

# Energy Diversification in the States



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# Topics



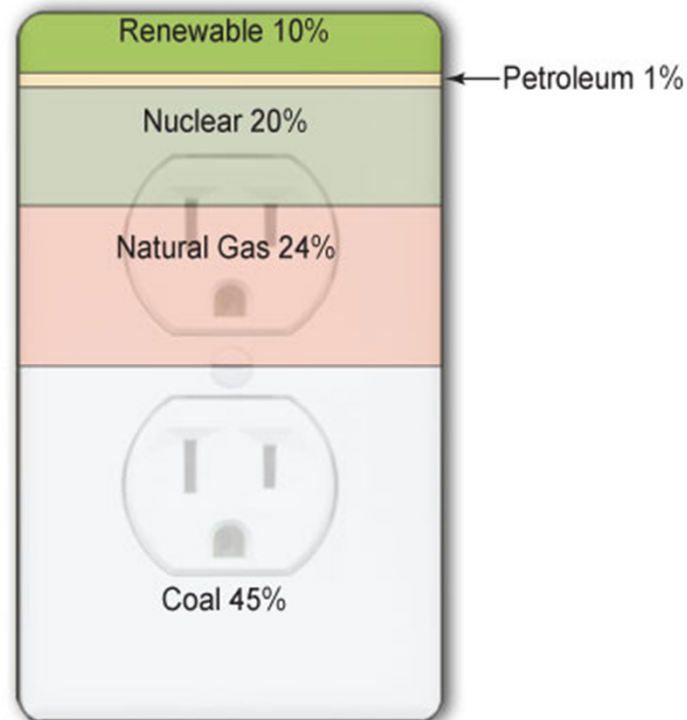
- Fuels used to generate electricity
- Renewables
- Issues in energy diversification
  - Demand management
  - Distributed resources
  - Smart Grid and Smart Meters

# Fuels Used to Generate Electricity



Varies by region

## Sources of U.S. Electricity Generation, 2010



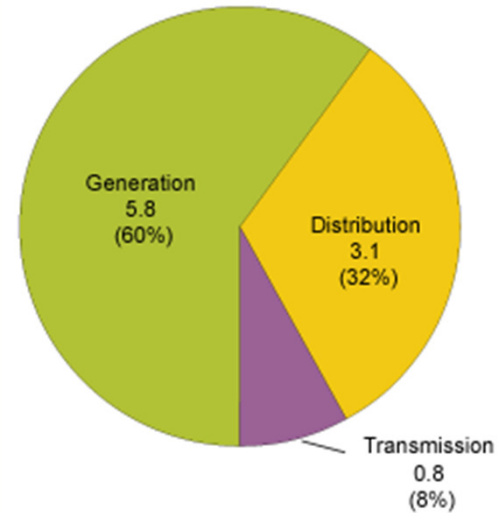
Source: U.S. Energy Information Administration, *Monthly Energy Review* (June 2011). Percentages based on Table 7.2a, preliminary 2010 data.

# Price of Electricity



Here we are talking about the generation—the cost of the electricity itself

**Major Components of U.S. Average Electricity Price, 2010**



Source: U.S. Energy Information Administration, *Annual Energy Outlook 2011*, Reference Case, Table 8: Electrical Supply, Disposition, Prices, and Emissions (2011).

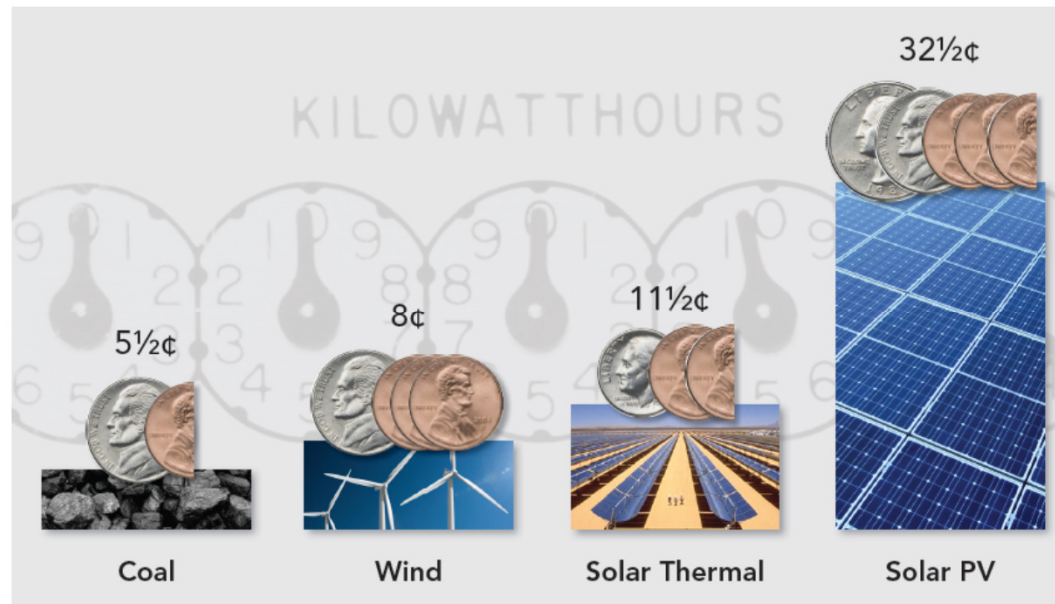
[http://www.eia.gov/energyexplained/index.cfm?page=electricity\\_factors\\_affecting\\_prices](http://www.eia.gov/energyexplained/index.cfm?page=electricity_factors_affecting_prices)

# Cost of Electricity



## Cost of Electricity by Fuel Source

Cost in Cents per kW-h



Levelized cost of electricity calculations by The Breakthrough Institute based on United States Energy Information Administration's Annual Energy Outlook 2010 project cost estimates by technology. Calculations assume 8.8% effective cost of financing and a range of overnight capital costs +/- 15% from EIA published estimates. To read the full "Creating a Clean Energy Century" report, visit <http://www.thirdway.org/publications/351>. © 2010 Third Way. Graphic design by Bill Rapp. For more information, visit [www.thirdway.org](http://www.thirdway.org).

Source: The Third Way, Creating a Clean Energy Century Energy Graphics:

[http://content.thirdway.org/publications/353/Third\\_Way\\_Graphics\\_-\\_Creating\\_a\\_Clean\\_Energy\\_Century.pdf](http://content.thirdway.org/publications/353/Third_Way_Graphics_-_Creating_a_Clean_Energy_Century.pdf)

# Coal



- **Over 600 coal powered electricity plants**
  - Coal plants generate close to half of the nation's electricity
  - Percentage varies by region
- **Lower costs and domestic abundance contribute to continued reliance on coal for electric generation**
- **The U.S. Energy Information Administration (“EIA”)**
  - Projects modest reductions in percentage of electricity generated by coal during the next 25 years
  - Suggests that environmental laws and regulations that have been enacted and proposed could result in the retirements of significant numbers of the nation's coal plants (from 2% to over 20% depending on scenario) [http://www.eia.gov/forecasts/aeo/chapter\\_executive\\_summary.cfm#environ](http://www.eia.gov/forecasts/aeo/chapter_executive_summary.cfm#environ)
  - Potential retirements are leading to reliability concerns in some areas of the country

# Natural Gas



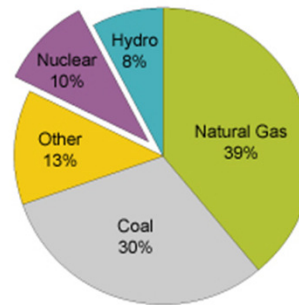
- Natural gas plants account for about 24% of generation
- Shale gas production has driven the cost of natural gas significantly lower as compared to peak prices seen prior to 2009
- Reduced carbon emissions, as compared to coal, and lower natural gas prices likely to drive use of natural gas for electric generation –
  - EIA estimates that by 2035 as much as 60% of new electric capacity will be supplied by natural gas ([http://www.eia.gov/forecasts/aeo/MT\\_naturalgas.cfm](http://www.eia.gov/forecasts/aeo/MT_naturalgas.cfm))
  - Concerns about the sustainability of low natural gas prices in the face of increased domestic demand
  - Not everyone confident about the projections for shale gas
  - Cornell study: Green house gas impact of shale greater than coal over 20 year period  
(<http://www.news.cornell.edu/stories/April11/GasDrillingDirtier.html>)

# Nuclear Energy

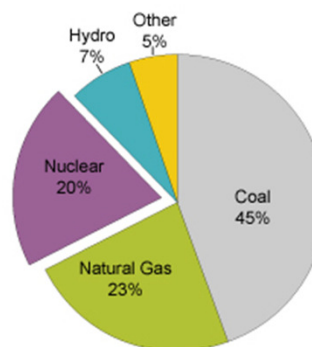
- 65 nuclear plants (104 reactors) generate close to 20% of the supply of electricity
- Thirty-one states have at least one commercial nuclear reactor
- EIA is currently projecting the supply of nuclear power to increase slightly over the next two decades

## *Nuclear Plants Use More of Their Capacity to Generate Electricity than Other Plants*

Capacity, 2009  
Total = 1,025,400 MW



Generation, 2009  
Total = 3,950 Million MWh



Source: U.S. Energy Information Administration, *Electric Power Monthly*, Table 1.1.

While nuclear energy makes up only about 10% of the nation's electric generation capacity, its capacity is utilized more intensively

# Hydro



- Hydropower contributes slightly over 6% to the electric generation portfolio in this country
- It is a renewable resource
  - Relied on heavily in certain areas of the country
    - ✦ Two-thirds of the electricity generated in the Pacific Northwest is from hydropower
- No measurable increase in hydroelectricity anticipated over the next two decades
  - Best sites for hydro are already in use

## Fuel Oil and 'Other Resources'



- Together, fuel oil and other resources account for less than 2% of the nation's generation portfolio

# Non-Hydro Renewables



- Non-hydro renewable resources include the following:
  - Wind
  - Solar
  - Biomass
  - Geothermal
  - Other technologies
- Currently non-hydro renewables account for 4.1% of the portfolio mix, but the US EIA expects an increase to over 8% by 2035

# Renewable Energy Drivers



- **RPS Requirements**

- Renewable Portfolio Standards or Renewable Energy Standard (RES) are legislative mandates
- They require that a specified percent of electricity be generated by renewable energy sources by a specified date
- Mandate may be in form of minimum percent of
  - ✦ Total energy sales (MWh) or
  - ✦ Installed capacity (MW)

- **Environmental Concerns**

- New and proposed regulations of the federal Clear Air and Clean Water Acts
  - ✦ May alter the electric generation portfolio of the United States
- The potential of a carbon-constrained economy will also help drive the growth of renewable energy

# Renewable Portfolio Standards



- **Mandates: 29 states and the District of Columbia**
- **Goals**
  - 9 states have renewable energy goals, and
  - The Tennessee Valley Authority (TVA) has established a goal which impacts its seven (7) state region
- **Renewable energy targets are incremental**
  - Percentage required increases annually
- **A number of state impose penalties, often called Alternative Compliance Payments (ACP), for failure to meet the required percentages**
- **Utilities may compliancy in several ways:**
  - Generate electricity using of renewable resources
  - Purchase renewable energy under bilateral contract
  - Purchase Renewable Energy Certificates or Credits (RECS)
- **Some states have, or are considering, increasing to their respective RPS mandates.**
  - Also several states reportedly considering scaling back or repealing their RPS
- **Carve outs**
  - Require that a specified amount of the renewable requirement be met by a certain type of renewable energy such as solar.
  - A number of states have enacted these

# Renewable Energy Standards and Goals

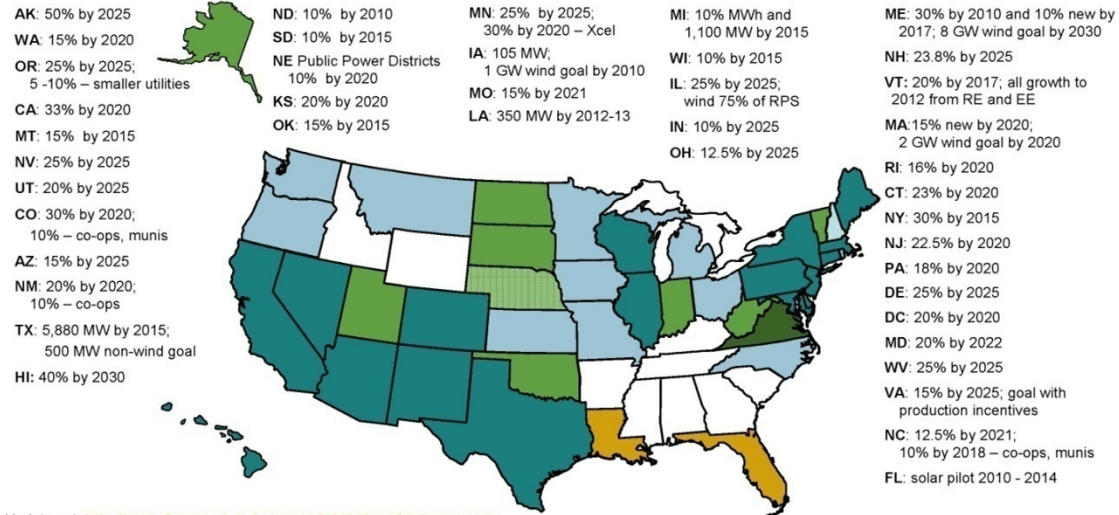


## Renewable Power & Energy Efficiency Market: Renewable Portfolio Standards

Federal Energy Regulatory Commission • Market Oversight • [www.ferc.gov/oversight](http://www.ferc.gov/oversight)

### Renewable Portfolio Standards (RPS) and Goals

29 states and D.C. have RPS policies; 9 states and 3 power authorities have nonbinding goals



Updates at: <http://www.ferc.gov/market-oversight/otr-mkts/renew.asp>

**Notes:** A Renewable Standard requires a percent of an electric provider's energy sales (MWh) or installed capacity (MW) to come from renewable resources; most specify sales (MWh). Map percents are final years' targets. Nebraska's two largest public power districts, which serve close to two-thirds of its load, have renewable goals. The Tennessee Valley Authority's (TVA) goal across its 7-state territory is 50% zero- or low-carbon generation by 2020.  
**Sources:** derived from data from: Lawrence Berkeley Labs, state Public Utility Commission (PUC) and state legislative tracking services, Pew Center. Details, including timelines, are in the *Database of State Incentives for Renewables and Energy Efficiency*: <http://www.dsireusa.org>

- RPS
- Accelerated or strengthened RPS
- Voluntary state or utility standards or goals
- Strengthened voluntary standard
- Pilot or study

Updated May 3, 2011

34002

**Source:** Federal Energy Regulatory Commission

# Challenges Facing Renewable Energy



- **Cost**

- Cost to generate using renewables is higher than fossil fuel
  - ✦ Movement toward consideration of “externalities” in determining cost of differing forms of energy
  - ✦ Renewables moving toward ‘grid parity’
- Growing aversion to government subsidization of various forms of energy, particularly renewables
- ‘Fuel’ sources, notably wind, are frequently located away from load centers necessitating increased transmission capacity

- **Reliability**

- With the exception of Hydropower, renewable energy resources can not be supplied when and where needed for reliability
- Integration of renewable resources into the transmission grid continues to be a challenge for grid operators
- Smart grid, demand response and batteries can help with reliability

# Forecasted Levelized Costs



**Table 1. Estimated Levelized Cost of New Generation Resources, 2016.**

Plant Type	Capacity Factor (%)	U.S. Average Levelized Costs (2009 \$/megawatthour) for Plants Entering Service in 2016				
		Levelized Capital Cost	Fixed O&M	Variable O&M (including fuel)	Transmission Investment	Total System Levelized Cost
Conventional Coal	85	65.3	3.9	24.3	1.2	94.8
Advanced Coal	85	74.6	7.9	25.7	1.2	109.4
Advanced Coal with CCS	85	92.7	9.2	33.1	1.2	136.2
<b>Natural Gas-fired</b>						
Conventional Combined Cycle	87	17.5	1.9	45.6	1.2	66.1
Advanced Combined Cycle	87	17.9	1.9	42.1	1.2	63.1
Advanced CC with CCS	87	34.6	3.9	49.6	1.2	89.3
Conventional Combustion Turbine	30	45.8	3.7	71.5	3.5	124.5
Advanced Combustion Turbine	30	31.6	5.5	62.9	3.5	103.5
Advanced Nuclear	90	90.1	11.1	11.7	1.0	113.9
Wind	34	83.9	9.6	0.0	3.5	97.0
Wind – Offshore	34	209.3	28.1	0.0	5.9	243.2
Solar PV <sup>1</sup>	25	194.6	12.1	0.0	4.0	210.7
Solar Thermal	18	259.4	46.6	0.0	5.8	311.8
Geothermal	92	79.3	11.9	9.5	1.0	101.7
Biomass	83	55.3	13.7	42.3	1.3	112.5
Hydro	52	74.5	3.8	6.3	1.9	86.4

<sup>1</sup> Costs are expressed in terms of net AC power available to the grid for the installed capacity.

Source: Energy Information Administration, Annual Energy Outlook 2011, December 2010, DOE/EIA-0383(2010)

[http://www.eia.gov/forecasts/aeo/electricity\\_generation.cfm](http://www.eia.gov/forecasts/aeo/electricity_generation.cfm)

# Emerging Issues in Energy Diversification



- Because of rising and volatile energy costs, States are looking at comprehensive integrated resource planning which considers alternatives to traditional electric generation and transmission, including:
  - Demand management
  - Distributed resources
  - Smart Grid solutions

# Demand Management



- **Demand side management (“DSM”)**
  - Managing of consumer electric demand in the face of supply constraints or increasing prices
    - ✦ Includes energy efficiency and making consumption responsive to price
    - ✦ Is cheaper than building new plants
- **Energy efficiency reduces demand**
  - Examples: appliance standards, changes to building codes, weatherization
  - "The cheapest watt is the one that's never created" or "Negawatts"
- **Load-shifting, or demand-response,**
  - Movement of customer demand from peak periods to off-peak periods
  - Uses prices to incent customers to move consumption off-peak
  - Examples:
    - ✦ Higher price during peak period,
    - ✦ Rebate to reward reduction during peaks
    - ✦ Real time pricing
- **Demand response is valuable tool for dealing with the intermittancy of renewables**
  - Provides a way to drop load quickly when, for example, wind slows
  - Can be done automatically by signal to appliances
- **As of April 2010, 24 states had adopted some form of an Energy Efficiency Portfolio Standards (EEPS) for electric and natural gas utilities**
  - Three additional states had an EERS under consideration (USDOE Report: [http://www1.eere.energy.gov/industry/states/pdfs/eers\\_web\\_final.pdf](http://www1.eere.energy.gov/industry/states/pdfs/eers_web_final.pdf))

# Distributed Resources



- Traditionally, power is generated at a centralized location then transmitted long distances to where it is used
- Distributed Resources (DR) generally smaller scale and located closer to load centers
- Examples of distributed resources
  - Combined heat power (CHP)
  - Fuel cells
  - Photovoltaic systems (solar power)
  - Small wind power systems
- Supporting the growth of distributed resources
  - Net-metering, feed-in tariffs, grants, REC/SREC proceeds and other financial incentives
    - ✦ (Net metering: the small generator pays only for the net amount of energy it uses. May even sell small amounts of power to the utility)

# Smart Grid

## Modernizing the national electrical grid



- **Smart Grid--an enhanced version of the current grid**
  - Will include a communications layer
  - Two way communications such as between smart meters and utilities
  - Will have more detailed information
  - Includes smart meters
- **Challenges**
  - Interoperability—parts need to be able to communicate, work together
  - Cyber security—more access points to grid
  - Privacy
- **Benefits**
  - Transmission and distribution lines will be more efficient
  - Grid will be more robust—able to recover more quickly from problems
  - Will facilitate the incorporation of renewable energy
  - Supports demand response/price responsive demand

# Smart Meters



- Digital meters; replace the old mechanical meters
- Provide detailed consumption information—hourly or more frequent
  - Gives customer tool to analyze consumption and change behavior
- Facilitate demand response
  - Typically can receive signal from utility or other provider
  - Where programs have been approved and adopted, customer can enroll in program to receive incentive payments
    - ✦ Customer gets price indicator and can choose to reduce consumption at peak period
- Electric cars
  - Will be important to incent customers to charge cars off-peak
  - Implement supporting price structure
  - Electric car charging can also help balance intermittency of renewables
  - Utility sends signal to car to charge when wind is blowing, for example.
  - Or even, with owner permission, put power back on grid during cloud cover

# Smart Meters



- Operational benefits to utility—save cost for all
- Eliminate meter readers; meters read over the air
- Eliminate the cars and trucks used for meter reading—environmental benefit
- Utility can turn power on and off remotely
  - Faster and more accurate changes for people moving in and out of houses
- Utility can detect outages automatically and thus restore power faster

# Smart Meter Issues/Concerns

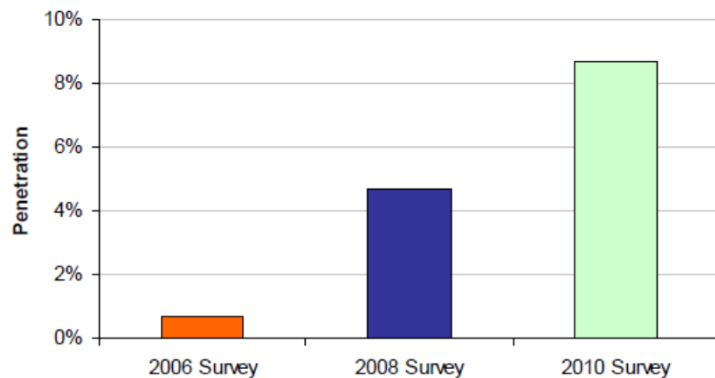


- **Data privacy**
  - Who owns the customers detailed usage information?
  - Is the system secure?
- **Radio frequency**
  - Some believe there are health concerns from the radio frequency fields
  - The Federal Communications Commission has concluded that there is no scientific evidence establishing a causal link between wireless device use and cancer or other illnesses.
  - Radio frequency signals from smart meters are much weaker than RF exposure from cell phones, cordless home phones, etc.
  - Signals are sent from smart meters for just a few minutes each day
- **Cyber security**
  - Many more access points to grid
  - For example, customer may be able to send signal from smart phone to home thermostat to raise air conditioner temperature setting

# Smart Meter Penetration

- ARRA funds granted for Smart Meters
  - Growth may slow somewhat now that ARRA funds have been used.

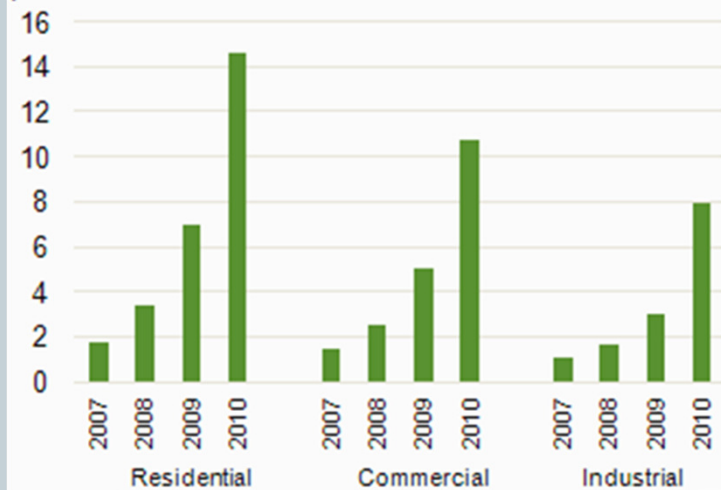
*Figure 3.1. Estimated advanced metering penetration nationwide in 2006, 2008 and 2010 FERC Surveys*



Source: FERC Assessment of Demand Response and Advanced Metering Staff Report, February 2011:

<http://www.ferc.gov/legal/staff-reports/2010-dr-report.pdf>

**Smart meter (AMI) penetration by end-use sector**  
percent of customers



Source: U.S. Energy Information Administration

# Case Study: Delaware



- **Delaware RPS requirement: 25% by 2025**
  - Includes a 3% ‘carve-out’ for solar installations
  - Electricity produced by natural gas fueled fuel cells (Bloom Boxes) may be used by Delmarva to meet its RPS obligations (2011 legislation)
  - 2006 legislation lead to purchased power agreement Delmarva Power and an off-shore wind farm, Bluewater Wind
- **Energy Efficiency Resource Standard (EERS): By 2015,**
  - 15% reduction in electricity use
  - 15% reduction in peak electric
  - 10% reduction in natural gas consumption
- **Smart Meters**
  - In 2009, PSC approved deployment of smart meters throughout the service territory of its largest electric distribution utility
  - As of December 2011, 99% of the electric meters installed
- **Dynamic pricing**
  - PSC recently approved a Critical Peak Rebate program for a 7,000 customers
  - Program will be expanded to the entire service territory by 2014