2011 Integrated Resource Plan

PUGET SOUND ENERGY

August 11, 2011

Presentation Road Map

Key Policy Findings & Overview—David Mills

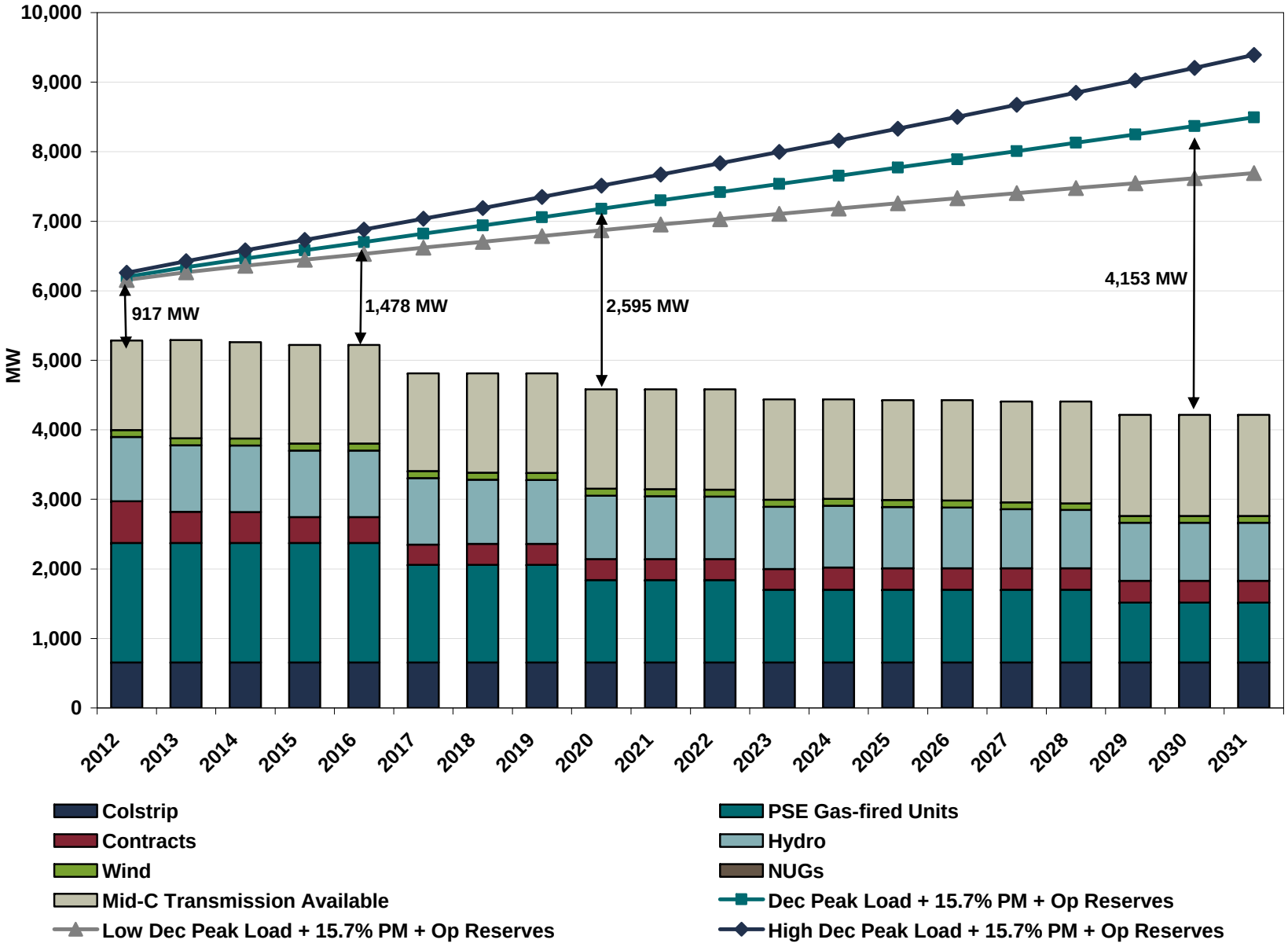
2011 IRP Review—Phillip Popoff

- Electric then Gas…
- Scope and Focus of IRP
- Key Risk Factors
- Analytical Findings

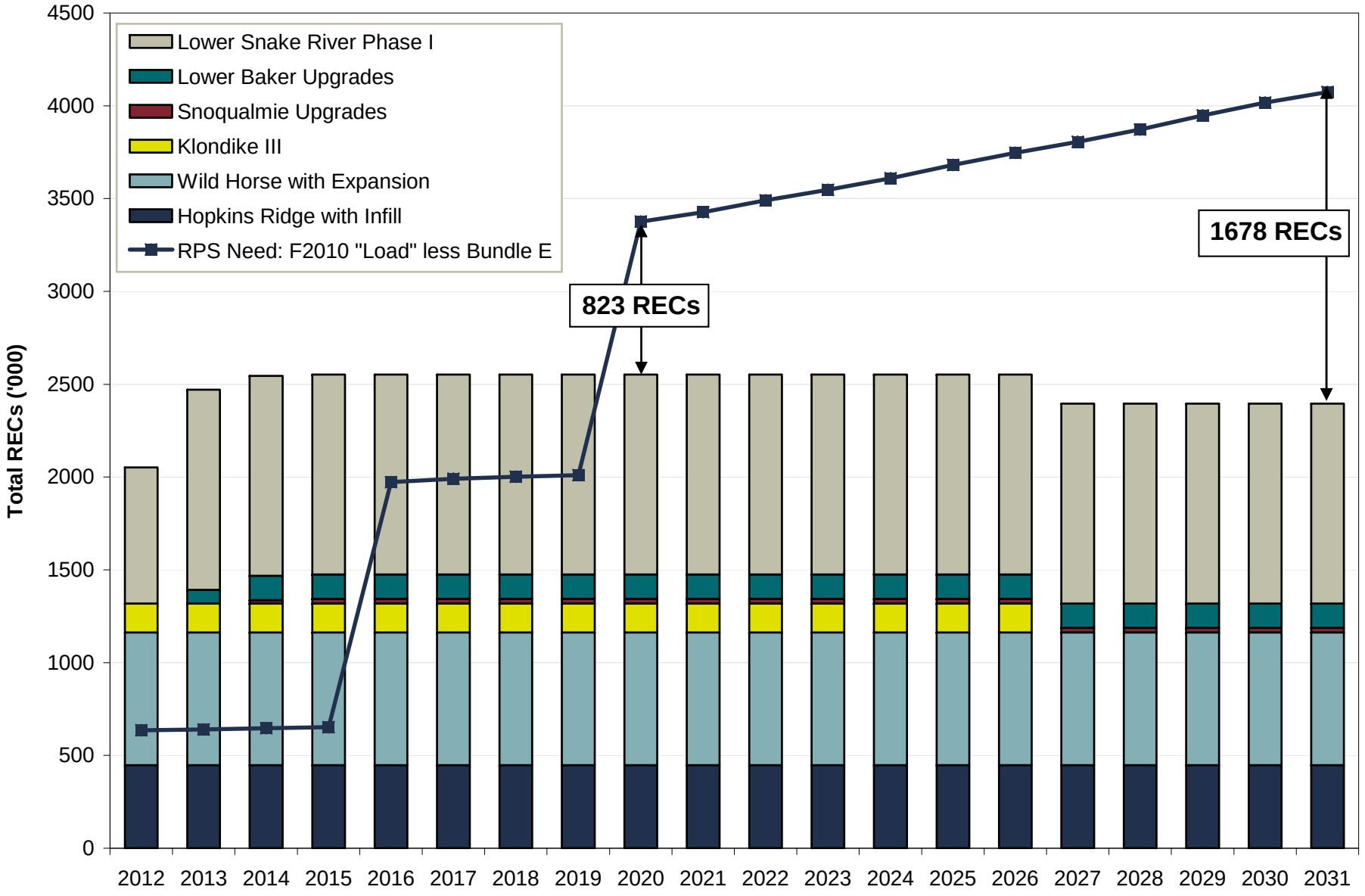
Key Conclusions

- Plan captures benefits of regional surplus for our customers
- Peakers over CCCT plants
- Transmission to market
- Demand-Side Resources: Renewables to meet RPS
- Need not immediate in natural gas portfolio
- Managing potential swings in generation demand

Peak Hour Capacity Need



Need for Qualifying Renewable Energy



Electric Resource Plan

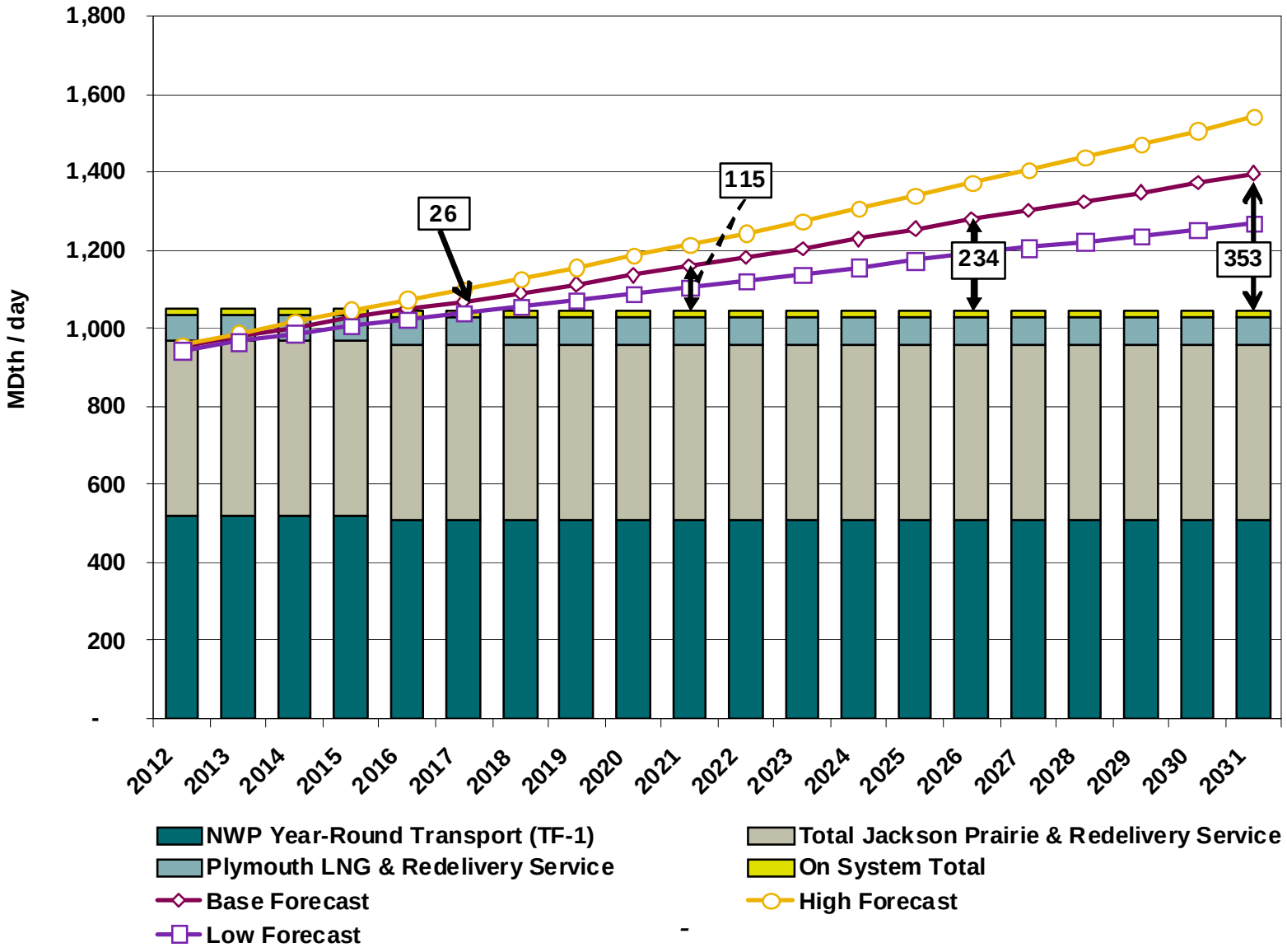
Incremental Additions in MW

	2016	2020	2025	2031
Demand-side Resources	423	815	1106	1319
Wind	0	300	300	400
Biomass	0	25	25	50
Transmission + Market	0	500	500	500
Peakers	1065	1278	1704	2443

Electric Action Plan--Highlights

- Demand-Side Resources: Work with CRAG on targets
- Renewables: Opportunistic approach for future needs
- Transmission: Consider cost effective alternatives
- Peakers are more cost effective than CCCTs
- Balancing Authority Needs

Design Peak-Day Resource Need-Gas



Gas Resource Plan

Incremental Additions in MDth/Day

	2016/17	2020/21	2024/5	2030/31
Demand-side Resources	31	56	65	78
NWP + Westcoast Exp	34	112	145	182
Cross-Cascades	0	0	0	31
Local LNG Storage	0	0	51	51

Gas Action Plan--Highlights

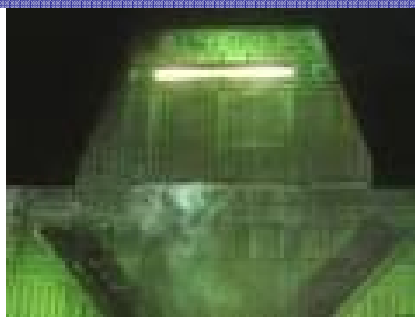
- Demand-Side Resources: Work with CRAG on targets
- Supply-Side Resources: Opportunistic approach & study possible expansion at Jackson Prairie
- Generation Fuel Supply

Detailed Summary 2011 IRP

2011 IRP Review—Phillip Popoff

- **Electric then Gas…**
- **Scope and Focus of IRP**
- **Key Risk Factors**
  - **Factors Affecting Least Cost Mix**
  - **Factors Affecting Cost**
- **Analytical Additional Findings**
  - **CCCT vs Peakers**
  - **Demand-Side Resources**
  - **Renewable Resources and Emissions**
  - **Load Forecasts**

Focus of Integrated Resource Plan



WAC 480-100-238 Integrated resource planning.

(1) Purpose. Each electric utility… has the responsibility to meet its system demand with a **least cost mix of energy supply resources and conservation**.

(2) (a) "Integrated resource plan" or "plan" means a plan describing the **mix of energy supply resources and conservation** that will meet current and future needs at the lowest reasonable cost...

(2)(b) "Lowest reasonable cost" means the **lowest cost mix of resources** determined through a detailed and consistent analysis of a wide range of commercially available sources….

Key Analytical Findings—Impact of Uncertainty

Factors Affecting Resource Plans (Mix)

- RPS Requirements Drive Renewable Need
- Expiring Renewable Incentives: Impacts Timing
- Load Forecast Changes
- Coal Regulated Out: Be Aware of Framework Boundaries

Factors Affecting Portfolio Costs

- Gas Prices
- Carbon Costs
- Shuttering Colstrip

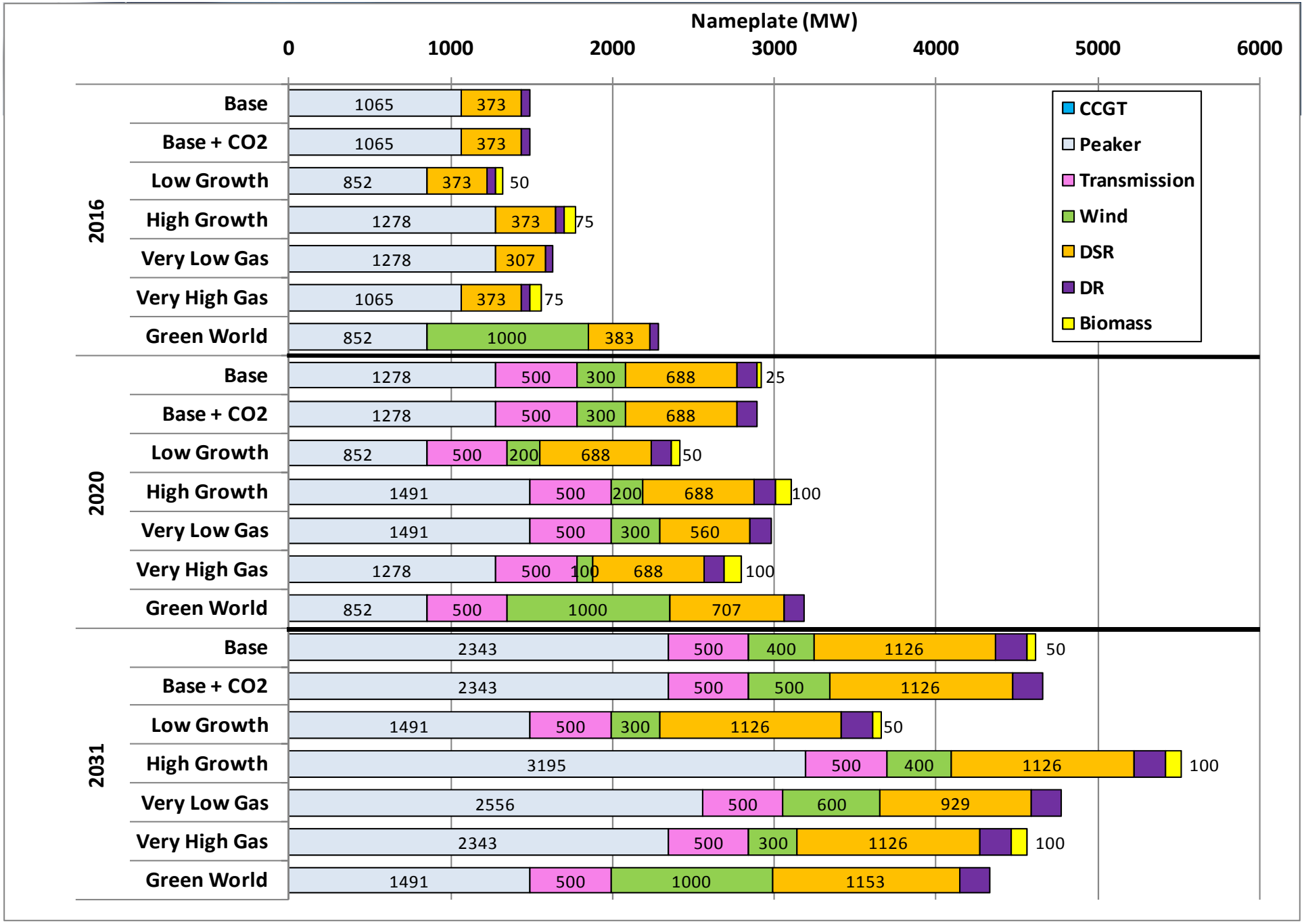
Scenarios and Sensitivities
Going In: Possible Risks Affecting Resource Mix

Scenarios: Complete Possible Futures

- Base Case: Mid Growth, Mid Gas Price, No New CO_2 Costs
- Green World: Low Growth, High Gas Price, High CO_2 Costs
- Low Growth: Low Growth, Low Gas Price, No New CO_2 Costs
- High Growth: High Growth, High Gas Price, No New CO_2 Costs

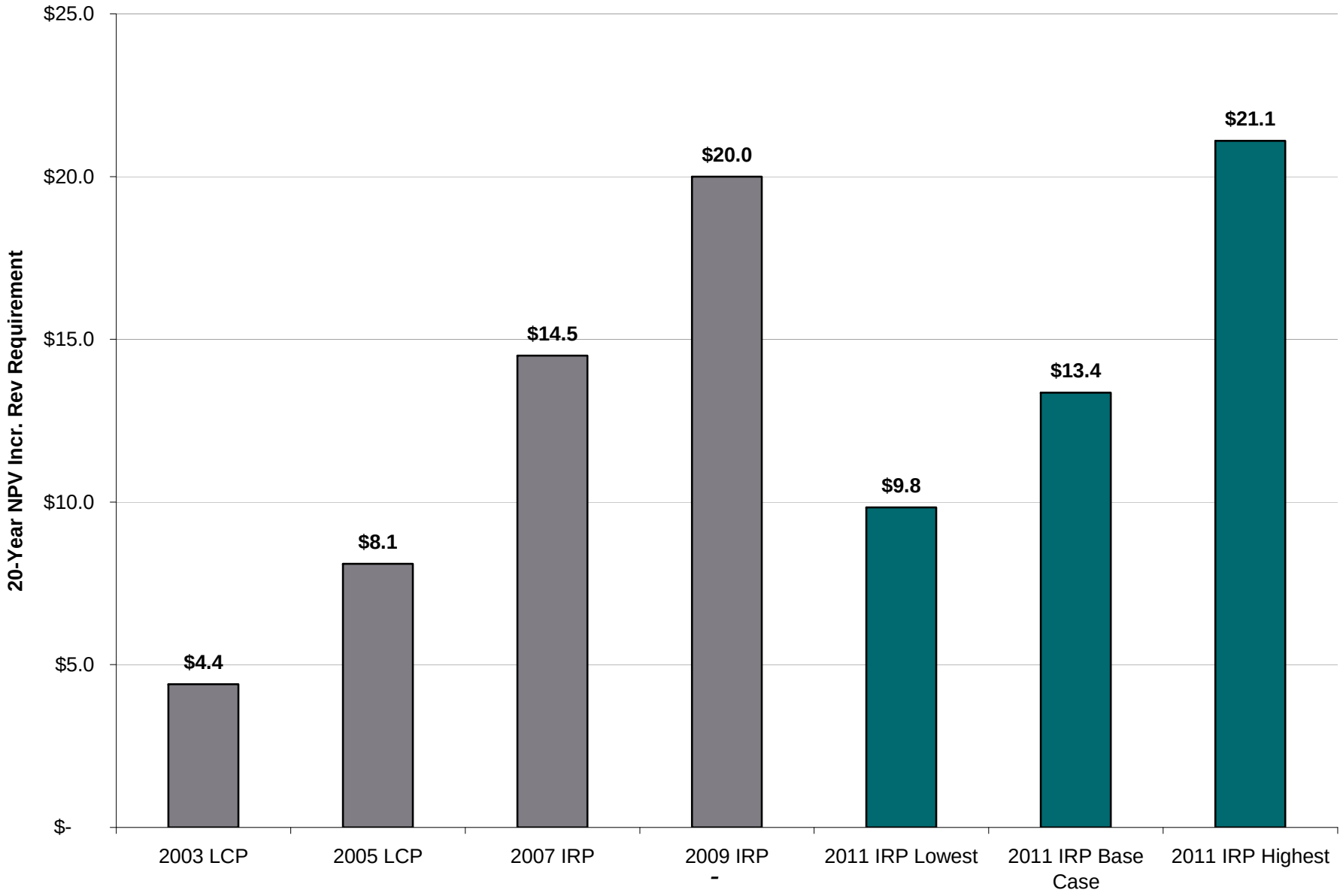
Sensitivities: What if/All Else Equal

- Base + CO_2 Costs
- No “Northwest Coal”
- Very High Gas Prices
- Very Low Gas Prices
- Electric Vehicles
- Financial Incentives for Renewables
- Accelerated Demand-Side Resources
- Drill Down on Peakers vs CCCT


Nameplate (MW)
0
1000
2000
3000
4000
5000
6000
CCGT
Peaker
Transmission
Wind
DSR
DR
Biomass
2016
Base
1065
373
Base + CO2
1065
373
Low Growth
852
373
50
High Growth
1278
373
75
Very Low Gas
1278
307
Very High Gas
1065
373
75
Green World
852
1000
383
2020
Base
1278
500
300
688
25
Base + CO2
1278
500
300
688
Low Growth
852
500
200
688
50
High Growth
1491
500
200
688
100
Very Low Gas
1491
500
300
560
Very High Gas
1278
500
100
688
100
Green World
852
500
1000
707
2031
Base
2343
500
400
1126
50
Base + CO2
2343
500
500
1126
Low Growth
1491
500
300
1126
50
High Growth
3195
500
400
1126
100
Very Low Gas
2556
500
600
929
Very High Gas
2343
500
300
1126
100
Green World
1491
500
1000
1153

-

Significant Range of Potential Costs



Additional Important Analytical Findings

CCCT vs. Peakers

- Can Lower Variable Cost of CCCT Cover Higher Fixed Cost?
- Do CCCT Plants Reduce "Risk?"

Demand-Side Resources

- Consistent With Council Methodology-But More Aggressive Ramp
- Reduces Cost and Cost Risks
- Reduces Emissions

Renewables and Emissions

- Factors Affecting Renewable Builds
- CO2 Emissions Under Different Conditions

Load Forecasts and Timing

- F2010 Forecast-IRP
- F2011 Forecast-GRC & RFP

CT versus CCCT

- Higher Capital Cost of CCCT Does Not Appear to be Offset by Higher Margins/Lower Variable Cost
- Gas CCCT Reduces Variable Cost Risk, But Not Sufficient To Cover Higher Cost

Portfolio Cost Differences: Peakers vs CCCT

Scenario	20-yr NPV Expected Cost (Incremental Rev Req $Billions)
Base	$13.36
Base + Peaker Fixed Gas Transport Cost	$14.10
Base + No Peaker	$14.54
Base + Peaker/CCCT Blend	$14.26

Annualized Difference
~$120 million/yr

Non-Trivial

~$45 million/yr

-

CCCT Not Cost Effective Way to Reduce Risk

Trade Off Table ($Billions) 20-Year View

+$1.18 Bil

Study Period	Base	Fixed Gas Transport	Peaker/CCCT Blend	No Peaker
20-yr NPV Expected Cost	$13.36	$14.10	$14.26	$14.54
20-yr NPV Power Cost	$10.36	$10.37	$10.17	$10.04
Tail Var 90 of Expected Cost	$17.90	$18.63	$18.41	$18.53
Tail Var 90 of Power Cost	$13.15	$13.14	$12.82	$12.60

-$0.55 Bil

Question:

Increase expected revenue requirement by $1.18 Billion to reduce power cost risk by $.55 Billion?

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Consistency with Council Methodology

http://www.nwcouncil.org/energy/powerplan/6/supplycurves/I937/default.htm

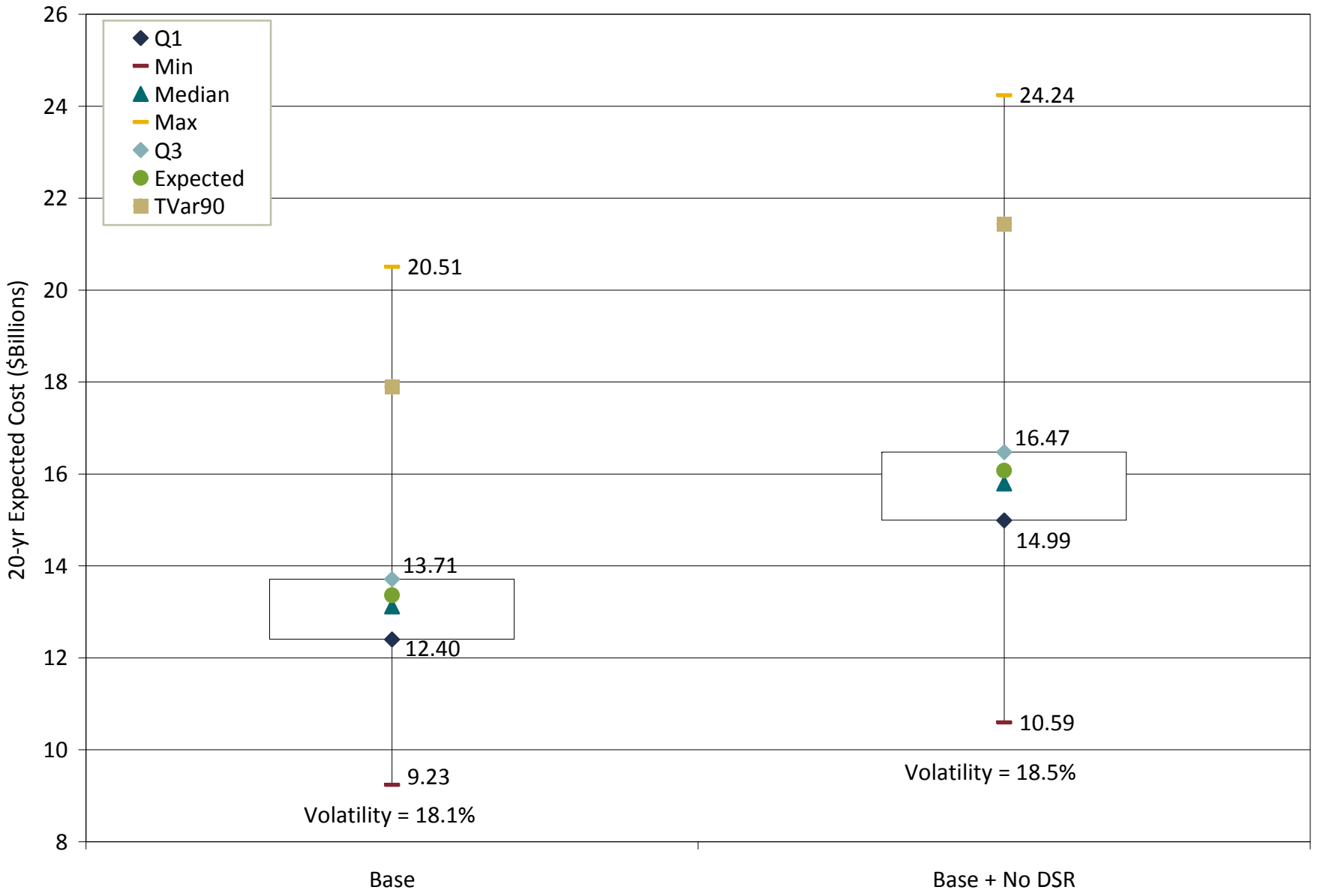
	Technical Potential	Economic Potential	Achievable Potential
Council	**See 2. a & b** -Wide array tech, all sectors -Saturations -New/Existing Units -Measure Life/Substitutions -Measure Shapes -Measure Interactions	**See 3. a - e** -Econ Screening-TRC -Shaped Energy/Capacity -Full Incremental Cost -T&D Savings & Losses -"Environmental Benefits" -NEB/10% Credit	**See 4. a - c** -Targets from IRP Analysis -DSM Versus All Resources -B&C from Econ Screen -Lost Opportunity/Discretion -Adjusted Historic Ramps -Revise Based on Exp.
PSE	**See 2. a & b** ☑ Wide array tech, all sectors ☑ Saturations ☑ New/existing units ☑ Measure life/substitutions ☑ Measure shapes ☑ Measure interactions	**See 3. a - e** ☑ Econ Screening-Bundles ☑ Shaped Energy/Capacity ☑ Full Incremental Cost ☑ T&D Savings & Losses ☑ Environmental Benefits" ☑ NEB & 10% Credit	**See 4. a - c** ☑ Targets from IRP Analysis ☑ DSM Versus All Resources ☑ B&C from Econ Screen ☑ Lost Opportunity/Discretion ☑ Adjusted Historic Ramps ☑ Revise Based on Exp.

Cost Effectiveness of DSR Estimated Directly

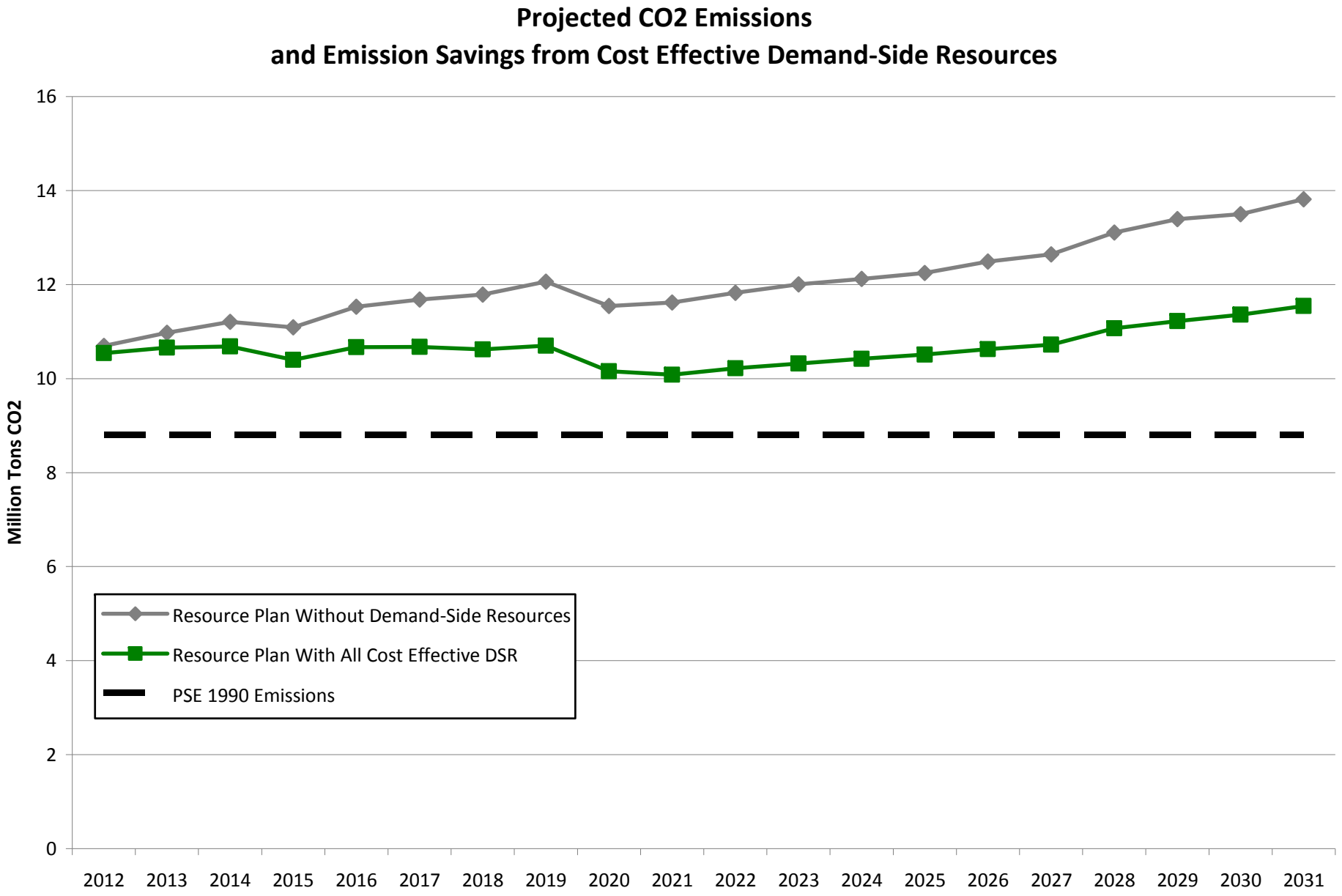
- Portfolio Analysis Determines Least Cost Mix of Resources
  - Demand and Supply-Side Resources Apples-to-Apples
  - Avoided Costs: Derived From IRP Output, Not Input

- Demand-Side Resource Potentials Developed
  - Technical and Achievable Potentials Estimated
  - Starts with RTF and Adjusts for PSE Service Territory
- Cost of DSR Measures Adjusted
  - Reflects T&D savings,
  - Non-Energy Benefits, and
  - 10% Regional Preference Electric
- Measures Aggregated by Adjusted Cost up Supply Curve in “Bundles”
- Bundles are Resource Alternatives Along Side Supply-Side Resources to Directly Estimate Cost Effectiveness

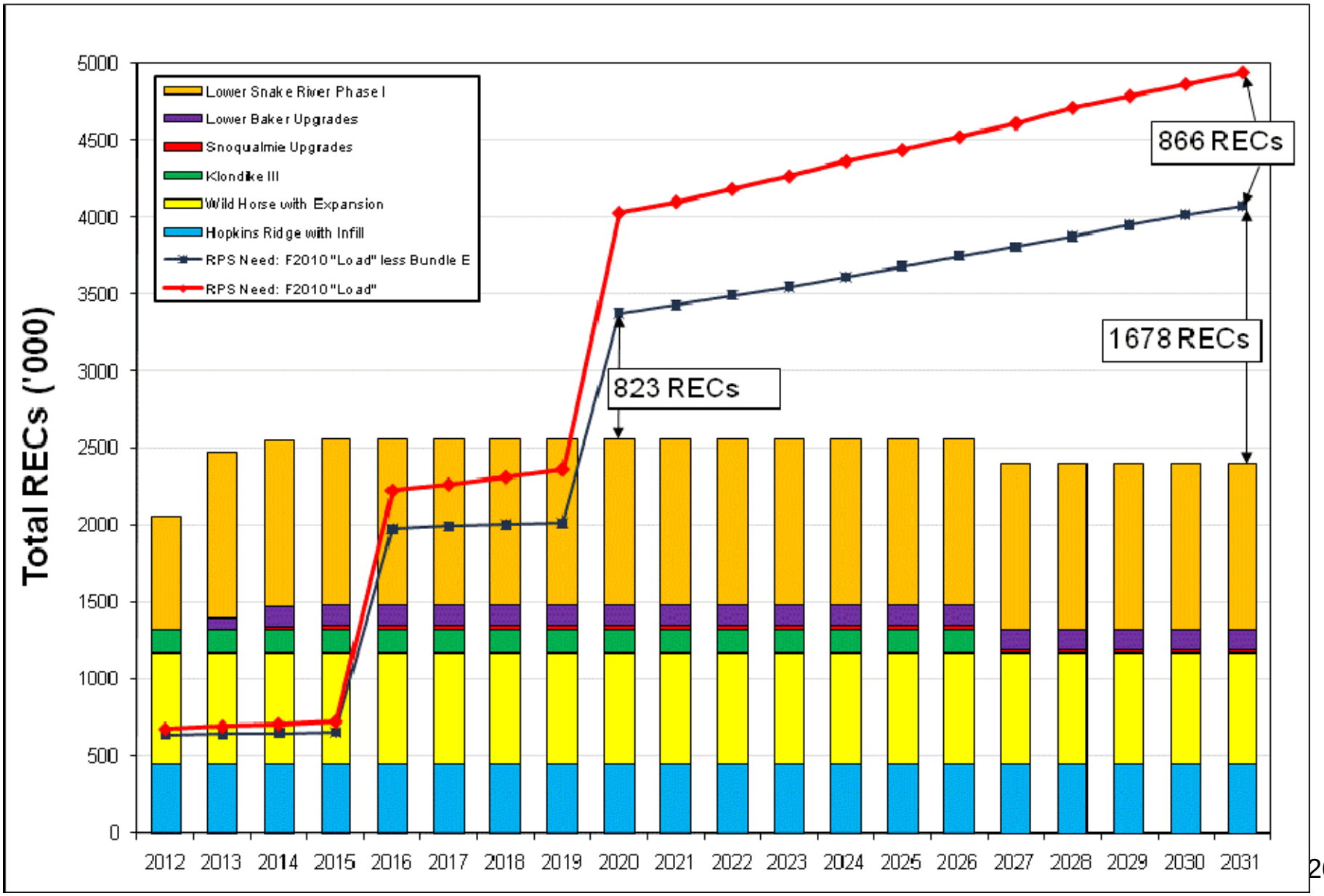
Impact of Cost Effective DSR on Cost & Risk



Impact of DSR on Forecast CO2 Emissions



Impact of DSR on Need for Renewables



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Renewables and Emissions

- Factors Affecting Renewable Builds
- CO2 Emissions Under Different Conditions

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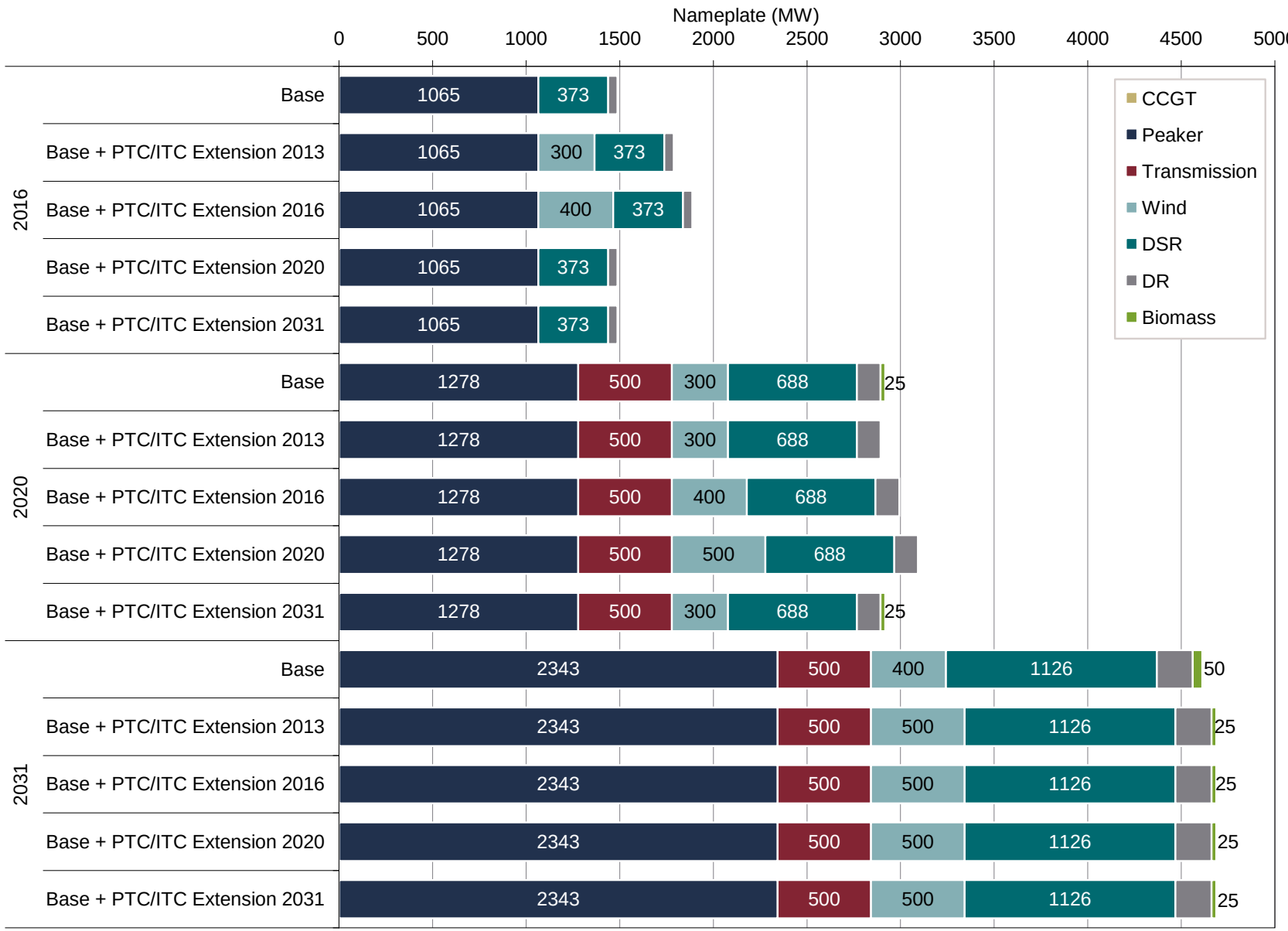
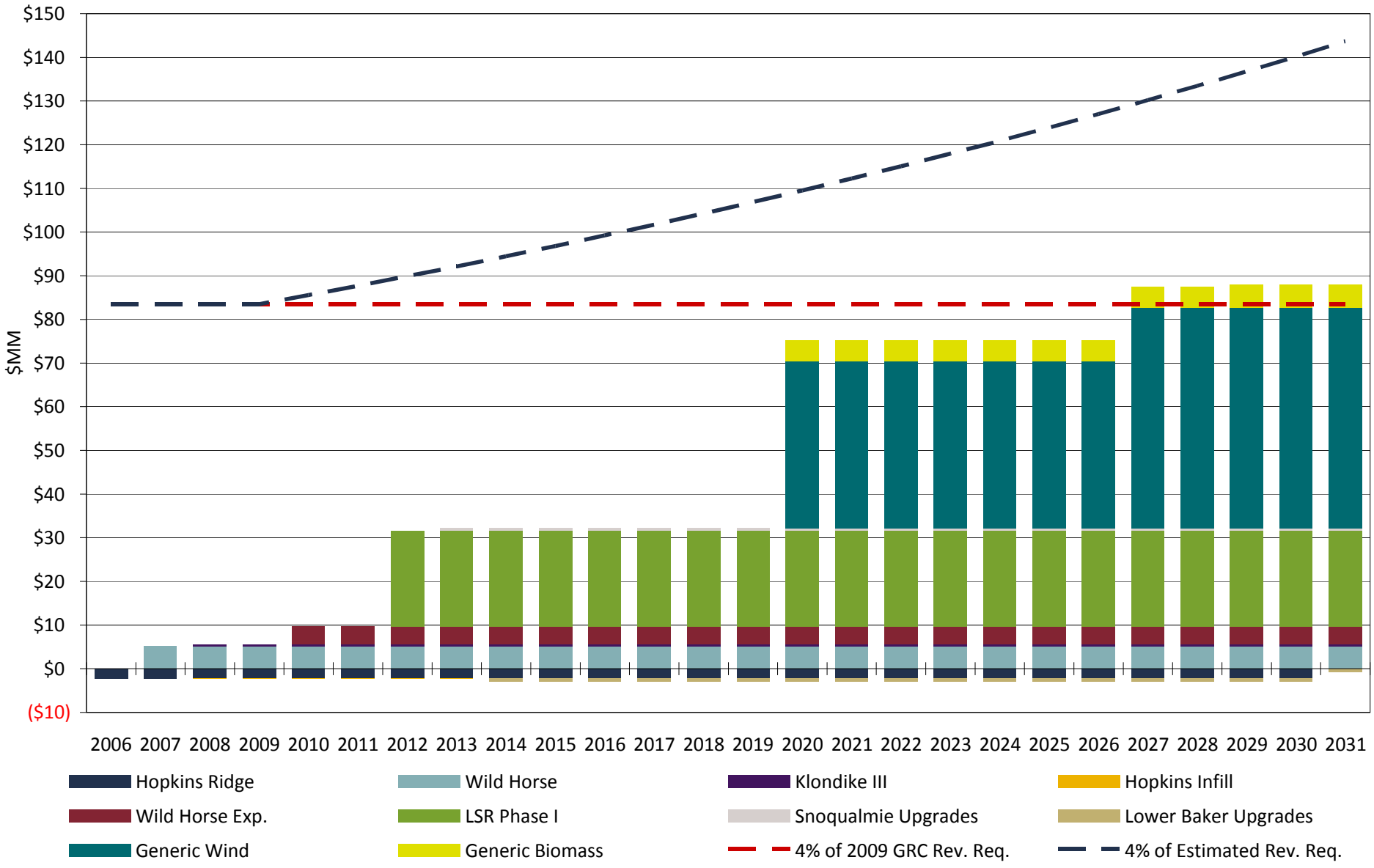
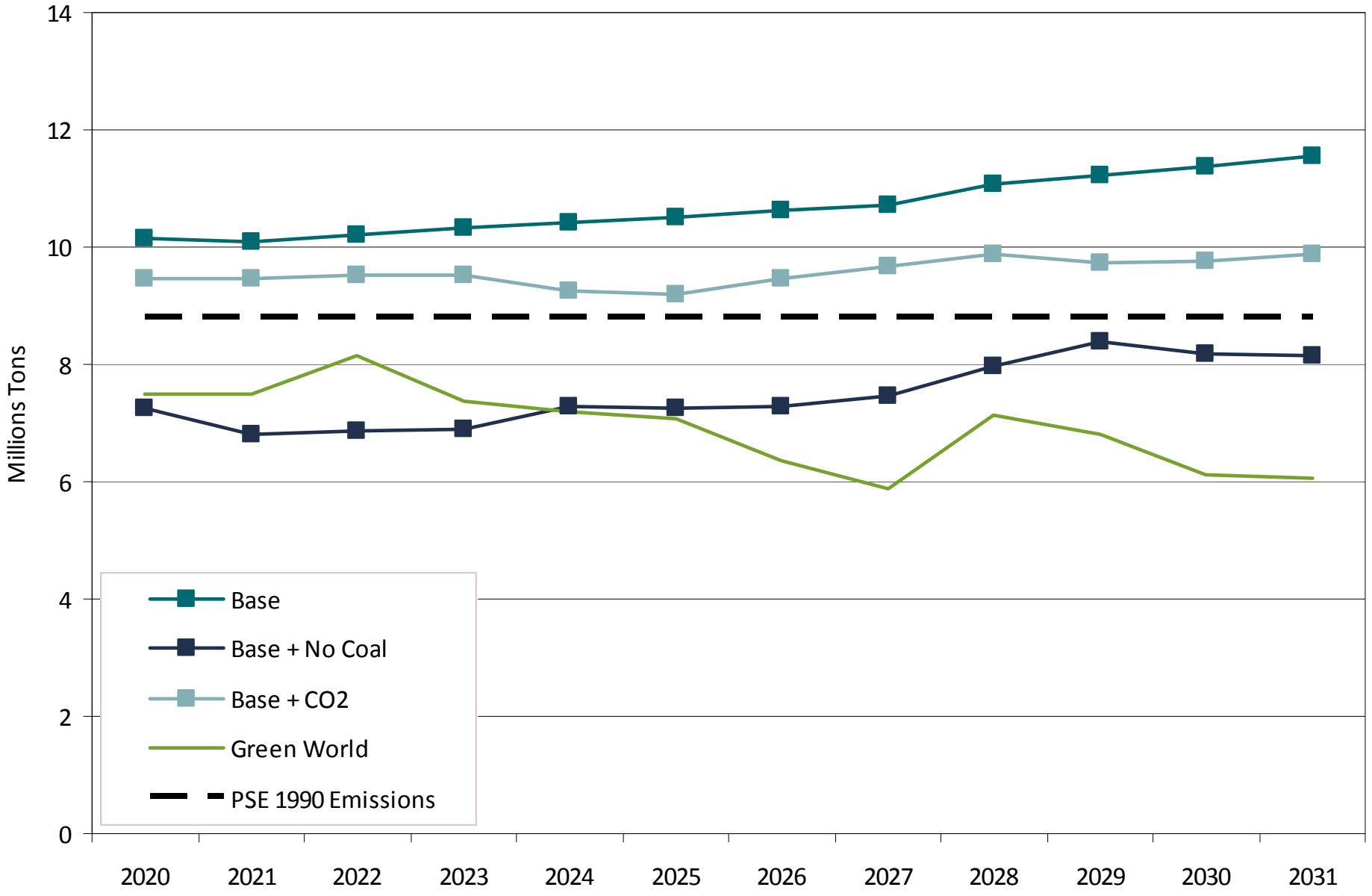
Expiring Financial Incentives Accelerate Least Cost Addition of Renewables-Given RPS



Expect to Stay Under 4% Rev Req Cap



Significant Cuts to Emissions Challenged



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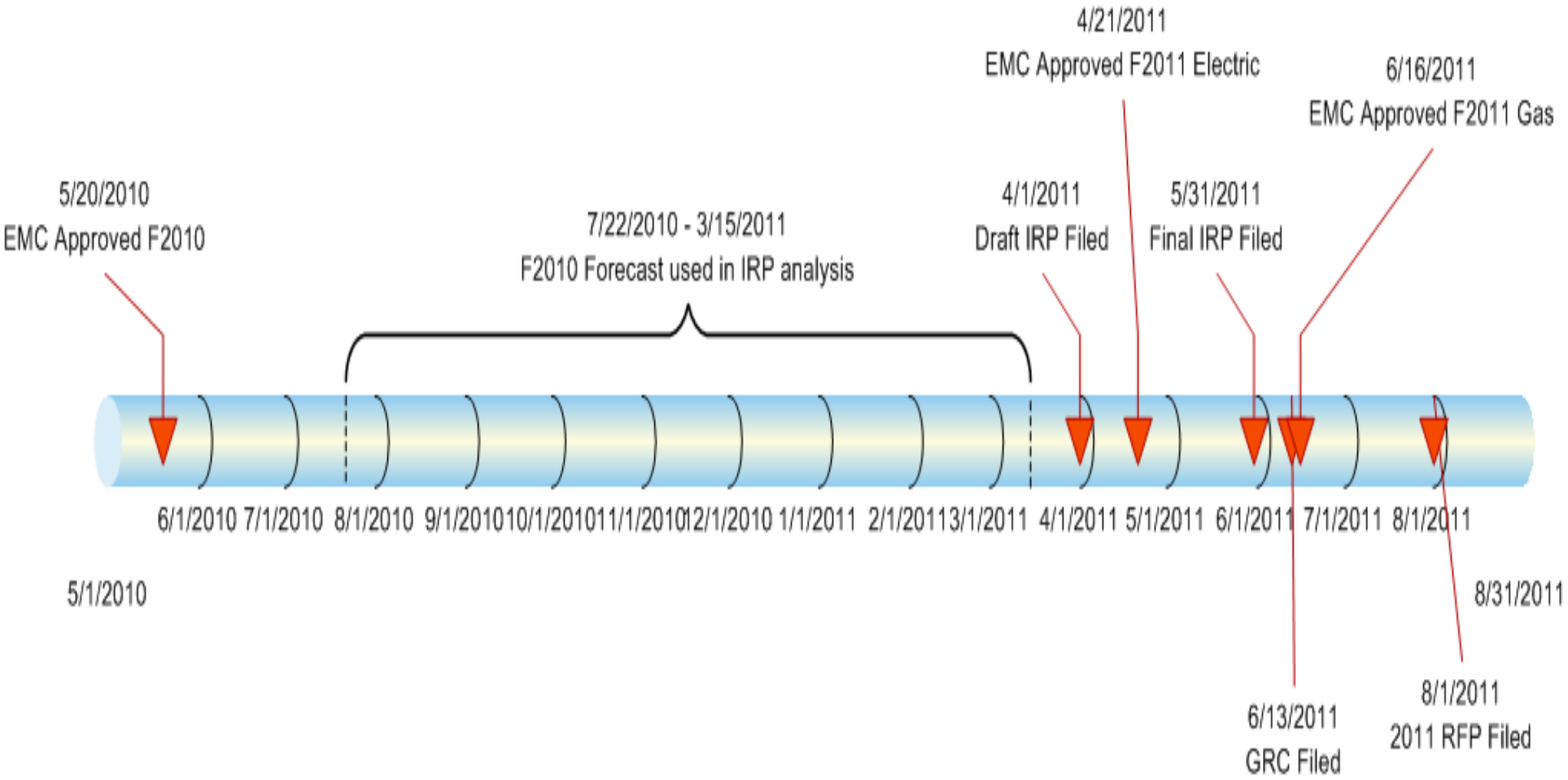
Demand Forecast Update Timeline



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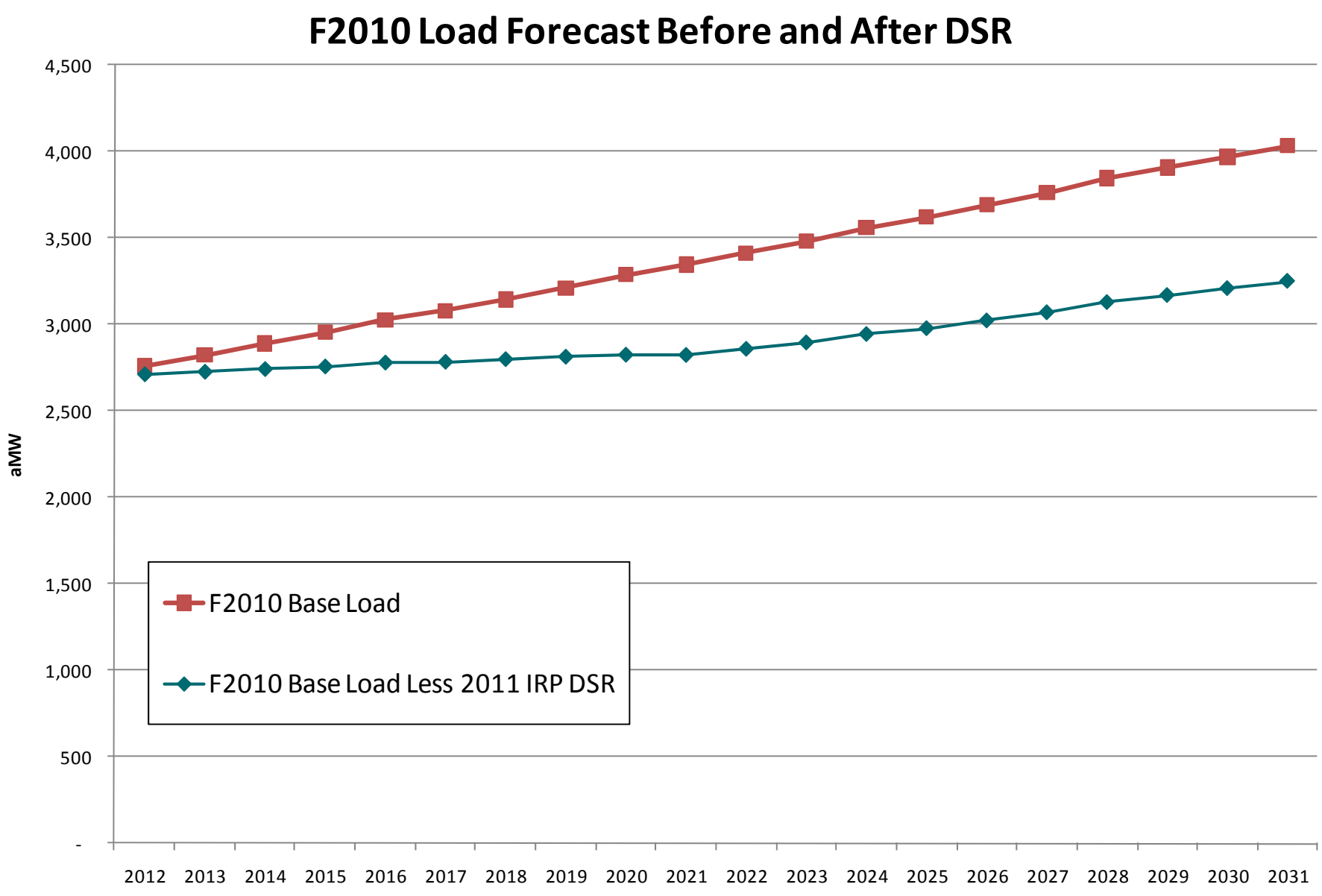
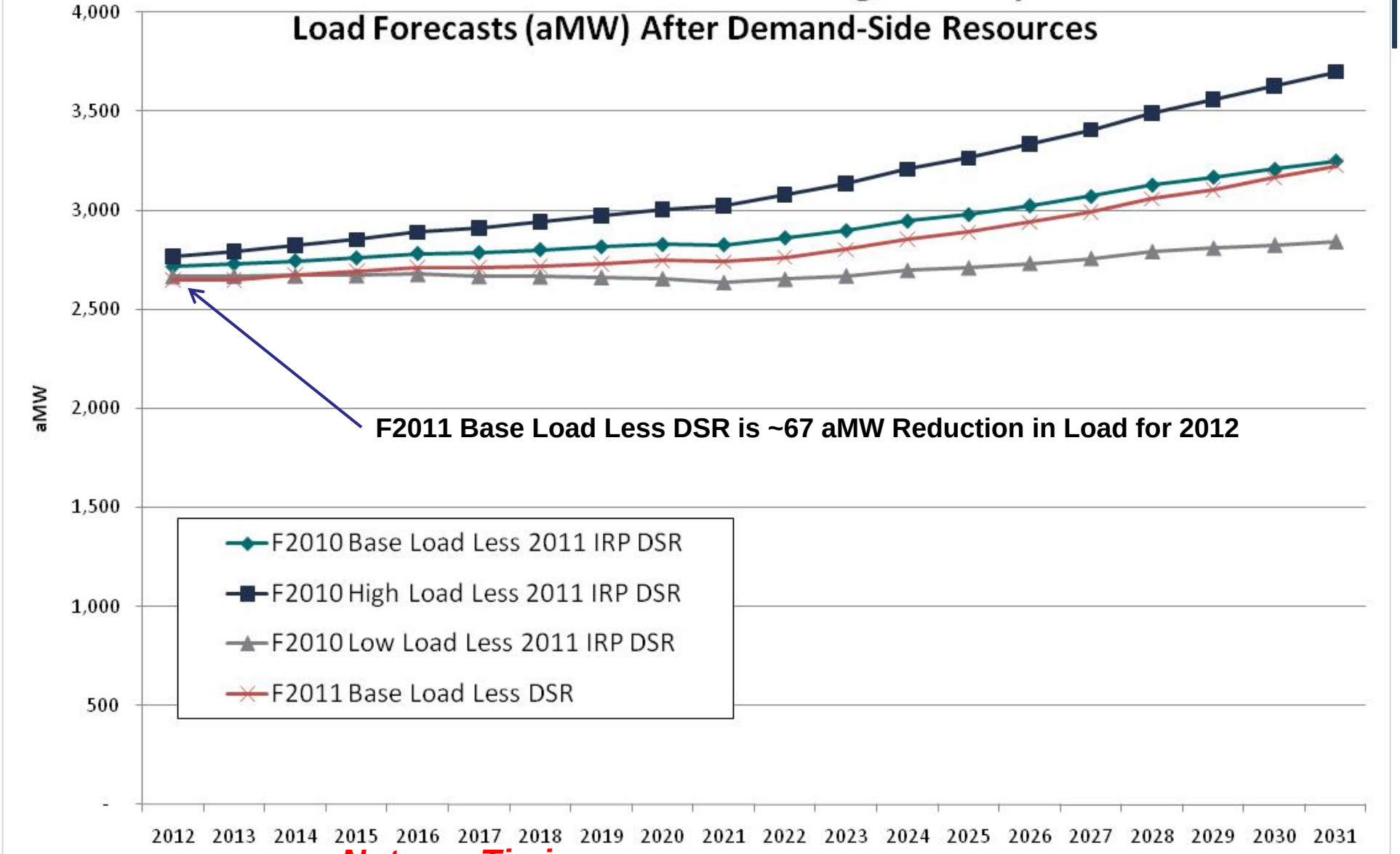
Impact of DSR on Load Forecast (aMW)



F2011 Load Forecast Down Significantly

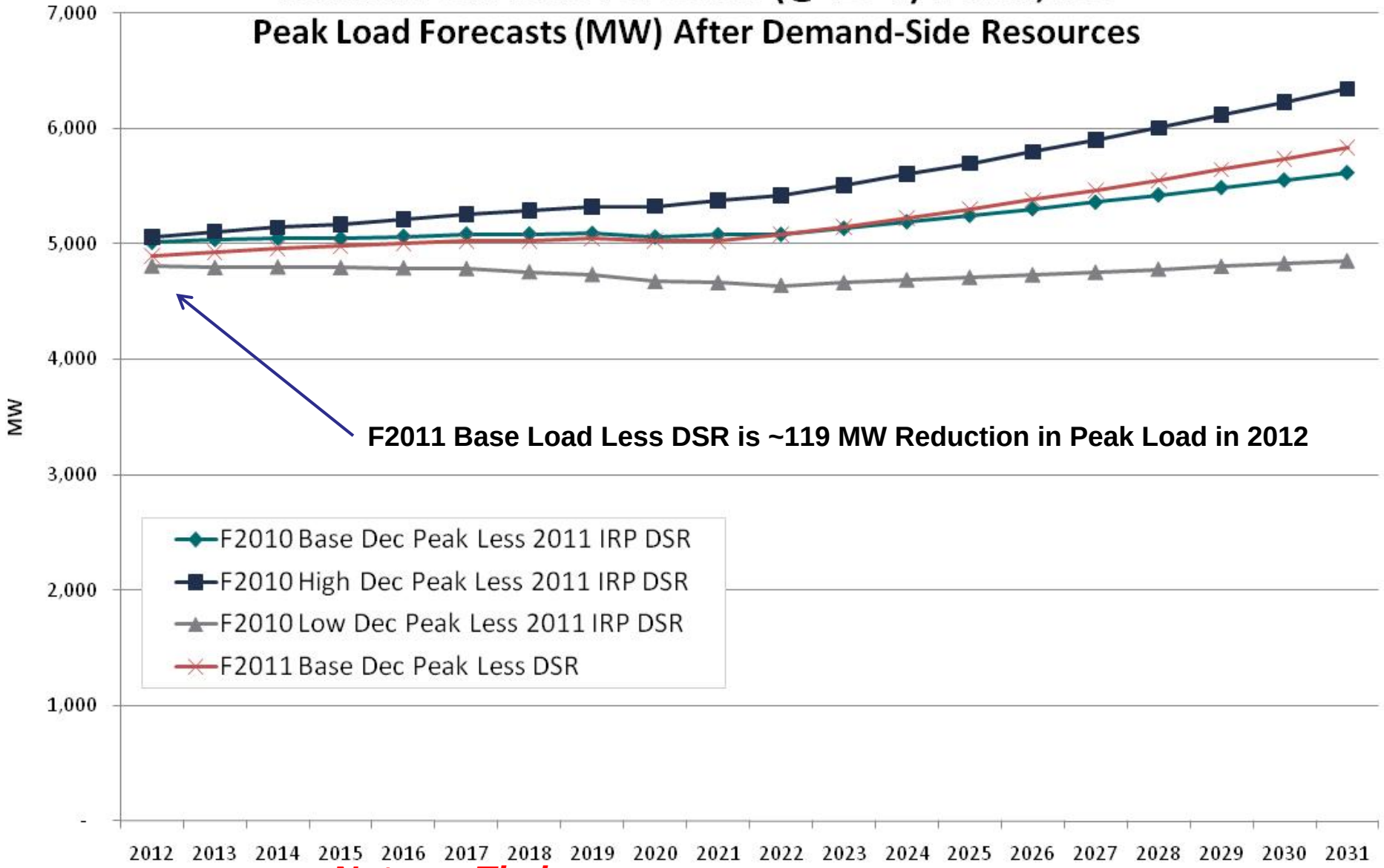


Note on Timing

F2010: Used for IRP

F2011: Used for GRC & Upcoming RFP

Normal Peak Load Forecasts (@ 23°F) Down, Too



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Conclusions on Electric Resource Plan

"Plans" Versus "Planning"

<u>The Planning:</u>

- Capture Benefits of Regional Surplus for Our Customers

<u>Plans—May Change:</u>

- Based on Actual Resource Alternatives/Contracts
- Evolving Market Conditions

Gas Resource Plan

- Scope and Focus of IRP
- Summary Findings
- Resource Needs
- Resource Alternatives
- Analytical Results

Integrated Resource Planning

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(1) Purpose. Each natural gas utility… has the responsibility to meet its system demand with a **least cost mix of natural gas supply resources and conservation**.

(2) (a) "Integrated resource plan" or "plan" means a plan describing the **mix of natural gas supply resources and conservation** that will meet current and future needs at the lowest reasonable cost...

(2)(b) "Lowest reasonable cost" means the **lowest cost mix of resources** determined through a detailed and consistent analysis of a wide range of commercially available sources….

Key Analytical Findings--Gas Plan

Factors Affecting Resource Plans (Mix)

- Avoided Commodity Costs: Significant Impact
  - Gas Prices
  - Carbon Costs
- Load Forecast Uncertainty

Factors Affecting Portfolio Costs

- Gas Prices
- Carbon Costs

Scenarios and Sensitivities Going In: Possible Risks Affecting Resource Mix

Scenarios: Complete Possible Futures

- Base Case: Mid Growth, Mid Gas Price, No New CO_2 Costs
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Sensitivities: What if/All Else Equal

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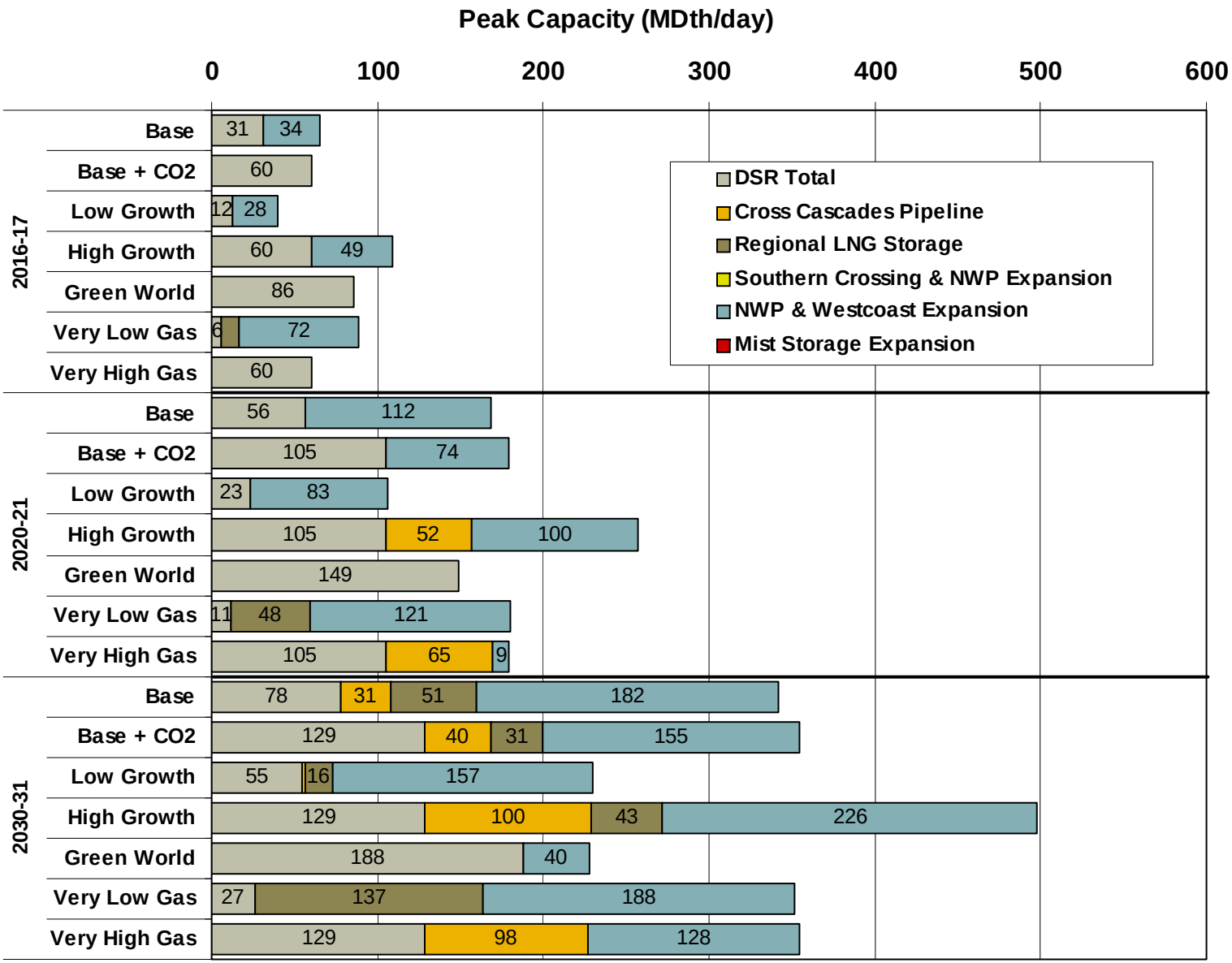
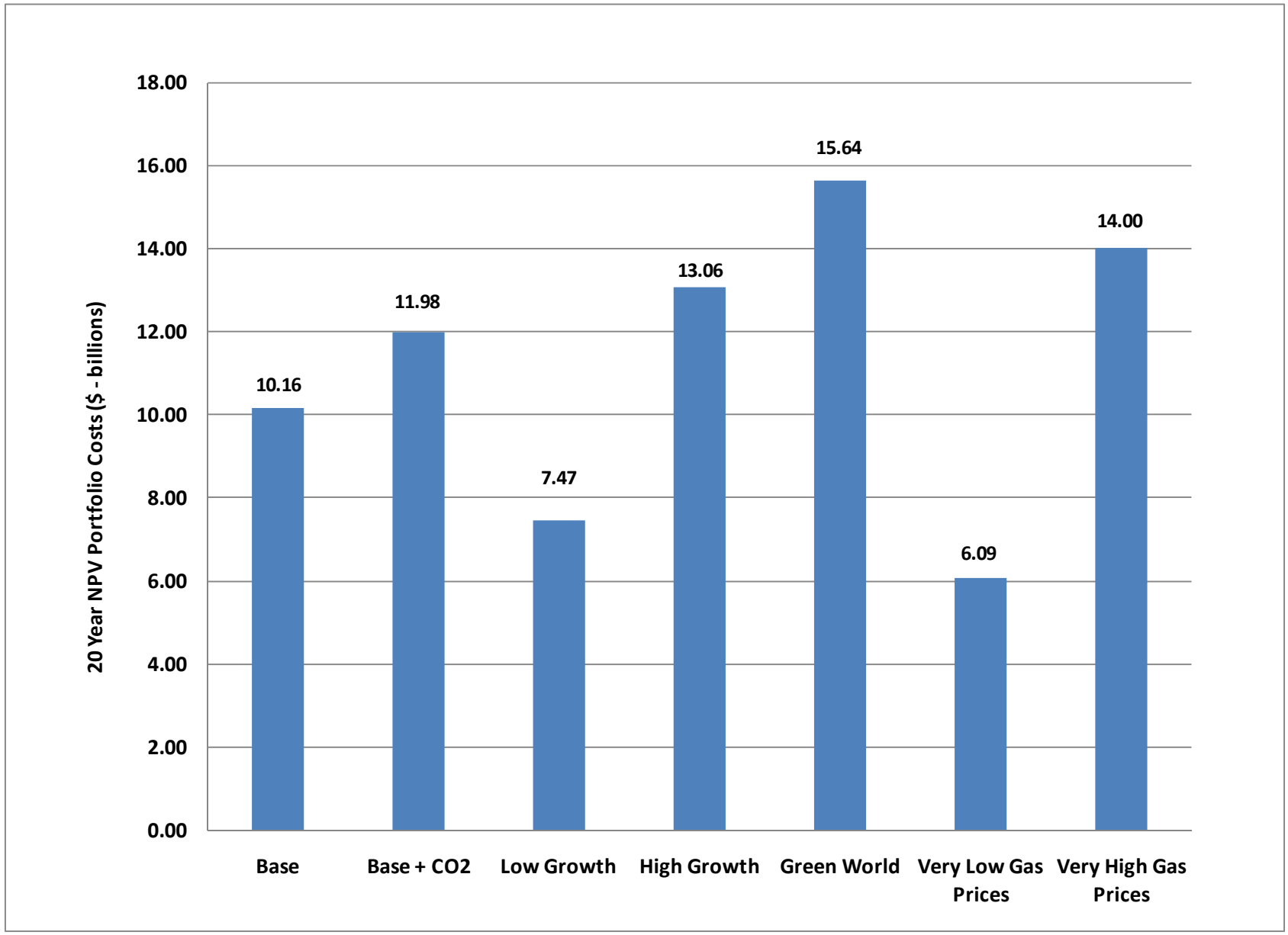
- No "Northwest Coal"
- Very High Gas Prices
- Very Low Gas Prices
- Electric Vehicles
- Financial Incentives for Renewables
- Accelerated Demand-Side Resources
- Drill Down on Peakers vs CCCT

Gas Sales Portfolio Additions



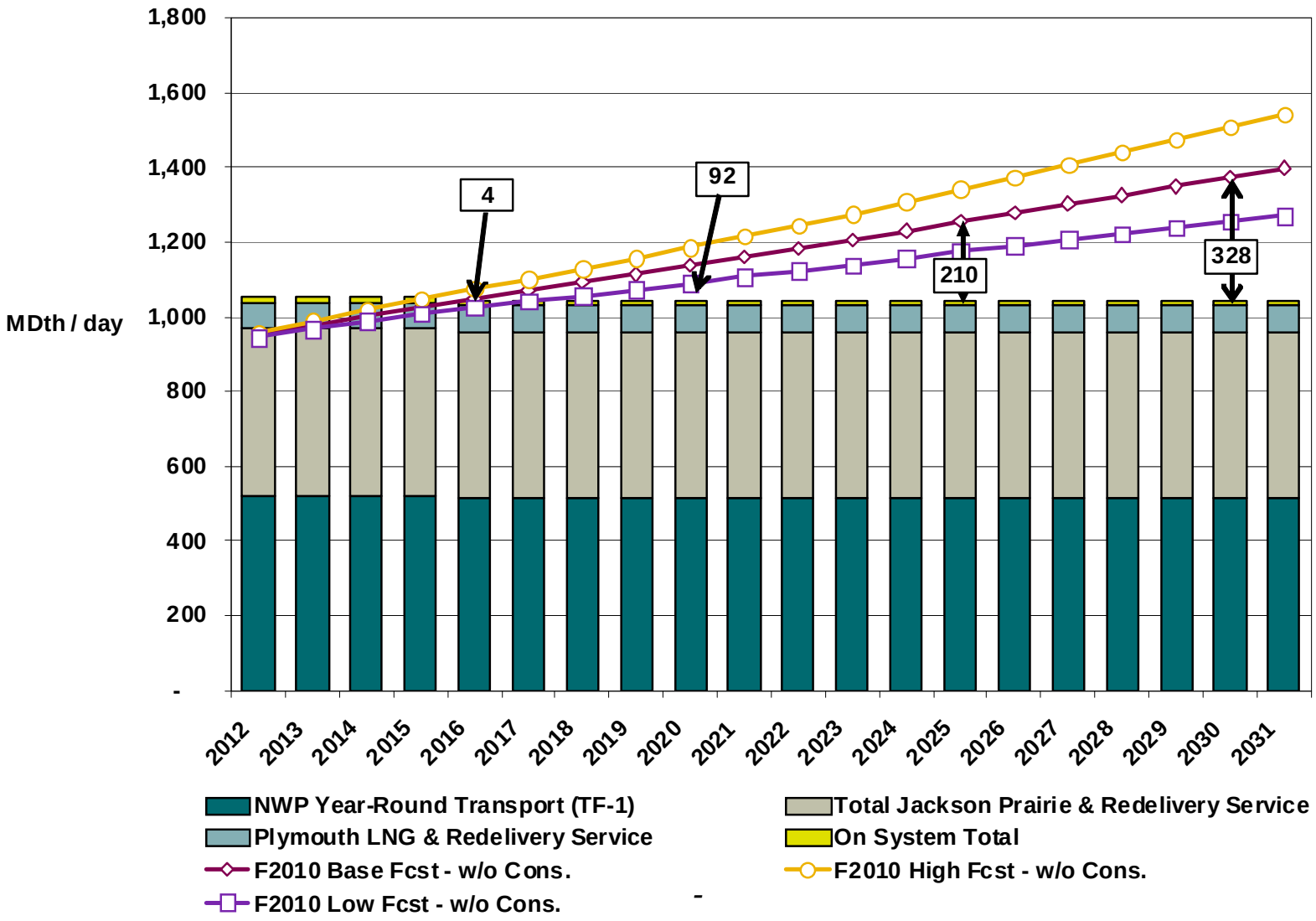
Gas Sales NPV Portfolio Costs



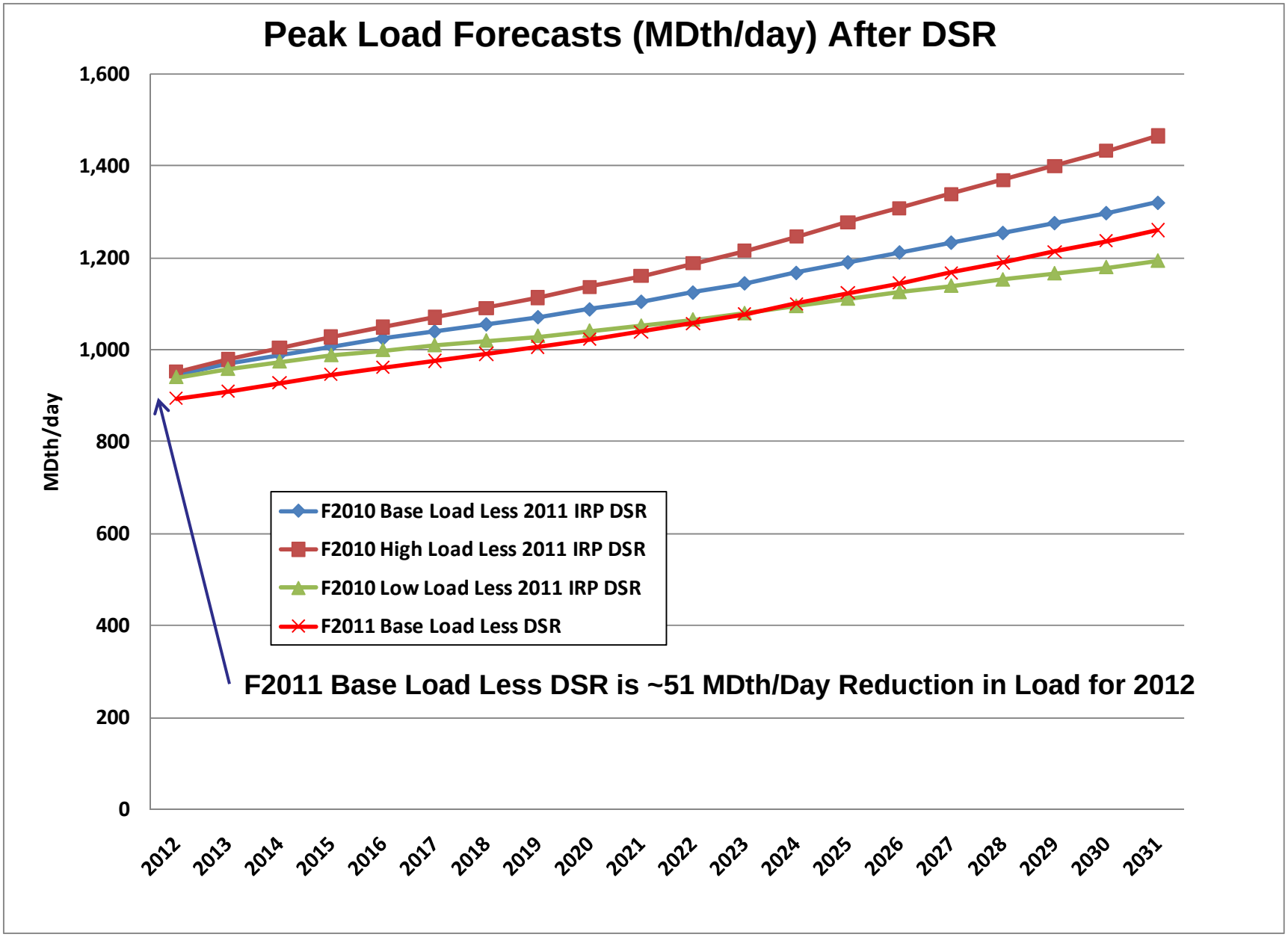
Gas Resource Plan

- Scope
- Summary Findings
- Resource Needs
- Resource Alternatives
- Analytical Results

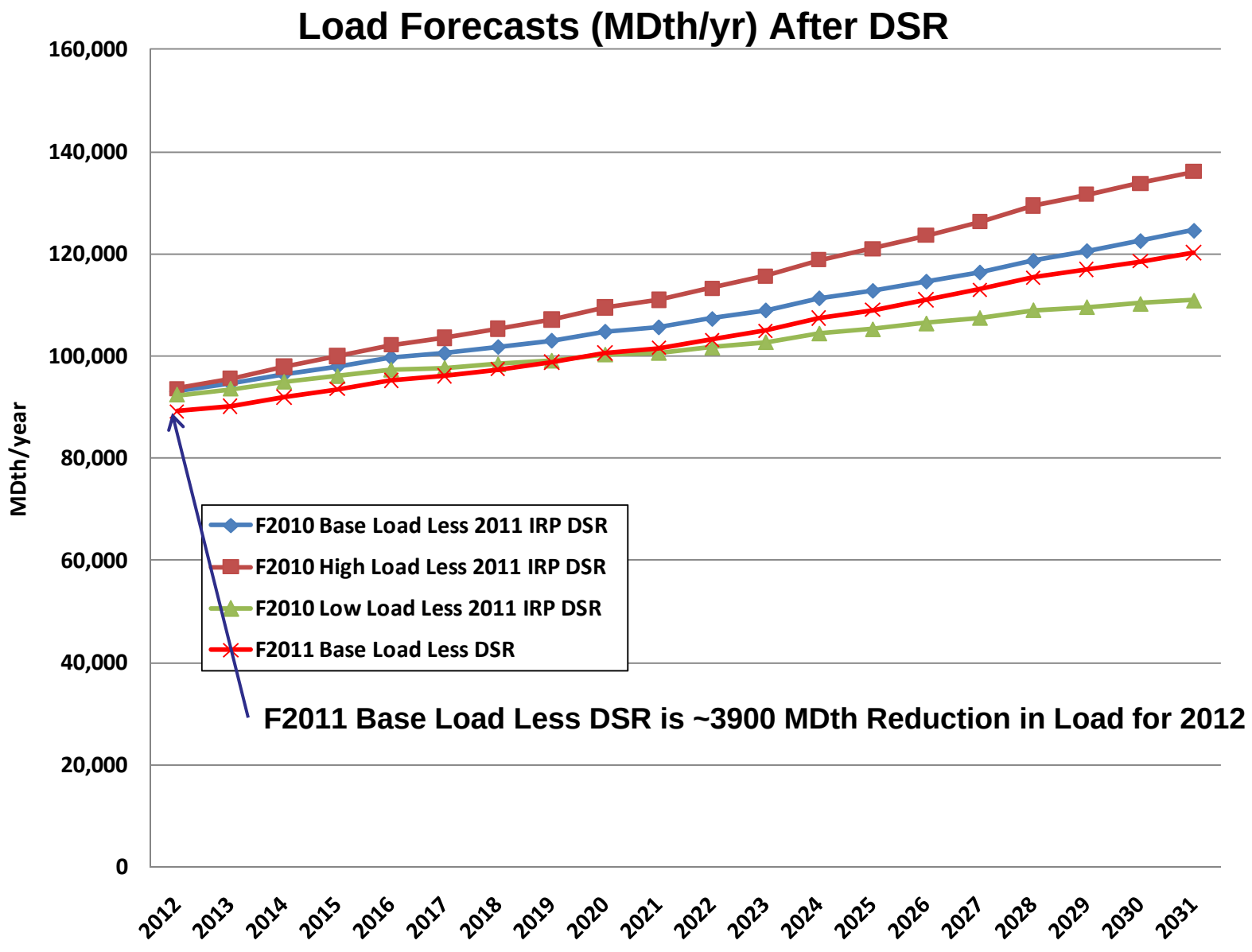
Gas Sales Peak Capacity Need-Before DSR



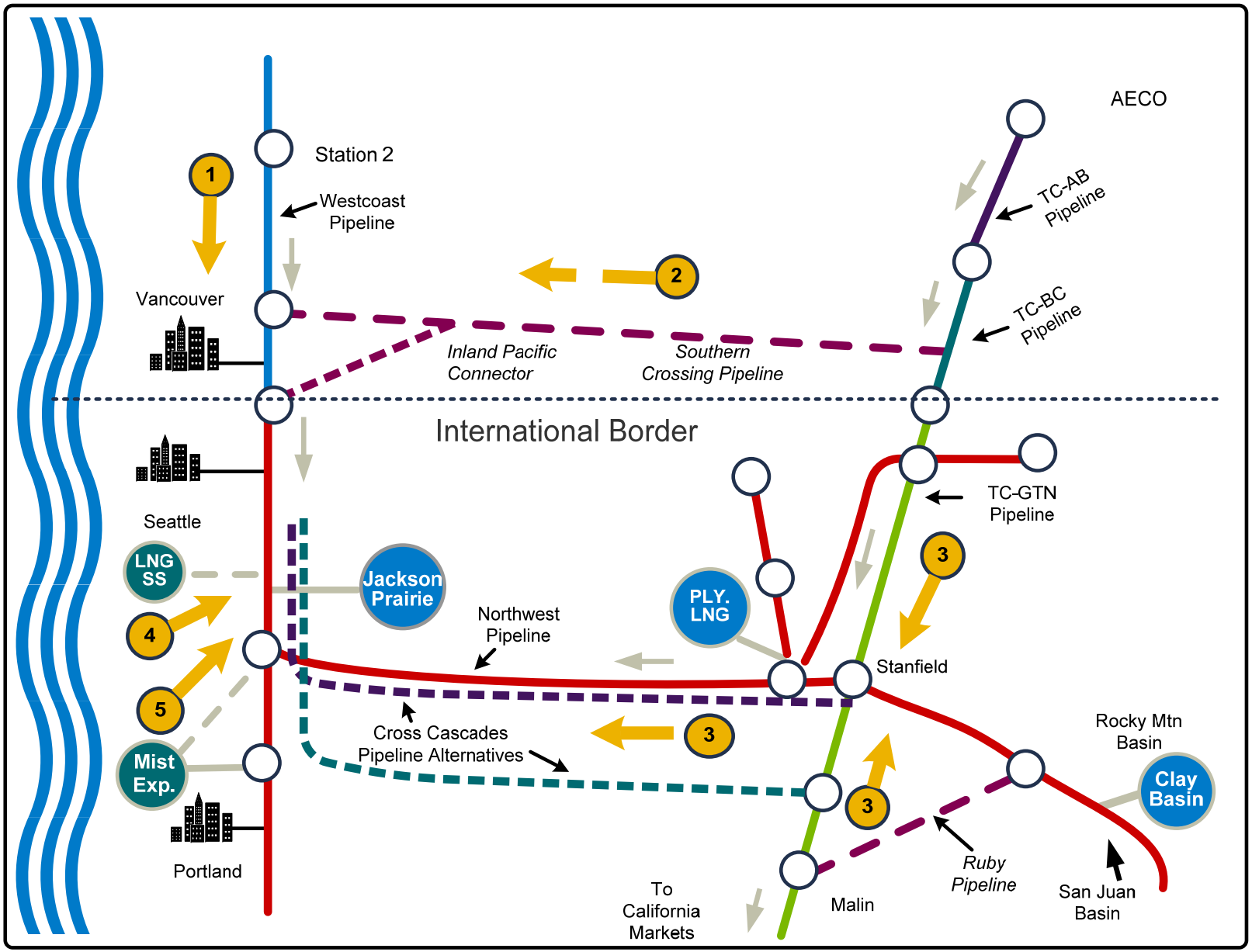
F2011 Design Peak Load Forecast Down



F2011 Load Forecast Down Significantly



Gas Supply Alternatives



Demand-Side Resources

- Similar to Electric: Cost Effectiveness Determined Directly, Not Based on Estimated Avoided Cost
- Tested Acceleration of Gas Similar to Electric Measures

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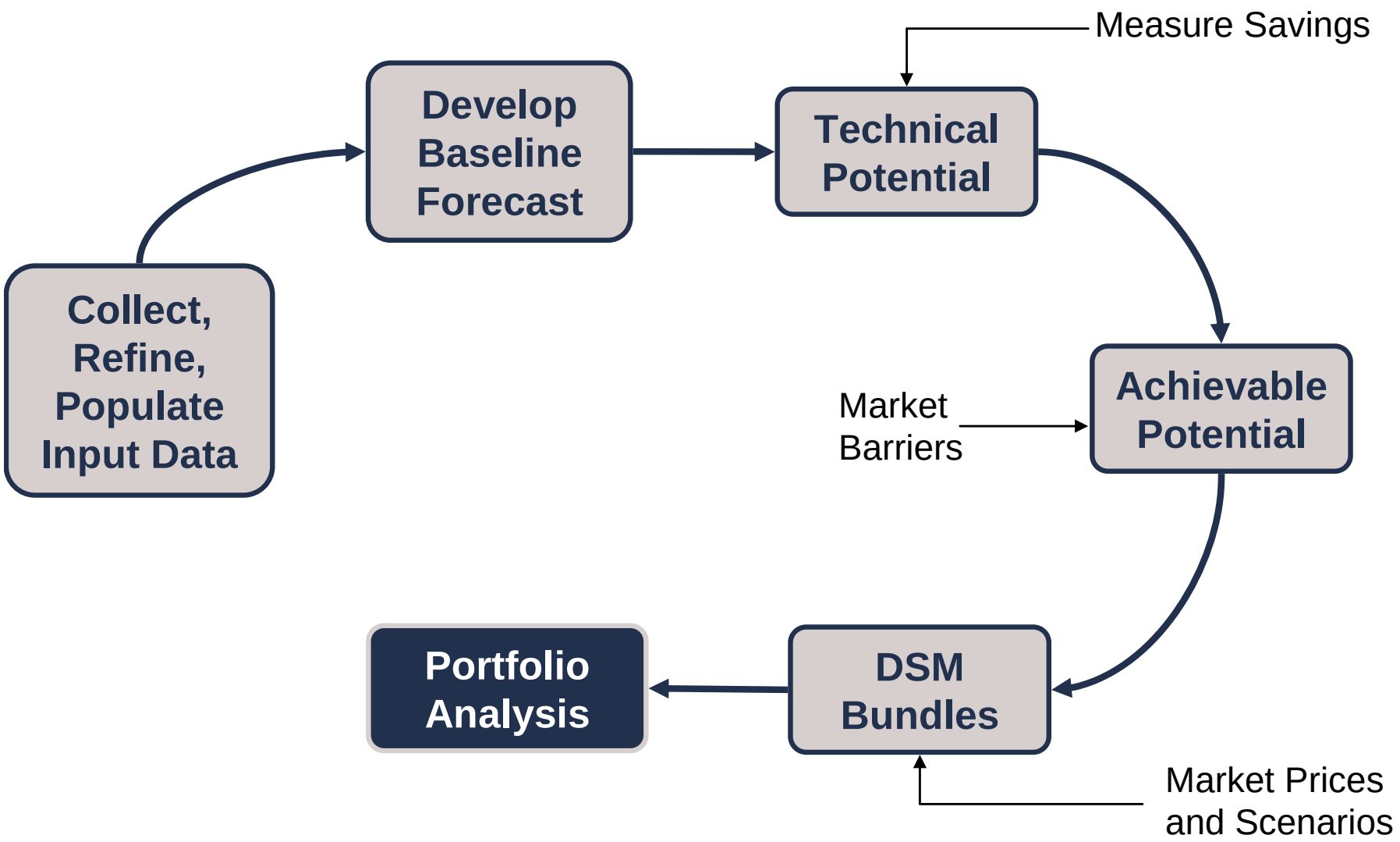
Overview: Assessing DSR Resource Potential



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DSR: NPV of Portfolio Costs - ($-Billions)

	20-year Ramp Rate	10-year Ramp Rate
Base	10.18	10.16
Base + CO2	12.05	11.98
Low Growth	7.47	7.50
High Growth	13.15	13.06
Green World	15.81	15.64
Very Low Gas Prices	6.09	6.13
Very High Gas Prices	14.12	14.00

-

2011 Gas Sales Portfolio Resource Plan

Peak Day Capacity (MDth/day)

	2016-17	2020-21	2024-25	2030-31
Demand Side Resources	31	56	65	78
NWP/Westcoast Expansion	34	112	145	182
Cross Cascades Pipeline				31
Regional LNG Storage			51	51

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Additional Questions/Follow-Up?

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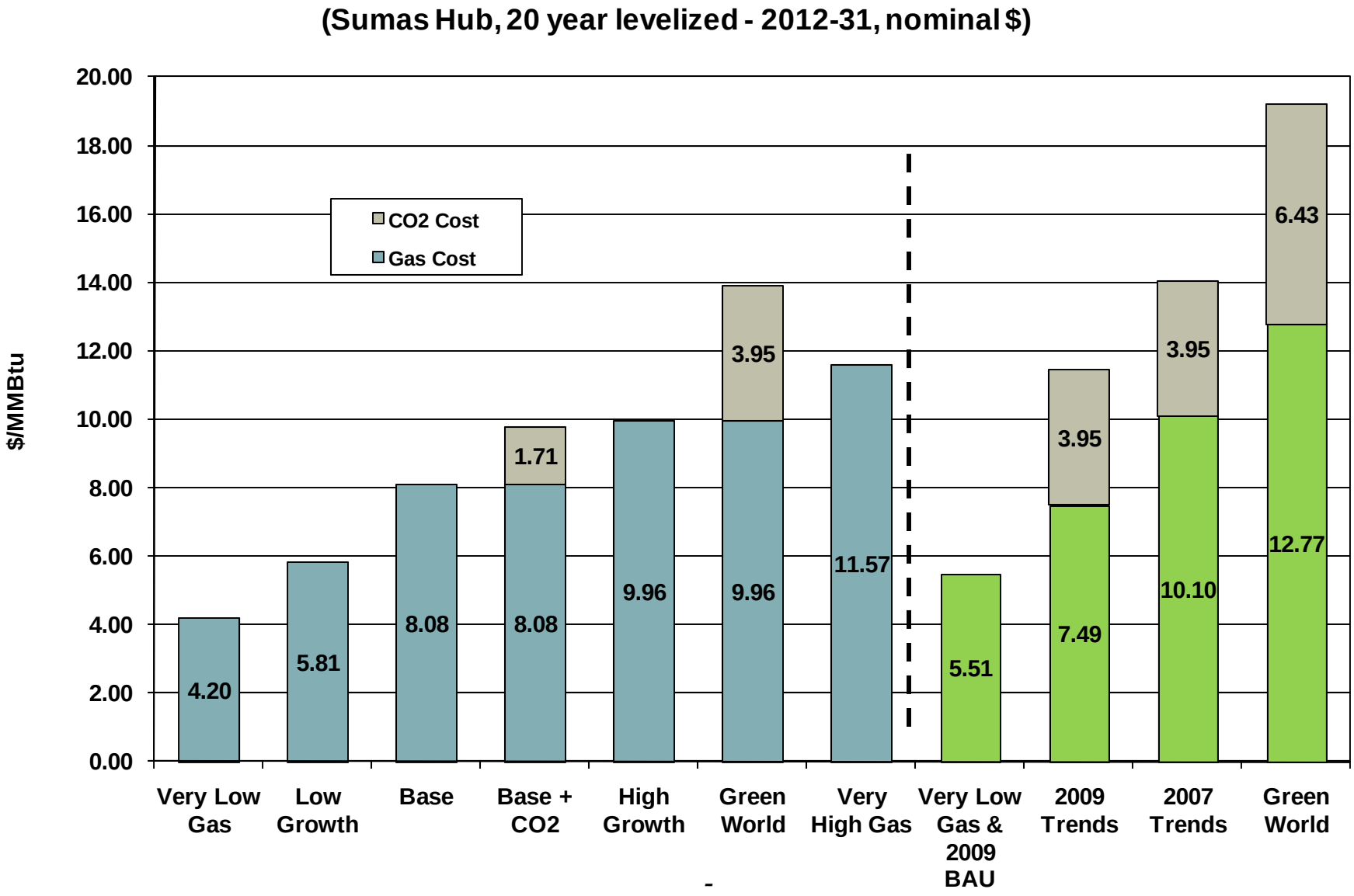
Appendix Slides

Some Non-Load Forecast Assumptions

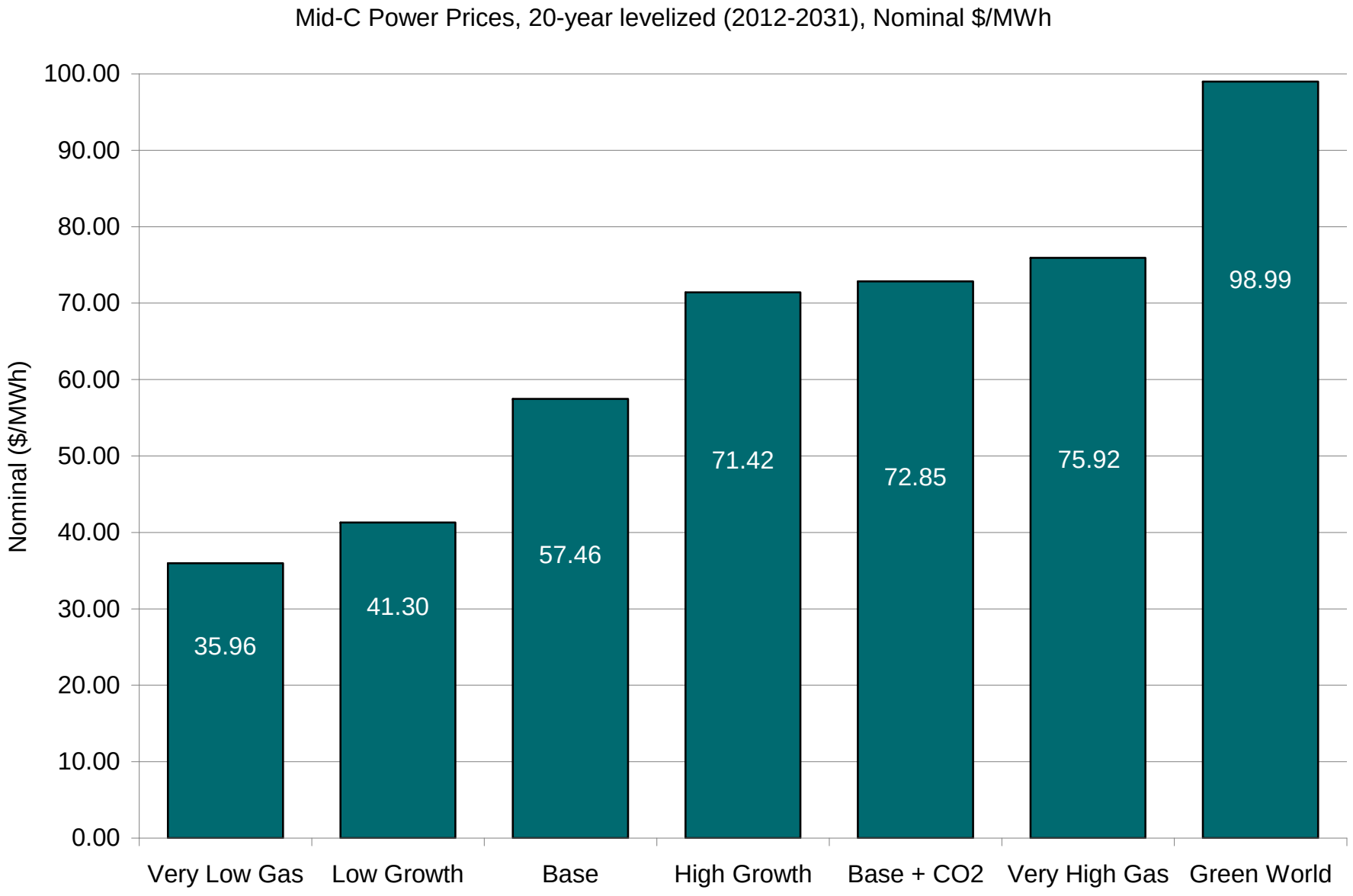
PUGET SOUND ENERGY

August 11, 2011

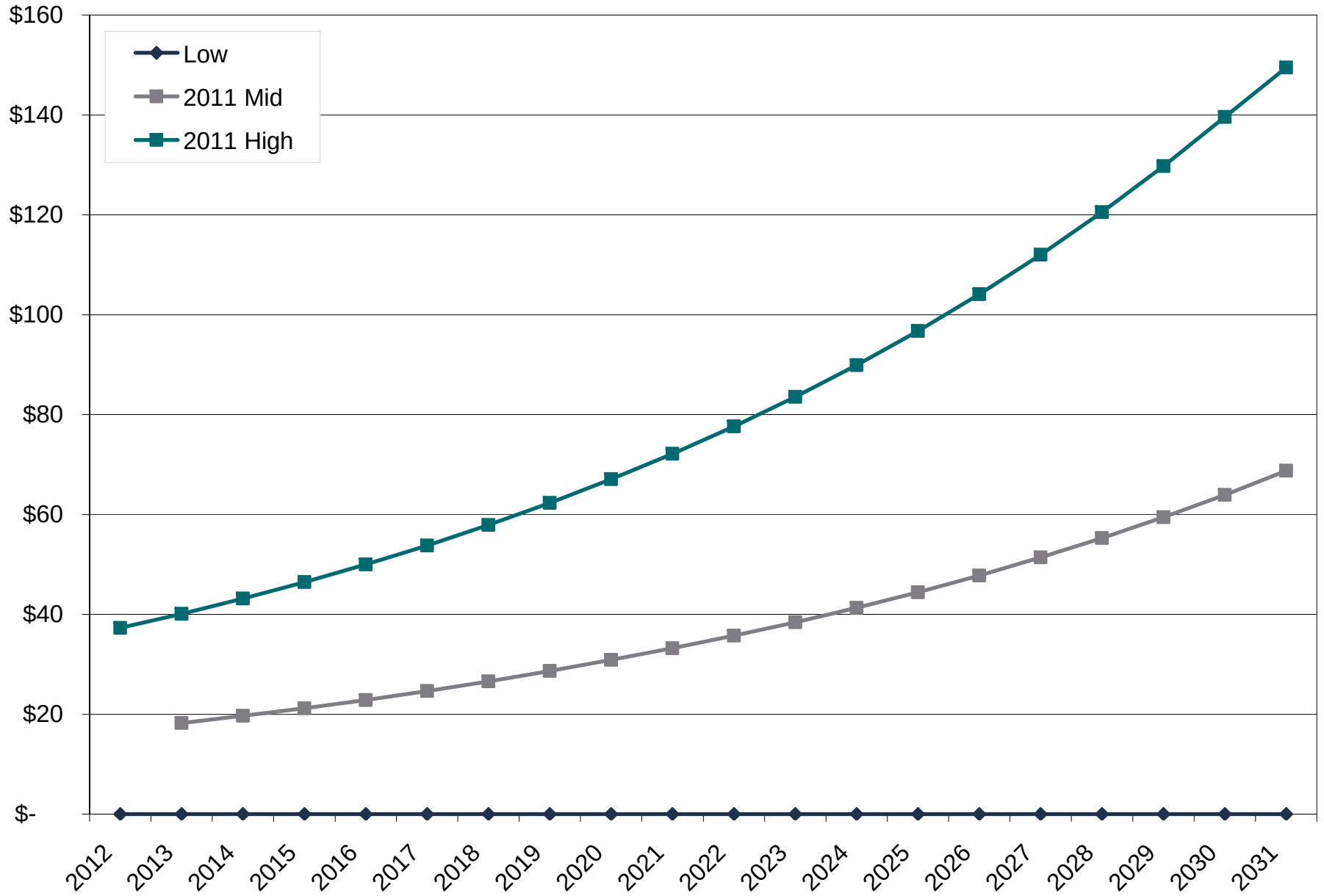
Levelized Gas Prices



Levelized Electric Prices

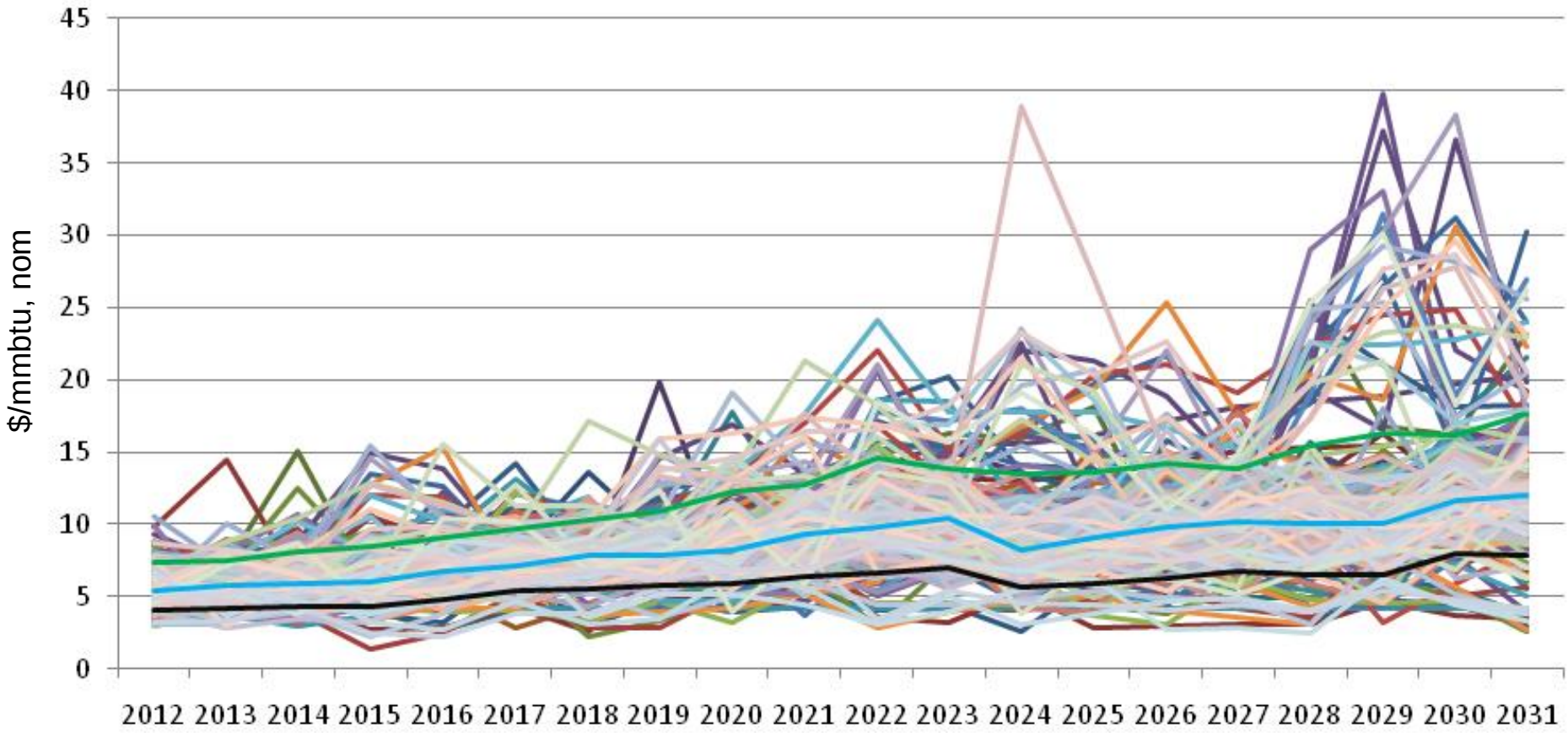


Annual CO_2 Prices



2010 $	Units	CCCT	Peaker	Wind	Biomass	Transmission
Winter Capacity	MW	334	213	100	25	500
Capital Cost	$/KW	$1,540	$1,010	$2,151	$4,330	$436
O&M Fixed	$/KW-yr	$22.00	$15.90	$29.90	$190.00	$15.25
O&M Variable	$/MWh	$0.44	$0.67	$3.50	$3.40	
Force Outage Rate	%	3%	3%		6.3%	
Wind Capacity Factor	%			30%		
Capacity Credit	%	93%	93%	1.8%	93%	100%
Heat Rate – GT	Btu/KWh	7,085	10,440		13,420	
Heat Rate – DF	Btu/KWh	9,350				
Fixed Gas Transport	$/KW-yr	$31.80	$0.00			
Variable Gas Transport	$/MWh	$2.00	$5.20			
Fixed Transmission	$/KW-yr	$0.00	$0.00	$34.30	$18.01	
Variable Transmission	$/MWh	$0.00	$0.00	$3.30	$1.71	
Water Consumption	Gallons/MWh	26				
Emissions:						
SO_2	lbs/MMBtu	0.010	0.010			
NO_x	lbs/MMBtu	0.007	0.009			
CO_2	lbs/MMBtu	115.9	115.9			
Location		PSE Control	PSE Control	WA/OR	PSE Control	Mid-C to PSE
First Year Available		2014	2014	2014	2014	2017

Annual Sumas Price Draws



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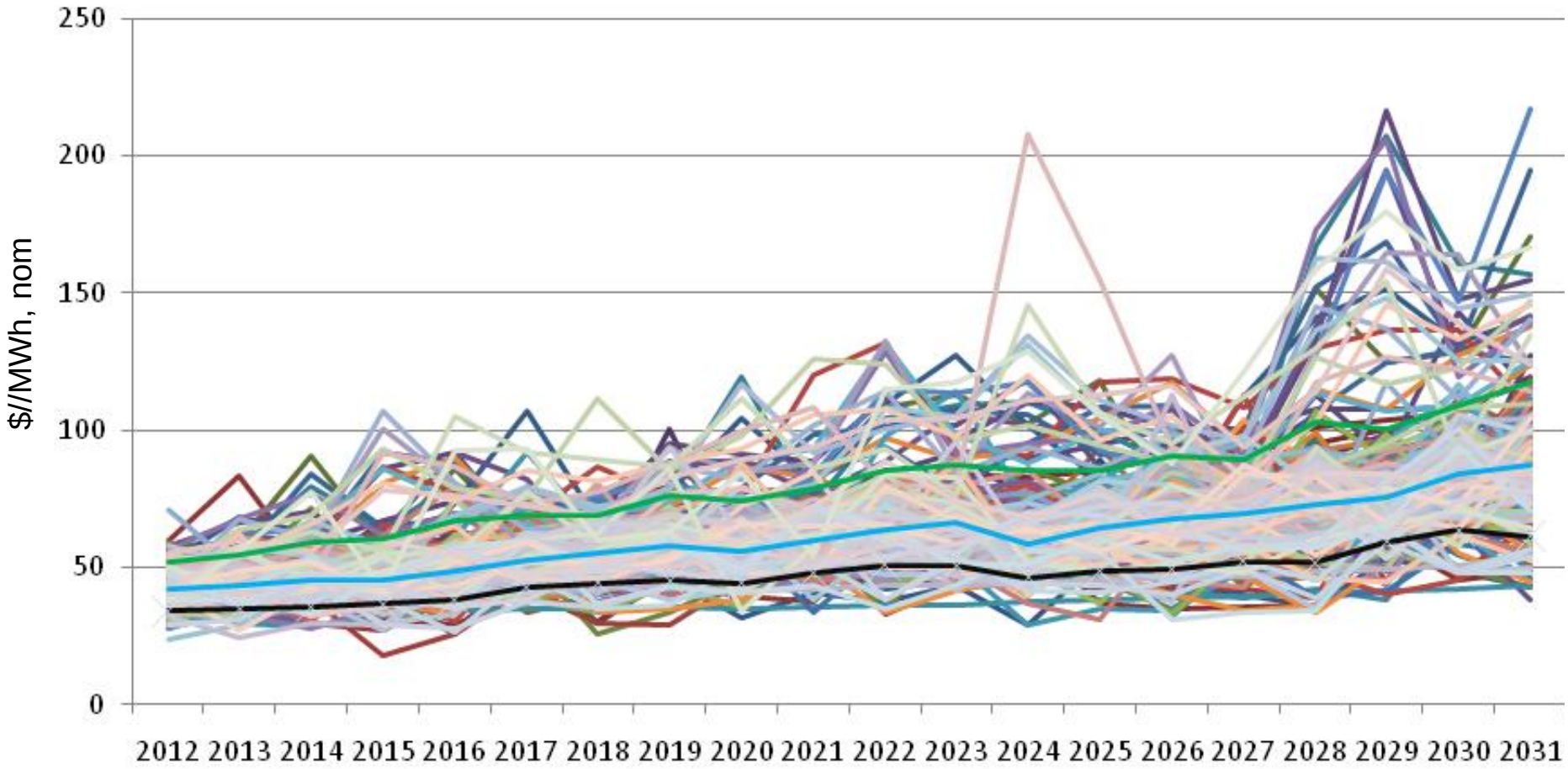
Annual Mid-C Price Draws



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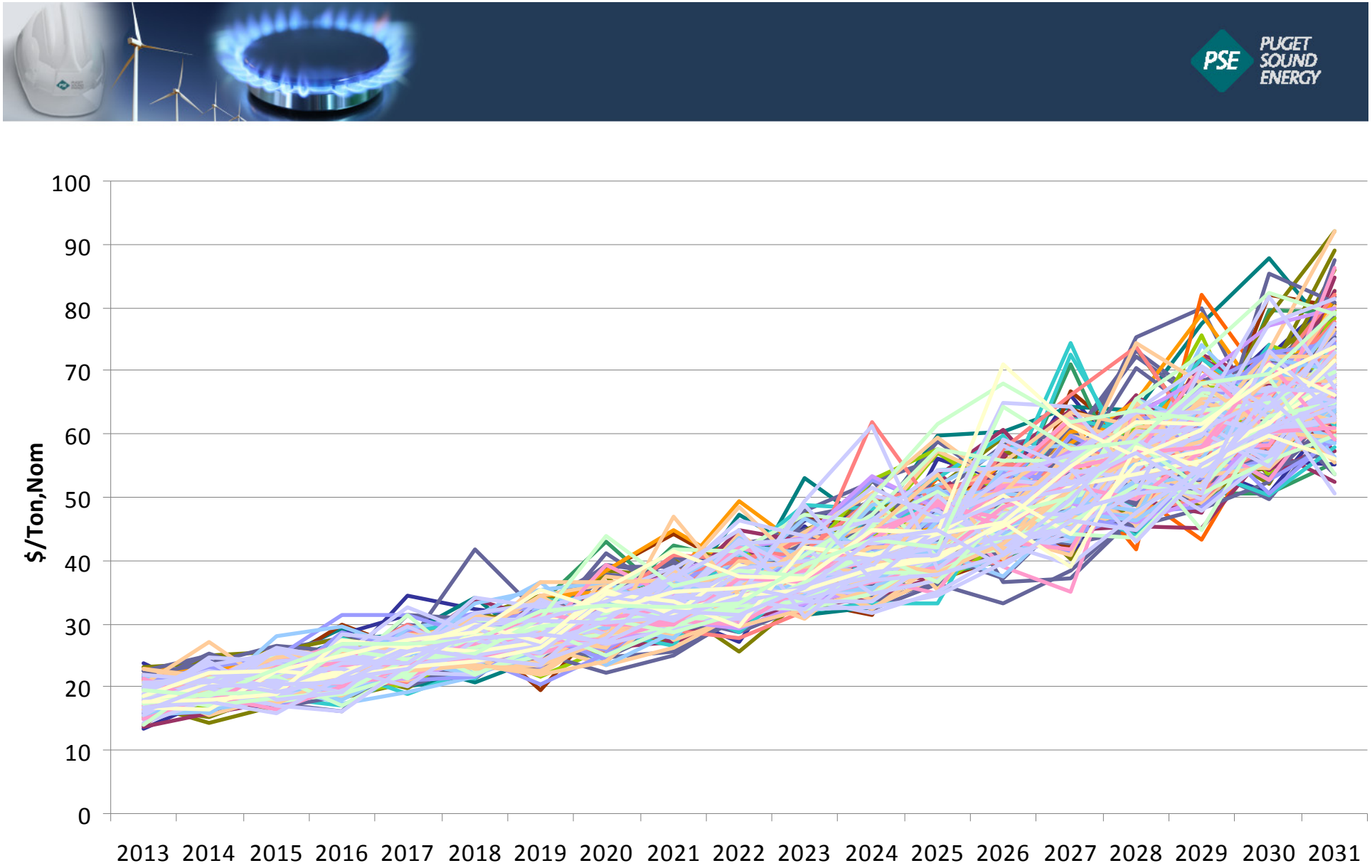

100
90
80
70
60
50
40
30
20
10
0
$/Ton,Nom
2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031

-

DSR Methodology and Some Details

PUGET SOUND ENERGY

August 11, 2011

Cost Effectiveness of DSR Estimated Directly

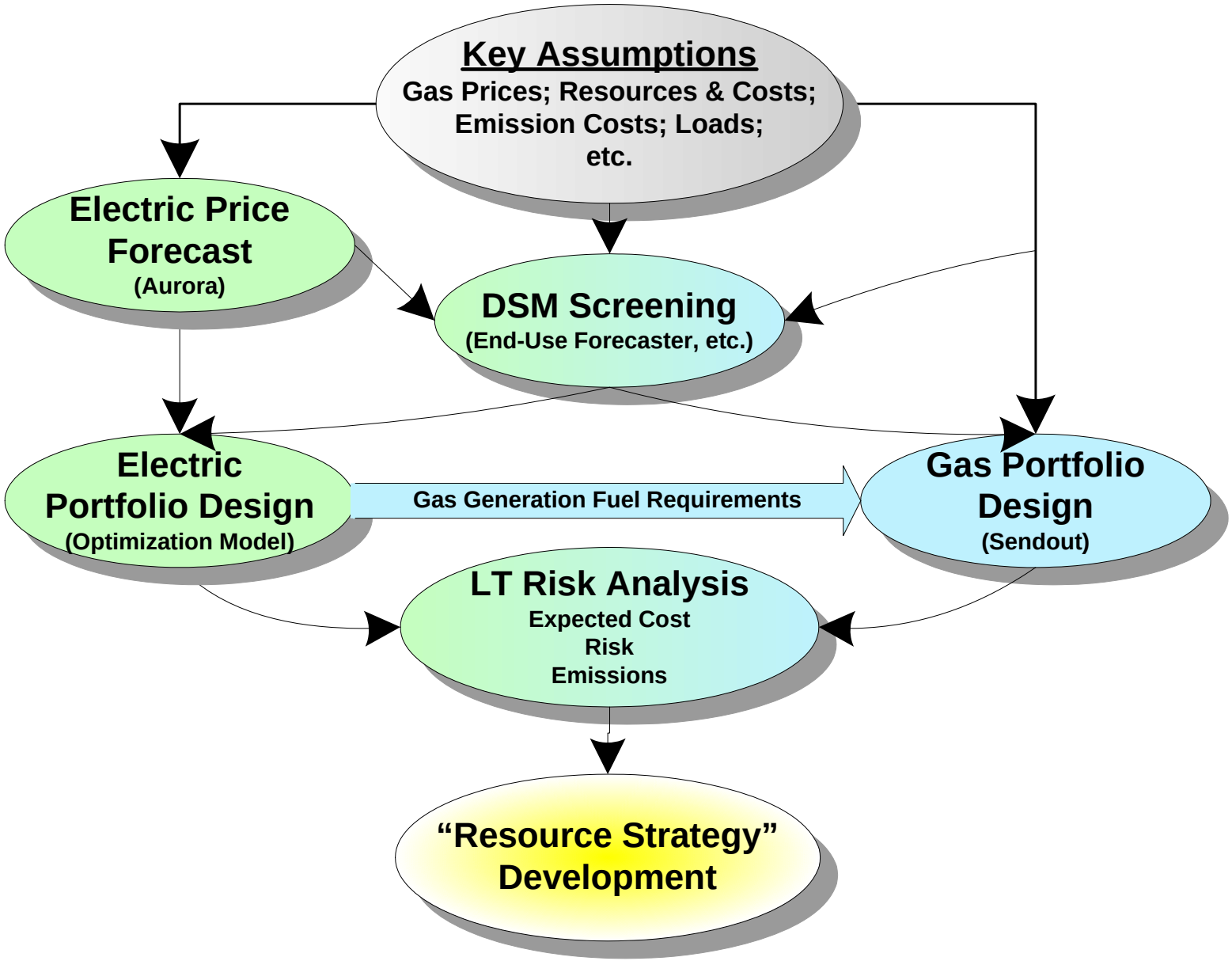
- Portfolio Analysis Determines Least Cost Mix of Resources
  - Demand and Supply-Side Resources Apples-to-Apples
  - Avoided Costs: Derived From IRP Output, Not Input

- Demand-Side Resource Potentials Developed
  - Technical and Achievable Potentials Estimated
  - Starts with RTF and Adjusts for PSE Service Territory
- Cost of DSR Measures Adjusted
  - Reflects T&D savings,
  - Non-Energy Benefits, and
  - 10% Regional Preference Electric
- Measures Aggregated by Adjusted Cost up Supply Curve in "Bundles"
- Bundles are Resource Alternatives Along Side Supply-Side Resources to Directly Estimate Cost Effectiveness

“Avoided Cost”

- Avoided Cost Derived From IRP Output, Not an Input
- WAC Rule Requires Annual Filing
  - Reference: WAC 480-107-055
- Avoided Costs Included in RFP
- Avoided Costs Starting Point for Conservation Program Planning/Design

Resource Planning
Portfolio Analysis Process



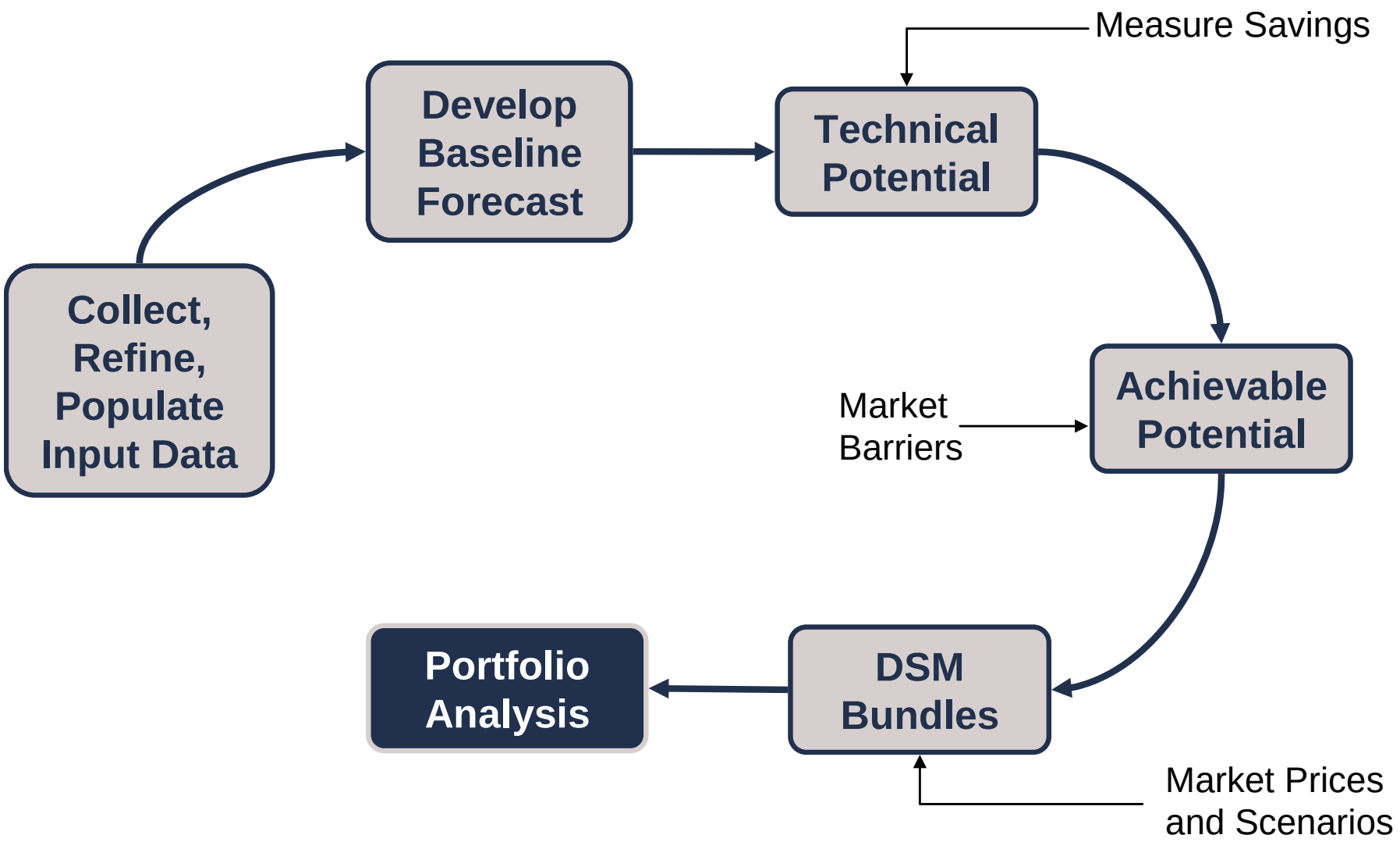
Consistency with Council Methodology

http://www.nwcouncil.org/energy/powerplan/6/supplycurves/I937/default.htm

PUGET SOUND ENERGY

	Technical Potential	Economic Potential	Achievable Potential
Council	**See 2. a & b** -Wide array tech, all sectors -Saturations -New/Existing Units -Measure Life/Substitutions -Measure Shapes -Measure Interactions	**See 3. a - e** -Econ Screening-TRC -Shaped Energy/Capacity -Full Incremental Cost -T&D Savings & Losses -"Environmental Benefits" -NEB/10% Credit	**See 4. a - c** -Targets from IRP Analysis -DSM Versus All Resources -B&C from Econ Screen -Lost Opportunity/Discretion -Adjusted Historic Ramps -Revise Based on Exp.
PSE	**See 2. a & b** ☑ Wide array tech, all sectors ☑ Saturations ☑ New/existing units ☑ Measure life/substitutions ☑ Measure shapes ☑ Measure interactions	**See 3. a - e** ☑ Econ Screening-Bundles ☑ Shaped Energy/Capacity ☑ Full Incremental Cost ☑ T&D Savings & Losses ☑ Environmental Benefits" ☑ NEB & 10% Credit	**See 4. a - c** ☑ Targets from IRP Analysis ☑ DSM Versus All Resources ☑ B&C from Econ Screen ☑ Lost Opportunity/Discretion ☑ Adjusted Historic Ramps ☑ Revise Based on Exp.

Overview: Assessing DSR Resource Potential



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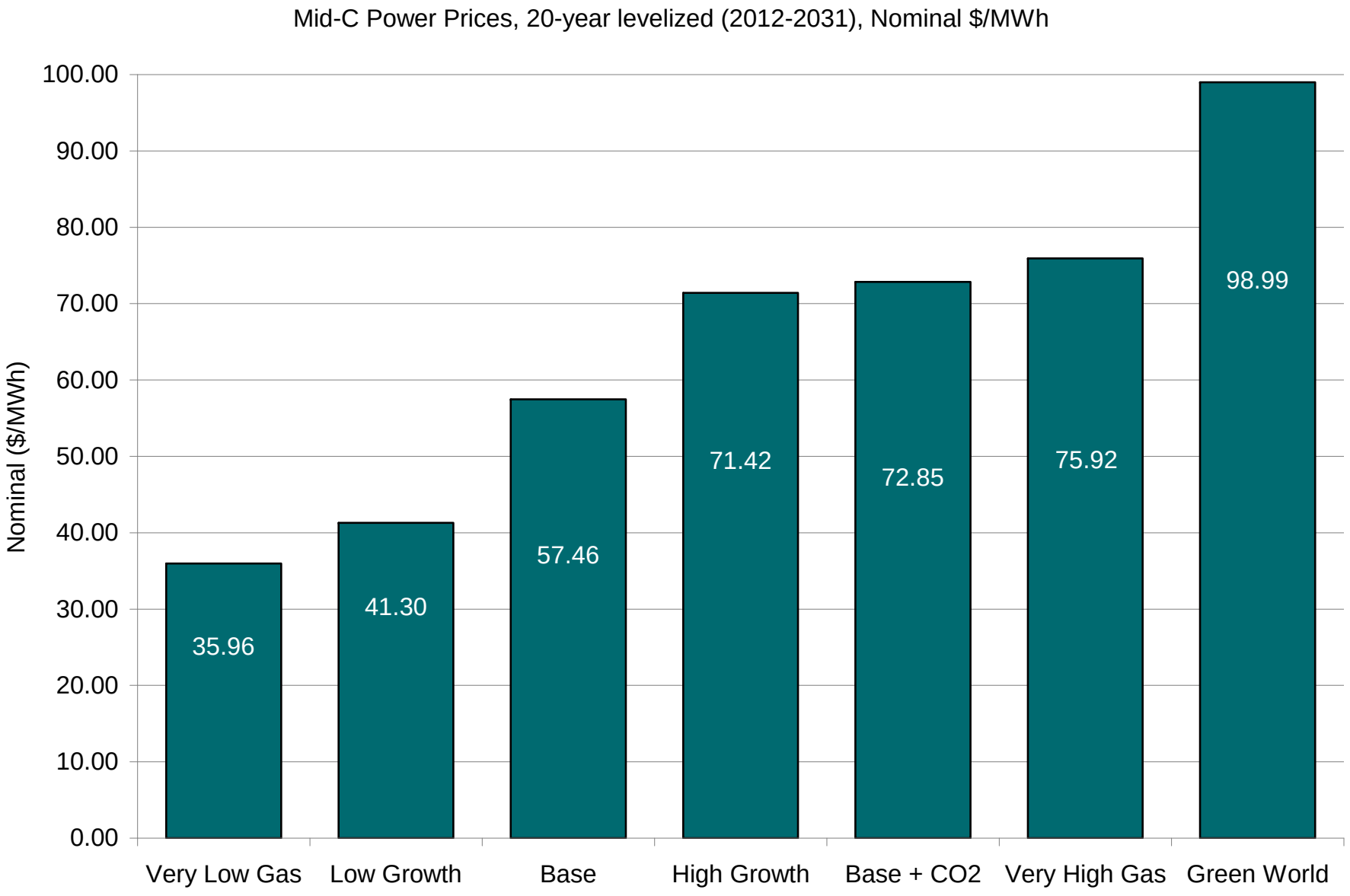
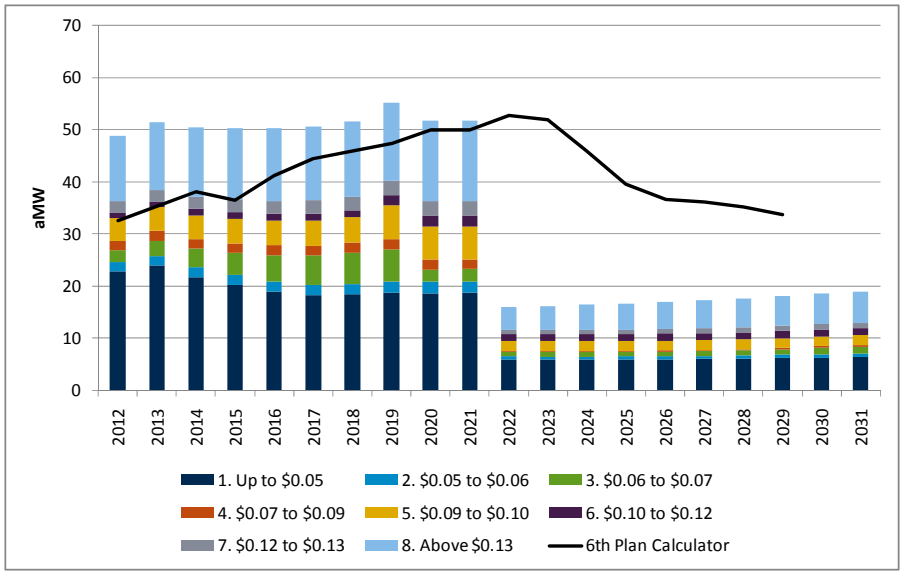
Levelized Electric Prices

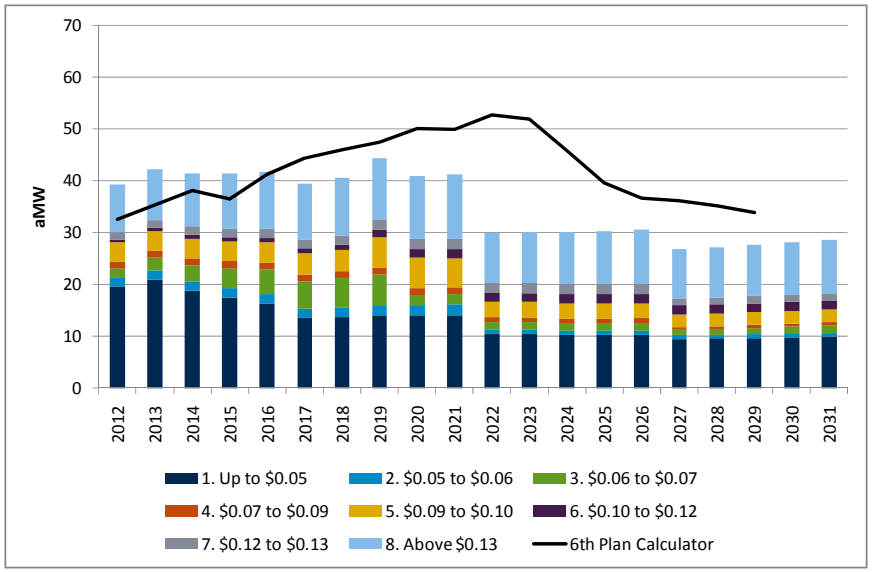


Electric Ach. Technical Potential Ramp Sensitivity

2011 IRP with PSE Ramp

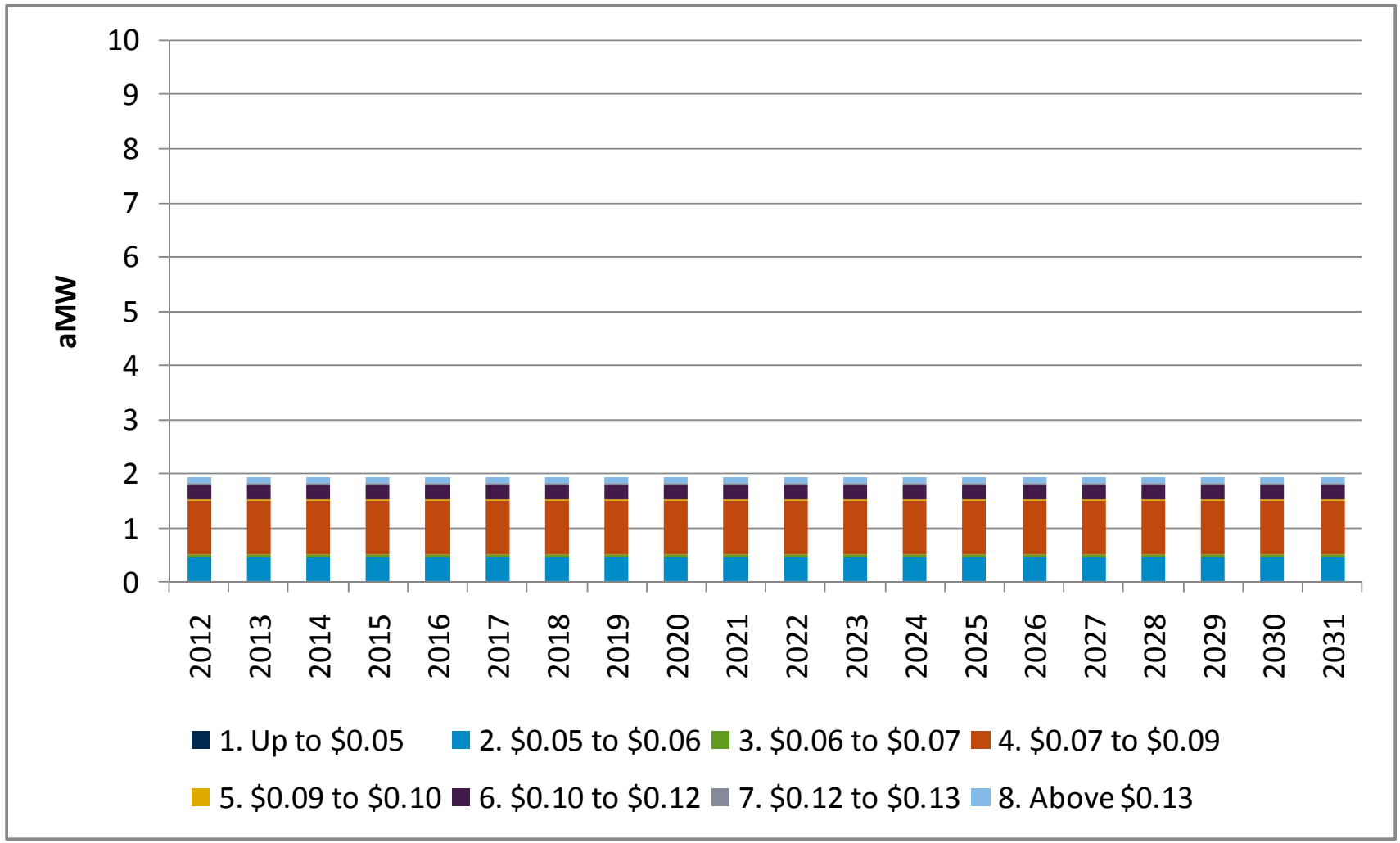


2011 IRP with Council Ramp Rates

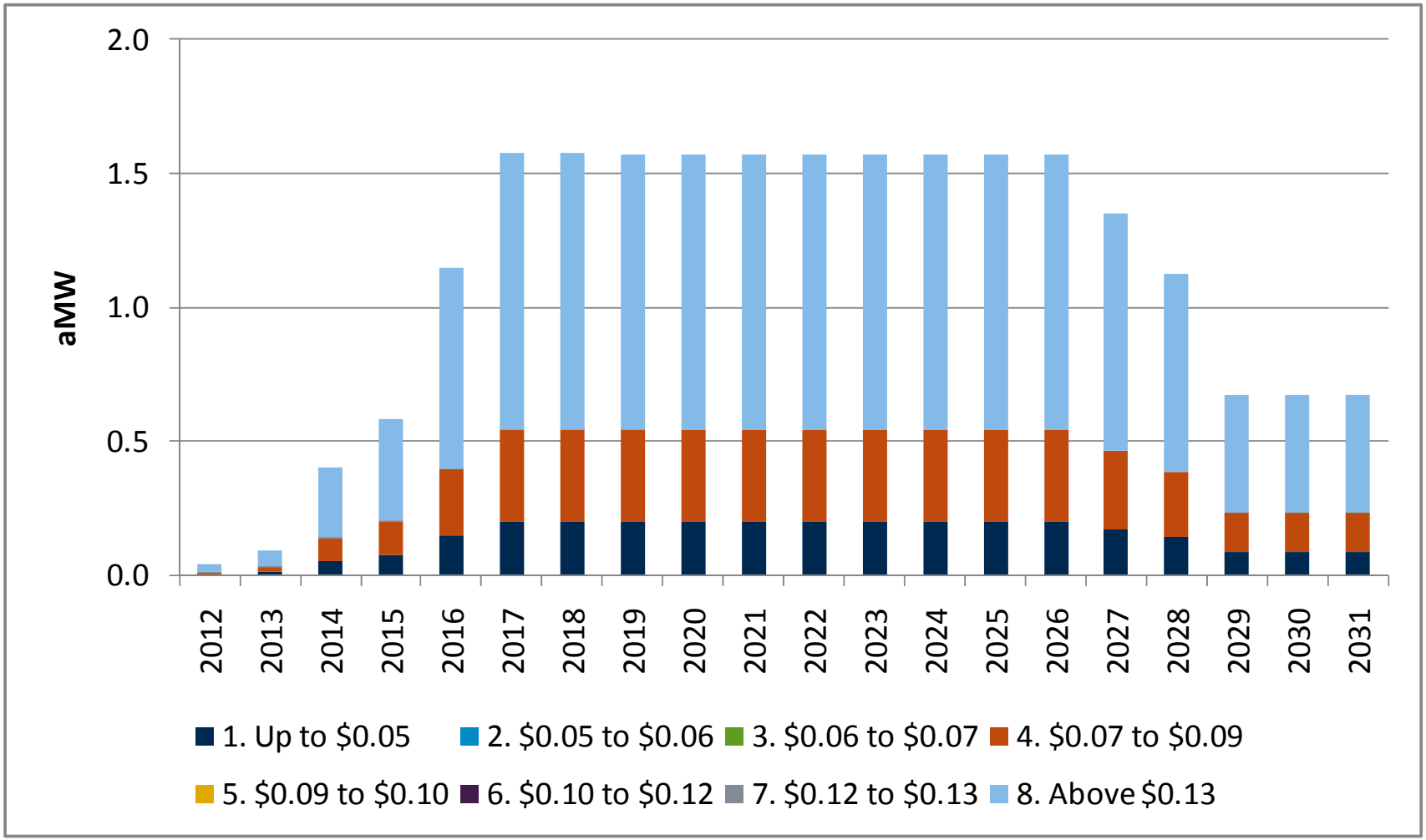


- Equivalent 20-year potential, but different timing
- Differences in ramping only for discretionary measures
- Council ramp rates lead to lower levels of acquisition in first ten years

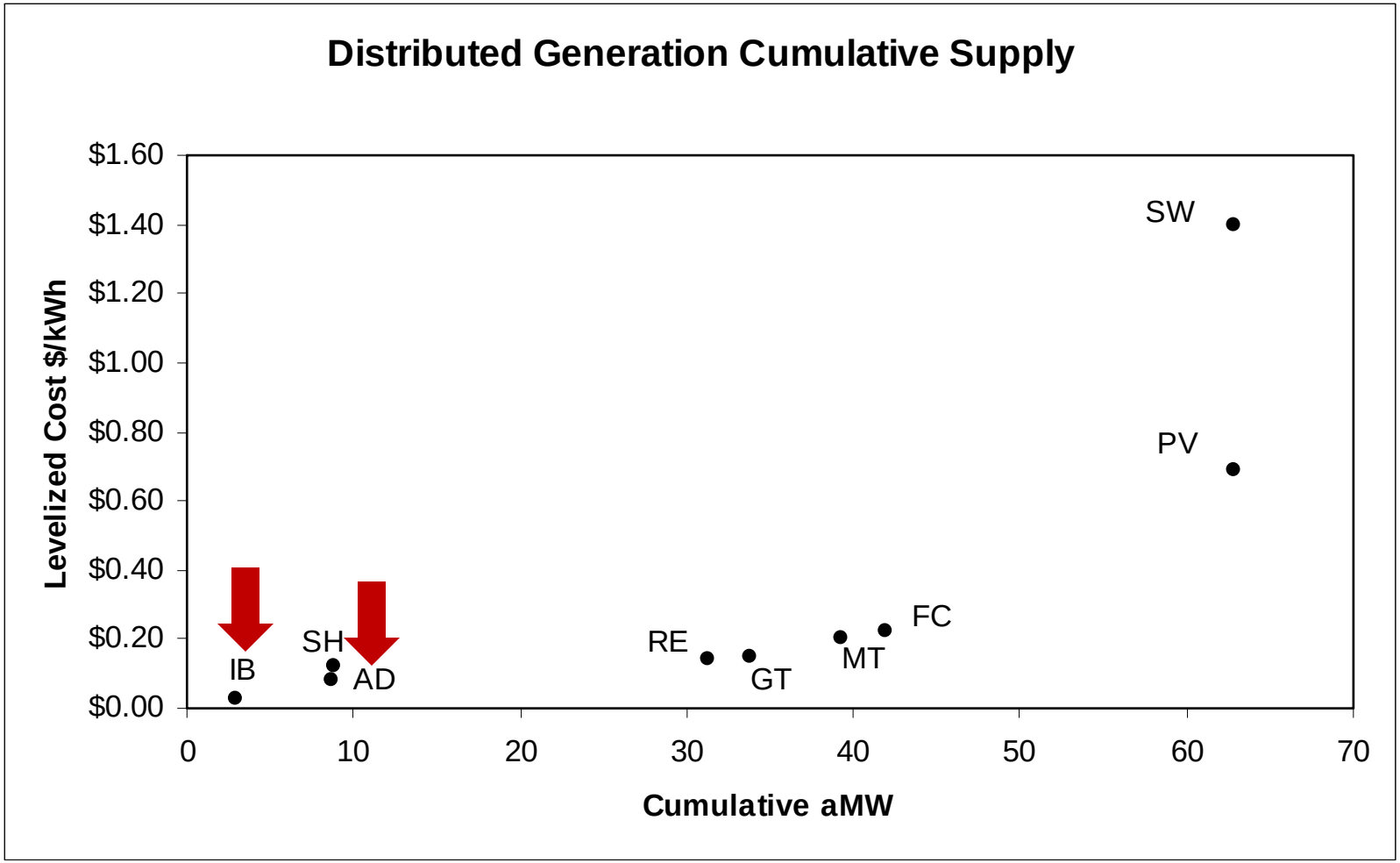
Fuel Conversion Ach. Technical Potential



DG Achievable Technical Potential



Distributed Generation – Supply Curve



RE: Reciprocating Engine, MT: Microturbine, FC: Fuel Cell, GT: Gas Turbine, IB: Industrial Biomass, AD: Anaerobic Digester, PV: Building Photovoltaics, SH: Small Hydro, SW: Small Wind.

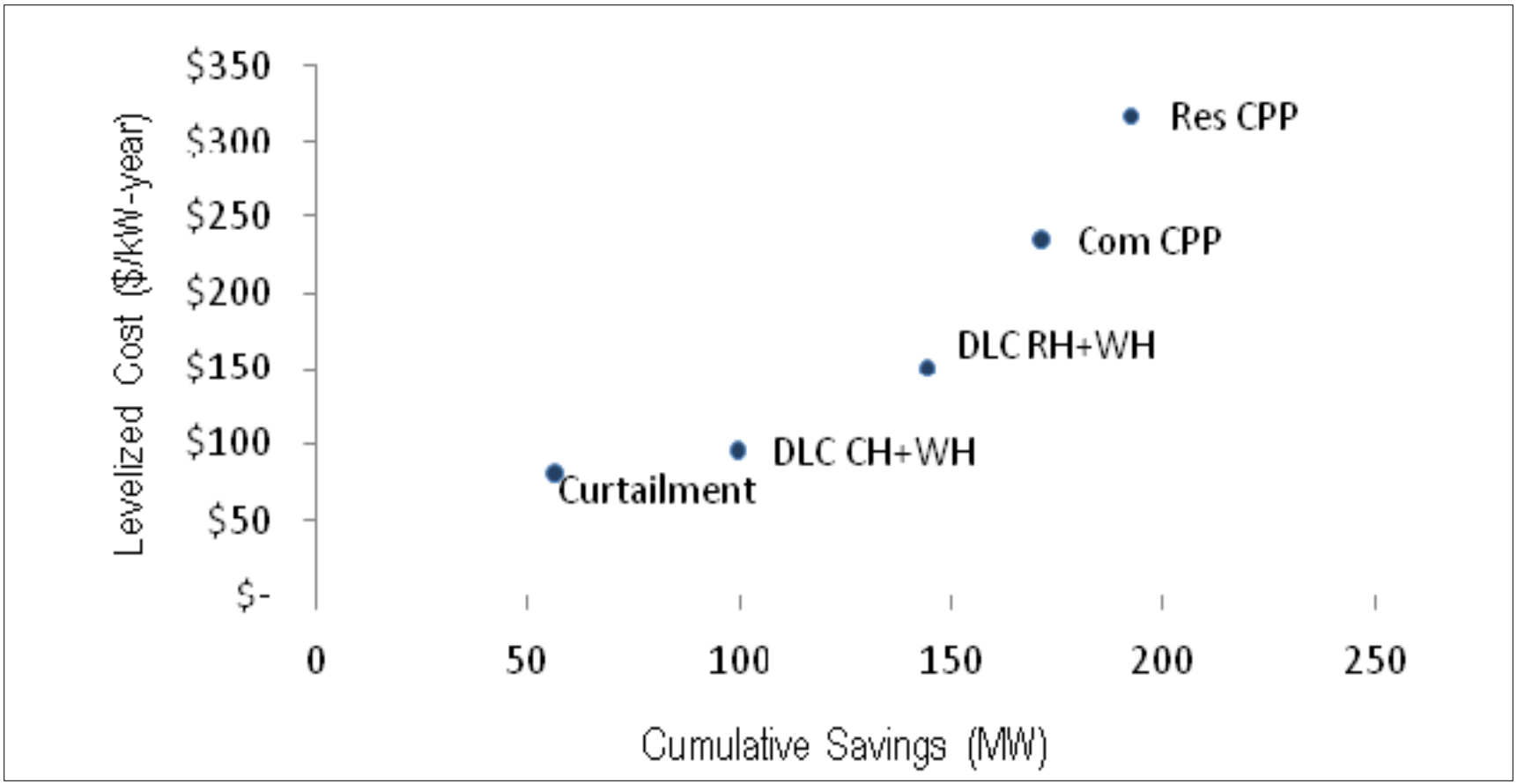
-

DG in Bundle E (<$150/MWh)

Sector	Industrial Biomass	Small Anaerobic Digesters	Large Anaerobic Digesters	Non-Renewable				Total
				Recip. Engine	Gas Turbine	Micro-turbine	Fuel Cell	
Industrial	3.0	0.0	0.0	5.6	1.3	0.7	0.5	11.1
Commercial	0.0	5.7	0.0	16.9	1.3	2.3	5.2	31.4
Total	3.0	5.7	0.0	22.4	2.5	2.9	5.8	42.5
% of 2029 System Sales	0.08%	0.16%	0.00%	0.63%	0.07%	0.08%	0.15%	1.13%
Levelized Cost ($/kWh)	$0.03	$0.08	$0.04	$0.13	$0.14	$0.19	$0.21	

-

Demand Response – Cumulative Supply Curve



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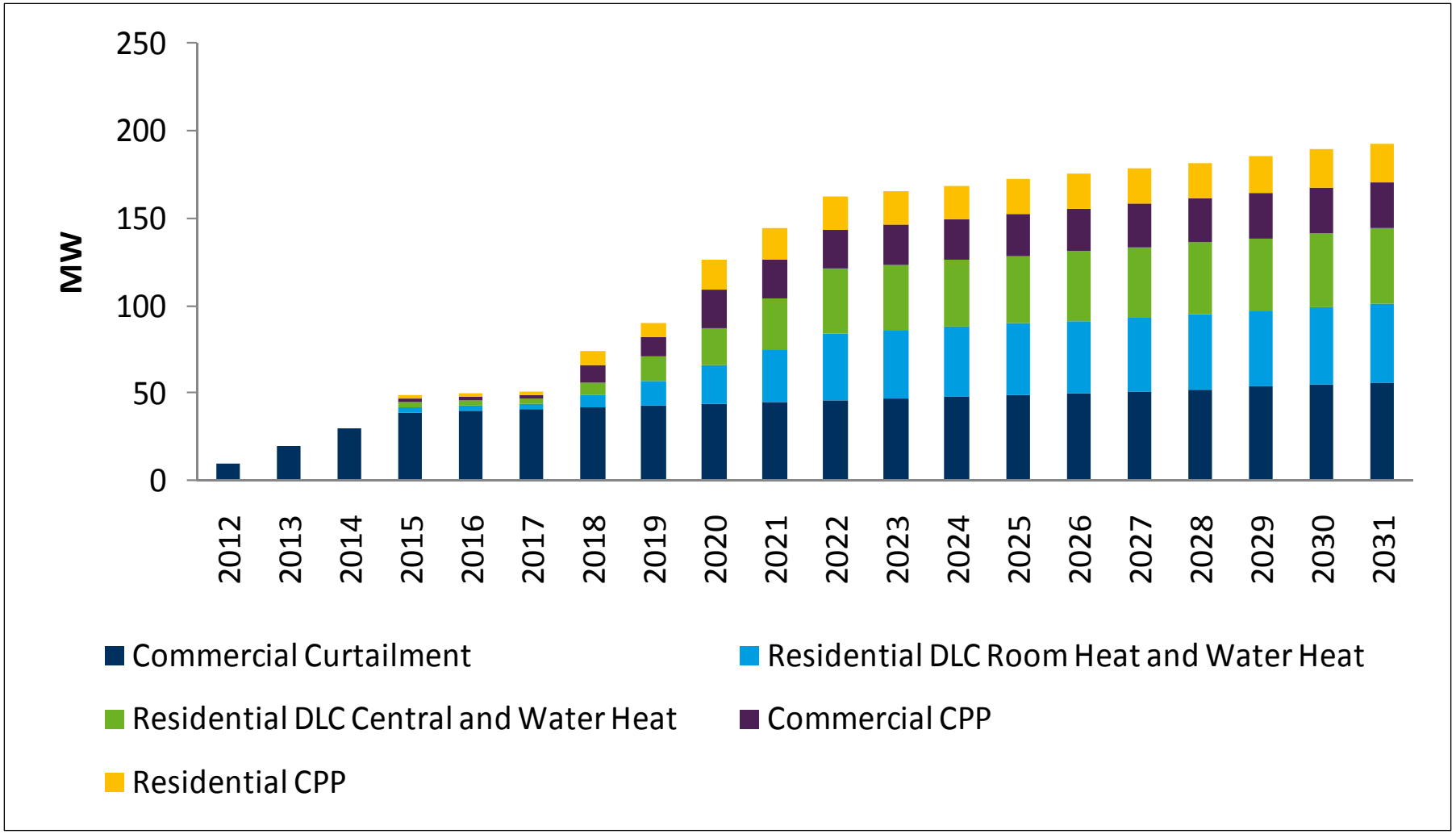
Demand Response – Ach. Technical Potential



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DSR Annual Energy Savings Comparison

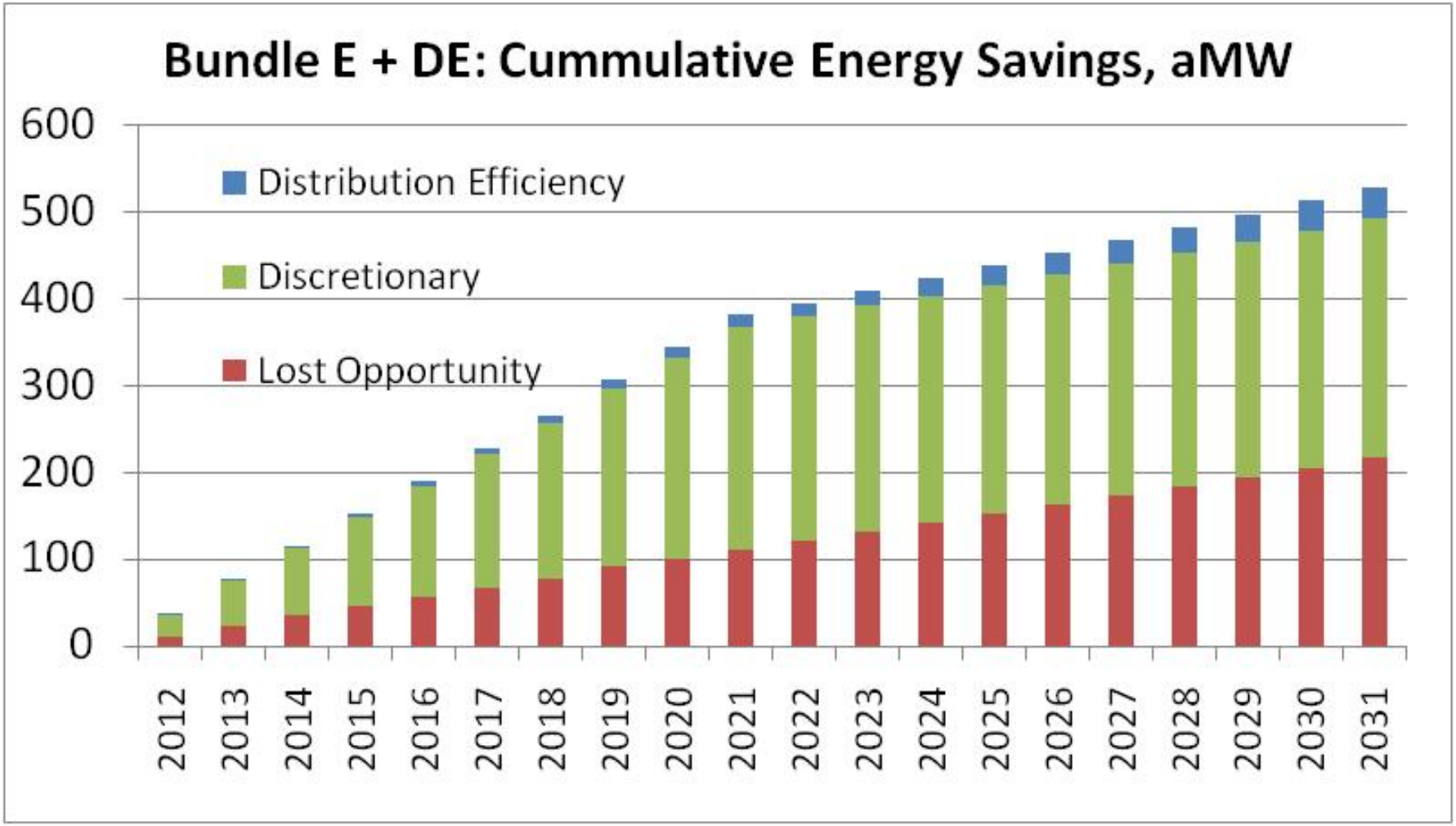
Bundle	Price Cut-Offs for Bundles	2011 IRP Annual aMW PSE Ramp	
		2012	2031
A	< $55	27	327
B	Bundle A + ($55 to $85)	33	438
C	Bundle B + ($85 to $115)	36	502
D	Bundle C + ($115 to $130)	38	528
E	Bundle D + ($130 to $150)	39	563
F	Bundle E + ($150 to $170)	41	587
G	Bundle F + ($170 to $190)	42	597
H	Bundle G + (>= $190)	50	737
EISA		4	186
DE		1	37

Levelized $/MWh

Least Cost DSR By Scenario

Scenarios	20-year Levelized Net Market Value	DSR Bundle
Base	$62.78	E
Base + CO2	$78.21	E
Low Growth	$49.35	E
High Growth	$90.94	E
Very Low Gas Prices	$45.48	B
Very High Gas Prices	$91.34	E
Green World	$127.57	G

Savings Type: Bundle E + Distribution Efficiency



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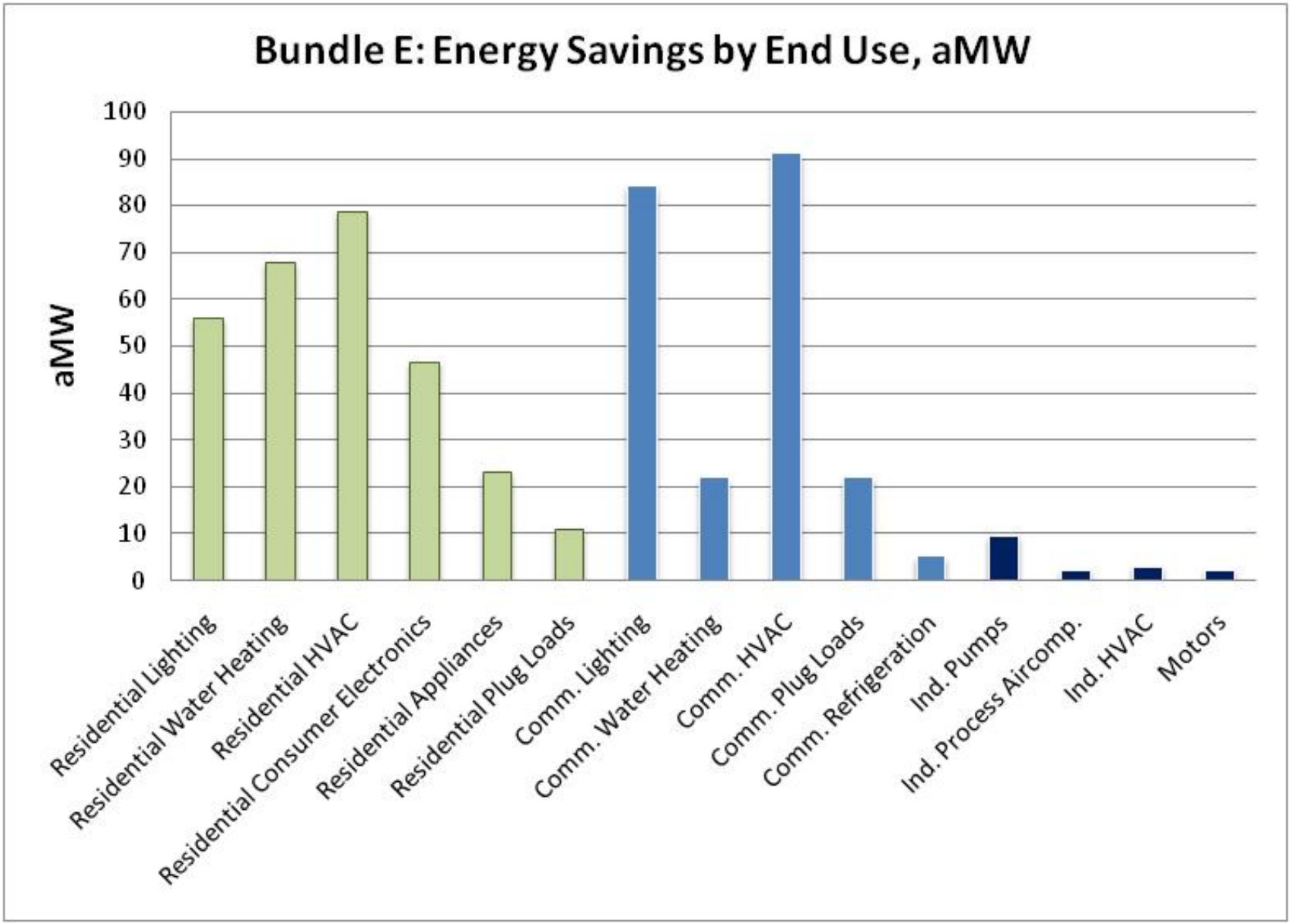
Bundle E Profile of Top Measures



Gas DSR: Incremental Bundles

Bundle	Price Cut-Offs for Bundles
A	< $0.45/therm
B	Bundle A + ($0.45 to $0.70)
C	Bundle B + ($0.70 to $0.95)
D	Bundle C + ($0.95 to $1.20)
E	Bundle D + ($1.20 to $1.50)
F	Bundle E + ($1.50 to $2.0)
G	Bundle F + ($2.0 to $2.5)
H	Bundle G + (>=$2.5)

Least Cost Bundles by Scenario

	Base	Base + CO2	Low Growth	High Growth	Green World	Very Low Gas	Very High Gas
Residential Firm	C	D	B	D	G	A	D
Commercial Firm	D	F	D	F	F	B	F
Commercial Interruptible	B	D	A	D	D	A	D
Industrial Firm	C	E	C	E	E	C	E
Industrial Interruptible	C	E	C	E	E	C	E

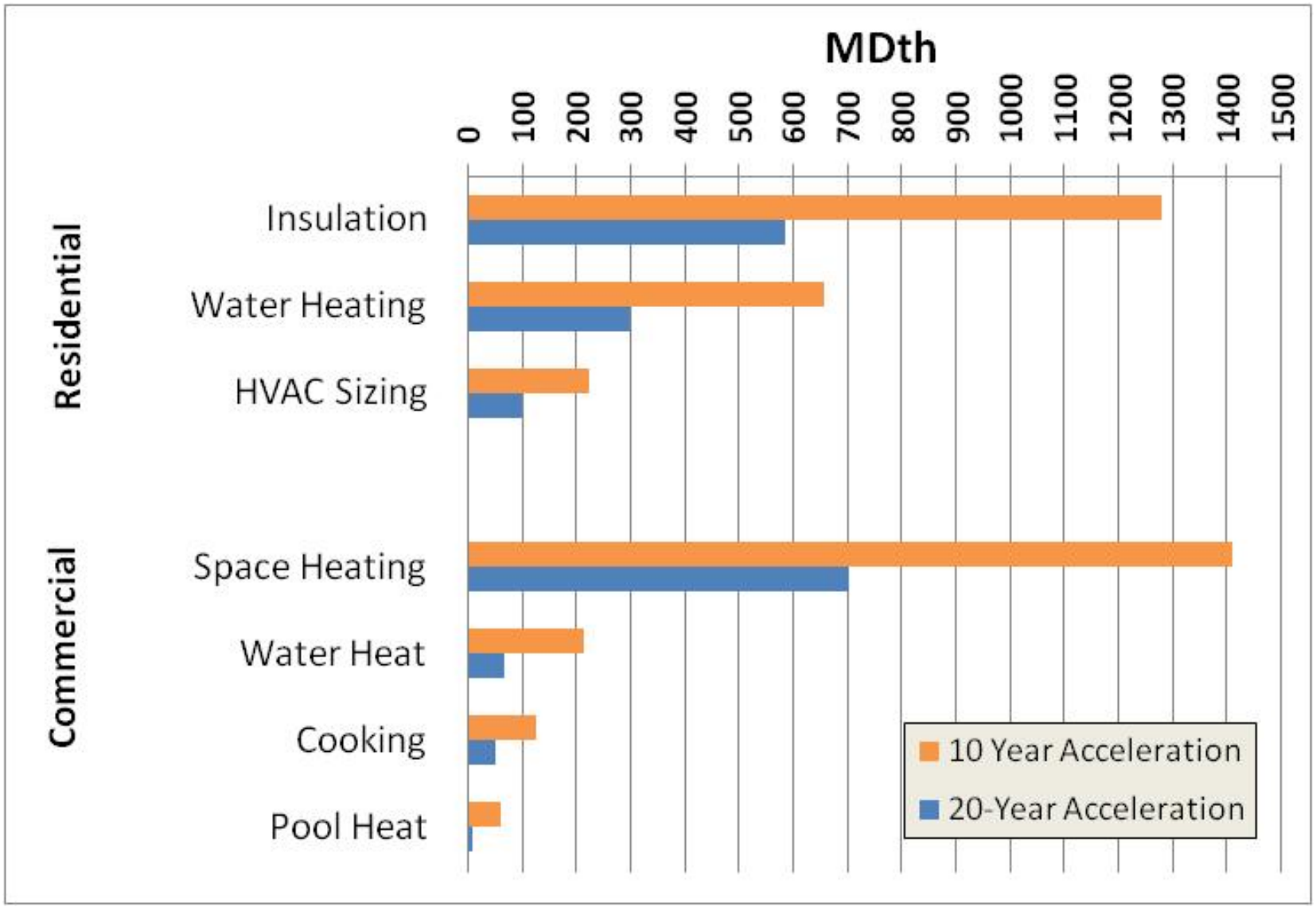
-

Least Cost DSR By Scenario

DSR: NPV of Portfolio Costs - ($-Billions)

	20-year Ramp Rate	10-year Ramp Rate
Base	10.18	10.16
Base + CO2	12.05	11.98
Low Growth	7.47	7.50
High Growth	13.15	13.06
Green World	15.81	15.64
Very Low Gas Prices	6.09	6.13
Very High Gas Prices	14.12	14.00

Top Discretionary Measures – Base Case

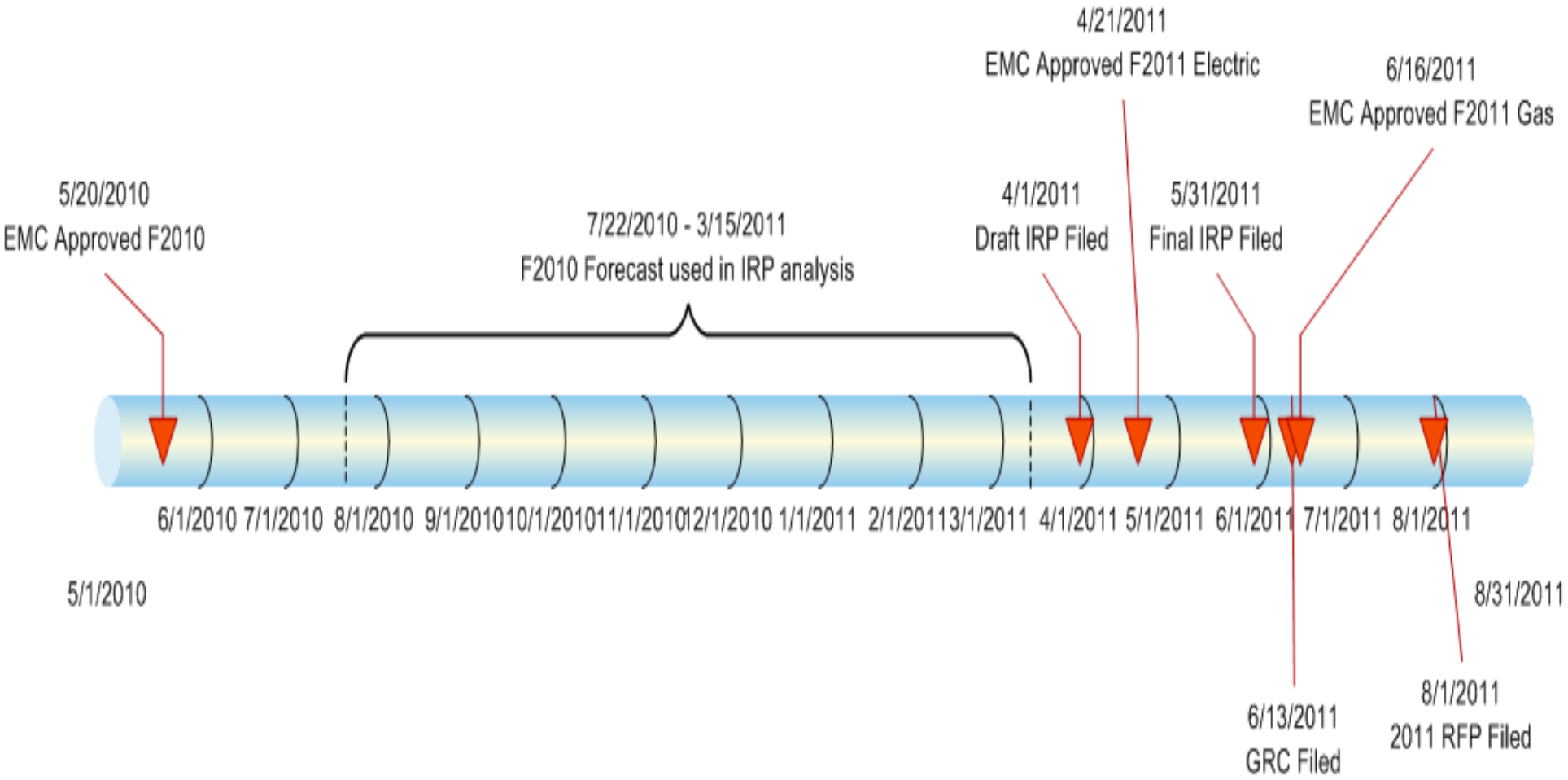


Some Load Forecast Details

PUGET SOUND ENERGY

August 11, 2011

Demand Forecast Update Timeline



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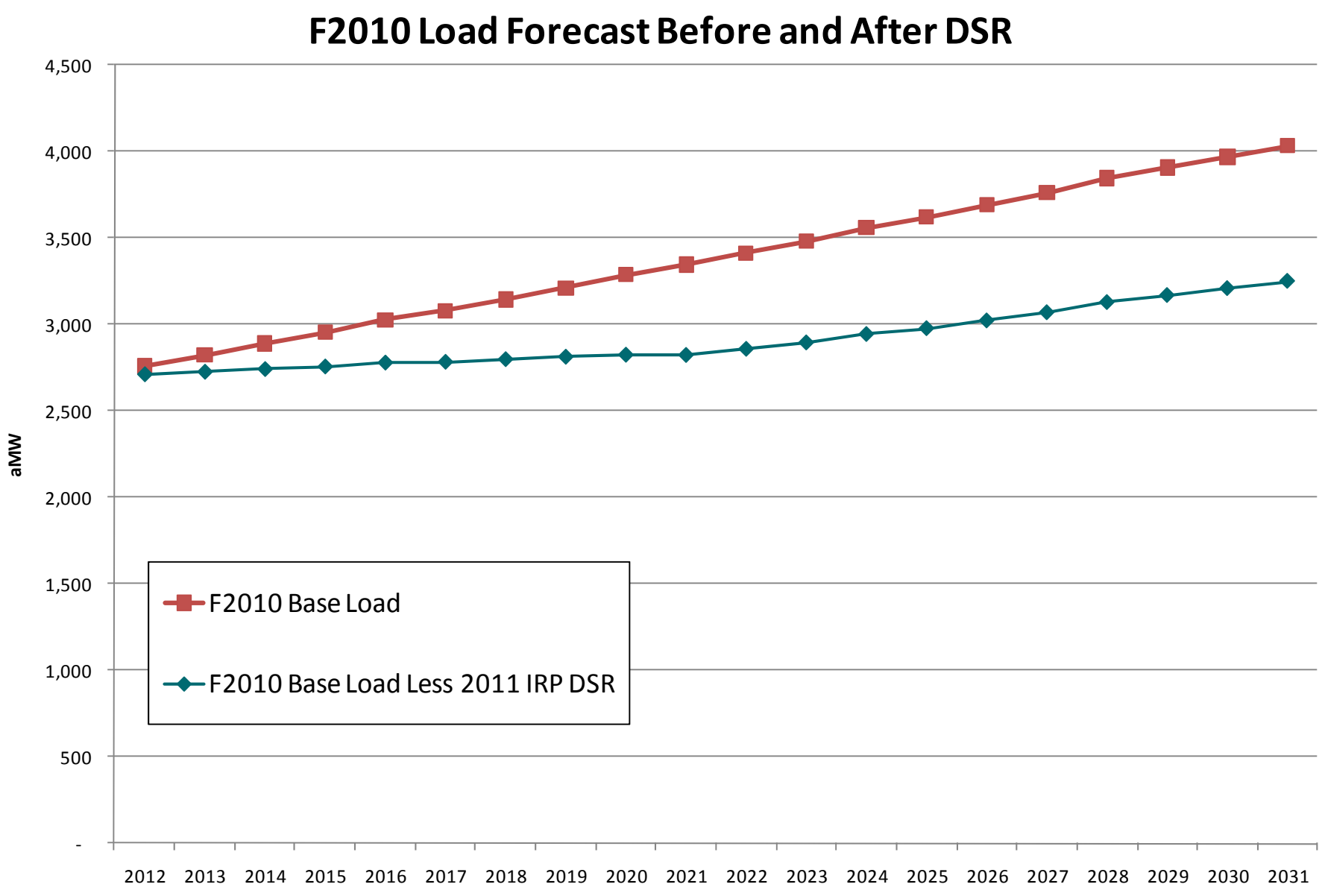
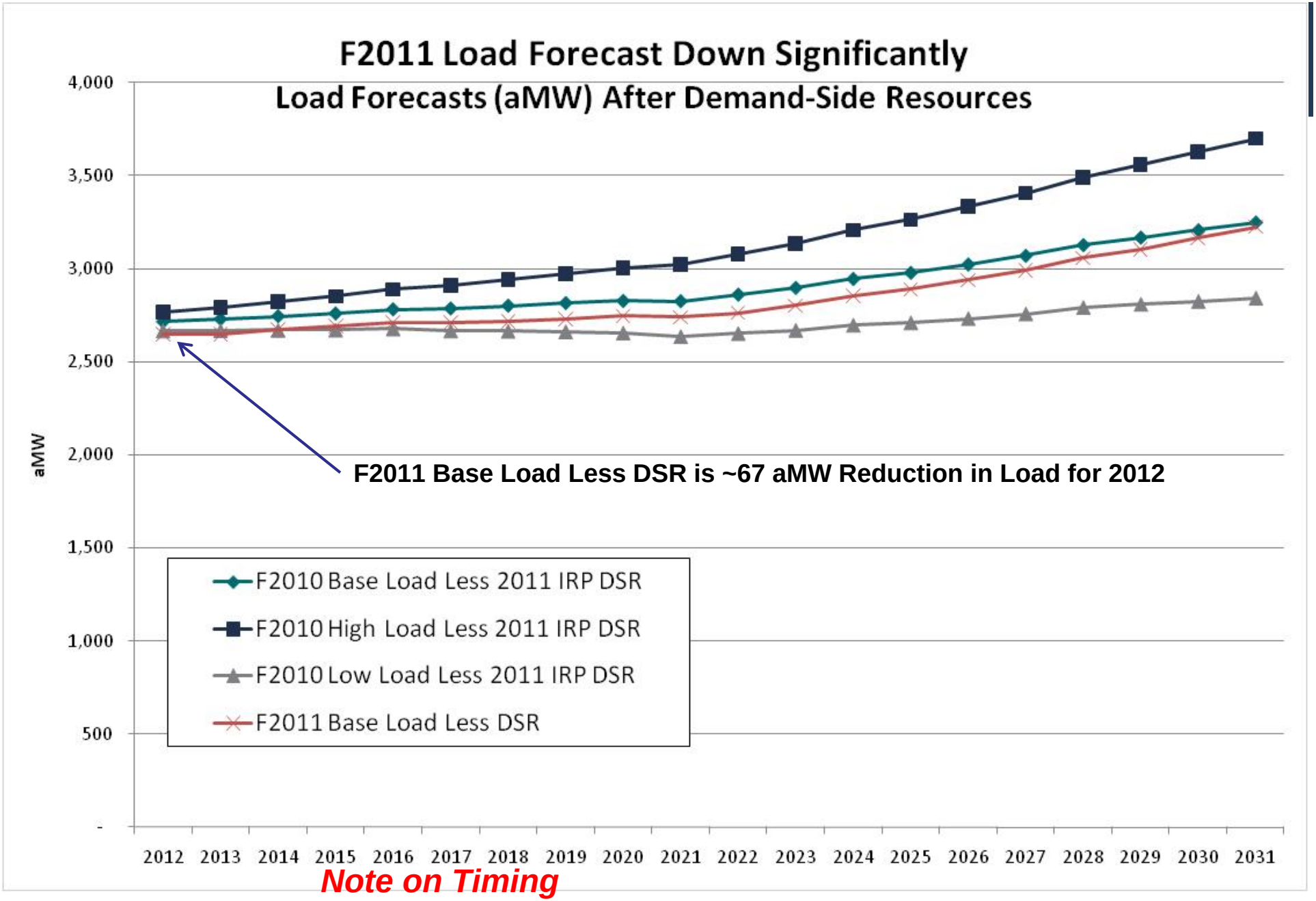
Impact of DSR on Load Forecast (aMW)



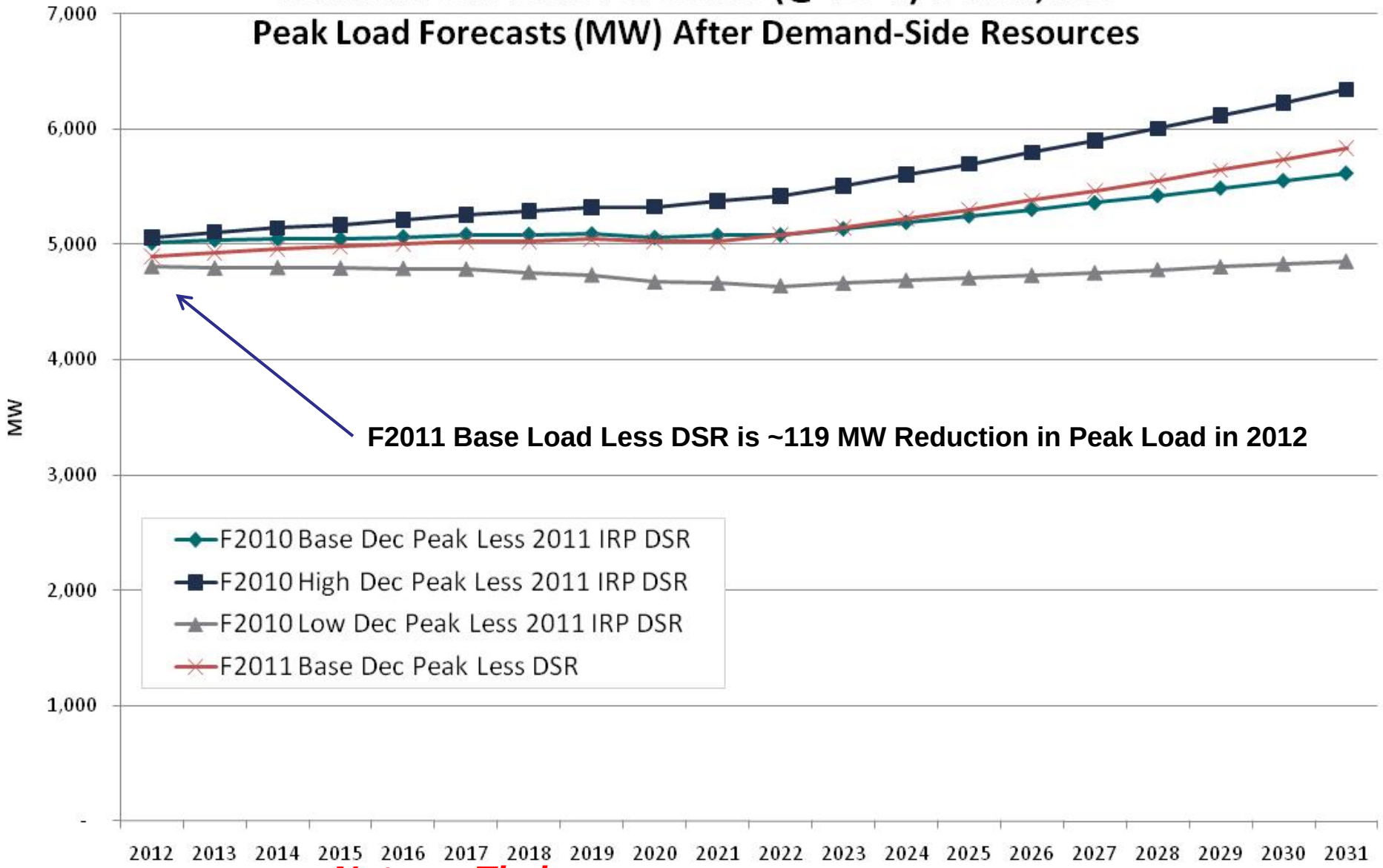


Note on Timing

F2010: Used for IRP

F2011: Used for GRC & Upcoming RFP

Normal Peak Load Forecasts (@ 23°F) Down, Too

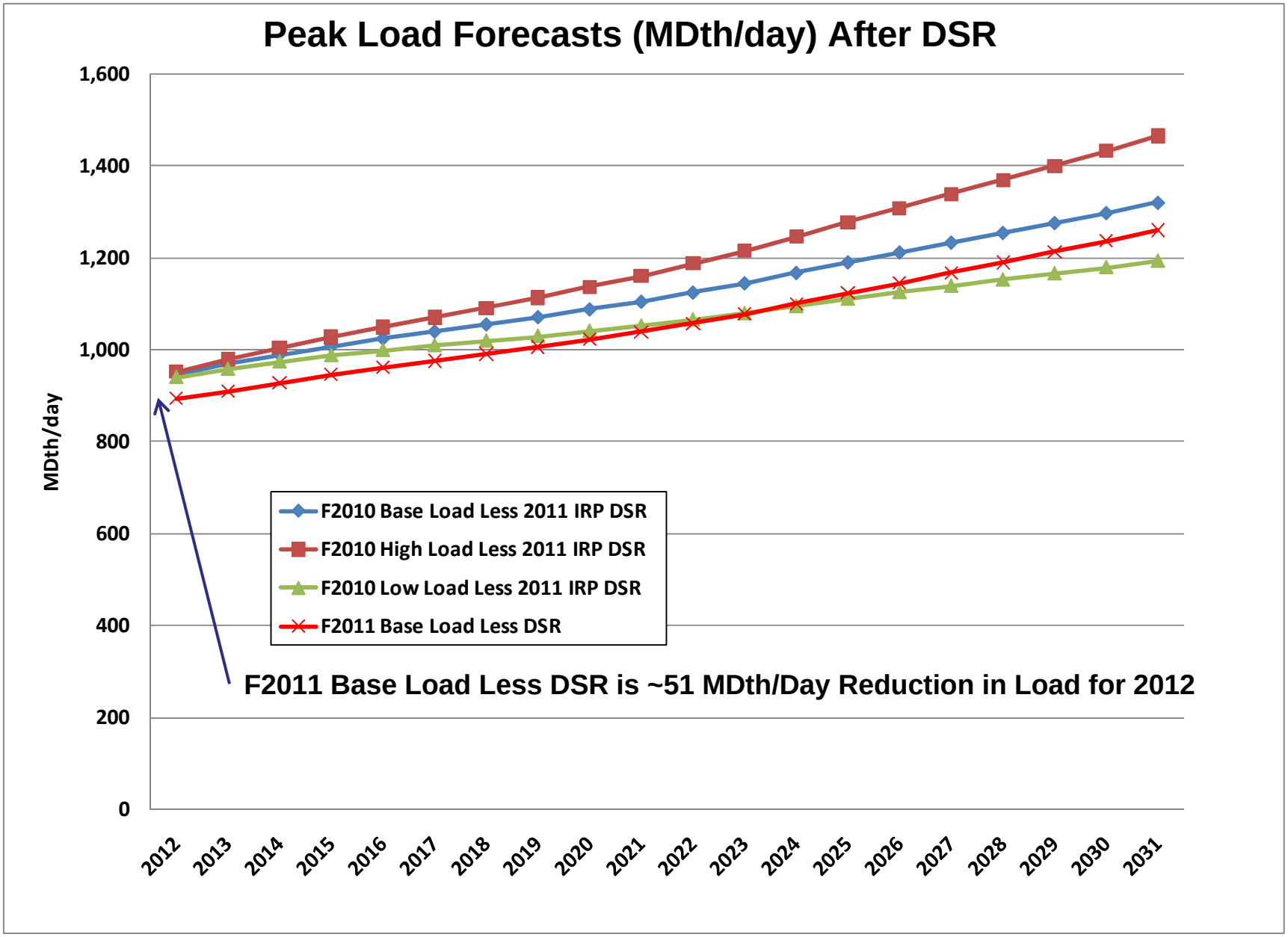


Note on Timing

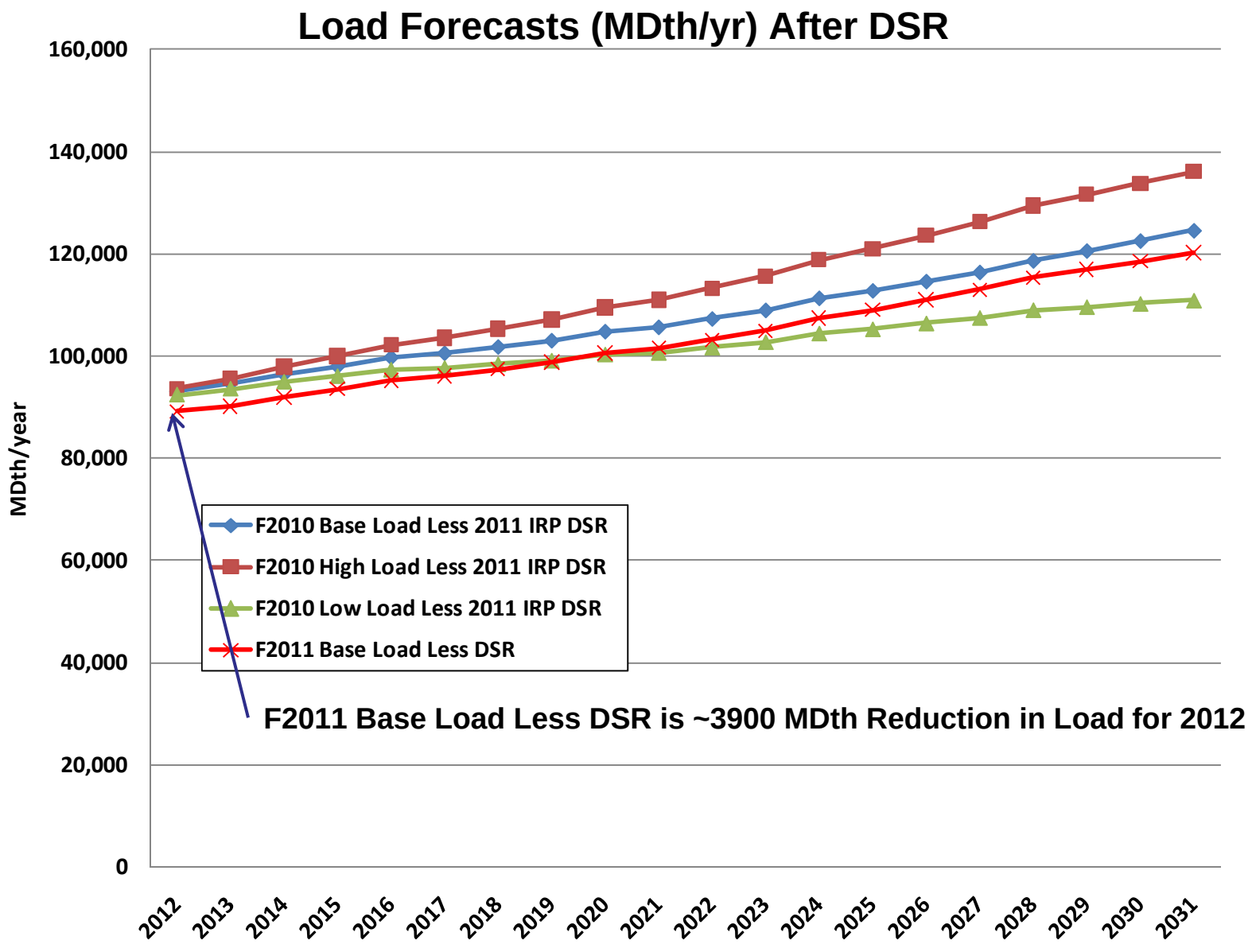
F2010: Used for IRP

F2011: Used for GRC & Upcoming RFP

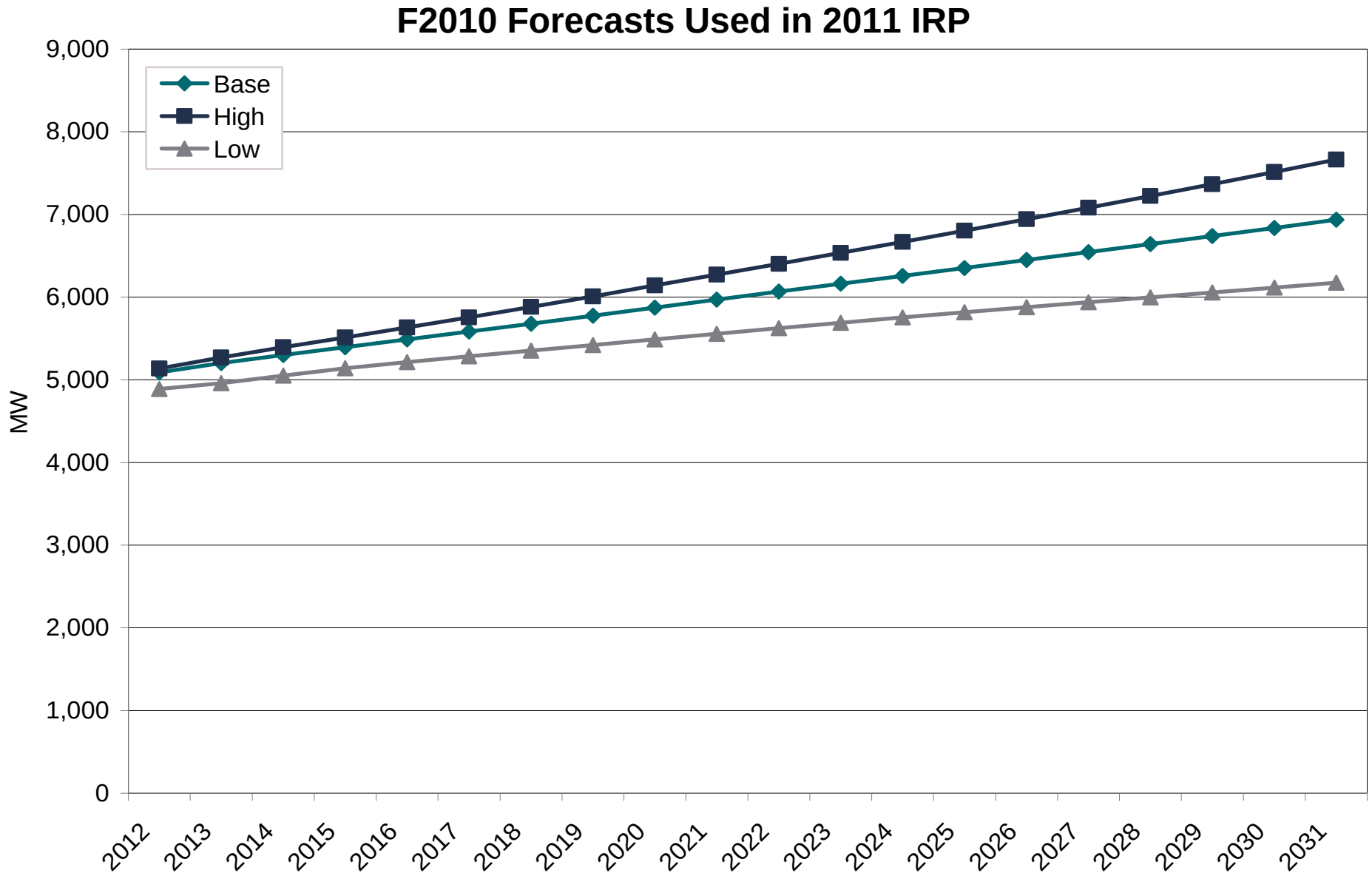
F2011 Design Peak Load Forecast Down



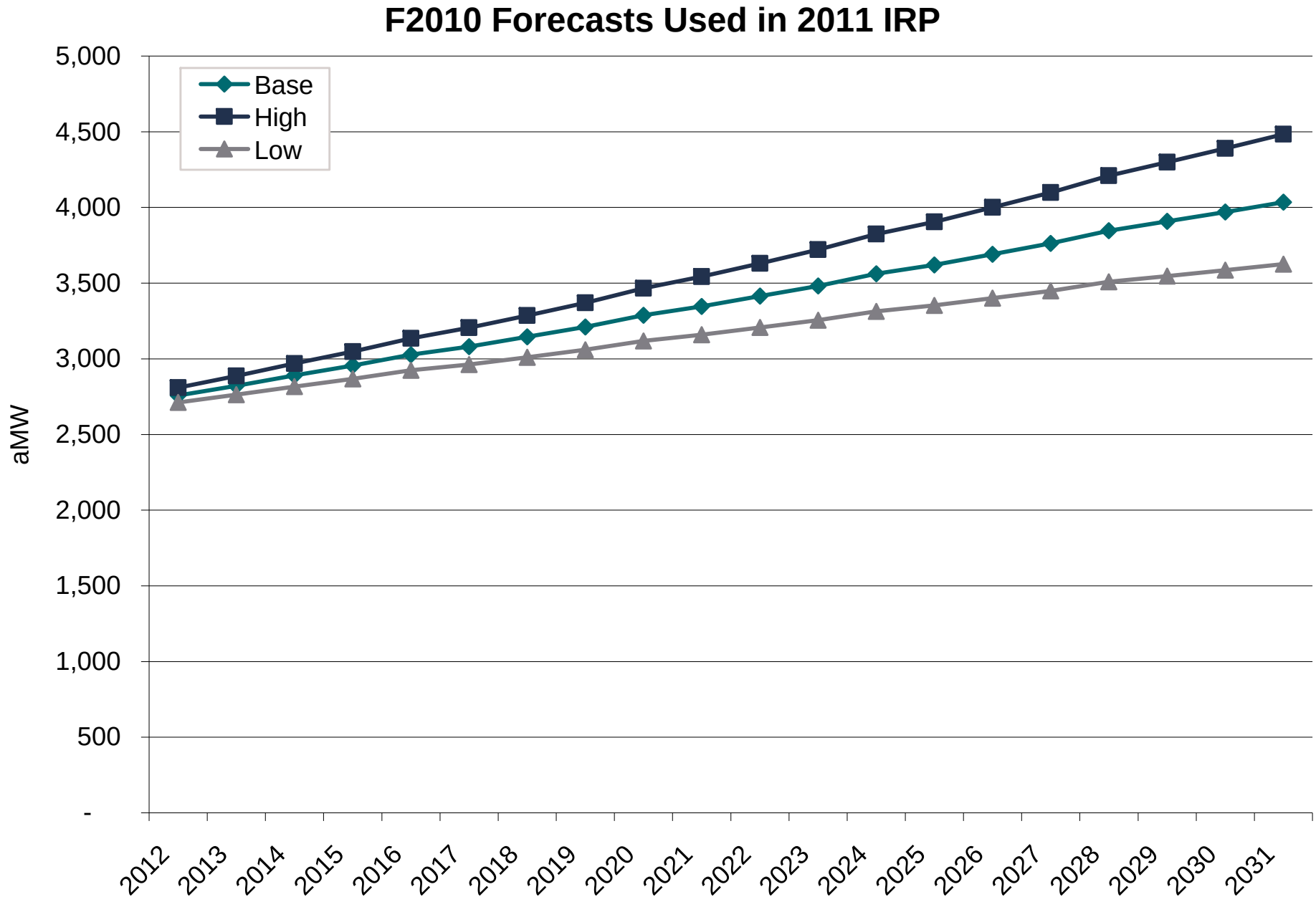
F2011 Load Forecast Down Significantly



Normal Peak Load Forecast (MW) Before DSR

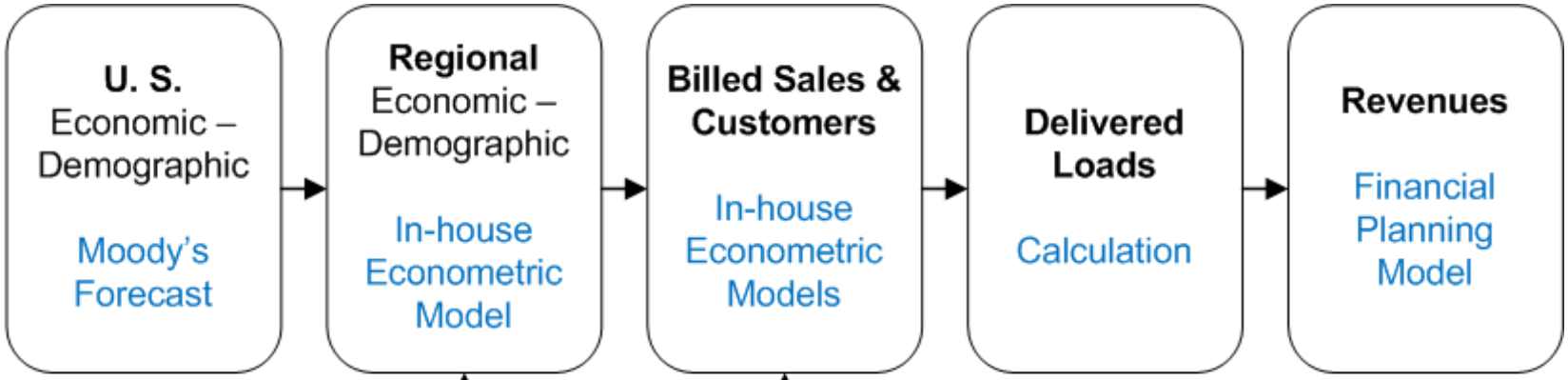


Load Forecasts (aMW) Before DSR



PSE Load Forecast Process

Forecast Models



Major Inputs

Major Load Forecast Variables

Electric	
Residential	
UPC	Customers
Unemployment Retail Rates Long-term Technology Trends	Population Building Permits
Commercial	
UPC	Customers
Employment Retail Rates Long-term Technology Trends	Employment
Industrial	
UPC	Customers
Manufacturing Employment Retail Rates	Manufacturing Employment

Gas	
Residential	
UPC	Customers
Unemployment Retail Rates Long-term Technology Trends	Households Building Permits Conversion Rate
Commercial	
UPC	Customers
Employment Retail Rates	Employment
Industrial	
UPC	Customers
Manufacturing Employment Retail Rates	Manufacturing Employment

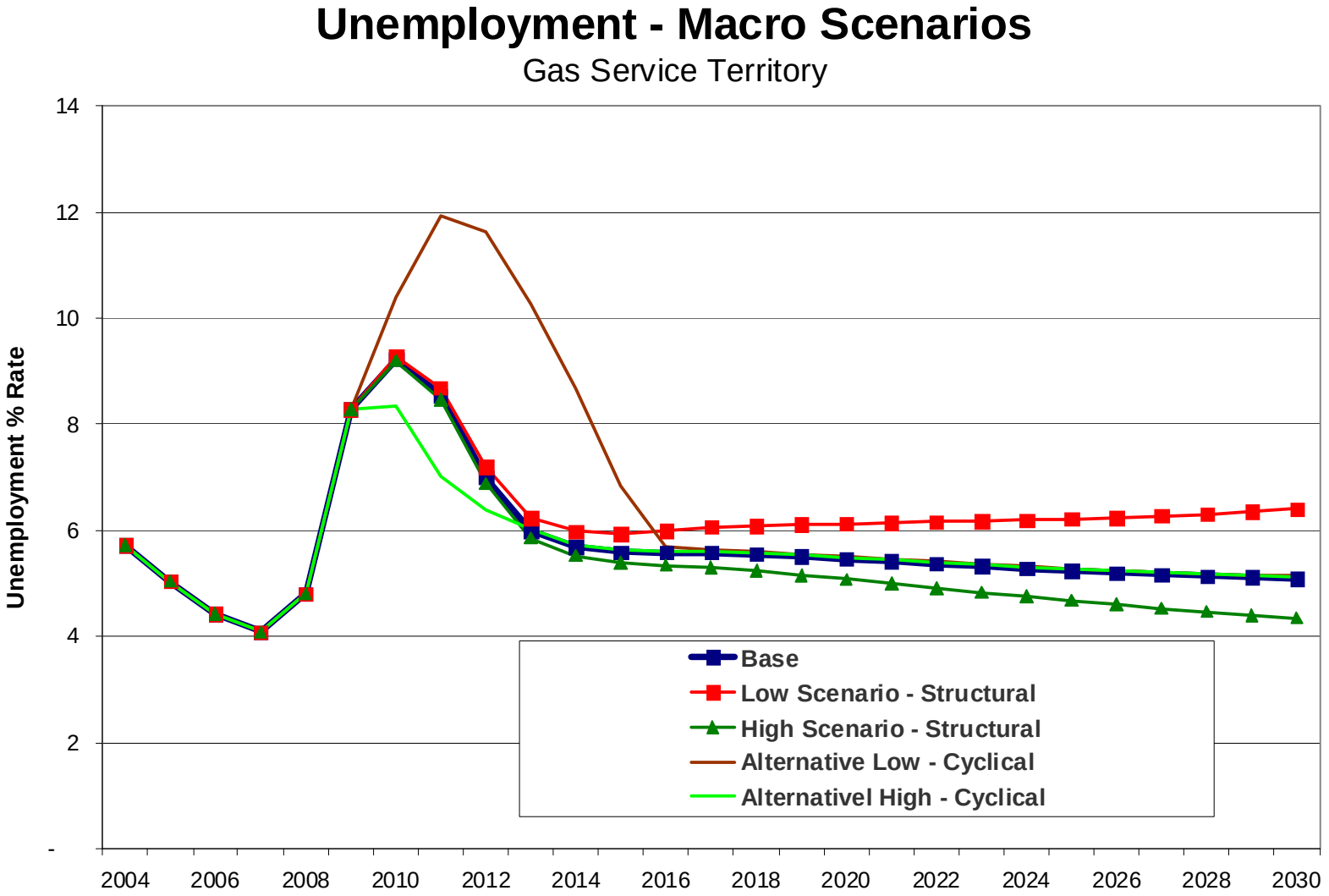
- Use per customer (UPC) growth is a function of lagged UPC growth, plus the effect of changes in variables such as prices, unemployment and employment
- Customer growth is a function of lagged customer growth, plus the effect of changes in variables such as population or manufacturing employment

Macro Economic Scenarios

- **Structural** Scenarios are based on Washington's Office of Financial Management's population projections
  - Low-to-Base (11-County): -0.4% Population AARG
  - High-to-Base (11-County): +0.4% Population AARG
- Estimates the long-term structural change to customer growth rather than shorter cyclical impacts

- **Cyclical** Scenarios are based on Moody's Macroeconomic scenarios
- Estimates the short-term change to economic variables based on different national economic outcomes

Unemployment Impacts Residential Load



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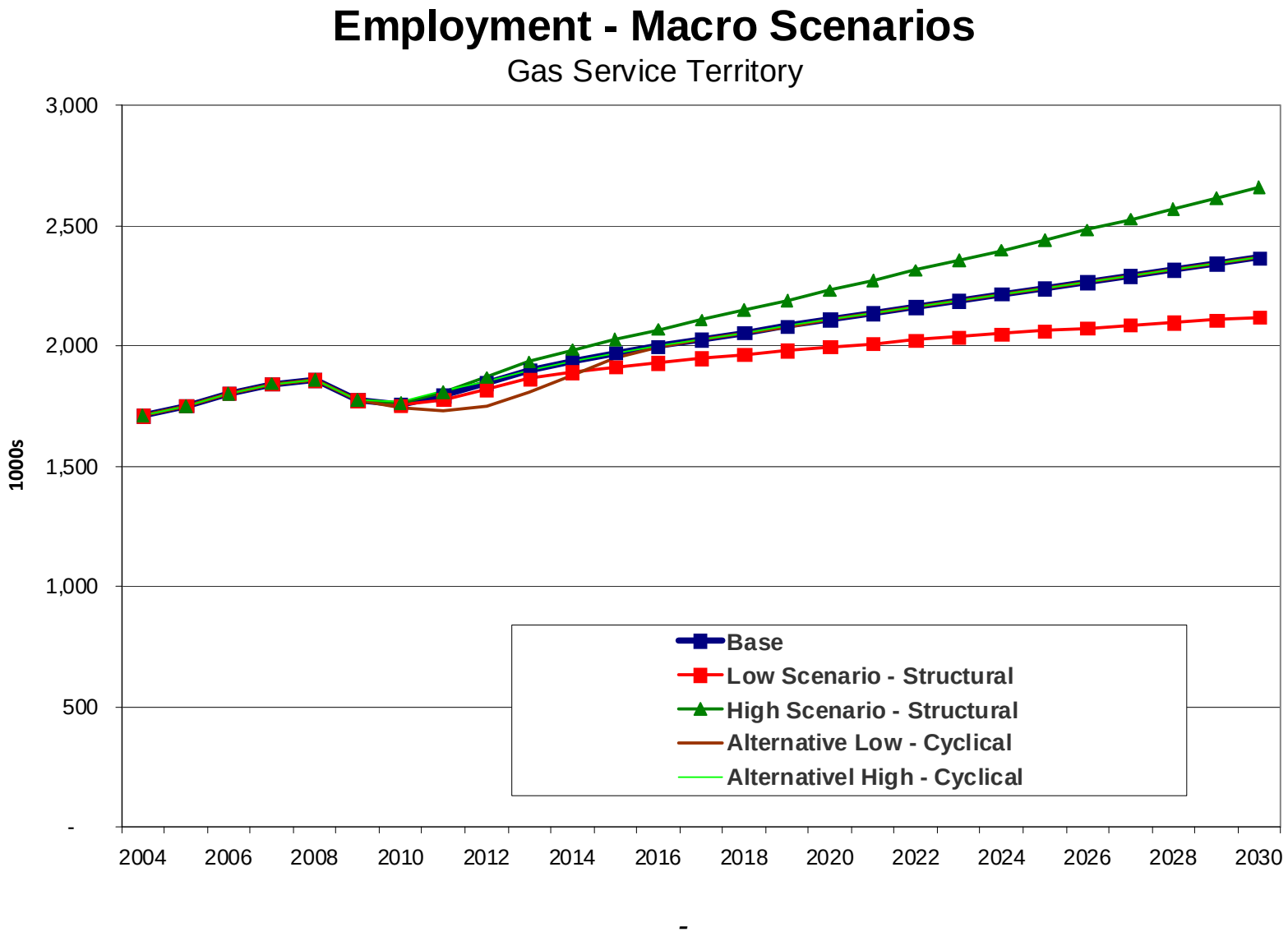
Employment Impacts Commercial Loads



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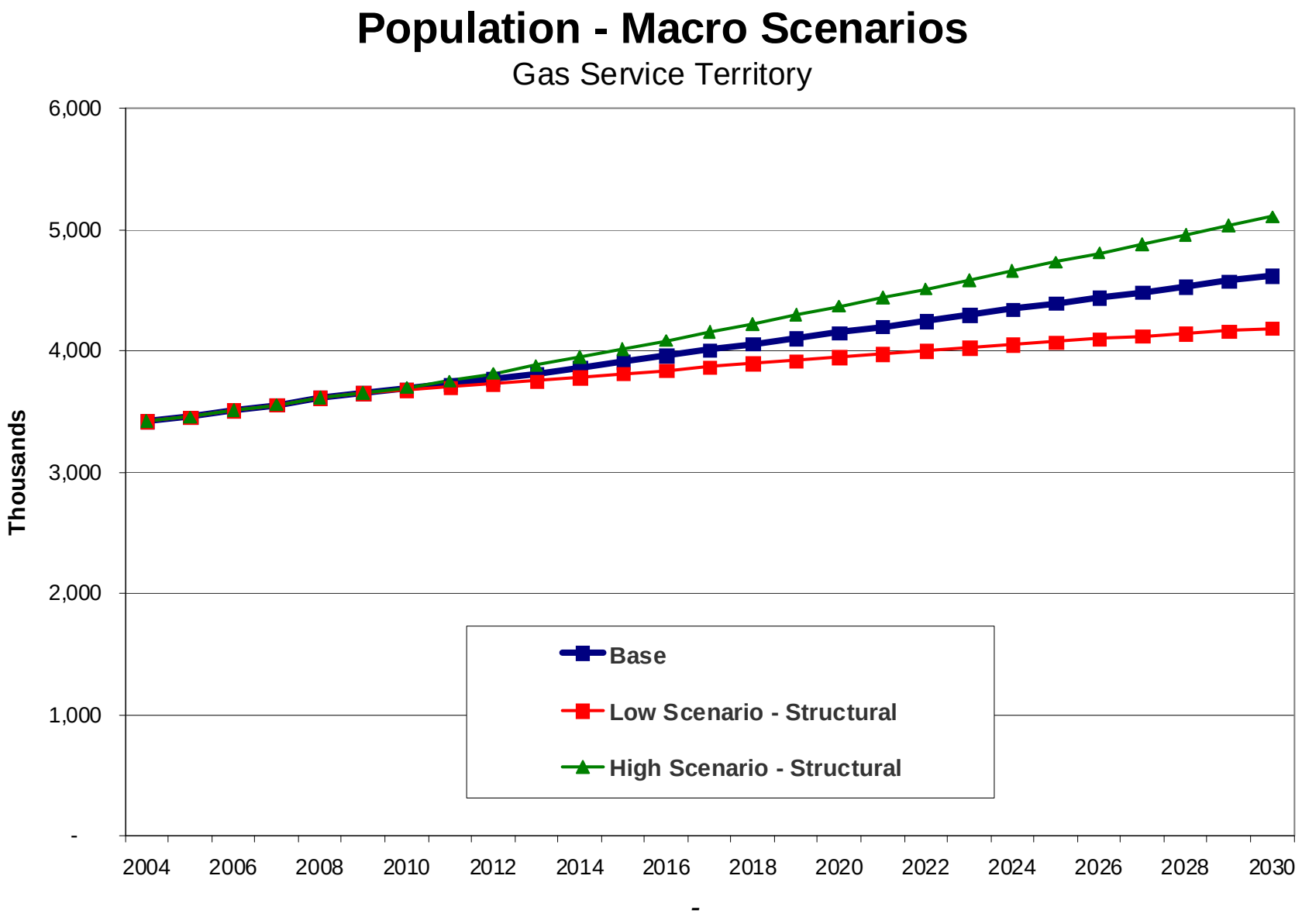
Population Impacts Customer Growth



RPS Cost Cap Calculation Details

PUGET SOUND ENERGY

August 11, 2011

WAC 480-109-030 (1)

Instead of meeting its annual renewable resource target in WAC 480-109-020, a utility may make one of three demonstrations.

(1) A utility may invest at least four percent of its total annual retail revenue requirement on the incremental costs of eligible renewable resources, renewable energy credits, or a combination of both.

The incremental cost of an eligible renewable resource is the difference between the levelized delivered system cost of the eligible renewable resource and the levelized delivered cost of an equivalent amount of reasonably available nonrenewable resource.

The system analysis used will be reasonably consistent with principles used in the utility's resource planning and acquisition analyses.

(Note: This is one entire paragraph in the WAC. It has been broken apart here to make it easier to follow each compōnent.)

Analytic Framework

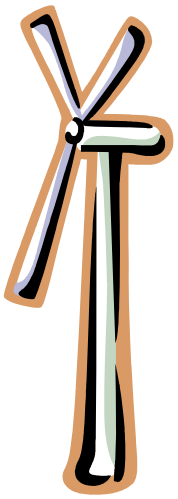
- Contemporaneous with decision making
- Compare revenue requirement cost of each renewable resource to equivalent non-renewable
- Equivalent non-renewable
  - Capacity
  - Energy
  - Imputed Debt

-

Eligible Renewable Resources

	Nameplate (MW)	Annual Energy (aMW)	Commercial Online Date	Market Price/ Peaker Assumptions	Capacity Credit Assumption
Hopkins Ridge	149.4	53.3	Dec 2005	2004 RFP	20%
Wild Horse	228.6	73.4	Dec 2006	2006 RFP	17.2%
Klondike III	50	18.0	Dec 2007	2006 RFP	15.6%
Hopkins Infill	7.2	2.4	Dec 2007	2007 IRP	20%
Wild Horse Expansion	44	10.5	Dec 2009	2007 IRP	15%
Lower Snake River I	342	101.8	Apr 2012	2010 Trends	5%
Snoqualmie Upgrades	6.1	3.9	Mar 2013	2009 Trends	95%
Lower Baker Upgrades	30	12.5	May 2013	2011 IRP Base	95%
Generic Wind 2020	300	89.7	Jan 2020	2011 IRP Base	1.8%
Generic Wind 2027	100	29.9	Jan 2027	2011 IRP Base	1.8%
Generic Biomass 2020	25	21.25	Jan 2020	2011 IRP Base	93%
Generic Biomass 2029	25	21.25	Jan 2029	2011 IRP Base	93%

Wild Horse: Equivalent Non-Renewable



Wild Horse Wind Facility

Nameplate: 228.6 MW

Annual Energy: 642,814 MWh

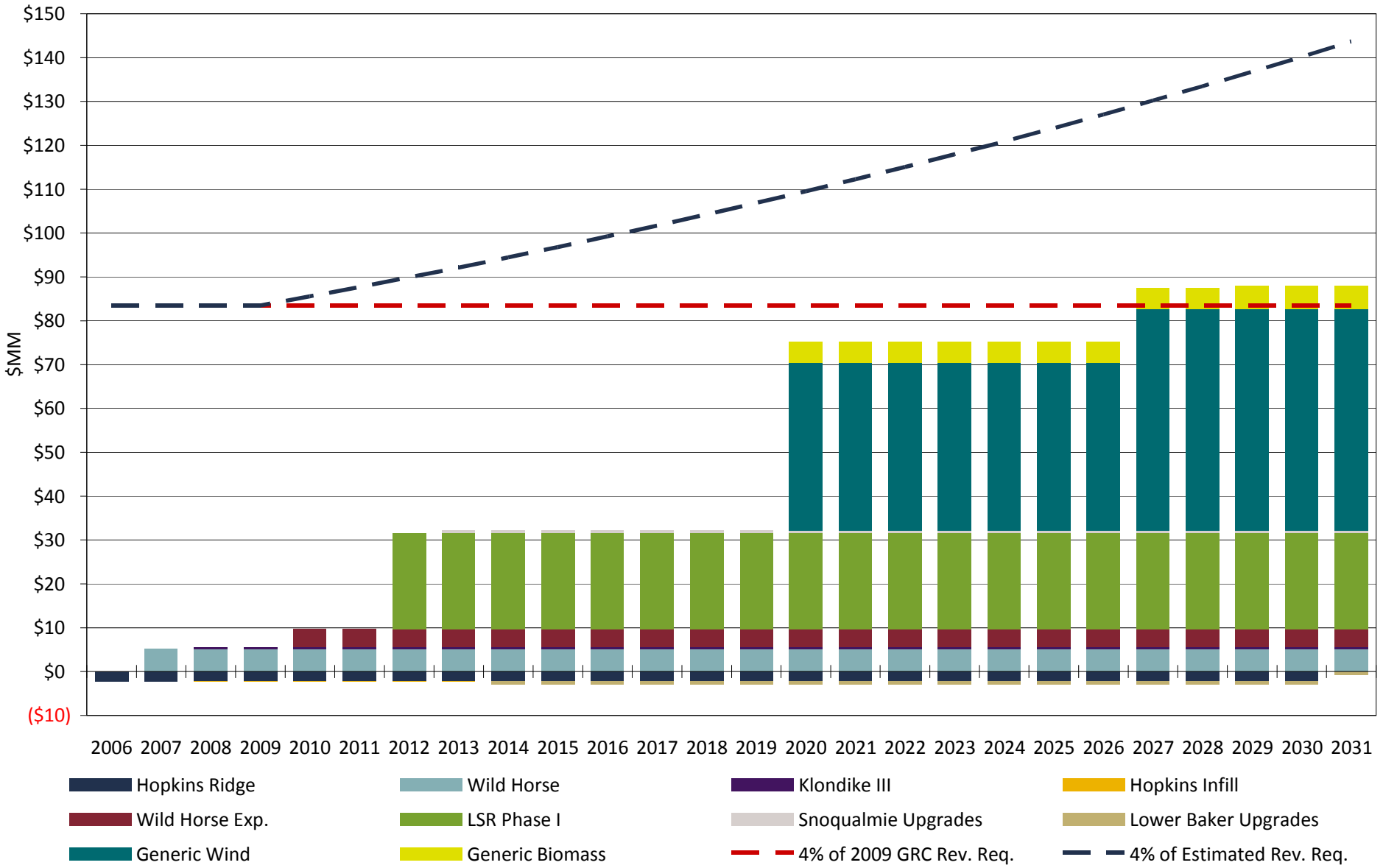
Capacity: 228.6 * 17.2% = 39 MW

Market + Peaker

Annual Market : 642,814 MWh

Peaker Nameplate: 39 MW

Expect to Stay Under 4% Rev Req Cap

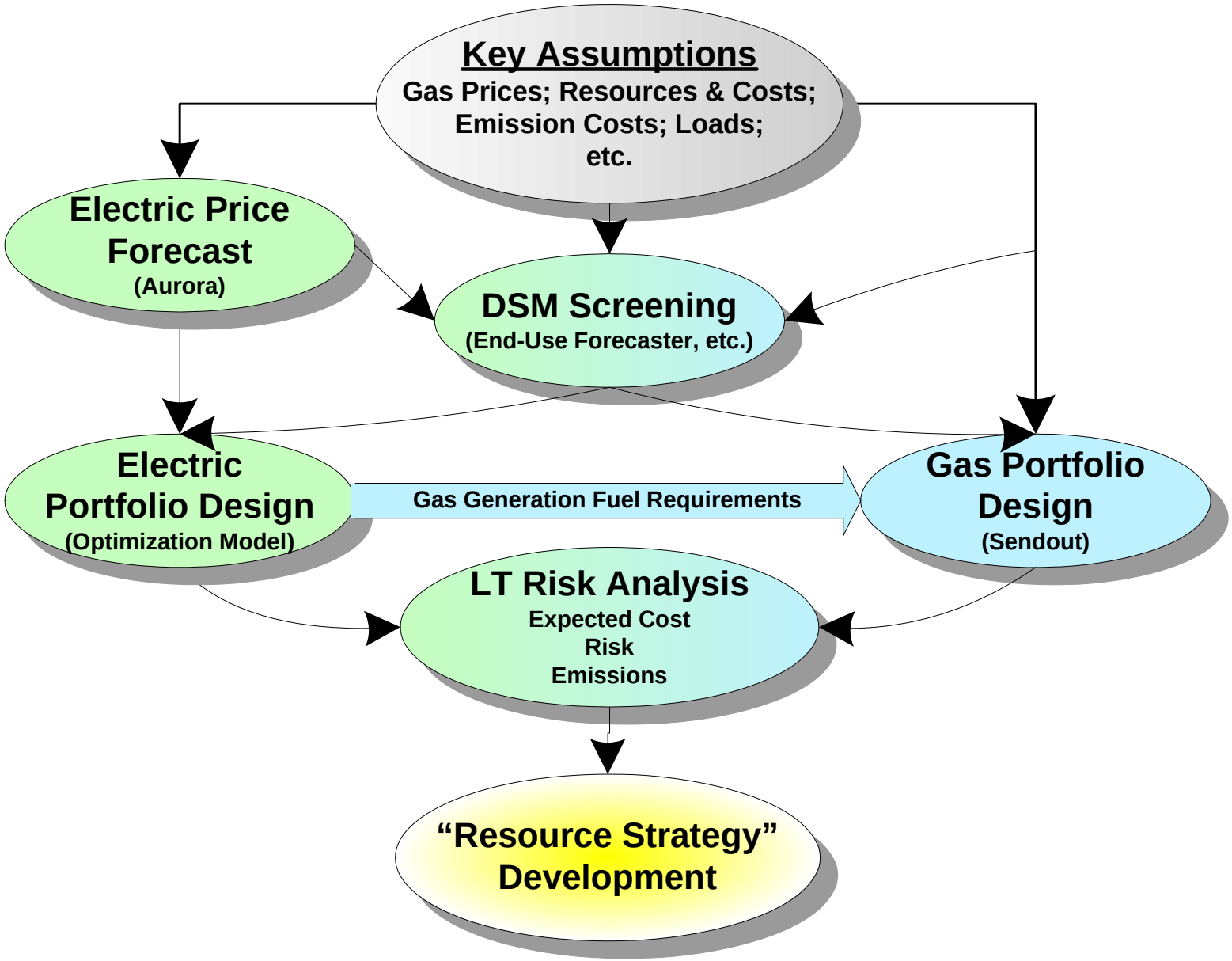


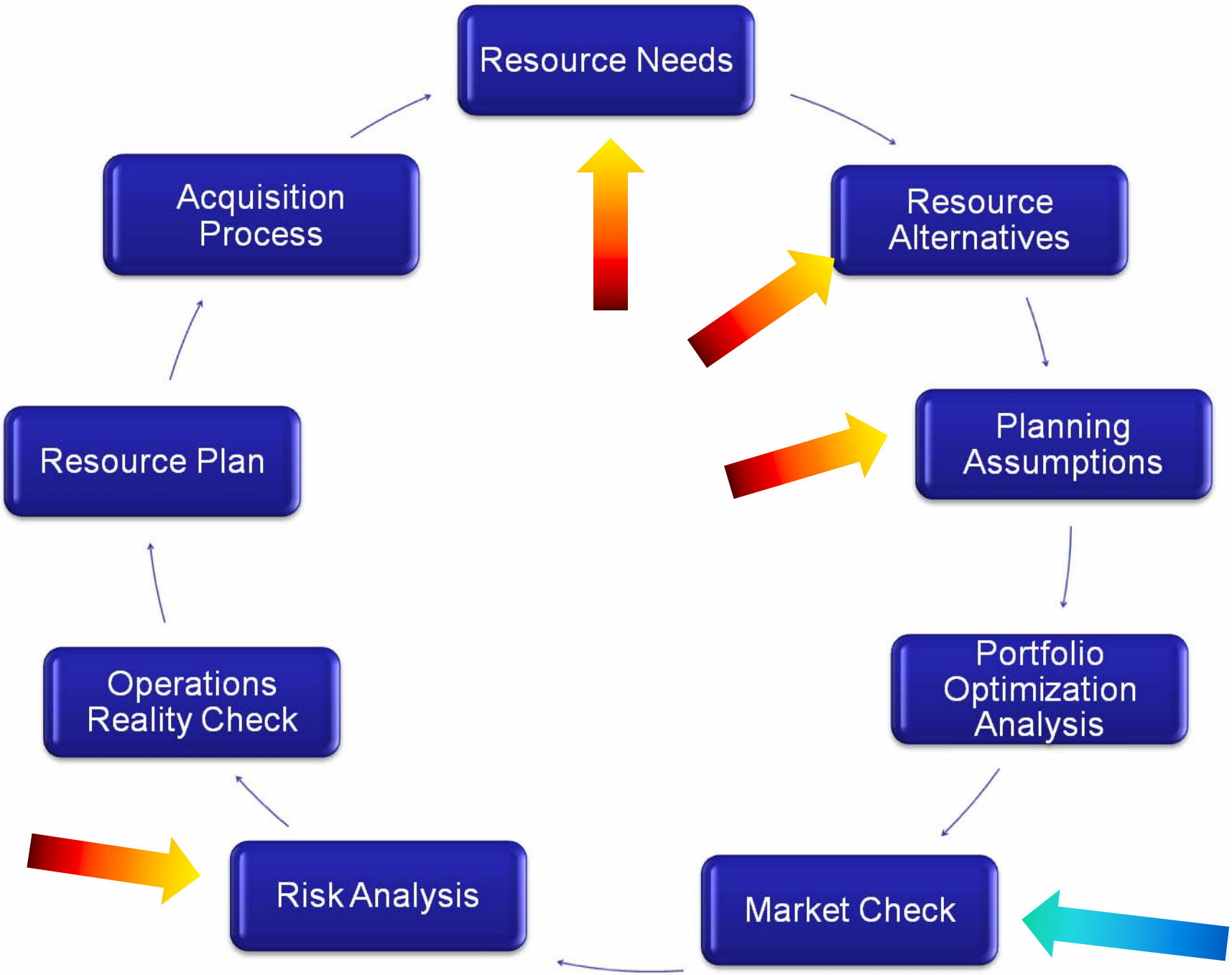
Some Analytical Methodology Details

PUGET SOUND ENERGY

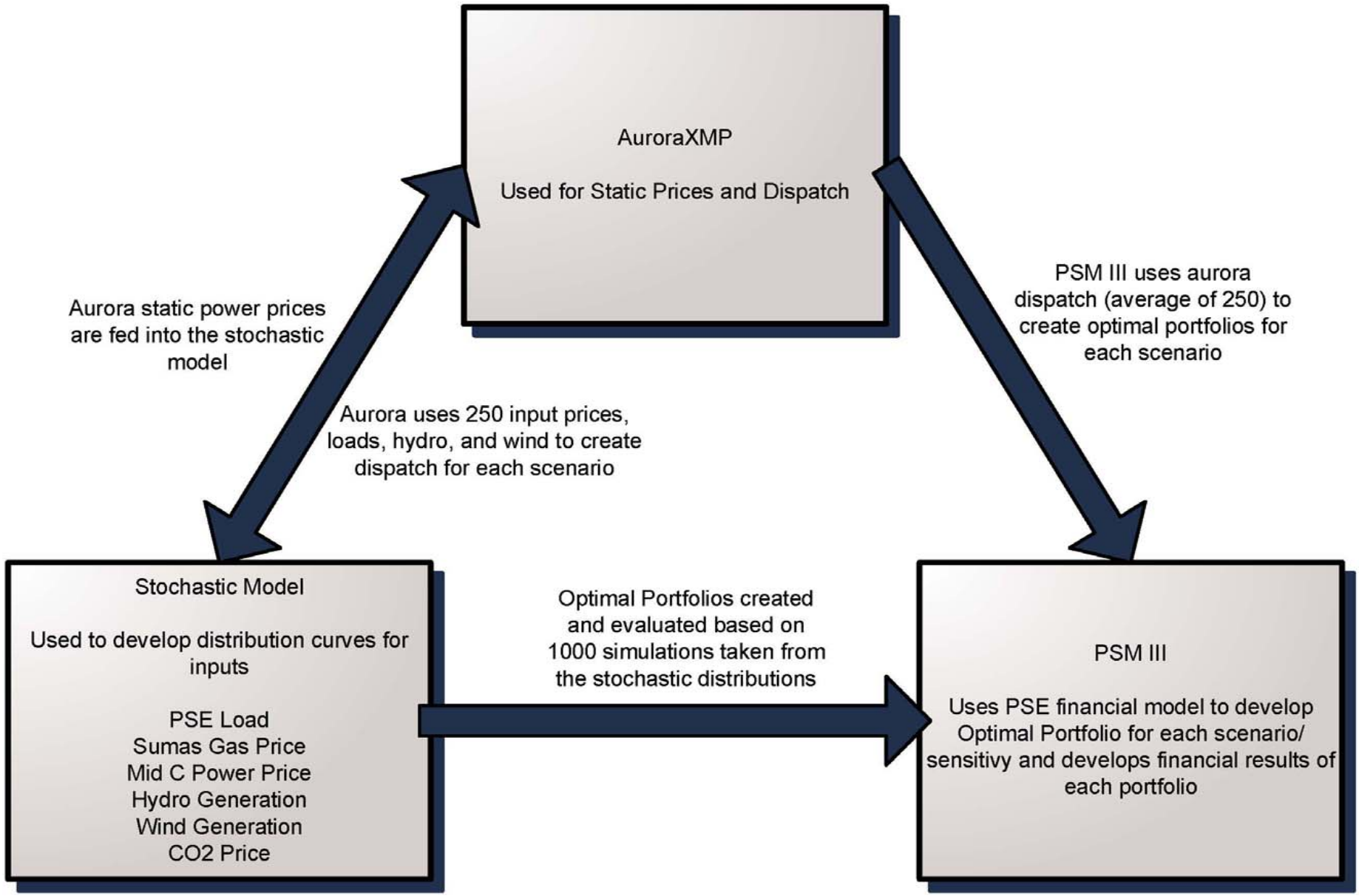
August 11, 2011

Resource Planning
Portfolio Analysis Process




Resource Needs
Resource Alternatives
Planning Assumptions
Portfolio Optimization Analysis
Market Check
Risk Analysis
Operations Reality Check
Resource Plan
Acquisition Process

Electric Analysis Methodology



Consistency with Council Methodology

http://www.nwcouncil.org/energy/powerplan/6/supplycurves/I937/default.htm

Council

Technical Potential	Economic Potential	Achievable Potential
See 2. a & b	**See 3. a - e**	**See 4. a - c**
-Wide array tech, all sectors	-Econ Screening-TRC	-Targets from IRP Analysis
-Saturations	-Shaped Energy/Capacity	-DSM Versus All Resources
-New/Existing Units	-Full Incremental Cost	-B&C from Econ Screen
-Measure Life/Substitutions	-T&D Savings & Losses	-Lost Opportunity/Discretion
-Measure Shapes	-"Environmental Benefits"	-Adjusted Historic Ramps
-Measure Interactions	-NEB/10% Credit	-Revise Based on Exp.

PSE

Technical Potential	Economic Potential	Achievable Potential
See 2. a & b	**See 3. a - e**	**See 4. a - c**
☑ Wide array tech, all sectors	☑ Econ Screening-Bundles	☑ Targets from IRP Analysis
☑ Saturations	☑ Shaped Energy/Capacity	☑ DSM Versus All Resources
☑ New/existing units	☑ Full Incremental Cost	☑ B&C from Econ Screen
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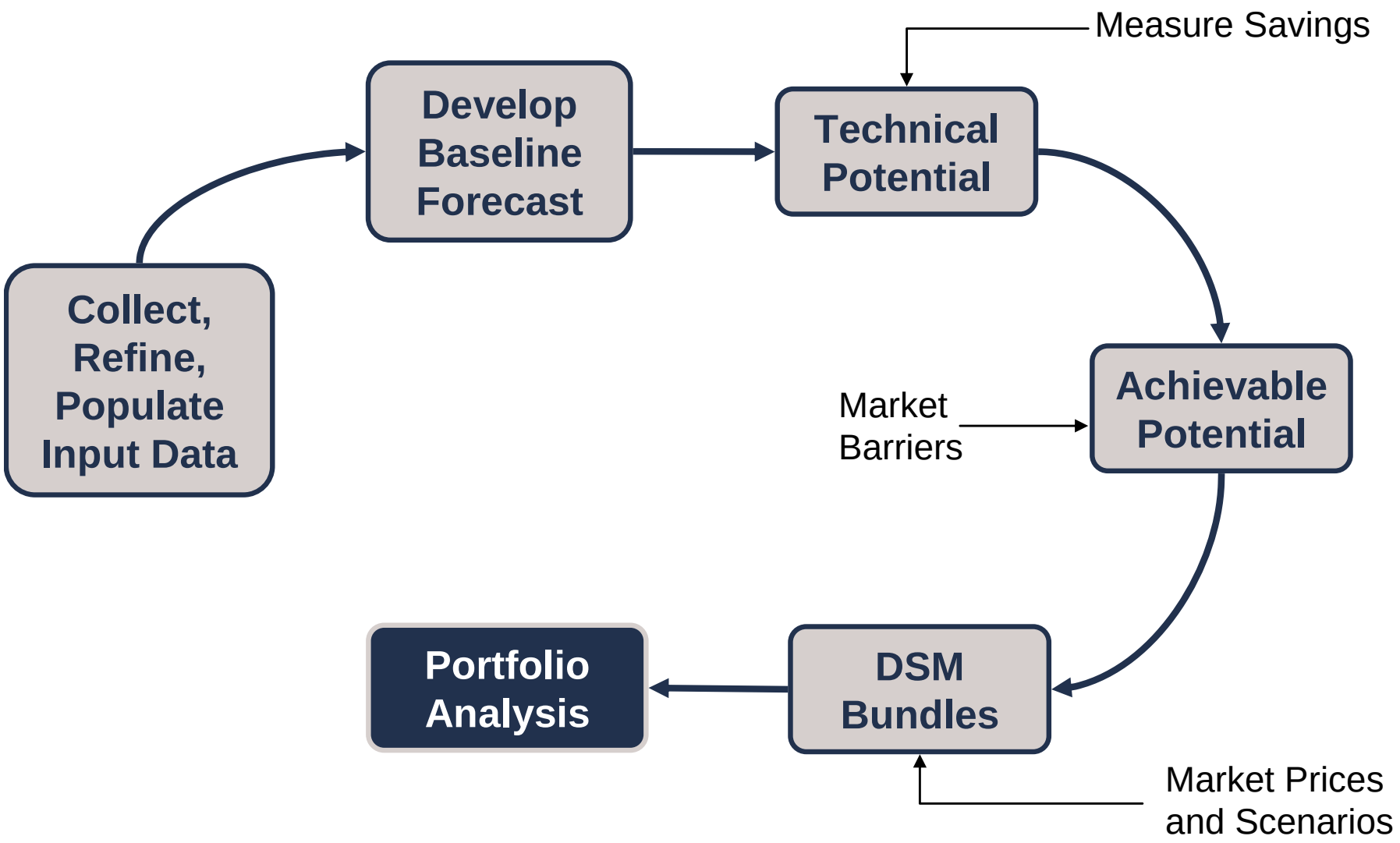
☑ Measure shapes	☑ Environmental Benefits"	☑ Adjusted Historic Ramps
☑ Measure interactions	☑ NEB & 10% Credit	☑ Revise Based on Exp.

Overview: Assessing DSR Resource Potential



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Some LOLP and Wind ELCC Details

PUGET SOUND ENERGY

August 11, 2011

Planning Margin Details

- Uses Loss of Load Probability Approach
- Stochastic Framework To Examine Possible Convergence of Drivers to Meeting Load
- Analytical Framework Unlocks Potential for Understanding Complex Impact on Reliability

Normal Peak*15.7% + Operating Reserves ~ 5% LOLP

PSE's LOLP

- 3000 Draws—8760 Hours for Sample Years Monthly
- Definition of Event
  - Event is a draw in which one or more hours show (load + operating reserves) > resources
  - Contingency reserves cover forced outage for 1st hr
- LOLP is Sum (Events)/3000

Sources of Variability

- Temperature Impact on Load
- Forced Outage: Likelihood
- Forced Outage: Duration
- Critical Hydro Conditions
- New for 2011 IRP: Wind

Temperature Impact on Loads

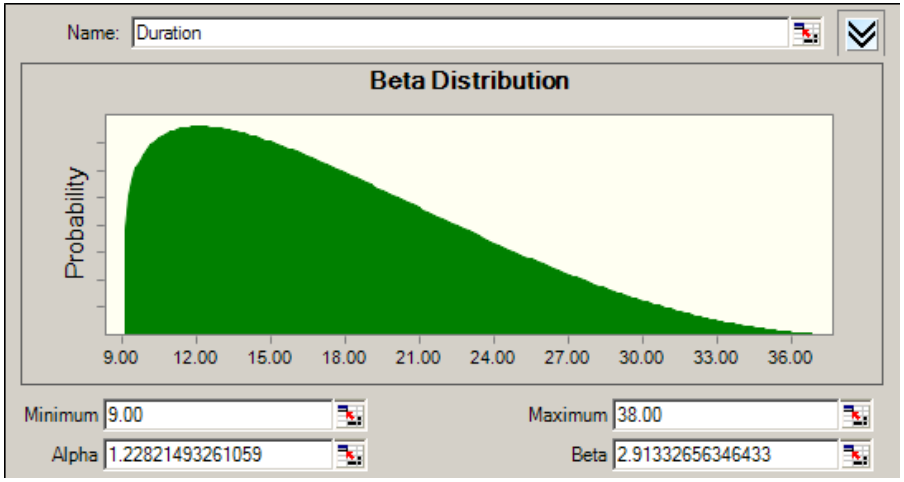
Jul 21

- Annual Hourly Temperature Draws
- Actual Data Since 1950

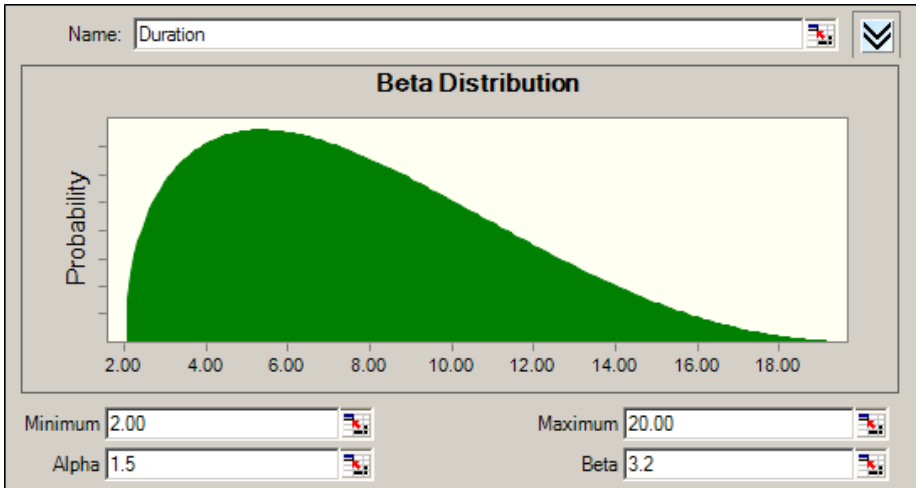
-

Thermal Plant Outage Distributions

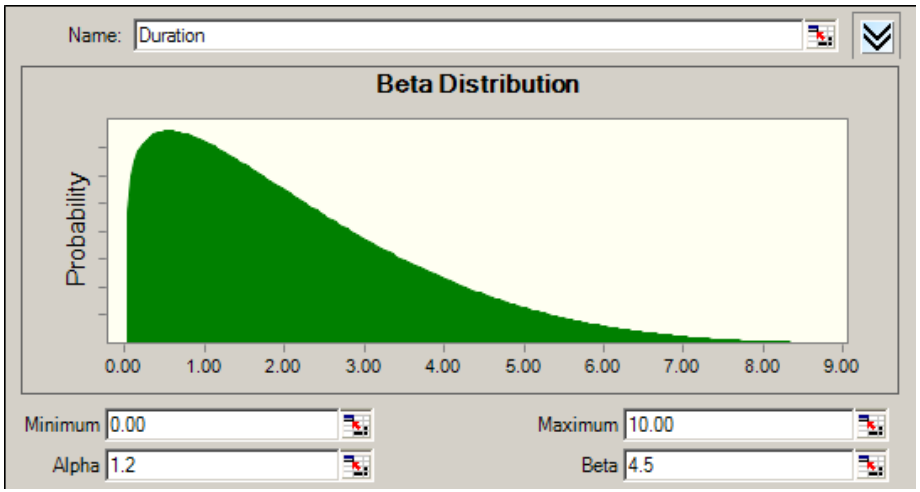
Coal



Gas CCCT



CT



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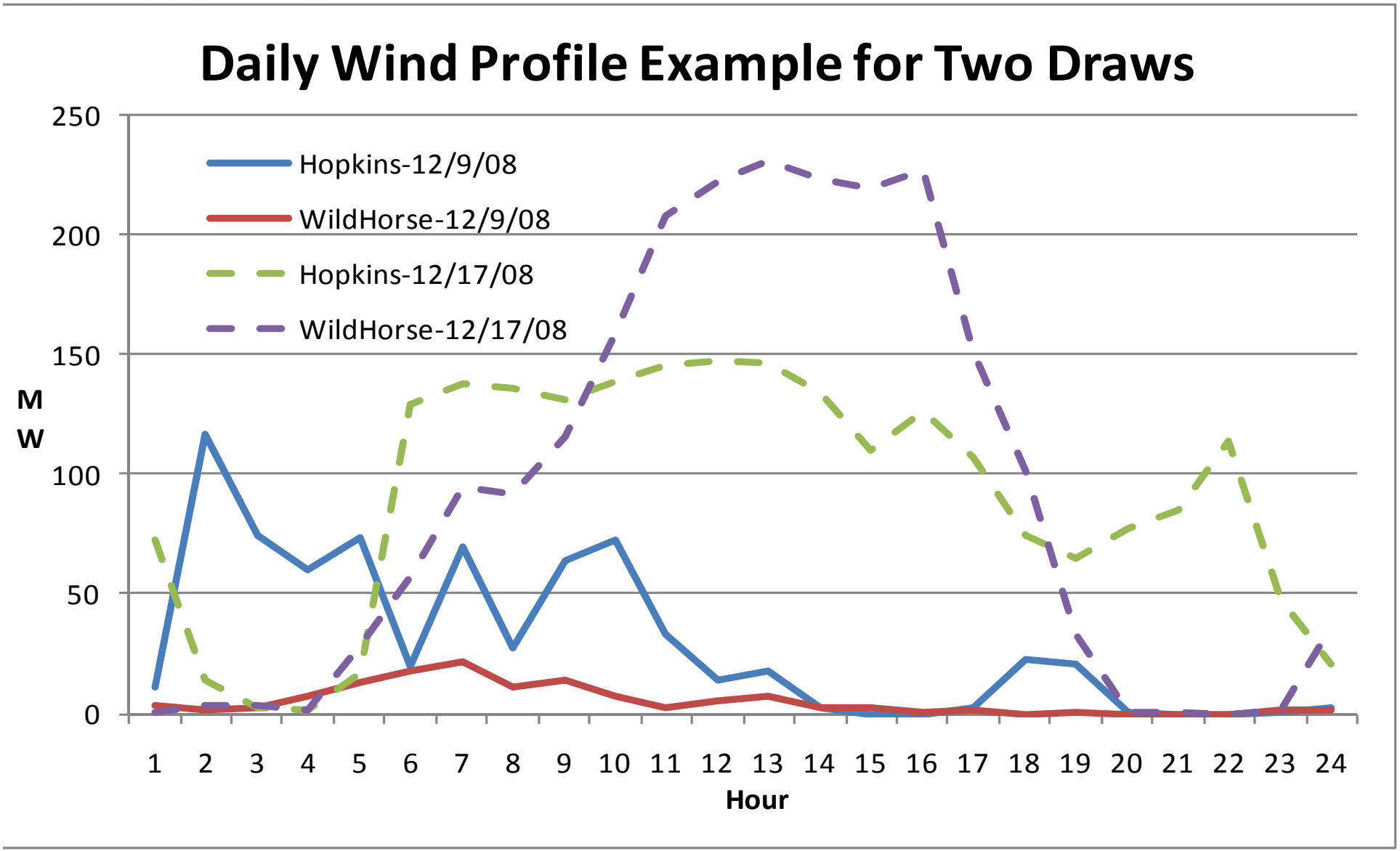
Hydro

- Hydro Storage Extremely Complex in an LOLP
- Simplification: Critical Hydro Reduces Capacity-Historic
  - May Overstate Hydro Reliability/Understate Capacity Need
- Correlated to Temperature

Wind Distributions

- Derived from 3.5 years of historical data from Hopkins Ridge and Wild Horse
- Draws of daily profiles are made within each month
- Each day has an equal probability of being chosen
- Draws across wind farms are synchronized on a daily basis
- LSR draws are based on lagged Hopkins profile scaled to its nameplate capacity
- Generic SE WA or Kittitas wind profiles are based on Hopkins or Wild Horse profiles, respectively, and scaled to 100 MW capacity

Example of Daily Wind Profile Draws for December 1



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Results of LOLP and Planning Margin

LOLP Results				Planning Margin Calculation			
Existing Resource Capacity (MW)	Additional Capacity (MW)	Total Capacity (MW)	Resulting LOLP	Required Operating Reserves (MW)	Total Capacity Net of Op Reservs (MW)	Normal Peak Load (MW)	Planning Margin Net of Op Reserves
a	b	c = a+b	d	e	f = c-e	g	h = (f/g) - 1
5260	0	5260	55.9%	250	5010	5236	-4.3%
5260	150	5410	38.2%	261	5149	5236	-1.7%
5260	300	5560	23.5%	271	5289	5236	1.0%
5260	450	5710	17.4%	282	5428	5236	3.7%
5260	600	5860	13.9%	292	5568	5236	6.3%
5260	750	6010	11.0%	303	5707	5236	9.0%
5260	900	6160	8.8%	313	5847	5236	11.7%
5260	1050	6310	6.1%	324	5986	5236	14.3%
5260	**1125**	**6385**	**5.0%**	**329**	**6056**	**5236**	**15.7%**
5260	1200	6460	3.9%	334	6126	5236	17.0%
5260	1350	6610	2.6%	345	6265	5236	19.6%
5260	1500	6760	0.8%	355	6405	5236	22.3%

Wind ELCC Study

- Goal: Estimate Capacity Contribution of Wind to PSE's Portfolio

- Effective Load Carrying Capability Approach
  - Estimate equivalent thermal resource to achieve same impact on LOLP as the wind added.

- Key Findings:
  - Wind is not the go-to capacity resource
  - PSE's existing wind has slightly higher capacity value than previously assumed based on regional study @ 5%
  - Adding more wind in same location shows declining capacity contribution…similar to trends in PacifiCorp's '07 IRP
  - Not much diversity in primary Northwest wind basins
  - Note: Individual utility portfolio & load are important

ELCC-Analytical Framework

- Incorporate given amount of wind into LOLP model
- Determine corresponding amount of peaker to match LOLP impact

Hopkins Ridge	Starting Capacity	Wind Addition	Thermal Addition	Resulting LOLP
Add Hopkins Ridge	5684	157	1150	5%
"Equivalent" Peaker	5684	0	1173	5%
			-23	
Hopkins Ridge Capacity:	157			
Equivalent Peaker:	23			
Ratio: ELCC Hopkins Ridge:	14.8%			
Starting + Effective Hopkins:	5707			

Contribution of Wind: ELCC Conclusion

Table 1
Effective Load Carrying Capability of Wind

Summary All Wind	Wind Capacity	Effective Thermal Capacity	ELCC	
Hopkins Ridge	157	23	14.8%	
Wild Horse	272	39	14.5%	(Supply Only)
Lower Snake River	342	33	9.6%	
Generic SE WA (w/Added Trans)	100	2	1.8%	
Generic Kittitas (w/Added Trans)	100	5	4.9%	

- Key Findings:
  - Wind is not the go-to capacity resource.
  - PSE's existing wind has slightly higher capacity value than previously assumed based on regional study @ 5%.
  - Adding more wind in same location shows declining capacity contribution…similar to trends in PacifiCorp's '07 IRP.
  - Not much diversity in primary Northwest wind basins.
  - Note: Individual utility portfolio & load are important.