The Changing Landscape of Electric Generation

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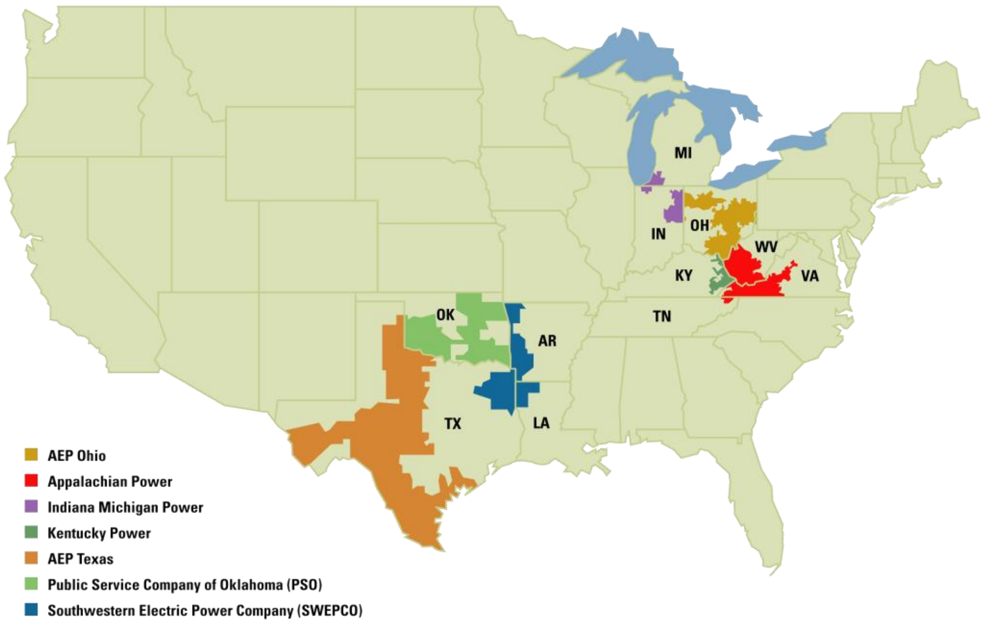
American Electric Power

Company Overview

Revenues (in billions)	$14.4
Net Income (in millions)	$1,211 [1]
Earnings Per Share	$2.53 [1]
Cash Dividends Per Share 2	$1.64
Service Territory	197,500 mi²
Transmission	39,000 miles
Distribution	215,800 miles
Generating Capacity	38,988 MW [2]
Generating Stations	More than 80
Renewable Portfolio (hydro)	364 MW [3]
Pumped Storage	586 MW
Renewable Portfolio (wind, solar)	1,406 MW [4]
Total Kilowatt-hour Sales (in millions)	195,312
Total Assets (in billions)	$48.3
U.S. Customers (year-end, in thousands)	5,220



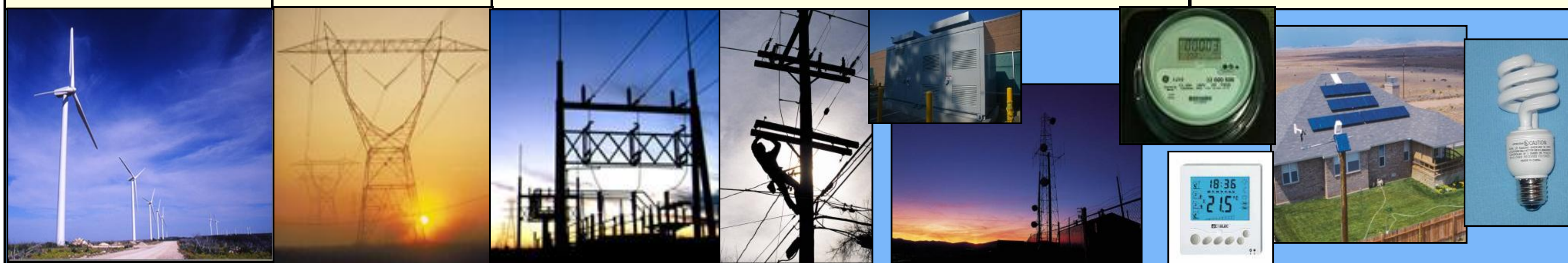
1. Generally Accepted Accounting Principles.

2. Represents nominal capacity; includes 270 MW of mothballed / decommissioned generation, AEP's interest in Ohio Valley Electric Corp., purchased power agreements and renewables.

3. Excludes pumped storage; includes owned capacity and purchased power.

4. Regulated wind and solar capacity on line or under contract.

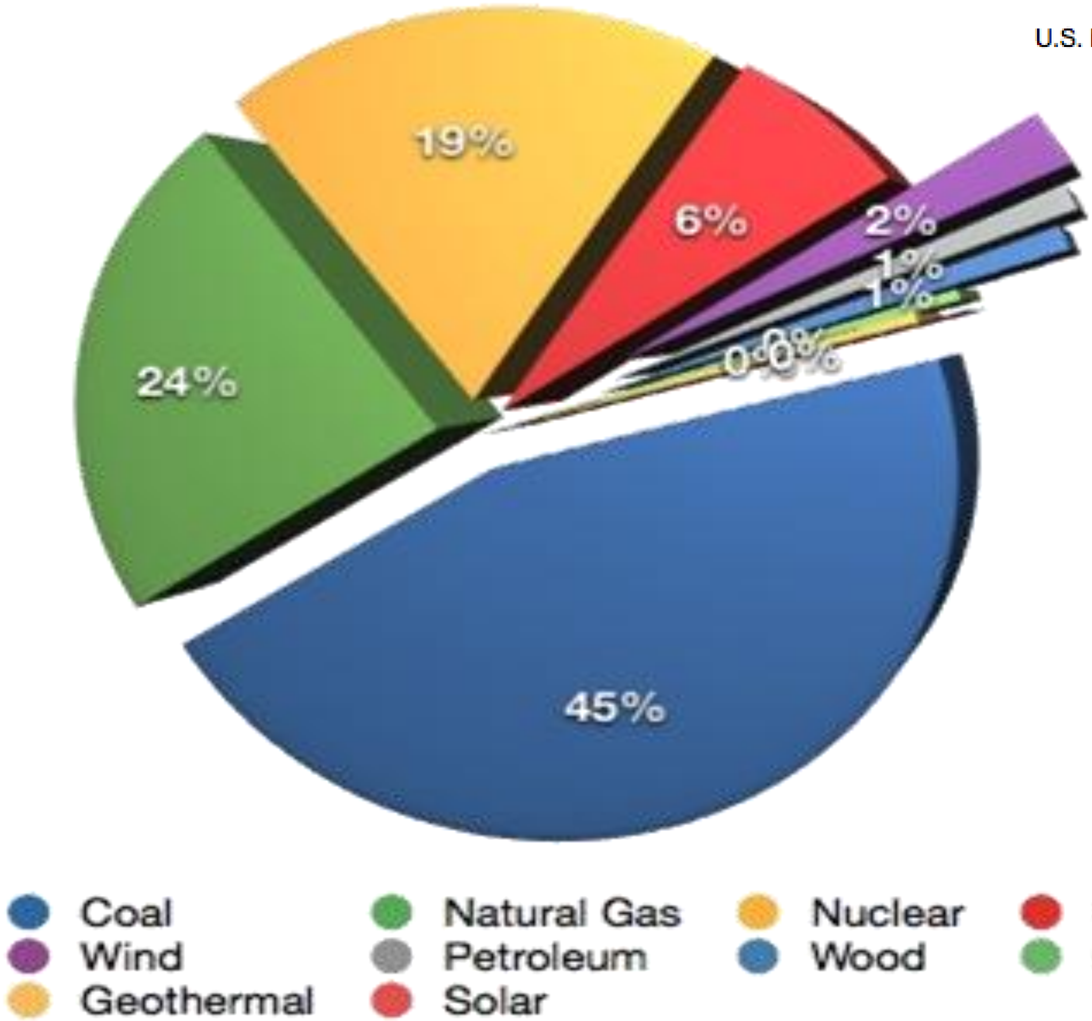
Current Initiatives at AEP



Generation	Transmission	Distribution	Customers
• Environmental Projects • Wind • IGCC • Carbon Capture & Storage	• I-765™ • Electric Transmission Texas JV • Electric Transmission America JV • AEP-ABB Alliance	• Distribution automation • Self-healing distribution circuits • Advanced metering • Communications infrastructure • Mobile workforce • Internal energy efficiency • Integration platform for advanced visualization and analytics • Distributed generation and energy storage	• Customer programs and incentives • Energy efficiency • Direct load control • Peak demand reduction • Energy storage • PHEVs

Generation and transmission control systems	gridSMART℠: bridging the gap to provide integrated two-way communications & control across the electricity value chain	Home energy automation

US Electric Generation by Source



U.S. Net Generation by Source - January 2010 - August 2010
in Thousand Megawatt-hours

Coal	1,269,309	45.50%
Natural Gas	669,327	23.99%
Nuclear	538,479	19.30%
Hydro	179,464	6.43%
Wind	58,541	2.10%
Petroleum	26,639	0.95%
Wood	25,364	0.91%
Biomass	11,772	0.42%
Geothermal	10,229	0.37%
Solar	755	0.03%

Total 2,789,879

Source: U.S. Department of Energy, Energy Information Administration (EIA), 2010 data.

Electric companies use a diverse mix of fuels to generate electricity.

Centralized Coal Fired Generation

- As of May 20, 2011, out of the U.S. installed coal-fired power capacity totaling 316 gigawatts (GW) and 1,400 units; 8.9 GW (3 percent of the fleet) are committed to retiring by 2020, 5.9 GW of which are set to retire by 2015.

- Another 8.5 GW (3 percent of the fleet) have been proposed to retire by 2020, 5.0 GW of which by 2015.

Source: IHS CERA

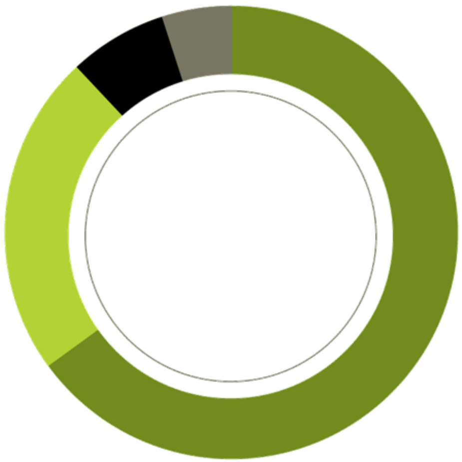
- AEP's compliance plan would permanently retire coal fired generation of 450 MW by Dec. 31 2011; an additional 165 MW by Dec 31, 2012; and an additional 5,241MW by Dec 31, 2014.

- An additional 1070 MW of coal fired generation will be refueled with natural gas.

Three – six percent of coal-fired centralized generation will be retired by 2020 creating an opportunity for cost competitive new generation technologies.

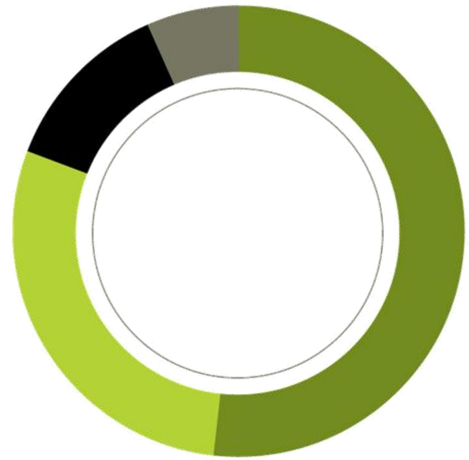
AEP's Generation Mix

2010 AEP Generating Capacity by Fuel



Coal/Lignite	65%
Natural Gas	23%
Hydro, Wind, Solar & Pumped Storage	7%
Nuclear	5%

2020 Projected AEP Generating Capacity by Fuel



Coal/Lignite	52%
Natural Gas	29%
Hydro, Wind, Solar & Pumped Storage	13%
Nuclear	6%

AEP's renewable generating capacity is expected to almost double by 2020.

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Life-Cycle Cost of Electricity

(Levelized) Life-Cycle Cost of Electricity (LCOE) in $ per MWh (2009 $ and 30 year life)

	Install Cost per kW	LCOE per MWh	Heat Rate (Efficiency %)
Ultra-Supercritical Pulverized Coal	$3,100	$104	8,750 (38 – 40)
Natural Gas Combined Cycle	$1,250	$91	6,700 (50 – 52)
Nuclear	$7,500	$119	10,500 (32.5)
Wind	$2,100	$145	Not Applicable
Solar PV	$4,500	$300	Not Applicable
Solid Oxide Fuel Cell	$3,500 - $7,500	$120	7,500 (50 – 60)

To effectively compete with incumbent centralized generation, new generation technologies need to have a LCOE less than or equal to $100/MWh.

Progression of Technologies

Crawl:

- Technologies must prove that they are reliable (80 – 90% capacity utilization)
  - **Distributed generation opportunities**

Walk:

- Technologies must prove that they are reliable and scalable
  - **Hybridization such as combining a high-temperature fuel cell with a traditional gas turbine**

Run:

- Technologies must prove that they are reliable, scalable, affordable and sustainable
  - **Central generation fuel cell deployment with coal gasification**

Reliability is the most important factor for a utility when considering a generating technology and then cost.

Why utilize distributed generation applications first?

Advantages

- Limited reliability risk
- Relatively small footprint compared to renewables or central
- Little to no permitting required
- Quick time to power
- Modular design
- Public policy – incentives, tax credits, cost sharing, etc.
- Plug & play with existing T&D infrastructure
- Potential solution for uninterruptible power/critical power
- Applicable for Purchase Power Agreements (PPA)
- Limited staff

Distributed Generation helps limit risk by enabling scalable deployment and requiring little to no permitting.

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Fuel Cell

Benefits:

- *Environmentally friendly – hydrogen produces zero emissions besides water vapor*
- *Size – individual fuel cells are the size of a cocktail napkin - 1MW units are typically the size of a 1-2 large parking spaces*
- *Easily sited due to minimal space requirements, little/no permitting requirements and no noise*

Source: Current

- *More efficient than other renewables (45% - 65%) Fuel cells can run off virtually any feedstock – natural gas, biogas, ethanol, methane, landfill gas*

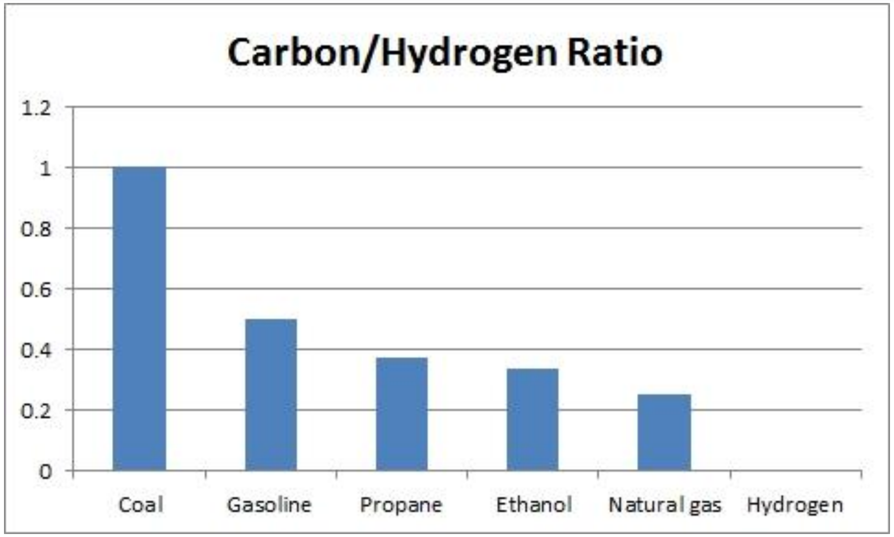
Disadvantages:

- *Technology is expensive*
- *Technology not fully developed and few products are available*

Fuel Cell

Environmental Impacts:

- Fuel cells emit 800lb/MWh CO2 output (this is typically 60%-75% cleaner than central gen) and have negligible levels of NOx or SOx.



Source: Fuel Cell & Hydrogen Energy Assn

Potential Applications:

- Institutions – colleges & universities, hospitals, nursing homes, prisons, military bases requiring backup power
- Commercial – data centers and other buildings with high power quality requirements and grocery stores or others requiring backup power
- Residential – widely used in Japan as sole source of power - units are about the size of a traditional AC unit

Fuel cells can power an extraordinary range of applications, from battery replacements in consumer electronics to backup and remote power generation to auxiliary power units to combined heat and power systems and high efficiency base load electrical generation.

Fuel Cell Technologies

Type	Electrolyte	Temp (^{O}C)	Applications	Advantages	Disadvantages
Proton Exchange Membrane (PEMFC)	**Hydrated Polymer**	**80**	■ **C&I** ■ **Residential** ■ **Transportation** ■ **Portable Power**	■ **Solid electrolyte** ■ **Low temperature** ■ **High power density**	■ **Extensive fuel processing** ■ **Expensive catalyst** ■ **Sensitive to fuel impurities**
Alkaline (AFC)	Aqueous solution in a solid matrix	65-220	■ Military, space	■ High performance	■ Expensive CO_2 removal from fuel & air
Phosphoric Acid (PAFC)	Liquid acid in a solid matrix	205	■ Electric utility ■ C&I	■ Tolerates fuel impurities ■ Commercially available	■ Expensive catalyst ■ Low power density
Molten Carbonate (MCFC)	Liquid metal solution in a solid matrix	650	■ Electric utility ■ C&I	■ High cogen efficiency ■ Fuel flexibility ■ Inexpensive catalyst ■Commercially available	■ High temperature (component failure)
Solid Oxide (SOFC)	**Ceramic**	**600-1000**	■ **Electric utility** ■ **Transportation** ■ **Residential** ■ **Portable power**	■ **Solid electrolyte** ■ **High cogen efficiency** ■ **Fuel flexibility** ■ **Inexpensive catalyst** ■Commercially available	■ **High temperature (component failure)**

Potential Opportunities for DG within AEP

Why would utilities consider DG?

- Less risk than traditional central generation
  - Less capital
    - Improves ability to finance
    - Limits rate recovery exposure
  - Limited permitting risk – quicker time to power
- Avoided construction of transmission and distribution for stand alone or small loads
- Deferred investment in substations
- Meets Renewable Portfolio Standards (RPS) in many jurisdictions
- Peak shaving/peak shifting opportunities
- Standby/spinning reserve capacity
- Islanding – system reliability
- Power Quality – potential solution for uninterruptible power/critical power
- Environmental concerns – little to no permitting

DG applications that enable us to avoid/delay a large capital expenditure are prime candidates.

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Why not Distributed Generation?

Why isn't small scale distributed generation widely adopted today?

- High initial capital cost & ongoing cost/kWh
- Lack of clarity on interconnection and local environmental rules
- No guarantee that primary fuel prices will remain low
- Limited system life (typical life for fuel cell stack is 3 - 5 years)
- Reliability concerns for some technologies
- Limited commercial availability of some technologies
- Limited incentives, which are then spread across all customers creating potential backlash
- Uncertain economy – DG not at the top of the list of investments for commercial customers

The primary barrier to widespread deployment of DG today is the cost, and it is coming down as technologies mature and become more commercially available.

Potential Business Models

Distributed Generation provides utilities with a number of potential business models including . . .

- Traditional ownership of generation and ability to use to support traditional loads or to meet Renewable Portfolio Standards (RPS) requirements
- "Green Power" rate applications
- "Premium Power" rate applications
- Consumer ownership of asset with utility utilizing a purchase power agreement (PPA) to meet RPS requirements

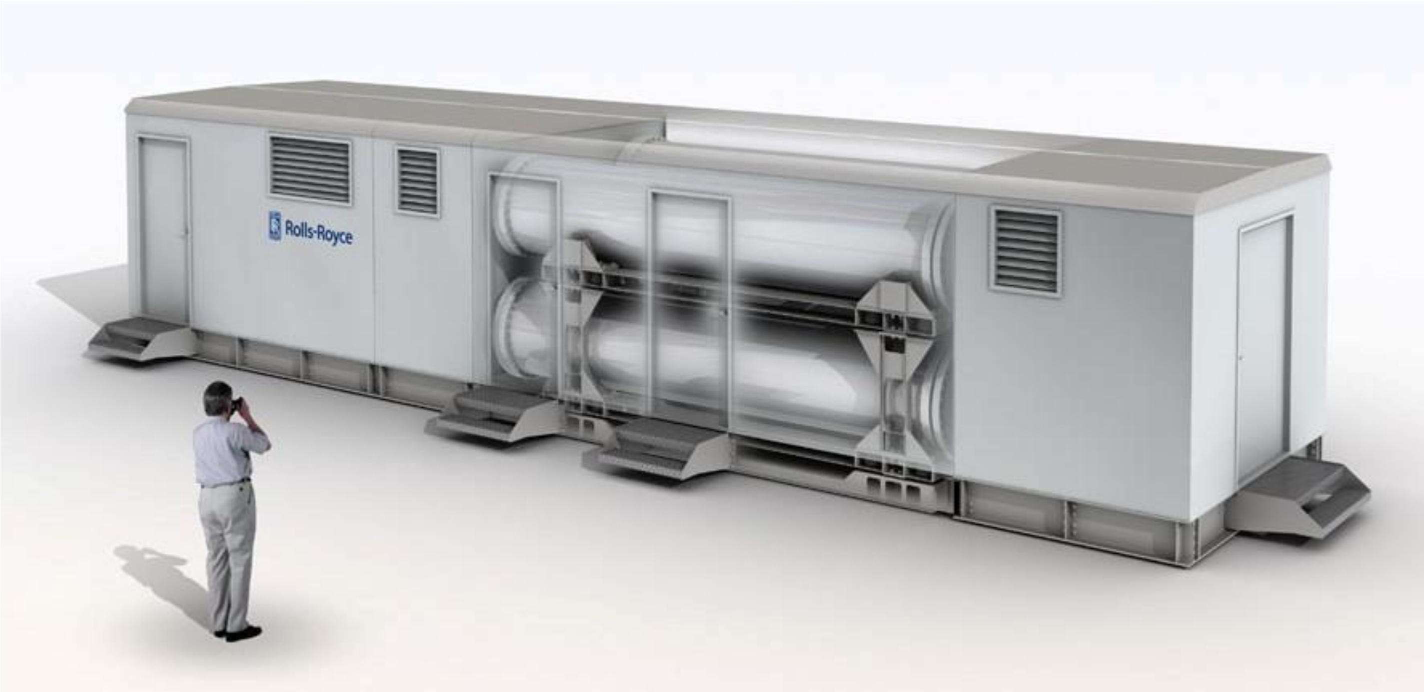
Distributed Generation provides utilities with increased flexibility in meeting RPS requirements and providing rate options to consumers.

AEP's Microgrid Test Bed

Rolls-Royce Solid Oxide Fuel Cell

Rolls-Royce Fuel Cell Systems

1 MW SOFC Test & Evaluation Program



ECHOGEN Waste Heat Engine

- ➢5 kW lab scale system built and demonstrated
- ➢15 kW pilot scale system built
  - ✓ Initial system demonstrations complete
  - ✓ Positive net power in August 2009
- ➢ 250 kW demonstration system field test
  - ✓ Installation @ Utility site – 1Q 2010
  - ✓ Shakedown and system testing –2-4Q 2010
  - ✓ Installation at launch customer site – 1QQ 2011
    - ✓ Fully automated, unattended operation
    - ✓ Long-term durability demonstration
- ➢ Scale up to 5 - 8 MW system underway with demonstration project initiated in 2011

Key Take Aways

For new generation technologies to be competitive at replacing traditional central generation they must…

Proven Reliability | **Scalable** | **Sustainable** | **Economical**

…provide reliable large scale power…

- Established, validated track record at large scale capacities
- Operate independent of the grid

….at a competitive cost.

- Readily available economical fuel source
- Low public policy risk (incentives, tax credits, cost sharing, cost shifting)
- Limited Siting/permitting
- Quick/easy/scalable projects, timely completion