Public consultation on the strategy for long-term EU greenhouse gas emissions reduction

Five main sectors contribute to emissions:

1. Transport

2. Industry

3. Heating (residential hot water, space heating, commercial building heat)

4. Electricity

5. Agriculture

1. Transport

There are a number of options here.

(i) Biofuels, renewable natural gas
(ii) Battery-electric
(iii) Hydrogen fuel cell electric
(iv) Natural gas
(v) Hydrogen-combustion (Conventional engine with retrofit)
(vi) Efficiency (via electrolysed hydrogen used in refinery processes, or via engine efficiency)

Many countries have extensive plans for hydrogen infrastructure. This is certain to become a growth industry as the cars operate in the same way as conventional vehicles, with much lower fuel costs, no emissions, no noise, much longer range, and refueling facilities that integrate smoothly with the grid by providing storage which allows for greater RES integration.

Long-distance vehicles, or vehicles that require maximal utilisation within a given time period will not be able to use batteries; for example emergency services vehicles, taxis, trucks and long-distance shipping.

Combustion engines in larger vehicles may also use hydrogen after retrofitting, enabling 100% hydrogen or dual-fuel operation. These are being used extensively in large vehicles with set routes such as road cleaning, refuse collection and delivery trucks. Access to hydrogen is key, also the size of hydrogen tanks.

Zero-emissions zones are a main driver for public transport.

Domestic hydrogen fuel production validates the use of initial subsidisation as the overall expenditure on fuel (electricity + capital costs) is retained by the economy.

2. Industry

(1) Process switching

If the industry already uses hydrogen, it may be possible to use regulation to switch the hydrogen from 'grey' to 'green'.

Many industries already use hydrogen; such as ammonia production for fertilizer, paints and chemicals including plastic production, oil refineries and some other niche uses in food and electronics.

These should all be regulated as the cost of hydrogen produced on-site via electrolysis is becoming competitive with methane-reformed (SMR) deliveries via truck or pipeline.

The CertifHy system offers a 'Guarantee of Origin' for different hydrogen sources.

(i) Switching from a different fuel-type

Further public-private-partnerships to expedite the uptake of hydrogen as a fuel in industry would enable companies to very quickly decarbonise, as hydrogen is a perfect fuel for high temperature processes; acting as a 'drop-in' replacement for natural gas.

Those industries still using coal will need regulations imposed.

The use of hydrogen means the production of hydrogen via electrolyser. The efficiency does not increase at scale, although the capex is likely to be much lower. This is also an opportunity to build RES capacity, where hydrogen can be stored (salt caverns exist throughout Europe for storage at scale, or plastic PE100 tanks).

Recent developments by thyssenkrupp in Germany have meant that new alkaline electrolysers are both low-cost and high efficiency (82%), being modular/scalable to the 100s of MW.

3. Heating

(i) Renewable Natural Gas
(ii) Hydrogen pipelines using CCS/CCUS
(iii) Electrification, using Air-to-air + air-to-water heat pumps
(iv) Direct electrification
(v) District heating
(vi) Home Fuel Cells

The use of Renewable Natural Gas is usually the best option here; using a combination of biogas and methanated hydrogen. This means doubling the quantity of biogas available via combination with the CO/CO2 fraction of biogas using either a single-step electrochemical process (CO2 is used within an electrolyser), biomethanisation (also low cost) or the Sabatier process, although others are being researched and higher efficiencies are likely to found in a single-step or bio-based process.

Seven major independent reports and a recent commercial report by SoCalGas have found that using either Renewable Natural Gas or hydrogen (usually via CCS/CCUS) is a cheaper option than electrification, and is also the prefered choice by consumers with far less costs relating to infrastructure or appliance-switching.

Any option that abandons the gas grid in favour of additional electricity infrastructure in most regions means up to 5-6 times peak load (for the grid) as gas is primarily used for warmth in winter, and encompasses the concept of storage which is a noted and perennial problem when considering the decarbonisation of heating via electricity.

4. Electricity

Electrolysis needs to be used in conjunction with electricity generation both to utilise excess capacity as percentages increase (large quantities of electricity are currently curtailed in many regions), and to switch off at times of high demand. Fees may be gained from this process.

This hydrogen can eventually be used in gas turbines, or more effectively used for industry or gas grid injection, for use in residential heating. This process is expected to be iterative as the cost of RES decreases.

The best use is in areas where the cost of SMR is high, and bottlenecks exist within the electricity infrastructure.

Most by-the-hour electricity peaks are met by dispatchable gas turbines; this gas will eventually have to be replaced by hydrogen.

Most of Europe's energy will either come from offshore wind from the North Sea, from nuclear plants and increasingly small modular reactors, and from solar in more southerly regions.

Floating offshore wind is expected to reach 4-6c/kWh by 2030.

The cost of solar is expected to fall far below wind, being the cheapest of all forms of energy. 1.4c/kWh is expected by 2022 in some regions - which makes hydrogen production via solar far cheaper than natural gas, even without the economic cost of importation (which is approximately double, or triple with social costs added).

5. Agriculture

Biogas is the only solution for the multiple crises that will effect agriculture this century.

Realistically, biomethane could supply about 50% of residential gas demand, with very promising developments in power-to-methane using some form of CO2 stream within a single-step application making up the remainder:

Waste streams utilised for biogas production are really a quick and simple way to reduce the many different types of agricultural GHG emissions. Below is why:

(i) The methane released by decomposing matter is the product being utilised; and when combusted this methane is downgraded to less immediately harmful CO2; while still being within the natural carbon cycle.

(ii) The residue from biogas production (substrate) is a valuable fertilizer, containing soil carbon and nutrients which can be returned to the soil.

(iii) Because less (or none at all – this is not uncommon) chemical fertilizer is being used, this offsets the use of fossil fuel for ammonia production, with its vast associated emissions.

(iv) This fertilizer is also not decomposing in the soil as it is not absorbed by plants, which halts the emission of NOx (nitrous oxide) emissions, which is the other major effect of chemical fertilizers.

(v) Pollution via run-off is eliminated.

(vi) The soil is gaining carbon rather than losing it, therefore being carbon-negative.

(vii) Because you avoid using chemical crop treatments, you can use bio-organic crop controls for pests and diseases.

(viii) No smell.

(ix) The soil becomes stronger with less water requirements and stronger crop resilience.

(x) Organic or semi-organic status improves the saleability of products.