

# H<sub>2</sub> Idrogeno

Hydrogen in the city – sustainable  
urban transport

EHA session at Sustainable Energy Week 2008



European Union 28 January → 1 February 2008  
**Sustainable Energy Week**  
2008



SUSTAINABLE ENERGY EUROPE  
2005-2008



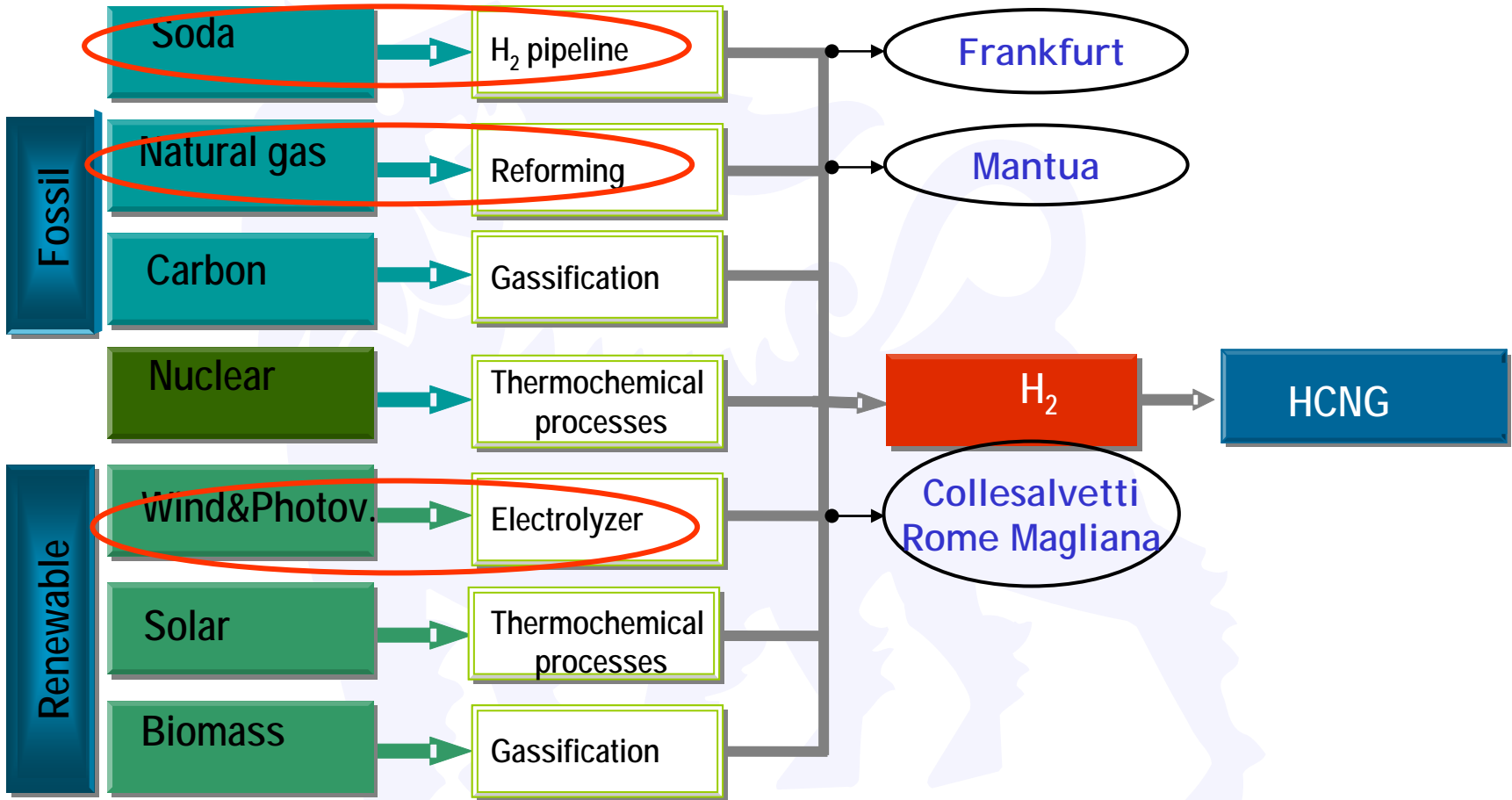


Eni, with the Agip brand, has a long track record in environmentally friendly technology:

- Liquid fuels with extremely low sulphur content (2003 – 2004)
- AdBlu for particle emission reduction in heavy transport (2006)
- Hydrogen from renewables (2006)
- HCNG (hydrogen – natural gas mix fuel, 2007-2008)

Eni is part of the **Dow Jones Sustainability World (DJSI)** and **FTSE4Good** indexes, which classify international companies based on sustainability.

# Eni H<sub>2</sub> technologies for transport





**Regione Lombardia**

Reti, Servizi di Pubblica Utilità  
e Sviluppo Sostenibile

# I PARTNERS

Regione Lombardia (Italia)

Comune di Mantova (Italia)

C.R.F. (Italia)

DaimlerChrysler (Germania)

Eni (Italia)

FPT (Italia)

Fraport AG Frankfurt Airport  
Services Worldwide  
(Germania)

Gruppo RAS (Italia)

Infraserv GmbH & Co.  
(Hoechst KG, Germania)

JRC (Italia)

Linde Gas Division (Germania)

Lunds University (Danimarca)

Roskilde University  
(Danimarca)

Sapio (Italia)

Saviko Consultants  
(Danimarca)

TÜV (Essen, Germania)

Università Commerciale  
Bocconi (Italia)



**Comune  
di Mantova**



**Regione Lombardia**

**Saviko  
Consultants Ltd**



# "Zero Regio" – Regions



5 class A

Open  
2006  
Frankfurt/M.



Mantova  
Open  
2007



3 Panda FC



GH<sub>2</sub> 350bar

## Zero Regio project: H<sub>2</sub> infrastructure and vehicle

GH<sub>2</sub> 700bar

Goal: Develop & demonstrate road transport systems for european cities based on H<sub>2</sub> as an alternative motor fuel.

Part of Zero Regio, EU RP6, Project-Coordinator: Infrserv Höchst

### H<sub>2</sub> Production / Sources

- Frankfurt: Byproduct of the Hoechst chemical plant
- Mantova: On site methane reformer

### Refuelling dispenser

- Frankfurt: liquid and gaseous hydrogen (350 and 700 bar), Photovoltaic (8 kWp), H<sub>2</sub> supply via High Pressure Pipeline (1000 bar)
- Mantova: gaseous hydrogen (220 bar)

### Fuel cell car fleet

- A-Class (Daimler-Chrysler)
- Panda (Fiat)

# Frankfurt Agip multiEnergy opening 2006



# Mantua Service Station



# Mantova – multifuel service station and H2 fleet

## Service Station

- liquid fuels, natural gas and gaseous hydrogen
- first italian service station with 350 bar hydrogen fueling pressure
- mini-fleet of three Fiat Panda, powered by fuel-cell, in use by the Comune of Mantova and Region Lombardia
- Fotovoltaic plant with ca. 20 kW peak power, estimated renewable energy production of 21.000 kWh/year.

## Fiat Panda Hydrogen

- PEM fuel cell (direct hydrogen)
- New air compressor
- Hydrogen tank in carbon fibre
- Fueling time <5 min
- Range 250 km



# Hydrogen plant at Mantova

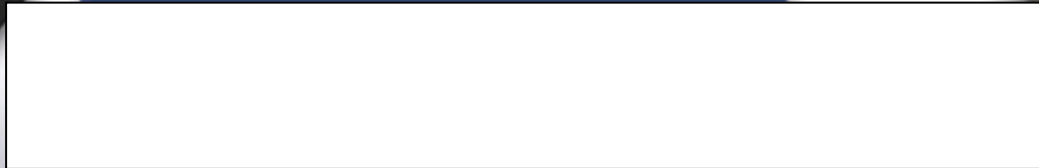
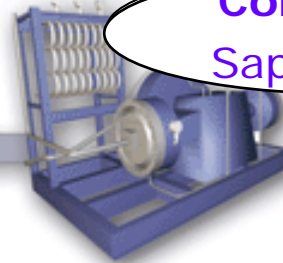
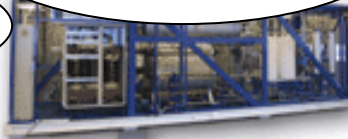
**Fuel cell vehicles**  
Fiat Panda

**Reformer**  
20 Nmc /h

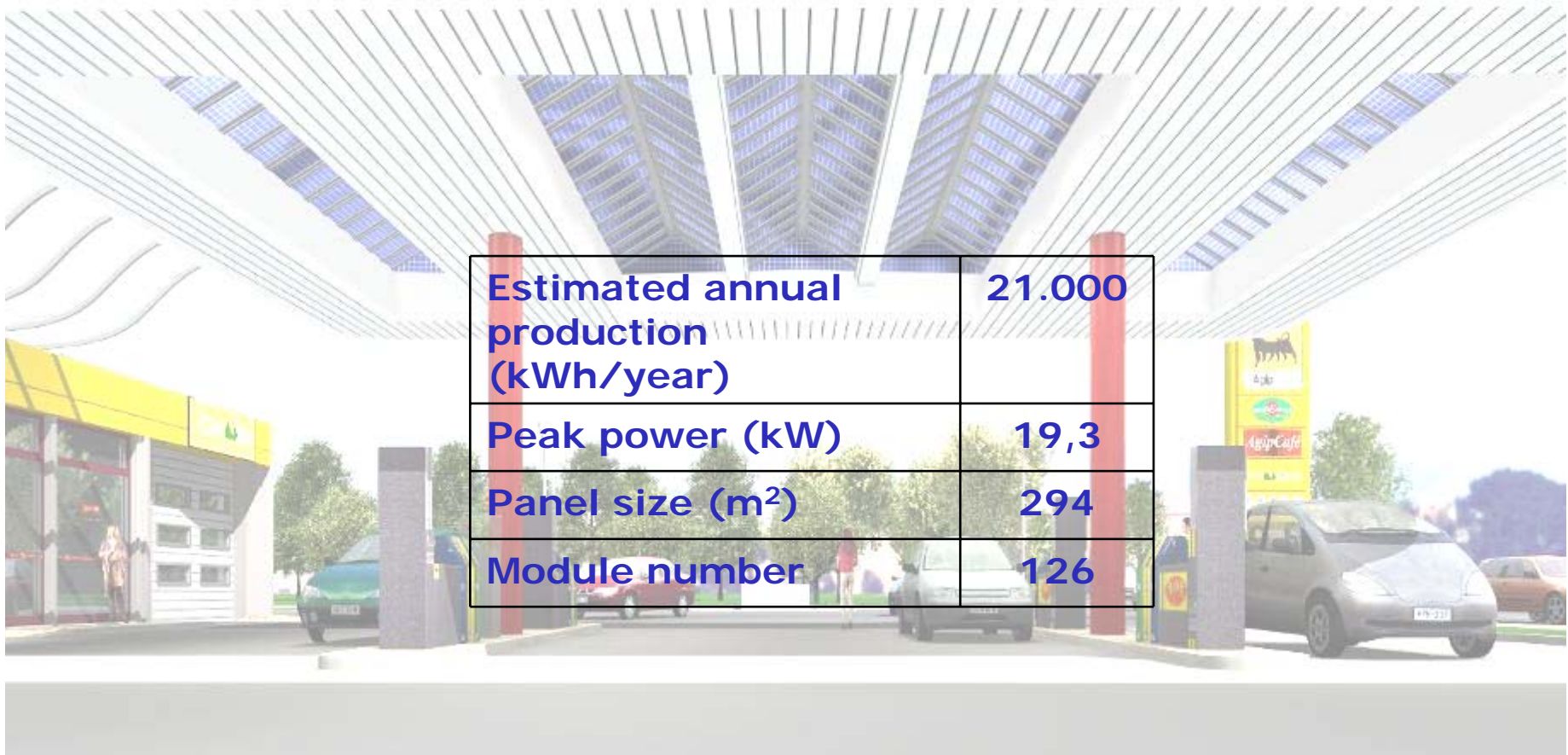
**Compressor**  
Sapio 420 bar

**Dispenser**  
350 bar

**Storage:**  
36 cylinders,  
82 liters each,  
at 420 bar  
(Sapio)



# Mantova Photovoltaic Installation



<b>Estimated annual production (kWh/year)</b>	<b>21.000</b>
<b>Peak power (kW)</b>	<b>19,3</b>
<b>Panel size (m<sup>2</sup>)</b>	<b>294</b>
<b>Module number</b>	<b>126</b>

# Mantova Service Station: opening 2007



# Mantua Agip multiEnergy opening 2007



# Italian HCNG Interregional Agreement

Italy created in 2008 the **Hydrogen Platform Fund** (€ 10 mln) to develop H2 technologies from renewables in transport, including **HCNG** applications.

## Italian competitive advantage:

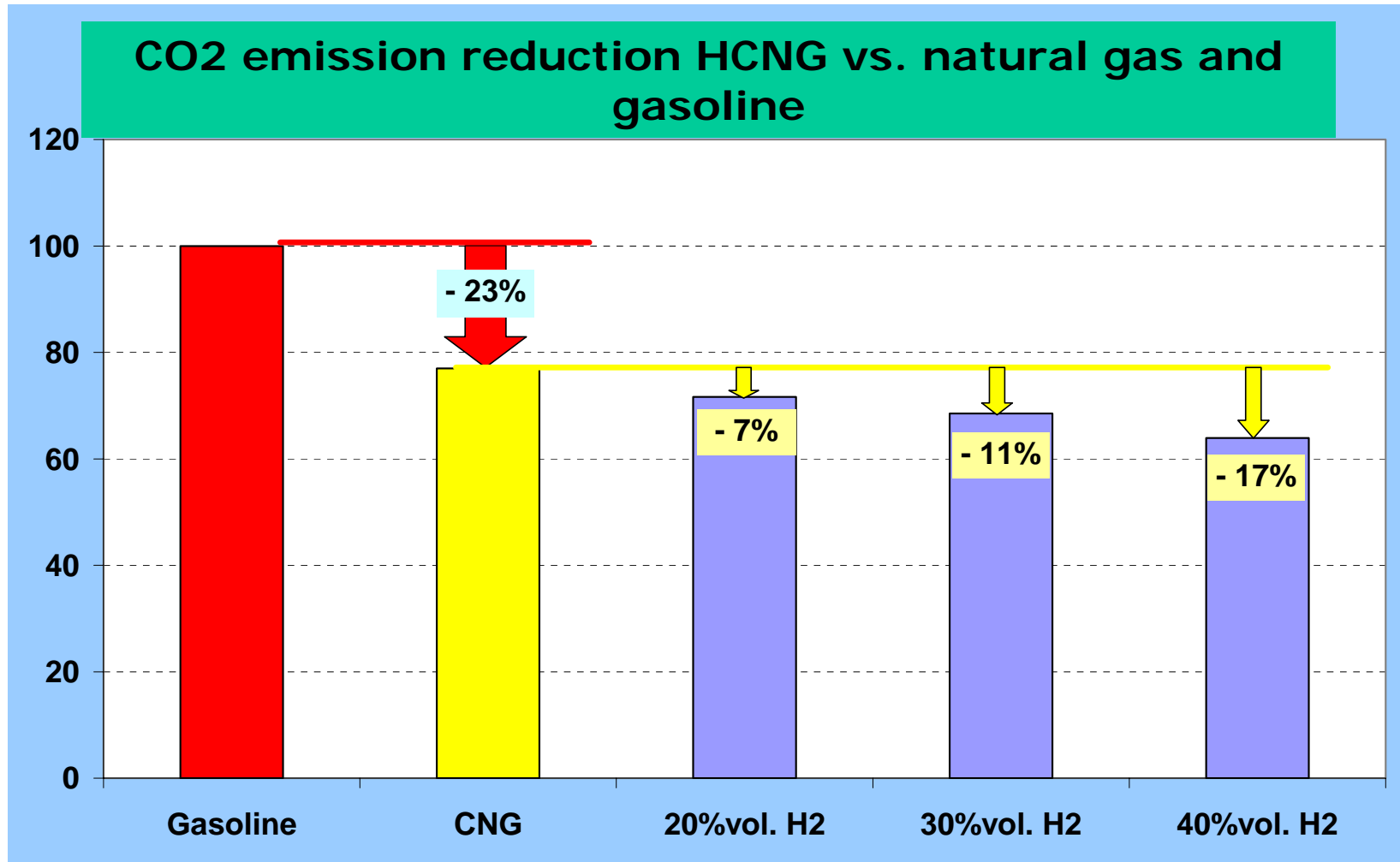
- the Fiat HCNG Panda vehicles (another 11% CO2 reduction from the already very low emission level of the Panda CNG)
- fast technological development in internal combustion engines for gaseous fuels (Fiat 2 cylinder high compression turbo engine)
- the Italian know-how in CNG technology since the 1920's, service station network (4<sup>th</sup> by size worldwide) and CNG vehicle fleet (ca. 400.000)



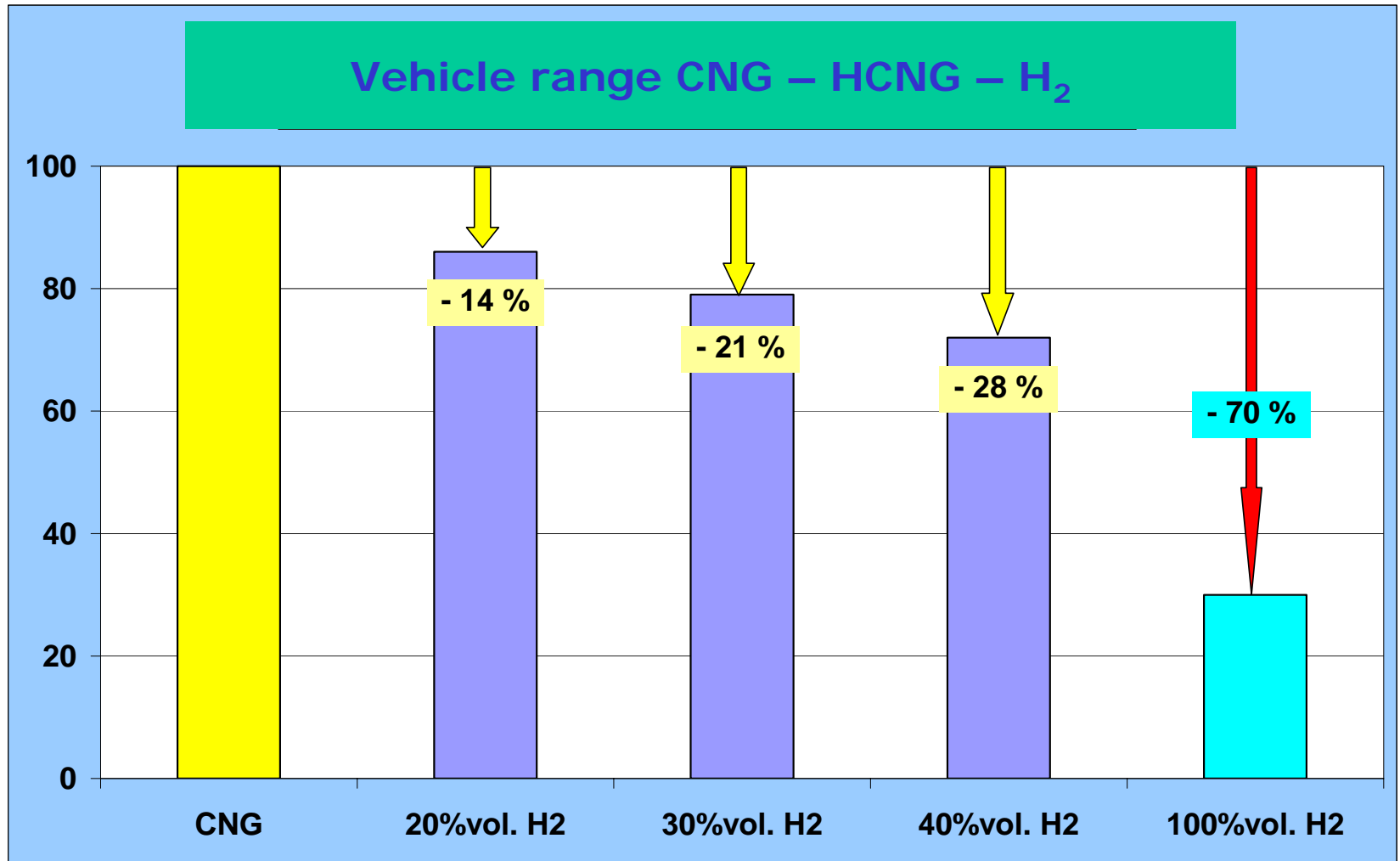
# Italian HCNG Interregional Agreement

## Action plan:

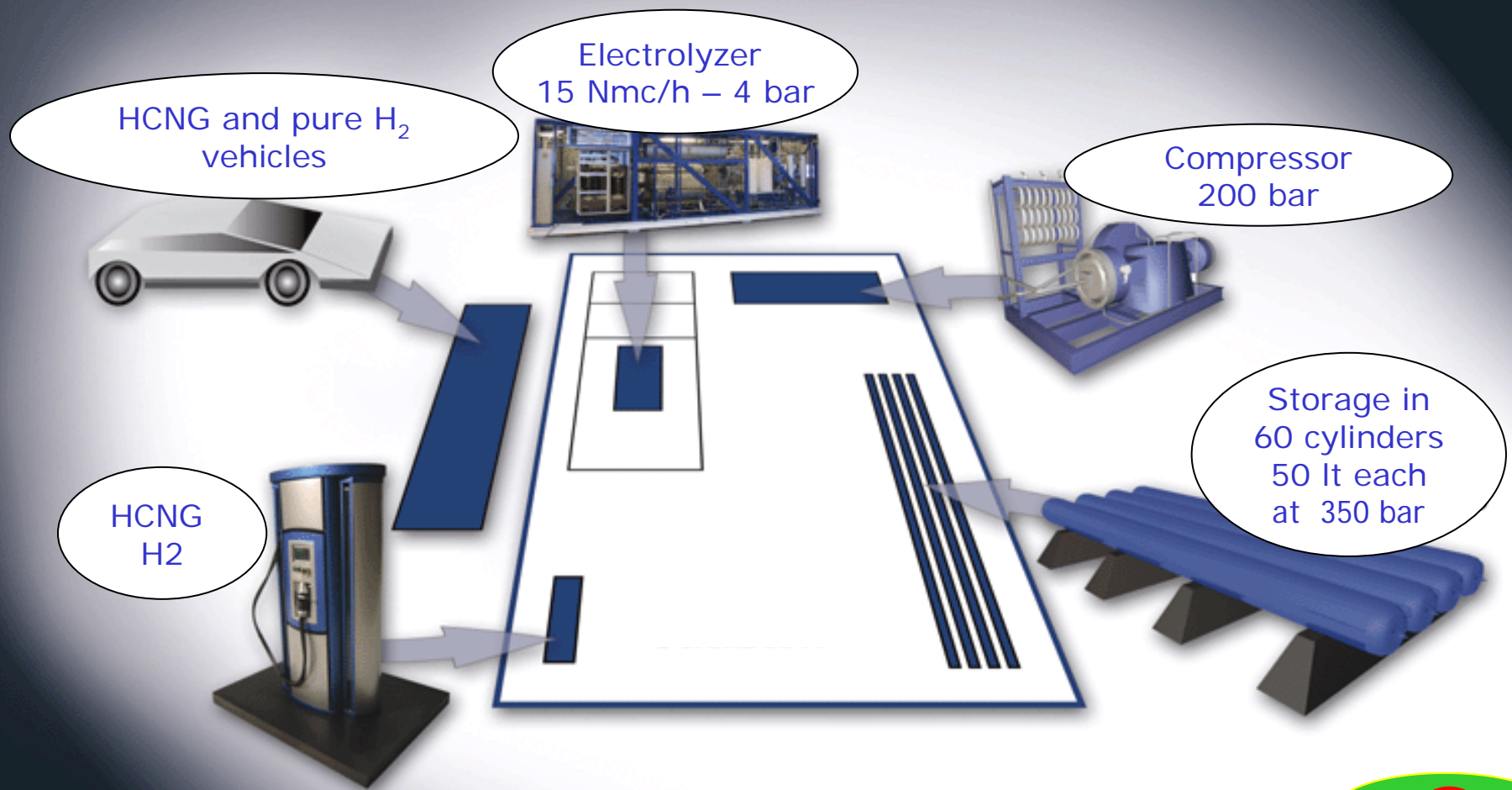
- Install in a series of Italian Regions Agip multiEnergy lighthouse stations for the fueling of HCNG and hydrogen powered vehicles
- Hydrogen production on site and with the contribution from renewables
- Develop hydrogen networks out of the actual lighthouse concept
- Put HCNG powered (30/70 % in volume) mini fleets on the road until fuel-cell technology becomes competitive
- Integrate distributed energy generation from renewables into the actual service station network, increase energy efficiency and savings through innovative technologies and materials



Source: Fiat Powertrain Technologies



Source: Fiat Powertrain Technologies



Power required for 1 Ncm of H<sub>2</sub>: 6,3 kWh



# Agip multiEnergy HCNG network development



2 SS



2 SS



4 SS



2 SS



2 SS



Our goal: build 10/12 HCNG service stations within two years

## The station

First station in Italy with a fuel offer of:

- liquid and gaseous fuels (Natural gas and LPG)
- Hydrogen-Natural gas mix fuel (30/70)
- Hydrogen (fuel cell quality level)

## Vehicle fleet

The Fiat HY Panda, powered by natural gas and HCNG, is an opportunity to make the first step towards the hydrogen economy. Other auto industry partners will participate in the Magliana H2 lab.

HCNG availability opens the field in a second step also for aftermarket conversions and the actual CNG fleet.

## Outlook

Open the Italian interregional partnership to european partners to develop HCNG solutions.

# Magliana Nord Service Station

Verso una mobilità a zero emissione





At Magliana Nord BMW installed temporarily a mobile Linde liquid hydrogen refuelling station for a fleet of six **Bmw Clean Energy series 7** 12 cylinder, 6 litre internal combustion vehicles. Liquid hydrogen is stored on board at  $-253^{\circ}\text{C}$  (20 K) using a low pressure cryogenic tank.

The vehicles were used as shuttles during the Rome Film Festival and the WEC (11-15 november 2007), demonstrating the actual workability and public enthusiasm for hydrogen in an high level internal combustion engine.

# Mobile LH<sub>2</sub> service station



- European standards and guidelines for H<sub>2</sub> distribution and storage
- European standards for hydrogen and mix fuel vehicle homologation and street use (actually in development)
- Safety standards with building provisions that allow for physical protection instead of distance in urban context
- Self service in Italy also for customers of gaseous fuels to deliver better refueling possibilities while the station network will be limited
- Definition of the fiscal treatment of H<sub>2</sub>
- The standard natural gas connector shall be used also for HCNG fuelling