**March 2016**

# Submission to the Welsh Affairs Committee

**for its inquiry on the**

# Future of Nuclear Power in Wales

cyfeillion y ddaear cymru
friends of the earth cymru

**Introduction**

Friends of the Earth Cymru is an environmental NGO that would like to see Wales leading the way to a green future for people and the planet.

We have been opposed to nuclear power in Wales, and indeed the UK and the world, since our inception.

**Will Wylfa Newydd be built on schedule?**

1. It is impossible to say with certainty – not least because it is not clear what schedule Horizon is working to. However on the balance of probability, we consider it *highly unlikely* that Wylfa Newydd will be built on schedule.

2. Horizon state that main construction will start in 2018, with operation of Unit 1 in 2026 and Unit 2 in 2028[1]. Main construction is envisaged to take nine years[2], with commissioning a further 2½ years[3].

3. Clarity should be sought from Horizon as to the timescale. As can be seen from the preceding paragraph, Horizon is simultaneously claiming that operation will start in 2026 for one unit *and* that main construction plus commissioning will take 11½ years, which puts the timescale closer to 2030.

4. New nuclear build projects like Wylfa Newydd frequently suffer from problems related to construction cancellations and program delays. There has been a clear trend towards increasing construction times for new nuclear[4].

5. The type of reactor under consideration is an Advanced Boiling Water Reactor (ABWR), which is a Generation III+ reactor to be supplied by Hitachi-GE[5]. This type of reactor has suffered from design issues and construction delays.

6. For example, two GE ABWR have been listed as 'under construction' in Taiwan since 1998 and 1999; they were due to be complete by 2004. The power station is now mothballed pending the outcome of a referendum on nuclear in Taiwan, although construction was completed in 2014[6].

7. All reactors under construction in 10 out of 14 countries have experienced delays of at least a year, with three-quarters (47) of all nuclear reactor construction being delayed[7]. Five reactors have been 'under construction' for more than 30 years: one in the USA and two each in Slovakia and Russia.

[1] http://consultation.horizonnuclearpower.com/download/documents/45 p5
[2] Ibid p11
[3] Ibid p11
[4] http://www.worldnuclearreport.org/IMG/pdf/20151023MSC-WNISR2015-V4-LR.pdf p33
[5] http://consultation.horizonnuclearpower.com/download/documents/45 p5
[6] http://www.taiwantoday.tw/ct.asp?xItem=232105&ctNode=2182
[7] http://www.worldnuclearreport.org/IMG/pdf/20151023MSC-WNISR2015-V4-LR.pdf p32

8. Horizon has also tied its participation in Wylfa to the outcome of the EDF Hinkley Point project[8], with the Chief Executive of Hitachi stating:
*"Hinkley Point [raises questions] about what are the real solutions for setting up financial support… Nuclear power construction requires huge money … we need to arrange a financial plan for which the kind of money needed can be introduced. Some part is government endorsement, some is more preferable investment conditions from the part of the finance industry"*[9].

9. The two Generation III+ reactors under construction in Europe[10] are at least five years behind schedule.

**What will Wylfa Newydd cost, and will it be value for money?**

10. The real problem with the question from the Committee though is that the proposed cost is unclear – Horizon have not provided an explicit estimate. The BBC has reported the cost to be £8bn[11], Miller Consulting estimates that planning and construction will cost £14bn[12] and Horizon is reported to estimate £5bn per reactor for a total cost of £10bn[13].

11. However, we know that the track record of nuclear power station construction is one of escalating costs.

12. The promise that Generation III+ designs would be simpler and therefore easier to build appears not to have been fulfilled. Real costs have increased significantly compared to their predecessors suggesting the attempt to reduce complexity was not a success.

Status of Generation III+ construction projects (where lastest costs are available)[14]

| Plant | Country | Forecast cost at start | Latest forecast cost | Cost increase (%) |
|---|---|---|---|---|
| Olkiluoto 3 | Finland | €3-3.2 bn | €8.5 bn | 283 |
| Flamanville 3 | France | €3.2 bn | €8.5 bn | 266 |
| Sanmen 1 | China | $1940/kWh | 20% 'over budget' | 20 |
| Sanmen 2 | China | $1940/kWh | 20% 'over budget' | 20 |
| Haiyang 1 | China | $1940/kWh | 20% 'over budget' | 20 |
| Haiyang 2 | China | $1940/kWh | 20% 'over budget' | 20 |
| Summer 2 | USA | $5.2 bn | $6.2 bn | 19 |
| Summer 3 | USA | $5.2 bn | $6.2 bn | 19 |
| Vogtle 3 | USA | $6.65 bn | $8.15 bn | 23 |
| Belarusian 1 | Belarus | $6.5 bn | $11.45 bn | 76 |
| Belarusian 2 | Belarus | $6.5 bn | $11.45 bn | 76 |

[8] http://www.telegraph.co.uk/finance/newsbysector/energy/9993564/Hitachi-reluctant-about-UK-nuclear-reactor-plan.html
[9] http://www.telegraph.co.uk/finance/newsbysector/energy/12128405/Hinkley-Point-nuclear-fiasco-spooks-Hitachi-boss.html
[10] Flamanville, France and Olkiluoto, Finland http://www.worldnuclearreport.org/IMG/pdf/20151023MSC-WNISR2015-V4-LR.pdf p20
[11] http://www.bbc.co.uk/news/uk-wales-north-west-wales-35451337
[12] http://www.miller-research.co.uk/project/nuclear-industry-in-wales-capability-study/
[13] http://www.telegraph.co.uk/finance/newsbysector/energy/9644399/Hitachi-unveils-20bn-plan-to-build-nuclear-reactors-in-the-UK.html
[14] http://www.worldnuclearreport.org/IMG/pdf/20151023MSC-WNISR2015-V4-LR.pdf pp66-67

13. Generation III+ plants under construction are posting an increase in cost varying from 19% to 283%. This increase in costs is universal and takes place in a variety of jurisdictions, including the USA, China, Finland and France.

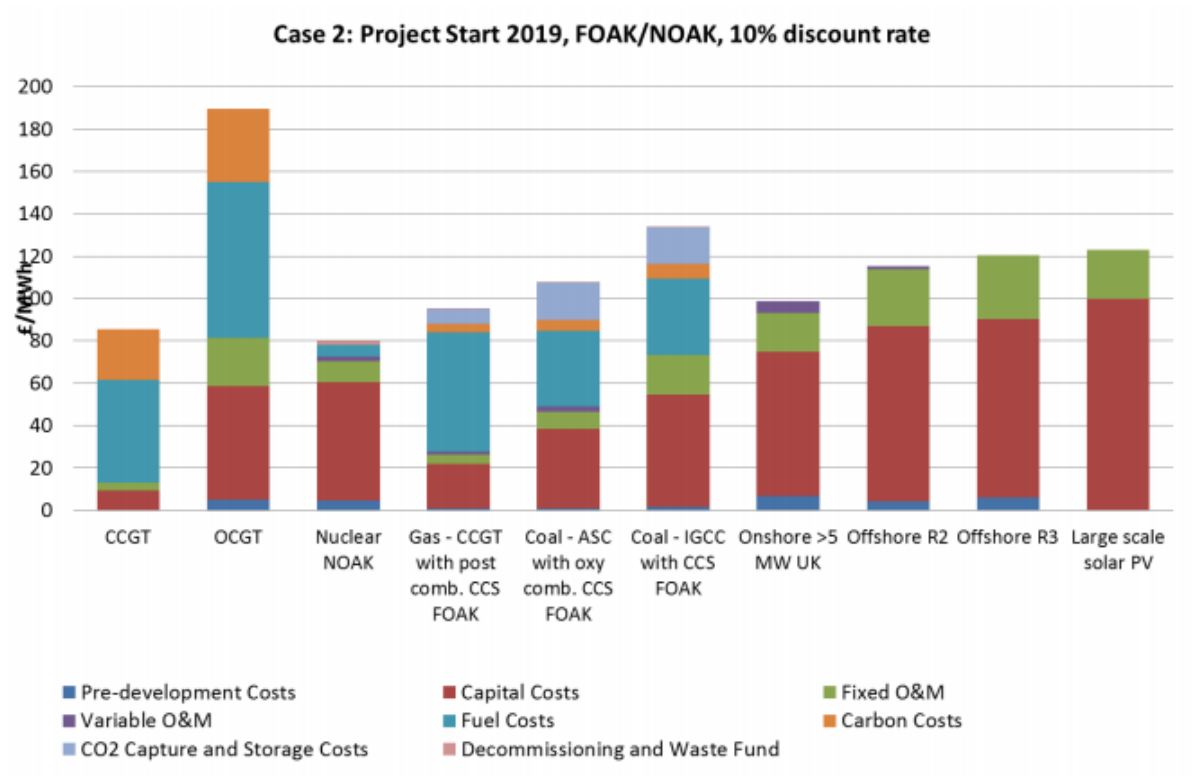
14. A number of factors are important in terms of value for money (defined by the National Audit Office as "the optimal use of resources to achieve intended outcomes"):
    - Efficiency – how well are inputs converted to outputs
    - Effectiveness – how well the outputs are achieving the desired outcome
    - Cost-effectiveness – how much impact does this intervention achieve relative to the invested inputs (or, what else might be achieved with similar expenditure (the opportunity cost))

15. This is not the place to debate the desired outcome, but we work with the definition of 'generating electricity with relatively low greenhouse gas emissions' (as compared to coal).

16. The levelised cost of energy is the industry standard technique for measuring the cost of electricity generated by different technologies.

17. DECC provided levelised cost of electricity estimates in 2013[15].

Chart 5: Levelised Cost Estimates for Projects Starting in 2019, 10% discount rate[39]




15 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/269888/131217_Electricity_Generation_costs_report_December_2013_Final.pdf p20

18. A series of assumptions was made by DECC in compiling its estimates. One of these was that construction would cost £4100/kW[16]. However using the latest estimates for Hinkley Point, we estimate construction costs to be £5625/kW[17].

19. Another assumption was to use a discount rate of 10%:
*"this report includes estimates using a standard 10% discount rate across all technologies, in line with the 'tradition' used in reports produced by other organisations. This allows estimates to be viewed as neutral in financing and risk terms when comparison is made across technologies"*[18].

20. This supposes that costs in the future are very low or negligible in today's terms. It is particularly nefarious to suggest that a 'standard' discount rate "allows [cost] estimates to be viewed as neutral". When applied to nuclear power in particular – because of the costs associated with storage of radioactive waste – this is a particularly powerful way of 'magicking away' future liabilities from the balance sheet. No other technology has these massive long-term liabilities, so the discount rate dramatically favours nuclear.

21. HM Treasury recommends the use of a discount rate of 3.5%[19], with a *lower* discount rate for long-term projects (>30 years)[20]. If DECC had used HM Treasury's recommended discount rates then nuclear in particular would end up very much more expensive.

22. To take a concrete example, at a discount rate of 10%, costs of £1 million at year 30 would be payable today at a cost of £57,300. But at a discount rate of 3.5%, these costs would be £356,300[21].

23. The other important assumption made by DECC was the load factor of operation. It assumed the following load factors (see table below), with the *actual* load factors of operating power sources for comparison.

[16] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/269888/131217_Electricity_Generation_costs_report_December_2013_Final.pdf p52

[17] £18 billion price tag to construct 3,200 GWe of electricity generating capacity

[18] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/269888/131217_Electricity_Generation_costs_report_December_2013_Final.pdf p12

[19] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/220541/green_book_complete.pdf p26

[20] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/220541/green_book_complete.pdf pp98-99

[21] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/220541/green_book_complete.pdf p100

| Technology | DECC load factor (%)[22] | Actual load factor (%)[23][24] | Exaggeration |
|---|---|---|---|
| Nuclear | 91 | 67 | +36% |
| Coal | 90 | 51 | +76% |
| Gas | 93 | 31 | +200% |
| Onshore wind >5 MW | 28 | 26 | +8% |
| Offshore wind | 38 | 36 | +6% |
| Large scale solar | 11 | 9 | +22% |

24. In every case, the load factor was exaggerated. However the exaggeration for thermal and nuclear plant is particularly striking.

25. And in the case of Wylfa, ABWR have a particularly poor track record for load factor. Of the reactors in current operation (all load factors only up to the end of 2010 to account for the Fukushima shut-down):
    - Kashiwazaki Kariwa-6 has a load factor of 71.2%[25]
    - Kashiwazaki Kariwa-7 has a load factor of 68.6%[26]
    - Hamaoka-5 has a load factor of 47.4%[27]
    - Shika-2 has a load factor of 49.7%[28]

26. So the load factor for ABWRs is 59.2%, further diminishing the likely value derived from Wylfa.

27. If we correct some of these assumptions made in the analysis then nuclear power in particular suffers from a severe increase in the levelised cost of generation. Accounting for the exaggerated load factor (+54%) and the diminished cost of construction (+37%) *alone* would push the cost of nuclear from £80/MWh to £153/MWh, rendering it outstandingly expensive compared to every other form of generation other than Open Cycle Gas Turbines. The significant flaw in relation to discount rates pushes the valuation even further in the direction of 'very expensive'.

28. This analysis provides us with part of the answer to the conundrum of the opportunity cost. That is, we would expect better value from money spent on almost any other mode of electricity generation.

29. But that is not all. In order to achieve our targets on climate change, security of supply and affordability, the following options arise in addition to a very strong focus on renewables:
    - Massive investment in energy efficiency
    - Much greater focus on demand management (using less, or changing patterns of use)
    - Energy storage

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22 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/269888/131217_Electricity_Generation_costs_report_December_2013_Final.pdf

23 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/447632/DUKES_2015_Chapter_5.pdf p122

24 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/450298/DUKES_2015_Chapter_6.pdf p193

25 https://www.iaea.org/PRIS/CountryStatistics/ReactorDetails.aspx?current=383

26 https://www.iaea.org/PRIS/CountryStatistics/ReactorDetails.aspx?current=384

27 https://www.iaea.org/PRIS/CountryStatistics/ReactorDetails.aspx?current=843

28 https://www.iaea.org/PRIS/CountryStatistics/ReactorDetails.aspx?current=842

30. What might investment of £10 billion in terms of energy efficiency achieve? At a cost of £20,000 per home, we could make half a million dwellings in Wales into nearly zero-carbon homes[29]. That would in turn provide savings of around £500 per home[30], for a net injection of £250 million *per annum* into the Welsh economy.

31. Additional focus on grid, demand management and energy storage to the tune of £10 billion would rapidly dwarf the contribution to generation that Wylfa would make. And because investment in demand management and storage do away with the need for generation, additional savings are made from the losses in transmission and distribution associated with large power stations.

**What will the strike price from Wylfa Newydd be and what impact it will have on energy prices in Wales?**

32. The strike price is the total price paid for electricity and is comprised of the wholesale electricity price (currently around £45/MWh) and a top-up from government up to the total price negotiated.

33. There is no doubt that Wylfa Newydd will be expensive, likely in the region of £90/MWh. Hinkley's strike price is £92.50/MWh, reducing to £89.50 if Sizewell goes ahead[31] (described by Nick Butler in the Financial Times as "a major defeat for the UK negotiators[32]). Offshore wind strike prices in 2015 were an average of £117/MWh; onshore wind and solar received an average of £82/MWh[33]. The UK Government has a policy of support for less established technology in a bid to help them mature and become more cost competitive (DECC had expected strike prices of £140-150/MWh for offshore wind[34]).

34. The strike price is index-linked and is guaranteed for 35 years for nuclear only. Other forms of generation such as offshore wind have to make do with contracts limited to 15 years[35].

35. It is inconceivable that electricity being generated at £253.25/MWh (in £ 2055) will be viewed as the negotiating work of a maestro when costs for all forms of generating electricity other than nuclear are rapidly reducing. In fact, nuclear is unique in being the only form of electricity generation that is becoming more expensive the more of it is deployed[36].

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29 http://www.constructionproducts.org.uk/?eID=dam_frontend_push&docID=6471&filename=Introduction_to_Low_Carbon_Domestic_Refurbishment_-_Abstract.pdf Assumed cost in 2014 was £25,000 per dwelling, but assuming a substantial saving from scheme roll-out

30 Assuming that £500 of the £700 average bill relates to space heating https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/487646/table_232.xls

31 http://www.world-nuclear-news.org/NP-Hinkley-Point-C-contract-terms-08101401.html

32 http://blogs.ft.com/nick-butler/2015/09/14/new-nuclear-time-for-serious-renegotiation/

33 http://www.carbonbrief.org/uk-renewables-auction-pushes-down-costs

34 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/437077/Offshore_Wind.pdf

35 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/437077/Offshore_Wind.pdf

36 http://webarchive.iiasa.ac.at/Research/ENE/GEA/doc/GEA-Summary-web.pdf p24

36. Energy prices will therefore increase in Wales if Wylfa Newydd goes ahead, and they will be artificially elevated not just for the remainder of the 35-year contract, but for all time[37]. That is because everyone who pays an energy bill is also a taxpayer. And of DECC's annual budget, the vast proportion (£2.2bn, or 65%) is devoted to managing civil and military waste and the decommissioning legacy[38]. The nuclear industry is further subsidised in a suprisingly creative variety of ways[39].

**What impact will Wylfa Newydd have on the economy of Anglesey and Wales?**

37. There is no doubt that the injection of up to £14 billion into a particular part of Wales will have a noticeable impact on the local economy. It could also have an impact on the economy of Wales overall, at least for the duration of the construction (the most labour-intensive phase).

38. Welsh workplace GVA[40] in 2014 was £54.3 billion[41]. So assuming a 14-year construction period, a £1 billion annual addition could potentially boost GVA by under 2%. Given that the costs are borne by bill- and tax-payers throughout the UK, the boost will be at the expense more of people in other parts of the UK than in Wales.

39. However, the *negatives* associated with the facility will principally accrue locally (including unnecessary residential development, construction traffic and impact, environmental degradation and the risk of radioactive release).

40. Furthermore, any multi-billion pound project will have the impact of boosting GVA and economic output. The same is as true for other energy projects such as offshore wind as it is for other infrastructure such as schools and hospitals. Money spent on Wylfa Newydd is money that cannot be allocated to more productive activities.

**What will the environmental impact of Wylfa Newydd be?**

41. This depends to some extent on everything going as planned. Should everything go as planned then the following environmental impacts will be visited.

42. There will be some permanent sterilisation of land. This is because there can be no future use of a site formerly used as a nuclear power station.

43. There will also be an increase in radioactivity. This occurs through the discharge of low-level radioactive waste and the transport and transfer of medium- and high-level waste. Radioactivity is mutagenic and low doses can have health impacts:

[37] Or at least for the several millions of years that radioactive waste takes to become safe
[38] http://www.carbonbrief.org/analysis-decc-budget-details-show-limited-scope-for-cuts
[39] http://www.mng.org.uk/gh/private/nuclear_subsidies1.pdf
[40] This excludes many critical components of the economy, including caring, housework, volunteering and so on
[41] http://gov.wales/statistics-and-research/regional-gross-value-added-sub-regional-gross-value-added/?lang=en

*"At low doses of radiation, the risk of inducing solid cancers is very small. As the overall lifetime exposure increases, so does the risk"*[42].

44. To put this in perspective, man-made radiation comprises 18% of human exposure, with the rest coming from the universe, the ground, food, drink and the atmosphere. Occupational exposure, fallout and the use of nuclear fuel constitute 5% *of the man-made component*[43], or about 1% of the total exposure.

45. From the start of the power station's life, high-level radioactive waste will need to be stored on Anglesey for 160 years[44]. If the power station is commissioned by 2030, that takes us to the year 2190.

46. There will also be a range of environmental impacts from the associated developments: residential units, increased traffic, construction noise and dust, air pollution from construction and traffic and so on.

47. Should things not go according to plan then a range of possibilities arise from the banal to the catastrophic.

**Decommissioning of Wylfa and Trawsfynydd**

48. No comment

**What will the economic impact of decommissioning Trawsfynydd be?**

49. Similar to any large investment of public funds, there will be increased economic activity for the period of decommissioning commensurate with the investment.

**What potential is there for small modular reactors to be built at Trawsfynydd?**

50. Almost none. The history of small modular reactors (SMRs) is replete with failure at gargantuan expense. The Pebble Bed Modular Reactor – long acknowleged to be the most advanced modular reactor in the world – was finally abandoned by the South African government in 2010 on account of having no customers after public expenditure of $1 billion[45]. In South Korea a design was approved by the regulator in 2012, following 20 years of design work. Not one unit has been sold[46]. One module of Chinese design is under construction in China[47].

51. Westinghouse, a company which spent years working on a small modular reactor design, quit the sector in 2013 with its CEO stating:

[42] http://www8.nationalacademies.org/onpinews/newsitem.aspx?RecordID=11340
[43] http://www8.nationalacademies.org/onpinews/newsitem.aspx?RecordID=11340
[44] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/47801/1984-aos-site-report-wylfa-en6.pdf
[45] http://www.worldnuclearreport.org/IMG/pdf/20151023MSC-WNISR2015-V4-LR.pdf p15
[46] http://www.worldnuclearreport.org/IMG/pdf/20151023MSC-WNISR2015-V4-LR.pdf p15
[47] http://www.world-nuclear.org/information-library/nuclear-fuel-cycle/nuclear-power-reactors/small-nuclear-power-reactors.aspx

*"The problem I have with SMRs is not the technology, it's not the deployment—it's that there's no customers.... The worst thing to do is get ahead of the market"*[48].

52. Why might there be no customers for SMRs? The Chief Scientist at the Rocky Mountain Institute puts the conundrum facing small modular reactors thus:
*"The basic challenge of the economies-of-mass-production model is that another kind of SMR, Small Modular Renewables (and efficiency), can scale down much better and is already decades ahead in exploiting its own formidable economies of mass production. Nuclear SMRs can never catch up"*[49]

**Are the Welsh and UK Governments co-ordinating their policy in this area?**

53. Welsh policy on nuclear is to support the UK policy. Because responsibility for large-scale electricity generating infrastructure is reserved to Westminster there is little in practice the Welsh Government can do.

54. Of some consternation is the weight of expectation that the Welsh Government appears to put on Wylfa Newydd providing the solution to Anglesey's economic development concerns[50]. The supposition that Anglesey's economic difficulties will be largely solved by the construction of a new nuclear power plant clearly portends problems if no such power plant is forthcoming.

[48] http://www.post-gazette.com/business/2014/02/02/Westinghouse-backs-off-small-nuclearplants/stories/201402020074
[49] http://www.worldnuclearreport.org/IMG/pdf/20151023MSC-WNISR2015-V4-LR.pdf p22
[50] http://www.northwaleschronicle.co.uk/news/149265/carwyn-jones-wylfa-newydd-could-make-real-difference-for-north-wales.aspx