



2008 Integrated Resource Plan  
Round 1

*IRP Stakeholders  
April 10, 2008*



# The 2006 IRP

IRP Stakeholders

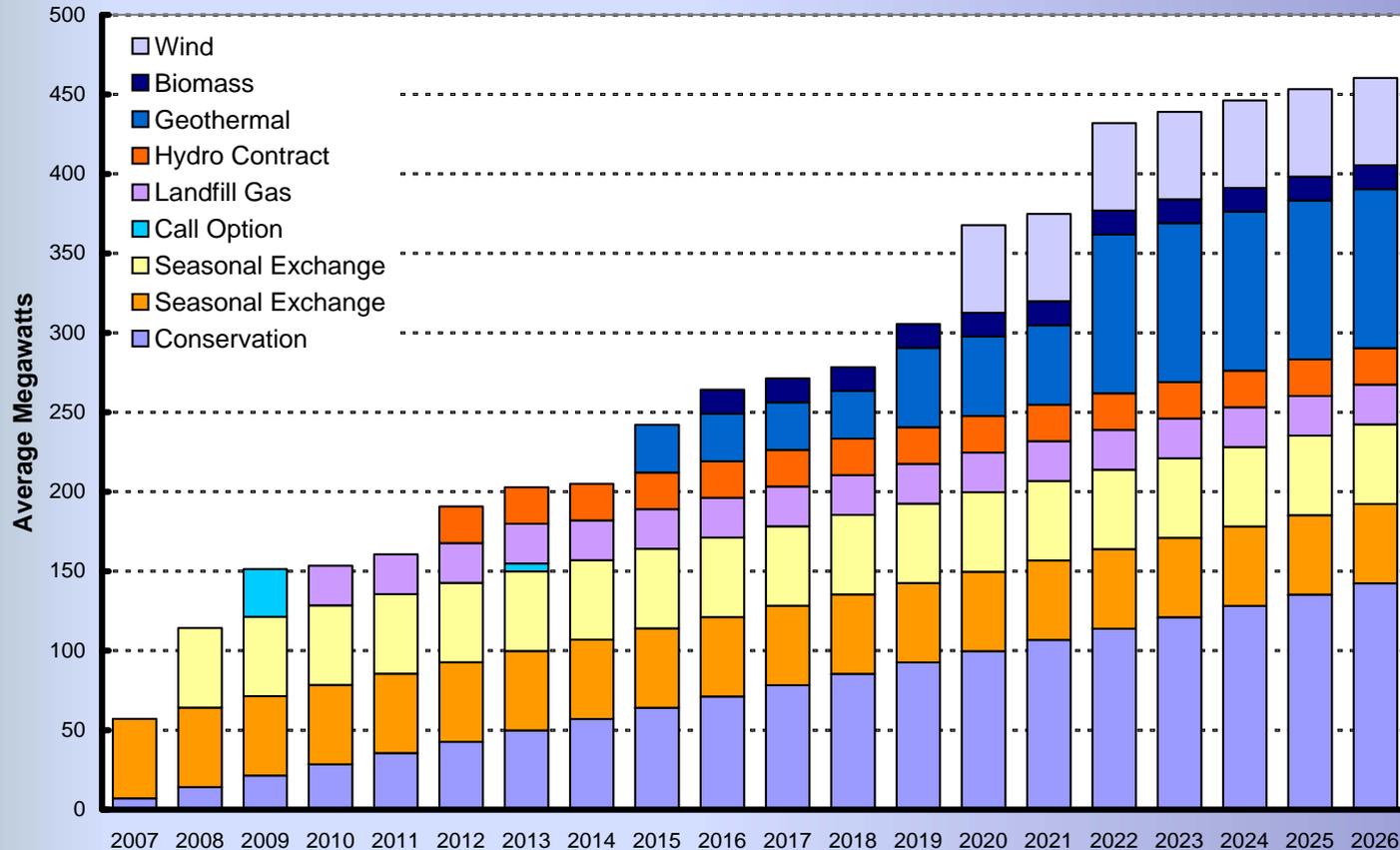


# Agenda

- Introductions 4:00 PM
- 2006 IRP 4:15 PM
- Round 1 Portfolios 4:30 PM
- Break 5:00 PM
- Round 1 Results 5:15 PM
- Overview of Special Studies 5:45 PM
- Adjourn 6:15 PM



# 2006 IRP Preferred Portfolio (Best Performing I-937 Compliant)





# Conservation and Renewables

## Lawrence Berkeley Lab Compares 15 IRPs

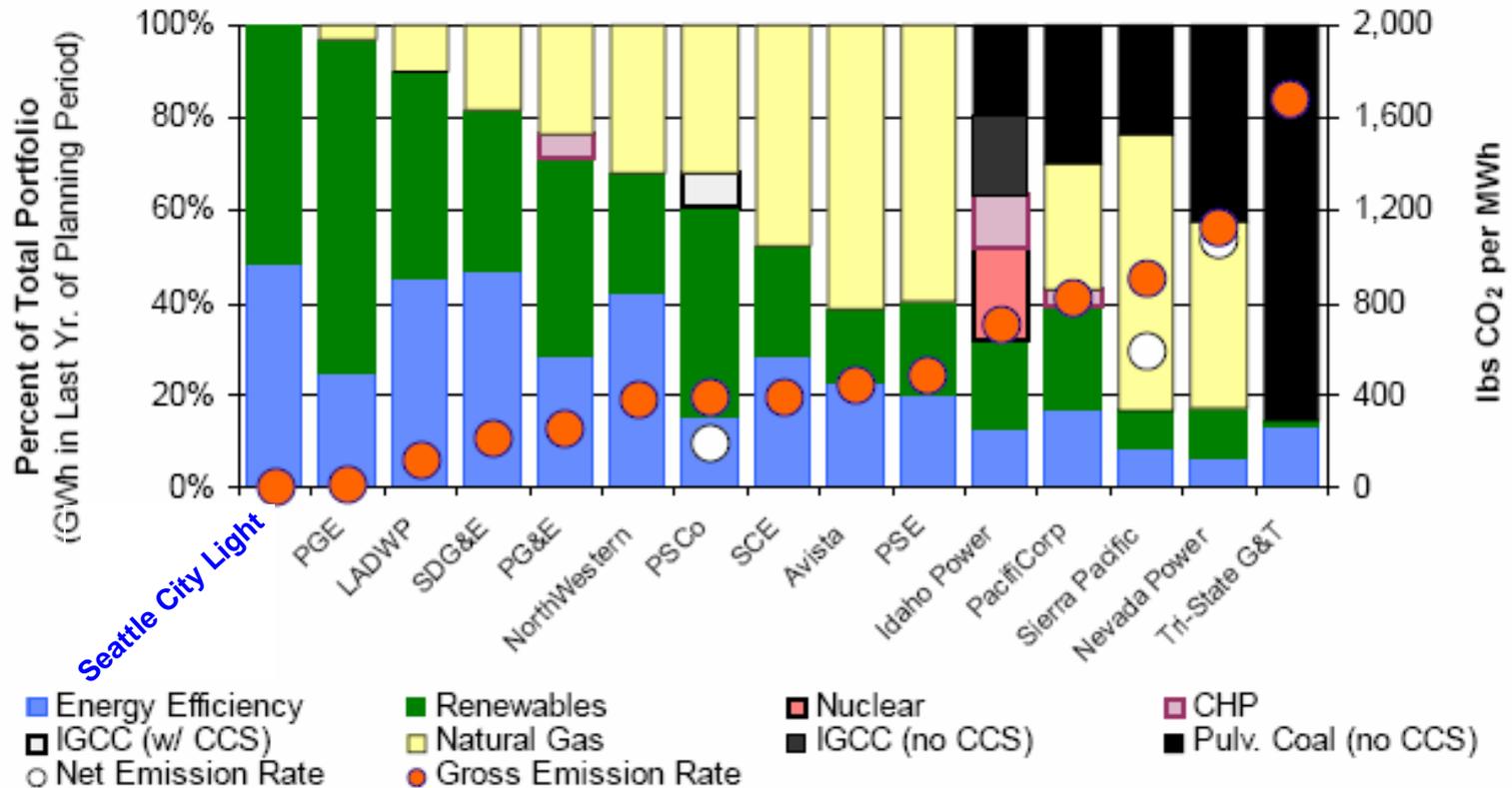


Figure ES - 3. New Resources in Utilities' Preferred Portfolios



# 2-Year Action Plan Summary

## 2006 IRP

- Study the costs and benefits of accelerating conservation
- Work to ensure reliable transmission capacity for City Light
- Pursue City Council approval for seasonal capacity contracts
- Pursue summer for winter exchanges as needed
- Pursue landfill gas opportunities in 2007-2008
- Investigate geothermal resources, distributed generation, and new renewable technologies
- Further investigate the impacts of climate change
- Investigate renewable energy credits for I-937 compliance
- Study cost-effectiveness of hydro efficiency projects
- Investigate costs and benefits of a hydro contract
- Begin 2008 IRP in 2007



# **The 2008 IRP**

**IRP Stakeholders**



# Aurora Model

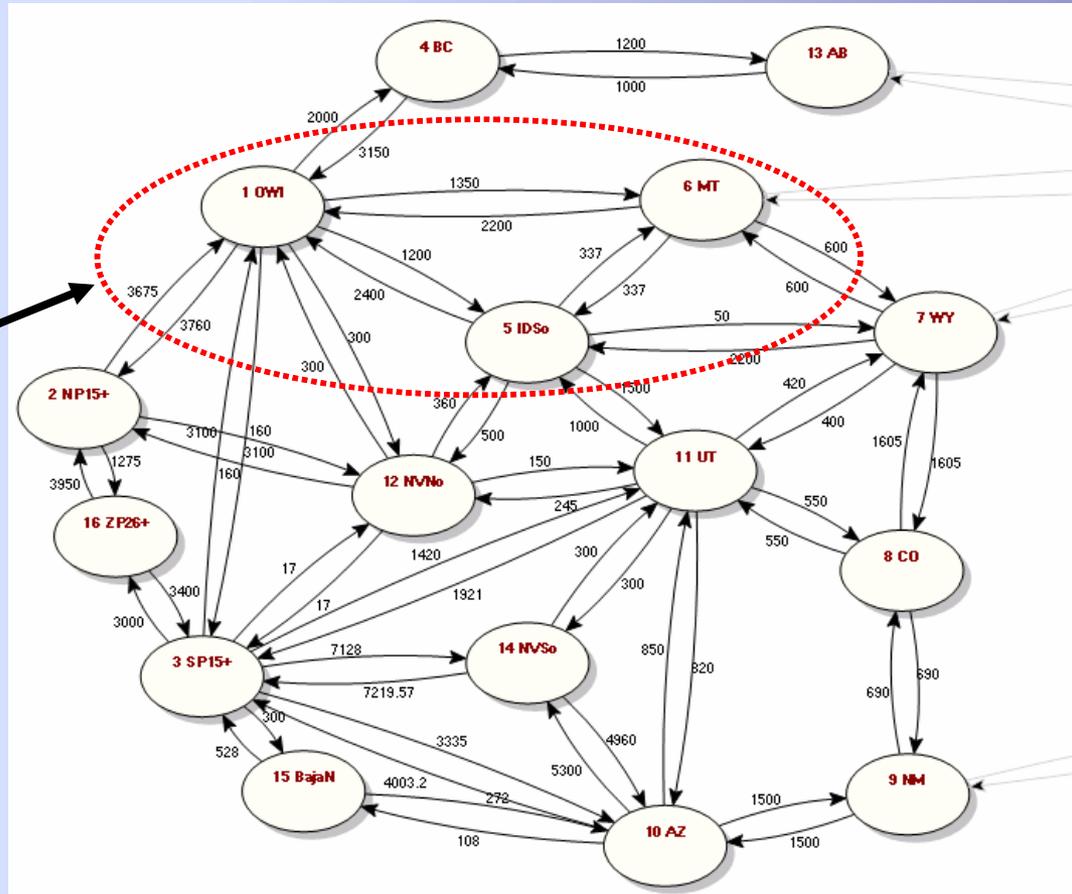


- Forecast of Hourly Prices by Zones and Hubs
  - Hourly to any user-defined aggregation period.
- Resource Operation
  - Reporting on all aspects of resource use (costs, emissions, output)
  - Zone resource stacks
- Resource Value
  - Costs and revenues for both existing and new projects
- Portfolio Value
  - Net costs (long or short) over any time period
- Fuel Usage
- Transmission Use / Congestion
- Risk Analysis (Monte Carlo-like approach)



# Aurora Model Topology for the West

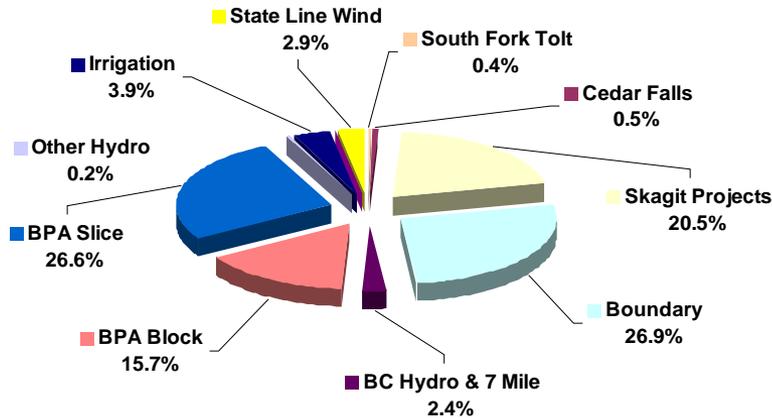
SCL Further Disaggregated the Pacific Northwest into Nine Market Areas to Improve Accuracy in the Depiction of Transmission





# Seattle's 2007 Resources: "Net Zero" Carbon Emissions

2007 Sources of Power



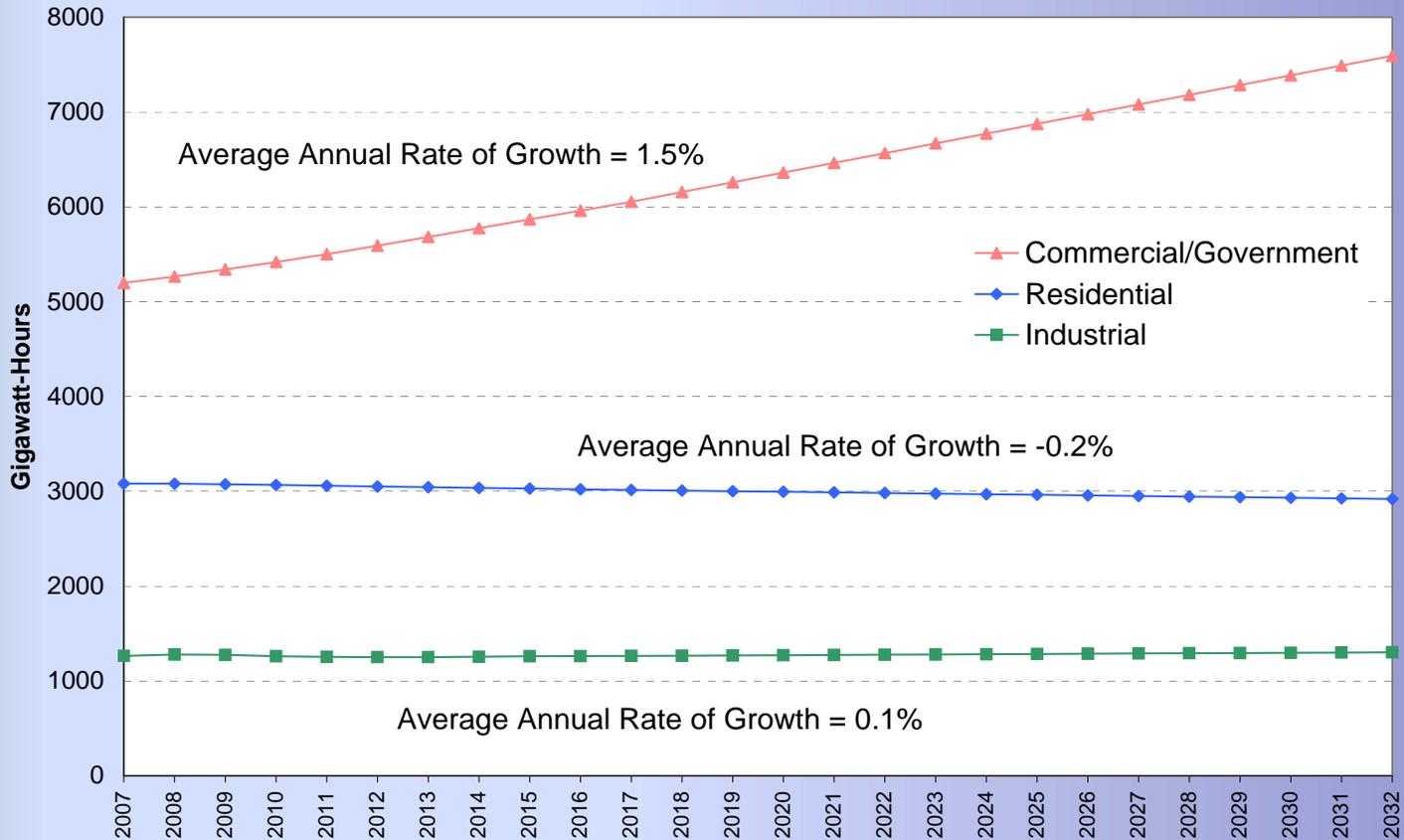
<i>Generation Type</i>	<i>Percentage</i>
Hydro	89.8%
Nuclear*	4.6%
Wind	3.5%
Natural Gas*	1.1%
Coal*	0.9%
Other*	0.1%

\*From BPA Contract and Market Purchases. These and other operations-related GHG emissions are offset.



# Forecast by Customer Class

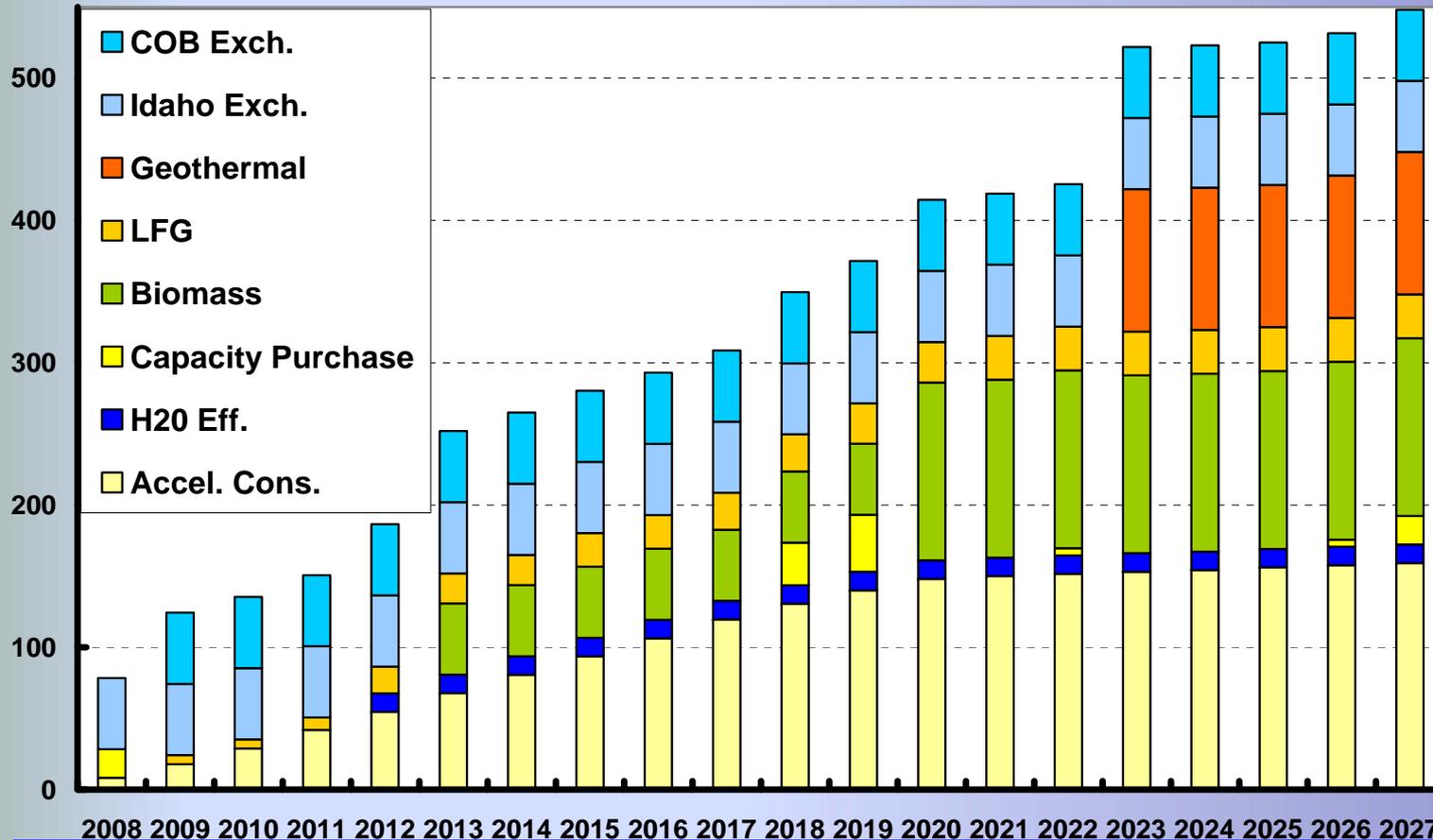
2007 Load Forecast by Customer Class





# Hi-Landfill Gas and Biomass Round 1 Portfolio

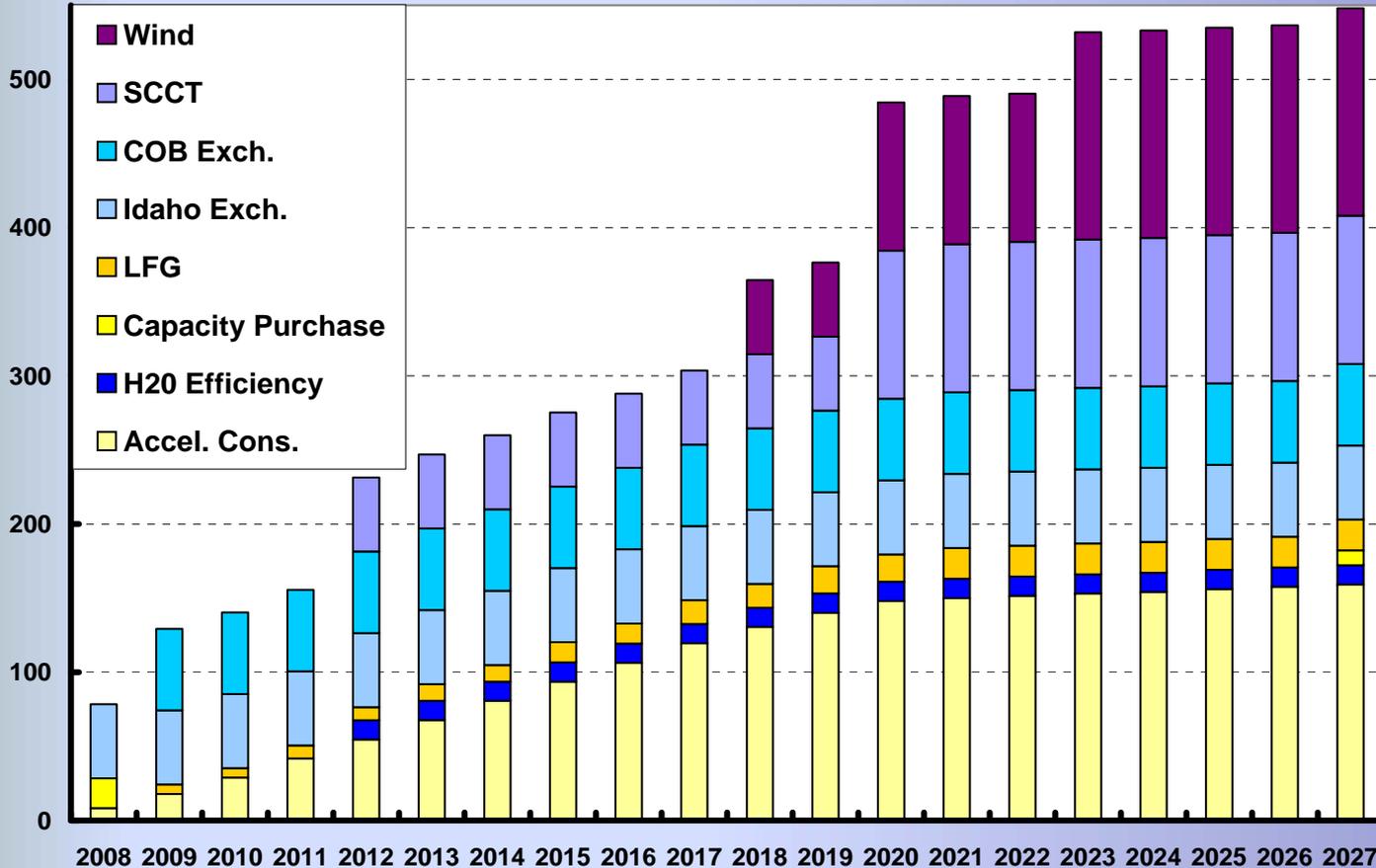
Meets Winter Energy Requirements for a 95% Confidence of No Unserved Energy Demand





# Hi-Wind Round 1 Portfolio

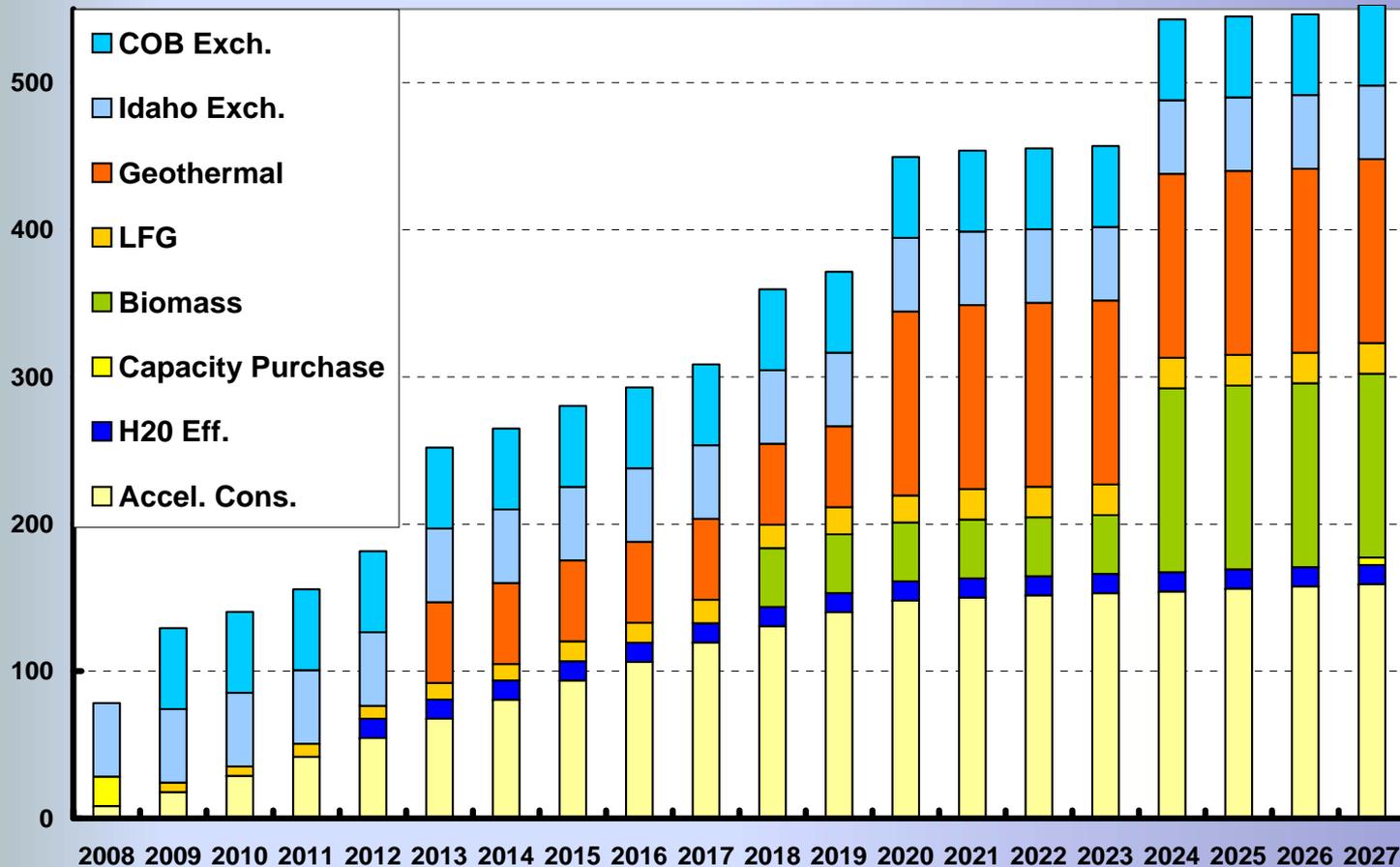
Meets Winter Energy Requirements for a 95% Confidence of No Unserved Energy Demand





# Hi-Geothermal Round 1 Portfolio

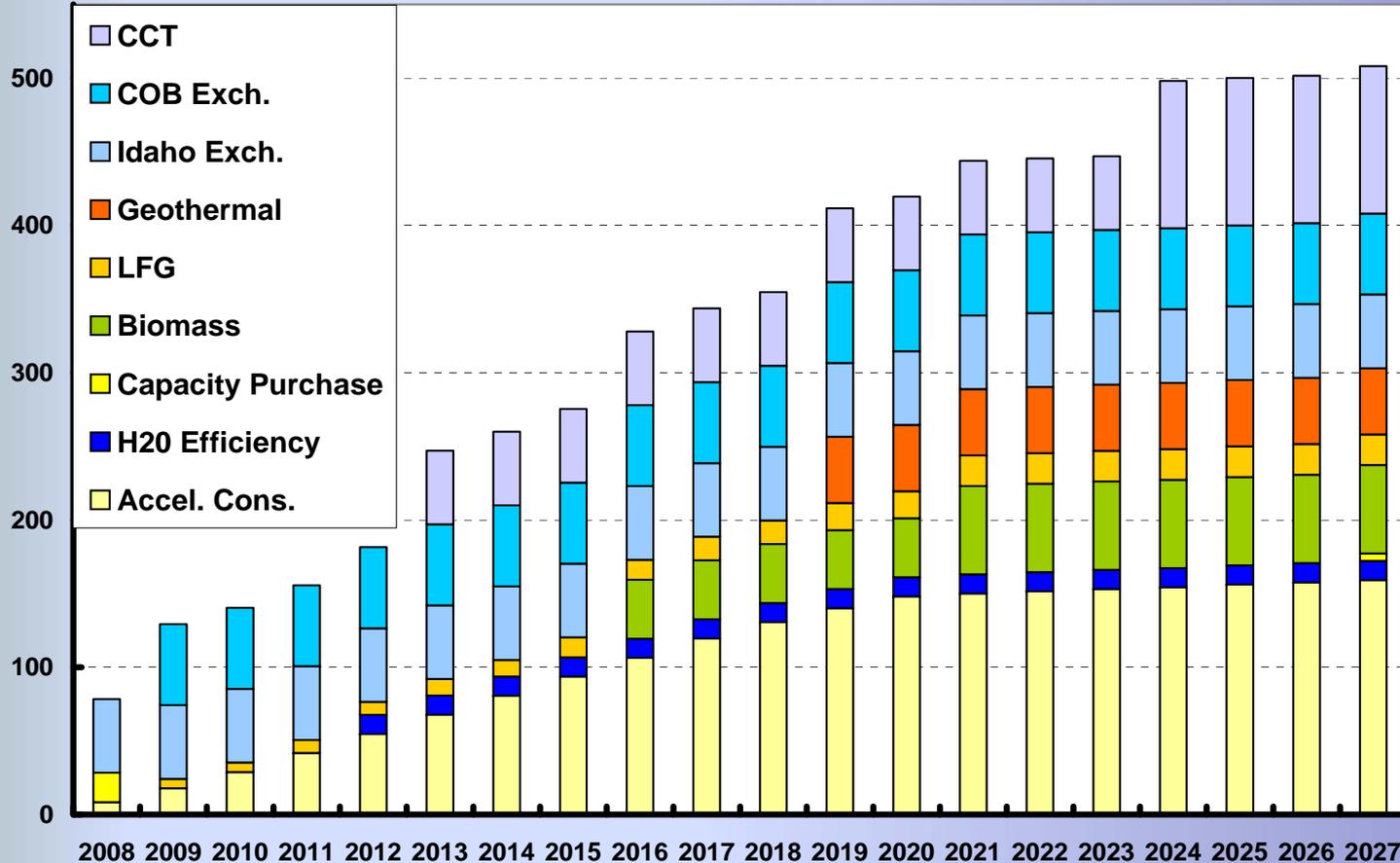
Meets Winter Energy Requirements for a 95% Confidence of No Unserved Energy Demand





# Hi-Combined Cycle Turbine (CCT) Round 1 Portfolio

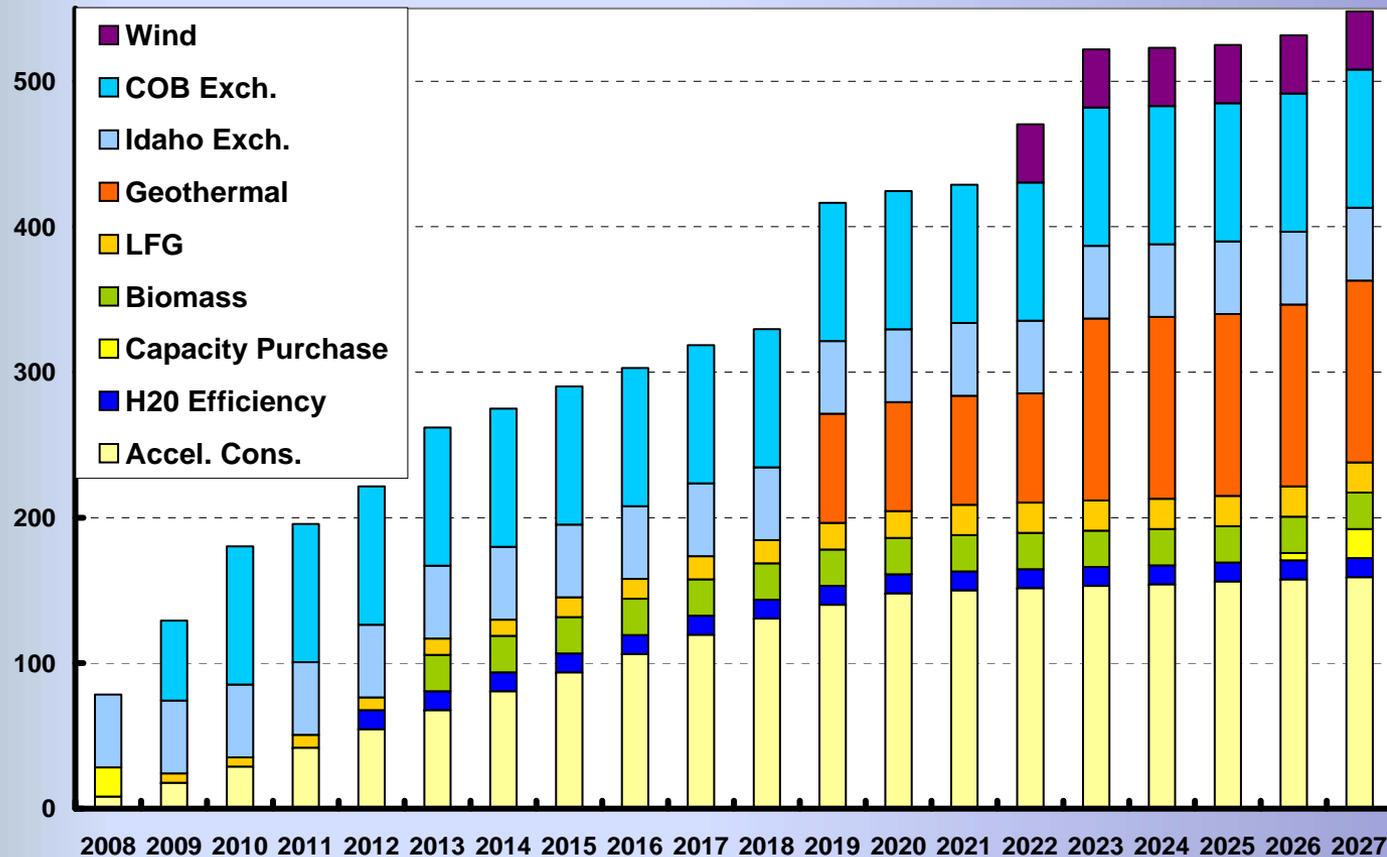
Meets Winter Energy Requirements for a 95% Confidence of No Unserved Energy Demand





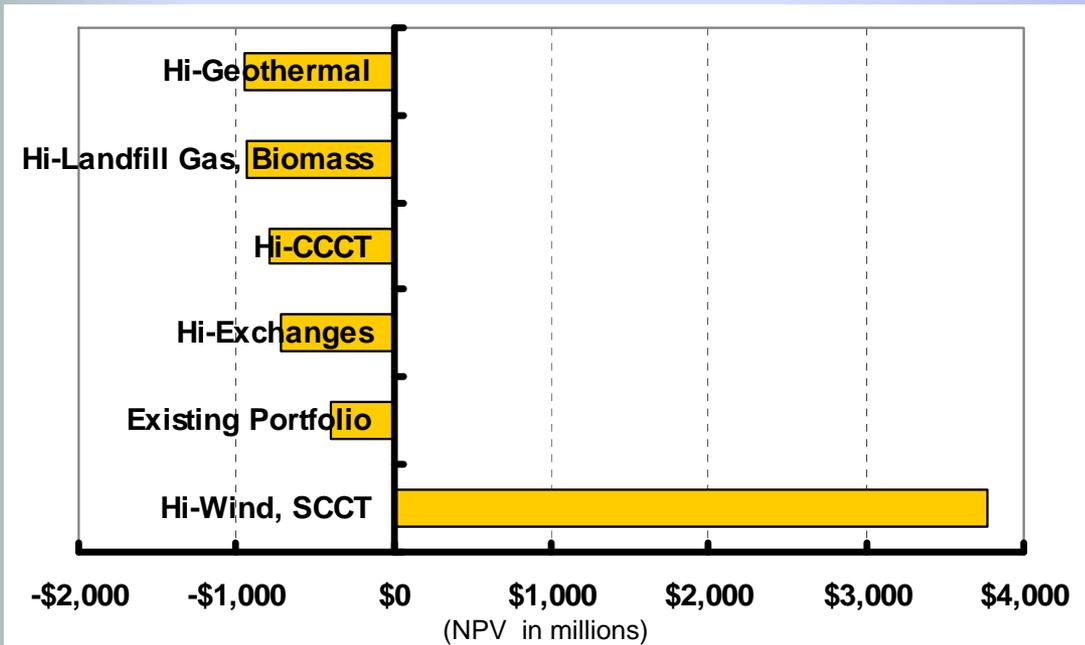
# Hi-Exchange Round 1 Portfolio

Meets Winter Energy Requirements for a 95% Confidence of No Unserved Energy Demand





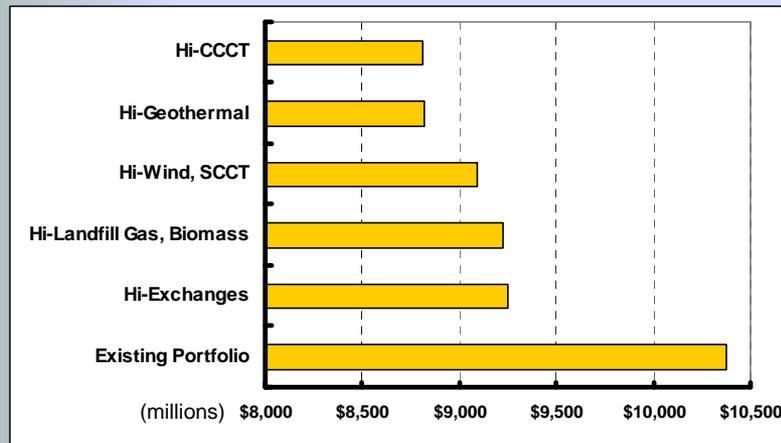
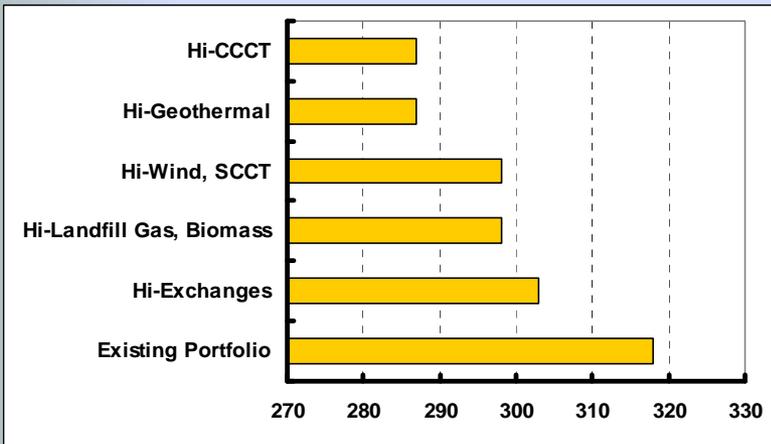
# Costs by Round 1 Portfolio



- **NPV of Power Costs**
  - Includes resource costs, contract purchases, contract sales, market purchases, market sales



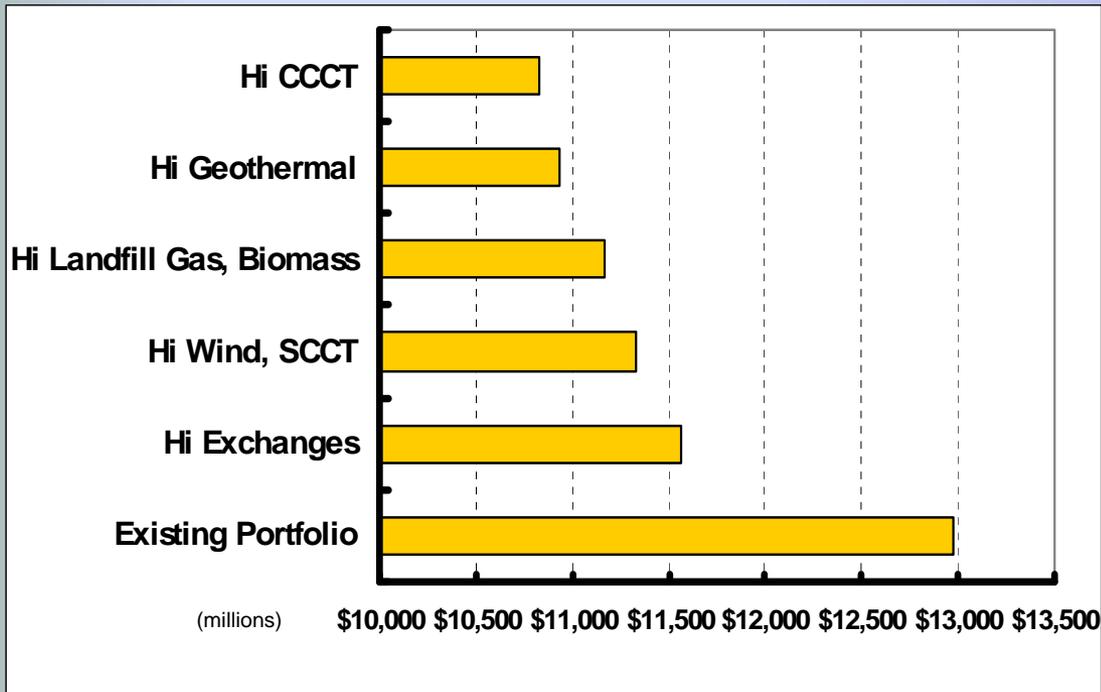
# Risk by Round 1 Portfolio



- Volume Risk
  - Implies substantial benefit from diversification
  - Volatility of net production of each portfolio
    - 20 yrs.
- Value at Risk
  - Cash flow-oriented
  - Studies maximum impacts on portfolio value from varying inputs



# Risk by Round 1 Portfolio

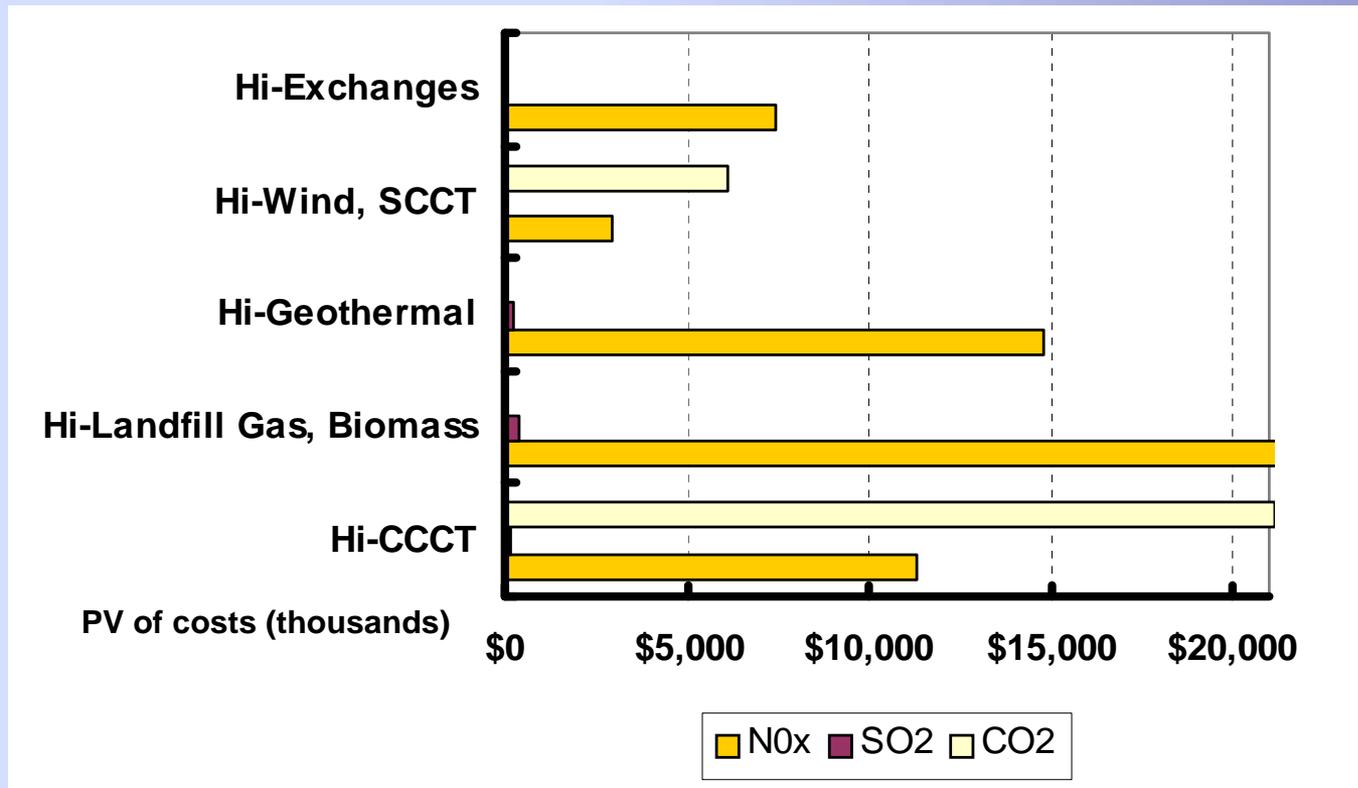


- Risk to NPV
  - Varies
    - Hydro
    - Demand
    - Fuel
  - 50 Water Years
    - 1929-1978



# Environmental Performance by Round 1 Portfolio

Does not yet reflect market purchases and sales





# Summary

## Rankings of Portfolios By Measure



\*Resources only, does not include market purchases

	<i>Cost NPV</i>	<i>NPV Risk</i>	<i>Volume Risk</i>	<i>Value at Risk</i>	<i>*Environment</i>
<b>Existing Portfolio: No Action</b>	●	●	●	●	○
<b>Hi-Landfill Gas, Biomass</b>	○	◐	◐	◐	●
<b>Hi-Geothermal</b>	○	○	○	○	◐
<b>Hi-Wind, SCCT</b>	●	◐	◐	◐	◐
<b>HI-CCCT</b>	◐	○	○	○	●
<b>Hi-Exchanges</b>	◐	●	●	●	○



## Summary of Findings

- Geothermal and landfill gas perform well using a broader range of risk metrics than in the 2006 IRP
- The range of the expected NPV (between the most costly and least costly portfolio) was 19% (~\$650 million NPV)
- The range between the most risky and least risky portfolio was over 300% for some risk measures
  - Risk should be given strong consideration during portfolio selection
- Diversification of resources brings measurable benefits for portfolio risk
- The high exchange (Hi-Ex) portfolio did not perform as well as expected



## Questions Raised by Round 1

- What other resource combinations could reduce costs and/or risk?
- Is natural gas price risk addressed adequately?
- Are we missing important cost or risk measures?
  - If we could measure commercialized technology risk, how important should it be to portfolio selection?
  - If we could measure supply risk by type of renewable resource, how important should it be to portfolio selection?



## Special Topics for 2008 IRP in Round 2

- **Climate Change Impacts**
  - Uses assumptions from the U.W. Climate Impacts Group
- **Growth in Hybrid Electric Vehicles**
  - Uses assumptions from the Electric Power Research Institute
- **High Natural Gas Prices**
  - Uses Ventyx (GED/Henwood) high natural gas price forecast
- **High Renewable Energy Prices**
  - Updates to today's prices and then assumes REC values grow faster than production costs



## Special Topics for the 2008 IRP in Round 2

- High Demand Growth
  - Assumes demand growth comparable to fastest historical growth period in the Seattle area
- Recession
  - Assumes a strong recession, comparable to the worst in the history of the Seattle area
- Demand Response
  - Investigative study of which of many types of demand response hold highest potential
- Distributed Generation
  - Assess 12 large customers for DG potential



## Special Topics: Plug-In Electric Vehicles

- Emissions, oil independence, off-peak power
- Not yet commercially available
- More expensive than gasoline-fueled vehicles
- Limited range, inferior performance

Assumptions, from 2007 study by EPRI/NRDC:

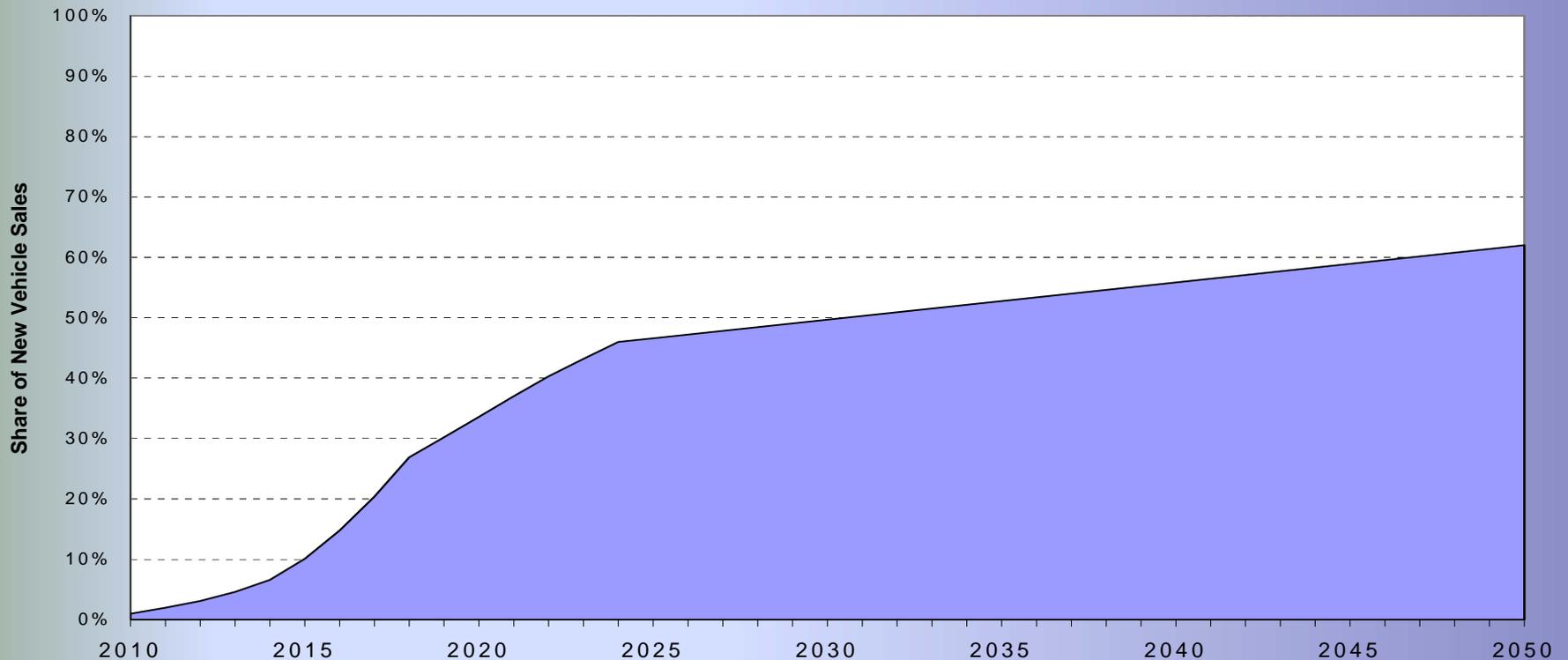
- Commercially available in 2010
- 62% of all new vehicle sales by 2050; 100% replacement
- PHEVs with range of 40 miles (EPRI incl 20s & 30s)
- 61% of charging occurs off-peak, with incentive
- 280,400 new vehicles in WA each year



# Special Topics: Plug-In Electric Vehicles

**New Vehicle Market Share for Plug-In Hybrids**

■ EPRI/NRDC 62% by 2050

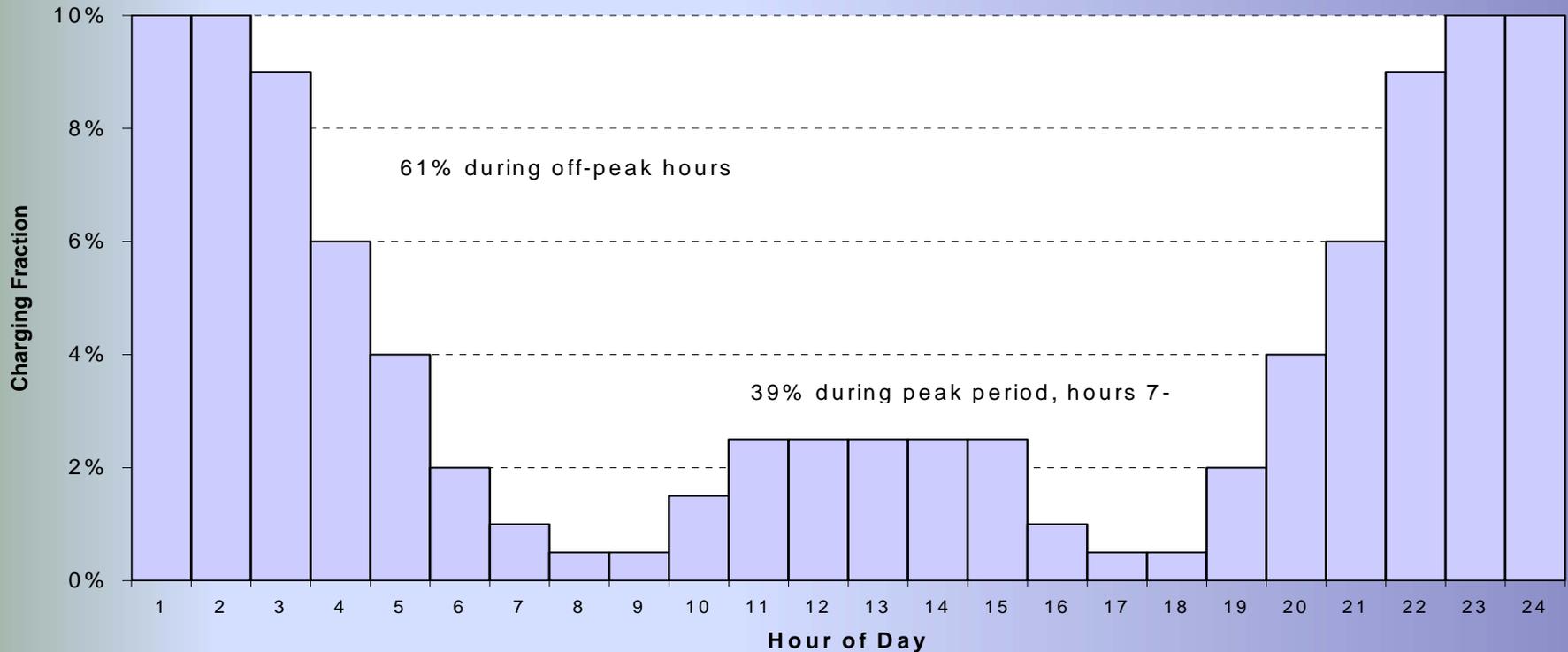




# Special Topics: Plug-In Electric Vehicles

**PHEV Charge Profile**  
(Assumes an incentive for charging off-peak)

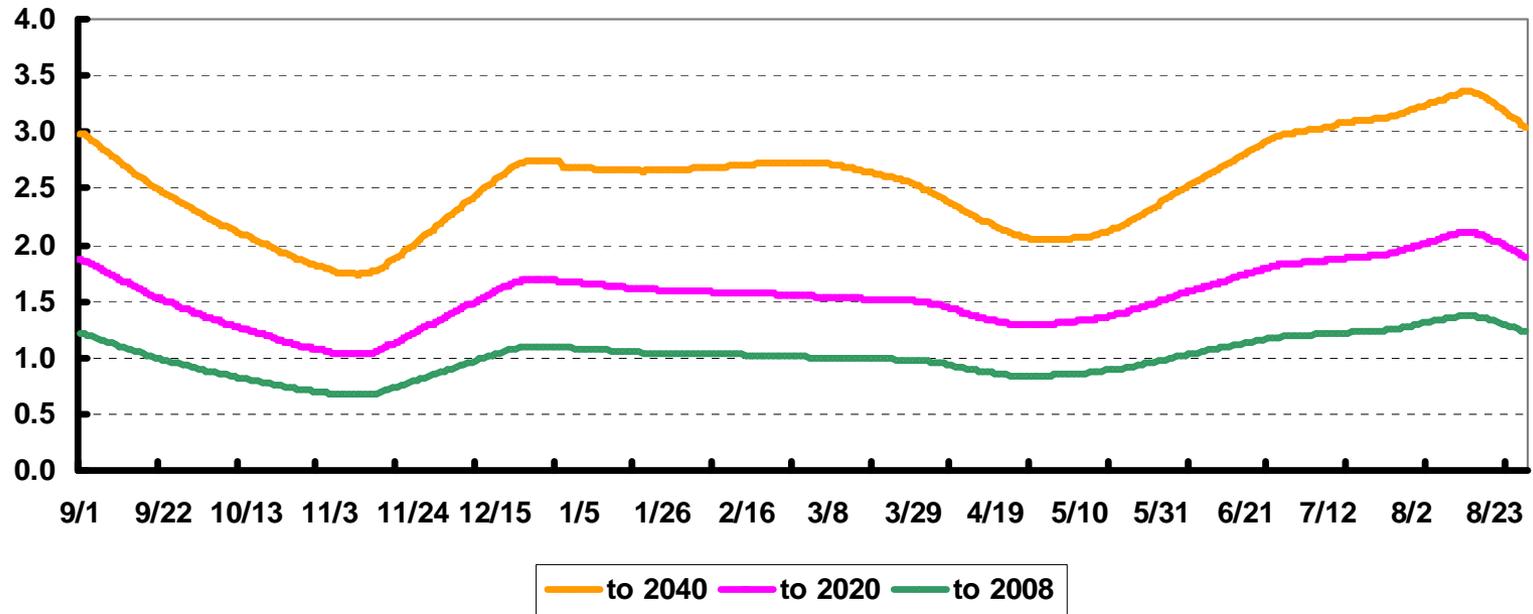
□ EPRI/NRDC





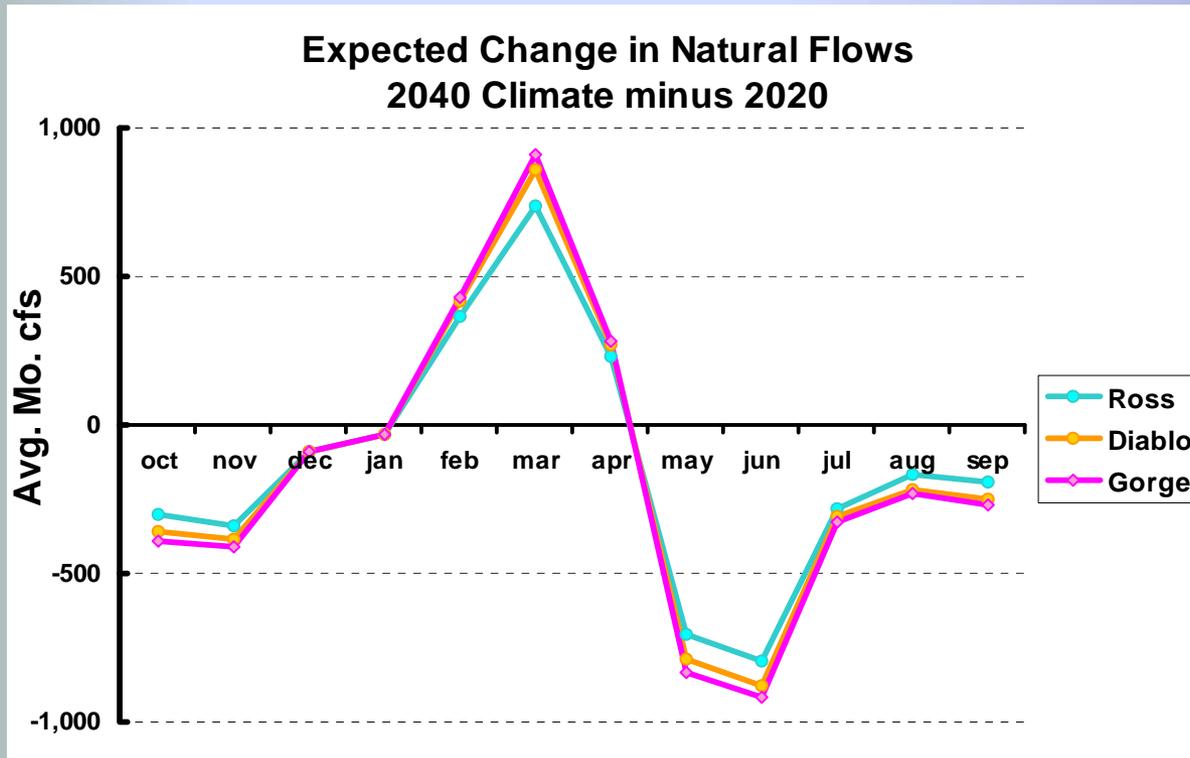
# Climate Change Impacts U.W. Temperature Outlook

## Daily Change from Normal (Degrees F)





# Estimating Climate Change Impacts Ross, Diablo, and Gorge



- Earlier snow melt shifts flows from spring/summer to winter/early spring
- March and June flows impacted the most



# Estimating Climate Change Impacts Boundary

Climate Change and Boundary Generation  
(aMW)

