

OITB service catalogue



The project has received funding from the European Union's Horizon 2020 research and innovation program under Grant Agreement N° 862330.

Structure of the catalogue and service providers

Pilot Lines: list of the 14 pilot lines under upgrading activities in the project

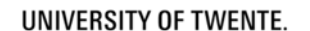
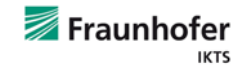
Services offered by the OITB and accessible through the Open Calls application

■ Technical services

- Membrane properties characterisation techniques
- Membrane scale up (equipment and techniques)
- Development and scale up of membranes
- Engineering & Design

■ Non-technical services

- Data management
- Software development
- Venturing activities
- Techno-economic analysis and market validation
- Consultancy
- Innovation services





PILOT LINES

List of the 14 pilot lines under upgrading activities in the project

Upscale/upgrade of 14 pilot manufacturing lines

- PL1 Dual layer mixed matrix HF manufacturing system
- PL2 Pd-based membrane plating system
- PL3 Grafting of ceramic membranes
- PL4 Nanostructured inorganic micro-tubular-membranes
- PL5 Flat sheet polymer membrane production.
- PL6 Zeolite membranes
- PL7 Roll-to-Roll coating of advanced nanophase-segregated ion-exchange polymer membranes

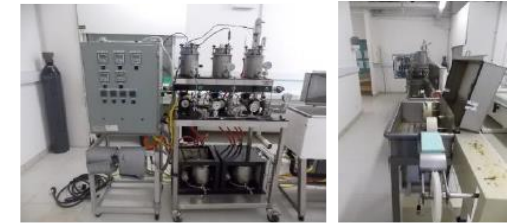


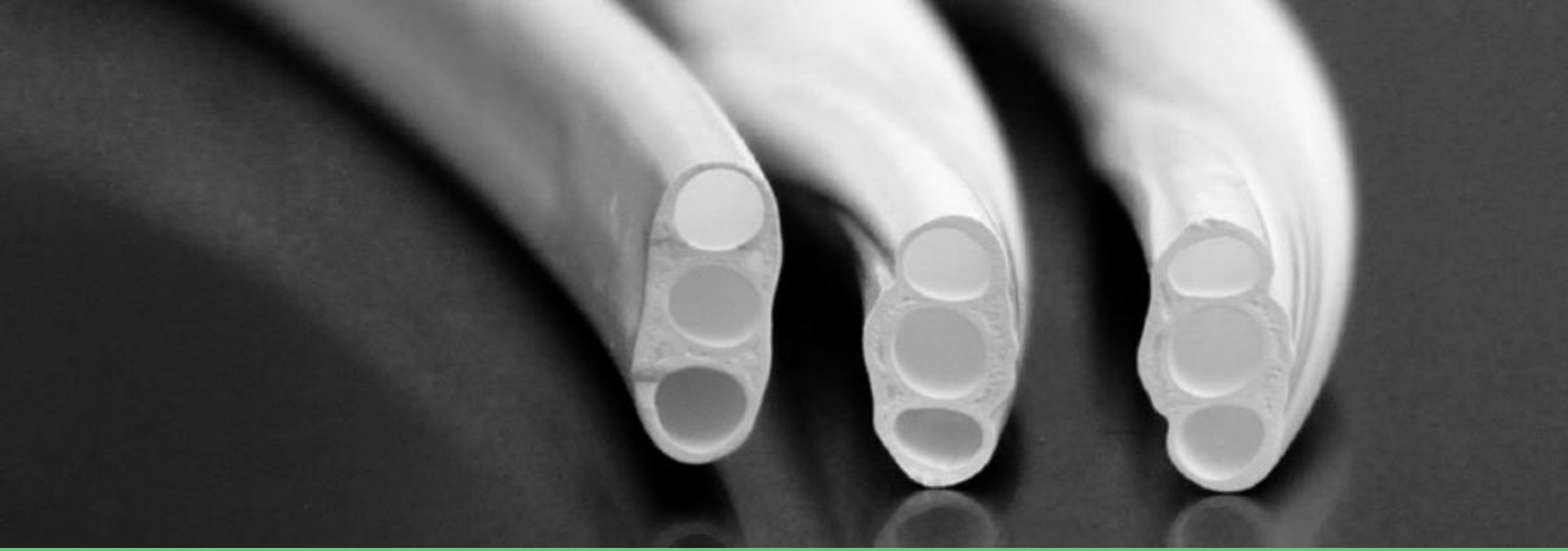
Upscale/upgrade of 14 pilot manufacturing lines

- PL8 Surface nano-structured and functionalized HFs
- PL9 Modification of HFs by microfluidics
- PL10 In-line modification of nano-coatings on hollow fiber membranes
- PL11 GO/CNTs mixed-matrix membrane system
- PL12 Molecular sieving nanoporous ceramic and CNT membranes system
- PL13 Hollow fiber membrane spinning with improved geometric features
- PL14 Centrifugal potting of HF membranes



UNIVERSITY OF TWENTE.





INNOMEM CATALOGUE

OITB technical services for nano-enabled
Membranes

Membranes properties characterisation techniques

GAS SEPARATION

EXPERTISE & CAPABILITIES

- Testing and characterisation of membranes for gas separation such as H₂ production, CO₂ capture, natural gas purification, air separation
- High pressure permeation testing setup
- Pore size distribution for supports and intermediate layers
- Helium-leakage test; nitrogen diffusion test
- Validation technologies for biogas production

UPSCALING FACILITIES

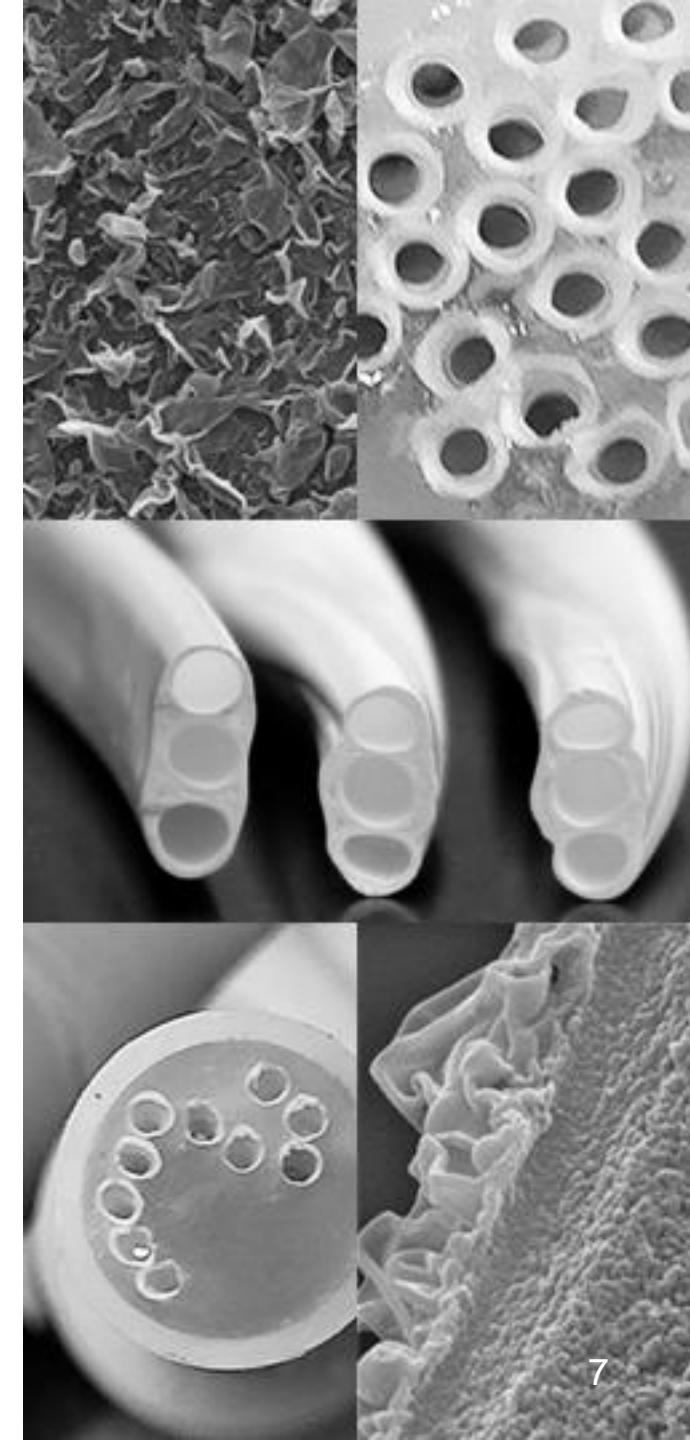
High pressure permeation testing setup:

- Up to 60 bar (**TUE, DBI**)
- 65 bar feed pressure and 250°C feed temperature (**HZG**);
- up to 100 bar (under construction) (**TEC**)

Permeation (single gas and dehumidification) and filtration measurements (**MF, UF, NF**)

Porosimetry (pore size and pore size distribution) (**UM**).

PEM electrolyzer: capacity of up to 10 Nm³/h H₂ (20 kg/day) at 30 bar. The storage brick composed by two storage units, one at 30 bar (up to 6 kg) and one from 50 to 200 bar (up to 40 kg) with a 2-stage compressor (**ENGIE**).



Membranes properties characterisation techniques

LIQUID SEPARATION

EXPERTISE & CAPABILITIES

- Testing and characterisation of membranes for liquid separation i.e. olefin/paraffin

UPSCALING FACILITIES

- Water and solvent fluxes (**RKV**)
- Retention measurement of different molecules (**RKV**).

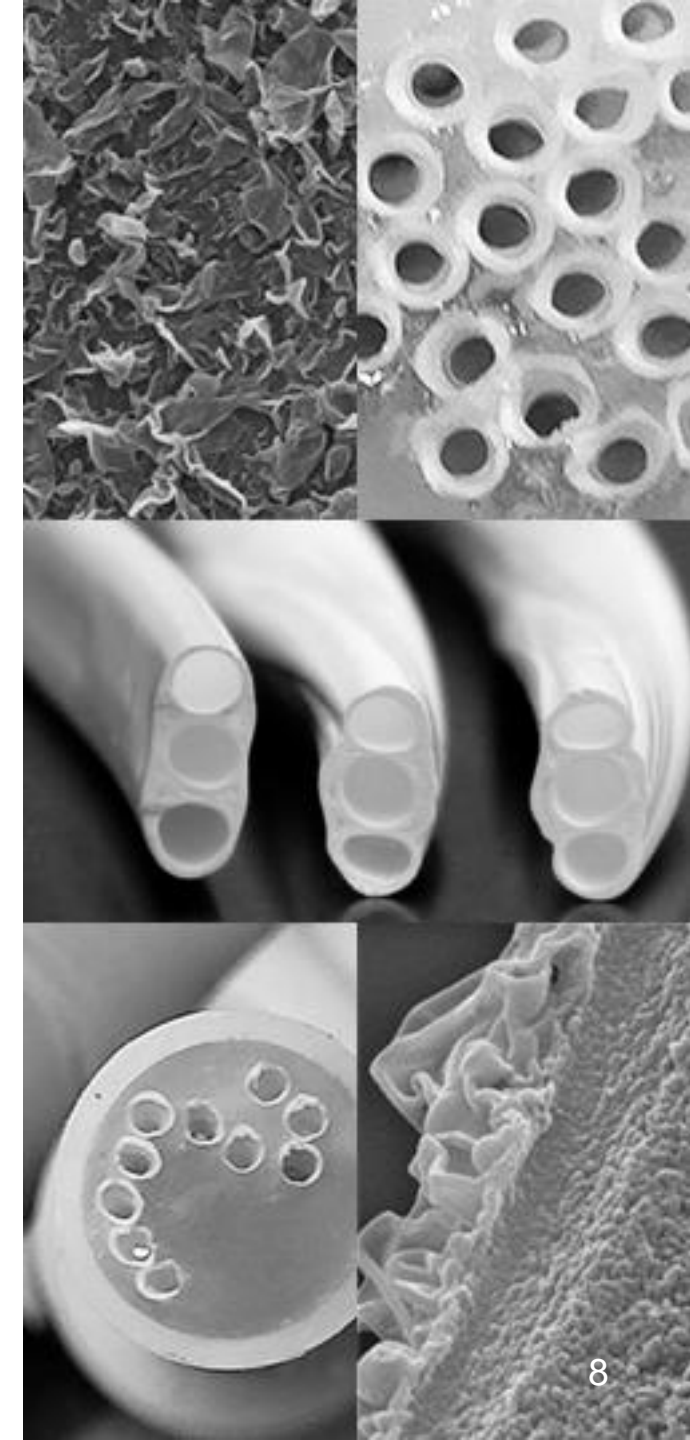
LONG TERM PERFORMANCES EVALUATION

EXPERTISE & CAPABILITIES

- Verification of separation performances and long-term stability

UPSCALING FACILITIES

- Separation performance and long-term stability of membranes up to 65 bar (**HZG**) and 50 bar (**TUE**, **DBI**) in mixed and single gas environments.



Membranes properties characterisation techniques

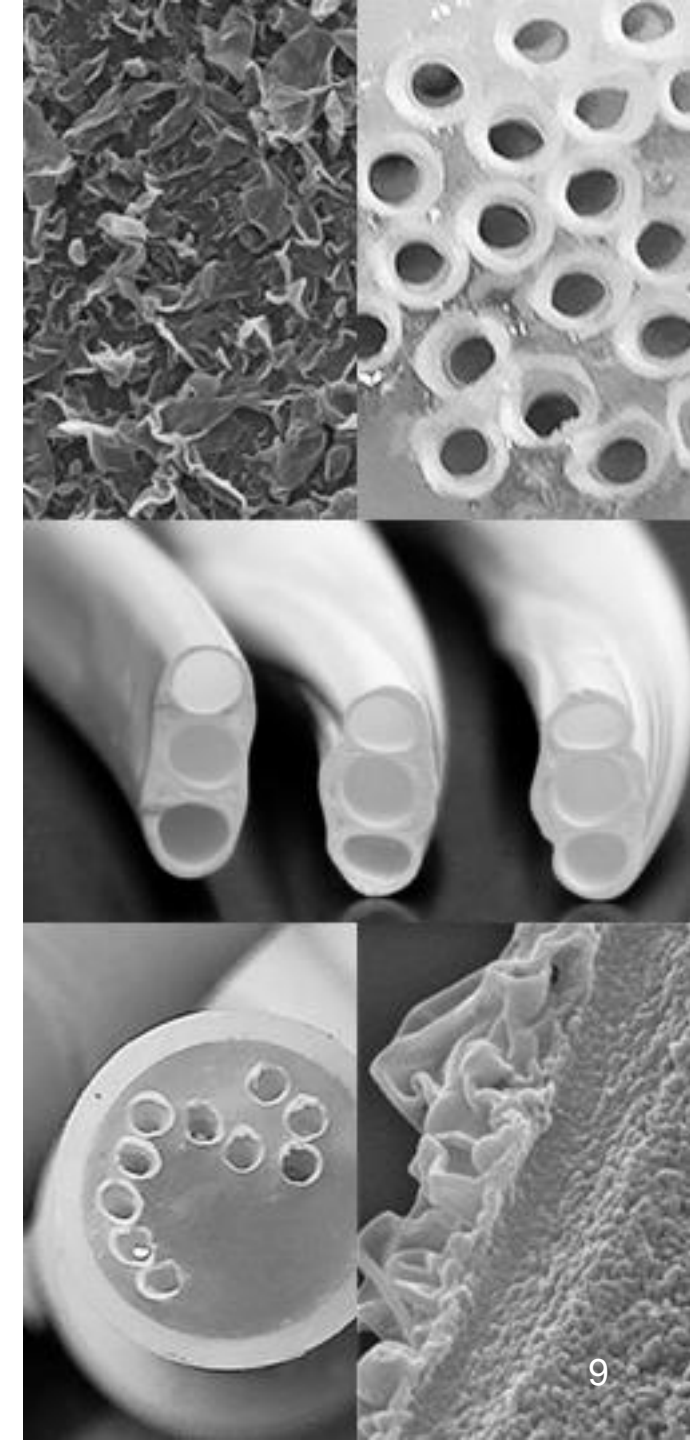
MEMBRANE RELATED EQUIPMENT

EXPERTISE & CAPABILITIES

- Flexible lab-scale equipment for aqueous as well as organic solvent filtration fit for down-stream purifications, but also for reaction-separation coupling.

UPSCALING FACILITIES

- Mobile pilots for liquid filtration, both water and organic solvent filtration (**Atex**). Some of them are also fit for GMP applications or high temperature applications (**VITO**);
- Test equipment for membrane-dewatering of solvents (**DBI**). Construction and installation of membrane filtration units for water and wastewater filtration (**POLYM**).
- Pilot installations for gas and liquid separation testing: - Ultrafiltration - Nanofiltration - Reverse Osmosis - Organic Solvent Nanofiltration - Electrodialysis – Pervaporation, High pressure and temperature mixed gas permeation setups (**UT**)



Membranes properties characterisation techniques

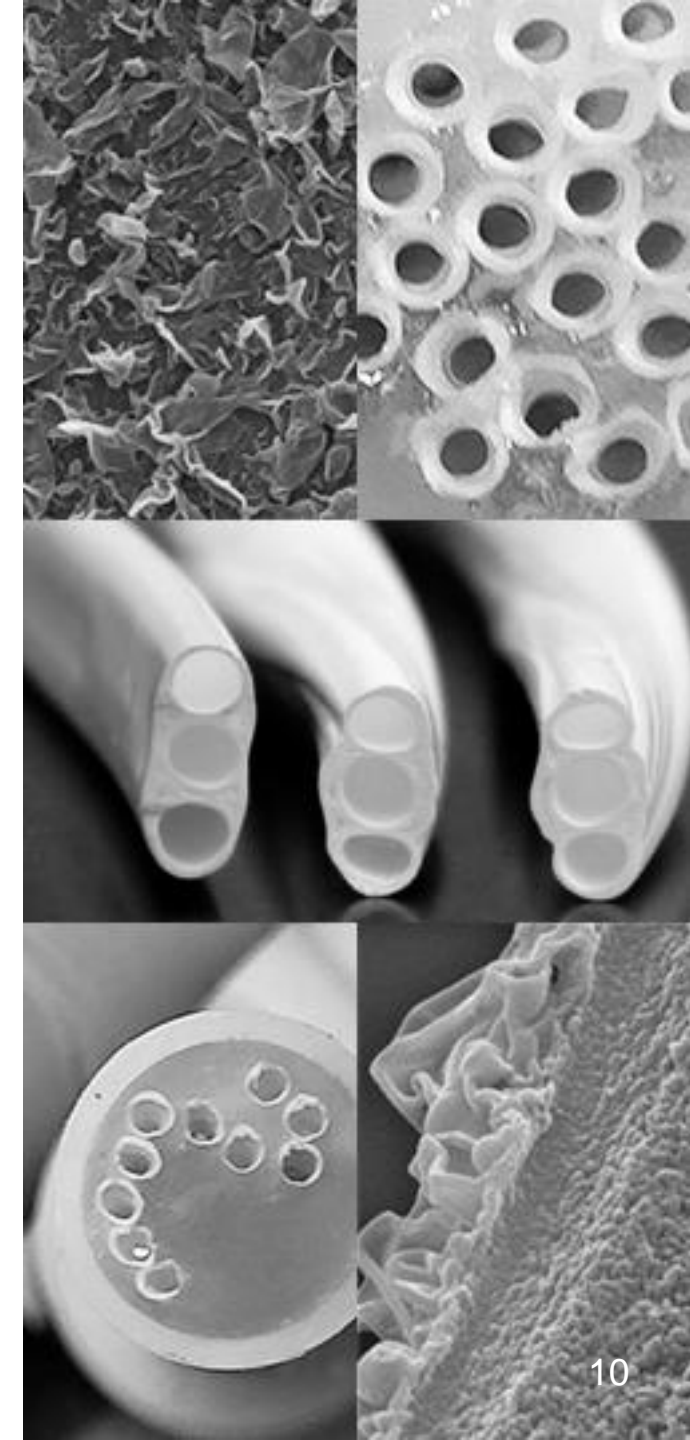
PHYSICO-CHEMICAL CHARACTERIZATION TECHNIQUES

EXPERTISE & CAPABILITIES

- Surface and bulk characterisation, electrokinetic measurements
- Laboratory rigs for membrane performance assessment

UPSCALING FACILITIES

- SEM, FE-SEM, EDX, SAXS, TEM, AFM, XRD, XPS, Raman spectroscopy, AFM, FTIR, MALDI-TOF, STED, Confocal, TGA, DSC, FLIM, Ellipsometry, QCMD, EIS, HPLC, GC, ion chromatography, Zeta-potential (**CNR, RWTH, TUE, UT, HZG, UM**)
- Automatic time lag permeation apparatus (**TEC, HZG**)
- Physico-chemical and performance characterization of membranes in a wide variety of liquid membrane processes (**VITO**)
- Permporometry, Custom-build lab equipment for membrane manufacturing and testing (**UT, HZG**)
- analytics and surface analytics of materials (**UDE**)
- Laboratory rigs for membrane performance assessment (**ICL, AU, TUE, HZG**)
- Electrokinetic analyzer for solid surface analysis (**UM**)



Membranes scale up

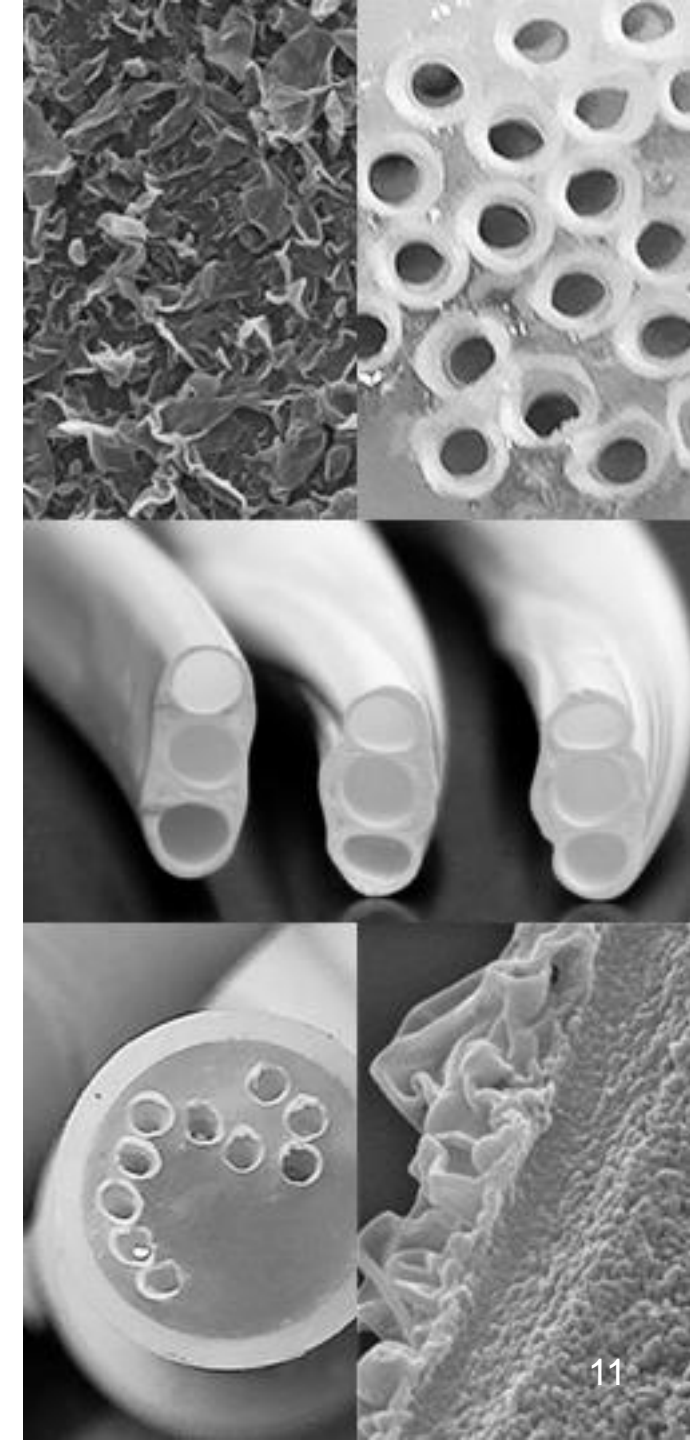
GAS SEPARATION & LIQUID PURIFICATION

EXPERTISE & CAPABILITIES

- Fabrication of modules for filtration, separation, permeation
- Module autopsy

UPSCALING FACILITIES

- Reverse osmosis, nanofiltration, ultrafiltration, microfiltration, membrane condensers, membrane contactors, membrane distillation (**CNR**)
- Construction of module manufacturing equipment (**MESEP**) Pervaporation (**TUE**)
- Testing facilities for membrane module sizes ranging from single fiber modules to 4"-modules (**RWTH**). Pilot scale units for the investigation of mixed gas permeation performance up to 20 m² module scale, 65 bar feed pressure and 250°C feed temperature, gas separation, vapour permeation, organic solvent nanofiltration and pervaporation modules (**HZG**)
- Module autopsy (**POLYM**)



Membranes scale up

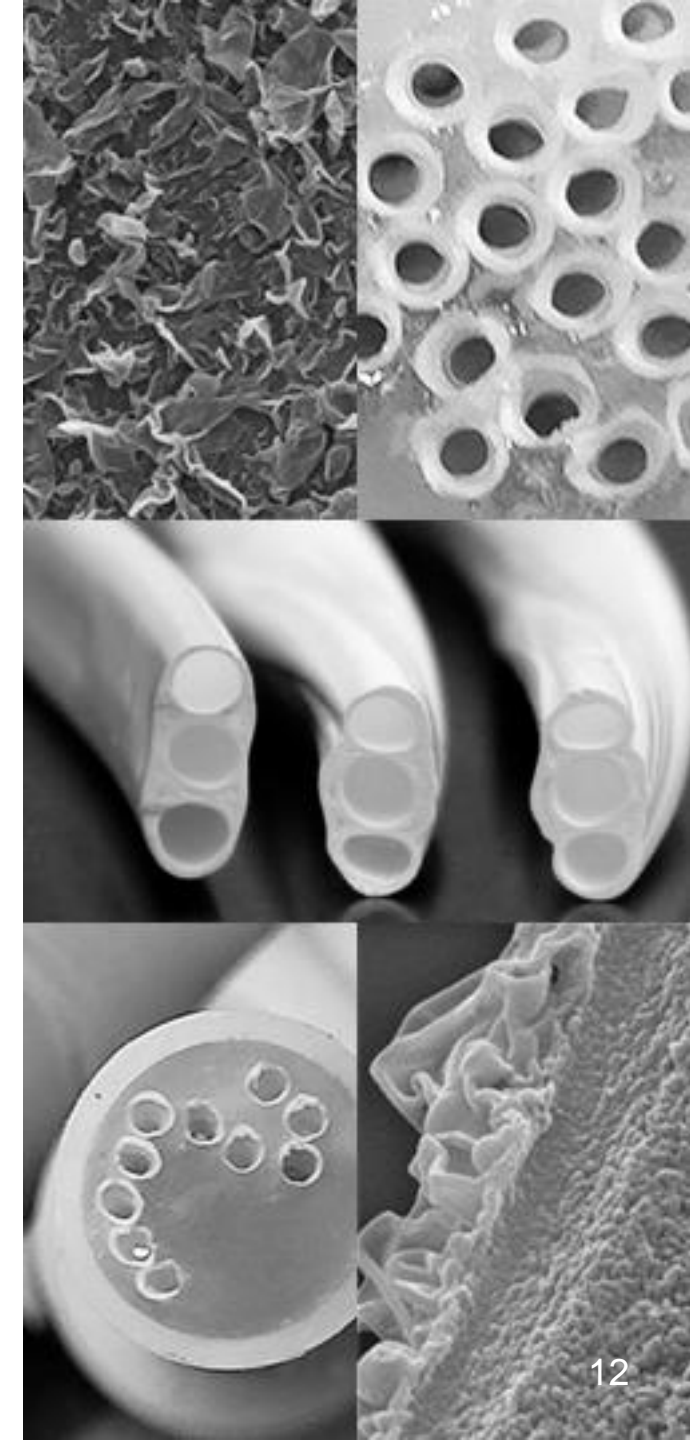
MEMBRANE MODULES CHARACTERIZATION

EXPERTISE & CAPABILITIES

- Membrane scale-up for gas separation (H₂ production, CO₂ capture, biogas upgrade, gas purification, air separation)
- Aqueous application (purification)
- Membrane module design, construction, and manufacture for large areas

UPSCALING FACILITIES

- Development and scale-up of membranes for gas separation applications and aqueous applications such as removal of organic micropollutants, pesticides etc (**TEC, HZG, UT**)
- Membrane module design, construction, and manufacture for membrane areas up to 75 m² (**HZG, UT**). Development and scale-up of membranes by different phase separation processes. Lab-scale and pilot-scale equipment for membrane preparation/fabrication (**UDE**)
- Scale-up spinning membrane recipes, module fabrication to large size module (the largest module fabricated so far contain 550 m² of hollow fibers (200 000 HF), building pilots and large membrane units (**POLYM**)



Development and scale up of membranes

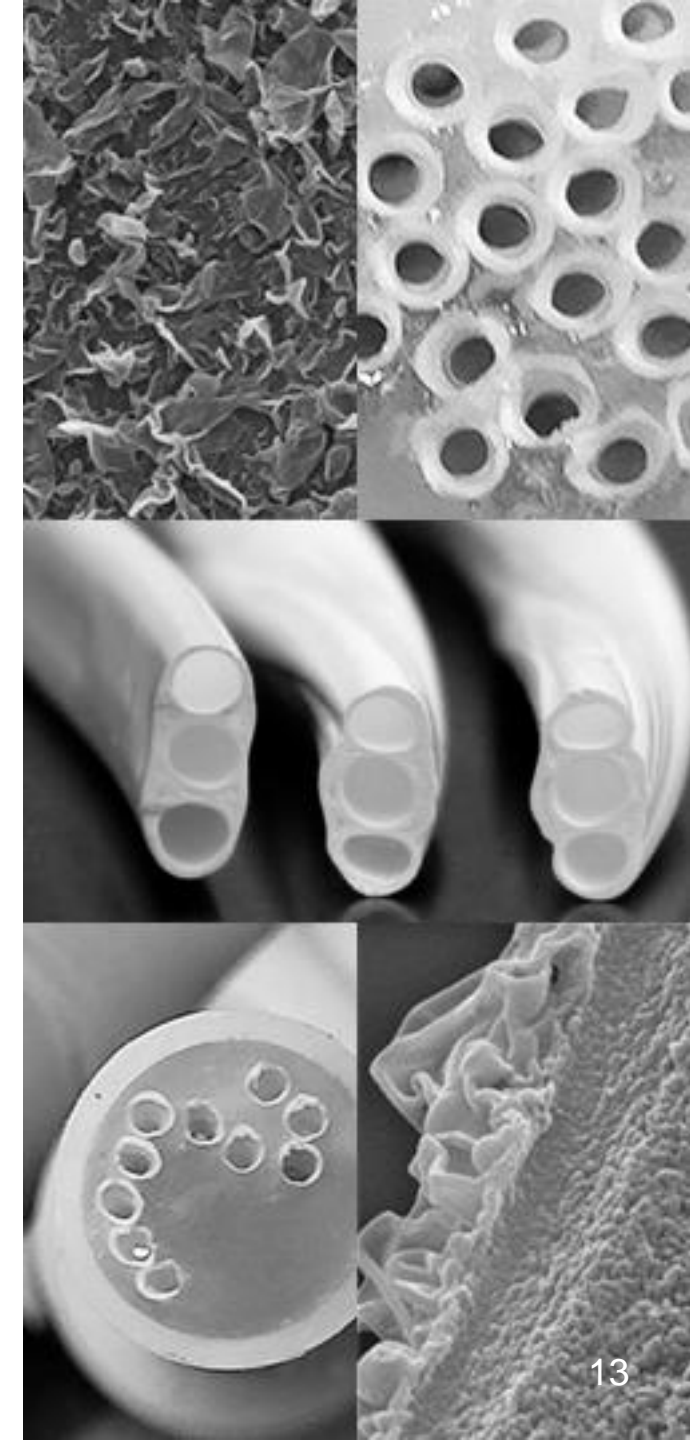
POLYMERIC MEMBRANES AND HF MEMBRANE

EXPERTISE & CAPABILITIES

- Polymeric, inorganic (metal, carbon)
- Mixed matrix membranes
- HF membrane

UPSCALING FACILITIES

- Polymeric and HF membranes: - geometries, Additives, Materials and solvents, Chemistry in a spinneret – simultaneous membrane formation and functionalization. Module and spacer design and flow MRI analytics. Simulation from pore-size to process level. Additive manufacturing techniques for prototyping and device manufacturing (**RWTH**)
- Polymeric, inorganic (metallic and carbon) membranes (i.e. Pd-based thin film membranes by electroless plating and/or PVD, pore fill Pd membranes, Carbon Molecular Sieve membranes) and mixed matrix membranes (**TEC**)
- Polymeric membranes for gas and vapour permeation, pervaporation and organic solvent nano filtration manufactured as thin film composite flat sheet membranes and mixed matrix membranes, membranes for filtration applications as flat sheet and hollow fibre membranes (**HZG, UT**)
- HF spinning (**POLYM**)



Development and scale up of membranes

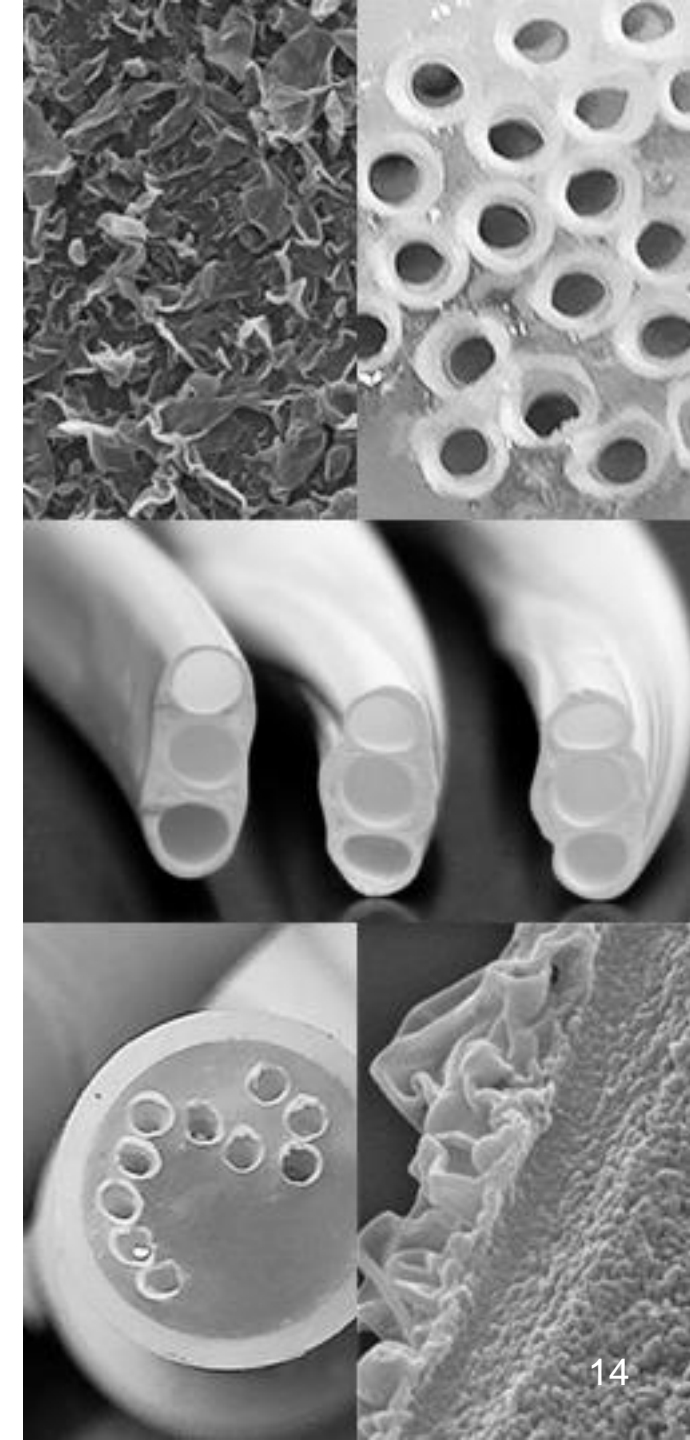
MICRO- AND NANOSTRUCTURED OR NANOCOMPOSITE MEMBRANES

EXPERTISE & CAPABILITIES

- Development by different type of separation processes
- Fabrication of thin films composites
- Surface functionalization of commercially available membranes

UPSCALING FACILITIES

- Development of separation membranes for ultrafiltration, nanofiltration, osmotic separations, membrane distillation and other processes, including micro- and nanostructured or nanocomposite membranes (**UDE**)
- Advanced surface functionalization of commercially available membranes (**UDE**)
- Development of porous adsorbers and membranes for contaminant removal from water (**UDE**)
- Fabrication of Thin film composite membranes, Fabrication of Thin film nanocomposite membranes (**UNIZAR**)
- ALD coating of different materials on various support (**UM**)



Development and scale up of membranes

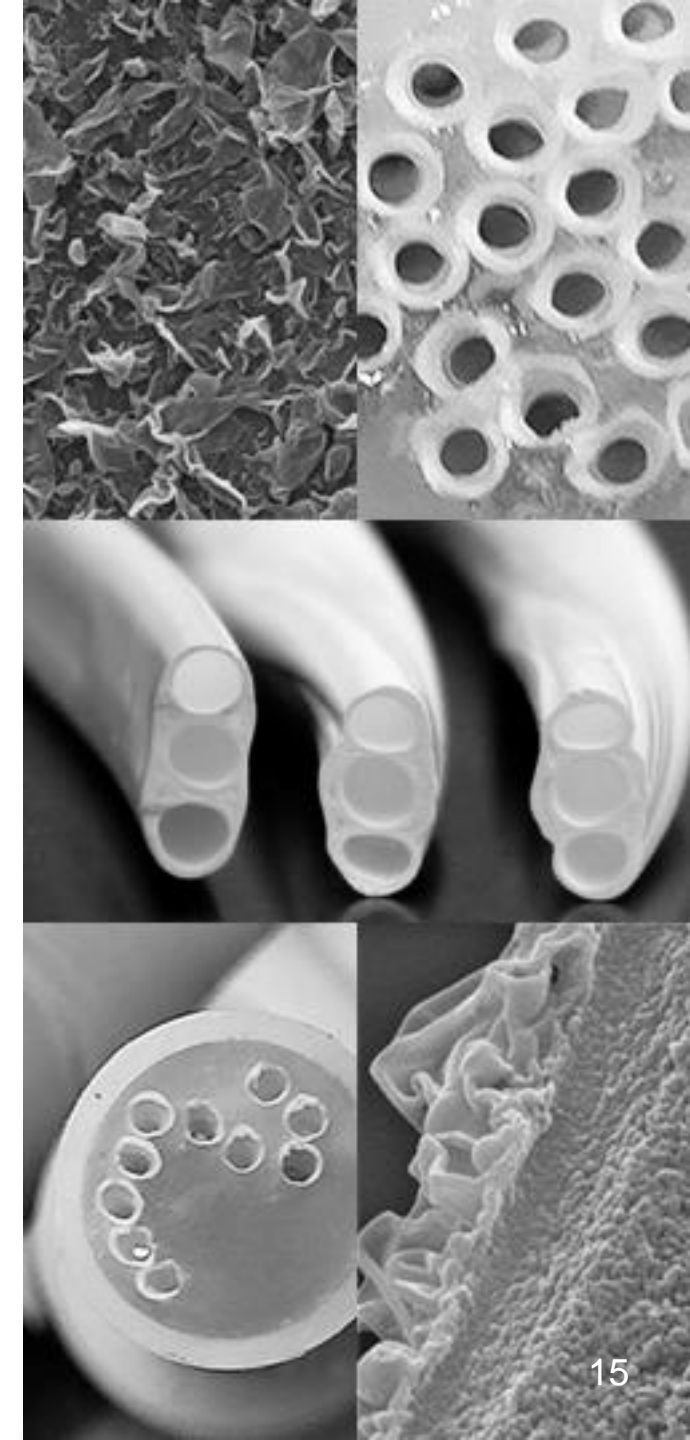
CERAMIC MEMBRANES

EXPERTISE & CAPABILITIES

- Functionalisation of ceramic membranes
- Multi-channel-tube-structures
- Catalytic membranes for emission control

UPSCALING FACILITIES

- Development of new methods for efficient functionalization of ceramic membranes, aimed at increased performance in liquid filtrations; extensive feasibility and proof of concept testing from lab to pilot scale in a broad range of separation problems. Unique expertise in Organic Solvent Nanofiltration (**VITO**)
- Production of ceramic membranes for micro-, ultra- and nanofiltration. Large multi-channel-tube-structures for filtration like honeycombs production (**RKV**)
- Manufacturing expertise for Ceramic membranes for water and wastewater treatment; Catalytic membranes for emission control; Ceramic membranes for gas separation, such as CO₂ capture; Ceramic membranes for energy conversion, such as solid oxide fuel cell and electrolysis (**ICL, AU**)



Modelling & design

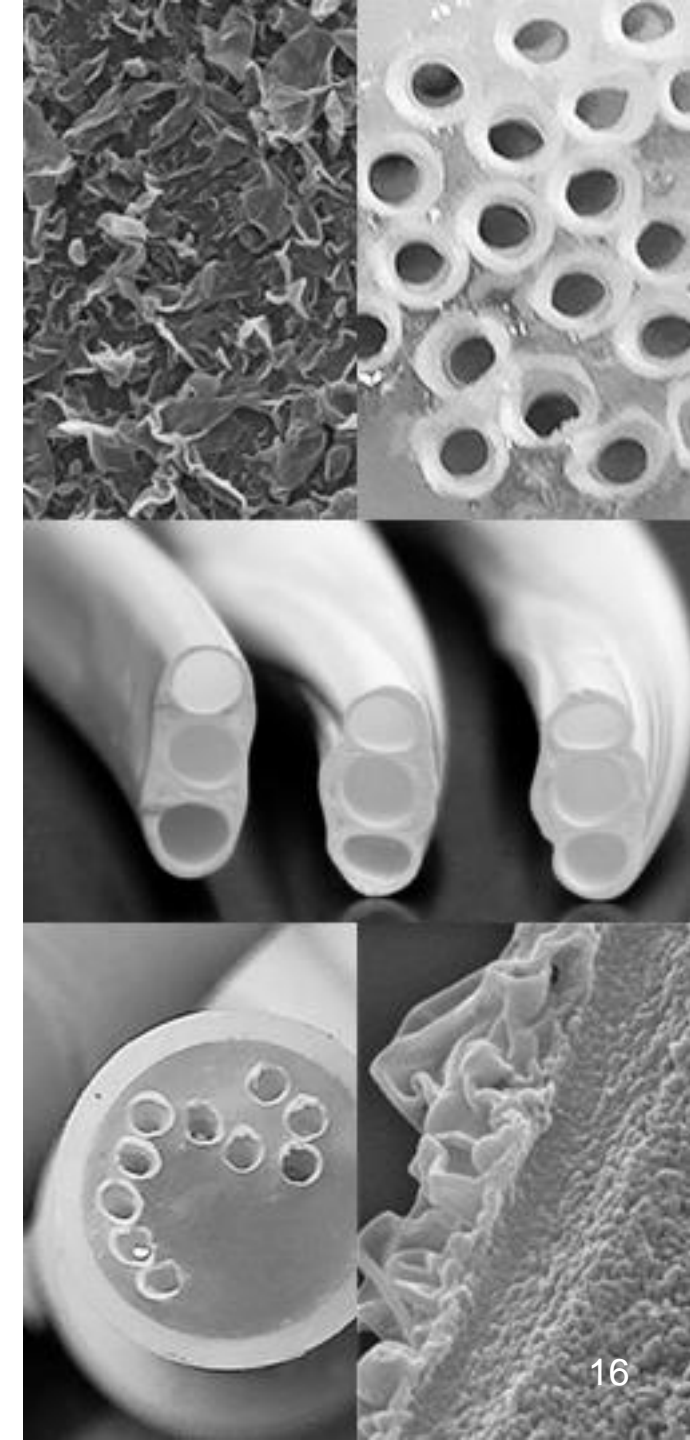
PROCESS DESIGN MODELLING AND SIMULATION

EXPERTISE & CAPABILITIES

- Process Design modelling, simulation for the development of membrane modules
- Prediction of topological, transport, separation and/or barrier properties, geometry characterization and 3D reconstruction.

UPSCALING FACILITIES

- Membrane modules for gas separation, distillation, contactors, etc; Modelling and simulation of mass transport (**CNR**)
- membrane modules and reactors (**TEC/TUE**)
- Design of membrane-based processes solving industrial purification and/or process intensification problems (**VITO/DBI**)
- HF module design and prototyping, design of the production lines with process optimization (**MESEP**)
- design and prediction of topological, transport, separation and/or barrier properties, geometry characterization and 3D reconstruction from SEM images (**FORTH**)
- Design of modules, processes, hybrid and integrated processes for gas separation. Performances and process simulation. (**HZG**)
- Modelling of fluid dynamic processes in COMSOL Multiphysics (**UNIZAR**)
- nanofiltration/gas separation processes/electrodialysis/swelling of modelling, molecular simulations in nanoporous materials, Ab Initio (Quantum. Calculations on molecular materials and process design (**UT**))





INNOMEM CATALOGUE

OITB non-technical services

Non technical services

DATA MANAGEMENT

EXPERTISE & CAPABILITIES

Software FURTHRmind for research data management; Consultancy on data management; Training on FAIR research data management; Rental of server capacity. **(FURTHR, TUE)**

SOFTWARE DEVELOPMENT

EXPERTISE & CAPABILITIES

Software FURTHRmind: Customized software development, programming as a service; Programming expertise: Python, Qt. **(FURTHR)**

VENTURING ACTIVITIES

EXPERTISE & CAPABILITIES

Support in corporate venturing activities to accelerate innovation in companies (B2B “deep tech” breakthrough innovation), addressing the business opportunity maturation process from challenge identification, scouting, acceleration, IP transfer, market validation. **(VNTRS)**



Non technical services

TECHNO-ECONOMIC ANALYSIS AND MARKET VALIDATION

EXPERTISE & CAPABILITIES

Techno-economic evaluations of membrane-based processes. Market studies for proposed technological solutions on green gases, Techno-economic evaluations of technologies. (**VITO, TUE, DBI, ENGIE**)

CONSULTANCY

EXPERTISE & CAPABILITIES

Module design, R&D activities in module development, Set up of the production process. desktop or consultancy work, feasibility studies, characterization of membrane samples, membrane development up to first prototype, application studies, small scale piloting, benchmarking, troubleshooting and building of customized equipment. (**MESEP, UT**)

INNOVATION SERVICES

EXPERTISE & CAPABILITIES

Market analysis, business plans, grants & funding scouting, intelligence (market, patent, stakeholders, technology analysis); grant scouting & funding strategy; business planning & modelling; exploitation and commercialization strategy, coaching and investor readiness support. (**PNO**)





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