EUREC Masters Starting Day
Sustainable Fuel Systems for Mobility (SFS)
Prof. dr.ir. J.J.Aue
Hanze Research EnTranCe @ Energy Academy Europe in Groningen/NL

- Two (old) universities: Hanze and RUG
- Vibrant & lively student life (> 80,000 students)
- International surroundings
- Focus on Energy Business and Research
Curriculum Sustainable Fuel Systems for Mobility (SFS): why

Mobility is key to future energy transition

➢ Mobility of people and goods
➢ Mobility of energy
➢ Mobility & environment and emissions

Mobility world is buzzing with innovation

➢ Efficiency, storage, electricity, testing protocols
 etc.
➢ Hydrogen, car as energy buffer, etc.
➢ Hypes, hopes and hurray’s
Main Focus System Approach SFS: Design/Development of a Hydrogen Economy

POWER GRID

POWER-TO-POWER
- Wind Turbine
- Solar PV
- Fuel cells
- Combustion turbines

SURPLUS
- Water → Oxygen

Optional
Hydrogen Storage

Electrolysis

Refueling Stations

Upgraded & synthetic fuels

Refineries

Blended gas

POWER-TO-MOBILITY
- Electric Vehicle
- Fuel Cell Vehicle
- Internal Combustion Engine Vehicle
- Natural Gas Vehicle

POWER-TO-CHEMICAL
- Petroleum Products
- Ammonia

POWER-TO-GAS
- Methanation
- Injection of hydrogen in the natural gas grid

GAS GRID

CO₂

Carbon Capture
Curriculum SFS: how

**Module 1: Supply Chain Design (SCD) (10 ECTS)**
- Theory: combustion, heat transfer, phase change, fuels for automotive
- Fuel production: gas, liquid, solid
- Case: supply chain modelling (Aspen) & lab
- Fuel storage: technologies

**Module 2: Bio-energy conversion (BEC) (10 ECTS)**
- Theory: biochemistry, thermodynamics, LCA
- Biofuels: biochemical conversion
- Biofuels: thermochemical conversion (by ECN)
- Case: Bioethanol production

**Module 3: Power2Hydrogen2Use (P2H2U) (5 ECTS)**
- Theory: power to hydrogen (P2H2)
- Storage, distribution and use of hydrogen & lab
- Case: P2H2 value chain research topics

**Module 4: New business development (NBD) (5 ECTS)**
- Theory: business models
- Case: existing/new (own) concepts
- Regulation, risks, costs & selling
Example SFS Module 3 Assignments
Sustainable Fuel systems for Mobility

This module consists of two submodules, which are complementary to each other, but assessed separately:
1. P2Hydrogen2Use Concepts (2 EC): lectures, visit, research proposal, presentation
2. P2Hydrogen2Use Modeling from a hub perspective (3 EC): lectures, model, paper

For both submodules an assignment is to be made. Both assignments are complementary to each other, with a focus on a hydrogen filling station, see Figure below
Examples Thesis Titles and Thesis Hosts

Thesis Title: Feasibility of Hydrogen Production for a Biomethanation Supply Chain in the Dutch Energy System
Company/Research Centre: NEC Groningen (NL)
Academic Year: 2016-2017

Thesis Title: The techno-commercial feasibility study of an energy supply chain connecting eucalyptus plantation and milk processing facility 'El Ordeño' in Ecuador
Company Research Centre; University of Zaragoza (Spain)
Academic Year: 2015-2016

Thesis Title: Feasibility study and thermodynamic analysis of storing one excess solar electricity in the form of superheated water for a household in Lathen using Aspen Plus and Dynamic software
Company Research Centre: Fach Hochschule Emden, Leer (Germany)
Academic Year: 2016-2017

Thesis Title: Simulation of different Argon flow rates in the Second Generation Solar Cavity-Receiver Reactor and Modification of the Focal Length for reducing the Radiation Losses and increasing the Oxygen Release
Company Research Centre
Academic Year: 2015-2016

Thesis Title: Systematic determination of scenario-dependent hydrogen demand for European regions in mobility sector
Company/Research Centre: NEC Groningen (NL)
Academic Year: 2015-2016

Thesis Title: Feasibility Study of a Biomethanation Supply Chain from Biogas and Renewable Hydrogen at Farm Scale in the Netherlands
Company/Research Centre: University of Zaragoza (Spain)
Academic Year: 2015-2016

Thesis Title: Hydrogen Delivery Chain for Maritime Applications
Company/Research Centre: Persee (Paris, France)
Academic Year: 2016-2017

EUREC MSc Starting Day
Future jobs and careers
Sustainable Fuel Systems for Mobility Scientists & Engineers

- Transport industry
- Consultancy (private/public)
- Energy equipment manufacturing
- Fuel producers
- Industry (biorefinery)

**Figure 2**: The amount of jobs created is based on the direct investment (billion €) within these sectors sources from the supporting EU funds

**Renewable Energies**
- jobs created
- EU Budget investment (supported by Cohesion Policy)

**Conservation/Natura 2000**
- jobs created
- EU Budget investment (supported by Cohesion Policy, CAP, LIFE programme, EMFF®)

**Energy Savings in buildings**
- jobs created
- EU Budget investment (supported by Cohesion Policy)

**Sustainable Transport**
- jobs created
- EU Budget investment (supported by Cohesion Policy, Connecting Europe Facility)
Practical information
Sustainable Fuel systems for Mobility

• Visa
  ➢ Contact International Service Desk (@ isd@org.hanze.nl)
  ➢ Non-EU: start arranging early; need financial guarantee
  ➢ www.hanze.nl/eng/study-at-hanze/practical-information/immigration

• Accommodation
  ➢ Contact Service Desk Housing (@ housing@org.hanze.nl)
  ➢ Register at www.sshxnl.nl
  ➢ Start arranging early
Contact details and info

@ www.master.eurec.be/en/Partnering-
Universities/Spe-Sustainable-fuel-systems-
for-mobility-Hanze-UAS-NL/
Mr. Gerrit Kuiken MSc
Program manager Energy Education

g.kuiken@pl.hanze.nl
Testimonials SFS Students
Sustainable Fuel systems for Mobility

Testimonial SFS Student Stelios

Already in the first week of the master, Stelios explained to me that his interest in the EUREC master was linked to the idea to combine space travel with renewable energy, even thinking about interstellar travelling using renewable energy sources. Although this idea seemed farfetched to me in the beginning, Stelios found a final project which was closely linked to his a his aspirations. Stelios final project was part of the SOLAR JET program, which stands for Solar-Cavity-Receiver reactor Optimization for Long-term Availability of Renewable JET fuel, where he did a very nice job.

Dr. Folkert Faber, reseacher, lecturerer, thesis supervisor Hanze UAS

Testimonial SFS Student Rizqi

Rizqi is persistent and thorough, and he gets things done. Although he has a chemical background, he learned a new programming language, python, to model the possible hydrogen demand of the mobility sector of the future. He is looking for a PhD position now.

Dr. Andras Perl, Researcher, lecturer, thesis supervisor Hanze UAS