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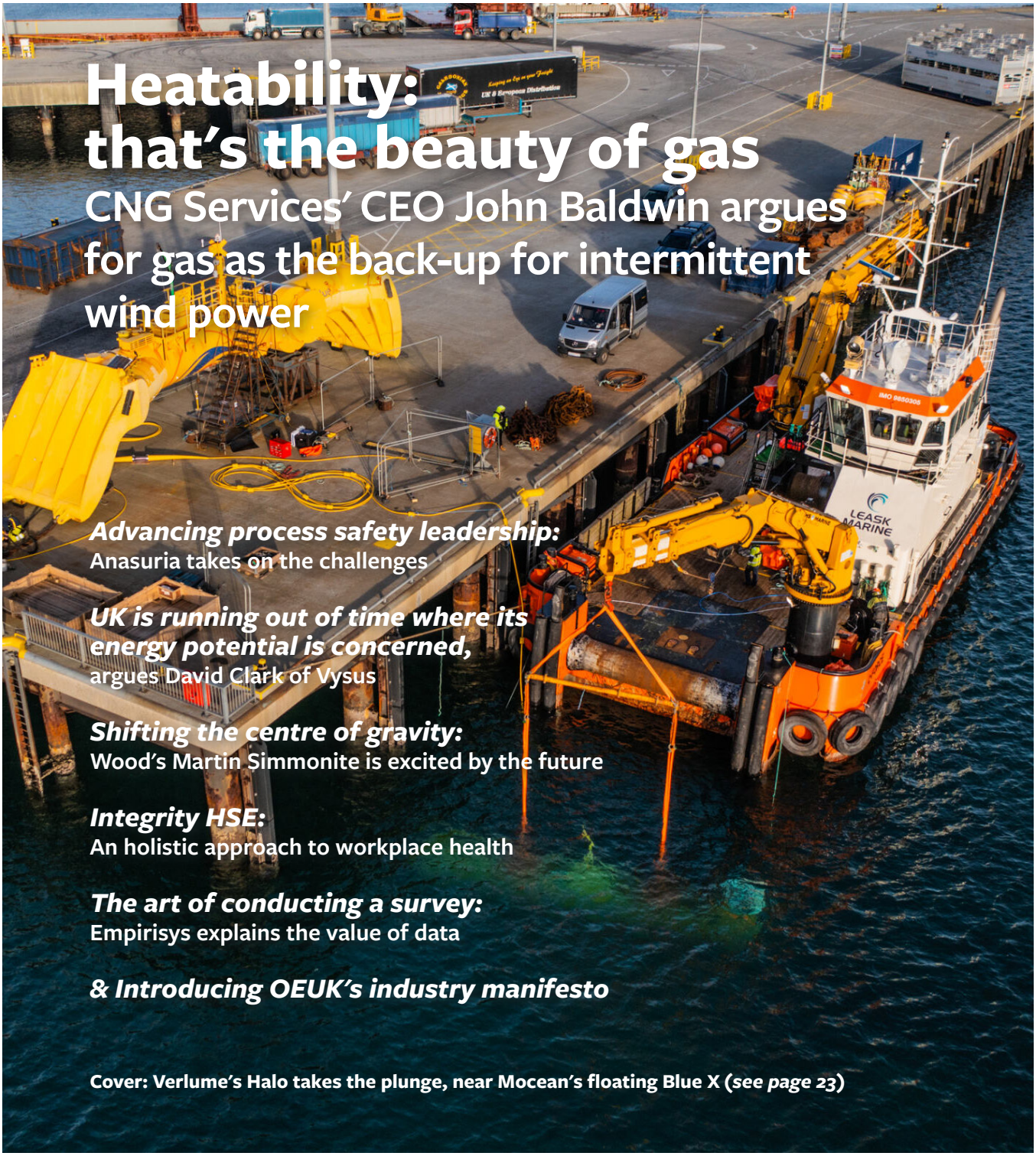

Heatability: that's the beauty of gas

CNG Services' CEO John Baldwin argues for gas as the back-up for intermittent wind power

Advancing process safety leadership:
Anasuria takes on the challenges

UK is running out of time where its energy potential is concerned,
argues David Clark of Vysus

Shifting the centre of gravity:
Wood's Martin Simmonite is excited by the future

Integrity HSE:
An holistic approach to workplace health

The art of conducting a survey:
Empirisys explains the value of data

& Introducing OEUK's industry manifesto

Cover: Verlume's Halo takes the plunge, near Mocean's floating Blue X (*see page 23*)

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Guest column

Heatability – that's the beauty of gas

Grid decarbonisation has become a polarised debate. But using green gas solves two problems: power grid capacity and carbon, writes CNG Services' CEO John Baldwin.

My professional interest in gas as a fuel goes back a long way, but most relevant is the time spent from 2011 onwards trying to help would-be shale gas developers make progress in Lancashire.

My view was that gas should be produced and taxed to fund good stuff: I had a plan for heat pumps and home refurbishment in Blackpool. But we did not do that and UK industry is now heading to Texas; fertiliser manufacturing has already gone; and now the energy culture wars have stopped any sensible debate.

These wars extend to the electricity versus hydrogen argument with such things as "time to decommission the gas grid."

The problem has been presented as a binary choice that we will decide in 2026 – should we electrify everything; or should we have a hydrogen grid?

Energy is complicated and decarbonising an economy burning over 800 TWh/yr of gas is difficult, especially when there are occasionally very cold and still winter days (known as the Dunkelflaute: dark doldrums).

The reality is that, in a democratic society with private housing, few politicians will want to ban gas central heating in existing homes. Cold is deadlier than heat. And there are no examples of villages or districts being moved off the gas grid. There is however, an overlooked hybrid option that breaks free of culture wars. In 2012, I spoke at a (shale gas) conference and said that the UK strategy for electricity was gas, but that we should generate as much electricity as possible from nuclear, biomass, wind, solar and have demand side response and interconnectors in order to burn less gas. And so it has turned out: the UK is using progressively less gas to produce electricity as renewable output has risen.

But some gas will still be burnt. The Hydrogen Business Model assumes factories go from 100% gas to 95% hydrogen with gas back-up. And gas will be used in back-up generation plants. Some of these on the low-pressure gas grid have capacity market payments (from the Electricity Supply Operator) into the 2040s.

By 2035, these gas engines might only operate infrequently and during the Dunkelflaute, if there were no back-up gas, we would have consumers with no heat. And industrial, commercial and domestic customers who cannot (or do not want to) move to electricity alone will also depend on gas. But what gas?

The Climate Change Committee (CCC) is now working towards its Seventh Budget next year and I am focusing on promoting the family of green gases, including biomethane and hydrogen, as a credible and attractive option for helping the UK meet its net zero target by 2050.

A total gas demand of 200 – 300 TWh/yr in 2050 is likely for all the above reasons and green gases is the obvious source of this. By 2035 we can reach 100 TWh/yr of green gas if we apply ourselves now.

Denmark and France are already showing what can be done with biomethane. Now there is E-methane (made from wind and bio-CO_2) and bio-synthetic natural gas (made by gasifying waste and converting the syngas to methane). There is also great potential to import biomethane by pipeline from Ukraine or as part of GB 's imported LNG cargoes.

Biomethane plants produce liquid bio-CO_2. The catalyst for the next generation of biomethane projects is carbon capture and storage (CCS) capacity. One such company, Future Biogas, uses crops for energy in its Carbon Harvest model. This keeps soil healthy through crop rotation and also captures bio-CO_2 from the biomethane production process and sends it to CCS sites such as Northern Lights in Norway or Acorn and Hynet in GB. This is transformational and this industry should be locking away 5mn tonnes/year of CO_2 by 2035. The challenge for the Association for Renewable Energy & Clean Technology (REA) is to work up credible annual TWh/yr production levels for all these categories of green gas and submit it to the CCC in 2024. Then it can inform the drafting of the Seventh

Carbon Budget in 2025. The key driver for the CCC in deciding how to allocate resources and incentives is the cost per tonne of cutting emissions.

Meeting peak, not average, demand

The gas industry has a design standard for pipeline capacity: the transporter's licence requires enough to meet demand on the coldest day that could occur over a 20-year period. For their part, suppliers must be able to meet gas demand in a one-in-50 year. The difficulty with a Dunkelflaute is its unpredictability, in that such a winter might never turn up – or it could be next year.

To eliminate the risk of blackouts, there will have to be a Dunkelflaute Standard for Electricity System design. This could involve the lowest wind strength seen in January-February in NW Europe over a 50-year period combined with low temperatures. And if it comes, it will need molecules to generate power.

Using today's gas grid, generation plant and storage capacity makes green gases a relatively low-cost option if we can secure enough of them. As an alternative, you can use pure hydrogen; but for that, there will have to be a vast investment in hydrogen pipelines, centrifugal compressors, salt cavity storage (with very big gas reciprocating compressors) hydrogen pressure reduction stations and hydrogen generation plant.

All these hydrogen assets are technically difficult, but the main issue is that all this expensive plant will hardly ever be used – except for testing once a month to satisfy the regulator.

If the Dunkelflaute occurs just 2% of the time over 30 years, it would be a huge amount of capex and opex for such little up-time. It would be like having Mo Salah on the bench and only playing him a match every season.

Electricity consumers may therefore want to keep most of the gas grid intact as the lowest-cost back-up option, along with the existing gas storage, LNG import terminals and gas-fired generation.

"It would be like having Mo Salah on the bench and only playing him a match every season:" a sports equivalent of using hydrogen as back-up

It may be feasible for some low-pressure gas networks to be completely replaced with heat pumps or district heating but most may remain. There is already 10 GW of back-up gas generation (and CHP) on the distribution networks in the form of low-maintenance and low-opex reciprocating gas engines. The UK could secure a large resource of renewable gases (including biomethane) that would allow a low-cost Dunkelflaute solution as part of the 200 TWh/yr green gas market.

A green gas grid also helps overcome congestion

as electric vehicles and heat pumps compete for connections to the already straining electricity grid.

It is not clear that CCC and the National Infrastructure Commission have fully appreciated the incredible benefit of CCS alongside biomethane. The old plateau number of 10 TWh/yr looks far too small.

Biogas from anaerobic digesters (AD) will supply around 8 TWh/yr in 2024.

Around 19 TWh of biogas is burnt in combined heat and power plants (CHP) and over three quarters of this should be upgraded to biomethane and injected into the gas grid. The UK can aim for 30 TWh/yr by 2035 from projects with at least 50% waste.

Eventually all bio-CO2 can be captured from these AD plants. It can be sequestered or it can react with hydrogen to make methane: 5mn tonnes/yr of it could be blended with hydrogen to make around 10 TWh/yr of CH4. AD plants also produce valuable organic fertiliser.

In addition to AD plants, we expect to see green hydrogen produced and injected into the national transmission system starting in 2025 with a volumetric target of 5% by 2035. This indicates around 10 TWh/yr. The gas grid is a key asset for hydrogen, just as it is for other green gases. Relatively abundant green gas also opens up new opportunities for decarbonising.

Using bio-CNG at distilleries in the Highlands, replacing heavy oil, also shows how off-grid energy consumers can reduce their carbon footprint. Other options include off--road vehicles and the 44-tonne trucks sector such as Scania and Iveco which is perfect for bio-CNG but not suited to H2 or electric vehicles.In summary, the growth of offshore wind and solar makes CH4 molecules essential for keeping the lights on during the Dunkelflaute: there is no economic Plan B for electricity consumers. The family of green gases presents an unbeatable option to use existing infrastructure and must play a major role in the Seventh Carbon Budget.

Interim total by 2035	**TWh/yr**
Existing biomethane (7 TWh/yr) plus food waste, sewage, manures etc	30
Grass, as per Ecotricity	10
Future biogas carbon harvest	10
Liquid biomethane imports	20
Ukraine via pipeline	10
Bio-synthetic gas from woody waste	10
E-CH4 from green H_2 and bio-CO_2	10
Green H_2 into the national transmission system	10
Direct air capture at St Fergus, removing $C0_2$ from unabated gas	10
Total	**120**

Source: CNG Services

Indicative demand for gas in 2050	**TWh/yr**
Dunkelflaute: low load factor back up for when wind/solar are down	50
10% back-up for industrial consumers on green H_2	20
I&C customers with no good electricity/ H_2 option	30
District heating support	10
Domestic customers with hybrid system	30
Trucks and other vehicles with no good EV/H_2 option	50
Sustainable aviation fuel	50
Total	**240**

Source: CNG Services

CNG Services Limited (CSL) provides consultancy, design and build services to the biomethane industry, focused on reducing greenhouse gas emissions. Our efforts over the last decade have produced a material impact, with an estimated 20-year project life reduction in CO2 emissions of 17.5mn tonnes. These have been achieved through a combination of: injecting biomethane into the gas grid; bio-CNG instead of diesel trucks; and developing, designing and building the Highlands CNG Project, decarbonising distilleries. CSL also worked on the Network Code modification to enable reverse compression from the low to high-pressure networks to create more capacity for biomethane injection. CSL is an ISO 9001, 14001 and 45001 approved company and has been certified as a competent design organisation for high pressure UK onshore natural gas pipeline work by DNV GL.