

# ***Challenging the Energy Mix: How Renewables Really Impact Cost and Energy Security***

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# RETs Provide Important Portfolio Benefits Without Increasing Cost.... But Investors Cannot Capture These

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

**Most significant aspect of energy security today**

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

- ⚠ **Fossil volatility hurts employment & GDP growth in consuming and producing nations**
- ⚠ **Macroeconomic cost of 2000-04 oil spikes in EU: €400 Billion**
  - Offsets *entire* 2020/20% RET investment needs estimated by EWEA / EREC
- ⚠ **Gas also plays a role (US): (LBNL, 2005)**
  - 1% nat-gas demand reduction → 0.8% - 2% price reductions
  - Every MWH of renewables saves consumers \$7.50 - \$20 through lower gas prices

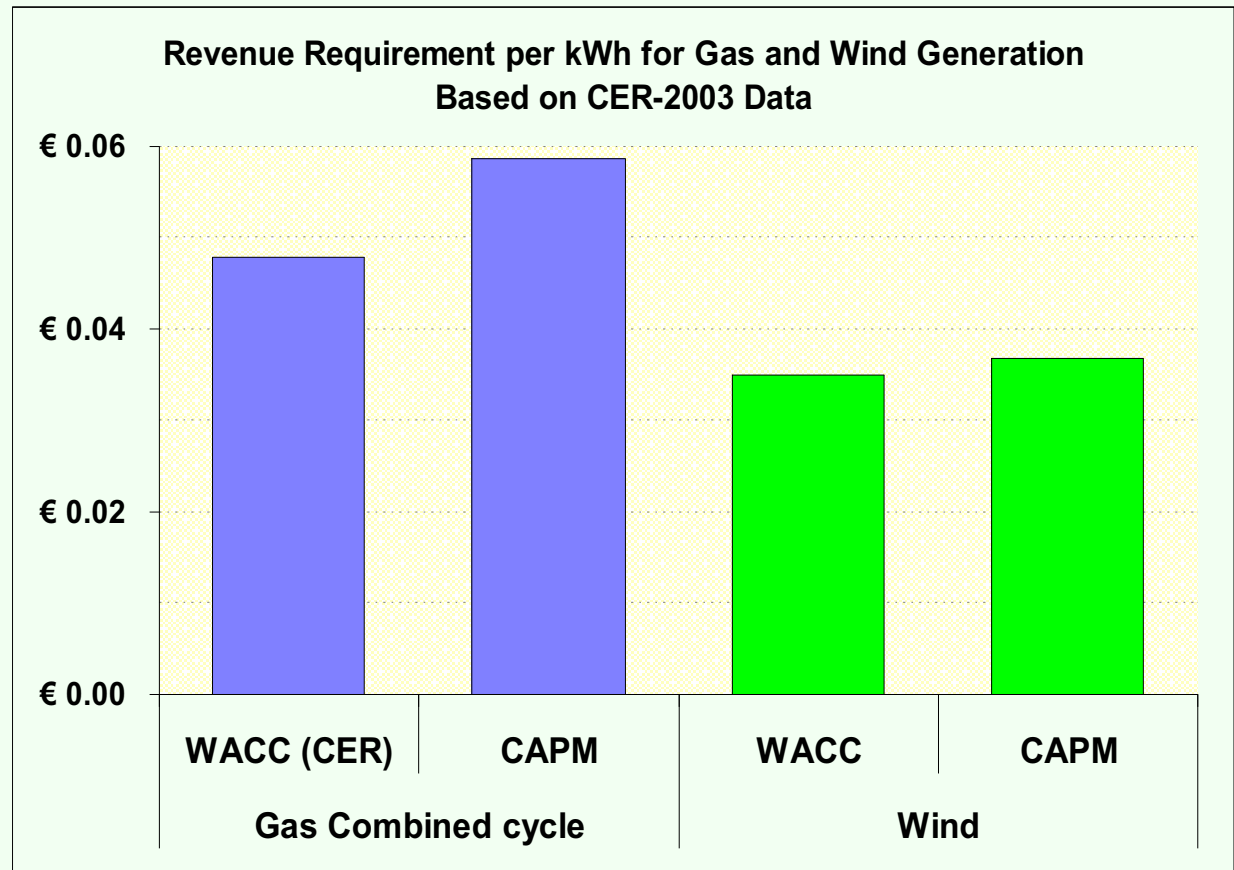
**Where is the Policy Disconnect?**

# Risk Affects KWH Cost Estimates

⚠ Risk affects *value* and economic *expectations*

⚠ Engineering cost estimates- arbitrary discounting

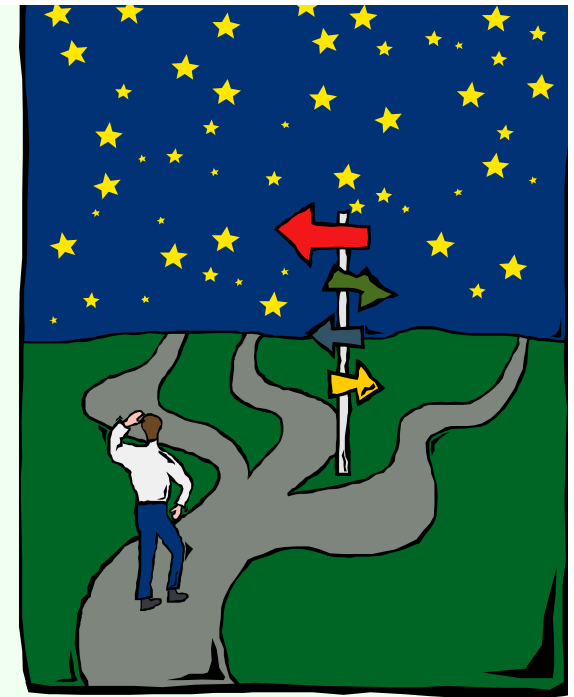
– No economic interpretation



Selecting *Least-Cost* Alternative:  
Like asking for 20-year stock forecasts

# 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***
- ⚠️ ***Textbook 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*

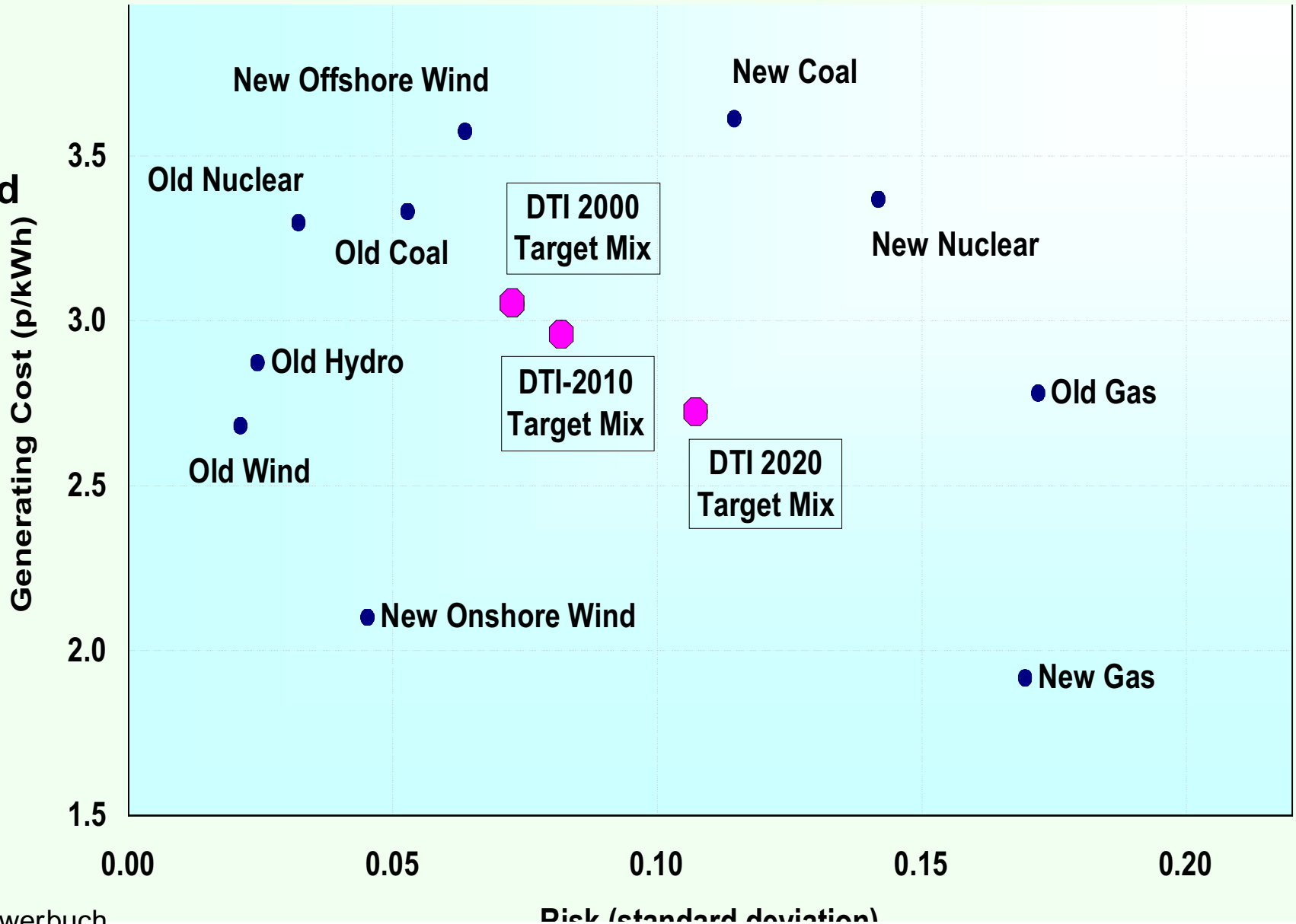


**Enhancing Energy Security  
Does Not Have to Raise Cost**

# DTI's UK Generating Mix: Cost-Risk Trends

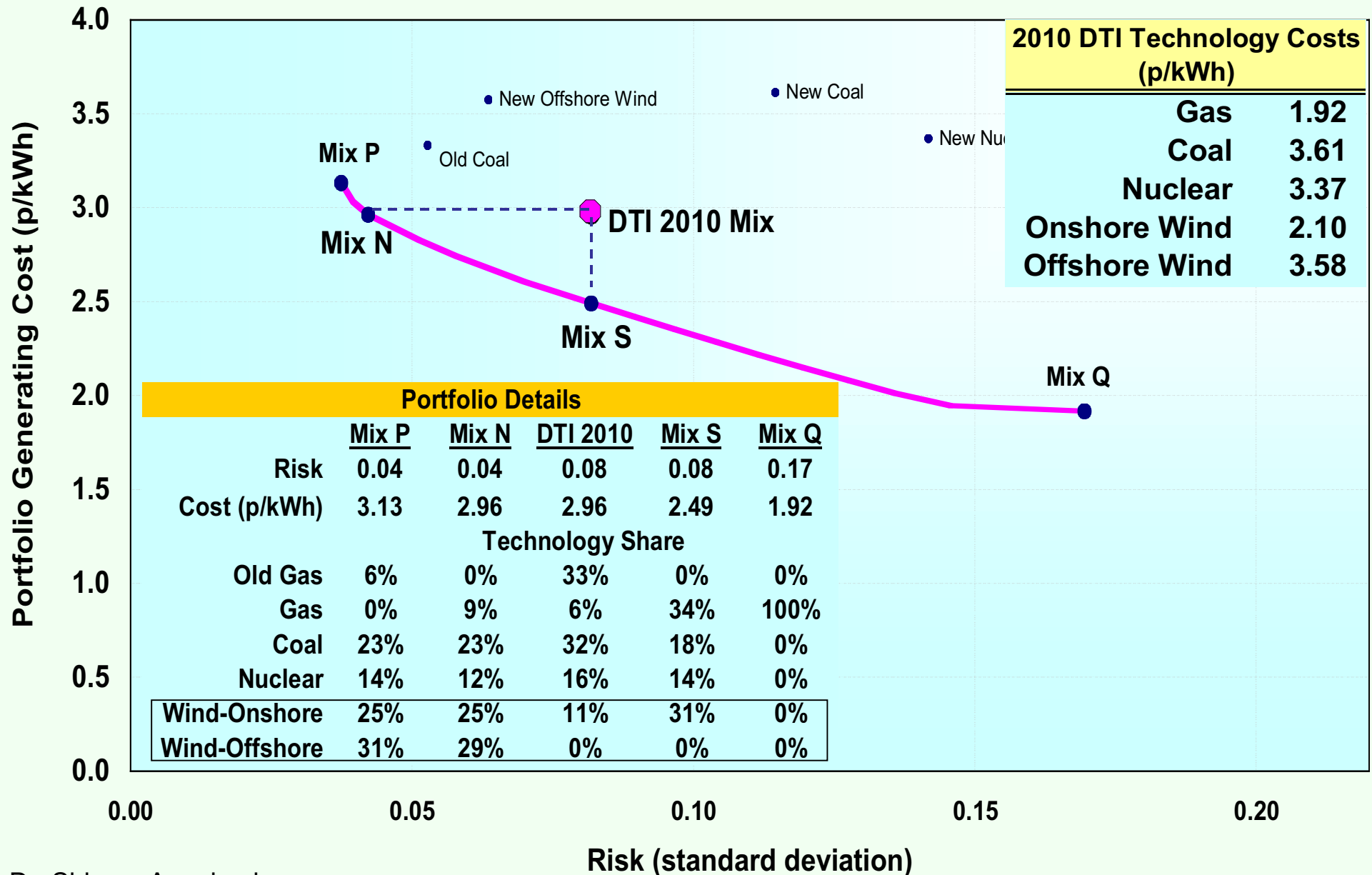
● Larger gas shares reduce portfolio Diversity-Security

● Wind ideally positioned to diversify mix and reduce cost/risk

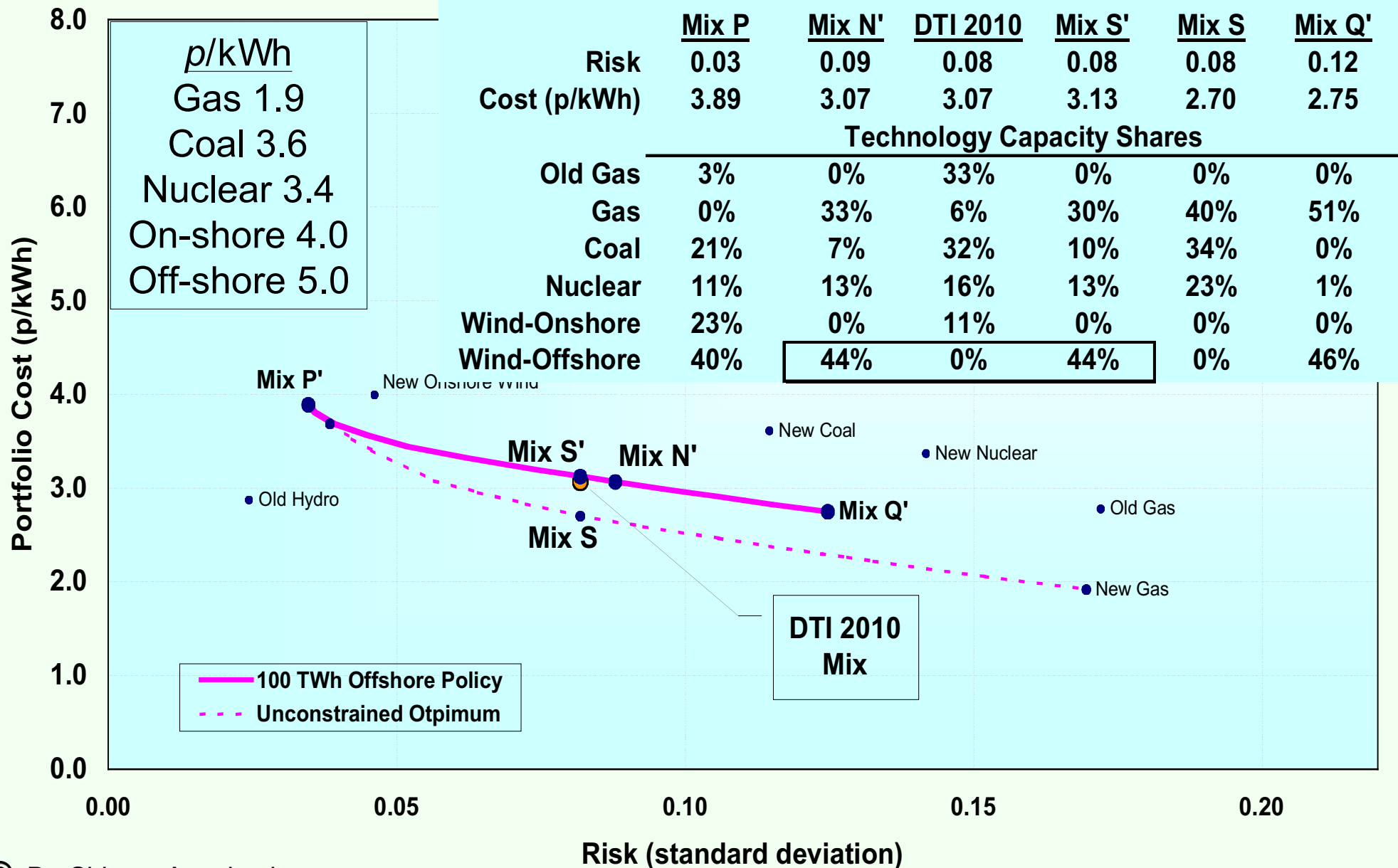


# 2010 UK Portfolio Optimization

## - DTI Technology Costs -



# Cost of UK Accelerated Wind Deployment Policy High Wind Cost Scenario – 2010 (2003–\_)



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

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

# Networks of the Future: *Informed, Decentralized and Market-Driven*

## ⚡ **Facilitate Markets - Deliver Market-driven products**

- Not just transporting commodity electrons

## ⚡ **Exploit technology attributes**

- Match to load's need
- Do not force all sources to resemble gas turbines

## ⚡ **Promote diversity: create opportunities for *all* new resources**

**Future networks must support re-conceptualized  
*just-in-time, mass-customized*  
electricity production/delivery paradigms**

# Baby Steps– Learning to Integrate Wind

## – people talk about capacity factors

**⚡ Capacity-Factor-** Fraction of *theoretically* feasible output a given asset produces in a year

- Ireland Wind *Capacity Factor* = 35% → high
- Is wind non-productive 65% of the time?
  - Exploiting resource is economic and sustainable

**⚡ No grid asset operates 100% of the time**

- In the US: Power grid itself operates at 15%-20% capacity-factor.

# Wind Intermittency: People worry about backup – Capacity–Credit (*ELCC*)

**⚠ Amount of conventional generation (KW) that can be replaced with wind**

–  $f\{\text{capacity-factor \& coincidence with system peak}\}$

**⚠ Every grid asset requires backup**

– e.g. 500-MW fossil plant with 15% forced outage rate

→ Capacity-credit might be 78% (Milligan, NREL, 2002)

→ At 77% plant availability?

**⚠ Backup issue complex**

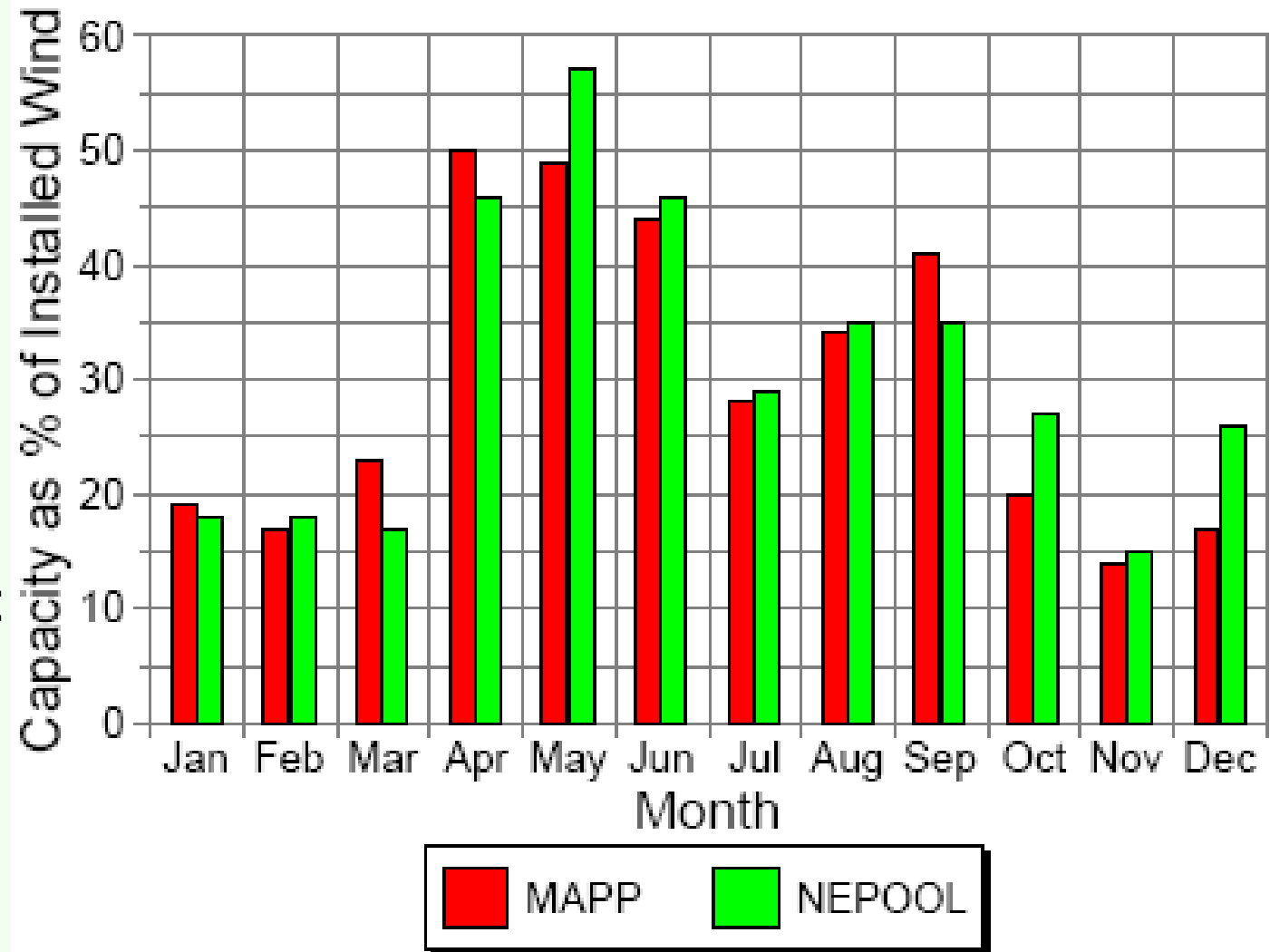
# Wind Backup Needs– Complex & Controversial: Estimated Wind Capacity–Credits

Simulated wind capacity credit: 10-year actual wind and load data (Source: Milligan, NREL 2002)

⚡ ESB  $\approx$  35%

⚡ R. Perez:  
(Martinique)  
approaches  
50%

⚡ A. Lovins:  
– 43% for PEI  
– Altamont Pass:  
40%;  
– Solano: 74%



# Wind Integration Costs

**⚡ Recent studies suggest wind deployment imposes very small system costs**

– e.g. kWh Cost of 20% wind penetration:

0.5p in the UK / 0.4 Euro-cent in Germany

(Sources: Dale, Milborrow, *et. al.*, National Grid Transco & UMIST (2004), and German *DENA Grid Study* (2005))

**⚡ Important – helps us understand wind integration**

– But are conceived in the context of today's grid protocols & architecture

**⚡ Ignore power of *organizational learning & market incentives***

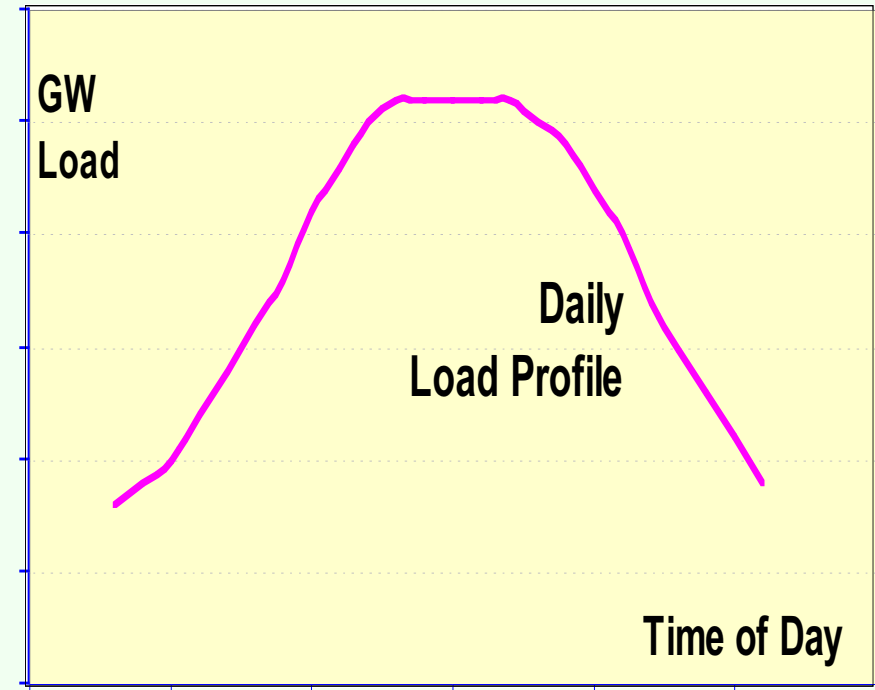


# Mass-Production vs. Mass-Customization in Electricity Production/Delivery

⚡ *Any color as long as it's black (Ford) vs. Have it your way (Dell)*

⚡ Electricity is mass-produced using “dispatchable” sources to meet aggregated network load

- Masks underlying dynamics of millions of transactions, each with a different valuation
  - High Value Vs. Interruptible loads
- Inhibits integration of “intermittent” sources



# Intermittent Resources: Mass-customization & Discrete Load Matching™

- ⚠ **Interruptible loads may = 5% - 17% of peak demand**
  - May not need backup for hours
  - Value backup less than price central-dispatch pays
- ⚠ **Mass-Customization Demonstration**
  - Feasibility of intermittent wind for UK hotel chain with 12 MW load / \_2.5 million p.a.
  - Goal: intermittent wind *exclusively* serves 50% of hotel chain's load
    - Will manage intermittency without relying on system power

# The power of market incentives

**⚡ Monopoly system operators cite costs of cycling fossil generators to compensate for wind intermittency**

- Heard in the monopoly days in the US, but now vanished with restructuring

**⚡ Market incentives induced fossil operators to learn new ways of tweaking and operating equipment**

- Coal plants cycled to meet market needs

**⚡ Demonstrates power of financial incentives over engineering standards that have never met a market test**



# How to efficiently integrate wind into the Irish system

**A** Provide system operator with financial incentives to add wind under *price-cap* regulation

**A** Allow organizational learning and incentives to work



**THANK YOU**

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