Energy Conversion and Storage Days

21 – 23 March 2023, Karlsruhe

- StoRIES-FLORES-EERA JP ES Workshop on „Applications for Hybrid Energy Storage“
- SUPEERA Workshop „Bringing research and industry closer: ES and PV“
- EERA JP ES & PV steering committee meetings
- StoRIES workshops
- VIPERLAB workshop
- Site visits: Hybrid energy storage demonstrators with PV, wind turbines, …

Organised by:

KIT Karlsruhe Institute of Technology

Info and registration: www.storiesproject.eu

Energy Conversion and Storage Days

21 – 23 March 2023
Karlsruhe

Schedule

Energy Conversion and Storage Days, Karlsruhe, 21 - 23 March 2023

Tuesday, 21 March	Wednesday, 22 March	Thursday, 23 March
Venue		
FTU KIT Campus Nord Hermann-von-Helmholtz-Platz 1, 76344 Eggenstein-Leopoldshafen		FTU KIT Campus Nord Hermann-von-Helmholtz-Platz 1 76344 Eggenstein-Leopoldshafen/ Fraunhofer ICT Joseph-von-Fraunhofer-Straße 7, 76327 Pfinztal
Bus transfer Karlsruhe to KIT Campus Nord: 8:15		
Start: 9:00		
SUPEERA Workshop "Bringing research and industry closer: ES and PV" 9:00 - 13:00 FTU Aula	EERA JP ES SPM 9:00 - 12:30 SP1: FTU room 164 SP2: FTU room 221 SP6: FTU room 155	VIPERLAB road mapping workshop for perovskite PV technology development and harmonization in Europe 9:00 - 12:30 FTU Aula
		StoRIES - FLORES - EERA JP ES Workshop on "Applications for Hybrid Energy Storage" 9:00 - 12:10 KIT Campus Nord/FTU Aula
Lunch: 13:00-14:00	Lunch: 12:30-13:30	Lunch: 12:10-13:10
EERA JP ES Steering Committee 14:00 - 18:30 FTU Aula	StoRIES WS "Succeeding with Scale-up of Energy Materials" 13:30 - 14:45, FTU Aula StoRIES WS „Energy System Benchmarking for Hybrid Storage“ 14:45 - 16:15, FTU Aula	EERA JP PV Steering Committee (EERA JP PV members) 13:30 - 16:15 FTU room 164
EERA JP PV Steering Committee incl. guided tour PV Research KIT (EERA JP PV members) 14:00 - 18:30 FTU room 164/ LTI KIT Campus Süd		Visit of BiFlow STAGE 76, Bruchsal and Fraunhofer ICT, Pfinztal 13:10 - 16:00
	Coffee break: 16:15 - 16:45	
	Visit of Energy Lab 2.0 16:45 - 18:30	StoRIES - FLORES - EERA JP ES Workshop on "Applications for Hybrid Energy Storage" 16:00 - 19:00 Fraunhofer ICT, Pfinztal, Building 95
Bus transfer to Karlsruhe / Bus transfer to dinner	Bus transfer to Karlsruhe	
Workshop dinner "Carls Wirtshaus" Alter Schlachthof 51 76131 Karlsruhe 19:00	Workshop dinner "Alte Bank" Herrenstraße 30 76133 Karlsruhe 19:30	Get-together + social match-making event HEU calls at Fraunhofer ICT, Pfinztal: 19:00, Building 95
		Bus transfer to Karlsruhe: 21:15

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21 March 2023
Karlsruhe

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Workshop dinner "Carls Wirtshaus" Alter Schlachthof 51 76131 Karlsruhe 19:00	

Organizing Committee

Dr. Myriam Gil Bardají

Dr. Olga Sumińska-Ebersoldt

Dr. Alexandra Lex-Balducci

Andreea Koch

Contact: eera-jpes@bl3.kit.edu

This project has received funding from the European Union's Horizon 2020
Research and Innovation Programme under Grant Agreement No 101036910

Support to the coordination of national research and innovation programmes in areas of activity of the European Energy Research Alliance

SUPEERA workshop

Bringing research and industry closer: accelerating innovation and uptake of new technologies

→ *The workshop is in hybrid mode (**recorded**)*

→ ***Do not turn on your microphone and camera during the event;** you **only** might be requested to do so during the Q&A session*

→ *Please **send your questions via chat** to all organisers*

→ *The **recording** of the webinar and the **PPT** will be **circulated shortly after***

Karlsruhe, Germany, 21.03.2023

AGENDA (speakers) 1/2

09:00	**Welcome and greetings**
09:10	Keynote speech Walter Tromm, Scientific Spokesperson Energy Centre, KIT
09:20	**The SUPEERA project / The SET Plan as a tool for EU-wide collaboration on R&I priorities of low-carbon technologies** Ivan Matejak, SUPEERA coordinator, EERA **Presentation of two pathways: Energy Storage, Solar Photovoltaics** Maria Oksa, Senior Scientist - Project Manager, VTT - online
09:40	**Collaboration between research and industry: best practices, barriers and replicability potential**
	Fundraising opportunities and innovation trends within the solar PV and energy storage area - Francesco Matteucci, Programme Manager, European Innovation Council
	EERA Joint Programme Solar Photovoltaics - Ivan Gordon, EERA JP PV Coordinator, IMO-IMOMEC / Energyville
	EERA Joint Programme Energy Storage - Myriam Gil Bardaji, JP Energy Storage Coordinator, KIT
	Modular e-Fuel production – the story of the university spin-off INERATEC - Tim Böltken, Founder and Managing Director, INERATEC GmbH
	Collaboration examples between research and industry at Fraunhofer - Simon Philipps, Head of R&D Strategy, Fraunhofer Institute for Solar Energy Systems ISE (EERA JP PV Coordinator)
	Panel discussion and Q&A - Moderator: Ivan Matejak, SUPEERA coordinator, EERA
11:10	Coffee break

AGENDA (speakers) 2/2

11:30 Cross-sectorial dialogue for system solutions towards the CET objectives

Systemic and cross-sectorial issues pertaining to the Clean Energy Transition - Spyridon Pantelis, Project Manager, EERA

From lab to market - new bio-inspired coatings for solar modules - Ruben Hünig, Co-Founder and CEO, Phytonics (energy efficiency)

Grid integration with Energy Storage System through OpenEMS - Sagar Venu, Software Engineer, Fenecon (energy system integration)

Engagement of solar PV industry and research at SolarPower Europe - Catarina Augusto, Senior Technical Advisor at SolarPower Europe (policy & international cooperation) - online

EU cooperation - The FLORES network - Peter Fischer, Head of Redox Flow battery and stationary storage group, Fraunhofer ICT (international cooperation)

Panel discussion and Q&A

Moderator: Spyridon Pantelis, Project Manager, EERA

13:00 Lunch break

Welcome and objective of the workshop

Ivan Matejak, EERA,
Project Coordinator

SUPEERA supports the SET-Plan and the Clean Energy Transition

We...

- → Facilitate the coordination of the research community
- → Accelerate innovation and uptake by industry
- → Provide recommendations on policy
- → Promote the SET-Plan and the Clean Energy Transition

We connect the dots.

EERA European Energy Research Alliance

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VTT

OBJECTIVES of the:

PROJECT ACTIVITY:

- Promoting and establishing a **dialogue between industry and energy experts** (including SET Plan IWGs, European industrial organisations & related platforms);
- **Analysing** the proposed energy measures in the **NECPs** and LTSs;
- **Defining pathways** covering different realities in terms of maturity & regional coverage;
- Delivering sectorial, cross-sectorial and systemic **recommendations on R&I priorities**; supporting uptake of new technologies by the industry

WORKSHOP:

- Update on selected pathways: **Energy Storage & PV;**
- Present and **discuss key findings** of initial analysis of NECPs and national & EU initiatives;
- Focus on **relevant cooperation practices/experiences** (esp. research-industry) to facilitate innovation & market uptake;
- Consider **preliminary recommendations** & their possible replicability in other countries;
- Follow up on **series of workshops**

The SET Plan & NECPs as tools for EU-wide collaboration on R&I priorities of low carbon technologies

Ivan Matejak,
SUPEERA Coordinator

Dynamism of R&I in the EU energy transition

Need for R&I coordination → Integrated SET Plan (2008; 2015; *2023*)

Climate emergency → European Green Deal (2019)

COVID emergency →Recovery Plans (2021)

Energy emergency → REPowerEU (2022)

Competitiveness emergency → Green Deal Industrial Plan + ? (2023, 2024…)

SET Plan evolution

Since 2007 :

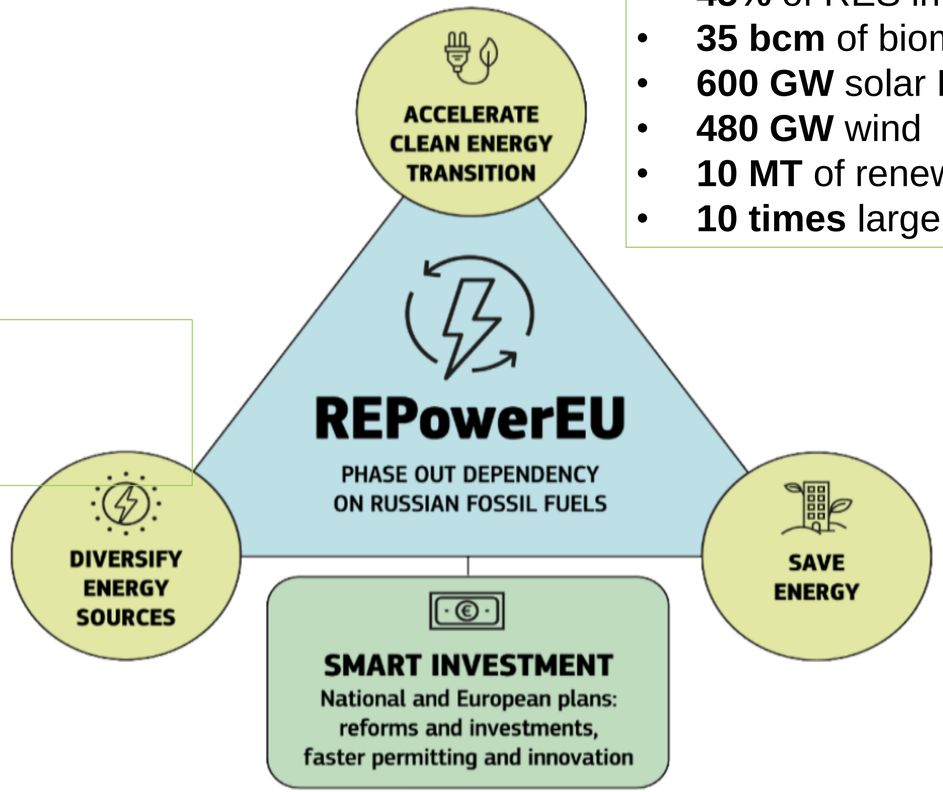
- the SET Plan has been **instrumental in fostering collaboration** between SET Plan countries, industry and research institutes
- successful in **coordinating national R&I agendas** on low-carbon energy
- **14 SET Plan IWGs** have established ambitious research and innovation targets
- **Cross-sectorial** collaboration has increased

Revamping process 2022/2023:

- Deliver on the goals of the **Green Deal**, the **Energy Union, Recovery Plans** and the **ERA**
- Strengthen EU's strategic energy **value chains** to increase our energy and technology independence and security of **energy supply**
- Adapt the **governance of the SET Plan** to ensure the delivery on issues of strategic importance while keeping flexibility and agility
- Promote synergies between different programmes and **leverage national financing**

REPowerEU

- **45%** of RES in the mix
- **35 bcm** of biomethane
- **600 GW** solar PV
- **480 GW** wind
- **10 MT** of renewable H2 produced in the EU
- **10 times** larger electrolyser manufacturing



- Joint **gas** and **H2** purchases
- **LNG** investment

- **15%** reduction in gas demand
- **35 bcm** gas saving in industry

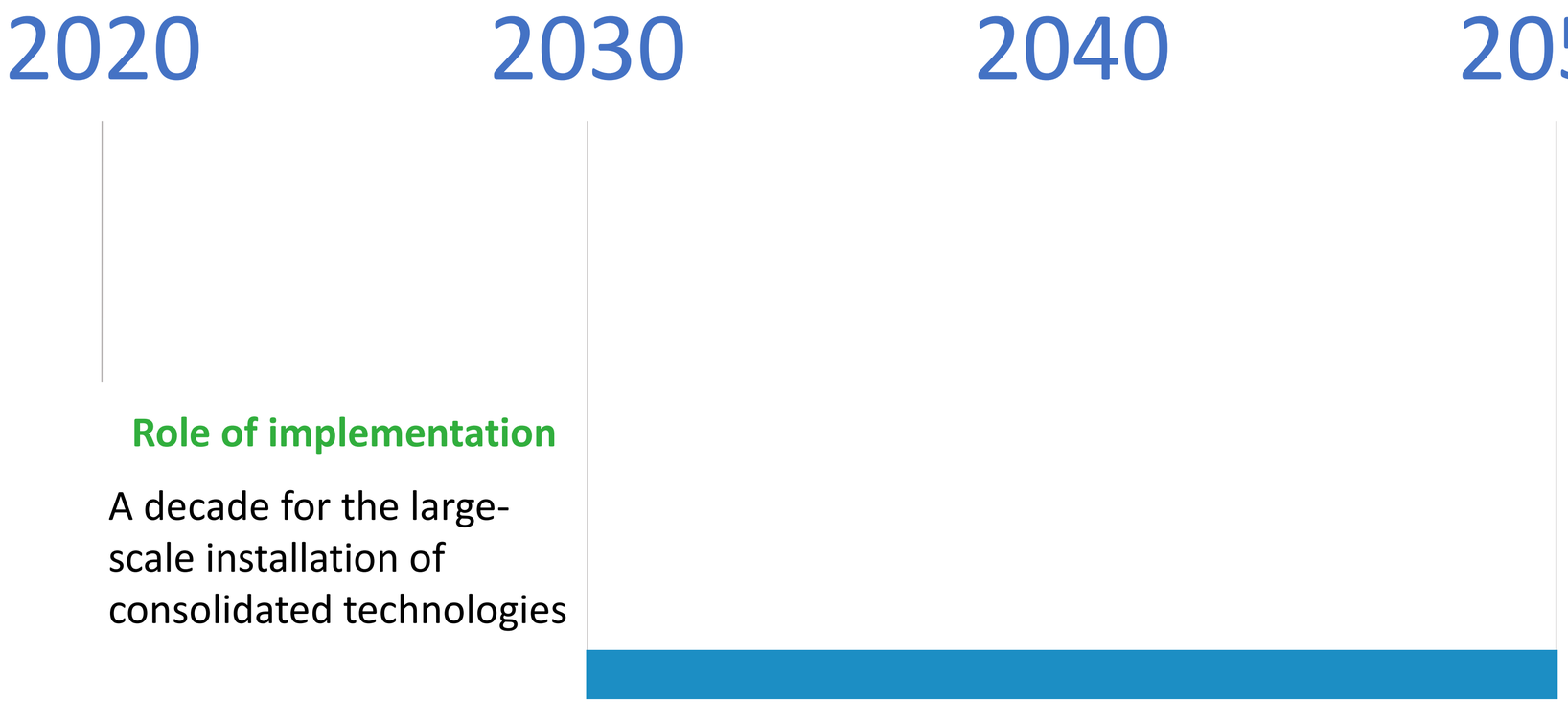
- **200 bln €** in diverse CET infrastructure
- **200 bln €** in green H2
- **10 bln €** in LNG

EERA REPowerEU Manifesto

- Based on an **iterative interaction** with JPs
- A 25 pages report
- Formalises a new contribution by research
- Detailed technology recommendations
- 12 high level policy recommendations

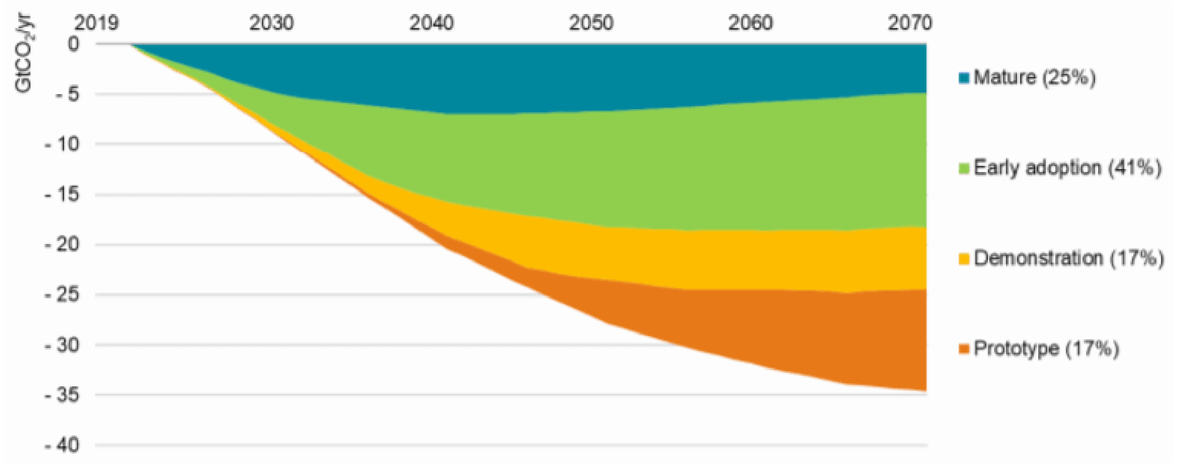
Link: EERA REPowerEU Manifesto

A new role for research: facilitating REPowerEU implementation



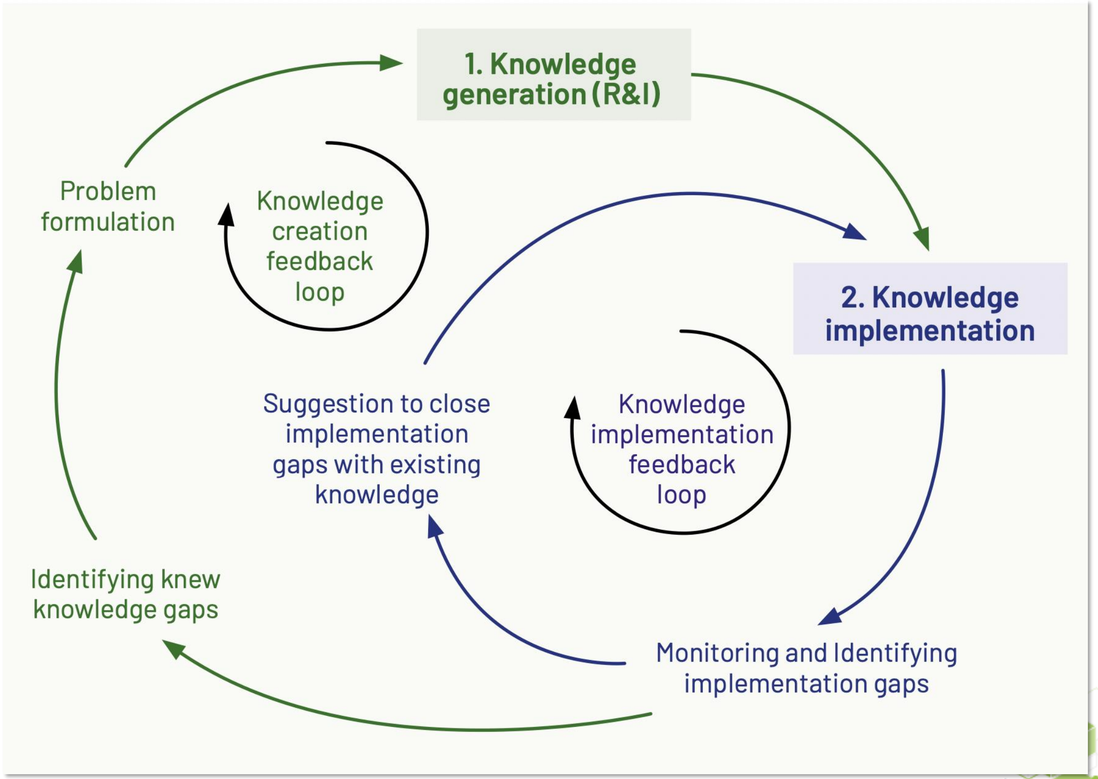
Need to accelerate the existing knowledge implementation

CO_2 emissions reductions by technology readiness category in the Sustainable Development Scenario



Notes: Percentages refer to cumulative emissions reductions by 2070 between the Sustainable Development Scenario and baseline trends enabled by technologies at a given level of maturity today.

Technologies that are at the prototype or demonstration stage today contribute more than one-third of the cumulative emissions reductions in the IEA Sustainable Development Scenario.



The European Commission's Green Deal Industrial Plan

- Largely a reaction to the **US IRA,** launched on 1st Feb 23

Four pillars:

Predictable and simplified regulatory environment

- **Net Zero Industry Act** → simplified regulatory framework for production of "net-zero" products; criteria for net-zero supply chain projects of "strategic interest"
- **Critical Raw Materials Act** → EU's access to minerals, metals critical for net-zero technologies
- **Electricity Market Design Reform** → shield households and businesses from high energy prices, increase resilience, accelerate the clean energy transition

Faster access to sufficient funding

- Changes to the **EU state aid rules** to unlock public national financing and increase the volume of EU funding for net-zero technologies

Enhancing skills

- **Net-Zero Industry Academies** to upskill, re-skill the workforce and facilitate the access of third-country nationals to EU labour markets in priority sectors

Open trade for resilient supply chains

- Development of **EU's Free Trade Agreements**, protection of the EU market from unfair trade, creation of **Clean Tech/Net-Zero Industrial Partnerships** and a "**Critical Raw Materials Club**"

- Other measures → EU-funded competitive **bidding process for the production of renewable hydrogen**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PANEL SESSION Collaboration between research and industry: best practices, barriers and replicability potential

Moderator: Ivan Matejak

European Innovation Council	Francesco Matteucci, Programme Manager
EERA Joint Programme PV	Ivan Gordon, IMEC, JP Co-coordinator
EERA Joint Programme ES	Myriam Gil Bardaji, JP Coordinator
INERATEC GmbH	Tim Böltken, Founder and Director
Fraunhofer ISE	Simon Philipps, JP Co-coordinator

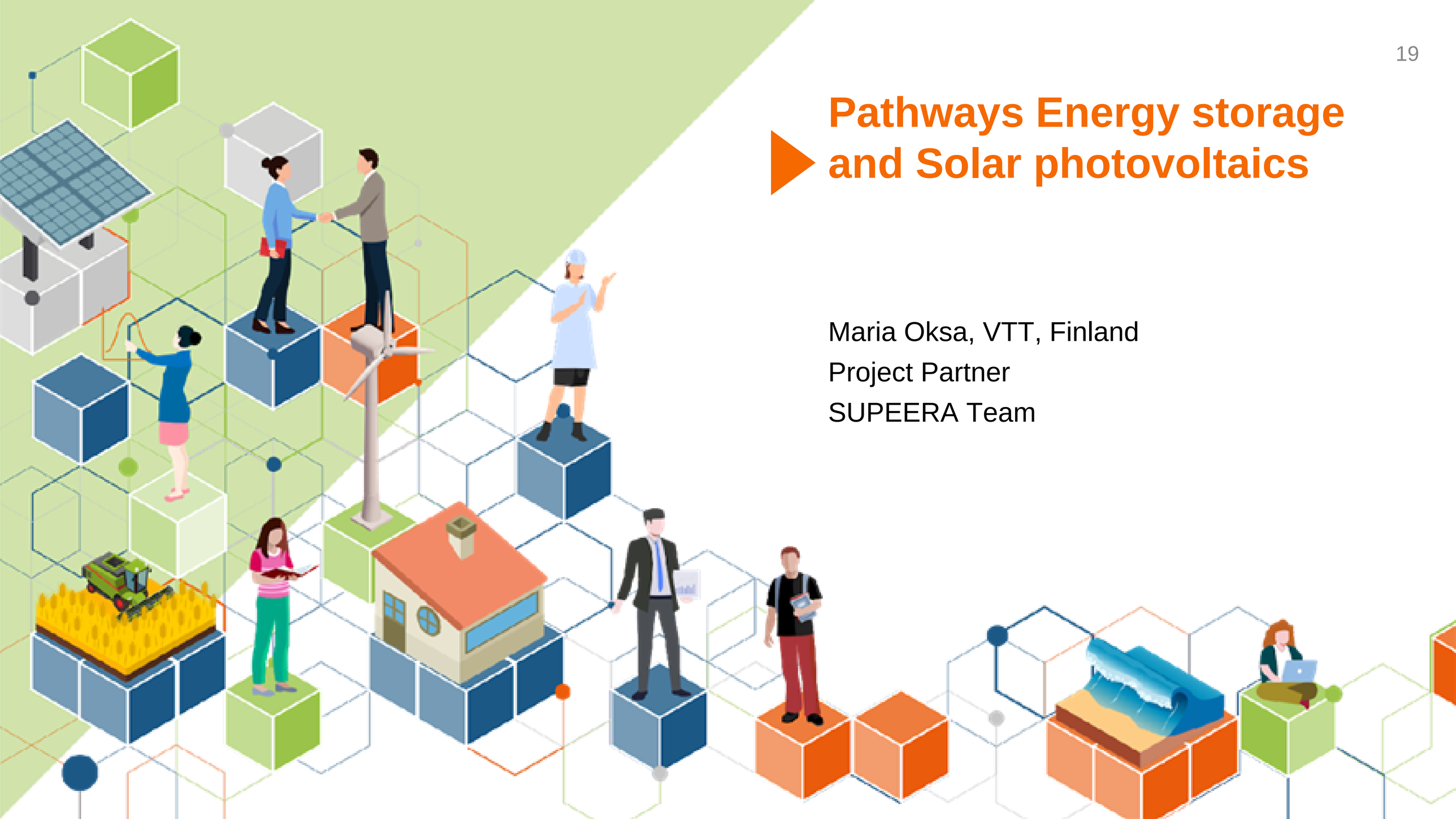
Support to the coordination of national research and innovation programmes in areas of activity of the European Energy Research Alliance

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 949125.

Workshop – Energy storage & Solar Photovoltaics

Bringing research and industry closer: Accelerating innovation and uptake of new technologies

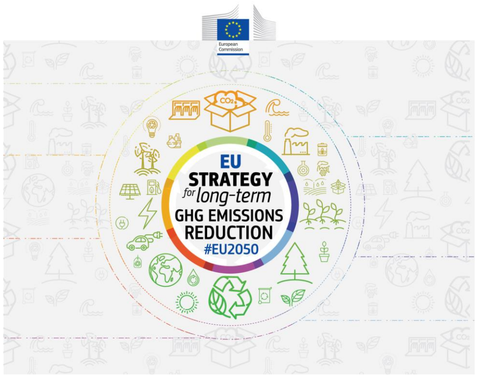
Karlsruhe, Germany, 21.3.2023 Hybrid



Pathways Energy storage and Solar photovoltaics

Maria Oksa, VTT, Finland
Project Partner
SUPEERA Team

SUPEERA supporting the energy transition



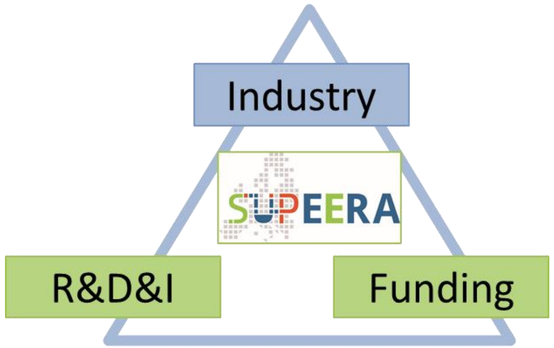
→**Context and background on EU level**

- EU Strategy for long-term GHG emissions reductions
- European Green Deal
- Integrated SET Plan and the SET Plan Implemantation Plans
- Recovery and Recilience Facility (RRF instrument)

→**National climate targets**

- EU countries' 10-year national energy and climate plans for 2021-2030

→**From research to industry**



National Energy and Climate Plans (NECPs)

→EU countries released 2019-2020 their **National Energy & Climate Plans (NECPs),** with strategy, objectives and activities to meet the EU´s energy and climate targets for 2030

→The plans include national targets, objectives, policies and measures for different **dimensions** and they address an array of **technologies**

→**Dimensions**

- *Decarbonisation*
- *Energy efficiency*
- *Energy security*
- *Internal energy market*
- *Research, innovation & competitiveness*

→The NECPs are being updated (original deadline June 2024)

Methodology on analysis of the NECPs

→***27 NECPs and the EC assessments (Oct 2020)***

→Criteria for selection:

- Increase regional coverage
- Matching regions with best practices
- Strong European competitive areas
- Pathways with needs of cross-sectorial and systemic activities
- Planned measures maturity

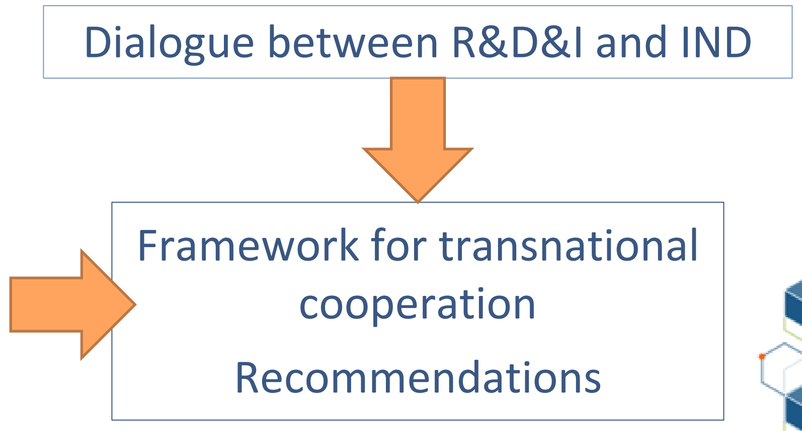
→Selection of pathways

Selection of the most relevant six pathways on energy (wind, hydrogen, **storage**, bio, energy systems integration and **solar**)

<u>Analysis of the pathways</u>

→Focus on NECP chapter 2.5 Research, innovation and competitiveness

→**Best practices, barriers and gaps**



Energy storage - overview

→Relevant European Policy

Clean energy for all Europeans package

- Energy storage addresses several central principles of package

A comprehensive European Approach to Energy Storage. The report:

- Was adopted by the European Parliament in July 2020;
- Calls on the Member States to fully explore their energy storage potential;
- Underlines the need for flexibility that arises from intermittent RES electricity generation;
- States that increasing amounts of storage capacity needed for excess electricity;
- Feasible technologies vary by country.

→Technology recap from the NECPs

Electricity storage technologies

- Pumped hydro storage plant has largest capacity (Europe, global)
- Battery storage for mobility and stationary uses, European priority
  - Scale from house to transmission substation battery banks
- *Islands and other remote areas with limited interconnections, storages especially valuable; range of feasible technologies limited*

Heat storage technologies

- Time scale from daily to long-term seasonal storage
- Primary needs in buildings and industry
- Store excess RES electricity as heat in liquid or solid matter
- Utilise currently wasted heat streams via heat pumps

Best practises in energy storage actions

→Regional cooperation in research and funding

- **France and Germany** launched 2018 bilateral funding of €20 million on energy storage and distribution. Funded projects create knowledge about energy storage conditions and operation in cross-border distribution system.
- **Nordic Energy Research**: seven key areas for joint Nordic research efforts, incl. Energy Storage, to be granted up to 4 million NOK to each key area

→Regulation

- **In Finland** the power reserve system ensures electricity supply in situations in which market-driven electricity does not cover demand, e.g. low RE generation
- Power plants, demand-side flexibility and storage can participate in the power reserve. The system has been in use since 2007.

→Projected storage capacity

- Planned capacity expressed in MW in **Austria, Bulgaria, Italy and Spain**

→Remote areas

- **Greece** plans to promote solar powered desalination plants with battery storage to produce water for drinking or irrigation on islands and in remote areas.
- RE and energy storage systems will supply stable power for these desalination plants.

→Circular economy

- Retiring the two last coal-fired power plants of **Portugal** in 2023 will involve studies for recycling and reusing the equipment
- Thermoelectric solar capacity with storage to produce renewable steam for existing turbines
- Direct use of green hydrogen as a fuel to substitute coal

NECP Key highlights on solar energy

Predict a visible growth for the solar energy production in the next 10 years

The NECPs can ease a cost-effective solar energy deployment by suggesting clear funding mechanisms, enabling regulatory frameworks, and simplifications in the permitting processes.

Decentralization of the renewable energy production as a vital aspect in order to achieve the Clean Energy Production targets.

Most of the countries consider future developments both at the small scale (community level) and large scale (solar plants or farms).

Best practices

BUILDINGS

- Roof photovoltaic in residential and non-residential buildings
  - AT: 100 000 rooftops solar panel and small-scale storage programme
  - FI: decarbonising the current building stock by 2050
  - FR: up to 200 km² of roof panels by 2028
  - HU: 200 000 households with roof PV panels

- R&I prefabricated active roof and facade elements combining photovoltaic and thermal solar systems (EL)

PROSUMERS/SELF-CONSUMPTION

- LU: tariffs for small installations, special categories for cooperatives for citizen participation and calls for tender for larger installations.
  - Preconditions, development and production permits no longer required
  - cost of connecting prosumers to the networks has been reduced
  - enterprises are allowed to become prosumers
  - the capacity limitation requirements have been revised
- LT: a sustainable ecosystem for prosumers and ensure its sustainable development.
- IE: supports customers' participation in the energy system
- PL: 'My Electricity Bill' with a pool of funds of PLN 1 billion

Factors that lead to the expansion of solar technology

Funding mechanisms, enabling regulatory frameworks, and simplifications in the permitting processes

- Tenders to speed up the expansion of photovoltaics (AT, DE, LU, FR)
- Administrative measures: Simplified processes for development of solar energy projects (IT, PT, SE, LT)
- Purchase Agreements (DK, LU, IT, ES)
- Subsidy grants (AT, NL, DK, DE, LU, SK)

Collaboration

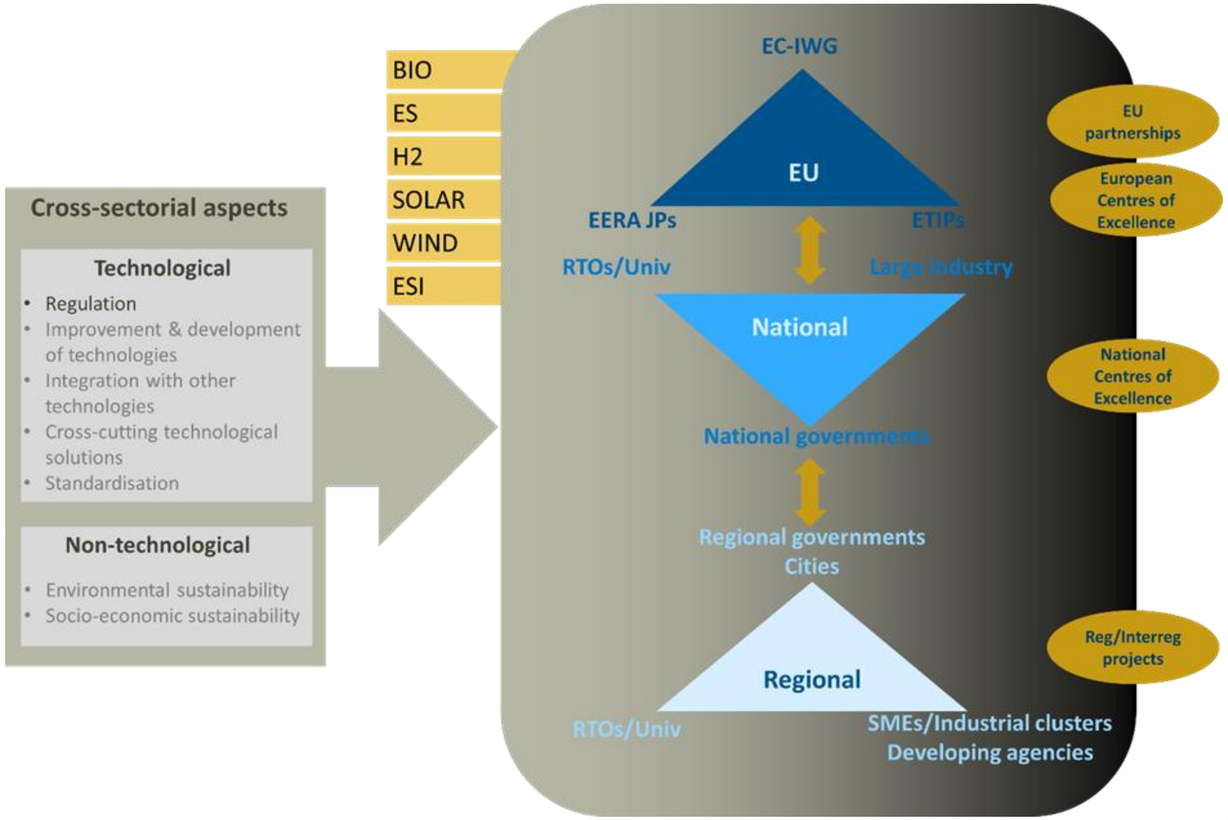
- INSHIP and CySTEM projects
- Denmark has entered a cooperation agreement with Germany for statistical transfers for the electricity production from 50 MW solar PV
- International initiatives: Clean Energy Ministerial, IRENA, International Solar Alliance.

Support to cooperation and dialogue

Collaboration model

- The model embodies a coherent form to map and discuss how technologies and cross-sectoral aspects correspond to the energy transition at different geopolitical levels.
- It focuses on the involvement and interconnections of actors committed to realizing local ideals mirror the transnational ones and vice-versa.
- The model is targeted to bring transnational awareness to support the energy transition in EU level.
- Collaboration interfaces (“collaboration triangles”) drafted for the six pathways
- *The model will be published in SUPEERA deliverable report later in March 2023*

Collaboration interface



Collaboration in batteries

→European level – complex ecosystem

- Collaboration comprises stakeholders from research organisations, industry and the government represented by Member States/Associated Countries representatives
  - Implementation Working group on Batteries (**IWG Batteries**), also known as the National and Regional Coordinators Group (NRCG), chaired by France. This IWG implements its SET Plan Action through **Batteries Europe** (ETIP Batteries).
  - Batteries European Partnership Association (**BEPA**), the international non-profit-making association representing research organisations and the private side of the BATT4EU Partnership.
  - **Battery2030+**, a collaboration network on batteries involves research organisations and industry to invent the batteries of the future.
  - The industry-led European Battery Alliance (**EBA**), an initiative launched by the EC.

→National level – Germany

- The collaboration triangle comprises National Government, industries (small and large size), non-profit foundations and research organizations, including (Research and Technology Organisations (RTO), research associations, research centres, and universities (Science and Applied Science Universities).
  - Governmental players: The German Federal Ministry of Education and Research (**BMBF**), the German Research Foundation (**DFG**) and the Federal Ministry for Economic Affairs and Climate Actions (**BMWK**).

→Regional level example

- The Ministry of Economics has established a collaboration program in Baden-Württemberg with around 7.2 million euros to develop battery research activities

Collaboration solar photovoltaic

→European level

- Collaboration across the government, industry and research of the PV sector is taken place through the European initiatives:
  - SET Plan Implementation Working group on Photovoltaics (**PV IWG**) with 11 SET Plan countries and 15 representatives from industry or research organisations
  - **ETIP PV**, plays an essential role in mobilising and bringing together experts from industry and academia
  - **PV-IMPACT**, a H2020 project coordinated by EUREC
  - the **European Solar Photovoltaic Industry Alliance**, brings together industrial partners to accelerate solar photovoltaic deployment in the EU
  - **EERA Joint Programme on Solar PV**

→National level – Italy

- The collaboration triangle is realised through several collaboration schemes between the government, industry, and research organisations in the field of solar photovoltaics.
  - **Ministry for Economic Development** and **Ministry of Research**
  - **ENEA**, one of the largest RTO in Italy, collaborates closely with industry
  - The Italian National Research Council (**CNR**) is a leading public research organisation in the field of solar energy
  - **RSE** (Energy System Research) is a research organisation that specialises in the study and development of sustainable energy systems

→Regional level example

- Collaboration between industry and regional authorities, Enel and the Emilia-Romagna regional administration, to support the sustainable energy transition, has realised with e.g. the development of large-scale solar PV plants.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Bringing research and industry closer: accelerating innovation and uptake of new technologies. Energy storage & Solar Photovoltaics

Fundraising opportunities and innovation trends within the solar PV and energy storage area

21th March 2023

Francesco Matteucci

EIC Programme Managers on Advanced Materials for Energy and Environmental Sustainability

European Innovation Council

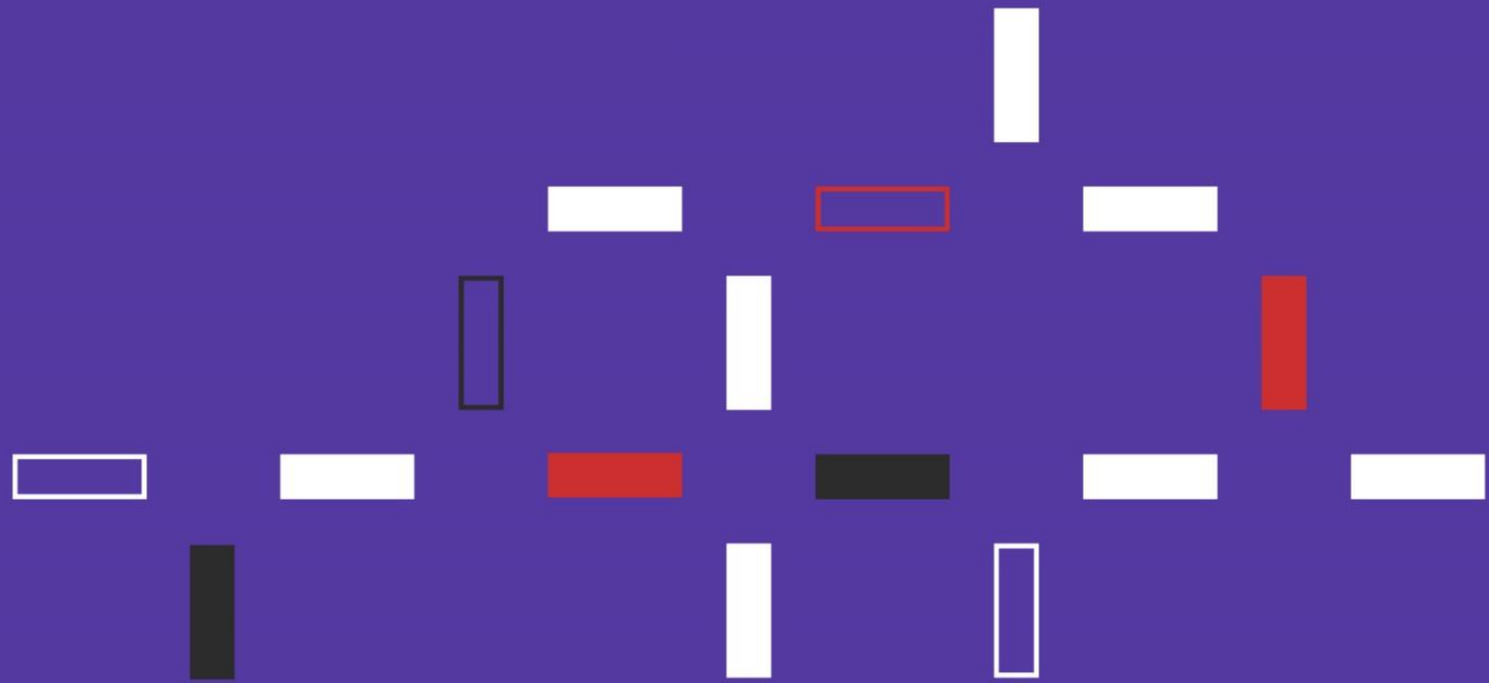
Index

1. The European Innovation Council – why, what, how?
2. EIC strategic approach for PV and Energy storage
3. Portfolio approach
4. Examples of EIC Funded projects on Energy Storage and Solar PV portfolios
5. Innovation trends and market opportunity for Energy system integration of Solar PV and energy storage technologies

European Innovation Council

The European Innovation Council

why, what and how?



Deeptech

European Innovation Council

Problem and Hardware oriented

Multidisciplinary

High risk, high fund needed

Open innovation approach (ecosystem of innovation)

investments include private investments, minority stakes, initial public offerings and M&A

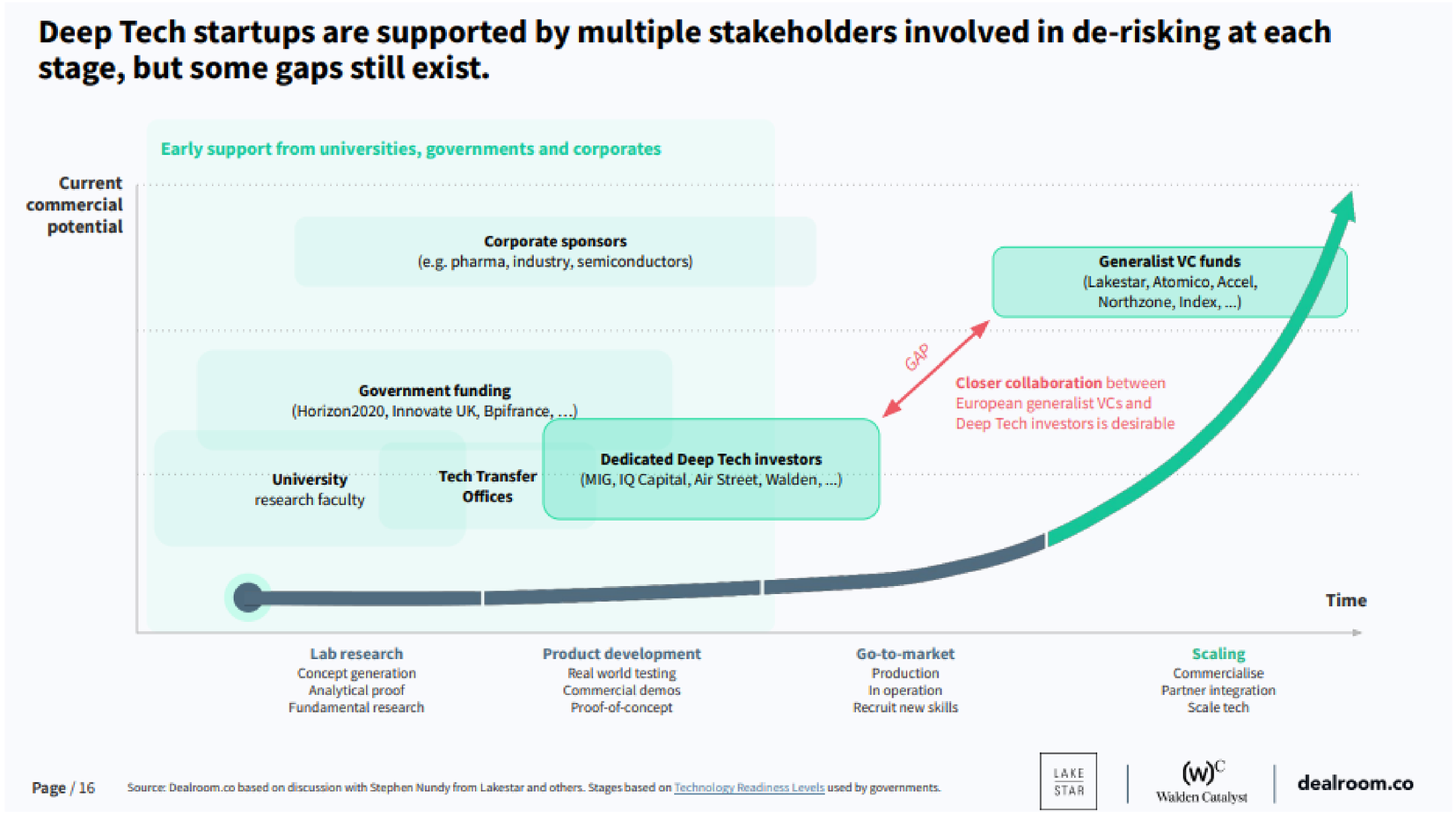
Source: Boston Consulting Group and Hello Tomorrow

Deeptech fundraising opportunities

European Innovation Council

Turning innovation into solid economic success requires patience

Nobel Laureate J. Goodenough developed the Li-ion battery in the 1970s, but it wasn't until 1991 that Sony first commercialised it.



What's holding back European innovation?

Innovation **performance**	• **Strong research performance not translated** into innovation • **Lack of breakthrough/ disruptive innovations** that create new markets
Innovation **funding**	Financing gaps (2 "valleys of death") in • **Transition** from lab to enterprise • **Scaling up** for high-risk innovative start-ups
Innovation **ecosystem**	• Many national & local ecosystems, but **fragmented at European** level • Need to **include all regions and all talent** (especially female)

We need to overcome European Paradox – perceived failure of EU countries to translate scientific advances into marketable innovations.

EU Research & innovation programme 2021–27

European Innovation Council

HORIZON EUROPE

EURATOM

SPECIFIC PROGRAMME: EUROPEAN DEFENCE FUND

Exclusive focus on defence research & development

- Research actions
- Development actions

SPECIFIC PROGRAMME IMPLEMENTING HORIZON EUROPE & EIT*

Exclusive focus on civil applications

Pillar I
EXCELLENT SCIENCE

- European Research Council
- Marie Skłodowska-Curie
- Research Infrastructures

Pillar II
GLOBAL CHALLENGES & EUROPEAN INDUSTRIAL COMPETITIVENESS

Clusters
- Health
- Culture, Creativity & Inclusive Society
- Civil Security for Society
- Digital, Industry & Space
- Climate, Energy & Mobility
- Food, Bioeconomy, Natural Resources, Agriculture & Environment

Joint Research Centre

Pillar III
INNOVATIVE EUROPE

- European Innovation Council
- European innovation ecosystems
- European Institute of Innovation & Technology*

WIDENING PARTICIPATION AND STRENGTHENING THE EUROPEAN RESEARCH AREA

- Widening participation & spreading excellence
- Reforming & Enhancing the European R&I system

EURATOM

- Fusion
- Fission
- Joint Research Center

* The European Institute of Innovation & Technology (EIT) is not part of the Specific Programme

The main EIC Support Schemes

European Innovation Council

Pathfinder

For advanced research on breakthrough / game-changing technologies

Pathfinder Open: bottom-up approach; no predefined topics

Pathfinder Challenges: top-down challenge-driven calls for tackling specific issues by portfolios of projects

Transition

For transforming research results into innovation opportunities; follow up results from EIC Pathfinder and ERC Proof of Concept

Transition Open: no topic prescription

Transition Challenges: selected challenges

Accelerator

For individual companies to develop and scale up breakthrough innovations with high risk and high impact

Grant Funding

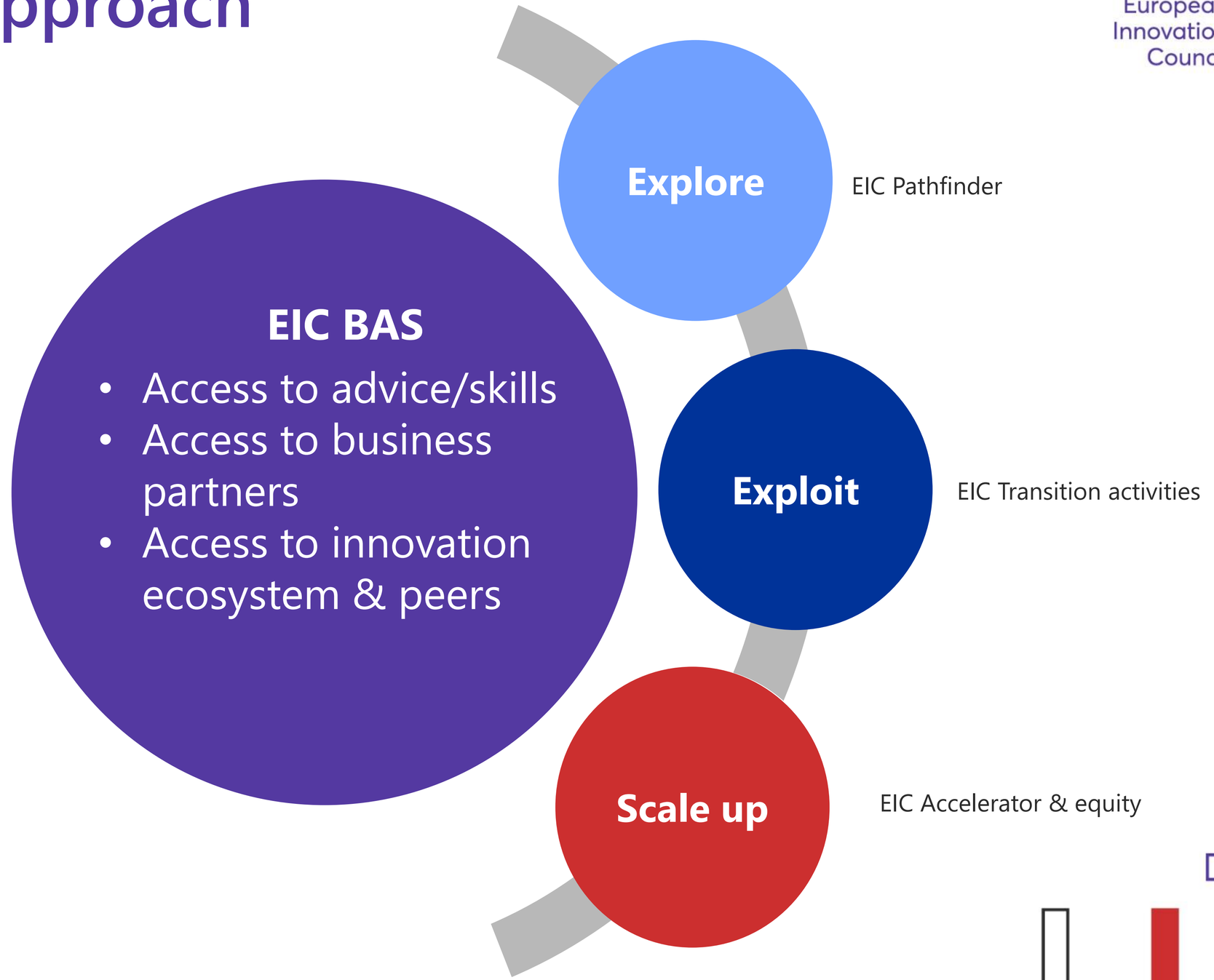
Equity Funding

Business Acceleration Service

EIC Fund: VC fund – EC shareholder / Bridging equity funding gap at early stage / Crowding in other investors

Business Acceleration Service: access to advice, to business partners and to innovation ecosystems & peers

Hands on approach



Hands on approach

European Innovation Council

Identify emerging challenges for Europe's deep-tech roadmap

Science and innovation intelligence activity

Hands-on approach

Strategic assessment and clustering of projects

Building strategic intelligence portfolios

Scientific / Business portfolios management

EIC Ambassador

Networking with other programmes and with innovation ecosystem communities

Outreach and organization of events, participation to national events / workshops

EIC Proactive Management

The EIC Programme Managers

https://eic.ec.europa.eu/eic-communities/eic-programme-managers_en

Carina Faber

Renewable energy conversion and alternative resource exploitation

Samira Nik

Quantum tech and electronics

Isabel Obieta

Responsible electronics

Antonio Marco Pantaleo

Energy systems and green technologies

Francesco Matteucci

Advanced materials for energy and environmental sustainability

Stella Tkatchova

Space systems and technologies

Iordanis Arzimanoglou

Health and biotechnology

Enric Claverol-Tinturé

Medical technologies and medical devices

Ivan Stefanic

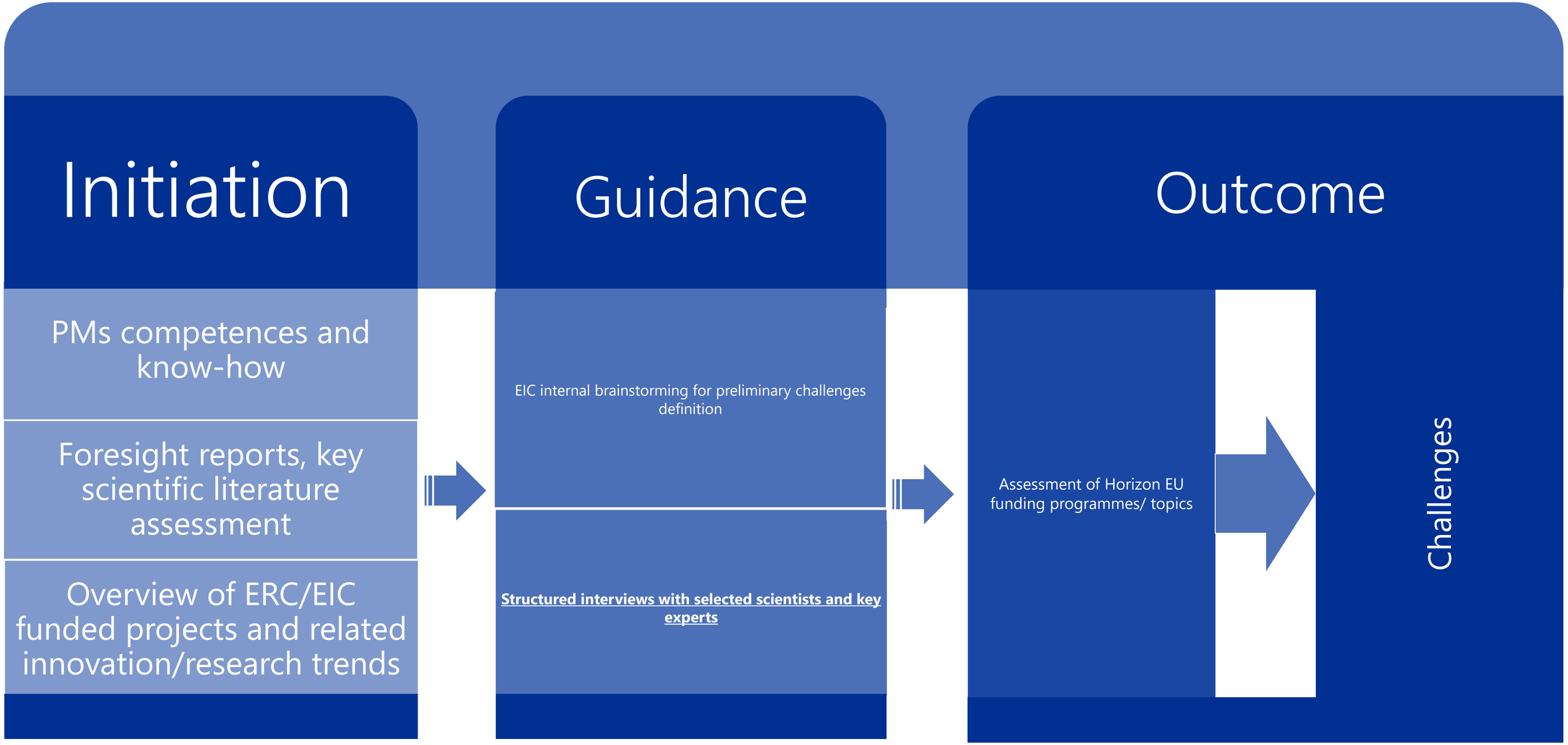
Food chain technologies, novel & sustainable food

Franc Mouwen

Architecture engineering construction technologies

Challenges Process of Selection (Methodology)

European Innovation Council



Thematic Portfolios & content-wise approach

European Innovation Council

Some of the **EIC Cleantech Thematic portfolios**

- **Renewable Hydrogen** (production, storage, logistics, end use)
- **Energy storage** (electrical, thermal, chemical, mechanical and electrochemical)
- **Solar conversion technologies** (solar-to: thermal, fuel, electricity)
- **Ocean technologies** (wave, tidal, offshore wind, etc.)
- **Sustainable Materials**
- **Climate and Environment** (air/water/soil monitoring/depolluting, environmental intelligence)

EIC Cleantech challenges

European Innovation Council

EIC Challenges 2021

	Pathfinder	Transition	Accelerator
Cleantech	• Novel routes to green hydrogen production (Portfolio kick off meeting October 2022)	• Energy harvesting and storage technologies	• Green Deal innovations for the economic recovery

	Pathfinder	Transition	Accelerator
Cleantech	• Carbon dioxide & Nitrogen management and valorisation (final retained list end March 2023) • Mid-long term, systems-integrated energy	• Process and system integration of clean energy technologies • Green digital devices for the future	• Technologies for 'Fit for 55'

EIC Challenges 2023

	Pathfinder (32.7mln Euro)	Transition (20mln Euro)	Accelerator (100mln Euro)

Some specific conditions in Cleantech Pathfinder challenges

- potential collaborations with key stakeholders, deployment strategy, and the steps required to scale up the process.
- also recurring to the DBTL (design-build-test-learn) cycle.

Requirements in Cleantech Pathfinder challenges

- non-critical raw materials (CRM)-based approach or their full recycle-reuse,
- systems integrated,
- life cycle and circular thinking driven approaches,
- not being harmful to the natural ecosystems

Portfolio content-wise approach in the different EIC funding schemes

A portfolio is a coherent set of projects aligned to a common “challenge” or “thematic area

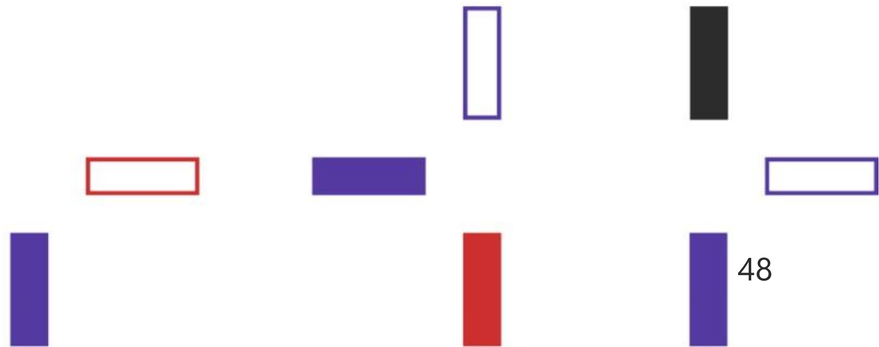
The EIC portfolio approach is aimed at facilitating the projects innovation journey via:

1. **Exploring:** competing approaches or complementary aspects of the Challenge;
2. **setting up** multidisciplinary interactions and exchanges for synergies;
3. **contributing** to an overarching medium to long-term business goal and technology-based strategic plan.

Photovoltaics

European Innovation Council

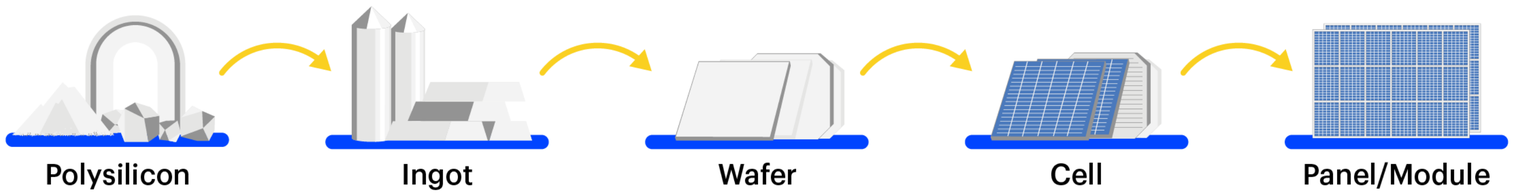
Source IEA



Photovoltaics - I gen
Power application

European Innovation Council

Key stages in the main manufacturing process for solar PV



China's share in all the manufacturing stages of solar panels exceeds 80%.
Global production capacity for polysilicon, ingots, wafers, cells and modules would need to more than double by 2030 from today's levels.
Low-cost electricity is key for the competitiveness of the main pillars of the solar PV supply chain.

Source IEA

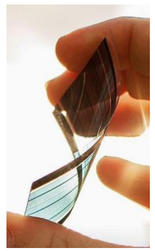
EC OPPORTUNITIES for promoting INNOVATION

1. **Recycling** of solar PV panels offers environmental, social and economic benefits while enhancing security of supply in the long term.
2. **Tandem solar cells (Silicon – on top Perovskite solar cells):** high efficiency, but needs to be better understood LCoE and durability

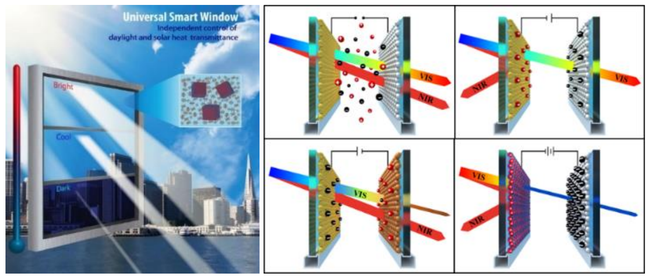
Photovoltaics III gen
Electronics and Building application

European Innovation Council

Powering IoT and portable devices



BIPV – Smart windows – Low power lighting



EC OPPORTUNITIES for promoting INNOVATION

1. **System integrated technologies for IoT / Portable / Building markets**
2. **New industrial value chains with the need to stimulate innovation in conservative, not highly skilled supply chain such as building ones.**

Not exhaustive list of EIC Funded projects

Solar energy conversion

Solar-to-thermal

Heating

828753 **Boostcrop**

951801 **MOST**

951976 **TPX-Power**

731976 **MAGENTA**

945858 **NATHALIE**

737054 **AMADEUS**

Cooling

964698 **Optagon**

964450 **MIRACLE**

Solar-to-fuel

Photosynthesis

Natural

899576 **FuturoLeaf**

800926 **HyPhOE**

Artificial

951843 **LICROX**

101017928 **Hysolchem**

828838 **SoFIA**

101046836 **CATART**

732840 **A-LEAF**

665085 **DIACAT**

Solar-to-electrical

Perovskite

862656 **Drop-IT**

951774 **FOXES**

687008 **GOTSolar**

899141 **POLLOC**

804554 **BRITE SOLAR**

190132742 **LAYER®**

967987 **EPINEX**

2D materials

101017821 **Light-CAP**

951761 **NANO-EH**

Other

863227 **PULSE-COM**

824072 **HARVESTORE**

951949 **NANOSTACKS**

101046909 **REMAP**

800926 **HyPhOE**

863170 **ARTIBLED**

858112 **SOLAR GAPS**

Ongoing project

Ended project

Associated project*

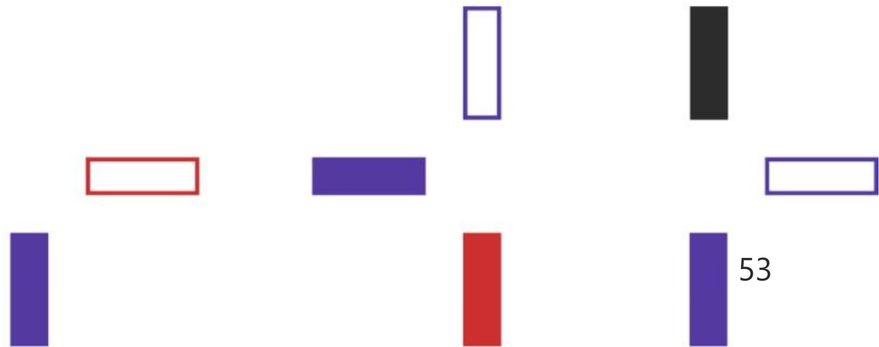
*An **Associated project** does not directly fall into one of the categories of the portfolio but could benefit from/to the exchange with the projects in the portfolio

EIC Solar Energy conversion Portfolio main challenges aligned with Solar EU Alliance

- Projects collaboration to accelerate their innovation journey (e.g. entrepreneurial approach)
- Market applicability (e.g. niche or mass market, cost, durability)
- Process Innovation (e.g. epitaxial, cells manufacturing)
- System integration (e.g. low power lighting, IoT, energy storage)
- Materials (e.g. not CRM, scalability, discovery, supply chain)
- Performance measurement standardization

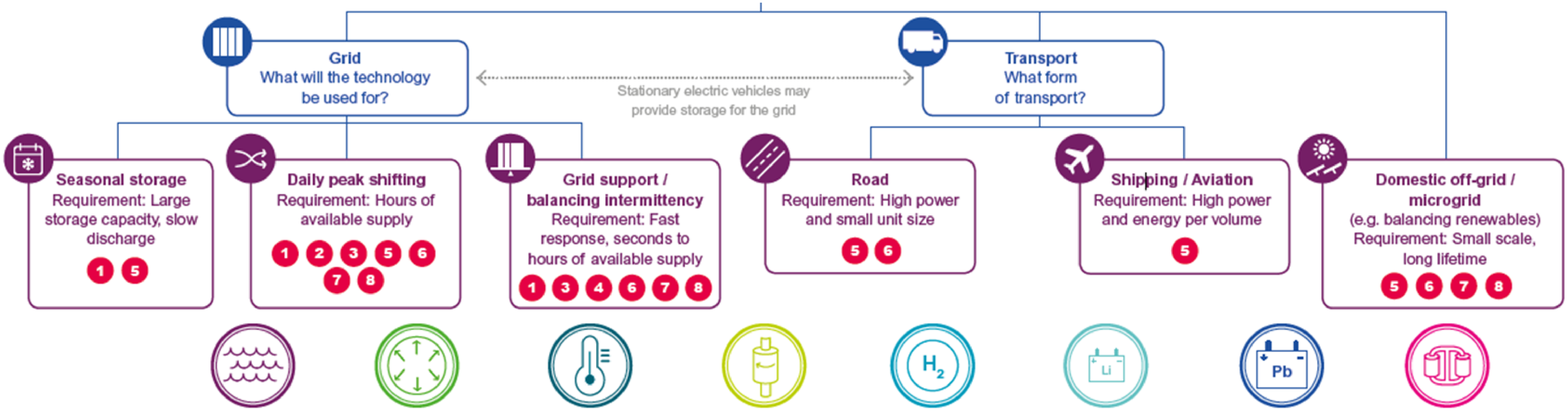
Energy Storage

European Innovation Council



Different types of electrochemical energy storage

European Innovation Council



Grantham Institute
Climate Change and the Environment
An Institute of Imperial College London

Expected growth in global battery demand

European Innovation Council

Figure 2 | Annual Battery Demand (GWh) - forecasted evolution of the electric mobility, stationary power storage, consumer electronics and machinery application areas from 2016 to 2030.

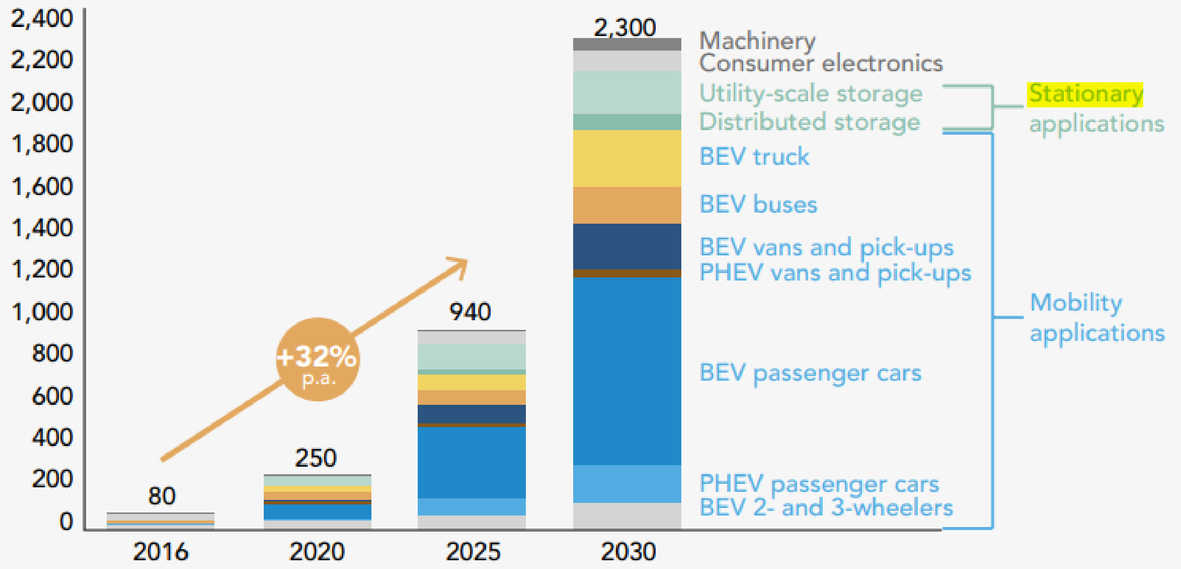
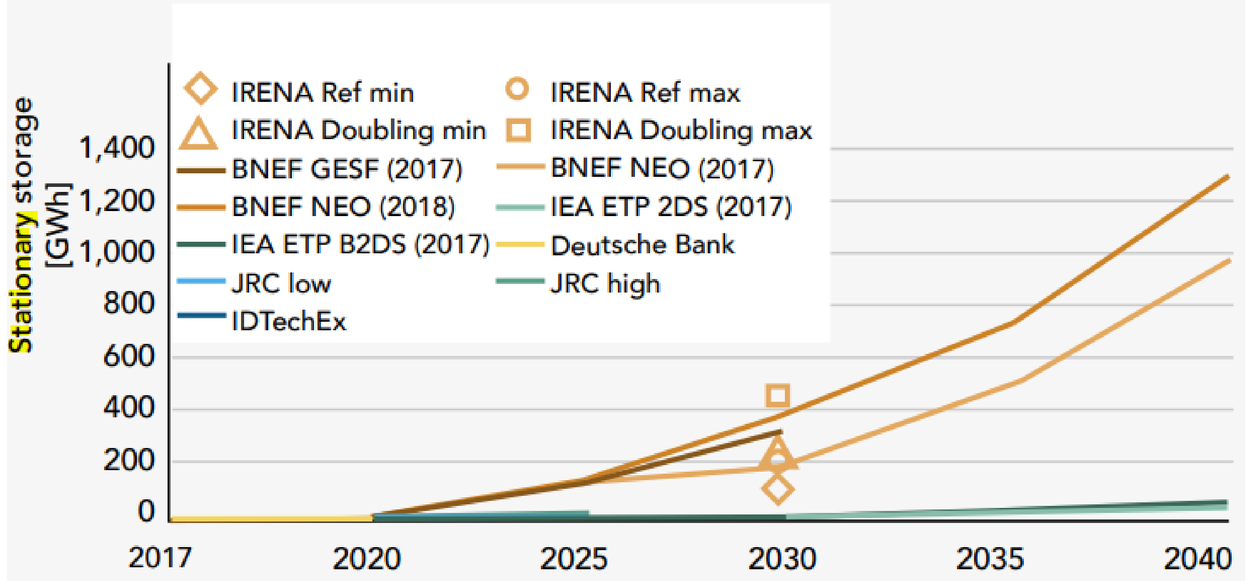


Figure 4 | Projections of total stationary storage installed front- and behind-the-meter globally

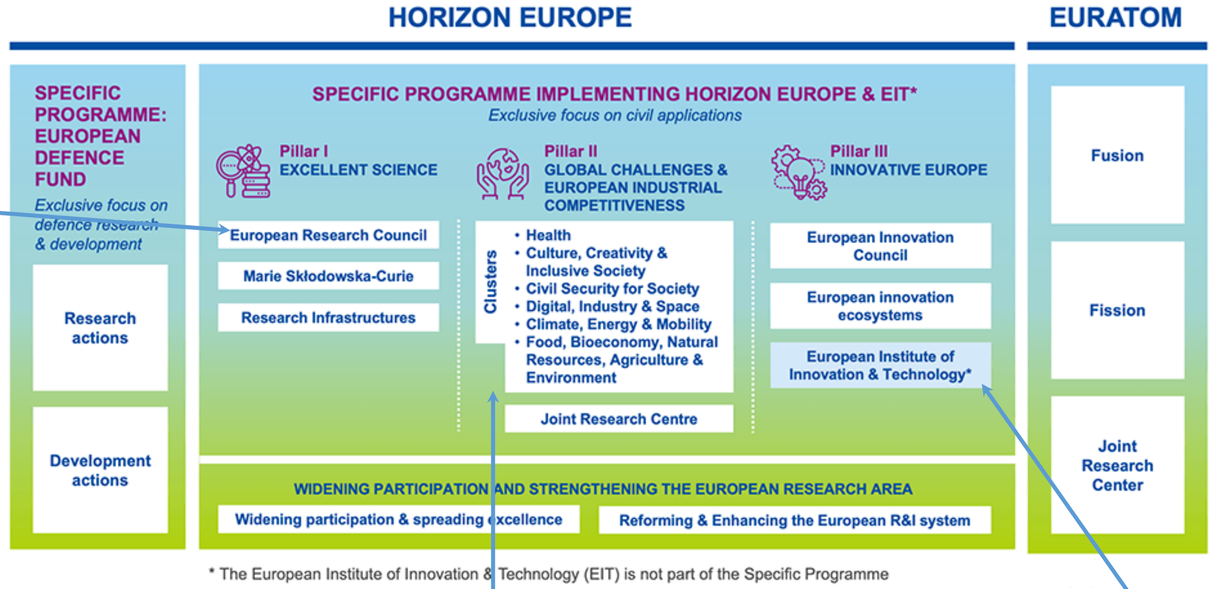


BATT4EU / SRIA - September 2021

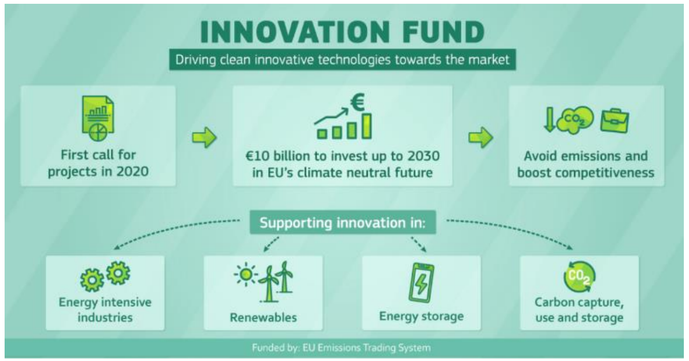
Inventing the sustainable batteries of the future. Research Needs and Future Actions, BATTERY 2030+ Roadmap.
On the Implementation of the Strategic Action Plan on Batteries: Building a Strategic Battery Value Chain in Europe, Brussels, 9.4.2019 COM(2019) 176 final

EU instruments to support innovation in energy storage

European Innovation Council



Other EU public funding options



IPCEI BATTERIES

European Investment Bank The EU bank

Pillar 2 – HEU Clusters and Partnerships

Clean Hydrogen Partnership

CSP The Clean Steel Partnership

2ZERO

925 MILLION TOTAL INVESTMENT IN BATTERY R&I

925 MILLION TOTAL INVESTMENT IN BATTERY R&I

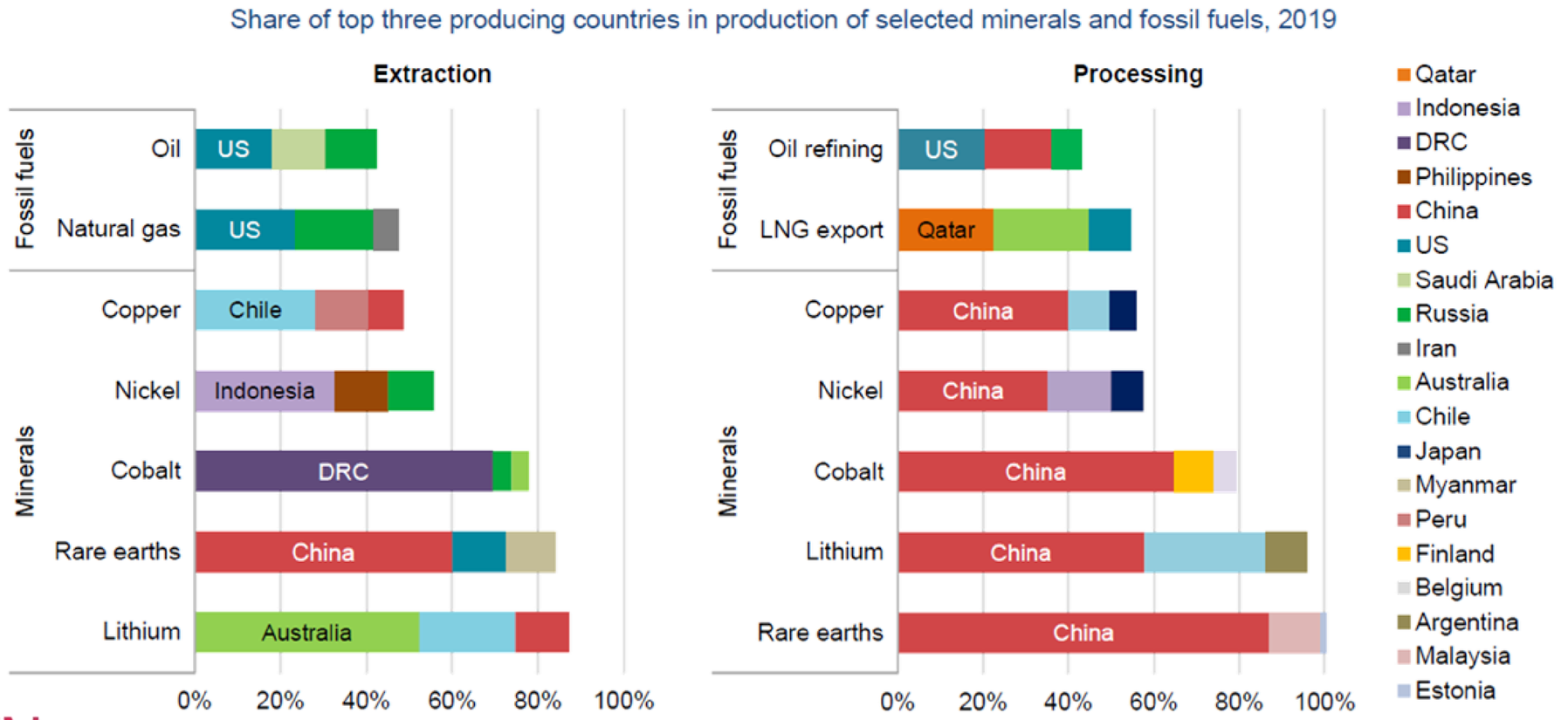
HEU Cluster 5: TES, transport, grids, industrial decarbonization, buildings..

HEU Cluster 4: EU Raw Materials Alliance, EIP raw materials; Manufacturing; automation AI and robotics; Key Digital Technologies

eit European Institute of Innovation & Technology

European Innovation Council

Production of many energy transition minerals



CNR ISMN
ISTITUTO PER LO STUDIO DEI MATERIALI NANOSTRUTTURATI

Inventing the sustainable batteries of the future. Research Needs and Future Actions, BATTERY 2030+ Roadmap.
On the Implementation of the Strategic Action Plan on Batteries: Building a Strategic Battery Value Chain in Europe, Brussels, 9.4.2019 COM(2019) 176 final

Recycling technologies

"The world doesn't have enough lithium" is a common pushback against a move to electric vehicles.

In this article, I look at whether this true.

There are two separate questions we need to answer.

1. Does the world have enough lithium, or will we eventually run out? To answer this we need to look at *cumulative* demand and supply.
2. Can we mine and produce it quickly enough? To answer this, we need to look at *annual* demand and supply.

If you want the TLDR *[Too long, didn't read]* version:

1. Yes, the world has enough lithium for our electric vehicles, decades into the future.
2. The world is *currently* not producing enough of it to keep up with demand. This could be a major bottleneck this decade.

or recycling

European Innovation Council

Energy Storage Pathfinder list

Electrical

- 951761 **NANO-EH**
- 951774 **FOXES**
- 964524 **EHAWEDRY**
- 964593 **e-Prot**
- 101057679 **Super-HEART**
- 800926 **HyPhOE**
- 101058284 **METATHERM**

Electrochemical

- 101017821 **Light-CAP**
- 766617 **CARBAT**
- 899659 **I-BAT**
- 101046742 **MeBattery**
- 711792 **LiRichFCC**
- 829145 **VIDICAT**
- 824072 **HARVESTORE**
- 766581 **SALBAGE**
- 824066 **E-MAGIC**
- 951902 **AMAPOLA**
- 854472 **BATTERY 2030**
- 801229 **HARMoNIC**
- 957213* **BATTERY 2030+**
- 952068 **LESGO**

*BATTERY 2030+ initiative and the corresponding projects are invited as active observers and will be represented by EIC funded Battery 2030

Chemical

- 101017709 **EPISTORE**
- 951949 **NANOSTACKS**
- 899895 **MagnifiCOF**

Thermal

- 737054 **AMADEUS**
- 951801 **MOST**
- 945858 **NATHALIE**
- 101046364 **ESiM**
- 101057954 **THERMOBAT**
- 101017858 **Electro-Intrusion**
- 190167786 **KRAFTBLOCK**

Ongoing project

Ended project

Transition

Energy storage Portfolio main challenges

- Projects collaboration to accelerate their innovation journey (e.g. entrepreneurial approach)
- Market applicability (stationary of mobility)
- Process Innovation (e.g. thermochemical, electrochemical)
- System integration (e.g. heat & electricity, renewable energy sources)
- Materials (e.g. not CRM, scalability, discovery (computational), supply chain)
- Performance measurement standardization

Energy Materials FOR future of batteries

- New mining technologies (sea mining) ?
- More raw materials EU processing facilities?
- New chemistries: increase collaboration between scientists (BIG-MAP), OITB, start-up, batteries industrial manufacturers and final users (stationary as well as mobility)
- EC intermediary knowledge role between different innovation actors
- Circular economy approach

Conclusions

Need to increase the full energy value chain “connection”, alignment and ambidexterial approach

Stationary applications

IoT devices powering

European Innovation Council

Thank you!

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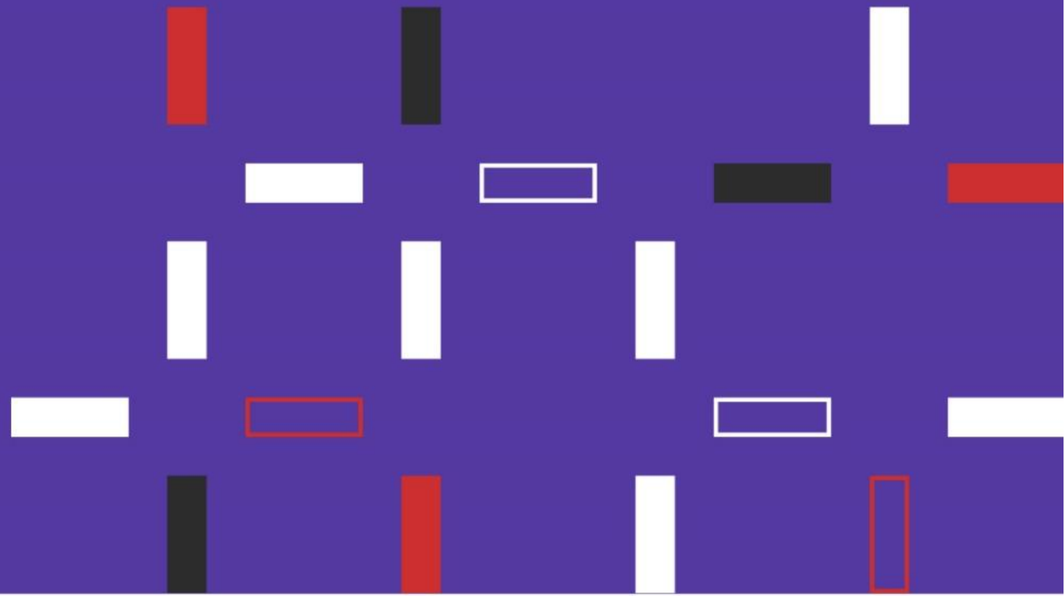
Carina.faber@ec.europa.eu

@EUeic

#Eueic



EERA
European Energy Research Alliance
Photovoltaic Solar Power



EERA Joint Program on Photovoltaic Solar Energy

Ivan Gordon, Simon Philipps, Martina Campajola

Joint Program on Photovoltaic Solar Energy (founded in 2010)

- Objective: To accelerate the development of Photovoltaic Solar Energy to help reach the European climate goals and to support a climate-neutral society by 2050.

- Focus: Cost reduction of PV systems through enhancement of performance, development of low-cost, high-throughput manufacturing processes, and improvement of lifetime and reliability of PV systems and components.

- Coordinators:
  - Dr. Simon Philipps, Fraunhofer ISE
  - Prof. Dr. Ivan Gordon, IMEC / TU Delft

Our members


AIT
AUSTRIAN INSTITUTE OF TECHNOLOGY


BERA
Belgian Energy Research Alliance


cea


CENER
CENTRO NACIONAL DE
ENERGÍAS RENOVABLES


ΚΑΠΕ
CRES


Ciemat


CTU
CZECH TECHNICAL UNIVERSITY IN PRAGUE


ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE


ENEA


JÜLICH
Forschungszentrum


Fraunhofer


Forschungsverbund
Berlin e.V.


HZB Helmholtz
Zentrum Berlin


IFE


INL
INTERNATIONAL IBERIAN
NANOTECHNOLOGY
LABORATORY


KIT
Karlsruhe Institute of Technology


LNEG


NTNU


ODTÜ GÜNAM
CENTER FOR SOLAR ENERGY RESEARCH AND APPLICATIONS


SINTEF


TAL
TECH


tecnalia
Inspiring
Business


TNO
innovation
for life


TÜBİTAK


UKERC
UK Energy Research Centre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POLITÉCNICA


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DI TORINO


Università di Roma
Tor Vergata

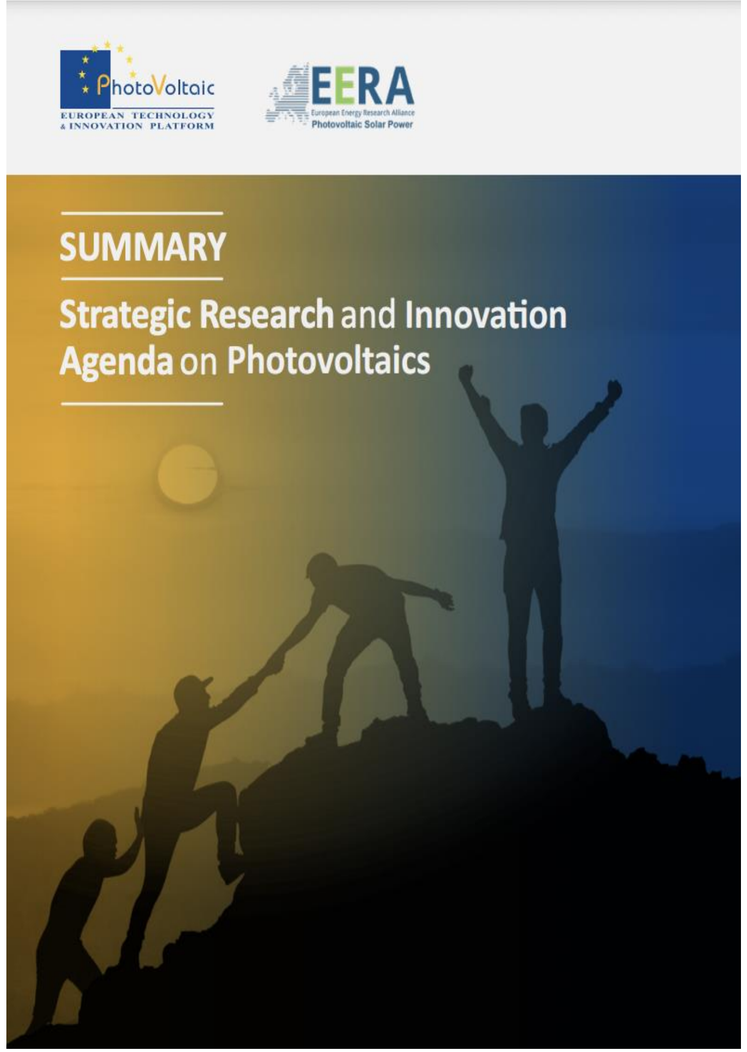

Utrecht University


VTT


ZSW

European Strategic Research and Innovation Agenda on Photovoltaics

- Produced as collaboration between ETIP PV and JP PV
- Published in May 2022
- Implementation Plan for PV of the SET-plan is being modified based on this EU-SRIA PV
- Making the energy transition a European success with PV as key building block
- Rebuilding the strategic value chain for PV by exploiting Europe's technological leadership



https://etip-pv.eu/publications/sria-pv/

Detailed challenges of the EU-SRIA PV

1. Performance enhancement and cost reduction

- Objective 1: PV modules with higher efficiencies and lower costs
- Objective 2: System design for lower LCoE of various applications
- Objective 3: Digitalisation of PV

2. Lifetime, reliability and sustainability enhancements

- Objective 1: Sustainable and circular Solar PV
- Objective 2: Reliable and bankable Solar PV

3. New applications through integration of Photovoltaics

- Objective 1: Physical integration of PV into the built environment, vehicles, landscapes & infrastructures

4. Smart Energy System integration of Photovoltaics

- Objective 1: Energy system integration

5. Socio-economic aspects of massive PV deployment

- Objective 1: Higher awareness of benefits that solar PV brings
- Objective 2: Economic & sustainability benefits

New JP-PV Management Structure is also tuned to the EU-SRIA PV

SP1: Silicon PV

SP2: Perovskite PV

SP3: Thin-film PV

SP4: Tandem and multi-junction PV

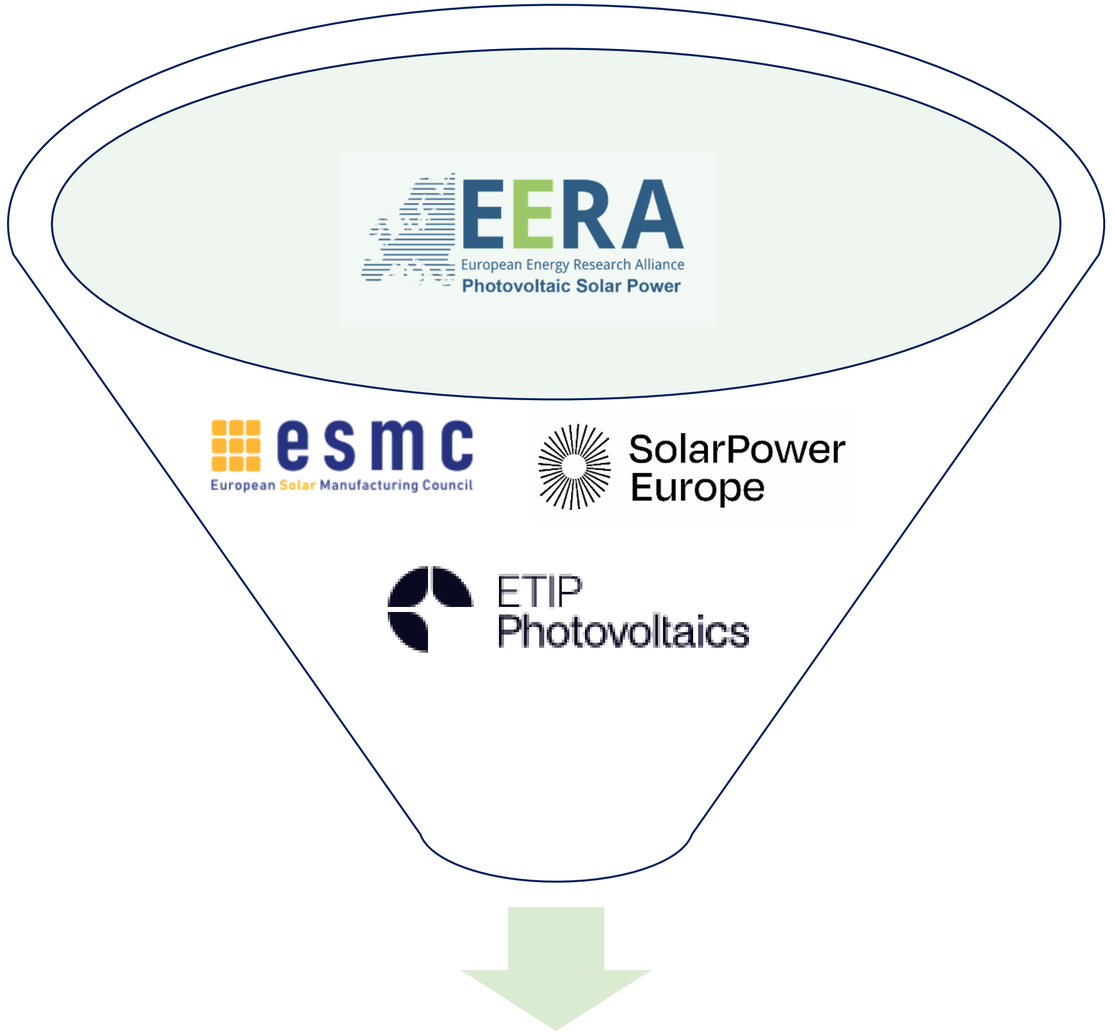
SP5: Lifetime, reliability and sustainabiity of PV systems

SP6: Integrated PV

SP7: Smart energy system integration of PV

SP8: Socio-economic aspects of photovoltaics

Interaction between EERA-PV and industry



EU Solar PV Industry Alliance
/ IPCEI on PV

European Solar Photovoltaic Industry Alliance

ESIA
European Solar PV Industry Alliance

- One of the concrete initiatives announced in **REPowerEU** as part of the **EU Solar Energy Strategy**

- Main goal → To accelerate solar PV deployment in the EU by scaling-up to **30 GW** of **annual solar PV manufacturing capacity in Europe by 2025**, facilitating investment, de-risking sector acceleration, and supporting Europe's decarbonisation targets.

- Brings together **industrial actors, research institutes, consumer associations, NGOs and other stakeholders**. Driven by EC and EITInnoEnergy building on the track record of the Batteries Alliance

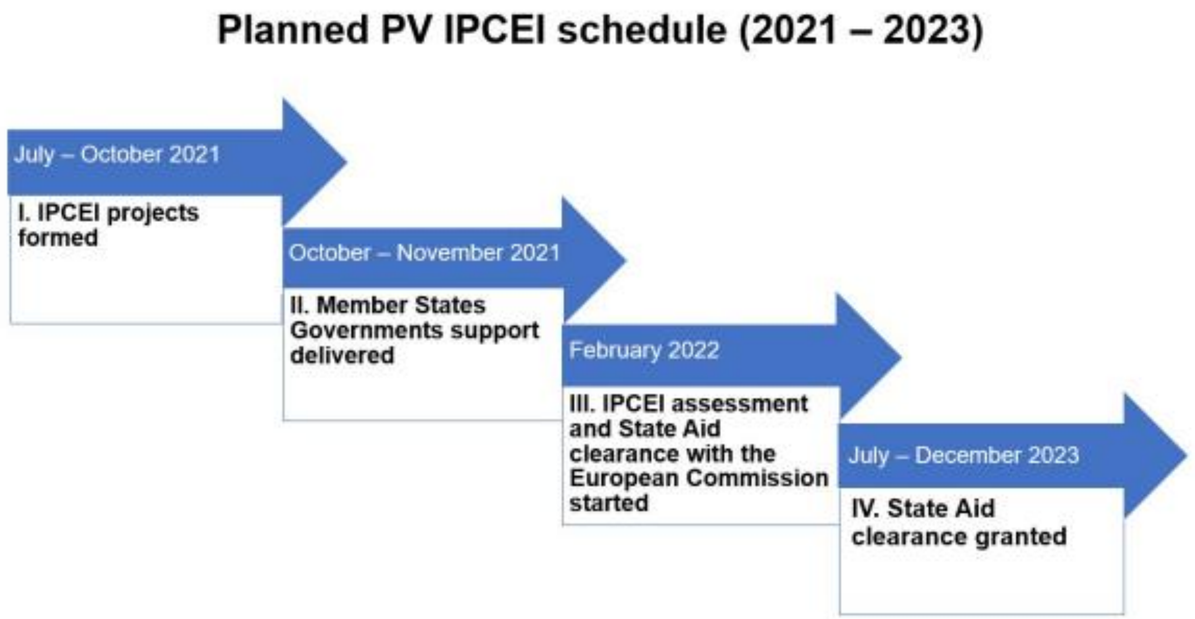
- Highlighted as main contributor in the **Net-Zero Industry Act** of the EC presented in March 2023.

- **Working groups** active on:
  - Non-pricing conditions: circularity, low CO2 footprint, local content, …
  - Supply Chain: Achieve 30 GW production along the whole value chain in EU
  - Financing: Financial support schemes
  - Skills: Solar Academy, skills gaps

https://solaralliance.eu/

IPCEI on PV (important project of common EU interest)

- Initiative driven by the European Solar Manufacturing Council (ESMC).
- Different project groups have been set up that are defining the content of the IPCEI and contain industry and research (JP-PV partners)
- Long and difficult process!



Summary

- The time is right to rebuild a complete PV manufacturing value chain in Europe.
- PV Industry and Research should work closely together to achieve this and to maintain Europe's technological leadership.
- EERA-PV is well positioned and connected to industry to help accelerate the development and deployment of Photovoltaic Solar Energy in Europe.

EERA Joint Programme Energy Storage

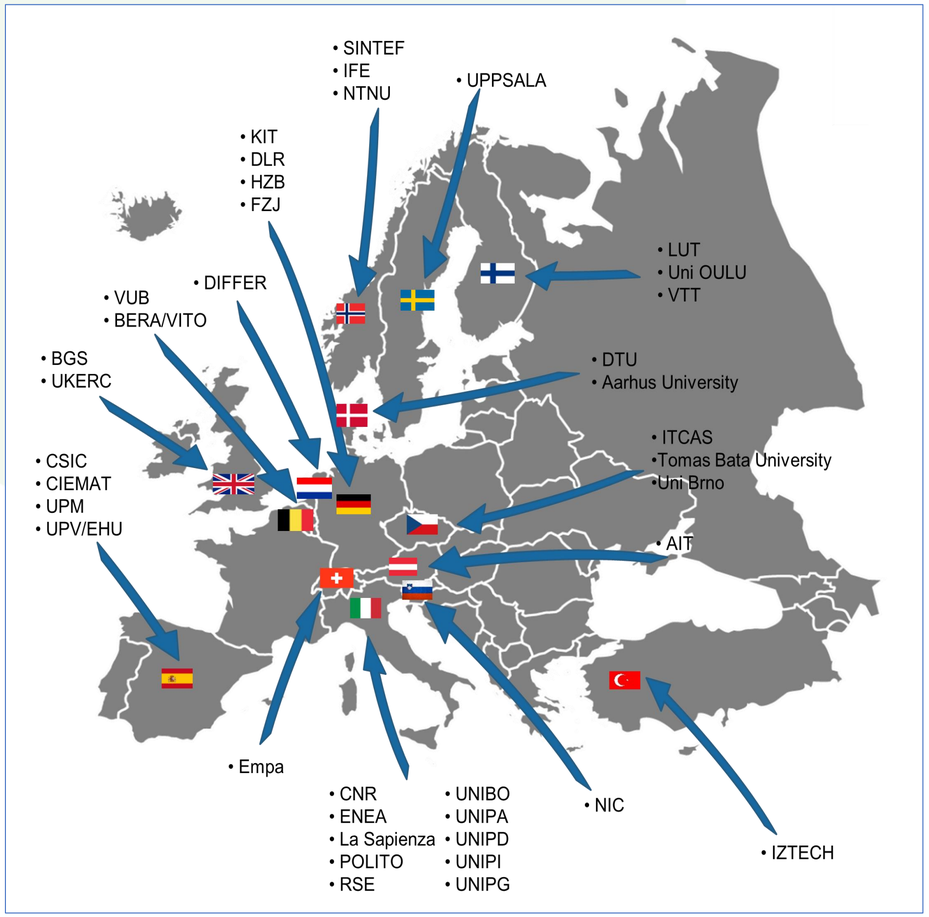
Myriam Gil Bardají (KIT) on Behalf of JP ES
JP ES coordinator
StoRIES project deputy coordinator

1

Introduction of JP ES

JOINT PROGRAMME ON ENERGY STORAGE (JP ES)

European Energy Research Alliance (EERA)



www.eera-energystorage.eu

VISION

- To accelerate the European energy storage research to achieve a renewable-based carbon neutral Europe by 2050

NUMBERS and FIGURES

- Launch: 2011
- Members: 40 RTOs and universities
- Countries involved: 15
- Energy storage areas: 5

MAIN ACTIVITIES

- Mobility Scheme
- Online PhD Days
- JP ES Award
- Workshops
- White Papers
- Technology Roadmaps

EERA
European Energy Research Alliance
Energy Storage

JP ES Mission

developing common research and coordinating the scientific community in Europe

EERA European Energy Research Alliance Energy Storage

JP ES Mission

developing common research and coordinating the scientific community in Europe

establishing a dialogue at European level among all stakeholders involved in energy storage R&D

facilitating knowledge transfer by communication with industry and stakeholders

advising policy makers by identification of regulatory barriers and providing policy recommendations

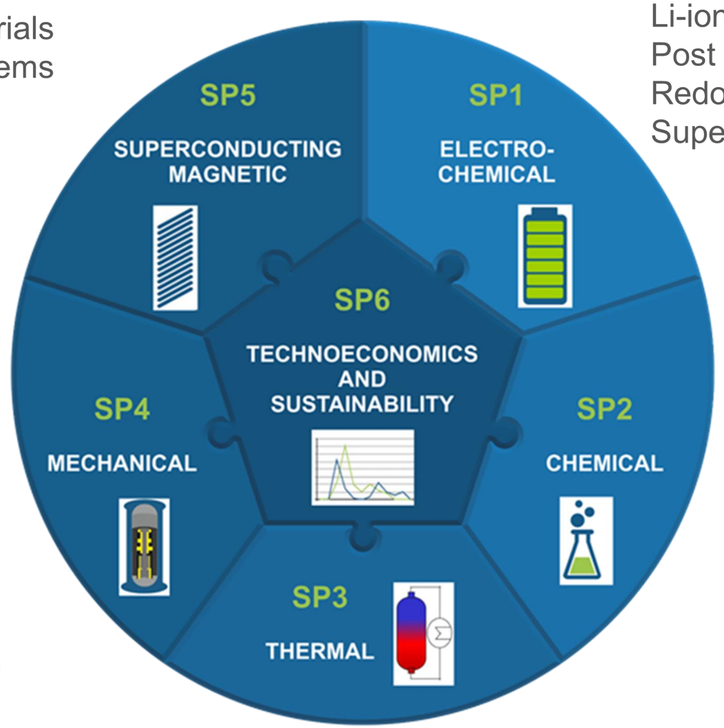
establishing best practices by developing new technologies and pave the way to market introduction

EERA European Energy Research Alliance Energy Storage

JP ES Structure

HTS materials
SMES systems

Li-ion batteries
Post Li-ion batteries
Redox Flow batteries
Supercapacitors



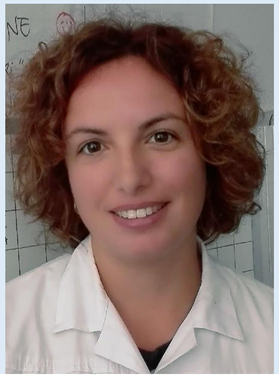
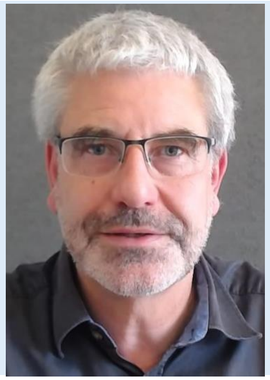
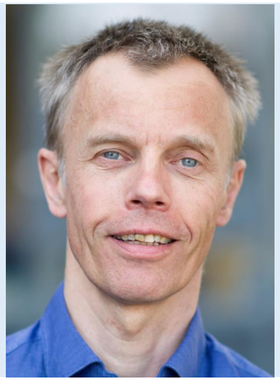
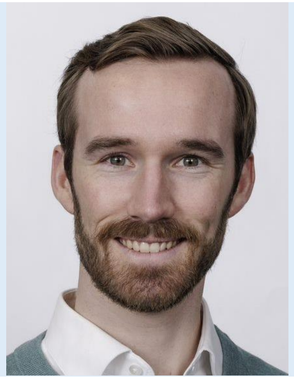
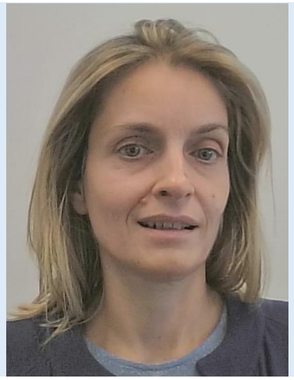
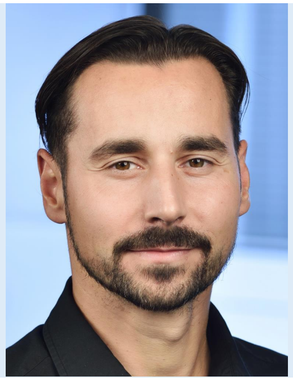
Pumped Hydro
Flywheels
Compressed Air
Liquid Air

P2X
Hydrogen
Reactive Metals
Direct Air Capture

Latent heat storage
Sensible heat storage
Thermochemical storage

JP coordinator

SUB-PROGRAMMES RESPONSIBLES

	SP1	SP2	SP3	SP4	SP5	SP6
COORDINATORS						
	Margherita Moreno ENEA (IT)	Peter Holtappels KIT (DE)	Salvatore Vasta CNR (IT)	Atle Harby SINTEF (NO)	Antonio Morandi UNIBO (IT)	Yolanda Lechón CIEMAT (ES)
DEPUTIES						
	Sigmund Kielland IFE (NO)	Linda Barelli UNIPG (IT)	Daniel Lager AIT (AT)	Giovanna Cavazzini UNIPD (IT)	Joffre Gutiérrez CSIC (ES)	Manuel Baumann KIT (DE)

2

Main Activities

JP ES Activities

- **Mobility Scheme:** up to €4,000 per exchange
- **Policy and Stakeholder Workshops:** facilitating knowledge transfer
- **Online PhD Days:** stimulate exchange and discussion on the topic with young scientist
- **JPES Award:** support activities in the field of energy storage
- **JPES @EUSEW:** networking with other initiatives and establish a dialogue with EC
- **Industry Advisory Board:** take into account current industry needs
- **Interaction with other EERA JPs:** use synergies and avoid duplication of work
- **Joint applications for EU projects:** SmiLES (2016 – 2019), StoRIES (2021 – 2025), RISEnergy (submitted)

3

Collaboration with Industry

STAKEHOLDER WORKSHOPS

Policy/industry oriented

EERA EVENT

14 April 2021 - online

Materials for Hybrid Energy Storage - Creating an Ecosystem for Innovation

READ MORE

EERA EVENT

24 November 2021 - Hybrid Event

JP ES Joint Workshop on EU Clean Energy Transition: Perspectives and Challenges for Energy Storage

READ MORE

Technology oriented

EERA EVENT

14 May 2021

New flexibility resources: the role of hybrid pumped hydropower

READ MORE

EERA EVENT

13-14 September 2021 - Lappeenranta, Finland

Future Energy Solutions

READ MORE

Recording and reports at www.eera-energystorage.eu

EERA
European Energy Research Alliance
Energy Storage

COLLABORATION WITH EASE

European Association for Storage of Energy

EASE was established in 2011 and represents approximately 60 members, including utilities, technology suppliers, research institutes, distribution system operators, and transmission system operators.

Technology Roadmap delivery to the European Commission on 18 October 2017, Brussels

Link

EASE-EERA Energy Storage Technology Development Roadmap

- Contributions from over 80 experts from research and industry
- RD&D needs for the coming decades
- Six recommendations for R&D policies and regulatory developments

EERA European Energy Research Alliance Energy Storage

INDUSTRY ADVISORY BOARD

Up to **10 members** from a variety of categories within the energy storage sector:

- Energy storage industry
- Power companies
- Manufacturers/suppliers
- Consultancy/advisory
- TSO/DSO regulators
- NGOs

The EERA Joint Programme on Energy Storage (JP ES) will include an Advisory Board, which will serve as a *forum for the energy storage sector* to advise and give feedback to the JP ES Management Board and Steering Committee. This will ensure that the JP ES is aligned with the research and innovation needs from stakeholders in the energy storage domain.

The Advisory Board shall:

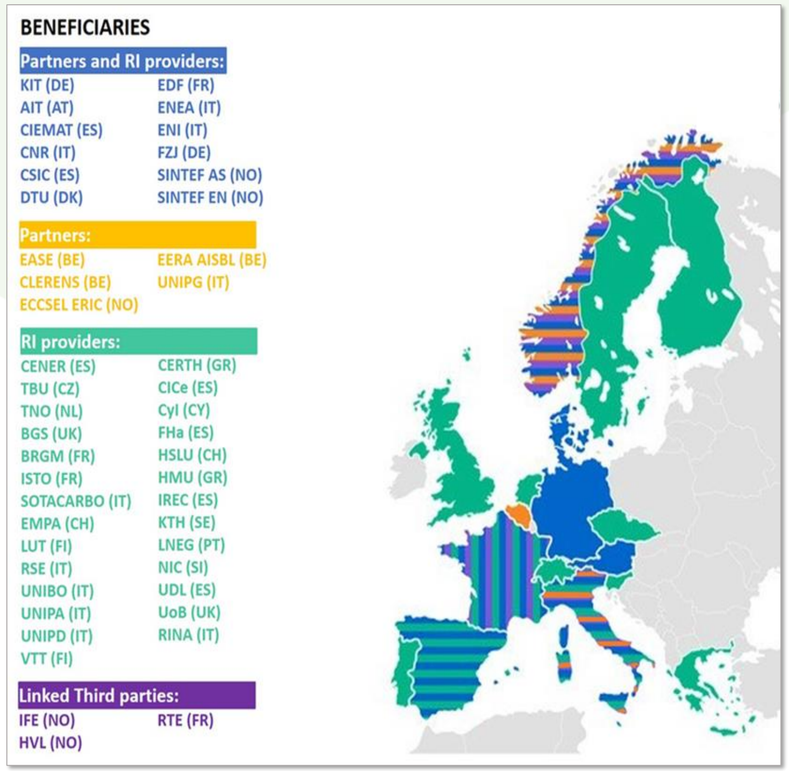
- Discuss the progress of the Joint Programme and provide strategic advice from industry, policy and civil society perspectives
- Identify R&D and innovation needs
- Bridge relevant networks and stakeholders
- Ensure JP ES's relevance to the energy storage sector
- Increase the awareness and knowledge about energy storage and hybrid energy storage research for the sector, and promote its role to enable the green energy transition

EERA European Energy Research Alliance Energy Storage

Research + Industry effort

JOINT EU PROJECT: STORIES

Storage Research Infrastructure Eco-System



www.storiesproject.eu

NUMBERS and FIGURES

- Duration: 2021-2025
- Budget: 7 Mio €
- Beneficiaries: 47
- Infrastructures: 64
- Countries involved: 17
- Stakeholders > 100

MAIN OBJECTIVES

- Foster a European eco-system of industry and research organisations on hybrid energy storage technologies
- Provide access to world-class materials and energy storage related research infrastructures

ECO-SYSTEM

PROJECT CORE

- 17 Full Participants (P)
- 18 Linked Third Parties (LTP)
  - 10 to EERA AISBL from academia and ressearch
  - 4 to EASE from industry
  - 4 to ECCSEL ERIC From large research infrastructure
- 12 Sub- Contractors (SubC) to KIT

~50

EXTERNAL LAYER

- Selection Panel (SP)
- Advisory Board (AB)
- Extended Network (EN)

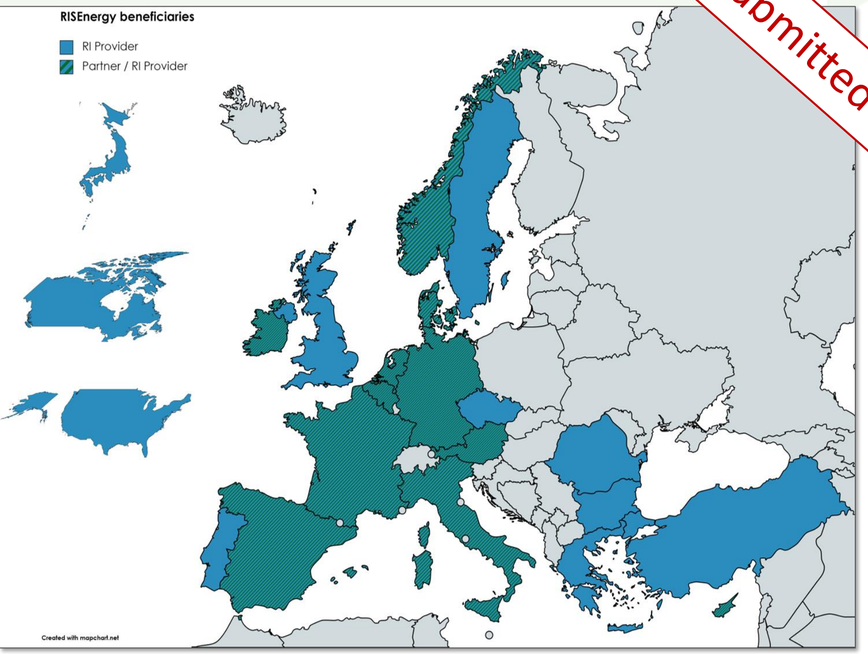
>100

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No 101036910

Research + Industry effort

JOINT EU PROPOSAL: RISENERGY

Research Infrastructure Services for Renewable Energy



submitted

RISEnergy

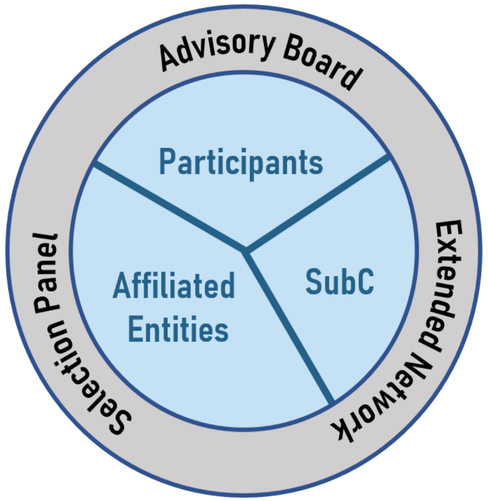
NUMBERS and FIGURES

- Duration: 4,5 years
- Budget: 14,5 Mio €
- Beneficiaries: 69
- Infrastructures: 87
- Countries involved: 22
- Stakeholders > 100

MAIN OBJECTIVE

- 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.

ECO-SYSTEM



PROJECT CORE

- 17 Participants (P)
- 37 Affiliated Entities (AE)
  - 23 to EERA AISBL
  - 7 to EU-SOLARIS
  - 3 to ECCSEL ERIC
  - 4 to DERLab
- 15 Sub-Contractors (SubC)

~ 70

EXTERNAL LAYER

- Selection Panel (SP)
- Advisory Board (AB)
- Extended Network (EN)

>100

Thank You Very Much For Your Attention

EERA European Energy Research Alliance
Energy Storage

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EERA JP-ES Energy Storage
@EERA_JPES
eera-energystorage.eu

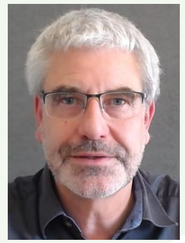
StoRIES

info@storiesproject.eu
StoRIES Project H2020
StoRIES Project
@StoRIES_H2020
storiesproject.eu

KIT coordination team


Myriam Gil Bardají


Stefano Passerini


Peter Holtappels


Olga Suminska-Ebersoldt


Alexandra Lex-Balducci


Holger Ihssen


Manuel Baumann


Andreea Koch

Based in Karlsruhe, Germany
Founded in 2016
Headcount >100

INERATEC GmbH

THE E-FUEL COMPANY

Company Overview

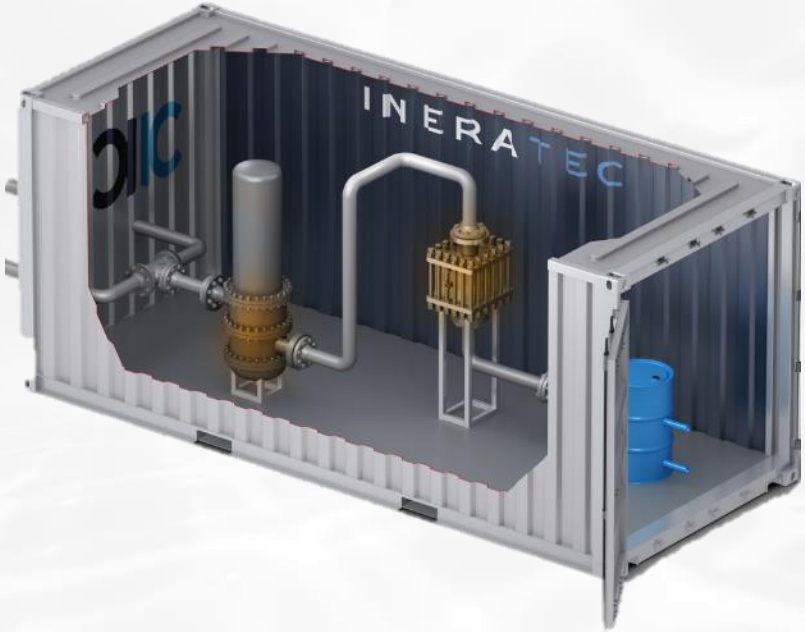
PROBLEM

PARIS CLIMATE TARGETS REQUIRE GREATER REDUCTION OF CO2 EMISSIONS

SOLUTION

MODULAR CHEMICAL PLANTS THAT PRODUCE RENEWABLE HYDROCARBONS

CO_2 + H_2
Power-to-X

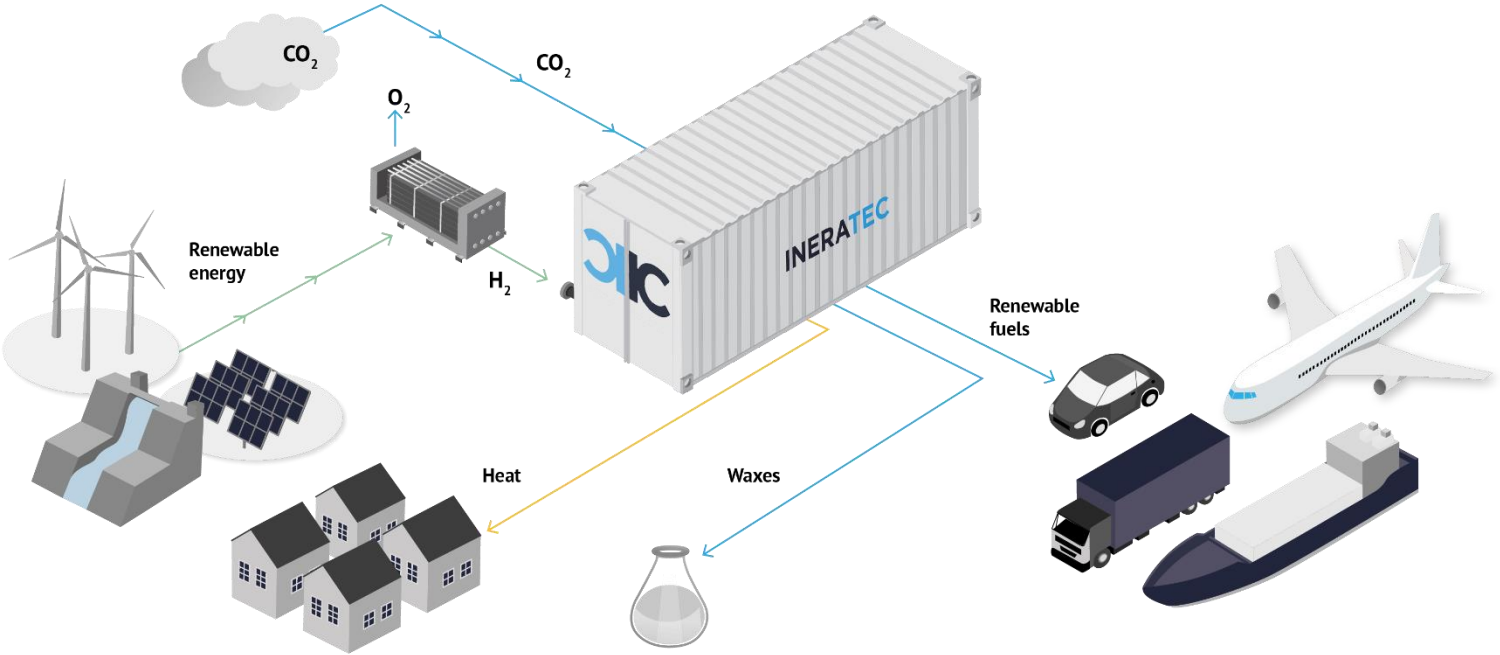


Renewable
Fuels and Chemicals

Greenhouse Gas Recycling by INERATEC®

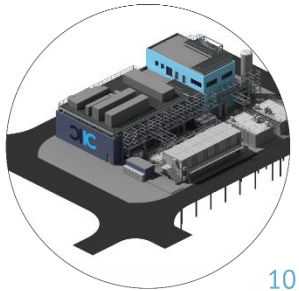
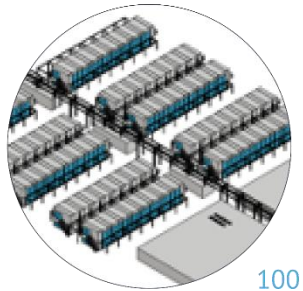
POWER-TO-LIQUID

SYNTHETIC HYDROCARBONS FROM CO2 AND RENEWABLE ELECTRICITY



BUSINESS SCALE-UP & NUMBERING UP

SOLUTIONS AT EVERY SCALE

DEMONSTRATION PHASE	INDUSTRIAL SCALE-UP PHASE	INDUSTRIAL ROLL-OUT	INDUSTRIAL MATURITY
Research & demonstration plants	Industrial demonstration plant	Industrial scale plant	World scale plant
			
	1 MW Unit	10 MW Unit	100 MW Unit

BUSINESS MODEL

PLANT & PRODUCT SALES

SINCE 2016

PLANT SALE

SINCE 2020

e-PRODUCT SALE

COLLABORATION

INDUSTRY AND RESEARCH

PtL/GtL Project:
Pilot plant installed in Finland in 2016

COLLABORATION

INDUSTRY AND RESEARCH

Power-to-X compound plant for e-kerosene synthesis

PILOT PROJECTS IN GERMANY

MARKET ROLL-OUT FOR AVIATION AND CHEMICAL INDUSTRY

- 1 MW plant module
- Production capacity up to 350 t/a e-Kerosene & e-Waxes
- Recycling of up to 1,000 t CO_2 /a

PtL PIONEER PLANT FRANKFURT HOECHST

PROJECT STARTING 2022

- Production capacity up to 2,500 t/a (Litres 3.5 M.)
- Recycling of 8,000 t of CO_2 /a
- Investment up to € 30 M.

Dr.-Ing. Tim Boeltken
Managing Director
Tim.boeltken@ineratec.de
+49 721 86484460

AWARDS

WINNER
Next Economy Award 2022

SOLARIMPULSE EFFICIENT SOLUTION NOVEMBER 2021

DEUTSCHER GRÜNDER PREIS

LOTHAR SPÄTH AWARD | 2018
Für herausragende Innovationen in Wissenschaft & Wirtschaft

INNOVATIONSPREIS DER DEUTSCHEN GASWIRTSCHAFT **2018**

CLEAN TECH OPEN

Collaboration examples between research and industry at Fraunhofer

Dr. Simon Philipps

SUPEERA Workshop
March 21st, 2023

www.ise.fraunhofer.de

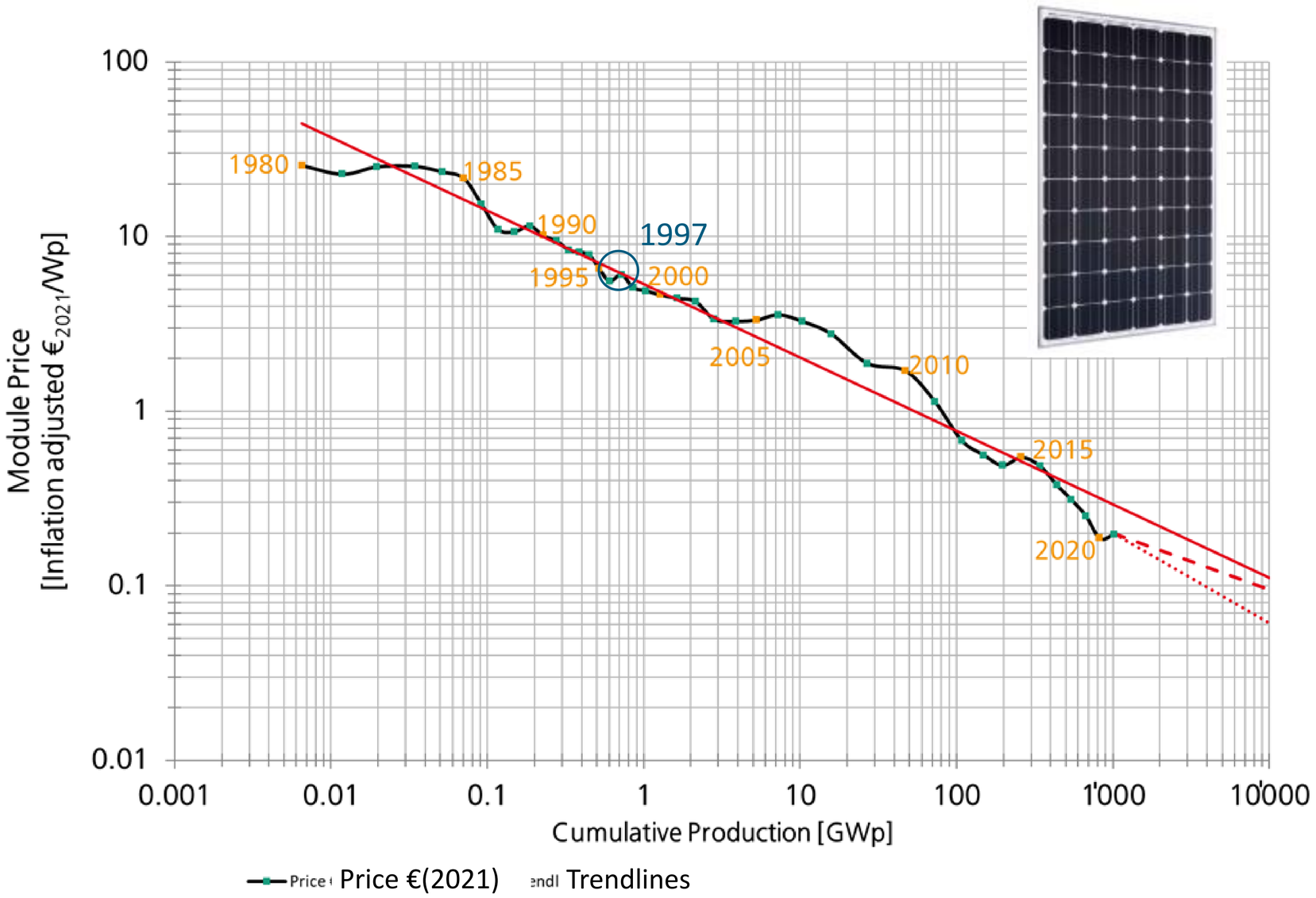
PV price experience curve

Learning by scaling

Module production 1997

- Shipments global: 110 MWp/a
- Price: 6 Euro/Wp

Learning rate
Each time the cumulative PV module production doubled the price went down by about 25% for the last 41 years.



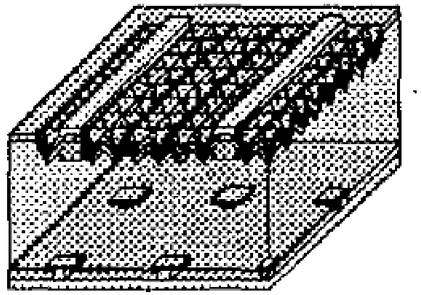
Philipps, S. Wener, W. et al.: Photovoltaics Report, Fraunhofer ISE,
Data: from 1980 to 2010 estimation from different sources: Strategies Unlimited, Navigant Consulting, EUPD, pvXchange; from 2011:
IHS Markit; Graph: PSE 2022

Slides: Ralf Preu et al., 8th WCPEC, Milano (2022)

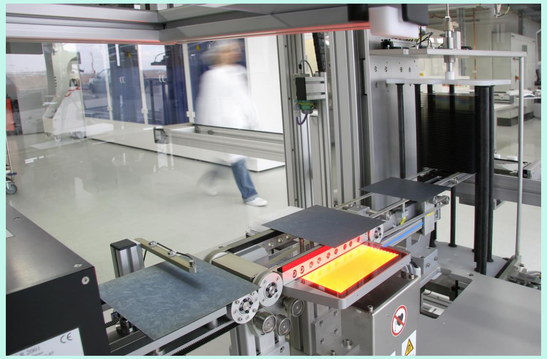
Fraunhofer ISE

Scaling up production technology R&D

Major steps taken in 1997 at Fraunhofer ISE

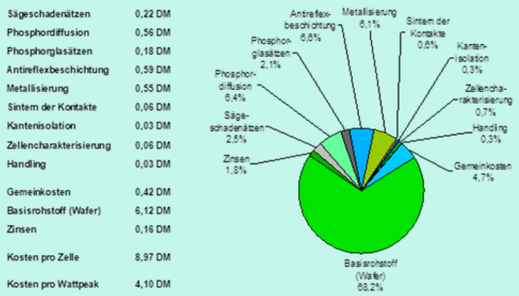


Scientific excellence

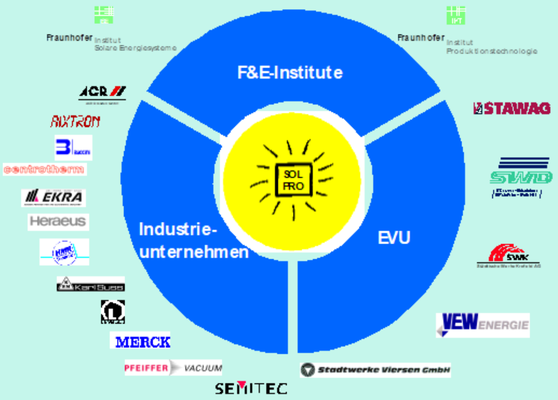


R&D infrastructure for technology scaling

Sägeschadenätzen	0,22 DM
Phosphordiffusion	0,56 DM
Phosphorglasätzen	0,18 DM
Antireflexbeschichtung	0,59 DM
Metallisierung	0,55 DM
Sintern der Kontakte	0,06 DM
Kantenisolation	0,03 DM
Zellencharakterisierung	0,06 DM
Handling	0,03 DM
Gemeinkosten	0,42 DM
Basisrohstoff (Wafer)	6,12 DM
Zinsen	0,16 DM
Kosten pro Zelle	8,97 DM
Kosten pro Wattpeak	4,10 DM



Techno-economic analysis



Industry partnership

Preu, R. et al., 16th EU-PVSEC (2000)

Slides: Ralf Preu et al., 8th WCPEC, Milano (2022)

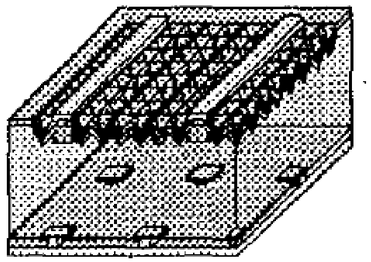
Fraunhofer ISE

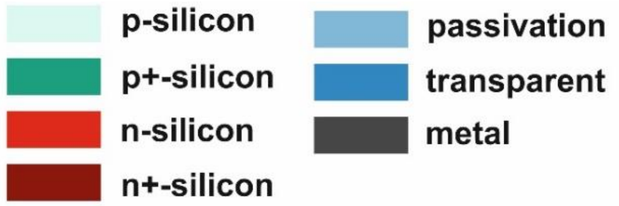
Scientific and technological milestones

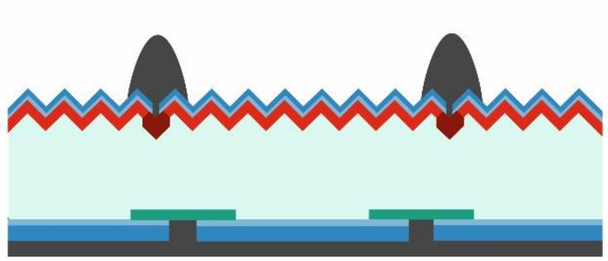
Passivated emitter and rear cell

1997

2022





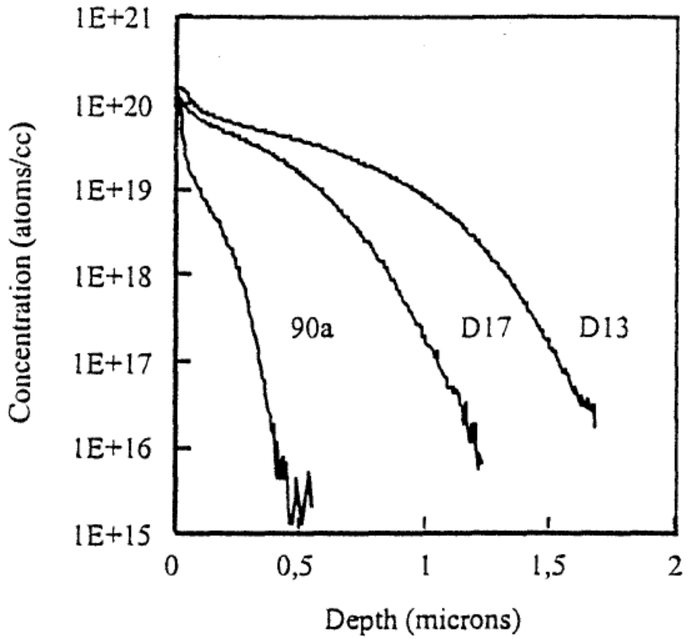


Slides: Ralf Preu et al., 8th WCPEC, Milano (2022)

Scientific and technological milestones

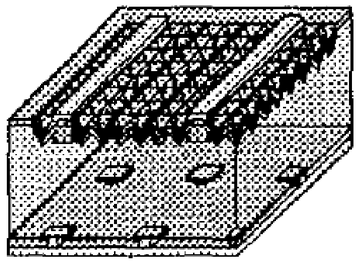
Passivated emitter and rear cell

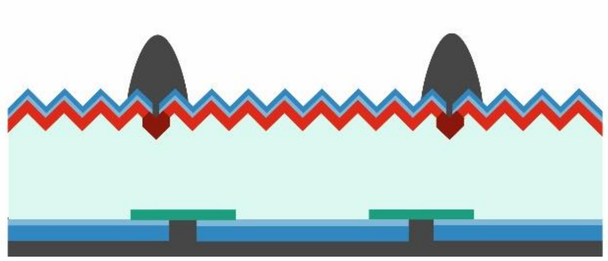
ENEL/CNRS
Laser doped seletive emitter
with screen printed contacts



1997

2022





Ventura, L et al., 13th EU-PVSEC (1995)
Besi-Vetrella, U. et al., 14th EU-PVSEC (1997)

Slides: Ralf Preu et al., 8th WCPEC, Milano (2022)

Fraunhofer ISE

Scientific and technological milestones

Passivated emitter and rear cell

Shin-Etsu

UNSW

ANU

Light induced degradation
B:Cz-Si vs Ga:Cz-Si

Tokio Univ

ISFH

Georgia Tech

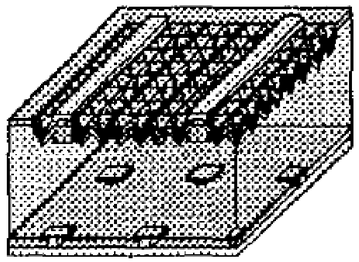
UKN

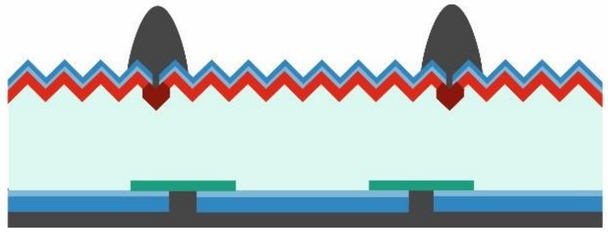
Fraunhofer ISE

1997

2022

2006





Schmidt, J. et al, 26th IEEE PVSC (1997)
Glunz, S.W. et al., 2n WCPEC (1998)
Saitoh, T. et al. 11th Asia-PVSC (1999)

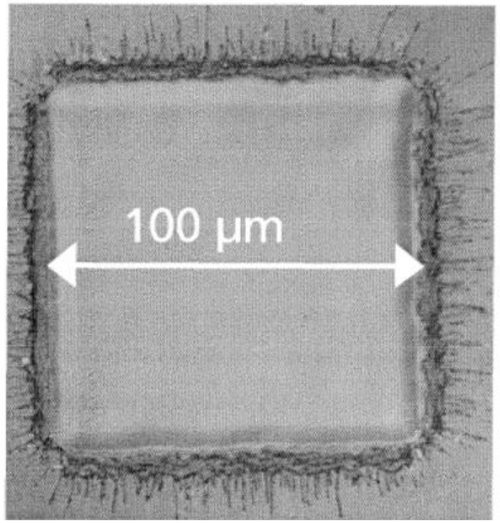
Herguth, A., et al, 21st EU-PVSEC(2006)

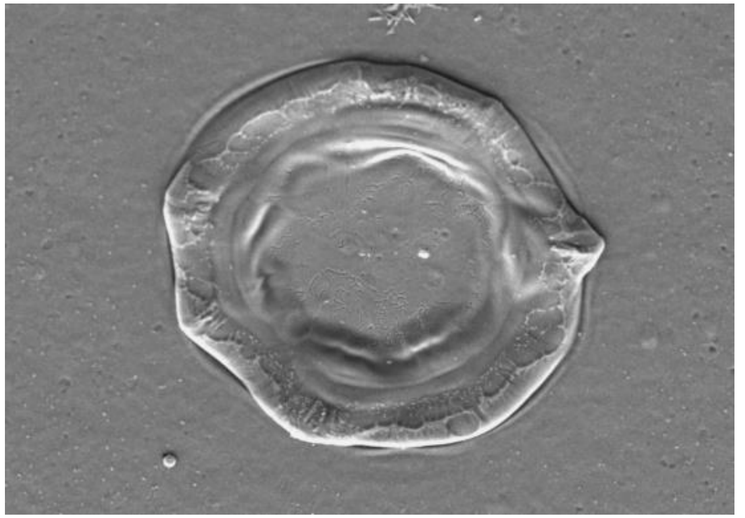
Slides: Ralf Preu et al., 8th WCPEC, Milano (2022)

Scientific and technological milestones

Passivated emitter and rear cell

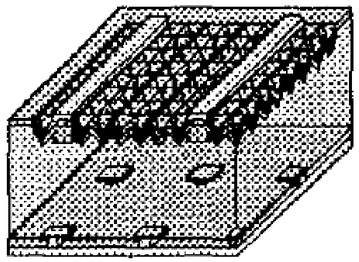
Fraunhofer ISE
Demonstration of shallow, low-invasive laser ablation of passivation layers and laser fired contacts



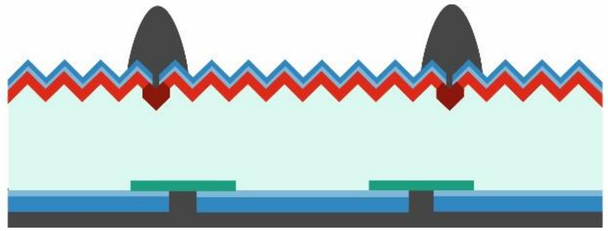


1997

2022



2000



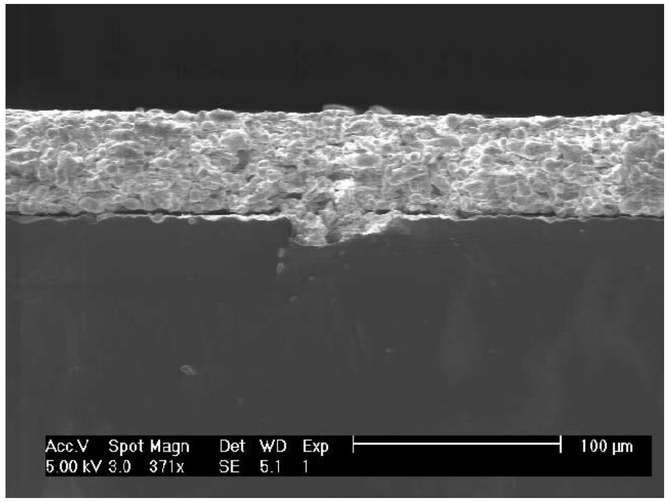
Preu, R. et al., 16th EU-PVSEC (2000)
Schneiderlöchner, E. et al., 17th EU-PVSEC (2001)

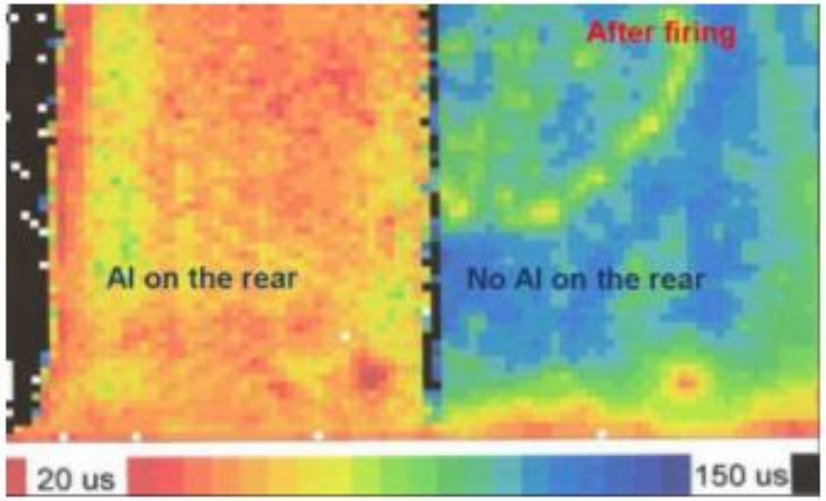
Slides: Ralf Preu et al., 8th WCPEC, Milano (2022)

Scientific and technological milestones

Passivated emitter and rear cell

IMEC
Effective capping layer to prevent indiffusion during contact firing

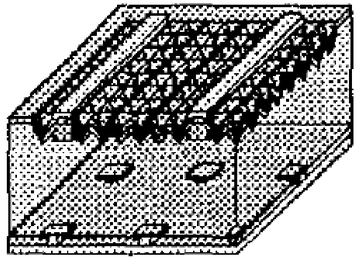


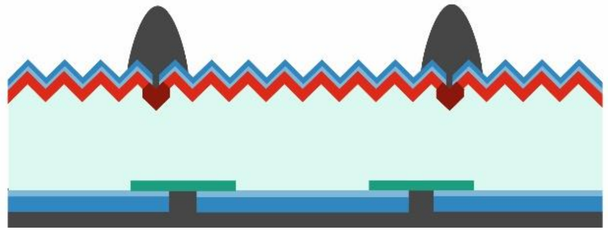


1997

2004

2022





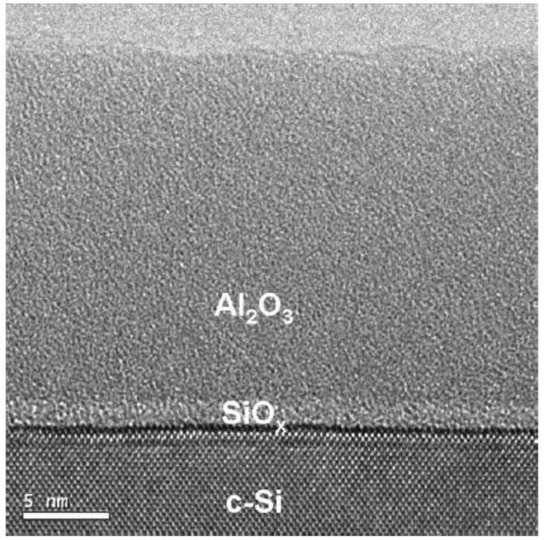
De Wolf, S. et al., 19th EU-PVSEC (2004)
G. Agostinelli et al., 20th EU-PVSEC (2005)

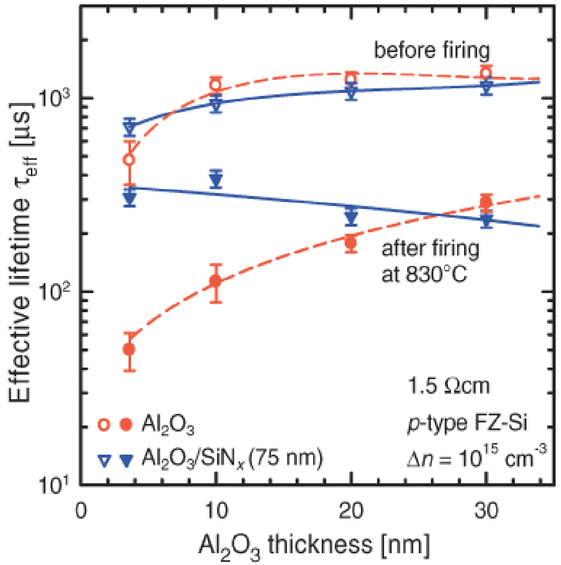
Slides: Ralf Preu et al., 8th WCPEC, Milano (2022)

Scientific and technological milestones

Passivated emitter and rear cell

Univ Eindhoven / IMEC
Positively charged atomic layer deposited aluminum oxide layers for passivation and firing stability by hydrogenation from SiN:H

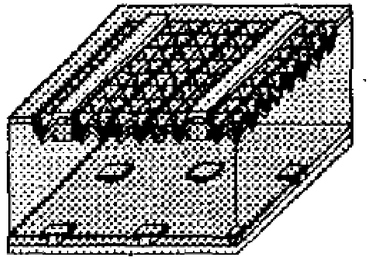


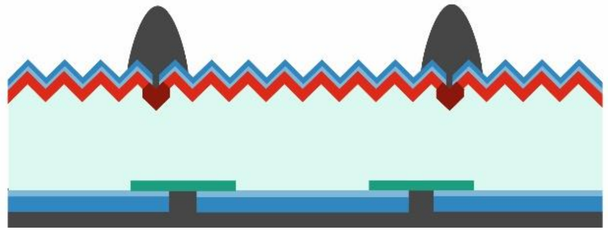


1997

2006

2022





Hoex, B. et al, APL 89, 042112 (2006)
Agostinelli, G. et al, SOLMAT 90 (2006)
Schmidt, J. et al., PSS RLL 3 (2009)

Slides: Ralf Preu et al., 8th WCPEC, Milano (2022)

Fraunhofer ISE

Scientific and technological milestones

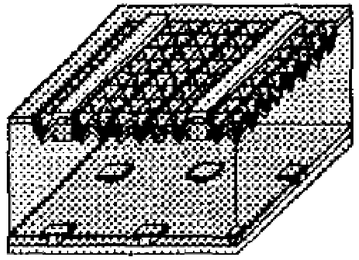
Passivated emitter and rear cell

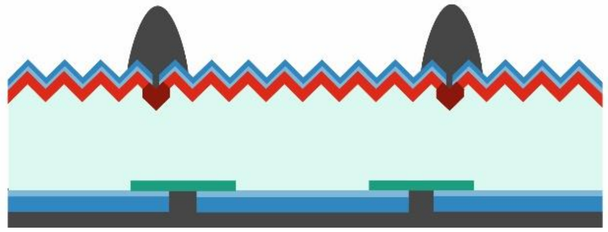
Fraunhofer ISE
First high-throughput aluminum oxide deposition and tool

1997

2022

2009





St. Cast, P. et al., Appl. Phys.Letters (2009)
Sperlich et al, P., 25th EU PVSEC (2010)

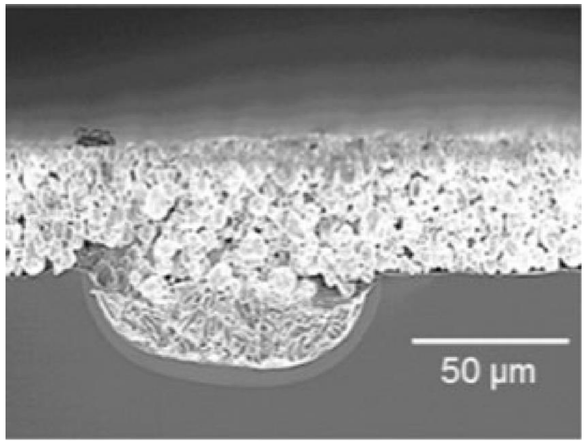
Slides: Ralf Preu et al., 8th WCPEC, Milano (2022)

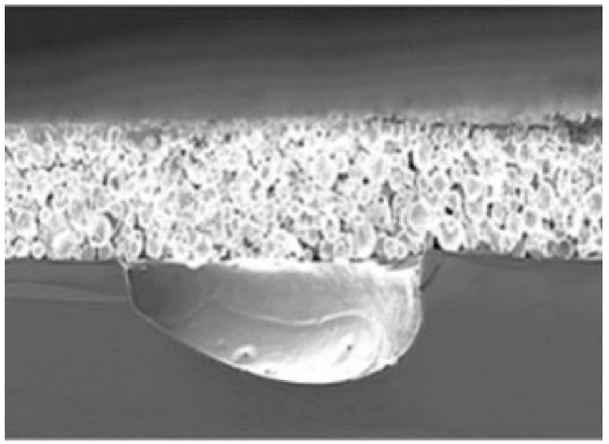
Fraunhofer ISE

Scientific and technological milestones

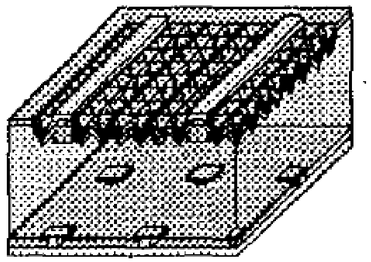
Passivated emitter and rear cell

ISFH
Deep local
Al-BSF formation
and void mitigation

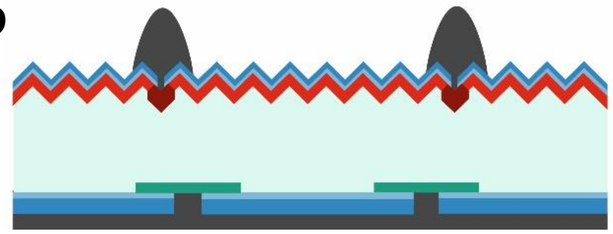




1997 [redacted] 2022



2016



Dullweber, T. and Schmidt, J., J.IEEE JPV (2016)

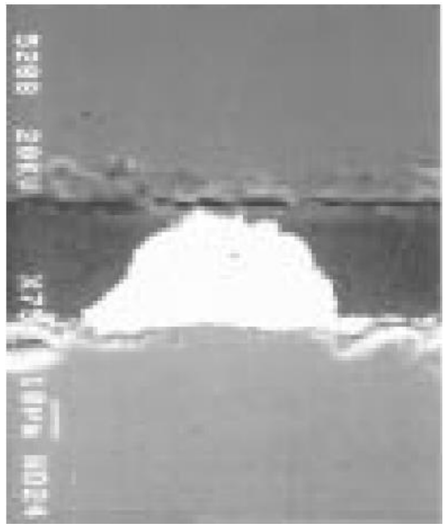
Slides: Ralf Preu et al., 8th WCPEC, Milano (2022)

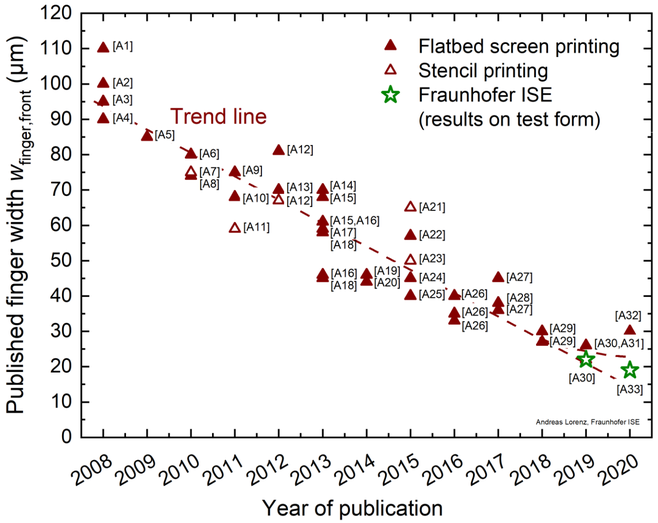
Fraunhofer ISE

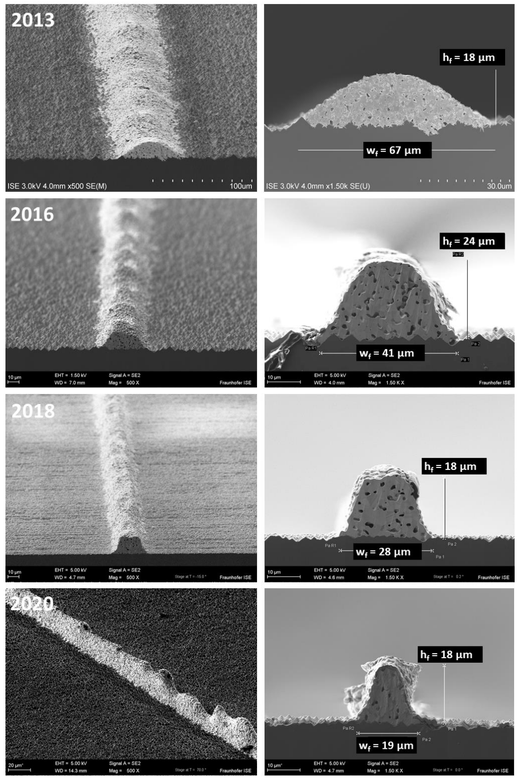
Scientific and technological milestones

Passivated emitter and rear cell

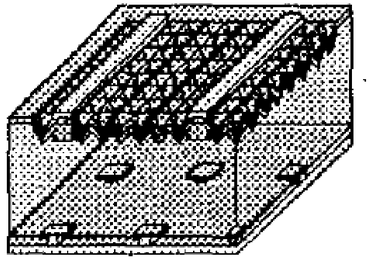
ECN / Fraunhofer ISE
Fine line printing of front contacts from silver paste

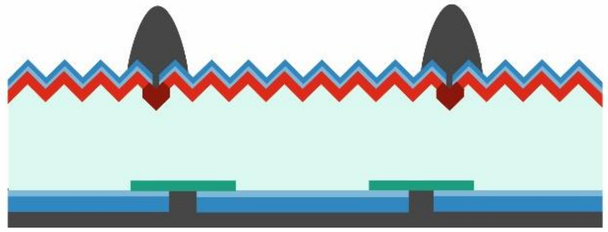






1997 — 2022





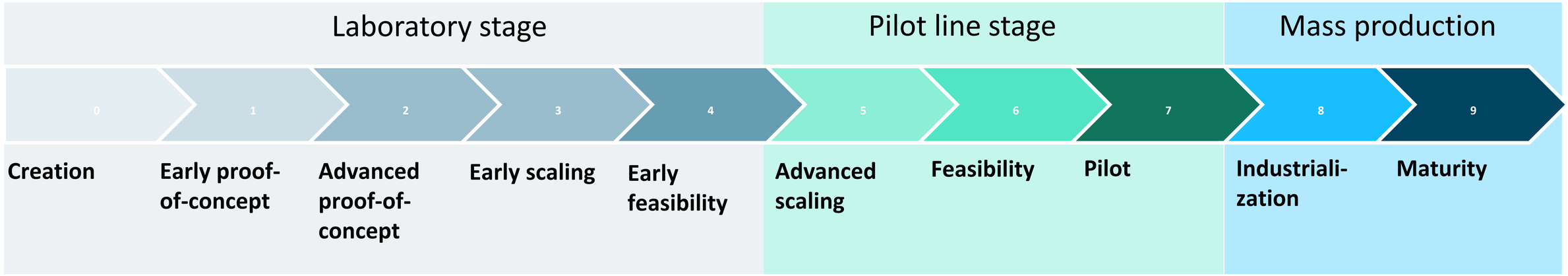
DeMoor, H. et al., 14th EU-PVSEC (1997)
Lorenz, A. et al., 35th EU-PVSEC (2018)
Preu, R. et al., APR 7 04315 (2020)

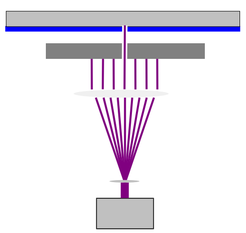
Slides: Ralf Preu et al., 8th WCPEC, Milano (2022)

Fraunhofer ISE

Technology Readiness Level (TRL)

R&D specific definition





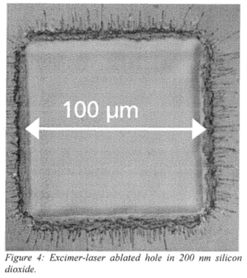
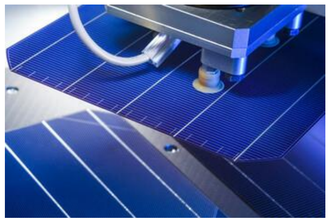
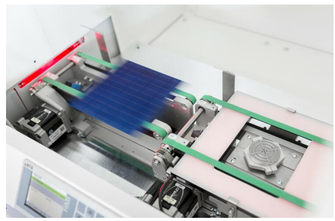


Figure 4: Excimer-laser ablated hole in 200 nm silicon dioxide.





Baliozian, P. et al., 32nd EU-PVSEC (2016)
Rentsch, J. et al., Photovoltaics International 48 (2022)
Slides: Ralf Preu et al., 8th WCPEC, Milano (2022)

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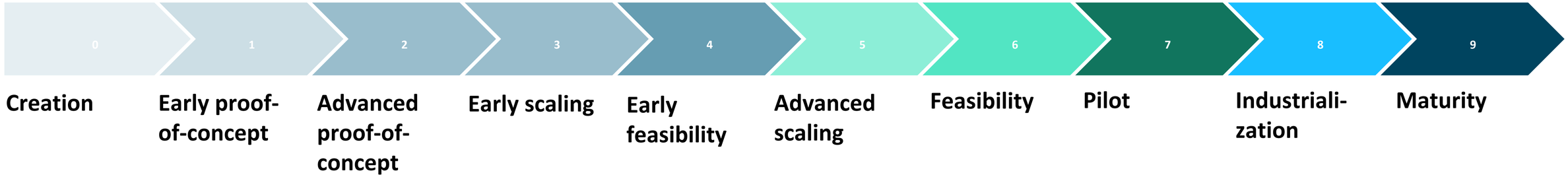
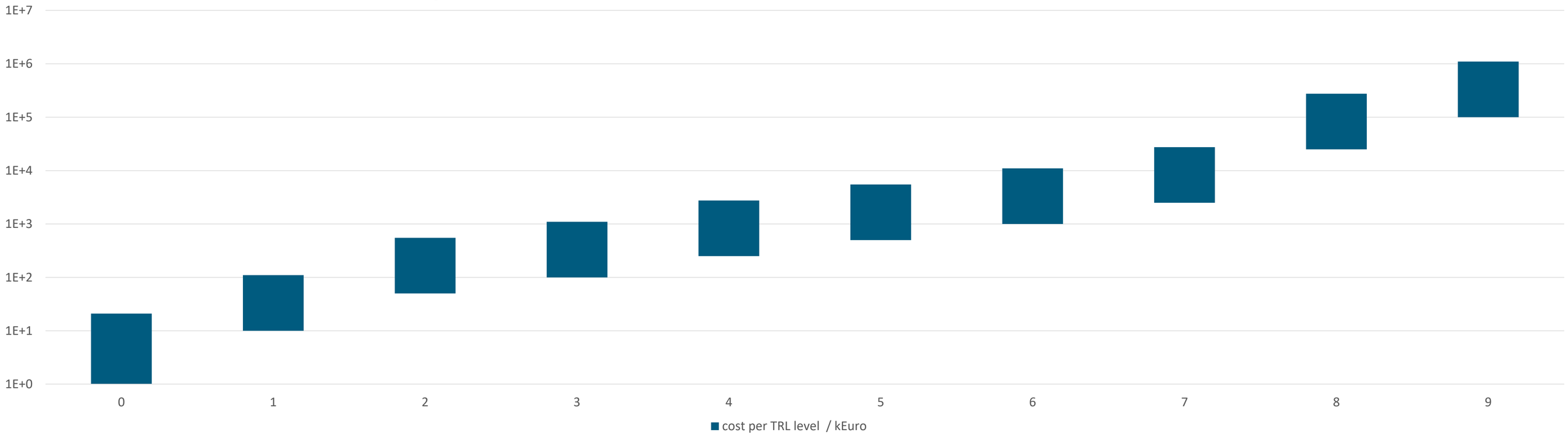
Cost along the TRL

Experienced typical expenditures

- **TRL schemes support efficient resource use**
- **Encourage creation!**





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PV Technology Evaluation Center

Some numbers

2.400 m² floor space - TRL-Focus 4-6

Database 2006-2021:

- 135 tools registered
- 6700 experiments started
- 916.000 wafer processed
- 87.000 processes executed

Quality management system installed

PV-TEC Front-End


PV-TEC Back-End

Slides: Ralf Preu et al., 8th WCPEC, Milano (2022)

Fraunhofer ISE

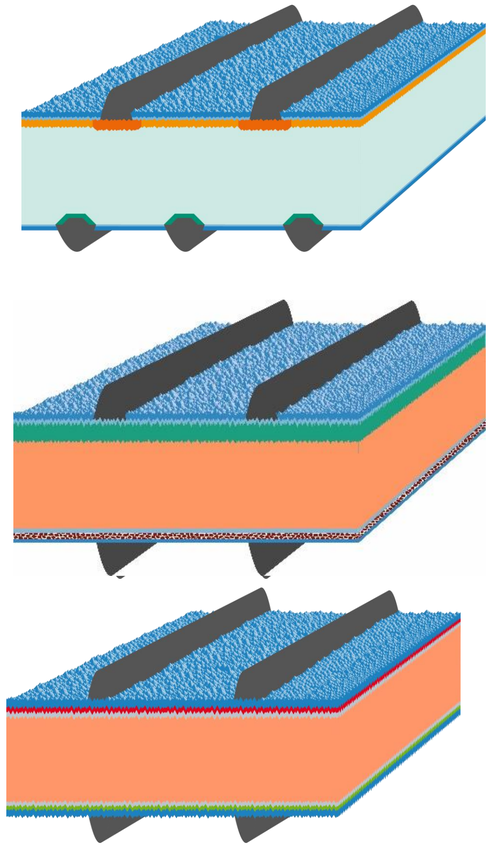
PV-TEC large area screen printed cells

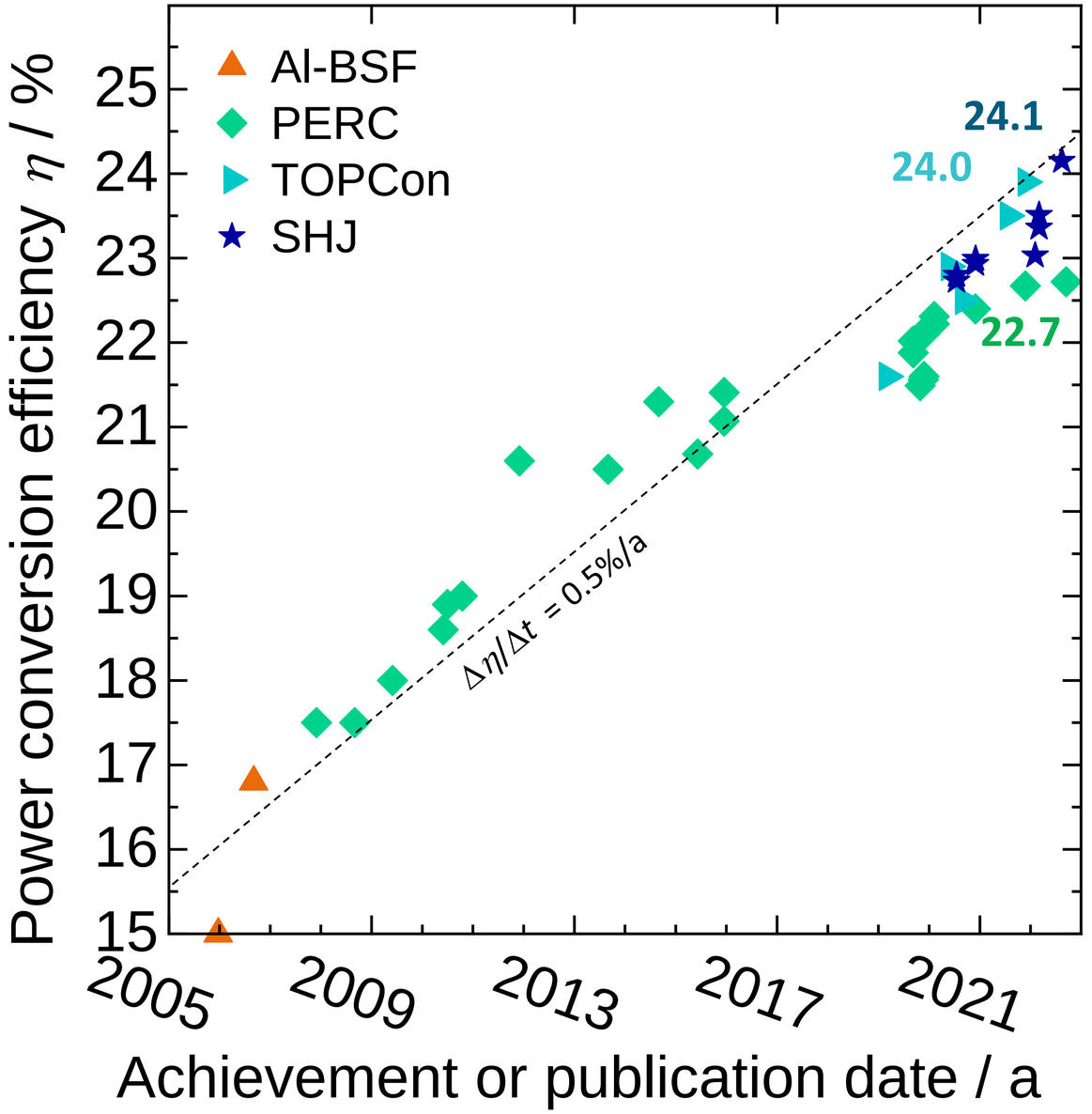
Efficiency development – calibrated measurement

p-PERC
Passivated Emitter and Rear Cell

n-TOPCon
Tunnel Oxide Passivated Contact

n-SHJ
Silicon Hetero Junction





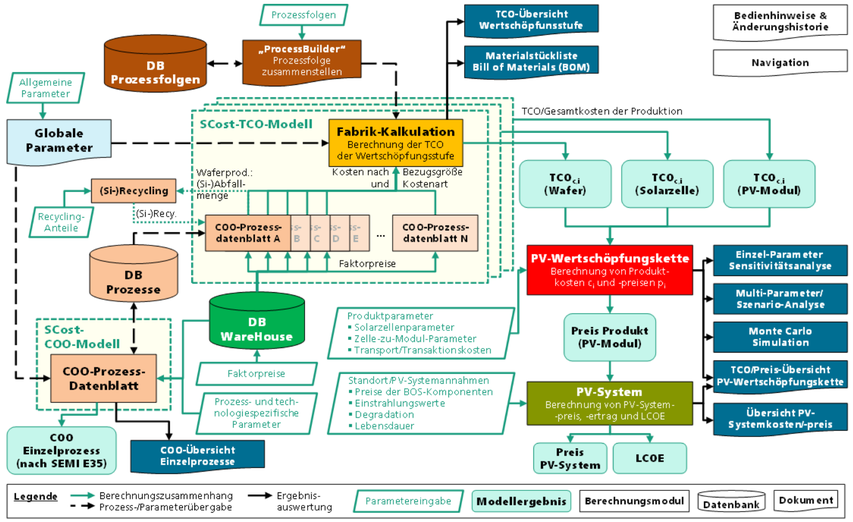
Slides: Ralf Preu et al., 8th WCPEC, Milano (2022)

Techno-economical analysis

Cost along the value chain

Model + continuos data acquisition[1]

- Total cost of ownership
- Levelized Cost of Electricity
- Life cycle analysis, resource criticality



$$TCO \cong \frac{1/t_{dep} \sum CAPEX + \sum OPEX}{\eta_{module}\, Y_{prod}}$$

TCO	: Total cost of ownership / ($/Wp)
t_{dep}	: depreciation time / a
$CAPEX$	: capital expenditure / $
$OPEX$	: operation expenditure / ($/a)
Y_{prod}	: production yield / (Wp/a)

[1] Nold, S., PhD thesis (2019)

Industry partnership

Trustful cooperation is key

equipment

silicon

manufacturer

metrology

material supplier

supported by

Horizon 2020 European Union Funding for Research & Innovation
Bundesministerium für Wirtschaft und Klimaschutz
Ministerium für Wirtschaft, Arbeit und Tourismus Baden-Württemberg

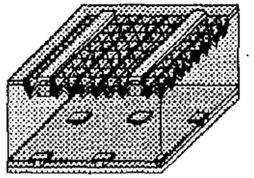
Slides: Ralf Preu et al., 8th WCPEC, Milano (2022)

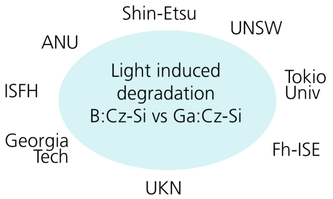
Conclusion

Important measures of effective and efficient production technology R&D

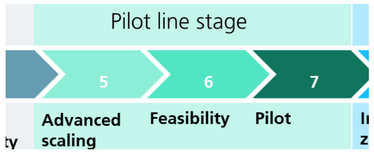
The progress of PV:
an outstanding success
of uncountable
individuals team
working for a
sustainable future

1 Scientific excellence, exchange, creativity

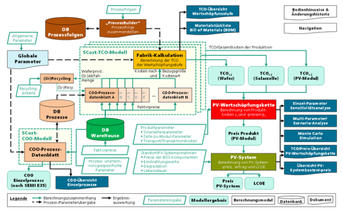


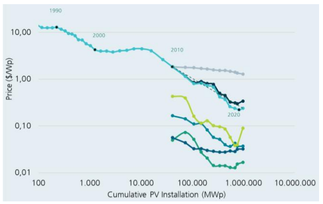


2 Infrastructure for scaling along TRL

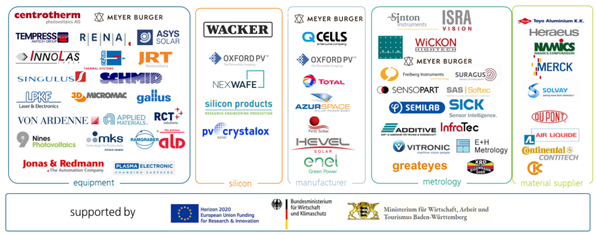


3 Techno-economic: TCO, LCoE, LCA,…





4 Industrial R&D partnership and support



Slides: Ralf Preu et al., 8th WCPEC, Milano (2022)

Fraunhofer ISE

Thank you for your attention

Dr. Simon Philipps
simon.philipps@ise.fraunhofer.de
www.energie.fraunhofer.de

SUPEERA

Support to the coordination of national research and innovation programmes in areas of activity of the European Energy Research Alliance

Panel discussion

Coffee break

Restart at 11:30!

Systemic and cross-sectorial issues pertaining to the Clean Energy Transition

Spyridon Pantelis, EERA,
Project Manager

Karlsruhe, Germany, 21.03.2023

Background

- A template for **identification** and **categorisation** of cross-cutting issues in energy
- Coordinated input to **decision-makers** for addressing systemic and cross sectorial solutions in the energy sector to support the **Clean Energy Transition**
- Initial mapping of **existing cross-cutting** and interdisciplinary **topics** – both technological and non-technological - and related activities in the SET Plan Implementation Plans

Goal

- Help to improve a conceptual framework for planning technological solutions for the Clean Energy Transition

Why it is needed?

Provide a context for the Clean Energy Transition planning beyond specific technologies

Ensure that the clean energy transitions are designed with the **systems-thinking approach** (key element for socio-technical transformations)

In line with the current **European and global agendas** (e.g. European Green Deal, SDGs) - Impossible to achieve with a purely techno-centric mindset and without taking into consideration the cross-cutting aspects

Methodology

Desk analysis of the SET Plan **Implementation Plans** (IP) and **National Energy Climate Plans** (NECPs) -> identify overlaps and complementarities

List of categories and sub-categories for classifying in a more specific way the cross-cutting issues (other sources: CETP SRIA & EERA White Paper on the Clean Energy Transition)

Feedback from the EERA Joint Programme Coordinators

Technological cross-cutting topics

Technological cross-cutting topics

- Energy efficiency
- Energy System Integration
- High temperature & advanced materials
- Energy storage
- Digitization
- Security & Safety

Non-technological cross-cutting topics

Non-technological cross-cutting topics

- Circular economy
- Education & training
- Policy & regulation
- R&I funding programmes & measures
- Social awareness, acceptance, engagement
- Standardization
- International cooperation

How it can be used?

- The template does **not** aim to serve as **an exhaustive list** of the technological and nontechnological cross-cutting topics
- **Preliminary exercise** that can be elaborated further to eventually provide a universal framework
- Be used for developing **energy** and **climate transition plans**

Thanks
Spyridon Pantelis
EERA
Email: s.pantelis@eera-set.eu

PANEL SESSION - Cross-sectorial dialogue for system solutions towards the CET objectives

Moderator: Spyridon Pantelis

energy efficiency

energy system integration

policy & international cooperation

international cooperation

Phytonics	Ruben Hünig, Co-Founder and CEO
Fenecon	Sagar Venu, Software Engineer
SolarPower Europe	Catarina Augusto, Senior Technical Advisor
Fraunhofer ICT	Peter Fischer, Head of Redox Flow battery and stationary storage group

phytonics

Boosting Solar Power

Anti-Reflective Coating

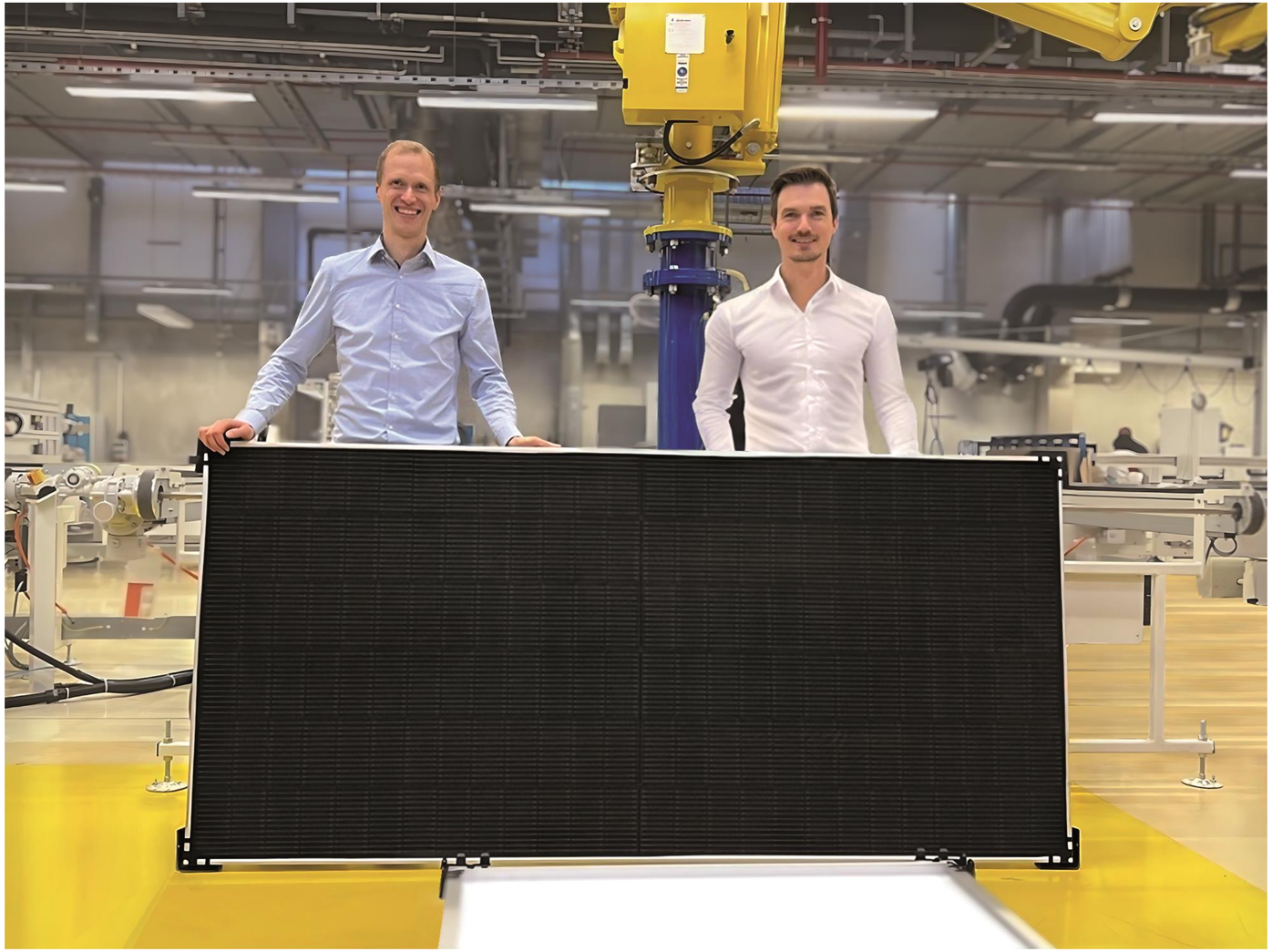
Bionic nano & microtextures for glare-free solar modules

STRICTLY CONFIDENTIAL

FROM LAB TO FAB

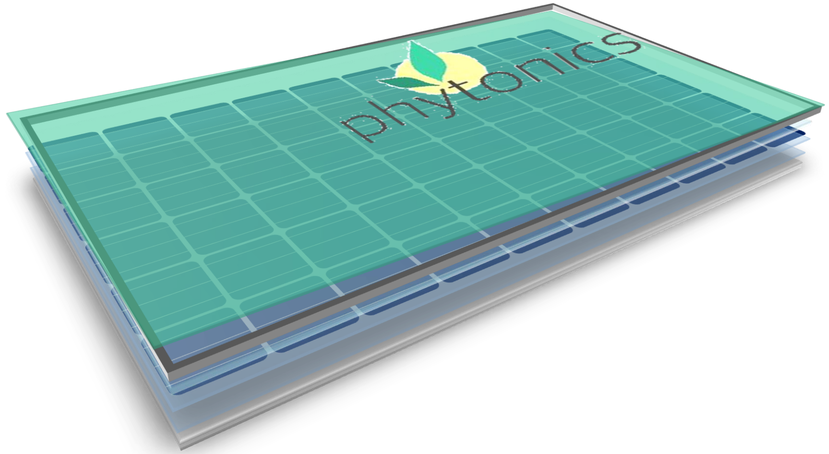
> 8 years of R&D

- **2011 – 2016**
  Light Technology Institute @ KIT
- **2016 – 2019**
  ZSW (Center of solar energy and hydrogene research)
- **2020 - 2023**
  Light Technology Institute @ KIT
  Phytonics GmbH



UNIQUE ANTI-GLARE COATING

Only solution that meets all legal limits



- ✓ **Highest yield increase**
- ✓ **Unique anti-glare**
- ✓ **Improved aesthetics**

GLARE – A PROBLEM IN NEIGHBOURHOODS

Increasing number of legal disputes

SPIEGEL Panorama

Fotovoltaik-Urteil

Solaranlage auf dem Dach darf Nachbarn nicht blenden

Die Spiegelung war annähernd so hell wie der Blick in die Sonne selbst: Ein Ehepaar sah sich von der Solaranlage der Nachbarn geblendet – und klagte. Mit Erfolg.

29.09.2022, 14.19 Uhr

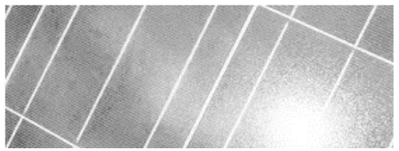
photovoltaik

AKTUELLE MELDUNGEN

Solaranlage darf Nachbarn nicht blenden

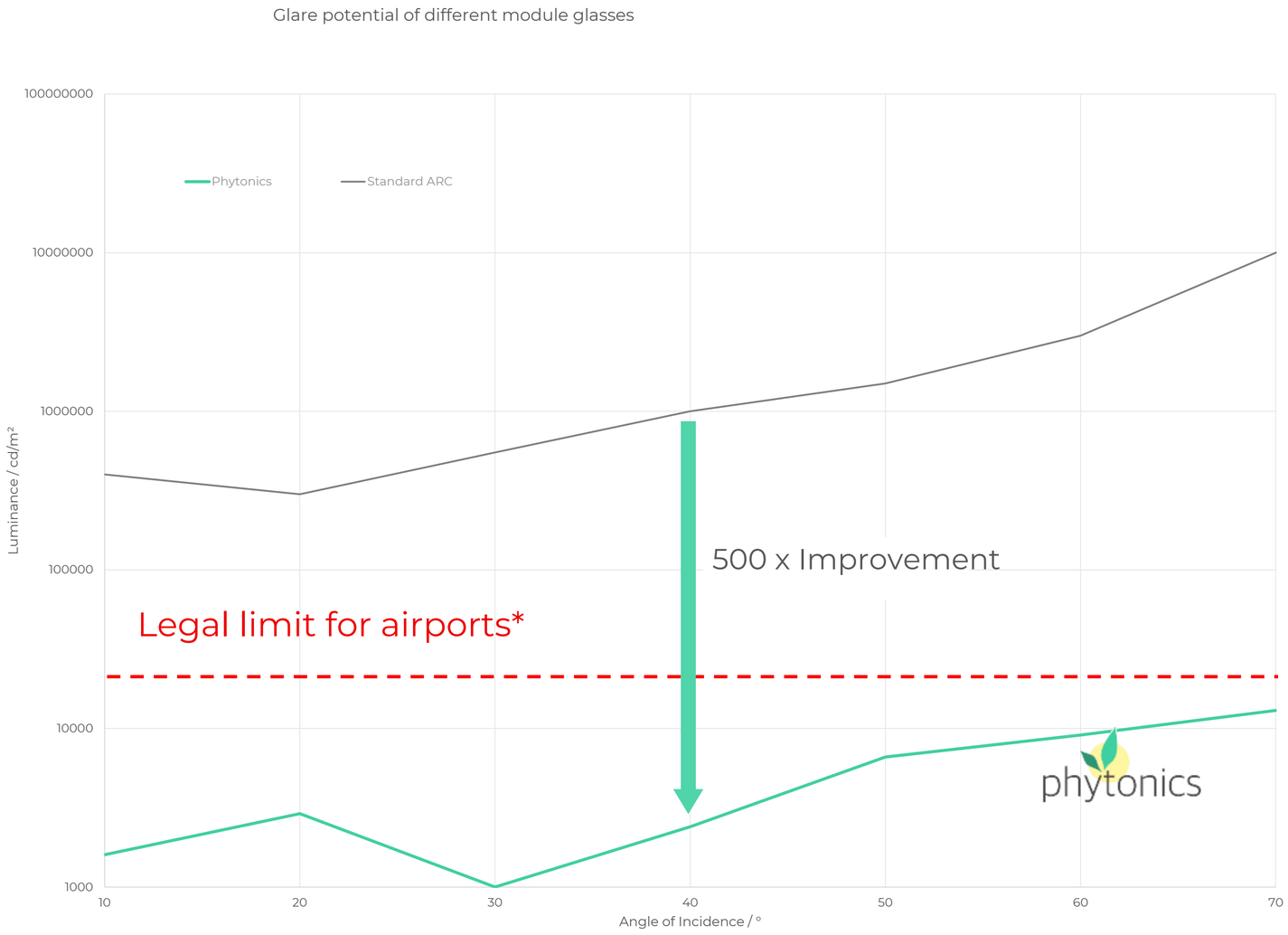
02.02.2018 12:51 | Druckvorschau

Das Oberlandesgericht Düsseldorf hat einen Betreiber einer Photovoltaikanlage dazu verpflichtet, die Reflexionen zu minimieren, die von seinem Generator ausgehen. Ein Gutachter hat festgestellt, dass das Nachbargrundstück von der Anlage an mehr als 130 Tagen massiv geblendet wird.



GLARE – A SAFETY RISK NEAR TRAFFIC INFRASTRUCTURE

Phytonics is the only solution that fully meets the regulation
BRDF (glare values) measured at SPF institute



*in EU

ANTI-REFLECTIVE PROPERTIES OF PETAL SURFACE STRUCTURES

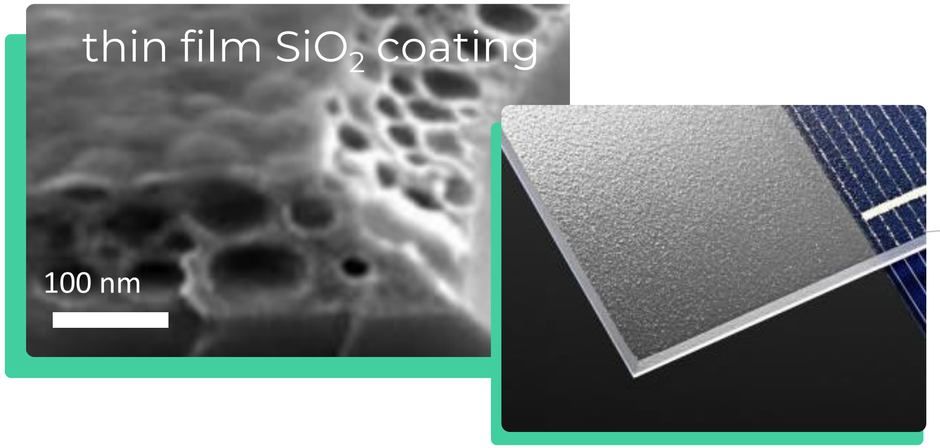
Saturated colors under all conditions are crucial for pollination success

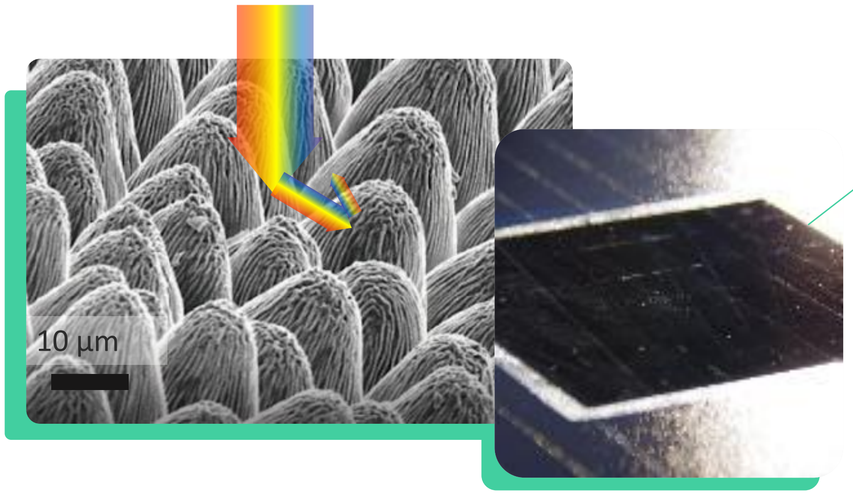
THE PLANT INSPIRED STRUCTURE

ALLOWS FOR BETTER LIGHT COLLECTION UNDER ALL CONDITIONS

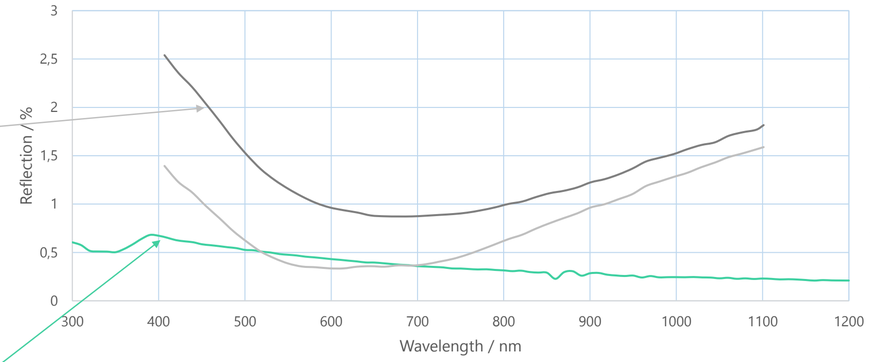
ANTI-REFLECTIVE PROPERTIES OF PHYTONICS SURFACE STRUCTURES

Gain from broad-band and omnidirectional anti-reflective (AR) film

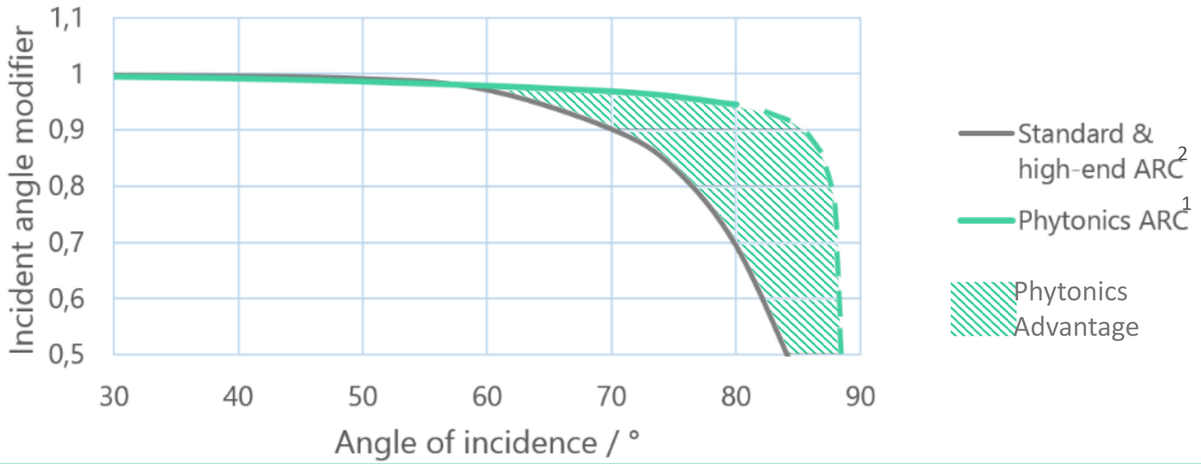




Reflection loss for normal incidence



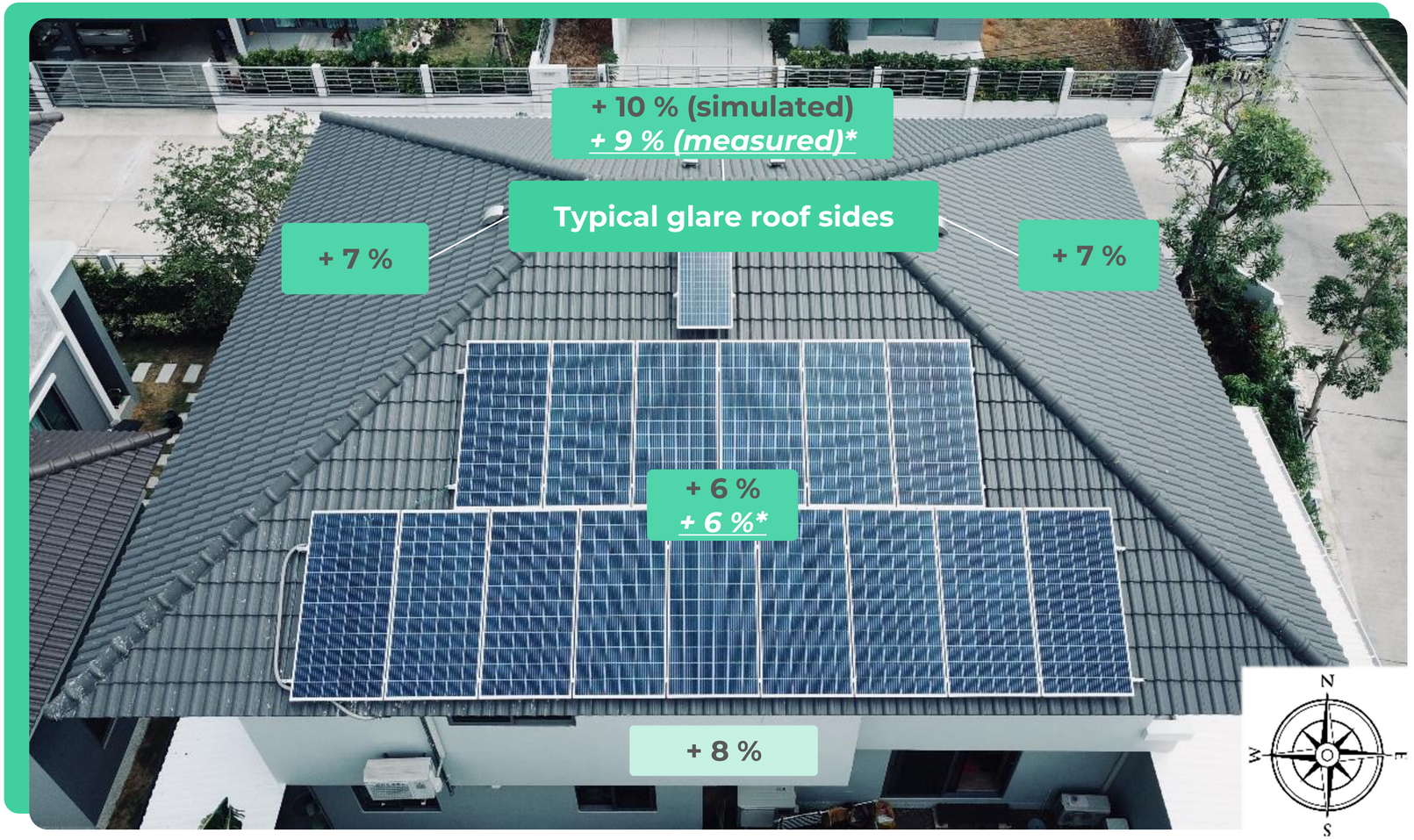
Performance change due to angular incidence



[1] Data from reflection measurements: Phytonics-structure on glass with black backside [2] ARC: Anti-reflective Coating - Data from DSM fact sheet (now Covestro)

HIGH ADDITIONAL ANNUAL YIELD

Calculated with PVSyst based on measured data (IAM, Isc)



Simulated Yield

- with market standard Pvsyst
- Based on lab data (IAM, PCE)
- Percentage relative to non-ARC PV
- Sub-optimal orientations with higher gains due to more light with flat incidence

*Measured on outdoor teststand (4 months)

phytonics

eXIST

ESF
European Social Fund
for Germany

Supported by:

Federal Ministry
for Economic Affairs
and Energy

on the basis of a decision
by the German Bundestag

European
Union

Grid integration with Energy Storage Systems through OpenEMS

FENECON GmbH

Sagar Bandi Venu | Software Engineer – FENECON GmbH

March 21, 2023 Karlsruhe

Content

fenecon

1. About FENECON.
2. Example Controller.
3. Research Projects.
4. Our Experience.

fenecon

About FENECON

About FENECON

Our Vision: For a future with 100% renewable energy

- Started in 2011.
- From Home storage to multi-MWh large scale storage.
- > 100 Employees.
- Strong R & D.

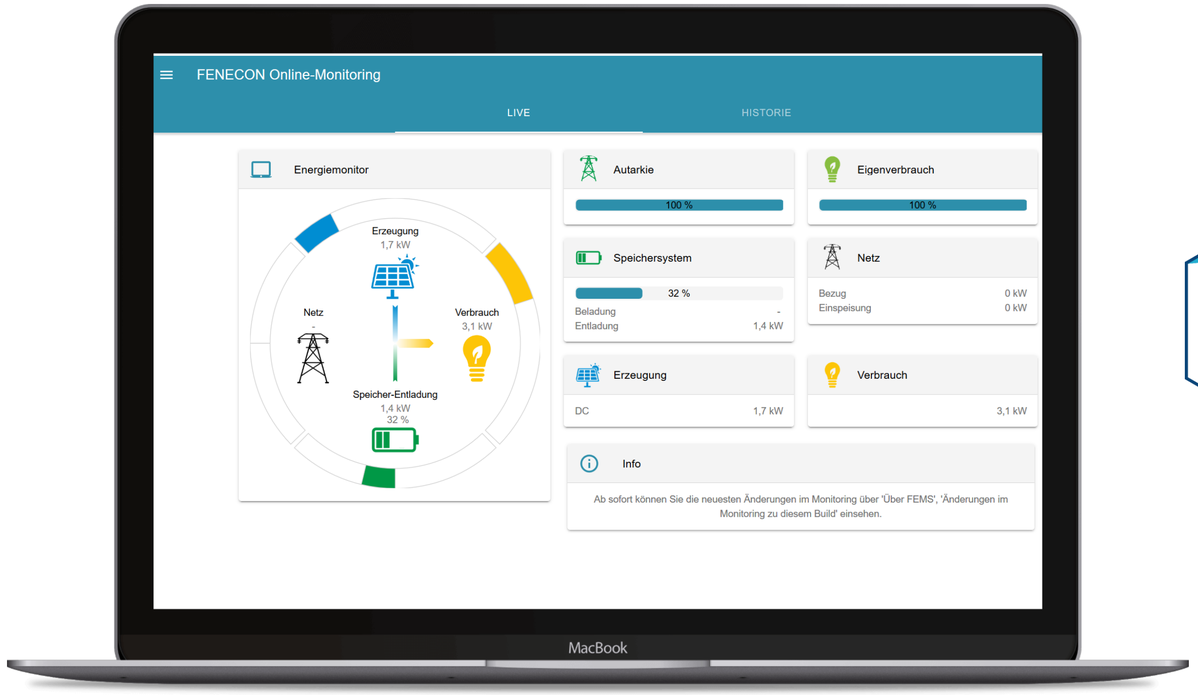
Multiple Awards

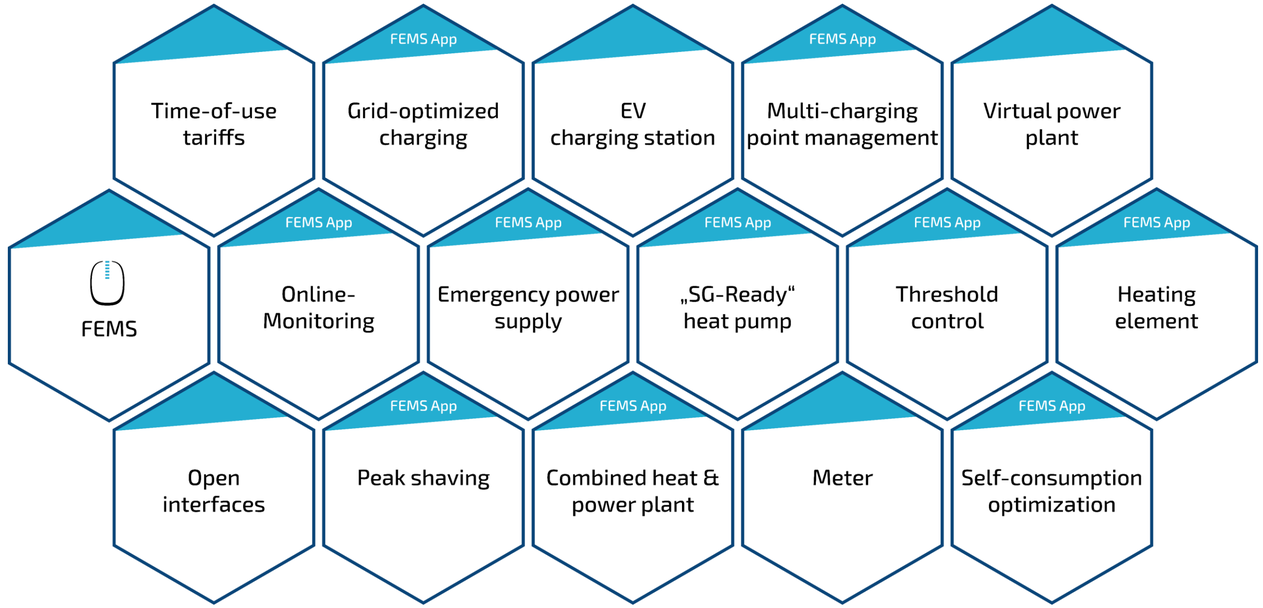
FEMS – FENECON Energy Management System

FENECON Energy Management System

OpenEMS

Hardware – Operating system – Applications/Controller





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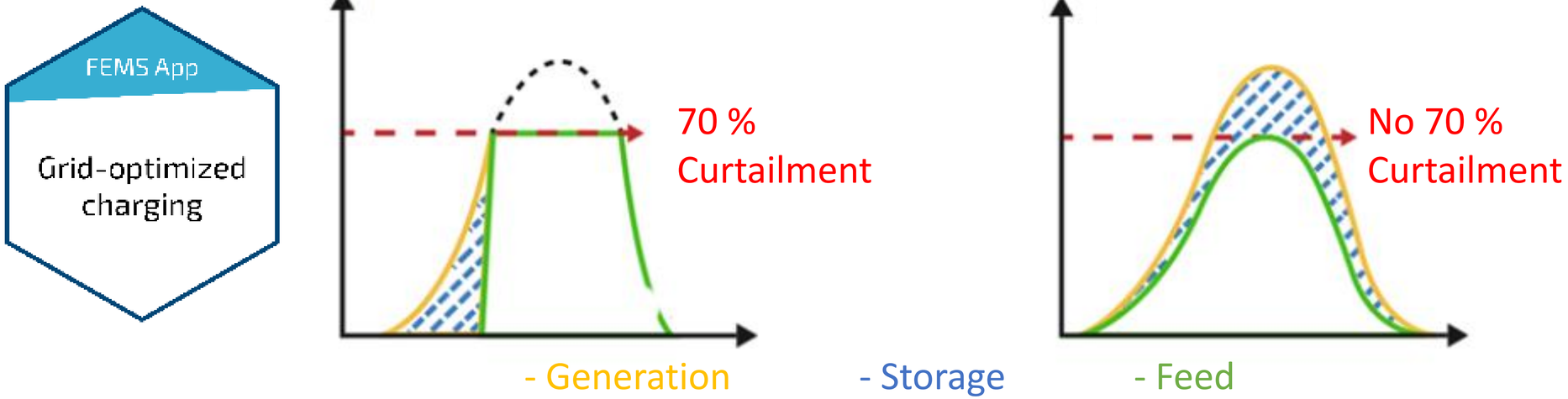
Example Controller

FEMS App – Grid-optimized charging



- Optimized storage loading by forecasting generation and consumption
- Higher self-consumption quota by avoiding the 70% (without subsidy) or 50% (with subsidy) curtailment
- Higher grid efficiency by avoiding the feed-in peak at midday

fenecon

Research Projects

Research Projects

fenecon

Enable Ancillary Services by Renewable Energy Sources

European Horizon 2020 Research Project

Vision: 100% Renewable, 100% Secure.

- Includes 5 universities, 1 industrial SME, 3 DSOs, 1 TSO and 1 SME acting as dissemination and exploitation manager.
- Our Contributions
  - Technical expertise on battery behavior, control algorithms.
  - Participation in development of new system services, laboratory tests.
  - Development of new EMS based on OpenEMS.

EASY-RES

Kofinanziert durch das Programm „Horizont 2020“ der Europäischen Union

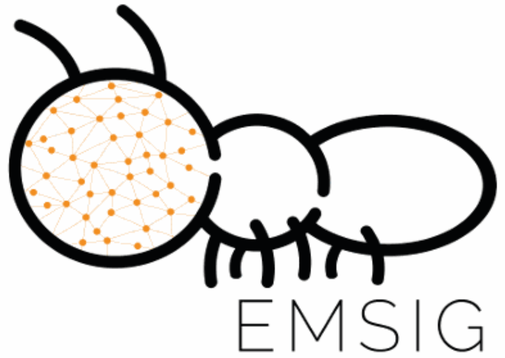
Research Projects

fenecon

Energy Management Systems for Integrated Business Models.

Aim: To explore potential of Storage systems for End user and Distributor (DSO) through Integrated Business models.

- Novel charging and Discharging algorithms developed.
- “Pooling“ of Storage Systems for better flexibility.
- Open-data platform for anonymized energy data for research purposes.



Bayerisches Staatsministerium für Wirtschaft, Energie und Technologie

Our Experiences with Collaboration

- Better understanding on Practical feasibility of the problem.
- Better structure on timeline to solve the problem.
- Unrealistic hardware parameters and Software limitation can be minimized with collaboration.
- End-Users can be directly benefitted with the end result of the research.

Research and Industrial collaboration is Vital for research product to advance from TRL5 or TRL6 to higher technological readiness levels.

Fenecon is always open for collaboration.

Thank you for your attention!
How to reach us

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+49 991 64 88 00 00

info@fenecon.de

www.fenecon.de

www.openems.io

https://www.facebook.com/FeneconDe

@fenecon

SolarPower Europe

Engagement of Solar PV Industry and Research

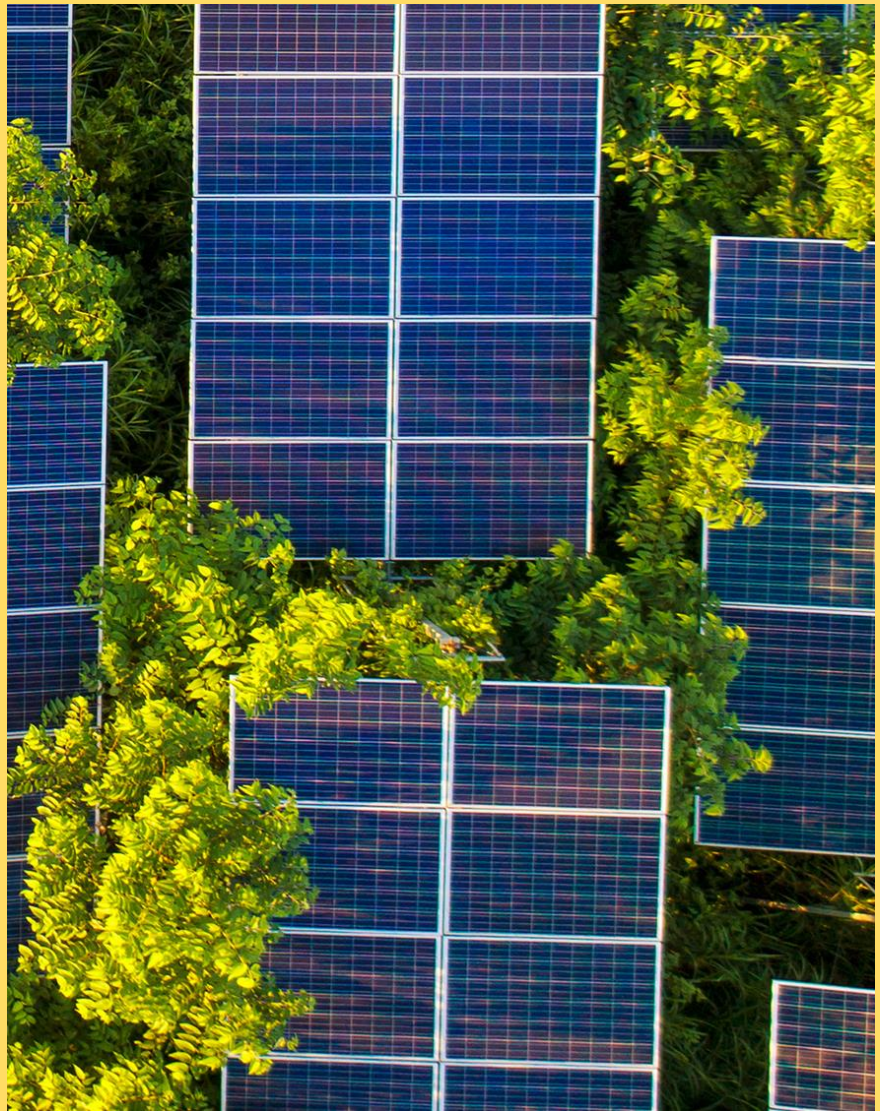
Energy Conversion and Storage Days – SUPEERA Workshop

Catarina Augusto

Senior Technical Advisor

Coordinator of the Grids and Flexibility Workstream

What is SolarPower Europe?



01

SolarPower Europe

SolarPower Europe Workstreams

We represent the whole solar value chain

280 organisations

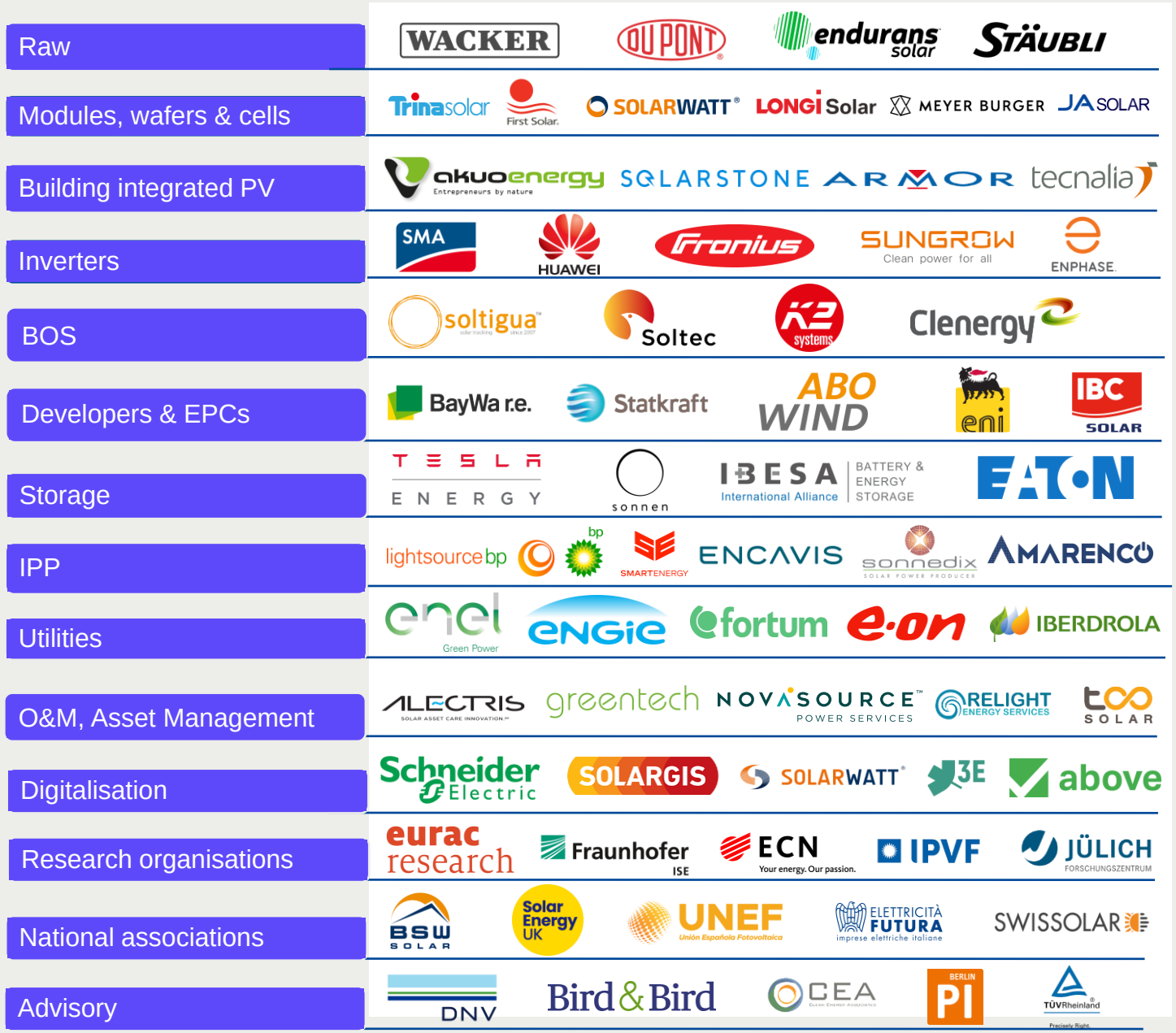
We work closely with

30+ national associations
20 research organisations

We help shape the policy environment and make business happen in the solar industry

We create award-winning market reports and best practice guidelines

SolarPower Europe



What are we working on Solar PV and Flexibility Policy Related topics?

Grids & Flexibility Workstream

02

SolarPower Europe

What is the Grids and Flexibility Workstream working on?

Workstream Proactive Actions

- **Solar Connection Roundtables between Solar PV and DSOs:** Grid Connection, Network Planning & Management and Flexibility Models
- **Benefits and Challenges of Hybrid Systems:**(Solar +Storage/Generation)
- **Grid tariffs systems**
- **Energy Storage Deployment**

Workstream Reactive Actions

- **Electricity Market Design**
- **Network Codes on Requirements for Generators:** a set of harmonised rules for generators to connect to the grid, namely synchronous power-generating modules, power park modules and offshore power park modules
- **Network codes on Demand Side Flexibility**

SolarPower Europe

How can Industry and Research collaborate?

ETIP-PV
European Technology and Innovation Platform PV

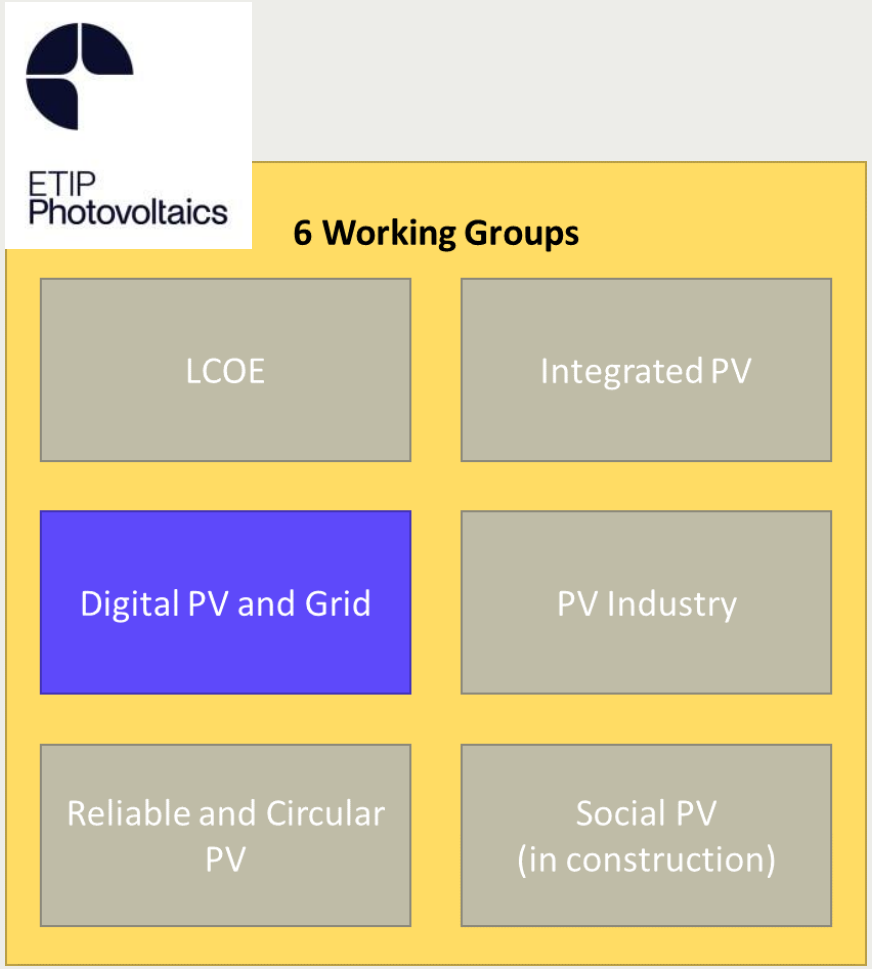
International cooperation

03

SolarPower Europe

ETIP PV: Bringing together Research & Industry experts

Secretariat: SolarPower Europe & WIP Renewable Energies



Digital PV and Grid Working Group Challenges:
(Led by CSEM and Co-Led by FOSS)

- Design
  - optimal design, web services, and application of artificial intelligence including image processing
- Operations
  - predictive maintenance, application of IoT for operations and maintenance, cost/benefit analysis on data-driven solutions, machine learning
- Control
  - optimal interaction with other energy system components such as battery storage systems, machine learning for forecasting, application of artificial intelligence to supervisory and distributed control
- Market
  - reduction of transaction costs in consumer-centric markets, local energy communities, trust and traceability (e.g., with blockchain) The special role of the inverter as a data collection hub, and control interface with high computing power and low inertia

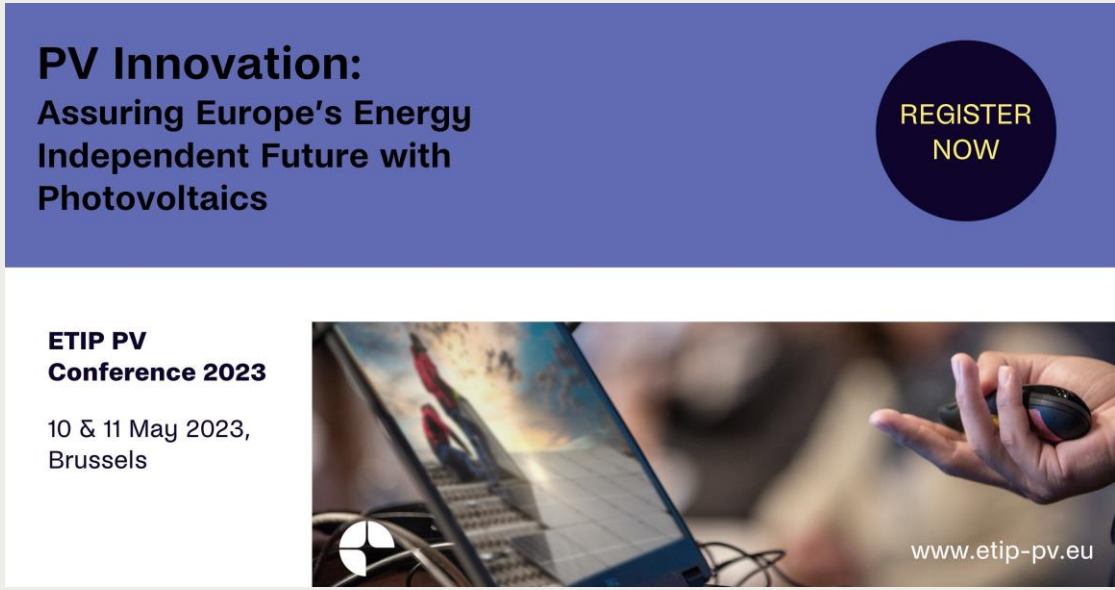
ETIP PV: Bringing together Research & Industry experts

How can you contribute?

- **ETIP PV Conference 2023**

PV Innovation: Assuring Europe's Energy Independent Future with Photovoltaics

- **Get involved in ETIP PV:**
  - Apply to become an Expert in one of the Working Groups by sending us your CV and Expression of Interest to info@etip-pv.eu
  - Apply to become a Steering Committee Member when calls are announced (the Steering Committee is renewed every two years)



SolarPower Europe

SolarPower Europe International Cooperation

SolarPower Europe is actively involved in various initiatives **supporting the scale-up of solar energy around the world**

- Research **projects funded by the European Union's**
- Cooperation projects funded by organisations such as the **German development cooperation (GIZ)**
- International partnerships:
  - **IRENA Coalition for Action**
  - **Global Solar Council**
  - **renewAfrica**

SolarPower Europe

SolarPower Europe

Thank you for your attention!

Catarina Augusto – c.augusto@solarpowereurope.org

Senior Technical Advisor

(Coordinator of Grids and Flexibility Workstream)

Twitter | LinkedIn | Facebook | Youtube

FLORES

Network of Flow Battery Research Initiatives

Bi3Boost FlowBat

HYBRIS

Enhanced Hybrid Storage Systems

BALIHT

compbat

CuBER

FLOW CAMP

REDOX FLOW BATTERY CAMPUS

HIGREEW

MELODY

NanoMMES

MFreeB

POLYSTORAGE

DualFlow

SONAR

HyFlow

HYBRID ENERGY STORAGE SYSTEM

MeBattery

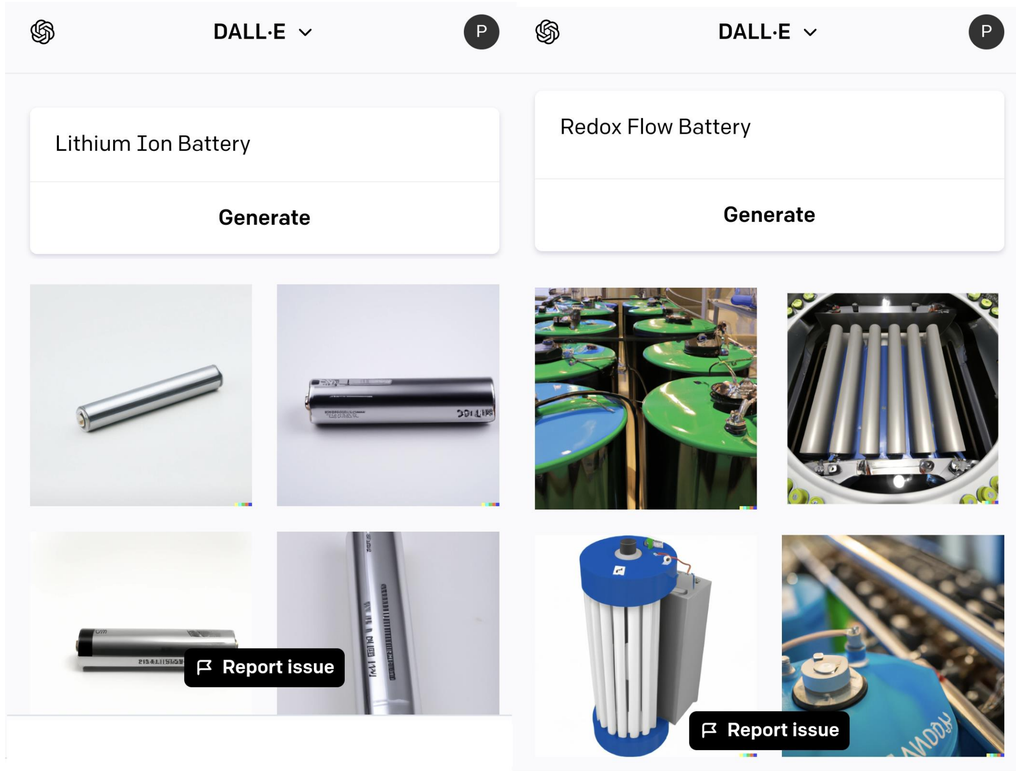
EU cooperation – The FLORES network

Flores 21st March 2023

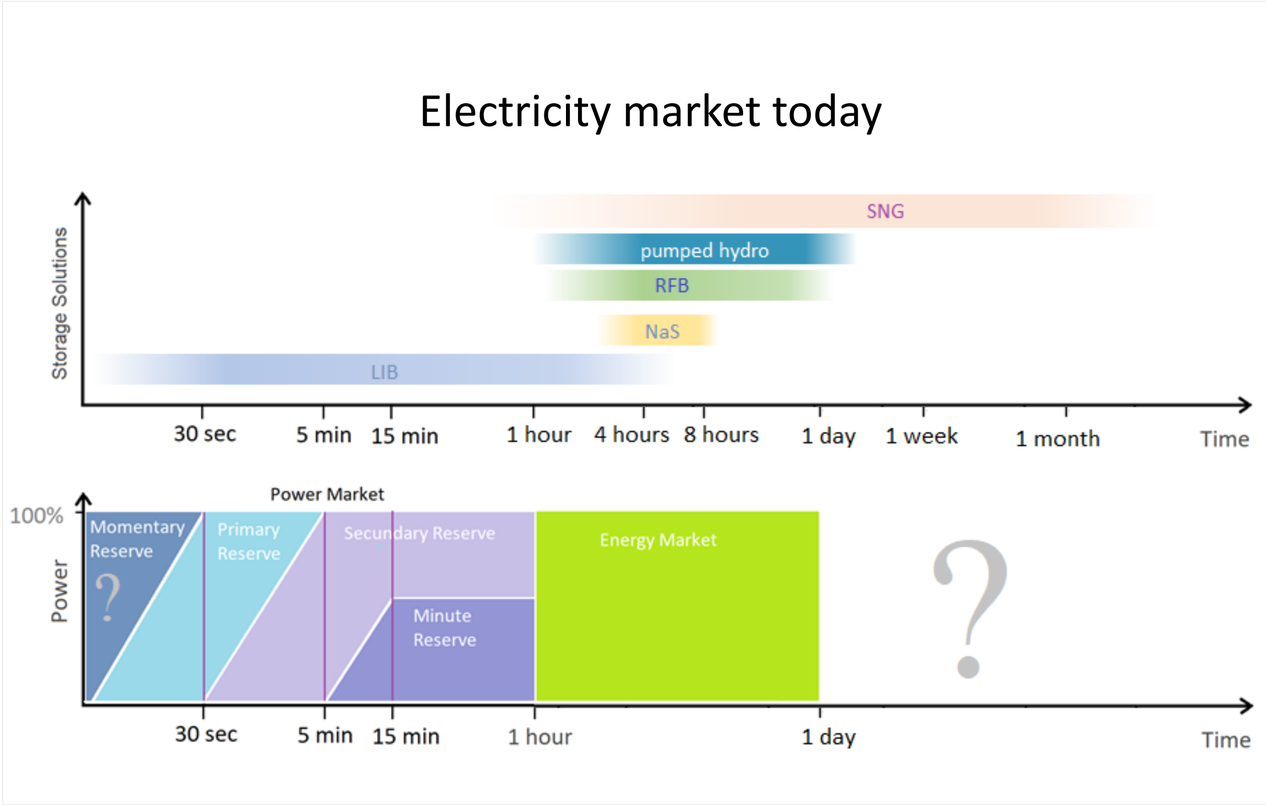
FLORES is a group of EU funded projects, created under the Horizon Results Booster. These projects have received funding from the European Union's Horizon 2020 research and innovation programme under the following grants agreements: 765289 (FlowCamp), 860403 (POLYSTORAGE), 875489 (SONAR), 875613 (HIGREEW), 875605 (Cuber), 875524 (Melody), 875565 (Compbat), 875637 (Baliht), 726217 (MFreeB).

Flow Batteries

The quirky battery storage solution?

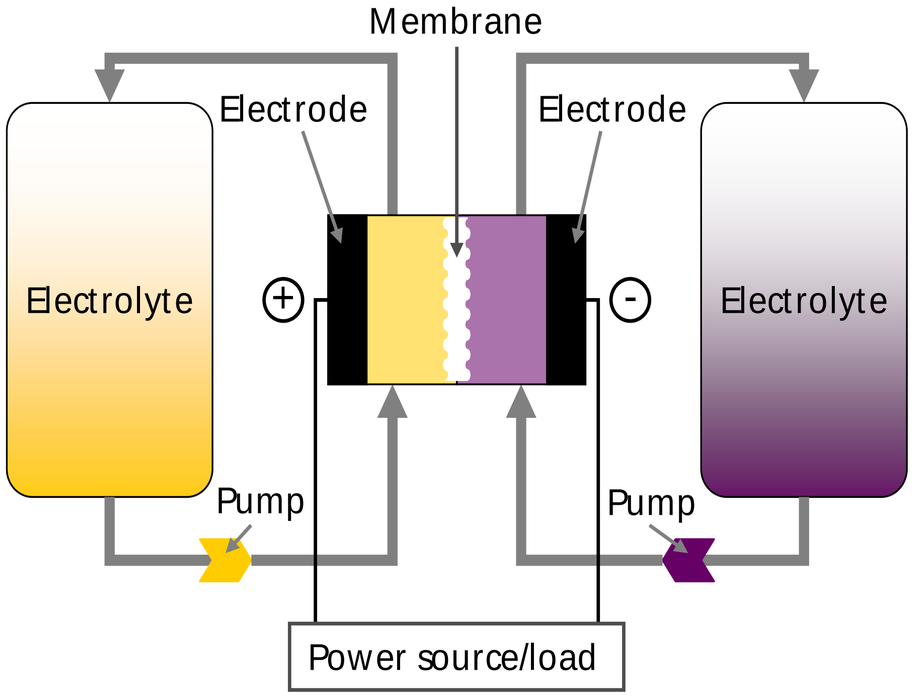


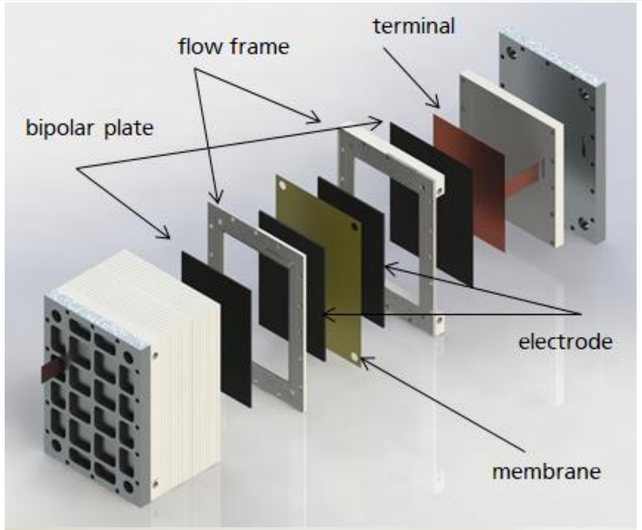
Typical applications

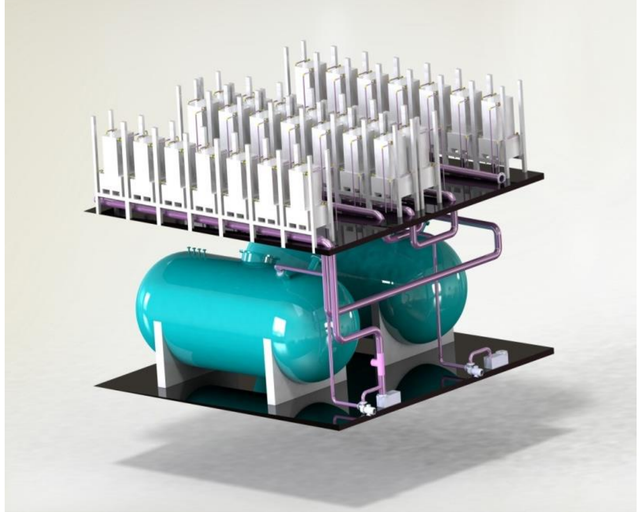


Flow Batteries

What is it?

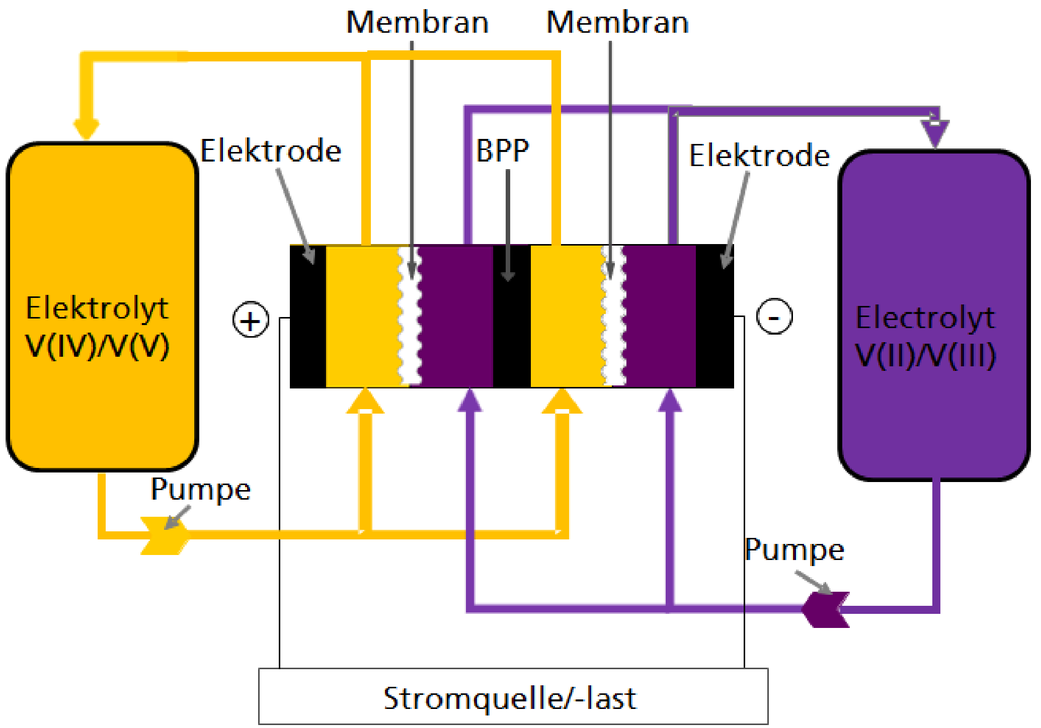


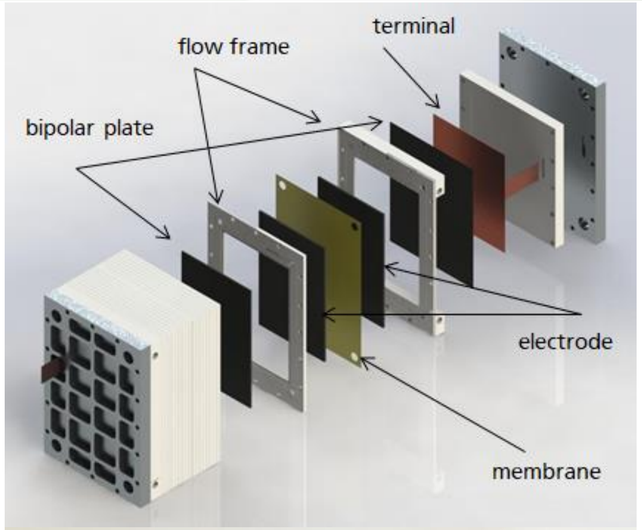


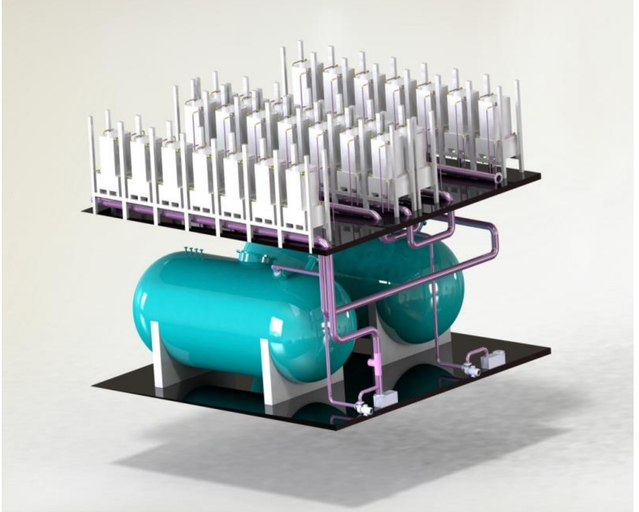


Flow Batteries

What is it?







What is FLORES network and what are we doing?

- FLORES is a network of 15 EU-funded research projects
- FLORES was created in the EU‘s HORIZON RESULTS BOOSTER program by the project *FlowCamp*
- The aims of FLORES are to ….
  - provide a networking platform for EU funded projects on flow battery technology
  - increase the visibility and impact of flow battery research through joint outreach activities, e.g. a shared social media platform
  - organize cross-topic activities hosted by different projects (e.g. workshops on policy briefing, statements for roadmaps, shared publications…etc)

Participating projects

FlowCamp – European Training Network to improve materials for high-performance, low-cost next generation RFBs

Polystorage - European training network in innovative polymers for next-generation electrochemical energy storage

SONAR – Modelling for the search for new active materials for RFBs

CompBat - Computer aided design for next generation flow batteries

HYFLOW – Development of a sustainable hybrid storage system based on high power vanadium redox flow battery and supercapacitor-technology

HYBRIS - A new generation of battery-based hybrid storage solutions for smarter, sustainable and more energy efficient grids and behind-the-meter systems

CUBER - Copper-based flow batteries for energy storage renewables integration

HIGREEW – Affordable high-performance green RFBs

BALIHT - Development of full lignin based organic redox flow battery suitable to work in warm environments and heavy multicycle uses

MELODY – Membrane-free low cost high density RFB

MFreeB – ERC grant for membrane-free RFBs

B3BOOST FLOWBAT - ERC grant for solid booster concept

NanoMMes – ERC grant for membrane research for RFB

MeBattery – EIC grant for the development of mediated biphasic flow batteries

DualFlow – EIC grant for the development dual circuit RFB with hydrogen development stage

Major achievements

Time line:

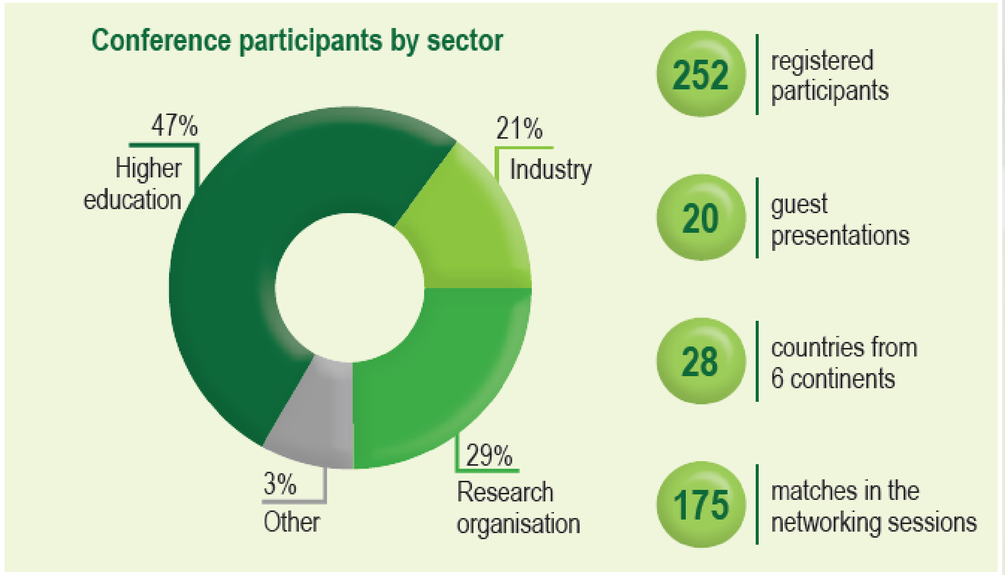
- 11.03.2021 – *NEXT GENERATION* - „Young Researchers‘ Flow Battery Conference and Networking Event
- 09.07.2021 – **SONAR workshop** on collaboration at IFBF
- 09.07.2021 – **SONAR workshops** on validation of the policy brief at IFBF
- 27.05.2021 – **Comment for Battery 2030+ roadmap** on carbon footprint of flow batteries
- 22.09.2021 – **FLORES workshop** on electrode kinetics
- 20.10.2021 – **FLORES workshop** on membranes
- 01.09.2021 – release of **EU policy brief**: Flow Battery Systems and their future in stationary energy storage
- 27.10.2021 – FLORES talk at Energy Talks at **EU Sustainable Energy Week** (EUSEW) + virtual booth
- 23.11.2021 – FLORES booth at **Battery Innovation Days** virtual fair
- 27.07.2022 – **Joint FLORES booth at IFBF**
- 01.10.2022 – **Joint review and opinion article** on LCA of RFB in Sustainable Energy Technology and Assessments
- 12.09.2022 – **CUBER & HYFLOW online workshop on Battery Passport and Virtual Twins of Flow Batteries**
- 23.03.2023 – **EERANET-StoRIES-FLORES workshop** on applications of hybrid energy storage at the Energy Conversion & Storage days in Karlsruhe

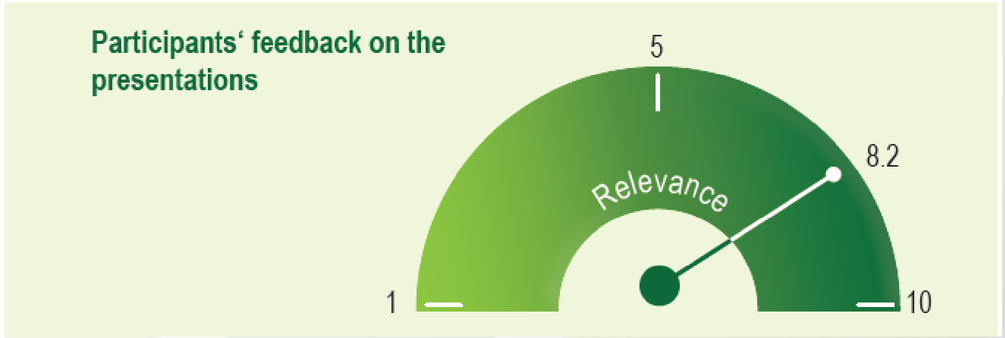
NEXT GENERATION - „Young Researchers‘ Flow Battery Conference and Networking Event

FlowCamp Project organized an on-line conference for doctoral students:

NEXT GENERATION - „Young Researchers‘ Flow Battery Conference and Networking Event“ held on **11.3.2021**

The conference attracted 252 participants. 20 PhD students and posdocs presented in 4 different sessions.





SONAR workshops on collaboration

SONAR workshops on **collaboration took place** on 9th July 2021

The workshop was organized in 4 groups:

- identifying potential new systems - **Jens Noack (SONAR)/Pekka Peljo (COMPBAT)**
- investigating fundamentals of RFB technologies - **Jürgen Schumacher (SONAR)**
- prototype development - **Javier Pena (BALIHT)/ Vincent (BALIHT)**
- joint dissemination (all projects) – **Peter Fischer (FLOWCAMP)/ Carolyn Fisher (SONAR)**

SONAR workshops on collaboration

Outcome of the workshop

22.09.2021
First internal FLORES **workshop on electrode kinetics** by Petr Mazur (HIGREEW)

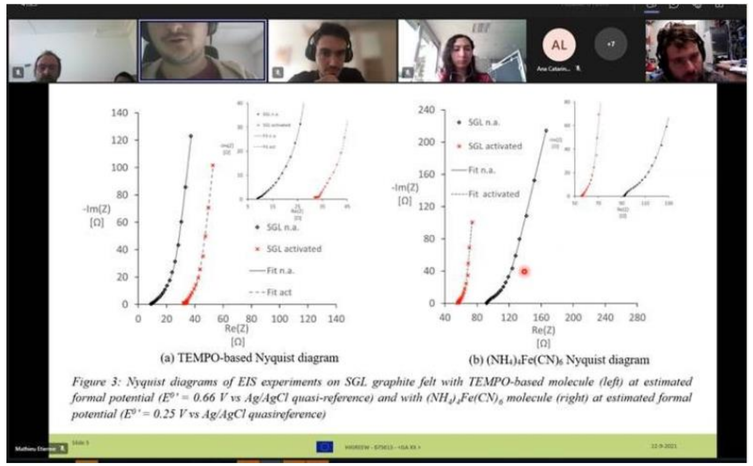
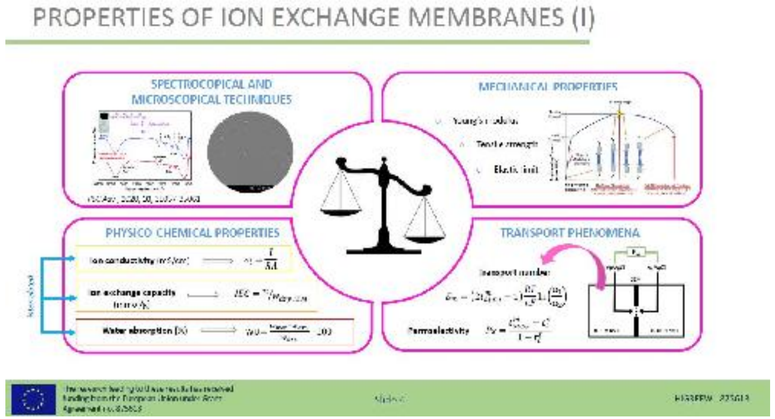


Figure 3: Nyquist diagrams of EIS experiments on SGL graphite felt with TEMPO-based molecule (left) at estimated formal potential ($E^{0'}$ = 0.66 V vs Ag/AgCl quasi-reference) and with $(NH_4)_4Fe(CN)_6$ molecule (right) at estimated formal potential ($E^{0'}$ = 0.25 V vs Ag/AgCl quasireference)

20.10.2021
Second internal **FLORES workshop on membranes** by Roman Schärer (SONAR).



SONAR workshops on collaboration

SONAR workshops on validation of the **policy brief** on 9th July 2021(afternoon session).
The policy brief has been validated by 6 groups:

SONAR – cost analysis of RFB (**roadmapping**) – Prof. Dr. Jens Noack
MELODY – environmental footprint of RFB (**roadmapping**) – Brenda Martinez-Cantú
BALIHT – materials for flow batteries (**materials**) – Dr. Vicente Vert
COMPBAT – new flow battery concepts (**materials**) – Prof. Dr. Pekka Pelljo
HIGREEW – sustainable battery chemistry (**materials**) – Dr. Eduardo Sanchez
POLYSTORAGE – upscaling of flow battery chemistry (**materials**) – Prof. Dr. Ulrich S. Schubert
CUBER – mini and micro grids with renewables (**demonstration**) – Prof. Dr. Corneliu Barbu
Hyflow – grid connected RFB (**demonstration**) – Prof. Dr. Karl-Heinz Pettinger
FLOWCAMP –analytical tools for cell/system monitoring (**demonstration**) – Dr. Peter Fischer

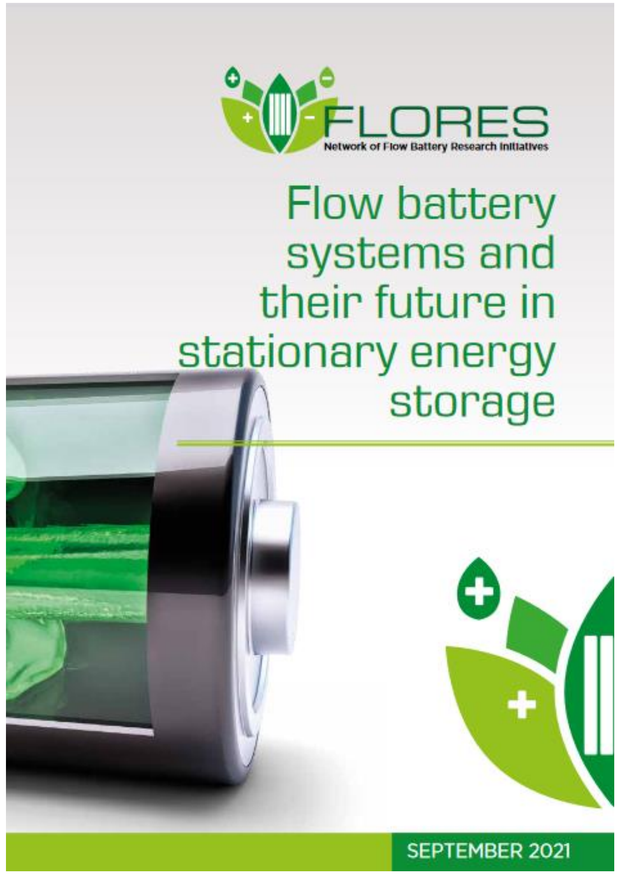
SONAR workshops on collaboration

The outcome of the workshop was a policy brief document.

The policy brief document was released in

September 2021

- Information on RFB market
- Recommondation for policy makers on status, market, challenges and research needs for the topics….
  - Materials & Modelling
  - Application, Demonstration & Validation
  - Technology Toolbox & Roadmapping



https://owncloud.fraunhofer.de/index.php/s/CE62QoMuBOWltyl

Participation in on-line events

FLORES participated on two fairs (activity hosted by HYFLOW)

EU Sustainable Energy Week

SONAR supported a booth together with HYFLOW, HIGREEW and BALIHT.

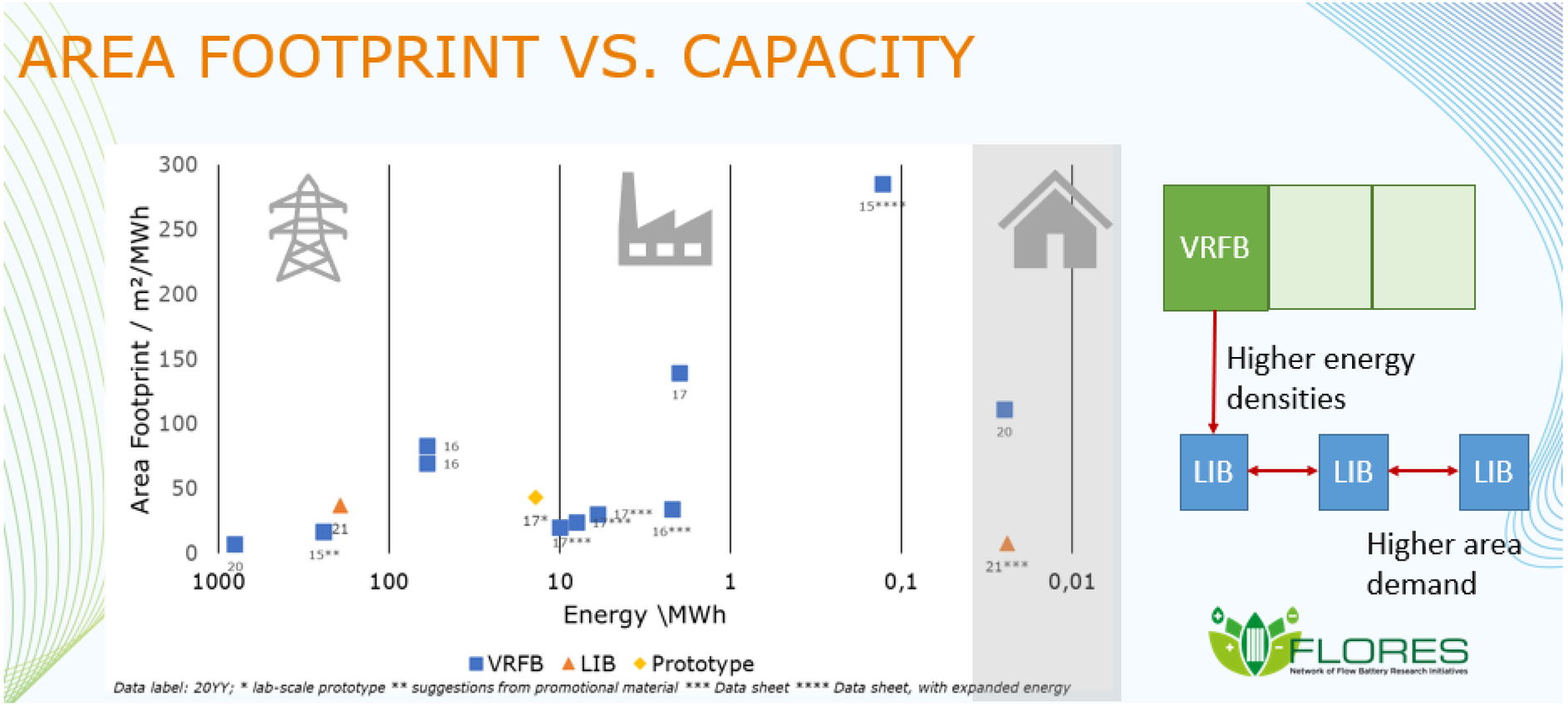
FLORES also had a 15 Min. talk on KPIs for RFB

Battery Innovation Days

SONAR supparted a booth together with HYFLOW and HIGREEW.

Talk at EU-sustainable Energy Week - EUSEW

For the talk HYFLOW, SONAR and HIGREEW started to map Key Performance Indicators (KPI) of RFB



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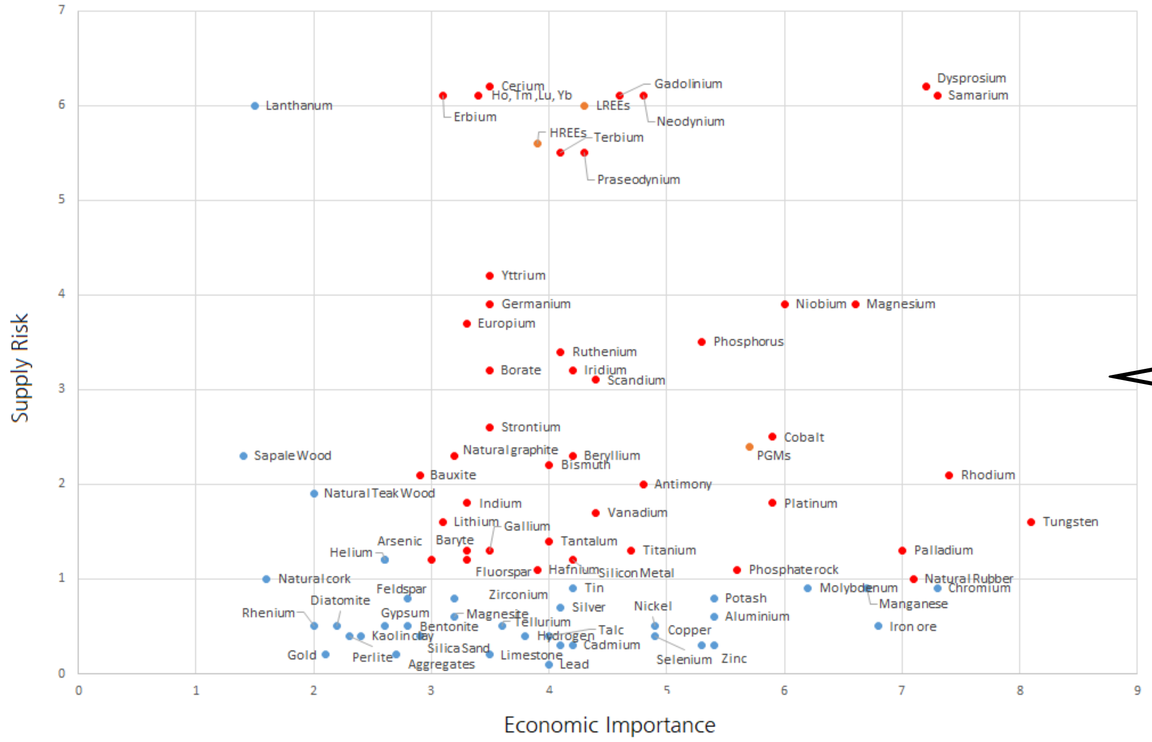
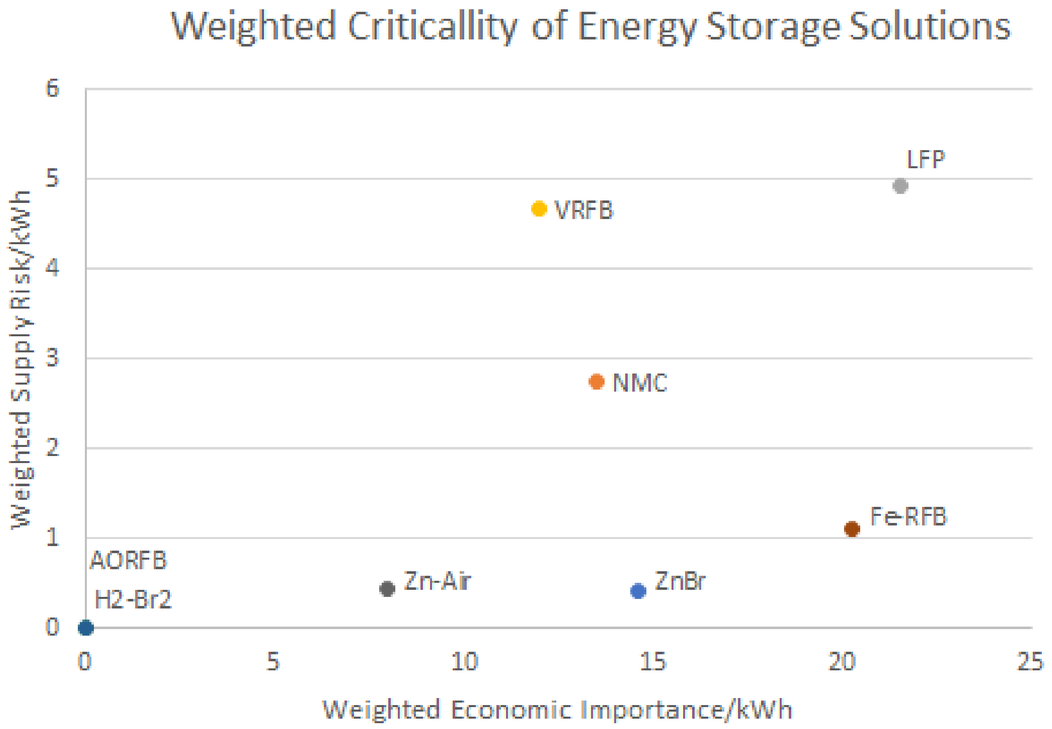


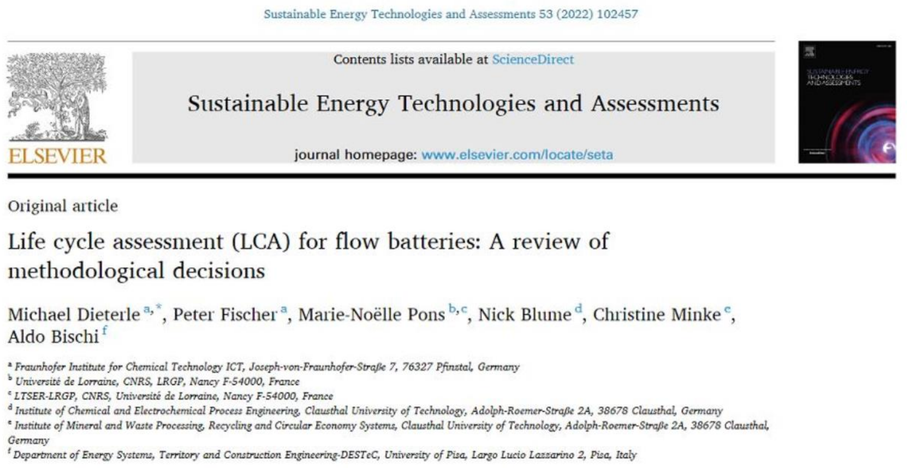


LCA Review Article

Review article and opinion piece on LCA of battery storage is the reaction on a statement of FLORES on **Battery 2030+ roadmap**, which stated RFB have **a bad environmental footprint**.

- After reviewing the literatur, it was really difficult to compare LCA of different battery storage options.
- The aim is to compare LCA of RFB and other stationary battery storage. FLORES would like to advertise for a PEF standard for Flow Batteries/ stationary battery storage

This activity is hosted by CUBER & MELODY, HIGREEW, COMPBAT and SONAR



Sustainable Energy Technologies and Assessments 53 (2022) 102457

Contents lists available at ScienceDirect

Sustainable Energy Technologies and Assessments

journal homepage: www.elsevier.com/locate/seta

Original article

Life cycle assessment (LCA) for flow batteries: A review of methodological decisions

Michael Dieterle [a,*], Peter Fischer [a], Marie-Noëlle Pons [b,c], Nick Blume [d], Christine Minke [e], Aldo Bischi [f]

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[b] Université de Lorraine, CNRS, LRGP, Nancy F-54000, France
[c] LTSER-LRGP, CNRS, Université de Lorraine, Nancy F-54000, France
[d] Institute of Chemical and Electrochemical Process Engineering, Clausthal University of Technology, Adolph-Roemer-Straße 2A, 38678 Clausthal, Germany
[e] Institute of Mineral and Waste Processing, Recycling and Circular Economy Systems, Clausthal University of Technology, Adolph-Roemer-Straße 2A, 38678 Clausthal, Germany
[f] Department of Energy Systems, Territory and Construction Engineering-DESTeC, University of Pisa, Largo Lucio Lazzarino 2, Pisa, Italy

https://doi.org/10.1016/j.seta.2022.102457

Workshop on Battery Passport

FLORES on-line workshop on digital twins for flow batteries - a roadmap toward redox flow battery passport

The workshop took place on 12th Sept. 2022 and had more than 400 participants

This activity was hosted by CUBER & HYFLOW project

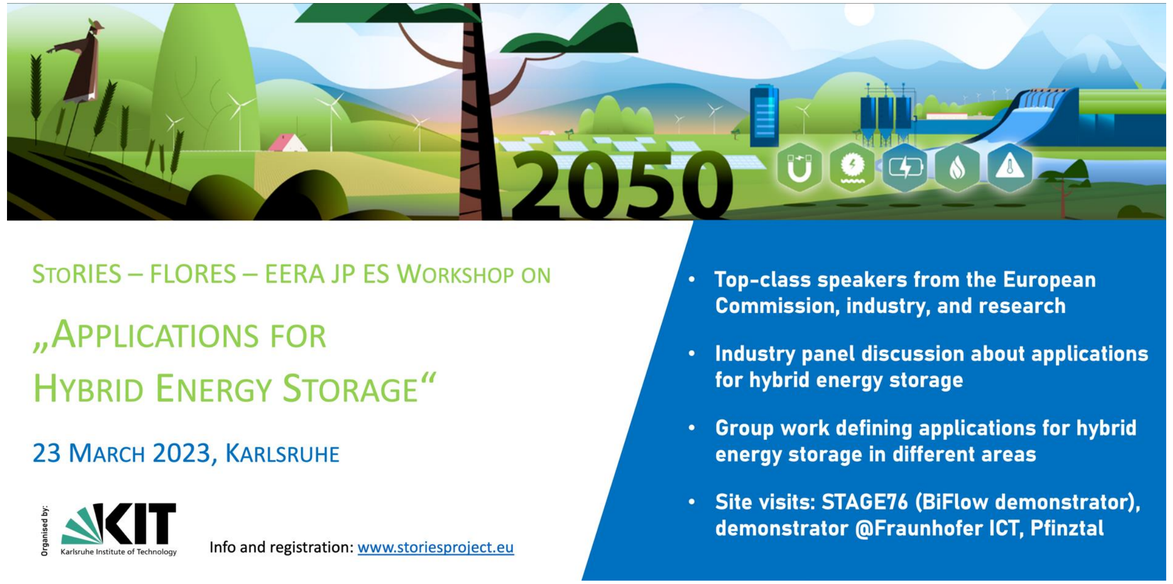
StoRIES – FLORES – EERA JP ES Workshop

StoRIES – FLORES – EERA JP ES workshop on “Applications of Hybrid Energy Storage”

The workshop will take place on 23rd March 2023 at KIT (organizer).

This activity will be hosted by HYFLOW, HYBRIS & DUALFLOW project.

We hope to see you all on Thursday!



FLORES

Network of Flow Battery Research Initiatives

SUPEERA

Support to the coordination of national research and innovation programmes in areas of activity of the European Energy Research Alliance

Panel discussion