2006 Integrated Resource Plan: Key Assumptions

IRP Stakeholders Group
February 2, 2006

Seattle City Light

Agenda

Introduction and Overview	David Clement
Futures and Forecasts	David Clement/Tony Kilduff
New Generating Resources	Marilynn Semro
Conservation	Steve Lush
Resource Adequacy	Charlie Black
Environmental Assumptions	Corinne Grande

IRP Team Leaders not Presenting Today:
Don Tinker, Cam LeHouillier, Mary Winslow

Objectives for the Integrated Resource Plan

- Prepare a plan that analyzes all viable supply and demand-side resource alternatives, leading to the selection of a portfolio that meets customer load reliably, cost effectively, while managing risk and meeting environmental goals
- Redevelop SCL's capabilities for resource planning
- Conduct an open process to incorporate stakeholder input

Update

- Since the Last Meeting:
  - Installed the "Planning and Risk" model, along with three computers for parallel processing
  - Configured the model for Seattle City Light resources
  - Established hydro probability distributions by plant
  - Gathered information on resource and environmental costs
  - Established base assumptions (today's topic)
  - Working on plan for structuring and evaluating portfolios

2006 Project Timeline

Input and Review

Policy, Stakeholder, Advisory, and Public Meetings on Assumptions

Policy, Stakeholder, Advisory, Public & Council Meetings on First Round Portfolios

Policy, Stakeholder, Advisory, Public, & Council Meetings on Second Round Portfolios

Policy, Advisory,Council Review of Draft Report

Public, External Review of Draft Report

Jan. Feb. Mar. Apr. May Jun. Jul. Aug. Sep.

Assumptions/ Analytical Framework Complete

Create and Model First Round Portfolios

Revise First Round Portfolios Model Second Round Portfolios

Revise Second Round Portfolios Model Revised Portfolios

Environmental Impact Statement Review Period Complete

Revise Draft Report

Final Report to Printer

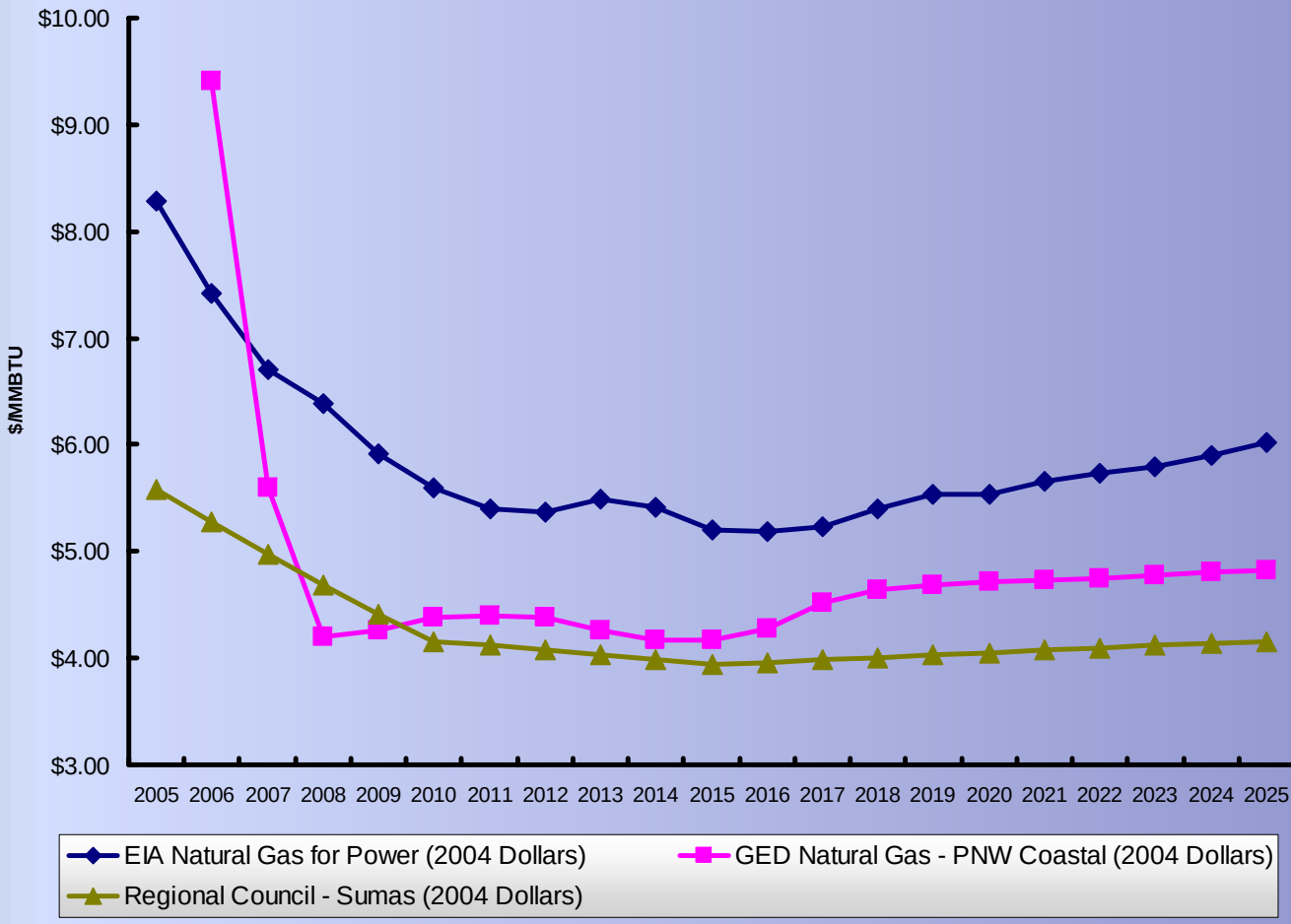
IRP Team Tasks

Going Forward

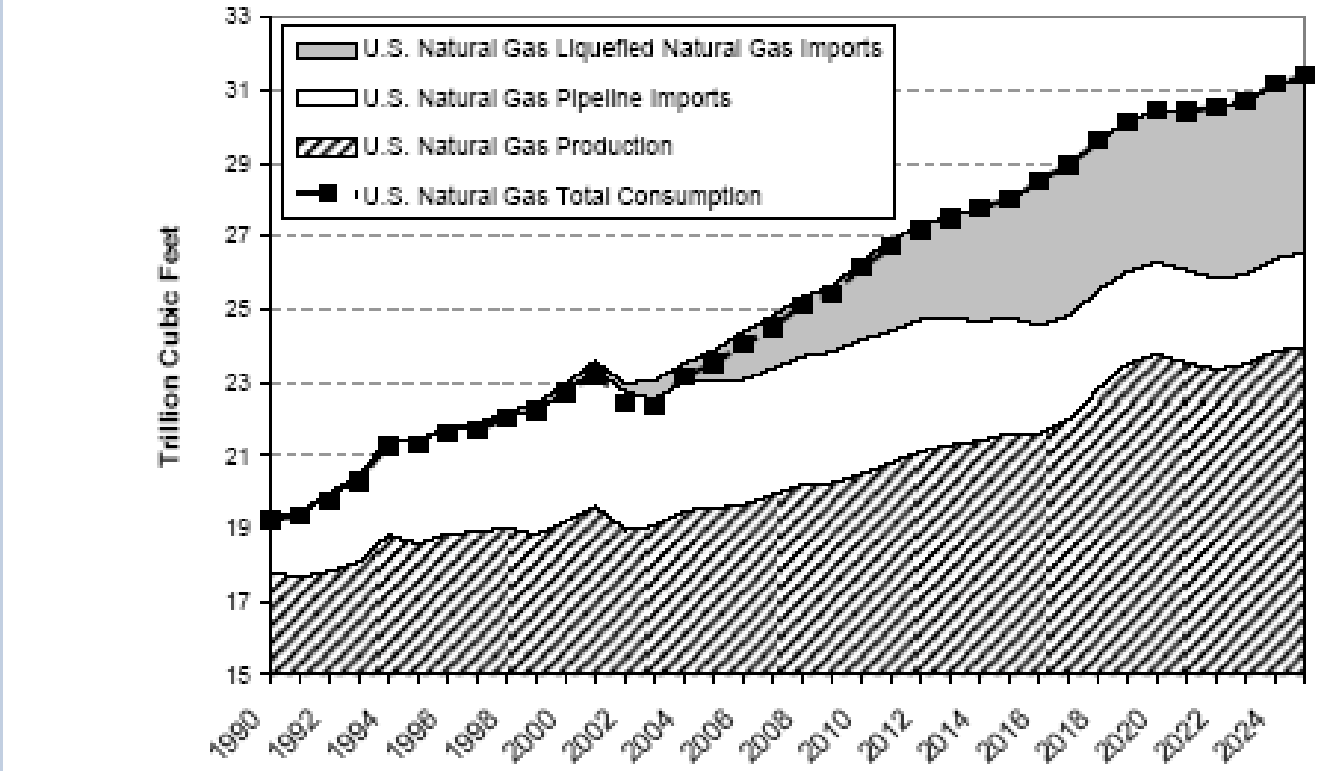
- In the Future
  - Two rounds of analysis with your input and the input of other committees and the public
    - First round portfolios
    - Second round (final draft) portfolios
- Today's Objective
  - Discuss the assumptions and obtain feedback on the assumptions

Forecasts and Futures

Natural Gas Price Outlook Influences Portfolios

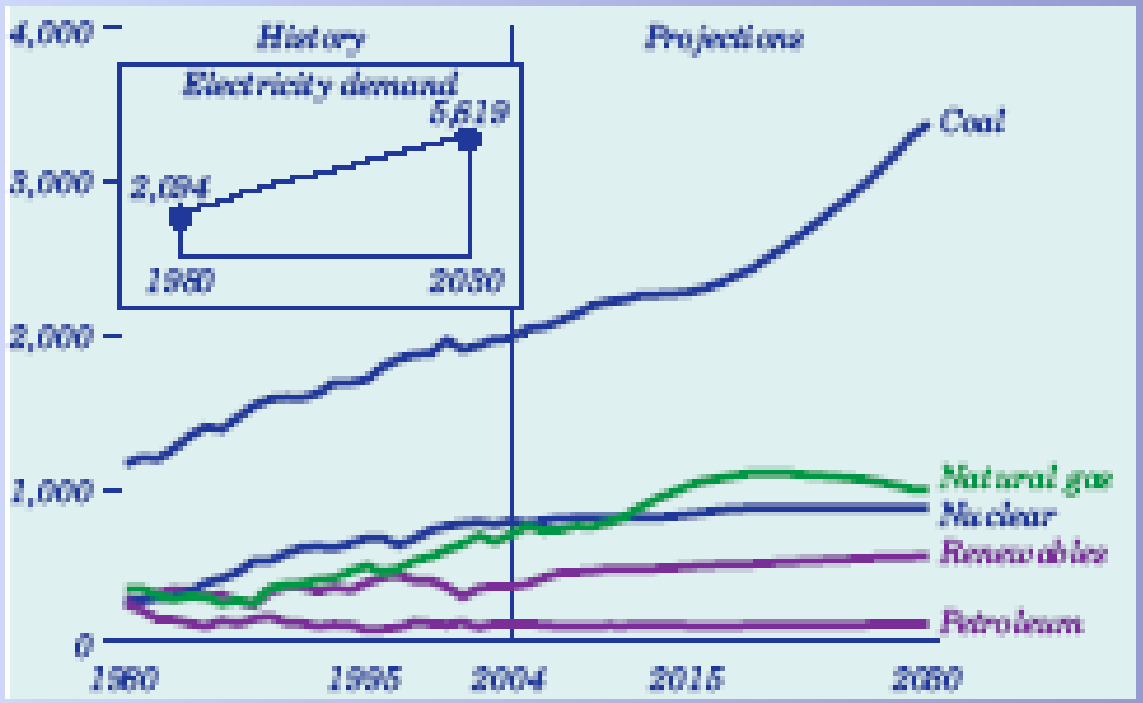


US Energy Information Administration (EIA) Forecast



Source: U.S. Energy Information Administration.

EIA Electric Generation by Fuel



New Natural Gas Supplies for the Pacific Northwest?

Global Energy Decisions (GED) Forecast and Scenarios

	Reference Forecast	Terrorism & Turmoil	Green World	Return to Reliability
Economic Growth	Medium	Slow	Medium	Medium
Gas Supply	LNG arrives (6 new US plants)	LNG constrained; N. Amer. growth	Tight supplies followed by LNG	LNG constrained; N. Amer. growth
Gas Price	Normal	Higher mid-term	Higher long term	Normal
Environmental Regulation	No new	No new	Four pollutants by 2020	No new
Coal Generation	No new before 2015 in US West	No new before 2015 in US West	Retires 466 GW by 2025	Adds coal over Reference levels
Transmission	Existing levels	Existing levels	Increase capacity by 1%	Increase capacity by 20%
Nuclear Build	0 plants	0 plants	2 plants	2 plants

Relationship of SCL Futures to GED Scenario Prices

SCL Future	SCL Demand Outlook	GED Scenario for Price Assumptions
Reference	Base Demand	Reference
High Demand	High Demand	Reference
Low Demand	Low Demand	Reference
Gas Rich	Base Demand	“Return to Reliability”
Gas Constrained	Base Demand	“Terrorism & Turmoil”
Green	Base Demand	“Green World” Plus
Alternate Gas	Base Demand	Reference

Forecasts and Futures Summary

- Utilizing previously described SCL futures
- Adding an Alternate Reference Case using the US Department of Energy EIA natural gas price forecast
  - Evaluate differences between GED Reference Case and Alternate Case with EIA forecast in constructing portfolios
- Updating GED forecast when available in second round of portfolios

Overview of Generating Resource Alternatives

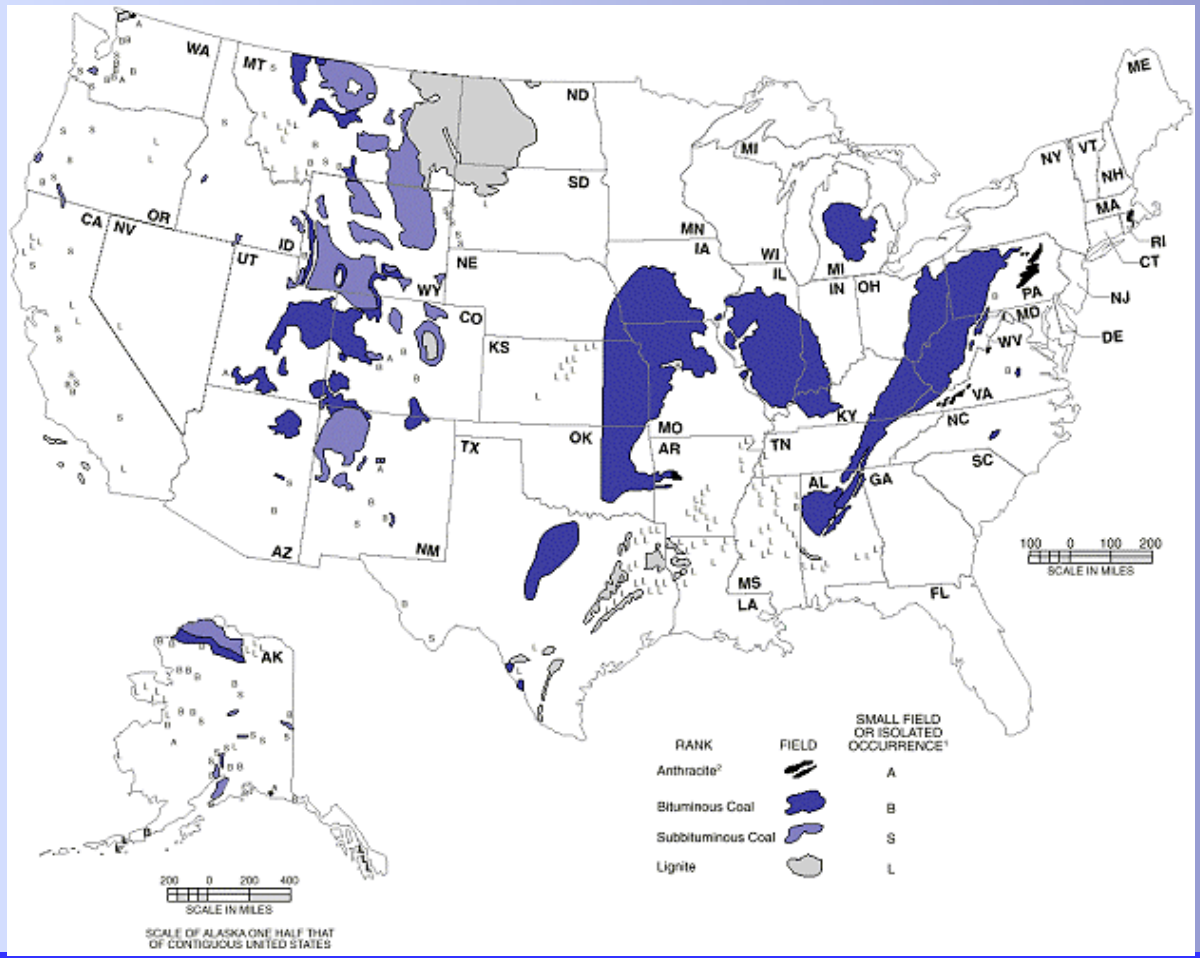
New Generating Resource Options

- Coal
- Natural Gas
- Wind
- Geothermal
- Biogas
- Biomass
- Contracts & Hydroelectric Efficiencies
- Transmission

Costs & Availability Range

Description	Availability/ Capacity %	Capital Cost $/kW	Fixed O&M $/kW-yr	Variable O&M $/MWh
Coal, Pulverized	85%-90%	$1,200-$1,700	$20-$40	$1.00-$4.00
Coal, Integrated Gas Combined Cycle	80%-90%	$1,400-$1,800	$30-$40	$2.00-$3.00
Coal, IGCC w/ Carbon Sequestration	80%-90%	$1,800-$2,400	$40-$55	$2.00-$4.00
Natural Gas Combined Cycle	92%	$525-$700	$9.00-$11.00	$2.80-$2.90
Natural Gas, Simple Cycle	90%-94%	$400-$600	$11-$13	$4.00-$8.00
Wind	23%-44%	$1,000-$1,700	$10-$30	
Geothermal, binary	98%	$1,300-$2,700		$24
Geothermal, flash	98%	$1,050-$3,100		$10-$33
Landfill Gas	90%	$940-$1,150		$18
Biomass	90%	$1,700-$3,100	$12-$50	$3-$30

Coal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SMALL FIELD OR ISOLATED OCCURRENCE¹
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Bituminous Coal
Subbituminous Coal
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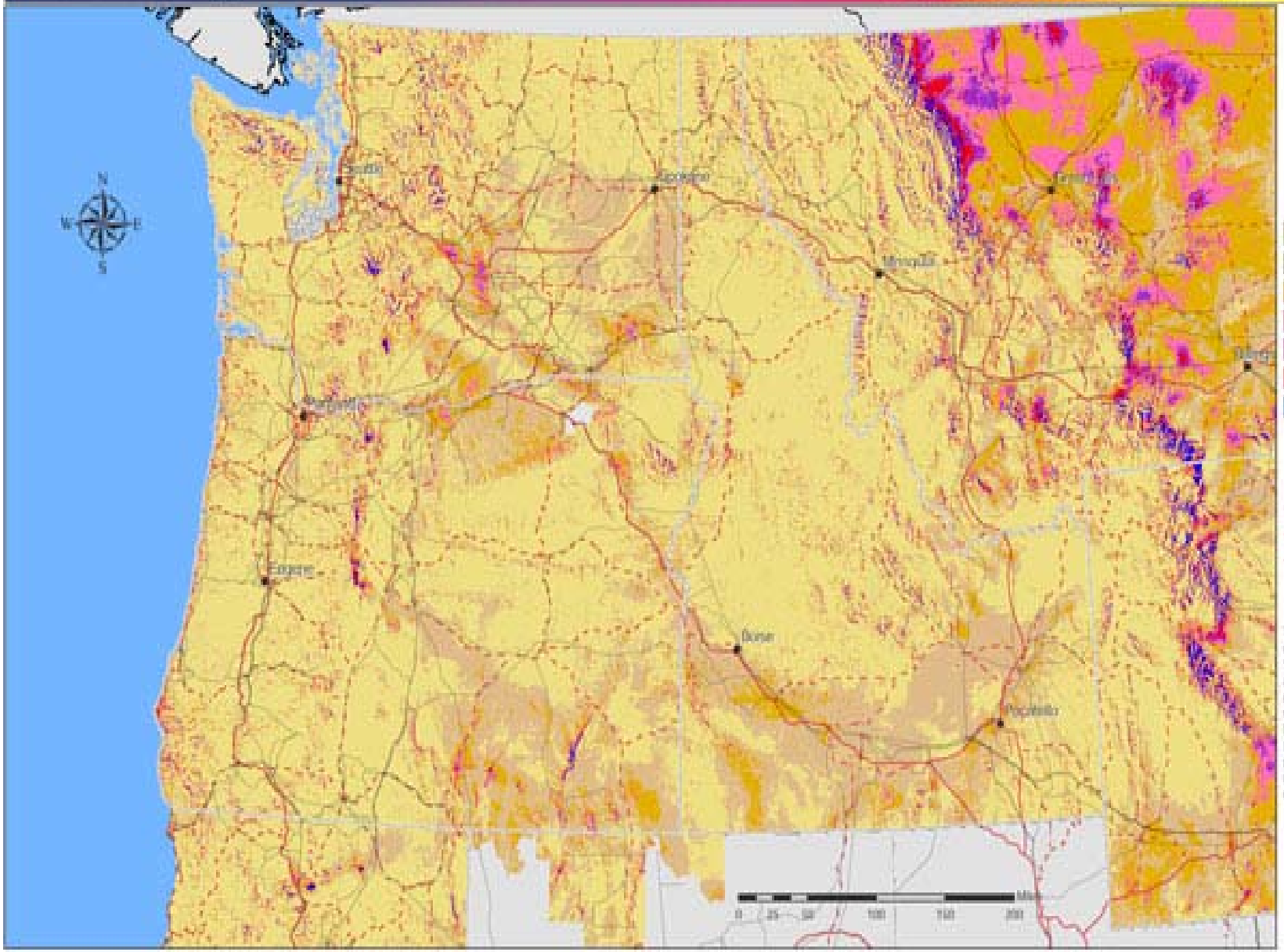
WINDPOWERMAPS.org

Bonneville Power Wind Power Resources



Wind Power Class	Resource Potential	Wind Speed at 50 m (mph)
Class 1	Poor	0 - 12.5
Class 2	Marginal	12.5 - 14.3
Class 3	Fair	14.3 - 15.1
Class 4	Good	15.1 - 16.8
Class 5	Excellent	16.8 - 17.9
Class 6	Outstanding	17.9 - 19.7
Class 7	Superb	> 19.7

- Major Cities
- Transmission Lines > 115 KV
- Limited Access Highway
- Highway

The wind resource estimates presented on this map were developed by TrueWind Solutions using MesoMap, a mesoscale atmospheric simulation system, at a spatial grid resolution of 400 meters (one-quarter mile). The estimates have been validated by the National Renewable Energy Laboratory (NREL) and independent meteorologist but should be confirmed by direct measurement according to wind energy industry standards.

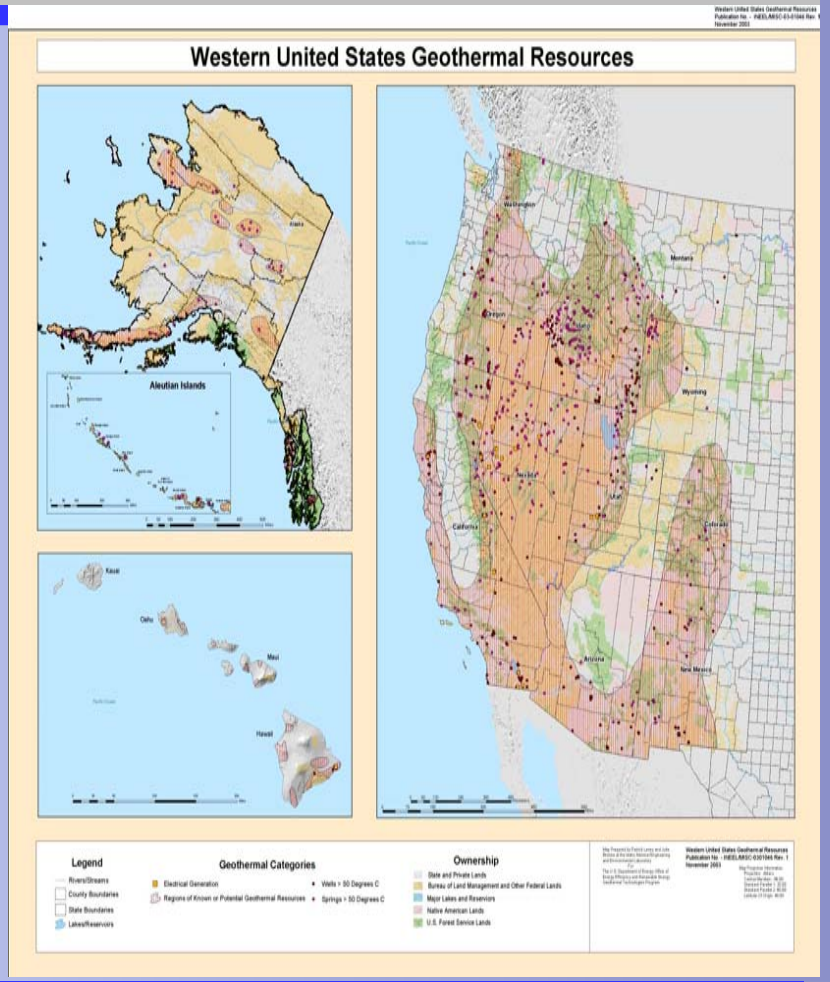
Project Sponsors

NREL, the Bonneville Power Administration, Northwestern Energy, the Wyoming Business Council, enXco, the Northwest Power Planning Council, Zilkha Renewable Energy, Klickitat County, EnronWind, ABB, Renewable Energy Systems (USA) Inc., Chelan Public Utility District, Idaho Power, Windland, Inc., WSACAA Energy Project, Vestas, Jones & Stokes, CH2M Hill, Suction Energy, Northwest Wildlife Consultants, Inc., and Gaia Wind Power

For more information see www.windpowermaps.org

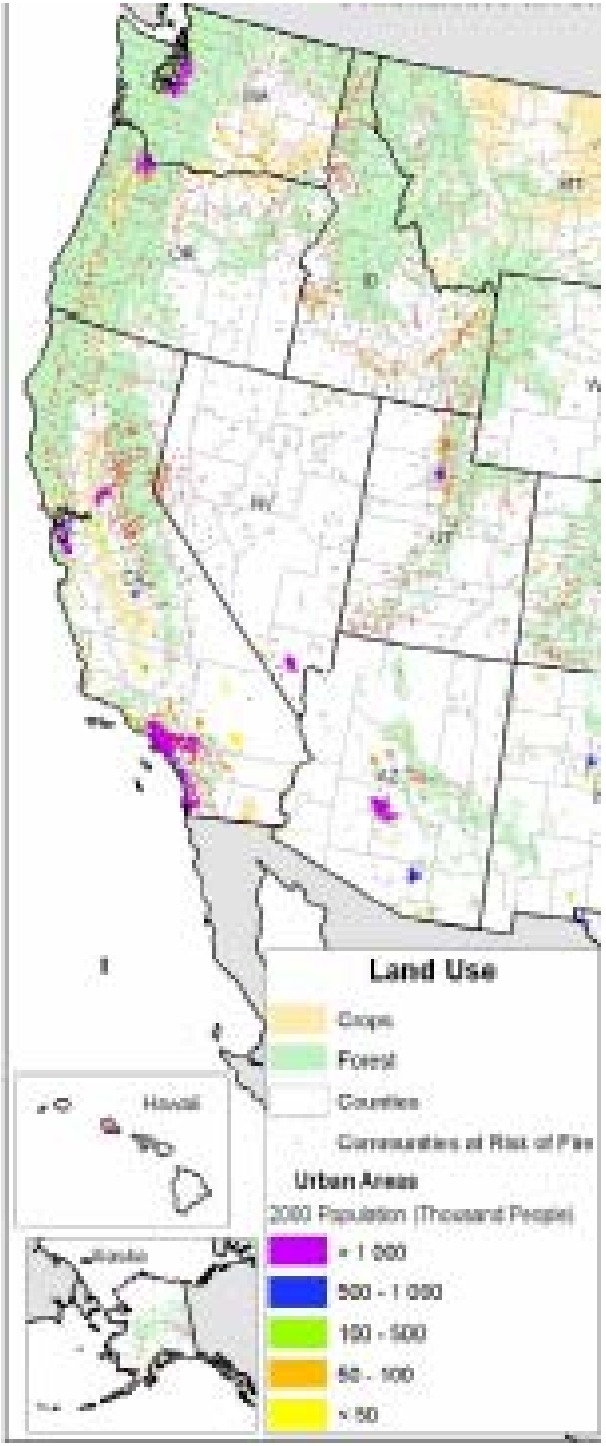
Geothermal

- Washington 50 MW 5 Sites
- Oregon 380 MW 11 Sites
- Idaho 860 MW 6 Sites
- California 2,400 MW 25 Sites
- Total Western US 5,630 MW 138 Sites
- Cost Range 5.3 to 7.9 cents/kWh (assumes extension of production tax credit - otherwise 2.3 cents/kWh higher)
- Consensus view of experts in geothermal technology, development and power generating operations by 2015.

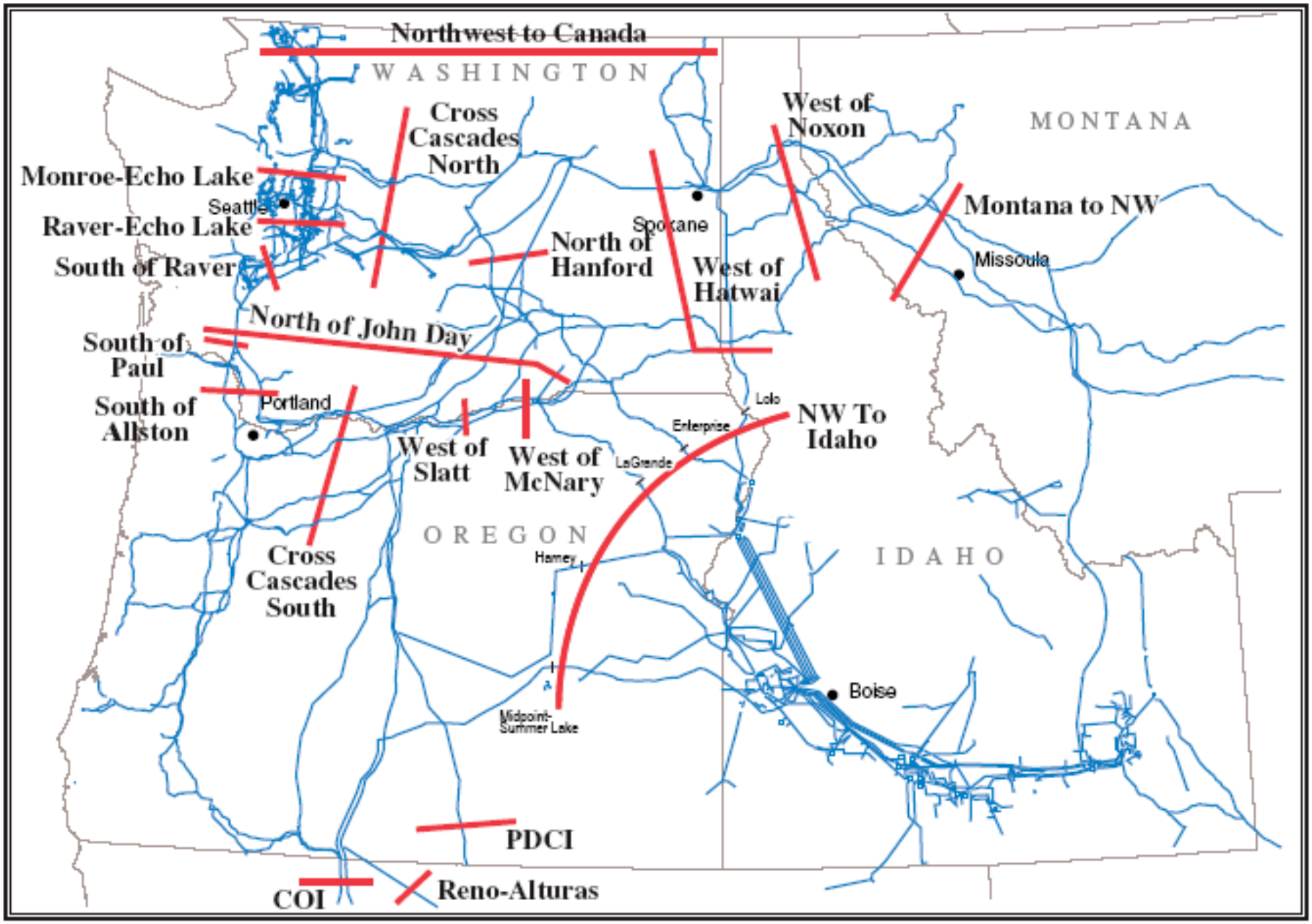


Bioenergy

- Typical Size
  - Biomass 15 MW - 30 MW
  - Biogas < 10 MW
- Transportation of fuel limits size
- Total Western US 10,000 MW by 2015
- Cost Range 8+ cents/kWh
- Societal Benefits > 8 cents/kWh
- Feedstocks include forest resources, agricultural residues and products, and resources from the municipal waste stream including solid wastes, biosolids, sewage, and waste buried in landfills.
- Distributed resource reduces need for transmission



NW Constrained Paths



New Resources Summary

- Use resources identified above including contracts and hydro efficiency improvements
- Use mid-point of cost range

Conservation in the IRP

Perspectives For Conservation Analysis

- Whose costs and benefits count?
- Primary perspectives:
  - Societal (Environmental externalities here?)
  - Service Territory (a.k.a., Total Resource Costs)
  - Utility
    - Program (a.k.a., Utility System)
    - Financial (a.k.a.., Non-Participant, Utility as a Business, RIM ---- "lost revenue" here)
  - Participating Customer ("bill savings" here)
- One perspective's costs may be another perspective's benefits

Analytical Framework for Conservation in the IRP

- Develop Conservation Potential Assessment (Quantec study; a.k.a, conservation supply curves)
- Construct alternative conservation options from Conservation Potential Assessment
- Analyze conservation options as part of overall resource portfolios for their effect on costs and risks
- Develop findings and recommendations for long-term conservation resource goals and policy

Framework for Conservation Potential Assessment

Market Inputs:
- Customer Forecast
- End Use Saturations
- Fuel Shares
- Baseline Consumption

Measure Inputs:
- Savings
- Costs
- Lifetimes

Characterize Market and Energy-Efficiency Measures

Potential of Energy-Efficiency Measures in all Technically Feasible Applications

Estimate Technical Potential

Potential of Energy-Efficiency Measures with and Market Constraints Applied

Estimate Achievable Potential

Resource Bundles by Customer Group, End Use, and Price Point

Integrated Resource Portfolio Analysis

Conservation Summary

- Treat conservation the same as a generation resource
- Model conservation options as bundles of conservation measures to include in resource portfolios
- Assess both utility and service territory (total resource) costs and benefits

Resource Adequacy

Resource Adequacy – Why?

- Receiving increased attention in the wake of
  - West Coast Energy Crisis of 2001
  - Northeastern Blackout of August 14, 2003
- Being addressed at various levels
  - Federal Energy Policy Act of 2005
    - Electric Reliability Organization to enforce reliability standards
    - FERC regulatory review and oversight
  - Western Electricity Coordinating Council (RRO)
  - Pacific Northwest Resource Adequacy Forum
  - Utility IRPs

Resource Adequacy – What?

- Resource adequacy and reliability are not exactly the same thing
  - Resource adequacy helps ensure reliability
  - Resource adequacy has a longer-term focus
- Two basic dimensions to resource adequacy:
  - Energy
  - Capacity
- City Light's large proportion of hydro generating resources mean that capacity is less of a concern than energy

Resource Adequacy – How?

- There is no single, widely-accepted approach
- Three types of approaches have been used in recent IRPs
  - Presume that a certain quantity of resources is needed, relative to load (e.g., 15 percent capacity reserve margin)
  - Evaluate what amount of resources is needed to achieve a specified level of reliability (e.g., 5 percent loss of load probability)
  - Analyze how a range of resource quantities would affect portfolio performance (reliability, cost, risk, environmental impacts)

Resource Adequacy - Approach

- Focus mainly on energy resource adequacy
- Conduct a probabilistic analysis that reflects key sources of risk:
  - Variability in City Light hydro generation
  - Variability in City Light retail loads
  - Volatility in spot market prices
- Meanwhile, monitor and participate in regional dialog on resource adequacy
  - Be able to translate City Light resource adequacy criteria to regional measures as they are developed

Environmental Assumptions

Policy Background

- Greenhouse Gas Resolutions
  - Net Zero Goal
  - Meet Load Growth with Conservation/Renewables/Mitigation
  - No Resource Excluded - Mitigation Required
- Mayor's Initiative, West Coast Governors, RGGI, federal proposals
- Historically, SCL has considered environmental externality costs in resource planning

Summary

- Consider all generic resources for candidate portfolios, including fossil
- Evaluate emissions and costs as part of IRP analysis

Generic Resource Emission Rates

- Data to be supplied by Global
- Emission Rates for Each Generic Resource:
  - SOx
  - NOx
  - CO2
  - Mercury
  - Particulates

Base Case
Emission Cost Assumptions

- Global's Market Electricity and Natural Gas price Forecast (Fall 2005)
- CO2: Zero cost during 2007-2026 period
- SO2: forecast based on CAIR
- NOx: forecast based on SCAQMD
- Hg: forecast based on CAMR
- Particulates: no forecast provided to date

Total Emission Cost Calculations

- Based on emission rate for the “generic resources” and cost assigned to emissions
- Cost will be calculated for each type of emission, for each portfolio

SOx Cost Assumptions

- From Global's Fall 2005 "Electric and Fuel Prices Outlook" for WECC
- Global assumes CAIR emission caps and timelines
- Assumes that cost of emission control equipment is reflected in allowance cost, so SOx allowance price equals marginal cost of emission control to reduce last ton of SOx under the cap
- Allowance Prices
  - Actual September 2005 - $900/ton
  - Forecast 2010 - $1,100/ton
  - Forecast 2015 - $1,750/ton

NOx Cost Assumptions

- From Global's Fall 2005 "Electric and Fuel Prices Outlook" for WECC
- Case #1: CAIR - Assumes that cost of emission control equipment is reflected in allowance cost, so NOx allowance price equals marginal cost of emission control to reduce last ton of NOx under the cap
  - Forecast 2010 - $2,600/ton
  - Forecast 2015 - $1,372/ton
- Case #2: SCAQMD
  - Forecast 2009 - $1,261/ton
  - Forecast 2015 - $1,970/ton

CO2 Cost Assumptions

- Globals' Base/Reference Case from Fall 2005 assumes CO2 cost is ZERO
- SCL has policy to mitigate CO2 emissions - wide range of cost for current projects
- SCL has recently used $40/ton CO2 for long term planning

Mercury Cost Assumptions

- Assumes Timelines and Caps in CAMR
  - 2010: 38 tons/year limit
  - 2018: 15 tons/year limit
- Global analysis says that limits between 2010 and 2018 will be met with NOx/SOx controls -
  - Forecast 2010 to 2018 - ZERO allowance cost
- Global analysis shows 36 tons per year emissions after 2015
  - Won't meet limit - will need allowances
  - Forecast 2018 and beyond - $35,000/lb cap from CAMR

Reference Case Summary

- Use Global's emission rate and cost values for SOx, NOx, Mercury, and Particulates (when available)
- Use SCL estimate of CO2 mitigation costs in analysis, to account for current net-zero policy

CO2 - Global's "Green World"

- Global's "Green World" Scenario - US meets Kyoto limits by 2018
  - by 2010 - CO2 emissions level off
  - by 2014, half way to Kyoto
  - by 2018 - Kyoto met
- Assumed major retirement of coal/oil, and new gas plants as compliance strategy
- Modeled price signal required to get enough "retirements" = CO2 cost for each period

Green Future Summary

- CO2: Global's "Green World" scenario
  - 2010 - $20/ton CO2
  - 2026 - $100/ton CO2
- SO2, NOx, Mercury, Particulates (when available):

  Global Fall '05 forecast values used, but assumed CAIR/CAMR emissions limits were implemented earlier by 3 to 8 years

Questions?

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