Citizen Participation and Public Petitions Committee
Wednesday 24 September 2025
14th Meeting, 2025 (Session 6)

PE2159: Halt the production of hydrogen from freshwater

Introduction

Petitioner	David Mackay on behalf of Innes Community Council
Petition summary	Calling on the Scottish Parliament to urge the Scottish Government to place a moratorium on the production of hydrogen from freshwater until scientific studies are undertaken to understand the impact on the environment, local economies and society.
Webpage	https://petitions.parliament.scot/petitions/PE2159

1. This is a new petition that was lodged on 6 May 2025.

2. A full summary of this petition and its aims can be found at **Annexe A**.

3. A SPICe briefing has been prepared to inform the Committee's consideration of the petition and can be found at **Annexe B**.

4. Every petition collects signatures while it remains under consideration. At the time of writing, 871 signatures have been received on this petition.

5. The Committee seeks views from the Scottish Government on all new petitions before they are formally considered.

6. The Committee has received submissions from the Scottish Government and the Petitioner, which are set out in **Annexe C** of this paper.

Action

7. The Committee is invited to consider what action it wishes to take.

Clerks to the Committee
September 2025

Annexe A: Summary of petition

PE2159: Halt the production of hydrogen from freshwater

Petitioner

David Mackay on behalf of Innes Community Council

Date Lodged

6 May 2025

Petition summary

Calling on the Scottish Parliament to urge the Scottish Government to place a moratorium on the production of hydrogen from freshwater until scientific studies are undertaken to understand the impact on the environment, local economies and society.

Background information

Green hydrogen is touted as a replacement for fossil fuels. Hydrogen production requires extreme and unsustainable volumes of fresh water. Borehole water is seen as a source. Manufacturing takes 25 to 40 litres of desalinated or freshwater to produce 1kg of hydrogen. 1kg of hydrogen will power a class 1 or 2 Large Goods Vehicle for 6 miles. One plant under development plans to use 500,000 litres of water per day to produce 12,800kg of hydrogen. Similar plants are proposed/under development. Water will be extracted from a very wide geographical area depending on ground conditions and regional rainfall. Water is a major element of life and is in short supply in many areas. The volumes to be extracted will adversely impact the countryside, local industries, agriculture, fishing, and households, and possibly affect flooding. Extracting water will cause serious adverse impacts on aquatic life.

Responses to my enquiries show little knowledge of the volume of water used and I have seen no scientific studies to identify possible adverse consequences.

Annexe B: SPICe briefing on PE2159

Petition Summary

Calling on the Scottish Parliament to urge the Scottish Government to place a moratorium on the production of hydrogen from freshwater until scientific studies are undertaken to understand the impact on the environment, local economies and society.

Brief overview of issues raised by petition.

Hydrogen is currently used in the UK as a feedstock in the chemicals industry and as part of the crude oil refining process, with a very small amount of hydrogen as a fuel in transport. There are thought to be very limited natural sources of pure hydrogen (more on this below) and thus it has had to be manufactured. Almost all of this manufacture involves the use of fossil fuels; globally it is 47% from gas, 27% from coal and 22% from oil with a very small remainder made using electricity. Water is also a necessary ingredient in many hydrogen production processes.

In Scotland, there is currently hydrogen produced via Steam Methane Reformation at the Grangemouth industrial site and also produced as a by-product in the production of ethylene at the Mossmorran industrial site.

Production via these means produces GHG emissions and is termed ‘grey hydrogen’. While the production may be polluting the combustion of hydrogen as fuel does not release GHG emissions, and as a result, there is an increasing interest in hydrogen as a low carbon source of energy. There are a variety of different methods of production being considered, each with its own colour code.

The currently prominent and prospective methods of production are:

- **Grey hydrogen**: hydrogen produced using natural gas and from steam methane reformers (SMR), resulting in GHG emissions. This grouping sometimes also includes hydrogen produced as a by-product in oil refining. The Scottish Government use the term ‘unabated hydrogen’.
- **Black / Brown hydrogen**: produced using coal, resulting in GHG emissions.
- **Blue hydrogen**: the same as grey hydrogen, but the carbon is captured and stored (CCS). CCS will likely not capture 100% emissions (see more information below). Inputs include methane and water. The Scottish Government sometimes use the term ‘low-carbon hydrogen’.
- **Green hydrogen**: produced using electrolysis, where electricity is used to split water into hydrogen and oxygen. When using renewable electricity this is

termed green hydrogen. Inputs include renewable electricity and water. The Scottish Government use the term ‘renewable hydrogen’.

- **Pink (or purple) hydrogen**: electrolysis to produce hydrogen but using electricity from nuclear power.

As Scotland moves to achieve its statutory net zero GHG emission, the Scottish Government and industry are focused predominantly on the blue and green methods of hydrogen production.

Water requirement for hydrogen production.

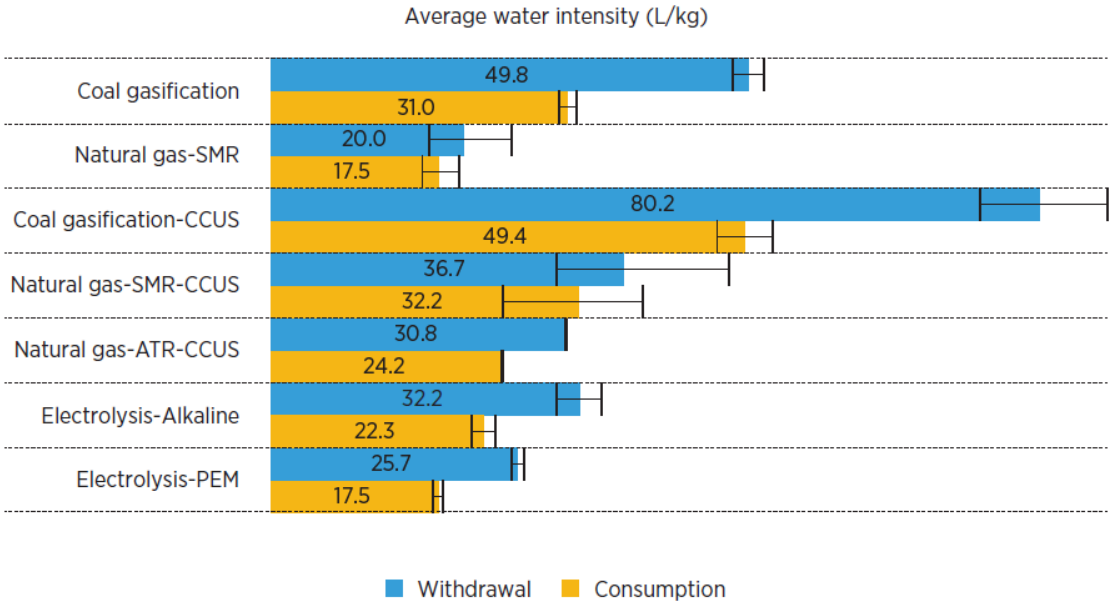
All hydrogen production technologies require water as an input. Green hydrogen production is the process of separating the hydrogen atoms from the oxygen atom in water, via electrolysis. While blue hydrogen production involves steam methane reformation, and thus also includes H_2O as a fundamental part of the process.

As Scotland moves to achieve it’s statutory net zero GHG emission, the Scottish Government and industry are focused predominantly on the blue and green methods of hydrogen production.

Within the general green and blue categories there are different methods that can be used. There are different forms of electrolysis, some involving alkaline methods and some involving a polymer electrolyte membrane (PEM). In blue hydrogen production, SMR can be used, or autothermal reforming (AMR). The International Renewable Energy Agency (IRENA) produced a report on Water for Hydrogen Production in 2023. They concluded that:

- It is found that on average, proton exchange membrane (PEM) electrolysis has the lowest water consumption intensity at about 17.5 litres per kilogramme of hydrogen (L/kg). Alkaline electrolysis follows PEM electrolysis, with a water consumption intensity of 22.3 L/kg. These may be compared with steam methane reforming–carbon capture, utilisation and storage (SMR-CCUS), at 32.2 L/kg, and autothermal reforming (ATR)-CCUS at 24.2 L/kg.

FIGURE S1 A comparison of average water withdrawal and consumption intensities by hydrogen production technology



In the above Graphic, taken from the IRENA report, there are figures for water Withdrawal and for Consumption. For each technology the Withdrawal figures are higher than the Consumption figures. The difference between the two figures is the amount of water that is returned to its source. The Consumption figure is the amount of water used in the production process, while the withdrawal figure includes water withdrawn but ultimately returned.

There are different sources of evidence on how much water is need for different hydrogen production techniques. A paper from Olaitan et al. (2024) finds that hydrogen production has a variable but generally high water footprint, and that hydrogen produced from water using renewable energy has a lower footprint than that produced using fossil fuels and carbon capture and storage (a similar finding to the IRENA study).

There are, however, sources which report higher water usage for green rather than blue hydrogen. A report from the engineering consultancy Arup from November 2023 on Water for Hydrogen has a different overall conclusion to the IRENA and Olaitan sources on which form of hydrogen production uses the most water, finding that:

- ‘water requirements are generally higher in the production of green hydrogen than blue, due to both feedstock water consumption and cooling water consumption and losses. There is also a higher water requirement when carrier conversion to liquid ammonia or liquid hydrogen is performed.’

The Clean Energy Group also report that more water is needed in the production of green hydrogen than there is for blue. The vast majority of the water required for blue hydrogen production is needed for cooling, with some amount of this able to be recycled.

Not all types of water are equally suitable for hydrogen production. Ordinarily, freshwater is used for electrolysis but seawater can be desalinated in order for it to be used; this adds to the overall cost of production. An article from the World Economic Forum, provides some useful background as to the type of water that is needed to produce hydrogen via electrolysis.

- 'Traditionally, water used for electrolysis undergoes purification through a commercial reverse osmosis process and may require subsequent deionization to remove remaining ions. Water quality supplied to the majority of modern water electrolysis systems must comply with ASTM Type II standard — essentially a cleaner quality of water — although many producers recommended compliance with ASTM Type I, the cleanest standard of commercially useable water.'

- 'ASTM Type I feedstock quality can easily be achieved by commercial reverse osmosis and deionisation plants. In essence, a vast number of large hydrogen projects announced globally will likely rely on seawater feedstock, however, they will require this extra processing step prior to feeding pure water into electrolyser to produce hydrogen.'

Scottish Water are promoting the use of treated waste water as a 'viable, cost-effective, and environmentally responsible alternative to traditional water sources' for hydrogen production. They believe that their Wastewater Asset Portfolio can provide good locations for hydrogen production. SEPA provide some guidance on the water abstraction and discharge involved with hydrogen production. They highlight that:

- 'Under the Water Environment (Controlled Activities) (Scotland) Regulations 2011 (CAR) the abstraction of water is a controlled activity and will require authorisation from SEPA. As hydrogen production may need a significant amount of water, pre-application discussions are strongly advised to ensure sufficient water is available at all times of the year'

They also suggest a hierarchy of supply, prioritised as follows

- Treated effluent.
- Seawater
- Ground/surface water.
- Treated public supply should be the last option.

Scottish Government hydrogen policy

The Scottish Government published a Hydrogen Policy Statement in 2020, which had little to say on the water requirements of hydrogen production:

- 'The key ingredients in green hydrogen production are renewable energy and water. Scotland has an abundance of wind, both on and offshore, tides, and reliable water resources within public control with which to support electrolysis.'

A Hydrogen Action Plan in 2022 included a commitment to:

- 'Ensure hydrogen development is planned where it can be best supported by available water resources: Our Enterprise Agencies have completed the Production Site Requirements Report that set out site requirements for large-scale renewable and low-carbon hydrogen production plants. Building on the production site requirements report, we will work with Scottish Water and industry to understand and map how water resources and infrastructure are distributed within Scotland and water availability for hydrogen production as part of our wider GIS-mapping activities.

The Scottish Enterprise commissioned 'Hydrogen Production and Export Locations: Site Requirements Study' was published in 2022.

The UK Government published a Hydrogen Strategy in 2021.

The UK Government have an explicitly 'twin-track approach' to hydrogen production policy, supporting green and blue. Although not so explicitly stated in policy documents, the Scottish Government has been thought to have similar approach. According to the UK's Scottish Affairs Committee report on Hydrogen in Scotland:

- **'**The UK and Scottish Governments have taken a twin track approach to hydrogen… the dual approach supported "both electrolytic (green) and CCUS enabled (blue) hydrogen'

In Scotland, the Hydrogen Policy Statement in 2020, committed to £100m funding towards the development of a hydrogen economy over the next five years. The Hydrogen Action Plan, set out that the £100m would come from the Emerging Energy Technologies Fund (EETF) and would be made available to support renewable (green) hydrogen production. As of April 2025, a total of £10.1m from the EETF has been pledged to hydrogen, with £8.6m of this disbursed.

The Hydrogen Innovation Scheme (part of the EETF) has offered grants totalling over £7m to 31 projects. A Hydrogen Business Development Service is also funded and delivered through the Energy Technology Partnership.

In September 2024, a new support fund for green hydrogen was announced with up to £7m available. Applications were open until the end of September with a maximum of £2m in match funding on offer.

In addition to this in August 2024, the Scottish Government announced £3.1m in support for the Speyside Hydrogen Project, operated by Storegga, who will match the funding.

£6.2m has been given to the Hydroglen project which is a 'green hydrogen powered farming community pilot project in north east Scotland' being run by the James Hutton institute.

At the UK level, the Hydrogen Production Business Model (HPBM) scheme, awarded its first contracts in July 2022 to solely green hydrogen projects (including two in Scotland), in Hydrogen Allocation Round 1 (HAR1)

- ‘The 11 projects have been agreed at a weighted average [footnote 1] strike price of £241/MWh (£175/MWh in 2012 prices). This compares well to the strike prices of other nascent technologies such as floating offshore wind and tidal stream.’

There is an HAR2 shortlist with 27 electrolytic projects, including various Scottish projects, hoping for a contract.

There is also the Net Zero Hydrogen Fund (NZHF) which aims to support the commercial deployment of new low carbon hydrogen production projects during the 2020s. Strand 1 of the NZHF provides development expenditure (DEVEX) for front end engineering design (FEED) and post-FEED activities, while Strand 2 provides capital expenditure (CAPEX) for projects that ‘do not require revenue support’ from the HPBM scheme. The first round of funding resulted in 15 successful applicants, four of which are based in Scotland. The second round of funding resulted in 7 successful projects, two of which are in Scotland. While all of these projects involve the production, storage or distribution of green hydrogen, the NZHF is open to blue hydrogen projects.

Niall Kerr

Senior Researcher, SPICe 10/06/2025

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Annexe C: Written submissions

Scottish Government written submission, 29 July 2025

PE2159/A: Halt the production of hydrogen from freshwater

Does the Scottish Government consider the specific ask of the petition to be practical or achievable?

Regulations are already in place for any activity which may affect Scotland's water environment. This includes the use of water for hydrogen developments which will require authorisation [P1] from SEPA under the terms of the Water Environment (Controlled Activities) (Scotland) Regulations 2011 (CAR). The CAR Regulations exist for the protection of the water environment, and the type of authorisation required will depend on the volume and location of the abstraction. SEPA must consult relevant public authorities about any CAR authorisations under consideration for activities likely to have a significant adverse effect on the water environment - and make the responses of those authorities publicly available during the period in which such authorisation applications are advertised. More information about this and the regulation of the water environment can be found on SEPA's website: Water | Scottish Environment Protection Agency (SEPA)

The development of Hydrogen Production projects will also require planning permission from the relevant planning authority. Scotland's planning system includes provisions for communities to contribute views about proposals which may affect them. In line with this, planning authorities front load consultation processes and take into account any comments on a case ahead of a decision being made.

It will fall to the relevant planning authority, in the first instance to consider whether a proposed development requires an Environmental Impact Assessment (EIA) to be undertaken. Planning authorities already have a well-established general responsibility to consider the environmental implications of developments which are subject to planning control, however an EIA can provide a more systematic method of assessing the environmental implications of developments that are likely to have significant effects.

Should an EIA be deemed necessary, the EIA regulations require the relevant planning authority to make details of any EIA development public - and provide details of where the EIA report is available for inspection free of charge or how copies may be obtained.

It will be for the relevant authority to interpret and implement relevant planning legislation and guidance as it deems appropriate given the circumstances in each case and to ensure that the provisions of the planning system are applied properly. Planning legislation requires that planning applications are determined in accordance with the development plan for the area unless material considerations indicate otherwise, each proposal being considered on its own merits.

Our National Planning Framework 4 (NPF4) sets out our strategy for working towards a net zero Scotland by 2045 and directly influences all planning decisions. It signals the key priorities for 'where' and 'what' development should take place at a

national level and is combined with national planning policy on 'how' development planning should manage change. NPF4 makes clear our support for all forms of renewable, low-carbon and zero emission technologies, including renewable and low-carbon hydrogen projects. Potential impacts on communities, nature and cultural heritage, including the cumulative effects of developments, are important considerations in the decision-making process.

What, if any, action the Scottish Government is currently taking to address the issues raised by this petition, and is any further action being considered that will achieve the ask of this petition?

None. Regulations are already in place for any activity which may affect Scotland's water environment.

Is there any further information the Scottish Government wish to bring to the Committee's attention, which would assist it in considering this petition?

It may also be helpful to highlight current work being undertaken by the Scottish Government on the future management of Scotland's water resources. This involved a recent consultation on the principles and considerations for water, waste water and drainage in developing policy for the future of the water industry in Scotland in response to the climate emergency. A analysis of the consultation feedback can be found on our website: Water, wastewater and drainage: consultation analysis - gov.scot (www.gov.scot)

Scottish Government is currently finalising its comprehensive **Planning and Consenting Guidance for Hydrogen Developments** which corals all the relevant information in one useful document – this will be published in the summer of 2025.

Hydrogen Policy Team

Petitioner written submission, 14 July 2025

PE2159/B: Halt the production of hydrogen from freshwater

We have read through the SPICe briefing and have the following observations.

Water usage is freshwater usage. Production of hydrogen is large scale. Freshwater required for the process will require additional rainfall. Groundwater is variable in volume and availability is dependent on soil structure and geographical location. Geological conditions control levels of groundwater. The geography increases runoff of rainwater, affecting groundwater levels. Groundwater feeds rivers and streams 24/7, and supplies moisture to plants and vegetation, which in turn support all species. Current water abstractions are already high on many river basins. There are no records of groundwater levels and storage capacity in different soil types and geographical locations. Water volumes/levels in rivers and streams control total aquatic biomass capacity. Less water, fewer aquatic species. Read rainfall, river flows, soil moisture deficit and groundwater storage on SEPA reports.

SEPA reports Scotland is experiencing longer, hotter and drier periods. Rainfall has hardly increased and is confined to shorter periods. Land becomes dry and hard, unable to soak up all rainfall, which runs off. It takes longer and more rain for

groundwater levels to recover. There is less snowfall, which melts quicker than previously, and no longer fully replenishes groundwater. Scotland has increasing periods of water shortages. Any process that abstracts additional groundwater will exacerbate that situation and will have major impacts on the ecology, environment and the economy.

The response identifies the volumes of water required to produce one kilogram of hydrogen. The electrolysis method uses the lowest volume. According to the graph, the freshwater requirement will be:

Abstracted:- up to 25.7 litres per 1 kg of hydrogen or 25,700 litres per 1 ton of hydrogen

Consumption:- 17.5 litres per 1 kg of hydrogen or 17,500 litres per ton of hydrogen.

More water will be abstracted than used for producing hydrogen. Excess abstraction will vary from plant to plant. Minimum excess extraction will be at least 25% of consumption. Excess abstraction will not be returned to groundwater.

One tonne of hydrogen will propel a large goods vehicle 6000 miles and a coach 10000 miles. Extrapolation of UK diesel consumption figures for 2023 suggests Scottish diesel consumption is approximately 2,500,000 tonnes a year. To meet that demand, the following additional volume of water will be required from groundwater abstraction:-

Abstraction - 64,250,000,000 litres or 64,250,000 cubic metres. That equates to 12% of the volume of Loch Lomond. Is equivalent to 2,141,666 road tankers of water.

Consumption - 43,750,000,000 litres or 43,750,000 cubic metres. That equates to the volume of 1,822,916 road tankers.

These calculations do not include water requirements to replace natural gas, heating and aviation fuel.

The water will be abstracted by borehole. It will be in addition to current abstractions, which are maintained by rainfall. Rainfall is not even across Scotland. Many areas experience the second-lowest levels in the UK. Many areas receive less than 1 cubic metre of rain per square metre of land per year. Natural water sources will require heavier rainfall to maintain current levels and support green hydrogen production. Current water resources are diminishing because of increasing water abstractions and weather. More high-volume abstractions are unsustainable.

Borehole abstraction draws water from a wide area. It lowers groundwater levels. SEPA records show Scotland is subject to longer and hotter dry spells. Scotland has lower snowfall, so the traditional snow melt no longer “tops up” groundwater levels. Groundwater levels sustain river and stream levels, vegetation, and the wide range of species that utilise the landscape. The lowering of groundwater levels will severely impact the whole of the countryside. Discharge of abstracted water will not replenish groundwater levels. This process of water abstraction, then partial discharging back into a river, will have a major impact on the dynamics of any water course, something that SEPA has not researched.

Water extraction has an adverse effect on streams and rivers. Longer, hotter, drier periods of weather reduce river water levels. Lower river levels increase temperatures and lower oxygen levels. That is fatal to fish and other aquatic species. Salmon numbers are already in decline, as are other aquatic species. Lower groundwater levels will have a major impact on vegetation, the ecology and environment, especially Sites of Special Scientific Interest and Special Areas of Conservation. A continuation of that situation will harm the environment, employment and the local economies.

Heavy rainfall does not initially soak in but runs off, causing flooding. Rainfall does not automatically replenish groundwater levels. Water abstraction draws water from wide areas. However, rainfall is not even across a whole river basin, therefore, heavy rain in one area will not raise groundwater levels in other parts of a catchment area.

Discharge water from sewage treatment plants will be minuscule against requirements and contain drug residues that will, when concentrated, impact the environment.

Green hydrogen production should be confined to coastal sites. Additional byproducts will cover extra costs.

Petitioner written submission, 3 September 2025

PE2159/C: Halt the production of hydrogen from freshwater

Innes Community Council (ICC) has considered the submission by the Government regarding our Petition. The response is the mandatory quote describing procedures and legislation for all developments. It demonstrates a lack of understanding/knowledge of the production requirements of that industry and the adverse impact it will have on any area/community. Communities in the ICC area express concerns about current procedures which do not reflect the impact that this industry will have on any community. Hydrogen production requires an extremely large volume of freshwater at the core of its function.

ICC does not believe that research has been commissioned by any Government Department/agency into the availability of freshwater nationally and its replenishment. Groundwater is replenished by rainfall and snowmelt. SEPA state that we are entering a period of long dry spells with less snowfall than historically, and the Meteorological Office confirms 2025 was one of the longest dry spells on record, evidenced by drought warnings across large areas of Scotland.

Large-scale hydrogen production is a new industry using a natural resource, i.e., freshwater. Neither the Government nor the hydrogen industry has calculated the total volume of water required to produce the hydrogen required for domestic and export markets, nor how groundwater will be replenished. Freshwater comes from groundwater reserves. Groundwater is replenished by rain. There is no other source to replenish groundwater. Freshwater for hydrogen production is an additional demand. That has not been factored into Government policies and the industry's push to market. There has been a complete lack of understanding within the Government and its departments as to why hydrogen production from freshwater is totally unsustainable. It will have a massive and adverse impact on the ecology, the

economy and the environment of Scotland. Ideology has overtaken research, reality, and public consultation, E.g., a scientific study of the Spey shows over 55% of the water from the catchment area, thus the river, is removed by abstraction, causing problems now and before extraction for hydrogen production is approved. Most Scottish rivers suffer this problem.

FOIs reveal SEPA, Marine Scotland Freshwater Division, Scottish Water, NatureScot and other agencies have done no research into groundwater levels and replenishment. International peer-reviewed/published papers explain the adverse impact of water abstraction through boreholes. SEPA does not believe water abstraction by borehole impacts river levels. No studies/research have been about the geological structures of Scotland, the ability of land to retain water, the mechanism of groundwater movements and replenishment. That should be part of every planning application.

The current consultation process was written before freshwater hydrogen production was considered. The current planning process ignores the environmental/ecological problems hydrogen production from freshwater causes. Public consultation is poor. Developers advertise plans to develop a plant. Prior consultation is short on detail. Current study requirements are for traditional construction projects, not projects that will have long-lasting and serious impacts on communities and the landscape of Scotland.

The current system of Planning Applications is rushed, allowing little time for public concerns and observations to be explored. SEPA is only involved initially with potential flooding. The EIA, the impact of water abstraction and other matters are done by desktop studies and speculation. Many are out of date. They fail to give proper environmental information because research has never been done. The public is not given technical information until after the application has been lodged. Applications are regularly submitted immediately before or during holiday periods, when they are less likely to be noted. Current planning applications are submitted before an application to SEPA for water abstraction licensing. SEPA gives a view on flood risk, not on the impact of water abstraction. SEPA permits the water abstraction after the planning application has been approved. There is no public consultation on water abstraction. The SEPA abstraction application should be processed before a planning application is submitted. That would save manhours and money should the abstraction is refused.

The public gets four weeks from the date of the lodging of an application to read, digest, and submit a comment. The public does not have access to the plans until the day after they have been lodged. Applications contain over 200 long technical documents (many desktop studies) that require close scrutiny and research. The public do it in their own time. It can take more than four weeks to receive, digest, research, and comment on these applications. As a result, a very high number do not respond. With no response from the public, it is assumed that there are no objections.

ICC is of the opinion that this subject is of such importance to the national economy, environment, ecology and communities that further discussion should be held in face-to-face meetings with the Committee and Government planning advisors and

policymakers rather than more paper processing. We would be willing to take part in those discussions.