RISEnergy

Research Infrastructure Services for Renewable Energy

Kick-off Meeting | Day 1 | 12 March 2024

This project has received funding from the European Union's Horizon Europe Research and Innovation Programme under Grant Agreement N. 101131793

1.
Welcome

Peter Holtappels | KIT, Project coordinator
Bodo Lehmann | LV-BW, Head of LV-BW Brussels

Kick-off Meeting | 12.03.2024

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Agenda

Day 1

Time	TOP	RISEnergy Kick-off Meeting - Day 1	Speaker	
13:30		**Registration**		
14:00	**1.**	**Welcome**	**Peter Holtappels (KIT), PC** **Bodo Lehman, Head of LV-BW, Brussels**	**(10')**
14:10	**2.**	**Project overview**	**Peter Holtappels (KIT), PC**	**(20')**
	3.	**Research Infrastructure presentation**		
14:30		General introduction	Peter Holtappels (KIT), PC	(15')
14:45		Research Infrastructures: PV, CSP/STE, Ocean, Bio, Wind	Thematic leaders	(5 X 10')
15:45		**Coffee break** (group photo)		
16:15		Research Infrastructures: Hydrogen, Storage, Grids, ICT	Thematic leaders	(4 X 10')
17:15		Research Infrastructures: Cross-cutting	Holger Ihssen (HGF)	(20')
17:35		Research Infrastructures: International	Olga Sumińska-Ebersoldt (KIT)	(10')
17:45		Discussion: Q&A	Peter Holtappels (KIT)	(20')
18:05	**4.**	**Structural needs for accelerated innovation: material research**	**Holger Ihssen (HGF)**	**(25')**
18:30		**End of meeting**		
19:00		**Networking dinner** (at the venue)		

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Agenda

Day 2

Time	TOP	RISEnergy Kick-off Meeting - Day 2	Speaker	
08:30		**Registration**		
09:00	**1.**	**Welcome & Agenda**	**Peter Holtappels (KIT), PC**	**(10')**
09:10	**2.**	**EC expectations**	**Anna Santoro (EC), PO**	**(20')**
09:30	**3.**	**RISEnergy concept**	**Peter Holtappels (KIT)**	**(20')**
	4.	**The scientific approach and the actions (WPs)**		
09:50	WP1	Building an energy R&I ecosystem	Mónica de Juan (EERA), WP1L	(15')
10:05	WP2	TNA and VA to world-class research infrastructures	Olga Sumińska-Ebersoldt (KIT), WP2L	(15')
10:20	WP3	Cross-cutting and RES services to support technolgies, systems & policy makers	Michael Hayes (UCC), WP3L	(15')
10:35		**Coffee break**		
11:00	WP4	Pro-active innovation management	Venizelos Efthymiou (EPL), WP4L	(15')
11:15	WP5	Project management, outreach & engagement	Myriam E. Gil Bardaji (KIT), WP5L	(15')
12:00	**5.**	**Administrative and financial managememt issues**	**Sabine Müller (KIT)**	**(15')**
12:15	**6.**	**General Assembly first decisions**	**Peter Holtappels (KIT), PC**	**(5')**
12:20	**7.**	**Advisory Board feedback**	**Peter Holtappels (KIT), PC**	**(30')**
12:50	**8.**	**Closing remarks and next steps**	**Peter Holtappels (KIT), PC**	**(10')**
13:00		**End of meeting**		
13:00		**Lunch**		

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2.
Project Overview

Peter Holtappels | KIT, Project coordinator

Kick-off Meeting | 12.03.2024

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Call Topic: HORIZON-INFRA-2023-SERV-01-01

RISEnergy targets the topic **HORIZON-INFRA-2023-SERV-01-01: Research infrastructure services to enable R&I addressing main challenges and EU priorities.** The proposals specifically addressed the sub-topic "**RI services for renewable energy technologies and systems"**. Proposals should integrated services provided by the key research infrastructures in the EU and Associated Countries in the fields of solar power (photovoltaic and concentrated solar power), hydrogen, biofuels, offshore renewable energy (ORE), integrated grids and energy storage.

Ongoing Research Infrastructure EU projects:

- Submitted 9 Mar 23
- Informed 10 July 23
- GA prep. July- Nov 2023
- GA signed 27 Nov 2023
- Pre-financing 21 Feb 2024
- Start 1 Mar 2024
- KoM 12 Mar 2024

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Renewable Energy

RISEnergy

10 target areas

Biofuels

CSP/STE

Offshore wind

Ocean energy

Photovoltaics

Energy storage

Hydrogen

Integrated grids

Materials

ICT

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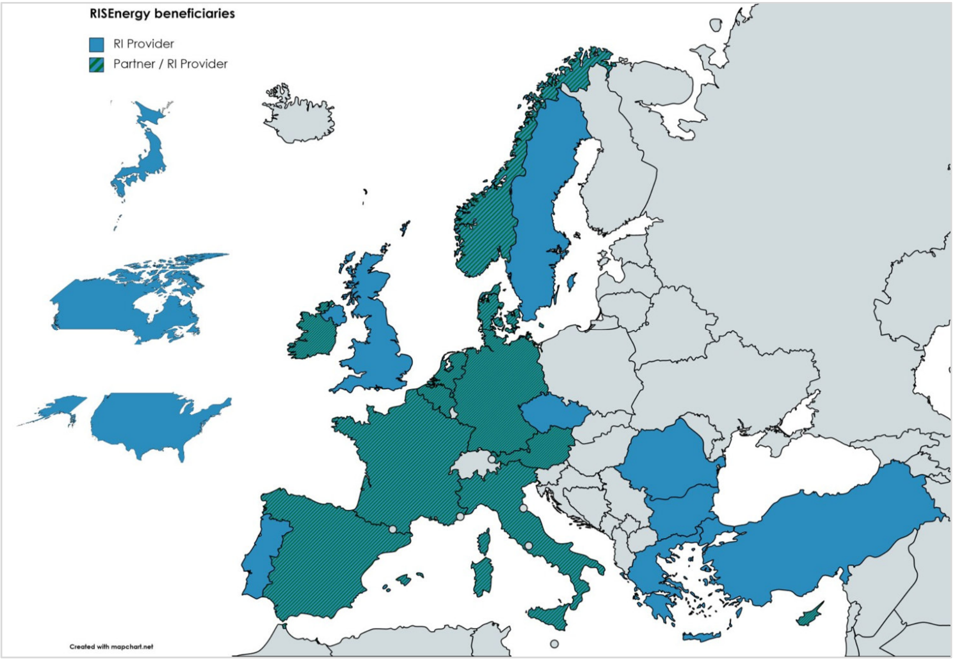
RISEnergy - Research Infrastructure Services for Renewable Energy

Figures and Numbers

- **Coordinator:** KIT (DE)
- **Duration:** 4,5 years (03/2024-08/2028)
- **Start:** 1st March 2024
- **Budget:** 14,5 Mio €
- **Beneficiaries:** 68 organizations
- **Research Infrastructures:** 84 (81 TNA + 3VA)
- **Countries involved:** 22



RISEnergy aims at initiating a **long-term, coordinated research effort** among leading private companies and research institutions with **common expertise related to energy technologies** to identify and promote ways to **scale up technologies within the EU.**

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Main Objectives

RISEnergy

MO1

Enable research and innovation to increase energy efficiency and reduce the cost of energy technologies to foster wider use of renewables into energy systems through proactive innovation management on two levels

- SO1a: The individual level, supporting ideas with a unique entry point with tailor-made access roads for academics, industry, and SMEs.
- SO1b: The global level, advising stakeholders, RI providers, academic and industry Users, and policy makers on LCA, ICT development and networking issues.

MO2

Provide transnational access (TA) on-site or remote and virtual access (VA), and training to facilities in a new constellation to support renewable energy technologies and systems: Provide more than 50,000 hours of access to major top level European and international world-leading research facilities

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Main Objectives

MO3

Set up a RI-ecosystem and reach out to all relevant stakeholders

- SO3a: stakeholders from "classical" academic research and industry R&D departments, including SMEs, performing research along the value chain, from materials and technology development to applications in the eight main areas, and in cross-cutting areas such as materials research or information and communication technologies to enable a smart energy system (ICT – enabling);
- SO3b: energy research related RI providers;
- SO3c: policy makers;
- SO3d: citizens.

MO4

Provide comprehensive cross-RI services of unprecedented quality to support and accelerate renewable energy technologies and systems, TRL progression & system integration, fostering collaboration across technology disciplines and stakeholder groups

- SO4a: Identify ICT enabling technology platforms, promoting and exemplifying their application usage;
- SO4b: Create frameworks for digital services, systems and digital twins
- SO4c: Create metadata structures along the value chain from materials and devices to frameworks and systems
- SO4d: Integrate LCA, critical raw materials (CRM) & socio-economic factors to drive member state acceptance

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Main Objectives

MO5

Education and training activities that address User needs for access planning, access execution, innovation acceleration and exploitation of cross-RI services, taking into account wide and diverse of background knowledge and time constraints of potential Users

MO6

Establish a European reference organisation to promote and coordinate international RI-access in energy research from and to Europe for a more effective use of relevant renewable energy RIs

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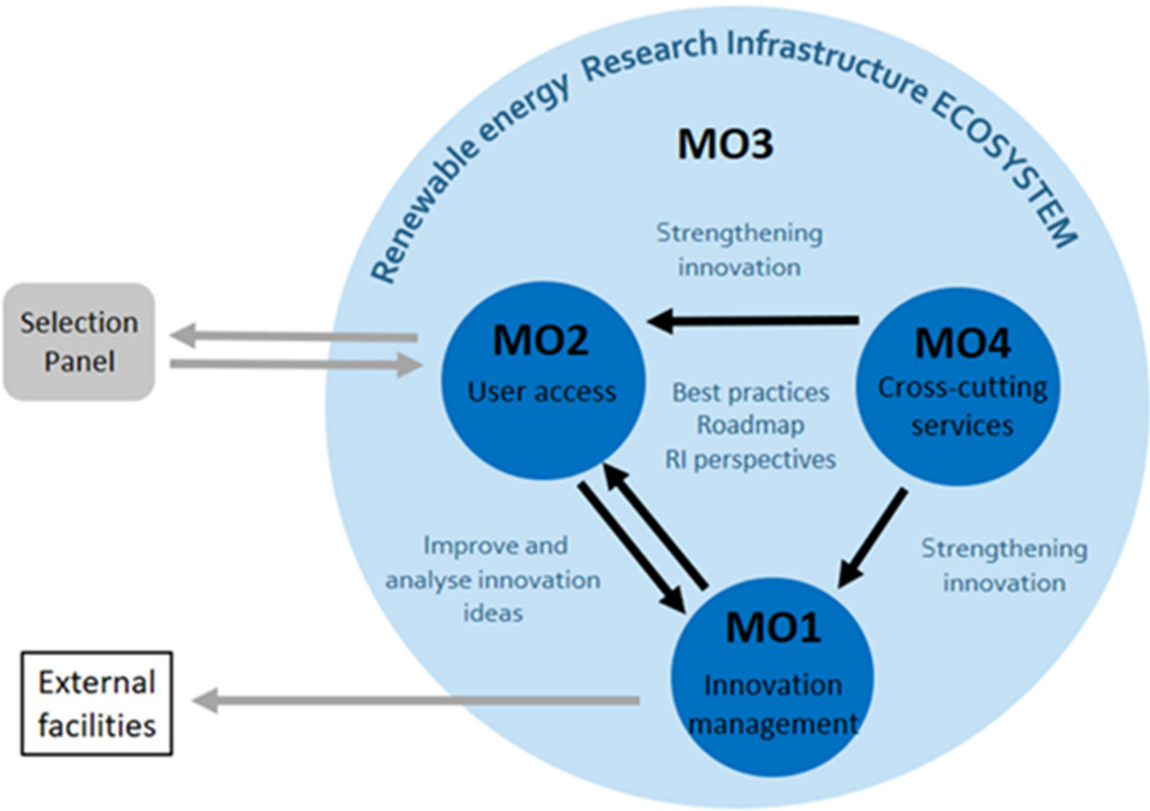
Overall Approach



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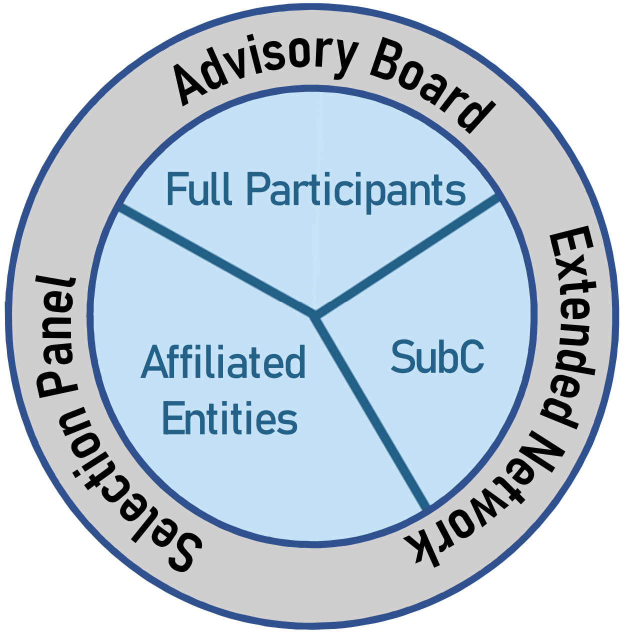
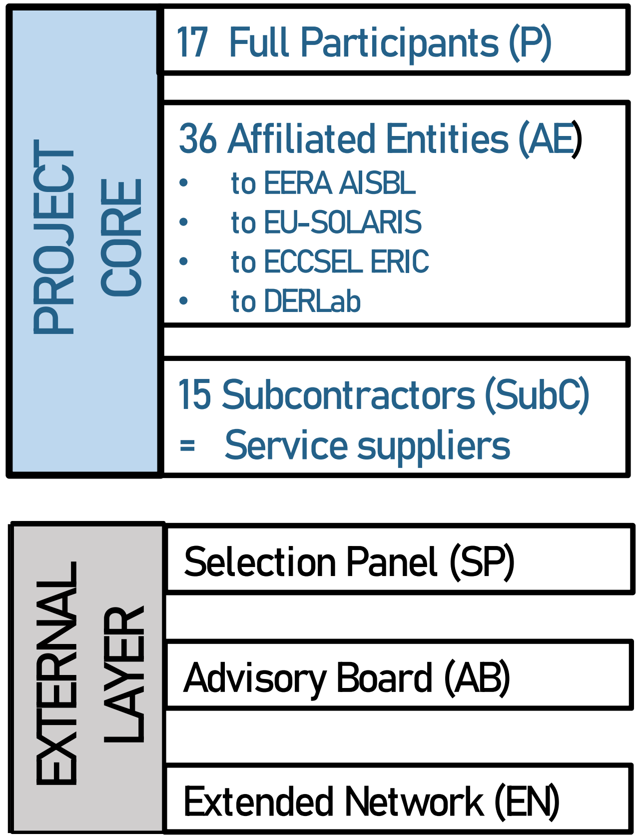
Project Structure

68 Participant Organizations





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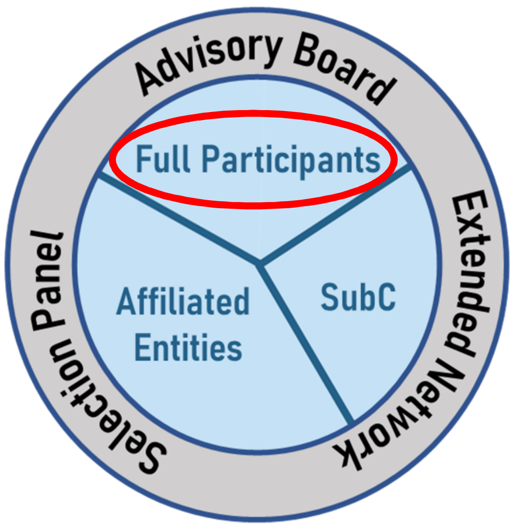
Project Core

17 Full Participants (P)



KIT Karlsruher Institut für Technologie

EERA European Energy Research Alliance

eccsel eric The European CCUS Research Infrastructure

JÜLICH Forschungszentrum

Ciemat Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas

DERlab European Distributed Energy Resources Laboratories

imec

EU SOLARIS ERIC

EnBW

AIT AUSTRIAN INSTITUTE OF TECHNOLOGY

cea

TNO innovation for life

DTU

ENEA Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile

EPL TECHNOLOGY FRONTIERS

UCC Coláiste na hOllscoile Corcaigh, Éire University College Cork, Ireland

Consiglio Nazionale delle Ricerche

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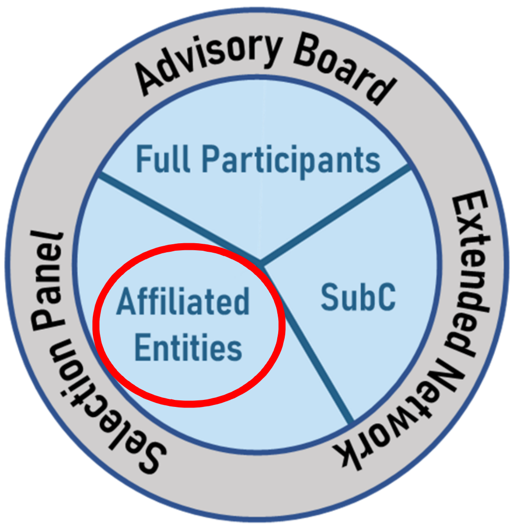
Project Core

36 Affiliated Entities (AE)



EERA

EU-SOLARIS

ECCSEL

DERLab

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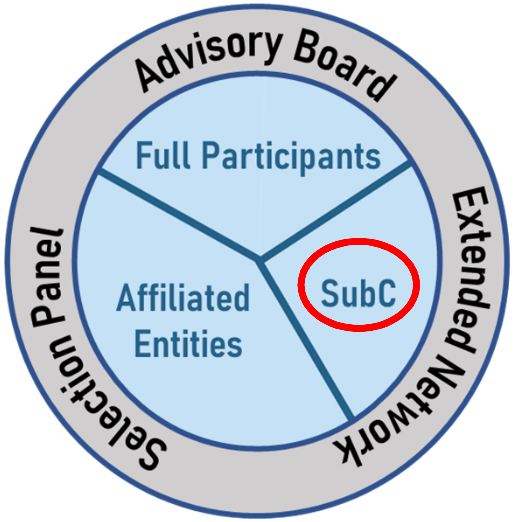
Project Core

15 Subcontractors (SubC)



KIT

DHI
MARIN
NREL NATIONAL RENEWABLE ENERGY LABORATORY
HELLENIC MEDITERRANEAN UNIVERSITY
Natural Resources Canada
DBFZ
FZK FORSCHUNGSZENTRUM KÜSTE
RE·CORD
CSTB le futur en construction

AIT

AIST NATIONAL INSTITUTE OF ADVANCED INDUSTRIAL SCIENCE AND TECHNOLOGY (AIST)

IMEC

ODTÜ GÜNAM

UCC

EMEC THE EUROPEAN MARINE ENERGY CENTRE
Ifremer
GHENT UNIVERSITY

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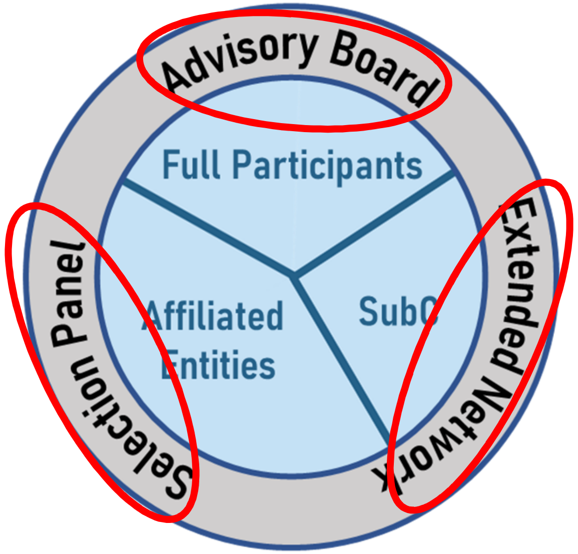
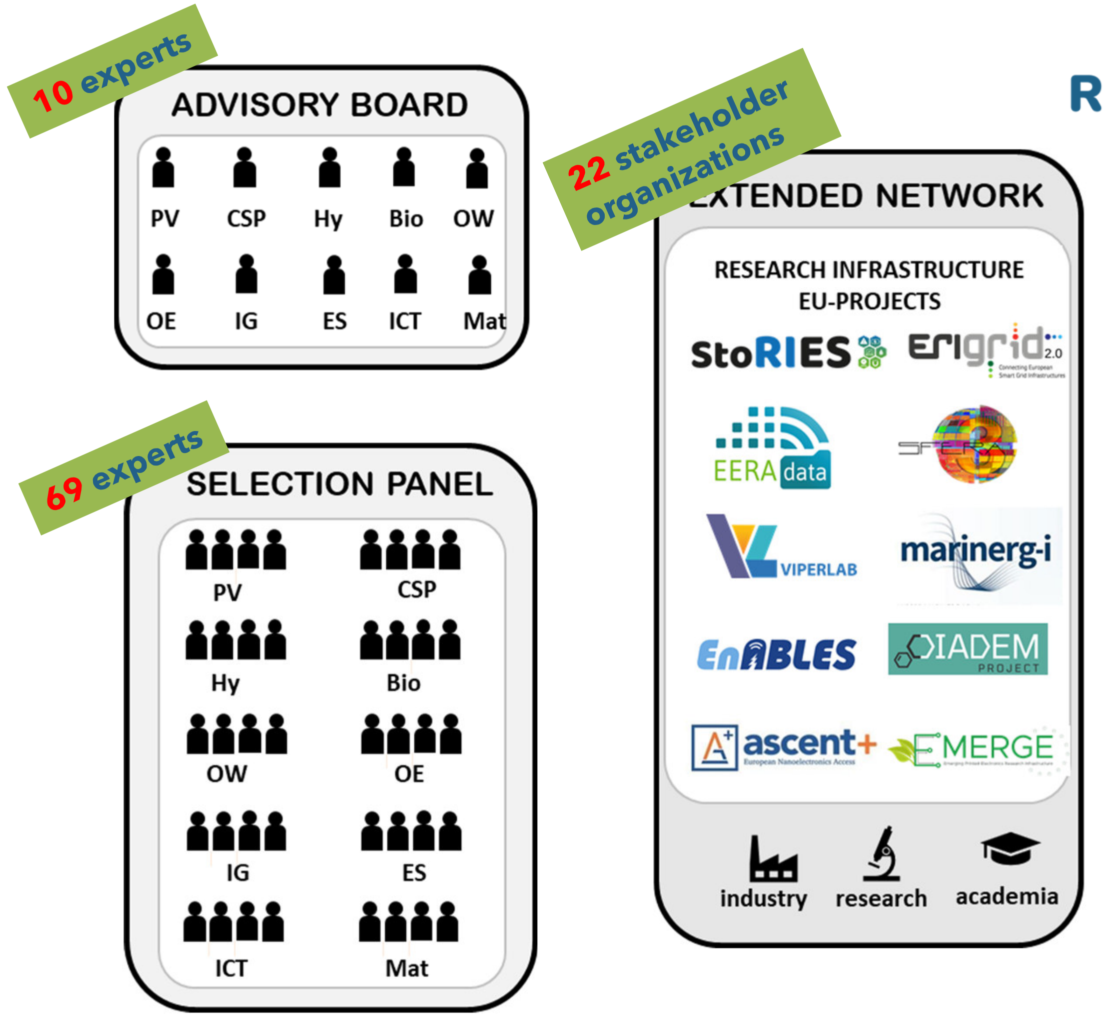
External Layer





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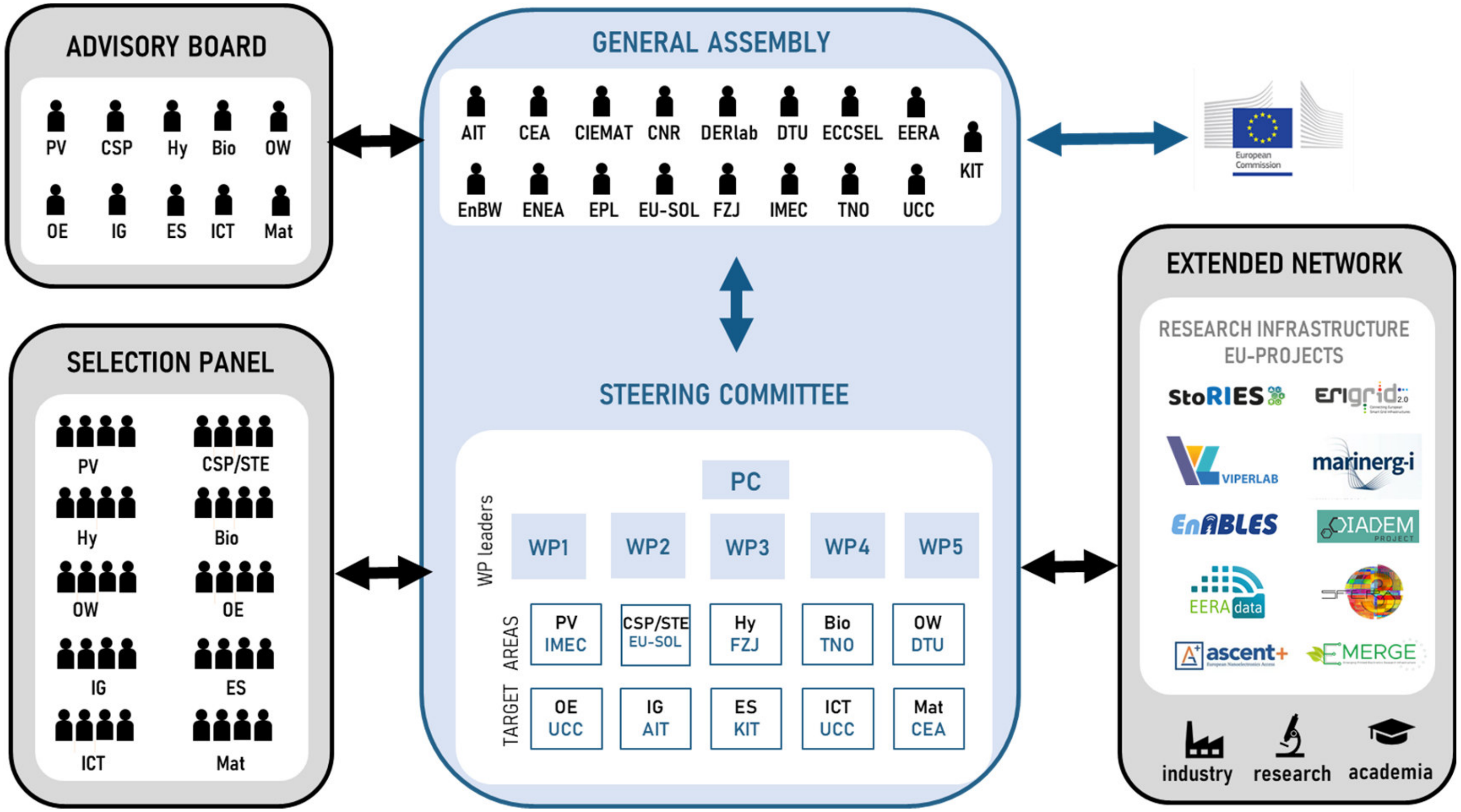
Mangement Structure



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3.
Research Infrastructure Presentation

Peter Holtappels | Thematic Leaders

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Objectives RISEnergy

long-term, coordinated research effort related to energy technologies to identify and promote ways to scale up technologies within the EU

- **MO1 Enable research and innovation to increase energy efficiency and reduce the cost of energy technologies :**
  - SO1a unique entry point with tailor-made access roads
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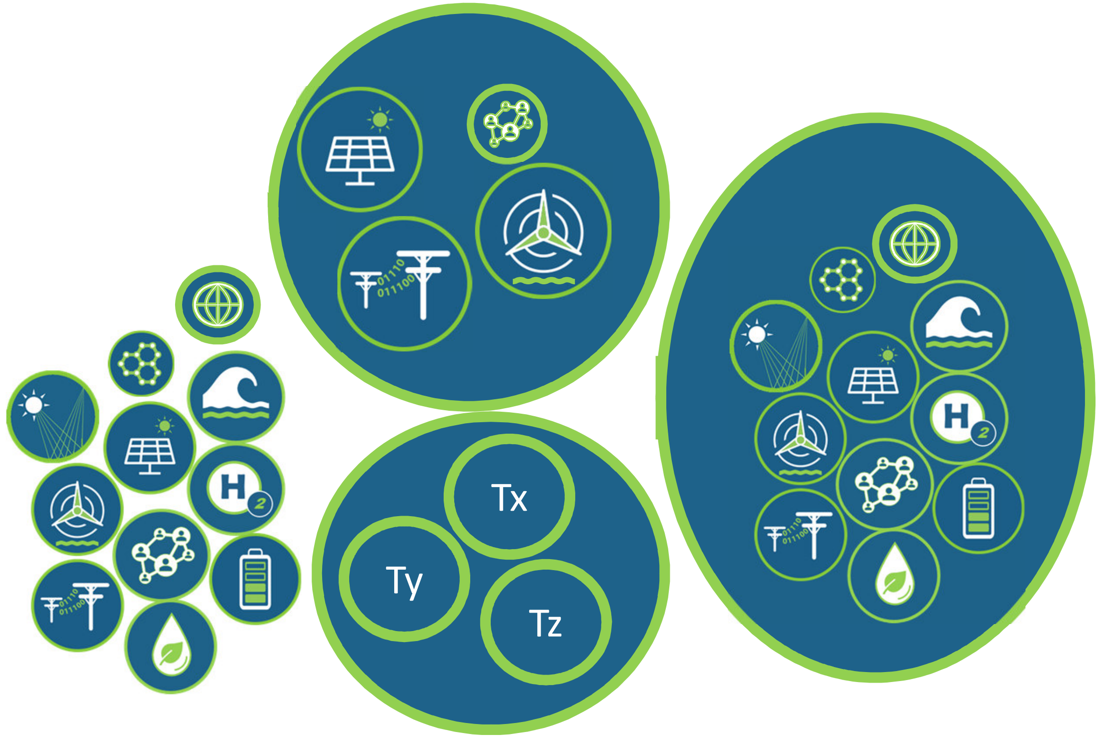
- **MO2: Provide transnational access (TA) and virtual access (VA)**
- **MO3: Set up a RI-ecosystem and reach out to all relevant stakeholders**



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Renewable Energy

9 target areas

- Photovoltaics
- CSP/STE
- Ocean Energy
- Biofuels
- Offshore Wind
- Hydrogen
- Energy Storage
- Integrated Grids
- ICT

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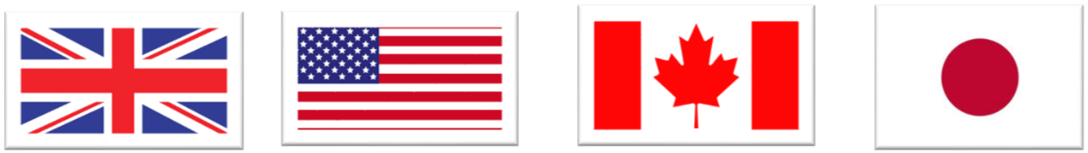
Cross-cutting infrastructures

Materials

International infrastructures

International



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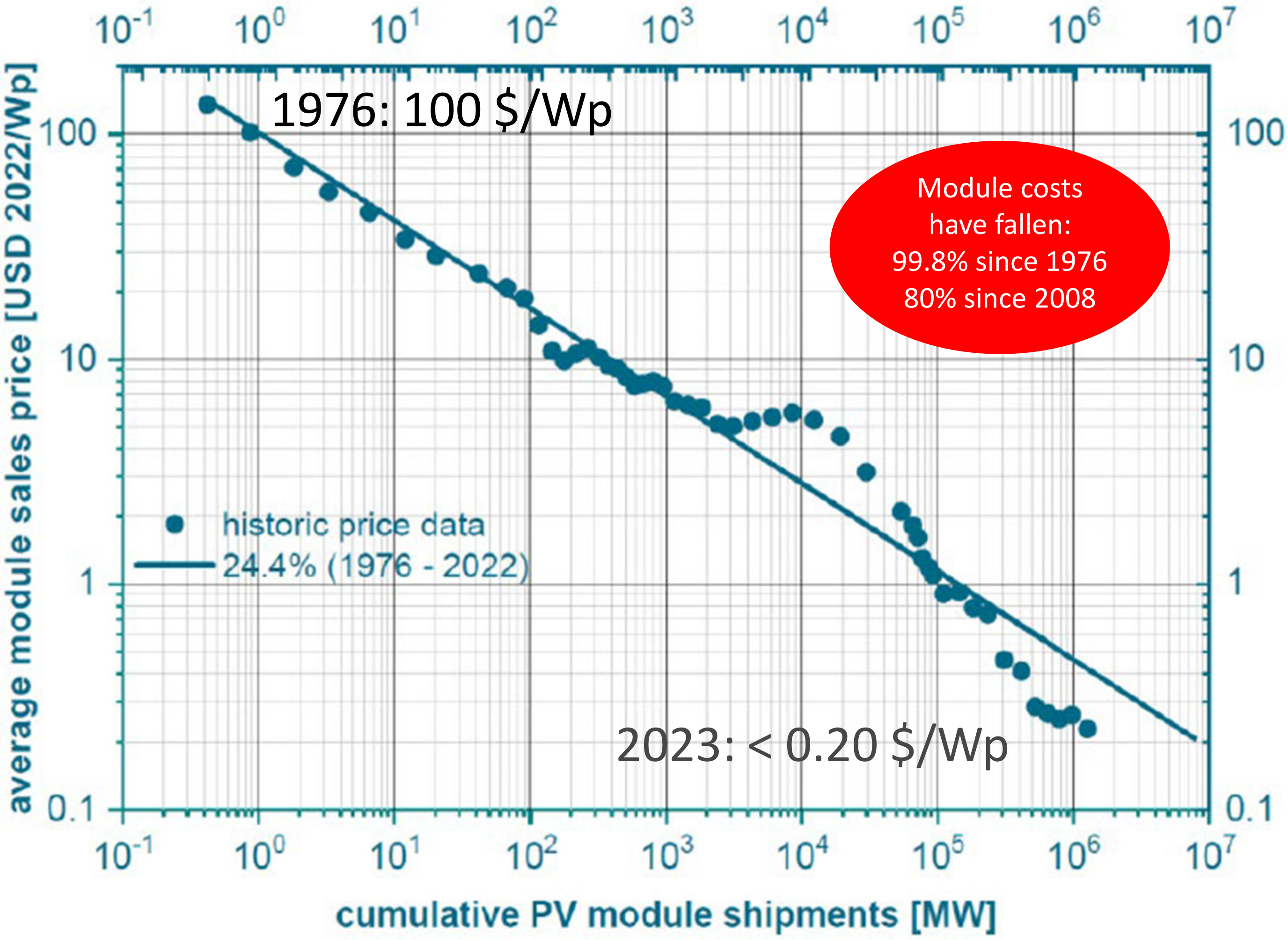
Photovoltaics

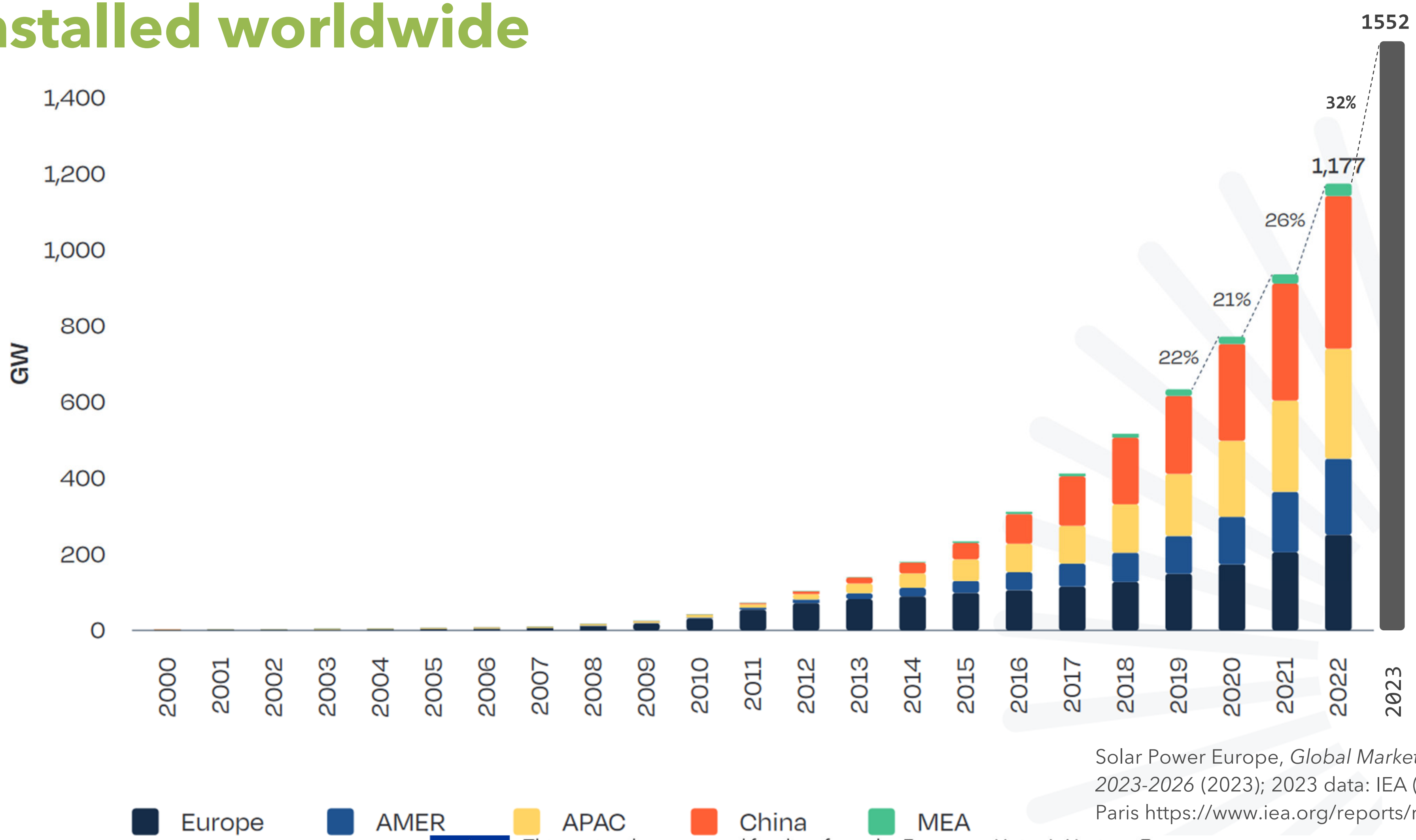
Ivan Gordon | IMEC, EERA-PV coordinator

The PV module cost decreased substantially during the last decades



ITRPV roadmap, 14th edition, 2023

At the end of 2023 more than 1,5 TeraWatt of PV was installed worldwide



Solar Power Europe, *Global Market Outlook for Solar Power 2023-2026* (2023); 2023 data: IEA (2024), Renewables 2023, IEA, Paris https://www.iea.org/reports/renewables-2023

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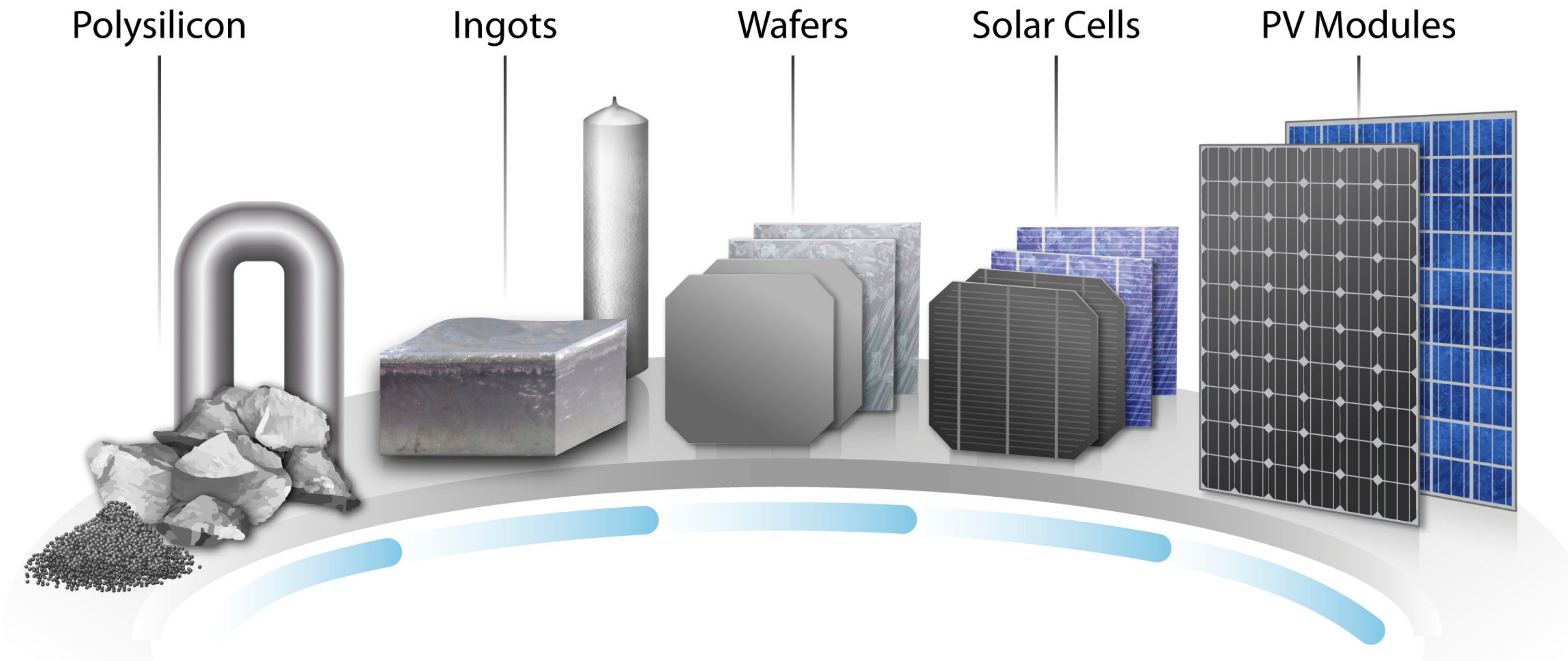
Around 95% of PV modules are based on crystalline-silicon wafers as absorber



Courtesy of Al Hicks (NREL)

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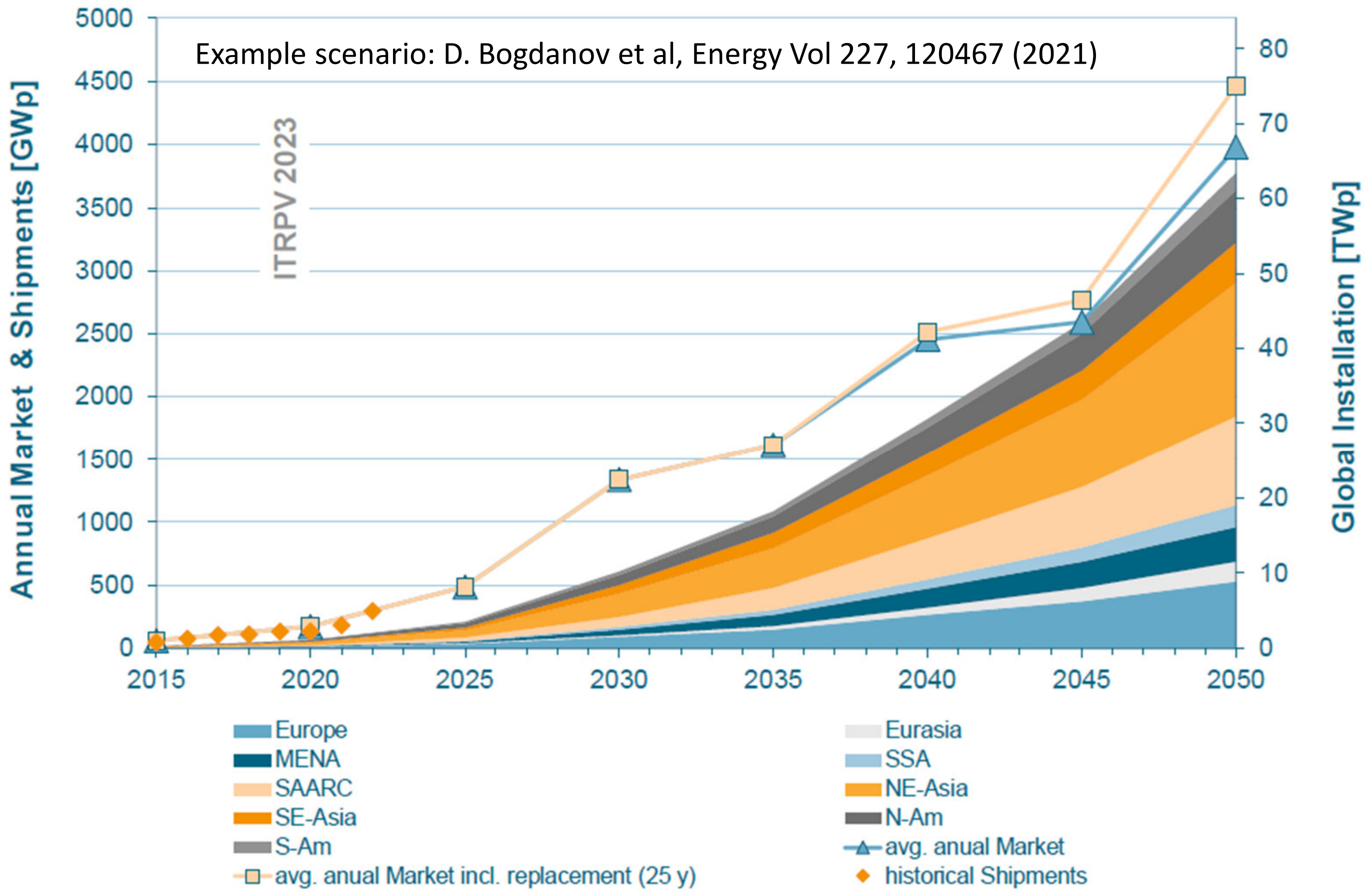
Challenge 1: Massive production and deployment needed in the coming decades

Path to >60 TWp in 2050

Net zero GHG emissions energy system by 2050: PV is key

1-3 TWp annual production capacity,
in 2022: 298 GW shipped

Very challenging!



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Challenge 2: Integrated Photovoltaics

"Standard" PV applications

Residential
<10 kW_p
flat/tilted roofs

Commercial/ Industrial
10 kW_p - 10 MW_p
mostly flat roofs, carports

Utility-scale power plants
>10 MW_p
mostly open racks, horizontal single axis trackers

New emerging integrated PV applications

Building-integrated PV (BIPV)

Urban PV (UPV)

Vehicle-integrated PV (VIPV)

Floating PV (FPV)

Road-integrated PV (RIPV)

Agrivoltaics (APV)

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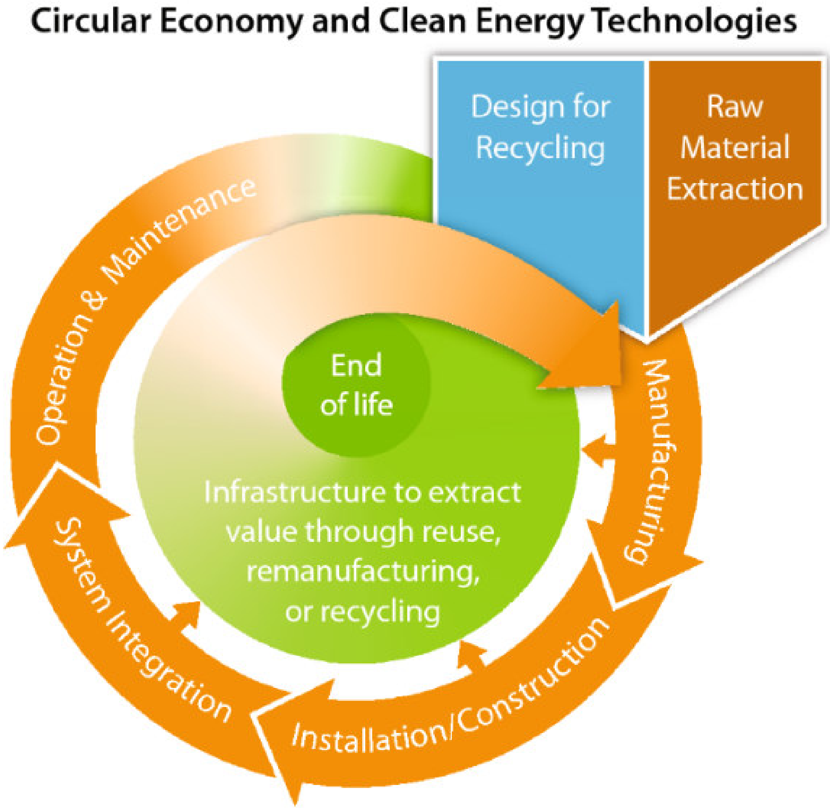
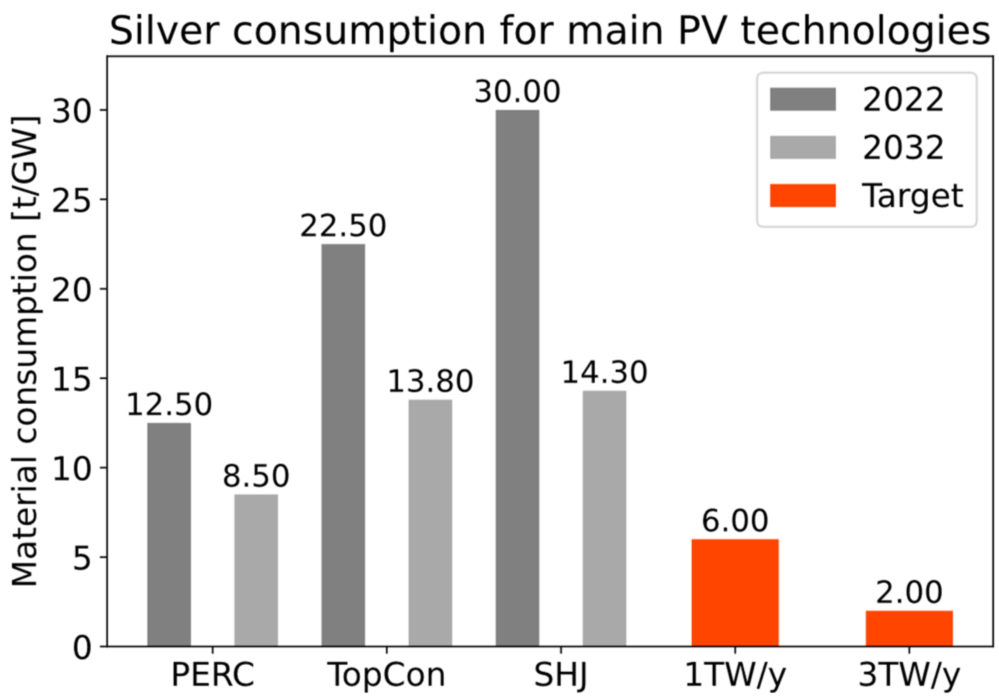
Challenge 3: Sustainable manufacturing and use of materials



Journal of Sustainable Metallurgy (2020) 6:761–774
https://doi.org/10.1007/s40831-020-00313-3



Y. Zhang et al., Energy Environ. Sci., 2021,14, 5587-5610

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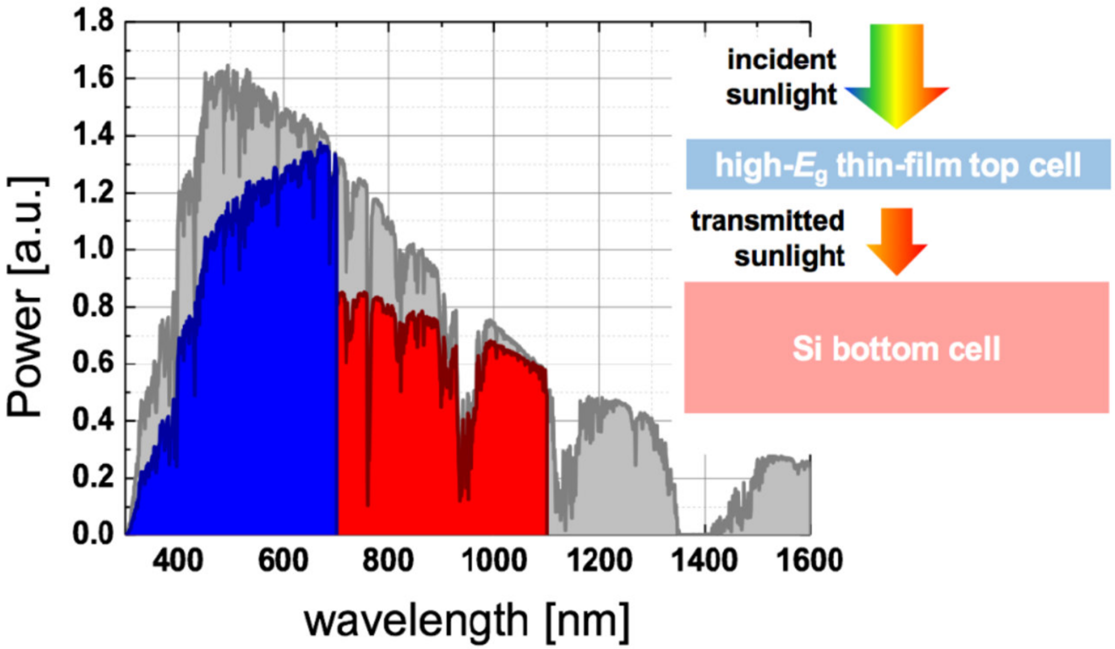
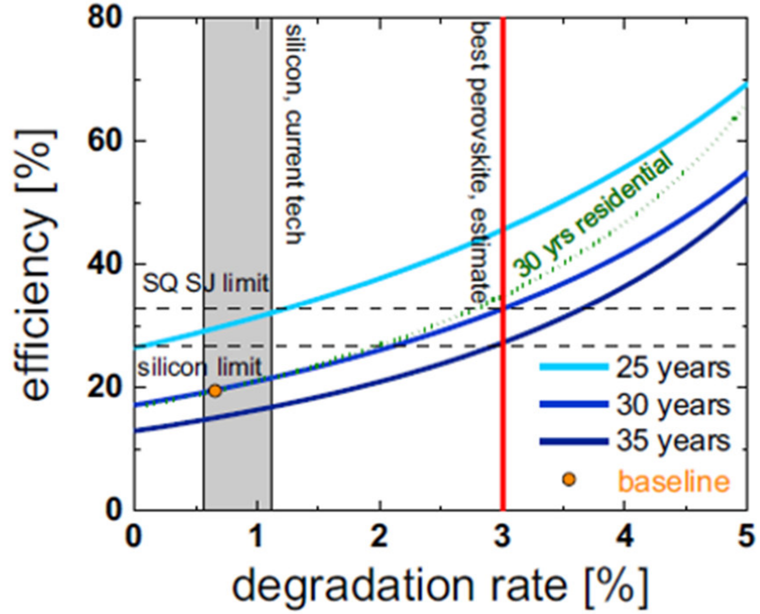
Challenge 4: Higher efficiency and energy yields

Tandem devices (perovskite on silicon) for higher efficiencies



Liu, PhD thesis: "Optical loss analysis of silicon wafer based solar cells and modules"

Increased operational lifetime



I.M. Peters et al. The value of efficiency in photovoltaics DOI: 10.1016/j.joule.2019.07.028

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Photovoltaic RIs @RISEnergy

TA43

RESIW

Silicon Ingots and wafers
Trondheim, Norway

TA62

SOLPVlab

PV components testing laboratory
Sarriguren / Imarcoáin, Spain

TA75

Energyville PV Lab

Silicon-perovskite tandem lab
Genk, Belgium

TA76

ODTU-GUNAM

Silicon solar cell technology
Ankara, Turkey

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Silicon PV Technology

TA43 RESIW

Highly Recyclable and Efficient Silicon Ingots and wafers

- Silicon material research and refining
- Silicon ingot crystallization
- Silicon ingot and wafer characterization
- Silicon material recycling

TA76 ODTU-GUNAM

Center for solar cell research and applications

- Pilot scale solar cell production facility
- Various Silicon solar cell device architectures
- Compatible with M10/G12 wafer size
- Testing and application of new materials

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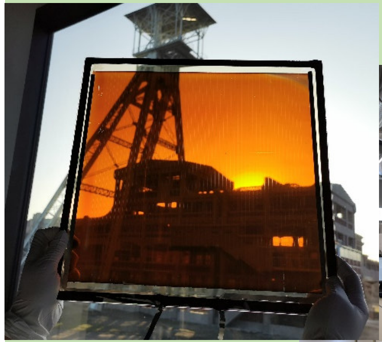
Tandem PV Technology

TA75 Energyville PV Lab



Silicon Perovskite tandem lab

- Tandem solar cells and mini-modules
- Perovskite on Silicon and Perovskite on Perovskite devices
- Upscaling of perovskite PV technology
- Advanced metallization and interconnection
- Module lamination, encapsulation and testing

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PV indoor and outdoor testing

RISEnergy

TA62 SOLPVlab

PV components testing laboratory, indoor and outdoor testing in moderate climate

- IEC accredited PV components testing
- Indoor testing of PV modules
- Outdoor testing of PV modules
- Tracking systems

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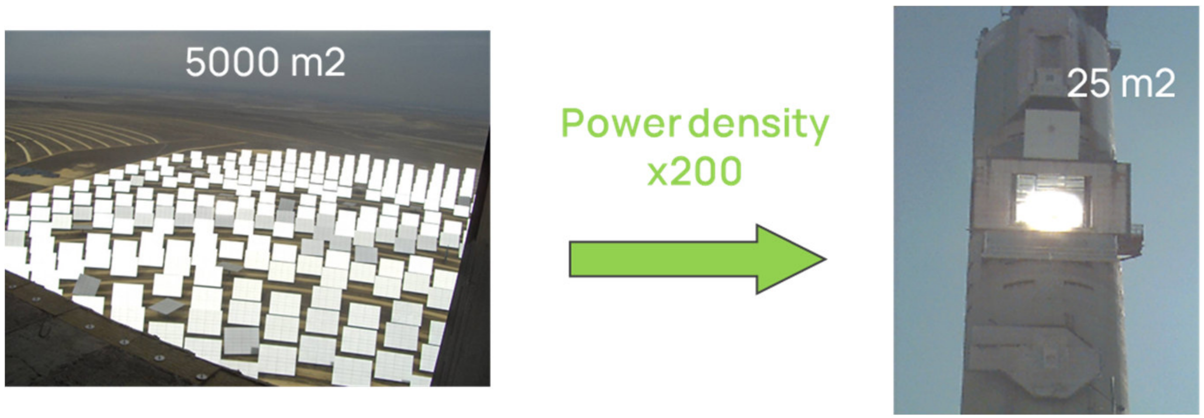
CSP / STE

Diego Martínez | EU-solaris

Concentrated Solar Power/Solar Thermal Energy

How does it work?

- **Direct Solar Radiation** reaches Earth's surface in a large amount, but with low density: **I < 1 kW/m2**.
- It's necessary to concentrate it by collecting with a large mirror surface and then reflecting it on a much smaller one. This way we can reach **energy densities in the order of MW/m2**.
- That can be done with sun-tracking **parabolic or spherical mirrors**.



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Concentrated Solar Power/Solar Thermal Energy

Main applications

- **Electricity Generation:** This is the most important commercial application at present.
- Operational capacity: 6,40 GWe
- Under construction: 2,46 GWe

377 MWe solar thermal power plant in Nevada (USA)

- **Industrial Process Heat:** The thermal energy is used to feed industrial processes demanding heat within the range 125 ºC – 2000 ºC.

1 GW solar thermal system for *Enhanced Oil Recovery* in Oman

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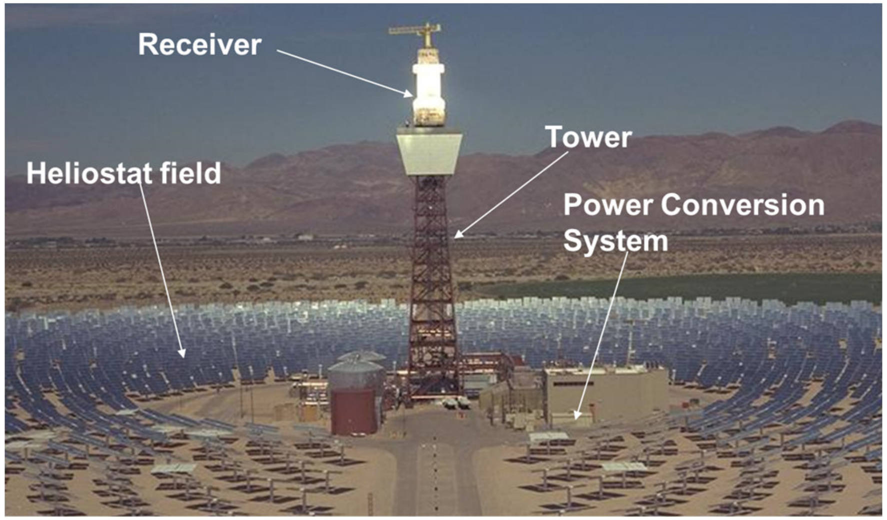
Concentrated Solar Power/Solar Thermal Energy

Main challenges

- **Development of advanced materials** for the receiver and for heat storage media (high temperatures under cycling conditions)
- Reduce the impact of **soiling**
- **Reduce water consumption** at the balance of plant section.
- New **power cycles / working fluids**: sCO2, molten salts,.....



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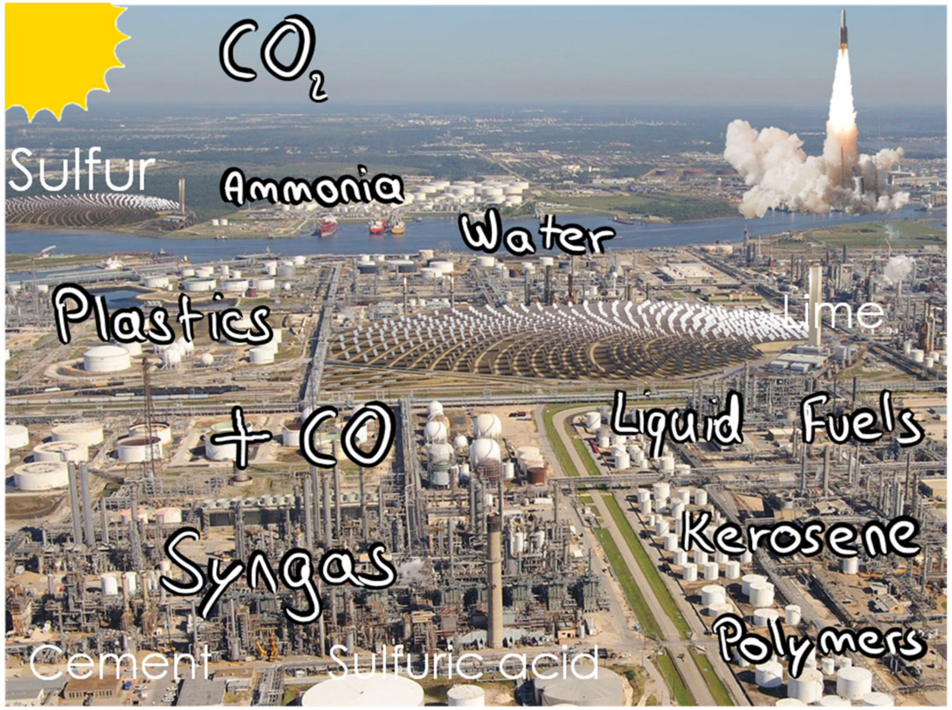
Concentrated Solar Power/Solar Thermal Energy

Main challenges (II)

- Improve **modularity and integrability** with other energy sources.
- Advance in **integrability with conventional industrial processes.**
- **All in all: Decrease LCOE**
  - Reduce *O&M Cost* (By advanced monitoring and automatic management predictive maintenance introducing IA techniques, etc)
  - Reduce *Capital Cost* (by introducing mass production and components standardization)
  - Improve reliability and performance (through IA & advanced monitoring)



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SOLAR THERMAL RIs @RISEnergy

TA17

CIEMAT-PSA

Plataforma Solar de Almería
Tabernas, SPAIN

TA72

UEVORA

Universidade de Évora
Évora, Portugal

TA68

IME

IMDEA Energy
Móstoles, Madrid, Spain

TA60

SESES

Simulation Environment for Solar Energy Systems
Pamplona, Spain

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SOLAR THERMAL RIs @RISEnergy

TA64

CYI - POLYRES

CYPRUS INSTITUTE – POLYGENERATION OF RENEWABLE ENERGY STORAGE SYSTEMS WITH HYBRID ENERGY STORAGE

LIMASSOL, CYPRUS

TA65

CYI - PROTEAS

CYPRUS INSTITUTE – PLATFORM FOR RESEARCH OBSERVATIONS AND TECHNOLOGICAL APPLICATIONS IN SOLAR ENERGY

LIMASSOL, CYPRUS

This project has received funding from the European Union's Horizon Europe Research and Innovation Programme under Grant Agreement N. 101131793

SOLAR THERMAL RIs @RISEnergy

TA63

PROMES-CNRS

PROcédés Matériaux et Energie Solaire
Odeillo, France

TA66

DLR-CSP

DLR CSP facilities Juelich
Juelich, Germany

TA69

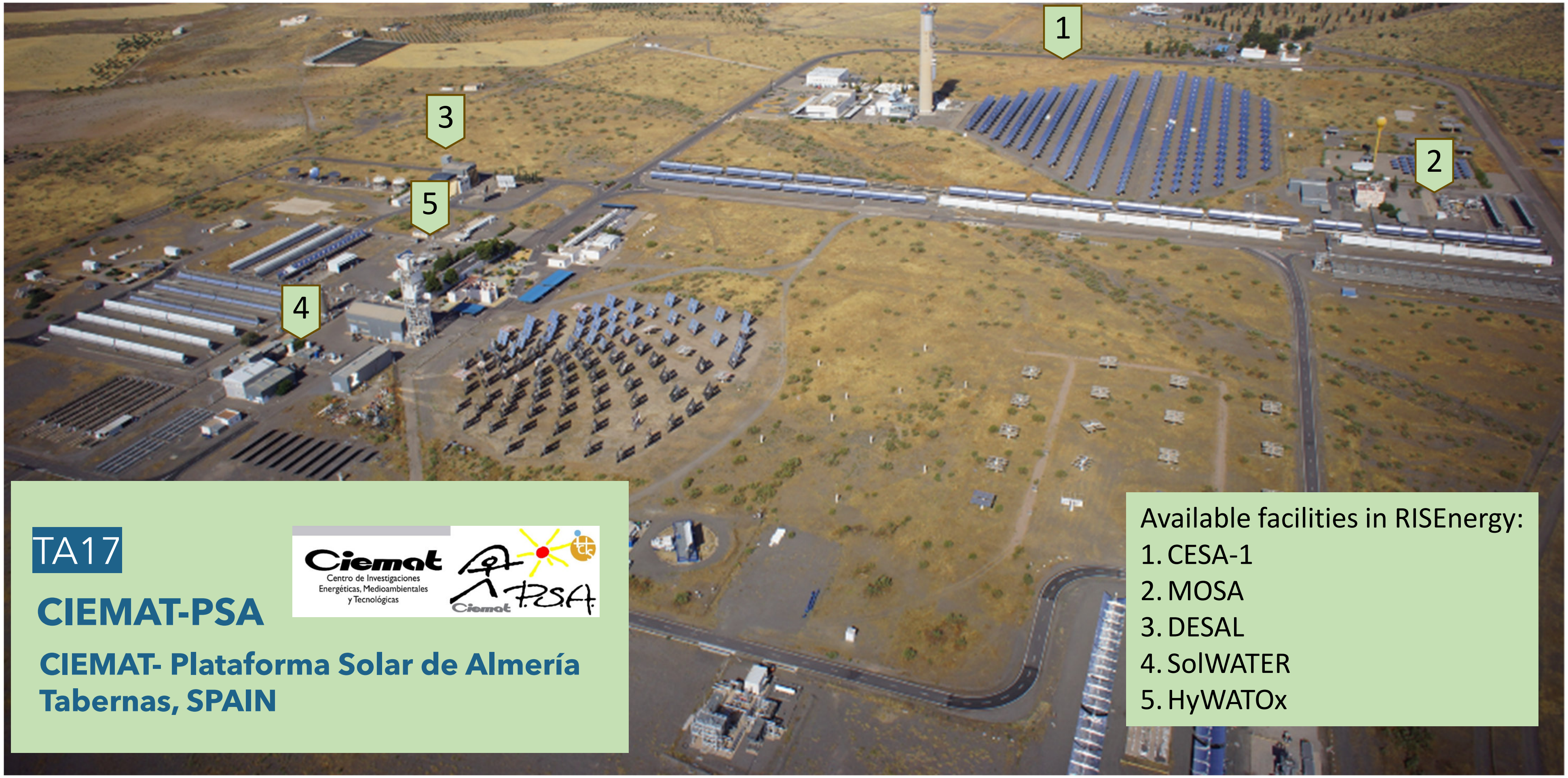
LNEG

Laboratorio Nacional de Energia e Geologia
Lisbon, Portugal

This project has received funding from the European Union's Horizon Europe Research and Innovation Programme under Grant Agreement N. 101131793

SOLAR THERMAL RIs @RISEnergy: Cluster 1

RISEnergy



TA17

CIEMAT-PSA

CIEMAT- Plataforma Solar de Almería
Tabernas, SPAIN

Ciemat
Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas

PSA

Available facilities in RISEnergy:

1. CESA-1
2. MOSA
3. DESAL
4. SolWATER
5. HyWATOx

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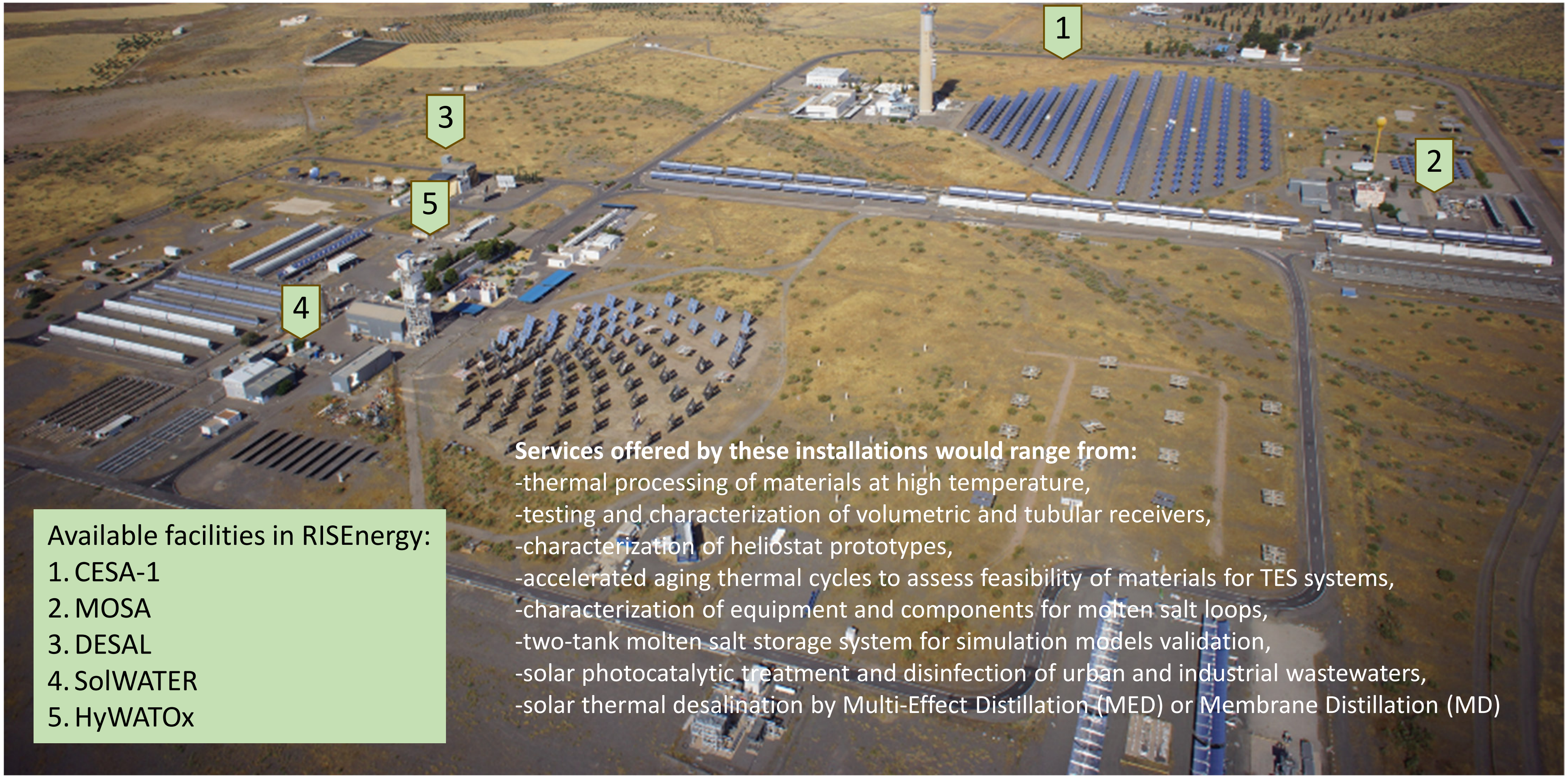
SOLAR THERMAL RIs @RISEnergy: Cluster 1



Services offered by these installations would range from:
-thermal processing of materials at high temperature,
-testing and characterization of volumetric and tubular receivers,
-characterization of heliostat prototypes,
-accelerated aging thermal cycles to assess feasibility of materials for TES systems,
-characterization of equipment and components for molten salt loops,
-two-tank molten salt storage system for simulation models validation,
-solar photocatalytic treatment and disinfection of urban and industrial wastewaters,
-solar thermal desalination by Multi-Effect Distillation (MED) or Membrane Distillation (MD)

Available facilities in RISEnergy:
1. CESA-1
2. MOSA
3. DESAL
4. SolWATER
5. HyWATOx

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Cluster 2 Solar Thermal

TA72 EMSP

UNIVERSIDADE DE ÉVORA

Évora Molten Salt Platform (EMSP)

- applied research in molten salt-driven systems and technologies
- 3.5MWth HelioTrough Parabolic Trough Collector
- 270kWth Advanced Linear Fresnel Reflector
- 2-Tank MS TES system
- 2.9 MWh MS Thermocline Tank

TA72 PECS

UNIVERSIDADE DE ÉVORA

Plataforma de Ensaio de Concentradores Solares (PECS)

- A 234m2 2-axis testing platform using thermal oil as Heat Transfer Fluid
- Testing of solar collector modules using ISO 9806:2017
- Maximum tilt angle of 40° and maximum azimuthal angle of 270°.

This project has received funding from the European Union's Horizon Europe Research and Innovation Programme under Grant Agreement N. 101131793

Cluster 3 Solar Thermal

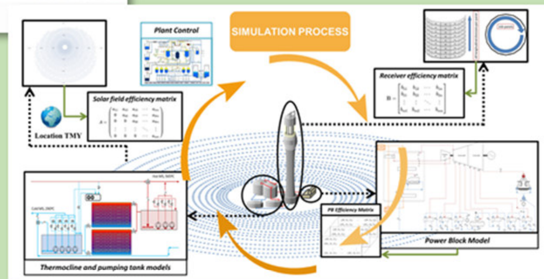
RISEnergy

TA68 IME

- **IMDEA Energy**
- **Description**
  - Dedicated experimental installations covering TRL up to 6.
  - Unique facilities able to achieve very high solar concentrations from 1 kW up to 250 kW (HTPU-LAB, KIRAN42, VHCST).
  - Highly flexible and manageable facilities that allows fast testing implementation in a wide range of operation conditions.

TA60 SESES

Tonatiuh
ray tracing for solar energy



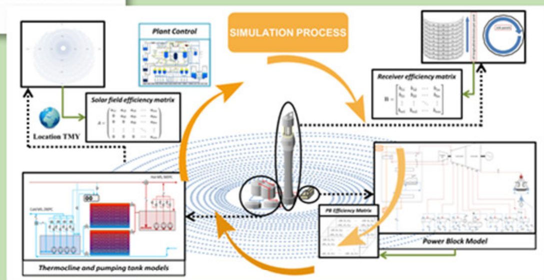
CENER | NATIONAL RENEWABLE ENERGY CENTRE

- Simulation Environment for Solar Energy Systems
- Description
  - TONATIUH is open-source software for the simulation of optical systems by the ray tracing method....
  - CSTLibrary, CENER's in-house Modelica library for the ST, CSP and storage simulation.

This project has received funding from the European Union's Horizon Europe Research and Innovation Programme under Grant Agreement N. 101131793

Cluster 4 Solar Thermal

TA60 SESES



- **Simulation Environment for Solar Energy Systems**
- Description
  - TONATIUH is open-source software for the simulation of optical systems by the ray tracing method….
  - CSTLibrary, CENER's in-house Modelica library for the ST, CSP and storage simulation.

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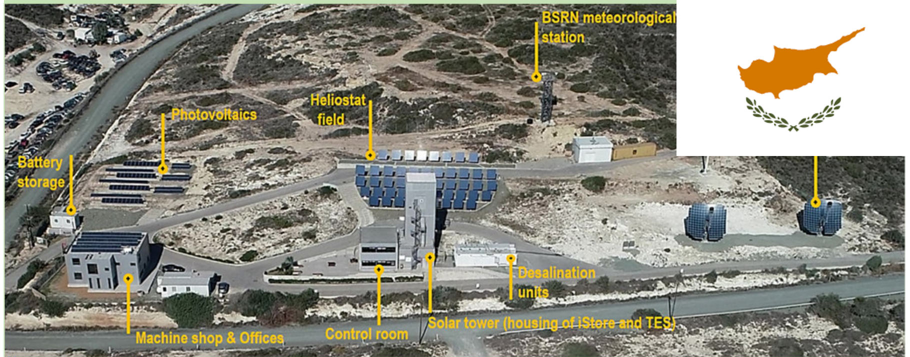
Cluster 5 Solar Thermal

RISEnergy

TA64 CYI - POLYRES



POLYRENEWABLE ENERGY SYSTEMS

- Testing, validating and demonstrating operation in real working conditions, of polyrenewable energy systems
- PVs, Wind Turbine, Stirling Dishes, Solar Thermal integrated together with storage in molten salts and batteries
- Forward Osmosis and Multiple Effect Desalination Units
- Baseline Surface Radiation Stations (BSRN)
- Instruments / Equipment: https://cri.gov.cy/en/research-infrastructures-database/engineering-and-energy/energy-engineering-facilities-non-nuclear/proteas-facility

TA65 CYI - PROTEAS

PROTEAS

- Testing, validating and demonstrating operation in real working conditions, of CSP components
- 50 heliostats delivering around 210kW thermal power
- 1.6MWh of storage using molten salt technology
- Integrated meteorological station
- Instruments / Equipment: https://cri.gov.cy/en/research-infrastructures-database/engineering-and-energy/energy-engineering-facilities-non-nuclear/proteas-facility

This project has received funding from the European Union's Horizon Europe Research and Innovation Programme under Grant Agreement N. 101131793

Cluster 6 Solar Thermal

TA63 THÉMIS

THÉMIS Solar Tower

Description

- A solar tower with 117 heliostats, 2 focal points: one up to 4500 kW and the second up to 450 kWth

TA63 MWSF

Mega Watt Solar Furnace

Description

- The largest solar furnace on Earth, delivering up to 1000 kWth on a 1 m wide disc, with peak of 10000 kW/m2 and 3500°C instruments, techniques, etc

This project has received funding from the European Union's Horizon Europe Research and Innovation Programme under Grant Agreement N. 101131793

Cluster 6 Solar Thermal

TA63 MSSF

Medium and Small Solar Furnaces

Description

- 11 solar furnaces and 5 heliostats, available power from 1 to 6 kWth, from 6000 to 16000 kW/m2 allowing to reach 4000°C.
- Fast shutters available for fine temperature and experimental control, thermal shocks or dynamic processes (simulation, ageing…).

TA63 MicroSol'R

MicroSol'R

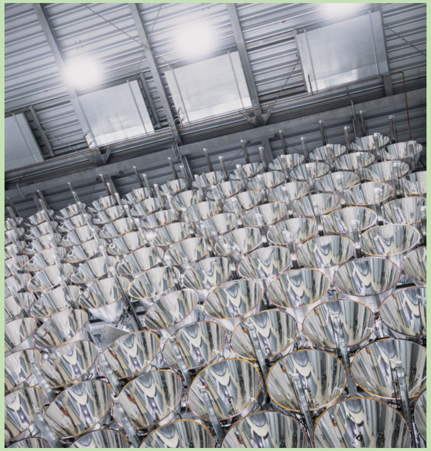
Description

- A complete 220 kWth parabolic trough with oil loop (300°C), steam generator, dual tanks and thermocline storage with easy filler materials replacement, ORC generator

This project has received funding from the European Union's Horizon Europe Research and Innovation Programme under Grant Agreement N. 101131793

Cluster 7 Solar Thermal

TA66 Synlight



High-flux solar simulator

Description

- 300kW power can be provided. For testing, flux and IR measurement systems and ethernet connectivity are available. Video surveillance can be used for test observation.

TA66 STJ

Solar Tower Power Plant Jülich

Description

- Up to 1000kW power can be provided. Testing of solar receivers. Flux and IR measurement systems and ethernet connectivity are available. Video surveillance can be used for test observation.

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Cluster 7 Solar Thermal

TA66 MFT

Multi-focus Tower

Description

- There are three levels with special equipment for the installation of specific experiments.

TA66 STJ-Helio

- **Heliostat Field**
- Description
  - 2.000 Heliostats independently controlled to focus solar irradiation into any of the receiver platforms.

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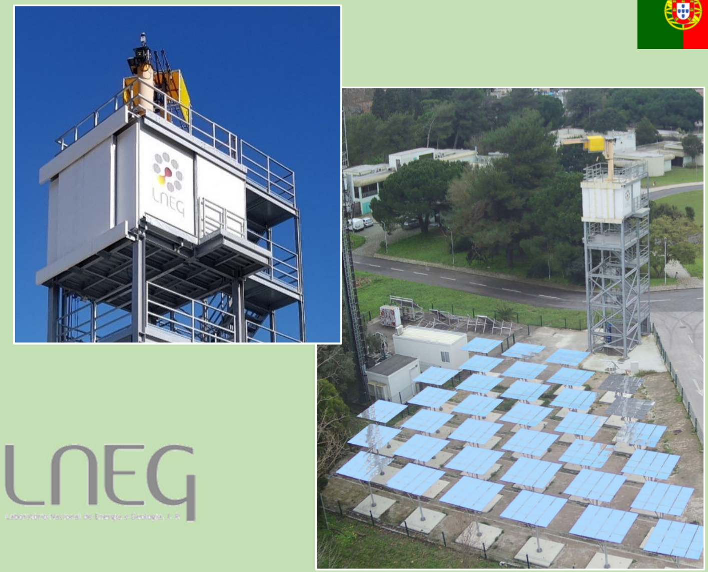
Cluster 8 Solar Thermal

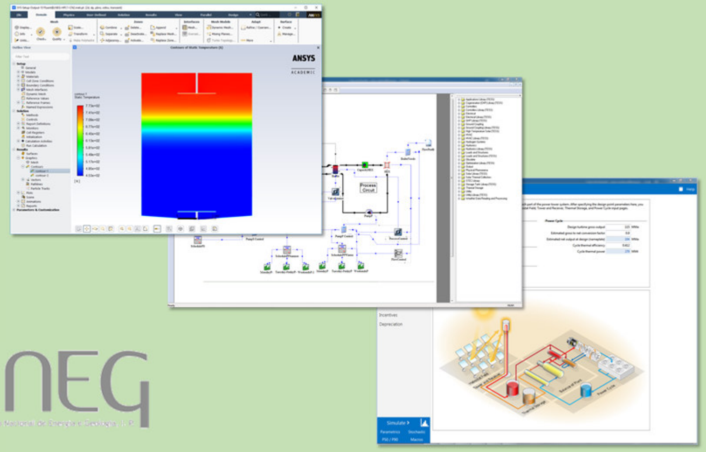
TA69 Lx-STE



Solar Tower Testing Facility (STTF)

Description
- Heliostat beam characterization
- Heliostat tracking accuracy characterization
- Operation and maintenance procedures testing
- Air receivers testing

TA69 Lx-STE



High-Performance Computing (HPC) Cluster

Description
- Computer fluid dynamics (CFD) simulation
- Simulation of transient systems
- Optical simulation of solar concentrating systems
- Computing time for user developed software

This project has received funding from the European Union's Horizon Europe Research and Innovation Programme under Grant Agreement N. 101131793

Cluster 8 Solar Thermal

TA69 Lx-STE

LNEG

Laboratory of Solar Energy (LES)

Description

- Optical characterization of reflectors and absorbers
- Solar radiation measurement and analysis
- Solar collector testing

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Ocean Energy

Jimmy Murphy | UCC

Ocean Energy (OE)

Offshore Renewable Energy (ORE) or Marine Renewable Energy (MRE)

- Generally includes the following energy sources:
  - **Offshore wind (fixed, floating, airborne)**
  - **Wave energy**
  - Tidal range
  - **Tidal currents**
  - **Solar (floating)**
  - Ocean currents
  - Salinity Gradient
  - Ocean Thermal Energy Conversion (OTEC)

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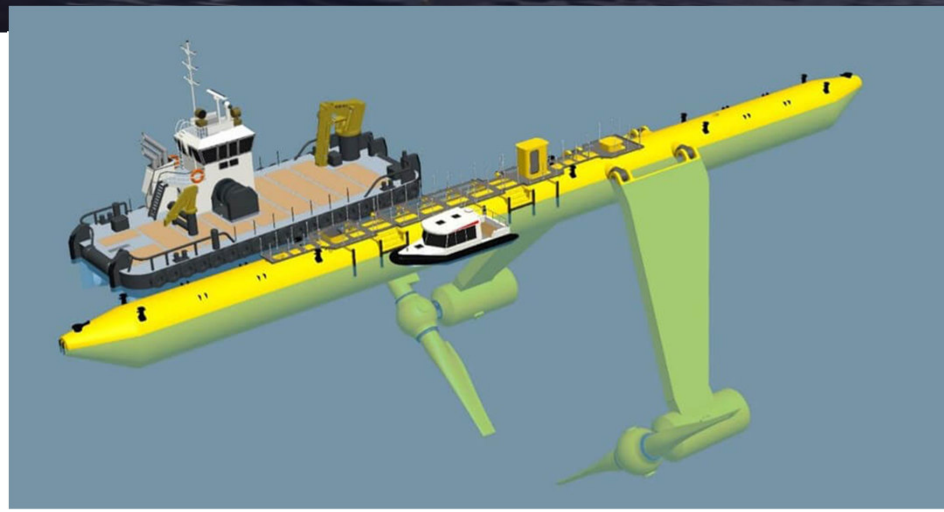
Ocean Energy (OE)

Wave and Tidal Energy

- Regarded as complementary and a 'more dependable' source or renewable power than wind energy
  - Tidal Currents - fully predictable
  - Wave Energy - not fully wind dependent

- Technologies not at as an advanced stage of development as offshore wind
  - Tidal Energy – small scale tidal farms
  - Wave Energy - primarily single unit demonstrators



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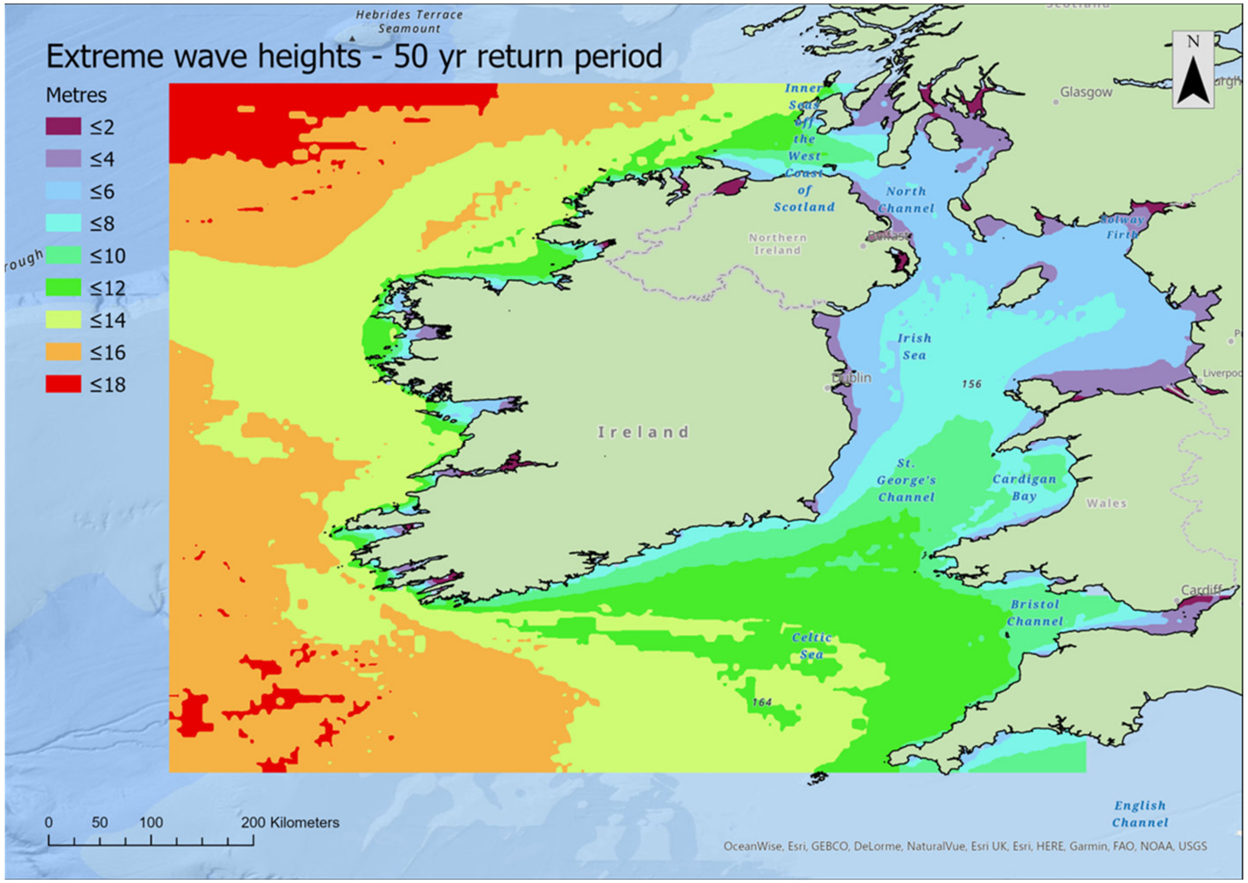
Ocean Energy (OE)

Wave and Tidal Energy Challenges

- High Levelised Cost of Energy (LCoE) and not competitive with offshore wind
- Placed in direct competition with offshore wind for subsidies
- Difficulty in scaling to offshore wind unit size
- Extreme environments – locating in best resource requires structural and component design for high survivability loadings
- Lack of convergence in technologies



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Ocean Energy (OE)

Technology Development Stages

- Stage 1 (TRL 1-3) Concept validation. Prove the basic concept from wave flume tests in small scale
- Stage 2 (TRL 4) Design validation. Subsystem testing at intermediate scale, Flume tests scale 1:10, Survivability;
- Stage 3 (TRL 5-6) Testing operational scaled models at sea + subsystem testing at large scale
- Stage 4 (TRL 7-8) Full-scale prototype tested at sea
- Stage 5 (TRL 9)   Economic validation; several units of pre-commercial machines tested at sea for an extended period of time.

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Ocean Energy (OE)

MaRINERGi (ESFRI Roadmap 2021)

- MARINERG-i seeks to form an independent legal entity of Distributed Research Infrastructures (DRI), united to create an integrated centre for delivering Offshore Renewable Energy.
- By consolidating expertise, investment and access to infrastructures, the MARINERG-I DRI will foster innovation across a variety of Offshore Renewable Energy technologies and stages of development.
- As the only integrated Offshore Renewable Energy platform of this scale worldwide, it will be the epicenter of this developing industry.
- Supporting Countries – Ireland, UK, Belgium, Spain, Netherlands and Portugal.
- Advanced discussions – France, Norway and Italy

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Ocean Energy RIs @RISEnergy

TA06

KIT -DHI-Deep Ocean Basin

Horsholm, Denmark

TA09

KIT-MARIN-Offshore Basin

Wageningen, Haagsteeg 2
The Netherlands

TA23

CNR-TT-ST

Test Center for thermal energy storage and conversion technologies

Rome, Italy

TA35

CTC-MCTS EL BOCAL

Marine Corrosion Test Site

Santandar, Spain

TA45

PLOCAN-TEST SITE

NE Gran Canaria, Canary Islands

TA48

TECNALIA-HarshLab

Offshore Materials, Components and Equipment Lab

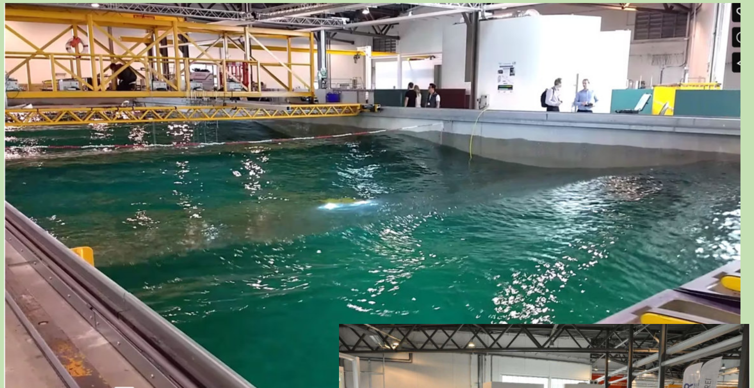
Bizkaia, Spain

This project has received funding from the European Union's Horizon Europe Research and Innovation Programme under Grant Agreement N. 101131793

Ocean Energy

RISEnergy

TA79 UCC-Lir NOTF



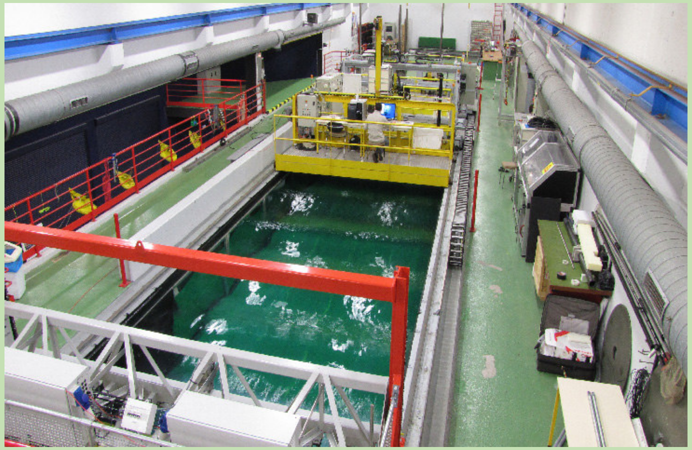
LiR NATIONAL OCEAN TEST FACILITY

Lir – National Ocean Test Facility

State-of-the-art wave tanks and electrical test infrastructure

- Testing to TRL 4 for wave, tidal, floating wind and floating solar technologies
- Power take off testing using linear and rotary test rigs

TA82 UCC-IFREMER-WaCuTa



Ifremer

IFREMER Wave and Current Flume TankT

Testing of tidal energy technologies

- Unique capabilities for scaled testing and the recreation of complex flows
- complete service for hydrodynamic force and moment measurements on fixed and moving devices, behaviour and performances characterisation in a range of wave and current conditions, non-intrusive velocimetry measurement systems (PIV, LDV)

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Ocean Energy

TA83 UCC-VGA-VGATL

VGA Testing Laboratory - SWEET LAB (Structural Wave Energy Equipment Test Laboratory)

Two state-of-the-art test rigs: one for powertrains and another for structural components for testing wave energy technologies

- Dry testing of ocean energy technologies to increase their maturity by measuring key performances indicators (efficiency, reliability and survivability)

TA84 UCC-UNIGhent-COB

Coastal and Ocean BasinT

Designed to study the effect of waves and currents on coastal and offshore structures, the generation of freak waves and the hydrodynamic and structural behaviour of devices for marine renewable energy.

- measurement portfolio features an advanced 6 DOF motion tracking system (above and under water) from Qualisys.

This project has received funding from the European Union's Horizon Europe Research and Innovation Programme under Grant Agreement N. 101131793

Ocean Energy RIs

Linked RIs

- TA10 - KIT-University of Hannover Coastal Research Centre -Forschungszentrum Küste (FZK). New upgraded test tank will offer unprecedented testing capabilities particularly for offshore wind and ocean energy systems as well as floating PV.
- TA53 – University of Edinburgh FastBlade (FastBlade). FastBlade offers structural fatigue testing of tidal turbine blades and other large composite structures.
- TA56 – University of Strathclyde Kelvin Hydrodynamics Laboratory. A tow and wave tank for testing wave and tidal energy technologies
- TA81 - UCC-EMEC The European Marine Energy Centre (EMEC). Full scale test site for ocean energy technology demonstration

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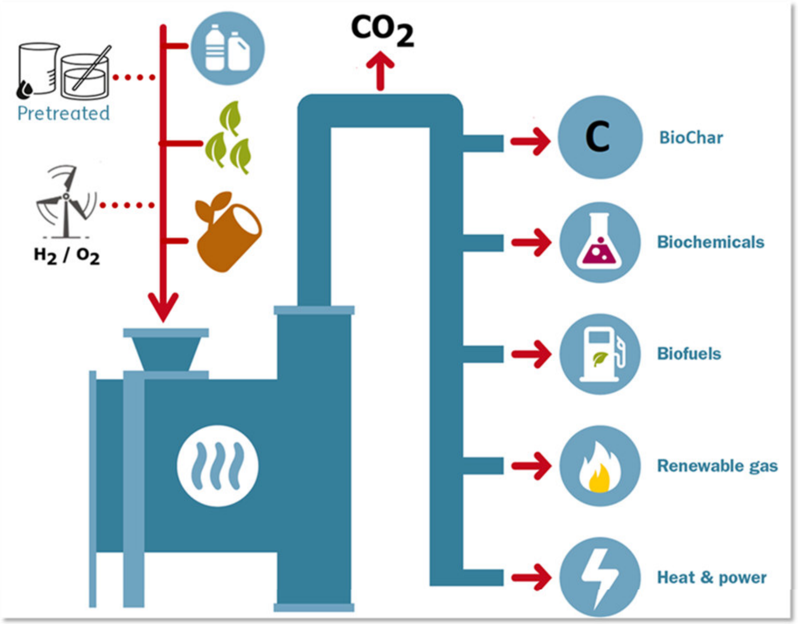
Biofuels

Berend J. Vreugdenhil | TNO, EERA-Bioenergy

Biofuels production pathways

What technology to choose



- Thermal and biological pathways to advanced fuels
- Extremely flexible towards feedstocks
- Links with renewable energy production (H_2)
- Options for negative emissions through surplus of CO_2
- Various back-ends applicable (CH_4, MeOH, FTS)

This project has received funding from the European Union's Horizon Europe Research and Innovation Programme under Grant Agreement N. 101131793

Challenges

How do we create a biofuel industry in Europe

- **Feedstock flexibility reflects in several different technology approaches. Ranging from biogas, hydrothermal processing, pyrolysis to gasification.**
- **Developing pathways on feedstocks is challenging with respect to availability, quality, mixability, therefor screening samples and blends becomes relevant.**
- **Taking into account other effects, land use change, food security, loss of biodiversity.**
- **Develop back-end application to match bio-derived gas/liquids, which is different in scale, composition and costs as fossil based pathways**

This project has received funding from the European Union's Horizon Europe Research and Innovation Programme under Grant Agreement N. 101131793

Biofuels RIs @RISEnergy

TA71

LNEG

The National Laboratory for Energy and Geology
Lisbon, Portugal

TA77

TNO

Nederlandse Organisatie voor Toegepast Natuurweten-schappelijk Onderzoek.
Petten, The Netherlands

TA04

DBFZ

Deutsches Biomasseforschungszentrum
Leipzig, Germany

TA49

TUBITAK

TUBITAK Marmara Research Centre Biomass Thermochemical Conversion and Upgrading Laboratory
Kocaeli, Turkiye

TA12

RE-CORD

Consorzio per la ricerca e dimostrazione sulle energie rinnovabili
Scarperia, Italy

TA05

DBFZ

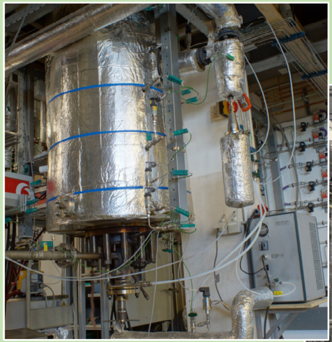
Deutsches Biomasseforschungszentrum
Leipzig, Germany

This project has received funding from the European Union's Horizon Europe Research and Innovation Programme under Grant Agreement N. 101131793

BIOFUELS

RISEnergy

TA77 TNO - SBT



TNO

Biofuels Laboratory

Description

- Indirect gasification platform for feedstock testing (~5 kg/h)
- Gas cleaning and tuning using sorbents and catalyst (~1.5 Nm^3/h)
- Up to 100 bar fuels synthesis (MeOH, CH_4 or FTS)
- Completely integrated line-up supported with extensive analytics

TA71 LNEG - BBRI

LNEG

Biomass and bioenergy research infrastructure

Description

- Microalgea biorefineries (CO_2 fixation, biofuels, waste water)
- Thermochemcial routes (Liquefaction, pyrolysis, gasification etc)
- Biomass deconstruction (high pressure, ionic liquids etc..)
- Fermentation (C5/C6 sugars to fuels/chemicals, metabolic eng.)

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Biofuels

TA04 DBFZ - FGBZ

Deutsches Biomasseforschungszentrum gemeinnützige GmbH

DBFZ Research Biogas Plant

Anaerobic digestion at industrial scale

- Experimental scale-up of AD processes
- Experimental testing of up- and downstream equipment, gas upgrading, and utilization
- Extensive analytical options

TA05 DBFZ - HTP

Deutsches Biomasseforschungszentrum gemeinnützige GmbH

Hydrothermal Processing and Biomass Disintegration

- Wide range of batch autoclaves (0.02–100 L) and processing conditions (T = 150–350 °C)
- Proof-of-concept and experimental scale-up of carbonization (HTC), liquefaction (HTL), and biomass disintegration
- Extensive analytical options

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Biofuels

TA49 TU - BIOTHEC

TÜBİTAK

Biomass to Biofuels - Thermochemical Laboratory

Description

- Thermal and Particulate Analysis Laboratuary (TGA-FTIR,-MS, BET)
- Fludized bed and Fixed Bed Pyrolysis and Gasification Setups
- Biofuel Upgrading and Catalyst Test Setups

TA12 RE-CORD - RECPARK

RE·CORD

Thermochemical experimental facility

Description

- Hydrothermal liquefaction (1-2 l/h)
- Slow and intermediate pyrolysis (1 to 100 kg/h),
- Chemical leaching of biochar
- Biofuel testing in micro gas turbines

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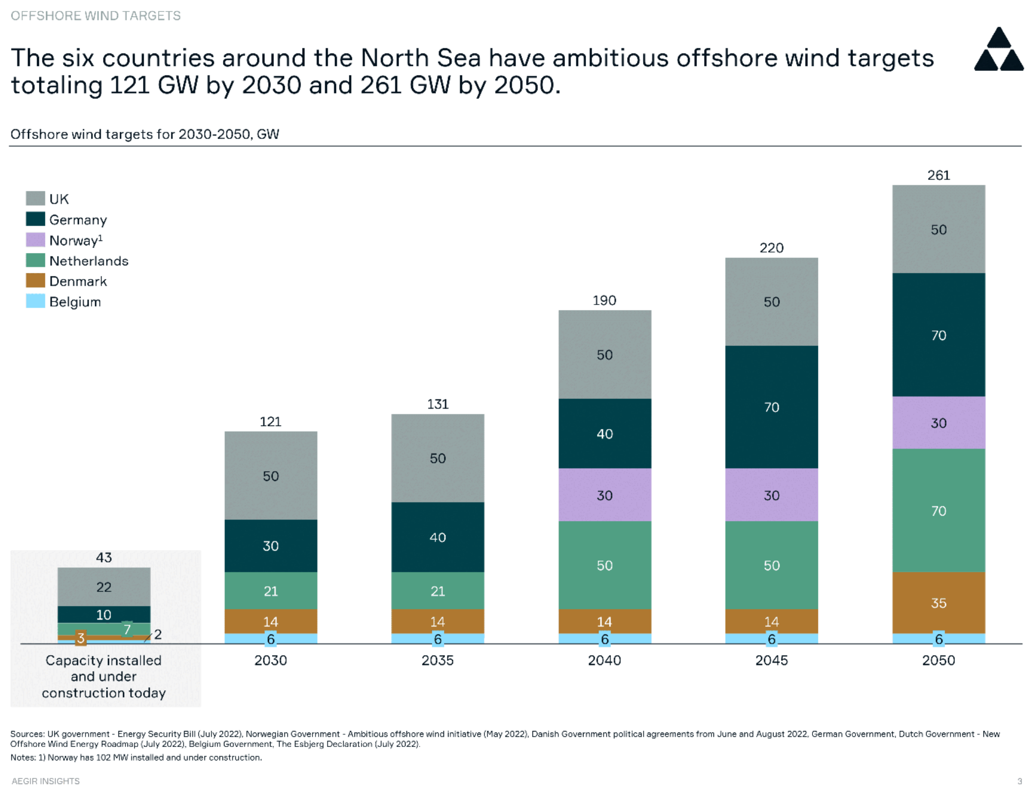
Offshore Wind

Julien Balsen | EERA-Wind

Offshore Wind

Helping the energy transition to reach large quantities and size

- **First offshore wind farm 1991 – already dismantled (Vindeby, DK)**
- **Blades were tested afterwards, significantly overdesigned**
- **Large areas available, eminent wind ressource in North Sea**
- **Bottom-fixed offshore wind is best with large turbines per foundation**
- **Floating is new, but might break the ”size arms race” of manufacturers**
- **Hydrogen transport is 8 times cheaper than electricity (per MWh)**



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Offshore Wind Research Challenges

RISEnergy

Are larger turbines the answer?

- How to scale up manufacturing and installations sustainably?
- Larger turbines have lower LCOE (really?)
- Unknown terrain for wind, materials, control
- How to build and connect floating turbines?
- Can the turbine be built differently? Airborne wind, vertical axis, other designs…
- Grid and energy system integration
- Grid connection, or hydrogen production?
- Co-existence with other inhabitants / users of the sea

- https://etipwind.eu/publications/

This project has received funding from the European Union's Horizon Europe Research and Innovation Programme under Grant Agreement N. 101131793

Field Offshore Wind RIs @RISEEnergy

RISEnergy

TA07
KIT-ECN-CSTB-JVCWT
Climatic Wind Tunnel
Nantes, FR

TA30
DTU-MaterialsLab
Risø, DK

TA34
CRES-Lid100ct
CRES 100m mast with Lidar at complex terrain
Lavrion, GR

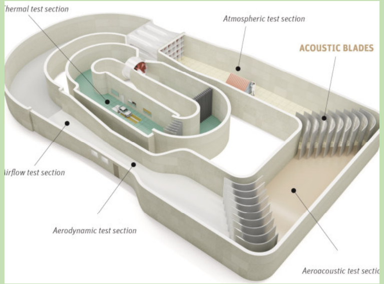
TA51
UNIChalmers-WTG
Chalmers wind turbine
Björkö, SE

TA78
TNO-SWITCH
TNO SWITCH Laboratory
Lelystad, NL

This project has received funding from the European Union's Horizon Europe Research and Innovation Programme under Grant Agreement N. 101131793

Field Offshore Wind

TA07 KIT-ECN-CSTB-JVCWT



CSTB
le futur en construction

Jules Verne Climatic Wind Tunnel (Nantes – FR)

Description:

- 2 large wind tunnels (up to 75m/s in a test section of 30m²)
- Wind loads, pressure and velocity (PIV) measurements
- Climatic simulations : -32°C to +55°C, rain, snow, sun…etc.
- High Reynolds simulations with various flow conditions

TA30 DTU MaterialsLab

DTU

DTU Materials Lab

Description

Accredited laboratory

- Vacuum infusion, press molding, filament winding
- Fiber content measurement, SEM, optical microscopy
- DSC, DMA, Single fiber testing
- 16 servo-hydraulic machines 50-500kN; up to 2m long samples
- 1 resonance machine 50kN
- Monitoring techniques ie DIC, AE….

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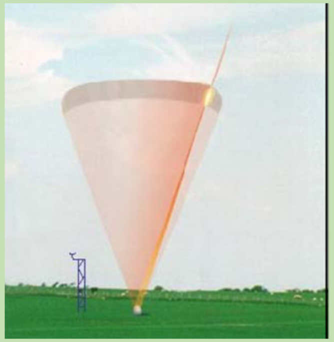
Field Offshore Wind

TA34 CRES-Lid100ct

ΚΑΠΕ
CRES



CRES 100m mast with Lidar at complex terrain

Description

- *Met mast and Lidar unit with web-enabled technologies for on-demand data, operating in complex terrain and near shore (1 km distance from the shore)*

TA51 UNIChalmers-WTG

CHALMERS

Chalmers wind turbine

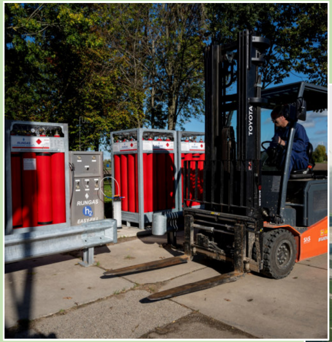
Description

- Variable speed, direct driven generator and a frequency converter Rated power is 45 kW, rated speed of 75 rpm
- Unique wooden tower, blades are of carbon fibre
- Full insight into design, drawings, hardware and software

This project has received funding from the European Union's Horizon Europe Research and Innovation Programme under Grant Agreement N. 101131793

Field Offshore Wind

TA78 TNO-SWITCH



SWITCH Laboratory powered by TNO & WUR

Scaled hybrid power plant test facility

- 60 kW Wind & 40kW Solar power generation
- 50 kW LiFePO4 battery system and 25kW PEM stack electrolyser
- Flexible Experiment & Scenario Control for research purpose

This project has received funding from the European Union's Horizon Europe Research and Innovation Programme under Grant Agreement N. 101131793

Coffee Break & Group Photo

15.45 – 16.15 h

Agenda

Day 1

Time	TOP	RISEnergy Kick-off Meeting - Day 1	Speaker	
13:30		**Registration**		
14:00	**1.**	**Welcome**	**Peter Holtappels (KIT), PC** **Bodo Lehman, Head of LV-BW, Brussels**	**(10')**
14:10	**2.**	**Project overview**	**Peter Holtappels (KIT), PC**	**(20')**
	3.	**Research Infrastructure presentation**		
14:30		General introduction	Peter Holtappels (KIT), PC	(15')
14:45		Research Infrastructures: PV, CSP/STE, Ocean, Bio, Wind	Thematic leaders	(5 X 10')
15:45		**Coffee break** (group photo)		
16:15		Research Infrastructures: Hydrogen, Storage, Grids, ICT	Thematic leaders	(4 X 10')
17:15		Research Infrastructures: Cross-cutting	Holger Ihssen (HGF)	(20')
17:35		Research Infrastructures: International	Olga Sumińska-Ebersoldt (KIT)	(10')
17:45		Discussion: Q&A	Peter Holtappels (KIT)	(20')
18:05	**4.**	**Structural needs for accelerated innovation: material research**	**Holger Ihssen (HGF)**	**(25')**
18:30		**End of meeting**		
19:00		**Networking dinner** (at the venue)		

This project has received funding from the European Union's Horizon Europe Research and Innovation Programme under Grant Agreement N. 101131793

Hydrogen

Kourosh Malek | FZJ

Current challenges of H_2 market

Ambitious targets

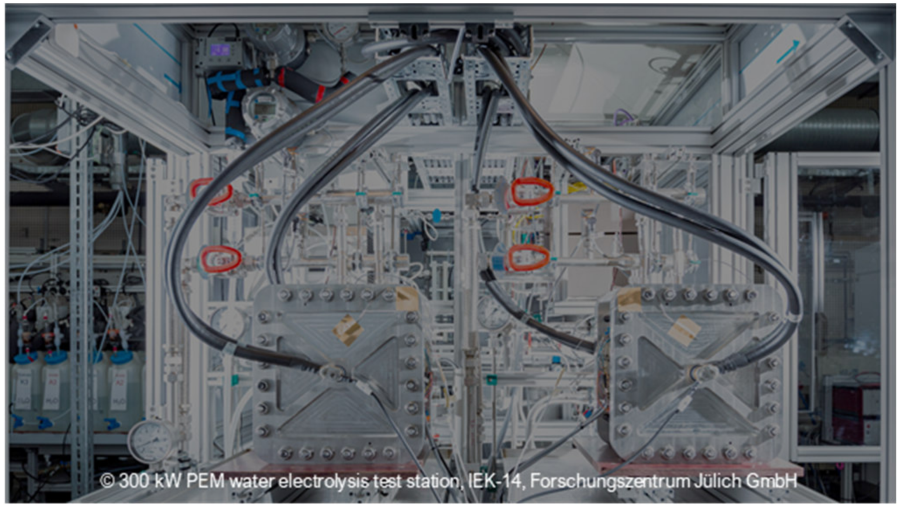
Next-gen materials for H2 technologies

- Ambitious goals
"more than 200 GW by 2030" Materials to device integration: acceleration by better adapting methods, tools, characterization and sustainability/circularity concepts

- **Hard-to-decarbonize** industry sectors

- Regulatory imperative
"non-toxic, safe-by-design **fluorine-free** materials by **2030**"

	Black Hydrogen	Gray Hydrogen	Blue Hydrogen	Green Hydrogen
Production price ($/kg)	0.95 – 1.90 (2020)	1.27 – 2.37 (2020)	4 – 5 (2022)	5.5 – 9.5 (2022)


© 300 kW PEM water electrolysis test station, IEK-14, Forschungszentrum Jülich GmbH

- **INFRA (**System level demo infrastructure (eg. renewable firming) | (Cell/stack) testing infrastructure | Materials and component development and characterization | Data and connectivity (real-time operational data, sensory data, visualization, digital twins)
- **ISSUES** (High cost of green hydrogen |unclarity of the demand for green hydrogen | the impacts on water and land resources | the absence of international regulations and standards | the general public's acceptance of this new fuel source)
- **COST** (High conversion cost (compression and liquification | High transportation cost (110 – 150% more expensive than a natural gas pipeline) | Storage cost | The lack of technical and international standards (issue with data harmonization)

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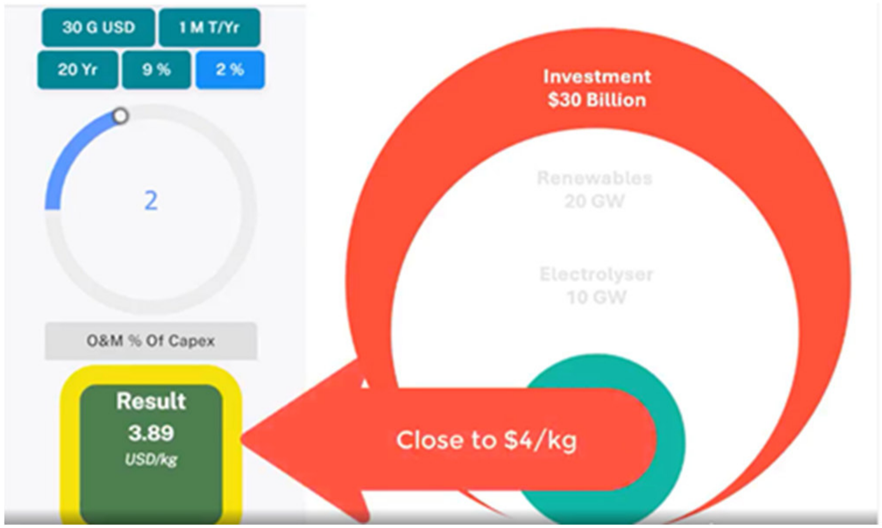
Current challenges of H_2 market

Cost of production



Keynumbers

THE WORLD BANK

European hydrogen development strategy
IEA-The Future of Hydrgoen-Seizing today's opportunities
https://www.jstor.org/stable/resrep26335.5?seq=8
https://www.iea.org/data-and-statistics/charts/global-emissions-by-scenario-2000-2050
https://100re-map.net/green-hydrogen-market-potentials-and-challenges/
https://www.bruegel.org/blog-post/hydrogen-development-strategies-global-perspective

	Period	Electrolyzer installed capacity (GW)	Green hydrogen production (Mil. tonnes)	Green hydrogen production
Stage 1	2020 – 2024	6	1	Decarbonization of hydrogen production in industries, such as oil refining, chemical manufacturing, and iron and steel production
Stage 2	2025 -2030	40	10 (1% of Europe's final energy consumption)	Gradually introduce hydrogen into new applications/industries, such as transportation, electrical systems, heat supply for buildings
Stage 3	2031 -2050	200	Large scale (10% of Europe's final energy consumption)	Gradually introducing hydrogen into sectors where it is difficult to reduce emissions

- **Produce 1 million tonnes -> 10 GW of WE -> 20 GW of renewable power -> costs $30 billion**
- **20 years plant operation -> $30 billion /20 billion kg -> $1.5/kg -> @ 1.5 per Kg return + O&M -> $4/kg (not $2/kg production cost as it is generally reported to make it competitive).**
- **Competitiveness of use cases such (fertilizer, shipping and transportation)**

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Field H_2 RIs @RISEnergy

TA58

PRAGA

ENEA Gasification / syngas
Rotondella, Italy

TA24

Green-H2-Lab

CNR Green-H2-Lab
Messina, Italy

TA74

LLEC

Living Lab Energy
Jülich, Germany

TA73

JULIO

Juelich Lab for Ink Optimization
Jülich, Germany

VA03

XR4MAT

VR/AR for energy materials
Jülich, Germany

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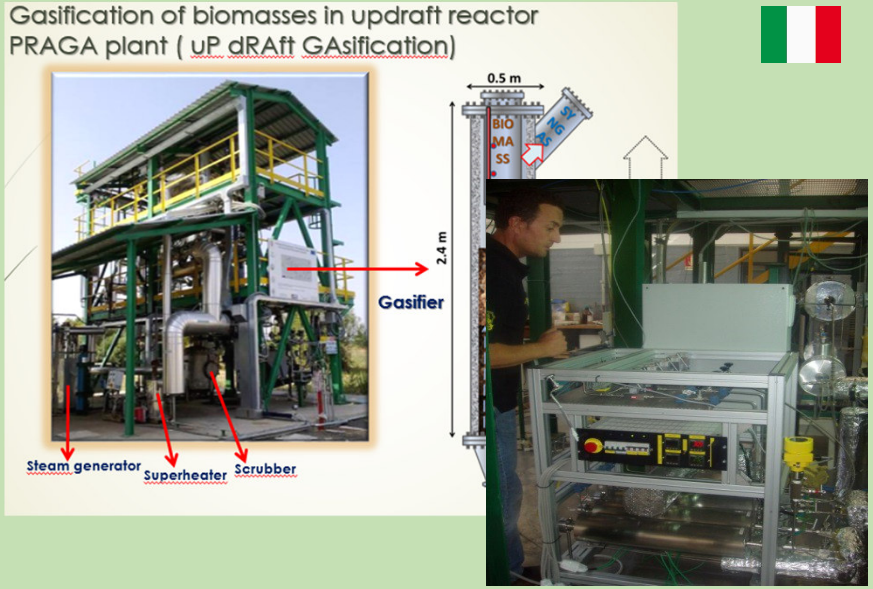
Hydrogen infrastructures

TA58 PRAGUP-ENEA



THE RESEARCH CENTER OF TRISAIA

- A full equipped 200 kW updraft gasification plant
- The nominal: **30-40 kg/h of feed**
- Two **catalytic fixed beds** operating between 400°C- 800 °C
- Two **hydrogen enrichment** sections
- **Production of syngas and pure hydrogen** from biomass and other carbon based and **catalytic test-beds**

TA24 Green-H2-Lab-CNR

ADVANCED ENERGY TECH INSTITUTE (ITEA)

- Electrochemical, catalytic and adsorption processes (materials, components and systems)
- **Modern testing building** (4000 m^2)
- Testing (max current 200A, upto 100 °C, max power 5 kW)
- Electrolysis: response to **renewables** (PV, wind), validating testing protocols and performance assessment (cell testing and scale up up to 5kW, Climate conditions, H2 quality)

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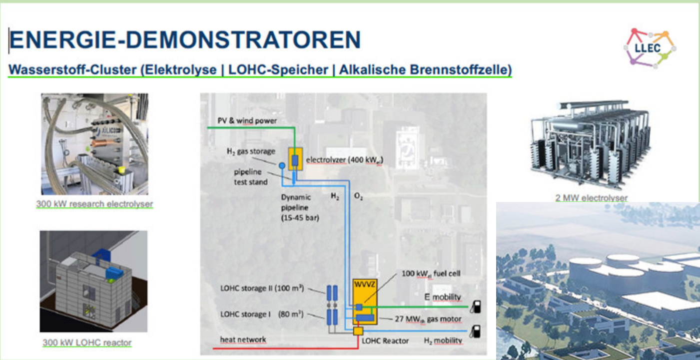
Hydrogen infrastructures

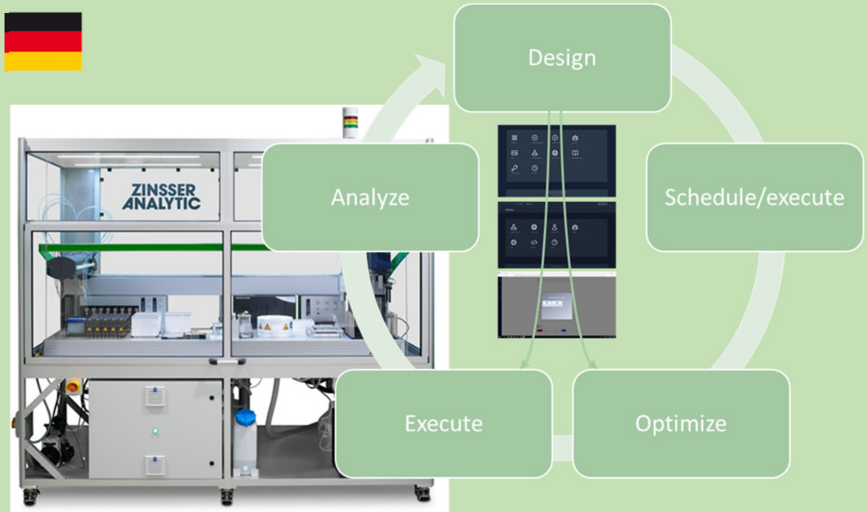
TA74 LLEC-Jülich



LIVING LAB ENERGY

- H_2 production, storage, delivery and usage
- **200 kW** research electrolyzer
- 300 kW **LOHC** reactor
- Renewable connected H2 production and storage
- **100 kW AFC**
- 2 MW electrolyzer
- Jülich H2-Campus (Brainergy) – Helmholtz Cluster H2 (HCH2)

TA73 JULIO-Jülich



INK OPTIMIZATION AUTOMATED LAB (JULIO)

- Provides optimal ink formulations for PEMWE, PEMFC and other ink-based components **(stability . cost . Performance) …in the building** …
- **Order and scheduling**
- **Inventory management**
- Default **workflows**
- **Optimization models**
- **Autonomously execute** the fabrication runs
- Data analytics and formulation including AI/ML training

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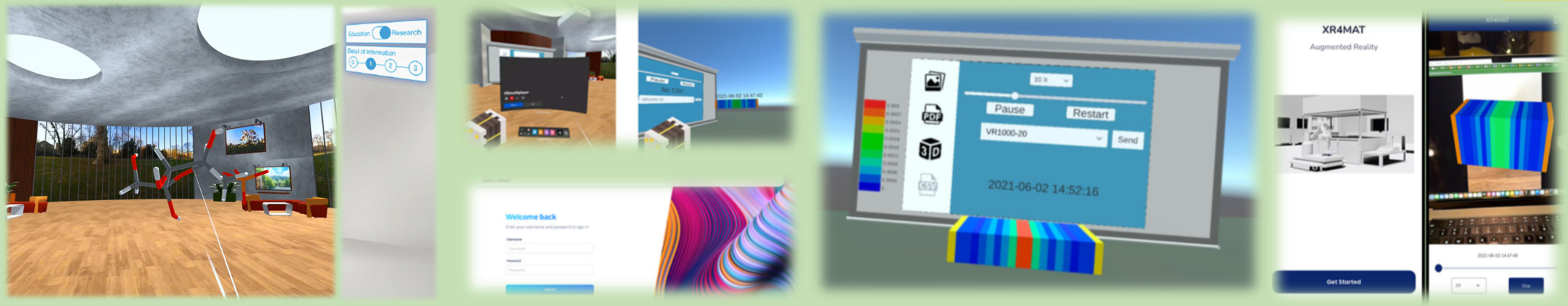
Hydrogen infrastructures

VA03 XR4MAT-Jülich



MIX REALITY for DATA MODELING, AUGMENTATION & VISUALIZATION

- An integrated mixed reality data platform with capabilities in modeling, simulation and testing data acquisition, data augmentation, and data visualization.
- Supported by tools and data for creating digital twins at the cell and stack levels productions: currently dedicated to H2 technologies.
- Services currently offered: (1) Immersive big-data visualization at cell and stack level, (2) Data augmentation for remote lab access, (3) Digital twins for testing and root-cause trouble shooting, and (4) Integration to self-driving labs and automated orchestration

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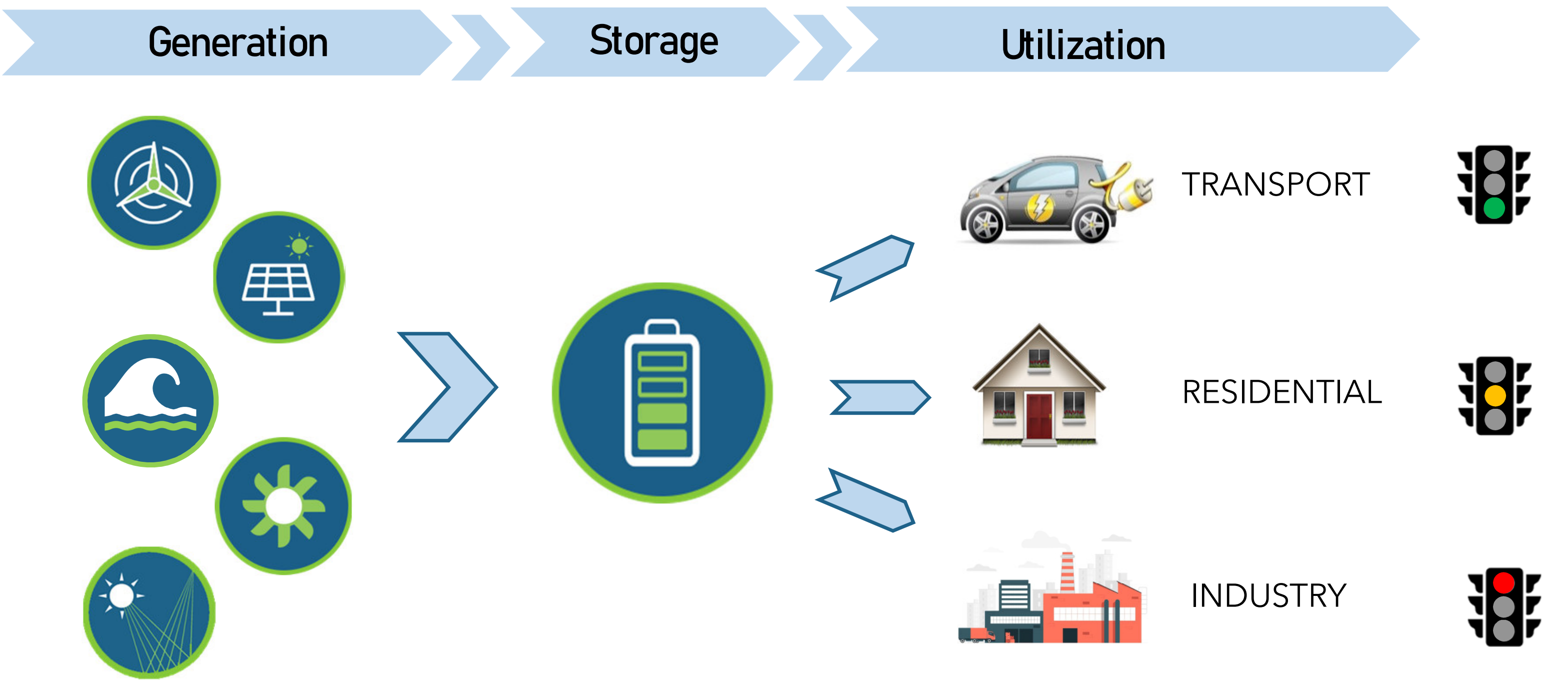
Energy Storage

Myriam E. Gil Bardají | KIT, EERA-ES coordinator

Decarbonising Europe by 2050 –
Can fossil fuels be replaced?



Batteries will play a crucial role for transportation, as the Well-to-Wheel energy efficiency granted by batteries is far higher than that offered by H_2 and liquid fuels, but hydrogen andfuel cells will also play a role e.g. in heavy transport.

Batteries can play an important role for residential uses but not for heating (seasonal storage).

Still no solution for large-scale heating in industry and long duration energy availability.

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Energy Storage Technologies

RISEnergy

...depending on the storage principle

- **Electrochmical ES:** batteries (Lithium, Na-ion, metal-ion, metal-air, redox flow, etc)
- **Chemical ES:** Power-to-X, e-fuels, hydrogen, ammonia, reactive metals, etc
- **Thermal ES:** Heat, PCM, molten salts, etc
- **Mechanical ES:** Pumped hydro, CAES, LAES, flywheels, etc
- **Electrical ES:** SMES, supercapacitors

Hybrid ES: utilisation of two or more energy storage technologies together on either a system, device, or material level to provide technical and economic advantages beyond what any single energy storage technology can provide.

StoRIES project: Storage Research Infrastructures Eco-System

StoRIES

- Duration: 2021-2025
- Budget: 7 Mio €
- Beneficiaries: 47
- Infrastructures: 64
- Countries involved: 17

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Energy Storage RIs @RISEnergy

RISEnergy

TA01

HIU

Helmholtz Institute Ulm
Ulm, Germany

TA03

KALLA

Karlsruhe Liquid Metal Laboratory
Karlsruhe, Germany

TA22

CNR-ITAE

Test Center for Thermal Storage
Messina, Italy

TA54

TES Lab

Fluid Machines and Energy Systems
Padova, Italy

TA55

E-StorHy

Electrical Energy Storage and Hydrogen Lab
Perugia, Italy

TA57

LiPCAL

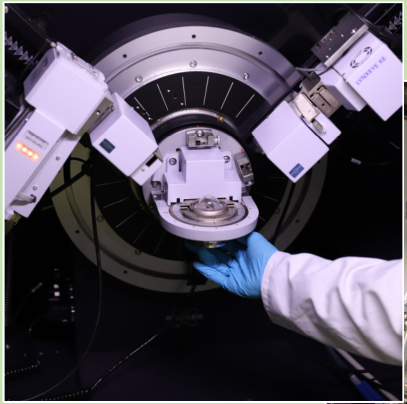
Lab-Scale Pouch Cell Assembly Line for Li-ion Batt
Zlín, Czech Republic

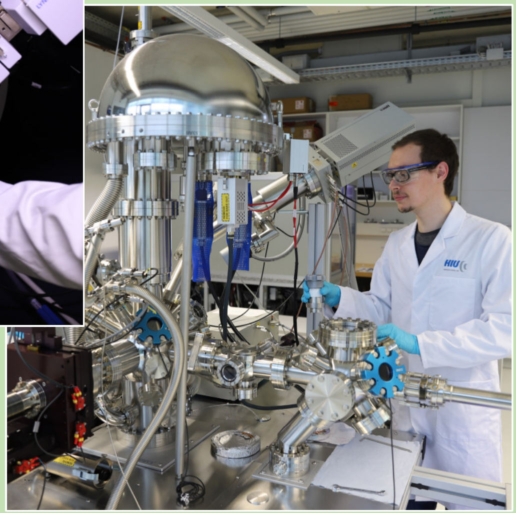
This project has received funding from the European Union's Horizon Europe Research and Innovation Programme under Grant Agreement N. 101131793

Electrochemical Energy Storage

RISEnergy

TA01 HIU





Karlsruher Institut für Technologie

Helmholtz Institute Ulm

- Batteries: cell components, assembly of coin and pouch cells
- material synthesis and characterization
- electrode preparation (up to pre-pilot-line level)
- cell assembly and testing
- advanced in/ex situ operando charachterization techniques

TA57 LiPCAL

UNIVERZITA TOMÁŠE BATI · TOMAS BATA UNIVERSITY

TBU Lab-scale cell assembly line for Li-ion batt

- electrochmeical performance of storage devices
- Na-ion, Li-ion, Li-Sulphur, Li-potassium, supercapacitors
- environmentally friendly compositions & self-healing properties
- solid-state litium-based batteries
- LCA and socio-economic aspects of energy

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Chemical & Electrical Energy Storage

TA55 e-StorHy

Electrical Energy Storage and Hydrogen Lab

- test bench for reactive metals steam oxidation for H2 production
- investigation of steam oxidation process (up to 900°C)
- SOFC/SOE/rSOC square single-cell test rig
- power-to-X

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Thermal Energy Storage

TA22 CNR-ITAE

Consiglio Nazionale delle Ricerche

Test-Centre for TES & conversion technologies

Full chain of characterization from materials to system level

- testing rig for water-to-water components & small-scale storage & heat pumps prototypes characterization
- testing rig for water-to-water large-scale storage & heat pumps units

TA03 KALLA

Karlsruher Institut für Technologie

Karlsruhe Liquid Metall Laboratory

Test of a first-of-its-kind heat storage system with liquid metal loops:

- for hydrogen production from methane or biogas (at >100°C)
- for production of solid carbon and oxygen from CO2 from air
- for testing for thermal energy storage materials (up to 400°C)
- for component testing in metall flows (up to 700°C)

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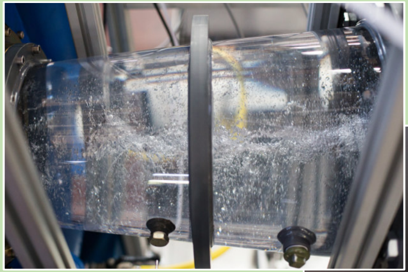
Mechanical Energy Storage

TA54 TES Lab



Laboratory of Fluid Machines & Energy Systems

- Optimal design and performance of hydraulic machines
  - off-design and flow field instabilities
  - hydrodynamic instability in pump-turbines
  - flow condition and cavitation behavior of Pelton turbine
  - hybrid storage systems (hydropower + other ES technologies)

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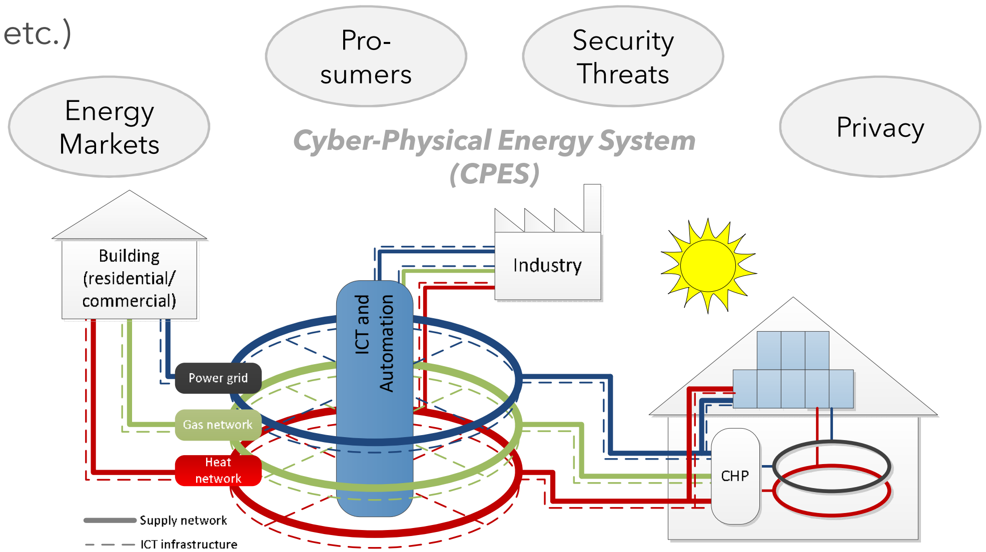
Integrated Grids

Thomas Strasser | AIT

Background and Motivation

Higher Complexity in Cyber-Physical Energy Systems

- **Planning and operation of the energy infrastructure becomes more complex**
  - Large-scale integration of renewable sources (PV, wind, etc.)
  - Controllable loads (batteries, electric vehicles, heat pumps, etc.)
- **Trends and future directions**
  - New energy solutions, such as energy communities, new market structures, etc.
  - Sector coupling energy (electricity, gas, heat), mobility, etc.
  - Digitalisation as the key enabler
- **Cyber-physical energy systems**
  - Physical systems and ICT systems can no longer be decoupled



Source: AIT

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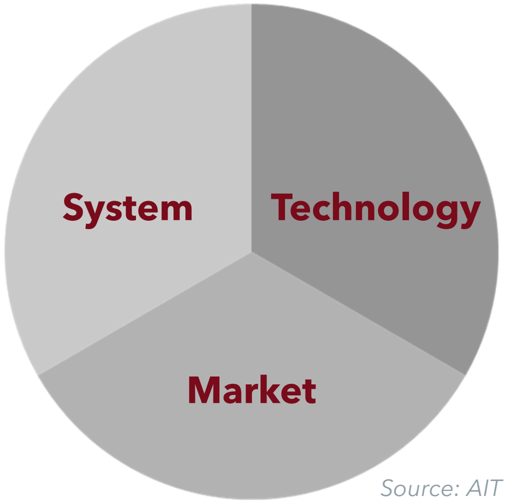
Main Challenges and Research Directions

Mastering Cyber-Physical Energy Systems

- Urbanization
- Stochastic behavior of renewables
- Distributed generation
- Electrification of mobility
- Aging infrastructure



Source: AIT

- Power electronics
- Communication and automation
- Electrical storages
- Generation (PV, wind power, etc.)
- Condition monitoring

- Liberalization and regulation of markets
- New business models for energy and mobility
- New industry players in energy business
- Market for primary energy, CO_2, nuclear waste, etc.

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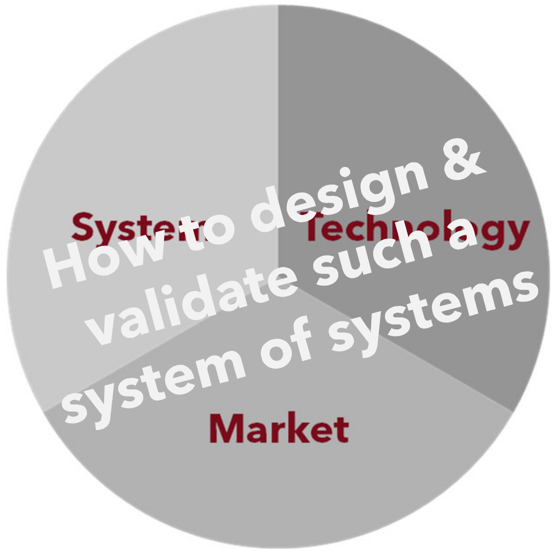
Main Challenges and Research Directions

Mastering Cyber-Physical Energy Systems

- **Key elements of future integrated smart grids and energy systems are**
  - Advanced communication, automation, and control systems
  - Power electronics
  - Smart algorithms
  - Monitoring and data analytics
  - Interfaces/interaction with other energy systems
- **Design and validation of power and energy systems characterized by**
  - Lots of manual engineering steps
  - Partly missing integrated view on sub-domains (power, ICT, etc.)
  - Usage of less formalized approaches and tools (compared to other areas)



Source: AIT

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European Smart Grids RI Collaboration

Long-term, pan-European cooperation

2005

DERlab – European Distributed Energy Resources Laboratories

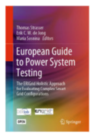
- GA-ID 5189299
- FP6 NoE (11/2005-10/2011)
- Coordinated by FhG
- 3 Mio EUR funding
- 12 partner
- Networking of DER labs, pre-standardization

DERri – Distributed Energy Resources Research Infrastructure

- GA-ID 228449
- FP7 RI IA (09/2009-12/2013)
- Coordinated by RSE
- 5 Mio EUR funding
- 16 partner from 12 countries
- TNA to DER labs, pre-standardization

ERIGrid – Connecting European Smart Grid Infrastructures

- GA-ID 654113
- H2020 RI IA (11/2015-04/2020)
- Coordinated by AIT
- 10 Mio EUR funding
- 18 partner from 11 countries
- TNA to Smart Grid and DER labs, pre-standardization



ERIGrid 2.0 – Connecting European Smart Grid Infrastructures

- GA-ID 870620
- H2020 RI IA (04/2020-09/2024)
- Coordinated by AIT
- 10 Mio EUR funding
- 20 partner from 13 countries
- TNA & VA to Smart Grid, Smart Energy Systems and DER labs, pre-standardization

RISEnergy

- GA-ID 101131793
- HORIZON RI SERV (03/2024-08/2028)
- Coordinated by KIT
- 14.5 MIO EUR funding
- 54 partners (17 core institutes)
- TNA & VA to renewables and energy systems

2028

This project has received funding from the European Union's Horizon Europe Research and Innovation Programme under Grant Agreement N. 101131793

Integrated Grid RIs @RISEnergy

TA14

AIT-EnergyLabs

AIT Austrian Institute of Technology
Vienna, Austria

TA27

TUS-PSSlab

Technical University of Sofia
Sofia, Bulgaria

TA29

DTU-SYSLAB+RisøHPP

Technical University of Denmark
Roskilde, Denmark

TA25

NTUA-EES-lab

Institute of Communication and Computer Systems
Athens, Greece

TA28

UPB-MicroDERlab

Politehnica University of Bucharest
Bucharest, Romania

TA44

OFFIS-eLab

OFFIS e. V.
Oldenburg, Germany

Cluster 1: Physical RIs/Installations

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Integrated Grid RIs @RISEnergy

Cluster 1: Physical RIs/Installations

TA47

SINTEF-NSGL

SINTEF Energy
Trondheim, Norway

TA52

UniCyprus-DGSF

University of Cyprus
Nikosia, Cyprus

Cluster 1: Physical RIs/Installations

VA01

AIT-EnergySim Lab

AIT Austrian Institute of Technology
Vienna, Austria

VA02

RWTH-Vlab

RWTH Aachen University
Aachen, Germany

Cluster 1: Virtual RIs/Installations

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Cluster 1 Physical RIs/Installations

RISEnergy

TA14 AIT-EnergyLabs

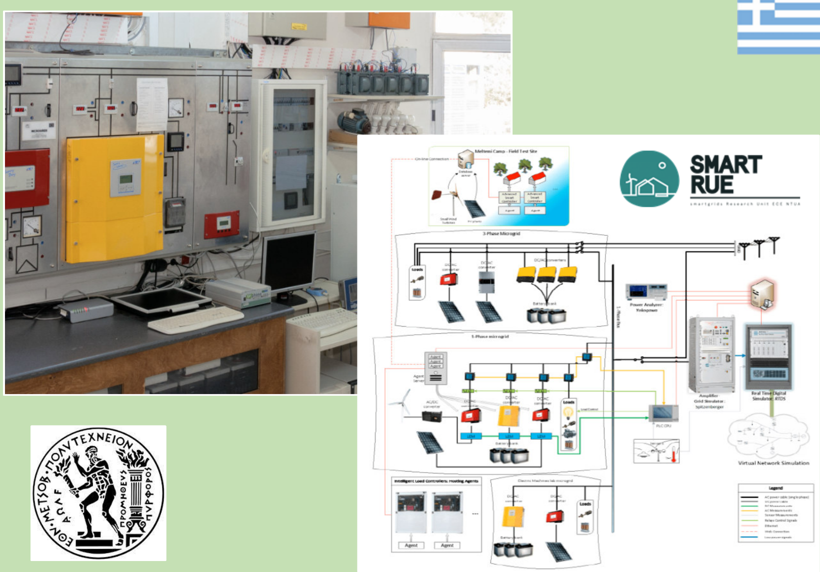
AUSTRIAN INSTITUTE OF TECHNOLOGY

AIT Energy Labs

Description

- Smart grid and inverter-based DER research and test facility
- Thermal energy storage systems and materials facility
- Multi-purpose test fields for electrolysis, fuel cells, battery storage and power electronics

TA25 NTUA-EES-lab



NTUA Electric Energy Systems Lab

Description

- Research and long-term experience on low voltage microgirds and multi-migrogrids
- Provision of multi-agent systems for microgrid operation
- Powerful laboratory SCADA system and CHIP/PHIL equippment

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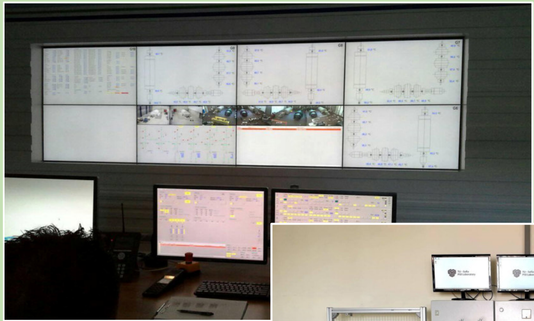
Cluster 1 Physical RIs/Installations

TA27 TUS-PSSlab



TUS Power System Stability Laboratory

Description

- Research focus on electrical power system stability
- Methods and tools for modeling, analysis, and management of electric power systems

TA28 UPB-MicroDERlab

UPB Advanced measurements and distributed renewable resources laboratory

Description

- Measurement technology for emerging power quality concepts in dynamic power system conditions
- Grid integration of renewables and active distribution grids

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Cluster 1 Physical RIs/Installations

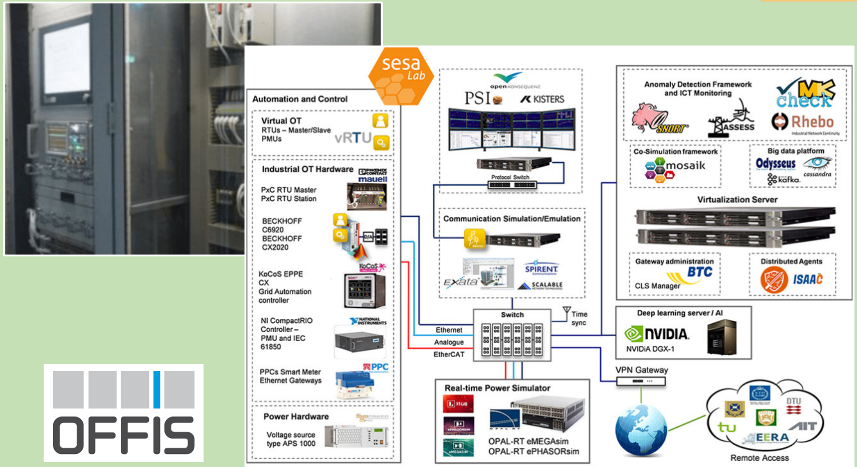
TA29 DTU-SYSLAB+RisøHPP

DTU PowerLabDK SYSLAB and DTU-DTEC Wind-Based Hybrid Power Plant at Risø Campus

Description

- Flexible intelligent energy lab for research and testing of control concepts and strategies for power systems with distributed control
- Flexible and configurable hybrid power plant with multiple MW scale units

TA44 OFFIS-eLab



OFFIS Energy Laboratory

Description

- Large-scale multidomain experimental facility for smart energy systems and renewables
- Provision of real-time communication, mosaik co-simulation, cyber security platform, big data, agent-based management, SCADA, and smart meter gateway

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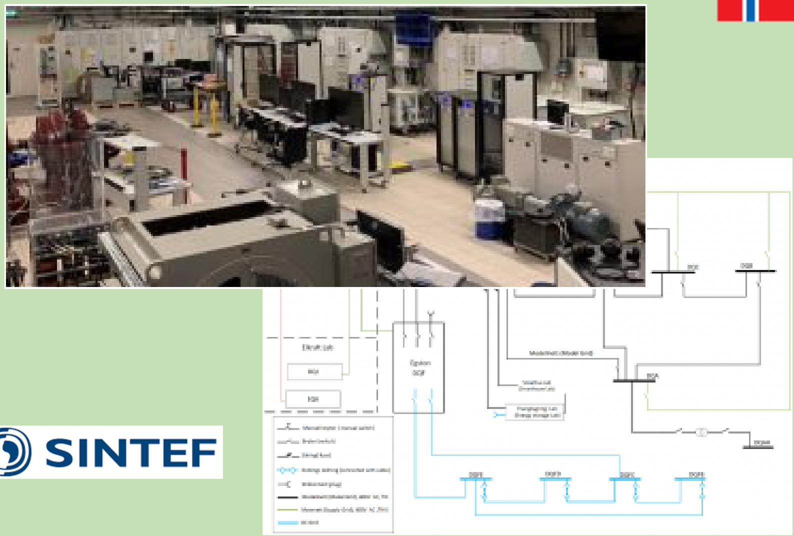
Cluster 1 Physical RIs/Installations

TA47 SINTEF-NSGL



SINTEF Norwegian National Smart Grid Lab

Description

- Reconfigurable electrical infrastructure for conducting experiments at low voltage levels
- Provision of powerful grid emulators, power electronic converters, electric machines, and communication infrastructure for smart grids

TA52 UniCyprus-DGSF

University of Cyprus

UniCyprus Distributed energy resources to Grid Smart Facility Infrastructure

Description

- Flexible and scalable research and development renewable to grid integration infrastructure (focus on nano- and microgrids)
- Provision of smart inverters and logs, storages, energy mgt, etc.

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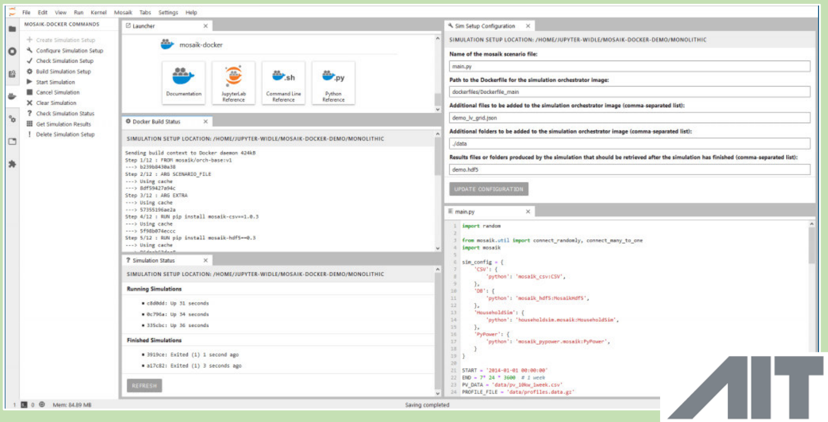
Cluster 2 Virtual RIs/Installations

VA01 AIT-EnergySim Lab

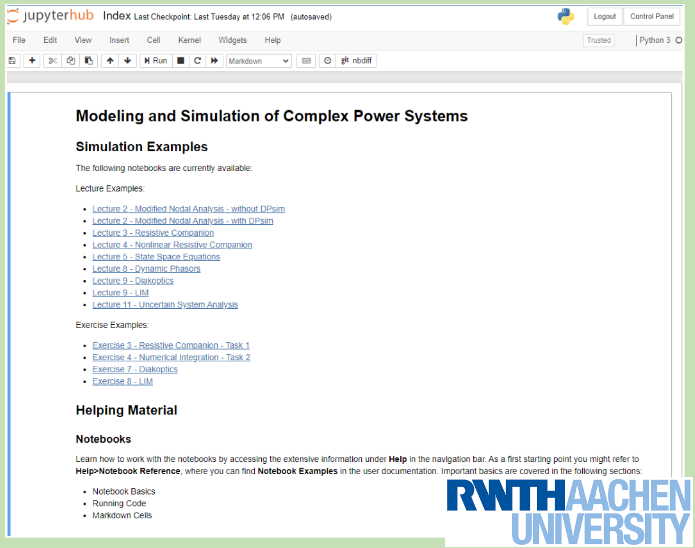


AIT EnergySim Lab

Description

- Simulation-as-a-service platform for integrated energy systems
- Open source-based approach
- Web-based co-simulation platform based on mosaik, Docker, JupyterLab and JupyterHub

VA02 RWTH-Vlab



RWTH Vlab

Description

- Simulation-as-a-service platfrom for virtual power engineering
- Open source-based approach
- Web-based simulation platform based on JupyterHub

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ICT

Michael Hayes | UCC

Objectives/Context (I)

Identify ICT enabling tech platforms, promote & exemplify usage across multiple cross-cutting RES* fields (e.g. PV, wind).

RISEnergy

Primary RIs (TA#08,80)

Leverage value proposition of retrofitting WSN devices on, in or near equipment and infrastructure bringing the following benefits:

- **Condition and energy efficiency monitoring** of equipment
- **Interoperability** for EDM, SES, DER, EEB optimization, etc.

Can do **temporarily** or **permanently** at development, deployment or operation phases of RES & components

Impediment:- WSN devices need significantly **longer battery life** for them to deployed at large scale.

Solution:- Better batteries, micro-power energy harvesting + WSN device collaborative eco-design based on real-life sensing and data processing requirements

So, a major portion of the effort will be dedicated to **Autonomous/Long battery life solutions** (energy harvesting, power management)

Key activity to support this:- WP3, Task 3.1, ICT enabled RES (WSN retrofit devices)

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RES = Renewable Energy Systems

Objectives/Context (II)

Secondary RIs (TA#26,74)

Fast prototyping of **control systems**, de-risk new control architectures via **simulators** and **HW interfaces**

ICT research platform for **building and district energy systems**, incorporating district heating network, HPC waste heat integration, high energy/power batteries, PV testbed for characterization and aging, high eff. 400 kW electrolyser, LOHC reactor system and storage coupled to CHP plant.

This project has received funding from the European Union's Horizon Europe Research and Innovation Programme under Grant Agreement N. 101131793

RES = Renewable Energy Systems

TA#08 Overview HMU-RC

Description:

Access to two installations:

Institute of Emerging technologies **(i-EMERGE)** leads the Energy Generation activities of the FET-Graphene Flagship initiative & participates in the new RI "Emerging Printed Electronics and Photonics", EMERGE

Institute of Environment, Energy and Climate Change **(IEECC)** conducts contemporary research and manages a high-level RI in the field of energy systems, renewable energy technologies (wind parks, PVs, micro-grids, storage, vehicle to grid, dispersed generation, etc.) and environmental assessments.

Support offered: The RIs can be offered both as stand-alone or integrated, combining capabilities for testing of ICT enabling technologies for power and energy systems.

TAs targeting low power IoT sensors retrofitting onto smart buildings/infrastructures allowing energy efficiency or condition monitoring or characterisation of various assets including PV and wind turbines.

The worldwide first Solar farm enabled by graphene perovskite panels of 4.5m² area in HMU's open air lab facilities

(cover on Nature Energy 2022)

TA#08 Overview HMU-RC

Services offered:

i-EMERGE:- TAs for a wide range of installations on flexible PV devices and beyond.

It includes power electronics and automatic data acquisition systems for continuous monitoring of PV panels to better understand reliability and benchmark with conventional PV.

i-EMERGE has access to numerous parks in Crete as well as act as technical advisor of the largest Greek Energy Community, Minoan Energy.

IEECC:- Testing of control and metering devices in low voltage microgrids, different low voltage microgrids configurations,

Novel control approaches for HVDC interconnections and DFIG wind turbines,

Testing of SCADA and EMS systems realization for smart grid scenarios,

Rapid control prototyping platform for single-phase inverters,

Prototyping platform for three-phase inverters (grid-connected or parallel), for DC/DC converters and for motor drive applications.

This project has received funding from the European Union's Horizon Europe Research and Innovation Programme under Grant Agreement N. 101131793

TA#80 Overview UCC-TYN

Description:

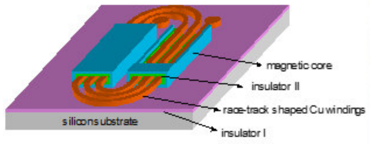
Facilities for materials, device and system integration experiments for long battery life WSN modules & systems for RES for 'ICT enabled' Condition Monitoring (CM) and Energy Efficiency Management (EEM).

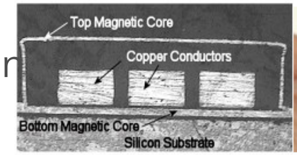
Nano and micro Materials & Structures, Materials & Device Processing.

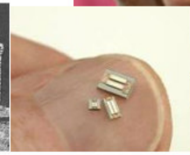
Full Si CMOS, MEMS Wafer Semiconductor fabrication facilities.

Development of battery life/energy simulation tools.

Novel 'More than Moore' offerings serves for miniaturisation and integration







Support offered under this proposal:

Leverage experience as co-ordinator and TA provider in the EnABLES 'power IoT' RI www.enables-project.eu

Manage the ICT enabling related TAs, provide access ourselves or select and assign HMU to provide the service.

Share best practises for access management (e.g. enquiry funnel management, selection and review process.)

This project has received funding from the European Union's Horizon Europe Research and Innovation Programme under Grant Agreement N. 101131793

TA#80 Overview – UCC-TYN

Services offered:

‘ICT enabling’ access services

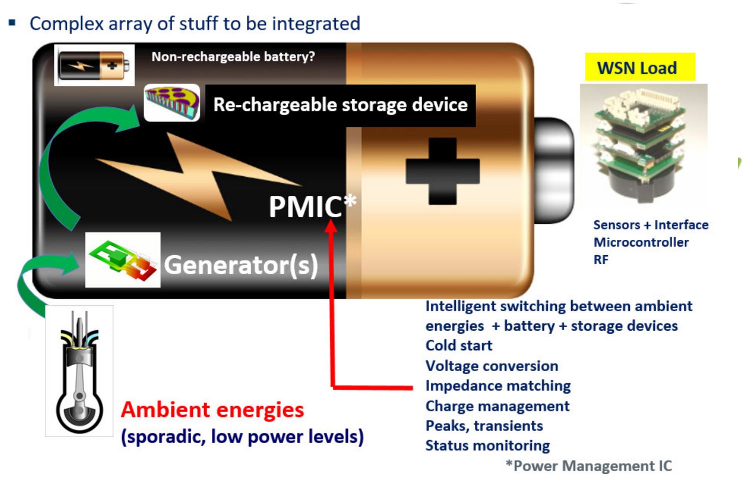
(i) *At system level:-* Tools and expertise to optimise WSN modules for RES CM & EEM. This can be applied to RES generation & storage as well as inter-operability with equipment on the load (demand) side.

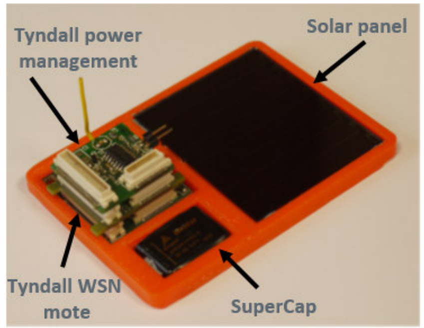
(ii) *At device level:-* Advanced characterisation & prototype assessment of micro-power energy harvesting, storage and power management materials and devices

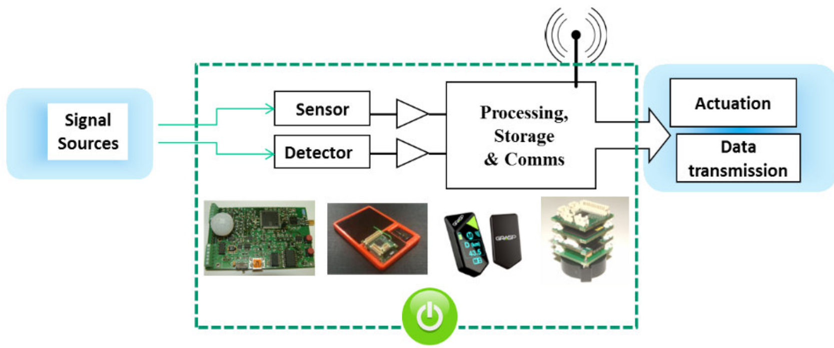
Development of smart materials, devices, test structures & simulation tools.

On-site deployment testbed to do real-life experiments.

Close proximity to RI#79 (UCC-Lir NOTF) – will explore synergies & opportunities to exemplify WSN retrofit value proposition







This project has received funding from the European U
Research and Innovation Programme under Grant Agre

Secondary TAs #26,74

TA26 - RWTH-RTlab

Supports fast prototyping of control systems and de-risk new control architectures for application in power systems. Achieved through a set of COTS & in-house real-time (RT) simulators and hardware interfaces as results of advanced research at the edge between power systems and ICT.

TA74 - FZJ Living Lab Energy (LLEC)

ICT research platform for building and district energy systems, low temp. district heating network with HPC waste heat integration, high energy/power batteries, PV testbed for characterization and aging, high eff. 400 kW electrolyser, LOHC reactor system and storage facility coupled to CHP plant, FIWARE based ICT platform (open source).

No doubt many other TAs and tech platforms have significant ICT content

These TAs will be covered in more detailed under the 'cross-cutting' theme

This project has received funding from the European Union's Horizon Europe
Research and Innovation Programme under Grant Agreement N. 101131793

Cross-cutting RIs

Holger Ihssen | Helmholtz Association

General Comments concerning Cross-cutting RI

- Criticism in the review: No dedicated RIs for these typ of clients in the field xy.

  Answer: Yes, but we have an innovation secretariat, guiding everybody to the best facilities. Therefore we cover many more cross-cutting (cc) research fields.

- The cc-RI providers need to (should) put some examples for the cc access

  on the access-website. May be with some ref. Publications ? If possible, all Ris should specify possible cross-cutting access options.

- May be, all the RIs could indicate a unique access use for their RI. What kind of investigation could only be done at your RIs (at least in RISEnergy).

- **The RIs presented are based on personal taste!**

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TA02/KIT Energy-lab

Energy Lab 2.0 researches the intelligent interaction of various options to generate, store and supply energy.

The Energy Lab consists of three interlinked elements: (1) Smart Energy System Simulation and Control Center (SEnSSiCC) implements a wide range of topologically variable microgrid experiments using real power system components and connects the microgrid directly to real-time simulated networks of real power systems to form a hardware-in-the-loop setup. (2) PtX Lab, a modular research facility designed for PtX technology validation in a semi-industrial environment to support the successful transfer of promising developments from the lab into application. (3) Carbon Cycle Lab is a research platform for scale-up, demonstration and transfer to application of key enabling technologies intended to close the anthropogenic carbon cycle based on complex feedstocks.

This project has received funding from the European Union's Horizon Europe Research and Innovation Programme under Grant Agreement N. 101131793

TA32 SOTOCARBO-XtL Pilot Plant

X-to-Liquids Plant

<u>Description of the infrastructure:</u> The X-to-Liquids plant is designed to test processes for liquid fuel production from captured CO2 and hydrogen (from renewable sources), and from plastic waste/biomass syngas. The system also allows to perform catalyst screenings. The XtL plant is made up of a bench-scale fluidized-bed gasifier for syngas production from biomass and/or plastic waste, a purification section of the syngas and a highly flexible section for syngas or CO2 conversion into liquid fuels. Represented technology: bioenergy, hydrogen

<u>Services offered by the infrastructure:</u> The facility is located in a laboratory of the Sotacarbo Research Centre. All the services, instruments and the other facilities of Sotacarbo are therefore available in support of the research activities performed at the XtL Pilot, such as: biomass characterization, biomass preparation, liquid fuel analysis, etc.

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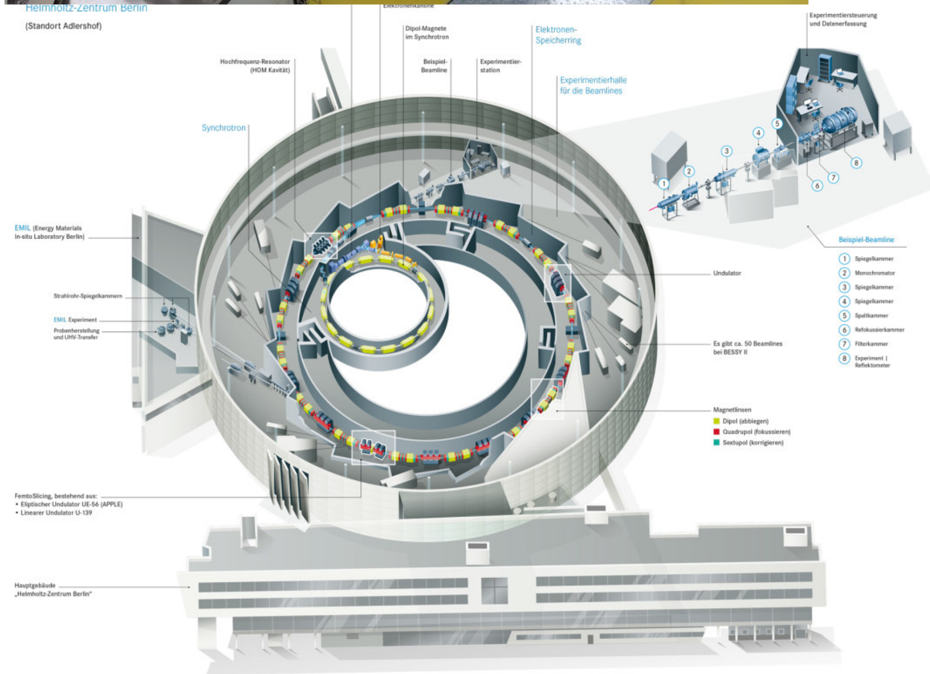
TA41 - HZB-Emil

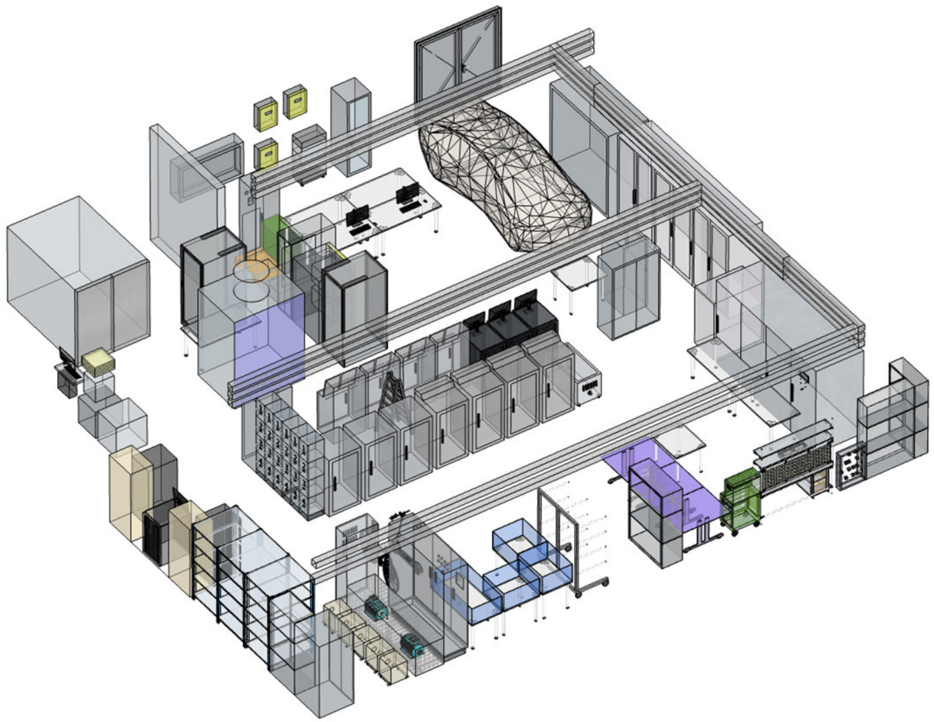


EMIL enables in-situ and in-operando measurements at several measuring stations. As a joint project of the Helmholtz Centre Berlin and the Max Planck Society, EMIL will primarily be used for research into materials for regenerative energy production. In the CAT research laboratory, the Fritz Haber Institute of the MPG and the Max Planck Institute for Chemical Energy Conversion will investigate catalytic processes. In the SISSY laboratory section, the HZB is investigating new thin-film materials for solar cells, solar fuels, thermoelectrics and materials for energy-efficient information technologies/spintronics.

This project has received fu
Research and Innovation Pr

TA42 IREC-EnergySmartLab

- The **Smart Energy Laboratory** is a low voltage microgrid working up to 200 kVA able to operate real systems and configurable emulators. The emulators can act as renewable generators, storage systems and consumers. It can test and demonstrate prototypes under development in order to improve their performance under real conditions.



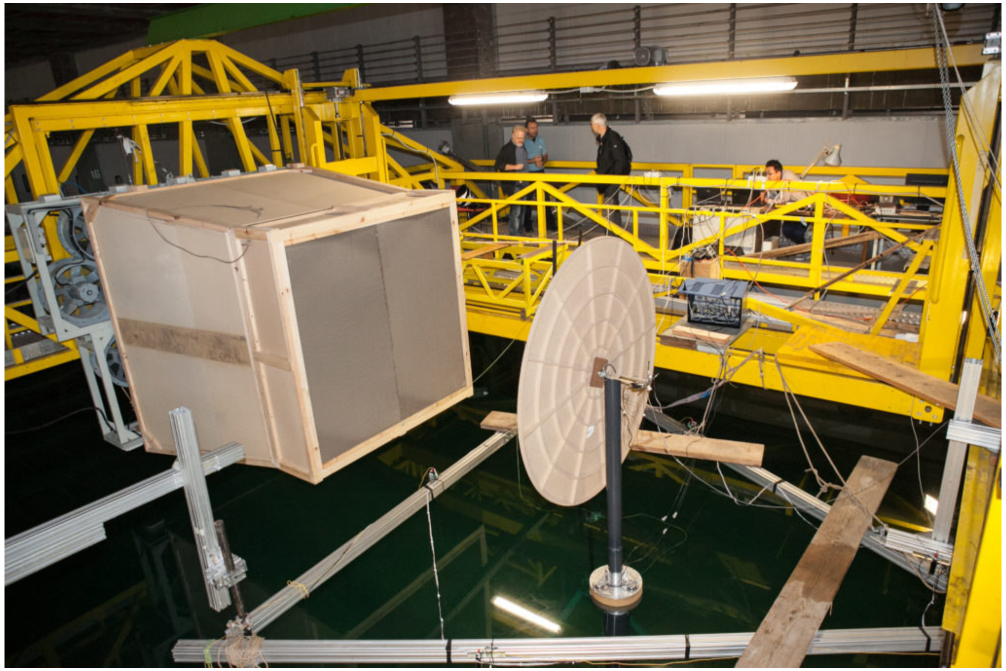
This project has received funding from the European Union's Horizon Europe Research and Innovation Programme under Grant Agreement N. 101131793

TA19 CNR-ST

Test Center for thermal energy storage and conversion technologies Seakeeping Tank

<u>Description of the infrastructure:</u> The ST facility features a 220 m long, 9.0 m wide, 3.5 m deep wave tank routinely used for testing Marine Renewable Energy (MRE) devices. Waves, winds can be generated using a single flap wave maker and a wind tunnel, currents can be simulated by towing models. A full range of measuring and data acquisition systems is available and all of them can be easily interfaced with Users'hardware.

<u>Services offered by the infrastructure:</u> The ST lab has attracted Users (academia and industry) from Europe and outside and has been widely used in the framework of collaborative research projects. Tests aimed at providing new knowledge and expertise in current challenges in MRE technologies can be performed. Devices can be tested under combined wave, wind and current forcing conditions, also in complex multi-device platform configurations. Tank dimensions allow to realise platform components at a scale suitable for an accurate characterization of relevant physics.



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TA67 DLR-TFCL
Coating Laboratory for thin film deposition

Combined inline coating systems for developing processes and prototypes at near industrial scale is designed for a substrate size up to 30x30 cm². It includes the following systems: glass cleaning, PECVD, magnetron sputtering, and lamination unit.

This project has received funding from the European Union's Horizon Europe Research and Innovation Programme under Grant Agreement N. 101131793

RI n°	RI Name	Comment
TA02	KIT-Energy-lab	**Energy system RI**
TA13	KIT-UNIHannover-GWK+	The Coastal Research Centre (Forschungszentrum Küste, FZK) is operating the Large Wave Flume (Großer Wellenkanal, GWK) to which access will be offered. With about 300 m length,, the "new" GWK+ will then allow for unprecedented testing capabilities particularly for offshore wind and ocean energy systems as well as floating PV. **Ocean , PV, Wind**
TA18	CIEMAT-CEDER-HEGSINT	Infrastructure of Hybrid Energy Generation and Storage for Grid Integration. It accounts for a 4.2km 15kV power line arranged as a ring, feeding 7 transformation centres (400V). 230kW of distributed wind and solar PV generation are installed, together with pumped-hydro, Li-ion and Pb-acid batteries, a flywheel, supercapacitors and an electrolyser. **Energy System**
TA21	CNR-I-ZEB and DEC	The two facilities are: i) the I-ZEB laboratory, a building recently retrofitted in the zero-energy perspective, equipped with a heat pump, photovoltaic and thermal solar panels and energy storage system and ii) A multi-storey test building for the testing of large BIPV system, under different configurations and orientations The buildings are used for scientific aims as well as booked by companies to test the energy behaviour and durability of their construction products under real conditions. **Energy System**
TA32	SOTOCARBO-XtL Pilot Plant	The X-to-Liquids plant is designed to test processes for liquid fuel production from captured CO2 and hydrogen , and from plastic waste/biomass syngas. The system also allows to perform catalyst screenings. The XtL plant is made up of a bench-scale fluidized-bed gasifier for syngas production from biomass and/or plastic waste, a purification section of the syngas and a highly flexible section for syngas or CO2 conversion into liquid fuels. **Represented technology: bioenergy, hydrogen.**
TA33	IEES-HITMOBIL	Technology and Systems for Generation, Storage and Utilization of Clean Energy. HITMOBIL is a newly built RI for development, testing, optimization and implementation of modern systems for renewable energy storage and mobility. RES– Storage– Conversion and Consumption. **Energy System**
TA41	HZB-Emil	EMIL at BESSY II allowing for 'depth dependent' characterization of thin-film layer stack samples using photons from the soft (80 eV) to the hard (10.000 eV) X-ray energy regime. **Materials**
TA42	IREC-EnergySmartLab	This laboratory provides emulation and testing facilities which operates a number of configurable units, also real storage , wind turbine emulators and EV charger. There is a grid emulator allowing different grid faults and configurations. Finally, the laboratory includes a Line emulator and OPAL-RT and TYPHOON-HIL for rapid-prototyping, HIL and Power-HIL .**Energy System**
TA46	RSE-METF	RSE Multi Energy Test Facility focuses on the integration of different energy vectors, namely electricity, heat, natural gas and hydrogen. It will be composed of three main subsystems: the electricalsmart-grid (DER-TF, currently available), the heating/cooling network and the gas network (including natural gas and hydrogen blends,. Finally, a Power Hardware In the Loop system will be installed in 23H2. **Energy System**
TA50	UNIBologna-ZEROCARBON	Carbon recovery, regeneration and recycling technologies for the production of advanced materials and the energy transition. FIP-WE@UNIBO: Lab on Waste Valorisation and Future Energy Supply, Enercube Lab: Knowledge transfer in electrochemical energy storage/conversion technologies, HC-hub-ER: Lab on Hydrogen and Carbon use from Renewables Energy. **Materials , Hydrogen, Storage**

RI n°	RI Name	Comment
TA60	**CENER-SESES**	Simulation Environment for Solar Energy Systems. - TONATIUH is open source software for the simulation of optical systems by the ray tracing method. - CSTLibrary, CENER's in-house Modelica library for the ST, CSP and storage simulation. - High temporal and spatial resolution long-term timeseries and representative yearly datasets. - CENER's in-house simulation tool of the performance of complex **PV systems. PV, CSP and Storage**
TA61	**CENER-SIMPV**	Solar Energy Technologies and Storage Department's modelling capacity. The following software and simulations tools can be accessed: • Climatological datasets: synthetic high frequency long-term climatological timeseries adjusted to the specific climatological and geographical conditions of the location of interest. And synthetic yearly timeseries such as Typical Meteorological Years and Plausible Years. •TONATIUH: open source programme based on ray-tracing simulations, which can be applied for the detailed estimation of the available solar resource at complex terrains and configurations. •SIMPV: in-house simulation tool of the performance of PV systems without restrictions on configuration or composition, based on high time resolution simulations and detailed models of the complete PV power plant and components. **CSP and PV**
TA19	**CNR-ST**	:The ST facility features a 220 m long, 9.0 m wide, 3.5 m deep wave tank routinely used for testing Marine Renewable Energy (MRE) devices. Waves, winds can be generated using a single flap wave maker and a wind tunnel, currents can be simulated by towing models. A full range of measuring and data acquisition systems is available and all of them can be easily interfaced with Users'hardware. **Ocean and Wind**
TA26	**RWTH-RTlab**	RTlab offers infrastructure to support fast prototyping of control systems and derisk new control architectures for application in power systems. **Prototypes in Network System**
TA74	**FZJ-LLEC**	ICT research platform for building and district energy systems, low temp. district heating network with HPC waste heat integration, high-power batteries , PV testbed for module characterization and aging, high eff. 400 kW electrolyser, LOHC reactor system and storage facility coupled to CHP plant. Energy Sytem
TA16	**CEA-FASTinMat**	FastInMat enables the synthesis of a very wide range of nanoparticles or nanostructured films by Flame Spray Pyrolysis coupled to a co-deposition tool (and LIBS to come in 2023), and liquid-phase reactor (to be automated in 2023) coupled to a SAXS platform. **Materials**
TA20	**CNR-IMA**	CNR Italy Materials Alliance (IMA) : DiaTHEMA Lab focuses the R&D activity on the development of advanced thin-film materials and related prototypes for demonstrating innovative devices for applications especially in harsh environments. Specifically, the main present activities are dedicated to the development of energy converters operating at high-temperatures for solar concentrating systems, ultra-high temperature thermal energy converters, spectrometers for fast neutrons. **Materials**
TA36	**DIFFER**	EnergyMaterials@DIFFER consists of a combination of large scale, in-house build RI for materials processing and characterization * Magnum PSI – linear plasma generator (14 m) for studying plasma-wall interaction in fusion reactors and nanostructure processing * PLD4Energy (2023-28) – vacuum cluster with small and large area pulsed laser .. **Materials**
TA59	**CENER-COATLAB**	CENER's coating, structuring and characterization laboratory. CENER puts at the service of the consortium its coating, structuring and characterization infrastructure. This infrastructure consists of several techniques for the deposition of thin films, for the nano and micro-structuring of different surfaces, lasers for ablation and thermal processes and the characterization set-ups for optical, surface and electrical properties. **Materials**
TA67	**DLR-TFCL**	Coating Laboratory for thin film deposition. Combined inline coating systems for developing processes and prototypes at near industrial scale. **Materials**
TA70	**LNEG-UME**	LNEG_UME carries out research, testing and technological development of materials for CSP, energy storage, hydrogen, PV and ocean energy. LNEG/UME's infrastructure comprises four main facilities: Laboratory of Materials and Coatings, accredited by EN ISO 17025 standard; Hydrogen; Batteries and Recycling and Material's Characterization **Materials**.

This project has received funding from the European Union's Horizon Europe Research and Innovation Programme under Grant Agreement N. 101131793

Summary and Conclusions for Cross-Cutting RIs

- **7 x Energy systems // 6 x materials // several RIs with a focus on 2 research fields (E.g. PV and CSP)**

- **It is difficult to find special RIs.**

- **We need to think about a good scheme to identify the best fitting RIs for the Users. Keywords, a special hierarchical scheme ?**

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International RIs

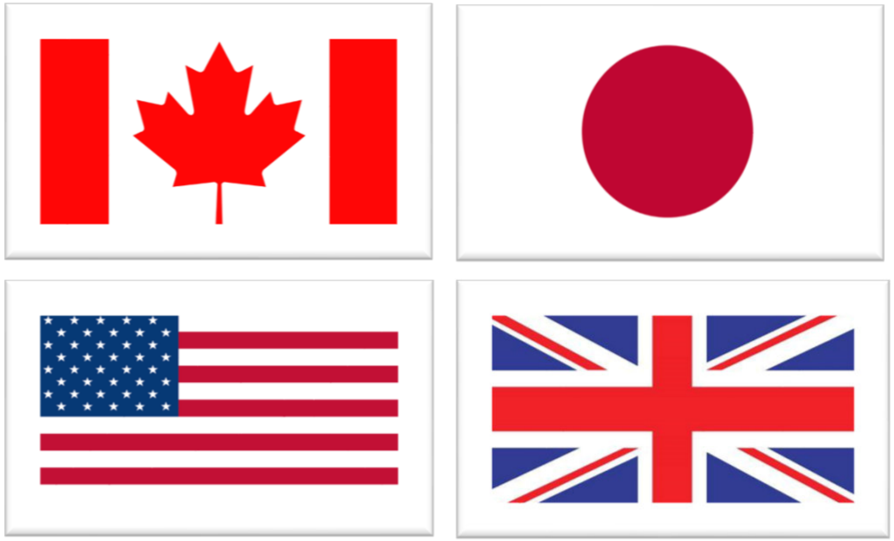
Olga Sumińska-Ebersoldt | KIT

International Research Infrastructures

International?

- **Research Infrastructure from non-EU countries**

TA10	KIT-NRCan-CAMDI	Materials
TA11	KIT-NREL-TCPDU	Bio
TA15	AIT-AIST-FREA	Smart Grid
TA31	UKRI-UKGEOS	Geothermal, storage
TA53	UNIEdinburgh-FastBlade	Wind, Ocean
TA56	UNIStrathclyde-KHL	Wind, Ocean, PV
TA81	UCC-EMEC-EMEC	Ocean



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TA10 KIT-NRCanNRC

Centre for Accelerated Materials Discovery and Innovation

The RI includes custom designed laboratory space for **Materials Acceleration Platforms (MAPs)** – self-driving or autonomous lab programme development and delivery; supported by a high performance (CPU/GPU) computing data centre, mechatronics and automation, dedicated AI/ML studio, and backed by conventional laboratory facilities. **Several self-driving labs for energy materials** are already under development for **thermoelectric materials, electrical conductors, electrocatalysts, corrosion** with additional platforms being considered for **batteries, plating, electrolysis, cement production and 3D printing**.

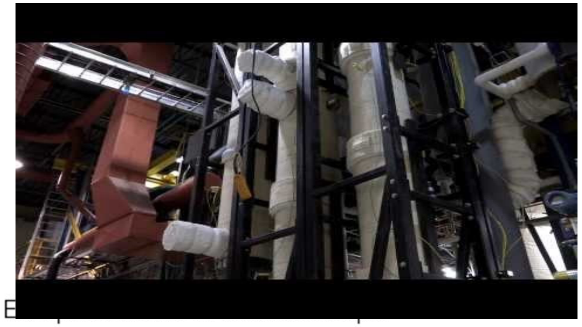
Cross cutting

This project has received funding from the European Union's Horizon Europe Research and Innovation Programme under Grant Agreement N. 101131793

TA11 KIT-NREL-TCPDU

National Renewable Energy Laboratory (TCPDU)

NREL's thermochemical R&D facility includes lab-scale batch and semi-batch plants, lab-scale continuous plants and continuous-scale integrated pilot plants for research into **biomass gasification and pyrolysis and the upgrading of biomass-derived syngas and bio-oil**. Certain facilities offer unique features for studying reactor environments and feedstocks not found in other publicly available laboratories. NREL's biomass thermochemical conversion capabilities include processing in two sophisticated, unique pilot plants. Both have coupled riser reactor/regenerator systems integrated into the product collection and can process up to 20 kg/hr of feedstock, including direct feeding of biomass and bio-oil vapours into the riser.



Biomass

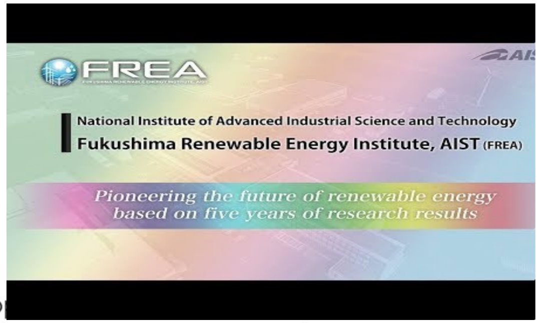
This project has received funding from the E
Research and Innovation Programme under Grant Agreement N. 101131793

TA15 AIT-AIST-FREA

Smart Grid R&D platform in Fukushima Renewable Energy Institute

It is possible to conduct integrated R&D at a megawatt-scale to test **individual components, systems**, and **strategies required to safely increase DER penetration in power grids**. The laboratory provides different types of **Digital Real-Time Simulators** for testing power electronics devices with power systems. It is also possible to **investigate cybersecurity aspects** in line with IEC standards.

It provides the ability to test and verify novel smart grid solutions, such as grid-forming inverter capabilities using power hardware-in-the-loop and controller hardware-in-the-loop environments.



Smart Grids

This project has received funding from the Euro
Research and Innovation Programme under Grant Agreement N. 101131793

TA31 UKRI-UKGEOS

UKRI UK Geology Observatory Glasgow (UKGEOS)

The RI provides scientific and engineering infrastructure for investigating **shallow geothermal energy and thermal storage resources available in abandoned and flooded coal mine** workings. It comprises 12 boreholes from 16-199 m deep including two abstraction and two re-injection mine water boreholes; a heat centre with three types of heat exchanger; a 200kW output heat pump/chiller; a sensor logging system and state-of-the-art downhole fibre optic and geoelectrical sensors. There is no equivalent RI in Europe open to Users.

Cross cutting

This project has received funding from the Eu
Research and Innovation Programme under Grant Agreement N. 101131793

THE UNIVERSITY of EDINBURGH | FASTBLADE

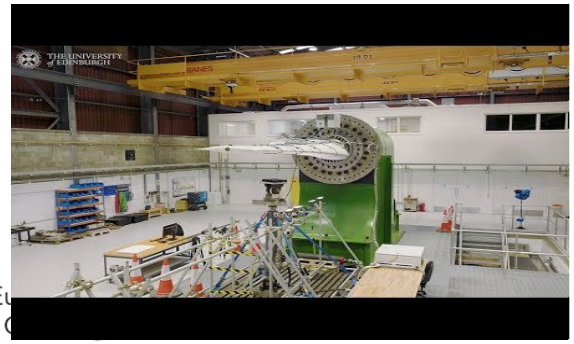
TA53 UNIEdinburgh-FastBlade

World's First Regenerative Fatigue Test Facility

FastBlade offers **structural fatigue testing** (at rates of up to 1 Hz for full scale tidal tests and up to 5 Hz for component testing) of **tidal turbine blades and other large composite structures**. 4 unique state of the art digital displacement hydraulic pumps offer the ability to recover up to 80% the energy used during fatigue testing. This allows for both fast and cost-effective testing of fullscale components.

The RI offers machine time to carry out structural testing, composite design and manufacture, ocean loading, and data analysis. That all provides insights into the performance of marine/tidal structures which are not possible to observe through ocean deployment.

Wind, ocean



This project has received funding from the Eu
Research and Innovation Programme under G

TA56 UNIStrathclyde-KHL

UNIStrathclyde Kelvin Hydrodynamics Laboratory

The RI enables **quantification and testing of a range of marine and wind based renewable technologies, sub-systems and support structures**.

The **tow, wave tank has working dimensions of 76m x 4.6m x 2.5m**, equipped with a **towing carriage**. The carriage has computer-controlled drive giving a **speed up to 5m/s**, at steady and unsteady speeds with **accelerations to 1m/s2**. Vertically movable absorbing wavemakers are computer-controlled generating regular or irregular **waves 0.5–1.2m height**. The wind tunnel is a recirculating, open jet with a working section of 1.6m diameter. The working velocities range from 0.2m/s – 25m/s.

Ocean, wind

This project has received funding from the Eur
Research and Innovation Programme under Grant Agreement N. 101131793

TA81 UCC-EMEC-EMEC

The European Marine Energy Centre LTD (EMEC)

The RI include real-time monitoring via SCADA system, and **wave, tidal and environmental baseline data**. The scale sites offer test facilities for earlier stage technologies, alongside a specially designed test support buoy with a microgrid for electricity and remote communications. EMEC has also been exploring new areas of research to demonstrate **green hydrogen production and energy storage using battery technologies**. The nature of the **open sea test sites** enables the collection of metocean, environmental and technological data.

Ocean, cross-cutting

This project has received funding from the Eur
Research and Innovation Programme under Grant Agreement N. 101131793

Discussion: Q&A

Moderator: Peter Holtappels

Agenda

Day 1

Time	TOP	RISEnergy Kick-off Meeting - Day 1	Speaker	
13:30		**Registration**		
14:00	**1.**	**Welcome**	**Peter Holtappels (KIT), PC** **Bodo Lehman, Head of LV-BW, Brussels**	**(10')**
14:10	**2.**	**Project overview**	**Peter Holtappels (KIT), PC**	**(20')**
	3.	**Research Infrastructure presentation**		
14:30		General introduction	Peter Holtappels (KIT), PC	(15')
14:45		Research Infrastructures: PV, CSP/STE, Ocean, Bio, Wind	Thematic leaders	(5 X 10')
15:45		**Coffee break** (group photo)		
16:15		Research Infrastructures: Hydrogen, Storage, Grids, ICT	Thematic leaders	(4 X 10')
17:15		Research Infrastructures: Cross-cutting	Holger Ihssen (HGF)	(20')
17:35		Research Infrastructures: International	Olga Sumińska-Ebersoldt (KIT)	(10')
17:45		Discussion: Q&A	Peter Holtappels (KIT)	(20')
18:05	**4.**	**Structural needs for accelerated innovation: material research**	**Holger Ihssen (HGF)**	**(25')**
18:30		**End of meeting**		
19:00		**Networking dinner** (at the venue)		

This project has received funding from the European Union's Horizon Europe Research and Innovation Programme under Grant Agreement N. 101131793

4.
Structural needs for accelerated innovation: material research

Holger Ihssen | Helmholtz Association

Kick-off Meeting | 12.03.2024

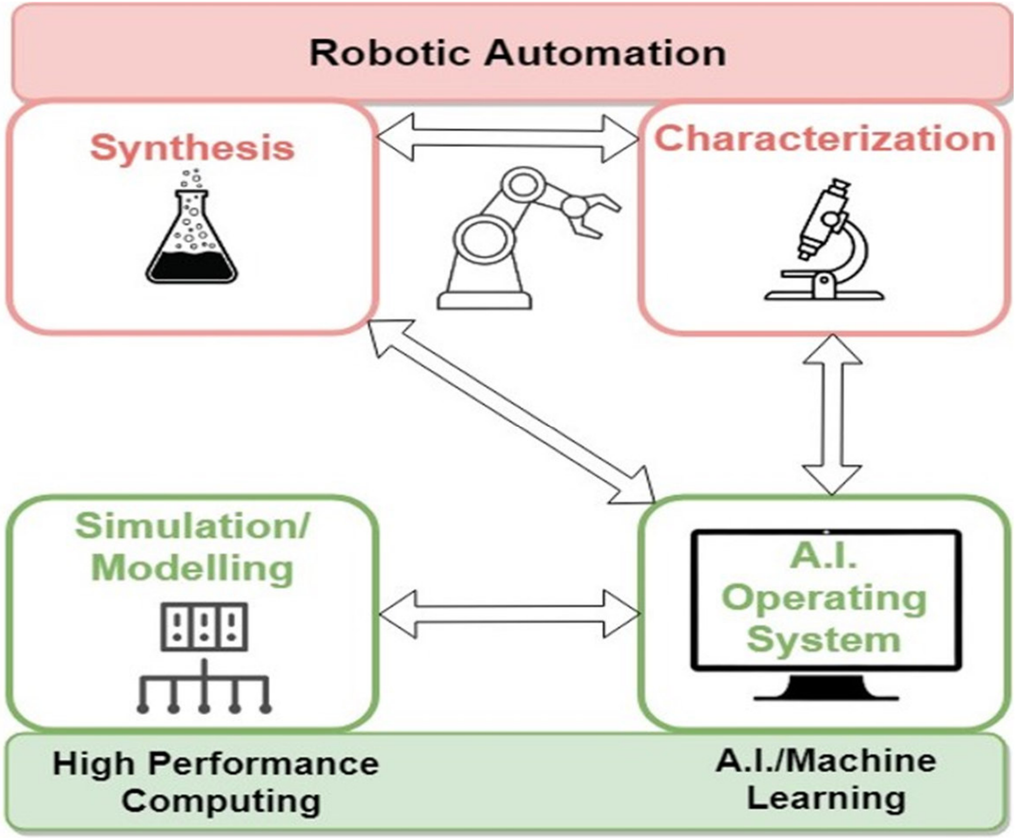
This project has received funding from the European Union's Horizon Europe Research and Innovation Programme under Grant Agreement N. 101131793

Significance of Materials in Clean Energy

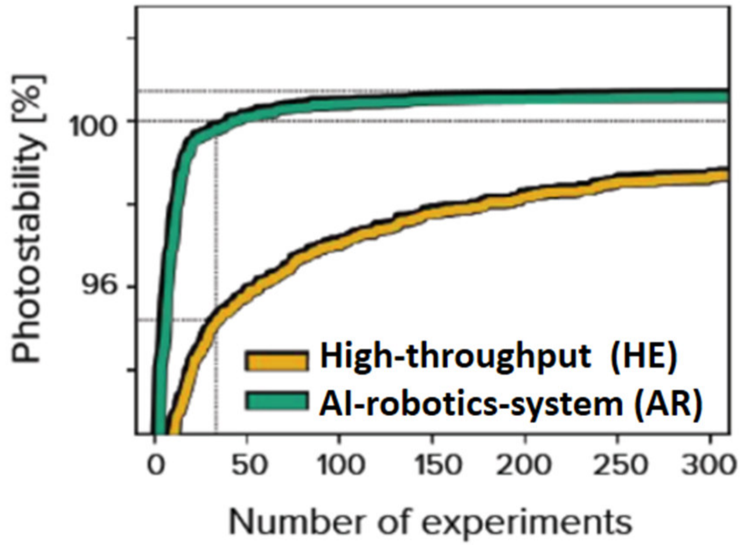
- Climate change
  - Unprecedented climate challenges
  - Spiraling rate of change
  - Myriad solution pathways:
  - 50-80% of the cost of clean energy is materials
- Materials supply chains
  - Critical material vulnerability, e.g. geopolitics
  - 50 elements are on the US critical minerals list
  - Many are essential to clean energy applications
  - Depleting amounts / quality of mineral deposits

This project has received funding from the European Union's Hori
Research and Innovation Programme under Grant Agreement N. 101131793

Materials Acceleration Platforms (or Self-Driving/ Autonomous Materials Laboratories) as a Solution



MAPs can accelerate materials optimisation



** Preliminary results, publication in preparation*

by groups of Brabec (FZJ)/Aspuru-Guzik (U Toronto)

This project has received funding from the European Union's Horizon Europe Research and Innovation Programme under Grant Agreement N. 101131793

AMANDA

Leading scientists :
Christoph Brabec
Jens Hauch

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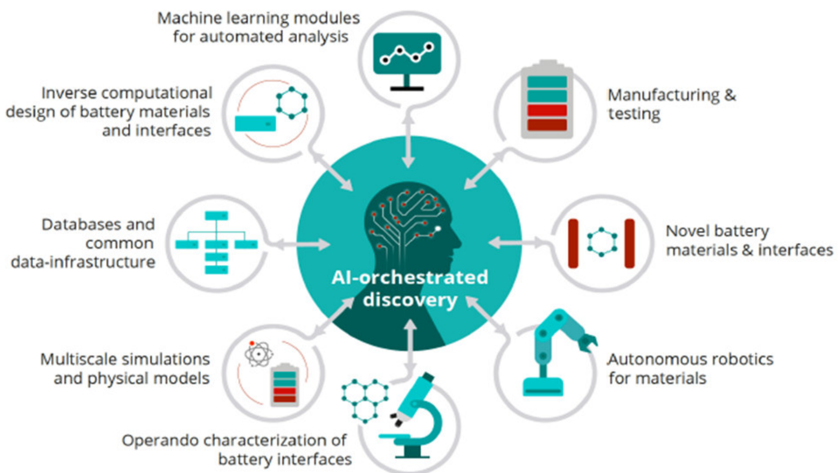
BIG – MAP Project

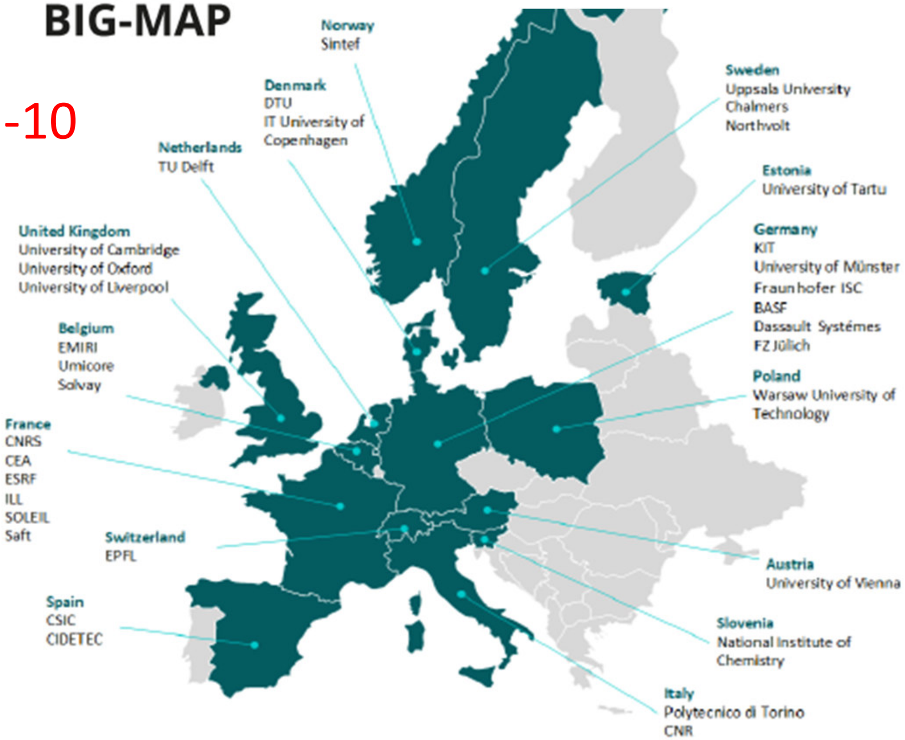
- 40 M€ for 6 years plus in kind contributions
- Can AI, simulations and closed-loop discovery accelerate the discovery & development process?
- 34 partners from academia, research organizations large-scale research infrastructure and industry
- Target: accelerating device innovation by factor of 5-10

BIG-MAP

Consortium

MAP: An AI-orchestrated Discovery Process





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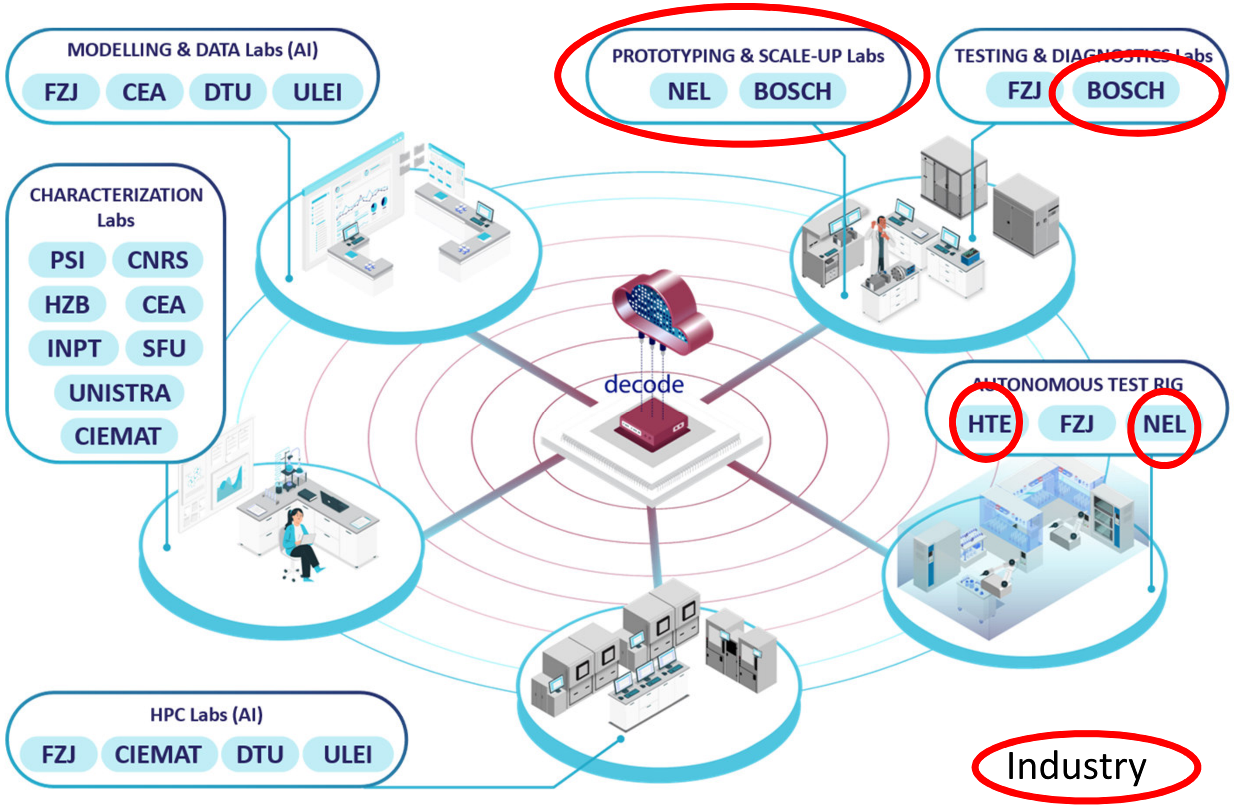
DECODE Aspiration and Vision

- **DECODE** aspires to revolutionize the process, by which **materials for clean energy technologies** are developed, integrated, and assessed.

- **DECODE** sets out to create and demonstrate one of the most advanced **pan-European Future Labs concept** in the sustainable hydrogen technology sector**. Main focus is on PEM electrolysers.**



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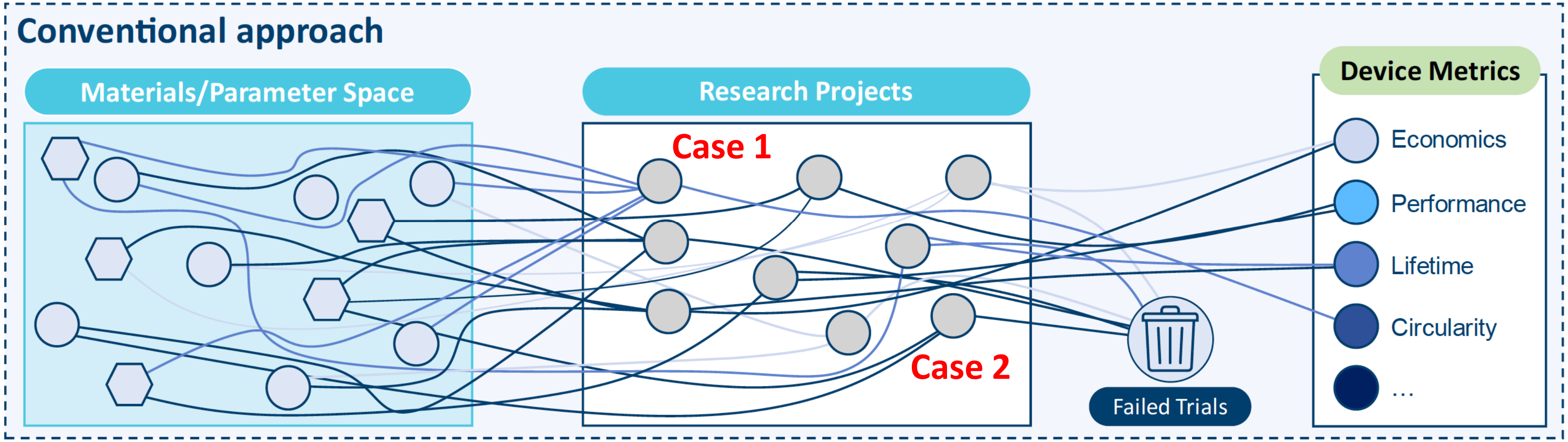
From Conventional Approach …



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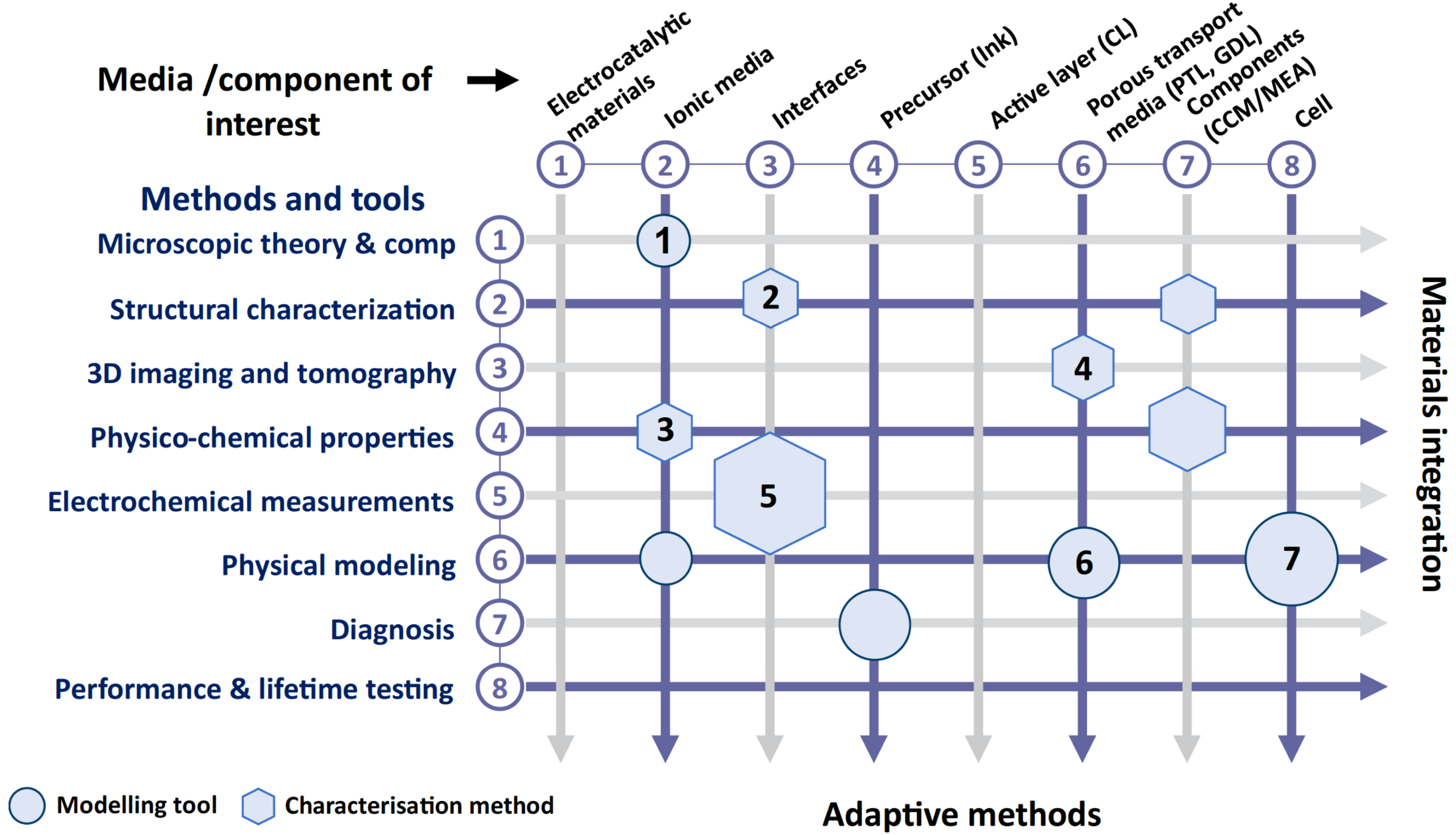
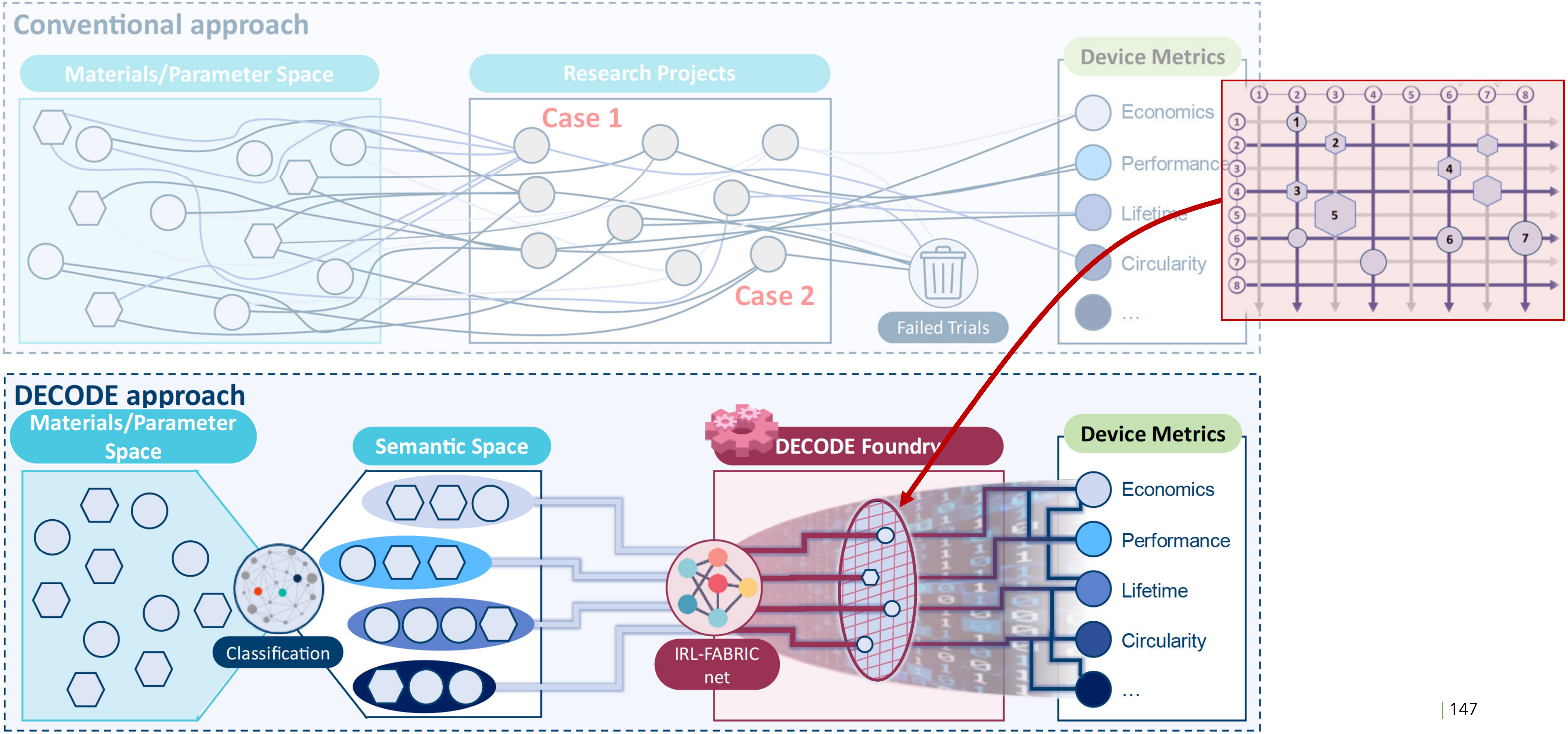
How to not get lost in integration and scale-up?



Develop and implement an orchestrated process

From Conventional Approach to DECODE



Mission Innovation

RISEnergy

Mission Innovation 2.0, launched on 2 June 2021, is catalyzing a decade of action and investment in research, development and demonstration to make clean energy affordable, attractive and accessible for all. This will accelerate progress towards the Paris Agreement goals and pathways to net zero.

Mission Innovation has seven collaborating organisations

Breakthrough Energy | Global Covenant of Mayors for Climate & Energy | Mission Possible Partnership | World Bank Group | iea | IRENA International Renewable Energy Agency | World Economic Forum

Mission Innovation **(MI)** is a global initiative of 22 countries and the European Commission

Australia	Austria	Brazil	Canada
Chile	China	Denmark	European Un
Finland	France	Germany	India
Italy	Japan	Morocco	Netherland
Norway	Republic of Korea	Saudi Arabia	Sweden
United Arab Emirates	United Kingdom	United States	

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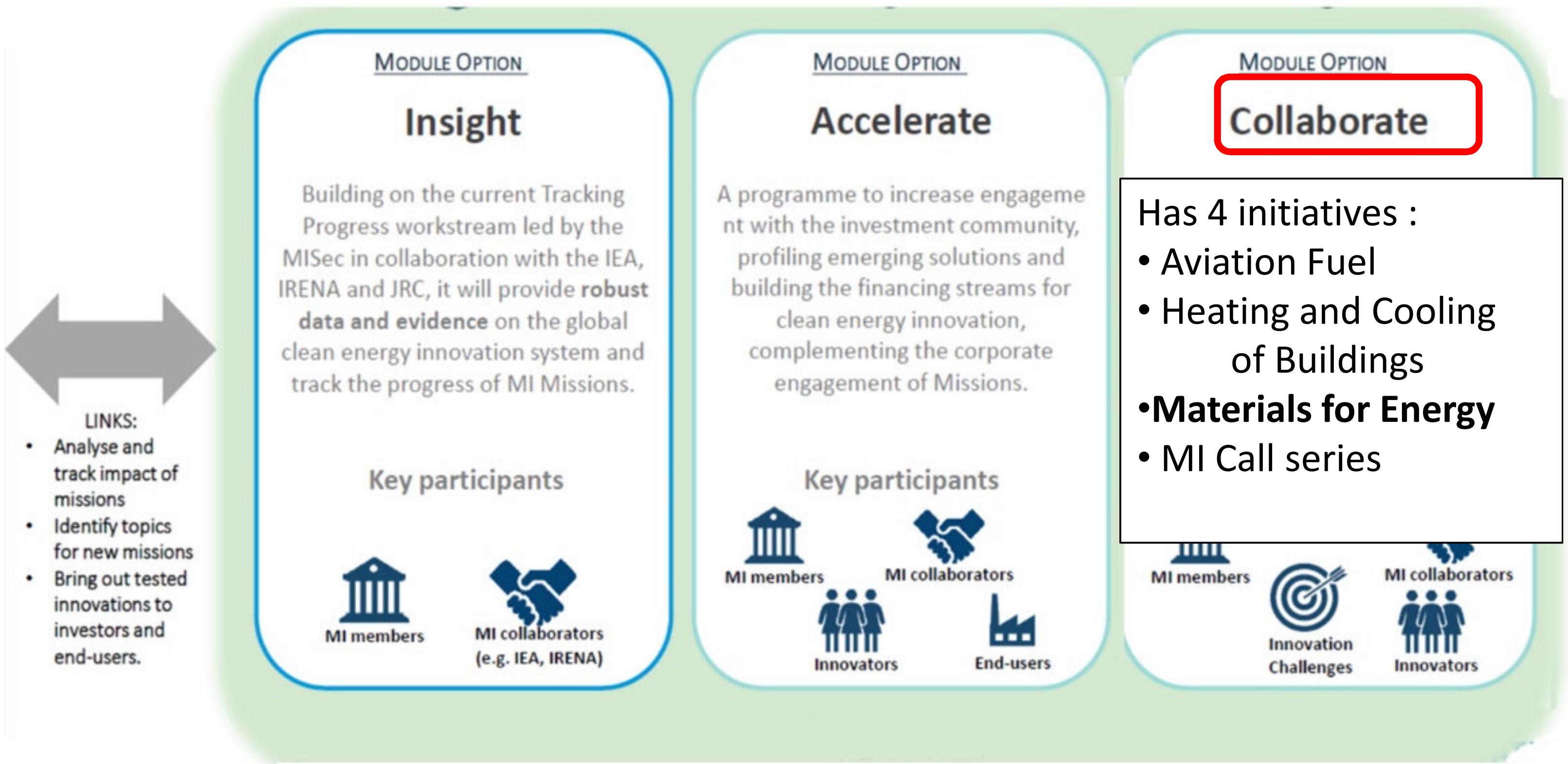
Mission Innovation Structure



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Collaborative Module Materials for Energy (M4E)

MISSION INNOVATION

Objectives of M4E

- To convene the international community through collaborative projects and infrastructure alignment, and deploy Materials Acceleration Platforms around the world
- To train the next generation of highly skilled talent
- **To transfer innovative technologies to industry partners for commercialization.**
- Accelerate innovation by a factor of 10

Co-leads: and soon

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Mission Innovation European Activities

- BIGMAP, DECODE, Helmholtz roadmap, etc ..
- GCMAC
  - 50+ participants from diverse German & Canadian backgrounds
  - Focus hydrogen and CO_2 reduction
- RISEnergy (StoRIES, …)
  - Research Infrastructure Eco-System
  - Materials research is a key issue
- EU-MACE
  - COST action establishing network

Funded by Federal Ministry of Education and Research

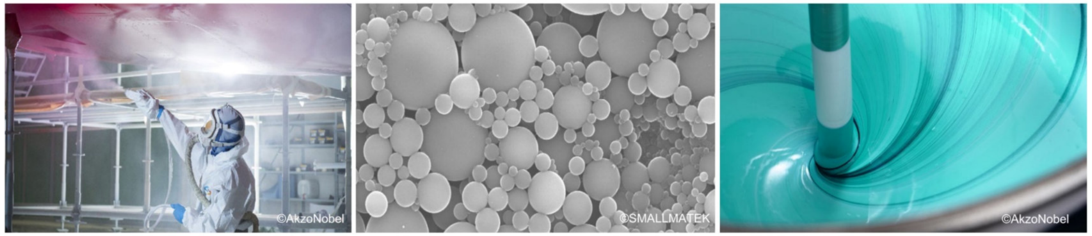
This project has received funding from the European Union's Horizon Europe Research and Innovation Programme under Grant Agreement N. 101131793

More Material Projects for Industries

RAISING THE DIGITAL MATURITY OF MATERIAL COMMUNITIES IN EUROPEAN PROJECTS

Natalia Konchakova, Helmholtz-Zentrum Hereon, Germany
Peter Klein, Fraunhofer ITWM, Germany

57th ECCA Autumn Congress, Brussels, 21.11.2022



VIPCOAT and OntoTrans projects receive funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 952903 and No 862136 correspondently.
DigiPass CSA project has been funded by the European Commission for the programme HORIZON-CL4-2023-RESILIENCE-01, Grant Agreement No 101138510

1

CONTENT

- VIPCOAT OIP → Interoperable Data Exchange
- Data Management → (Semi-)Automatization of knowledge generation and sharing
- Open Innovation Environment → Co-design and Co-development in a B2B2B relationship
- Support Decision Making → SSbD/ Circularity
- Digital Materials and Product Passport
- Conclusion

2

This project has received funding from the European Union's Horizon Europe Research and Innovation Programme under Grant Agreement N. 101131793

Communication on advanced materials

- Published on 27.02, link here
- Advanced materials → engineered materials with innovative properties and functionalities, **crucial for renewable and low-carbon energy conversion and generation, energy storage, grid development, renewable fuels, and enhancing energy efficiency.**
- Strategy aims to **enhance EU competitiveness** and **reduce the bloc’s reliance on critical materials** through the development of new advanced materials.
- Five main pillars of action:
  - **strengthening the R&I ecosystem**,
  - accelerating the development of market-ready innovative materials,
  - increasing investments and improving access to financing,
  - fostering the production and use of advanced materials through innovation procurement, creating clear interoperability standards and workforce reskilling,
  - establishing an overarching governance framework via the constitution of a Technology Council
- Establishes the new **public-private partnership under HEU “Innovative Materials for EU”,** with the potential to unlock €250 million in private investments, doubling the EU’s contribution between 2025 and 2027. **Total budget of €500 million**.

All HEU partnerships are mainly supporting industry high TRL actions.

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Breaking down barriers for data sharing I

Business model for a cross-industry collaboration

- **Objective:** building a cross-industry-RTO-academic collaboration to empowers project operators to share their data securely.

Energy Intelligence data

- The platform gives all partners a cohesive view of key information like operational and testing data, while still protecting privacy and confidentiality of those involved.

Key elements

- Platform opens to all permissioned parties
- A novel data sharing and permission model ensures security and protection of sensitive data by governing parties provided or granted data access. Sensitive information remains in the control of the providers across a de-centralized network of secured ledgers.
- The platform utilizes open API environment and interoperability for deploying new applications.

- **Tap on legacy data systems**
- **Success cases:**
  - DOE Global Energy Storage Database
  - OpenEI.org

- **Business Model**
  - Free access to marketplace of ontologies
  - Access to most common data pipelines for typical testing protocols and workflows
  - Pay-per-use

- **Content**
  - model deployment and automated meta-data management
  - Materials and process intelligence

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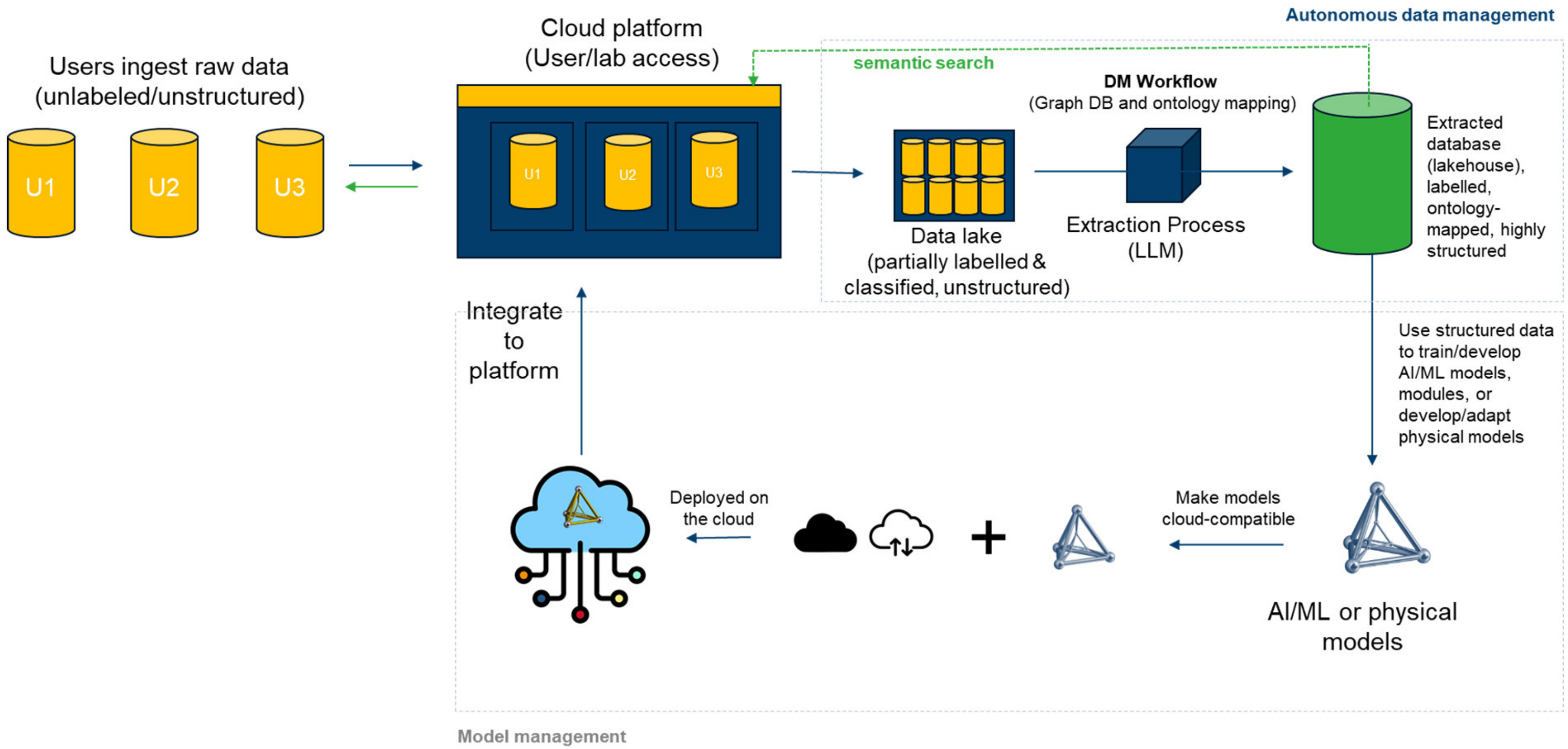
Breaking down barriers for data sharing II

Business model for a cross-industry collaboration



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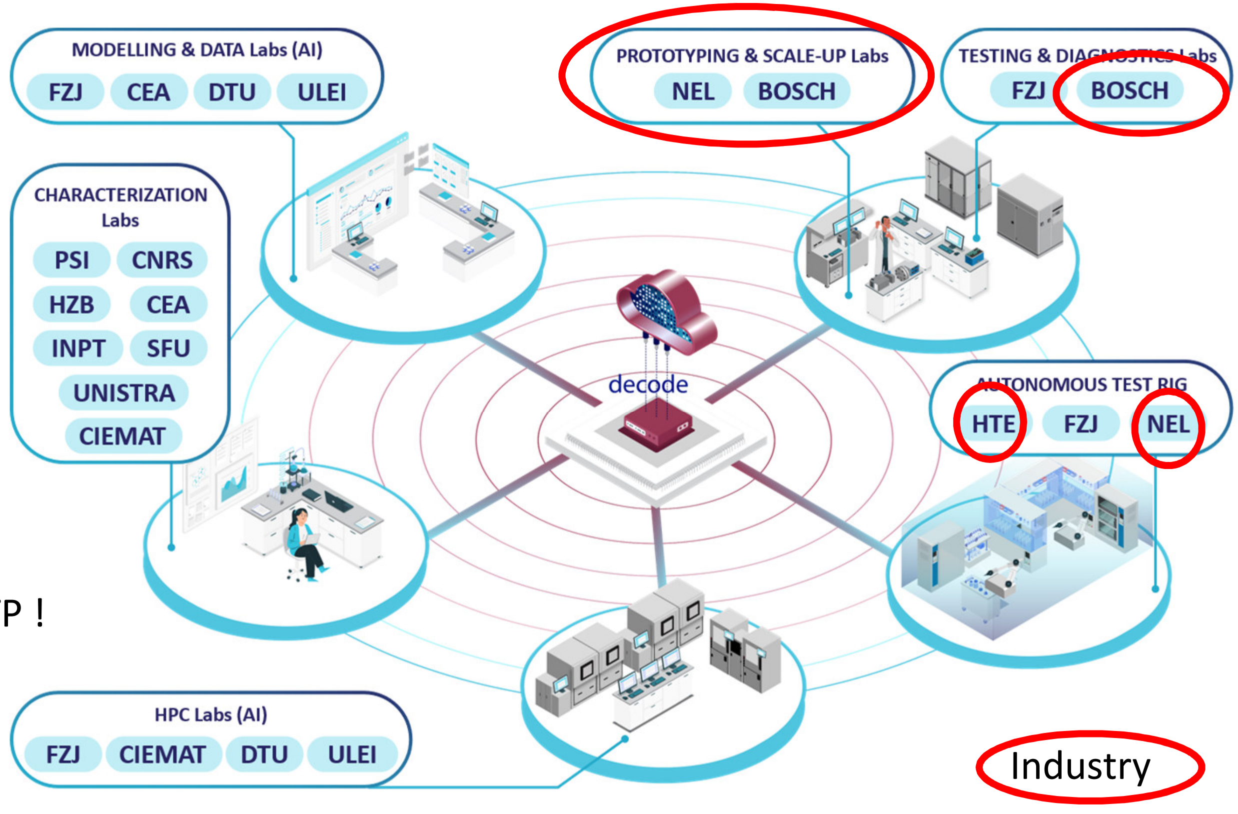
What kind of Framework do we need to bring Materials faster into new Devices/Application ?

- Public support for AI related data bases ?
  -> Commercialized after 5-10 years ?
- ESFRI support for an organised network of RTO focusing on electrolysers, batteries, advanced alloys, etc .. ?
- How to integrate the new partnership AM4IL ?



MISSION INNOVATION ⟷ cet Partnership

There is an attemptto to connect M4E and the CETP !

- Do we need a public portefolio management ?
- If so, could it be done be the ESFRI structure or may be by a CETP structure ?

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Thank You for Listening

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Acceleration: Where and How?

Intrinsic | **Microscale** | **Mesoscale** | **Macroscale** | **Device/Product**

SCALE UP

Integration

scale-to-scale | component-to component | lab-to-lab

- theory, modeling, simulation
- autonomous labs
- AI-enabled materials design
- fabrication characterization
- data handling and workflow optimization

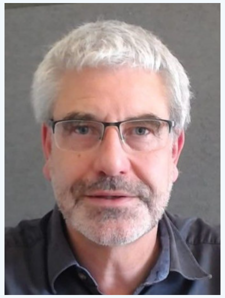
Networking Dinner

Enjoy!

Thank you

RISEnergy

KIT coordination team



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