The illustration depicts a thorny rose branch with several green leaves and a large, purple rose bud. The background is a light, textured yellow and white. The text is centered on the page in a brown, serif font.

*THE WORM*  
*IN*

*THE ROSE*

Gwythian Prins

N  
ZW

# The Worm in the Rose

Gwythian Prins

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## About the author

Professor Gwythian Prins is Research Professor Emeritus at the LSE where he directed the Mackinder Programme. He is a member of the Academic Advisory Council of the Global Warming Policy Foundation. He was Convenor of the Hartwell Group on Climate Change and Energy 2007–19, co-author with the late Professor Steve Rayner of two seminal papers 'The Wrong Trousers' and 'Time to Ditch Kyoto' (2007) and lead author notably of 'The Hartwell Paper' (2010) and 'The Vital Spark: Innovating Clean and Affordable Energy for All' (2013). Before that he was the first security consultant to the Hadley Centre for Climate Prediction & Research at the Meteorological Office loaned by the Defence Evaluation & Research Agency of the MoD (1999–2001), and afterwards a member of the Chief of the Defence Staff's Strategy Advisory Panel. During his early career he was a Fellow in History and University Lecturer in Politics at the University of Cambridge. He wishes to acknowledge the indispensable assistance of Dr John Constable, Director of the Renewable Energy Foundation, in the preparation of this paper and the invaluable peer-review comments of others, while absolving them all from any errors or omissions. Only the author should be held accountable for the judgements that appear in this paper.

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## The SICK ROSE

O Rose thou art sick.  
The invisible worm,  
That flies in the night  
In the howling storm:  
Has found out thy bed  
Of crimson joy:  
And his dark secret love  
Does thy life destroy.

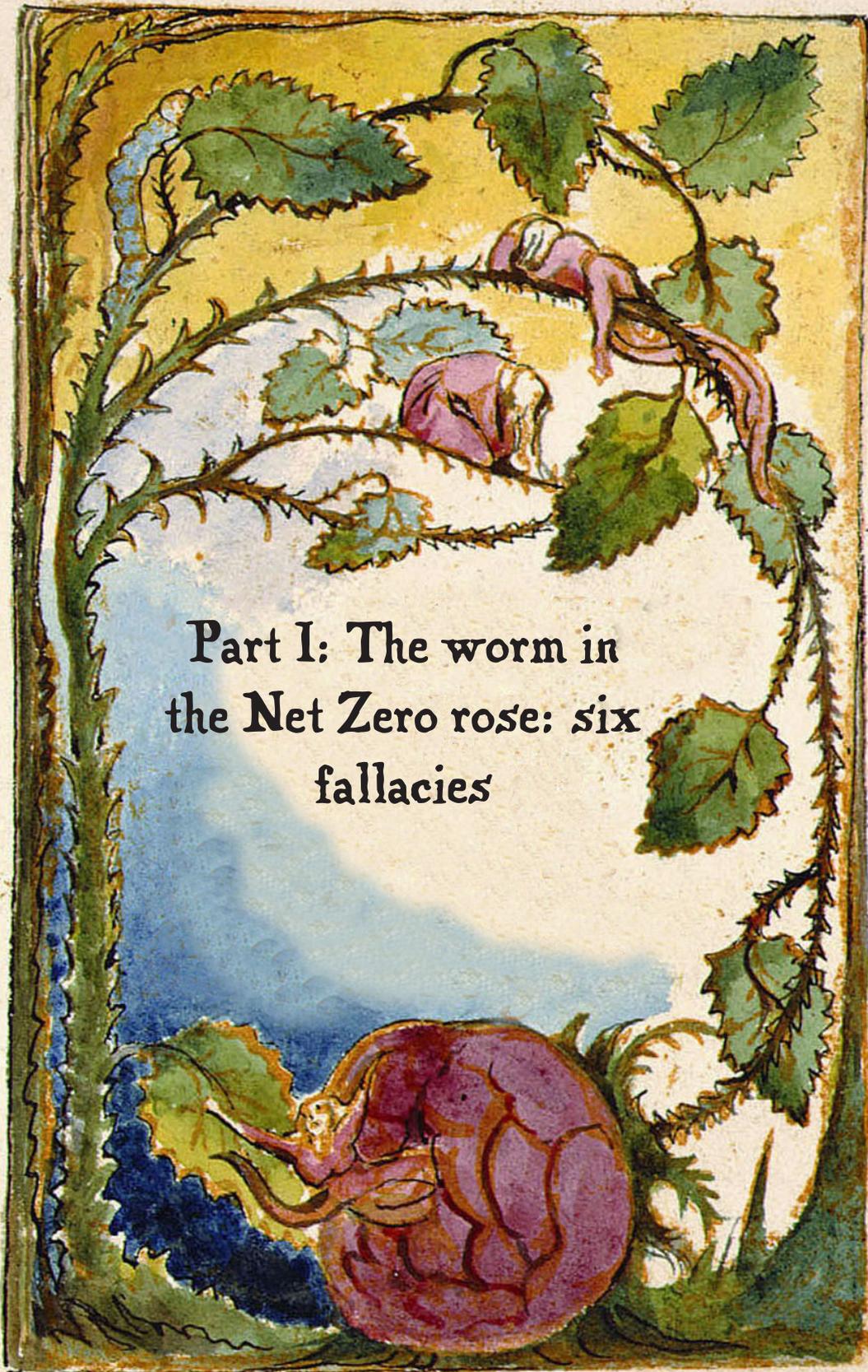
## Summary of main points

- 'Green growth' is vitiated by six key fallacies. The pursuit of a 'green energy transition' is the first: there has not been and is not now such a transition. 'Modern renewables' (wind/solar/geothermal/tidal/biomass for heat and electricity) were 2% of world total primary energy in 2018, so wind and solar are even less than that. All renewables (old and modern) were 13% of world total primary energy in 1971 and 13.8% in 2018. These percentages are stuck, for good reasons, explained in this paper.
- The Free World is attempting to force a back-to-front energy transition, which has no historical precedent. All previous transitions have been from low-quality to high-quality, from high- to low-entropy, from disordered to ordered sources of energy.
- 'Net Zero' is a 'Veblen good' – consumed for purposes of conspicuous consumption – doing self-harm to the Free World's international competitiveness, because energy is not an optional variable but integral to the health of any economy. Virtue signalling is not cost free.
- However, executive powers in market economies are resorting to market distortion, by legal fiat and by all manner of taxpayer-provided subsidy, to force forward their preferred environmentally and economically flawed so-called 'green' technologies, which try and fail to extract reliable power from thin flows of high-entropy fuels and which do not offer goods or services that people wish freely to adopt and buy.
- The key market signal when environmental impact and sustainability are at issue is EROEI (energy return on energy invested). However, it is little used because it is shockingly bad or even negative for renewables.
- Renewables often have worse full-cycle environmental costs worse than fossil fuels, which have, in the free market, delivered spontaneous decarbonisation of around 1.3% per year since 1800. 'Market failure' is a risky and arrogant concept. Stop meddling.
- There is a security imperative too. We are in a darkening geo-political environment: Xi Jinping's Chinese Communist command group – which is not to be equated with all Chinese people – has launched a 'grey war' against us. Supporting and facilitating the Free World's distractions with 'Net Zero', and promoting the wish-lists of the International Energy Agency and United Nations, helps that group to undermine us.
- Evidence points to China having no belief in nor intention of adopting the decarbonisation agenda. They will supply us with the means to adopt dead-end technologies such as BEVs (battery electric vehicles), but will concentrate on more reliable ones at home. They are playing us for fools.
- China is eagerly acquiring our key strategic technologies including, critically, geostrategically important motive power technologies, such as advanced diesels and jet engines. Thereby it seeks to supplant the West's dominance of the world order. 'Net Zero' is self-destructive of that dominance.
- COP26 is set to fail like all 25 predecessors. The BRICS nations have already rejected the Net Zero agenda. Yet a golden bridge exists, which reconciles economic growth, environmental stewardship, and the security of the Free World. Crossing it will take us to the high-energy, low-pollution future that will be freely chosen in open markets and hence spontaneously adopted. It is a gas bridge to new types of nuclear power.

**'Energy is eternal delight'**

WILLIAM BLAKE<sup>1</sup>





Part I: The worm in  
the Net Zero rose: six  
fallacies

## **Green growth, Veblen goods and the pursuit of the impossible**

Over the last two decades, the West has committed itself wholeheartedly to two surprising plans. The first is to 'build back better' and – a crucial qualifier – 'greener'. The second is to attain 'Net Zero' carbon dioxide emissions via a wholesale energy transition. The welcome given in the summer of 2021 by the British government to Nissan's decision to build a new lithium-ion battery production facility in Sunderland, or Vauxhall's ditching of the popular Astra family car and – with £30m taxpayer subsidy – going into electric vans instead, may serve as specific symbols of this general ambition.

Both these plans are to be delivered via top-down targets and timetables, and will have implications for every nook and cranny of the economy: nothing will be left untouched. Yet they represent a triumph of hope over experience, for neither will work, and both will do much harm in their failing, starting with abrasion of the fragile prerequisite of public trust in government, at a time when it is already badly frayed. They will not work because so-called 'green' investments cannot achieve spontaneous growth in a free market, because they do not deliver goods or services that people actually want. Therefore, there are subsidies to build and subsidies to buy, all paid for involuntarily with our money as taxpayers or consumers.

Windfarms are a case in point. The cost of subsidies, added to electricity bills to push forward new renewables in the UK, against popular surliness and market resistance, is now £12 billion per year and rising. Stagnant, possibly rising, wind capex, definitely rising opex and network costs<sup>2</sup> and the like are not reported in headlines. Entirely in line with a 2020 analysis of the accounts of wind power operators,<sup>3</sup> a report from Scottish & Southern Electricity in July 2021 stated that most windfarms in Britain will not be economically viable when existing subsidies end, and will close. It therefore pleaded for more revenue support.<sup>4</sup>

The British government has had great hopes of new, privately financed wind capacity taking over from the subsidy-dependent industry which has been built to date. That hope is in vain, for another report claims that fully merchant (unsubsidised) onshore wind is 'unviable and will not lead to mass capacity' because it is not financially worthwhile for investors.<sup>5</sup> Only 7% of 258 wind industry leaders questioned considered a fully merchant onshore wind project to be financially viable.

So, when the subsidy tap is turned off, the expensive distraction of renewables will crumble away as quickly as it came. Of course, there will be serial bankruptcies among speculators. They have only themselves to blame – they have forgotten the old rule that if it looks too good to be true it probably is. But on the positive side, shipyards will be able to return from building white elephants to building ships: Scottish firms that switched

in good faith from supporting North Sea oil and gas operations to supporting the construction of wind turbines now stand empty, because state-supported Chinese manufacturers have driven them out of business. The Scottish National Party's promised green jobs boom has evaporated because there was no level playing field. The story is the same across northern Europe.

One must wonder, therefore, why on earth the British government – and governments across the Free World – are pursuing this course? Preferring these costly goods and services that deliver imperfectly over cheaper ones that work better, marks them out as subject to a Veblen effect.<sup>6</sup>

A Veblen good is a type of luxury good or service where demand increases as the price increases – in violation of the law of demand – because ownership permits 'conspicuous consumption' of some quality that is especially prized. With supporters of 'green growth', that quality is a 'virtue signal', enabling them to demonstrate moral superiority over people they view as benighted and less qualified, to instruct them in 'better ways', and generally to ignore criticism. Virtue signallers are like Plato's Guardians.

However, 'green growth' is more complex than just a Veblen effect, because there is a worm at work deep in the heart of the 'Net Zero' rose, riddling it with fallacies. Six, in fact.

## **Fallacy One: There is a 'green' energy transition**

To be sure, there have been many energy transitions in human history.<sup>7</sup> Yet never has there been one such as is now being attempted. This experiment is new: it only started in earnest at the turn of the millennium. It is doomed to fail.

Vaclav Smil, the pre-eminent historian of energy, has documented those past transitions, which all have a common feature, certainly since the introduction of agriculture. All have been from inferior to superior fuels, from fuels of higher to lower entropy, from more chaotic to more ordered sources of energy, from the diffuse flows of wind, biomass and water, to the unusually dense stocks of coal, oil, gas and uranium (Figure 1). Thus, all these transitions have been in the opposite direction to the one that is now being attempted. Therefore, current 'green' policies, which bet on wind and solar generators, are nothing if not ambitious, for they are no less than an attempt to reverse the entire course of the last five hundred years of humanity's relationship with energy.

It is now well established that attempting this reversal has the effect of driving 'firm power' – constant, controllable power with inertia\* – off electricity grids, rendering them fragile.<sup>8</sup> It makes electricity less abundant, and progressively much more

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\* *Rotational inertia* refers to the kinetic energy stored in the turning mass of shafts and flywheels that is instantly available to be translated into another form, such as electricity via a generator, or motion via the wheels of a car.

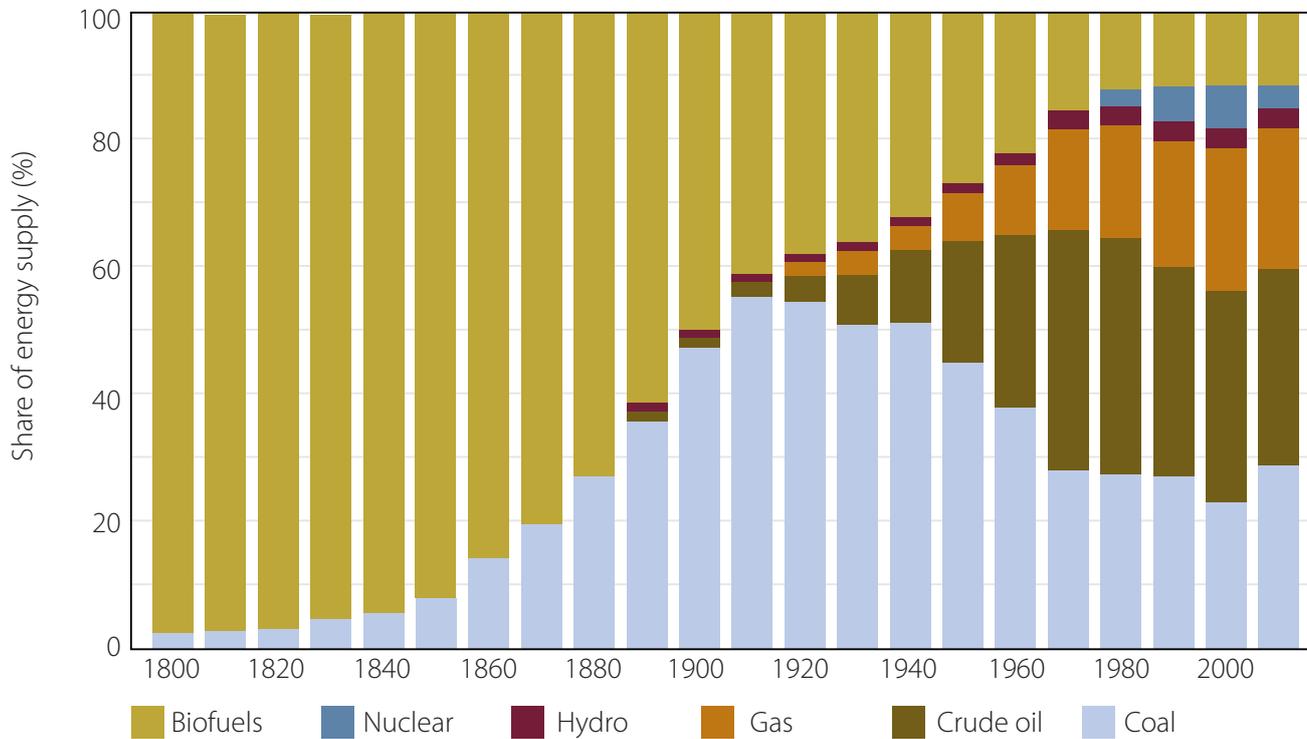


Figure 1: Energy transitions since 1800

Source: Smil, *Energy Transitions*.<sup>7</sup>

expensive to consumers, at exactly the same time that they are being told to electrify their homes and vehicles. These twin political ambitions are therefore in an inescapable, flat contradiction.

The contrast with the twentieth century experience in Great Britain is striking. Despite two world wars, the inflation-adjusted cost of electricity fell continuously to a low in 1973; and even as it began to rise, by 1980 was still not above the 1948 price. The major improvements – both in size and in thermal efficiency – of turbo-generators in the 1950s and 60s overseen by F.H.S. (Stanley) Brown, the chief generation design engineer of the Central Electricity Generating Board (CEGB), led all Europe, and stood the British grid in good stead for a generation. Then the ‘dash for gas’ in the 1990s compensated for the mishandling of the first nuclear programme. Meanwhile, the CEGB’s ‘merit order’ (long since abandoned and made impossible in a politically constrained market), rationally prioritised least-cost baseload generators, and led to a grid that was stable through thick and thin. This legacy stood until the turn of the millennium.<sup>9</sup>

‘New renewables’ are insignificant in the global energy mix, but hugely disruptive when policy-driven to high levels of market penetration. There have been many examples of power failures in places that have taken a lead in renewables, for example, in South Australia on 28 September 2016,<sup>10</sup> in the UK on 9 August 2019,<sup>11</sup> and in Texas between 1 and 5 February 2021. In the first two cases, the blackouts were shown beyond reasonable doubt to have been caused principally by the fragility of

too much renewable generation in the mix, although attempts were made to deny it. In the Texas case, failure of renewables was a contributory factor, alongside a failure to winterise the gas supply system and the fact that ERCOT, the Texas grid operator, has no interstate interconnectors.<sup>12</sup> These episodes demonstrated that more than nominal wind and solar with ‘mandated priority in dispatch’ – meaning that the grid is obliged to use it when it is there, in preference to any other source, and regardless of market logic – makes grids extremely fragile and difficult to run without failures, and condemns them to have very high operating costs. They are harbingers of what is to come if there is not a radical change of direction. Therefore, why would one choose to ignore such lessons, make such choices, and go backwards in this way?

With a virtual political unanimity in the Free World, uncontrollable thin-flow energy sources converted into usable electric power by wind turbines or solar cells, are presented to the public as a positive benefit, because they are said to be the drivers of the next great energy transition. Yet for good scientific and economic reasons, it is an inconvenient truth that globally there is no ‘green energy transition’ occurring; nor has there ever been. The Emperor wears no clothes. This is the first and fundamental fallacy of ‘green growth’: and if the energy transition is an illusion, then so too will be everything predicated upon it. It is here that we begin to see the worm at work in the rose of ‘Net Zero’.

All ‘renewables’ (old and modern) were 13% of world total primary energy<sup>†</sup> in 1971. They were 13.8% in 2018, of which ‘modern renewables’ viz wind/solar/geothermal/tidal/biomass for heat and for electricity – therefore generously calculated – amounted to 2%. In other words, the particularly favoured modalities of wind and solar were less than 2%; despite being supported by some of the most costly and *dirigiste* coercions ever attempted in any economy in history. It’s a fact.

These figures beg for an explanation. Why are renewables stuck? The answer is that aggressive top-down coercion has not moved the markets, because the markets have nowhere to go. Why is that? Because ‘new renewables’ are thermodynamically incompetent. In other words, they affront the first two laws of thermodynamics.

## **Fallacy Two: Energy is like other commodities**

That real energy transitions only progress from high to low entropy fuels is not a new discovery, only a forgotten one.

The essential reasons why ‘green growth’, as currently envisaged, just won’t work were first stated in a short book that was published one hundred and fifty six years ago, in the middle of one of the most formative periods of creative thinking in natural and social science in modern times. These were years when

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<sup>†</sup> Primary energy is energy in its raw state – crude oil, coal, wind and so on – before losses in reformulation, transmission and conversion are subtracted.

a protean generation of mid-Victorians laid down the foundations of many intellectual disciplines upon which our civilisation still stands.

Those remarkable years opened with publication of Darwin's *Origin of Species* (evolutionary biology) and J.S. Mill's *On Liberty* (political philosophy) in 1859, followed two years later by Sir Henry Maine's *Ancient Law* (comparative legal philosophy). Four years after that came Walter Bagehot's serialisation of *The English Constitution* (1865–67), and ended with Sir Edward Burnett Tylor's *Primitive Culture* in 1871 (cultural and philosophical anthropology and the beginnings of psychology). In the middle, in 1865, came W. Stanley Jevons' *The Coal Question* in which he acknowledged his own great debt to J.S. Mill.<sup>13</sup> These innovative thinkers read each other.

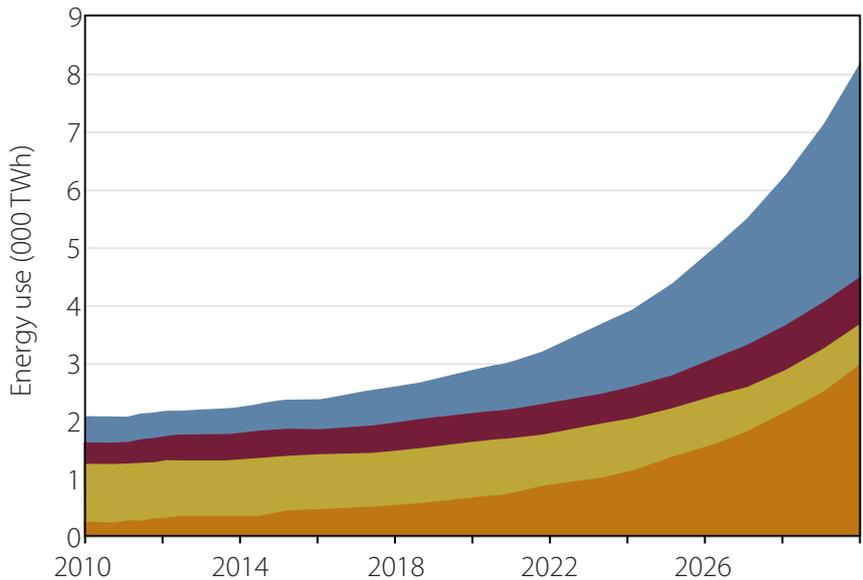
Less well known than its contemporaries, *The Coal Question* was Jevons' first book. In essential ways, it is still the foundation text for all modern comparative studies of ecological economics and energetics, since Jevons understood that the former is entirely dependent on the latter. This is something that modern proponents of 'green growth' have either forgotten or never knew. 'Green' thought leaders, such as Mark Carney and Adair Turner, behave and write as if energy is just like any other variable. This is a second major fallacy. The truth is that if the energy system is wrecked, inescapably the economy is wrecked as well. All that we make and all that we do,<sup>14</sup> not only in manufacturing but in services too, embodies – renders – energy, and requires energy to bring it to life. Energy, as Blake wrote, is indeed 'eternal delight'.

Enthusiastic senders of emails and social media messages – including those using them as tools to aid protests about climate change – may believe that the internet behind their screens is saving energy in some way. However, although they travel through cyberspace rather than in planes or on trains, they stand in lineal descent from users of steam railways, ocean liners and jet aircraft as major energy users. The power demands of the internet's nodal data centres and of the information and communications technology backbone of the modern, advanced global economy may not be obvious to users, but they are enormous.<sup>15</sup> Together, in 2018, they were 2,200 TWh, or 10% of global electricity use (see Figure 2).

The implications of current and future information and communications technology (ICT) energy use have been examined by Mike Berners-Lee (brother of the inventor of the World Wide Web) and colleagues who are aware of Jevons' Paradox (see fallacy three). They conclude that ICT energy use will continue to grow exponentially, but that the emissions have been seriously underestimated because full-cycle costs have not been hitherto included. When these are taken into account, they suggest that total emissions for ICT may actually be 2.1–3.9% of global emissions, which is 25% above previous estimates – or up to twice the global emissions of civil aviation (2%), which self-righteous

Figure 2: The internet's rising demand for power

Source: Jones.<sup>15</sup>



green activists, obstructing runways and busy on their social media accounts, currently choose to demonise.<sup>16</sup>

Much ingenuity is, of course, being applied to improving the power usage efficiency of the new generation of data banks, called hyperscale-centres.<sup>17</sup> In Europe's major digital gateway, Amsterdam South<sup>18</sup>, astride the fibre-optic cable nodes that link Europe to North America, internet data centres also serve as *de facto* power stations for district heating schemes. But these are minor savings: service-led economies will remain very energy hungry.

Furthermore, although economies of scale can improve power usage efficiency in hyperscale-centres, this is not an unqualified benefit to society. Reducing the number of nodal installations increases the strategic vulnerability of the Free World's ICT infrastructure. ICT vulnerability is already a front-line security issue because of potential threats to subsea data cables. In June 2021, Russia commissioned the *Belgorod* (K-329), a gigantic Oscar 2 'special operations' nuclear submarine modified to carry a deep-diving daughter submarine capable of monitoring or cutting western ICT cables.<sup>19</sup> Russia is much less dependent on undersea cables than we are, and therefore is investing in the ability to threaten our communal 'nervous system'.

### Fallacy Three: Energy efficiency will bring nett reductions

The powering of global information technology provides an excellent illustration of Jevons' Paradox, the concept for which he is best known. It states that improving efficiency in the use of any energy source will result not in less consumption of that source, but in the very opposite. To self-confident eyes, it is a happy paradox, as Jevons explained:

...as a rule, new modes of economy will lead to an increase of consumption according to a principle recognised in many parallel instances...it is a familiar rule of finance that the reduction of taxes and tolls leads to increased gross and even nett revenues; and it is a maxim of trade, that a low rate of profits, with the multiplied business it begets, is more profitable than a small business at a very high rate of profit...No-one must suppose that coal [or any other dense stock of energy] thus saved is spared – it is only saved from one use to be employed in others and the profits gained soon lead to extended employment in many new forms.

In more everyday examples, money saved by improved efficiency in heating the home or running the family car will, in a free market, not lead to leaving coal, oil or gas in the ground. It will turn into more holidays in Ibiza, or more commodious homes and cars, or more whizzy electronic devices. More consumption is to be desired because more economic growth means more fundamentally valuable things: better health, longer life, better education, more interesting jobs, all of which rational voters desire and all of which low-entropy fuels have delivered.

The Paradox appears to be unknown to or ignored by 'green growth' proponents. Yet it knocks the legs out from under a key plank of emissions reductions plans. For example, the International Energy Agency (IEA)<sup>20</sup> banks on nett savings from efficiency gains to deliver an absolute reduction in the use of fuels. We know that the IEA's Head of Energy Efficiency does not understand the Paradox, because he describes energy efficiency as 'the first fuel'.<sup>21</sup> This fallacy makes it inevitable that the attempt to bring about a 'green' energy transition will be futile, and that it will damage people's standard of living, and potentially even fracture the very pattern of freedom, health and happiness that low-entropy fuels have made possible. It should be no surprise that the green agenda is not popular with those who are not wealthy or leisured or ideologically committed to the dogma.

Delving deeper, Jevons set out why transitions that have actually happened have always moved from higher to lower entropy – from thinner to denser forms of energy. He explained it as follows:

...material nature presents to us the aspect of one continuous waste of force and matter beyond our control. The power we employ in the greatest engine is but an infinitesimal portion withdrawn from the immeasurable expense of natural forces...The rude forces of nature are *too great for us as well as too slight* [emphasis added]...[for]...the first great requisite of motive power is that it shall be wholly at our command...Civilisation...is the economy of power [his emphasis], and consists in withdrawing and using our small fraction of force in a *happy mode and moment* [emphasis added].

Control of 'happy mode and moment' is the test which 'new renewables' cannot pass:

The wind, for instance, as a direct motive power, is wholly inapplicable to a system of machine labour, for during a calm season the whole business of the country would be thrown out of gear...no possible concentration of windmills...would supply the force required in large factories or iron works...Hence the gradual substitution of steam for sailing vessels...though steam is a most costly power, *it is certain* [emphasis added] and our sea captains are beginning to look upon wind as a noxious, disturbing influence.

In these mid-nineteenth-century words we read, foreshadowed, the 2021 discoveries of the German audit office, the *Bundesrechnungshof*.<sup>21</sup> In March 2021 it repeated, with heightened anxiety, its 2018 and 2019 warnings of the failure of the Merkel 'Energiewende', the forced energy transition that resulted from the Chancellor's precipitate decision to close German nuclear power stations after the Fukushima tsunami and incident of 2011. As in the UK equivalent, the *Energiewende* was all back to front, deploying politically visible wind turbines before the expensive – both financially and ecologically – but less visible networking and supply-smoothing infrastructure that the resulting lack of control of 'happy mode and moment' made vital. Germany is Europe's pre-eminent manufacturer, and manufacturing electricity costs were protected in the Merkel *Energiewende* as a political choice. As a result, 70% of German domestic electricity bills is now made up of policy, not power-production costs, making electricity a luxury product (*luxus ström*). The audit office has concluded that the *Energiewende* has put the German economy into serious jeopardy.

### **Fallacy Four: Renewables are cheaper than fossil fuels**

We also read in Jevons the dismissal of another frequently expressed fallacy, our fourth, which believes that it is surely common sense that 'new renewables' must be cheaper than fossil fuels, because the source fuel – wind or sunbeams – is actually free. Yet control of mode and moment is where the costs lie, and new renewables bring a lack of control of either. Paradoxically, therefore, renewables are expensive, in both environmental and economic terms.

Past energy transitions have occurred, and emissions reductions have been achieved, without government coercion. The metric which encapsulates the prime variables in energy transitions is energy return on energy invested (EROEI): the ratio between the energy delivered and the energy required to deliver it.

EROEI demands full-cycle energy measurement of a process

$$EROEI = \frac{\text{Energy delivered}}{\text{Energy required to deliver that energy}}$$

(or any complex institution, such as an empire<sup>22</sup>) from inception to disposal. It is directly related to power density, an important characteristic of a fuel, and one to which we will return later. One last quotation of Stanley Jevons makes this importance vivid: 'there is *spring* [his emphasis] enough in coal to raise a million times its own weight a foot high'.

In fact, EROEI asks the decisive question of any investment in a free market: does it wash its face? A new energy source that has a larger value for EROEI than existing ones is likely to be cheaper, and therefore adopted spontaneously in a free market. Improved EROEI is thus a characteristic of successful energy transitions. When EROEI turns negative, it is a sign of structural weaknesses that presage eventual collapse.

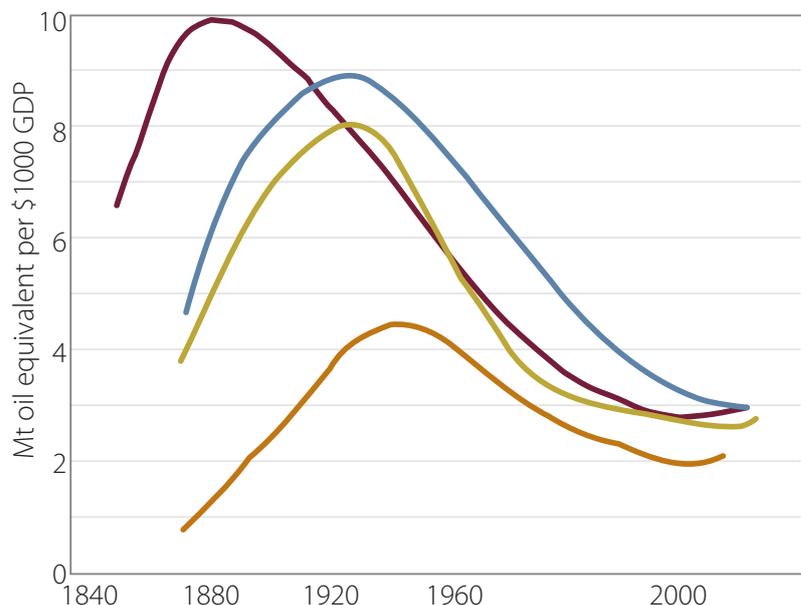
Figure 3 shows the energy intensity of an economy: the amount of energy used per unit of gross domestic product. The energy intensity curves are replicative and clear. Because of cumulative, learned innovation, the peaks are lower and earlier in the transition at each successive industrialisation. The back-slope, which shows the impact of innovation, is also indicative of progressive and spontaneous background decarbonisation in free markets, which occurs at a rate of around 1.3% each year. This is why, with the advent of shale gas, the USA has decarbonised much faster outside the UN's *dirigiste* 'targets and timetables' regime than, for example, the European Union managed inside it. Pre-emptively picking winners – coercing energy choices in other words – derails the process of spontaneous discovery of better solutions, and thereby contorts these curves. What happens as a result is no secret. The experiment has been run.

The stuck figures for world total primary energy, and the bruising German experience of its *Energiewende*, tell us that quite apart from the damage that is done to consent in democracies, any executive government in any country that embarks

Figure 3: Energy intensity and industrial revolutions

Note the non-linearity of the x-axis.

- England
- USA
- Germany
- Japan



on forcing such a transition by subsidy and/or bribe runs two strategic risks: externally, it can incur a disproportionate loss of competitive advantage, while internally it can wreak havoc, distorting markets, confusing innovators and manufacturers (as is now happening in the British motive power sector), and impoverishing consumers.

Even more elemental arguments can be made. The ecological and scientific defectiveness of renewables means that, apart from being retrogressive in terms of performance, making all services more expensive and more fragile, they will actually increase pollution and make no useful contribution to global emissions reductions at all.

### **Fallacy Five: You can legislate around the laws of thermodynamics**

A fifth fallacy is that some laws can be broken simply by legislating that it shall be so. The following syllogism explains why that is not the case. Unless Free World governments can repeal the Laws of Thermodynamics, their renewables-led 'Net Zero' policy is doomed. They cannot repeal the Laws of Thermodynamics. Therefore, those plans are doomed. There really is no escape from this logic.

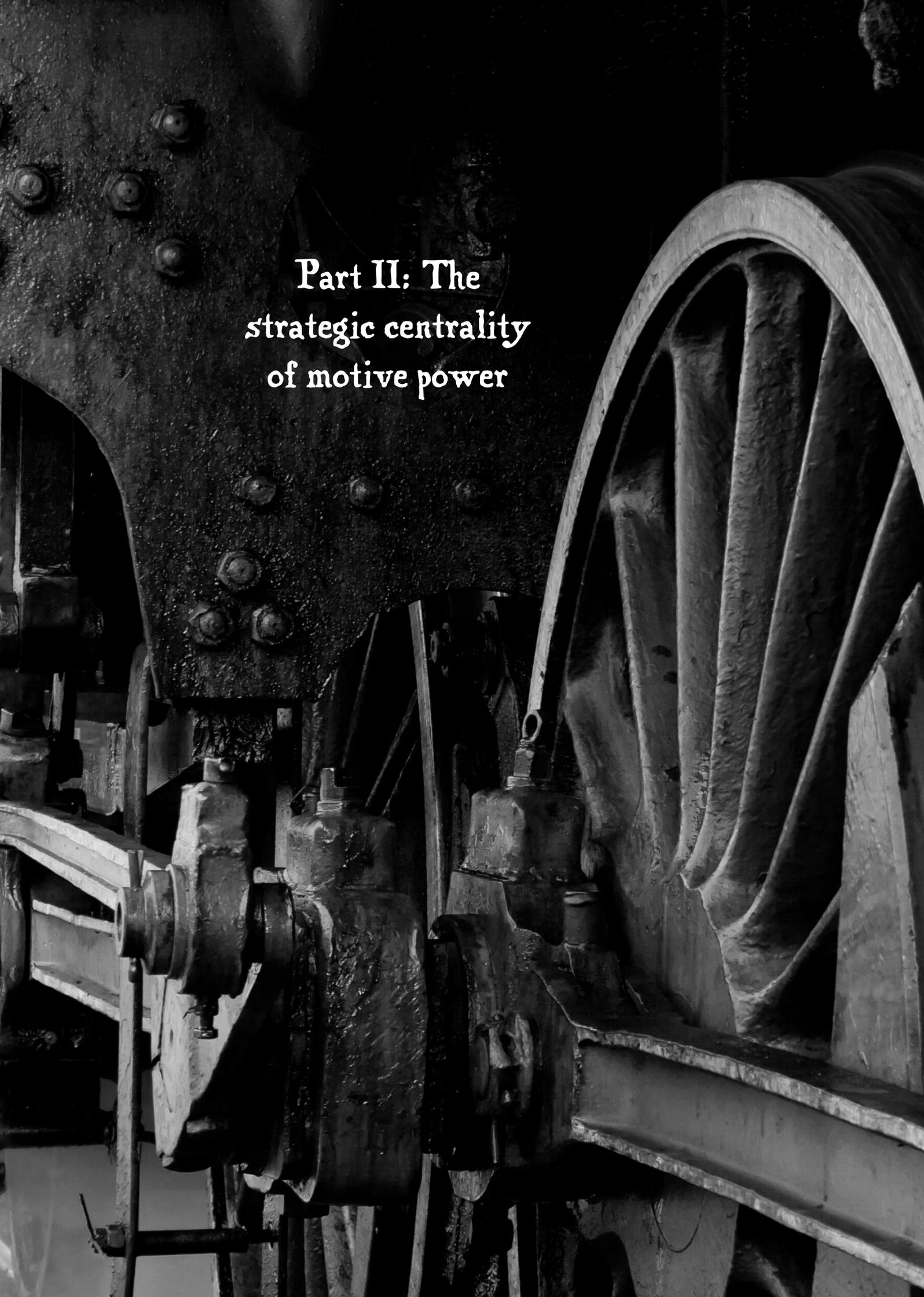
### **Fallacy Six: The UK has shown world-leading decarbonisation**

Finally, a sixth fallacy is about a conjuring trick. The claim that the UK is admired around the world for its example and for the speed of its 'decarbonisation' since 2000 – which is actually a de-industrialisation – is much repeated by British politicians and 'green' bureaucrats. This too is an illusion because much 'decarbonisation' is sleight of hand. Manufacturing and its associated emissions have simply been shipped offshore over the last two decades, mainly to China (so-called 'carbon leakage'), and then the products re-imported and the related emissions debited to the manufacturers' account. A totemic pride is also taken in 'driving' coal out of the power generation sector with no apparent comprehension of the true meaning and implications of what that means for the resilience of an advanced economy, nor, it seems, awareness of what has happened in Germany's *Energiewende* when this experiment was conducted.





W.S. Jevons



Part II: The  
strategic centrality  
of motive power



## Lock-in and the two Cinderellas: diesels and aerojets

There is also a strategic issue with Net Zero. Forcing 'lock-in' to a suite of structurally defective technologies by law is a serious industrial innovation error. By so doing in the energy arena, a country surrenders the chance to lead in a future cycle of thermodynamically competent, environmentally friendly technologies. That prize will go to those who are scientifically better informed, less imprudent, more agile and less ideologically blinkered. 'Lock-in' means what it says – and it lasts. For example, in transport, the contest between Henry Ford's internal combustion engine and the external combustion engine used in the 'Stanley Steamer'<sup>23</sup> was initially close-run, but once the public made its choice, it became quickly irreversible.

Historically, 'lock-in' has had an especially strong grip in the transport technologies. This is why it is strategically so risky for governments to meddle with innovation in this area. There is a real danger that they will pick low- or negative-EROEI technologies, and by doing so will lock in higher costs and inefficiency. The risks to the economy of forcing a move away from dense, low-entropy fuels and the machines that convert them into motion, are therefore stark. Diesel engines – scalable for use in everything from a tiny Mini car to a massive merchant ship – are, along with turbofan aerojet engines, globalisation's prime movers.<sup>24</sup> They have literally driven the third wave of globalisation since 1948. Without them, the global economy simply stops. In ton-kilometres, 94% and increasing of all global freight by land and by sea is diesel hauled.<sup>25</sup> Perhaps because they are so ubiquitous, no-one notices them and they are not accorded the attention which they deserve: they are Cinderellas at the globalisation ball. As their biographer, Vaclav Smil, has written:

The massive (mostly two-stroke) diesel engines that power every kind of ocean-going cargo vessel and the gas turbines that propel jet airplanes are fundamentally (that is, in energetic, physical sense) more important to the global economy than are any particular corporate modalities or international trade agreements. The latter can be (and often are) easily renegotiated or abrogated, and the former do not have (as yet) any equally capable substitutes.<sup>26</sup>

Smil makes it clear in detail that the 'as yet' will be a very long wait indeed, because problems with substitute fuels or non-combustion engines will leave the two divas in command of the stage for the foreseeable future. Of the aerojet, he writes that, 'without a single exception, all airplanes on interregional, transcontinental and intercontinental routes are powered by large turbofan engines. There simply is no practical alternative in sight...'<sup>27</sup> Therefore it is a deeply unwise misdirection for governments to strong-arm western aero-engine manufacturers into experiments with electric powered flight. Vanity projects,

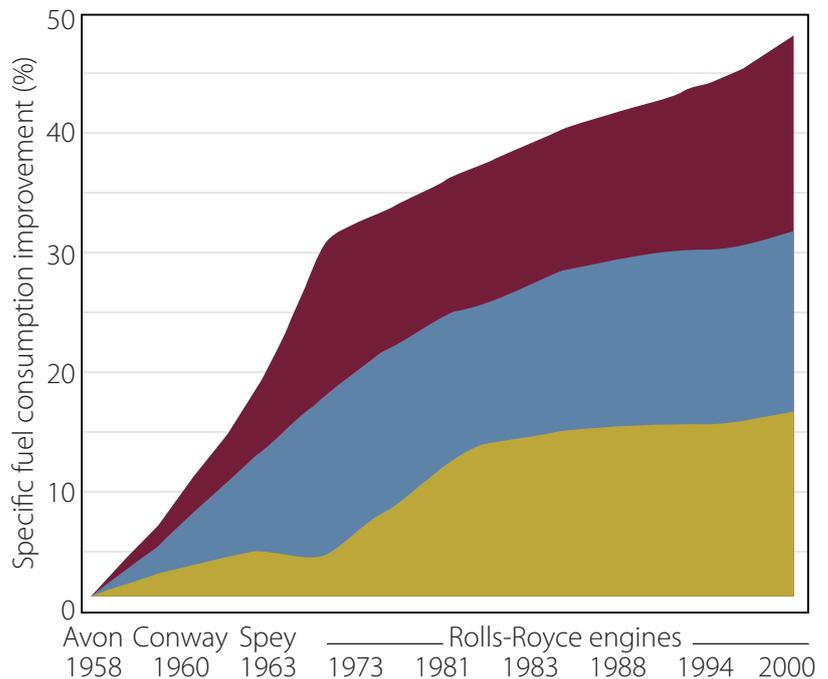
such as the Harbour Air seaplanes in British Columbia, have no scalability.<sup>28</sup> Rolls Royce should be left alone to continue improving its world-leading avgas-fuelled aerojets.

The main low-entropy fuels – gasoline, light diesel, heavy No. 6 (marine bunker), diesel and avgas (kerosene) are highly convenient and relatively safe to handle. Moreover, we are continually getting better at extracting the latent energy which they contain. For the last fifty years, diesels and especially aerojets have delivered steady increments in power-to-weight ratios and fuel efficiency, bringing ‘natural’ emissions reductions as a bonus. The aerojet has the longest run of year-on-year improvements of any major motive power technology (Figure 4).

Figure 4: Long-term performance trend for Rolls-Royce aeroengines

Source: Smil,<sup>24</sup> p. 228.

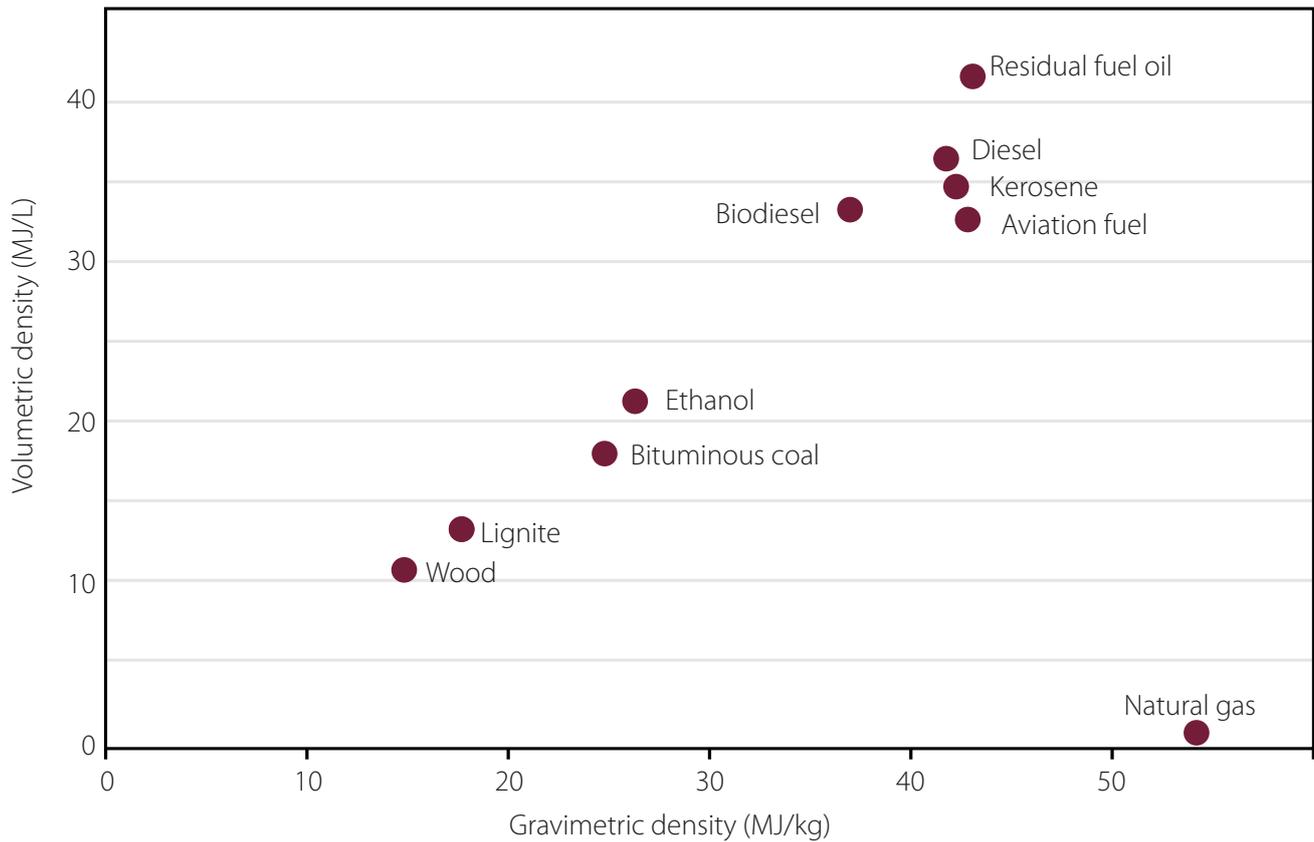
- Propulsive efficiency
- Cycle efficiency
- Component efficiency



## Power density

Diesels and jets burn their energy-carrier fuels directly, without the waste of intermediary fuel transformation, and they depend on fuel power densities in those carriers that lithium-ion batteries will simply never attain (Figure 5).<sup>29</sup> Simple physical facts tell that story, and they are expressed as rates. The key metric to grasp is Watt-hours per kilogramme (Wh/kg). Diesel fuel has an energy density of 13,750 Wh/kg.

A rough illustration may help. A modern mid-weight agricultural tractor weighs about 5.5 tons and carries 40 gallons of diesel, weighing 0.125 tons, on which it will happily work a normal farming day from dawn to dusk. That diesel represents 2,186,250 Wh of energy. The same weight of lithium-ion battery holds 47,700 Wh of energy, 98% less. Therefore, the capacity to work a full day on the farm would need a battery weighing



**Figure 5: Volumetric and gravimetric densities of common fuels**

The figure demonstrates the advantages of diesel fuel and kerosene for mobile applications. Source: Smil,<sup>24</sup> p. 36.

about the same as the tractor. Even allowing for the better energy conversion of current to movement by an electric motor, the superior practicality of an ICE tractor for its task is self evident.

## Alternative energy carriers

### Batteries

The power density of batteries has greatly improved over the decades, from 25 Wh/kg for a lead-acid battery in 1900 to 300 Wh/kg for the best lithium-ion batteries today. A logistic curve projection (a generous assumption) suggests a maximum innovative improvement of this technology to around 500 Wh/kg by 2050.<sup>30</sup> Even with the greatest optimism, it is therefore unlikely that batteries will ever match the energy carrying capacity of diesel which is orders of magnitude superior.

The manufacture and disposal of lithium-ion batteries signal another, unavoidable defect in this technology: they have low or negative EROEI. This is because they start life with massive lithium and rare-earth mining operations, which demand energy-intensive earth shifting and are both highly polluting and environmentally destructive. The manufacturing process which then follows involves intensive concentration and purifi-

cation processes, and then stabilisation with resins at high temperature. This all consumes a great deal of energy. The resulting batteries then have a lifespan limited by the well-known progressive 'memory effect', which worsens over successive charging cycles, progressively reducing capacity. To date no way has been found to extend batteries' relatively short finite service lives, so when this expires, they must be replaced. Moreover, the depleted batteries present an acute pollution risk, with yet more energy input required in any attempt to make the residues safe. To date no elegant recycling pathway has been found for lithium-ion batteries.

The use of lithium-ion batteries in a battery electric vehicle (BEVs) thus significantly increases its 'whole of life' energy budget, which is already much higher than for an equivalent vehicle powered by an internal combustion engine (ICE). The batteries are the single most expensive component in BEVs.

The inadequacy of battery power density is implicitly conceded with the announcement of a hair-raising government ambition to electrify Britain's trunk roads for HGVs with pantographs, using overhead electrified cables. The safety implications are obvious, the engineering obstacles (bridges, for example) are waved aside, and it seems that all the lessons learned from half-heartedly electrifying the railways, where the costly overhead wire technology did at least make some sense, are to be ignored as well.<sup>31</sup> The superiority of straight diesel-electric freight locomotives to trucks is well proven. In the USA, the world's largest rail-freight system, they use an order of magnitude less energy per ton-km (300-600 kJ/tkm, cf 2-4 MJ/tkm).<sup>32</sup> Estimated cost calculations<sup>33</sup> for the mad-cap British electric HGV scheme are horrendous: £130-150 billion capex – over three times the entire annual defence budget (£44.6 bn) – open-ended and unspecified opex, and a doubling of the installed wind turbine capacity (assuming this to be the electricity source). Even for a Veblen good, that is intolerably expensive.

However, problems with lithium-ion batteries do not stop there. Not only do they have shocking EROEI as just explained, they also condemn us to strategic dependence on Communist China for the minerals used in their manufacture – of which more below – as well as complicity in the human rights abuses that plague the mines from which they are extracted. Lithium-ion batteries are also hazardous if damaged or defective, being subject to 'thermal runaway': anaerobic fires that burn without need of oxygen. These mean that BEVs are a different order of crash risk to ICE vehicles – in other words, a straight fires-per-mile rate does not adequately capture the risk. There is a 'quality factor' in risk that statistics do not capture.<sup>34</sup>

For example, on 29 June 2021, in the Superior Battery Corp warehouse in Morris, south Chicago, 100 tons of lithium-ion batteries overheated and spontaneously combusted.<sup>35</sup> The owner, a solar power developer, one Mr Jin Chen, evidently had

not notified anyone that they were there, and the fire crews were unprepared for a thermal runaway. A standard extinguisher, Purple K, inevitably failed, and, fearing that more water would be counterproductive and result in pollution to the nearby river, the fire service in the end experimentally dumped 28 tons of dry Portland cement on the batteries to absorb and dissipate the heat. The fumes led to evacuation of over a square mile around the site, the removal of 3000 people, and the declaration of a state of emergency by the Governor of Illinois. Legal action is now in train.

Then, on 30th July 2021, just one month after the Chicago incident and one day after it began operations, a 13-ton Tesla Megapack battery<sup>36</sup> at Moorabool, Victoria, Australia, part of what is planned to be the biggest battery 'farm' in the southern hemisphere, experienced thermal runaway and caught fire, also igniting its neighbour.<sup>37</sup> The battery units were closely packed and hard to access, and the fire services, unable to extinguish the flames, decided to watch and let them burn themselves out, meanwhile issuing a fume alert to surrounding communities.

Amazingly, despite the dangers just documented, lithium-ion batteries are excluded from the UK Health and Safety Executive's list of hazardous items. It is an omission that must be swiftly corrected. The issue is now particularly pressing because of the expansion of battery 'farms' here. Once wartime conditions had given British governments a taste for detailed meddling in agriculture, over the next eighty years they have been unable to resist the temptation, most especially during the excursion into and under the EU. As, under that dispensation, contemporary British farmers are encouraged to become rent-seekers and to sacrifice arable farm-land for a more profitable but potentially deadly crop, the British countryside is to be peppered with 400 visually and audibly intrusive lithium-ion battery 'farms'.<sup>38</sup> They are installed to 'smooth' the Grid: to put power into the National Grid when the wind doesn't blow or the sun doesn't shine; and all will run the Chicago risk.

## Hydrogen

There are some who would explore the possibility of hydrogen as an alternative way to power transport.<sup>39</sup> Hydrogen is not difficult to burn, as JCB has demonstrated in a digger; but at what cost? The problem is not combustion; it is production. Hydrogen is just an energy carrier. Neither of the current technologies – 'blue' hydrogen from steam methane reforming using a gas feedstock, nor 'green' hydrogen from renewables-powered electrolysis – is even a starter in a free market. Neither can generate high process heat at low cost. They are commodity production processes, not energy-delivery systems. The EROEI for both is negative, strongly so for steam methane reforming. Far better to burn the gas feedstock directly. We shall have to wait for high-temperature small modular nuclear reactors and the

thermal decomposition of water for large-scale hydrogen to become environmentally or economically viable, and even then, it may be a niche market. Hydrogen is also a highly inflammable companion with which to travel – much more so than petrol or diesel.

## Biofuels

What then about ‘greener’ liquid fuels? Sadly, fuel policy has been captured by yet another simple-minded fallacy, which is that the addition of plant-based ethanol to motor fuel is ‘green’ (coming from plants?) and should therefore be inflicted on the ignorant public by fiat. The ethanol story actually began in a less than high-minded way, with policy capture in the USA by large industrial farming conglomerates seeking protected markets for their maize. ‘Cutting’ mineral fuels with plant-derived ethanol has been picked up by green-tinted policy advisers, ignorant of the concept of EROEI. They also knew nothing of ICE technology: admixture of biofuel above very low levels (5%) actively damages pipes and seals in older vehicle engines, necessitating premature scrappage and replacement.<sup>40</sup> This increases the environmental impact, since it wastes a portion of the energy invested in manufacture, which is often the largest portion of whole-life energy. That investment amortises across vehicle life, so in the real world, extending the lives of older ICE vehicles through good maintenance can make them ‘greener’ than new BEVs, which, as explained above, have much higher embodied process energy per unit in manufacture, shorter component (battery) and overall lifespans, as well as the considerable pollution risks relating to their lithium-ion batteries.

Straight gasoline contaminated with ethanol also has much reduced keeping qualities. The water content can damage fuel tanks and clog injectors and carburettors if left standing even for a relatively short time. Pure petrol has none of those issues. In short, terrestrial vehicle biofuel has no operational benefit and no net environmental benefit.

On similar lines, Smil dismisses suggestions of biofuels for aircraft on grounds of EROEI, the opportunity/costs of farmland diverted from food production, low energy density, unstable fuel formulation, and proneness to freezing. He makes the low-key and practical proposal to introduce diesel-powered aeroplane tugs, which could eliminate long taxi transits under an aircraft’s own power, cutting pre-flight fuel use by a third, enough to give a significant reduction in overall flight emissions.<sup>41</sup>

## Applying Occam’s Razor<sup>‡</sup>: LPG and CNG

The previous subsections have set out the excellent physical reasons why there are, as yet, no viable alternatives to fossil fu-

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<sup>‡</sup> *Entia non sunt multiplicanda praeter necessitatem*: entities should not be multiplied without necessity (prefer the least complicated way with the fewest steps to get from here to where you want to be).

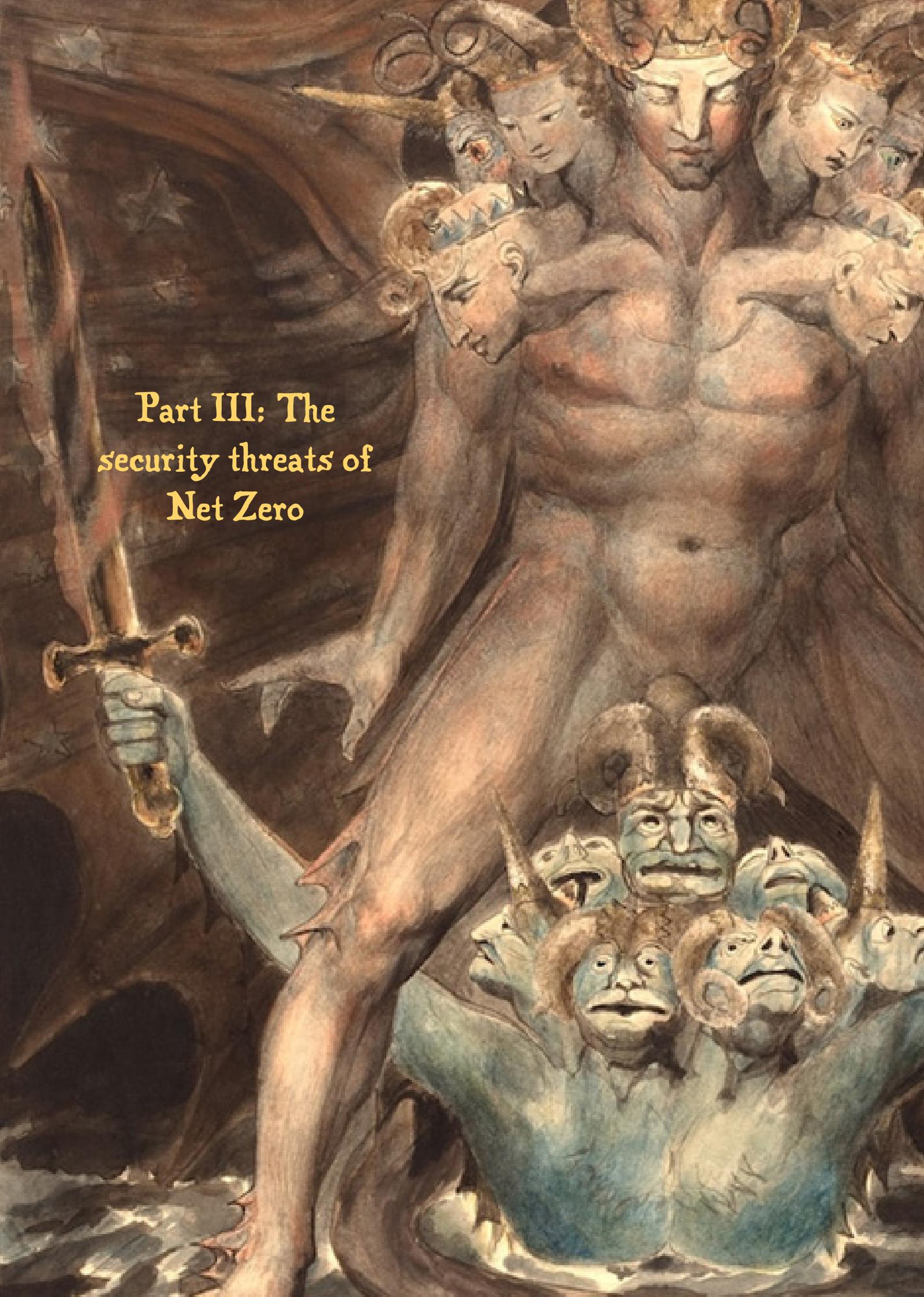
els for heavy duty applications (for example agricultural tractors, HGVs, tanks, ships) or for 'off infrastructure' use in Africa, South America, India, and other places, which is much of the world – or for aircraft. No-one who has driven a modern heavy-duty turbo-diesel agricultural tractor or truck all day would willingly surrender such a reliable, safe and powerful capability, still less accept it being outlawed. Living in and writing from a rural community, as I do, I know that to threaten to do so will lead to civil disobedience. France's *'gilets jaunes'* should be a warning.

Fortunately, there are proven engineering-technology and energy-carrier pathways to hand that would be less damaging to the environment than the 'green' technologies that are currently fashionable, as well as cheaper to deploy. In the transport sector, liquid petroleum gas (LPG) is a mature technology that could clean up tailpipe emissions at a stroke. It is simple and inexpensive to retro-convert petrol ICE vehicles to dual-fuel (petrol-LPG) capability. If a fraction of the government subsidy being spent on attempting to force us to use BEVs were instead put into extending the LPG refuelling network at existing petrol stations; if a stable fuel tax advantage for LPG were to be increased; and if new ICE vehicles were offered in dual-fuel alternatives, tailpipe particulates would be swiftly and radically reduced, without the need for ever more oppressive low-emission zones and other bureaucratic constraints on driving and the freedom that it brings. The oil industry would respond to market demand by simply tuning its refinery processes.

In some applications, compressed natural gas (CNG) can carry part of the load. The acute air pollution in Indian cities was successfully ameliorated this way by mandating the conversion of 'tuk tuk' auto-rickshaws from two-stroke fuel to CNG.

Measures to encourage the use of LPG or CNG, as outlined above, would be tolerable policy 'nudges', commensurate to real and present problems. They could take immediate effect, the public would be at ease with them, and as a result they would probably be swiftly and spontaneously adopted, with minimum fuss or disruption. Such a policy would, like Smil's aeroplane taxi tugs, be virtuous, although modest and undemonstrative.

Yet advanced industrial countries are not applying Occam's Razor. They are not taking the easier, simpler, natural, evolutionary and cheaper pathway of autogas fuels. Instead, they impose by legislative fiat, more expensive, less energy-dense and more problematic technologies. One must wonder at the mind-set that can even contemplate extravagances such as BEVs and 'green' hydrogen. Surely it is because these activities are, to reverse Thorstein Veblen's famous title from his 1899 masterpiece,<sup>42</sup> the leisure of the theory class; and they provide many examples of the Veblen effect. Virtue signalling with someone else's money (ours, the taxpayers') by impressionable politicians with shallow knowledge, their often rather young advisers, and their increasingly politicised civil servants, is surely to blame.

The illustration depicts a large, muscular, horned figure with a crown of horns and a stern expression. He has multiple heads, with several faces visible around his main head. He holds a sword in his right hand. Below him, a group of smaller, horned figures with various expressions (some angry, some pleading) are gathered. The background is dark and textured, suggesting a cavernous or ancient setting.

Part III: The  
security threats of  
Net Zero



## The hinterland of Xi Jinping

For three thousand years, Chinese rulers have been haunted by the same elemental fears. A basic fear was, and is, of barbarian invasion, civil war and social disintegration. Uneasy rests the head that wears the crown. Although contemporaneous with the golden age of the Athens of Pericles (495–429 BC), which is labelled as ancient history in the West, the memory of the chaos of the era of the Warring States (475–221 BC) continues to be prominent in Chinese culture and learning today. It was an era of wall-building long predating the Great Wall, and as the leading historian of Chinese walls put it, there are always two types of walls: the physical bricks-and-mortar sort but also ‘... the mental wall that the Chinese state has built around itself to repel foreign influences and to control and encircle the Chinese people within’. Professor Lovell illustrates how axiomatic wall-thought is in Chinese culture: ‘The Chinese love of enclosing walls is written deep into the language itself’, she writes. ‘The earliest versions (roughly 1200 BC) of the ideograms for ‘settlement’ and ‘defence’ represent walled compounds...wall-building and the written language have intertwined to define Chinese civilization both physically and figuratively ever since it came into existence.’<sup>43</sup>

The later turbulent era of the Three Kingdoms of Wei, Shu and Wu (220–280 AD) – contemporaneous with the Imperial Crisis of the Roman Empire that ushered in the period we know as Late Antiquity – gave rise to the swashbuckling, giddy epic *Romance of the Three Kingdoms*, widely read still, and reported to have been Mao Tsetung’s favourite novel. I can attest that it is one heck of a ride.<sup>44</sup>

In this millennium-long timescale, the titanic destructiveness of the civil war known as the Taiping Rebellion (1850–64) was but the day before yesterday.<sup>45</sup> It was the event that destroyed more human life by human hand during the nineteenth century than any other. Upwards of twenty million died, a death toll not surpassed until the Great War in Europe. After the Communist victory over the Kuomintang in 1949, after which the Nationalists of Chiang Kai-Shek withdrew to Taiwan, mainland China’s twentieth century continued in like vein, with millions of deaths from Mao’s self-inflicted famine and the social turmoil of the Cultural Revolution, both events still within living memory.<sup>46</sup>

The other fear that makes Chinese rulers uneasy is the remorselessness and decisiveness with which the Mandate of Heaven moves from one hegemon to the next. It is a constant in Chinese history. In short, the decline of the West and the rise of China is by no means pre-ordained, either in the material world or (which we might forget if we did not know) in the minds of Chinese rulers.<sup>47</sup>

So entrenched fear of chaos was perhaps a contributory factor in the adoption by Chinese premiers from Mao up to Hu

Jintao§ of an oblique approach to the Free World. They have long hidden their hostile intentions in plain sight, observing the first and one of the most famous of the Thirty Six Stratagems (see below) to ‘deceive the heavens to cross the sea’ (瞞天過海).

### **Xi’s grey war**

Xi Jinping shares this cultural hinterland but, as we will see, he has adopted a different strategy to his predecessors, while retaining very similar tactics.

Xi is a man with whom it appears that compromise is not possible. In him, and his command group, we face a severe modern form of Han-centric Chinese nationalism with Communist tinges – not Communism with Chinese tinges. He is supported from below by a growing number of ‘angry youth’, obsessed with the roots of Chinese weakness, and filled with thoughts of racial superiority.<sup>48</sup> This ideology finds expression in a victim narrative, notably in recent times in the book *China Dream*, a national bestseller written by Liu Mingfu, a Colonel working at the National Defence University. Liu analysed how the USSR had failed to supplant the USA, and devoted an entire chapter to eight ways in which China would be different. In his book, Liu adopted as his own the phrase ‘the hundred year marathon’, using the English word and equating it in Mandarin to ‘rejuvenation’.<sup>49</sup>

The first hints that Xi might be adopting a different strategic approach to the Free World were seen shortly after he was appointed General Secretary of the Communist Party of China in 2012, when he announced his own *China Dream* – a plan for the rejuvenation of the Chinese nation and global pre-eminence by mid-century.<sup>50</sup>

Since then, the Chinese leadership’s hostility to the Free World, and its intensity, have been completely unveiled. The Chinese Communist Party’s Fifth Plenum text of October 2020, setting out the strategy to 2035, told the nation for the first time in decades to ‘prepare for war’ (备战) – meaning in any and all forms. It is true that the Chinese military build-up since 2000 has been relentless and remarkable. However, as we will see, at present we do not face open war, but instead war by other means. It is a war with the Communist Chinese of Xi Jinping’s command group rather than with the Chinese people as a whole, of course. About all of this we ought to be clear-sighted.

But although Xi has changed the grand strategy to one of open confrontation with the Free World, we should not assume that he is any less haunted by the prospect of chaos than his predecessors. Famously, Winston Churchill defined Russia as ‘a riddle, wrapped in a mystery, inside an enigma’; and there is a general tendency to say the same, if not more so, of the allegedly inscrutable Chinese Communists. But in both cases surely the rhetorical flourish is overdone? The strategic goals are not

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§ President of the People’s Republic of China from 2003–13

obscure. What is not well understood – but needs to be – is that both of these authoritarian opponents think tactically in far more systematic ways than our more haphazard elected leaders. In the Chinese case, there has been great continuity from one ruler to the next, and so Xi Jinping's choice of strategic confrontation stands out as eccentric. Yet tactically, his approach to winning seems little different from predecessors: he follows Sun Tzu's famous advice in Chapter III of *The Art of War*: '...to fight and conquer in all your battles is not supreme excellence; supreme excellence consists in breaking the enemy's resistance without fighting.'<sup>51</sup>

Xi's tactics are also informed by The Thirty Six Stratagems from the era of the Warring States, a manuscript which is probably a little older than Sun Tzu's. However, both emerged from periods of great internal turbulence.<sup>52</sup> The Thirty Six are usually grouped into six chapters, and three – two 'war winning' strategies and one 'enemy dealing' strategy – are most apposite in framing Xi's conduct. The first is *kill with a borrowed sword* (借刀殺人); in other words, to use our inventions to attack us. The second is *loot a burning house* (趁火打劫); to take advantage of an enemy's misfortune. This metaphor facilitates the principle of 'ghost attack' – the perpetration of hostile actions with plausible deniability, such that the attacked party is powerless to retaliate without seeming to be the aggressor. An example would be the current Covid pandemic. It also encompasses the idea of creating adverse circumstances – setting the house on fire – and pushing the enemy into self-harming behaviour. The third is an 'enemy dealing' strategy: *hide a knife behind a smile* (笑裏藏刀), the tactic of concealing hostile intent behind apparent co-operation. Conduct over energy and climate policy appears to be a leading arena for this stratagem, as we shall see in detail. Other stratagems cover other eventualities, both of victory and to cover defeat. Most relevant to our concerns are the 'chaos creating', 'enemy dealing' and 'attacking' stratagems.

The spear-point for Xi's ghost attacks is China's Ministry of State Security United Front Work Department (UFWD): a multi-headed hydra. Xi Jinping has described it as '...an important magic weapon for strengthening the party's ruling position... and an important magic weapon for realising the China Dream of the Great Rejuvenation of the Chinese Nation'. A magic multi-headed beast from the deep indeed.<sup>53</sup>

The UFWD's tactics towards us can also be seen to derive from long-standing Chinese strategies such as the Thirty Six. For example, employing the stratagem *let the enemy's own spy sow discord in the enemy camp* (反間計), it has, with considerable success, 'made friends for China' within and across the western elite establishment. In the British case, that embraces the worlds of business (notably the 48 Group Club), of politics (green activists have been a particular focus for the UFWD<sup>54</sup>), and spans academia and universities, notably Cambridge under its current Vice-Chancellor, and Nottingham. Science and science publish-

ing, where a naïve belief in the global community of science can, wittingly or not, be exploited to meet China's objectives are especially targeted. Winning influential friends – 'Fifth Columnists' witting or unwitting – so as to destroy an enemy's ability to resist is a classic indirect approach, straight from the pages of Sun Tzu, and conforming to the first of the 'chaos strategies' of the Thirty Six: *'Remove the firewood from under the pot'* (釜底抽薪). In western idiom, it is to draw the fires from the boilers to slow and eventually stop the engines.

## **China, Britain and the awakening of the Free World**

If memory of past chaos and disintegration is one part of Xi Jinping's cultural hinterland, the other is bitter resentment of the 'century of humiliation' after the Opium War and the Treaty of Nanking on 29 August 1842, which gave Hong Kong island to Great Britain in perpetuity.<sup>55</sup> It cannot have been an accident that it was in a museum gallery devoted to that subject that Xi Jinping chose first to introduce his 'China Dream' in 2012. The signs are therefore that the humiliation of Great Britain is a special objective. Great Britain is also a particular focus because of its perceived responsibility for the seed of democracy that grew in Hong Kong under British rule and that then, magnificently, demonstrated the strength of its roots in Chinese soil after the colony was handed back to Peking in 1997.

Britain is seen in Peking as weak and likely to crack under pressure – to *kow-tow* to the Emperor. The precedent was set by the decision made to hand the colony back on the 'declinist' advice of the Foreign Office's China expert, Sir Percy Cradock, and against the will of the Hong Kongers. The impression (and reality) of weakness was compounded by Blair and Cameron's active courting of Chinese trade and investment after the unwise decision to allow Peking into the World Trade Organization on 11 December 2001. This was tantamount to letting a fox into the hen house in the expectation that it would become like the other hens. The damage done in that ill-advised era was grievous.<sup>56</sup>

We may safely assume that we did not change Xi's views of us during the pandemic year, when we failed to react strongly to his flagrant abrogation of the 1984 agreement under which Hong Kong was handed back. This had solemnly inscribed the promise that the principle of 'One Nation, Two Systems' – in other words that democratic freedoms would continue in Hong Kong – would endure for fifty years from 1997. But it was cast aside by the Hong Kong National Security Law of June 2020, crushing democracy in the territory and also demonstrating palpable British inability to resist it in any meaningful way.

With Britain – and the rest of the Free World – having demonstrated nothing but weakness (and greed) for two decades, the decision of the core countries of the Anglosphere – the 'Five Eyes' nations of Australia, Canada, New Zealand, USA and UK –

to place national security above least-cost considerations with regard to the possibility of the Chinese commercial giant Huawei becoming involved in the rollout of 5G mobile systems, had an importance far beyond the immediate ones related to IT. Indeed, it was of capital strategic significance. It was followed by the announcement on 15 September 2021 of the new AUKUS (Australia, UK, USA) tripartite defence collaboration, centred upon supplying Australia with Anglo-American nuclear propulsion for its new fleet of hunter-killer submarines, a still more important signal of Western resolve, which doubles down on and consolidates the message implicit in the rebuffing of Huawei.

The new-found resolve of the Anglosphere nations may reinforce the views of those in Peking who have been doubtful of the wisdom of Xi Jinping's abandonment of the first of the Thirty Six Stratagems (*Deceive the heavens to cross the sea*), for it is a sign that open hostility has awakened the Five Eyes, as they warned and feared. All officers in the Queen's navies – RN, RAN, RCN, RNZN – hold Crown Commissions, and her navies are already fully interoperable, and share a professional culture with those of the USA, India and Japan. Xi's critics in Peking will fear that his aggression has prompted the making (or rather, re-making) of a global navy for the Free World, led by the English-speaking peoples. We should not assume that his ascendancy is any more secure than that of previous emperors.

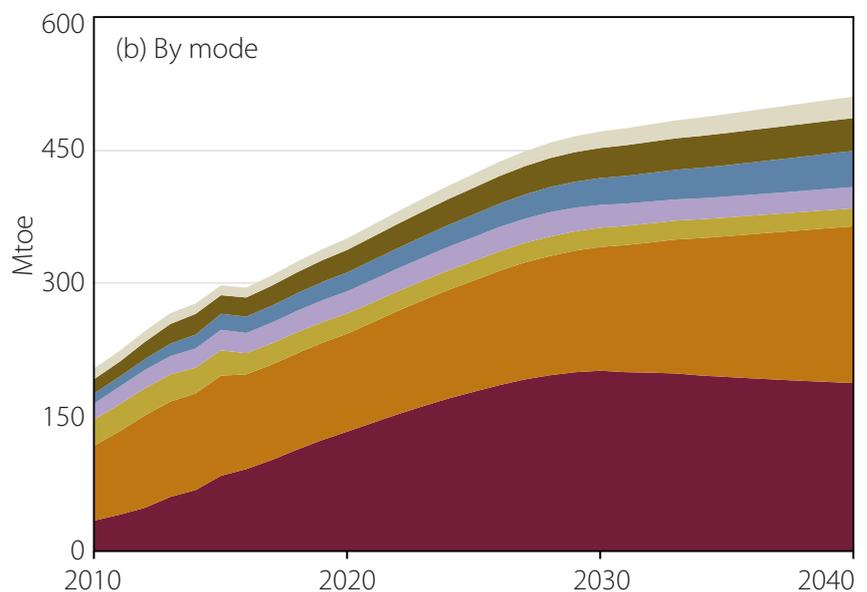
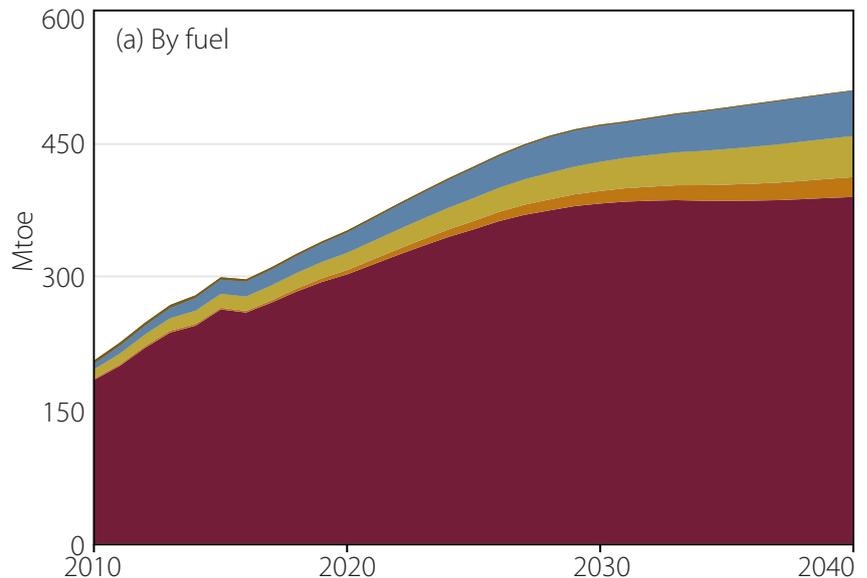
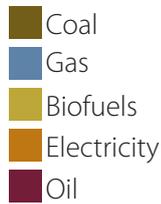
## **Xi's climate promises decoded**

Similar clearheadedness and firmness of purpose is required as we deal with China in the climate and energy arena. Xi's command group plainly intends to deploy the 'enemy dealing' strategy: *hide a knife behind a smile* once more, using our current fixation with 'green growth' and 'Net Zero' to encourage us to self-harm. That this is China's intention is evidently not sufficiently well understood in western political circles, but Xi's speech to the UN 'Climate Ambition Summit' on 12 December 2020 must be viewed in that light.<sup>57</sup>

On the surface, it promised two things: 'We aim to peak carbon dioxide emissions before 2030 and achieve carbon neutrality before 2060'. This is the smile. The words leave plenty of room for manoeuvre. Achieving carbon neutrality by 2060 is, of course, a 'dead cat' misdirection, while 'aiming' to peak carbon dioxide emissions before 2030, is merely a statement of intent, and can be read as allowing emissions to remain high for some time thereafter.

Examination of China's policies and actions shows us the knife. In the medium term (as we shall see, the longer term may be very different), it will focus almost entirely on dense, low-entropy fuels. Peking's published plans show that it expects total energy consumption to increase by around 20% by 2030. China's oil consumption is projected to *double* by 2040 (Figure 6), mostly due to a vast increase in passenger cars and road freight. ICE

**Figure 6: China's energy demand in transport**  
 (a) By fuel, (b) by mode. Source: New Policies Scenario, IEA, World Energy Outlook (2017), p. 526.

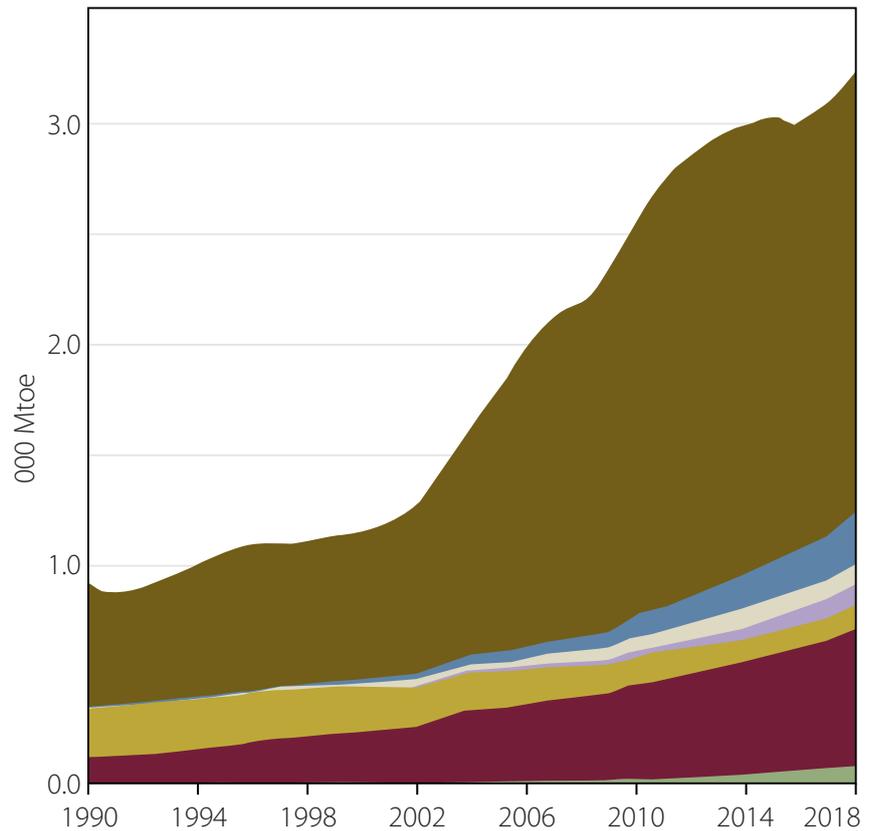
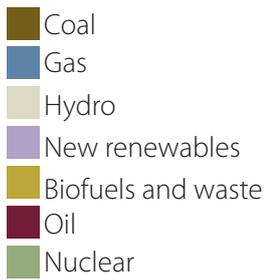


passenger cars will number 400 million in 2040, *more than double* today's total (western BEV boosters please note!). Furthermore, this assessment is supported not only by Xi's statement but also in China's Middle East policy. During 2020, in quick order, China made three long-term oil and gas agreements, with Iran, Abu Dhabi and Saudi Arabia. These trend lines and trade deals are eloquent, especially when contrasted with the IEA's aspirational May 2021 Roadmap to Net Zero in 2050.<sup>58</sup>

Similarly, China is currently building 250 GW of additional new coal-fired plant, more than currently exists in the entire USA (229 GW), and a 25% increase on current capacity. Alongside other conventional capacity, such as nuclear and gas, this will support a 50% increase in electricity consumption by 2040 (>10,000 TWh, as compared to 7,000 TWh today). Figure 7 shows China's fuel mix trends, dominated by coal, and with 'new renewables' barely visible traces.

We may therefore safely deduce that China has no intention of embracing western 'green' obsessions. Communist re-

Figure 7: China's energy mix



gimes have tended to value their engineers, and we may also assume that the Xi Jinping command group is fully familiar with the problems (and, in Xi's case, the opportunities) of technological 'lock-in'. It is simply using our green obsessions to its advantage and against our interests. In the terms of the Thirty Six, Peking intends to *loot a burning house*: it will encourage its competitors (us) to use thermodynamically inferior fuels in order to build in economic weakness, and will assist us in compromising our transport and electricity infrastructures. It will ignore biomass, tidal, geothermal and hydro as strategically insignificant. Nor will it involve itself in hydrogen, recognising that both the current 'green' and 'blue' routes to its production, as explained earlier, are unviable economically. But it will happily continue to manufacture wind power components and solar panels for us, and it will use uncompetitive market practices to displace western (and Japanese) competitors, and so dominate the markets for these items. In this way, China will weaken our manufacturing bases, while indulging our 'green' and 'Net Zero' obsessions and it will thus control these markets – and hence us – for so long as we allow it to do so.

Likewise, with EV and lithium-ion battery technology. Given its cornering of markets in rare earths (which did not occur without planning aforethought), and its willingness to trash inner Mongolia to mine lithium, China has immense global stock of essential minerals and so gains strategic leverage once we create and permit critical dependence. President Biden's cut-and-run from Afghanistan has simply made a gift of that strategic country's vast mineral resources, including lithium, to Peking.<sup>59</sup>

We need to wake up before the lights go out.

## **Free World builds towards weaknesses, Communist China builds towards strength**

### **China seeks to deny resources to the Free World**

China is planning vastly to expand its consumption of dense fuels in the short and medium term. But this is only part of the story. Achieving the global predominance of 'China Dream' will involve denying these resources to the Free World, and so another of its primary objectives is to control their supply. The three 2020 oil deals were already mentioned. In parallel to these efforts, China is doing everything it can to get its hands on advanced fossil fuel extraction and combustion technologies.

Denying resources to the Free World is a key feature of China's neo-imperialist 'Belt and Road' programme. This programme successfully entraps many poor countries that ought, by culture and past affinity, to be natural allies and members of the Free World. Peking's chosen tactic is to trap nations in debt, often for unnecessary large projects, and then to take assets in payment at default. A prominent example is China's funding of the construction of the barely used Hambantota Port in Sri Lanka. When the Sri Lankan government failed to pay back the loans on time, the Chinese forced them to hand over the facility and the surrounding land on a 99-year lease. The Belt and Road also redraws the maps. It puts sino-centric lines of communication as facts on the ground.

### **Leapfrogging to EROEI-positive energy**

In the long term, and understanding the dangers to us – and opportunities for them – of technological 'lock-in' as a weapon, Peking intends to use the wealth created from dense fuels to leapfrog the Free World to the next generation of energy technologies: low-entropy ones, with strongly positive EROEI.

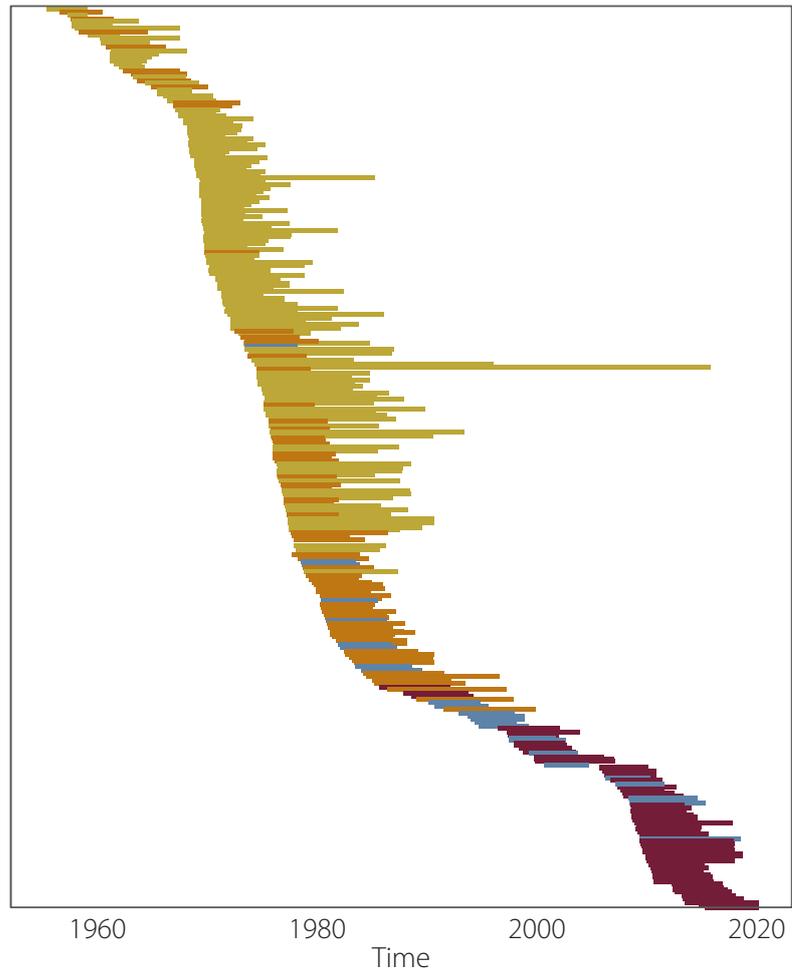
The evidence suggests that large nuclear power stations, used to generate electricity from lower-temperature output heat, will be the first focus: since 2000, the lead both in scale and speed of building of new large-nuclear capacity has shifted decisively from west to east, to China and, to a lesser extent, to Russia (Figure 8).

The next step may see the focus shift to hydrogen production at scale, generated via thermal decomposition of water in high-temperature nuclear reactors. This may be expected to be a process with positive EROEI, and would give China an abundant low-cost energy carrier that could be used economy-wide. Fusion will be projected a distant option.

### Figure 8: The history of nuclear reactor construction

Time from first concrete to production.  
Source: IAEA, <https://prisiaea.org>.

- USA
- France
- Republic of Korea
- China



### China's need for advanced technologies

China's medium-term (dense low-entropy fuels) and long-term (new energy sources) plans require the acquisition of advanced scientific knowledge. Alternative nuclear fuels and nuclear processing technologies, electricity transmission and distribution technologies, and expertise in cable manufacture, transformers and power electronics are seen by Peking as national security investments (as we too should see them). ICE and turbine-related technologies, such as jet engines, are considered of special priority too.

Fortunately for Peking, the renewables-obsessed Free World currently undervalues these foundation technologies.<sup>60</sup> Once again we see stratagems of the Thirty Six in play: *kill with a borrowed sword* (using an enemy's own weapons against them), and also *borrow a corpse to resurrect the soul* (借屍還魂), meaning to appropriate undervalued people, institutions or technologies. The borrowed sword is double-edged: not only do the Chinese gain use and control of our century-long heritage of ICE diesel and aerojet technology, which they could not quickly replicate, but, by helping us to self-harm – encouraging us to adopt BEVs, for example – they cause us to destroy our strategic global dominance of the transport sector, ceding it to the PRC without a fight. Perhaps without the Free World's lead-

ers even knowing that this is what they are doing?

China is achieving these ends through the systematic theft of intellectual property. This is the domain of the hydra-headed beast from the sea: the UFDW. There are two modes to its pilfering of Western knowledge: by insertion of its own agents, and by extraction through compliant or naïve westerners. The 'Thousand Talents' programme plants bright Chinese students and researchers in leading universities,<sup>61</sup> and even defence-sensitive establishments, across the western world. These operatives syphon out intellectual property of value to the CCP.<sup>62</sup> This approach is recognisable as one of the 'enemy dealing' strategies within the Thirty Six: *'Take the opportunity to pilfer a goat'* (順手牽羊).

China's extraction efforts also involve recruiting senior western academics, not just as cheerleaders but as sources of knowledge, to *'borrow a corpse to resurrect the soul'*. Professor Charles Lieber, formerly Head of the Department of Chemistry at Harvard University, is a high-profile example: he was allegedly paid a monthly salary of up to \$50,000, on top of approximately \$158,000 in living expenses and more than \$1.5 million in funds to establish a research lab, by Wuhan University.<sup>63</sup> Lieber has sought to sue Harvard but currently stands arraigned on various charges in Massachusetts.

The hotting up of Xi Jinping's grey war – with sabre-rattling in the South China Sea, and the threats to Taiwan – means this has to stop. The protection of know-how in fields in which the UK has a global lead – diesels and advanced jet engines for example – and breakthrough technologies such as Sabre (Synergetic Air Breathing Rocket Engine) – a revolutionary, proven and entirely British invention – should be declared national security priorities.



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Earl Macartney's audience with the Qianlong Emperor on 14th September 1793, in which he refused to kowtow and the Emperor refused George III's requests. From the sketch of the event by William Alexander.



Part IV: What is to be done?





## Stop self-harming

Fossil fuels in China will be reserved for some military purposes in the long term (note that their promise is for carbon neutrality in 2060; some emissions will remain). We, of course, should make the same exclusion as we belatedly begin to rebuild our armed forces, if we are slightly sensible. But it appears that we are not. The MoD has a three-star 'green' champion, and a drive towards BEV armoured vehicles and fighter aircraft running on bio-fuels. As the commanders of Veterans for Britain observed:

...the ambition to substitute less energy dense 'carbon free' fuels for avgas in aerojets or marine applications, or diesel in other military vehicles, has trivial if any environmental benefit but has certain operational penalty...swapping Battery Electric Vehicle drive-trains into heavy AFVs [Armoured Fighting Vehicles] is a frightening prospect. Who would wish to be in a tank with a lithium battery fire?

They concluded acidly:

...Thank goodness, therefore, that Dowding and Parks didn't spend their time worrying about running their Spitfires and Hurricanes on recycled chip oil or household waste instead of fighting and winning the Battle of Britain. It is not the job of MoD to engage in 'climate catastrophism' virtue signalling but to prepare to defend the realm, quite possibly quite soon.<sup>64</sup>

The actions of the Ministry of Defence are the kind of thing that would make the generals of the People's Liberation Army rub their hands in glee – the success of the Thirty Six Stratagems made real. In seeking to answer the question posed in the title to this part of my essay, it is clear that the most urgent actions involve putting a stop to our self-harming behaviours. This paper has sought to show how Veblen-effect 'green growth' virtue-signalling is far from cost free. Under darkening skies of rising tensions between the free and the authoritarian worlds, we need to return to the realities of international relations and of basic physics, and to do so quickly. Therefore, in this section, I shall set out the six urgent steps that will address the immediate dangers, and which will enable us to approach the 'Golden Bridge' to a secure and prosperous high-energy, clean-energy, 'China-proof' future.

## A six-point plan to reach the Golden Bridge

### Abandon command-economy planning

First, in all areas of public life, abandon command-economy planning: it didn't work under communist regimes, and it has failed twenty five times at global climate conferences. Similarly, do not heed the Siren call of 'market failure'. To do so is to cede power to select – usually self-selected – individuals, over

the collective wisdom of all consumers expressed through the free market. Ukrainian tractor-factory production methods from the Soviet era – targets, timetables and Stakhanovite rhetoric – are not a good model. *How often do we have to learn this lesson?* Let the free market be free and then invention and innovation will follow. It will supply what people desire, which is not being made to feel guilty, or experiencing rationing, shivering, and the end of overseas holidays. It will deliver a high-energy future, lifting the poor from poverty and increasing the wealth, health and happiness of all.<sup>65</sup> Governments must keep out of the free market, except to police it against predatory conduct by authoritarian state companies. That is all that government needs to do or should do.

As my colleagues and I argued in *The Vital Spark*,<sup>66</sup> ‘Only general prosperity can produce widespread consent for emissions reductions, and only affordable energy can deliver prosperity for all.’ This can be achieved by following three principles. The first is to take an *oblique* line of approach that commands public legitimacy: make people richer, more comfortable, safer and *take the environmental gains as benefits on the side*. The second is to follow a *universal* policy. Only a high-energy, global economy is morally defensible or politically viable: it is not acceptable to pursue policies that will leave the bottom billion of humanity without the energy services they require for wellbeing and dignity. This is the one great positive lesson of China’s escape from general poverty to a rising middle class, all in one generation. The third is to be *ambitious* – *ambire*, ‘to go around’ is the Latin root – emphasises the need for careful cultivation of political support. So relentless pragmatism is the most ambitious approach, not extravagant promises of impossible things.

As new, thermodynamically competent technologies emerge, less polluting and coincidentally less carbon-intensive than be-jewelled Veblenesque white elephants, their spontaneous adoption will follow if free people wish to buy and use them.

### **Repeal the Climate Change Act**

Second, abjure directive legislation, and repeal targets, starting with the target for ‘Net Zero’ carbon dioxide emissions, the virtue signal of all virtue signals, which sounds scientifically precise but signifies nothing. This can be done in the UK by repeal of the 2008 Climate Change Act, a piece of legislation that parliamentarians should have recognised as a category mistake from the start. No parliament has the power to regulate the awe-inspiring and largely mysterious self-organising complex adaptive systems of the global climate any more than King Canute had the authority to reverse the tides. Repeal will bring with it the benefit of the euthanising the ‘Climate Change Committee’ and the dispersal of its rent-seeking minions (and the multiplicity of its minions’ minions). It is a body that has always claimed to be objective, leading even the Office for Budget Responsibility astray,<sup>67</sup> despite obviously being the polar opposite.

### **Cut the Gordian Knot of renewables subsidies**

Third, cut the Gordian Knot of renewables subsidies. This is best done

in a clean stroke, and will provide a useful recurrent source of relief after the pandemic debt explosion. Wind power is truly the modern successor to the South Sea Bubble.<sup>68</sup> It is already in trouble, as was explained at the beginning of this paper, and withdrawal of subsidy will cause it to collapse as surely as the great speculations of the past. Likewise, the BEV industry will quickly implode, in what Schumpeter called 'a perennial gale of creative destruction'.<sup>69</sup>

These collapses are in the national interest and much to be desired. The loss of these industries is a much lesser evil than allowing them to continue in existence. The (ICE) motor industry is a prime Free World geo-strategic asset and, as has been explained, it is a national security priority that we reverse the damage being done to it, and put an end to the perverse investment decisions that are forced upon it by coercive decarbonisation targets. Fortunately, still only a small proportion of the UK vehicle fleet is composed of BEVs. That is why it is important to admit the error and reverse out of the cul-de-sac decisively – and fast. Take note that James Dyson, that canny inventor who holds patents on the finest micro-electric motors, has withdrawn entirely from his earlier intention to enter the electric car business.<sup>70</sup>

### **Secure the energy system and fix the grid**

Fourth, we must take all necessary steps to avoid the risk of energy (or strategic-mineral) blackmail. Mr Putin knows exactly how to use gas and pipelines to exert his will, as he did over Ukraine in 2006; he now appears to be playing a role in the UK's rolling 2021 gas supply crisis, alongside serial civil service mismanagement and political decisions that have distorted the energy market. Furthermore, the strategically illiterate and weak Biden administration has just twice folded its hand: in the high stakes poker game that it was playing with Putin over the Nordstream-2 pipeline to Germany,<sup>71</sup> and in the Great Game over Afghanistan, where its ignominious surrender has left the China, along with Iran and Pakistan, as principal beneficiaries of that strategic space and its mineral riches.

In the electricity sector, security also means fixing the grid. The aim should be to restore firm dispatchable power and grid stability, such as the UK had in abundance only twenty years ago, before the renewables excursion began. This too is a national security priority.

As the Germans have discovered, that may mean a return to coal, as well as freeing the market for gas. Fluidised-bed coal combustion<sup>72</sup> and modern scrubbers could quickly provide reliable, dispatchable and acceptably clean baseload power, as well as bringing valuable inertia to stabilise the system. This is the road already taken by Germany in attempting to limit the damage caused by the *Energiewende*. Great Britain still has excellent coal reserves and a wealth of natural gas resources. If the temperatures in our Cold Wars continue to drop, a serious security policy would not refuse to use them.

And of course, there is nuclear power (of which more below), now on the verge of a spectacular rebirth through the adoption of small modular reactors, an area in which the US, the UK and Japan all hold technological first-mover advantage. The Anglosphere possesses abundant uranium reserves.<sup>73</sup>

## Protect critical industries

Fifth, industries that are critical to our national security should be protected from hostile take-over or investment. This would cover areas where Peking has gained a foothold, such as infrastructure, and the power generating sector. However, although China is manifestly the primary surfaced threat, it is not alone, as Russian submarine development and deployments remind us.

Properly drafted legislation can protect our critical national security industries and infrastructure from predatory attack from any direction. Such protection is quite consistent with a presumption for free trade. Indeed, it is required in the current geo-political environment.

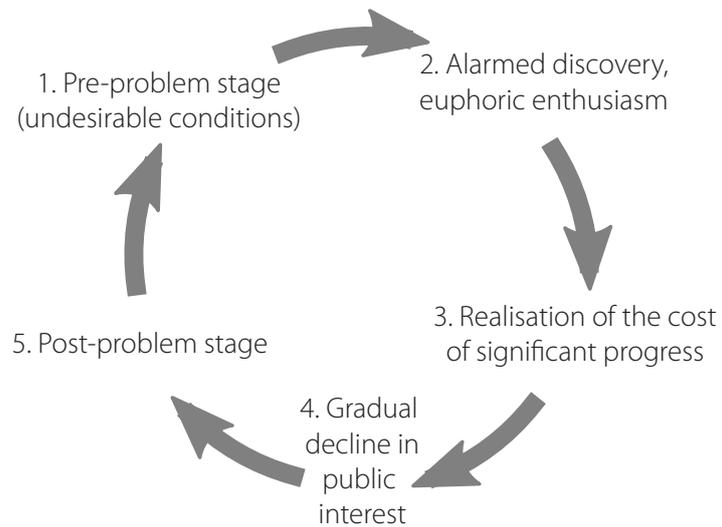
## Take back the COP

Sixth and finally, we must take back control of the 26th IPCC Conference of the Parties (COP26) from environmental extremists. The previous 25 COPs have all failed, a history that has been documented and explained in detail by Dr Eija-Riitta Anneli Korhola, a historian of the COPs and a former senior participant in the process.<sup>74</sup> There is little evidence that Glasgow will be any different.

It must be clearly understood that the entire COP process has irremovable design faults built into it. My colleague the late Steve Rayner and I explained these faults in 2007 in a *Nature* article that became one of the most read of that year. First, we explained why politicians find our analysis so difficult to digest: 'Economic theory,' we wrote, 'recognizes the futility of throwing good money after bad. In politics, however, sunk costs are seen as political capital or as an investment of reputation and status.' They still do. We then explained that the Kyoto strategy, of which the COP process is a main product, '...is elegant but misguided', being a combination of three major policy initiatives of the 1980s to deal with, respectively, ozone depletion, acid rain and nuclear arms control. All three of these difficult problems are bounded whereas climate change is unbounded (often described as 'wicked', after the famous coinage of Rittel and Webber<sup>75</sup>). It was not foolish of diplomats to cast about for examples of processes that had worked in the past, but the rough analogies they drew committed category errors along the way. Tons of CO<sub>2</sub> are nothing like nuclear warheads in the START (Strategic Arms Reduction Treaty) template that was loosely borrowed; a top-down global carbon trading market, as Kyoto envisaged, was far less likely to be valid when applied to the global economy than a national market for a single, very controllable pollutant in a single industrial sector, the approach that had successfully controlled US sulphur emissions.<sup>76</sup>

Moreover, public attention appears to be shifting away from climate change. Figure 9 shows the celebrated 'issue-attention' cycle, first published by Anthony Downs in 1972. It has proven to be an accurate account of the way in which three cycles of interest in environmental

Figure 9: The Downs issue-attention cycle



causes have waxed and waned since then.<sup>¶</sup> While different communities are obviously at different points in the cycle, rational mainstream public opinion in the West is currently at and moving from Stage 3 to Stage 4, in which interest in an issue declines. This paper is a reasoned contribution to Stage 3. We could soon enter the fifth stage: ‘a twilight realm of lesser attention or spasmodic recurrences of interest.’<sup>77</sup>

The BRICS nations have already declared in increasingly blunt language that they will not accept dictation from catastrophist-influenced western leaders such as Biden or Johnson. We therefore risk seeing a repeat of the ambush at the Copenhagen COP15 in December 2009, when China and its BRICS allies seized the pen.

The British PM’s boosterish instinct and natural competitiveness are to call always for more of whatever it is.\*\* Yet here, with the security of the Free World at stake, that would be a bad mistake, and possibly something more: as Albert Einstein observed, the definition of insanity is to continue doing the same thing while expecting a different outcome.

Failure may seem the most likely outcome for COP26, but it doesn’t have to be this way. COP26 also represents an opportunity for the Free World. It is an opportunity to break three chains simultaneously: the cycle of serial failure in climate summits, to free itself from the shackles of centrally planned stupidity, and to address the security threat of Xi’s grey war. Furthermore, if we were to do so, we could reap vast collateral environmental benefits along the way. To seize this opportunity, Mr Johnson must take back control from the rampant ‘green’ lobbyists and keep them away from the diplomatic control levers. He must turn his position around and lead the nation – and indeed the entire Free World – across a narrow, well-specified and strong golden bridge to that prosperous future.

¶ It has also been deployed operationally, with notable success, in tracking other extremist movements. Empirical research suggests that the ‘dwell time’ for a well-balanced individual in Stage 2 is at maximum eighteen months to two years.

\*\* Usually described as Johnsonian ‘cakeism’: the simultaneous having and eating of cake.

Part V: The Golden Bridge





## A plan for energy security

To understand the Golden Bridge, one must recall the Laws of Thermodynamics (usefully aided perhaps by Flanders and Swann's immortal song on the subject<sup>78</sup> – the lyrics are supplied in the endnote) and ask how, in the real worlds of geo-politics and of physics, the following puzzle might be solved.

Which technologies might provide enough high-quality energy to enable all to flourish, while meeting all five of the following conditions:

- (1) does not require subsidies
- (2) lower cost
- (3) lower emissions
- (4) avoids 'lock-in' to defective, thermodynamically incompetent technologies
- (5) sustains national security?

The technologies that meet these tests are the Golden Bridge to a prosperous future.

## Free energy markets and the Golden Bridge

It can be done. The Free World's aim at COP26 should be simply to liberate the energy market. No less, no more. This will deliver spontaneous decarbonisation without need for intrusive and democratically corrosive government-set targets and timetables. Phalanxes of civil servants can be let go to find economically nett positive employment in the non-parasitic economy.

Once freed, the energy market is likely to move swiftly to natural gas (combined cycle gas turbines) and then to nuclear (advanced small modular reactors, SMRs), since these technologies align best with the five conditions specified above.

This is no pipe-dream. CCGTs are here, and mature. The technology has evolved from the great industrial success story of aerojets, and our strong historical tradition in heavy electrical engineering going back to the 'Brown Revolution' of the 1950s and 60s in the UK. Its rational deployment has simply been throttled by anti-competitive bias towards 'new renewables'.

Some major reactor designers, notably Rolls Royce in the UK and Nuscale in the USA, are already zeroing in on small modular nuclear reactors capable of raising steam for electricity generation.<sup>††</sup> SMRs' smallness is a virtue, conferring flexibility: such designs can eventually be built on production lines, and they are inherently fail-safe. Higher demand can be met by modular ad-

<sup>††</sup> It is a case of history repeating itself for Rolls Royce, in that they are bringing ashore their highly mature nuclear submarine propulsion technologies. The first US – indeed world first – civil power plant at the appropriately named Shippingport, which went critical in 1957, was in fact a landed version of the US Navy's pressurised water reactor.

dition rather than building an entire new plant, which was the philosophy in the past, when bigger was better and when thoughts of terrorist attack were not so prominent. There is therefore both a security of supply and a physical security advantage in modular distributed generation compared to vulnerable large-scale pressurised water reactor designs, and there are good grounds to expect that they will bring much lower costs as well.

The current world-leading demonstrator of small modular nuclear technology is the Japanese High Temperature Helium Gas Cooled Test Reactor (HTTR). The first design concepts for the reactor were published in 1969, and it is now tested and fully operational. It uses pelletised uranium fuel, which ingeniously increases cooling surface area without increasing reactor size. This allows it to generate prodigious amounts of heat, and in 2004 the HTTR became the first nuclear unit to achieve 950°C output. Such temperatures mean that HTTR can be used to provide high process heat, in volume and at competitive cost, as well as electricity. It also means that unlike the 'blue' and 'green' production methods, it will be EROEI-positive to use HTTR to create hydrogen at scale from water in the presence of catalysts. The design has positive control (like the deadman's handle on a railway loco), meaning that with hands off, the reactor goes to sleep. It is essentially meltdown proof. Since that time, the reactor has undergone long test runs, at full power, without problems, as well as a successful loss of coolant test. In 2020 it obtained regulatory approval to commence operations in July 2021.

Crucially, all the key intellectual property involved in these technologies is in Free World brains and hands, making this bridge China-proof. Four key jurisdictions – Australia, Japan, the United States and the United Kingdom – matter above all (Australia as a secure source of uranium ore). Therefore AUKUS, the nuclear submarine propulsion alliance between the three Anglophone nations, opens the way to saving COP26 by crossing the Golden Bridge to a gas and nuclear future, for both involve nuclear co-operation. Nuclear technology co-operation is proven to be the premier diplomatic bonding agent because it signals a unique depth of trust. AUKUS will reinvigorate Five Eyes and Anglosphere collaborations in other areas of advanced science too; quantum computing for example.<sup>79</sup> The diplomatic message that AUKUS sent out has been widely seen as exceptionally powerful. Comparisons have been made to the original 1958 UK–USA nuclear collaboration agreement. If, at a minimum, the UK, the US, Australia and Japan were to adopt the Golden Bridge goal at COP26, the signal sent out would produce a phase-change in international attitudes to the energy–environment nexus. It would also – amazingly – break the run of failure that is the history of the COPs, and deliver the prospect of sustainable emissions reductions – sustainable in the sense of not harming the OECD states, not hampering the developing world, and not leaving us vulnerable to Chinese ghost attack.

## **The need for adaptation**

In addition, it would be prudent to underpin the Golden Bridge on clean energy with a global public safety strategy composed of adaptation measures to extreme weather events, unpredictable and irregular in incidence as they are. From the Group's inception in 2007, the Hartwell Group members advocated lifting the taboo on adaptation.<sup>80</sup> It did not happen at the required scale. During the 2021 Hurricane Ida event, contrasting the success of levée strengthening and other measures that occurred after Hurricane Katrina in 2005 on the Gulf Coast with the unpreparedness for extreme weather in New York City, showed just how cost-effective investment in adaptation can be as a way to deal with irregular extreme weather events.<sup>81</sup> Adaptation is just a sensible insurance policy.

The costs of failure to invest in adaptation, not the arrival of evidence of climate change in extreme weather signals, are the principal lesson of recent floods in Germany and fires in the USA and in Australia last year where, despite warnings, environmentalists, overruling foresters and aboriginal knowledge, had prevented controlled burning which allowed the fires to become more intense. For decades, green zealots have disapproved of spending on adaptation which they saw as defeatist. Even more, they feared adaptation as an obstruction to their more intrusive agenda. Al Gore said as much. We are now seeing the results. Today, prudent cost minimisation and adaptation strategies are advocated pre-eminently by the Government of Japan.

## **A coalition of the willing**

It is rational to have a proportionate policy on decarbonisation. But any decarbonisation policy must itself be rational rather than an exercise in virtue signalling. A firmly EROEI-positive clean energy policy – which is where the Golden Bridge of gas-to-SMR nuclear leads – alongside pre-emptive adaptation to extreme weather, can create a coalition of the willing among the democracies, the likes of which we have never yet had in the energy and environment nexus.

It would also put the Free World onto the front foot geopolitically. It would deny the United Front Work Department its opportunities to encourage us to continue self-harming. It would sever our reliance on the PRC for any critical elements in our energy security. It would enable the Free World once more to offer real help to its friends, whose loyalties are being tempted away by China through its Belt and Road neo-imperialism.

In sum, the Golden Bridge can lead us back into the rose garden where, like all right-thinking people, we long to be; and the roses that we shall find there will not disappoint, for they will no longer conceal worms in their beds of crimson joy.

Devon  
20 September 2021

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# First and Second Law

The first law of thermodynamics:

Heat is work and work is heat.

Heat is work and work is heat.

Very good.

The second law of thermodynamics:

Heat cannot of itself pass from one body to a hotter body.

Heat cannot of itself pass from one body to a hotter body.

Heat won't pass from a cooler to a hotter.

Heat won't pass from a cooler to a hotter.

You can try it if you like but you far better not-er!

You can try it if you like but you far better not-er!

'Cause the cold in the cooler will get hotter as a rule-r,

'Cause the cold in the cooler will get hotter as a rule-r,

Because the hotter body's heat will pass to the cooler

'Cause the hotter body's heat will pass to the cooler

First Law:

Heat is work and work is heat and work is heat and heat is work.

Heat will pass by conduction.

Heat will pass by conduction.

Heat will pass by convection.

Heat will pass by convection.

Heat will pass by radiation.

Heat will pass by radiation.

And that's a physical law!

Heat is work, and work's a curse

And all the heat in the universe

Is gonna cool down

'Cause it can't increase

Then there'll be no more work

And there'll be perfect peace

Really?

Yeah, that's entropy, man!

And all because of the second law of thermodynamics, which lays down:

That you can't pass heat from a cooler to a hotter

Try it if you like but you far better not-er

'Cause the cold in the cooler will get hotter as a rule-r

'Cause the hotter body's heat will pass to the cooler

Oh, you can't pass heat from the cooler to the hotter

You can try it if you like but you'll only look a fool-er

'Cause the cold in the cooler will get hotter as a ruler

And that's a physical law...

Oh, I'm hot!

Hot? That's because you've been working!

Oh, Beatles nothing!

And that's the first and second law of thermodynamics!



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