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GROUPE EDF

2023 – Business Development | Energy

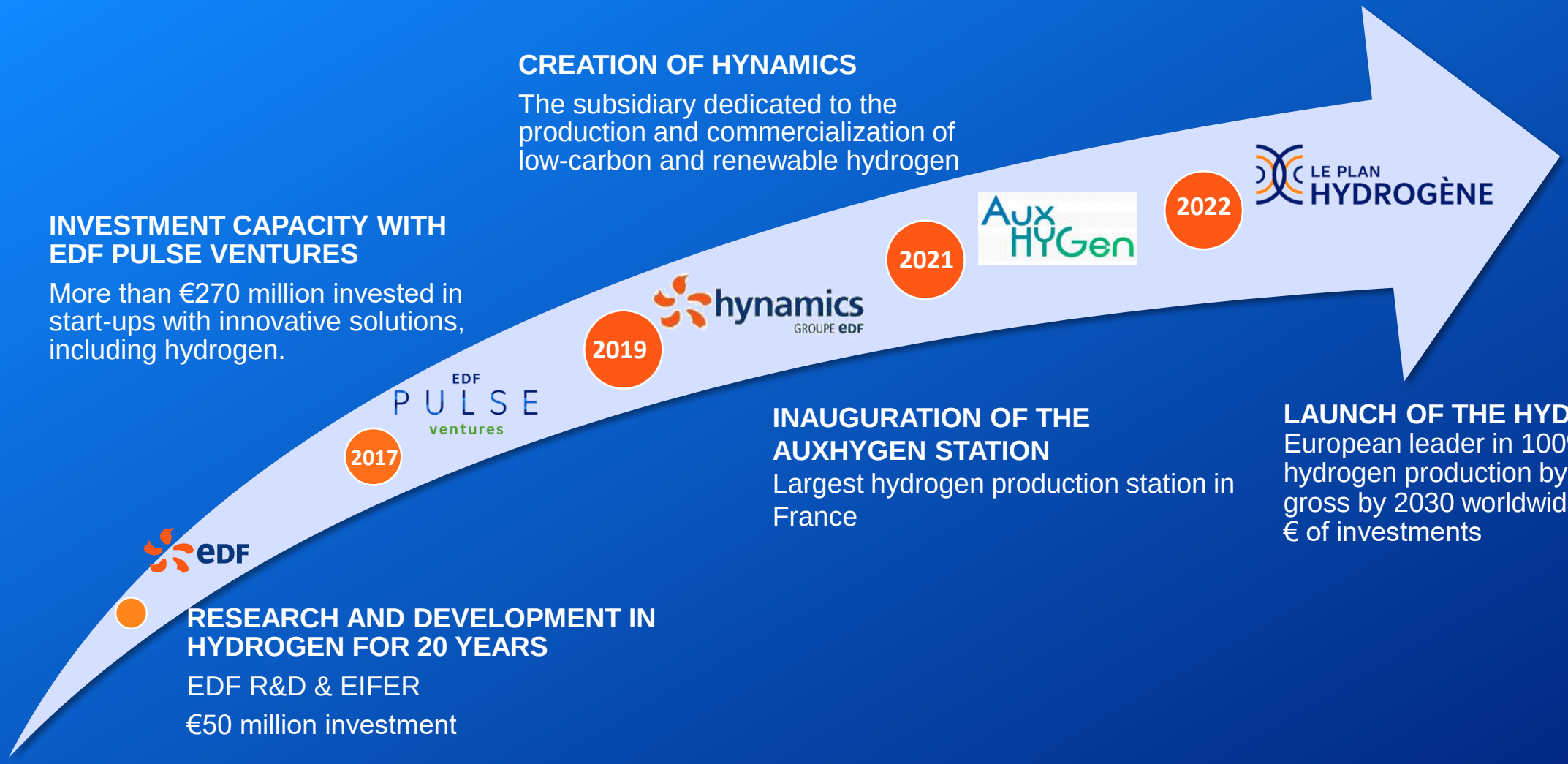
Agenda

- Hydrogen Rainbow
- Who are Hynamics
- Hynamics ambitions
- Hydrogen demand
- H2 cost fundamentals
- Case studies

The Hydrogen Rainbow

Source: AskConsultingSolutions.com

EDF Group is accelerating in Hydrogen



RESEARCH AND DEVELOPMENT IN HYDROGEN FOR 20 YEARS

EDF R&D & EIFER

€50 million investment

2017

INVESTMENT CAPACITY WITH EDF PULSE VENTURES

More than €270 million invested in start-ups with innovative solutions, including hydrogen.

2019

CREATION OF HYNAMICS

The subsidiary dedicated to the production and commercialization of low-carbon and renewable hydrogen

2021

INAUGURATION OF THE AUXHYGEN STATION

Largest hydrogen production station in France

2022

LAUNCH OF THE HYDROGEN PLAN

European leader in 100% low-carbon hydrogen production by 2030 3 GW gross by 2030 worldwide 2 to 3 billion € of investments

LE PLAN HYDROGÈNE

Hydrogen Plan of the EDF group

Develop **3 GW gross** of projects for low-carbon hydrogen production by 2030 across the globe

Be a European leader for the production of **100 % low carbon** hydrogen by 2030

2 to 3 Bns € of investments co-financed through industrial partnerships and with national and European support mechanisms

Main markets addressed: **Industry and transport** (in territorial mobility and e-fuels for maritime and air transport)

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Our 2023 Data

"COMMITTED TO LOW-CARBON HYDROGEN TO INVENT AND BUILD A SUSTAINABLE FUTURE".

01

100% SUBSIDIARY OF THE EDF GROUP

02

2 MARKETS ADDRESSED

INDUSTRY

MOBILITY

the largest CO_2 emitters

03

>100 EMPLOYEES

04

PRESENT IN 3 COUNTRIES

2019
Creation
of Hynamics

2020
Creation
of Hynamics
Deutschland

2021
First
projects in the
United Kingdom

05

60 PROJECTS IN DEVELOPMENT

More than 1 GW of electrolysis

06

MANY PARTNERS

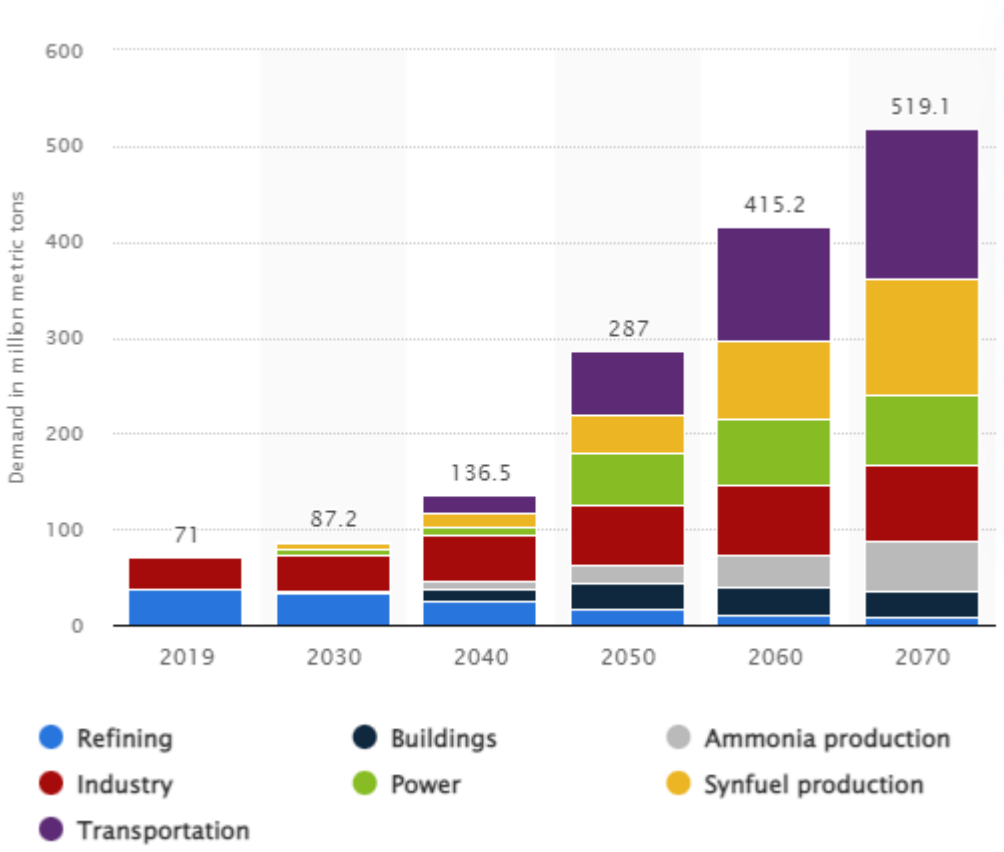
To innovate

To develop projects

Provider of turnkey hydrogen solutions for both the transport and industrial markets

Ecosystem Identification → Development → Investment → Construction → Operations Maintenance

Forecast hydrogen demand worldwide in a sustainable development scenario from 2019 to 2070, by sector.



Source: statista 2023

Hydrogen Demand

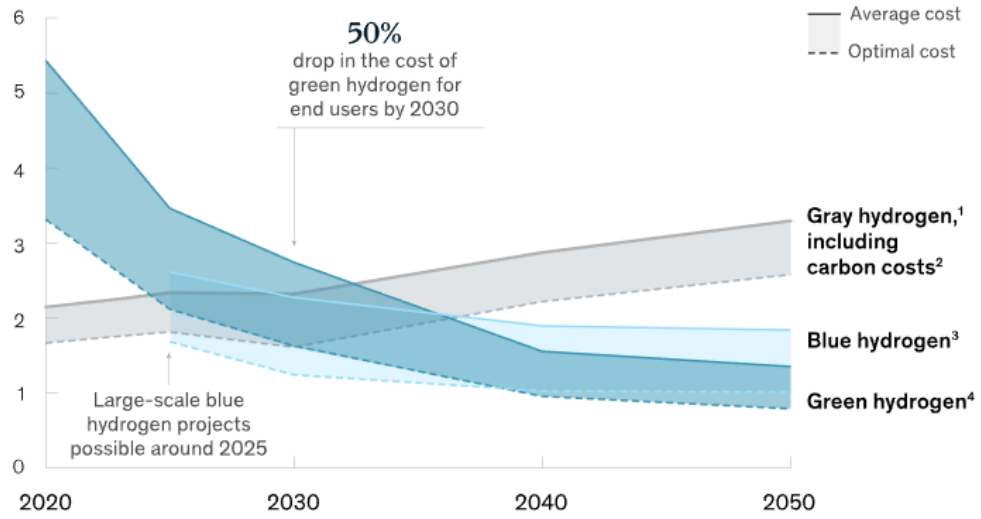
Mobility
- HGV
- Buses
- Trains
- Static and mobile plant
- Aviation
- Maritime

Industry
- Fertiliser
- Hydrogenation
- Hydrocracking
- Desulphurisation
- Chemical feedstock
- Natural gas replacement

Green hydrogen production costs are expected to fall by approximately 50 percent by 2030.

Forecast as of September 2022

Projected global production cost of hydrogen, $/kilogram



[1]Steam methane reforming (SMR) without carbon capture, utilization, and storage (CCUS).
[2]Based on projected average global CO_2 costs of $57/ton (2030), $94/ton (2040), and $131/ton (2050). For Saudi Arabia, CO_2 costs are assumed to be $33/ton in 2030, $69/ton in 2040, and $105/ton in 2050.
[3]Gas prices of $2.60 to $6.80/MMBtu (approximately $3/MMBtu in Saudi Arabia).
[4]Refers to the cheapest green hydrogen, which is provided by solar energy.
Source: McKinsey Hydrogen & Derivatives Flows Model, October 2022

Source: McKinsey

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Challenges

Infrastructure
- Power / Grid
- Water supply
- Planning consent
- Distribution

Cost, Regulation and Funding
- Carbon tax
- Better incentives for uptake

Safety
- Highly flammable

Supply Chain
- Electrolysers
- Compressors
- Tube trailers
- HGVs
- HRS

CONTEXT

WHAT DOES THIS MEAN IN REALITY

Hydrogen Vehicle	Typical H2 Consumption Rate (kg/100km)	Typical Fuel Tank size (kg)	Range per fill (km)
Car	1	5kg @ 700bar	500
Bus	8	30@ 350bar	375
HGV	9	40@ 350bar	444

So what this means is:

5MW ELY = 2,000 kg/day
e.g. **80 cars** at 5kg each, **plus**
20 buses at 30kg each, **plus**
25 HGV at 40kg each

Project Experience

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Project experience

Les Renardières – first of a kind in the EU

Location
- Paris (France)

Capacity
- 1 MW

Demand Use
- R&D (Mobility and Industry)

Stage
- Operational since 2020

Project experience

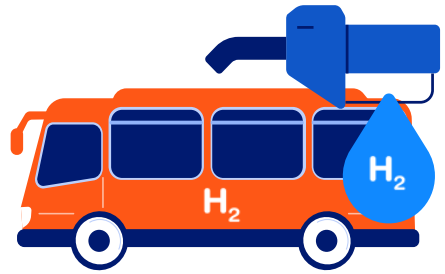
AuxHYGen – one of the only operational, commercial projects in the EU

Location
- Auxerre (France)

Capacity
- Stage 1 (2021) : 1 MW – 400 kg/d
- Stage 2 (2025) : 3 MW – 1200 kg/d

Demand Use
- Mobility (buses via dispenser)

Stage
- Stage 1 : Operation (since 2021)
- Stage 2 : FEED



Project experience

Teesside Green Hydrogen – on track for FID

Location

- Teesside (United Kingdom)

Capacity

- Stage 1 (2026) : 7,5 MW – 3 000 kg/d
- Stage 2 (2027) : 100 MW – 40,000 kg/d
- Stage 3 (2028) : 200 MW + e-Methanol

Demand Use

- Mobility & Industry
- PD Ports, NGN, British Steal

Stage

- Stage 1 : FID – Q4 2023

Project experience

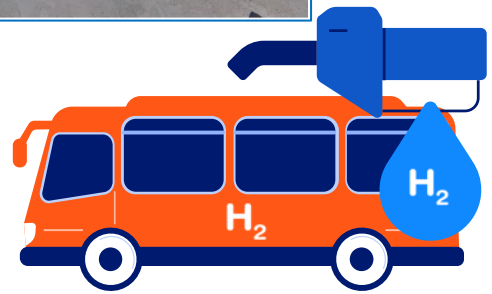
Great Belfort – under construction and operational in 2023

Location
- Belfort (France)

Capacity
- Stage 1 (2023) : 1 MW – 400 kg/d
- Stage 2 (2025) : 2 MW – 800 kg/d

Demand Use
- Mobility (buses)

Stage
- Construction
- COD : end of 2023



Project experience

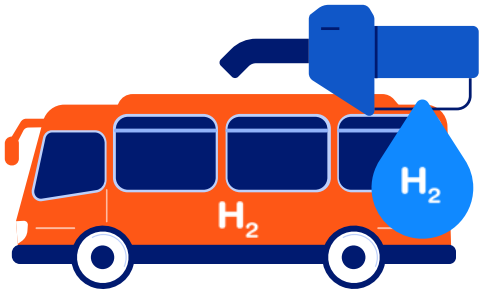
SHYMED – our 4th project to reach FID

Location
- Dunkerque (France)

Capacity
- 1,25 MW – 540 kg/d

Demand Use
- Mobility (buses via dispenser)

Stage
- Past-FID
- COD : 2024



Project experience

LH2 – learning lessons, improving our developments, increasing scale

Location
- Le Havre (France)

Capacity
- Stage 1 (2025) : 2 MW – 800 kg/d
- Stage 2 (2028) : 4 MW – 1600 kg/d
- Stage 3 (2030) : 6 MW – 2400 kg/d

Demand Use
- Mobility (buses via HRS tube trailer)
- Industry (port uses)

Stage
- In targeting (FID expected in July 2023)
- COD (stage 1) : 2025

Project experience

ABC Ottmarshein – the most advanced industrial project in the EU

Location
- Ottmarshein (France)

Capacity
- 50 MW – 36 000 tonnes of low-carbon amomonia produced per year

Demand Use
- Industry (ammonia production)

Stage
- In targeting (FID expected at the end of 2023)
- COD : 2026

Project experience

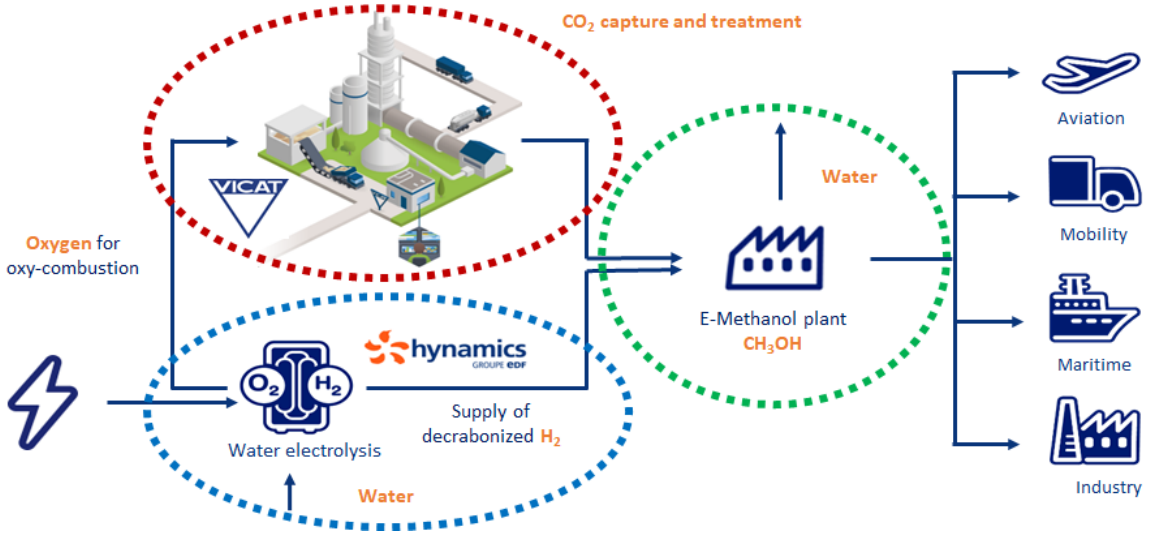
HyNovi – the most advanced E-Methanol project in Europe

Location
- Montalieu-Vercieu (France)

Capacity
- 200 MW
- 125 000 tonnes of methanol/year

Demand Use
- Industry (methanol production)

Stage
- In targeting (FID expected at the end of 2023)
- COD : 2028



Hydrogen knowledge

Active monitoring of various suppliers and emerging technologies:

In order to optimise its fleet and offer the best hydrogen power plants, Hynamics carries out a commercial and technological watch. This monitoring, combined with regular exchanges with companies in the sector, ensures that the best existing technologies are considered and integrated into each project.

In the last 6 months the Hynamics Engineering & Procurement Team have conducted vists across the globe to audit electrolyser, compressor and hydrogen refuelling manufacturers and this will continue as standard to ensure we are always **fully in control of our supply chain costs** and safety of our sites

A referencing of suppliers and companies to ensure the reliability of procurement of the various materials.

Hynamics has developed a referencing system to ensure the reliability of the installed equipment in terms of costs, deadlines and quality.

This involves regular technical exchanges with numerous suppliers, visits to production and demonstration sites, and compliance with various criteria (capability, experience, sustainability, QHSE, etc.).

This reference concerns all types of equipment present on the sites (ELY, HRS, …).

R&D

THROUGHOUT THE WORLD

With 3 centres in France and 6 abroad, EDF conducts research both nationally and at international level