

Agenda – Y Pwyllgor Amgylchedd a Chynaliadwyedd

Lleoliad:	I gael rhagor o wybodaeth cysylltwch a:
Ystafell Bwyllgora 3 – y Senedd	Alun Davidson
Dyddiad: Dydd Mercher, 4 Tachwedd	Clerc y Pwyllgor
2015	0300 200 6565
Amser: 09.00	SeneddAmgylch@Cynulliad.Cymru

1 Cyflwyniad, ymddiheuriadau a dirprwyon

2 Cynnig o dan Reol Sefydlog 17.42 i benderfynu gwahardd y cyhoedd o'r cyfarfod ar gyfer eitemau 3, 5 ac 8

3 Trafod Bil Cymru drafft

(09:00 – 09:30)

(Tudalennau 1 – 28)

E&S(4)-30-15 Papur 1

4 Ymchwiliad i 'Ddyfodol Ynni Craffach i Gymru?'

(09.30-10.30)

(Tudalennau 29 – 54)

Craig Anderson, Prif Swyddog Gweithredol, Cymru Gynnes

Gill Kelleher, PENODOL, Canolfan Wybodaeth Arloesi, Prifysgol Abertawe

Shea Jones, Swyddog Polisi, Cartrefi Cymunedol Cymru

Steve Curry, Rheolwr Adfywio Cymunedol, Cymoedd i'r Arfordir

5 Trafod y dystiolaeth (yn breifat)

(10.30-10.45)

6 Ymchwiliad i 'Ddyfodol Ynni Craffach i Gymru?'

(10.45-11.30)

(Tudalennau 55 – 57)

Mark Harris, Cyngorydd Cynllunio a Pholisi, Cymru – Ffederasiwn yr Adeiladwyr

Cartrefi



E&S(4)-30-15 Papur 2

7 Ymchwiliad i ‘Ddyfodol Ynni Craffach i Gymru?’

(11.30-12.30)

(Tudalennau 58 – 71)

Yr Athro Gareth Wyn Jones, Athro Anrhydeddus, Ysgol Amgylchedd, Adnoddau
Naturiol a Daearyddiaeth, Prifysgol Bangor

Dr Caroline Kuzemko, Cymrawd Ymchwil, Coleg Gwyddorau Bywyd ac
Amgylcheddol, Prifysgol Caerwysg

E&S(4)-30-15 Papur 3

E&S(4)-30-15 Papur 4

8 Trafod y dystiolaeth (yn breifat)

(12.30-12.45)

Mae cyfyngiadau ar y ddogfen hon



Alun Ffred Jones AC
Cadeirydd
Y Pwyllgor Amgylchedd a Chynaliadwyedd
Cynulliad Cenedlaethol Cymru
Caerdydd

23^{ain} Hydref 2015

Annwyl Alun

BIL DRAFFT CYMRU

Ysgrifennaf atoch mewn ymateb i'ch llythyr 9 Hydref yn gofyn am papur ar sefyllfa'r Llywodraeth ar y bil drafft.

Rydym mewn trafodaeth gyda'r Llywydd ynglŷn â sut i symud ymlaen gyda threfniadau i roi tystiolaeth i Bwyllgorau. Hyd nes bod hyn wedi cael ei egluro nid wyf yn gallu roi tystiolaeth ysgrifenedig cyn cyfarfod y Pwyllgor ar 4 o Dachwedd.

Byddaf yn ysgrifennu atoch eto unwaith y bydd y sefyllfa yn gliriach.

Yn gywir

CARWYN JONES



Alun Ffred Jones AC
Cadeirydd
Y Pwyllgor Amgylchedd a Chynaliadwyedd
Cynulliad Cenedlaethol Cymru
Caerdydd

30 Hydref 2015

Annwyl Alun

BIL DRAFFT Cymru

Ysgrifennaf atoch mewn ymateb i'ch llythyr 9 Hydref yn gofyn am bapur ar sefyllfa'r Llywodraeth ar y bil drafft.

Yn dilyn fy llythyr ar y 23 Hydref ar y mater, rwy'n nawr medru cadarnhau y bydd papur yn cael ei rhannu efo'ch Pwyllgor ond yn anffodus ni fydd yn bosib cwrdd gyda'r amserlen nodwyd yn eich llythyr. Dylai'r papur fod ar gael ar neu ar ôl y 10fed o Dachwedd.

Yn gywir

CARWYN JONES

Mae cyfyngiadau ar y ddogfen hon

Cynulliad Cenedlaethol Cymru Pwyllgor Amgylchedd a Chynaliadwyedd	National Assembly for Wales Environment and Sustainability Committee
Dyfodol Ynni Craffach i Gymru?	A Smarter Energy Future for Wales?
Ymateb gan Grŵp Cartrefi Cymunedol Cymru (Saesneg yn unig)	Response from Community Housing Cymru Group
SEFW 16	SEFW 16



Cynulliad
Cenedlaethol
Cymru

National
Assembly for
Wales

CHC response to the National Assembly for Wales' Environment and Sustainability Committee inquiry into a "smarter energy future for Wales"

The energy mix

How can we decarbonise our energy system at a sufficient pace to achieve the necessary reductions in emissions?

1. Welsh Government in 2010 committed to two greenhouse gas reduction targets- To reduce emissions within all areas of devolved competence by 3% each year from 2011 to 2020 and to reduce all Welsh emissions by 40% by 2020. CHC understands that progress towards the 40% residential target requires a reduction in non-electricity based emissions from households, so achieving this target requires further energy efficiency measures to reduce heating demand, plus significant uptake of renewable heating technologies to reduce the carbon-intensity of heating. Given what is required, achieving a 40% emission reduction in the residential sector by 2020 will be extremely challenging. Our analysis indicates that around 2.2 million additional energy efficiency measure installations will be required between now and 2020 for the target to be met; this is almost 3 times the number of installations made from 2007 to 2014. Significantly greater investment will therefore be required for a reduction in source emissions to be achieved. Estimates in a Bevan report on poverty states that it will take 78 years for Nest to reach each and every home suffering from fuel poverty in Wales.¹
2. We also need to reduce carbon emissions by shifting to renewable energy generation. Schemes such as the Feed-in Tariff scheme have big potential for reducing carbon emissions and cuts to the tariff have had big impacts on community's ability to install renewable energies. The key objective in the first instance should be to increase the uptake and public acceptance of renewable technologies in the early days and social landlords have an important part to play in achieving this objective. Social landlords can and should play a vital role in the roll out and eventual mainstreaming of renewable technologies.
3. Appropriate incentives and subsidies would enable RSLs to install renewable technologies into their properties and in communities at a faster rate available in order to help reduce fuel poverty. We strongly suggest that attractive incentives exist for social housing providers in order to support the social housing business model and stop schemes becoming regressive in their application. Incentives should form an important part of the process and this could include financial incentives as well as other incentives. Regulatory drivers should include the need

¹ <http://www.bevanfoundation.org/publications/rethinking-poverty/>

for financial incentives and disincentives introduced by Government (including forms of subsidy), stronger enforcement, council tax reductions, etc.

4. We must also focus on the reduction of energy use at the point of use through behaviour change (whilst Welsh Government does not have control over electricity generation, their actions can have significant influence on electricity consumption by end-users).

What mixture of distributed generation resources best meets Wales' renewable energy needs in respect to the supply of a) electricity, b) gas, and c) heat?

5. There is potential for making more use of certain technologies such as biomass, combined heat and power, district heating and cooling. We need to consider good practice from other countries including Denmark's experience of district heating, with Denmark being one of the most successful nations in spreading low carbon heat networks. One of CHCs members, for example, is installing a new Biomass energy centre to complement existing gas fired gas boilers. One of our members is also exploring the potential for a district heating energy service company, although this is not an area that the RSL sector have a lot of experience in installing.
6. CHC's members have been mostly active in installing solar photovoltaics and renewable heat technologies (mostly solar thermal, heat pumps which do have further potential). Experience of installing solar PV has generally been positive and solar PV is increasingly becoming economically competitive. Although there has been positive feedback following the installation of renewable heat technologies, it can be accepted that renewable heat technologies are generally less well known and there are more hassle factors associated with their installation, which increases the barriers to installation. There are barriers to design, installation, operation and maintenance of renewable heating systems in particular. RSLs are still assessing the effectiveness, running costs and tenant satisfaction from installations. What is evident from projects is that householder education is an important factor to improve both the acceptance and operation of renewable heating systems.
7. The sector hasn't got much experience in installing hydro, although some RSLs have been involved in working with other partners to install Hydro. Although it has been stated that natural flow hydro and thence for small hydro will not itself likely lead to regionally significant employment or carbon-mitigation impacts, a report shows that small hydro developments can have significant local socio-economic impacts, often in challenged communities and places.² Wales should harvest its abundant rainfall and prioritise this as there are thousands of untapped streams

² http://regenwales.org/resource_85_The-Economic-and-Social-Impact-of-Small-and-Community-Hydro-inWales

pouring off hillsides across Wales and the potential for micro hydro is almost limitless.

The grid

How does the grid distribution network in Wales enable or restrict the development of a new smarter energy system?

8. The grid and distribution network in Wales has significantly affected the ability of projects (particularly small and medium sized) to connect to the grid. The lack of availability of the grid and the cost of new connections is a barrier to development. CHCs members have found the capacity of the national grid to be a barrier in the past with regards to installing renewable energy systems. How we address this needs to be considered further by OFGEM, the Distribution Network Operators, Government and other partners.
9. The privatised grid in much of rural Wales is owned by Western Power Distribution (WPD) and as the grid is full for the foreseeable future in many parts of Wales, it can be very expensive to upgrade the grid and connect even small scale schemes. Due to the high levels of embedded generation currently connected, or seeking connection to the distribution networks, there are areas in south Wales where significant reinforcement work is required.
10. Following the UK Government's decision to launch a consultation on electricity distribution costs in the north of Scotland, CHC feels that the same could be considered for North Wales which has the second highest regional energy costs. However, CHC would go a step further and argue that we need a major overhaul in this area and big investments in infrastructure are needed to create a flat national rate.
11. Smarter strategies appear most cost-effective, with modelling showing that a smart grid strategy of using innovative smart solutions in conjunction with conventional reinforcement options appears to be more cost effective than using conventional solutions alone.

What changes might be needed in terms of ownership, regulation, operation and investment

12. CHC recently welcomed OFGEM's consultation into Non-traditional Business Models³, which acknowledged an increase in enquiries about new ways to interact with the energy market with many proposals seeking new and non-traditional business models.

³ <https://www.ofgem.gov.uk/publications-and-updates/non-traditional-business-models-supportingtransformative-change-energy-market>

13. The consultation notes a range of issues, including that Wales has experienced an increase in the development of localised generation as technology, systems and processes are developed. This has resulted in an upward pressure on the networks. The shift to “local” has also promoted the question of how to capture the ownership of such interests to help retain benefits in Wales. These discussions form part of a longer-term engagement in this area to help understand drivers, consumer benefits and risks. As part of developing Smart Living, there should be proactive discussions on types of models that could be beneficial for organisations and communities in Wales to consider. Planning needs to account for more recognition of benefits and social ownership and we need active promotion of social ownership in communities.
14. CHC is currently active in helping our members secure energy supply for RSL tenants via local energy production through renewable energy systems. CHC wants to address the market failure impacting on low income households and impact fuel poverty directly through price. The feed-in tariff schemes work very well where they have been installed, but there is a lot more to be done now around enabling communities to generate their own power and thereby have a greater control over future fuel usage and costs. CHC would like to see the ability for more direct local supply and, for example, a generator (e.g. ESCO) being able to sell directly to a customer at a good price.
15. There is a significant and growing appetite amongst our members to intervene directly in the market and therefore CHC is looking to set up a partnership to weigh up options for setting up an energy supply company. A good example is the “Our Power” model in Scotland⁴, which is a new independent energy supply company and the first in the UK to operate on a non-profit distributing basis. In the future, Our Power hopes to develop renewable energy projects as part of its business for the benefit of local communities.

Storage

How can energy storage mechanisms be used to overcome barriers to increasing the use of renewable energy?

16. Energy storage not only has the potential to provide back-up power in case of power cuts, but storage can also help electricity grids run at average rather than peak load, therefore reducing the chances of power cuts in the first place. Energy storage can also be used to obviate the need to upgrade or install new grid capacity. Puerto Rico, for example, has set a 30% storage requirement for any new renewable capacity. Storage is also proving invaluable for isolated communities that have no access to the national grid, with “islanders in particular enjoying continuous power without the need for additional diesel generation”.

⁴ <http://news.scotland.gov.uk/News/Power-to-the-people-1b3b.aspx>

17. Renewables, together with energy storage, open the possibility of communities and individuals becoming energy self-sufficient. CHCs members do not have a lot of experience in assessing energy storage mechanisms, but CHC understands that the costs today are prohibitively high for mass adoption, but there are already residential energy storage solutions on the market and costs will come down. Support from Government and others would be essential in driving the use of energy storage mechanisms into the market due to initial costs and significant commercial risk.
18. It could also lead to a point where demand from the grid is much reduced. This raises important questions about who will pay for grid maintenance - initially at least only the wealthy may be able to afford renewables and storage, leaving those who can't afford them to pick up the bill. Therefore, if Wales did decide to pursue energy storage options, this must be taken into account in helping to enable low income households to get access to new technologies so that they aren't disproportionately affected.
19. There are an increasing number of energy services companies able to provide everything their customers need to generate and store their own energy. The ultimate beneficiaries could be consumers. Large-scale generation and national grids are not going to disappear overnight, if ever, but CHC would like to see individuals and communities having the power to choose their own energy futures.
20. The huge problems in grid capacity across large areas of Wales (most notably mid and west Wales but also across all of Wales) could be considered as a great opportunity to incentivise innovation in the smart grid and storage sectors, particularly if Government funding and structural funds are used to financially support projects which demonstrate a diminishing need for upgraded or new infrastructure. We need to consider the potential for energy storage, smart grids and other technological advances. CHC understands that locally installed energy storage could, in principle, be able to connect islands of generators and users without the need for "wider" grid connection.

Ownership

To investigate the desirability and feasibility of greater public and community ownership of generation, transmission and distribution infrastructure and the implications of such a change.

21. Please see our answer above to the question "What changes might be needed in terms of ownership, regulation, operation and investment?" We have insufficient knowledge of this area to make a full response.

Energy efficiency and demand reduction

How can the planning system and building regulations be used to improve the energy efficiency of houses (both new build and existing stock)?

22. Improving the energy efficiency of homes is one of the key levers to tackling fuel poverty. Energy efficiency lies at the heart of discussions about energy. A home which is highly energy efficient can provide the occupants of those buildings with a more comfortable experience, lower fuel bills, enable reductions in carbon emissions and help ensure increases in energy security for individuals, businesses and communities. Wales has responsibility for setting energy efficiency requirements for new buildings. The integration of renewable energy technologies when feasible into the built environment offers clear benefits and an additional improvement in the skills and expertise of the workforce operating in the sector in Wales. The Welsh Government needs to increase its support for the smart energy sector and commission an assessment of potential impact of the smart grid and storage sectors.

What would the environmental, social and economic impacts be if Wales set higher energy efficiency standards for new build housing? (e.g. Passivhaus or Energy Plus)

23. CHC is committed to its members delivering economic, social and environmental benefits through the building of new homes. In assessing the environmental, social and economic impacts of Wales setting higher energy efficiency standards for new build housing, there are several to take into account. In making the argument for increasing standards, increases in the energy efficiency requirements for new-build could support the skill base of our construction sector ready for the forthcoming requirement for all new buildings to be “close to zero carbon” by 2020. Zero carbon buildings can also mean reduced energy bills for tenants, lifetime energy use would be drastically reduced (reducing greenhouse gas emissions, fuel bills, fuel poverty), improvements in people’s health and this would result in economic cost savings to the NHS and whole-life savings for tenants. A project that is of particular interest to our members and the health service at the moment is the Boiler Prescription service which is being delivered by Gentoo.⁵

24. In making the argument against, or in making the argument in regards to how much and how quickly standards are increased, our members report that development costs have increased in recent times with ever improving standards as there are many different tiers of design criteria that our members are required to meet for new build properties. As well as the mandatory Building Regulations and Code Level 3 applicable to all new build dwellings, affordable homes also have to be compliant with DQR (Development Quality Requirements), WHQS

⁵ <http://www.gentoo-group.com/news/gentoo-group-launch-boiler-on-prescription-pilot/>

(Welsh Housing Quality Standards) and Lifetime Homes. Although this additional level of design results in consistency in design and standards across the affordable homes sector, it should also be noted that this comes at an extra over development cost. The review of Part L under the building regulations and the intention for the requirement to install automatic fire suppression systems in all new residential dwellings from spring 2014, as outlined in the domestic fire safety measure, will add to that cost and they are coming at a time when there are a lot of difficulties in the sector including viability challenges and technical challenges to be looked at.

25. It is important that these changes are balanced against the backdrop of the current financial situation, cuts in social housing grant and increasing housing demand. The viability of development schemes is challenged with increasing standards and less rental income/grant. Furthermore, there is considerable financial pressure on the sector at a time when there are significant cuts to the welfare system which are considerably impacting the income of RSLs. With the cuts to welfare reform, there will be a greater need for more efficient properties in terms of accommodation which could have a larger footprint and associated build cost but may be necessary in order to meet housing need. Our members have commented that rising standards will drive developers including RSL's away from build.

Communities- making the case for change

How can communities, businesses and industry contribute to transforming the way that Wales thinks about energy? Does the answer to this challenge lie in enabling communities to take greater responsibility for meeting their future energy needs?

26. Taking into account the energy hierarchy, energy reduction should be considered firstly before considering energy efficiency. Undoubtedly the first and best option is to use less energy, to be less profligate. With less waste, the adoption of modern technologies, better insulation, regulation and planning, we can save over 35% of our total energy bill and Wales could reduce its internal consumption from ~100 TWh to below 65TWh.⁶ Useful figures can be seen within this article in the footnote⁷. Therefore a priority should be to increase energy efficiency and reduce our total national energy use without increasing imported embedded energy.

27. In England, 100% of business rates from new energy projects are retained by local authorities and we believe Wales should emulate this approach as the retention of local business rates from renewable energy projects would help link projects with the communities in which they are based, and support the "fairness"

⁶ <http://www.clickonwales.org/2015/07/the-energy-conundrum/>

⁷ <http://www.clickonwales.org/2015/07/re-energising-wales-2/>

principle of supporting the local authorities which play host to more developments.

28. Wales must reconfigure and re-engineer its energy supplies to a “zero carbon”, minimal greenhouse gas (GHG) emission format. Energy is essential to the Welsh economy and though we are traditionally an exporter of electricity, we are likely to become a net importer from 2016. We face many unique challenges, as well as opportunities, in terms of developing our energy resources in a way that is compatible with our obligations to future generations and greenhouse gas emission targets

If you require any further information on the content of this submission, please contact Shea Jones at XXXXXXXXXXXXXXXXXXXX We are willing to provide oral evidence to the Committee if required.

Response from Homebuilder Federation Wales

National Assembly for Wales' Environment and Sustainability Committee inquiry into 'A Smarter Energy Future for Wales'.

1. How can we achieve reductions in energy demand and to what extent is this linked to local community engagement?

As new housebuilders we already consider we are playing our part in this process as the modern home build today is far more efficient than those built previously.

A recent HBF report concluded that, on average, new homes built in England and Wales today are 65% more energy efficient than a Victorian house of the same style. Further new homes currently built in the UK are roughly 50% cheaper to run per year than the equivalent Victorian house. That could mean an annual saving of £440 for a 1-bed ground floor flat, and £1,410 for a 4-bed detached house.

However new homes still make up a small percentage of the total housing stock, for this reason a continued drive to improve the energy efficiency of the existing stock should take place.

A lot of energy is used by the users in the home (not heating or light) and through transport and would not be stopped by physical changes to the dwelling. These require culture change, information, and better understanding of how energy is used. Areas like improved public transport, legislation around efficiency of electrical goods and better education all need to be considered.

The main service providers also use a large amount of energy providing energy to its users, investment in update infrastructure, for water, gas and electricity could help save significant amounts of energy.

We are not sure that local community engagement can help with a lot of these issues other than possibly education. However there is an opportunity for it to support small scale local production of energy from renewable resources such as wind or hydro power.

2. What are the social and economic impacts of increases in building energy efficiency standards?

If household energy bills are reduced as a result of using less energy, then this will give people more money to spend. Although a small improvement in energy efficiency in current new build is likely to have a small impact on how much money would be saved.

The new technology required to achieve this goal could lead to new companies and associated jobs created, but to counter this jobs may be lost which relate to the old technology.

The drive to be more energy efficient also needs to be balanced against other factors which can have an impact on people's health such as daylighting and ventilation regimes. The overheating of over insulated houses had already been established as an issue.

3. What scale of housing refurbishment programme is needed and how could this realistically be managed/funded?

The private house building industry is not in a position to comment on this .

4. What are the skills/training implications of a large-scale energy efficiency programme?

One of the issues in recent years and has been the lack of a long term Government commitment to renewables, without this why would companies invest in the training needed to support the industry.

If the programme of work involves physical building work to properties then there is potential for a shortage of skilled labour as this has already been felt for some time by the private house builders.

5. What are the real barriers to building low cost, energy smart homes given that they can be built as cheaply as 'normal' homes and then can make money by generating surplus energy?

Firstly we are not aware of the evidence base to back up the statement 'given that they can be built as cheaply as 'normal' homes'.

Secondly we are not aware of what is the accepted definition of a 'normal house' as there are a wide variety of building techniques available.

Without going into detail the ability of a house to generate a surplus supply would appear to rely on a number of factors some of which are listed below:

Building orientation- this is critical if the sun's energy is being used (one of the cheapest and easiest forms of renewable energy), if orientation was looked to be a key factor this would be extremely restrictive on which sites could be built on the type of layout and the densities achievable, all of which are likely to restrict the number of units which could be built on a site.

Ground conditions – likely to affect the use of ground source heat collection and again could affect layouts and densities.

Design – is the design of such a house likely to be acceptable in all locations and all sites. The customer also has to be willing to buy the house.

Other planning requirements – planning is always a balance between various competing policy requirements, if energy is to become the main driver then other policy requirements would have to give.

We would finally question the benefit or incentive for individuals to generate excess energy for others particularly as the UK government are looking to reduce FIT by 86% for small scale pv.

Mark Harris
October 2015

Eitem 7

“Y Storom Berffaith”: Her Fwyaf ein Hoes?

‘Fe all mai’r storom fawr ei grym
A ddaw a’r pethau gorau im;
fe all mai drygau’r byd a wna
i’m henaid geisio’r pethau da.’ Moelwyn

1. Y Cefndir

Ers yr 16^{fed} ganrif bu chwyldro. Mewn cwta 400 mlynedd gweddnewidiwyd ein byd; cyfnod byr iawn o’i gymharu a 10,000 mlynedd ers i ddyn modern ymgartrefu yng Nghymru, o leiaf 150,000 blwyddyn o bresenoldeb *Homo sapiens* ar ein planed Daear, tua 2 filiwn ers esblygiad *Homo erectus*, ac oed ein Daear o tua 4,500 miliwn o flynyddoedd. Sylfaenwyd y chwyldro ar gyfuniad o wyddoniaeth, technoleg, cyfalafiaeth ac unigolyddiaeth. Rhoddwyd rhwydd hynt i’n chwilfrydedd, i’n dyfeisgarwch a’n gwanc. O ganlyniad daeth golud nid yn unig i’r ychydig freintiedig – brenhinoedd, tywysogion ac ati - ond i’r llaweroedd, er wrth gwrs nid i bawb o bell ffordd. A thalwyd pris am y cynnydd.

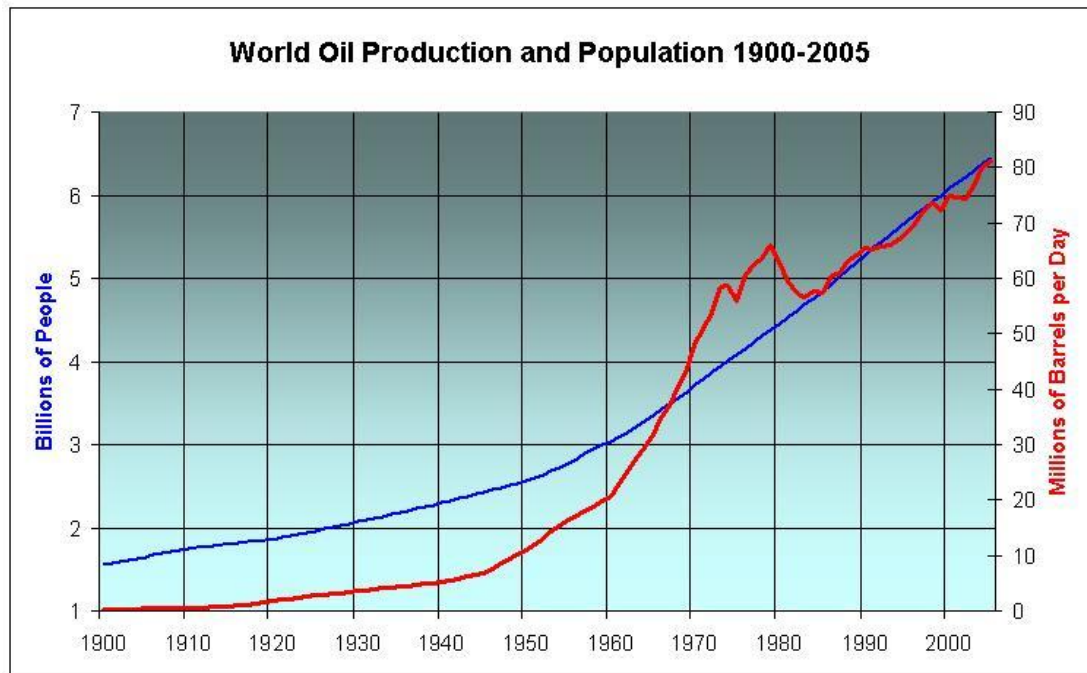
Sylfaenwyd hyn oll ar ein gallu i ffrwyno ynni rhad (Ffig. 1.). Dros tair canrif llosgwyd glo, olew a nwy – tanwydd ffosil pob un – i hybu cynnydd - cynnydd hyd yn oed mwy syfrdanol (o’i fesur fel GDP [Gross Domestic Product: Crynswth Cynnyrch Dynol]) na’r un yn ein niferoedd (Ffig. 2.). Ffrwynwyd ffynhonellau grym llawer llai anhydrin na chaethweision!

Tyfodd poblogaeth *Homo sapiens* o lai na 200 miliwn yng nghyfnod Iesu i tua 500 miliwn ar drothwy’r chwyldro (diwedd Oes y Tuduriad); sef cynnydd o tua 300 miliwn mewn 1,600 o flynyddoedd. Carlamodd wedyn i dros 7 biliwn heddiw; sef codiad o 6,500 miliwn mewn ~400 mlynedd. Disgwylir oddeutu 2,000 i 3,000 miliwn ychwanegol erbyn canol y ganrif - cwta deugain mlynedd i ffwrdd. Llwyddwyd yn rhyfeddol i fwydo, dilladu a chartrefu rhan helaeth o’r twf hwn. Sicrhawyd gwell iechyd a hir oes i ganran sylweddol. Ni wireddwyd ofnau Malthus!

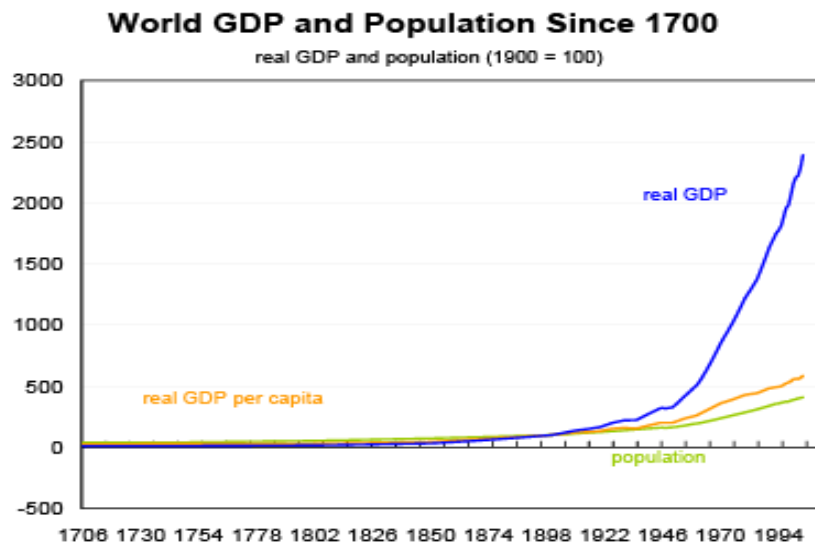
Rydym yn dystion i dra-argwyddiaeth dynoliaeth - i’r Oes Anthroposen. Mater i’w ryfeddu ato! Llwyddiant ysgubol i wyddoniaeth a chyfalafiaeth? Heb os dibynna’r cynnydd ar oruwchafiaeth y meddylfryd gwyddonol a’n llwyddiannau technol yn ogystal â masnach a chyfalafiaeth.

Dibynna’r ymchwydd dynol, felly, nid yn unig ar arloesi diwydiannol ond ar gynnydd anferth yn ein gallu i gynhyrchu bwyd, er i hyn ddigwydd ar draul cynefinoedd gwyllt a’n hoel troed ar y Ddaear. Llwyddwyd i fwydo’r biliynau ychwanegol a hyd yn oed i greu digonedd; cymaint felly y tyfodd gor-dewdra yn broblem bron mor ddifrifol â newyn. Diwallwyd ein chwantau am ynni a’n bara beunyddiol a hynny’n hael.

Ffig. 1. Cynnyrch Olew a Phoblogaeth y Byd drwy'r 20^{fed} Ganrif



Ffig.2. Cyfoeth a Phoblogaeth y Byd ers y Chwyldro Diwydiannol



Onid rhesymol felly yw ceisio ymledu'r golud i bawb - i'r cyfan o'r 10 biliwn arfaethedig a ddisgwylir erbyn canol yr 21^{fed} ganrif? Oni ddylid coleddu y dogma o dwf diderfyn yn ein cyfoeth ac yn wir yn ein poblogaeth? Yn ôl economegwyr disglair ar y dde a'r chwith dyma'r unig ffordd ymlaen i greu'r cyfoeth a'r swyddi angenrheidiol i dalu am ein golud personol a'r holl wasanaethau lles ac iechyd

rydym erbyn hyn yn eu chwenych. Onid dyma'r ffordd i ryddhau'r tlawd a'r anghenus o'u gofidau a'u beichiau? Yn wir dyma sylfaen deallusol ein cyfundrefn! Yng ngeiriau John Kenneth Galbraith – “y doethineb confensiynol”. Oes, mae’na annhegwch a phwysau cystadleuol! Oes, mae rhai yn dioddef! Oes, mae’na anghyfartaledd! Oes, mae’na leiafrifoedd a ieithoedd yn cael eu gwasgu. Ond dros bedair canrif daeth y gyfundrefn economaidd-dechnolegol â chynnydd a gobaith i filiynau! Pa hawl felly sydd gennym, yn ôl y ddamcaniaeth hon, i ymatal ac amddifadu gweddill y byd o'r gobaith a'r golud? Wiw i wleidydd amau y doethineb confensiynol os am gael ei ethol.

Ond perir amheuan dwys. A yw'r dadansoddiad uchod a'r cysyniad o olud byd-eang, **ar ei wedd presennol o prynwriaeth-cyfalafol**, yn gredadwy ac yn gynaliadwy? Oes posib glynnu at y drefn bresenol am byth neu o leiaf am ddegawdau lawer? Oes 'na rwystrau - o bosib terfynau pendant - i'n huchelgais dynol? Yn hanesyddol dibynna'r twf ar gynnydd ac ar feddiannu mwy a mwy o adnoddau naturiol ein planed. Gwelir ein hoel traed eisoes ar bob milltir sgwar o dir ein planed a'n cefnforoedd. Newidir hinsawdd y byd o ganlyniad i losgi tanwydd hydrocarbon a rhyddhau nwyon tŷ gwydr [NTG] fel CO₂, ond hwn yw'r ynni rhad sy'n sylfaenol i'n cyfoeth. Sut felly mae cysoni'r gyfundrefn economaidd (a'n chwantau dynol) gyda realiti y prosesau geo-biolegol sy'n eu tro yn caniatáu bywyd ar ein planed? A fydd ein dyfeisgarwch technolegol yn drech na unrhyw atalfa ffisegol a biolegol? A yw ein ffydd mewn unigolyddiaeth a chyfalafiaeth yn ddilys gan gofio y cyfrir oes dyn mewn degawdau ond cyfrir cylchoedd bywydeg a daeareg mewn canrifoedd a milenia.

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2. Y Storom Berffaith?

Prydera llawer i wyddonydd syber fel John Bedington, James Hansen a Martin Rees ynglyn â rhagolygon dynoliaeth. Nid yw'r awduron yn ymboeni am fygythiad unigol, ond am wead tyn o broblemau sy'n cyd-asio a phentyrru ar eu gilydd.

Megis y pwysau i gynhyrchu mwy o fwyd (+40% erbyn 2030; +70% erbyn 2050) i gynnal y boblogaeth cynyddol o dros 9 biliwn yn 2050 (sef + 25 - 30%) ac hefyd ymateb i'r newynog. Yn bresenol dioddefa bron i filiwn o fwyd annigonol, yn ogystal ag effeithiau mwy cuddiedig e.e. mae diffyg fitaminau yn dallu rhwng chwarter a hanner miliwn o blant y flwyddyn. Rhaid ymateb i'r galw am fwyd yn ngwyneb erydiad ein priddoedd, lleihad yn y coedwigoedd trofannol, effeithiau y gor-ddefnydd o wrtaith nitrogen, colli bioamrywiaeth gwerthfawr a chanlyniadau cynhesu byd eang. Rhagwelir bydd y newidiadau hinsoddol yn lleihau cynnyrch bwyd i'r erw a lefelau mineralau a fitaminau yn y cnwd, heb son am effeithiau trychinebus mwy lleol llifogydd a sychder. Mae ardaloedd ffrwythlon a phoblog megis Bangladesh, Delta y Nil a Gwastadedd Gogledd Tseina dan fygythiad o'u boddi gan y codiad yn lefel y mor – eto o ganlyniad i gynhesu byd eang a meirioli iâ yr Antarctig a'r Ynys Las. Mae'r môr ei hun yn

cynhesu ac yn mynd yn fwy asidig gydag effeithiau negyddol ar bysgodfeydd a'r gadwyn fwyd.

Canlyniad y twf yn y boblogaeth ac yn safon-byw canran sylwedol o ddynoliaeth yw cynnydd yn y galw am 'bethau' sy'n ei dro yn creu pwysau ar adnoddau crai, adnewyddol ac an-adnewyddol, ein planed. Er engraifft, ceir cystadleuaeth brwd am dwr ffres rhwng y cefngwlad - i ddyfrio cnydau - ar trefi mawr. Felly hefyd rhwng gwledydd (e.e. Y Nil - Swdan, Ethiopia a'r Aifft; yr Ewffrates - Twrci, Syria, Irac), rhanbarthau a llwythau.

Rhagwelir galw cynyddol am ynni - yn bennaf, fe dybir, o losgi glo, nwy ac olew (+40% erbyn 2030) er y tystiolaeth di-wad bod y CO₂ â'i rhyddheir yn newid ac yn ansefydlogi ein hinsawdd. Am gyfnod gobeithiwyd byddai'r stor o olew rhad yn prinhaus [peak oil!] ac yn creu ysfa cyfalafol i ddatblygu ynni cynaliadwy. Ond, yn arbenig yn yr UDA, tanseilwyd y gobaith hwn gan lwyddiant ffracio.

Yn barod rhwygir llawer i wlad gan ryfeloedd ac aflonyddwch lleol. Dyfynir tystiolaeth glir i gost bwyd a'r sychder mawr gyfrannu at y 'Gwanwyn Arabaidd' a'r rhyfel cartref yn Syria. Problem arall yw y diweithdra argyfyngus ac anghyfartaledd affwysol yn llawer i wlad, sy'n denu ieuenctid i freichiau mudiadau eithafol ac/neu i fudo ar draws Môr y Canoldir neu i'r UDA. Dioddefir anghyfartaledd safon byw enbyd nid yn unig o wlad i wlad ond o fewn gwledydd. Perchen yr 1% ganran rhyfeddol o gyfoeth ein byd a cuddir dros \$25 triliwn gan y 70,000 cyfoethocaf mewn hafanau di-dreth. Ni fu codiad yng nghyflogau y mwyfrif yn yr UDA mewn 40 mlynedd.

(Mae'r boblogaeth dynol yn heneiddio (tuedd sy'n gwbl angenrheidiol os am gydbwysedd hir dymor) ond o ganlyniad bydd llai yn gweithio a chostau gofal yn sicr o godi. Mae'r byd yn urbaneiddio gan greu trefi anferthol, gyda dinasoedd o dros deg miliwn yn gyffredin. Ynddynt yn aml dioddefir llygredd dwys ac ynysoedd o wres.) hepgor??

Hawdd iawn, felly, dychmygu sut y gallai argyfyngau yn y cadwyni bwyd a dŵr, poblogaeth cynnyddol, newid hinsawdd, cystadleuaeth am adnoddau, anghyfartaledd, anhegwch a therfysg gyd-gerdded i greu y 'storom berffaith'.

O'r holl broblemau a wynebwn, erys newid hinsawdd fel yr un arbennig o heriol o ganlyniad i'n dibyniaeth economaidd a gwleidyddol ar ynni rhad a'r gadwyn fwyd. Fel y gŵyr pawb, rhyddheir y NTG CO₂ o losgi tanwydd ffosil hydrocarbon ac ychwanegir at y gronfa naturiol yn yr awyr. Cyfanswm y nwy a gronnir yn yr atmosffer dros y degawdau yw'r ffactor tyngedfennol. Po fwyaf y cyfanswm o'r nwy a ryddheir rwan (ac a ryddhawyd ers cychwyn y Chwyldro Diwydiannol), llai yw'r ddogn a gyniateir yn y dyfodol os ydym am osgoi gwresogi peryglus a chroesi pwyntiau llithriad. Yn bresennol allyrir tua ~50 G tunell[t] CO₂ cyf. y flwyddyn a rhaid lleihau i tua 15 Gt y flwyddyn o fewn llai na 25 mlynedd. Ond tyfu mae'n allyriadau a'n defnydd o olew.

Llechir ffeithiau anghysurus dan y ffigurau byd-eang moel: cyfartaledd ein allyriadau yw tua 7t y pen; y nod yw ~1.5t y pen; rhyddheir ~16t y pen yng Nghymru rwan; mwy fyth yn UDA ac Awstralia. Yn fyd-eang rhaid ceisio ymgodymu â'r lleihad mawr hwn er bod, fel crybwyllwyd eisoes, galw am ynni a phoblogaeth sawl gwlad yn tyfu'n gyflym. Rhaid hefyd ceisio osgoi tanseilio a datgymalu'r gyfundrefn economaidd global; hwn sydd, er ei wendidau, yn ein cynnal ac yn caniatáu gobaith i'r gwan a'r anghenus. Ond ni ellir anwybyddu'r mathamateg syml - po fywaf y boblogaeth, y **llai o NTG y pen a ganiateir** i bob un ar ein planed. Er nad oes gofod i drafod yn yr erthygl hon, rhaid pwysleisio ryddheir canran sylweddol o'r NTG o'r gadwyn fwyd [dros 30%] yn arbennig o'r ymborth dosbarth canol gorllewinol o gig a chynhyrchion llaeth. Felly ni ellir anwybyddu'r eflen hon o'r broblem. Ni fydd di-garboneiddio ein ffynhonnellau ynni, er yn her anferth, yn ddigonol. Ond mater am erthygl arall!

Yn dra anffodus mae cwmnïau ynni megis Exxon, Shell a'u tebyg yn parhau i wario miliynau yn chwilio am fwy o danwydd ffosil, er y dysiolaeth cadarn rhaid i o leiaf 66% y cant o'r adnoddau hydrocarbon y **gwyddom amdanynt eisoes** aros dan y ddaear, os ydyn am osgoi cyfalfan e.e. codiad o 5 i 10 metr yn lefel y môr. Un canlyniad i ymddygiad anghyfrifol y cwmnïau yw'r mudiad cynyddol dylanwadol a chymeradyw i ddi-fuddsoddi ynddynt ['Divest']. Heb newidiadau mawr, nid yn unig fydd hi'n 'Ta Ta Porthdinllaen' ond hwre Shanghai, Lagos a thalpiau mawr o Lundain ac Efrog Newydd.

(Amcangyfrifir bod \$1triliwn o fuddsoddadau 'ofer' ym meddiant y cwmnïau ynni os ydym am osgoi codiad o fwy na 2°C yn nhymeredd ein planed. Yn naturiol, mae canran o'r pwerus a chyfoethog [yr 1% bondigrybwyll!!] yn llwyr ymwrthod â'r ffeithiau a'r dadansoddiad uchod am resymau gwleidyddol, economaidd a hunanol.) hepgor??

Anodd iawn llywio llwybr trwy'r gwead o broblemau sy'n ein gwynebu heb faglu; amhosib heb gydnabod maint a chymhlethdod y sialens yn y lle cyntaf. Rhan o'n trasiedi yw bod yr awyr a'r lefelau NTG ynddo yn 'asedau cyffredin' (common goods). Nid oes perchnogaeth unigolyddol arnynt, ac nid yw'r costau llygru na'r dioddefaint yn ymddangos ar fantolen unrhyw gwmni na gwlad. I'r gwrthwyneb cyfrifir rhain, yn iaith economeg, yn 'allanolion' -- '*externalities*'. Yn ddiweddar cyhoeddwyd adroddiad gan yr IMF yn amcangyfrif bod gallu'r cwmnïau i gyfri sgil effeithiau llosgi tanwydd hydrocarbon ar yr amgylchedd ac ar iechyd fel "allanolion" yn cyfateb i swbsidi cudd o **\$5.3 triliwn y flwyddyn!** O'i gymharu, pitw yw'r cymorthdaliadau a roddir i ynni adnewyddol neu i arbed ynni. Mae'r economegwr enwog, Nicolas Stern yn awgrymu dylid rhoi treth o tua £50 y tunell ar holl allyriadau carbon i adlewyrchu eu gwir gost i ddynoliaeth. Ond pa wleidydd fydd ddigon dewr i gytuno? Yn foesol ddyrys, ein cenhedlaeth ni sydd ar ein hennill (yn y tymor byr o leiaf) am nad ydym yn talu'r gwir pris am ein

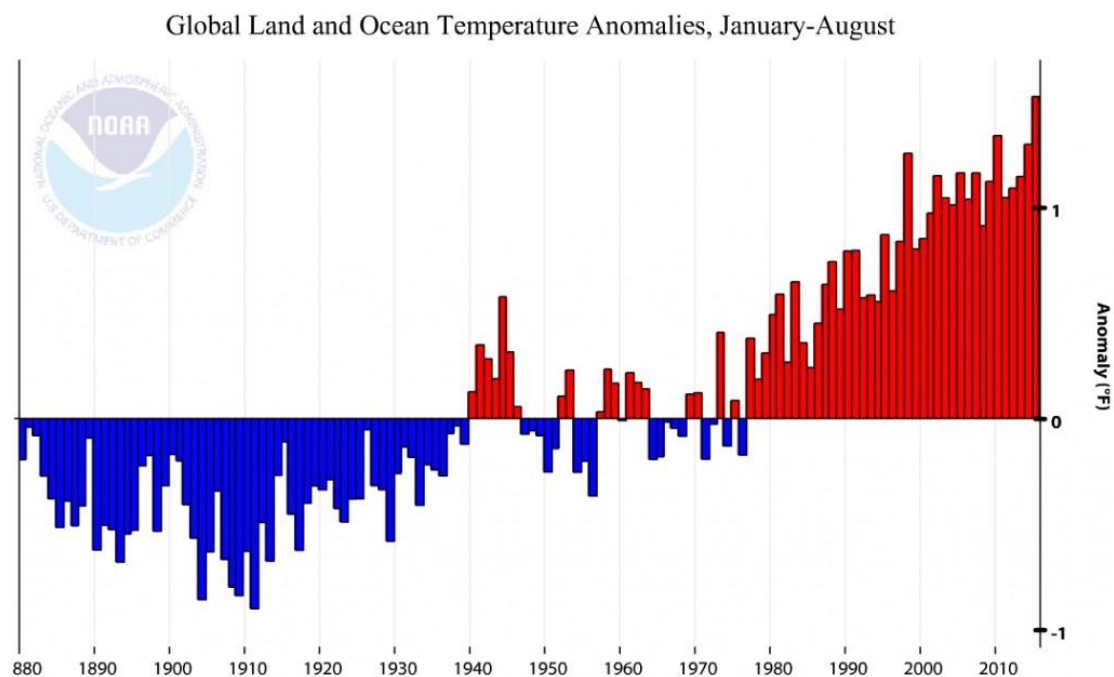
ynni nac am ein ffordd o fyw; trosglwyddir y 'storom' i'n plant ac i blant ein plant.¹

3. Ar ein gwarthau

Fel pe bai'n ein paratoi ar gyfer y cynhadledd tyngedfennol ym Maris yn Rhagfyr, daeth y flwyddyn 2015 â thystiolaeth brawychus o effeithiau presenol cynhesu byd eang a newidiadau hinsoddol.

Yn 2014 cofnodwyd cyfartaledd tymheredd uchaf y cyfnod fodern, ond o drwch blewyn. Yn 2015 ceir naid sylweddol o dan ddylanwad El Niño fel bod y codiad ers y diwedd y 19fed canfrif dros 1°C [Ffig. 3]. Os dilynir y patrwm arferol

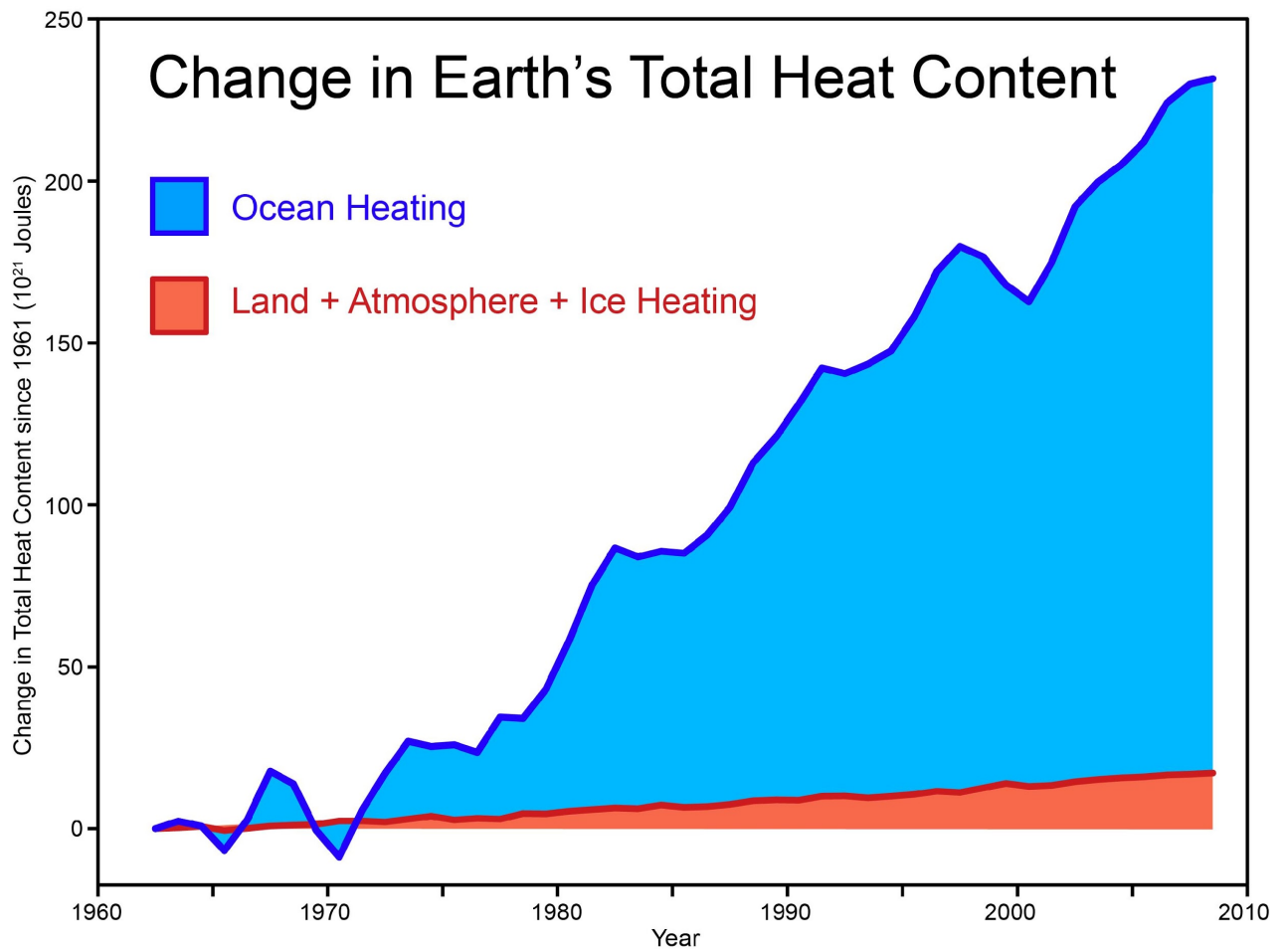
Ffig 3. Gwriad yn Nhymeredd Tir a Môr hyd at Awst 2015.



disgwylir codiad eto yn 2016 ar ol i El Niño ostegu. Rydym yn ddigamsyniol ar y llwybr i godiad o dros 2°C o fewn degawdau - a mwy wedyn. Eleni dioddefodd India, Pakistan, rhannau o'r Dwyrain Canol a California wres llethol. Marwodd miloedd o ganlyniad. Fe recordiwyd 52°C yn Baghdad a threfi ger Gwlff Persia. Pan gysylltir tymheredd o dros 45°C a lleithder uchel mae'n ladd. Gwelwyd codiad hefyd yn nhymeredd y cefn-foroedd; ffaith sy'n y pen draw yn fwy arwyddocael gan taw'r moroedd yw'r sinc i dros 90% o'r gwres ychwanegol â gronnir yn ein planed.

Ffig.4.

1



Am y tro cyntaf am gannoedd o filoedd o flynyddoedd bu lefel CO₂ yn yr atmosffer yn 2015 yn gyson dros 400 canran y miliwn; dros 480 canran y miliwn o fynegi cyfraniadau yr holl NTG fel yn gyfwerth a CO₂. Codi yn gyson a didostur yw hanes crynhoad pob un o'r nwyon hyn. Llosgir mwy o danwydd ffosil bob blwyddyn. Yn ddiweddar mae'r cynnydd yn allbwn olew ffracwyr America a gwledydd OPEC wedi cywasgu pris olew yn syfrdanol. Un canlyniad ym Mhrydain yw mwy o defnydd o'n ceir a phryniant uwch o 'dractorau Chelsea' sy'n ein ymrwymo i fwy o allyriadau NTG yn y dyfodol. Felly hefyd y paratodau i adeiladu mwy o feysydd glanio i awyrennau yn ne Lloegr ac awyrennau ym Mhrychdyn. Mae'r olew rhad yn llyffetheirio'r ymdrechion i ddatblygu ynni adnewyddiadwy. Anwybyddir y goblygiadau negyddol gan y BBC, S4C a'r wasg.

Yn 2015 gwelwyd yr iâ a'r eira yn rhewlifoedd a maesydd eira'r byd, o'r Arctig i'r Antarctig a'r copaon mynyddig, yn lleihau gan codi lefel y môr yn gyflymach fyth a crebachu ffynhonnellau dwr cyson a dibynadwy i rai o ddinasoedd ac ardaloedd amaeth pwysicaf ein byd. Cafwyd peth cyhoeddusrwydd i helyntion California lle mae dogni ar y dwr a'r cnydau yn crino, ond prin yw'r sôn am y peryg i drefi yn yr Andes neu yn Asia. Yn Sao Paulo, Brazil, ni ddarperir dŵr yn gyson am i sychder wagu'r argae.

Cafwyd tannau anferthol yng ngogledd Canada, Siberia ac UDA. Llosgwyd ardaloedd yng Nghogledd America tua pum gwaith arwynebedd Cymru; mwy fyth yn Siberia. Dioddefwyd gwres, sychder a thannau anarferol yn nes adref yng nhanolbarth a dwyrain Ewrop, a'r hyn oll yn ychwanegu CO₂ i'r awyr a thywyllu gwyneb gweddillion yr iâ (newid yr albedo). Rhyddheir methan o ymddatodiad y twndra; nwy sydd, dros 20 mlynedd, 80 gwaith cryfach fel NTG na CO₂. Fel y rhagwelwyd dioddefodd eraill, o Burma i Texas, lifogydd eithriadol.

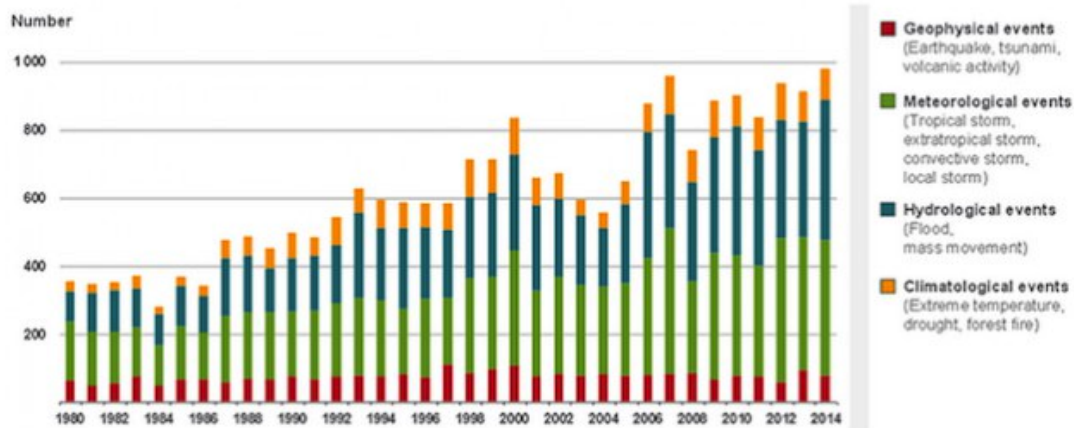
Er 'mod i'n tanlinellu digwyddiadau 2015 mae hyn oll yn rhan o batrwm cyson a effeithir ar filiynau o bobl. Amcanir gan yr iDMA i 158 miliwn o bobl orfod symud o'u cartrefi o achos y tywydd rhwng 2008 a 2014. Mae adroddiad gan y Centre for Climate and Security a NOAA yn UDA yn dangos fel bu'r sychder mawr yn Syria ers 2008 yn sbardun i'r rhyfel cartref erchyll yno ac i'r llu o ffoaduriaid; llif sy'n sicr o droi yn liferiant mawr gan fod rhagolygon hinsoddol y Dwyrain Canol a Gogledd Affrica mor wael. Er nad yw'n bosib priodoli digwyddiadau unigol yn sicr i "newid hinsawd", mae'r tueddiadau yn gwbwl glir.

Ffynhonnell di-duedd o dystiolath yw ystadegau'r cwmnïau yswiraint anferth, Munich-Re a Swiss-Re. Ynddynt dangosir cynnydd mawr mewn galwadau yn deillio o'r 'tywydd a'r hinsawdd' ond nid o fygythiadau eraill e.e. llosgfynyddoedd a daearynfeydd (Ffig. 5)

Nid ydym felly yn trafod problemau haniaethol, damcaniaethol, i'r dyfodol. Mae cynhesu byd-eang yma ar ein gwarthau ac yn cyfrannu at y dryswch byd eang. Megis dechrau mae'r storm.²

WORLD NATURAL CATASTROPHES, 1980–2014

(Number of events)



Source: © 2015 Munich Re, Geo Risks Research, NatCatSERVICE. As of January 2015.

² Gweler hefyd fy erthyglau: Barn Ebrill 2015; Y Traethodydd Ionawr/Ebrill 2013

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3. Diwedd glo: Yr Her a'r Gobaith

Gwynebwn sialensau gwyddonol a thechnolegol sylweddol, ond credaf bod yr her i'n cyfundrefnau economaidd a gwleidyddol ac i'n byd-olwg yn fwy pellgyrhaeddol [gweler Naomi Klein; *This Changes Everything*, Penguin, 2014 a'r Traethodydd]. Ofnaf yn ddifawr nad yw trwch y boblogaeth, na'n arweinyddion, am gydnabod maint y risg i'r drefn na'r cydberthynas rhwng yr elfennau gellir cyd-adeiladu i'r 'storom berffaith'. Mae fel petai dau fyd nad ydynt yn gorgyffwrdd – ein dealltwriaeth ffisegol a bywydegol ar un llaw, a byd ein gwleidyddion a'n cyfalafwyr ar y llaw arall. Sut arall mae esbonio polisiau llywodraeth Brydain a'u tebyg sy'n cwtogi'r nawdd i (neu yn gwrthod) gynlluniau ynni adnewyddol, tra'n hybu ffracio a pharatoi am fwy fyth o awyrennau?

Rwy'n ffyddiog bod atebion gwyddonol a thechnolegol ar gael i gynhyrchu ynni carbon isel (heb drydan niwclear ac nid yn hawdd i gynnal awyrennau [taith i Awstralia ac yn ol = ~7-10tCO₂]) er, yn baradocsaid, i wyddoniaeth a thechnoleg gyfrannu at ein problemau yn y lle cyntaf. Felly hefyd y galw am ddyfeisgarwch ac entrepreneuriaeth i ateb yr anghenion newydd. Ail-adeiladwyd Ewrop ar ol dinistr yr Ail Rhyfel Byd gan Gynllun Marshall goleuedig. Gellir ail-strwythuro ein cyflenwadau ynni yn fyd-eang ac, yn llawn mor berthnasol, gellir fyw yn dda ar lawer llai o ynni. Mater mwy dyrys yw'r allyriadau o'r gadwyn fwyd gan mor boblogaidd yw'r fwydlen gorllewinol yn Tseina a gweddill y byd.

Ond rwy'n cloffi wrth ystyried nid yn unig ein cyfundrefn ariangar unigolyddol ond hefyd ein trefn gwleidyddol byr-olwg a'r natur ddynol. Deil ymateb llywodraeth Prydain i gyd o fantais gwleidyddol byr-dymor. O anghenrhaid porthant eu dilynwyr â thwf economaidd. Sylfaenwyd ein cyfundrefn wleidyddol ac economaidd, yn enwedig ers diwedd y 70au, ar glodfori a chyfiawnhau materoliaeth, unigolyddiaeth ddihid a thwf di-derfyn yn GDP. Ers Cytundeb Westffalia ymgorfforwyd statws 'Y Wlad Sofran' annibynnol yn y drefn rhyngwladol. Ond nid yw unigolyddiaeth cyfalafol, na sofraniaeth gwleidyddol, na chwmniau grymus, dylanwadol, di-wraidd a di-dreth, na'n dibynniaeth ar dwf di-derfyn (a'i ddyledion) yn gyson â gweddnewid ein ffynhonnellau ynni a gwarchod dyfodol ein plant. Eto mae'n gweithgareddau fel unigolion, cwmniau a gwledydd trahaus yn dylanwadu ar ffawd y **Ddaear**. Mae parhad yr iâ yn yr Antarcig miloedd o gilomedrau i ffwrdd a lefel y môr yn Llundain, Shanghai ac Alexandria erbyn 2200 yn gysylltiedig ac yn dibynnu ar ein dewisiadau nawr. Hunan-les heddiw yw ein unig consyrn fel pleidleiswyr ac, o ganlyniad, ein gwleidyddion.

Anghofwyd gwersi'r canrifoedd am beryglon ein hyfrdra a'n haerllugrwydd. Ysgrifennodd yr economegwr enwog John Maynard Keynes am ein bargaen Ffawstaid gyda gwanc i hyrwyddo twf economaidd. Mae canran o'n harweinwyr

wedi troi'r fargen yn grefydd - y farchnad dilyffethair. Eto ein hyfdra a'n natur afreolus, anturus sy'n cyfri am lwyddiant *Homo sapiens* a'r Oes Anthropsen. A ydwy felly yn bosib i ni, er ein hunain-les, mewn ugain mlynedd, ffrwyno ein trachwant a symud at weledigaeth mwy aeddfed?

Hawdd darogan bydd ein dyfodol stormus yn arwain at fyd totalitaraidd, didostur, drylliedig – pob gwlad a thref yn amddiffyn eu golud a'u hasedau yn erbyn y llai ffodus. Dyma'r ryseit am Armageddon. Am y tro cyntaf erioed rydym fel dynoliaeth yn gwbl gyd-ddibynnol. Os codir lefel y môr 5 metr a mwy nid Porthdinllaen yn unig a ddiflanir. Pan fydd miliynau yn dianc y sychder neu'r llifogydd yn Asia, Affrica neu De America, nid Kos yn unig â effeithir. Ni fydd y môr yn eu rhwystro yn Calais. Bydd ein holl gyfundrefn a'n marchnadoedd stoc a bwyd yn datgymalu. Sôn ydym am risg, risg anferth mi wn, ond nid oes rhagweld â sicrwydd.

Gofynir ymateb cadarnhaol yn bersonol, cenedlaethol a byd eang. O dan bwysau'r 'doethineb confensiynol', anodd gweld llawer yn deillio o Lundain nac yn wir o'r cynhadledd mawr ym Mharis (gobeithio fy mod yn anghywir). Cyfyd mwy o obaith o Ewrop am fod yr Almaen a Denmarc yn fwy blaengar. Ond ar ein ysgwyddau ni mae'r gyfrifoldeb i ymdrechu i leihau allyriadau, lleihau anhegwch, torri crib y cyfoethog a datblygu ein adnoddau lleol. Gwych o beth clywed y Pab yn codi ei lais ac yn cyplysu problemau newid hinsawdd a thlodi. Hyd y gwelaf, yr unig ateb yw dibynnu mwy a'r ein hadnoddau lleol, adnewyddiadwy. Yn hyn mae Cymru yn hynod ffodus gydag amrywiaeth o adnoddau i'w datblygu yn ein glaw, haul, moroedd, gwynt, coedwigoedd a'n tiroedd. Dyma yw'r gobaith - gobaith am fywyd llawnach, tecach, iachach a mwy gwar. I ddyfynu Naomi Klein 'mae hyn yn newid popeth'.

National Assembly for Wales: Environment and Sustainability Working Group Consultation: A Smarter Energy Future for Wales?

Response by the Energy Policy Group, University of Exeter

Dr Caroline Kuzemko, Jessica Britton, Iain Soutar and Dr Bridget Woodman

Thank you very much for the opportunity to respond to this exciting consultation on a smarter energy future for Wales. We are very encouraged by the Welsh Assembly's emphasis on community and/or local energy when considering how to progress sustainably.

The responses below are partly based on research undertaken over the past 3 years by the 'Innovation and Governance for a Sustainable, Secure and Affordable Economy' (IGov) research project.ⁱ As part of this project the research group has undertaken extensive research on governing for sustainable energy system change in Germany, Denmark and the UK.

Question 1: *What is the overall vision for a smarter energy future for Wales? Is it simply about reducing carbon, or is it also about economic regeneration for local communities, and/or tackling fuel poverty?*

Response:

Any future, 'smart' energy system should be sustainable in environmental, security and affordability terms, thereby making it politically acceptable. Whilst one element of a sustainable energy system is clearly that it should be low carbon, a too narrow focus on carbon comes with the risk of alienating people, in particular vulnerable energy consumers, and allowing for other kinds of environmental damage to ensue from energy production and use. Indeed, vulnerable energy consumers should be a priority during processes of system change – for example by taking them off expensive pre-payment tariffs, improving price competition, through active demand management,ⁱⁱ and/or through better welfare support for heating.

One of the lessons that can be taken from the German energy transition so far is that sustainable energy system change should not only not alienate people, but should actively include as many as possible. This is because there is far greater buy-in to sustainable system change when local populations are involved in, and can benefit from, changes made.ⁱⁱⁱ As such, actively engaging consumers should be a strategy from the outset rather than a positive side-effect of a smart strategy.^{iv}

In order to support a broad assessment of the economic and social benefits and of the costs of low carbon development the Welsh Government may wish to consider preparing an economic assessment of the 'green economy'. Several UK cities (such as Leeds, Sheffield and Manchester) have prepared similar studies which outline economic evidence of the impact of acting now on the low carbon economy. These studies have generally been termed 'mini-Stern' reports, after Sir Nicholas Stern's influential report on the economics of climate change, and as well as identifying the direct local economic benefits of action on climate change, identify benefits in terms of increasing resilience to climate change impacts and avoiding energy cost increases.

Question 2: *How can we achieve the right mix of distributed generation resources for the supply of electricity, gas and heat? Should there be specific targets?*

Response:

We note that distributed generation can have positive implications in addition to including local populations in the process of sustainable system change. As detailed in a recent report for the Department of Energy and Climate Change distributed generation can also have the effect of improving energy savings, partly through fewer losses over transmission and distribution systems.^v

Targets are useful for clearly setting a direction for change and giving clarity to potential investors, and in this sense targets for efficiency, renewables and potentially distributed generation are to be encouraged. Given its high carbon properties it might also be worth considering setting targets for phasing out, in particular, coal.

However, as various analyses of international climate targets highlight, targets make little impact on practice change in energy systems without strategies, policies and regulations designed specifically to meet targets. Turning again to Germany, performance against medium and long-term emissions, renewables, energy efficiency and demand reduction targets is monitored regularly and policies adjusted if it appears likely that targets will be missed. This also requires that policymakers are knowledgeable and that policies can be flexible.

Question 3: *How much low carbon renewable energy can come from dispersed sources within Wales and how much will still be required from large commercial initiatives or imported?*

No Response, except to say that maintaining gas and electricity interconnections will be important for flexibility and security and that the degree to which the Welsh energy system becomes dispersed will depend upon political will and strategic planning.^{vi}

Question 4: *Is there a need for comprehensive survey patterns of energy consumption and of Wales' renewable energy potential?*

Response:

It would appear that, in order to answer question 3 above, a survey of Wales's renewable energy potential would be a useful asset – not least to give indications of where different technologies (wind and solar in particular) would be best sited for maximum efficiency. Whilst it is important, when siting local generation, to understand local consumption patterns these may be altered somewhat through demand management policies and technologies (such as insulation, smart meters, time-of-use tariffs).

As such any survey should seek to not only carry out a top-down assessment of technical renewable energy potential but to also work with local areas to integrate assessment of electricity generation, heat generation, waste heat, energy efficiency and demand response potential. Variations in consumption, housing stock, locality and socioeconomic status will impact upon both the effectiveness and rates of renewable uptake. For example, distributed heat deployment may particularly benefit those communities not currently served by the main gas grid.^{vii}

Question 5: *Do energy transition processes that rely heavily on the views of existing organisations risk being shaped by the short-term interests of those organisations?*

Response:

A recent IGov paper argues that some existing energy organisations have tended to prioritise short-term (profit and or shareholder) interests over sustainability and that their ability to influence policymaking in the UK has been considerable for structural reasons.^{viii} This has provided some barriers to sustainable energy system change, in particular in terms of making market conditions for new, more innovative market entrants difficult.

It should be noted, however, that not all energy organisations are currently driven by short-term (private) interests. In this respect the landscape of energy organisations is already changing. For example, Ofgem's recent consultation on non-traditional business models highlights the growth in non-traditional business models pursued by new energy organisations, such as some Welsh and English local authorities and companies like Ebico.^{ix} Some energy companies that do have short-term profit motives also have a longer-term sustainability and/or affordability ethos built into their business model, such as Good Energy and Ovo. Ovo, in particular, is working with local authorities to enable them to provide affordable local energy supply through versions of White Label contracts.^x

As such, it is possible to enlist the support of (certainly in advisory terms) and even to rely on existing, progressive local authorities and energy companies. Indeed, regular communication with other organisations who, like the Welsh Assembly, are driven towards achieving sustainability goals would be recommended.

Question 6: *How can we achieve a whole systems approach (joining up, reducing demand, energy efficiency, renewable generation, grid, storage, ownership, subsidy etc.)?*

Response:

Achieving a genuine whole systems approach is complex and probably unprecedented. There has been a good deal of research into this question, in particular by the UK Energy Research Council, with an emphasis on modelling and pathways but less into how policy can encompass a whole systems approach. It should be noted, however, that if a distributed energy system is planned that this does necessitate a joined up approach.

One way to learn about adopting a whole systems approach is to look at energy systems that are further down a sustainable system transition pathway, for example Germany or Denmark. In this way it is possible to draw lessons from the ways in which new technologies affect market conditions (i.e. variable generation and low wholesale prices) and how policies and regulations are having to change to adapt.^{xi}

Question 7: *How can the necessary behavioural change be achieved?*

Response:

Please refer back to the response to question 1. Behaviour change is much more likely when citizens can become involved in or benefit from system change. There are also arguments that behaviour change can be achieved through long-term local debate, information services and inclusion. This goes much further than information campaigns at moments in time but more takes the form of regular opportunities for two-way dialogue about what the issues are, how they can be addressed and how people can get involved. One example of this is the on-going campaigns that the Centre for Sustainable Energy (CSE) has been running to make residents of Bristol aware of sustainability and of how to go about becoming pro-active.^{xii}

Behaviour change may also be facilitated through the development of greater trust between energy service providers and consumers, which is currently at a low level. There is some evidence to suggest that community and local authority involvement in energy systems increases levels of public trust. Therefore, increasing the involvement of these groups in the energy system, together with growth in the number of new entrant suppliers focussed on customer service, may help to increase engagement in the energy system and promote behaviour change. This implies a need to keep barriers to entry low.

Question 8: *What can be done using existing executive/legislative powers?*

Response:

We are not experts on existing Welsh executive/legislative powers, but it might be worth mentioning that the Scottish devolution appears to have allowed for a good deal of progress in terms of energy system change (albeit there is still also a good deal of emphasis on oil and gas production). In addition, Cornwall's devolution deal includes some new powers over energy. It might be worth exploring in more detail how Scotland and Cornwall included energy in their devolution deals.

Question 9: *What is the scope for public investment/support for innovation to encourage new forms of local renewable energy?*

Response:

As well as direct support for innovation (through for example R&D funding) public bodies can also support local renewable energy innovation through directly funding infrastructure and supply operations. Such schemes (see for example Nottingham and Bristol) can be funded through various local government/public funding arrangements that tend to access capital at sub-commercial interest rates allowing projects that might otherwise not be pursued to be viable. These schemes can provide long-term revenue to public bodies and create a structure through which it is also possible to support community owned energy projects.^{xiii}

There is also a role for public bodies to explore the potential for new supply and balancing arrangements in the energy sector which would support innovation and new entrants. Both DECC and Ofgem are currently exploring the impact of regulation on energy system innovation and we would encourage the Welsh Government to engage with these debates and to ensure that Welsh interests and concerns are represented in any ensuing regulatory framework changes.

Question 10: *What are the skills/training requirements and implications to ensure a successful transition? To what extent are these skills already available in Wales?*

Response:

It is vital that skills and training keep up with Welsh sustainability ambitions – not least to ensure that the full range of available green manufacturing, building, engineering and supply chain jobs can be located in Wales. It is worth noting that in Germany, where there has been sustained support for renewable energy and energy efficiency skills over time, that some 800,000 people are now employed in servicing renewable and efficiency technologies.^{xiv}

This refers not just to training around new technologies and associated supply chains, but also to having appropriate *public knowledge* at local authority and Assembly levels. One of the downsides of having relied so much on large, private energy companies to provide energy services in the UK has been that knowledge capacity and data about how our complex energy systems work lies in the private not public sector. This has arguably made it harder for UK policymakers to stay abreast of markets, to make policy decisions and may be one reason for their reliance on large energy companies for policymaking advice.^{xv} It is notable that in other countries, like Denmark for example, all data about generation, networks and supply is publically available via the ‘DataHub’.^{xvi}

ⁱ For more information see: <http://projects.exeter.ac.uk/igov/>

ⁱⁱ See [here](#) for a discussion on the demand side

ⁱⁱⁱ On the need for energy transitions to be inclusive of broader populations see [here](#) and [here](#).

^{iv} For a discussion of the strategic need to democratize energy, see [here](#).

^v The report can be accessed [here](#).

^{vi} The impact of varying degrees of supportive policy and regulatory frameworks is analysed [here](#) with particular reference to community energy in the UK.

^{vii} See [here](#) for a discussion on the opportunities of community heat generation.

^{viii} This paper can be accessed [here](#).

^{ix} Ofgem’s report is available [online](#).

^x This is done through [Ovo Communities](#) and their own (remodelled) version of a white label contract.

^{xi} A [recent report](#) by Elmar Schuppe outlines how markets have changed and policy responses in Germany.

^{xii} Examples of these programmes can be seen [here](#).

^{xiii} For an interesting analysis of the role of public institutions in innovation see Marianna Mazzucato’s ‘The Entrepreneurial State’.

^{xiv} For reference see [here](#).

^{xv} For a paper that makes this argument in more detail see [here](#).

^{xvi} Details of the Danish model of energy governance for sustainability is [here](#).