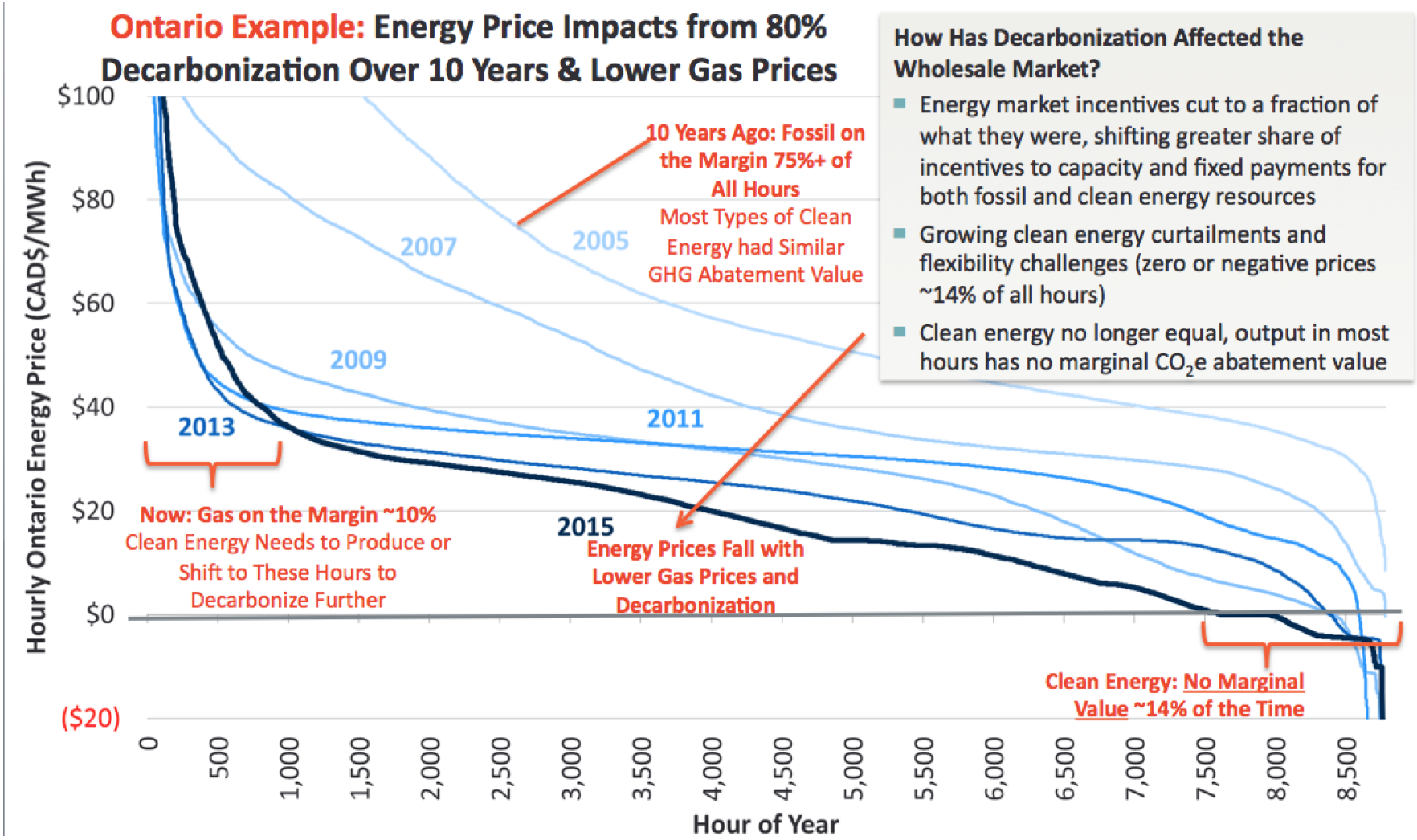
What Might the Future Look Like with a Large Share of State-Supported Clean Energy?



Source: Brattle Group
Notes: Data from Monitoring Report on the IESO-Administered Electricity Markets for May-Oct 2015, and ABB, Inc., Energy Velocity Suite (2016).

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Thank you for your time.

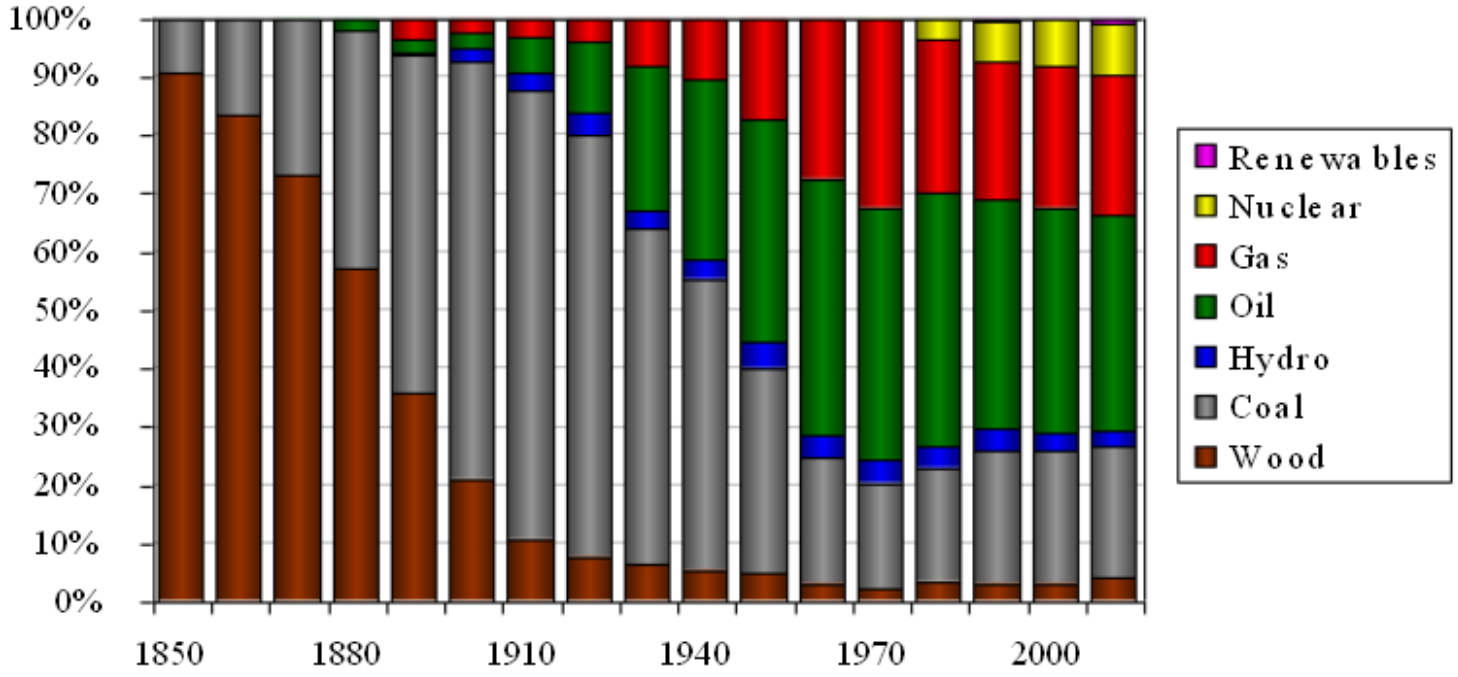
Future Use of Natural Gas

July 17, 2017

Steven Weissman, Lecturer
UC Berkeley Goldman School of Public Policy

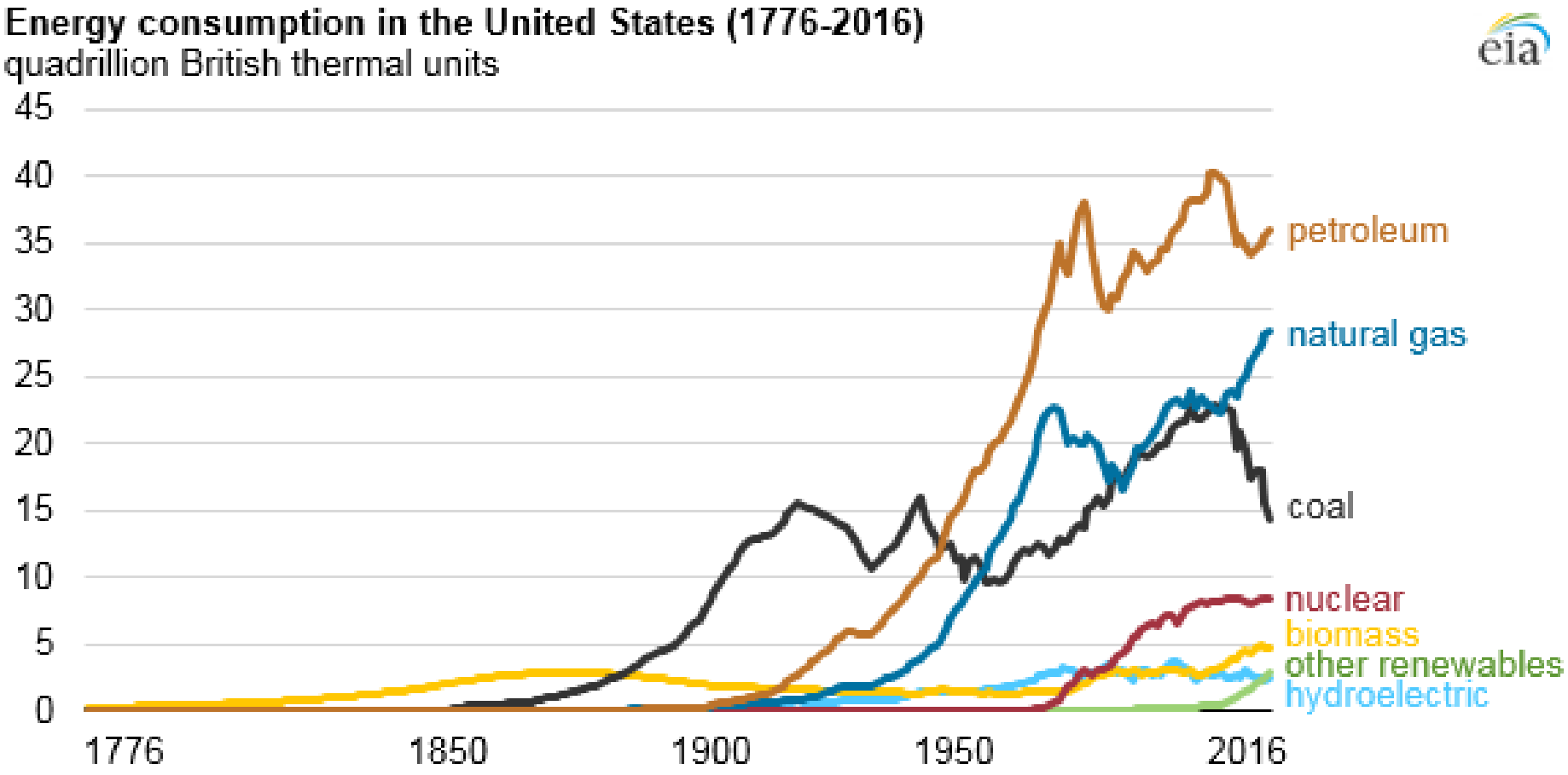
Center for Sustainable Energy®

U.S. Energy Supply Since 1850



Source: EIA

Energy Consumption in U.S. 1776-2016



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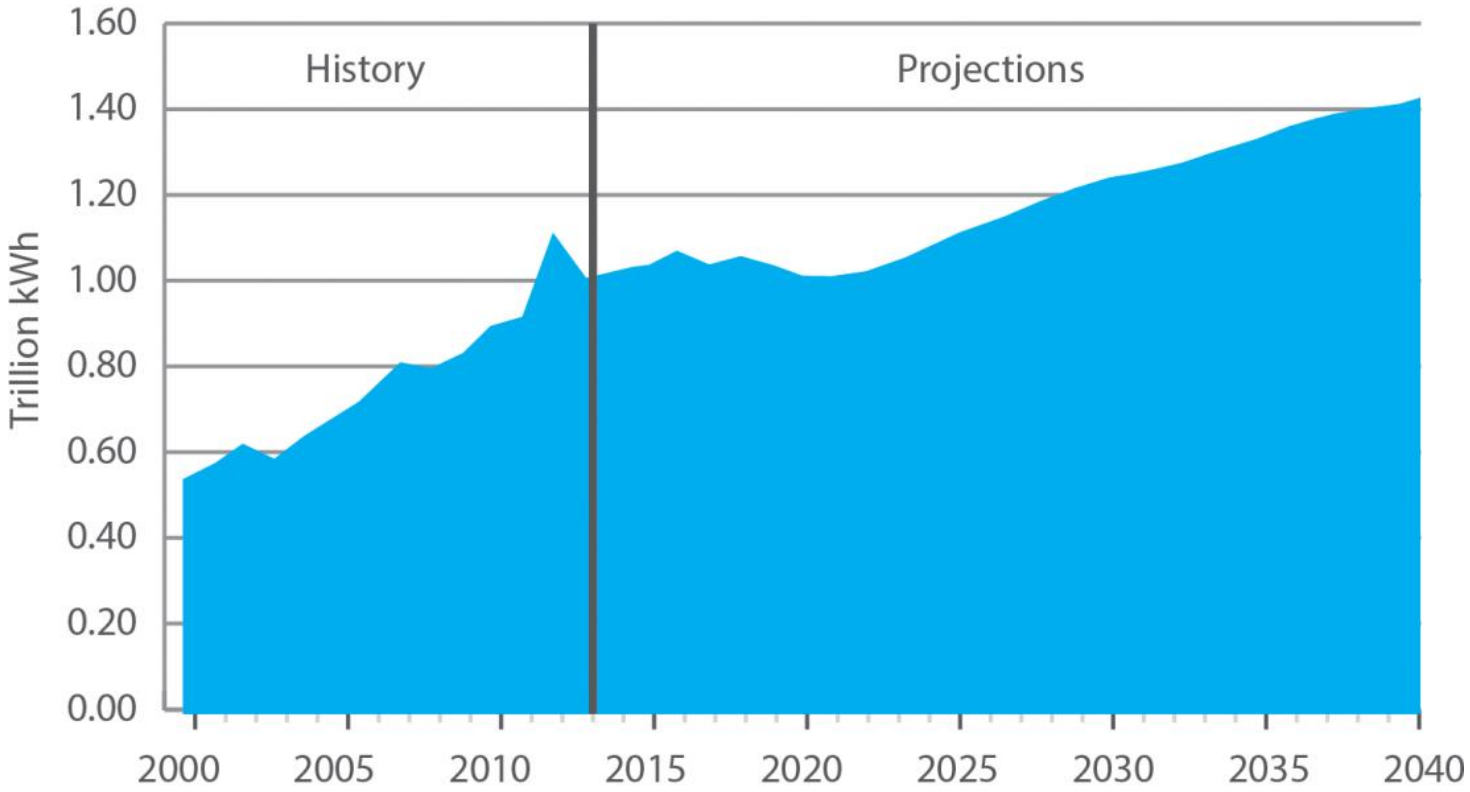
Natural Gas Electricity Generation

Figure 2: Natural Gas Electricity Generation: EIA AEO2015 Reference Case, 2000–2040



Data source: U.S. Energy Information Administration (EIA), 2015.

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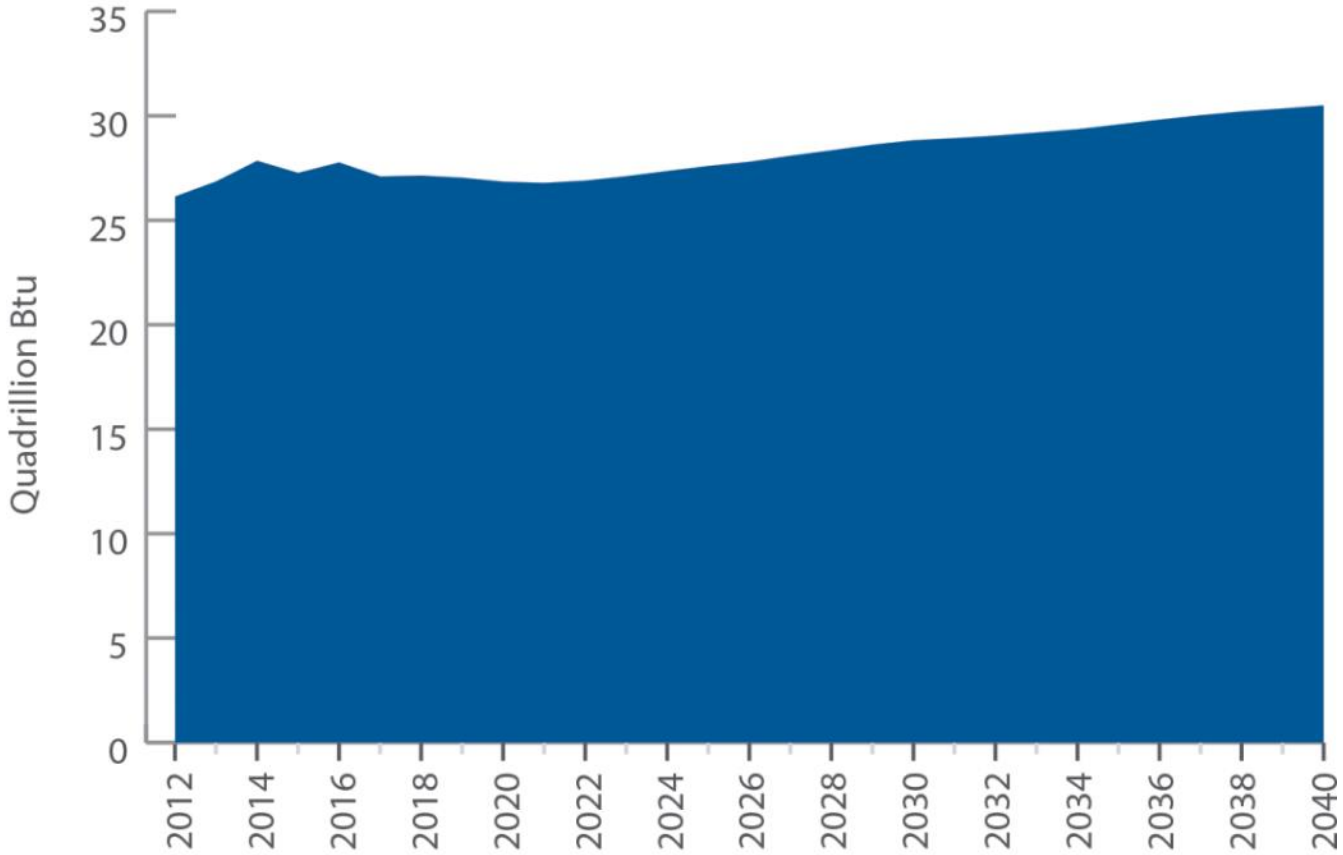
Projected Total U.S. Natural Gas Consumption

Figure 5: Total Natural Gas Consumption (in quadrillion Btu), 2012–2040



Data source: U.S. Energy Information Administration (EIA), 2015.

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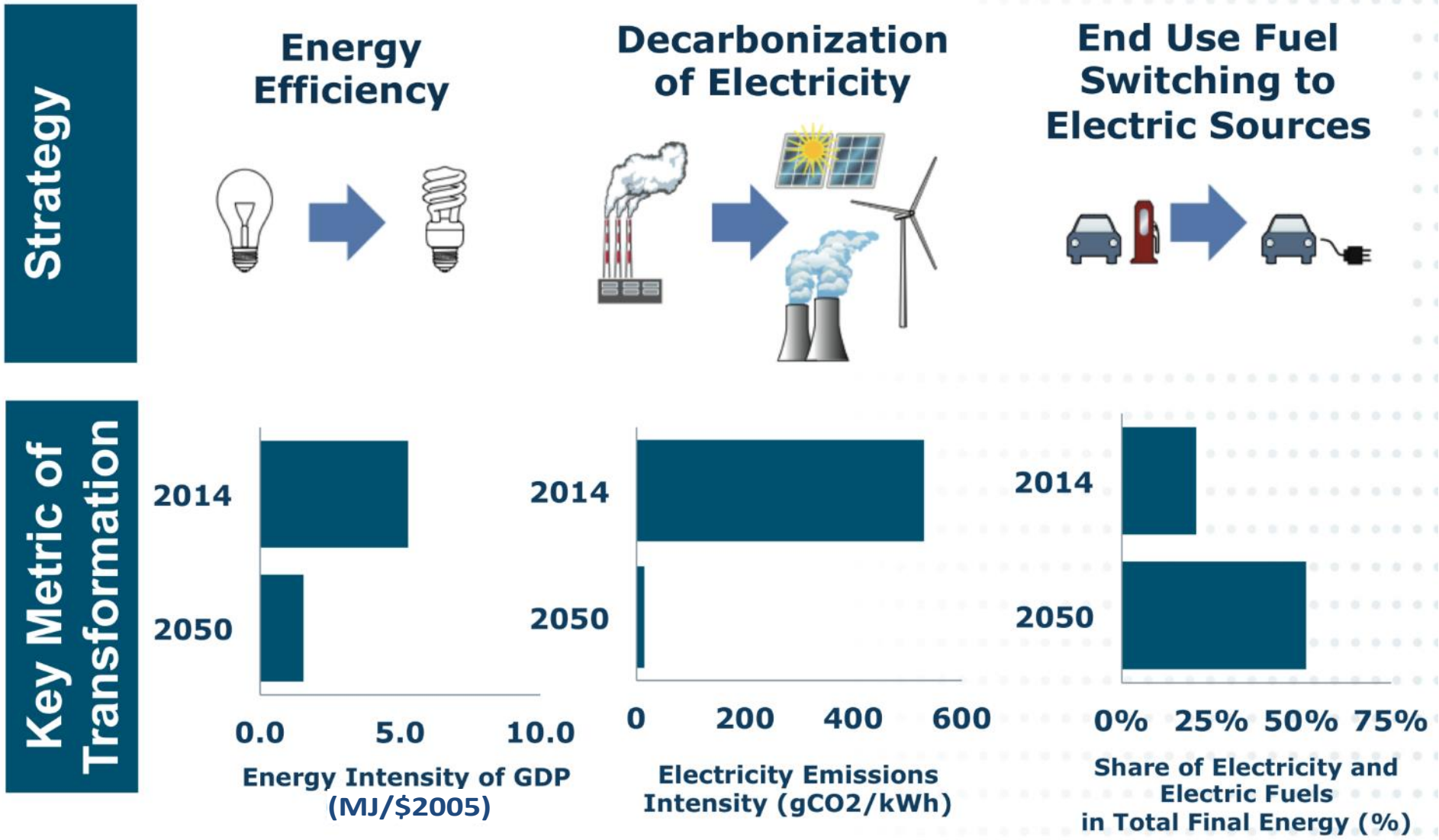
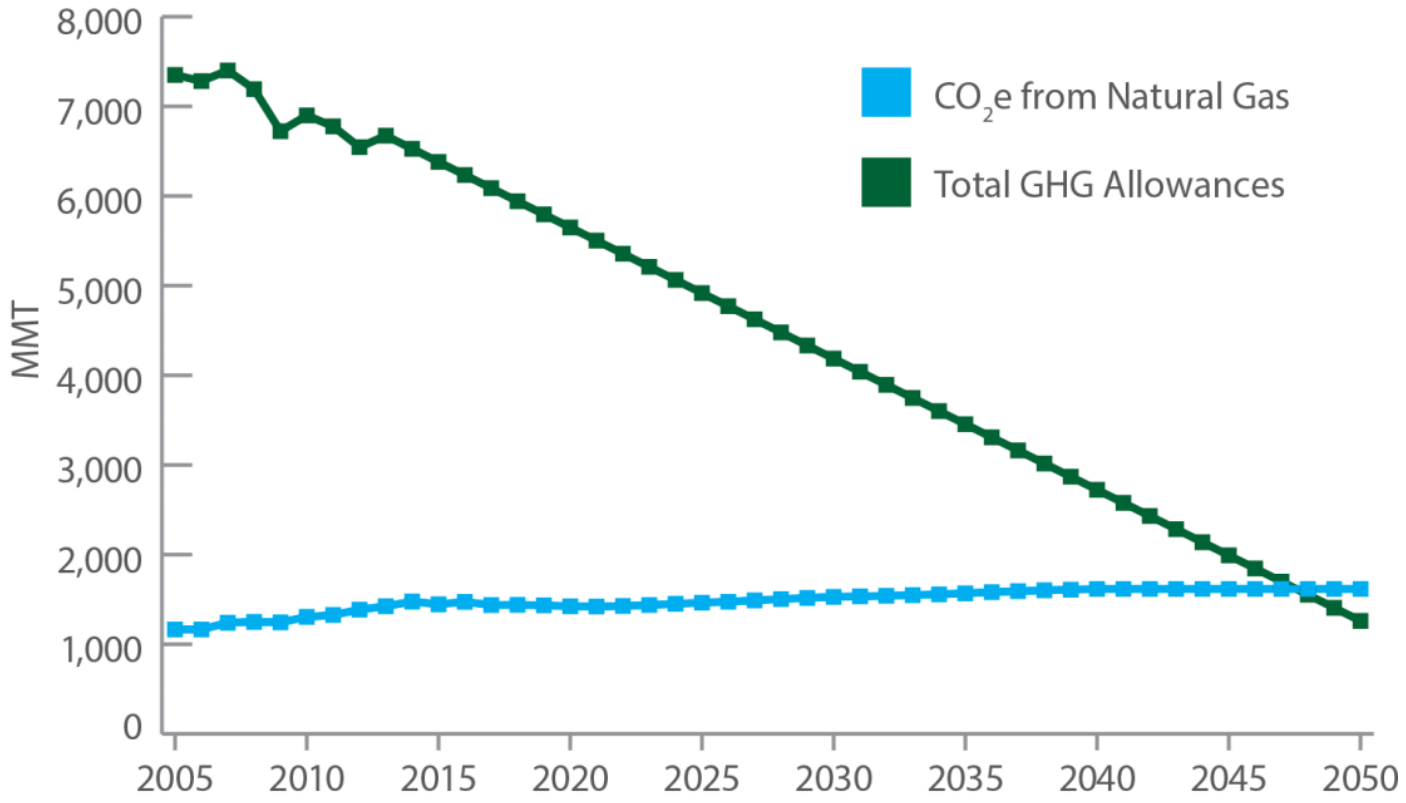
Result: Three Pillars Required In All Deep Decarbonization Scenarios



Pathways to Deep Decarbonization in the United States, Mixed case results

Total CO_2^e from Natural Gas

Figure 8: CO_2e from Natural Gas vs. Total Greenhouse Gas Allowances*



*The total natural gas consumption rate (CO_2e) is derived from EIA data for National Energy Consumption by Sector and Source. The conversion factor used to determine MMT is 0.1 mmBtu/1 therm × 14.46 kg C/mmBtu × 44 kg CO_2/12 kg C × 1 metric ton/1,000 kg = 0.005302 metric tons CO_2/therm. The excel data is provided by the EIA Annual Energy Outlook 2015: Website access: http://www.eia.gov/forecasts/aeo/.

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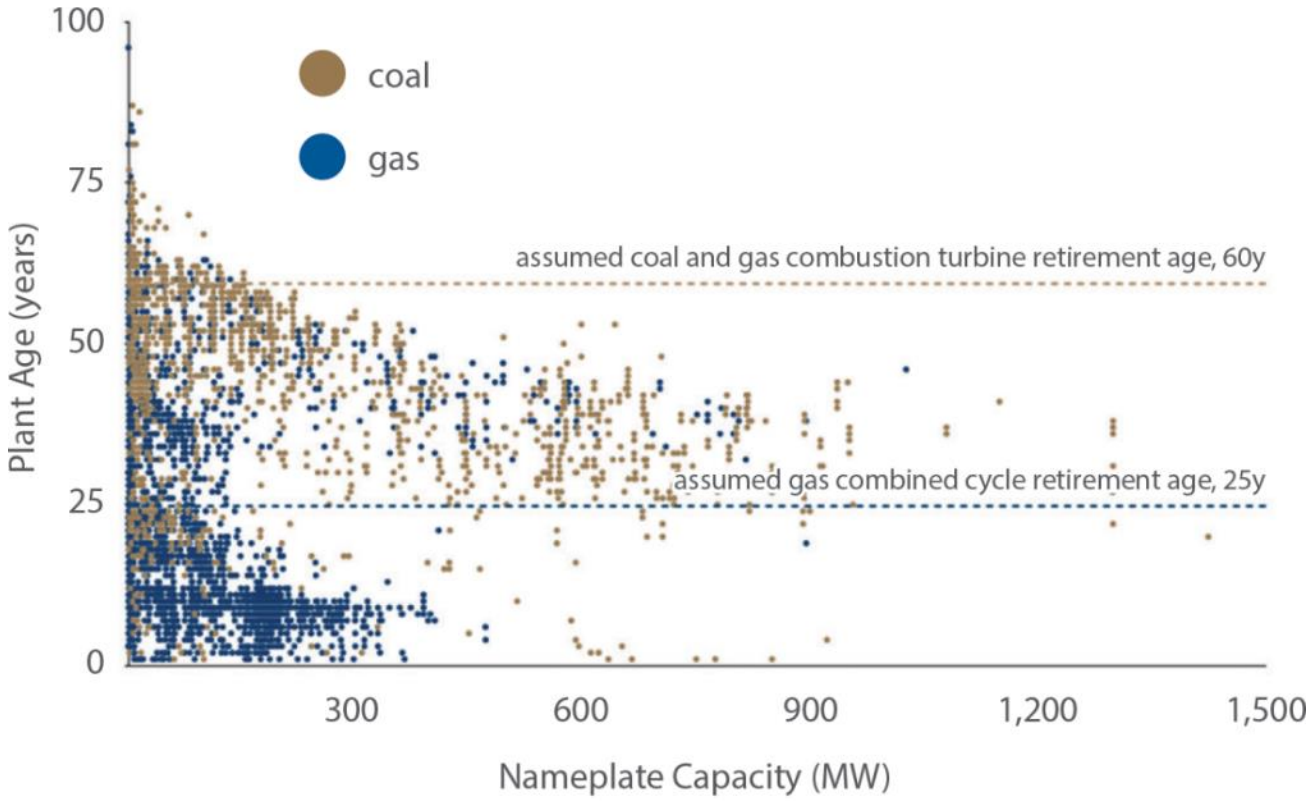
Age & Capacity of Gas Plants Operating in 2011

Figure 6: Age and Capacity of Operating U.S. Coal and Gas-fired Generators, Fall 2011



Source: Rocky Mountain Institute © 2011. For more information see www.RMI.org/ReinventingFire.

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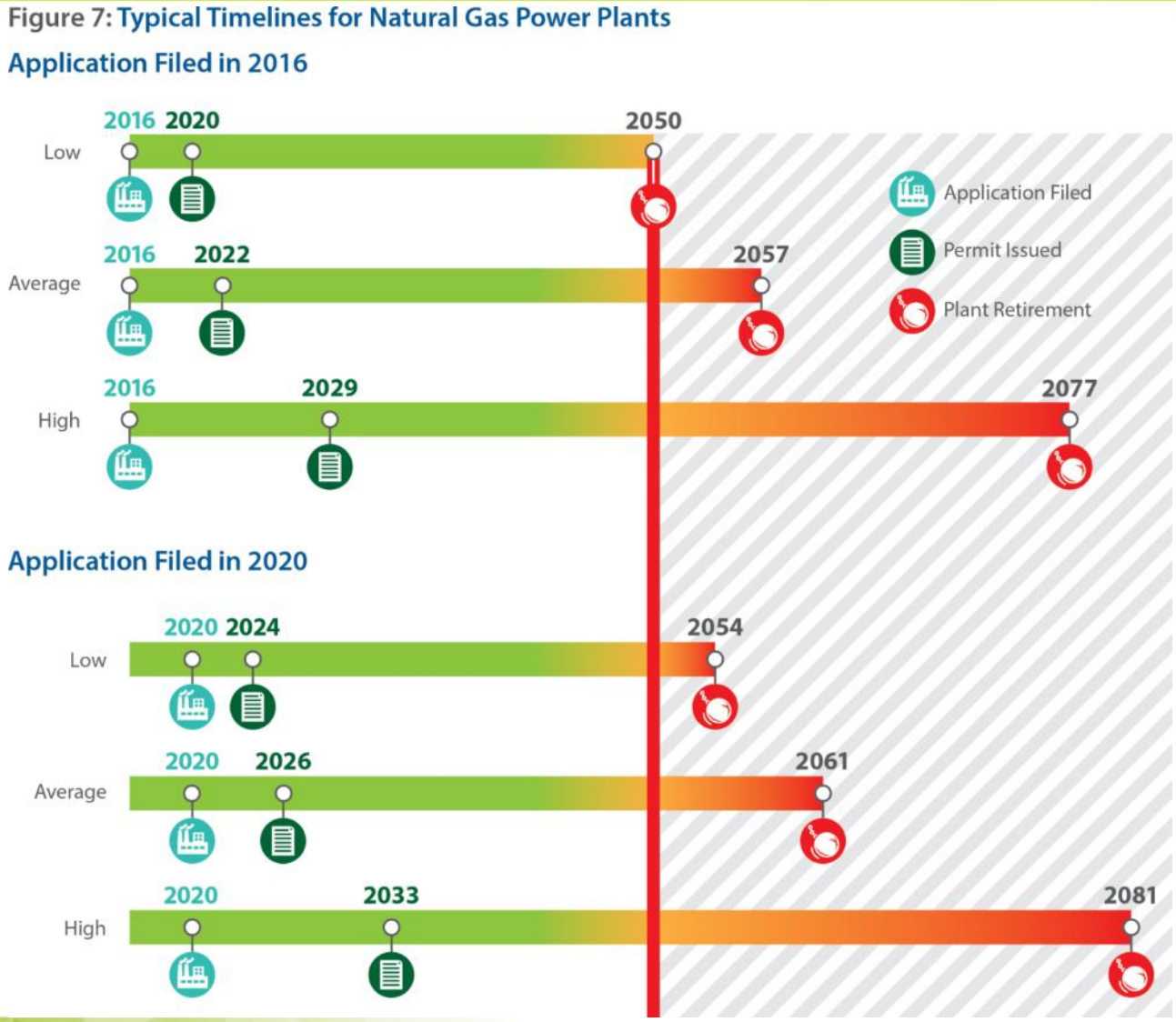
Timeline for New Gas-fired Power Plants



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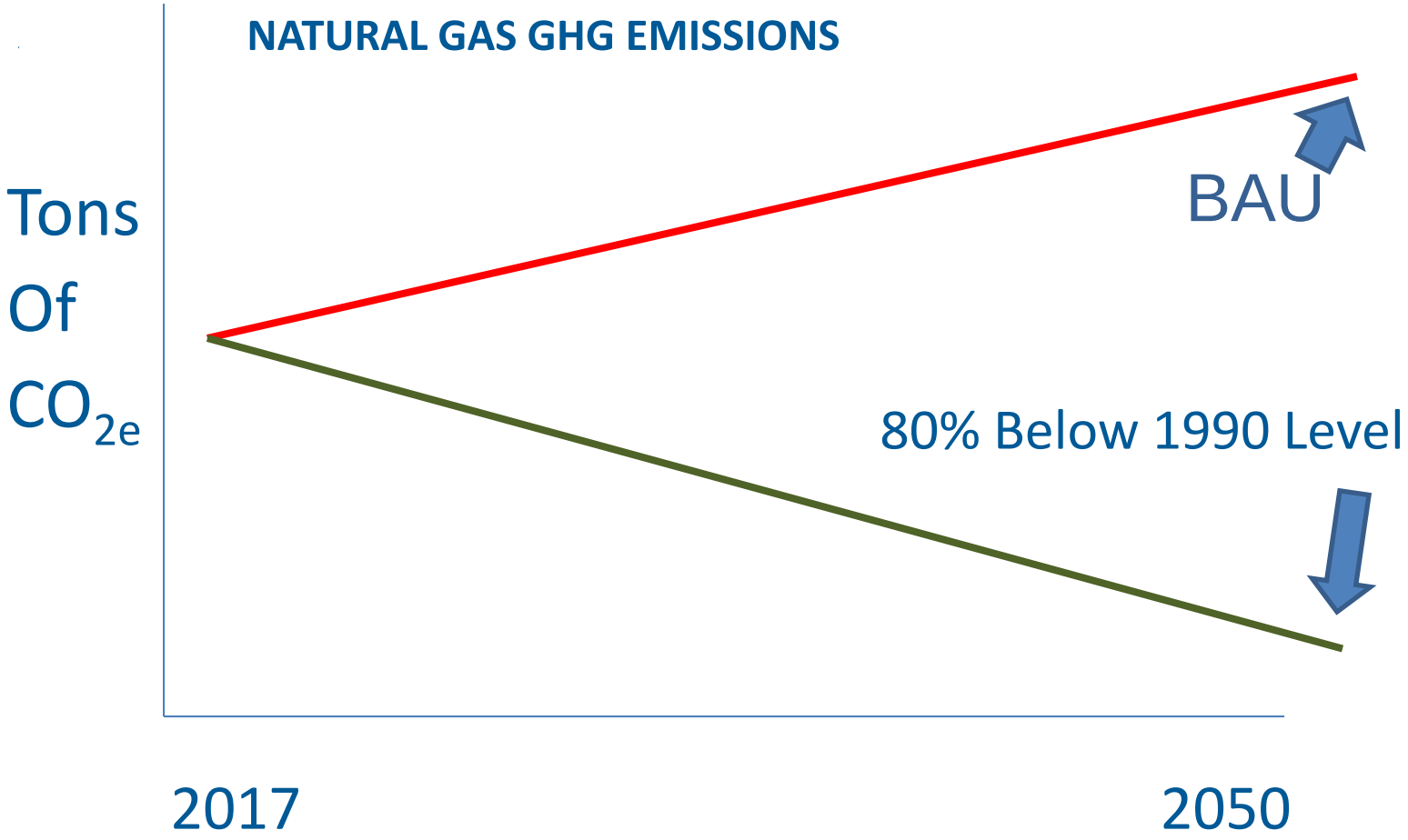
Critical Steps and Legal Pathways to Phasing Out Fossil Fuel

1. Planning is key
2. State limits on coal and gas(?)) use
3. Banning the use of fossil fuels
4. Limiting GHG emissions
5. Setting an effective price on carbon
6. Internalizing cost through environ. compliance
7. Closing or divesting government-owned plants

Starting to Plan



LADWP Reconsiders Repowering Plans

Potential Alternatives may Include…

- Repowering of OTC Units at a Reduced or Requisite Capacity
- Renewable Energy Resources with Energy Storage System
- Transmission Line(s) Improvement Only
- Repowering of OTC Units as Originally Planned
- Transmission Line(s) Improvement with Energy Storage System
- Deployment of Distributed Energy Resources
  (Energy Efficiency, Demand Response, PV solar, Electric Vehicle Charging, Energy Storage)
- Combination of Any of the Above *or* Any Other Viable Alternatives

CA Energy Commission Reconsiders Puente Project

Objective of this Moorpark Subarea Local Capacity Alternative Study

- Objective of this ISO study is to identify and evaluate potential resource portfolio alternatives to the Puente Project to meet the local resource adequacy need in the Moorpark area
- The study is performed for the purpose of informing the CEC's proceeding regarding NRG's application to construct the Puente Project
- The study will be based on the parameters and assumptions stipulated in the CEC order regarding the study
- The study does not assess the cost, timing or feasibility of procurement of the alternative resources

CA Energy Commission Reconsiders Puente Project

Resource portfolio options

Resource	Maximum capacity (MW)	Output Characteristics
EE (with new measures; includes permanent load shift products)	15 MW (see Note 1)	constant
Demand response (load reduction/behind the meter energy storage)	80 MW	4-hour
PV solar/energy storage hybrid	25 MW	7-hour
Storage enabled existing slow-responding demand response	~ 30 MW	6-hour
Preferred resources total	150	
Battery storage	≥ 114 MW *	Minimum 4-hour
	* 150+114=264	

Notes:

(1) As ~111 MW (2026) of additional achievable energy efficiency in the Moorpark area is already included in ISO studies based on information provided by the CEC, this 15 MW is assumed to contribute towards that additional achievable energy and not modeled in addition to the 111 MW.

(2) The procurement viability, timing and cost of developing these resources is not part of the scope of this study

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