

HAN SCHOOL OF ENGINEERING AND AUTOMOTIVE

WE WANT MORE!

MODULAR RESEARCH
VEHICLE

PRESENTATION H₂ EVENT
26 JANUARY 2023
SASKIA MONSMA, AD OOMEN



CONTENT

- **WHY** do we want MORE?
- **HOW** did & do we achieve MORE?
- **WHAT** do we want MORE?

WHY do we want MORE?



MORE future-proof mobility engineers



MORE hands-on education



HANDS-ON DEVELOPMENT AND USE

OF A HAN MODULAR RESEARCH VEHICLE

FOR APPLYING THE LATEST ENGINEERING TECHNOLOGIES

IN RESEARCH AND EDUCATION

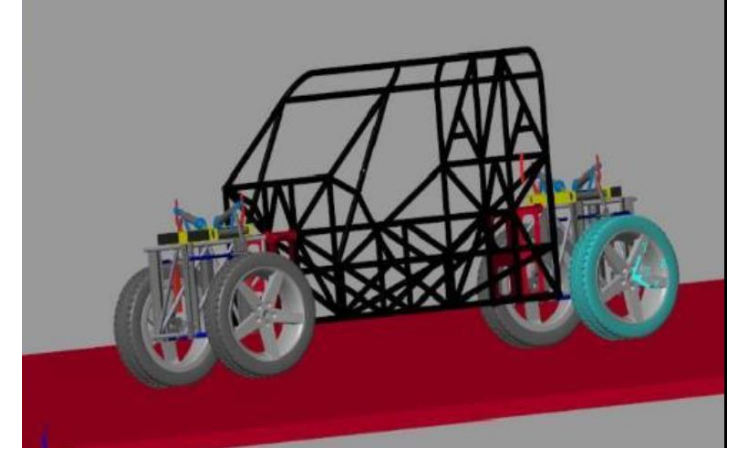
TO IMPROVE KNOWLEDGE, SKILLS AND MOTIVATION

OF STUDENTS, STAFF AND SOCIETY

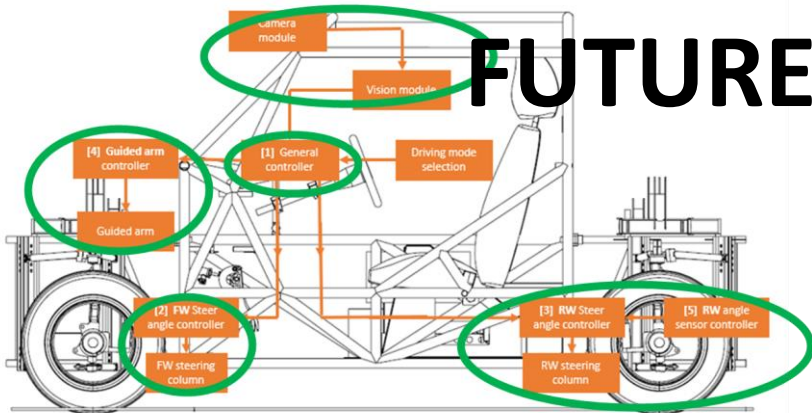


CONTENT

- **WHY** do we want MORE?
- **WHAT** is MORE?
- **HOW** did & do we achieve MORE?



MORE =
BUILDING AND USING A MODULAR RESEARCH
VEHICLE TO EDUCATE
FUTURE PROOF MOBILITY ENGINEERS



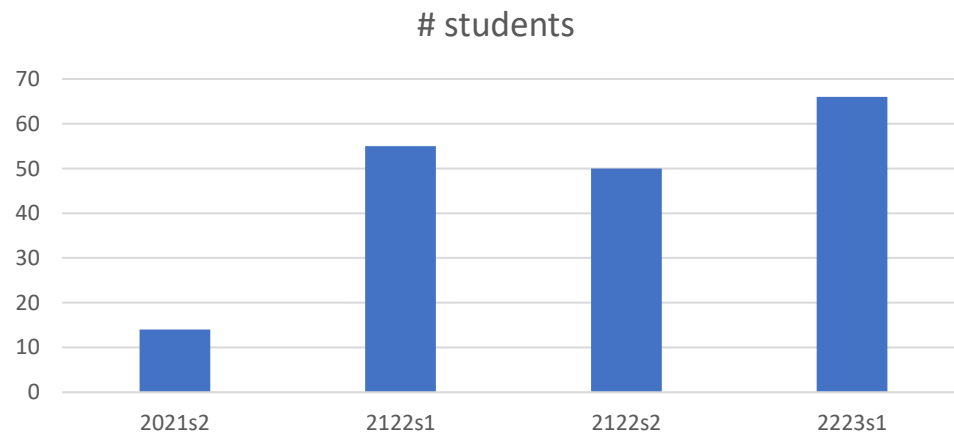


CONTENT

- **WHY** do we want MORE?
- **WHAT** is MORE?
- **HOW** did & do we achieve MORE?

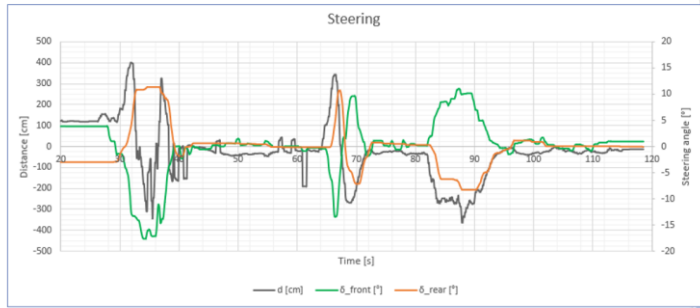
HOW did & do we achieve MORE?

- Initiated in February 2021 by Ad Oomen and Saskia Monsma
- Started with 12 semester 6 students with “nothing”; end of the semester MORE drove in the Gelredome
- Now over 60 students work on MORE in several multidisciplinary projects



More than 50/60 students per semester, presentations on several events and many interested visitors at MIC from HAN and outside

Autonomous steering



Graduation Folke den Besten



HAN AR kennisfestival: reveal MORE

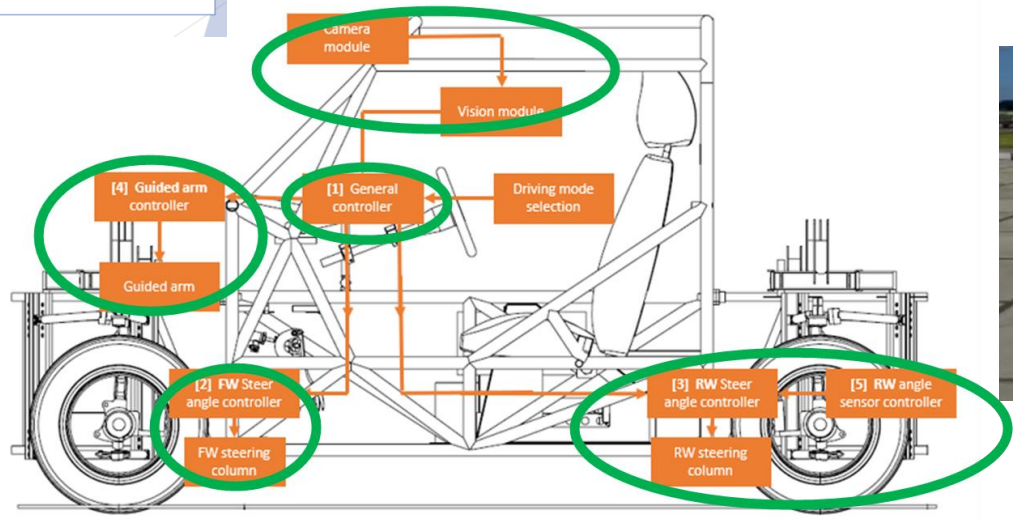
We want MORE!
 How we educate our future mobility engineers with a Modular R&Search vehicle
 Saskia Morzma, Ad Oomen, Tonnis van den Heuvel, Melvin Lance
 HAN University of Applied Sciences, Arnhem, The Netherlands

The future of mobility is uncertain and changing rapidly: Will we drive electric, on hydrogen, on biofuel or hybrid? Will we still drive cars? Or will we drive autonomously? Will we even use cars for anything? The point is: we hardly know. This uncertainty requires a training program that can prepare our future engineers to create new innovations with relative ease. We use MORE, a modular, multi-integration, learning-by-concept R&Search vehicle is used to educate our current engineering students for this future of mobility.

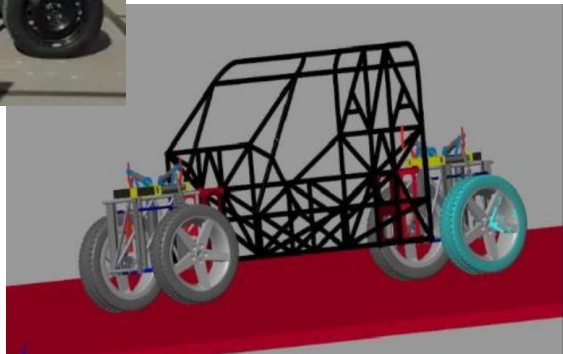
At the HAN University of Applied Sciences in The Netherlands, we specialize in design, vehicle technology, powertrain, vehicle electronics and control, management and business management. As automotive expanded to mobility, new disciplines in the traditional automotive domain, like ICT, embedded systems, artificial intelligence and human-machine interaction, are becoming increasingly important. The pace of innovations in all these disciplines is fast. Having limited resources, we need to prepare our students to professional engineers, this leaves us with a huge challenge: How can we prepare our engineering students for working in this broad, multi-disciplinary field of engineering and innovation? But even as important: without losing the so-required depth of an engineer.

A few years ago, a HAN automotive student presented this research which he did at the company ThyssenKrupp in Luchterstein using their so-called MRP, a Modular Research Platform. The MRP is their agile development tool for all their vehicle research and development. The senior lecturer/researchers Ad Oomen and Saskia Morzma, involved as supervisor and co-supervisor, this thesis research, were so inspired by this tool, that soon the idea of using this concept in education sowed the seeds of our own "baby-MRP", MORE.

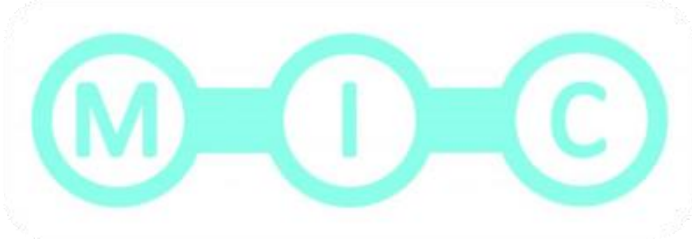
This started bottom-up: driven by the enthusiasm of its initiators, the management picked up the "buzz" about MORE and made the first steps with MORE possible. In our bachelor and master engineering education, students have courses where projects are integrated to apply their knowledge and skills from the theoretical lectures and practical lab assignments. Many different nationalities are



AVD Master students: testing and multibody model



Master research: Autonomous driving, with vision, 4wheel steering, steer by wire, brake by wire and many integrated controls



MORE COLLABORATIONS AND SPONSORS

REACOLLEGE

HAN_



bIBUS
INDUSTRIAL TOOLS



thyssenkrupp



Technasium



Den Besten
Metaalconstructies

HAN_ UNIVERSITY
OF APPLIED SCIENCES

PR



POWERHOUSE OF INNOVATION

Semester 6 Symposium of Engineering and Automotive

On the 21st of June the semester 6 symposium will take place. On this day all the students will present their final work.

On behalf of the students we would like to invite you to join us on this wonderful day!

At the end of the day we will celebrate the end of a semester, and the schoolyear together!

Date: 21st of June
Venue: Ruffenberglaan 29, Arnhem
Start demonstration: 14.00
Start celebration: 17.00
Dinner will be provided for the Symposium, if you have any dietary wishes, send an e-mail to: Symposium-S6-AEA@HAN.nl

HAN

We want MORE!

How we educate our future mobility engineers with a Modular REsearch vehicle

Saskia Moroma, Ad Dornen, Tonnis van den Heuvel, Melvin Lance
HAN University of Applied Sciences, Arnhem, The Netherlands

The future of mobility is uncertain and changing rapidly: Will we be electric, on hydrogen, on biofuel or hybrid? Will we still drive manually or will it drive autonomously? Will we even use cars for delivery? The point is: we hardly know. This uncertainty requires a learning program that can prepare our future engineers for new innovations with relative ease. We call it MORE: a modular research vehicle. It is used to educate your current engineering students for this future of mobility.



At the HAN University of Applied Sciences in The Netherlands, we have been educating engineers for over 75 years. Automotive is multidisciplinary by itself, so is our education. Specializing in design, vehicle technology, powertrain, vehicle electronics and CO2, we are embracing and integrating new disciplines. As automotive expanded to mobility, new disciplines emerged in traditional domains, like ICT, embedded systems, artificial intelligence and human-machine interface. The pace of innovations in all these disciplines is fast. Having limited resources, we educate our students to professional engineers, this leaves us with a huge challenge: how can we prepare our engineering students for working in this broad, multi-disciplinary, expanding and changing domain? But, even as important, without losing the so-required depth and detail of an engineer?

A few years ago, a HAN automotive student presented his thesis research where he worked at the company ThyssenKrupp in Lichtenstein using their so-called MRP, a Modular Research Platform. The MRP is their agile development tool for all their vehicle research and development. One of the senior lecturer/researchers Ad Dornen and Saskia Moroma, involved as supervisor and external examiner in this thesis research, were so inspired by this tool, that soon the idea of using this concept in education sowed the seeds of our own 'baby-MRP': MORE.

This started bottom-up: driven by the enthusiasm of its initiators, the management picked up the 'buzz' about MORE and made the first steps with MORE possible. In our bachelor and master engineering education, students have courses where projects are integrated to apply their knowledge and skills from the theoretical lectures and practical lab assignments. Many different nationalities are



han.more



More Vehicle



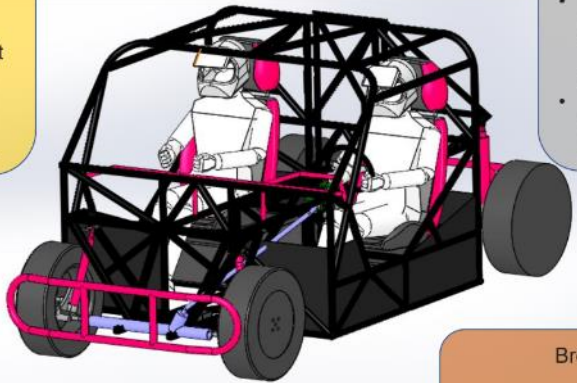
MORE Vehicle

crowdfunding

- Gold € 1.000
- Sticker of 400 cm²
- Reference on social media, our blog and in our presentation at the Symposium.
- If interested, an invitation to the Symposium in June.

- Silver € 500
- Sticker of 200 cm²
- Reference on social media, our blog and in our presentation at the Symposium.
- If interested, an invitation to the Symposium in June.

- Bronze € 250
- Sticker of 100 cm²
- Reference on social media and our blog.



HAN UNIVERSITY OF APPLIED SCIENCES

KPI'S

- ✓ Working in the triangle with students as professionals
- ✓ Multidisciplinary: all specializations of AEA (AUT and ENG)
- ✓ Integration / multilevel: bachelor + master + intermediate vocational + secondary school
- ✓ MORE offers customized, agile solutions
- ✓ **High student results, motivation, satisfaction and eagerness to learn (ownership)**
- ✓ “Contagious enthusiasm”
- ✓ MORE’s strategy discussed and aligned with HAN AR, MES, bachelor (professors and team leaders)
- ✓ High quality PR for HAN (MORE is presented on open days, events, fairs, (world) conferences, symposia, international paper, social media, ...)



...MORE from vehicle to brand...

MORE AS HAN EDUCATIONAL CONCEPT!

MORE FUTURE roadmap



2025

Fully autonomous MORE

2024

Automated driving

Further integration with the world

2023

High speed testing with MORE

ADAS systems
Sustainable driveline

2022

Drive by wire

Functional 4 wheel steering
Lectures and practicals using MORE

2021

New suspension
4 wheel steering prototype
Integration with all HAN faculties and studies

Operational MORE

WHY H₂ IN MORE?

- To gain experience in H₂ systems:
 - Various systems and their components
 - Energy management systems
 - Safety
- To get hands on experience for high schools, vocational education, bachelor, master, research and industry.



HOW TO?

- 5 systems:
 - microMORE: table size hybrid driveline with a 30 [W] fuel cell
 - a hybrid driveline with a 1 [kW] fuel cell and a 2 [kW] motor
 - a range extender with a 1 [kW] fuel cell on MORE
 - a hybrid driveline with a 10 [kW] fuel cell together with Burgaflex
 - a 17 [kW] fuel cell, application t.b.e.



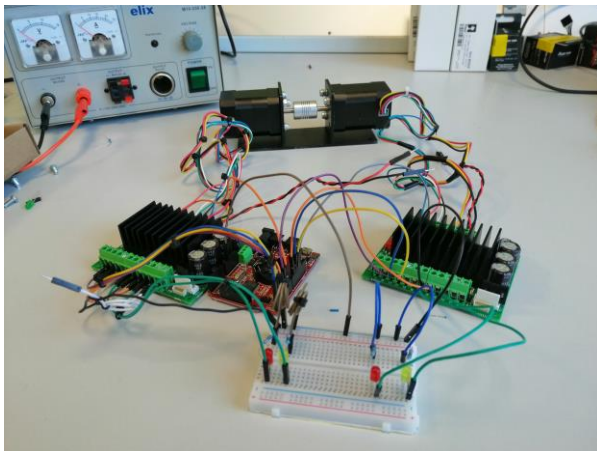
MICRO MORE

MORE
MODULAR RESEARCH
VEHICLE

- Table size full hybrid driveline with a 30 [W] fuel cell:
 - Modular configuration
 - Energy management system based on matlab Simulink flashed in an Olimexino
 - Scalable with the full sized fuel cell drivelines

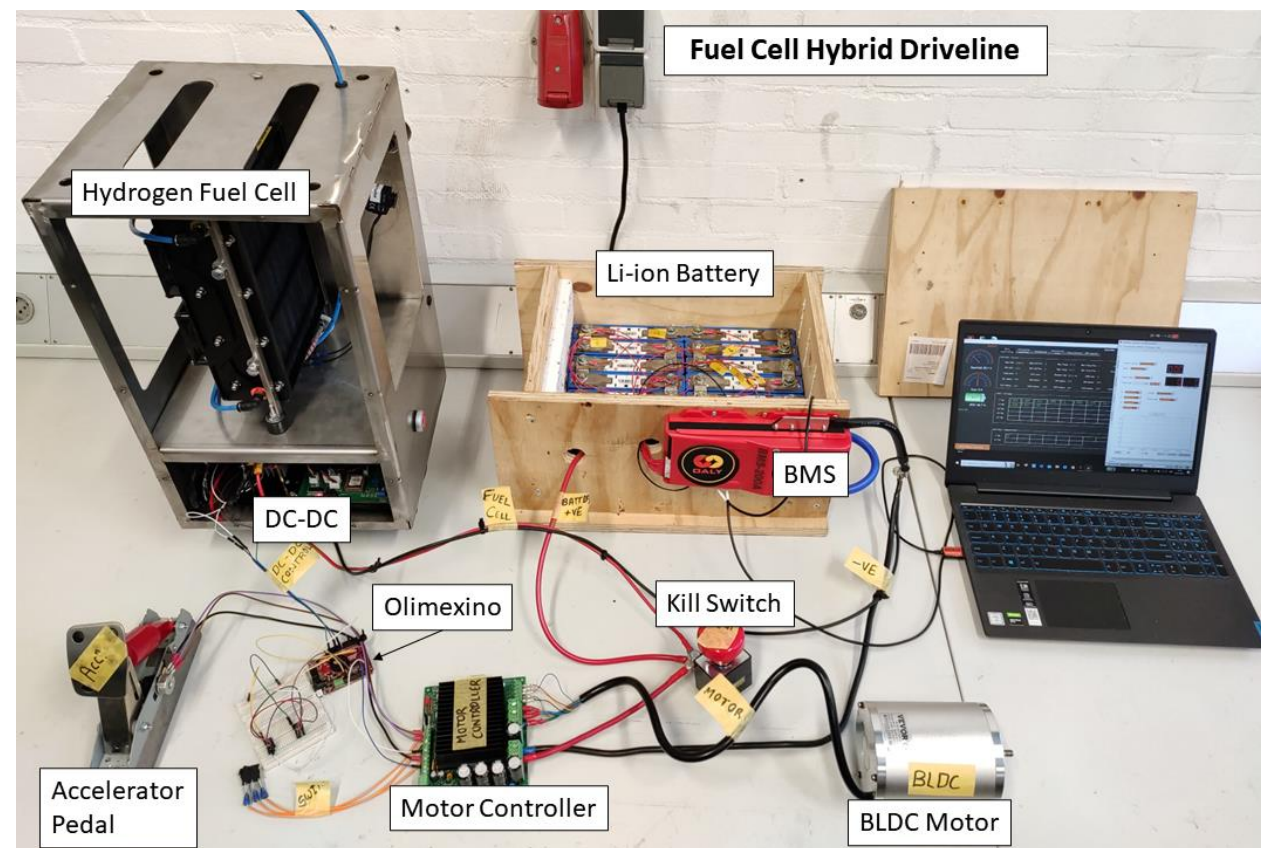
Started in December 2022, operational in April 2023

Can be used in multiple applications e.g. getting familiar with hydrogen in the industry



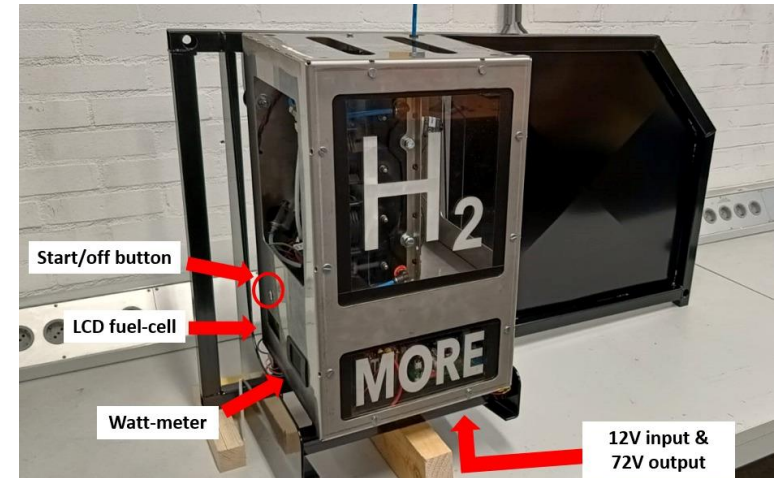
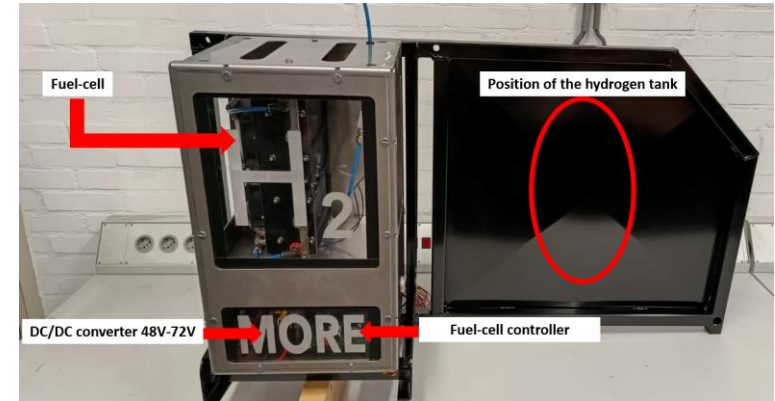
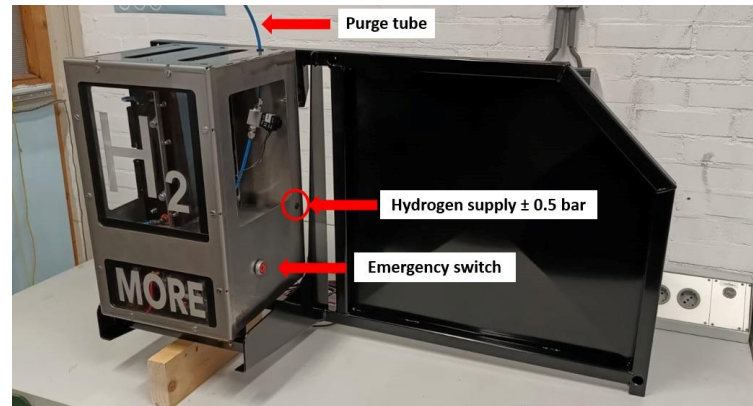
1 [KW] FUEL CELL TESTRIG

- 1 [kW] testrig similar to the table sized micro-MORE
- Scalable
- Energy Management System programmable in matlab Simulink, flashed in an Olimexino or Bodas Rexroth RC30
- Operational in March 2023



1 [KW] FUEL CELL RANGE EXTENDER

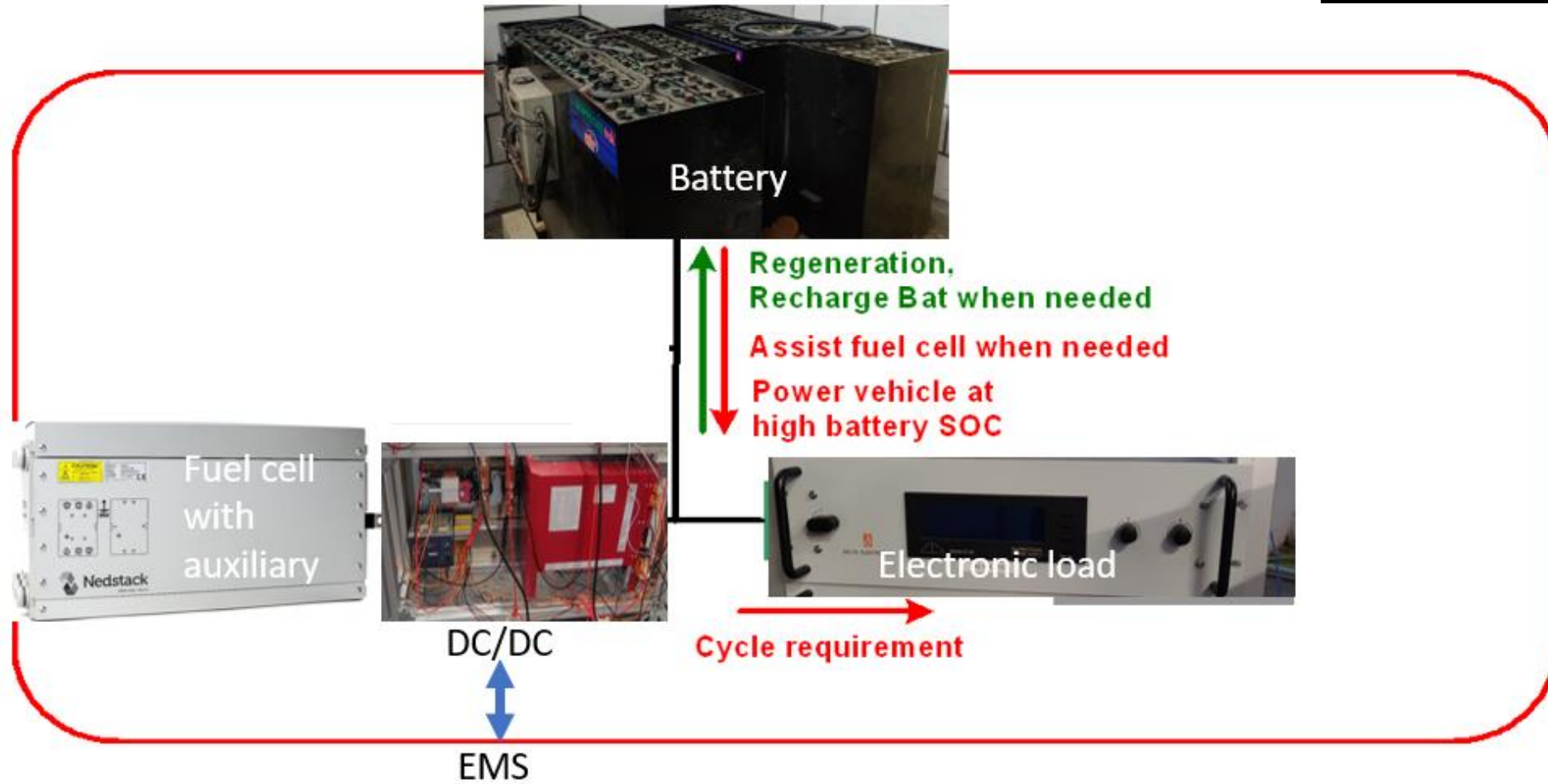
- 1 [kW] range extender on MORE
- Fuel cell is operational
- Full integration on the MORE vehicle in April 2023.



10 [KW] FCEV DRIVELINE

In cooperation with Burgaflex, operational in March 2023

MORE
MODULAR RESEARCH
VEHICLE



QUESTIONS?

**WE WOULD BE HAPPY TO ANSWER THEM!
PLEASE, CONTACT AD OOMEN OR SASKIA MONSMA**



Ad.Oomen@han.nl

0655206387



S.Monsma@han.nl

0611209681