Technology & Customer Trends Impacting Coal-fueled Power Generation

Matt Usher – Director, New Technology Development & Policy Support

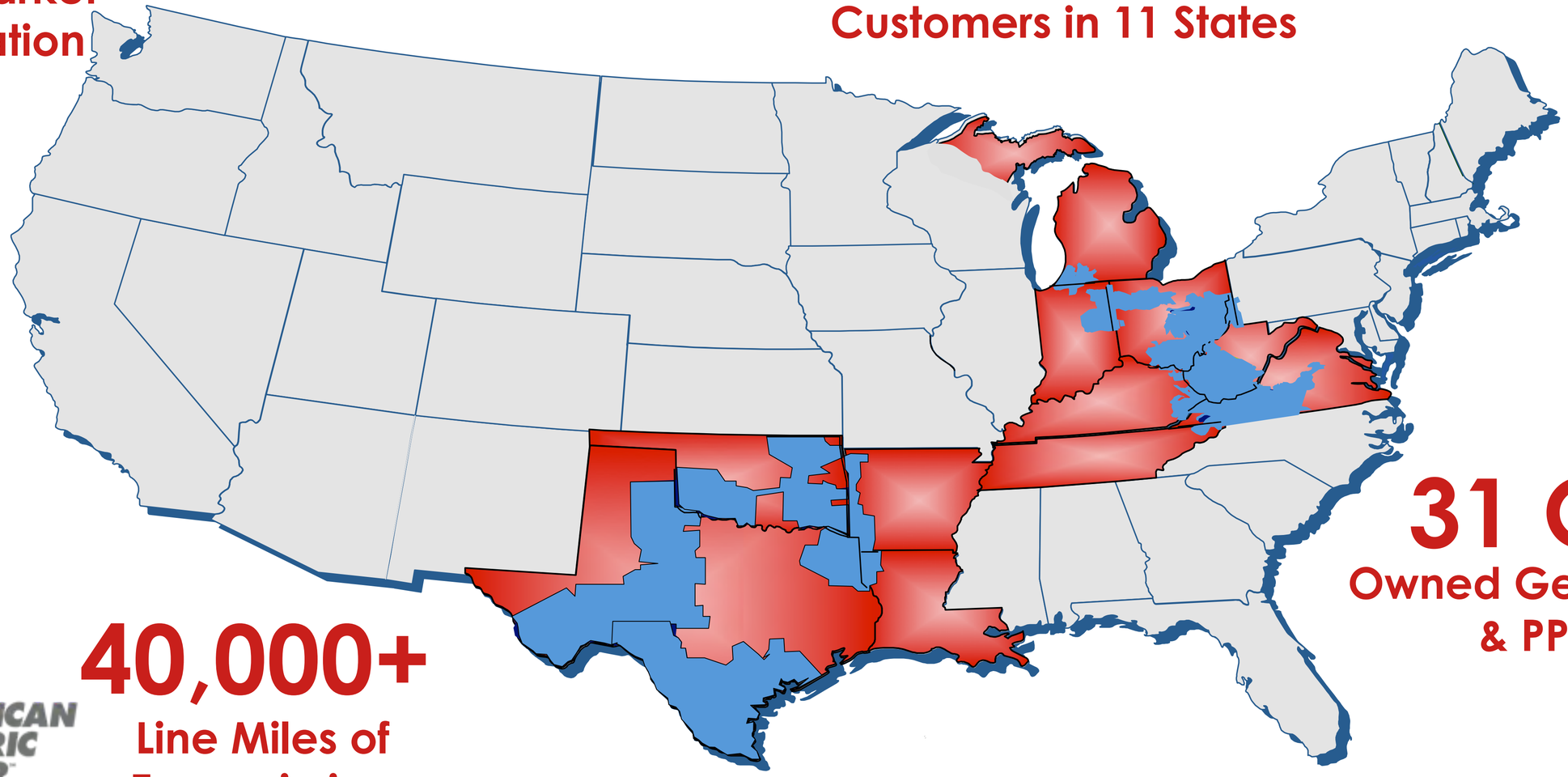
AEP Generation

Virginia Coal & Energy Alliance
Southern States Energy Board
38th Annual Conference & Expo
May 22 & 23, 2017

American Electric Power Company Overview

$31B
Current Market Capitalization

5.4 million
Customers in 11 States



31 GW
Owned Generation & PPAs

40,000+
Line Miles of Transmission

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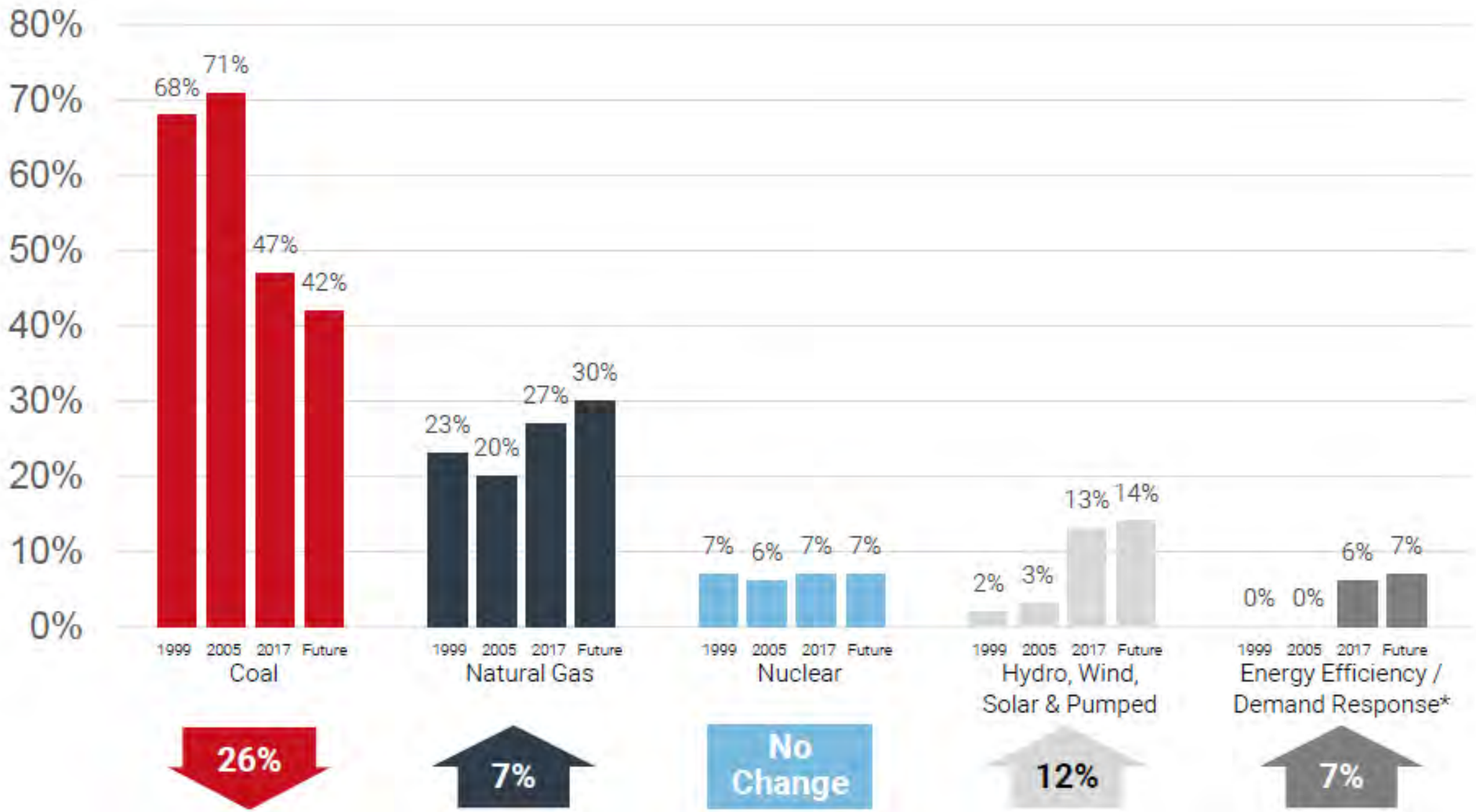
Generation Portfolio



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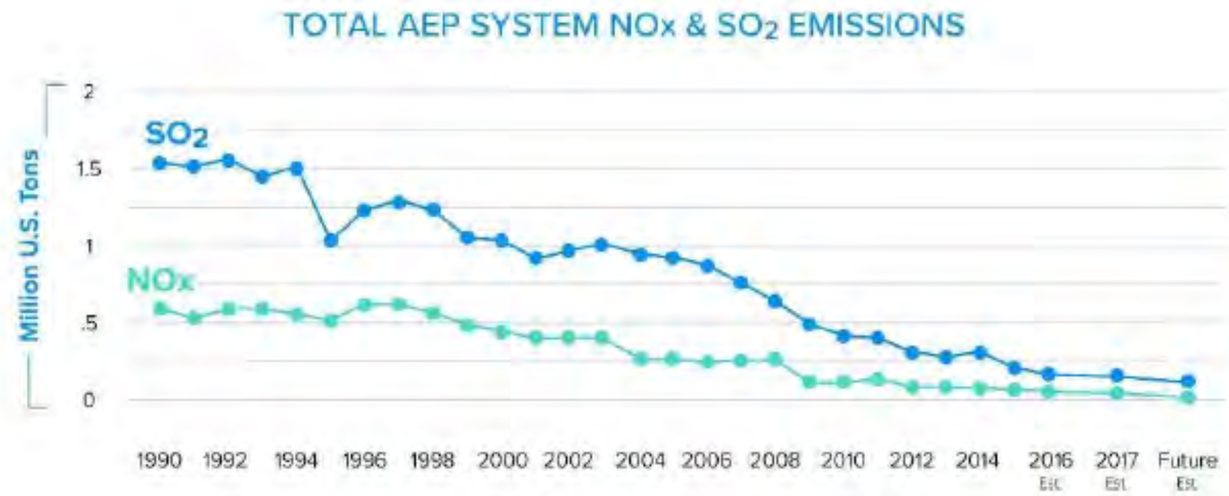
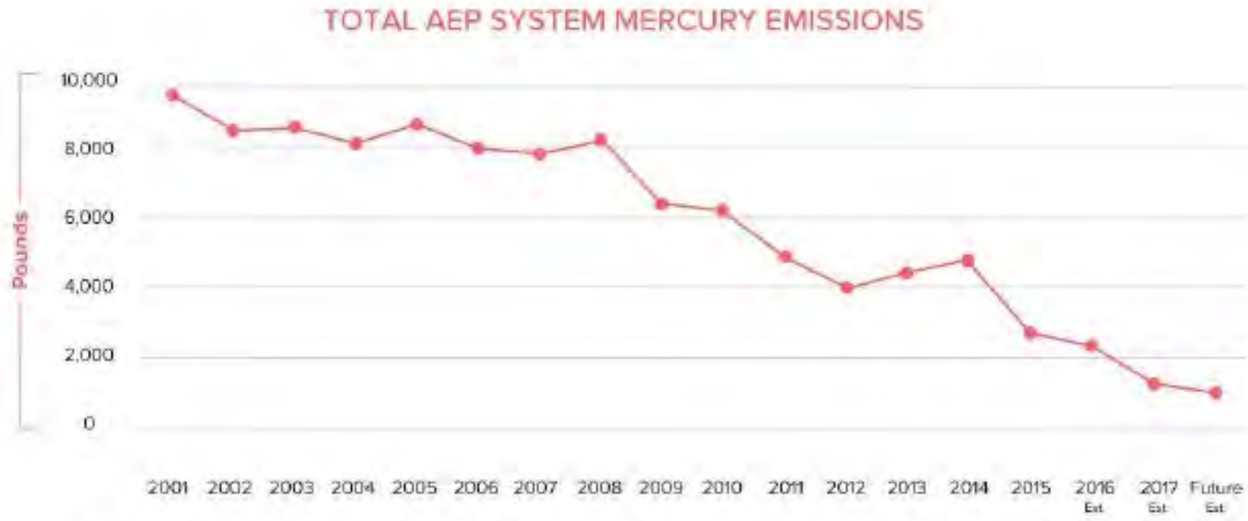
1999 includes AEP and Central and South West generation combined. All periods presented include Purchase Power Agreements
Future excludes Cardinal, Conesville, Stuart and Zimmer plants
* Energy Efficiency / Demand Response represents avoided capacity rather than physical assets

Prudent Decisions → Sustainable Results



	1990-2015 ACTUAL	1990-2017* ESTIMATED	1990-Future ESTIMATED
SO_2	88%	94%	94%
NO_x	87%	89%	93%



	2001-2015 ACTUAL	2001-2017* ESTIMATED	2001-Future ESTIMATED
Hg	73%	87%	89%

* Reflects impact of sale of Lawrenceburg, Waterford, Darby and Gavin plants
Future excludes Cardinal, Conesville, Stuart and Zimmer plants

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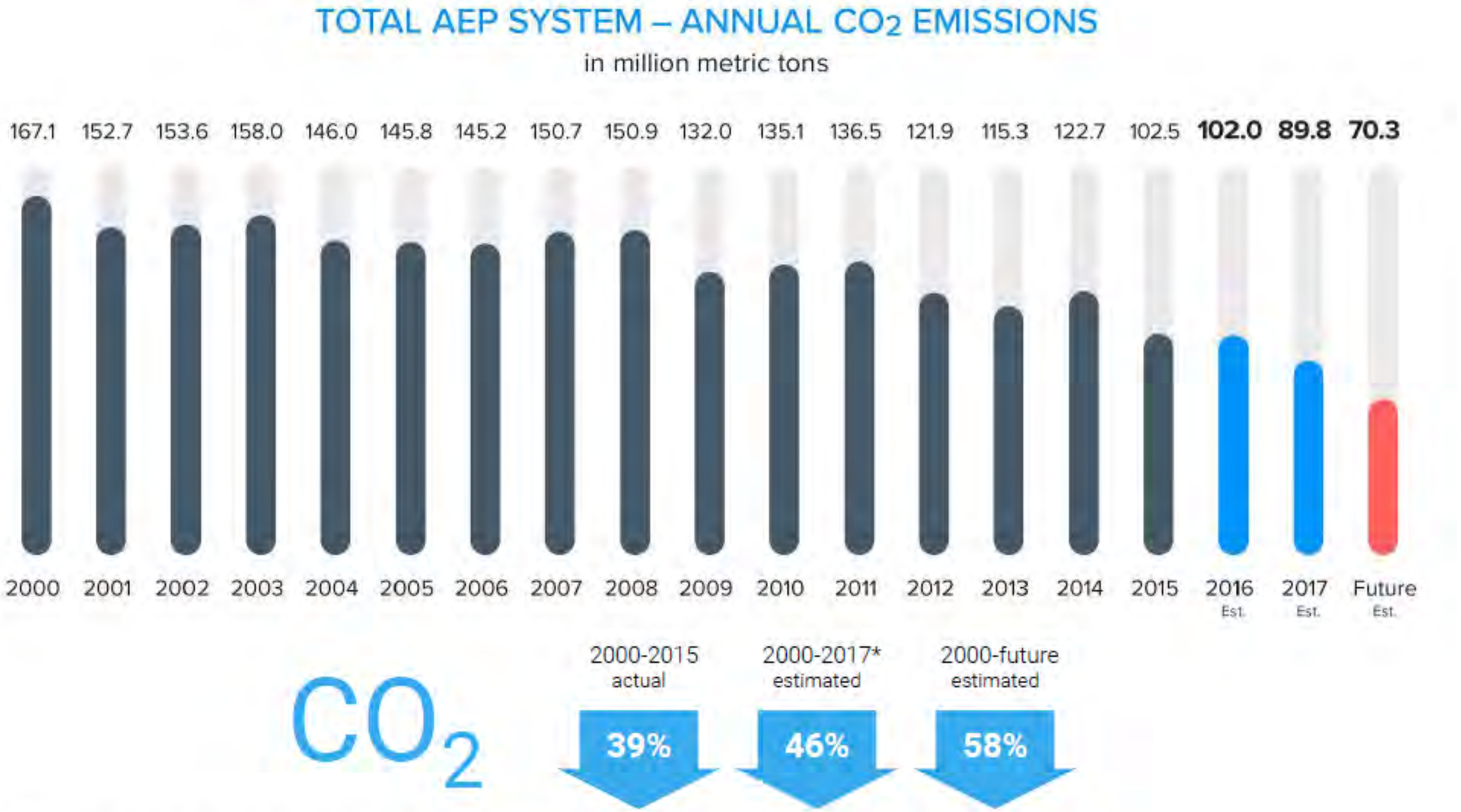
Prudent Decisions → Sustainable Results



* Reflects impact of sale of Lawrenceburg, Waterford, Darby and Gavin plants
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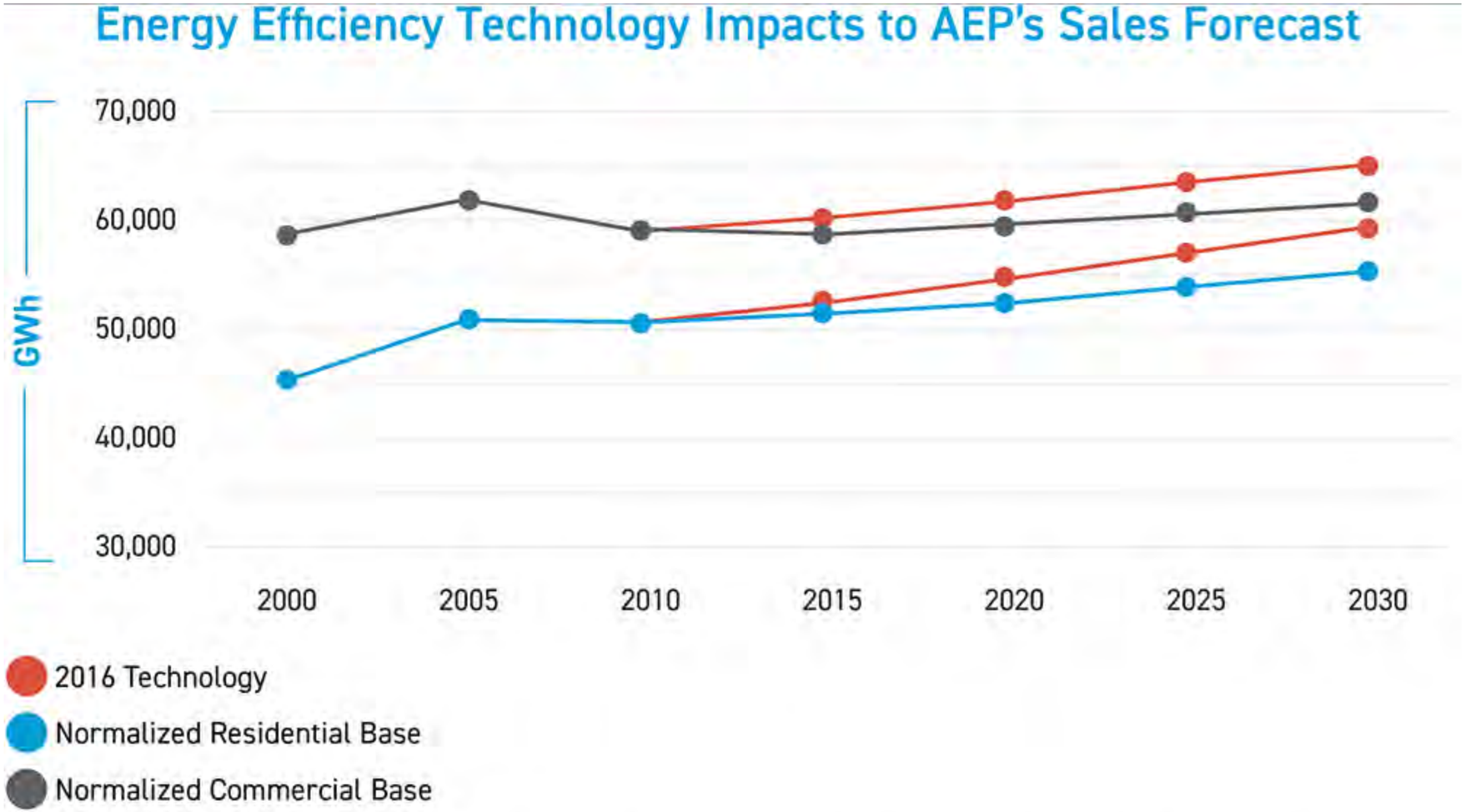
Demand Growth & Energy Efficiency



This chart reflects forecasted impacts of energy efficiency on residential and commercial sales within AEP's service territory. The red line represents what our residential and commercial sales would have been if not for the increasing energy efficiency that is assumed will occur.

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Drivers for Change

Energy Efficiency Standards

ARKANSAS (mandatory)
0.9% of 2015 retail sales in 2017 and 2018; 1.0% of 2015 retail sales in 2019.

LOUISIANA (voluntary)
Voluntary 2-phase EE plan.

OHIO (mandatory)
22% reduction of retail electricity sales by 2026 phased in beginning in 2009; but in 2014 SB 310 put a two year freeze on mandates.

MICHIGAN (mandatory)
1% annual reduction of previous year retail sales in 2012 and remaining at that level.

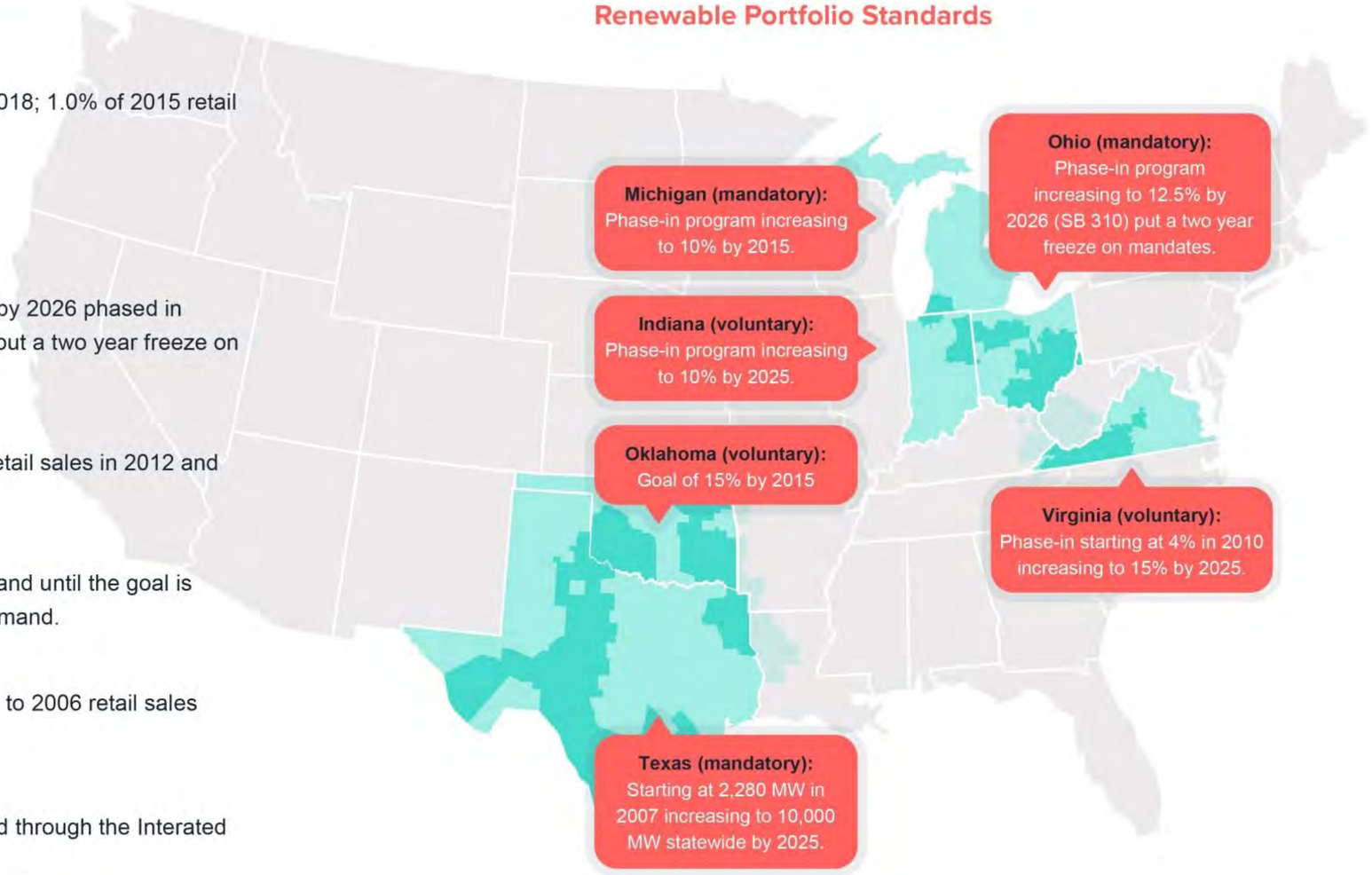
TEXAS (mandatory)
30% reduction in annual growth in demand until the goal is equal to 0.4% of previous year peak demand.

VIRGINIA (voluntary)
10% electricity savings by 2022 relative to 2006 retail sales (voluntary).

Note: Indiana–EE goals are determined through the Interated Resource Planning Process (SB 412).

There are currently no energy efficiency standards in Kentucky, Oklahoma, Tennessee or West Virginia.

Renewable Portfolio Standards



There are currently no renewable portfolio standards in Arkansas, Kentucky, Louisiana, Tennessee or West Virginia.

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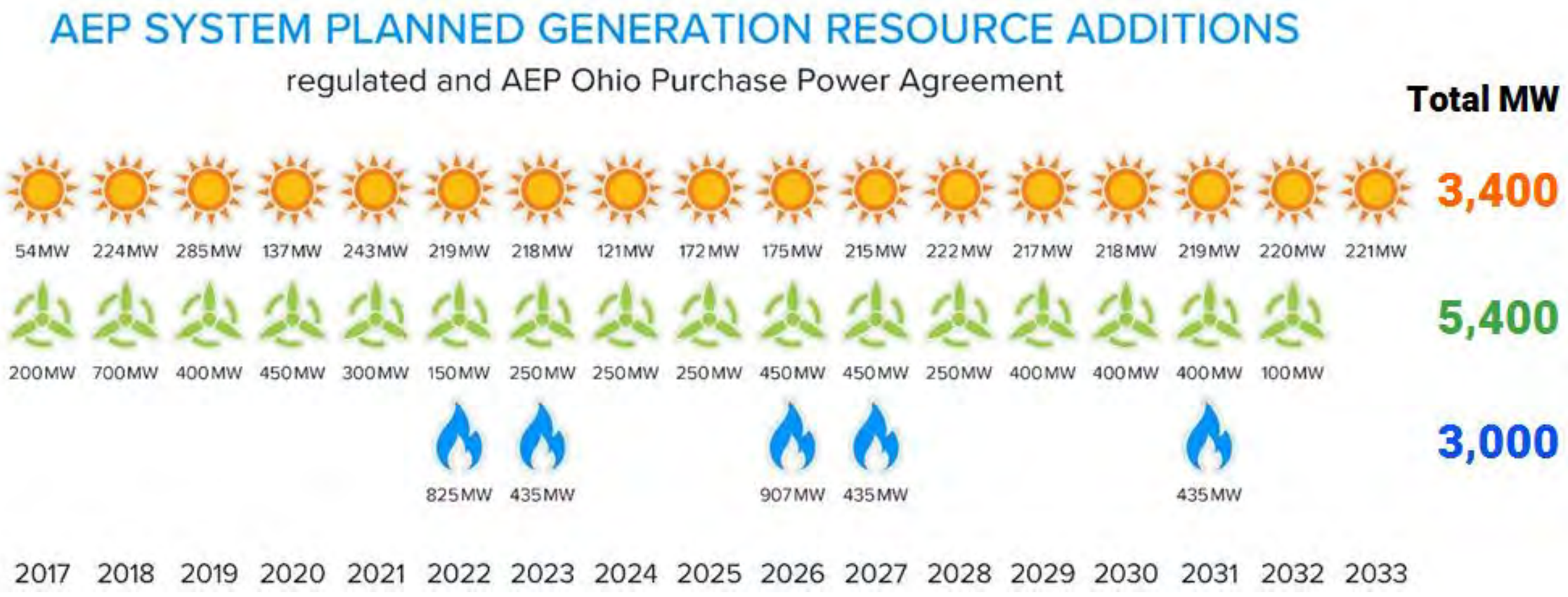
AEP 2016 Integrated Resource Plan



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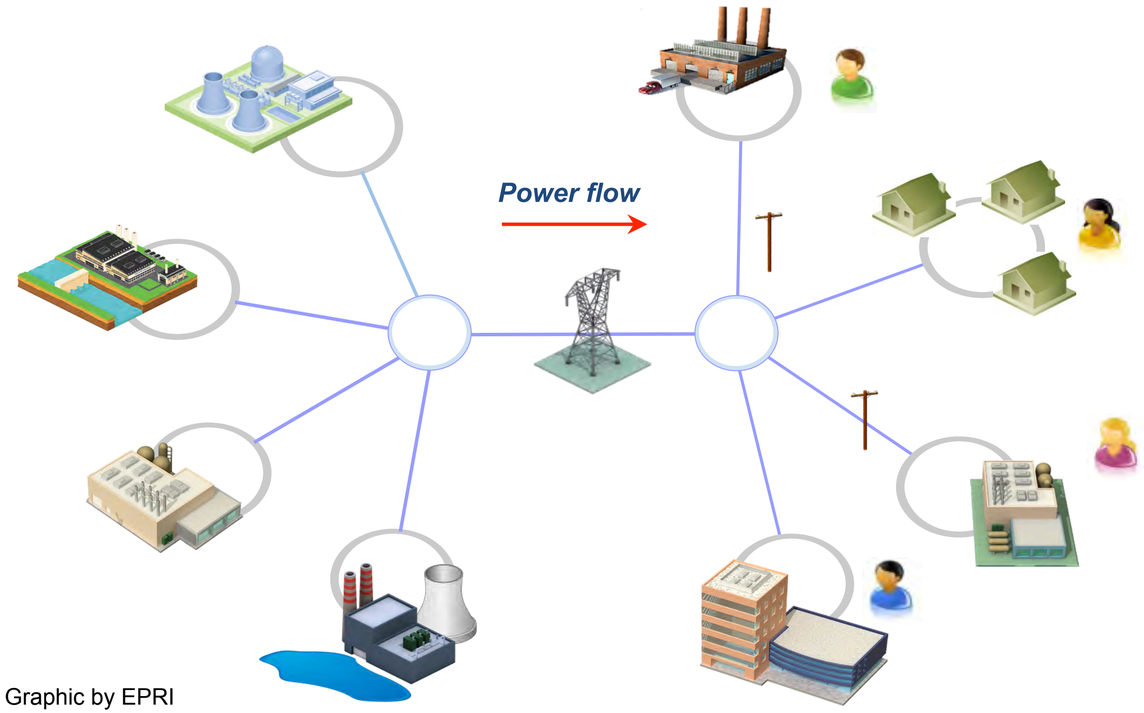
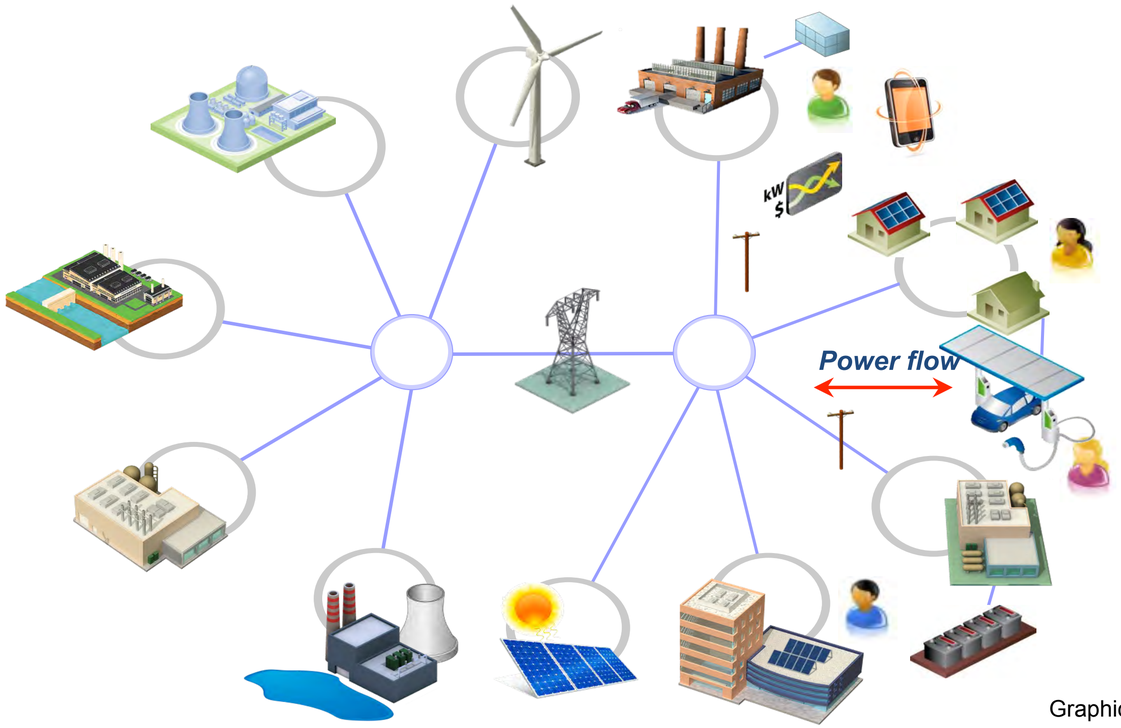
Source: Current Internal Integrated Resource Plans, which largely do not reflect ITC/PTC extension, bonus depreciation or potential impact of Clean Power Plan. Wind and solar represent nameplate MW capacity

Traditional Vs. Integrated Grid



Graphic by EPRI



Graphic by EPRI

- Centralized generation sources feed transmission/distribution network.
- Electricity flows “one-way” from centralized generators to consumers.
- Mature regulatory rate structure and market infrastructure.

- Greater integration of entire electric system.
- Distributed generation: supports localized demand along with central generation and supplies excess generation to grid (“two-way” flow).
- Energy efficiency and demand response program can augment and/or offset “steel-in-the-ground” generation capacity.
- Requires innovative rate design and cost transparency at the retail level.

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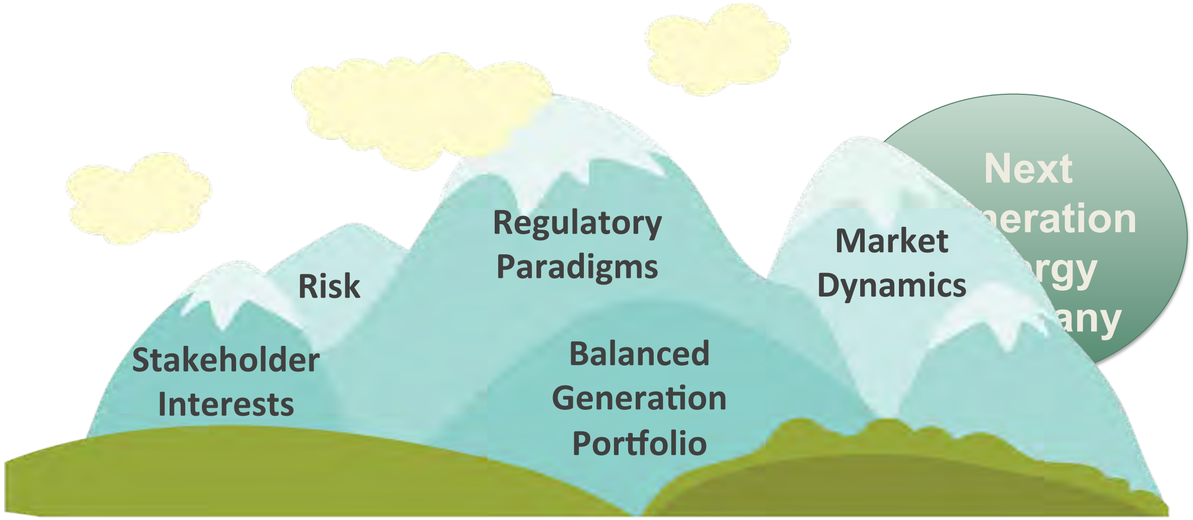
Navigating a Path to the Future

We think we can see clearly the next generation energy company…



…but when we look more closely, it's not completely clear how we get there

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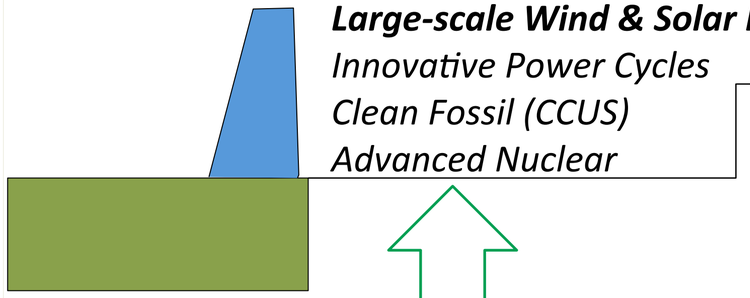
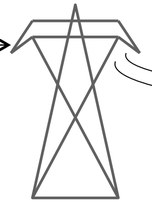
Technology Plays a Key Role

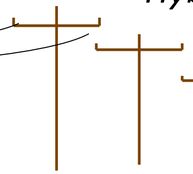


NGCC
Large-scale Wind & Solar PV
Innovative Power Cycles
Clean Fossil (CCUS)
Advanced Nuclear



Transmission

Community Solar PV
Energy Storage
Microgrids

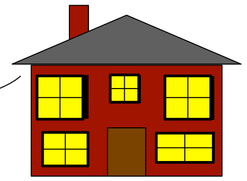


Distribution

Recip Engines & Aero Turbines
Combined Heat & Power
Hybrid Technologies
Fuel Cells

Meter

Rooftop PV
Energy Storage
"Smart" Home



Generation

Customer

Improve the efficiency, reliability, flexibility & maintainability of the existing generating fleet.

Improved Technology
Monitoring & Diagnostics
Lean Principles

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Options / Solutions / Satisfaction

Data / Feedback / Preferences

Develop and deploy new generation technology, systems and equipment to support the integrated grid of the future.

Explore opportunities "Behind the Meter" to improve overall grid efficiency and maximize customer benefits.

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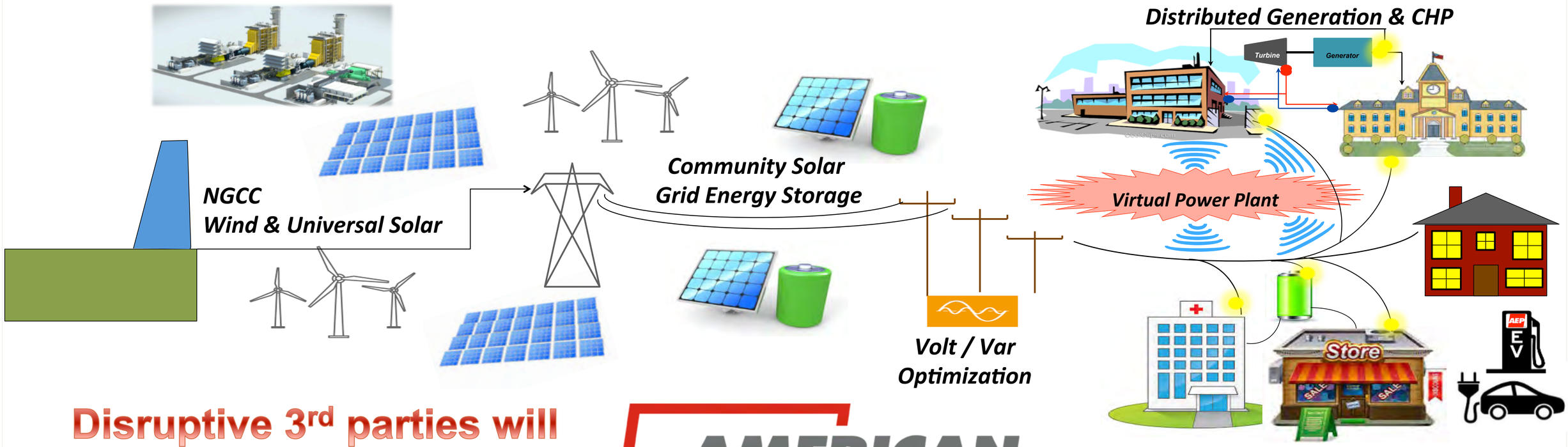
The Role of Technology in the Customer Experience



Disruptive 3rd parties will threaten to take our load and our customers if we don't take action.

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Opportunities exist across the value stream for AEP to succeed, avoid disruption and become….

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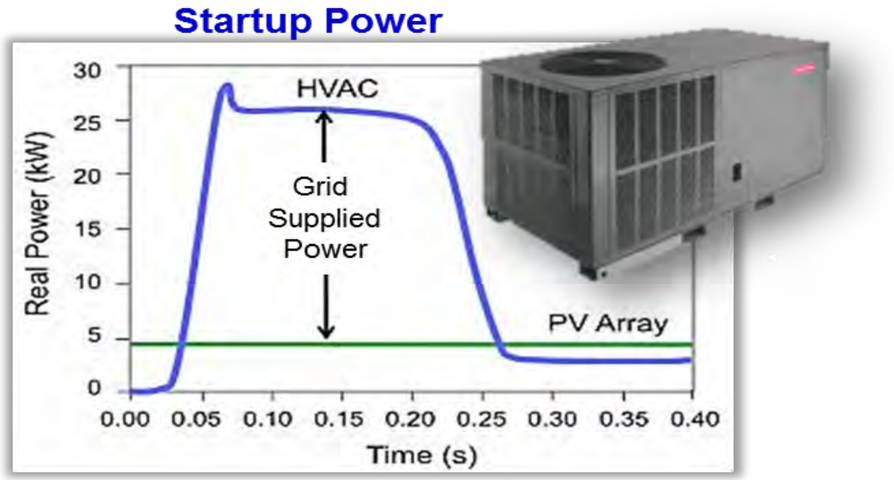
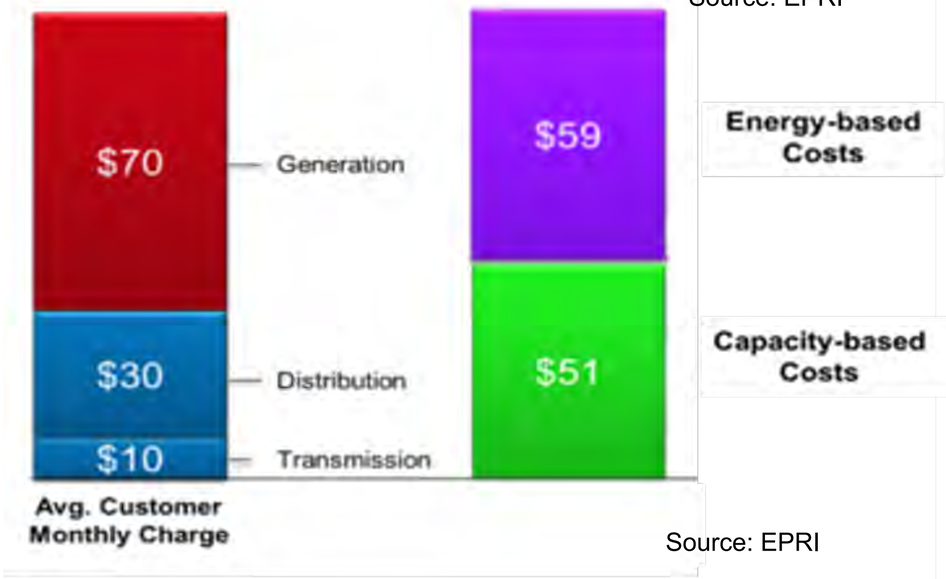
The Premier Energy Company of the Future

The Value of Firm Fossil-fueled Generation Capacity

- Fundamental disconnect between energy and capacity and the value that capacity brings to the integrated grid and to the customer.
  - Steel-in-the-ground capacity makes today's grid reliable and the integrated grid of the future, possible.
    - Startup power
    - Backup power / reserves
    - Voltage and frequency stability
    - Load following / peak power



Source: EPRI



Source: EPRI

Energy In = Energy Out

Energy + Capacity In = Grid Reliability Out!

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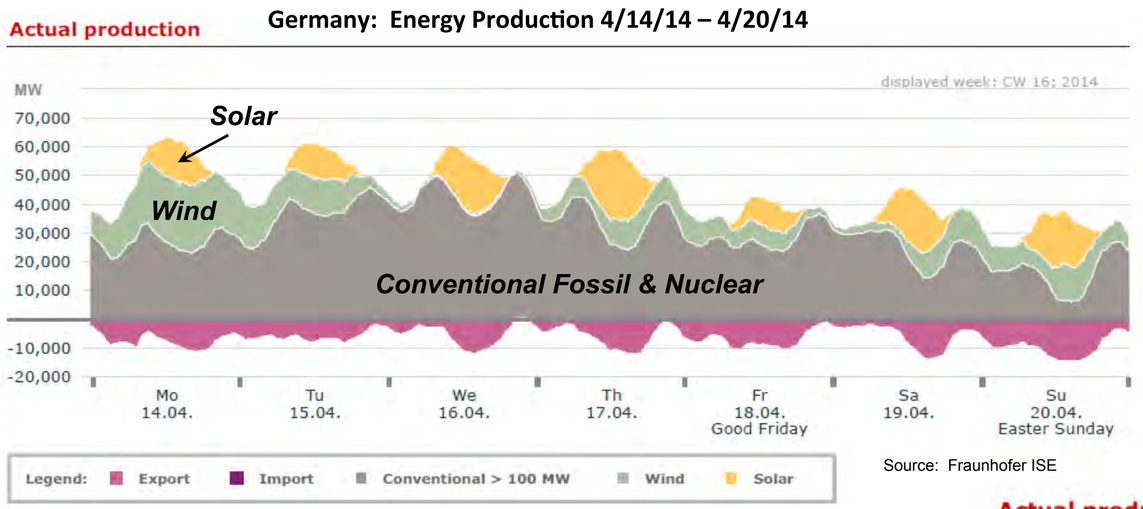
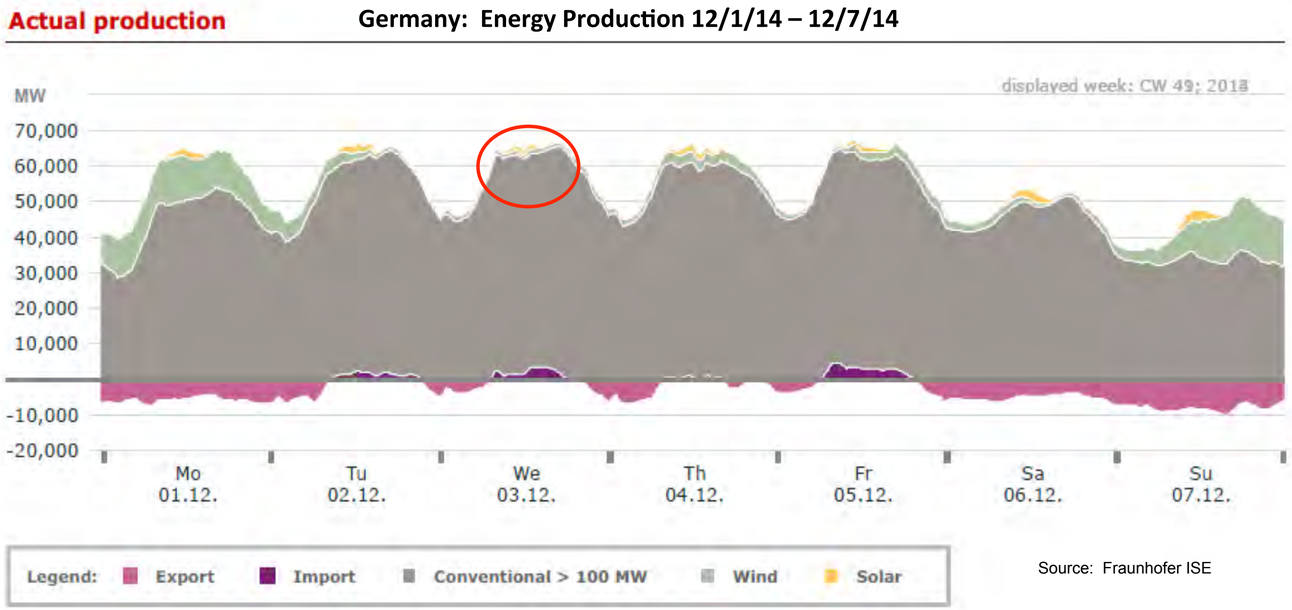
Dispatch-able Generation - When You Need It – 24X7



Source: Fraunhofer ISE

- Dispatch-able, fossil-fueled generation is the reliability backstop for intermittent renewable energy.
- Utilities must plan for and provide generation during periods of little or no renewable energy output.



Source: Fraunhofer ISE

- Challenges:
  - Flexibility (e.g. ramping / load-shedding)
  - Economic sustainability as more and more renewables are placed on the grid

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Why Natural Gas Stays in the Mix

- Risk profile advantage relative to other dispatch-able capacity.
- Low emissions
- Efficiency
- Flexibility
- Size, Modularity and Constructability.
- Fuel availability and Cost
- Use Cases and Applications
  - Combined Heat & Power
  - Microgrid applications
  - Grid ancillary services
- New technologies under development – advanced NGCC, natural gas fuel cells, Oxy-gas-fired supercritical CO_2 power cycle (NET Power), etc.

AEP Dresden NGCC

Photo by Wartsila

Photo by GE & Clarke-Energy

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21st Century Fossil-fueled Generation Technologies and AEP Focus

- *Advanced Cycles (e.g. A-USC Steam, Supercritical CO_2)*
- *Advanced Fossil Combustion / Thermal Energy Conversion Technologies (chemical looping, pressurized oxy-fuel combustion)*
- *IGCC & Post-Combustion CO_2 Capture*
  - *Kemper IGCC*
  - *Petra Nova Post-combustion Capture w/ EOR*
  - *Selective CO_2 membranes*

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AEP Fossil R&D Engagement

- EPRI – Program and supplemental project involvement to support transformational fossil technology development
  - Supercritical CO_2 Power Cycles
  - Advanced Ultra-supercritical Advisory Committee
  - Advanced water research
- Ohio State University R&D Projects
  - Coal direct and syngas chemical looping
  - Prototype CO_2 membrane development
- Gas Technologies Institute
  - DOE/SwRI STEP sCO_2 Test Facility (10MW)
- Funding Partner since 2009 in DOE/Southern Co. National Carbon Capture Center

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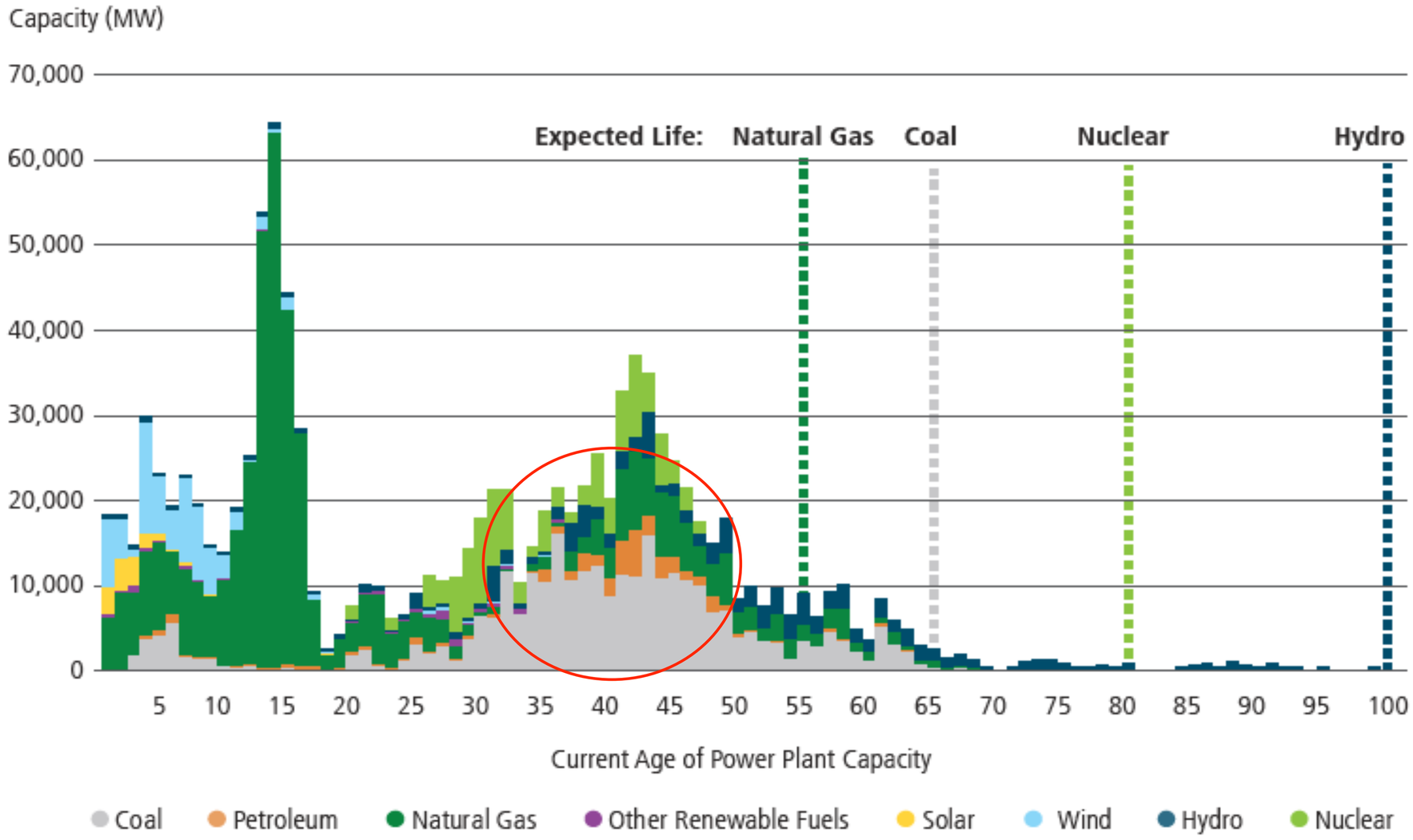
The timeline is real

- **U.S. DOE 2017 Quadrennial Energy Review**

Figure 1-8. Current Age and Expected Life of Generation Fleet by Nameplate Capacity, 2015[73]



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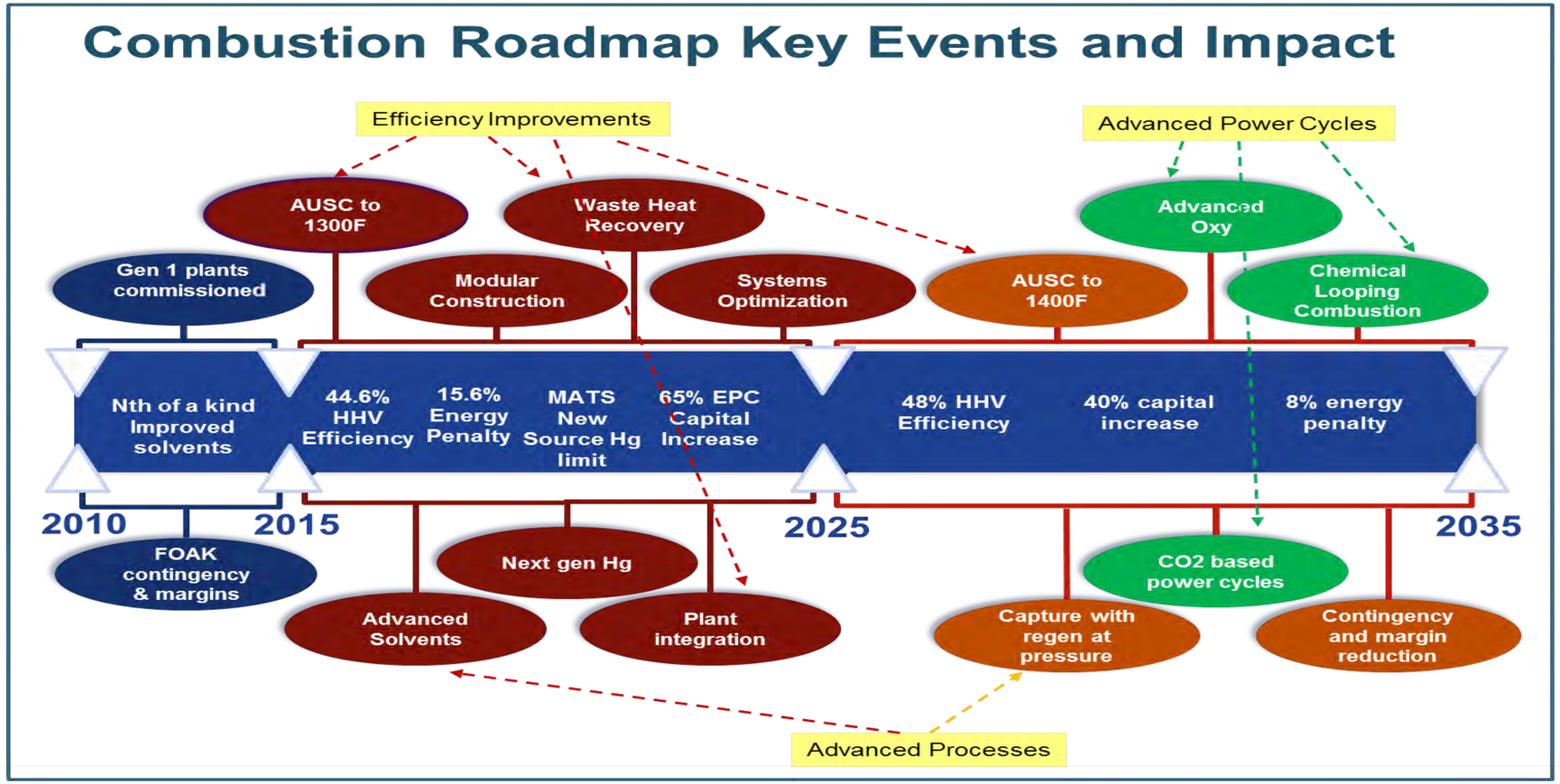
Technology Pathways are Needed

- DOE – Fossil Energy R&D budget appropriations
- EPRI – Long Term Research Imperatives that include low-carbon fossil energy
- Carbon Utilization Research Council (CURC) / EPRI Technology Roadmap



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Balance is Essential

- A *balanced* diet is essential to good health.

- A *balanced* budget is essential to financial well-being.

- A good work / life *balance* is essential to personal happiness.

- A *balanced* stock portfolio is essential to sound wealth management.

A *balanced* energy infrastructure is essential to providing safe, reliable, and affordable electricity.

Limiting our fuel and generation resource diversity threatens the balance!

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Thank You!

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