



Cynulliad  
Cenedlaethol  
Cymru

National  
Assembly for  
Wales

# Cofnod y Trafodion The Record of Proceedings

[Y Pwyllgor Newid Hinsawdd, Amgylchedd a  
Materion Gwledig](#)

[The Climate Change, Environment and Rural  
Affairs Committee](#)

09/02/2017

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o'r Cyfarfod Hwn ar gyfer Eitem 8 ac o Gyfarfodydd y Pwyllgor ar 15  
Chwefror ac 8 Mawrth  
Motion under Standing Order 17.42 to Resolve to Exclude the Public  
from Item 8 of this Meeting and the Committee's meetings on 15  
February and 8 March

Cofnodir y trafodion yn yr iaith y llefarwyd hwy ynnddi yn y pwyllgor. Yn ogystal, cynhwysir trawsgrifiad o'r cyfieithu ar y pryd. Lle y mae cyfranwyr wedi darparu cywiriadau i'w tystiolaeth, nodir y rheini yn y trawsgrifiad.

The proceedings are reported in the language in which they were spoken in the committee. In addition, a transcription of the simultaneous interpretation is included. Where contributors have supplied corrections to their evidence, these are noted in the transcript.

**Aelodau'r pwyllgor yn bresennol**  
**Committee members in attendance**

Jayne Bryant <a href="#">Bywgraffiad</a>   <a href="#">Biography</a>	Llafur Labour
Sian Gwenllian <a href="#">Bywgraffiad</a>   <a href="#">Biography</a>	Plaid Cymru The Party of Wales
Vikki Howells <a href="#">Bywgraffiad</a>   <a href="#">Biography</a>	Llafur Labour
Huw Irranca-Davies <a href="#">Bywgraffiad</a>   <a href="#">Biography</a>	Llafur Labour
David Melding <a href="#">Bywgraffiad</a>   <a href="#">Biography</a>	Ceidwadwyr Cymreig Welsh Conservatives
Jenny Rathbone <a href="#">Bywgraffiad</a>   <a href="#">Biography</a>	Llafur Labour
Mark Reckless <a href="#">Bywgraffiad</a>   <a href="#">Biography</a>	UKIP Cymru (Cadeirydd y Pwyllgor) UKIP Wales (Committee Chair)
Simon Thomas <a href="#">Bywgraffiad</a>   <a href="#">Biography</a>	Plaid Cymru The Party of Wales

**Eraill yn bresennol**  
**Others in attendance**

Mark Crowther	Cyfarwyddwr, Kiwa Ltd Director, Kiwa Ltd
Jacqueline Edge	Rhwydwaith Ymchwil Storio Ynni Energy Storage Research Network
Steve Edwards	Wales & West Utilities
Oliver Farr	Solar Plants

Andy Ling	Perpetual Systems V2G
Jon Maddy	Prifysgol De Cymru University of South Wales
Guto Owen	Cyfarwyddwr, Ynni Glân Director, Ynni Glân

**Swyddogion Cynulliad Cenedlaethol Cymru yn bresennol**  
**National Assembly for Wales officials in attendance**

Louise Andrewartha	Dirprwy Clerc Deputy Clerk
Marc Wyn Jones	Clerc Clerk
Sean Evans	Y Gwasanaeth Ymchwil Research Service

*Dechreuodd y cyfarfod am 10:20.*  
*The meeting began at 10:20.*

**Polisi Ynni yng Nghymru: Gwres sy'n Dod o Hydrogen**  
**Energy Policy in Wales: Heat from Hydrogen**

[1] **Mark Reckless:** Thank you very much indeed for coming to join us today. I'm particularly grateful for all of you having rescheduled at short notice to come for a morning session rather than an early afternoon one. I appreciate you all have important jobs of work to do, and we really are very grateful that you've managed to rearrange your diaries to facilitate the committee session this morning. Thank you. Could I ask each of you, perhaps, from Steve through to Jon, just to sort of introduce your name and position or responsibility for the record, please?

[2] **Mr Edwards:** Yes, certainly. Bore da. Good morning. Steve Edwards from Wales & West Utilities. I'm the director of regulation and commercial, and I look after energy futures for Wales & West Utilities. We run the gas distribution network in Wales.

[3] **Mr Crowther:** Mark Crowther, technical director at Kiwa Gastec and a

hydrogen enthusiast since 1974.

[4] **Mr Owen:** Guto Owen, Ynni Glân. Bore da. Mae gennyf ddidiordeb mawr mewn celloedd tanwydd a hydrogen. Rydw i'n gweithio gyda chwmnïau o'r tu allan i Brydain i ddatblygu marchnadoedd yn bennaf ar gyfer celloedd tanwydd—rhai ohonyn nhw'n defnyddio hydrogen yng Nghymru a Phrydain.

**Mr Owen:** Guto Owen, Ynni Glân. Good morning. I have a huge interest in fuel cells and hydrogen. I work with companies outwith the UK in developing markets, mainly for fuel cells—some of them using hydrogen both in Wales and in the rest of the UK.

[5] **Mr Maddy:** Good morning. I'm Jon Maddy from the University of South Wales. I run the university's hydrogen research and demonstration centre at Baglan, which is part of the university's broader activity on hydrogen and fuel cell research. My background is industrial gases. I was with BOC and ran the BOC assets in Wales for—well, I was part of BOC for 20 years, and a lot of that was hydrogen. So, I've got, also, a long history in hydrogen.

[6] **Mark Reckless:** Good. This is a relatively new area for certainly a number of us on the committee, where we're grateful to our clerks who have provided something in the way of a technical briefing. Could I ask you to start by briefly describing the current development of hydrogen technology in Wales and the UK, with a view to what stages we would still need to do if we were going to see a substantive roll-out of this technology?

[7] **Mr Maddy:** Can I start there?

[8] **Mark Reckless:** Yes, please, Jon.

[9] **Mr Maddy:** The south Wales industrial belt, especially, is well-disposed in terms of current hydrogen production, and that's centred both at Margam, which predominantly supplies Port Talbot steelworks, but also in Barry, supplying the chemical complexes at Barry. There's some hydrogen in Pembrokeshire as well, in the refinery complexes. The problem with that hydrogen is that it's made predominantly from natural gas, or at least from fossil fuels, and through a process called steam methane reforming, which basically takes a fossil fuel, reforms that with steam and makes hydrogen, but releases carbon dioxide. It is the predominant method of making hydrogen around the world, around about—. Well, whoever you believe, but

upwards of 80 per cent, and possibly more than 90 per cent of the hydrogen made worldwide is made by that method. So, it is resource-intensive, and it does currently release carbon dioxide.

[10] Predominantly, hydrogen is used for its chemical properties, and it's used in things like steel finishing, particularly—[*Inaudible.*] It's used in metal refining, so nickel refining at Vale in Clydach, for example. Also, within the chemical industry, for various precursors—I know Dow Corning, for example, use a lot of hydrogen in a number of the preparations of their materials made at Barry. It's also used in micro-electronics. So, it pervades many areas of our industry in Wales and is therefore an established industry. We do have a lot of expertise in hydrogen handling.

[11] What it's not used for in any great extent is for its energy content and as an energy gas. We are, and have been for the last decade, or a little bit more than a decade, interested as part of a global movement to try and use hydrogen as a clean energy vector for transport and for a broader energy use. The compelling argument is that hydrogen, when combusted, only gives water. That isn't quite true, because the high temperature will potentially give oxides of nitrogen as well, but it won't give particulate matter, and it certainly won't give carbon dioxide when combusted. Better still, you could use hydrogen in a fuel cell, and a fuel cell's a more efficient device for converting that chemical energy in the hydrogen to electricity. And—well, I'll mention it, because someone's got to mention it—we do have the benefit of the fuel cell being invented by a Welshman in Swansea. It's taken a long time, but I think we're finally starting to see the benefits of William Grove's great step forward. So, that's some background to hydrogen in Wales. I'm sure there's more that we can touch on later.

[12] **Mark Reckless:** Mark, can I perhaps ask you to come in? You describe yourself, I think, as a hydrogen enthusiast since the 1970s. Have you got anything to add to what Jon's—

[13] **Mr Crowther:** Can I add a little bit of a ground-up UK picture sort of thing?

[14] **Mark Reckless:** Very much so, please.

[15] **Mr Crowther:** Professor MacKay, the late adviser to the Department of Energy and Climate Change, wrote his famous book *Sustainable Energy—Without the Hot Air* in 2008, which was electricity-focused. He envisaged by

the mid-2030s the gas network beginning to be decommissioned. I didn't think that was very reasonable, and gave a short lecture in DECC one day, and Professor MacKay was there, and he said that—. What I explained was the benefit of storing hydrogen because, electricity, obviously, you produce it and you use it instantly. Hydrogen should be viewed as another fuel vector, just like electricity, and in fact, for those, I'll pass around just some of the sort of concept that I was developing, which was to replace the natural gas in the existing gas network with hydrogen. Professor McKay and the Department for Business, Energy and Industrial Strategy were quite taken with the idea, and they provided some money. Scottish and Southern Energy provided us a house in Scotland, which we flooded with hydrogen, with natural gas, broadly to investigate the comparative risks of gas leaks in that property. Natural gas and hydrogen are both flammable gases, but hydrogen's not carcinogenic, it's not inherently poisonous, it's a pretty benign gas. So, the outturn risks are probably not dissimilar between natural gas and hydrogen.

[16] That then led on to us doing a project with Northern Gas Networks, partially supported by Wales and the West Utilities, to look at the feasibility of converting the whole of Leeds to hydrogen. That might come out at about £2 billion, which sounds a lot of money, but that is 'well to sofa'. So, many of the energy people who come forward with solutions will quote, for example, electricity at the terminals rather than the full cost of 'well to sofa', as I call it: the person sitting there enjoying the heat. People love combi boilers. I don't know in the committee how many of you have combi boilers—about 80 per cent of people do. They want to keep their combi boiler. They don't want to go to a heat pump with a tank of water, which when you've finished the tank of water you're finished, et cetera. And the idea is to repeat the same exercise that was carried out on the conversion from town gas to natural gas in the 1970s—40 million appliances changed over 10 years. There are about the same appliances about today—slightly more houses, but not that different. So, a guy turns up on a Tuesday morning, changes your boiler, changes your gas fire, and then leaves at lunchtime the following day. That's the sort of concept behind it.

[17] We supported a study with KPMG, who showed that the cost of this—assuming that it works technically, which still has to be proven—was significantly less than electrification. The classic example I give to that is that the cost of the new wires from the Sellafield power station to Heysham and Carlisle are £2.8 billion. That's just the wires. You don't get the nuclear power station; you only get the wires for that. And, yet, the cost of

converting the whole of Leeds to hydrogen, well to sofa, is only £2 billion. So, it gives you some idea of the different scales of numbers that we're talking about. There is considerable interest from BEIS in London, and, yes, there's a lot of enthusiasm from British appliance manufacturers. We haven't spoken to them, to be honest, but there's a medium-sized bread oven manufacturer here in Cardiff that we do work with, who could, I imagine—I don't know, I haven't spoken to them on the matter—be interested in producing hydrogen-fired bake ovens, because the whole raft of technology will have to be replaced, will have to be developed. It gives the UK a real chance to be up there with fuel cells because it also offers opportunities. Low-cost hydrogen offers great opportunities for fuel cells as well—it really does. There are so many ways it ticks the boxes. Yes, we may still find that there's an issue, but we haven't found it yet.

10:30

[18] **Mark Reckless:** Thank you. I think we'll explore all these issues further, but I value that introduction. Could I bring in Vikki, please?

[19] **Vikki Howells:** Thank you, Chair. So, the UK Committee on Climate Change has identified the use of hydrogen in place of natural gas as one of the main options for the greening of Britain's heating supply. So, bearing that in mind, could you expand on and tell us a bit more, as a committee, about the role that hydrogen can play in reducing our greenhouse gas emissions and in helping us, as a nation, to transition to a low-carbon energy future?

[20] **Mr Edwards:** Shall I start? Just to build as well—I don't think we quite answered your question directly in terms of where are we at. So, from the gas network point of view, we obviously transport CH<sub>4</sub> and the regulations that govern the gas quality and composition of the various gases are defined by the Gas Safety (Management) Regulations 1996. Those allow currently for 0.1 per cent of hydrogen in the mix. So, that's where we're at.

[21] When we had town gas, there was approximately 50 per cent of hydrogen in town gas, funnily enough, and that's how it's operated in Hong Kong at the moment. So, where we're at is that the UK gas networks fully understand that we need to reduce the carbon footprint of heating significantly. The role of hydrogen offers the opportunity to completely take the 'C' out of the CH<sub>4</sub> mix and, therefore, completely decarbonise heat. Clearly, there would be significant cost, and we're in the process of



understanding all the different elements of the chain in terms of gas quality, billing, blending, impact on the network, and impact on appliances, which some of my colleagues here are doing some fantastic research on.

[22] But, to answer your question, we're probably at the early stages of reports and feasibility studies. Where do the gas networks want to go now? We work within the Energy Networks Association and we are pulling together a number of studies and potentially pulling together an umbrella of collaborative innovation projects that may help get over and answer some of the clear questions in terms of demonstrators. So, there is a huge opportunity that hydrogen can bring in terms of decarbonising gas. It is one pathway. There are other pathways in terms of blending hydrogen, not a complete changeover. There's also the opportunity to use biomethane and synthetic gas and hybrid appliances. If I'm honest, hydrogen is probably a mass-scale changeover that would deliver the zero-carbon heat, but there would be a trigger point at which point that would happen. But there are other pathways and things that we can do now along that pathway, including more biomethane and syngas to take us along the way. So, hopefully, I've tried to answer the two questions there.

[23] **Mark Reckless:** Thank you. Guto, you haven't come in yet. Did you want to—?

[24] **Mr Owen:** Yes. I can answer that. We're already working on, basically, commercial fuel cell projects that can plug into the gas network as it is. One of the benefits of the gas network is that it's prevalent—the infrastructure is there. The assets should be sweated as long as possible, but, in the transition that Steven, Jon and Mark are talking about, the more hydrogen that you put into that gas network, it decarbonises it. So, you can look at a step change of low carbon now, if you like, in the commercial world, and then a transition based on the studies and all the analysis that has taken place, in order for whole-scale change of the gas network towards a path of decarbonisation, using hydrogen, ultimately, but also biomethane in the mix.

[25] There's only so much biomaterial that is available. You can get up to—I'm not sure—about 10 per cent, maybe 20 per cent, of the gas network that has biomethane in it, but hydrogen is ultimately limitless—it's in water, so that would be the source of the fuel, through electrolysis, and that releases the full potential of renewables, which are generally fed into the electricity grid as currently, but it opens up the gas network for more renewable development as well.

[26] **Mark Reckless:** Can I bring in Huw?

[27] **Huw Irranca-Davies:** From what you say, are you content at the moment that the right strategic policy framework is in place to help develop this hydrogen economy or the role that the hydrogen economy could play within overall energy and electricity generation? Are you content that the right strategic levers are there?

[28] **Mr Edwards:** Honestly, Huw, I don't think they are yet. I think we're in the period of understanding what we need to do. If I go back to the 2013 DECC pathway, the original view was that, actually, to decarbonise heat, electrification was the answer. But I think people now understand that, because of inter-seasonal storage, the huge cost of storage and the upgrading that would be a requirement of the electricity system, it just would not cope with the transition. So, I think there was a potential direction of electrification. I think there is a greater understanding now within BEIS and other Government officials that, actually, mass electrification is not the answer. Where do I think the policy is? I think they're information gathering at the moment to understand what the future policies could be. I would say there are no barriers to us developing the innovation work and what's going on, so there's nothing blocking us, but I don't think there is a clear policy direction yet, Huw.

[29] **Huw Irranca-Davies:** And, from what you're suggesting there, neither should there be at the moment, until we can fill in all these gaps.

[30] **Mr Edwards:** I would absolutely agree with that. What we should be looking to do at the moment is not back any winners. I think we should be looking to allow further analysis and demonstration, and making sure we don't make any policy-disaster decisions in closing off any routes at the moment.

[31] **Huw Irranca-Davies:** Well, that's a fascinating difference then, not closing routes off as opposed to changing anything or putting the forward thrusters under this technology. On that basis, is there any call from you for the Welsh Government to do anything or, actually, are we in a good place at the moment?

[32] **Mr Maddy:** I think there's a lot that can be done in terms of supporting the development. Hydrogen is a very broad subject. The ways of producing

hydrogen are many. The ways of handling hydrogen are many. The ways of using hydrogen are many. It crosses the energy system into the transport system. So, it's a very complex subject and it does take a while to do that. It doesn't, to me, seem as though something that's regulated or controlled too much is going to support that type of complex development. So, what the Welsh Government can do, in my view, is to support the ongoing investigation of the best routes, of the best solutions for Wales in that respect. Hydrogen has huge potential to be a low-carbon fuel. Many people around the world recognise this and many Governments are taking action to support. So, for example—

[33] **Huw Irranca-Davies:** Can you be a little bit more specific?

[34] **Mr Maddy:** Yes, sure. For example, yesterday we hosted—and, indeed, many colleagues here met with—a delegation from Osaka. Japan has taken a significant lead on the deployment of fuel cells. At source, or at the point of use, they're using hydrogen. They haven't just deployed one or two, they've deployed nearly 200,000 fuel cells in domestic situations in Japanese homes, yet they're still coming to us to learn about technology and learn about what we're trying to do. That was a Government-supported programme; it's been supported with finance that's being tapered as the technology reaches commercial maturity. We're not quite at that stage, and they're still supporting that. Whether or not the Welsh Government is in a position to provide subsidy to particular technologies is a moot point that we could discuss further. But, on the other hand, the Welsh Government does have a route towards stimulating research and development through, for example, the regional development fund, while it still exists, and, I think, moving forward to a post-Brexit situation, we need to ensure that we continue to get the support of the very good work that Welsh universities and Welsh companies are doing in this field.

[35] **Mark Reckless:** Can I bring in Simon Thomas?

[36] **Simon Thomas:** A gaf i ofyn yn Gymraeg? Bydd eisiau'r cyfieithu. Rwyf eisiau dilyn pwynt Mr Edwards, rydw i'n meddwl, wrth ymateb i Huw Irranca-Davies. Fe soniodd am beidio â chefnogi'r *winner*s, hynny yw, peidio â phigo'r dechnoleg neu'r dull ar hyn o bryd. Ond mae yna dipyn **Simon Thomas:** If I could ask my question in Welsh, you'll need the interpretation. I just want to follow up the point Mr Edwards made in response to Huw Irranca-Davies. I think he mentioned not backing any winners, that is, to not pick the technology or method at present. But

bach o ddryswch—wel, mae yna broblem gyda hynny achos, oni bai ein bod ni yn dewis rhywbeth i'w gefnogi, byddem ni efallai yn afradu adnoddau ac amser ac ni fyddem ni'n cymryd y naid tuag at y dyfodol digarbon rydym ni'n chwilio amdano. Felly, dau gwestiwn, mewn ffordd. Yn gyntaf oll, rwy'n cymryd eich bod chi, serch yr hyn rydych chi wedi ei ddweud, am inni gefnogi hydrogen. Felly, mae'r holl ddadl yr ydym wedi'i chael yn y gorffennol ynglŷn â thrydaneiddio am gael ei gosod o'r neilltu. Felly, os ym ni am gefnogi economi hydrogen, rŷm ni angen gweld rhai newidiadau i'r rhwydwaith nwy, i'r rhwydwaith dosbarthu ac i'r penderfyniadau ymchwil a buddsoddi a wneir gan y Llywodraeth. Felly, fe fyddwn i'n licio clywed a ydych chi i gyd yn cytuno â Mr Edwards, ac a ydych chi'n meddwl bod yna rai pethau y mae Cymru mewn sefyllfa neilltuol o dda i ddechrau arbenigo ynddynt.

[37] **Mr Owen:** Os caf i gychwyn ar hynny, rwy'n cytuno y dylem ni ddim cefnogi'r enillwyr—y *winner*s—fel y cyfryw, ond gofyn y cwestiwn: pam yr ydym ni'n gwneud hyn? Y rheswm yr ydym ni'n gwneud hyn yw ar gyfer ansawdd yr aer, a byddwch yn trafod ansawdd yr aer yn hwyrach y bore yma, rwy'n meddwl. Mae'n rhan o astudiaeth y pwyllgor hwn, ac mae'n hynod, hynod bwysig. Mae'n broblem fawr ar draws y byd—datgarboneiddio ar gyfer yr amgylchedd a *resilience* ar gyfer y

there is some confusion—well, there is a problem with that, because, unless we do select something that we can support, then we may waste resources and time and won't take that jump into the carbon-free future that we're seeking. So, two questions, in a way. First, I assume, despite what you said, that you want us to support hydrogen. So, all the debate that we have had in the past on electrification and so on is to be put to one side. So, if we are to support a hydrogen economy, then we need to see some changes to the gas network, the distribution network, and changes in terms of decisions on research and investment by Government too. So, I would like to hear whether you all agree with Mr Edwards, and whether you think that there are some things that Wales is in a strong position to start to specialise in.

**Mr Owen:** If I could start on that, I agree that we shouldn't support the winners as such, but ask the question: why are we doing this? The reason is for air quality, and you are discussing air quality later this morning, I think. It's part of this committee's inquiry, and it is extremely important. It is a major problem across the world—decarbonisation for the environment, and resilience for electricity use and heating as well. Expanding that to fuel for transport, hydrogen can be

trydan sy'n cael ei ddefnyddio, a gwres hefyd. I ehangu hynny i danwydd ar gyfer trafniadaeth, mae hydrogen yn gallu cael ei ddefnyddio mewn ceir, mewn bysiau, ac mewn trenau, hyd yn oed, y dyddiau yma. A chost, wrth gwrs. Felly, dyna lle rydych chi'n anelu ato. Dyna beth y mae pawb yn anelu ato. Os ydych chi'n gofyn y cwestiwn: beth sy'n gallu cyfrannu at hynny, o ran y technolegau? Wel, mae gan hydrogen ran fawr i'w chwarae yn y broses honno. Nid wyf i'n meddwl y buasai neb yn dweud mai hydrogen yw'r unig ateb, ond, digwydd bod, mae hydrogen yn gallu ateb y galw ar hyn o bryd. Dyma'r defnydd gorau, mwyaf effeithlon, a glanaf o danwydd ffosil sydd gennym ni, ac y bydd gennym ni am ddegawdau i ddod. Ond, hefyd, mae'n rhan allweddol o'r trawsnewid a phontio tuag at ddyfodol mwy ymarferol, os caf i ddweud hynny, o ran defnyddio ynni cynaliadwy.

[38] **Simon Thomas:** Ac a oes yna unrhyw beth penodol y bydd Cymru'n gallu arbenigo ynddo?

[39] **Mr Owen:** Rwy'n meddwl bod yna. Beth rydym ni'n gallu ei wneud ydy cael mwy o *demonstrator projects*, efallai, a dangos bod o'n gweithio, a thestio fo. Mae yna ddigon o'r rhain yn yr Almaen ac yn Siapan. Mae yna alw i gael ychydig ym Mhrydain yn gweithio ar yr astudiaethau yma sydd wedi cael eu gwneud. Oes, mae angen mwy o

used in cars, buses and even in trains these days. There is also the cost, of course. So, that's what you are aiming for. That's what everybody's aiming for. If you ask the question: what can contribute to that, in terms of the technologies? Hydrogen has a significant role to play. I don't think anybody would say that hydrogen is the only answer, but, as it happens, hydrogen can meet the demand at the moment. This is the best, most effective and cleanest use of fossil fuels that we have, and that we will have for decades to come. Also, it is a key part in the transformation process and transitioning towards a more practical future of using sustainable energy.

**Simon Thomas:** Is there anything specific that Wales could specialise in?

**Mr Owen:** Yes, I think so. We could have more demonstrator projects, perhaps, to show that this works, and to test it. There are plenty of those in Germany and Japan. There is demand to have a few in Britain, working on the studies that have been undertaken. Yes, there is a need for more studies. This is a new field, but if we can place certain projects at the

astudiaethau hefyd. Wrth gwrs, mae hwn yn faes newydd, ond, os ydym ni'n gallu gosod prosiectau *demonstrator* o flaen y maes *commercial*, yna gwnaiff hynny roi'r wybodaeth a'r arbenigrwydd, drwy ddefnyddio'r prifysgolion a'r cwmnïau yng Nghymru, ac adeiladu gwerth allan o hynny hefyd.

forefront of the commercial side, that will provide us with information and expertise, by using the universities and companies we have in Wales, and build value out of that as well.

[40] **Mark Reckless:** Can I bring in Jenny Rathbone?

[41] **Jenny Rathbone:** We seem to have rather consistent inconsistent Government leadership. We have invested public money in taking forward this technology, and yet we seem to be leaving it to the Japanese and the Germans to reap the benefits. This is very strange, and I just wondered if you could explain. By contrast, we are leaping into nuclear technology at Hinkley Point, which, frankly, has huge question marks over it and some known disadvantages as well. So, could you just explain why we are not really delighted at the progress we have been making here in Wales and elsewhere and building on it?

[42] **Mr Maddy:** To start with, this has to be seen as a global effort. The collaboration between research communities in all parts of the world has been important. We are talking about a major change here, and it's not an easy transition. As we have already said, it is complex. We haven't really touched on the interface between the electricity system and hydrogen, and the growth of renewables leading to the role of hydrogen in storage, which I know you are going to talk about and we could spend all day talking about. The situation, I would suggest, is that Japan, very early on, because of its resource situation, took a view that was very far-reaching that said, 'We see hydrogen as an answer, and we are going to support that.' What I have known in my dealings with the Japanese is that they generally stick to a plan once they have agreed on that plan, and, sure enough, they are seeing that through. That's not to say we are not doing things or we are not reaping any benefits in Wales or in the broader UK. We are starting to see hydrogen vehicles appear. For example, from next month onwards, there will be a fleet of vehicles operating, actually, from our site at Baglan, but it's involving public and private entities coming to fill those vehicles. That picture is mirrored throughout the UK. Fuelling stations are being deployed, vehicles are being deployed, and these are completely zero-carbon vehicles.

10:45

[43] So, we are doing things. The Leeds City Gate study—and it is just a study at this stage—is a very far-reaching study. I don't see anything quite as ambitious elsewhere in the world at this stage. Actually, if anything, it may be too ambitious because it precludes some of the idea that we might inject small amounts of hydrogen into the gas grid to overcome variants of renewables.

[44] So, I reject the fact—in fact, I'd have to stand up for the efforts of the R&D community, but also the translation of that R&D to practical measures in the UK, but, let's be frank: support for the technology has not been as broad, and has not been as deep as it has been in some parts of the world—Japan, Korea and Germany, to name but three. I hope that answers your question.

[45] **Jenny Rathbone:** And that's just because of political preferences, or a sort of anxiety about the unknown.

[46] **Mr Maddy:** I think, to a certain extent, it's about market approach and whether or not a Government chooses to intervene. Hydrogen is an example of a technology that is disruptive, and therefore, I guess—

[47] **Jenny Rathbone:** Disruptive in what sense?

[48] **Mr Maddy:** Well, if you group it in with renewable technology, it needs support to be introduced. The market wouldn't ever see that through if you didn't nurture the technology to start with. So, from that point of view, hydrogen—as we have done with wind or photovoltaic technology—will similarly and continue to need that preferential support if we value the carbon reductions that hydrogen technology can bring.

[49] **Jenny Rathbone:** Yet, hydrogen appears to be a very attractive option, given the state of the electricity market, in that we actually have a reduction in demand overall because we have homes that are more fuel-efficient or heat-efficient. But then we have these spikes. You know, when everybody comes home at 5 o'clock they all want to turn on all their appliances. So, hydrogen appears to be an attractive option for meeting that spike in demand.

[50] **Mr Crowther:** Sorry, I'm going to interrupt here. Even better, hydrogen

will meet the interseasonal demand for heat. Because, if you look at the picture there, you'll see that the blue spikes there are the gas demand and the little brown one running along the bottom is the electricity demand. So, you can see we use vast amounts of gas in winter. You'll also see, though, a little red square on your map of Europe there. That's the amount of solar PV area that you need to meet the whole of UK end use. So, if you like, it also has a long-term potential about it.

[51] In answer to your question about where Wales goes, the advantage of Teesside is that they have a hydrogen network. They have a pipeline from which small quantities of gas can be taken, for converting new houses and that sort of thing. They have a similar pipeline on Merseyside. If you wanted to do something, there clearly are—. You could imagine Port Talbot and/or Baglan being involved in that in some fashion, and converting some houses and generally taking things forward in a stepwise but positive fashion. I think we have to achieve, by law, 80 per cent carbon reduction by 2050. Whether we make it is another matter.

[52] **Jenny Rathbone:** Well, we hope to make it.

[53] **Mr Crowther:** We hope to make it. That means probably, sort of, three quarters—. There are 23 million boilers in the UK, so that's three quarters of a million boilers, even if you start in 2020, which is only three years away. So, you have to start moving, dare I suggest, out of the university laboratory into doing some sort of real-life practical things like the Japanese do, and we've got the Chinese coming to see us in a week's time.

[54] **Jenny Rathbone:** So, is there any hint of—. You mentioned a medium-sized bakery in Cardiff that might be interested.

[55] **Mr Crowther:** Yes. You really have to do it. That's why Wales & West Utilities are so key to this. Wales & West Utilities own the yellow pipes. Unfortunately, you can't use a little bit. You can convert a small area of the network to hydrogen, but you either do it or you don't do it. You can't have every other house on hydrogen. Do you see what I mean?

[56] **Jenny Rathbone:** No, I understand that.

[57] **Mr Crowther:** Therefore, there needs to be some political will. It's permitted by the Gas Act 1986 and the Utilities Act 2000 for someone to say, 'We will convert this village of whatever it is'. An easy way to do it would be



to say, 'If you were to extend the gas network to village A, you can design it for both hydrogen and natural gas. If the hydrogen didn't work out, you can always run natural gas on it—you've done good because you've brought gas to a community—and if it does work with the hydrogen, you could just run on with 10 houses'. Scotia Gas Networks in Scotland are out to tender at the moment to convert a modest amount of area in a locality to hydrogen.

[58] **Jenny Rathbone:** But what about using it for some of the really big energy users—Celsa Steel down the road?

[59] **Mr Crowther:** Yes, that would be—. That's almost possibly—it's just different. In the domestic and commercial area, one could imagine using the gas networks at the moment, if you like, and some sort of demonstrators and roll-outs involving fairly small sums of money. If you're going to convert a whole area, or if you're going to decarbonise Port Talbot for example, you're talking more like a Teesside type investment, and Teesside inevitably involves carbon capture and storage. In Wales, you haven't quite got—I mean, I'm loath to say it, but there are not many empty oil rigs off the south Wales coast here into which you could put the carbon dioxide. Maybe there are options. In the north of Wales, there's the running-down gas fields in Morecombe bay there, so there might be options in north Wales. But you really need, I'd suggest, to begin to look at a big picture, but then with small pictures that can feed into that big picture.

[60] **Jenny Rathbone:** Okay, so you mentioned that as a potential constraint, the lack of any large-scale existing development.

[61] **Mr Crowther:** There is Morecombe Bay up in the north, but, in the south here, it's probably a little bit more problematic. But then, there were some studies that might have found an aquifer and things off Cardiff, so I stress that very, very as in 'might and may', but that might be worth looking at. Certainly, the Scots have done quite a bit of it, and the northern Irish have also done quite a bit of looking at geological sites for carbon capture and storage.

[62] **Jenny Rathbone:** Okay, so there's potential in north Wales, but at the moment you wouldn't start in south Wales.

[63] **Mr Maddy:** I just wanted to maybe express a slightly different view and this sort of scale. We've been doing, we continue to do, a lot of with Tata in Port Talbot, looking at hydrogen. They're an existing hydrogen user in scale.

There is a hydrogen pipeline, which is mostly within their works but does cross their border in Port Talbot. Similarly, there's a pipeline network in Barry, but they're all within complex so it does vary slightly from Teesside.

[64] **Mr Crowther:** Yes, they're not quite public network.

[65] **Mr Maddy:** But, from that point of view, Tata, for example, are looking at a whole series of hydrogen options. A number of the steelworks' arising gases have high hydrogen content in them, and one way of capturing hydrogen, whether it's green hydrogen or not, would be to capture the hydrogen portion of coke oven gas, blast furnace gas, BOS gas, and these are very large volumes of gas. Indeed, yesterday, an Austrian steel maker announced that they were looking at complete conversion to hydrogen as their main route of reduction in their furnace. So, from that point of view, it's displacing coke and it's using hydrogen and the reducing agent. So, again, unfortunately this just presents further options, but, I guess, I wanted to just indicate that there are matters being considered at vast scale, and, with that, the potential to use that hydrogen for the community.

[66] So, I know, for example, Tata have been talking with Neath Port Talbot council about crossing over the boundary and then using heat or potentially hydrogen as a source for district use, district heating and also for transport. So, there are some sophisticated discussions at scale already going on within Wales, and, in terms of the idea of carbon capture, I think it's right that north Wales is better placed for the geological structure to capture carbon, if hydrogen was to be produced using fossil fuels. There is the potential to look again at carbon capturing in the south Wales coalfield, and I wouldn't reject that. It's not my area of expertise, but it is something that could be looked at, and/or it could be feasible, and I think, moving forward, if we are looking at carbon capture on a large scale, we may even need to look at transporting carbon dioxide via ship. It may seem a little far-flung at this stage, but I assure you that that's being considered by a lot of people worldwide.

[67] **Mr Crowther:** That ties in—. Sorry, the availability of—I didn't know those hydrogen pipelines existed in south Wales. That might offer some opportunities there, which I don't—is it worth all of us sitting together and having coffee afterwards, almost? [*Laughter.*]

[68] **Jenny Rathbone:** So, in theory, Barry or Port Talbot might be useful places to try out the sort of thing that's being investigated for Leeds?

[69] **Mr Maddy:** Absolutely. I'm sure the others want to come in as well, but the question was: what can Wales do, what is the specific thing that Wales can do? We've got a huge advantage in that we've got a lot of hydrogen handling, we've got a lot of hydrogen present in Wales already. Also, we have a lot of industries that we are aligned with. The automotive industry in Wales and the energy industry in Wales are big employers, so let's see this movement towards hydrogen as a huge opportunity for them to diversify towards hydrogen and create jobs and wealth through that method as well.

[70] **Jenny Rathbone:** Could you just say a little bit about the constraints that you would have to get over to use hydrogen in vehicles? For example, our bus network at the moment is all diesel fuel—very polluting. What would it take to enable us to convert it into a hydrogen fleet?

[71] **Mr Owen:** It's already happening. London's got hydrogen buses and Aberdeen's got a fleet as well, I think the largest in Europe. There are fleets being introduced into cities across the world. So, the technology is there. It can be done, and that's one of the great advantages of hydrogen—that it is so versatile. You can use it for the heating applications in the gas grid. I should say that transition is already under way, you could argue. On the school run every morning in Cardiff, I see the yellow pipes—Wales and West's programme of roll-outs—being introduced. Well, those are hydrogen ready, unlike the steel pipes, the old pipes, which are corroding with metal. But that hydrogen can be used for transport applications as well as electricity applications.

[72] What's needed for it to happen is, I guess, some pump-priming for funding in order to introduce some of these vehicles, and it's where you were with solar maybe 10 or 15 years ago. It's not quite commercially ready, but it needs that injection of support in order to get it market ready. But that is the push, in a sense, from the commercial side of things; there are also more pressing issues of air quality, which are going to, maybe, make it happen a bit more quickly. You've got directives coming from Europe on air pollution, and there are consultations currently on the medium combustion plant directive, which applies to the combustion plants, but it's the same kind of issue in terms of air quality. So, there's also some legislative issues that are pushing in this direction—

[73] **Jenny Rathbone:** Most definitely—something we talk about quite a lot. Why would the hydrogen option be the option of choice, rather than what we would call electric vehicles?

[74] **Mr Crowther:** Because you don't have the issues with range or have the issues with batteries. HGVs will always struggle with batteries in the foreseeable future, and the great advantage, from what I hear now, is there's hydrogen on tap here. Making hydrogen—apart from electrolysis, which is very expensive, other than small amounts of spill electrolysis—. To take existing hydrogen and clean it up needs some work on it, but there are a couple of companies in the UK that offer hydrogen clean-up already that could take what is the presumably fairly rough hydrogen off the steelworks and clean it up to fuel-cell quality. So, that is R&D that could, very usefully, be polished off.

[75] **Mr Edwards:** Could I just come in as well, Jenny, and maybe try to answer Simon's question, as well, about clarity on policy? We're not in the position of understanding what the best thing is to do from a customer perspective yet. Yes, we have the environmental targets to 2050, but we also have significant security of supply, fuel poverty and affordability issues, specifically, in Wales. Where we're at at Wales & West Utilities at the moment is that we are supporting and working on innovation, and we may well be part of quite a significant innovation submission to Ofgem this year on hydrogen. But we are not going to put all our eggs in that basket.

[76] So, in parallel to this work, which is absolutely the right thing to do to try and find out if hydrogen can be the answer, we're also working with Welsh Water in north Wales and other producers to see if, actually, we can improve anaerobic digestion and see how far we can get down the track of putting more biomethane in. We're also working in Bridgend with the local authority, where we're going to be putting in—it's called project FREEDOM—100 hybrid heating appliances, which are a mixture of a gas boiler and a ground source heat pump to see how we can actually save money, reduce carbon and provide security. That's why I was saying we can't make policy. Obviously, policy makers will need to make decisions, but from our point of view, we need to provide the policy makers with the impact assessments and evidence in terms of the cost benefit and carbon impacts of these different things so we can make policy on concrete and robust pathways. So, all this work is going on, and we're supporting this, but we're not convinced—well, we know it's not the only game in town yet. What we do know, because of these diagrams and the cost, is that electrification, unless there is a huge breakthrough in cost and inter-seasonal storage, is a non-starter. So, what we need to do is, very early on now, in the next three or four years, go through this discovery phase of what are the real options and hopefully then

that can inform robust policy making that will have implications for 20, 30 or 40 years, because these are long-term assets. So, I just wanted to make sure that we understand our position here.

11:00

[77] **Mark Reckless:** Simon, did you want to come back on that?

[78] **Simon Thomas:** Yes, just on the point. You talk about not making certain decisions, but on the other hand, we are about to make some other decisions that could stop us going further down this route, unless we get it right. So, this may be slightly off the ball, but we'll be making some decisions around the south Wales metro. We'll be making decisions around electrification of railways and a bus network to meet that, which currently runs, as Jenny said, on diesel. Is there not a potential to look at hydrogen in that context?

[79] **Mr Crowther:** The Germans have just ordered 200 hydrogen trains.

[80] **Simon Thomas:** Indeed they have.

[81] **Mr Crowther:** You may have seen it in the press. If there are supplies of hydrogen in south Wales, existing, that could be tapped off and cleaned up, that sounds to me something well worth looking at.

[82] **Simon Thomas:** So the idea of a hydrogen train to Aberdare, for example, would be good. We could use that as a pathfinder, in a way.

[83] **Mr Crowther:** Particularly if they all return to base here.

[84] **Mr Owen:** Yes, and it's important to say that that same hydrogen can be used in cars, in buses and in the gas network. That's one of the beauties of it. It's such a simple molecule. It's the lightest, and it's not like you've got different grades of diesel or different grades of petrol. It is the same fuel for all these different applications, and integrating between power, heat and transport. So, you're not going into any roadblocks as you go down each of those separately, perhaps.

[85] **Mark Reckless:** Can I ask around the carbon capture and storage? Clearly there is the issue of the basin where you may be able to store that carbon. Can you also perhaps just update us on how the technology and cost

and applicability of CCS has developed? Is that a major block? Who would like to take that? John.

[86] **Mr Maddy:** I'll be honest, it's not my area of expertise at all, but what I would say is that it's unfortunate that the UK halted some of the two main trials on carbon capture and storage. But it's not to say that the technology is not progressing elsewhere in the world. Cited within the H21 Leeds City Gate study was the current carbon capture from a hydrogen plant in Port Arthur in America, and I think the technology is moving on. Now, is it fully effective, is it cost effective? Well, I'm sorry, I can't answer that effectively for you. But with hydrogen being the subject, if you're going to go down a fossil route towards making that hydrogen, the only way of making it viable from a carbon reduction point of view is to capture the carbon dioxide, or, indeed, to use the carbon dioxide.

[87] **Mark Reckless:** Mark, do you want to add to that?

[88] **Mark Crowther:** The IEA published a report yesterday, or it comes out—I think I saw an early copy yesterday—which says that hydrogen is about 3.8p to 4p per kWh ex SMR and CCS, which is a very similar sort of cost to the one that we found in Leeds H21. I think that's round about £40 a tonne. Certainly, the Carbon Capture and Storage Association have recently done a report saying that carbon dioxide storage is in a large range of about £12 to £60 a tonne. But, particularly as methane doesn't have a very high carbon content anyway, that's not the additional expense that you would have found if it was, say, using coal as a feedstock. I was quite pleased by the costs in that report.

[89] **Mr Owen:** You may also want to refer to the report from Lord Oxburgh about three months ago on carbon capture and storage, and I think utilisation is in there as well, and that has hydrogen in it as a central plank, especially in relation to heat as well.

[90] **Mark Reckless:** Can I just briefly explore the alternative? You need CCS with the current main production process for hydrogen, but is an alternative to go down the route of using renewably generated electricity, particularly at times when the wind is blowing strongly and we're getting a lot from that source, in order to generate hydrogen and then store the hydrogen? Is that a plausible path?

[91] **Mr Crowther:** You can, but it's very capital intensive, and certainly in

the medium term, until you get a very high penetration of renewables and you have a lot of renewable electricity that's 'spare', it's difficult to make the—. Electrolysers are quite expensive—£1,000, £1,500 per kW. And to have that amount of capital sitting idle when the wind isn't blowing or the sun's not shining means that the economics are quite difficult, and people would tend to sell electricity as raw electricity in the foreseeable future. If you note the numbers, I was talking about 3.8p to 4p per kWh ex SMR for hydrogen, whereas, of course—

[92] **Mark Reckless:** Can you just take me through that 'ex SMR'?

[93] **Mr Crowther:** That means off the plant. The trouble is people mix up the cost of energy at the terminals of the plant and what it costs you at the sofa, which is why I talk about 'well to sofa'. If you talk about Hinkley Point, that's about 9.8p per kWh at the terminals. At the moment, our wholesale electricity is about 5p per kWh at the terminals of most generating plants. It sells at retail—so it goes from 5p to 15p per kWh in terms of the ratio from wholesale to retail, because electricity is expensive stuff to move about, and because you can't store it and it's just ephemeral, sort of thing, whereas gas is, at the moment, about 1.8p per kWh wholesale, or something like that, to about 4.8p per kWh retail. So, all of the costs of gas are much, much less than electricity.

[94] **Mark Reckless:** And hydrogen, you were suggesting, is about 4p at the plant gates.

[95] **Mr Crowther:** Correct.

[96] **Mark Reckless:** Which would translate into how much at retail, compared with that 4p?

[97] **Mr Crowther:** It depends how much you include the full conversion of the house. The house itself, we reckoned, in Leeds H21, will be similar to the recent conversion in the Isle of Man, from town gas to natural gas, which is about £3,500 per house, which sounds about right. If you think a new boiler, £2,000; a new cooker; and a new gas fire. So that's the sort of price. And so the cost of the hydrogen that the consumer will pay then depends very much on whether and how you smear that £3,500.

[98] **Mark Reckless:** Thank you. Perhaps this is the moment to bring in Vikki, who I think had a question about consumer behaviour and what we'd

need to adapt.

[99] **Vikki Howells:** Yes. Really, you've given the answer to the question I was going to ask, but just thinking practically, especially in relation to what you said, Steve, how realistic is it for us to expect consumers, particularly in Wales, where there is a high degree of fuel poverty already, to be able to make that switch? Has any thought been given as to how we can address that issue?

[100] **Mr Edwards:** I've got some background for you in this, because we understood very quickly that there are customers at the end of our networks and technology. So, we did a study in Bridgend, and in that study we looked at the cost, carbon and security implications of the different heating systems. What we found through the Bridgend study was over 80 per cent of customers in Bridgend wouldn't have a penny to actually invest upfront. There was about 1 per cent who were fortunate and would be savvy investors and take advantage of any, perhaps, renewable heat incentive associated. What we've also found as well, in terms of consumer behaviour—. We actually do fuel poverty schemes and gas infills, where we clearly demonstrate to a community that, actually, having gas will actually lower their costs, lower their carbon footprint and improve their security. It actually takes about 20 years to get a 70 per cent penetration, and that's when there's something that's actually a real benefit. So, if left to market forces and their own devices with no subsidy arrangements, you would probably get very little consumer take-up. People love their gas boilers, they love their comfort and they make these decisions probably once every 10 to 15 years. So, you would have to think of the policy levers to actually stimulate and support, especially those in most vulnerable situations, to move this over.

[101] **Mark Reckless:** The boiler—can you be clear whether, generally, people would need new combi boilers if we were to switch to hydrogen?

[102] **Mr Crowther:** The simplest answer to that is they would—. We've costed it on the basis of total appliance replacement. That's quite a hot debate at the moment in London, and that really all needs a lot more research and thought about it. There are implications in terms of whether it's technically possible to make appliances that could burn lots of fuels, a whole range of gasses, but then they're going to probably—. Well, they will cost you more and they may well be larger than if you bought a specific appliance that would burn a specific gas.



[103] **Mark Reckless:** The ones that people have currently got fitted, if I was to instead put hydrogen or natural gas in—

[104] **Mr Crowther:** No, they just wouldn't work. They only—. What's happened in recent years is that manufacturers have been driven to produce more and more efficient boilers, and so there are parallels with racehorses. You feed a racehorse on best-quality Scottish or maybe Welsh oats, whereas if you had an old nag you could put it in a field somewhere. What's happened is because the Government have put enormous pressure on manufacturers to produce more and more sophisticated and efficient gas boilers, they are more and more dependent on the perfect quality of gas. We've done a large study for Scotia Gas Networks in Oban where we went round and visited every house in Oban, and did a big study there. This whole area is very live for debate at the moment, because at the moment Scotia Gas Networks want to just very slightly tweak the quality of the current gas, and even that is a contentious matter. So, all of that lot is still—. I won't go into it this morning, but it's all to play for, really, and that's really where there needs to be some serious spent to do those sort of optimisations in conjunction with the appliance manufacturers.

[105] **Mr Owen:** I understand that this is subject to a project that is about to start, I think—Keele University with Northern Gas Networks.

[106] **Mr Crowther:** Yes, we're doing the bottle wagons on that. It's all quite a challenge.

[107] **Mr Owen:** Yes, to test the appliances and to see whether they are hydrogen-ready.

[108] **Mr Crowther:** Absolutely.

[109] **Mark Reckless:** Can I bring Jenny in for a question, and then I'll go to David?

[110] **Jenny Rathbone:** Just coming back to the potential for doing a microscale combined heat and power district heating system using hydrogen, given the resistance to change that Steve has described, what would be the best way of taking that forward? What about having—? Where there's a new housing community being built, would that be a way of testing the new technology?

[111] **Mr Edwards:** It would certainly be less intrusive and easier to test without impinging on the gas safety management regulations, the billing and the existing network issues. What we do—and some good things, actually, do go on in Wales—we've now got a hydrogen centre at Swansea University, SA1. We're engaged with south Glamorgan university and we're engaged with Tata Steel. And we actually were looking at a scheme in Lamby Way where we were looking to inject hydrogen, but, actually, we need to smaller-scale innovation on the components first to knock those out of the way, and then go for the demonstrator. That's what we are trying to do—pick off the elements along the chain to make sure that we tick those little things off, and then you're in the position to get the support from the Ofgem network innovation competition panel to go for a bigger demonstrator, and that's exactly where we're at.

[112] I don't know whether it would be worth the committee—we do actually have an energy networks association portal where all our innovation projects are logged. We could supply the committee with the different types of projects that relate to hydrogen that actually are ongoing, which may be helpful. And a part of our desire as Wales & West Utilities is that if we do these large collaborative next steps for hydrogen, which we are supportive of, we'd like to see some of those demonstrators in Wales, and we'd like to make sure that we understood where it would make sense for us in Wales, with the things that we have to do as certain elements of that project.

[113] **Mark Reckless:** I think we'd welcome that, wouldn't we, and certainly our research team, perhaps in the first instance, can look at that portal and draw examples to the committee's attention?

11:15

[114] **Mr Crowther:** One of the problems with new build and district heating is that the heat demand of the property is so low. CHP is ideal on an old property. If you have a new property, which hardly uses any energy anyway, you have to run all these pipes for a heating system you might turn on for 10 days in January or something. I exaggerate, but do you see what I mean?

[115] **Jenny Rathbone:** The point's well made because, obviously, we have a considerable problem of people living in fuel poverty in old houses that are difficult to convert.

[116] **Mark Reckless:** Perhaps an example is a village that's coming on to the

gas network. That might be appropriate for a trial. David.

[117] **David Melding:** Thank you, Chair. Earlier, you said hydrogen is about as safe as natural gas. However, I don't think it's been tested in the sort of patterns of accommodations and buildings that we have. You made reference to Hong Kong and Japan, and obviously there's a very different style of living there. If we are going to shift in this direction, I think the public would expect a particularly robust assessment of all the safety requirements in actual life situations. So, has any work been done in this area, and also, would there be any risk factors in the actual transition process separately as well?

[118] **Mr Crowther:** In terms of—. We need a lot more—. That is somewhere that needs a lot more research. I'm in no way being complacent about that, though it's a good start, the HyHouse project in Scotland. The Hindenburg is of course the classic example, which always brings up the fire, but, in fact, 67 people survived. There were 100 people on board, and the ones who died, died from falls and from burning by fuel oil from the engines rather than hydrogen. Nobody was killed by the hydrogen. There is around 60 million tonnes of hydrogen used a year around the world, and we know there are pipelines in south Wales here. There are long pipelines in Belgium—300 miles of it. So, in that sense, the pipelining is not too much of an issue. And people fly in aeroplanes all day—aluminium tubes surrounded by kerosene, sort of thing. So, providing the engineering is done correctly, and that's what we need the engineering to do, I don't see, fundamentally, why hydrogen is that much more fundamentally dangerous than natural gas. I don't know if Jon, as someone who's worked with hydrogen for years, has another view.

[119] **Mr Maddy:** I guess what I would say is that in an industrial setting, there are well-established, over 100 years' worth of experience of designing and engineering the right systems, to ensure that that safety is there. The step that we're talking about here is moving towards a domestic setting, and, of course, we would have to go through the rigour that the gas appliances go through, and all of the regulations that surround that, if we're going to introduce hydrogen to our homes in great numbers, then I'll accept that that work needs to be done. But it's certainly not something that we should be afraid of. It is also an area of expertise within Wales, which I think is something that's valid as well, and because we've got so used to handling hydrogen over so many years, we do have a head start in that respect.

[120] No-one takes the issue of hydrogen safety more seriously than those

involved in it currently, and that's because we have a vested interest in trying to make this succeed, and it will only succeed if it's seen to be safe. There are differences in perception. Different generations view hydrogen in a different way. There's plenty of studies that show that, and memory of—Mark mentions the Hindenburg, and some erroneous association with the hydrogen bomb seem to crop up from time to time. A new generation is perhaps more accepting, but having said that, we still need to do the work, and there is work to be done to ensure that standards are applied for use of hydrogen in a domestic setting.

[121] **Mr Owen:** I just wanted to say that we do use hydrogen already, in that it's locked to carbon in methane. Some of the fuel cells that I've been involved with, in installing—and you can see these, you can kick the tyres, the boxes in buildings in Wales, and other large ones that are being introduced to the UK market, based on experience going back decades in the States, in Korea, in Japan, Germany, places like this, from companies like Doosan—yes, they take in natural gas as the input fuel, and make the cleanest and most efficient use of that fuel, but they convert that methane into hydrogen within the box. The steam methane will form a reaction, and that is instantaneously fed into the fuel cell. A fuel cell needs hydrogen and oxygen to produce the electricity and the heat and water as the output fuel. These are CE marked; these have gone through safety tests and everything, going back decades, really. So, it's the appliance and the use of that hydrogen that is critical, but you can extend that to the automotive industry. Toyota have got hydrogen tanks, but they're very safe: they've fired bullets at them, for example So, it's only—

[122] **Mr Maddy:** I don't recommend it. [*Laughter.*]

[123] **Mr Owen:** No, but they've gone over the mark to prove the safety. But it's only as safe or as dangerous as you allow it to be. There are rigorous checks and there are global standards that have been introduced as well.

[124] **David Melding:** And Mr Edwards, are you as sanguine?

[125] **Mr Edwards:** I agree with my colleagues in that what we need to do is make sure that we fully went through the processes of testing and there's obviously then the gas network impacts as well. So, we've seen some early research reports from Dodds, from London, in terms of the fact that it's a little bit wetter as well than natural gas, so there's a potential impact on steel. So, you know, we would certainly need to make sure—. We operate to a

safety case in Wales & West Utilities and we would continue to do that. We would work with the Institution of Gas Engineers and Managers and the likes of Mark's organisation to make sure that we went through, collaboratively with the Health and Safety Executive, a programme of that in parallel to the demonstrators and commercialisation as well.

[126] **David Melding:** I'm going to make a slightly political point now—given the fact that we've not had these thorough safety trials on domestic products and different domestic buildings and whatnot, is it fair for me to conclude that we're quite a long way from a tipping point on any change here, otherwise that work would have been done pretty quickly by those who are keen to see this change?

[127] **Mr Edwards:** Yes, I would agree with that, but what is perhaps positive for the committee is that there is a lot of work that is going on to develop that road map because we all share the vision that we want to decarbonise our energy system, including heat at the lowest cost and the safest way for customers. We are looking to develop that practical pathway, including innovation testing, hopefully using Welsh universities, Welsh businesses and Welsh expertise to maximise what we can do to inform that policy. So, there's a real will there because we have a legislative requirement to do it, and because we own and operate a gas network, I've got a real vested interest in trying to make sure that happens.

[128] **Mark Reckless:** Jayne, have you got a further question or has it already been dealt with?

[129] **Jayne Bryant:** Coming in at the end, thanks to your comprehensive answers, most of my questions have been touched on, but I was particularly interested in your comments around the industrial sector and the work going on with Port Talbot. It has come out in some of your answers already, but what are your views on the need for further investment in research opportunities and pilot projects to investigate the feasibility of hydrogen for heat? You mentioned some of the partnerships that have been going on as well.

[130] **Mr Maddy:** Can I just take that? I think it's essential to look at the Wales-specific case. I hold a slightly different view to Mark on the way in which hydrogen is made and the applicability of hydrogen from renewables—so using renewable electricity via electrolysis or using biomass and converting that biomass to hydrogen. I think the cost trajectory of that is

coming down quite quickly and I think, therefore, we should continue to look at that. Therefore, the case for hydrogen, as we've shown, is a complex issue, and so to try and get some sense out of the fog, we need to try and understand the Wales-specific case. I don't think anyone has properly done that.

[131] We, in the University of South Wales, are collaborating with Cardiff University and Swansea University on the FLEXIS project, which enables us to look at energy systems, with a very strong focus on Wales's energy systems. So, within that, we'll be doing some of that work, but I'd certainly say that more investigation is needed. It definitely needs to include a very strong input from industry as well as the academic community. We are working together on that, but we need to do a lot more to understand what the potential is, what the cost is and what the challenges are. We know them in general terms, but I think we need to end up with a more specific study in that respect.

[132] **Mark Reckless:** Would anyone else like to make one final contribution on that question?

[133] **Mr Owen:** Just a quick comment: we should see it as an opportunity. It's a challenge, yes, but it's a big opportunity. It's our expertise. It's developed in Wales with the universities, business partners and community partners as well, if you extend that to renewables as a source of the power. I can refer you to a report that was published just last week from the European Commission, 'Energy storage—the role of electricity', which I think is the subject of your discussions later today—you're looking at energy storage—and that has a lot in it about hydrogen as well, not just as a small piece of the jigsaw, but potentially a very large piece, and that's important to state going forward: there's no point doing it if it's just a small bit, but it is a big opportunity to develop expertise in Wales.

[134] **Mark Reckless:** Could I perhaps ask you to send us a link, or just highlight to one of the staff on the way out the nature of that report, which sounds like it's something we'd like to look at? Thank you all very, very much for coming in, and again for being so flexible to change the time of the session. I declare a five-minute break. Diolch.

*Gohiriwyd y cyfarfod rhwng 11:25 a 11:35.  
The meeting adjourned between 11:25 and 11:35.*

## Polisi Ynni yng Nghymru: Technoleg Storïo Energy Policy in Wales: Storage Technology

[135] **Mark Reckless:** Thank you very much for coming in. As I was saying to you just informally outside, the purpose of this session is, I think, primarily to improve the committee's knowledge of the area on which you are expert. We have an expert reference group on climate change, which the committee is setting up, and I think one thing we're quite keen to feed into them is to have a level of knowledge at the committee, in terms of we've just done hydrogen in terms of the gas network, and now electricity storage. So, if you're able to enlighten us about what is happening in your area and how that can feed into the carbon agenda, we would be very, very grateful to you all. Can I highlight that translation is available if needed from Welsh on channel 1 of your headsets? Could I start by asking what steps you see as the key priority in making energy storage part of the future for our development in Wales? Who would like to start with that? Do I have any willing volunteers?

[136] **Mr Ling:** I'm willing; I'll start. I think that, as an industry, everyone needs to understand what it is they want out of energy storage. It took quite a long time to get wind right. It took just as long to get solar right, if not a little bit longer. We're involved with quite a few big, large-scale projects for blue-chip level clients in the UK, and, when we asked them what they want the storage to do, people didn't know the answer. So, whether that is to export once into the grid, once a day, in which case you need a big battery, or do you want it to export 50 times in one day, in which case you need a small battery but you need it to charge and export extremely quickly? I think the challenge is that they still don't understand what they want. There's nothing in place for any of the big utility companies to do anything on it. So, in terms of EDF, E.ON—RWE are doing a little bit—there is no solution yet in terms of what the grid needs and what the end user needs. Again, there isn't just one big answer for it. Each site needs to be treated as a project in its own right. Each windfarm, each solar farm, will work in a different way, as would every house in a street have a different demand profile.

[137] **Mark Reckless:** From your knowledge of electricity demand, could you hazard a view as to whether their key requirement is that once a day, perhaps at night, taking electricity, charging up that battery and then, at perhaps one or two peaks of electricity demand during the day, discharging it? Do you see that as the major challenge and policy opportunity, or do you think it's more what you were saying, the balancing and very regular use of a battery many times?

[138] **Mr Ling:** I think frequency response would be the ideal output from it, rather than working with the grid's triad periods, which are periods where a generator would earn up to seven times, in some cases, what the normal price of electricity would be. So, it depends on how you look at it, from which perspective, whether you look at it from a commercial, 'I want to times my money by seven, two times a day', or, 'Do I want to balance the grid?'

[139] **Mr Farr:** I think from our— Andy, I believe, is more commercial. We've been dealing more with the domestic, really. We get loads of customers coming to us going, 'I want a battery. I want a battery. I've got solar; what I need is a battery'. The problem we're finding is that we don't know if a battery's worthwhile for them. With some of our customers, we're lucky enough that they've had good equipment, and we can see what they're exporting for the last two years, and we can say, 'Actually, based on the information we've got, a battery makes a little bit of sense for you'. Without that information, you have no idea. So, just because you have solar doesn't mean you need a battery. So, the people buying batteries at the moment are more the early adopters.

[140] Comparing it to the market, the battery storage market, I feel, is where solar PV was before there was a tariff. It was just people buying it because they were either interested in it or it fits well with their PV. It doesn't make financial sense. They don't necessarily need it, and, at the moment, you would probably be better off buying from the grid than spending thousands on a battery, unless you had some sort of grid-sharing going on with Western Power. But I think that, at the moment, we are trying to push customers to, 'Yes, you want a battery. However, let's do something else, like fit exporting monitoring gear. Let's look at it for a year's time and see if it's worth while you doing it.' I think that's where domestic customers at the moment should be pushed down, not buying a battery. I think that anyone who buys a battery on a domestic scale at the moment and they even mention payback or does it make sense, they have either been missold or they are buying it because they just want it. Someone's got an Apple phone; they buy an Apple watch. Those are the sorts of people at the moment who should be buying batteries—not for any sort of financial payback. I just think it's quite early on to be thinking about it making sense so much for a customer. Commercial's a little bit different: high users, paying a premium for their usage. But I think, with domestic, I'm struggling to see why it'd be rolled out on a mass market without any sort of incentives or grid-sharing.



[141] **Mark Reckless:** Jacqueline, do you have anything that you would like to add at this stage, before I bring in Jenny?

[142] **Ms Edge:** Yes, I think it's important to understand that, in a developed nation such as ours, we already have a very good, established grid. So, there's no immediate need for energy storage. Most of the benefits of the energy storage are in supporting the grid in the long term. If you look at the work from Imperial College, they show there are massive savings up to 2030, 2050, and it's in supporting the grid and making it a flexible system; that's the most important thing that energy storage can do. I don't know if shoehorning a load of batteries in at this stage is the best thing, but, certainly, it makes sense in certain issues, like, for example, co-location of storage and wind; that seems to work. There are a number of use cases, some of which are ready for market. But I think it's really important that we stand back and look at the whole system, and also look at how all the energy networks integrate—perhaps auto-integrating with water networks—and maybe do a bit more thinking before we just shove storage in here and there.

[143] **Mark Reckless:** Jenny.

[144] **Jenny Rathbone:** I was involved in the smarter energy inquiry we did in the previous Assembly, and I remember hearing people saying that we aren't that far away from being able to use old car batteries to shove in the garage and then avoid paying for electricity in the evening, when we have got all this wonderful electricity being generated off our solar panels.

[145] **Ms Edge:** That is correct, yes. So, I think there's a lot of work in Newcastle and Sheffield working on second-life batteries. I think most of them are looking at large-scale systems, but any of us could just buy a second-life battery. Maybe we're not there yet, but, yes, that's certainly a low-cost option.

[146] **Jenny Rathbone:** So, technically, what's the barrier to that? I appreciate Oliver saying, 'Don't do it. There's no—'.

[147] **Mr Farr:** I don't think most consumers with their houses would want to shove a load of second-hand dirty lead-acid batteries in their house. It's just not something that appeals to people. It's not long term. What is the warranty on them? How long are they going to last? Lead-acid batteries have probably only got a shelf life of maybe five years anyway; now they're second hand. I don't think, for consumers, it would go down well. I don't think it

would take off.

[148] **Mr Ling:** You'd have no room left in your garage.

[149] **Mr Farr:** Yes, it would take up your whole garage.

[150] **Jenny Rathbone:** Okay.

[151] **Simon Thomas:** I have no room left in my garage already. [*Laughter.*]

[152] **Mark Reckless:** Can I bring in Vikki?

[153] **Vikki Howells:** Thank you, Chair. So, building on what you've said so far, looking at the different storage options that are out there, what would you consider to be the most promising in terms of what is viable on a small scale for domestic customers, or on a larger scale? I'm thinking particularly in terms of costs there as well.

[154] **Mr Farr:** I think, on a domestic scale, there are so many different priorities for consumers, and so many different types of usage, it's hard to say what is the perfect battery that fits all. In a perfect world, if I was imagining a perfect battery, it would be this big, it would be 20 kW and it could give out 20 kW at a time—in an ideal world. But not every customer needs that anyway. So, you might have some consumers with a low usage but a low baseline: a nice little small battery with a little discharge might cover their baseload. You might have a high user but they've not got much PV. So, it really is difficult to say. You do need those data of what they've been generating from PV if they've got it, and what their actual usage is, and what their lifestyle is looking like, to actually look at it and think what battery's right for them. There is no one battery that fits all. There are a few people that are going with a big battery. There's Tesla: yes, a nice big battery, and it can discharge at a good rate, and consumers like it because it's a brand thing, and there's an LG Chem—. There are a lot of different batteries out there, but there's not one size that fits all, and you really need those data. You could put in the switchgear, and in a year's time, why would you buy a battery? You're hardly ever going to charge it; it makes no financial sense. But if I'm in front of you now, saying, 'Do you need a battery?', 'Well I don't know', I could missell it and say, 'Yes, it's brilliant. It makes financial sense for you—let's go', because there's no consumer law governing it. There are no governing bodies telling me how I should sell it. There's no Microgeneration Certification Scheme, like on solar, or anything like that, so

consumers at the moment are massively exposed. I would say that a lot of our battery inquiries come from customers who have been told by other companies, 'Buy a battery', and then they are just now shopping around. We're trying to educate them in the facts of, 'Well, how do you know it's right for you?', 'Oh, well, we don't', and trying to get them down the route so that in a year's time, we'll have a big existing base where we can look at the ones who actually need it, and actually target the ones it makes sense for, not just roll out loads of batteries to make some money.

11:45

[155] **Vikki Howells:** So, would you agree with the evidence that the previous committee heard from the Green Valleys, where they described the Tesla battery as,

[156] 'effectively a £2,000 wallet which holds £1 worth of electricity'?

[157] **Mr Farr:** Yes. It makes no financial sense. This is what I'm saying. We were in the vanguard in fitting the first Tesla Powerwall, and it was sort of a good battery that came out. We've never let any of our surveyors sell it. The only person who can buy a Tesla Powerwall is an inbound inquiry that is sold on the internet or on the phone, so that we can call listen to make sure that customer is not being told anything about financial payback, because it does not make sense. The only people who buy them are early adopters. They have a nice, flashy house, with solar PV, and they want to spend a few grand and put a battery in. It doesn't make sense, but they'll just do it. Those are the people who are buying batteries at the moment, or missold. There isn't anyone, really, in the middle.

[158] **Mr Ling:** From my point of view, if you want the perfect way to do it, like Oliver said, the individual domestic as a model isn't—. There is so much work to do on it, you're never going to get it right. You'll get it right for house No. 1, but you'll get to house No. 5 and they've got a completely different demand profile. So, I think if you want the ideal way to do it, then you have to look at what people have done before. If you want to look at energy storage, you go to California and look at what they've done before, because I'm pretty sure they were having these conversations maybe 15 years ago, so, if you want to learn from their mistakes and what they've got right. Individual domestic storage in a house, you're up against it; it's never going to happen. Whereas, if you don't discount domestic storage, because if you decentralise that storage—so instead of having one where your washing

machine used to be, you've got a battery there with your own solar, trying to match your own demand profile—and move it to a whole street's worth of houses that all have solar on there, with a decentralised battery that they can either pull off if they need energy, or their solar is charging that battery, you can link that battery to external solar or you can link it to a wind farm if there's one anywhere near. If anyone's got an electric vehicle, and they come home and they're not going to use it for eight hours during the night, then you can backfeed into that battery. That, in my way, would be the ideal way to do domestic storage—and the only way.

[159] **Mark Reckless:** Can I bring in Simon, and then David?

[160] **Simon Thomas:** It was just on that point, actually, that I wanted to ask, because you could put a battery on wheels and call it an electric car, and that may be one of the ways that we introduce storage into the domestic setting that matches the use of solar and wind in certain areas. I just wondered if you could just expand a little bit on that, in terms of how we might be able to get a wider appreciation of how that might work in a domestic setting. And then the wider question, because I visited your company in Lampeter, is the wider question of how storage is integrated into our transport system, and something that isn't the answer to storage, but is just an additional part of how we try to decarbonise our electricity generation.

[161] **Mr Ling:** How we came about doing the work that we do at the moment is by taking the existing—. I used to work in wind energy, so it was all about new infrastructure—multimillion-pound turbine installations—whereas our solution takes existing infrastructure, which is vehicles and lorries and trucks that are already there, that people already have, and maximises the energy harvest out of those vehicles. So, as much as we're doing mainly commercial stuff, it can transfer over into domestic, depending on what electric vehicle you have and how far your journey is to work, there will be, at some point, additional energy that you're not doing anything with. Whether it's that you drive to work, and you plug into work when you get there, and then you drive back home and you plug back into your house, depending on what time you plug in, you're going to get different tariffs and different feed-in rates. The US navy have just switched all of their big American trucks over to, not Teslas, but I think the Nissan Notes. So, instead of all the big trucks, they've all got electric vehicles that are all travelling around the camp every day, and they will all plug into multiple points on that camp. Their energy usage has been cut 67 per cent, I think it was, over a six-month period. Again, it's got to be a solution that not everybody has to do,

but if you do it then there are—. There is a system where you can monitor what you've fed in or monitor what you've taken out, whether you're at work or whether you're at home. That's where the decentralised bit comes in because it doesn't matter if your next door neighbour drives a V8 truck, the fact that you're driving an electric vehicle and you're trying to be efficient, that will still work for that system.

[162] **Simon Thomas:** And the integration with solar as well, is that something that we should be doing more of?

[163] **Mr Farr:** Yes and no. I mean, it's just I don't feel we're quite there yet to justify—. I mean, if you can come up with a model that was easily adaptable to every single consumer, then brilliant, and that's what NCS and, sort of, the feed-in tariff did; they looked at it and said, 'Right, well, how can we incentivise this? Let's do a feed-in tariff.' But, that's a lot simpler because that's based on generation, and I don't know how you would do that with storage. It is the question that gets asked all the time: if they were going to do some sort of incentive or grant scheme, you're almost putting your badge of honour on it; you're saying, 'This is worth you doing.' So, with the feed-in tariff, it's almost like the Government going, 'Buy PV.' With batteries, if you put an incentive on it that's wrong, and you're saying as a Government, 'We'll give you a £1,000 towards your battery', or something like that, you're saying it's worth them buying it, but it could be a total and utter waste of money for that consumer. By you giving some sort of incentive, you're promoting that it's worth doing. So, I think it's a risky place to get into until you really understand it more.

[164] Again, talking about the American market, the German market, we've been placed to go there, sort of rolling it out in different schemes. That's where I'd go, whether it's that you've got to prove your generation and what you're exporting from your solar, I don't know, but I would just tread carefully, I think. Once you put incentives or any sort of schemes behind something, you are giving it a badge to say, 'We say you should do this.' I know you're not doing that, but that is ultimately how it is looking and it doesn't—. Probably 90 per cent of the people that say that they want a battery it makes no sense for. And a lot, as I was saying, are the early adopters and it's not about finance. Some do just want to do more self-consumption, whereas at the moment they've got PV and it's 40, they want to get it up to around 60 or 70, but it's not about the finances, it's just, 'I want to be less reliant on the grid.' That's great; that's the people that you want to buy batteries, do you know what I mean? It's not for money or

anything like that, it's just to be more eco-friendly and be less reliant on the grid because they can see prices are going up. That's your ideal customer, but there are not many of them. They are around, but there aren't loads of them, and probably 90 per cent of people buying batteries—or thinking about it—it makes no sense for. And that's just on a domestic scale, obviously it's different on the commercial and other markets; I'm just speaking purely on the consumer level.

[165] **Mark Reckless:** David.

[166] **David Melding:** Transport is obviously an area where public policy's been quite active in encouraging a shift to electric cars. There's speculation that most cars in 10 years, 15 years certainly, will be electric. So, I wonder if in other viable parts, if they are viable, of the market—commercial, public, leisure centres and the community assets—should the Welsh Government and the UK Government, or could they, be doing more to incentivise a shift to storage solutions in those areas.

[167] **Mr Ling:** I think the Welsh Government could do a lot more. I can't buy a Tesla because I can't get to Cardiff because I wouldn't have enough miles in the tank to get here, and that is an infrastructure issue that someone has to face. It's the same for mid Wales, possibly even if you're in Swansea you wouldn't get to Cardiff in an EV if the traffic was bad. So, infrastructure-wise there's a huge amount to be done because people would actually consider it on a number of different levels, but if they physically can't get to work in an electric car, then they're not going to buy one. But, yes, in terms of public service stuff, if everywhere you went you could take two minutes to plug your car in, whether that's your car exporting or inputting, then that is where everyone will need to be sooner or later. But, yes, until there's at least a charging infrastructure there, which is easily done in Wales when you compare it to trying to plug cars in to London, into the grid with how it is down there, to do it in Wales would be a million times easier.

[168] **Mark Reckless:** Sorry to interrupt, David, but can I just ask: when you say 'infrastructure', I just wonder whether that gives a sort of message that there's huge sort of capital spend and this is technically sort of difficult or there's something about these things that makes it a challenge. What more is it than a sort of a plug and a supply of electricity, and why is that so difficult to make available?

[169] **Mr Ling:** It wouldn't be difficult to make it available in Cardiff or

anywhere in Wales. Rural Wales would be even easier. If you've got access to electricity, you pull a cable out of the ground, you put a plug in it and you meter it. There would be a software-based system where you would need to monitor who has taken charge from that point and how much they have taken, but that is it. You're not talking of a massive project. There are probably four or five big charge-point entities in the UK, privately owned, that will probably end up doing it anyway, at some point, because they will make money out of the people that are charging their vehicles from it.

[170] **Mark Reckless:** And are they running the software behind it to measure who is taking how much electricity?

[171] **Mr Ling:** Yes. So, it is almost like a contactless platform. You press it to activate it, charge your car for x amount and get charged x amount for doing so, and then away you go. From your point of view, if the Welsh Government doesn't get involved in that, then the private entities will come and do it anyway.

[172] **Mark Reckless:** Back to you, David; sorry about that.

[173] **David Melding:** Looking at this idea, I suppose, that we're exploring, whether storage is going to get cheaper and more efficient, I think you've very clearly told us, you know, 'Forget the domestic market from being the leader here.' So, I basically want to explore whether the commercial market or the public service, possibly, is likely to be a leader, and will that happen inevitably just because the economics will drive in that direction, or should there be more active public policy, either at the Welsh or UK level. Now, I'm moving away from it in transportation because, obviously, as we've heard, there is at least a level of encouragement there.

[174] **Ms Edge:** So, there are a number of use cases. Obviously, domestic seems to be the most exciting one because that's where batteries seem to fit, but there are a number of use cases developed by DNV-GL about where storage could work in other sectors and in other solutions. So, for example, quite an exciting one is the cold chain concept of using liquid air energy storage to manage your food delivery and your medicine delivery networks. I think Dearman Engine is doing quite a lot of work on that. They're now called—I can't remember. So, Toby Peters from Dearman Engine is doing liquid air energy storage but on a smaller scale, and for transport networks. So, that works for delivery vans for food, flowers and anything like that that needs to be cold-stored. So, there are other use cases, not just domestic. So,

you could possibly look at all these different use cases and see how you might incentivise each of those, rather than only focusing on domestic and batteries.

[175] **Mr Ling:** You mentioned policy and what you can do to help. Jacqueline's mentioned Dearman and the liquid stuff. From a small and medium-sized enterprise in Wales, working in this area every day, everybody understands the need to innovate and to constantly push and constantly look at what you could be doing next, but I think that, policy-wise, there is a big gap between what we've got readily available now. Dearman's probably my biggest competitor in the market, and they're still probably three or four years away from commercial roll-out, whereas we've already got stuff that is ready for the market that you can go and do and would provide an immediate carbon saving and an immediate difference. So, yes, from my point of view, from a policy outlook, it's great to be innovating and carrying on looking 10 years down the line, but don't miss the current opportunities that are present right now.

[176] **David Melding:** Is, for instance, double charging a huge problem in terms of how stored electricity is viewed?

[177] **Ms Edge:** So, the issue with double charging only happens in certain cases where you would charge up the battery from an electricity supplier and, in that case, you paid for that electricity, and then you re-export the charged electricity to another user, and then they would get charged again. So, that's where the double charging comes in. It doesn't happen if you have an electric vehicle battery. It wouldn't happen if you're using the battery onsite, for a domestic installation. So, it's only very specific cases, but those are the cases that will support the grid in the future.

12:00

[178] **Mr Ling:** Double revenue could be looked at the same time as double charging. So, if someone does have solar panels with a meter and they're getting paid to generate that energy—they're getting paid to generate it—does it actually go back to the grid, or do they keep it in their decentralised battery system? Because we don't want to go for individual stuff. It's just as much of a benefit as it is a risk.

[179] **David Melding:** We're sometimes told in this committee, for instance, that we need the grid, a 1930s mega thing, central command and control—



you can tell I'm a Tory—and now we need to move to much more flexible transmission processes. In particular, we want to encourage local electricity generation, but the real problem with local projects is that there is no storage and they can't feed in to the grid, often. So, is this an area where storage is much more critical?

[180] **Ms Edge:** Yes, that's the co-location case. So, that's another one of the use cases: where you install the batteries onsite where the solar or the wind or tidal, perhaps, would be. I think that's quite close to being ready for roll-out. So, I think domestic and co-location are the two that people are looking at the most.

[181] **Mr Farr:** There's a lot of businesses that want to be green, but now they're getting stung with the grid costs. So, you've got all these rooftops that are really good for solar—they've had the carrot with the feed-in tariffs, but they've not had the stick yet—and it makes sense for them, and then all of a sudden they're hit with grid costs, which the grid are going to have to do at some point because it's so ruined anyway. It's like Western Power trying to fund upgrading the grid by penalising people that want to go green. So, I think, although we're here talking about storage, and I don't want to go into solar too much, I think we're just so far off it right now. If you're trying to lower carbon, I don't see why we're looking at storage yet. It just seems far off. Let's try and generate electricity a lot more, before we worry about storing it. I think there's so much more to do with solar PV.

[182] What's mental is that they're changing the business rates, and people who've had solar over the years are getting penalised because they've got solar, which is just crazy. They should have reduced business rates because they've got solar. That could be a way for you to promote to businesses: 'Go green, we'll lower your business rates.' That could be seen as something maybe Welsh development could do in Wales. It would be spearheading at what no-one else is doing. But it just seems crazy that we're now saying, 'Well done for going green, you're now going to pay more tax.' I just don't know how that came about.

[183] **David Melding:** Thank you, Chair.

[184] **Mark Reckless:** Can I bring in Huw?

[185] **Huw Irranca-Davies:** Can I just, as an extension to David's question, ask whether you, first of all, agree with the House of Commons inquiry,

which looked at the issue of procurement targets around energy storage? They were quite firm on this; they said by 2020 we should have in place a procurement target for energy storage. Would you agree with that broadly, or not? Do you think it's premature?

[186] **Mr Farr:** I think it's premature.

[187] **Huw Irranca-Davies:** Okay. And Mr Ling.

[188] **Mr Ling:** I think what they're trying to work out is what they need. The grid won't tell them what they need, because the grid doesn't know what the end user would need. So it all goes back to, 'Do I need a big battery or do I need a little battery, what is it that's required?' When you're up against the procurement processes of National Grid and all of the energy companies that have no interest in doing it anyway—otherwise they would be at the forefront of energy storage—there's a lot of work to do.

[189] **Ms Edge:** I think it is actually worthwhile taking a longer view and then also looking at the whole system. So, the problem is that the way the system works now is that if we need more capacity, we build another generator, and that seems to be the way we want to do solar and wind as well. But, of course, they're not flexible. So, if you keep building more and more generators, and you electrify transport and heat as well, what's going to happen is that the peak demands in your energy are going to go massively higher, and you have to then try and match that, because obviously we have to keep the security of supply. We have to make sure we have enough generator capacity to match that peak. If that peak suddenly goes much higher, then you have to build an enormous amount of generators, but you're actually using them far less. So, actually, you're wasting a lot of money building these generators, whereas what you could do is install storage and make better use of the generators you already have. So, storage is another way to match those peaks, and that's the biggest benefit of storage. That's why I think it is worthwhile considering installing some storage now so that we can match those energy demands as they arrive.

[190] **Huw Irranca-Davies:** But based on what we've already heard from all of you on the complexity and the uncertainties around this at the moment, and the fact that there are other more easily and more affordably deployable technologies that are currently there, how would you actually determine what this target should be for storage?

[191] **Ms Edge:** I'm guessing they're basing quite a lot of it on Imperial College's work, where they've taken a whole-systems approach. They've analysed what are all the inputs and what are all the scenarios that we want. If we need those carbon targets, then we have to either use nuclear with CCS—but actually, if we do it using wind and solar, we can do it with far less nuclear and it costs less. So, that's why they're focusing on that, because it will cost a lot less over 10 years.

[192] **Huw Irranca-Davies:** So, you could have some sort of broad target around energy—

[193] **Ms Edge:** Yes, I think that's where it's coming from.

[194] **Huw Irranca-Davies:** So, could you translate that down to a local and regional level, or is that just a bridge too far?

[195] **Ms Edge:** I think there has been some work looking at where are the generators, where's the most solar, where is the most wind and where's the best place to put them. With co-location being the best option at the moment, it's best to put the storage right there next to the windfarm, for example. But you do want a combination of large-scale energy storage installations and domestic distributed storage, because both of those add value. Unfortunately, there is no easy solution that fixes everything. You do need to use lots of different scales of energy storage, and you need to use lots of different types of technologies, because they all provide different benefits. So, I think that that's the thing: a whole-system approach looks at what are all the needs in the system and how do we make sure that all of that is accounted for.

[196] **Mr Ling:** New developments should be looking at the storage. So, if you look at the work that Redrow and Persimmon do, especially in Wales, when they're building thousands of houses all at once, the fact that they have this tiny little target of x amount of those developments need to be looking at new technology—it's amiss, I think.

[197] **Huw Irranca-Davies:** So, would you argue, then, that there is, actually, a role, in that granulated approach, that perhaps says that new developments should actually have some sort of indicative target of what they should be doing on storage?

[198] **Mr Ling:** If you could flick the switch between how we operate now in

terms of generation and enough solar, enough wind and enough storage to keep everyone's lights on, the complexity comes with managing it all the way through the process. Whereas on a new housing development, with a new grid connection that gets specified at x amount of megawatts, that would be the easiest way to get that housing development right. You've got demand profiles for every house, because you've just built them all. You've got energy profiles for every house, because they're all brand new. But then, you revert back to the decentralised part and, if people want to come in on it, they can; if they don't, then they don't have to. But it doesn't take the opportunity away from everything else. And when you're doing a new build, it wouldn't be—you know, you're not retrofitting into people's lofts et cetera. That would be the way to do it, I think.

[199] **Mark Reckless:** Simon, quickly, has a question.

[200] **Simon Thomas:** I just wondered what role price mechanisms play in this, because we've talked about legislative approaches, but there's also a price delivery here. So, we've always had storage. At least, in the last 40 or 60 years in Wales, we've had pumped hydro storage, in effect. That's the way we've managed electricity demand, and also price differentials. I just wondered: is there anything in the pricing system at the moment, or something that we could change in regulatory terms, that would drive the sort of storage that would be appropriate? Because you've been quite clear in your evidence that sticking a Tesla battery in your garage is not the way to go. But how we could drive that? So, just to give an example of the Pen y Cymoedd windfarm, which I think is the biggest in Wales, when I visited there, they were talking about having car battery storage onsite, so that they would smooth out and be able to store, I think, up to 45 MW, which is quite a lot to store in car batteries, I thought. But that was clearly driven by price. So, are there things that we should be doing around the pricing regime? In theory, governments have control through Ofgem, and the pricing regime as well, to try and drive storage in a different way.

[201] **Ms Edge:** Definitely. I think the problem at the moment is that you can't really access the benefits of storage. So, with the old metering systems, we can't access all the benefits. The smart meters will help; that'll be the first step towards that. But we also don't fully understand, yet, all those benefits and how each technology supplies that. So I think, at the moment, pricing schemes that encourage fast-response storage, they're the ones that are working the most, and that's where battery fits in very nicely. So, certainly, I think it's looking at what are all the values that storage provides, how does

each technology provide that, and then deciding how do we price those different mechanisms. And I think a lot of aggregators are helping to make that a bit simpler by letting people buy technologies and then buy into all the different revenue streams at the same time. That's quite useful.

[202] **Mark Reckless:** Jenny.

[203] **Jenny Rathbone:** Given that our collective obligation is to reduce our carbon emissions to meet our 2050 target, we should be using all the mechanisms at our disposal to achieve that. So, the base Ofgem consultation is offering four different possible ways of approaching storage. Which, if any of these, is actually the way forward, in your view, in terms of stimulating both having a more conservation approach to energy—not keeping the lights on when we don't need them—but also stimulating the market for storage?

[204] **Mr Farr:** Again, when you're coming back to it being about lowering emissions et cetera, and all this sort of stuff, why push it into storage? It's not there yet. I don't understand. You can come up with all different scenarios that will help storage, but I don't think we're generating enough from green energy to justify storage yet. I think the money is better placed into solar and wind et cetera at the moment. It may be different on a commercial scale, but on a domestic scale, I just don't see why. Why incentivise customers to buy something that seems a little bit early? It doesn't make a lot of sense, because—

[205] **Jenny Rathbone:** Okay. When you're talking to schools about putting solar panels on their roofs, one of the disincentives is that the time when there's most sun is during the school holidays, when nobody's in school. And they obviously would like—. If there was a way of storing energy in order to use it in the autumn term—

[206] **Mr Farr:** But to store enough from that six weeks to then use, you'd need a massive amount of area. It's one thing doing storage to maybe take away the peaks and troughs throughout the day, but to store six weeks' worth of energy to then give you six weeks—it's going to cost a massive amount, and then for the rest of the year, it's not really going to be doing a lot, if anything. So, you're just buying a massive amount of batteries to store six weeks' worth of energy to maybe give you a few weeks' worth of energy that side. I can't see how that would make any financial sense.

[207] **Jenny Rathbone:** Okay. So your response to the consultation would be,

'Forget all of those options'.

[208] **Mr Farr:** I just don't think we're there yet, personally.

[209] **Mr Ling:** Again, if you're looking at that school as an individual location, you're never going to—like Oliver was just saying, you're never going to keep it all there, but you don't need to keep it there. So, all the energy that that school generates during the daytime gets put somewhere else and used—

[210] **Jenny Rathbone:** Into the resident community nearby.

[211] **Mr Ling:** Yes—

[212] **Jenny Rathbone:** But that's not permitted under the current system; everything has to go back to the grid.

[213] **Mr Ling:** But there's technology available and there are platforms available. I don't want you to go away and start trying to commission loads of work that people have already done. Upside Energy is a system, an online platform, where, if you have storage in your house, you can sell it to whichever DNO you like, at whichever time you like, for the best price. So there's all this other stuff going on that would make things like that possible. It's just a metering point, and knowing where it's gone, and knowing how much you sold it for. You haven't taken that actual energy out—you haven't kept it in the school for six weeks, but it has still been used in general.

[214] **Jenny Rathbone:** Okay. So, the conversation with the school is, 'Don't worry about the fact that your school isn't going to be using the energy; you can make the money from selling it on'.

[215] **Mr Ling:** Yes, it's got to be community—[*Inaudible.*—]grid sharing.

[216] **Jenny Rathbone:** Okay. So, at the moment, that aspect of the consultation is not of any particular interest. Do you disagree with that, Jacqueline?

[217] **Ms Edge:** Maybe if we're looking just at batteries and if we're looking at the short term, yes, but batteries are not the only solution. You could do interseasonal storage using hydrogen, or you could use compressed air, or you could use thermal energy storage, which is longer term and actually

more appropriate, because then you're actually storing heat as heat. So, there are different technologies. They might not be ready today, but they will be ready in five or 10 years, so I think that's why it's important to keep those in mind as—

12:15

[218] **Jenny Rathbone:** So, it would be more important at the moment to be imposing obligations on new estates being built and ensuring that they've got storage built in, because we want these houses to last 50 years.

[219] **Mr Ling:** Using stuff that is available today. You've got to put it out and trial it before you've got any data back to see if it is of massive benefit or not, otherwise you will constantly do table-top studies on what could happen in 10 years.

[220] **Mark Reckless:** Can I just check: is there a difference of view between Andy and Oliver on this? You're emphasising that, certainly for the individual house, it makes no sense at all, is your view of battery storage, whereas Andy's saying that if you've got a new estate, it would be a good idea to trial that. Do you think, when you go from the level of the individual house to a new housing estate, that that is something where you think it makes sense?

[221] **Mr Farr:** I think the housing estate is a very good idea, and at least it would give you data. I don't think it would necessarily make financial sense right now, but it would be very good data for moving forward to see how that project worked. New estates—very easy for Persimmon and Western Power to work out that a 100-house development of similar size generates and uses this much, and to try and match that with some PV in certain amounts of the house and storage, and see how that worked. It will take an element of trial and error to see if that works, and that is something that you need to invest in now to see if it's worth doing in five or 10 years' time. It's not something you'd want to do to roll out to every customer. It's an incentive. We research on your behalf and research on Western Power's to try and do it now.

[222] Grid share is the only way that I can see there is some sort of way of making sense. Like we were discussing, [*Inaudible.*] do it or they're trying to do it, where they're paying a consumer. For every battery that they've installed they'll give them this, 'But we want to be able to export into your battery at some point in the day and pull it out'. And that's a different thing because then you can almost work out, even if they don't store anything

themselves, what value that battery has got based on that grid share. That has some sort of legs, possibly.

[223] **Jenny Rathbone:** So, if it's so unattractive at the moment, why are other countries offering quite considerable subsidies?

[224] **Mr Farr:** Because they pay a lot more for energy than we do as well.

[225] **Jenny Rathbone:** They're paying a lot more for energy.

[226] **Mr Ling:** And the model is different.

[227] **Jenny Rathbone:** Well, I appreciate in Germany the model is different because you are able to sell to the next village without having to go via the grid, but is that then something that we should be laying on Ofgem?

[228] **Mr Ling:** We could do that in Wales, it's just that there needs to be a system in place to do that.

[229] **Jenny Rathbone:** Okay, so we could establish a local grid.

[230] **Mr Ling:** Yes, you can use the existing grid, but there are metering points where you track what's gone from left to right. The individual house saying, 'I've paid £6,000 for a battery that I'm not going to get a payback for for 10 years', isn't going to work, but that does not mean domestic storage cannot work; it just needs to be done in a different way.

[231] **Jenny Rathbone:** Okay, because there is a loss of energy by selling it back up the line and then delivering it back up again. So, this is surely the conundrum that we need to somehow solve. And I think what we're trying to explore is whether the regulatory mechanisms are so out of kilter with what we need to be doing. You know, is Ofgem failing in its duty to ensure that we have the best possible situation? Because at the moment, we're just littered with private monopolies who have little incentive to bring down prices.

[232] **Mr Ling:** Yes, and like I mentioned earlier with the EV charging points, there are more private companies coming with different ways of doing it.

[233] **Mark Reckless:** I'll bring in Huw, I think, on this point.

[234] **Huw Irranca-Davies:** Yes, it's tangential to this. We're already aware



with new housing developments of scale that, in the water sector, there have been innovations where, in essence, bespoke packages of water and sewerage have been provided. And sometimes that's a great solution, but sometimes consumers at the end of it get to realise, as the years tick by, they've been sold a pup. If you have this estate-based approach, which could include estates with a school or a medical centre, or whatever, all buying into it, and then five years, 10 years down the line they realise that, actually, the estate next door is doing a hell of a lot better than them in terms of affordability and reliability of their energy supply and storage, who carries the can?

[235] **Mr Ling:** The solution company that have specified that system for that location. People will do it, and there are companies out there that are trying to do it, and if it is mapped out properly it will work. If it doesn't work, again, it's not that one person in the house that's £6,000 out of pocket because their system isn't working. It's a centralised system that is fed from all sorts of different areas, all sorts of different supplies, and, again, in that community-based location, you'll have people who are extremely energy-efficient and you'll have other guys who are running welders all night long and incurring much larger costs. But so long as everything is metered, then everything is reportable.

[236] **Huw Irranca-Davies:** What is the regulatory structure of consumer protection that overlies this at the moment?

[237] **Mr Farr:** Absolutely none. There is absolutely none, and this is what—. And I think the solar market may just about possibly have got away with being fully tarred with the double glazing reputation, but only just—and it has in certain areas—and they'd all jumped on the fact of, 'Let's sell batteries. For all these people who've got PV, batteries make sense', and this is what is driving it—the misselling is actually driving consumers to consider batteries.

[238] **Jenny Rathbone:** Isn't that surely a role for Ofgem?

[239] **Mr Farr:** Yes.

[240] **Jenny Rathbone:** It's their job, surely, to prevent this, isn't it?

[241] **Mr Farr:** But they're not doing—. There's no—. With solar, they develop RECC, and HIES and that sort of stuff, and they say, 'Well, if you're selling

solar PV,' and it's under a scheme, so they could do it, 'you have to abide by these certain things'. It is all bark and no bite; they didn't actually show any teeth at any point, but they need something like that for batteries, but they only really need to do that if you give some sort of scheme to it. Otherwise, there's nothing to really protect them. So, is a very difficult market at the moment, and it is going to have—. Batteries are going to get a bad name shortly, because there are going to be consumers in the next year or two going, 'I got battery; it's not worth while', and that is going to become the general, sort of, thought process, I think, a lot across batteries over the coming years, unless you get hold of it.

[242] **Huw Irranca-Davies:** But my point was not purely in terms of individual purchase of batteries and whether it's the right applicable technology for a particular setting or not. It's more to do with the advice, very much the field that you're in. What regulatory structure overlaps the good advice that's given that has a good outcome down the line, or, frankly, poor advisers—and I've seen this in some sectors with the water industry, where 200, 300 houses find that they don't have either the service or the costs that they were told, but they don't realise it until seven or eight years down the line? What's the regulatory structure overlapping the advice that's given?

[243] **Mr Farr:** On the storage or the PV?

[244] **Huw Irranca-Davies:** On the solutions.

[245] **Mr Farr:** On the solutions. Not a lot.

[246] **Huw Irranca-Davies:** That's quite fascinating.

[247] **Mr Farr:** Not a lot.

[248] **Huw Irranca-Davies:** Okay. Sorry, Chair, I didn't, you know—.

[249] **Mark Reckless:** Can I bring in Vikki and then Jayne?

[250] **Vikki Howells:** Thank you. Based on everything that you've said so far, I'm just wondering whether you feel that Wales has the necessary skill set to be able to really start looking and planning for energy storage, or is that something that we need to be looking at in the long term and trying to upskill some people?

[251] **Ms Edge:** That's a difficult question, because I don't know what skill set Wales has, but I would imagine that you do. I mean, at the moment, you'd be engaging network specialists, and you have a lot of district network operators in Wales, so you would just engage them to work along the same lines as the bay's call-for-evidence plan sets out. So, I imagine that, yes, you do have the skill set.

[252] **Mr Ling:** We struggle quite hard for correctly skilled people, but I think everybody does outside of the west coast of America. But, that said, you know, the answer to that is: is it to make a battery storage academy in Wales and try and catch up, or is it to simply look at what you can gain from other people's successes?

[253] **Vikki Howells:** Are you able to train people up in-house? You know, so that could tie in perhaps to the apprenticeship agenda within Wales, then.

[254] **Mr Ling:** Yes. So, we look for lots of transferable skills that we can use as a baseline to then go on to energy storage—so, electricians, electronics specialists, mechanics sometimes. We've managed to do what we've managed to do by borrowing information from lots of other places and by using consultancies from California.

[255] **Mr Farr:** I think there's a lot of skill in Wales. There's loads of skill in Wales. I think that's undersold, sort of; there are loads of skilled people in Wales, and when you take—. I know, I believe the Welsh Government have put a lot of money into it—a specific research centre—and the skill that's in that is enormous, and it seems like, if you're wanting to investigate batteries more, it's to commission those sorts of research centres that are independent and you're dealing closely with already, and say, 'Let's do a study, let's see if it's worth while'. I know they're building a battery test centre in their shared development to trial different batteries. They're keen to do all this and the skill is there—they're there, they're advising us. I think we should also try and learn, like Andy said, from other countries. Germany—we'll always tend to be a few years behind Germany on many things, especially with solar, and with batteries we're now behind them as well. They have a similar climate to us in lots of areas, so let's go over there and see what they're doing that actually works and how would it affect us. Or, we do it ourselves here and make our own mistakes, but they've probably made those mistakes, so let's go learn from theirs. It just seems to make the most sense to go and learn from them.

[256] **Ms Edge:** I think it would be worth while also to have a look at what SPECIFIC in Swansea are doing and to actually integrate a lot of these technologies into buildings. So, if you're looking at new builds, then that would be a really good option. If you're doing retrofitting, that's a slightly different skill set. But certainly, what Cardiff and SPECIFIC have done on that solar house is a fantastic project and they've found that that's actually cost effective and carbon zero.

[257] **Mr Farr:** The SOLCER house they've done with batteries in, so they've obviously been testing it on that house. Chris Williams, the professor there—we fitted batteries in his house, because he's had PV off us and he was looking at different batteries in his house. So, there's plenty of skill there to get some studies done from them. They would love to do it; that's all they're about.

[258] **Mark Reckless:** Jayne.

[259] **Jayne Bryant:** I think you've answered one of my questions around cost and transport and what role that can play. But you just mentioned we're playing catch-up. Do you think there's any chance that we can be world leaders in energy—capturing the market leaders in energy storage? Or is that just—are we so far off that?

[260] **Ms Edge:** I think the perception is that we are world leaders, certainly in the research area, because many of the technologies that people are using are actually UK technologies. We have some of the top battery researchers in the world and also we're looking at so many different types of energy storage technology—liquid air, compressed air, et cetera. So, we are world leading already, I'd say. It's just a matter of now actually installing those and making sure they actually come to market.

[261] **Mr Ling:** To make the switch from trying to be world leaders in five years' time to being world leaders right now would be where I am on want it. Otherwise, you're just going to keep trying to be—

[262] **Jayne Bryant:** Keep catching up.

[263] **Mr Ling:** Yes, keep going.

[264] **Jayne Bryant:** Thanks.

[265] **Mark Reckless:** Does any Member have any final questions to the panel? Thank you all very, very much for coming in and joining us today.

[266] **Mr Farr:** Thank you for having us.

[267] **Ms Edge:** Thank you.

[268] **Mr Ling:** Thank you.

12:27

### **Papurau i'w Nodi Papers to Note**

[269] **Mark Reckless:** Can I ask the committee to note one paper we've had come in—a letter from Peter Mackintosh of Newport council? We've basically fired off a letter to five Cabinet Secretaries we thought had relevant interest around air quality and also to Caerphilly council and Aneurin Bevan health board. We've got that back from Newport. I think it's probably more sensible to think about the letters in the round once they've come in, rather than have any detailed discussion, but I just wanted to ask Members to note that.

12:28

### **Cynnig o dan Reol Sefydlog 17.42 i Benderfynu Gwahardd y Cyhoedd o'r Cyfarfod Hwn ar gyfer Eitem 8 ac o Gyfarfodydd y Pwyllgor ar 15 Chwefror ac 8 Mawrth**

### **Motion under Standing Order 17.42 to Resolve to Exclude the Public from Item 8 of this Meeting and the Committee's meetings on 15 February and 8 March**

*Cynnig:*

*Motion:*

*bod y pwyllgor yn penderfynu that the committee resolves to gwahardd y cyhoedd o weddill y exclude the public from the cyfarfod ac o'r cyfarfodydd ar 15 remainder of the meeting and from Chwefror ac 8 Mawrth yn unol â the meetings on 15 February and 8 Rheol Sefydlog 17.42.*

*March in accordance with Standing Order 17.42.*

*Cynigiwyd y cynnig.*

*Motion moved.*

[270] **Mark Reckless:** Can I also move at this point a motion under Standing Order 17.42 to go into private session? I'd just like to give a bit of explanation around this because it's quite an extensive motion. I want to propose going into private session for the remainder of this meeting but also for the meetings on 15 February and on 8 March, unless George Eustice tells us he's coming to either of those meetings, in which case we would have that in public session. The reasons for wanting to go into private session for this extensive period is, on 15 February, we want to discuss the key principles of our post-Brexit agriculture and rural development report and for us to give staff a further steer on the drafting of that report. We also hope to have a draft report on the snares work that we did earlier. The following week is recess. The committee then has a visit to Milford Haven. Then, on 8 March, we are proposing to look at the written evidence we've received on the marine protected areas and who we may want to invite to give evidence in light of that, and we may do further work on agriculture and rural development post Brexit. I'm also hoping to have a discussion on the key issues around TB and see if the committee can come to a view as to what we would like to say on some key points in that area. So, broadly, that's the agenda I'm setting out. I'd just like to put on the record why I'm proposing the motion to go into private session for more of an extended period than would be usual. Can I just asked if that's agreed by the committee?

[271] **Simon Thomas:** Cytuno.

[272] **Simon Thomas:** Agreed.

[273] **Mark Reckless:** Excellent. Thank you very much.

*Derbyniwyd y cynnig.*

*Motion agreed.*

*Daeth rhan gyhoeddus y cyfarfod i ben am 12:30.*

*The public part of the meeting ended at 12:30.*