Green Hydrogen Esbjerg
The European Green Deal set the blueprint for a transformational change:

All 27 EU Member States committed to turning the EU into the first climate neutral continent by 2050. To get there, they pledged to reduce emissions by at least 55% by 2030, compared to 1990 levels.

'Green Deal' triggers Energy Transition
Implications of the ‘Green Deal’

1. **Generation** of new renewable energy sources (and retiring current fossil sources)
2. Realization of new **energy distribution networks**
3. **Decarbonization**: enabling energy consumers to run on non fossil energy carriers
1.) Generation of new renewable energy sources

Hydrogen: Catalyst to additional renewable Energy infrastructure

Renewable Energy Production needs

• Investment security
• Green energy off-take
  - PPA
  - Certificates
• Long term reliability
• Overcoming grid congestion
• Flexibility to fluctuating energy

Hydrogen Production offers

• Transport and storage of energy
• Reliant and flexible consumer of renewable electricity
• Range of purposes of use
• Long term investment
• Additionality
2.) Realization of new energy distribution networks

Hydrogen: most efficient energy transmission – example Switzerland

Transmission cost per MWh, full cost comparison in Switzerland in CHF/MWh

<table>
<thead>
<tr>
<th></th>
<th>Gas-infrastructure (natural gas or hydrogen)</th>
<th>Electrons</th>
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<td>7,7</td>
<td>More than 14 times less expensive for transportation of energy</td>
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Further advantages of gas versus electrons

- Storage function
- Infrastructure mostly underground
- Footprint: higher power-density of transport/lower land need
- Lower exposure to weather variance, natural hazards
- Faster permitting processes
- Political acceptance
- Faster/immediate ramp-up possible
3.) Decarbonization
Hydrogen plays key role – high variety of hydrogen products

- Biofuels
- Battery electric
- Hydrogen
  - Direct use
  - All synthetic fuels depend on hydrogen
- Quality and availability constraints

- ‘Green Energy’ fueling options*
  - Electrification through hydrogen fuel cells
  - Hydrogen combustion engine
  - Liquid synthetic fuels
  - Gaseous synthetic fuels

Most common use for hydrogen
Intermediate technology
- Carbon eFuels, methanol
- Ammonia
- Synthetic methane
- Others

* Heat not included
Esbjerg is a seaport town and seat of Esbjerg Municipality on the west coast of the Jutland peninsula in southwest Denmark. By road, it is 71 km west of Kolding and 164 km southwest of Aarhus. With an urban population of 72,044 it is the fifth-largest city in Denmark, and the largest in West Jutland.

Elevation: 11 m


According to WEF, Denmark ranks 3rd for the most sustainable countries

<table>
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<tr>
<th>Rank</th>
<th>Country</th>
<th>ETI score (2012 - 2021)</th>
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<td>11</td>
<td>Netherlands</td>
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</table>

DK is strong regarding:
- Political support
- Permitting effic.
- World-leading country in wind energy and wind turbine prod.
- Export ambitions
- Geography

Source: Fostering Effective Energy Transition 2021 edition

Esbjerg is the central location in one of the two key landing zones in Denmark

Connection to off-takers (HD trucks and shipping): ideal place for pipeline development, 50km to road transportation off-takers, 3km to port of Esbjerg, proximity to Germany/exports

Denmark is located in an area with a shallow seabed and an above-average amount of wind in the North Sea

Denmark has approved a plan to build an artificial island in the North Sea that will be a hub to hundreds of offshore wind turbines, 260m tall, that will generate 10GW, enough energy for 10 million households

Restricted grid capacity of max 0.7GW and power demand leading to electric grid congestions