



**2006 Integrated Resource Plan:  
Scenarios, Conservation, Resources**

*IRP Stakeholders Group  
March 7, 2006*



# Agenda

**Scenarios**

David Clement

**Conservation**

Steve Lush

**New Generating Resources**

Marilynn Semro

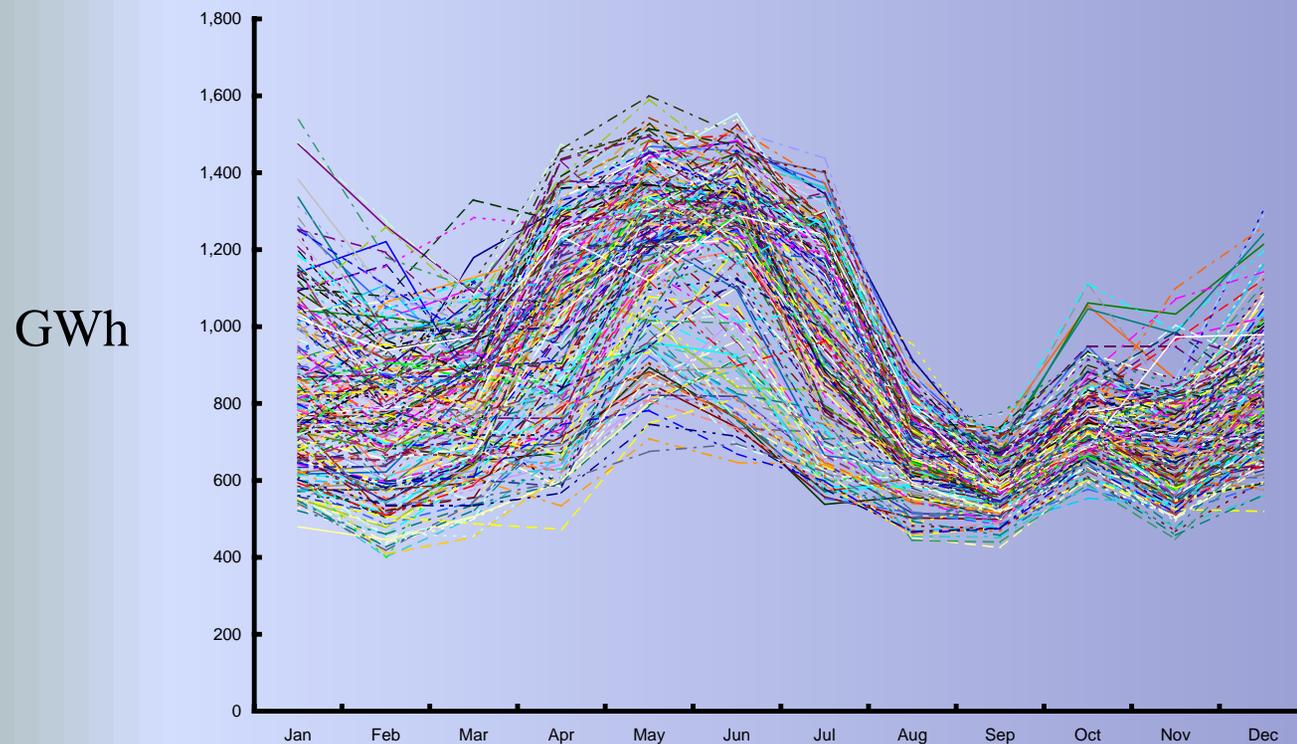
**Discussion**

All



# Analyzing Variability and Risk

## Simulating Hydro Generation





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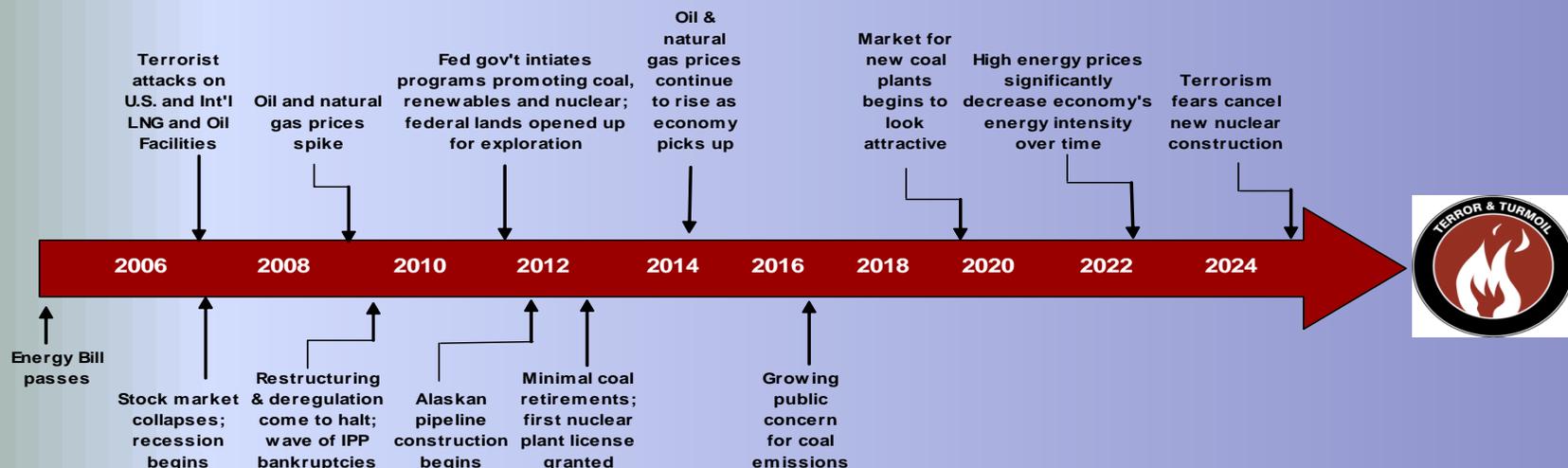
# Electric Power Horizons Scenarios

Global Energy Decisions



# Terrorism & Turmoil

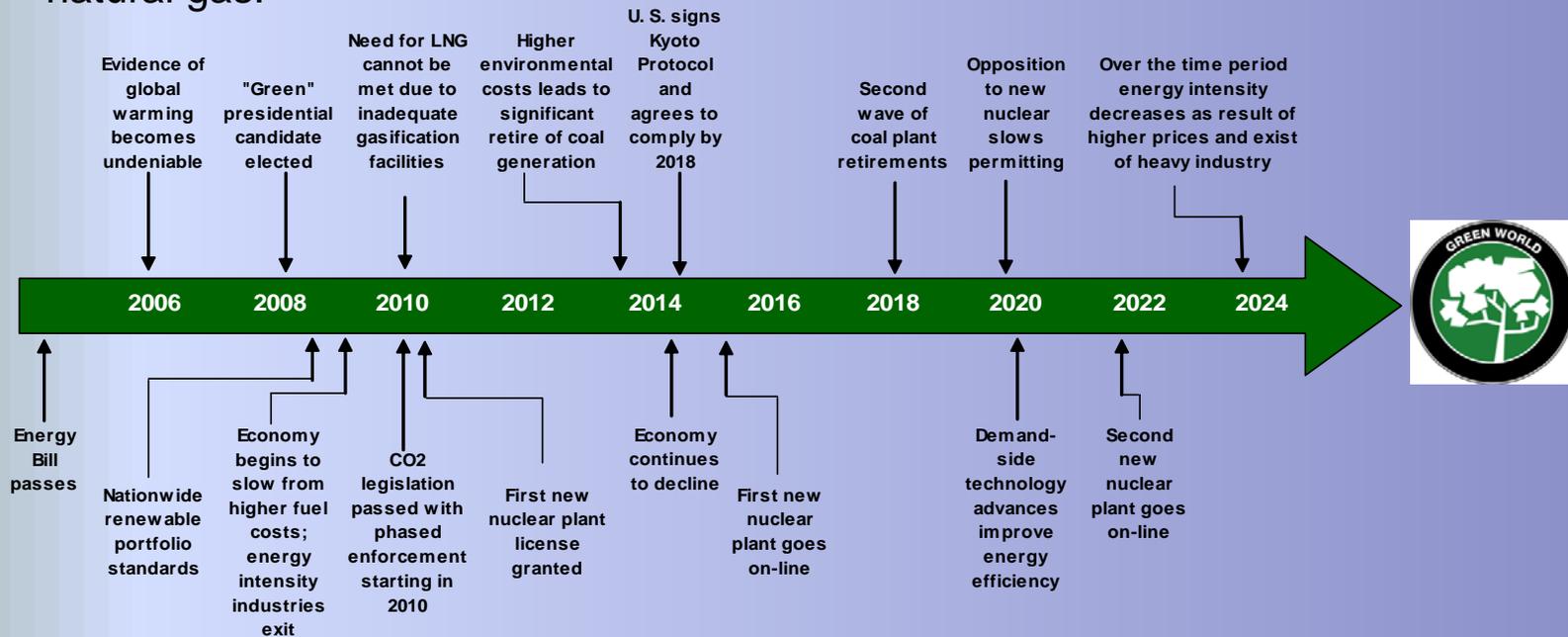
- Terrorist attacks constrain gas and oil imports and leads to global stagnation, and a U.S. recession, which is followed by sustained low economic growth where energy independence away from Middle East Oil and LNG imports is critical. Little competition or retirement of generation capacity, extended recovery from overbuild, and utilities gain vis-à-vis IPPs in a business environment where competition takes a backseat to energy independence.





# Green World

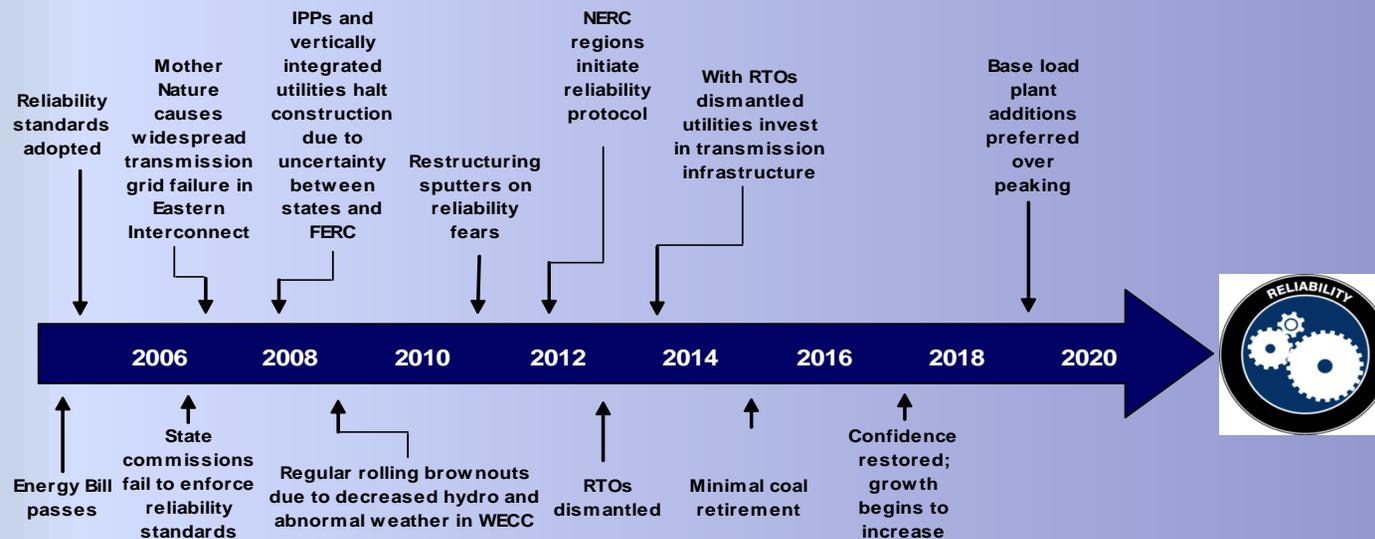
- Undeniable evidence of global warming leads to election of “green candidates,” passage of CO2 legislation, which is phased-in, and big push for renewable energy and energy efficiency. Some competition and retirement of inefficient and highly polluting plants, nuclear capacity added, but more emphasis placed on natural gas.





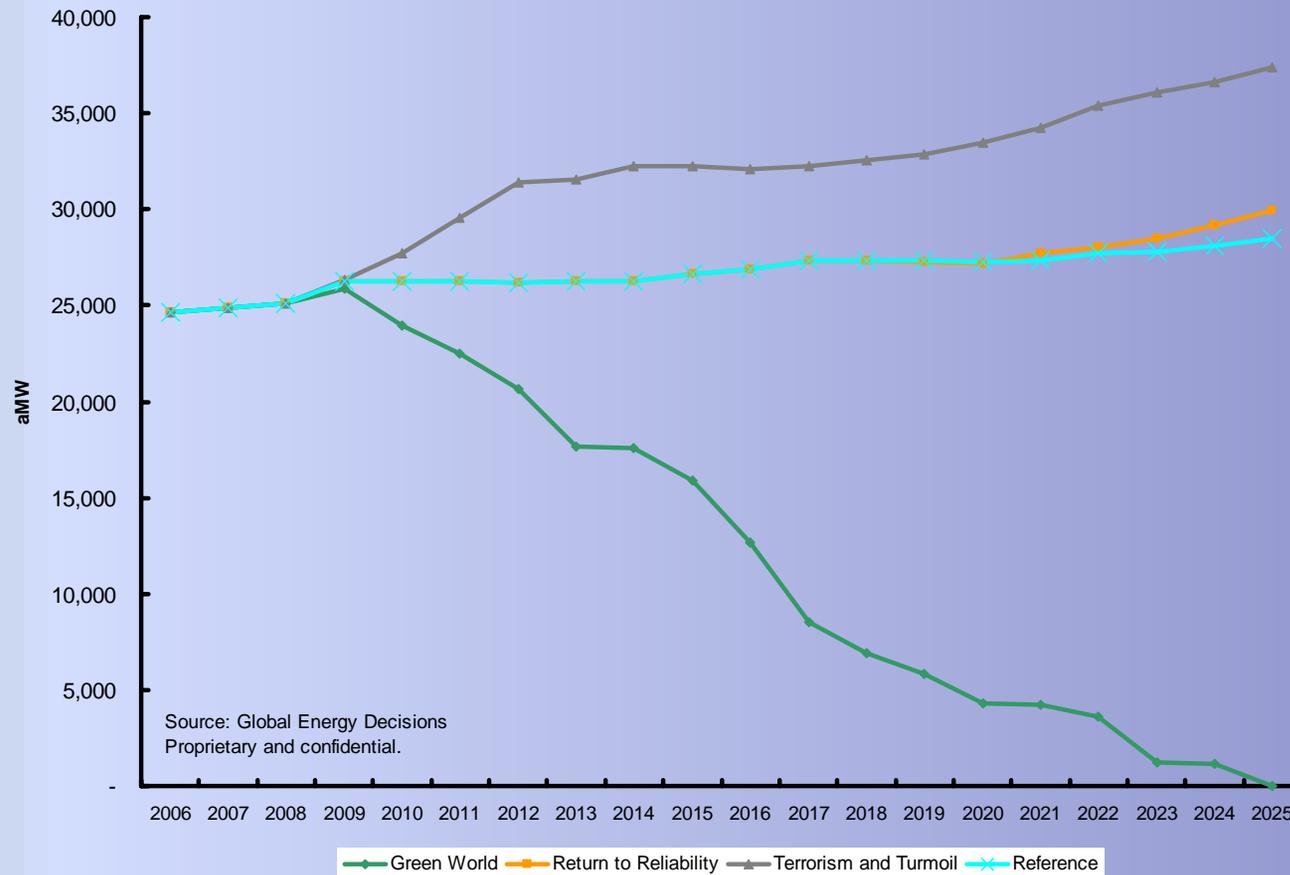
# Return to Reliability

- Natural disasters create transmission gridlocks that spread through the interconnect system. Brownouts affect the WECC region creating concerns about transmission and resource reliability. To address concerns, reliability protocols are created increasing reserve margins for regions. Utilities and RTO's are incented to build additional transmission lines to meet demand.





# US Coal-Fired Generation



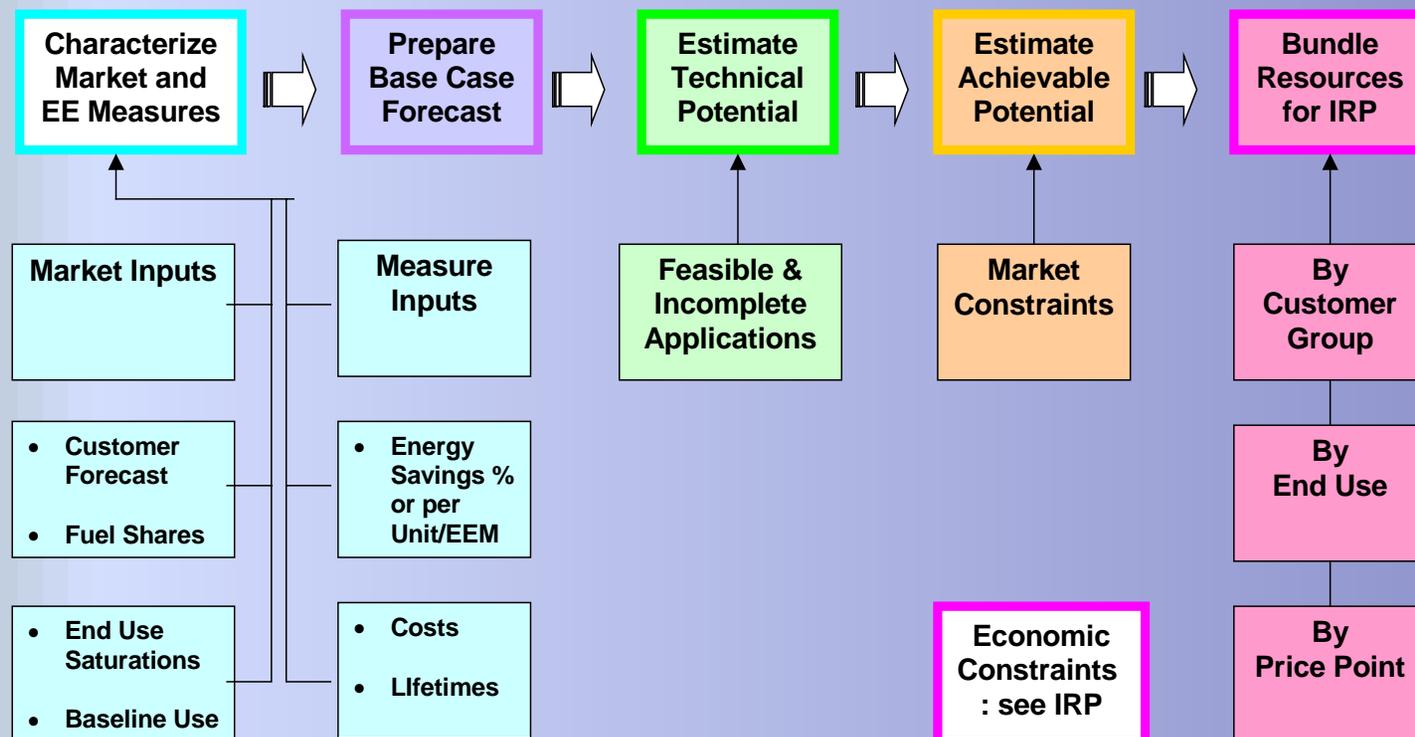


**Conservation Resource: Potential Assessment Process**

**CP  
A**



## Conservation Resource: Analytical Framework Illustration



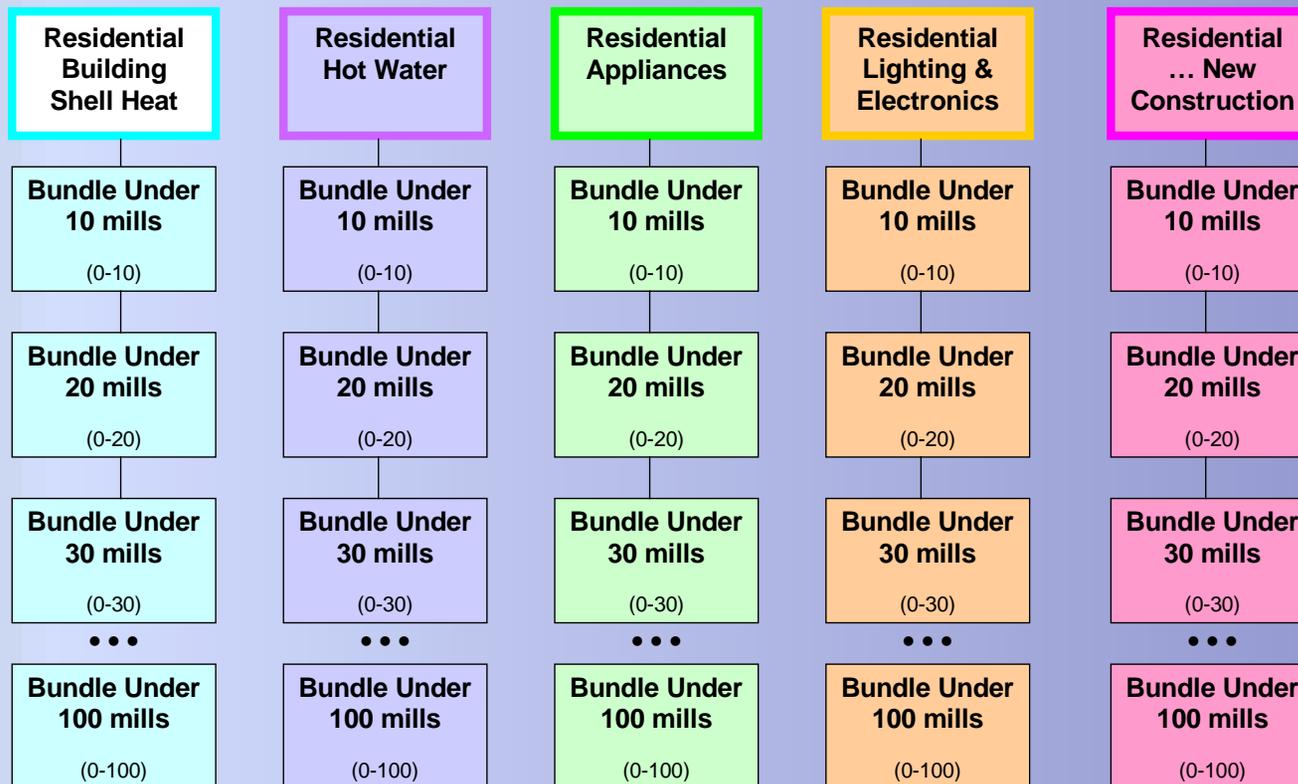


## Conservation Resource: Technical Potential Illustration

Total Housing Units in Building Stock 350,000	With End Use Saturation: e.g. Central Heating	With Source Fuel Share: e.g. Electricity	With Feasible Application of E.E.Measure E-Star Windows	With Incomplete Penetration of E.E.Measure	Energy Savings per Measure: Energy Star+ Windows	<b>Sum = 10,755 MWh 1.292 aMW</b>
↓	✗	✗	✗	✗	✗	↑
Single-Family Subsector <b>165,000</b>	Central Heat System <b>X 86.0%</b>	Electric Heat Fuel <b>X 8.1%</b>	Inefficient Windows <b>X 75.0%</b>	Energy Star Windows EEM <b>X 85.0%</b>	KWh Window Savings <b>X 7,060 X 16.9%</b>	MWh Savings Potential <b>= 8,743</b>
Multiplex (2-4) Subsector <b>18,000</b>	Central Heat System <b>X 40.0%</b>	Electric Heat Fuel <b>X 16.7%</b>	Inefficient Windows <b>X 75.0%</b>	Energy Star Windows EEM <b>X 95.1%</b>	KWh Window Savings <b>X 2,445 X 26.8%</b>	MWh Savings Potential <b>= 562</b>
Multifamily (5+) Subsector <b>168,000</b>	Central Heat System <b>X 12.3%</b>	Electric Heat Fuel <b>X 45.3%</b>	Inefficient Windows <b>X 75.0%</b>	Energy Star Windows EEM <b>X 39.3%</b>	KWh Window Savings <b>X 1,962 X 26.8%</b>	MWh Savings Potential <b>= 1,451</b>



### Conservation Resource: End Use & Price Point Bundle Illustration





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# **New Generating Resources Assumptions & Costs**



# New Generating Resource Options

- Coal
  - Pulverized (500 MW) - Montana/Wyoming
  - Integrated gasification combined cycle (565 MW) - W. WA
- Natural Gas
  - Combined Cycle (500 MW) - W. WA
  - Simple Cycle (100 MW) - W. WA
- Wind
  - Montana/Wyoming (100 MW)
  - Northwest (100 MW)
- Geothermal
  - Binary (25 MW) - Northwest
  - Flash (25 MW) - Northwest
- Landfill Gas - Northwest
- Biomass
  - 15 MW - W. WA
  - 50 MW - Northwest



# Generation Graph \$/MWh





# Assumptions

- **General**
  - Capital Recovery Factor - Assumes Discount Rate 8% - applied to all resources
  - No environmental adders
  - Assumes new 500 kV transmission @ \$1.8m/mile, 2500 MW ATC for Montana coal, CCCT, wind.
  - Assumes new transmission for IGCC, geothermal & biomass, but cost does not exceed BPA's transmission rate, therefore uses BPA's transmission rate + 2% losses.
- **Pulverized Coal - 500 MW - Montana/Wyoming**
  - Uses Power River Basin Coal 2016 coal price
- **IGCC - 565 MW - W. WA**
  - Uses W. WA Coal 2016 coal price



## Assumptions (cont'd)

- **CCCT - 500 MW - W. WA**
  - Uses 2016 Sumas gas
- **SCCT - 100 MW - W. WA**
  - Uses 2016 Sumas gas
  - Assumes 15% usage (capacity factor)
- **Wind - 100 MW - PNW & MT/WY**
  - NW Wind assumes 27% capacity factor
  - Montana/Wyoming wind assumes 38% capacity factor
  - All costs are fixed
  - 0 fuel cost
- **Geothermal and Landfill Gas**
  - Shows all O&M costs as variable O&M
  - Fuel included in capital cost



## Assumptions (*continued*)

- Biomass - 15 MW - W. WA
  - assumes 100% O&M is fixed
  - assumes fuel free
- Biomass - 50 MW - PNW
  - assumes 50% of fuel is purchased at \$15/ton
  - assumes 50 mi transportation
  - assumes transportation at \$0.30/mi/ton



## Fixed & Variable Costs

Description	Capital Cost \$/kW-yr	Fixed O&M \$/kW-yr	Fuel \$/MWh	Variable O&M \$/MWh
Coal, Pulverized (500 MW)	\$1,450	\$30	\$6.28	\$2.50
Coal, IGCC (565 MW)	\$1,600	\$35	\$15.88	\$2.50
Coal, IGCC Carbon Ready	\$2,100	\$47.50	\$15.88	\$3.00
Natural Gas Combined Cycle	\$613	\$10.00	\$31.97	\$2.85
Natural Gas, Simple Cycle	\$500	\$12.00	\$43.02	\$6.00
Wind (Northwest)	\$1,350	\$25.00		
Wind (Montana/Wyoming)	\$1,350	\$25.00		
Geothermal, binary	\$2,000			\$24
Geothermal, flash	\$2,075			\$21.50
Landfill Gas	\$1,045			\$18
Biomass (15 MW)	\$2,476	\$219.00		
Biomass (50 MW)	\$2,127	\$80.00	\$19.69	\$27.34



## Costs \$/MWh

Description	Capacity Factor	Resources \$/MWh	Transmission \$/MWh	Total \$/MWh
Coal, Pulverized (500 MW)	87%	\$28.00	\$11.13	\$39.12
Coal, IGCC (565 MW)	86%	\$40.08	\$1.93	\$41.98
Coal, IGCC Carbon Ready	86%	\$47.57	\$1.93	\$49.47
Natural Gas, Combined Cycle	80%	\$43.47	\$2.09	\$45.55
Natural Gas, Simple Cycle	15%	\$92.45	\$10.90	\$103.36
Wind (Northwest)	27%	\$62.02	\$7.58	\$69.60
Wind (Montana/Wyoming)	38%	\$44.07	\$25.58	\$69.64
Geothermal, binary	93%	\$44.27	\$1.79	\$46.06
Geothermal, flash	93%	\$42.53	\$1.79	\$44.32
Landfill Gas	90%	\$29.33	\$1.85	\$31.18
Biomass (15 MW)	90%	\$54.62	\$1.85	\$56.48
Biomass (50 MW)	90%	\$99.93	\$1.85	\$101.78



## Questions?

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