# The costs of the transition to low-carbon mobility in France

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The results presented here come from the study « Décarbonation du parc automobile français à horizon 2040 » realized by the CEA and IFPEN for the Office OPECST of the French Parliament

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# Objectives

"In-depth and forward-looking study that would make possible to implement technological scenarios aimed **at achieving the target set for the 2040 deadline** (i.e stop sales of Personal Vehicles with greenhouse gas emissions)“

**For doing that:**

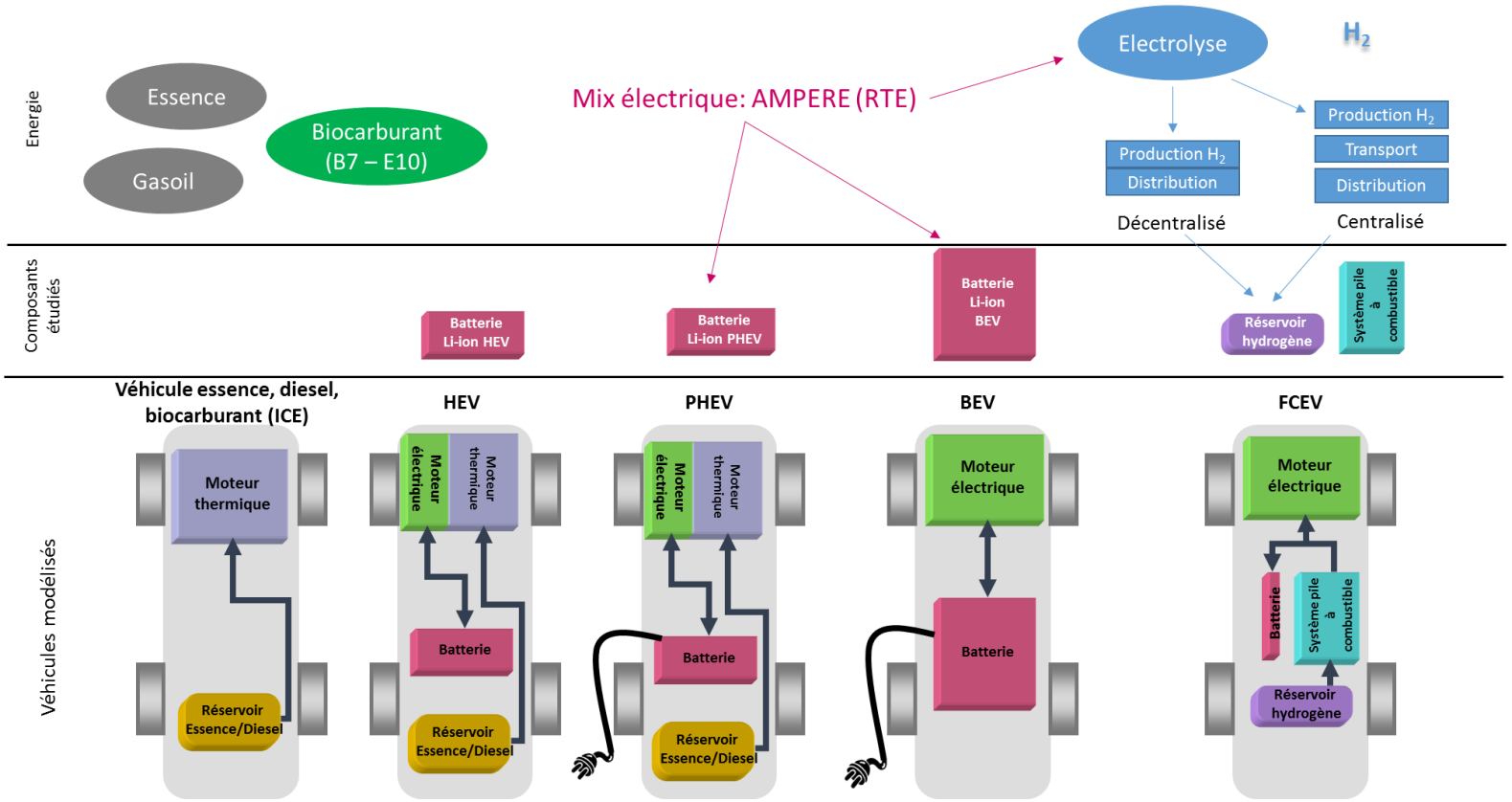
- Technological foresight Vehicle approach and components
- Main actors strategies (focus on batteries & fuel cells)
- Infrastructure for electric mobility and H2

➔ State of the art on mobility, technology, changes in the electricity mix

- **Three scenarios: Median, Pro-battery, Pro-H2**

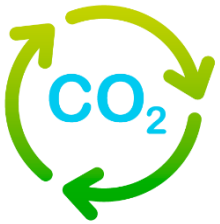
Technological vision (all other things being equal on mobility behavior)➔ Evolution of vehicle prices + economic context (in particular fiscal) ➔ Modeling (with Times) ➔ fleets ➔ **Economic impacts**

# New vehicles




HEV: Hybrid Electric Vehicle
PHEV: Plug-in Hybrid EV
BEV: Battery only EV
FCEV: H2 Fuel Cell EV

# Three scenarios




## Median

- AMPERE (RTE) electricity scenario (up to 2035)
- 46% nuclear / 50% ENR by 2035
- Reasonable R & D Progress on **Batteries and Fuel Cells** ➔ Reduced Associated Costs
- Increase of the **carbon tax** ➔ 100 € / t in 2030 and 141 € / t in 2040 ➔ Continued increase in prices of thermal vehicles

## Pro-batteries

- Assumptions identical to the Median scenario
- Accelerated R & D on **batteries** ➔ 50% further cost reduction in 2030


## Pro-hydrogen

- Assumptions identical to the Median scenario except for the **fuel cell price** ➔ 65% additional reduction in 2040 and **H2 price** ➔ 40% additional reduction in 2040
- Greater purchase assistance for the FCEV

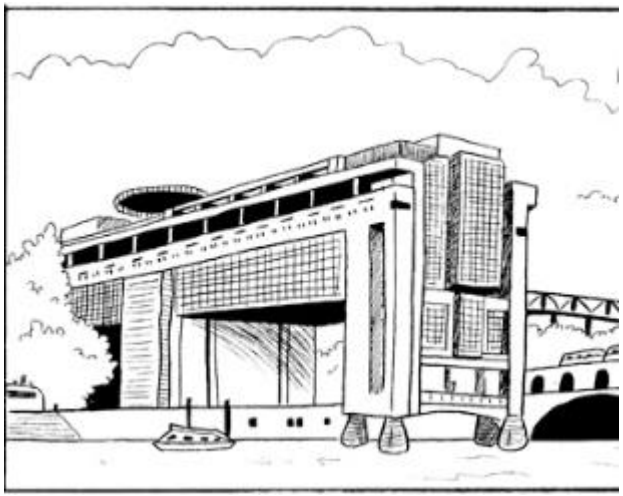
# Main results

# Who are the Winners/losers?

Households

Subsidies

Taxes



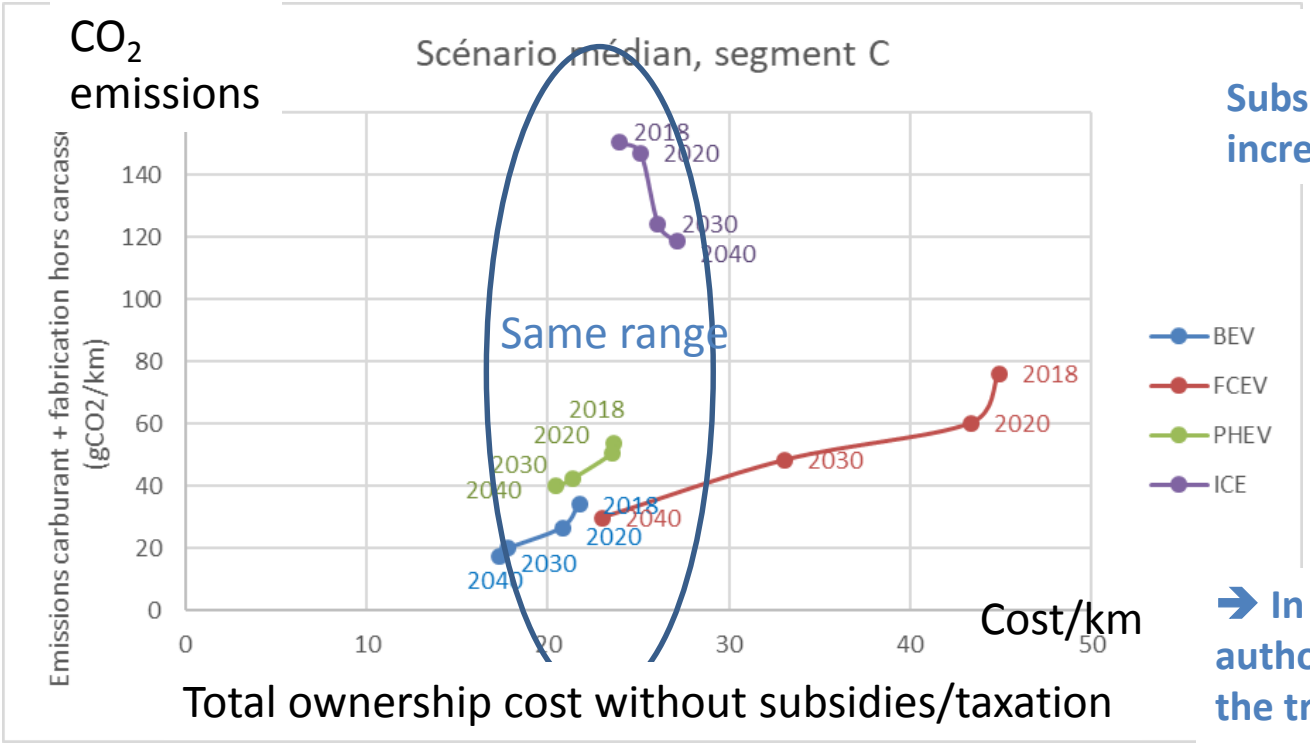
The State

Payments for Oil imports

Ext Countries

# Who is bearing the costs?

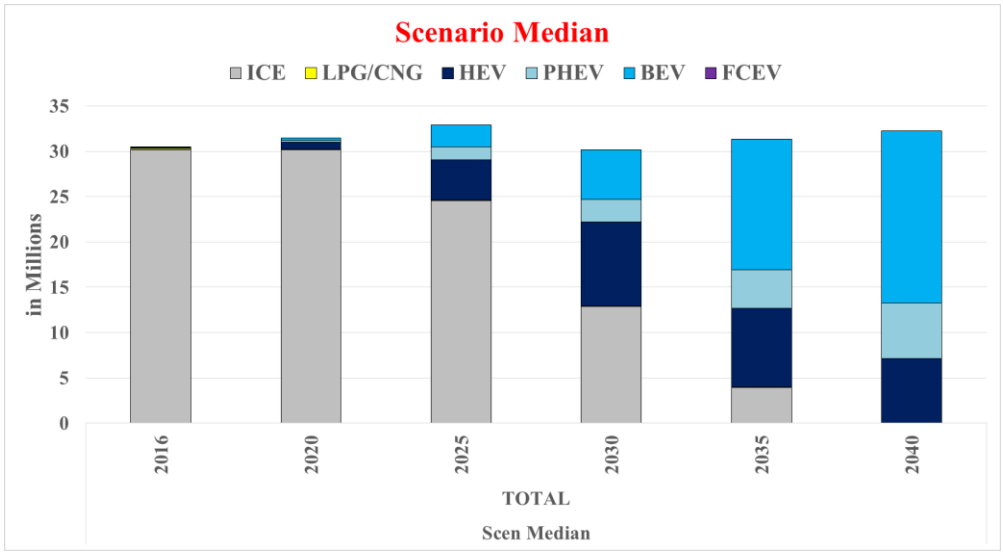
With the assumptions made, which are ambitious but realistic, the TOCs of the vehicles fall for the households ➔ the “social feasibility” will be facilitated

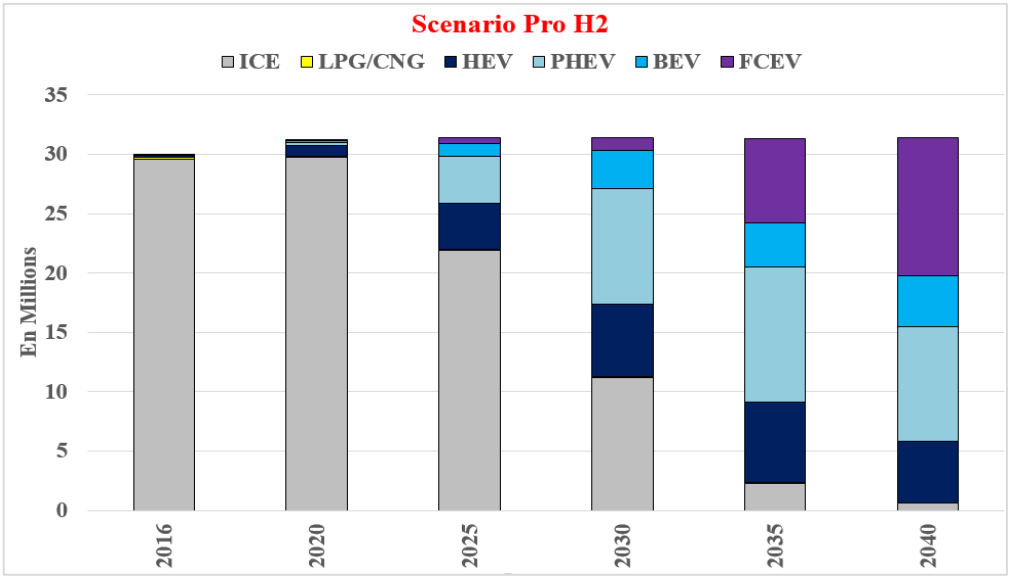



**Subsidies can decrease TOC and increase the speed of transition**

**➔ In the end, the State (and local authorities) bear the burden of the transition**

# Résults: Vehicle fleet




- Progressive electrification of the French fleet HEV
- then BEV / PHEV from 2030
- No penetration of the H2 vehicle

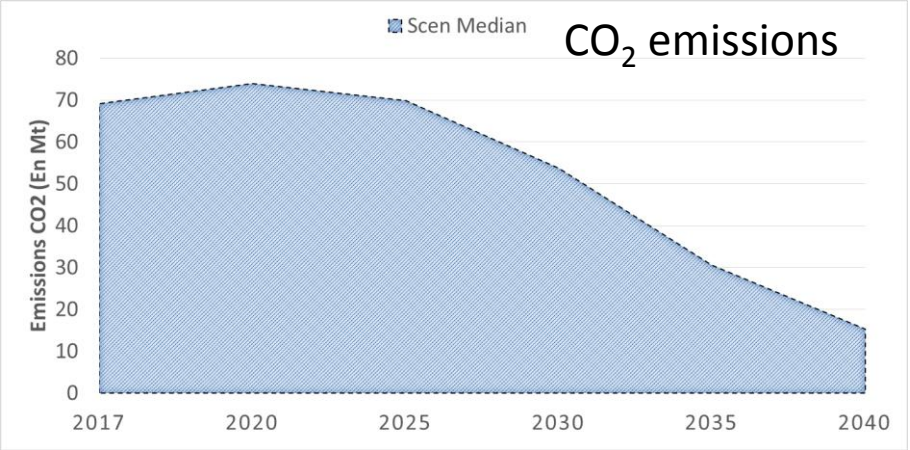
- Development of $H_2$ Vehicles largely after 2030

# Benefits of the transition to low-carbon mobility in France

# Several kinds of « benefits »

## Main benefits:

- Impacts on $CO_2$ emissions
- Balance of trade



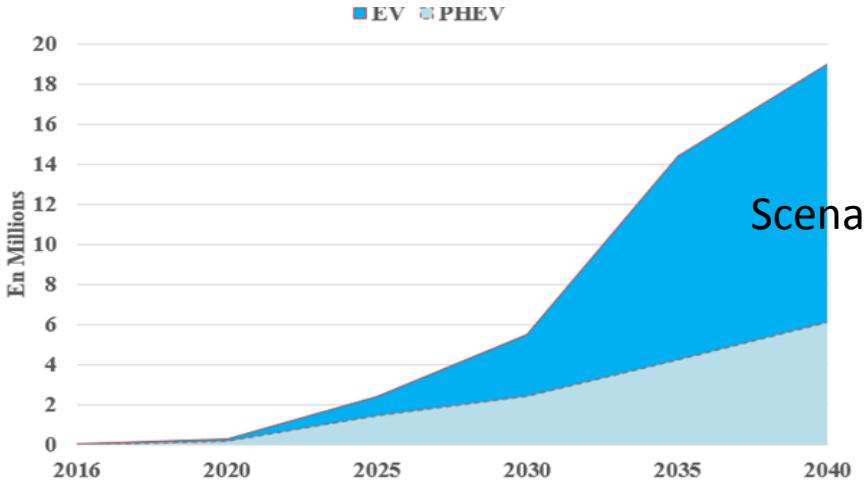

## Other items:

- Pollution (NOx, SOx, particles…)
- Impacts on the French car industry and associated services

# Costs of the transition to low-carbon mobility in France

# Results: Vehicles

## Number of BEV+FCEV

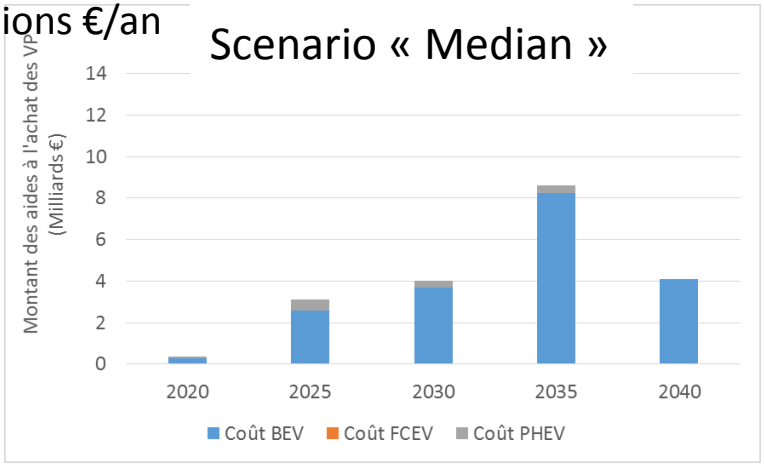



Scenario « Median »

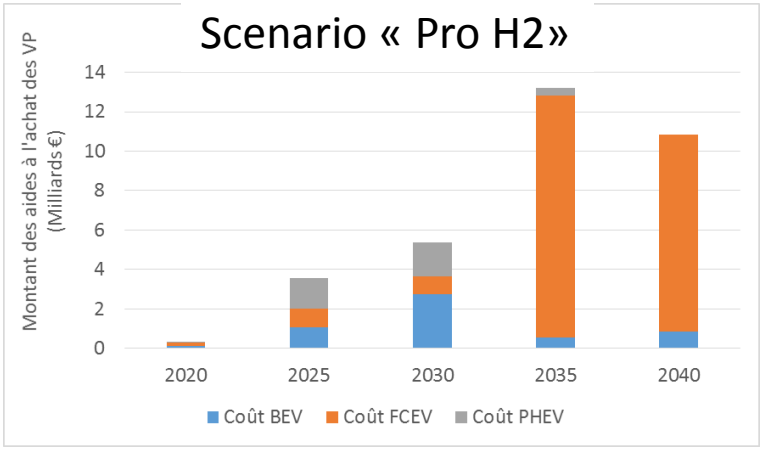
## Cost of annual subsidies for the State:

Billions €/an

Scenario « Median »




Scenario « Pro H2»



# Results

## Cost of infrastructures

| Expenditures (€B, cumulated over the period) | | MEDIAN | PRO-BATT | PRO-H2 |
|---|---|---|---|---|
| **10 EV per electric charging point (1a)** | Min unit price per e-charging point | 30.7 | 32.8 | 25.7 |
| **10 EV per electric charging point (1b)** | Max unit price per e-charging point | 100.6 | 108.0 | 85.8 |
| **$H_2$ charging station (2)** | | 0.0 | 0.0 | 14.6 |
| **Electricity production dedicated to an H2 mobility (3a)** | Min (electrolysers capacity utilization rate) | 0.0 | 0.0 | 1.7 |
| **Electricity production dedicated to an H2 mobility (3b)** | Max (electrolysers capacity utilization rate from 30 to 70%) | 0.0 | 0.0 | 3.5 |
| **Total (1a) + (2) + (3a)** | **Min** | **30.7** | **32.8** | **42.0** |
| **Total (1b) + (2) + (3b)** | **Max** | **100.6** | **108.0** | **103.9** |

- EV infrastructure costs amount **to € 30 to 100B**
- H2 charging stations (**~40 % of the car fleet) cumulated cost that amount to € 15B for the decentralized dedicated H2 production (centralized units are not taken into account)**
- The share of those investments between the State, the public local communities and the private actors is still to be defined

# Results

## Taxation regime : a key component of any mobility transition

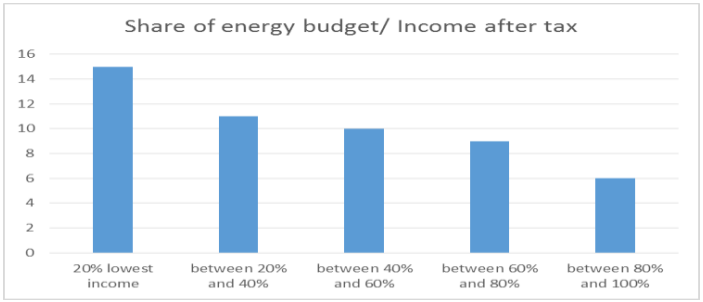
Why a liquid fuel taxation ? Two main reasons:

- For the **efficiency of this mechanism** (liquid fuels demand is poorly sensitive to prices)
- For **internalizing the externalities** (social impact, traffic jams, climate issues) and financing the required road transport infrastructures.

| Shares of households expenses in energy in income after tax | |
|---|---|
| **Depending on income** | |
| 20% lowest income | 15 |
| between 20% and 40% | 11 |
| between 40% and 60% | 10 |
| between 60% and 80% | 9 |
| between 80% and 100% | 6 |
| | |
| **Depending of living places** | |
| Country | 12 |
| Small cities | 10 |
| Medium cities | 9 |
| Large Cities | 9 |
| Paris Conurb. | 6 |

➔ Setting a precise weight to these two components is a quite challenging issue

➔ Another issue is to adopt a **fair tax regime** as fuel taxes is clearly not a redistributive policy ; social movements occurring in France in winter 2019 are a clear sign of it.



# Taxation regime : a key component of any mobility transition


## Carbon tax in TIPCE €/$tCO_2$

| 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|
| 30,5 | 44,6 | 55 | 65,4 | 75,8 | 86,2 |

Before « freezing » the carbon tax

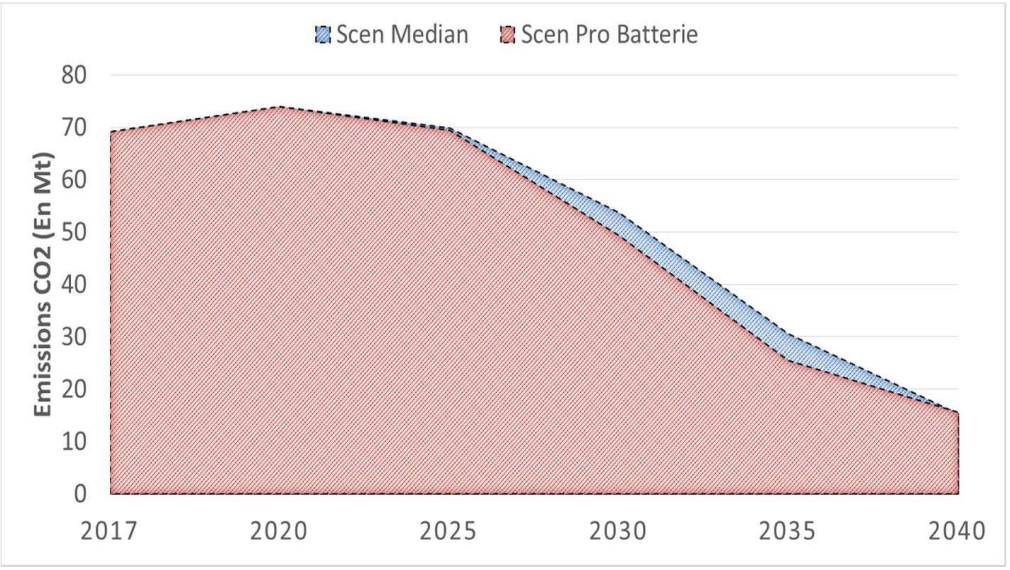
## Share of taxes in super gasoline

- transfer to local communities
- transfert to national body for energy transition
- transfert to agency of transpot infrastructure
- transfert to central budget

## Carbon tax uses in France (2018)

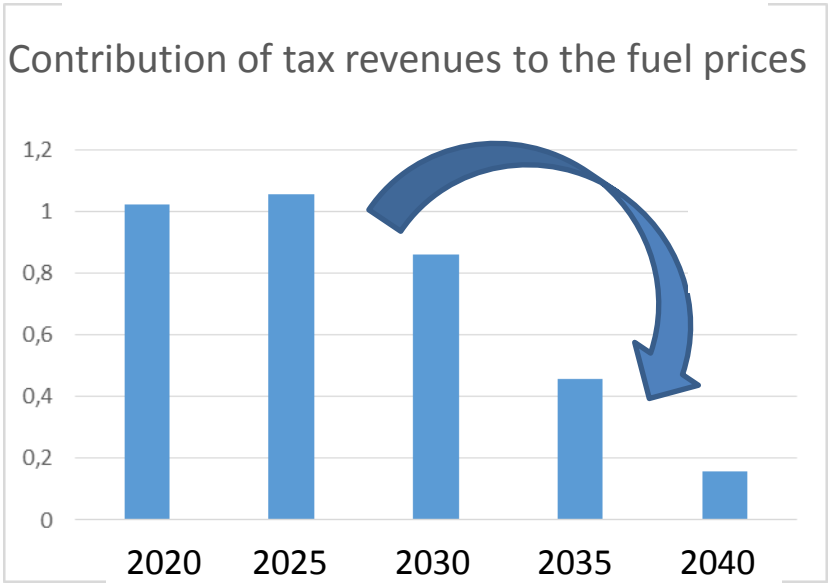
# Taxation regime : a key component of any mobility transition

A growing carbon price in addition to other measures leads to discarding fossil fuels in totality by 2040; related taxes disappeared consequently.




Emissions calculated at the tailpipe

**A € 20B by loss in 10 years !**



# Total costs

- **For the households**: total impact is **neutral in average** (but true questions remains about the burden sharing cities/rural territories)

- **For the French State**:
  - Few billion / year for infrastructure
  - € 20 to 30 B TIPCE less/year
  - € 10 B/year amount of subsidy purchase (average value)

  That is an amount of nearly **€ 40 B/year,** even taking into account the additional VAT on electricity or hydrogen

- **For the foreign countries/oil producers**: a loss in the range of **€ 40 to 60 B/year**, depending on international oil price.

# Conclusions

# Conclusions (1/2)

- By 2040, with the assumptions of improving the costs and performance of engines, **the deployment of low-carbon electric vehicles appears to be feasible**. It begins with the HEV and continues with the BEV and PHEV / FCEV according to the scenarios envisaged

- The **main benefits** are highly significant in terms of both the **drastic reduction of $CO_2$ emissions (~ 75% in 2040: - 50 Mt / year compared to 2017) and balance of trade (~30 to 60 billion €/year depending on oil prices)**

# Conclusions (2/2)

- The total cost for the Households + State is in the range of 500 Billions Euros of the period of time
  - A very important question is to drive the **path of the impact for the households**

- **Government Revenues from liquid fuels will decrease very hardly** after 2030 (not before):
  - We can prepare this new era
  - But the impacts will be large

- **Many Caveat apply,** such as the need to use a macroeconomic model to obtain results taking account of technical, fiscal and trade effects together.