2008 Integrated Resource Plan
Public Meeting

CO$_2$ Regulatory IRP Modeling
May 23, 2008
Agenda

• Proposed Oregon Public Utility Commission IRP guidelines on CO₂ risk
• Range and timing of CO₂ costs represented in the IRP
• Overview of the IPM (Integrated Planning Model) and usage for the IRP
• Overview of the EPRI study on CO₂ policy impacts on western power markets
• Wrap-up
Proposed Oregon Public Utility Commission IRP guidelines on CO2 risk

Kyle Davis / Pete Warnken
IRP Guideline 8, Environmental Costs

• Hand out: “Staff’s Additional Comments: In the Matter of an Investigation into the Treatment of CO2 Risk in the IRP process,” January 17, 2008

• Status?

• Requirements
  – Section a, Base Case and Other Compliance Scenarios
  – Section b, Testing the Preferred and Alternative Portfolios Against the Compliance Scenarios
  – Section c, Trigger Point Analysis
  – Section d, CO2 Risk Adaptability
  – Section e, Oregon Compliance Scenario
Range and timing of CO$_2$ costs represented in the IRP

General Discussion
The Integrated Planning Model (IPM®)

Rick Link
IPM® Description

- The Integrated Planning Model (IPM®) is licensed from ICF International in Fairfax, VA
- IPM® is a linear programming model with a detailed representation of every boiler and generator operating in the United States and Canada
  - The objective function determines the least-cost means of meeting electric energy and capacity requirements
  - The solution of the objective function is subject to a wide range of constraints
    - Emission regulations
    - Plant operating characteristics
    - Power system transmission constraints
    - Fuel availability
  - IPM® has a forward view of the market solving across all years and regions simultaneously
Application of IPM®

- IPM® is the principle analytical tool used by the federal government to measure the impact of air quality issues on the power sector
  - Clean Air Act Amendment of 1990
  - SIP Call
  - 1997 National Ambient Air Quality Standards
  - Clean Air Interstate Rule
  - Clean Air Mercury Rule
  - Numerous GHG policy proposals
  - Environmental compliance

- IPM® also has been used extensively in the private sector
  - Asset financing support
  - Asset and allowance allocations
  - Plan compliance decisions
  - Power, gas, emission price forecasting
  - New resource additions
  - Integrated resource planning
IPM® Analytical Framework

POWER PLANT DISPATCH AND GRID OPERATIONS

New and Existing Power Plants
- Coal
- Oil & Gas Steam
- Combustion Turbines
- Combined Cycle
- Qualifying Facilities
- Geothermal: New and Site Expansions
- Nuclear
- Hydro
- Renewables
- Cogeneration
- Other

Operational Factors
- Maintenance
- Outages
- Must Run

Existing Power Plant Variable Cost
- Fuel Transportation
- Fuel Costs
- Heat Rates
- O&M Costs

New Power/CHP Plants
- Capital Costs
- Financing Costs
- Wind Generation Profiles

Electricity Demand
- Hourly Demand
- Peak & Energy Growth
- Reserve Margins
- Steam Demand

Transmission
- New FERC Policies
- Long-term tradeoffs with Generation

Power Plant Retrofits
- SCR, SNCR, and New NOx Control Options
- Wet and Dry FGD
- ACF and Fabric Filter
- Cost benefits for Hg

Air Policy Specifications
- NOx, SOx, Hg, and CO2
- MACT, vs. Cap and Trade
- Banking and Progressive Flow Control
- National, Regional, and State Programs
- Renewable Portfolio Standards

Resource Supply
- Gas Supply
- Coal Supply
- Biomass Supply
- Wind Availability
IPM® Model Regions*

* Canadian provinces, and additional sub-regional detail for California, NYISO, ISO-NE, ERCOT, SPP/Entergy, and PJM/ECAR are not shown.
Analyzing Environmental Policies with IPM®

• IPM® determines the marginal cost of emission reductions for the power sector
  – Technology-driven emission control retrofits
  – Fuel switching
  – Modified dispatch
  – Plant retirements, mothballing, & new resource additions
• IPM® can simulate a wide range of regulatory tools available to policy makers
  – Cap-and-trade, tax, command-and-control (i.e. plant level MACT)
  – Backstop & safety valve prices
  – Offset curves
  – Banking & borrowing
  – Allowance surrender ratios
• IPM® can simulate Renewable Portfolio Standards
  – Met through the construction and operation of qualifying renewable assets
  – Configuration allows for trading, technology specific surrender ratios, and location driven surrender ratios
Integrated Fuel and Power Market Modeling with IPM®

GMM®
- Regional delivered natural gas prices
- Supply area production by type
- Pipeline flows and utilization
- Regional natural gas consumption

IPM®
- Regional electric energy and capacity prices
- Individual power plant dispatch and fuel consumption
- Regional expansion decisions
- Environmental compliance

CoalDOM®
- ICF’s Coal Depletion Optimization Model (CoalDOM®)
- Coal mine costing and investment
- Mining productivity improvements
- Coal seam characteristics

GMM® and IPM® are used in an iterative process to develop natural gas supply curves for IPM®

CoalDOM® provides IPM® with Coal supply curves and reserve estimates for each coal type, coal quality, and region
• 40 U.S. supply regions & 23 international supply regions are broken down by:
  – Rank
  – Sulfur content
  – Existing vs. new
  – Surface
  – Underground
• Coal plants are assigned to one of 200 different demand regions defined by location and mode of delivery
• Coal transportation matrix links coal supply regions with coal demand regions
Use of IPM® in the IRP

Integrated Planning Model (IPM®)
- Gas price response to environmental policy
- Regional resource additions

MIDAS
- Western electricity prices
- Western gas prices
- Emission prices (pass through)

System Optimizer
- Resource portfolio
- Deterministic
- Case driven

Planning and Risk (PaR)
- Resource portfolio
- Stochastic
- Risk adjusted least cost
EPRI Study on CO$_2$ Policy Impacts on Western Power Markets

Kyle Davis