UNIVERSITY OF CAMBRIDGE | Electricity Policy Research Group

Policies for Renewables: the UK experience

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11th December 2009

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Plan

- Targets
- Potential
- Delivery
- NFFO
- Renewables Obligation
- UK vs Other Countries
- A sensible policy?

2008 Memo Numbers

- 177mt CO2 emissions from power stations
- 623mt CO2e, UK economy
- 0.6 Euro cent per KWh at 15 Euro / EUA for gas
- 1 therm of gas = 14.6 KWh electricity (at 50%)
- 25p per gas therm = 1.7 pence / KWh
- 2.7p/KWh for CCGT at 25p per gas therm
- Wholesale price of power c.£35/MWh
- 400 TWh, total electricity demand
- Total electricity expenditure: £ 30.7bn

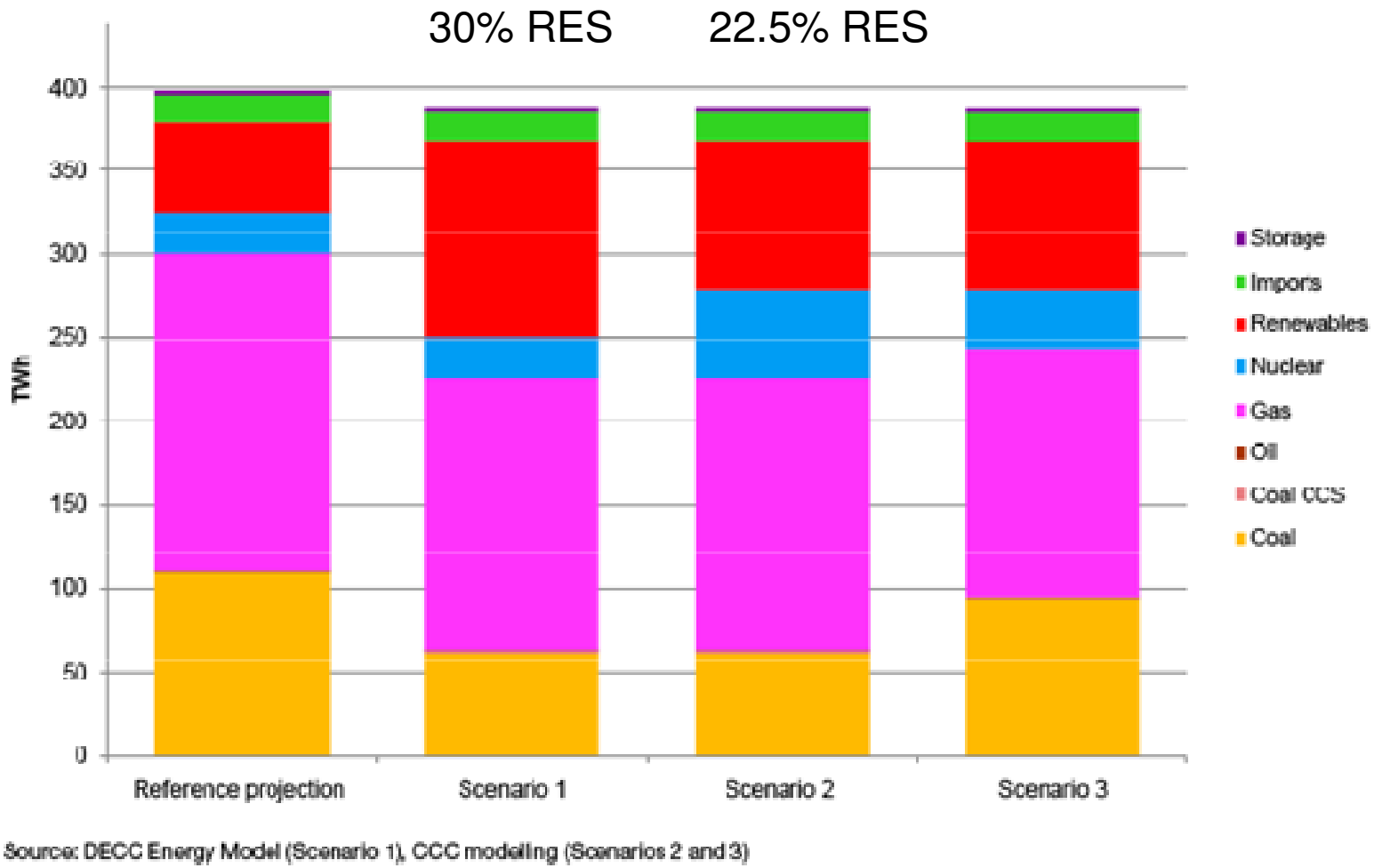
UK Renewables Targets

- UK committed to 15% target for renewables contribution to total final energy consumption in 2020 (2009/28/EC)

- Currently support regime only envisages 15.4% renewables in electricity by 2015-16.

- 2010 target of 10% for electricity from renewables (2001/77/EC)

Renewables in UK Electricity in 2020



Source: CCC (2008, p.203)

Potential for Renewables

Technology Category	Technology Detail	Annual Potential
Wind power	Onshore	50 TWh
	Offshore	100 TWh
Bioenergy	Biomass	41 TWh
Geothermal	Ground source heat pumps	8 TWh
Hydro	Large scale	5 TWh
	Small scale	10 TWh
PV	Retro fitted and Building integrated	>1 TWh
Marine	Wave energy	33 TWh
	Tidal barrage	50 TWh
	Tidal stream	18 TWh
Total		**~316 TWh**

Source: Jamasb et al., 2008.

Cost of Specific Technologies

- Onshore wind: 4.7 - 8.9 p / KWh
- Offshore wind: 6.1- 9 p / KWh
- Tidal Stream: 9 -18 p / KWh
- Severn Barrage: 10.4 - 31.7p / KWh
- Wave: 12 - 44 p / KWh
- Domestic PV 65p / KWh

- Sources: Jamasb et al., 2008, BWEA, DECC, Solar Century

Cost of Renewables to System

		Renewable scenarios		
	Conventional	Lower	Middle	Higher
New Generation Capacity (£ bn)				
Renewable Capacity	2.3	50.1	60.2	77.4
Non-Renewable Capacity	14.9	12.6	12.3	12.0
Total	*17.2*	*62.7*	*72.5*	*89.4*
Network (£ bn)				
Offshore wind connection	0.0	8.4	10.6	14.1
Onshore wind connection	0.1	1.0	1.2	1.4
Other reinforcement	0.8	0.8	0.8	0.8
Total	*0.9*	*10.2*	*12.6*	*16.3*
Total Grid Investment Costs (Generation+network, £bn)	**18.1**	**72.9**	**85.1**	**105.7**
Marginal Generation Cost (£/MWh)	35.9	25.0	22.6	18.9
Cost per MWh produced (£/MWh)				
Generation Costs (fixed and variable)	46.8	51.9	52.6	54.5
Balancing and intermittency	1.7	6.3	7.2	8.7
Grid expansion for renewables	0.1	3.5	4.1	5.2
Total cost including network (£/MWh)	**48.6**	**61.7**	**63.9**	**68.4**

Source: SKM (2008, p.8)

Renewables Delivery

	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008
Generation(GWh)											
Wind											
Onshore wind	9	391	945	960	1251	1276	1736	2501	3574	4491	5792
Offshore wind	0	0	1	5	5	10	199	403	651	783	1305
Solar photovolatics	0	0	1	2	3	3	4	8	11	14	17
Hydro:											
Small scale	91	166	214	210	204	150	283	444	478	534	568
Large scale	5080	4672	4871	3845	4584	2987	4561	4478	4115	4554	4600
Biofuels:											
Landfill gas	139	560	2188	2507	2679	3276	4004	4290	4424	4677	4757
Sewage sludge digestion	316	367	367	363	368	394	440	470	456	496	564
Municipal solid waste combustion	221	747	840	880	907	965	971	964	1083	1177	1226
Co-firing with fossil fuels					286	602	1022	2533	2528	1956	1613
Biomass	0	334	410	743	807	947	927	850	797	964	1155
Total Biofules and wastes	676	2008	3796	4493	5047	6174	7364	9107	9288	9270	9315
Total Renewables	5857	7237	9828	9516	11093	10600	14147	16940	18136	19646	21597
Total Generation	319701	334042	377069	384778	387506	398209	393867	398313	398823	397044	389649
%											
Total Renewables	1.83%	2.17%	2.61%	2.47%	2.86%	2.66%	3.59%	4.25%	4.55%	4.95%	5.54%
of which Wind	0.00%	0.12%	0.25%	0.25%	0.32%	0.32%	0.49%	0.73%	1.06%	1.33%	1.82%
Hydro	1.62%	1.45%	1.35%	1.05%	1.24%	0.79%	1.23%	1.24%	1.15%	1.28%	1.33%
Biofuels	0.21%	0.60%	1.01%	1.17%	1.30%	1.55%	1.87%	2.29%	2.33%	2.33%	2.39%

Source: DUKES, 2009.

Cost of main support schemes

Table 6: Financial support for renewables in the UK (nominal)

	£m		
	**R&D	RO	NFFO
1990-1991	14.7		6.1
1991-1992	17.1		11.7
1992-1993	16.1		28.9
1993-1994	15.2		68.1
1994-1995	9.1		96.4
1995-1996	9.1		94.5
1996-1997	6.2		112.8
1997-1998	4.3		126.5
1998-1999	3.3		127.0
1999-2000	4.6		56.4
2000-2001	4.4		64.9
2001-2002	6.1		54.7
2002-2003	10.5	282.0	-
2003-2004	11.6	415.8	-
2004-2005	19.7	497.9	-
2005-2007	36.6	583.0	-
2006-2007	49.5	719.0	-
2007-2008	41.6	876.4	-

Sources:

** UK government renewable R&D budget data from IEA renewable R&D database, http://wds.iea.org/WDS/ReportFolders/ReportFolders.aspx; Mitchell and Connor (2004, p.1943).

Note: RO does include revenue recycling.

NFFO

- Originally aimed at subsidising nuclear
- Auctions for renewable generation 1990-99
- 5 rounds in E&W, 3 in Scotland, 2 in NI
- Levy rate 0.9% in 1999 in E&W
- Different technology bands
- Bids for energy indexed to RPI for 15 years
- 5 years to begin to operate
- Last contract expires 2019

NFFO

- Price of onshore wind fell from 10p/KWh to 2.88p/KWh between NFFO-1 and -5.
- Some technologies successfully supported:
  - Landfill gas 208/308 contracts with 458 MW/660 MW operational in 2008.
- Some much less successful:
  - Onshore wind 75/302 contracts with 391 MW / 2659 MW operational in 2008 (0/33 in NFFO-5).
- Overall: 477/933 awarded contracts were built, representing 1202 MW / 3639 MW.

NFFO

- Problem of under-bidding
  - due to pent-up demand Mitchell and Connor, 04
- Lack of up-front commitment
- Lack of preparation and consultation
- Difficulty of changing plans

- All these issues could have been solved.

RO Scheme

- From April 2002
- Tradable Green Certificate (TGC) Scheme
- Annual targets for renewable generation for suppliers
- Must supply specified quantity of credits or face buyout payment
- Renewable generators receive price of RO certificate *plus* their share of buyout revenue.

RO Scheme

- 2007-08 buyout price was £34.30/MWh
- Delivery rate only 64%
- Implies buyout price binds
- Renewable generator therefore receives:
  - £34.30 plus £18.65 (i.e. an additional 36/64 times £34.30) = £52.95 / MWh
  - Plus the wholesale cost of power
  - Total buyout revenue £316m (1% of total)
- Government gains via NFFO fund (£200m?)

RO Scheme Performance

	Target renewable share in GB	% Delivery in UK	Nominal Buyout Price £/MWh	Total Cost £m
2002-03	3.0	59%	30.00	282.0
2003-04	4.3	56%	30.51	415.8
2004-05	4.9	69%	31.59	497.9
2005-06	5.5	76%	32.33	583.0
2006-07	6.7	68%	33.24	719.0
2007-08	7.9	64%	34.30	876.4
2008-09	9.1		35.36	1036.2
2009-10	9.7		37.19	
2010-11	10.4		+ inflation thereafter	
2011-12	11.4			
2012-13	12.4			
2013-14	13.4			
2014-15	14.4			
2015-16	15.4			Estimated: ~1753m (2008-09 prices) assuming no demand growth

Note: From 2016, the share is fixed at 15.4% until 2027.
ROC scheme cost is total cost including revenue recycling.

Rebanding of ROCs 1 April 09

Generation type	ROCs per MegaWatt hour
Landfill Gas	0.25
Sewage gas Co-firing of biomass	0.5
Onshore wind Hydro Co-firing of energy crops Energy from waste with CHP Co-firing of biomass with CHP Geopressure Standard gasification Standard pyrolysis	1
Offshore wind Biomass Co-firing of energy crops with CHP	1.5
Wave Tidal stream Advanced gasification Advanced pyrolysis Anaerobic digestion Energy crops Biomass with CHP Energy crops with CHP Solar photovoltaic Geothermal Tidal impoundment – tidal barrage Tidal impoundment – tidal lagoon	2

Offshore wind re-banded to 2 for 2009-10 and 1.75 for 2010-11.

Assessment

- RO scheme unnecessarily expensive
- Unsolved problem is on-shore wind
- One analysis of 51 proposals (Toke, 2005a):
  - If planning officer objects than almost always refused.
  - If CPRE object then local Parish council almost always rejects.
  - Wind Prospect achieve better local engagement.

Assessment

- Local ownership of energy under-exploited (Szarka, 06)
- Issue of willingness to pay for off-shoring (Bergmann et al, 08)
- Planning reform only helps larger projects (>50 MW onshore (only 8, at the moment))
- Zoning (experience of Wales in 2005, Cowell, 07)
- Little evidence of transmission constraints
  - GB queue 13.2 GW in 2008
  - Ofgem only found 450 MW could be speeded up

Lessons from elsewhere

- FITs vs TGCs
- UK RO scheme very generous (Neuhoff and Butler, 08)
- NZ, Australia and Sweden successful (Kelly, 07;IEA, 06)
- Risk argument for FITs weak in UK
- No evidence FITs will solve UK planning issue
- UK policy not less stable than elsewhere

Four Windy EU Countries

	1000 sq miles Land /per million population 2008/9	% Onshore Wind owned by utilities/ corporates	% Owned by Farmers	% Owned by Cooperatives	Wind capacity MW end 2008
UK	1.5	98	1	0.5	3288
Germany	1.7	55	35	10	23903
Spain	4.3	99+	<0.5	0	16740
Denmark	2.9	12	63	25	3160

Source:Wikipedia; www.thewindpower.net/23-countries-capacities.php; Toke (2005b).

A sensible UK renewables policy?

- Not about jobs (only 38,000 in *German* Wind)
- Need to distinguish stage of maturity carefully:
  - Co-firing, landfill gas, waste left to carbon price
  - Emerging technologies (wave, tidal stream) need RD&D competitions
  - Offshore wind needs CFD type auctions (Ofgem, 06)
- RO mechanism clearly not delivering
  - Re-banding and re-cycling cover up problems
- Local ownership needed

Current Decarbonisation policies

Scheme	Description	Cost	Paid by
Renewables Obligation	Electricity suppliers must buy a proportion of their sales from renewable generators, or pay a buy-out charge	£874 million in 2007/8 [a]	Electricity consumers
EU Emissions Trading Scheme	Renewable generators indirectly benefit from the increase in electricity prices as other companies pass the cost of emissions permits into the price of power	Perhaps £300 million in 2008, given current permit prices [b]	Electricity consumers
Carbon Emissions Reduction Target	Energy companies must install low-carbon items in homes, which could include microgeneration from 2008	Total cost will be £1.5 billion over 3 years—most spent on energy efficiency	Gas and electricity consumers
Renewable Transport Fuel Obligation	Fuel suppliers must supply a proportion of biofuels or pay a buy-out charge	No more than £200 million in 2008/9 [c]	Consumers
Climate Change Levy	Electricity suppliers need not pay this tax (passed on to non-domestic consumers) on electricity from renewable generators	£68 million to UK generators; £30 million to generators abroad in 2007/8	Taxpayers, via reduced revenues
Lower fuel duty for biofuels	The rate of fuel duty is 20 pence per litre below that for petrol and diesel	£100 million in 2007	Taxpayers, via reduced revenues
Environmental Transformation Fund	Grants for technology development and deployment, including subsidies for installing renewable generation, planting energy crops and developing biomass infrastructure.	£400 million over three years from 2008/9	Taxpayers
Research Councils	Grants for basic science research	£30 million in 2007/8	Taxpayers
Energy Technologies Institute	Grants to accelerate development (after the basic science is known) of renewables and other energy technologies	Allocation (and eventual size) of budget not yet announced.	Taxpayers and sponsoring companies

Source: http://www.publications.parliament.uk/pa/ld200708/ldselect/ldeconaf/195/19509.htm#a53

Total renewables support: c.£2.5bn in 2008/9

Plus: c.£2bn more for EUETS

Plus: support for: CCS via levy

Total current cost: £4.5bn

Conclusions

- EU policy towards carbon/renewables flawed – UK cannot deliver both.
- However last EU Renewables Directive never enforced!
- Industrial policy and renewables do not mix.
- Both NFFO and RO have lessons.
- Quality of analysis poor.
- Local GIS mapping of renewable potentials has merit.
- Carbon reduction must be main aim.

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