



Biomass for Electricity:

Government Expectations; Commercial Intentions; Public Perceptions

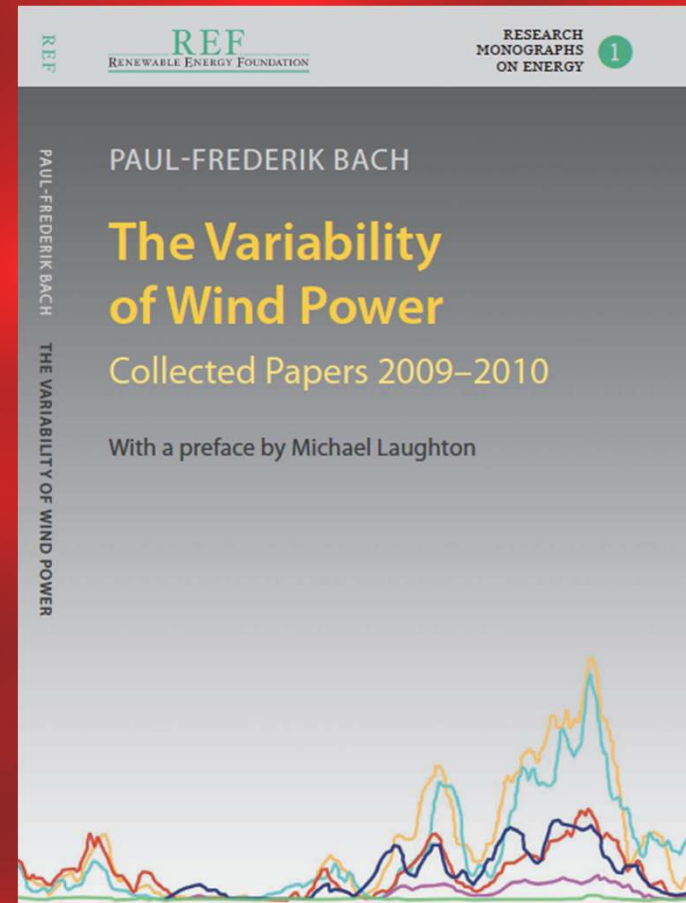
John Constable

Biofuels, Science & Society
Durham University

28 March 2012

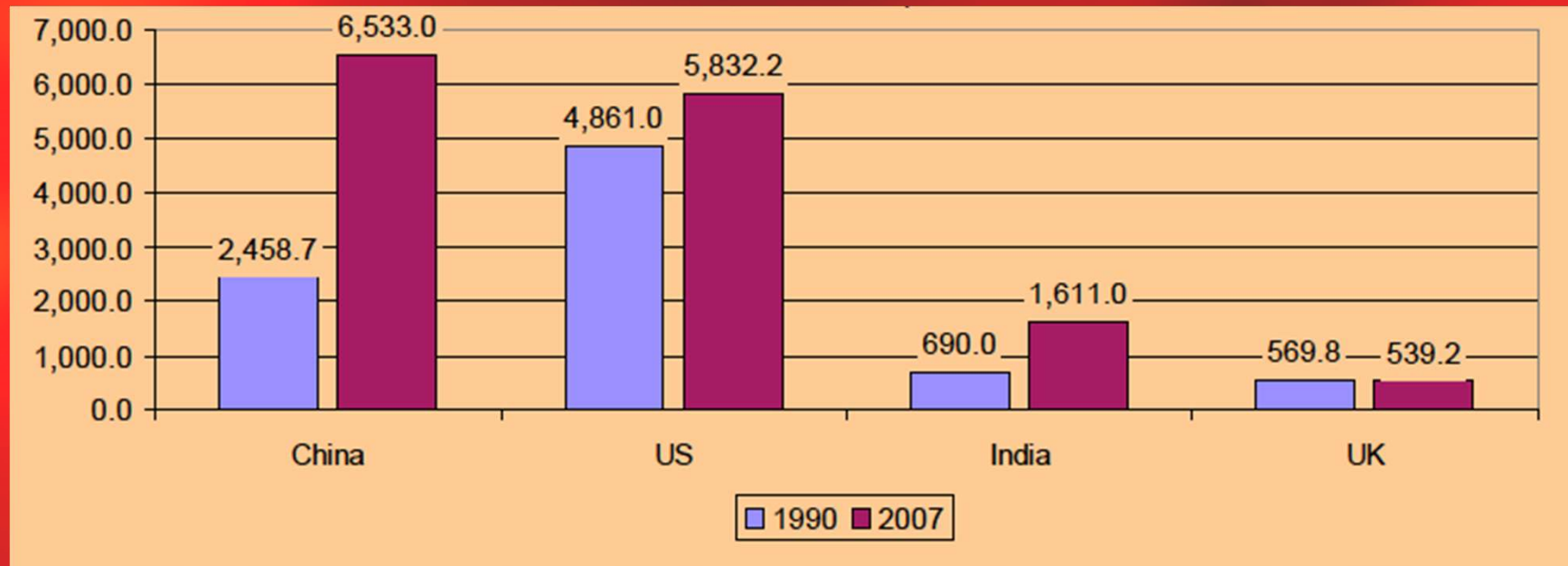
Renewable Energy Foundation

- UK registered charity
- No political affiliation
- Data and analysis on the energy sector
- Free databases of all UK renewable installations
- www.ref.org.uk



Emissions in the Developing World

Emissions 1990 and 2007 (Millions of tonnes)

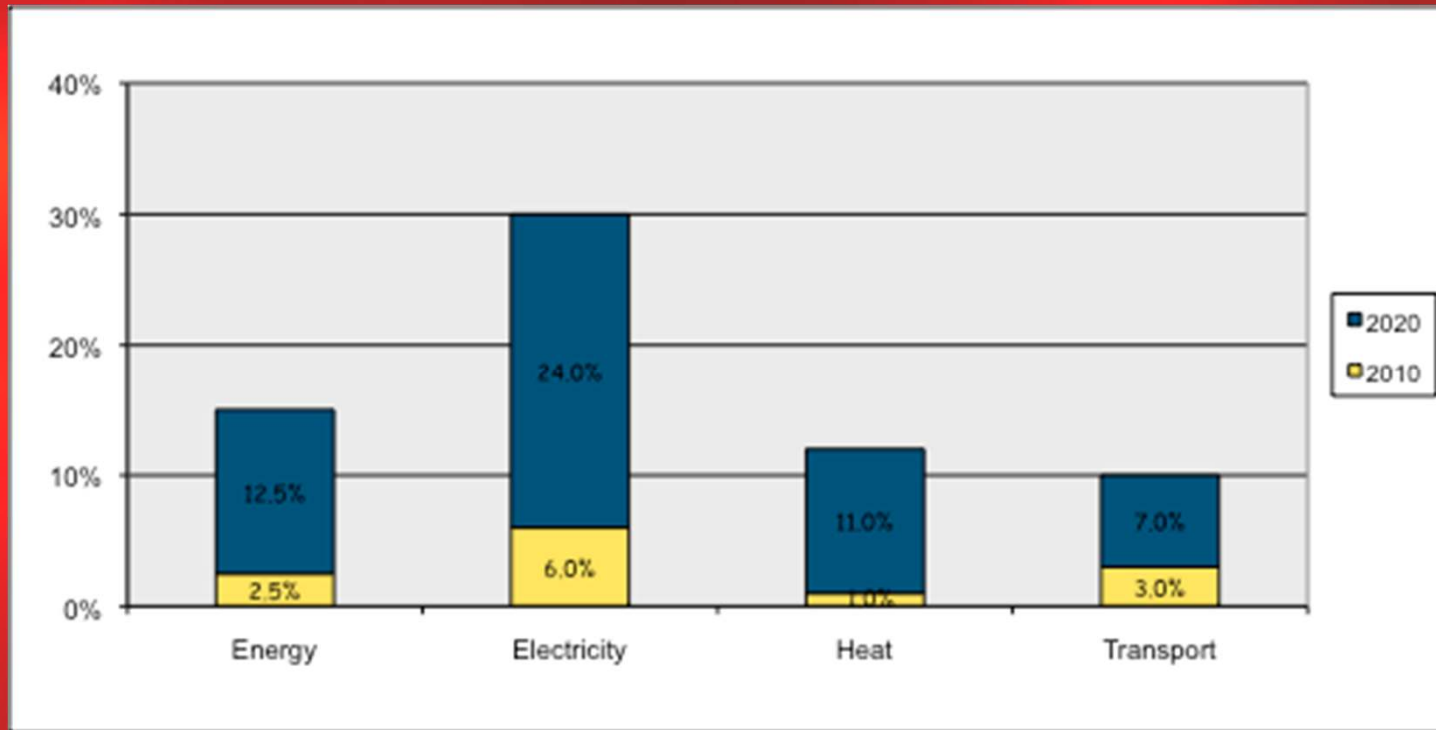


Source: Martin Wolf, "Living within limits". Annual Lecture
Grantham Institute, Imperial College, 3 November 2011

EU 2020 Renewables Directive Target

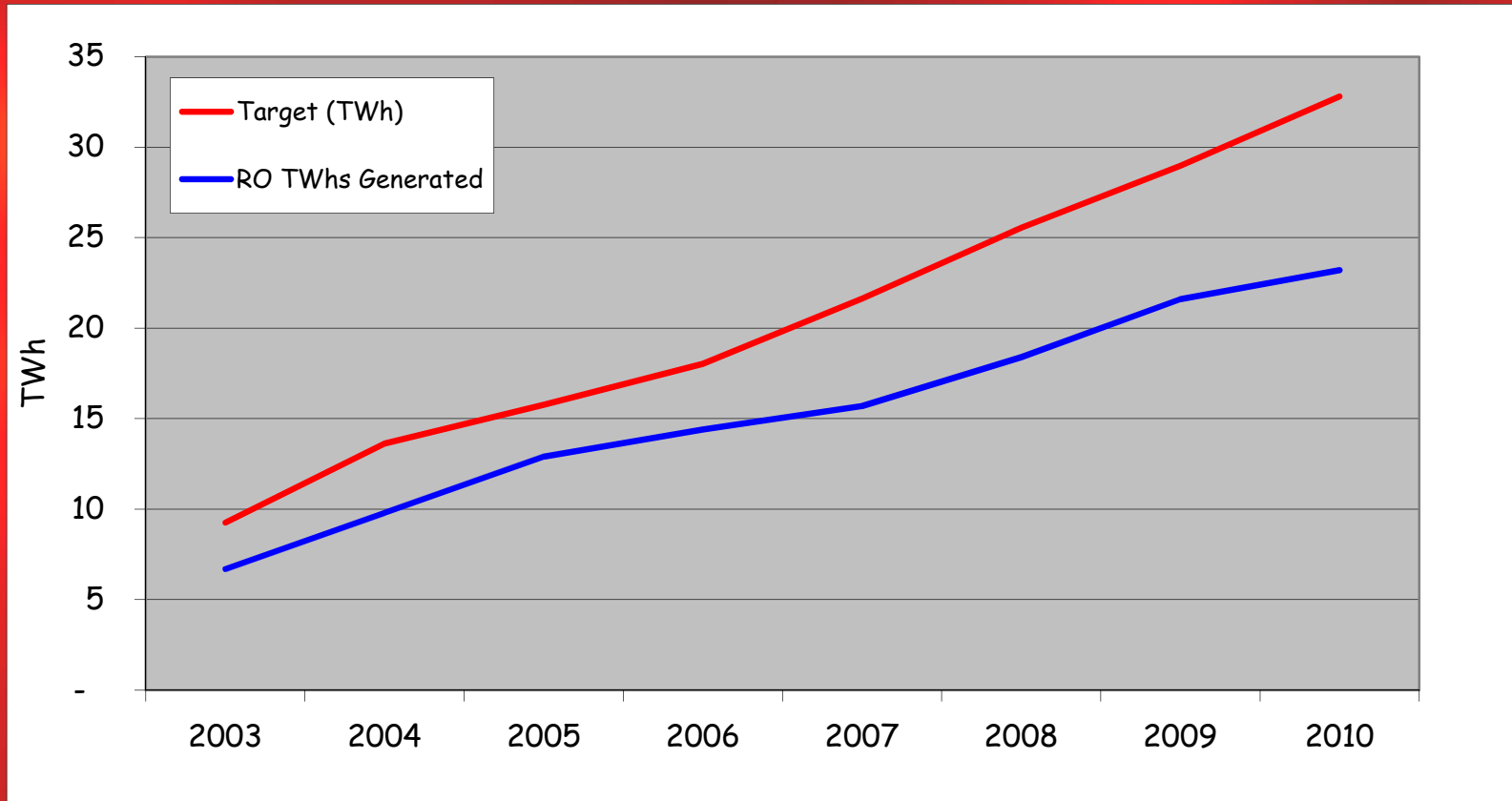
- UK energy policy driven by EU directives
- 15% of Final Energy Consumption (FEC) must be renewable in 2020
 - UK 2010 FEC: 2.5% renewable
- UK FEC = 150 mtoe
- $150 \text{ mtoe} \times 0.15 = 22.5 \text{ mtoe}$ (260 TWhs)
 - UK electricity consumption: 330 TWhs

Meeting the 2020 Target



Source: DECC National Renewable Energy Action Plan (2010)
and REF calculations (2011)

2010 Electricity Target : 10% Renewables



Source: Ofgem data. Chart by REF.

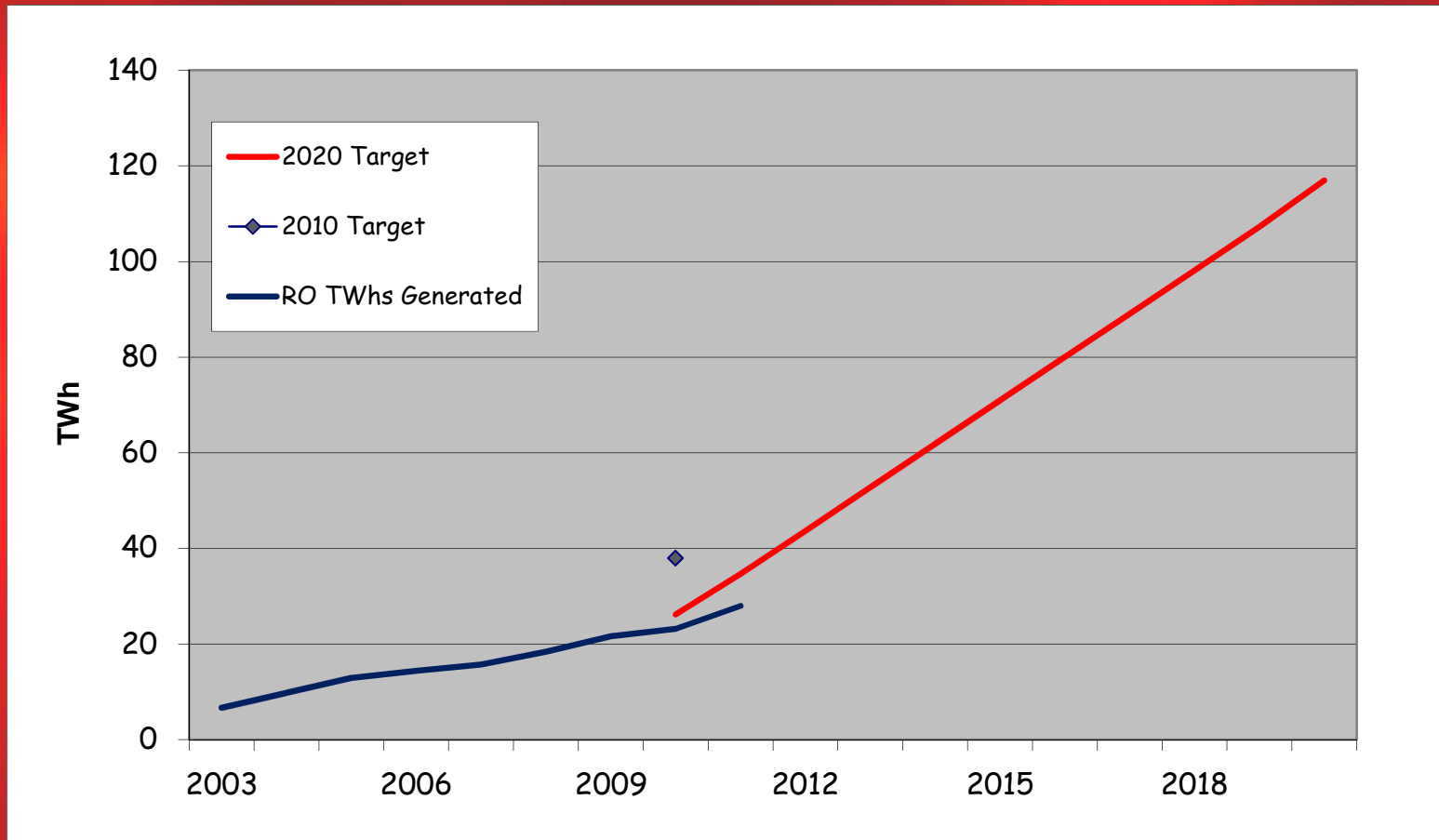
Environmental Subsidy Costs

Levied on electricity and gas bills.

| Policy | Period | Cost (£ billion) |
|--------|-------------|--------------------|
| EEC | 2002 – 2008 | 1.5 |
| CERT | 2008 – 2011 | 3.9 |
| CESP | 2009 – 2011 | 0.2 |
| FiT | 2010 – 2011 | 0.02 |
| RO | 2002 – 2011 | 7.3 |
| Total | | 12.3 |
| VAT | | 1.9 (REF estimate) |

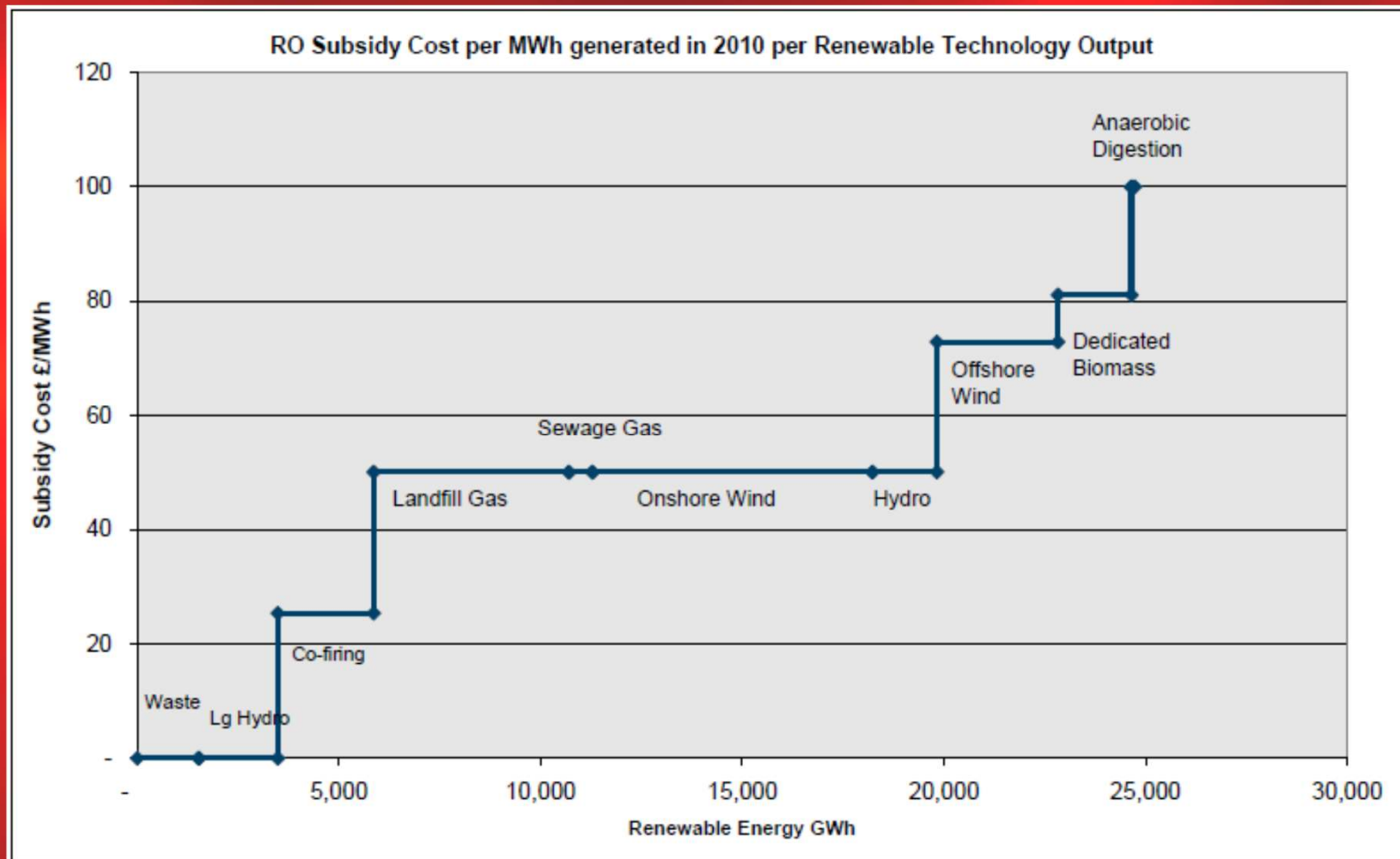
Source: Lord Marland to Lord Vinson, 25.10.11, Hansard
WA128

Progress towards 2020 Target



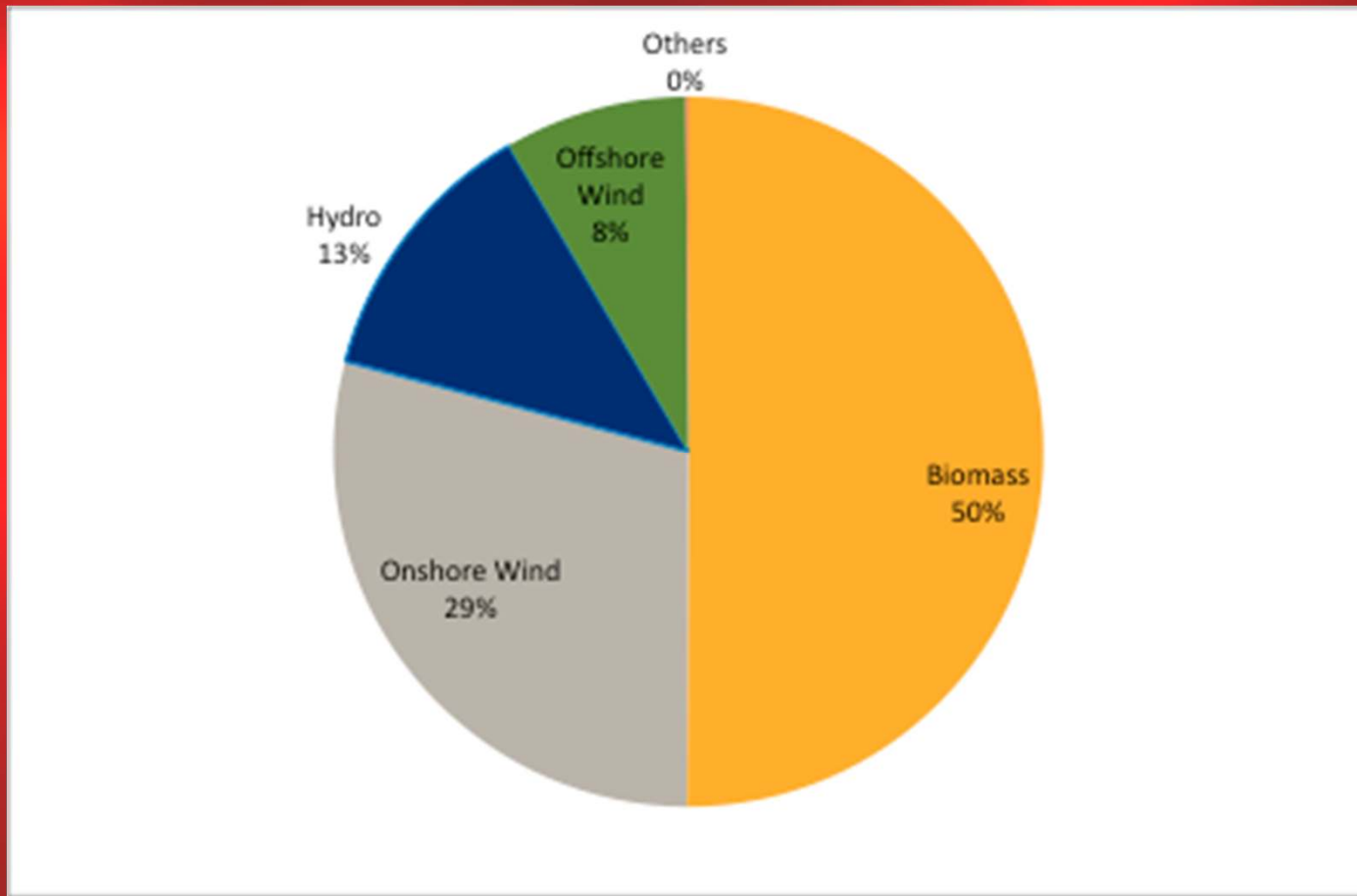
Source: Ofgem, DECC. Chart by REF.

RO Technology Costs and Contributions



Source: REF calculations from Ofgem data

RO: 149.3 TWhs since 2002



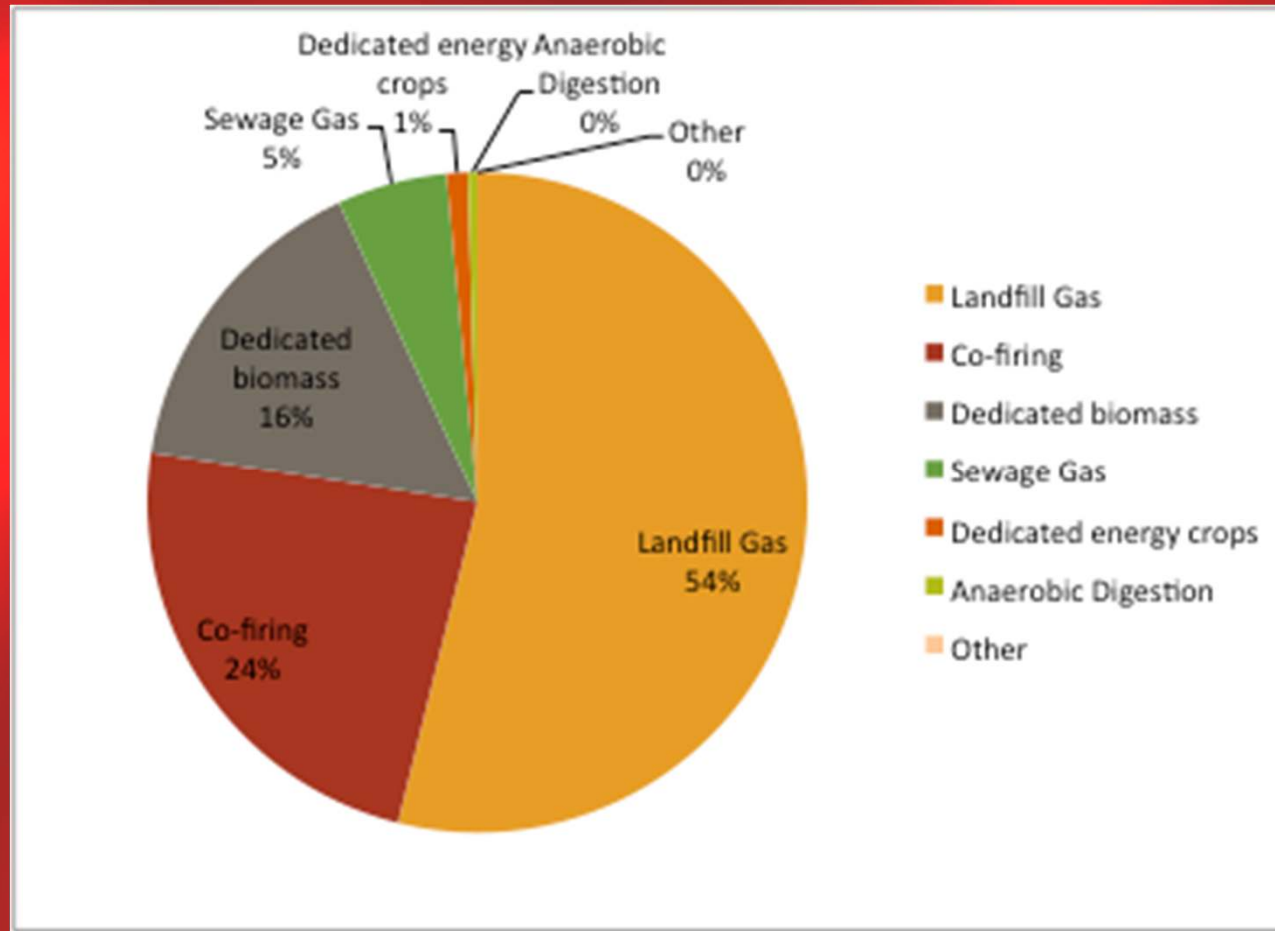
Source: REF Calculations from Ofgem Data

RO Generators 2012

| Technology | Number of sites | Installed capacity |
|--------------------|-----------------|--------------------|
| All | 2,355 | 8,889 MW |
| Wind | 801 | 6,422 MW |
| Offshore | 19 | 1,970 MW |
| Onshore (> 250 kW) | 278 | 4,434 MW |
| Biomass | 132 | 545 MW |
| Landfill Gas | 438 | 1,020 MW |
| Sewage Gas | 162 | 165 MW |

Source: REF Calculations from Ofgem Data

Biomass: 74.8 TWhs since 2002



Source: REF Calculations from Ofgem Data

Relative Costs of CO₂ Reduction: £ / tCO₂

EU Emissions Trading Scheme cost: €12 / tCO₂

| Technology | Large Scale | Small Scale |
|--------------------------|-------------|-------------|
| RO: Biomass co-firing | £46 | |
| RO: Onshore Wind | £93 | |
| RO: Offshore Wind | £185 | |
| FiT: Anaerobic Digestion | £174 | £224 |
| FiT: Hydro | £167 | £387 |
| FiT: Wind | £167 | £671 |
| FiT: Photovoltaic | £167 | £803 |

Source: REF calculations. Grid average emissions factor assumed

Planning Success Rate

| Status | Biomass | Waste | PV | Offshore Wind | Onshore Wind |
|--------------|-----------------|-----------------|---------------|-----------------|------------------|
| Approved | 3,812 MW | 1,266 MW | 357 MW | 6,176 MW | 10,242 MW |
| Refused | 179 MW | 362 MW | 11 MW | | 5,350 MW |
| <u>Total</u> | <u>3,991 MW</u> | <u>1,628 MW</u> | <u>368 MW</u> | <u>6,176 MW</u> | <u>15,592 MW</u> |
| % Refused | 4% | 22% | 3% | 0% | 34% |
| | | | | | |
| In Planning | 1,140 MW | 315 MW | 62 MW | 1,720 MW | 6,977 MW |

82% of applications are approved

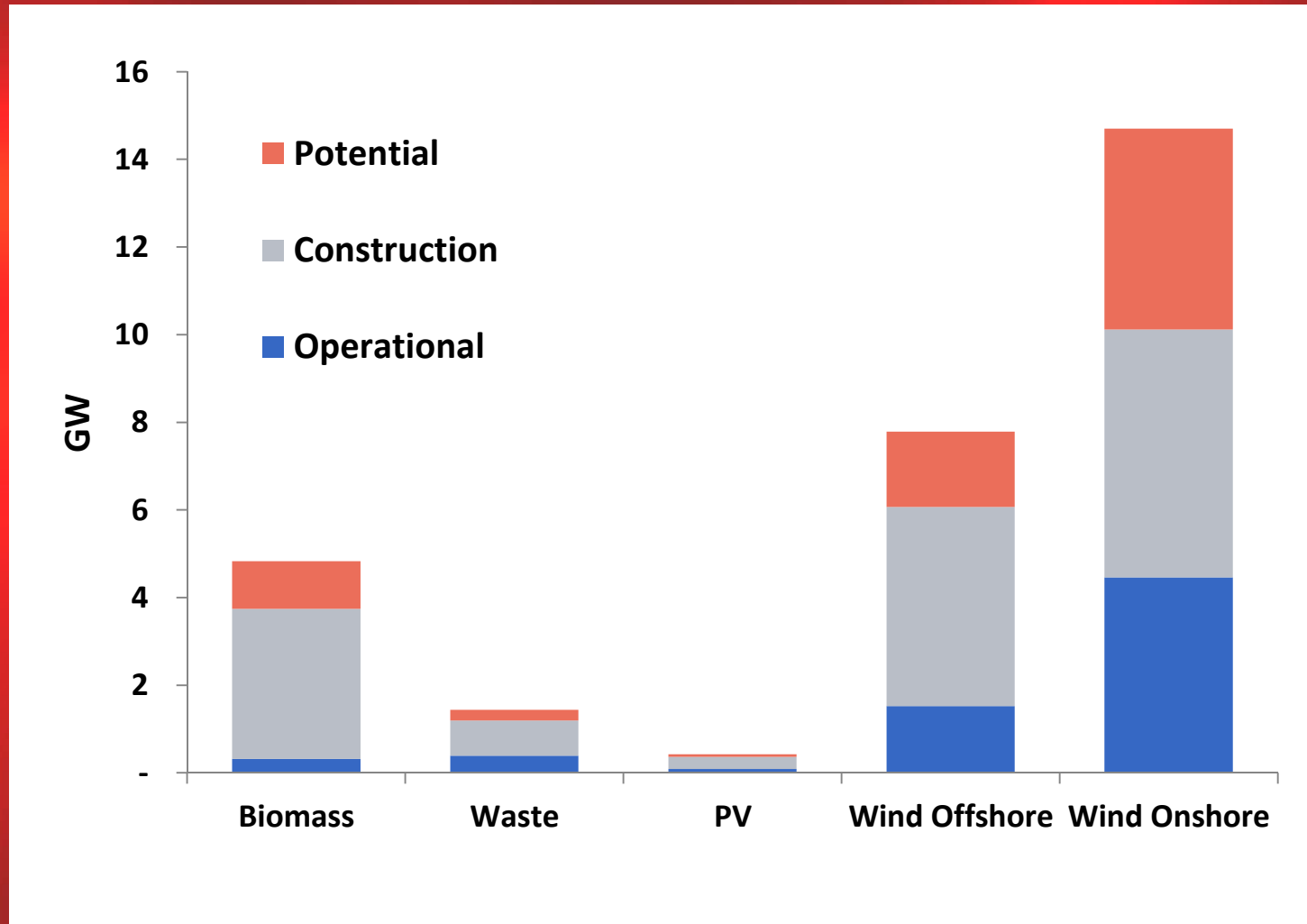
Source: REStats (DECC)

RO Generators & Planning

| Status | Biomass | Waste | PV | Offshore Wind | Onshore Wind | All Technologies |
|--------------------------|----------|--------|--------|---------------|--------------|------------------|
| Operational | 322 MW | 390 MW | 87 MW | 1,525 MW | 4,463 MW | 8,030 MW |
| Under & Pre-Construction | 3,421 MW | 806 MW | 276 MW | 4,543 MW | 5,658 MW | 15,478 MW |
| In Planning | 1,140 MW | 315 MW | 62 MW | 1,720 MW | 6,977 MW | 10,417 MW |
| Refused | 179 MW | 362 MW | 11 MW | 0 | 5,350 MW | 5,915 MW |

Source: REStats (DECC)

RO Generators & Planning



Source: REF calculations from DECC REStats data. Assuming current success rates at planning

HMT *Control Framework for Levy Funded Spending*

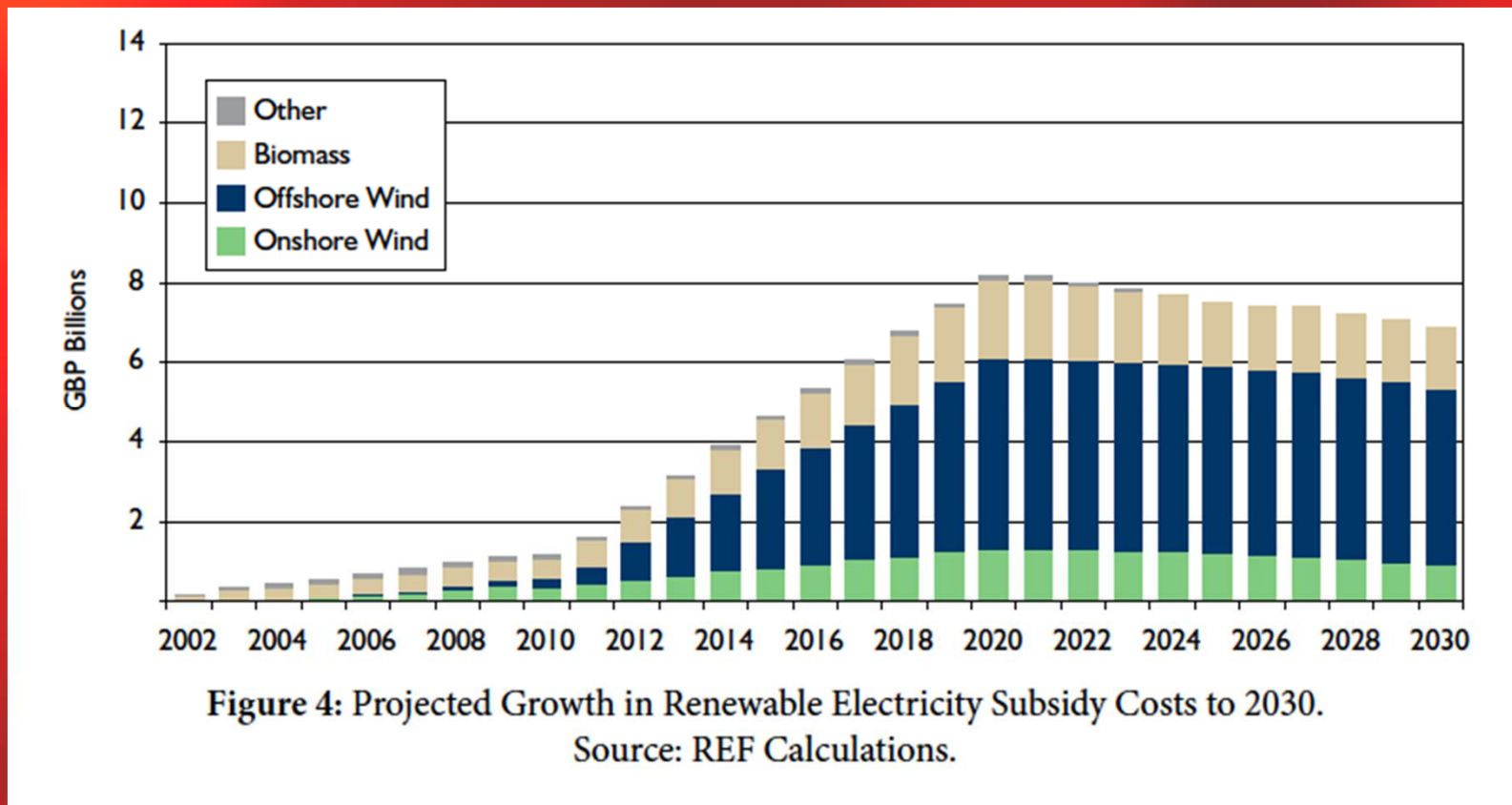
- Caps DECC's ability to draw subsidies from consumer bills

| Policy | 2011–12 (£m) | 2012-13 (£m) | 2013–14 (£m) | 2014–15 (£m) |
|--------|--------------|--------------|--------------|--------------|
| RO | 1,764 | 2,191 | 2,615 | 3,203 |
| FiT | 80 | 161 | 269 | 357 |
| WHD | 250 | 275 | 300 | 310 |

DECC, Control Framework for DECC levy-funded spending: Questions and Answers (29 March 2011. URN 11D/675).

UK Renewable Electricity Subsidies

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



Some Proposed RO Re-Bandings

| Technology | ROC / MWh | | | |
|-----------------------|-----------------------------|------------|------------|------------|
| | Current | 2013/15 | 2015/16 | 2016/17 |
| Advanced gasification | 2 | 2 | 1.9 (-5%) | 1.8 (-10%) |
| Anaerobic digestion | 2 | 2 | 1.9 (-5%) | 1.8 (-10%) |
| Biomass conversion | 1.5 | 1 (-33%) | 1 (-33%) | 1 (-33%) |
| Co-firing of biomass | 0.5 | 0.5 | 0.5 | 0.5 |
| Landfill gas | 0.25 | 0 (-100%) | 0 (-100%) | 0 (-100%) |
| Onshore wind | 1 | 0.9 (-10%) | 0.9 (-10%) | 0.9 (-10%) |
| Offshore wind | 2013/14: 2 2014/15-: 1.5 | 2 | 1.9 (-5%) | 1.8 (-10%) |

Source: DECC

Wind Integration Costs

- System Operation Costs (£16 / MWh).
 - Caused by errors in the wind forecast.
- Transmission upgrades (£20 – £23 / MWh).
 - To move energy from wind farms to load centres.
- Planning Reserve (£24 – £28 / MWh).
 - Conventional plant equal to peak load plus a margin, for windless days, running at reduced load factor.

Source: Colin Gibson, “A Probabilistic Approach to Levelised Cost Calculations”, (Institute of Engineers and Shipbuilders in Scotland, 2011).

System Cost from Consumer's Perspective

- Base cost + Subsidy + Integration
- Onshore wind: £190/MWh
- Offshore wind: £270/MWh
- Nuclear: £61/MWh
- CCGT: £66/MWh
- Coal: £60/MWh

Source: Gibson (IESIS, 2011)

Subsidy + Integration Costs (£5bn p.a.)

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

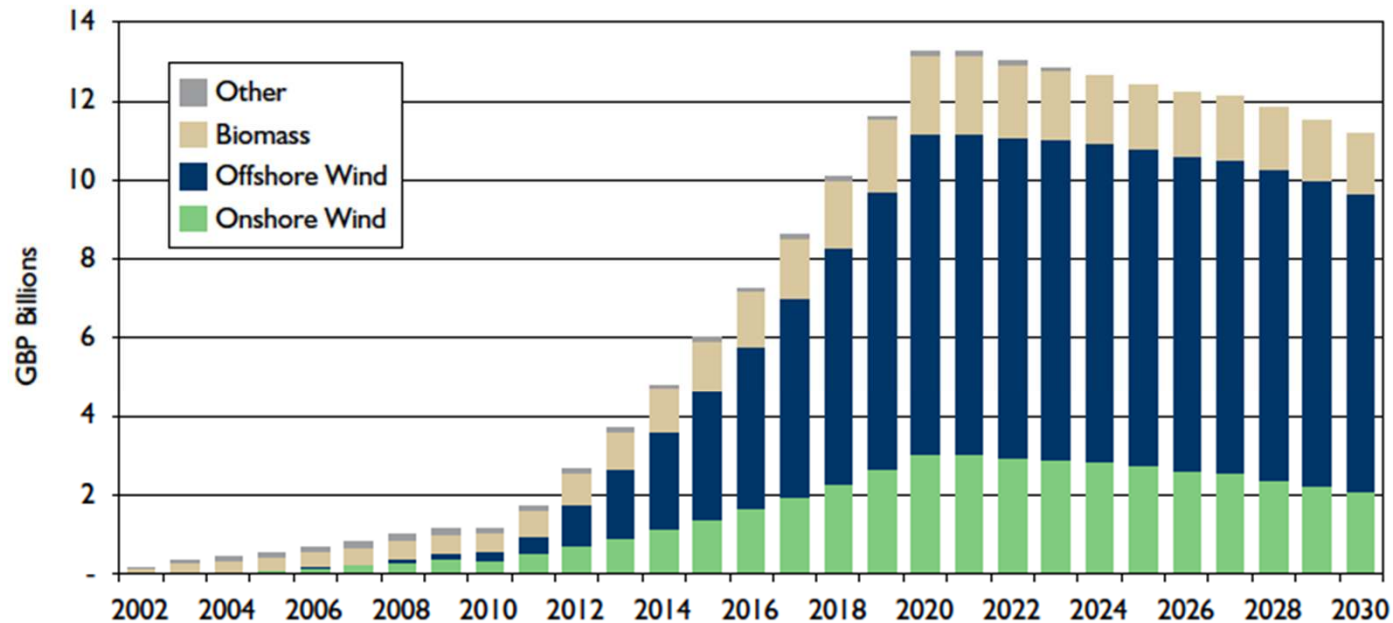


Figure 6: Projected Growth in Total Cost of Renewable Electricity Programme (Subsidy + Ancillary Costs).

Source: REF Calculations, Gibson 2011.

Tilbury B: Biomass Conversion

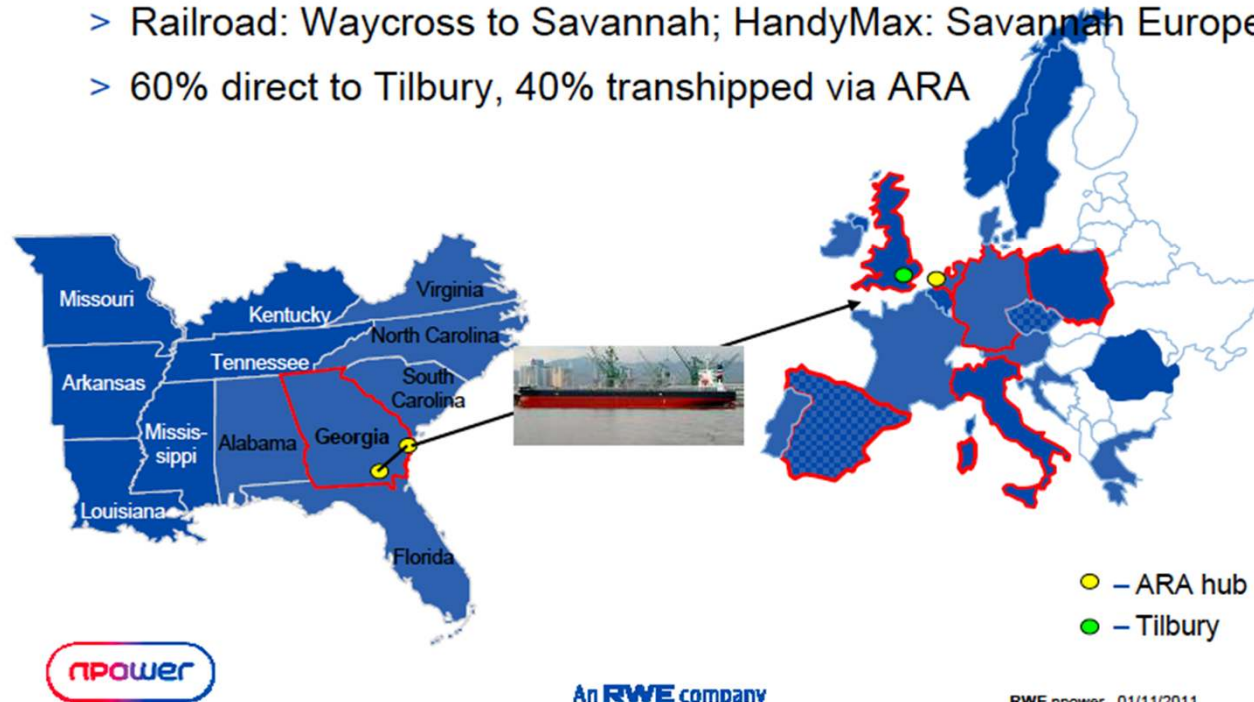


Tilbury: Biomass Conversion

- 750 MW. World's largest dedicated biomass plant?

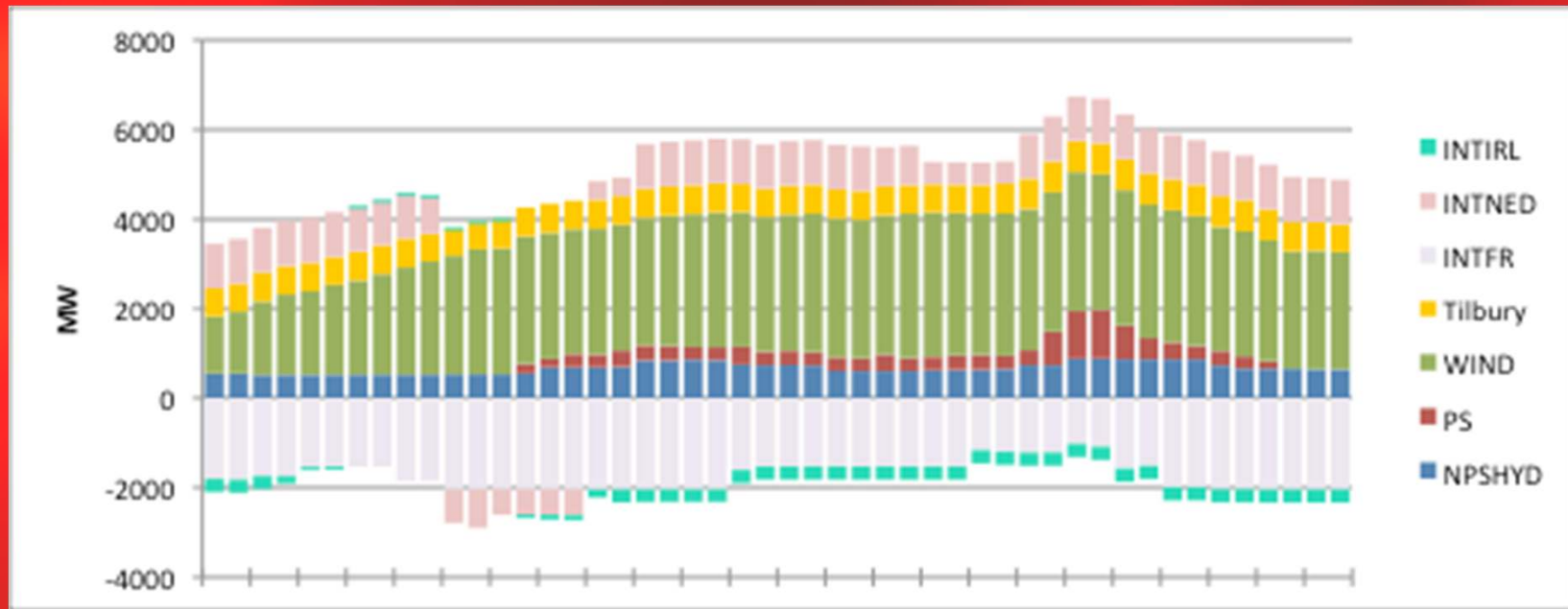
Supply of c 2.5mt sustainably sourced wood pellets

- > c 60% from Canada, c 10% from Europe and c 30% from RWE's own 750kt pa Waycross, GA pellet manufacturing facility.
- > Railroad: Waycross to Savannah; HandyMax: Savannah Europe
- > 60% direct to Tilbury, 40% transhipped via ARA



Source: Npower 2011

Tilbury: Output on 20.02.12



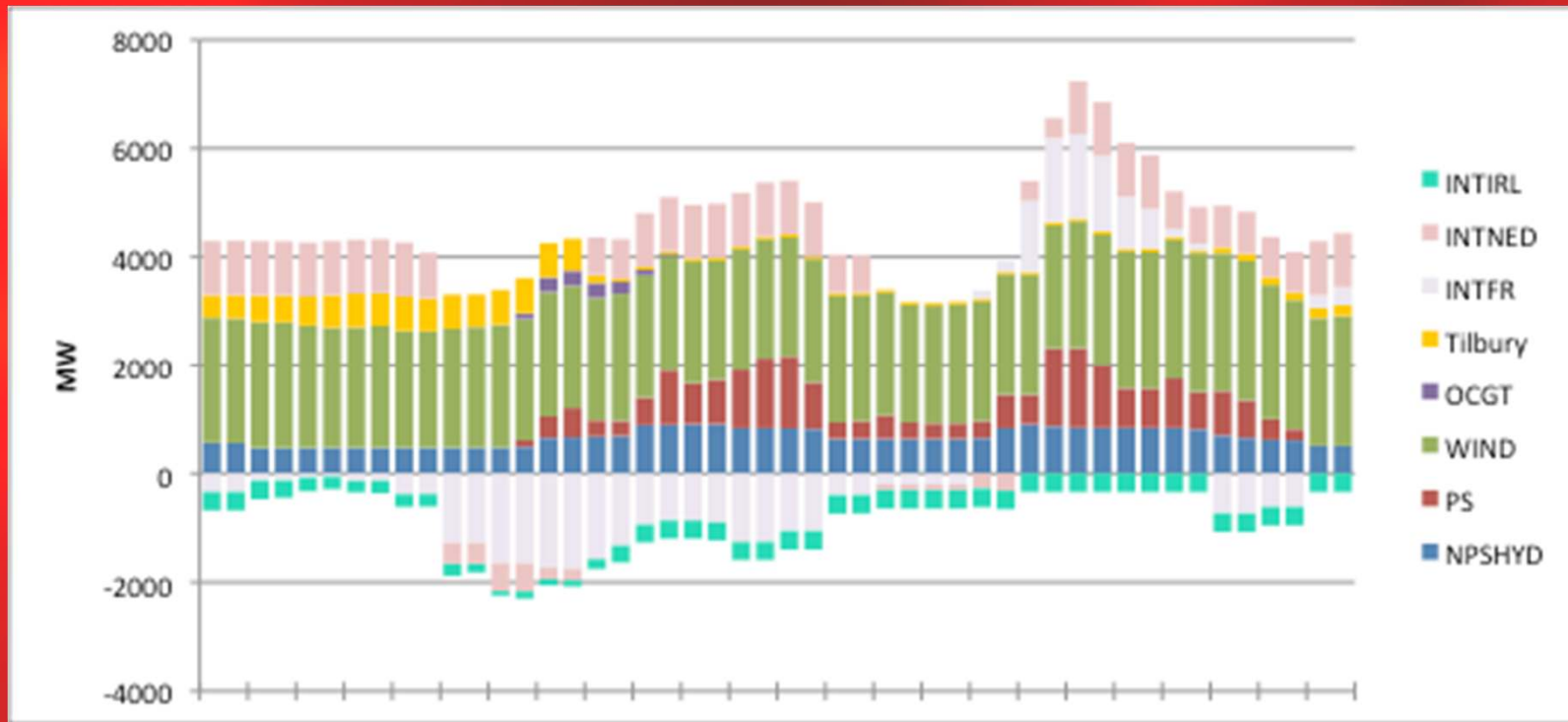
Source: REF Chart, BM Reports data
Gas, Coal, Nuclear omitted

Tilbury: Fire in Stored Biomass



Source: *Daily Mail*, 27.02.12

Tilbury Output 27.02.12



Source: REF Chart, BM Reports data

Biomass for Electricity

- Major source of renewable MWhs, 2002 to 2011, in spite of modest capacity
- Almost unknown to the general public
- Co-firing, LFG, relatively low cost
- Government expectations in 2020 significant
 - But future cost will rise (1.5 ROCs)
- Commercial experiments and plans significant
 - But teething problems are real