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(ASP2024)**

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Faculty of Sciences Semlalia Marrakech
Cadi Ayyad University

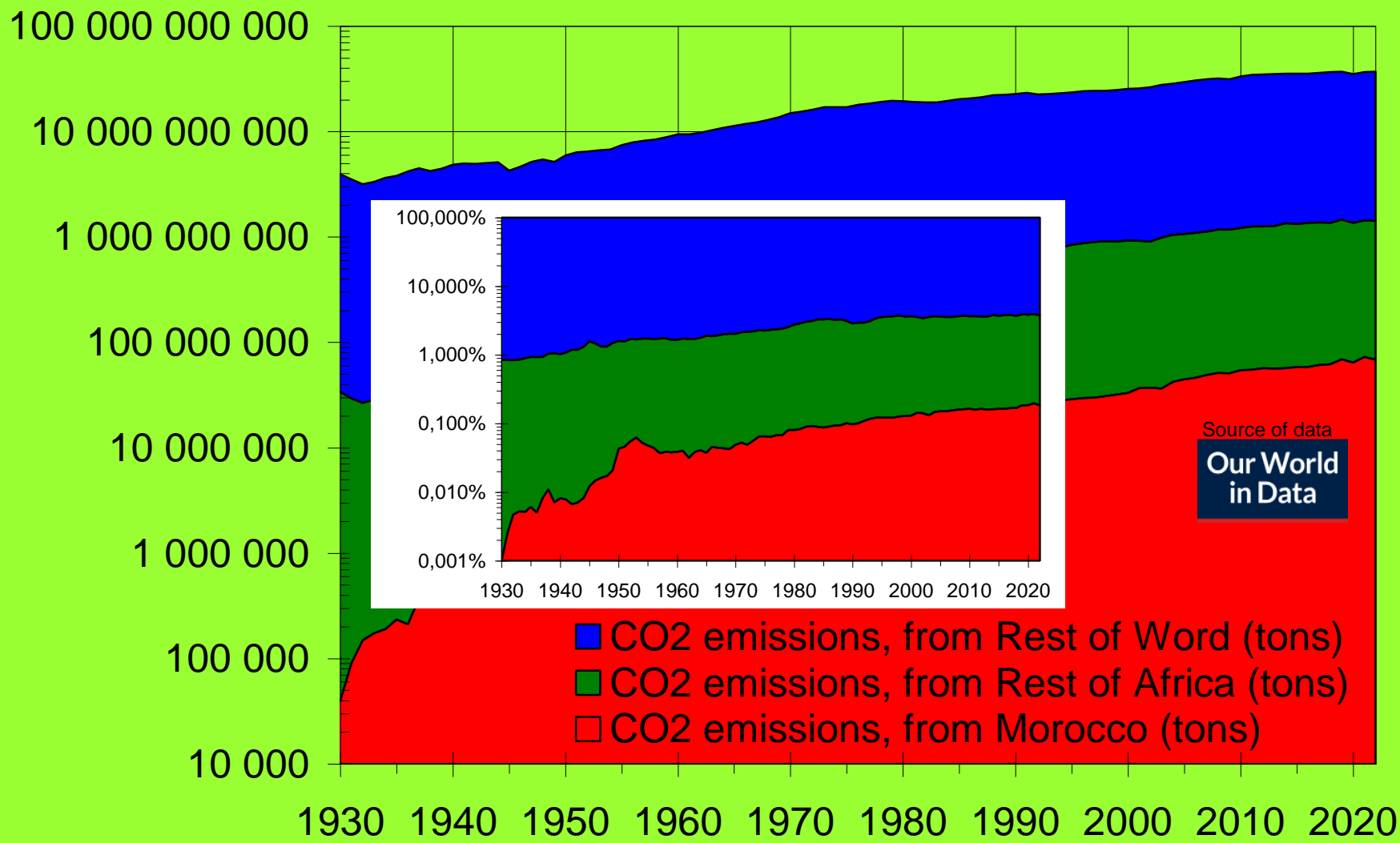
***"Evolution of energy and electricity needs by 2050 in
Morocco in the light of several penetration scenarios of
battery electric vehicles"***

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INTRODUCTION

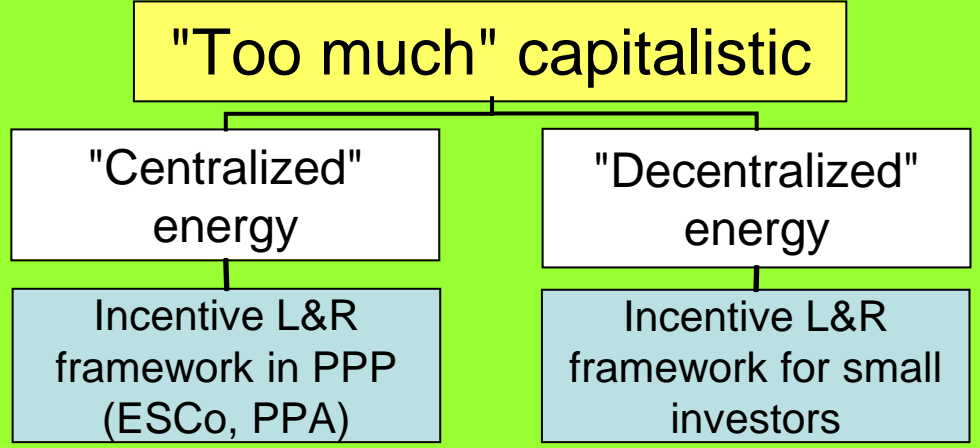
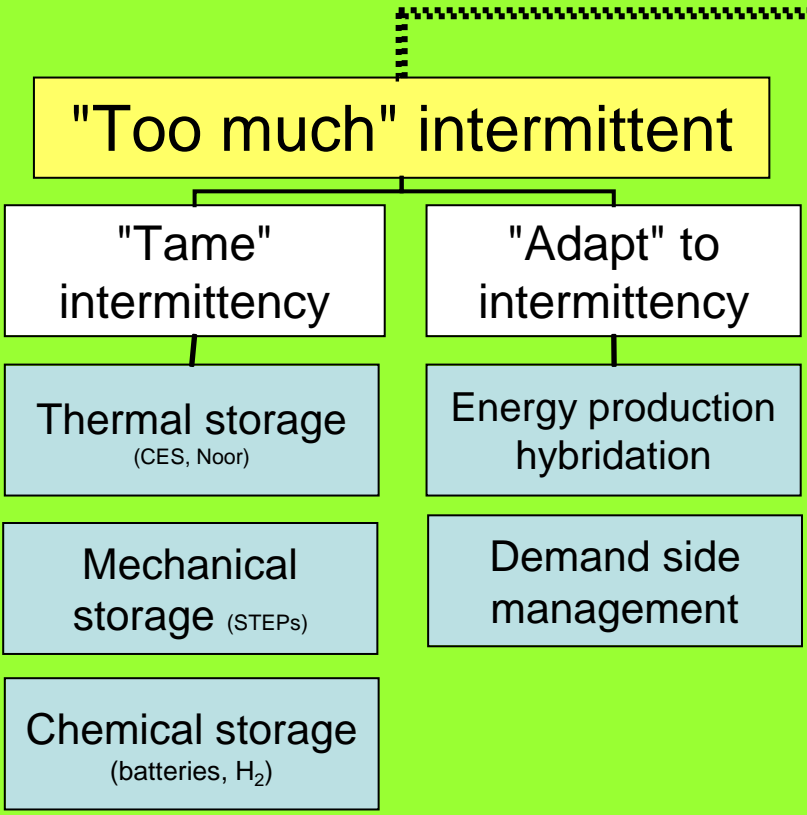
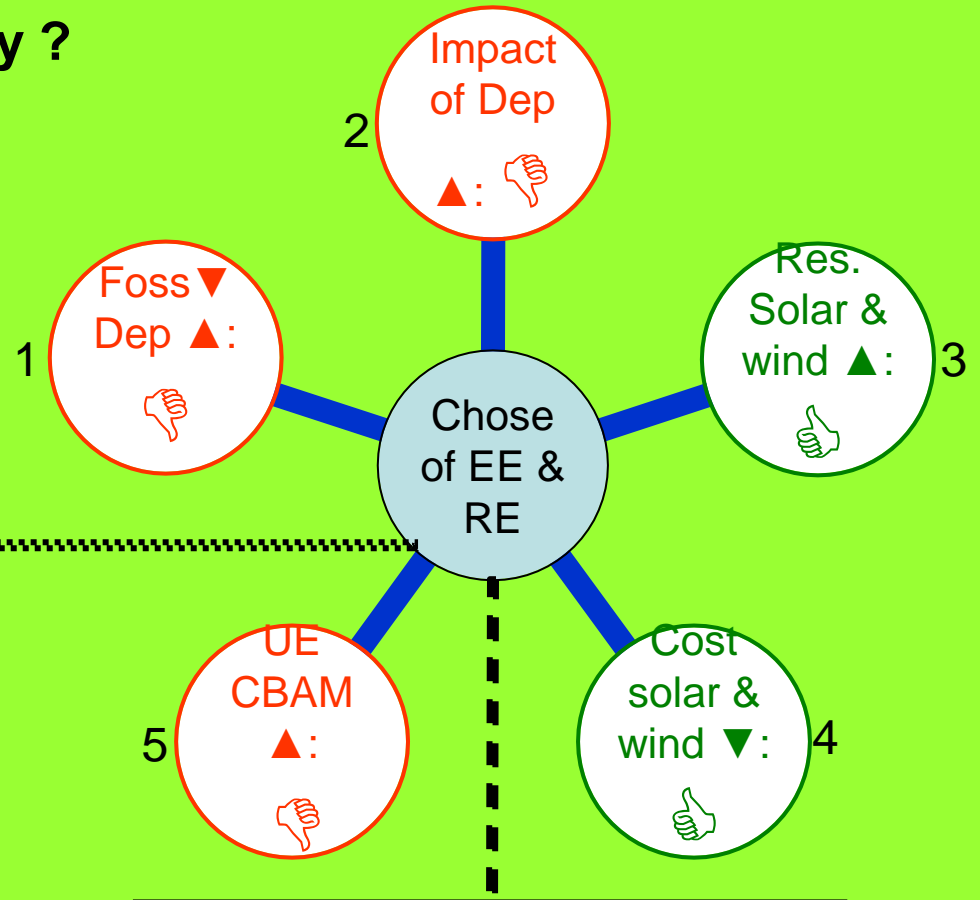
What is pushing Morocco towards renewable electricity production and its intensive exploitation ?

Morocco has no “objective” reasons to move towards renewable energies to fight global warming, and yet...



Morocco has only 0.16% of the planet's anthropogenic emissions in 2022 (37 Gt), despite having 3 times more population share (0.48%): Morocco is one of the countries which suffer the most from global warming while having a negligible impact on its causes!

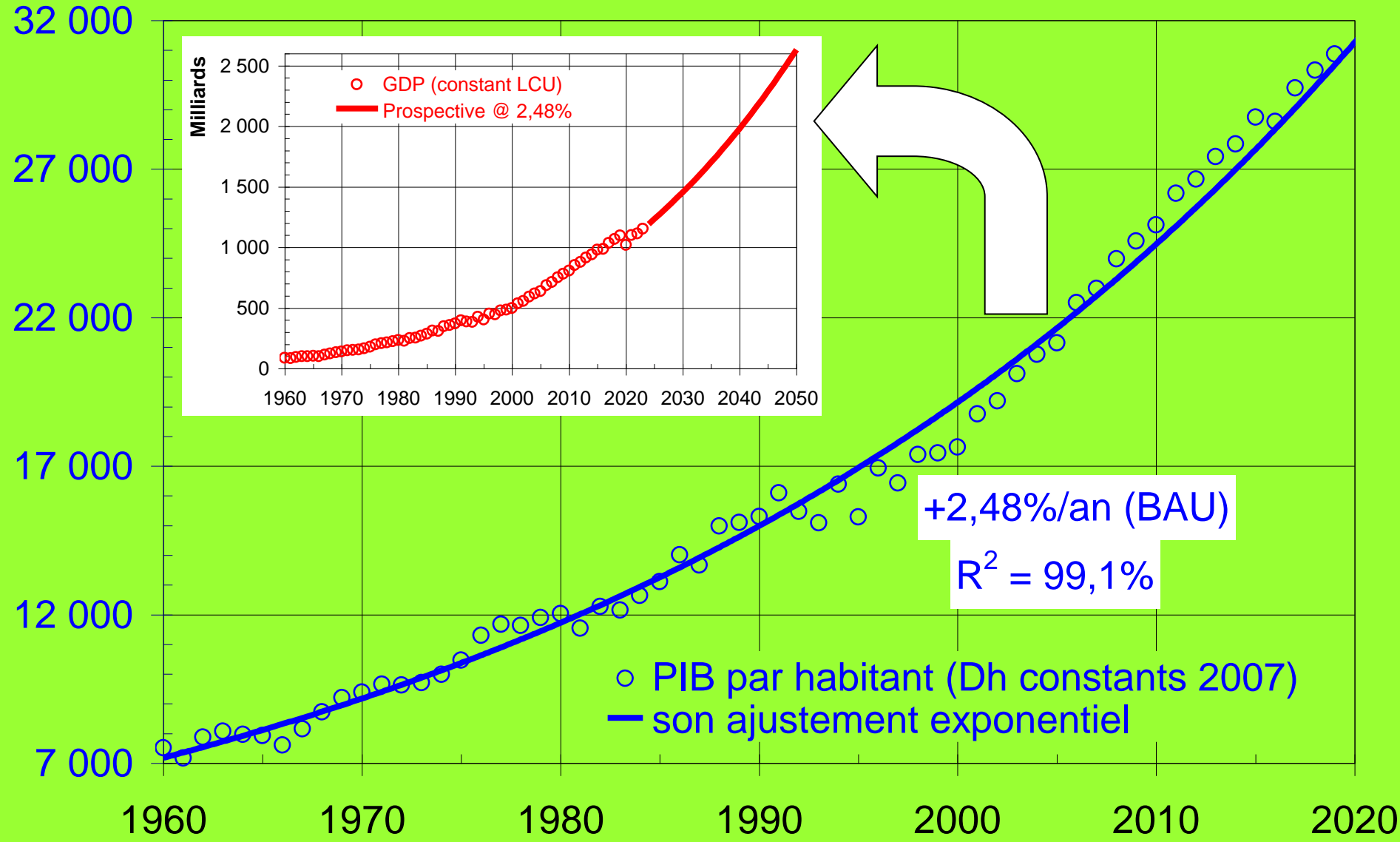
... then why chose renewable energy ?



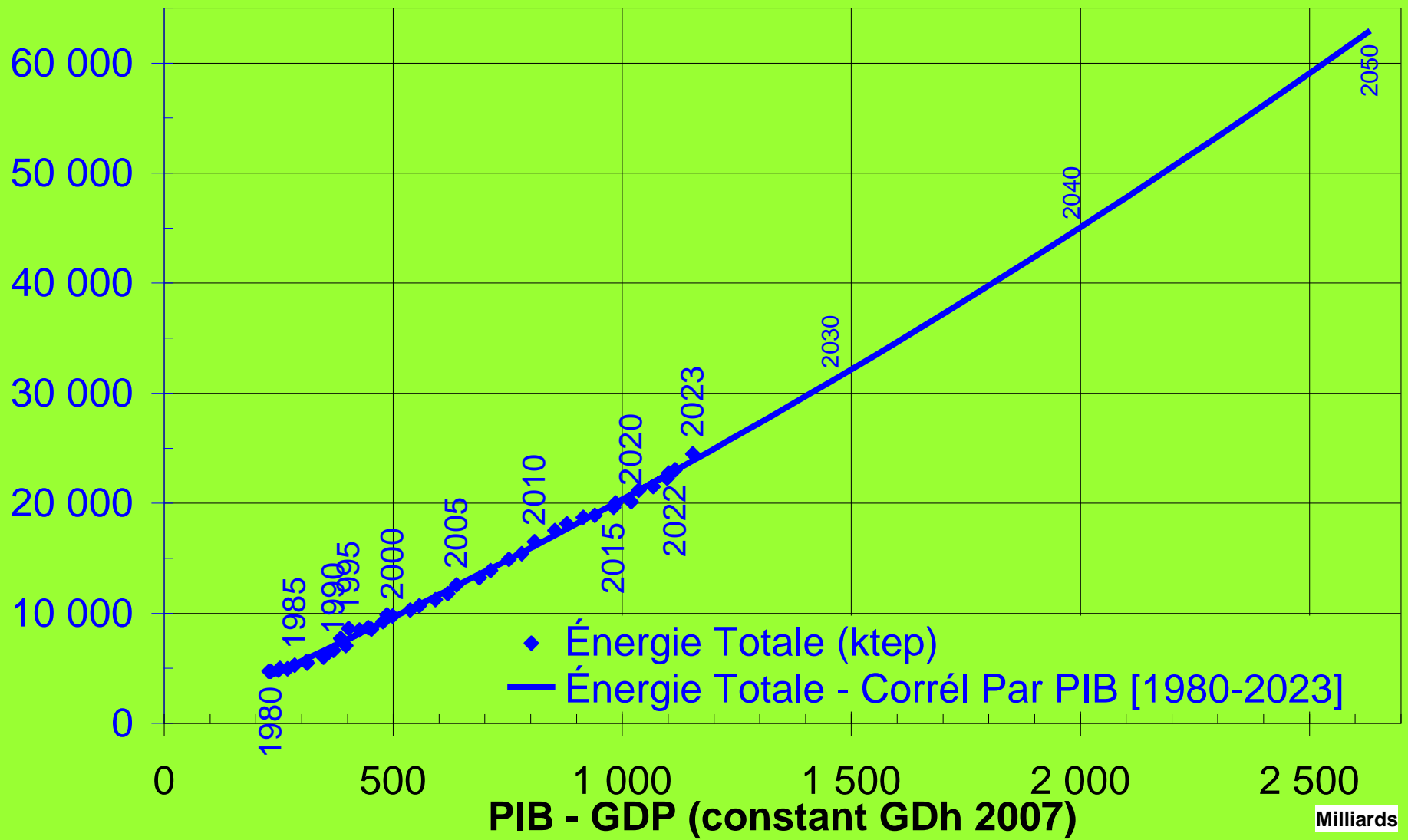
PART 1

The foundations of a 'major trend' in energy and electricity in Morocco

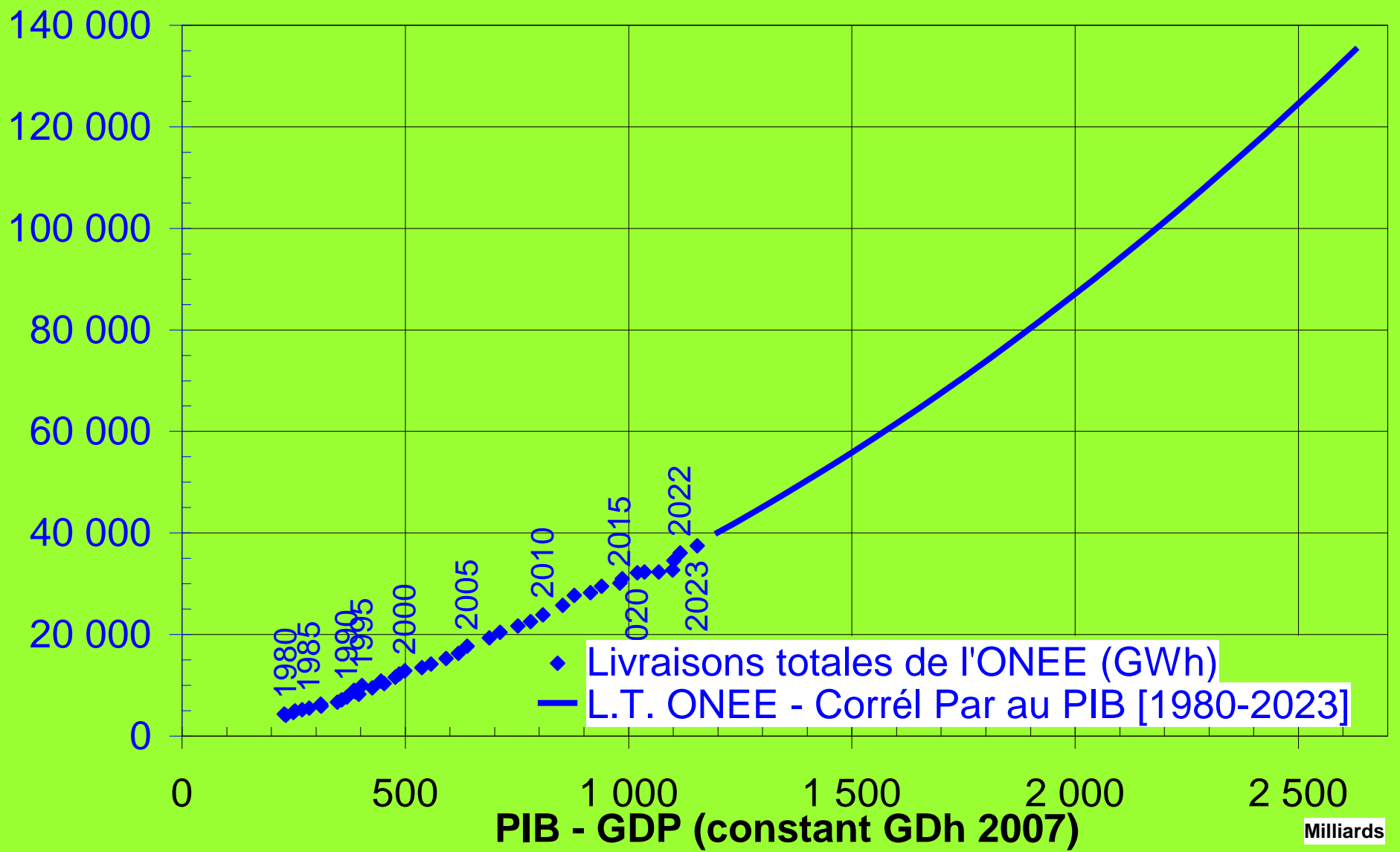
Evolution of Gross Domestic Product (PIB) in constant Dirhams (Dh) per capita between 1960 and 2019 in Morocco



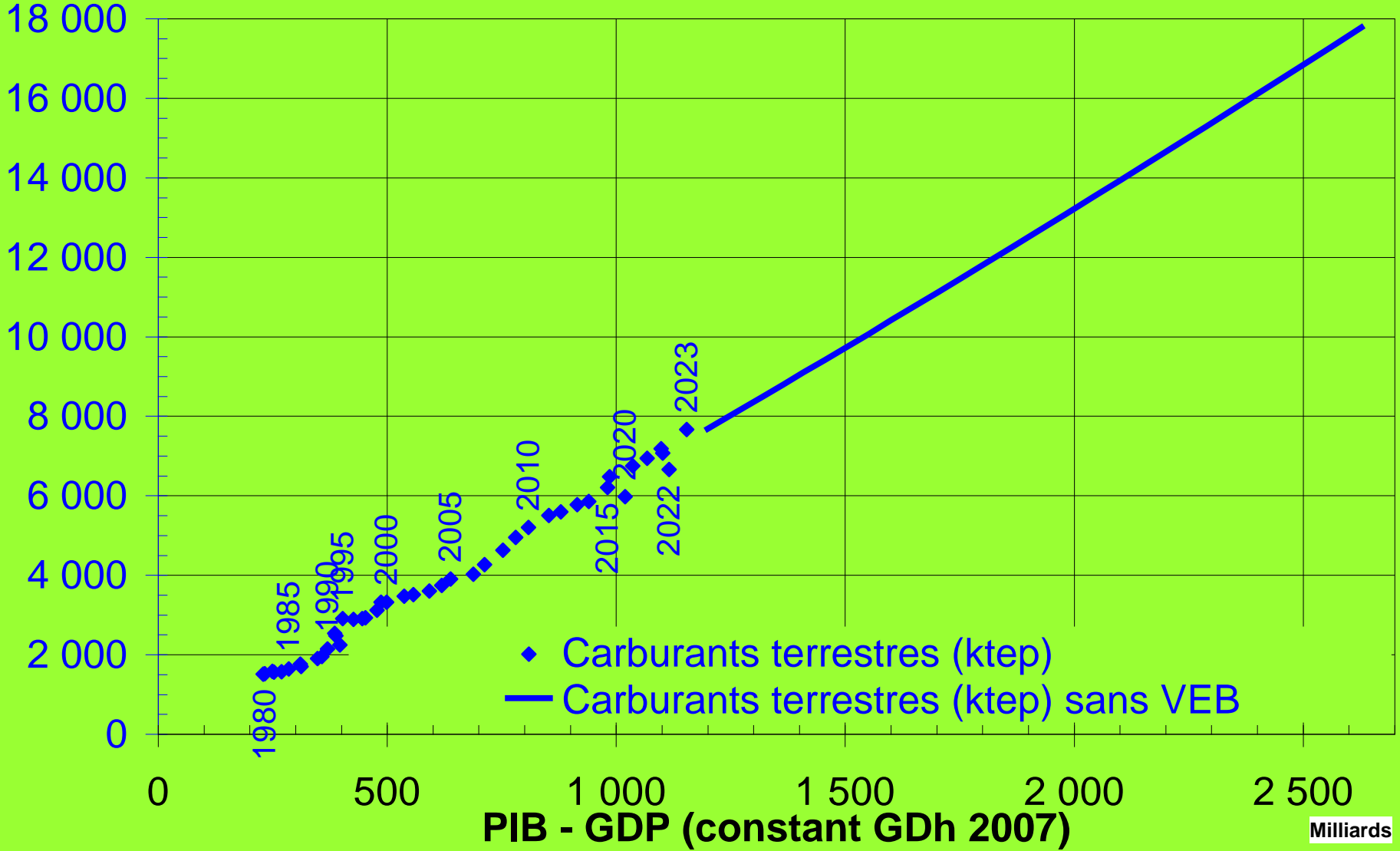
Correlation between total energy consumption and GDP in constant Dh (energy - GDP nexus) extrapolated to 2'600 billion Dh



Correlation between ONEE electricity deliveries and GDP in constant Dh (energy - GDP nexus) extrapolated to 2'600 billion Dh



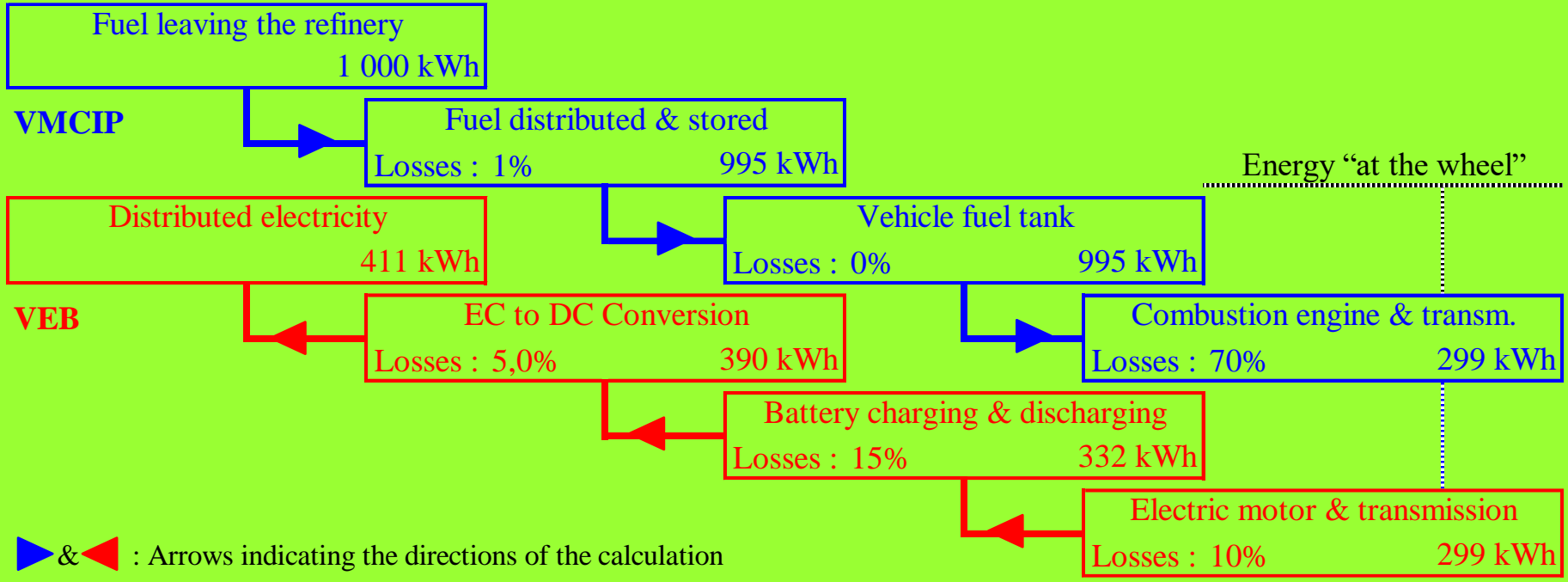
Correlation between land transportation fuel energy and GDP in constant Dh (energy - GDP nexus) extrapolated to 2'600 billion Dh



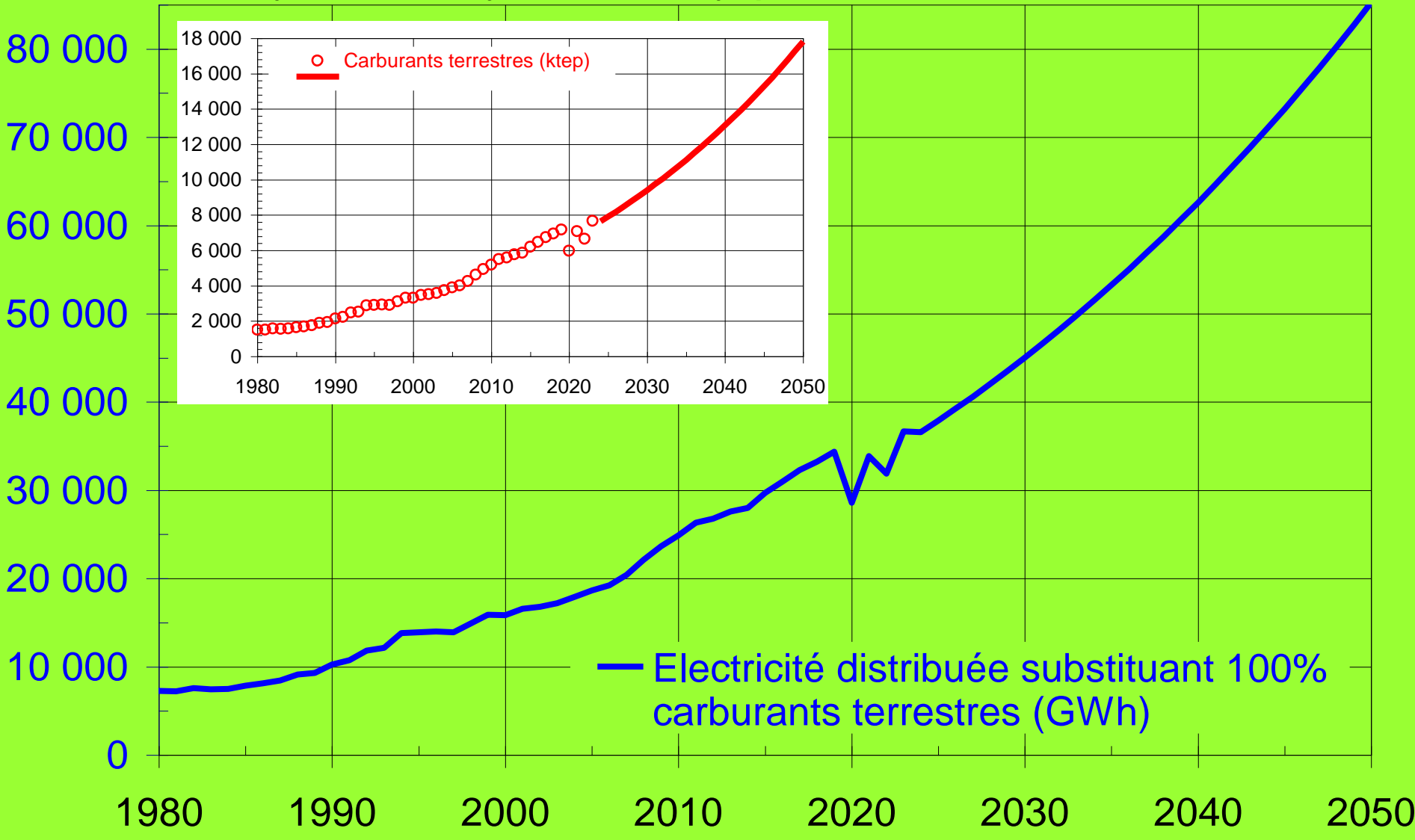
PART 2

***Forecast of electricity needs for the penetration of
battery-powered electric vehicles in Morocco***

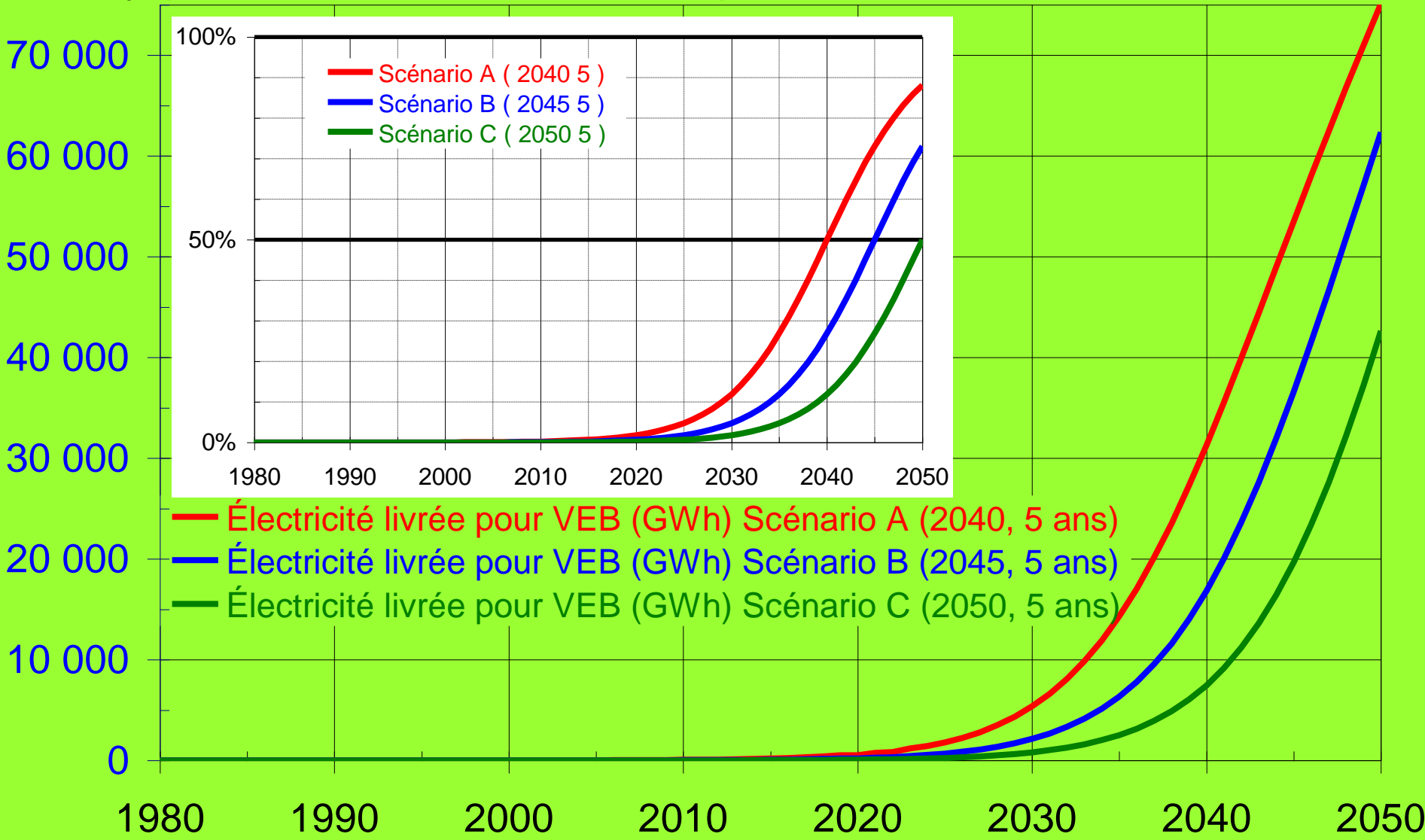
Conversion chain energy requirements for combustion engine vehicles (VMCIP) and for battery-powered electric vehicles (VEB)



Land transport energy for combustion engine vehicles (VMCIP) substituted by electricity for battery-powered electric vehicles

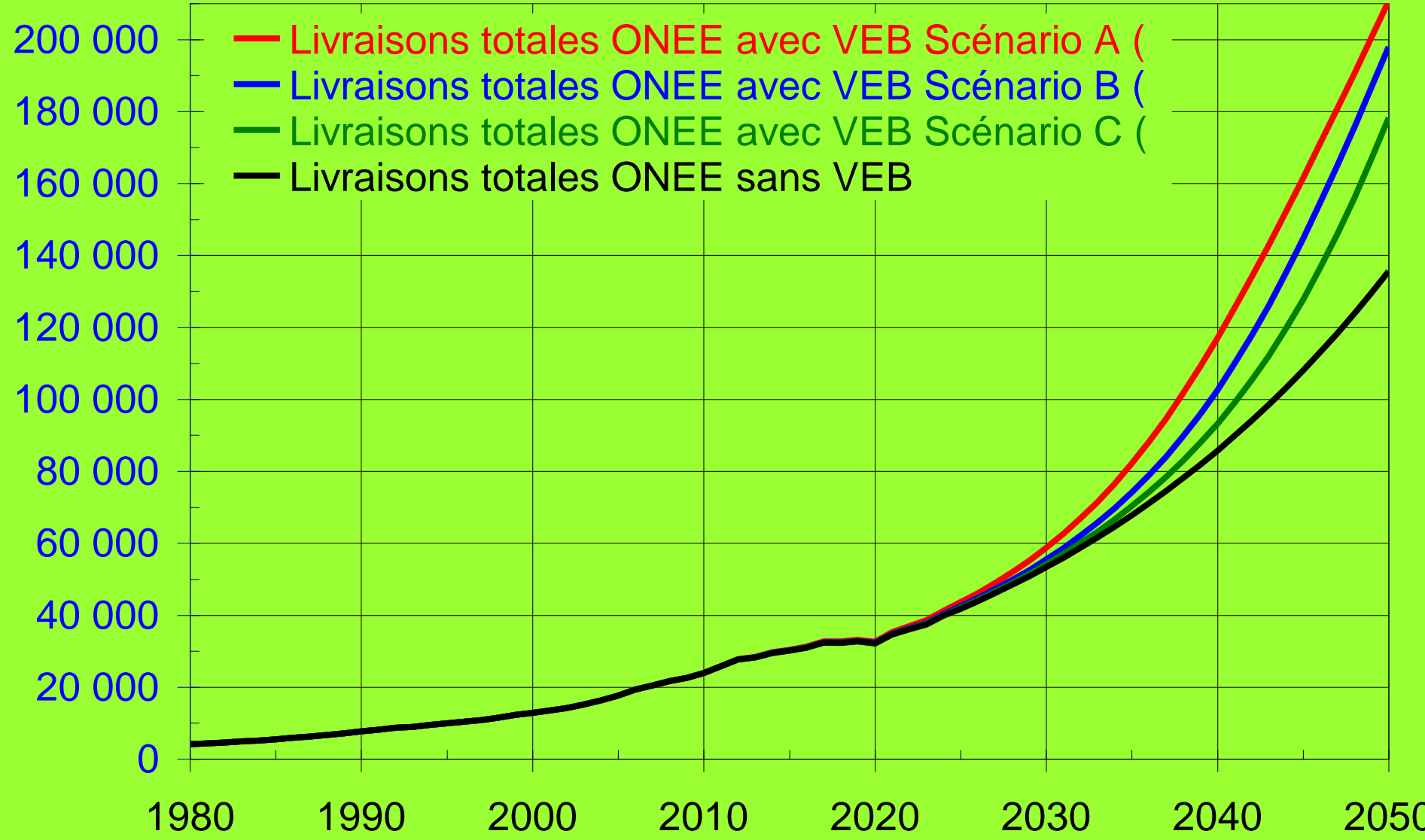


Additional electricity deliveries for electric vehicles in three battery-powered electric vehicles penetration scenarios.



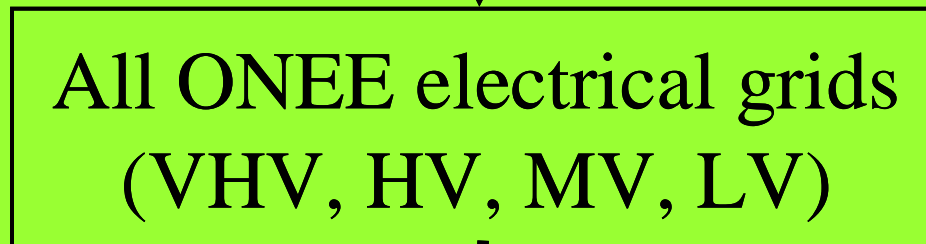
— Électricité livrée pour VEB (GWh) Scénario A (2040, 5 ans)
— Électricité livrée pour VEB (GWh) Scénario B (2045, 5 ans)
— Électricité livrée pour VEB (GWh) Scénario C (2050, 5 ans)

Electricity requirements for all scenarios of battery-powered electric vehicles penetration



A (very) simplified diagram of the Moroccan electricity grid

Net electricity called
(production and net imports)

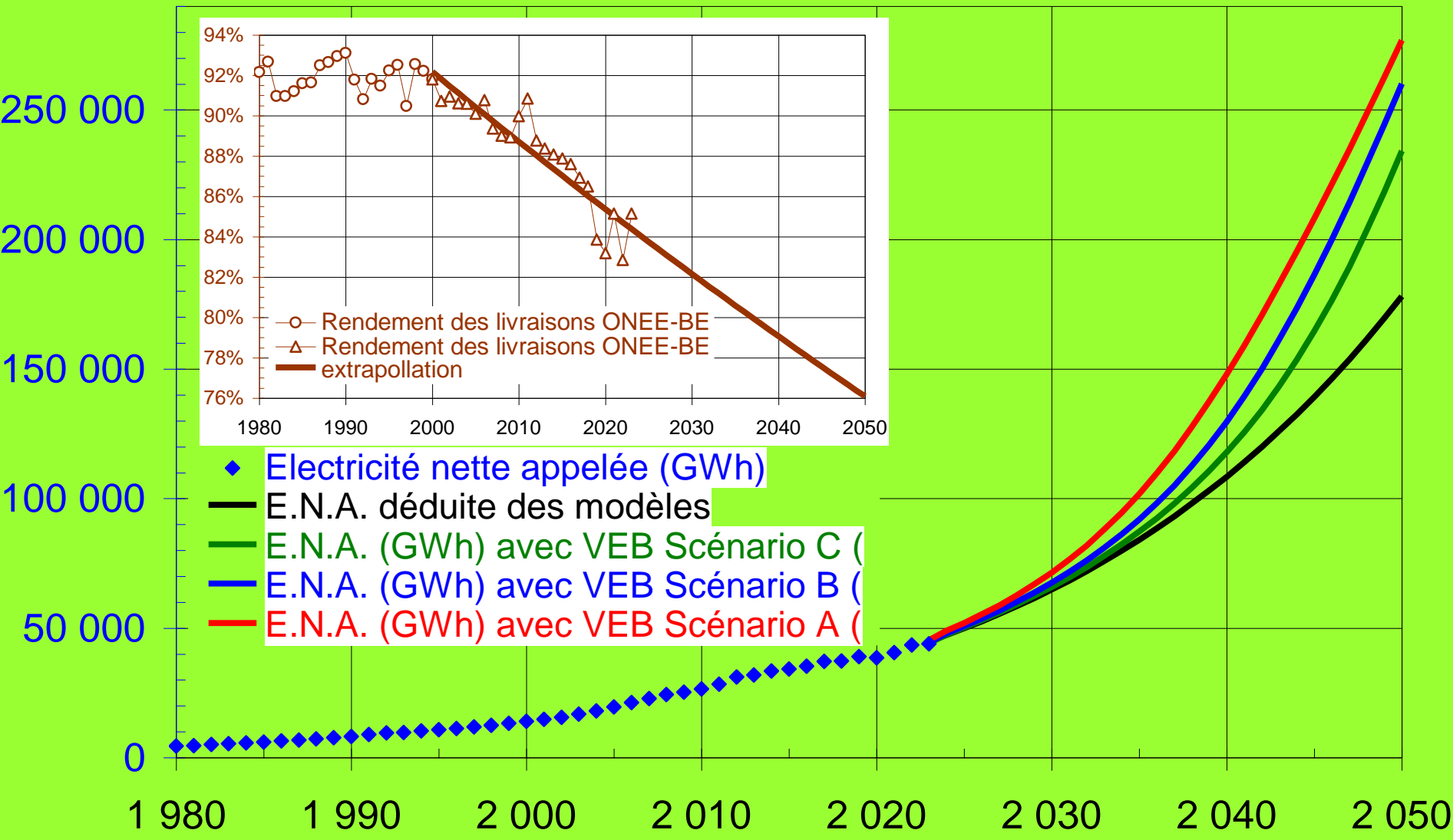


Line
losses

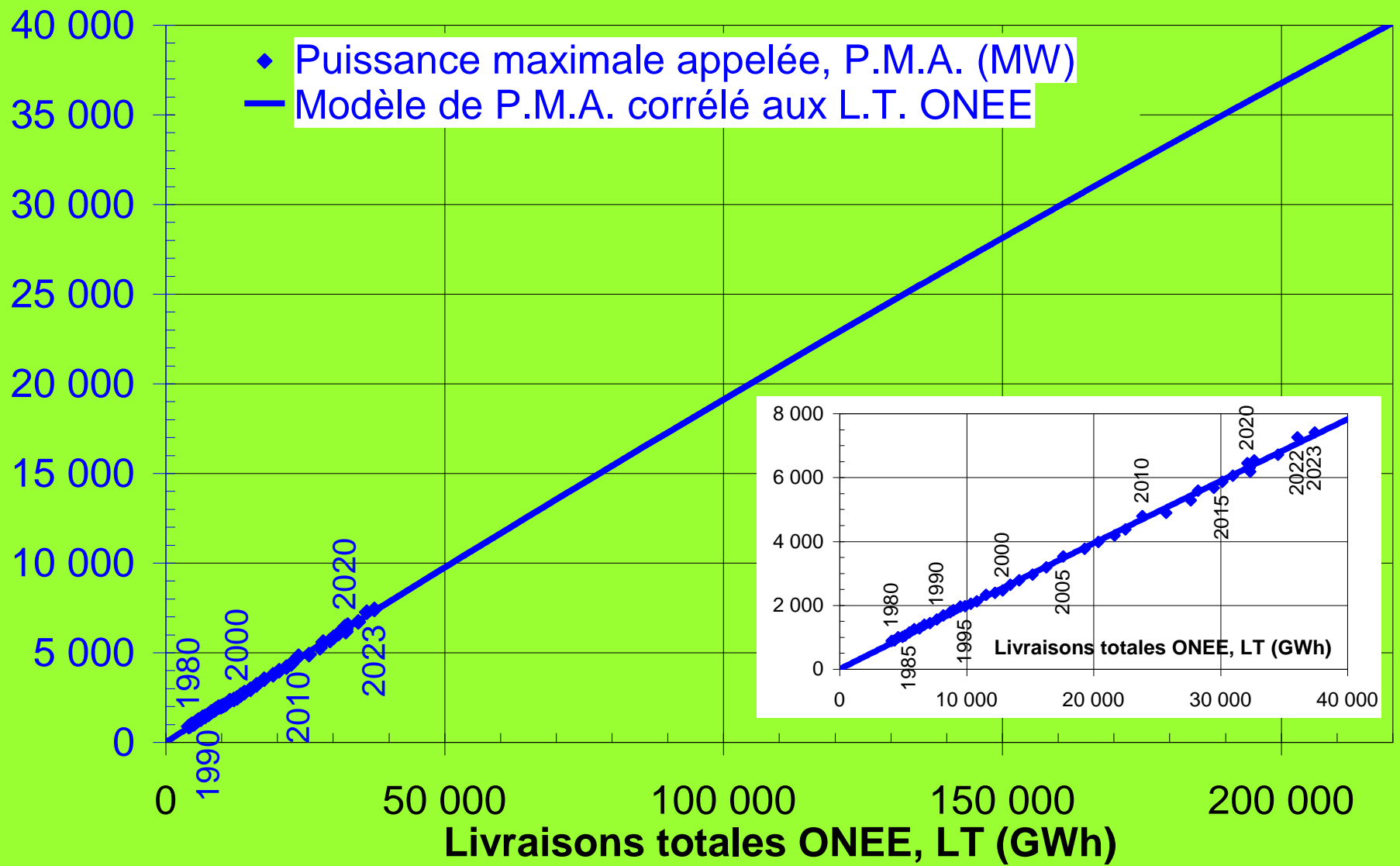


ONEE total deliveries
(its customers, REL customers, distributors)

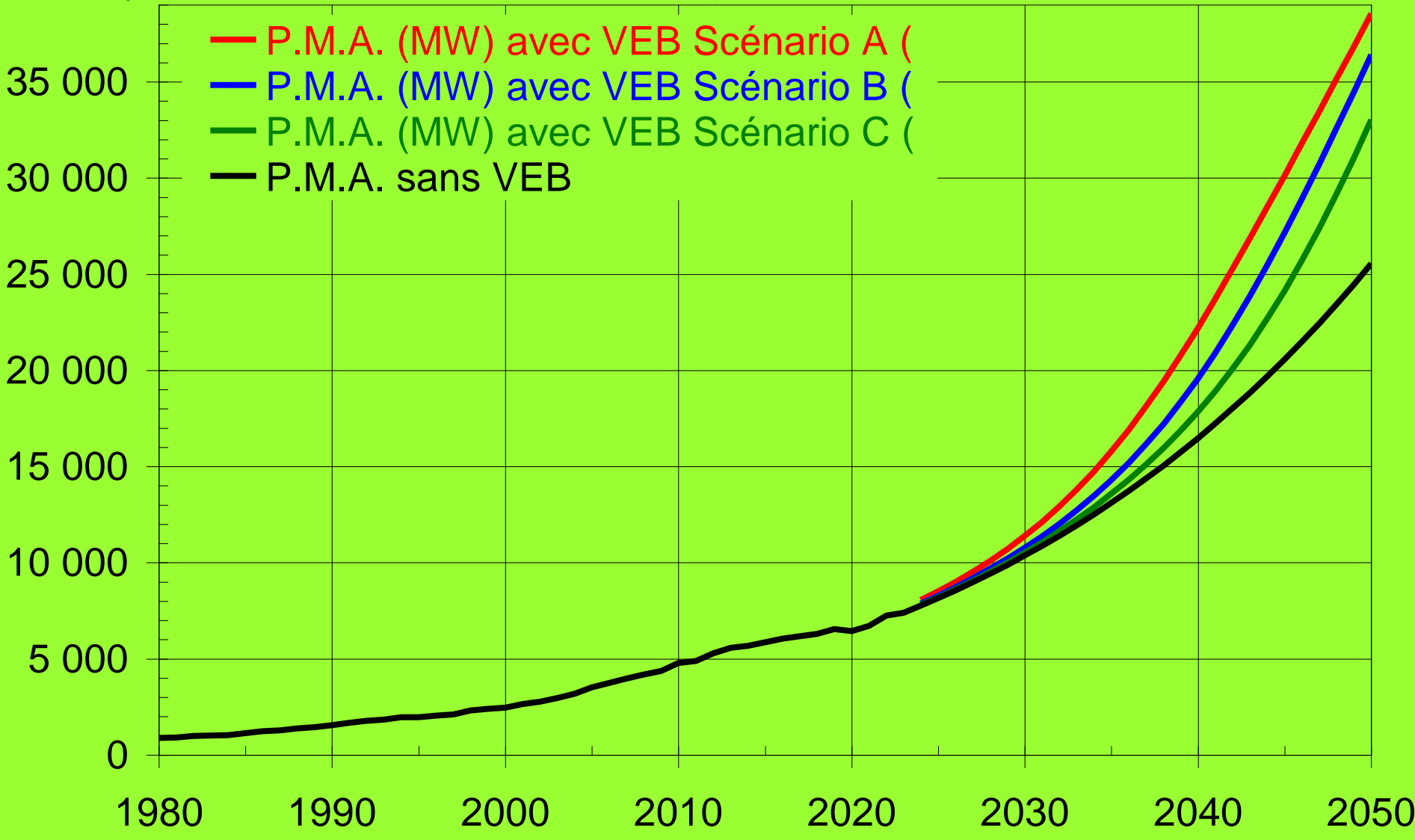
Grid efficiency and grid electricity requirements (ENA) for all battery-powered electric vehicles penetration scenarios



Correlation between yearly maximum power demand (PMA) and ONEE deliveries extrapolated to above 210 TWh



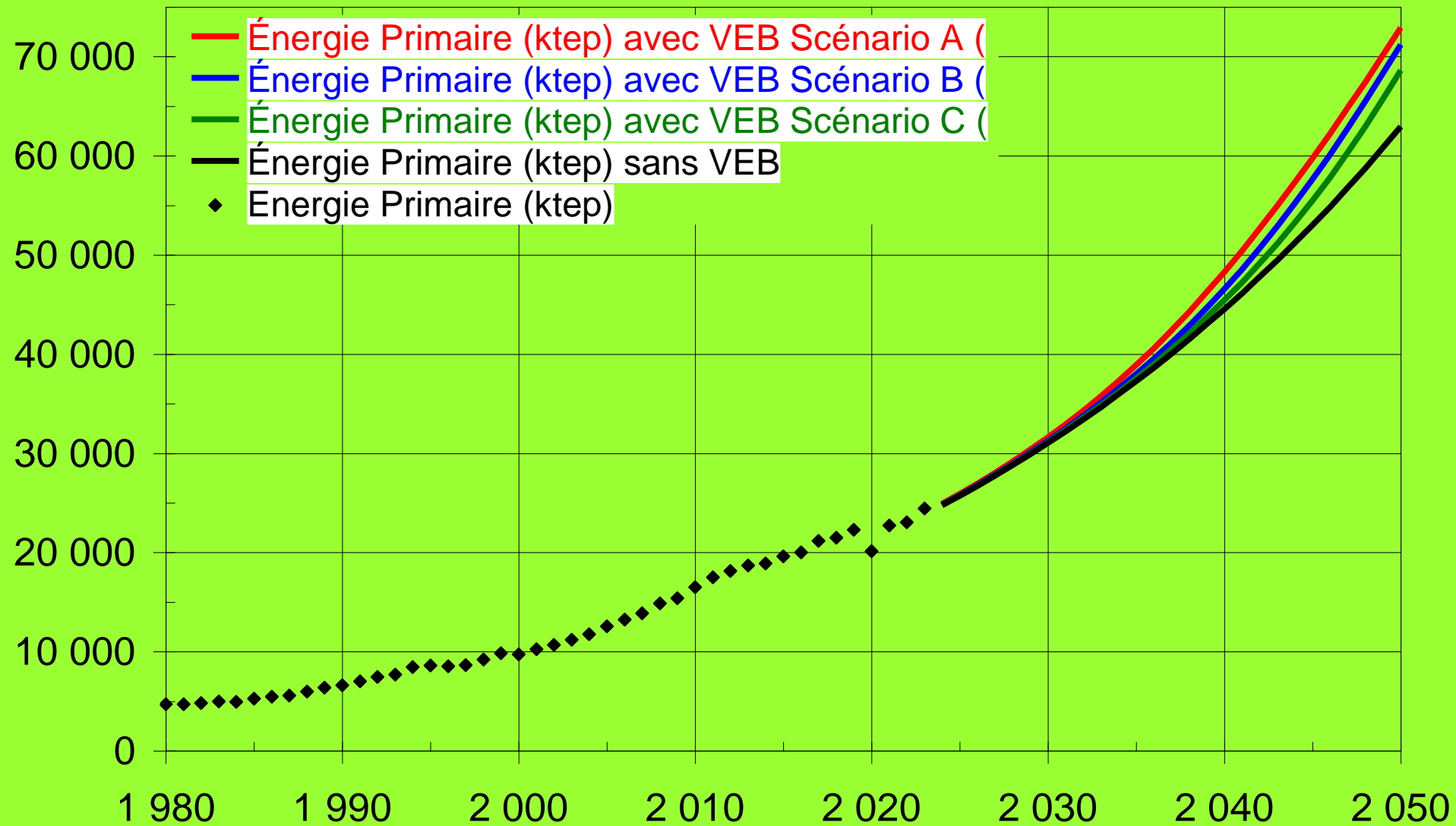
Evolution of the yearly maximum power demand (PMA) for all battery-powered electric vehicles penetration scenarios



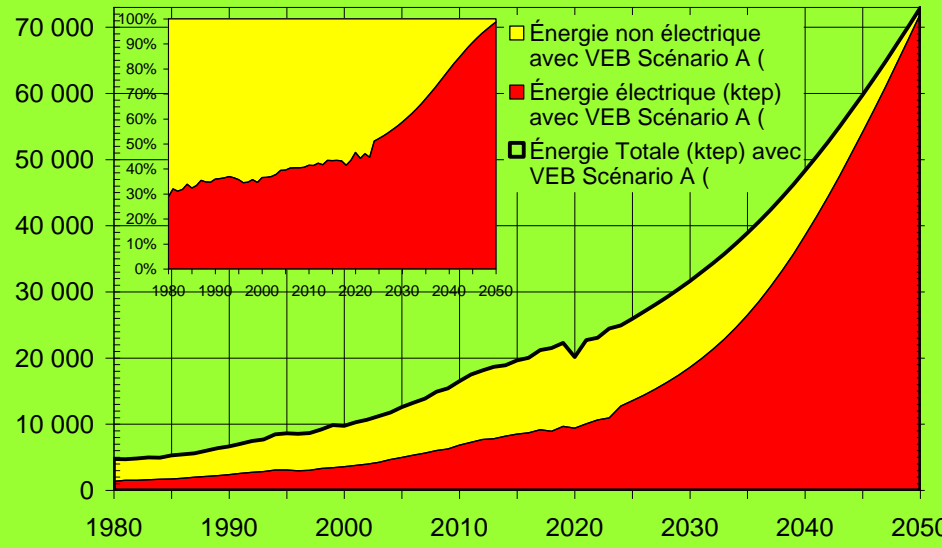
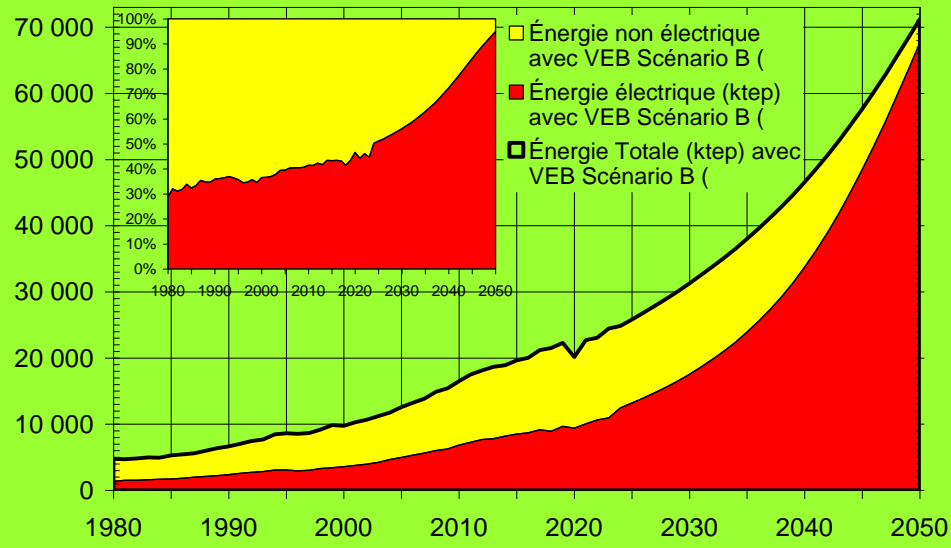
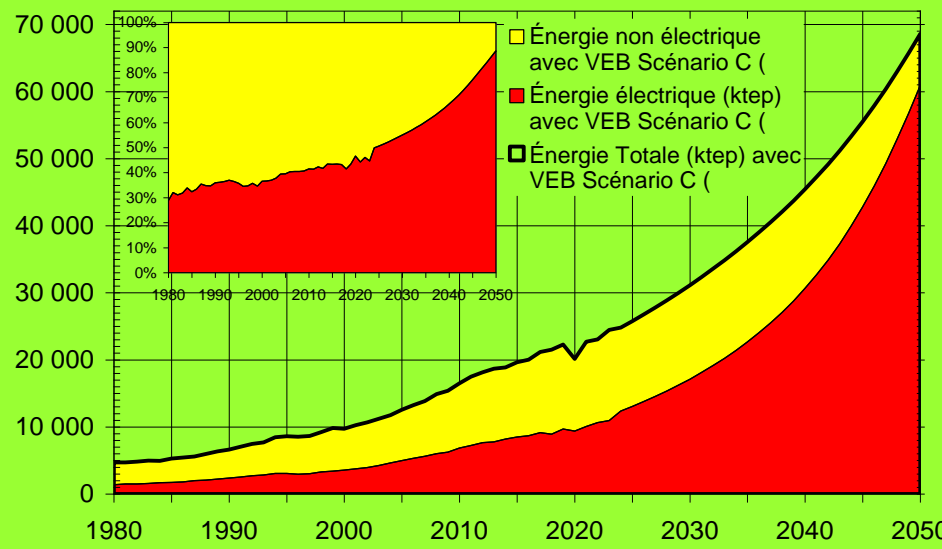
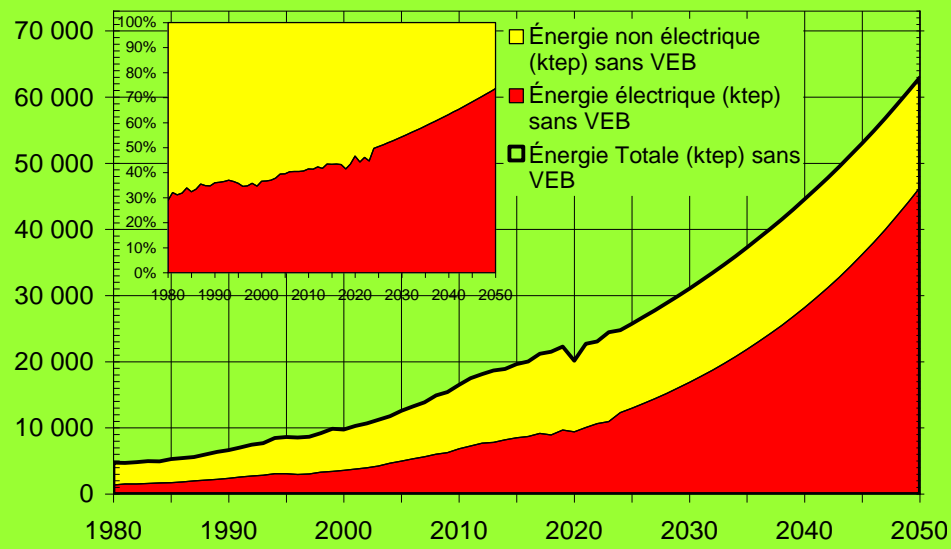
PART 3

Energy impacts of three battery electric car penetration scenarios in Morocco

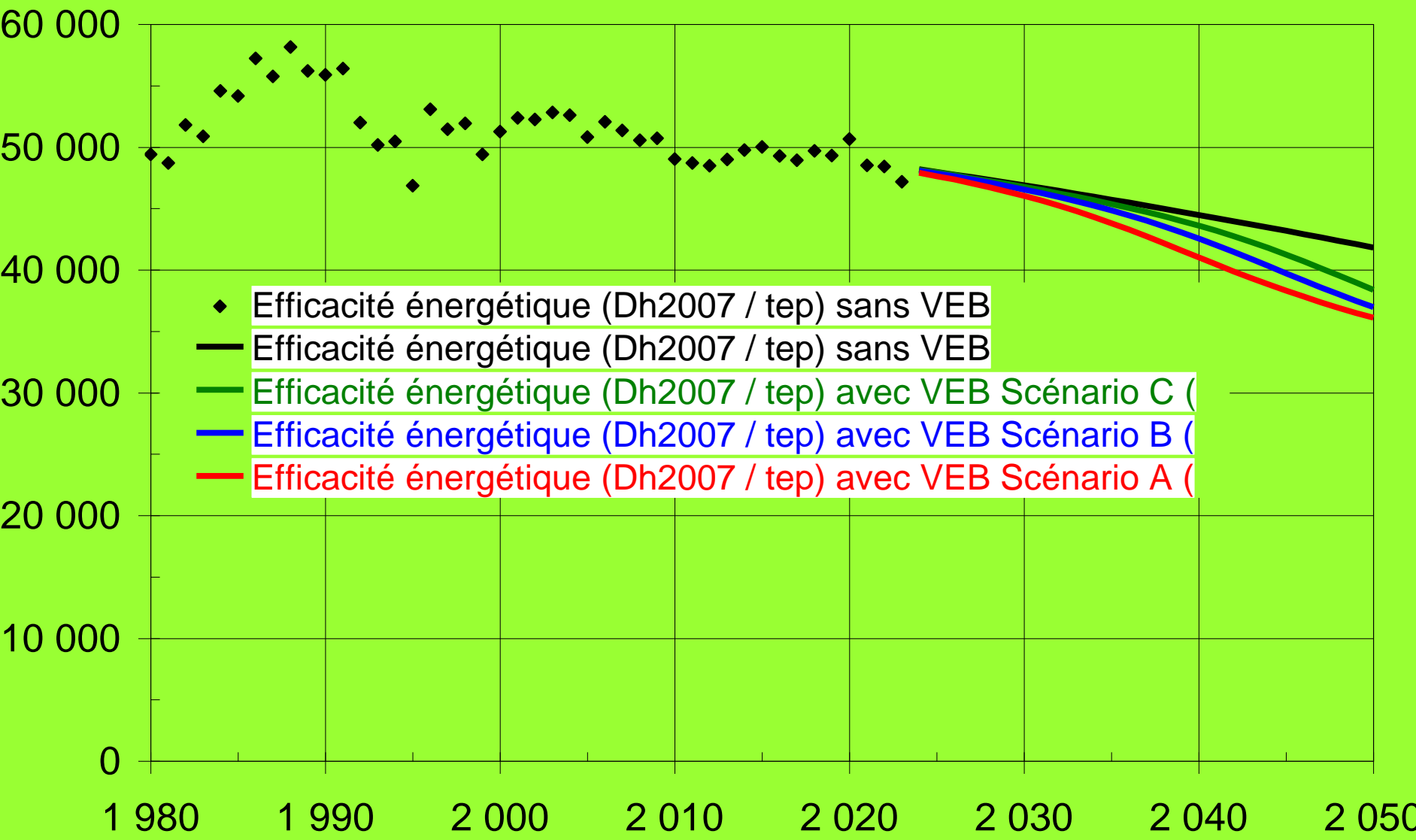
Primary energy for all battery-powered electric vehicles penetration scenarios



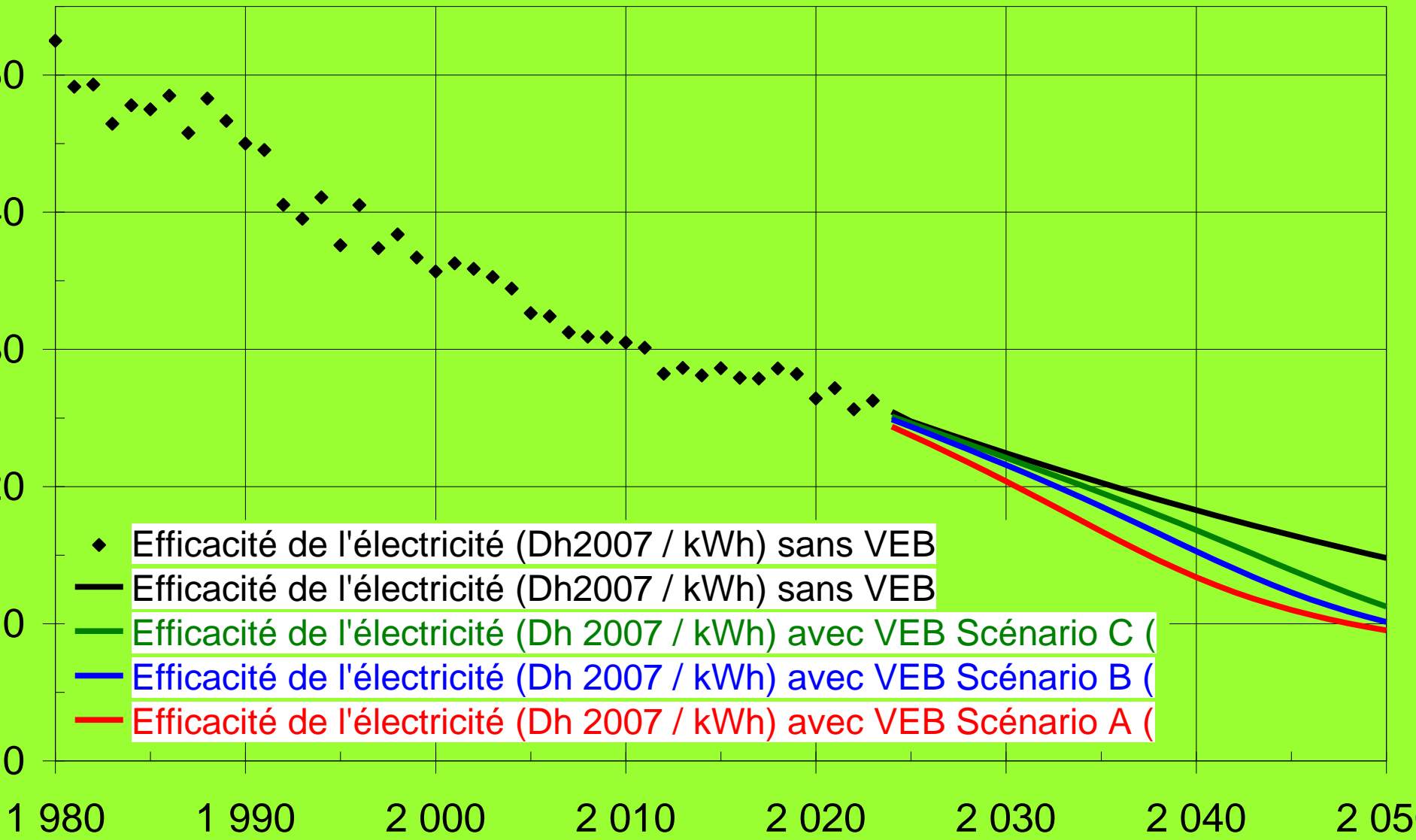
Evolution of shares of electric/non-electric energy for all battery-powered electric vehicles penetration scenarios



Evolution of economic energy efficiency for all battery-powered electric vehicles penetration scenarios



Evolution of electric energy economic efficiency for all battery-powered electric vehicles penetration scenarios



- ◆ Efficacité de l'électricité (Dh2007 / kWh) sans VEB
- Efficacité de l'électricité (Dh2007 / kWh) sans VEB
- Efficacité de l'électricité (Dh 2007 / kWh) avec VEB Scénario C (
- Efficacité de l'électricité (Dh 2007 / kWh) avec VEB Scénario B (
- Efficacité de l'électricité (Dh 2007 / kWh) avec VEB Scénario A (

CONCLUSION

Main lessons

The results of energy and electrical efficiency tend to show that if, during the next quarter of a century, the growth of constant GDP per capita cannot be increased to more than 2.5% per year, it will absolutely be necessary for the prices of energy to be reduced if we do not want the cost of energy to become economically unbearable.

For the moment, the simulations show that acting on the cost of electricity would be the most efficient since this is where the drop in efficiency is the greatest: to produce 1 Dh constant of added value, it will take approximately 4 times more electricity in 2050 than was needed in 1980.

The 3 parts of this work were published, in French, in a non-indexed general public magazine "EcoActu" devoted to the Moroccan economy. They are separately available for download:

- <https://DOI.ORG/10.13140/RG.2.2.11744.49925>,
- <https://DOI.ORG/10.13140/RG.2.2.11918.16964>,
- <https://DOI.ORG/10.13140/RG.2.2.30607.39846>.

Thank you for your attention !

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