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Presentation

Grid development for hydrogen and renewable gases – technical and regulatory requirements

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What are renwable gases according to EU Taxonomy?

BIOGAS
BIOMETHANE

METHANE

Biogas is produced in the process of methane fermentation of biomass, meaning it doesen’t mitigate methane emissions and does not lift the exposure to external costs of fuel related to – biomass market and its regualtory evolution.

COMPATIBLE WITH INFRASTRUCTURE

At the same time biomethane is virtually compatible with exisitng infrastructure and gas market assets.

PRODUCED LOCALLY

BUT unlike today it is going to be produced locally, from local biomass suplies to narrow its carbon footprint.

RENEWABLE HYDROGEN

Produced via electrolysis powered by RES

RES CAPACITIES

Apart from complex market architecture it requires additional RES capacities.

LOAD EFFICIENCY

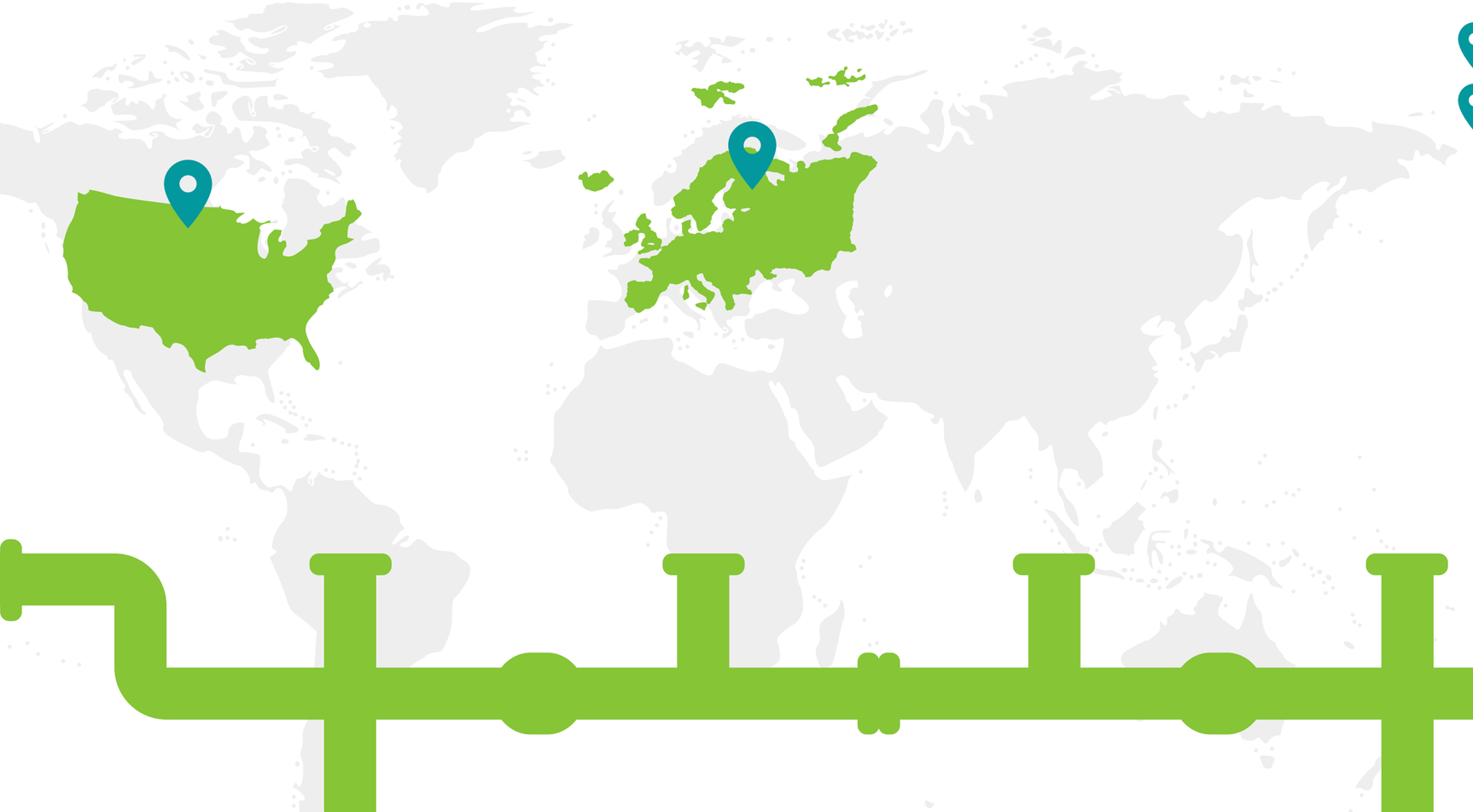
It is true that it will improve the load efficiency of new and exisitng RES BUT there's more to it.

POOR ENERGY DENSITY

Changing the method of production won’t change the physics and chemistry, hydrogen will still feature poor energy density by volume, making its moving inefficient and expensive.

HYDROGEN PIPELINES

There are piplines around the world capable of supplying pure hydrogen, actually total of 4542 km’s of such pipliens exist as of today.



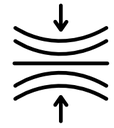
2608 km’s in the US

1598 km’s in Europe

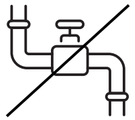
...and only **337** km’s in rest of the world.

4542 km’s today

SO WHY IS THAT?

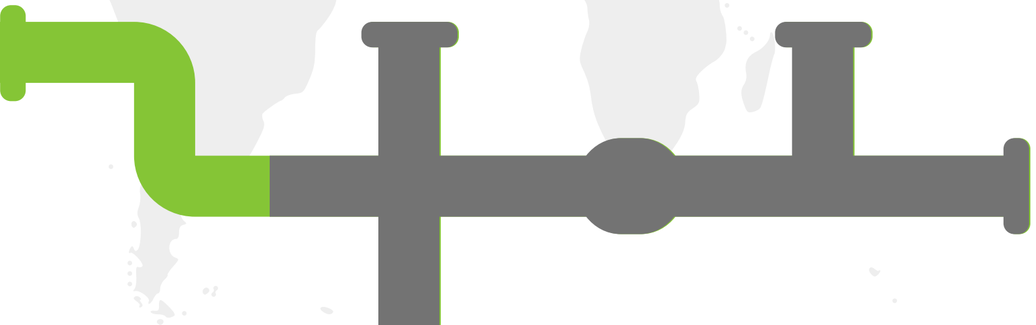


It's because to move any gas economically, it needs to be compressed. And it turns out this is the big problem with hydrogen distribution — it's the reason that **85% of hydrogen produced in Europe, for instance, travels basically no distance to where it's consumed, because it's made right on the same site or right next door.**



This is why we don't move hydrogen around much by pipeline. Instead, we move natural gas to where hydrogen is needed, and build a hydrogen plant there.

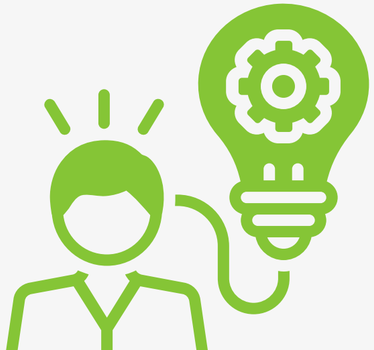
4,542 km's vs. 956,700 km's



Shifting from Steam Methane Reforming to ELY won't change this.

SO IF NOT GOING PURE HYDROGEN, MAYBE BLENDING IS AN OPTION?

All early bird projects try to smooth over pure hydrogen problems by mixing a little H2 into natural gas instead of making the big leap to pure hydrogen. **And when you hear about "replacing 20% of natural gas with hydrogen", you'd think that would make a big difference!**



No.
Think again.

1

A 20% mixture of H2 in natural gas is a 20% mixture by volume.

2

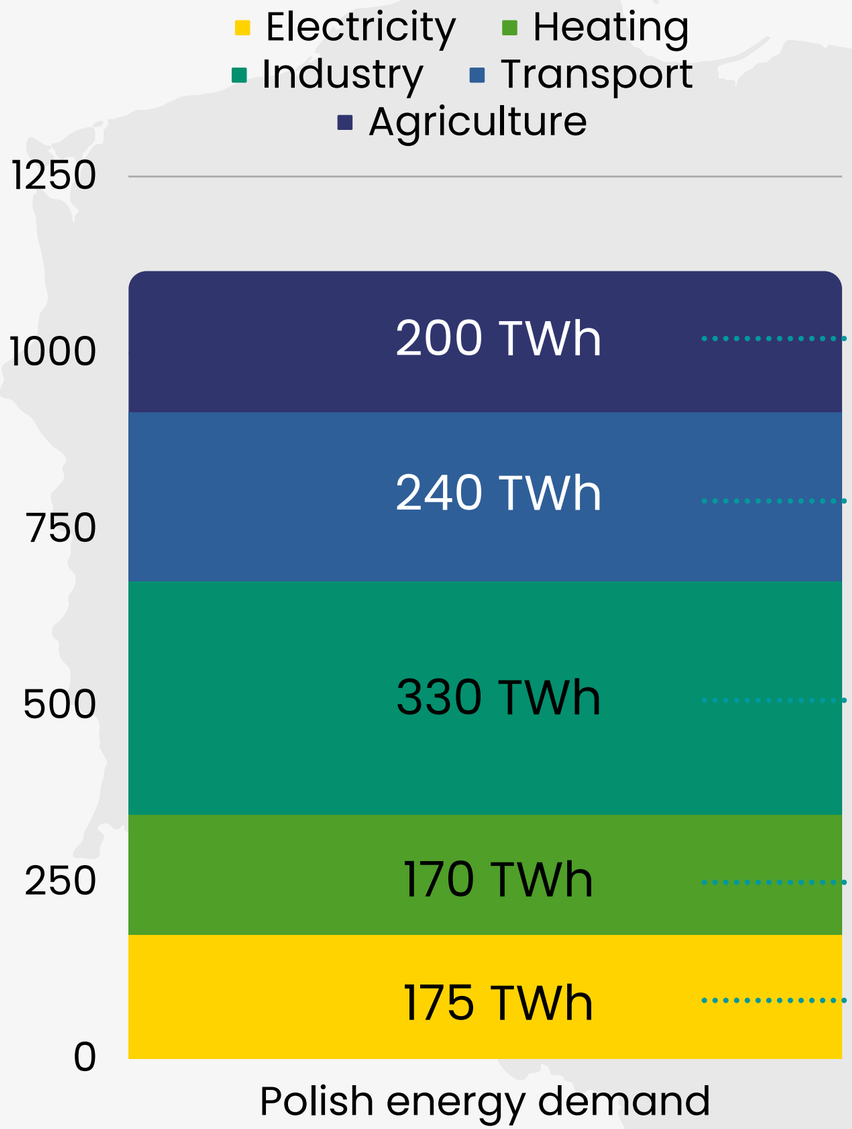
That mixture has only 86% of the energy of an average natural gas, meaning that **you'd have to burn 14% more volume of gas** to make the same number of joules or BTU of heat.

3

The savings in GHG emissions are nowhere nearly 20% — they're closer to 6% just looking at the burning, and less than that when you consider the compression and pressure loss noted above.

POLISH ENERGY DEMAND

Polish market annual TWh consumption



- Agriculture
- Transport
- Industry
- Heating
- Electricity

Combined it gives ca. **1000 TWh of energy that has to be entirely emission free by 2050**, now it is 30 TWh that come from RES.

IS CENTRALISED HYDROGEN PRODUCTION POSSIBLE TO FEED THE EXISTING INFRASTRUCTURE?

What would we need to produce **196 TWh** from renewable hydrogen?

Poland's annual gas consumption is **20 bln ³, or 196 TWh**

PV surface area required
421 200 ha ❗

Hydrogen production
66 bln m³ ❗

VOLUMES – THE GAS INDUSTRY DAILY BREAD

Polish natural gas annual consumption is ca. 20 bln m³

To meet the same energy needs with pure hydrogen over 66 bln m³ will be needed (as methane is 3.2 more energy dense by volume).

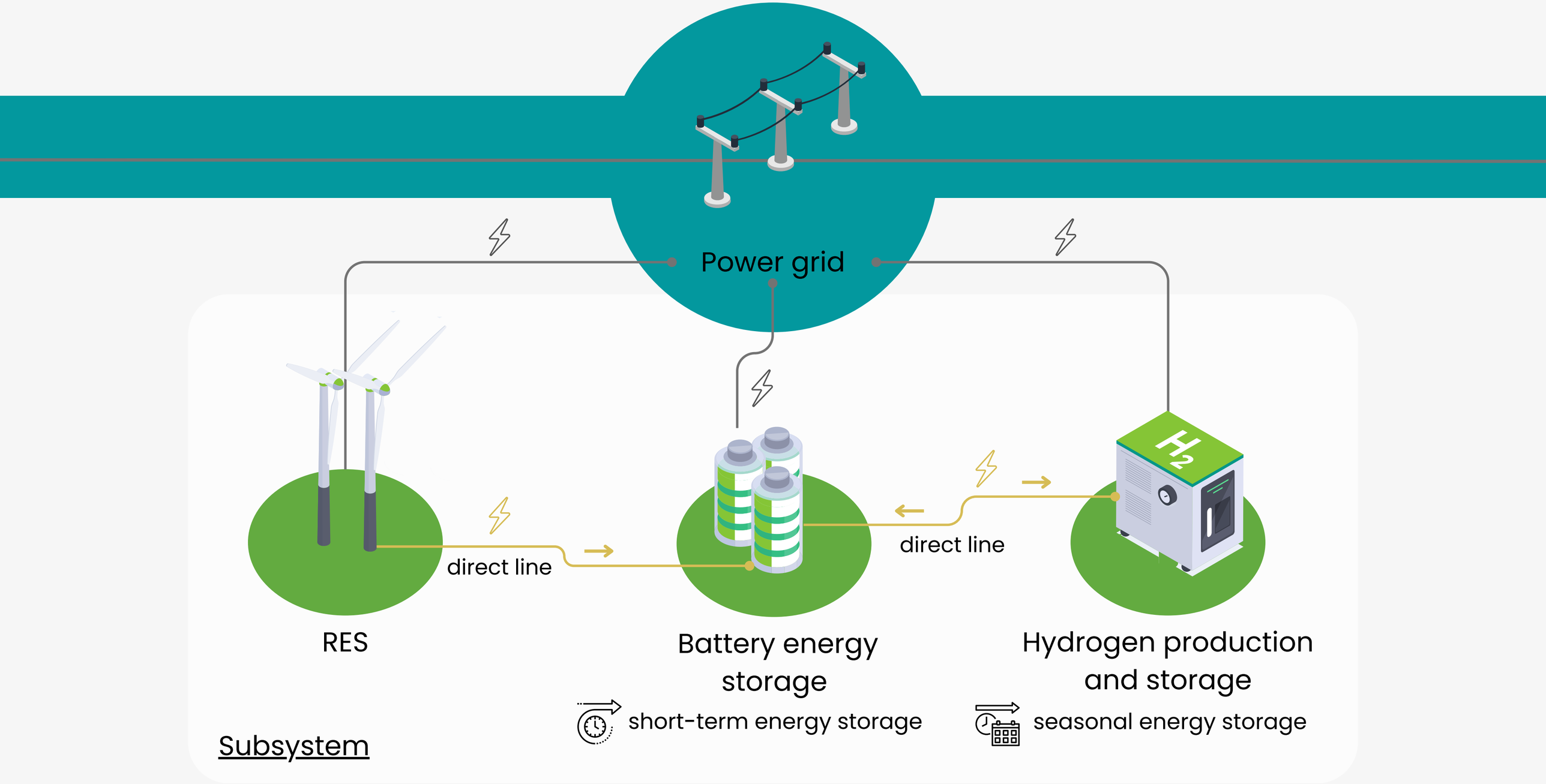
To make **66 bln m³** of hydrogen by electrolysis will require PV of **421 200 ha** of footprint…

And this is even before we get to the storage capability that we don’t have in terms of large scale mature technology.

Bottomline is that this is not possible in the world as we know it or at least with known electric energy and gas system architecture.

ENERGY SUBSYSTEMS

Without the possibility of development of subsystems based on direct lines and cooperation of short- and long-term storage, with marginal support from the grid, the **full decarbonisation of cities in Poland cannot be effectively carried out.**


Power grid
direct line
direct line
RES
Battery energy storage
Hydrogen production and storage
short-term energy storage
seasonal energy storage
Subsystem

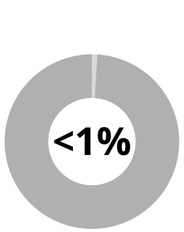
AMMONIA CRUCIAL ROLE IN ENERGY –DRIVEN DECARBONIZATION

Green ammonia made from renewable hydrogen is the **most efficient green hydrogen carrier**. Also entire ammonia market shall be replaced with renewable one. This demand will be quadrupled by demand for ammonia fuels until 2050.

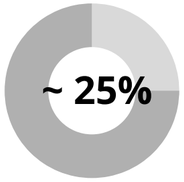
The International Renewable Energy Agency (IRENA) estimates that the **ammonia market will grow from the current 180 mln mt/yr to over 600 mln mt/yr by 2050.** That means 400% growth in 30 years.

Source: The International Renewable Energy Agency (IRENA)

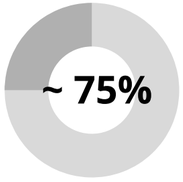
2022 AMMONIA MARKET



Renewables



Coal and HFO



Natural gas and naphtha

Ammonia

183 mln mt/yr

155.55 mln mt/yr

Fertilizers

Urea
Ammonium nitrate (AN)
Diammonium phosphate (DAP)
Ammonium sulphate (AS)
Monoammonium phosphate (MAP)

27.45 mln mt/yr

Other current uses

Textiles
Refrigeration
Explosives
deNOx
Pharmaceuticals

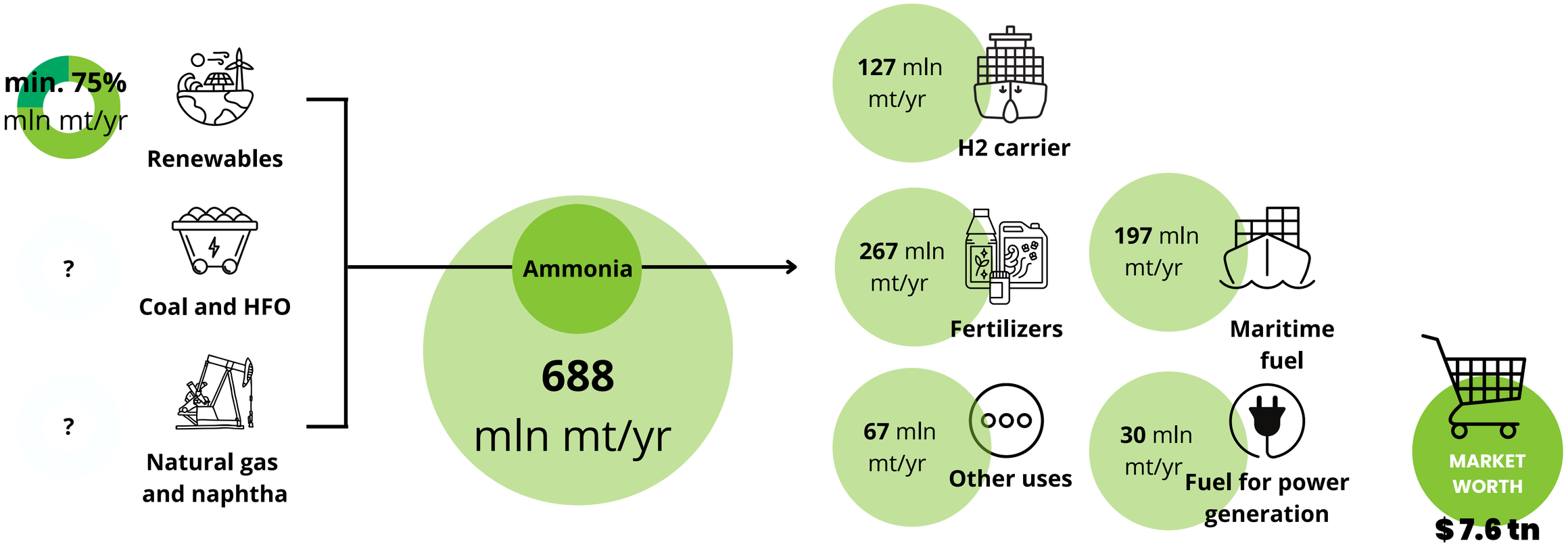
<**1.83** mln mt/yr

New uses

Direct use:
Maritime fuel
Stationary power
Indirect use:
Hydrogen carrier

Source: The International Renewable Energy Agency (IRENA)

2050 RENEWABLE AMMONIA MARKET



Source: The International Renewable Energy Agency (IRENA)

Thank you for your attention

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