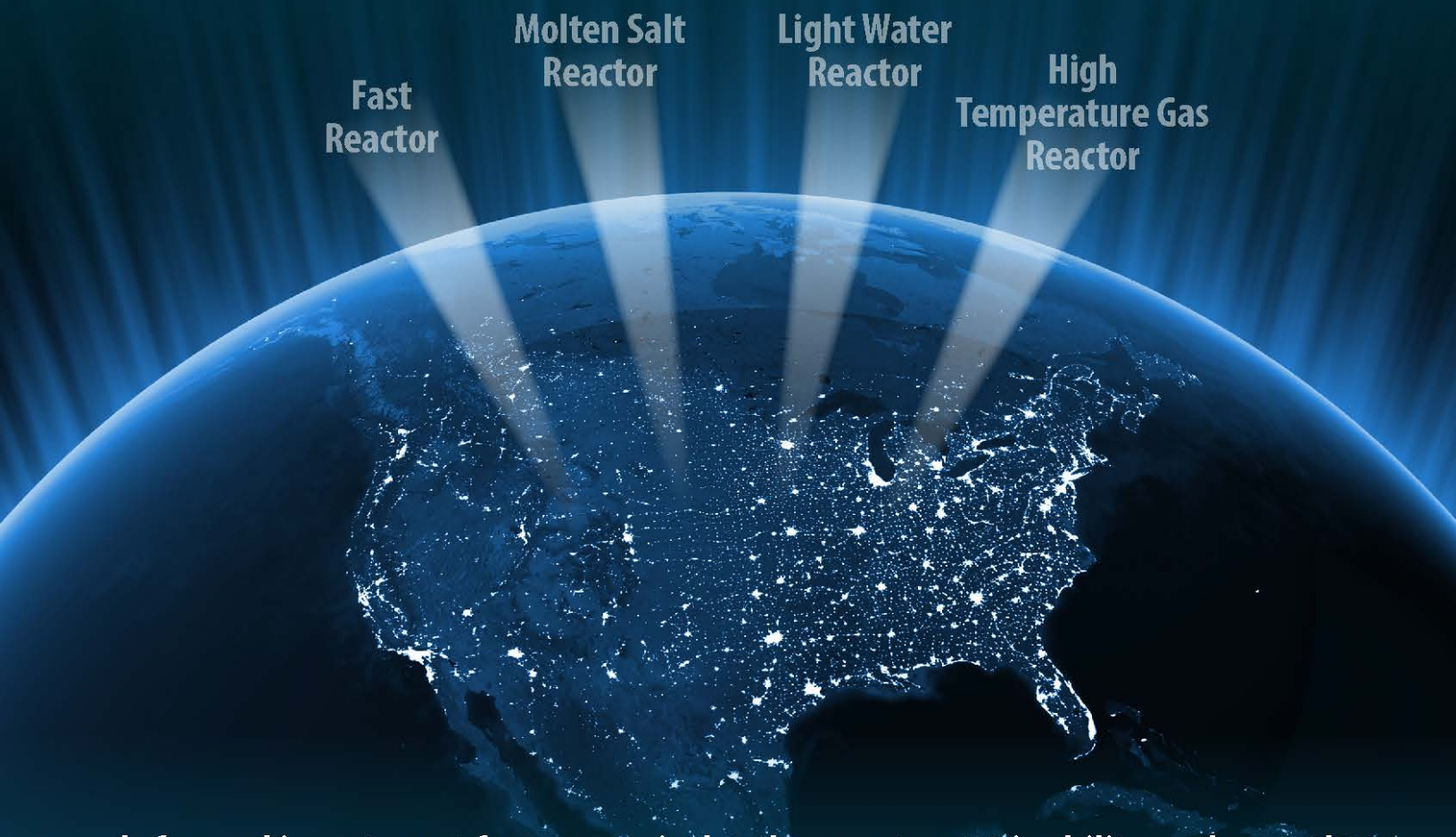
Enabling Advanced Reactors for the Market

George Washington University • March 8-9, 2018



Informed investment for economic development, sustainability and growth

EPRI
ELECTRIC POWER RESEARCH INSTITUTE

GAIN
Gateway for Accelerated Innovation in Nuclear

NEI
NUCLEAR ENERGY INSTITUTE

GEORGE WASHINGTON UNIVERSITY
Science and Engineering Hall, Lehman Auditorium
800 22nd Street NW, Washington, DC
(Invitation Only Event)

Objectives

- Identify opportunities and gaps associated with the economic deployment of advanced reactors and associated technologies
- Enable connection between technology developers and customers
    - Provide an energy market context and explore technical deployment opportunities
    - Understand the "voice of the customer"
- Understand the federal government's role in advanced reactor policy, regulation, and R&D investment
- Capture the necessary steps to enable advanced reactors for the market.

Being prepared for the future means anticipating and adjusting to the ever-changing factors that shape our society. A resilient, affordable, and clean energy infrastructure is at the heart of our quality of life and a crucial factor for broad economic competitiveness and employment. Leading us into this future are companies, consumers, and organizations that supply and use energy in novel and purposeful ways.

Advanced nuclear reactors are being developed to meet these future energy needs, including new markets, uses, and applications. Developers, energy producers, industrial users, the government, and other organizations each stand to gain from the success of advanced reactors with the assurance of sustainable and secure energy. However, there are several gaps and hurdles to overcome before realizing this future.

The Department of Energy's Gateway for Accelerated Innovation in Nuclear (GAIN) Initiative, the Nuclear Energy Institute (NEI), and the Electric Power Research Institute (EPRI) are organizing this symposium, "Enabling Advanced Reactors for the Market," to bring together technology developers, energy users, government representatives, and others in a dialogue about the future energy market and the role of advanced nuclear technologies. This event is being hosted by George Washington University to provide a central location to connect the technology developers with energy end users and federal regulatory, policy, and research and development decision makers. The symposium will identify opportunities and challenges associated with deployment of advanced reactor technologies for future energy markets. Information on the regulatory environment and incentives used to support deployment of advanced reactors will also be discussed.

SPEAKERS

Session 1 – Symposium Kickoff

David Dolling	Dean, School of Engineering & Applied Science	George Washington University
Mark Peters	Laboratory Director	Idaho National Laboratory
John Parsons	Senior Lecturer	Massachusetts Institute of Technology
David Petti	Executive Director	Massachusetts Institute of Technology
Rita Baranwal	GAIN Director	Idaho National Laboratory

Session 2 – Developer Perspective

Jon Ball	Executive Vice President	GE Hitachi
Ron Faibish	Sr. Director of Business Development	General Atomics
Richard Meyer	VP Engineering Operations & Product Development	Kairos Power
Marcia Burkey	Chief Financial Officer	TerraPower
Robin Rickman	VP Business Development	Terrestrial Energy, USA
Harlan Bowers	President	X-Energy

Session 3 – Utility and Energy End User Perspective

John Bistline	Senior Technical Leader	Electric Power Research Institute
Marilyn Kray	Vice President	Exelon
Chris Deir	Senior Business Manager	Ontario Power Generation
Laura Olson	Manager	Salt River Project
Brandon Waites	New Projects Manager	Southern Company
Dan Stout	Senior Manager	Tennessee Valley Authority
Frederick Moore	Global Director for Mfg., Technology, & Energy	Retired-Dow Chemical Co.

Session 5 – Industry, DOE and Regulatory Perspectives

Dan Brouillette	Deputy Secretary of Energy	U.S. Department of Energy
Maria Korsnick	President and CEO	Nuclear Energy Institute
Kristine Svinicki	Chairman	U.S. Nuclear Regulatory Commission

Session 6 – Policy Discussion

Adam Rosenberg	Staff Director, Energy Subcommittee	U.S. House Committee
Kristy Hartman	Energy Program Manager	Nat'l Conference of State Legislatures
Matt Crozat	Senior Director of Policy Development	Nuclear Energy Institute
Ben Reinke	Professional Staff Member	U.S. Senate Committee

Session 7 – Pulling it Together

Mark Menezes	Under Secretary of Energy	U.S. Department of Energy

Symposium Moderators

Justin Coleman	Symposium Integrator	Idaho National Laboratory
Mark Peters	Laboratory Director	Idaho National Laboratory
Dan Lipman	VP Suppliers, New Reactors, and Int'l Programs	Nuclear Energy Institute
John Kotek	VP Policy Development & Public Affairs	Nuclear Energy Institute
Ashley Finan	Policy Director	Nuclear Innovation Alliance

AGENDA - Thursday, March 8, 2018

7:45 a.m.	**Registration**		
8:30 a.m.	**Session 1 – Symposium Kickoff** • Welcome from GWU • Opening Remarks • Importance of Advanced Reactors to the Market • GAIN Perspective	**Justin Coleman** David Dolling Mark Peters John Parsons David Petti Rita Baranwal	**INL** GWU INL MIT MIT INL
10:00 a.m.	**Break/Networking**		
10:30 a.m.	**Session 2 – Developer Perspective** *Current and Future State of Technologies* Presentations and Panel Session	**Ashley Finan** Jon Ball Ron Faibish Richard Meyer Marcia Burkey Robin Rickman Harlan Bowers	**NIA** GE Hitachi General Atomics Kairos Power TerraPower Terrestrial Energy X-Energy
12:30 p.m.	**Lunch – Hosted by GWU**	**Ekundayo Shittu**	**GWU**
1:30 p.m.	**Session 3 – Utility and Energy End User Perspective** *Current and future state of the market and energy needs. End user perspectives on markets and federal incentives for deployment of advanced reactors.* • Economics of Advanced Reactors Presentations and Panel Session	**Dan Lipman** John Bistline Frederick Moore Marilyn Kray Chris Deir Laura Olson Brandon Waites Dan Stout	**NEI** EPRI Dow Chemical Co. Exelon OPG Salt River Project Southern Company TVA
3:45 p.m.	**Break**		
4:00 p.m.	**Session 4 – Breakout Session: Gallery Walk**	**Darcie Martinson**	**INL**
6:00 p.m.	**Reception and Poster Session - Hosted by EPRI and NEI**		
7:30 p.m.	**Adjourn**		

AGENDA – Friday, March 9, 2018

7:45 a.m.	**Registration**		
8:30 a.m.	**Session 5 – Industry, DOE, and Regulatory Perspectives**	**Mark Peters**	**INL**
	• DOE Perspective on Advanced Reactors	Dan Brouillette	DOE
	• Industry Perspective	Maria Korsnick	NEI
	• Regulatory Perspective	Kristine Svinicki	NRC
	• Moderated Discussion		
10:00 a.m.	**Break/Networking**		
10:15 a.m.	**Session 6 – Policy Panel Discussion**	**John Kotek**	**NEI**
	Address Government's Role in Advanced Reactor Policy		
	• National Conference of State Legislatures	Kristy Hartman	
	• U.S. Senate Committee on Energy and Natural Resources	Ben Reinke	
	• House Committee on Science, Space, and Technology	Adam Rosenberg	
	• Senior Director of Policy Development	Matt Crozat	
11:15 a.m.	**Break/Networking**		
11:30 a.m.	**Session 7 – Pulling it Together**		
	• DOE Closing Message	Mark Menezes	DOE
	• Summarize High Level Symposium Takeaways	Justin Coleman	INL
12:30 p.m.	**Lunch – Hosted by GWU / Symposium Wrap-Up**		
	• Participant Feedback	Participants	
	• Path Forward	Rita Baranwal	INL
	• Closing Remarks	Justin Coleman	INL
1:30 p.m.	**Adjourn**		
1:35 p.m.	**Information Session**		

ACRONYMS

DOE	Department of Energy
DOE-NE	Department of Energy-Nuclear Energy
EIA	Energy Information Administration
EPRI	Electric Power Research Institute
ERCOT	Electric Reliability Council of Texas
FERC	Federal Energy Regulatory Commission
GAIN	Gateway for Accelerated Innovation in Nuclear
GWU	George Washington University
INL	Idaho National Laboratory
ISO	Independent System Operators
MIT	Massachusetts Institute of Technology
NEI	Nuclear Energy Institute
NIA	Nuclear Innovation Alliance
NRC	Nuclear Regulatory Commission
OPG	Ontario Power Generation
RTO	Regional Transmission Organization
TVA	Tennessee Valley Authority
US	United States

GALLERY WALK BREAKOUT SESSION
March 8, 2018; 4:00 p.m. – 6:00 p.m.

A "gallery walk" breakout session is designed to promote active engagement by all symposium participants and provide the opportunity to share ideas in a smaller group setting, allowing more people to provide input during a large event.

Instructions

1. Prior to the breakout session, review the eight (8) regions in your symposium booklet and select five (5) where you have the most interest, knowledge or passion.
2. When instructed, assemble at one of your top five selected regions (posters of each region will be hung near the meeting room). A moderator will be stationed at the region and will provide instructions. If the group is overcrowded, move to a different region.
3. The moderator will begin the discussion by giving a **brief (less than 2 minutes)** overview of their assigned region.
4. Using the markers provided, review the regional information on the poster and write down your responses to the questions below on the flipcharts. Before leaving the region, place checkmarks by those ideas with which you strongly agree. The moderator will allow **15 minutes** for your responses to the questions for this first region.
5. An announcement or signal will be made when it is time to move to the next region. Move to another region of your choice, keeping each station balanced regarding number of people (allow 1 minute to move between stations).
6. The moderator at the next region will provide **a brief (less than 2 minutes)** overview of previous ideas. Your new group will be allotted **10 minutes** to provide additional answers to the questions. Before leaving the region, use checkmarks to signify strong agreement with ideas.
7. An announcement or signal will be made when it is time to move to the next region. Move to another region of your choice, keeping each station balanced regarding number of people.
8. After you have rotated to a total of five (5) regions, each moderator will summarize the input from all participants.
9. Moderators will provide a 3 to 5 minutes report out to the entire group, seeking input and clarification.

Questions

With respect to advanced reactors:

1. What are the opportunities?
2. What are the barriers/challenges/issues (e.g., technical, policy, economic, regulatory, social, political)?
3. What actions should be taken to exploit the opportunities, remove barriers or address the challenges/issues?

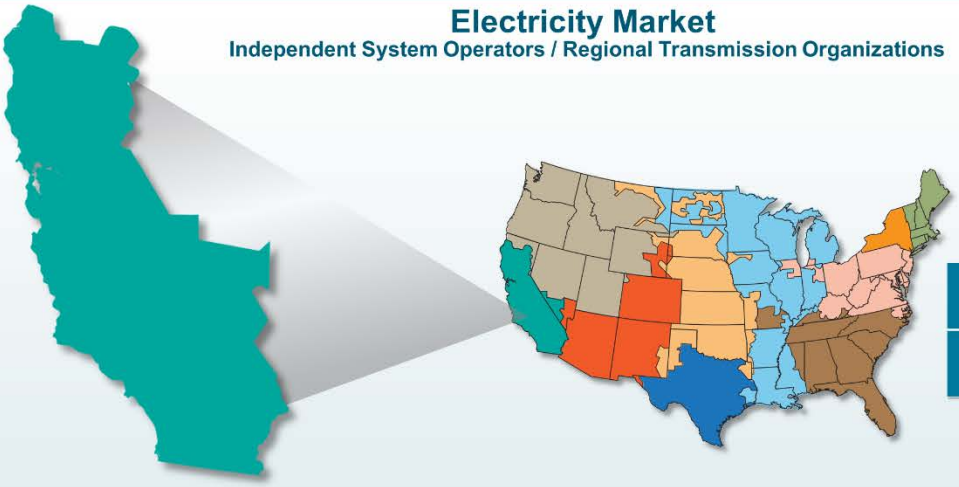
Regions

- California
- Midcontinent
- New England and New York
- Northwest
- PJM Interconnection
- Southeast
- Southwest Power Pool
- Texas

California

Electricity Market

Independent System Operators / Regional Transmission Organizations

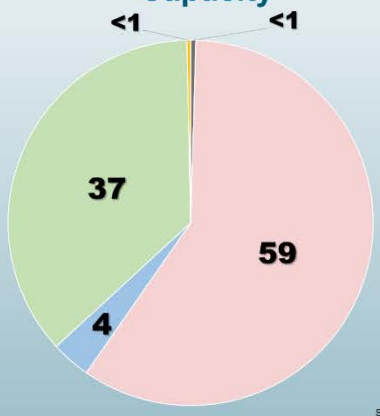


California Energy Price

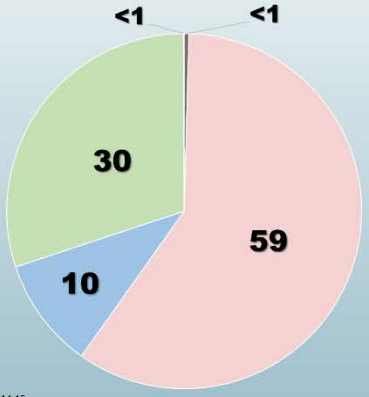
15.23¢ per kW/hr

SOURCE: EIA 1990-2016 Average Price

Capacity



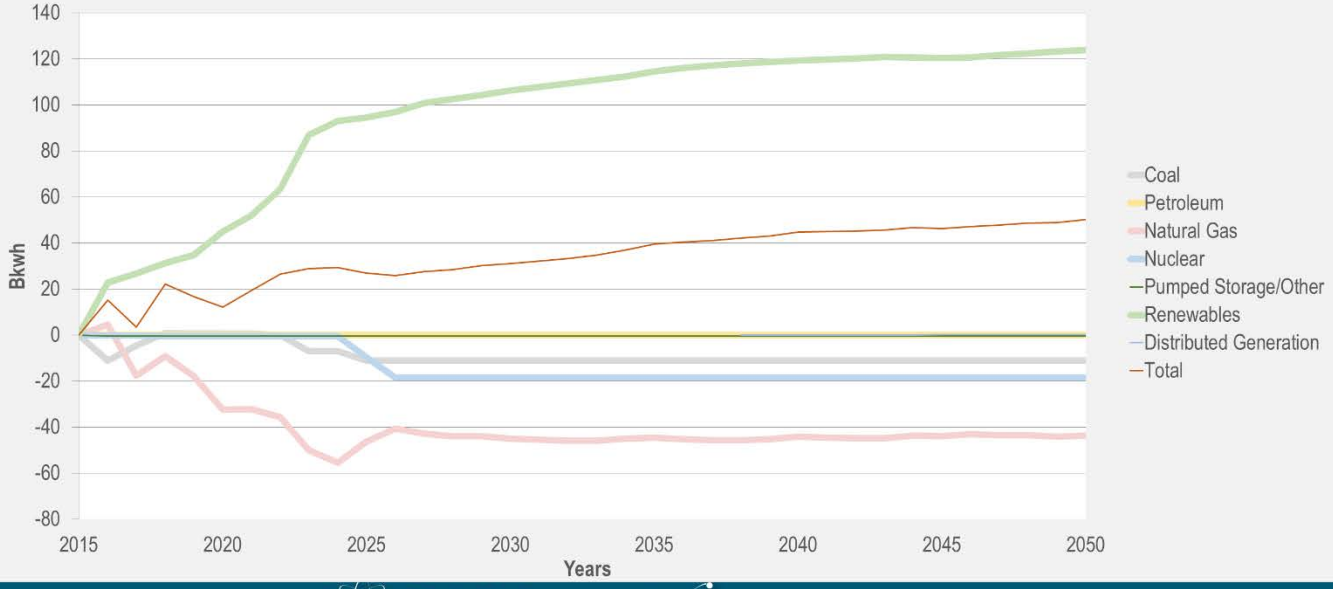
Generation



SOURCE: FERC 2016 Common Metrics Report under AD14-15.

EIA projections to 2050, indexed to 2015

SOURCE: EIA Annual Energy Outlook 2018



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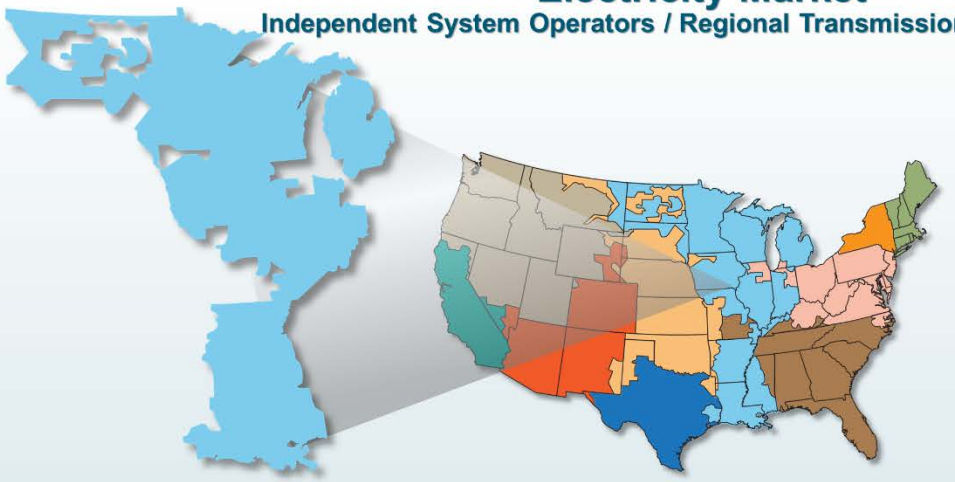
Midcontinent

Electricity Market

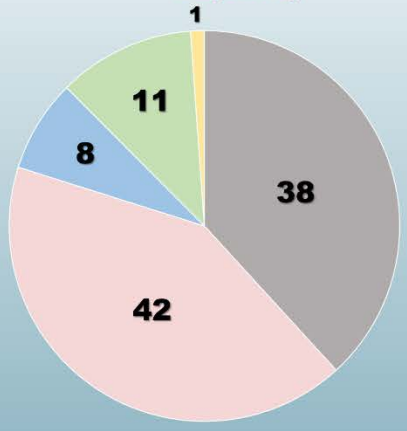
Independent System Operators / Regional Transmission Organizations

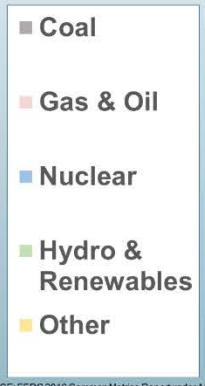


Midcontinent ISO Prices	¢ per kW/hr
Louisiana	7.46
Arkansas	8.13
Michigan	11.05
Missouri	9.74
Illinois	9.38
Iowa	8.55
Wisconsin	10.67
Michigan	11.05
Minnesota	9.99
North Dakota	8.94
Average	9.50

SOURCE: EIA 1990-2016 Average Price

Capacity





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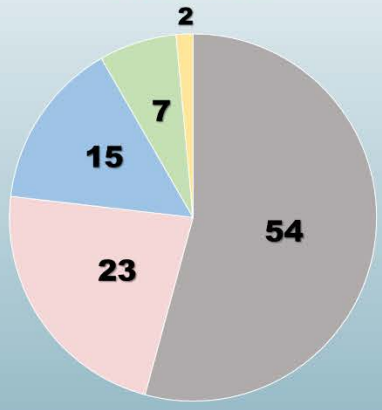
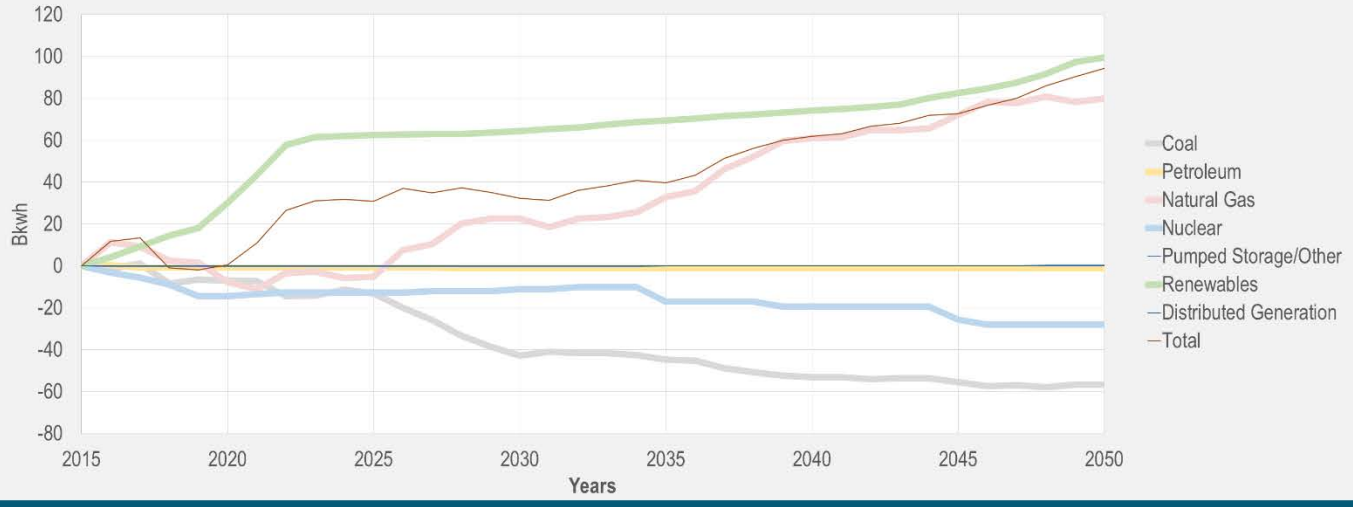


SOURCE: FERC 2016 Common Metrics Report under AD14-15.

SOURCE: EIA Annual Energy Outlook 2018



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New England

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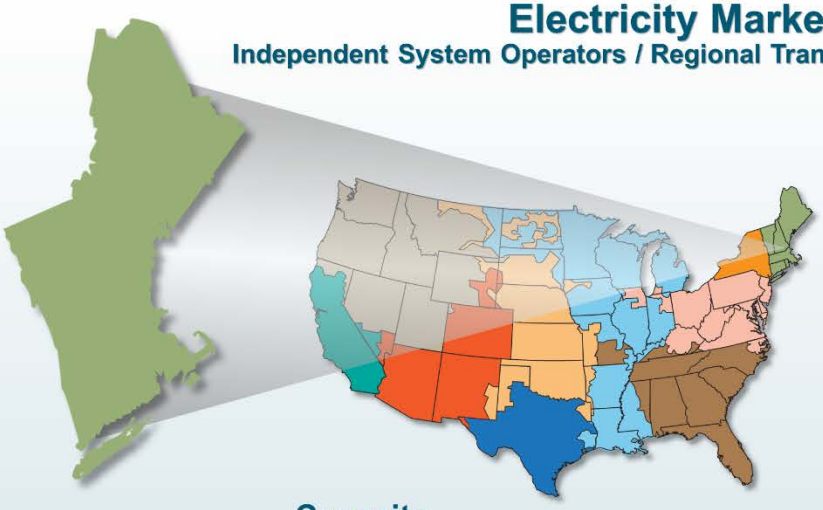
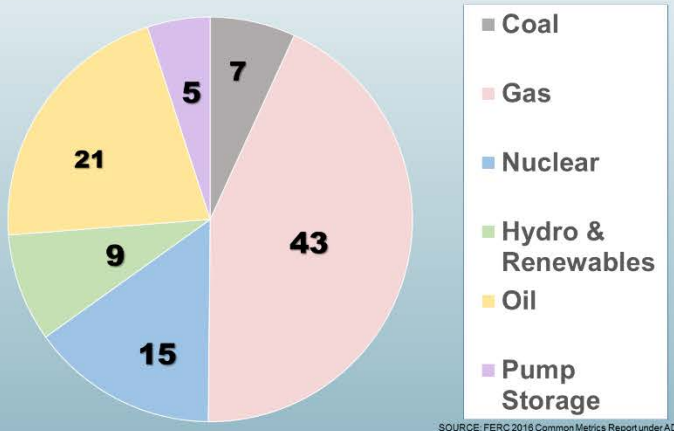


New England ISO Energy Prices	¢ per kW/hr
Maine	12.80
New Hampshire	15.66
Vermont	14.46
Maryland	12.21
Connecticut	17.24
Rhode Island	16.28
Average	14.77

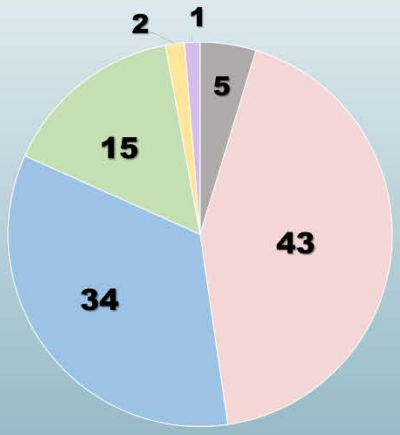
SOURCE: EIA 1990-2016 Average Price

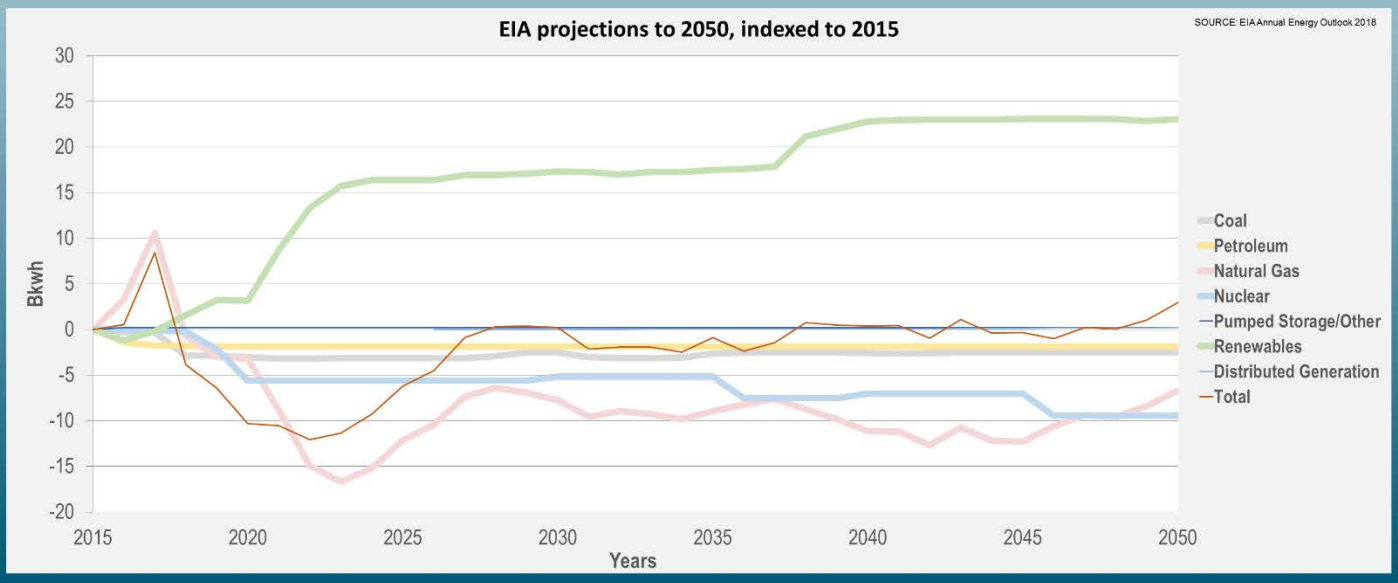
Capacity



SOURCE: FERC 2018 Common Metrics Report under AD14-15.

Generation





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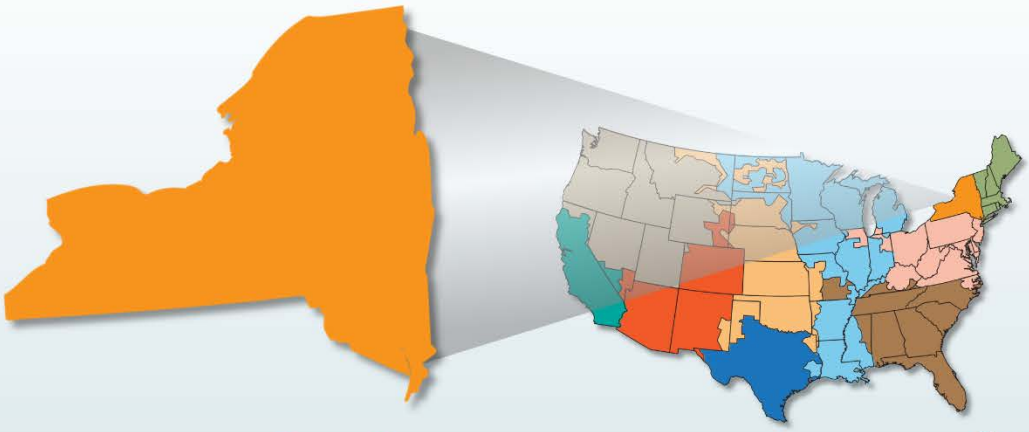
New York

Electricity Market

Independent System Operators / Regional Transmission Organizations

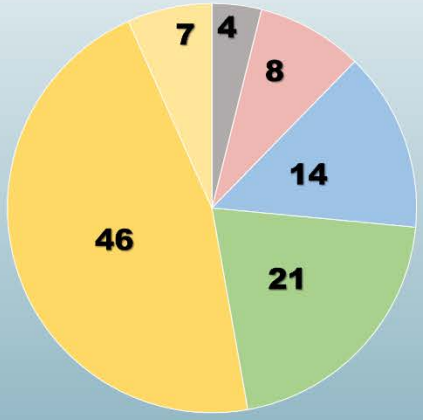


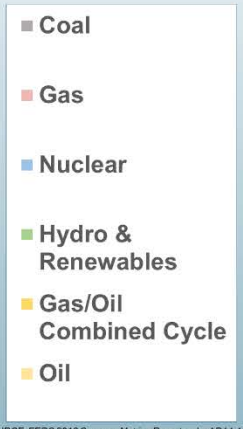
New York Energy Price

14.47¢ per kW/hr

SOURCE: EIA 1990-2016 Average Price

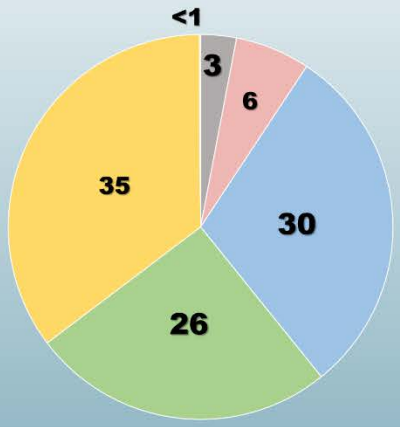
Capacity

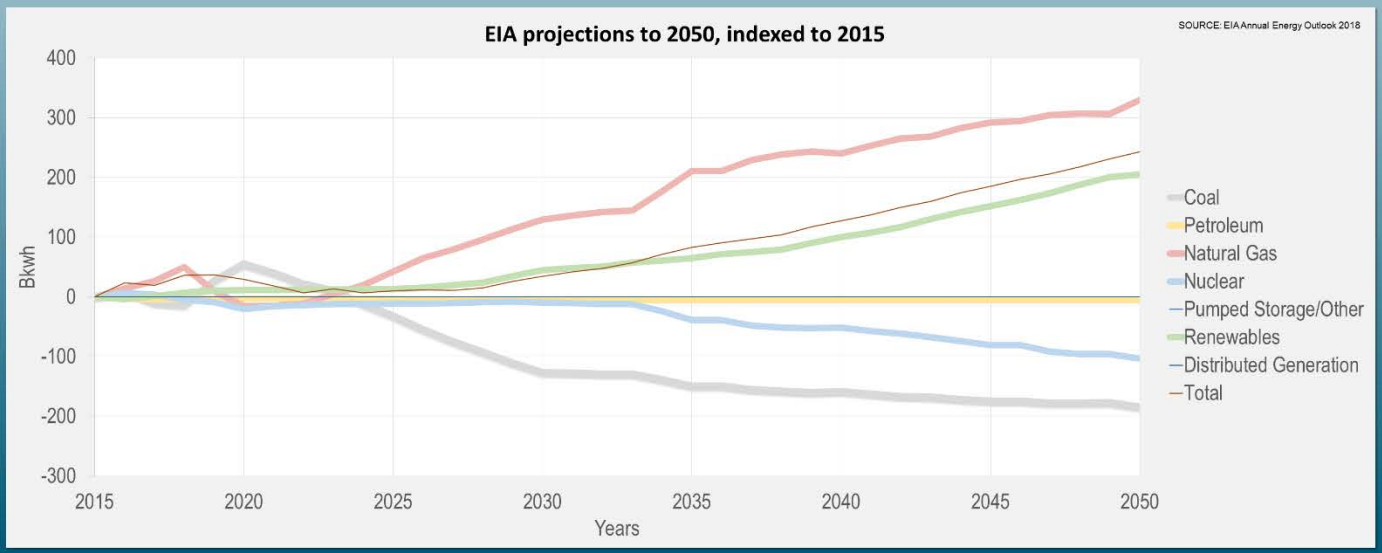




SOURCE: FERC 2016 Common Metrics Report under AD14-15.

Generation





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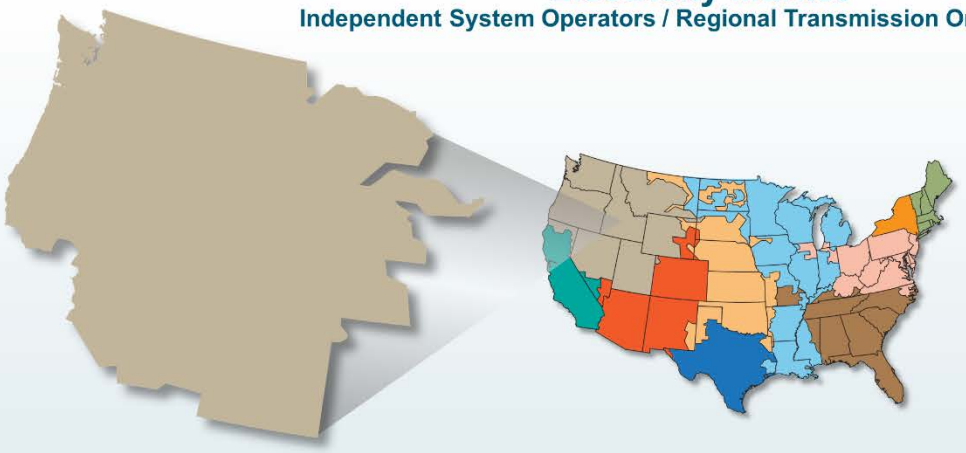
Northwest

Electricity Market

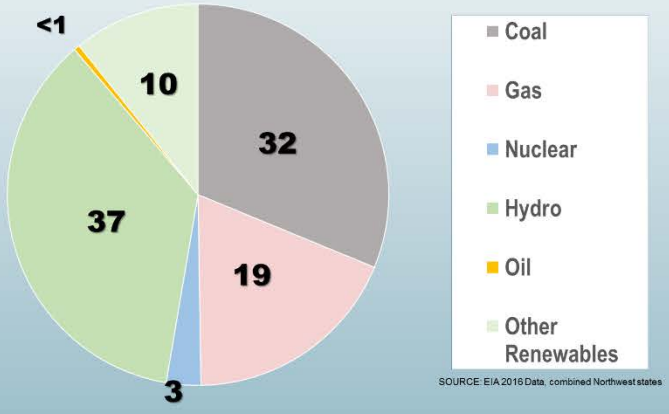
Independent System Operators / Regional Transmission Organizations



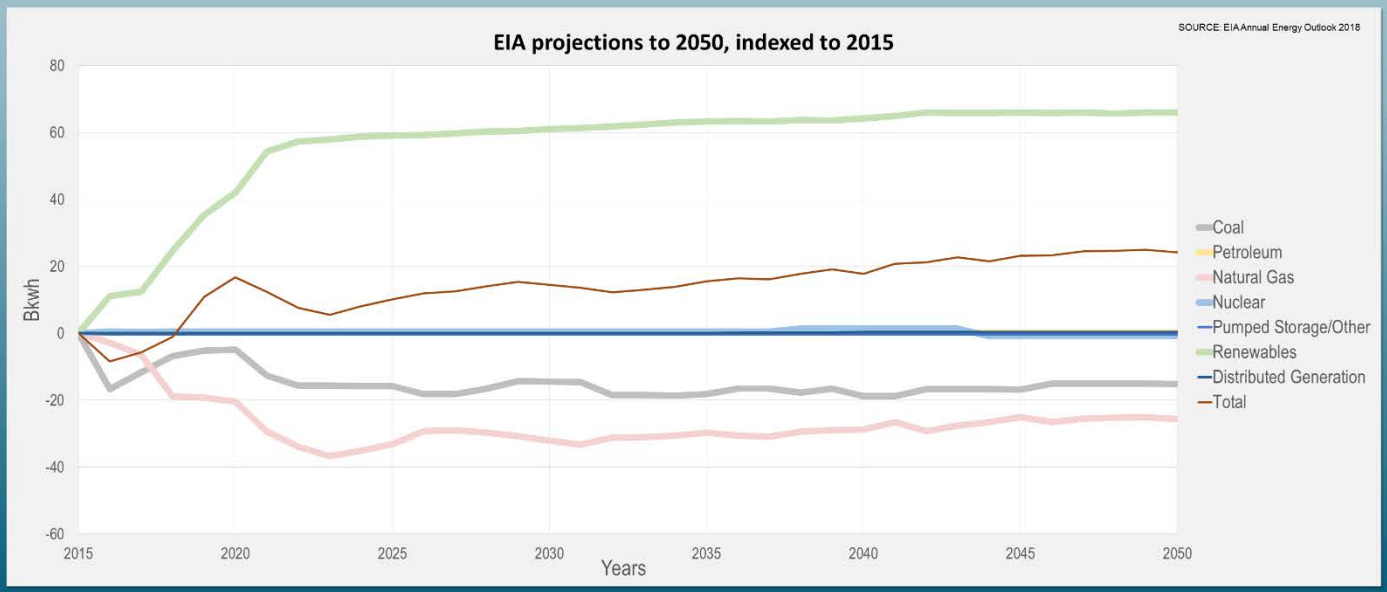
Northwest Energy Price	¢ per kW/hr
Washington	7.68
Oregon	8.83
Nevada	8.39
Montana	8.84
Idaho	8.05
Wyoming	8.19
Utah	8.72
Average	8.38

SOURCE: EIA 1990-2016 Average Price

Generation



SOURCE: EIA 2016 Data, combined Northwest states



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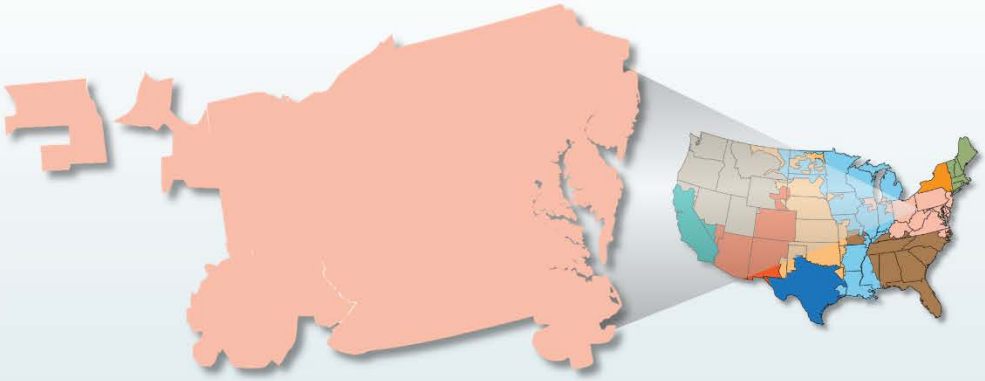
PJM Interconnection

Electricity Market

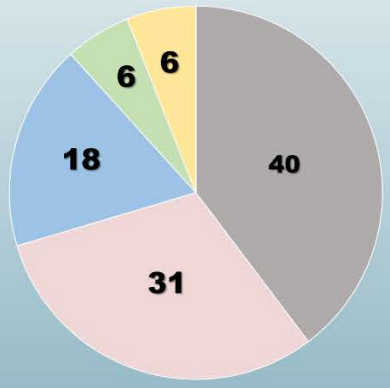
Independent System Operators / Regional Transmission Organizations



PJM Energy Prices	¢ per kW/hr
Virginia	9.09
West Virginia	8.78
Maryland	12.21
Pennsylvania	10.19
Ohio	9.84
Kentucky	8.42
New Jersey	13.38
Delaware	11.09
Average	10.38

SOURCE: EIA 1990-2016 Average Price

Capacity



SOURCE: FERC 2016 Common Metrics Report under AD14-15

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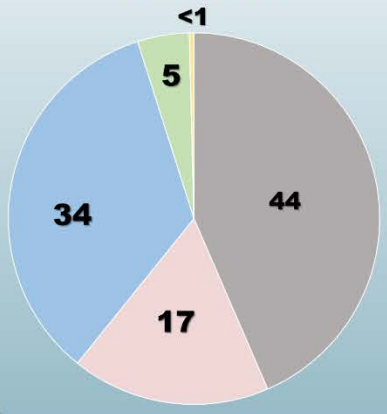

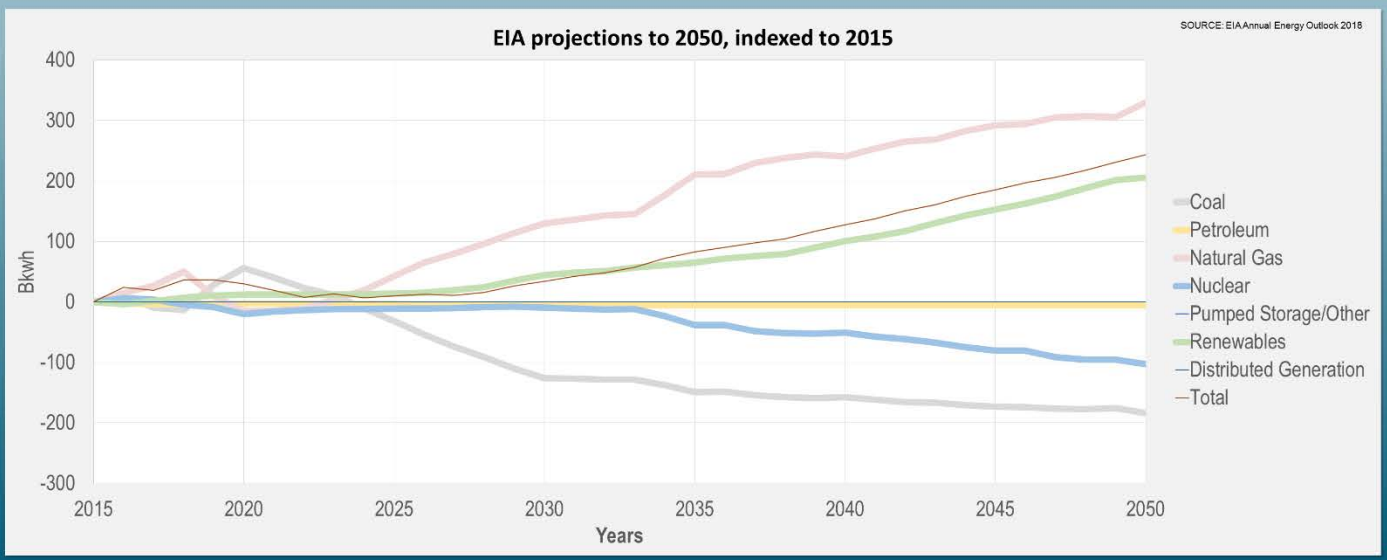

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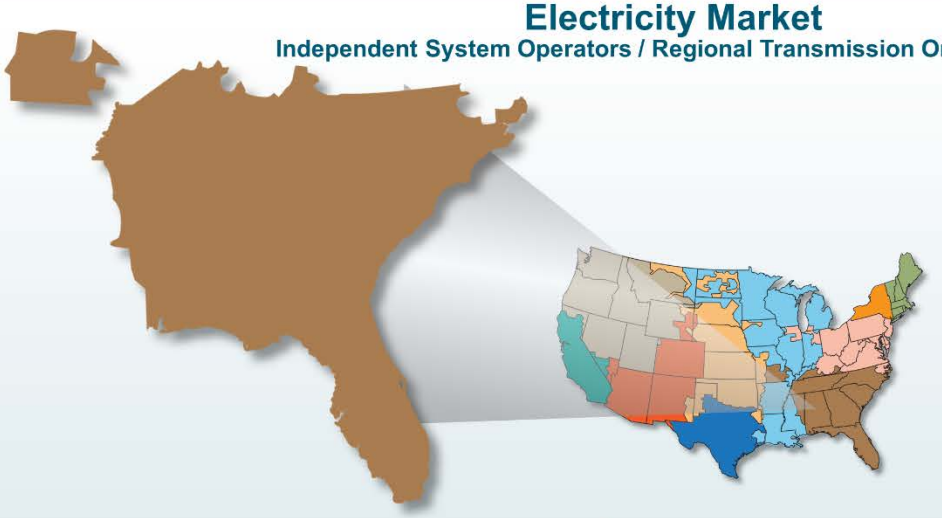
Southeast

Electricity Market

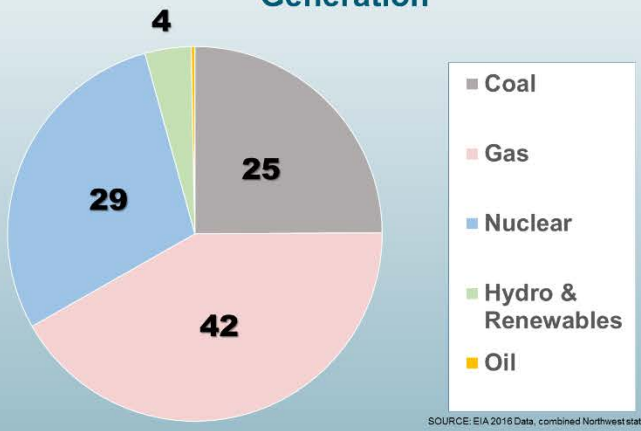
Independent System Operators / Regional Transmission Organizations



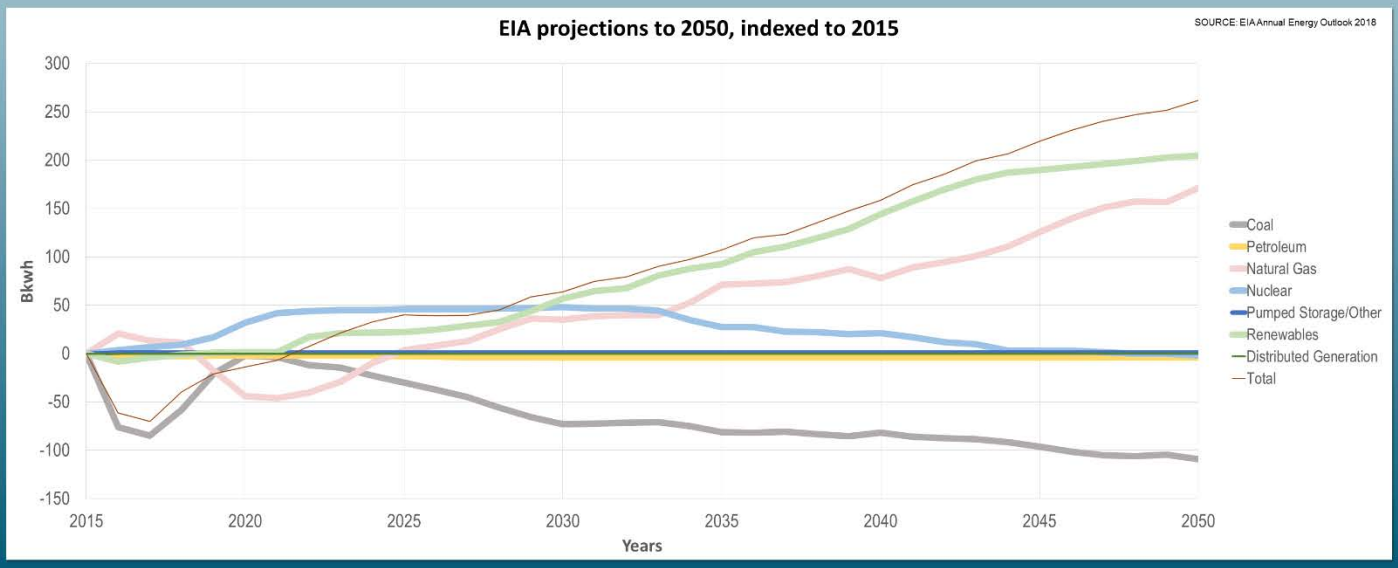
Southeast Energy Prices	¢ per kW/hr
Florida	9.91
Georgia	9.59
Alabama	9.56
Tennessee	9.23
South Carolina	9.79
North Carolina	9.20
Average	9.55

SOURCE: EIA 1990-2016 Average Price

Generation



SOURCE: EIA 2016 Data, combined Northwest states



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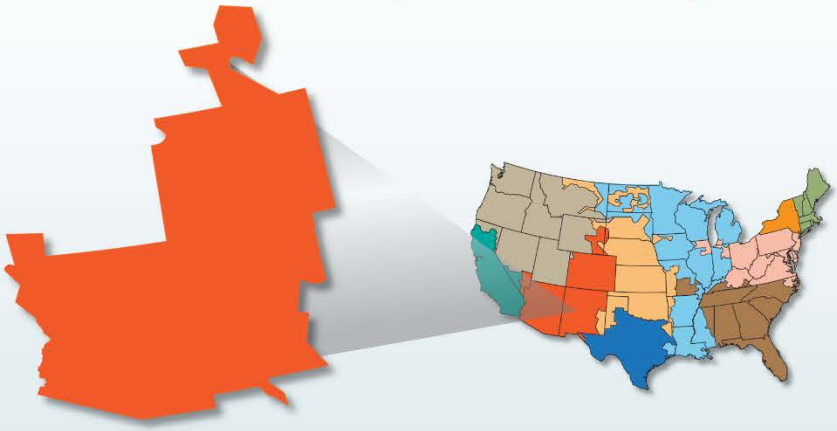
EPRI ELECTRIC POWER RESEARCH INSTITUTE

Southwest Power

Electricity Market

Independent System Operators / Regional Transmission Organizations



Southwest Power Pool Energy Prices	¢ per kW/hr
Arizona	10.33
Colorado	9.83
New Mexico	9.12
Average	9.76

SOURCE: EIA 1990-2016 Average Price

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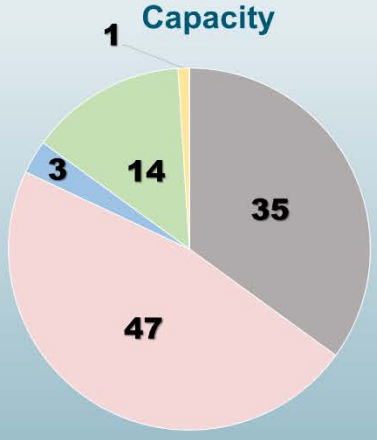

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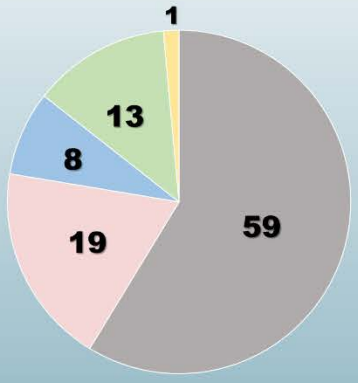
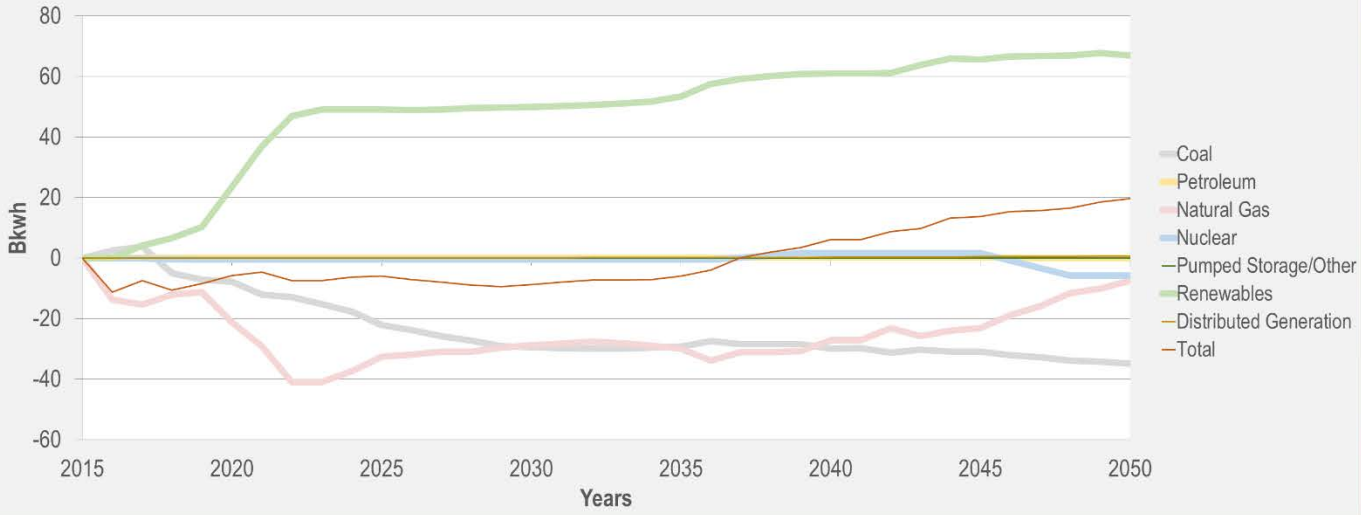


SOURCE: FERC 2016 Common Metrics Report under AD14-15.

SOURCE: EIA Annual Energy Outlook 2018



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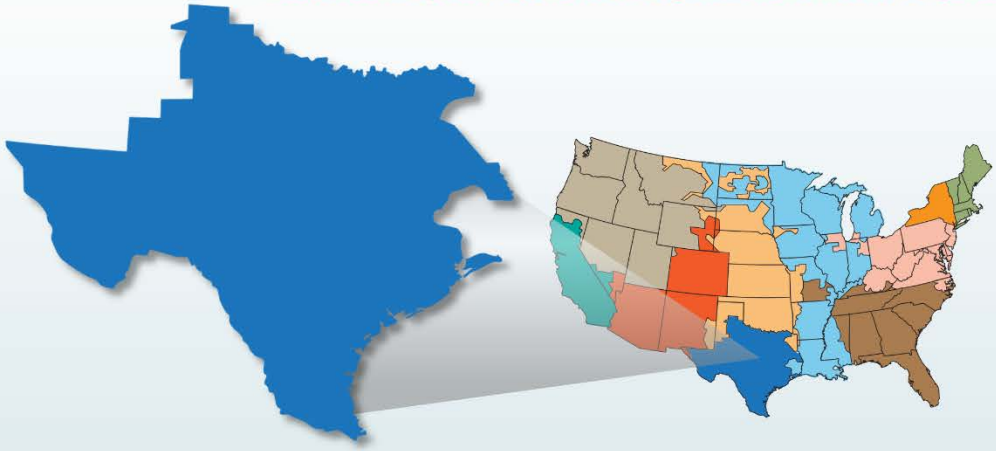
EPRI ELECTRIC POWER RESEARCH INSTITUTE

Energy Reliability Council of Texas

Electricity Market

Independent System Operators / Regional Transmission Organizations

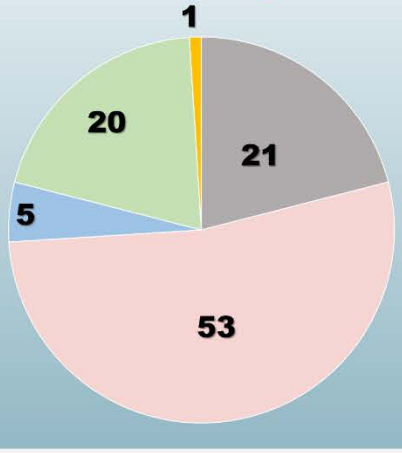


Texas Energy Price

8.43¢ per kW/hr

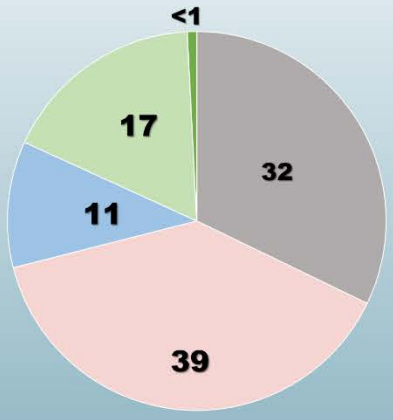
SOURCE: EIA 1990-2016 Average Price

Capacity



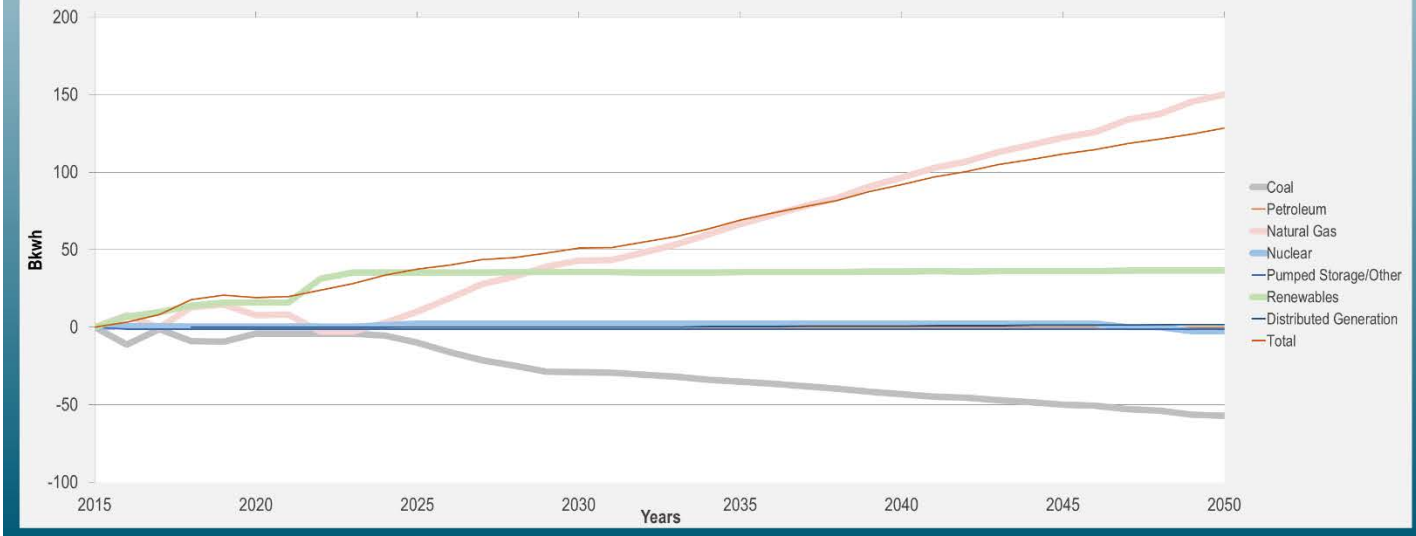
SOURCE: ERCOT Quick Facts 2018

Generation



EIA projections to 2050, indexed to 2015

SOURCE: EIA Annual Energy Outlook 2018



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