Although the natural gas reserves in Europe and in the rest of the world are still growing, a high percentage them are classified as stranded. Shipping gas is uneconomical, and the costs of liquefaction or building a pipeline are excessively high. The conversion of methane from this and other sources like biogas into shippable high valuable liquids can solve these problems but in some cases the capital costs of current industrial multi-step conversion routes represent a limitation.

Therefore, this project aims at establishing alternative direct and cost efficient routes through the development of radically new 3D hierarchical structured catalysts with bi-functional activity (two types of active centers), achieving multimodal pore size distribution (micro-, meso1-, meso2-, macro-porous) and high dispersion of metal active sites that will allow for:

i. Effective control on the product selectivity,

ii. Easy regeneration and avoidance of coking and

iii. Increase of the reactor productivity for the process of direct methane dehydroaromatization (MDA) into high value chemicals such as aromatics (benzene, naphthalene, among others).

The project will overcome problems related to low methane conversion, low selectivity towards the desired products, and the quick deactivation associated with carbon deposition on catalyst by the use of hierarchical zeolites structures, synthesized by 3D-printing and loaded with doped molybdenum nano-oxides.

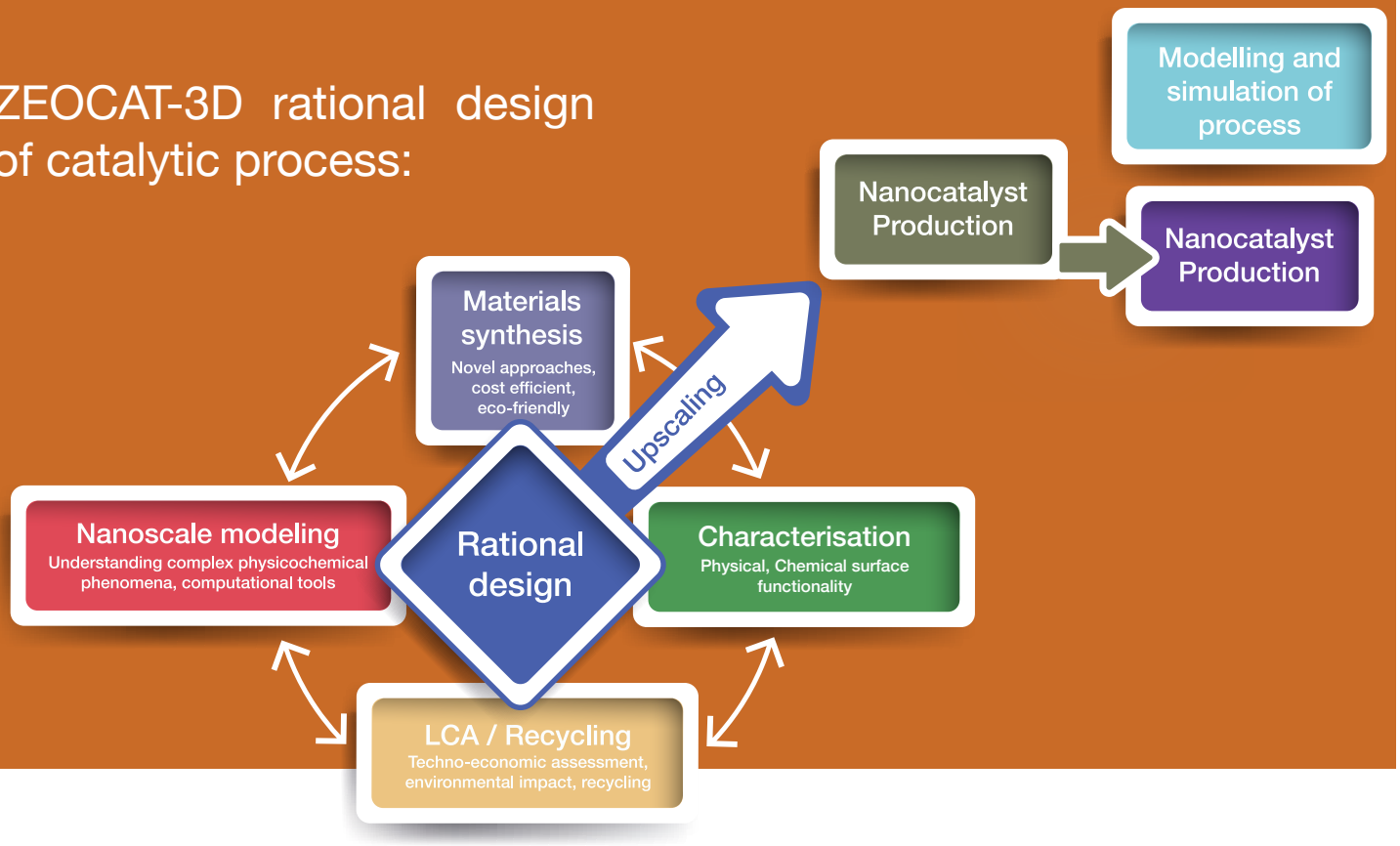
Challenges of the MDA process	Effect	Expected results
Difficult activation of the C–H bond of CH_4 molecule	Low methane conversion	Improved methane conversion (>50%)
High reactivity of the products compared to methane	Low selectivity towards the desired products	Increased selectivity towards benzene (>90%)
Acid sites of zeolites are occupied by coke deposition	Deactivation of catalyst	- Enhanced performance (7 times less deactivation) - Higher yield rates (up to 80%)

From laboratory to pilot-scale demonstration in a real environment, ZEOCAT-3D will optimize the catalyst design and the conditions of the operation for different methane feedstocks at lab-scale. The project will then upscale the obtained solution and build a prototype reactor.

Specific objectives of ZEOCAT-3D:

1. Development and production of improved catalyst
2. Design, construction and validation of catalytic reactor
3. Rational design of catalyst/multi-scale modelling

ZEOCAT-3D rational design of catalytic process:



ZEOCAT-3D

Development of a bifunctional hierarchically structured zeolite based nano-catalyst using 3D-technology for direct conversion of methane into aromatic hydrocarbons via methane dehydroaromatization.

The consortium is composed of seven SMEs and 7 research centers covering five main groups of competences: 1) Supply of raw materials (biogas/gas natural), 2) Optimization of multiscale modelling, 3) Optimization and development of catalytic material and 3D-printing process, 4) Design and optimization of upstream and downstream components and prototype of MDA reactor, and 5) Specialized processes assessment.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 814548

Coordinator: IDENER
Total cost and EC contribution: €6.764.020
Call: H2020-NMBP-ST-IND-2018
Funding scheme: RIA
Duration: from 2019-04-01 to 2022-09-30