

Development of Business Cases for FCH Applications for Regions and Cities

2nd General Assembly Meeting



2nd General Assembly Meeting, 11 July 2017 in Brussels

Agenda

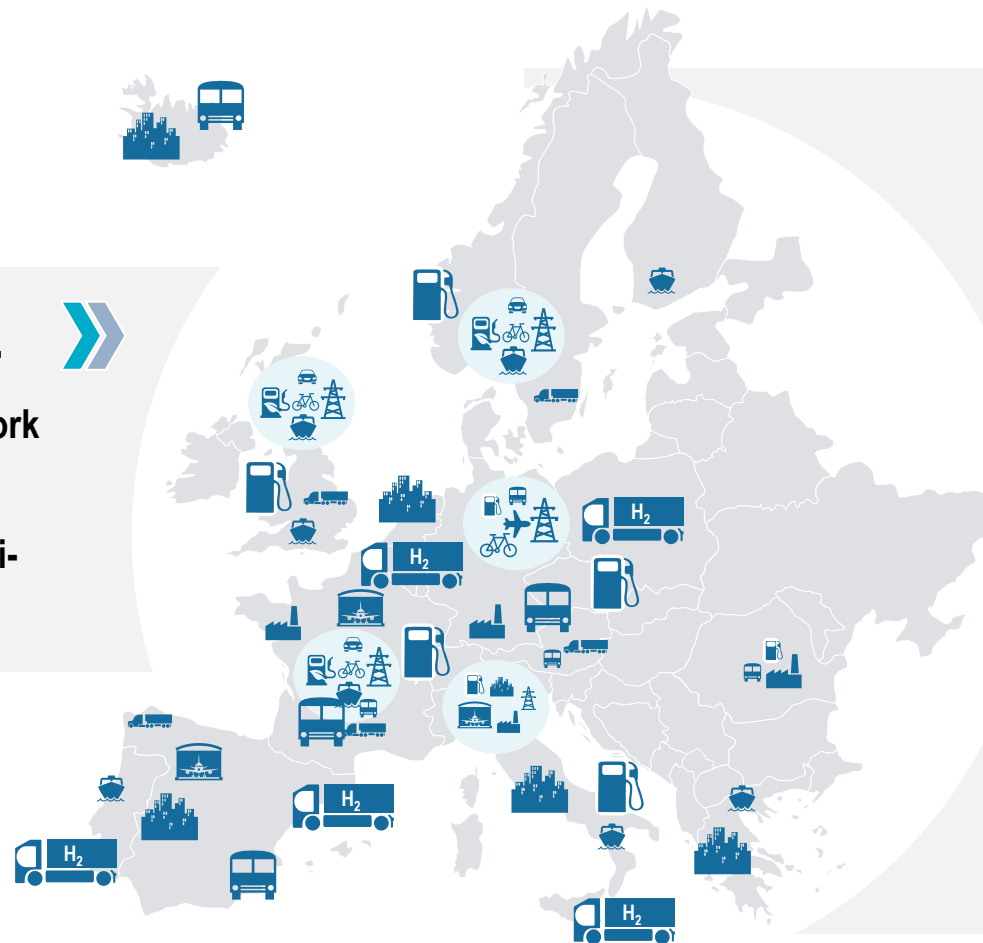
Topic	Presenter	Time
A. Welcome coffee and registration	-	09:30 – 10:00
B. General introduction, "State of the Union"	FCH2 JU, RB	10:00 – 10:15
C. Results of the self-assessment survey of regions/cities	RB	10:15 – 11:00
<i>Coffee break</i>		11:00 – 11:30
D. Introduction to the funding/financing module (incl. case study)	RB	11:30 – 12:30
<i>Lunch break</i>		12:30 – 13:30
E. Technology introduction forum – FCH "Mini-Fair"	RB, FCH industry	13:30 – 14:45
<i>Coffee break</i>		14:45 – 15:00
F. Framework for the preliminary business case analyses	RB	15:00 – 15:45
G. Conclusion and next steps	FCH2 JU, RB	15:45 – 16:00
H. Networking drinks / get-together	-	from 16:00 on

A. Welcome and objectives for today



Today, we'd like to bring cities/regions and FCH industry together and lay the foundations for the preliminary business cases

Today's objectives



Connections ...



Possibility to network and get together throughout the day particularly the "mini-fair" to interact with industry



Updates ...

Presentation and discussion of the **self-assessment** results, Interim conclusion of the **Tech Intro** and introduction to the **Funding Database**



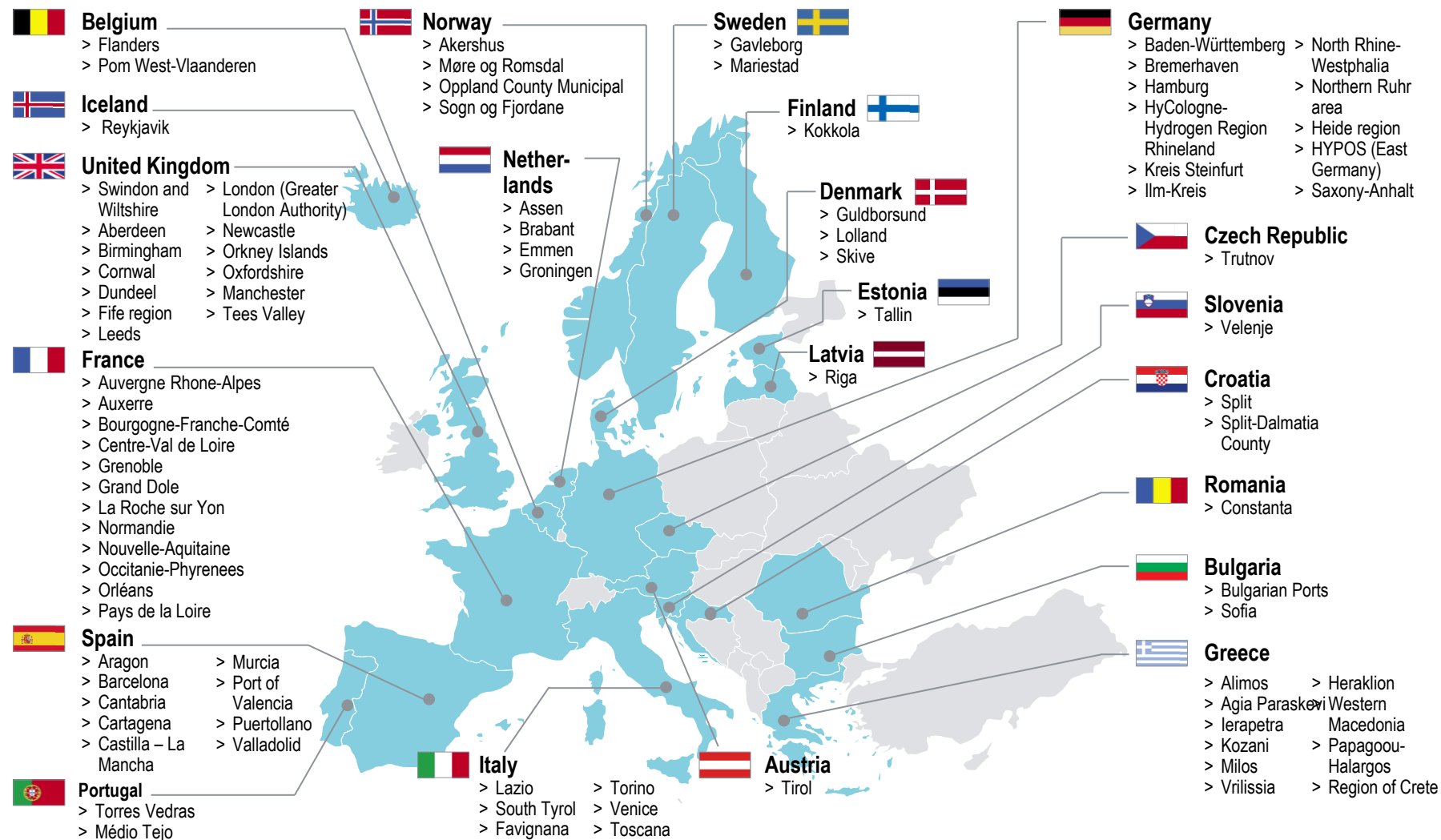
Progress

Presentation and discussion of the framework to assess preliminary **business cases**

B. General introduction, "State of the Union"



80+ regions from 20+ countries now participate in the project – and the coalition keeps on growing








Current and prospective FCH industry participants



The self-assessment survey has been completed, Tech Intro and funding/financing mapping are under way

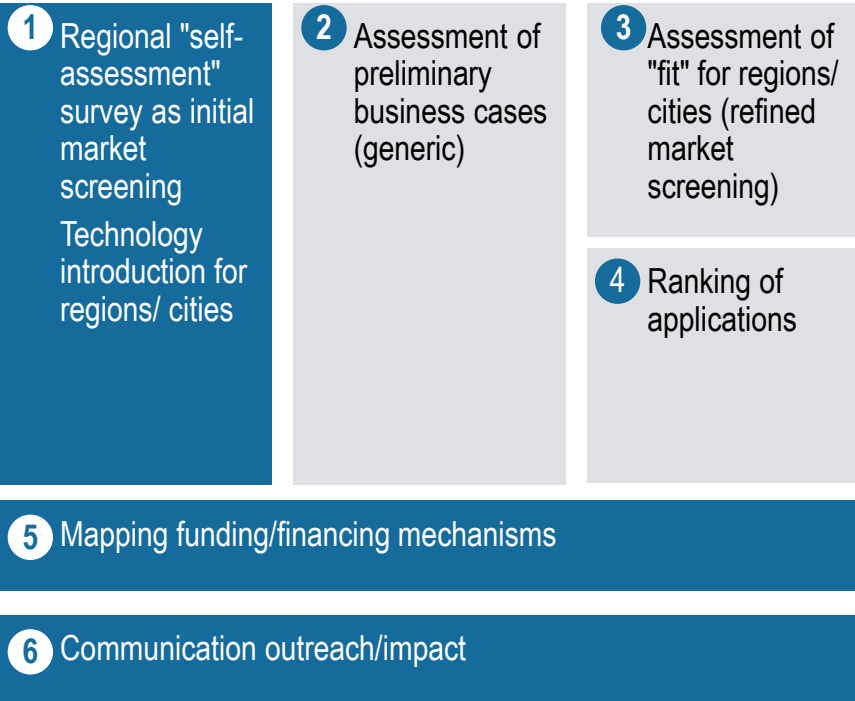
Project status – What we have achieved so far

-  The coalition has been continuously growing to **80+ regions and cities from 20+ countries** – now organized in 5 Working Groups
-  **30+ industry partners** (and counting) have been mobilized to support the coalition
-  **70+ self-assessments** have been completed by cities and regions from 19 countries
-  The **Technology Introduction Dossiers** are under way, **7 FCH applications** have been discussed in the respective Working Groups already
-  The **funding and financing tools database** has been designed and is now being populated, among others with >50 instruments identified in the self-assessment survey

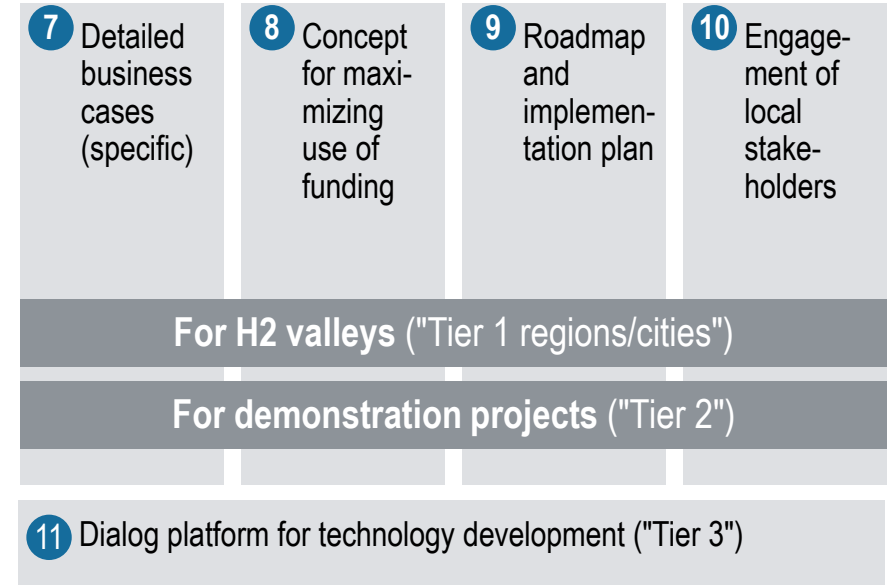
Moving forward, we will start the analysis of preliminary business cases of FCH applications

Detailed project approach: two phases and eleven modules

Phase 1: Preliminary business cases



Phase 2: Detailed business cases, roadmaps



Modules currently under way

C. Results of the self-assessment survey of regions/cities



The survey provides specific insights into the regions'/cities' current situation, ambitions and challenges for FCH deployment

Key findings of the self-assessment survey



Experience – 66% of the cities and regions have concrete plans or have already deployed FCH applications; the average experience level is equally distributed across Working Groups



Objectives – Regarding this project, 64% of participants indicated a strong and concrete interest towards deploying FCH applications, with 58% indicating strong interest in financing options



Challenges – Funding & financing (57%) as well as viable business cases (42%) were stated as major challenges for the successful deployment of FCH applications



Drivers – For 60-65%, the strongest drivers for pursuing FCH applications are industrial innov. & development and the creation of employment (slightly ahead of environmental reasons)



Financing – Almost half of the participants have no dedicated internal FCH-budget available, but the aggregated, averaged 5-year FCH-related project volume is expected to increase by 163% to EUR 5.6 m between 2017 and 2022

C.1 Introduction



The high participation in the self-assessment survey and the clear results underpin the pan-European interest in FCH deployment

Key facts about the survey

74 completed, **84** partially completed surveys¹⁾...

...from **19** European countries...

comprising ca. **23%** of European population...

...covering ca. **14%** of European surface...

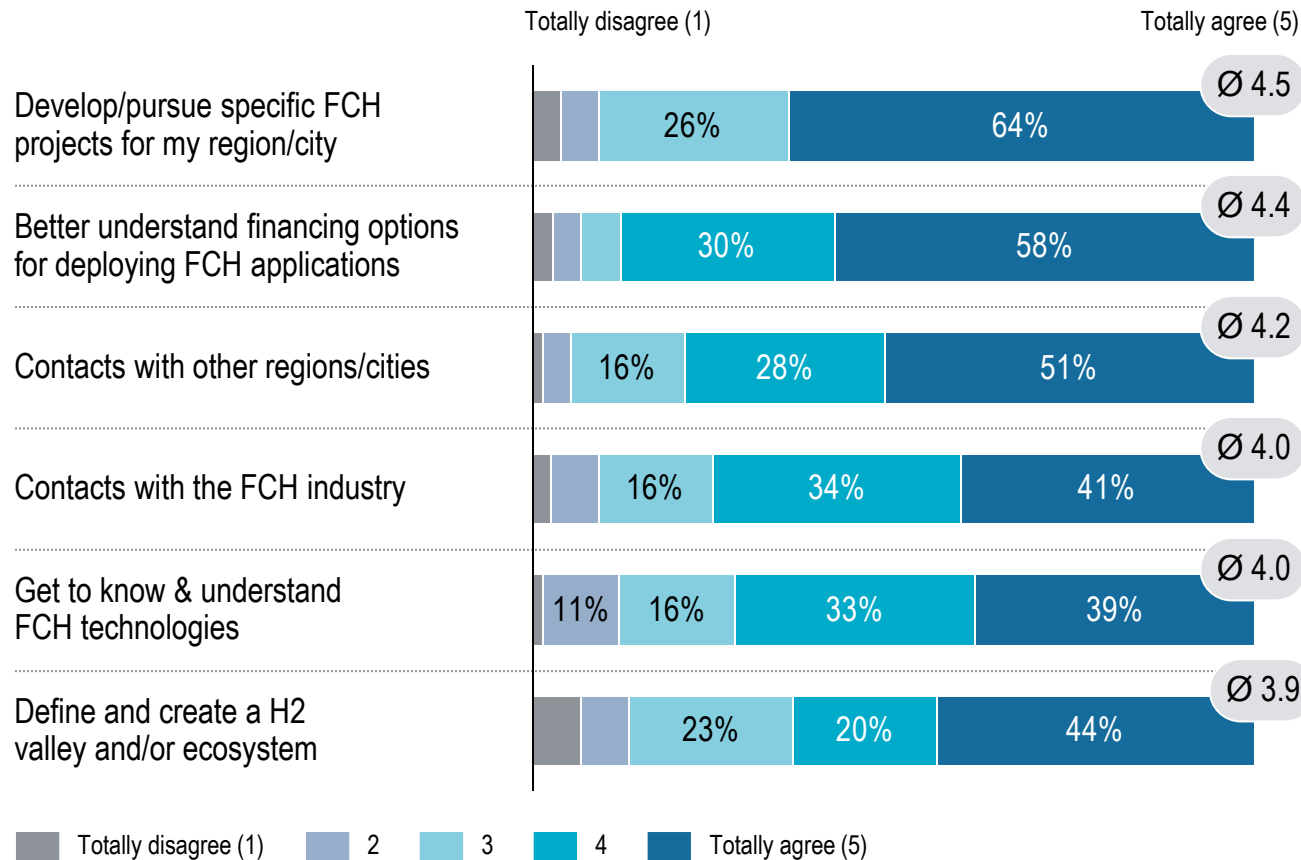
...with **>94%** of the participants indicating a moderate to strong interest in future deployment of FCH applications²⁾



1) All answered questions were included 2) Question: "How interested is your region/city in actively pursuing the future deployment of FCH applications?" (n=71), 94,37% of the participants set either 3, 4 or 5 points on a 5-point Likert Scale

Survey participants state a strong interest in pursuing concrete FCH projects and exploring FCH financing options

Reasons for participating in the project¹⁾



Other reasons (selection):



"Communicate internally and increase buy-in across departments within municipality"

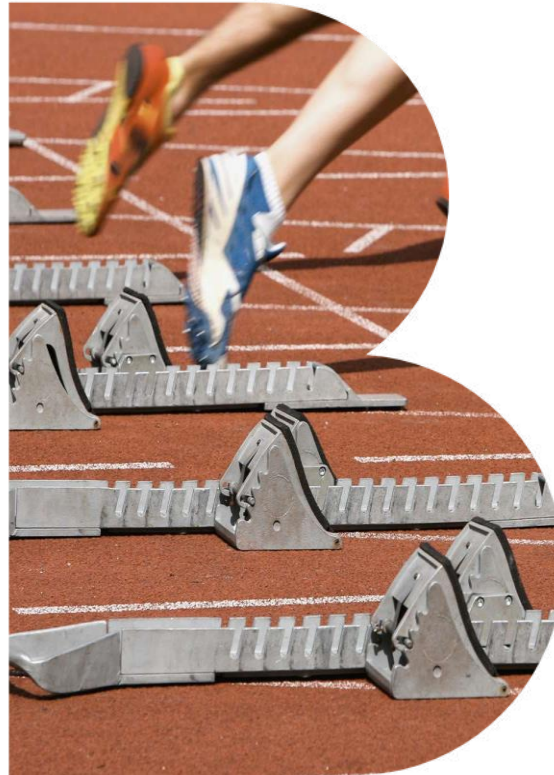
"Develop approaches to public acceptability"

"Specify funding needs to be considered for future policies"

"Overview of Pro`s and Con`s of H₂ compared to other energy carriers"

1) Question: "Please evaluate the following reasons for participating in this project" (n=74-76)

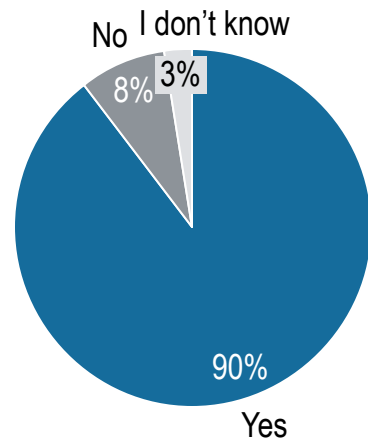
C.2 Current set-up and starting point of regions/cities



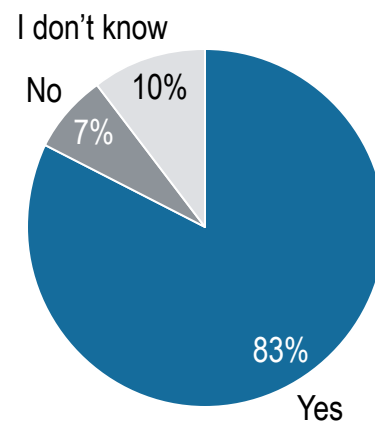
More than 80% of the regions & cities report ambitious quantitative targets for reduction of local emissions

Emission reduction within regions and cities

Question: "Does your political agenda include reduction of local emissions like GHG, pollutants and fine dust?" (n=77)



Question: "Is there a concrete quantitative target for reducing local emissions?" (n=69)



Concrete targets (selection)¹⁾



"100% electricity generation from renewables by 2050, 50% zero emission public transport by 2030, 100% by 2050"

"40% reduction in CO₂ emissions by 2020 compared to 2005"

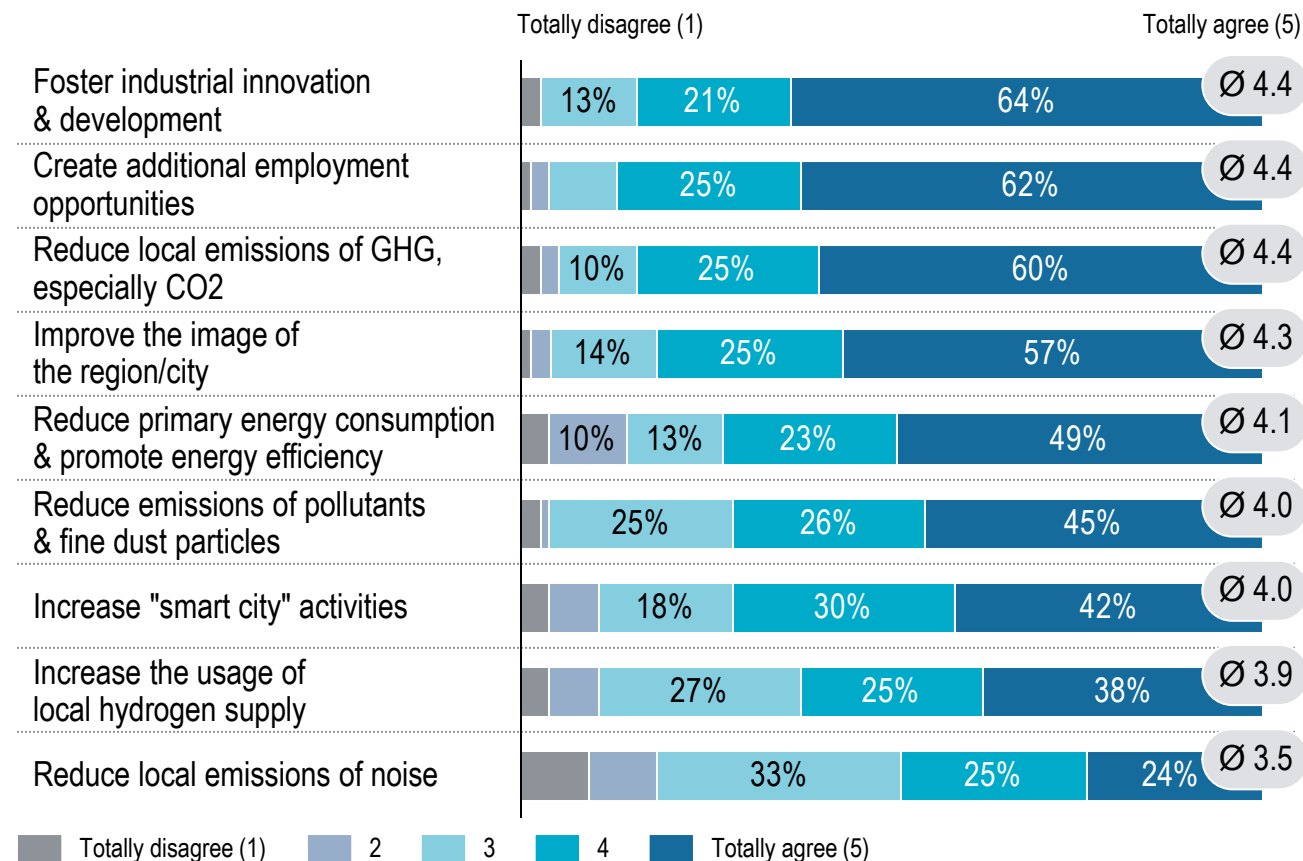
"Replace petrol share in energy mix for mobility to 40% by 2050"

"Reduce CO₂ emissions to 4t p.p. by 2020, less than 1.5t by 2050"

1) Question: "Please specify one or more concrete targets."

The strongest drivers for pursuing FCH applications are industrial innovation & development as well as additional employment

Reasons for pursuing FCH applications¹⁾



Other reasons (selection):



"Boost scientific research and innovation"

"Unlock grid constraints and make better use of renewable generation"

"Usage of excess renewable energy"

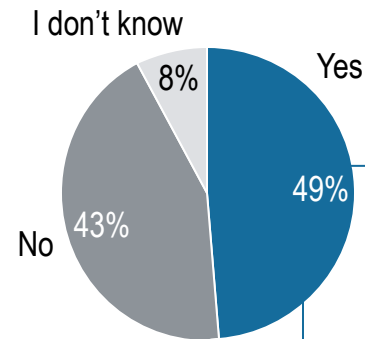
"Increase smart, sustainable living using resources at hand"

1) Question: "What are your region's/city's main reasons for pursuing FCH applications? How relevant and important are typical drivers for FCH technologies to you, also compared to one another?" (n=76-77)

~50% of participants say FCH applications are part of their political agenda, with 32% having a dedicated FCH strategy in place

FCH applications as part of the political agenda

Question: "Does your political agenda explicitly include the promotion of FCH applications?" (n=76)



Exemplary elements of promoting FCH applications:

"Deploy at least 300 FCEV in the region by end of 2018"

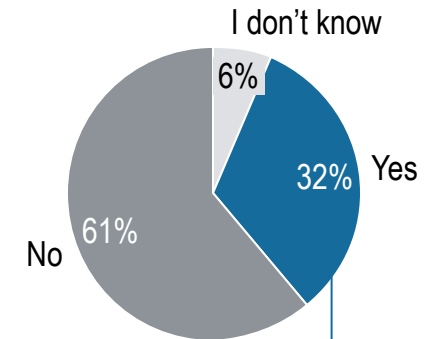
"Develop a pilot project for hydrogen production in 2017"

"Establish FCH demo infrastructure"

"Attract further partners of hydrogen technology to region"

"Test hydrogen storage solutions associated to renewable energy sources"

Question: "Does your region/city have a dedicated strategy in place to promote FCH applications?" (n=77)



Exemplary strategies:

"Swindon Hydrogen Roadmap"

"Hydrogen Strategy for Oslo and Akershus (2014-2025)"

"Hydrogen Masterplan in Aragon (2016-2020)"

"Vendée Hydrogène"

"Roadmap for the Realisation of a Wind Hydrogen Economy in the Lower Elbe Region"

Internally, less than half of participants have an designated FCH unit or manager; externally, most partnerships are with industry

Internal capacities

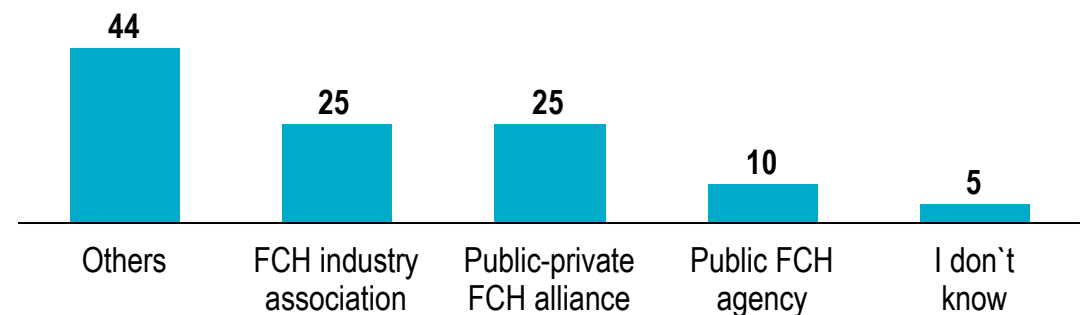
Question: "How many staff in your team are working on FCH-related activities" (n=70)



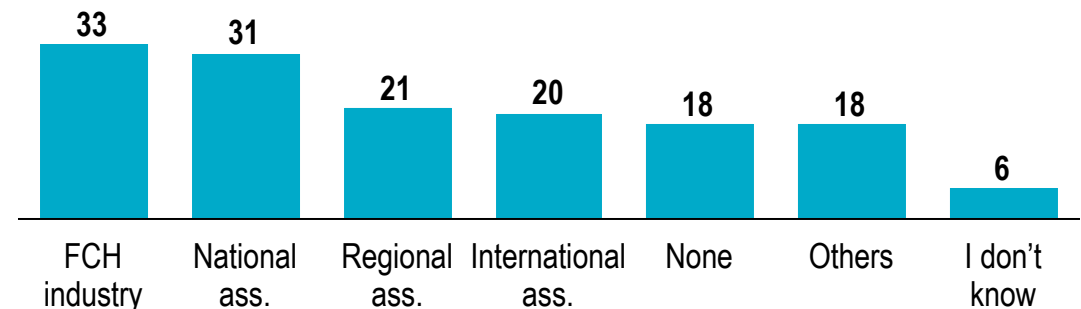
...**40%** of the regions/cities have a designated FCH activities unit or manager¹⁾

External partnerships and cooperation's

Question: "Which institutions are active within my region/city?"



Question: "My region/city has already partnered up with..."



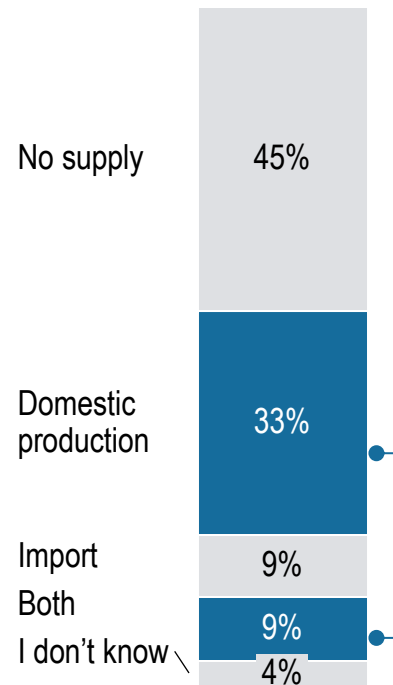
1) Question: "Is there a designated FCH activities unit or manager within your regional or municipal authority?" (n=75)

~50% of participants have access to H₂, with renewable electricity being the most relevant source – "Grey" H₂ still important

Origins and sources of hydrogen supply for regions and cities

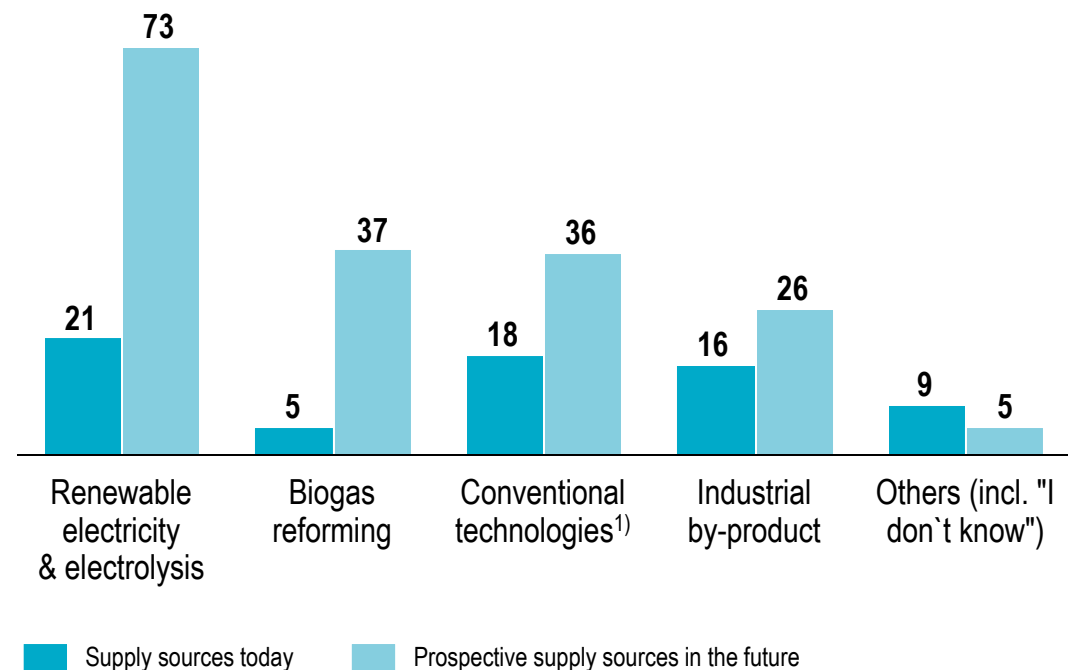
Origins of hydrogen supply

Question: "Is hydrogen already supplied in your region/city today?" (n=76)



Sources of hydrogen supply if produced within region/city

Question: "What is your source for hydrogen supply today and where do you see it in the future?" (n=77)



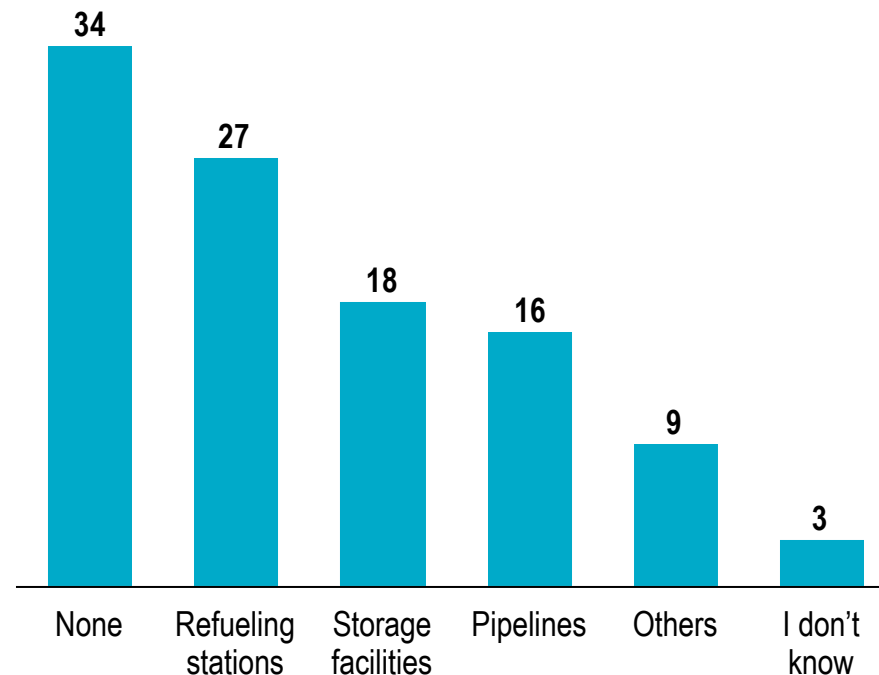
1) Steam-methane reforming (SMR), chloralkaline electrolysis

Most of the participants have no H₂ infrastructure in place yet, but the majority states plans to further develop infrastructure and supply

Hydrogen infrastructure today and tomorrow

Infrastructure in place

Question: "What hydrogen infrastructure does your region/city have in place?" (n=76)



Future infrastructure

... **70%** of the regions/cities have plans to further develop hydrogen supply or hydrogen infrastructure within their region until 2022¹⁾.

Exemplary initiatives:

"BIG HIT – Hydrogen Refuelling Station by 2017 for fleet of vans"

"DIMES – Distributed Integrated Multi Use Energy System for urban developments"

"ENRgHy Project, Vhyctor – co-produced hydrogen transported under high pressure and refuelling stations"

1) Question: "Does your region/city currently have any plans to develop further hydrogen supply or hydrogen infrastructure until 2022?" (n=74)

C.3 Experience with FCH applications within regions/cities

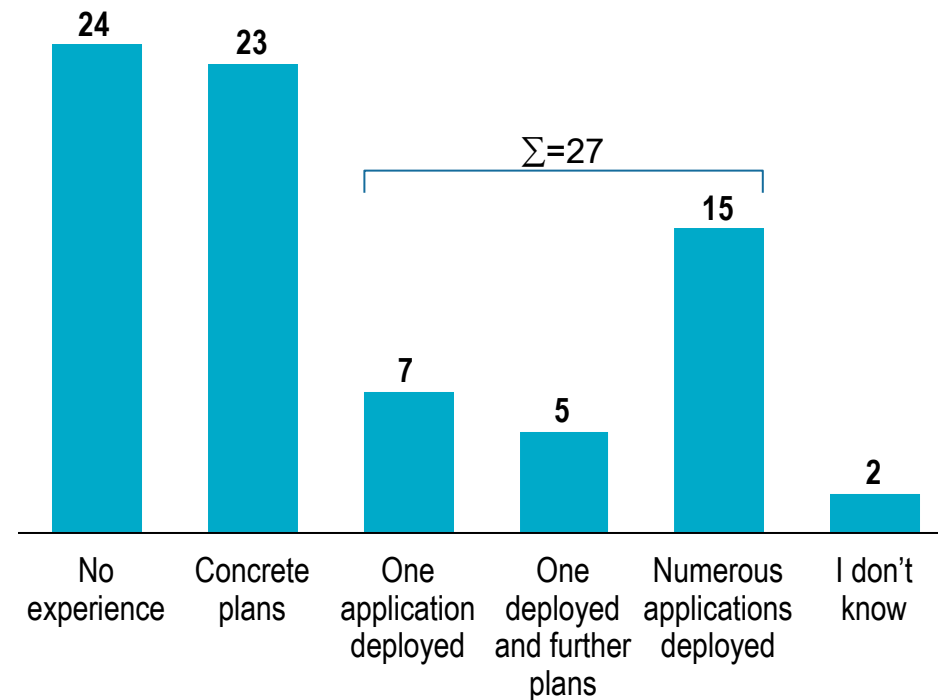


~60% of participants have not deployed FCH applications yet –
The average experience level is equally distributed across WGs

Experience with deployment of FCH applications

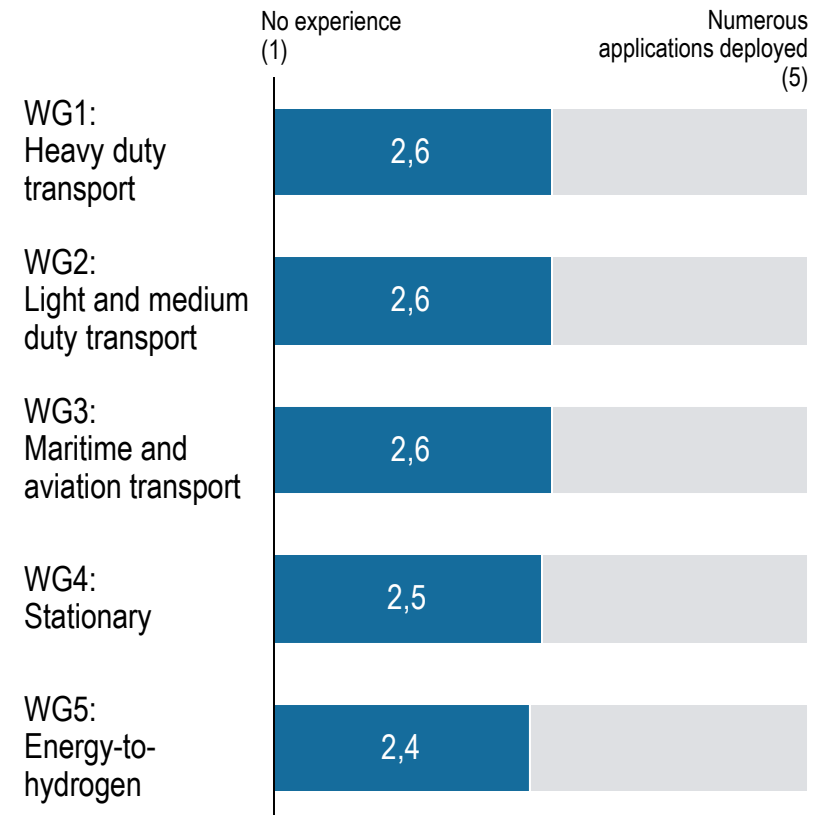
General Experience

Question: "What is the experience of your region/city regarding the deployment of FCH applications?" (n=76)



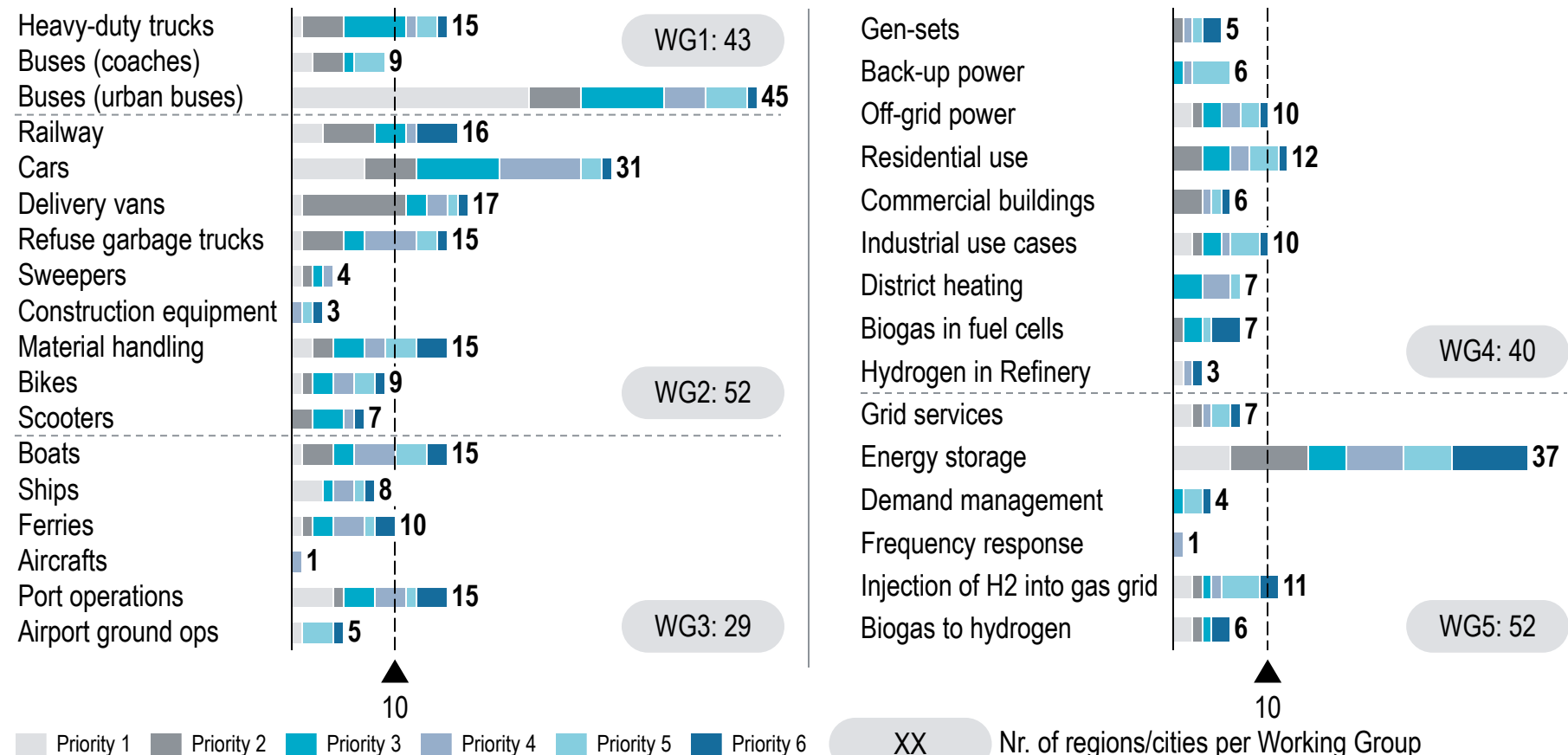
1) Averaged value on a 5-point Likert scale (n=74)

Averaged experience level per Working Group



Buses, cars and energy storage accumulated the highest interest while a number of applications were hardly mentioned

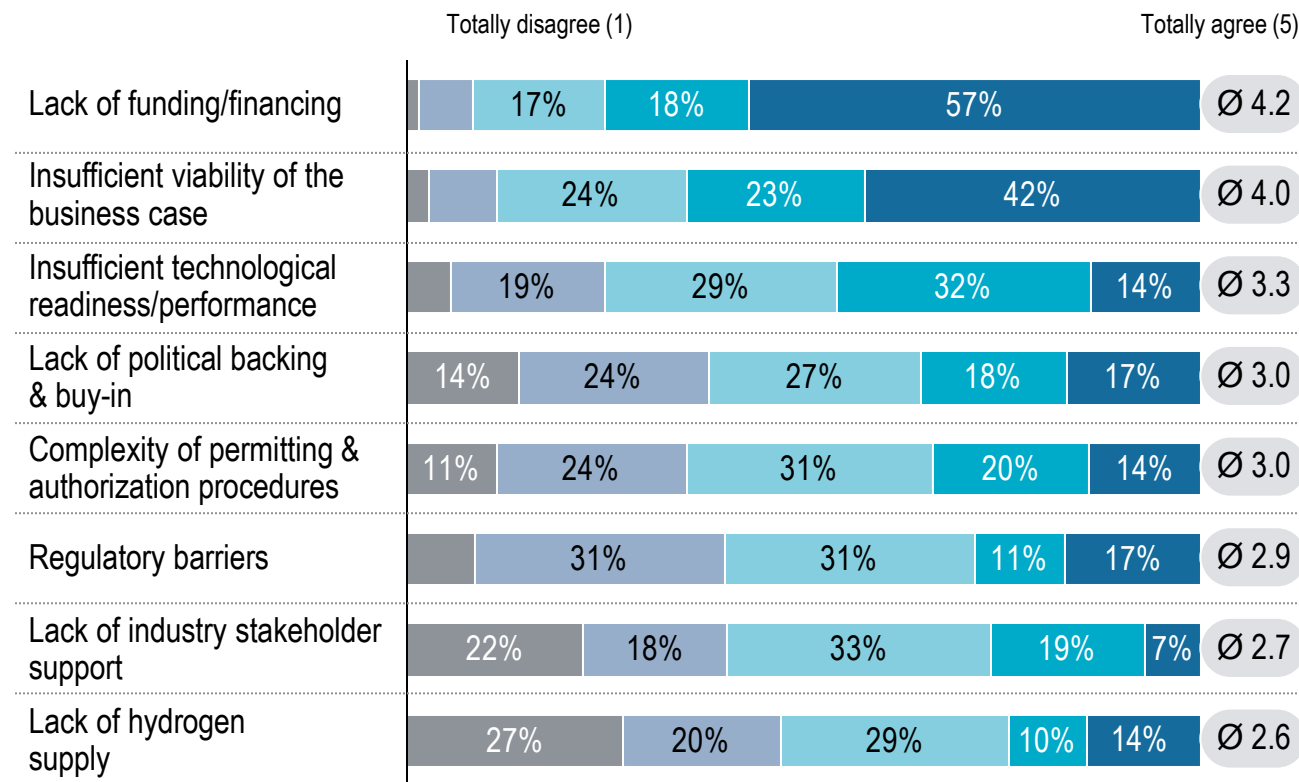
Number of participants ranking FCH applications among their top-6 applications¹⁾



1) Question: "Please rank up to six FCH applications according to their potential for future deployment in your region/city" (n=69)

Funding/financing as well as business cases are the most acute challenges to the successful deployment of FCH applications

Hurdles and challenges posing obstacles for FCH deployment¹⁾



Other reasons (selection):



"Lack of skilled local people"

"Missing public awareness"

"Lack of time"

"Insufficient coordination between different initiatives"

"Large area with small population density"

Totally disagree (1) 2 3 4 Totally agree (5)

1) Question: "Within your region/city, which hurdles and challenges currently pose obstacles to the deployment of FCH applications?" (n=70-72)

C.4 Regulatory framework in regions/cities



Beside emission-regulation, there is other considerable regulation both favouring and hindering FCH application roll-out

Regulation concerning emissions and deployment of FCH applications

Regulation in place on emission reduction (selection)

Question: "In your region/city, what regulatory measures are in place to help reduce local emissions?"

"Low emission zones in cities"

"Periodic driving ban of diesel cars"

"Energy efficiency programme for council buildings"

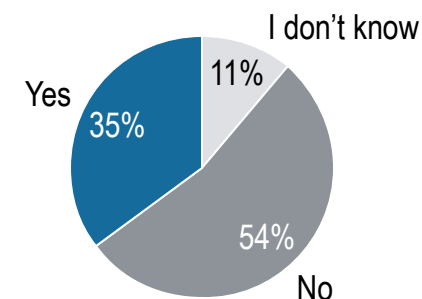
"Establishment of bus lines"

"Procurement of emission free buses only"

Regulatory barriers favouring the deployment of FCH applications



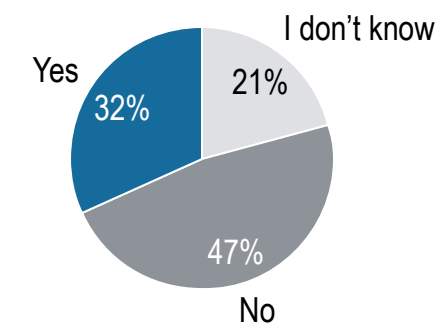
Question: "Are there any regulations in place favouring the deployment of FCH applications (directly or indirectly)?" (n=71)



Regulatory barriers in place hindering deployment of FCH applications



Question: "Are there any regulatory barriers in place hindering the deployment of FCH applications in your region/city?" (n=72)



C.5 Financing of FCH related activities in regions/cities

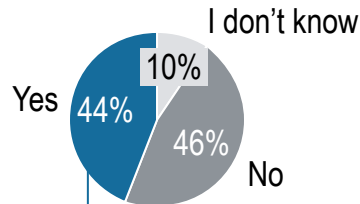


46% of participants have no internal FCH budget available yet, but the averaged 5-year project spent is projected to more than double

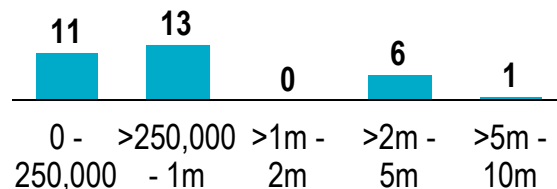
Internal budgets for deploying FCH applications of regions and cities

Current situation

Question: "Does your region/city have internal budgets available for implementing FCH application deployment projects?" (n=72)

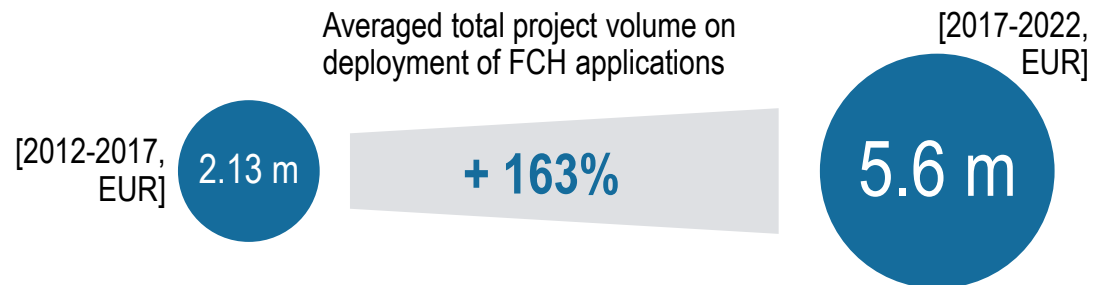
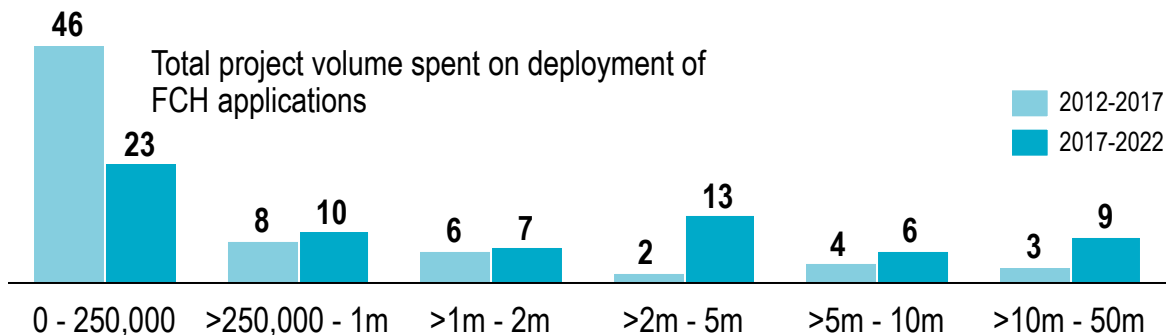


Question: "What is the aggregated volume of your internal, FCH-related budgets per year [EUR]?" (n=31)



Track-record and future ambitions

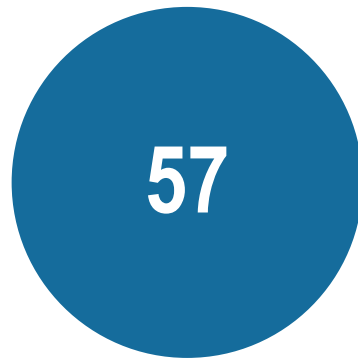
Question: "What total project volumes did your region/city spent on the deployment of FCH applications over the last five years (2012-2017, n=69), how much is envisaged over next five years (indicative, 2017-2022, n=68) [EUR]?"



There is a large variety of funding instruments that regions consider relevant, with most experience on country specific instruments

External, non budgetary funding sources

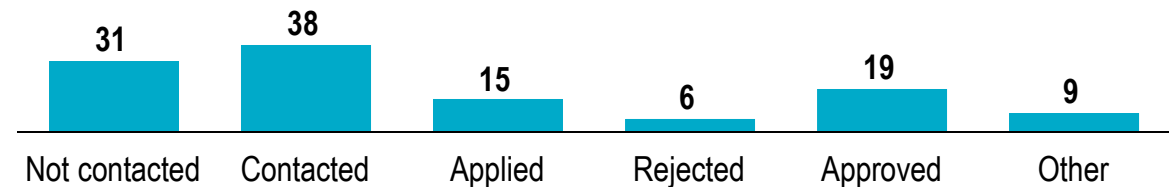
Number of funding/financing sources named in the survey



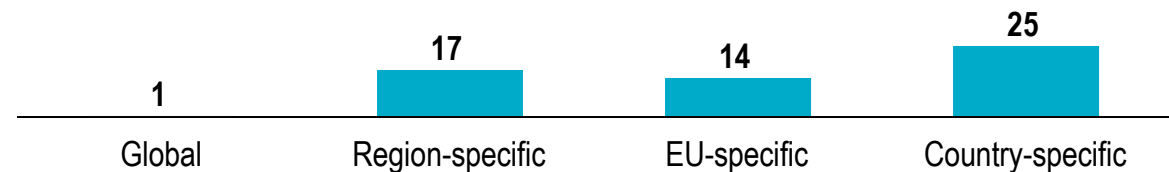
... 44%

of the regions/cities have a designated person, unit or agency in charge of identifying FCH-related funding sources¹⁾.

Question: "What is your current status of tapping this source of financing?"



Question: "What is the geographic focus?"



Question: "What FCH applications are eligible?"

"Hydrogen vehicles & refuelling stations"

"Development and implementation of environmentally friendly technology"

"Hydrogen production and use, hydrogen transport, etc."

1) Question: "Do you have a designated person, unit or agency in charge of identifying FCH-related funding sources?" (n=72)

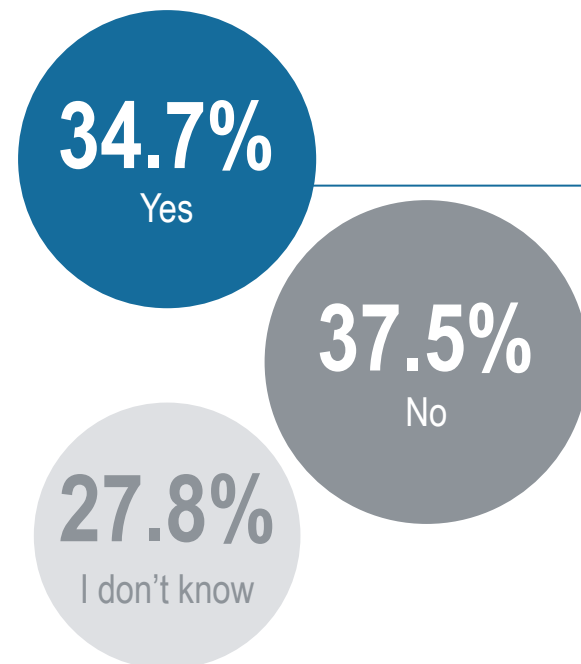
C.6 Smart specialisation



~35% of participants are registered on the S3 Platform, with some calling for a stronger interaction between FCH and S3 initiatives

Smart Specialisation Strategy (S3)

Are you a registered member of the EU's S3 platform?²⁾



What activities has your region/city realised so far (exemplary)?

- > "Participation in the S3 Chem program, which promotes innovation in chemical related areas"
- > "Chymène project: generation of hydrogen compressors for refuelling stations which are intended for hydrogen mobility"
- > "LAVOISIER, a technological research program"
- > "Establishment of an on-line environmental platform for the submission of proposals, ideas and observations by citizens and bodies"

What role do you envisage for FCH applications in the context of S3 (exemplary)?

- > "A pivoting role for boosting the development of local economies based on scientific research, innovation and entrepreneurship"
- > "Funding for projects related to the hydrogen domain"
- > "Implementation of new activities targeted at the promotion of new technological solutions"
- > "Creation of an industrial network to implement innovative tech-projects"

1) Question: "Is your region/city currently a registered member of the Smart Specialisation Strategy (S3) platform?" (n=72)

C.7 Survey and project feedback



Participants provided a large variety of comments on the survey and overall project – Food for further discussions on project steering

Feedback of participants regarding the survey and the project

Question: "How did you like the survey?"

"I believe it is **comprehensive** without feeling overwhelming"

"Would be nice to be able to jump between questions by clicking on the page number"

"I consider it **adequate** to this initial stage"

"Maybe we can **dig a bit deeper** about the technologies we intend to set?"

"Could you add the notion of duration and ready deadline"

"Some points do not fit very well to **our situation**"

"Really good application but missed things like **H₂ boilers**"

"It was good. Most difficulties regarding the **financial questions**"

Question: "Any further comments about the project?" (selection)

"(...) politicians have agreed on the **hydrogen strategy and its ambitions**. We now see that questions are raised mainly of two reasons: 1) BEVs are getting a higher range resulting in a discussion whether FCE passenger vehicles are a suitable application. 2) The **lack of vehicles** is becoming an increasing problem. Some million XX¹⁾ have been invested in infrastructure, and still only some XX¹⁾ FCEVs are on the road. We need **more models and a higher volume** of vehicles available. Car manufacturers limiting their production and deploying vehicles only in selected countries are resulting in and **increasing impatience** which may hinder the development. I hope the project in some way can help on this situation"

"(...) **poor air quality** is gaining increasing importance, delivery vans is a very interesting segment. Several cities will introduce **zero emission zones**, and this is a perfect segment for hydrogen and fuel cells. The project should help identify the market and business models so that the manufacturers will provide such vehicles"

"From our point of view this self assessment is a good approach to analyse the regional funding activities and topics. The objective should be to **align the available funding sources** (EU, national and regional)"



1) Answers have been anonymized

D. Introduction to the funding/financing module



We'd like to address three financing-related topics today: basic financing concepts, database structure, case study

Three financing-related topics for today

1 Principle concepts for financing FCH projects



- > Brief description of each archetype
- > Requirements regarding commercial viability
- > Requirements regarding experience levels

2 Database for FCH financing solutions



- > Short overview of the database structure for FCH financing mechanisms
- > Presentation of two particular financing instruments

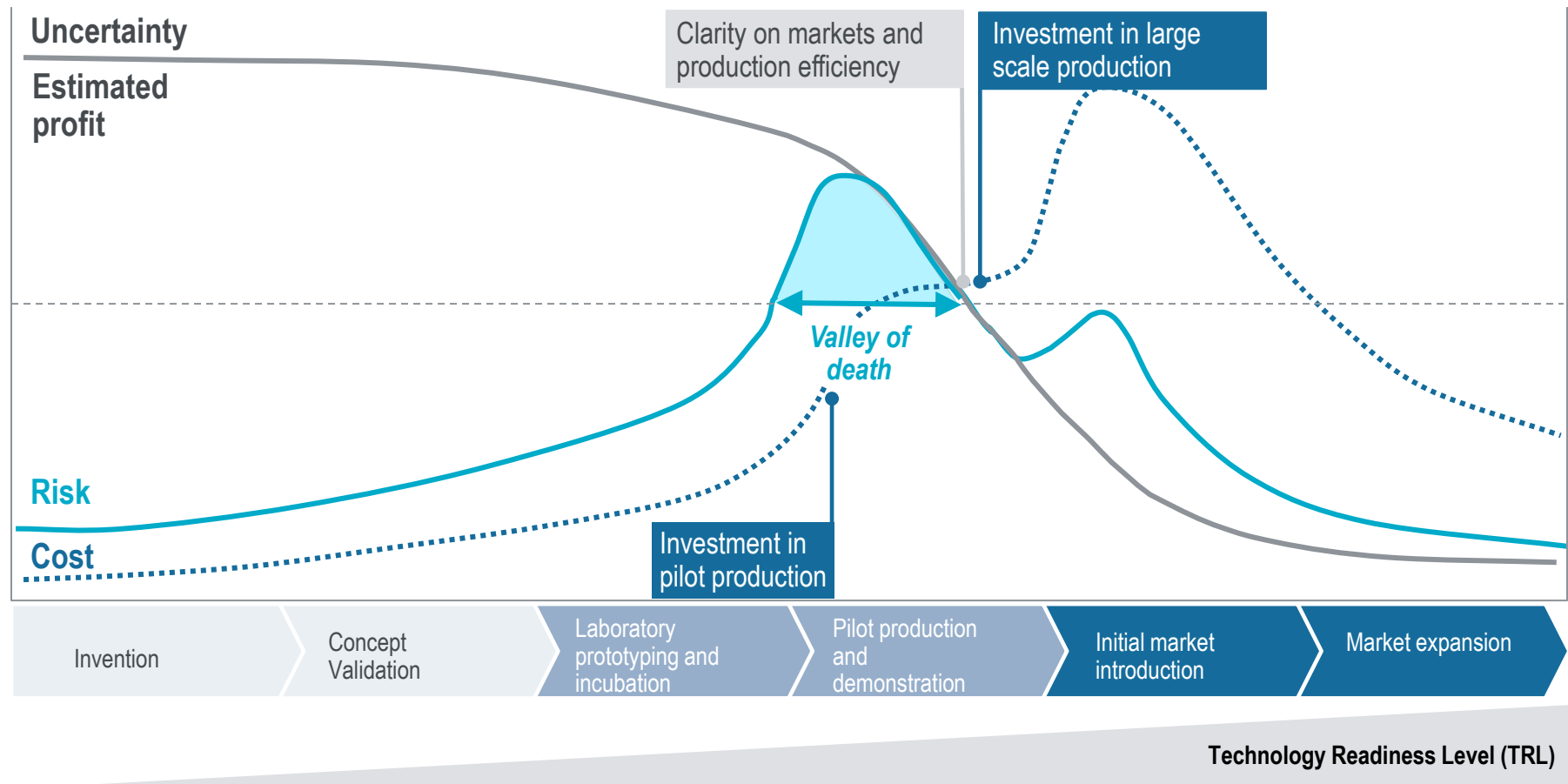
3 A first case study: FCH in Bolzano, Italy



- > Presentation of an FCH financing case study from South Tyrol, Italy by Fabio da Col (Institute for Innovative Technologies Bolzano)

In financing innovation technologies the main challenge is overcoming the "valley of death" before commercialisation

Core issues in innovation financing and financing FCH applications (1/2)



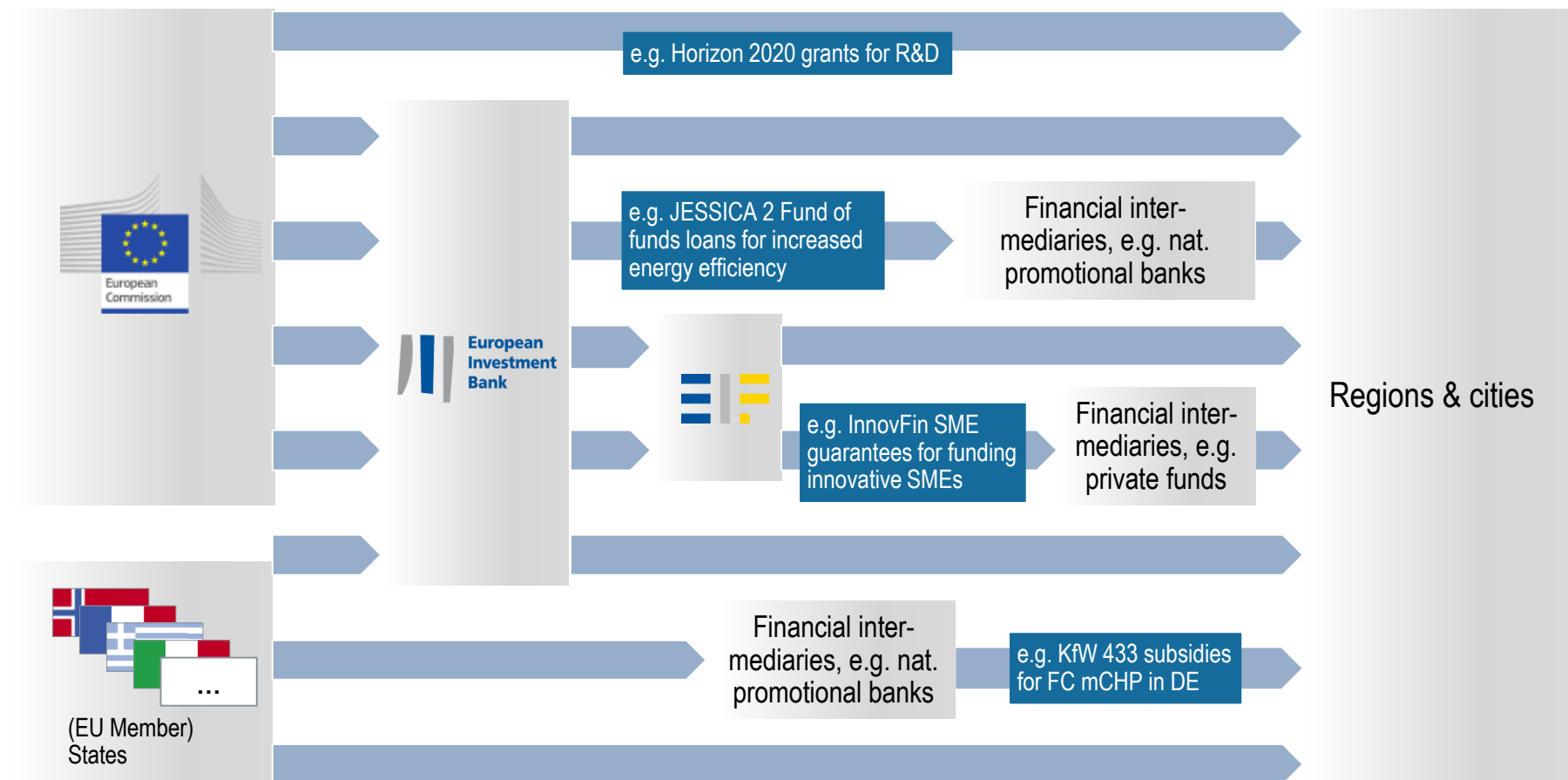
Hence, public (financing) institutions step in by providing grants ("non-repayable funding") and/or repayable financing

Core issues in innovation financing and financing FCH applications (2/2)

- > **Financing new technologies is difficult** – Developing and testing new technologies requires investments that will not generate enough revenues in the beginning (i.e. products are not yet "commercial")
- > **The phase between pilot production and commercialisation is called "valley of death"**, as some prototypes may not successfully advance to the next stage
- > **Allocating money to bringing a prototype to a commercial stage bears high risks**, hence typical (private) financing institutions will typically hesitate to debt-finance such investments – this applies to most FCH applications
- > **Hence, public (financing) institutions step in by providing grants ("non-repayable funding") and/or repayable financing**, provided there is a strategic (political) interest in the technology and a prospect of commercialisation
- > **Both kinds of public financing (non-repayable and repayable) for FCH applications are available** from various EU, national and regional sources
- > **Accessing non-repayable funding mostly requires following a specific application process**, meeting specific criteria of eligibility and co-financing of some sort – combining funds is possible if double financing rules are respected

The European financial landscape relies on manifold instruments and interposed institutions

Simplified overview of European funding institutions and intermediaries – SCHEMATIC



3 kinds of basic financing models – main focus will be on public financing, but also consider PPP structures and private financing

Archetypes of financing technology innovation (projects) – SIMPLIFIED

	Public	Public-private (PPP)	Private
Brief description	<ul style="list-style-type: none"> > Public grants (EU, national., regional), budget financing, comprehensive subsidies and tax incentives – with co-financing from project promoters > Non-repayable finance 	<ul style="list-style-type: none"> > Combination of public and private finance, e.g. (development) bank loans and government grants/subsidies > Partially repayable finance 	<ul style="list-style-type: none"> > Financing from private intermediaries, i.e. comm. bank loans, other debt finance, mezzanine, (private) equity > Repayable finance
Project bankability/ commercial viability	<ul style="list-style-type: none"> > Low > Pilot & prototype phase of new technologies; typically unbridgeable gap to purely commercially funded and viable business cases 	<ul style="list-style-type: none"> > Medium > Bridgeable gap to viable business case, thus revenue support, CAPEX relief mechanisms, etc. 	<ul style="list-style-type: none"> > High > Typically available for applications that are comm. developed with a defined use/business case (TRL¹ 8-9)
FCH examples (selection)	<ul style="list-style-type: none"> > FCH transport project in South Tyrol / Bolzano, Italy (today's case study) 	<ul style="list-style-type: none"> > FCH (and other) buses and infrastructure in Riga, Latvia > KfW 433 for FC mCHP in DE 	<ul style="list-style-type: none"> > Amazon procurement of Plug Power FCH Forklifts

Technology readiness, commercial viability

1) Technological Readiness Level

Project Module 5 will thus provide a comprehensive database on available sources of financing for FCH projects

Scope of project Module 5 "mapping funding/financing mechanisms"

Objectives

- > **Map** and **assess** currently **available grant funding sources** for hydrogen and fuel cells, esp. on EU and national level
- > **Create comprehensive listing** and dossier of available and relevant public funding sources
- > **Analyse** and present **potential private funding** options for nearly commercially ready projects



Approach & methodology

- > Research and collect **financing/funding instruments** and vehicles
- > Consolidate and systematically describe **funding programmes** in a **dossier**
- > Highlight programmes suitable for large scale demonstration or with potential to act as "game changers" – produce **recommendations on specific programmes** for regions for Phase 2

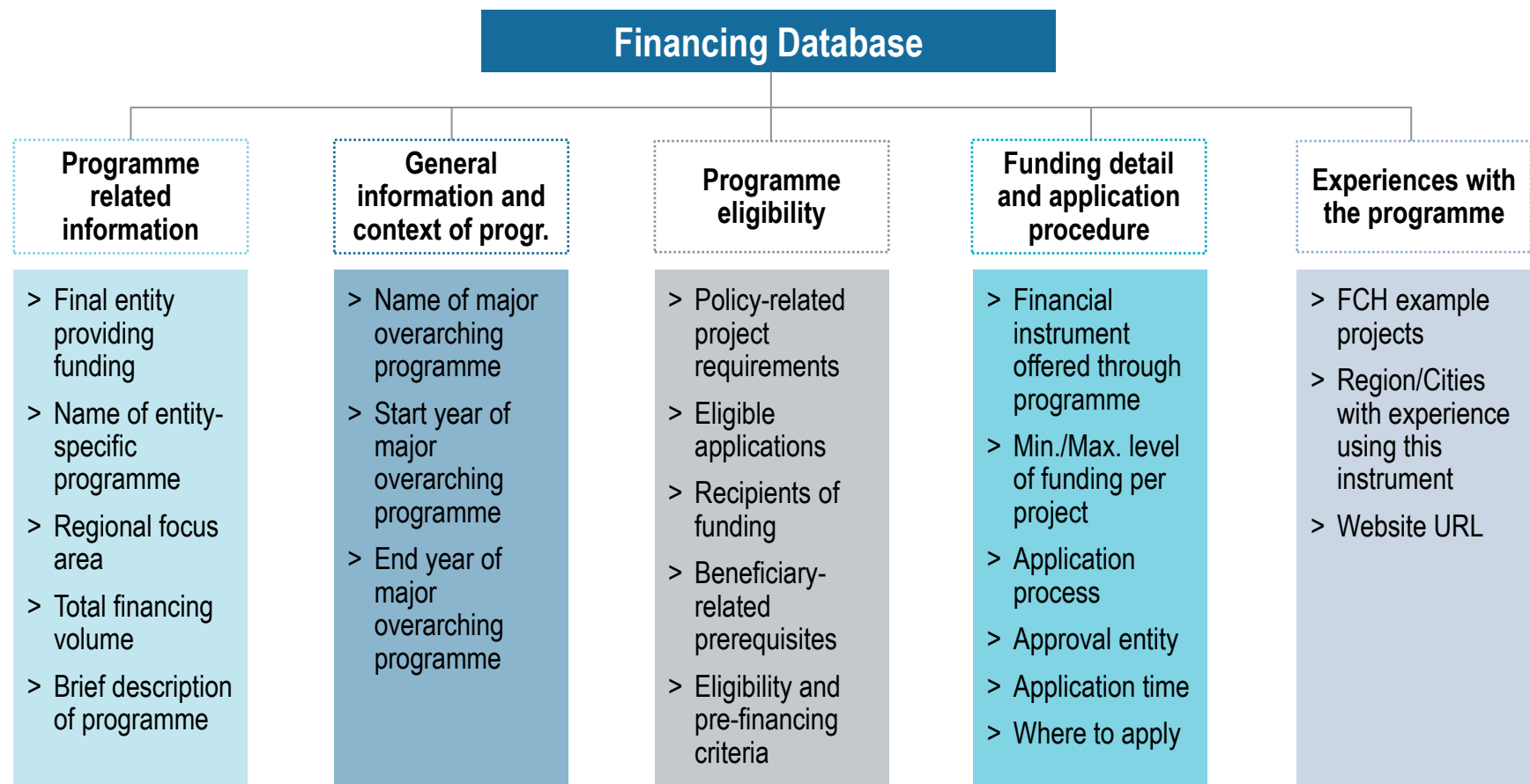


Expected results and deliverables

Comprehensive database on available sources of funding/financing to navigate the funding/financing landscape and identify suitable sources of financing, presentation of results regarding their suitability

The database covers information on 5 different thematic categories and enables the identification of funding instruments

Database structure



There are many grants available for a variety of applications, geographies, priorities, etc. – CEF as EU example

Exemplary illustration of an EU-level grant: Connecting Europe Facility (CEF)

Programme Outline

CEF: key EU funding instrument to promote growth, jobs and competitiveness through targeted infrastructure investment at European level

CEF Transport: funding instrument to realise European transport infrastructure policy; it aims at supporting investments in building new transport infrastructure in Europe or rehabilitating and upgrading the existing one

CEF Transport MAP General call

H2Benelux: accelerate the market development of hydrogen as a fuel for road transport

Specifications

12 hydrogen refuelling stations (HRS) in Benelux (1 in Luxembourg, 5 in Belgium and 6 in the Netherlands) across **3 Core Network Corridors** and **120 Fuel Cell Electric Vehicles**

- > Public **grant (non-repayable)**
- > Recommended CEF funding: **EUR 3.4 m**
- > Priority on **innovation** and deployment of **alternative fuels**
- > Covers **studies** with **pilot deployment** on urban nodes and works

National governments set-up own grant and subsidy programmes as well – KfW 433 as national example

Exemplary illustration of a national subsidy: KfW funding scheme 433 (Germany)

Programme Outline

Bundesministerium für Wirtschaft und Energy (BMWi, Federal Ministry of Economic Affairs and Energy): broad policy objectives – "reinvigorate the social market economy, stay innovative in the long term and strengthen the social fabric"

Kreditanstalt für Wiederaufbau (KfW): national German promotional bank

Subsidy 433: Energy efficient constructing and renovation – fuel cells support

Specifications

For **private** owners of personally-used or rented single- or multiple family homes as well as apartment buildings in Germany

- > **Subsidy** of up to 40% of eligible product costs
- > Fixed amount of EUR **5,700** and performance-based **EUR 450** per 100 W_{el} – i.e. EUR 10,200 subsidy for a 2 kW_{el} FC mCHP system
- > Covers **installation** of stationary fuel cell systems with electric capacity of min P_{el}=0.25 kW_{el} to P_{el}=5.0 kW_{el} into new or existing residential buildings

Institute for Innovation Technologies Bolzano – South Tyrol, Italy

Fabio Da Col



H2 South Tyrol



FC-Busses



Refill Units



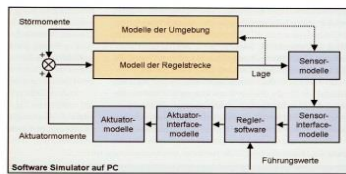
Stationary Plants



Private Vehicles



Information



R&D



Political Strategies

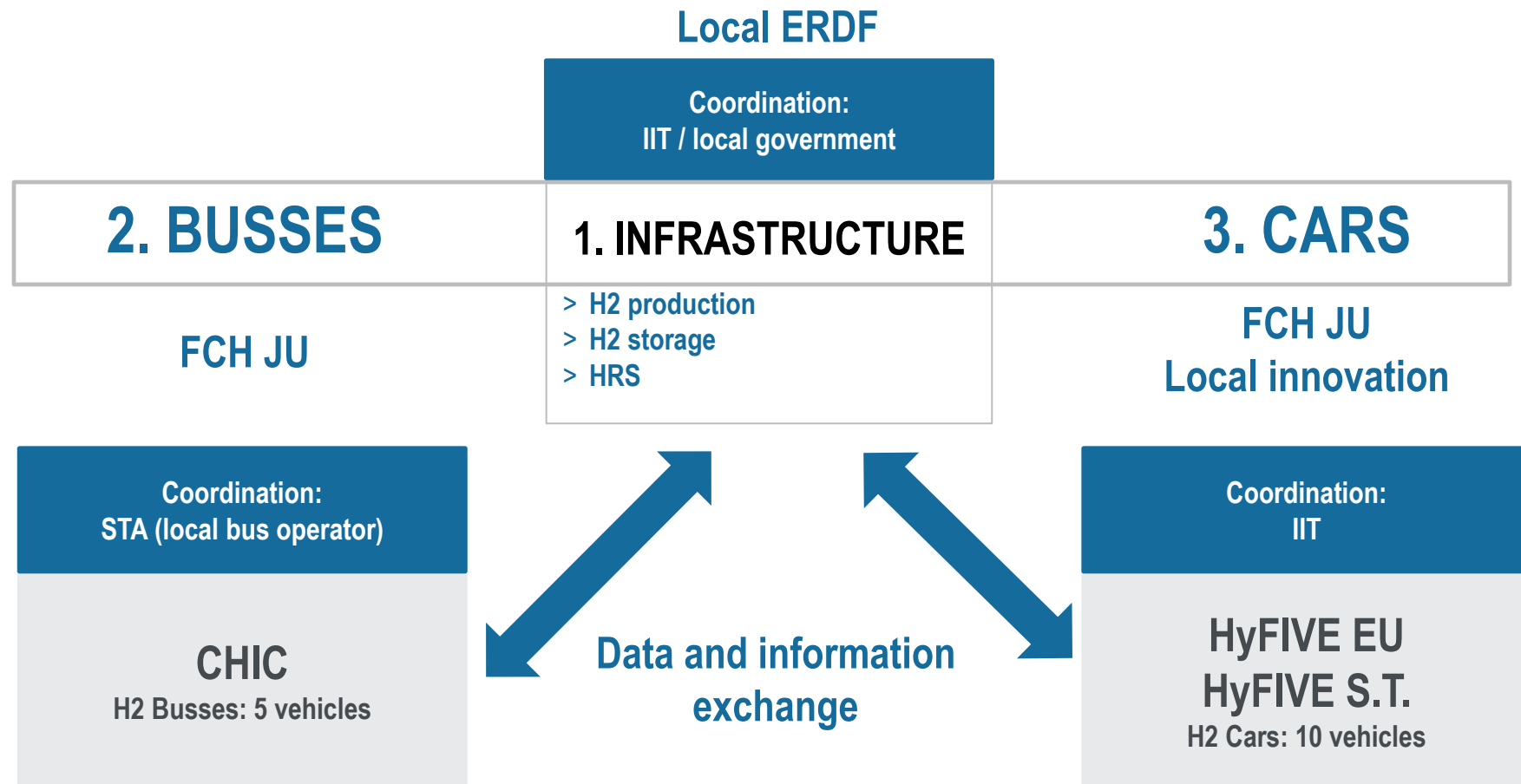


Education



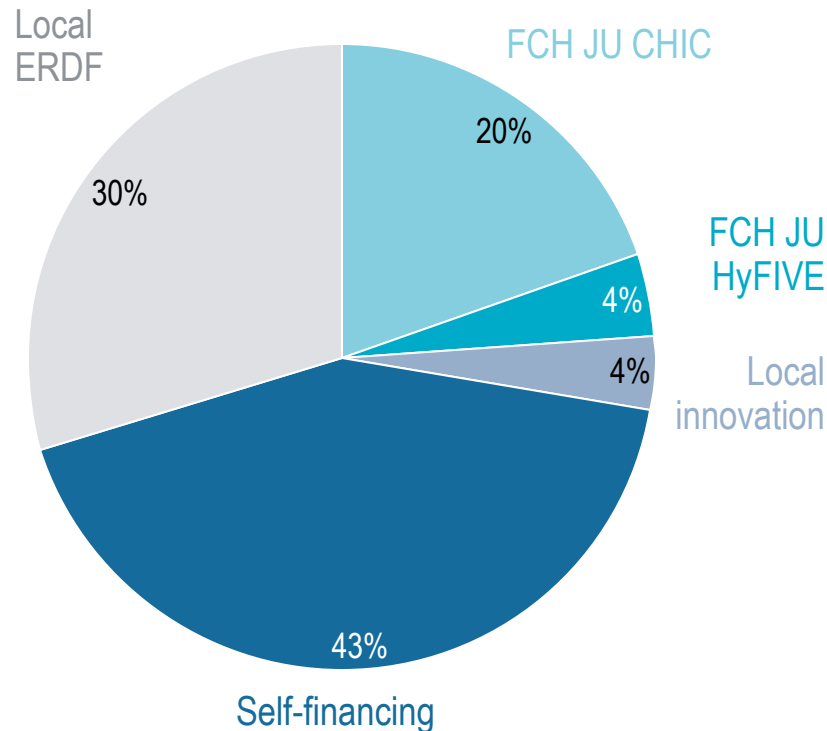
Concepts & Contracts

IIT SOUTH TYROL – Project 2011 - 2017



Financing structure

Total project volume approx. EUR 20 m



Key lessons learned

- > 1 project, different parts, different partners
- > Funding can be optimised through a combination of different instruments
- > Resource limitations in the consortium have to be taken into account from the beginning
- > Tasks and risks can be distributed quickly in comparatively small regions with institutions of manageable size; this helps swift project development
- > Motivated regional partners help to keep the project active and progressing
- > Sharing of data and information is a key element to a successful demonstration / deployment project
- > Involvement of the local government is critically important in order to reach an overall strong commitment for the project

Next alike projects

FCH JU

Coordination:
SASA, local bus operator

JIVE
H2 busses: 12 vehicles

JIVE + Mehrlin



Data and information exchange

CEF / TEN-T Local Innovation

Coordination:
IIT

Mehrlin
HRS

FCH JU

Coordination:
2 local waste operators

H2 garbage trucks:
2 vehicles

Garbage trucks



Data and information exchange

Local Innovation

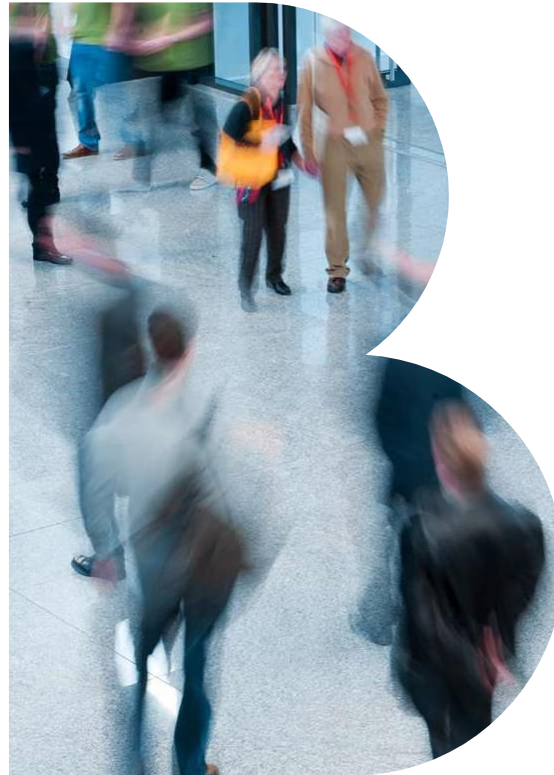
Coordination:
IIT

**HRS in the city of
Merano**

Thank you very much for your attention
and let's keep in touch

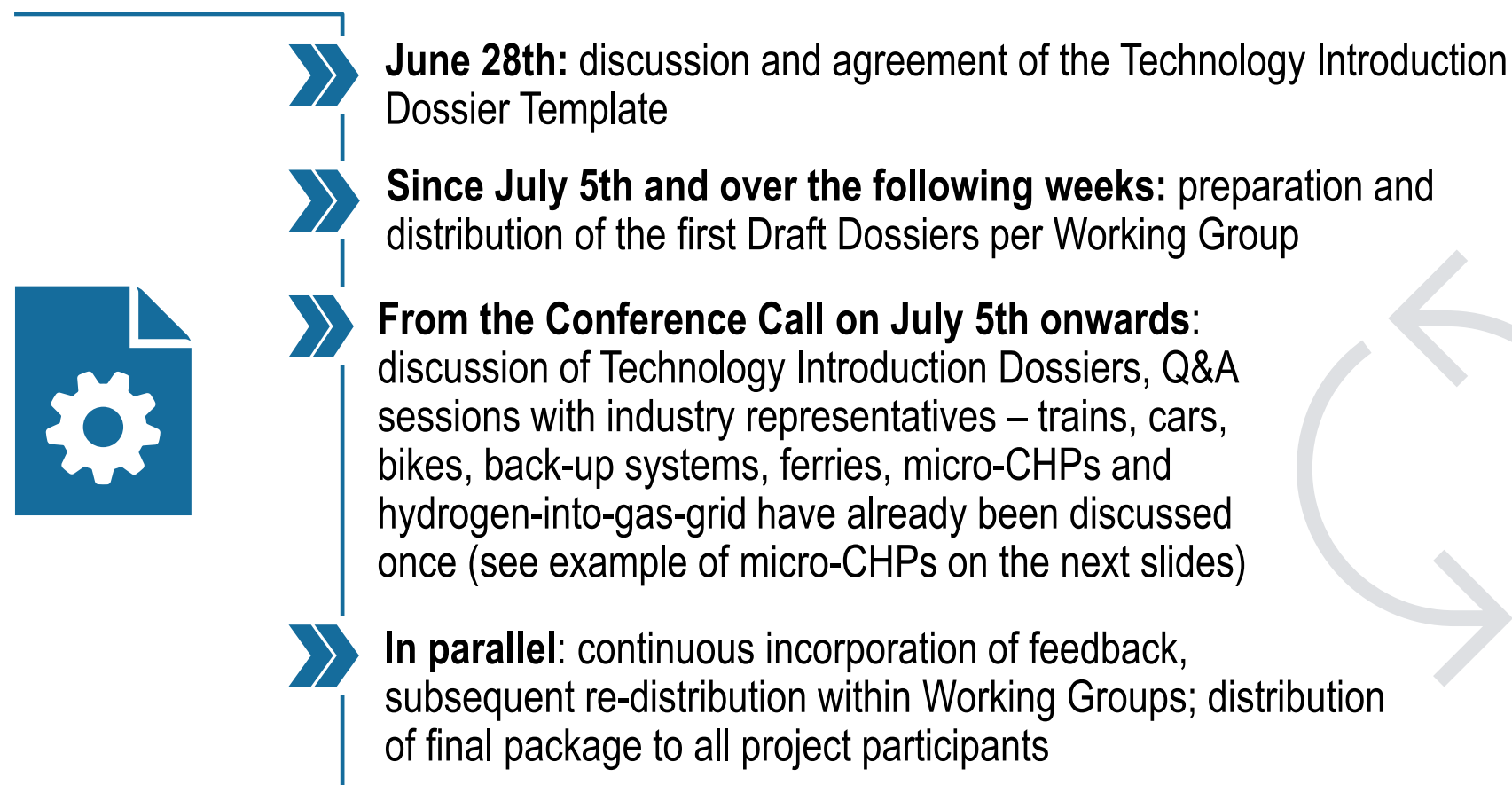
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E. Technology introduction forum – an FCH "Mini-Fair"



We follow a systematic, iterative approach for preparing and discussing the Technology Introduction Dossiers

Modus Operandi for Technology Introduction Dossiers



Residential fuel cell CHPs provide heat and electricity to 1/2-family dwellings, using natural gas as a fuel and thus existing infrastructure

Fuel cells for residential use (fuel cell micro-CHPs)

1/4



Brief description: fuel cell micro combined heat and power units (FC mCHPs) use natural gas as fuel to generate electricity and heat through a fuel cell stack (reforming natural gas on site to hydrogen of differing purity). Combined with an auxiliary boiler, they can replace entire residential heating systems or they can supply base-load electricity with add. heat supply

Use cases: Cities/regions can promote FC mCHPs in 1/2-family dwellings, SMEs or other residential developments (e.g. in municipal housing developments, office complexes) to lower carbon emissions, improve efficiency and facilitate smart grid development. Using natural gas, they typically build on existing fuel infra.

Fuel cell for residential use (ranges reflect industry portfolio, selection of companies)

Key components	Fuel cell stacks, system module, inverter, heat exchanger, auxiliary condensing boiler, combined storage tank
Fuel cell technologies	Proton Exchange Membrane (PEMFC), Solid Oxide (SOFC)
Fuel	Natural gas (generally also biogas or other methane)
Combined efficiency	85-90%/104% (PEM), 80-95% (SOFC)
Output	1-5 kW _{el} (PEM), 0.8-2.5 kW _{el} (SOFC)
Approximate capital cost	EUR 10,000-35,000 ¹
Original equipment manufacturers	Viessmann, SolidPower, Elcore, Bosch, SenerTec
Fuel cell suppliers	Sunfire, SolidPower, Hexis, Panasonic, Elcore
Typical customers	Private home owners, municipal housing providers, residential real estate developers, utilities
Competing technologies	Heating systems (e.g. boilers, heat pumps), power grid

1) Please refer to the next slide for three examples

Fuel cell mCHPs are one of the most mature FC technologies with several European products commercially available




Fuel cells for residential use (fuel cell micro-CHPs)

2/4







Overall technological readiness: Large scale field tests completed across Europe and esp. in Germany; fuel cell CHP systems of advanced generations from various OEMs now commercially available, other OEMs have announced to follow in the near term (EU catching up to East-Asian markets)



Demonstration projects / deployment examples (selection)

Project	Country	Start	Scope	Project volume
PACE		2016	Horizon 2020 funded project to help European mCHP sector take the next step to mass market commercialization with ~2,650 units by 4 mCHP OEMs	EUR 90 m
European wide field trials for residential fuel cell micro-CHP (ene.field)		2011	Europe's largest demonstration project with ~1,000 residential fuel cell micro CHP installations across 11 countries to demonstrate market potential and push commercialization	EUR 52 m
Callux field test		2008	Field test of ~500 fuel cell powered heating units for residential use for a period of 7 years demonstrating commercial feasibility and long lifetime of application	EUR 75 m

Products / systems available (selection)

Name	OEM	Product features	Country	Since	Approx. cost ¹
BlueGEN	SolidPower 	1.5 kW _{el} / 0.6 kW _{th} SOFC mCHP with efficiency of up to 60% _{el} and combined 85% for distributed base-load electricity supply with waste heat for warm-water supply		2012	EUR 10,000 – 25,000 (possibly add. installation cost), strongly dep. on local sourcing cond. and use case
Vitovator 300-P	Viessmann 	FC mCHP as full heating system (incl. aux. boiler) with 0.75 kW _{el} / 1kW _{th} , heat-driven operations, PEM FC from Panasonic with combined efficiency of up to 90%		2014	
Elcore 2400	Elcore 	305 W _{el} / 700 W _{th} PEM FC mCHP for base-load electricity supply with waste heat for warm-water supply with combined efficiency of up to 104%		2014	

*) Technology Readiness Level  ≤ 5  6-7  8-9 1) Indicative range – not considering specific use case context, local sourcing conditions (esp. installation cost), subsidies

Fuel cells in residential homes significantly reduce local emissions of CO₂ and pollutants while building on existing infrastructure

Fuel cells for residential use (fuel cell micro-CHPs)

3/4

Use case characteristics

Stakeholders involved



- > FC mCHP OEMs, FC technology providers
- > Wholesalers and installers
- > Utilities, gas and electricity grid DSOs
- > Private consumers, real estate owners

Demand and user profile



- > Heat and electricity demand of 1/2 family dwellings or small commercial buildings
- > 2 basic operating models: heat-driven FC mCHPs follow heat-load profile of building and produce electricity in the process, add-on mCHPs provide base load electricity with waste heat for warm water

Deployment requirements



- > Connection to natural gas grid for fuel supply and electricity grid (for feed-in of surplus electricity)
- > Typically availability of local installation, service and maintenance force

Key other aspects



- > Emerging trend of partial self-sufficient energy supply in households / "self-reliance"

Benefit potential for regions and cities

Environmental



- > Low emissions of pollutants and greenhouse gases (esp. CO₂) – reduction of >30% of CO₂ in representative German 1/2-family home, reduction of primary energy consumption
- > Low noise pollution due to almost silent operation

Social



- > Promotion of distributed energy systems, lowering social cost of electricity grid expansion esp. by DSOs (e.g. local combination of FC mCHPs and heat pumps)
- > Enabler for more RES in power mix with complementary role of distributed CHP

Economic



- > With reduction of product cost due to volume uptake and learning effects, TCO-competitiveness with other high-end heating solutions in reach (esp. in near term thanks to subsidy programs) – esp. in markets with high spark spreads for consumers (difference of gas and electricity prices)

Other



- > Creation of micro-CHP networks throughout regions and communities to help balancing grid needs – smart grid potential

Pressure to reduce cost for a fully convincing economic value proposition is a key issue – as is business model innovation

Fuel cells for residential use (fuel cell micro-CHPs)

4/4

Hot topics / critical issues / key challenges:

- > Need to reduce high product cost and CAPEX for consumers (currently still higher capital and maintenance cost than for conventional heating units), obstacle in residential market (even as TCO-competitiveness with other premium systems comes within reach)
- > Technical standardization as lever for cost reduction (inhomogeneity of installation procedures in different countries posing barrier for market expansion)
- > Sustaining and improving technical performance (esp. durability and system lifetime, but also electrical efficiency)
- > Defining innovative business models, esp. financing solutions and sales channels ("go-to-market")
- > Regulatory and policy-support circumstances (demand for FC mCHP systems currently supported by subsidies)
- > Public acceptance (lack of public awareness or acceptance of fuel cell powered micro-CHP)

Further recommended reading:



- > "Advancing Europe's energy systems: Stationary fuel cells in distributed generation":
<http://www.fch.europa.eu/studies>
- > ene.field project report:
http://www.fch.europa.eu/sites/default/files/project_results_and_deliverables/D3%20Grid%20connections%20issues%20and%20status.pdf

Key contacts in the coalition:

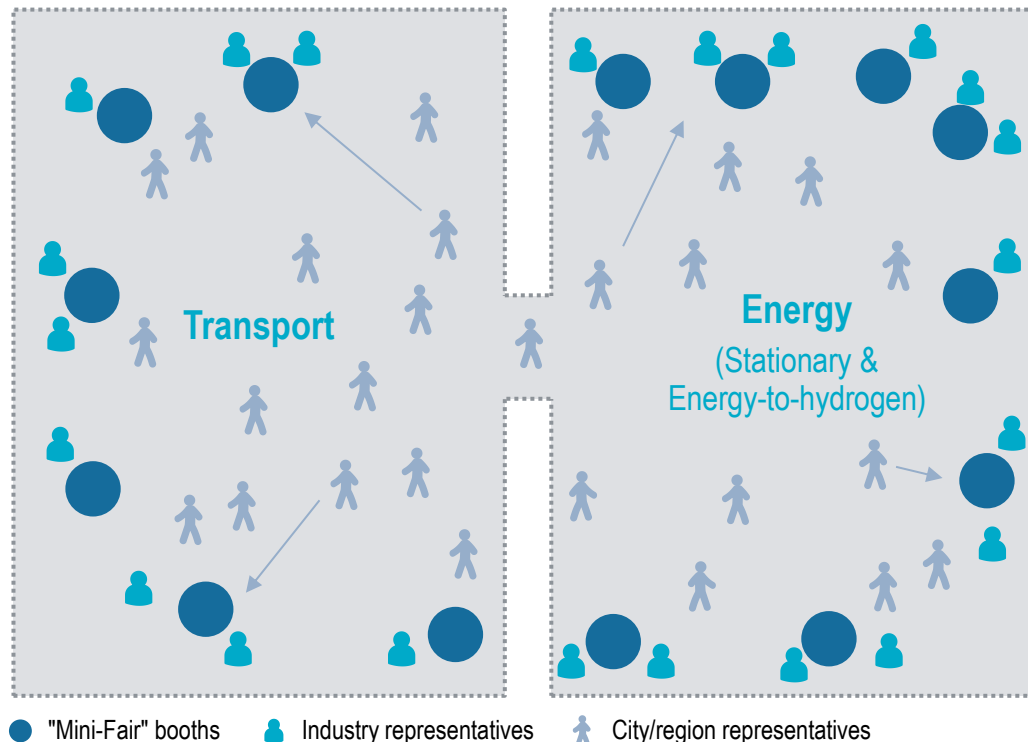


TBC

In the next 60+ minutes, we invite you to explore some FCH applications in a dialogue with industry representatives

FCH Industry "Mini-Fair" for regions/cities

The layout



The main idea

- > The "Mini-Fair" offers the opportunity to explore various FCH applications
- > FCH transport and energy applications (stationary and energy-to-hydrogen)
- > Industry representatives will be present to answer specific questions related to their products and the underlying technologies in general

Today, 19 industry representatives from 16 companies are present to participate in the "Mini-fair"

Participants in the "Mini-fair"

Energy

- > Air Liquide Advanced Business
- > AREVA Energy Storage
- > Asahi Kasei Europe
- > Cockerill Maintenance et Ingénierie
- > Hydrogenics
- > ITM Power
- > Nedstack
- > SOLIDpower
- > Sunfire

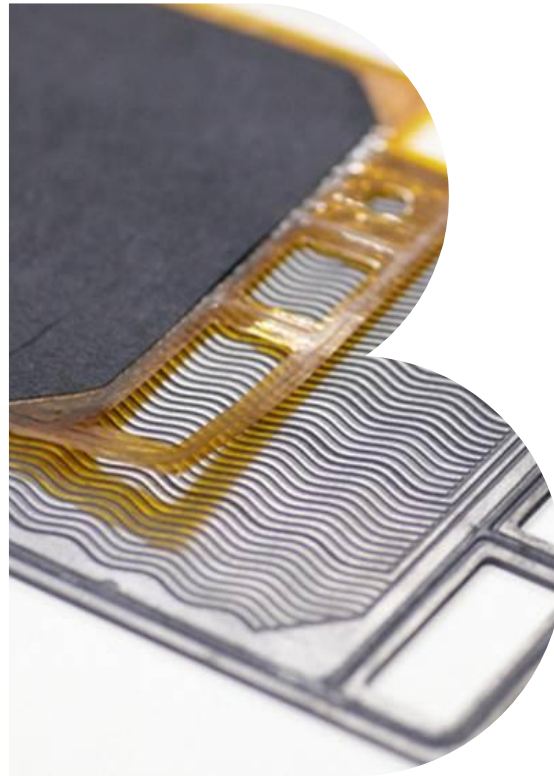


Transport

- > Alstom
- > Atawey
- > Daimler Buses EvoBus
- > Hydrogenics
- > ITM Power
- > Naval group
- > Nedstack
- > PersEE
- > Symbiofcell
- > Toyota



F. Framework for the preliminary business case analyses



The analysis of prel. business cases is the most crucial module in Phase 1 – Key ingredient to subsequent application ranking

Module 2: Assessment of preliminary business cases

Objectives

- > Provide a **preliminary business case** analysis of all FCH applications under consideration
- > **Evaluate applications according to key criteria** e.g. **technology readiness, basic economics, environmental impact**, etc. in order to – generally – evaluate their commercial and otherwise attractiveness for European regions and cities
- > **Basis for ranking and decision making** regarding potential further focus in phase 2 ("Detailed Business Cases")



Approach & methodology



1. Agreement on **analytical framework**
2. **Definition of business case components:** generic use case (incl. infrastructure requirements), FCH application, benchmark application, exogenous assumptions
3. **Preliminary performance analysis (technical/operational, economic, environmental)** – dep. on techn. readiness
4. **Establishment of a joint view on analysis results** (incl. willingness to pay, requirements)
... iterative, separate processes in **Working Groups**, results to be presented at 3rd GAM



Expected results and deliverables

- > Evaluation of all applications on all key analysis factors based on joint evaluation framework
- > Documentation of evaluation results in a standardized evaluation summary for all applications

Each preliminary business case analysis consists of application inputs, a generic use case and general performance dimensions

Prel. business case components and flow of analysis – SCHEMATIC

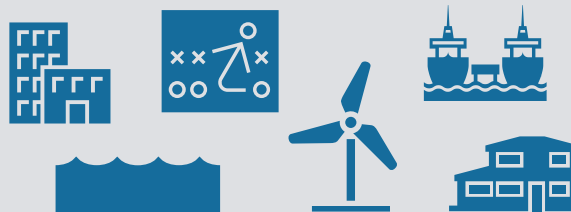
Exogenous assumptions, e.g. energy/fuel cost

FCH application

- > Technical features (e.g. output, efficiency, lifetime, fuelling requirements) and general readiness
- > Est. CAPEX / system cost
- > Est. OPEX (e.g. maintenance)

... plus 1 conventional application as benchmark

1 "generic" use case



... consisting of typical deployment requirements of European regions and cities

Basic performance

Technical / operational



Economic

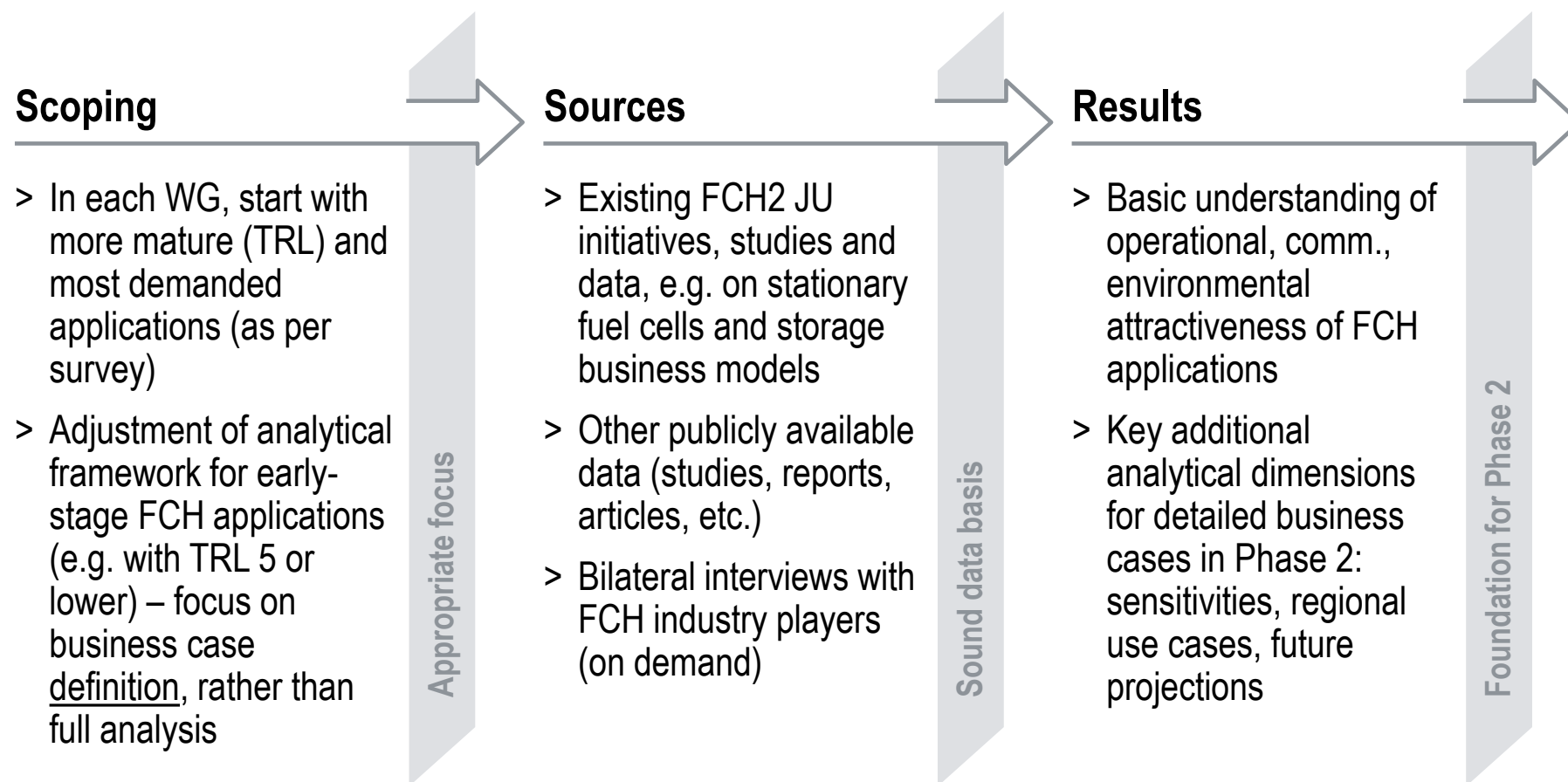


Environmental

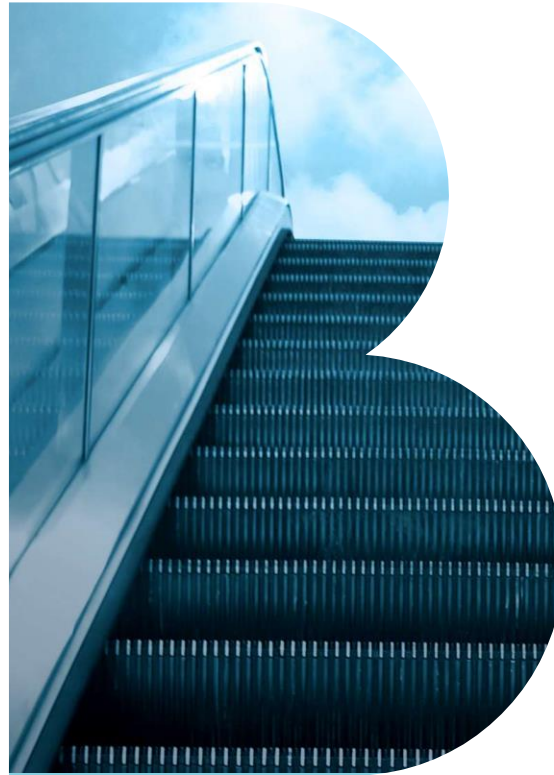


We will address each FCH application based on its TRL and rely on existing data where possible – Clear distinction from Phase 2

Key considerations on scoping, sources and results



G. Conclusion and next steps



Next steps



Next activities:

- > Incorporation of GAM feedback from dial-in participants
- > Distribution of updated GAM presentation to the coalition
- > Invitation and presentations for next Working Group Conf. Calls
- > Inclusion of further industry participants as well as additional regions and cities
- > Continuation of populating funding/financing tools database

Upcoming events:

- > Next Working Group Conf. Calls: Wednesday, 19 July 2017
- > 3rd General Assembly Meeting: 13 September 2017 in Brussels

Please do not hesitate to get in touch with us

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