ADREM

Adaptable Reactors for Resource- and Energy-Efficient Methane Valorisation

PROJECT OVERVIEW

- **START DATE**
  1st October 2015
- **DURATION**
  48 months
- **BUDGET**
  6 million €
- **10 PARTNERS**
  in 8 countries
- **Project coordinator**
  Prof. A. Stankiewicz
- **Project manager**
  E. Gruchattka

PROJECT WEBSITE:
www.spire2030.eu/adrem

MOTIVATION

METHANE AS SOURCE OF ENERGY AND CHEMICALS

- **Enormous reservers**
  - existing gas networks
  - small natural gas reservoirs
  - shale gas
  - coalbed methane
  - agricultural biogas
  - deep-sea methane hydrates
- **Environmental sustainability**
- **Economic advantage**

FLARING OF METHANE IN REMOTE LOCATIONS

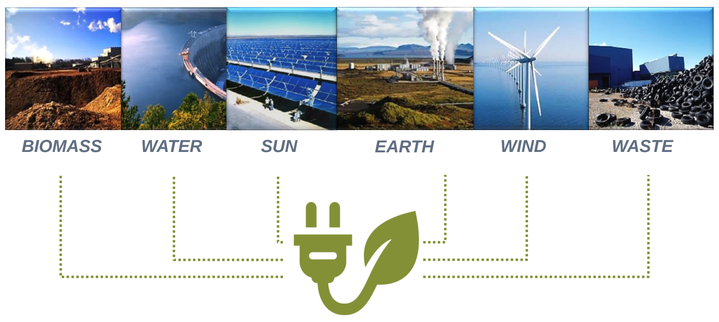
PROJECT AIM

GENERAL AIM:

develop an highly innovative, economically attractive and **resource- & energy efficient** valorisation process of variable methane feedstocks to higher hydrocarbons and liquid fuels

LONG TERM AIM:

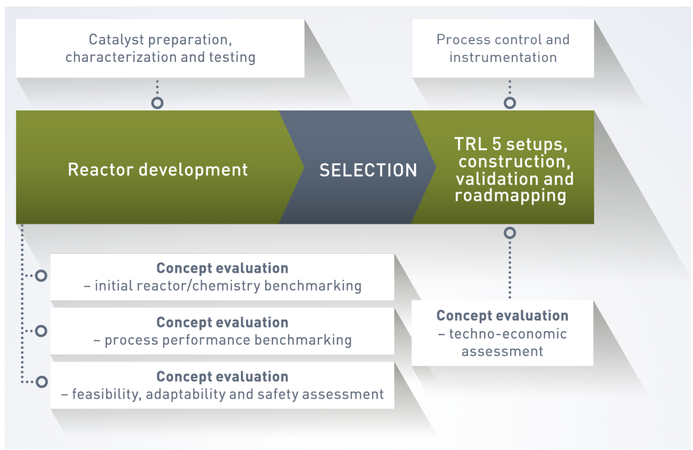
valorisation process based on **green electricity**



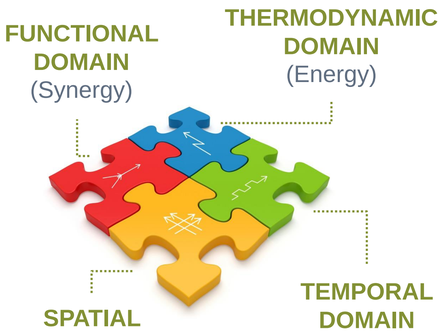
CHALLENGES

- *Diversity and distribution of the methane sources*
- *Adaptibility with respect to feedstock and product distribution*
- *Specific catalyst design for single-step conversion*
- *Catalyst lifetime and exchangeability*
- *High energy efficiency of process*

APPROACH & CONCEPT

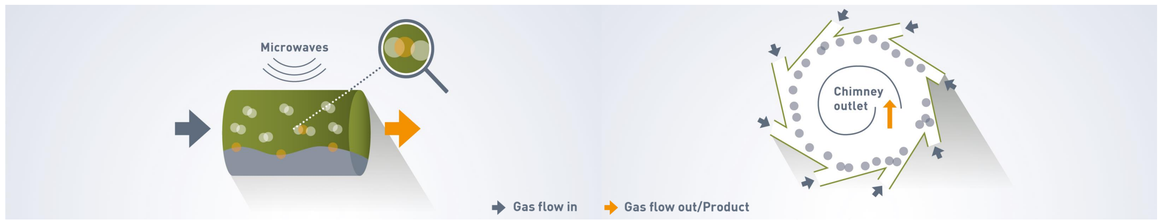


CONSTRUCTION OF REACTOR CONCEPTS AS MOBILE, MODULAR BENCH-SCALE UNITS



INTEGRAL, FOUR-DOMAIN PROCESS INTENSIFICATION METHODOLOGY (PI)

REACTOR TECHNOLOGIES

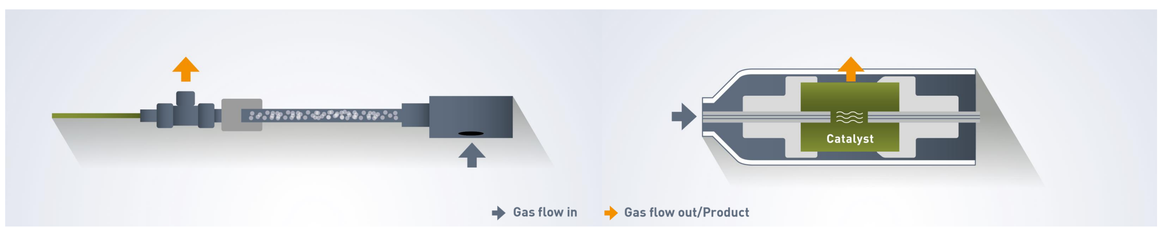


MICROWAVE / RADIOFREQUENCY

- Selective, energy efficient heating of the catalyst by electromagnetic waves
- Implementing a non-steady state operating cycle
- Reduction of undesired reactions

GAS-SOLID VORTEX (STATIC GEOMETRY)

- Static, cylindrical geometry with a solid catalyst
- Tangential injection of gas-phase causes the solid catalyst to rotate in the reactor – centrifugal force
- The two opposing forces – centrifugal and drag force – for high heat and mass transfer rates on both particle and reactor scale



NON-THERMAL PLASMA

- Far from equilibrium plasma processing, using nanosecond pulsed discharges, favours conversion of electrical energy to heat and reduce the heating effect

TEMPERATURE GRADIENT PLASMA

- Merger of two unit operations (intensification): reactor and separator (separation of gas feedstock and liquid product) in outer reactor jacket
- Central reactor axis: plasma source

EXPECTED IMPACTS, INNOVATIONS AND SAVINGS

ADREM IMPACTS

- On-site valorisation of methane from diverse sources
- Filling the processing gap of methane to avoid flaring
- Decreased carbon footprint
- Increased resource and energy efficiency

TECHNOLOGICAL INNOVATIONS

- Flexible, adaptable equipment design
- Process development including electricity as primary energy source
- Tailored, energy-responsive catalysts
- Process control

SAVINGS

20% less emissions

20% less energy intensity

10% better overall resource efficiency

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under the Grant Agreement No. 680777

SPIRE Sustainable Process Industry through Resource and Energy Efficiency