AEP perspectives on 21st century power generation

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Perspectives on 21st Century Power Generation

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American Electric Power Company Overview

$62B
Total Assets

$31B
Current Market Capitalization

5.4 million
customers in 11 states

32 GW
Owned Generation

40,000+
Line Miles of Transmission

Note: Statistics as of December 31, 2015, except market capitalization which is as of February 25, 2016.
Prudent Decisions – Positive Results

Total AEP System Emissions 1990-2017 projected

- **SO₂** projected 90%
- **NOₓ** projected 85%
- **Hg** projected 85%

Total AEP System Annual CO₂ Emissions (in million metric tons)

- 145.9
- 145.2
- 150.7
- 150.9
- 132.0
- 135.1
- 136.5
- 121.9
- 115.3
- 122.7 (projected)
- 109.7

25% estimated reduction in CO₂ emissions from 2005–2017
Diversifying our Fuel Portfolio

- 7,000+ MW of generation retiring by mid-2016
- Some planned coal to natural gas conversions and/or repower considerations
- No new fossil generation planned between now and 2020
- Utility Scale Solar PV under construction in Indiana (3-5 sites, 1-5MW each, 16MW total by 2017)
Environmental/Regulatory Signposts & Milestones

- Renewable Portfolio Standards (RPS)
- Production Tax Credit (PTC) for renewables
- Light Duty Vehicle CAFE Standards (54.5 mpg)
- New Taxes / Regulations on Drilling & Fracking
- GHG New Source Performance Standards (New Plants)
- GHG New Source Performance Standards (Existing Plants)
- Revised SO₂, PM₂.₅, and Ozone NAAQS Implementation
- Steam Electric Effluent Guidelines
- 316(b) Cooling Water Intake Requirements
- MATS
- Coal Combustion Residuals

Timeline:
- 2015
- 2020
- 2025
What Might the Future Look Like?

2040 Electricity Generation by Fuel (EIA AEO2015 Ref. Case)

Visible Trends Today

Ever-tightening environmental regulations for new & existing sources

Increased shale gas recovery

Renewable Portfolio Standards

Reduced Federal fossil energy R&D budgets

Federal & state renewable subsidies

Aging fossil & nuclear fleet

2040 Electricity Generation by Fuel

Oil & Other 1%

Coal 34%

Natural Gas 31%

Nuclear 16%

Renewables 18%
Traditional Vs. Integrated Grid

- 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

Graphic by EPRI
The Role of Technology

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

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

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

- **Customer**
  - Rooftop PV
  - Energy Storage
  - “Smart” Home

- **Meter**
  - Options / Solutions / Satisfaction
  - Data / Feedback / Preferences

**Explore opportunities “Behind the Meter” to improve overall grid efficiency and maximize customer benefits.**
21st Century Technologies and AEP Focus

- Distributed Generation & Renewables
- Virtual Power Plants and Microgrids
- Bulk Energy Storage
- Advanced Fossil Combustion / Thermal Energy Conversion Technologies (chemical looping, pressurized oxy-fuel)
- Advanced Cycles (e.g. Supercritical CO$_2$ direct & indirect-fired)
- IGCC & Post-Combustion CO2 Capture
- Advanced Nuclear
Value Proposition for Fossil Generation

• Diverse fuel options promote reliability, security and affordability both today & in the future.
• Reliable, dispatch-able, low-cost fossil-fueled generation is the backbone for intermittent renewable energy.

Sources: Fraunhofer ISE & US EIA
With properly focused R&D investment and policies that minimize financial and technical risk we can have options to build cost- & performance-competitive, technology to satisfy the demand for new, clean, reliable, & flexible fossil-fueled capacity.

Right now we are just “kicking the can down the road” when it comes to clean fossil technology innovation and policy.

Graph by International Energy Agency
Technology Pathways

- U.S. DOE 2015 Quadrennial Energy Review, 2016 & 2017 Budgets
- EPRI – Long Term Research Imperatives
- Coal Utilization Research Council / EPRI Technology Roadmap
Challenges to Overcome

- We need technologies, equipment and components to support new generation paradigm and reduce **ALL** risk:
  - Increased efficiency and reduced emissions
    - Sustainable resource utilization (fuel, water, landfill)
    - Lower energy penalty
  - Scalability and practicality of use
    - Footprint
    - Constructability
    - Process Complexity & Operability
    - Utilities’ first priority is to generate electricity
  - Ability to Accommodate demanding duty cycles (etc. startups, shutdowns, fast-ramping ability)
- Favorable policies and **meaningful** incentives toward developing and demonstrating clean coal technology at scale
  - Consider **ALL** risks to CCUS deployment (financial, technical, legal, practical)
  - Set example for the global community that the U.S. is serious about clean fossil technology development for the future, even in the midst of low-cost, abundant natural gas.
AEP Engagement

- EPRI – Program and supplemental project involvement to support
transformational technology development
  - Supercritical CO₂ Power Cycles
  - CO₂ selective membrane research
  - Advanced water research

- Ohio State University R&D Projects
  - Coal direct and syngas chemical looping
  - Prototype membrane development

- Gas Technologies Institute
  - Proposed Oxy-PFBC Pilot Project (10MW)

- Funding Partner in DOE/Southern Co. National Carbon Capture Center
NCCC Overview

• Located in Wilsonville, Alabama
• Sponsored by the U.S. Department of Energy and its National Energy Technology Laboratory
• Partners include the Electric Power Research Institute and leaders in the power and coal industries
What NCCC Provides

- A cost-efficient test site for numerous technology developers
- Real industrial conditions with coal-derived flue gas and syngas
- Capability for testing at multiple scales and for on-site scale-ups
- Expert staff for support of design, installation, and testing
- High quality data acquisition and gas/liquid sampling and analysis
State-of-the-Art Capabilities

- **Real-World Conditions**
  Operates with flue gas from commercially dispatched coal-fired unit with full environmental controls

- **High Availability**
  Two to three campaigns per year with continued, long-term testing and new testing during each campaign

- **Infrastructure for Parallel Tests**
  Multiple test bays for bench- and pilot-scale developers’ skids

- **Support for Solvent Testing**
  Fully integrated solvent units at bench- and pilot-scales

- **Flexibility for Natural Gas Conditions**
  Air dilution system for simulated natural gas-fired conditions when desired
Thank You!