

Consequence of the Expected Transportation and Energy Disruptions on the Future Air Quality And Environmental Studies

Clappier A.

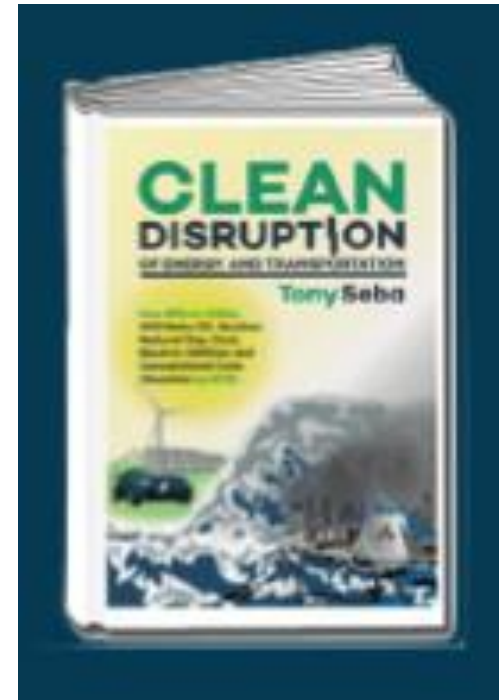
Data concerning disruption come from:

Tony Seba

www.tonyseba.com

 YouTube

<https://www.youtube.com/watch?v=Kxryv2XrnqM>



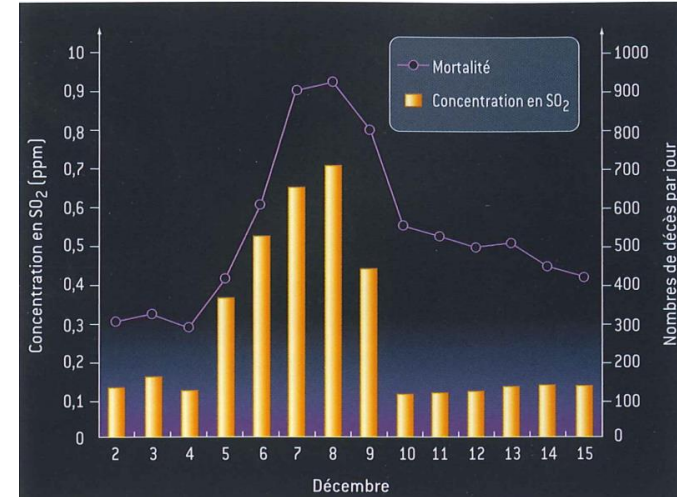
Evolution of the Environmental Issues in Atmospheric Sciences

In the fifties and sixties

SMOG is due to the **SO₂** resulting from the **coal** combustion in residential and industrial activity sectors.



December 1952, a SMOG episode killed 4'000 persons in London.



In the seventies and eighties

Photochemical SMOG is due to the **ozone (O₃)** resulting from the action of the solar radiation on **NO_x** and **VOC** which are emitted by the **fuel** combustion in thermal engines (vehicles).

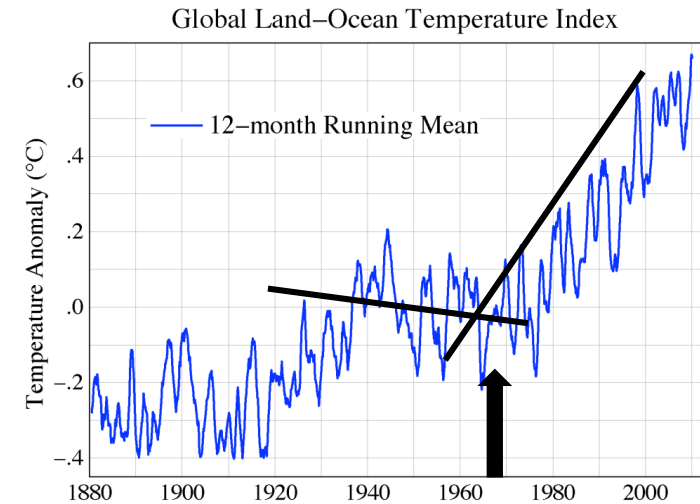
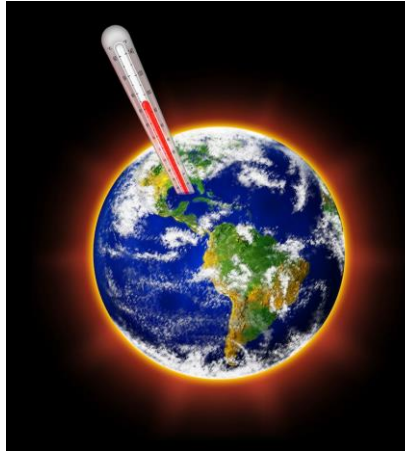


In the seventies in Los Angeles, frequent Photochemical SMOG events affected strongly population health in the city as well as crop yields outside the city.

Evolution of the Environmental Issues in Atmospheric Sciences

In the nineties and 2000

At the end of the eighties it became clear that **global warming** results from the anthropic emissions of **greenhouse gases** (especially **CO₂** produced by the fossil fuels combustions).



2000 to 2018

In 2013, air pollution deaths, mainly cause by **Particulate Matters (PM)**, cost global economy US\$225 Billions.



In China and India, the emitted **Particulate Matters** generate the Asian Brown Cloud.

Future Environmental Issues in Atmospheric Sciences?

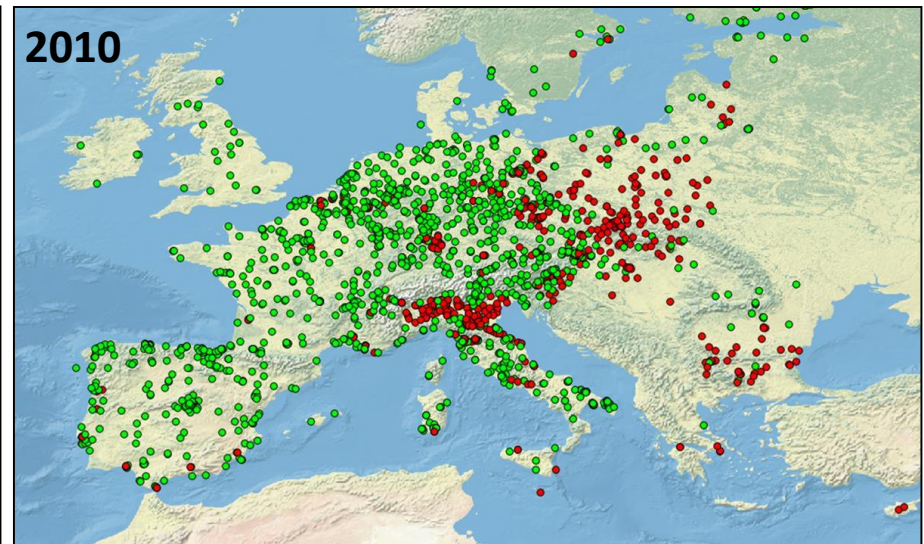
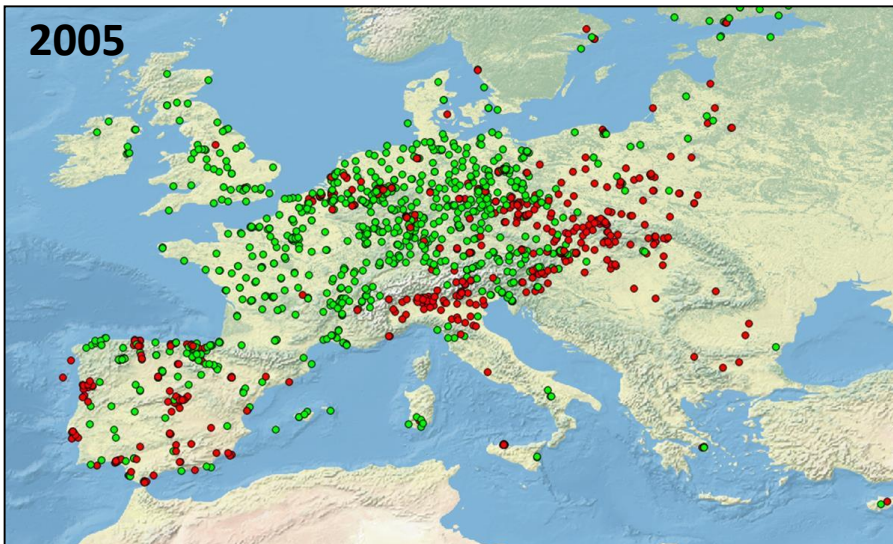
In the past, each new environmental problem occurring in the atmosphere have been caused by the use of specific technologies and energy resources.

- Which technology and energy resources will be used in the next 10 or 20 years?
- What will be their the environmental impacts?
- What will be the **next issues for environmental researches** ?

« Hot Spots » in Europe

Exceedances of the PM₁₀ limit (i.e. 50µg/m³ PM₁₀ average over 24H, 35 days/year

Measurement stations: urban background

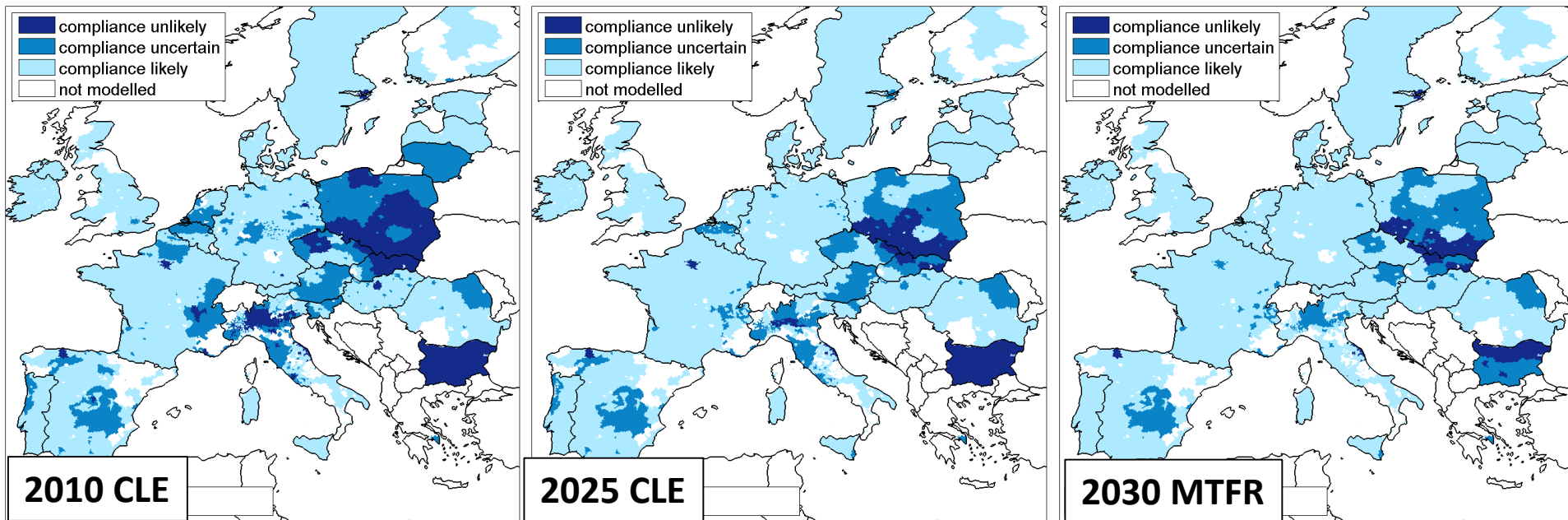


Green = Stations complying the limit
Red = Stations exceeding the limit

« Hot Spots » in Europe

Exceedances of the PM₁₀ limit (i.e. 50µg/m³ de PM₁₀ average over 24H, 35 days/year)

Projections computed by IIASA using the GAINS model

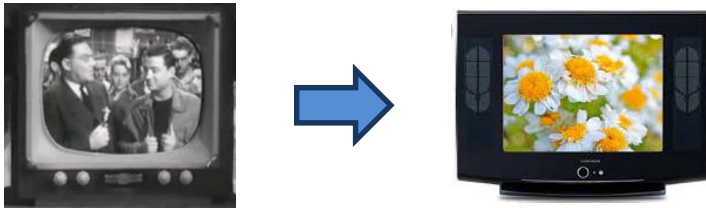


CLE: Application of the current legislation

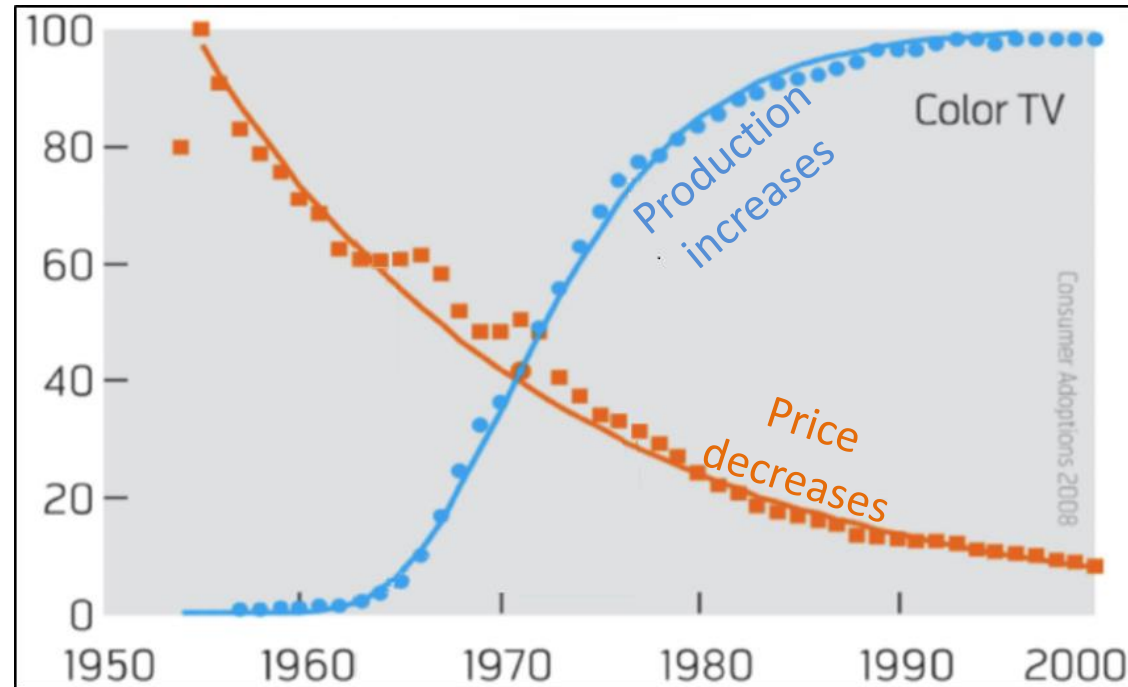
MTRF: Maximum technical feasibility

Technological Changes and Disruption

Example of color TV



Exponential evolution of a technological change.



When disruption can happen?

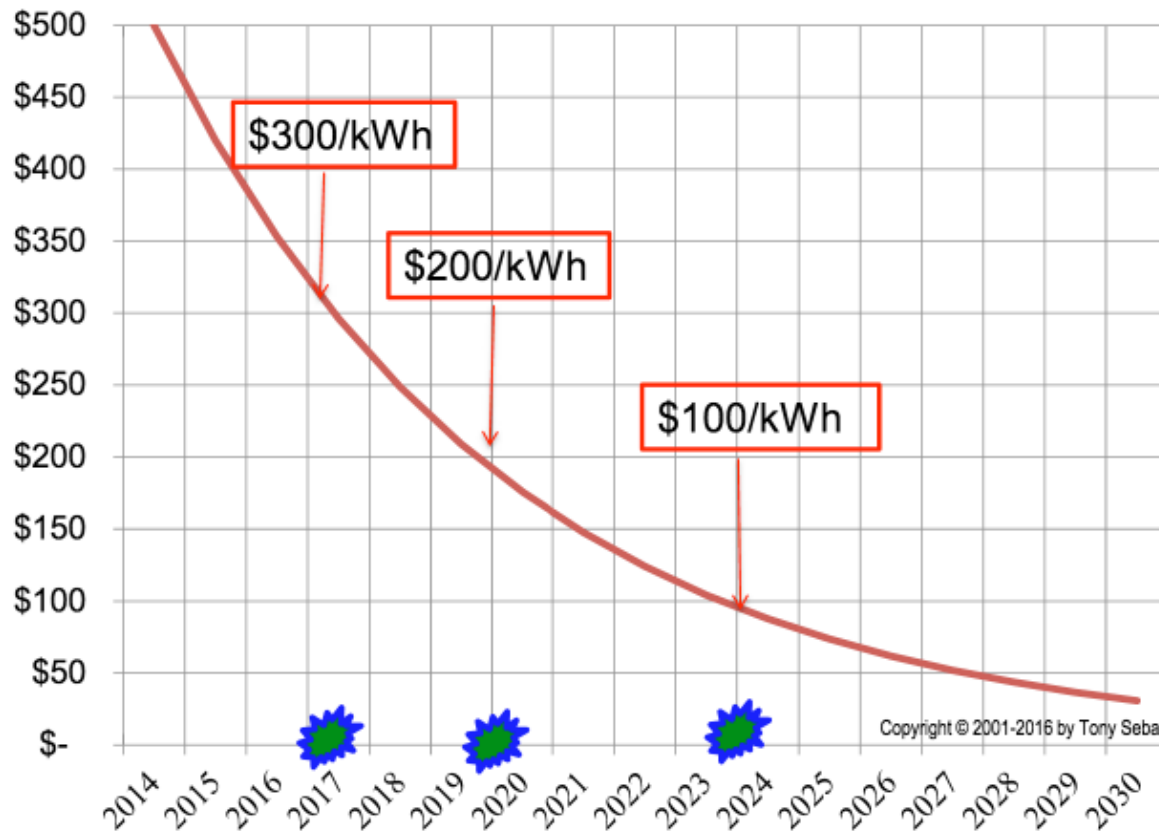
- Available new technologies (investment on research)
- Available potential market
- Enough investments to start a massive production
- Enough available resources (raw materials and energy)

Even smart peoples **often fail to forecast** disruptions because it happens much faster than expected

Energy Storage

Example of disruption: Battery price is decreasing exponentially

Projected Cost of Li-On Battery Storage (\$/kWh)

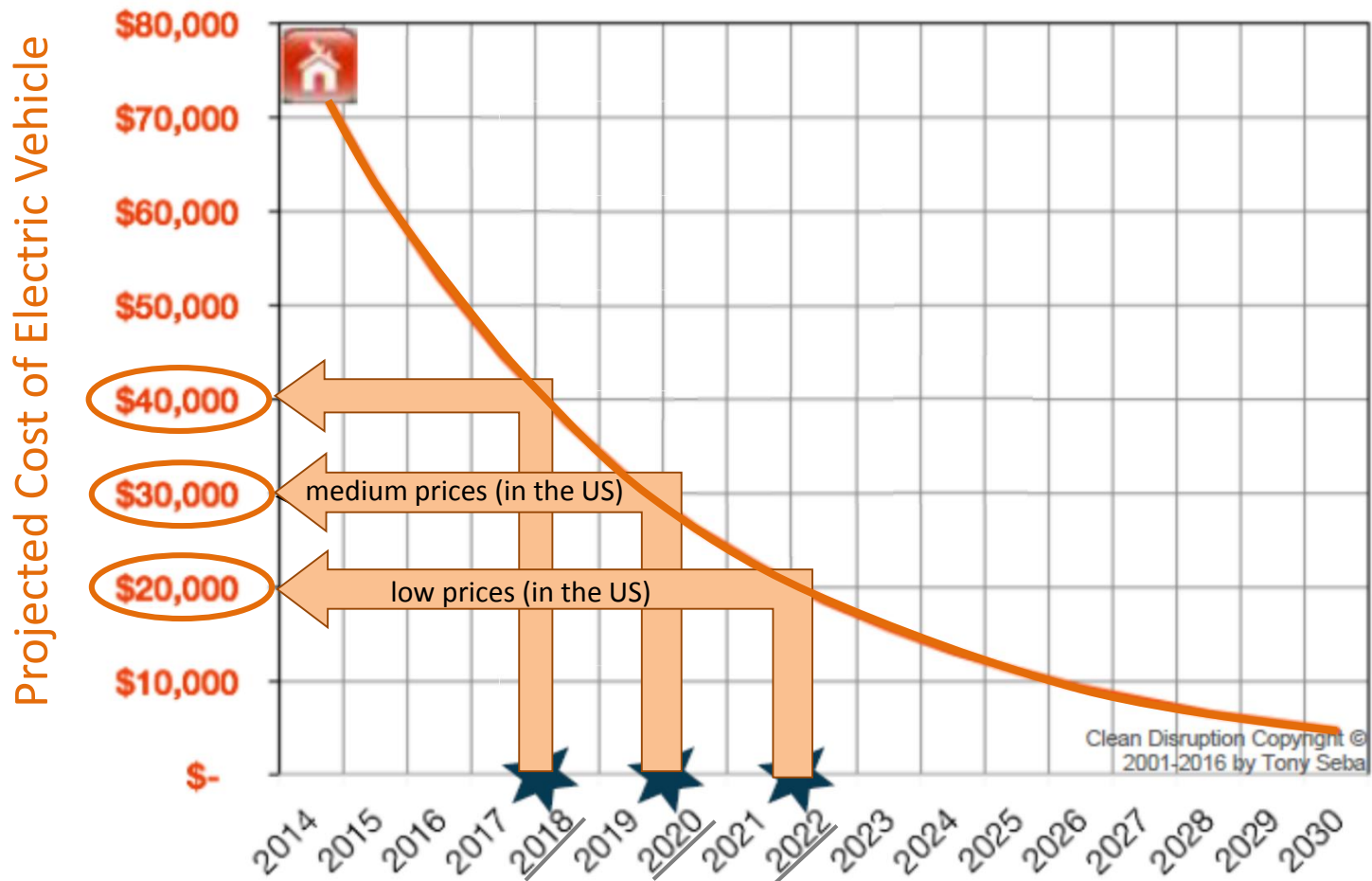


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Assumption: 16% /year Technology Cost Curve

Vehicle Technology

Electric vehicle prices is following the trend of battery prices.



Electric Vehicle Cost and Performances

For the same performances electric vehicle prices are already lower than thermal vehicles.



Tesla model S

37'000 Euros

from 0 to 100 km/h in 5,1 s

around 500 km of autonomy



Porsche Cayman

66'000 Euros

from 0 to 100 km/h in 5 s

more than 1000 km of autonomy

autonomy is still low, but it is constantly progressing...

Progression of Battery Technology

Tesla's Battery GigaFactory



- double world battery production
- reduce battery pack costs by 30 to 50%

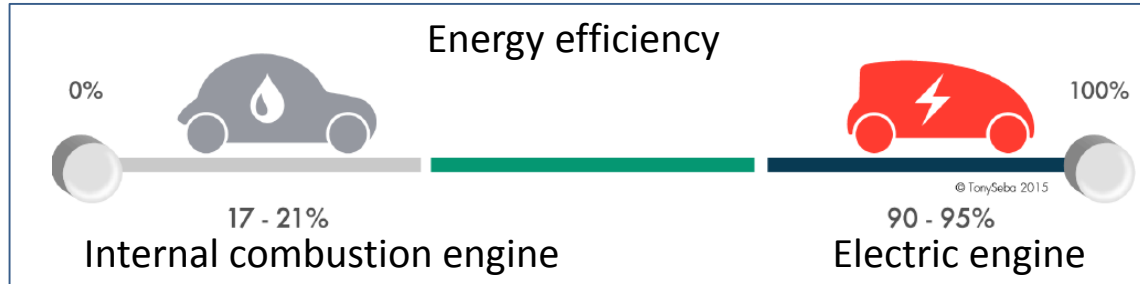
Toyota's new solid-state battery could make its way to cars by 2020



This improved battery technology would make it possible to create smaller, more lightweight lithium-ion batteries for use in electric vehicles, that could also potentially boost the total charge capacity and result in longer-range vehicles.

Cost of Use of Electric Vehicles

Electric vehicles use less energy than thermal vehicles



Maintenance costs of electric vehicles are lower than for thermal vehicles

more than **2'00 moving parts** in an internal combustion engine

18 moving parts in an electric engine

→ an electric vehicle is **10 to 100 time chipper to maintain.**



Electricity is cheaper to transport than fuels

Cost of Use of Electric Vehicles are already lower than for Thermal Vehicles

Electric Vehicles Technology is Disruptive

Une euro-commissaire: 'Le passage à la voiture électrique sera beaucoup plus rapide que prévu'



Pieter Van Nuffel
Journalist DataNews

19/09/17 à 12:29 - Mise à jour à 12:29
Source: Belga

Selon la Commission européenne, le passage à la voiture électrique se fera plus rapidement que ce qui avait été prévu, il y a quelques années encore. Il s'agira donc de corriger sa stratégie industrielle: ne plus injecter de l'argent dans la recherche sur les moteurs à combustion, soutenir le déploiement de l'infrastructure de recharge et encourager l'industrie à produire des batteries.

"Je pense que la plupart d'entre nous dans cette salle conduiront une voiture électrique d'ici dix à quinze ans", a expliqué l'euro-commissaire **Elzbieta Bienkowska** hier lors d'une conférence de presse consacrée à la stratégie industrielle, organisée à Bruxelles. "Pour les voitures de société, cela pourrait même se faire d'ici cinq ans déjà", a ajouté le vice-président **Jyrki Katainen**. "Cela se passe beaucoup plus vite que ce qui était prévu, il y a quelques années. Cette révolution progresse très rapidement", a poursuivi Bienkowska.

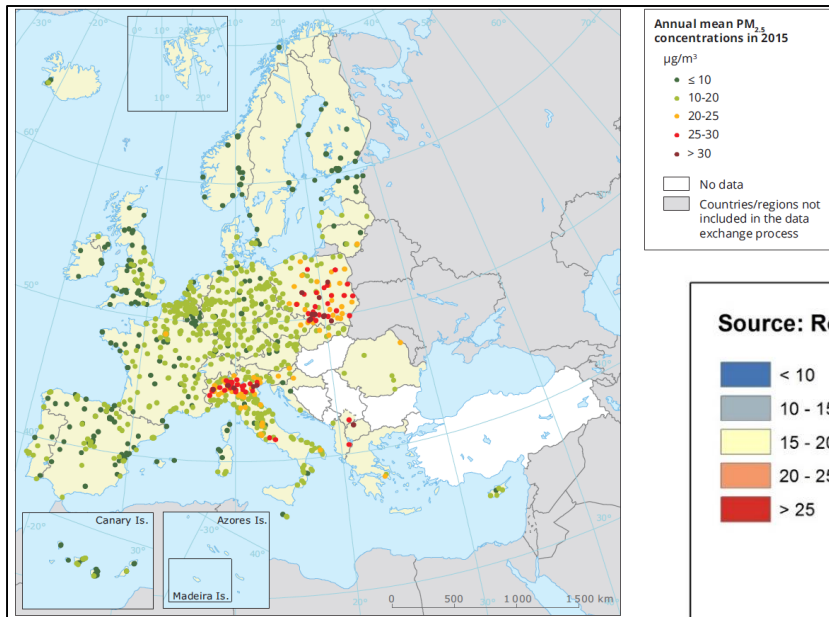


Elzbieta Bienkowska, l'euro-commissaire en charge du Marché Interne et de l'Industrie, lors de la conférence de presse consacrée à la stratégie industrielle © REUTERS

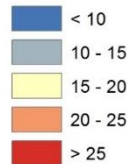
The transition to electric vehicle already starts, it will be faster than expected and it should be completed in the next 10 to 15 years (i.e. around 2030).

Air Quality without Thermal Vehicles?

Drastic abatement of vehicle emissions

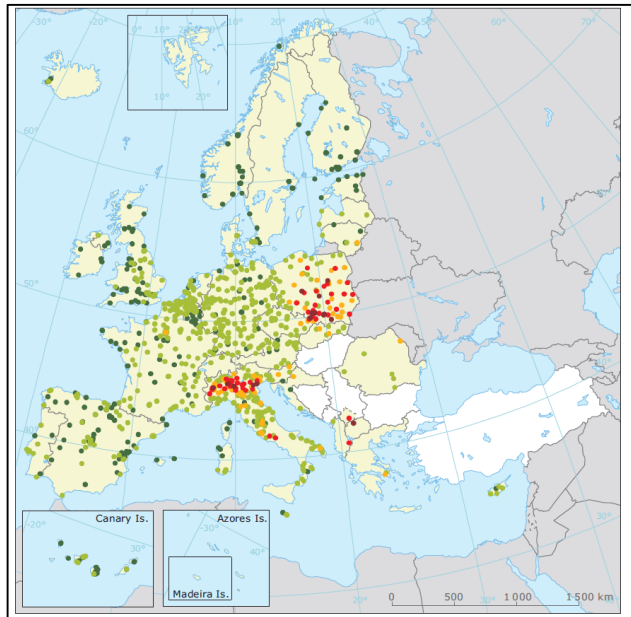


Source: Road Transport [%]

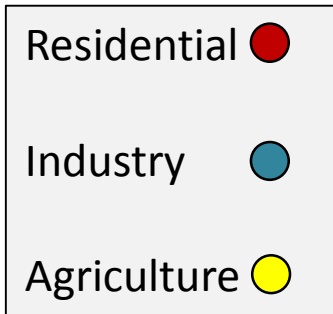
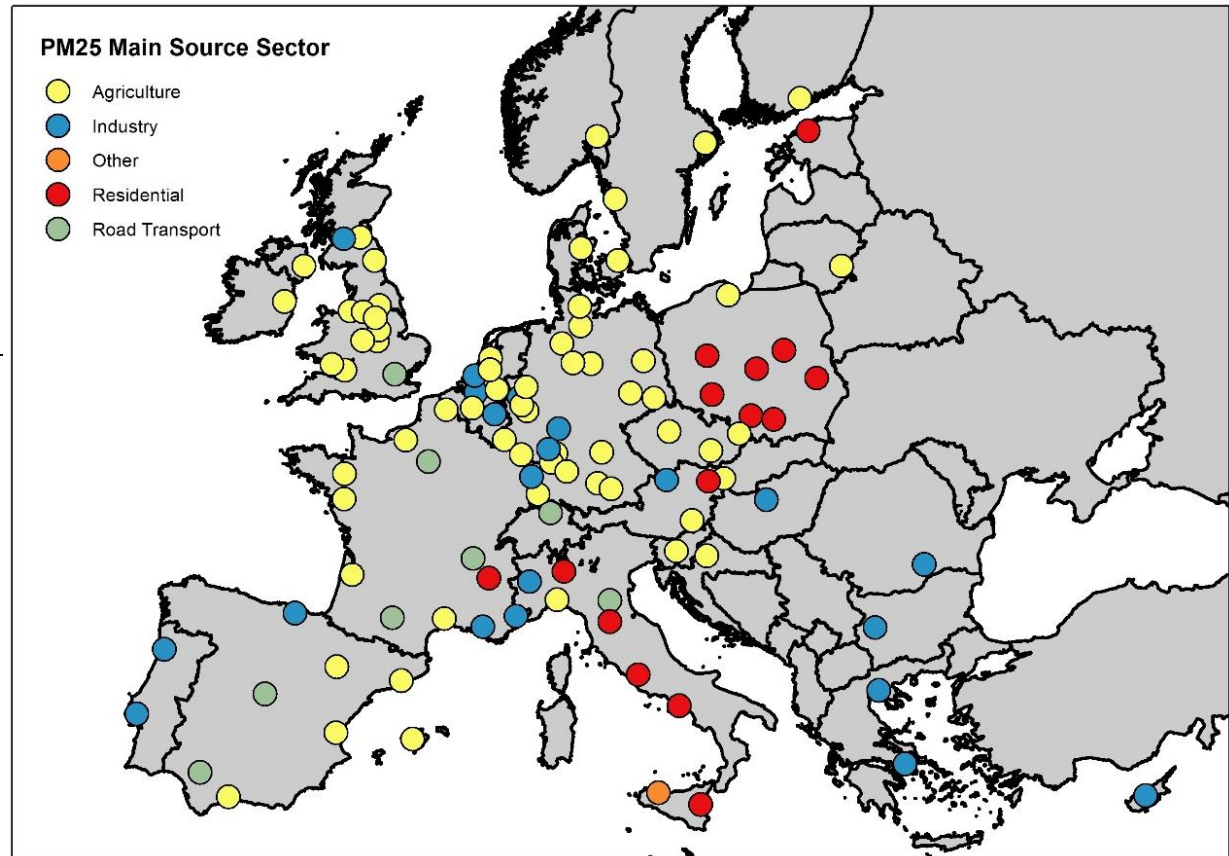


Now (i.e. 2015), road transport emissions contribution (due to thermal vehicles) to PM formation can reach almost 40% in few spots (Madrid, Paris) but it is less than 25% for most European cites.

Other PM Sources



Air quality researches will have to focus on other emission sources because they will become the most important.



Electric Vehicles and New Environmental Issues

Despite the reduction of direct emissions into the atmosphere the emergence of electric vehicles will still cause environmental problems:

- ❑ even an electric vehicle emits PM (breaks, tires...),
- ❑ what will be the environmental issues caused by a massive use of batteries (environmental impacts of battery production and recycling processes)?
- ❑ what will be the environmental issues caused by the increase of electricity demand (environmental impacts of electricity production)?

To choose the best environmental strategies it will become more and more necessary to study the entire impact of technology (use of **Life Cycle Assessment approaches**).



Obrigado pela sua atenção