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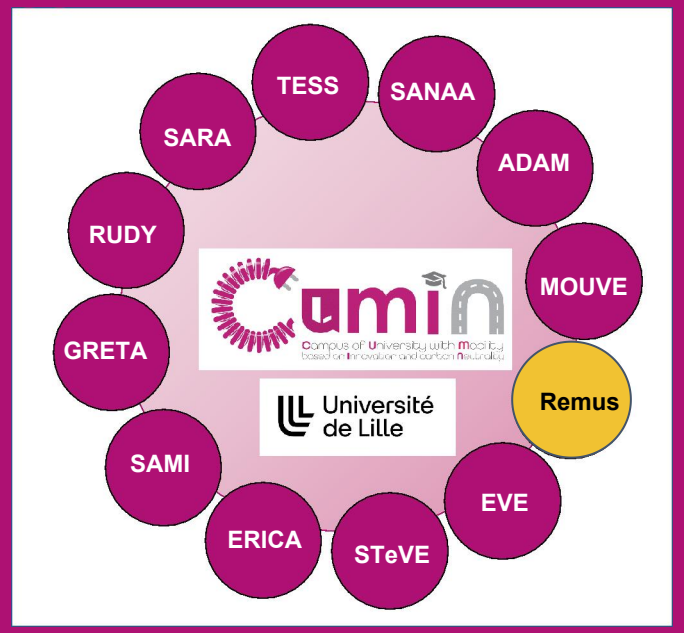

Tramway energy consumption

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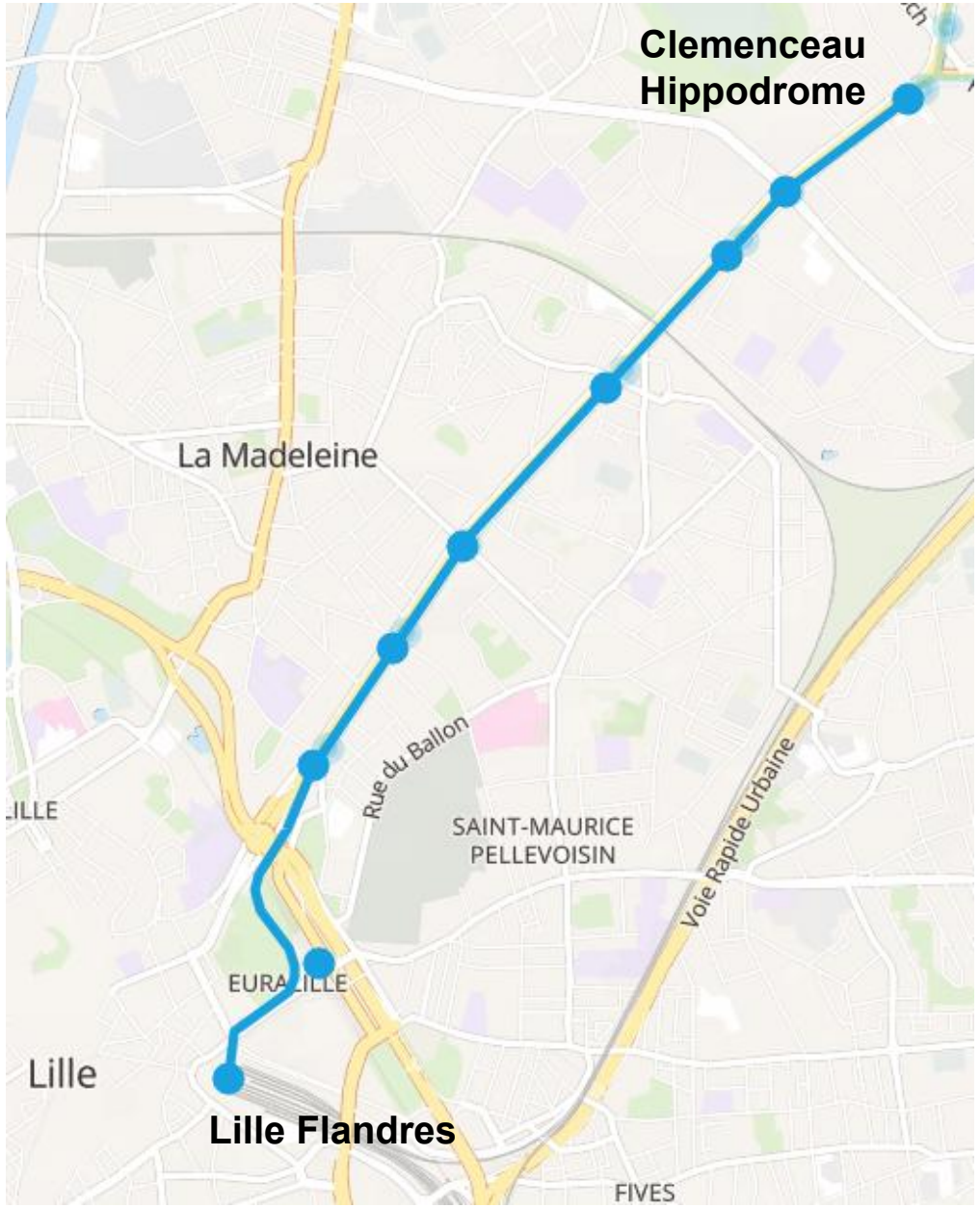
Objective

What is the energy consumption of a person taking a round trip tramway from Clemenceau Hippodrome to Lille Flandres ?



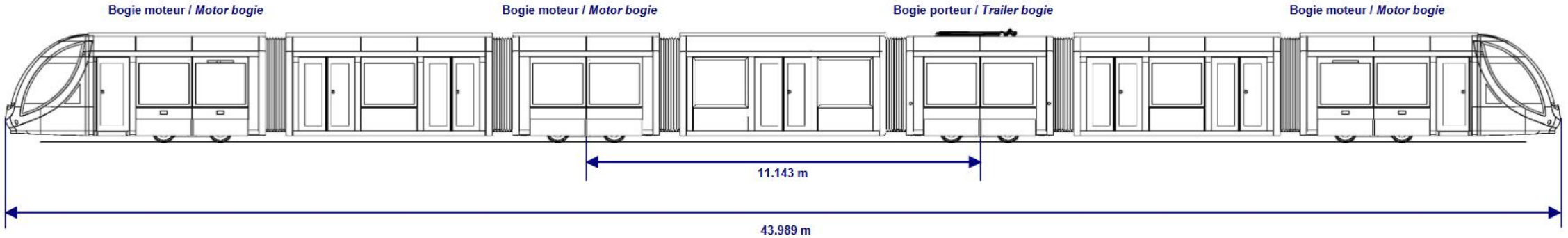
From **Clemenceau Hippodrome** to **Lille Flandres**

Summary

Tramway description

Tramway Citadis 402

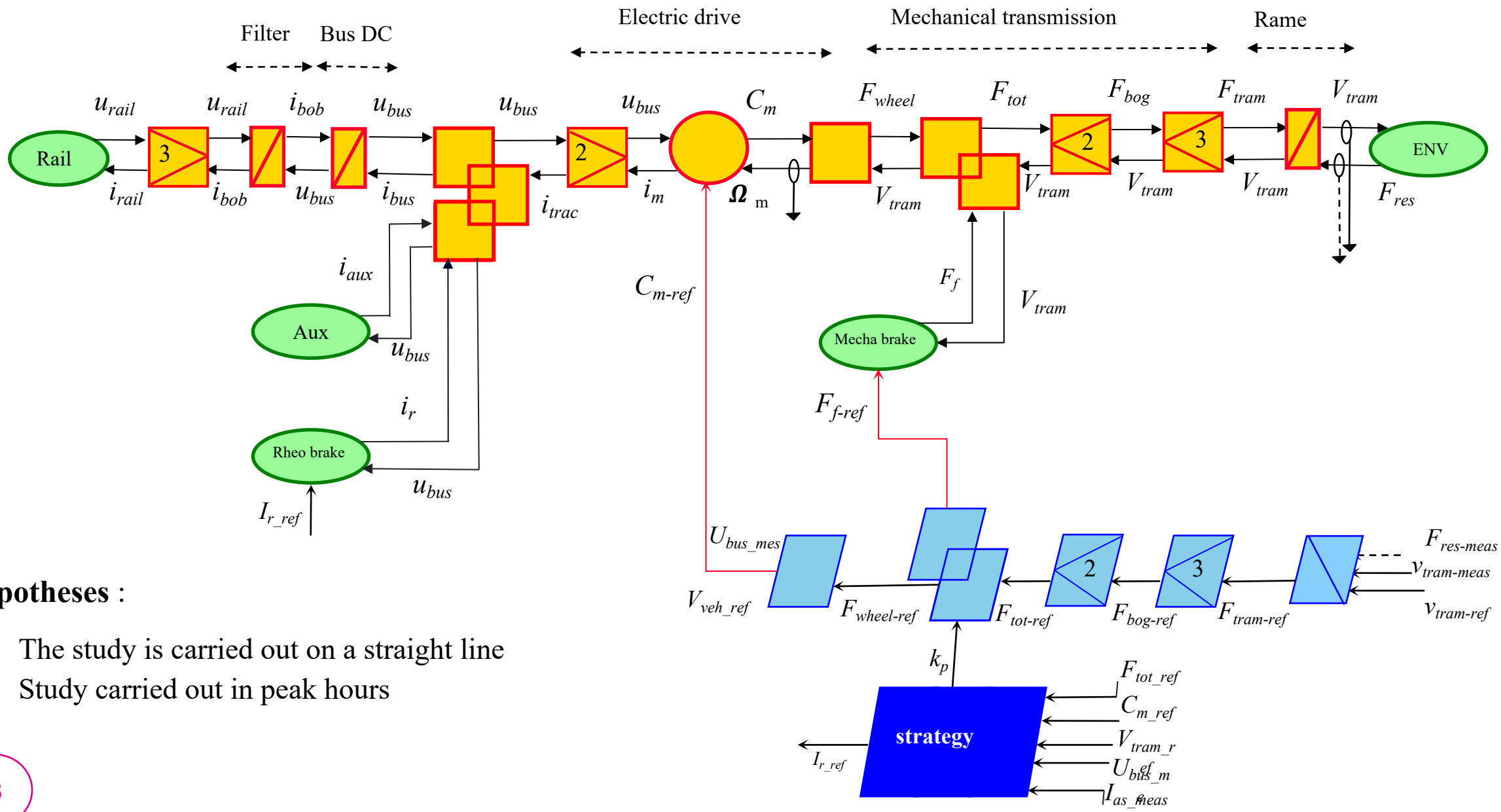
Builder	ALSTOM
Model	Citadis 402
Mass	54 t empty / (80t)
Number of motor bogies	3
Maximum speed in service	60 km/h
Power for a Motor (MAS)	175 kW
Auxiliary power	13 kW



source :FicheCIT-Bordeaux.pdf

Tramway Citadis 402

Model of the tramway



Hypotheses :

- The study is carried out on a straight line
- Study carried out in peak hours

Results for one tramway

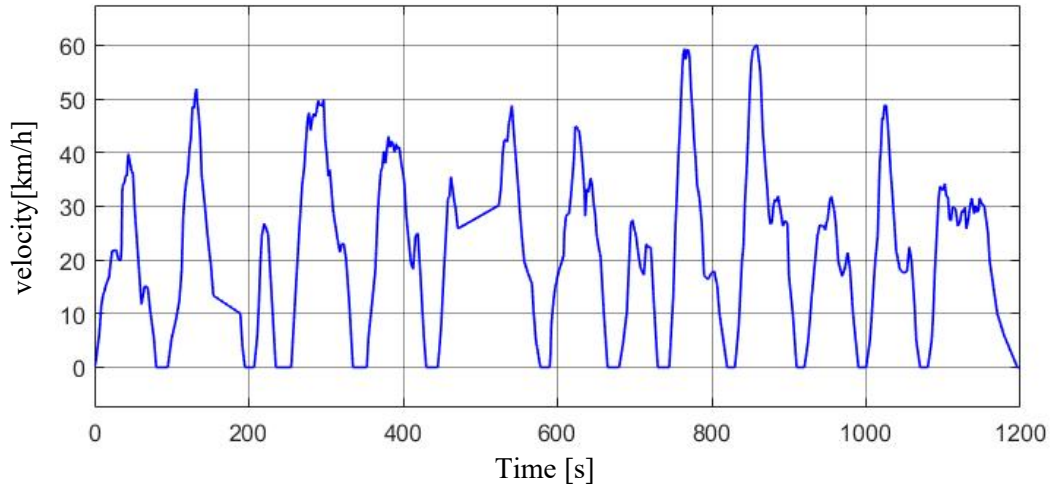


Figure 1: Velocity cycle of a tram (round trip)

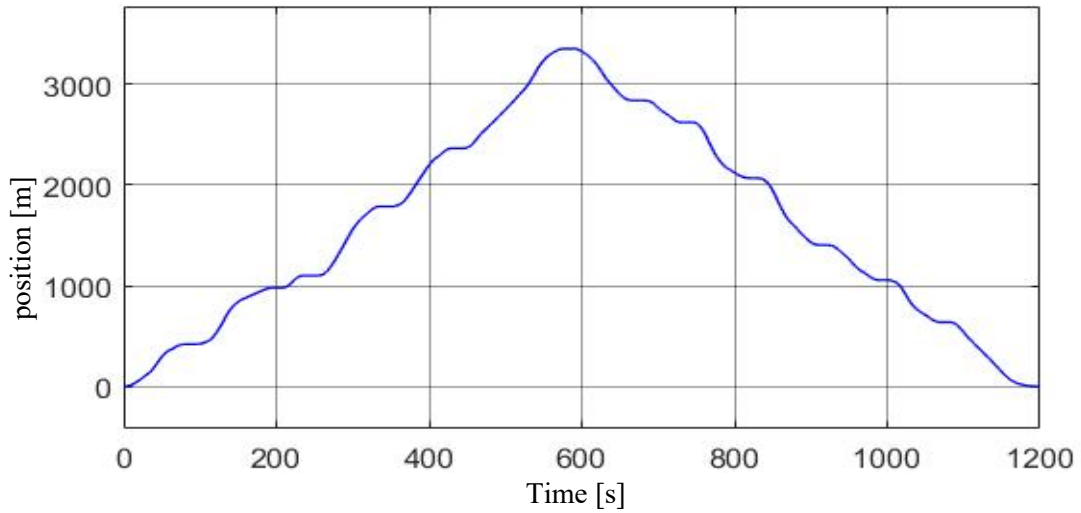


Figure 2: The position of the tram

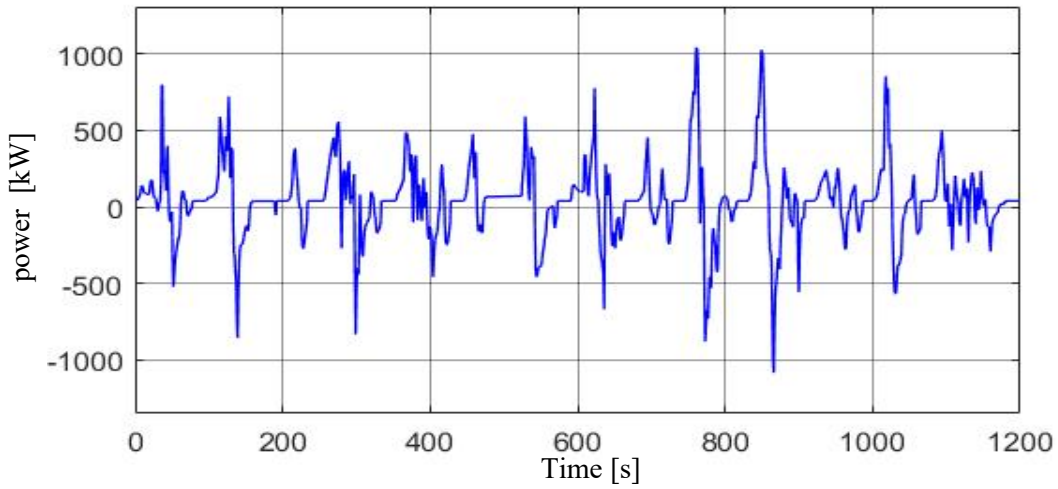


Figure 3: Total power of a tram

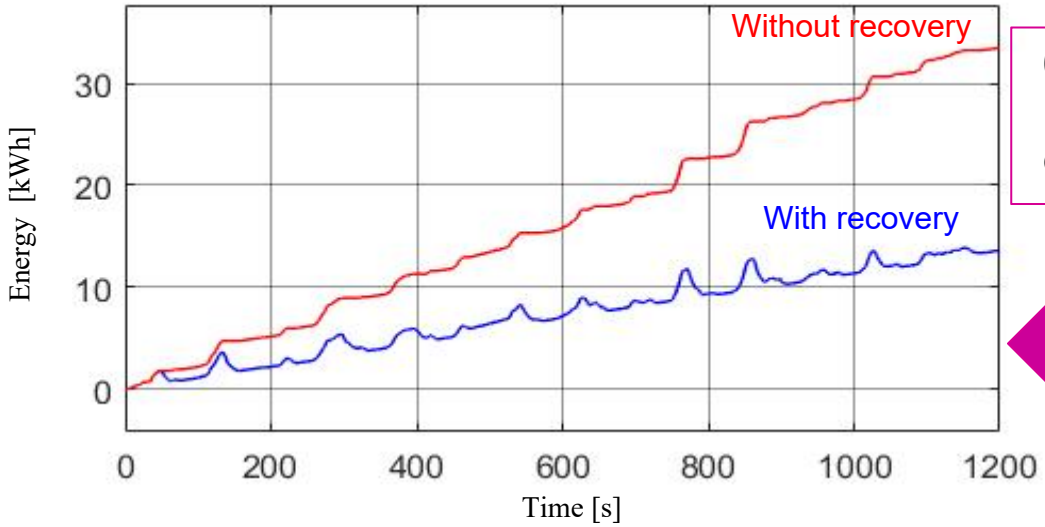
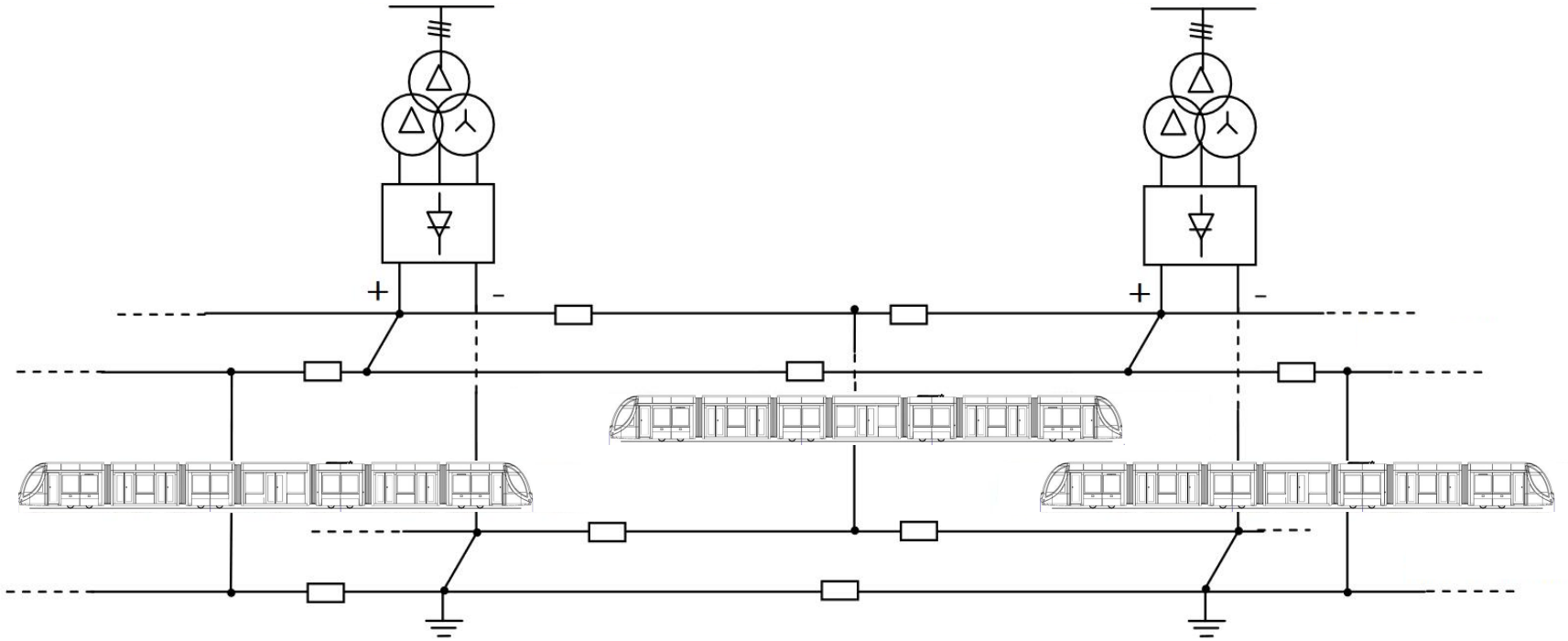


Figure 4: Tram energy with and without recovery

Study of several trams



Hypotheses :

- Filtered speed profile
- 10% energy lost in supply system
- Partial line (only between Clemenceau Hippodrome and Lille Flandres)

Results

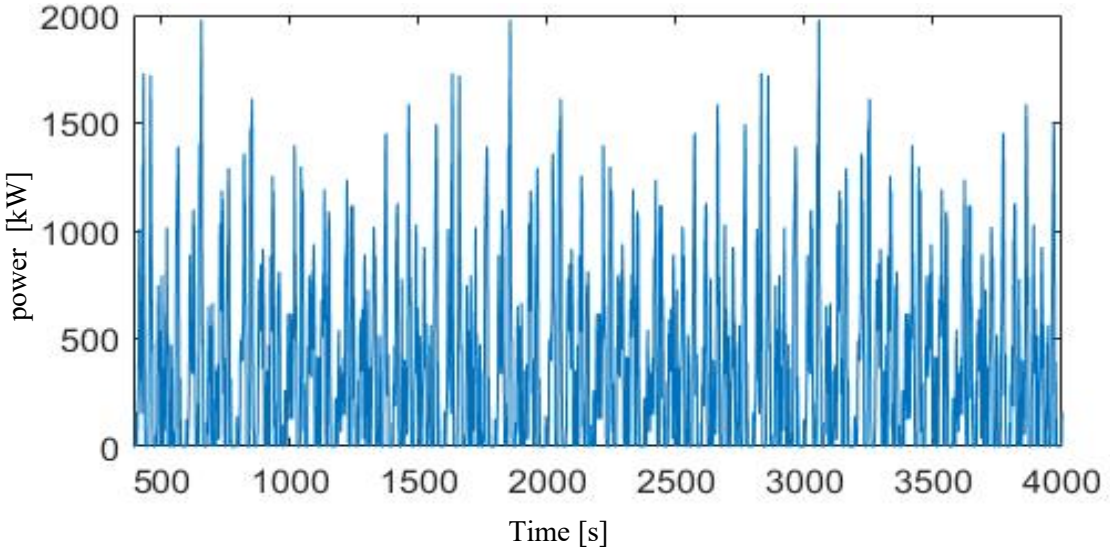


Figure 1: Total power of a line

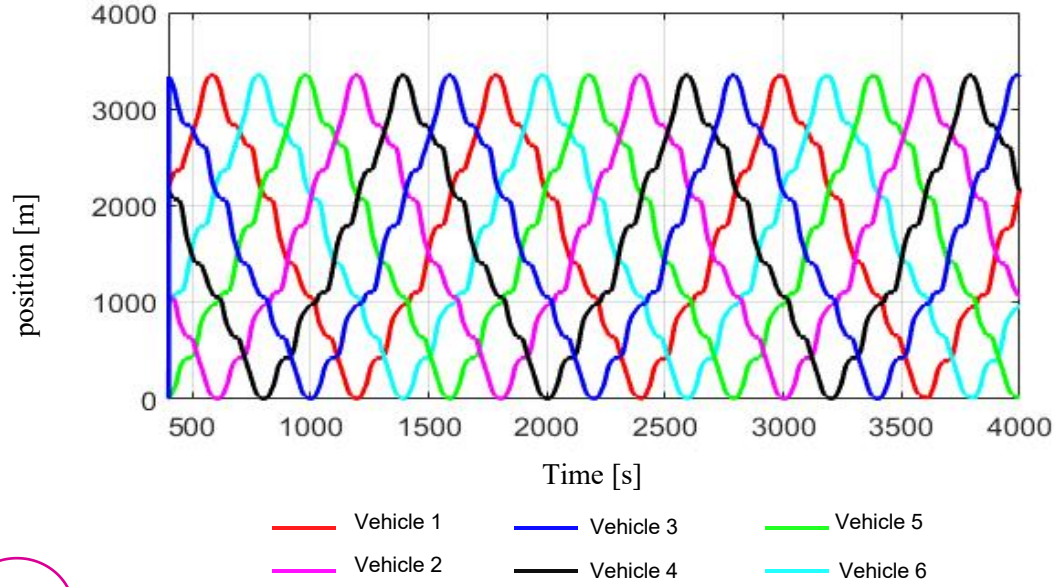


Figure 2: The position of the trams

30% recoverable energy

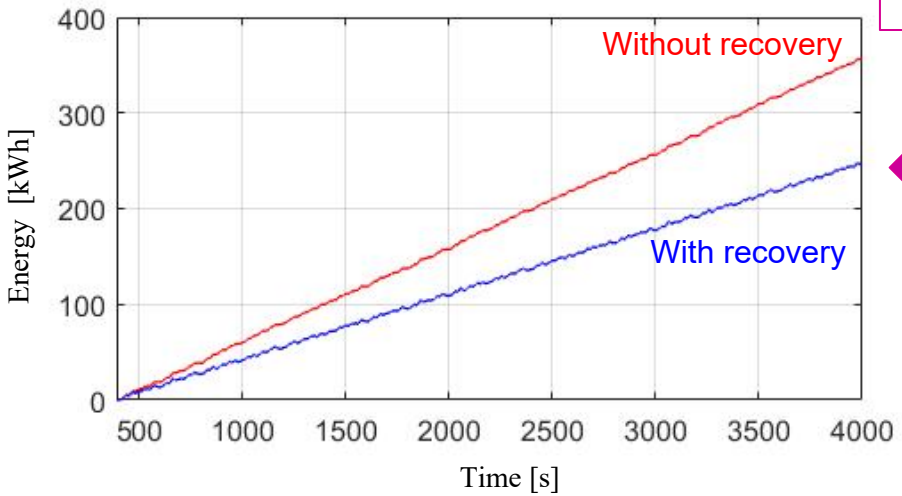


Figure 3: Trams energy with and without recovery

key numbers (1h simulation):

- Total energy: 391.71 kWh
- Total distance: 126 km
- 200 passengers per vehicle in average

15.54 Wh/pass.km
0.49 gCO2eq/pass.km

32 gCO2eq/kWh (RTE, 2023)

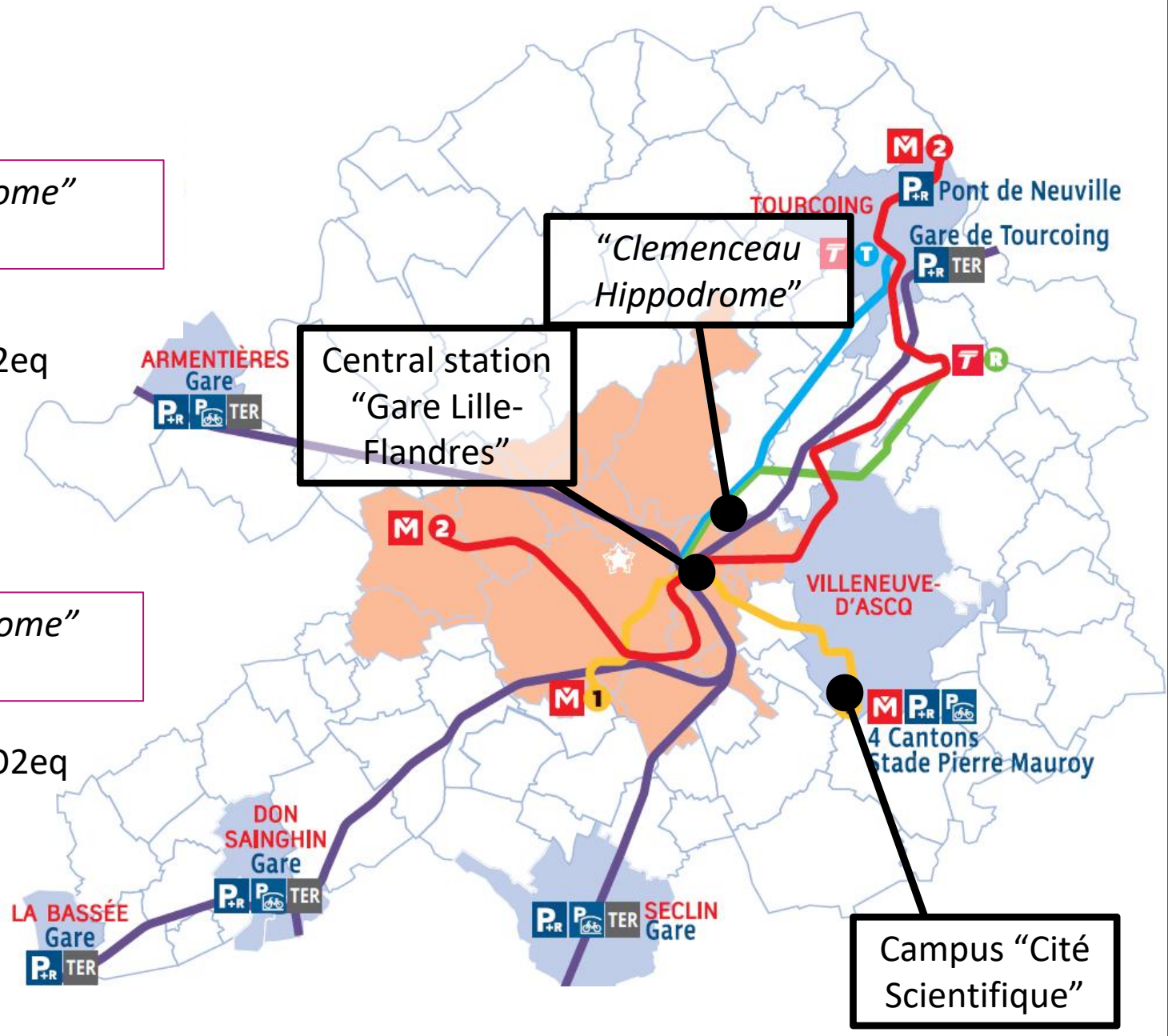
Results

*3.5 km between stations "Clemenceau Hippodrome" and "*Gare Lille-Flandres"

Daily round trip for 1 person ≈ 108,8 Wh / 3.4 gCO2eq

11.08 km between stations "Clemenceau Hippodrome" and "4 Cantons Stade Pierre Mauroy"

Daily round trip for 1 person ≈ 492.8 Wh / 17.4 gCO2eq



Conclusion

Assessment:

- Modeling of the traction system
- Consumption of one person for a round trip taking the tram

Perspectives:

- Choose more realistic traffic
- Consider the whole line
- Validate the model
- Simulation model of tram with energy storage system

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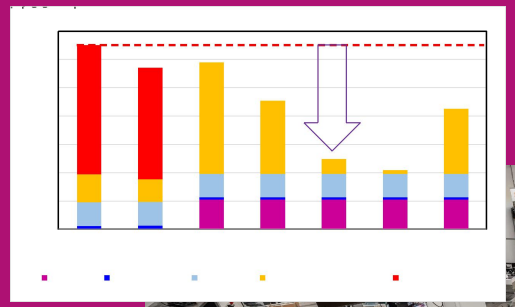

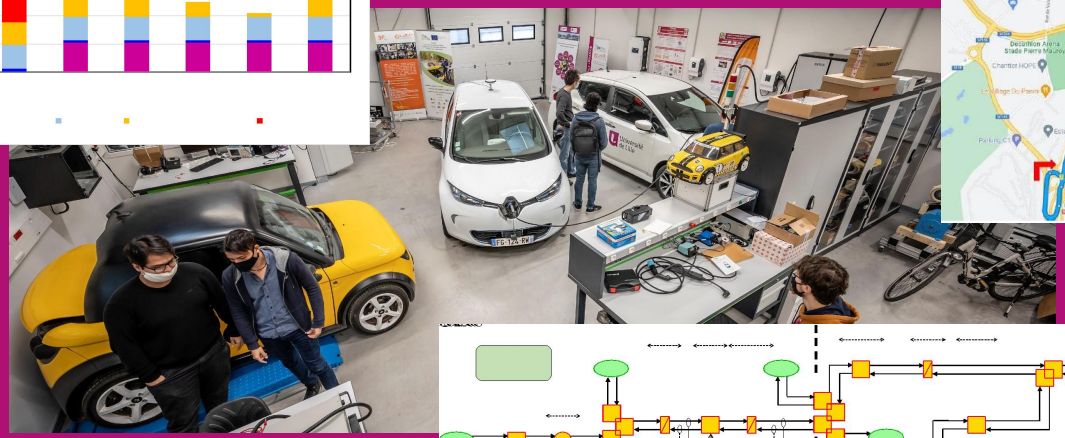

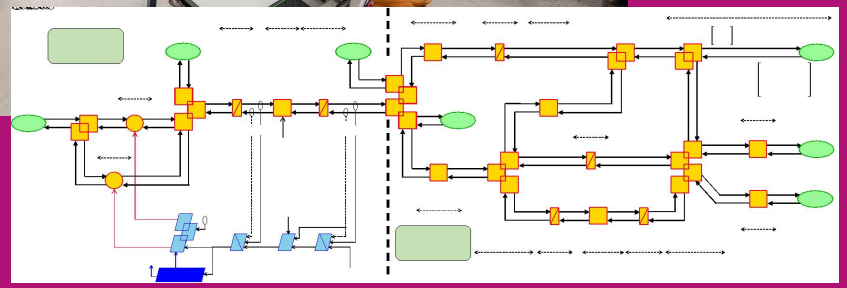

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Structural diagram