an *"out of the box"* **Hardware Approach** to secure an **AllWeather <u>Affordable</u> Monodirectional Level 4* Driving System**

** without transition demand from the driving system*

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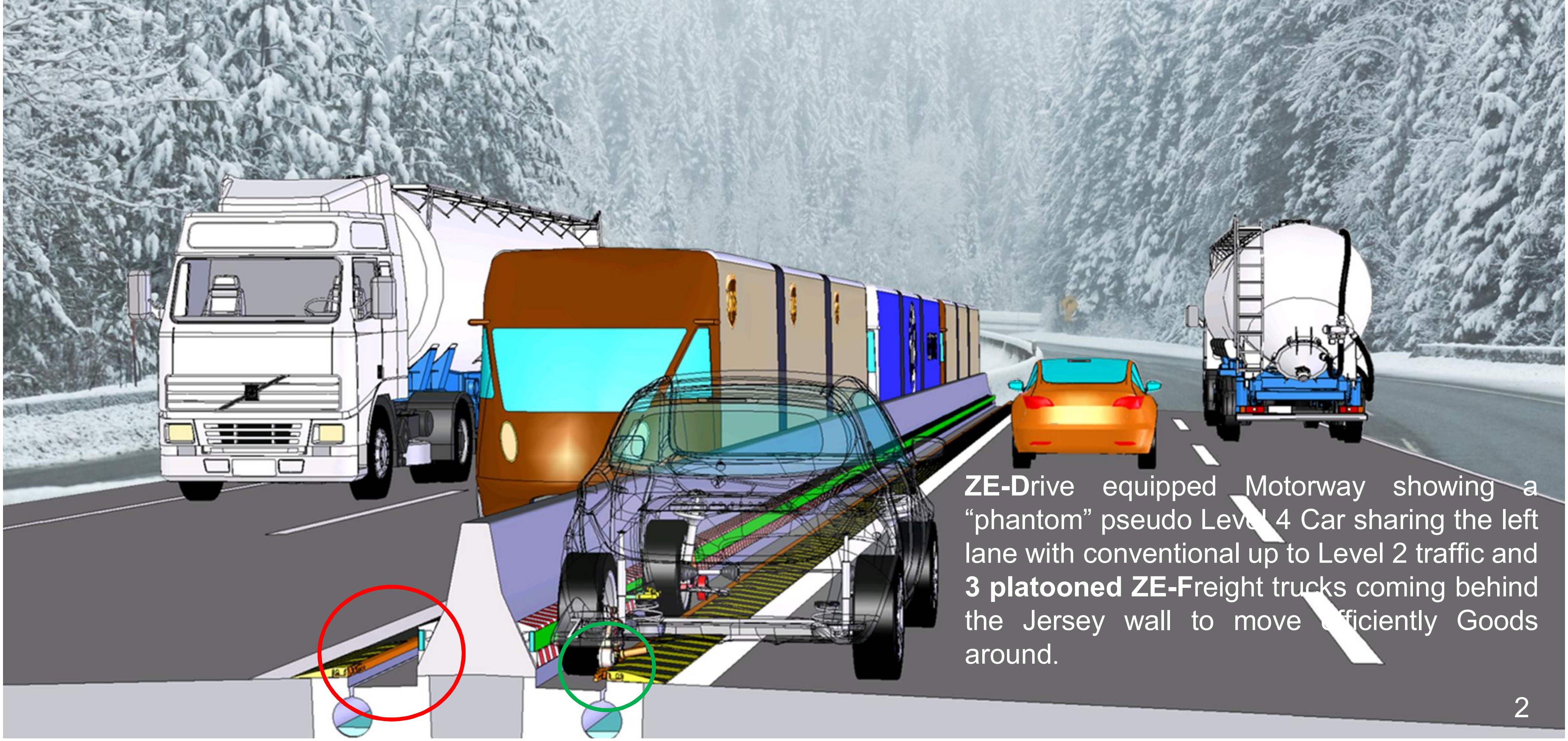
Hardware Solutions

for Emergency Line Keeping System… ;

the vehicle's left wheels ride contactlessly in a Gutter in Automated Driving

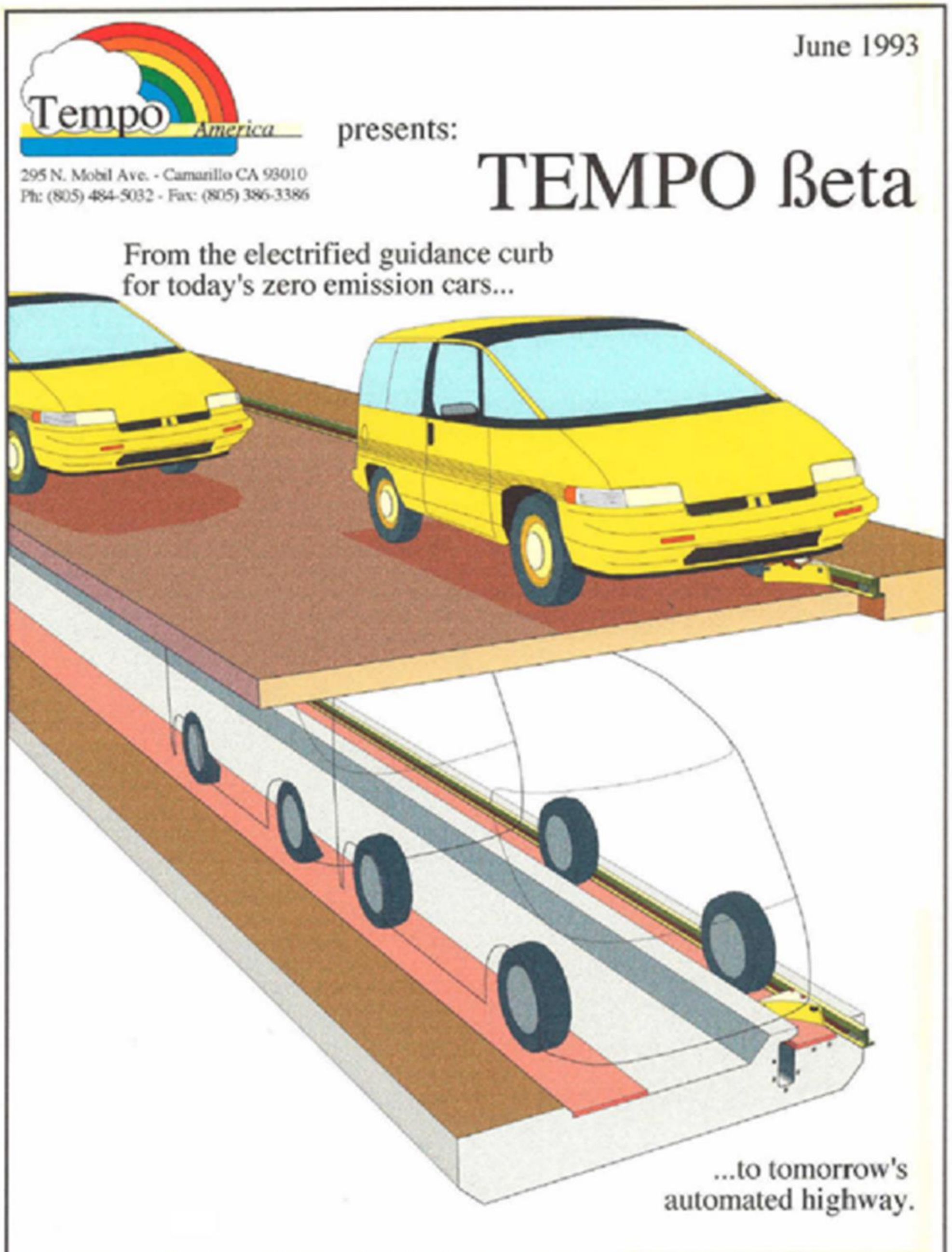
for an all Weather Emergency Braking…

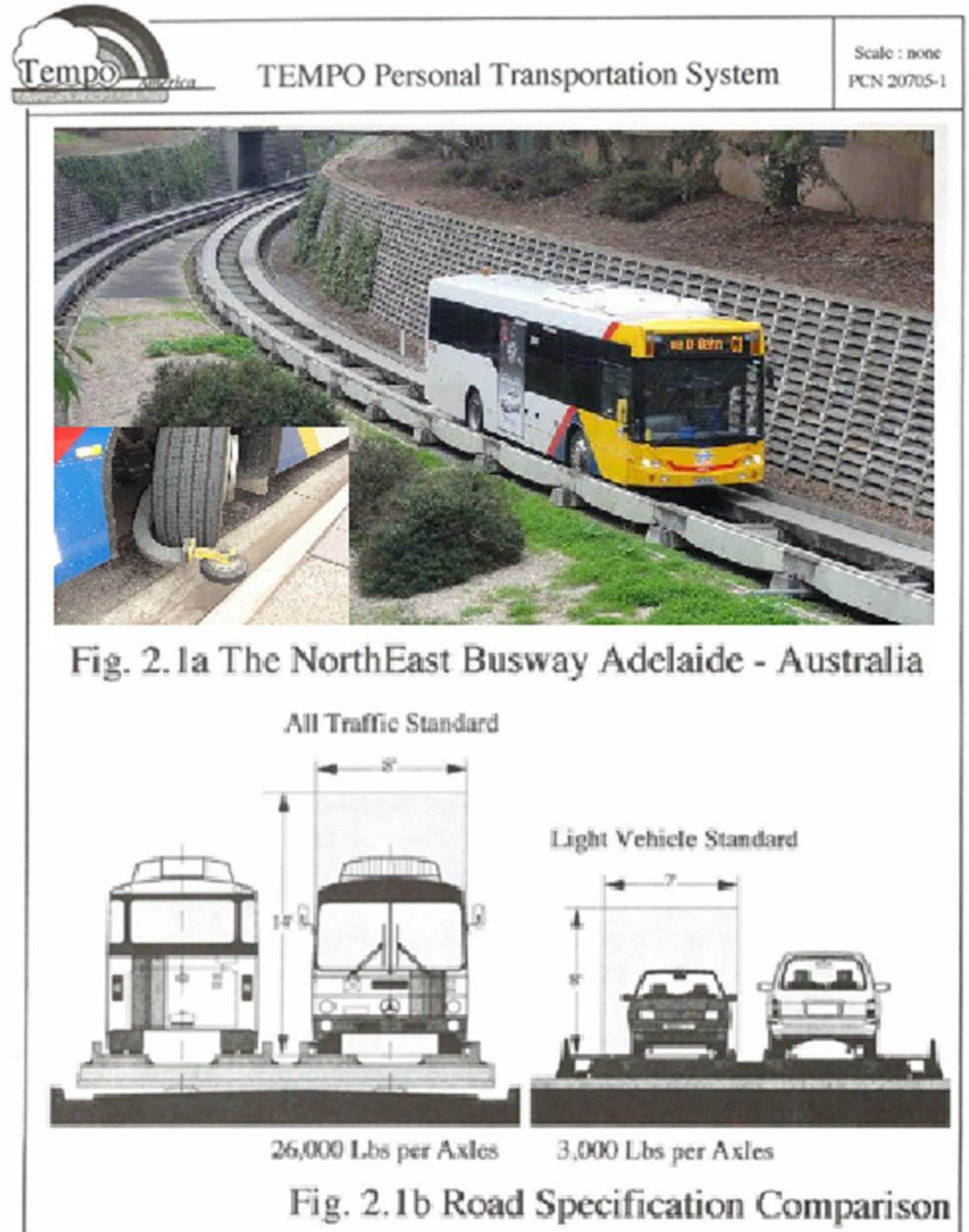
a swinging 2g Braking Caliper grabs a Rail bordering the Gutter



ZE-Drive equipped Motorway showing a "phantom" pseudo Level 4 Car sharing the left lane with conventional up to Level 2 traffic and **3 platooned ZE-F**reight trucks coming behind the Jersey wall to move efficiently Goods around.

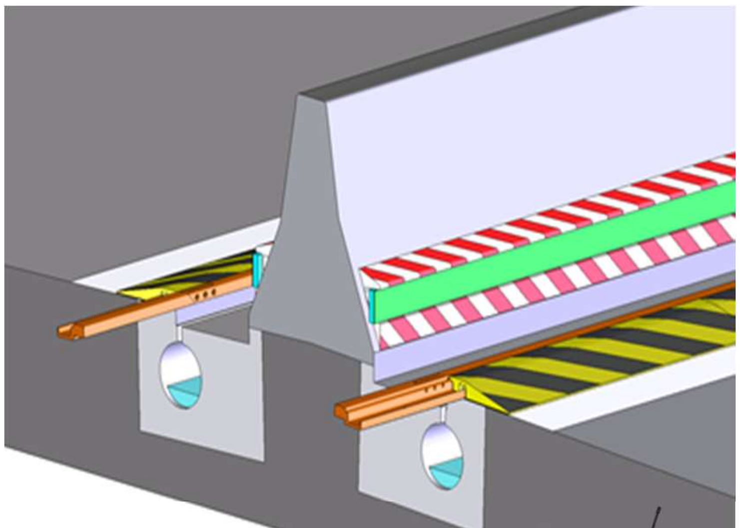
Background years 90’





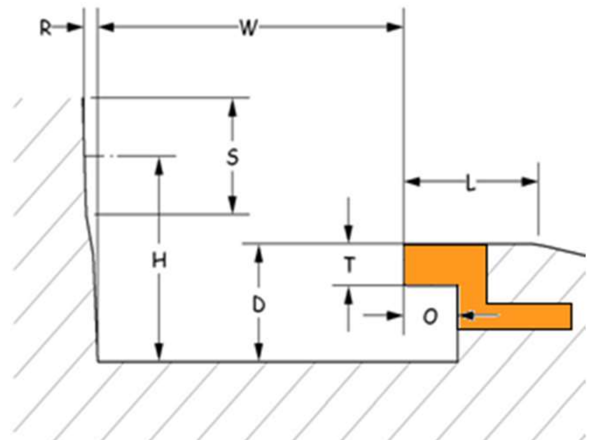
How it works

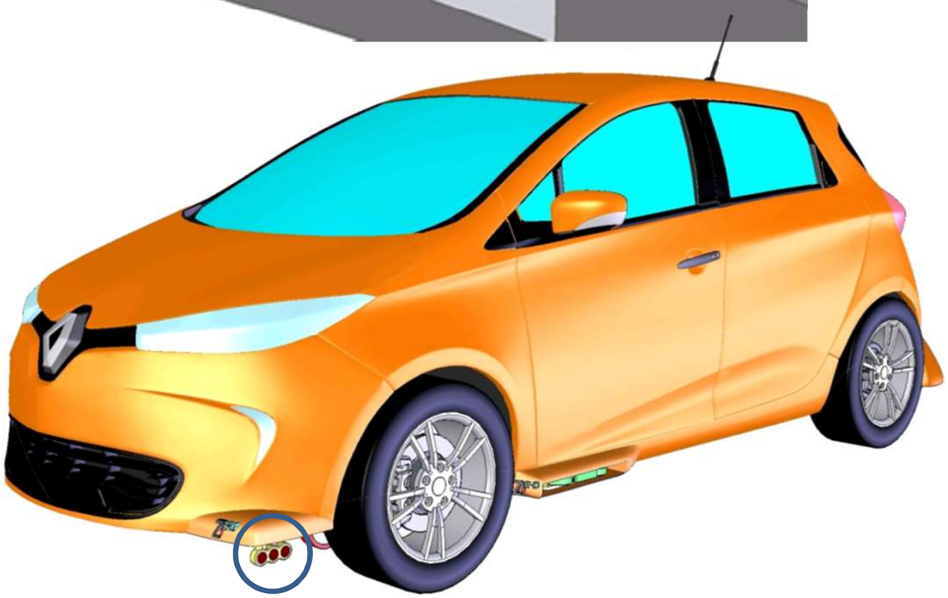
The infrastructure required for the deployment of **ZE-D**rive technology is minimalist and concentrated on the central strip separating freeways, integrated into the Jersey wall and the slotted gutters, without encroaching on conventional traffic lanes.



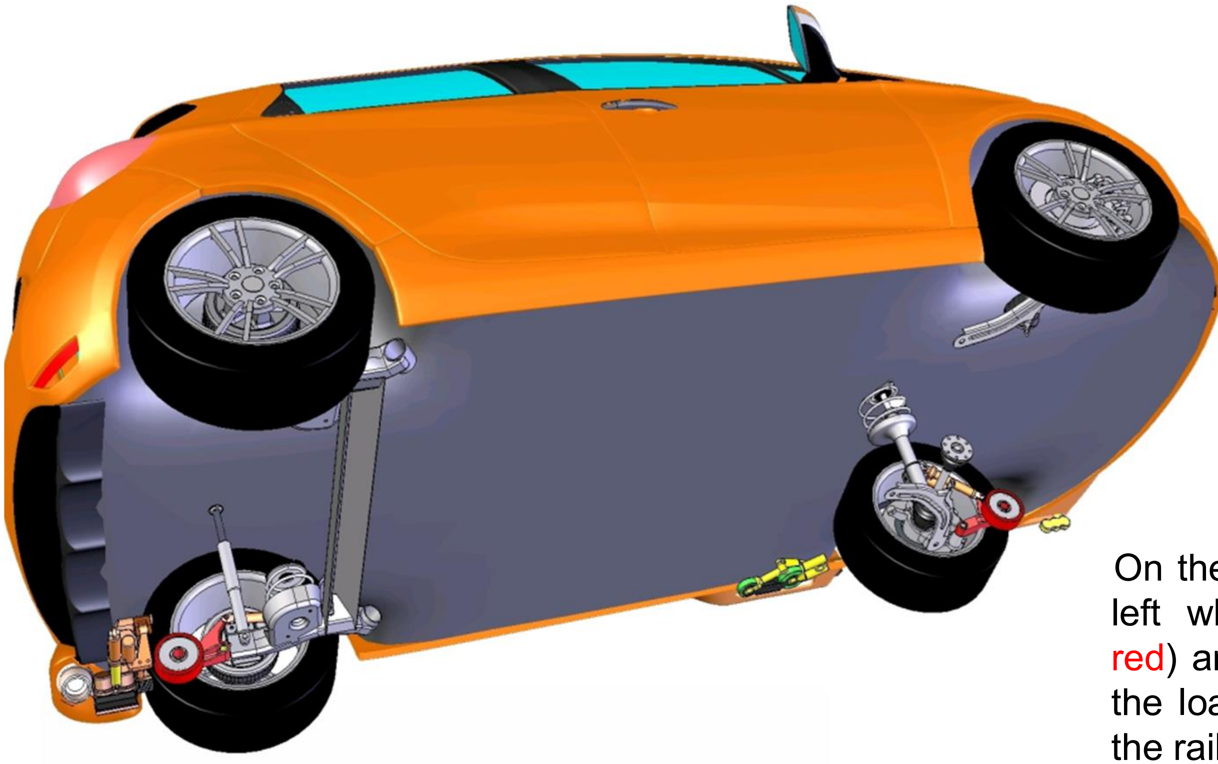
A 24 kg/m (16 lbs/ft) rail (in orange) is attached to the gutter.

Sloped ramp sections (yellow-black striped) connect the pavement to the top surface of the rail.

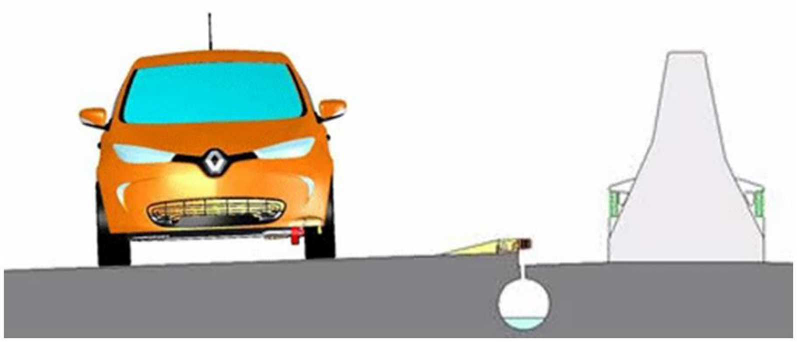


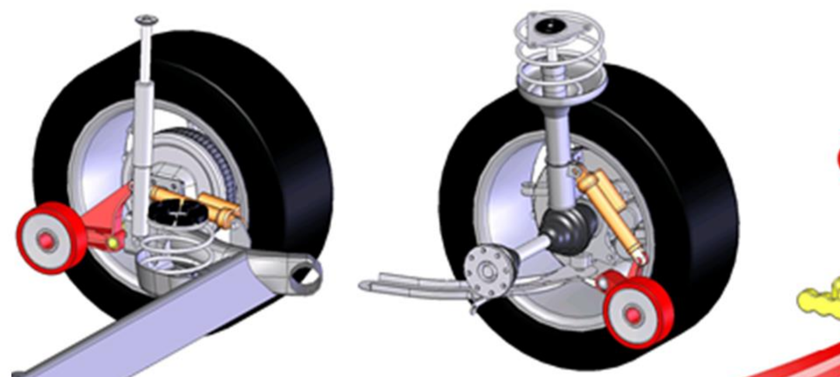


In front of the left front wheel, a multi-sensor device continuously detects the lateral distance of the vehicle from the Jersey wall and, in **ZE-D**rive mode, reliably controls automatically the car steering in order to keep the left wheels centered on the dedicated curbed track in all weather conditions.

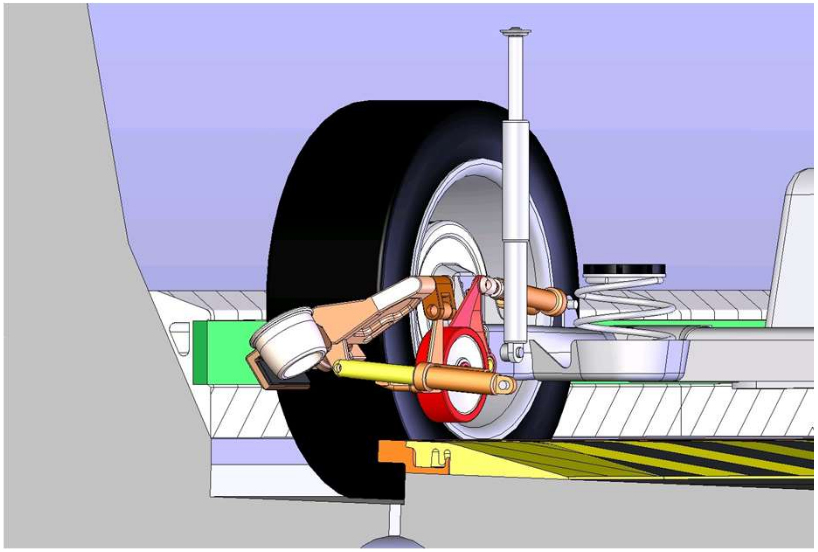


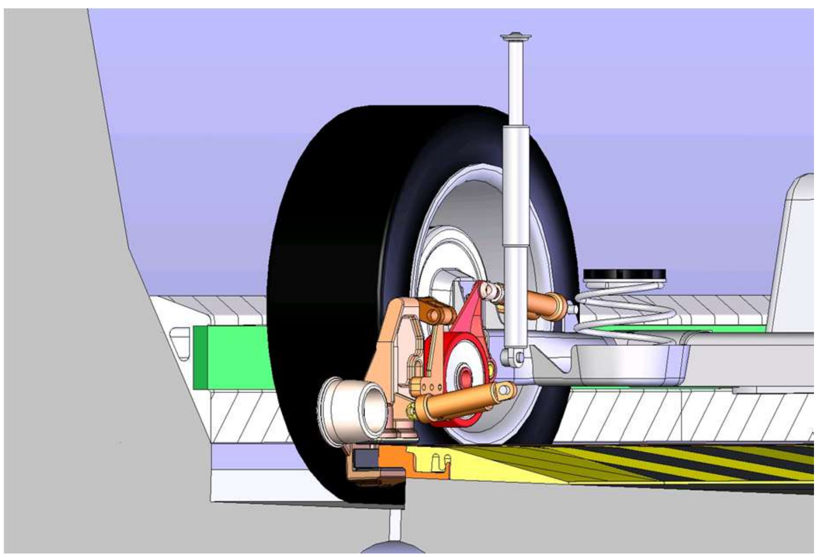
On the inside of the stub axles of the two left wheels, two **retractable rollers** (in red) are attached to temporarily take over the load of the left wheels when crossing the rail sideways.

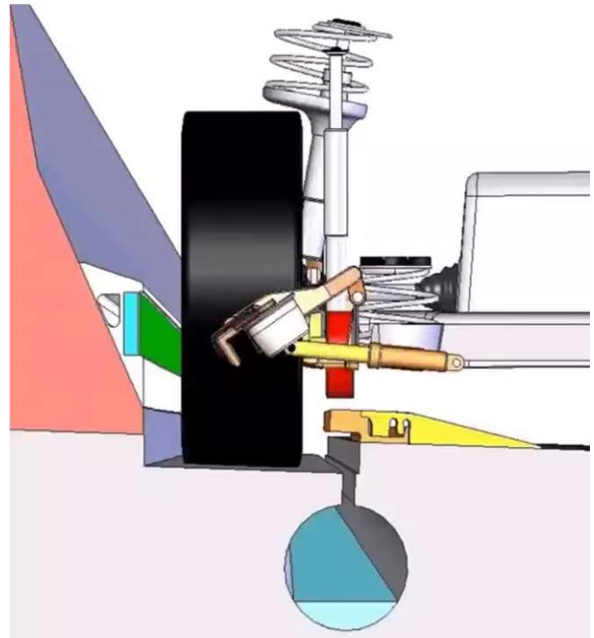




AllWeather Emergency 2g Braking System



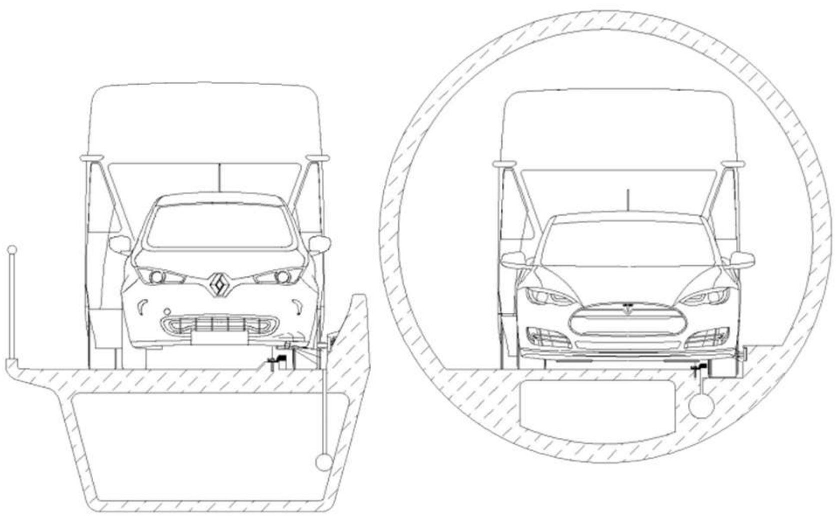




Why it's better

ZE-Drive is currently the **only Automated Driving System (ADS) capable of reducing stopping distance by 50% in dry weather and 75% in wet weather**, which could **save thousands of lives per year**.

In addition, **ZE-Drive** has the potential to increase user confidence in **Platooned Traffic** through the emergency inertial activation of the **2 g braking system** or in the event of an *electrical "blackout" or cyber-attack*.



The emergence in the current decade of a **fleet of ZE-Drive** equipped **EVs**, vans up to the "light truck" size capable of carrying out a substantial portion of the transportation done today by full size trucks (bus, tractor, semitrailer) with axle loads reduced from 13 Tons (18/20,000 lbs in the US) down to 2,25 Tons (5,000 lbs) will enhance **the safety record of road transportation** and open up prospects for dedicated, **light expressways** capable of running along large span for **economical light overpasses** or small diameter for **economical light underpasses.**

Proof of Concept and Validation

ZE-Drive propose to form a **Joint Industry Project (JIP)** to bring together :

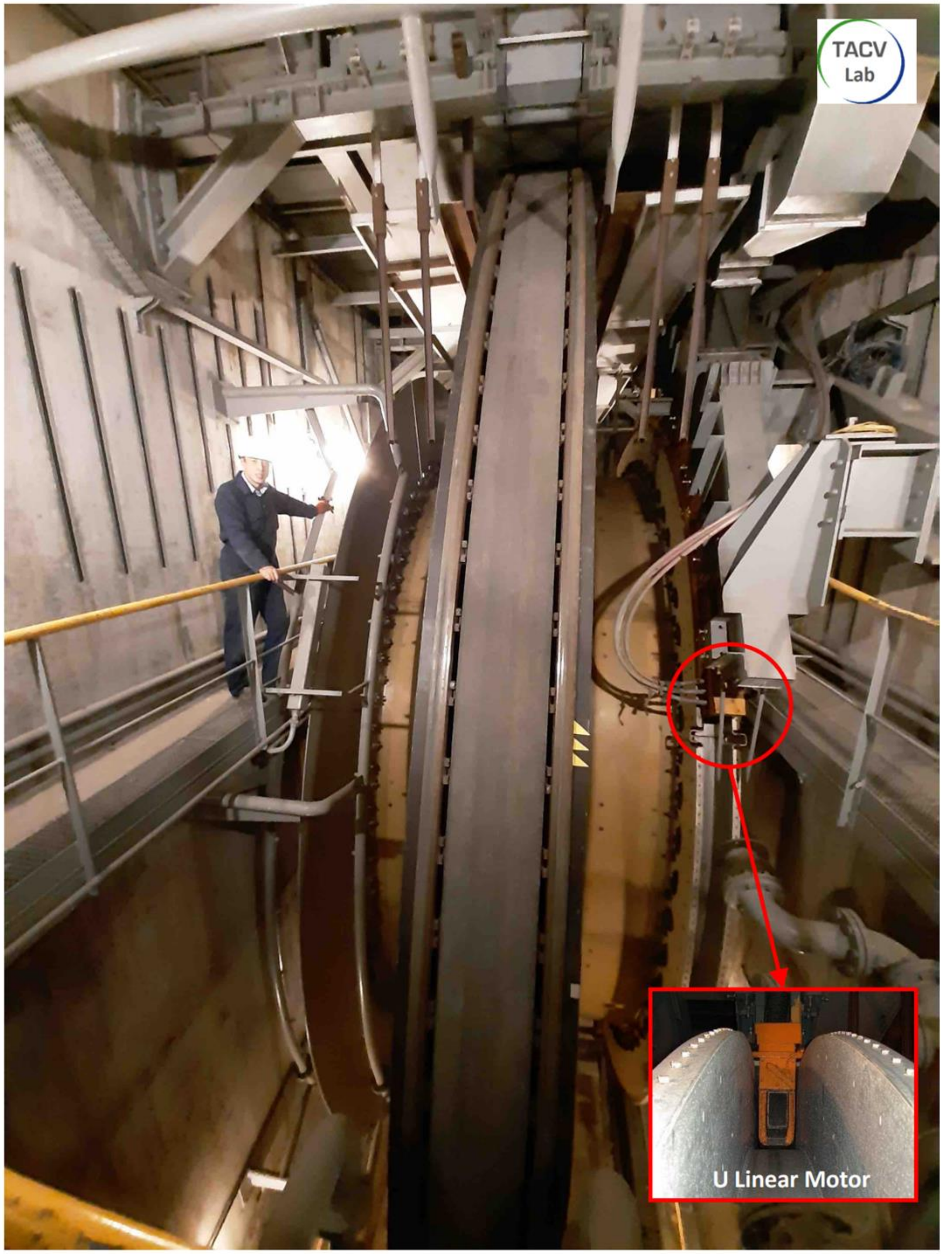
- ***International Academia and Research Institutes***
- ***Car Makers***
- ***Motorway Constructors***
- ***Toll Operators***
- ***Power Distribution Network Public/Private Entities***
- ***National Road Infrastructure Authorities***
- ***National and International Road Safety Authorities***
- ***Clean Mobility Authorities***

to validate through ***JIP demonstrations*** the viability and the readiness to market an **AllWeather Affordable Monodirectional Level 4 Driving System**

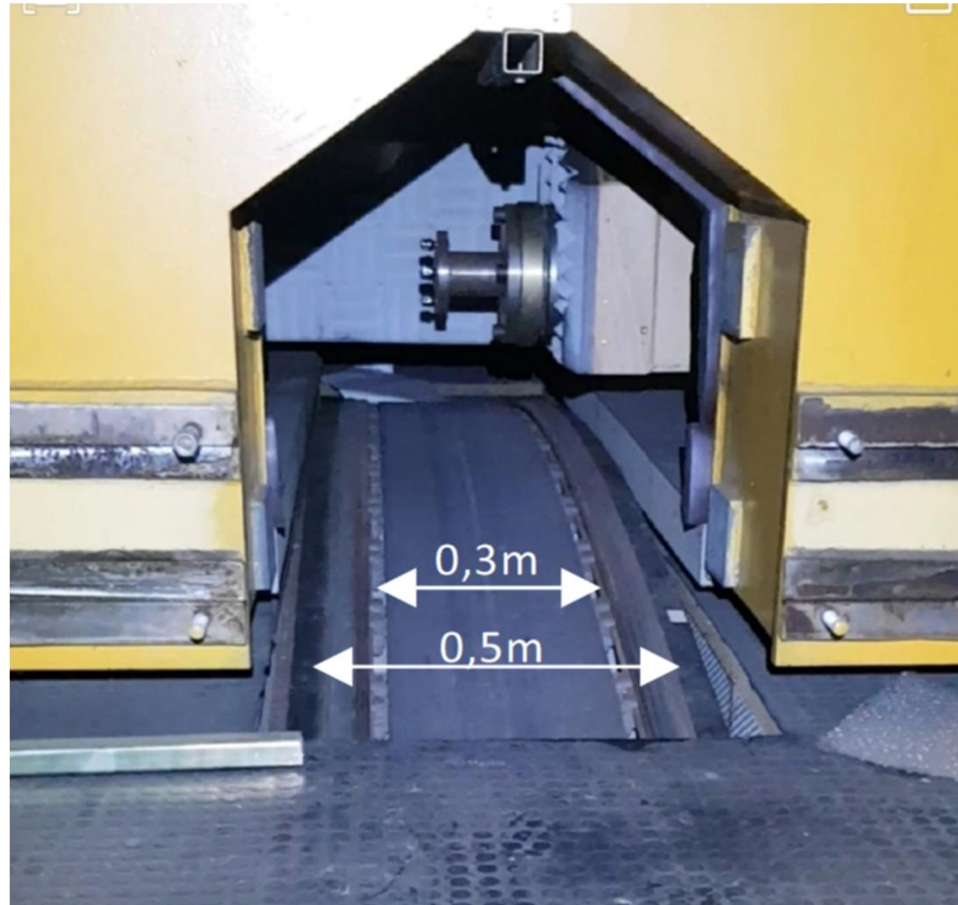
- **Phase 1 (2024) Proof of Concept** aims to demonstrate the ease of automated **ZE-D**rive **lateral entry/exit** on a 500 m track at a Transportation Research Center.
- **Phase 2 (2025)** will test the **ZE-D**rive **powerful 2 g emergency braking system** and demonstrate the **platooning capability** and the viability of **ZE-D**rive **TBT/ELV 120 Volts DC power dynamic feed**.
- **Phase 3 (2026)** will entail a **ZE-D**rive **open road pilot installation** to collect usage data and show case the technology to users and industry players.

A consensual international standard for the **ZE-D**rive curbed track will emerge from the **JIP steering committee** work.

Testing and Qualification



TACV Lab. Grenoble Wheel Laboratory, 13m diameter, 300km/h



A 40 tons, 13 meters testing wheel will be used to run 100 000 km endurance tests on entering/exiting the **ZE-D**rive gutter & testing of the Monodirectional Level 4 Driving System with power feed transmission up to 400 Amp. in ELV.

Roadmap

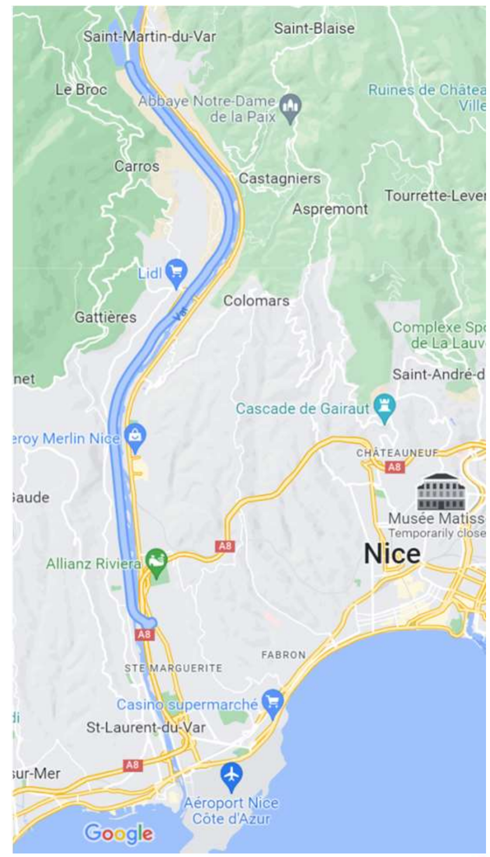
- **Phase 0 (2024)** aims to build **ZE-C**harge prototypes and install them on cars as well as designing a fatigue/homologation test bench for the collector and pavement bar on the “Roue de Grenoble”.

- **Phase 1 (2025)** aims to conduct extensive debris management of the dynamic current collector with the **ZE-F**eed cable and a 4 month Endurance Test on the “Roue de Grenoble”

- **Phase 2 (2026)** aims to run a 12 km pilot installation on the **M6202bis** in the VAR valley which links the **CARROS-LE BROC** Logistic Base to the city of **NICE**.

ZE-Charge SAS RevA pcn 230305

ZE Feed infrastructure		**80m**	**24 km**
ZE-Feed/ ZE-Charge vehicles	**1**	**2**	**15**
Development & Launch Costs (€ ‘000)	**Phase 0**	**Phase 1**	**Phase 2**
Internet Site with Animations & Videos	5	15	50
EVs equiped with ZE-Charge/**F**eed collectors and Bars	20	40	900
ZE-Charge Fatigue/Homologation test bench	15	45	
ZE-Feed Debris Management Linear Test Bench		150	150
ZE-Feed Endurance Test "Grenoble Wheel" 100,000 km		350	
ZE-Feed Manufacturing Plant Engineering		70	
ZE-Feed Manufacturing Pilot Plant Construction			500
ZE-Feed Spool installation/removal truck (Eng-Constr)		50	200
M6202bis 12 km Open Road Test Demonstration			5 800
Management and Tech Staff	10	80	500
SG&A	5	40	100
Contingency	5	100	500
Total: €9,7 Millions	**60**	**940**	**8 700**



CONCLUSION

ZE-D*rive* **Hardware approach** *and* **Monodirectional automated control** *of the vehicle aims to remove the red requirements of the recommendations which require in fact* ***SAE Level 4***

III. Recommendations regarding automated driving systems issuing transition demands

3. Automated driving systems issuing transition demands should:

- Safely exercise dynamic control when engaged and interact with the driver through an effective and intuitive human-machine interface;

- Monitor the driver's availability and manage the driver's attention to ensure that the driver is ready and able to respond to a transition demand;

- Issue a transition demand when appropriate, in an effective manner with sufficient lead time for the driver to safely assume dynamic control;

- After issuing a transition demand, continue exercising dynamic control until the driver has taken dynamic control of the vehicle;

- Transition dynamic control safely and in a clear and foreseeable manner to the driver;

- Verify that the driver is exercising dynamic control at the end of a transition process;

- Perform a risk mitigation manoeuvre if the driver does not take over dynamic control.