

The Role of Renewables in Enhancing Energy Diversity and Security: Portfolio Approaches

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Energy Security: The “Other” Externality Benefit of RET

Benefit	Policymaker Awareness
<ul style="list-style-type: none"> ● Environmental Benefits <ul style="list-style-type: none"> - Widely understood—undervalued by regulators 	HIGH
<ul style="list-style-type: none"> ● Help Mitigate Market Power <ul style="list-style-type: none"> - Help <i>Unlock</i> Benefits of Liberalization by Enhancing Competition along Power Network - Requires NO restructuring & incentives 	MOD
<ul style="list-style-type: none"> ● Security: <i>Mitigate/Diversify</i> Fossil Risk <ul style="list-style-type: none"> - <i>Reduce</i> overall electricity generating costs - <i>Minimize</i> exposure to macroeconomic fossil risk 	LOW

Diversity/Security & Sustainability: Powerful Benefits of Properly Structured Generating Portfolios

- **Everyone *talks* about energy diversity & security**
 - Little analytic work exists
- **Diversity is poorly understood**
 - Not a “mix and match” concept
- ***Security* focuses on catastrophic supply interruptions**

Energy Security: Market Aspects

- **Oil Traded in World Markets (gas less)**
 - *Security*: more a *market*, than geo-political concept
(RFF- Michael Toman, Paul Leiby, et al)
- **Exposure to Fossil Volatility: Subtle, But More Powerful Security Concept**
- **Fixed-Cost RETs Enable *Efficient* Generating Mixes that:**
 - Create joint product: *Diversity & Sustainability* at *minimum cost*, and
 - Minimize needless exposure to fossil risk

Most Significant Aspects of Energy Security

The Macroeconomic Consequences of Fossil Price Risk: A major external cost

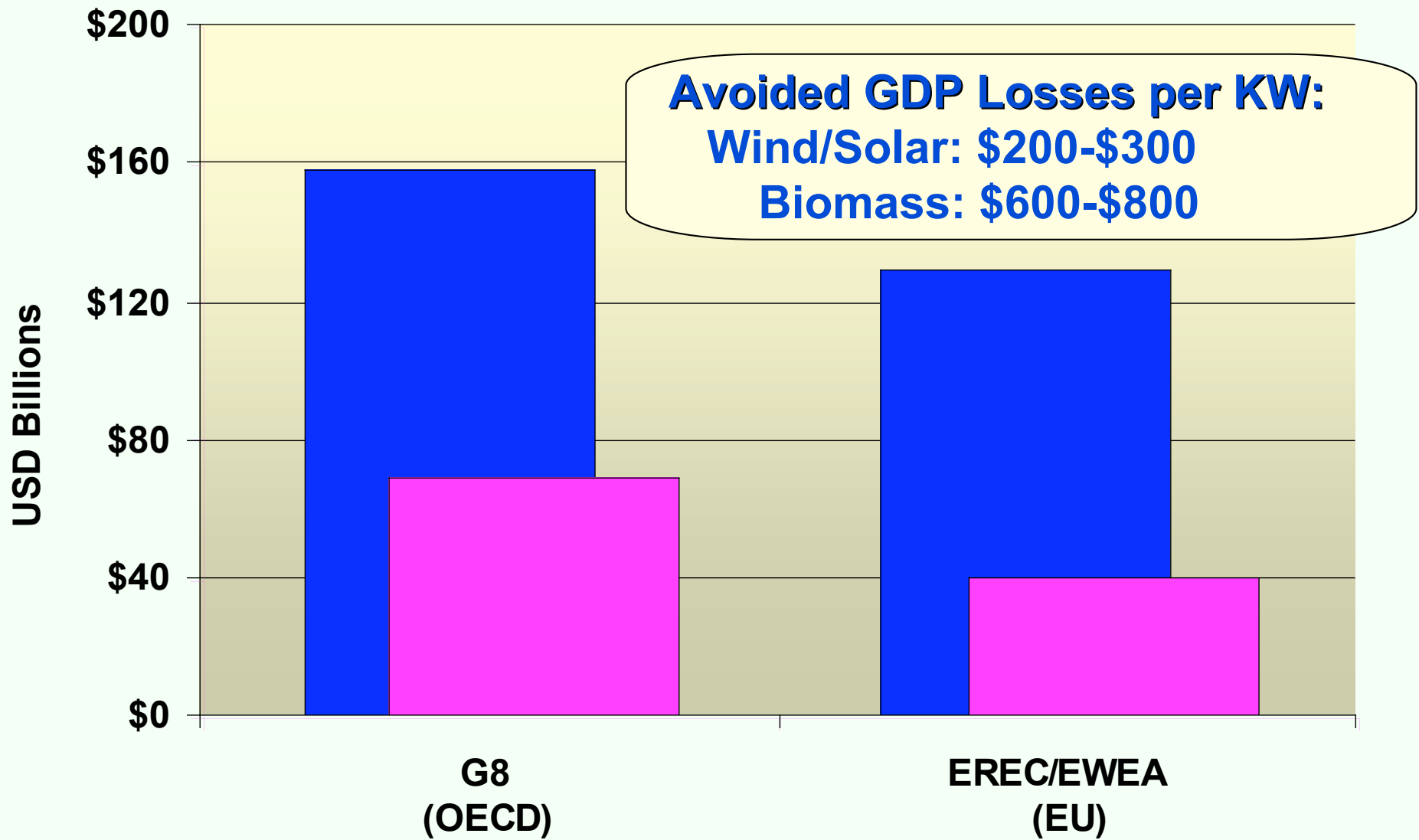
- **Fossil volatility hurts employment & GDP growth in oil consuming and producing nations**
 - Idea widely accepted in academic literature and the press
- **Policy makers *seem* aware– but apparently do not see connection to renewables** IMF
- **Macroeconomic cost of 2000-04 oil spikes in EU: Approximately €700 Billion**
 - Sufficient to offset *entire* 2020/10% OECD Renewables investment needs estimated by G8/IEA

Where/What is the Policy Disconnect?

Avoided GDP Losses for 10% RE Addition

GDP Elasticity Measure	Loss Estimation			Avoided GDP Losses (USD \$Billions)			
	GDP Elasticity	Oil Price Reduction	GDP Loss %	US	EU-25	OECD	World
PANEL I: Long Term Oil-Gas Correlation ($\bar{n} = .75$)							
Pre-1986 Average	-9.8%	-6.2%	0.61%	\$66	\$67	\$113	\$221
1986 Inclusive Average	-7.3%	-6.2%	0.45%	\$49	\$49	\$84	\$164
Leiby (2004) Average	-6.4%	-6.2%	0.40%	\$43	\$43	\$74	\$144
			Averages	\$53	\$53	\$90	\$176
PANEL II: Using Gas-Only GDP Elasticity ($\bar{n} = .40$)							
	Gas-only Elasticity	Gas Price Reduction	GDP Loss %				
Pre-1986 Average	-3.9%	-8.4%	0.33%	\$36	\$36	\$61	\$119
1986 Inclusive Average	-2.9%	-8.4%	0.24%	\$27	\$27	\$45	\$89
Leiby (2004) Average	-2.6%	-8.4%	0.21%	\$23	\$23	\$40	\$78
			Averages	\$29	\$29	\$49	\$95

Required RES-E Investment for OECD/ EU and Associated GDP Offset



What's the "Catch?"

- **Adding Renewables Enhances Energy Security/sustainability**
 - Helps avoid sizeable GDP losses
- **But Don't Generating Costs Rise When you add 6-cent wind to a 3-cent generating mix?**

**Talking about cost without risk is like watching a movie with the sound turned off—
You miss much of the story!**

Modern Portfolio Theory – Widely Used by Financial Investors

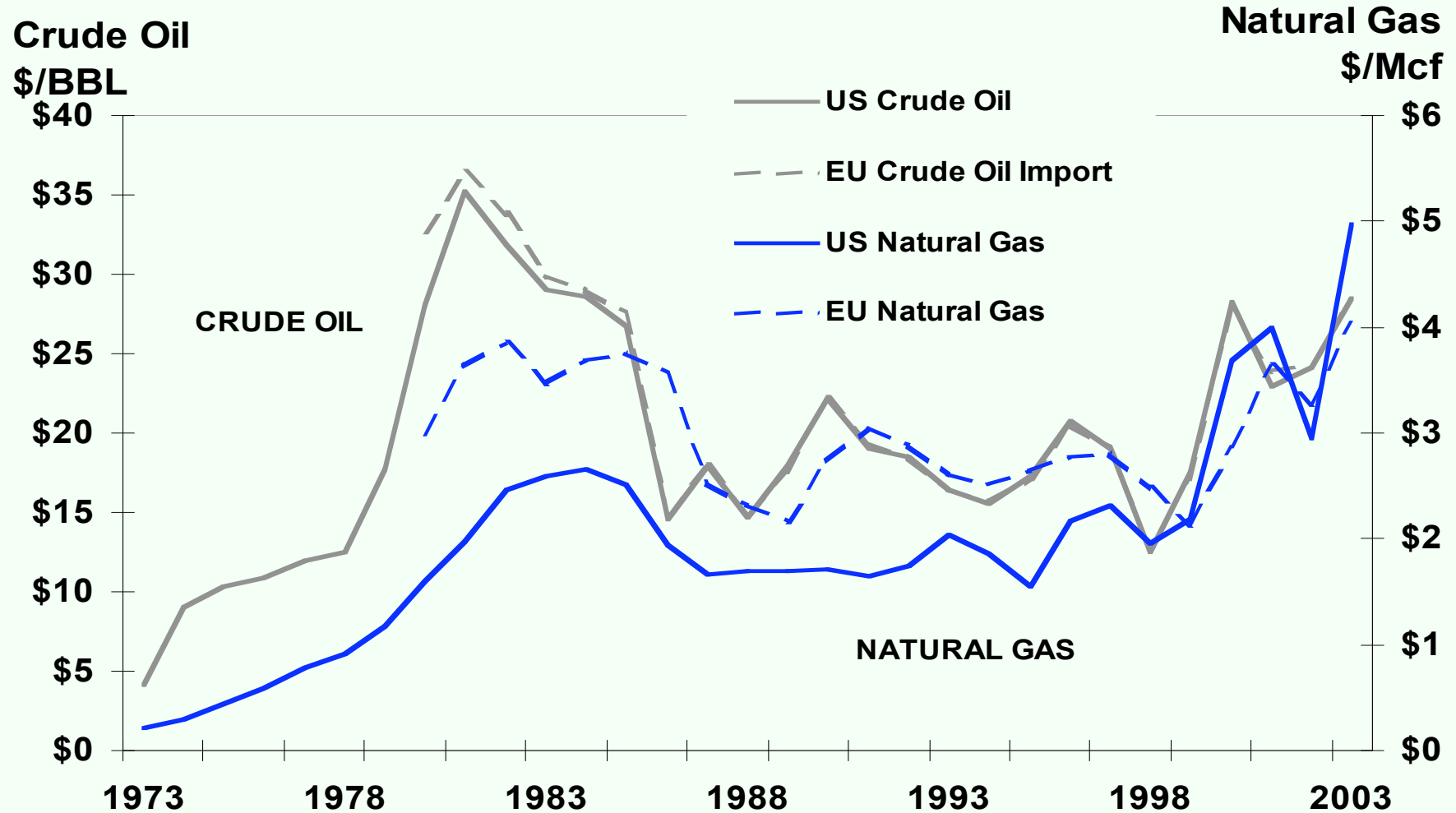
- **Predicts: Adding Fixed-Cost RETs to a Fossil Generating Mix Will *Reduce* Cost at any Level of Risk....**
....Even if *stand-alone* costs are *higher*

**Enhancing Energy Security
Does Not Have to Raise Cost!**

Diversification is Key

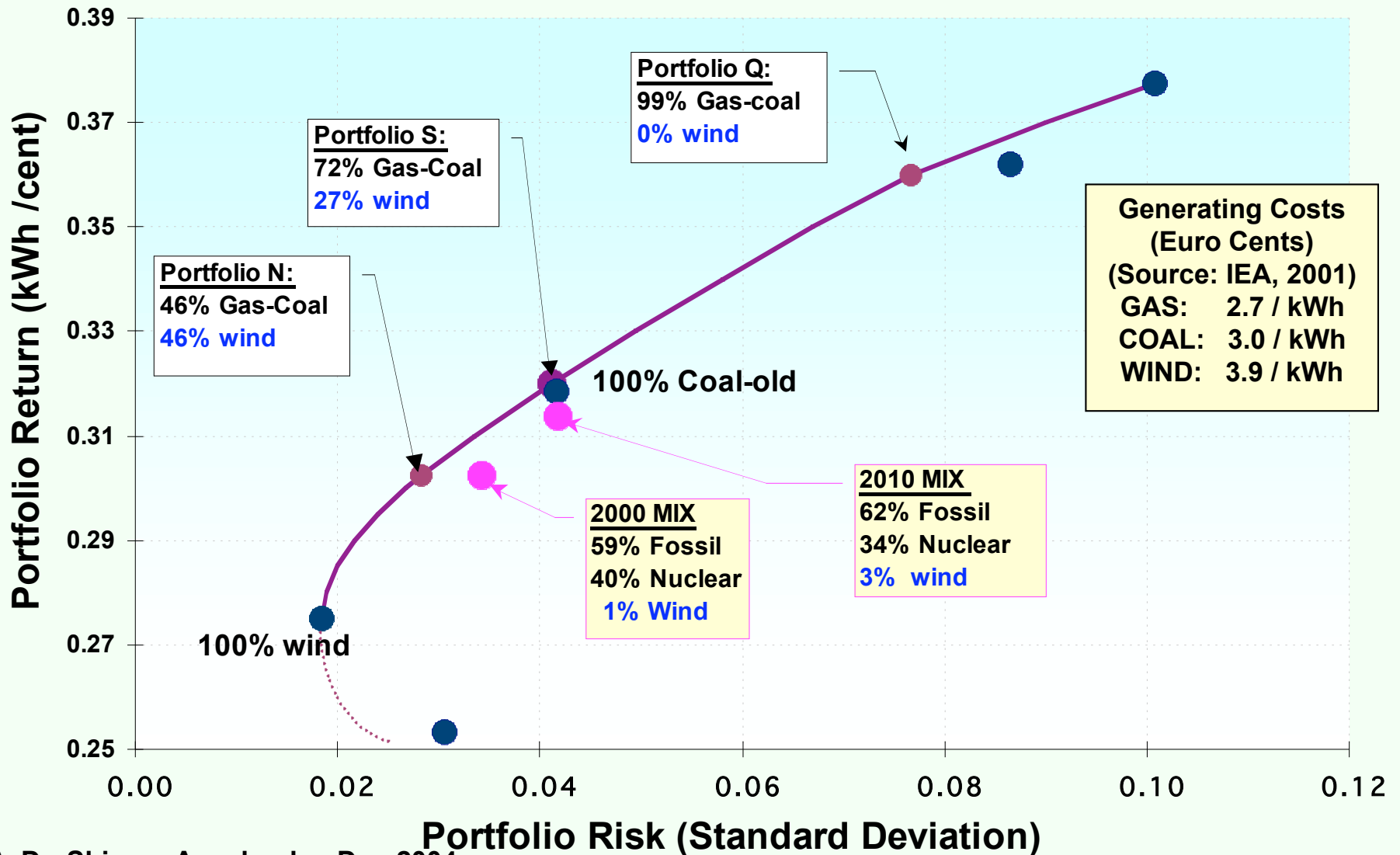
Fossil Portfolio is Highly Undiversified

U.S. and EU Fossil Prices



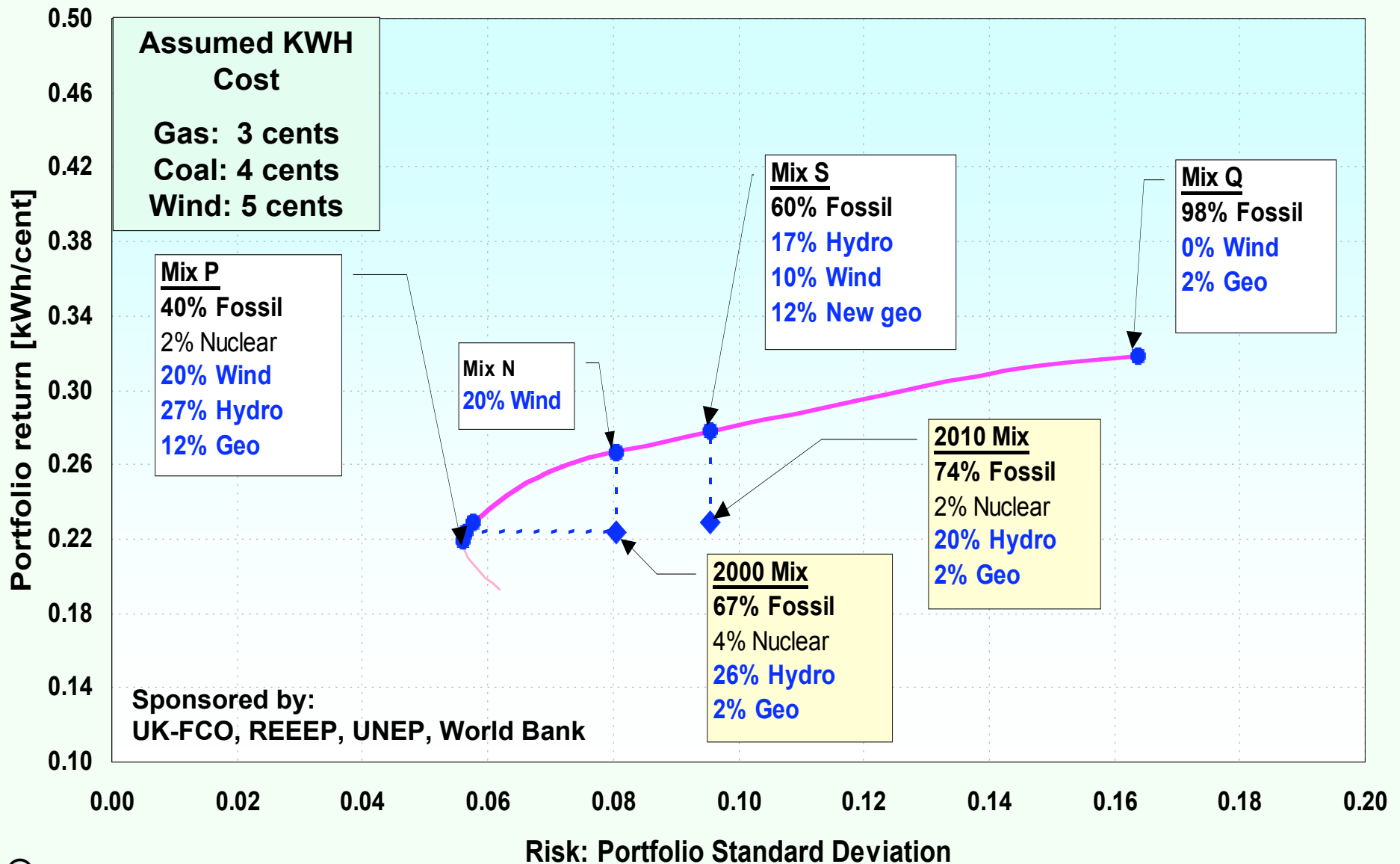
Adding Wind to EU Generating Mix Enhances Security Without Raising Cost

COST and RISK: EU Generating Portfolios

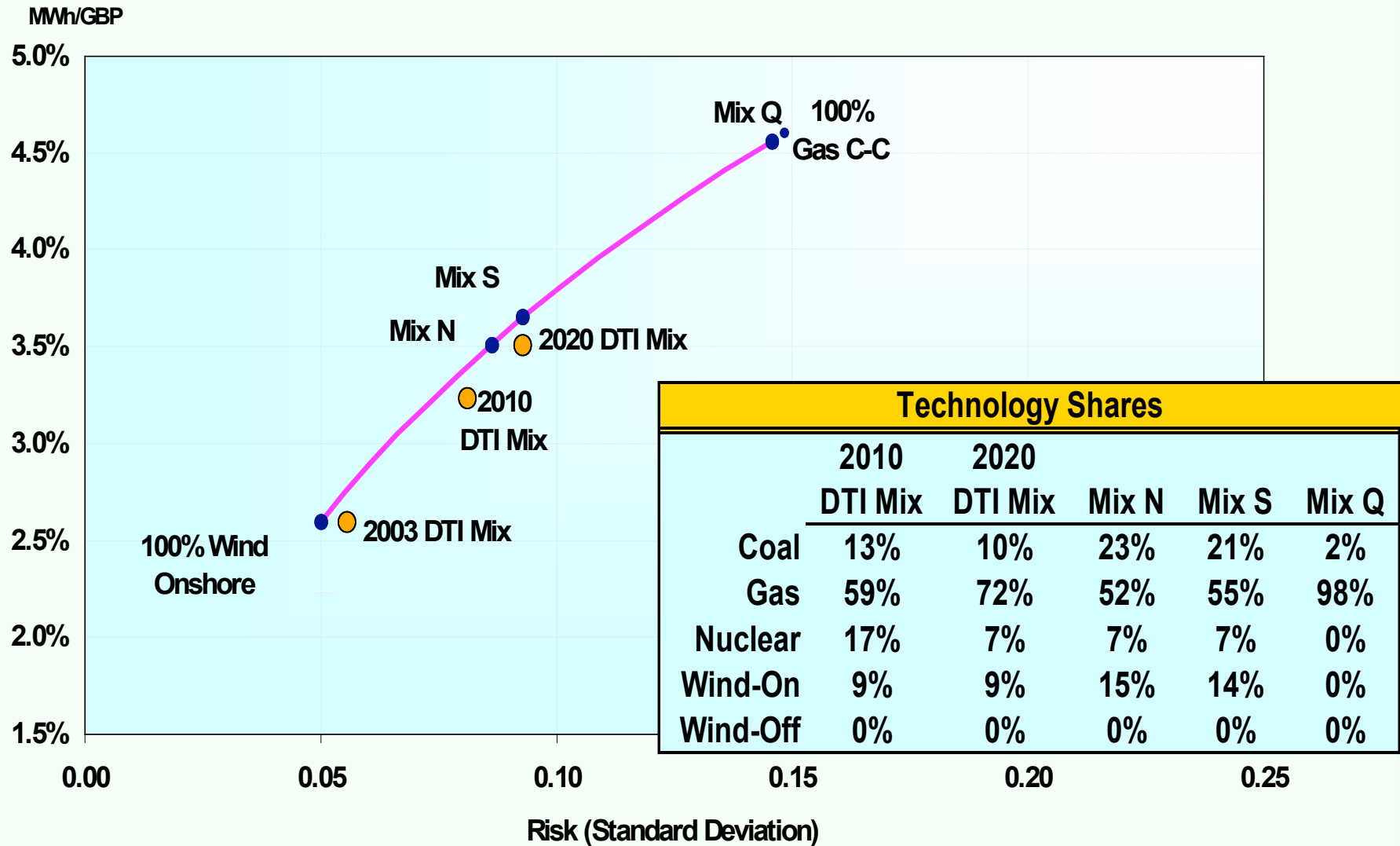


Wind/Geo Lowers Mexico Generating Cost

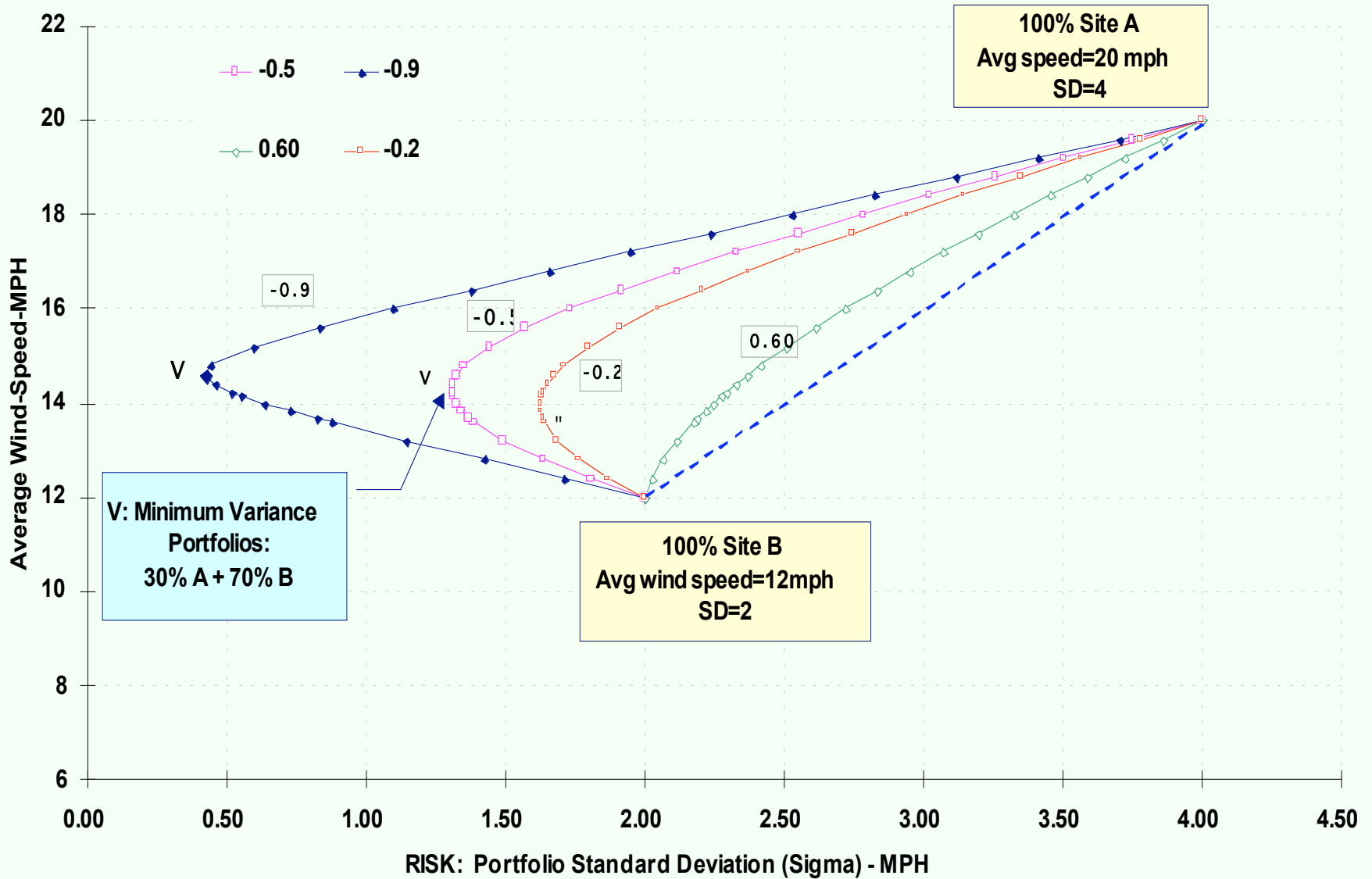
Mexico Generating Portfolio Risk/Return



UK Generating Mix Getting Riskier

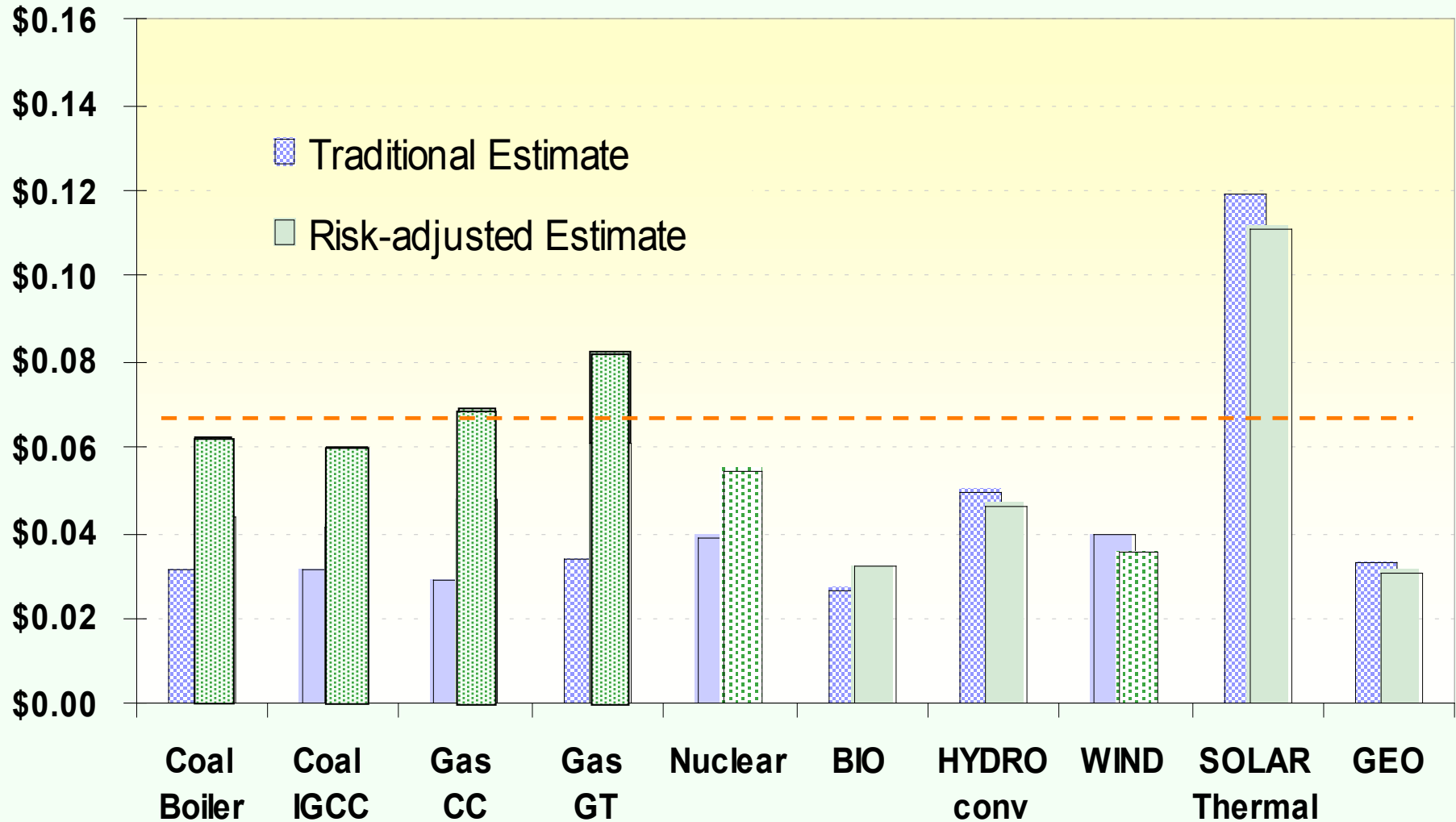


Expected Overall Wind Variability: Two-Site Wind Portfolio



Risk-Adjusted Levelized Cost-of-Electricity Estimates

Historic Fossil Price Risk



Benefits of Integrating Renewables

- **Promote Energy Security**
 - Mitigate Oil-induced GDP Losses
 - Provide *Counter-cyclical* Benefits
 - “National insurance” (R.C. Lind and J.K. Arrow, 1984)
- **Produce Sizeable Portfolio Benefits**
 - Reduce cost
 - Reduce Market Power: Help open markets & unlock promised benefits of liberalization
- **Security-Diversity-Sustainability at Minimum Cost:**
 - Joint products of properly designed energy portfolios