PLATTS
McGRAW HILL FINANCIAL

scottmadden
MANAGEMENT CONSULTANTS

Smart. Focused. Done Right.

Energy Industry Update – A Strategic Overview

Platts Utility Supply Chain Conference

January 19, 2015

Discussion Outline

- A Changing Generation Portfolio
- An Increasing Reliance on Natural Gas
- A Changing Grid Architecture and Business Model Evolution
- A Changing Energy Utility Ecosystem and Closing Thought

scottmadden
MANAGEMENT CONSULTANTS

A Changing Generation Portfolio

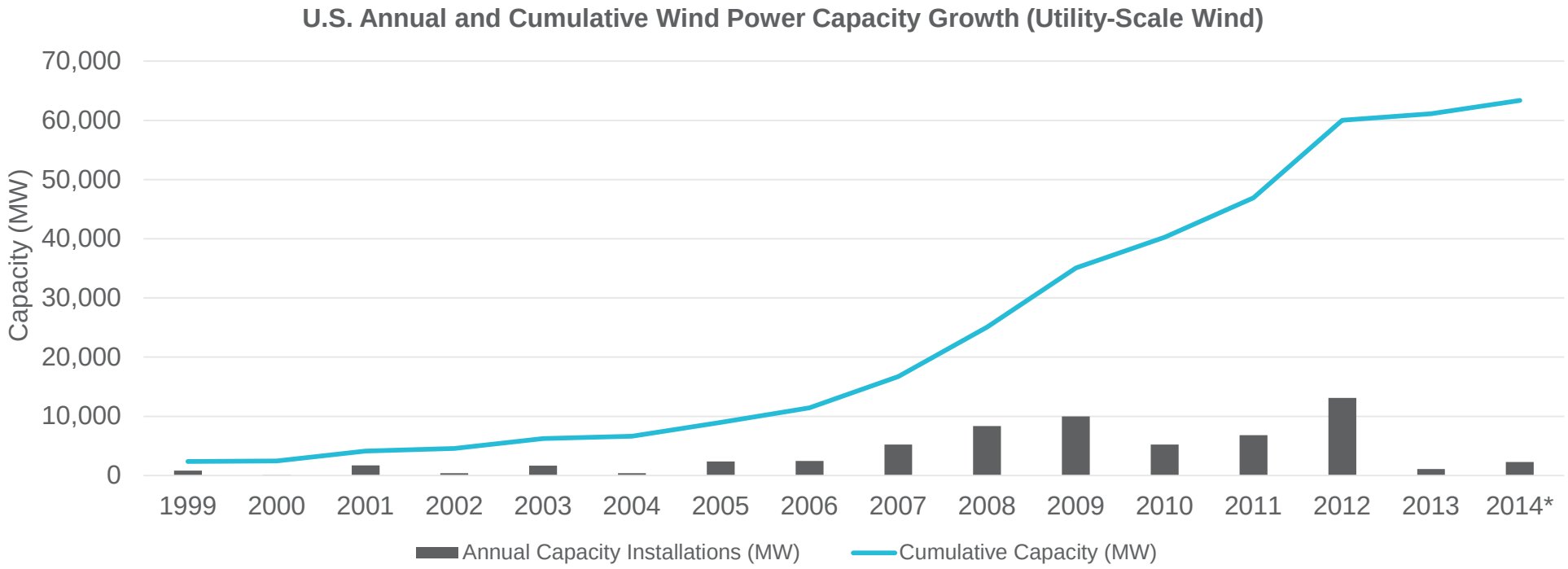
A Changing Generation Portfolio

- Growth of Renewables
- Environmental Pressures on Fossil
- EPA's Proposed Clean Power Plan
- The Importance of Portfolio Diversity

scottmadden
MANAGEMENT CONSULTANTS

A Changing Generation Portfolio

Growth of Renewables



Continued State Renewable Portfolio Standard (RPS) Challenges	❑ After some "near death" experiences last year, state RPSs continue to face legislative challenges, but Governor Jerry Brown recently proposed 50% by 2030 for California ❑ Ohio froze renewable and efficiency standards for two years ❑ EPA's Clean Power Plan may act like a "back door federal RPS," encouraging states to expand RPSs
Stop Gaps for Now; Uncertainty in the New Congress	❑ After lobbying for a more ambitious long-term deal, the wind energy industry will likely only be granted a one-year production tax credit extension ❑ In May, the bipartisan Shaheen-Portman energy efficiency bill to encourage deployment of "off-the-shelf" efficiency technologies, failed in the Senate

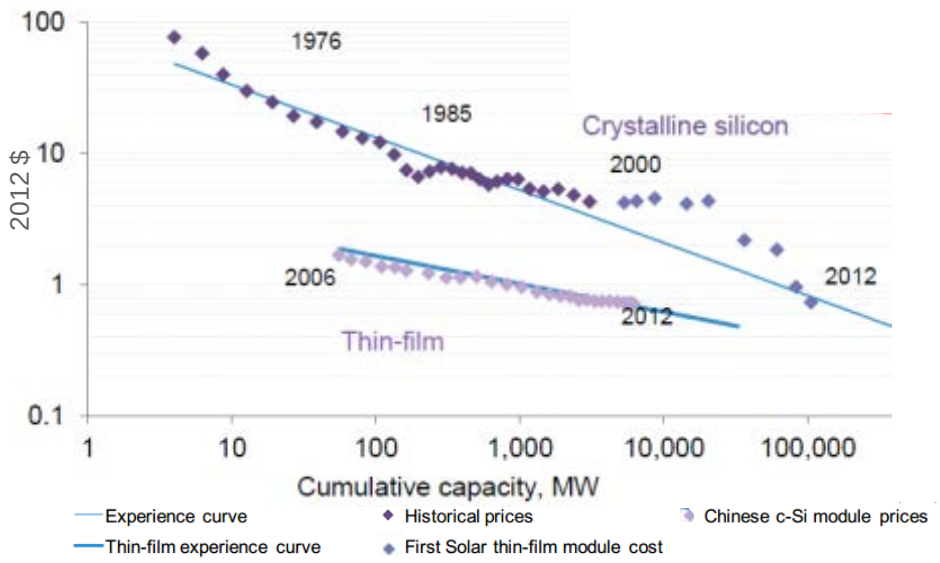
Note: *2014 figures are estimates based on the first three quarters of 2014 and annualized by adding the fourth quarter of 2013

Sources: Industry news; Greentech Media; American Wind Energy Association

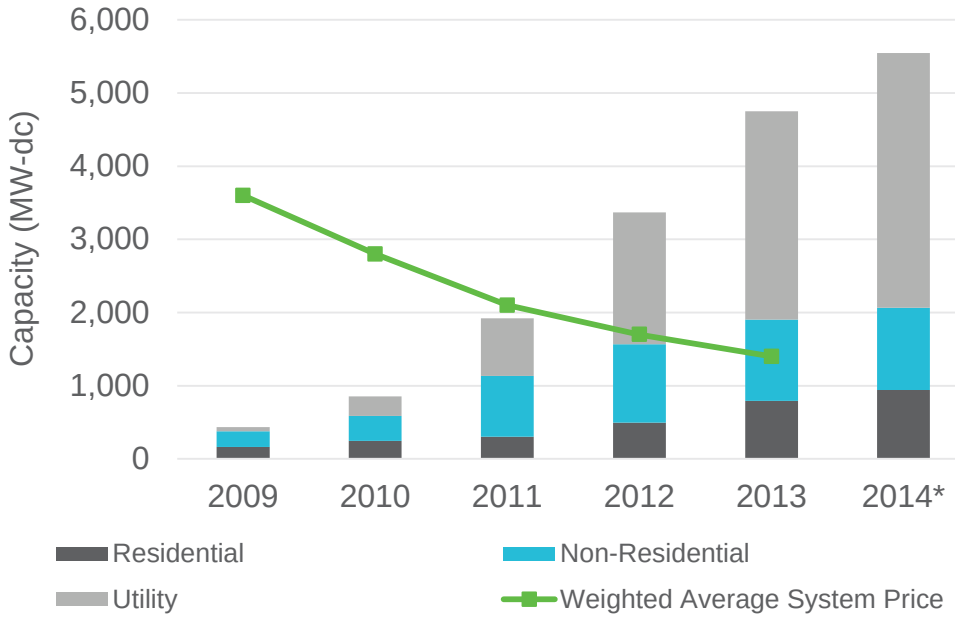
scottmadden
MANAGEMENT CONSULTANTS

Growth of Renewables (Cont'd)

Photovoltaic Experience Curve (1976–2012) (2012 $/W)



U.S. Annual PV Capacity and Average System Price (2009–2013)



Development in Absence of Mandates in the Peach State	❑ Georgia has emerged as a success story for solar development—it is the only top-10 solar market without an RPS mandate ❑ Demand is being driven by Georgia Power, which is seeking nearly 800 MW of utility-scale solar
Investment Tax Credit (ITC) Step-Down Might Not Be a Bad Thing	❑ The federal ITC is slated to fall from 30% to 10% at year-end 2016 ❑ Some solar developers see the ITC change as means to move beyond tax equity financing and use other vehicles (e.g., REITs**, yieldcos, etc.) ❑ Others are pushing to make under construction projects ITC-eligible

Notes: *2014 figures are estimates based on the first two quarters of 2014 and annualized by adding the third and fourth quarters of 2013; **REIT means real estate investment trust
Sources: Industry news; Greentech Media; The Pew Charitable Trusts

Solar has expanded rapidly in Germany as part of its Energiewende. In September 2014, the Solar Electric Power Association (SEPA) and ScottMadden led 25 U.S. energy industry executives to the bellwether energy market to exchange information with market leaders.

Environmental Pressures on Fossil

Area	Timing	Status	Implications
Clean Power Plan (CO_2 for existing plants)	**Proposed June 2014** **Final rule expected mid-summer 2015** **Major reductions begin in 2020**	■ Final rule due out mid-summer 2015, along with new and existing source rules – a delay ■ EPA has received two million comments concerning the rule ■ States required to submit compliance plans one year after rule finalized* ■ Proposed rule is being challenged in court in two separate suits by: • Murray Energy Corp. • Coalition of a dozen states	■ According to EPA, Clean Power Plan could cost $7.3B to $8.8B a year in 2030 ■ NERC has identified multiple reliability challenges posed by the rule ■ Lacking a veto-proof majority, the GOP-led Congress may attempt modifications to key deadlines and other rule provisions—delay may be an attempt to block that and/or limit hang up in the courts
Cross-State Air Pollution Rule (CSAPR)	**Restored by Supreme Court in April 2014** **Implementation begins January 2015**	■ Restored by the Supreme Court in April after being vacated by D.C. Court of Appeals in 2012 ■ D.C. Circuit Court lifted stay in Oct. 2014 ■ Phase one of implementation starts Jan. 1, 2015, with phase two starting in 2017	■ EPA can get rid of the legally rickety Clean Air Interstate Rule ■ Further industry challenges unlikely as the vast majority of the CSAPR region can easily comply with the rule ■ Some generators may opt to move planned retirements associated with the Mercury and Air Toxics Standards (MATS)** rule up to Jan. 2015 (from Spring 2015)

Notes: *Under certain conditions, states may be granted a one- to two-year extension; **See next page

Sources: SNL Financial; *Inside EPA*; Law360; Van Ness Feldman

Environmental Pressures on Fossil (Cont'd)

Area	Timing	Status	Implications
Mercury and Air Toxics Standards (MATS)	**Implementation begins Spring 2015** **Some plants asking for extra year; one requesting "fifth year"**	■ D.C. Circuit Court upheld the rule in April 2013 saying that the EPA need not consider cost when designing the regulation ■ U.S. Supreme Court recently agreed to review the rule after push from the Utility Air Regulatory Group, 21 states, and the National Mining Association ■ MATS will remain in place during the Supreme Court review	■ Biggest driver of coal retirements to date ■ EPA estimates up to $9.6B a year in compliance costs; industry says much higher ■ The Supreme Court review means continued uncertainty in the industry
Cooling Water Intake (Clean Water Act §316(b))	**Final rule released** **Challenges from environ-mental groups** **Compliance schedule varies on NPDES* permit timeline**	■ The EPA released the rule in May 2014, but only published it in the Federal Register in Aug. 2014 ■ Environmental groups have filed three separate challenges to the rule	■ Affects 544 power plants ■ Utilities must use one of seven best technologies available ■ Industry has largely backed the flexibility in the final rule ■ More stringent entrainment standards for new units at an existing facility ■ Implementation costs are estimated by the EPA at up to $297M annually, far less than estimated costs in original 2011 draft

Note: *National Pollutant Discharge Elimination System, a program under the Clean Water Act
Sources: SNL Financial; *Inside EPA*; Van Ness Feldman; Reginfo.gov (accessed Aug. 19, 2013); http://www.epa.gov/ttn/atw/utility/utilitypg.html (accessed Aug. 19, 2013); TheHill.com

Environmental Pressures on Fossil (Cont'd)

Area	Timing	Status	Implications
National Ambient Air Quality Standards (NAAQS)	**New standard proposed in late Nov.** **Rule to be finalized in Oct. 2015**	■ In 2008, EPA under George W. Bush updated the NAAQS ozone standard to 75 parts per billion (ppb) ■ In Oct. 2014, the Supreme Court declined to review a federal court ruling that upheld the standard ■ On Nov. 26, 2014, the EPA proposed to lower the ozone standard* to 65–70 ppb; update was required by Dec. 1 by court order	■ According to the EPA's analysis, the rule in 2025 would cost annually: • At 70 ppb – $3.9B** • At 65 ppb – $15B** ■ Sen. Jim Inhofe, R-Okla., believes the EPA's new standards for ozone would face "rigorous oversight" in the Congress ■ API President and CEO: "Tightening these standards could be the most expensive regulation ever imposed on the American public"
Coal Combustion Residuals	**Final rule issued Dec. 19** **Rule to take effect 180 days after published in federal register**	■ After over four years of consideration, EPA issued a final rule regulating coal combustion residuals (CCRs) on Dec. 19 ■ The final EPA rule treats CCRs as solid (rather than hazardous waste) under subtitle D of the Resource Conservation & Recovery Act (RCRA)	■ Power producers now have some degree of certainty in treatment of CCRs ■ States will drive oversight and enforcement, under federal minimum standards, but there may still be differences in degree under different regimes; however, potential exists for nuisance citizen suits against CCR producers

Notes: *Refers to primary ozone standard; **Measured in 2011 dollars and excluding California
Sources: SNL Financial; *Inside EPA*; The Hill; POWER; EPA; EnerKnol

scottmadden
MANAGEMENT CONSULTANTS

EPA's Proposed Clean Power Plan

What It Would Regulate	▪ Regulates existing power generation sources, but states may use portfolio approach regulating "outside the fence," e.g., renewables and efficiency providers ▪ Targets reduction of 17% from 2013
How It Works	▪ EPA gives states state-specific emissions goals based on "building blocks" ▪ States submit compliance plans for EPA approval using best system of emissions reduction...adequately demonstrated ▪ States may submit multi-state plans ▪ States have choice of mass (total lbs.) or rate (lbs./MWh) emissions limits ▪ Use of "building blocks" not required
Comments: Hostile an Under-statement	▪ Texas agencies*: "[T]his is a completely unrealistic and unattainable goal for Texas," referring to the interim CO_2 rate of 853 pounds CO_2/MWh ▪ Sierra Club: "EPA should require full compliance by 2025 because the vast majority of emission reductions can be achieved early on in the compliance period"

EPA Proposed "Building Blocks" for Compliance

Building Block 1

Heat rate improvement at existing coal-fired generating units
- Assumed 6%

Building Block 2

CO_2 reduction from increased generation at natural gas combined cycle facilities (vs. coal-fired)
- Assumed 70% minimum capacity factor
- New NGCC facilities

Building Block 3

Increase in cleaner generation
- Increased nuclear capacity (new units) or avoided retirements (6% at risk)
- Increased renewables (EPA assumed 13% renewable energy by 2030)

Building Block 4

Increased energy efficiency
- Reduced generation through EE improvements (EPA assumed 1.5% annual savings)

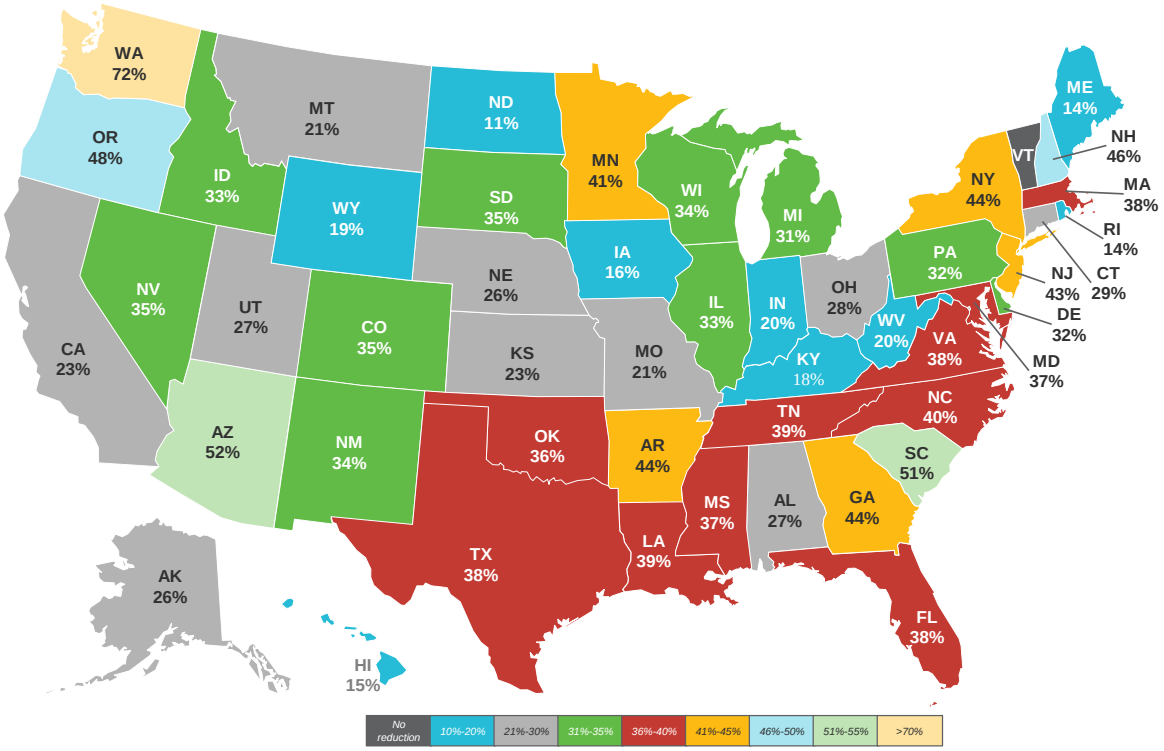
Compliance "building blocks" were used to set state targets. While not required to be used by states, these "building blocks" are controversial.

Note: *Refers to Public Utility Commission of Texas, Texas Commission on Environmental Quality, and Texas Railroad Commission
Sources: SNL Financial; NARUC; RTI International; EPA

scottmadden
MANAGEMENT CONSULTANTS

EPA's Proposed Clean Power Plan (Cont'd)

2030 Goals (by State) as Percent Reductions from 2012 CO_2 Emission Rates*



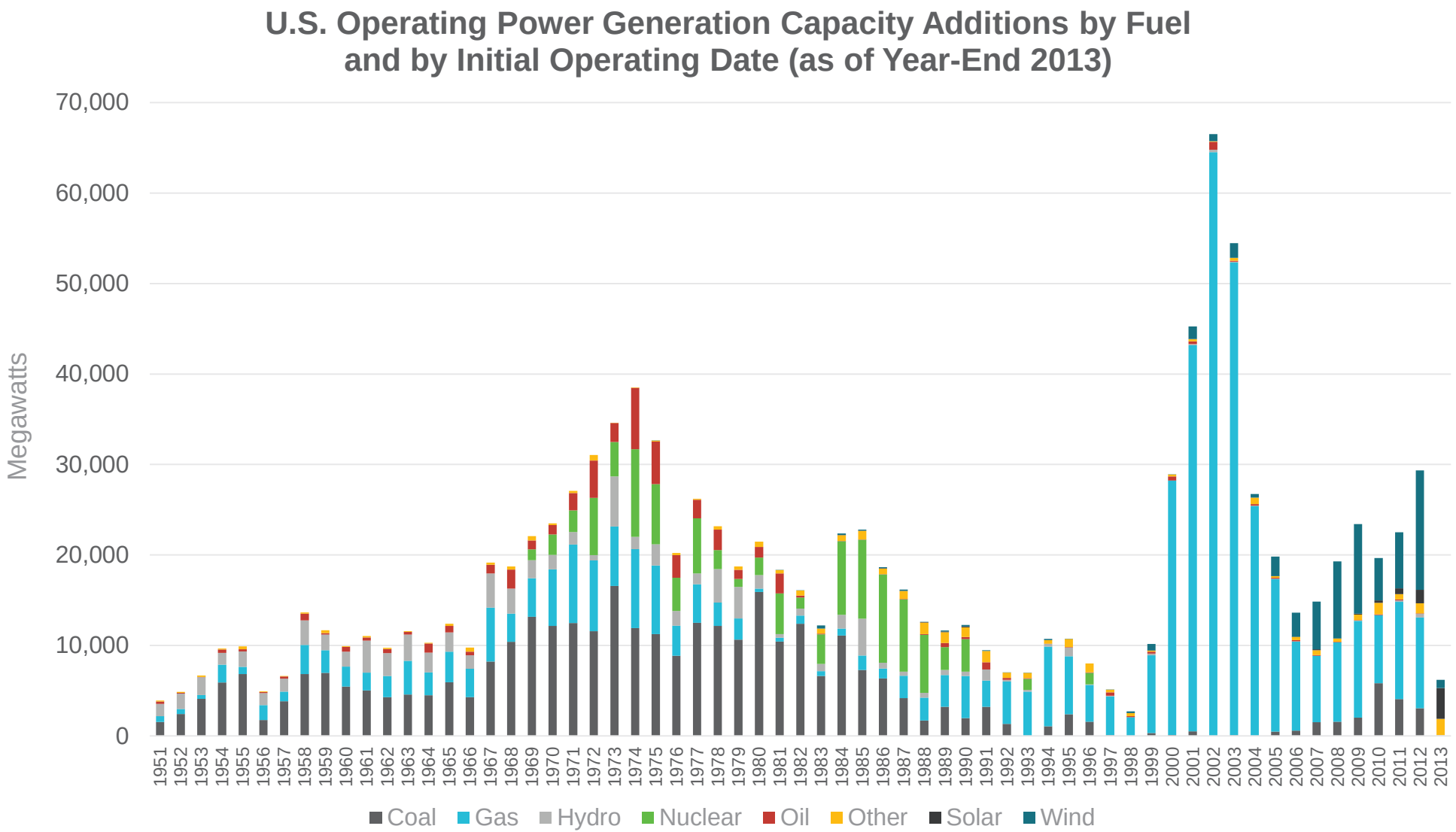
Selected Issues Regarding Proposed EPA Rule

Threshold Issue of EPA Authority	▪ Does EPA have authority to regulate CO_2, in particular under little used (§111d) of the Clean Air Act?
"Outside the Fence" Jurisdiction	▪ Can EPA extend obligations under plan beyond power plants?
Cost and Feasibility of Plan	▪ Disagreement over cost and feasibility
Reliability and Role of FERC	▪ Grave warnings from many about reliability impacts ▪ FERC's level of involvement to date and going forward, a source of contention
Treatment of Nuclear	▪ Treatment of nuclear under construction and at risk for retirement
Accounting/ Calculations	▪ Challenges of accounting for efficiency savings and emissions reductions (e.g., what would have been vs. what is emitted)

Note: *In pounds of CO_2 per MWh-hour
Sources: NARUC; RTI International ; EPA; ScottMadden analysis

scottmadden
MANAGEMENT CONSULTANTS

The Importance of Portfolio Diversity



Sources: EIA data; ScottMadden analysis

scottmadden
MANAGEMENT CONSULTANTS

An Increasing Reliance on Natural Gas

An Increasing Reliance on Natural Gas

- 2014’s Polar Vortex: Déjà Vu All over Again?
- Gas-Power: Can the Cowboy and Farmer Be Friends?
- Natural Gas Fracking – A Supply Chain Game Changer?

Polar Vortex: Déjà Vu All over Again?

January 2014: Very cold weather spiked gas and electricity markets in the upper Midwest, Northeast, and the Southeast for several days. Some brushed with emergency conditions due to insufficient generation. Gas pipeline utilization was pushed to its limits by coincident heating and generation load peaks.

2014: It Was Not Just Gas Availability

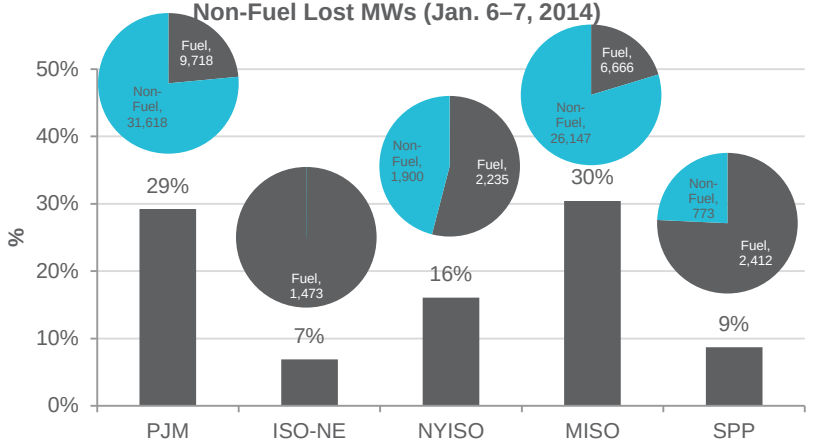
- Pipeline capacity tight, especially in New England
- Many outages were not fuel related
- Fuel issues were not limited to natural gas
- Fuel diversity was critical as available gas capacity was far less than "advertised"
- Generators faced significant fuel price risk: Due to gas and power day mismatch, generators assumed gas price risk in advance of dispatch, as gas prices soared to $100/MMBtu

2015: Are We Ready for the Next One?

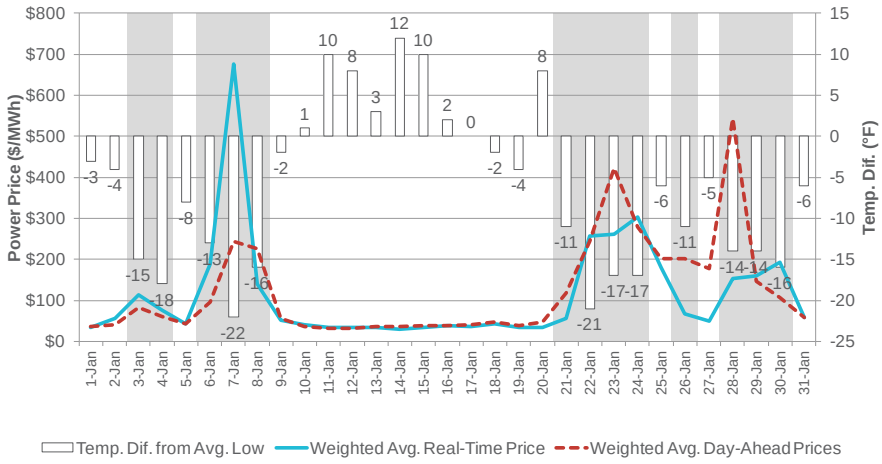
- PJM has asked FERC to temporarily raise its cost-based offer cap to compensate generators in polar vortex-type event
- NERC has proposed to consolidate and streamline emergency grid operations requirements, EOP-011-1
- Even so, many forecasts do not indicate another polar vortex this winter

"We see the bulk of the pull back in power (and gas for that matter) as attributable to winter-gas expectations, with premiums for another polar vortex having reversed"
– UBS Global Research, December 31, 2014

% of MW Lost vs. Peak Load and Split between Fuel and Non-Fuel Lost MWs (Jan. 6–7, 2014)



Jan. 2014 PJM-Wide Day-Ahead and Real-Time Power Prices vs. Temperature Difference from Average Low (°F) (Philadelphia, PA)

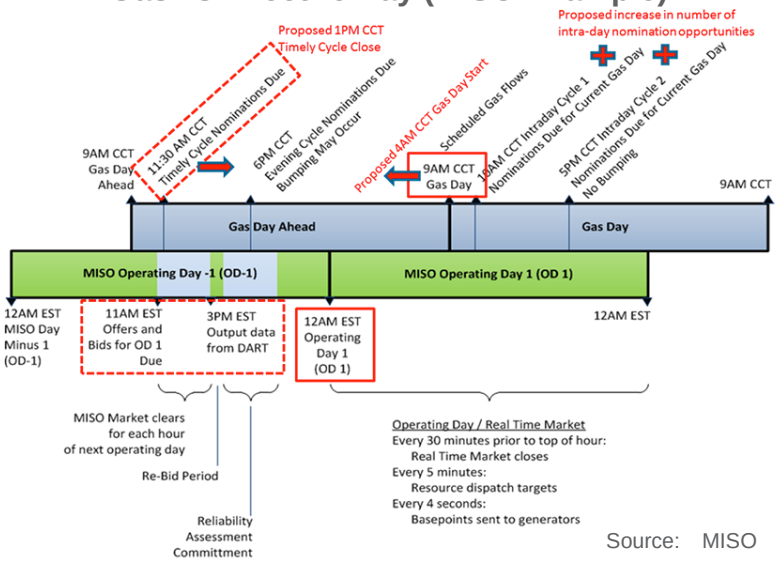


Sources: SNL Financial; FERC Technical Conference on Winter 2013–14 Operations and Market Performance in RTOs and ISOs (Apr. 1, 2014); PJM; AccuWeather; EBW Analytics Group/Weather Decision Technologies Inc.; UBS Global Research; industry news; ScottMadden analysis

scottmadden
MANAGEMENT CONSULTANTS

Gas-Power: Can the Cowboy and Farmer Be Friends?

Gas vs. Electric Day (MISO Example)



Source: MISO

Qualitative Assessment of Regional Gas/Electric Issues

	Criterion	PJM	MISO	NYISO	ISO-NE	TVA	IESO
Natural Gas Supply	Gas Supply Portfolio Diversity						
	Pipeline Connectivity Level						
	Conventional Storage Deliverability						
	LNG Storage Capability						
Electric-Gas Interface	Firm Transportation Entitlements						
	Direct Pipeline Connectivity						
Gas Tariff Impact on Electric Market	Pipeline or LDC Penalties						
	LDC Provision of Flexible Service						
	Active Secondary Market						

Source: EIPC

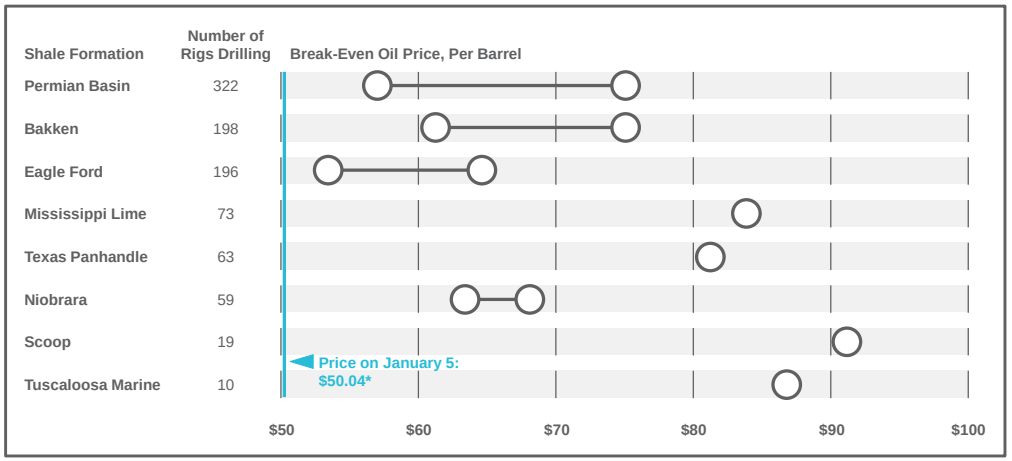
Some Regional Studies Find Adequacy	❑ The Western Interstate Energy Board in second phase of gas-electric coordination study found that gas infrastructure satisfactory except for extreme winter conditions ❑ MISO found it had sufficient resources available for the 2014/15 winter
FERC Reports Progress	❑ In it's Winter 2014–15 Energy Market Assessment, FERC reported "increased natural gas-electric coordination" ❑ Indeed, ISO-NE has promised to continue to communicate with pipeline operators this winter
NAESB Submits Standards	❑ In Sept., NAESB filed comments under FERC's NOPR recommending three intraday nomination cycles—10 AM, 2:30 PM, and 7 PM—but not including a 4 AM* start preferred by RTOs
Infra-structure Challenges in ISO-NE	❑ The New England States Committee on Electricity put on hold after Massachusetts failed to pass key related legislation ❑ Construction of new pipelines is largely predicated on amending market rules to allow generators to recoup the costs of firm service

Note: *All Central time; different than proposed in FERC NOPR
Sources: SNL Financial; FERC; Eastern Interconnection Planning Collaborative; Midcontinent ISO

Natural Gas Fracking – A Supply Chain Game Changer?

Oil prices are tumbling down, with some commentators opining that oil will fall and stay below $50/bbl. The U.S. price of natural gas used to be tied to the price of oil before the unconventional supply glut broke the correlation. How will oil prices impact gas going forward?

Shale oil breakevens vary widely...



Note: *Nymex front month settlement price; select oil fields, doesn't include drilling for natural gas and some petroleum liquids

Sources: Baird Oil & Gas Research; Wall Street Journal

...so the impact on associated gas as oil and NGL prices fall will be regional.

Sources: SNL Financial; BBC; Morgan Stanley Research

Implications of Low Oil Prices on Shale Gas Supply

Decrease in Shale Gas Production in Oil Plays?

- Natural gas is relatively price inelastic in the short run, both on demand and supply sides
- But in "oily" plays such as Eagle Ford, oil production may be scaled back, reducing associated gas production
- However, market discipline is difficult to achieve with many independent operators in shale plays, and gas production in shale formations like Marcellus is growing

Power Markets Can Provide Release Valve

- With continued gas supply increases and little demand growth, the power sector will be crucial to taking excess
- This will benefit new gas generation as well as coal-to-gas switching that is encouraged by EPA's Clean Power Plan

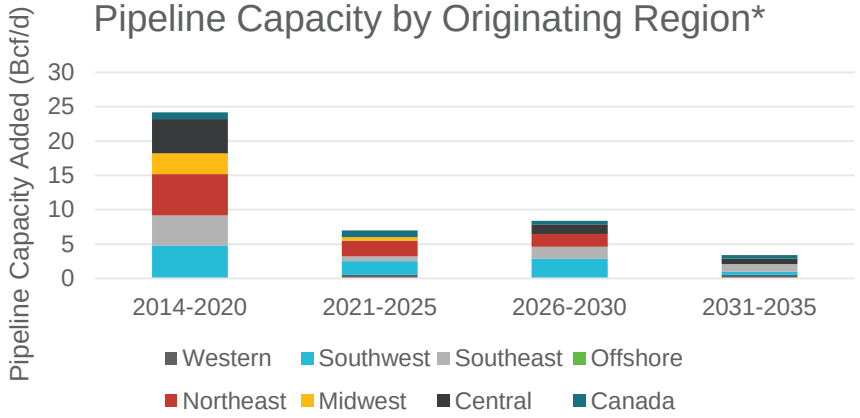
NGL Markets Are a Key Uncertainty

- Revenue from "wet" gas plays has been buoyed by strong NGL market demand for feedstock for chemicals
- Oil products (in form of naptha) compete as feedstock, so continued cheap oil may affect those economics

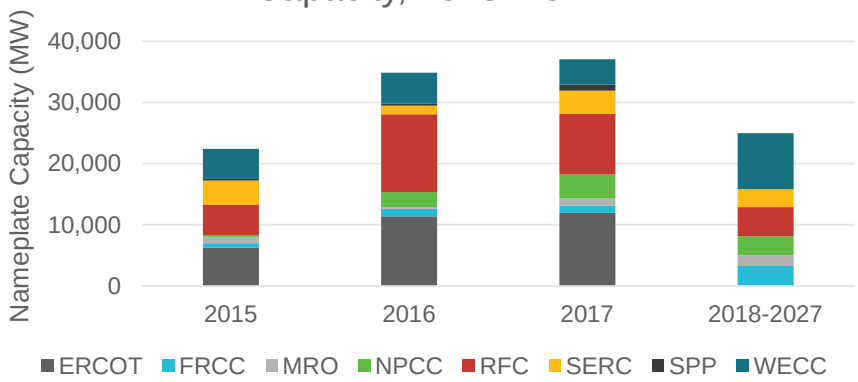
Natural Gas Fracking – A Supply Chain Game Changer?

Increased investment in natural gas infrastructure—including pipeline, electric generating units, storage, and liquefied natural gas (LNG) terminals—is planned but is not expected to keep pace with supply

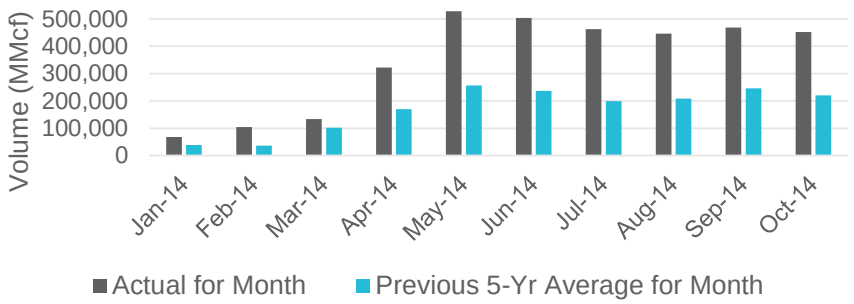
Planned Inter-Regional Natural Gas Pipeline Capacity by Originating Region*



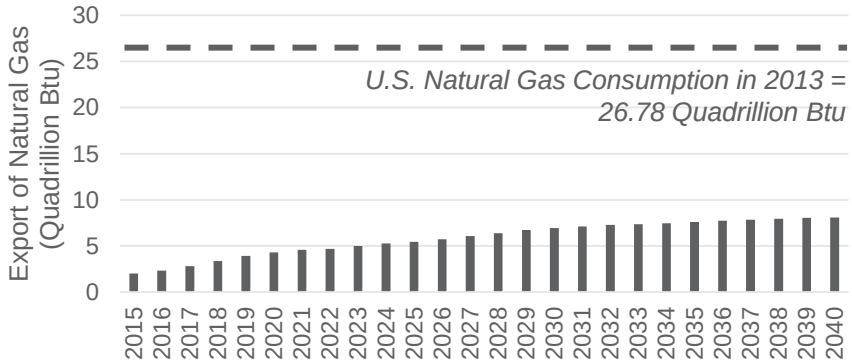
Natural Gas Electric Generating Unit Capacity, 2015–2027



Lower 48 States Total Natural Gas Injections into Underground Storage, Jan.–Oct. 2014



Forecast Export of Natural Gas Originating in the United States, 2015–2040



Notes: *Base case from INGAA Foundation report "North American Midstream Infrastructure through 2035: Capitalizing on Our Energy Abundance;" LNG data include re-exported liquefied natural gas

Sources: INGAA Foundation; EIA; Ventyx (EIA 860, NERC ES&D, CFE, StatsCanada, CEMS, U.S. Federal and State Agencies, ISOs, Unit Owner and/or Operator Websites, Ventyx Primary Research)

scottmadden
MANAGEMENT CONSULTANTS

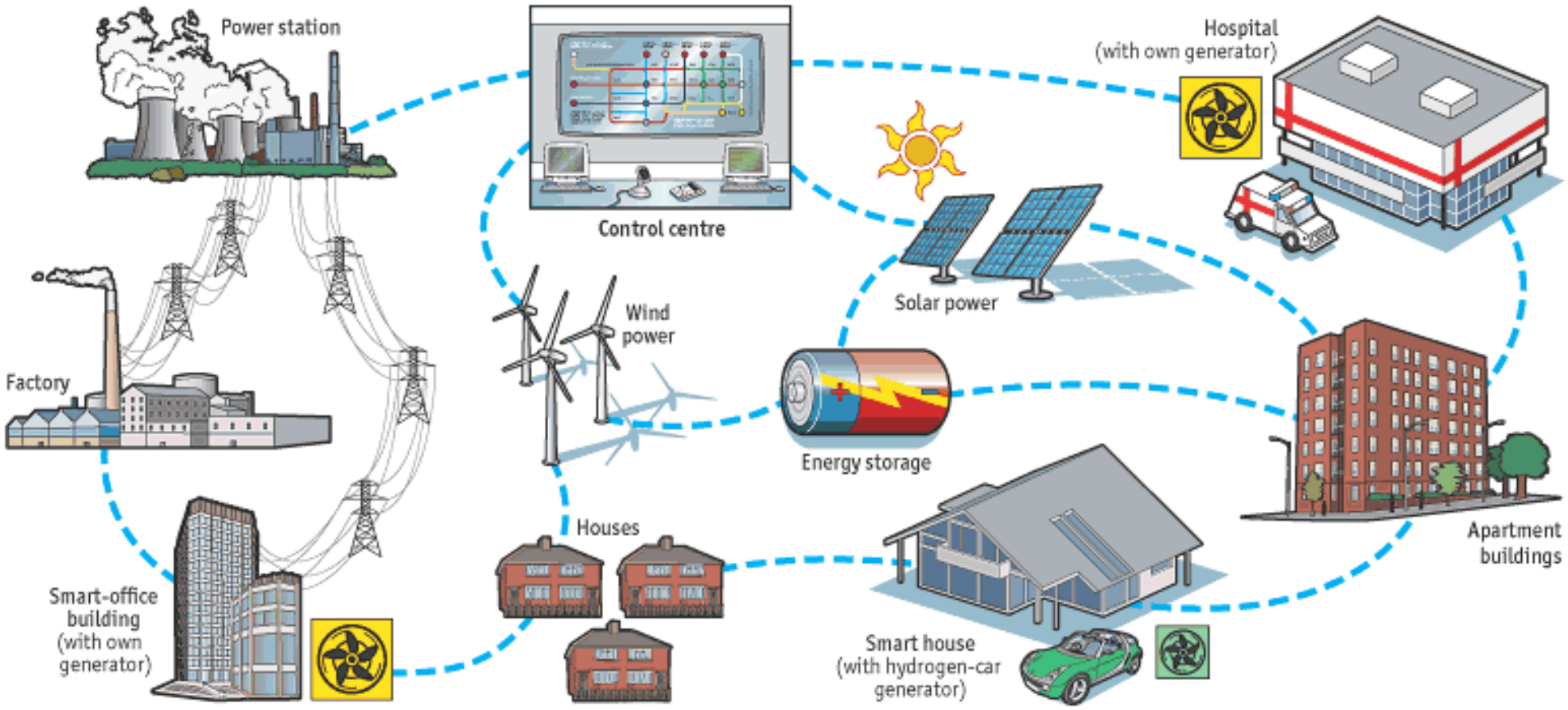
A Changing Grid Architecture and Business Model Evolution

A Changing Grid Architecture and Business Model Evolution

- New Technology and a New Physical Model
- Declining Consumption
- Utility Business Models

New Technology and a New Physical Model

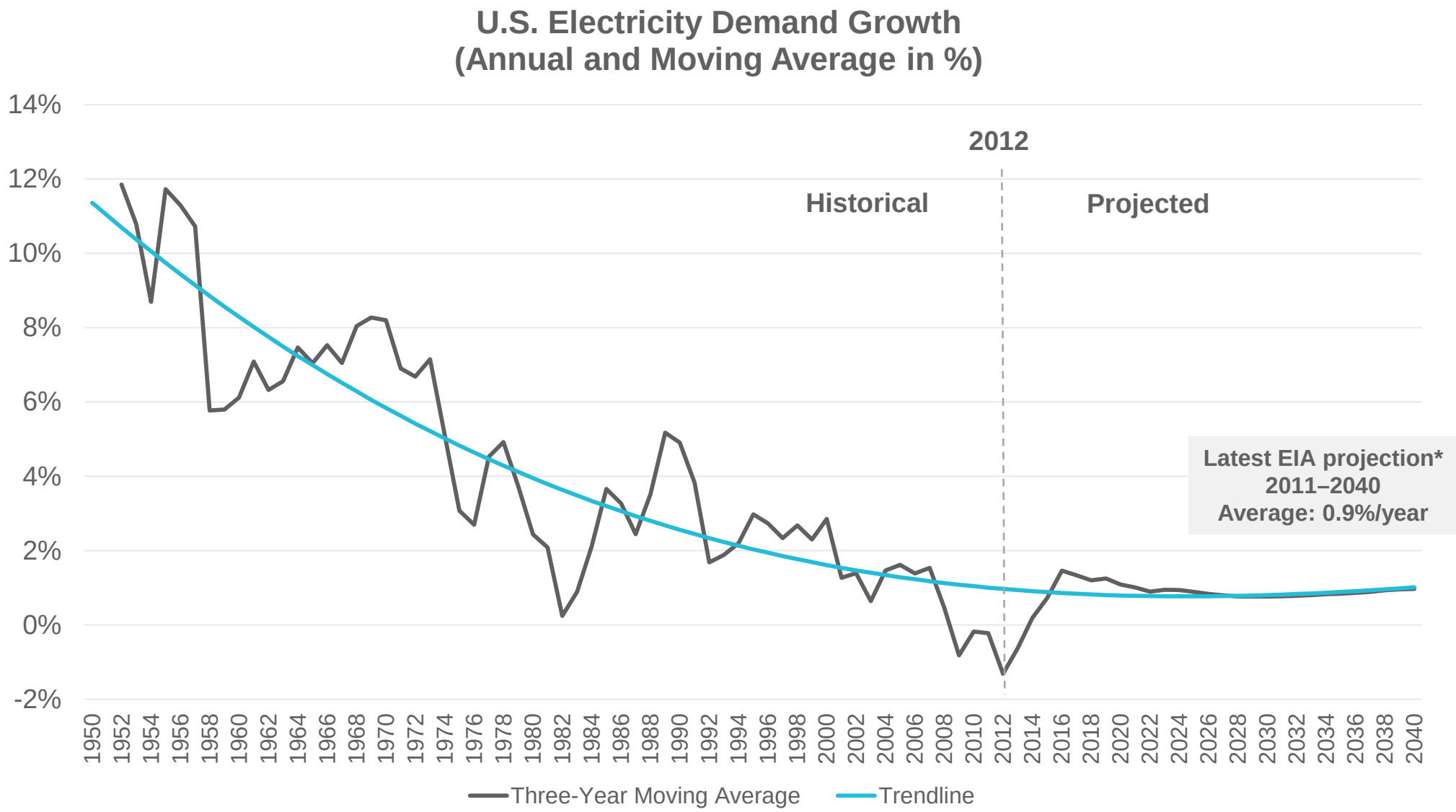
More a two-way network, less hub and spoke, more heterogeneous, and more geographically dispersed.



Sources: The Economist; ABB

scottmadden
MANAGEMENT CONSULTANTS

Declining Consumption



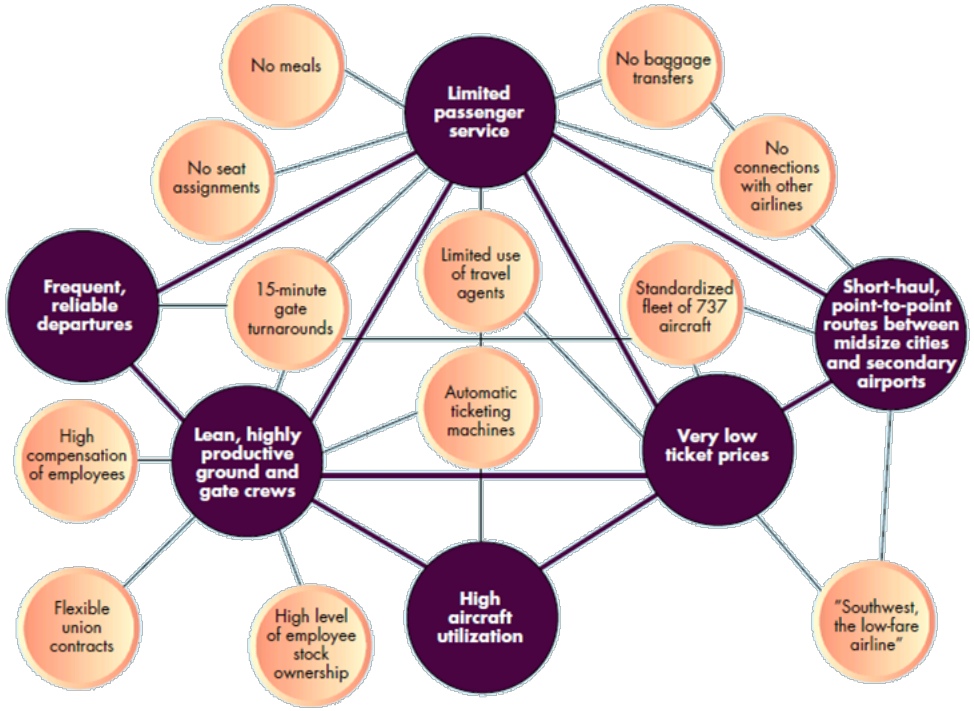
Sources: *EIA, Annual Energy Outlook 2013; EIA, Monthly Energy Review (Dec. 2013); ScottMadden analysis

scottmadden
MANAGEMENT CONSULTANTS

Are Utility Business Models in Play?

- **What is a business model?**
  - A system of interconnected and interdependent activities…
  - that determines the way the company "does business"…
  - with its customers, partners, and vendors…
  - to create value/competitive advantage
- **Do business models change?**
  - Average S&P 500 company tenure
    - 1958: 57 years
    - 1983: 30 years
    - 2008: 18 years

Southwest Airlines' Original Business Model



Source: Michael Porter, What is Strategy?, Harvard Business Review (Nov. 1996)

Sources: MIT Sloan Management Review; Bloomberg BusinessWeek; www.digitalbusinessmodelguru.com

scottmadden
MANAGEMENT CONSULTANTS

How Might Changes Affect Business Models?

Think Global, Act Global

(Controlled centrally, one integrated system)

Think Global, Act Local

(A Centrally Orchestrated Network)

Think Local, Act Local

(Control is dispersed, many systems loosely tied)

Low — ***Increasing change and complexity*** — High

Traditional Vertically Integrated Utility

- Continued focus on central station generation, long-haul transmission
- Technology initiatives focus on improving the existing integrated system
- May see reduced loads due to energy efficiency and distributed resources, but customers do not secede
- Utilities driving the "discussion"

Managed Network

- High penetration of DG (combined heat & power and renewables)
- Emergence and increased penetration of microgrids
- Initiatives focus on integrating new grid components
- Utilities orchestrating the "discussion"

Disaggregated Supply and Demand

- High penetration of DG (combined heat & power and renewables)
- Emergence and increased penetration of microgrids
- Others driving the "discussion"

scottmadden
MANAGEMENT CONSULTANTS

A Changing Energy Utility Ecosystem

A Changing Energy Utility Ecosystem

- New Kinds of Players
- Will Disruptive Technologies Be a Game Changer?
- Closing Thought

New Kinds of Players

Generation

SolarCity

nrg

SunEdison

SUNRUN

Bloomenergy

oci solar power

Storage

TESLA

ALEVO

United Technologies

S&C ELECTRIC COMPANY
Excellence Through Innovation

Optimization

OPOWER

nest

Honeywell

bidgely

comverge
energy made better

TENDRIL

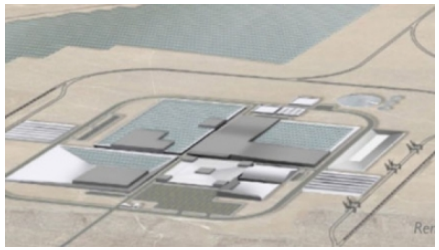
scottmadden
MANAGEMENT CONSULTANTS

Will Disruptive Technologies Be a Game Changer?

Nest

- Smart digital thermostats, smoke/CO alarms
- Google announced acquisition of Nest in January 2014 for $3.2B
- Part of Google's "internet of things" strategy
- Energy management partner or disintermediary?

Tesla Gigafactory



- Tesla proposing a $4B to $5B "gigafactory" for EV battery production
- Targeting 2020 scale of 500,000 vehicles/year and lowering battery costs to $200 to $300 per KWh
- Some skepticism about ability drive down costs
- "Auto firm or missing link for renewables?"

Beacon 10

- CHP energy appliance about the size of a washing machine
- Generate power from natural gas, balance battery and rooftop solar, provide backup
- Sterling engine based; Dean Kamen-designed (Segway fame)
- To be marketed by NRG in early 2015
- Science experiment or breakthrough product?

Bloom Box

- Launched in 2011 with much fanfare solid; oxide fuel-cell
- Aided by low gas prices, has spurned interest in entire sector: ~120 MWs of fuel cells installed in 2012 (3x that in 2011), totaling $1B
- Science experiment or breakthrough product?

scottmadden
MANAGEMENT CONSULTANTS

A Final Thought

What Is This?

We are seeing the early stages of complex change and innovation in our industry. The best way to predict the future is to develop it.

scottmadden
MANAGEMENT CONSULTANTS

Contact Us

Stuart M. Pearman

Partner and
Energy Practice Leader

ScottMadden, Inc.
2626 Glenwood Avenue
Suite 480
Raleigh, NC 27608
spearman@scottmadden.com
O: 919-781-4191

scottmadden
MANAGEMENT CONSULTANTS

Smart. Focused. Done Right.

scottmadden
MANAGEMENT CONSULTANTS