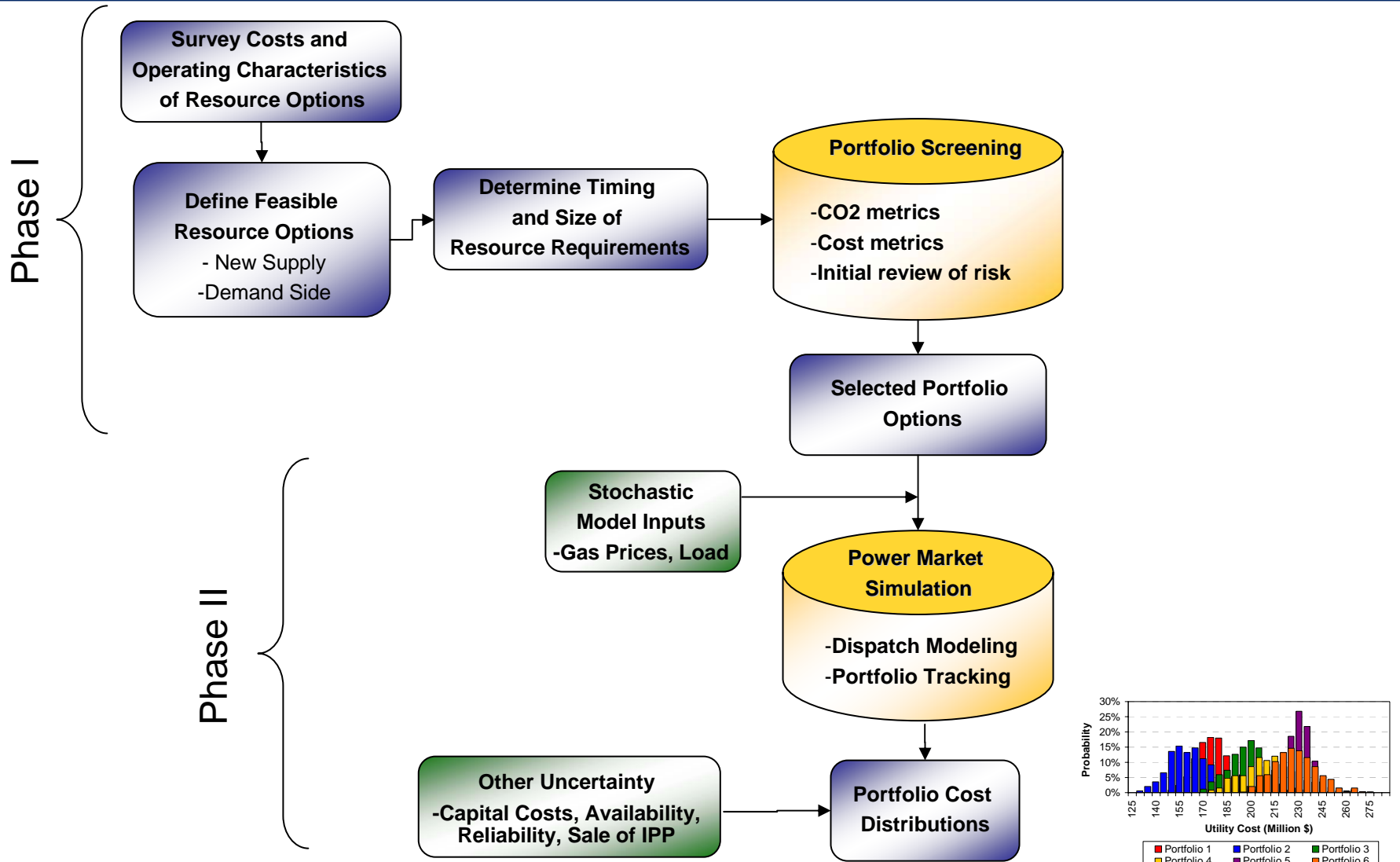




# Phase II Preliminary Results

November 19, 2008

# Two-Phase Process for Resource Evaluation



# Key Areas of Uncertainty

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- Natural Gas Price
- Load (PWP and neighboring regions)
- Market Power Prices
- Capital Costs for New Generating Assets
- Availability of Renewable Resources (locally or remote)
- Sale Price for Liquidation of IPP Coal Power
- Reliability of Older Gas-Fired Units in Pasadena

# Portfolio Analysis around Uncertainty

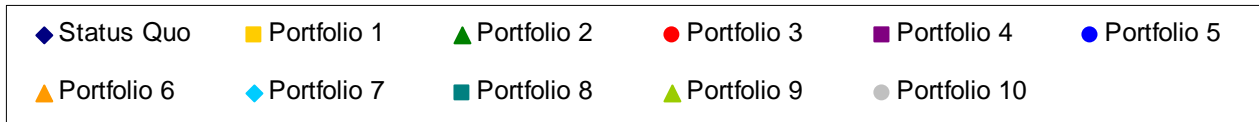
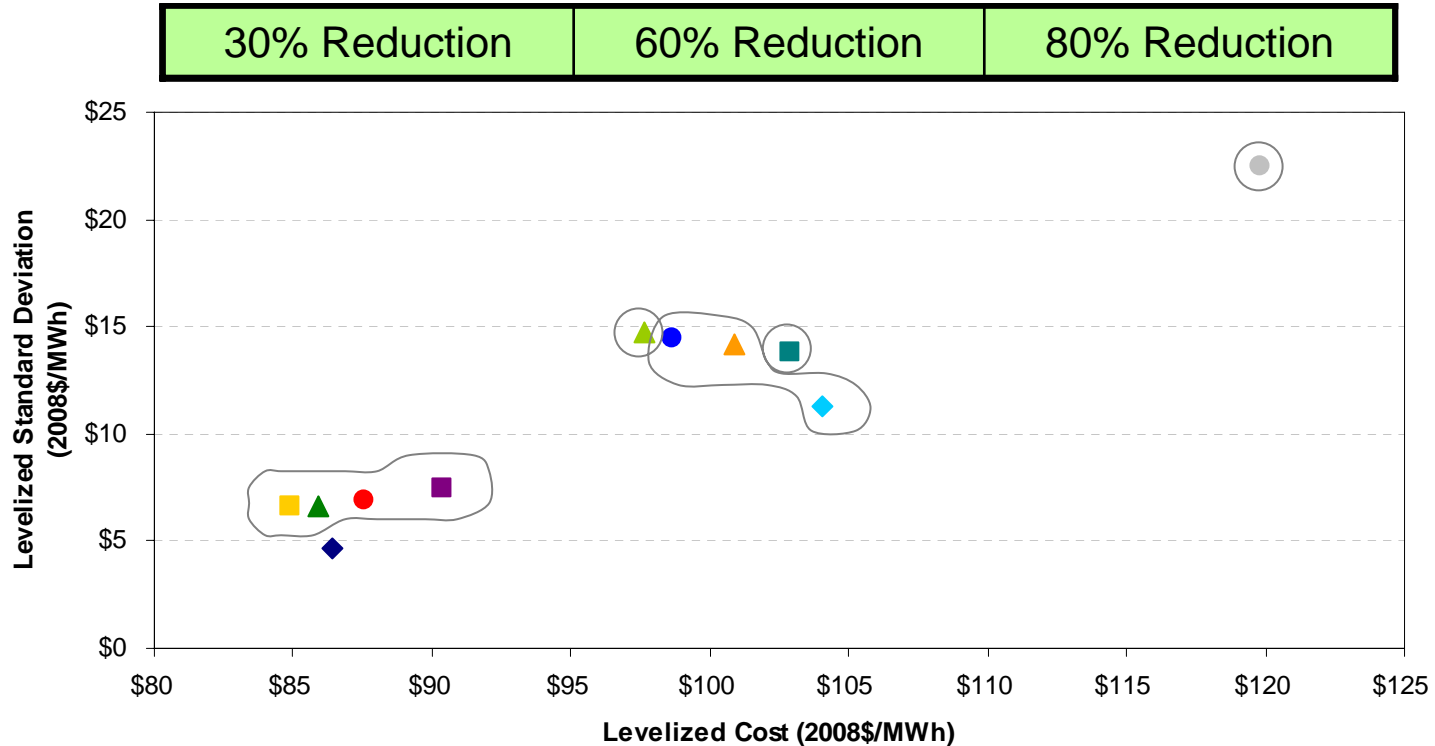
- Analyze each portfolio initially in the context of uncertainty around:
  - Fuel prices, load (and consequently market power prices)
  - Capital costs
  - Feasibility/Availability

CO2 Reduction Target	Portfolio #	Fuel and Load	Capital Cost	Feasibility/ Availability
		F&L	CC	F/A
30%	1	✓	✓	
	2	✓	✓	
	3	✓	✓	
	4	✓	✓	✓
60%	5	✓	✓	
	6	✓	✓	
	7	✓	✓	✓
80%	8	✓	✓	✓
	9	✓	✓	✓
	10	✓	✓	

- Examine performance of certain portfolios under other key uncertainties:
  - Sale price of IPP power
  - Reliability of portfolio under scenario where older, local gas-fired capacity fails

# **Initial Uncertainty Analysis Summary of Results**

# Summary: Cost vs. Risk Comparison

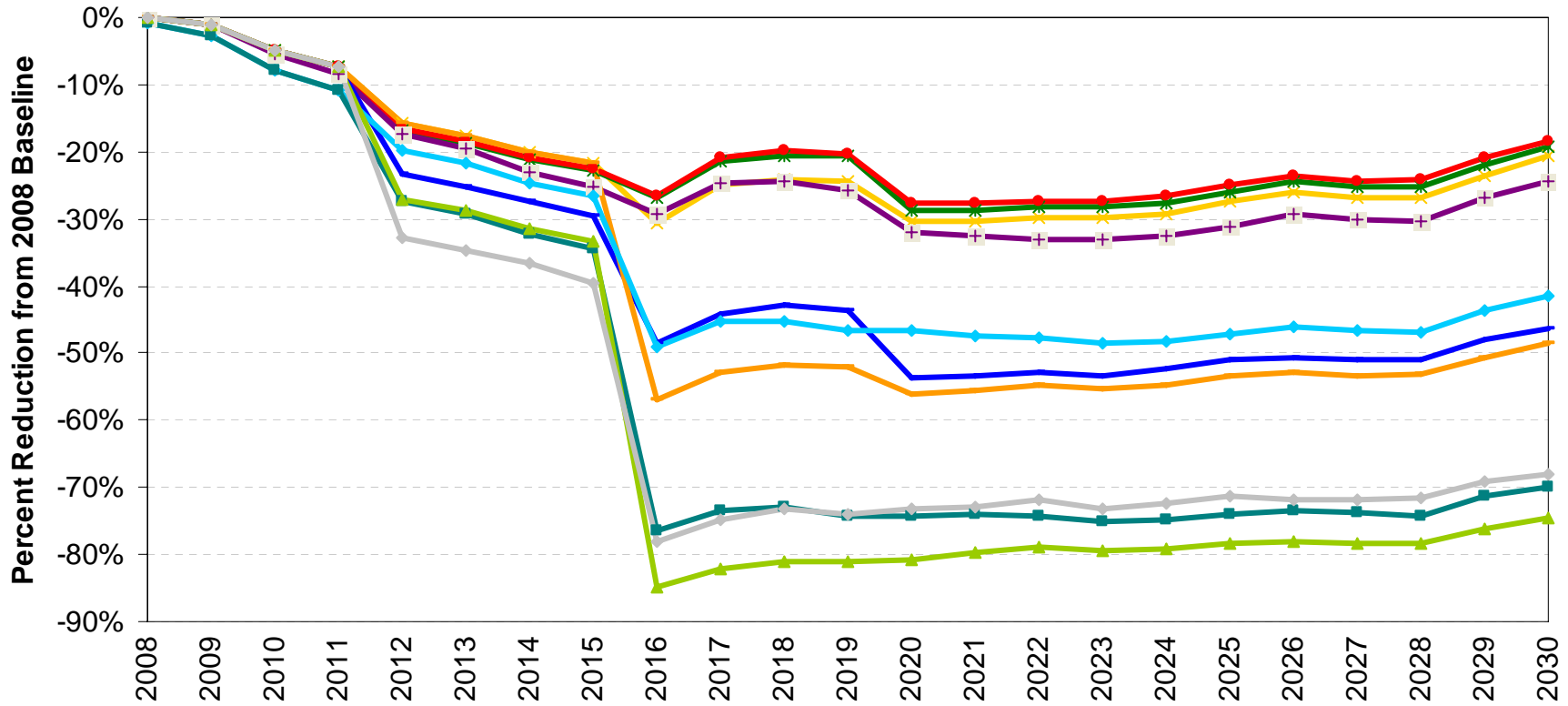


■ LFG ■ GEO □ Wind ■ Solar T. ■ Solar PV ■ Feedin Tariff ■ Gas CC □ RA ■ DR

	1	2	3	4	5	6	7	8	9	10
Total MW Added	30	40	40	56	150	95	101	131	90	250
IPP Replacement					47	108	108	108	108	108

# Emissions Reductions from 2008 Baseline

30% Reduction      60% Reduction      80% Reduction

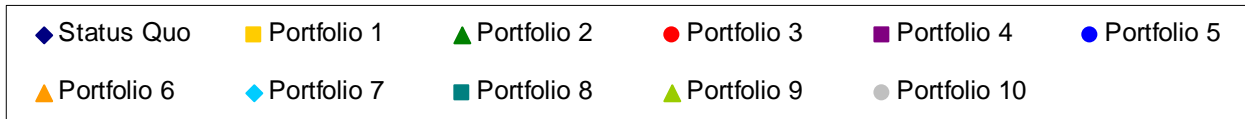
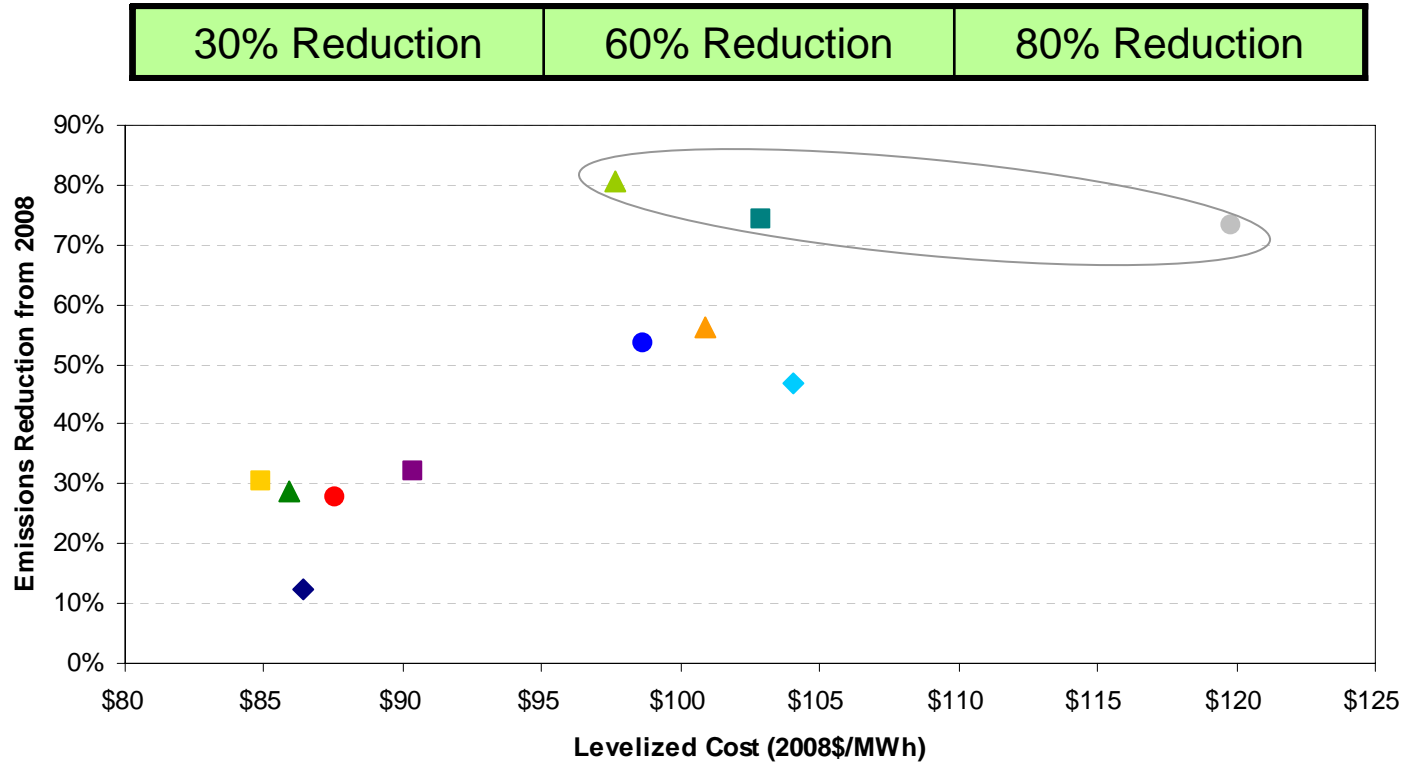


1 2 3 4 5 6 7 8 9 10

LFG GEO Wind Solar T. Solar PV Feedin Tariff Gas CC RA DR

	1	2	3	4	5	6	7	8	9	10
Total MW Added	30	40	40	56	150	95	101	131	90	250
IPP Replacement					47	108	108	108	108	108

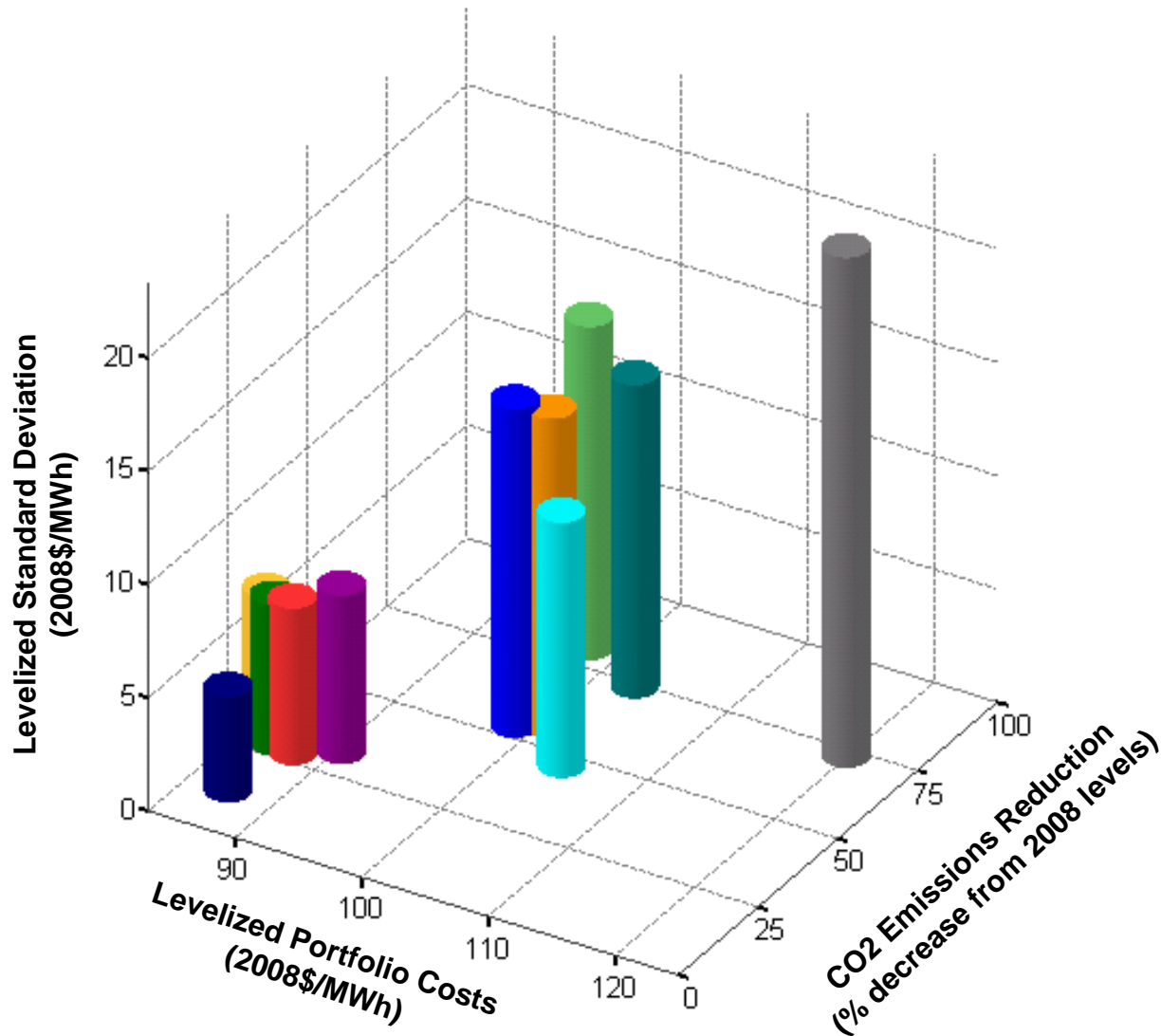
# Summary: Cost vs. CO2 Emissions Comparison



■ LFG ■ GEO □ Wind ■ Solar T. ■ Solar PV ■ Feedin Tariff ■ Gas CC □ RA ■ DR

	1	2	3	4	5	6	7	8	9	10
Total MW Added	30	40	40	56	150	95	101	131	90	250
IPP Replacement					47	108	108	108	108	108

# Summary: Cost, Risk, and CO2 Emissions

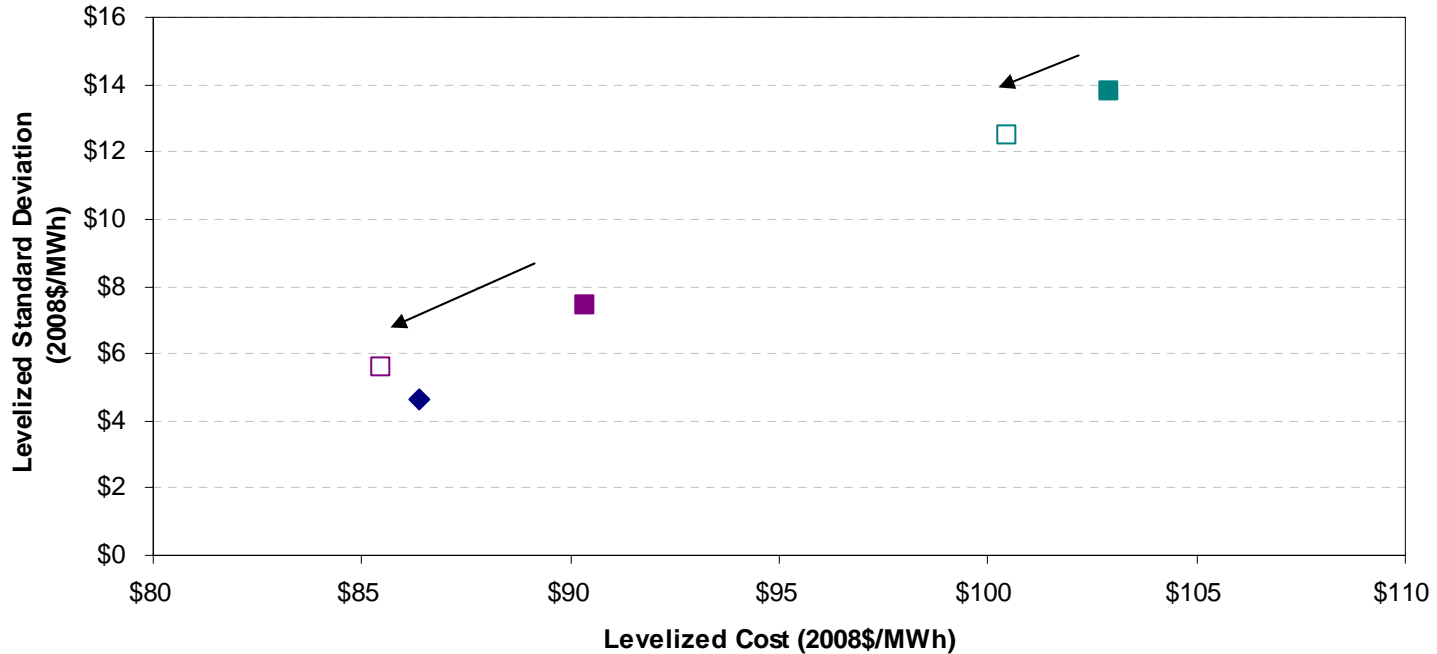


Portfolio	Mix	Total MW Added	IPP Replacement
1		30	
2		40	
3		40	
4		56	
5		150	47
6		95	108
7		101	108
8		131	108
9		90	108
10		250	108

■ LFG    ■ GEO    ■ Wind  
■ Solar T.    ■ Solar PV    ■ Feedin T.  
■ Gas CC    ■ RA    ■ DR

# Uncertainty in Availability Affects Cost and Risk

Replacing higher cost renewable capacity with market purchases lowers costs and reduces uncertainty around capital



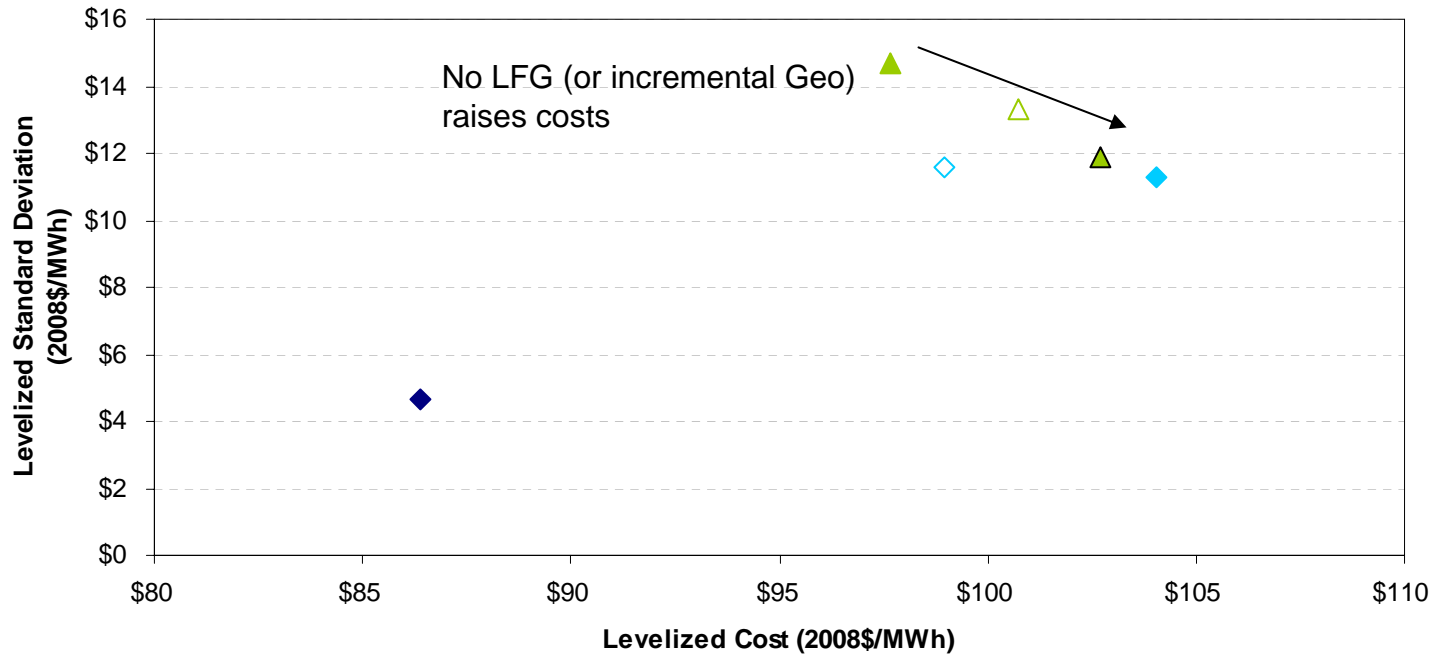
■ LFG ■ GEO □ Wind ■ Solar T. ■ Solar PV ■ Feedin Tariff ■ Gas CC □ RA ■ DR

	1	2	3	4	5	6	7	8	9	10
Total MW Added	30	40	40	56	150	95	101	131	90	250
IPP Replacement					47	108	108	108	108	108

4a: No incremental PV or feed-in

8a: No incremental PV, feed-in, or efficiency

# Uncertainty in Availability Affects Cost and Risk Differently



■ LFG  
 ■ GEO  
 ■ Wind  
 ■ Solar T.  
 ■ Solar PV  
 ■ Feedin Tariff  
 ■ Gas CC  
 ■ RA  
 ■ DR

	1	2	3	4	5	6	7	8	9	10
Total MW Added	30	40	40	56	150	95	101	131	90	250
IPP Replacement					47	108	108	108	108	108

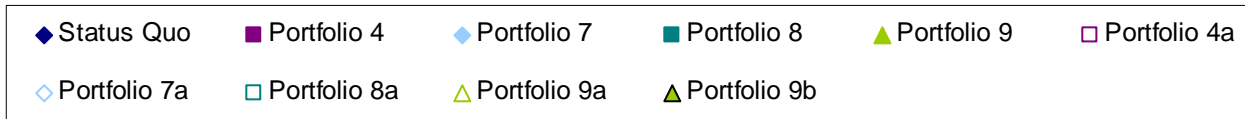
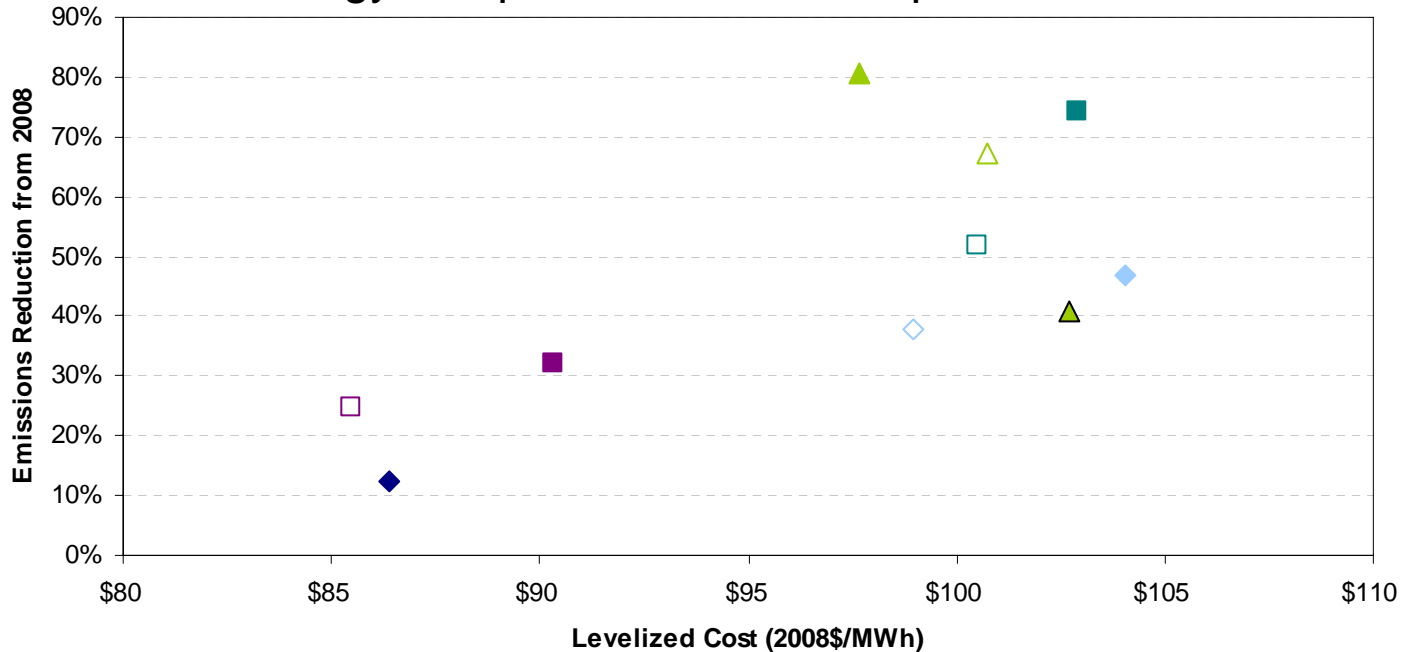
7a: No incremental PV, feed-in, efficiency, or LFG

9a: No LFG

9b: No LFG or additional 50 MW of Geo

# Availability Affects Emissions Reductions Targets

Reductions fall if renewable generation is not available and energy is replaced with market purchases



■ LFG ■ GEO □ Wind ■ Solar T. ■ Solar PV ■ Feedin Tariff ■ Gas CC □ RA ■ DR

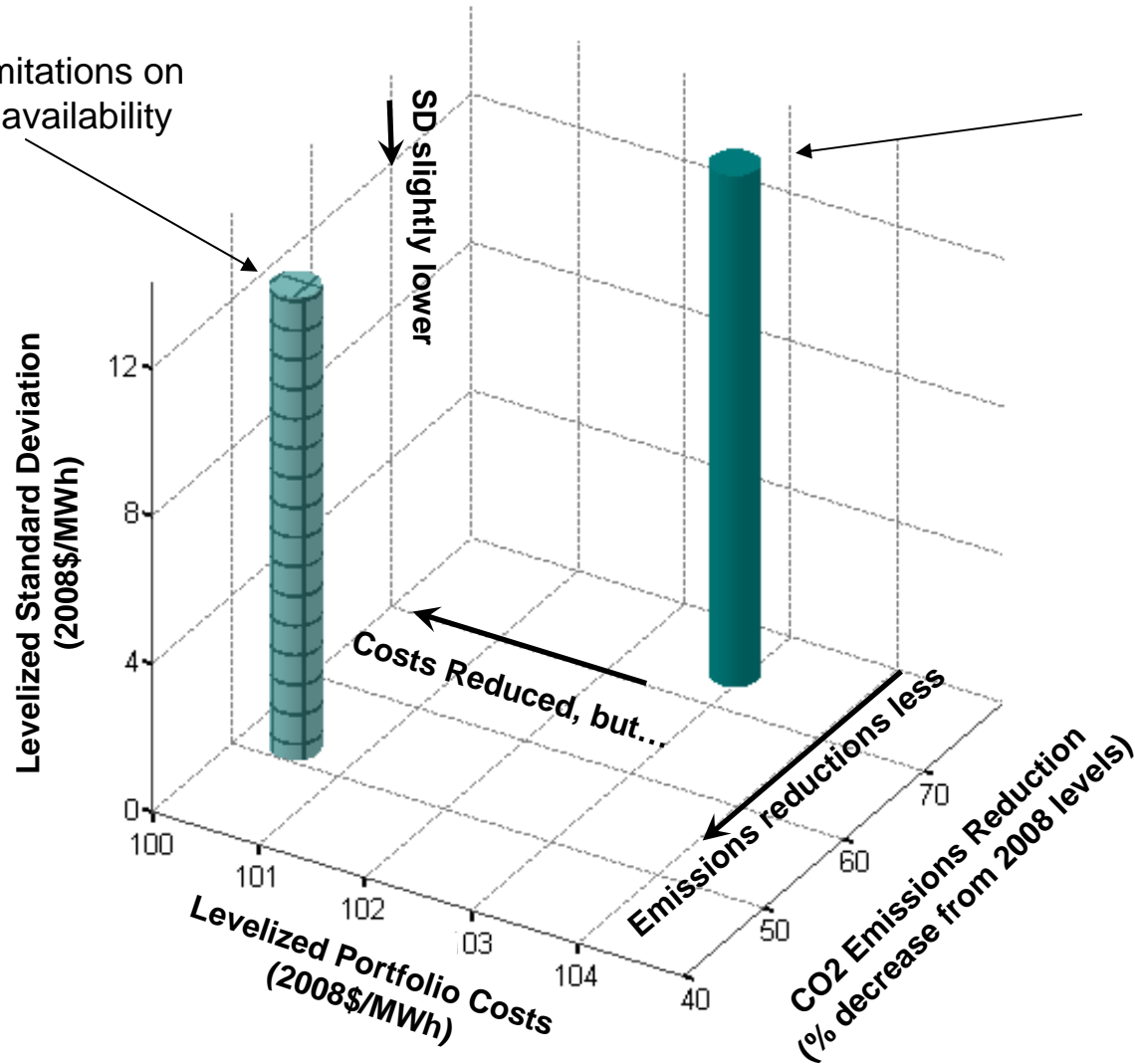
	1	2	3	4	5	6	7	8	9	10
Total MW Added	30	40	40	56	150	95	101	131	90	250
IPP Replacement					47	108	108	108	108	108

4a: No incremental PV or feed-in  
 8a: No incremental PV, feed-in, or efficiency  
 7a: No incremental PV, feed-in, efficiency, or LFG  
 9a: No LFG  
 9b: No LFG or additional 50 MW of Geo

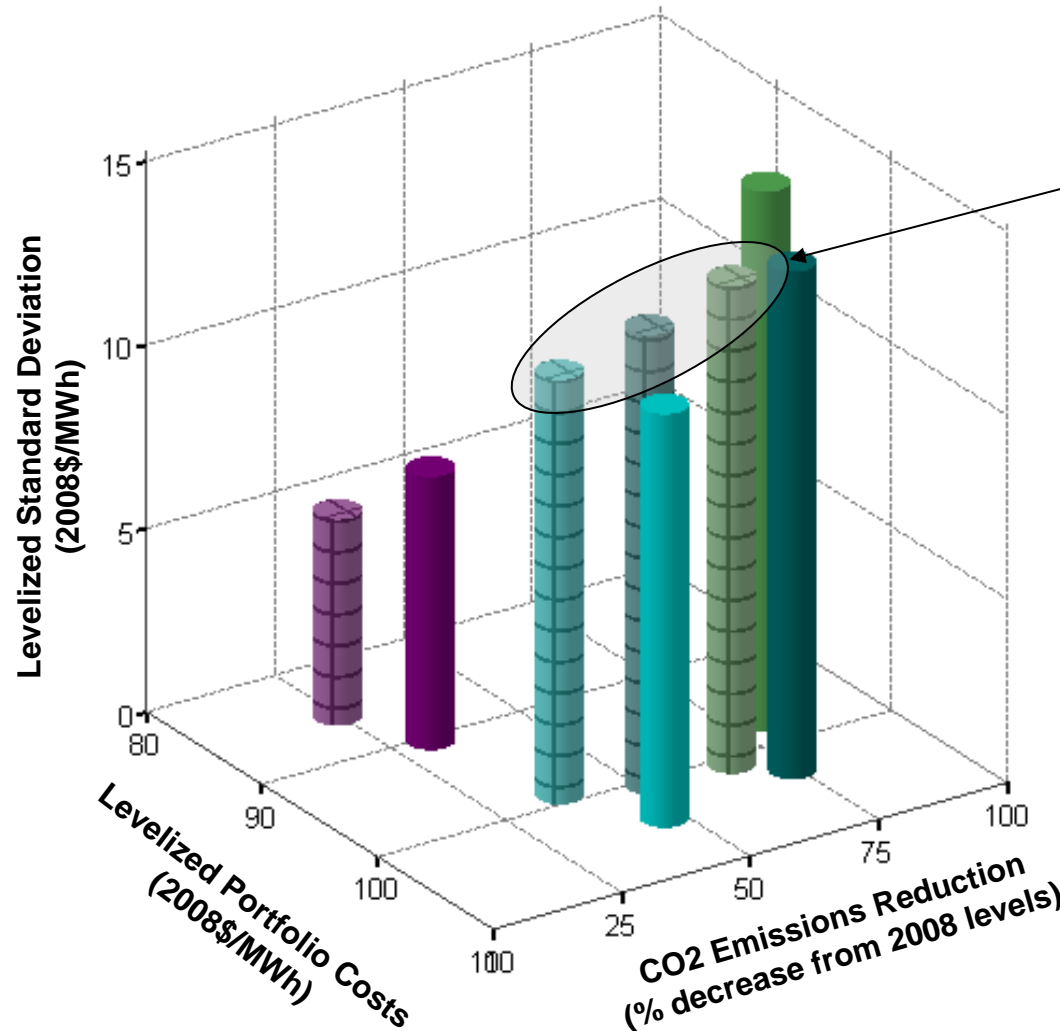
# Availability Affects All Metrics

Portfolio 8 with limitations on LFG, PV, feed-in availability

Portfolio 8



# Availability Uncertainty Can Affect Rankings



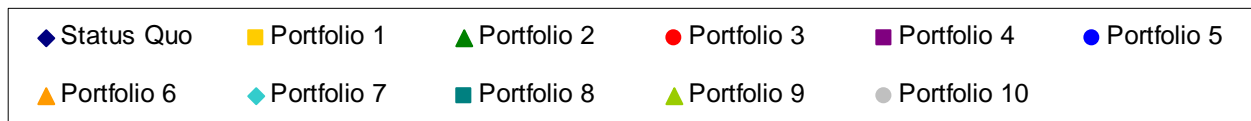
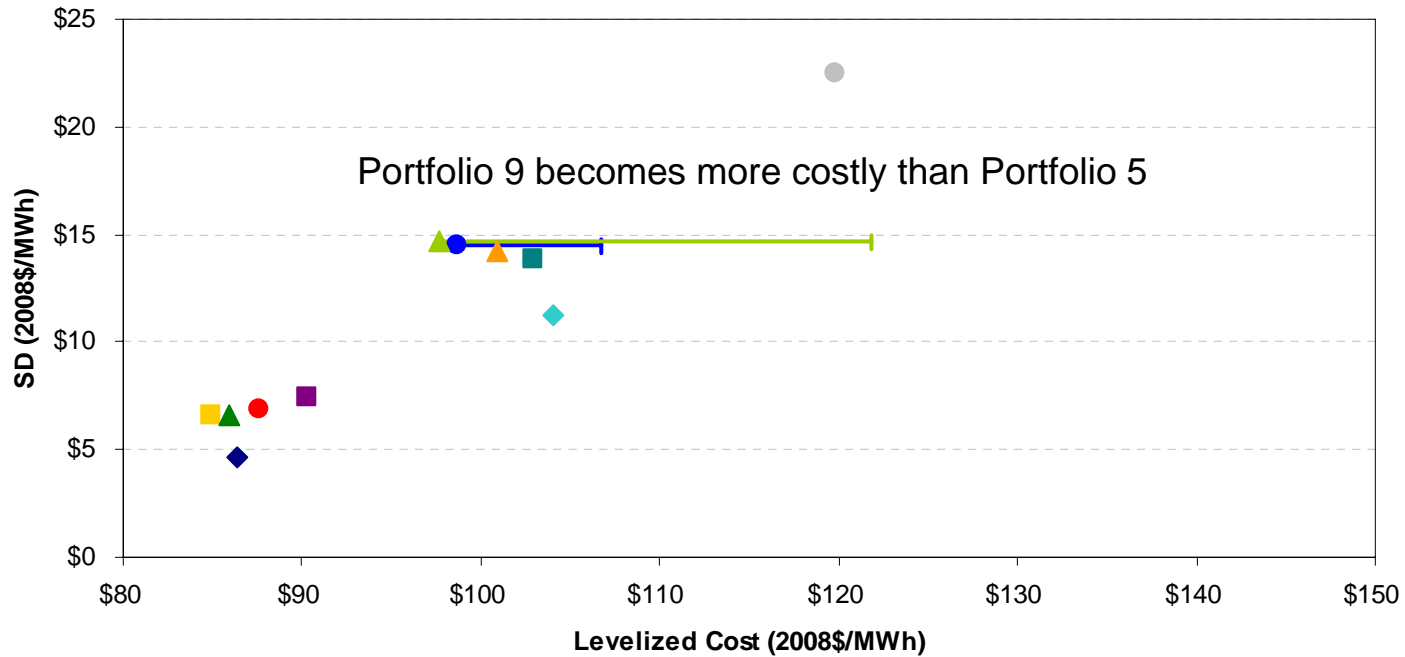
Portfolios 7,8,9 look much closer on cost and risk metrics after availability considered

- Portfolio 4
- Portfolio 7
- Portfolio 8
- Portfolio 9

# Quantum Uncertainty Considerations

# Sale of IPP Power – Liquidation at a zero price

- Inability to liquidate power at a price raises portfolio costs, especially for portfolios where entire 108 MW is displaced

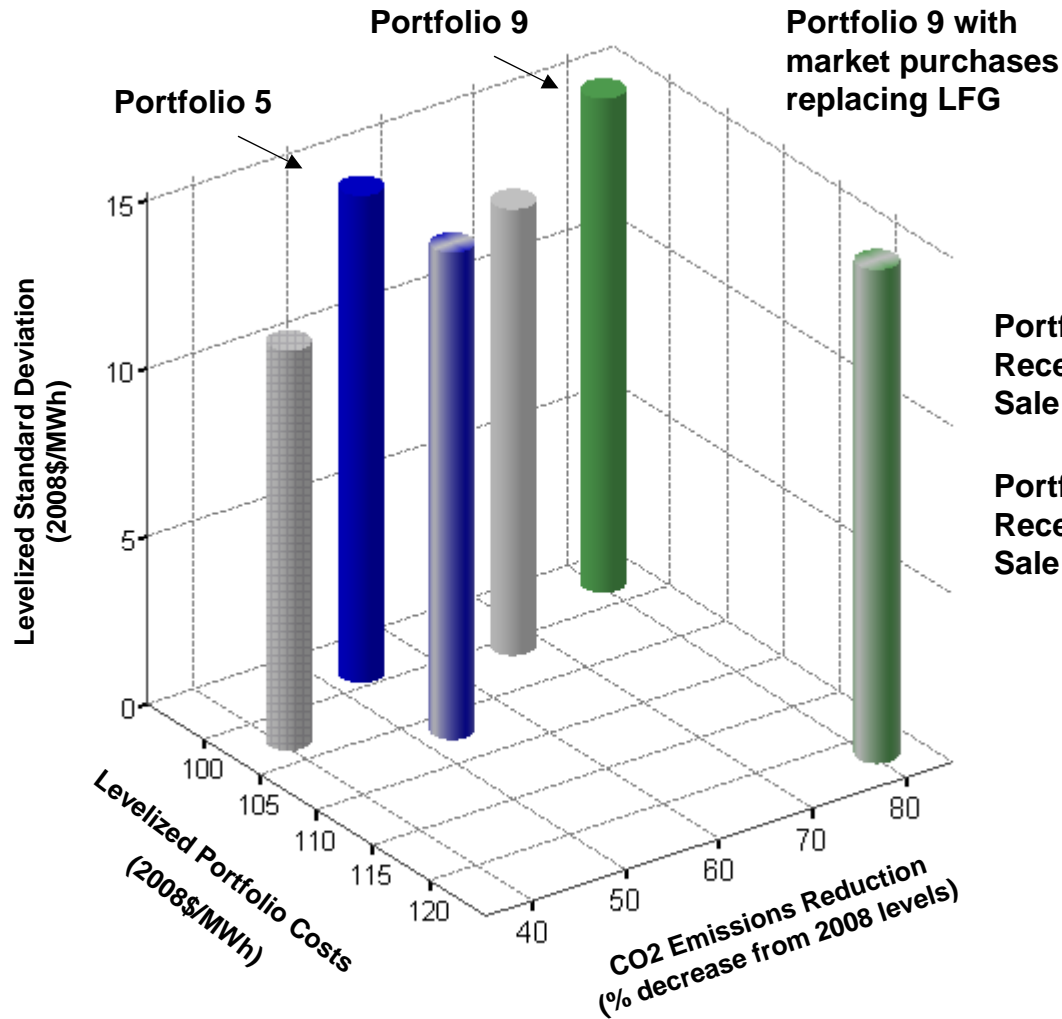


■ LFG ■ GEO □ Wind ■ Solar T. ■ Solar PV ■ Feedin Tariff ■ Gas CC □ RA ■ DR

	1	2	3	4	5	6	7	8	9	10
Total MW Added	30	40	40	56	150	95	101	131	90	250
IPP Replacement					47	108	108	108	108	108

# Risk Scenario Effects on Portfolios 5 & 9

Portfolio 9 with market purchases replacing both LFG and Geothermal



Portfolio 9  
Receiving \$0 for the Sale of IPP power

Portfolio 5  
Receiving \$0 for the Sale of IPP power

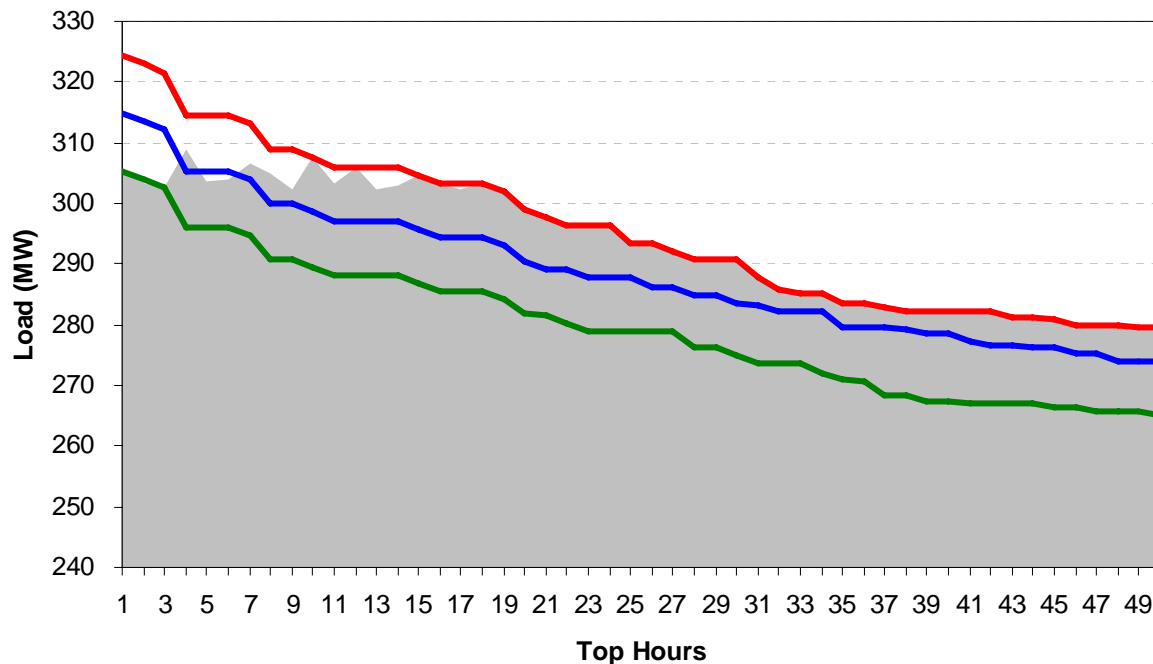
# System Reliability Dependent on Local Generation

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- Test scenario where older, in-city gas-fired units are unavailable
  - Hourly load profile assessment
  - New Glenarm units available
  - 215 MW of transmission capacity available
  - Hourly generation profiles of local PV, feed-in tariff resources, efficiency, and demand response determined and analyzed
- Quantify ability of different portfolios to meet load under Reference Case load forecast and statistically determined high cases

# Portfolio 9 – Local Units Outage (176 MW unavailable)

- Due to a larger reliance on external resources in Portfolio 9, an in-city capacity outage has a more pronounced effect on reliability



Available Generation Reference Case Load 75 Percentile Load 95 Percentile Load

RC: 1 Hour  
75%: 5 Hours  
95%: 13 Hours

# **Initial Phase II Conclusions**

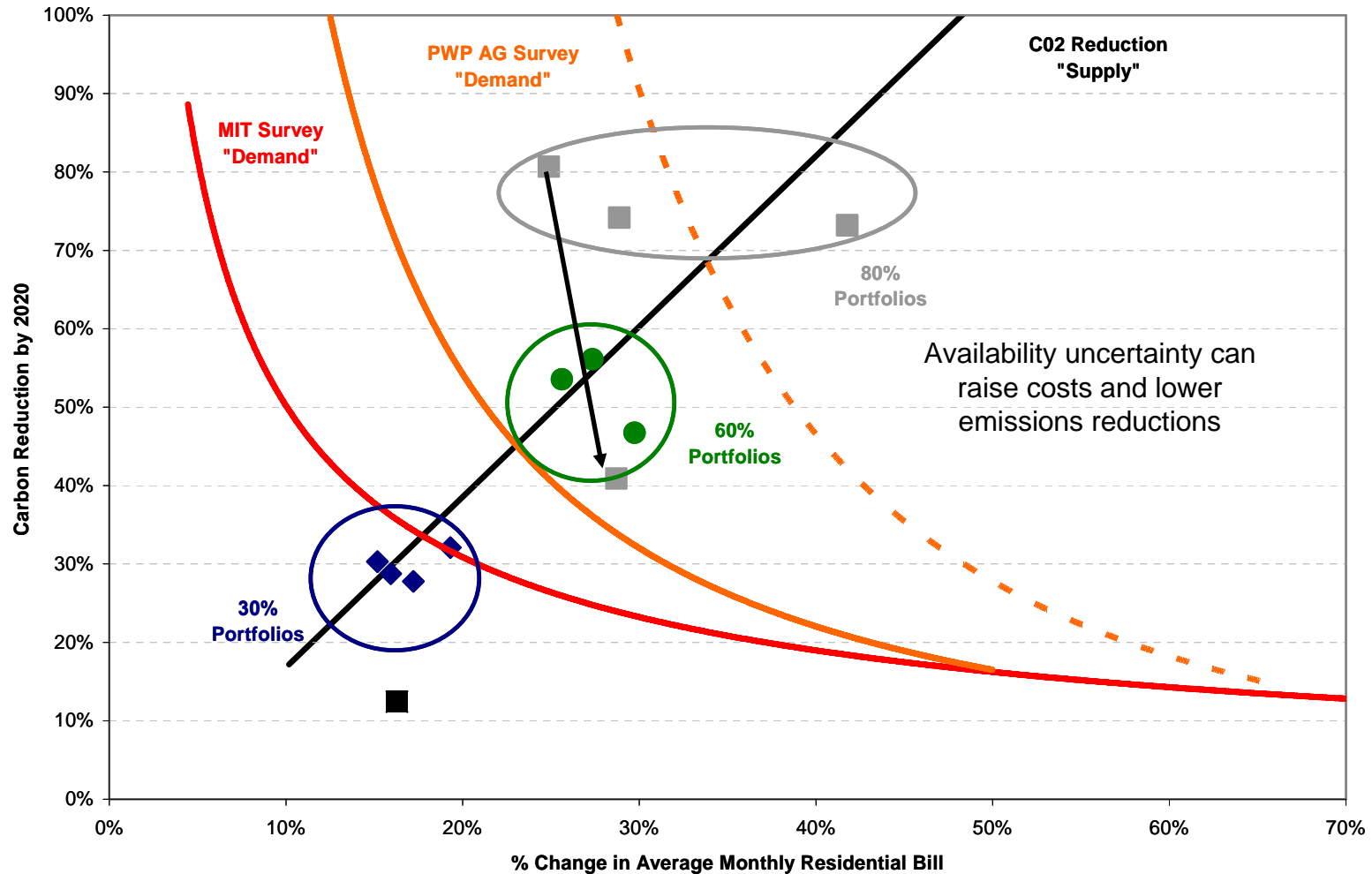
# Summary Portfolio Ranking including Initial Quantum Scenarios

		CO2 Emissions Reduction	Cost	Risk (Gas & Load)	Risk (inc. Capital)	Feasibility/ Availability	Exposure to IPP Sale	Reliability
30% Reduction	Portfolio 1	2	1	2	1			
	Portfolio 2	3	2	3	2			
	Portfolio 3	4	3	4	3			
	Portfolio 4	1	4	1	4			

		CO2 Emissions Reduction	Cost	Risk (Gas & Load)	Risk (inc. Capital)	Feasibility/ Availability	Exposure to IPP Sale	Reliability
60% Reduction	Portfolio 5	5	2	1	5			
	Portfolio 6	4	3	5	4			
	Portfolio 7	6	5	6	1			
80% Reduction	Portfolio 8	2	4	4	3			
	Portfolio 9	1	1	2	2			
	Portfolio 10	3	6	3	6			

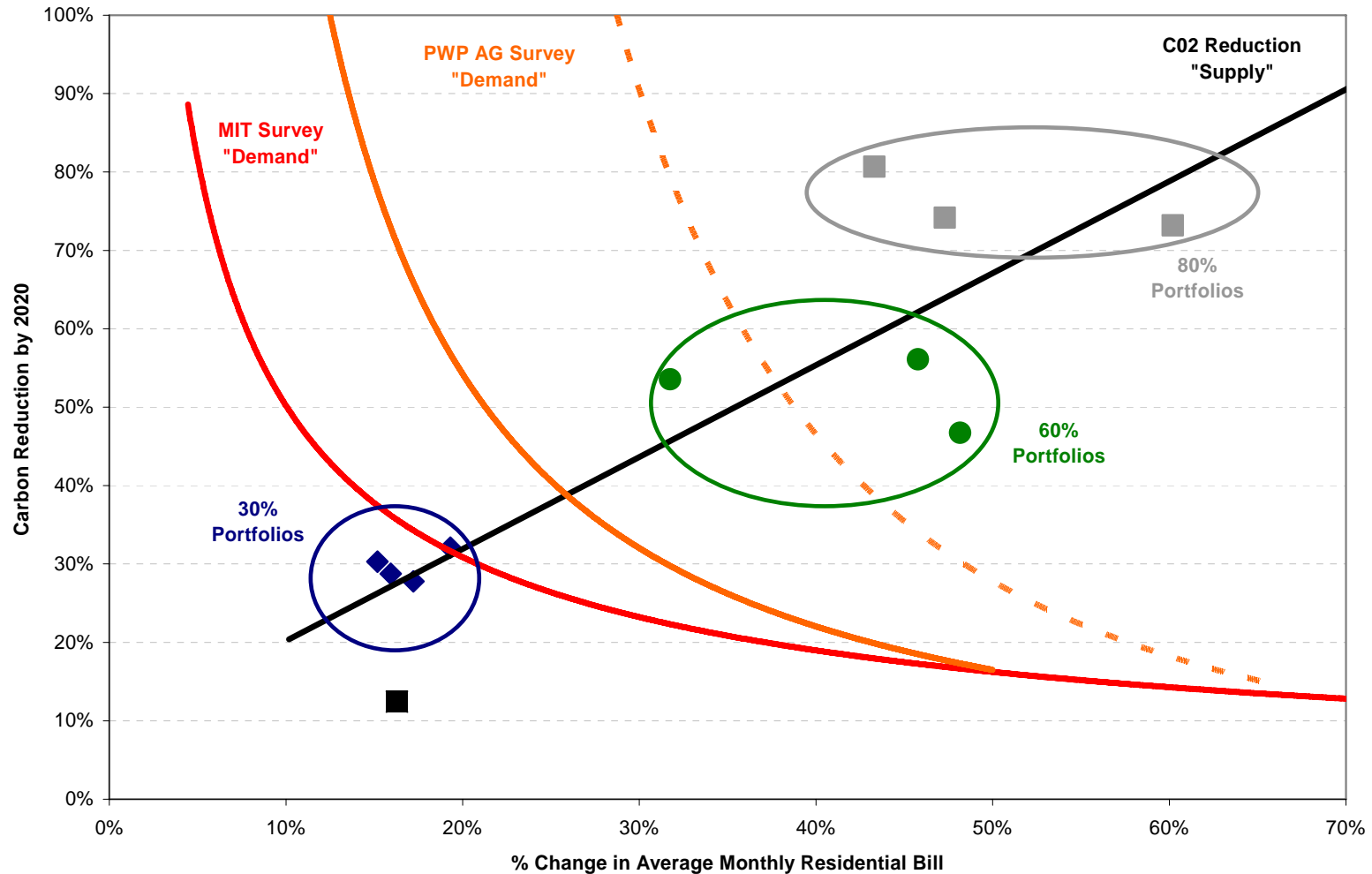
- Portfolios 4, 7-10 face availability and feasibility uncertainties
- Portfolios 6-10 are exposed to high risks around sale of IPP power
- Portfolio 5 not fully exposed to IPP sale risk (only sells 47 MW)
- Portfolio 6 adds local capacity (CC), which improves local reliability, but it is highly exposed to gas volatility
- Portfolios 7 and 8 provide emphasis on local “resources” (PV, feed-in, efficiency), so although cost is high, they perform adequately on reliability metric

# Supply/Demand for Emissions Reductions



# Uncertainty around IPP Sale Can Alter Conclusions

No revenue from sale of IPP Power



# Preliminary Conclusions

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- Plans with LFG and Geothermal (1 and 9) effectively reduce emissions as baseload renewable resources at lowest cost
- Significant uncertainty exists around the price of power from the sale of IPP generation
  - Portfolios 6-10 exposed to the full uncertainty of selling all power from IPP
  - Portfolio 5 achieves 60% emissions reduction, but still holds some of IPP power
- Portfolios that contain local resources like gas CC, solar PV, feed-in tariff, efficiency, and demand response provide reliability benefits not seen in those that rely solely on remote resources

# Additional Quantum Scenarios

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- High CO2 Case
  - Specific attention desired for portfolios 5 (holding significant portion of IPP) and 6 (gas CC option)
- Transmission/Reliability Sensitivity
  - Portfolios 5 and 9 rely on remote resources, so additional transmission sensitivity analysis may be desired
- Other issues that must be addressed?