TOWARDS THE HYDROGEN ECONOMY

THE ITALIAN VISION

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Italian Ministry for Environment and Territory

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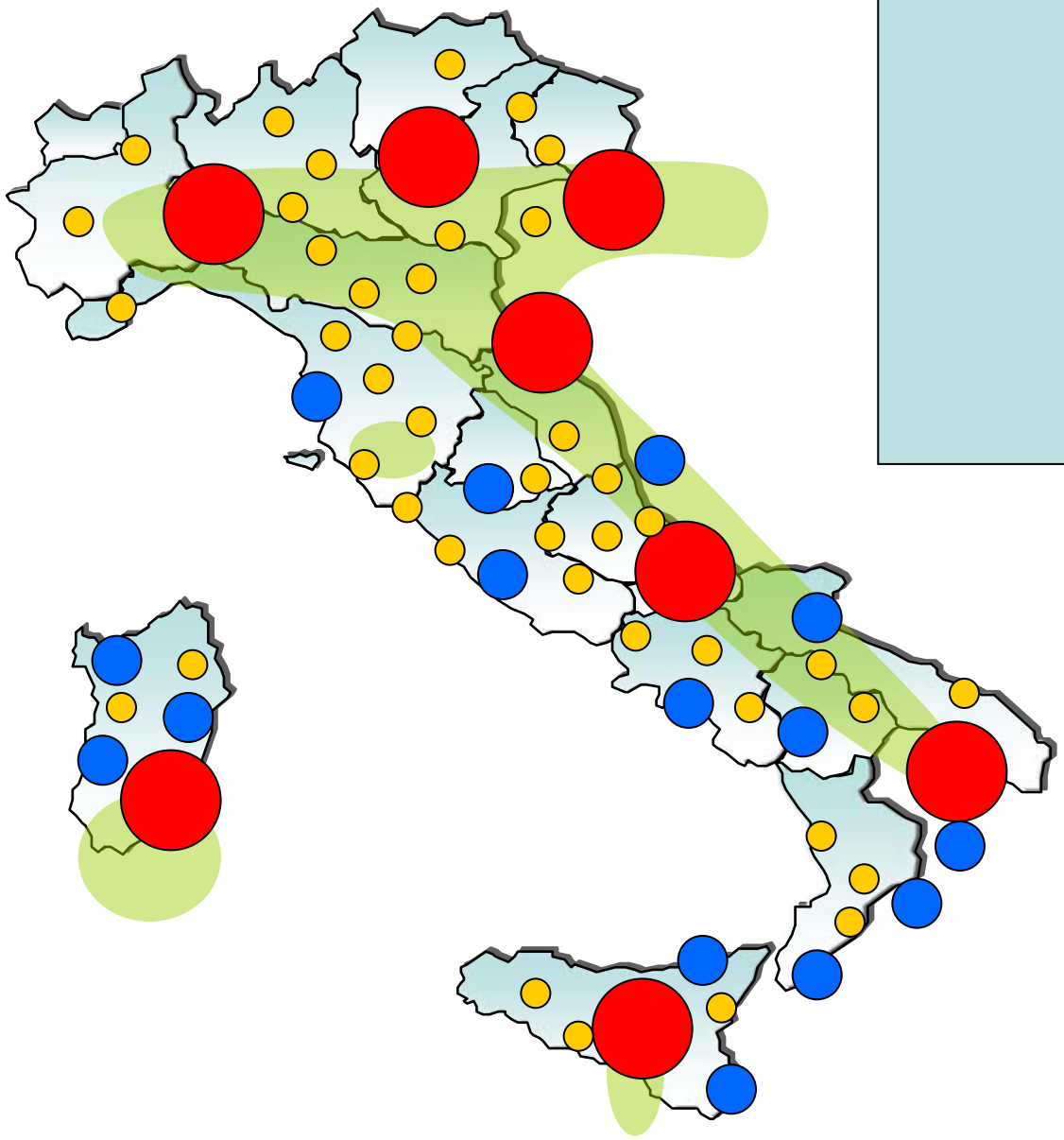
ITALY
H_2 Vision



Possible sites for CO_2 geological sequestration

Hydrogen Hub
Fossil Fuel based

Hydrogen Hub
Solar Energy based

Hydrogen Hub
Biomass based

Hydrogen Hub Fossil Fuel based

Power generation
560 MW

Coal

Oil

Gas

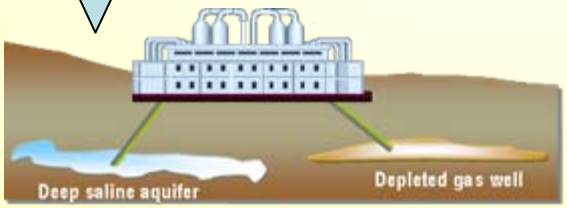
Hydrogen vehicles
2500 buses
25000 cars

H_2

Hydrogen production plant

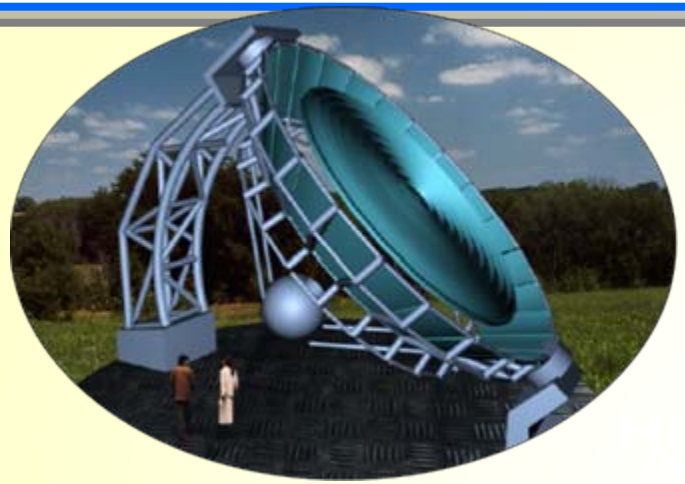
Distributed
generation
240 MW

2.3 ÷ 2.7
Mt /year



CO_2 sequestration

Solar Energy based



Solar production plant

Hydrogen vehicles
1350 buses
13500 cars

H_2

Distributed generation
50 MW

Solar thermal HT
Photolysis LT

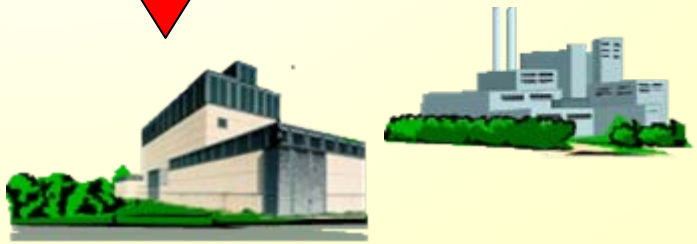
Hydrogen from biomass and wastes

Hydrogen production plant
Gasification/Fermentation

Hydrogen vehicles
250 buses
2500 cars

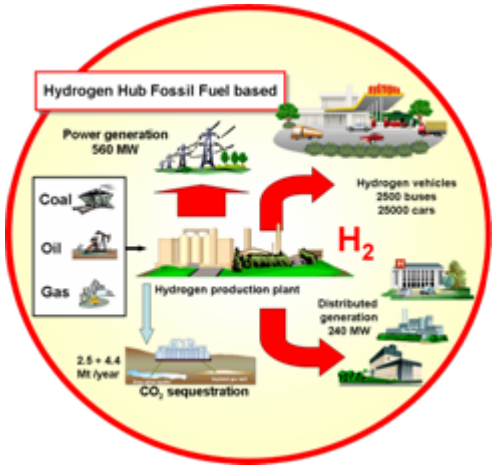
H_2

Distributed
generation
10 MW



Biomass
Municipal wastes
Industrial wastes

Avoided CO_2 for each hydrogen hub



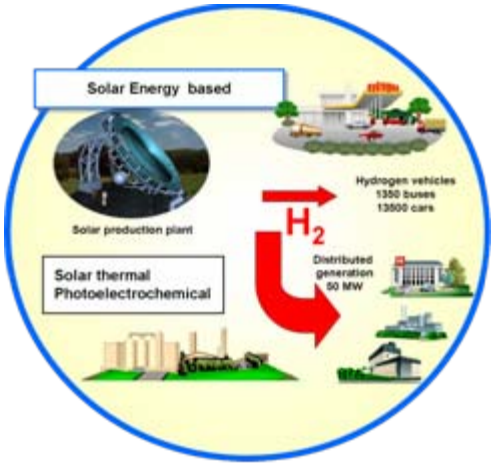
Fossil Fuel Hydrogen Hub

Installed electric power 800 MW

Vehicles **~ 2,500 buses**

~ 25,000 cars

2.3 – 2.7 million ton CO_2/year



Solar Hydrogen Hub

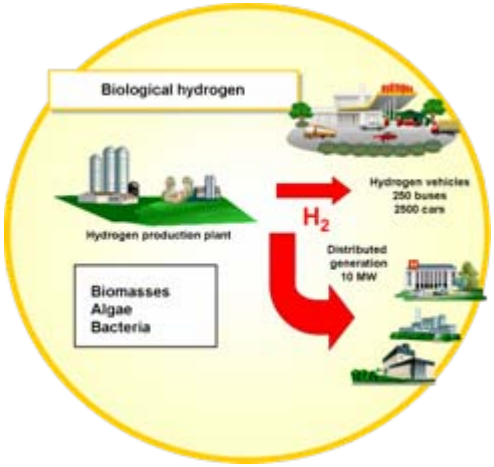
Installed electric power 50 MW

Vehicles **~ 1,300 buses**

~ 13,000 cars

0.3 million ton CO_2/year

Avoided CO_2 for each hydrogen hub



Biomass Hydrogen Hub

Installed electric power 10 MW

Vehicles ~ 250 buses

~ 2,500 cars

50,000 ton CO_2/year

Summary		
Fossil hub	**2.3-2.7**	**Mton/year**
Solar hub	**0.3**	
Bio hub	**0.05**	

Hydrogen Economy cannot be developed by itself

Evolution of energy vectors from 1850 up to date

Experience on hydrogen as an “alternative” energy source in 70s was negative

Why hydrogen comes out again?

Barriers to the market

Therefore transition towards hydrogen economy should be fostered

Hydrogen from Fossil Fuels
Critical steps

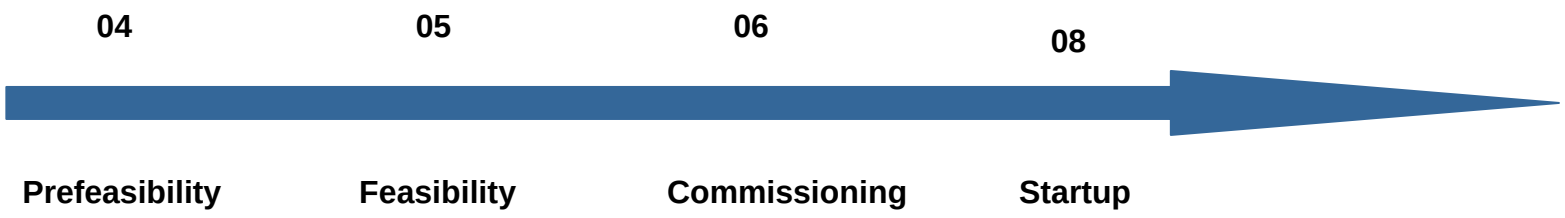
CO_2 SEQUESTRATION

- ***Depleted gas wells***
- ***Deep saline aquifers***

Demonstration program

Actions

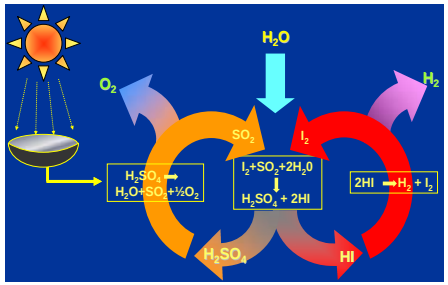
- **Geological survey**
- **Demo plant testing**
- **Long term behavior modeling**
- **Monitoring technologies**



SAFETY, CODES AND STANDARDS

Hydrogen from Solar Energy
Critical steps

Thermochemical cycles



Basic Research

Pilot plant development

Hydrogen production pilot plant

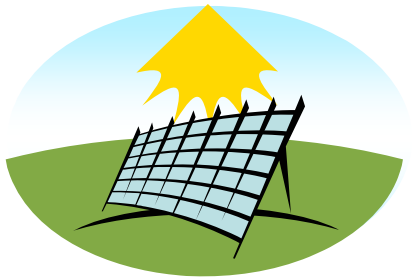
H_2

Stationery Transportation

Demonstration

Best technologies

Photolysis processes



- ***Basic research for catalysts***
- ***Development of photoreactors***

SAFETY, CODES AND STANDARDS

Hydrogen from biomass and wastes
Critical steps

Gasification of carbon-containing wastes and biomass

Technological development ⟹

Hydrogen production pilot plant

Direct fermentation of organic materials to H_2

Basic Research ⟹

Lab-scale test

Hydrogen utilization
Critical steps

Turbogas	**Trials on pilot and commercial units**
Stationary Fuel Cells	**Demo for distributed generation**
	Logistics
Automotive Fuel Cells	**Demo for city buses and dedicated cars**
	Basic for onboard storage
	Logistics

2004-2011

Economics
The most critical issue

Goal : CO_2 mitigation

(Improvement of air quality)

Hydrogen can be the least expensive solution, but……
…. the present market rules don't allow the exploitation of such a way

New market rules and public acceptance

are needed!

International partnership has a key role!

ITALY IS A STEP HAED

- ITALY HAS A LONG EXPERIENCE IN NATURAL GAS (LOGISTICS, GASTURBINE, AUTOMOTIVE, INDUSTRY, HEATING)
- ITALY HAS THREE UNITS ALREADY ONGOING BASED ON TAR GASIFICATION FOR SYNGAS AND POWER GEN THROUGH COMBINED CYCLE
- SALINE ACQUIFERS COULD PROVIDE A LONG TERM CO2 STORAGE