



Renewable Energy in the United Kingdom

2002 to 2013

Performance, Costs, Warnings

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REF

RENEWABLE ENERGY FOUNDATION

- Energy policy think tank
- UK registered charity (since 2004)
- No political affiliation
- Supported by private donations and research contracts
- Publishes databases of all subsidised UK renewable installations

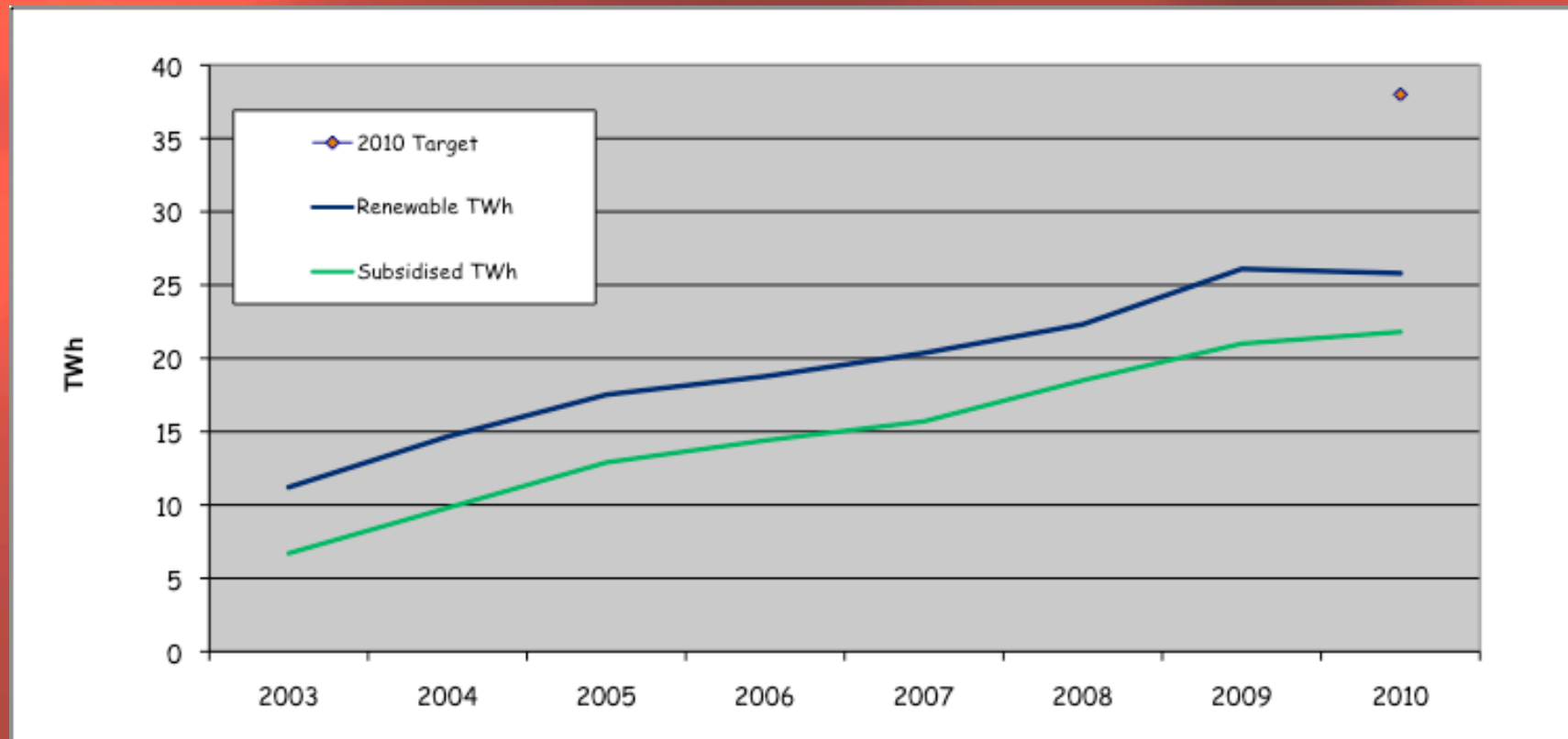
www.ref.org.uk

2002 Renewable Electricity Target for 2010

- 10% of electricity to be renewable
 - Instrument: *Renewables Obligation* (RO)
 - Subsidy = £50 / MWh
 - In addition to wholesale price (£25 / MWh)
- Subsidy level set by least economic technologies / sites
 - ➔ Major over-support for lower cost technologies / sites
- Rising wholesale price (↑ £50 / MWh) created hyperprofits and overheated the renewables sector
 - ➔ Poor site choice; Bad PR; Rent seeking...

2010 Target Was Missed

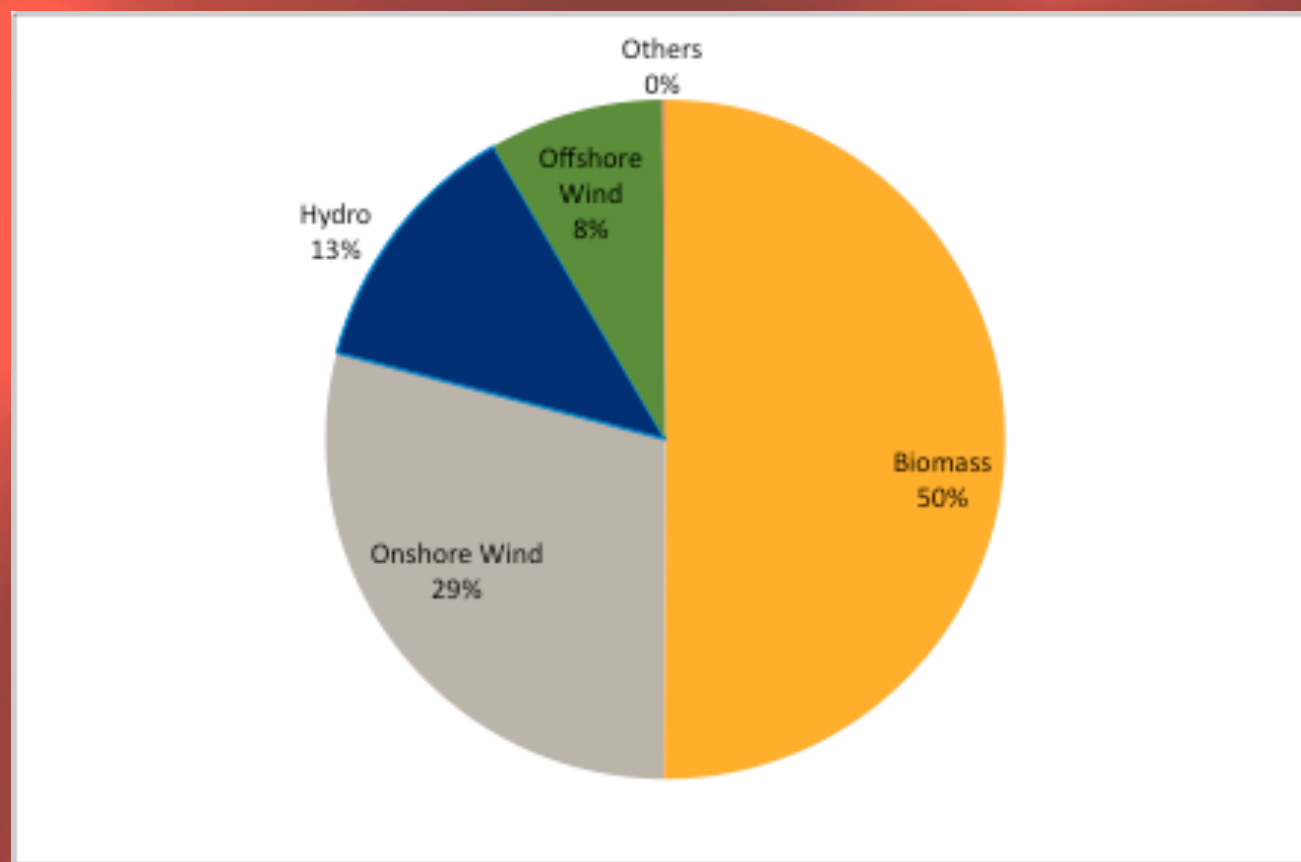
- 6.5% of UK electricity consumption was renewable in 2010
- Total subsidy cost: £5 billion (2002–2010)
- Annual cost: £1.1 billion (in 2010)



Source: DECC, Ofgem data, REF estimates. Chart by REF.

RO Output (Apr. 2002–Mar. 2012): 149.3 TWhs

50% of all RO MWhs were from Biomass



Source: REF Calculations from Ofgem Data

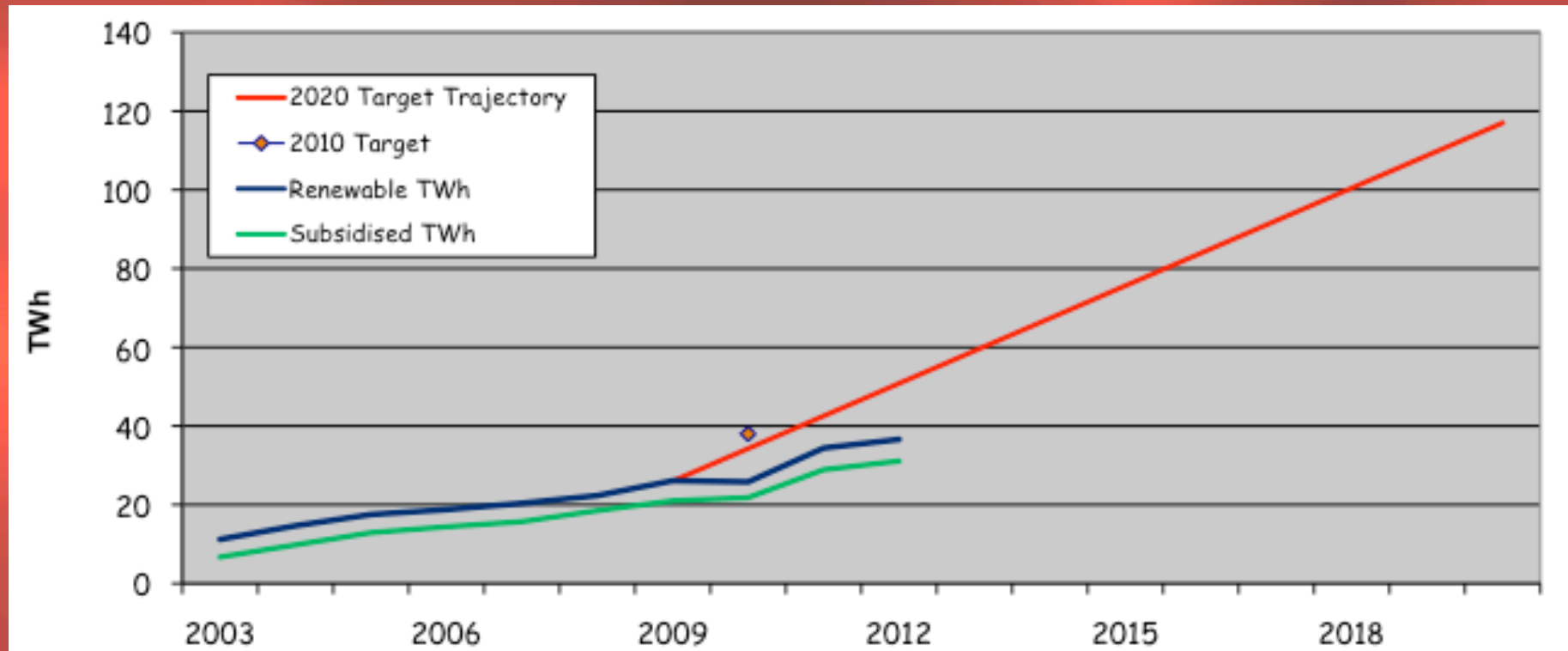
European Union Renewables Directive (2009)

- 20% of EU 27 Final Energy Consumption (FEC) in 2020 to be from renewable sources
- UK burden share: 15% of FEC
 - Largest increase of any major state
 - > 25% of EU-wide costs fall on the UK
- UK FEC = 150 mtoe \times 0.15 = 22.5 mtoe = 260 TWh
- Electricity target 120 TWh (30% of UK electricity)
- 140 TWh from transport fuel (10%) and heat (12%)

Electricity Policy Instruments

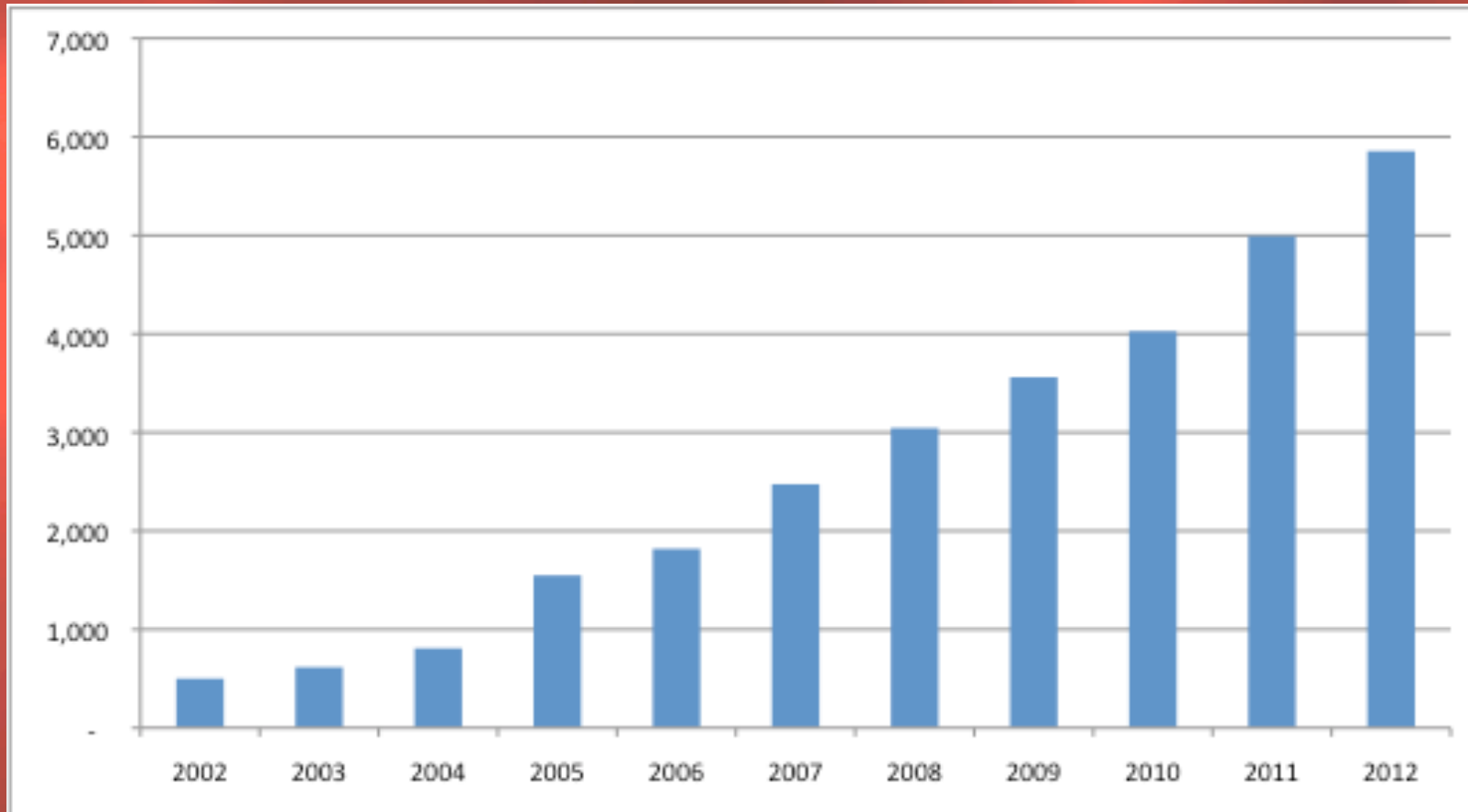
1. Renewables Obligation (RO).
 - Closes to new registrants in 2017
2. Feed-in Tariff (FiTs)
 - For generators up to 5 MW
3. Feed-in Tariffs with Contracts for Difference (FiTs CfDs)
 - Replaces RO from 2017
4. Carbon Price Floor.
 - Tax on carbon fuels for electricity. Increases wholesale price (in effect an extra subsidy for renewables)

Can the 2020 Electricity Target be Met?



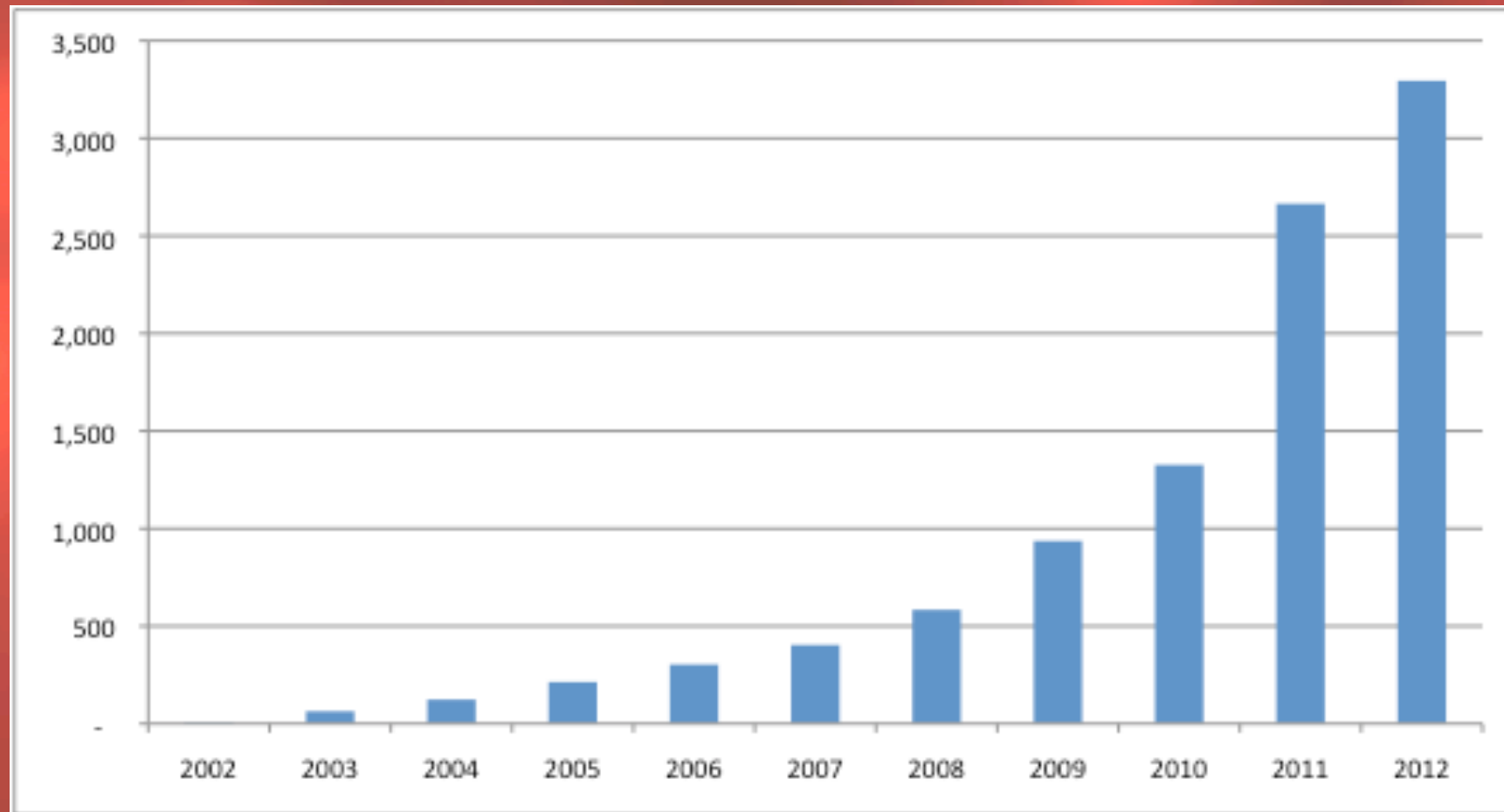
Source: DECC, Ofgem data, REF estimates. Chart by REF.

Onshore Wind Capacity Build (Cumulative MW)



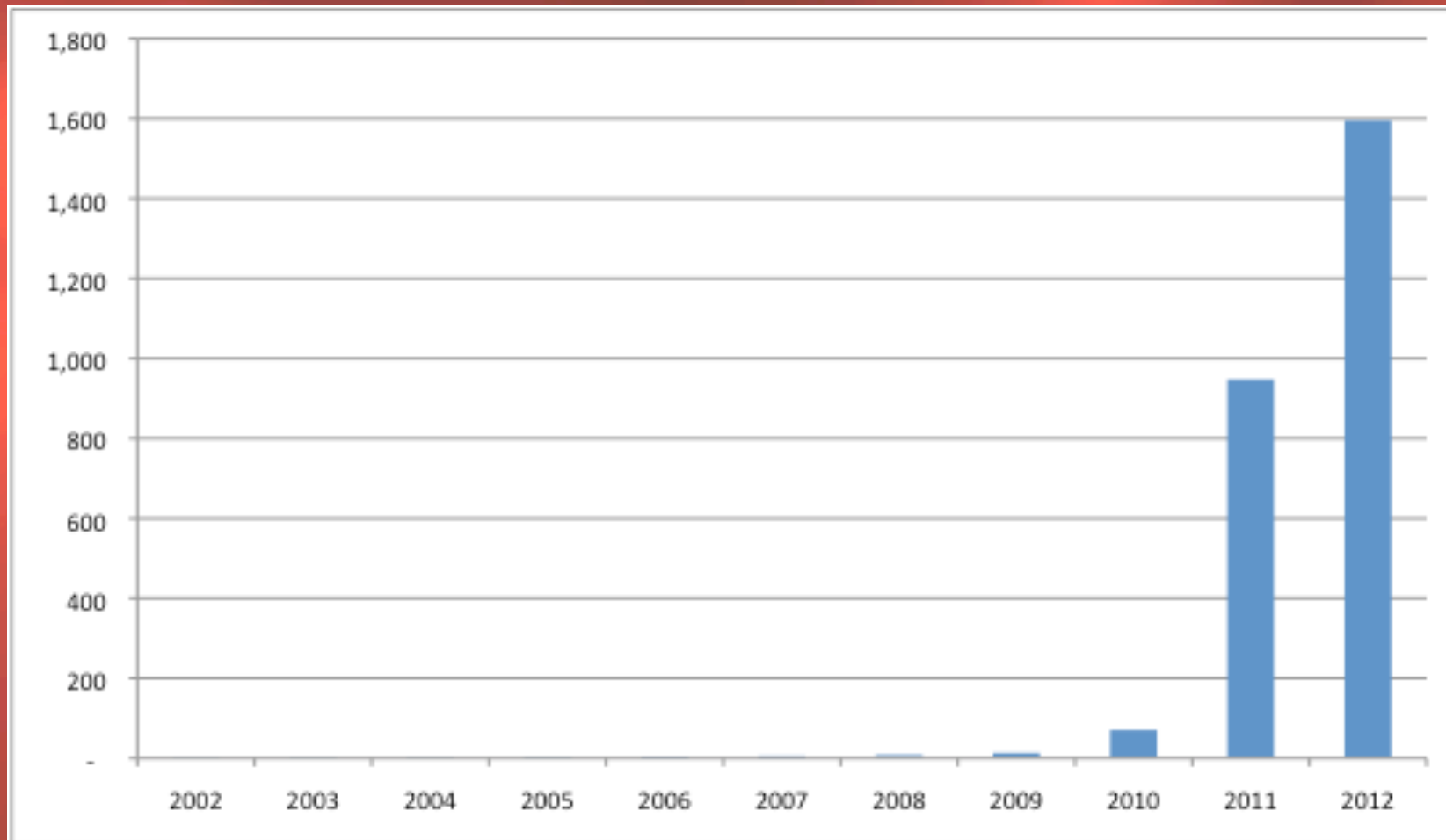
Source: DECC, Ofgem data. Chart by REF.

Offshore Wind Capacity Build (Cumulative MW)



Source: DECC, Ofgem data. Chart by REF.

Solar PV Capacity Build (Cumulative MW)



Source: DECC, Ofgem data. Chart by REF.

Capacity & Performance in 2012

<i>Technology</i>	<i>Sites</i>	<i>Installed Capacity (GW)</i>	<i>2012 Generation (TWh)</i>	<i>2012 Load Factor</i>	<i>Share of UK Renewable Electricity</i>
All	376,364	16.3	38.4	28.8%	100%
Wind	5,179	9.3	19.4	22.7%	51%
Onshore	5,157	5.9	11.9	22.5%	31%
Offshore	22	3.3	7.5	30.6%	20%
Biomass	716	2.8	12	48.9%	31%
Hydro	619	2.3	4.5	41.8%	12%
Solar	369,829	1.6	1.4	7.5%	4%
Waste	17	0.4	1	30.4%	3%

Source: REF Calculations from Ofgem / DECC / Elexon Data.

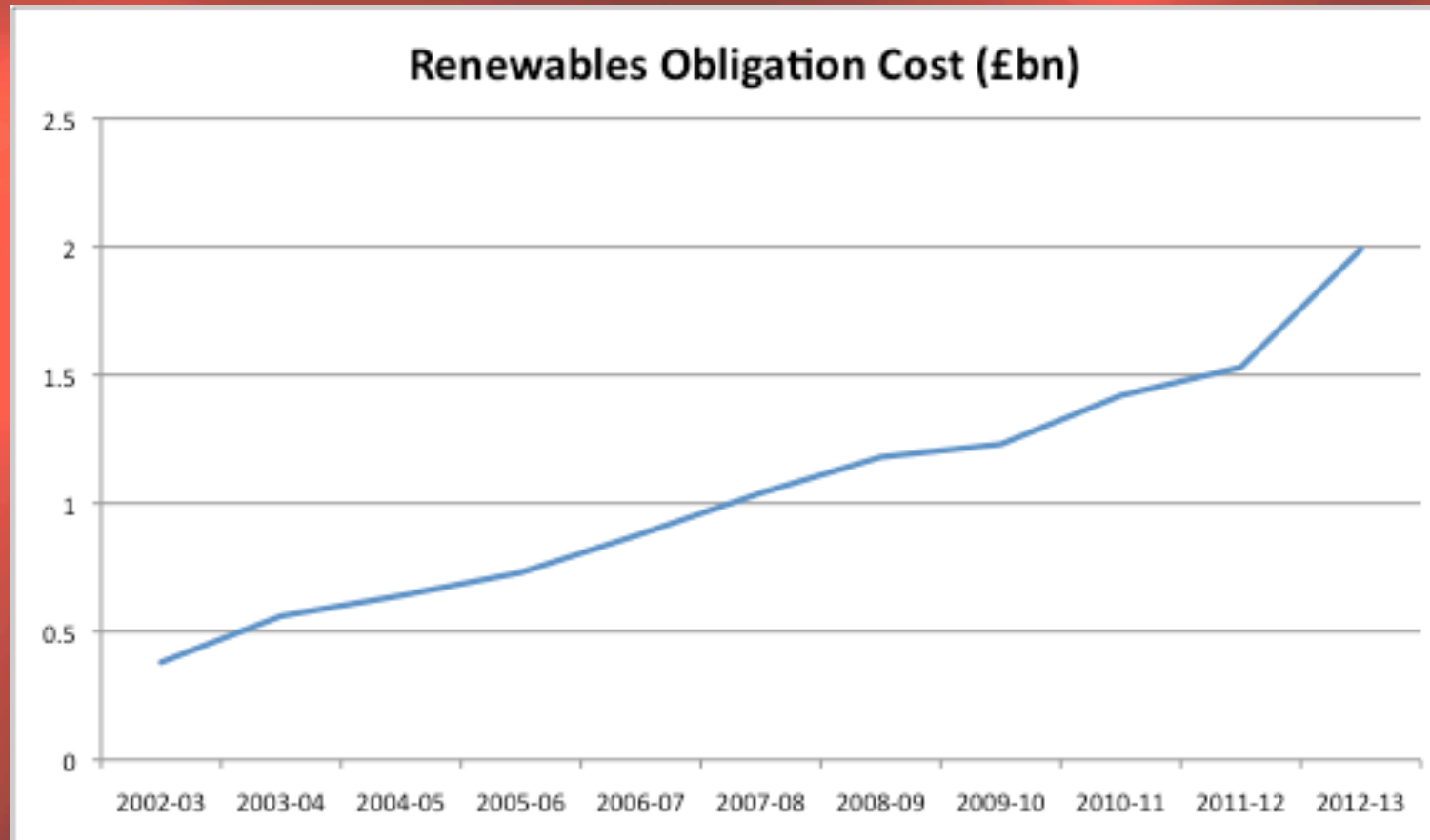
RO, Unsubsidised, and FiT (2012)

<i>Support</i>	<i>Sites</i>	<i>Installed Capacity (GW)</i>	<i>2012 Generation (TWh)</i>	<i>2012 Load Factor</i>	<i>Share of UK Renewable Electricity (%)</i>
RO	1,664	12.6	33.3	32.2%	87%
Unsubsidized	36	1.9	3.1	29.9%	8%
FiT	374,664	1.8	1.9	21.9%	5%
<i>Photovoltaic</i>	369,518	1.6	1.4	8.8%	4%
<i>Onshore wind</i>	4,716	0.15	0.3	22.9%	0.7%
<i>Anaerobic Digestion</i>	46	0.05	0.2	52.6%	0.4%
<i>Hydro</i>	384	0.04	0.1	42.1%	0.3%

Source: REF Calculations from Ofgem / DECC / Elexon Data

Total RO Costs to 2013: £11.6 billion

Annual Cost in 2012: £2 billion

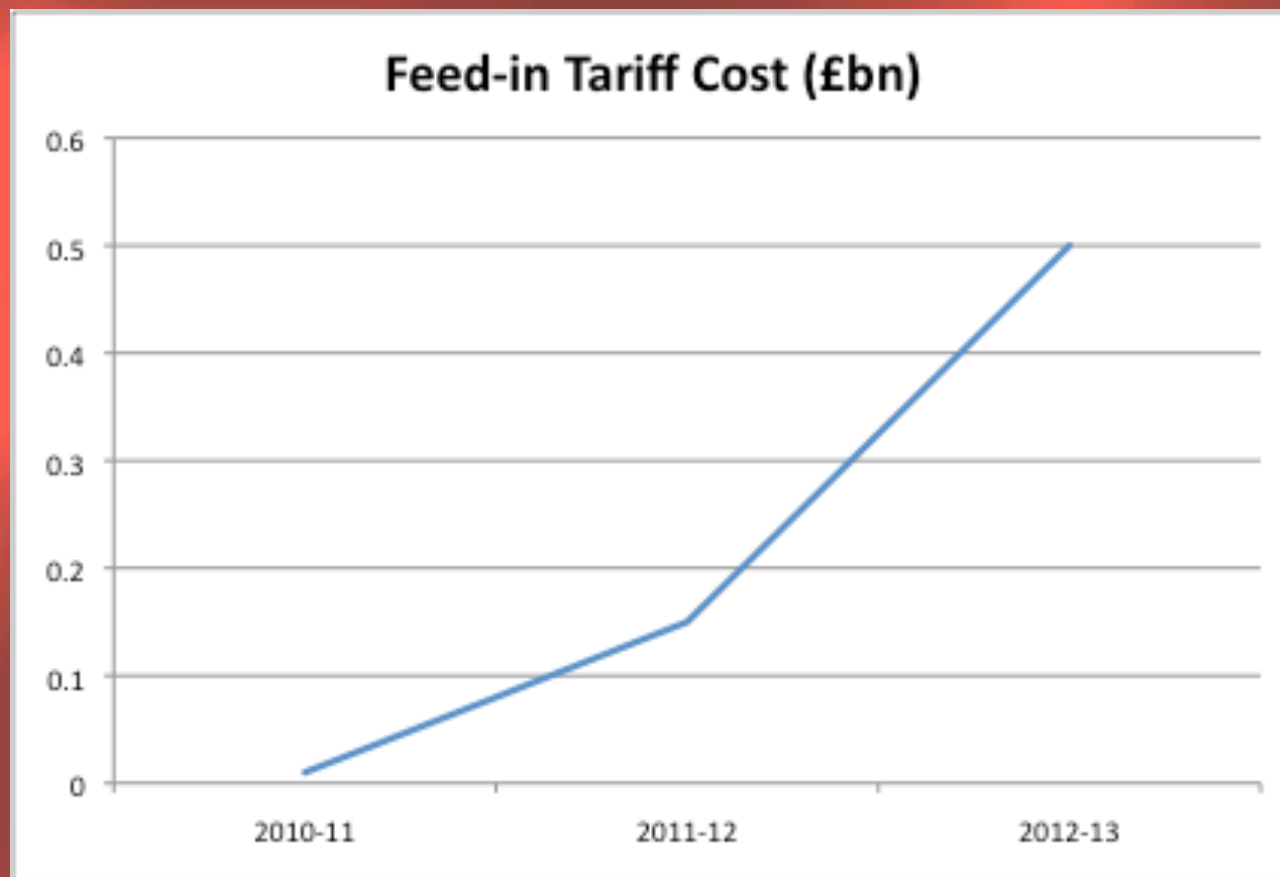


Real 2012 / 13 prices

RO years run from April to March. Source: DECC. Chart by REF.

Total FiT Costs 2010–2013: £660m

Annual Cost in 2012: £500m

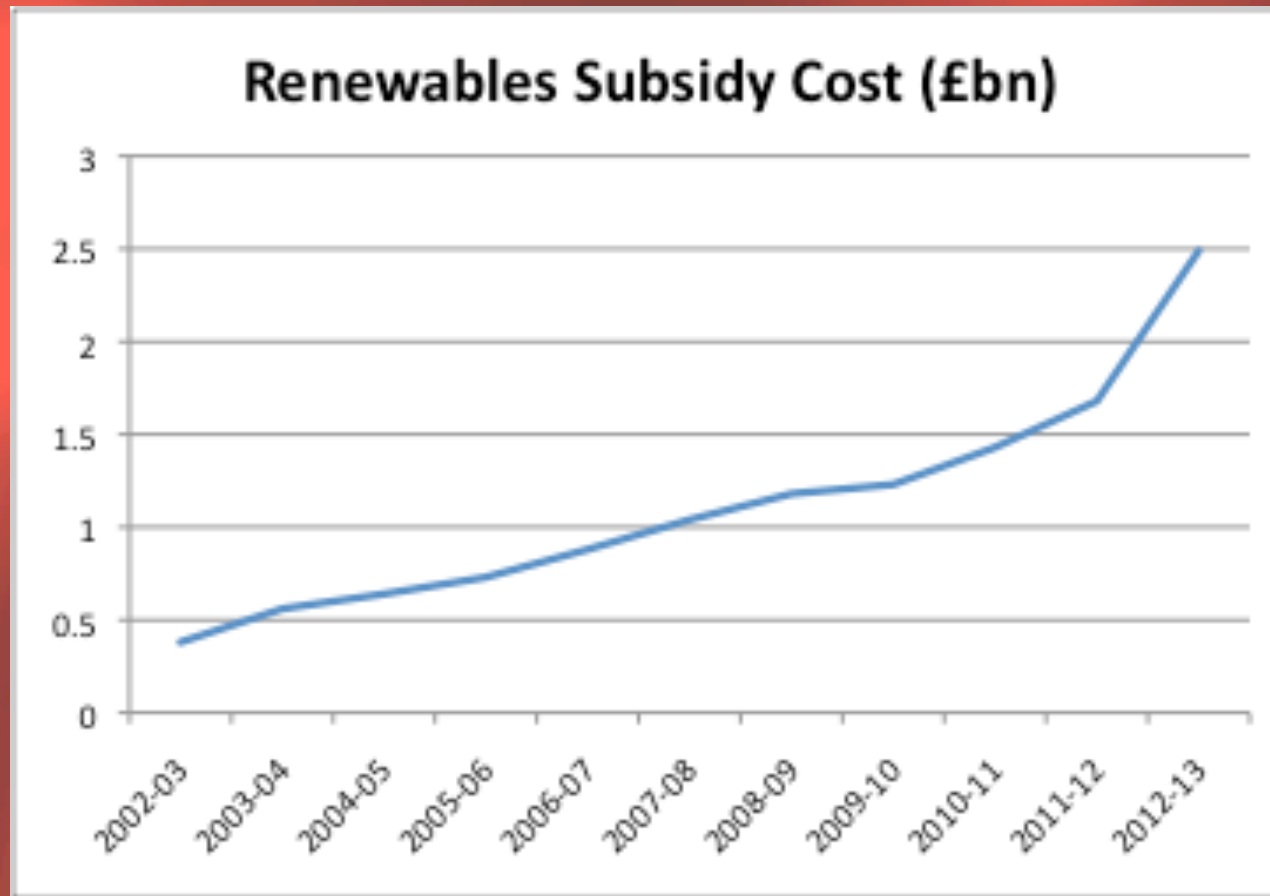


Real 2012/13 prices. Source: DECC. Chart by REF.

RO + FiT Costs

Cumulative: 2002–2013: £12.2bn

Annual in 2012/13: £2.5bn and rising....



Source: DECC. Chart by REF. (Real 2012 / 13 prices.)

RO and FiT Costs Compared

- FiT accounted for 5.4% of subsidised renewable electricity in 2012
 - 1.9 TWh / 35.3 TWh
- FiT accounted for 20% of renewables subsidy cost
 - £500m / £2.5bn
- Average subsidy costs:

FiT: £260 per MWh

RO: £58 per MWh

Can the Consumer Afford the Targets?

Three Areas of Doubt

1. Cumulative subsidy cost of EU 2020 renewables target is extremely high
 - ~£130bn (2002–2030)
2. System costs of renewables (wind and solar) are very likely to be greater than government admits
 - Wind integration cost: £60 / MWh (Source: Gibson 2011)
3. Economic life of key plant (wind power) appears to be much shorter than expected
 - Levelised costs are higher than anticipated
 - Capital refreshment cycle is short, so cost of maintaining target levels of renewable energy is higher than predicted

Renewable Electricity Subsidies

- Subsidy cost: £8bn per year in 2020
- Cumulative subsidy Cost 2002–2030: ca £130bn

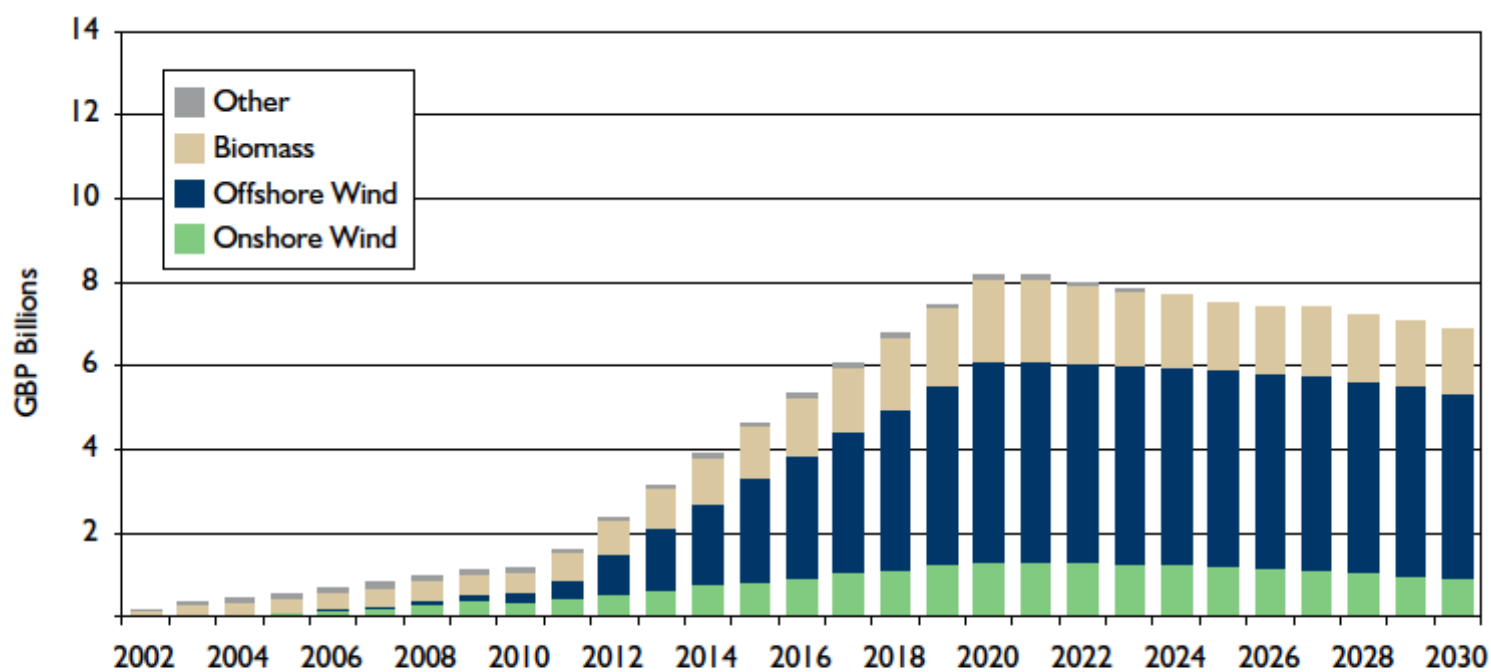


Figure 4: Projected Growth in Renewable Electricity Subsidy Costs to 2030.

Source: REF Calculations.

Source: REF, *Energy Policy & Consumer Hardship* (London 2011)

UK Govt. Relaxed about Policy Impacts

- “[...] taken together, the Government’s policies mean that household bills will be on average 11%, or £166, lower in 2020”
 - Optimistically assumes that energy efficiency will offset policy cost through conservation
- “For most businesses, direct energy costs are a relatively small proportion of total costs. [...] around 2.5% of total costs for UK manufacturing as a whole.”
 - Ignores embedded energy costs in labour and capital

Source: DECC, *Estimated Impacts* (2013)

Policy Impacts on Electricity Price in 2020

DECC Models

- Domestic Households
 - Low fossil price scenario: + £54/MWh (+ 44%)
 - High fossil price scenario: + £45/MWh (+ 26%)
- Medium Sized Businesses
 - Low fossil price scenario: + £48/MWh (+74%)
 - High fossil price scenario: + £37/MWh (+33%)
- Even in DECC's High Fossil Price scenario prices rise by ca. 30% due to climate and other policies

2. Integration Costs (+ Subsidy)

- Total cost in 2020: £13bn per year in 2020
- Total Cost 2002–2030: ca. £175bn

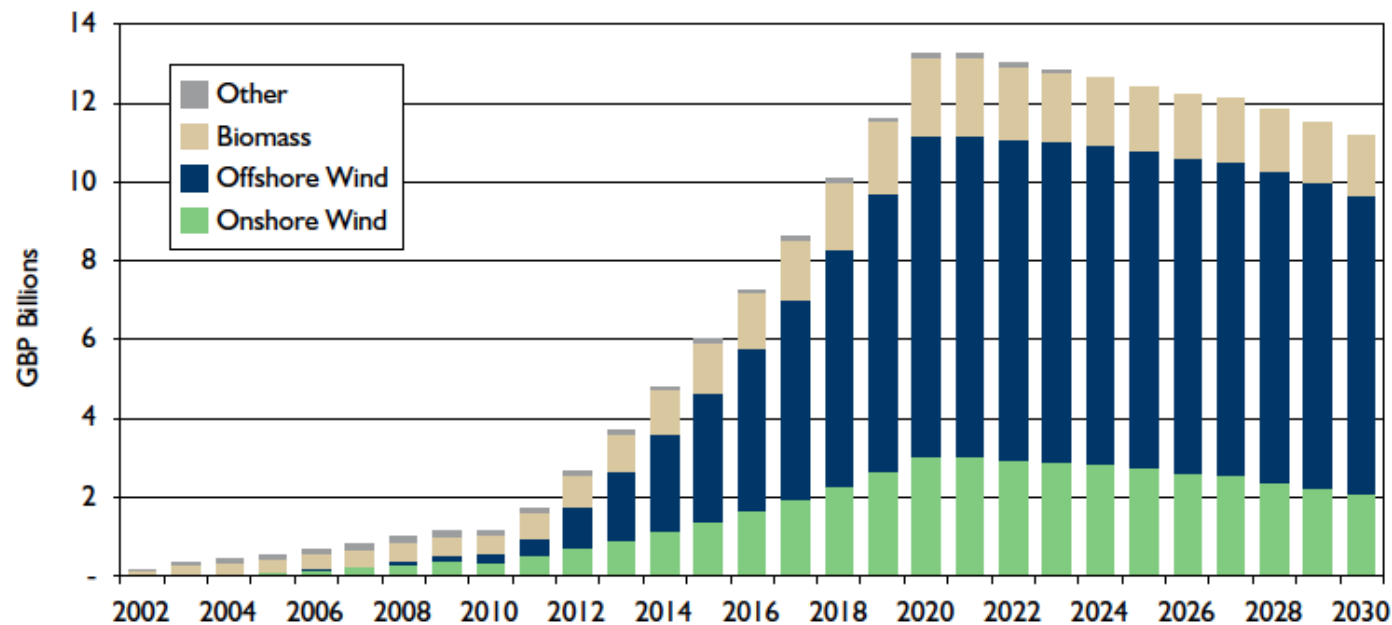


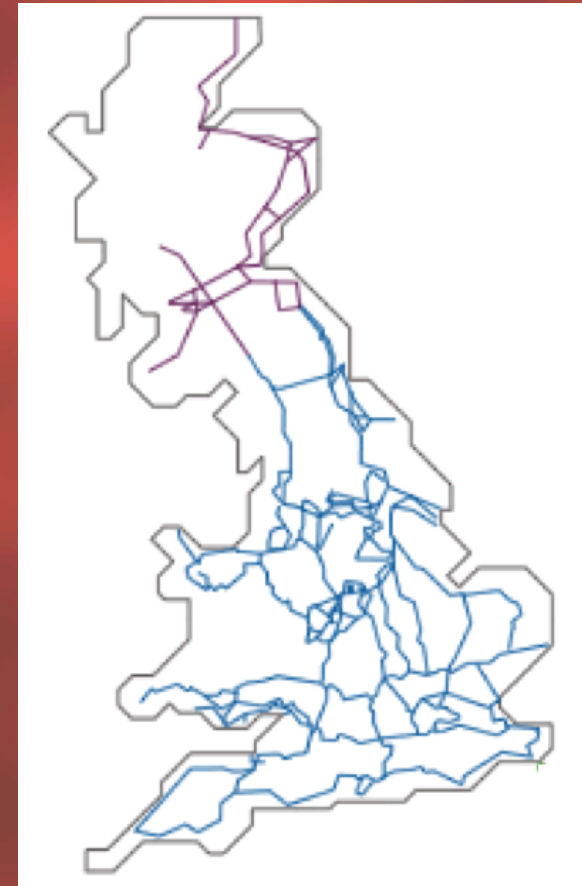
Figure 6: Projected Growth in Total Cost of Renewable Electricity Programme
(Subsidy + Ancillary Costs).

Source: REF Calculations, Gibson 2011.

Source: REF, *Energy Policy & Consumer Hardship* (London 2011)

2. Integration Problems: Constraint Payments to Wind Power

- Total 2010 to present day:
£41.6m
 - £22.7m in 2013 alone
- Average price to reduce generation: **£145/MWh**
 - Three times lost income
- But constraining wind off the system may be cheaper than building more network
 - Colin Gibson, Former National Grid Power Networks Director



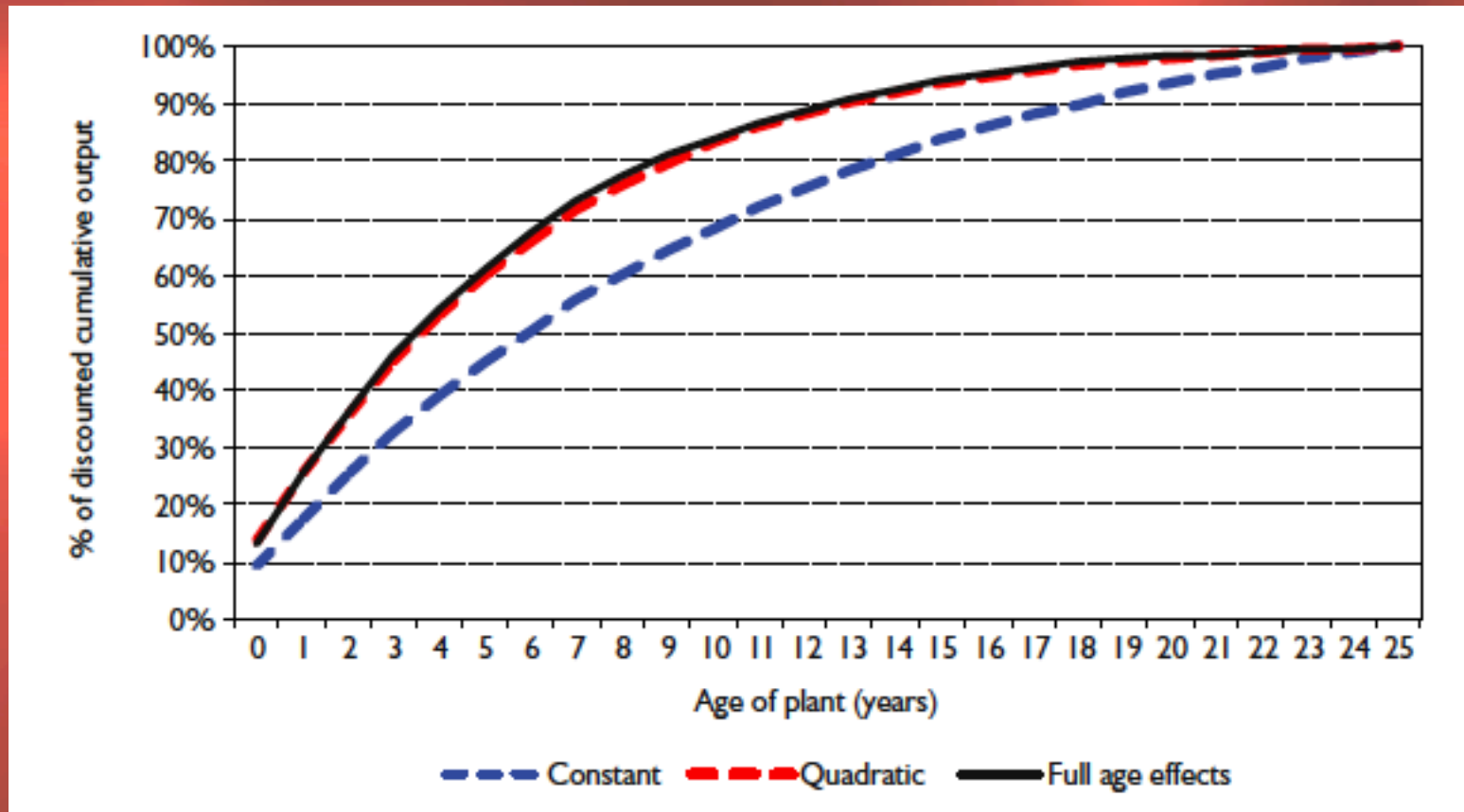
The UK HV Network
Source: National Grid

3. Economic Lifetime of Wind Turbines

- Gordon Hughes, *The Performance of Wind Farms in the United Kingdom and Denmark* (REF: London, 2012).
- The normalised load factor for UK onshore wind farms declines from a peak of about 24% at age 1 year to 15% at age 10 years and 11% at age 15 years.



Load Factor Decline and Discounted Cumulative Output



Source: Hughes, *The Performance of Wind Farms in the UK and Denmark* (2012)

Conclusion: Acute & Cumulative Costs

- Policy costs are:
 - *Acute and Chronic*: £14bn a year up 2040
 - *Cumulatively vast*: £175bn up to 2030
- Higher energy costs will be embedded in capital stocks and in cost of supporting labour
 - All “Non-energy” business input costs will rise
- UK now embarking on infrastructure renewal
 - Higher costs will be embedded in major capital stocks, increasing cost of use for decades to come

But Acute Costs are Now a Political Issue...

- Ed Miliband, Labour party leader, has promised to freeze electricity prices for two years after the 2015 election
- Conventional and renewables investment now uncertain
- Reports suggest £4.5bn of cost (ca. 50% due to renewables) that cannot be passed through to consumers

