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EDITORIAL

TIPPING POINTS

A recent news item from Australia, discussed on SEFnews suggested that the cost of grid electricity supply is approaching parity with off-grid generation cost. We may not have reached that point yet in New Zealand, but as retail electricity prices, loaded as they are with post generation costs, keep rising and the cost of own-generation technology keeps falling, it is only a matter of time before the tipping point is reached where DIY power becomes the rational option for consumers. That scenario would have significant implications for the NZ electricity supply industry and infrastructure.

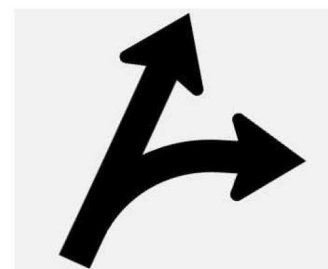
I recently attended a Solar Energy School in the tiny Northland town of Kaiwaka to learn a bit more about developments in solar hot water and PV technologies. What amazed me was not so much the technology advances, but the fact that that event was attended by about 140 people. It was a clear sign that interest in local distributed generation of energy is becoming mainstream.

SEF's Ian Shearer contributes an article from Scotland describing issues with transmitting electricity from wind turbines in the Orkneys. When the wind blows strongly it makes more electricity, but it also cools transmission lines increasing their capacity. He also comments that in that location home-made electricity is approaching the tipping point of parity with mainland grid power.

The term "tipping point" has long been associated with the potential impact of Arctic methane releases on climate change. Recent studies suggest that this tipping point into accelerating climate change may have already occurred. If not then it is probably a matter of "when" not "if".



Next month it will be three years since the "Signs of Change" national e-conference show-casing transition and sustainability. The air of optimism that that event generated may have evaporated somewhat in New Zealand as the old school agenda has prevailed. However, the imperative for change has grown stronger as critical tipping points eventuate. It is time to wake up.



Whilst on a recent long flight to China I immersed myself in an anthology of the music of Bob Dylan. It struck me how relevant today are Dylan's prophetic lyrics written 50 years ago.

The Times They are a-Changin'

Come gather round people wherever you roam,
And admit that the waters around you have grown,
And accept it that soon you'll be drenched to the bone.
If your time to you is worth savin',
Then you better start swimmin' or you'll sink like a stone;
For the times they are a-changin'.

Come writers and critics who prophesize with your pen,
And keep your eyes wide the chance won't come again,
And don't speak too soon for the wheel's still in spin,
And there's no tellin' who that it's namin';
For the loser now will be later to win;
For the times they are a-changin'.

Come senators, congressmen please heed the call.
Don't stand in the doorway, don't block up the hall,
For he that gets hurt will be he who has stalled.;
There's a battle outside and it is ragin'.
It'll soon shake your windows and rattle your walls;
For the times they are a-changin'.

Come mothers and fathers throughout the land,
And don't criticize what you can't understand.
Your sons and your daughters are beyond your command.
Your old road is rapidly agin'.
Please get out of the new one if you can't lend your hand;
For the times they are a-changin'.

The line it is drawn the curse it is cast.
The slow one now will later be fast,
As the present now will later be past.
The order is rapidly fadin'.
And the first one now will later be last;
For the times they are a-changin'.

Bob Dylan - 1964

In this issue of EnergyWatch there is a report on the SEF AGM and seminar, which focussed on transport and renewable electricity generation.

Frank Pool has recently returned from Turkey with some observations that are of relevance to New Zealand.

Molly Melhuish expands on the debate in EnergyWatch 69 concerning ideas for restructuring the electricity industry and asks whether electricity is NZ's biggest regulatory failure.

Kerry Wood reviews the on-going debate about a transport system to serve Wellington.

I share some insights that I have recently gained about steps being taken in China to address their CO₂ emissions. I also present some worrying perspectives on the increasingly important issue of methane emissions.

Stephan Heubeck contributes some analysis on the realities of the US shale boom and its limitations.

As usual this issue wraps up with an update on the progress of oil prices, now stabilised at over US\$100 per barrel.

Steve Goldthorpe, Editor

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SEF Seminar : August 2013

SEF held a pre-AGM seminar on transport and renewables in August. Speakers were Eric Martinot, a lead author on the recent Global Futures Report on renewable energy; Paul Young on the Generation Zero campaign for a zero-carbon goal in transport; and Doug Clover on his PhD thesis on attitudes to electric cars.

Eric Martinot – REN21

The Global Futures report is produced annually by REN21; the Renewable Energy Policy Network for the 21st Century.

Global electricity generation is now nearly 22% renewable, over a quarter of this is non-hydro. The non-hydro component is growing very fast, with China and the USA prominent contributors, where wind-power capacity increased by 13% in 2012, compared with 2.4% in Germany and 1.9% in the UK.

Solar photovoltaic (PV) is growing even faster, with global installed capacity up 40% in 2012. It is still smaller than wind, about a third of the installed capacity. PV panels now cost one dollar per watt of peak output, so the barrier is installation and hook-up costs. PV investment is now over half of all renewables investment, wind about a third and everything else about 10%. Renewable energy investment now exceeds fossil and nuclear investment.

The REN21 report on the transport issue highlights the following issues: -

- Public transport, car-sharing, walking and cycling can all help.
- Biofuel investment is tapering off.
- Electric vehicles are growing rapidly, but better integration will help; especially fast-charge batteries. However, many ideas are still largely conceptual. Ideas include a Chinese bus with a super-capacitor instead of a battery, but large-scale PV for transport looks unlikely.

- Electric freight is an option, especially on electrified rail.

Paul Young, Generation Zero

The Generation Zero challenge is zero carbon in a working lifetime; i.e. by 2050.

Transport is a main focus area because it is the biggest and most intransigent CO₂ emitter in NZ at 205 PJ, compared with 190 PJ for industry and heating, and 140 PJ for electricity generation.

Vehicle-kilometers in New Zealand have been essentially stable since 2004, which is a world-wide trend in developed countries.

Transport reform would have large-scale co-benefits in health, urban design, carbon and cost. A recent *AA Directions* poll got a 92% positive response to the question: - *If we could improve the safety of cycling on our urban roads, would you give cycling a go?*

Public transport has huge potential. Patronage of Auckland's Britomart interchange quadrupled in nine years, with more to come from electrification and the CBD Loop.

Doug Clover on Electric Vehicles

Doug's thesis is on modeling of electric cars and greenhouse gas emissions, using a discrete choice demand model.

There are very few electric vehicles available outside certain US cities; virtually none in NZ.

A city car can get by with battery storage of 20 kWh but general use needs at least 100 kWh. The best all-electric car is the Tesla, with a maximum range of 300 km. Battery capacity is still 85% of original, after 130,000 kilometers.

Plug-in hybrids show benefits of up to 40–60% in GHG reduction because of range, but current New Zealand policies do not capture that benefit.

At least 120 million electric bikes are in use world-wide.

The biggest changes needed are inside heads.

Reported by Kerry Wood

Turkey – Sustainable Energy Observations and Some NZ Implications

By Frank Pool

In the year to August I worked in Turkey at the General Directorate of Renewable Energy (GDRE) as the Chief Technical Adviser & Project Manager



It was a US\$6 million energy efficiency project in the Turkish industrial sector, focussed on implementing the new continuous improvement ISO 50001 Energy Management Systems/Standard led approach. But unfortunately GDRE still remains focussed on the ineffective designated energy manager and comprehensive energy audit led approach.

Energy security is a big issue in Turkey. So Turkey is building every possible hydro scheme - and to hell with the downstream water supply impacts in Syria and Iraq. Two incredibly expensive nuclear plants are planned - in a country with no indigenous uranium supplies and as earthquake prone as NZ. Nearly all Turkey's oil, natural gas, and coal are imported - from historical enemies Russia and Iran, from the Caspian Sea basin via Georgia and from Iraqi Kurdistan. Fossil fuel import costs are of similar magnitude to Turkey's trade deficit. Petrol, diesel, natural gas and electricity are very highly taxed, with petrol being the most expensive in any OECD country.

Petrol and diesel are around 50% more expensive in Turkey than in NZ. With Turkish GDP/capita being less than 30% of NZ's, petrol and diesel costs are therefore five times higher compared to income levels than in NZ. So fuel costs are clearly more important to vehicle purchase choices in Turkey, than in NZ.

In Turkey, it is widely understood that a diesel vehicle used for more than 30,000km/year has a lower overall ownership cost than a petrol

vehicle. New diesel cars now have oil change intervals of up to 40,000km, major service intervals of up to 250,000km, and expected engine lives of 1 million km. So even though they are around 20% more expensive to buy new, a large percentage of cars are diesel.

From personal rental car experience with a Fiat Linea diesel, diesel cars in Turkey offer running costs lower than for a comparable petrol vehicle in NZ. I would love to drive a modern Fiat Linea or similar diesel in NZ, but it would make no economic sense when NZ Road User Charges (RUCs) are a single rate for all vehicles below 3500kg. In NZ a 4 litres/100km Fiat Linea diesel would cost me more to run than a similar size, and similar 1200kg weight, petrol Honda Civic using 6 litres/100km – both being open road figures I have personally achieved.

Another notable energy feature in Turkey is that most houses and apartments on the Aegean and Mediterranean coasts, and in rural areas, have solar water heaters – there is no nonsense in Turkey about whether SWH actually are cost effective in practice like there is in NZ.

Another observation is that nearly all Turkish farms now use tractors. Even at an equivalent oil price of US\$350/bbl and cheap farm labour, diesel tractors are still cheaper than horses for farm work. So even with Brent Crude oil at US\$112/bbl, oil is still cheap compared to the alternatives.

Frank Pool

Chinese overtures to CCS

The highly influential National Reform and Development Committee in China has made a significant step towards combating Climate Change by signalling that Carbon Capture and Storage (CCS) could become a requirement for new Chinese power stations. However, on closer inspection the preference is for CCUS, including the commercial Use of the captured CO₂. The only market large enough to accommodate the vast tonnages of CO₂ that would be produced is for enhanced oil recovery, making the net climate benefit marginal at best.

Editor

Regulatory failures

By Molly Melhuish

Electricity deregulation, it can be argued, is New Zealand's greatest regulatory failure, but only amongst a depressing list of regulatory disasters in the last 30 years.



The relentless electricity price rises in the news now are a core policy that was proposed even before the “Rogernomics” era in 1984. A justified public revolt against relentless electricity price rises has now led to the recent inevitable Labour/Greens proposal to re-regulate the electricity industry.

Electricity price rises since 1990 have led directly to poor and still deteriorating health and social outcomes. The lowest income sectors in society were the first to be hurt, then progressively more householders and tenants. Physical, social and psychological impacts have increased as more households must choose whether to “heat or eat”. Money worries not only cause family stress, they have been shown scientifically to cause loss of productivity, and even reductions in measured IQ.

The price-rise policy was proposed in a 1984 report to the Ministry of Energy (Trading) months before the change in government. All of the Government's trading departments, the report said, should move from their traditional historical-cost based accounting to a regime where profits were in line with any “similar” private corporations.

In line with the neoliberal economics of the Chicago School, the report said that electricity prices should rise to the cost of electricity from new power stations, otherwise (it was said) new capacity would not be built and electricity would get less reliable.

This policy was unfortunately wildly successful. A Parliamentary Select Committee Inquiry in 1991 concluded the price rises were not justified economically, but ECNZ ignored it, and continued raising prices till about 1998 when Government condoned a “price pause” – perhaps to help sell to the public the split, and hoped-for privatization, of the ECNZ monolith.

In a separate initiative, the Bradford “energy” reforms split the local lines companies, allowing the “baby ECNZ's” to buy up their retail customers. Now the vertically integrated “Gentailer” companies could offset any variations in generation revenues by simply charging their customers more. And they did, and as promoted by the original policy, they built more and more power stations. The result now is an electricity glut – a glut that will increase when the Tiwai Point smelter inevitably closes down.

And now, just as Government is part-selling its electricity Gentailers to further the privatization agenda and line the pockets of a few favoured people, the companies' expected revenues have been savaged by the electricity glut, and their stock value has been savaged by the Labour/Greens proposal to re-regulate the electricity system. This is regulatory failure indeed!

A wide-ranging inquiry into New Zealand's regulatory management has been launched by the Productivity Commission, which was created in 2011. They say, correctly, that any regulatory regime seeks to control the behaviour of individuals and businesses in order to move towards a defined “regulatory goal or target”. Government should then monitor the outcomes and revise the regulation if the target is not achieved.

The Commission seeks comments on how the 80-odd regulatory regimes are designed, how the regulators are chosen and resourced, and how compliance is enforced. They specifically exclude, from this consultation, submissions on whether the regulatory goals are appropriate. And they probably exclude whether the

outcomes for society are good or poor. This consultation is, therefore, for academics and industry experts only to debate the theory and not the reality affecting NZ'ers. But the consultation does invite a wider consideration of regulatory failure from the view of the affected public.

So is electricity New Zealand's biggest regulatory failure? Maybe not. A two-year academic project by the Law Foundation proposes the Building Act 1992 as another failure – as Price Waterhouse Cooper estimates that the leaky buildings condoned by the Act will cost some \$11 billion to repair. But the chapter concludes that the net benefit of that Act might be positive, because it led to innovation that may have a greater net present value than represented by the \$11 billion cost.

Arguably a much bigger failure is the Building Act 1978. New Zealand is notorious world-wide for its cold houses. Unlike in North America and Europe, our houses appear to be livable if uncomfortable, while they're killing people from chronic illnesses. The 1978 Act made a start in requiring basic insulation levels in houses.

A single building lobbyist, Lockwood Homes, was then instrumental in delaying any increase in insulation levels for 22 years. This was in spite of Lockwood always having a pragmatic concessionary lower insulation levels for their solid wooden-wall houses. One outcome has been some 1600 excess winter deaths each year in NZ, more than five times the entire road toll.

The NZ Emissions Trading Scheme is another spectacular regulatory failure. Designed to put a market price on carbon, it was repeatedly watered down after extensive lobbying, exploiting a Kyoto loophole which saw emissions in NZ units devalued from around \$20 per unit to a few cents per unit. But the real failure was not the “market” signal, it was the outcome: New Zealand businesses face virtually no incentive to change their practices to reduce their carbon emissions. The Scheme has added to the price of electricity and fossil fuel, in an inelastic market, without giving consumers any

choices to move to more climate-friendly behavior. The outcome supports the international position of an influential small country being used to promote the interests of the world's biggest lobbyists, the fossil fuel industry.

So what has been New Zealand's greatest regulatory failure? That depends on whether the metric is loss of money, loss of life or loss of global resilience. But nothing will change while the academics keep their stranglehold on the regulatory debate in NZ. Let's bring it out into the public arena, and call for a political commitment to change. Regulation must address issues recognized by the public, and aim to change the behaviour of people and businesses, not just benefit the “Crony capitalist” and “revolving door” insiders who have controlled electricity and other regulations for the last 30 years.

Molly Melhuish¹

SEF AGM

After the August Seminar, the Annual General Meeting of the Sustainable Energy Forum was held in Wellington. 15 members attended including 2 via Skype, which is now the regular meeting mode for the SEF executive committee. SEFexec now comprises:- Tom Adson, Paul Clutterbuck, Steve Goldthorpe, Neil Mander, Molly Melhuish, Frank Pool, Ian Shearer, Alan Thatcher, Kerry Wood and Paul Young with Ian Baxter continuing as interim treasurer. Steve Goldthorpe was re-appointed as convenor.

There was a general discussion about the future direction of SEF. It was recognised that SEF has not been as active as the current energy scene demands and there was a need to involve younger members. It was decided to draw up a focus list of issues as a basis of an action plan.

Editor

¹ This article is based on Submission 42 to the Productivity Commission which can be viewed at <http://www.productivity.govt.nz/view/submissions/1788>

Smarter grid solutions for constrained networks

By Ian Shearer²

Renewable energy resources are plentiful and the feed-in tariff in the UK is a tremendous support mechanism, but



the grid resources are not so plentiful, and gaining practical and economic grid connections for turbines in wild, and not so wild, places in the Highlands & Islands of Scotland is not easy.

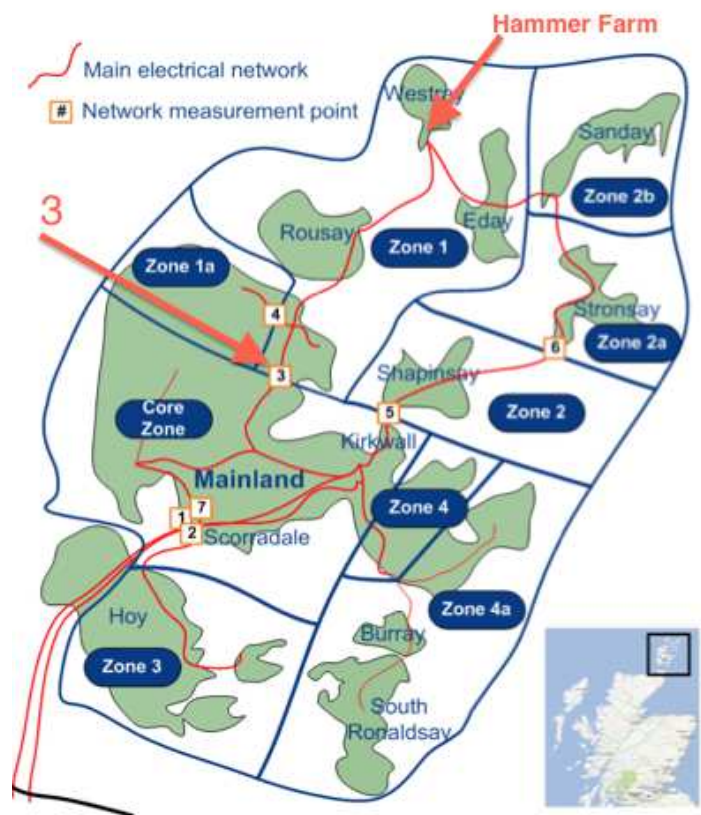
Many landowners and rural communities are looking to renewable electricity generation to provide a new revenue stream to help them to continue to live on their land or in their community. The wind and rain are great renewable resources – but the local electricity distribution networks are often 2-wire (single phase) systems that are too weak to allow connection of even a modest sized 500kW turbine. Where there is a 3-phase network available there may already be too many turbines connected to the network, causing potential overloads when the wind is blowing strongly.

In the Orkney Islands, to the north of Scotland, an innovative, smart network solution is being tried to allow more turbines to be connected to the grid. Each new turbine connected must include remote controls to allow the system operator to reduce generation when network cables and overhead lines are reaching maximum rated loadings.

This map of the main (33kV) network on Orkney shows seven numbered “pinch-points” where the current in the sub-sea cables or overhead lines are monitored and control actions are initiated as necessary to keep the cables and wires below their rated capacity figures. See

²Ian Shearer is currently working with Windflow in Scotland to facilitate grid connections for their turbines (www.windflow.co.uk).

<http://anm.ssepd.co.uk/ANMGen.aspx> for a more detailed (live) view of the status of the network constraints situation in each zone associated with that pinch-point.



The first New Zealand made Windflow 500kW turbine is installed at Hammer Farm on Westray, Orkney and when the wind is blowing strongly and all turbines in Zone 1 and Zone 1A (see map) are generating, a constraint signal may be issued when the current at pinch-point 3 reaches a critical level. Turbines are constrained by an Active Network Management (ANM) system that operates on a “last one consented - first to be constrained” basis – an arrangement that had to be agreed by developers requesting a network connection once the grid was “full”.

Historically electricity lines have poles spaced so that at the maximum current during the peak summer temperature the conductor temperature will not cause line sag below the maximum safe clearance height. The installation of “live” monitoring points on the network, with communications back to the control centre, has opened up opportunities for “smart network features” to be introduced.

The first smart step tried was for the network company to accept higher fixed current ratings through the pinch-points during winter. This increased the generation potential significantly. As confidence in the system grows it is intended that this will be extended to four fixed seasonal ratings.

The Importance of Methane

By Steve Goldthorpe

After CO₂, the second most significant contributor to long term climate change is methane. In the short term, I would argue that methane is more worrying than CO₂.



The average lifetime of a molecule of methane in the atmosphere is 12.4 years (IPCC AR5). However, the standard Global Warming Potential (GWP) for methane of 21 was originally assessed in 1998 (IPCC AR2) on the basis of its cumulative effect over 100 years. That GWP factor for methane is enshrined in UNFCCC international greenhouse gas accounting and Kyoto Protocol methodologies as one tonne of methane emitted being equivalent to 21 tonnes of CO₂ emitted.

The science has moved on. In the 2007 IPCC fourth assessment report (IPCC AR4) the 100-year GWP for methane was revised to 25 and it was acknowledged, but not quantified, that additional aerosol effects would further increase the GWP of methane. IPCC AR4 also considers the relative climate impacts of methane and CO₂ over a 20-year time horizon and assessed that on that basis the GWP of methane should be 72. The basis for emissions trading remains at 21.

The fifth IPCC assessment report (IPCC AR5) is currently being drip-fed into the public domain. The weighty technical support documentation is available in the internet, but is clearly labeled as a draft with “Do Not Cite, Quote or Distribute”

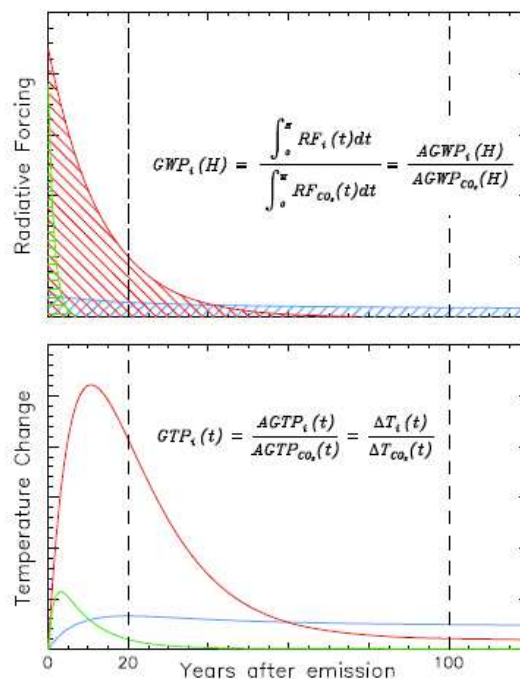
But real smartness will only be seen when real-time conductor temperatures are used for real-time line ratings – this would be a really smart network. Confidence in such controls would also help facilitate the future of really smart customer energy usage systems. But that would be for a future article.

Ian Shearer

on every page. So, with that health warning in mind - What are latest estimates of CH₄ GWPs?

There is lengthy discussion in IPCC AR5 about how the metric GWP, based on relative radiative forcing and also embodying value judgments on relevant time frames, is imperfect as a measure. The alternative metric of Global Temperature Potential is presented as more informative. Nevertheless, buried in the Chapter 8 appendix, the latest estimates of the GWP of fossil methane are reported as 30 over a 100 year time frame and 85 over a 20-year time frame. These significant changes from AR4 are not mentioned in the AR5 summary for policy makers.

These draft charts from Chapter 8 illustrate the significance of the shorter life of methane (in red) compared with CO₂ (in blue) and signal that a peak in consequential global temperature occurs about 10 years after methane emission.



In light of the foregoing discussion I suggest that there is a clear case for adopting the 20-year planning horizon for consideration of the impact of methane emissions, i.e. using the GWP value of 85. That would mean that the incentive to control methane would be four times greater than is provided by emissions trading at GWP = 21.

This table shows illustrative data for sources of global methane in Mtonnes (10⁶te) CH₄ per year.

Natural methane sources	
Ocean hydrates	2 - 9
Freshwater	8 - 73
Wetlands	177 - 284
Termites	2 - 22
Geological sources	33 - 75
Anthropogenic methane sources	
Livestock	87 - 94
Rice cultivation	33 - 40
Landfills and Wastes	67 - 90
Fossil fuels	85 - 105
Biomass burning	32 - 39

(IPCC AR5)

These data show that the contributions of methane are about equal from natural sources and these anthropogenic sources. After decay mechanisms the net build up in the atmosphere is currently about 17 Mtonnes per year.

The total anthropogenic emissions shown in the above table is about 340 Mtonnes per year. Applying the new 20-year GWP factor of 85 would give an annual CO₂-eq emission rate of about 29,000 Mtonnes per year, which is almost exactly the same as the global CO₂ emission rate. Hence, on this basis, the contributions to climate change from CO₂ and methane are about equal.

The reported contribution of methane from fossil fuels corresponds to about 1% of the global production of coal (8 Gtonnes) and natural gas (2 Gtonnes) combined, which is broadly in line with the low end of industry estimates.

Methane emission inventories in the USA report that methane emission from natural gas well production activities typically amount to about 1% of production and might occasionally exceed 2%. An additional 0.5% is typically lost if gas is reticulated to small consumers.

However, two recent novel studies of methane concentrations in the air above natural gas fields in the western USA found average methane concentrations in air corresponding to 4% and 9% of gas produced. These findings suggest the possibility of substantial unmeasured and perhaps unmeasurable, natural gas losses to air from natural gas production activities.

With a GWP factor of 85, an additional loss of 5% of natural gas from shale gas field would eliminate the greenhouse gas advantage of switching from coal to gas for power generation. If all gas fields were found to have losses of that magnitude then the anthropogenic methane emissions would be increased by about 30%.

The elephant in the room is the potential release of methane due to warming of the Arctic Ocean. A recent article in *Nature* (499; 25/7/2013; p401) reports “*As the amount of Arctic sea ice declines at an unprecedented rate, the thawing of off-shore permafrost releases methane. A 50 Gigatonne reservoir of methane, stored in the form of hydrates, exists on the Eastern Siberian Arctic shelf. It is likely to be emitted as the seabed warms, either steadily over 50 years or suddenly.*” This specific matter is not addressed in IPCC AR5, because it is a new research. Old data suggests significant impacts are unlikely.

The more optimistic scenario of a steady release of that frozen methane over 50 years would yield 1,000 Mtonnes of methane per year, which is three times the anthropogenic methane emissions and would more than double the total emissions of all greenhouse gases over the next 50 years.

A pessimistic scenario is that 50 Gtonnes of methane could be released over the next decade. The IPCC AR5 report indicates that about 4,000 Gtonnes of extra CO₂-eq in the atmosphere may correspond to a 2°C higher global temperature than pre-industrial. 2,000 Gtonnes has already been added. On that basis, with a short term GWP of 85 for methane, this pessimistic scenario points to a world that is about 3 degrees warmer before 2030. A tipping point indeed!

Steve Goldthorpe

Transport Choices for Wellington

By Kerry Wood

Greater Wellington Regional Council has done a million dollar study of options for the 'public transport spine route.'



The principal objective was to sort out a very crowded two-lane bus route through the city centre. Twenty minute delays are not unusual, spreading across the city and later services.

Submissions closed at the end of September. The choice came down to Bus Rapid Transit (BRT) for \$207 million or Light Rail Transit (LRT) for \$940 million. Both costs were later scaled up by 28% to \$270 million and \$1,200 million. BRT has been approved by the Regional Council's Transport Committee but there is a problem - capacity.

BRT comes in three sizes: huge (100,000 passengers/hour (p/h) each way), large (30,000 p/h; equal to a London tube line) and small (3,000 p/h, known as European BRT). The Regional Council is noticeably vague about specifications, but what detail there is points to a European size BRT using bendy-buses. That would give about half the passenger capacity of the existing (under-used) central-city buses, i.e. about 3,000 p/h. That is fair enough at present, but is risky as a maximum.

Brisbane has a large BRT system, carrying over 20,000 passengers an hour, twice as many as expected when it opened. The stops are twice the width of Manners Mall (because the buses need overtaking lanes), and it crosses almost all existing roads on bridges or in tunnels. Such a scheme is too big for Wellington.

European cities rarely have the space for large-scale BRT, but sometimes use the small-scale BRT. Central Wellington is like a European city

and could reasonably do the same, if it fills the bill. European BRT goes through city junctions on the level, like an ordinary bus route. It needs traffic-signal priority for quality timekeeping, with heavy use of green-time at junctions. Traffic signal priority for too many European BRT buses creates problems elsewhere.

A table of selected European systems in the GWRC³ study shows peak-hour services of only 8 to 18 buses an hour, say 1,500 p/h. The city of Nantes, in France, started with 15 buses an hour and increased that to 17 because of crowding but is unlikely to go higher; more capacity there will come from longer buses.

The GWRC report proposes 32 European BRT buses an hour on Lambton Quay, plus another 21 local buses in the same lane. The report concludes that local buses would have to go, perhaps onto the so-called secondary spine or another through route. A secondary-spine scheme was proposed in the diagnosis study, confirmed in a preliminary spine study and then apparently slipped in to the Evaluation Report at the last minute. It is in an undated four-page report which refers back to the preliminary report for its justification.

Sixteen European BRT bendy-buses an hour are proposed to run down Adelaide Road in the morning peak, and join another 16 buses an hour from the Mount Victoria Tunnel. The buses in the tunnel are already overloaded at 101% of capacity. That is hairy. Public transport begins to overload at about 80% of nominal capacity.

In practice inconsistencies between tables make for uncertain passenger numbers. Totals in 2031 might be 2500, 2600 or 3600 an hour. The lowest of these demands would generate overloading.

The GWRC report does not expect any new passengers. That is the traffic model's surreal

³ Tables 6, 7 and 31 of the Evaluation Report, and Table 7.4 of the Modelling Report. Both are available on the GWRC website.

prediction. Trams in the UK have averaged about 5% annual patronage growth, the Brisbane Busway 8% p.a. growth city-wide, Auckland's Britomart Interchange saw 16% p.a. growth. Perhaps Wellington ought to plan for 5% p.a. growth in demand? That would need 50 buses an hour on Lambton Quay by 2031, pushing European BRT to the limit within ten years.

Obviously, there is room for more buses. If the Golden Mile can handle 120 buses an hour in the 2010s it can do it in the 2030s. But look out for unreliable services, 'cascading delay' and long 'platoons' of buses waiting at traffic signals. This is the problem the spine study was to solve. If it happens the options are bleak, with capacity falling dramatically and few good options:

- Turn off traffic-signal priority.
- Find bigger buses, if possible.
- Take out bus seats: two seats occupy standing space for four.
- Find another route (not the secondary spine - that is already needed for local buses).

A million dollar study has achieved almost nothing.

- The quality vision of the Regional Land Transport Strategy and the Terms of Reference have been lost (although both also contribute some problems);
- BRT and LRT have different characteristics and need careful comparison in key areas. It was not done;
- Modeling used a traffic model, inadequately adapted to public transport and incapable of the interchange studies needed to make sensible comparisons;
- The study has missed the very large benefits of transfers. A spine route frees the suburban routes from all the central-city delays, and a frequent central-city service will itself improve the timings;
- A rush to publication has compromised quality control. There is too little detail and

too many vague conclusions. Would LRT fit? The study casts vague doubts which are useless to decision-makers.

Light rail has three or four times the capacity of European BRT, for about a third of the latest cost estimate, and it will fit. From the consultant's estimate take out two unnecessary tunnels, three unnecessary route-kilometers of track and the four trams that were going to run on them, and you get about \$400 million for light rail from the Railway Station to Wellington Hospital and Kilbirnie, with three interchanges.

But LRT typically takes a decade from approval to opening. It will need interim bus measures.

It is hard to predict the next moves. The Regional Council has a very large credibility-gap to close, and in a climate of Auckland-style local government reform that might be fatal. Or perhaps strong leadership and institutional change can pull it through.

At a project level the best to hope for might be:

- More work on a realistic light rail proposal, meeting Wellington's needs.
- More work on bus options, with a target opening date in perhaps 2016, designed as a transition solution to facilitate light rail in the later 2020s.
- A firm political commitment to light rail, perhaps reached by 2017.

In 1992 Ridley^{4*} identified "*three essential prerequisites*" for progressing LRT:

- *There must be political consensus regardless of the means of finance.*
- *It must be part of an urban strategy.*
- *There must be a clear decision-making framework."*

None of Ridley's prerequisites is yet in place in Wellington. Kerry Wood

⁴ Ridley, TM (1992). Light Rail: Technology of Way of Life. London: *Proc Inst Civil Eng*, May

Will the American Way of shale oil and gas fundamentally change the energy sector?

by Stephan Heubeck



Many arguments about the extraction of unconventional

petroleum resources start and end in a quagmire of imprecise definitions and deliberate loose ends.

The fossil fuel industry, politicians and environmentalists all over the globe often tip words like “hydraulic fracturing”, “shale gas”, “oil shale”, “fracking”, “shale oil” “directional drilling” “fracked gas” “tight oil” “unconventional petroleum” etc. into a rhetoric blender and mix until the argument fits a particular agenda, constructs a Potemkin village for the opposition or confuses the public.

Let’s acknowledge up front, that directional drilling is today a standard practice for accessing conventional and unconventional petroleum deposits, that hydraulic fracturing has been successfully used to extract oil and gas from conventional deposits since the 1960s and that kerogen-containing rock deposits are different from tight oil in shale oil formations. Rather, this article focuses on what one may label the “American Way of shale oil and gas”. That is the extraction of unconventional petroleum from until recently inaccessible, low permeability rock through the hydraulic fracturing of horizontally drilled wells. What does this shale boom mean for global petroleum supply?

The “miracle” developments of shale plays in the US, such as the Barnett and Eagle Ford in Texas, the Bakken in North Dakota or the Marcellus in Pennsylvania, have worried environmentalists regarding air pollution, increasing GHG emissions and contamination of water resources. However, they have led the fossil fuel industry to promise an “era of plenty” just around the corner, which will change the global energy,

economic and political landscape, once the American way of shale oil and gas is also applied to the unconventional petroleum deposits that underlay Paris, the southern counties of England, the Sichuan basin, the Gisborne and Hawkes Bay back-country, and many other places beyond.

The negative direct environmental consequences of the US shale-miracle are increasingly acknowledged. More stringent regulation, such as mandated drilling site (methane) gas capture and utilization, banning of the most problematic fracking chemicals, improved site air emission and noise control, etc. could go some way to alleviate the most extreme consequences. Nevertheless, it is basically a given that the environmental burden associated with “shale oil and gas” will always be higher than for conventional petroleum. However, the fossil fuel industry’s promise of plenty may cause even more environmental damage. Already in the US today, government support for energy efficiency and renewables is waning, since the promise of plenty has hijacked the national energy security argument. Long term plans for other environmentally questionable projects, such as LNG export facilities, and (shale gas fuelled) tar sand mining operations are drawn up all over North America, based on the belief that the shale-miracle will go on forever. Bombarded with good news from the shale front, the average US consumer is also not following through with the mini-steps towards less energy consumption and waste, that were the flavour of the month in the late 2000’s – Why not get the bigger SUV now that the oil no longer needs to be conquered in the Middle East?

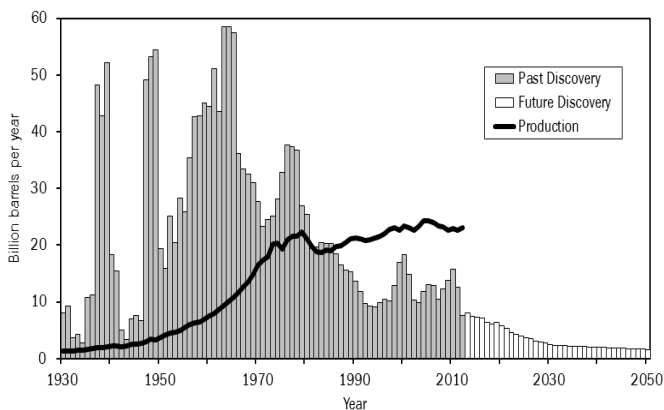
Is it wise for the American politician, consumer and industrialist to base plans of the future on an on-going shale-miracle? Does it make sense to abandon energy efficiency and renewables, based on the fossil fuel companies’ promise of plenty? Is the concept of peak oil really dead, as

announced by Forbes⁵ and others⁶⁷? And most important for us outside of North America - environmental concerns aside – is there a possibility that the shale-miracle can actually arrive on our shores, and is it therefore sensible to hedge our bets on the American Way?

The short answer for all questions is “NO!” because the American Way of shale oil and gas doesn’t even work out in America. Here’s why.

1) The numbers

Depending on the definition of crude oil the world is consuming something like 70 to 77 MMbbl/day (million barrels per day) or 25 to 28 Gbbl/year (Giga-barrel/year) (*Note: including NGL, coal to liquids, refinery gains, bio-fuels etc. the “all liquids” figure is between 86 and 89 MMbbl/day*). So far the shale-miracle has added less than 2 Mbbl/day (<1Gbbl/y) to global petroleum supplies. However, since the mid 1980’s the world is consuming about 10 Gbbl/y more petroleum than is discovered annually. In order to fill the “growing gap” illustrated in this graphic, shale oil extraction would need to ramp up at least ten-fold to reverse the situation where mankind eats away the cushion built up with past



World Conventional Oil Discoveries and Production, 1930–2050. (Source: Colin Campbell, Association for the Study of Peak Oil, 2012.)

⁵ <http://www.forbes.com/sites/realspin/2013/06/27/if-you-remember-peak-oil-and-peak-wireless-spectrum-youre-laughing-now/>

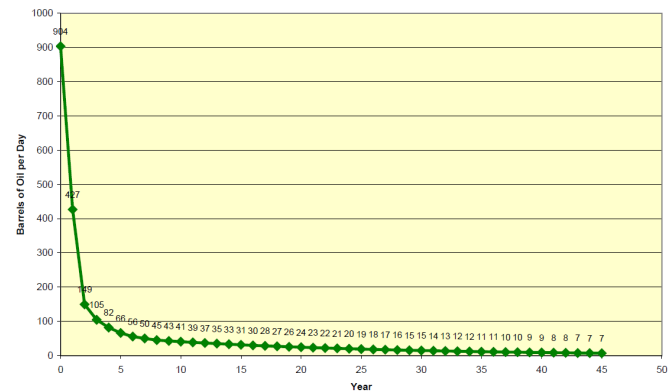
⁶ <http://www.bbc.co.uk/news/science-environment-18353962>

⁷ <http://blogs.wsj.com/source/2012/02/17/citigroup-says-peak-oil-is-dead/>

exploration success. The situation for natural gas is not much different.

Fracked wells have very high annual decline rates, requiring high well replacement rates. Shale oil and gas wells typically decline by 40 to 70% each year and are practically depleted after 3 to 5 years of extraction.

Typical Bakken Well Production



Typical Bakken Well Production (Source: North Dakota Department of Mineral Resources; https://www.dmr.nd.gov/oilgas/presentations/TribalLeaderSummit09052012_50.pdf)

This is very different from traditional oil fields (in particular giant oil fields) where wells, once completed, remain productive for many decades. This means that even if unlimited acreage for shale wells is available, in order to increase total petroleum output the fleet of drilling rigs needs to grow at a much faster rate, because about 50% of the drilling rig fleet mobilized for increasing petroleum output will be required for replacement drilling of shale oil wells in rapid decline.

2) The world doesn’t have enough drilling rigs

To achieve a fixed flow rate of petroleum the number of completed wells needs to be higher if the resource is distributed in many smaller deposits compared to a situation where oil is extracted from giant or super-giant fields. Unconventional shale oil and gas deposits escalate this effort into the extreme, due to the relatively small individual well flow rates and high decline rates. In a recent short report Euan

Mearns⁸ has calculated, that: “*The shale oil drilling frenzy has produced around a 1 million bpd (MMbbl/day) contribution to US and global oil production. But this has taken around 55% of the global drilling effort*”. If half the world’s drilling rigs are already employed for the addition of about 1MMbbl/day shale oil supply in the US, what equipment is the rest of the world going to use when the other 70 to 77 MMbbl/day of current petroleum supply need to be replaced (with smaller conventional or unconventional supplies), or if the global petroleum supply needs to be expanded? Sure the worlds drilling rig fleet can be expanded over time, but can it be quickly increased by more than a factor of 10, to have a marked impact on the growing gap between discoveries and production? Furthermore, substantial expansion of the drilling rig fleet will require a large amount of investment capital, and this will only be available if shale oil and gas extraction is highly profitable.

3) The economics for “shale oil and gas” don’t stack up – is most of the industry a pyramid scheme?

Because of the high annual well decline rates (short well life) and the huge technological effort required, oil and gas extracted from shale formations is expensive – most likely more expensive than the < US\$ 4/MMBtu and about US\$ 100/bbl, that shale gas and shale oil currently fetch, respectively. Exxon Mobil Corp. CEO Rex Tillerson is on record stating that “*We are losing our shirts*” on current natural gas prices, and Berman and Pittinger⁹ have projected that natural gas from most “shale plays” needs to fetch >US\$8/MMBtu to be profitable. James Hamilton reports¹⁰ that Chesapeake, a big player in US shale oil and gas reported an operating loss for 2012, and that Royal Dutch Shell is leaving the Eagle Ford play

⁸ <http://www.theoil Drum.com/node/9795>

⁹ <http://www.theoil Drum.com/node/8212>

¹⁰ http://www.econbrowser.com/archives/2013/10/making_money_fr.html

taking a billion US\$ loss in doing so. The Financial Times calls shale oil and gas surprisingly unprofitable¹¹. Other reporters and analysts^{12,13} ponder if the shale-miracle is in the end really about petroleum production, or if more (or the only) money is made from speculation, buying and selling exploration acreage, and proofing-up reserves to inflate the company share value.

A shale-miracle with an unprofitable core business can’t finance the required expansion of the drilling rig fleet, and will fizzle out over time. If the trends outlined above are confirmed, it is possible that the “shale boom” in the US could end up as a re-run of the sub-prime mortgage saga.

4) Alternative land value and mineral rights ownership

Environmental concerns aside, shale oil and gas extraction is land intensive, severely restricting agricultural use and being more or less incompatible with simultaneous residential use, as shown on the aerial photo from Texas, below, in which each pale patch is a well pad. This means that some of the most promising shale plays in Europe and Asia (i.e. Paris, Sichuan, etc.) are either not available at all for extraction, or only at astronomical prices that fully compensate for the alternative uses of the land. Even in situations where the alternative land value is manageable, the situation is further complicated in almost all countries outside the US and Canada, by the fact that the state, not the landlord, owns the mineral rights. This adds another layer of complexity. With no direct and clear avenue to the proceeds of petroleum extraction, the appetite of landlords for shale oil and gas extraction from their land will be severely subdued.

¹¹ <http://www.ft.com/intl/cms/s/0/3e56228a-2ce4-11e3-8281-00144feab7de.html#axzz2ja0rRIN6>

¹² www.desmogblog.com/2013/03/28/more-financial-worries-coming-light-domestic-drilling-industry

¹³ <http://www.fwweekly.com/2013/03/13/shale-game/>



Image credit: Fracking inTexas - amymyou/flickr

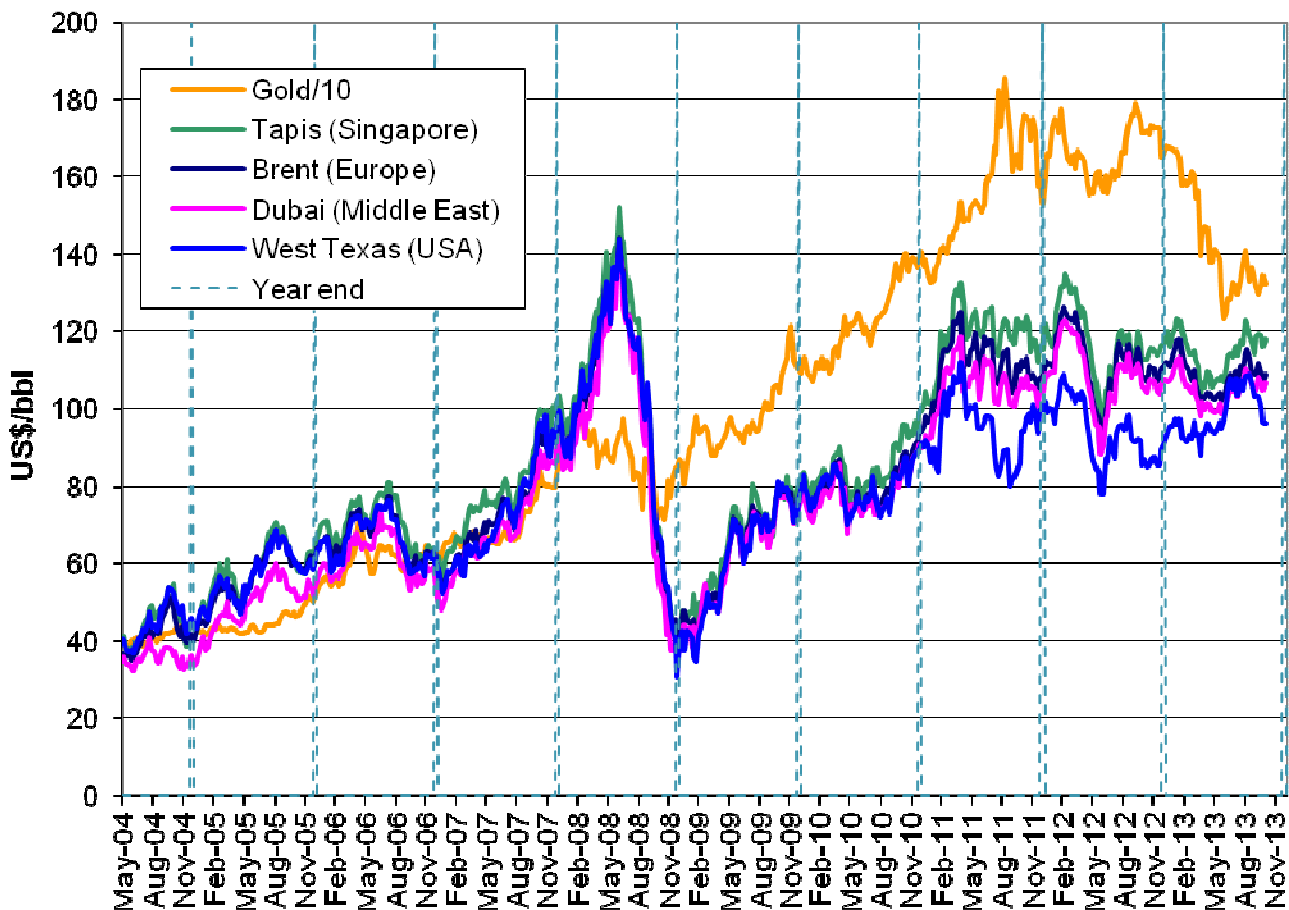
Conclusion

There are many warning signs that indicate that the American way of “shale oil and gas” is going around in circles, and in fact is much more hype than substance. While higher oil and gas prices could theoretically correct the financial ills of the sector, there appear to be too many other (physical) constraints for “shale oil and gas” to become a long term stable contributor of petroleum supplies that meet a substantial

fraction of US, let alone world, demand. The marginal rewards of “shale oil and gas” do very probably not warrant the environmental risk regarding water, air and atmospheric pollution associated with the practice. Even more importantly it appears foolish for US political and economic leaders to hedge so many financial, national security, economic development and environmental policy bets on an on-going and growing “shale boom”. For the rest of the world, hopes that a future shale-miracle can spare us the necessary adaptations towards more energy efficiency, renewables development and economic and societal re-organization towards less petroleum dependence and more resilience, will be disappointed. Or to paraphrase vice president Dick Cheney: The American Way is non-negotiable – but that doesn’t preclude it from becoming a dead end.

Stephan Heubeck

Neil’s Oil Price Chart



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