

Hydrogen: Decarbonisation & Economic Sustainability

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Hydrogen Mobility Ireland

Hydrogen Ireland Association

Peru & Ireland

PERU
1,285,216 sq km



Population: 34million

Highest Mountain:
6,768m Huascarán

Exports: US\$38 Bn

- Ores / Slag
- Gems & Precious Metals
- Fruit & Veg

Ireland
70,273 sq km

Irish Offshore Territory
c.880,000km²



Population: 5million

Highest Mountain:
1,038m Carrauntoohil

Exports: US\$190 Bn

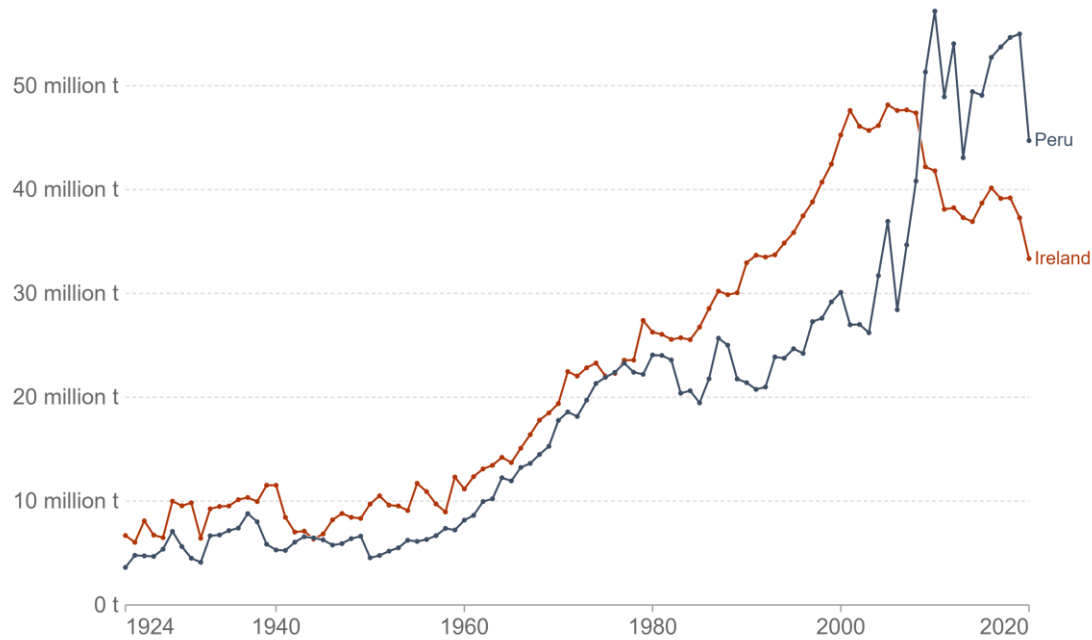
- Pharmaceuticals & Chemicals
- Technology
- Meat & Dairy

Peru & Ireland

Annual CO₂ emissions

Carbon dioxide (CO₂) emissions from the burning of fossil fuels for energy and cement production. Land use change is not included.

Our World in Data



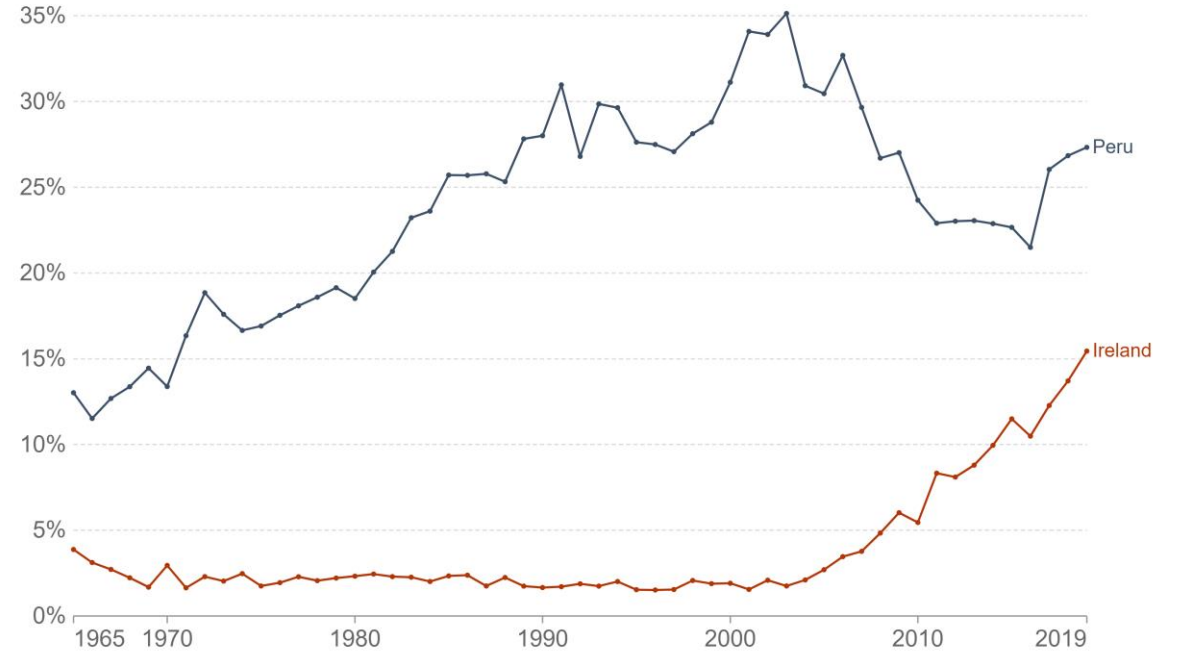
Source: Global Carbon Project

OurWorldInData.org/co2-and-other-greenhouse-gas-emissions/ • CC BY

Share of primary energy from low-carbon sources

Low-carbon energy is defined as the sum of nuclear and renewable sources. Renewable sources include hydropower, solar, wind, geothermal, wave and tidal and bioenergy. Traditional biofuels are not included.

Our World in Data



Source: Our World in Data based on BP Statistical Review of World Energy (2020)

OurWorldInData.org/energy • CC BY

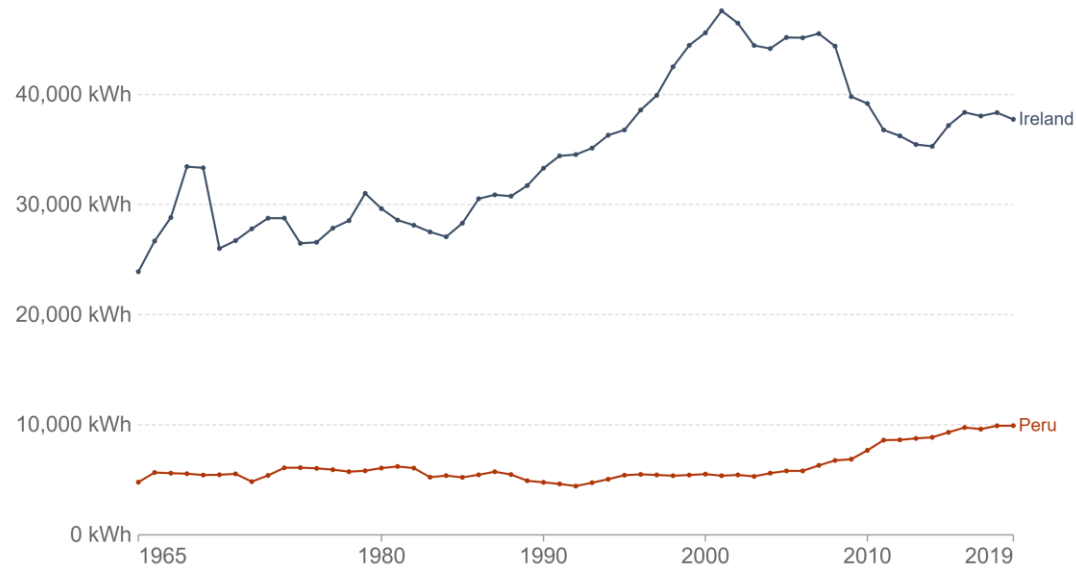
Note: Primary energy is calculated using the 'substitution method' which takes account of the inefficiencies energy production from fossil fuels.

Peru & Ireland

Energy use per person

Energy use not only includes electricity, but also other areas of consumption including transport, heating and cooking.

Our World in Data

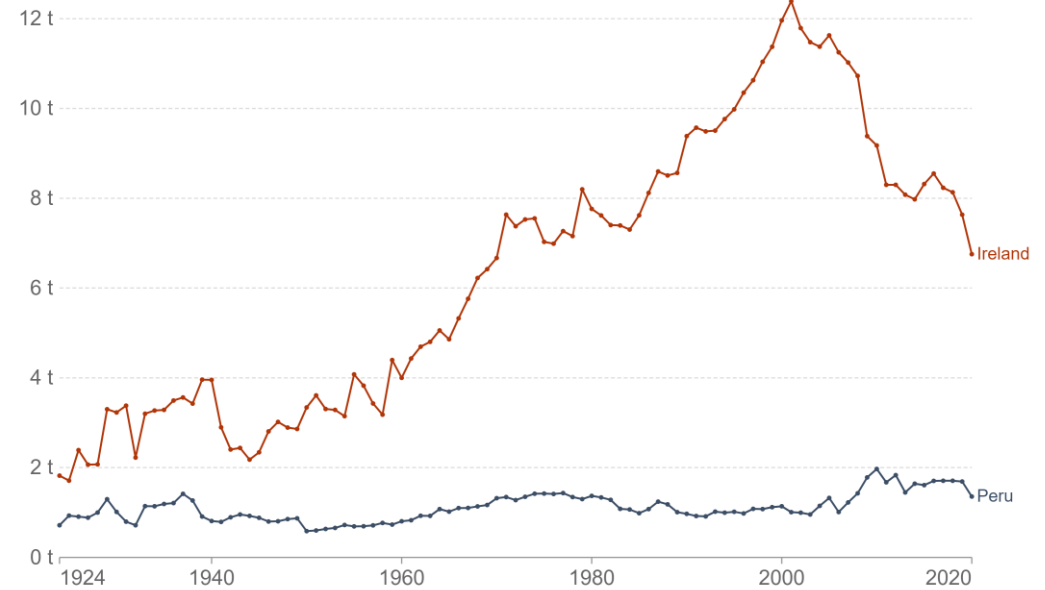


Source: Our World in Data based on BP & Shift Data Portal
 Note: Energy refers to primary energy – the energy input before the transformation to forms of energy for end-use (such as electricity or petrol for transport).
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Per capita CO₂ emissions

Carbon dioxide (CO₂) emissions from the burning of fossil fuels for energy and cement production. Land use change is not included.

Our World in Data



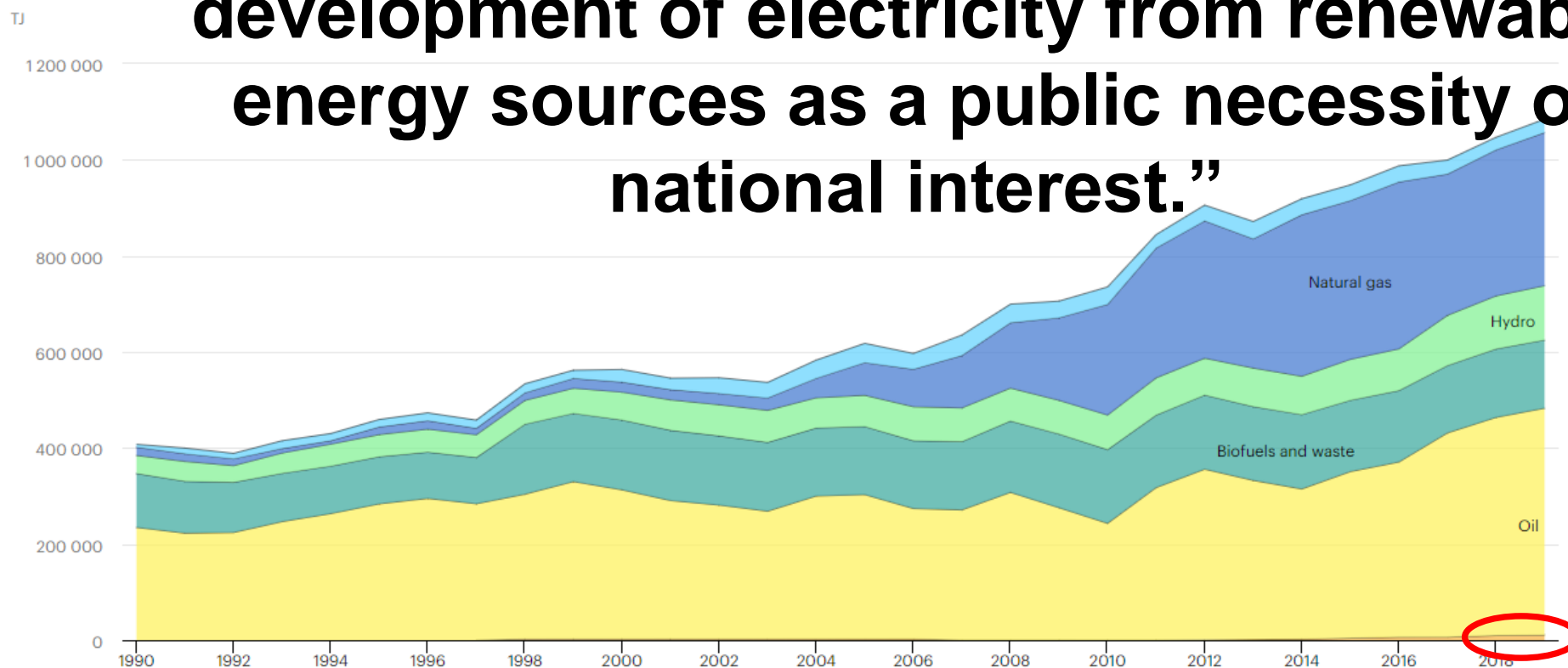
Source: Our World in Data based on the Global Carbon Project
 OurWorldInData.org/co2-and-other-greenhouse-gas-emissions/ • CC BY

Peru & Ireland Decarbonisation....

“....submitted updated NDC to the UNFCCC that represents progress beyond its previous submission but that is still incompatible with limiting global warming to 2 ° C above pre-industrial levels.....”

Decarbonisation Peru

“Peru’s government identified the development of electricity from renewable energy sources as a public necessity of national interest.”



<https://www.iea.org/countries/peru>

Where does Hydrogen fit?

What is Hydrogen?

First element of the periodic table

Simplest & lightest element in the universe

Fuels the Sun for Billions of years

Non toxic, non poisonous

Burns in air

Abundantly available on the Earth bound within water



<https://cafcp.org/sites/default/files/hydrogenuse.jpeg>

Why Hydrogen?

Can be produced carbon free

Can be used to store renewable energy

Can be used to produce heat by burning in air

Can produce electricity directly using a fuel cell

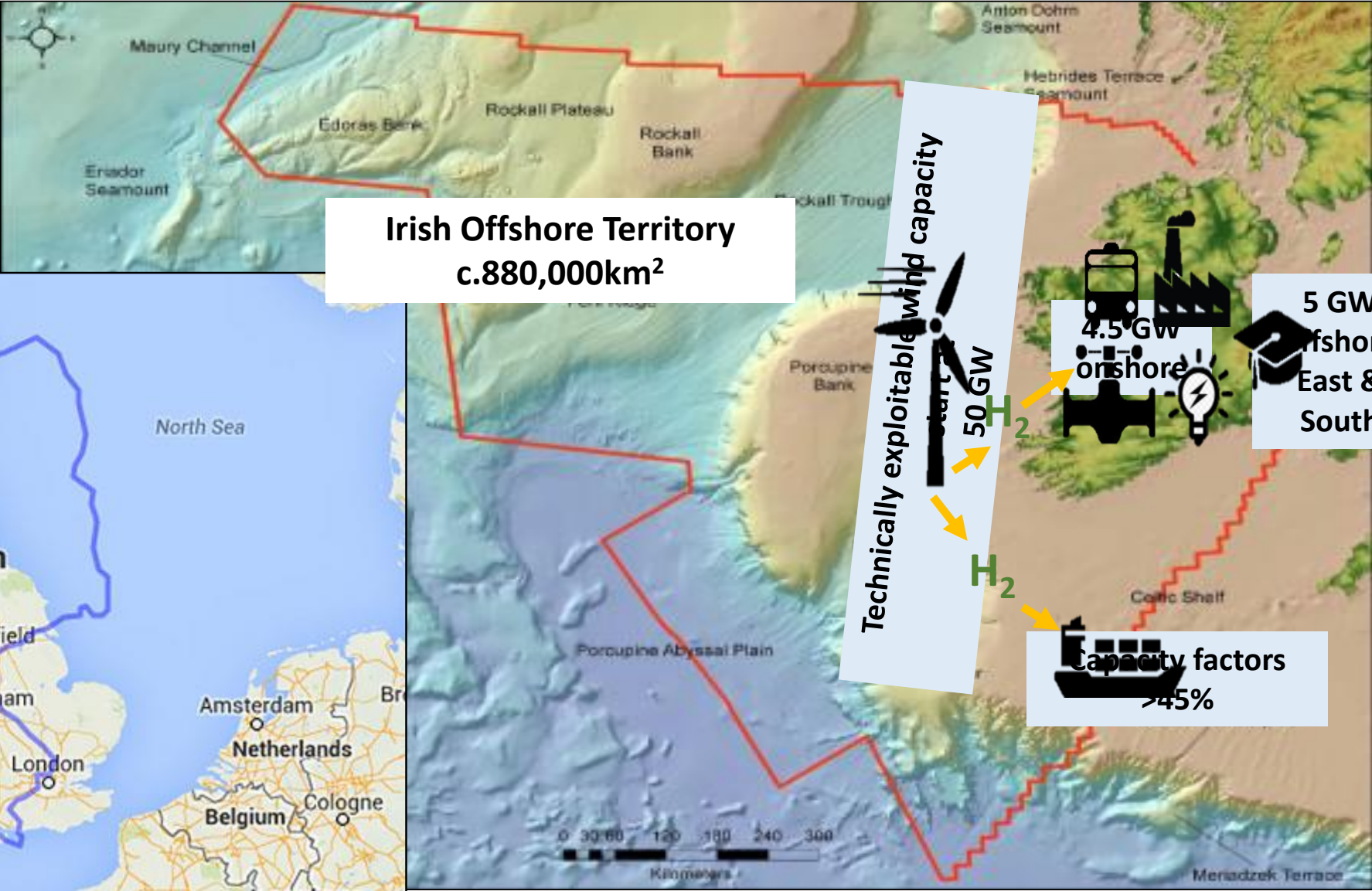
When you react or burns in air it produces pure water

Hydrogen can fuel your transport, cars, buses, ferries, heat your homes, cook your food, supply chemicals to local industry

You can produce it yourselves!

What have we done in Ireland...

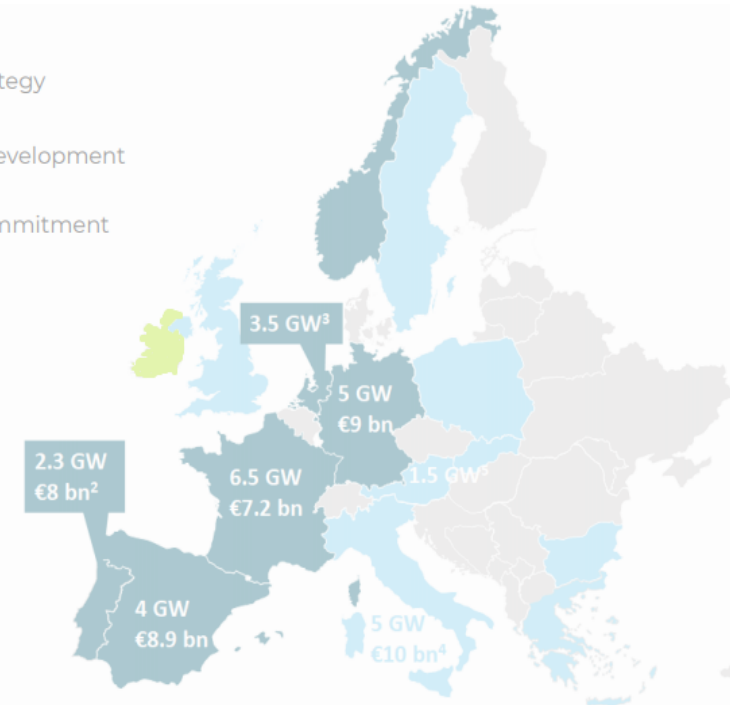
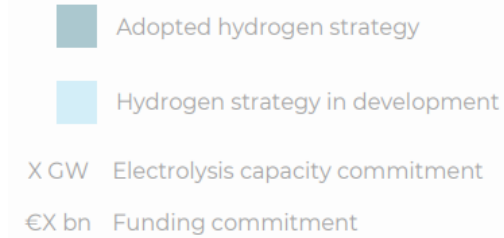
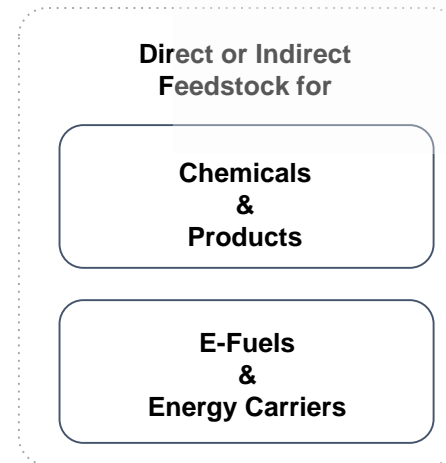
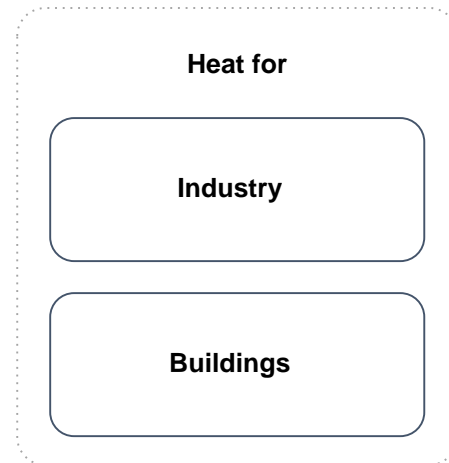
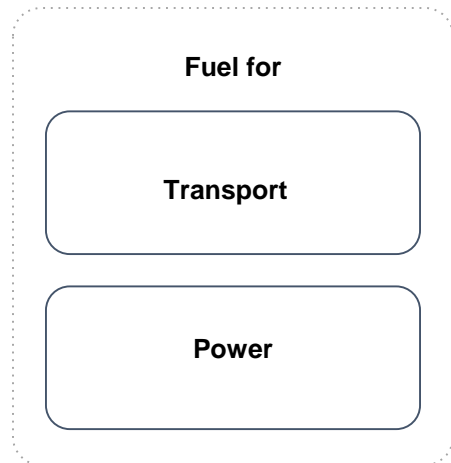
Irish Potential for Renewable Energy & Hydrogen



Hydrogen Strategy

Indigenous, Regionally produced & used, Green

Hydrogen can help cut greenhouse gas emissions in sectors of the economy which are hard to abate



The Colour of Hydrogen Matters

| |
|------------------|
| Black |
| Brown |
| Grey |
| Blue |
| Green |
| Turquoise |
| Purple |
| Pink |
| Red |
| White |



GREY HYDROGEN

Hydrogen produced from fossil fuels via carbon intensive processes. For each tonne of "grey hydrogen" produced using these two sources

The main techniques are steam methane reforming and coal gasification.

9 to 12 tonnes of CO₂

Cost today: \$1–1.80/kg
(Not including Carbon Tax)



BLUE HYDROGEN

Blue hydrogen is grey hydrogen whose CO₂ emitted during production is sequestered via carbon capture and storage (CCS).

Only about 80% of the carbon emitted from the most common H₂ production process — steam methane reforming — can physically be captured

2 to 3 tonnes of CO₂

Cost today: \$1.40-2.40/kg
(Not including Carbon Tax)



GREEN HYDROGEN

Low or zero-emission hydrogen produced using clean energy sources.

Green hydrogen come from electrolyzers

(the machines that split water molecules into hydrogen and oxygen).

c.0 tonnes of CO₂

Cost today: \$2.50-6.80/kg

In which **sectors** & what **applications** should green hydrogen be deployed?

In what order / **timeframe** would likely progress?

Hydrogen Demand Hierarchy (Ireland):

1. Industry – Ammonia, Steel, SemiCon, HVO, Oil, etc - **2022**
 2. Heavy Transport - **2025**
 3. Heavy Heat Loads – **2025***
 4. Gas Grid - heating / electricity CCGT/OC – **2025***
 5. Direct Electricity CHP CCGT/OC - **>2030***
 6. Direct Electricity Grid Fuel Cell - **>2035**
 7. Hydrogen for Export - **>2035***
- (Oxygen for Waste Water/Industry) - **2022**



*could happen sooner depending on policy

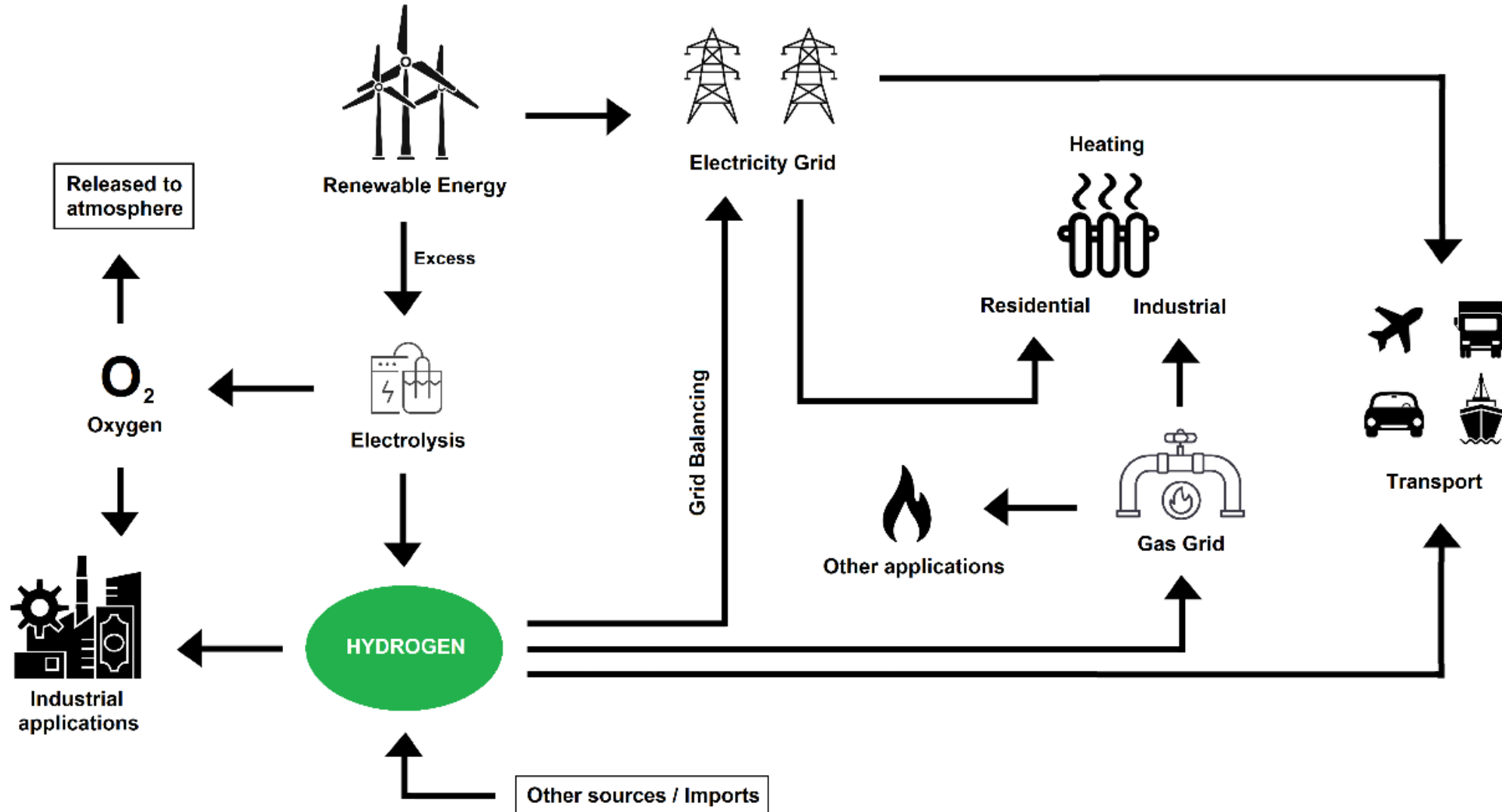
“At H2 Peru, it is essential that MINEM can take the lead in our national green hydrogen strategy, to offer favorable conditions for its development in the country and position Peru as one of its largest exporters.”

Roadmaps for Hydrogen to Support Decarbonisation of Ireland's Economy by 2050

- **Large scale investment** –
 - Needed to get to economies of scale
- **Strategy** –
 - A hydrogen Strategy focuses the mind
- **Clear policy** –
 - Policy Direction on Hydrogen
 - Incentivise the clean energy market
 - Potentially a carbon price
- **Market** –
 - Where to produce hydrogen
 - What color?
 - How do you get it to customer
- **Public** –
 - Need to socialize benefits of clean hydrogen to the public
 - Educate about misconceptions around safety



Power-to-X (e.g. Ireland)



The Association for Energy, Mobility, Industry and Community



@IrelandHydrogen

<https://hydrogenireland.org/>

A Plan for Decarbonisation – to 2050

- Decarbonisation & Energy Security - Life Cycle Emissions / Societal Benefit
- Whole System Approach
 - Industry
 - &
 - Energy
 - Electricity
 - Heat (Industrial & Residential)
 - Transport
- All solutions must be on the Table
 - Renewables & supporting technologies including;
 - BioFuels / Hydrogen
 - Interconnectors
 - Batteries / Heatpumps
 - Nuclear
- Plan today for 2030 & 2050

Thank You

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