CLEANERGY SOLUTIONS
NAMIBIA

Project description

Supported by:

Ohlthaver&List GROUP SINCE 1919

CMB.TECH

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Presentation topics

- Cleanergy partners
- Background of PV2Fuel
- Step-by-step approach
- Project setup
- Ammonia terminal
- Pipelines
- Timeline
- Q&A

Cleanergy believes in the opportunities of the hydrogen economy and has a strong commitment towards Namibia

Cleanergy is a joint venture of a Namibian company (Ohlthaver & List) and a Belgian company (CMB.TECH).

- ✓ O&L Group is rooted in, and committed to, Africa and her people.
- ✓ Namibia's largest privately held group of companies with revenues contributing roughly 4% to GDP.
- ✓ 18 major subsidiaries representing 12 sectors of the economy.
- ✓ Employing more than 5600 people.

- ✓ CMB.TECH builds, owns, operates and designs large marine and industrial applications that run on hydrogen and ammonia.
- ✓ Stock listed in Brussels and New York and a market leader in sustainable shipping.
- ✓ Creating value through a diversified fleet and a strong focus on decarbonization.
- ✓ Produce, use and distribute low carbon fuels.

CLEANERGY SOLUTIONS NAMIBIA

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Namibia has unique qualities to develop a renewable energy industry

Green hydrogen can drive industrialisation and promote economic prosperity in Namibia.

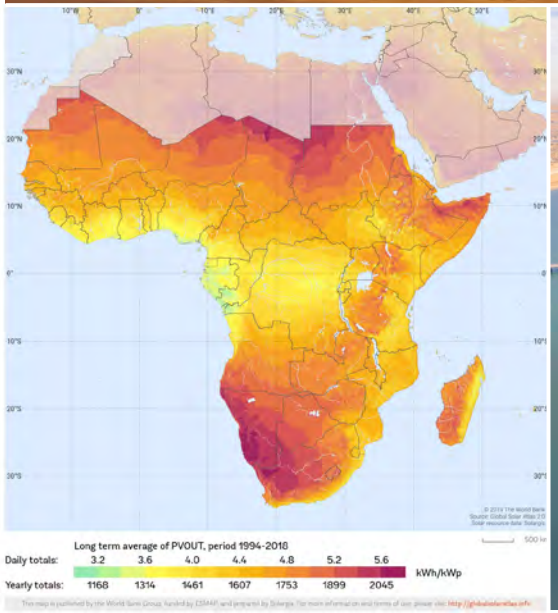
Namibia's unique strengths:

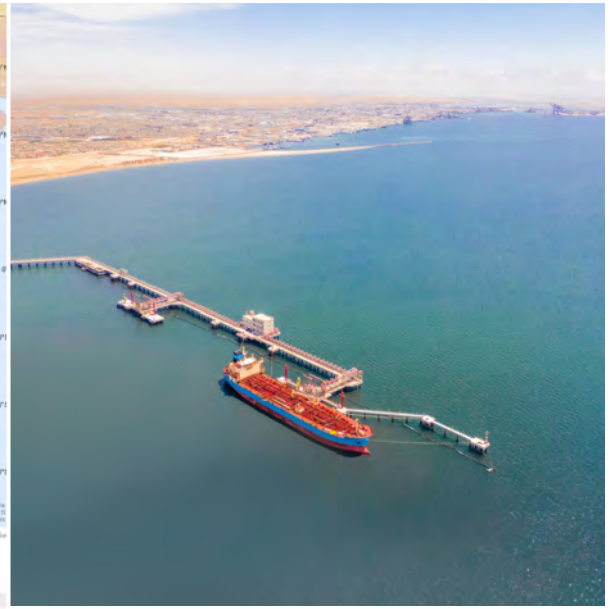
1. **Stable Country**
   Namibia is one of the most peaceful countries in Africa. Given its political stability, Namibia has created a strong economic environment which is conducive for investors.

2. **Supportive Policies**
   The Namibian governement considers green hydrogen as an emerging market opportunity with the potential to spur national and regional economic growth.

3. **Solar Potential**
   Locations with abundant availability of sun are key to allow low cost clean fuel production. Namibia has high solar irradiation values which rank among the highest in the world.

4. **Availability of infrastructure**
   Walvis Bay is an infrastructural hotspot in Namibia and Western Africa. Walvis Bay hosts not only Namibia's largest commercial port but also an international airport.





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Port of Walvis Bay is strategically located

Shipping lanes

The Port of Walvis Bay handles container imports, exports and trans-shipments as well as bulk and breakbulk of various commodities. Namport serves a wide range of industries such as petroleum, salt mining and fishing industries. Walvis Bay is a strategically located port on the international trade route from the cape of Africa to Europe. Furthermore, it has been identified as a promising bunker hub for the (iron ore) trade between Brazil and China.

Bunker hub for ships

CMB.TECH believes that green hydrogen (for small ships) and green ammonia (for large ocean-going ships) can play an important role to decarbonize the shipping industry.

CMB.TECH is already building a future proof fleet with ammonia class approval including bulk carriers, chemical tankers and container vessels on order, allowing the future retrofit for using ammonia as a fuel without losing cargo capacity.

The integration of the drivetrain, the storage and the bunkering of hydrogen and ammonia, are implemented by a diverse and experienced in-house engineering team in partnership with manufacturers and shipyards.

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How does Cleanergy translate its vision “Creating a sustainable future”on a day-to-day basis

Focus on local employment and upskilling.

Respect for local community and environment. Seeking / discovering the best approach forward via open communication.

Step-by-step approach: gives the opportunity to Namibia to get acquainted with hydrogen & ammonia

Added value for Namibian economy: hydrogen and ammonia production for local usage as a starting point

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Step-by-step approach: small-scale hydrogen and ammonia production as an enabler for sustainable growth

IMPLEMENTED BY SASSCAL

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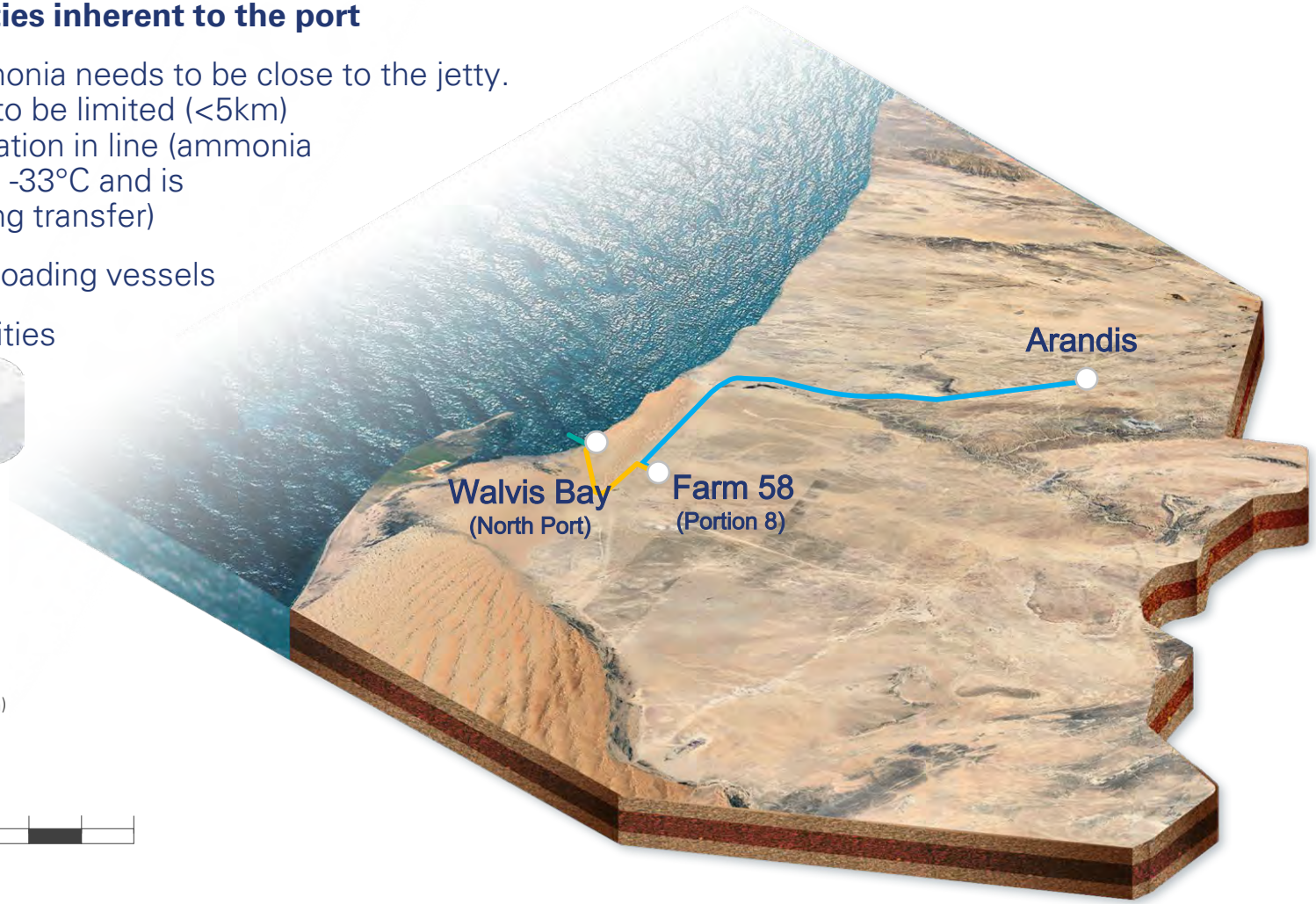
CLEANERGY SOLUTIONS NAMIBIA

Overview 5-year plan: building upon Namibian strengths with respect for the environment

Port Site : activities inherent to the port

- Storage of ammonia needs to be close to the jetty. Pipeline needs to be limited (<5km) to avoid evaporation in line (ammonia is transferred at -33°C and is heating up during transfer)
- Loading and unloading vessels
- Bunkering activities

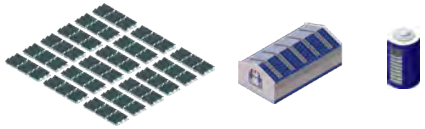


Ammonia pipeline (cold)
Ammonia pipeline (warm)
Hydrogen pipeline
Project location

SCALE 10km

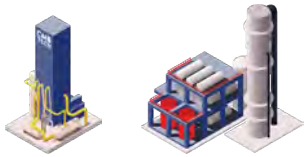
Arandis: harvesting best solar

- Production of renewable energy and hydrogen. Further away from the ocean, as yield solar park would decrease due to fog belt and lower solar irradiation.



Farm 58: industrial activities

- All industrial activities which don't need to be in the port from operational point of view (ammonia production).



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Overview 5-year plan: different projects and building blocks with separate timelines

FARM 58 – FIRST STEPS

Experience with hydrogen & ammonia

PORT SITE

Bunkering with (blue/green) ammonia

ARANDIS

Hydrogen at industrial scale

FARM 58 – LARGE SCALE AMMONIA

Industrial scale ammonia production

HYDROGEN PIPELINE

Connect Arandis with Farm 58

AMMONIA PIPELINE

Connecting facilities

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Scope of current Public Participation - EIA

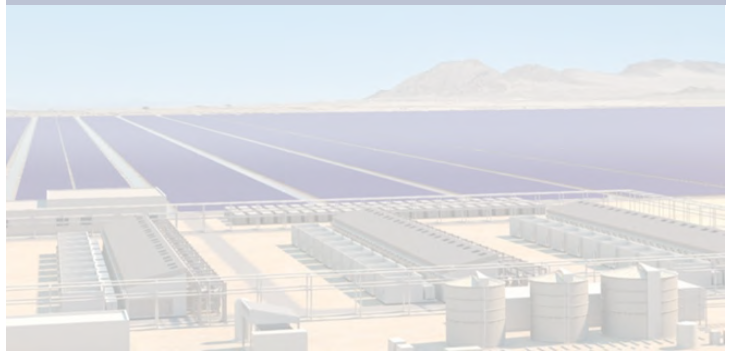
FARM 58 – FIRST STEPS

Experience with hydrogen & ammonia

PORT SITE

Bunkering with (blue/green) ammonia

ARANDIS



Hydrogen at industrial scale

FARM 58 – LARGE SCALE AMMONIA

Industrial scale ammonia production

HYDROGEN PIPELINE

Connect Arandis with Farm 58

AMMONIA PIPELINE

Connecting facilities

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Port site for bunkering with blue/green ammonia

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General info terminal

Project requirements:

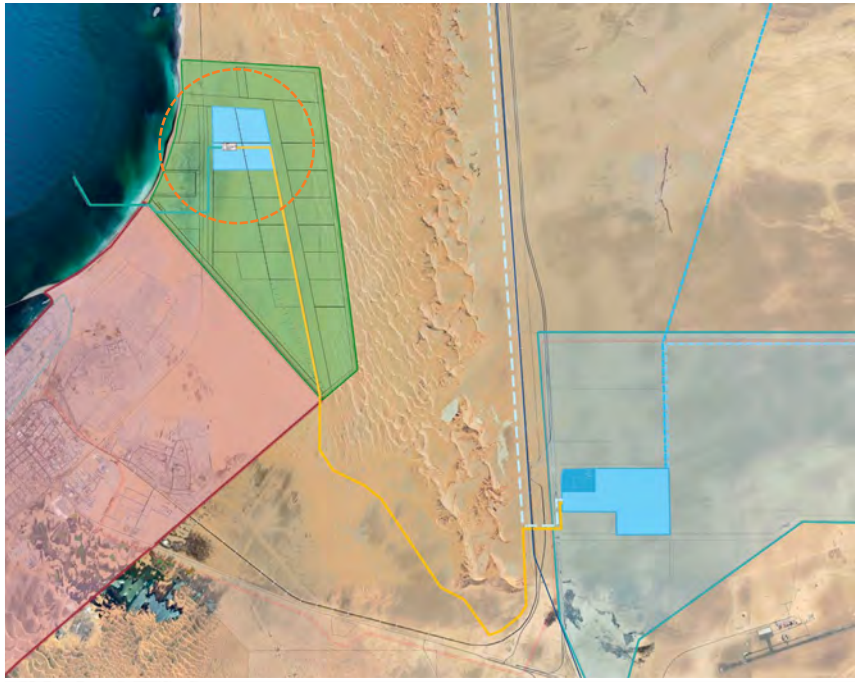
- Import / export of ammonia via a Mid-Size Ammonia/LPG Carrier (25,000tons)
- Vessel needs to be loaded within 16 hours
- Storage of 40,000tons (height: +/- 30m; diameter: +/- 55m)

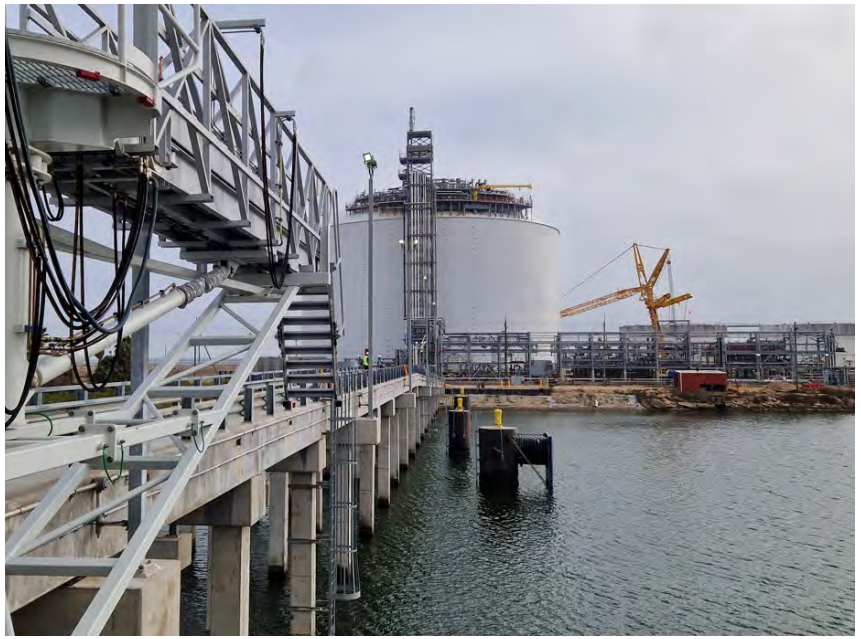
Location:

- Length of loading line (needs to be limited to avoid evaporation; 5km is considered as a limit)
- A typical distance of 1.5km from the nearest inhabitants is based on best practices from Europe. An indepth Quantitative Risk Analysis will be conducted during the next months of design.
- For building the tank terminal, a minimal area of 10ha is required.

Utility requirements:

- Water consumption: ~20m^3/day
- Power consumption: 750kW (holding) / 4000kW (peak)





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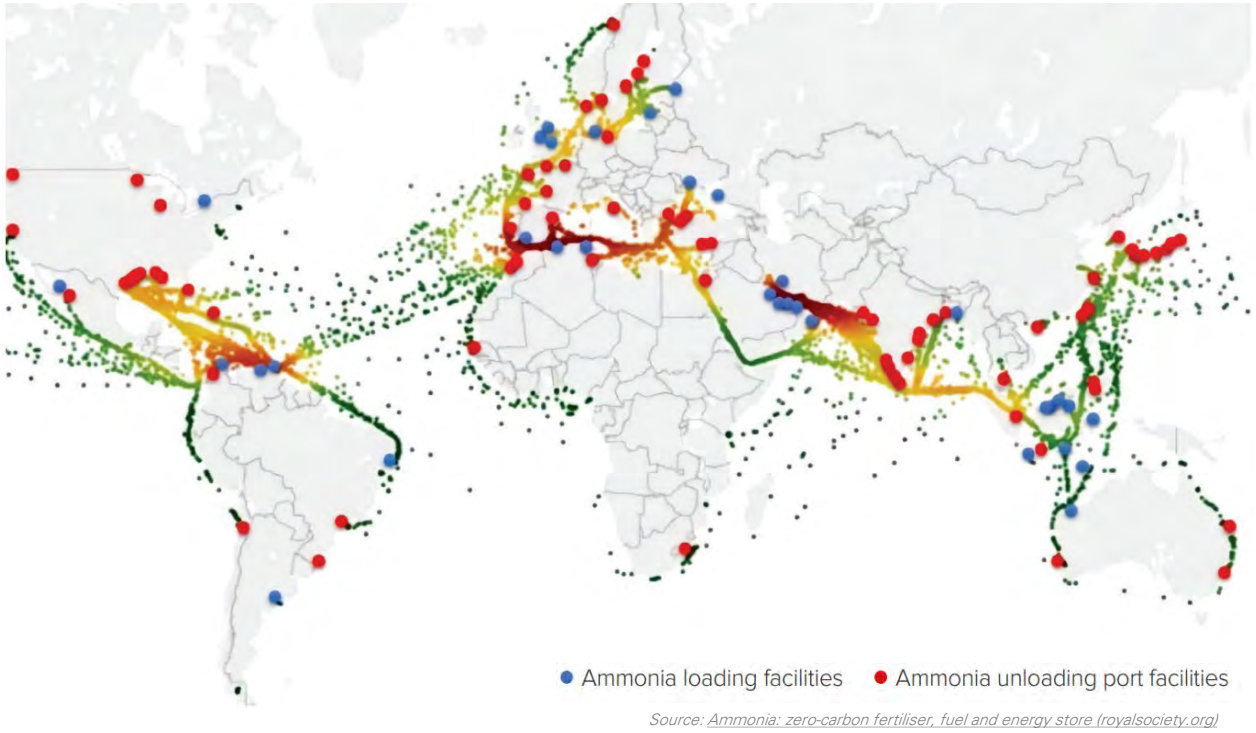
Worldwide, more than 100 ports are equipped with ammonia storage tanks: a lot of experience and proven technology

Ammonia infrastructure today

- Ammonia requires special purpose infrastructure, including pipelines, tanks and facilities for maritime bunkering.
- At present, nearly 8,000 kilometres of ammonia pipeline run worldwide, along with 38 export and 88 receiving terminals.
- Worldwide, there are ammonia terminals in 122 ports with the capability to import or export ammonia equipped with specialized storage tanks and bunkering infrastructure.

Ammonia factory with terminal located in Europe



Ammonia shipping infrastructure, including a heat map of liquid ammonia carriers and existing ammonia port facilities (2017)

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Ammonia tank: all available safety measures included

Design features

1. Concrete outer wall to protect the tank from outside (e.g. blast, collision).
2. Piled foundations with an air gap to prevent freezing of the ground.
3. Pumps are installed inside the tank to avoid side wall penetrations.

❖ Design for redundancy (refrigeration system, power supply,..).

Process control systems

5. Temperature and pressure sensors control the plant automatically during normal operations.
6. Automatic overfill and overpressure protection.

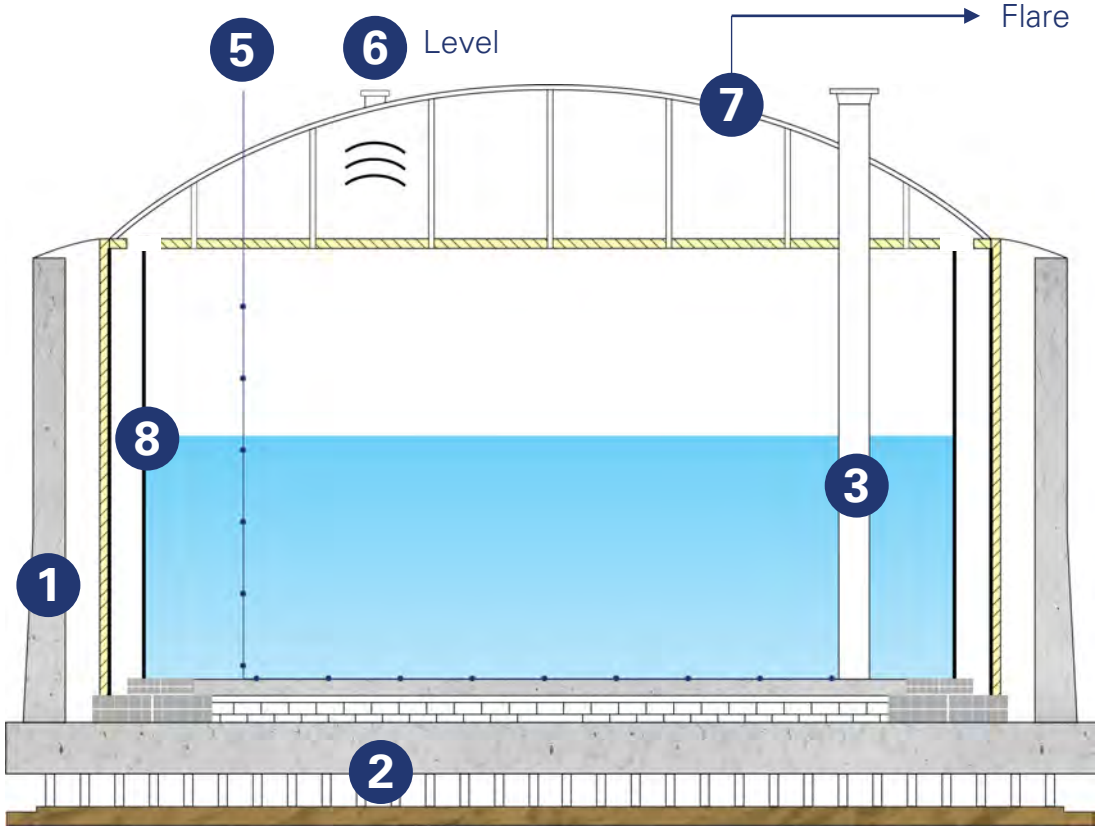
Emergency safety system

7. Pressure release valves will open and disperse product to a flare (or to safe location) in case of emergency situations.

Mitigating measures

8. Double walled: outer steel tank containing the liquid in case of a failure of the inner steel tank.

❖ Safety distance to nearest inhabitants (cfr. European standards)



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General info on hydrogen pipeline

Project requirements

- Connect 2 sites: Arandis where hydrogen can be produced at low cost, based on the high solar irradiation and Farm 58 with pre-defined industrial site close to the harbour.
- Hydrogen pipeline needs to be large enough to store a volume of 15,000m^3 of gaseous hydrogen given the design requirements of the NH_3 production.

Location:

- Exact location of hydrogen pipeline: subject to EIA-process and public consultation. Three different routes are proposed and will be examined (see picture).
  - Routing 1
  - Routing 2
  - Routing 3
- Under ground / above ground: match requirements stakeholders during EIA-process with technical feasibility.

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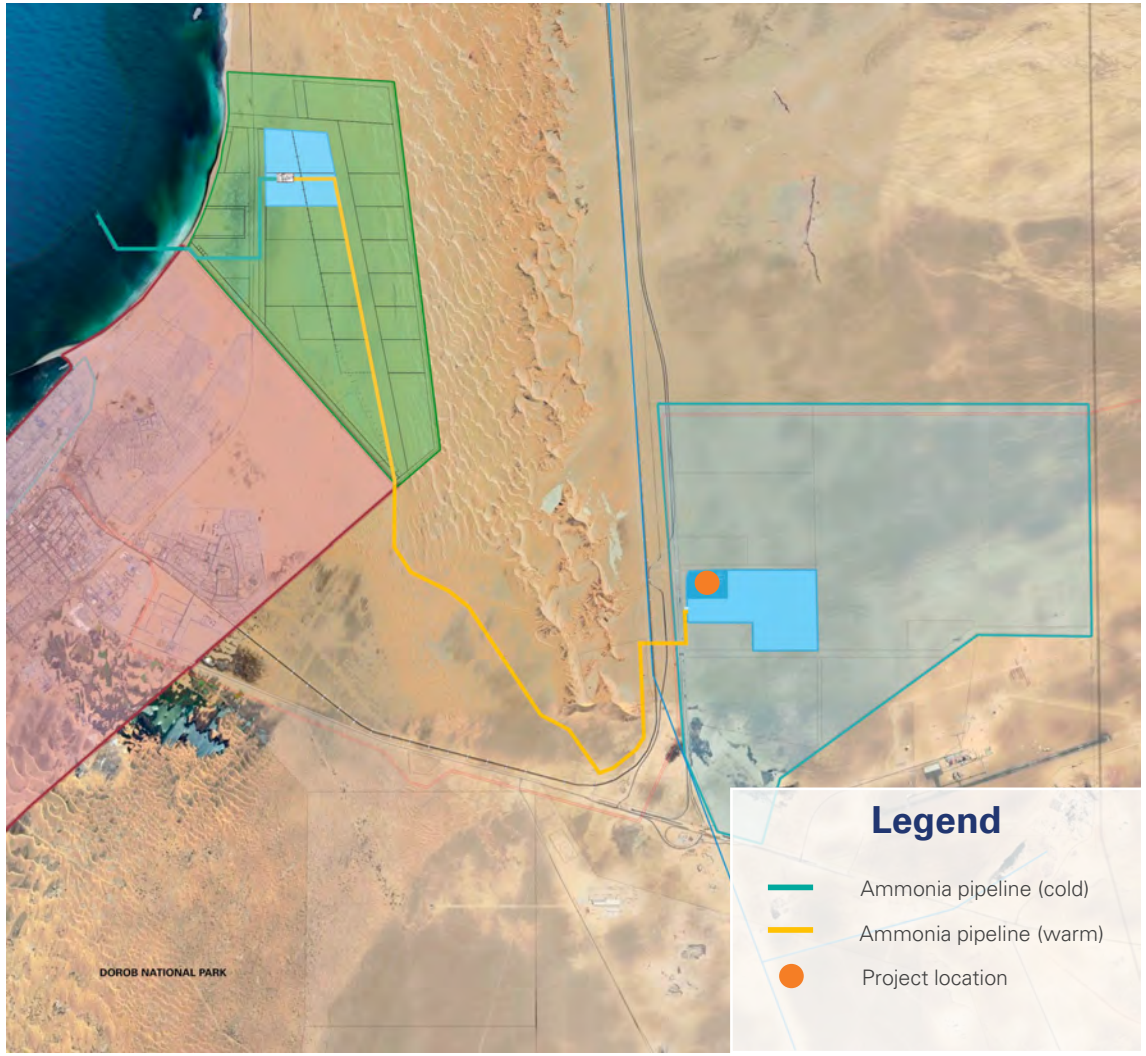
General info on ammonia pipeline

Project requirements

- Connect 2 sites: Farm 58 where ammonia is produced and the North Port where storage, import and export can be done. An ammonia pipeline is a prerequisite of our choice to place as much as possible industrial activities at Farm 58.
- Evaporation of liquid ammonia in the pipeline needs to be avoided. As the liquid ammonia will be heated-up in the pipeline, transporting "cold" ammonia over a distance of 12.7km is not the preferred option given the ambient conditions.

Location:

- Around "Dune 7" and maximise trajectory within Port Area.
- Under ground is preferred to minimise impact on area.
- The trajectory aligns with the Namport corridor.



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Pipeline transports molecules safely and efficiently

Design features

- ❖ Taking pipe flexibility into account by proper supporting and stress engineering analyses.

1. Pipeline hybrid between under ground / above ground:
   - Under ground: coated and wrapped against soil corrosion
   - Above ground: insulation additional to under ground setup

Process control systems

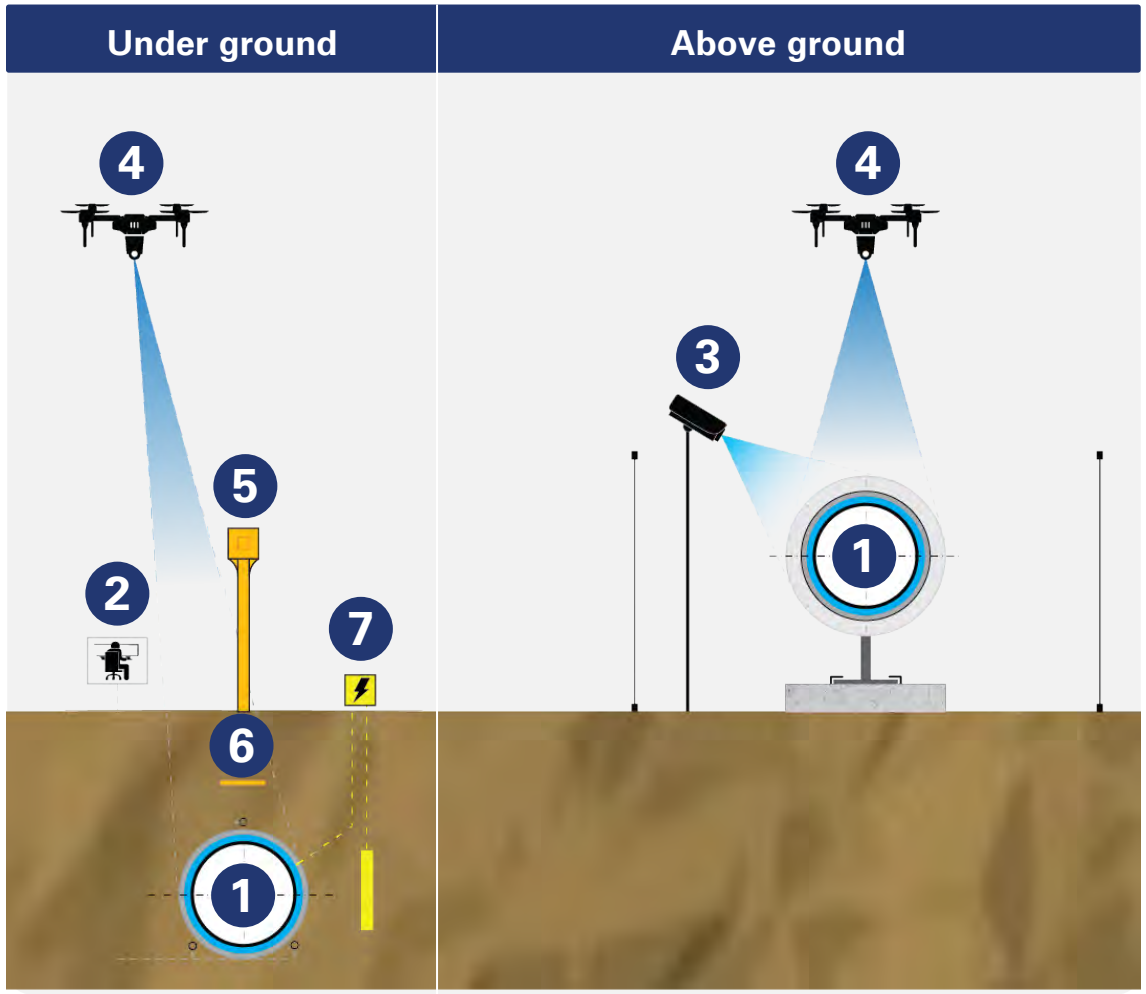
2. Fibre-optic sensors to monitor the pipe process conditions (e.g. temperature, pressure, strain, vibrations,…)
3. Fencing and camera control (CCTV)
4. Frequent (drone) inspection:
   - Noticing excavation works
   - Monitoring with thermography (infrared)

Shutdown systems

- ❖ Valve sectioning: to isolate a certain section in case of leakage, maintenance.

Mitigating measures

5. Pipeline marking posts indicate the presence of an under ground pipeline. (each 500m and at each road / rail crossing).
6. Indication tape: positioned 300 mm above the under ground pipe to indicate the construction workers that they are approaching a pipeline.
7. Cathodic protection: mitigating the failure of pipe wrapping, to prevent the pipe from soil corrosion.



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Europe’s Hydrogen pipelines infrastructure

In Belgium, already 670km of H_2 pipelines in use connecting all major industrial clusters. The first pipes were constructed in 1938 and were mainly expanded in the ’60s and ’70s.

Germany has a comprehensive infrastructure plan summing up to 9,700 kilometre “hydrogen highway”, to be fully operational by 2032.

Wilhelmshaven / 26km / 18”

Wardenburg / 290 km / 48”

Lippe / 236 km / 32”

Intermediate Pigging stations are installed at regular intervals

Olbernhau / 314 km / 31”

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Ammonia pipelines and terminals in USA

Ammonia storage facilities in Los Angeles

>4500km of ammonia pipelines are installed in USA. The storage is in refrigerated (liquid) above-ground steel tanks of 10 - 60,000tons each.

10,000 farmers are using ammonia directly as fertilizer in the agricultural sector specifically for growing corn and almonds.

A refinery with 30,000tons storage capacity is situated less than a kilometre from the runways at Los Angeles International Airport indicating the long-term safety record of these facilities.

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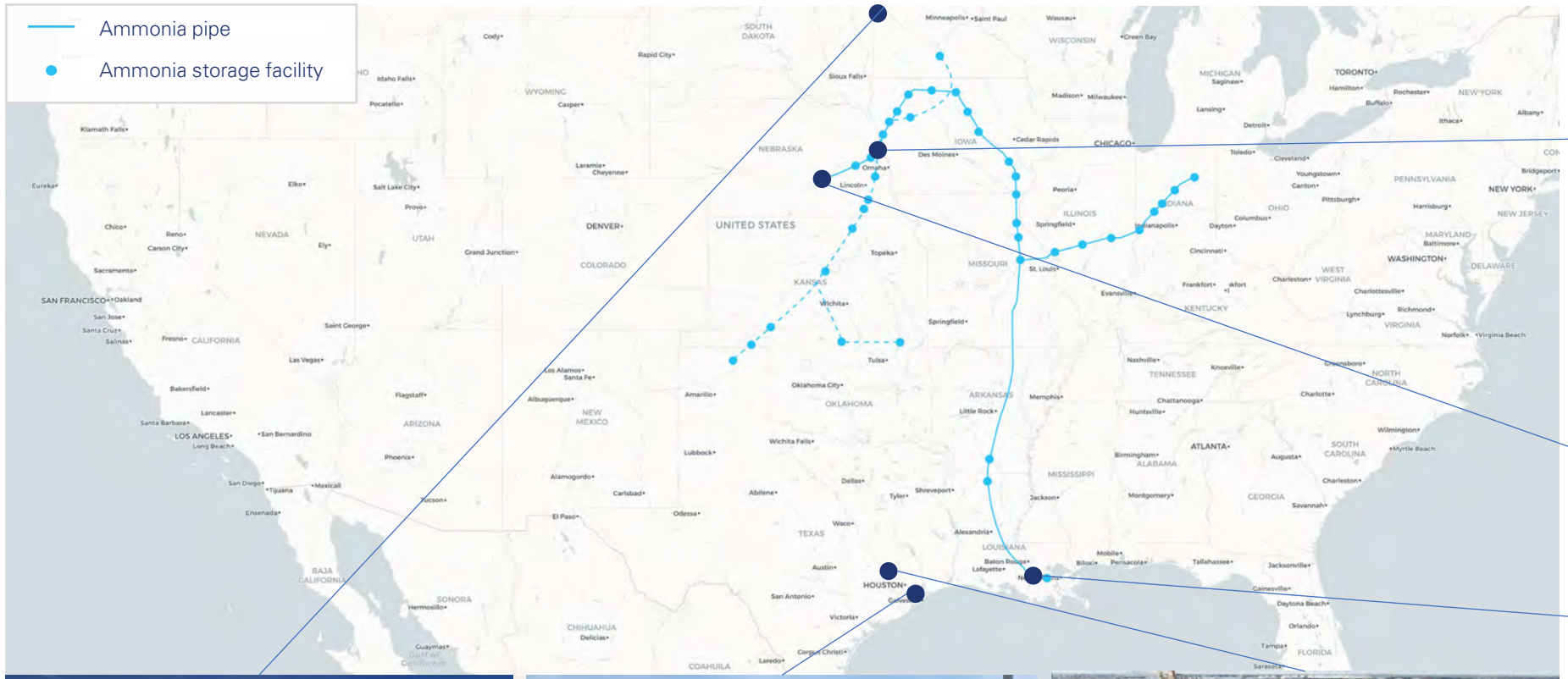
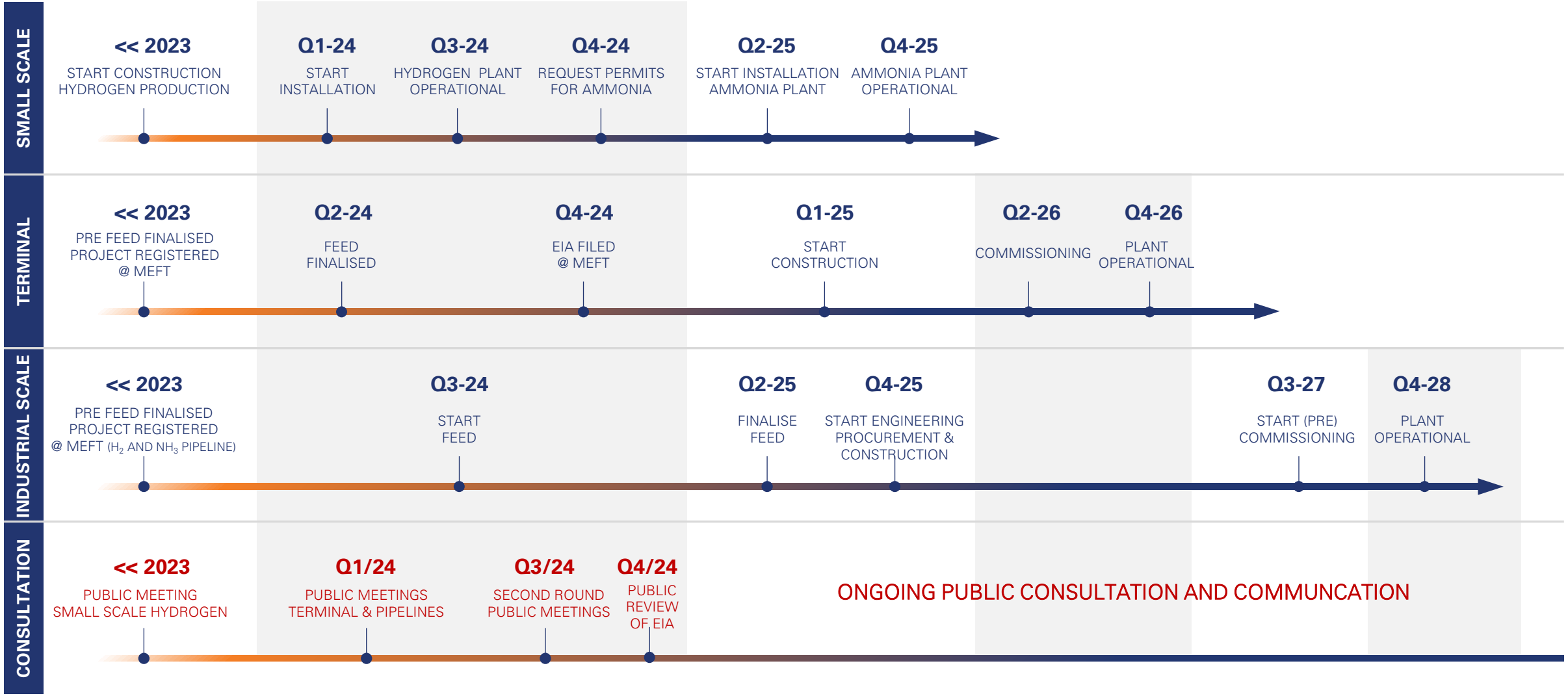
Ammonia pipelines and terminals in USA



Proposed project timelines



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