The £200bn energy investment fantasy

Dan Lewis, Chief Executive of Future Energy Strategies and the Economic Policy Centre, sets out why the UK simply can't spend £200bn on its energy infrastructure by 2020.

Will the UK's largely foreign-owned energy industry find £200bn to meet the 2020 targets for renewable energy usage and carbon reduction?

Following the Government's proposed electricity market reform,[1] the Secretary of State for Energy and Climate Change, Chris Huhne, seems to think – or certainly hopes – so. The Coalition's energy policy is, after all, very much a continuation of the previous government's policy.

For all that, £200bn remains a staggeringly large sum of money. It is enough fully to finance other supposedly unaffordable projects several times over, such as 21 London 2012 Olympic Games,[2] or 33 Queen Elizabeth Class aircraft carriers,[3] or even clearing the UK's budget deficit with room to spare for hefty tax cuts.

But where does the £200bn figure actually come from and how does it break down?

Ofgem, the UK's statutory regulator for gas and electricity markets, built a model in 2009 to calculate the investment costs over the years to 2025. 'Project Discovery', as it became known, worked within the confines of the UK's regulatory environment and focused on targets that must be met. Wary of how much assumptions can

[1] See: *Planning our electric future: a White Paper for secure, affordable and low-carbon electricity*, Department of Energy and Climate Change, CM 8099, July 2011, available at: http://www.decc.gov.uk/assets/decc/11/policy-legislation/EMR/2176-emr-white-paper.pdf.

[2] See: *Preparations for the London 2012 Olympic and Paralympic Games: Progress report February 2011*, National Audit Office, HC 756 Session 2010-2011, 16 February 2011. In March 2007 the then Secretary of State for Culture, Media and Sport announced that the budget for the Games, also referred to as the 'Public Sector Funding Package', would be £9.325bn. In May 2010 this Funding Package was reduced by £27m to £9.298bn. See: http://www.nao.org.uk/publications/1011/preparations_for_the_2012_olym.aspx.

[3] Albeit without aircraft. Source: "Navy aircraft carrier will be sold after three years – and never carry jets", *Daily Telegraph,* 18 October 2010, available at: http://www.telegraph.co.uk/news/newstopics/politics/defence/8072041/Navy-aircraft-carrier-will-be-sold-after-three-years-and-never-carry-jets.html.

SNAPSHOT

- Analysis by Ofgem in 2009 of the UK's energy prospects drew up four illustrative scenarios. One of these scenarios, 'Green Transition', put the costs of delivering secure energy supplies and meeting carbon targets at almost £200bn.
- The £200bn figure has subsequently been widely cited. But the Green Transition scenario is undeliverable. The underpinning assumptions are not valid, the major utility companies and the National Grid can't afford it, consumers won't have it, and the system in all likelihood would not cope.
- A new approach is needed. This article puts forward a lower cost 'Plan B' based on the acknowledgement of some basic facts.
- The longer it takes for policymakers to accept that the £200bn investment will not happen, the more expensive it will be to change direction. There will have to be a renegotiation of the EU's 2020 target for renewable energy and an extended life for the UK's existing coal plants. Quite the worst of all worlds would be to keep pretending everything is going to plan.

change, Project Discovery came up with four different scenarios: 'Green Transition', 'Green Stimulus', 'Dash for Energy' and 'Slow Growth'. The £200bn figure – which was actually £199bn – is from the Green Transition scenario, and has been on everybody's lips ever since.

TABLE 1

Cumulative investment costs of four Ofgem Discovery scenarios (£bn)

	Green Transition	Green Stimulus	Dash for Energy	Slow Growth
2010	14.1	14.1	12.6	12.6
2015	77.7	76.2	56.1	48.6
2020	**199.0**	**195.0**	**109.6**	**95.6**
2025	240.4	235.8	146.8	127.9

Source: *Project Discovery Energy Market Scenarios,* Office of Gas and Electricity Markets, 9 October 2009.

Ofgem described the Green Transition scenario thus:

- **Characterised by rapid economic recovery and a significant expansion in investment in green measures.**
- **A global agreement on tackling climate change is reached leading to the EU implementing a target of a 30% reduction in carbon dioxide emissions from 1990 levels by 2020.**
- **The EU 2020 renewables target is met and deployment reaches 30% and 12% in the electricity and heat sectors respectively.**
- **Energy efficiency measures are also effective, and carbon dioxide emissions reduce rapidly.**
- **New nuclear and Carbon Capture and Storage (CCS) demonstration projects are operational by 2020, supported by high carbon prices and/or additional subsidy.**
- **Total energy demand is lower towards the end of the next decade.**
- **Gas demand falls but electricity demand increases on the back of increasing electrification of the heat and transport sectors.**
- **Against the backdrop of economic recovery, investment in gas and electricity infrastructure worldwide is significantly higher than current levels.**
- **There is some rebound in the supply of pipeline gas from outside the EU and of indigenous gas production from recession levels.**
- **As a result, the liquefied natural gas (LNG) market is tight into the medium term, but demand later falls back as renewables investment comes through.**
- **This is a world of high gas and carbon prices but relatively low coal prices due to the shift to cleaner forms of thermal (i.e. gas and coal) production.**[4]

[4] See: *Project Discovery Energy Market Scenarios,* Office of Gas and Electricity Markets, 9 October 2009, pp. 14-15.

DECONSTRUCTING THE GREEN TRANSITION SCENARIO

Yet, just two years on, this scenario is considerably out of sync with today's resource constraints and new trends in global energy markets.

We are not experiencing a rapid economic recovery but one of the weakest on record. There is no binding global agreement on tackling climate change and Europe will not reach its 2020 renewables targets without doubling annual spending to €70bn, according to the European Energy Commissioner, Günther Oettinger.[5]

CCS advocates would disagree, but this immature and difficult-to-scale technology is ultimately dependent on an elusive inter-generational high value placed on CO_2 stored underground. CCS has died a quiet death over the last two years as vast new finds of low carbon gas have emerged as a new competitor to coal in both the developing and developed world.

Meanwhile, rather than falling, UK gas demand set a new record in 2010 at 104.3 billion cubic metres (bcm).[6] If we can read the medium term to mean the period from 2015 onwards, then we really must factor in a huge amount of unconventional and LNG gas becoming more accessible through LNG exports from North America and other countries.

As daily news reports attest, continuing unrest in the Middle East, together with the failure of OPEC to agree a production increase, have thrown the underlying commodity price range assumptions for the Green Transition scenario upside down. For 2011, for example, crude oil prices were given a range of $65-$100 per barrel. In fact, for the first half of 2011, Brent Crude averaged around $110 a barrel. Oil prices have a major impact on UK consumer gas prices because so many of them are still derived from oil price-linked contracts.

And then we had the ultimate 'black swan' event. A tsunami in Japan inundated the backup generators of one of its nuclear power plants at Fukushima, which failed to shut down, triggering panic and worldwide delays in nuclear programmes, nuclear abandonment in Germany and probably delayed UK nuclear construction by two to three years beyond 2020.

> ***The Green Transition scenario is considerably out of sync with today's resource constraints and new trends in global energy markets.***

[5] See: "Renewable Energy Targets: Commission calls on Member States to boost cooperation", European Commission press release, 31 January 2011, available at: http://europa.eu/rapid/pressReleasesAction.do?reference=IP/11/113&format=HTML&aged=1&language=EN&guiLanguage=en.
[6] See: "How the UK meets record gas demand", BBC News Online, 15 February 2011, available at: http://www.bbc.co.uk/news/business-12338189.

BOX 1

The micro-macro paradox of energy efficiency

In his 1865 book, *The Coal Question*, the economist William Stanley Jevons wrote:

"It is a confusion of ideas to suppose that the economical use of fuel is equivalent to diminished consumption. The very contrary is the truth."

William Stanley Jevons
(1835–1882)
British economist and logician

This has since become known as the 'Jevons Paradox': that technological progress that increases the efficiency with which a resource is used tends to increase, rather than decrease, the rate of consumption of that resource.

As might have been expected, the UK's recent recession did reduce energy demand substantially as people and companies went out of their way to cut costs. However, greater energy efficiency can only diminish energy consumption for a short period of time. This is because energy saved in the micro-economy rebounds in the form of money – an additional energy input – in the macroeconomy. Sure enough, in the recovery year of 2010 UK electricity supplies increased by 1.5% to 363,126 gigawatt hours (GWh) and gas consumption reached a new annual high of 104.3bcm.

Unfortunately, the Department of Energy and Climate Change (DECC) does not model for this indirect rebound effect to the macroeconomy, which is why UK governments have for decades been continuously surprised by energy efficiency not yielding lower energy consumption.

Although this is being looked at again, existing DECC policy is only to model the direct rebound effect for some (not all) energy efficiency measures like cavity and loft insulation. Such rebound effects arise where there is an increase in the demand for an energy service because improvements to energy efficiency have made the cost of that service cheaper.

In the domestic sector the direct rebound effect, also known as 'comfort taking', is reckoned to be 40% for vulnerable groups and 15% for non-vulnerable groups following the installation of insulation. The Coalition Government's Green Deal is currently estimated by DECC to create a direct rebound effect of 15%, although this may be split again into two groups depending on their underlying income.

We must accept that unless we have another recession or a dramatic decline in the population, energy consumption is going to increase. And the Government will not have a proper idea of future energy demand until it starts to model the indirect rebound effect with a compound rate.

THE HIGH COST OF ENERGY EFFICIENCY MEASURES

The capital costs for energy efficiency measures can be high, and the cost per tonne of carbon saved very high indeed. It would be useful to have some updated measurements for the Green Deal. However, a 2005 paper commissioned by the Department for Environment, Food and Rural Affairs (Defra), *Reducing carbon emissions from the UK housing stock*, came up with some very high figures and did not include the indirect rebound effect. The paper calculated that if all the measures were enacted, the total capital cost could be as high as £264bn. This should raise doubts about the Renewable Heat Incentive (RHI)[7] introduced earlier this year. The Green Transition scenario forecast that the capital expenditure requirement for renewable heat would be a staggering £52.8bn by 2020. A new study should be conducted on the cost per tonne saved of all the renewable heat technologies eligible for the RHI.

[7] On 10 March 2011, the Government announced the details of the Renewable Heat Incentive policy, an £860m scheme designed to provide long-term financial support to renewable heat installations to encourage the uptake of renewable heat. For more information, see: http://www.decc.gov.uk/en/content/cms/meeting_energy/Renewable_ener/incentive/incentive.aspx.

So, the Green Transition and the accompanying projected investment cost of £200bn is manifestly not happening because the scenario does not match today's reality. Yet even if – by some miracle – this scenario did indeed transpire, would these be optimally allocated resources and would consumers feel justified in paying for it?

TABLE 2

Breakdown by sector of Green Transition investment to 2020

Sector	Investment (£bn)
Nuclear	6.4
Renewables	59.5
Carbon Capture and Storage (CCS)	6.6
Combined Cycle Gas Turbine (CCGT)	4.4
Transmission & distribution	39.5
Interconnectors	1.0
Energy efficiency	16.0
Renewable heat	52.8
LNG terminals	0.7
Gas storage	1.0
Selective Catalytic Reduction (SCR)	1.2
Smart meters	10.0
TOTAL	**199.1**

One would have to say 'no'. The breakdown illustrated in Table 2 is far from being a carefully balanced portfolio, aimed at delivering bang for the buck. Rather, the investment emphasis has been placed primarily on low bandwidth, high cost, short lifespan, intermittent renewables, and experimental technologies that have yet to be proven to be scalable.

THE NOT-SO-WILLING CONSUMER

Deep down, the quietly reluctant utility companies understand that the 'elephants in the room' for the Green Transition scenario are consumers. Will they pay for it or might they demand political action to curb an apparently poorly thought-out programme of over-investment?

The recent uproar after ScottishPower announced that it would increase gas prices by 20% and electricity prices by 10% augurs badly for a huge future investment programme. In fact, this single price jump wiped out half what was forecast by Ofgem as a price rise – 25% – by 2020.

The most alarming forecast was produced in June 2009 by the price comparison website uswitch.com. It predicted that household combined electricity and gas bills could reach £4,733 by 2020, up from £1,243 in 2009. The forecast took into account pricing trends over the previous five years that saw a doubling of bills from £580, and also factored in both volatile gas prices and an estimate of the investment required by the energy industry. Indeed, an Ernst & Young study of the latter has put the cost at £233.5bn, a very similar figure to the Green Transition scenario, as illustrated in Table 3 below.

TABLE 3

Key costs from the Ernst & Young £233.5bn investment scenario

Sector	Investment (£bn)
Renewable energy generation	112.5
Power plants (including gas-fired, coal-fired and nuclear)	52.1
Upgrading pipes, networks and gas storage	39.8
Roll-out of smart metering	13.4
Carbon emissions reduction target	15.7

Source: *Securing the UK's energy future. Meeting the financing challenge*, Ernst & Young, February 2010, Table 1, p. 4.

The Government endeavoured to produce cost estimates too. In July 2010, the Department of Energy and Climate Change published *Estimated impacts of energy and climate change policies on energy prices and bills*.[8] It estimated that domestic retail gas prices would be 18% higher in 2020, and retail electricity prices 33% higher, due to energy and climate change policies. For medium-sized non-domestic customers, the increases in retail gas and electricity prices were put at 24% and 43% respectively.

The trouble is that no one quite knows how much it will cost the consumer as there are just too many variables. The only point of agreement appears to be that bills – usually measured as annual combined gas and electricity bills per household – will go up.

THE RISE OF THE ANTI-PYLON 'NIMBY'

It's not just the cost to the consumer that may scupper the green programme; it just might be the environmentalists. If the UK was to increase wind power seven-fold to 26.8GWh, it would not merely be a lot of wind farms that risked upsetting local residents. By dint of wind farms' location requirements in order to achieve maximum output – windswept and lightly populated areas in Scotland, Wales or at sea – the National Grid will have to transmit power over much greater distances to the population hubs, using many new electricity pylons. These are beginning to cause far more consternation than the wind farms themselves.

THE HIGH COST, LOW BANDWIDTH INVESTMENT EMPHASIS FANTASY

Considering what a large chunk of the £200bn has been allocated to the power sector, uncommon faith has been placed in the

[8] Report available to download at: http://www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/aes/impacts/impacts.aspx.

TABLE 4

Capital expenditure and lifecycle CO_2 costs per major power technology within existing £200bn policy

Technology	£m Capex per MW	% of £200bn	CO_2 grams per kWh
Nuclear	1.250-1.750	3.2	5
Onshore Wind	1.000-1.200	5.5	12
Offshore Wind	3.000	18[9]	20
CCS	2.500	3.3	0
Gas	0.500	2.2	450
Coal	1.800	0	1000

replacement effect of onshore and offshore wind, which diminishes with its growing penetration. With a wind capacity of 5GW, the UK has already reached the point where the National Grid is regularly asking – and paying – wind farms to switch off their turbines as they are not always able to match their supply of power to demand in real time. This is happening 25 days a year.

With a projected swing in matching power of up to 17GW[10] in one hour at a moment of the wind's choosing, one can fully expect these types of payments for non-production from wind farms to become common occurrences and for them to be switched off more often, further negating the reason for their construction.

SMART METERS AND RENEWABLE HEAT TO THE RESCUE?

The lion's share of investment was set to be allocated to wind and its related infrastructure. But questionably large resources were also to be given to untested technologies: smart meters and a renewable heat programme.

To make consumers more energy efficient and reduce their emissions, the following have to be installed by 2020 at the instigation of a UK mandate and an EU directive:

- **27 million smart electricity meters;**
- **23 million smart gas meters;**
- **27 million real time displays;**
- **27 million communications hubs (HAN or Home Area Networks and WAN or Wide Area Networks).**

The official cost of the UK's smart meter programme is put by Ofgem at (a suspiciously round) £10bn.

Thus far, insufficient attention has been paid to the potential

[9] Assuming 12GW of offshore wind and 11GW of onshore wind – this does not include associated offshore transmission costs put at £7bn by PricewaterhouseCoopers in *Meeting the 2020 renewable energy targets: Filling the offshore wind financing gap,* July 2010, based on the Ofgem Green Stimulus scenario.

[10] According to Richard Green, Professor of Energy Economics at the University of Birmingham. See: http://www.bloomberg.com/news/2011-03-02/u-k-ready-to-pay-power-users-to-switch-off-in-negawatt-plan.html.

downsides. There are increasing grounds to believe that the cost could significantly exceed £10bn,[11] that the savings could be much less and that, for a range of reasons, consumers will be less than satisfied – not least due to technological leapfrogging and obsolescence. (What electronic kit lasts for 15 years and, even if it did, must we spend it all over again on another 100 million replacements?)

Meanwhile, spending more than a quarter of the £200bn on renewable heat – equipment like biomass boilers, heat pumps and solar thermal technology – is a huge risk. Experience also suggests that it is unlikely to scale up as envisaged. Currently, around a half of the UK's carbon emissions arise from the energy used to produce heat – more than that consumed to generate electricity. Against that background, the Government has been keen to provide financial incentives for investment in renewable heat technology, especially in the industrial/commercial markets.

To date, renewable heat investment in the UK has fallen far short of its targets. Most proposed schemes are quite complex and carry material risks, from the technological to the financial. Many also involve considerable management time to ensure delivery, with the projected returns – some of which are subsidy-related – being uncertain. With many countries cutting back on renewable subsidies, it seems unlikely that renewable heat investment will take off for some years yet.

THE BIG SIX, NATIONAL GRID AND THE BALANCE SHEET 'CHALLENGE'

Critical assumptions have been made that the 'Big Six' utility companies[12] and the National Grid can – and want to – meet this investment 'challenge'. Challenge is a word that suggests an element of nobility on the part of the person or organisation undertaking it. Yet there's nothing noble about forcing utility companies to leverage

TABLE 5

The financial situation of the Big Six and the National Grid

Company	Market capitalisation (£m)	Net debt (£m)	Enterprise value (£m)
Centrica	16,315	3,312	19,627
EDF Energy	46,514	30,165	76,679
E.on	38,242	33,071	71,313
Iberdrola (Scottish Power)	32,303	21,239	53,542
RWE Npower	20,243	25,439	45,682
Scottish and Southern Energy	12,245	5,362	17,607
National Grid	21,624	19,200	40,824

Source: *Financial Times,* Monday 9 May 2011. Net debt figures from announcements of company results.

[11] Even back in May 2009, Ernst & Young put the cost at a more likely £13.4bn.
[12] Centrica, Scottish and Southern Energy, EDF Energy, RWE Npower, ScottishPower (Iberdrola Group), and E.on.

their balance sheets and increase their prices to UK consumers. It is often overlooked that the UK electricity industry is almost totally owned by the private sector or, in EDF's case, by the French government. It follows, therefore, that large privately-owned companies hold the key to the UK's future energy supply. It should be clear that the current net debt levels of most of these companies leave little room for heavy investment uplifts. And all of them have competing avenues for future investment.[13] There are valid reasons, therefore, to doubt the utility companies' appetite for, and ability to meet, the investment challenge.

TIME FOR A PLAN B

The £200bn Green Transition scenario is undeliverable: the scenario assumptions are not valid, the Big Six and the National Grid can't afford it, the consumers won't have it and the system in all likelihood would not be able to cope with balancing such large quantities of intermittent supply with random demand.

A lower cost Plan B would face these problems head-on by acknowledging some basic facts. The UK should be investing in high bandwidth,[14] low carbon, predictable, long-life baseload[15] capacity.

To keep costs down to the consumer, National Grid and Big Six, the solution is to downgrade substantially those components of the Green Transition that don't fulfil these criteria and increase the profile of those that do.

TABLE 6

Plan B

Sector	Investment (£bn)
Nuclear	15.0
Renewables	10.0
Combined Cycle Gas Turbine (CCGT)	15.0
Transmission & distribution	10.0
Interconnectors	5.0
Energy efficiency	5.0
Renewable heat	2.0
LNG terminals	0.7
Gas storage	5.0
Selective Catalytic Reduction (SCR)	1.2
Smart meters	2.5
Total:	**71.4**

[13] The financial situation of Germany's utility companies is now even more precarious since Germany took the decision to close down its fully amortised nuclear power stations. They are consequently even less likely to find the money to invest in the UK.

[14] The term 'high bandwidth', in this context, means high capacity – large quantities of power, in gigawatts or hundreds of megawatts, in contrast to distributed wind farms producing tens of megawatts at peak output.

[15] 'Baseload' is always-on power. It is best provided by nuclear power stations, which are very expensive to switch off, followed by coal. For this reason, nuclear power never exceeds 80% of a nation's electricity generation (as in France) because, unlike gas, its supply is not suited to following the daily peaks and troughs of demand.

> ***The longer it takes for our policymakers to accept that the £200bn investment will not happen, the more expensive it will be to change direction.***

In plain English this means more interconnectors, nuclear, gas plant and gas storage and much less wind, the related transmission infrastructure, 'energy efficiency', renewable heat and smart meters. The most important components of this programme will be additional subsea interconnectors with France and Scandinavia to create redundancy[16] and increase liquidity in the electricity market, driving forward the nuclear programme on brownfield sites with additional plant orders, and increasing gas storage to arbitrage against extreme supply interruptions. Together, these are the big items that can start to drive down and stabilise prices.

The longer it takes for our policymakers to accept the reality that the £200bn investment will not happen, the more expensive it will be to change direction. We have been here before. It was late 2008 when the then government admitted that the 10% renewables target would not be met by 2010. Chris Huhne and David Cameron will have to move much faster. No doubt they won't like it, but there will have to be a renegotiation of the EU's 2020 target and for a life extension for the UK's existing coal plants under the Large Combustion Plant Directive. It may well take an event such as the break-up of the euro to make this possible and effectively reset the European landscape.

Quite the worst of all worlds would be to keep pretending everything is going to plan. IoD

Dan Lewis is Chief Executive of Future Energy Strategies and the Economic Policy Centre. Visit: www.future-es.com and www.economicpolicycentre.com.

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[16] 'Redundancy' here means spare, back-up capacity. The idea is that by cross-stabilising the National Grid with more interconnectors from abroad, it is possible to reduce the huge cost of demand exceeding supply, for whatever reason, which leads to blackouts.