Low carbon energy: Scenarios, aspirations and delivery

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Overview

- Introductions
- Review of scenarios
- Policy context and scale of challenge
- Aspirations vs progress
- Learning from experience - policy case study
- Conclusions

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UKERC – UK Energy Research Centre Technology and Policy Assessment

- UKERC - Research council funded cross-university collaboration: *‘pre-eminent UK centre of research and source of information and leadership on sustainable energy systems’*
- TPA function - policy reports drawing upon research evidence base
  - Systematic assessment of literature
  - Stakeholder and expert consultation
  - Topics chosen in consultation with policymakers and industry
- High impact on policy development and engagement with policymakers

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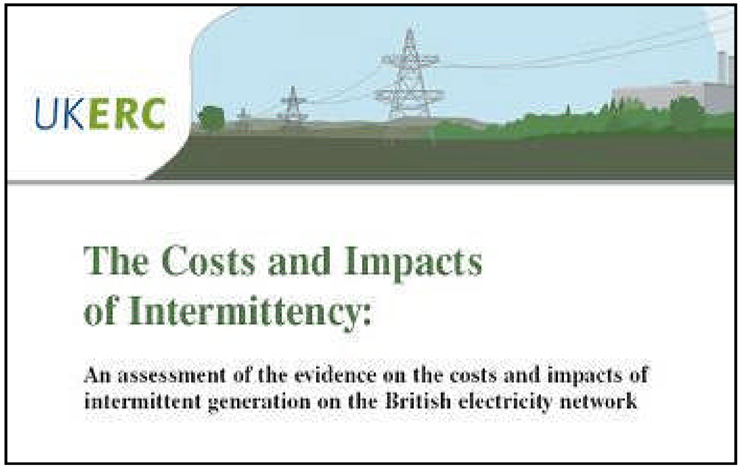
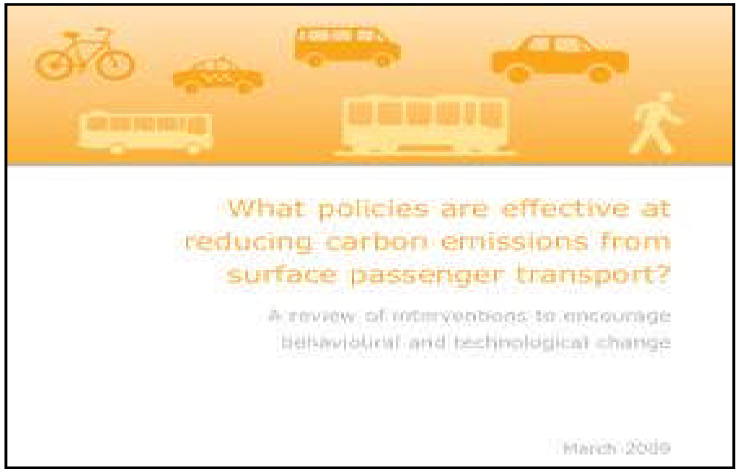
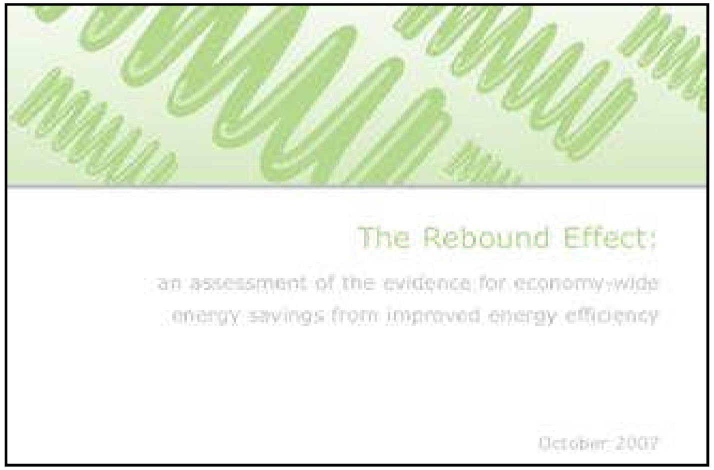
TPA Projects







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ICEPT at Imperial College

Imperial's Centre for Energy Policy and Technology (part of the Centre for Environmental Policy)

- Research at the interface of policy and technology
- Manage the TPA function for UKERC
- Other activities in decentralised generation, bio-energy, energy systems and transitions, fuel cells and hydrogen
- MSc in Environmental Technology in particular the Energy Policy Option
- PhD programme, interdisciplinary work on environmental policy and technology, in particular work on energy issues

Renewable energy scenarios
(just a few examples)

- Shell from 1995 on
- UNDP/WEC 2000
- Royal Commission 2000
- Foresight 2001
- PIU 2002
- IAG 2003 (White paper)
- IPCC – various, from early 00s
- CCC 2008
- UKERC 2009

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Resource is not the constraint (economics and networks might be)

Technology	Technical potential TWh/yr	Practicable potential TWh/yr
Building integrated photovoltaics (BIPV)	250+	37
Offshore wind	3000	100
Onshore wind	317	8
Biomass (energy crops)	140	~30
Wave	700	50
Tidal stream#	36	1.8
Small Hydro	40	3
Waste technologies: MSW (municipal solid waste)	13.5	6.5
Landfill gas	7	7

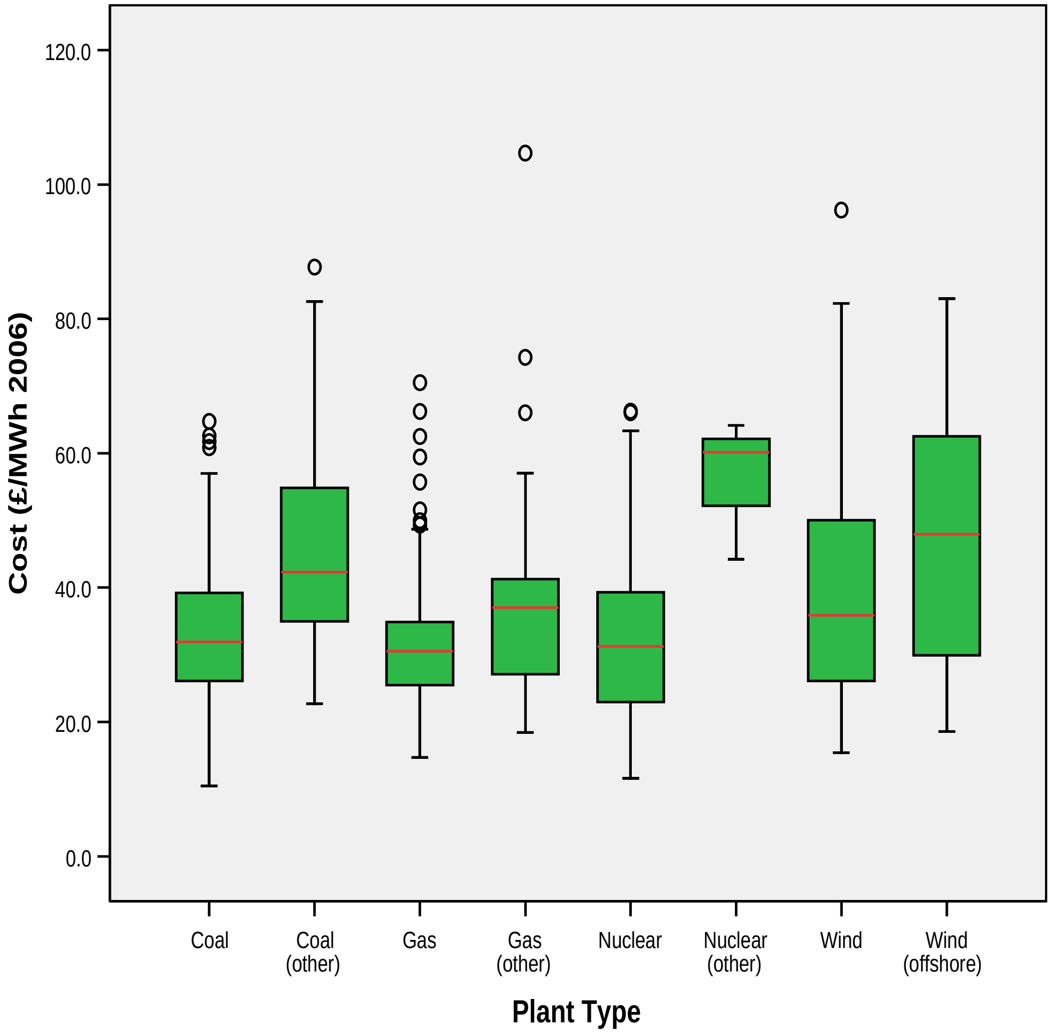
UK electricity production ~ 400 TWh/yr

UK Resource 2025 (DTI 1998, Bauen 2000)

Scenarios – cost ranges (1)

UKERC review: 1200 data points extracted from 145 sources and converted to a consistent currency and year

With such a wide range it is not surprising that commentators differ and interest groups can ‘pick a number’



Scenarios – cost ranges (2)

Technology	*Current cost (US c/kWh)*	*Medium term projections[1] (US c/kWh)*
Biomass Energy[2] • Electricity • CHP-mode	 5 – 15 7[3]	 5 – 9 2 – 5
Wind Electricity[4] onshore offshore	 5 - 8 9 - 12	 2 – 4 3 – 8
Tidal Stream/Wave[5]	13 – 20	<15
Grid connected PV[67] 1000 kWh/m²/year (UK) 2500 kWh/m²/ year (Africa, South Asia)	 50 – 80 20 – 40	 15 – 25 5 – 15
Nuclear Power[8]	5 – 7	4 – 8
Capture and storage[9] Natural Gas with CO2C&S IGCC Coal with CO2 C&S	 NA NA	 4 – 6 5 – 8

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Scenarios implications - renewables growth ought to be feasible

- Modelling suggests that expansion is possible, at a cost
  - Marginal costs *may* be large (depends on counterfactual, supply chain, other factors)
  - Absolute costs *smaller* than recent fluctuations due to fossil prices
  - Economic burden (GDP impact) small
- Network issues are significant, but manageable
- Other countries have achieved dramatic growth rates
- Political will and policy effectiveness key…

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Political commitment is there

(unprecedented political consensus)

emissions over 5-year periods starting 2008

- Initiates a programme for looking at adaptation
- Became law on 26th November 2008

periods

- The inclusion or otherwise of aviation and shipping
- The powers and make-up of the Committee

The Climate Change Bill passed in the House of Commons by 463 votes to 4.

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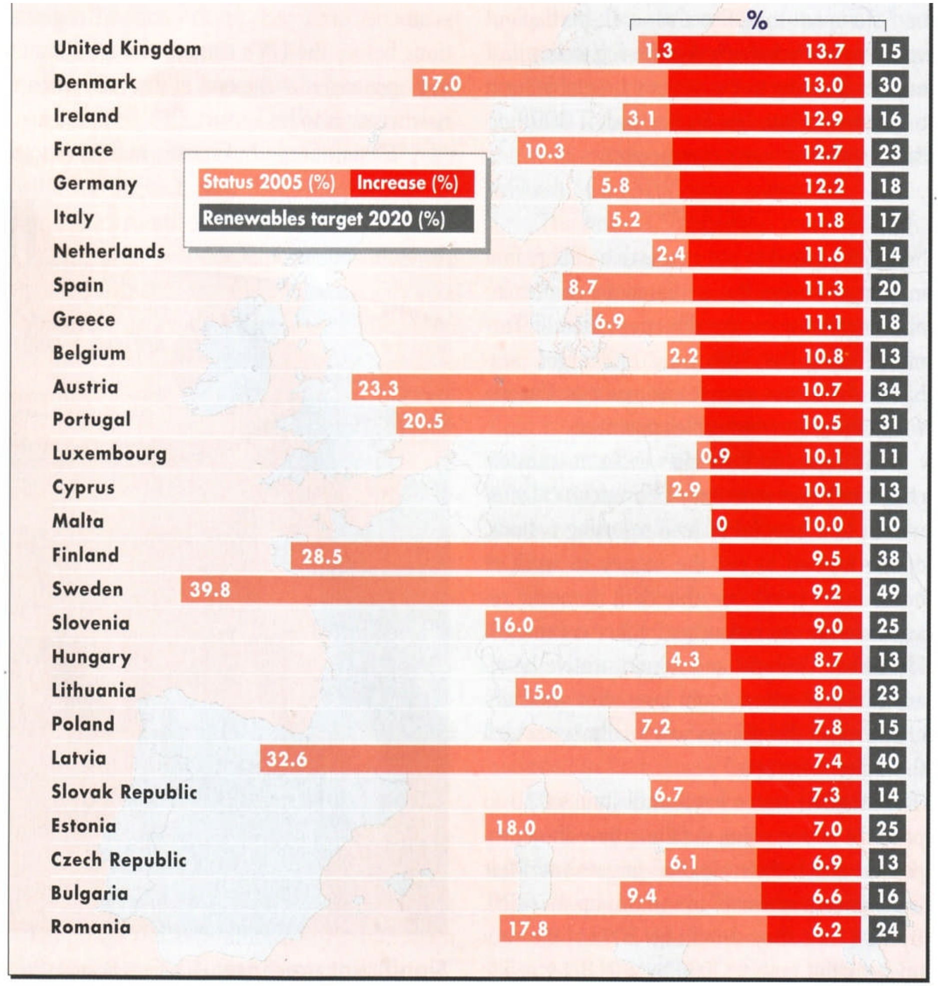
Recent policy IS ambitious
(aka moving the goal posts very quickly indeed!)

- UK target of 80% emissions reduction in 2050
- Interim targets set by Committee on Climate Change
- EU target – 20 20 20 in 2020



EU consumption targets by state
(windpower monthly 2009)

Radical development of RE desired much faster

Renewable energy technology	**Current contribution to UK electricity**	**Potential 2020 scenario**			
		GW	**Load factor**	**TWh**[1]	**% UK electricity**
Biomass	2%	6	50%	26.3	**6.7%**
Wave energy	<0.1%	1	34%	3.00	**0.8%**
Tidal energy	<0.1%	1	42%	3.7	**0.9%**
Severn barrage[2]	0%	5	25%	11.00	**2.8%**
Wind energy	1%	37	35%	112.7	**28.5%**
PV	<0.1%	2	20%	0.5	**1.00%**
TOTAL					**40.7%**

UKERC electricity supply scenario for House of Lords 2008 report on 2020 target

The new conventional wisdom?
(committee on climate change and UKERC)

- Electricity decarbonisation is key to the future – it unlocks potential in other sectors of the economy
- A low-carbon economy is a high-electricity economy – the sector will grow substantially
- Electricity use will increase in transport and buildings – electric vehicles, plug-in hybrids, heat pumps etc
- Energy efficiency is key to rapid initial progress
- TECHNOLOGY POLICIES essential to grow markets and reduce costs – Renewables obligations etc….

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Do policies match aspirations?

- The UK is a world leader in low carbon *aspirations*
- The UK climate bill sets the most ambitious targets of any country, AND they are binding
- Britain has been a *policy innovator*
- BUT UK policies to date have not been delivering. Others do BETTER…

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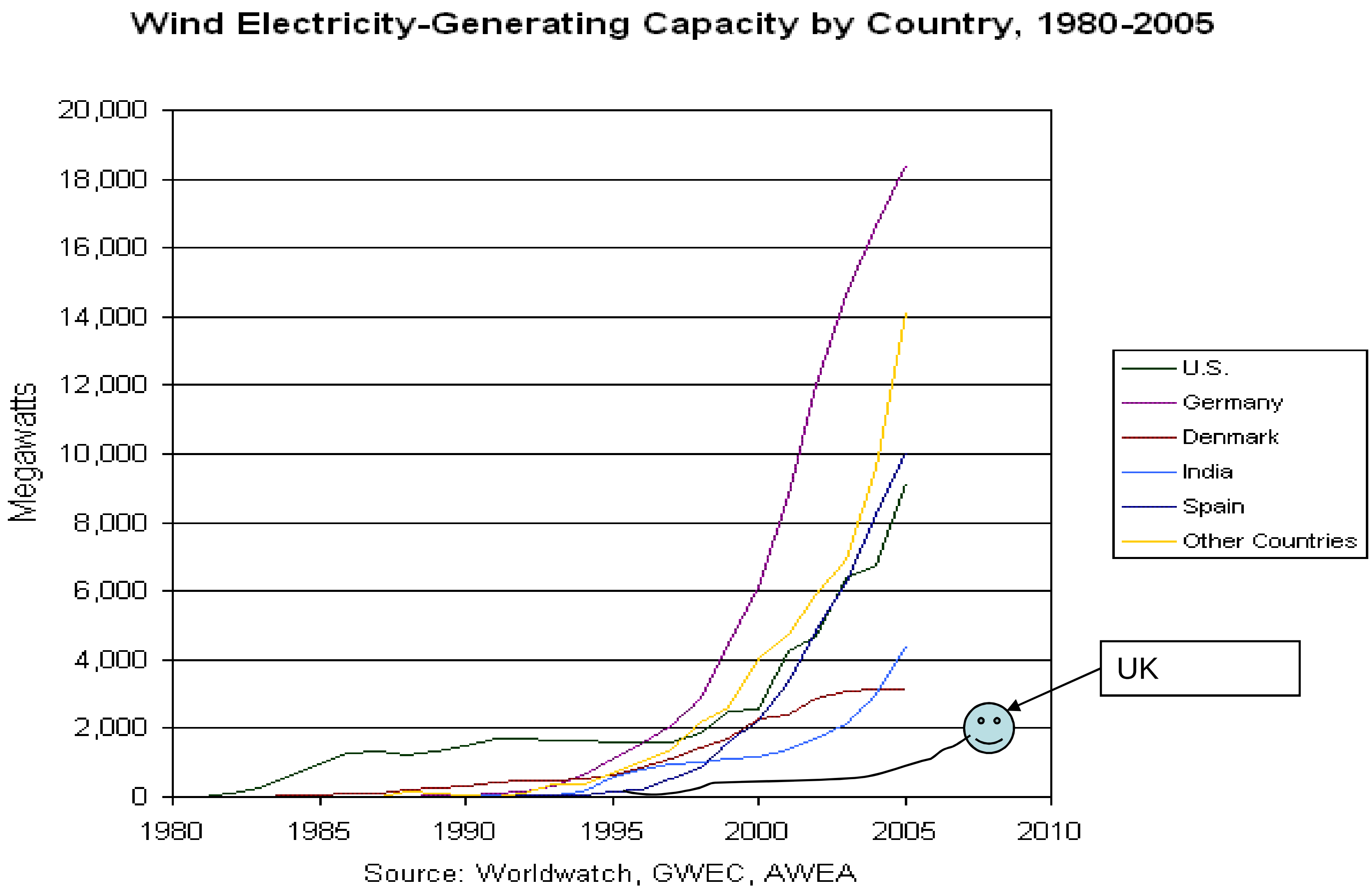
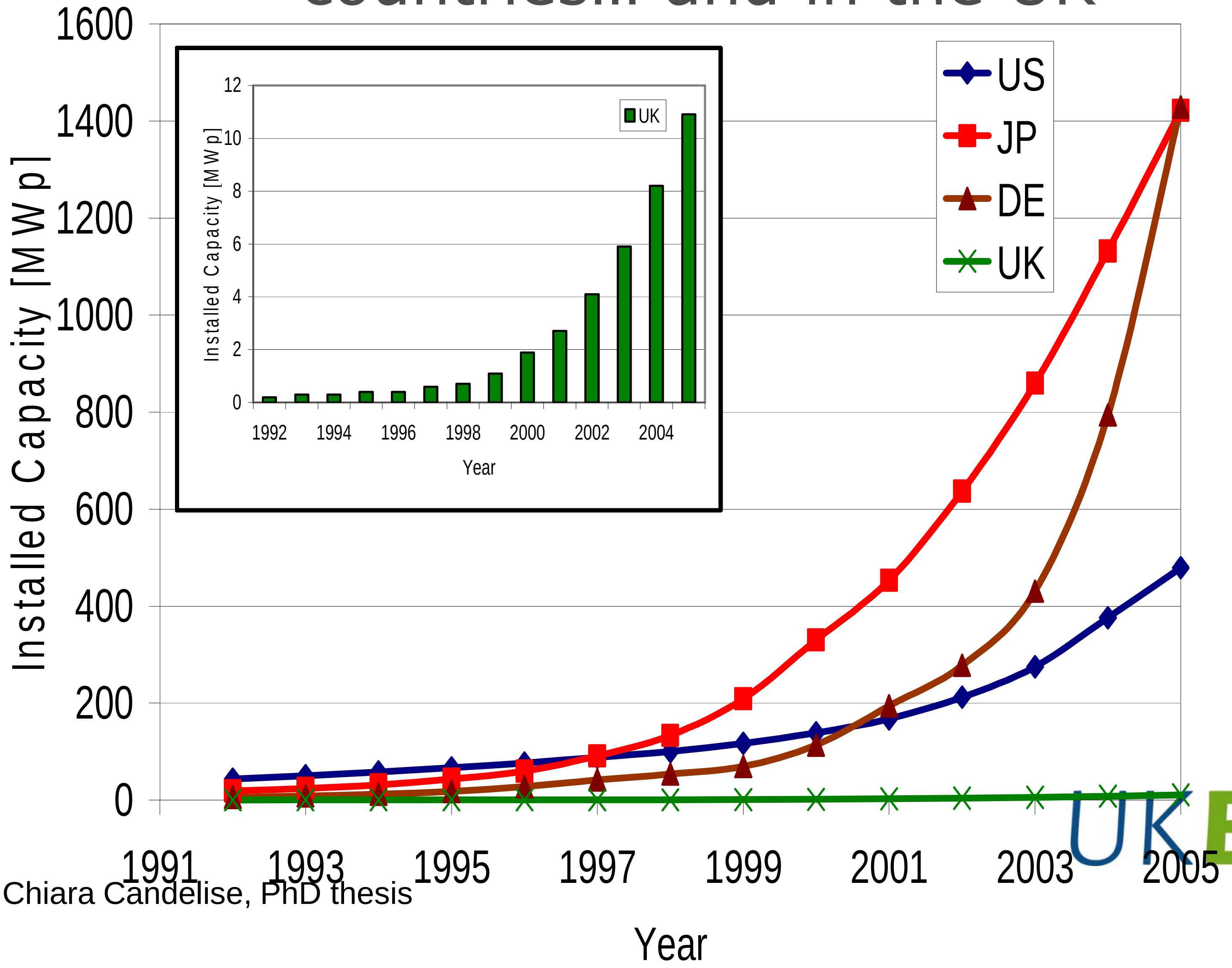
Wind capacity



Solar PV capacity growth by leading countries… and in the UK



Chiara Candelise, PhD thesis

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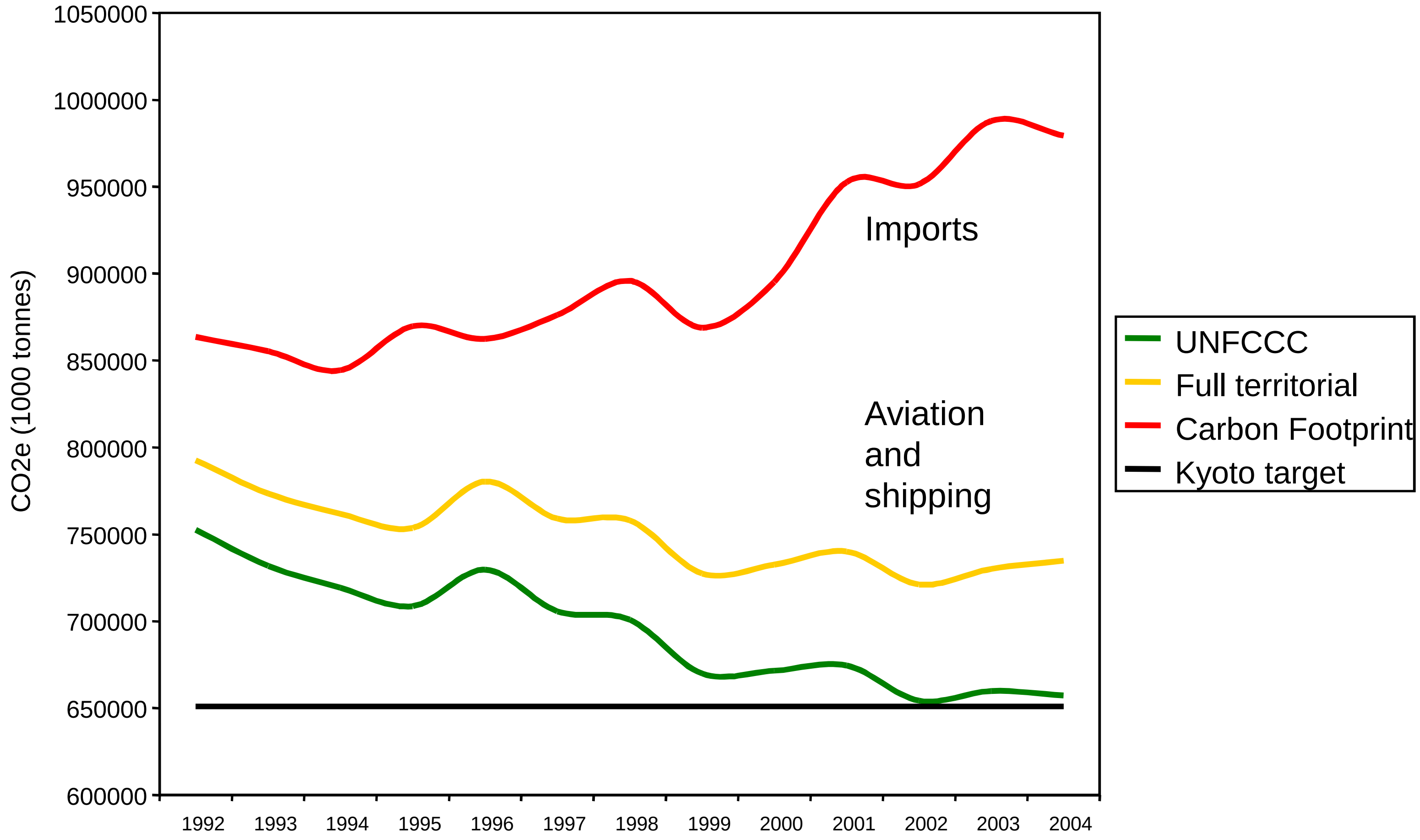
UK emissions including imports



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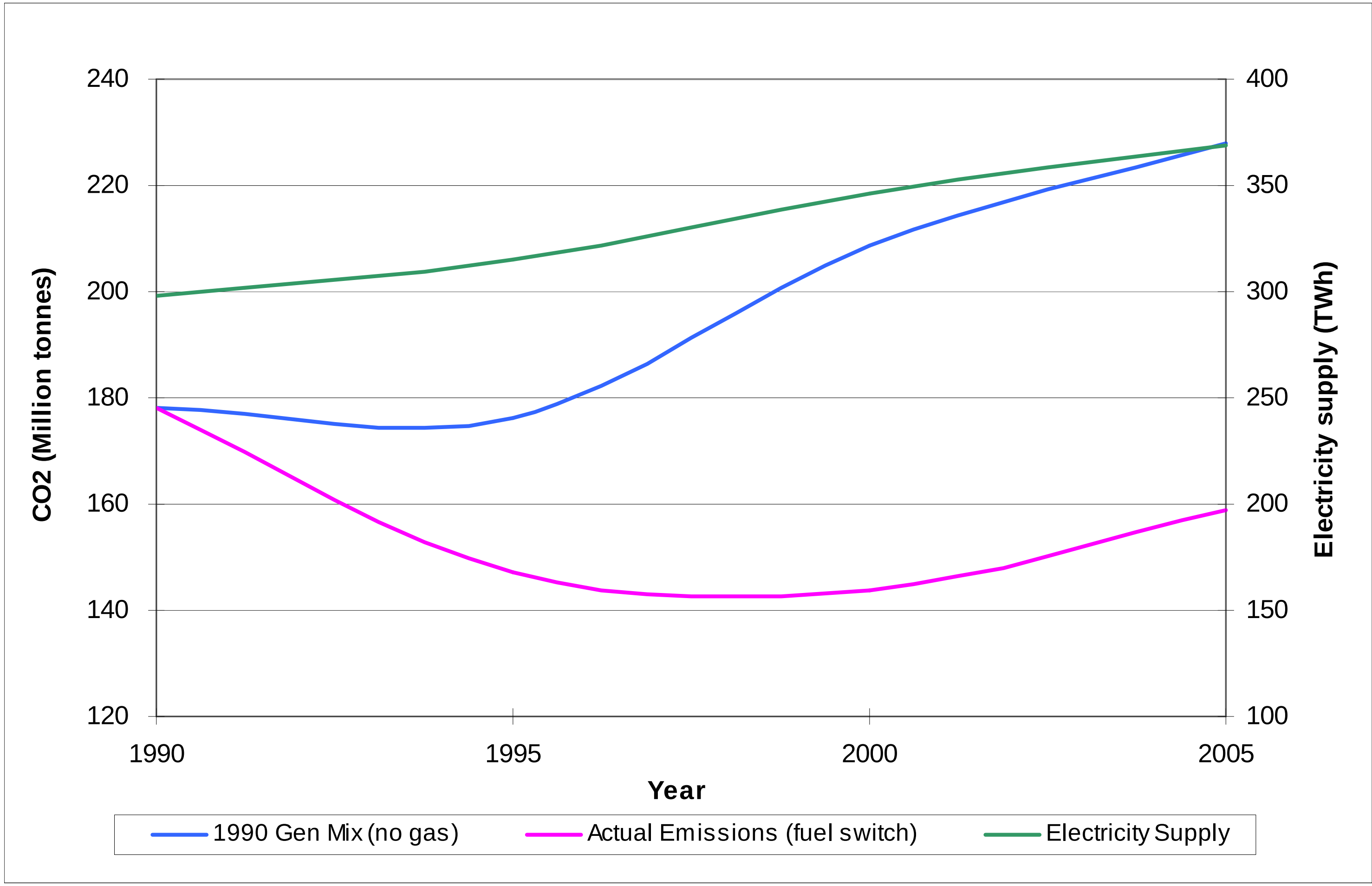
UK power sector emissions with and without dash for gas

(data from DTI 2006)



Short run emissions trends cannot (yet) signal long run decarbonisation

Why?

- Fuel switching (coal to gas) is not a long term/deep cut solution
- 'Carbon exports' can disguise real trends
- The priority is *building the means* to deep decarbonise, not shallow decarbonising now

Better indicators?

- Progress with efficiency
- Progress with renewables
- Progress with CCS
- Systemic change (transmission evolution, smart loads and development of micro-generation)

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Case study:

- Policy design and progress with renewables
- Understanding the differences between UK and countries like Germany, Denmark and Spain

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Models of policy development

UK	'EU consensus'
▪ Power market full liberalisation ▪ Renewables support through trading (**Renewables Obligation**) ▪ Market based grid access ▪ Energy efficiency and microgen through supplier obligations (**CERT**)	▪ Power market part liberalisation ▪ Renewables support through fixed prices (**Feed in Tariffs**) ▪ Priority grid access ▪ Energy efficiency and microgen through direct regulation and subsidy
'Revolution'	'Evolution'

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Renewable support schemes

Feed in tariffs or Fixed Premium Schemes

Obligation on utilities/suppliers to accept renewable generation subject to tech criteria

Guaranteed price or price premium for fixed time

Cost borne by utility and passed to consumers

18 out of 25 EU states and many other OECD countries

Renewables Portfolio standards or Green Trading Schemes

Obligation on suppliers to source a proportion of their power from renewables

Tradable certificates – e.g. UK ROCs - to prove compliance

Competitive market for ROCs

6 EU states and some US – but note role of Production Tax Credit – functions like a FiT

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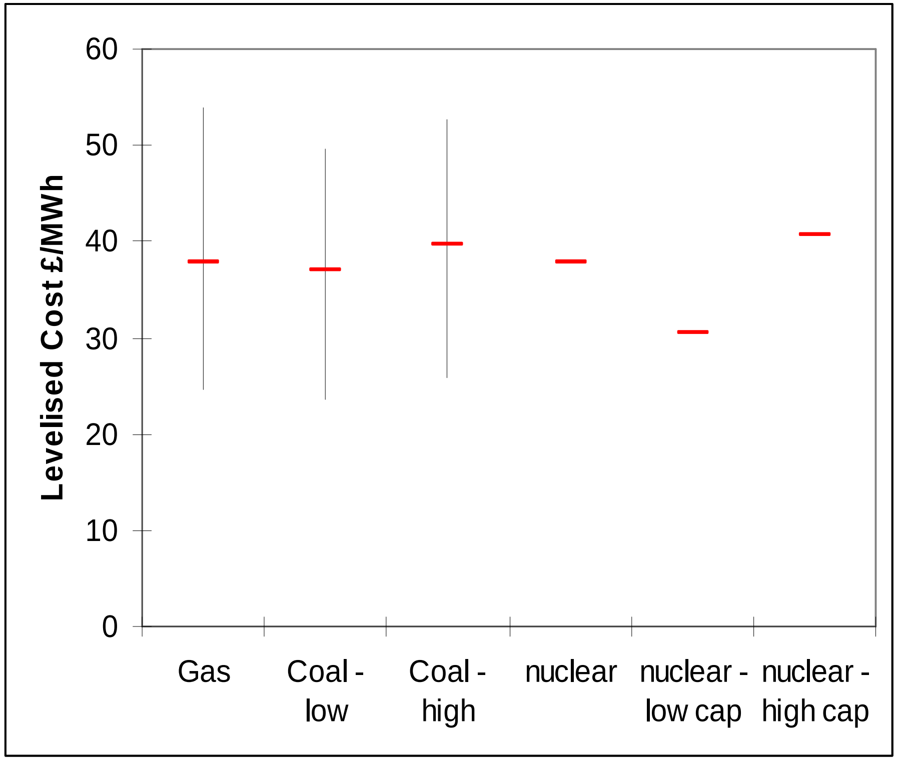
Policy design affects investor risk

- Under the RO Renewable generators are BOTH power market price takers AND exposed to ROC price variation

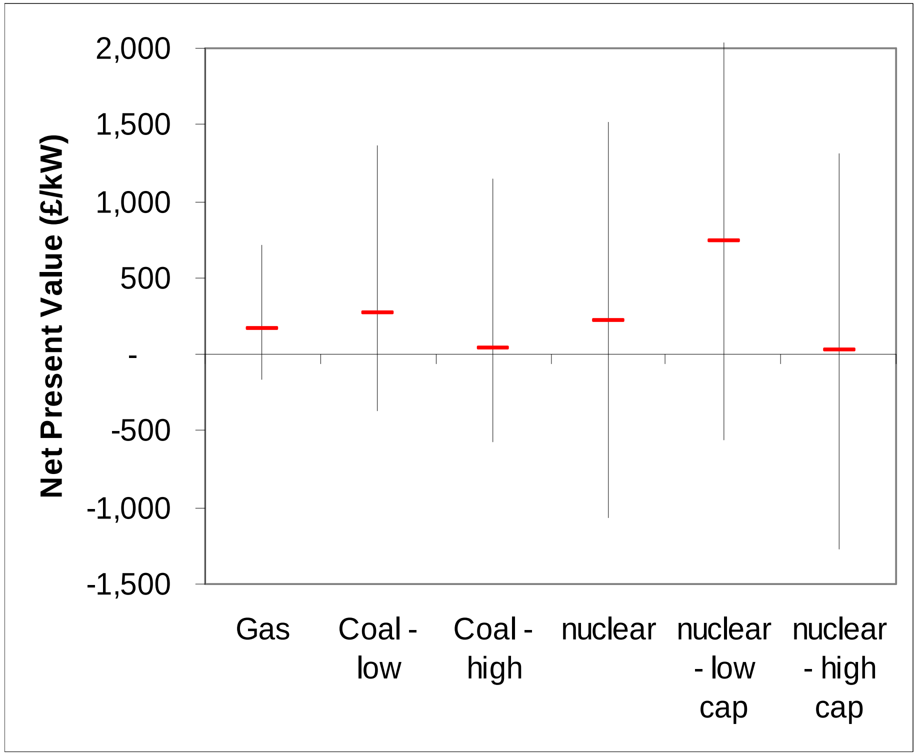
- A FiT removes all price risk

Price risks may outweigh cost differentials

Spread in levelised costs arising from different CO2 and fuel price scenarios (taken from UK Energy Review) **(Working Paper by Will Blyth 2006)**



Net present value representation of the spread of returns arising from different CO2 and fuel price scenarios (taken from UK Energy Review) **(Working Paper by Will Blyth for UKERC 2006)**



Where to place risk is a political choice not a market characteristic

Feed in tariffs *socialise* the price risk usually associated with a 'free' market. Prescribe price not volume

RPS schemes create (or expose) price risk for investors. Prescribe volume not price

What is the question?

- **What is the optimal model based on economic theory?**
- **What works in practice?**

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Policy *interactions*

- German wind farms often owned by closed mutual funds – local middle class
- Why? Partly because FiT offers secure returns
- Important result – few planning objections

- UK wind farms almost all owned by large utilities able to manage ROC price risks.
- Partial result - local people feel marginalised - LOTS of planning objections

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Grid access and grid upgrading

- Grid access is a major factor in renewables development
- Four things matter. They interact:
  1. Do renewables get priority access?
  2. Is upgrading needed and will it happen on time?
  3. Who pays for both access/priority and upgrades?
  4. Does smart management of demand play a role?

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Priority access supports renewables

- Germany, Denmark, etc have ‘priority access’ for renewables
- Priority access ensures that when renewable output is available it is used – saving fuel/CO_2
  (the whole point of renewables!)
- Gets renewables online *fast* – upgrades can follow if needed
- Helps avoid *unnecessary* upgrades – why size cables for *both* fossil and RE at once?

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Grid upgrading must be strategic

- Ultimately low carbon power will require new grid
  - Because the location of resources will be different
  - Because the flow of power may be in different directions
  - Because interconnection can help with intermittency
- Strategic investment allows timely connection
  - E.g. Irish All Island Grid Study and German Energy Agency ()DENA grid studies and Infrastructure Acceleration Planning Law

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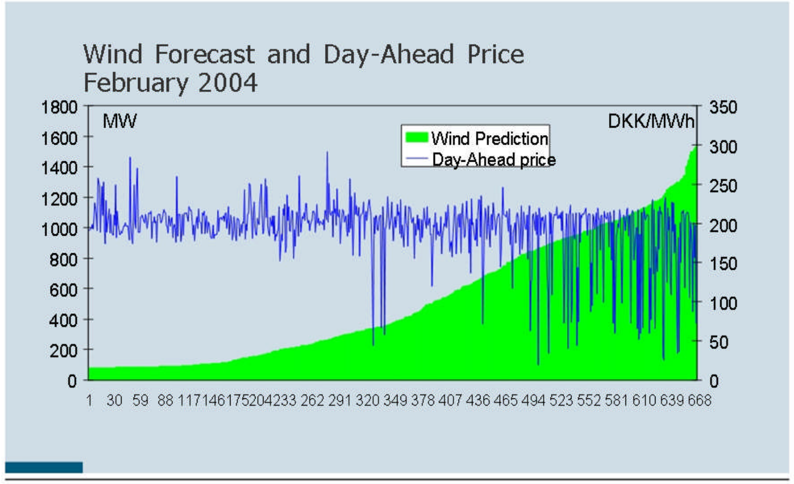
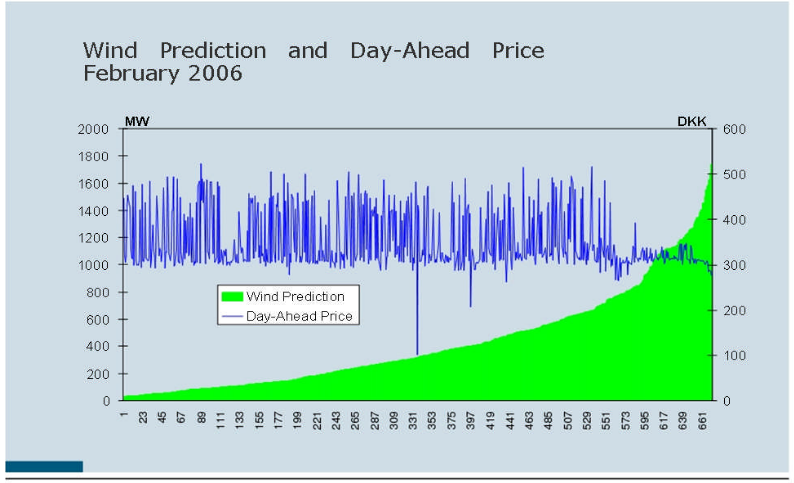
Demand response helps manage intermittency

E.g. Denmark CHP





- Electrical heating fitted to district heating plants
  - Exposure to real-time electricity prices
- Outcome
  - Reduced incidence of low electricity prices
  - Reduced gas usage
  - Increased renewable utilisation

(thanks to Phil Baker of Exeter University for this slide)

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UK policies are rather different…

- No priority access, congestion managed through BETTA & RO – overvalues upgrading over power flow management
- Upgrades are oversized – Regulation treats wind (30% LF) and coal (90% LF) as if they are the same
- No strategic investment, upgrading responds to requests to connect – creates the ‘queue’
- No demand side action

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Conclusions

- This is not a case of 'markets vs planning'. Markets *can* deliver. The first question is *deliver what?*
  - Current UK regulation designed to optimise use of existing assets. Market good at this
  - Success at this and lack of progress with RE are not coincidences. Market efficiency is pursued as a PRIMARY goal, RE is a 'bolt on'. The former can hinder the latter
- Building *new* assets – low carbon or otherwise – requires a *different* policy framework.
- Success in Germany etc isn't a great 'grand design' playing out – they just got lucky. But we can learn 'what works' from these global experiments in policy
  - *Pragmatic* combinations of planning and markets–for example *strategic* investment in wires and *competitive* development of generation
  - Fixed prices - In Britain scrapping the RO is not easy - BUT pragmatism favours fixed price support. We KNOW it works
  - Community benefit creates public acceptance
  - Priority grid access is key to cost effective grid utilisation/development
  - Demand side participation helps reduce costs of grid management

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Thank you

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