

# REF

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## RENEWABLE ENERGY FOUNDATION

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### Information Note

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## Renewables Output in 2010

### Summary

- The United Kingdom failed to reach its 10% renewable electricity target for 2010, producing only 6.5% of electricity from renewable sources.
- This shortfall occurred in spite of a subsidy to renewable generators amounting to approximately £5 billion in the period 2002 to 2010.
- Renewables electricity subsidy, which increases year on year, is drawn from consumer bills, and amounted to £1.1 billion in 2010.
- Although low wind in 2010 accounts for some part of the target shortfall, it is clear that the target would have been missed by a large margin even if wind speeds had exceeded the highest annual average in the last 10 years.
- Planning delays do not appear to have been responsible for the missed target, with large capacities of wind farms, both on and offshore, consented but unbuilt.<sup>1</sup>
- The failure to meet the 2010 target confirms doubts as to the UK's ability to reach the 2020 EU Renewable Energy Directive target for 15% of Final Energy Consumption, a level requiring at least 30% of UK electricity to be generated from renewable sources.
- Onshore wind Load Factor in 2010 fell to 21%, as opposed to 27% in 2009, a variation with significance for project economics, particularly Internal Rate of Return (IRR), and future cost of capital.
- Offshore fared better declining from 30% in 2009 to 29% in 2010, a point of importance for investors and government energy planners alike.
- Low wind output in 2010 is matched by low hydro output, and examination of the data since 2002 reveals a close correlation at the annual level, confirming the view that while hydro is a good partner for wind over short timescales, compensating for errors in the wind forecast, it has less to offer over longer timescales.

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<sup>1</sup> See <http://www.bwea.com/ukwed/consented.asp>

- Due to scalability and what appear to be less variable annual load factors, offshore wind shows comparative promise, with 11 of the top 16 producers in December 2010 being offshore sites. Indeed, one offshore project, Thanet, supplied 10% of total wind output in December 2010.
- Examination of the costs of the various technologies and their contribution to the targets confirms arguments that subsidies are inefficient for reaching targets, and suggests that if these subsidies are to be used they should be redesigned as a means of exploring an experimental field, with measures to reduce undue reward.
- The wisdom of targets may be doubted, but if they are to be met then emphasis should be placed on maximizing output from the most cost-effective technologies, such as unsubsidized large hydro and energy from biodegradable waste, and on those requiring less subsidy, such as biomass co-firing.

### ***Introduction***

The recent availability of final quarter data for 2010 makes it possible to offer a commentary on progress of the renewables sector in that year. This information note draws on recently published data from the Department of Energy and Climate Change,<sup>2</sup> and on data made available as part of Ofgem's reporting of subsidy claims under the Renewables Obligation.<sup>3</sup> By combining information from these two sources we generate a series of illustrative charts, and arrive at conclusions not available from either data source considered in isolation.

#### ***1. UK Missed 2010 Renewable Electricity Target***

The United Kingdom failed to meet the 2010 target of generating 10% of electricity from renewable sources set by the 2001 EU Renewables Directive. Renewables accounted for only approximately 6.5% of all electricity demand in 2010.

Renewables were responsible for approximately 25 TWh compared with the 10% target of 38 TWh.<sup>4</sup>

The following figure shows the contributions to the total from the different renewable technologies.

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<sup>2</sup> <http://www.decc.gov.uk/en/content/cms/statistics/publications/trends/trends.aspx>

<sup>3</sup> REF publishes detailed monthly load factors for all generators subsidized under this scheme. This data is freely available from the REF website: [www.ref.org.uk](http://www.ref.org.uk).

<sup>4</sup> Energy Trends March 2011 [www.decc.gov.uk](http://www.decc.gov.uk)

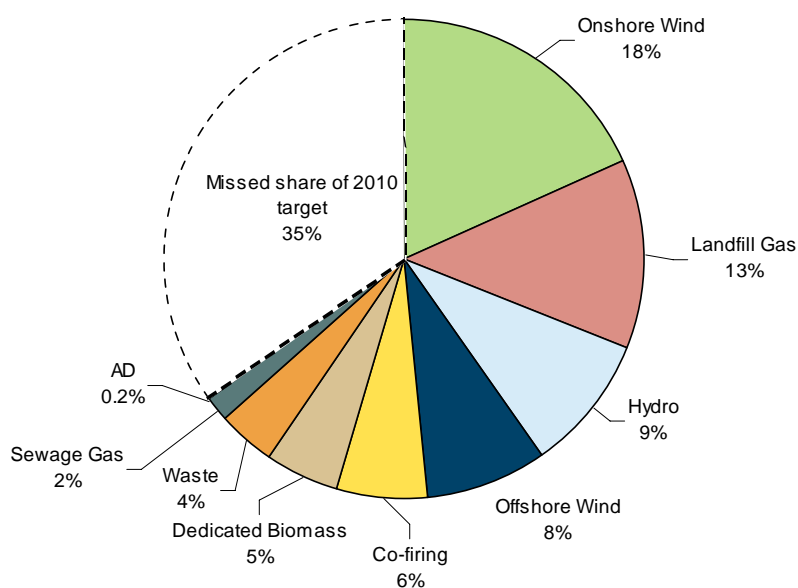


Figure 1. Renewable Generation Technology Share of 2010 Target.

Source: REF calculations from Ofgem and DECC data.

The shortfall is highly significant and although some of the failure can be attributed to the low wind speeds experienced in 2010, the target would not have been met even if wind speeds had exceeded the highest annual average in the last 10 years.

Since planning delays are often cited by the industry as being an important factor in delaying wind sector growth, it is important to note that this appears to be incorrect, with the Renewables UK website revealing high levels of consented but unbuilt capacity. In May 2009 this was as high as 7 GWs, roughly 3,000 turbines, with approximately half on- and half offshore.<sup>5</sup> At the time of writing this still stood at 5.5 GWs, roughly twice the capacity currently constructed in the United Kingdom.<sup>6</sup> Grid connection problems, and difficulties in obtaining finance, probably account for these delays.

The ease and transparency with which progress towards meeting renewables targets can be reported is complicated by the complexity and inconsistency of the various targets. For example, the 2001 *Renewables Directive 2010* renewable electricity target is for 10% of **electricity demand** (383 TWh in 2010<sup>7</sup>), whereas the Renewables Obligation 2010 target is for approximately 11% of

<sup>5</sup> <http://www.guardian.co.uk/environment/2009/may/01/wind-turbine-renewable-energy>

<sup>6</sup> <http://www.bwea.com/ukwed/consented.asp>

<sup>7</sup> <http://www.decc.gov.uk/assets/decc/Statistics/publications/trends/1511-trendsmarch11.pdf>

**electricity supplied by licensed Suppliers** (308 TWh in 2010<sup>8</sup>). Hydro stations greater than 20 MW built before 2002 and the biodegradable fraction of incinerated municipal solid waste applies to the former target but not the latter.

However, neither target was reached in 2010. The renewables fraction of licensed supply on the Renewable Obligation basis was approximately 7%.

The scale of the shortfall for the 2010 target, in spite of the very high subsidy levels discussed below, suggests that the target was unreachable from the outset.

Furthermore, the 2010 target shortfall strengthens arguments that the >30% target for renewable electricity implicit in the 2020 EU Renewable Energy Directive is also infeasible, as can be inferred from the following chart, which plots renewable electricity production from 2002 to 2010 (yellow line), shows the 2010 target level (blue dot), and indicates the trajectory necessary to reach the target levels believed by the UK government to obtain in 2020 in order to contribute to the 2020 target of 15% of renewables in Final Energy Consumption.

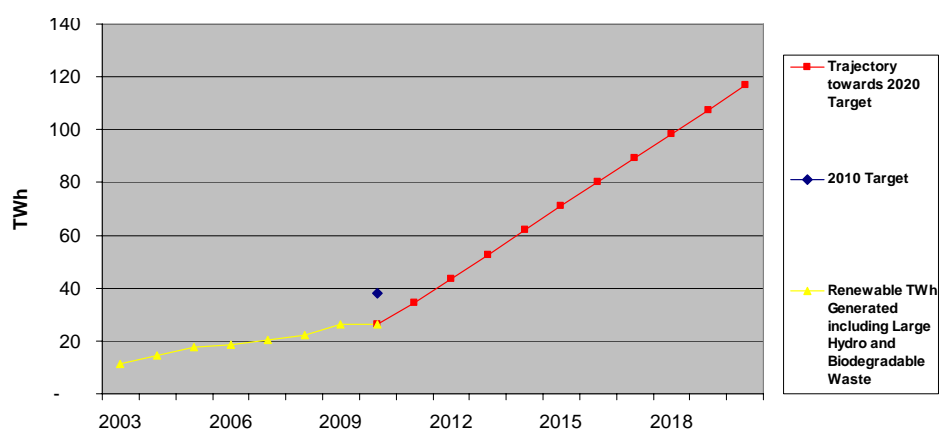


Figure 2: Progress towards the 2020 renewable electricity target. Renewable electricity generated to 2010 (yellow), 2010 target (blue dot), and the trajectory to 2020 target (red).

Source: REF calculations from DECC and Ofgem data.

## 2. Reduced Wind Output across all Regions of the UK

Renewables Obligation data up to the end of December 2010 is now available for most generators, allowing the derivation of load factors for both the on- and off-shore wind fleets by year and by country. The following chart shows that the UK average on-shore wind farm load factor dropped to 21% in 2010, as against approximately 27% in 2009. However, the off-shore fleet was not as significantly affected, and had an average load factor of 29%.

<sup>8</sup> 308 TWh is calculated by apportioning the predictions in Table 2 of 'Calculating the Level of the Renewables Obligation' see [www.decc.gov.uk](http://www.decc.gov.uk)

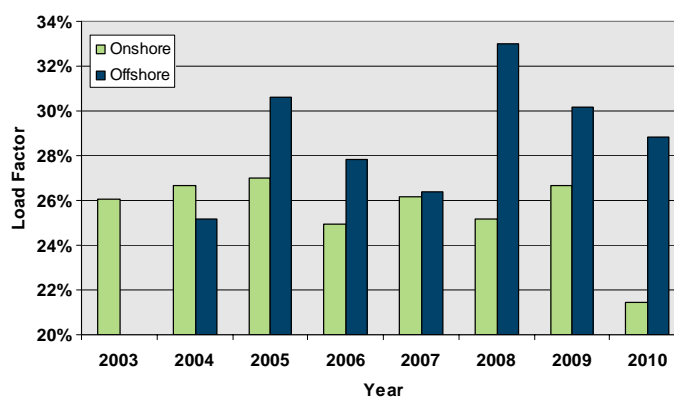


Figure 3: UK onshore and offshore load factors by year.

Source: REF calculations from Ofgem data.

Year on year variations of the scale observed for onshore wind have real significance for project economics, particularly Internal Rate of Return (IRR), and may have a bearing on future cost of capital.

In this context, it is interesting to note the following figure, which compares the 2009 and 2010 wind farm load factors for offshore and the different countries in the United Kingdom.

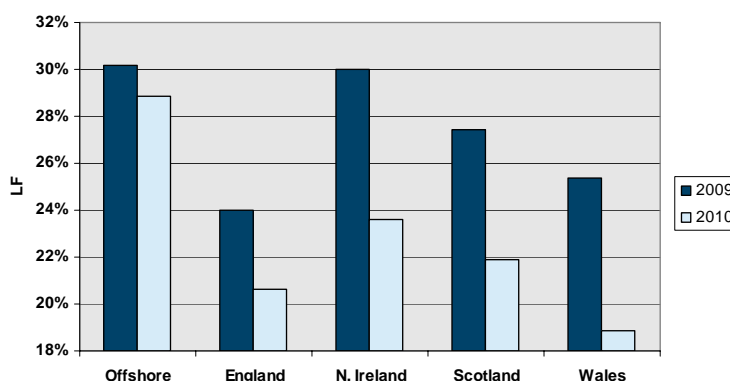


Figure 4: Offshore and onshore wind load factors in 2009 and 2010 compared.

Source: REF calculations from Ofgem data.

The impact of low winds in 2010 is significant for Scotland, and particularly so for Wales, which has previously been considered a high wind region. Lower winds in 2010 clearly had a less significant impact on the offshore fleet, suggesting that the marine wind regime may be more stable at an annual level, an important consideration for investors and government energy planners alike.

### **3. Offshore Windfarms are Major Contributors to the Wind Total**

Due to the increasing installed capacity of the large offshore wind farms and the improved load factors obtained, these wind farms are the key contributors to current and prospective total wind power. For example, the following figure shows the contribution of individual wind farms to the wind generation total for December 2010. A single offshore wind farm, Thanet, installed in 2010, generated 10% of the whole UK wind fleet's output. Sixteen wind farms produced nearly half of

the total output of UK wind power, with the remainder being generated by 268 wind farms. Eleven of the sixteen are offshore wind farms.

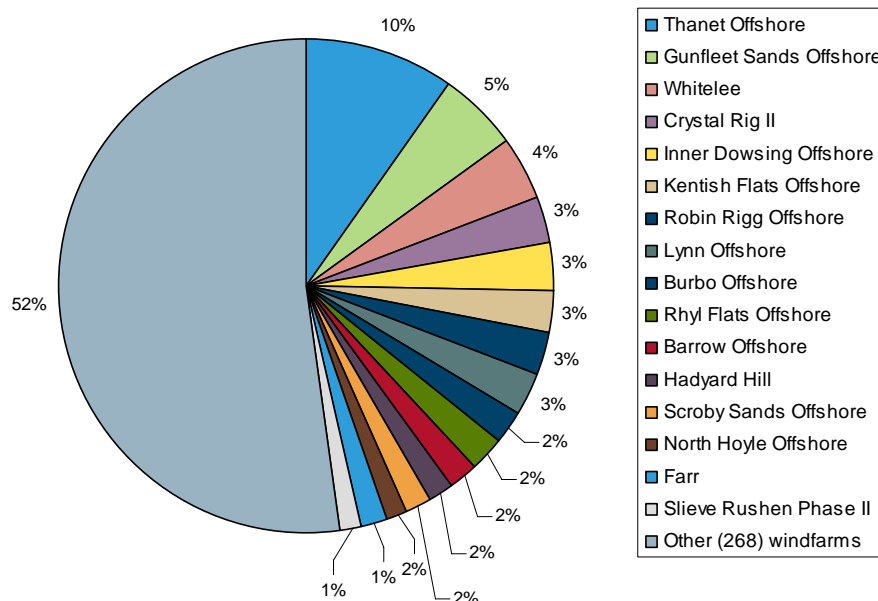


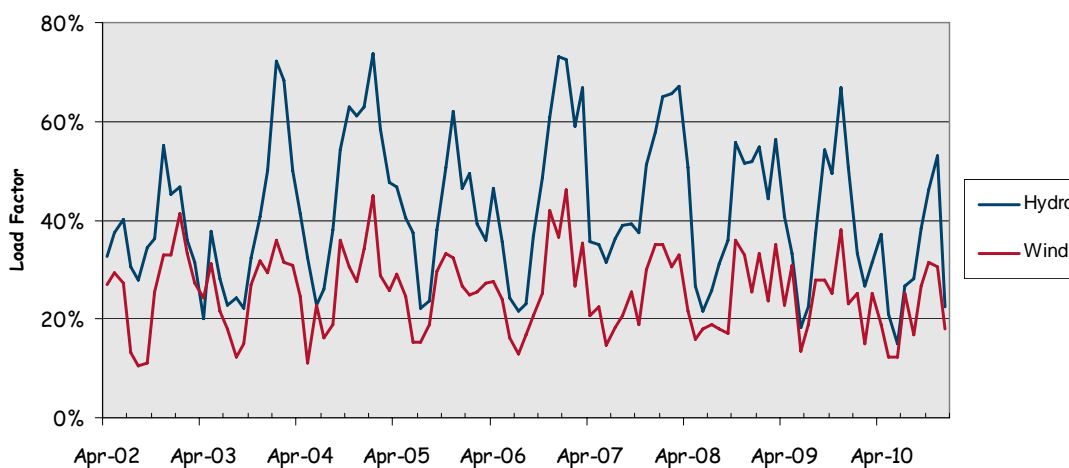
Figure 5: Contribution of individual wind farms to total wind output in December 2010.

Source: REF calculations from Ofgem data.

#### 4. Hydro and Wind Output is Correlated

The statistical team at DECC have noted that hydro station output, as well as wind farm output, was reduced in 2010. This is consistent with work conducted for REF in 2007 by Oswald Consultancy Ltd, which noted that wind and hydro output are correlated.<sup>9</sup> Years of high precipitation tend to be those with successive south-westerly weather systems passing over the UK, and wet windy weather increases both wind farm and hydro load factors, and vice versa.

The following figure demonstrates the correlation between hydro and wind.



<sup>9</sup> <http://www.ref.org.uk/images/PDFs/hydro.overview.2007.pdf>

Figure 6: Load factors for hydro and onshore wind, April 2002 to April 2010.

Source: REF calculations from Ofgem data.

This is an important finding, since it shows that while hydro may be a good partner for wind over short timescales, hours and days for example, when it might compensate for errors in the wind forecast, it will only be able to offer limited compensation for low wind over longer timescales, in a windless year for example.<sup>10</sup>

### **5. Subsidy Costs and Targets**

The Renewables Obligation (RO) subsidy results in higher costs to consumers, with costs to date amounting to £5bn, and costs for 2010 expected to exceed £1.1 billion.

The Government introduced banding to the RO in 2009, thus providing differing reward levels for the various technologies. Co-firing now receives 0.5 of a Renewables Obligation Certificate (ROC) per MWh generated, whereas Anaerobic Digestion and new offshore wind farms receive 2 ROCs per MWh. The following graph shows the renewable electricity generated by each technology along the horizontal axis, starting from the technologies with the least subsidy and progressing to those enjoying the highest subsidy level. The cost per MWh of the electricity generated is indicated on the vertical axis, and for the purposes of this chart the value of one ROC is assumed to be £50.<sup>11</sup> For example, co-firing of biomass in coal power stations produced approximately 2,000 GWhs at a subsidy cost to the consumer of about £25 per MWh.

It should be noted that the proportion of co-fired renewable energy used to meet a supplier's obligation is capped at 12.5% (10% for 2009/2010). Following the introduction of banding, which reduced the support for co-firing, only one supplier made maximum use of the allowable limit signaling a marked reduction in interest in co-firing from the generators who previously made full use of the co-firing allowance.<sup>12</sup>

'Large' hydro denotes those hydro plants built before 2002 and in excess of 20 MW installed capacity that do not receive subsidy under the RO. Similarly, the fraction of incinerated municipal waste, which is deemed to be biodegradable, and thus, contributes toward the renewable energy target, does not receive a subsidy.

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<sup>10</sup> Readers may also wish to consult Paul-Frederik Bach's work on Norwegian hydro: <http://www.theoil drum.com/node/7404>

<sup>11</sup> For ROC prices achieved at auction see: <http://www.e-roc.co.uk/trackrecord.htm>

<sup>12</sup> Ofgem, *Renewables Obligation: Annual Report 2009-2010* (2011).

Offshore wind farms receive 1, 1.5 or 2 ROCs per MWh depending on when they were built, with the newest being in the highest band. As more off-shore wind comes online, the subsidy cost will rise above the 2010 average level of £73 per MWh.

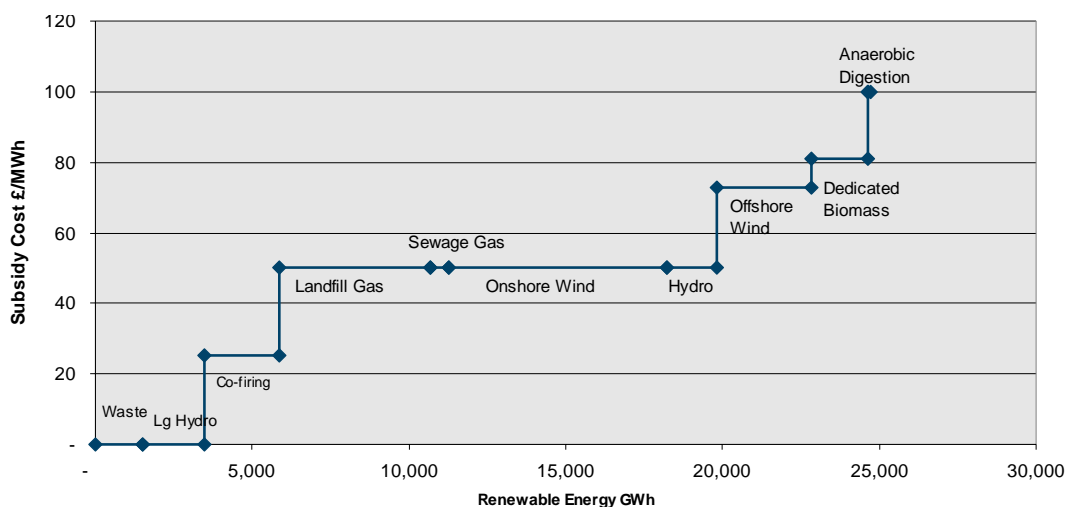


Figure 7: 2010 Renewables Obligation subsidy cost and energy output by technology.

Source: REF calculations from Ofgem data.

While it is clear that banding of the Obligation has succeeded in producing a more diversified portfolio of technologies, which is desirable from the point of technological experimentation, it is questionable whether this aim should be combined with the meeting of targets for renewable energy generation. A diversified experimental portfolio which is also expanded to meet arbitrary energy targets inevitably results in much higher costs to the consumer than the least cost portfolio. From Figure 7 we can see that this might consist of significantly increasing the contribution from unsubsidized energy from biodegradable waste, and from low cost co-fired biomass, for example, which would also result in useful savings in systems integration and grid expansion costs.

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