PUTTING THE GENIE BACK

Solving the Climate and Energy Dilemma

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BY

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INVESTOR IN PEOPLE

‘ … there remains inevitability around political action and legislation to deal with carbon dioxide emissions. It’s not just politics that dictates this, but physics. Society can’t keep on adding carbon dioxide to the atmosphere and expect nothing to change’.

GLOSSARY OF TERMS

AAU	Assigned Amount Unit.
AOSIS	Alliance of Small Island States.
BECCS	Bioenergy Use with Carbon Capture and Storage.
CBDR	Common but Differentiated Responsibilities.
CCS	Carbon Capture and Storage.
CDM	Clean Development Mechanism.
CER	Certified Emissions Reduction.
CFC	Chlorofluorocarbon.
CLG	The Prince of Wales' Corporate Leaders Group (on climate change).
COP	Conference of the Parties
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation.
CPLC	Carbon Pricing Leadership Coalition.
DACCS	Direct Air Capture of Carbon Dioxide and Storage.
ENSO	El Niño Southern Oscillation.
EOR	Enhanced Oil Recovery.
ERU	Emission Reduction Unit.
ETS	Emissions Trading System.
EU ETS	European Emissions Trading System.

EV	Electric Vehicle (including hydrogen, battery electric and plug-in hybrid vehicles).
GCCSI	Global Carbon Capture and Storage Institute.
GDP	Gross Domestic Product.
GHG	Greenhouse Gas.
HFC	Hydro-fluorocarbon.
HSFO	High Sulphur Fuel Oil.
ICE	Internal Combustion Engine (vehicle).
ICAO	International Civil Aviation Organisation.
IEA	International Energy Agency.
IETA	International Emissions Trading Association.
IGSM	Integrated Global System Modelling.
IPCC	Intergovernmental Panel on Climate Change.
ITL	International Transaction Log.
ITMO	Internationally Transferred Mitigation Outcomes.
JI	Joint Implementation.
LNG	Liquefied Natural Gas.
MBM	Market Based Mechanism.
MITJP	Massachusetts Institute of Technology (MIT) Joint programme on the Science and Policy of Global Change.
NDC	Nationally Determined Contribution (but prefixed with 'I' for intended prior to the adoption of the Paris Agreement).
NDRC	National Development and Reform Commission.

NER	New Entrant Reserve (of the EU ETS).
NET	Negative Emission Technology.
NOAA	National Oceanic and Atmospheric Administration.
PV	Photo Voltaic (solar cell).
ROW	Rest of World.
RPK	Revenue Passenger Kilometres.
SLCP	Short Lived Climate Pollutants.
UNEP	United Nations Environment Programme.
UNFCCC	United Nations Framework Convention on Climate Change.
WBCSD	World Business Council for Sustainable Development.
WMO	World Meteorological Organization.

ENERGY DEFINITIONS AND UNIT ABBREVIATIONS USED

This book uses energy units in discussing the energy system. There are three that are most important.

Joule	The joule, symbol J, is a derived unit of energy in the International System of Units. Approximately 4.2 J is required to heat 1 gram of water by 1°C.
Watt	The SI unit of power, symbol W, equivalent to 1 joule per second, it is the rate of consumption of energy.
Watt-hour	A measure of electrical energy, symbol Wh, equivalent to a power consumption of 1 watt for 1 hour. The Watt-Hour and Joule are interchangeable through a conversion factor of 3600 J/Wh, but Watt-Hour is used for electricity generation, whereas the Joule is used for energy more broadly.

In addition, the energy system is described in terms of primary and final energy.

Primary	Primary energy is an energy form found in nature that has not been subjected to any conversion or transformation process. It is

	energy contained in raw fuels such as coal, and other forms of energy received as input to a system. Primary energy can be non-renewable or renewable.
Final	Final energy is energy supplied to the final consumer for all energy uses. Electricity is final energy, as is natural gas when used directly for cooking and heating at home. But natural gas can also be classified as primary energy when taken directly from the ground into the energy system for use in a power station.
Barrel	A quantity of oil, 42 US Gallons or about 159 litres. Global oil production is about 95 million barrels per day.
EJ	Exajoules — one quintillion (10^{18}) joules. In 2015 global primary energy use was approximately 550 EJ.
Gt	Gigatonnes — one billion (10^{9}) tonnes. The largest coal fired power station in the world, a 5.5-GW facility in Taiwan, will emit about 2 billion tonnes of carbon dioxide over its lifetime.
GW	Gigawatt — 1 billion (10^{9}) watts. A 1-GW power station is the typical size for a modern coal, gas, or nuclear installation. The UK has about 50 GW of installed gas- and coal-fired power-generation capacity.
kg	Kilogramme, an SI unit of mass.
Mt	1 million tonnes.
Mtpa	Million tonnes per annum.

ppm	Parts per million by volume (of a gas in the atmosphere).
t	1 tonne or 1000 kg.
TWh	Terrawatt hours – 1 trillion (10^{12}) Watt-hours. A 1-GW power station operating for 300 days per year will produce about 7 TWh.
°C	Degree Celsius, a measure of temperature.

ABOUT THE AUTHOR

David Hone is Chief Climate Change Advisor at Shell International Ltd. He joined Shell in 1980 after graduating as a Chemical Engineer from the University of Adelaide in Australia, and previously held positions in refinery technology, oil trading, and shipping areas for Shell. David has been the principal climate change adviser for Shell since 2001 and has represented the company in that capacity in a wide variety of forums. He is a board member of the International Emissions Trading Association (IETA), was Chairman of IETA from 2011 to 2013, and is a board member of the Center for Climate and Energy Solutions (C2ES) in Washington.

FOREWORD: DONALD TRUMP AND THE PARIS AGREEMENT

As this book was being readied for publication, President Donald Trump announced that the United States would withdraw from the Paris Agreement. Heads of State from all corners of the world quickly responded, vowing to uphold the Agreement and ensure its continuance. But can the Paris Agreement, as discussed extensively in the pages that follow, survive?

There is an element of déjà vu to this event. Just days into my new job as climate change adviser in Shell, then President George W. Bush announced that the United States was withdrawing completely from the Kyoto Protocol and would follow an alternative path forward in terms of climate action. At the time, he proposed a significant step-up in technology development through the National Climate Change Technology Initiative and a leadership role by the United States to work within the United Nations framework and elsewhere to develop with its friends and allies and nations throughout the world an effective and science-based response to the issue of global warming.

The June 2001 Bush announcement was widely expected and indeed, it helped spell the end for the Kyoto Protocol. The UNFCCC process fractured as a result, with some Parties continuing to pursue the Kyoto

Protocol and all Parties brought back to the table to negotiate a new deal that worked for the United States. This gave birth to the Ad-Hoc Working Group on Long Term Cooperative Action, which together with the Kyoto Protocol arrangements could have potentially combined into a satisfactory global deal. Unfortunately, they didn't, with the meltdown in Copenhagen being the outcome. But the pieces were reassembled, in large part led by the United States under President Obama, with the result being the Paris Agreement in December 2015. That process took over 14 years to complete.

Sixteen years on from the Bush announcement and again from the White House lawn, President Trump has now declared that the United Stated will exit the Paris Agreement, once again with the caveat that the Administration would be open to a renegotiation or even an entirely new agreement. The reasons given are largely the same as those of President Bush; unfairness, competitiveness concerns, negative economic impact, layoffs of workers and price increases for consumers. But the circumstances are very different this time around.

Looking 14 years ahead from today we will be in the 2030s. My own analysis in Chapter 2 shows this as the time when we may start to see years in which the global average temperature rise could equal or exceed 1.5°C above the level in the mid-1800s. There isn't any grace period remaining to reorganise, negotiate and agree yet another climate deal. Nor should that happen; the Paris Agreement is structured to reflect what countries can offer, with no requirement other than that successive offers should improve over time and ratchet towards the end goal of net-zero emissions in the second half of the

century. The Agreement isn't a good or bad deal for anyone; it simply reflects the progression required over time as nations either continue or begin to proactively manage emissions and eventually contain them.

The Paris Agreement is made up of national contributions, determined by nations per their domestic circumstances. This is the case for all countries, from the United States of America as the world's largest economy through to Zimbabwe as one of the poorest. Although the Agreement asks for developed countries to implement economy-wide absolute emission reduction targets, there is an expectation that all countries move in this direction and the Agreement encourages such movement. Several developing countries have structured their national contributions to reflect this and in the time since the negotiations concluded, more have implemented measures to that effect. For example, China is implementing a nationwide emissions trading system and emissions within their economy are now expected to peak well before 2030, ahead of their stated national contribution.

With all nations supposedly on a pathway towards absolute targets and eventually net-zero emissions, there is nothing left to negotiate other than the timeline along which this proceeds, although as I discuss in Chapter 3 the current timeline leaves the world well short of a 2°C outcome. Once again, the Agreement sets out the process for addressing this, rather than Parties having to resort to yet another negotiating process towards an alternative agreement. There is a transparency framework, a stocktake process and a mechanism to facilitate implementation of and promote compliance with the provisions of the Agreement. Although the proposed mechanism is

facilitative in nature and should function in a manner that is transparent, non-adversarial and non-punitive, it nevertheless offers the opportunity for a country such as the United States to negotiate more rapid convergence of effort.

Both Chancellor Merkel and President Macron, along with UNFCCC Executive Secretary Patricia Espinosa, made it clear the morning after President Trump's announcement that there would be no renegotiation of the Paris Agreement. While anything is possible in theory, a renegotiation would put an end to the Agreement and probably not deliver a replacement for a decade or more. They were right to reject the proposal; in any case, it simply isn't necessary under the structure that exists.

Given all the above, the current Administration may still be concerned about the effort required by the United States to deliver its stated goal of a reduction of 26–28% in emissions by 2025 against a 2005 baseline, particularly when compared to some countries. Although the current surge in natural gas production and its replacement of coal for power generation, the advance of renewable energy and the roll-out of electric vehicles are all contributing to a fall in US emissions, the target remains ambitious. While the prospect of success is visible within the energy transition that is underway, the United States could simply resubmit its national contribution. Various parts of the Paris Agreement and the accompanying Decision Text open the door to such a step, and former Secretary of State John Kerry, who negotiated the Agreement for the United States, said as much on the BBC shortly after the Trump announcement. Although successive national contributions are required to demonstrate

increased ambition under the Agreement, this is the first such submission and therefore can be revised.

By resubmitting its national contribution, some semblance of renegotiation would be achieved, at least in part. A new contribution from the United States would still require an absolute target as this is required of developed countries under Article 4.4, but the number could have a much wider margin, covering the expectation of economic growth that the President alluded to in his speech on June 1. Of course, this isn't an ideal outcome from an emissions perspective, but it would keep the United States in the frame for some time to come and allow them to pursue further equivalency of effort through the implementation mechanism.

Should the United States end up on a path of true departure, this will still take until November 2020 to execute. A Party cannot serve notice of termination until three years after the Agreement enters into force and then there is a period of one year before their participation ends. While such a period does not extend beyond the term of the current Administration, it nevertheless represents a long time in politics.

In the meantime, some 195 other countries will continue to implement their national contributions through a variety of approaches. The European Union, for example, is pursuing a reduction of 40% by 2030 against a 1990 baseline, utilising a cap-and-trade system for the large emission sources such as power stations. Even within the United States, the current energy transition will continue, with much the same result in terms of emissions in 2020 and possibly even 2025 as would have been the case with the national contribution in place. Deactivation of the

contribution is unlikely to spur new construction of coal-fired power stations given the intense competitive pressure from natural gas and renewables. Even discounting current competition, there remains the prospect of future carbon constraints imposed at some point within the 50+ year lifetime of a new coal-fired power station.

But the energy transition is just one element of the Paris Agreement; emissions management is at its core. This will require more than just an energy transition to implement, probably requiring large-scale deployment of negative emissions technologies which I discuss at length in Chapters 3, 5 and 7, including geological storage of carbon dioxide. This latter step may be the one that suffers following the US announcement.

The Paris Agreement can and likely will survive the events of June 1. But if other nations don't step up and look beyond their own energy transitions, focussing squarely on the need for a net-zero emissions outcome within the next 50-80 years, then the goal of the Agreement may be at risk.

INTRODUCTION

In mid-2008, the head of the Shell media team dropped by my desk with a proposal for the company to take an early step out of the world of traditional corporate communication and into the then new and emerging world of social media. The idea was to set up a regular blog series that discussed issues pertinent to the company and its stakeholders. With climate change a central issue for society, the plan was to start on this subject. As the leading climate change person within the company, I was asked to think about topics to kick off the initiative. A few months later I was up and running with my first posts covering emissions trading, policy development, and the energy transition. The opportunity was also a great fit with my role, which requires me to be something of an independent voice internally on climate change.

The blog is now heading towards a decade of posts and somewhat perversely, it has rather outlasted the initial enthusiasm for the idea. By 2017 there were nearly 400 posts, with several hundred thousand words of content covering almost every aspect of the climate issue. I have found that readership is quite wide, mainly through direct feedback from readers who I meet by chance at conferences and even socially.

As a chemical engineer with 37 years' experience in the oil and gas industry, my goal has always been to tackle the climate issue from an engineering perspective; based on data, built on facts and without the histrionics and emotion

that have come to define this subject in many quarters. In 2014, I began work on a series of three short e-books that bought to life some of the ideas from my blog, succinctly covering many of the pertinent issues of climate change today, including carbon trading and the Paris Agreement.

This book brings together and builds on my blog and the e-books. It tells the story of the climate change issue and the transition in the energy system that must be implemented to finally address the issue. At its most ambitious, the Paris Agreement implies economic and societal change on a scale that sees carbon dioxide emissions fall rapidly from 40 billion tonnes per annum in 2016, to net-zero by the middle of the century. Yet our fossil fuel based energy system which ushered in the Industrial Revolution nearly 200 years ago continues to grow and evolve even as new sources of energy come into the market and compete.

The principal economic instrument for change is clear and has been for over two decades, but in 2017 only a fraction of the global economy actively employs government led carbon pricing policies and within that none of these systems operate at a level commensurate with the pace of change that is necessary. As deployment of new energy technologies accelerates, can solutions be found to cover the full range of services delivered by fossil fuels and can warming be limited to the agreed global goals? The book explores the climate issue from its very beginnings through to the end of the 21st century and looks in depth at the transition challenge that society faces.

Data from the book are sourced from Shell and from the University of Oxford, IEA, NASA, NOAA and CDIAC and all proceeds of the book will go to an NGO working on climate change-related issues.