



Horizon Europe Photovoltaics (PV) Calls

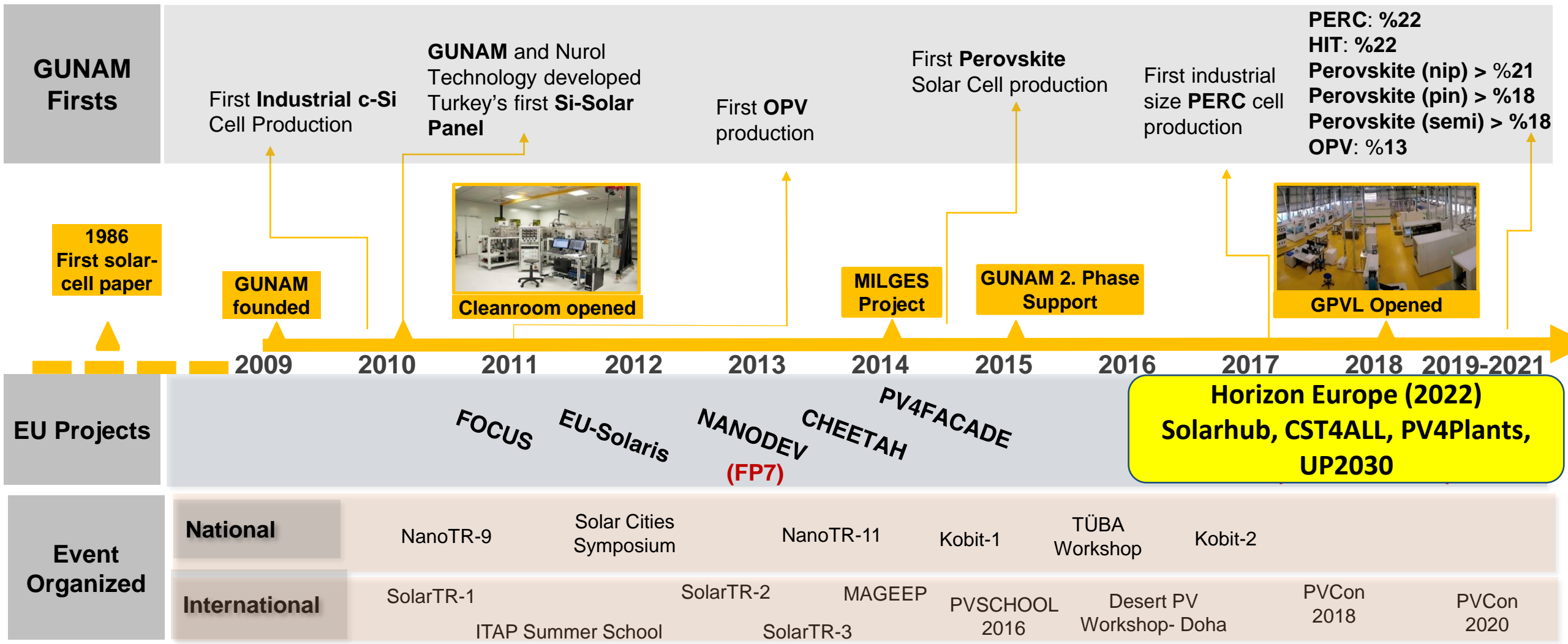
2022-2023

Rařit Turan

ODTÜ-GÜNAM, METU



METU-GÜNAM : History and Achievements



HUMAN POTENTIAL

- 26 Faculty Members
- > 100 Grad. Students
- ~10 Management Personnel
- ~20 Full-time Researcher

NATIONAL PROJECTS

- 1007
- 2244
- 223
- 1004
- 16
- 1001
- 9
- 1003
- 10 U. i.

SCIENTIFIC OUTPUT

- >150 Thesis
- >350 Articles
- >100 Completed Projects

ODTÜ - GUNAM Divisions

Si Photovoltaics



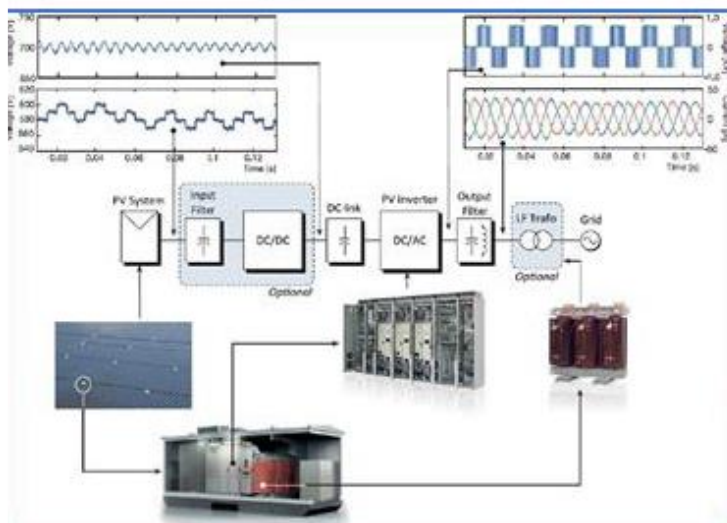
Emerging Photovoltaics



Module Technologies, PV
Integration, Outdoor Testing



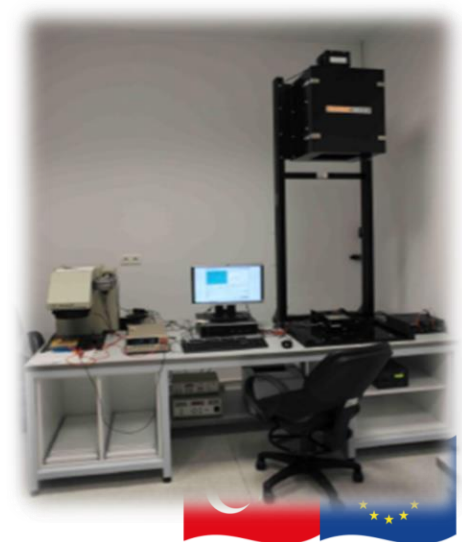
Power Electronics and Systems



Solar Thermal Power (ODAK)



Test and Characterization



Zero Emission-Green Energy Transition

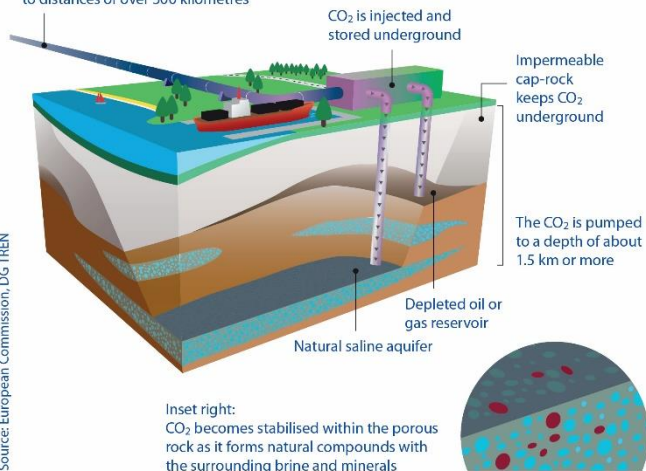


Solar energy will play a central role in this transition

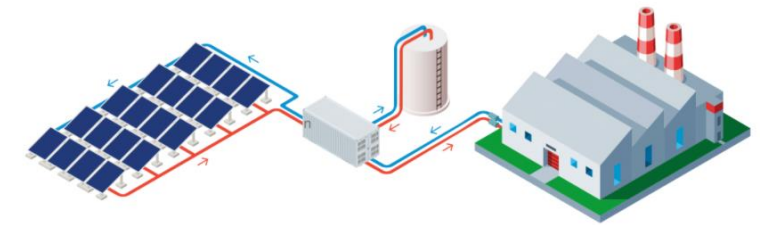


Carbon Capture and Storage (CCS)

The distance between the power station and the CCS storage facility can extend to distances of over 500 kilometres



Source: European Commission, DG TREN

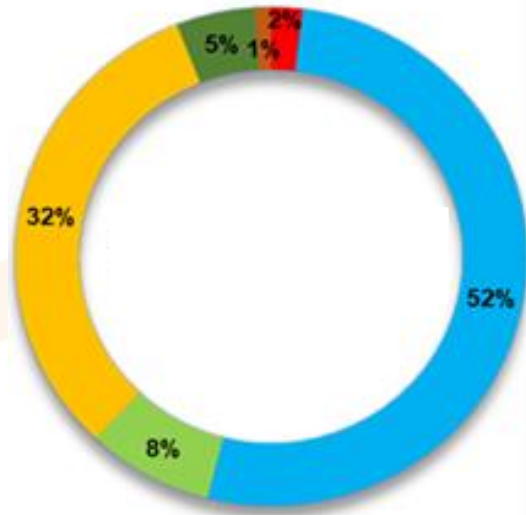




Future Net Zero Scenarios: 2050

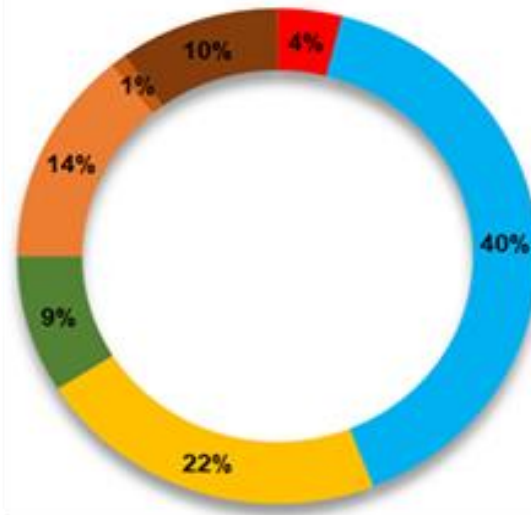
Solar and Wind
% 84

Green Scenario



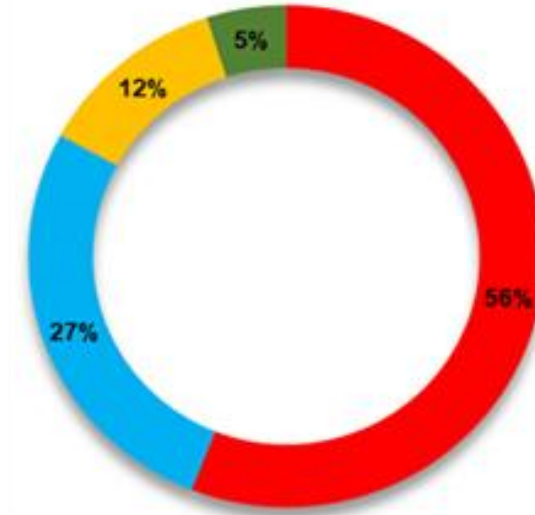
Solar and Wind
% 62

Gray Scenario



Solar and Wind
% 39

Red Scenario



- Diğer
- Doğalgaz
- Doğalgaz - CCS
- Nükleer
- Güneş
- Biyoenerji

- Petrol
- Petrol - CCS
- Kömür - CCS
- Rüzgar
- Kömür

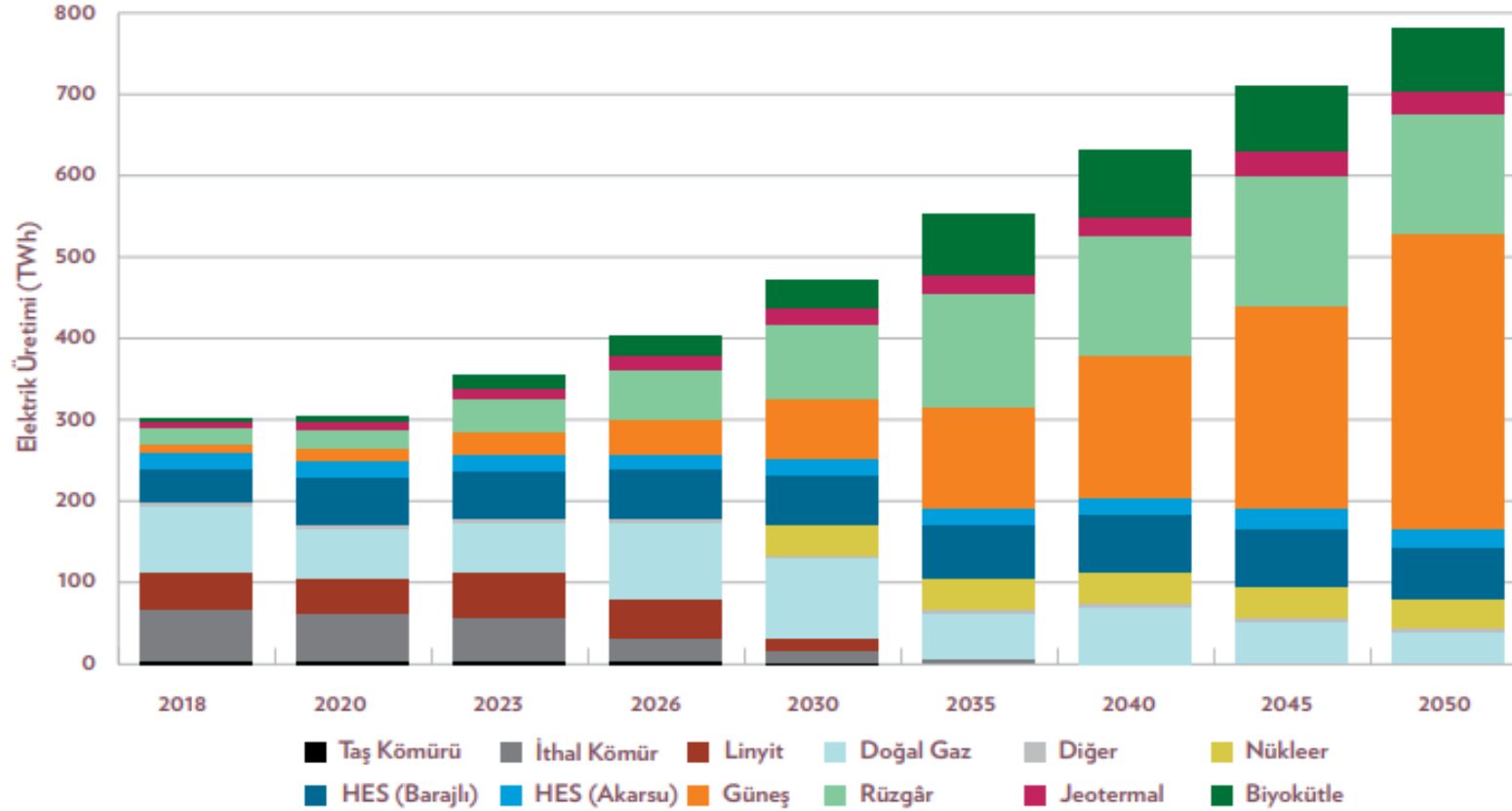
- Hidrojen
- Diğer yenilenebilir

Source :
Bloomberg
NEF



Net Zero Scenario : Turkey

Şekil 6.28. Net Sıfır Senaryosunda elektrik sektöründe kaynaklara göre üretimin gelişimi (TWh)



Solar electricity

2022 : 13.5 GWh (%4)

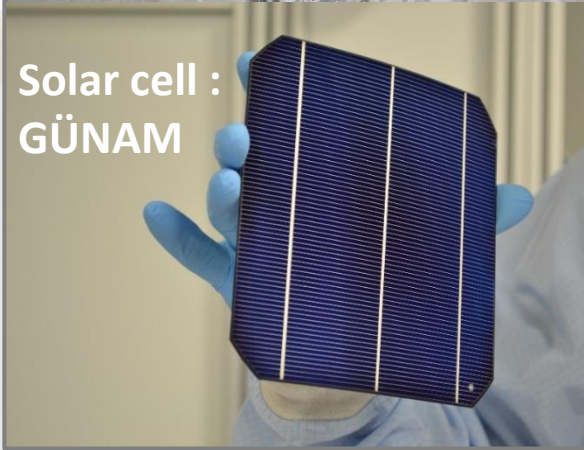
2030 : 72.6 GWh

2050 : 362.4 GWh (%46)

Source : IPC, 2022



PV everywhere





Horizon Europe Projects on PV

Cluster 5 Research and Innovation Actions

Technology

- High efficiency solar cell development
- New materials and devices (thin films, perovskites, tandem)

PV Integration/Technology

- Building and city integrated PV
- Floating PV
- Vehicle integrated PV
- Agri PV

In other programs

- Excellence hub
- Twinning
- Other CSAs
- Mobility and education
- Mission



Our Experience/Initiatives : ODTÜ-GUNAM' Projects on PV

PV Integration/Technology

- Building and city integrated PV
- Floating PV
- Vehicle integrated PV
- Agriculture integrated PV (Agri PV)

Acronym	Topic	Status	Project type
SOLARHUB	Agri-PV	Accepted	CSA
PV4Plant	Agri-PV Integration to Agriculture	Accepted	IA
UP2030	Integration to city	Accepted	CSA
LEGOFIT	BIPV	Under review	IA
NEXUS	Tandem solar cell development	Under review	RIA
TRIUMP	Tandem solar cell development	Under review	RIA

Technology

- High efficiency solar cell development
- New materials and devices (thin films, perovskites, tandem)



Best performing research institutes in Horizon Europe

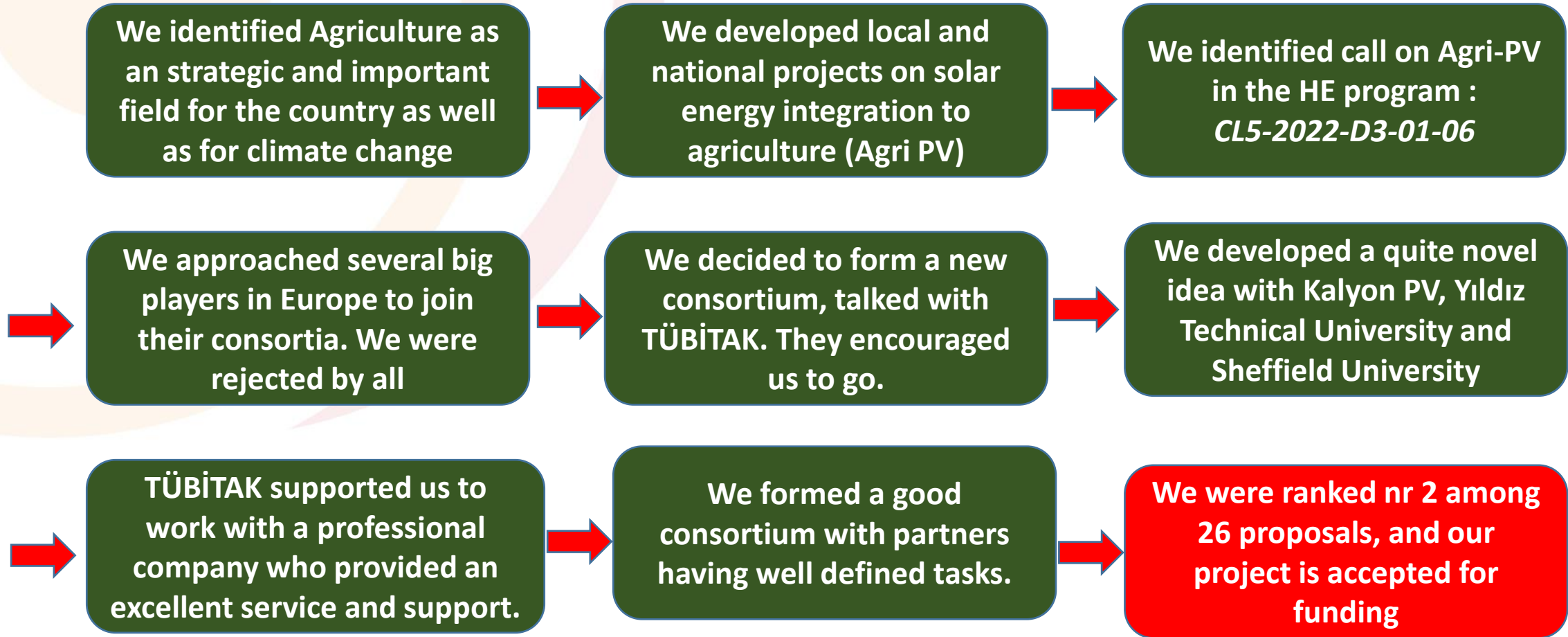
Published by European Commission and TÜBİTAK

Best performing research institutions in Türkiye	Fund generated (Milion €)
ORTA DOĞU TEKNİK ÜNİVERSİTESİ	7,13
İHSAN DOĞRAMACI BİLKENT ÜNİVERSİTESİ	6,92
KOÇ ÜNİVERSİTESİ	6,85
İSTANBUL TEKNİK ÜNİVERSİTESİ	4,03
TÜBİTAK	2,82
İZMİR YÜKSEK TEKNOLOJİ ENSTİTÜSÜ	1,96
ODTÜ GÜNAM	1,27
HACETTEPE ÜNİVERSİTESİ	1,13
SABANCI ÜNİVERSİTESİ	1,02
EGE ÜNİVERSİTESİ	0,99



Pathway to a success story in HE program : PV4Plants

(HE project created by ODTÜ-GÜNAM, KalyonPV and YTU)





Calls with opening date 2022

Call ID	Title	Type	Call budget (M€)	Project budget (M€)	Number of projects	Opening date	Closing date
HORIZON-CL5-2022-D3-03-05	Novel Thin Film (TF) technologies targeting high efficiencies	RIA	20	5	4	Sep 6, 2022	Jan 10, 2023
HORIZON-CL5-2022-D3-03-09	Recycling end of life PV module	IA	20	6-7	3	Sep 6, 2022	Jan 10, 2023
HORIZON-CL5-2023-D3-01-02	PV integration in buildings and in infrastructure	IA	16	8	2	Dec 2, 2022	Mar 30, 2023
HORIZON-CL5-2023-D3-01-03	Floating PV Systems	IA	14	7	2	Dec 2, 2022	Mar 30, 2023



Calls with opening date 2022

Call ID	Title	Type	Call budget (M€)	Project budget (M€)	Number of projects	Opening date	Closing date
HORIZON-CL5-2023-D3-02-11	Advanced concepts for crystalline Silicon technology	RIA	9	3	3	May 4, 2023	Sep 5, 2023
HORIZON-CL5-2023-D3-02-12:	Large Area Perovskite solar cells and modules	IA	14	7	2	May 4, 2023	Sep 5, 2023
HORIZON-CL5-2023-D3-02-13	Operation, Performance and Maintenance of PV Systems	IA	10	5	2	May 4, 2023	Sep 5, 2023

Research and Innovation action (RIA) : Project outcomes should have TRL : 2-6 , more fundamental research, novelty

Innovation action (IA) : Project outcomes should have TRL : 6-8 , more applied research, industry involvement is more important, industrialization is key



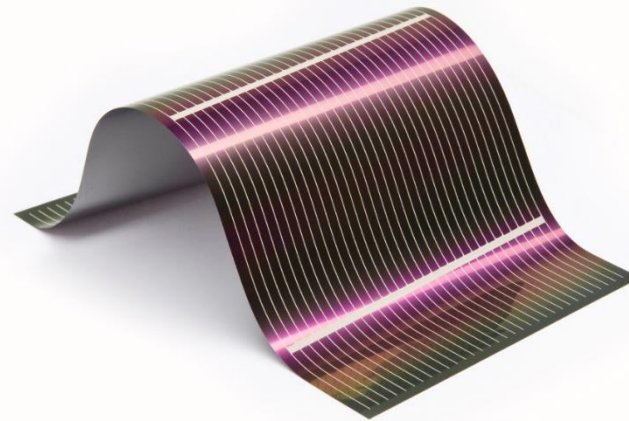
HORIZON-CL5-2022-D3-03-05 , Novel Thin Film (TF) technologies targeting high efficiencies

Type	Call budget (M€)	Project budget (M€)	Number of projects	Opening date	Closing date
RIA	20	5	4	Sep 6, 2022	Jan 10, 2023

Thin film solar cell and module technologies

- Amorphous Si
- CIGS (Cu-In-Ga-Se)
- CdTe
- Perovskites
- Organic Solar cells
- DSSC (Dye synthesized Solar Cells)
- Tandem structure (Perovskite/Perovskite or Perovskite/CIGS)

They can be made on glass or on flexible substrate



Call requirements

TRL 5 should be targeted

- 25% efficiency is within reach even higher efficiencies in tandem architectures.

This is a too ambitious goal. Only perovskite cells or tandem cells can reach this efficiency value



HORIZON-CL5-2022-D3-03-05 , Novel Thin Film (TF) technologies targeting high efficiencies

EXPECTED OUTCOMES

- Develop **novel environmentally benign** thin-film technology concepts that optimise PV cell and module architecture, **increase durability, decrease losses** and target **very high efficiencies (>25%) with flexibility** for specific applications.
- Employ simple, **scalable and low cost/low energy** consumption and higher rate deposition processes.
- Ensure compliance with **all relevant standards**, including those related to the specific applications targeted.
- Perform device/module real-life (under actual **outdoor operating conditions**) characterisation for reliability and energy yield assessment.
- Perform a **life cycle analysis** to bring evidence of the lower environmental impact, better resource efficiency than current commercial PV technologies, and circularity potential.



HORIZON-CL5-2022-D3-03-05 , Novel Thin Film (TF) technologies targeting high efficiencies

Partner Suggestions

- **ODTÜ-GÜNAM**
- Helmholtz Center Berlin (Germany) (CIGS, Perovskite)
- TNO (Netherlands) (Perovskite)
- EPFL (Switzerland) (Perovskite)
- ETH (Switzerland) (CIGS, Perovskite)
- IMEC (Belgium) (Perovskites)

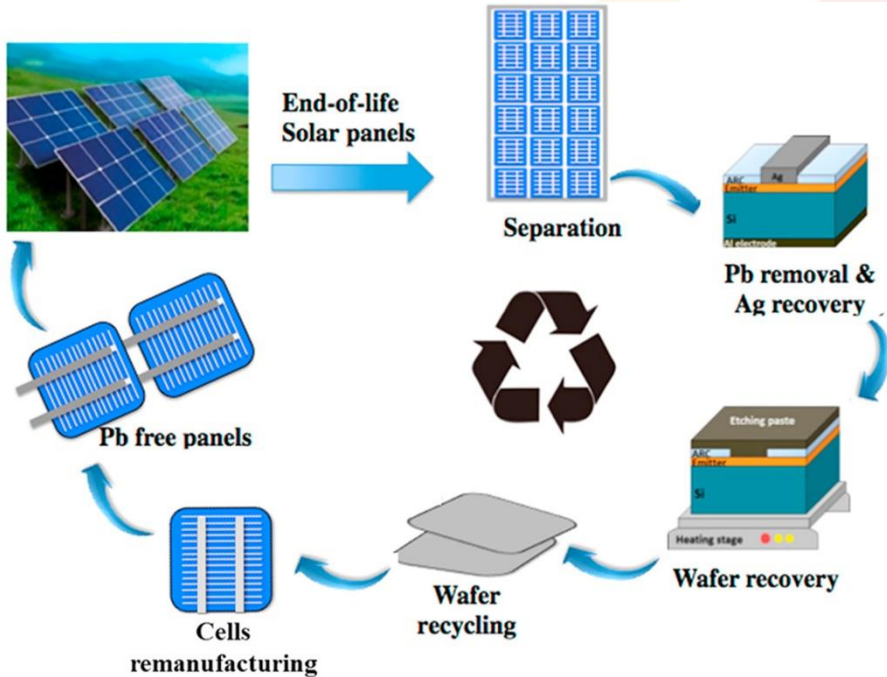


HORIZON-CL5-2022-D3-03-09: Recycling end of life PV module

Type	Call budget (M€)	Project budget (M€)	Number of projects	Opening date	Closing date
IA	20	6-7	3	Sep 6, 2022	Jan 10, 2023

TRL 7 Should be targeted

TRL 7 Should be targeted



Source : Solar Energy Materials and Solar Cells 162, 1, (2017)

Technologies

- Crystalline Si solar modules (%95)
 - CIGS (Cu-In-Ga-Se) (%1-2)
 - CdTe (%1-2)
 - Perovskites
 - Organic Solar cells
 - DSSC (Dye synthesized Solar Cells)
 - Tandem structure (Perovskite/Perovskite or Perovskite/CIGS)
- **Although no technology is specified in the call, “recycling” is referring to “reuse” of the material**
 - **This implies that present and future technologies should be addressed in the project**
 - **Then, c-Si modules and tandems are the most important candidates for the winning proposals**



HORIZON-CL5-2022-D3-03-09: Recycling end of life PV module

EXPECTED OUTCOMES

- Demonstrate **efficient, low-cost**, emerging recycling technologies for PV modules/products.
 - avoid the loss of the valuable materials employed to produce photovoltaics
- Increase **recyclability and minimise the environmental impact** of PV technology.
 - prevent harmful elements, including, for example, heavy metals, to be dispersed into the environment
- Introduce **new business** models and open new markets in PV recycling.
- Reduce dependency on primary raw materials through the **circular use of resources**, sustainable products and innovation.

Partner Suggestions

- **ODTÜ-GÜNAM**
- Fraunhofer CSP (Halle, Germany)
- SINTEF (Norway)



HORIZON-CL5-2023-D3-01-02: PV integration in buildings and in infrastructure

Type	Call budget (M€)	Project budget (M€)	Number of projects	Opening date	Closing date
IA	16	8	2	Dec 2, 2022	Mar 30, 2023



(Source : Energypeida)



(Source : Solar Power World)

TRL 7 Should be targeted

BIPV Definition

- Photovoltaic products are considered to be building-integrated, if they have been designed following the basic requirements for construction works in order to form and/or replace a construction product.
- If the integrated PV product is dismantled, it would have to be replaced by an appropriate conventional construction product.

Technology

- meet **multi-functional and aesthetic requirements** such as yield-friendly colouring or modular transparency, antifouling property, structural flexibility, module lightness and flexibility, suited voltage levels, the use of and combination with (building) materials other than glass, and an overall high aesthetical value



HORIZON-CL5-2023-D3-01-02: PV integration in buildings and in infrastructure

OUTCOMES

- Demonstrate **economic and sustainable** PV integration in the built environment and infrastructure.
 - Establish enhanced structural **collaborative innovation between PV companies and the (building) construction sector.**
 - Contribute to the Renovation Wave, the Mission on climate-neutral and smart Cities and the New European Bauhaus initiative.
-
- *The **Renovation Wave initiative** builds on the national long-term building renovation strategy, other aspects of the Directive on Energy Performance of Buildings, and building-related aspects of each EU country's national energy and climate plans (NECPs)*
 - ***New European Bauhaus (NEB)** initiative is an environmental, economic and cultural project, aiming to combine design, sustainability, accessibility, affordability and investment in order to help deliver the European Green Deal. The NEB is a growing movement, connecting people across fields in culture, education, science, architecture and the arts*



HORIZON-CL5-2023-D3-01-02: PV integration in buildings and in infrastructure

EXPECTED OUTCOMES (Details)

Proposals are expected to:

- Demonstrate how to **solve technological challenges** : **partial shading, the interconnection of PV modules with different sizes**, optical and thermal control solutions, service life/easy replacement, safety and simplicity of maintenance, software control, module substructures and fixing systems to enhance aesthetics and functionality
 - **Decrease costs and enhance lifetime**, quality, reliability and sustainability with new approaches for both PV module and BOS.
 - Develop **energy integration and social behaviour concepts** to maximize the energy matching between PV production and local buildings consumption
 - Demonstrate integration of **PV design and manufacturing within the construction value chain.**
 - **Form alliances between all stakeholders** (PV and building sectors, distribution system operators, investors, owners, architects, installers)
-
- Demonstrations **are expected to be carried out in more than one different construction typologies** (residential buildings, tertiary building (hospital, schools, public administration...), or civil infrastructures (roadways, noise barriers, parking lots, bridges, etc.) and in more than one locations in Europe.



HORIZON-CL5-2023-D3-01-03: Floating PV Systems

Type	Call budget (M€)	Project budget (M€)	Number of projects	Opening date	Closing date
IA	14	7	2	Dec 2, 2022	Mar 30, 2023



Floating PV (FPV) has unique aspects and challenges

- PV system design
- Floating platform
- Mooring
- Connection to the ground and grid

Lakes of Turkey							
Name	(km2)	Name	km2	Name	km2	Name	km2
Van Gölü	3713	Hazar Gölü	86	Durusu Gölü	25	Akdoğan Gölü	11
Beyşehir Gölü	656	Bafa Gölü	60	Karine Gölü	24	Çavuşçu Gölü (Ilgın Gölü)	9
Tuz Gölü	1300	Köyceğiz Gölü	52	Tuzla Gölü	23	Düden Gölü	8
Eğirdir Gölü	482	Işıkli Gölü	49	Küçükçekmece Gölü	16	Gala Gölü	8
Akşehir Gölü	353	Nazik Gölü	48	Yarıklı Gölü	16	Karataş Gölü	6
İzmit Gölü	308	Sapanca Gölü	47	Haçlı Gölü	16	Mogan Gölü	6
Burdur Gölü	200	Salda Gölü	45	Seyfe Gölü	15	Paradeniz	6
Manyas Gölü (Kuş gölü)	166	Yay Gölü	37	Akyayan Gölü	15	Sarıkum Gölü	1,84
Acıgöl	153	Akyatan Gölü	35	Aktaş Gölü	14	Ulugöl	0,1
Eber Gölü	150	Balık Gölü	34	Arin Gölü	13	Gaga Gölü	0,07
Uluabat Gölü	134	Marmara Gölü	34	Nemrut Gölü	12	Uzungöl	0,02
Çıldır Gölü	115	Çöl Gölü	32	Büyükçekmece Gölü	11	Total	7828
Erçek Gölü	98	Palas Tuzla Gölü	27,2	Bolluk Gölü	11		

Capacity of lakes > 500 GW
(Produces more electricity than Turkish electricity demand)



HORIZON-CL5-2023-D3-01-03: Floating PV Systems

TRL 6-7 should be targeted

EXPECTED OUTCOMES

- Develop (and verify) predictive **yield models** including dynamic behaviour of the PV
- Demonstrate advanced module and system concepts of adequate scale (**min 5 MW**)
 - considering the disturbance of environmental factors to the electrical output characteristics of PV modules and systems.
- Demonstrate system components that **satisfy the structural and functional requirements** for the entire lifecycle
- Address **reliability and performance loss rates** through test and inspections
- Demonstrate **low impact on ecosystem biodiversity** by developing methodologies
- Satisfy **end-of-life recycling** aspects.



HORIZON-CL5-2023-D3-01-03: Floating PV Systems

TRL 6-7 should be targeted

Partner Suggestions

- **ODTÜ-GÜNAM**
- **METU**
- TNO (Netherland)
- FPV Companies - BayWa-r.e. (Germany), Ciel Terra (France), OceanSun (Norway)
- IMEC (Belgium)
- SINTEF (Norway)



HORIZON-CL5-2023-D3-02-11: Advanced concepts for crystalline Silicon technology

Type	Call budget (M€)	Project budget (M€)	Number of projects	Opening date	Closing date
RIA	9	3	3	May 4, 2023	Sep 5, 2023

Photo : GÜNAM



Varieties of c-Si technology

- PERC cells (main stream)
- TOPCon solar cells
- Heterojunction solar cells
- IBC solar cells

TRL 4-5 should be targeted

OUTCOMES

- PV modules with higher efficiencies and lower costs, paving the way for mass production.
- Lower environmental impact with efficient and optimised use of materials/resources.

- Crystalline Si technology dominates the PV industry
- Market share > 95%
- Large scale production in Turkey (Kalyon PV)
- Majority of the PV deployment is c-Si worldwide



HORIZON-CL5-2023-D3-02-11: Advanced concepts for crystalline Silicon technology

Workprogram has not been finalized yet

OUTCOMES

Proposals are expected to develop architectures **approaching the theoretical efficiency limit** of c-Si cells (29%) and providing the direction for even higher mass-production industrial cell performance with:

- 1. Nanophotonic structures** to maximize absorption and minimise reflection, enabling reduced silicon consumption and higher efficiencies.
- 2. Innovative texturisation** and light-trapping concepts for thin and ultrathin c-Si solar cells.
- 3. Advanced low-cost surface passivation** and novel passivating contacts; novel heterojunctions.
- 4. Low-cost and Ag-free metallisation**, TCOs using abundant materials (In-free), such as AZO.
- 5. Direct bandgap architectures** for very high efficiencies and/or thinner cells.



HORIZON-CL5-2023-D3-02-11: Advanced concepts for crystalline Silicon technology

Partner Suggestions

- **ODTÜ-GÜNAM**
- Fraunhofer ISE ((Germany)
- TNO (Netherland)
- IMEC (Belgium)
- INES (France)
- ISC Konstanz (Germany)
- ISFH (Germany)



HORIZON-CL5-2023-D3-02-12: Large Area Perovskite solar cells and modules

Type	Call budget (M€)	Project budget (M€)	Number of projects	Opening date	Closing date
IA	14	7	2	May 4, 2023	Sep 5, 2023

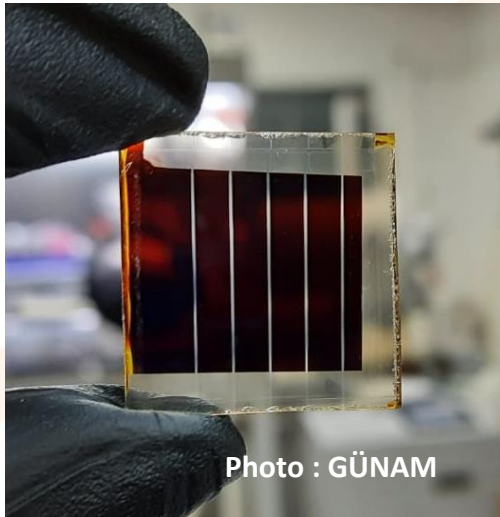


Photo : GÜNAM

Very rapid development : Efficiency > 25%

Main Challenges

- Durability, life time
- Large scale production

TRL 6-7 should be targeted

EXPECTED OUTCOMES

- Increase the lifetime, efficiency and minimise the environmental impact of Perovskite PV.
- Enlarge with novel perovskite device architectures the integration and application possibilities of PV technology.
- Increase the potential for industrial production and commercialisation of perovskite PV creating a competitive technological know-how for the European PV industrial base.



HORIZON-CL5-2023-D3-02-13: Operation, Performance and Maintenance of PV Systems

Type	Call budget (M€)	Project budget (M€)	Number of projects	Opening date	Closing date
IA	10	5	2	May 4, 2023	Sep 5, 2023



TRL 6-7 should be targeted

EXPECTED OUTCOMES

- Increase PV system performance, reliability, security and flexibility under various topology and operating conditions with enhanced digitalisation
- Increase utility-friendly integration of PV generation into the European energy system at high-penetration levels and the profitability of PV systems

PV installation in Turkey : 9 GW

PV installation in the world : 1000 GW



HORIZON-CL5-2023-D3-02-13: Operation, Performance and Maintenance of PV Systems

Type	Call budget (M€)	Project budget (M€)	Number of projects	Opening date	Closing date
IA	10	5	2	May 4, 2023	Sep 5, 2023

EXPECTED OUTCOMES (DETAILS)

- Demonstrate integrated **multi-aspect sensing (optical, thermal, electrical)** into PV modules to suppress degradation, detect unwanted operating conditions and avoid failures
- Demonstrate **smart control/tracking systems** (e.g. coupled with real-time monitoring data, forecasting, EMS, etc.) for performance optimization.
- Demonstrate hybrid or **integrated monitoring-diagnostic imagery solutions**
- Apply **AI and Big Data to improve the energy yield** (advanced module control, self-reconfigurable topologies, etc.)
- Demonstrate automated and **predictive PV asset management software** based on sensor-data-image fusion to reduce human effort



Thank You

