THE OPTION VALUE OF ELECTRIFIED VEHICLES FROM A WELFARE PERSPECTIVE

MANON SOLIGNAC
ADRIEN VOGT-SCHILB
CELINE GUIVARCH
solignac@centre-cired.fr

C.I.R.E.D. UNITÉ MIXTE DE RECHERCHE
EHESS ET CNRS - UMR 8568

Motivation & Literature Review

- Availability of electrified vehicle as an option
- What social value can be placed on this option?

- Option value and automobile market
  - Hassett et Metcalf (1993) : purchase of equipments and energy savings
  - Baker (2010) : purchase decision between efficient and inefficient car when waiting is possible. Slow diffusion of efficient and inefficient technologies.
- Individual choice, instantaneously available technology

- We choose a static choice framework to find the social value of EVs availabilty

Outline

1. Motivation & Literature review
2. Automobile market modeling
3. Option price of EVs in a BAU framework
4. OP of EVs facing uncertain future carbon price
5. OP of Evs when reaching an emission target
6. Sensitivity analysis
7. Conclusion

Each household chooses the cheapest of two or three technologies

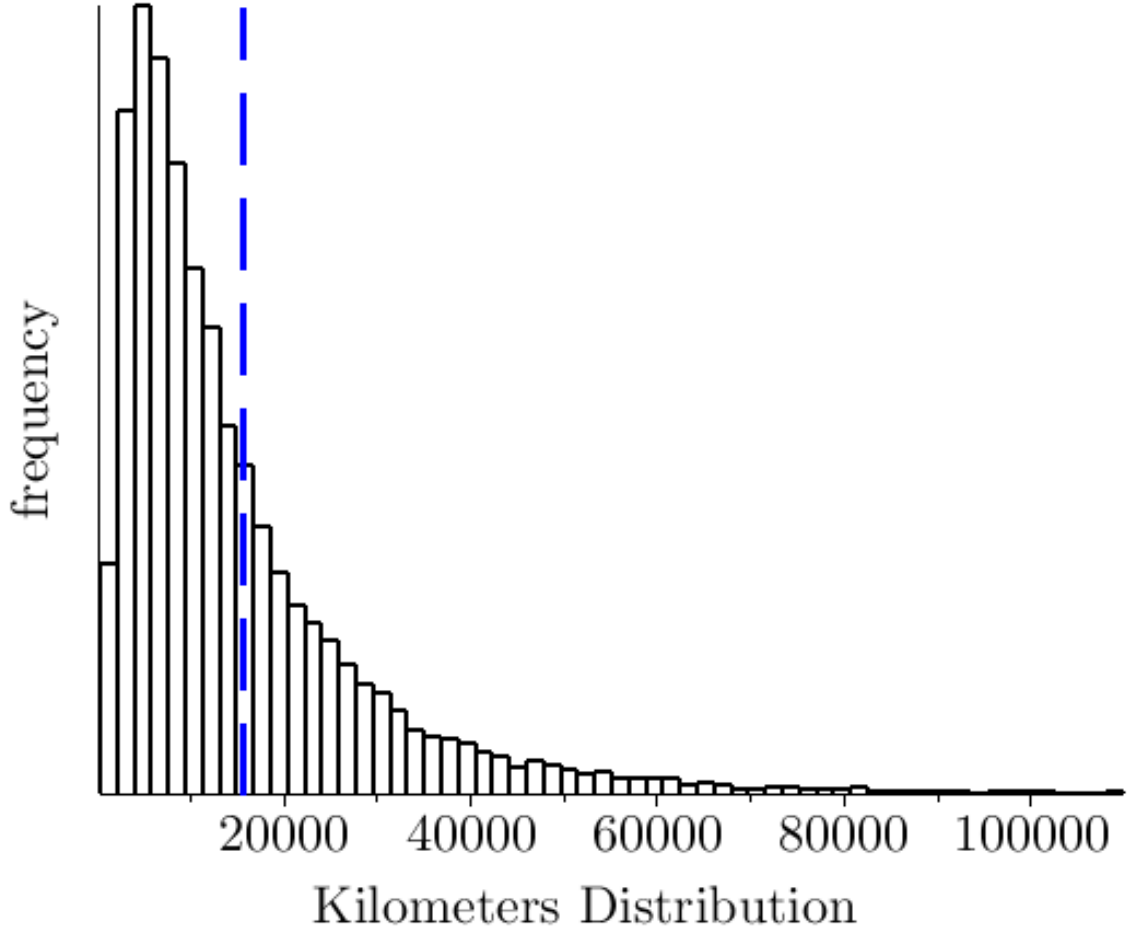
	Classic	Efficient	Electric
Cost (€)	16 000	22 000	29 000
Fuel consumption (L/100km)	6.8	3.7	0
Electricity consumption (kWh/100km)	0	0	20
Equivalent consumption (kWh/100km)	64.2	34.7	20

$$ATCO = \frac{C_{Inv}}{\sum_{t=1}^{T} \frac{1}{(1+i)^t}} + L \cdot (c_{fuel} \cdot p_{fuel} + c_{elec} \cdot p_{elec})$$

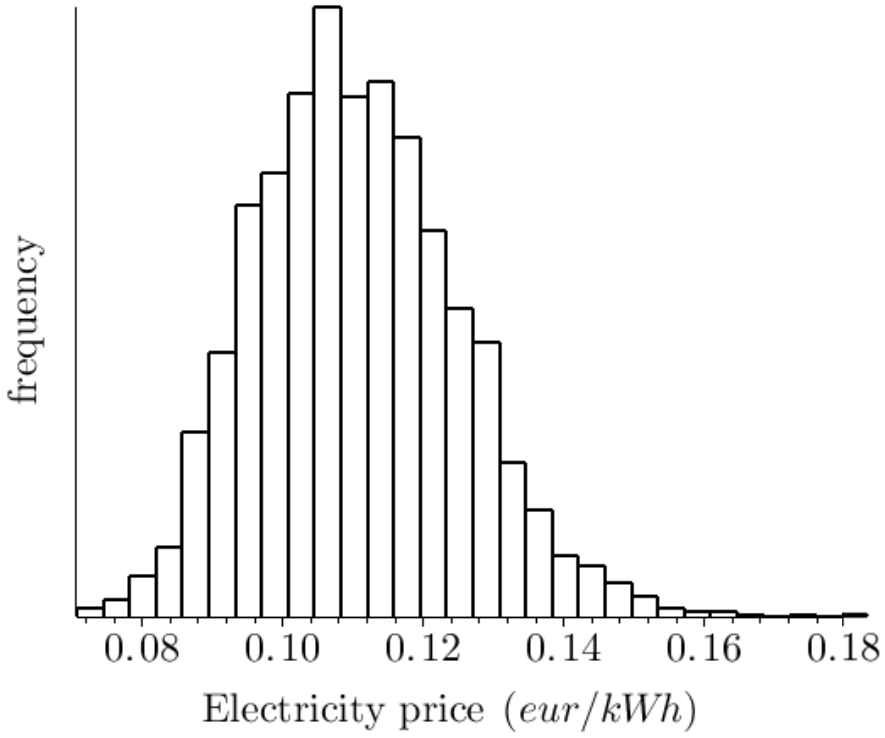
Market shares

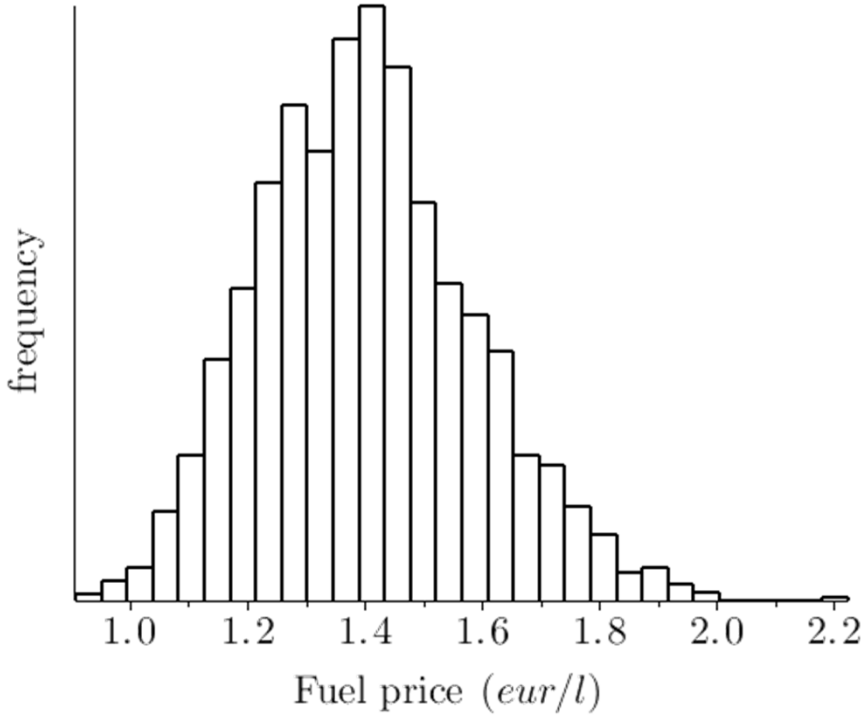
$$CSA = \frac{\sum_{v=1}^{V} ATCO_{min}(v)}{V}$$

French data: housholds have different mobility needs

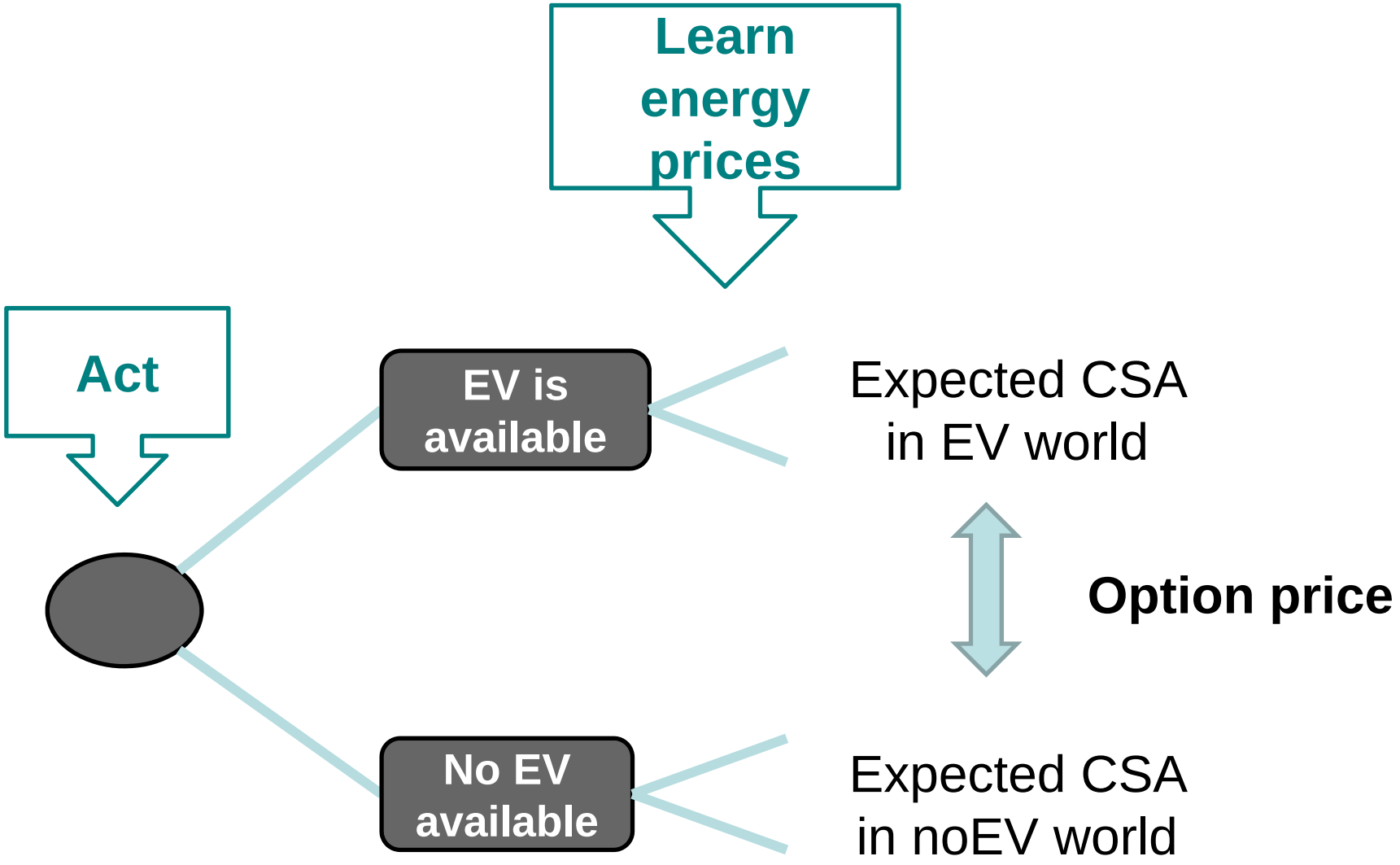


We simulate energy prices based on a prospective model developped at CIRED





Two worlds


Learn energy prices
Act
EV is available
No EV available
Expected CSA in EV world
Option price
Expected CSA in noEV world

Investing now on EV developpment makes EV available tomorrow

	Classic	Efficient
Cost (€)	16 000	22 000
Fuel consumption (L/100km)	6.8	3.7
Electricity consumption (kWh/100km)	0	0
Equivalent consumption (kWh/100km)	64.2	34.7

$$ATCO = \frac{C_{Inv}}{\sum_{t=1}^{T} \frac{1}{(1+i)^t}} + L \cdot (c_{fuel} \cdot p_{fuel} + c_{elec} \cdot p_{elec})$$

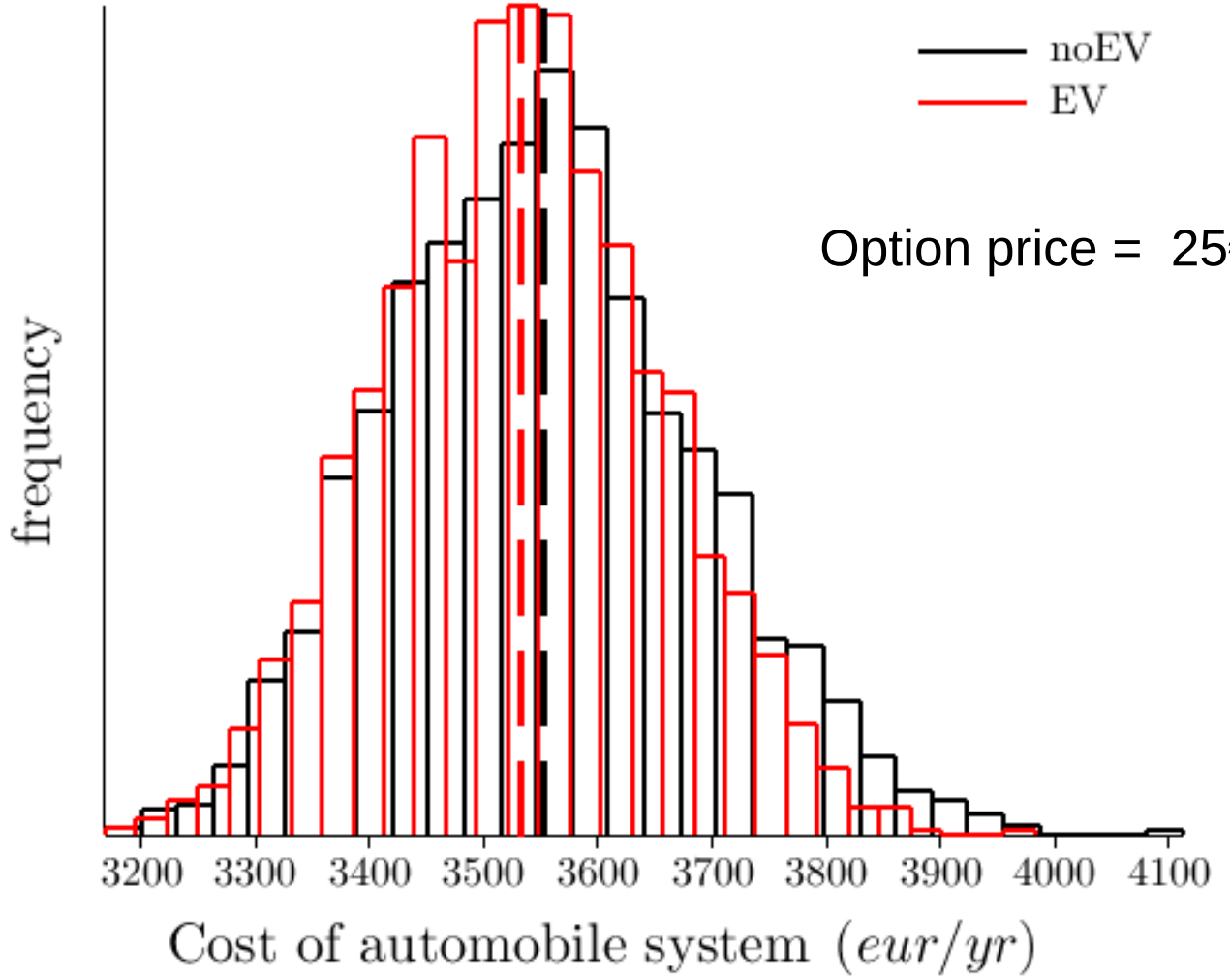
Market shares

$$CSA = \frac{\sum_{v=1}^{V} ATCO_{min}(v)}{V}$$

Outline

1. Motivation & Literature review
2. Automobile market modeling
3. Option price of EVs in a BAU framework
4. OP of EVs facing uncertain future carbon price
5. OP of Evs when reaching an emission target
6. Sensitivity analysis
7. Conclusion

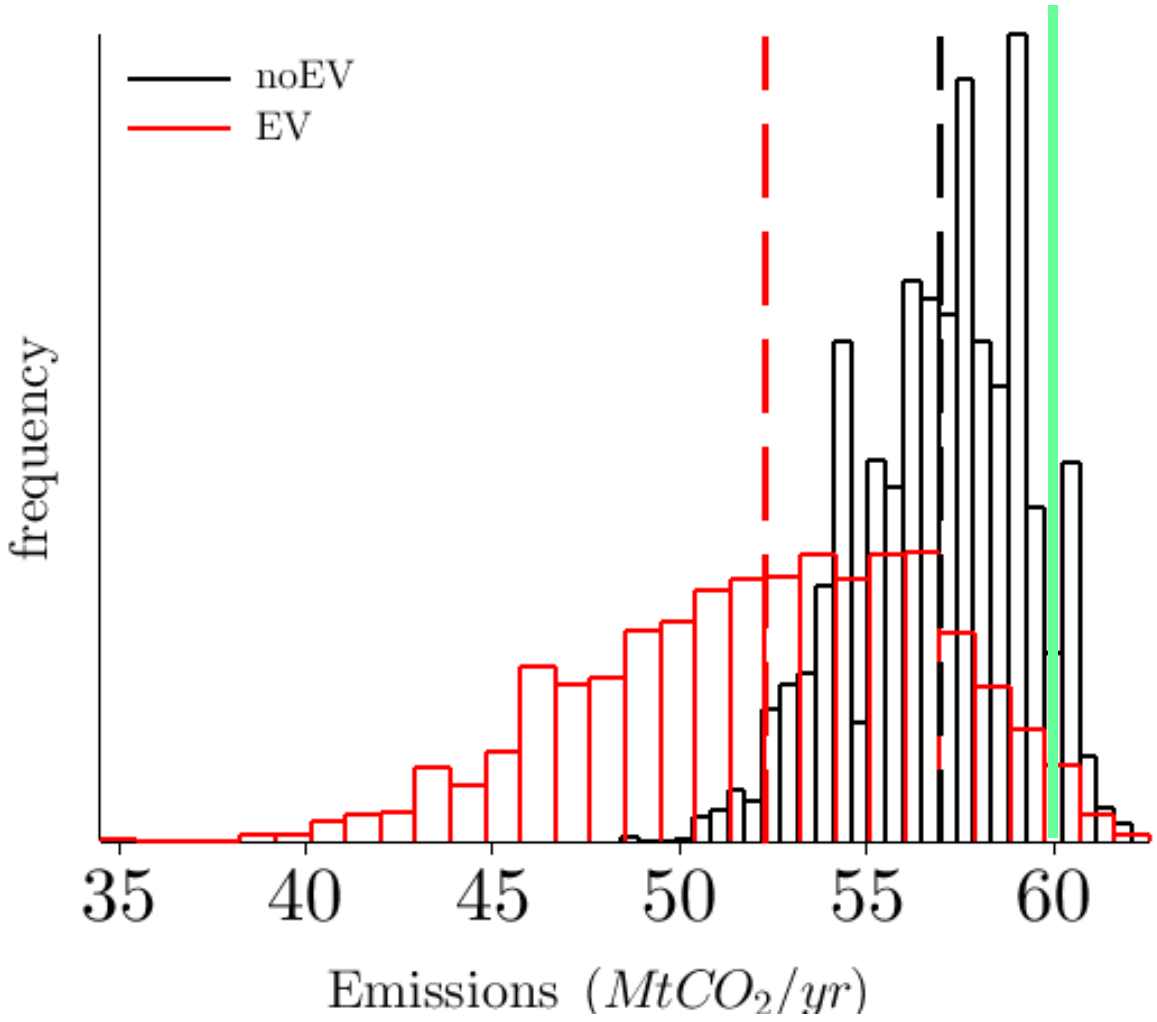
In BAU, small OP for Evs: 25€/hh/yr



Option price = 25€ / household/yr

(CSA)

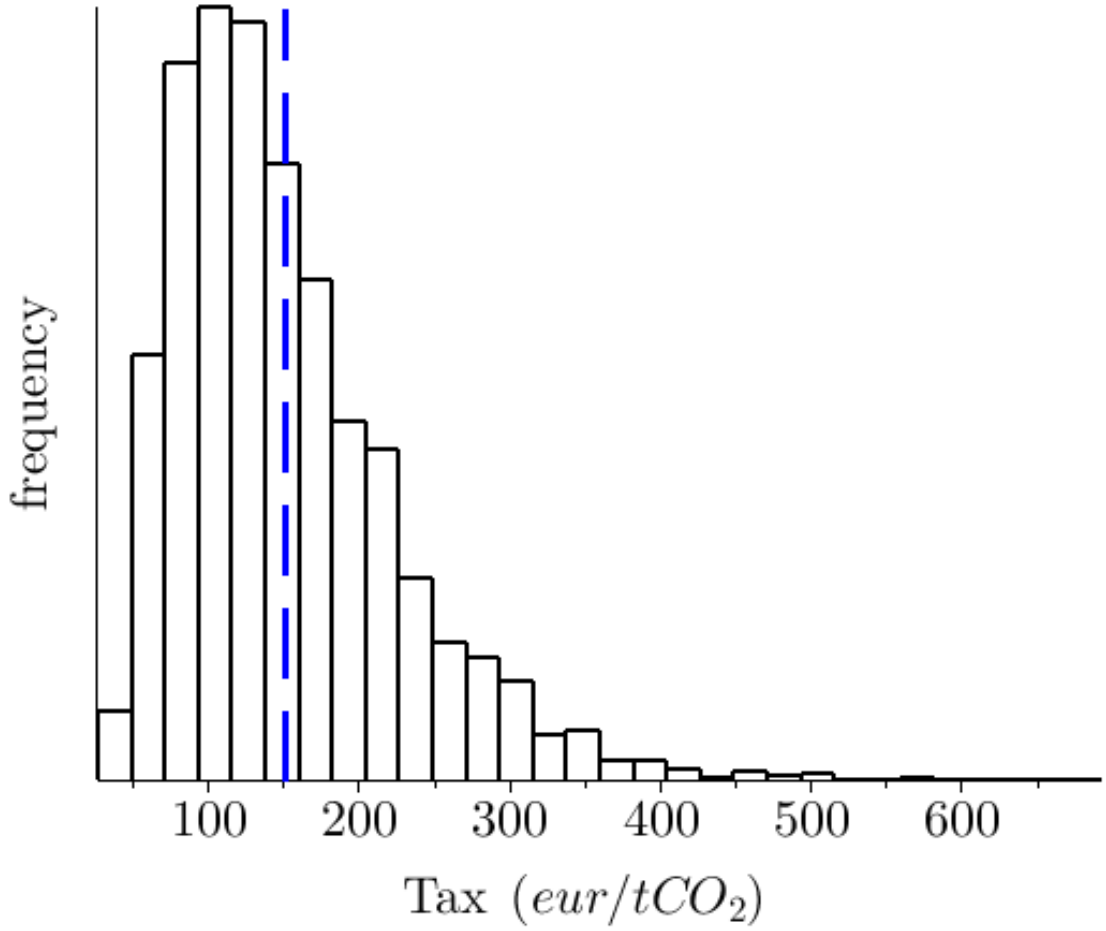
EVs availability reduces emissions from automobile system



Outline

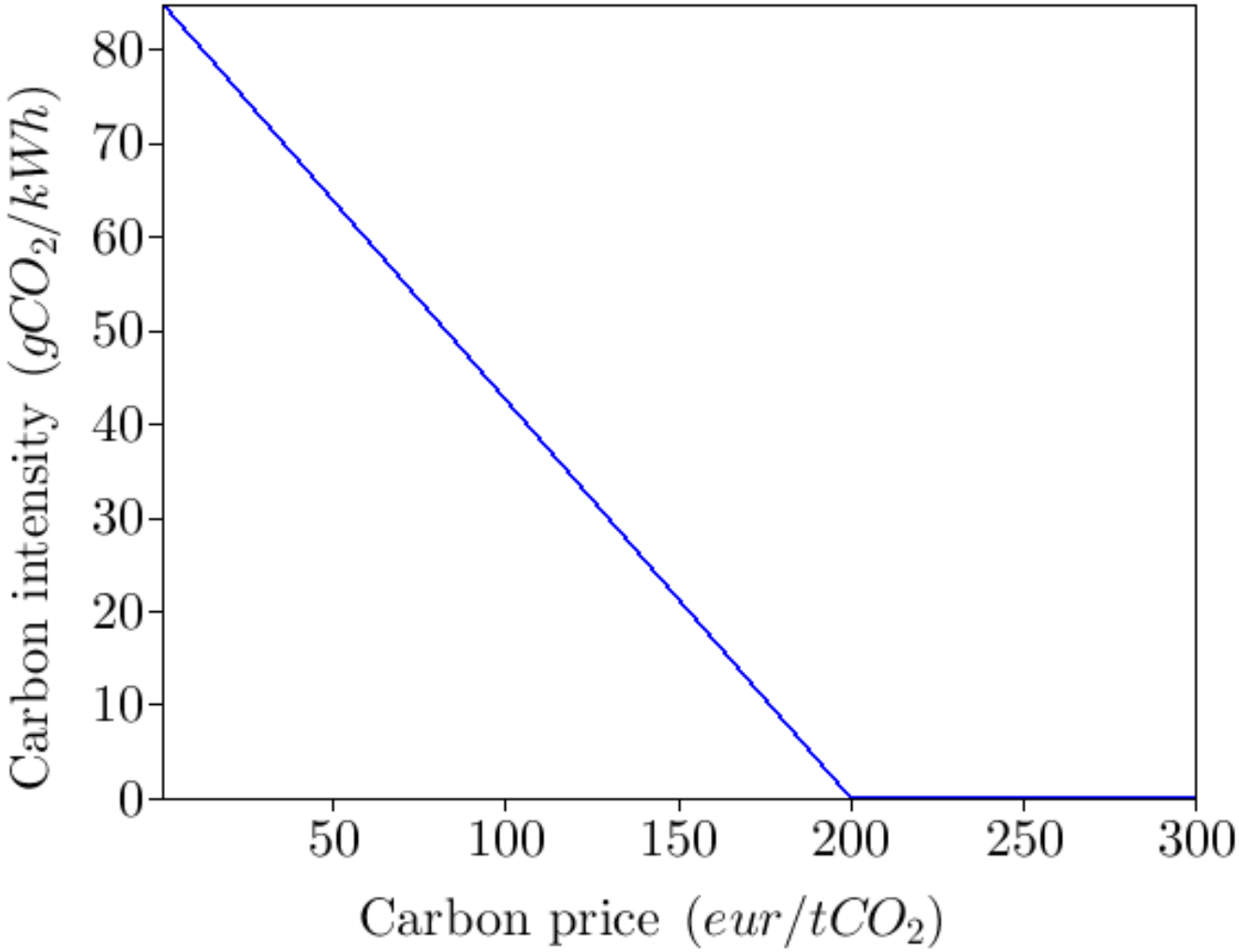
1. Motivation & Literature review
2. Automobile market modeling
3. Option price of EVs in a BAU framework
4. OP of EVs facing uncertain future carbon price
5. OP of Evs when reaching an emission target
6. Sensitivity analysis
7. Conclusion

We simulate a carbon price distribution from French proposals

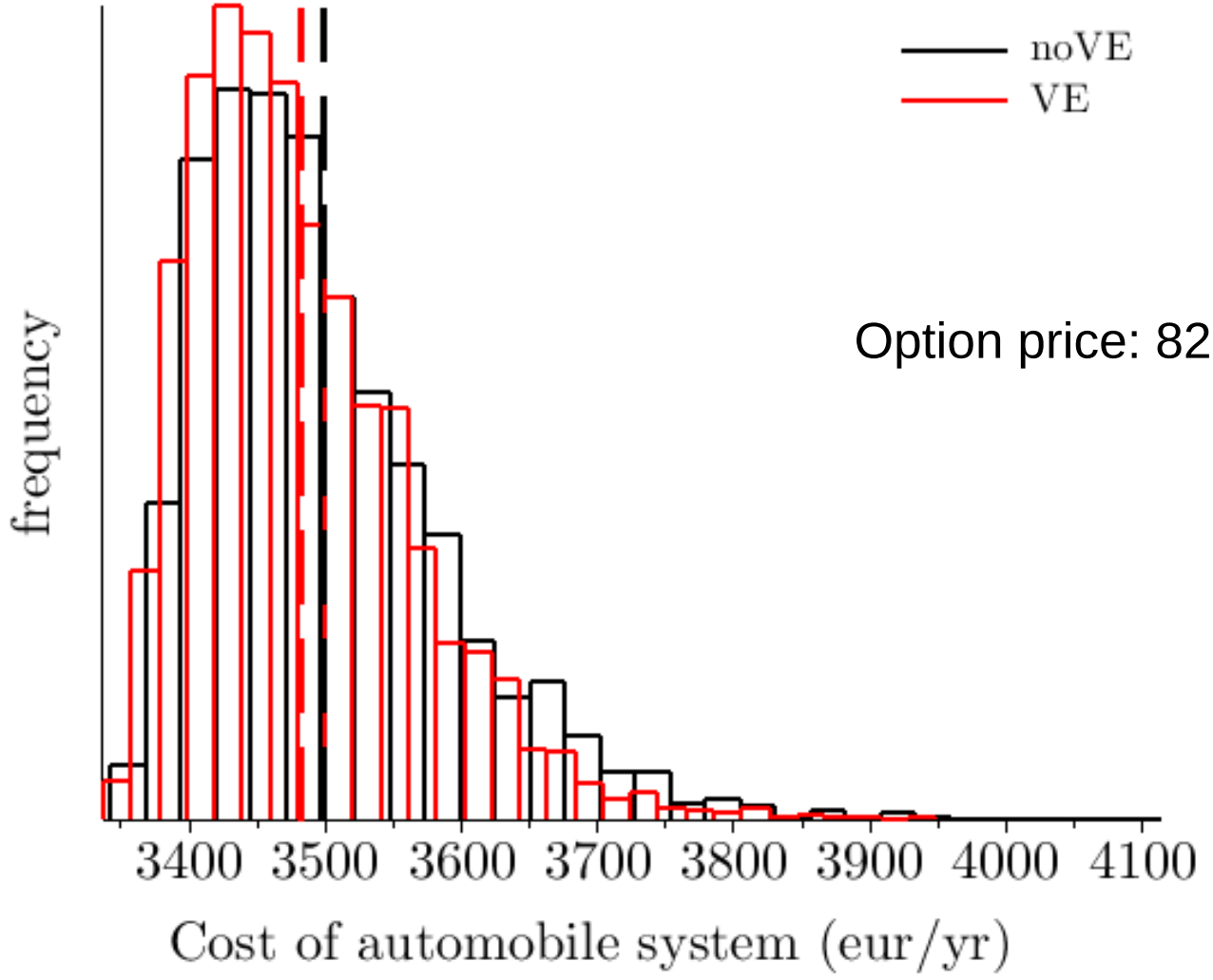


- This tax adds to the random energy prices

Electricity carbon intensity decreases with tax

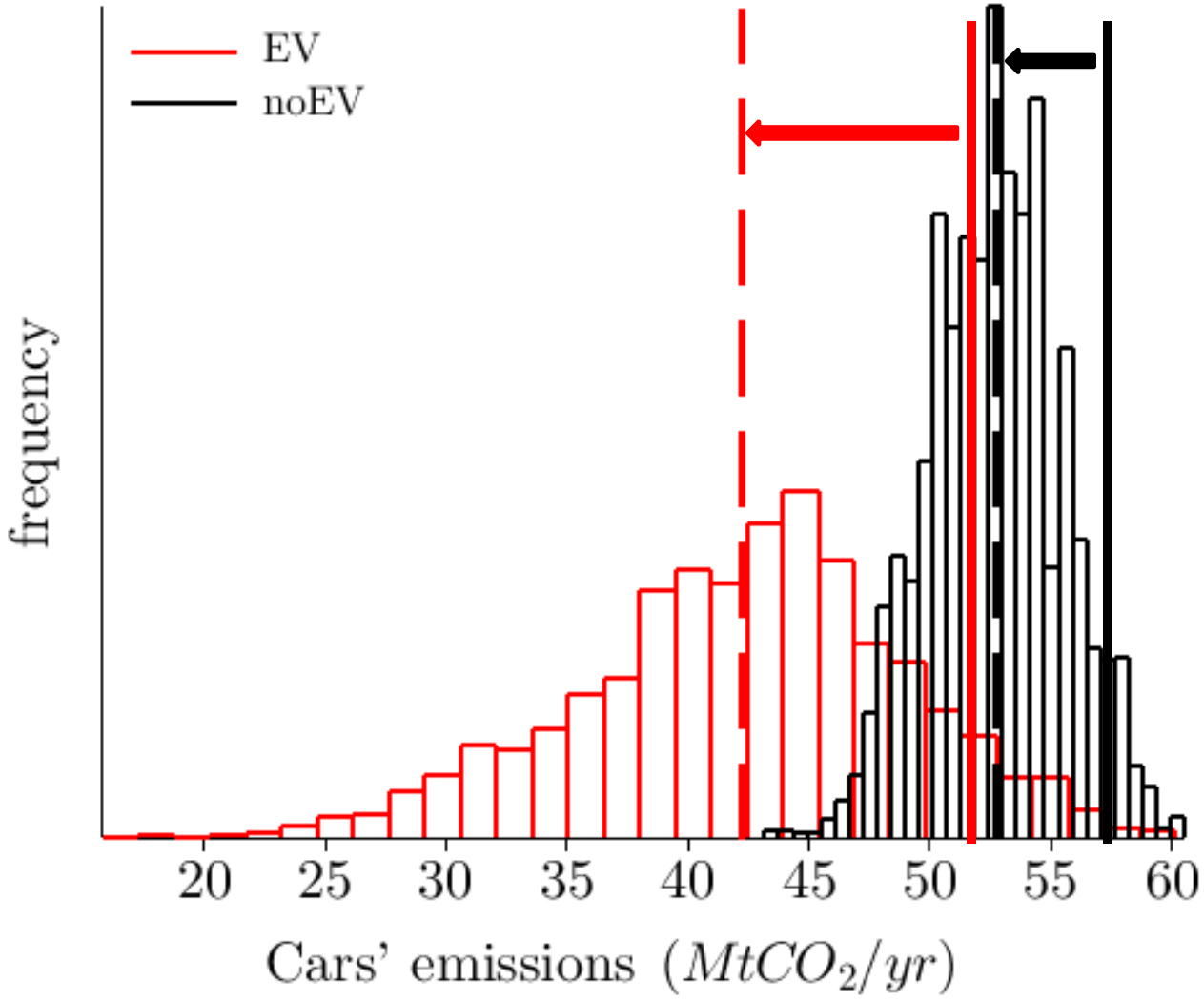


EVs are an hedge against high carbon prices



Option price: 82 € /household/yr

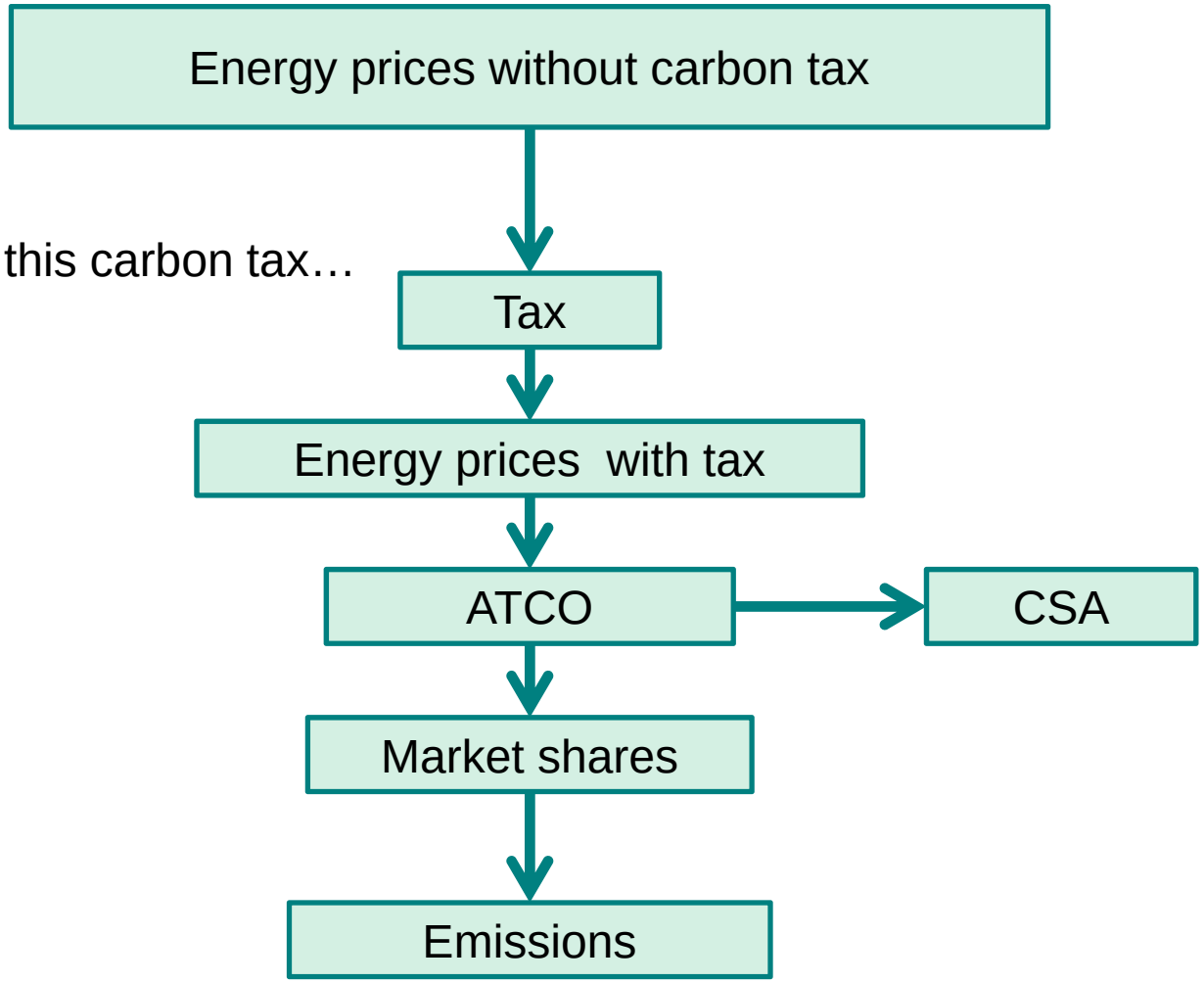
Emissions lower more in presence of EVs



Outline

1. Motivation & Literature review
2. Automobile market modeling
3. Option price of EVs in a BAU framework
4. OP of EVs facing uncertain future carbon price
5. OP of Evs when reaching an emission target
6. Sensitivity analysis
7. Conclusion

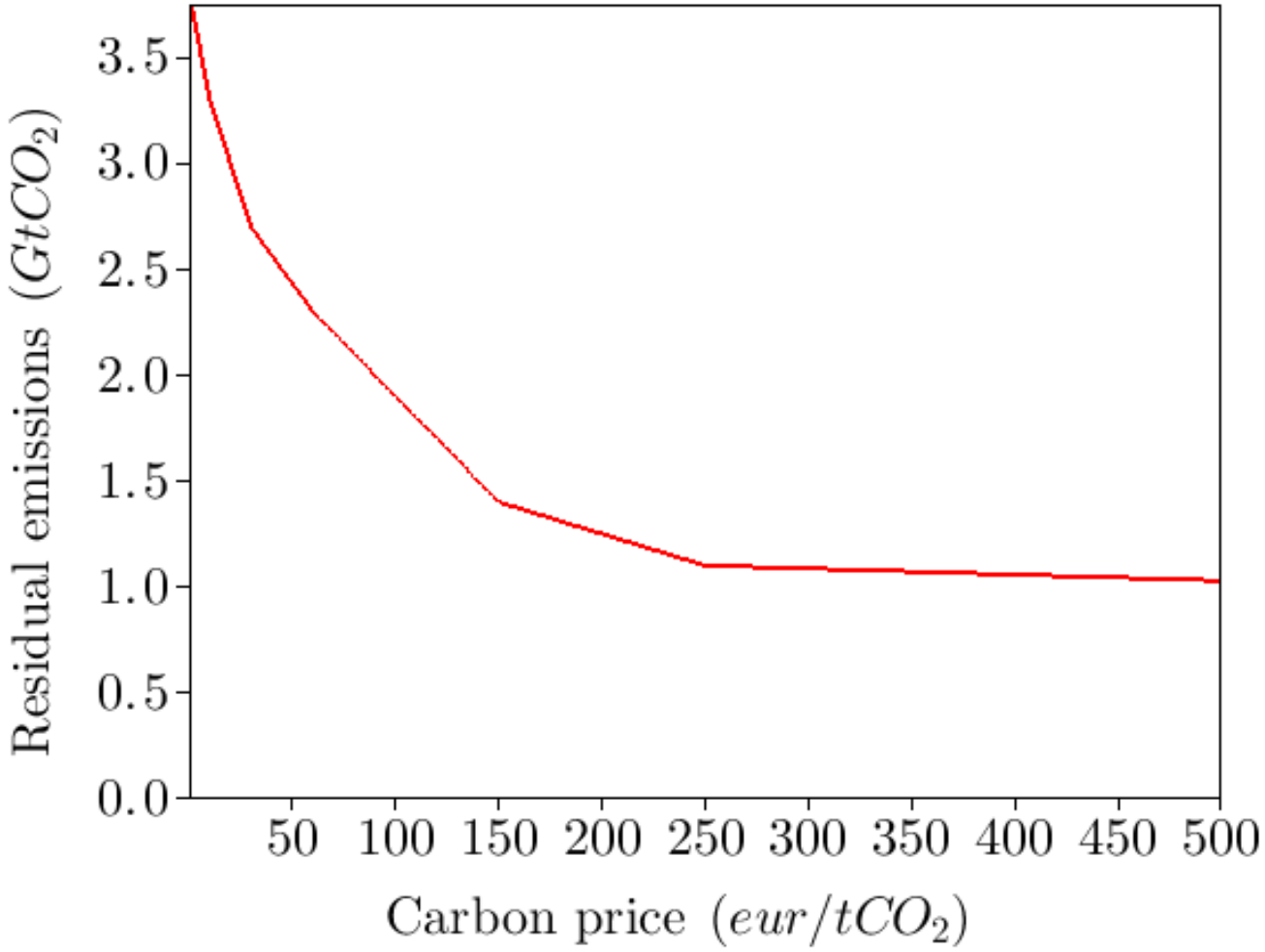
Calculation of the tax



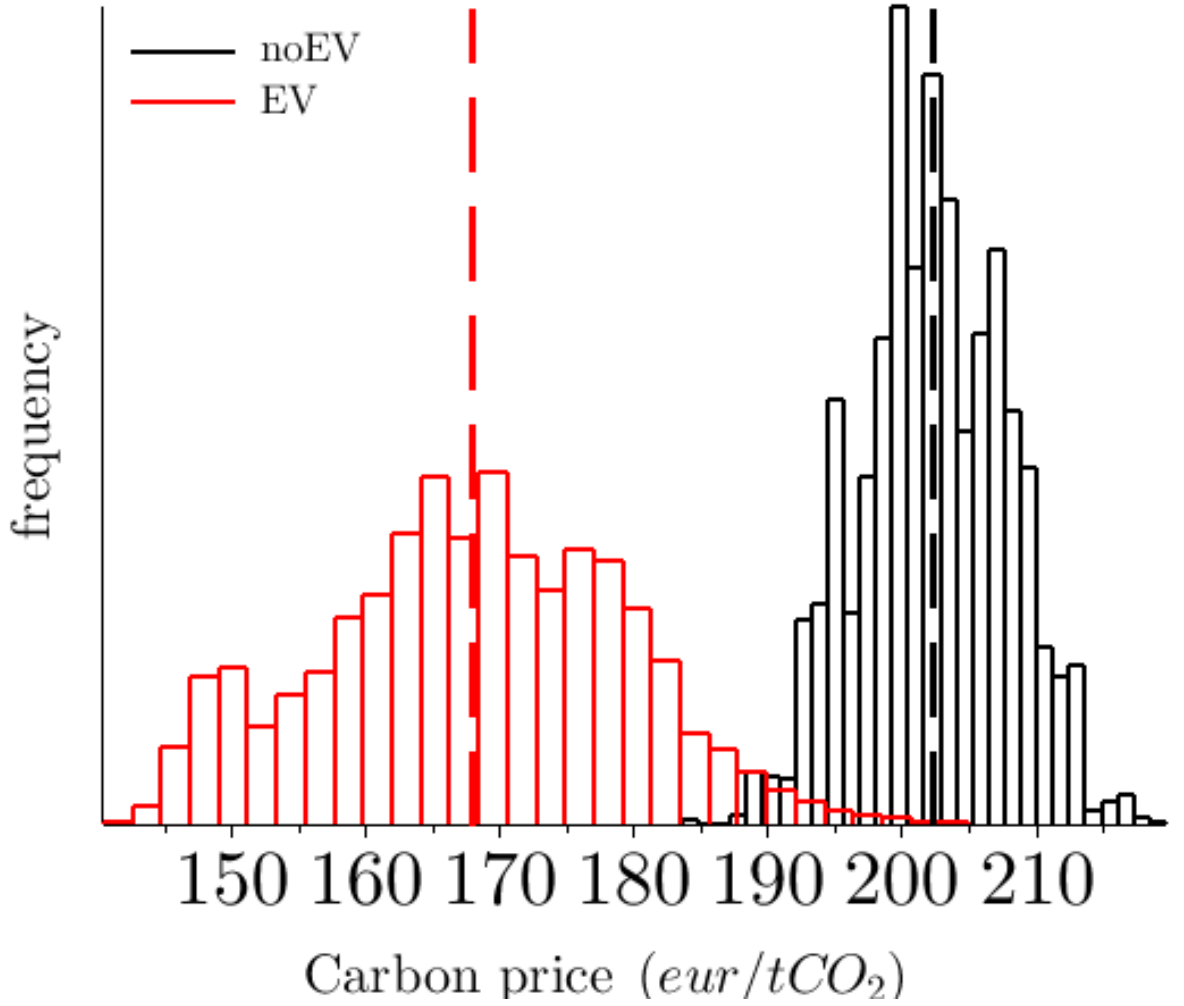
The model finds this carbon tax…

…such that total emissions are reduced 60%

Reaction of the rest of the french economy to the carbon tax



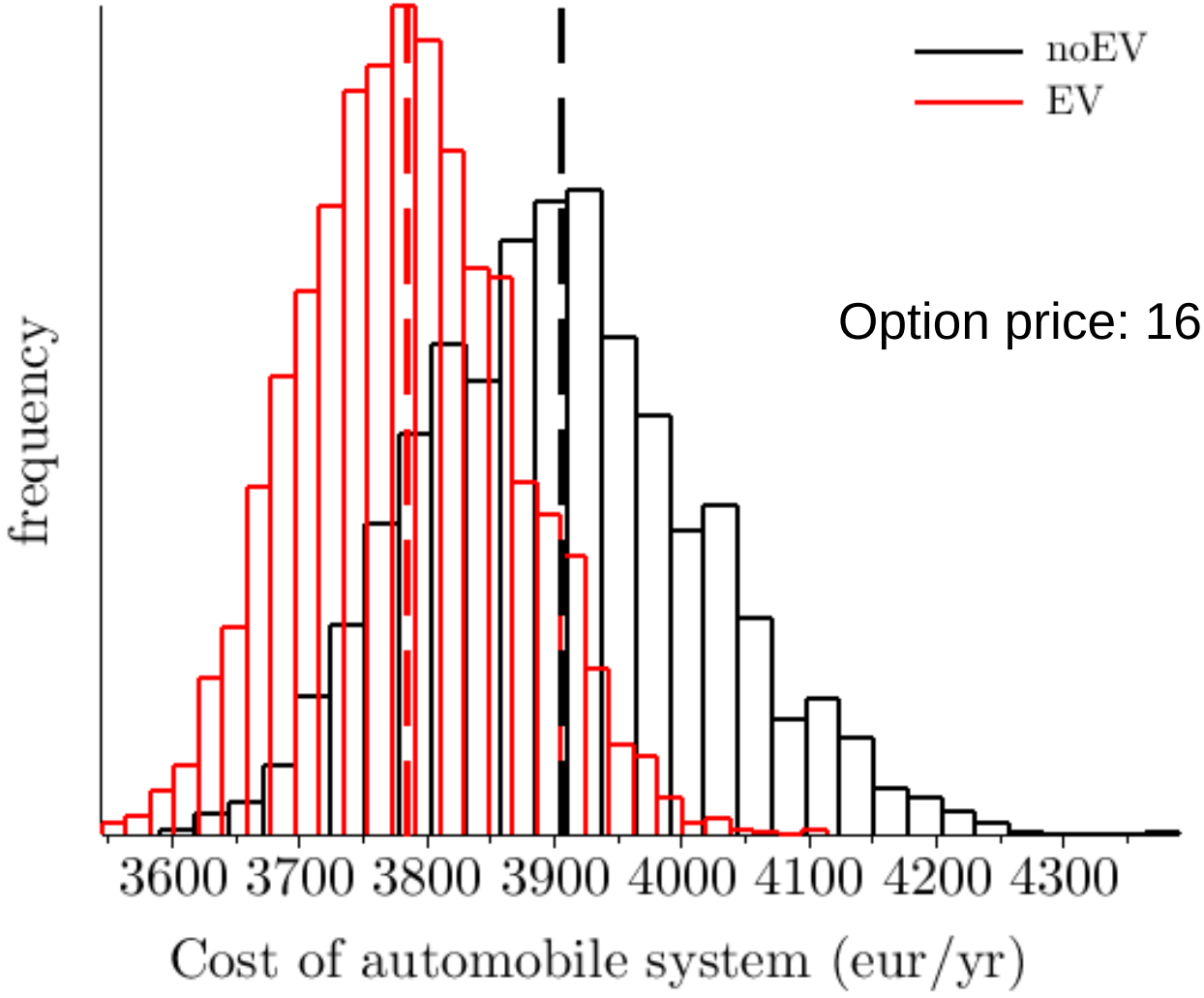
EV lowers carbon price to achieve the same emission target



Cars emissions

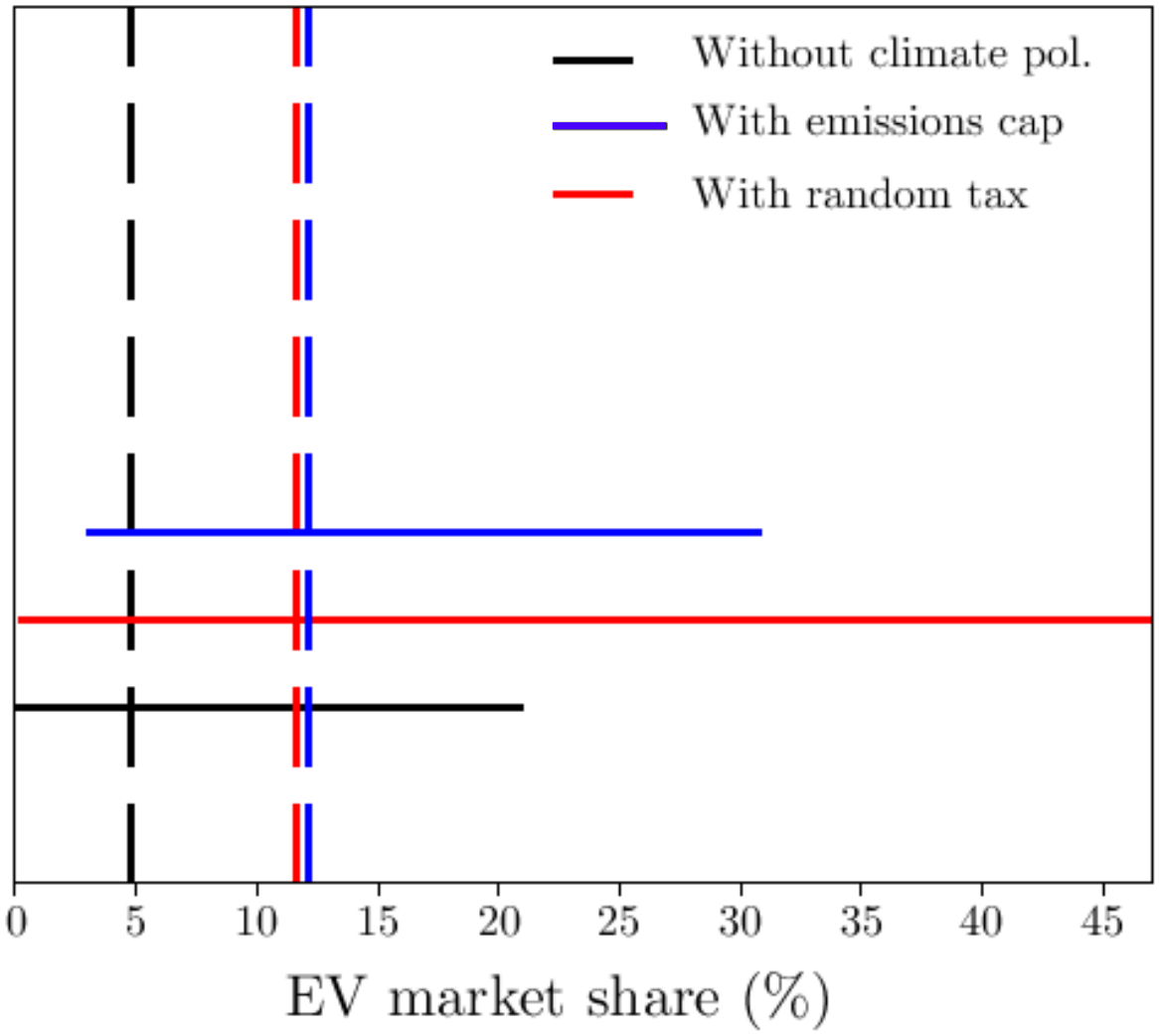
- EV : 40 MtCO2
- noEV : 51 MtCO2

OP higher than in previous scenarios



Option price: 160 €/households/yr

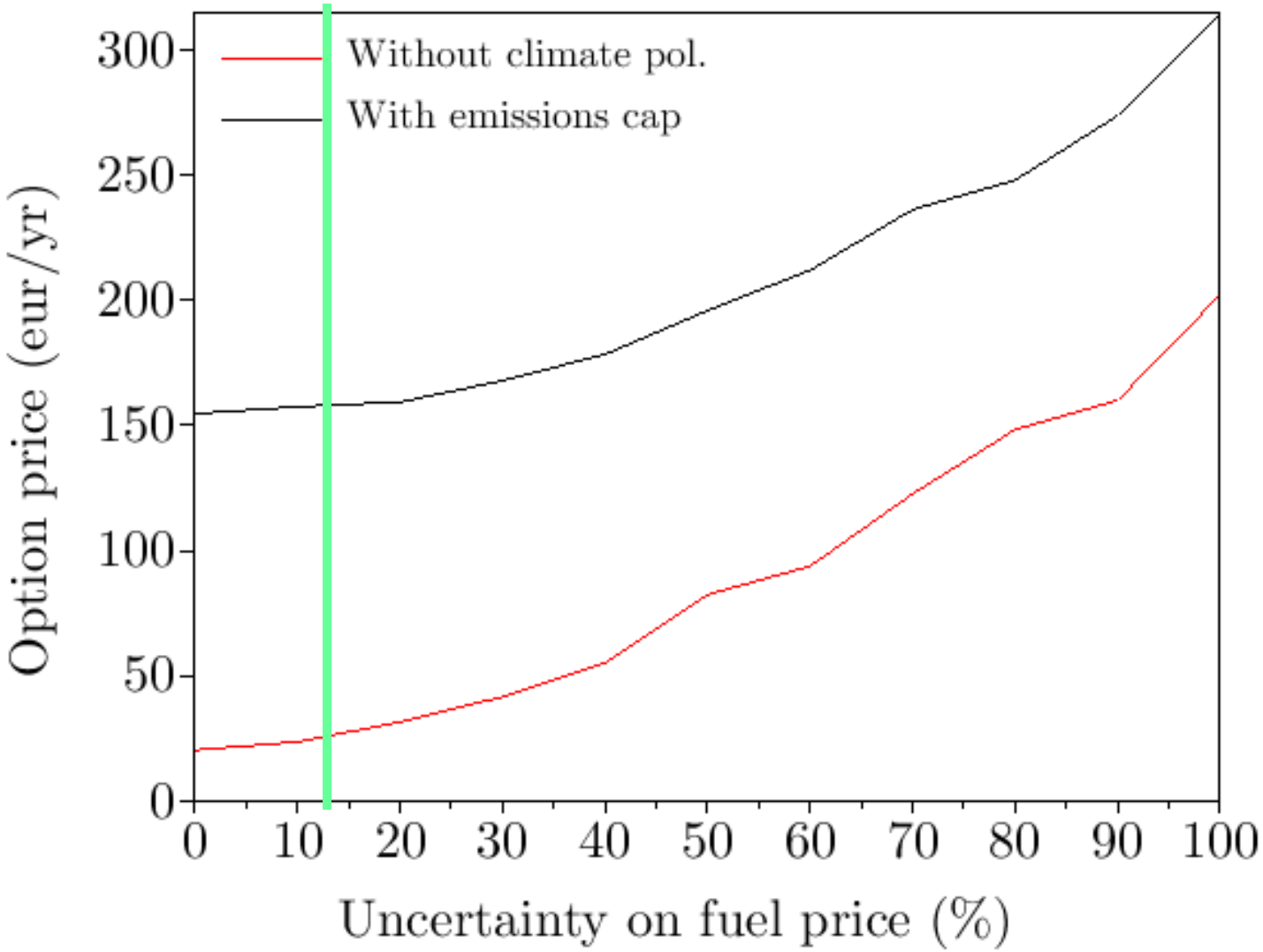
Markets shares are more spread in scenario with random tax



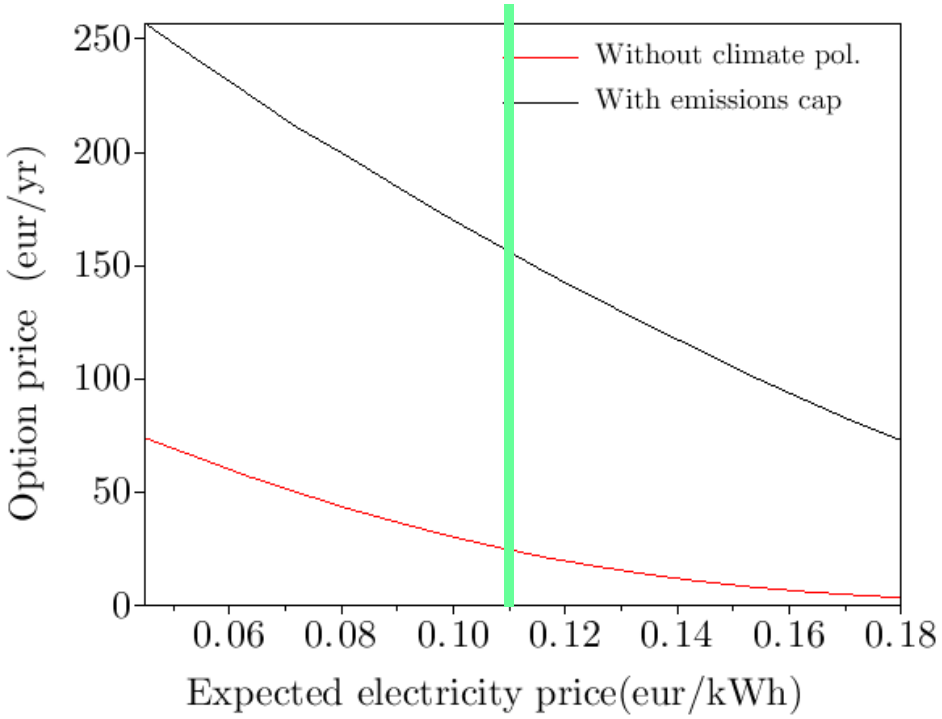
Outline

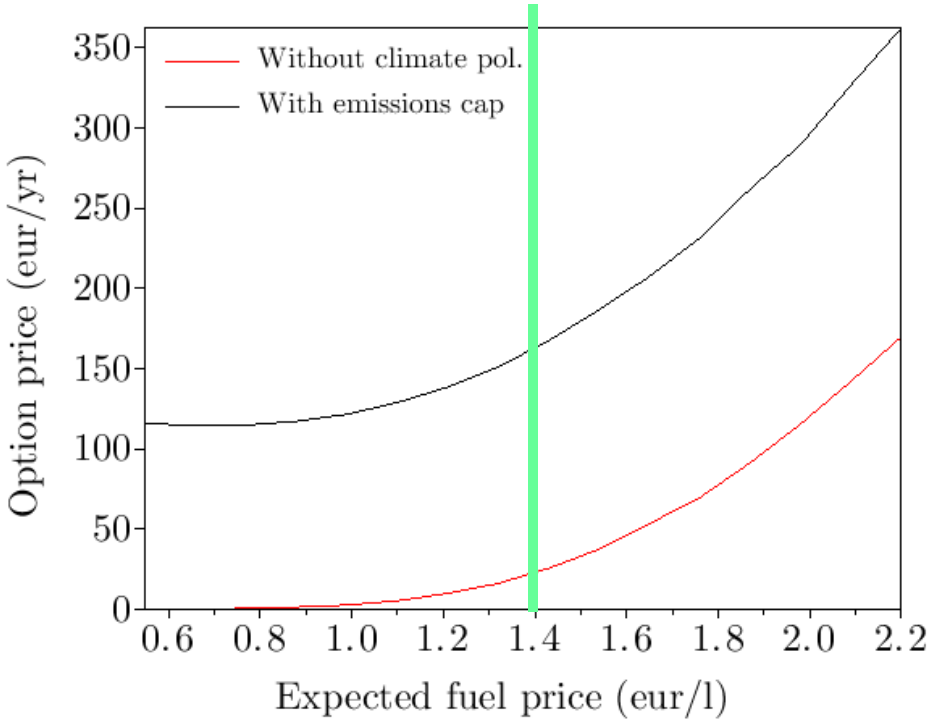
1. Motivation & Literature review
2. Automobile market modeling
3. Option price of EVs in a BAU framework
4. OP of EVs facing uncertain future carbon price
5. OP of Evs when reaching an emission target
6. Sensitivity analysis
7. Conclusion

Option price is sensitive to fuel price volatility



OP is more sensitive to variations in the expected fuel price

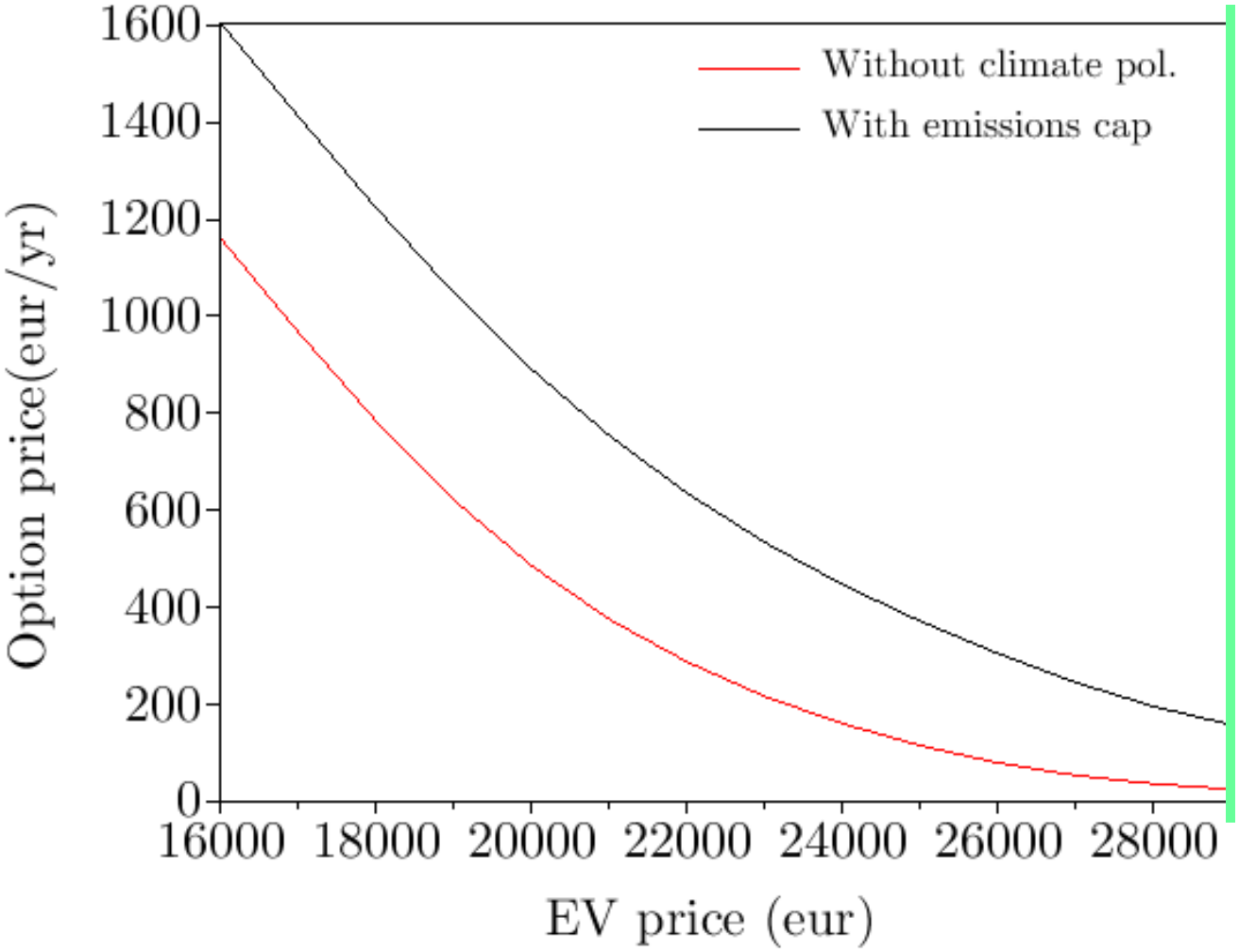




Mean of energy prices : half to twice today's prices

Constant **Relative** Standard Deviation

EV's price is a key parameter for OP



Conclusion

	Without climate policy	Random tax	Emissions cap	emis. Cap + EV price : 20 000 €
€/households/ year	25	80	160	900
Tot. €/ year (France)	650 Millions	2 Billion	4 Billion	22 Billion

- Electric vehicle availability is a hedge against uncertain carbon price
- Learning on Evs prices is essential

- Extension to deciles of income: regressive impact