Pilot kick-off event

Istanbul, April 2026

Next e-TRUCK Istanbul Use Case: Implementing Digital Twins for EV Thermal and Energy Optimization

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Co-funded by UK Government

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Agenda:

- Digital Twin Description and Pre-Studies
- HIL Testing and Vehicle Application Test Results
- Effective Energy Management
- Question and Answers

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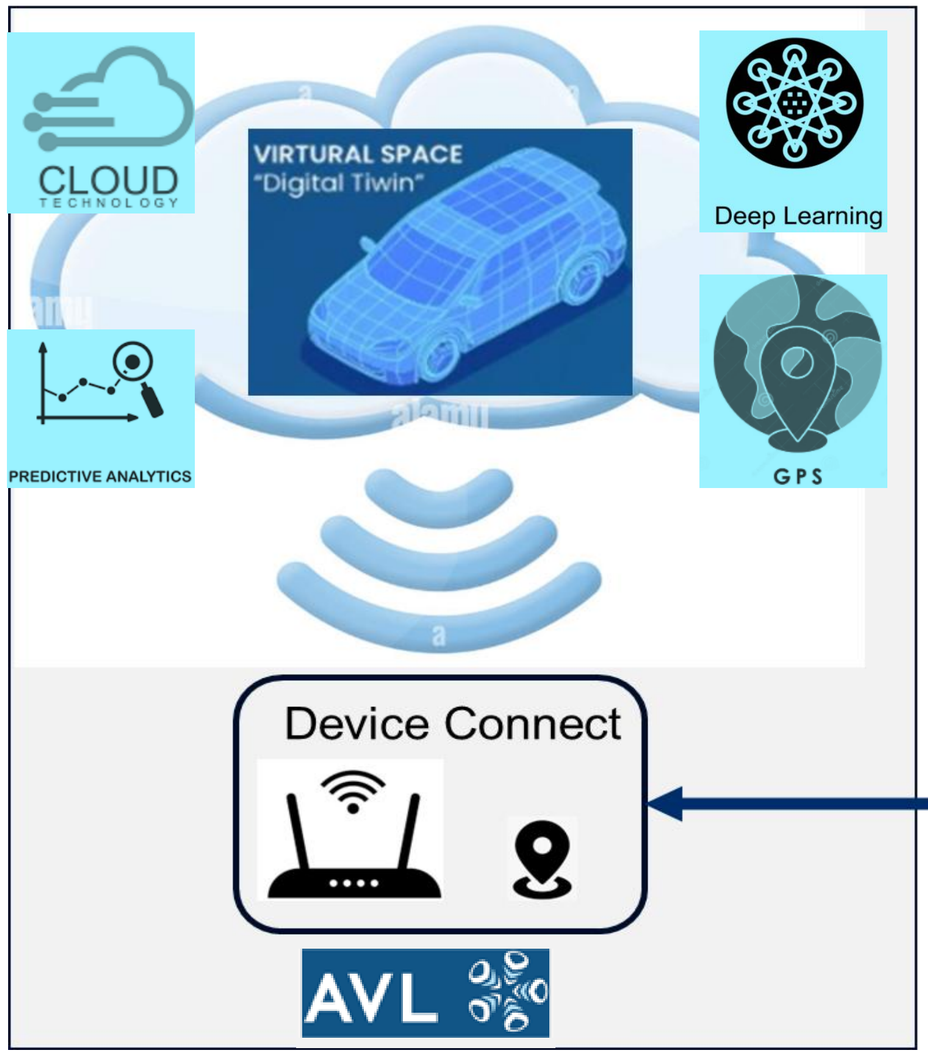
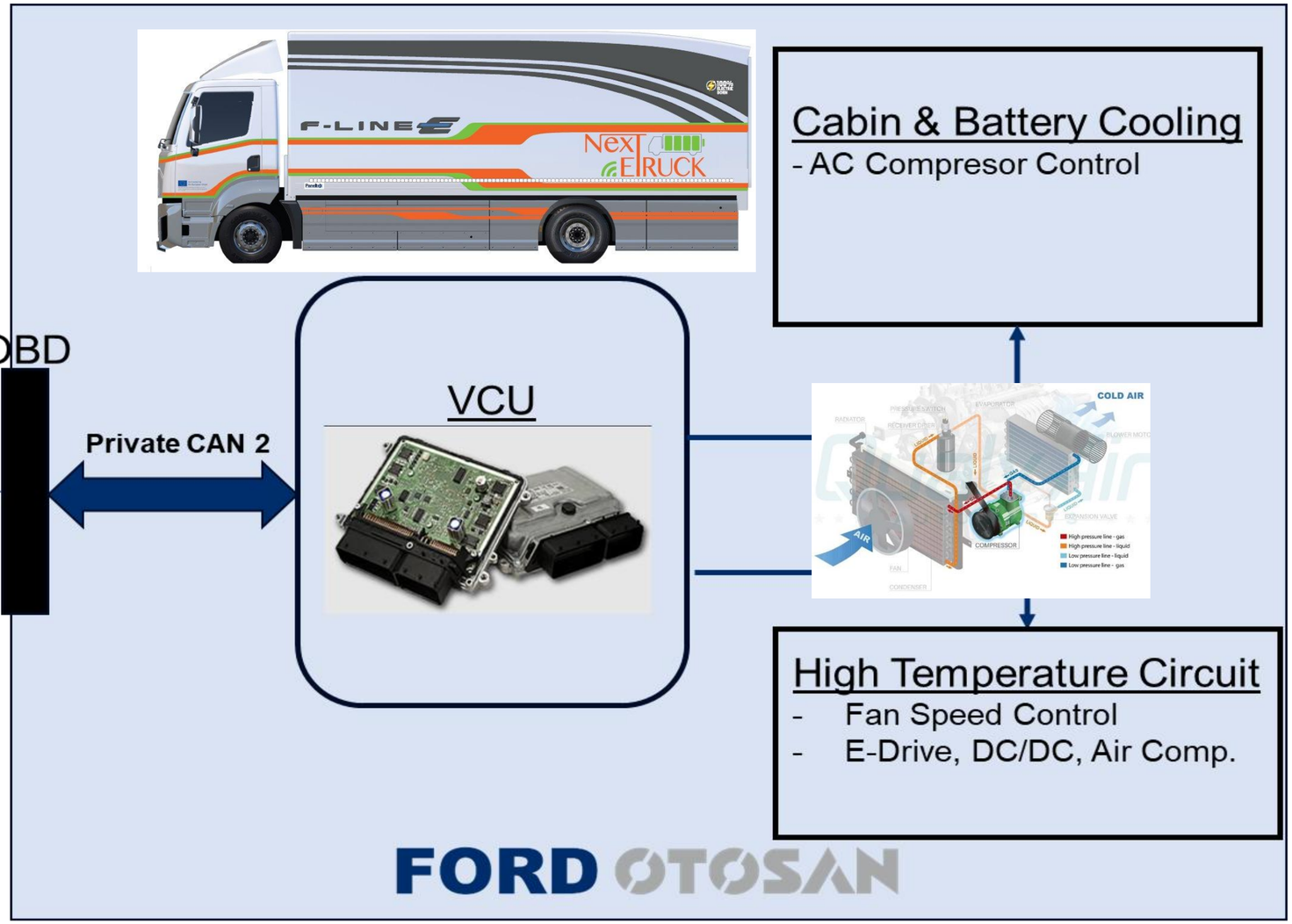
Digital Twin Description and Pre-Studies

Digital Twin: Vehicle Application Layout





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Information Flow Schematic by AVL

Cloud

Track Data
NNG

Energy Consumption
Estimation
AVL

Smart VTM DT
AVLD

Setpoints via
CANConnect
AVL

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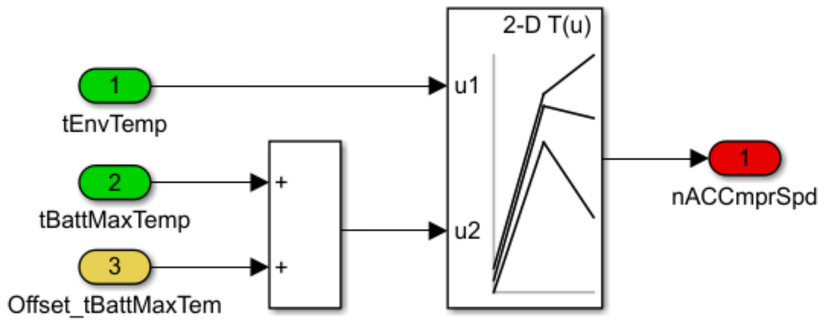
Setpoints and Signal Definitions

- Digital Twin model **optimizes fan and compressor control** in e-trucks by integrating real-time and cloud-based thermal signals.
- **Offset adjustments enhance cooling decisions**, ensuring efficient and intelligent control.



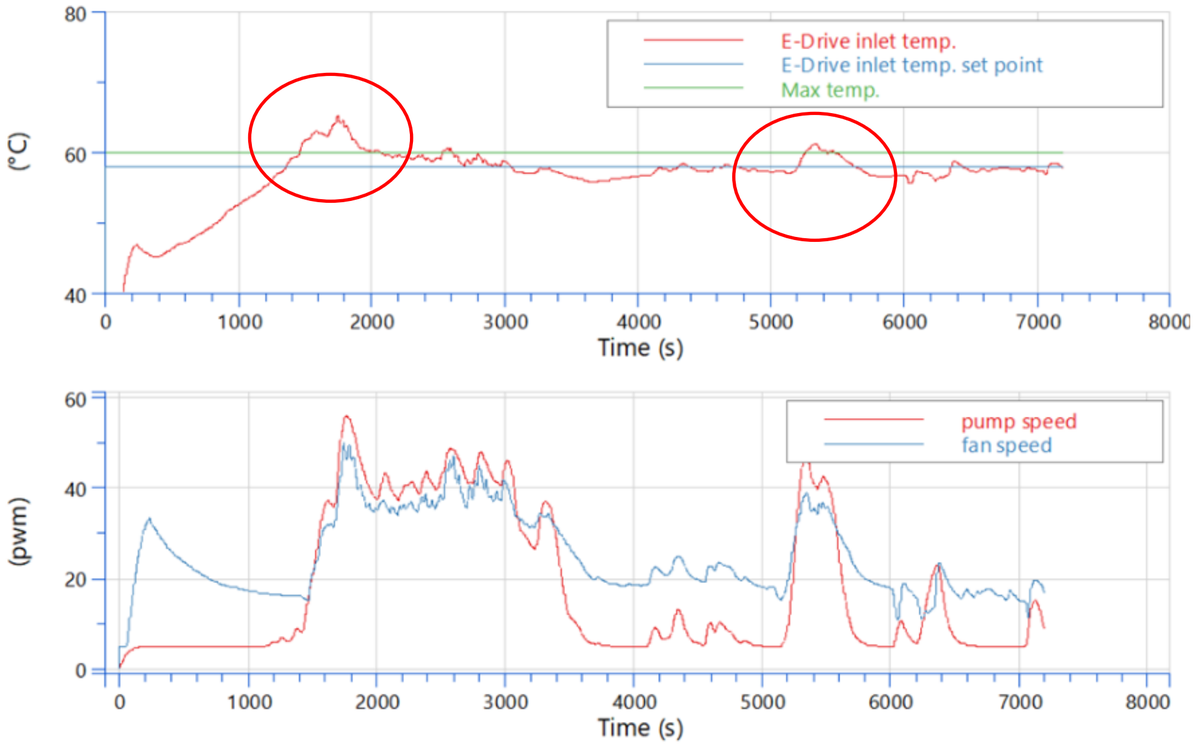
- This approach reduces energy consumption, improves thermal stability, and extends system longevity.

From Cloud to VCU
Set temperature of coolant at powertrain inlet
Set temperature of coolant at battery temperature
Connection Check value DT

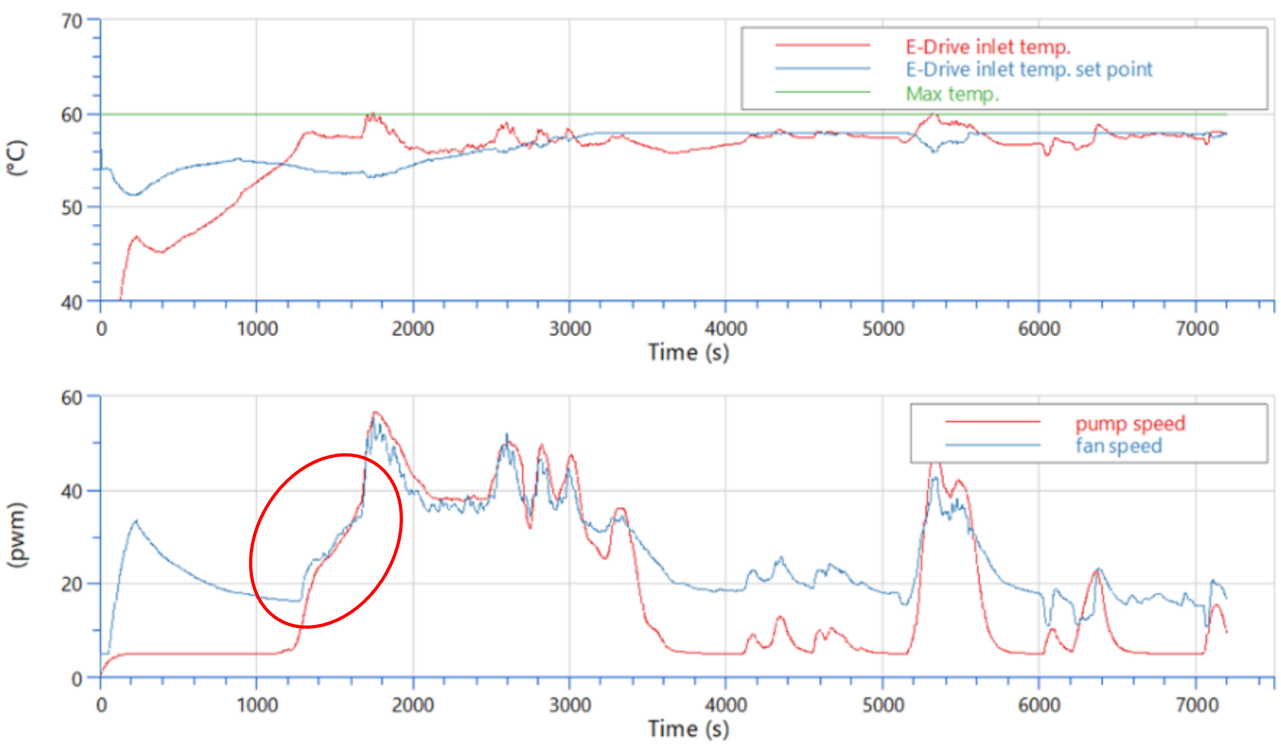
From VCU to Cloud
Connection Check value Truck
Cloud connection established
Actual vehicle speed
Vehicle slope
Vehicle total weight
Battery SoH
Battery SoC or SoE
Battery current
Battery voltage
Actual Ambient temperature
Cabin temperature Setpoint
Actual coolant temperature at powertrain inlet
Actual coolant temperature at battery inlet
Actual coolant temperature at battery outlet
Actual Maximal battery temperature
Actual Minimal battery temperature

Comparison of Predictive and Non-Predictive Setpoint

GoEkGo_V2 cycle at 30 °C with static setpoint of 58 °C



GoEkGo_V2 cycle at 30 °C with predictive setpoint up to 58 °C



A static setpoint of 58 °C without predictive adjustment leads to the temperature limit being exceeded.

HIL Testing and Vehicle Application Tests

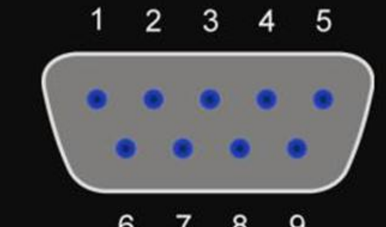
HIL Test Bench

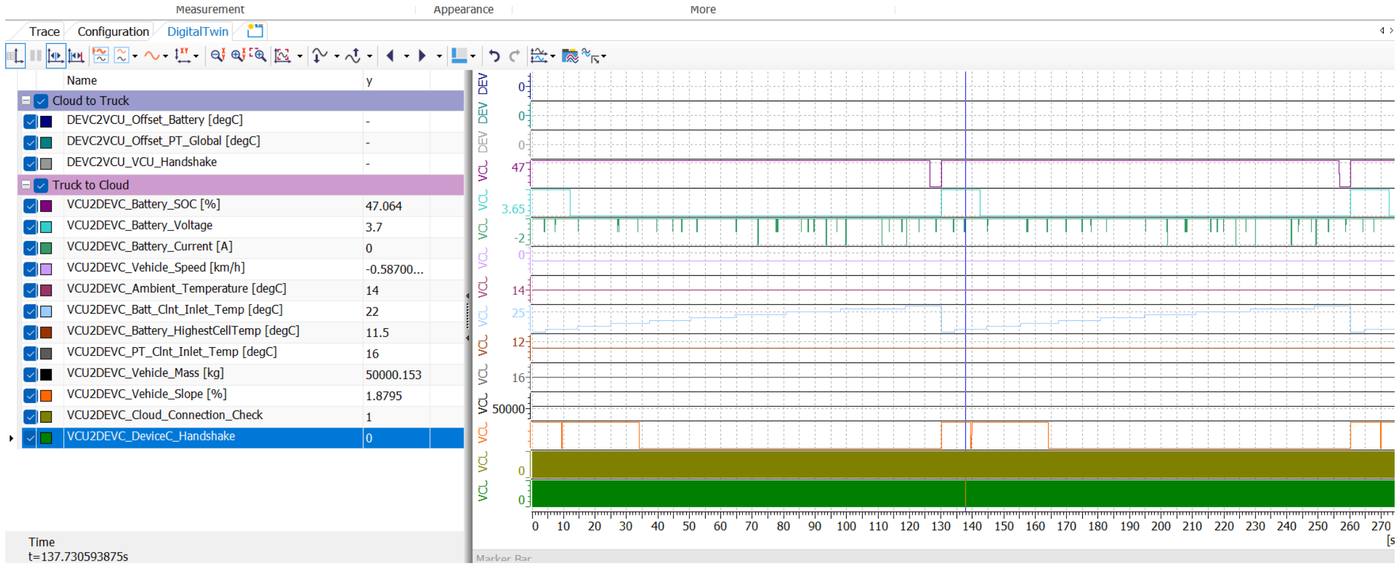
- The aim of this study is to power up the Can Connect device on the HIL test bench and verify the successful transmission of signals to the Cloud.

- These tests were carried out in coordination with AVL.

Pin	Assignment
1	CAN_V+ (optional)
2	CAN_Low
3	CAN_GND
4	Not connected
5	Not connected
6	CAN_GND
7	CAN_High
8	Not connected
9	CAN_V+ (optional)

D-Sub plug





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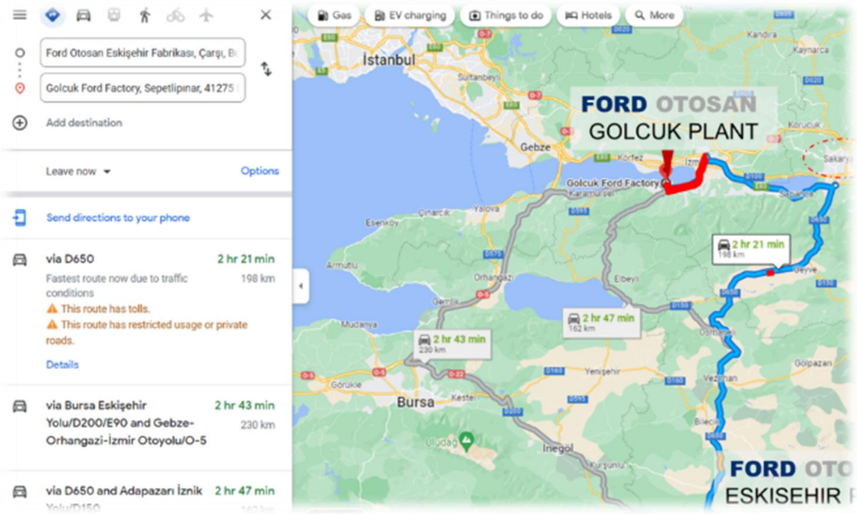
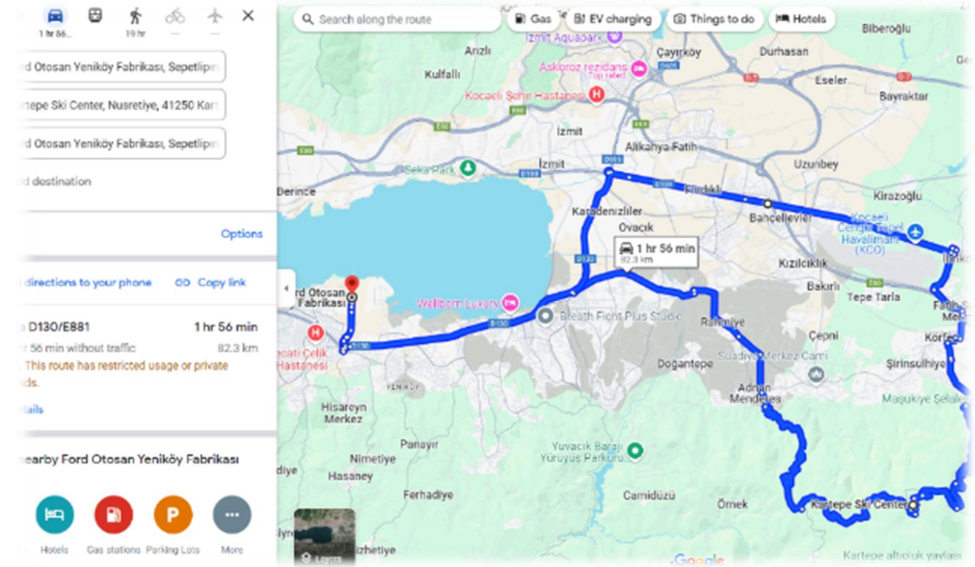
Demo Route & Driver Details – Public Road





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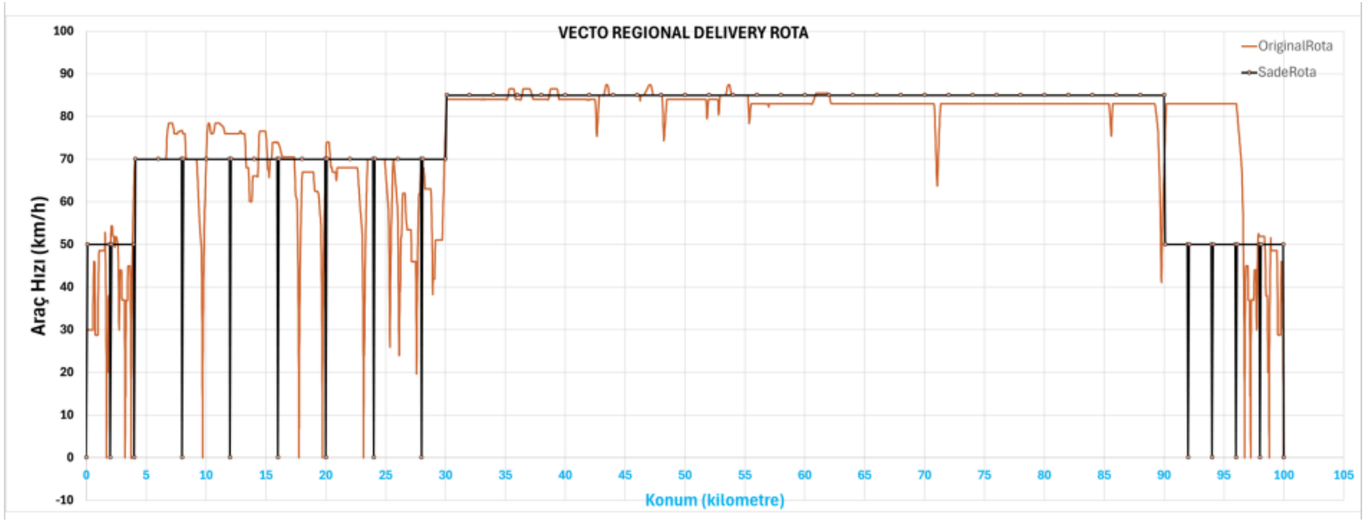
Demo Route Profile

Distance & Lap	Target Speed	Notes
Preparation Phase	-	The vehicle must be fully charged first. Wait at least 30 minutes after charging.
Laps 1 and 2	~ 50 km/h	The vehicle must perform a full stop-and-go at the end of each lap.
Laps 3 to 15	~ 70 km/h	The vehicle must perform a full stop-and-go every 2 laps.
Laps 16 to 45	~ 85 km/h	Continue driving without stop-and-go.
Laps 46 and 47	~ 50 km/h	The vehicle must perform a full stop-and-go at the end of each lap.
Rest Period	-	The 2nd phase will be an exact repeat of the first 47 laps. However, the vehicle must be rested for 30 minutes before the 2nd phase.
Laps 48 and 49	~ 50 km/h	The vehicle must perform a full stop-and-go at the end of each lap.
Laps 50 to 62	~ 70 km/h	The vehicle must perform a full stop-and-go every 2 laps.
Laps 63 to 92	~ 85 km/h	Continue driving without stop-and-go.
Laps 92 and 93	~ 50 km/h	The vehicle must perform a full stop-and-go at the end of each lap.
Battery Depletion	Free Driving	If the battery is still not depleted after 93 laps, continue free driving until the battery is completely depleted.



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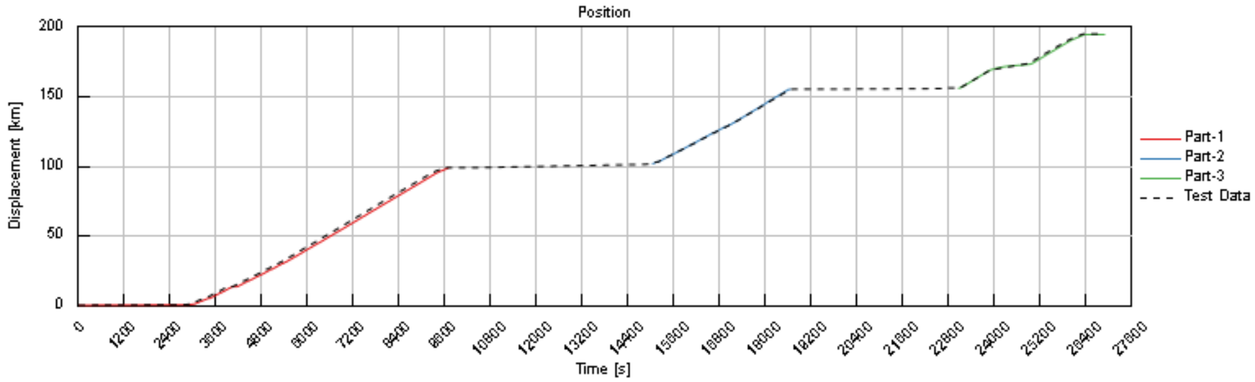
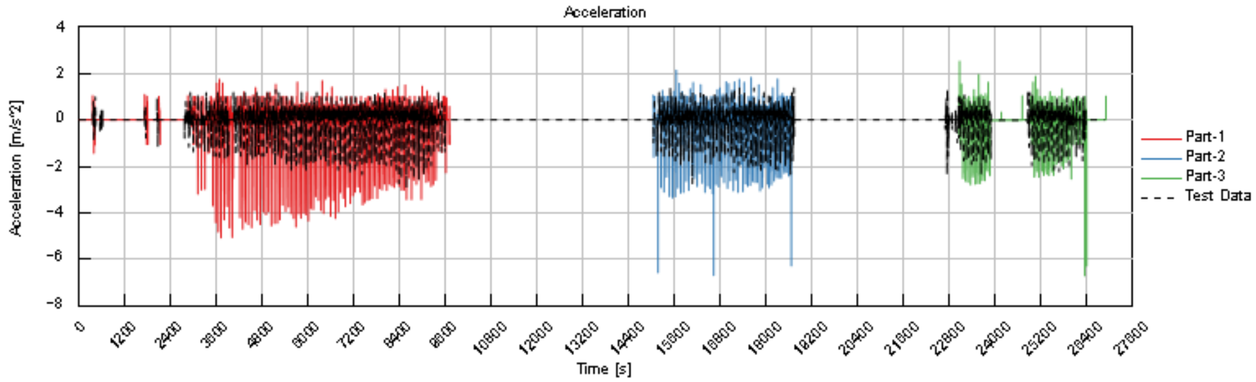
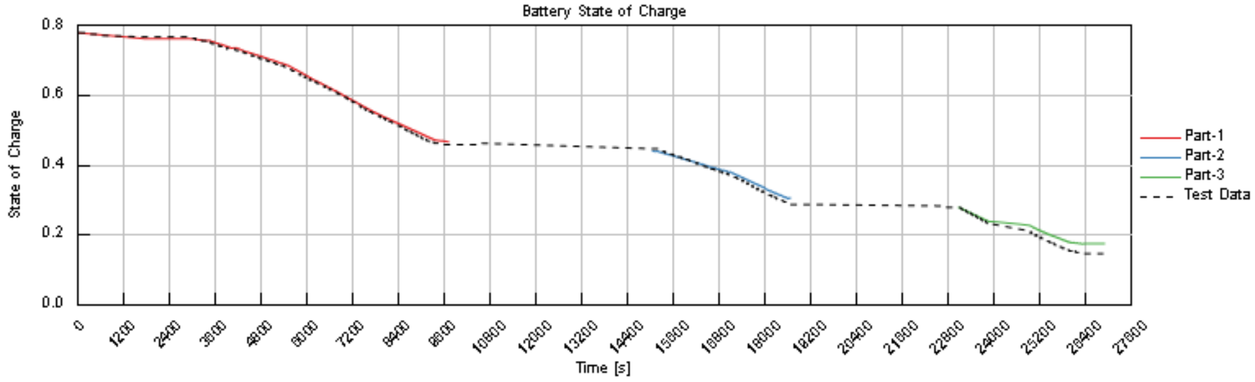
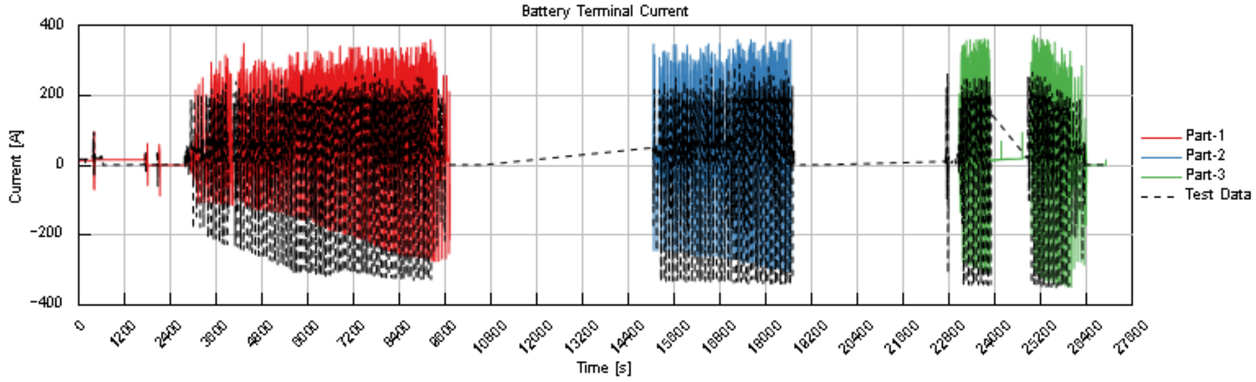
Internal Test Data & Model Comparison









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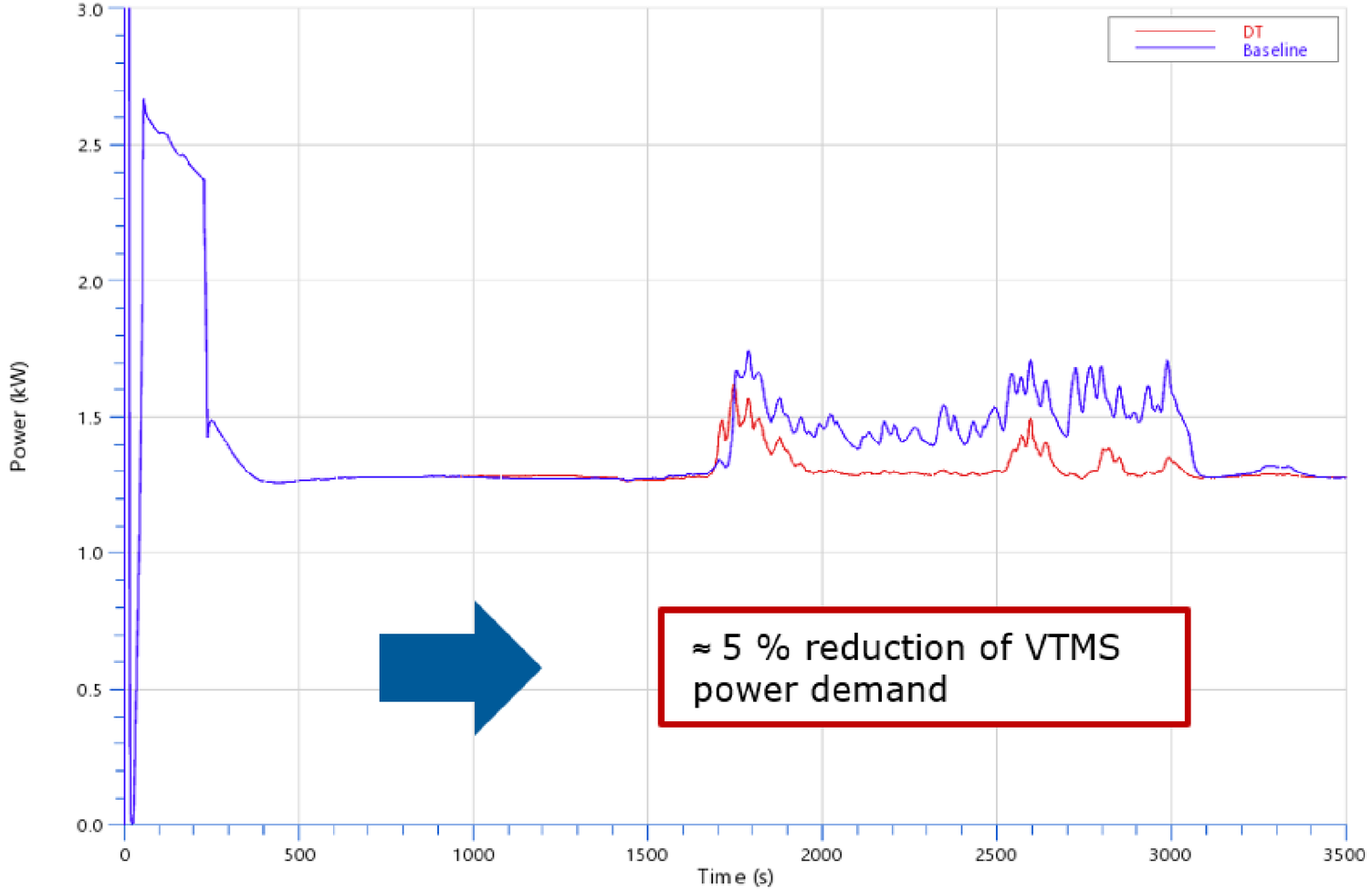
EFFECTIVE ENERGY MANAGEMENT

Digital Twin: Benefit in Simulation



By using a higher setpoint, which is verified predictively, savings of up to **5% TMS energy** consumption and **0.3% vehicle energy** saving can be achieved.

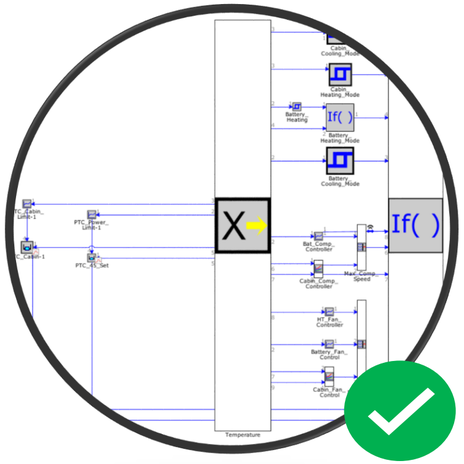
Thermal System: Benefit in Simulation

15% Thermal Efficiency Improvement Target

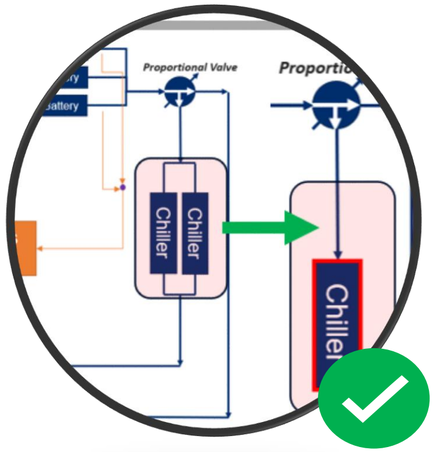
Done – Will be demonstrated on the vehicle

Assessment Completed.

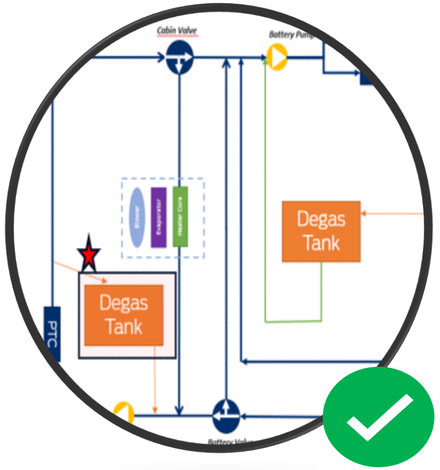
Calibration improvements



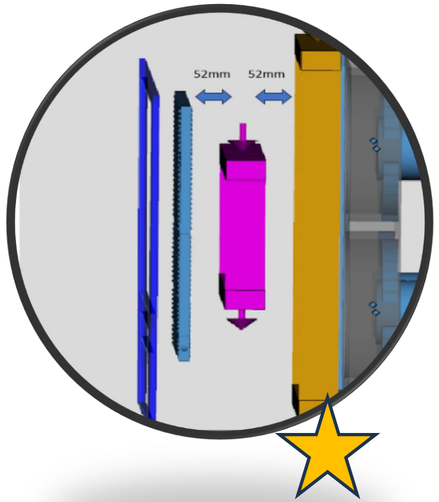
Battery Cooling - Chiller



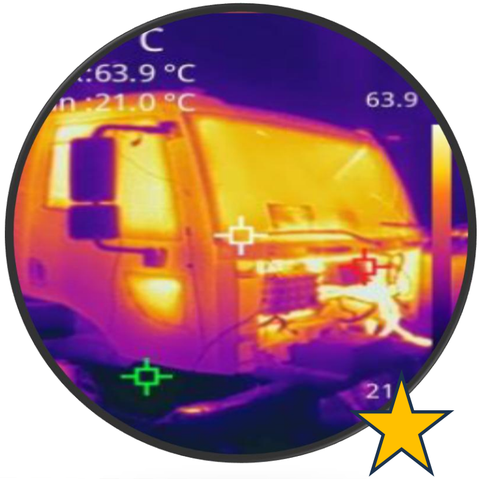
Degas Solutions



Active cooling for battery



AIT (Austrian Institute of Technology) / Cabin İmprovements



15%

Improvements;

1. Up to 20% improvement for winter case from degas study
2. Up to 8% improvement for summer case from chiller study
3. Up to 40% improvement for spring case from active cooling(in progress)

Up to 1,1% improvement overall vehicle energy effcieny for winter case from degas study

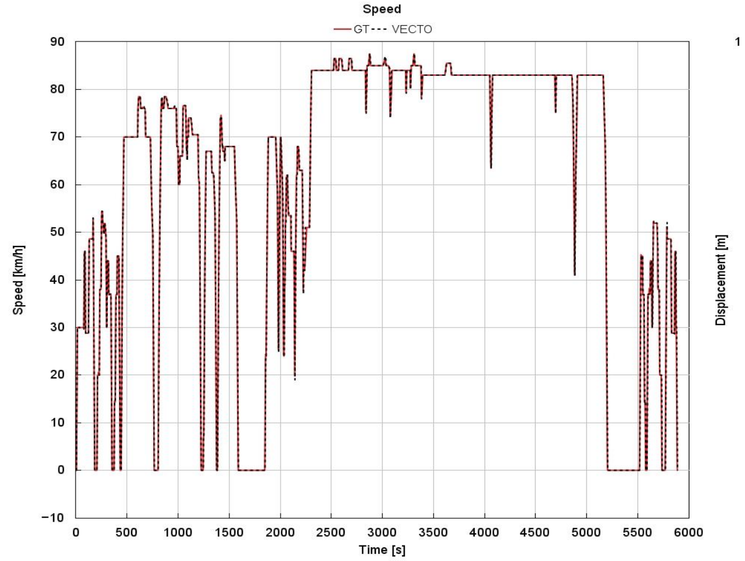
Next e Truck

Powertrain: Benefit in Simulation

Base Line – 4x2, 19T F-Line BEV

NextETRUCK Vehicle
4x2, 16t New BEV Platform

Parameter	Baseline Truck (Rigid 4x2 – 19t)	NextETRUCK (4x2 – 16t)
Battery Configuration	3-pack, 294 kWh	3-pack, 294 kWh
Continuous Power Output	234 kW (voltage-limited) – Central Drive	210 kW (fully usable) – e-axle
Peak Torque	24,700 Nm	26,000 Nm
Payload	~9.1 t	9.1t
Usable Energy of Battery	~235.2 kWh	~235.2 kWh
Average Energy Consumption	0.974 kWh / km	0.895 kWh/km (%8,2 efficient)
Estimated Max Range	~242 km standard	~266 km standard ~up to 316 km
Energy Efficiency (kWh/ton-km)	0.107 (Calculated with 9.1t sim. payload)	0.097 (Calculated with 9.1t sim. payload)



VECTO Regional Delivery route is used in the simulations.

$$\text{Energy Efficiency (kWh/ton-km)} = \frac{\text{Energy Used}}{\text{Payload} \times \text{Distance}}$$

9.3 % Energy Efficiency (kWh/ton-km) improvement with simulations

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NextETRUCK

Energy Efficiency Executive Summary

10.7 % Vehicle Energy Efficiency Improvement is reported.

0.3 % Digital Twin: Thermal Energy Efficiency Improvement

1.1 % Thermal Energy Efficiency Improvement

9.3 % Powertrain Energy Efficiency Improvement

Baseline -NextETRUCK

Base Line – 4x2, 19T F-Line BEV

Next e-TRUCK Vehicle
4x2, 16t New BEV Platform

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Next eTRUCK

Thank you for your attention!

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NextETRUCK

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Co-funded by UK Government

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