Northwest Power and Conservation Council

Discussion Of Scenario Results

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for the

Power Committee Web Conference

Thursday, May 28, 2009

Scenarios

- Base case
- Suspend Carbon Policy
- $100/ton CO_2 Policy
- No RPS
- Close Existing Coal Plants
- Dam Removal
- Low Conservation
- High Conservation
- Plug-In Electric Hybrid Vehicles (Remaining)
- Climate Change (Remaining)

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Format

- The least-risk plan for each
- NPV study cost and TailVaR$_{90}$ risk
- Average CO2 emission rate (MMt/year) over futures, 2030 resource- and load-based
- Resources
  - Total conservation, discretionary and lost-opportunity, by end of study, average over futures (MWa)
  - Wind complementing RPS
  - Other resources optioned
    - Earliest possible construction and amount
    - Greatest amount by the end of the study

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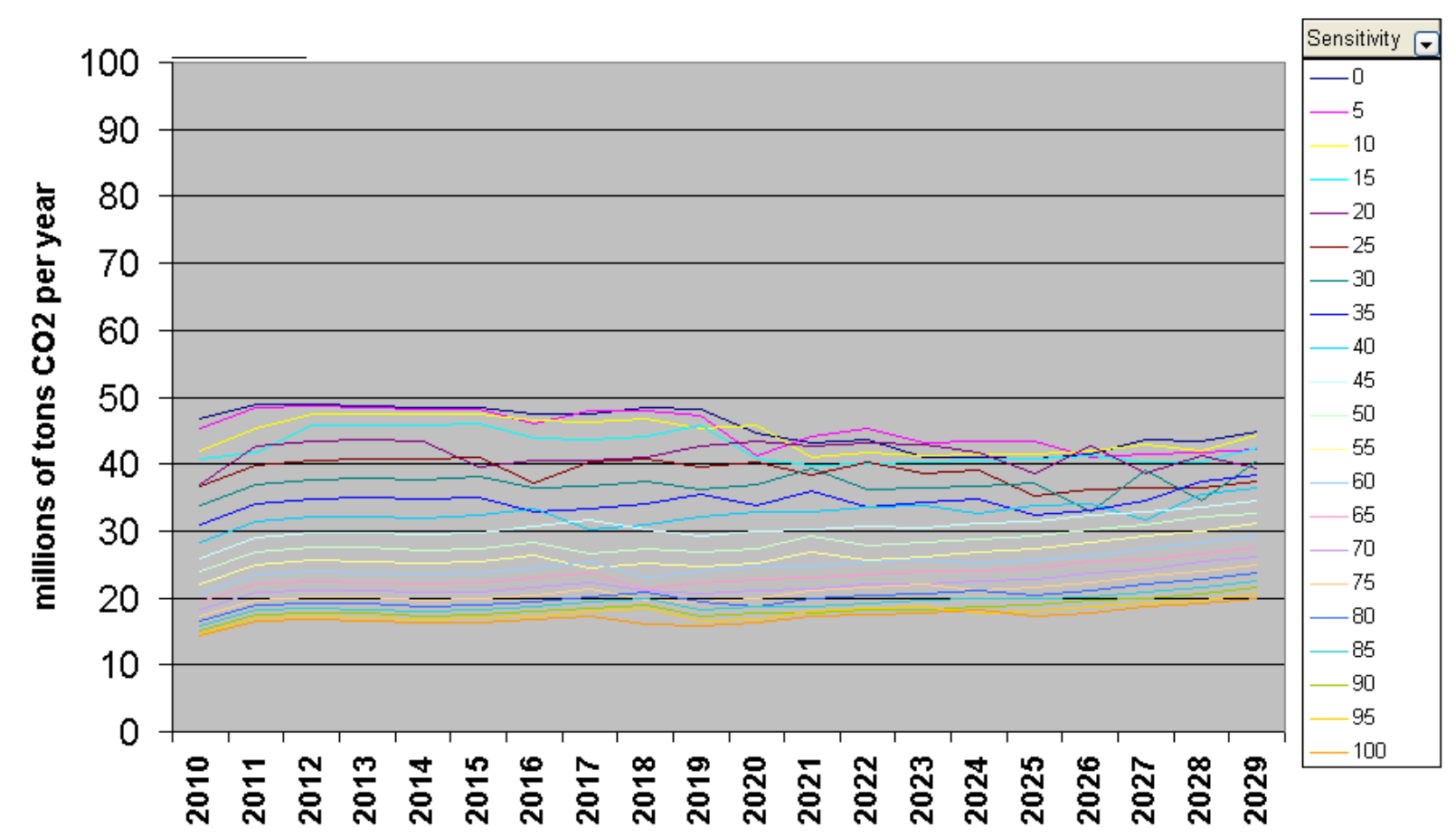
CO2 Comparisons
Resource-based Perspective

no adjustment for imports and exports



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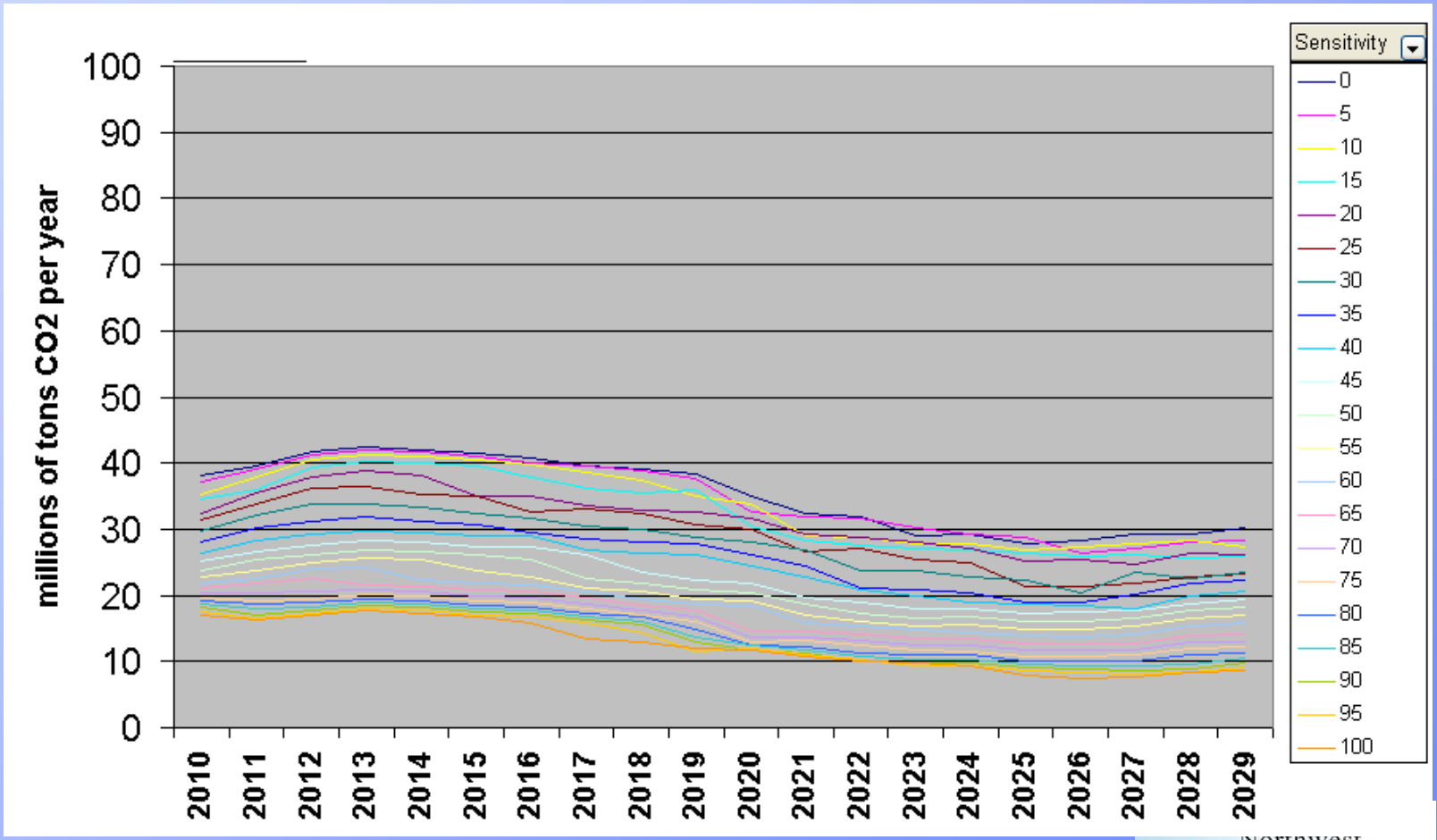
CO2 Comparisons
Load-based Perspective
adjustment for imports and exports



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Definition of Regional Resources

Name	Installed Capacity (MW)	Availability (%)	Capability (MWa)	Average Heat Rate (Btu/kWh)	tons CO2/MWh	RPM & Genesys (%)	Council's Carbon Footprint paper
Boardman	601.0	84%	504.8	10840	1.149	75%	100%
Centralia 1 (85% IPP)	730.0	84%	613.2	10240	1.085	100%	100%
Centralia 2 (100% IPP)	730.0	84%	613.2	10240	1.085	100%	100%
Colstrip 1	358.4	84%	301.1	11170	1.184	50%	100%
Colstrip 2	358.4	84%	301.1	11170	1.184	50%	100%
Colstrip 3	778.0	84%	653.5	10870	1.152	70%	100%
Colstrip 4	778.0	84%	653.5	10870	1.152	92%	100%
Corrette (J.E. Corette)	172.8	84%	145.2	11010	1.167	0%	100%
Jim Bridger 1	577.9	84%	485.4	10570	1.120	100%	100%
Jim Bridger 2	577.9	84%	485.4	10570	1.120	100%	100%
Jim Bridger 3	577.9	84%	485.4	10570	1.120	100%	100%
Jim Bridger 4	584.0	84%	490.6	10570	1.120	100%	100%
North Valmy 1	254.3	84%	213.6	10450	1.108	50%	50%
North Valmy 2	267.0	84%	224.3	10450	1.108	50%	50%
Steam Plant 2 (retired)	2.0					0%	100%

- At 84% capacity factor, the Council's Carbon Footprint Paper estimates regional coal plant carbon emission would be 16.6% higher than the Regional Portfolio Model (58.9 vs 50.5 M tons)
- Note that Centralia is an Independent Power Producer

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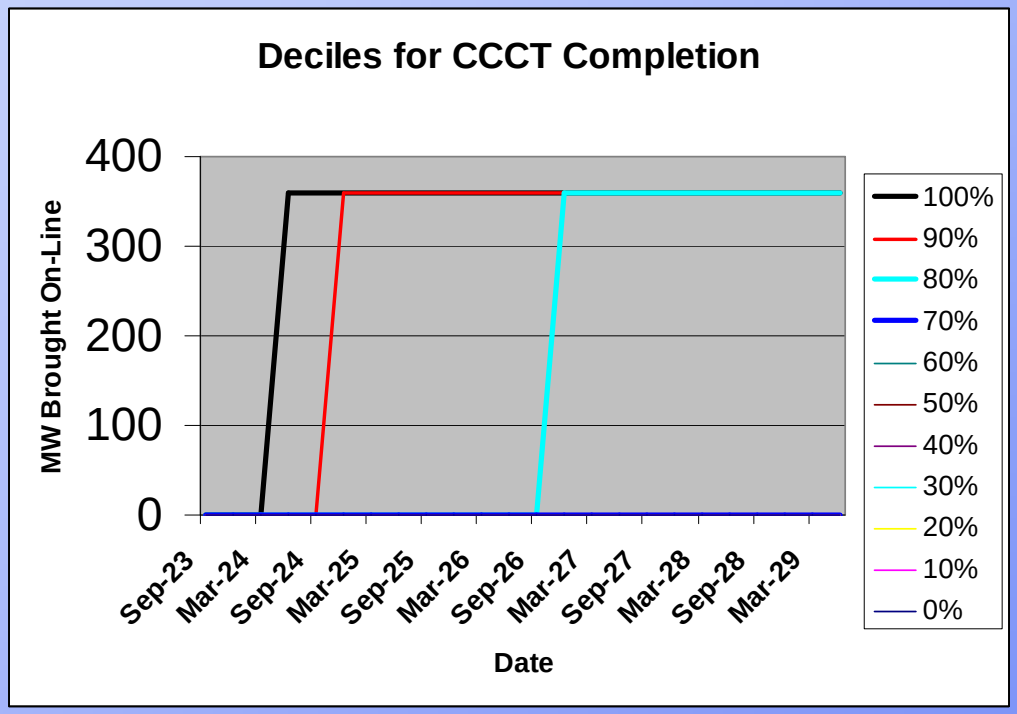
Not Yet Available

- Average RPS development
- Expected operation of units over time
- Likelihood of resource completion



Source: Illustrations for the 090512 P4 PPT.xls based on L810X.sls

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Base Case

- NPV Cost ($B): 105.6; TailVaR90 Risk ($B): 155.5
- CO2 2030 rate (average MMt/year CO2)
  - resource-based: 40.1
  - load-based: 26.8
- Resources
  - Average conservation (MWa) by end of study: 5826.7
  - Wind complementing RPS (MW): 1200 (Dec-15); 3000
  - Geothermal (MW): 52 (Dec-17); 169
  - CCCT (MW): 378 (Dec-17); 378
  - SCCT (MW): 162 (Dec-15); 324

Source: Portfolio Summaries.xls

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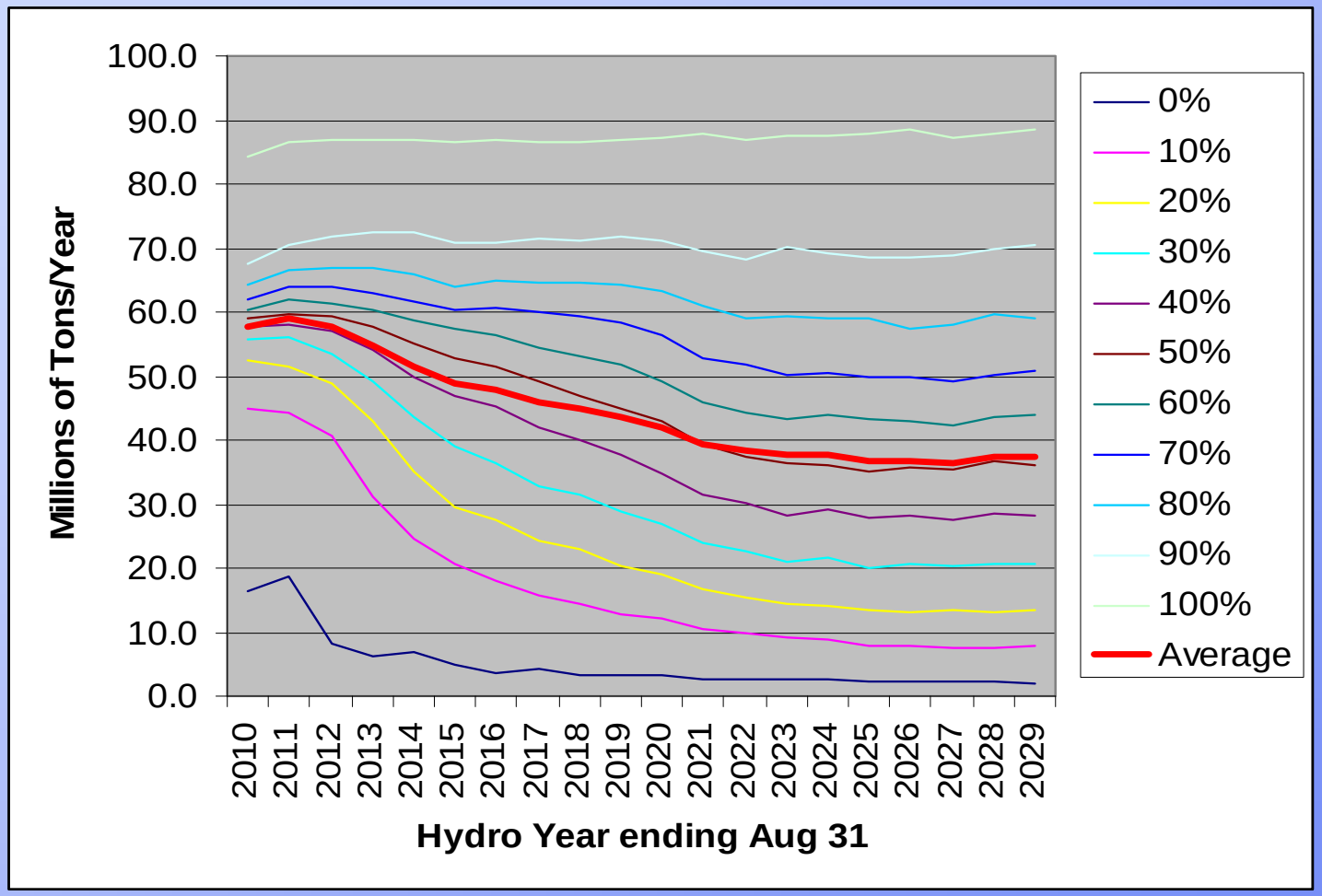
Base Case CO_2 Emission Rate



Source: "Studies\L811\L811 Extractions\Qtrly Rates, CO2, and others - LR+LC\ L811x1_LR.xls", worksheet "Data (6)"; no imp/exp adjustment, includes standard year and regional resource definition adjustments

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Suspend Carbon Policy

- No carbon penalty, no RPS, no RECs for Wind
- NPV Cost ($B): 56.5; TailVaR90 Risk ($B): 84.8
- CO2 2030 rate (average MMt/year CO2)
  - resource-based: 65.1
  - load-based: 52.8
- Resources
  - Average conservation (MWa) by end of study: 5432
  - Wind complementing RPS (MW): 0
  - Geothermal (MW): 52 (Dec-17); 52
  - CCCT (MW): 1512 (Dec-19); 1890
  - SCCT (MW): 648 (Dec-23); 648

Source: Portfolio Summaries.xls

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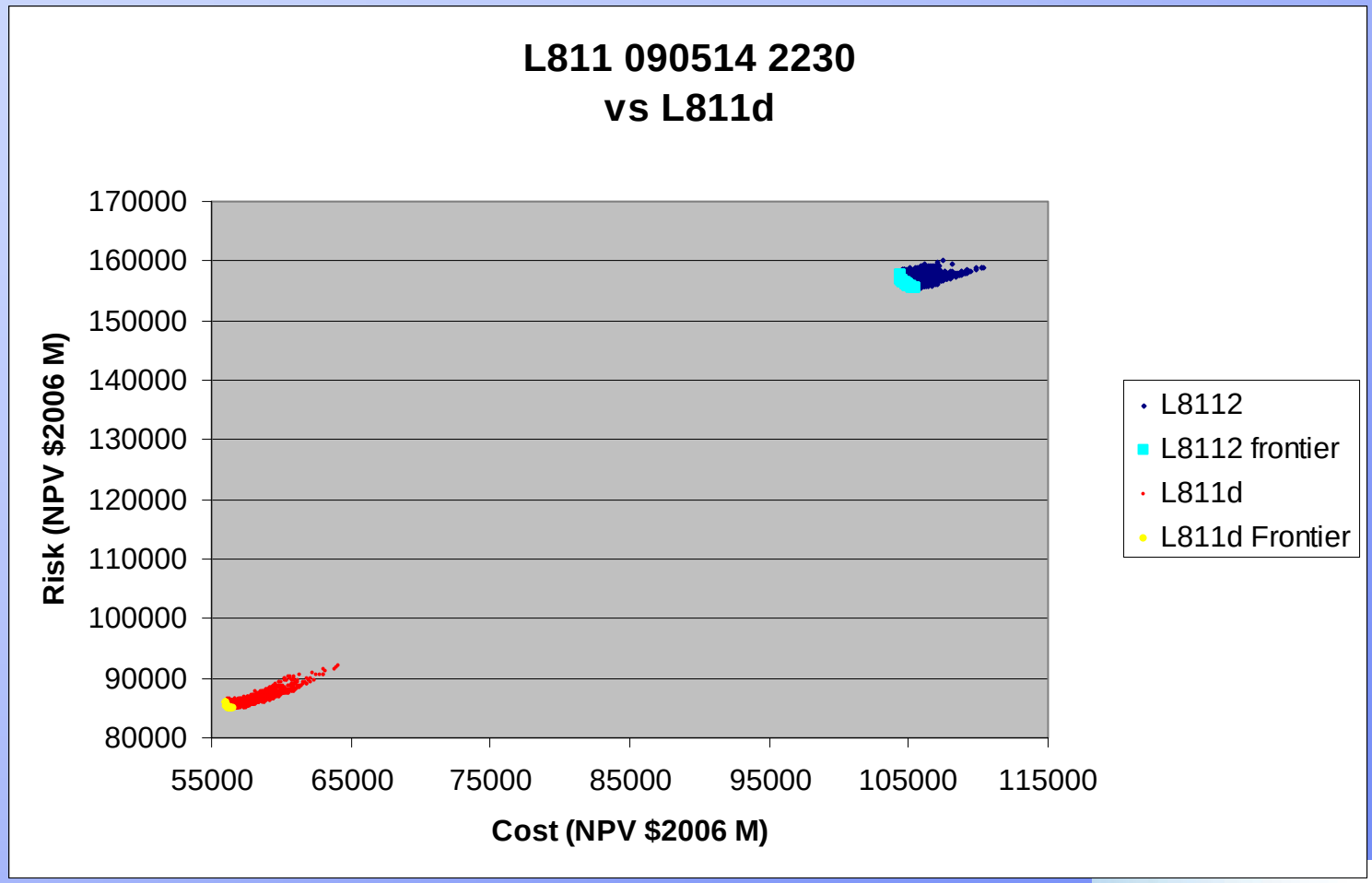
Suspend Carbon Policy
Shift in the Feasibility Space



Source: Analysis of Optimization Run_L811d 090514 2230.xls

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$100/ton CO2 Policy*

- Fixed carbon penalty, RPS included, Wind w/o REC
- NPV Cost ($B): 152.7; TailVaR90 Risk ($B): 193.2
- CO2 2030 rate (average MMt/year CO2)
  - resource-based: 29.6
  - load-based: 20.0
- Resources
  - Average conservation (MWa) by end of study: 5847
  - Wind complementing RPS (MW): 1500 (Dec-13); 3000
    Geothermal (MW): 840 (Dec-09); 840
  - CCCT (MW): 1512 (Dec-17); 2268
  - SCCT (MW): none

Source: Portfolio Summaries.xls

* estimated from previous base case

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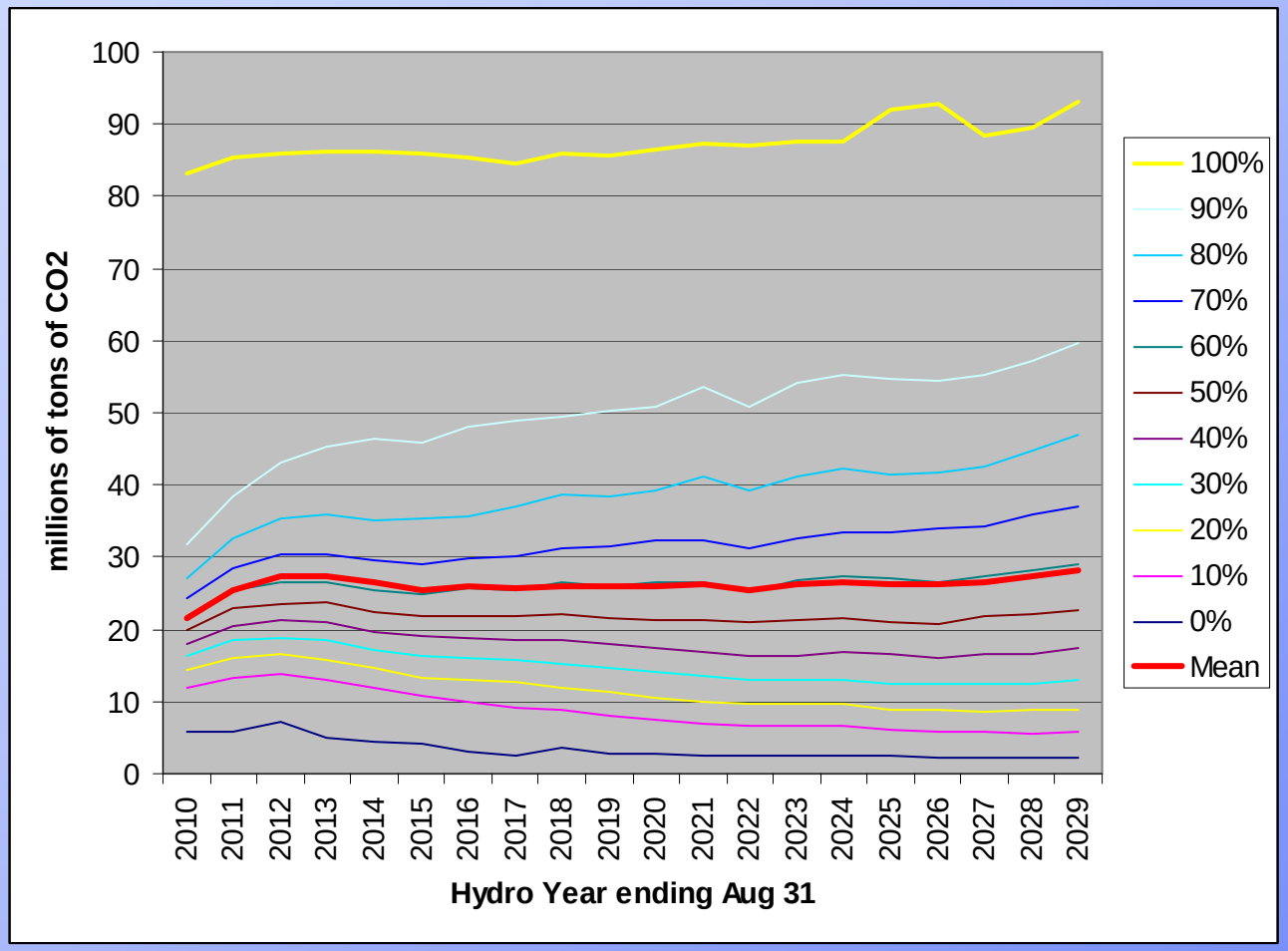
Carbon Emissions Under $100/ton Penalty



Source: "Plan 6\Studies\L810\L810a $100 per ton carbon penalty\Extraction for carbon effect\L810a.xls" , worksheet "Data (3)"

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No RPS Case

- RPS excluded, Wind with REC value
- NPV Cost ($B): 101.4; TailVaR90 Risk ($B): 153.8
- CO2 2030 rate (average MMt/year CO2)
  - resource-based: 43.7
  - load-based: 30.3
- Resources
  - Average conservation (MWa) by end of study: 5935.4
  - Wind complementing RPS (MW): 700 (Dec-13); 4800
  - Geothermal (MW): 13 (Dec-13); 208
  - CCCT (MW): 378 (Dec-15); 378
  - SCCT (MW): 162 (Dec-13); 648

Source: Portfolio Summaries.xls

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Close Existing Coal Plants*

- All regional coal plants closed today
- NPV Cost ($B): 143.8; TailVaR90 Risk ($B): 201.9
- CO2 2030 rate (average MMt/year CO2)
  - resource-based: 18.4
  - load-based: 12.1
- Resources
  - Average conservation (MWa) by end of study: 5710
  - Wind complementing RPS (MW): 2000 (Dec-13); 4000
  - Geothermal (MW): 840 (Dec-09); 840
  - CCCT (MW): 4536 (Dec-17); 6804
  - SCCT (MW): none

Source: Portfolio Summaries.xls

* estimated from previous base case

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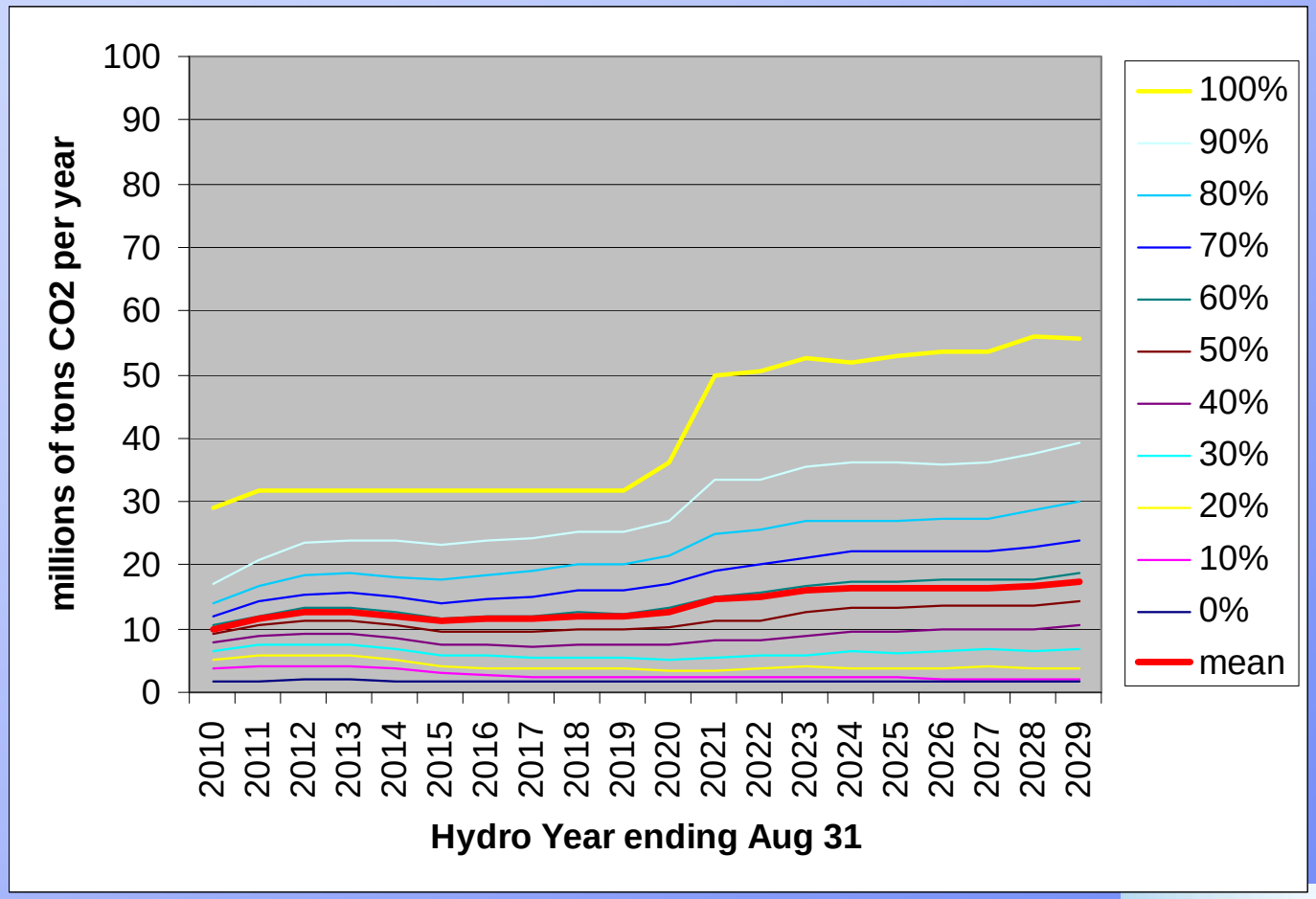
Curtailment Of Existing Coal-fired Power Production



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Dam Removal

- Loss occurs around 2019, Modeled 70-year record for Ice Harbor, Lower Monumental, Lower Granite, Little Goose
- NPV Cost ($B): 112.5; TailVaR90 Risk ($B): 168.5
- CO2 2030 rate (average MMt/year CO2)
  - resource-based: 43.6
  - load-based: 33.1
- Resources
  - Average conservation (MWa) by end of study: 5923
  - Wind complementing RPS (MW): 900 (Dec-15); 3000
  - Geothermal (MW): 52 (Dec-15); 208
  - CCCT (MW): 378 (Dec-13); 1134
  - SCCT (MW): 162 (Dec-15); 324

Source: Portfolio Summaries.xls

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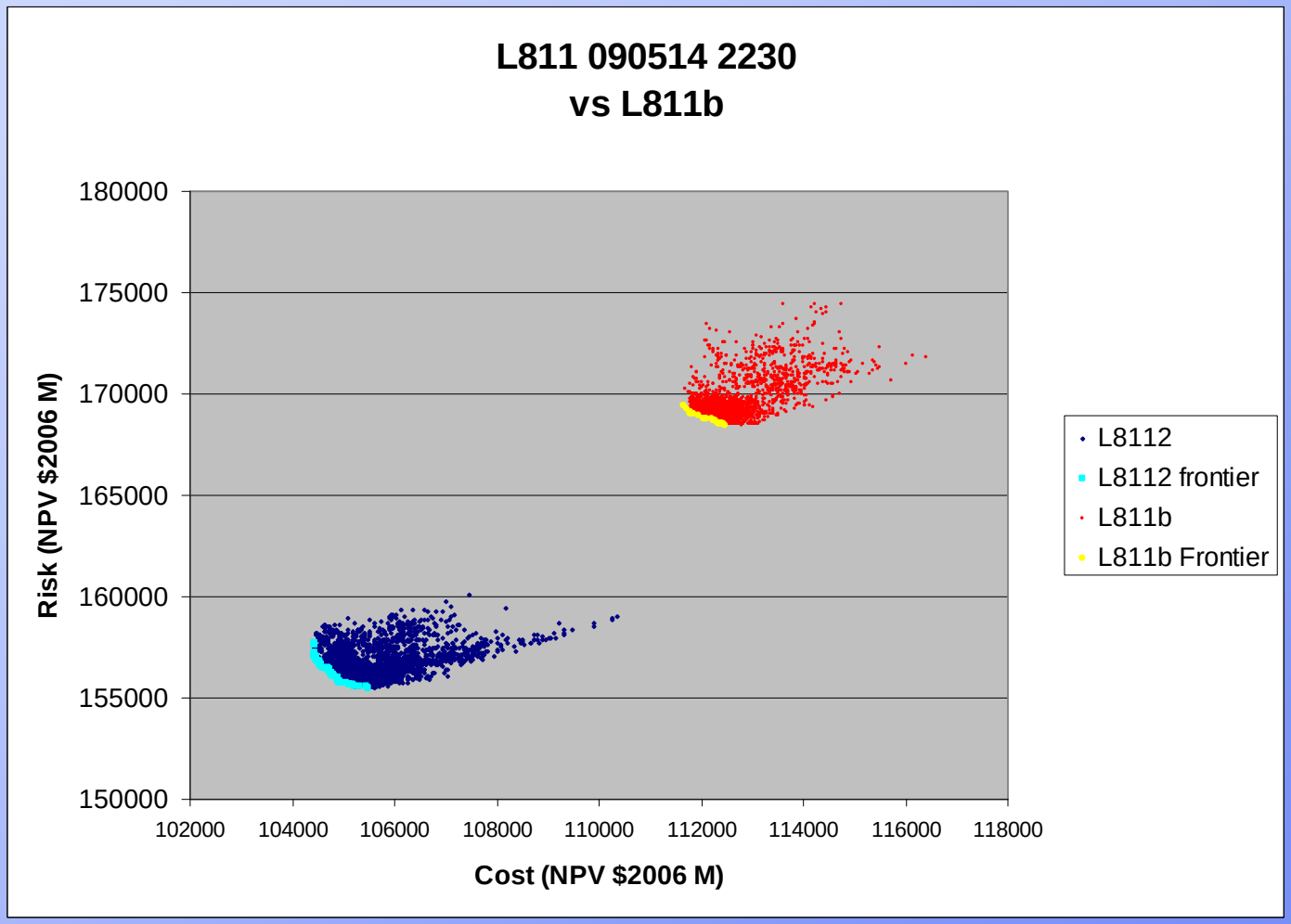
Dam Removal Feasibility Spaces



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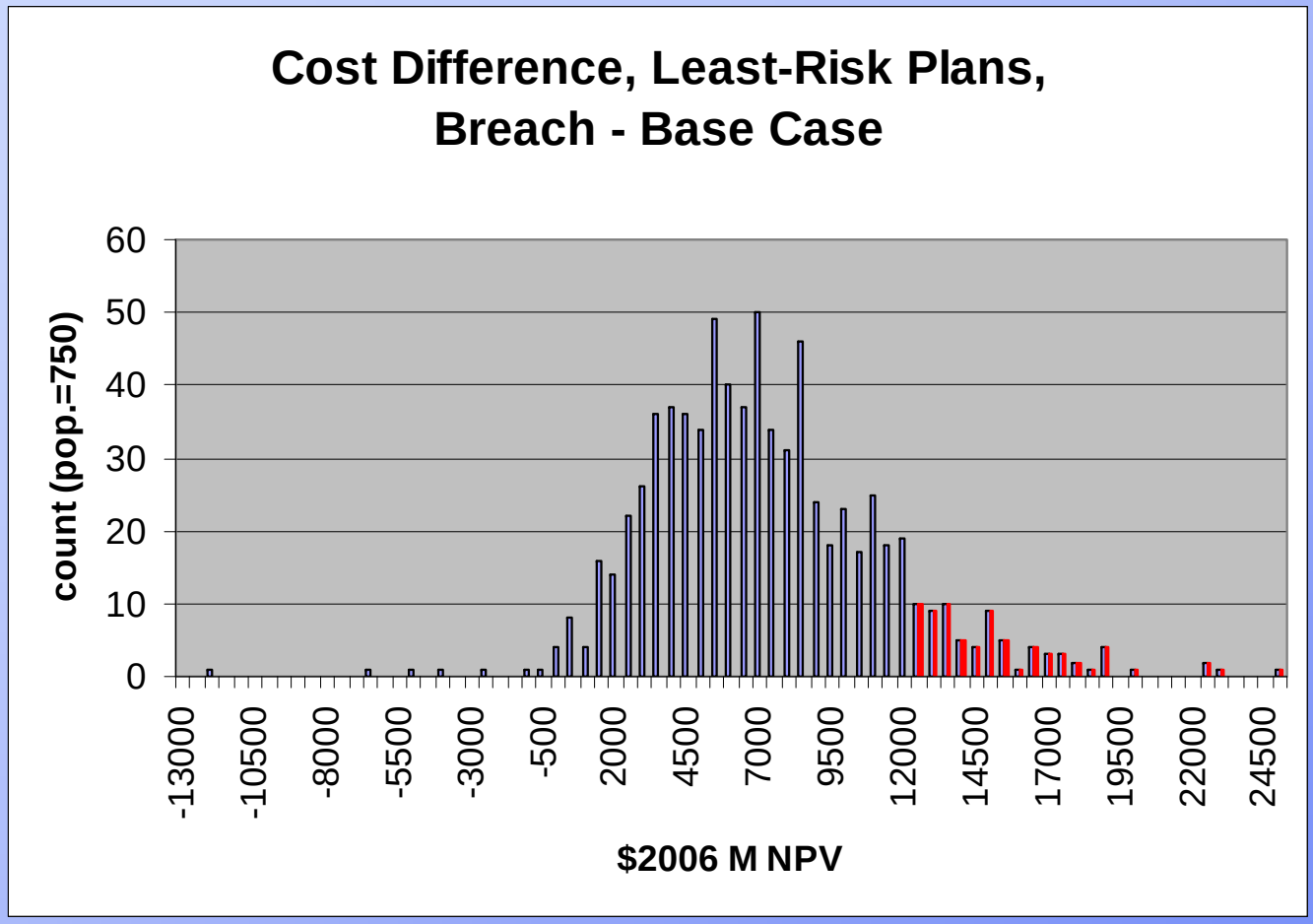
Dam Removal Costs



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Low Discretionary Conservation

- 100 MWa/year ramp, instead of 160 MWa/year
- NPV Cost ($B): 114.3; TailVaR90 Risk ($B): 173.9
- CO2 2030 rate (average MMt/year CO2)
  - resource-based: 44.5
  - load-based: 33.9
- Resources
  - Average conservation (MWa) by end of study: 4566
  - Wind complementing RPS (MW): 300 (Dec-15); 3600
  - Geothermal (MW): 52 (Dec-17); 208
  - CCCT (MW): 1512 (Dec-17); 2268
  - SCCT (MW): 162 (Dec-15); 162

Source: Portfolio Summaries.xls

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High Discretionary Conservation

- 220 MWa/year ramp, instead of 160 MWa/year
- NPV Cost ($B): 103.8; TailVaR90 Risk ($B): 152.1
- CO2 2030 rate (average MMt/year CO2)
  - resource-based: 39.7
  - load-based: 26.5
- Resources
  - Average conservation (MWa) by end of study: 5849
  - Wind complementing RPS (MW): 1800 (Dec-15); 2100
  - Geothermal (MW): 52 (Dec-15); 195
  - CCCT (MW): 378 (Dec-17); 378
  - SCCT (MW): 162 (Dec-15); 162

Source: Portfolio Summaries.xls

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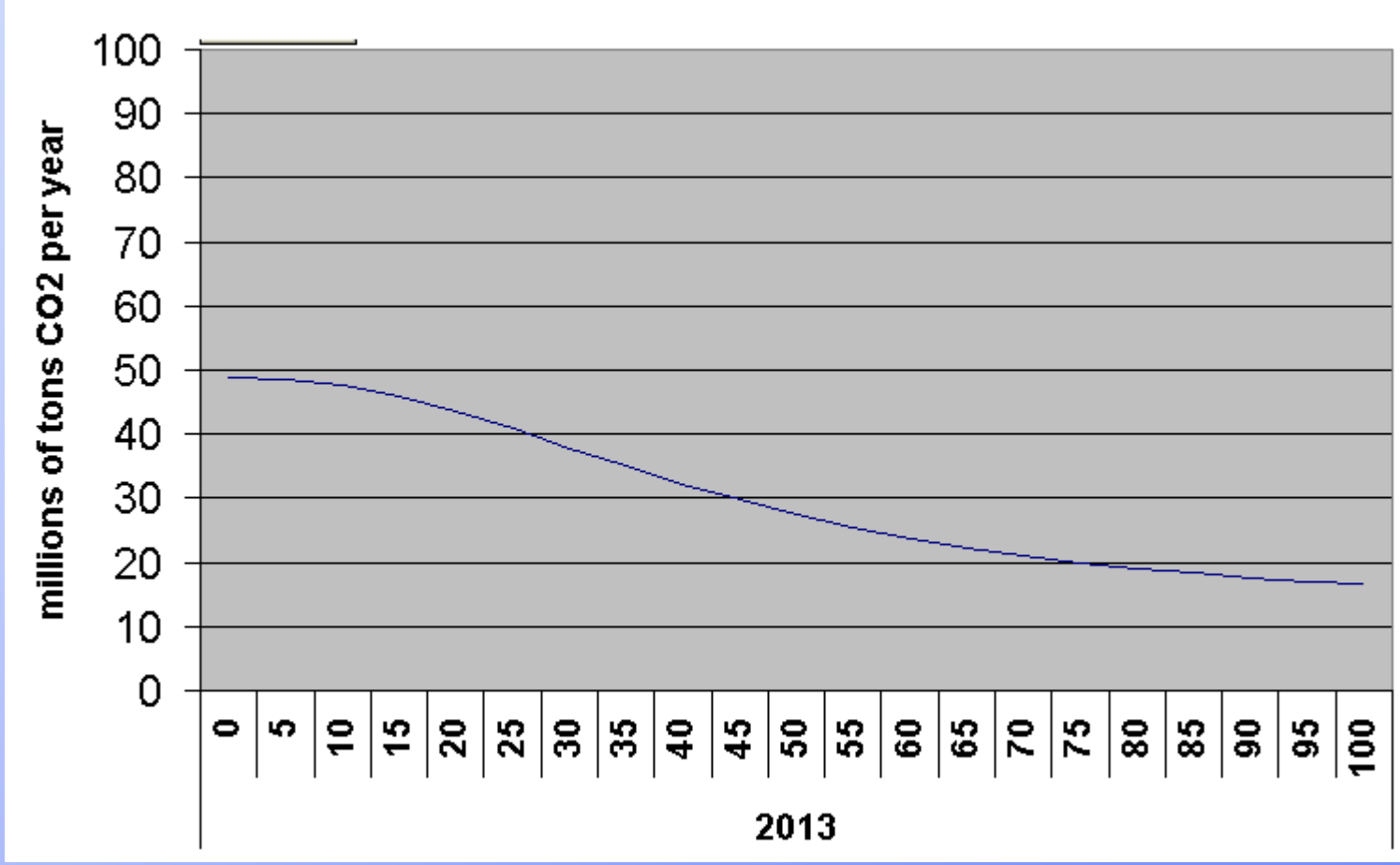
End

Trade-Off Curves for Emissions and Penalties



Source:: L811s - Sensitivity study on Carbon.xls, with sensitivity moved

to the horizontal axis and 2013 selected

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Transfer Cost Effects

- Some carbon control policies rely on taxes that would be collected somewhere along the fuel stream (production, conversion, use)
- The identity of winners and losers, and whether these costs should be considered "real", depends on what happens to those tax revenues
- Regional Portfolio Model produces costs and risks both with and without the carbon penalty cost
- While the costs and rates would differ significantly, preliminary studies suggest the plan selection *would be the same irrespective* of the treatment of these costs.