Transformation Moment
- can Britain make it to the Age of Clean?

Preface

This pamphlet is a 'Call to Arms'. It comes at a time of confused and divisive global politics, accelerating climate damage and a dangerous retreat into tribal answers to international problems. The UK's contribution has been to add to the confusion.

Britain's Brexit decision may or may not run its course. If so, it will almost certainly end in tears. Issues that call for a new 'post 1945' international consensus are being met by a pre-1939 resurgence of narrow nationalisms. These distractions and divisions obscure the bigger challenge of a world spinning towards climate crisis.

Energy policies, on their own, are no 'magic bullet' solution to this crisis. What they offer is a way into radically different choices that are still open to us; ones that might just limit the climate crises, allowing us to live more lightly on the only planet we have.

With or without Britain's approval, an energy revolution is taking place. The forces that transformed telecommunications are doing the same to energy. Britain's difficulty is that, faced with a host of transformative technologies, the government chose to throw its weight behind the past rather than the future: subsidising non-renewable rather than renewable energies; penalising 'clean' solutions in favour of 'dirty', and propping up a rigged energy market.

The most exciting issues raised within this pamphlet touch as much upon 'democracy' as 'technology'.

Countries leading the race into the Age of Clean have benefitted from strong national leadership; changing energy market ground-rules and the thinking that underpins them. But the real momentum for change is coming from the grass roots; from empowered localities and included communities. People are becoming the architects of tomorrow's solutions rather than just recipients of today's problems.

Across the planet, towns, cities, villages and communities are emerging as critical players in the democratisation of energy. They are the key to a different energy politics; one which focusses as much on how we save and share, as on what we produce and consume.

Transformation Moment is a narrative journey, not a 'Techies manual'. It will be overtaken by innovations within the emerging clean-technology sector. What it explores is how energy thinking is being turned on its head, where this is happening ... and how Britain can join in.

Today's global leaders are demonstrating how to live within reducing carbon budgets, how 'clean' and 'smart' can displace 'dumb' and 'dirty', and how active citizens (and localities) can drive the transition to a sustainable future.

If Britain is to become a part of this process it must fundamentally restructure its energy market -

- **Mandating the shift to a more interactive and decentralised Grid**
- **Introducing a UK right of 'local supply'**
- **Establishing a national framework of carbon budgeting (including the reduction of grid carbon levels to 50 gCO2/kWh by 2030), and**
- **Setting out duties to deliver annual reductions in total energy consumption**

Such a change involves a wholesale re-think of tomorrow's energy markets and the rules that govern them. Germany, California, Denmark and Sweden all understood that, to do so, a raft of policies had to be changed *at the same time*. Germany and California passed a dozen pieces of separate legislation in single sessions. Denmark, the real pioneer, now treats 'whole system' transformation as the norm. Norway, the Netherlands and (perhaps) Germany are taking 'transport' into the Age of Clean too.

Countries serious about the Paris Climate Agreement recognise that energy saving and energy storing become as important as (clean) energy generation. Seamlessly, the carbon footprint of food policies and waste re-use will become connected to transport, planning and air quality strategies. Carbon recycling and re-use will be as important as carbon reduction.

What can be produced, used and shared *locally* are already emerging as cornerstones within new *national* energy security thinking. Within this, the role of the State is also being re-defined; providing the legislative, regulatory and fiscal frameworks that underpin transformational change and (increasingly) taking more direct responsibility for the trans-national and intra-national balancing mechanisms that *keeping the lights on* still requires. But it is a politics of empowerment and engagement that is driving the change.

This is the 'Age of Clean'. ***Transformation Moment*** sets out to explore some of the ways in which Britain might become part of it, by -

re-thinking the Grid,
making energy 'systems' more important than individual technologies,
putting 'clean' before 'dirty',
consuming less before producing more,
making citizens and 'local' the drivers of change,
putting carbon reduction duties on energy networks, and
making 'smart', 'clean' and 'light' the new benchmarks of sustainable economics.

Britain does not face a crisis of 'keeping the lights on'. The challenge is just to create an energy system that is sustainable, accountable and affordable for all. This is why the 'Age of Clean' needs a completely different framework of energy thinking.

Transformation Moment recognises that these changes form a battleground. The conflict is not just between the polluting and non-polluting, the national and the local, or between new technologies and old. Ultimately, the most critical issues are rooted more questions of in 'power' -democratic power - than 'energy'.

Who should own, control and hold to account the energy systems that will define Britain's future? *Transformation Moment* is an invitation to shape the answer.

Alan Simpson
April 2017

1. Crisis, what crisis?

If the world were not distracted by the resurgence of regressive, divisive trends in global politics, we might realise that a bigger, existential crisis stares us all in the face. The messages could hardly be clearer.

> "The impacts of human-caused climate change are no longer subtle – they are playing out, in real time, before us," says Prof Michael Mann, at Penn State University in the US. "They serve as a constant reminder now of how critical it is that we engage in the actions necessary to avert ever-more dangerous and potentially irreversible warming of the planet."[1]
>
> *"2016 will be the hottest year ever measured. 2015 set the previous record; 2014 set the one before. Fifteen of the sixteen warmest years have occurred in the 21st Century. Each of the fourteen months from spring May 2015 to July 2016 beat the global monthly temperature record."*[2]
>
> "Arctic sea ice covered a smaller area in the winter of 2016 than in any winter since records began. In Siberia, there is a major anthrax outbreak amongst local people and reindeer, because infected corpses locked in permafrost since the last epidemic in 1941 have thawed. India has been hammered by cycles of drought and flood, as extreme heating parches the soil and melts glaciers in the Himalayas. Southern and eastern Africa have been pitched into humanitarian emergencies by drought. Wildfires move across America; coral reefs around the world are bleaching and dying."[3]
>
> "*February didn't break climate change records – it obliterated them. Regions of the Arctic were more than 16°C warmer than normal – whatever constitutes normal now. But what is really making people stand up and notice is that the surface of the Earth north of the equator was 2°C warmer than pre-industrial temperatures. This was meant to be a line that must not be crossed.*"[4]
>
> "The need for urgent action is clear. The largest body of climate scientists, the Intergovernmental Panel on Climate Change (IPCC), has concluded that if the average global temperature rises by more than 2°C there will be catastrophic effects for humanity and the rest of the natural world[5] and that human influence is the dominant cause of climate change[6]."

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[1] Guardian newspaper, 18 June 2016, Shattered records show climate change is an emergency today, scientists warn http://gu.com/p/4yexh?CMP=Share_iOSApp_Other

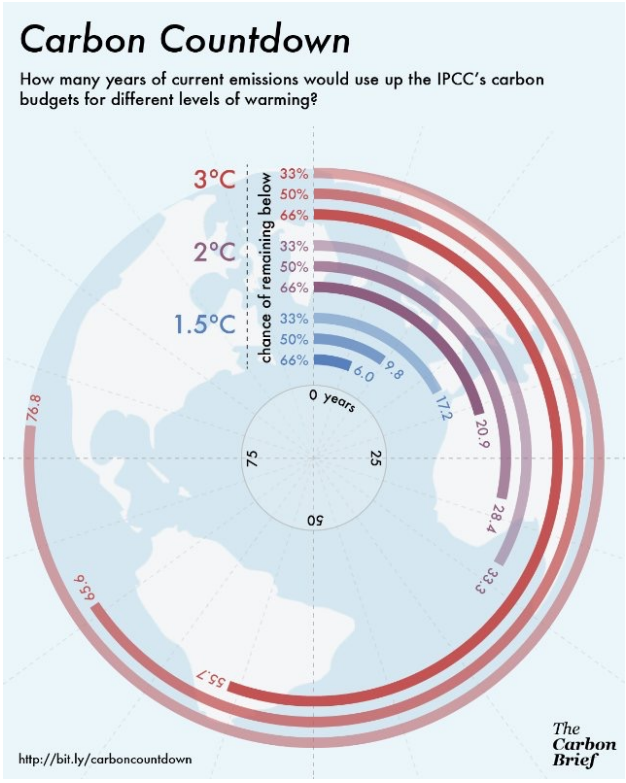
[2] Guardian newspaper http://monbiot.com/2016/08/04/the-purse-is-mightier-than-the-pen/

[3] Monbiot, op cit

[4] http://www.theguardian.com/environment/2016/mar/15/record-global-temperatures-are-shocking-and-yet-we-dont-respond-seriously

[5] IPCC, http://www.ipcc.ch/pdf/assessment-report/ar5/wg2/ar5_wgII_spm_en.pdf

[6] IPCC, http://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5_SPM_FINAL.pdf , p17



Carbon Brief[7] encapsulated these warnings within a powerfully simple graphic.

To give ourselves a 50% chance of holding the world to within a 1.5C temperature rise this century, we have (perhaps) 10 years in which to construct a radically different 'sustainable' economics.

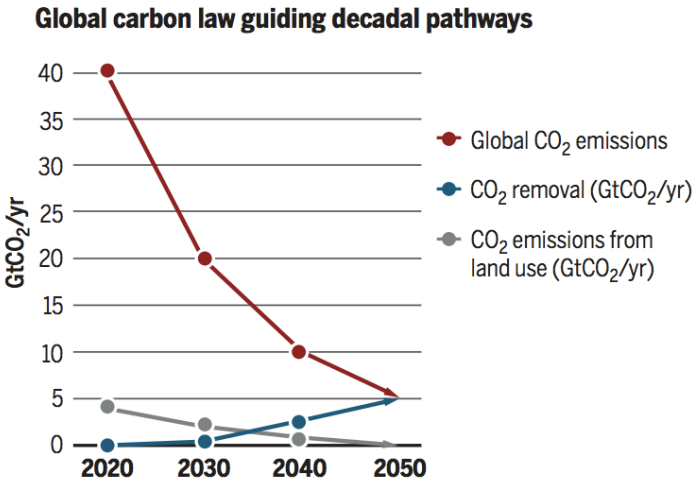
May 2016 was the 13th consecutive month of record global temperatures[8]. The resulting floods, droughts, hurricanes and wildfires touched every part of the planet.

This is the pattern of 'weather' reporting we had better get used to. It will put increasing pressure on global leaders - including Britain's - not only to sign and ratify the Paris Climate Agreement... but to deliver programmes of radical carbon reduction that keep the planet within a 1.5C temperature rise this century.

It may even be too late.[9] As Carbon Brief now points out, on existing trends Britain has just 4 years left of its carbon budget to make reductions that keep the 1.5C target within reach.

This will require the biggest 'peacetime' transformation in human history; a fundamental change in the way we think as much as in how we produce and consume. As the magazine *Science*[10] pointed out, there is no 'slow route' option left.

Practically, we need to ***halve our carbon emissions in the next decade, halve them again in the following one, and halve them again in the third decade***. In Britain, with a government anxious to ditch its climate



[7] Carbon Brief, http://www.carbonbrief.org/scientists-discuss-the-1-5c-limit-to-global-temperature-rise

[8] Guardian, op cit.

[9] http://www.independent.co.uk/environment/scientists-warn-mankind-will-miss-crucial-climate-change-target-eight-months-after-agreeing-it-a7177556.html

[10] Science 355: (1269-1271), 24 March 2017 - The "carbon law" for the 2-degree target, from “A roadmap for rapid decarbonization”, Rockström, Gaffney, Rogelj, Meinshausen, Nakicenovic and Schellnhuber,

commitments, such a conversation has barely begun.

There is no 'magic wand' answer to the problems we have created. The Paris Climate Summit recognised that existing policies - on trade, transport, agriculture and energy - all contribute to making matters worse. Every nation - Britain included - needs a Plan B, of how to live more lightly within the natural limits of this fragile planet. Energy policy will be at the centre of this re-think.

1.1 The *Moment*: when local meets global

The 'transformation' key involves a shift in energy thinking; from power stations to *energy systems.* ***Transformation Moment*** explores some of the ways in which other countries are already making this shift; linking integrated national policies with more localised citizen ownership; focussing on energy systems that deliver more but consume less; putting clean energy before dirty; making energy saving more important than energy consuming; and putting communities/localities at the heart of the transformation process. All this makes citizens the drivers of change, not passengers within a problem.

Such change isn't necessarily driven by the most affluent or hi-tech. Despite the country's wretched dependence on coal, the Indian State of **Uttar Pradesh** set a new world record during the summer of 2016 - involving 800,000 volunteers - planting 50 million trees in 24 hours; an action both humbling and inspiring.[11]

China may have an appalling legacy of carbon emissions and air pollution, but it leads the world in currently *installing one wind turbine every hour*[12] as its part of the global clean-up race. **Uruguay** went into the Paris Summit promising an 88% cut in carbon emissions *by 2017,* largely on the basis of already producing 94.5% of its electricity from renewable sources.[13] **Costa Rica** went one better, already running on 100% clean electricity since 2015.[14]

At some point, Britain must connect with tomorrow's energy thinking. And it's at the level of the local that we might usefully start exploring 'how'.

The village of Wilpoldsried, in southern Germany, is a good place to begin. Wilpoldsried produces 5 times as much energy as it needs; a problem most towns, villages or cities in the UK would love to have.

[11] http://indiatoday.intoday.in/story/india-planted-50-million-trees-in-just-24-hours/1/718368.html, 19 July 2016

[12] Greenpeace, http://energydesk.greenpeace.org/2016/09/08/data-chinas-new-power-demand-met-wind-solar-last-year/

[13] Jonathan Watts, the Guardian, http://www.theguardian.com/environment/2015/dec/03/uruguay-makes-dramatic-shift-to-nearly-95-clean-energy

[14] http://www.theinertia.com/environment/costa-rica-is-running-entirely-on-renewable-energy-so-why-cant-other-countries/

Over the last 17 years Wilpoldsried has built up an impressive array of renewable energy projects, including -

> "... 4,983 kWp of photovoltaics, five biogas facilities, 11 wind turbines and a hydropower system. As a result, the village has gone beyond energy independence – it now produces 500% more energy than it needs, and profits from sales of the surplus power back to the grid."[15]

Cows graze the Wildpoldsried fields, at the foot of village wind turbines that keep the lights on, and which 'fuel' the village finances. The problem the region has been grappling with is how do you integrate this into an energy grid originally designed to support a one-way flow of electricity 'from power station to plug'?

The answer is found in the nearby town of Erlangen, where Siemens constructed a state-of-the-art, energy management centre; running a Smart-Grid that balances, stores and shares energy to provide stability. This is the shape of tomorrow's 'virtual' and flexible energy *systems*. The key is interconnectivity; from the local to the regional, to the national and transnational.

So, at the other end of the scale (and country) -

"Germany's 50Hertz Transmission and Denmark's Energinet.dk have placed an order worth $140 million with ABB for the 'back-to-back' converter station which, once complete, will be the first of its kind in Europe."[16]

The project will develop a single 'converter station' that links clean energy generation in the 2 countries; offering a different approach to energy balancing, sharing and storing. Their interconnector will have a capacity of 400MW; enough to supply the power needs of 400,000 local households.

This is where local meets national, meets trans-national. It is what tomorrow's energy systems will look like; with towns, cities and communities becoming central players in the energy transformation process. For the planet, it will not come before time.

Britain's political parties may have difficulty getting the message but most parts of the energy sector know that, for 'old energy', the writing is on the wall. Nicola Shaw, executive director of National Grid, told the public to 'stop fretting' about 'keeping the lights on' because

> "A 'smart energy' revolution could help ensure that the UK does not suffer blackouts..." adding

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[15] Inhabitat: http://inhabitat.com/german-village-produces-500-of-its-energy-from-renewable-sources/

[16] http://www.pv-magazine.com/news/details/archive/2016/march/beitrag/abb-to-create-140m-converter-station-linking-danish-and-german-clean-energy-projects_100023652/#axzz42yNHkvFT

> "We are at a moment of real change in the energy industry. From an historic perspective we created energy in big generating organisations that sent power to houses and their businesses. Now we are producing energy in those places - mostly with solar power."[17]

More surprisingly, the same message is beginning to come from 'Big Energy' itself.

> "Mark Boillot [a Senior Vice President of EdF] contends that 'large nuclear or thermal power plants designed to function as baseload are challenged by the more flexible decentralised model'. He says that the centralised model of power production is dying, to be replaced by local solar and wind, supplemented by batteries and intelligent management of supply and demand."[18] [19]

Perhaps it should be less surprising, given that ***France*** has introduced laws requiring all new buildings to have solar or nature-friendly roofs.[20] This follows a lead given by the city of ***Toronto*** in Canada in 2009.

The USA expects to see one third of new construction coming in the form of 'green' buildings by 2018[21], with 2016 delivering a bumper summer for solar installations -

> "Between July and September of this year, 4.1GW of solar photovoltaic cells (PV) were installed in the US. That's enough new power for ***one home every 11 seconds*** – using the Solar Energy Industries Association's (SEIA) average figure that 1MW powers 164 homes on average."[22]

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[17] Roger Harrabin, BBC News, 31 Aug 2016, http://www.bbc.co.uk/news/business-37220703

[18] Carbon Commentary, http://us9.campaign-archive2.com/?u=a336c39e55a6260d59adbffb0&id=6945e1e273&e=59b188af48 , 19th February 2017

[19] Le solaire peut-il tout emporter dans l'énergie?, Le Cercle: http://www.lesechos.fr/idees-debats/cercle/0211803366658-le-solaire-peut-il-tout-emporter-dans-lenergie-2065262.php#xtor=EPR-130

[20] CSGlobe, Apr 8, 2015, http://linkis.com/csglobe.com/VoSSj

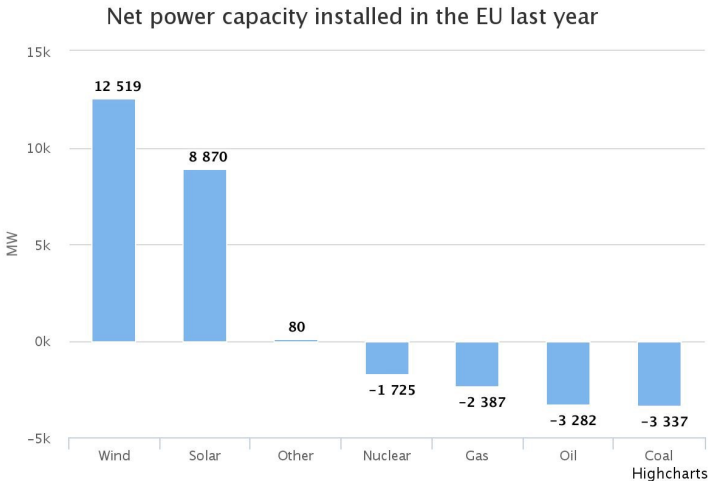
[21] 'One third of US construction market could be green by 2018', Guardian, 19/9/2015

[22] http://www.climatechangenews.com/2016/12/13/us-solar-power-smashes-records-in-2016/

San Francisco now requires all new buildings, of up to 10 storeys, to have solar PV or solar thermal roofs.[23] ***Brazil*** will construct at least 1.2 million 'self-powered' homes by 2024.[24]

Germany has moved from passive-haus to energy-plus designs for new building and (more importantly) is supporting refurbishment schemes for existing buildings that aim for near-zero-energy standards. ***India***, is underpinning plans for 100GW of solar generating capacity (by 2020), with a network of devolved, clean-energy storage schemes.[25] And one of ***New Zealand****'s* leading house builders has announced that all its new homes will be pre-wired for solar power, batteries and electric car charging.[26]

Britain may (or may not) be about to leave **the EU** but it should not ignore Europe's achievements in driving this clean energy revolution. In 2015, across the EU, all new 'net' power additions came from renewable energy.[27]



Britain was responsible for half of the 8GW of new solar generating capacity installed across Europe that year.[28]

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[23] http://reneweconomy.com.au/2016/73875

[24] 1.2m Brazilian homes to be self-powered by 2024, http://news.xinhuanet.com/english/2016-03/08/c_135168620.htm

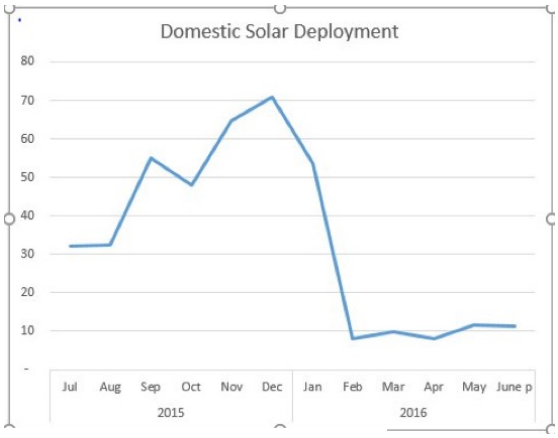
[25] http://www.greentechmedia.com/articles/read/india-wants-more-battery-storage?utm_source=twitterfeed&utm_medium=twitter&utm_campaign=Feed%3A+GreentechMedia+%28Greentech+Media%29

[26] http://www.stuff.co.nz/life-style/home-property/77053905/new-homes-prewired-for-solar-power-batteries-and-electric-car-charging

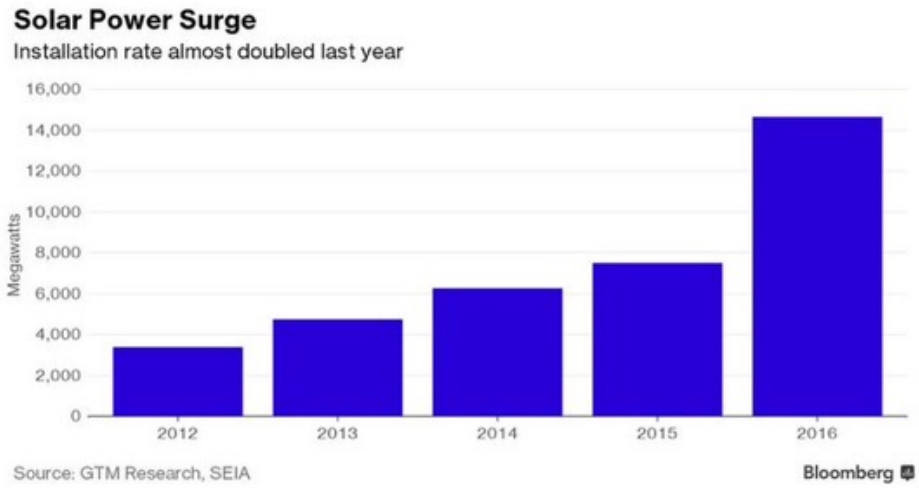
[27] Greenpeace, http://energydesk.greenpeace.org/2016/02/09/data-100-of-the-net-additions-to-the-eus-power-mix-last-year-came-from-renewables/

[28] Solar Power Portal: http://www.solarpowerportal.co.uk/news/uk_installs_roughly_half_of_total_european_solar_deployment_in_2015_4572

Sadly, this was more of a blip than evidence of policy UK leadership. It reflected a public rush to install solar systems before draconian government cuts were made to UK clean-energy tariffs. A bleaker picture was offered in the government's own 2015/2016 figures for solar deployment.[29]

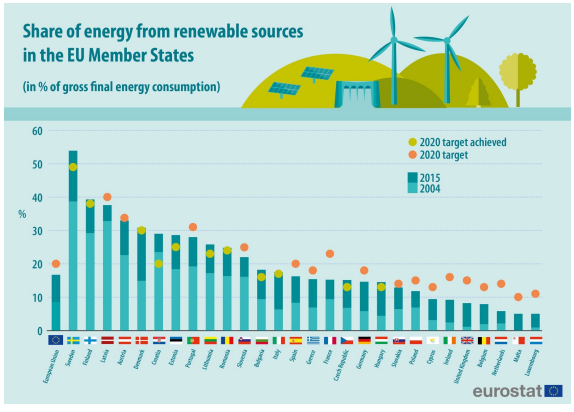


Compare this with the prodigious growth of solar deployment in the USA.



It isn't just solar that the UK has been seeking to constrain. Across the whole spectrum of renewable energy technologies, Britain's performance has been less than inspiring. Compared with its European partners, Britain lags behind the pack.

A roller-coaster of policy changes contributed to the UK's chequered performance.



> "Government policy support, together with falling technology and installation costs, has driven a remarkable surge in renewables investment since 2010. However, this started to slow in 2015/16 as cuts in support took effect. In total, 3GW of renewable electricity and 0.46 GW of renewable heat capacity were installed last year, a third less than the previous year...
>
> England meets 5% of its total energy demand from renewables – still a long way short of the UK's 2020 15% target."[30]

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[29] https://www.gov.uk/government/statistics/solar-photovoltaics-deployment, 25 August 2016.

[30] Renewable Energy: a local progress report for England, https://www.regensw.co.uk/7283018298372873/wp-content/uploads/2016/07/Progress-Report-2016.pdf

Meanwhile, ***Canada, the USA and Mexico*** all pledged to deliver 50% of their energy needs from clean energy by 2025.[31] ***Sweden*** is on track to meet its '100% renewable energy' target by 2040.[32] And ***Scotland*** set

> "...a renewable electricity target to generate the equivalent of 100% of Scotland's own electricity demand from renewable resources by 2020, a target which will require the market to deliver an estimated 14-16 GW of installed renewable capacity."[33]

Often, such progress appears to be in spite of UK government policy rather than because of it. National Grid predicts that ***the UK***, as a whole, will miss its legally-binding 2020 renewable energy target (of 15%) by "up to 9 years".[34]

1.2 Britain needs a new plan.

For a more convincing strategy, Britain could look at the approach taken by ***Denmark***. By 2050 Denmark aims to have a 100% fossil-free economy. Already, 50% of Danish electricity comes from renewable sources; most of it underpinned by citizen shared-ownership.

Denmark symbolises today's fundamental shift in energy thinking; from power stations to energy *systems*, and from unlimited consumption towards a more circular economy. It is an approach that makes the links between energy efficiency, clean transport, waste reduction, water management and energy recovery. Nothing captured this better than their '***State of Green***' video, outlining the country's 2050 roadmap towards a fossil-free economy.[35]

The most important aspect of the changes taking place, however, is not to be found in any array of clean technology solutions, nor in the leadership of national governments. It is in the emergence of localities and citizens movements, unwilling to wait for national leadership that sometimes isn't there.

This is what ***Transformation Moment*** seeks to connect with.

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[31] http://www.theguardian.com/environment/2016/jun/28/us-canada-and-mexico-pledge-50-of-power-from-clean-energy-by-2025?CMP=Share_iOSApp_Other, 28 June 2016.

[32] http://www.dailymail.co.uk/wires/reuters/article-3869478/Sweden-track-meet-100-pct-renewables-target-2040-regulator.html, 25 Oct 2016

[33] Energy in Scotland 2015, p9, http://www.gov.scot/Resource/0046/00469235.pdf

[34] http://www.bbc.co.uk/news/science-environment-36710290, 5 July 2016

[35] 'State of Green: Join the future. Think Denmark'. https://m.youtube.com/watch?v=-JxKOJSNNBQ

2. Rethinking 'energy'

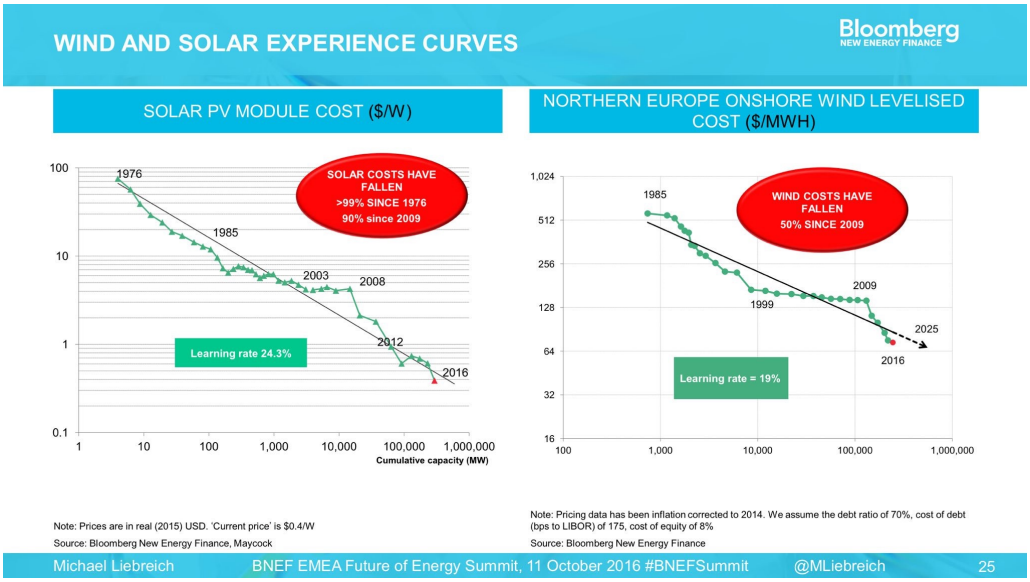
Energy is a vital part of everyday life. It powers industry and keeps us warm. It runs our transport and keeps the lights on. Energy has brought huge benefits to humankind, but also heavy costs. Today's energy systems are largely based on dirty, outdated, dysfunctional and anti-democratic structures. The key challenge is to transform energy thinking along lines that will -

- avoid climate crises,
- keep people's homes warm (i.e. end fuel poverty), their transport systems moving, and electronic/communications systems running,
- make communities and localities active partners in more accountable energy systems, and
- develop more flexible approaches to energy security.

All this has a cost but, as others have discovered, the economic benefits of transformation vastly outstrip its costs. This has undoubtably drawn on the huge reductions in clean energy technology costs.

In ***Germany***, their *Energiewende* programme has been a driving force in the tumbling global costs of both solar power and onshore wind.

Internationally, the fall in solar and wind costs has been little short of astonishing.[36]



Solar will achieve grid parity within the decade. Where permitted, onshore wind energy has already done so; now being cheaper than oil, gas, and coal power stations.

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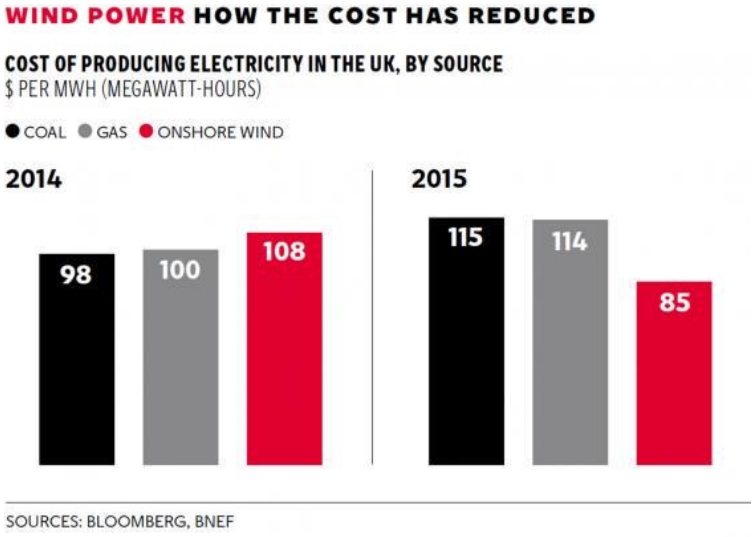
[36] Michael Liebreich, Oct 11, 2016, https://about.bnef.com/presentations/liebreich-state-industry-keynote-emea-summit-2016/



In 2016, Vattenfall won a contract to supply Denmark will (off-shore) wind electricity at a groundbreaking price of €49.50/MWh.[37] The Netherlands then awarded a second contract for its 'Borssele' wind farm, supplying electricity at €54.5/MWh.[38] Energy pricing (and thinking) will never be the same.

Within the UK, Scotland hopes to become a world leader in wind power, developing prototype turbine blades that are 50% lighter, 30% stronger and almost 10% cheaper than existing ones.[39]

What the UK lacks is a secure market and development plan. It also lacks the insight Denmark has brought to the question of public acceptability of on-shore wind.

The majority of Danish wind turbines are community-owned. The popularity/acceptability of this enabled Denmark set a world record; delivering 42.1% of its annual electricity needs from wind power alone. Moreover,

> "The Danish parliament wants the Scandinavian country to get at least half of its electric power from wind by 2020. According to the forecast, this target looks to be met. By 2030, the country hopes that 90% of the electricity and heating supply will come from renewable energy."[40]

But real transformational change comes when this energy can also be sold locally - at discounted rates - and where markets can 'sell' energy saving (the consumption of 'less') in preference to the production of more.

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[37] http://energydesk.greenpeace.org/2016/11/15/offshore-wind-power-vattenfall-denmark-record/

[38] https://www.government.nl/latest/news/2016/12/12/dutch-consortium-to-construct-second-borssele-offshore-wind-farm

[39] Scottish blade to cut wind costs: http://www.scottishenergynews.com/scottish-start-up-set-to-lead-charge-of-the-renewables-extra-light-blade-for-home-grown-turbine-manufacturing-sector/

[40] http://www.euractiv.com/section/climate-environment/news/denmark-breaks-its-own-world-record-in-wind-energy/ 15 Jan 2016.

2.1. Old energy: an existential crisis

Clean energy is throwing the business model of conventional energy into an existential crisis. Disinvestment campaigns disrupt the viability of coal and oil investment[41],[42] while the U.S. Fracking industry rides a tidal wave of bankruptcy and debt.

> "Nearly a year of low oil prices has been a disaster for drillers of oil and gas in American shale. Their costs of production are mostly far above sales prices, notwithstanding innovative improvements in the cost-efficiency of fracking. They have only been able to keep going because of Wall Street's willingness to shovel mountains of debt in their direction: nearly a quarter of a trillion dollars of it to date, mostly junk rated.
>
> Eight drillers have already gone bankrupt and many more can be expected not to survive the review by banks of credit lines coming up in October. Analysts speak of imminent carnage. The US shale boom is heading for bust. There is a whiff of sub-prime in the spectacle".[43]

Alongside this, nuclear, with an ever-rising cost curve - and ever-elusive disposal strategy - runs from crisis, to delay, to cost over-run ... and always in the pursuit of eternal public subsidies.[44]

The astonishing level of UK public subsidy demanded by new nuclear almost defies understanding.[45] With the estimated public costs of Hinkley Point now running at over £37bn[46] the whole basis of the UK debate looked drunk, deluded, or both. No wonder the government hit the 'pause' button.

Better, cheaper, alternatives are pouring in.[47] Vattenfall's off-shore wind farm development[48] (set to supply electricity 10 years earlier and 25% cheaper) was just the first to expose the paucity of thinking behind Hinkley Point. The UK decision to press on may still be relying on EDF's financial incompetence to pull the plug.

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[41] http://www.telegraph.co.uk/business/2016/03/16/world-coal-giant-peabody-faces-bankruptcy-as-industry-implodes/

[42] Reuters:'Rockefeller Family Fund hits Exxon', 23 March 2016, divests from fossil fuels, http://mobile.reuters.com/article/idUSKCN0WP266

[43] Jeremy Leggett: http://www.theguardian.com/business/economics-blog/2015/oct/06/conservatives-21st-century-energy-crisis-20th-century-fuels.

[44] http://www.jonathonporritt.com/blog/hinkley-c-most-expensive-white-elephant-british-history 15 Oct 2015.

[45] http://www.jonathonporritt.com/blog/hinkley-point-insanity-just-keeps-giving ,14 March 2016.

[46] Damian Kahya, http://energydesk.greenpeace.org/2016/07/07/hinkley-fall-in-wholesale-price-adds-billions-to-consumer-costs-says-decc/

[47] http://www.thetimes.co.uk/edition/business/investors-finally-spot-the-obvious-xlvr5lcds, August 26 2016

[48] http://www.telegraph.co.uk/business/2016/09/14/new-record-for-cheapest-offshore-wind-farm/

The real problem for nuclear, however, lies in its claim to be the provider of 'base-load power', when base-load power will not be at the centre of tomorrow's energy systems.[49] Flexibility, transparency, locality and interactivity are already becoming more critical cornerstones.

Traditional energy industry assumptions are being torn apart, only to be replaced by markets that are lighter, smarter, more interactive and adaptable than today's.

In Germany, by the end of 2012, "190 communities had been successful in bidding to run their local grid (at least nine of these being co-operatives) and 70 municipal utilities had been founded."[50] Internationally, a burgeoning array of towns, cities and regions are en route to becoming their own 'virtual' power stations.

Tomorrow's 'smart energy systems' will need to

- ***deliver more, but consume less***
- ***take clean energy before dirty***
- ***use smart technologies for localised balancing and storage and***
- ***be more open, democratic, sustainable and accountable.***

Countries embracing such changes will become the leaders of the clean energy revolution. Those living in denial will become its laggards. Countries wedded to an unsustainable energy past will become the inheritors of an unaffordable energy future. At the moment, Britain is amongst the laggards.

2.2. A different starting point

Britain could begin its own transformation by shifting government financial support from 'bads' to 'goods'. This is not just about the extortionate cost of new nuclear. According to the IMF, in 2014 Britain spent 7 times as much on fossil fuel subsidies as it did on renewables.[51],[52]

Professor Ian Arbon, at the Institute of Mechanical Engineers, described this with painful clarity:

> "The UK is the only country in the world who thinks it is going to hit its renewable targets by doing more fossil fuels."[53]

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[49] Chris Nelder,"Why baseload power is doomed" – see http://www.zdnet.com/article/why-baseload-power-is-doomed

[50] Caroline Julian, p13, http://www.respublica.org.uk/wp-content/uploads/2015/01/creating-local-energy-economies-lessons-from-germany.pdf

[51] http://www.renewableuk.com/en/news/renewableuk-news.cfm/2015-08-04-imf-stats-show-uk-fossil-fuels-still-get-billions-in-subsidies-while-renewables-slashed

[52] IMF, Counting the Cost of Energy Subsidies, http://www.imf.org/external/pubs/ft/survey/so/2015/NEW070215A.htm

[53] http://www.theguardian.com/environment/2016/feb/04/from-liquid-air-to-supercapacitators-energy-storage-is-finally-poised-for-a-breakthrough?CMP=share_btn_link

The latest UK government proposal - a £1bn Shale Wealth Fund - to bribe the public into supporting the insupportable case for Fracking - would merely fuel the crisis[54]. It exemplifies the paucity of leadership that drives UK energy and climate thinking.

Perversely, the UK government has (mis-)used such public subsidies at the same time as cutting programmes that promote energy efficiency, zero-carbon homes and carbon taxation. None of this makes any sense. Instead Britain needs to -

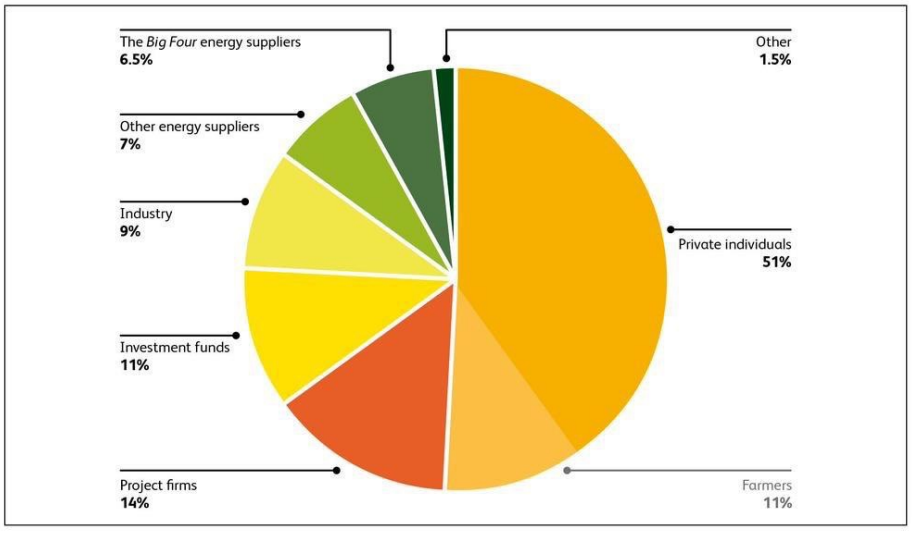
- **Introduce a UK 'right of local supply'**, where the benefits (and cost savings) of clean energy production can be shared within the communities delivering it.
- **Use towns and cities as the drivers of change**, promoting the innovative social partnerships needed to deliver security within a more sustainable energy system.
- **Put energy efficiency at the heart of new energy obligations**, making energy saving (the consumption of 'less') a central element in a new era of 'Smart',
- **Rethink the Grid**, it's structure, priorities and responsibilities; including an extended role for existing Network Operators (DNO's), allowing them to act as service providers and co-investors in the delivery of devolved carbon budget, and
- **Become a leader in decentralised and innovative energy storage systems**.

3. Local Supply

The importance of decentralised energy in today's transformations has as much to do with democracy as electricity. The involvement of households and communities is central to its success.

Germany's *Energiewende* programme already has over 83GW of installed capacity of renewable electricity generation. The most important aspect of this is found in the new pattern of energy ownership.

German renewable energy ownership.



Craig Morris, 'Citizens own half of German renewable energy', Energy Transition website, 29th October 2013, http://energytransition.de/2013/10/citizens-own-half-of-german-renewables/

[54] Caroline Lucas, https://www.theguardian.com/commentisfree/2016/aug/09/climate-ministers-bribe-local-fracking-environment

Over half of clean energy generation in Germany is owned by households, communities, farmers and localities. By giving this priority access to the Grid, Germany also uses it to drive down peak prices. This has profoundly changed public expectations about their entitlements within a more democratic energy system.

> *"A typical household in Germany can choose to buy energy from around 72 different suppliers out of 1,100 supply companies nationally. Almost half of these are owned by local government, communities and small businesses. Meanwhile Britain has around 25 active energy suppliers, with the big six squatting on a 93.5% share of the retail supply market last year. Germany's big four had a mere 43.8% share."*[55]

and where

> "...by the end of 2012, 190 German communities had been successful in bidding to run their local electricity distribution grid, with at least nine of these being wholly community-owned ventures."[56]

German citizens (in towns, cities and communities) can sell (locally) the energy they produce themselves. It helps to connect the climate/carbon saving agenda to the cost-saving one.

At the moment, **Britain has no right of local supply**. UK households (and schools) that produce surplus electricity (mainly solar) put that surplus into the Grid. For this, households can get paid an 'export bonus' of 4.91p/kWh.

The trouble is that, when households buy the electricity back, it costs 3 times as much. For those on pre-payment meters it is even more expensive.

The obvious answer would be for communities to sell (or share) surplus electricity with their neighbours, at somewhere between the 2 prices. Those without south-facing roofs (or without the money to install PV systems) could then share the benefits of this ability to drive down electricity prices. The same would apply for electricity from a community wind turbine or community-hydro. This is what also drives the pace of change in Denmark.

For a while, Britain did look as though it intended to go down the same path. The 2010 Coalition government wrote a promise to promote *'community-owned renewable energy generation'* into their Coalition Agreement. The Treasury, however, soon kicked this into touch; limiting DECC consultations to a question of community *engagement* but not of *ownership*. There was no mention whatsoever of a right of local supply.

And so it remains.

It has been generally illegal for people in Britain to sell electricity into a local market. In order to avoid being a criminal, you must sell into a national market, at a national price ... Oh, and there's the little matter of a Supply Licence.

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[55] Leo Murray, http://www.theguardian.com/sustainable-business/2015/jul/10/uk-energy-system-in-thrall-to-giant-utilities-customers-budget-renewables

[56] Leo Murray, op cit

Obtaining a full Supply Licence costs in excess of £3 million. Understandably, most households don't bother. Nor do the schools or community energy co-ops involved in clean energy (solar, wind or hydro-) schemes. Historically, big energy interests have simply blocked out local supply options.

In countries with smarter, localised, energy systems, localities may see electricity bought at better wholesale prices, sold at lower retail prices, and whole towns and communities being better off... but not in Britain.

Instead, 'solar schools' have been asked to pay over £1million for grid connection of their school roof. Godalming F.E. College was quoted £2 million for connection of its phase-2 solar roof extension. In Wales, community wind co-ops have been quoted over £6 million for grid connection. In parts of the South-West, they are just told that the grid is 'full'; no amount of money will buy them connection.

It is hard to know whether to describe this as sabotage, folly or just a persistent pattern of British 'organised underachievement'.

Yet despite the government's wholesale assault on renewable energy support mechanisms, Britain still has just over 1 million installed solar roofs. Solar continues to deliver the fastest falling price of all renewable energy technologies. It could so easily be turned from a threat to a success story.

In Germany, the government adjusted its level of tariff support for solar and wind, to deliver roughly 3GW of new installed capacity/year. Efficiency gains drove down prices, but within an expanding market sector. Britain failed to grasp this, adopting a restricted market framework that was only ever designed to fail.

Every time industry managed to produce cheaper/better PV panels, DECC dramatically cut its tariff payment rates; turning a success story into a roller coaster of redundancies.[57] It also prevented solar from becoming one of the new norms in house building/renewal strategies.

DECC made no secret of its fear that ambitious local authority/social housing programmes would make the widespread installation of PV roofs the new norm[58]. Bringing the poor into the 'clean energy' game (and cutting their energy bills) was never part of the Treasury plan, so support was slashed.

This had an absurd logic to it, and nothing to do with public costs. The Chancellor's £1bn Budget subsidies to the oil industry[59], his 'freedom to pillage' offered to Fracking, and the

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[57] More than half of jobs in UK solar industry lost in wake of subsidy cuts, http://gu.com/p/4kzgy?CMP=Share_AndroidApp_Gmail , 10 June 2016

[58] Independent, 08 November 2014, http://www.independent.co.uk/news/business/news/power-to-the-people-a-revolution-in-britains-energy-market-9847890.html

[59] New Economics Foundation, 18 March 2016, http://www.neweconomics.org/blog/entry/energy-round-up-another-1-billion-tax-cut-for-oil-and-gas

open wallet promised to new nuclear[60], made it clear that Britain's central choices had more to do with politics than energy. Local leadership may be the place to look for fresh thinking .

4. Towns and cities; joining the big 600 million.

The real drivers of today's change are as likely to be found outside national governments as inside. The largest of these movements is the recently formed ***Global Covenant***; an agreement signed by the Leaders of over 7,100 of the world's major towns and cities.[61] As Michael Bloomberg said at its launch in June 2016,

> "Today, the two biggest coalitions of cities in the world – the EU-based *Covenant of Mayors* and the UN-backed *Compact of Mayors* – are forming an alliance to link more than 600 million city dwellers in the fight against climate change.
>
> Cities are key to solving the climate change challenge. They account for most of the world's carbon emissions, and mayors often have control over the largest sources. Just as importantly, mayors have strong incentives to attack those sources because steps that reduce carbon also improve public health and strengthen local economies."[62]

Europe already has a strong ***EnergyCities*** movement of over 1,000 localities, with several leading the race within a "POst-CArbon CIties of TOmorrow" project.[63]

The excitement contained within this movement brings its own challenges, not least the challenge of leadership. The local is losing patience with the national. The most visionary leadership increasingly emerges from towns and cities with little interest in the constraints of yesterday's technologies and yesterday's politics. The scene is set for numerous conflicts both between Big Society and big business, and between the local and the national. Even now, you can see this being played out.

> "One example of the growing friction: ***Oslo***, where left-wing authorities are at odds with ***Norway's*** right-wing government over their push to more than halve the capital's greenhouse gas emissions within four years, to about 600,000 tonnes - one of the most radical carbon reduction intentions in the world.
>
> The plan for the city of 640,000 people includes car-free zones, 'fossil-fuel-free building sites', high road tolls and capturing greenhouse gases from the city's waste incinerator.
>
> In a sign of city power, a 2016 study projected that climate plans by cities and regions could cut an extra 500 million tonnes of annual greenhouse gas emissions

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[60] http://www.theguardian.com/uk-news/2016/mar/18/hinkley-point-c-nuclear-deal-22bn-poison-pill-taxpayer?CMP=share_btn_tw

[61] Global Covenant: http://www.edie.net/news/9/Michael-Bloomberg--Our-new-alliance-unites-600m-city-dwellers-in-fight-against-climate-change/ , 23 June 2016.

[62] Global Covenant, op cit.

[63] see Local authorities in energy transition, http://www.energy-cities.eu/

by 2030 - equivalent to the emissions of France - beyond cuts pledged by governments."[64]

Globally, all the energy market ground rules are set to change. The market influence of 600 million city dwellers makes this a certainty. They will be joined by millions more, in rural and off-grid communities, in both industrial and developing nations of the world. What needs to be addressed is how best to shape this transformation 'in the public interest'.

Britain's towns and cities could also provide the leadership parliament currently lacks. A UK 'right of local supply' would offer immediate connection to *Global Covenant* transformations that other city leaders are able to promise. It is a leadership that begins and ends in 'clean'.

For a long time London looked to have taken the 'local supply' lead, with proposals for a *License Lite* shell company. This was to allow Londoners (or at least London Underground) to buy back clean electricity they produced for themselves. The gestation period for *License Lite*, however, has tested the patience of even its most ardent supporters. The new Mayor promises to turn this into something real and transformative. Londoners hold their breath.

One *municipal* energy company, however, did make it through the bureaucratic nightmare of Britain's regulatory processes. This was the ***Robin Hood Energy Company*** in **Nottingham**[65].

Robin Hood Energy is the first, not-for-profit, municipal energy company to be formed in Britain since 1948. It still has to offer 4 tariff rates (an Ofgem requirement), but the lowest of these tariffs is specifically for those who live within Nottingham itself.

Robin Hood offers a lower local rate by keeping overheads down and reinvesting all surplus revenue back into the company. Its 40 staff members do not receive bonuses and its directors are not paid a salary.

Robin Hood has its drawbacks. It is not a 'clean' energy company and has no network of renewable energy suppliers. But is is 'local', and its business model - as a not-for-profit, municipal energy company - may provide the breakthrough Britain has been looking for.

Already, cities like **Manchester, Leeds, Liverpool,** and **Newcastle**, with their own ambitious transformation plans, are looking at the Nottingham model to see if it can be borrowed, copied or 'white labelled'. This may be the easiest way for other localities to join the energy game. But what follows must be ***Robin Hood 'plus' -*** 'plus' being ***the right to take clean energy before dirty, the right to save, store and share locally, and a duty to reduce overall energy and carbon consumption.***

In this journey, *Robin* hasn't been alone. Merry Bands of men and women have been working on it all around Britain's 'energy' forests.

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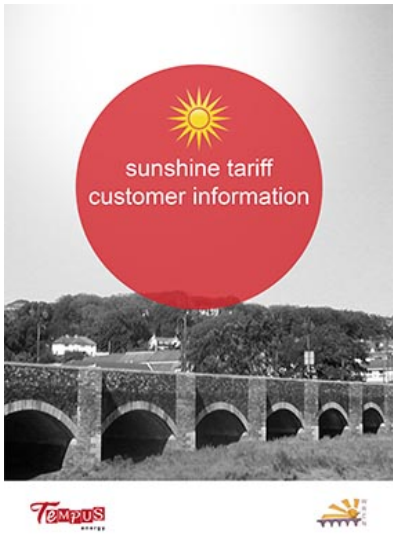
[64] 'In race to curb climate change, cities outpace governments', http://www.reuters.com/article/us-climatechange-cities-insight-idUSKBN16K0JI Reuters, March 13, 2017

[65] http://www.theguardian.com/environment/2015/sep/07/robin-hood-energy-nottingham-council-launches-not-for-profit-energy-company

In **Wadebridge, North Cornwall**, - where 1 in 10 homes already have solar roofs[66] - a pioneering partnership between *WREN* (Wadebridge Renewable Energy Network), the consistently innovative RegenSW, electricity supplier Tempus Energy, and Western Power Distribution, has launched a unique project in Great Britain.



WREN offers cheap electricity, at fixed times every day, when solar power drives down electricity wholesale costs.

Their ***'Sunshine tariff'*** offers daytime electricity at as little as 5p/kWh, but higher rates (18p/kWh) for later use; looking to by-pass the Grid 'lock out', get more (low cost) renewables into the system, and pass the benefits on to consumers. [67]

Bristol, after forming its own local energy company[68], is funding a series of community solar programmes to boost the City's generation of clean, socially-owned, energy.[69]

Exeter, Stoke, Hull, Salford and Southampton all have ambitious 'whole city' plans of their own, and **Swindon** have used a 'Green ISA' to finance a solar farm, able to supply 100% of their domestic electricity needs by 2020.[70]

Bethesda, in Wales, is trying to do the same on a smaller scale; supplying themselves with electricity (at 7p/kWh) from a community hydro scheme *(Ynni Ogwen)*[71] and looking at a 'virtual' net metering system that allows preferential charging for the whole local community.

By clubbing together, 100 households in the Gwynedd village are able to purchase the power generated by a local hydro scheme for half the retail price of electricity.[72]

Glasgow plans to become the centre of an energy revolution that could radically alter how cities power homes and businesses. It's ambitious proposals involve establishing a

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[66] http://www.bbc.co.uk/news/business-32782324, 25 May 2015

[67] 'Sunshine powers electricity bill savings for Wadebridge homes' | Regen SW: April 2016, https://www.regensw.co.uk/blog/2016/04/sunshine-powers-electricity-bill-savings-for-wadebridge-homes/

[68] http://www.bristolpost.co.uk/Plans-approved-set-Bristol-Energy-company-owned/story-26849524-detail/story.html

[69] http://www.solarpowerportal.co.uk/news/bristol_solar_projects_to_receive_new_grant_funding_from_city_council , 15 April 2016

[70] 'For cleaner, more powerful communities', UK 100, http://uk100.org/images/UK100_Round_Table_November_2016.pdf,

[71] https://ntenvironmentalwork.net/2016/02/24/sharing-shares-and-social-media/

[72] BBC News, 12 December - http://ow.ly/lnTp3074NeH

community-owned company to convert derelict land or buildings into renewables hubs; weaning the city off its reliance on the national grid.[73]

If there was a UK prize for joined-up policy making **Scotland** would currently run away with it. Scotland already boasts a 39.5% reduction in greenhouse gas emissions, making it the second best performer across the whole of Europe[74]. It also has one of the most ambitious clean-energy programmes.

'***Our Power',*** **Scotland** - a new energy supply company established by Scottish social housing providers - aims to reduce heat and fuel costs to 200,000 homes across Scotland; passing on the energy sector savings directly to local communities; not paying dividends to shareholders but reinvesting profits to the benefit of customers. And *Our Power* will buy a minimum of 30% of its energy from renewable sources.

> "*Our Power* entered the market at the end of 2015 as an Ofgem licenced supplier of gas and electricity. It plans to be selling heat and power to tenants in 200,000 homes across Scotland by 2020. It expects to save its members up to ten per cent on their household utility bills compared to standard commercial tariffs. Over the next five years, this could see up to £11 million of savings for households in some of the most disadvantaged communities across the country. In the future, *Our Power* hopes to develop renewable energy projects as part of its business for the benefit of local communities. *Our Power* is backed by £2.5m from the Scottish government and another £1m from Social Investment Scotland."[75]

Scotland's plans run much further. The ***Scottish Climate Change Delivery Plan*** sets out four major transformational outcomes:

> • A largely decarbonised electricity generation sector by 2030.
> • A largely decarbonised heat sector by 2050 (with significant progress by 2030).
> • Almost complete decarbonisation of road transport by 2050 (also with significant progress by 2030).
> • A comprehensive approach to ensure that carbon (including the cost of carbon) is fully factored into strategic and local decisions about rural land use.[76]

Under the Climate Change (Scotland) Act 2009 public sector bodies, including local authorities require ***Carbon Management Plans*** for tackling climate change; reducing carbon emissions from local authority operations and estate. Moreover, many of these plans were being translated into local action through the ***Covenant of Mayors***.

Signatories to the Covenant in Scotland currently include **Aberdeen, Aberdeenshire, Dumfries and Galloway, Edinburgh, Glasgow, and North Ayrshire**.

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[73] http://www.scotsman.com/business/companies/energy/could-glasgow-become-scotland-s-biggest-power-station-1-4100482, 14 April 2016

[74] http://www.energylivenews.com/2016/08/02/scotland-ranks-second-in-cutting-emissions-in-western-europe/?utm_source=Daily+Carbon+Briefing&utm_campaign=190b6d7b1b-cb_daily&utm_medium=email&utm_term=0_876aab4fd7-190b6d7b1b-303470677

[75] Pete Roche, http://www.microgenscotland.org.uk/news/news-2016/role-local-authority-energy-companies-community-energy-co-operatives-building-low-carbon-energy-system-scotland/

[76] Pete Roche, July 2016, op cit, p.6

In **Wales,** the policy is heading in the same direction. The Environment and Sustainability Committee of the Welsh Assembly urged the new Welsh Government to form a public, not-for-profit energy company - along *Robin Hood* lines - to serve the whole of Wales.[77]

Ahead of the 2015 Paris Climate Summit, over **50 Labour local authorities** pledged to run on 100% renewable energy by 2050.[78] To this should be added similar interests from a string of **Conservative controlled councils**, including **Peterborough, Woking, Bournemouth, Swindon, Suffolk, St Albans and Northamptonshire**; the point being that the biggest existential challenge of out lifetime is being addressed beyond party political boundaries ... and beyond the gates of Parliament.

This is the dawning of ***'the Age of Clean',*** and with it will come the democratisation of energy itself. Britain may have led the way in the last 2 energy revolutions, but it must play catch-up in the current one. As the Guardian pointed out -

> "...in some countries, like Germany, there is a long tradition of local companies taking care of electricity and gas networks, telecoms, waste and water. We are witnessing a revival of locally integrated network companies partly motivated by smart city initiatives supported by local governments."[79]

In 'post-Trump' USA, a host of towns, cities and States are heading down the same path. Twenty five cities have already committed to becoming '100% renewable-energy cities'.[80] Major cities, including **New York** and **San Francisco** have set ambitious plans (and budgets) to radically accelerate their own shift into renewable energy. Whole States are doing the same.

The leader of the pack is undoubtably **San Diego;** the one major city (so far) with **a legally binding commitment to 100% renewable *energy* by 2035** - not just renewable electricity, but their entire power and transport systems too.[81] Not far behind comes the Canadian city of **Vancouver**, with the same pledge of 100% renewable *energy* by 2050.[82]

There is now an international (unstoppable) dimension to this movement, from which Britain's major political parties have remained sadly detached. ***What the UK needs is to give the same delegated powers to towns, cities and communities across the land.***

But real 'climate' leadership requires something more.

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[77] A Smarter Energy Future for Wales, http://www.senedd.assembly.wales/documents/s49669/Report%20-%208%20March%202016.pdf

[78] http://www.cleanenergynews.co.uk/news/efficiency/labour-councils-make-clean-energy-pledge-1010 Nov 23 2015

[79] 'Will the micro-grid put major power companies out of business?' Guardian, 23 July 2014

[80] 25 Cities Now Committed to 100% Renewables, http://www.ecowatch.com/cities-commit-renewable-energy-2324917492.html

[81] http://www.nytimes.com/2015/12/16/science/san-diego-vows-to-move-entirely-to-renewable-energy-in-20-years.html?_r=0

[82] http://www.vox.com/2016/7/26/12074370/vancouver-100-percent-renewable, July 26, 2016

4.1 Après Paris: the carbon connection.

The Paris Summit put the world on notice. Whatever Donald Trump thinks, ***climate duties will have to underpin all mainstream economic policies ...*****including any right of local energy supply**. If it were to grasp this, Britain could become a genuine leader in the energy transformation process.

Localities, looking for the right to deliver their own energy security, will need to work within a framework of climate security, and climate security will become inseparable from rapid reduction of our carbon footprint. It is a process that will re-define economics itself.

For the UK the simplest approach would be via one of the recommendations of the government's Climate Change Committee. At the end of 2013, the CCC noted that -

> "... decarbonising the power sector to an average grid intensity of around **50 gCO2/kWh** remained an appropriate objective for 2030."[83]

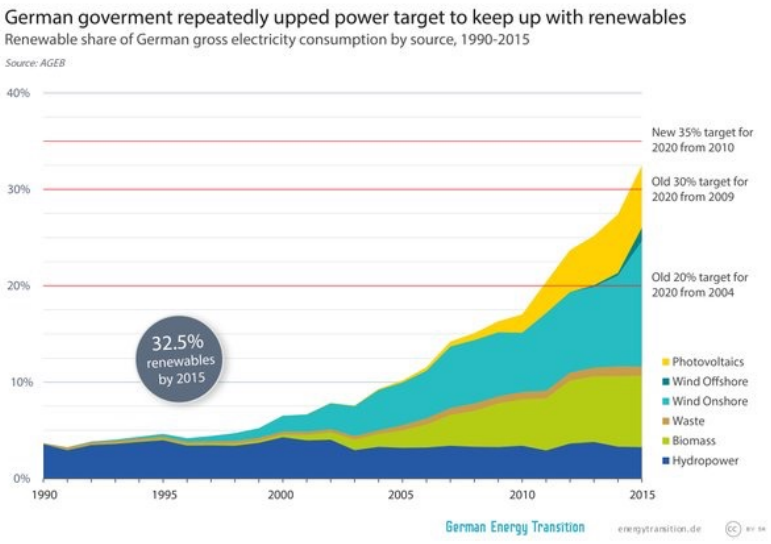
This must be turned into a statutory duty.

Elsewhere, the same message is beginning to sink in. Parts of the United States are already doing so. State/regional governments have been able to place climate/carbon consumption obligations on their distribution network operators. Network operators (DNOs) then discover there are more productive (energy saving) collaborations to be found with cities and housing providers than in supply contracts with power stations.

This will be the shape of any sustainable 'post-Paris' world; one that will place carbon-reduction duties on distribution grids, set demand reduction targets on localities and put an increasing reliance on clean energy.

In Germany, national targets are deemed to be local duties. Sustainability, accountability and security become the pillars of a quite different 'competitive' energy market.

What keeps the German momentum on track has been a public, self-critical appraisal of how much more they might do[84]... and a willingness to use every step as the basis of raising targets even further.



Moreover, Germany turned this into benefit rather than a cost.

'Transformation' brings with it a host of practical challenges - grid balancing, the management of

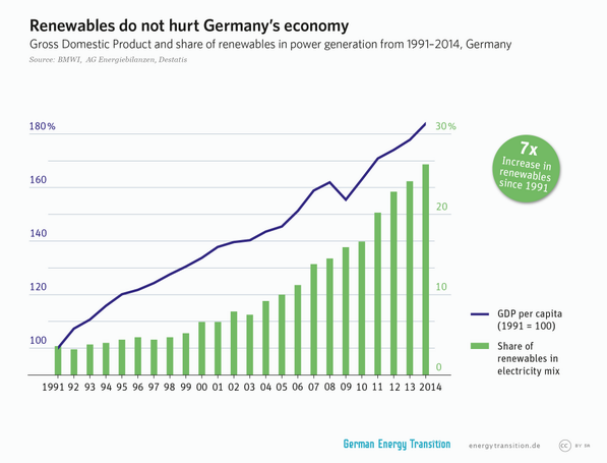
[83] https://www.theccc.org.uk/wp-content/uploads/2013/12/1785b-CCC_TechRep_Singles_Chap2_1.pdf

[84] Report on the German power system - Agora Energiewende www.agora-energiewende.de/fileadmin/.../Agora_CP_Germany_web.pdf

peaks and troughs in demand, the means of local infrastructure investment, the mechanisms for taking clean energy before dirty, and how to prioritise the consumption of 'less'. But two central trends are emerging -

- new 'smart' technologies are making answers to Grid balancing problems much simpler to find, and

- the switch into energy markets that consume 'less' is opening up new ways of simultaneously tackling climate change, fuel poverty and economic wellbeing.



4.2 Joining up the dots

If Britain is looking for fresh visions of joined up policy making, beyond European shores, there are plenty it can draw on.

California scheming. Just before midnight on 12 September 2015 the California State legislature rushed through

> "...a package of 12 bills addressing environmental and health concerns, such as off-shore drilling, divestment of investment funding from coal companies, water quality, energy efficiency in disadvantaged communities, and increased public transportation."[85] ...
>
> "The most far-reaching climate change goals of the climate bill package were enshrined in **SB 350**. The proposed Bill ... called for a 50% reduction in petroleum use in cars and trucks, a 50% increase in energy efficiency in buildings, and for 50% of the state's utility power to be derived from renewable energy, all by 2030; termed **the "50-50-50" formula**."[86]

Intense lobbying from the fossil fuel industry subsequently forced the targets for reduced petrol use in cars to be dropped - though the Governor insists these will be met through other means - but the energy saving and clean energy commitments remain. Moreover, the California Energy Commission (CEC) has been given new duties to drive these changes through.

Not to be outdone, in January 2016, **New York State** Governor, Andrew Cuomo, launched a $5bn Clean Energy Fund to drive the City's clean energy economy. Central to this was the commitment

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[85] 'California passes groundbreaking legislation increasing renewable energy and energy efficiency mandates... ' http://www.lexology.com/library/detail.aspx?g=b0bf0bcb-7b30-4965-b065-704807996833

[86] California passes groundbreaking legislation... (above) http://www.lexology.com/library/detail.aspx?g=b0bf0bcb-7b30-4965-b065-704807996833

> "... to accelerate the growth of New York's clean energy economy, address climate change, strengthen resiliency in the face of extreme weather and lower energy bills for New Yorkers ... starting this year."[87]

Other U.S. States have been taking a different approach; placing grid-performance/carbon reduction duties on electricity network operators. The result is to open up new strategic partnerships with localities - investing in energy efficiency upgrading of existing buildings as the most direct way of delivering demand reduction and carbon saving.

In **Canada,** the State of **Ontario** launched a $7bn, 4 year, radical Climate Action Plan, in which

> Ontario will begin phasing out natural gas for heating, provide incentives to retrofit buildings and give rebates to drivers who buy electric vehicles. It will also require that gasoline sold in the province contain less carbon, bring in building code rules requiring all new homes by 2030 to be heated with electricity or geothermal systems, and set a target for 12 per cent of all new vehicle sales to be electric by 2025.[88]

In each case, the key has been the adoption of challenging carbon reduction *duties*, which themselves lead to integrated energy efficiency programmes across different sectors. This turns joined-up thinking into joined-up doing. But *it begins from a binding duty to do so...* and energy saving is the key.

5. Energy efficiency: the key to connectedness

Britain has some of the most energy inefficient housing in Europe, and one of the highest rates of fuel poverty. The Green Building Council argues that 25 million homes need refurbishing to the highest standards by 2050 - at a rate of 1.4 homes every minute - if Britain is to seriously cut carbon emissions.[89]

This has to be the starting point for any radical reduction in the amount of energy Britain wastes. Politicians may argue about the rate of new house building but the more critical question is 'what will Britain do with the 26 million homes it already has?'

Heating the buildings people live and work in accounts for over 60% of domestic energy consumption and 50% of UK carbon emissions. Energy conservation is the low-hanging fruit in tomorrow's low-carbon economies. It creates jobs, saves lives and cuts carbon faster than any other measure. Moreover, one recent study estimated the size of

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[87] http://www.governor.ny.gov/news/governor-cuomo-launches-5-billion-clean-energy-fund-grow-new-york-s-clean-energy-economy?mc_cid=79a0942c2f&mc_eid=0cb11e14c9

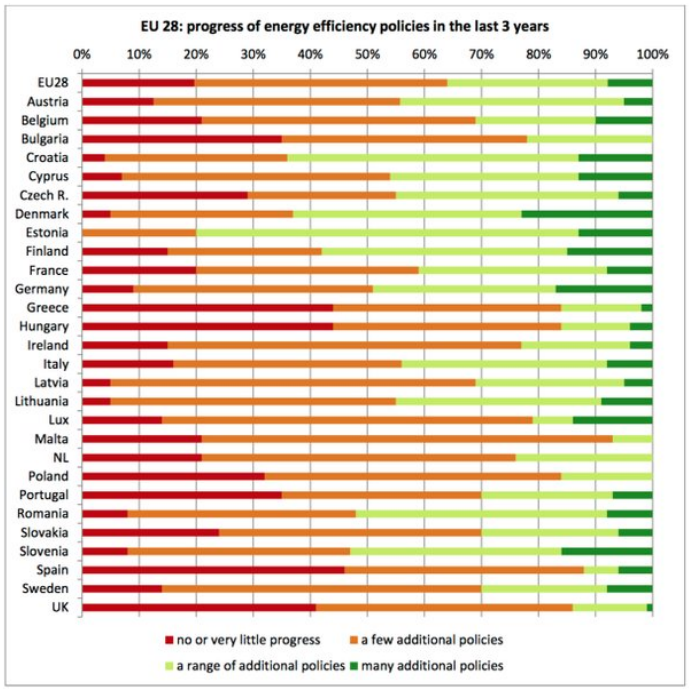
[88] Toronto Globe and Mail, 16 May 2016, http://www.theglobeandmail.com/news/national/ontario-to-spend-7-billion-in-sweeping-climate-change-plan/article30029081/

[89] UK 'must insulate 25 million homes', Green Building Council, http://www.bbc.co.uk/news/business-39107973, 28 Feb 2017

> "... the EU energy renovation market at EUR 109 billion in 2015 and 882,900 jobs. It shows that the size of the EU energy renovation market could increase by almost half the current energy renovation market if a 40% energy savings target is adopted for 2030. This would lead to more than one million additional jobs."[90]

Unfortunately, this is another policy area that seems to have been blindsided by BREXIT.

In April 2016, Ecofys produced a European analysis of recent progress made in energy efficiency policies across Europe.[91] Britain's performance was sobering.



The paucity of the UK position - limited progress and even more limited new policies - was a combination of factors;

- insufficiently robust building standards, patchwork home improvement strategies, and

- an enduring policy subservience to 'lower standards' demanded by Britain's construction industry and private landlords.

Far too often, the U.K. addressed short-term conveniences measures rather than long-term consequences; reflecting a lack of political will more than a shortage of cash.

On 23 October 2015, Britain's Communities and Local Government Minister made such short-termism unambiguously clear -

> "As detailed in the Productivity Plan - *'Fixing the foundations: Creating a more prosperous nation'* - the Government will ***not*** be implementing zero-carbon homes. The zero-carbon homes standard, in particular the 'allowable solutions' carbon off-setting element, would have placed a significant regulatory burden on the house building industry."[92]

Britain's abandonment of its zero-carbon homes standard (originally set to apply to all new housing construction from 2016 onwards), the collapse (in disrepute) of its Green Deal energy efficiency programme[93], and the low level/long lead-time of minimum standards set for the private rented sector, all sent out perverse signals about Britain's commitment to

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[90] http://www.openexp.eu/publications/energy-transition-eu-building-stock-unleashing-4th-industrial-revolution-europe, 22nd July 2016

[91] Ecofys analysis: http://www.eceee.org/all-news/news/news-2016/2016-04-08b

[92] Hansard, 23 October 2015, Written Answer 12628

[93] http://www.theguardian.com/environment/2016/apr/14/green-deal-scheme-did-not-deliver-energy-savings-audit-finds

reducing energy consumption. This was reflected in the low level of new UK initiatives in the Ecofys analysis.

Moreover, a disproportionate number of Britain's fuel-poor households live in private-rented properties. These are the households most affected by regulatory standards rather than grant inducements. Now, local authorities seeking to set higher minimum standards for private rented properties have seen their powers reined in even further by Ministers. Local authorities

> ..."need to request permission from Whitehall if they want to introduce licensing schemes covering more than 20% of privately rented homes in their area."[94]

Post BREXIT, it may cease to be relevant to ask how this squares with Britain's legal commitments within *the 2010 EU Energy Efficiency Directive*. Under Article 7, however, Britain pledged legal improvement targets for existing buildings, specifying -

> “That target shall be at least equivalent to achieving new savings each year from 1 January 2014 to 31 December 2020 of 1.5 % of the annual energy sales to final customers of all energy distributors or all retail energy sales companies by volume, averaged over the most recent three-year period prior to 1 January 2013.”[95]

And for all new buildings

> "Member States shall ensure that by 31 December 2020 all new buildings are nearly zero-energy buildings; and after 31 December 2018, new buildings occupied and owned by public authorities are nearly zero-energy buildings". Member States shall furthermore "draw up national plans for increasing the number of nearly zero-energy buildings".[96]

When/if Britain leaves the EU such commitments may go out of the window. But - in or out - energy efficient buildings (and an end to fuel poverty) offers the fastest route into carbon reduction, and into markets delivering more jobs but less energy.

Germany offers one of the clearest frameworks for doing so. Central to their approach is the role given to their KfW Bank. This is Germany's equivalent of the Green Investment Bank (only with real cash, and a much clearer ecological remit).

Germany's energy efficiency programmes cut out power companies completely. Instead, the KfW Bank de-risks clean energy investment, then loans money directly for energy efficiency improvements... *and does so at 1% interest rates*.

The German programme has been underpinned by formal Bank targets/priorities to deliver

- ***a 50% reduction in primary energy consumption by 2050 (20% by 2020)***
- ***doubling the refurbishment rate of existing buildings, and***

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[94] 'Rogue landlords 'let off the hook by ministers',' Nigel Morris, i@inews.co.uk, 12 April 2016

[95] Article 7, EU Energy Efficiency Directive 2010/31

[96] Article 9, EU Energy Efficiency Directive 2010/31

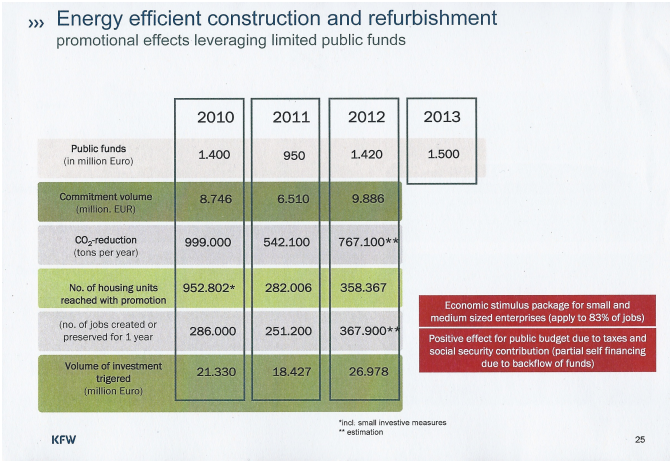
- ***cutting the primary energy consumption of* 'buildings' *by 80% by 2050.***

The KfW Bank reinforces its low interest loans with long payback periods and partial debt relief/write-off. The higher the standard of energy efficiency a home is improved to, the higher the portion of the loan (up to 17.5%) the Bank is prepared to write off/convert to a grant.

The effectiveness of the programme can be seen in the outcomes table presented by the Bank itself.[97]

Bank officials proudly point out how much of these costs come back in taxation.

Some 2/3 of the jobs created in the German *Energiewende* programme are now in energy efficiency and installation services, all within the domestic economy - feeding income, consumption and taxation back into domestic circulation.



The practical consequences of this can be seen (creatively) in every town and city in Germany.

Blocks of flats in Hamburg have had conventional balustrades replaced by solar ones, flats provided with curtains and wall coverings that are 'phase-change materials' - absorbing heat during the day/releasing it at night - and solar thermal systems on the roofs.

In Munich, the Akermanbogan estate's solar thermal roofs have been linked to a sealed (and landscaped) reservoir that supplies several apartment blocks, cutting heating bills in half. Surpluses are 'pooled' within their district heating network.

In Freiberg, 'energy-plus' housing supplies more electricity to the local grid than they consume.

The KfW de-risked much of this investment by taking responsibility for designing the loan protocols; training High St bank staff to deliver

[97] KfW Bank presentation, Co-op study tour, 2014

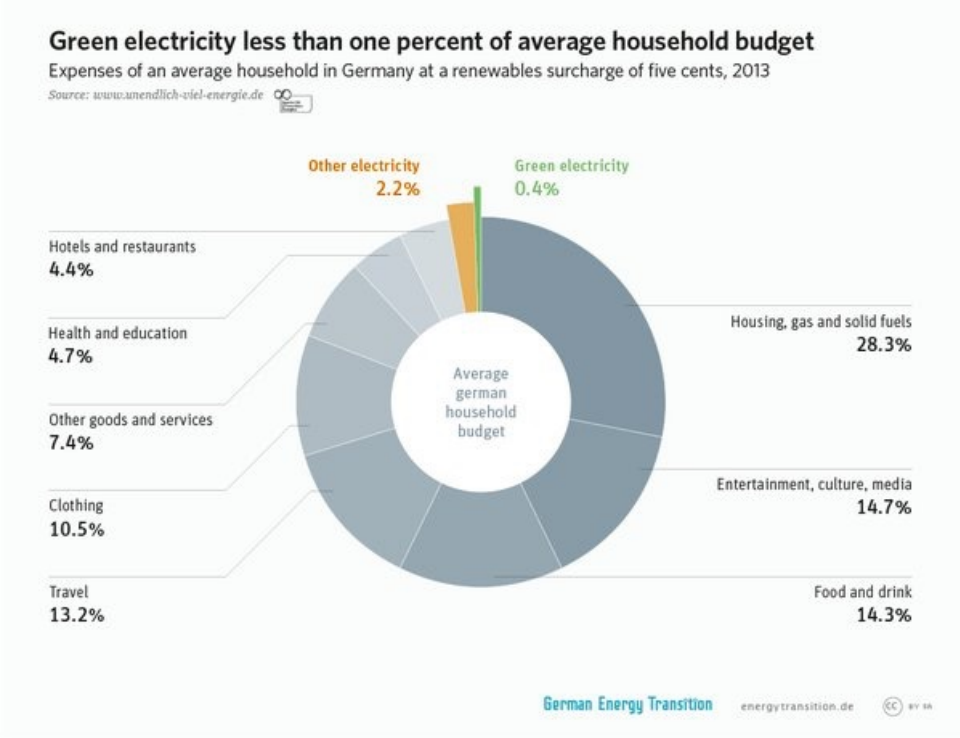
loan approvals quickly... and with a minimum of fuss; a far remove from the bureaucracy and delay wrapped up in a succession of UK housing and fuel poverty programmes.

In addition, the KfW finances work on 'whole area' strategies as well as improvements in individual homes. In 2012, the Bank

> "...started a special and successful support scheme entitled “Energetische Stadtquartiere” that provides financial incentives to municipalities to plan, organize, and implement district-wide retrofit schemes and to implement district heating networks. In addition, within the urban development promotion programs and another programs targeted towards municipalities, efficiency measures and the installation of renewable and district heating infrastructure is funded.[98]

Fundamentally, what Germans have grasped (and what Britain has not) is that the gains from such programmes can be socialised, not just the costs.

For all the fuss Britain makes about 'expensive' energy in Germany the reality is that **energy efficiency and clean energy policies form just 0.5% of average German household spending.**



The key lies in grasping that joined up ***strategies - rather than individual technologies*** - is the key to a different economics; one that can deliver jobs, skills, innovation, economic gain, security and 'smart', all in one go.

Britain's has showed little interest in following the German model, extending the remit (and resources) of a Green Investment Bank, or the Danish/North American models (driven by higher regulatory standards). Nor has parliament driven a meaningful national energy

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[98] Energy-Conservation Ordinance (EnEV) and financial support schemes – http://energytransition.de/2012/10/energy-conservation-ordinance-enev-and-financial-support-schemes/

efficiency programme or set demanding requirements that power networks reduce annual energy consumption.

Yet this is the change in energy thinking Britain must somehow engage with.

A 'smart cities' movement needs to be at the heart of this, demanding not only **devolved powers** but also **devolved carbon budgets** to operate within. This is would put energy efficiency and energy saving at the centre of the transformation process. Such additional duties are also the key to democratic renewal.

Leading voices in commerce and industry have been making their own efforts to go carbon-neutral[99]. Many already invest in on-site, clean-energy generation. Many more would welcome integrated policies that incentivise energy saving, waste reduction, recycling and re-use. In energy terms, all are constrained by the rigidities of UK energy thinking.

Pioneers within the Smart Cities movement have grasped that this is what invites them to become drivers (and co-ordinators) of a much bigger change agenda.

The leadership of a UK transformation movement will be found in towns and cities whose Leaders shift their focus from 'ownership' to 'partnership'. For some, it will be a bridge too far, for others it will bring about the most rejuvenating democratic change in over a century.

Localities will need powers to set grid-performance (and demand-reduction) targets for energy distribution networks; opening up new possibilities for co-financing energy efficiency programmes. Local (not-for-profit) energy companies can become vehicles for developing smart systems for energy storage, clean generation and cross-sector use ... all at lower costs to consumers. And these partnerships will need to include communities and community co-ops that have often been held at arms length from local decision making.

And one way or another, all of us will have to learn how to 'dance differently' with the Grid itself.

6. Re-thinking the Grid

No one is going to democratically re-structure the Grid without at least a basic grasp of what it is, and how it works. Alongside electricity, heat and power form the complementary parts of Britain's energy equation.

Heat accounts for 45% of UK energy use and is responsible for the bulk of residential greenhouse gas emissions. The UK's Committee on Climate Change (CCC) provided the most useful info-graphic of the significance of 'heat' within Britain's bigger energy picture.[100]

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[99] 'Setting the Pace', Aldersgate Group, http://www.aldersgategroup.org.uk/asset/download/513/AG%20Report%2007.2016%20-%20LowRes.pdf, Sept 2016

[100] https://www.theccc.org.uk/2016/10/13/infographic-the-future-of-heating-in-uk-buildings/

Even more useful are their 2 reports on Next Steps for UK Heat Policy[101] and Best Practice in Residential Energy Efficiency Policy.[102] Paradoxically, the more devolved nature of heat networks has also led to more contentious divisions between the competing technologies that form part of the answers.

The good news is that 'heat' is an area that generates as many answers as it does obstacles. These range from 'green gas' to zero carbon homes, from power-to-gas to the hydrogen economy.

Ecotricity, for example, has been trialling its 'grass to gas' proposal for a network of Green Gas Mills, claiming that by 2035 -

"The construction of 5,000 Green Gas Mills, each of 5MW capacity, would be enough to supply 97% of British households and would create around 75,000 jobs and pump £7.5 billion into the rural economy."[103]

	Low ambition	Middling ambition	Maximum Green Gas
Green Gas Mills	1000	2500	5000
Green gas generated (TWh)	42.5	106.3	212.5
UK households supplied (%)	20%	49%	97%
Estimated carbon saving (mn tCO2)	6.6	16.6	33.2
Revenues generated per year (£mn)	1500	3750	7500
Employees	15000	37500	75000

Table 1. Green Gas Mills 2035 scenarios
Source: Ecotricity calculations, Energy Savings Trust, DECC

The scale of these claims (and their land-use implications) were almost instantly challenged, along with other existing UK policies promoting the use of bio-fuels.

Homes need heating, but an increasing body of evidence suggests that neither maize, nor grass, nor any other bio-fuel is the answer, unless Britain tackles the problem of cold homes first.

> "The sad truth is that biogas from crops, alongside so many other approaches to bioenergy production, deliver very little apart from the opportunity to harvest large subsidies from the public purse, which as we know is rather empty at the moment.

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[101] https://www.theccc.org.uk/wp-content/uploads/2016/10/Next-steps-for-UK-heat-policy-Committee-on-Climate-Change-October-2016.pdf

[102] https://www.theccc.org.uk/wp-content/uploads/2016/10/Annex-3-Best-practice-in-residential-energy-efficiency-policy-Committee-on-Climate-Change-October-2016.pdf

[103] Green Gas, https://www.ecotricity.co.uk/download/file/1728102/36631822/file/green-gas-report.pdf, October 2016

> If we really wanted to do something about reducing carbon emissions, there are probably better ways of using the money – like a massive national housing insulation project."[104]

Answers will invariably come in a combination of technologies and strategies. An array of green 'solutions' - including syngas and biogas, from waste, and hydrogen from wind/solar surpluses - will join in. All will add to existing local 'heat' plans running from **Cornwall** to **Newcastle**, **Leeds** to **Southampton**, and from **Peterborough** to **Edinburgh**.[105]

What really matters is whether the various solutions are used to *democratise* the UK energy sector or not. These are the lessons Britain has to learn from Europe and elsewhere.

If technology solutions fail to directly reduce energy costs to the poor, they will remain 'developer' solutions, not 'consumer' ones. Tomorrow's smart-energy systems will undoubtably embrace far more flexible connections between power, heat, electricity and transport. The more critical questions are about who will be the owners of the new 'smart'.

The basis of a more democratic and sustainable energy 'system' probably needs to begin with electricity.

6.1 From one-way street to two-way traffic.

Physically, the electricity Grid is the hard-wiring that moves electricity around the country.

Much like the roads network, it is a combination of 'motorways', 'trunk roads' and 'local roads'. The Grid is the system we use to connect power producers to consumers, and is responsible for the balancing and back-up storage of electricity. It is what 'keeps Britain's lights on'.

For the technically minded, parliament produced a 2001 handy guide to the Grid itself.[106] You don't have to be an engineer to grasp its outlines. There are several levels at which the Grid operates:

- the high voltage ***transmission*** network (**400kV-275kV**) from power stations to distributors (DNOs), and
- localised ***distribution*** networks (**132kV-230V**) serving the majority of customers.

Within the (regional) distribution networks there is also separate provision for large and small scale industrial consumers (**33kV-11kV**) and for household supply (**230V**).

For most people, the relevant starting point is their own home - the small (230V) end of the electricity system. It is the point where 'keeping the lights on' matters most. No one really

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[104] Sense and Nonsense on Biogas, December 15, 2016, https://anewnatureblog.wordpress.com/2016/12/15/sense-and-nonsense-on-biogas/

[105] 'For cleaner more powerful communities', UK 100, op cit

[106] UK Electricity Networks - Parliament, www.parliament.uk/documents/post/pn163.pdf

has a direct connection to the high voltage transmission grid. If we see any connection with others it is only in recognition of our common dependence on the local sub-station(s).

Britain's current electricity grid was designed as a one-way street; a 'power-station to plug' supply system, intended to sell electricity but not to receive it. Smart cities and smart technologies are turning this thinking on its head.

Many countries already refer to the public as 'prosumers'; households and businesses that are both producers and consumers of (clean) electricity. Towns, cities and villages are beginning to treat these producer/consumers as the core of their new energy systems. For Big Energy, this has become an existential challenge.

A system designed to sell consumption doesn't welcome invitations to sell less. It is even less enthusiastic about paying customers for energy they generate themselves. Power stations that used to be at the centre of everything, suddenly aren't.

What the UK needs to understand is that other/wider choices already exist...without anyone's lights going out.

> "About 48 million Americans, in over 2000 cities and districts, get their electricity supplied by public sector companies, at a price which is on average 12% lower than the price charged by private energy companies. This represents 14.5% of the total market – and a further 13% are supplied by electricity co-operatives...
>
> "Over 80% of the distribution networks [in Germany] are now owned and run by organisations owned by the regional and municipal public authorities. Municipal organisations – 'Stadtwerke' – supply half of all the electricity in Germany to households. Stadtwerke have also developed a greater role in generation of electricity, mainly in order to develop renewable energy much faster than the private sector..."[107]

Part of the UK answer could be to separate discussions about the High Voltage Transmission grid (which National Grid and central government have an enduring responsibility for) from those about regional Distribution Networks and more dynamic local grids.

Tentatively, some of this is reflected in the proposed change of Distribution *Network* Operators (DNOs) to Distribution *Systems* Operators (DSOs). The big caveat is that the proposed changes do not include rights - currently denied to DNOs - to discriminate in favour of clean (and local), or to any duty to reduce annual grid-carbon content and overall energy consumption.

These rights/duties become essential if Britain is to move rapidly towards a low-carbon economy and catch up with changes taking place elsewhere. Rapid advances in communications technologies are making it possible for 'micro-grids' - serving much smaller areas - to transform grid operation, energy security and system financing. Examples of doing so now run well beyond the boundaries of the German village of Wilpoldsried.

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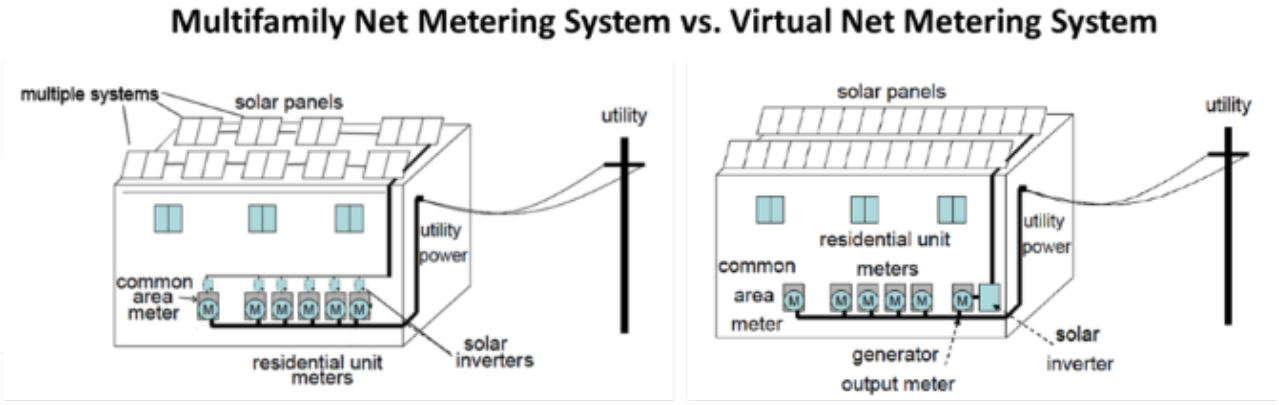
[107] David Hall, op cit, p6

6.2 Micro-Grids: where 'smart' meets 'local'.

Internationally, the biggest changes in grid and energy thinking are being found in partnerships that don't include big energy generators. They revolve more around localities and smart technology providers.

California's 'MASH' programme[108] - 'Multi-family Affordable Solar Housing' - offers community-scale scheme 'virtual' net metering, allowing collectively generated solar power to be shared equally between tenants in the whole scheme. By July 2013, 6,265 social tenancies were benefitting from schemes delivering almost 100% of their electricity - and which power common/lighting services - before putting surpluses into the grid.



Source: www.cpuc.ca.gov

Not to be outdone, the **Brooklyn** district of New York set up its own ***'TransActive Grid'***, within which

> "Instead of being locked in to buying (and/or selling) electricity through a large utility company, TransActive Grid (TAG) will allow for greater choice for consumers, and can help individuals become local energy providers by selling their excess rooftop solar electricity production to other local residents or businesses."[109]

The micro-grid planned for Brooklyn is being developed as a partnership between LO3 Energy and Siemens Digital Grid in the US. For the first time, a micro-grid control solution from Siemens is being combined with the peer-to-peer trading platform from LO3 Energy, known as the TransActive Grid.

> "This solution will enable 'blockchain'-based, local energy trading between producers and consumers in Brooklyn's Boerum Hill, Park Slope, and Gowanus neighborhoods as well as balance out local production and consumption.
>
> ***Blockchain technology*** is an innovative method of storing and validating data that permits direct transactions between energy producers and consumers. Transactions are trackable and tamper-proof on distributed systems without the need for centralised monitoring. Thanks to a cryptographic process and distributed

[108] M*A*S*H - as 'smart' as it gets. Alan Simpson, https://t.co/tCryNhH1jD?ssr=true

[109] http://www.decentralized-energy.com/articles/2016/03/brooklyn-to-host-pioneering-microgrid-project.html

> storage, the possibility of manipulation is virtually eliminated. In addition, authentication processes guarantee the confidentiality of user data.
>
> The combination of a microgrid control solution and blockchain technology will make it possible for a provider of photovoltaic systems on the roofs of buildings in Brooklyn to feed its excess electricity back into the existing local grid and receive payments from the purchasers."[110]

In an effort to break into the **Australian** energy market, the Germany battery company 'Sonnen' is even offering free electricity to customers who join their virtual grid.

> "The deal, called 'Sonnen flat', offers free power to households using the company's integrated solar and storage system, including for any electricity drawn from the grid when the sun goes down and stored energy is used up.
>
> In return, Sonnen has access to its customers' installed battery storage capacity to use as a sort of virtual power plant, to provide grid balancing services to network operators – most of the time, without any discernible impact at the customer's end.
>
> ...you buy a Sonnen battery to go with your solar and don't pay for electricity any more."[111]

Similar micro or mini-grids are also emerging in the emerging economies of **Bangladesh, Pakistan, the Yemen and Peru**[112], along with island nations including the **Dominican Republic, Samoa, Fiji and Indonesia**[113].

Within Europe, September 2016 saw the village of **Eeklo** (in **Flanders, Belgium)** hosting the first gathering of areas involved the EU's own '***Nobel Grid'*** Project.[114] Funded as part of the Horizon 2020 Programme, this involves partners in 5 pilot areas, developing their own ***dynamic local energy grids.***

Eeklo's 'Smart Grid' revolves around *Ecopower*, a co-operative that is both a renewable energy producer and retailer. *Ecopower* has nearly 50,000 co-operative members and more than 40,000 customers, consuming 98GWh annually. The village already has eight wind turbines, a solar system and cogeneration based on biomass.

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[110] http://www.decentralized-energy.com/articles/2016/11/siemens-and-lo3-energy-to-develop-brooklyn-blockchain-microgrid.html

[111] https://onestepoffthegrid.com.au/german-battery-maker-offer-free-power-slice-australian-electricity-market/?utm_source=RE+Daily+Newsletter&utm_campaign=b29d82978f-EMAIL_CAMPAIGN_2017_02_22&utm_medium=email&utm_term=0_46a1943223-b29d82978f-40399941, 27 Feb 2017.

[112] Energy Transition, 27 Feb 2017, https://energytransition.org/2017/02/pay-as-you-go-solar-and-microgrids-considered-new-class-of-infrastructure-investment/

[113] Bloomberg New Energy Finance's (BNEF) inaugural quarterly "Q1 2017 Off-Grid and Mini-Grid Market Outlook.", https://about.bnef.com/blog/off-grid-mini-grid-q1-2017-market-outlook/

[114] http://nobelgrid.eu/first-peer-review-of-nobel-grid/ Sept 2016

Other areas piloting schemes within the 'Nobel Grid' programme include **the Alginet co-operative (Spain), the public DSO in Terni (Italy) and the Meltemi eco-village (Greece).** For the UK, there is some comfort in the programme's inclusion of the ***Carbon Co-op's*** *micro-grid project* in **Manchester.**[115]

Britain's initiatives are, however, not limited to Manchester, Wadebridge's 'Sunshine Tariff' and Bethesda's 'Energy Local'. **Low Carbon London** will offer a time-of-use tariff linked to electricity from wind turbines. **ACCESS (in Scotland)** offers a tariff linked to hydro.

Oxford's '**ERIC' project** has installed PV on over 100 homes, with back-up from a 40kW and a 60kW solar array - promoting localised self-consumption and reduced grid impact.

Oxfordshire's Low Carbon Hub also launched their *'People's Power Station';* aiming to turn the County into a series of interconnected micro-grids, beginning with a mapping of all the renewable energy projects across the County.

Their opening, interactive map has

> "... plugged in our own Low Carbon Hub projects and other community-owned renewables projects in Oxfordshire, as well as Oxford City Council's solar PV projects."[116]

Each of these stands as a sub-set of the evolving Smart Towns and Smart Cities movement; expanding, rather than subtracting from, visions of a quite different energy future.

6.3 Energy Democracy

The problem is that, in every case, Britain's best local initiatives exist almost in defiance of the national energy framework. As Nottingham's ***Robin Hood Energy*** discovered, local energy companies are anything but welcome entrants into the UK energy market.

New entrants to the UK market have to navigate their way through over 10,000 pages of Grid Balancing Codes. These codes have been written by the Big 6, take years to alter, and can be amended only by a panel made up of them. As 10:10 observed

> "To enter the UK supply market, one must first escape the bewildering thicket of network codes and agreements that comprise over ten thousand pages of obscure jargon. This alphabet soup can only be deciphered by career specialists employed by the giant utilities and grid operators party to the regulations. Changes to the codes typically take years to process and are decided on by opaque panels of

[115] European Union, Horizon 2020 research and innovation programme, http://nobelgrid.eu/

[116] Low Carbon Hub, December 2016 Newsletter, gudrun.freese@lowcarbonhub.org

> industry technocrats. You and I cannot propose changes, nor can Ofgem or the Department of Energy and Climate Change."[117]

For a long time, this has been where Britain's energy debate has been stuck; locked into 'big ticket' answers, trying to make yesterday's markets work. Often the pretext for doing so was the claim that renewables just couldn't be relied on: sheltering behind the truism that the sun doesn't always shine and the wind doesn't always blow.

But rivers and tides do. And heat can be drawn from recycled and renewable sources. And vehicles can be powered in non-polluting ways. And energy can be saved more cheaply than new energy generated. And smart technologies can weave these together in ways that no previous generation could access.

At every level, there will still be balancing problems to resolve. But that's what smart engineers are really good at. And the biggest game-changer of all could come from the breakthroughs they have been making in how to store, share and transform energy.

7. Energy storage

Once the Achilles Heel of the clean-energy movement, energy storage has now become the most dynamic piece in the transformation jigsaw.

> "Led by price declines in lithium ion (li-ion) batteries, system prices have fallen significantly over the last few years, according to the Grid-Connected Energy Storage Report from the IHS Energy Storage Intelligence Service. Average li-ion battery prices fell 53 percent, between 2012 and 2015, and by 2019 they are forecast to again decline by half again."[118]

Developments in the energy storage sector could bring savings to British consumers, secure energy supply for a generation and meet carbon reduction targets. Moreover,

> "In 2020, America's energy storage market will likely surpass 1.6 gigawatts - making it 28 times bigger than it was in 2015. The U.S. market in 2020 will be defined not just by higher volumes, but by diversity in project types. While large storage projects on the utility's side of the meter currently dominate deployments, smaller batteries in homes and businesses on the customer's side of the meter will become the biggest segment in terms of capacity in the next four years."[119]

It is the scale of this deployment that is most breathtaking.

> "Three massive battery storage plants—built by Tesla, AES Corp., and Altagas Ltd. —are all officially going live in southern California at about the same time. Any one of these projects would have been the largest battery storage facility ever built.

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[117] Leo Murray, Guardian, 10 July 2015, op cit

[118] https://technology.ihs.com/552430/price-declines-expected-to-broaden-the-energy-storage-market-ihs-says, November 23, 2015

[119] http://www.greentechmedia.com/articles/read/how-distributed-battery-storage-will-surpass-grid-scale-storage-in-the-us-b , March 2016

> Combined, they amount to 15 percent of the battery storage installed planet-wide last year."[120]

Even the nature of batteries themselves is in a state of flux. Researchers in Harvard University have developed a new *flow* battery that stores energy in organic molecules dissolved in neutral pH water. This new chemistry allows for a non-toxic, non-corrosive battery with an exceptionally long lifetime and offers the potential to significantly decrease the costs of production.[121]

And, in a whistle-stop review of some of the most exciting battery storage research nearing deployment stages, Daily Telegraph columnist Ambrose Evans-Pritchard observed that

> "Cutting-edge research into cheap and clean forms of electricity storage is moving so fast that we may never again need to build 20th Century power plants in this country, let alone a nuclear white elephant such as Hinkley Point...
>
> Once storage costs approach $100 per kilowatt hour, there ceases to be much point in building costly 'baseload' power plants such as Hinkley Point. Nuclear reactors cannot be switched on and off as need demands - unlike gas plants. They are useless as a back-up for the decentralised grid of the future, when wind, solar, hydro, and other renewables will dominate the power supply."[122]

Other studies, specific to the UK, suggest that energy storage could bring equally profound changes, both to democratic engagement in the energy sector, and to saving money,

> "Energy storage could save £2.4 billion a year system wide by 2030; if regulatory hurdles are overcome this could rise to £7 billion a year."[123]
>
> "...If 50% of this [£2.4bn] saving was simply passed on to domestic customers it could reduce the average electricity bill per household by c. £50 per year."[124]

'Behind the meter' storage at a household level, offers even more intriguing possibilities. One project, monitoring energy consumption in a 4 bedroom, 'solar-plus-storage' house in the North of England, has delivered huge savings (even in less-than-Mediterranean conditions).

The MyGridGB house has been delivering almost 40% of its own electricity from solar and storage, even before it gets anywhere close to summer months.

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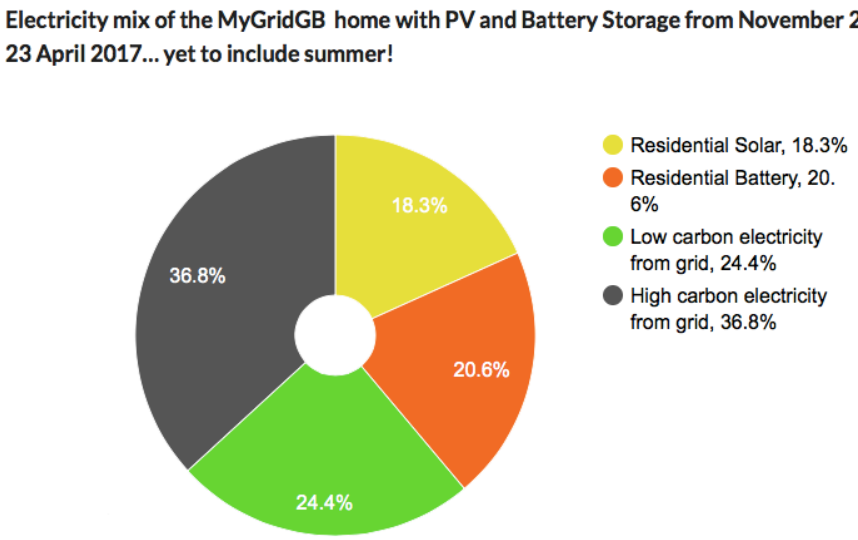
[120] Tesla's Battery Revolution Just Reached Critical Mass - Bloomberg, 30 Jan 2017, https://www.bloomberg.com/news/articles/2017-01-30/tesla-s-battery-revolution-just-reached-critical-mass

[121] Harvard University, https://www.seas.harvard.edu/news/2017/02/long-lasting-flow-battery-could-run-for-more-than-decade-with-minimum-upkeep , 9th Feb 2017

[122] Ambrose Evans-Pritchard, Daily Telegraph, 10 August 2017, http://www.telegraph.co.uk/business/2016/08/10/holy-grail-of-energy-policy-in-sight-as-battery-technology-smash/

[123] Can storage help reduce the cost of a future UK electricity system?, March 2016, http://www.carbontrust.com/resources/reports/technology/energy-storage-report/

[124] Carbon Trust, above, p6



It is at this point that bigger issues emerge.

The UK energy market is laced with market and regulatory barriers to the savings energy storage might bring. Not least of the absurdities is that electricity storage is *double taxed*; first as an 'end user', when electricity is stored, and again when it is actually used. Ofgem has been in no hurry to resolve this, focussing instead on a desire to tax households that are using 'behind the meter' storage as a way of reducing their energy bills.

A large part of the coming debate about energy storage will revolve around who are to be its principal beneficiaries.

In the Carbon Trust study, its '£50 savings' figure carried no guarantee that savings would be passed on to consumers. The emphasis was more on a refreshed business case for big energy providers. Nowhere did 'Smart City', 'smart community', or even household storage get a look in.

This absence can also be seen in National Grid's £65 million programme of energy storage contracts, mainly awarded to large providers in August 2016.

> "In the last week, National Grid awarded eight ‘enhanced frequency response’ contracts to storage providers to help regulate the system.
>
> The largest contract awarded was to RES to provide 35 MW at £11.93 £/MW of EFR/h. Contracts were also awarded to EDF Energy Renewables, Vattenfall, Low Carbon, Eon UK, Element Power and Belectric - a total capacity of 201 MW and contract value of £65.95 million."[125]

Energy storage is already a huge political battleground. Much will depend on whether it is used to support incumbent generators or to promote more decentralised (and democratic) energy systems.

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[125] 'National grid award £65 million storage contracts', Regen SW newsletter, 31 Aug 2016

The Carbon Trust study overlooked the more ambitious/democratic scenario, merely commenting that -

> "National Grid scenarios do not currently consider storage beyond a limited build of pumped hydro. The annual saving of up to c.£2.4 billion per year is based on additional storage that is retrospectively, rather than incrementally, added to the 2030 generation portfolio and network infrastructure as described by the National Grid's 'Gone Green' scenario."[126]

Without being unkind - as the USA, Germany, China, Japan, and all points beyond demonstrate - a myriad of opportunities exist outside the realms of pumped-hydro. **Three London Boroughs**

> "...have begun testing the potential of more than 40 solar-plus-storage installations to reduce the bills of households in fuel poverty.
>
> The 24/7 Solar project, which is part funded by National Energy Action, is being led by **Camden** Council working in partnership with **Islington** and **Waltham Forest** councils. The scheme is testing the potential benefits of storing daytime electricity generated by solar PV to supplement the householder's evening use."[127]

SoLa Bristol (in partnership with Western Power) is already piloting decentralised energy plus storage.[128]/[129] Project **SENSIBLE[130]** in the **Meadows, Nottingham,** is trialling storage in homes with and without PV systems, looking at its impact on bills and grid demand, and **Stirling (Scotland)** has just installed its 1,500th solar roof on the latest of 50 new bungalows with battery storage built in.[131]

Thousands of individual houses and businesses are doing the same. It is where some of the most exciting cultural changes in energy thinking may yet be found; changes running (inclusively) from the household to the State.

Whether he turns out to have the best product in the market doesn't matter. Elon Musk's *'Powerwall'* battery storage system has been a game-changer in the politics of energy storage. Musk's marketing deal with Walmart turned electricity storage from a 'niche' market into a mass one. Within months, Musk discovered he was not alone.

Germany, facing problems of an *over*-supply of wind energy in the North, has been pursuing storage solutions (especially for its 'solar' South) in the most structured way -

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[126] Carbon Trust, op cit

[127] London boroughs tackle fuel poverty with solar and storage, 13 Dec 2016, http://www.solarpowerportal.co.uk/news/london_boroughs_tackle_fuel_poverty_with_solar_and_storage,

[128] http://kwmc.org.uk/projects/solabristol/

[129] http://www.connectingbristol.org/sola-bristol-project/

[130] Project SENSIBLE, http://www.h2020-project-sensible.eu/sensible/demonstrator-sites/nottingham-demonstrator-site.aspx

[131] Energy Live News – Energy Made Easy – UK council installs 1,500th solar kit, http://www.energylivenews.com/2017/03/07/uk-council-installs-1500th-solar-kit/

> "The *Renewable Energy Storage Subsidy Program* of the KfW Development Bank arranges low-interest federal loans and payback assistance covering up to 25% of the required investment outlays.
> KfW has determined that ***41% of Germany's new solar installations in 2015 included battery storage,*** compared with less than 14% the previous year. This level of adoption likely constitutes a world record for dedicated solar storage."[132]

Last year, Germany installed 15,000 clean energy storage systems and plans to install 35,000 this year. **Italy** already has 75MW of installed battery storage. While, in the UK, ***Local Energy*** **Scotland** have been installing hundreds of 'heat batteries' (in combination with PV) as part of their Eastheat trial scheme, combatting fuel poverty in social housing.[133]

Scotland is additionally looking to become a world leader in new technologies to store excess electricity from wind farms; creating thousands of jobs and looking to store surpluses, not just as electricity but in batteries that can deliver both heat and hot water on demand.[134]

The real dynamics, however, are being driven from elsewhere. In late 2016, **Chinese** battery giant BYD announced it would launch

> "... a residential battery system for ***the UK market*** and host a series of training events for installers later this month. The Mini ES battery has been designed with a 20-year life expectancy through a built-in battery management system, and the product will be initially launched in 3kW and 6kW sizes.
>
> The product launch builds on BYD's presence in the UK, which was dealt a significant boost late last year when it was awarded a £2 billion contract to supply its battery technology for London's future fleet of electric buses. The contract was one of many signed during Chinese president Xi Jinping's visit to the UK."[135]

In the **USA**, over 220MW of energy storage was installed in 2015 alone; an astonishing annual growth rate of 243% (with an astonishing ***growth rate of 403% in home energy storage***).[136]

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[132] http://www.energypost.eu/author/jeffrey-michel/, July 18, 2016

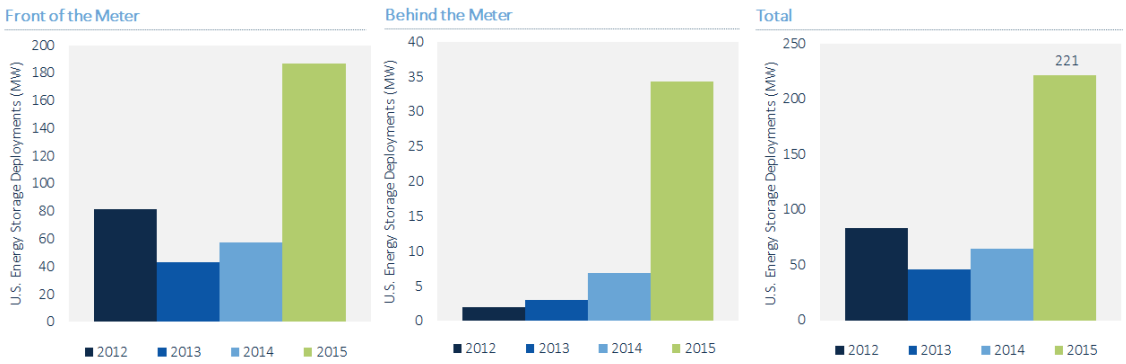
[133] http://www.solarpowerportal.co.uk/news/video_heat_batteries_for_pv_in_production_at_scotlands_sunamp

[134] http://www.heraldscotland.com/business/14451293.Scotland_could_be_world_leader_in_technologies_to_store_excess_renewable_energy/ 26th April 2016

[135] http://www.solarpowerportal.co.uk/news/byd_to_launch_uk_residential_battery_product_with_new_training_dates_3572

[136] https://www.greentechmedia.com/articles/read/us-energy-storage-market-grew-243-in-2015-largest-year-on-record

Annual U.S. Energy Storage Deployments, 2012-2015



Even batteries themselves are being reinvented. Researchers from Harvard University report that they have tested a 'flow battery' that uses cheap and abundant chemical elements, can be operated with plastic components, will not catch fire, and can operate at 99% efficiency.The battery they have developed uses common food additives to enable abundant solar and wind power to be stored cheaply and safely in homes and offices.[137]

In a race for market share, international companies are 'teaming up' to offer the ease of setup (for installers) and cloud connectivity (for consumers); with current partnerships including Tesla and SolarCity, Sungevity and Sonnenbatterie, SunPower and Sunverge, Sunrun and Outback Power, and Enphase and Eliiy.

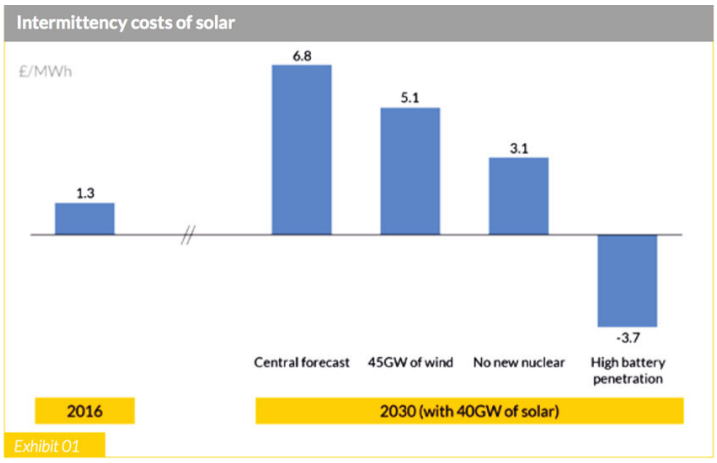
This rate of change is forcing critics of the clean energy revolution to revise their thinking.

The traditional criticism of renewables was not only their intermittency, but the 'hidden costs' - of back-up and balancing - that came with it. Storage is changing the terms of this debate.

A report by Aurora Energy Research turned the 'hidden costs' argument on its head.[138]

Aurora took the view that, if Britain had 40GW of installed solar capacity on the Grid by 2030 this would (conventionally) bring 'hidden costs' with it of £6.80/MWh.

What they did next, though, was to model this cost alongside a presumption of 8GW of installed storage by the same date. This transformed the economic case



[137] http://climatenewsnetwork.us6.list-manage.com/track/click?u=6e13c74c17ec527c4be72d64f&id=d1763842f7&e=5d5af99f0d

[138] Intermittency and the cost of integrating solar in the GB power market: http://www.solar-trade.org.uk/wp-content/uploads/2016/10/Intermittency20Report_Lo-res_031016.pdf

A serious UK investment programme of energy storage would turn a net cost of £6.80/MWh into a net saving of £3.70/MWh.

Such calculations make a mockery of UK government subsidies to new nuclear, to a 75% write-off of capital costs for Fracking and to on-going subsidies to North Sea oil.

Britain needs to look at the more integrated programmes already being deployed elsewhere. In addition to **Germany, Italy** and the **USA,**

- **Japan**, offers a 2/3 cost subsidy for all homes/companies installing solar-plus-storage[139] and
- in **Puerto Rico**, all new renewable energy projects must include a 30% 'energy storage' element.

8. Britain's 'sting in the tail'/ the Empire Strikes Back

In this moment of huge excitement, the UK has chosen to pursue policies designed more to protect the power of existing generators than promote systems change.

It began with a succession of Treasury cuts to Feed-in-Tariff payments for clean energy generation. Then came de-recognition of community energy Co-ops and the removal of tax advantages available to them. Carbon taxation (the Climate Change Levy) was extended to include clean energy and followed by proposals for a 6-fold (or 8-fold) increase in 'business rate' charges on companies that installed their own solar roofs.

Businesses and commercial leaders, who were the pioneers of clean-energy generation, found themselves penalised for doing so ... while subsidies for fossil fuels continued unabated.

National Grid may recognise that clean, decentralised generation - and the rapid growth of energy storage - is changing the world in which we live[140] but this has not triggered a shift in UK policy. If anything, it provoked the backlash.

Ofgem - more consistently the voice of power stations rather than the public - treated the changes as a threat rather than an invitation; never placing climate change, fuel-poverty or clean energy high on its agenda.

Behind a veneer of short-term, 'consumer interests', Ofgem's role has been to secure the financial viability of existing generators. It's approach to the clean-energy revolution has focussed more on how this might be taxed and limited; protecting existing generators who would otherwise be left with 'stranded assets'.

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[139] Rooftop Solar Booms in Japan as Market Moves Beyond Rich Nations, http://www.bloomberg.com/news/articles/2016-03-23/rooftop-solar-booms-in-japan-as-market-moves-beyond-rich-nations

[140] Nicola Shaw, National Grid, see 12 above.

> "Energy regulator Ofgem is worried that people who can afford to install solar panels and generate their own power for much of the day may end up not paying their fair share of the costs of the UK's electricity pylons and cables...
>
> "Dermot Nolan, [Ofgem chief executive, warned that] the question of how to charge for networks in an equitable way was a "huge challenge" facing the UK energy system in coming years.
>
> "Currently, the cost of maintaining and upgrading the networks is factored into the prices energy suppliers charge for electricity, accounting for about £140 a year on a typical household bill. Households that install their own panels will need to buy less electricity, so will avoid paying as much toward the costs of the network.
>
> "If people all go off grid, the phrase has sometimes been used that there will be a '*death spiral*'; that you'll end up with some bizarre example that there's only one person left paying the entire cost of the network. I think those examples are very extreme, but I still think there's a huge challenge," he said."[141]

In simple terms, what Ofgem wants is to tax households, schools and businesses that have solar roofs for the extent that they *don't* draw on the high voltage Transmission grid. This is like fining drivers who obey speed limits because they don't contribute to speeding fines and maintaining the network of speed cameras.

Other countries laugh at Britain, pointing out that *if you want to go 'clean', tax the problem not the solution.*

Ofgem tacitly recognise this. The official notice of their *concern* about embedded generation explained that the growth of household and community 'clean' electricity was distorting the market by:

> "... leading to an inefficient mix of generation by encouraging investment in smaller distribution connected generation (which can take advantage of the embedded benefits revenue stream) over potentially more efficient larger transmission connected generators (TG) or over-100MW EG (which do not have that revenue stream);
> "... leading to TG exiting because it cannot compete;
> "... distorting dispatch by dampening prices at peak times when EG dispatch out of merit15 to generate in the triad periods; and
> "... distorting the outcome of the capacity market by holding down prices since smaller EG can bid in at significantly lower prices than larger EG and TG;"[142]

Skip past the Ofgem language and abbreviations. The message is a simple one: ***Ofgem is desperate to rig the market (again) in favour of large scale (non-renewable) generators.***

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[141] Emily Gosden, Telegraph newspaper, http://www.telegraph.co.uk/news/2016/05/29/households-could-be-charged-annual-insurance-premium-for-access/

[142] 'Embedded benefits "distorting" energy market', https://networks.online/gphsn/news/1000230/embedded-benefits-%E2%80%9Cdistorting%E2%80%9D-energy-market

Even smaller generators are now objecting to what they regard as 'Mafia-style' rigging of the market reform process.

> "The panel of industry leaders responsible for reviewing modifications to network charging arrangements in the UK has been accused of skewing reforms to favour established players in the energy system.
>
> UK Power Reserve chief executive Tim Emrich told Utility Week the make-up of the Connection and Use of System Code (CUSC) panel is “mafia-like”.
>
> “I do not believe that employees of National Grid and big utilities are in a position to act impartially in the context of the CUSC panel," he insisted.
>
> “As anyone who has worked in both a big and a small company will know, there are profound differences in culture, loyalties and thinking. It would be difficult for panel members not to reflect their big company thinking and the votes show this.”...
>
> "The CUSC panel is currently made up of an independent chair, a secretary and appointed representatives from Ofgem, National Grid and Citizens Advice, as well as seven members representing energy system users who are elected every two years.
>
> Out of the seven elected members, four are employed by big six energy companies - EDF Energy, Eon, SSE and Scottish Power. The remaining three work for Drax, First Hydro Company and the trade association Energy UK.[143]

The existential crisis is a simple one: old energy is being being undercut by new 'systems' - particularly of storage and sharing - that are set to change the whole concept of future grids.

Much of how we think about energy will change from being a market to a service; a change that will ill-suit those obsessed with selling consumption.

Nothing is going to avert the *death spiral* of today's energy system. What Ofgem fails to grasp is that grid balancing and maintenance costs must be put on polluting, rather than non-polluting, energy sources. Families with solar roofs are not the problem: dirty power sources are.

Ultimately, clean energy will supersede dirty, and 'dirty' will be left with stranded assets and clean-up costs. None of this will mean "...there's only one person left paying the entire cost of the network". It just means that the role of networks (and the nature of the Grid) must itself be re-defined.

But the race for control of this re-definition has already started.

Stung by earlier criticism, Ofgem produced a 'conversation' paper on Local Energy as the third of its Future Insights programme. Though it usefully summarises varying approaches

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[143] Utility Week, 'Mafia-like' panel skewing network charging reforms, 15/02/2017, http://utilityweek.co.uk/news/mafia-like-panel-skewing-network-charging-reforms/1295842#.WLl6aOvfWK3

to what this might mean, Ofgem steers away from the more profound market changes. The most interesting part of its 'Insights' turn out to be the omissions.

- Nowhere does Ofgem make the case made for markets that sell 'less' consumption (ie energy saving) in preference to more.
- It offers no exploration of energy systems that live within contracting carbon budgets.
- Nowhere does Ofgem recognise that clean energy must be taken before dirty.
- Nowhere does it explore the role network operators might play as co-investors in energy saving and 'smart' balancing systems, and
- Ofgem studiously avoids any recognition that tomorrow's 'security' will see local energy being stored and shared for cross-sectoral purposes (transport, heat, air quality, environment, etc).

Ofgem's *Insights* turn out to focus more on the limitations of local energy rather than its transformational possibilities.

> "Some consumers desire greater control over their energy affairs and more independence from familiar utility arrangements. Reductions in technology costs may make this more realistic, even if more expensive than traditional solutions. Greater control and independence could serve the interests of those consumers.
>
> Historically, 'off-grid' micro-grids have emerged as a means of providing more reliable energy to isolated communities which could not feasibly connect to the national grid (such as some Scottish isles and particularly remote mainland locations). However, if consumers place increasing value on independence we may see consumers choosing off-grid solutions even where a national grid connection is a feasible alternative. Under this scenario, households on off-grid micro-grids may not be afforded some of the other benefits associated with a connection to the national grid, such as the ability to choose a different supplier if they are dissatisfied. Where this is an informed choice, that may be acceptable. We should however recognise that, for example, subsequent occupiers of the same property may inherit the choice.
>
> Another implication may be that they avoid contributing to the costs of national energy policies and systems."[144]

This is a world away from the villagers of Wilpoldsreid or the citizens of San Diego. Ofgem's *Insight* only turns out to be a view of the world, as seen by big energy.

Charging households and businesses that have 'embedded generation' ie solar roofs[145] becomes a mechanism through which existing major power producers secure a re-structuring that will keep them in control.[146]

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[144] Ofgem Future Insights series, 30 Jan 2017, https://www.ofgem.gov.uk/publications-and-updates/ofgem-future-insights-series-local-energy-transforming-energy-system,

[145] Ofgem Open Letter, 29 July 2016, https://www.ofgem.gov.uk/publications-and-updates/open-letter-charging-arrangements-embedded-generation

[146] ETI, Sept 2016, http://www.eti.co.uk/wp-content/uploads/2016/09/Enabling-Efficient-Networks-for-Low-Carbon-Futures.pdf

9. Silver linings

Clean, decentralised energy does, however, have its champions. One collaboration - between Distribution Network Operators and renewable energy advocates 'RegenSW' - organised regional 'community' consultations around local energy systems. Their focus was around the *principles* upon which more sustainable and interactive energy networks might be built;[147] a counterweight to everything the government, big nearby operators and Ofgem are now pushing for.

If one paper crystallised the more democratic, alternative approach Britain might take, you would be hard pressed to improve on ***the Centre for Sustainable Energy*** response to Ofgem and government 'consultations'.[148]

Ignoring the straitjacket of government-framed questions, the CSE has argued for changes that would make the public *partners*, not just consumers, in tomorrow's energy system

> "...we need to establish the meaningful public consent of people as consumers, citizens and members of many communities (from neighbourhoods to workplaces to networks of shared interests) because the shift to a low carbon electricity system ultimately requires everyone:
>
> • to alter their individual and collective energy using behaviours and habits
> • to invest, purchase and spend differently in relation to energy and energy using equipment
> • to give consent for changes in the buildings and landscapes where they live and work and in the markets in which they participate and in the services they receive
> • to pay for many aspects of this transition through their bills (mainly) and taxes."[149]

In effect, the CSE make the case for something that looks more like a public service than a private market.

9.1. Pushing the boundaries

Nothing will stop technology from transforming energy in the same way it has done in telecommunications. Tomorrows energy systems will have find a different centre of gravity.

Maintenance of the high voltage network (and interconnectors that support it) will probably revert to National governments (and National Grid). More sophisticated balancing mechanisms will become the responsibility of Distribution networks and (within them) local supply companies. Critical to everything, however, is the acceleration of 'Smart'; a process with little connection to the current UK 'smart meter' rollout.

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[147] RegenSW, Network Charging for a Flexible Future, Sept 2016, https://www.regensw.co.uk/Handlers/Download.ashx?IDMF=a820b208-5e9f-4916-99fe-d4c172861f0b

[148] Centre for Sustainable Energy, https://www.cse.org.uk/downloads/file/CSE-response-smart-flexible-energy-system-consultation-jan-2017.pdf

[149] A smart, flexible energy system: call for evidence CSE's response to BEIS and Ofgem I January 2017, p2.

Micro-grids - whether in Berlin, Brooklyn and Flanders or Bristol, Bridgend and Falkirk - will depend on 'real time' information flows, not just local supply. Britain's current smart-meter roll-out programme does not begin to address this. A £10bn+ rip-off, it is principally a means of delivering remote-metering for big generators, not smart balancing for local communities.

Smart-grids, however, are now critical to systems change. These are the access routes to a much wider concept of energy thinking. Scotland's heat networks, Ecotricity's 'grass to gas', Leeds' race into the hydrogen economy, and network operations that sell 'energy and carbon saving', all depend heavily on more interactive grids. Such grids will then provide pathways into improvements in air quality and housing, heating and transport, food and flood prevention. This is the economics of low carbon living.

Already, conversations about energy storage, transformation and sharing are well beyond the 'keeping-the-lights-on/grid-modulating' stage. The **US Energy Department** has invested more than $20 million in 10 projects to advance fuel-cell and hydrogen technologies. In part, this is to enable early adoption of fuel-cell applications such as light-duty, fuel-cell electric vehicles (FCEVs).[150]

Norway will ban the production of fossil-fuel vehicles by 2025. Already, 37% of its new car sales are of electric vehicles. In another 8 years they expect it to be 100%.[151] In the **Netherlands** - the home of Shell -

> "The Dutch government has presented a long-term energy plan that stipulates that no new cars with combustion engines may be sold from 2035 on."[152]

and the **German Bundesrat**

> "... has passed a resolution asking the European Commission 'to look into existing tax regulations of member states in regard to how useful they are to support emission free mobility - so that starting from 2030 at the latest, only emission free cars will be allowed in the Union'."[153]

Denmark will establish an energy and transport system which relies on 100% renewable energy sources by 2050. (As an intermediate step, it has set a target of delivering an electricity and heat sector based on 100% renewables by 2035).

Sweden is turning all biodegradable waste into bio-fuel, in order to power the entirety of its public transport fleet vehicles.

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[150] http://www.energy.gov/articles/energy-department-invests-more-20-million-advance-fuel-cell-technologies-new-report-shows

[151] https://thinkprogress.org/norway-aims-to-end-sales-of-fuel-burning-car-by-2025-as-ev-market-soars-edeac854f1e 21 Feb 2017.

[152] Energy Post, Dec 8, 2016, http://energypost.eu/dutch-government-evs-hydrogen-cars-2035-phase-natural-gas/?utm_campaign=shareaholic&utm_medium=twitter&utm_source=socialnetwork

[153] http://energydesk.greenpeace.org/2016/11/01/germany-really-going-ban-petrol-diesel-cars/

In the UK, **Bristol** followed Sweden, with an imaginatively designed bio-bus; more affectionately known locally as the 'poo' bus, and running on fuel derived from its sewage waste.

Renewable electricity surpluses are already crossing into a raft of other energy spheres; electricity-to-gas, electricity-to-fuel, hydrogen fuel-cells, electric vehicle charging networks and sustainable heat.

Smart energy networks are what will bind them together.

9.2 Leaders or laggards?

In or out of the EU, Britain looks a long way off the pace of European plans for *integrated urban infrastructures.* Within them, energy storage will become an everyday part of grid systems that combine decentralised generation and distribution, decarbonisation, demand reduction ... and 'Smart' everything.

For a more coherent approach, the UK needs to

- **promote the rapid growth of decentralised 'smart grids'**
- **remove the double taxation currently levied on energy storage,**
- **copy international initiatives offering soft finance for combined clean-generation and energy storage,**
- **enable communities and localities to store and share their own clean energy, and**
- **develop the skills infrastructure necessary to make the UK not only an installer of energy storage systems, but an innovator in the international 'smart grids' sector**.

Energy storage and interactive grids will be integral parts of the transformation that supports the growth of Smart Towns, Smart Cities and Smart Regions. It will underpin the

development of localities that become their own *'virtual'* power stations; a journey cities like Munich began almost 20 years ago.[154] Britain needs to join the same race.

9.3. Back to the future

The idea of towns and cities turning themselves into *'virtual'* power stations - using state of the art technologies to store, share, generate, distribute and save their own energy - may seem daunting. It certainly looks a long way from the cumbersome framework that currently constrains UK energy thinking.

It is easy to forget that Britain has been here before. In 1817, Britain's first public energy company was set up (by the Police Commissioners) in Manchester - installing a gas lamp above the entrance to the police station at the corner of Water St. Within 10 years this had become the Manchester *Municipal* Gas and Water Company. For the next 70 years municipal energy transformed the character of Britain's towns and cities. Most of Britain's parks, libraries, museums and swimming baths came, not from central government, but from the profits of their municipal utilities.

These companies were set up to reduce the cost of street lighting, add to public security and to supplement local authority incomes from the sale of gas to industrial and commercial customers[155]. It was driven by

> "... the desire of local authorities to get access to gas company profits in order to relieve local taxes ***and finance urban improvements***."[156]

The whole process was financed through municipal bonds; people putting small or large savings into long-term investments which offered modest returns but huge 'quality of life' gains. After the catastrophic crash of casino economics, it is a model Britain might revisit.

By the time the industry was nationalised in 1948 almost 50% of local authority income came from the supply of municipal utility services - gas, water and electricity.

Even now, this might be a better starting point for today's challenge to deliver energy policies that can live within much tougher ecological limits.

The self-interest of localities today must begin by including the fuel-poor rather than ignoring them; re-directing public subsidies from the polluting to the non-polluting, using integrated energy-saving and Smart Energy programmes,[157] [158] and re-structurin energy markets in favour of 'clean', 'local' and 'less'.

To make this possible, Britain needs to -

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[154] cf Stadtwerke München: https://www.swm.de/english/company/energy-efficiency.html

[155] Katrina Hyde, Profession v Trade, op cit

[156] From Private to Public Ownership of Gas Undertakings in England and Wales, 1851-1947, Prof Robert Millward, Manchester University press

[157] The Political Economy of Urban Utilities, Robert Millward, Cambridge Urban History of Britain

[158] Ending Cold Homes, Association for Energy Conservation, March 2014

1. ***Make the 2030 'grid carbon' target - 50gCO2/kWh - a binding obligation across the energy sector.***

2. ***Turn DNO's into Distribution System Operators (DSOs); with a right to discriminate in favour of clean energy, co-invest in energy saving, sharing and storing, and a duty to deliver grid-carbon reductions***

3. ***Give localities the right to set up local (not-for-profit) energy companies, supplying local markets, at local prices and within local carbon budgets***

4. ***Restructure a Green/Infrastructure Investment Bank (along German lines) to provide low-cost finance for energy efficiency, climate repair programmes and the growth of Smart Towns/Cities***

5. ***Give localities intervention powers to set higher energy efficiency standards for existing buildings***

6. ***Require the Grid to take clean energy before dirty (a Merit Order system),***

7. ***Make 'energy-plus' the new standard for all new housing construction***

8. ***'Socialise' grid connection charges of community-owned renewable energy,***

9. ***Adopt a 'polluter pays' approach to grid-balancing charges, and***

10. ***Restructure UK energy market subsidies in favour of renewables; making support time-limited (with degression rates), and with each fuel/technology carrying its own disposal/clean-up costs.***

9.4. A '50-50-50' plan

In reality, we do not have a lot of time to play with. Politics cannot negotiate with climate physics, and the scope for working with (or around) it narrows by the day.

Researchers at the London School of Economics warned that climate change could wreck the global economy; with up to 17% of the entire world's assets (£1.8 trillion) wiped out by temperature rises over 2C.[159] Carbon Brief already warns that (on current emissions levels) Britain has just 4 years left of its carbon budget if we are to stay within the 1.5C global warming target range.

Avoiding climate crisis requires transformative change on a scale bigger than anything seen outside war-time. Some part of this journey will have to be in hope as much as expectation, but an element of this can be found elsewhere. Germany's *Energiewende* programme led the way into the clean energy revolution, with their own mixture of successes and failures. The most interesting evaluation came as a description of it as a *50-50-50* process.

[159] Simon Dietz et al, Nature Climate Change, 4 April 2016, http://www.nature.com/nclimate/journal/vaop/ncurrent/full/nclimate2972.html

Local and national leaders expected that 50% of their pilot schemes would work (and continue) and 50% might fail (and be put to one side). The surprise came from the other 50% - the avalanche of innovations and ideas that the process itself threw up. Politicians of all persuasions recognise that it was the pace of innovation that has given Germany its biggest boost.

One look at the 'Cleantech Innovate' website[160] makes it clear that Britain is no less creative or innovative. What is missing are the 'routes to market' that Germany has been more rigorous in delivering. Radically changing today's energy market framework is the key. If parliament cannot rise to this challenge, then the leadership must come from elsewhere. That means us.

Smart citizens ... in towns, cities and communities; in universities and technology hubs; in business and commerce, in faith groups and village halls...can (and must) become the drivers of this ***Transformation Moment.***

The key is not to get stuck in small details. These may be important but smart engineers and innovators are currently coming up with answers faster than we can come up with questions. We need to focus on the bigger picture. This probably comes down to 3 key elements

- **a right of local supply**
- **a duty to reduce grid carbon levels to 50 gCO2/kWh by 2030, and**
- **a commitment to annual reductions in UK energy consumption**

Energy policies that are 'clean', 'smart', 'democratic' and 'sustainable' will then race into the transformation space.

At some point the ideas will make it into Westminster too. But Britain's intellectual gridlock on energy policies will not be broken by parliament.

The transformation process will have to be driven from outside - by us - often in the strangest of coalitions. But a 10-year window of opportunity is probably all we really have. This means being as brave as we ever dreamed we might be ... And doing it now.

Alan Simpson
April 2017

A Postscript

The lives of others

If any extra courage is needed, we might just want to draw it from the 'ordinariness' that drove Germany into its own *Energiewende* transformation programme.

[160] info@cleantechinnovate.com

In 1986, in the aftermath of the Chernobyl disaster, people in the small Black Forest town of Schönau asked their local energy company if they could have clean (non-nuclear) electricity. The energy company refused. So the community, led by a primary school teacher (Ursula Sladek) decided they had better do so themselves.

It took a decade of organising and campaigning for this citizen's movement to take control of their local electricity grid away from the energy utility. They were to become a movement that inspired a nation. Today, Germany has over 1,000 community energy co-operatives, 90 co-ops that own their local grid, and 190 local authorities that do so.

Schönau's original bid to buy the rights to their own grid was followed by a national fundraising appeal (a precursor to today's crowd-funding initiatives). This, in turn, was followed by a share issue not dissimilar to the *municipal bonds* that underpinned Britain's 19th century energy revolution.

German pension funds and commerce then joined in as investors, largely on the basis that the German government was forcing its energy market to open up.

Low risk, environmentally virtuous, investment in the Schönau company became a badge of honour. Then, Germany's long history of decentralised governance facilitated a much wider citizen engagement that eventually became their *Energiewende* transformation.

Britain, is not without a large body of expert advice on how it might to do the same.[161] The problem is that, politically, the UK energy market has been designed to be anything but clean, open and democratic.

British law prohibits energy co-ops from selling (beneficially) into local markets in ways that are permitted in Germany. Thus (both the Treasury and Financial Conduct Authority have argued) Britain's energy co-ops can't be real co-ops. Germany had little truck with such nonsense, knowing it wasn't co-ops that were the problem. The problem was the market. So this was what they changed.

What Germans also learned was that single, clean-energy technologies were the start, not the end of the process. Joined-up technology solutions began to form the bedrock of 'Smart' (integrated) energy *systems*. They, in turn, needed joined-up social partnerships. Local authorities had to learn to lose (or share) power in order to gain it. At some point, Schönau seamlessly melded into Wilpoldsreid, into Munich, into Hamburg. It is an '***energy democracy***' story, now beautifully documented by Craig Morris and Arne Jungjohann.[162]

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[161] Community energy and the low-carbon transition - The Energy Research Partnership, Sept 2015, info@erpuk.org › Projects

[162] Energy Democracy: Germany's Energiewende to Renewables, Morris & Jungjohann, Palgrave Macmillan press, Sep 2016

What motivated people in Schönau was the desire to be the answer to a problem, rather than the problem itself. German energy co-ops are full of parents, grandparents, nurses, farmers and innovators; a grand coalition of voices hungry for change.

Such voices have moved 'community ownership' and interdependency into a different space; making shared ownership an integral part of common security. ***Transformation Moment*** invites Britain to do the same.

Tomorrow's energy security will be found in adaptability and accountability, in interdependency and inter-connectedness. In such a world, we will also discover how to build an economics that delivers 'more' but consumes 'less'.

This transformation is not just about energy. It is about how, publicly, we see (and nourish) the world we share. It is the moment when Britain's towns and cities really could put themselves at the heart of the new ***Global Covenant;*** leading the way in how we must live more lightly on an increasingly fragile planet.

Everything that follows will be shaped by whether we rise to this challenge.