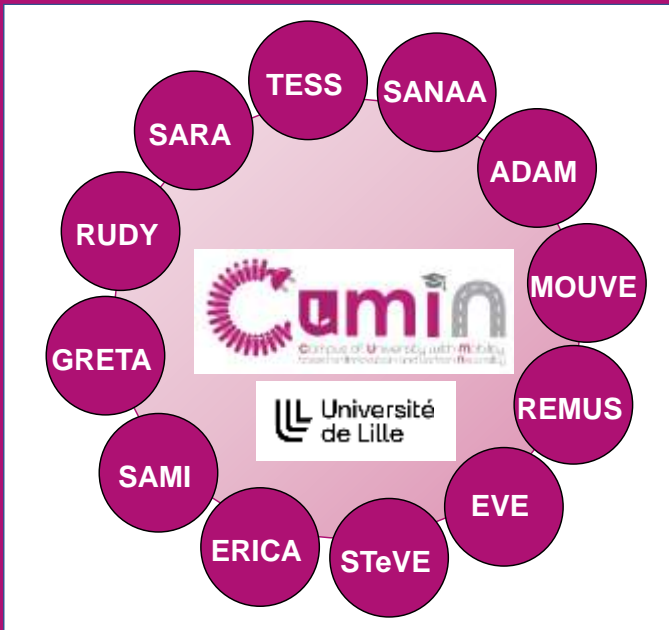




CUMIN - SARA

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

Inès BOUAKADIA  
Imane JAMAL EDDINE

Supervisor: Pr. Alain BOUSCAYROL

# Outline



**Objective**



**Simulation of Nissan Leaf**



**Generation of driving cycles**



**Conclusion**



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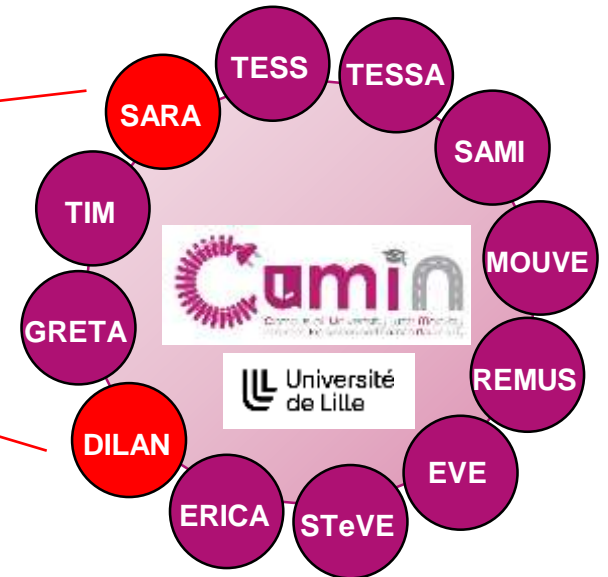
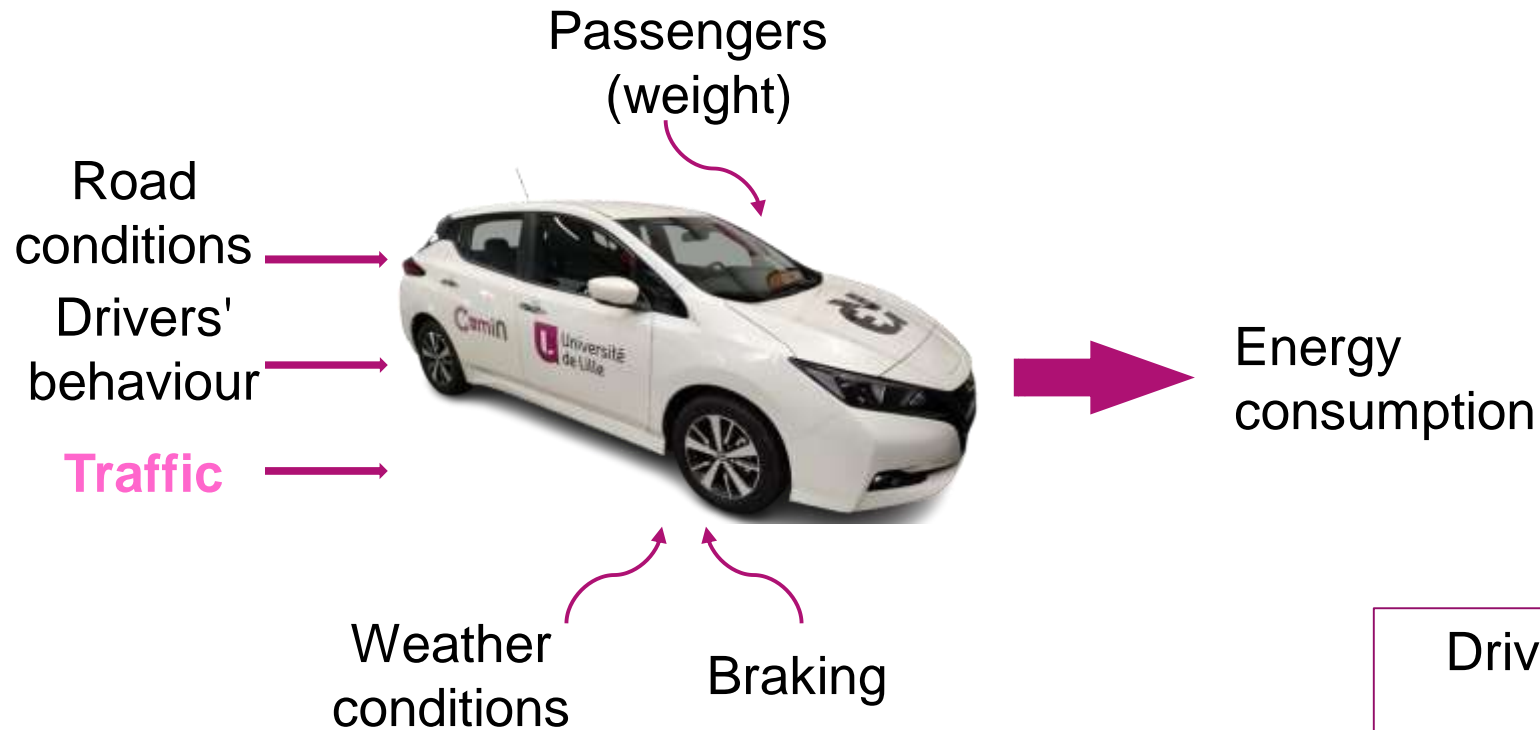
# 1. objective



# Context

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

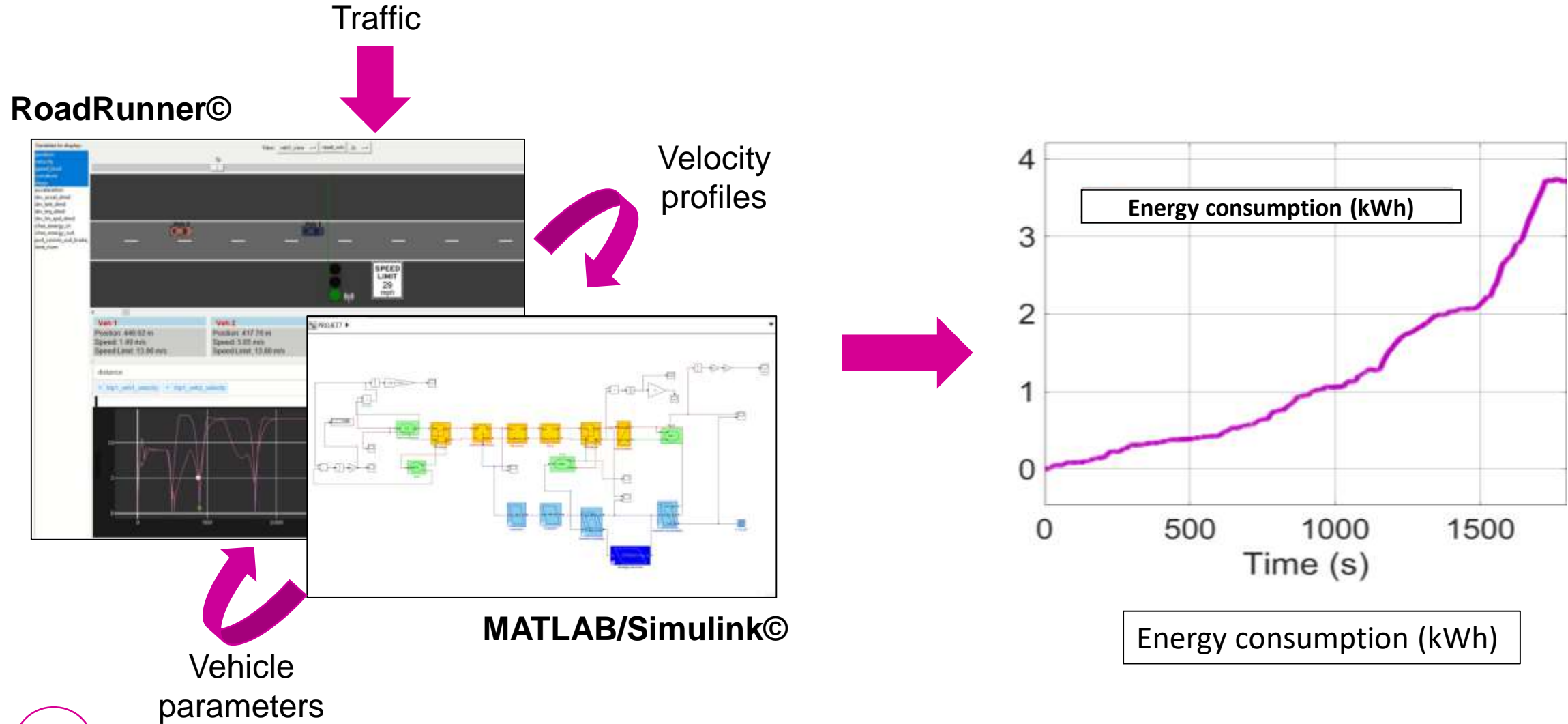
**DILAN** project: Driver-In-the-Loop for better analyze of energy consumption



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



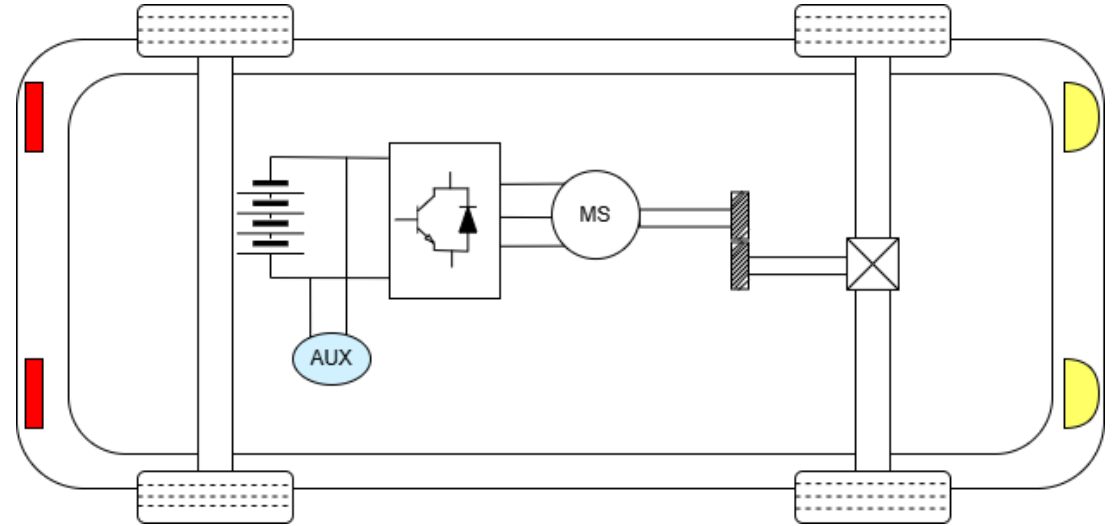


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## 2. Simulation of Nissan Leaf

(Matlab/Simulink ©)

# Studied vehicle parameters



Structural diagram of Nissan Leaf

Autonomy (WLTP): 270 km

maximal velocity: 144 km/h

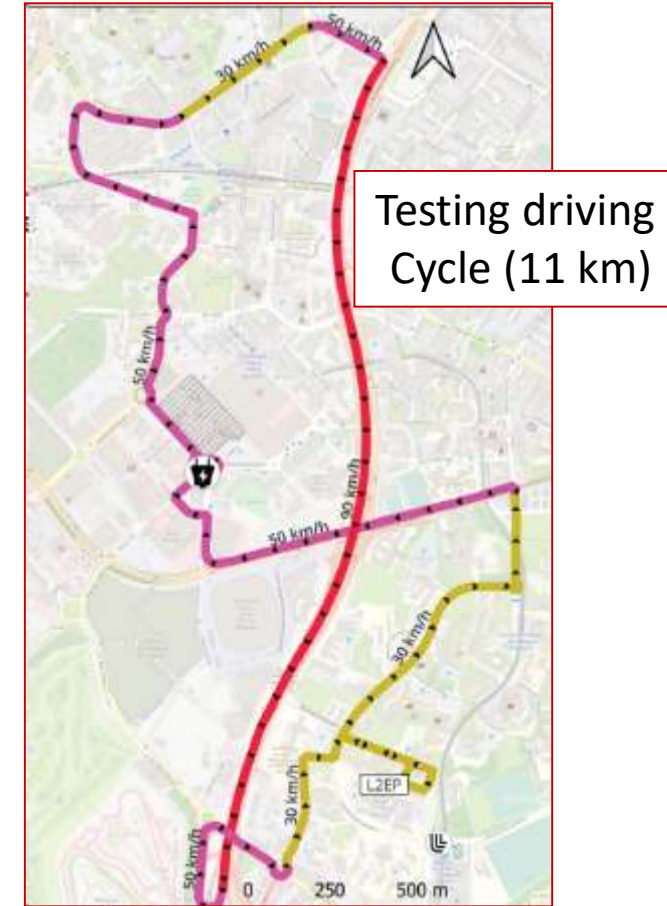
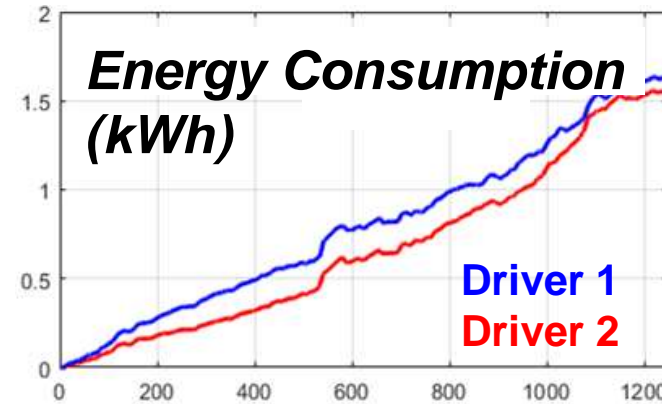
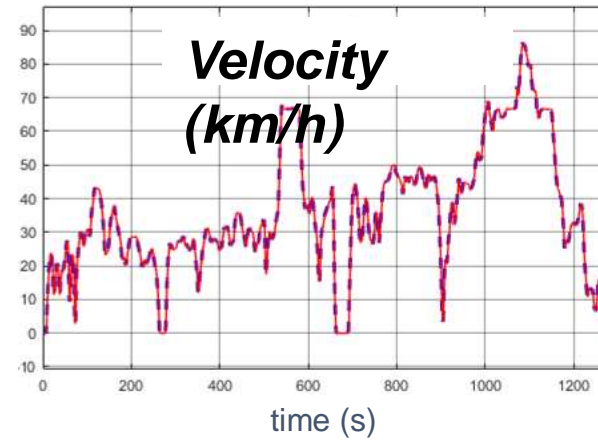
Weight (empty): 1505 kg

Battery: 40 kWh

Nominal voltage of the battery: 350.4 V

Power of the electric machine: 85kW

# CUMIN-SARA



## Technical aspects

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

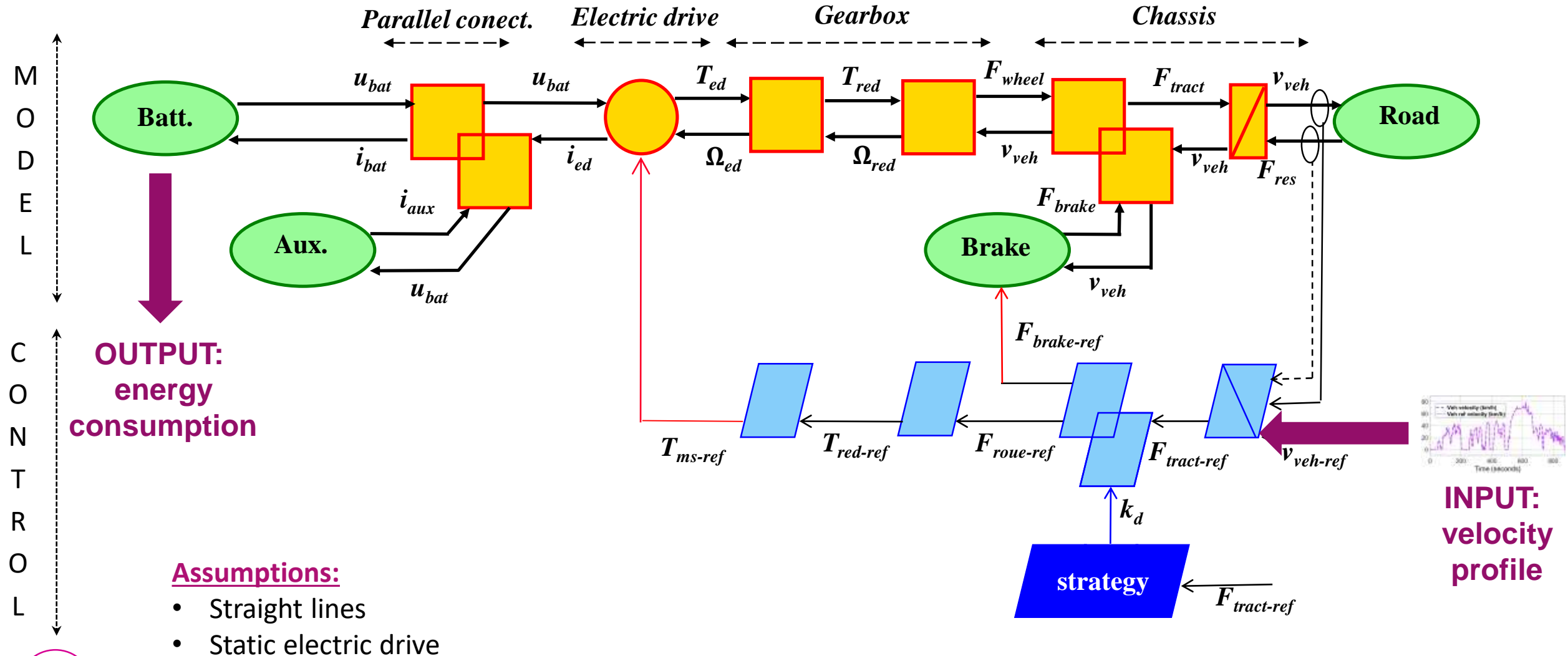


DILAN (Driver-In-the-Loop)  
and/or  
simulation of the traffic



# Model organization

using the EMR (Energetic Macroscopic Representation) formalism

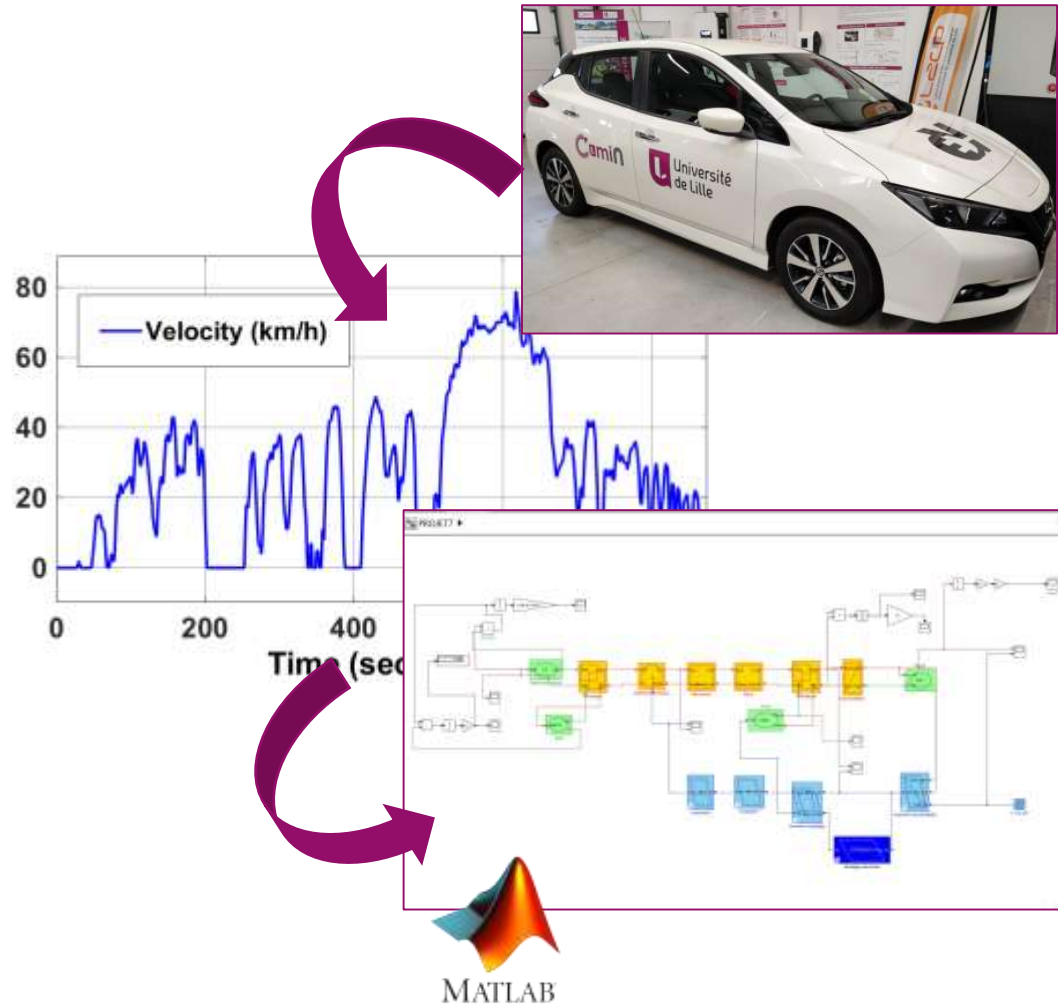


Assumptions:

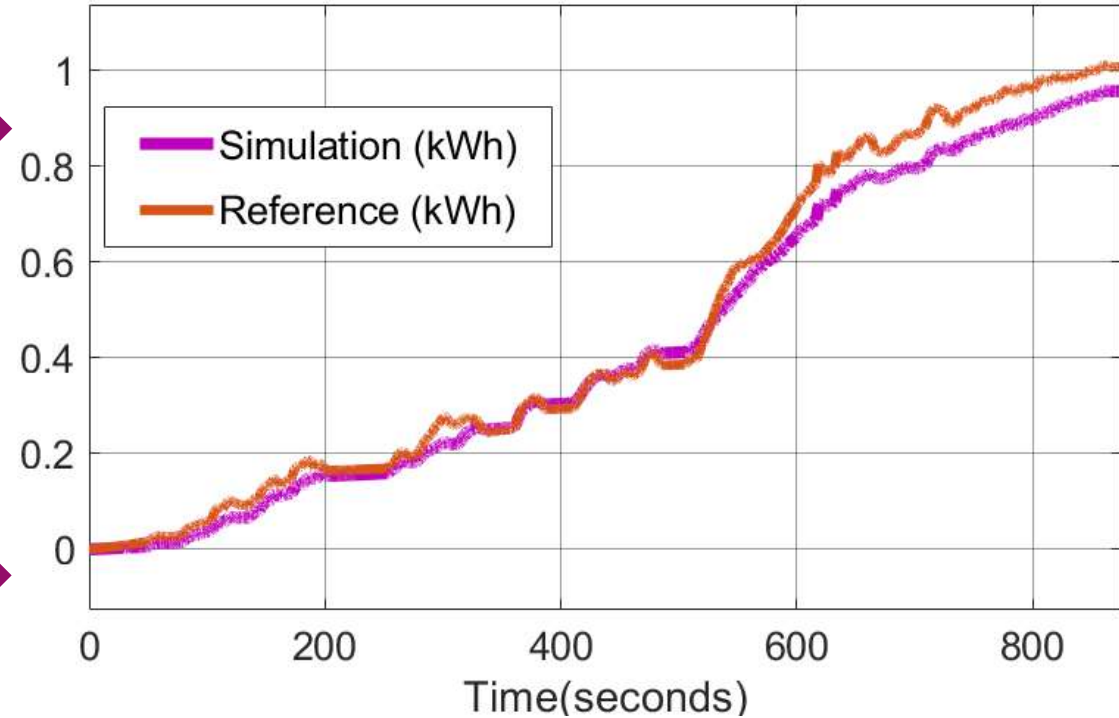
- Straight lines
- Static electric drive

# Simulation and validation

Test performed during a real driving cycle



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

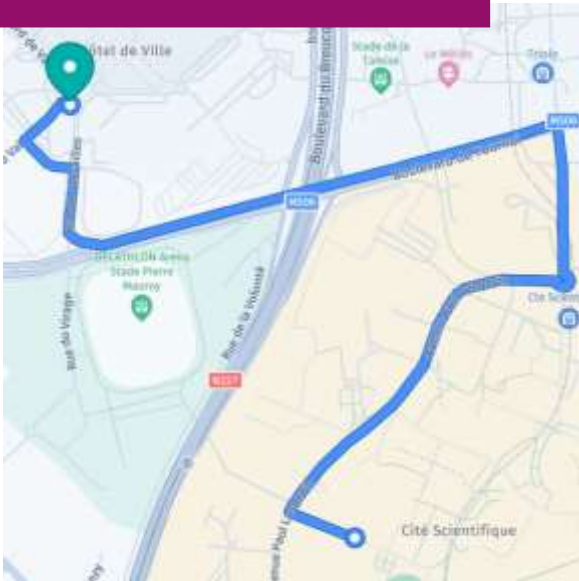
(RoadRunner ©)

# Road Runner: Example



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

Choose a real road



Position (m)	Road Attribute	Value	Unit
0	Speed Limit	5.55	m/s
75	Curvature	0	1/m
80	Curvature	0.1	1/m
120	Curvature	0	1/m
260	Speed Limit	0	m/s
495	Curvature	0	1/m
500	Curvature	0.05	1/m
510	Curvature	0	1/m
510	Speed Limit	8.33	m/s
1275	Curvature	0	1/m
1280	Curvature	0.067	1/m
1320	Curvature	0	1/m
1615	Curvature	0	1/m
1620	Curvature	0.05	1/m
1620	Speed Limit	0	m/s

Connected	Green Time (s)	Yellow Time (s)	Red Time (s)	Initial Phase (s)	Range (m)
<input checked="" type="checkbox"/>	30	5	20	5	250

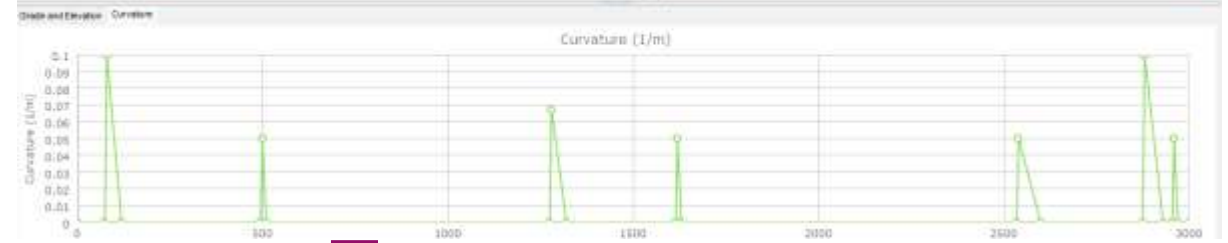
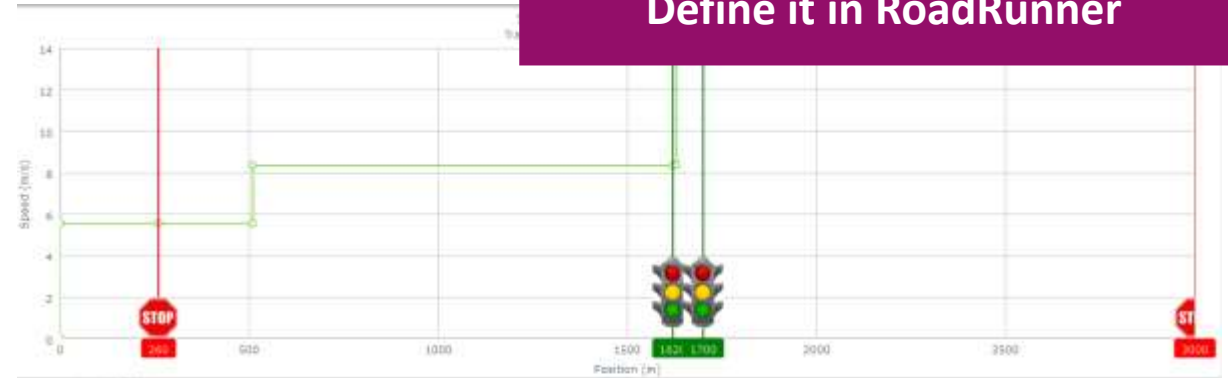
  

Position (m)	Road Attribute	Value	Unit
1630	Curvature	0	1/m
1630	Speed Limit	13.88	m/s
1700	Speed Limit	0	m/s

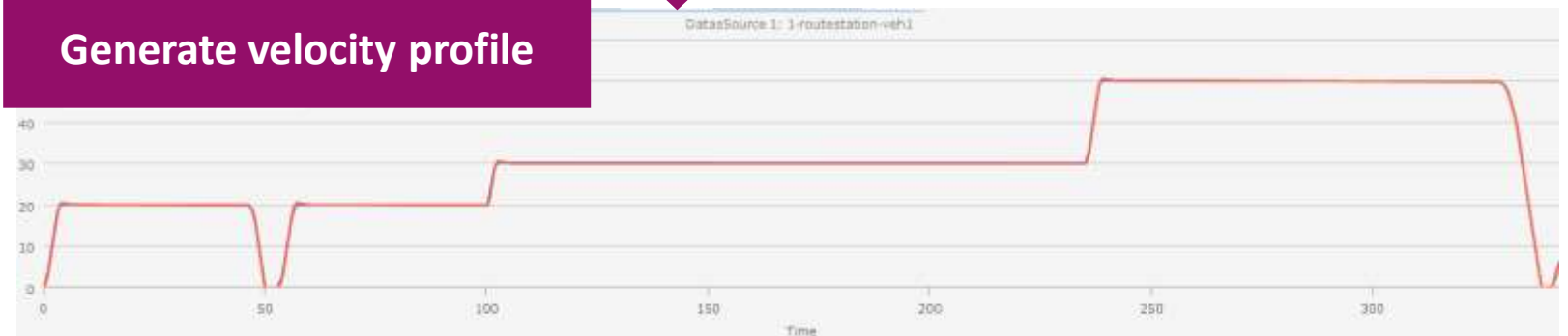
  

Connected	Green Time (s)	Yellow Time (s)	Red Time (s)	Initial Phase (s)	Range (m)
<input checked="" type="checkbox"/>	30	5	20	5	250

Define it in RoadRunner

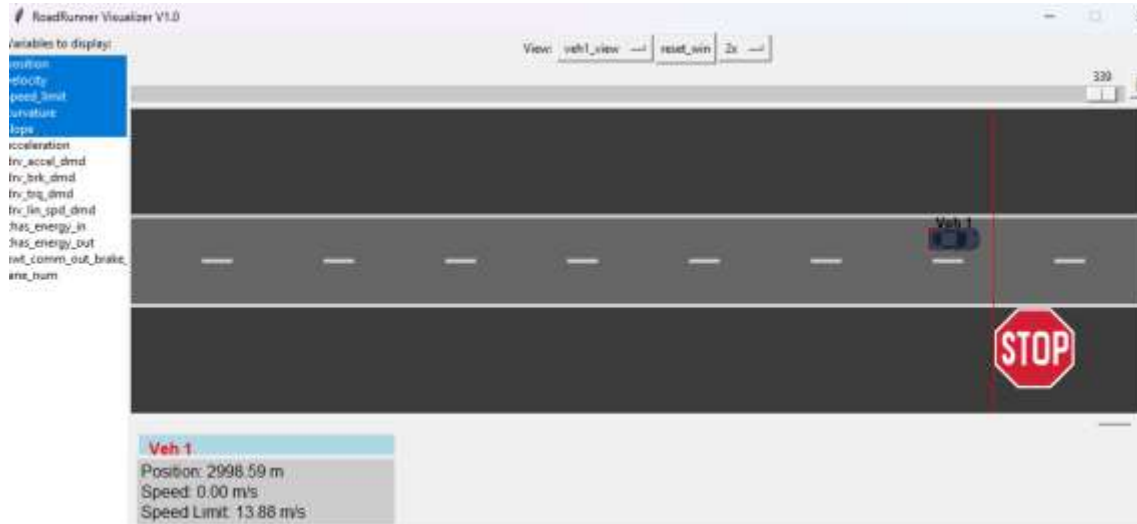
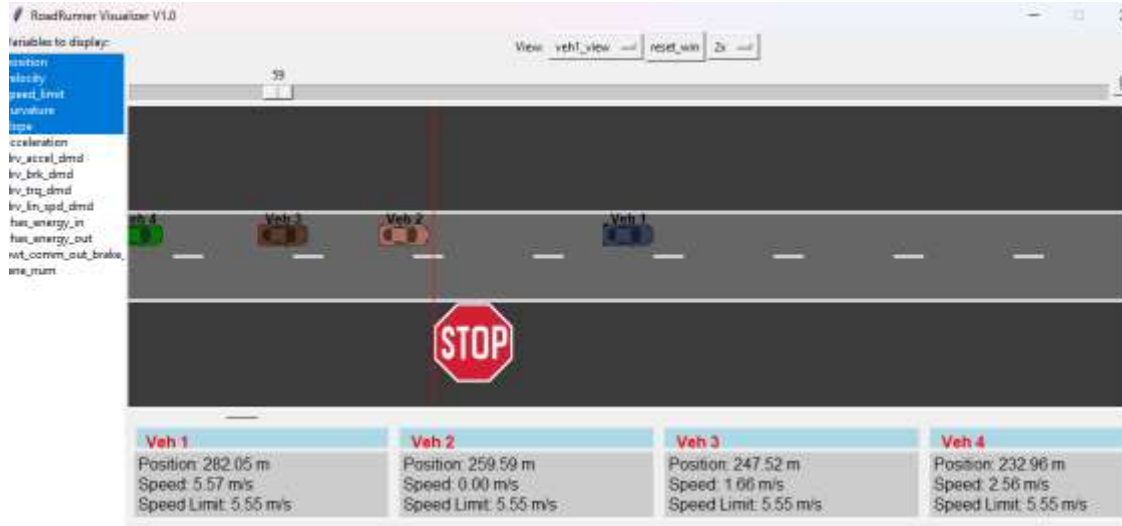


Generate velocity profile

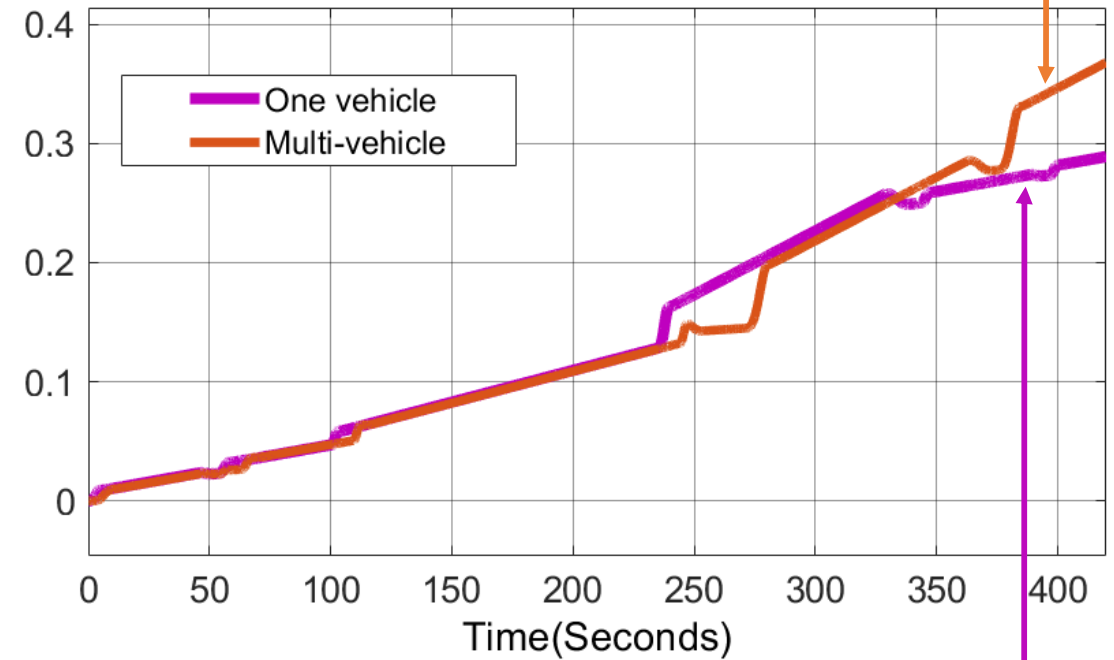


A trip of 3km

# 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

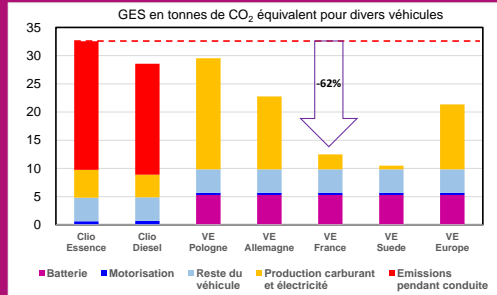
- Matlab/Simulink © model of Nissan leaf for energy consumption
- Model validation by a real driving cycle
- First analysis of Road Runner ©

## Perspectives

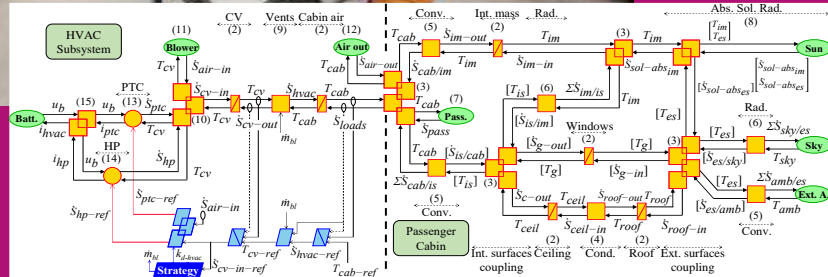
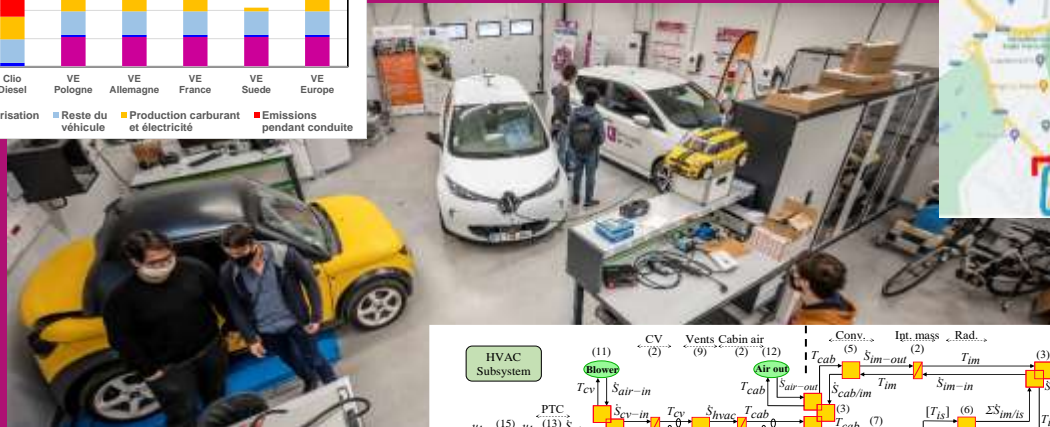
- Generation of velocity profile using Road Runner ©
- Coupling both software packages
- Study the impact of the traffic on energy consumption



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Our university as an exciting living lab towards eco-cities through an innovative transdisciplinary framework !





# Annex: Road Runner workflow

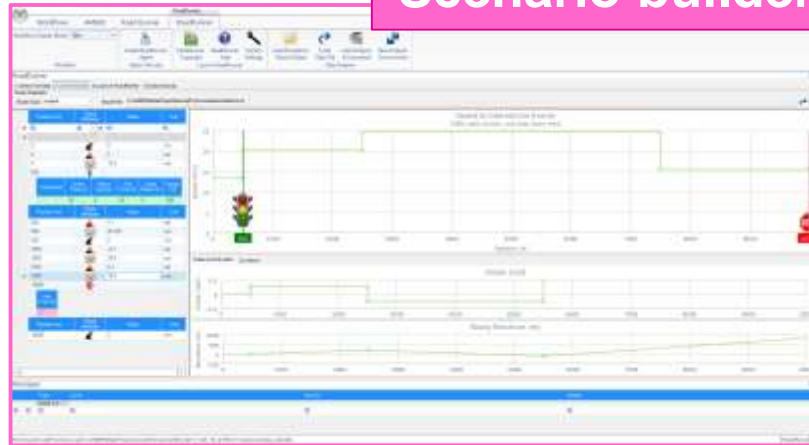
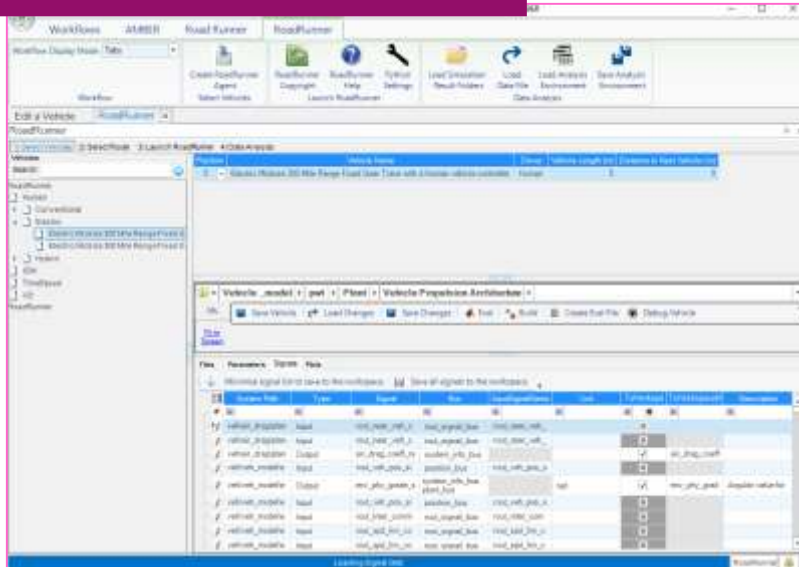


Route-based multi-vehicle simulation tool that focuses on vehicle energy consumption and performance estimation.

## Result analysis

## Scenario builder

## RoadRunner Workflow



System	Energy	Efficiency	1-roadexmp	1-roadexmp-veh1
Electrical Access	Forward Link	94.5%		
Electrical Access	Reverse Input	94.5%		
Electrical Access	Reverse Output	94.5%		
Electrical Access	Reverse Link	94.5%		
Final Drive	Forward Input	98.0%		
Final Drive	Forward Link	98.0%		
Final Drive	Reverse Input	98.0%		
Final Drive	Reverse Output	98.0%		
Final Drive	Reverse Link	98.0%		
Motor	Forward Input	104.7%		
Motor	Forward Link	104.7%		
Motor	Forward Output	104.7%		
Motor	Reverse Input	104.7%		
Motor	Reverse Link	104.7%		
Motor	Reverse Output	104.7%		
Power Converter	Forward Input	90.5%		
Power Converter	Forward Output	90.5%		
Power Converter	Forward Link	90.5%		
Power Converter	Reverse Input	90.5%		
Power Converter	Reverse Output	90.5%		
Power Converter	Reverse Link	90.5%		
Transmission	Forward Input	98.0%		
Transmission	Forward Output	98.0%		
Transmission	Forward Link	98.0%		
Transmission	Reverse Input	98.0%		
Transmission	Reverse Output	98.0%		
Transmission	Reverse Link	98.0%		
Wheel Axle	Forward Link	98.0%		
Wheel Axle	Reverse Input	98.0%		
Wheel Axle	Reverse Output	98.0%		
Wheel Axle	Reverse Link	98.0%		

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%
Motor	Aggregate		104.7%

