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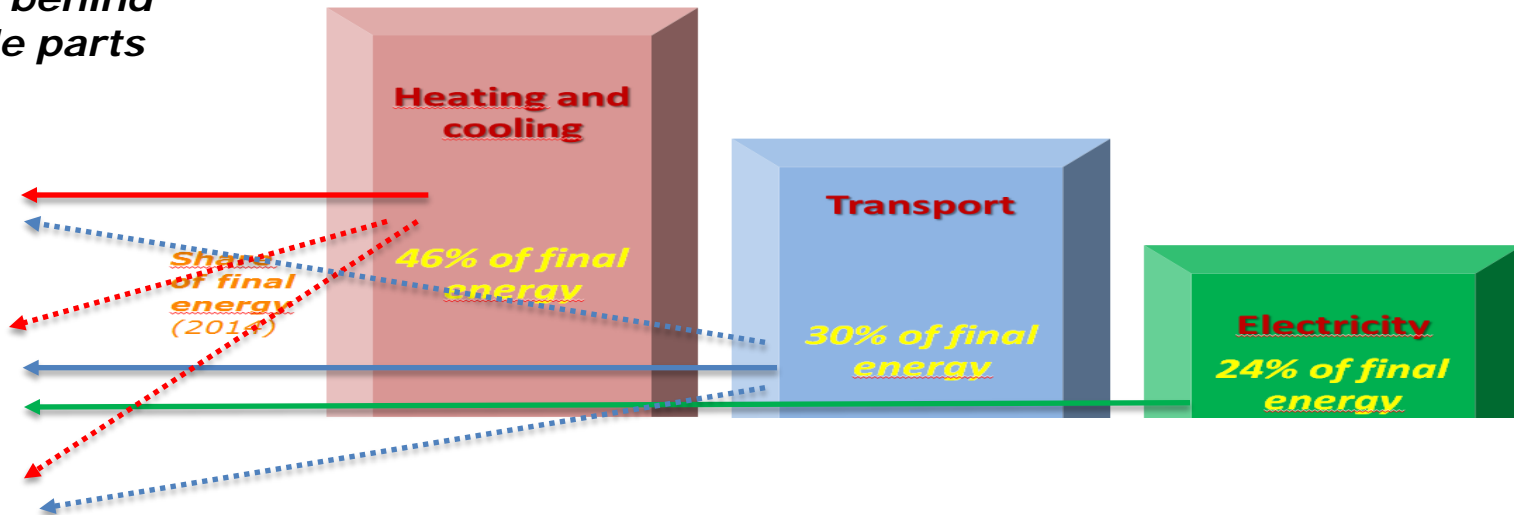
# *Innovations in the Gas Value Chain*

*Raphael Schoentgen – CTO ENGIE &  
President Hydrogen Europe*

# Renewable Energy Targets

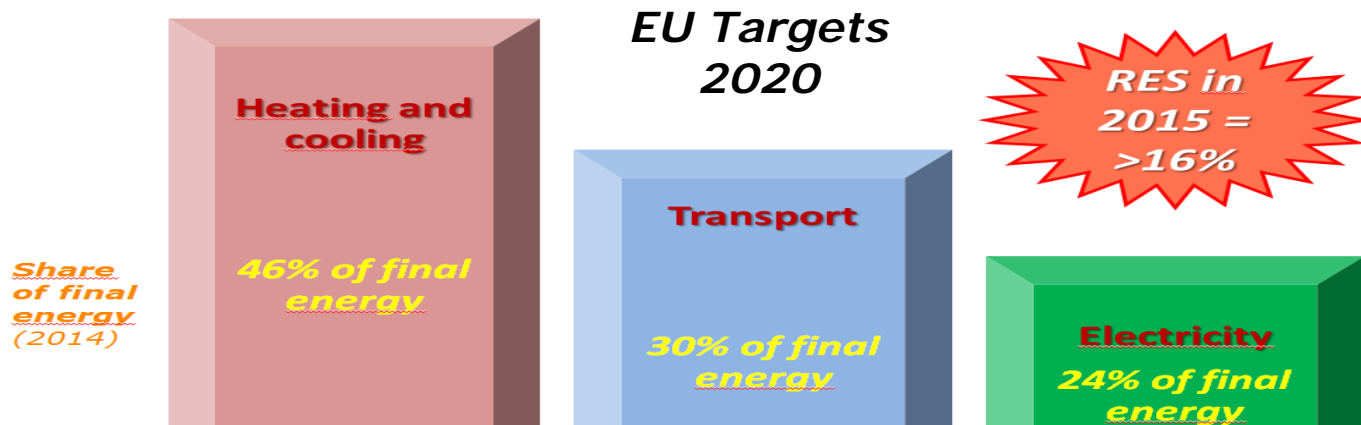
*A starting point for innovation regarding the gas chain*

**Main energies behind  
non renewable parts**



# Renewable Energy Targets

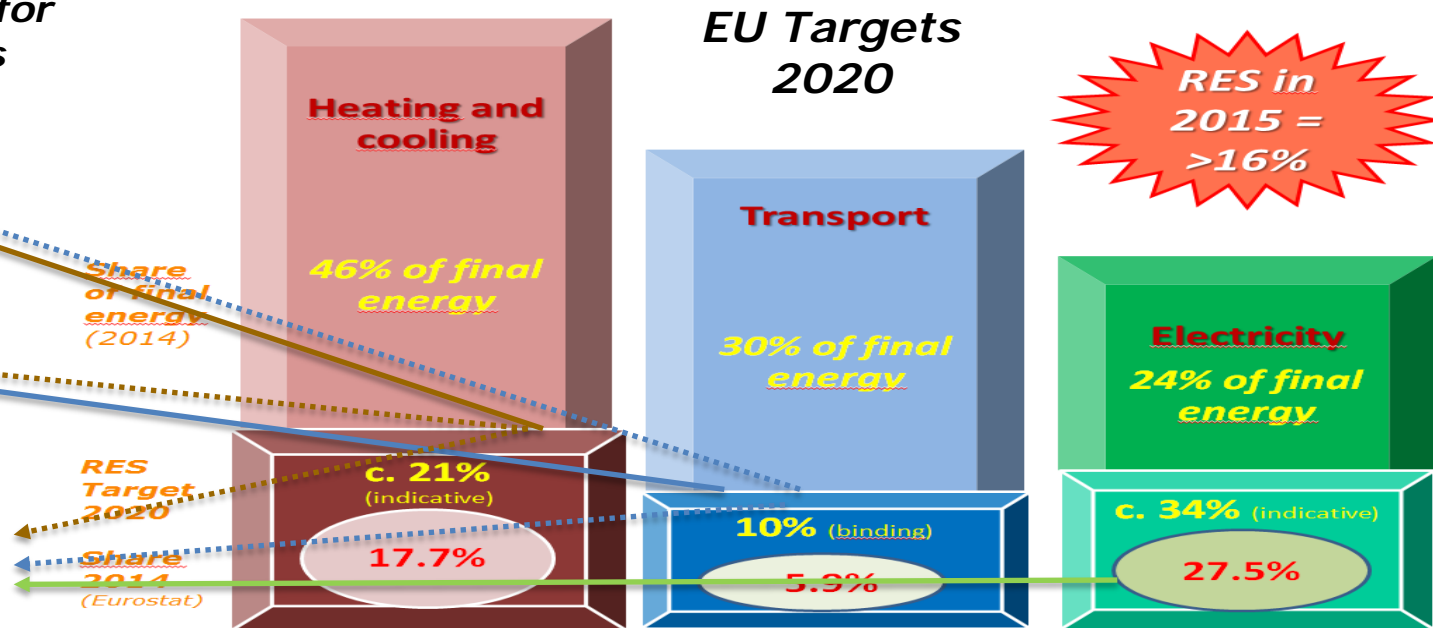
*A starting point for innovation regarding the gas chain*



# Renewable Energy Targets

A starting point for innovation regarding the gas chain

Main alternatives for renewable parts



# Renewable Energy Targets

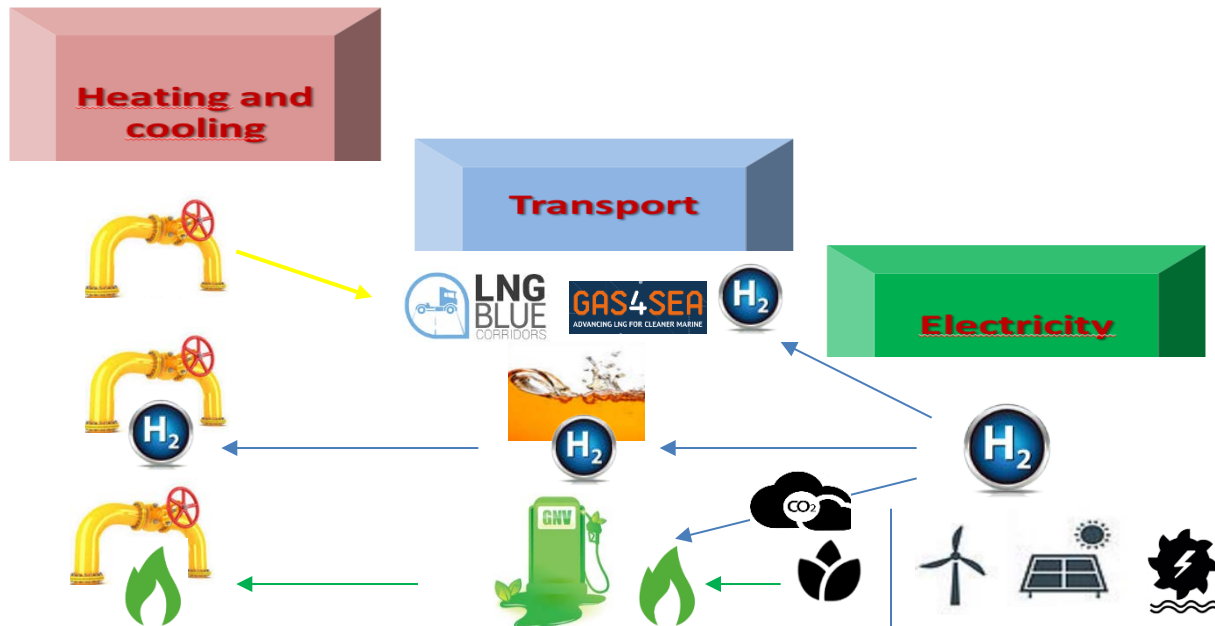
*A starting point for innovation regarding the gas chain*

## Main innovation ideas based on gas systems

*Increase gas in transport as a fuel alternative*

*Transform renewable electricity in renewable gases and liquids*

*Find new biogas production routes*



# *LNG based mobility*

*LNG for trucks and for ships*



# ENGIE and LNG stations for heavy vehicles

March 2016

ENGIE announces investment of 100 Meuros to develop LNG based refueling stations accross Europe





# ENGIE and LNG bunkering for ships

September 2016



**ENGIE, MITSUBISHI CORPORATION AND NYK LINE ANNOUNCE A NEW GLOBAL BRAND FOR LNG BUNKERING: GAS4SEA**

February 2017



**DELIVERY OF THE ENGIE ZEEBRUGGE, THE WORLD'S FIRST PURPOSE-BUILT LNG BUNKERING VESSEL!**



## *ENGIE and LNG bunkering for ships*

*October 2016*

ENGIE and CMA CGM signed an MoU that aims at developing the use of LNG as a fuel for tomorrow's container ships. CMA CGM is the 3rd biggest operator of container ships in the world with a fleet of 532 ships and it serves 160 countries.



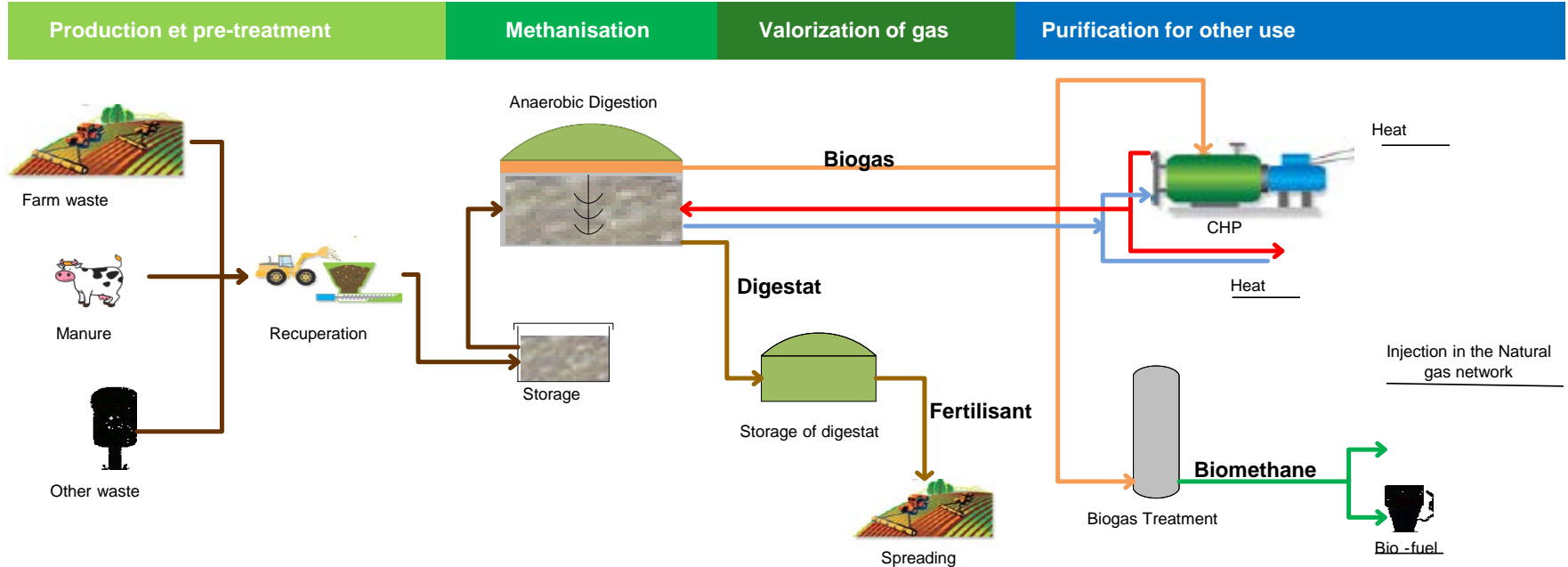
# ***Biomass to biogas***

*From wet biomass to dry biomass to get biogas*



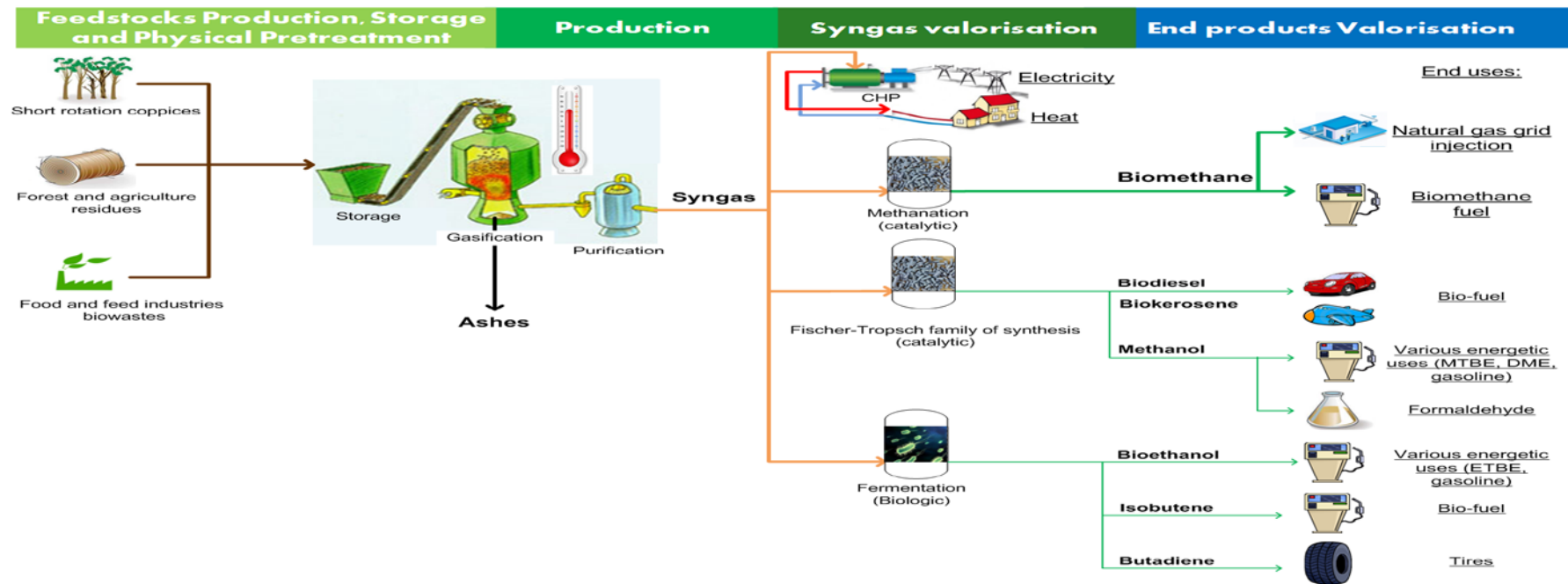
# 1<sup>st</sup> generation – biogas from wet biomass

Anaerobic digestion is the proven technology for biogas production. It can be then transformed into electricity, heat, or purified in biomethane.



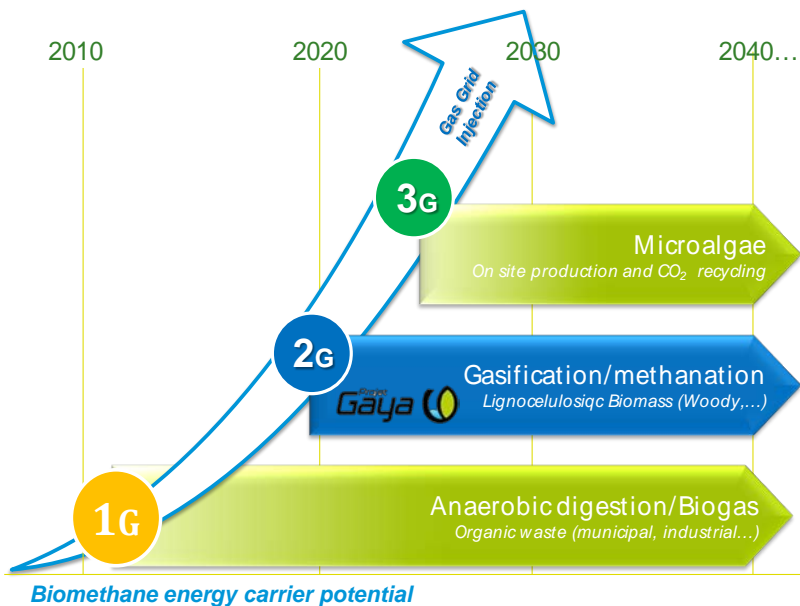
## 2<sup>nd</sup> generation : biogas from dry biomass

Gasification is one of the alternative technologies to produce a syngas which can be then transformed into biomethane or other products.



# Biomethane production technologies roadmap (France/EU)

## 3 Generations of technologies



R&D needs

+++  
Concept proof

++  
Pilot scale

+  
Available

### Technology Readdiness level of the Technology



Technical maximum potential  
2050

France Europe

23 TWh

257 TWh > 560 TWh  
~ 1000 plants

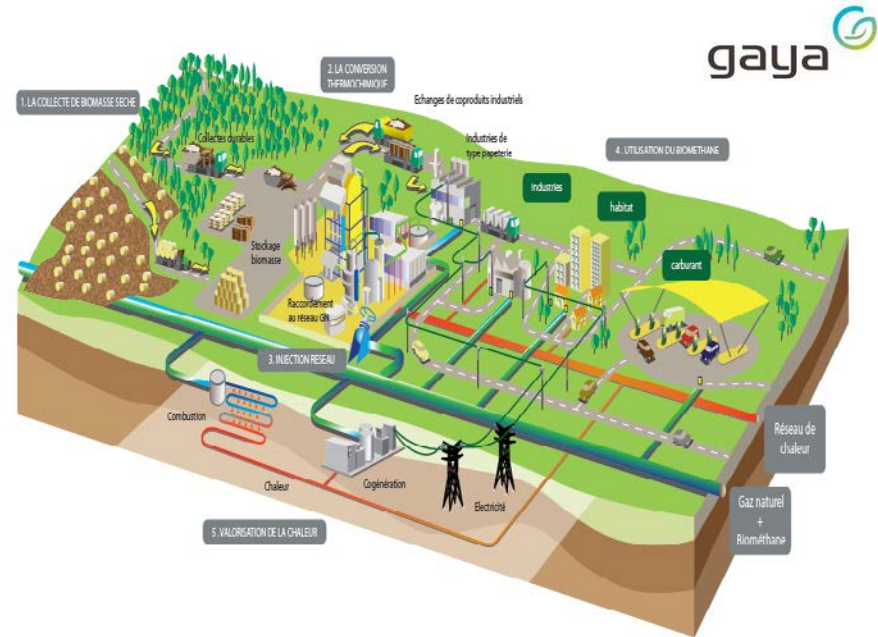
185 TWh > 500 TWh  
~ 20 000 plants



# GAYA R&D Project

biogas production with short supply from dry biomass & local heat valorization

- Biomethane plant size target : 20 à to 80 MW / 100 to 300 kt biomass
- Overall efficiency improved from 4 to 7% with a valorization of excess heat from methanation



# GAYA R&D Project

Enable the potential of 2G Biomethane via its industrialisation



20 to 60 MW<sub>bioSNG</sub>  
2 000 - 6 000 Nm<sup>3</sup>/h



400 kW<sub>bioSNG</sub>  
30 Nm<sup>3</sup>/h

gaya

# GAYA R&D Project

## Partnership



- A **major project** towards the energy transition  
**Turning Biomass into Green Gas**
- **60 M€ over 9 years including 18,7 M€ of subsidies** from ADEME
- One R&D demonstration platform with the **complete chain of conversion process**
- **11 Partners** involved

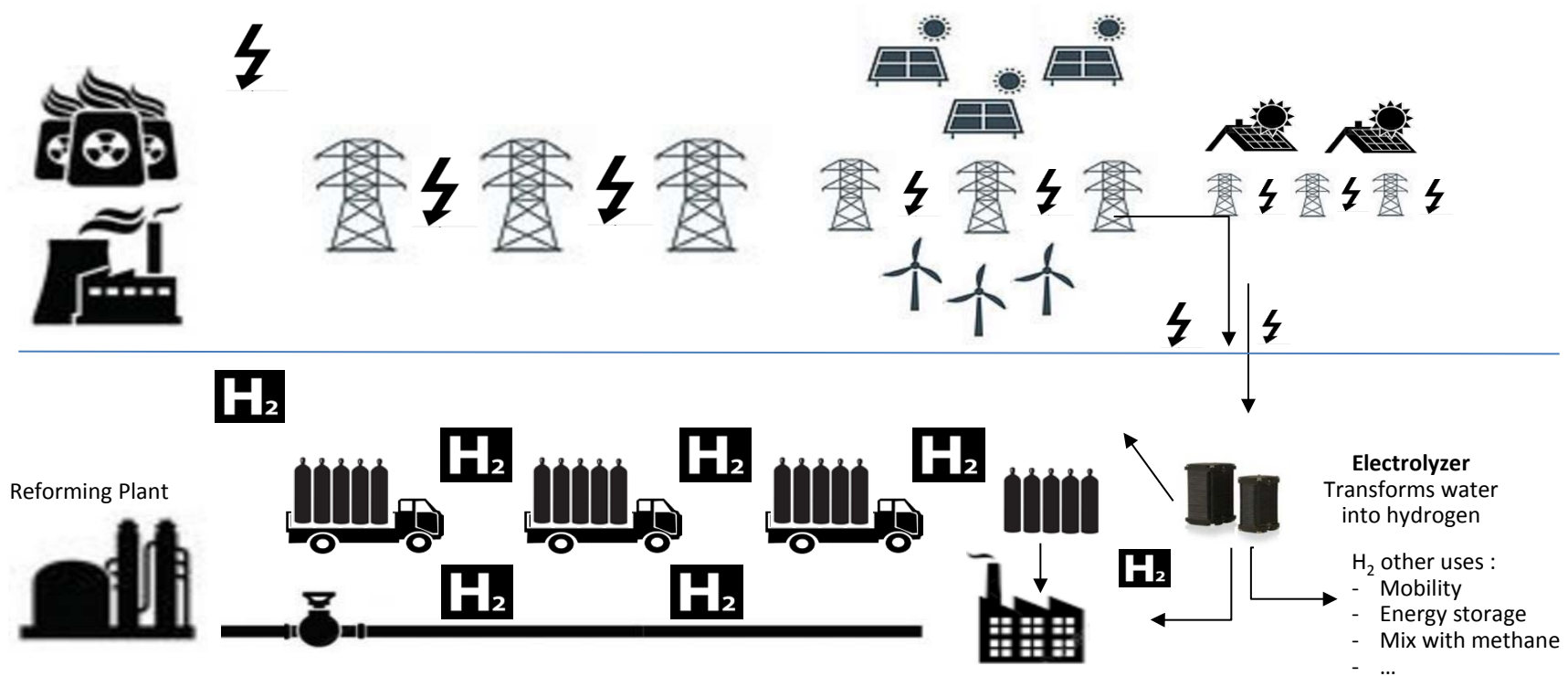


# Hydrogen Ecosystem

*A new economy around a new gas*



# The hydrogen chain is undergoing its own energy transition: towards a greener and more decentralized one





# *Hydrogen in gas pipelines*

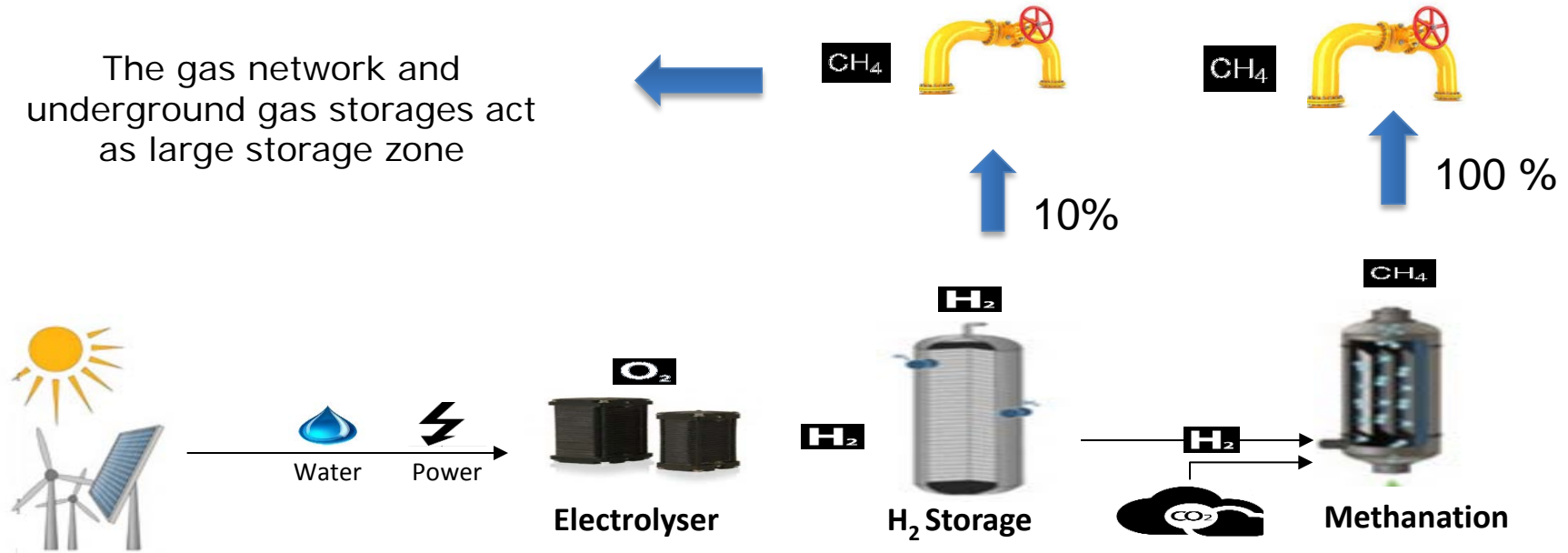
*Either injected directly or via the production of syngas*



# Hydrogen in gas pipelines

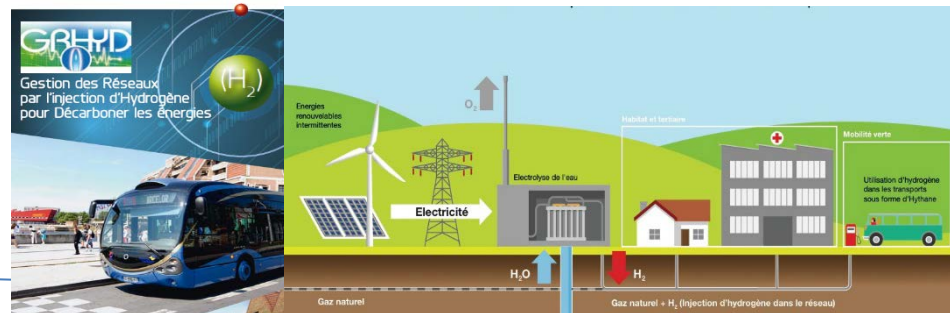
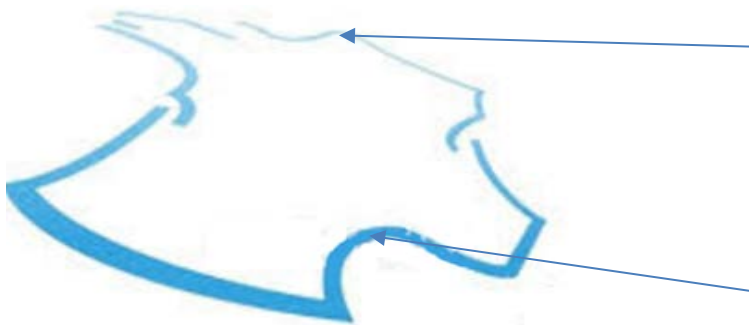
*Either injected directly or via the production of syngas*

The gas network and underground gas storages act as large storage zone

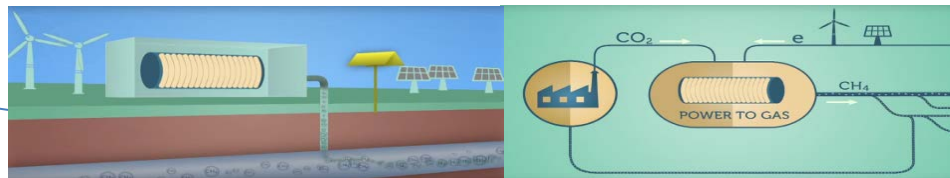


# Hydrogen in gas pipelines

ENGIE projects with partners



*Production of H<sub>2</sub> to mix it with methane and test it in urban applications (homes, buildings and mobility)*



*Production of H<sub>2</sub> for injection in the transport network and the production of methane from CO<sub>2</sub> emissions*

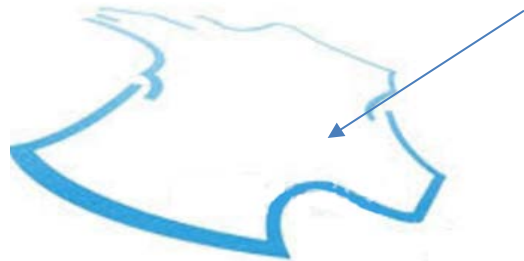
# *Hydrogen based mobility*

*Producing and using H<sub>2</sub> directly for mobility*



# Hydrogen based mobility

*ENGIE partner of the Hyway Project*



*Production of H2 for commercial / industrial use and local mobility*





# Hydrogen based mobility

ENGIE investor in SymbioFCell



French start-up which develops a technology from CEA with Michelin and ENGIE as industrial and financial partners :

- **A Fuel Cell Range Extender to equip BEV (Battery Electric Vehicles) allowing to double autonomy**
- Agreement with Renault to equip 2 BEV models: Kangoo ZE and Maxity
- Kangoo represents 30% market share on light duty vehicles in Europe



*Renault Kangoo ZE and Maxity*



# *Hydrogen for green fuels*

*Reducing the impact of fuel production on climate change*



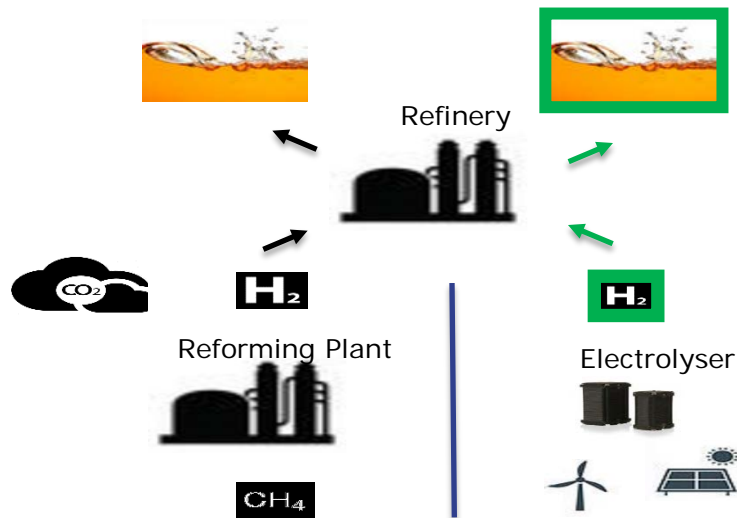
# Hydrogen for green fuels

Reducing the impact of fuel production on climate change

## Current uses of Hydrogen



Fuel are used as « storage » of wind and solar and thus reduce the emissions of cars



# *As a summary*

*Hydrogen is a new energy vector that allows to capture increasing intermittent energies to integrate them into existing gas and liquid energy systems, next to efforts to develop bio-gases and bio-liquids.*