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CUMIN - SARA

Velocity profiles for impact of the traffic on energy consumption of EVs

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Outline

1. Objective
2. Simulation of Nissan Leaf
3. Generation of driving cycles
4. Conclusion

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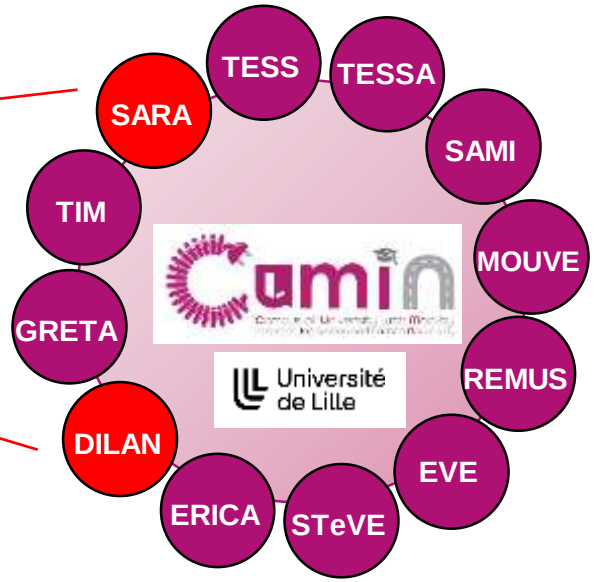
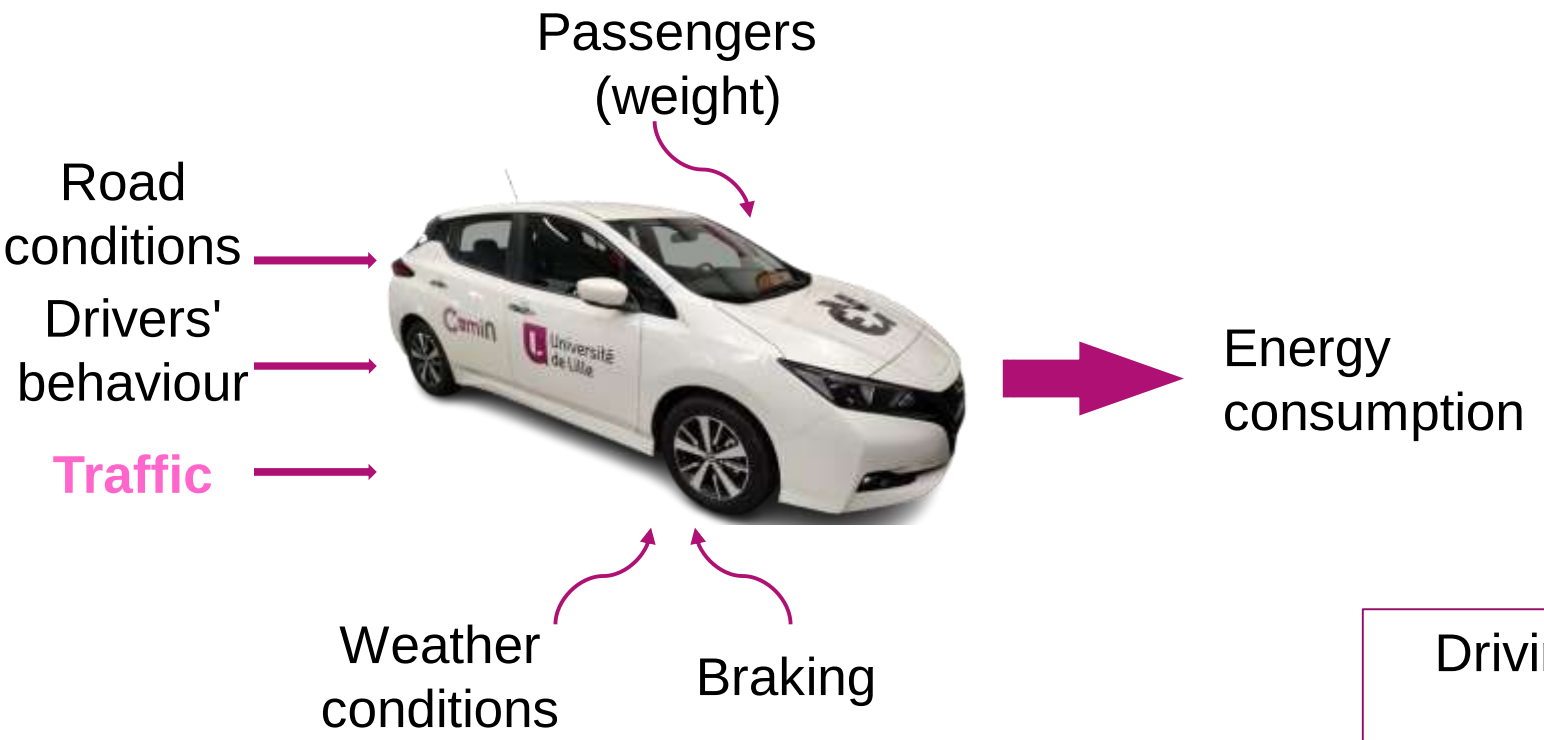
1. objective

Context

SARA project: acceptability to switch from thermal to eclectic vehicles
(driver perception and energy consumption)

DILAN project: Driver-In-the-Loop for better analyze of energy consumption





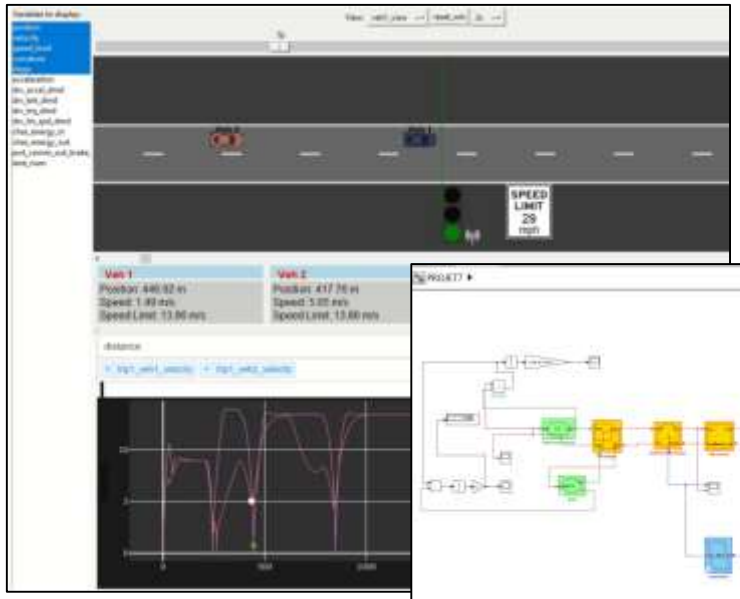
Driving tests cannot separate the different effects:
Simulation as a flexible tool

Objective of the project

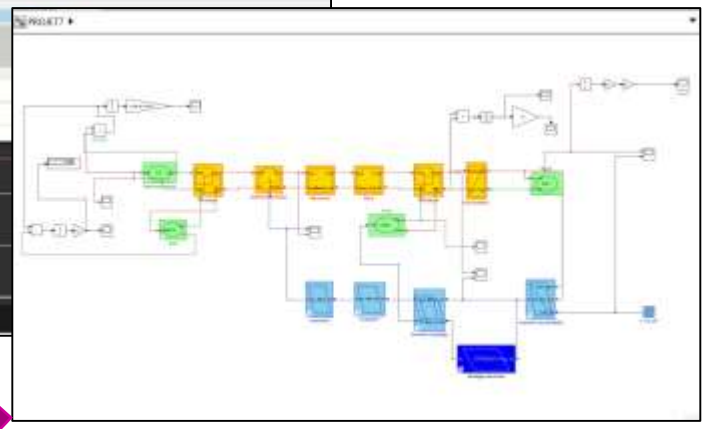
Coupling 2 softwares to analyze the impact of traffic on the energy consumption of EVs

Traffic

RoadRunner©

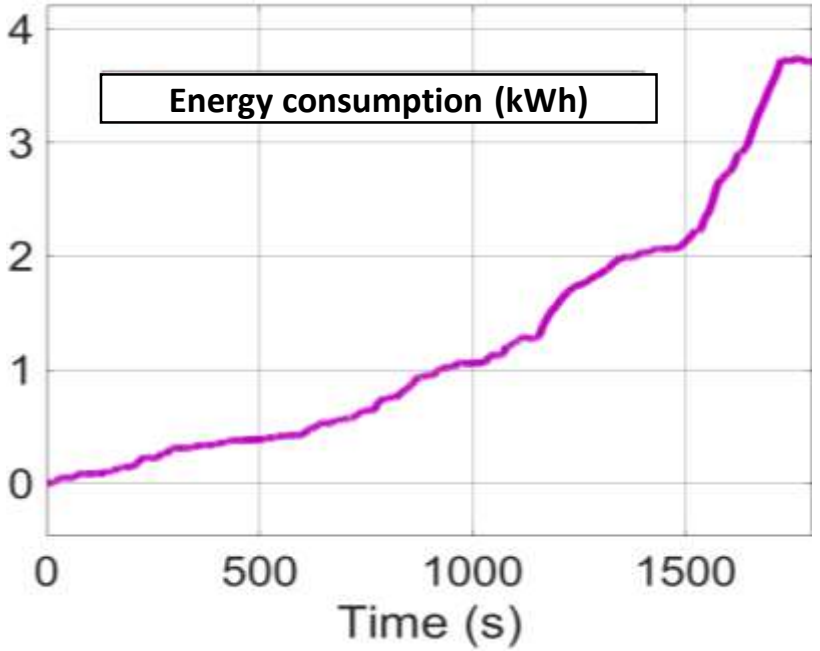


Velocity profiles



MATLAB/Simulink©

Vehicle parameters



Energy consumption (kWh)

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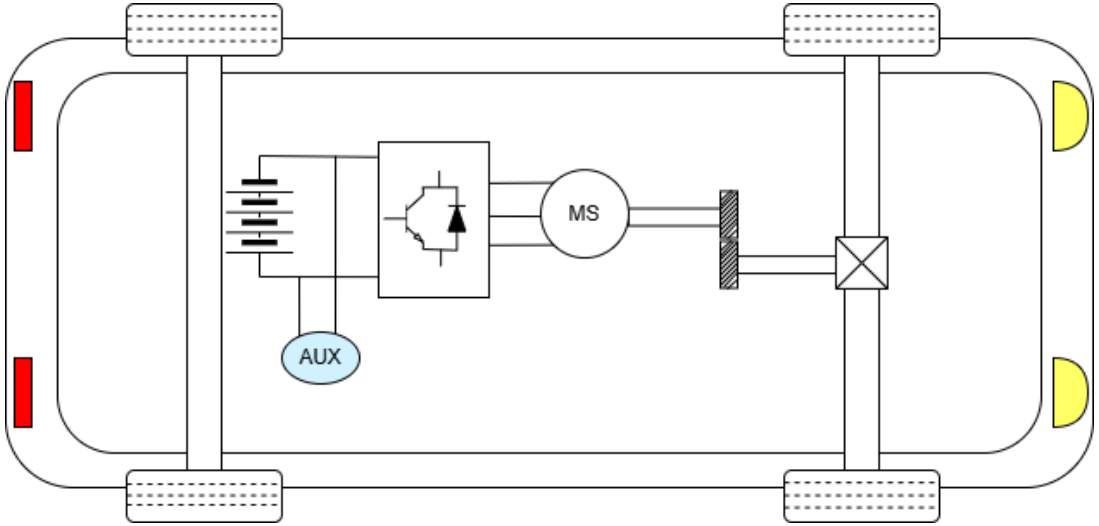
2. Simulation of Nissan Leaf

(Matlab/Simulink ©)

Studied vehicle parameters



Structural diagram of Nissan Leaf

Autonomy (WLTP): 270 km

maximal velocity: 144 km/h

Weight (empty): 1505 kg

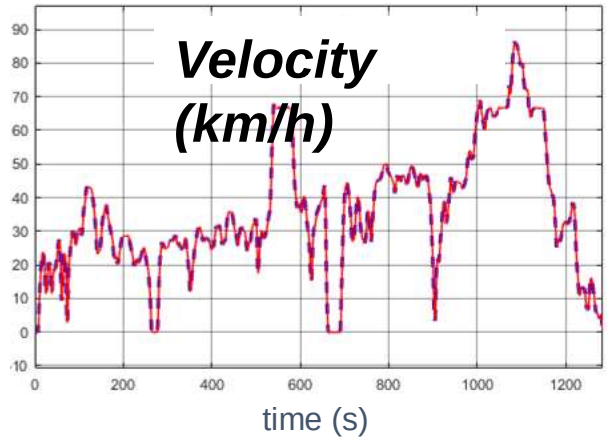
Battery: 40 kWh

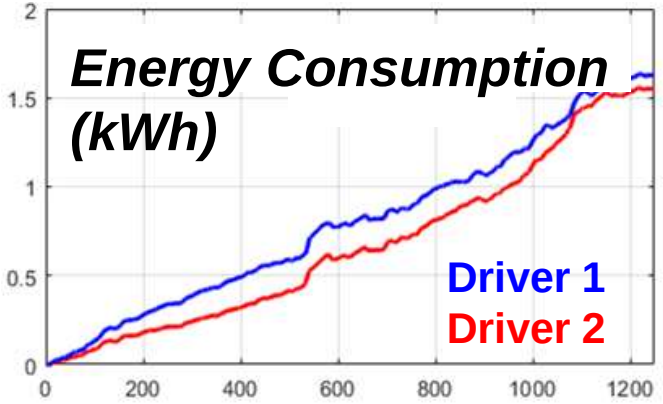
Nominal voltage of the battery: 350.4 V

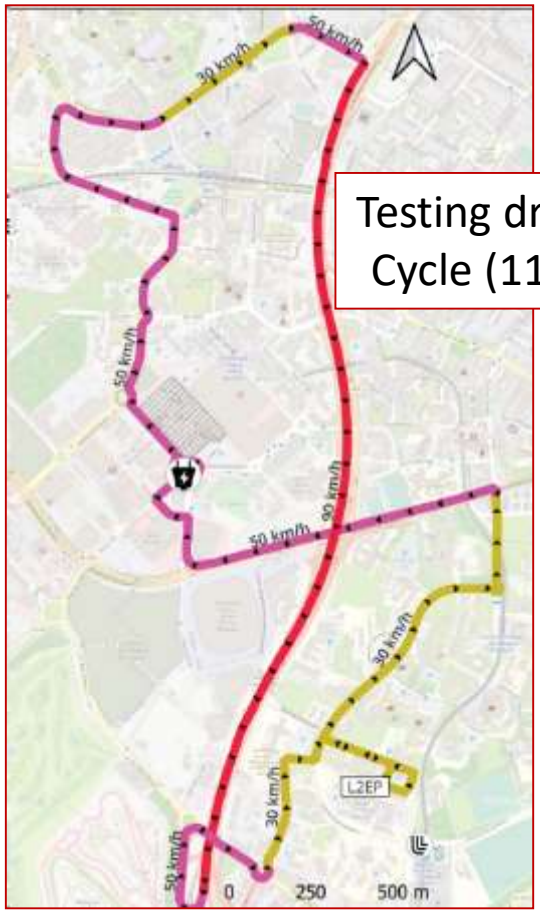
Power of the electric machine: 85kW

*[Nissan LEAF ZE1 Technical Documentation]

CUMIN-SARA







Testing driving Cycle (11 km)

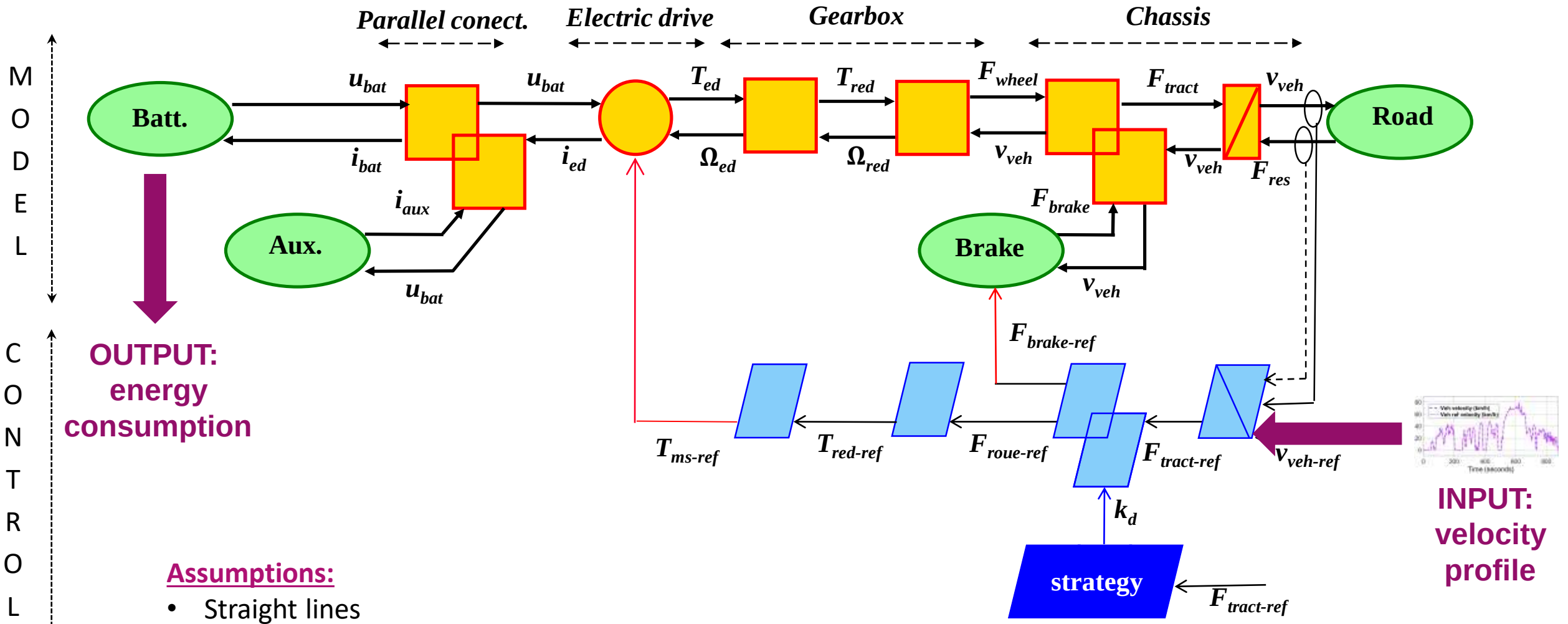
Technical aspects

- Same trip for more than 120 drivers
- Variation in terms of energy consumption of **21%**
- Impact of traffic ?
- Impact of driver ?

DILAN (Driver-In-the-Loop)
and/or
simulation of the traffic

Model organization

using the EMR (Energetic Macroscopic Representation) formalism

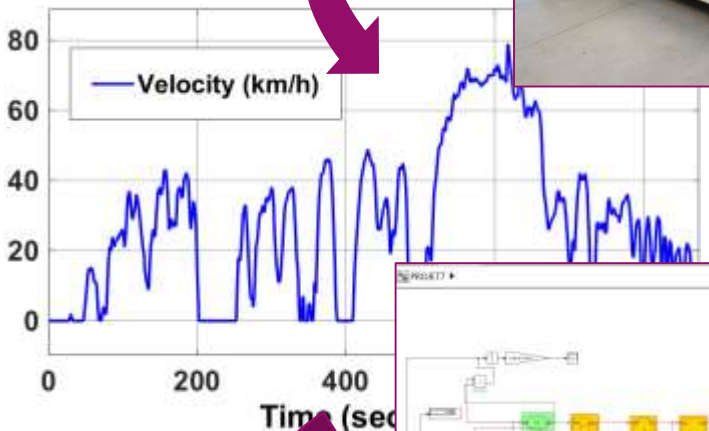


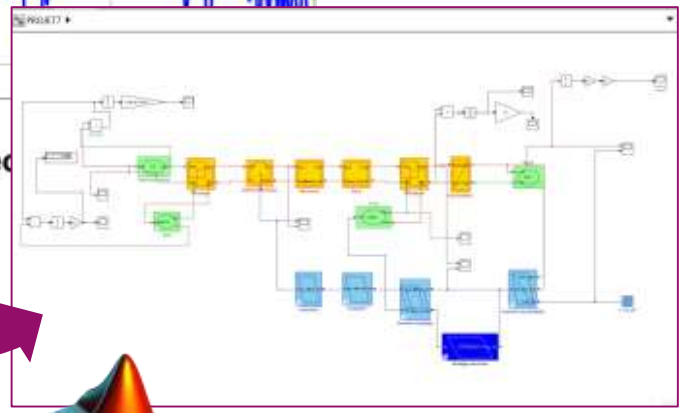
Assumptions:

- Straight lines
- Static electric drive

Simulation and validation

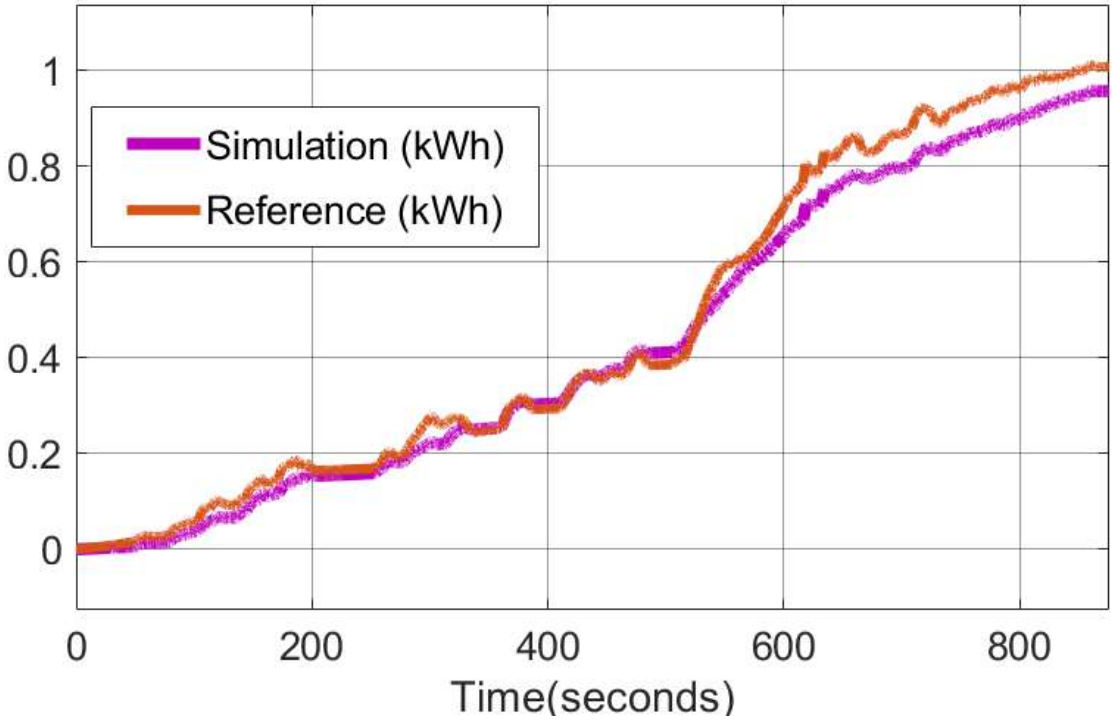
Test performed during a real driving cycle





MATLAB

Energy consumption (kWh)



Simulation model presents an error of **2.4 %** compared to experimental driving test

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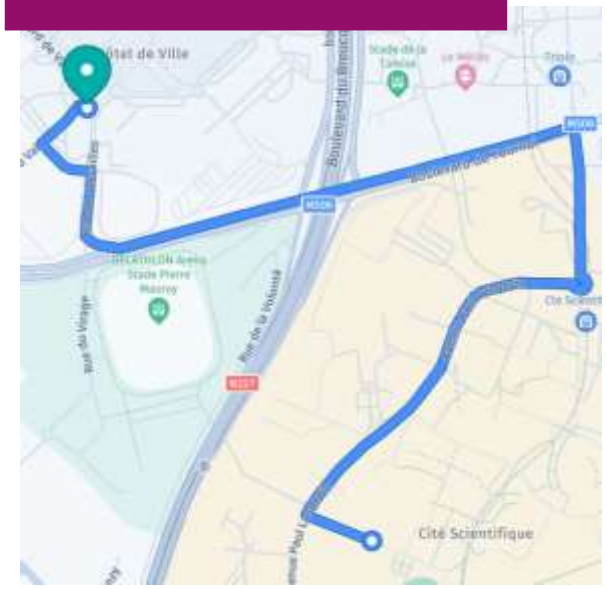
3. Generation of driving cycles

(RoadRunner ©)

Road Runner: Example

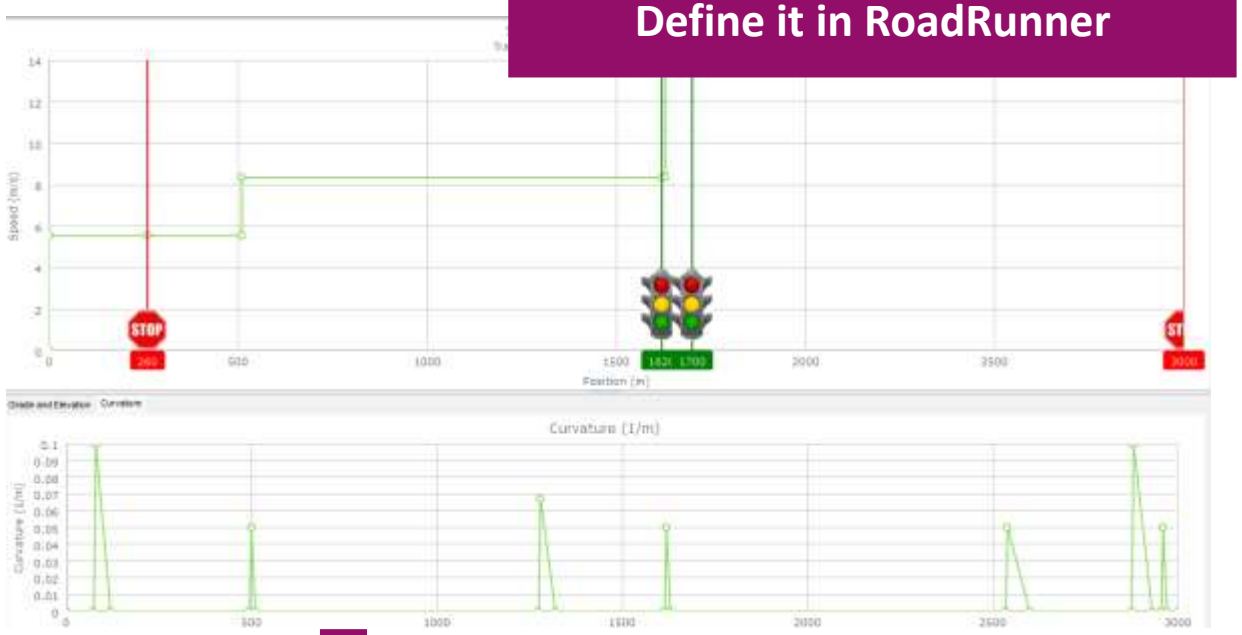
Route-based multi-vehicle simulation tool that focuses on vehicle energy consumption and performance estimation.

Choose a real road

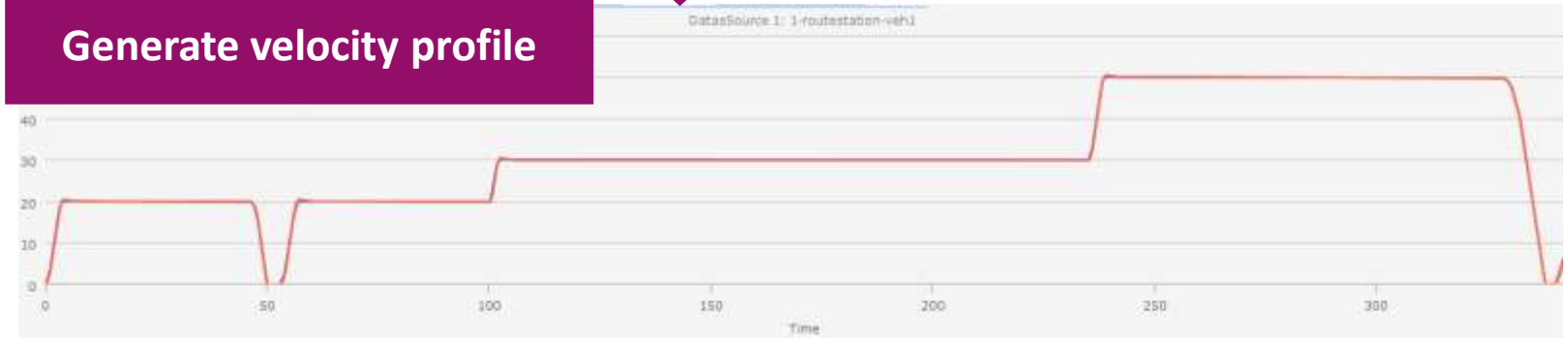


A trip of 3km

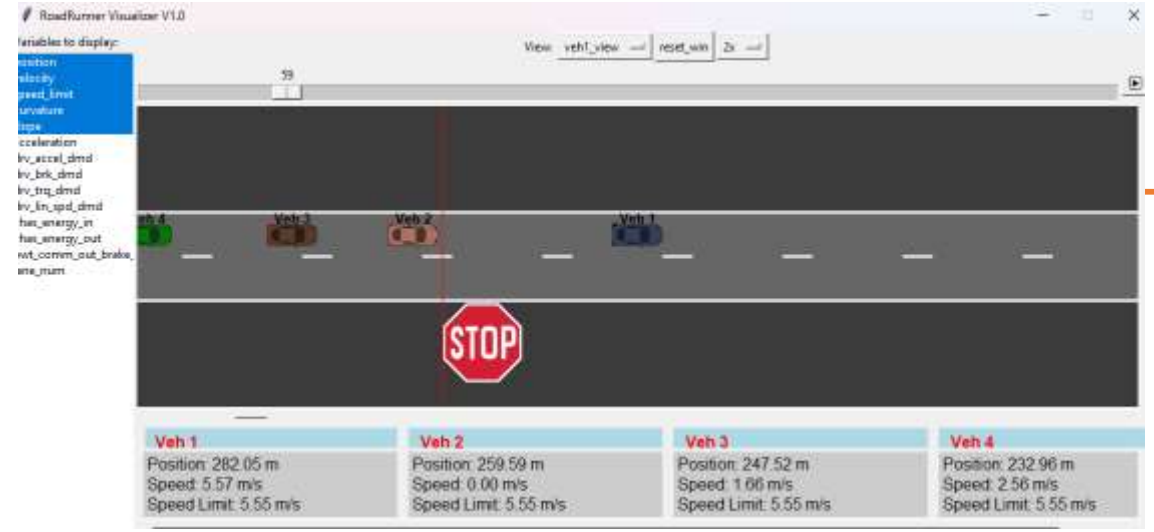
Define it in RoadRunner

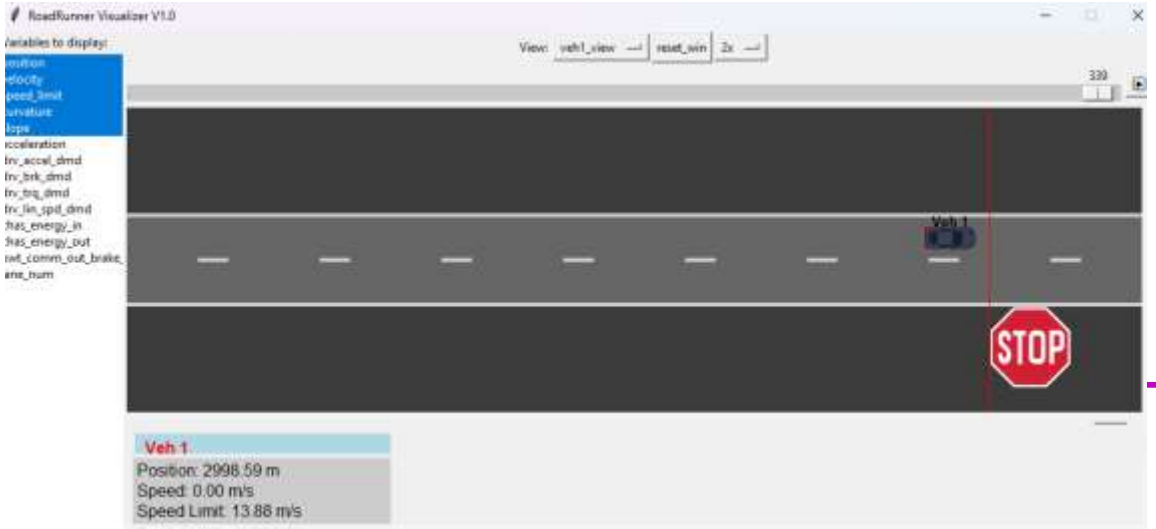


Generate velocity profile

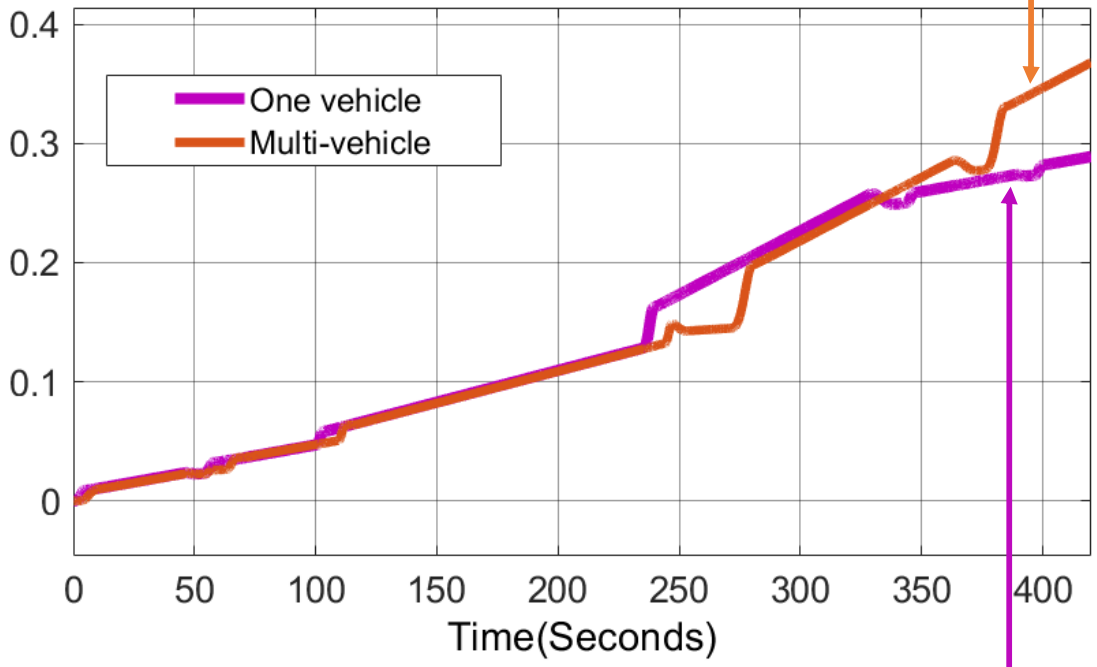


Same route with a different traffic





A 24% difference in energy consumption between a single vehicle on the road and a vehicle in traffic.



Energy consumption (kWh)

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4.Conclusion

Conclusion and perspectives

Conclusion

- Matlab/Simulink © model of Nissan leaf for energy consumption
- Model validation by a real driving cycle
- First analysis of Road Runner ©

Perspectives

- Generation of velocity profile using Road Runner ©
- Coupling both software packages
- Study the impact of the traffic on energy consumption

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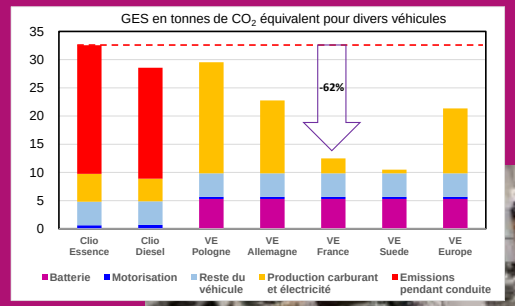

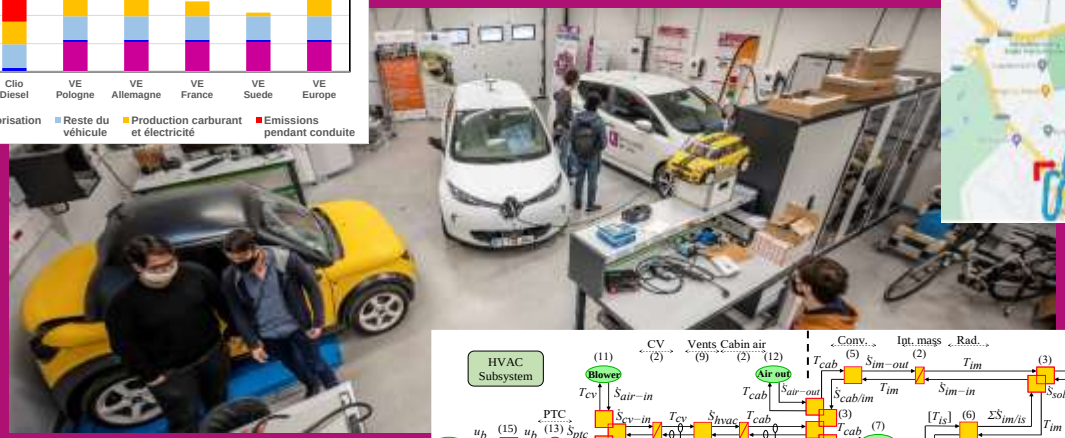

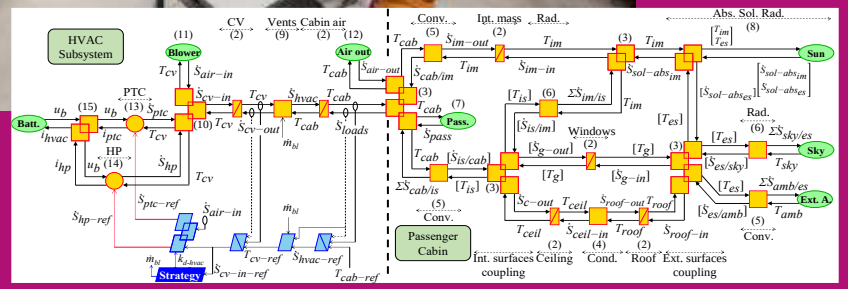

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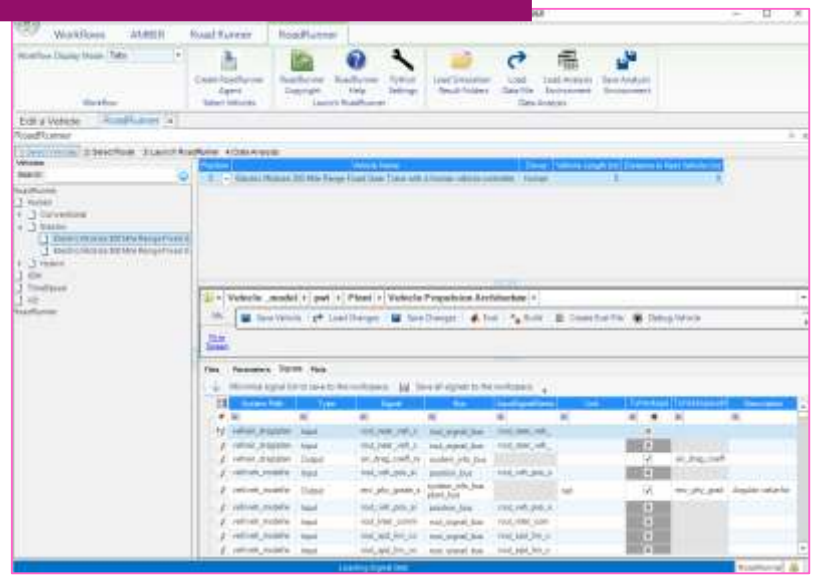
Annex: Road Runner workflow

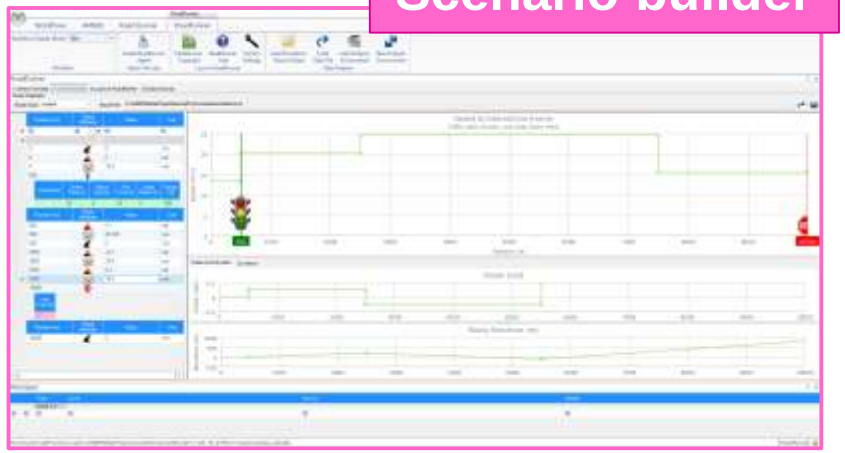
ROAD RUNNER

Route-based multi-vehicle simulation tool that focuses on vehicle energy consumption and performance estimation.

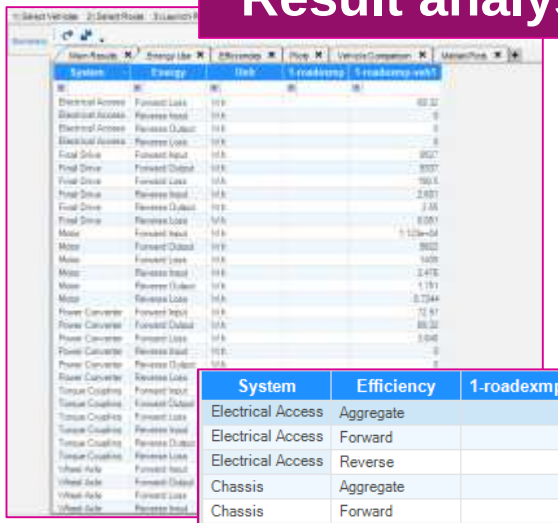
RoadRunner Workflow



Scenario builder



Result analysis



System	Efficiency	1-roadexmp	1-roadexmp-veh1
Electrical Access	Aggregate		0.0%
Electrical Access	Forward		0.0%
Electrical Access	Reverse		0.0%
Chassis	Aggregate		94.5%
Chassis	Forward		95.4%
Chassis	Reverse		83.7%
Battery	Aggregate		90.5%
Battery	Forward		90.5%
Battery	Reverse		104.7%
Final Drive	Aggregate		98.0%
Final Drive	Forward		98.0%
Final Drive	Reverse		98.0%

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