

Situación internacional del sector Hidrógeno y Pilas de Combustible



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AeH₂
ASOCIACIÓN ESPAÑOLA
DEL HIDRÓGENO

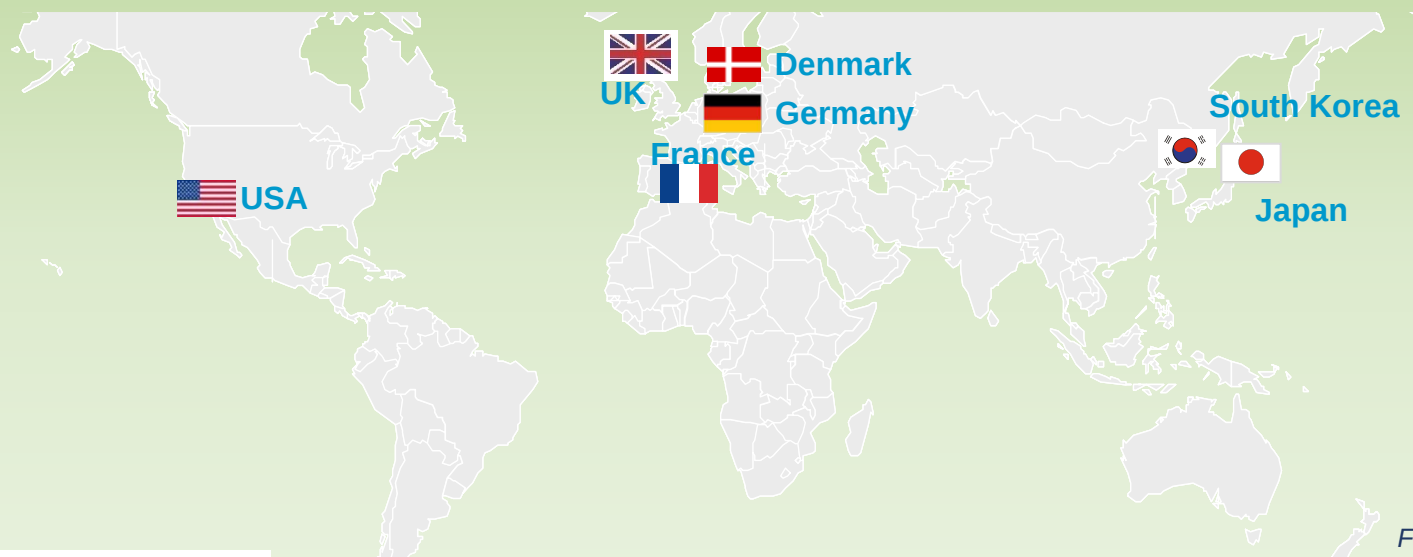
Situación Internacional del sector Hidrógeno y Pilas de Combustible

Contenido

- ❑ Introducción: Visión global
- ❑ Hidrógeno y pilas de combustible en Norteamérica:
 - ✓ EEUU: Coste Oeste (California) y Costa Este (NY, NJ, MA, RI).
 - ✓ Canadá.
- ❑ Hidrógeno y pilas de combustible en Asia:
 - ✓ Japón
 - ✓ Corea del Sur.
- ❑ Hidrógeno y pilas de combustible en Europa: “Fuel Cell & Hydrogen JU”:
 - ✓ Alemania.
 - ✓ Escandinavia.
 - ✓ Reino Unido.
 - ✓ Francia.
 - ✓ Holanda.
- ❑ H₂ y PC en la transición energética: El “Hydrogen Council”

Situación Internacional del sector H₂ & PC: **HRS vs FCEV**

Actualmente existe un fuerte impulso para establecer el transporte basado en el hidrógeno y superar sus desafíos iniciales en los mercados de todo el mundo



Current state of initiatives



H2Mobility Germany:

Recent announcement made - 350M€ for 400HRS by 2023



H2 Mobilité: Government and industry partners building common strategy



UK H2Mobility: Government and 11 companies developed common strategy

Business case in development



Danish Government has announced an Energy Plan 2020 that includes a **range of initiatives** for hydrogen infra-structure and FCEVs, amongst which are significant incentives



Government and 13 companies announced program for FCEV mass production and 100 HRS by 2015 connecting 4 metropolitan areas



Government announced program to finance and deploy 100,000 FCEV and 170 HRS by 2020



Demo initiatives in California and East Coast H₂ Highway; partially funded by Department of Energy. New "Clean Fuels Outlet" regulation in California requiring deployment of HRS (to avoid penalties). California Fuel Cell Partnership announced roadmap to rollout 68 stations by 2015
H2USA started

Situación Internacional del sector H₂ & PC: **HRS vs FCEV**

Fuente:
Hydrogen Council

*How hydrogen
empowers the energy
transition*

Enero 2017

How hydrogen empowers
the energy transition

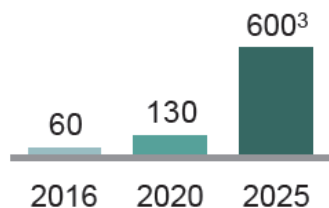
Hydrogen Council January 2017

Los principales países occidentales y asiáticos planean implantar una importante infraestructura de hidrógeno en la próxima década.

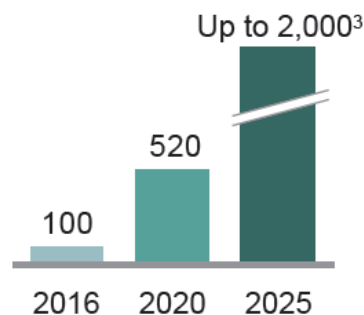
Nº de estaciones de repostaje de H₂ (HRS) ¹

■ Significant HRS network development ■ Minor HRS network development²

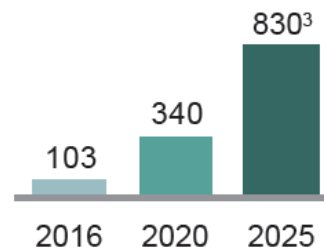
US



Europe



Asia



¹ HRS públicamente disponible en países con un desarrollo significativo de la red de HRS

² Países o estados sin perspectivas actuales de HRS

³ Dependiendo del número de FCEV en la carretera

Programas del H₂ y Pilas de Combustible en el Mundo



Los Programas de EEUU

Programa de US DOE H₂ y PCs: Situación 2017

DOE Hydrogen and Fuel Cells Program

U.S. DEPARTMENT OF
ENERGY | Energy Efficiency &
Renewable Energy
Fuel Cell Technologies Office | 3

Focus

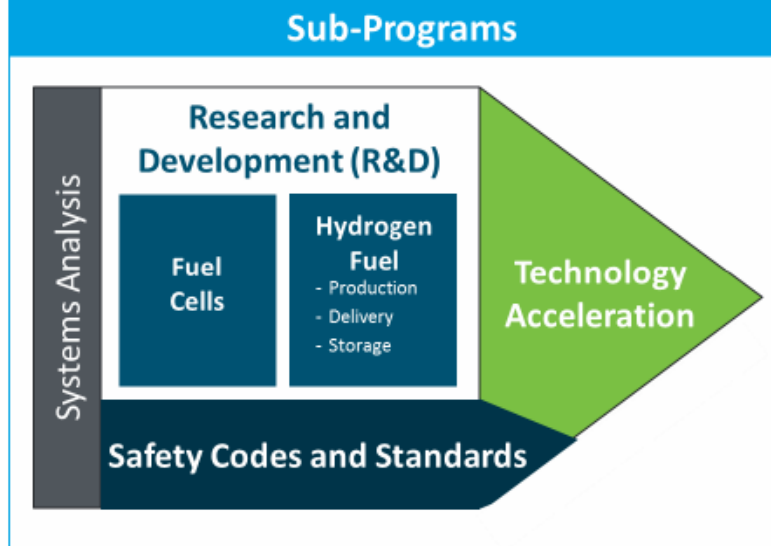
Applied research, development and innovation of hydrogen and fuel cell technologies that enable energy security, resiliency, and a strong domestic economy in emerging markets.

2020 Targets by Application



Fuel Cell Cost	\$40/kW	\$1,000/kW* \$1,500/kW**
Durability	5,000 hrs	80,000 hrs
H ₂ Storage Cost (On-Board)	\$10/kWh 1.8 kWh/L, 1.3 kWh/kg	
H ₂ Cost at Pump	<\$4/gge <\$7/gge (early market)	

*For Natural Gas
**For Biogas



Strengthening U.S. energy security and the economy through R&D on hydrogen and fuel cells

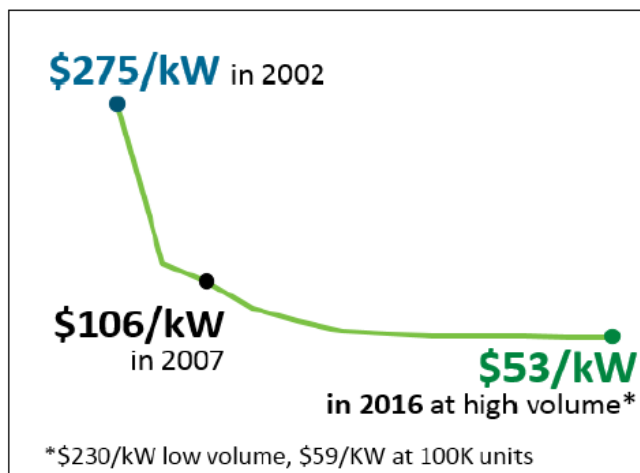
Programa de US DOE H₂ y PCs: Situación 2017

The Role of the Government Enabling Progress

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Fuel Cell Technologies Office | 23

Technology Innovation

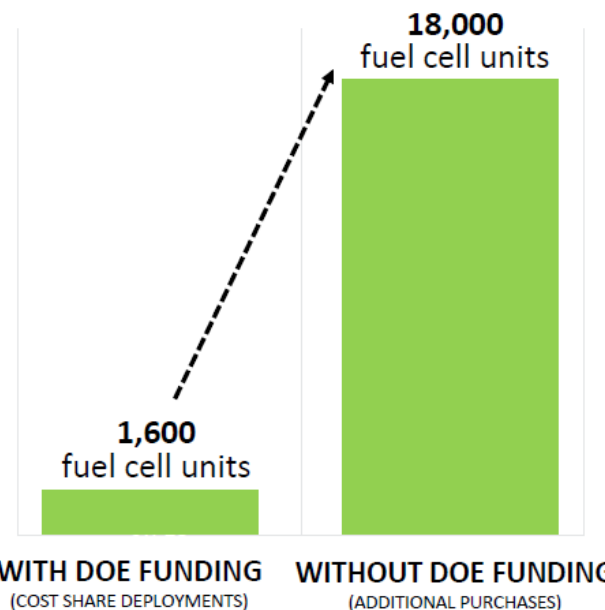
- Cut fuel cell cost by 80%



- Quadrupled fuel cell durability
 - More than **220** fuel cell cars
 - Driving over **6** million miles
 - **>360 mi** range, **>2X** efficiency of gasoline vehicles
- Validated Research Advances

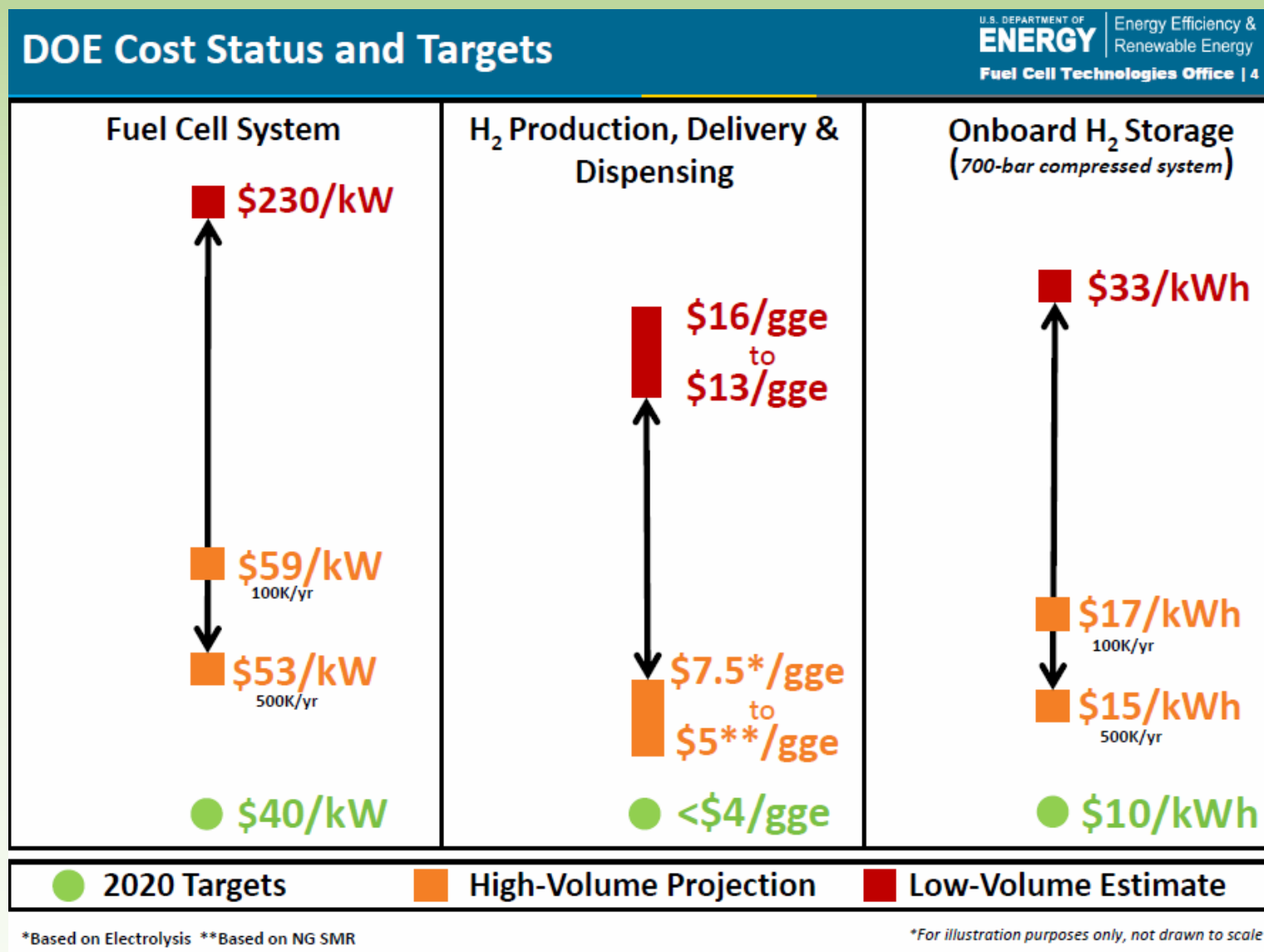
Market Impact

- Jumpstarted **early markets** by magnitude of more than 11X

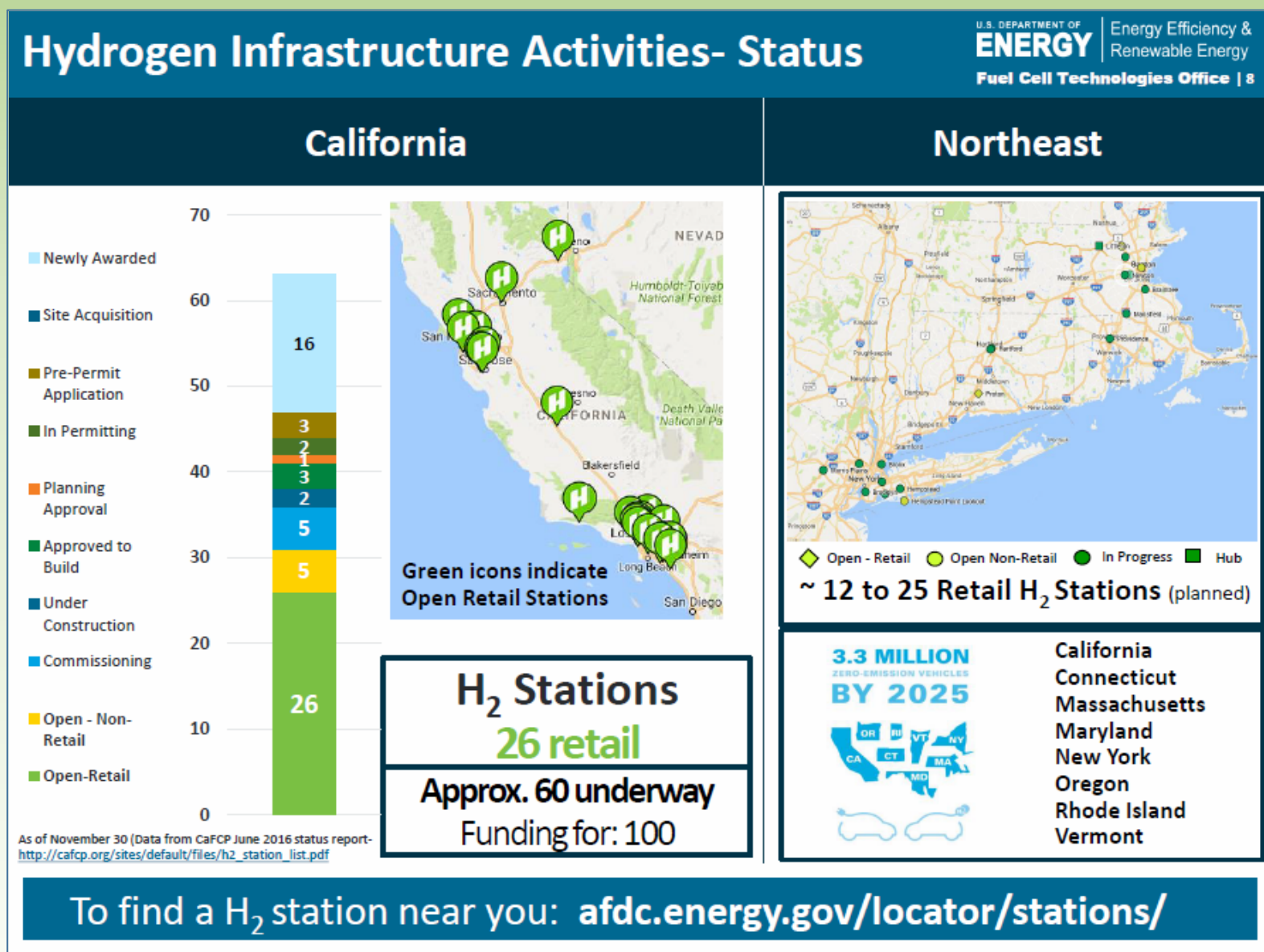


- Catalyzed Additional Private Investment

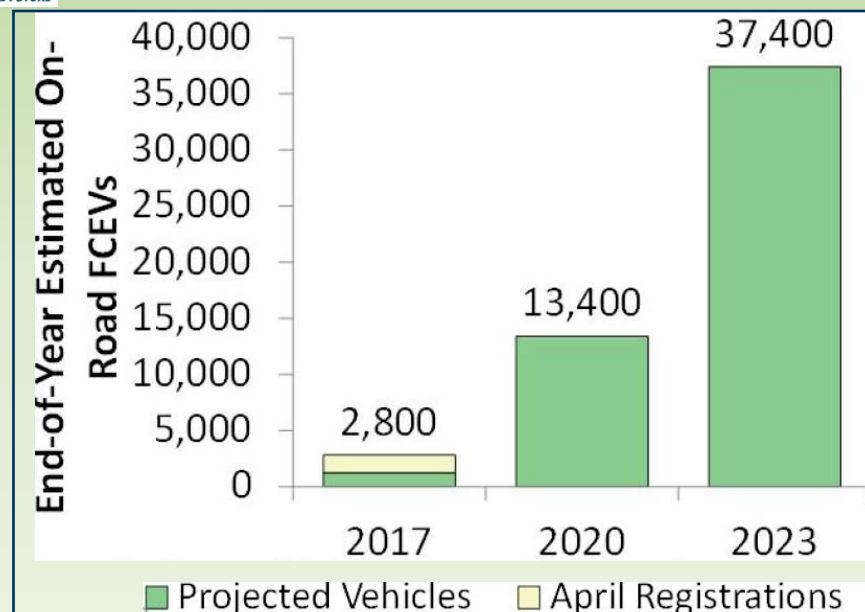
Programa de US DOE H₂ y PCs: Situación 2017



Programa de US DOE H₂ y PCs: Situación 2017



Programa de US DOE H₂ y PCs: Situación 2017



Fuente California Environment Protection Agency – Air Resources Board.
2017 Annual Evaluation of Fuel Cell Electric Vehicle Deployment and
Hydrogen Fuel Station Network Development

Programa de US DOE H₂ y PCs: Situación 2017

H2 Stations Covering the Northeast



Network of 12 Stations

Start-up over Q4 2017-Q1 2018

Dedicated H₂ supply chain by



Project in collaboration with



New York

Bronx
Hempstead
Brooklyn
Site Location TBA



Connecticut

Hartford



Massachusetts

Braintree
Mansfield
Two others TBA



New Jersey

Lodi
Whippany



Rhode Island

Providence



2017

CaFCP Quarterly Update

Air Liquide, world leader in gases for industry, health and the environment

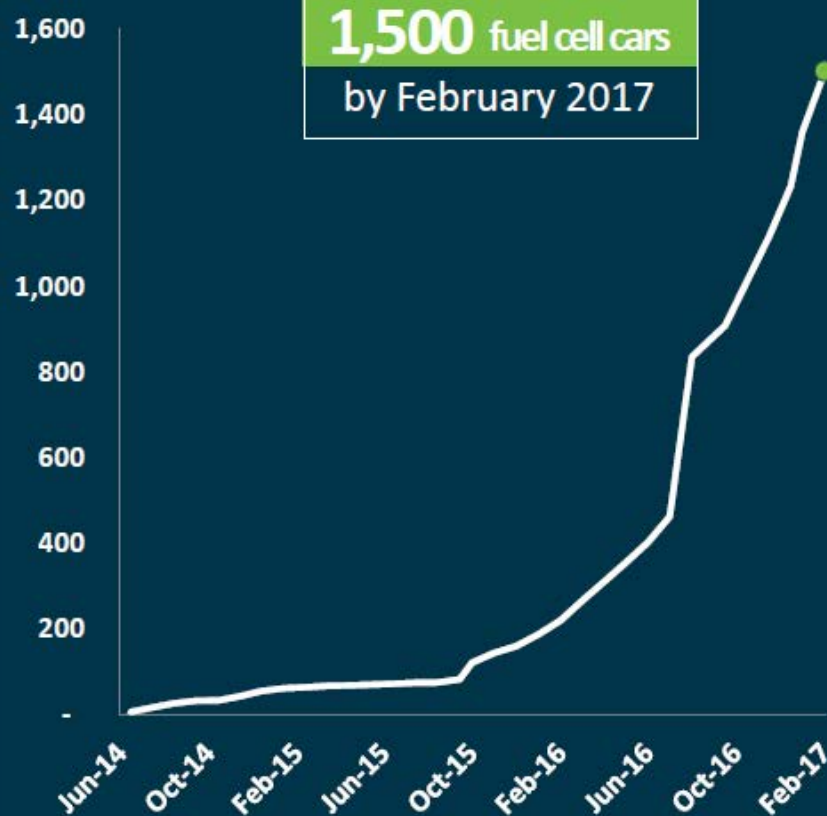


Programa de US DOE H₂ y PCs: Situación 2017

Commercial Fuel Cell Cars are Here

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Fuel Cell Cars Sold/Leased in the U.S



1,500 fuel cell cars
by February 2017

Note: Cumulative number of vehicles sold/leased. Source: hybridcars.com



Programa de US DOE H₂ y PCs: Situación 2017

Stationary Fuel Cells- Opportunities Emerging

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Fuel Cell Technologies Office | 11



Data centers require non-stop electrical power



Reliable power is vital at hospitals



Supermarkets- growing interest for reliable power

Fuel Cell Stationary Power in the U.S.

Installations

More than
235 MW
in at least
43 states

Top States

- By unit size: DE (30 MW) and CT (14.9 MW)
- By number of units CA (480 systems)

Source: DOE Fuel Cell Technologies Office. State of the States Report (2016)



New World Trade Center using fuel cells

Programas del H₂ y Pilas de Combustible en el Mundo



Los Programas de Canadá

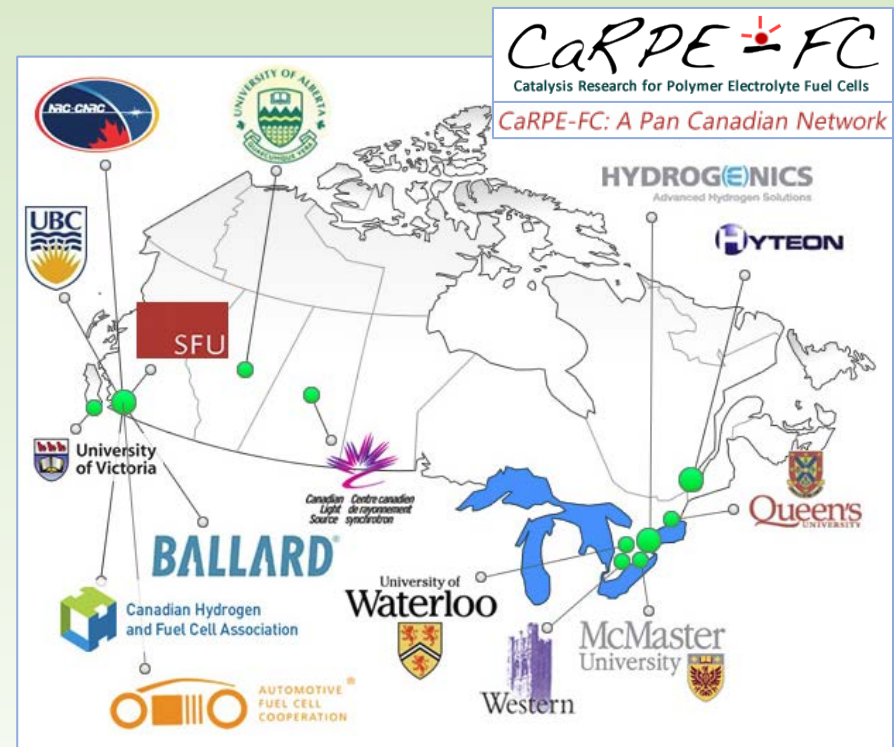
Hidrógeno y Pilas de Combustible en Canadá

- ✓ Líder en tecnologías del hidrógeno y pilas de combustible.
- ✓ Gran apoyo por parte del Gobierno a la industria y a la I+D+i → rápida implementación de la tecnología.

- ❑ National Research Council of Canada
- ❑ Natural Sciences and Engineering Research Council of Canada



- ❑ Canadian FC and H₂ Association (CFCHA)



Programas del H₂ y Pilas de Combustible en el Mundo



Los Programas de Japón

Programas del H₂ y Pilas de Combustible en Japón



20 Jan. 2017: Policy Speech by Prime Minister Shinzo Abe to the 193rd Session of the Diet

Hydrogen energy is the trump card for:

- Energy security
- Measures to address global warming.

11 April, 2017: Prime Minister Shinzo Abe attended the first Ministerial Council on Renewable Energy, Hydrogen and Related Issues

"Japan will be the first in the world to realize a hydrogen-based society.

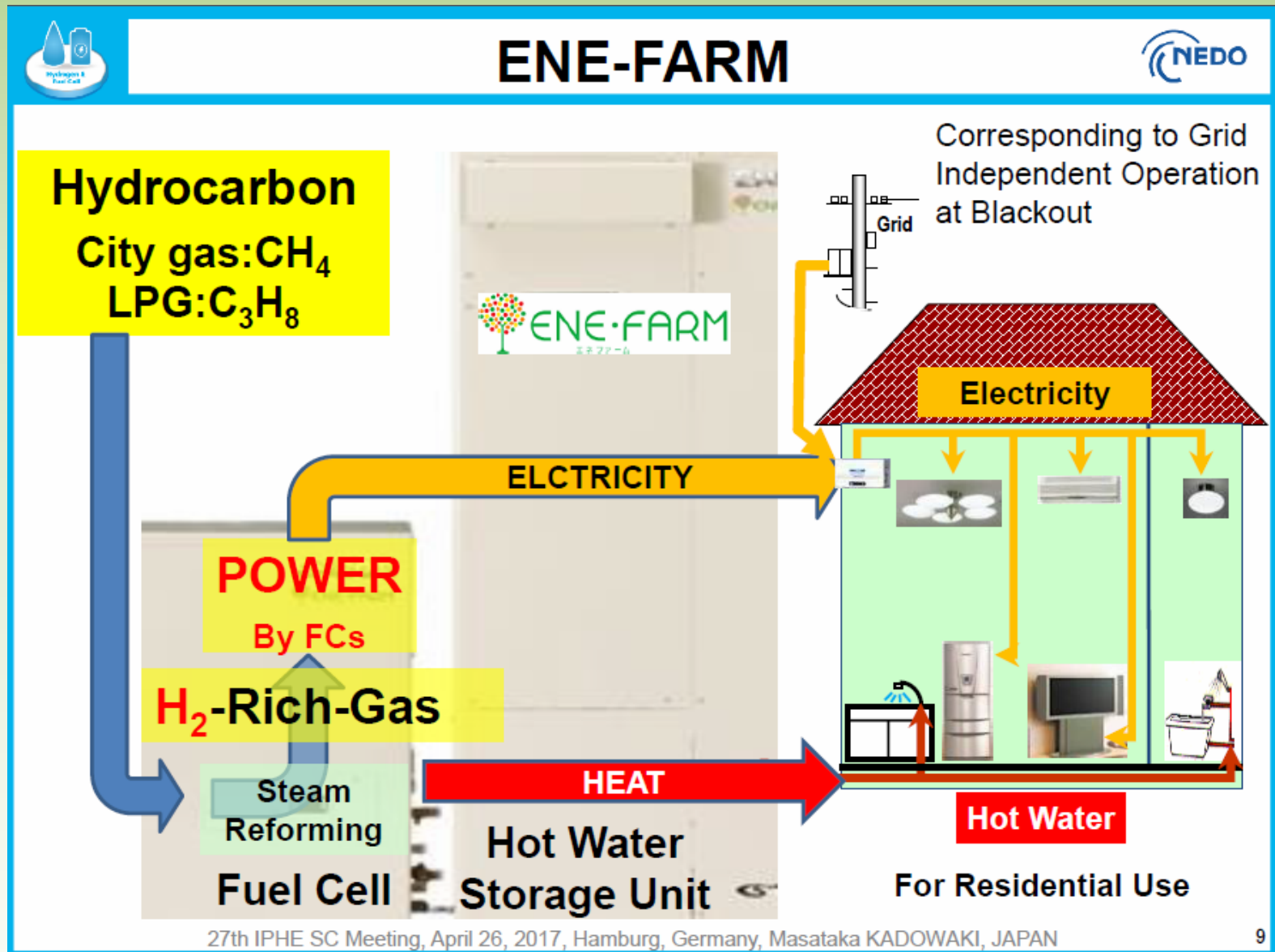
I request that relevant ministers formulate the basic strategy within this year so that the Government can work as one to achieve this.

In particular, **I would like you to create a framework to accelerate the establishment of hydrogen stations, in order to promote the use of fuel cell vehicles to a scale of over 40,000 by 2020**, and also conduct comprehensive inspections that take into consideration comparisons of overseas regulations and domestic gas stations, so as to streamline regulations on hydrogen stations.

The key to building international hydrogen supply chains, from production through to transport and consumption, is hydrogen power generation that creates large-scale and stable hydrogen demand. Toward the building of supply chains and the full-scale introduction of hydrogen power generation, I ask that you formulate a common scenario that will form the basis of collaboration among diverse stakeholders."



Programas del H₂ y Pilas de Combustible en Japón



Programas del H₂ y Pilas de Combustible en Japón

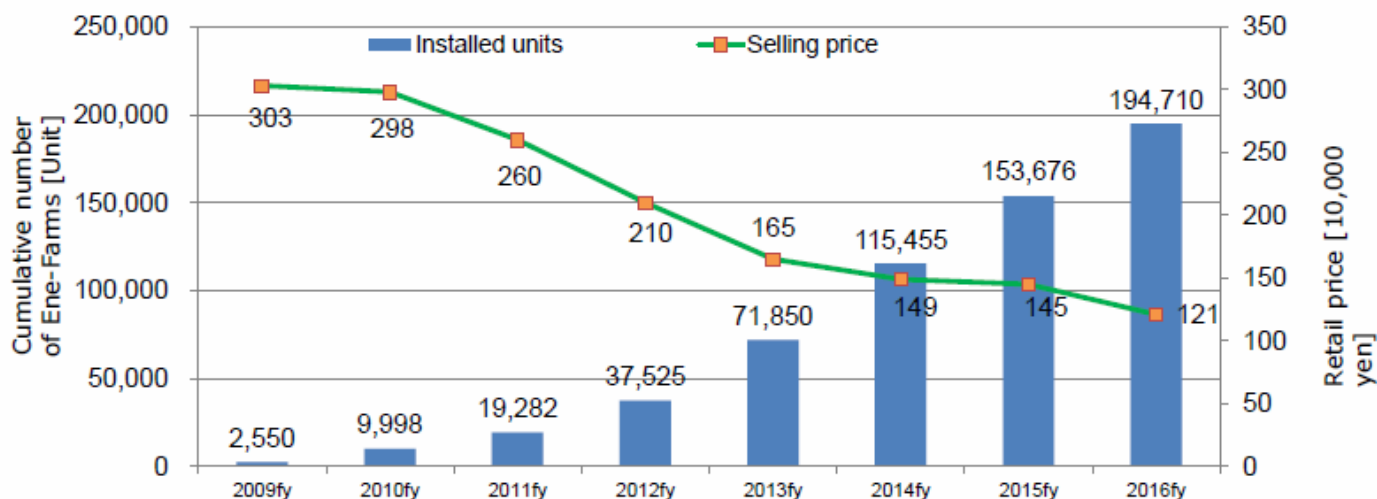


Current Status: micro-CHP for household



- Total units installed: 194,710 (as of March 2017)
- Target: 1.4million units by 2020, 5.3million units by 2030
- Price: Currently dropped to less than half of 2009

Changes in the diffusion number and retail price



* Based on determination subsidization base

(As of the end of March 2017)

Programas del H₂ y Pilas de Combustible en Japón



Current Status: FCV & FC Bus



TOYOTA



<December 2014>

- Released "MIRAI" at a price of 7.23 million yen

<October 2015>

- Announced its FCV sales plan of 30,000 in global market around 2020 or later.

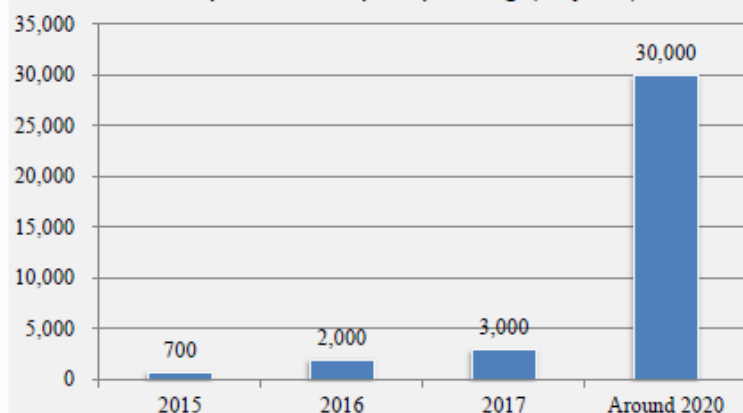
HONDA



< March 2016>

- Released "CLARITY FUEL CELL" at a price of 7.66 million yen

FCV production prospecting (Toyota)



TOYOTA



<March 2017>

- Operating two fuel cell buses on metropolitan bus routes
- 100 FC-Bus in 2020 for Tokyo Olympic / Paralympic Games.

Programas del H₂ y Pilas de Combustible en Japón



Current Status: FCV & HRS



Status of HRSs (as of April 2016)

- Budget secured: 90 stations
- Open: 77 stations



H₂ Price: JPY 1,000 – 1,100 / kg H₂ (US\$ 8.7-9.6)

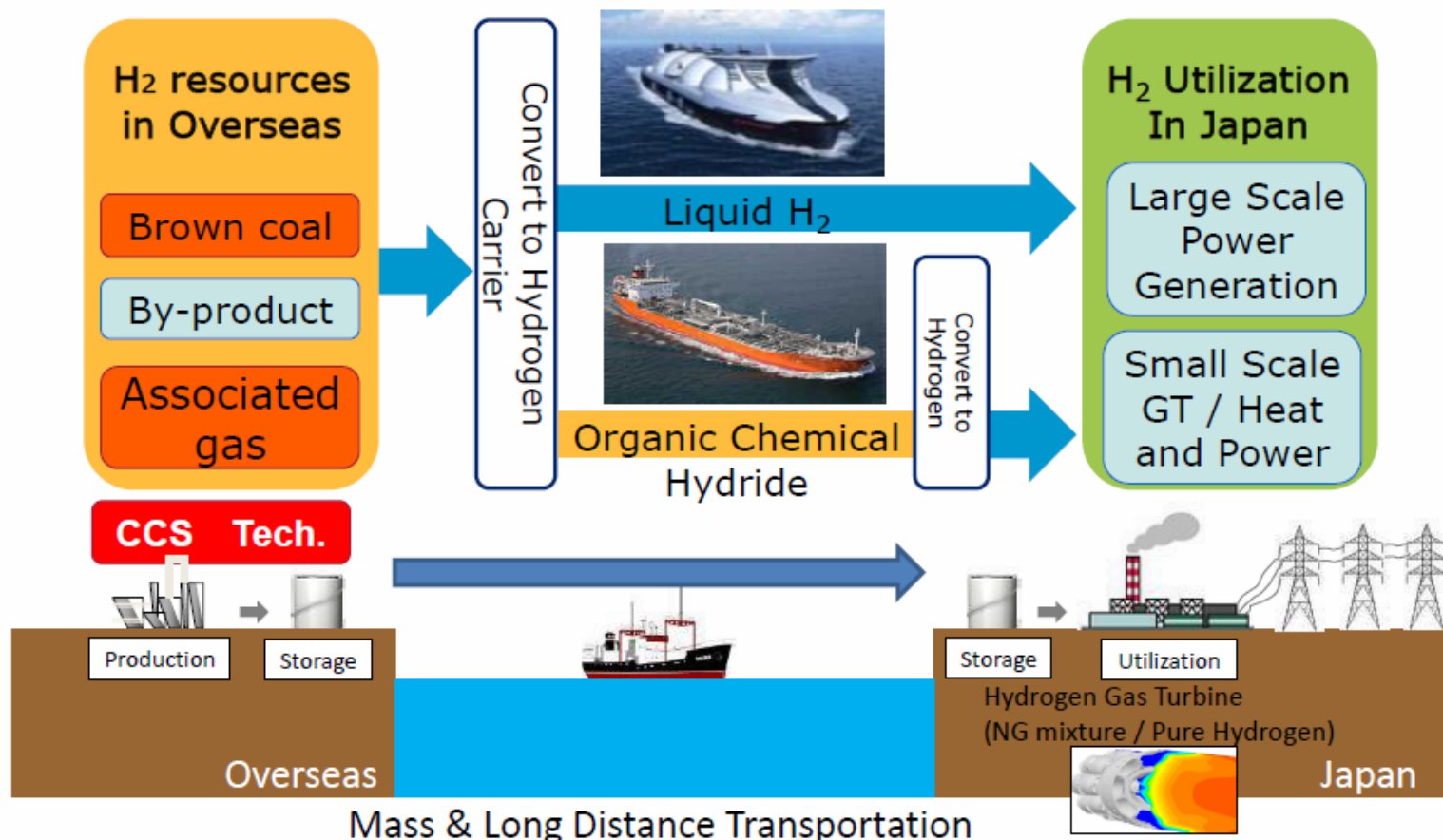
Source: Fuel Cell Commercialization Conference of Japan

Programas del H₂ y Pilas de Combustible en Japón



Large Scale H₂ Energy Utilization Project

Just Started Large Scale Hydrogen Energy Utilization Project:
Enhancing Hydrogen Utilization



Programas del H₂ y Pilas de Combustible en el Mundo



Los Programas de Corea

Programas del H₂ y Pilas de Combustible en Corea

ix35 Fuel Cell



Primer FCEV
de producción en masa
2013

300
coches entregados
en Europa



Fuente: Javier Arboleda, GENERA 2017



Hyundai ix35: primer coche de “carsharing” en Munich

El Confidencial

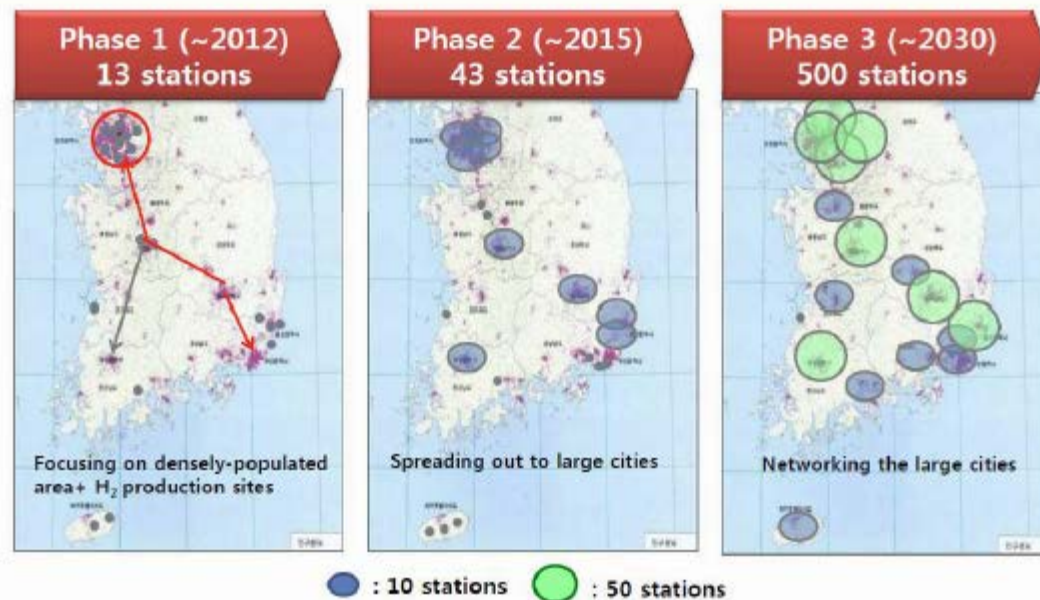
Agosto 2017

Así será el nuevo coche de hidrógeno de
Hyundai a la venta en 2018



Programas del H₂ y Pilas de Combustible en Corea

Hydrogen Fueling Station Roadmap in Korea (Ministry of Environment)

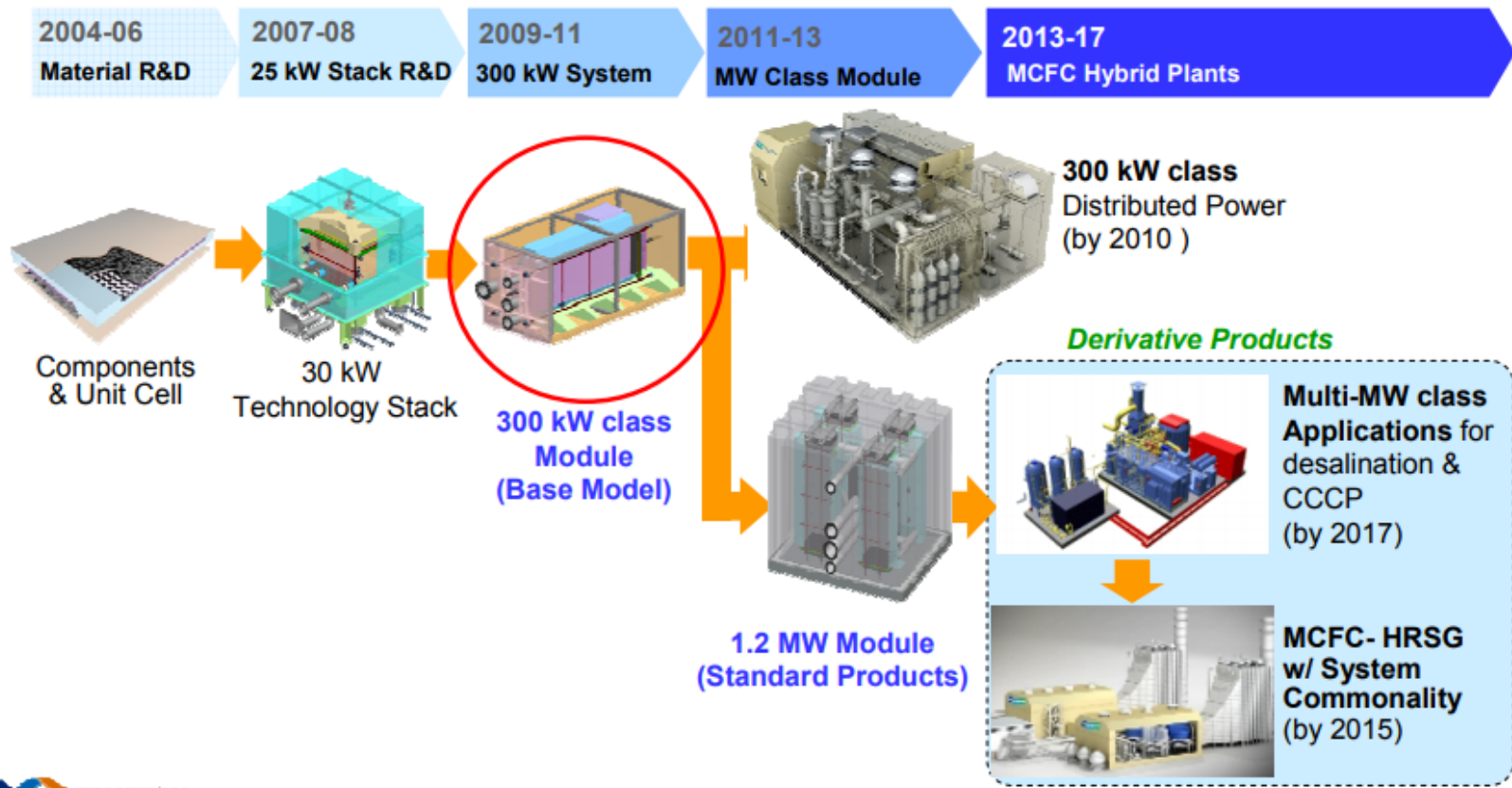


Timeframe	~2012	~2013	~2015	~2020
Number of hydrogen fueling Stations	13	18	43	168

Programas del H₂ y Pilas de Combustible en Corea

MCFC Progresses and Product Plan

- Develop core technology by 2008, and diversify product portfolio from 2013.



Programas del H₂ y Pilas de Combustible en Corea



The 59 MW Gyeonggi Energy fuel cell park in Hwasung City is the world's largest (Fuel Cell Energy photo)

Programas del H₂ y Pilas de Combustible en el Mundo



Los Programas de Europa

Programas del H₂ y Pilas de Combustible en Europa: FCH JU

FCH JU is a strong Public-Private Partnership with a focused mission

European
Commission

Budget of €1.33 billion in 2014 - 2020

Fuel Cells & Hydrogen Joint Undertaking (FCH2 JU)



The Joint Undertaking is managed by a Governing Board composed of representatives of all three partners and lead by industry.

Strategic
objective:

To bring FCH
technologies to
the point of
market
readiness by
2020

Legal basis:

Council Regulations:

521/2008 of 30 May 2008 (FP7)

559/2014 of 6 May 2014 (H2020)

Fuel Cell and Hydrogen Joint Undertaking: **Proyectos**

185 PROJECTS SINCE 2008, €640 MILLION FUNDING

Planned numbers of applications (deployed numbers*)



Forklifts:
273 (105)



Cars and vans:
1760 (240)



Refuelling stations:
81 (20)



Bus:
67 (41)



Micro-CHP:
3600 (750)

Off-grid power supplies: **10**
Back-up power systems: **19**

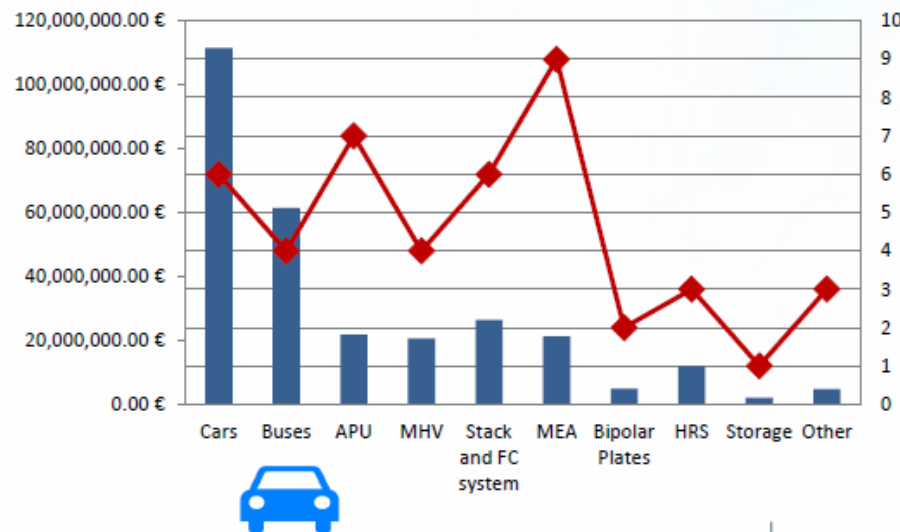
Large micro-CHP x CHP (500 kW_e): **3 (2)**
H₂ production demonstration plants/
electrolysers: **5 (3)**

... CREATING THE BRIDGE BETWEEN TODAY'S ADVANCED TECHNOLOGY
AND TOMORROW'S WIDESPREAD DEPLOYMENT.

*As of 1 October 2016

Fuel Cell and Hydrogen Joint Undertaking: **Proyectos**

Transport portfolio



- Total of 1,785 passenger cars in 6 projects
 - Of which 1,123 with FCs as range extender
- Total of 62 refuelling stations



- Total of 67 buses from 4 projects in 12 locations

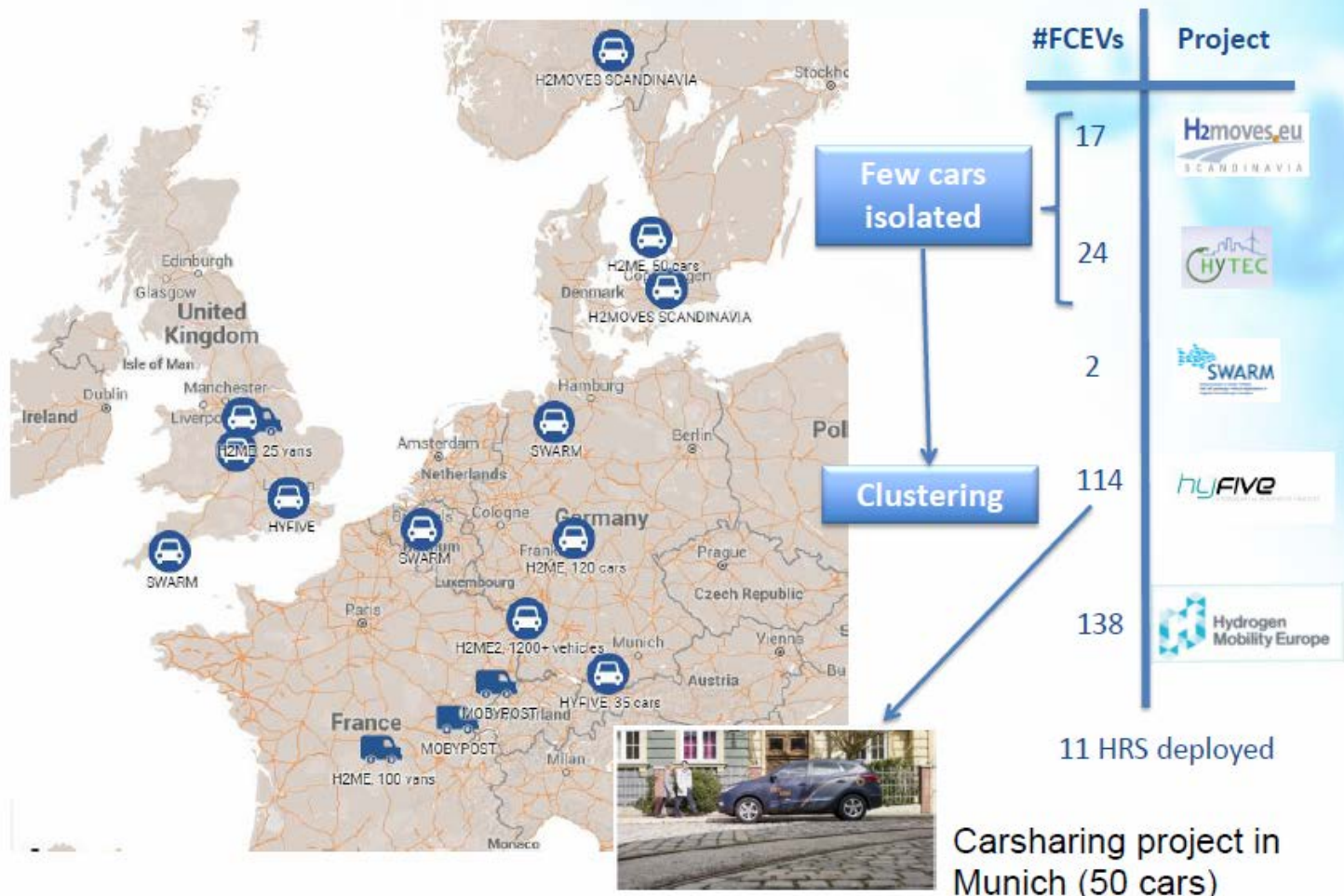


Total FCH JU support:

- 286.6M€ for 45 projects of which 215.3M€ for demos (incl. 21.8M€ APUs)

Fuel Cell and Hydrogen Joint Undertaking: **Proyectos**

Cars - Situation in FCH JU projects: 295 cars in operation or about to start



Fuel Cell and Hydrogen Joint Undertaking: **Proyectos**

Buses - Situation in FCH JU projects: 67 buses in operation or about to start

Ongoing EU-funded fuel cell bus projects

CHIC

- ✓ Aargau, CH – 5 FC buses (2011)
- ✓ Bolzano, IT – 5 FC buses (2013)
- ✓ London, UK – 8 FC buses (2011)
- ✓ Milan, IT – 3 FC buses (2013)
- ✓ Oslo, NO – 5 FC buses (2013)

- ✓ Cologne, DE* – 4 FC buses (2011/14)
- ✓ Hamburg, DE* – 6 FC buses (2011/2015)

High V.LO-City

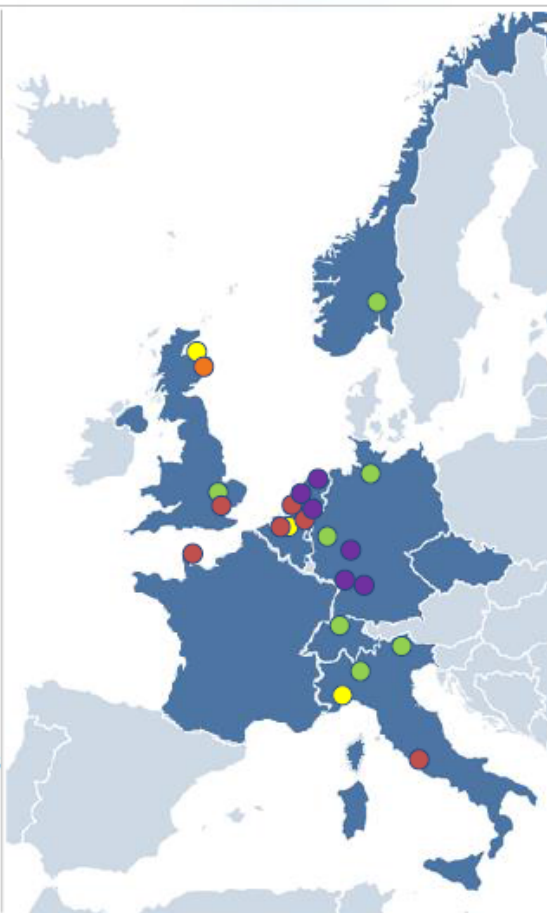
- ✓ San Remo, IT – 5 FC buses (2016)
- ✓ Antwerp, BE – 5 FC buses (2015)
- ✓ Aberdeen, UK – 4 FC buses (2015)

HyTransit

- ✓ Aberdeen, UK – 6 FC buses (2015)

Legend

-  Countries with (upcoming) fuel cell buses
- ✓ In operation
- ✓ Planned operation
- (2015) Operation start/planned start
- * Co-financed by regional/national funding sources



Ongoing EU-funded fuel cell bus project

3Emotion

- ✓ Cherbourg, FR – 5 FC buses (2017)
- ✓ South Rotterdam, NL – 2 FC buses (2017)
- ✓ South Holland, NL – 4 FC buses (2017)
- ✓ London, UK – 2 FC buses (2017)
- ✓ Antwerp, BE – 3 FC buses (2017)
- ✓ Rome, IT – 5 FC buses (2017)

Current national/regional-funded fuel cell bus projects

- ✓ Karlsruhe, DE* – 2 FC buses (2013)
- ✓ Stuttgart, DE* – 4 FC buses (2014)
- ✓ Frankfurt, DE* – 1 FC bus (2016)
- ✓ Arnhem, NL* – 3 FC buses (2017)
- ✓ Groningen, NL* – 2 FC buses (2017)
- ✓ North Brabant, NL* – 2 FC buses (2016)

Fuel Cell and Hydrogen Joint Undertaking: **Proyectos**

Heat and Power solutions



SOFT-PACT

- 65 units Solid Oxide FC mCHP
- 40% η_{electric} 79% η_{total}
- 25% cost reduction
- FC system life > 10,000 hours



PACE

ene.field★

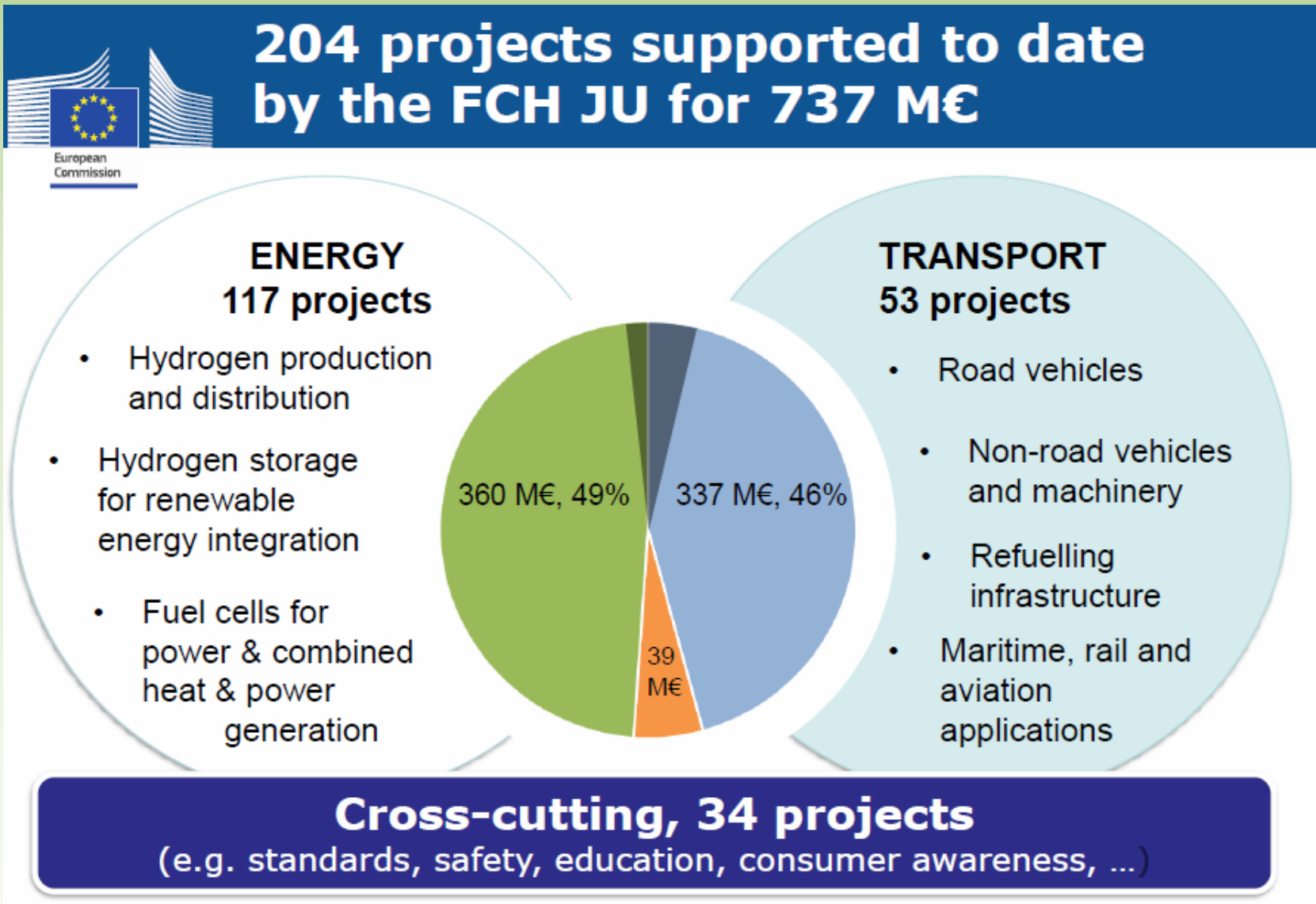
- 1,000 units (10 manufacturers) in 11 EU member states
- 30-150 units from each manufacturer

Dachs InnoGen	Geyser Laggen	FEDER FC100	ELC S10	ELC S100	ELC S100 H	ELC S100 H	ELC S100 H	ELC S100 H	ELC S100 H	ELC S100 H
ITP100 700W	SOFC 200W	ITP100 200W	ITP100 200W	ITP100 200W	ITP100 200W	ITP100 200W	ITP100 200W	ITP100 200W	ITP100 200W	ITP100 200W
Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas
Floor	Floor	Floor	Floor	Floor	Floor	Floor	Floor	Floor	Floor	Floor
Serotec	Boch	Boch	Boch	Boch	Boch	Boch	Boch	Boch	Boch	Boch

- 2650 units
- 4 manufacturers min 500 units
 - Bosch
 - Vaillant
 - Solidpower
 - Viessmann
- Build a real production line

Thanks to those μ CHP demo projects learnings,
national governments now make end-customer subsidy program

Fuel Cell and Hydrogen Joint Undertaking: **Proyectos**



Programas nacionales europeos “Hydrogen Mobility”

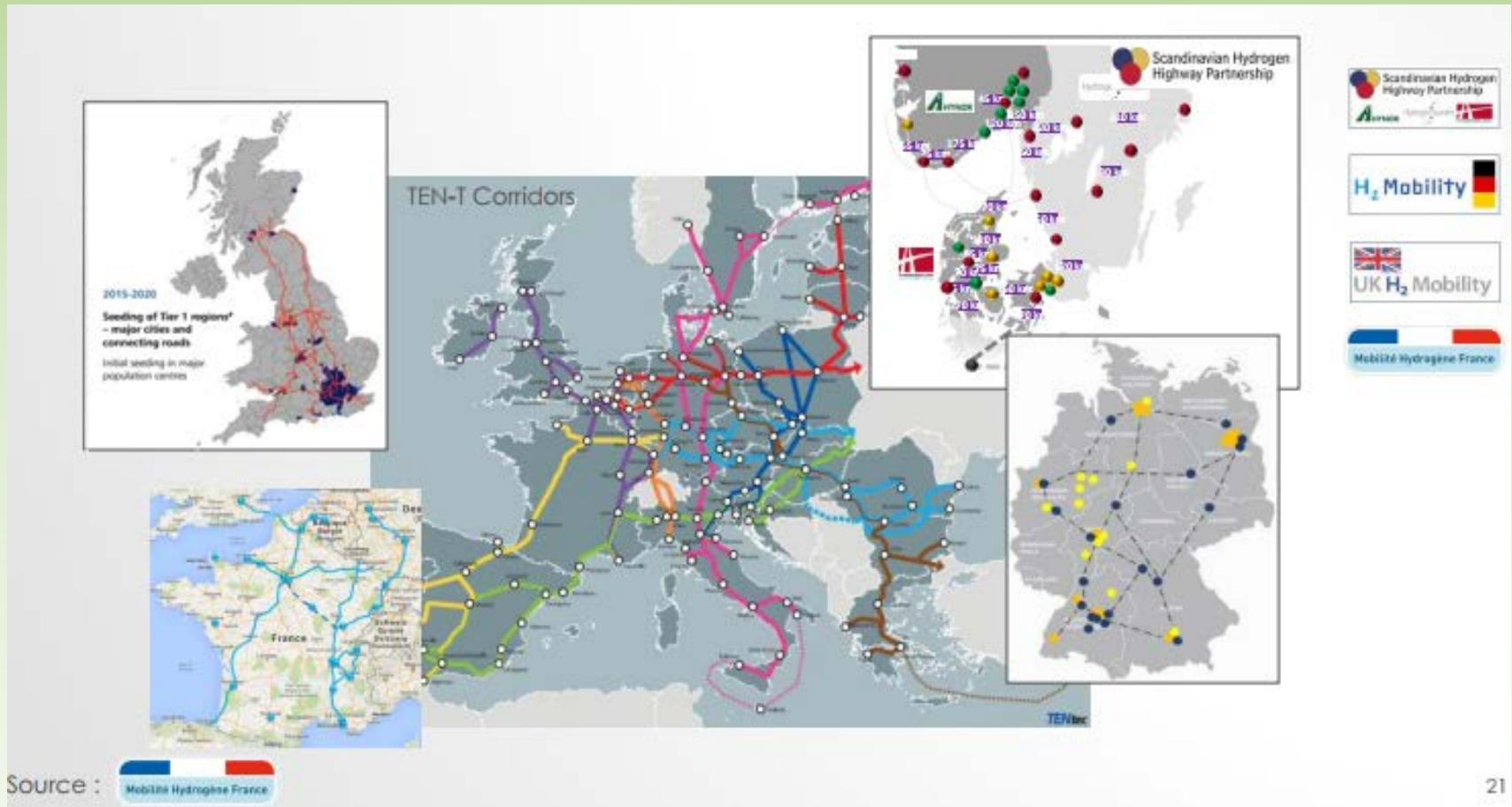
COUNTRY	PROGRAM		FINDINGS			
	 H ₂ Mobility		2015	2025	2030	2050
		HRS	90	500	1,000	NA
		FCVs	200	500,000	1,87 mill	NA
		H2 (tons)	24	60,000	216,000	NA
			2015	2025	2030	2050
		HRS	NA	355	600	>1,000
		FCVs	NA	167,000	773,000	7.3 mill
		H2 (tons)	NA	22,000	89,000	880,000
	 UK H ₂ Mobility		2015	2025	2030	2050
		HRS	65	380	1,150	NA
		FCVs	<500	255,000	1,27 mill	NA
		H2 (tons)	<100	30,600	152,000	NA
	 H2moves.eu SCANDINAVIA		2015	2025	2030	2050
		HRS	12	185	NA	450 - 1000
		FCVs	26	87,000	NA	3,3 mill - 7,3 mill
		H2 (tons)	3.2	10,400	NA	394,000 - 880,000

H₂ Mobility public-private partnerships

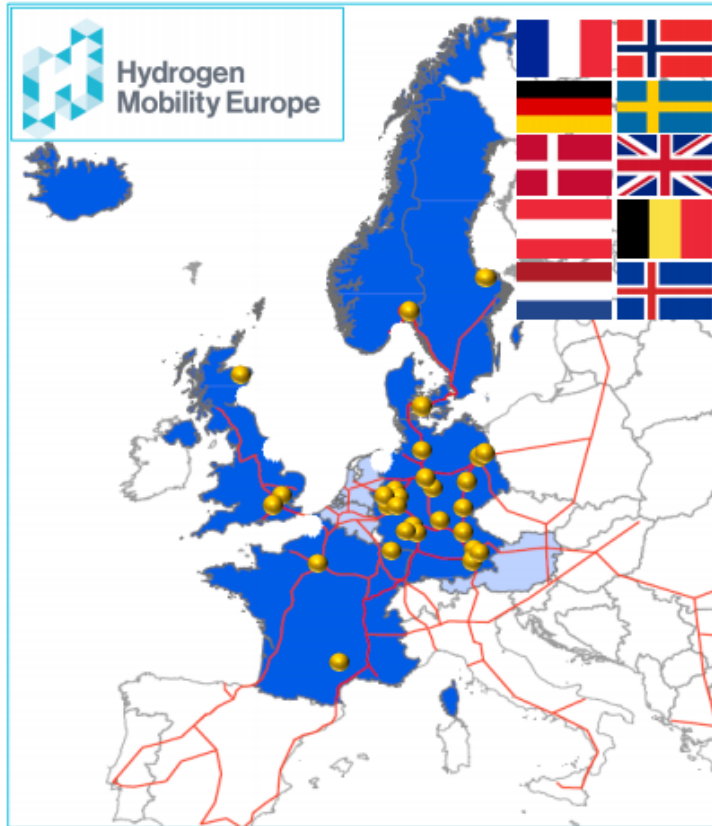
Source: *Hinicio analysis based on : (Mobilité_Hydrogène_France), McKinsey, (UKH2 Mobility, 2012), (EUDP_Transnova, 2012), and (NOW, 2013).*

Information of 2015 based on expectations taken from the report of H2Mobility Program.

FCH JU: Hydrogen Mobility Europe (H2ME)



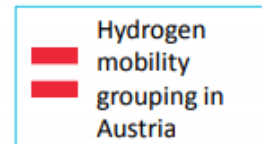
FCH JU: Hydrogen Mobility Europe (H2ME)



Concept description:

- Joint initiative from the most ambitious European hydrogen mobility initiatives
- The project will see the deployment of 29 new HRS and 325 FCEVs (200 FCEVs and 125 FC RE-EVs)
- One 'working framework' linking the hydrogen mobility initiatives of 10 countries, which will provide the opportunity to:
 - 1) identify optimal commercialisation strategies and synergies between countries
 - 2) develop a pan-European strategy for commercialisation
 - 3) Refine sales and support strategies for the early FCEV customer across Europe

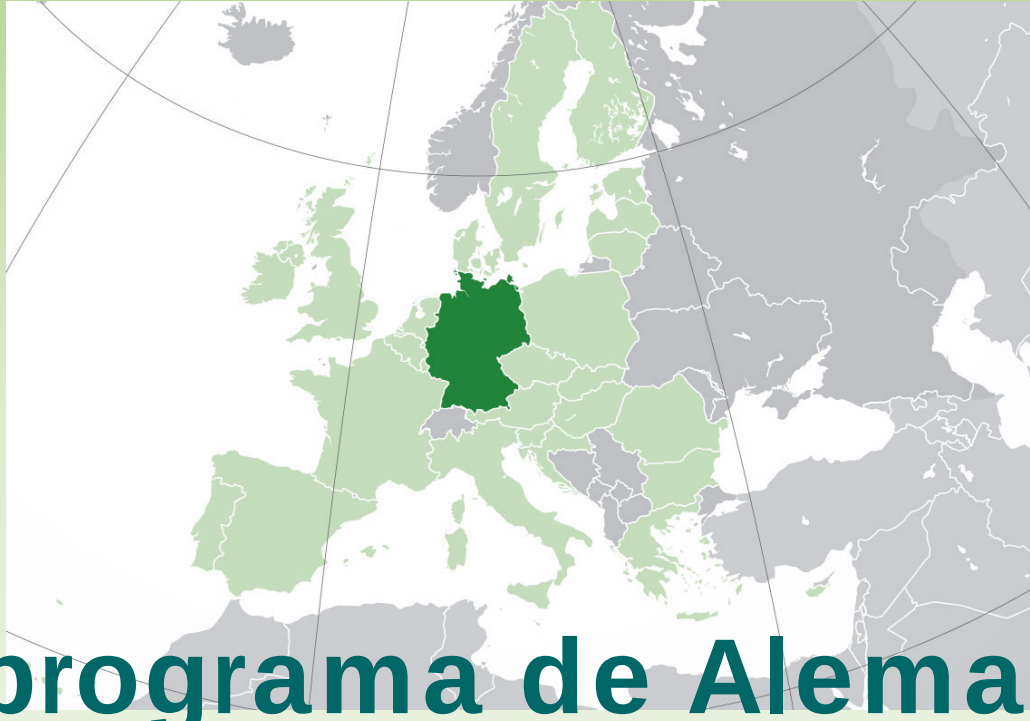
Endorsers:



FCH JU: Hydrogen Mobility Europe (H2ME)

	National Strategy	H2ME network	H2ME vehicles
	Risk sharing JV - Widespread deployment of up to 100 HRS by 2017/2018 and up to 400 HRS by 2023 to provide a national network and so allow OEM vehicle introduction	20 x 700 bar HRS in Germany	200 FCEVs across Scandinavia, Germany and the UK
	Deployment based on expected sales of OEM vehicles (facilitated by tax regime). Aiming at a network of stations by 2020 across the SHHP countries to allow transnational driving within the region	3 x 700 bar HRS in SE, NO and DK	
	Deployment in 3 stages: clustered phase (2015-2020), accelerated ramp-up (2020-2025) and established market (2025-2030) characterised by a progressive introduction	3 x 350 /700 bar HRS in Aberdeen and London	125 RE-EV vans in France and the UK
	Initial strategy based on 350bar RE-EVs in captive fleets linking H2 supply and vehicles, which de-risk early H2 infrastructure investments before OEM vehicles arrive	3 x 350 bar HRS in France	

Programas del H₂ y Pilas de Combustible en Europa



El programa de Alemania



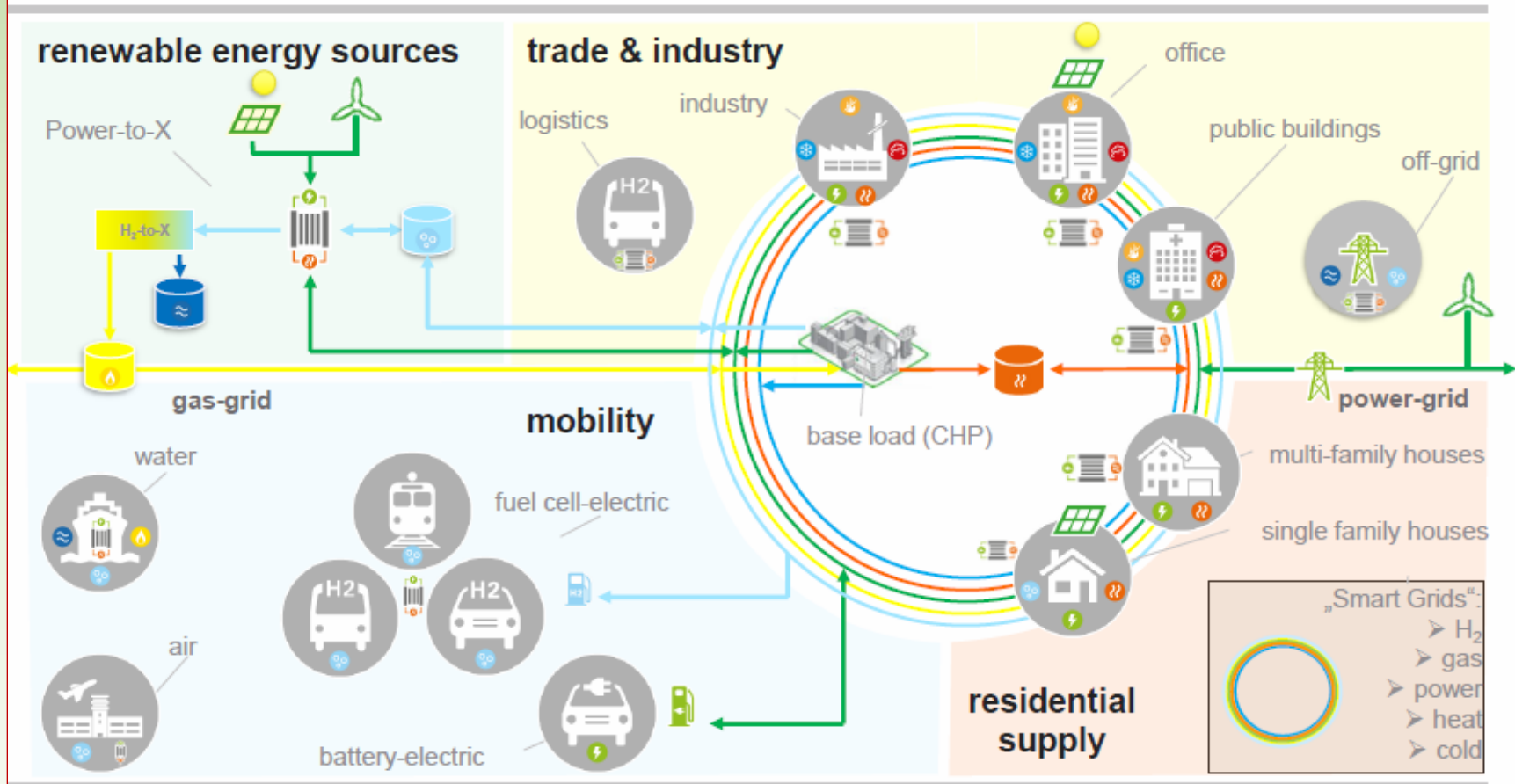
Nationales Innovationsprogramm
Wasserstoff- und
Brennstoffzellentechnologie



Programas del H₂ y Pilas de Combustible en Alemania

Hydrogen and Fuel Cell technologies

– efficient – flexible – emission-free – renewable – coupling the energy sectors –



Programas del H₂ y Pilas de Combustible en Alemania

CALLUX

Successful market preparation for residential fuel cells



EnBW

e-on | Ruhrgas

EWE

MVV Energie

Verbundnetz Gas AG

BAXI | INNOTECH
fuel cell heating

HEXIS

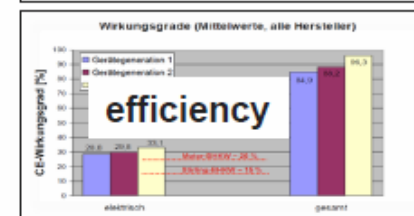
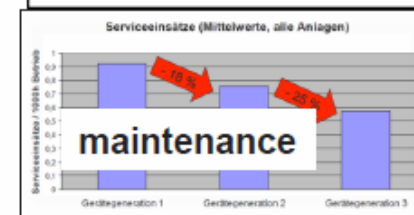
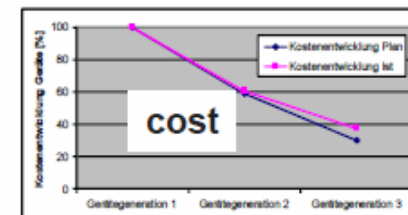
Vaillant

ESW



<http://www.callux.net>

- almost 500 systems
- 4.5 million operating hours
- system availability > 97 per cent
- 2.5 million kWh delivered
- proven stack life time > 20,000 h



Programas del H₂ y Pilas de Combustible en Alemania

Clean Energy Partnership

Technology validation with more than 100 fuel cell vehicles (passenger cars and busses)
including hydrogen infrastructure



Vehicle Performance efficiency, cold start, range



Fast Refueling 700 bar technology



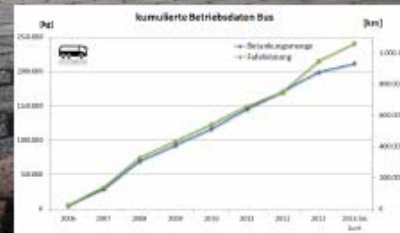
Safety standards defined and tested



Sustainable > 50% green hydrogen



Customer Acceptance



Programas del H₂ y Pilas de Combustible en Alemania

H2 Mobility

A partnership to make refuelling hydrogen possible throughout Germany



Berlin
October 13, 2015

Shareholder



Associated Partners and Advisors



2018

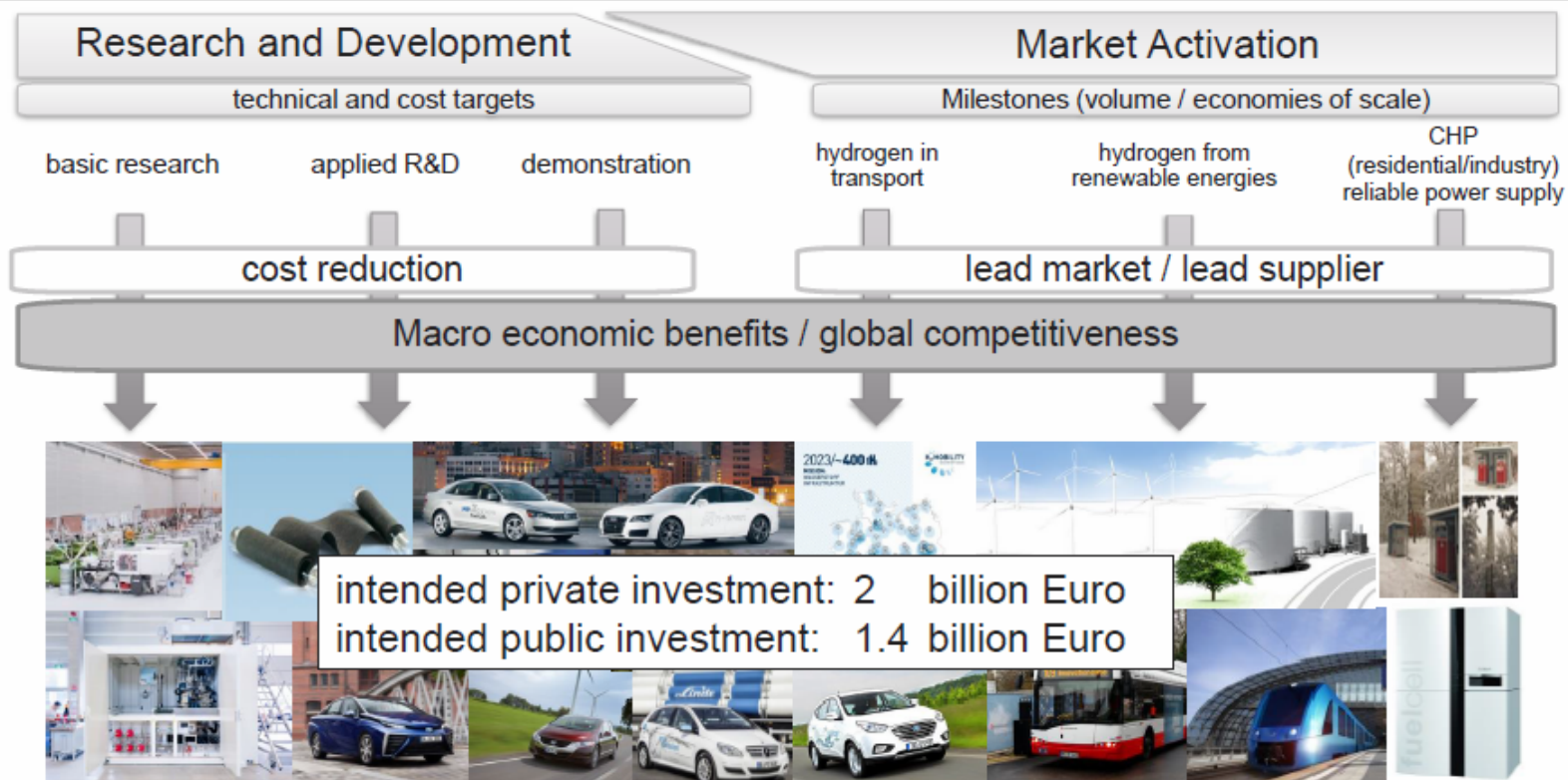


2023



Programas del H₂ y Pilas de Combustible en Alemania

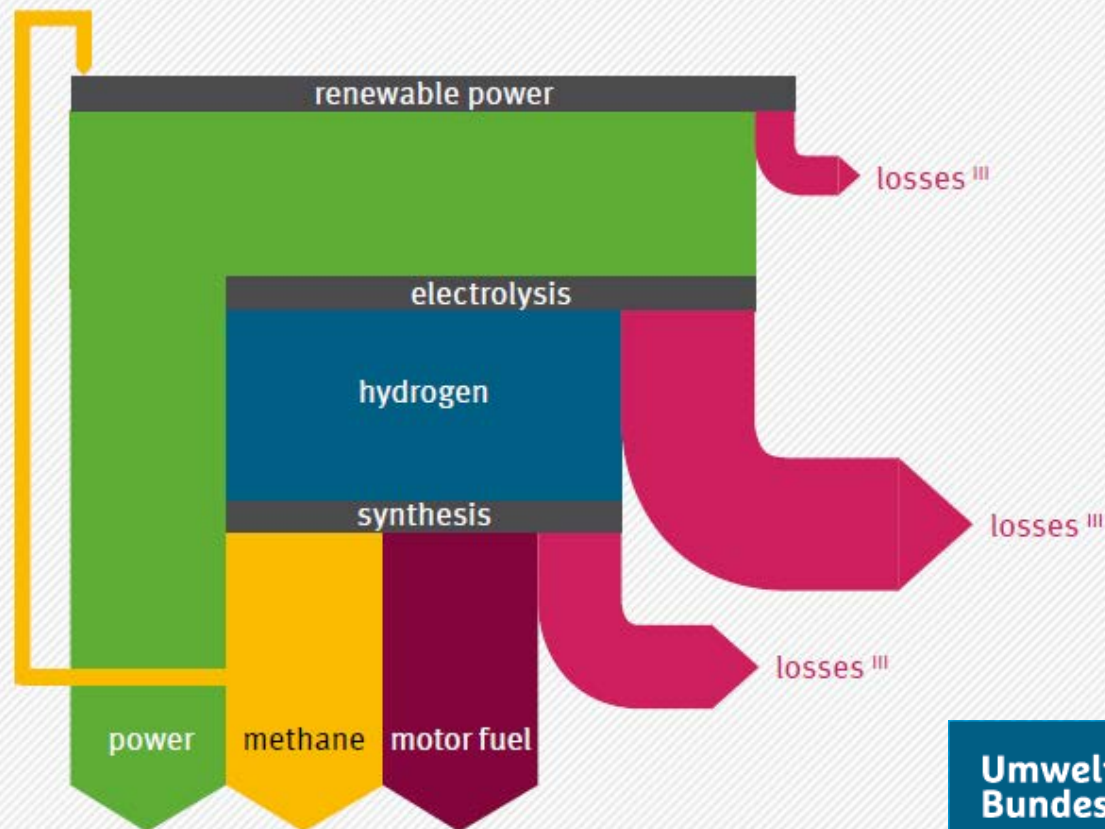
The federal Government approved the continuation of the National Innovation Program (NIP) 2016-2026 on Sept. 28, 2016



Programas del H₂ y Pilas de Combustible en Alemania

A greenhouse gas-neutral Germany
in 2050

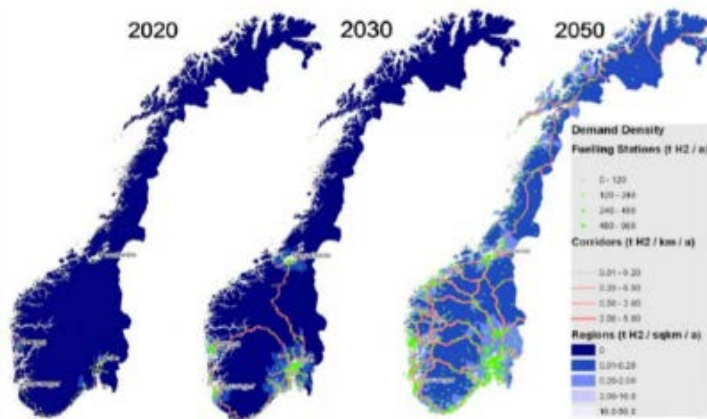
Qualitative representation of the energy flow in the UBA THGND 2050 Scenario^{i,ii}



Programas del H₂ y Pilas de Combustible en Escandinavia



Period covered in this report	11/2011 – 12/2012
Number of vehicles	19 (10 Daimler + 4 Hyundai + 5 Th!nk)
Location of FCEVs	17 in Oslo, Norway + 2 in Denmark
km driven	213,641 km
Hydrogen refuelled	2,334 kg
Number of refuellings of FCEVs	1,170
Number of HRS	1 (in Oslo) + 1 moveable refueller
Hydrogen dispensed at station	701 kg plus 51 kg for moveable refueller
Number of refuellings at station	313 plus 26 for moveable refueller



Source: Hydrogen Roadmap 2009-2050

Programas del H₂ y Pilas de Combustible en Reino Unido

- ✓ Consorcio público-privado establecido entre el sector industria y el Gobierno de Reino Unido (2012)
- ✓ Objetivo: desarrollar y asegurar el despliegue comercial de los vehículos de pila de combustible en Reino Unido.

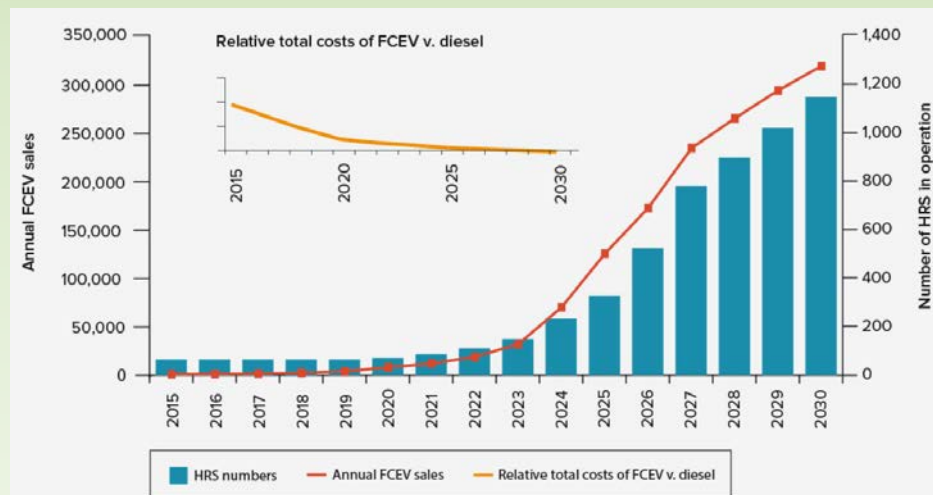
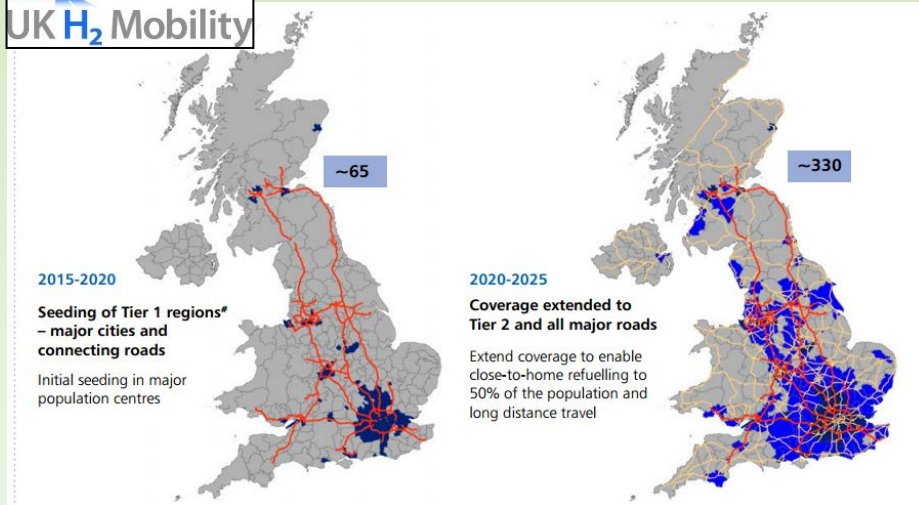


Figure 1: UK consumer demand for FCEVs increases as the cost premium diminishes and the network of HRS expands. © UK H2Mobility Project



Fuente: <http://www.ukh2mobility.co.uk/>

Programas del H₂ y Pilas de Combustible en Francia



- ✓ **Iniciativa público-privada (2014)**
- ✓ **Objetivo: desarrollar y asegurar el despliegue comercial de los vehículos de pila de combustible en Francia**

Gouvernement	   
Entreprises de l'énergie	  
Producteurs d'hydrogène et stations	   
Véhicules et systèmes pile à combustible	     
Electrolyseurs	   
Centres de Recherche	  
Associations régionales-et-pôles	   
Associations européennes et françaises	  

Relier les Clusters

Couverture nat

Déclencheurs du plan national

- Disponibilité réelle des véhicules à des prix de marche
- Une réglementation adaptée
- Un support politique clair
- Des intentions marquées des clients

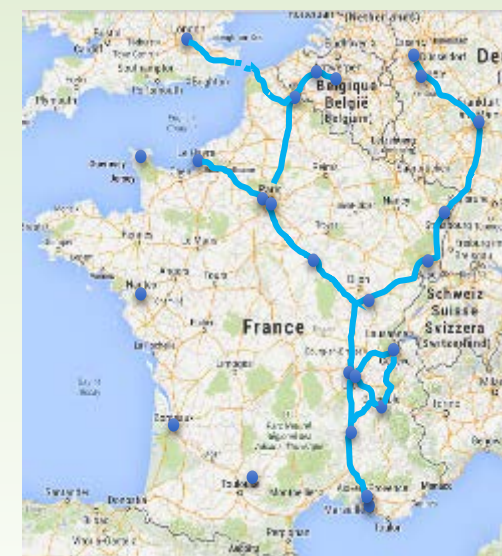
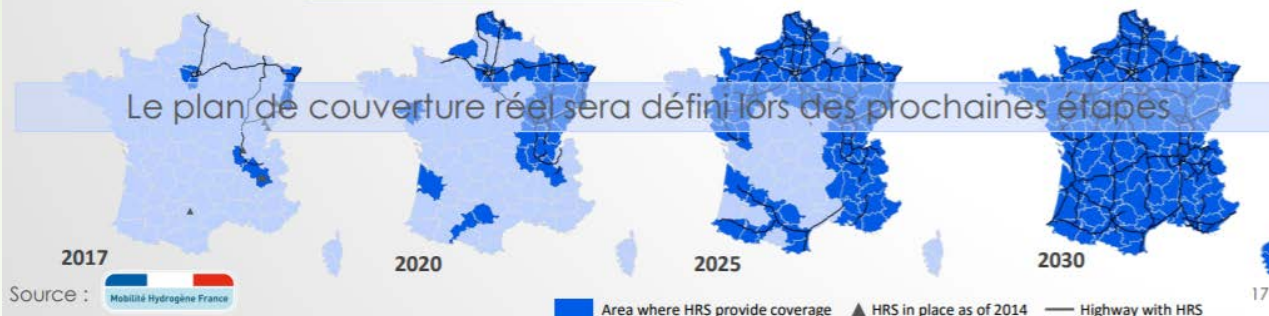
Déploiement national

- Déploiement d'une infrastructure qui donne une bonne qualité de service aux clients

Clusters

- Des investissements raisonnables
- Des stations H₂ chargées

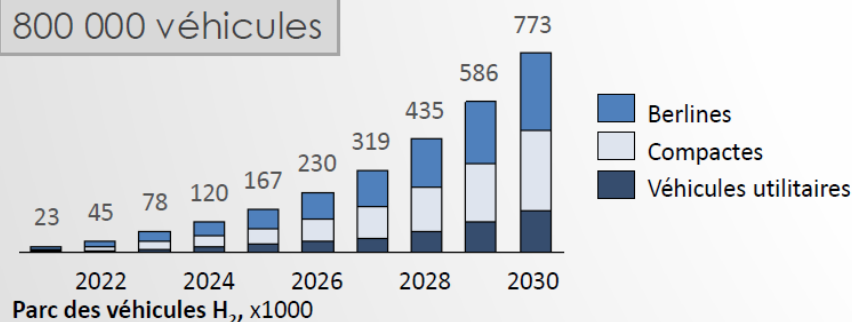
Le plan de couverture réel sera défini lors des prochaines étapes



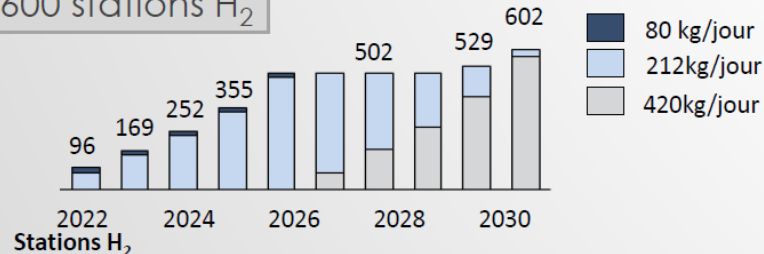
Programas del H₂ y Pilas de Combustible en Francia

LE MARCHÉ DES VÉHICULES HYDROGÈNE POURRAIT REPRÉSENTER EN 2030 :

800 000 véhicules



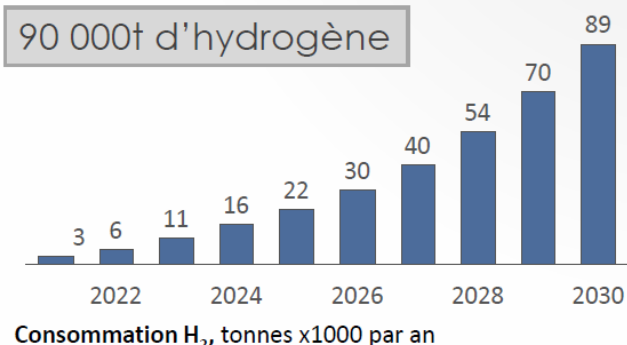
600 stations H₂



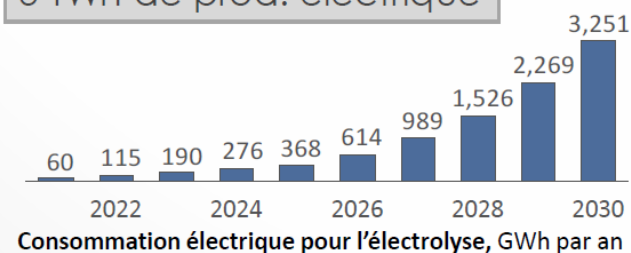
Source :



90 000t d'hydrogène



3 TWh de prod. électrique



Programas del H₂ y Pilas de Combustible en Francia

El enfoque de “clusters” de flotas cautivas: una forma de comenzar el mercado, antes de un despliegue nacional completo

LE DÉPLOIEMENT EST EN MARCHÉ

- Début : 2014
- 2015 : 10 stations
- 2018 : 40 stations déjà financées
- Objectifs 2018 : 100 stations



Programas del H₂ y Pilas de Combustible en Holanda



The Green Hydrogen Economy in the Northern Netherlands

2 Northern InnovationBoard

Executive Summary

**By 2050,
the Netherlands
is aiming to
achieve a carbon
emission free
economy.**

**The Northern
Netherlands
is determined
to realize a
Green Hydrogen
Economy**



Hidrógeno y pilas de combustible en la transición energética

Hydrogen Council

(Enero 2017)



7 septiembre, 2017

Mitsui & Co, Plug Power, Faber Industries,
Faurecia, First Element Fuel (True Zero),
Gore y Toyota Tsusho

Antonio González García-Conde



COP21 • CMP11

PARIS 2015

CONFERENCIA DE NACIONES UNIDAS
SOBRE CAMBIO CLIMÁTICO 2015

How hydrogen empowers the energy transition



Hydrogen Council January 2017

Hidrógeno y pilas de combustible en la transición energética



Hydrogen scaling up

A sustainable pathway for the global energy transition

Hydrogen Council November 2017

This study is the first comprehensive, ambitious Hydrogen roadmap



Objectives of the study

- First **comprehensive quantified vision** and **roadmap** for deployment
- Not a forecast, but an **ambitious yet realistic** scenario
- Answers the question “How could hydrogen contribute to **achieving the two degree scenario?**”

Hydrogen: a central pillar of the required energy transition

Estimated impact in 2050



¹ Value add of fuel cells

SOURCE: Hydrogen Council, IEA ETP Hydrogen and Fuel Cells G20, National Energy Outlook 2016

Muchas gracias por su atención



Antonio González García-Conde

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DEL HIDRÓGENO