Statoil – Strategic fit of Hydrogen

November, 2017

De-Carbonizing Energy Systems

TRANSPORT

Battery EV

Electrolyser + Fuel Cell Truck

Fuel Cell Train

Cruise Line + Liquid Hydrogen

POWER GEN

Air Condition -> Solar

Grid battery

Hydropower as battery

Smart Cities

Clean Back Up/Base Load

INDUSTRY

Light Industry -> Solar/Wind

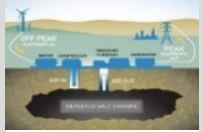
Heavy Industry -> Hydrogen

Post Combustion CCS

HEAT

Heat Pumps

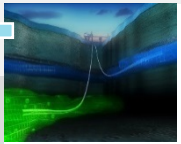
Solar Capture

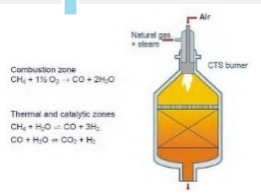


Short term storage

Seasonal Swing

Long term storage





Natural Gas Reforming to Hydrogen with CCS

Easy — Complexity — Hard

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Strategic Fit of Hydrogen

- A Low Carbon Solution

Statoil invests heavily in offshore wind projects

Hydrogen

Cost	Natural gas is lowest cost
Emissions	CO_2 can be captured and permanently stored
Scalable	Gas reforming is easily scalable, Electrolysis is not

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CCS: Proven technology, developing commerciality

Potential market

CCS to deliver 13% of CO_2 emission cuts by 2050 in IEA 2DS

Playing to Statoil's strengths

Leveraging our oil & gas competence and experience

Statoil operates some of the world's largest CCS projects

Capturing up to 1.8 MT CO2/yr / ~850,000 cars/yr

Sleipner	In Salah	Snøhvit LNG	TCM	NCS CO_2 storage
				
In operation	Injection stopped*	In operation	CO_2 capture	Concept/ FEED studies
1 MT/yr.	~1 MT/yr.	0.7 MT/yr.	0.1 MT/yr.	0.4-1,5 MT/yr.
1996-	2004-11	2008-	2012-	2016-

** Due to preliminary conclusions regarding reservoir properties – mainly related to capacity*

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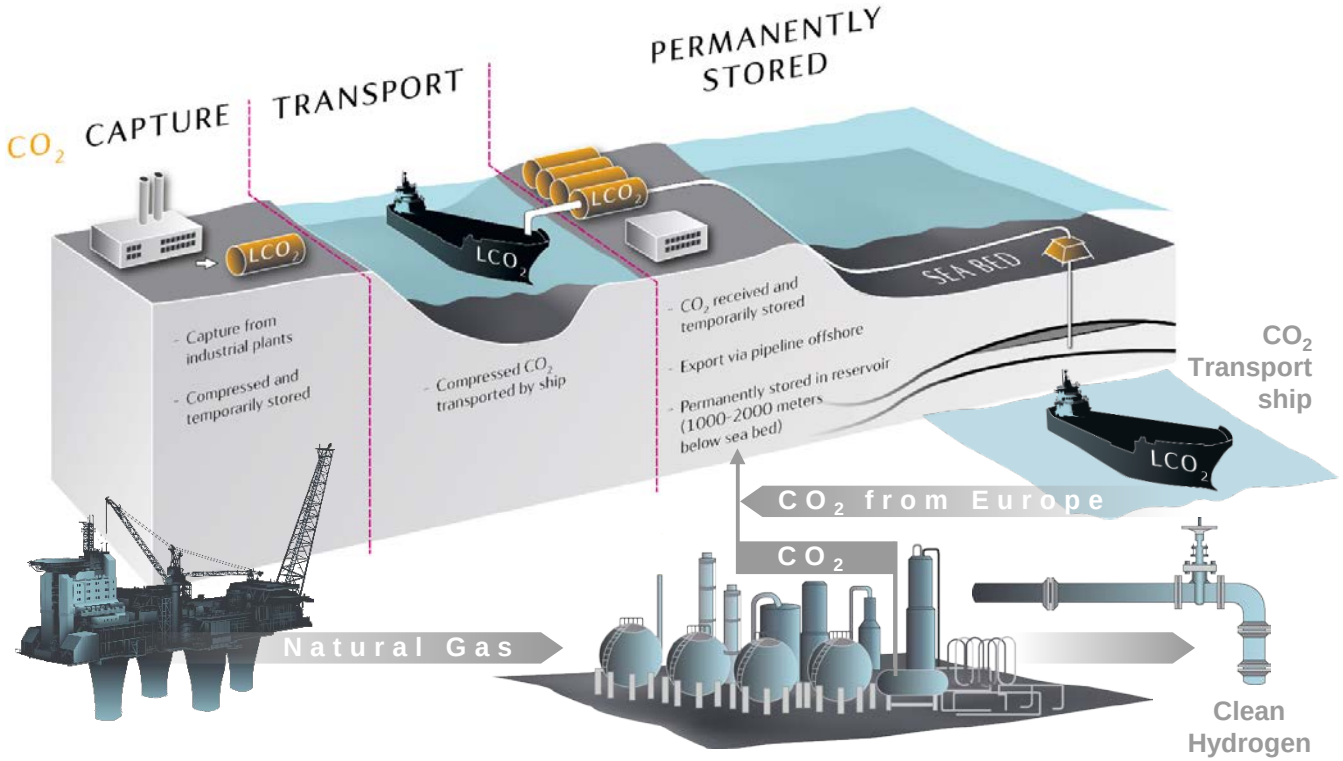
CCS value chain as enabler for clean Hydrogen production

Step 1

Establish CCS infrastructure

Step 2

Utilize CCS infrastructure to produce clean hydrogen from natural gas and/or import CO2 from Europe



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Statoil Hydrogen Portfolio

Power Generation

- Utilize existing gas power-plants
- Switch fuel from gas to hydrogen
- Clean baseload electricity
- Clean back-up for solar and wind
- Launch large-scale H2 economy
- Enables H2 to transport later

Heat

- Large energy sector in UK
- Difficult (and expensive) to de-carbonize with electricity
- Utilize existing gas network
- Synergies with industry/power gen
- Enables H2 to transport later

Maritime

- Battery solutions not available
- Compressed or Liquefied H2
- Utilize existing gas processing plants to provide low cost H2
- FC efficiency -> CO_2 reductions
- Centralize CO_2 emissions which provides CCS optionality

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Energy Storage Solutions

x 1.500

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Energy Storage Solutions

360 MW

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Energy Storage Solutions

360 MW

(10 sec)

20.000 x 20ft (2,5 days)

440 MW

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