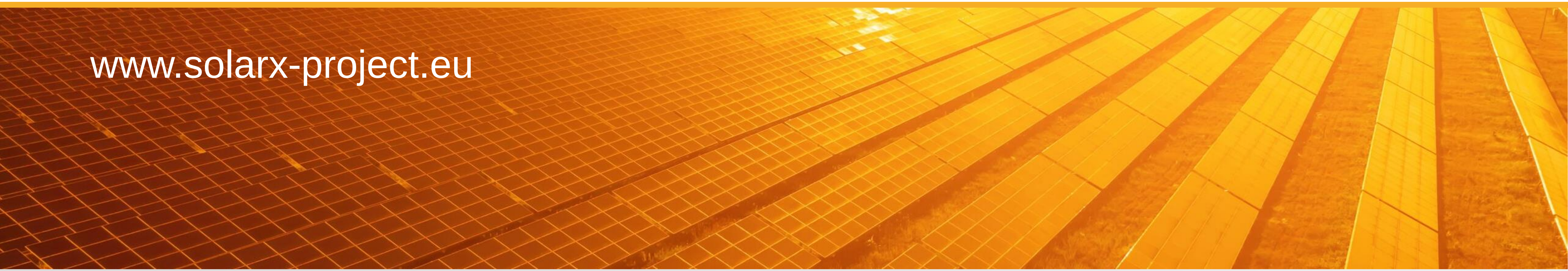
SOLAR X

SOLARX

Dispatchable concentrated Solar-to-X energy solution for high penetration of renewable energy



Co-funded by the European Union

Funded by the European Union (grant No. 101084158) and supported by the Swiss State Secretariat for Education, Research and Innovation (SERI). Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Climate, Infrastructure and Environment Executive Agency (CINEA). Neither the European Union nor the granting authority can be held responsible for them.

Horizon Europe: SOLARX

SOLARX

TOPIC ID: HORIZON-CL5-2021-D3-03-02 (RIA)
Next generation of renewable energy technologies

Sustainable, secure and competitive energy supply (HORIZON-CL5-2021-D3-03)

Dispatchable concentrated Solar-to-X energy solution for high penetration of renewable energy

Duration: 3 years (01.11.2022 – 31.10.2025)
Coordination: University of Lleida (UdL)
Funding: 3 M€

Co-funded by the European Union

Funded by the European Union (grant no. 101084158) and supported by the Swiss State Secretariat for Education, Research and Innovation (SERI). Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Climate, Infrastructure and Environment Executive Agency (CINEA). Neither the European Union nor the granting authority can be held responsible for them.

SOLARX Consortium

SOLARX

Coordinator

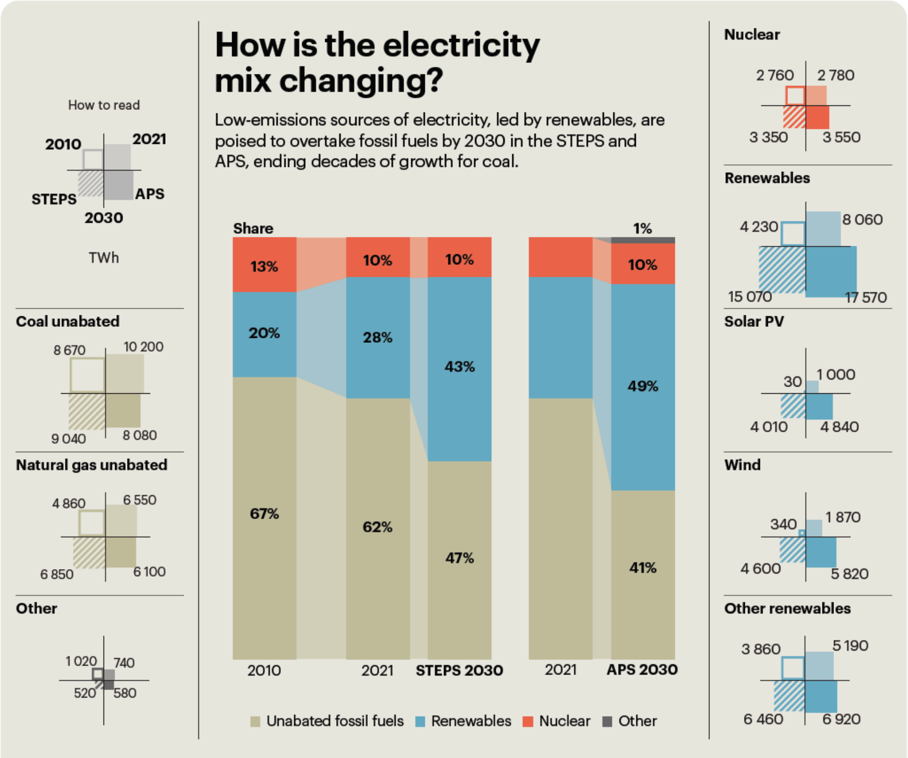
- Universitat de Lleida (UdL), ES

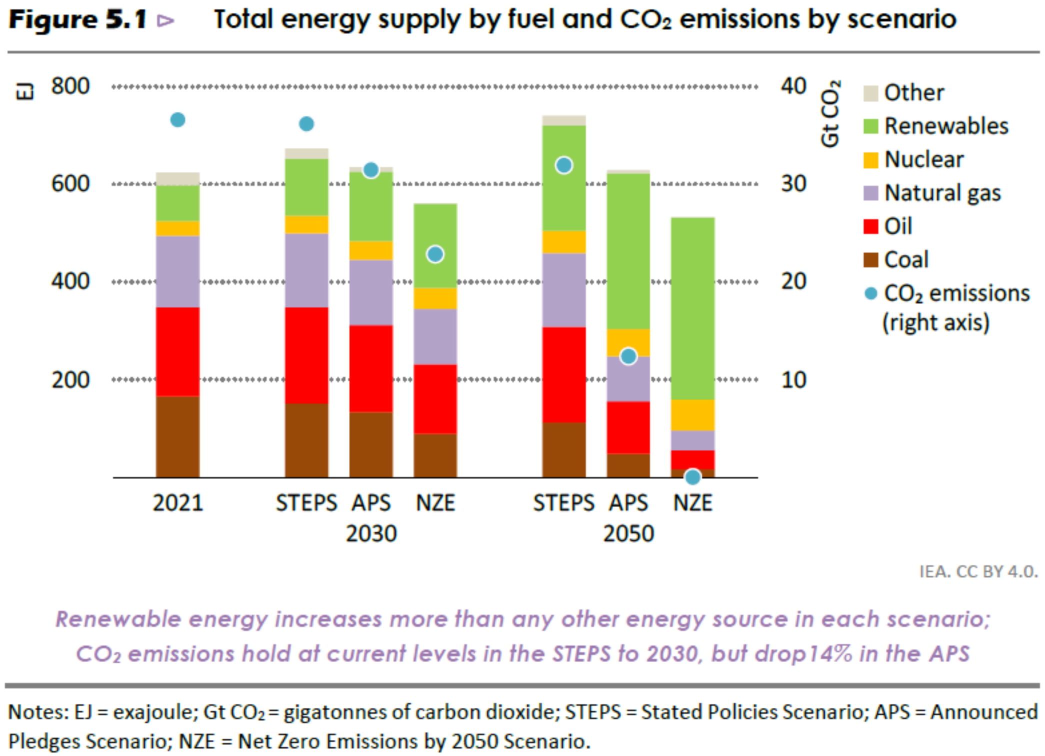
Partners

- HyGear B.V. (HYG), NL
- ACCIONA SA (ACC), ES
- EMD International A/S (EMD), DK
- Fraunhofer - Institute for Solar Energy Systems (F-ISE), DE
- Danmarks Tekniske Universitet (DTU), DK
- Laboratoire Nanotechnologies et Nanosystèmes (Université de Sherbrooke/CNRS), FR
- accelopment Schweiz AG (accelCH), CH

The context

In all the scenarios established by the IEA, both for electricity and energy supplies, the share of intermittent RES increases strongly in the next years

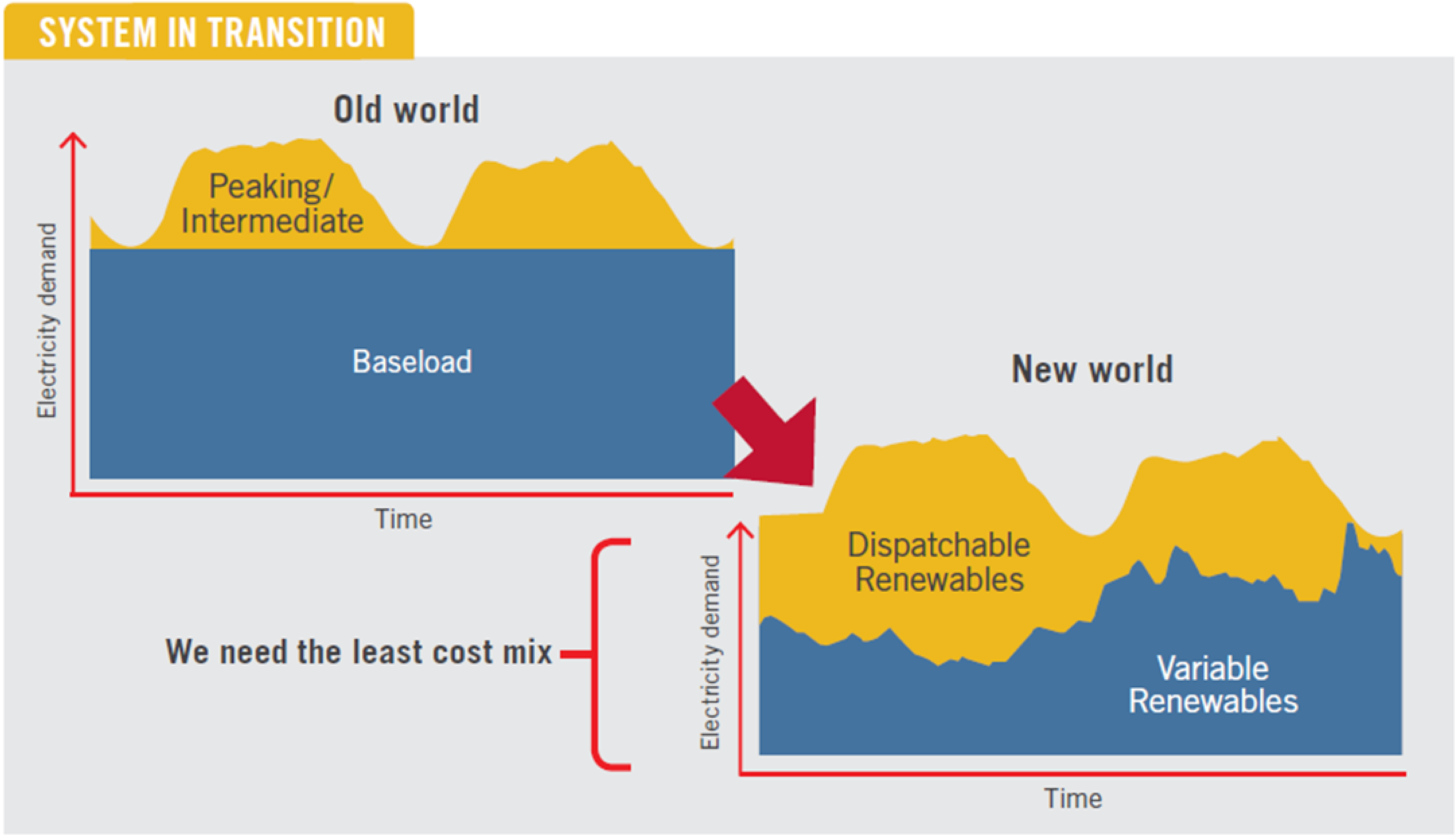




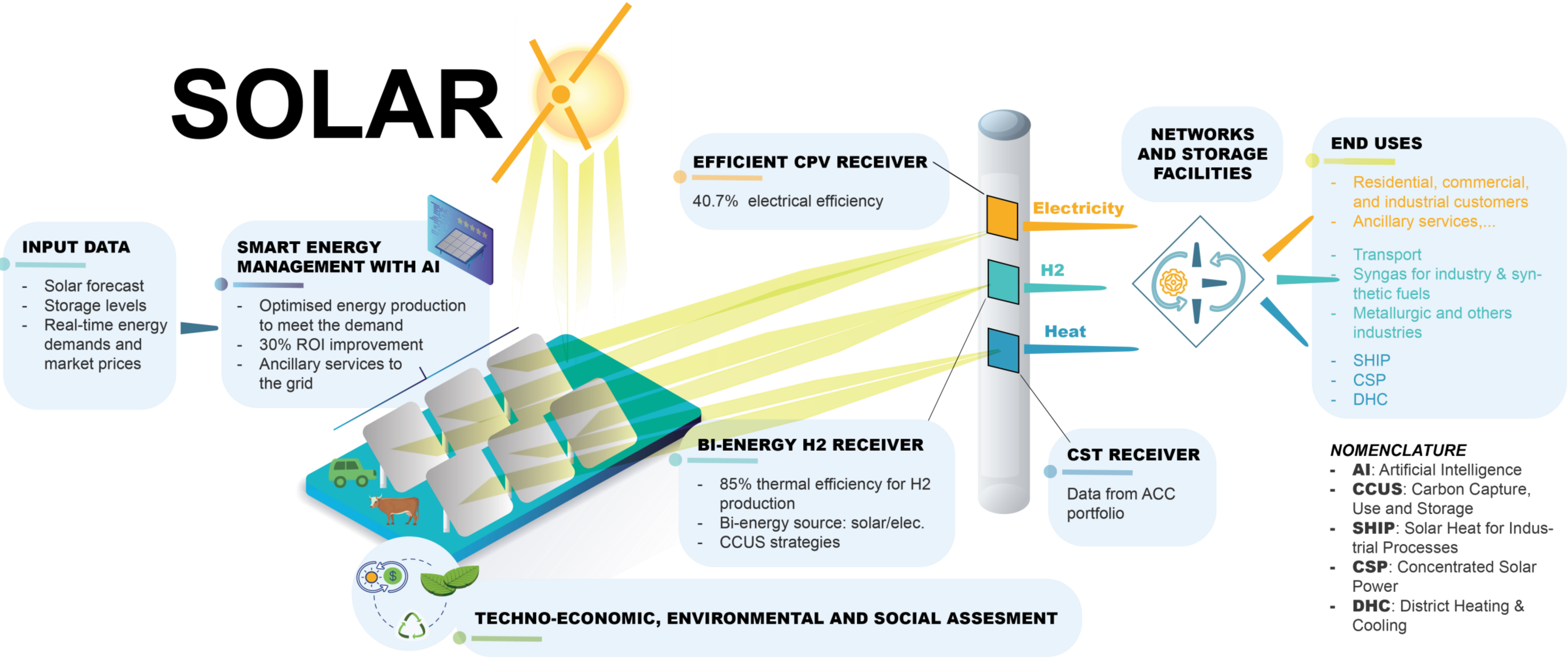
World Energy Outlook 2022 (IEA)

The context

On the way to a 100 % RES supply, the gap between demands and intermittent (variable) RES must be filled by dispatchable RES, substituting technologies relying on fossil fuels.



The concept



NOMENCLATURE

- **AI**: Artificial Intelligence
- **CCUS**: Carbon Capture, Use and Storage
- **SHIP**: Solar Heat for Industrial Processes
- **CSP**: Concentrated Solar Power
- **DHC**: District Heating & Cooling

3 Key Technological Elements

SOLARX

KTE 1

Smart solar resource management

To be able to predict the **dynamic behavior of the SOLARX system**, including **dispatchability** aspects (related to storage capacities for Heat and H_2) and **ancillary services** providing, a complete system **model**, **based on AI**, will be set up. The **adaptive aiming strategy** developed by **F-ISE** will provide great **flexibility** in distributing the available energy to the different receivers depending on the current and near future demand of electricity, H_2 and heat. **ACC** will provide CST central tower data for the models, support for the solar management strategy and, together with **EMD** and **DTU**, the application scenarios (demand behaviors, applications…). Energy Pro (**EMD**) will be used to assess the impacts of the proposed smart management strategies.

KTE 2

CPV dense array receiver

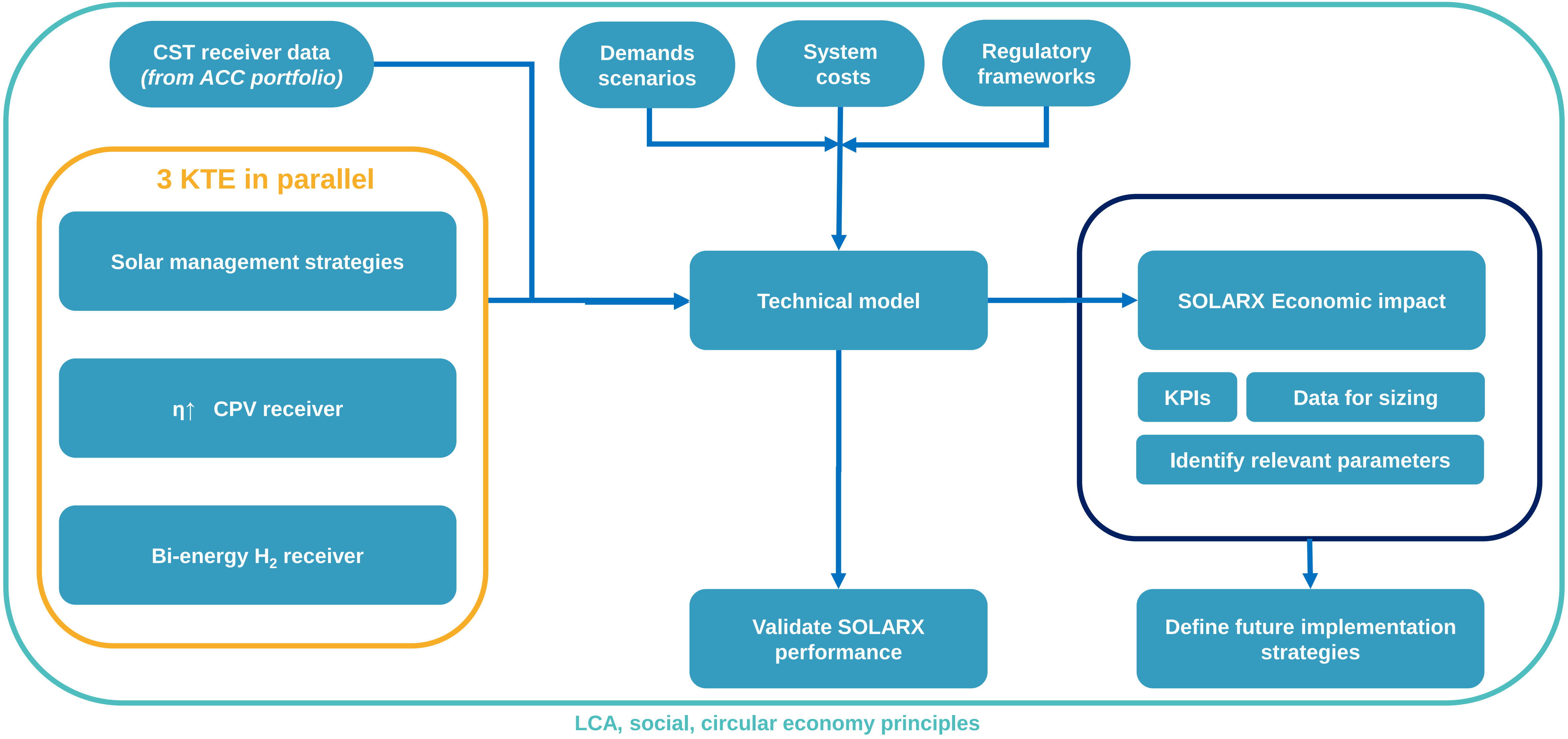
CNRS and **UDL** will demonstrate **a 45.9% cell efficiency** and will **address each source of losses at the receiver level** (current and voltage mismatch losses and pumping power) by revising each component to **improve the receiver electrical efficiency by 30%** with respect to the state of art (from 32% to 40.7%).

KTE 3

Bi-energy H2 receiver adapted for low-carbon to carbon-negative operation

CNRS will modify these solar microreactors for compatibility with biogas, incorporate electrical heaters and integrate them into an **H_2 receiver** that has the unique capability of **operating either with solar or electrical energy** and **integrate Carbon Capture, Use and Storage (CCUS)** strategies (**ACC**), while **HYG** will provide the support for the gas and H_2 management.

Methodology



Objectives

SOLARX's main goal is to demonstrate its **technical and economic reliability**, at the **laboratory scale**. It involves the synergetic efficient production of **heat, electricity and H_2** from solar resource in a **single facility** considering **real-time energy demands** and **market prices** for a wide range of locations and application scenarios.

SOLARX includes the following objectives:

- Demonstrate the socio-economic value of the SOLARX systems
- Align modular production potential with solar resource and energy demand
- Develop high efficiency CPV receivers
- Develop a bi-energy modular H_2 receiver with CCUS
- Anticipate the industrial deployment of SOLARX systems
- Disseminate the project results to different stakeholders and ensure the technological uptake of the SOLARX systems
- Manage the innovation process along the entire value chain and coordinate multidisciplinary SOLARX R&I actions.

The ambition is to develop a framework for the **future implementation of carbon-neutral or even carbon-negative, energy system**.

KPIs

Technological, environmental, economic and social assessment

SOLARX will demonstrate its role as a future KET for a game-changing RES through a technological, environmental, economic and social assessment

- **KPI-1.1**: LCOE reduction by 9-18% (relative to CSP generation with thermal energy storage)
- **KPI-1.2**: COVE improvement by 15-23%.
- **KPI-1.3**: ROI improvement by 15%.

To achieve these assessments, the technical model with be coupled with demands scenarios, system costs and regulatory frameworks to assess the economic impact of SOLARX for varying levels of deployment, through the assessment of the relevant KPIs, identifying the relevant parameters that will characterize the optimum application scenarios (and the ones to be discarded) and the associated optimum sizing of the SOLARX components. The results of this techno-economic model will be the base for the definition of the future implementation strategies.

From the beginning of the project, on the base of the inputs from the project development, economic, environmental and social assessment will be carried out in order to analyse the SOLARX solution in a holistic way. The LCA study will include the identification of measures to promote the alignment of SOLARX with circular economy principles. Recommendations for SOLARX deployment will be supplied from technical, regulatory frameworks, environmental, social and economic perspectives.

3 specific KPIs have been defined to monitor these goals:

- **KPI-5.1**: SOLARX 2-5%, 2-5% and 1-3% penetration potential in the energy mix for electricity, SHIP and Green H_2, respectively, by 2050.
- **KPI-5.2**: Demonstration of SOLARX low environmental impact (LCA).
- **KPI-5.3**: Establishment of guidance for a socially acceptable system.

Outputs and outcomes

SOLARX

2023 — TRL 3 - 4 — 2025 — TRL 5 - 6 — 2028 — TRL 7 - 9 — 2030 — 2050

Key components development:

- Smart solar resource management
- CPV receivers fabrication
- H2 receiver fabrication
- Concept validation

Transfer of technology:

- CPV receivers fabrication
- H2 receiver fabrication
- Smart management implementation

Scale up:

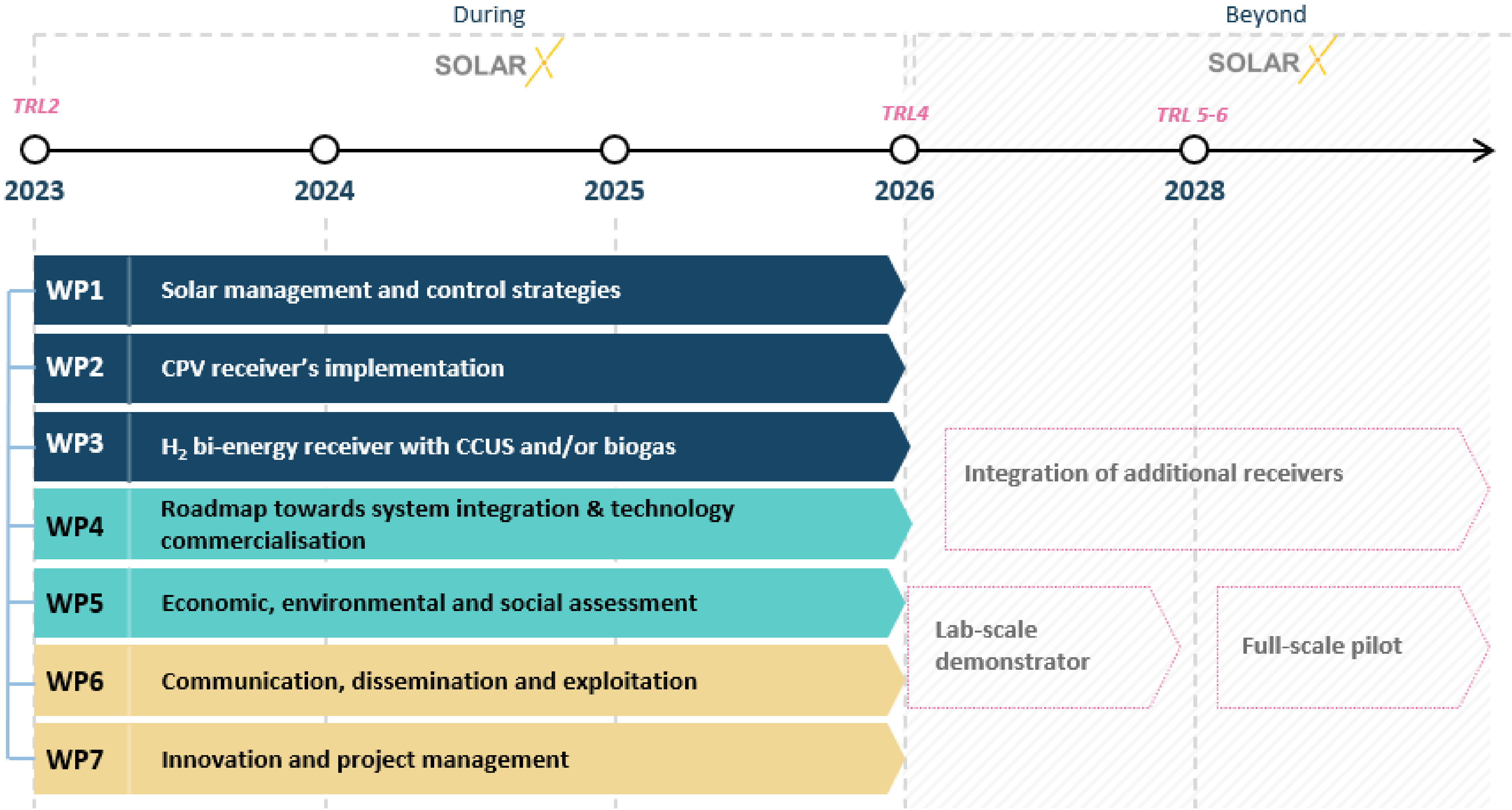
- First installation of >50kWp system

Industrialisation:

- First industrial-scale SOLARX system in operation

Commercialisation and ramp-up to reach 2-5% of electricity, 2-5% of SHIP and 1-3% of renewable H_2 market

Work plan



During
SOLAR X
Beyond
SOLAR X
TRL2
TRL4
TRL 5-6
2023
2024
2025
2026
2028
WP1 Solar management and control strategies
WP2 CPV receiver's implementation
WP3 H_2 bi-energy receiver with CCUS and/or biogas
WP4 Roadmap towards system integration & technology commercialisation
WP5 Economic, environmental and social assessment
WP6 Communication, dissemination and exploitation
WP7 Innovation and project management
Integration of additional receivers
Lab-scale demonstrator
Full-scale pilot

Challenges

SOLARX will provide **dispatchability and flexibility, maximizing the owner benefits,** making the solution **attractive for investors, grid operators, industries** and **citizens** whilst creating favourable conditions for the **transition to high-RES penetration.** The main challenges are:

- Design and trial more efficient CPV and bi-energy H2 receiver / conversion technologies
- Provide a smart solar resource management system that will align production and energy demand.
- Create a roadmap towards system integration and technology commercialisation.
- Assess the economic, environmental, and social impact of the SOLARX Innovations.

Adding to these technological breakthroughs, SOLARX is **disruptive** by **transforming the variable solar resource into dispatchable multiple outputs on a single facility**, engineering **synergies** between them and by using Artificial Intelligence (AI) to **develop an intelligent energy demand response mechanism**.

SOLARX management strategies includes not only innovation involving **solar resource characteristics**, as usual, but also the **demands and prices of the multiple energy vectors**, leading to **improved cost-effectiveness and resource optimisation**.

Contact

Jerome Barrau
SOLARX Coordinator
jerome.barrau@udl.cat

Universitat de Lleida

Miriam Frances
Communication and Dissemination
mfrances@accelopment.com

accelopment takes you further

SOLAR

Dispatchable concentrated Solar-to-X energy solution for high penetration of renewable energy

Co-funded by the European Union

Funded by the European Union (grant No. 101084158) and supported by the Swiss State Secretariat for Education, Research and Innovation (SERI). Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Climate, Infrastructure and Environment Executive Agency (CINEA). Neither the European Union nor the granting authority can be held responsible for them.