Dynamics between electric vehicles and renewable power generation: application to New Caledonia (*)

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(*) The ongoing research is based on preliminary works with Maria-Julian Suarez-Forero (Ensta)

Agenda

- 1. Introduction : development of Electric Vehicles and REN power units
- 2. Review of the litterature
- 3. Methodology
- 4. Empirical analysis : data
- 5. Results and Discussion
- 6. Conclusion

1. Introduction

- The use of electric vehicles for daily journeys aim to reduce the pollutant emissions from the car.
- Both the direct CO_2 emissions from the petroleum engines and the CO_2 emissions from the thermal conventional power generation units have to be taken into account
- Consequently, the development of electric vehicles and renewable electricity should be considered together to reach objectives of reduction of CO_2 emissions.
- We analyze the equilibrium between that the development of both electric vehicles and renewable power units through a modelling approach.

2. Review of the litterature

- Power generation : Loulou, Goldstein, Nobel (2004), Lund et al (2009), Xydis, Koroneos (2012)
- Electric Vehicles :Codani P., Petit M. and Perez Y. (2015), Marrero G., Perez Y., Petit M., Ramos-Real F. (2015)
- Energy in New Caledonia : Velut (2010)

3. Methodology

- Electric Vehicles (simulation model):
  - **Sales of new electric vehicles**
  - **Increase of the stock of cars**
  - **Daily Car use, electricity demand and power storage**
- Power generation (optimization model):
  - **Optimization of the power units with respect to the capacities and the availability of the units and to the demand**
- The Electric vehicles simulation model and the power generation optimization model are linked.
- The model is run from 2018 to 2030
- CO_2 emissions:
  - **From the automotive fuel and the thermal power units**

4 Application to New Caledonia

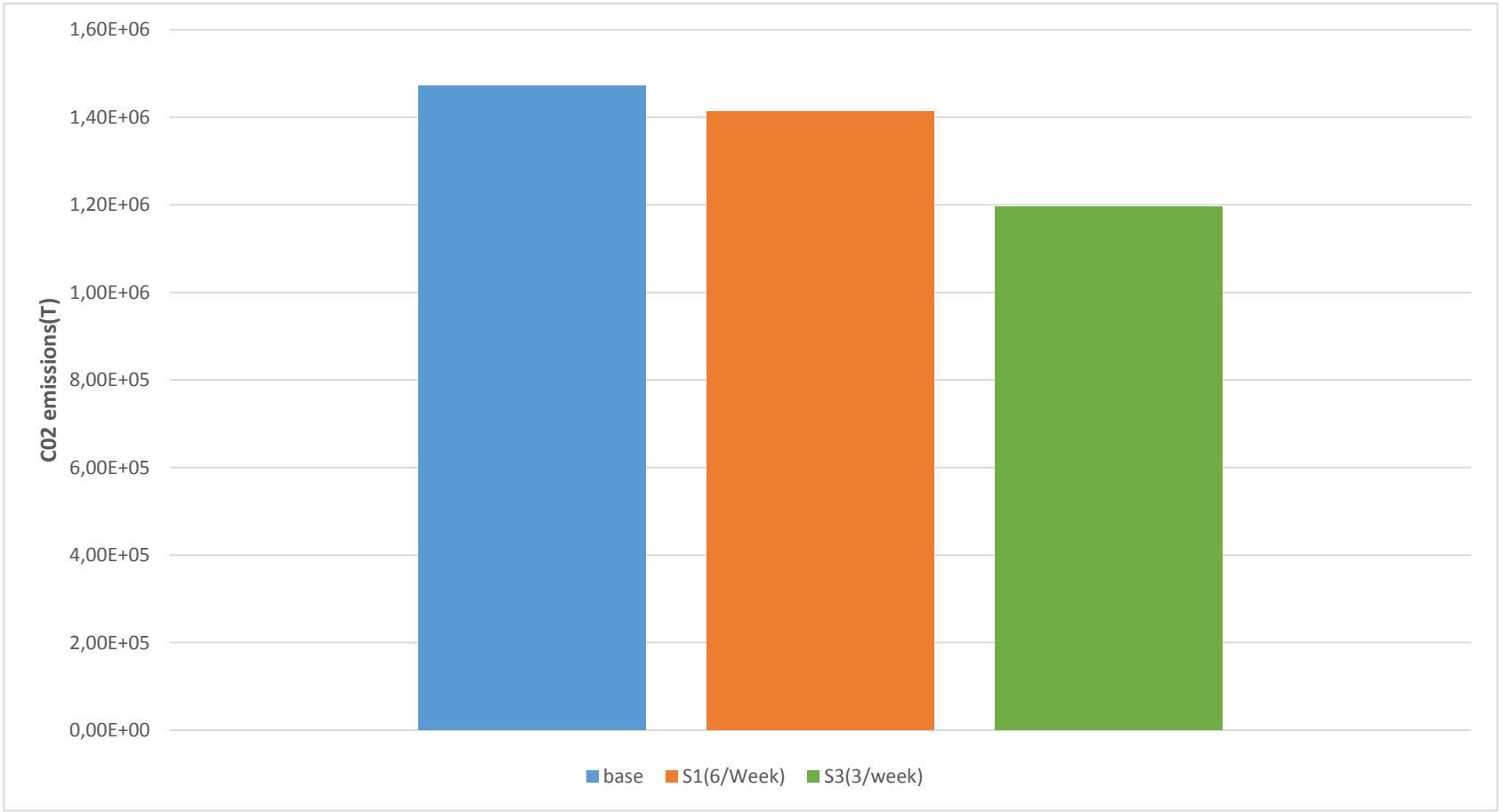
- Transportation :
  - **242 000 vehicles**
  - **The automotive fuel consumption is approximately 1.4 toe/head** (*)
- Power generation:
- The power demand is 2210 GWh
- The Power supply comes mainly from thermal units (80%) with coal, fuel and gas (at the Worldwide level, nuclear and thermal stands approximately to 77%)

(*) The high level of consumption is parly explained by the Nickel mining activity which requires a lots of trucks.

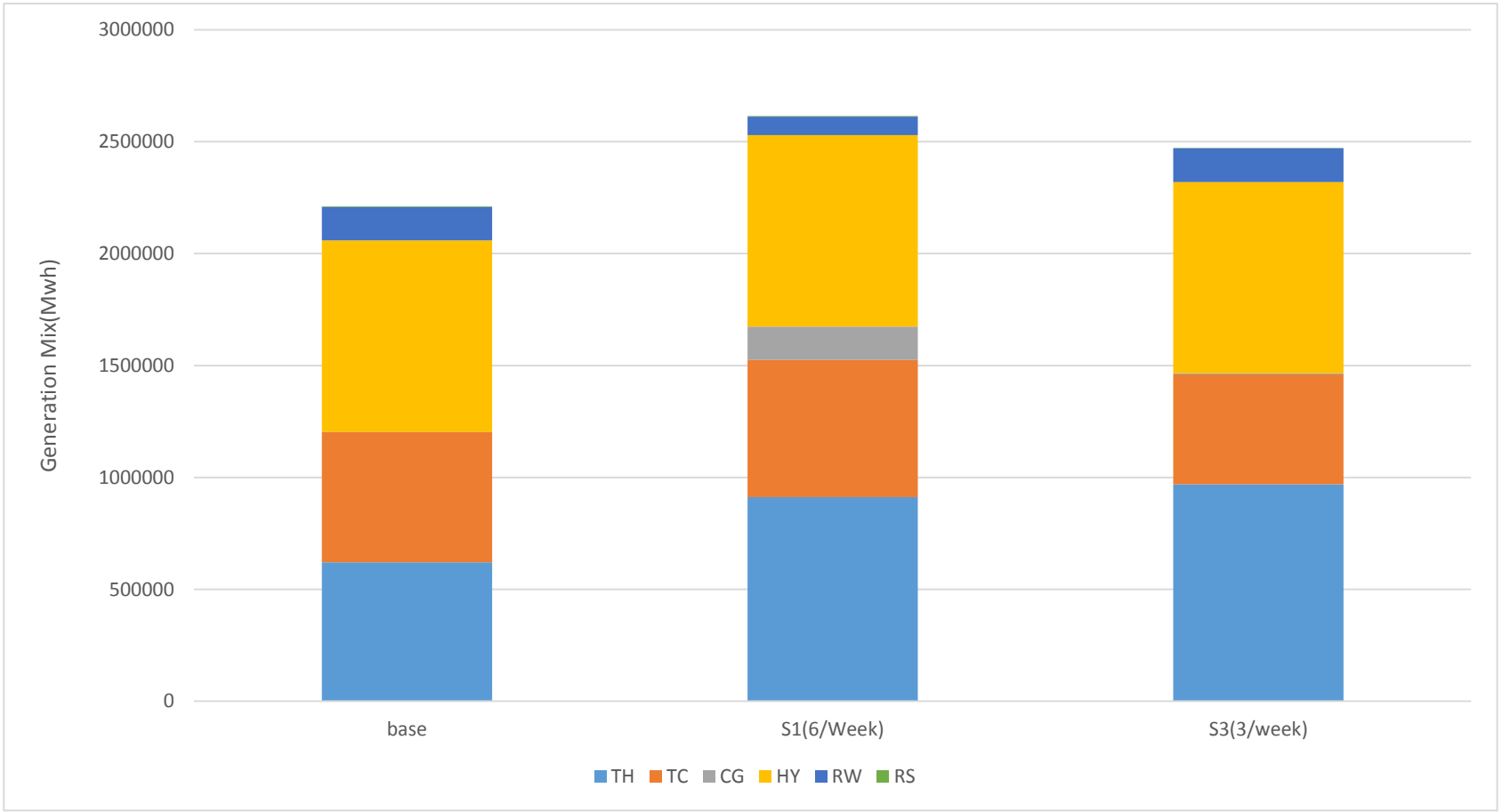
Three Scenarios

- Introduction of 49000 Electric Vehicles in 2030 in scenarios S1 and S3. V2G is investigated
- Base case : current policy for power generation, without Electric Vehicle
- S1 : Electric Vehicles are introduced and they can be used for power storage. They are recharged 6 times/week during the night and they can used for power supply next peak hours (2/3 of the cumulated energy).
- S3 : Electric Vehicles are introduced. They are recharged 3 times/week (1/3 of the cumulated energy). 20% of the coal power unit is cut.

5. Results and discussion : CO_2 emissions in 2030

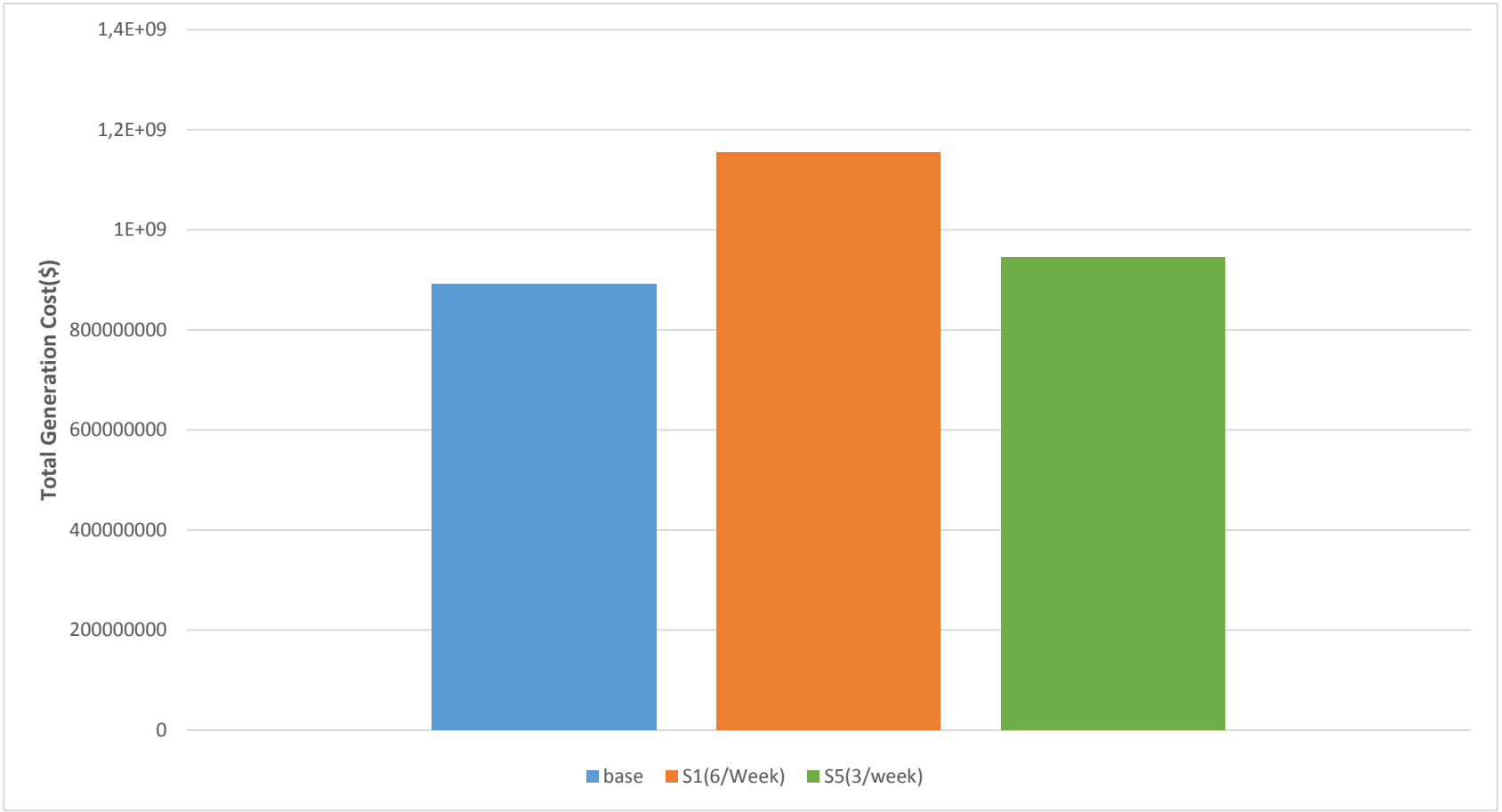


5. Results and discussion : Electricity mix in 2030



TH : Thermal (fuel) Power Unit, TC : Coal Power Unit, CG : Combined Gas Cycle Power Unit, HY: Hydropower unit, RW : Wind Turbine, RS : Solar PV

5. Results and discussion : Power generation cost in 2030



6. Conclusion

- In the present study, the simulation of the power sector in New Caledonia was proposed for economic and environmental analysis of EVs operated in different conditions.
- From the simulation results, combining Electric Vehicles and reduction of the thermal power aim to achieve the objective of reduction of CO2 emissions.
- The comparison of the base case and the third scenario point out a 190$/t CO2 abatement cost(*).

(*) This abatment cost doesn't include the subsidies which should support the EV sales.