

Portfolio-Based Capacity Planning: How Renewables *Really* Impact Overall Generating Cost and Energy Security

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SPRU Energy Group

University of Sussex, UK

- **SPRU: One of the oldest & largest institutes for the study of science and technology policy**

- 50 faculty, 70 Ph.D. / 50 MSc students
- Science & Technology Policy, Technology and Sustainability

- **Energy Group Focus**

- The low-carbon transition
- Energy and Sustainability
- Climate Change Adaptation & Mitigation



REITs Provide Important Portfolio Benefits Without Increasing Cost....

But Lenders/Investors Cannot Capture These

| 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 |

Most significant aspect of energy security today

Valuing Renewable Energy Technologies (RET):

The Oil-GDP Externality

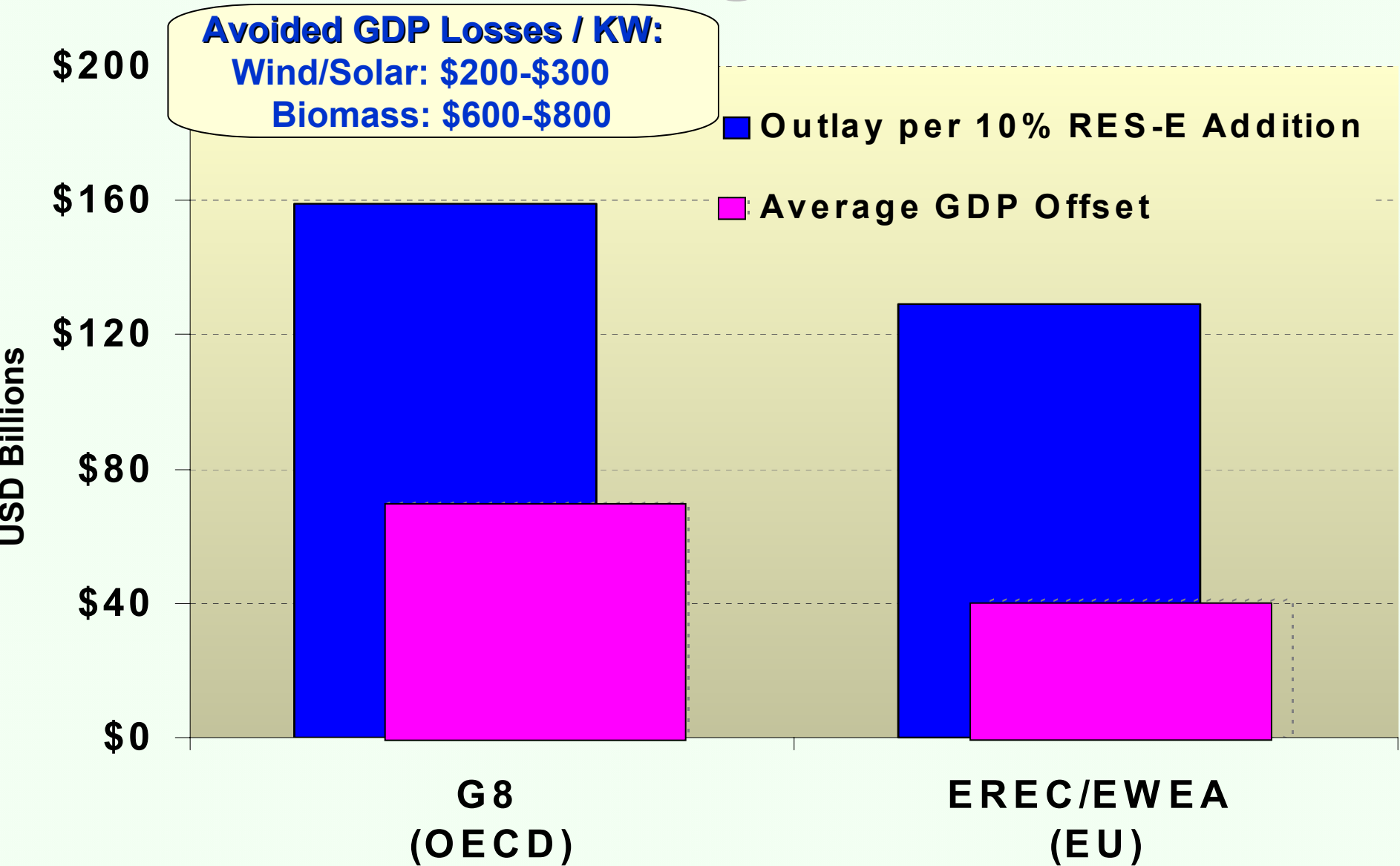
Macroeconomic Consequences of Fossil Price Risk: A Major External Cost

- **Fossil volatility hurts employment & GDP growth in oil consuming & producing nations**
 - Widely accepted in academic literature and the press
- **US: 1970-2000 Oil Price Movements Imposed \$7 Trillion Costs (Oak Ridge, 2000)**
- **Macroeconomic cost of 2000-04 oil spikes in EU: Approximately €700 Billion**
 - Sufficient to offset *entire* 2020/20% RET investment needs estimated by EWEA/EREC

Where/What is the Policy Disconnect?

- **Financial policy makers recognize issue**
 - *IMF* managing director Rodrigo Rato: pursue alternative energy to mitigate Oil-GDP effect [*FT*, 30-Sep-04]
- **But energy policy makers apparently do not see connection to renewables**

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



What's the “Catch?”

- **Adding Renewables Enhances Energy Security**
 - Helps avoid sizeable GDP losses
- **But Doesn't it Raise Generating Cost?**
- ***Adjusting for market risk*, the stand-alone levelized cost of many renewables is lower than gas**

REFLECTING MARKET RISK

**Valuing Energy Technologies
Necessarily Involves
an Assessment of Financial Risk**

Risk Affects KWH Cost Estimates

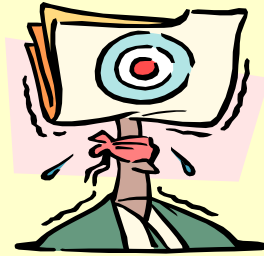
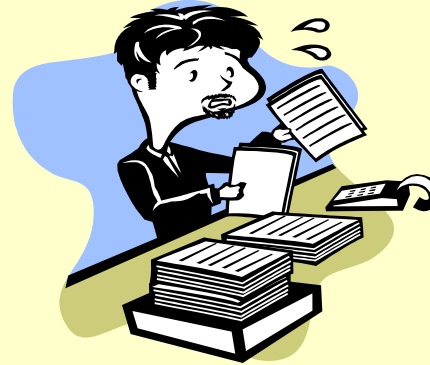
- Risk affects *value* and economic *expectations*

- Stock returns mean little without risk

- Engineering kWh cost estimates use arbitrary discount rates

- Have no economic interpretation

GAS = 3p/kWh?



Wind = 5p?...6p...?

**Talking about kWh cost without also talking about risk is like watching a movie.....
With the sound turned off!**

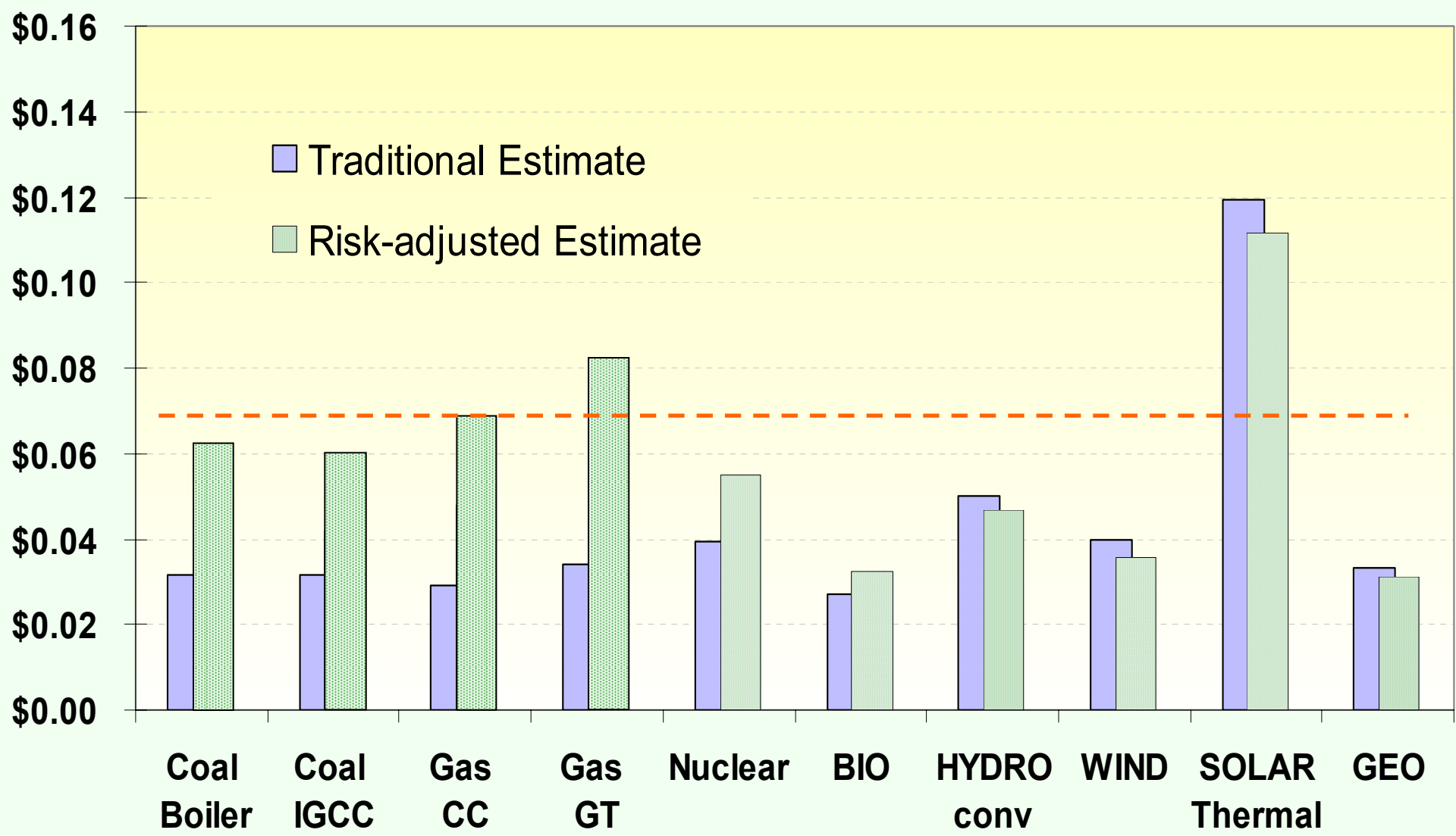
Arbitrary Discounting Produces Arbitrary Results

Valuing Two Bond Investments Using a Single Arbitrary Discount Rate

| | Junk Bond | Government Bond |
|---|------------------------------------|--------------------------------|
| | Tenet Hlth Care 7-3/8% due 2013 | US Treasury 3-7/8% due 2013 |
| | Yearly Proceeds | |
| 2005 | \$73.75 | \$38.75 |
| 2006 | \$73.75 | \$38.75 |
| 2007 | \$73.75 | \$38.75 |
| ⋮ | ⋮ | ⋮ |
| 2013 | \$1,073.75 | \$1,038.75 |
| Present Value @ 10% Discount | \$860 | \$673 |

But US-Treasury is Worth More!

Traditional vs. Risk-Adjusted Levelized Cost-of-Electricity Estimates Historic Fossil Price Risk



Portfolio Based Valuation

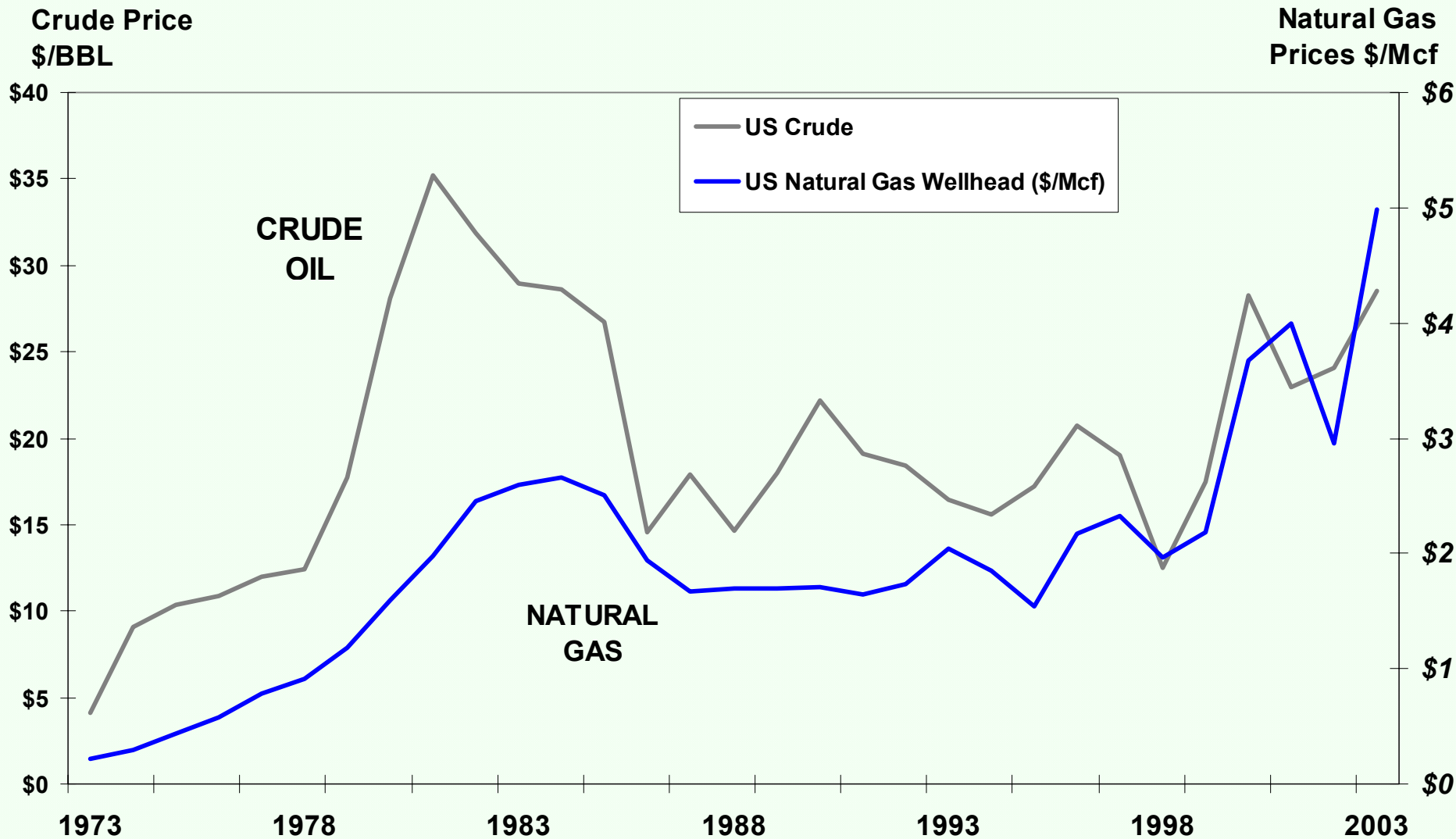
- A Generating Alternative's *Stand Alone Cost* Not Very Meaningful
- Must consider its contribution to portfolio *cost* relative to its contribution to portfolio *risk*
 - Differs from IRP analyses
- ***Standard Portfolio Theory Predicts:***
 - Adding Fixed-Cost Renewables to Generating Mix *Reduces Overall Generating Cost at any Level of Risk..... Even if stand-alone costs are higher*



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

Fossil Prices are Highly Correlated

U.S. Crude Oil and Natural Gas Prices



Portfolio Diversity and Security: REITs Provide Important but Poorly Recognized Energy Security Benefits

- **Mitigate fossil price volatility - intuitive**
- **Provide Important *Counter-cyclical* Benefits:
a form of “national insurance”**
 - (R. C. Lind & Nobel Laureate J. Kenneth Arrow, 1984)
- **Payoff occurs when economy is doing poorly**

**Energy security is reduced when nations
hold inefficient portfolios that are
needlessly exposed to fossil risk**

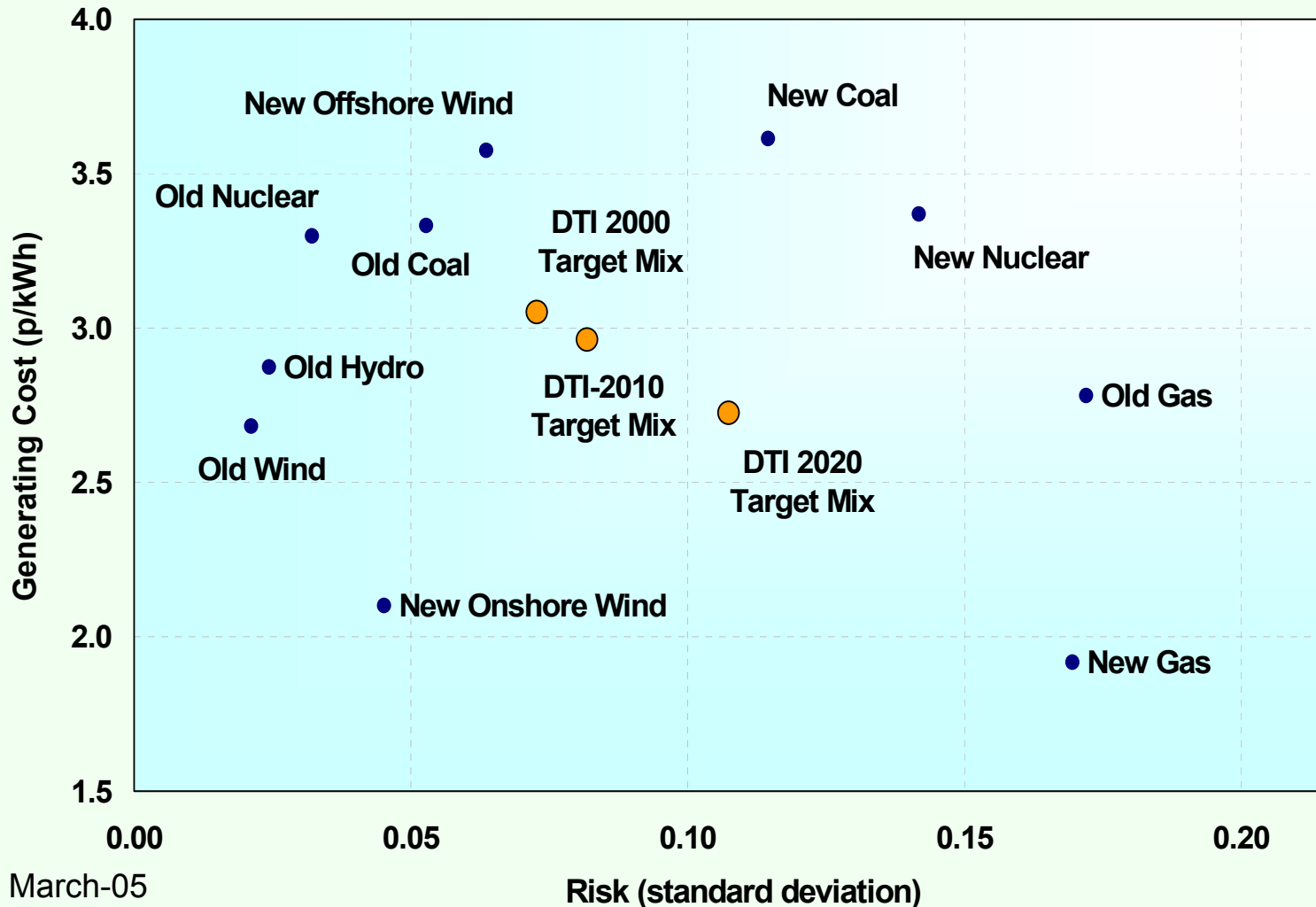
UK Generating Mix: Cost-Risk Trends

- Move to larger gas share increases portfolio risk
 - Increases year-to-year expected generating cost volatility

• Reduces Energy Diversity/ Security

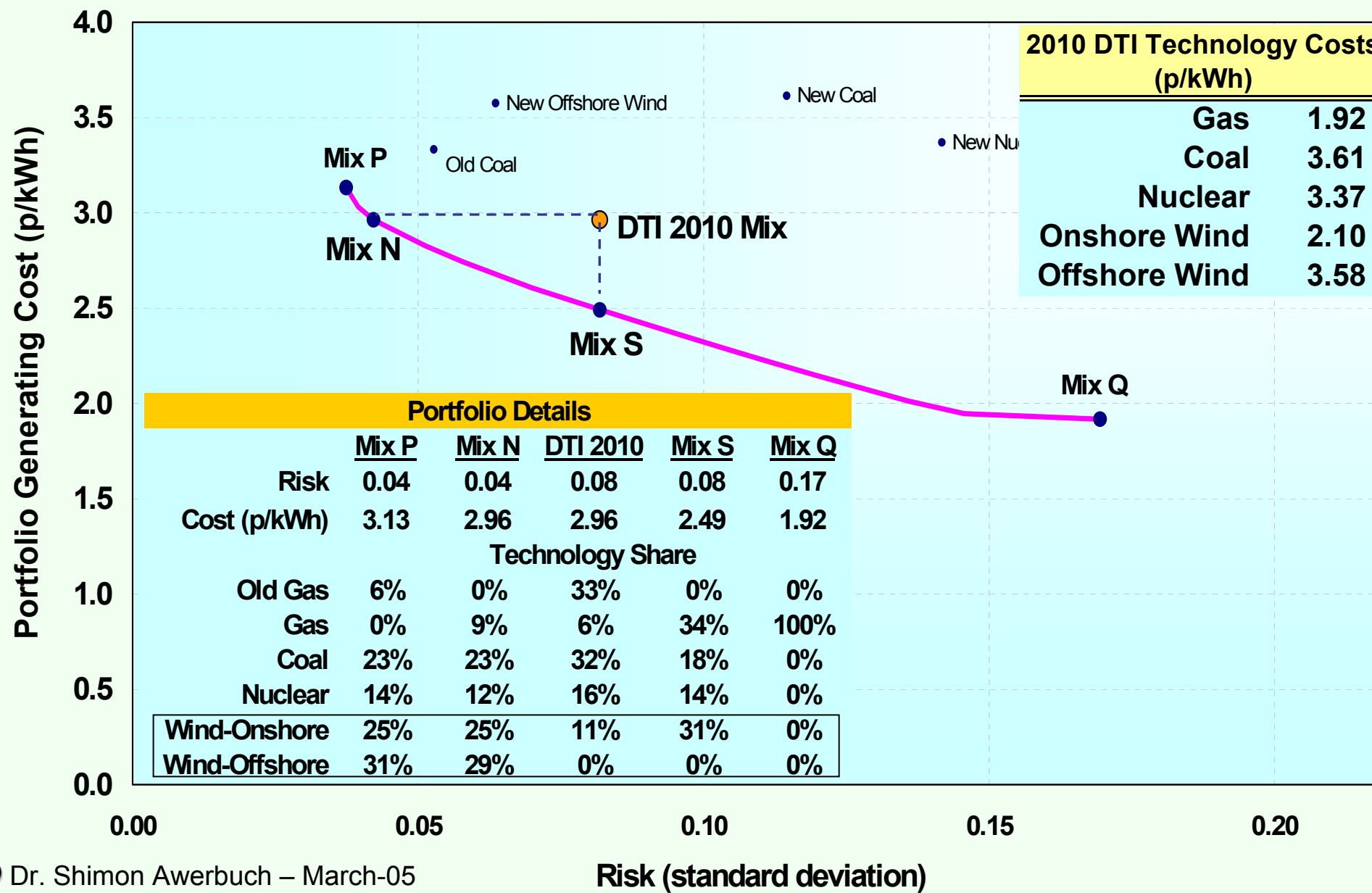
• RETs ideally positioned to diversify mix and reduce cost/risk

UK 2010 Technology Costs and Estimated Risk
DTI Projected 2010 and 2020 Target Mixes

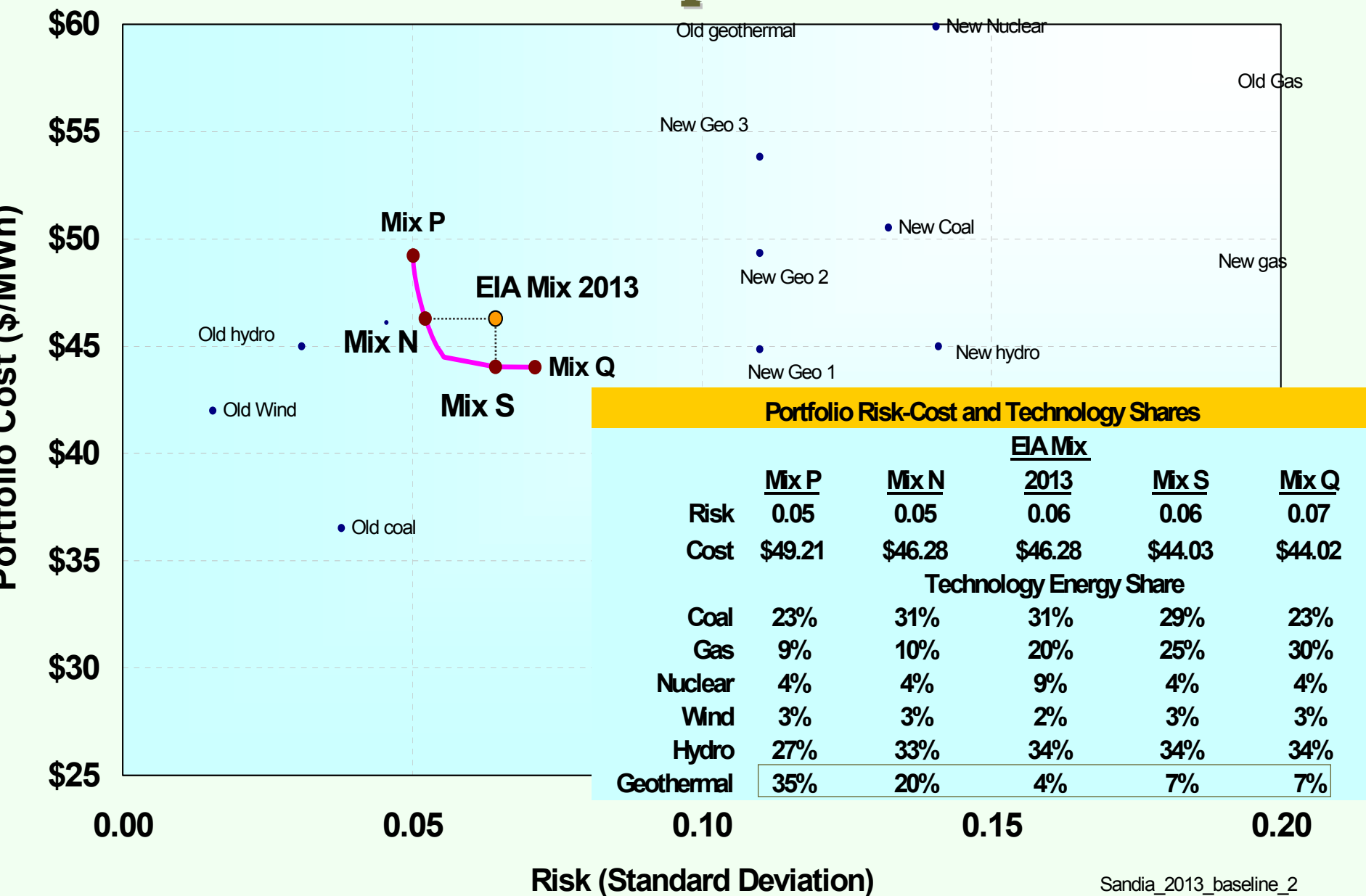


2010 UK Portfolio Optimization

- DTI Technology Costs -



2013 US Western-Region Geothermal Baseline Optimization



***Renewable Energy and the
Power Grid:***

***RE Can Help Reconceptualize
Electricity
Production & Delivery
Paradigms***

The Issues Surrounding Integration of RE into the Network Are Not New

- **Exploiting New Technology Always Requires Changes in Organizations, Support Systems & Infra-structures**
 - Bessemer, Word Processing
- ***Bicycles, RE and LNG:***
 - Cannot work without new supporting systems

Current efforts to integrate Renewables make as much sense as side-saddle bikes

Why Integrate Renewables into the Power Network?

- **Create Sizeable Portfolio Benefits**
 - *Reduce* overall generating cost and risk
- **Enhance energy security/diversity**
- **Reduce Market Power:**
 - Help open markets & *unlock* the potential benefits of liberalization

The Power Grid Has a Pivotal Role in Implementing These Crucial Objectives

STOP