

Automobile industry and Hydrogen economy



RENAULT

The Renault – Nissan approach

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Paris 28th January 2005

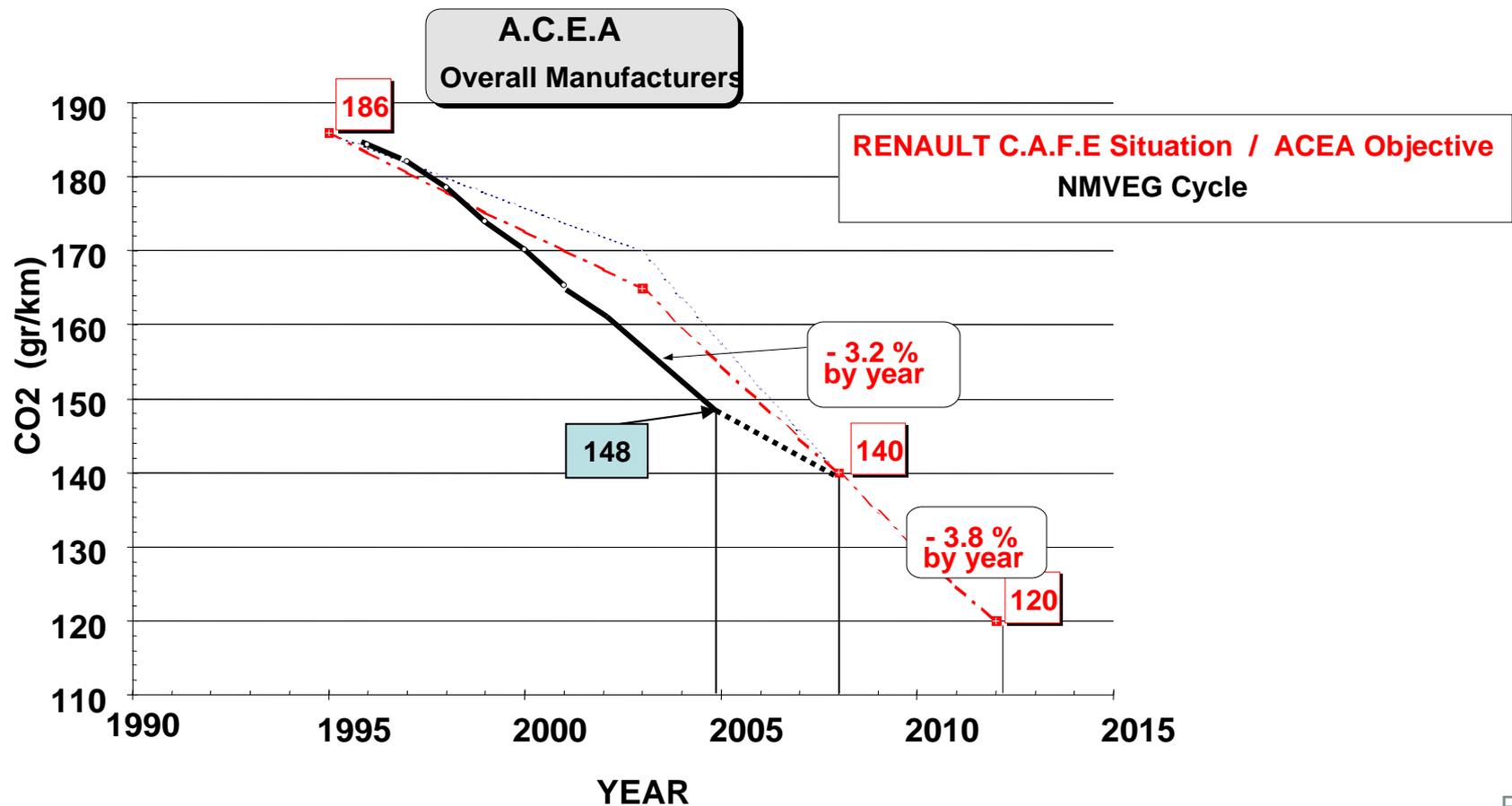


The main challenges in energy area (Europe)

- ❖ Elimination of pollutants: Euro V / sulev ~2010/2012
- ❖ Reduction of CO2 emissions
 - 140g/km in 2008 (TTW)- commitment with EC
 - 120g/km in 2012? (TTW)- in negotiation
 - 45g/km in 2050 (WTW)- asked by French Govt
- ❖ Alternative fuels: 20% in 2020 (EC)
- ❖ Renewable fuels



Reduction of emitted greenhouse gas (CO₂)





Is hydrogen an accurate solution?

Renault and Nissan say **Yes**

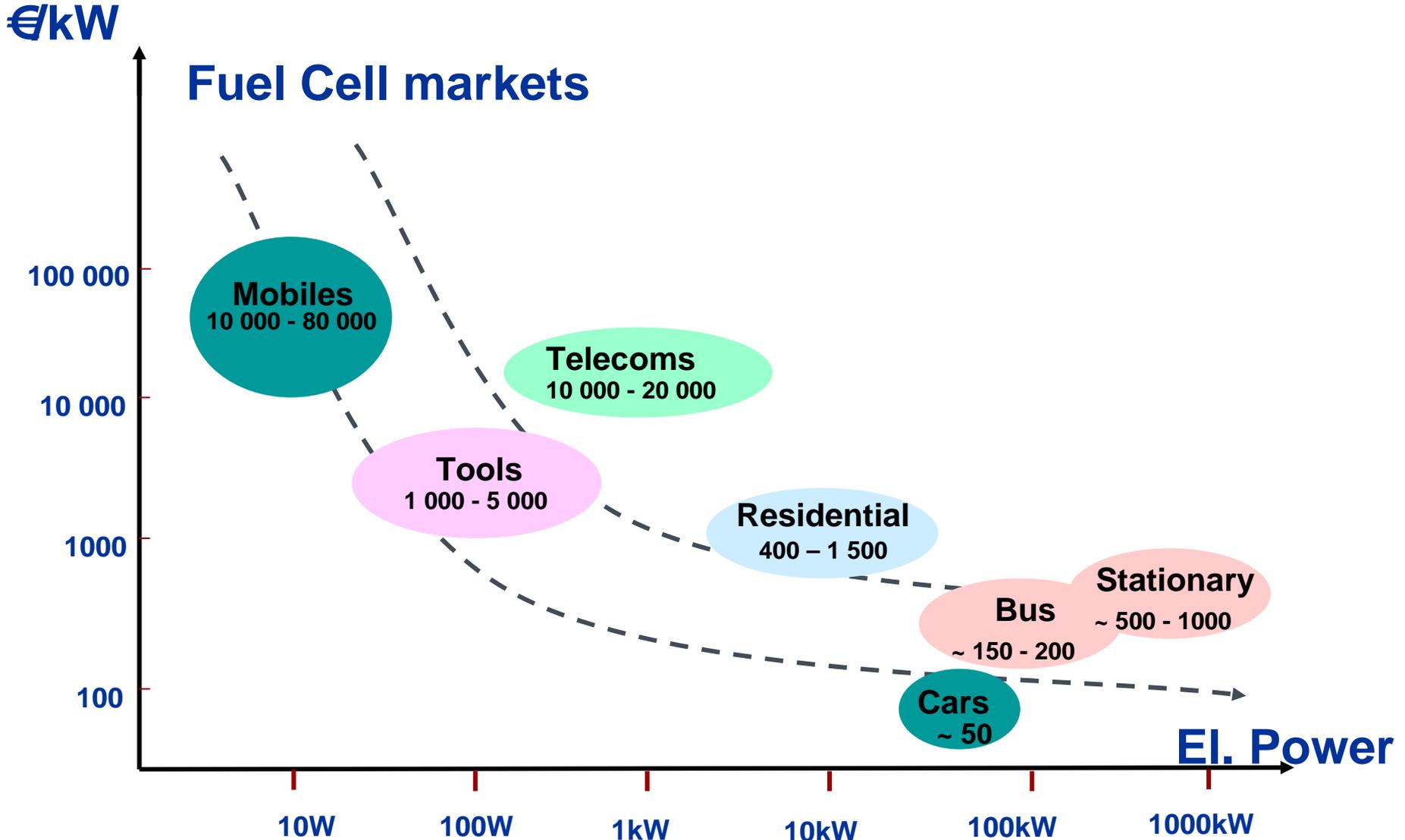
But:

- ❖ **Operating by fuel cell**
- ❖ **Using pem technology**
- ❖ **A big research effort to be done before the first commercial application**



The main difficulties to overcome

- ❖ To supply hydrogen
- ❖ To store H₂ on board (range > 500km)
- ❖ To increase fuel cell efficiency (> 50%)
- ❖ To increase the durability (> 5000 hours)
- ❖ To become cost competitive (< \$50 / kW)
- ❖ To develop an hydrogen / fuel cell industry





Renault - Nissan strategy

❖ **Two ways for hydrogen supply to stack:**

Direct

On board reformer

❖ **Strong involvement in national and international programs**



Renault - Nissan strategy

Nissan leads a direct hydrogen fuel cell program:

- ❖ **Involved in California demonstration program**
- ❖ **Involved in the Japanese public funded programs**
- ❖ **Develops an in-house stack**



Nissan





Direct hydrogen fuel cell

The main problems to solve :

- ❖ **H₂ production without CO₂ emission**
- ❖ **H₂ distribution**
- ❖ **stack: efficiency, durability, cold start, cost**
- ❖ **On-board storage at 700 bars (min. 150l)**



Renault - Nissan strategy

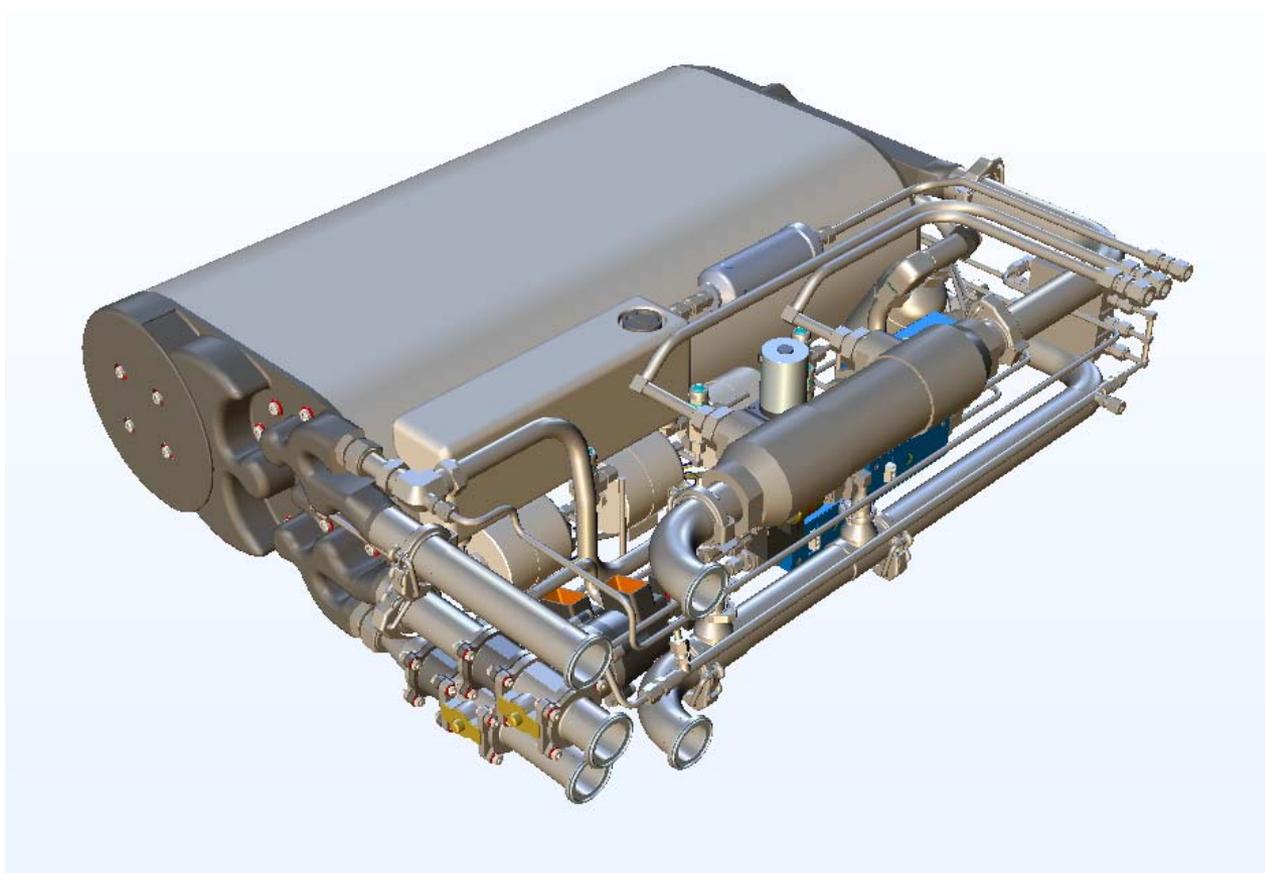
Renault leads a fuel cell program

with on-board fuel processor

- ❖ **Research organized in partnerships with potential suppliers and laboratories (EU and USA)**
- ❖ **Involved in public funded projects (F and EU)**



Reformer Renault-Nuvera: 70kW / 80l

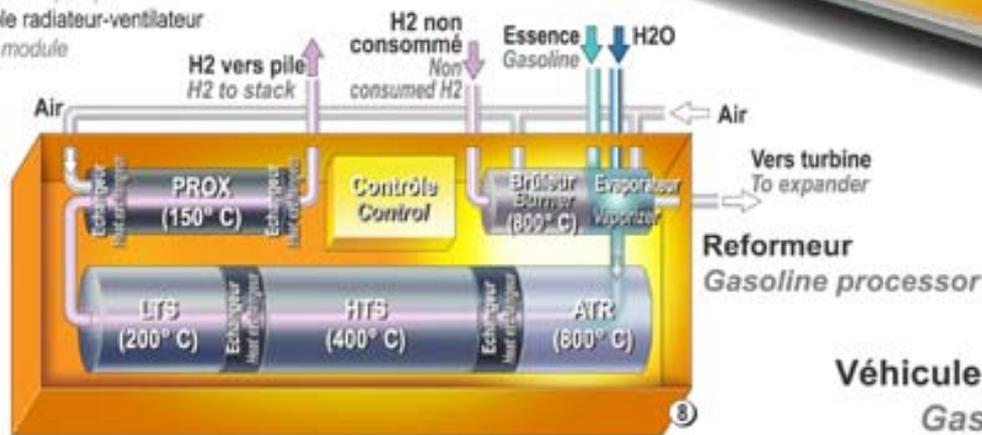
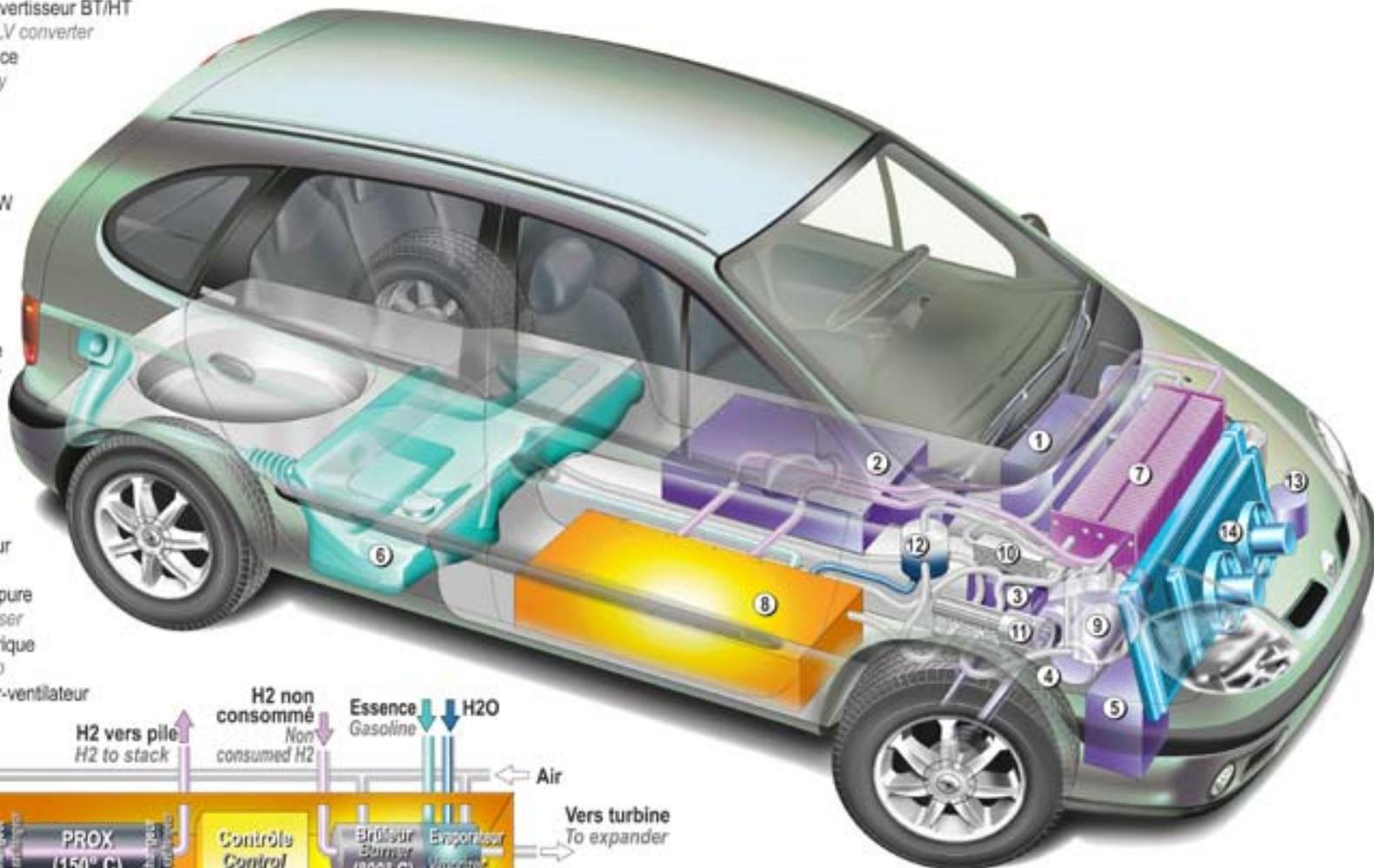




FEVER



- ① Batterie 42 V + convertisseur BT/HT
42 V battery + HV/LV converter
- ② Batterie de puissance
High voltage battery
- ③ Onduleur
Inverter
- ④ Moteur électrique
Electric motor
- ⑤ Convertisseur 15 kW
15 kW converter
- ⑥ Réservoir essence
Fuel tank
- ⑦ Pile à combustible
Fuel cell stack
- ⑧ Reformeur essence
Gasoline processor
- ⑨ Filtre à air
Air filter
- ⑩ Refroidisseur d'air comprimé
Intercooler
- ⑪ Ensemble turbine-compresseur
Air module
- ⑫ Condenseur d'eau pure
Pure water condenser
- ⑬ Pompe à eau électrique
Electric water pump
- ⑭ Ensemble radiateur-ventilateur
Cooling module



Véhicule pile à combustible essence
Gasoline Fuel Cell Vehicle



La pile pour la traction : 70 kW



The strategy of Renault

Three steps strategy:

I - 1999-2000 definition of the main challenges

- ❖ Fever prototype
- ❖ cooperation with PSA
- ❖ public funded research program (PaCo)

Results: identification of the technical barriers
 agreement on the targets
 roadmaps



The strategy of Renault

New factor:

Alliance (Renault-Nissan) program

II - 2001-2004 new technologies for each part

- ❖ System approach by models
- ❖ Research on high temperature membrane
- ❖ New multifuel reformer with Nuvera



The strategy of Renault

III – 2004-2008 integration phase

❖ **Experimental program: Respire (public funded)**

- 1 – association of reformer and stack
- 2 – complete power train on the bench
- 3 – complete system into the vehicle

Main partners:

3M France / Total / Snecma / Inria / Armines

❖ **Technological program to improve:** cost
durability
efficiency



The strategy of Renault

At the national level:

- ❖ Renault is involved in the new national program: PAN-H
 - H2 production by high temperature electrolysis
 - H2 distribution by gas network
 - the power plant

At the European level:

- ❖ Renault contribute to several projects in the 6th framework

program

- ❖ We are actors of the European technological platform to prepare the 7th FWP



The strategy of Renault-Nissan

Automotive roadmap:

- 2008 mainly research

2008 – 2012 APU / niche applications

2012 – 2015 limited fleets

2015 - start of mass production



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The main challenges in energy area

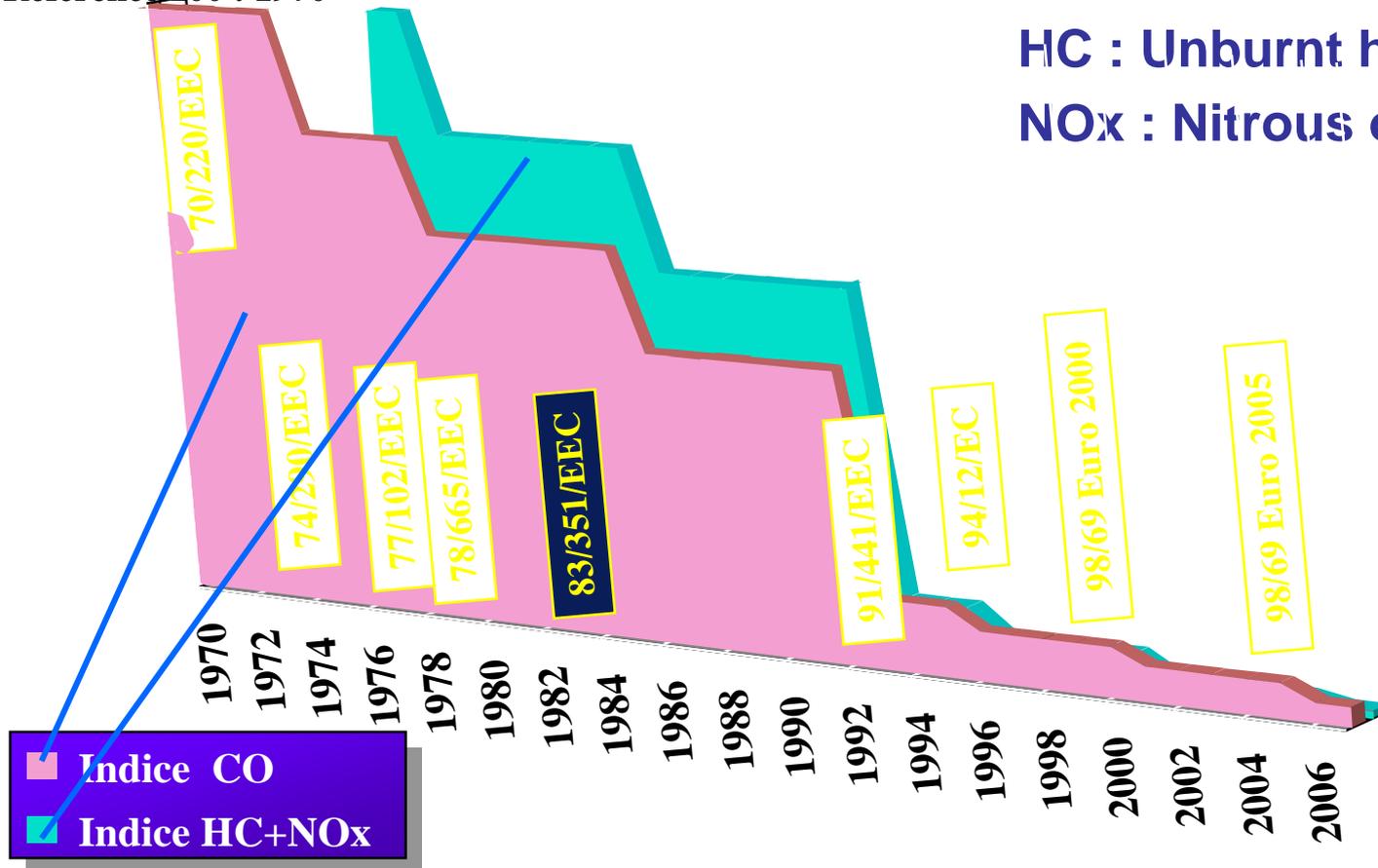
Traditional technology adress pollutants emissions :

Reference 100 : 1970

CO : Carbon Monoxide

HC : Unburnt hydrocarbons

NOx : Nitrous oxides

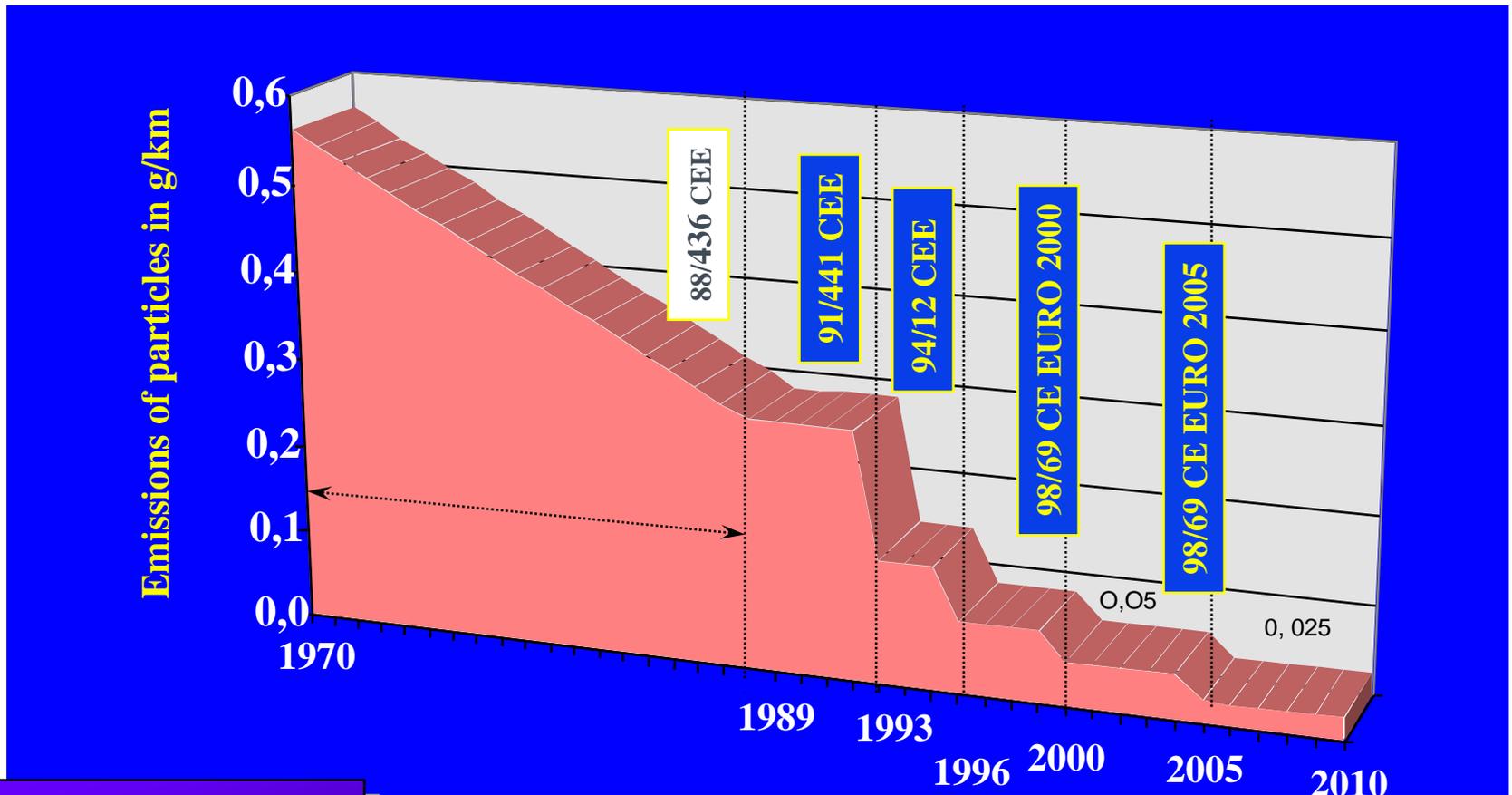




The main challenges in energy area

Traditional technology adress pollutants emissions :

p.m. : particulate matters (g / km)



■ particles in g/km