

Major Capital Projects Review - Call for Evidence.

Evidence submission by Equilibrion Limited

About You

1. What is the name of your organisation?

Equilibrion Limited

Equilibrion is a UK SME determined to be the world's first producer of Sustainable Aviation Fuel (SAF) using the input power from nuclear energy.

Nuclear-derived SAF uses electricity and heat to produce zero-carbon sustainable aviation fuel. These fuels are predicted to make up 45% of the global aviation fuel market by 2050 but require vast quantities of uninterrupted electricity and heat that only nuclear energy can provide. There is strong HMG policy support through the proposed SAF Mandate and from Europe within the ReFuelEU package.

We plan to develop and deploy SAF production facilities powered by Small Modular Reactors (SMRs) and Advanced Nuclear Reactors (AMRs) in the UK. Securing offtake agreements from global airlines will lead to final investment decisions by the late 2020s and operation in 2035, with the potential for at least 20 facilities in the UK to meet SAF demand. We have received extensive interest from the airlines in our nuclear-derived SAF projects, collectively known as 'Eq.Flight'. Airlines are increasingly alert to the fact that only nuclear energy can deliver on their decarbonisation targets and Eq.Flight projects can meet these targets.

Other approaches for SAF production are either reliant on crop and biomass feedstock, so have an inherent limitation on scale and ability to localise in the UK with a high demand on land use for agriculture, or are inefficient and higher cost in the case of renewables-powered SAF production which also presents the intractable challenge of how a variable energy source can power a refinery scale system that requires heat and power 24 hours a day 7 days a week.

One nuclear-derived SAF facility could provide up to 6000 jobs in construction and up to 1000 for 60 years of operation. New nuclear siting and routes to market policies, currently being consulted on could enable us to breathe new life into communities across the UK. With our approach, the UK can steal a march on international competitors and become a great SAF-producing nation.

HMG policy includes measures to promote the production of SAF from nuclear energy but the upcoming SAF Mandate treats imported SAF the same as that produced in the UK with the risk of diluting the UK benefits that could be achieved from this nascent green industry.

We believe that UK air miles should drive UK investment and create UK jobs and that SAF production on UK shores should be prioritised in locations across the UK particularly in industrial heartlands where jobs could be at risk due to the energy transition.

We would be delighted to talk further with you on the opportunity for the UK to be a world leader in this new and exciting area of nuclear-derived SAF.

2. Do you represent a particular interest group? If so who?

No.

3. Which sectors are you particularly interested in?

Nuclear, Hydrogen, Aviation

4. What are your contact details for any follow-up?

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Headline Questions

1. How can we improve estimates of costs, benefits, and timescales to completion for major projects?

Estimates of cost: Learning from experience and cross-sector expertise

Nuclear is an internationalised market and approaches to project delivery in one country are highly relevant to another. The UK can learn from international projects through its multilateral and bilateral strategic partnerships with countries including USA, UAE, South Korea and Japan where previous fleet-build nuclear programmes have been delivered at scale and pace with the effect of reducing overall unit cost and increasing build certainty.

Benefits: UK infrastructure development should be prioritised over imports

For SAF production, we believe that UK infrastructure build-out should be incentivised over SAF imports which would see benefits felt by other countries over the UK. The SAF Mandate does not offer a distinction between SAF produced in the UK and SAF imported, which means the UK could lose out on the jobs and tax revenues compared to UK production. A distinction between UK and international production would deliver clear additionality of UK socio-economic benefits compared to the current baseline.

Timescales: Rushing to partial solutions could risk net zero and lead to additional cost

Many HMG policies, targets and direct funding focusses on achieving near-term deployment and quick wins, which drives investment in technologies that can deliver quickly but are likely to be less scalable, less sustainable or with fewer benefits to the UK in the longer term. HMG should take a holistic view of infrastructure deployment that can be delivered on a range of timescales. This means supporting projects with a range of delivery timescales in a proportionate way including those with longer timescales where the long-term benefits to

energy consumers, taxpayers, the public and the exchequer are clear, as is the case with Eq.Flight.

2. Does the Civil Service have access to the skills it needs for the successful delivery of major projects? If not what is needed?

In respect of nuclear-related projects, of which Eq.Flight would be, the civil service has access to but does not appropriately deploy its capability. The nuclear team in DESNZ is highly capable, but the nuclear knowledge in other relevant departments and teams is lacking. For example, although DfT includes nuclear in its policies for achieving aviation decarbonisation it has limited access to the skills needed to achieve this. The same is the case in other areas, for example, hydrogen where nuclear is also included as a qualifying production route, but again there is no clear access route for the hydrogen team to access nuclear knowledge. Ensuring that all relevant 'end-use' sector teams have access to the appropriate nuclear capability should be a priority.

This could be achieved through providing access to industry specialist expertise to be called on by a range of teams and departments as required, or by ensuring appropriate X-Whitehall engagements to leverage HMG's wider capability.

3. How can we ensure greater transparency and regular reporting of project data to improve delivery?

No comment

4. How can government plan for changes in the external environment, including inflation, rising interest rates and other factors?

The three most effective approaches for reducing risks in these areas are provided below.

- a. Maximise UK production of primary energy and fuels, including SAF, thereby partially insulating the UK from international market price fluctuations and ensuring socio-economic value and tax revenues stay in the UK. In the aftermath of the Russian invasion of Ukraine, France saw the smallest electricity price spike of any European country due primarily to its strength of domestic nuclear-electricity production, thus demonstrating the value of producing domestic energy products with nuclear energy. This could be the case for the UK and for energy products other than electricity;
- b. Maximise the UK content in the supply chain for infrastructure projects to ensure value and jobs remain in the UK. This can be achieved by providing the Department for Business and Trade with the resources to work with project development companies and set targets for projects to achieve minimum percentages of UK content. This should be a X-Whitehall priority. HMG's current approach does not press for UK content as much as it could and there is an opportunity to reflect the approach taken by other countries, which tend to place a higher priority on securing scope for their domestic supply chains than the UK does.

- c. To develop technologies that have a greater UK content in the supply chain by default. It is well known that the vast majority of renewable energy technology is produced elsewhere and imported to the UK. The UK is left with assembly and construction jobs, while the higher value-add activities in the supply chain are in other countries, including a high proportion in China. Nuclear energy is an optimal example of where supply chain jobs are inherently UK-based with deep and extensive capability, including in enriched uranium and nuclear fuel production. These UK-based activities place a demand for well-paid jobs and supply chain activity throughout the life of a nuclear asset, unlike other technologies that support only a fraction of through-life jobs. But there are opportunities to do more. The UK should also reassess its ability to support SMRs in new ways, building UK factories that can export SMR/AMR components around the world. This will not happen automatically and the right HMG support and incentives are required to ensure these jobs and facilities are placed in the UK in preference over other countries.

5. How can projects contribute more to UK economic goals, including supporting UK supply chains, jobs, and skills?

First and foremost, the priority should be ensuring the projects are in the UK in the first place, which then enables HMG to utilise further levers to ensure maximum benefits are realised and socio-economic goals delivered.

Achieving this means policy must be set to incentivise UK deployment with a focus on economic, social, supply chain and skills outcomes. If decarbonisation policy in energy end-use sectors and other policies do not promote UK infrastructure development, then commercial profit could drive international deployment and perverse outcomes for UK consumer and energy user spending that, as a result, benefits the treasuries of other international Governments and their residents.

For example, the current SAF Mandate policy, due to come into force in 2025, does not currently propose to incentivise UK production of SAF and does not distinguish between UK-produced and imported SAF. This could draw investment to other countries and away from the UK. Alternatively, incentivising UK production could improve socio-economic outcomes and better deliver on levelling up, value to the taxpayer (in terms of tax revenues) and ensuring no community is left behind as part of the energy transition.

6. How can the machinery of government be improved to support the delivery of major capital projects?

Equilibrion staff have previously held roles within and supporting HMG departments and would like to make the following observations:

- a. X-Whitehall coordination and communication should be installed as a key part of departmental functioning where there are interlacing policy objectives and

priorities. An example is the linkage between nuclear deployment policy and DfT transportation decarbonisation policy. To the best of our knowledge, the nuclear teams within DESNZ do not engage with the DfT teams tasked with delivering low-carbon fuels and SAF policy despite nuclear-derived fuels being written into policy on both sides. There is a clear opportunity to enhance cross-departmental engagement to ensure that the right projects are commissioned and particularly those that stand to support the objectives of multiple departments, as is the case for nuclear-derived SAF and Eq.Flight.

- b. Treasury has in the past prioritised shorter-term returns over longer-term savings for energy users and the taxpayer. This is borne out in the National Audit Office assessment on the value for money assessment of the Hinkley Point C strike price agreement (<https://www.nao.org.uk/wp-content/uploads/2017/06/Hinkley-Point-C.pdf>). This report found that consumers would be significantly better off if HMG had invested directly into the Hinkley Point C project. HMG investment in domestic, long-lifetime energy infrastructure pays dividends in the long-term, not only in terms of reduced bills but in the ability of the UK to attract manufacturing and industry, which desire low-carbon, secure and consistent energy supplies and make long-term investments based on where these can be guaranteed. The relocation of BASF chemical plants from Germany to China to avoid high energy prices is a prime example of commercial decisions disadvantaging domestic jobs and supply chain security.
- c. Energy System Modelling should equitably represent all technologies available to us and consider socio-economic benefit as a key driver for decision-making on energy system infrastructure. For example, system modelling on hydrogen production can prefer CCUS-enabled hydrogen deployment, which requires imported natural gas. However, nuclear-enabled hydrogen is often not included fully in the modelling despite this technology having clear environmental, jobs and socio-economic benefits owing to its nature as a strong UK jobs driver that delivers on all levelling up priorities for 60 years into the future. These issues are also the case for nuclear-derived SAF, where the technology is not included in modelling despite commercial organisations already pursuing projects. There is a further issue in that different government departments use different energy system modelling approaches and draw different conclusions, which hinders overall HMG decision-making and can confuse investors and project developers. For example, the energy system modelling relied on by DESNZ and the Treasury are different.
- c. Equilibrion supports the principle of setting up Great British Energy but doing so should recognise the equally valuable role of Great British Nuclear as a complementary but separate entity. Governments around the world recognise the value in having state-owned energy infrastructure including operators and developer organisations that can bring major investment and capability to bear in the long-term interest of their public. Examples include Ontario Power Generation in Ontario, Canada; EDF in France; Korea Hydro and Nuclear Power in South Korea; Vattenfall in Sweden. In fact, the UK is one of the few

nations that does not have public ownership of nuclear operator capability and it is our view that HMG intervention is required in this area.

Current and future major projects

1. What projects or initiatives do you think should be prioritised for the future development of UK infrastructure, and why?

Eq.Flight provides a means for the UK to be a global leader in the production of nuclear-derived SAF and steal a march on international competitors to become a great SAF-producing nation. Based on UK policy and public and regional support, combined with a strong nuclear regulatory regime and world-leading academic capability (Cranfield University, for example), the UK is the best place in the world to mobilise aviation-sector capital to deliver low-carbon infrastructure development. Eq.Flight has been introduced and the benefits outlined in previous sections.

2. Are there specific technological advancements or innovations that you believe can significantly benefit infrastructure delivery?

In respect of Eq.Flight, the technologies for nuclear-derived SAF are available now but require projects to drive commercial scale-up of sub-system manufacturing including electrolysers, fuels synthesis reactors, small modular reactors, direct air capture systems and fuel upgrade systems.

Innovation is required in the regulatory approval pathway for nuclear-derived SAF and in the method of operating the combined and adjacent nuclear and SAF systems.

3. What can we learn from the experience and approach taken by other nations in terms of accelerating infrastructure projects?

Thus far the UK has made progress in decarbonising its electricity generation but this is the lowest-hanging fruit for whole energy system decarbonisation. The primary energy challenge to replace fossil fuels in heating, industry and transportation leaves an enormous gap to be filled. Due to the energy density of extracted fossil fuels, the extent of primary energy production required far exceeds any energy-producing infrastructure built to date and for this reason, we believe a programmatic, fleet approach to the deployment of energy infrastructure is essential to achieve net zero while maximising value to the UK public and energy consumers. This includes the production of SAF and other synthetic fuels as drop-in replacements for today's fossil fuels while utilising existing infrastructure for fuels transportation and distribution. In this way, synthetic fuels reduces the investment required in infrastructure replacement and focusses investment on new, green building.

Procurement and supply chains:

4. How can we enable more efficient local supply chains?

Eq.Flight places demands on complex supply chains within both the nuclear, oil and gas and green industries. We believe that mobilising the UK's current supply chain capability offers a rapid and cost-effective way of scaling up deployment by pivoting existing oil and gas capability to this new, green enterprise that can deliver aviation decarbonisation and UK global leadership.

The UK also has world-leading capability in the nuclear fuel supply chain through Urenco enrichment facilities in Capenhurst in the Northwest of England and Westinghouse fuel fabrication facilities at Springfields, also in the Northwest of England. Nuclear-derived SAF facilities will place a demand on these critical parts of the nuclear fuel supply chain for 60 years, supporting well-paid jobs for generations of workers and site supply chains with a potential need for more extensive facilities.

The nuclear industry is highly skilled in local stakeholder engagement and centralised leadership to coordinate supply chains and bring together consortia of companies that may ordinarily be considered competitors can ensure competitiveness, reduce red tape, ensure equal opportunities for all companies and promote UK content in a competitive international environment.

The nuclear sector is also highly internationalised and working with multi-lateral and bilateral fora to undertake supply chain mapping and where appropriate share supply chains to reduce overlap or duplicated investment.

As a result of Brexit, the UK is currently unable to participate in the 'European Industrial Alliance on Small Modular Reactors' (https://single-market-economy.ec.europa.eu/industry/strategy/industrial-alliances/european-industrial-alliance-small-modular-reactors_en), which places the UK at risk of being isolated and left behind in the race to secure investment for SMR projects. This should be addressed with urgent actions to ensure the UK has a seat at this important table or risk developers, investors and technology companies favouring the EU market. A recent statement from Rolls-Royce SMR indicated that the UK could lose out on its first deployment (<https://www.proactiveinvestors.co.uk/companies/news/1041657/rolls-royce-warns-first-mini-nuclear-reactors-could-be-built-elsewhere-1041657.html>).

Supply chains can be mobilised more effectively when there is foresight for multiple projects to demand components, materials and resources. In the case of nuclear, and in particular SMRs and Eq.Flight, the best and in fact only way to achieve this is to set a path to fleet deployments to enable investment in the technology and manufacturing facilities needed to deliver reactors and fuel production systems with a production line approach that drives down costs through economies of multiples.

Future reforms, funding and investment

5. What do you see as the main obstacle to the private sector investing more significantly to help improve UKs infrastructure?

For Eq.Flight, the primary obstacles are:

1. Long-term policy certainty. The SAF Mandate and the Revenue Certainty Mechanism (RCM) are essential frameworks but DfT must be willing to engage with projects that have a longer time to first operation, rather than focussing exclusively on projects delivering by 2030. Continuing this mindset will hinder the ability of the UK to achieve net zero carbon emissions by 2050 and severely constrain the technologies that the UK can rely upon for decarbonisation. In doing so, opportunities for job creation and levelling up will also be lost.
2. HMG needs to show leadership with initial investment in nuclear-derived SAF projects to show commitment to this groundbreaking technology that goes beyond inclusion in policy. Equilibrion stands ready to deliver an Eq.Flight project alongside some of the largest engineering companies in the world, who all back our plans. This could be an early win for the new Government showing leadership in nuclear, aviation and clean industries projects. We have in place the project team, regional support, technology providers and the strong potential for matched funding from the private sector contingent on HMG support.

Further specific policy enablers are included below.

6. Are there regulatory changes or policy recommendations that you believe would be beneficial to accelerate investment and delivery?

The UK has mature nuclear regulatory and conventional health and safety frameworks, which are both relevant to our project but we do not see the need for significant, or potentially any, changes. There is an interface between the nuclear and non-nuclear SAF plant which will require engagement with the UK nuclear regulator, however, we are confident that there are no showstoppers.

Finalising the SAF Mandate and RCM are essential to provide investors with confidence in long-term offtake revenue, backed by HMG. For the RCM, there should be specific approaches to support nuclear-derived SAF projects, rather than include it in a generic RCM approach. For electricity RCMs, there are specific wind, solar and nuclear frameworks and we believe the same is required for the SAF market. For example, to enable nuclear-electricity projects to come forward and reduce risk to investors HMG introduced the Regulated Asset Base model, which is not available to solar and wind project financing.

The current activity of Great British Nuclear is for electricity projects, however, we encourage this to be widened to include all nuclear projects including those for SAF.

- 7. What do you see as the main alternative funding models* available to the sector to fund stations and their surrounding city developments?**
- 8. Are you aware of best practice approaches and case studies that have used alternative models with successful outcomes?**

No Comment

**Potential funding models may include, but not be limited to, examples that include the use of development corporations, private sector investment, and co-location of other infrastructure.*

Additional

- 9. Are there any other issues you would like to raise that are relevant to the Review's Terms of Reference?**

No comment