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TEN KEY PRIORITIES, INNOVATIONS AND ACTIONS TO MITIGATE THE CLIMATE CRISIS

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Abstract

We discuss ten key priorities, innovations and actions to mitigate the climate crisis. These priorities were identified by the Hutton Series on Climate Change, which took place across 2020–2021 at Adam Smith's Panmure House. The Hutton Series brought together a diverse cross section of experts, business leaders, scientists and concerned citizens in open discourse around energy, climate change and resource use and availability. The priorities highlight the increasing need for reasoned debate and action between industry, NGOs, government and the public.

Keywords: climate change; James Hutton; Adam Smith; Carbon; Energy transition

1. Introduction

This article outlines the ten key priorities that emerged from debates between experts, business leaders, scientists, and concerned citizens as part of the Hutton Series on Climate Change under the auspices of Panmure House—the house of Adam Smith in the heart of Edinburgh (Panmure House, 2022a). Panmure House is the final remaining home of the 18th century philosopher and economist Adam Smith. James Hutton, ‘the father of modern geology’, was the executor of Smith’s will and a frequent visitor to Panmure House at the height of the Scottish Enlightenment. Working from Panmure House, Adam Smith created a fresh understanding of how human societies function, while his colleague and friend James Hutton redefined our understanding of the Earth. We feel that we are at a similar juncture in society at present.

The discussions held at Panmure House and Edinburgh then, at the dawn of the industrial revolution, resonate strongly with those required now as we grapple with a global energy use transition. The Hutton Series on Climate Change, which took place in 2020–2021, explored the relevance of Smith’s philosophies to society’s greatest challenge—climate change. The series was designed to provide open discourse around energy, climate change and resource use and availability, in recognition of the increasing need for reasoned debate between industry, NGOs, government and the public. It brought together a diverse cross section of speakers in the service of one simple aim: to identify ten key priorities, innovations and actions to mitigate the climate crisis.

While the full output, videos, quotes and additional perspective contributions can be found at the Panmure House website (Panmure House, 2022a), here, we provide a brief outline of the format. The Hutton Series ran over six sessions in 2020/2021 and was directly impacted by the COVID crisis. Initially planned as a series of think tanks working within Panmure House, in the end, all the sessions were run virtually and streamed globally. Although this might have reduced the open and frank discussion format

that would have been achieved inside a Panmure House debate, it did result in far greater reach with some sessions reaching more than 500 people. In the final session, it was possible to have an open vote on priorities and these are discussed in this article.

The participants in each of the six sessions are listed in Panmure House (2022a). The outcomes are also summarised in an infographic that is available from the Panmure House website (Panmure House, 2022b). <https://www.panmurehouse.org/programmes/hutton-series-on-climate-change/series-reports-perspectives/hutton-series-infographic/>.

2. Key priorities, innovations and actions to mitigate the climate crisis

The Hutton Series identified ten key priorities for mitigating the climate crisis. These priorities and proposals are outlined and discussed below.

2.1. Ambition

An ambitious whole-system approach is required, involving innovation in technology and in social, economic and political spheres. Globally, people must address this problem now as there are inherent social and economic costs in not transitioning to zero-C as quickly and as justly as possible.

Priority 1: Create a mission that prioritises positive and transformative discussion, embedding a measurable pathway for community awareness of climate and environmental action in the public's mind, as well as in business and scientific practices.

2.2. Education

We need to provide future generations with a platform for discussing the ways in which their lifestyles can and must change in order to achieve zero-C consumption.

Priority 2: Through schools, universities and citizens assemblies, provide a platform for global conversation on how lifestyles can and will change within a generation to achieve net-zero carbon emissions. Provide people with training as well as accredited, intelligent and interactive tools that allow them access to information on the environmental consequences of their actions.

2.3. Rank investments on environmental, social and governance criteria

Through bold and impactful choices, the financial sector must think beyond its traditional sphere. The extent of corporate commitments to net zero and to science-based targets is increasingly more important than government commitments. We must firmly decouple growth from the use of fossil fuels and the associated carbon dioxide emissions, and thus need a broader definition of what it means to have a thriving economy. We have a responsibility to demonstrate through sustainable financial reporting how we can indeed decouple economic growth from carbon emissions.

Priority 3: Provide clarity of purpose through better branding of environmental, social and governance (ESG) investments, including the removal of default investment pension positions. In the United Kingdom, enforce the requirements of the Task Force on Climate Related Financial Disclosures (2023) and create an open marketplace discussion around the rankings of ESG financial tools and the setting of social values in investment—'saving to save the planet'.

2.4. Innovative investment opportunities

The science and technology needed for the energy transition already largely exists but requires optimisation. The transition is achievable. Nonetheless, governments and industries must scale and accelerate activities to achieve net zero targets. There are challenges in developing the capital front-end

infrastructure expenditures needed to achieve net zero. The focus needs to be on technology to remove greenhouse gases (GHGs) at large scale (i.e., multiple technologies each capable of removing at least one billion tonnes per year), but also respect trade-offs within the global ecosystem. The costs of the engineering solutions are not considered a blocking point, and as for wind turbines, EV and solar power capacity, costs are expected to decrease with deployment.

However, a capital injection of at least three times current capital deployment is needed.

Priority 4: Focus business models that attract inward investment and support the skills transition for the reduction to net-zero carbon on the more difficult innovation challenges. These will include aviation fuels, energy-intensive industries (cement, metals and chemicals) and data centres. Use a regional corridor approach that considers the whole system and measures the trade-offs and benefits of integrating zero-carbon solutions, including carbon capture, utilisation and storage (CCUS), low-carbon fuels, bioenergy and renewables.

2.5. Taxes and incentives

The development of new technologies and policy frameworks should be encouraged and supported so they can then be exported and help the journey to net zero in the rest of the world. China is the world's biggest emitter of GHGs; it has announced generally moderate new energy and climate targets but is now moving significantly to talk about net zero by 2060.

It is possible to continue to see growth and prosperity globally and to tackle the climate issues that we face, and there is a role for groups such as the G20 (responsible for ~80% of the GHG emissions) to push the technological implementation.

In developing nations, there needs to be a net zero movement that skips the use of fossil fuels in developing their economies and thus moves immediately onto clean fuels.

Corporates have moved from discussing climate change issues as an economic threat to viewing them as an economic opportunity with potential for innovation and profits. The extent of corporate commitments to net zero and science-based targets is increasingly more important than government commitments. Governments should support the development of carbon markets but ensure that they put an appropriate price on carbon to enable investment in technologies—global carbon trading and offsets envisaged by some of the UN processes must be accountable.

Stakeholders must firmly decouple growth from the use of fossil fuels and the associated carbon dioxide emissions and thus need a broader definition of what it means to have a thriving economy. Therefore, we have a responsibility to demonstrate through sustainable financial reporting how we can indeed decouple economic growth from carbon emissions.

There is a need for awareness that technologies such as Bioenergy with carbon capture and storage (BECCs) (Fajardy and Greenfield, 2023) might create complacency among businesses who may then ease their own GHG reduction efforts.

Aviation should only be using scalable-engineered offsets through BECCS (or comparable technologies) to offset the remaining emissions from using fossil fuels in the future. Corporates must not misuse offsets, and we should not be thinking of forestry as a scalable offset, as that is already part of the path to net zero. Corporates channelling their resources into decarbonisation solutions will reduce the amount of support that governments need to provide. However, ongoing and potential use of low-quality offsets will undermine support for the whole carbon removal industry, and where this occurs, it must be challenged.

Priority 5: Instate selected taxes coupled with regulation, including levies on hydrocarbons and coal production. Incentives from the government and finance sectors must ensure that the industry adapts to new ways of working. Measure this through investment progress, actions and achievements against climate change targets, and present this alongside the United Kingdom and Devolved Administrations' annual budgets.

2.6. Carbon tax

We need to quantify the value of carbon avoidance and the creation of a spectrum of country- or region-specific carbon trading systems.

Introduce progressive pricing, taxing and otherwise identify carbon on a global scale with regional application modelled along the lines of the Baker-Schultz Plan (2019).

China is establishing country-specific carbon trading policies and actively pursuing zero-C technology. India, which is currently >80% dependent on fossil fuels, requires help and incentives to engage with the energy transition.

Governments will need to provide confidence for investors and encourage commercial investment through a well-connected public and private sector operating through targeted investments, for example, in asset-backed infrastructure with private sector leaseback, decarbonising housing stock and in EV charging networks. It was suggested that governments can build on earlier public sector pilot investment success, such as for wind energy. The United Kingdom should lead by example on zero-C actions, but these actions must be global.

People need to change behaviours as consumers to reduce the stress on global resources and to reduce waste resulting from consumption. As improvements in technology are unlikely to move at the rate needed to curb demands for natural resources, lifestyle changes, both physiological and psychological, are required. The consent for the transition will come from the people, and it is vital that there is the involvement of local communities. The population is continuing to increase as is the average income in developing economies. Better quality of life, along with female empowerment and education, will result in a stabilisation of population growth. People should be allowed to control what they consume and focus on demand-side values, rather than supply-side. Thus, people need to be provided with the tools to understand what they can achieve, for example, tools allowing an understanding of energy density versus power density.

Priority 6: Create a fair carbon tax coupled with regulation and introduce progressive pricing and taxing on a global scale with regional application modelled along the lines of the Baker-Schultz Plan. At the same time, ensure social harmony and shield those who are least able to afford the costs of the transition to net zero.

2.7. Global engineering ethos

The oceans are a significant reservoir for carbon, for which we can enhance carbon uptake: a) through natural systems (enhanced fish stocks, kelp beds, cold coral and warm coral installations) and b) through biomimicry, including ocean seeding and refreezing in polar regions—for example, with cloud-brightening technology Committee on Geengineering Climate (2015). Direct air capture in projects, such as Carbfix (2023), is a reality and needs to be sacked up globally.

Priority 7: Research and test novel technological solutions. Some may be high-risk, for example, the application of biomimicry; direct air or mineralisation capture, bioenergy with carbon capture and storage, ocean-seeding and refreezing in polar regions with cloud-brightening technology. The ethos of engineering must progress rapidly by adopting a duty of care for the planet and achieving the required fossil fuel, nitrogen oxide and other man-made GHG reductions. This shift needs to mirror the scale of progress achieved by recent advances in vaccine technologies.

2.8. Energy and energy storage

There is an import transition in energy use and associated infrastructure, and related behavioural patterns. A value shift is needed where engineers are viewed as providing a gift to humanity rather than doing something bad for humanity (Quote from Professor Susan Krumdieck, Professor and

Chair in Energy Transition at Heriot-Watt University). Engineers must have as their ethos, as part of their training and professional life, the substitution of fossil fuels, in the same way as for health and safety. The focus will be transition engineering, where engineers work on changing what is unsustainable.

Deep and rapid emissions reduction is required to see that the fossil fuel era is in the past, and we must also ensure that we stop deforestation, particularly in tropical forests. There is a need to focus on technology to remove GHGs at large scale (e.g., multiple technologies, each removing at least one billion tonnes year and totalling 20–30 billion tonnes a year removal), but also respect trade-offs within the global ecosystem.

The costs of the engineering solutions are not considered a blocking point; as for wind turbines, EV and solar power capacity, costs are expected to decrease with deployment.

A capital injection of ~£3.5 trillion which is at least three times the current capital deployment, is needed. We need to look particularly at solutions to remove carbon dioxide from the atmosphere that mimic what happens in the biological world—biomimicry is a way forward.

Although nuclear fission energy to date is the only low-carbon source for which costs have increased year-on-year, it needs to be part of the solution, especially as a very reliable base-load, with a focus on small nuclear. Research in nuclear fusion should be maintained.

The transition will require incentives and levies on oil and gas and coal companies to reduce production by as much as 10% p.a. year-on-year. State-owned companies produce ~80% of the world's oil and gas, and incentives to replace revenue must be found to accelerate the process of decommissioning oil, gas and coal production. People of all sectors and degrees of income cannot do without traditional sources of energy unless they are provided with readily available substitutes at a cost, which is affordable across the whole nation.

CCUS can be deployed rapidly and globally, even if only as a transitional measure.

Priority 8: Accelerate the energy transition through the removal of hydrocarbons as an energy source and decarbonise heating and cooling. Augment renewable solutions, including the rapid rollout of hydrogen technologies and energy storage possibilities, and consider nuclear technology to provide a reliable energy base-load.

2.9. Transport

Carbon-negative mass transport needs to become a focus of the transition to Net Zero, especially in city environments. Low-to-zero-C fuels for transport, including synthetic fuels, may replace EV in time, given the existing infrastructure availability.

Priority 9: Create a new infrastructure for transport that will enable the replacement of conventional transport systems. Implement growth in electric vehicles, electric rail and urban trams, as well as innovation in marine and terrestrial freight logistics and airline travel. Develop low-to-zero-carbon synthetic fuels for transport.

2.10. Global availability of resources

Demand might outstrip supply for critical metals: care can be placed on environmental consequences of mining, especially in the developing world where artisanal sources are still predominant for critical metals, including tin, tungsten, tantalum (the 3Ts) and lithium. New batteries and fuel technology will change the demand for metals.

Priority 10: Rationalise and optimise the demand for critical metals. Manage the environmental consequences of mining, recycling and repurposing, including optimising material processes through redefining design and manufacturing. Develop new battery storage technology.

2.11. Ranking of priorities

The Hutton Series’ final session was structured by visiting each of the above priorities and corresponding actions in turn by asking the speakers to comment on them before turning to a Mentimeter poll (Mentimeter, 2023) to gauge the audience response. The poll results are given in Table 1 and listed in order of priorities identified. These can only be viewed as an indication and may not be the priorities of the speakers, although all the categories listed were introduced during the five technical panel discussions.

3. Conclusion

The Hutton Series was completed during the COVID pandemic, the last event being on 29 June 2021; most of the participants are featured in Panmure House (2022a) and listed in the acknowledgements. It provided a unique meeting place for scientists, engineers, business, finance and civil society and the sort of discussion that we believe James Hutton, Adam Smith would have had towards the end of the 18C when society was changing rapidly, and new energy sources were being harnessed.

The science and engineering that we now know was less siloed then and engineers readily took on new discoveries from basic science. The social and business frameworks around these developments changed dramatically during the industrial revolution although some of the consequences of the changes on our ecosystem were not predicted. When the Hutton Series was completed, Russia had not invaded Ukraine and one suspects that some of the arguments on the national security of energy systems would have been enhanced, but the underlying messages related to the solutions needed for climate change remain the same.

Overall, it is clear that we as a global population need to change our behaviours as consumers to reduce the stress on global resources and to reduce waste resulting from consumption. As improvements in technology are unlikely to move at the rate needed to curb demands for natural resources, lifestyle changes, both physiological and psychological, are required. The consent for the transition will come from the people, and it is vital that there is involvement of local communities.

We must firmly decouple growth from the use of fossil fuels and the associated carbon dioxide emissions, and thus need a broader definition of what it means to have a thriving economy. We have a responsibility to demonstrate through sustainable financial reporting how we can indeed decouple

Table 1. Mentimeter poll result

1) RANK IN ORDER OF PRIORITY IN MITIGATING CLIMATE CRISIS: BEHAVIOURAL CHANGE, CULTURE SHIFT & COMMUNITY ACTION
<p>Culture: embed a culture of climate and environmental action</p> <ol style="list-style-type: none"> 1. Collaboration: innovations must engage with consumers’ choices via citizen’s assemblies 2. Education: in schools and universities starting at primary level 3. Tracking: provide interactive tools for carbon footprint tracking 4. Self-perception: modify the way we talk and think about ourselves
2) RANK IN ORDER OF PRIORITY IN MITIGATING CLIMATE CRISIS: GOVERNMENT, POLICY AND GLOBAL COHESION
<p>Taxes and incentives</p> <ol style="list-style-type: none"> 1. Circular economy 2. Levies on oil and gas 3. Annual climate target budget 4. Carbon tax 5. Supply chains
3) RANK IN ORDER OF PRIORITY IN MITIGATING CLIMATE CRISIS: SCIENCE, TECHNOLOGY AND ENGINEERING
<p>Carbon capture</p> <ol style="list-style-type: none"> 1. Engineering 2. Transport

economic growth from carbon emissions. Through bold and impactful choices, the financial sector must think beyond its traditional sphere.

Governments must provide leadership, as well as policy decisions that have a long-term sustainability focus. Governments need to provide confidence for investors and encourage commercial investment through a well-connected public and private sector, operating through targeted investments, building on earlier public sector pilot investment successes. The United Kingdom should lead by example on zero-C actions, but these actions must ultimately be adopted globally.

The science and technology needed for the energy transition already largely exists but requires optimisation. The transition is achievable. Nonetheless, we must scale and accelerate activities to achieve net zero targets.

The Hutton Series led to the development of the second declaration of the Panmure House, which is given below, and all participants endorsed with the hope that this declaration will guide future actions and decisions.

The second declaration of Panmure House urges citizens, leaders, and investors to act collectively to ensure the success of net-zero carbon goals within a generation. All must commit to a culture of equitable and environmentally sustainable actions to ensure a rapid reduction in carbon use and to preserve our way of life through innovative science and engineering, financial and social accountabilities, open collaboration and long-term decision-making.

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