Questionnaire Responses

"Hydrogen Valley" projects in attendance at the Mission Innovation Challenge #8 workshop

Antwerp, March 2019

Australia - "Hydrogen Valley" projects for the Antwerp workshop

1. **Key characteristics of the project (location, applications concerned, targeted size etc.)**

   The project is based in Brisbane, Queensland. It has recently completed demonstration of conversion of ammonia to fuel-cell-grade hydrogen at 5kg per day. It is currently scaling up to 100's of kg a day in its current phase with a commercial partner with a focus on enabling ammonia as a hydrogen storage technology supporting renewable energy distribution and export.

2. **Status (including indicative timeline)**

   The technology has been proven at demonstration scale and is now undertaking the required R&D to support the transition to commercial scale. The current 2 year activity aims to have that commercial scale demonstration unit operational at an industrial site.

3. **Main promoters and envisaged sources of financing**

   The technology has been developed at CSIRO, Australia's national science agency. The technology was conceived in work initially supported by the low-emissions power sector, and developed for hydrogen energy applications with additional funding from CSIRO, ARENA, and support from industrial partners. Demonstration and commercialisation of the work has been supported by SIEF, BOC, Toyota and Hyundai. The technology has recently been licensed to Fortescue Metals Group, who are supporting the current scaleup phase.

4. **Key drivers for developing the project and hydrogen's unique added value in this context**

   Ammonia has been identified internationally as a promising hydrogen carrier for international transportation, due to its high hydrogen density and zero carbon content. Export using this carrier also leverages existing commercial infrastructure. A key challenge for end-use is the cost and energy efficient recovery (via catalytic ammonia dehydrogenation) and separation of the hydrogen product at a purity suitable for use in fuel cell applications. The CSIRO technology addresses this requirement, completing one 'renewable hydrogen export' value chain.

5. **Is the project scalable? Replicable? Under which conditions?**

   Yes, the membrane system relies on a continuous flow tubular reactor system which will be modular in design. Scaling is expected to be readily achievable using this modular approach.

<u>In addition, we kindly request that the presentations address the following issues:</u>

- **Main hurdles that you have encountered/you anticipate to encounter**

  Development of cost effective materials for membrane fabrication, providing the required hydrogen flux and durability for industrial application (solved). We are currently addressing engineering and design challenges related to scaling of laboratory and pilot scale processes to industrial scale.

- **How have you overcome these problems? / How do you plan to overcome them?**

  Use of novel, CSIRO-developed vanadium-based alloys and unique approaches to manufacturing and preparation which minimise the requirement for expensive palladium.

- **Main success factors for "Hydrogen Valley" projects**

  Demonstrated scale up to industrial quantities of hydrogen which meets end user requirements for purity and can be achieved at commercially viable process economics

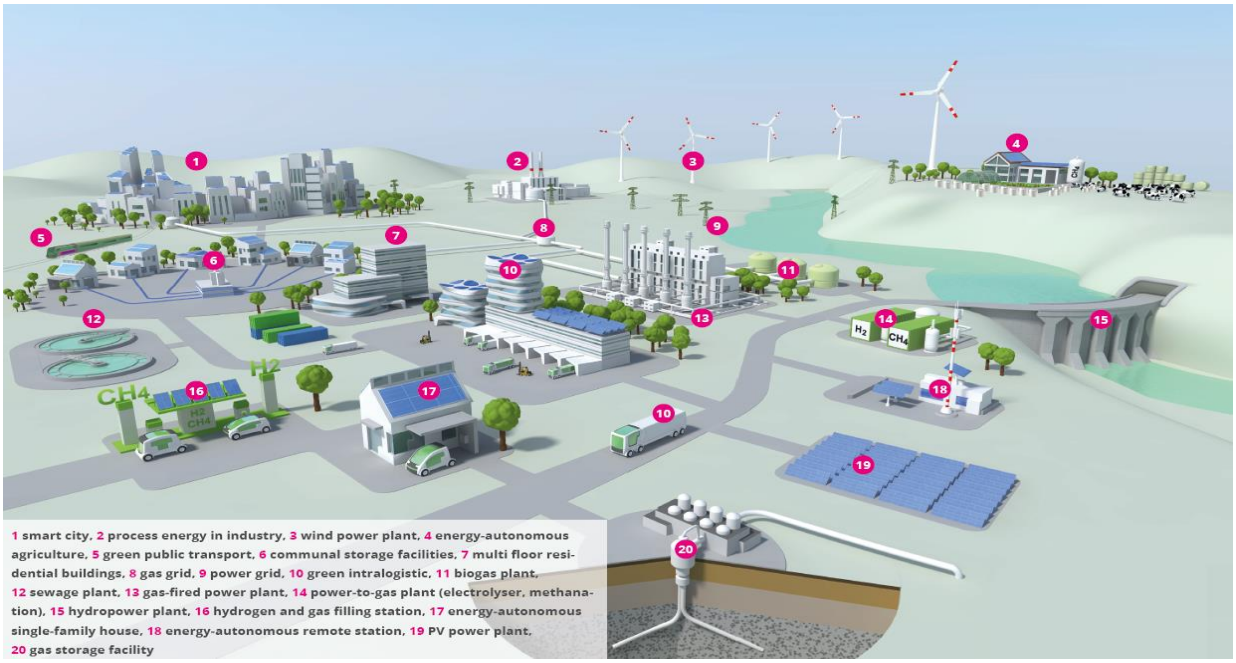
- **Where is collaboration/information exchange between "Hydrogen Valley" projects needed? / What should the Mission Innovation Hydrogen Challenge information sharing platform focus on?**

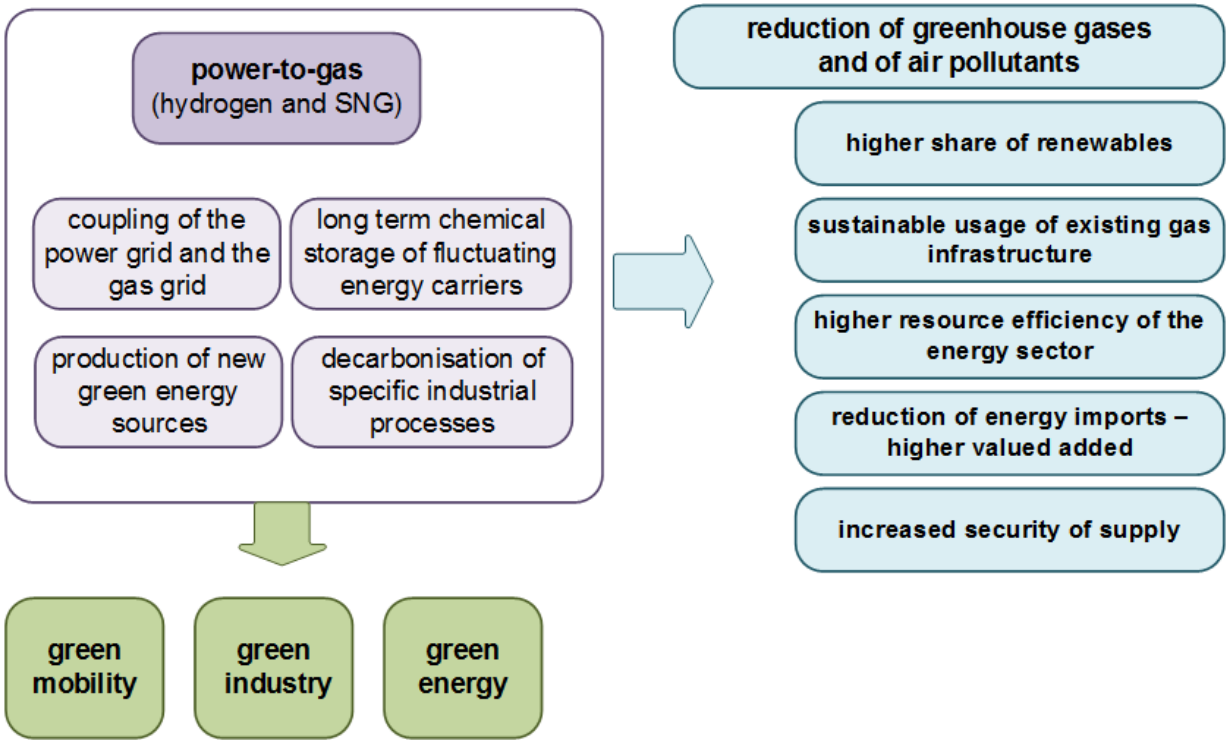
  Sharing lessons learned through demonstration projects, identifying R&D challenges / opportunities. A feature of hydrogen energy value chains is their diversity of production, distribution, and utilisation pathways. There is considerable benefit in information sharing at all stages of demonstration or 'Hydrogen Valley' projects to ensure that outcomes from one value chain scenario can be translated to others.

Austria - "Hydrogen Valley" project for the Antwerp workshop

1. Key characteristics of the project (location, applications concerned, targeted size etc.)

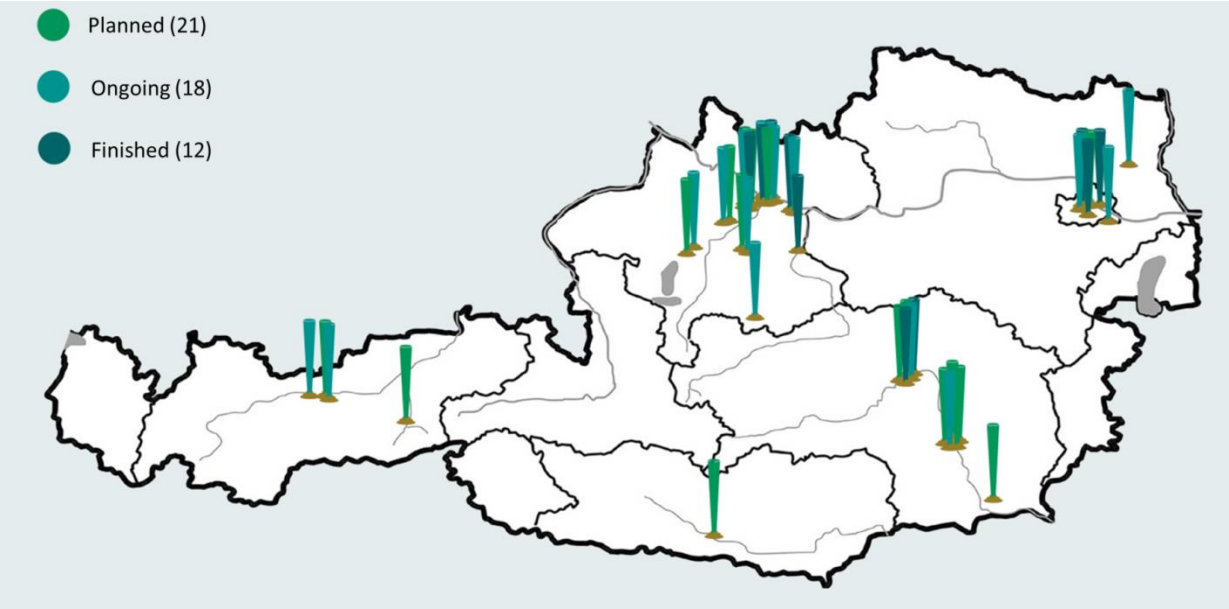
Vision: a hydrogen based energy system with the renewable sources water, wind and sun can supply all economic sectors





2. Status (including indicative timeline)

This vision will be implemented in the Energy Model Region WIVA P&G, which has started in 2018 and will last until 2025 by interconnecting more than 30 individual projects in whole Austria by taking into account the regional characteristics



1. Main promoters and envisaged sources of financing

WIVA P&G is one of three PPP Energy Model Regions public financed by Klima und Energiefonds.

2. Key drivers for developing the project and hydrogen's unique added value in this context

10 companies (AVL, Energie AG, EVN, Energie Steiermark, Fronius International, OMV AG, RAG Austria AG, Verbund Solutions, voestalpine AG, Wiener Stadtwerke GmbH) lead the individual projects and finance more than 50 % of the overall project cost. In addition four R&D groups support the individual projects. The association WIVA P&G is responsible for the interconnections.

3. Is the project scalable? Replicable? Under which conditions?

Different countries have different characteristics, especially concerning their infrastructure, their environment and their economic situation. The change to a hydrogen based economy will need different answers. Due to the different single projects but the interconnection in whole Austria the replicability as well as the scale-up is guaranteed.

Chile - "Hydrogen Valley" projects for the Antwerp workshop

Please provide the following information by 15th March 2019:

1. **Key characteristics of the project (location, applications concerned, targeted size etc.)**

In Northern Chile, there is a unique opportunity to develop competitive green hydrogen production to meet local needs and, in the future, to export hydrogen to other markets.

The project consist in develop an area in the north of Chile to take advantage of the high radiation resources, the energy consumption of mining industry and the available infrastructure to develop an hydrogen economy.

A Pilot project is under prefeasibility studies for production and end use of hydrogen for mining sector, mining related industry and transport; taking into advantage of the unique conditions of low cost solar energy to produce renewable hydrogen.

2. **Status (including indicative timeline)**

The project is under pre-investment, and pre-feasibility studies, and it will be part of the interaction of all the initiatives in the pipeline to be identified during the development of the national strategy of green hydrogen for Chile (H2 Chilean roadmap).

The national Strategy will be defined with public and private stakeholders, during the first semester 2019, there are some projects under initial state of surveying (in confidentiality) and they will be included and coordinated under the umbrella of the concept "hydrogen valley"

3. **Main promoters and envisaged sources of financing**

The Main Promoters are:

Public Sector: Ministry of Energy, Corfo (Chilean Development Agency) and Solar Energy and Innovation Committee.

Private Sector: Engie, Enaex, Alset, CAP, BHP, Ntt Data, AngloAmerican, Hydrogenics, Acciona, Linde, Ballard, Nel Hydrogen, Codelco, National Agency of Sustainable Energy

R&D: Universidad Católica de Chile, Universidad de Santiago, Universidad Técnica Federico Santa María, Fraunhofer Chile

Financing from the first stage is coming from Corfo for two projects to incentivize the development and adoption of new technology than can stimulate the consumption of hydrogen in the industry with the highest levels of energy consumption, the mining sector.

In Other hand the Solar and Energy Innovation Committee with the Ministry of Energy are working to elaborate with public and private stakeholders a national strategy of green hydrogen that will be available in the second semester of 2019, in this

Part of the finance of specific projects will come from CORFO's financing and from the private companies.

4. Key drivers for developing the project and hydrogen's unique added value in this context

The establishment of a hydrogen valley in the north of the country could transform Chile into a major producer of green hydrogen, for local use and for export.

The comparative advantages of northern Chile region occur throughout the hydrogen value chain are summarized in the following table.

Production	Transport and Storage	Utilization
Highest solar generation potential in the world, with a horizontal global irradiation (GHI) greater than 2,800 kWh/m^2 and a direct normal irradiation (DNI) higher than 3,800 kWh/m^2. Good wind resource associated with certain high potential sites, e.g. Tal Tal, and existing geothermal resources. Existing Water Desalination plants due to mining activity Desert area with less impact on communities.	Solar and water resource in the same place of potential consumption, e.g. Mining. Existing infrastructure of gas pipelines. Existing power distribution and transmission infrastructure. Existing water infrastructure, pumping from the coast to the mountains. Existing rail and port infrastructure.	Large number of potential direct consumers concentrated in the same region, e.g. Mining, Industries, cities, ports, airports, trains, heavy transport, etc. Imminent need for energy storage for integration of solar and wind energy. High demand for Ammonium Nitrate for explosives, which are manufactured from Ammonia. Interest of the mining sector to achieve a greener Mining (massive diesel consumption).

Comparative advantages of the north of Chile for implementing a hydrogen valley.

The establishment of a hydrogen valley in the Atacama Desert, could transform Chile into a leading country in the use and export of green hydrogen.

Recent Corfo study[1], shows that a 100% renewable ecosystem if feasible in the north of Chile by combination of different renewable electricity based on CSP and PV and the production of Hydrogen mainly to substitute the diesel and other fuel of the energy matrix.

[1] Tractebel, 2018 Opportunities for the development of a solar hydrogen industry in the regions of Antofagasta and Atacama: Innovation for 100% renewable energy system. Solar and Energy Innovation Committee, Santiago, Chile.

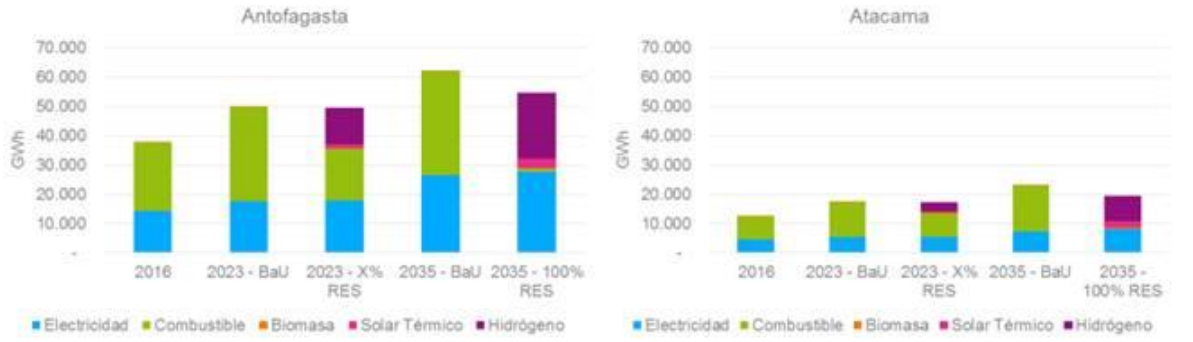


Figura 68: Resumen de la demanda de energía en Antofagasta y Atacama para los diferentes escenarios.

According to the latest report of the Hydrogen Council "Hydrogen Scalling Up", by 2050 hydrogen could cover up to **18% of the final energy demand**, could drop **6 Gton of CO2 annually** and could represent a market of **2.5 trillion dollars a year**.

5. Is the project scalable? Replicable? Under which conditions?

The project can scale depending on the increase of the demand of hydrogen, new private investment interested, and the development of local hydrogen economies in the country. It can be replicable in territories (nationals and sub-nationals) that have the access in the same zone to high potential for hydrogen consumption (for energy, storage, chemical, food industry, etc), high renewable and low cost energy potential (solar, wind) and a basic infrastructure to decrease the cost of storages and transport of the hydrogen.

In addition, we kindly request that the presentations address the following issues:

- Main hurdles that you have encountered/you anticipate to encounter
- How have you overcome these problems? / How do you plan to overcome them?
- Main success factors for “Hydrogen Valley” projects
- Where is collaboration/information exchange between “Hydrogen Valley” projects needed? / What should the Mission Innovation Hydrogen Challenge information sharing platform focus on?

BIG HIT project (EU/FCH JU) - "Hydrogen Valley" projects for the Antwerp workshop

1. **Key characteristics of the project (location, applications concerned, targeted size etc.)**

   - Location: Orkney Islands, Scotland
   - Project scope and applications concerned: demonstration of a locally integrated energy system based on hydrogen (H2 Valleys/Territories concept), including deployment of hydrogen across the whole value chain, that is:
     - Production/supply of green hydrogen generated locally from curtailed renewables (wind and tidal) through 1.5 MW of electrolysis capacity
     - Distribution across Orkney Islands by ferries and five hydrogen trailers (specifically designed and certified to be transported on the local interisland RO-RO ferries)
     - Local end use for heat, power and mobility: includes deployment of two 30 kW H2-based heating systems at two community buildings; a 75 kW fuel cell-based combined heat & power system to supply auxiliary heat & power at the harbour and on-shore power to three ferries; a refueling station capable of supplying hydrogen to up to ten commercial light duty vehicles (capacity 20 kg H2/day)
   - Total Green H2 production capacity: 125-150 tonnes per annum

2. **Status (including indicative timeline)**

   Timeline: May 2016 – April 2022 (5 years + 1 year expension)

   Status: 50% completed – finalizing commissioning stage

   The project deployment phase is currently underway, along with the development of business and replication models, and the analysis of societal and environmental impacts.

3. **Main promoters and envisaged sources of financing**

   - Initially co-financed by FCH JU, & Scottish Government up to a total of 10.9m€ project costs

   - Subsequently additional private funding from project partners and national UK funding added up to a total of circa. 13m€

4. **Key drivers for developing the project and hydrogen's unique added value in this context**

   - To our knowledge, BIG HIT is the only project in Europe at the deployment stage that demonstrates the use of renewable hydrogen locally across the whole value

chain (supply, distribution and end-use) in 3 different applications: thermal, cogeneration (heat & power) and transport.

- The combined benefits are: (i) reduction of curtailed energy from RES in the islands, with the associated economic benefits; (ii) drastic reduction of local fossil-based (diesel and fuel-oil) fuel demand for heating, power and transportation and subsequent decarbonisation of the local-economy; (iii) local socio-economic improvements like creation of new jobs, skills and supply-chain opportunities.

- The BIG HIT project provides a blue print for green hydrogen deployment for island systems and other potential hydrogen territories. The project addresses a number of operational and development challenges including the logistical and regulatory aspects for transport of hydrogen fuel between islands, and the orientation and familiarisation with new hydrogen building and transport technologies.

5. Is the project scalable? Replicable? Under which conditions?

- The project is fully replicable to other islands and regions. Using the data generated during the project, BIG HIT is developing a replicable model of integrated hydrogen production, storage, distribution and local utilisation for low-carbon energy applications. The findings of this model will set out the basis for the replication to other island regions and territories.

- The replication model will also be validated with data provided by "follower" territories, i.e. other regions and territories worldwide that are interested in deploying a similar concept to that demonstrated by the BIG HIT project.

In addition, we kindly request that the presentations address the following issues:

- Main hurdles that you have encountered/you anticipate to encounter
- How have you overcome these problems? / How do you plan to overcome them?
- Main success factors for "Hydrogen Valley" projects
- Where is collaboration/information exchange between "Hydrogen Valley" projects needed? / What should the Mission Innovation Hydrogen Challenge information sharing platform focus on?

Template for "Hydrogen Valley" projects for the Antwerp workshop

Presentation of the Hydrogen Valley concept of South Tyrol – Italy: actual situation, ongoing projects, further developments

1. Key characteristics of the project (location, applications concerned, targeted size etc.)

   The Hydrogen Valley project is located at Bolzano – South Tyrol in Italy, designed and realized by Institute for Innovative Technologies Bolzano (IIT) together with several partners and includes as follows:

- The Hydrogen Center Bolzano as pilot- and demonstration plant of hydrogen production using renewable energy, including a refuelling station (2 nozzles at 350 bar and 1 nozzle at 700 bar) for several hydrogen vehicles (buses and cars) and a bottle rack and trailer filling station. The production plant has a capacity of 180 Nm3/hour and is operated by IIT.

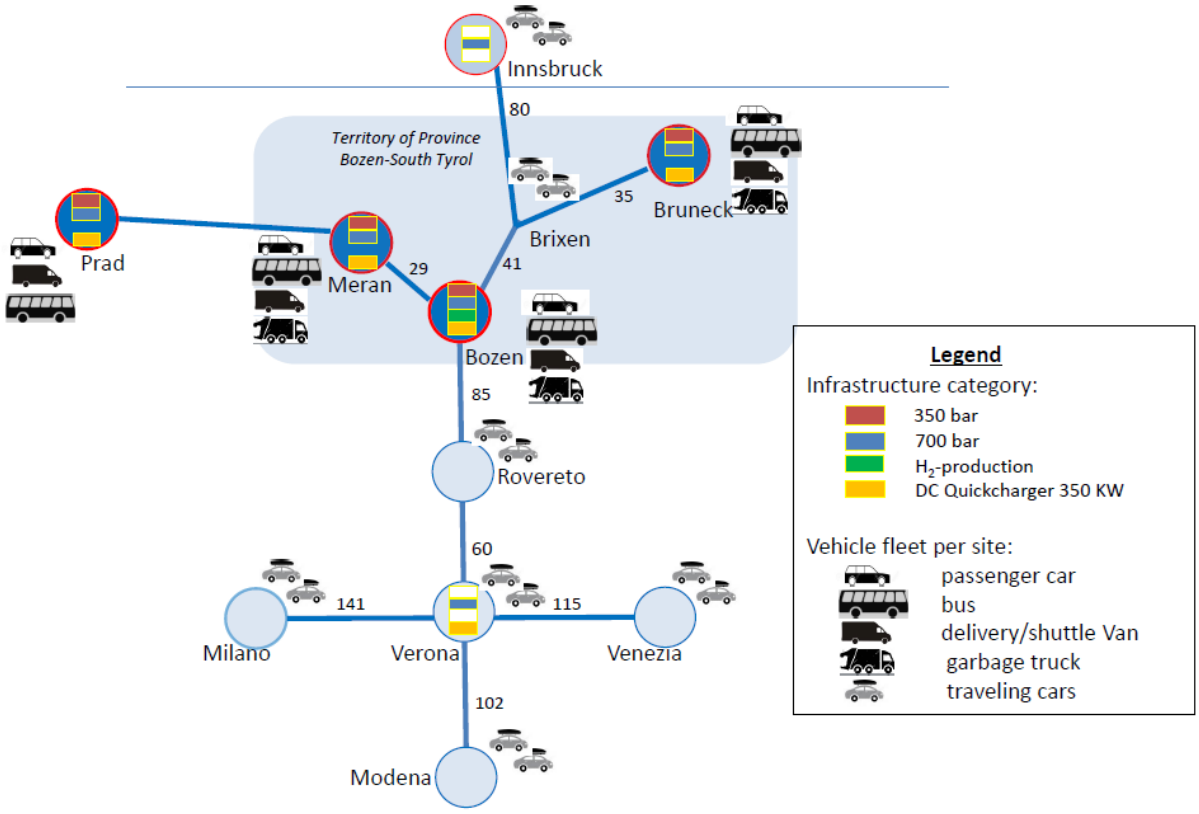
The Hydrogen Centre Bolzano with the Hydrogen refuelling Station

- Several hydrogen application projects like hydrogen buses in public transport system (project: "CHIC"), hydrogen cars in a mid term rental system (project: "HyFIVE") and stationary application for hydrogen blend in a cogeneration district heating plant (project: "Sinfonia") are directly liked to the Hydrogen Center Bolzano and represents the first application projects

The Bolzano hydrogen buses in operation and Mr Loacker from the worldwide well-known cookies – one of the first users of the Bolzano hydrogen cars.

Institut für Innovative Technologien Bozen Konsortial- GmbH
Istituto per Innovazioni Tecnologiche Bolzano Società Consortile ARL
I-39100 Bozen/Bolzano (BZ), Via Enrico Matteistr. 1, Tel. +39 0471 050444, Fax +39 0471 050445, PEC: iit.bz@pec.it, mail: info@iit.bz.it, www.iit.bz.it, MwSt/P. IVA + St.-Nr./C.F. 02274870217

- Those first application projects actually and in the near future will be integrated by additional projects for refuelling infrastructure directly at a bus depot (project: "MEHRLIN") and a fleet of 12 new hydrogen buses (project:" JIVE").
- Another project ("REVIVE") foresees the operation of a waste collecting truck with fuel cell-battery combination at Bolzano and Merano. Within a brand new project funded by LIFE: ("Zero Emission Services for a Decarbonized Alpine Economy") the hydrogen infrastructure in South Tyrol will be enlarged with 5 new hydrogen stations and a production site and foresees several pilot fleets of hydrogen vehicles.



Overview: planned infrastructures and vehicles in South Tyrol and along Brenner Corridor.

2. <u>Status (including indicative timeline)</u>

- Hydrogen Centre Bolzano: inauguration 2014 and since there fully in operation
- CHIC-project: already concluded
- HyFIVE-project: already concluded
- SINFONIA project: already concluded
- Mehrlin project: start in 2017, end foreseen in 2020
- JIVE project: start in 2017, end foreseen in 2022
- REVIVE project: start in 2017, end foreseen in 2021
- LIFE-project: start in January 2019, end foreseen in 2026

3. Main promoters and envisaged sources of financing

- Hydrogen Centre: funded by ERDF, realized in partnership between IIT and A22 (Brenner Highway company)
- CHIC-project: funded by FP7 (FCH-JU), realized by STA and SASA (local bus operators) and IIT
- HyFIVE-project: funded by Horizon 2020 (FCH-JU), realized by IIT
- Sinfonia project: funded by FP7 realized by many local partners (municipalities and energy companies)
- Mehrlin project: funded by CEF (TEN-T), realized in South Tyrol by SASA (local public bus operator) and IIT
- Jive project: funded by Horizon 2020 (FCH-JU), realized by SASA and IIT
- REVIVE project: funded by Horizon 2020 (FCH-JU), realized by Municipalities of Bolzano and Merano
- LIFE-project: funded by LIFE funding, realized by SASA in cooperation with IIT, Alperia, Eurac, A22 Brenner Highway Company and several Municipalities and local energy companies.

4. Key drivers for developing the project and hydrogen's unique added value in this context

=> beside IIT see players mentioned at point 3.

South Tyrol is rich in hydrogen power; mostly in use are fluent power plants without basin. During night, there is less demand for that electric energy. Also in some South Tyrolean municipalities the installed photovoltaic capacity overcharges the local grid. Beside this classical problems linked to higher percentage of renewable energy use, South Tyrol suffers also for traffic caused air pollution problem: in some cities in South Tyrol and along the Brenner Corridor – one of the most important European traffic axis – the air pollution exceeds regularly the legal limits.

Hydrogen offers a solution for both problems: the hydrogen production in the hydrogen centre is done in smart grid function and therefor allows enhancing the efficient use of local produced renewable energy acting as buffer. The conversion of surplus electric energy in to hydrogen as clean fuel for electric driven fuel cell buses and cars allows installing a kind of emission free electric mobility, that will not enhance or overstress the electric energy consumption and electric grid in the daily pic hours – a big and unsolved problem with battery based electric mobility, where the additional energy stress in the future has to be covered by fossil fuels in certain hours and the grid has to be enforced with decentral (fossil-natural gas) power plants.

5. Is the project scalable? Replicable? Under which conditions?

Yes, of course. If local players together with local politics and administration supports such projects and funding sources are available, the shown hydrogen actions and projects are replicable.

Template for “Hydrogen Valley” projects for the Antwerp workshop

NAME: Yamanashi Hydrogen Energy Society Realization Roadmap

Efforts making the best use of Yamanashi’s characteristics such as the highest solar power potential in Japan, cluster of research institutes on hydrogen and fuel cells, through following three approaches;

- Expansion of use of hydrogen energy
  Shown Yamanashi’s own introduction target for FCV, HRS, Enefarm
- CO2 free hydrogen supply chain construction
  Promotion of PtG utilizing PV
- Promotion of hydrogen and fuel cell related industries
  Yamanashi “hydrogen fuel cell valley strategy”

1. Key characteristics of the Yamanashi Hydrogen and Fuel Cell Valley project (location, applications concerned, targeted size etc.)

Target: Realizing “Yamanashi Hydrogen and Fuel Cell Valley” which is a cluster of hydrogen and fuel cell industry.
(Expected outcome in 2030)
- Sales amount 100 billion yen, 200 enterprises entering, 5,000 employees

Character: Cluster of research institute / facility
Yamanashi University: R&D on fuel cell material / analysis of reaction mechanism
Yamanashi prefectural industrial technology center: Fuel cell evaluation
Hysut hydrogen technology center: HRS equipment test, training
Komekura-yama energy storage site: Power to Gas

Activities
- Dispatching advisor to promote entering hydrogen and fuel cell industry
- Organizing seminar / technical course for education
- Subsidy for developing hydrogen and fuel cell application
  (Up to 5million yen, Subsidy rate: 2/3 (SME), 1/2 (others)
- Joining national R&DD program

2. Status (including indicative timeline)

-Promoting industry / academia collaboration to develop business on fuel cell power supply system, metal separator integrated with GDL, CCM production, etc.
-Conducting R&D on analyzing / evaluation for PEFC
-Start a new power to gas project with 1.5MW PEM electrolysis

3. Main promoters and envisaged sources of financing

- Main promoter: Yamanashi Univ. Yamanashi prefectural industrial technology center, private sector
- Financing: Yamanashi Prefecture, METI/NEDO, MEXI, etc.

4. Key drivers for developing the project and hydrogen's unique added value in this context

Developing technical knowledge of universities obtained by state-of-the-art research into companies in the region
Development of related industries / economy in Yamanashi Prefecture through intervention of administrative

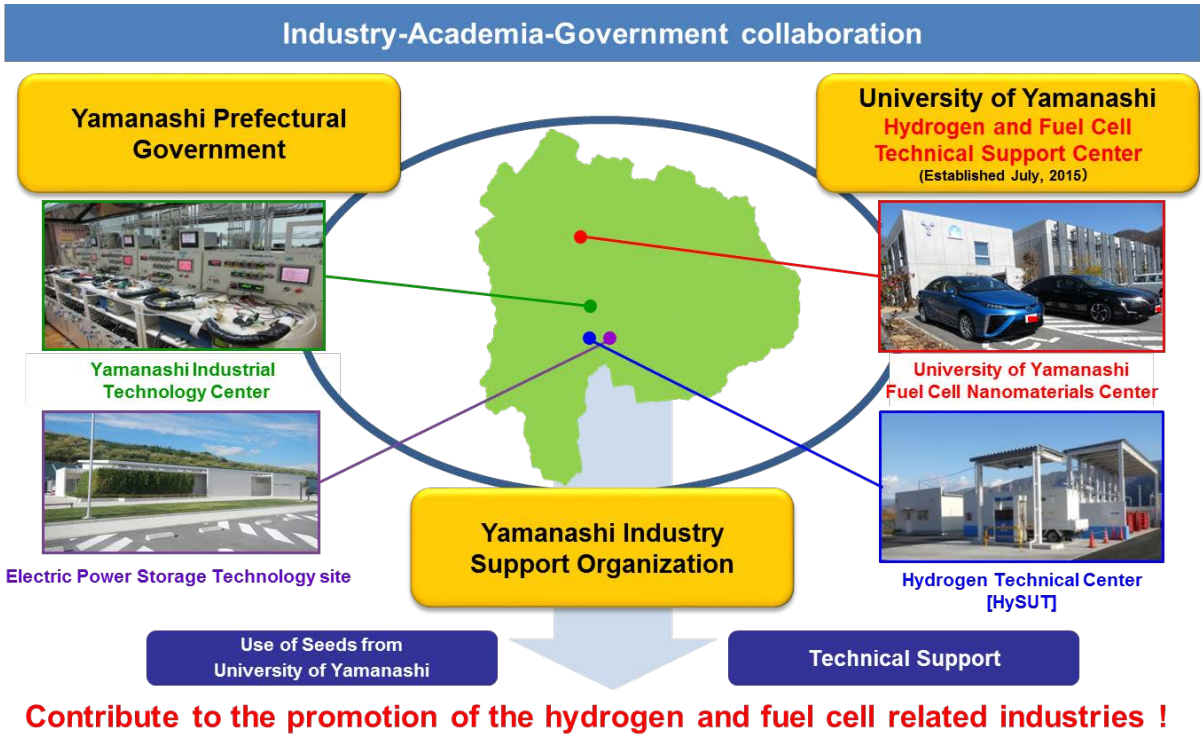
Utilization of CO2-free hydrogen obtained from PtG project
Contribution to local production of energy and low carbonization of energy

5. Is the project scalable? Replicable? Under which conditions?

Yes

Reference:

✓ Image of Hydrogen Valley in Yamanashi



Template for “Hydrogen Valley” projects for the Antwerp workshop

NAME: Fukushima

○Fukushima Plan for a New Energy Society

- Fukushima prefecture is attempting to make itself a pioneering region in terms of renewable energy, and thus promoting its expansion, the clustering of related industries and R&D in the field.
- In order to accelerate these efforts, Fukushima prefecture formulated the “Fukushima Plan for a New Energy Society” which aims to maximize the introduction of renewable energy and establish a futuristic model of society in Fukushima prefecture. In this model, new energy such as hydrogen is “Produced”, “Transported”, “Stored” and “Used”.

1. Key characteristics of the project

Activities

○R&D

－The National institute of advanced industrial science and technology, Fukushima Renewable Energy Institute (FREA) is conducting R&D on state-of-the-art technologies related to production of hydrogen using renewable energy and its subsequent storage and usage to ensure the establishment of these technologies.

－“Fukushima Hydrogen Energy Research Field (FH2R)” which has a 10,000 kw water electrolysis system, one of the largest scale systems in the world, could produce hydrogen from renewable energy on a large scale. The aim is to utilize the hydrogen during the Tokyo 2020 Olympic and Paralympic Games.

○Expansion of hydrogen utilization

－To accelerate hydrogen use, Fukushima prefecture provides subsidy for constructing hydrogen refueling stations and the introduction of FCV. Also, feasibility studies of FC forklifts and Fuel Cell Cogeneration have been conducted.

○Human resource development

－A human resource development course on renewable energy and hydrogen was established in cooperation with universities to produce excellent engineers who will be able to continuously support the energy industry in the future.

○Establish cooperation network with industry, government and schools.

－The Fukushima Prefectural Renewable Energy Related Industry Promotion Research Association (with about 740 member organizations) was established to formulate networks, consider joint research and share information on accumulation of related industries. The members of the associations consist mainly of companies and universities. The Hydrogen subcommittee was established as one of its five subcommittees. The subcommittees are conducting seminars and site visit.

○Industrial development and accumulation

- Fukushima Renewable Energy Industry Fair (REIF Fukushima) has been held every year since 2012. REIF Fukushima aims to provide negotiation and communication opportunities for industry and organizations in order to foster and accumulate renewable-energy related companies. A large number of visitors have visited the hydrogen exhibition and hydrogen session from all over the world.

2．Status (including indicative timeline)

○R&D

－At FREA, R&D on organic chemical hydride using MCH is being conducted in order to establish the necessary technologies for hydrogen storage and transport.

－The demonstration of large scale hydrogen production using renewable energy is planned for launch in 2020 at H2R.

○Current status of hydrogen usage in the prefecture

－FCV:35 vehicles (As of March 2018), HRS:3 stations (As of March 2018)

○Human Resource Development

－In the human resource course, field work has been carried out as well as lectures by researchers of FREA. These activities gave companies in the prefecture the opportunity to consider the future of the hydrogen energy business.

－Some of the employees in Fukushima prefecture was dispatched to FREA for training and they were able to obtain the qualification for running HRS. This led to the opening of a mobile hydrogen refueling station.

○Establish network with industry, government and school

－The network among the members has been established through the seminars and visits to the Hydrogen Subcommittee. Also it contributes to

deepening the attendees' knowledge regarding hydrogen.

○Industry accumulation

－REIF Fukushima has led to new businesses and contracts between exhibitors and visitors.

3. Main promoters and envisaged sources of financing

Practitioner：Fukushima prefecture, FREA、NEDO etc.
Funds：Fukushima prefecture、FREA、METI/NEDO etc.

４. Key drivers for developing the project and hydrogen's unique added value in this context

○To build the model for hydrogen-powered society in Fukushima prefecture.

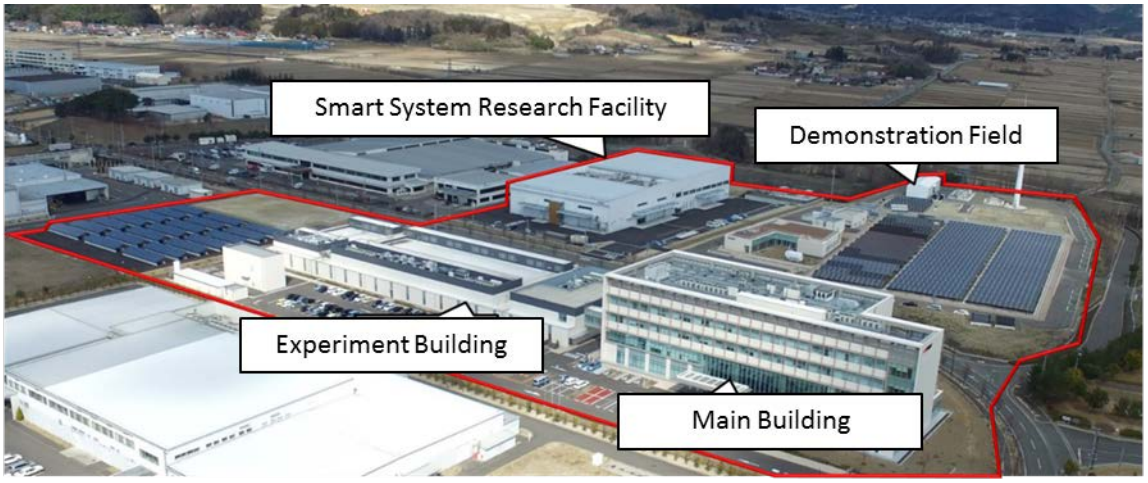
○ Development of hydrogen related industry (Economy) in Fukushima Prefecture

1. Is the project scalable? Replicable? Under which conditions?

Yes

Reference

✓ FREA



✓ Completion image of Fukushima Hydrogen Energy Research Field(FH2R)

(Source: Toshiba Energy Systems & Solutions Corporation)

● Opening Ceremony of Iwaki Kashima Hydrogen Refueling Station

In order to open the Iwaki Kashima Hydrogen Refueling Station, the first stationary hydrogen refueling station in the prefecture, the Iwaki chamber of commerce and industry and other supporting companies have introduced more 22 FCVs.

Template for “Hydrogen Valley” projects for the Antwerp workshop

NAME: Fukuoka Strategy Conference for Hydrogen Energy

- The conference is collaborative government-industry-academia organization established in August, to take the initiative in creating an environmentally-compatible, sustainable society based on hydrogen energy.
- Implementing “Hy-Life Project” which includes comprehensively promotes formulation world cutting edge R&D cluster, human resource development and technology transfer, developing hydrogen energy industry, demonstrations of hydrogen energy technologies.

1. Key characteristics of the Hy-Life Project (location, applications concerned, targeted size etc.)

Consisting following main activities:

(1) Cutting edge R&D cluster on hydrogen

Supporting research and development centered on research centers of Kyushu University.

- Research Center for Hydrogen Industrial Use and Storage (HYDROGENIUS)
- AIST-Kyushu University Hydrogen Materials Laboratory (HydroMate)
- Next-Generation Fuel Cell Research Center (NEXT-FC)
- International Institute on Carbon-Neutral Energy Research (I^2CNER)
- International Research Center for Hydrogen Energy

(2) Demonstration project

Promoting advanced social demonstrations for utilizing hydrogen in the real world.

- Kitakyushu Hydrogen Town (hydrogen supply to demonstration housing etc. through hydrogen pipeline)
- Energy interchange project using fuel cell in apartment house
- Renewable energy derived hydrogen utilization project in automobile factory
- Hydrogen production project from sewage sludge

(3) Hydrogen human resource development

Conducting human resources program for business owners and engineers who aim to enter hydrogen related fields

(4) Advanced hydrogen information base

Disseminating of Japan's efforts with a focus on Fukuoka and inclusion of regional information in each country

(5) Development and accumulation of hydrogen energy new industry

Supporting for commercialization by hydrogen energy product collaboration with the Hydrogen Energy Test and Research Center (HyTReC), which is the only product testing facility under ultra-high pressure in the world's.

2. Situation (including timeline)

(1) Research and Development:

- Research and development on long life, anti-high pressure hydrogen seal, joint and equipment.
- Research, development and demonstration on hydrogen production using electricity from renewable energy, high efficient hydrogen production technology.

(2) Demonstration project

Promoting advanced social demonstrations for utilizing hydrogen in the real world.

- Kitakyushu Hydrogen Town (hydrogen supply to demonstration housing etc. through hydrogen pipeline)
- Energy interchange project using fuel cell in apartment house
- Renewable energy derived hydrogen utilization project in automobile factory
- Hydrogen production project from sewage sludge

(3) Human resource development：

- At the Fukuoka Hydrogen Energy Human Resources Development Center, cultivate engineers who can play an active role at the forefront of hydrogen-related product development. More than 1,200 people attended from 2005 to the present.

(4) Development of new industries:

- Support local company product development
  (Hydrogen visualization sheet, stainless steel packing, hydrogen gas impurity analyzer, O-ring, etc.)

(5) Others: FCV, HRS

FCV: 109, 10 Hydrogen Refueling Stations

3. Main promoters and envisaged sources of financing

Implementer: Fukuoka Prefecture, Kyushu University, HyTReC etc.

Funding: Fukuoka Prefecture, METI / NEDO, etc.

4. Key drivers for developing the project and hydrogen's unique added value in this context

- Development of related industries (economy) by entry of prefecture enterprises into hydrogen field
- Development of technological knowledge of universities obtained through cutting-edge research to regional companies
- Accumulation of data such as CO2 reduction effects obtained from social demonstration (model business)
- Contribution to local production for local consumption and low carbonization of energy

5. I Is the project scalable? Replicable? Under which conditions?

The demonstration projects are is scalable

Reference:

✓ **Products development according with Kitakyushu Hydrogen Town**

Create an environment to provide products development demonstration fields by branching and extending pipelines.

✓ **I²CNER / NEXT-FC**

✓ **HYDROGENIUS/HydroMate**

Northern Netherlands - "Hydrogen Valley" projects for the Antwerp workshop

1. **Key characteristics of the project (location, applications concerned, targeted size etc.) and status**

   The Northern Netherlands is well on its way to deploy a fully-fletched, robust, future oriented and sectoral integrated green hydrogen value chain. In this region the deployment of hydrogen in various applications is becoming substantial in industry, mobility and the built environment.

   There is an extensive portfolio of hydrogen projects covering the spectrum of innovation to investments. This project portfolio involves all aspects of the hydrogen value chain: sourcing of feedstocks, production, transportation & distribution and utilization of hydrogen including the built up of a strong knowledge and innovation infrastructure supporting and intertwining with this development. Dominant locations are Delfzijl (electrolysers, chemical industry), Eemshaven (electrolysers, power plants), Emmen (chemical industry, electrolysers) and Groningen (mobility applications, research centres). The total investment foreseen in the period up to 2030 is in the order of magnitude of € 2.8 billion and we project a gradual increase of hydrogen production and uptake to 70 PJ in 2030.

2. **Main promoters and envisaged sources of financing**

   The projects in the regions are promoted and brought forward by private and public companies, among them BioMCN, Engie, EMMTEC, Gasunie, NAM, Nouryon, Nuon and Shell, Public Transport Authority and Public Transport Operator (QBuzz). But also the provinces Friesland, Groningen and Drenthe and the municipalities like Groningen and Emmen. Apart from substantial investments on behalf of the companies the projects will require contributions from European, national and regional support schemes.

3. **Key drivers for developing the project and hydrogen's unique added value in this context**

   The Northern Netherlands is driven to green the Northern Netherlands economy in order to contribute to the climate change objectives for the Netherlands while strengthening the economic position of the Northern Netherlands and creating sustainable employment opportunities in the region. We consider hydrogen as being an essential element in this strategy, serving as green feedstock for our chemical industry, making it possible to integrate large volumes of renewable electricity in mobility and serve as a storage medium for large energy volumes. Moreover, we can built upon a long time experience in the handling of gaseous energy carriers.

4. **Is the project scalable? Replicable? Under which conditions?**

   The Hydrogen Valley Northern Netherlands foresees in step by step scaling up the production and use of hydrogen in various applications. It goes almost without saying that one of the objectives of the Hydrogen Valley Northern Netherlands is to develop

concepts that can be applied elsewhere, so that hydrogen can play its role as the linking pin between green energy generation and its use in all sectors of the economy.

UK - "Hydrogen Valley" projects for the Antwerp workshop

1. **Key characteristics of the project (location, applications concerned, targeted size etc.)**

   HyNet North West: 6TWh / Year hydrogen production per year using Autothermal Reforming of natural gas feedstock with Carbon Capture and Storage (CCS) in depleted gas reservoirs in Irish Sea. 4TWh / year of hydrogen production for fuel switching for major industrial consumers and 2 TWh / year for blending in distribution network to reduce carbon intensity of domestic heat. Future expansion of hydrogen infrastructure to provide hydrogen for transport and flexible power generation.

2. **Status (including indicative timeline)**

   2017/18: Feasibility

   2018/19: pre-FEED (CCS, Hydrogen Production and Fuel Switching) and demonstration of 20% hydrogen blending in distribution network.

   2020/22: FEED / Consent / CO_2 Storage License

   2022: Financial Investment Decision

   2024/5: Operational

3. **Main promoters and envisaged sources of financing**

   Major industrial partners and collaborators include Cadent (gas network), Essar (oil refinery), CF (Fertiliser Production), Eni (oil and gas major and owner / operator of Irish Sea infrastructure) plus industrial users. Pre-FEED funded through UK Government Innovation stimulus funding. FEED / Construction to be funded through further grant funding plus partner investment (subject to appropriate policy framework / market instruments being in place).

4. **Key drivers for developing the project and hydrogen's unique added value in this context**

   Hydrogen is an essential vector to decarbonise the 'hard to reach' sectors of the economy, such as energy intensive industry, domestic heat and heavy transport. HyNet combines hydrogen production with CO_2 emissions capture from existing industrial processes such as oil refining and fertiliser production. Many of the industrial processes addressed by HyNet are not suitable for electrification or other decarbonisation pathways. Finally, hydrogen represents a major opportunity for decarbonisation of domestic heat in the UK due to the need to provide significant flexibility in supply.

5. Is the project scalable? Replicable? Under which conditions?

Future scalability will see the project develop from 1-2$MtCO_2$ / year captured up to 10$MtCO_2$ / year based on widespread rollout of hydrogen infrastructure in the NW of the UK. This will cover demand for industrial fuel switching, distribution network blending, transport and flexible power generation (which is more cost effective than post combustion capture). Similar projects are being considered in Teesside, Humberside and Scotland, and a South Wales project will eventually integrate with HyNet North West.

<u>In addition, we kindly request that the presentations address the following issues:</u>

- Main hurdles that you have encountered/you anticipate to encounter
- How have you overcome these problems? / How do you plan to overcome them?
- Main success factors for "Hydrogen Valley" projects
- Where is collaboration/information exchange between "Hydrogen Valley" projects needed? / What should the Mission Innovation Hydrogen Challenge information sharing platform focus on?

USA - "Hydrogen Valley" projects for the Antwerp workshop

1. **Key characteristics of the project (location, applications concerned, targeted size etc.)**

   San Pedro Bay Ports of California, hydrogen fuel cell trucks and CHE

2. **Status (including indicative timeline)**

   Development and demonstration stage

3. **Main promoters and envisaged sources of financing**

   CARB, SCAQMD (State of California)

4. **Key drivers for developing the project and hydrogen's unique added value in this context**

   Reducing criteria pollutants and GHGs with extended range of fuel cells.

5. **Is the project scalable? Replicable? Under which conditions?**

   The project is scalable, replicable under the right cost conditions.

In addition, we kindly request that the presentations address the following issues:

- Main hurdles that you have encountered/you anticipate to encounter
- How have you overcome these problems? / How do you plan to overcome them?
- Main success factors for "Hydrogen Valley" projects
- Where is collaboration/information exchange between "Hydrogen Valley" projects needed? / What should the Mission Innovation Hydrogen Challenge information sharing platform focus on?

Sharing of lessons learned.