SolarHub

SolarHub Ignition Acceleration Program
Guide for Applicants

Mar 2023

DEADLINE FOR APPLICATIONS: 30 APRIL 2024

HE SolarHub Project:
A Greek-Turkish Solar Energy Excellence Hub to Advance the European Green Deal

Funded by
the European Union

ID2.2.1 SolarHub Ignition Acceleration Guide

Submission Information				
Class	☐	Deliverable (D)	☒	Internal Deliverable (ID)
Level	☒	Public (PU)	☐	Sensitive (SEN)
Work Package	WP2. CAPACITITES			
Lead Beneficiary	IDI: International Development Ireland Ltd [16]			
Due Date				
Submitted Date				

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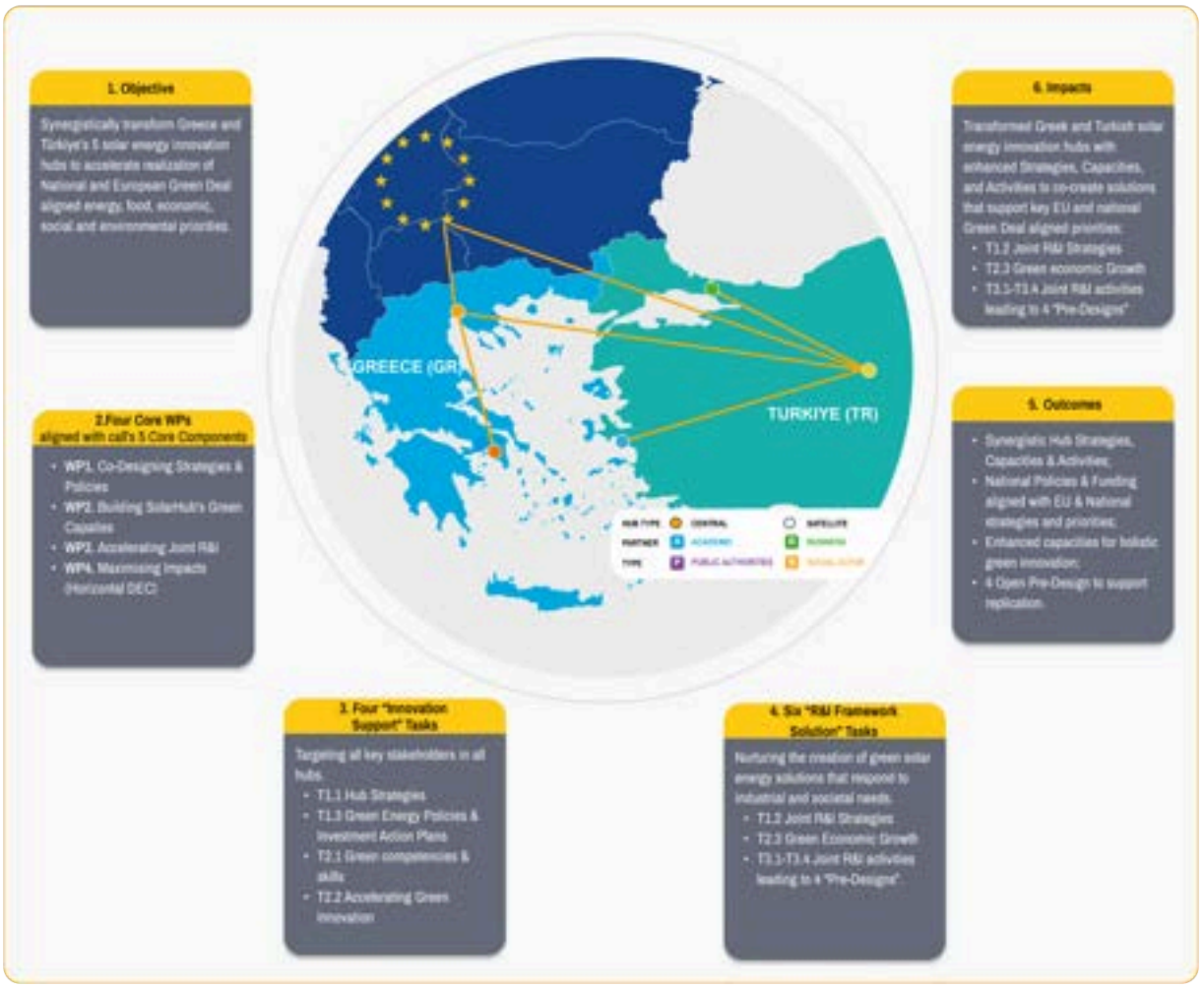
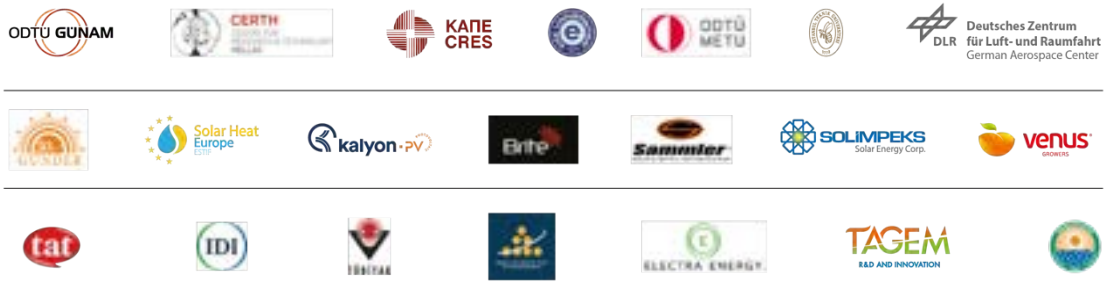
Document History		
Ver.	Date	Notes
0.1	23 Feb 2024	1st draft circulated to COORD for comments.
1.0	29 Feb 2024	First official version of the Guide.

Project Summary	
Short Name:	SolarHub
Long Name:	A Greek-Turkish Solar Energy Excellence Hub to Advance the European Green Deal
Grant Number:	101086110
Start & End Dates:	1 Jan. 2023 – 31 Dec. 2026
Overall Budget:	€4 846 397.50
Coordinator:	ODTU Center for Solar Energy Research & Applications, Ankara / Turkiye
Project Webpage:	https://horizonsolarhub.eu
EU Cordis Webpage:	https://cordis.europa.eu/project/id/101086110



Consortium



List of Abbreviations and Acronyms	
EC	European Commission
ESR	Evaluation Summary Report
SME	Small & Medium Enterprise

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1 Executive Summary

SolarHub is a perfect blend of Quadruple Helix collaboration in practice to create an Excellence Hub. Through linking academia, businesses, governments, and civil societies, SolarHub a four-year project with 21 partners from funded under the Horizon Europe WIDERA Excellence Hubs call. The SolarHub consortium came to effect in January 2023 aiming to interconnect and scale-up five solar energy innovation ecosystems located in Ankara, Thessaloniki, İzmir, Athens and İstanbul standing by a mantra of accelerating the Clean Energy Transition and the Green Deal initiative. Thanks to the diverse structure derived the quadruple helix formation, this Greek-Turkish Solar Energy Excellence Hub takes on the challenge of aligning concrete and co-developed solutions for clean and secure energy and food supplies.

The SolarHub Acceleration Program is a strategic component of the project, designed to foster the development and commercialization of innovative solar energy technologies. The program aims to bridge the gap between research and market needs, facilitating startups and research teams in navigating the complex journey from ideation to market entry. It offers comprehensive support across various stages of startup development, including mentorship, technical support, access to advanced R&I infrastructure, training, and networking opportunities. This multi-layered approach ensures that participants receive the necessary resources and guidance to scale their solutions effectively, addressing key challenges in the solar energy sector such as market access, technological development, and financial sustainability. The program operates in cycles, each focusing on different stages of startup maturity, from early-stage ideation to market expansion, thus catering to a wide range of needs within the solar energy innovation ecosystem.

This document is a detailed guide for the applicants of the SolarHub Ignition Acceleration Program. It is structured in the following chapters:

- **(2) Introduction and Overview**: Introduces SolarHub's mission to connect regional ecosystems for solar energy R&D and outlines the acceleration program's role within this framework.
- **(3) SolarHub Acceleration Program**: Details the program's three cycles—Ignition, Momentum, and Synergies—each designed to support startups at different maturity stages within the solar energy sector.
- **(4) SolarHub Ignition**: Focuses on the first cycle for early-stage startups, covering eligibility, benefits like training and mentorship, and the application and selection process
- **(5) Program Components:** Dives into the specifics of what participants will gain, such as education and training, mentoring and coaching, ideation workshops, access to pre-designs, and networking opportunities.

The guide serves as a comprehensive manual for potential applicants, providing all necessary information to participate in the SolarHub Ignition program.

2 Introduction

2.1 SolarHub at a glance

The SolarHub Project aims to **advance solar energy innovation within Greece and Türkiye** by connecting five regional ecosystems. This EU-funded effort is strategically designed to foster collaboration between industry, government, academic institutions, and the public to promote the research and development (R&D) of solar energy solutions. Our objective is straightforward: to **co-create a unified strategy and a shared R&D agenda** that will **streamline solar innovation** and expedite the process of bringing these innovations **to market**. By doing so, we hope to contribute significantly to the acceleration of solar energy commercialization.

The project's approach includes implementing a range of complementary interventions that encourage the participation of all relevant stakeholders. These interventions are aimed at supporting ongoing R&D and ensuring that the resulting solar energy solutions are commercially viable and sustainable.

A pivotal aspect of SolarHub is the development of four distinct solar energy solution designs (pre-designs). These pre-designs will serve as foundational models for future solar energy products and applications, with an initial focus on the agri-food sector and the potential for further application in other industries. To achieve maximum impact, SolarHub has laid out a comprehensive plan that includes creating relevant R&D strategies, establishing robust networks, and providing training opportunities that are essential for stakeholders. The project will also promote the integration of R&D infrastructures to create synergies that enhance innovation capacity. The core components of the SolarHub Project include:

1. **Co-development of a Hub Strategy and Joint Strategic R&D Agenda**: Aligning the goals and resources of the five ecosystems to streamline efforts towards common objectives.
2. **Implementation of a Diverse Set of Interventions**: These interventions are designed to involve all key players, from industry experts to government officials, in supporting R&D and the acceleration of commercialization.
3. **Joint R&D Activities**: Collaboration on research activities between partners to produce the four pre-designs, which are critical to the project's success.
4. **Maximizing Impact through Dissemination and Communication**: Ensuring that the project's outcomes are communicated effectively to engage all stakeholders and promote the adoption of the innovations.

SolarHub presents an opportunity to researchers and aspiring entrepreneurs, to be part of a larger, focused effort that aims to bring research outcomes into practical, market-ready solutions. The project emphasizes the translation of scientific and technical knowledge into products and services that meet market needs and societal challenges. SolarHub's vision is to build the environment that will propel the solar energy sector forward, equipping researchers, entrepreneurs and innovative companies with the tools and networks necessary to thrive in a competitive market.

2.2 Identifying the problem

Companies seeking to innovate within the renewable energy sector, particularly solar power, face several significant hurdles. These challenges stem from various sources and create interconnected problems for innovation and business support organizations. One of the primary challenges is aligning Research and Innovation (R&I) with genuine market demands. Companies often **struggle to identify real market needs**, leading to misdirected efforts and resources. The linkage between academia and the market is inadequate, which can result in technologies that are impressive in theory but have little practical application or commercial viability.

Access to finance is another significant hurdle. Securing funds critical for growth and innovation is daunting, with access to the banking system for such purposes almost non-existent. This financial gap is particularly pronounced in the early stages of a startup's life, often referred to as the "Valley of Death," where initial funding has been spent but revenue generation has not yet begun. Startups in the renewable energy sector may find this stage even more challenging due to the capital-intensive nature of R&D in this field.

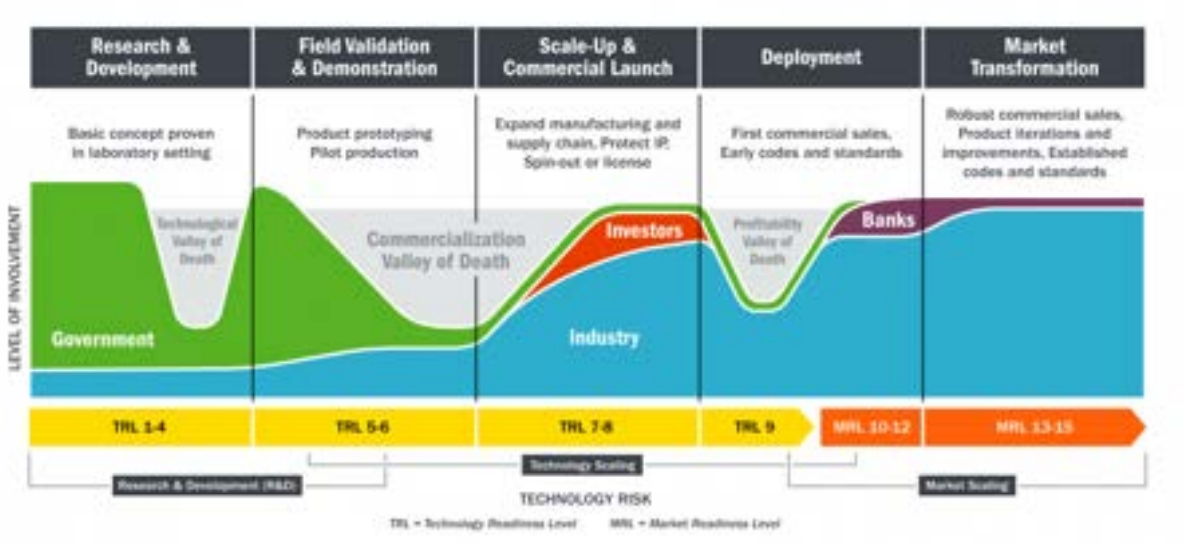


Figure 1: Technology to Market according to the USA Office of Energy Efficiency and Renewable Energy

The innovation ecosystem itself can be fragmented, with insufficient cross-border collaboration and networking. Knowledge transfer and entrepreneurial development are often lacking, which is crucial for startups to scale and integrate into larger markets. Without a robust network and support system, startups may find it difficult to navigate the complexities of the solar power industry, which includes rapidly evolving technologies, regulatory requirements, and a competitive global market.

For business and innovation support organizations, these challenges translate into a demanding set of needs. They must provide targeted support to bridge the gap between R&I and the market, facilitate access to finance through various channels, and foster a cohesive and collaborative innovation ecosystem that encourages knowledge sharing and partnerships.

In the solar power industry, where the technology lifecycle is constantly accelerated by new discoveries and the urgent global need for clean energy solutions, these organisations must also provide advanced infrastructure and investments. They have to work on closing the skill gaps in R&I-intensive domains, providing the necessary training and development to ensure that the workforce is equipped to meet the industry's evolving demands.

Support organisations themselves face the challenge of staying abreast of the latest advancements in solar technology to provide relevant and timely assistance. They also need to navigate and leverage national, regional, and European funds effectively to support startups in the renewable energy sector.

Innovation acceleration programs are designed to address these gaps, offering startups targeted support and resources to navigate the market effectively. They provide a structured framework that helps bridge the gap between R&D and market demands, ensuring that startups not only survive the 'Valley of Death' but also thrive beyond it. By facilitating access to finance, mentorship, advanced R&I infrastructure, and robust networking opportunities, these programs aim to catalyse the growth and scalability of innovative solar energy solutions, thus contributing to the sector's competitiveness and alignment with the urgent global transition to sustainable energy.

2.3 Understanding Innovation Acceleration

Understanding innovation acceleration is a crucial process for startups, especially in fields like renewable energy and solar power, where rapid technological advancements and market readiness are vital. This process involves expediting the **development and commercialization of ideas**, technologies, and products. It is accomplished through a comprehensive support system that includes **mentorship and coaching** to **guide business strategy**, **technical support** to resolve specific industry challenges, training to **build skills and knowledge**, **networking** to connect with industry experts and potential partners, and facilitating access to funding, which is often a barrier for early-stage ventures.

Acceleration programs play a pivotal role in fostering these innovative ideas and technologies at a stage when they are most vulnerable and when access to resources and guidance is typically limited. The operational model of innovation acceleration **encourages rapid iteration cycles**, where startups quickly test their ideas and refine them based on real-world feedback. This approach also involves embracing failures as learning opportunities, allowing entrepreneurs to pivot their strategies in response to market feedback without the significant penalties typically associated with R&D missteps. Through this process, startups can develop resilience and adaptability, which are key to success in the fast-paced and ever-evolving landscape of solar energy technology.

2.4 Benefits of participation

Participating in the SolarHub Acceleration program unlocks a multitude of benefits for research teams and companies focused on solar energy, furnishing them with the tools and expertise necessary to navigate the complexities of the industry and scale their innovations effectively:

- **Training and Education**: training sessions on solar technologies, business model development, market analysis, and financial planning, all specifically designed for the solar energy sector.
- **Mentoring and Coaching**: Personalised guidance from experienced industry and business professionals and subject matter experts, providing critical insights, advice, and feedback to sharpen business strategies and advance technology development.
- **Networking**: Opportunities to connect with a diverse network of entrepreneurs, investors, industry leaders, and potential partners, paving the way for new collaborations, customer bases, and investment opportunities.
- **Access to Cutting-Edge Solar Technologies**: Exclusive access to the latest pre-designs and advancements in solar energy, granting a competitive edge in the development and refinement of solar-based solutions.
- **Market Entry and Expansion Support**: Targeted strategic assistance in penetrating new markets and growing existing ones, with support in market research, positioning strategies, and sales plan development tailored to the solar energy industry.
- **Sustainability and Growth Focused**: A strong emphasis on cultivating sustainable and scalable business models, ensuring startups' long-term viability and growth in the solar energy sector.

3 SolarHub Acceleration Programme

3.1 Overview

The SolarHub Acceleration Program is a comprehensive initiative designed under the SolarHub project to support research teams and startups at various stages of maturity within the solar energy sector. It comprises three distinct cycles, each tailored to address the specific needs and challenges of different stakeholders in the innovation process.

The first cycle, **SolarHub Ignition**, focuses on early-stage startups, entrepreneurs, and research teams, providing ideation workshops, basic business model formation, and initial market research. The subsequent cycle, **SolarHub Momentum**, is geared towards more established startups with a defined product or service, offering advanced business development, market penetration strategies, and investor readiness training. Finally, the **SolarHub Synergies** cycle caters to mature startups or SMEs with established products or services, aiding in expansion strategies, advanced market analysis, and partnership and network expansion.

As the SolarHub project progresses, the acceleration program will evolve to meet the changing landscape of the solar energy industry and the emerging needs of its stakeholders. **Each cycle is built to be dynamic, allowing for the integration of new insights, technologies, and market trends**. This ensures that participants receive the most current and impactful support, fostering innovation, growth, and sustainable success. Through this structured but flexible approach, SolarHub aims to cultivate an integrated ecosystem of solar energy solutions that will address today's energy challenges while trying to anticipate and help shape a future vision in the sector.

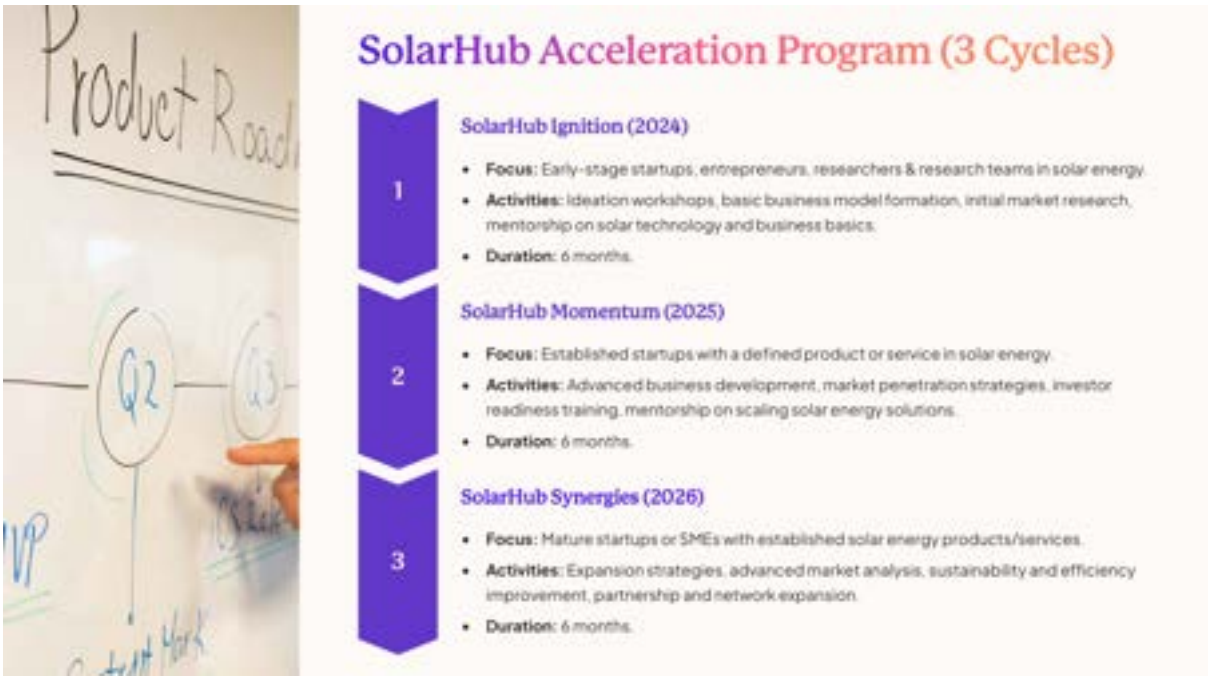


Figure 2: Overview of the SolarHub Acceleration Program

3.2 SolarHub Ignition

	Focus:	Early-stage startups, entrepreneurs, researchers & research teams in solar energy.
	Activities:	Ideation workshops, basic business model formation, initial market research, mentorship on solar technology and business basics.
	Duration:	6 months (May 2024 – Nov 2024)

The **SolarHub Ignition phase** is the 1st cycle of the SolarHub Acceleration Program, designed for early-stage startups, entrepreneurs, researchers, and research teams dedicated to solar energy innovations. It is an essential starting point for those who are at the very beginning of transforming their solar energy concepts into reality, offering a six-month-long innovation support environment.

Participants in the SolarHub Ignition phase will benefit from a structured program that includes education and training, ideation workshops, mentorship and coaching, networking opportunities, and access to both finance and cutting-edge solar technologies. These components are aimed at enhancing the participants' understanding of both technical and commercial aspects of solar energy solutions, thereby fostering a holistic approach to innovation.

Through the Ignition phase, **teams or startups are not required to be incorporated**, providing flexibility and encouraging participation from a broader range of innovators and researchers based in Greece, Türkiye, or Southeast Europe with links to the 2 countries. The ultimate goal of this phase is to prepare participants to refine their business strategies, advance their technological development, and effectively communicate their vision to investors and stakeholders, setting them on a trajectory for growth and long-term success in the solar energy sector.

3.3 SolarHub Momentum & Synergies

As the program will evolve from the foundational Ignition phase, it will broaden its scope and deepen its impact with the following **Momentum** and **Synergies** phases. The Momentum phase is tailored for startups that have progressed beyond the initial stage and have a defined product or service in the solar energy domain. Finally, the Synergies phase will target mature startups or SMEs that have established products or services and are now looking to expand their reach and consolidate their market position. This phase will support strategic expansion, advanced market analysis, and further development of partnerships and networks.

4 SolarHub Ignition

4.1 Who is this program for?

- Early-stage startups & Research Teams working on Solar Energy.
- Entrepreneurs & researchers ready to start a spin-off (related to Solar Energy).

4.2 Eligibility Criteria

<table>
<tr><td>Entrepreneurs</td><td>Research Teams</td><td>Startups</td></tr>
<tr><td colspan="2">No Legal Entity necessary.</td><td>< 5 years of operations</td></tr>
<tr><td colspan="2">Any Widening Country.</td><td>Any Horizon Europe Country.</td></tr>
<tr><td colspan="2">30% of the team members are operating either in GR or TR.</td><td>Proven Collaboration with GR or TR entity (MoU[1])</td></tr>
<tr><td colspan="3">Working on Solar Energy innovations regardless of the application domain.</td></tr>
</table>

- Entrepreneurs, Research Teams or Startups with less than 5 years of operations.
- Teams do not need to be incorporated (have established legal entities) to participate in this stage of the acceleration program.
- Teams must be based in any Widening Country as defined in Horizon Europe programme[2], as long as at least 30% of the team members are operating in the Greek or Turkish ecosystem.
- Start-ups can be established in any Horizon Europe eligible country but need to have a proven collaboration with the Greek or Turkish entity (of any type: Academic, business, organisation, etc.) proven through a simple MoU.
- In the case of start-ups outside Greece or Türkiye these must establish a business collaboration with an entity in Greece or Türkiye. This must be described in a Memorandum of Understanding (MoU).
- Working on products, services or solutions related to Solar Energy regardless of the application domain.

[1] MoU: Memorandum of Understanding (See Annex)

[2] See Widening Countries here: https://rea.ec.europa.eu/horizon-europe-widening-who-should-apply_en

4.3 What participants will get from the program?

The Program is tailored to help startups and young researchers by providing comprehensive support and resources necessary for the development and commercialization of solar energy innovations. Here's what participants can expect to gain from the program (the services are further analysed in the following chapter):

- **Education & Training**: A mix of entrepreneurship and technical training covering key areas such as business strategy, market analysis, financial planning, and the technical aspects of solar energy.
- **Ideation Workshops**: Workshops aimed at deepening the understanding of both technical and commercial aspects of solar energy solutions, encouraging a comprehensive approach to innovation.
- **Mentorship / Coaching**: Expert mentoring in business, entrepreneurship, and strategy, coupled with coaching on technical matters with the support of our scientific partners to refine your project's direction and focus.
- **Networking Opportunities:** Access to a wide range of networking events with industry professionals, peers, and potential collaborators, designed to forge new partnerships, expand customer bases, and initiate collaborative projects.
- **Access to Finance & Funding:** Direct assistance in navigating financing opportunities, including introductions to funds and venture capitalists (VCs), along with guidance on how to effectively pitch projects to potential investors.
- **Early Access to Pre-designs:** Exclusive early access to cutting-edge pre-designs to inspire and guide the creative process, offering participants a unique competitive advantage in developing innovative solar energy solutions.

This comprehensive suite of services is designed to address the various needs of startups and researchers in the solar energy field, facilitating their entrepreneurial journey from concept to market.

4.4 How it works?

The **SolarHub Ignition Acceleration Program** operates through a four-step process designed to identify, support, and showcase high-potential startups and researchers in the solar energy sector.

- **Application through an Open Call [MAR – APR 2024]:** We begin with an **open call**, inviting potential applicants from across the spectrum—including researchers, entrepreneurs, startups, and SMEs interested in solar energy innovations—to submit their proposals. This stage is about reaching out to a broad audience to ensure we attract a diverse range of innovative ideas and projects.
- **Evaluation & Selection of 25 Research Team [MAY 2024]**: Once applications are submitted, they undergo an evaluation by a panel of independent experts. These experts assess each proposal based on its innovation, market potential, and readiness level, selecting those that demonstrate the most promise and maturity for the next stage of the program.
- **Acceleration through Innovation Support [JUNE – NOV 2024]:** Selected applicants enter the acceleration phase, where they receive comprehensive support tailored to their specific needs. This includes a series of training on business and technical aspects of solar energy, personalised mentoring and coaching from industry veterans, networking opportunities to connect with peers and potential partners, and early access to cutting-edge pre-designs. The aim is to equip participants with the knowledge, skills, and resources they need to refine their innovations and prepare for market entry.
- **Demonstration & Access to Finance [DEC 2024]:** The program culminates in an Open Day event, designed to showcase the progress of participants to a wider audience, including investors, industry stakeholders, and potential collaborators. This event is not just a demonstration of what has been achieved but also a platform for networking and brokerage, opening doors to future opportunities and partnerships. **Venture Funds from both countries specialising in financing of early stage start-ups in green and digital transformation will participate in this process.**

Through this structured approach, the SolarHub Acceleration Program aims to foster the growth and success of the next generation of solar energy innovations, from concept to commercialization.

4.5 How can one apply?

To apply for the SolarHub Acceleration Program, we're utilising the F6S.com platform, a leading global online hub for startups, entrepreneurs, and accelerators. F6S.com is renowned for its extensive network and ease of use, offering a streamlined application process for programs like ours.

Here's how you can apply:

1. **Visit F6S.com**: Start by navigating to the F6S.com website. If you're new to F6S, you'll need to sign up; if you already have an account, simply log in.
2. **Create Your Profile**: Once signed up, you'll be prompted to create a profile. For individuals, this involves providing some personal details and your professional background. For teams,

you will create a team profile that includes information about your startup or project, including team members, your mission, and what you're working on. Ensure your profiles are as detailed and clear as possible to stand out.

3. **Find the SolarHub Acceleration Program**: Search for the SolarHub Acceleration Program within the F6S platform. You can find it under the accelerators section or by using the search function.
4. **Complete the Application:** Follow the instructions to fill out the application form. You'll be asked to provide information about your idea or start-up, your team, and how you plan to leverage the SolarHub program to accelerate your growth. An application template with all the questions can be found at the end of this Guide.
5. **Submit Your Application:** Once you're satisfied with your application, submit it through the platform. Make sure to review your application for completeness and accuracy before submission.

F6S.com is designed to be intuitive and user-friendly, ensuring a smooth application process. Creating individual and team profiles on the platform allows you to not only apply for our program but also gain visibility within a global network of startups, investors, and other accelerators. We look forward to seeing your innovative solutions and how you plan to change the solar energy landscape.

4.6 How is an applicant selected?

The selection of teams for the SolarHub Ignition phase is aimed at identifying startups and teams with the highest potential for impact and success in the solar energy sector. This process is guided by a set of carefully chosen criteria, designed to evaluate the breadth and depth of the proposed technology, the entrepreneurial spirit of the team, their achievements and expertise, and their engagement with the program's resources.

#	Criterion	Weight
1	**Breadth of innovation:** Assessing the platform potential of the proposed solution. Evaluating how broadly the solution can be applied and its potential impact across various sectors.	25%
2	**Depth of Innovation:** Analysing the unique features and innovations of the technology/innovation focusing on the distinctiveness and advanced aspects of the proposed solution.	25%
3	**Entrepreneurial Motivation and Spirit:** Assess the team's enthusiasm, commitment to entrepreneurship, and the drive to succeed within the solar energy sector.	25%
4	**Achievements, Experience, and Technical Skills:** The team's past accomplishments, relevant experience in the field, and technical expertise, which indicates their ability to successfully execute and develop the proposed project.	25%
5	**Engagement with Pre-Designs:** Evaluating how the team plans to utilise or integrate the provided pre-designs into their solutions, demonstrating creativity and innovation.	+10%

*While not required, **using our pre-designs or proposing alternatives** in the solar energy sector can boost your application's chances in the evaluation process. So, you have 2 options to get these bonus points:*

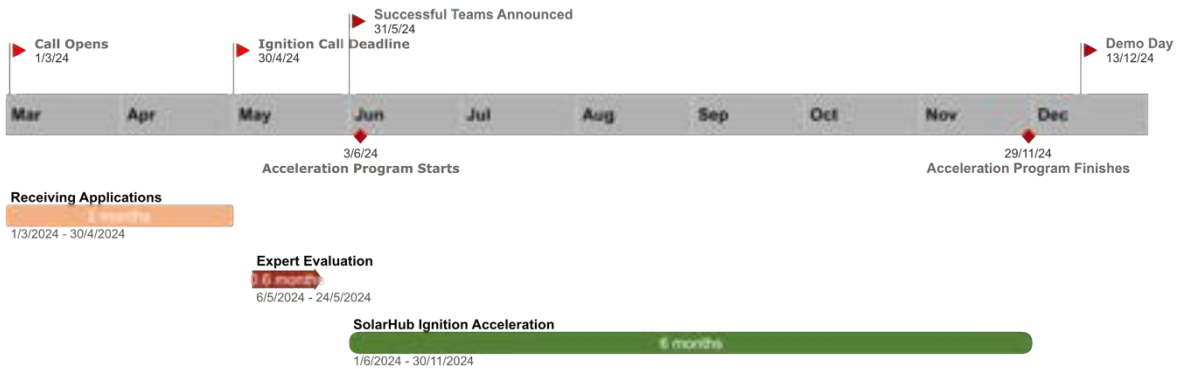
- *Demonstrate how you'll use or contribute to our **pre-designs**.*
- *Suggest innovative and feasible **alternative solutions (not using our predesigns)** in solar energy. Proposals that contribute significantly to the field will be favourably considered.*

4.7 Timeline

The key dates of the Ignition Acceleration program are:

Based on the provided timeline details in the document, here are the key dates for the SolarHub Acceleration Program:

- **March 1, 2024**: Official announcement of the Open Call, inviting applications from researchers, entrepreneurs, startups, and SMEs.
- **March - April 2024**: Application submission period, with the deadline for receiving applications set for April 31, 2024.
- **May 2024**: Evaluation phase, where independent experts review and evaluate the submitted proposals, concluding by May 24, 2024.
- **June - November 2024**: Implementation of the Acceleration Program, including training, mentoring, coaching, and networking, along with access to pre-designs and workshops. The program officially starts on June 3, 2024, and ends on November 31, 2024.
- **December 1 - 15, 2024**: Demonstration & Networking Day, a closing event showcasing the progress of participants, aimed at attracting investors and facilitating networking and brokerage opportunities.



Please note that the mentioned dates are tentative and subject to change. The SolarHub Acceleration Program organisers reserve the right to adjust the timeline as necessary. Any changes to the schedule will be communicated promptly to ensure all participants and stakeholders are

informed in a timely manner. We advise all interested parties to stay updated by regularly checking our communications for any updates or modifications to the program's key dates.

5 Ignition Components

5.1 Education & Training

The SolarHub Ignition Program has a strong education and training component, designed to equip participants with the foundational knowledge and skills necessary to operate successfully in the solar energy sector. This component of the program will be delivered **online**, through **interactive webinars** led by seasoned sector and business experts who bring a wealth of experience in their respective fields. Each training session is planned to last between **2 to 3 hours**, providing an intensive learning experience without overwhelming participants.

Scheduled **bi-weekly**, these sessions are structured to ensure a consistent and manageable learning pace, allowing participants to absorb and reflect on the information presented. The curriculum covers a broad spectrum of topics, from business foundations, market analysis, and strategy, to more specialised subjects such as financial planning, environmental, social, and governance (ESG) impacts, and technical aspects of solar energy technology. The aim is to introduce participants to business basics and delve into the development of sustainable business models, foster innovation, and encourage effective networking and collaboration within the solar energy ecosystem.

Training Title	Aim	Description
Business Foundations	Introduce business basics	Covering key concepts in business and entrepreneurship, tailored to the solar energy sector.
Market Analysis and Strategy	Develop market understanding	Training on conducting market research, identifying target markets, and developing market entry strategies.
Business Model Development	Create business models	Focusing on the development of sustainable and scalable business models for solar energy startups.
Pitching and Communication Skills	Enhance presentation skills	Techniques for effectively presenting business ideas and technology pitches to investors and stakeholders.
Financial Planning and Management	Financial literacy	Training on budgeting, revenue projections, and managing financial resources.
ESG and Sustainability	Understand ESG impacts	Exploring the environmental, social, and governance aspects relevant to the solar energy industry.
Innovation and Creativity	Foster innovative thinking	Sessions designed to stimulate creativity and innovative approaches in solar energy solutions.
Networking and Collaboration	Build connections	Training on how to effectively network, form partnerships, and collaborate within the solar energy ecosystem.

Energy Communities	Learn about social innovation in energy	Explore the concept of energy communities, focusing on the regulatory, technical, and social aspects critical for their formation and success.
Legislation, Standardisation, Certification	Understand the framework	Learn about the regulatory and legal framework of EU. Understand standardisation and certification in the industry.
Technical Training 1 - 6	Specific technical topic	Content defined by technical partners, focusing on a key aspects of solar energy technology and the Pre-Designs.

*It's important to note that the **detailed training schedule**, including specific dates and times for each session, **will be announced at the start of the acceleration program**. While the table provided is indicative and serves as a reference, participants can expect the final schedule to reflect the same commitment to comprehensive and practical learning opportunities tailored to the needs of solar energy startups and entrepreneurs.*

5.2 Mentoring & Coaching

The SolarHub Acceleration Program offers a **Mentorship & Coaching component**, specifically tailored to assist participating teams in refining their business cases and enhancing their technological innovations. This structured approach is integral to the program, ensuring that each team receives the guidance and support needed to navigate the complexities of the solar energy market successfully.

- **Mentorship**: Participants will have access to 12 hours of mentorship from industry professionals who bring a wealth of business and entrepreneurship skills to the table. These mentors will work closely with teams to validate their projects, develop compelling business cases, identify potential issues, and make informed decisions. The ongoing support and feedback provided by these mentors are crucial in ensuring that teams make steady progress toward their goals.
- **Coaching**: In addition to mentorship, the program includes up to 6 hours of coaching from subject matter experts in the research sector, who possess deep technical knowledge in solar energy and related fields. These coaches will advise startups on the technical aspects of their projects, from the specifics of solar technology implementation to the application of scientific principles in practical, real-world scenarios.

- **Objective**: The primary objective of this mentorship and coaching framework is to guide each team towards developing a solid business case and a persuasive pitch by the end of the program. This ensures that participants not only progress in developing and refining their solar energy solutions but also gain proficiency in articulating their vision and value proposition to potential stakeholders and investors. Through this comprehensive support system, the SolarHub Acceleration Program aims to equip solar energy innovators with the skills, knowledge, and confidence needed to bring their ideas to fruition and make a significant impact in the renewable energy landscape.

5.3 Ideation & Co-Design Workshops

The Program incorporates **Ideation & Co-design Workshops** as a core component to stimulate creativity and foster collaboration among participants. These workshops are designed to leverage the collective expertise and insights of ecosystem partners and technical experts, enabling teams to explore and expand upon the applications and use cases for the provided pre-designs.

- **Brainstorming Sessions**: Participants will engage in creative brainstorming activities, aimed at uncovering innovative applications for the pre-designs. These sessions encourage free-flowing ideas and collaborative thinking, setting the stage for ground-breaking solar energy solutions.
- **Case Study Development**: In these workshops, teams will work together to develop practical case studies that highlight the real-world potential and application of the pre-designs. This hands-on approach not only demonstrates the viability of these solutions but also provides valuable insights into their implementation challenges and opportunities.
- **Technical Insights**: A key feature of the workshops is the opportunity to receive direct input from technical partners regarding the capabilities and limitations of pre-designs. This guidance is crucial for refining concepts and aligning them with practical and technical realities.

5.4 Access to Pre-Designs

The SolarHub Acceleration Program provides participants with unparalleled access to pre-designs, which are foundational components designed to accelerate the pathway from research to commercialization. These pre-designs embody innovative solar energy solutions, offering a structured approach to overcoming the traditional barriers faced by research findings and technological innovations in reaching market readiness and scalability. Through integrating these pre-designs into the innovation ecosystem, the program not only fosters market-driven research but also enables participants to leverage cutting-edge advancements for practical application and development.

- **PD1 / Low Temp Solar Thermal Solution:** This pre-design offers a scalable solar thermal solution for low-temperature heat applications, utilising high-efficiency flat plate collectors. It's geared towards moderate temperature heat production and incorporates innovative materials and smart system controls, making it suitable for both agri-food and industrial applications.
- **PD2 / Hydrothermal Treatment:** Focused on the solar-aided hydrothermal treatment of agri-food residual products, this system uses solar heat to process agricultural and livestock waste into bio-oil and other valuable products. It features scalable reactors designed for effective processing, embodying a practical approach to waste management and resource recovery.
- **PD3 / PV for Power & Micro-Climate:** This pre-design involves a fixed-tilt structure with semi-transparent PV modules optimised for dual land use. It aims to produce energy while creating a microclimate for tree plants, protecting crops from extreme weather and optimising light management for agricultural productivity.
- **PD4 / Crop Production (Light + Water) PV:** Tailored for efficient crop production through controlled light and water management, this system utilises PV modules to adjust transparency and potentially modify the light spectrum. It enhances crop efficiency for

plants like tomatoes and peppers, demonstrating an innovative approach to maximising agricultural output and sustainability.

By offering access to these pre-designs, the program empowers participants to explore new ideas in solar energy applications, driving forward the development of solutions that meet the pressing demands of today's energy and environmental challenges.

How can you engage with the Pre-Designs?

Here's how research teams can work with and leverage these pre-designs:

- **Design Innovation**: Teams have the opportunity to design and develop missing components such as software, controllers, IoT devices, etc. This allows for the customization and enhancement of pre-designs, tailoring them to meet specific needs or to fill gaps in the market.
- **System Integration**: Pre-designs serve as a foundational framework upon which teams can build and integrate their unique systems. This process of system integration encourages the synthesis of new and existing technologies, creating more comprehensive and efficient solutions.
- **Design Enhancement**: Research teams are encouraged to offer suggestions and improvements to the current pre-designs. This collaborative feedback mechanism ensures the pre-designs remain cutting-edge and continuously evolve to meet emerging challenges and opportunities.
- **Creative Application**: The program invites teams to present original and innovative use cases that effectively leverage pre-designs in practical applications. This encourages out-of-the-box thinking and the exploration of novel approaches to utilizing solar energy solutions.
- **Freedom of Exploration**: While direct use of pre-designs is not mandatory, teams are encouraged to generate original ideas that may extend beyond the provided options and to consider how the applications or domains of the pre-designs might be incorporated into their solutions.

Value Proposition and Rationale

Access to pre-designs opens multiple possibilities for creativity and innovation within the solar energy sector. It encourages the development of diverse, impactful solutions by providing a structured pathway to commercialise research findings and technological innovations. This approach substitutes traditional pilot projects with a more streamlined route towards market adoption, focusing on scalability and practical applicability.

By exploiting these pre-designs, research teams can significantly accelerate their development timelines, enhance the technical and commercial viability of their solutions, and contribute to the broader innovation ecosystem in the solar energy sector.

5.5 Networking & Demo Day

Our networking component is designed to provide participants with ample opportunities to connect, collaborate, and showcase their innovative solar energy solutions to a broader audience, including potential investors and industry stakeholders.

- **Local Networking Workshops and Regional Collaboration:** At the heart of the program are **city-specific events** organized in key hub cities such as Ankara, Thessaloniki, Istanbul, Athens, and Izmir. These local networking workshops will be tailored to foster regional interactions and collaborations, enabling participants to engage directly with peers, experts, and potential partners within these strategic locations. The aim is to cultivate a vibrant community of innovators and entrepreneurs dedicated to advancing solar energy solutions across the region.
- **Matchmaking Opportunities:** Recognizing the importance of finding the right partners for project success, the program plans to offer access to matchmaking opportunities. This is intended to connect participants with potential partners for EU projects, thereby broadening the scope of their projects and facilitating collaborations across Europe.
- **Open Day Event (Dec 2024):** The culmination of the SolarHub Acceleration Program is the Open Day event, a significant networking opportunity that aligns with our annual meetings. This event is designed to showcase the startups within the consortium to a wider audience, including investors and key stakeholders in the solar energy sector. It offers a platform for direct interaction with potential investors, providing participants with a chance to present their progress, pitch their solutions, and engage in meaningful discussions aimed at fostering investment and collaboration.

Through these components, the SolarHub Acceleration Program aims to accelerate the development of innovative solar energy solutions and to build a strong, interconnected community that supports the growth and success of startups and researchers in the solar energy field.

6 Next Steps

6.1 Proposal preparation

1. If you are interested in applying, you must do it online through the F6S platform and answer all mandatory questions.
2. Be concrete and concise. Please carefully read this document and all relevant instructions.
3. A series of Info Webinars will be organised to present the opportunity. These will be announced through our website (https://horizonsolarhub.eu/), our LinkedIn account (https://www.linkedin.com/company/solarhubeu/) our F6S space and through our social media, so stay tuned.
4. It is highly recommended to submit your proposal well before the deadline. If the applicant discovers an error in the proposal, and provided the call deadline has not passed, the applicant may request from SolarHub Acceleration team to resubmit the proposal (for this purpose please contact us at s.dogrusoz@idi.ie . However, we cannot guarantee that resubmission in time will be feasible in case the request for resubmission is not received by our team at least 48 hours before the call deadline.

It is strongly recommended not to wait until the last minute to submit the proposal. Failure of the proposal to arrive in time for any reason, including network communications delays or working from multiple browsers or multiple browser windows, is not acceptable as an extenuating circumstance. The time of receipt of the application as recorded by the F6S submission system will be definitive.

6.2 Proposals reception

Submissions will be done ONLY via the F6S platform. A full list of proposers will be drafted containing their basic information for statistical purposes and clarity (which will be also shared with the European Commission for transparency reasons).

The application reception for **SolarHub Ignition Acceleration program** will close as indicated on **April 30, 2024,** at **17:00 CET.**

The application form template is available in ANNEX 1.

6.3 Language

English is the official language for SolarHub Calls. Submissions done in any other language will not be eligible and, thus, will not be evaluated. English is also the official language during the execution of the program.

6.4 Data protection

The proposals are confidential, and each person involved in the program outside our consortium, will sign a non-disclosure agreement (NDA). To process and evaluate applications, SolarHub will need to collect Data. SolarHub partners will act as Data Controllers of data submitted through the F6S platform for these purposes. The F6S platform's system design and operational procedures ensure that data is managed in compliance with the General Data Protection Regulation (EU) 2016/679 (GDPR). Each applicant will accept the F6S terms to ensure coverage. Please refer to https://www.f6s.com/privacy-policy to check F6S platform data privacy policy and security measures.

7 ANNEX 1 - Application Form Template

Application Form Questions for SolarHub Ignition Program

1. **Team and Organization Identification** *[Short text fields]*
    - Provide the names and roles of your team members.
    - Identify any associated R&D organisations or institutions.
2. **Technology Description** *[Paragraph Field < 2000 words]*
    - Describe your proposed technology or scientific discovery, focusing on its functionality rather than technical details.
3. **Uniqueness and Innovativeness** *[Paragraph Field < 2000 words]*
    - What makes your ideas unique or innovative? Describe its distinctive features or approaches.
4. **Development Status and Next Steps** *[Paragraph Field < 2000 words]*
    - Outline the current status of your innovation development.
    - List the main tasks required for the next stage of development.
5. **Scientific Field of the Project** *[Paragraph Field < 2000 words]*
    - Specify the scientific field or domain your project falls under.
6. **Sustainable Development Goals (SDGs)**
    - Which SDGs does your project aim to address? *[Check boxes for all SDGs]*
    - Explain how your project contributes to these goals. *[Paragraph <1000 words]*
7. **Intellectual Property (IP) Status**
    - Provide details on the current status of intellectual property related to your project. *[Paragraph field < 1000 words]*
8. **Involvement with Pre-Designs**
   Explain how you intend or envision using or incorporating our pre-designs into your solutions. *[Paragraph field < 2000 words]*
    - **Design Innovation**: If planning to design or develop missing components (e.g., software, controllers, IoT devices), describe your approach.
    - **System Integration**: Explain how you might utilize pre-designs as a foundation for your own systems.
    - **Design Enhancement**: Offer your ideas for improvements or modifications to the current pre-designs.
    - **Creative Application**: Present any original and innovative use cases that leverage the pre-designs effectively.
    - **Freedom of Exploration**: Describe any unique ideas you have that extend beyond the provided options, and how you plan to consider the applications or domains of the pre-designs in your solution.

8 ANNEX 2 - The Pre-Designs

8.1 PD1 - Solar Thermal solution for low temp heat applications

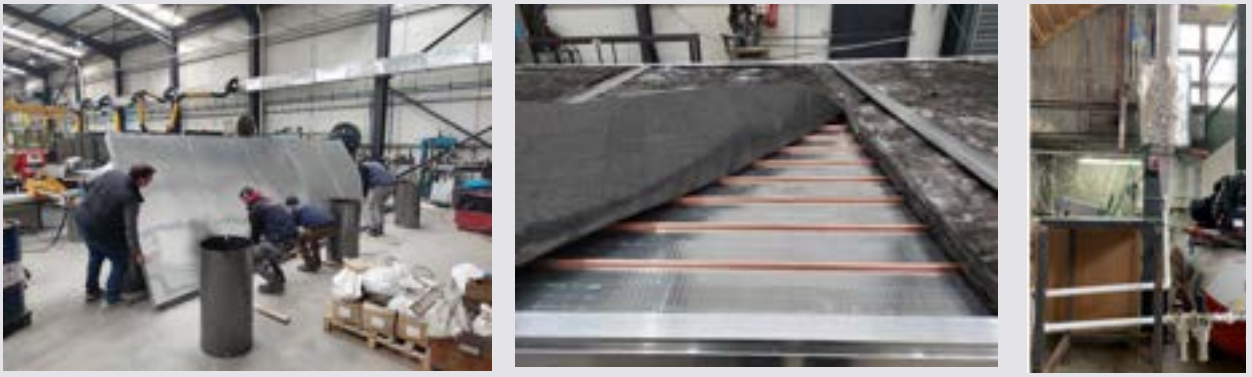


Figure 3: Solar thermal collector pilot construction phase & Laboratory test bed for the storage tank

Overview

This predesign consists of **4 items** and is composed of three pylons:

1. **High efficiency flat plate collectors** for heat production at 80-120°C utilising innovative materials and concepts. (PYLON 1)
2. **Low-cost Heat Storage tank**. Integrated heat storage based on low cost and abundant ceramic materials (PYLON 2)
3. **Smart System Control**. Integration of a smart system control for efficient energy management, specialised for agri-food and industrial applications (PYLON 3)
4. Cost and Dimensioning tool

Following the analytical description and the concept definition, a sample of the solar thermal collector will be constructed, validated and processed for certification. As parallel work, this predesign will also include a user-friendly calculation tool for the dimensioning of the system and for the cost efficiency (i.e. Levelized Cost of Heat).

Technical Description

Regarding the solar thermal collector, the concept is to design and construct a high efficiency solar thermal collector that will be able to produce heat in temperature level 80-120°C and will be used for industrial and agricultural applications. The solar thermal collector will have to fulfil the following requirements: High efficiency, Low heat capacity, High reliability, Modularity applicable for large scale systems (>50m^2), Dimensions that satisfy the requirements of high energy loads as well as transportation and logistics limitations, dimensions of the solar thermal collector that satisfy the means of transportation (trucks and containers Truck TIR: 13600x2400x2650mm, volume 86m^3, container 40ft: 12000x2350x2200mm, volume 62m^3).

Regarding the control system, the concept is to ensure that the production of heat is stable and satisfies the needs of the end user. The control will have to fulfil the following requirements: ensuring optimal system efficiency, reduction of maintenance costs and prevention of system failure. The control will utilise AI methods to achieve an autonomous and self-optimising solar thermal energy generation, through the data analysis of the system operation, the identification of patterns and anomalies and the planning of predictive maintenance actions.

Regarding the thermal storage tank for operating temperatures in 80-120°C, the considered technology includes a sensible heat storage system that will be based on low-cost, abundant ceramic materials. Waste materials directly coming from the Ceramics Industry will also be considered as candidate storage materials.

Regarding the tool, the concept is to calculate the levelized cost of heat (LCOH) and to dimension the system subcomponents, with the view to link the pre-design with the end users of the technology.

Potential Applications

The great market needs for high-efficiency solar thermal systems for heat production in the temperature range of 80-120°C seen in Greece, Türkiye and Europe, initiated the idea for this pre-design. Therefore, this pre-design addresses a scalable, replicable and efficient solar thermal system for low temperature heat applications for industries, including agri-food. The target is the partial substitution of conventional fossil fuel boilers and the decrease of the carbon footprint associated with the heat requirements.

Development Status

The development status per item is listed below:

Feb 2024	Development Status	Status
Pylon 1	Solar thermal collector	First pilot collector constructed to identify operational issues and implement construction improvements.
Pylon 2	Heat Storage tank	Building process of the simulation model.
Pylon 3	Smart System Control	Identification of system specifications.
Tool	Cost and Dimensioning	A preliminary version has been developed.

Performance Metrics

The KPIs identified for this predesign are shown in the table below.

	Description	**Means of verification**
KPI - 1	Solar thermal collector design	technical drawings and specifications
KPI - 2	Solar thermal collector construction	photos
KPI - 3	Solar thermal collector testing	Test report
KPI - 4	Solar thermal collector certification	Certification report

KPI - 5	Design of Smart Control System	Concept and Algorithm
KPI - 6	Development of efficient and low-cost ceramic materials for sensible TES	Simulation results
KPI - 7	LCOH & Dimensioning tool	Online tool

Challenges and Limitations

Challenges for Control i) Ensuring optimal system efficiency, ii) Reduction of maintenance costs and iii) Prevention of system failure. The control will utilise AI methods to achieve an autonomous and self-optimising solar thermal energy generation, through the data analysis of the system operation, the identification of patterns and anomalies and the planning of predictive maintenance actions.

The challenge is to successfully integrate all the three components (solar thermal collector, heat storage and smart system control) into a unique system that will provide renewable heat of low temperature for agricultural and industrial applications. This system will be accompanied by a dimensioning tool and a cost efficiency tool, to act as useful guidance for the installers and engineers and to act as dissemination and communication tool for the potential end users and stakeholders of this technology.

Collaborative Opportunities

Collaborative opportunities exist with:

- Control suppliers for the further development of the smart control subcomponent.
- Engineering, Procurement, Construction companies for the Pre-Design entrance to market.
- Solar specialist for further feedback about installation and maintenance procedures and requirements.

Partners Involved

- CRES: Centre for Renewable Energy Sources & Saving
- ODTU-GUNAM: Center for Solar Energy Research & Applications
- ITU: Istanbul Technical University
- SHE: Solar Heat Europe
- SAM: Sammler Solar Thermal Systems
- CERTH: Centre for Research & Technology Hellas, CPERI, ARTEMIS Lab

8.2 PD2 - Solar-Aided Hydrothermal Treatment solution for agri-food residual products

The pre-design of "**Solar-aided hydrothermal treatment solution for agri-food residual products**" aims to utilise different types of agri-food waste in the designed system by increasing its calorific value through the thermochemical conversion of the waste, mainly into bio-oil (alternatively, biocrude) and an aqueous phase used as a fertiliser, with the aid of concentrated solar energy and thermal energy storage.

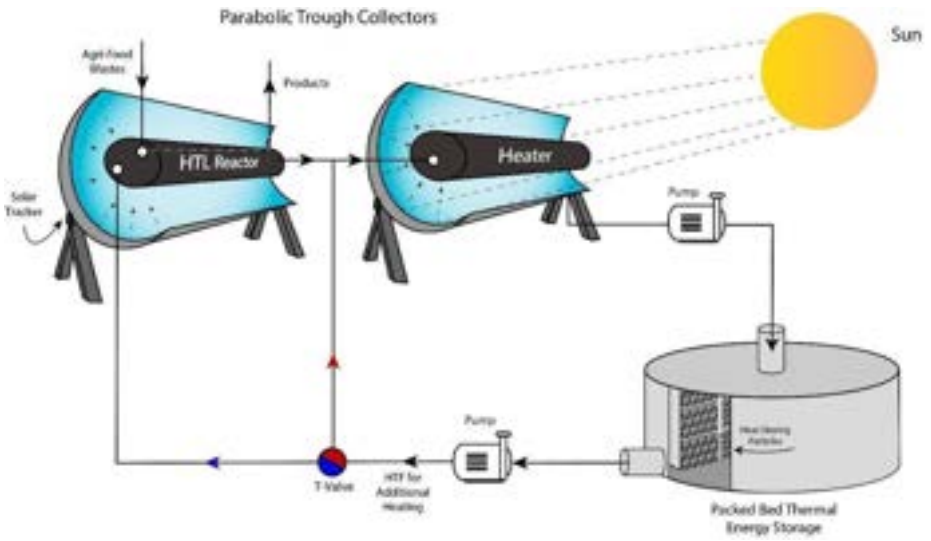


Figure 4: Representative sketch of the combined system of HTL reactor supported with parabolic trough collectors and packed bed thermal energy storage.

In countries with high agricultural activity like Türkiye and Greece, valorisation of the residual products generated by agricultural activities is crucial. This pre-design utilises four main components:

1. A Hydrothermal Liquefaction (HTL) reactor operating under high temperature and pressure conditions,

2. Parabolic trough collectors (PTCs) supplying the essential high temperature heat to supply thermal energy to HTL and thermal energy storage (TES),
3. A TES system ensuring continuous, prolonged operation during off-sun hours (whether night-time or cloudy days), and
4. An appropriate heat transfer fluid (HTF) circulating through these components to carry thermal energy. Overall, the proposed system will be designed to serve as a solution to handle different agri-food waste in any location with promising solar energy potential. One of the inherent advantages of such a system is the fact that it can operate in remote, off-grid areas. Products of the reaction can be used to produce sustainable and cleaner alternatives to fossil fuels while at the same time reducing the total waste produced.

Technical Description

HTL reactor is a pressure and temperature-resistant autoclave vessel that contains water and residual food biomass. It is used to mainly convert Agri-waste into bio-oil as well as other, added value by-products. It can operate in pressures of up to 350 bar and temperatures exceeding 400°C.

PTCs are parabolic mirrors that focus the sunlight onto its focal axis, which heats the HTL reactor and HTF in the system. Mirror size can be scaled depending on the required installation capacity.

HTF transfers the collected heat to the TES system for storage and later use. In this pre-design, a synthetic oil will be used as HTF, which fits well within the operation temperature range of 300-400°C.

TES stores the excess thermal energy generated by the PTC system during periods of high solar irradiation by elevating the temperature levels of the packed particles. In the design, ceramic particles that have high thermal conductivity and can withstand the high temperatures required for the system will be used.

Potential Applications

The pre-design addresses different users and markets by accommodating various feedstocks as inputs, allowing to effectively tackle the issue of seasonal variation in the waste. The pre-design market also includes the autoclave reactor (batch or continuous), solar collector, energy storage and heat transfer fluid. The final products are bio-oil (a viscous, oily phase that can be further upgraded into biofuels) and other valuable products, such as biochar (depending on the waste type and applied conditions), a gaseous phase rich in CH_4, CO and CO_2, as well as an aqueous phase mainly consisting of phosphates and nitrates (can be used as a fertiliser).

In a realisable scenario, stakeholders from the agriculture-food-beverage industry can implement this system into their production line where the agri-food waste is rejected; with the pre-design, they can turn their waste into added-value bio-oil and other useful products. For instance, they can use the bio-oil as a fuel or sell it to refineries, where it can be upgraded to biofuel, while the CH_4 of the gaseous phase can be directly combusted to cover part of the production line's thermal power needs

and the aqueous phase can be used as a fertiliser. Lastly, the resulting biochar (where applicable) can be used, among others, for soil amendment or as an asphalt additive.

Development Status

Various types of agri-food waste have been characterised and tested in laboratory-scale HTL reactors (heated both electrically and with artificial light in an in-house solar simulator), and the yield of feedstock to bio-oil has been obtained. A semi-pilot reactor coupled with modular PTCs has been built for testing. Also, another PTC is being constructed to couple with TES. Subsequently, the pre-design has been conceptually developed while technical performance characteristics were evaluated by numerical simulations. Possible waste options have been considered for feedstock and resulting products have been thoroughly characterised in the laboratories. A computer model has been developed to evaluate expected solar energy yield since location characteristics greatly impact both bio-oil production and TES design.

In the upcoming months, it is expected to optimise all systems conceptually as a single integrated combination and build a mobile agri-food waste valorisation platform that can operate on multiple locations employing different waste types. Moreover, there is an ongoing collaboration with WP2 (Task 2.3) Green Business Plan about the possible adoption and integration of the pre-design in the relevant markets considering the commercial needs.

Performance Metrics

Properties and compositions of the bio-oil need to be analysed to evaluate the performance of the system. The resulting characteristics of the bio-oil will be used to calculate the bio-oil yield, conversion efficiency, product composition, and heating value of the bio-oil (energy potential of the intermediate product prior to upgrading). After incorporating sustainability parameters into the process, such as total water consumption or process stability, the economic viability of the process and the sustainability of the design will be revealed.

Challenges and Limitations

A considerable capital investment and complex licensing processes are the main challenges the full implementation of the solar HTL technology has to face. Moreover, the concentrated solar thermal (CST) systems have a lower market penetration compared to photovoltaic (PV) systems, imposing another challenge to the technology implementation. The same applies to the required technical expertise and particularities, which in several cases is a major issue when it comes to CST systems. Last but not least, the current technology maturity can be considered as both a challenge and an opportunity, as one can elaborate on the advantages it offers to researchers and early investors.

The limited regulations and policies regarding waste management and products (e.g. bio-oil), can be stated as examples of the implementation barriers, requiring policymakers to take action. Another limiting factor is the intermittent nature of solar energy and the fluctuating weather conditions,

which can be effectively tackled through the introduction of robust TES systems that prolong the operational window of solar HTL systems.

Collaborative Opportunities

The agriculture-food-beverage industry can be interested in implementing the pre-design, and technology providers for HTL, PTC, TES, and HTF can also collaborate to improve the pre-design performance and/or lower the pre-design costs. Moreover, as an outcome of the regular meetings and discussions for the pre-design's Green Business Plan, a stakeholder list regarding Ankara that includes the companies in the solar thermal ecosystem, relevant non-governmental organisations, and public authorities is prepared. This list will be used to clarify the relationships and links between these organisations and specify the potential collaboration and partnership opportunities. A more detailed plan can be made after determining how these ecosystem stakeholders assess possible collaborations. Also, a market analysis outline is being developed, which will be implemented in the markets regarding this pre-design. Such methodology can also be followed in other ecosystem s as well.

References

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Partners Involved

- ODTU-GUNAM: Center for Solar Energy Research & Applications
- CERTH: Centre for Research & Technology Hellas, CPERI, ARTEMIS Lab
- SHE: Solar Heat Europe
- DLR: German Aerospace Center, Institute of Future Fuels
- Solimpeks Solar Energy

8.3 PD3 - Power Production & Micro-Climate Creation for tree plants PV

Figure 5: Photos of Agri-PV installations (BRITE)

This pre-design focuses on Agri-PV systems designed for both power generation and microclimate control for tree cultivation. It involves the use of semi-transparent solar panels that can adjust their transparency according to the required photosynthetically active radiation (PAR) levels necessary for achieving the highest possible crop yields.

Technical Description

This pre-design concerns a fixed tilt support structure of semi-transparent PV modules that can be installed in various fields cultivating a variety of crops, mainly tree plants (vines, tree peaches). A key characteristic of the design for achieving the balance of light and shadow is the utilization of semi-transparent modules. As the aim of the predesign is a commercial technical solution, a mature technology of PV cells (e.g. crystalline silicon cells) will be the first choice to adopt. The transparency of the modules will be achieved by appropriate spacing of the PV cells in customised PV modules. A Luminescence Shifting nanocoating material on the PV panels will yield an optimum glass panel for the crops in terms of PAR. The electrical design of the components of the PV system (inverters, wiring, protection equipment etc.) will be adapted to the characteristics that result from such non-standard design based on customised PV modules.

The mounting structure, which is required for the elevated installation of PVs over the crops, will be designed and dimensioned according to the crop type and its requirements. Particular attention will be given to ensure it provides protection from severe conditions such as frost, snow, and hail, while still allowing for unrestricted movement of both workers and machinery in the cultivation field. The utilization of support structures offers the opportunity for synergistic effects that can be achieved by the direct protection from extreme climatic effects through the PV panels themselves or by using the same supporting structures for other means of protection. Additionally, the structure will have the capability to collect and store rainwater for later use, at a time and quantity suitable for the crops under the canopy.

Potential Applications

By combining the agricultural production and the electricity production from solar photovoltaic panels on the same land (dual use of land), Agri-PV solutions may substantially increase land use efficiency, boost agricultural production by improving the micro-environmental conditions, and shield crops against extreme weather conditions as well as reduce water footprint. At the same time, agri-PV has the potential to contribute to the economic growth of the local community and the rural area development offering more job opportunities, diversification - and additional - income for farmers.

The aim of the pre-design is a commercial technical solution, based on mature PV technologies, ready for application in the agricultural sector.

Development Status

The activities under development concern

- the collection of information regarding the requirements of the crops under study, which affect the requirements of the Agri-PV system,
- an initial design and identification of key parameters regarding the mounting structure dimensions, spacing of PV modules, transparency level etc.
- the development of S/W tools, for calculations and optimization of the design, e.g. models for the simulation of the irradiation levels underneath the Agri-PV system and tools for the financial assessment of the system

Performance Metrics

The KPIs identified for this predesign are shown in the table below.

KPI	Description	Target Value
KPI-1	Crop production index: the average annual crop production per unit of area of the designed Agri-PV system, compared to the production of a piece of land without the PV system.	Minimum value 90%
KPI-2	Solar energy production index: the annual energy yield per installed power (in kWh/kWp) of the designed PV system compared to the value of a fixed tilt PV system designed for optimum energy yield	Minimum value 90%
KPI-3	Cost index: the cost of installation per unit of installed power (in €/kWp) of the Agri-PV system, compared to the cost of a conventional PV system	Maximum value 170%

Challenges and Limitations

Given the early stage of Agri-PV development, key issues such as microclimate effects, especially shading on crop productivity, are still largely unexplored. The effect of the agri-PV system on the productivity of the selected crop is probably the most determinant factor for the success of the technical solution under development. This effect depends both on the crop species and the local climatic conditions.

This SolarHub project's Agri-PV pre-design prioritizes validating the installation's impact on crop yield, aiming to minimize negative effects and ideally create a positive impact. This validation will rely on data from small pilot plants in similar conditions and simulations to calculate irradiation changes beneath the agri-PV array.

Collaborative Opportunities

Collaborative opportunities exist with:

- Experts and scientists with a good knowledge on requirements of the crops under study, e.g. in terms of agricultural practices, as well as on the effect of microclimate factors on the crops' productivity.
- Developers of S/W and models for the simulation of the shading effects and reduction of irradiation levels underneath the Agri-PV system, and on the financial assessment of the Agri-PV investment.

Partners Involved

- CRES - Centre for Renewable Energy Sources & Saving
- GUNAM – ODTU - Center for Solar Energy Research & Applications
- BRITE - Brite Solar Hellas
- VENUS - Venus Growers
- TAT - Tat Food

8.4 PD4 - Efficient Crop Production through Light and Water Management PV

The pre-design consists of four key components:

- Development of a scalable and replicable AgriPV system tailored for crops such as tomatoes, peppers, berries, and grapevines, focusing on enhancing efficiency through light and shading control.
- Engineering adjustments to the intensity and spectrum of light reaching the crops based on their specific requirements. Fine-tuning the transparency of PV modules and the overall system to manage shading. This involves modifying the light spectrum to optimize crop efficiency (e.g., coloring PV modules to convert the light spectrum into a more beneficial form for crops).
- Implementation of a rainwater collection and storage system integrated with the PV modules to support crop irrigation.
- Enhancements of a digital platform for monitoring weather and soil conditions using various sensors.

Following the comprehensive definition of the pre-design, the general concepts and technical details will be fully elaborated. Subsequently, a small test unit consisting of 50 modules will be constructed for research and development purposes. This step aims to validate the technical success and feasibility of the pre-design before scaling up for larger implementations.

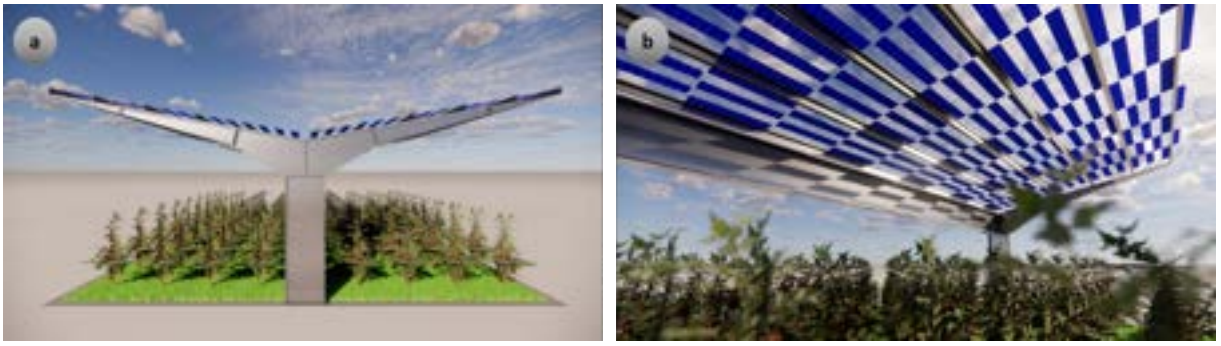

Figure 6: The overall view (a) and bottom view (b) of the Agri voltaic system pre-design.

Technical Description

The pre-design of the scalable and replicable AgriPV system for efficient crop production through light and water management involves a systematic approach integrating various methodologies and tools. The following technical processes to achieve the desired outcomes are as follows:

- **Requirements Analysis**: Conducting a comprehensive analysis of crop production requirements, focusing on tomatoes, peppers, berries, and grapevines. This analysis includes studying specific light intensity and spectrum requirements for each crop, considering growth stage, photosynthetic efficiency, and light response.

- **System Design and Simulations**: Designing the AgriPV system based on requirements analysis, with PV modules central to providing light and shading control. Modules with adjustable transparency for precise shading control, and engineering modifications will be developed to explore enhancing crop efficiency through light spectrum modification. Simulations and modelling techniques will assess system performance and optimise design, evaluating the impact of light and shading control on crop growth.
- **Prototyping and Experiments**: Establishing a small-scale test unit comprising a minimum of 50 PV modules to validate technical success and feasibility. Collaboratively installing and monitoring the test unit under different light and shading conditions will provide insights for fine-tuning system design and improving efficiency.
- **Sensor Integration and Data Monitoring**: Integrating sensors within the AgriPV system to monitor weather conditions, soil moisture, and other parameters critical for crop management. Sensor technologies and digital platforms for real-time monitoring and analysis of environmental conditions, automating irrigation processes, and optimising water management will be designed.
- **Surveys and Feedback**: Conducting surveys and gathering feedback from farmers and agricultural stakeholders to assess the practicality, acceptance, and potential challenges of the AgriPV system.
- **Continuous Improvement and Feasibility Assessment**: Continually refining and improving the pre-design based on experimental results, simulations, and feedback. Assessing feasibility for system implementation within the farming community, considering economic viability, scalability, and regulatory compliance.

Potential Applications

- **Target Industry/Sector:** The growing global demand for sustainable agriculture highlights the need to assess the market size and potential of AgriPV systems within SolarHub ecosystems, offering dual benefits of enhanced crop production and renewable energy utilization. By integrating land for both energy generation and food production, this pre-design presents a promising business opportunity for farmers and stakeholders, with scalability to suit various agricultural settings.
- **Use Case Scenarios:** Some potential real-world applications and scenarios where the pre-design of AgriPV systems can be utilized are as follows:
    - ***Crop Farming:*** AgriPV systems can be integrated into crop farming operations, such as fields growing vegetables, fruits, or grains. The systems can provide both renewable energy for irrigation and other agricultural needs while also shading crops to reduce heat stress and improve yield [1].
    - ***Vineyards and Orchards:*** Vineyard and orchard owners can benefit from AgriPV systems by installing them along the rows of vines or trees. The panels can generate electricity to power irrigation systems and equipment while also providing shade to protect delicate fruits from sun damage [2].

- ***Livestock Farming:*** AgriPV systems can be used in livestock farming operations to provide renewable energy for barns, feeding equipment, and other facilities. The panels can also serve as shade structures for animals, helping to keep them cool during hot weather [3].
- ***Aquaculture:*** In aquaculture operations such as fish farms or shrimp ponds, AgriPV systems can be installed above the water surface to provide shade and generate renewable energy for pumps and aeration systems [4].
- ***Greenhouses:*** AgriPV systems can be integrated into greenhouse structures to provide renewable energy for heating, ventilation, and lighting while also shading plants to regulate temperature and humidity levels [5].
- ***Rural Communities:*** AgriPV systems can be deployed in rural communities to provide renewable energy for off-grid electricity needs, such as powering homes, schools, and community centres. The systems can also support local agriculture by providing shade and energy for irrigation [6].
- ***Urban Agriculture:*** In urban environments, AgriPV systems can be installed on rooftops or in vertical farming facilities to maximise space utilisation and provide renewable energy for indoor farming operations [7].
- ***Remote Areas:*** AgriPV systems can be deployed in remote or off-grid areas to provide sustainable energy solutions for agricultural activities, helping to improve food security and economic development in these regions [8].

Overall, the versatility of AgriPV systems allows for a wide range of applications across various agricultural settings, providing renewable energy solutions while also supporting crop growth and farm productivity.

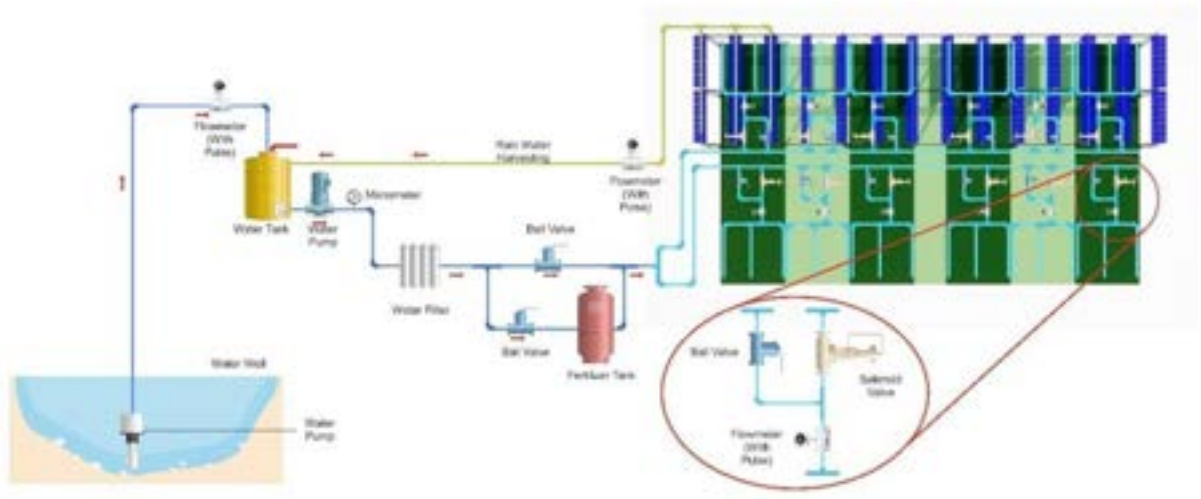

Figure 7: A schematic diagram representing the irrigation system design and system equipment

Development Status

Within the scope of the project, necessary conditions, including PAR values, were identified for the cultivation of different crops in three regions of Türkiye (Marmara, Central Anatolia, and Aegean Regions). Shade analyses started to be conducted for different panel designs. Sensors to be used in

an AgriPV system design were determined, and work began on the software that will interpret the data from these sensors. Discussions were held with other stakeholders regarding control algorithms for this software, tailored to both stationary and tracking systems. Furthermore, literature reviews were conducted on rainwater harvesting. Drawings and designs for the solar power plant were completed, with the inclusion of a rainwater harvesting system in these designs. Various panel designs were also implemented.

Performance Metrics

Performance metrics for the AgriPV system include energy generation, crop yield, water use efficiency, land use efficiency, economic viability, environmental impact, and system reliability and durability.

Challenges and Limitations

Despite the potential benefits, AgriPV systems face several challenges and limitations. One major challenge is the need to balance the competing demands of solar energy production and agricultural productivity, as shading from solar panels can affect crop growth. Additionally, the upfront costs of implementing AgriPV systems can be prohibitive for some farmers, especially small-scale operators with limited financial resources. Furthermore, technical considerations such as system design, maintenance, and compatibility with existing agricultural practices pose significant challenges. Addressing these challenges and finding innovative solutions will be critical to the widespread adoption and success of the projects.

Collaborative Opportunities

Opportunities for collaboration or partnership in the further development of the project include engaging with academic institutions, research organizations, and industry stakeholders to advance technological innovation and enhance system efficiency. Additionally, forming partnerships with agricultural communities, government agencies, and renewable energy companies can facilitate the widespread adoption and implementation of AgriPV solutions, thereby contributing to sustainable agricultural practices and energy production.

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Partners Involved

- GUNAM – ODTU - Center for Solar Energy Research & Applications
- TAGEM - Ministry of Agriculture And Forestry, Türkiye
- EGE – Ege University
- KALPV - Kalyon PV
- CRES - Centre for Renewable Energy Sources & Saving
- BRITE - Brite Solar Hellas
- TAT - Tat Food

9 ANNEX 3: MoU Template

Below is a template for a simple Memorandum of Understanding (MoU) designed for startups outside Greece or Türkiye that need to establish a business collaboration with an entity within these countries as part of their application to the SolarHub Acceleration Program.

A word file of this template can be downloaded here.

Collaboration Agreement for SolarHub Acceleration Program Participation

Establishing a Framework for Business Collaboration

Between

[Start-up Name],
[Start-up Address],
[Country of Origin]

And

[Partner Entity Name],
[Partner Entity Address],
[Greece/Türkiye]

1. Introduction

1.1. This Memorandum of Understanding (MoU) is made on [Insert Date] between [Start-up Name], hereinafter referred to as the "Start-up", and [Partner Entity Name], hereinafter referred to as the "Partner", collectively known as the "Parties".

1.2. The purpose of this MoU is to establish a framework of collaboration between the Parties to support the Start-up's participation in the SolarHub Acceleration Program, particularly focusing on [specify area of collaboration, e.g., technological development, market research, etc.].

2. Objectives

2.1. The primary objectives of this MoU are to:

2.2. Facilitate the Start-up's entry and participation in the SolarHub Acceleration Program.

2.3. Outline the responsibilities and contributions of each Party towards the collaborative project.

2.4. Support the development and commercialization of [specify technology/product/service] in the solar energy sector.

3. Scope of Collaboration

3.1. The Parties agree to collaborate in areas including, but not limited to:

- Joint research and development activities.
- Sharing of knowledge, resources, and facilities related to solar energy.
- Market analysis and entry strategies in Greece/Türkiye.
- Any other activities that are mutually agreed upon to further the objectives of this MoU.

4. Responsibilities of the Parties

4.1. Start-up's Responsibilities:

- Provide detailed project proposals and necessary documentation for SolarHub Acceleration Program application.
- Lead the development of the [technology/product/service], incorporating inputs and feedback from the Partner.

4.2. Partner's Responsibilities:

- Assist the Startup in understanding the Greek/Turkish market, including regulations, customer preferences, and business culture.
- Provide access to local networks, including potential clients, partners, and industry experts.

5. Intellectual Property and Confidentiality

5.1. The Parties agree to respect each other's intellectual property rights and ensure that any shared knowledge or technology is protected under the applicable laws.

5.2. Confidential information exchanged during this collaboration must be kept secure and not disclosed to third parties without prior written consent from the disclosing Party.

6. Term and Termination

6.1. This MoU is effective from [Insert Start Date] and will remain in effect until [Insert End Date] unless terminated earlier by mutual agreement of the Parties.

6.2. Either Party may terminate this MoU with [Insert Notice Period, e.g., 30 days] written notice to the other Party.

7. Amendments

7.1. Any amendments to this MoU must be made in writing and signed by authorized representatives of both Parties.

Signatures

This MoU is signed on the date first written above:

For [Start-up Name]:	For [Partner Entity Name]:
Name:	Name:
Title:	Title:
Signature:	Signature:
Date:	Date:

Appendix: [Optional]

Include any additional documents or annexes that are part of this MoU, such as project proposals, detailed plans of collaboration, etc.