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KoNSTanZE – Multi Sector Coupling of Renewable Produced Hydrogen for the Development of a CO_2-free Industry

Dr. Bodo Groß

HYDROGEN IRELAND CONFERENCE 2023, 28. – 29. November 2023
Titanic Belfast, Northern Ireland

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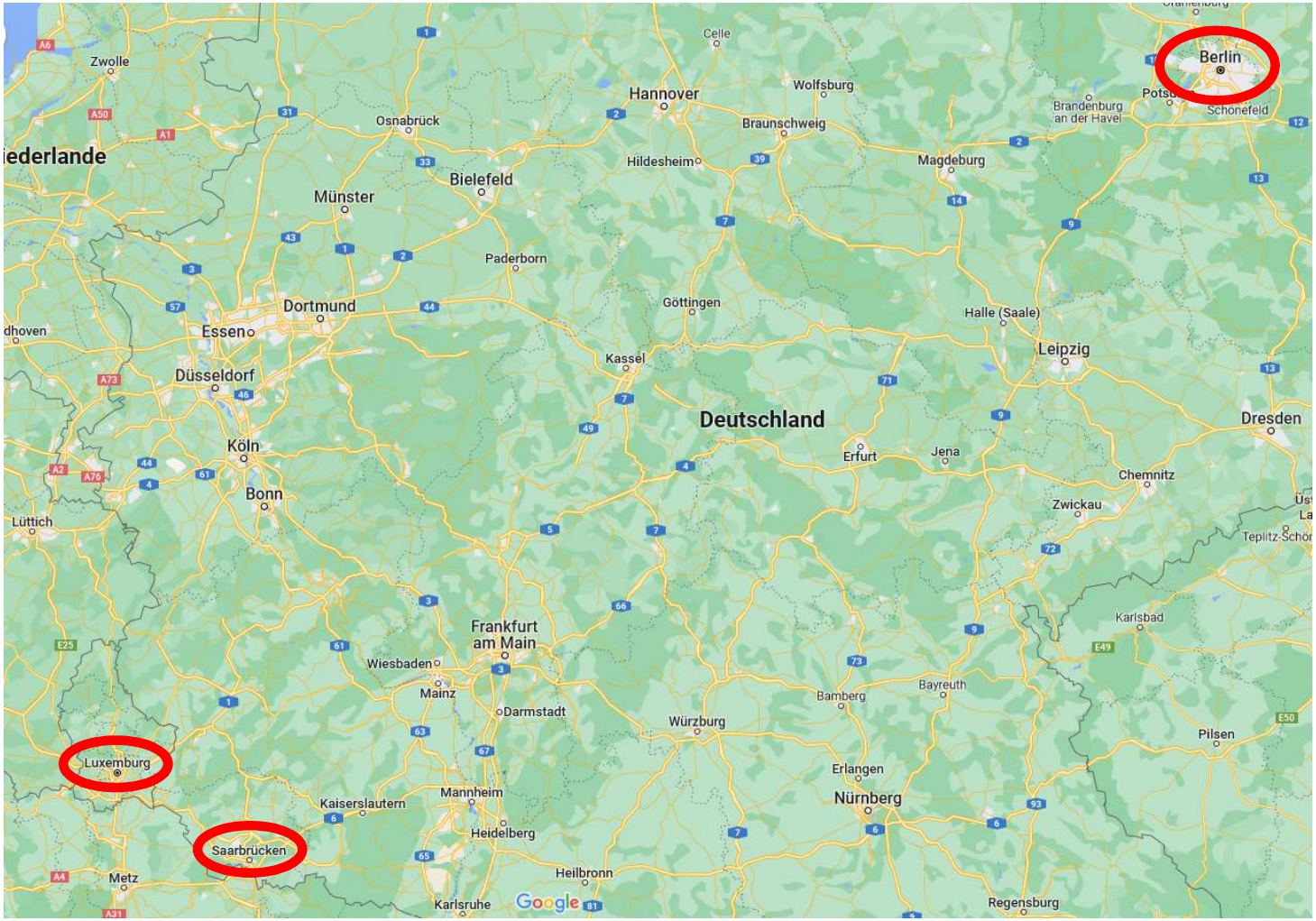
IZES gGmbH – Location



- Headquarter of IZES is located in Saarbrücken, the Capital of the German Federal State Saarland
- Approx. 90 km from the city of Luxembourg
- In addition IZES has an office in Berlin

IZES gGmbH – Fact Sheet

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- IZES gGmbH was founded in 1999 as Non-Profit research organisation in Saarbrücken
- The shareholders are the Federal State Saarland (~70%), several regional utilities, the Saarland University and the University of Applied Science Saarbrücken
- The company consists of an interdisciplinary team with educational background in engineering, law, economics, forestry, social and natural sciences
- 80 employees, including the administrative department as well as bachelor, master and PhD students

25 Years ago…!

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BOSCH

- Joint Project of Robert Bosch GmbH Homburg & IZES gGmbH
- Funding Reference Numbers: 03EI3043A&B
- Funding Period: October 2021 – September 2024
- Total Budget: ~ 3.5 Million €
- Funding Rate: ~ 43%
- Funding Authority: Federal Ministry of Economics and Climate Protection
- Project Management Agency: Research Centre Jülich GmbH

ptj
Projektträger Jülich
Forschungszentrum Jülich

Gefördert durch:

Bundesministerium
für Wirtschaft
und Klimaschutz

aufgrund eines Beschlusses
des Deutschen Bundestages

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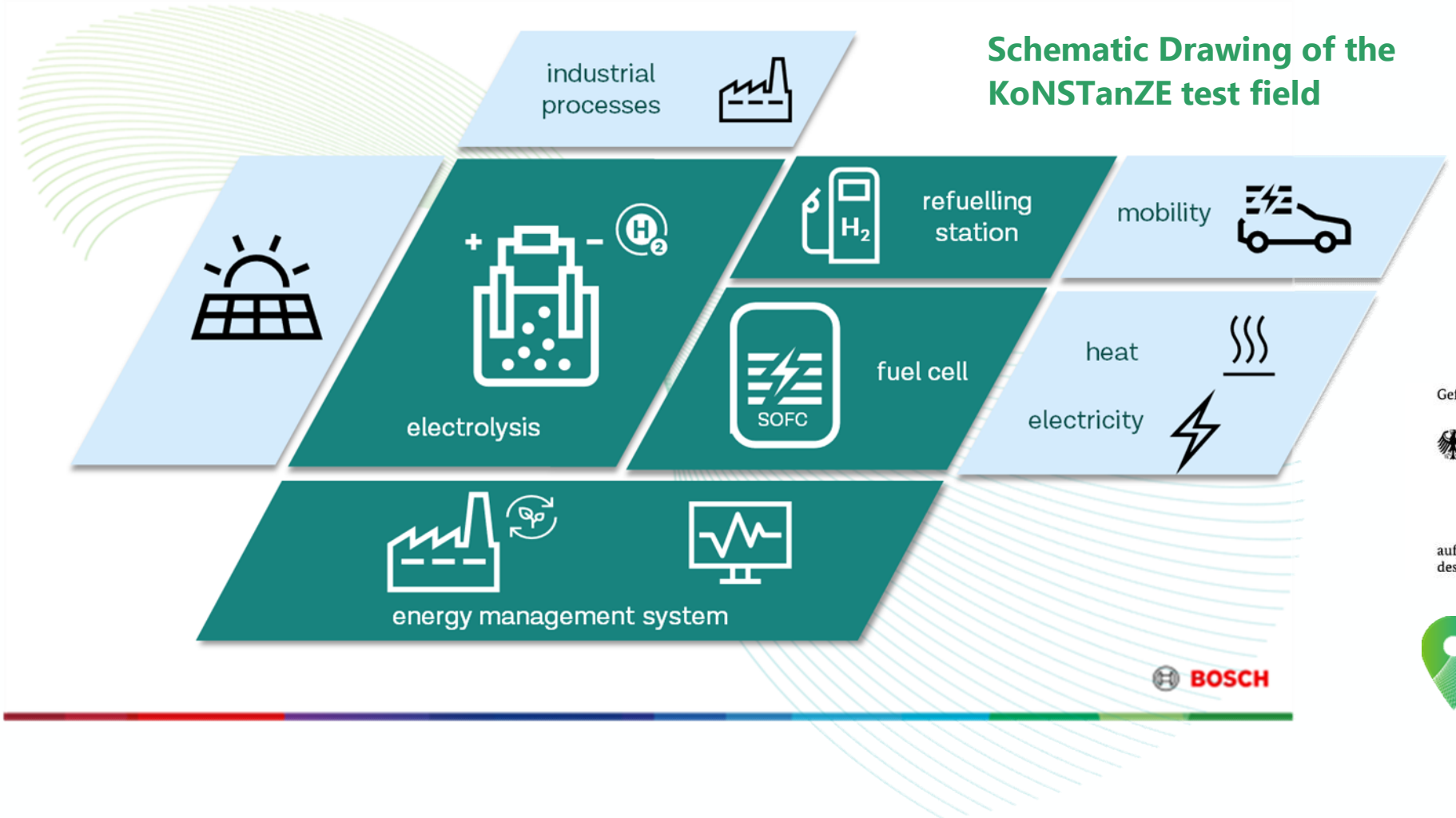
Schematic Drawing of the KoNSTanZE test field



Gefördert durch:
Bundesministerium für Wirtschaft und Klimaschutz
aufgrund eines Beschlusses des Deutschen Bundestages

Wir bewegen die Zukunft
BOSCH HOMBURG

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Current Status of the KoNSTanZE test field

The following components can be seen:
Cylinder bundle filling station, electrolyser, low and medium pressure storage, compressor and the hydrogen cooling system. The stationary HRS is hidden under the roof.
Current Status of the KoNSTanZE test field

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Simulink is used to model complex dynamic systems, such as mechanical systems

Continuous-Time & Discrete-Time Models

Plant Simulation is used to model material flows in discrete production processes

Discrete Event Model

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SIEMENS
TECNOMATIX
Plant Simulation

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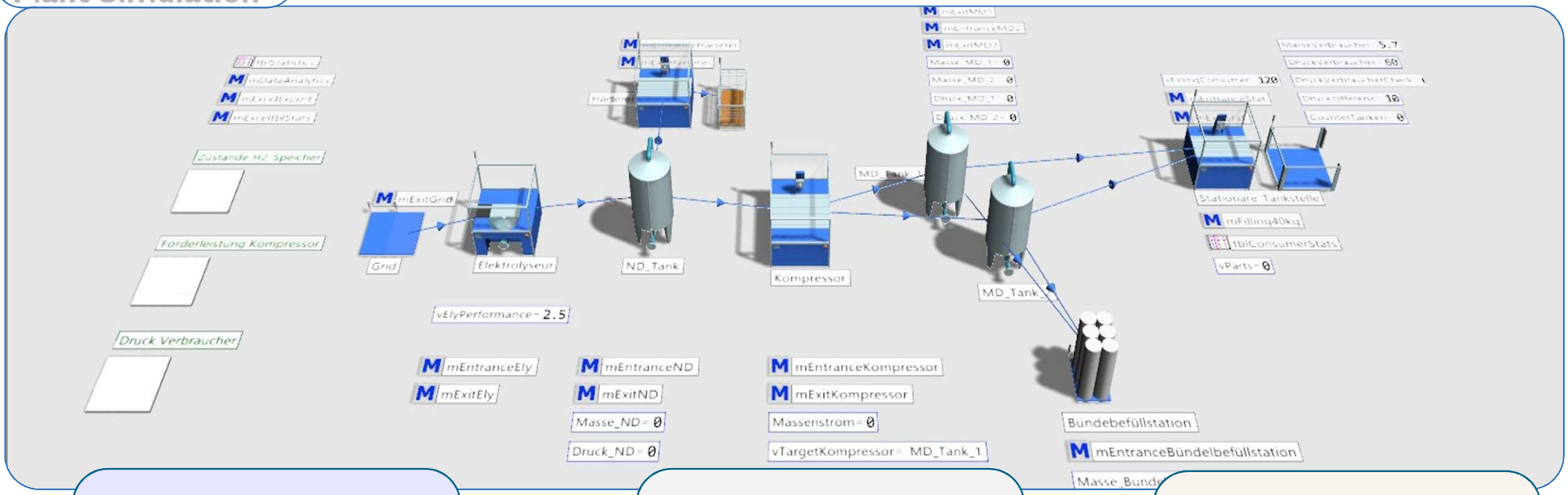

- Energy supply
- Electrolyser
- Low pressure Tank
- Hardning shop

- Compressor
- Mid pressure Tank 1
- Mid pressure Tank 2

- Vehicle

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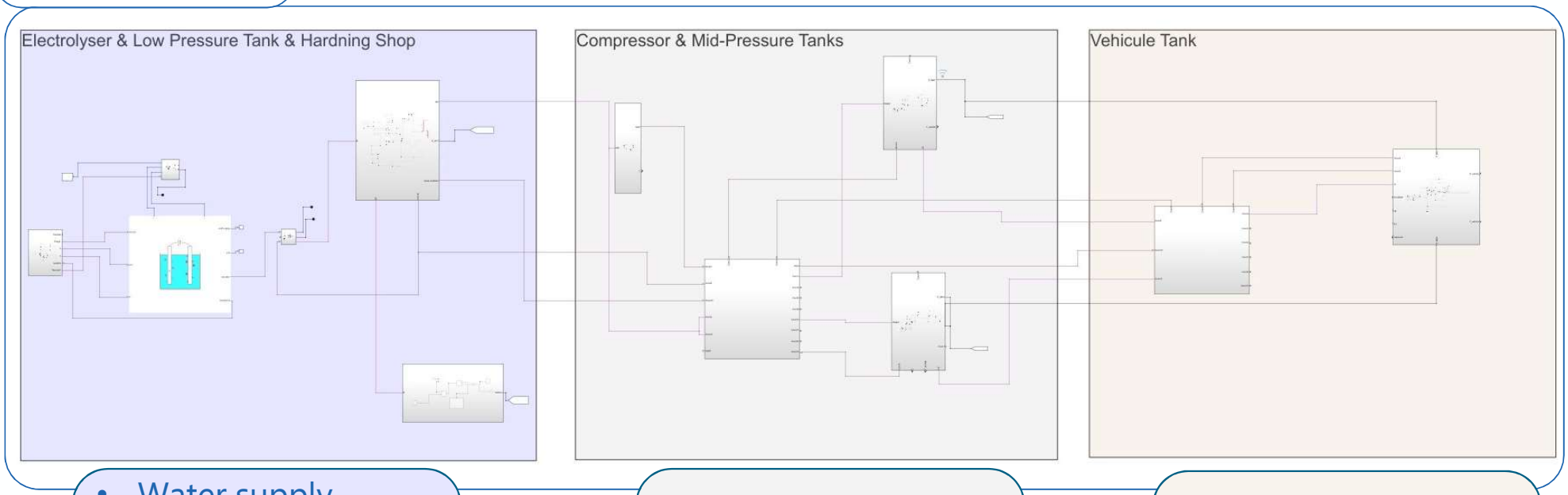

- Water supply
- Energy supply
- Electrolyser
- Low pressure Tank
- Hardning shop

- Compressor
- Mid pressure Tank 1
- Mid pressure Tank 2

- Vehicle

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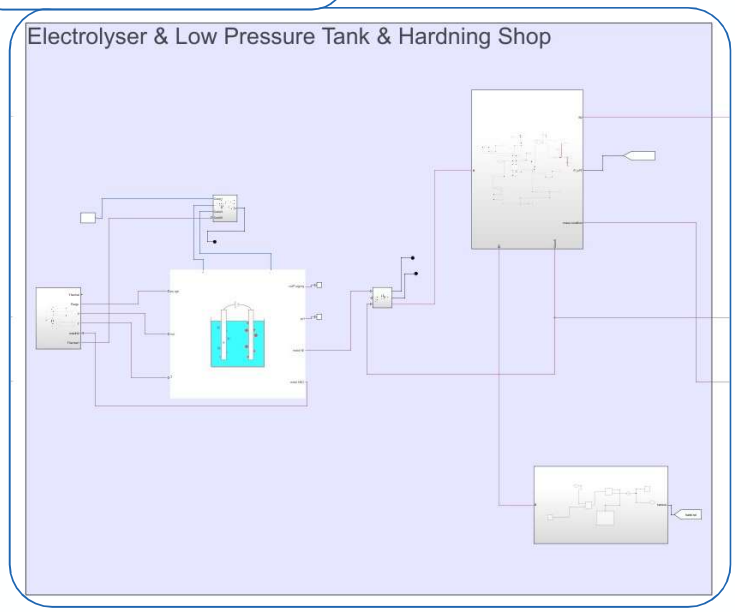
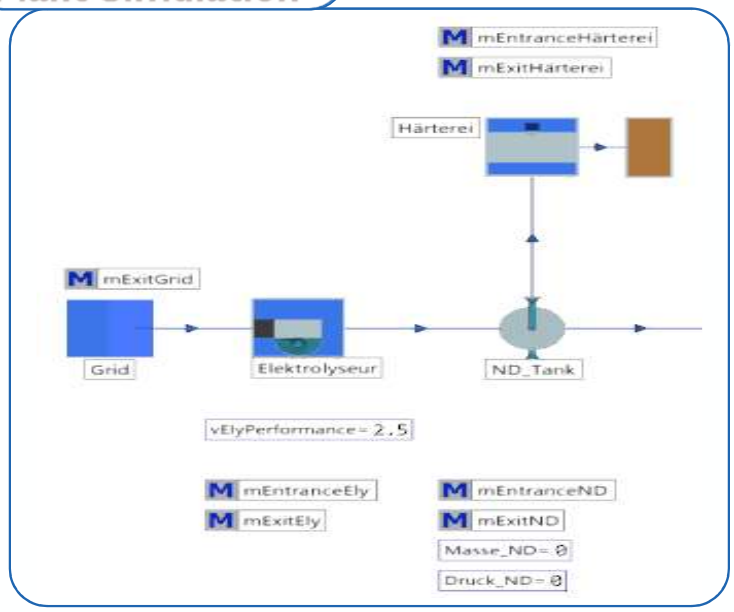
MATLAB® & SIMULINK®



SIEMENS TECNOMATIX Plant Simulation



Electrolyser		Low pressure storage		Hardening Shop (continuous consumer)	
Production rate	2.5 kg/h	Volume	100 m^3	Need	6T/Year
		Mass	328 kg		
		Pmax	40 bar		

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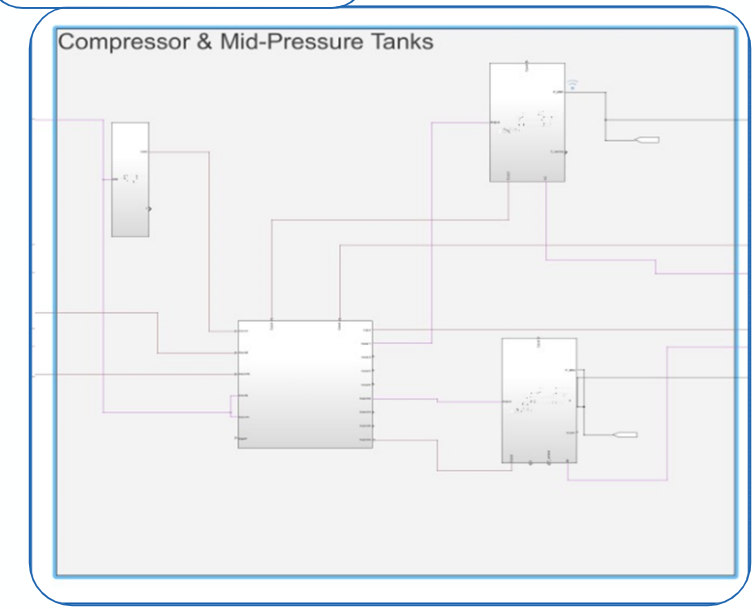

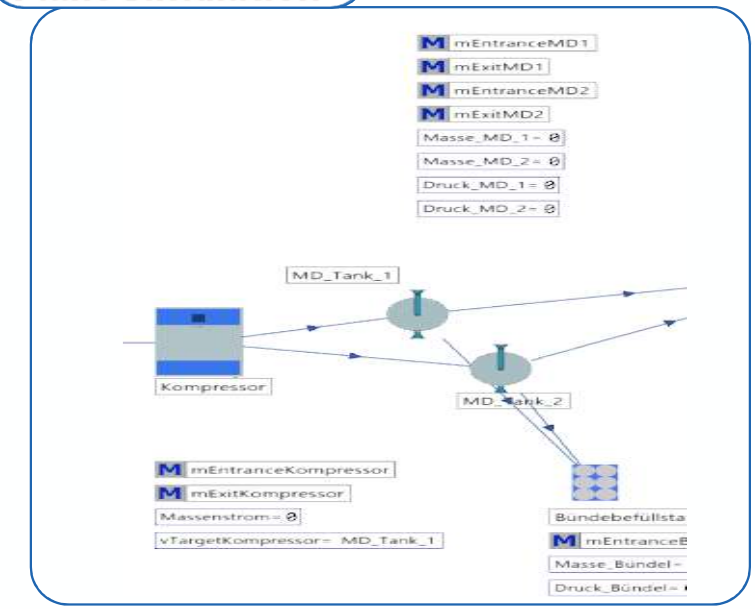

Compressor : mass flow rate according to the pressure of the low pressure tank

Mid pressure tank (MD)	
Volume	1.2 m^3
Mass	38 kg
Pmin	50 bar
Pmax	500 bar

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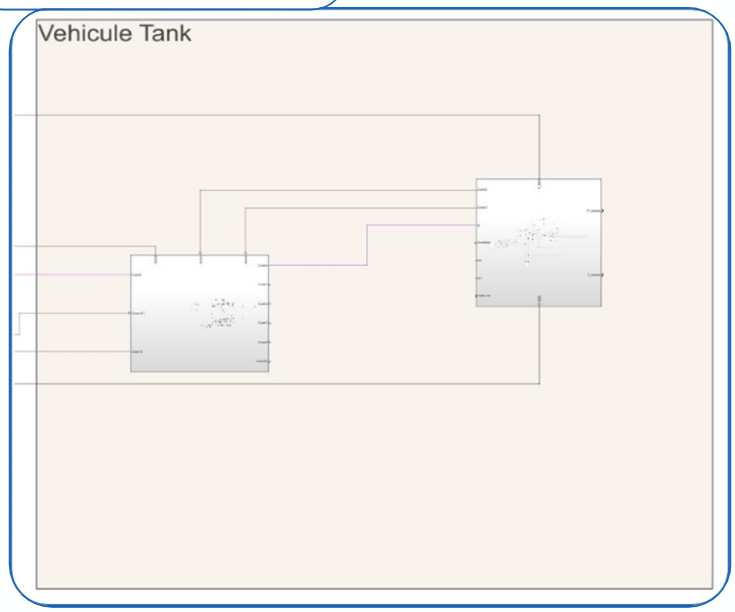

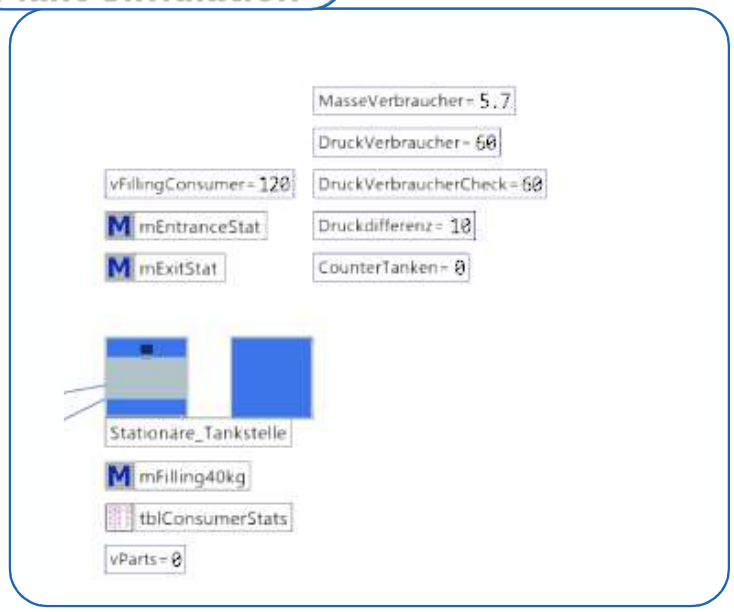

Vehicle tank	
Mass max	40 kg
Pmin	60 bar
Pmax	420 bar

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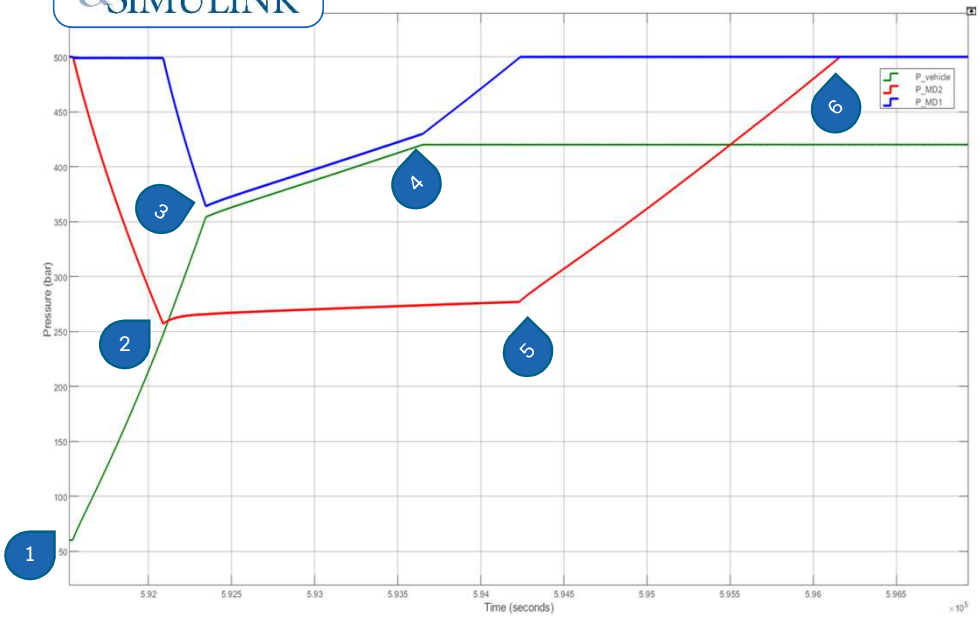
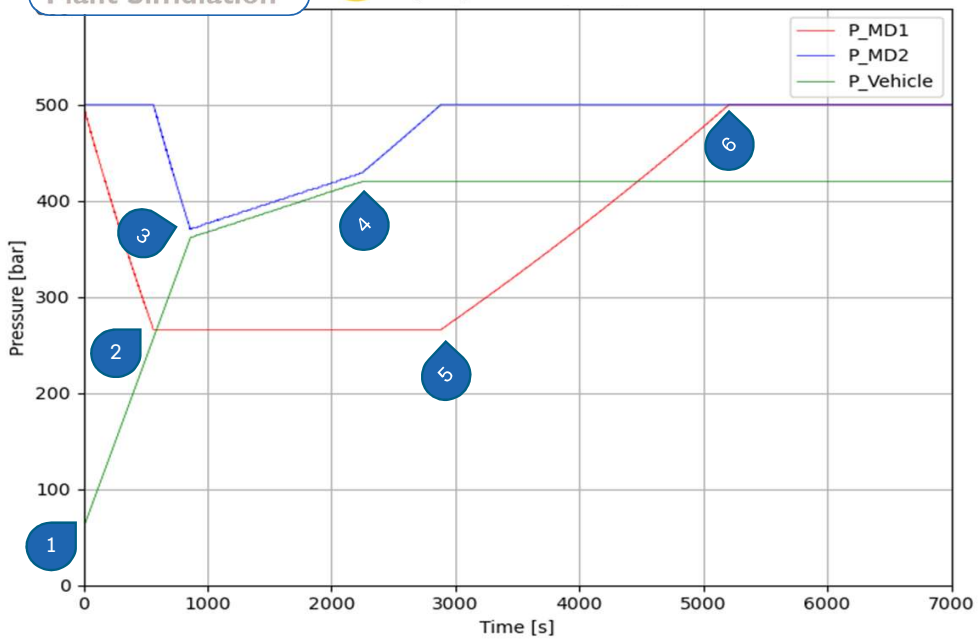
❖ Results & analysis of the filling process (40kg)

MATLAB & SIMULINK



SIEMENS TECNOMATIX Plant Simulation

python™



Comparative Analysis → Filling time | Pressure | Mass

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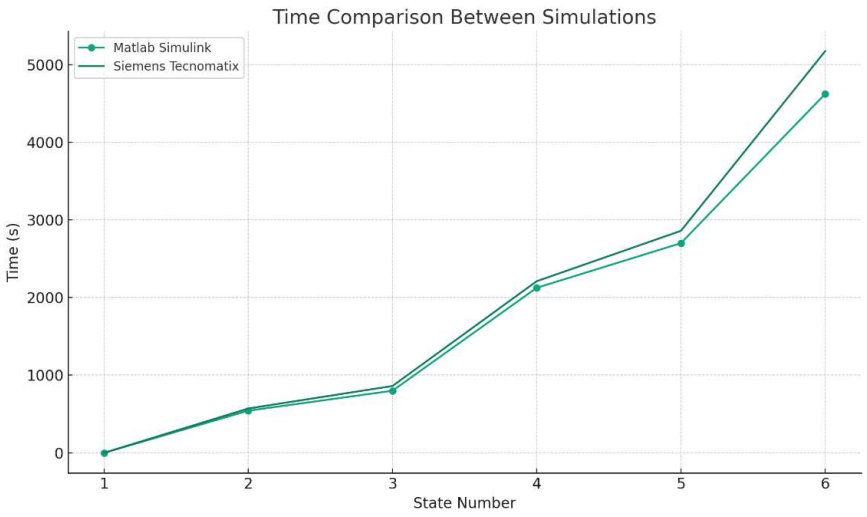
No.	State	Time(s)			Mass Vehicle (kg)			Pressure (bar)		
		Matlab Simulink	Siemens Tecnomatix		Matlab Simulink	Siemens Tecnomatix		Matlab Simulink	Siemens Tecnomatix	
1	Start Vehicle Filling	0	0	0	6,7	6	0,7	60	60	0
2	Stop MD 2 Filling Vehicle (-10 bar reached)	543	571	-28	26,5	24,7	1,8	260	270	-10
3	Stop MD 1 Filling and Start Compressor	800	861	-61	35,9	34,6	1,3	366	370	-4
4	Vehicle stop filling & refill MD1	2126	2211	-85	40	40	0	420	420	0
5	Refill MD 2	2701	2860	-159	40	40	0	420	420	0
6	Stop Filling MD 2	4623	5174	-551	40	40	0	420	420	0



- In conclusion, although the two simulations are **consistent,** the **differences** highlight how each simulation tool perceives and executes the operational timeline, impacting overall process efficiency.
- Understanding these differences is key **to optimising** the workflow and **validate the simulated projections and real-world operations**. for complex, time-sensitive processes.

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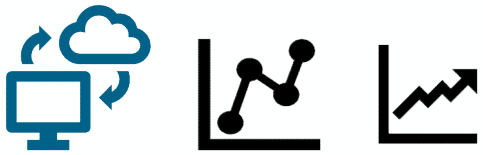
❖ Conclusions

KoNSTanZE Partnership: collaboration between IZES and Bosch Industry, in order to bridge the gap between industrials and academics



KoNSTanZE Scientific Advancements: scientific monitoring and data analysis, ensuring the efficacy, safety and sustainability of the hydrogen power plant.

KoNSTanZE Dual Modeling Approaches: showcasing our dual-model approach - using both MATLAB and Plant Simulation - to simulate and optimise the plant's operations. This methodological innovation provides a comprehensive understanding and enhances the predictive accuracy.

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Thank you for listening!

Questions?

Dr Bodo Groß, Dr Feriel Mustapha & Laura Gerart (IZES)
Sascha Andres (Bosch)

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