Publishable summary - M12

1.1. Summary description of project context and objectives

Today's challenges in PV

Photovoltaics (PV) is one of the most promising renewable energy technologies for Europe. In fact, PV is now, after hydro and wind power, the third most important renewable energy source in terms of global installed capacity. PV can significantly contribute in achieving the EU's 20-20-20 climate change objectives, as well as to the longer term goal of reducing greenhouse gas emissions by 80-95%, as targeted in the European Energy Roadmap 2050.
In that purpose, the European Commission has challenged the PV industry to set new, ambitious targets for 2020 as part of the Commission's Strategic Energy Technology (SET) – Plan. For this purpose the Solar Europe Industrial Initiative (SEII) and the European Energy Research Alliance Photovoltaics Joint Research Programme (EERA-PV) were launched in 2010.

The CHEETAH project is directly linked to the EERA-PV Joint Research Program, which aims to increase the effectiveness and efficiency of PV R&D through alignment and joint programming of R&D of its member institutes, and to contribute to the R&D-needs of the Solar Europe Industry Initiative.
CHEETAH R&D will specifically support Pillar A (performance enhancement & energy cost reduction) of the SEII Implementation Plan (*http://www.eupvplatform.org/*)

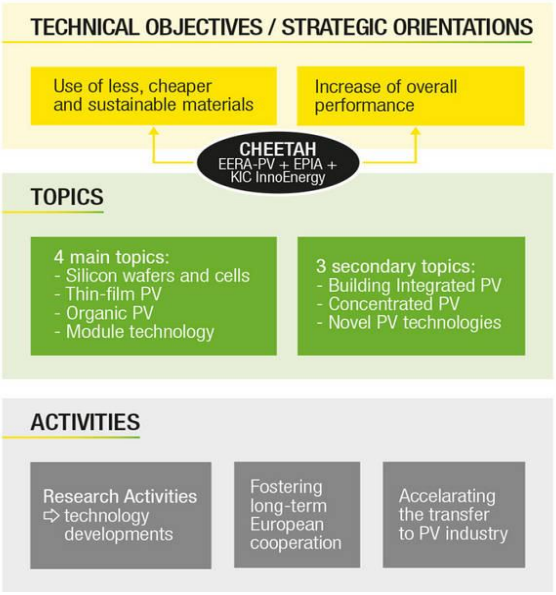
Objectives

The CHEETAH objectives are threefold:

Developing new concepts and technologies for wafer-based crystalline silicon PV (modules with ultrathin cells), thin-film PV (advanced light management) and organic PV (very low-cost barriers), resulting in (strongly) reduced cost of environmentally benign/abundant/non-toxic materials and increased module performance.

Fostering long-term European cooperation in the PV R&D sector, by sharing knowledge, organizing workshops, exchanging and training researchers inside and outside Europe, providing efficient use of infrastructures, promoting best practices and standards. This is promoted through Joint Support Activities.

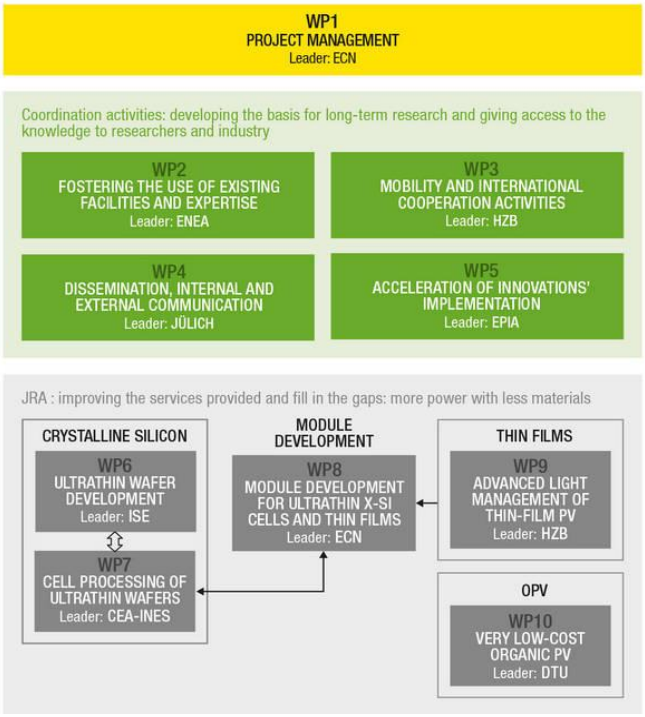
Accelerating the implementation of innovative technologies in the PV industry, by a strong involvement of EPIA and EIT-KIC InnoEnergy in this program. This is promoted through Joint Support Activities.



1.2. Description of the work performed since the beginning of the project

The Cheetah project is structured around two blocks of activities:

- **Coordination activities** (CSA): developing the basis for long-term research and giving access to the knowledge to researchers and industry (WP2,3,4,5)
- **Joint research activities** (JRA): improving the services provided and fill in the gaps: more power with less materials (WP6,7,8,9,10)



In the first year of the project, the following work was performed:

Coordination activities (WP2-5)

- Collection of available expertise/Research infrastructure, identification of technical-scientific needs of European PV RTD Sector at project partners via questionnaire/inventories;
- Developing ICT tools to improve effectiveness of the collection and dissemination of the information and its management;
- Definition of the overall strategy for mobility, education, industry collaboration and internationalization;
- Organization of first exchanges, summer schools training workshops;
- launching of a project website and creation of the identity set;
- Definition of strategies to reinforce the project's outreach of market uptake.

Joint research activities (WP6-10)

- X-Si (WP6-8)
    - Development of processes to produce ultrathin wafers as well as the definition of electronic and mechanical properties of ultrathin wafers;
    - Definition of the requirements for fabrication of high efficiency cells and modelling of ideal solar cell structure reaching target efficiencies of 23 % ;
    - Definition of requirements and specifications of module components in relation to the wafers and cell requirements.

- Thin films (WP9)
    - Startup of R&D on three novel approaches (incl. device fabrication, modeling and analyses) on light management nano-patterning/nano-structuring, flat grating structures and monolithic micro-concentrator cells for thin films Silicon and CIGS/CZTS solar cells.

- OPV (WP10)
    - Building a database for materials and characterization tools in an online platform, syntheses of (two) stable materials, production of OPV devices with various architectures for improved lifetime preliminary round robin characterization of a number of active materials and devices.

1.3. Description of main results so far

Coordination activities (WP2-5)

- Launch of the project website, the project identity set, a press release, newsletters for mobility and education activities and dissemination purposes
- Establishment of an open CHEETAH knowledge sharing web area containing a large database of available expertise, research infrastructure and a complete e-learning platform to offer lectures, courses and remote on-line experiments, on-line forum/fora and on-line poll to foster any internal/external technical/scientific discussions on specific themes
- Researcher exchange was successfully launched (22 internal, 2 to industry)
- Establishment of international links (NREL, NEDO) and with IEA PVPS Task 13 to share knowledge and build up a relationship for international cooperation

Joint research activities (WP6-10)

- Fabrication of 450 wafers with a thickness of 117 +/- 30 micrometer and distributed to WP7 and WP8 partners for further cell and modules assembly (WP6)
- Fabrication of 250 wafers, highly doped, of ~500 µm thickness for porosification delivered (WP6)
- The specifications for ultra-thin wafers, cells and modules have been finalised by WP6,7 and 8 and summarised to ensure the compatibility of the wafer fabrication, the solar cell processing and the module integration (WP6,7,8)
- Detailed simulations on IBC-HIT cells using Silvaco software have been done resulting in a comprehensive report on the ideal IBC-HIT cell architecture on thin and ultrathin substrates (WP7)
- Successful application of a testing method to evaluate module integration of thin metallized wafers, i.e. a method to detect damage in the metallization as a result of module processing (WP8)
- Several advanced thin films device structure (double, triple junctions with textures) and light management strategies (FIB nanomachning, concentrator designs) have been investigated in the first year supported by an advanced modelling and characterization platform (WP9)
- Online platform for knowledge and sample exchange and database for materials and characterization tools was created (WP10)
- Two stable photoactive polymers were successfully synthesized and integrated in devices with different architectures and investigated in comparative lifetime tests performed by all the partners (WP10).

1.4. The expected final results and their potential impact and use

As mentioned under the objectives, the technology developments within CHEETAH should lead to the realization of innovative and competitive PV concepts with a significant reduction in cost of materials and increase of the overall performance. These innovative developments should lead to a contribution to an accelerated implementation in the European PV industry, so that Europe can regain and build up own manufacturing capacity in all parts of the value chain in due time.

In addition, the establishment of an effective collaborative platform for the PV R&D sector via the coordinative support actions in CHEETAH will help Europe in realizing these goals.

1.5. Consortium and contact information

Coordinator

Dr. Jan Kroon, ECN, j.kroon@ecn.nl
www.cheetah-project.eu/

Partners

1. ECN, Stichting energieonderzoek Centrum Nederland, Netherlands
2. CEA-INES, Commissariat à l'énergie atomique et aux énergies alternatives, France
3. Fraunhofer, Fraunhofer Gesellschaft zur Foerderung der angewandten forschung e.v, Germany
4. DTU, Danmarks Tekniske Universitet, Denmark
5. Helmholtz-Zentrum Be, Helmholtz-Zentrum Berlin fur materialien une energie GmbH, Germany
6. Jülich, Forschungszentrum Juelich GmbH, Germany
7. AIT, Austrian Institute of Technology GmbH, Austria
8. ENEA, Agencia Nazionale per le nuove technologi, l'energia e lo svilippo economico sostenibile, Italy
9. EPFL, Ecole Polythechnique Fédérale de Lausanne, Switzerland
10. IFE, Institutt for Energiteknikk, Norway
11. Forschungsverbund Be, Forschungsverbund Berlin E.V, Germany
12. IMEC, Interuniversitair Micro-electronica Centrum VZW, Belgium
13. NPL, NPL Management Limited, United Kingdom
14. SINTEF, Stiftelsen SINTEF, Norway
15. Tallinna Tehnikaulik, Estonia
16. ZSW, Zentrum for Sonnenenergie und Wasserstoff Forschung Baden Wurttembergstiftung, Germany
17. LNEG, Laboratorio Nacional de Energia e Geologia I.P, Portugal
18. TOR VERGATA, universita Degli Studi di Roma Torvergata, Italy
19. METU, Middle East Technical University, Turkey
20. TECHNALIA, Fundacion Technalia Research & Innovation, Spain

21. UPM, Universidad Politecnica de Madrid, Spain
22. CENTRO DE INVESTIGAC, Centro de Investigaciones Energeticas, Medioambbientles y Technologicas CIEMAT
23. CRES, Center for Renewable Energy Sources and Savings, Greece
24. LU, Loughborough University, United Kingdom
25. EMPA, Eidgenoessische Materialpruefungs und Forschungsanstalt, Switzerland
26. Imperial, Imperial College of Science, Technology and Medicine, United Kingdom
27. JRC, Joint Research Centre - European Commission, Belgium
28. TUBITAK, Turkiye Bilimsel ve Teknolojik Arastirma Kurumu, Turkey
29. VTT, Teknologian Tutkimuskeskus VTT, Finland
30. UPVLC, Universitat Politecnica de Valencia, Spain
31. UNIMIB, Universita' Degli Studi di Milano-Bicocca, Italy
32. EPIA, European photovoltaic Industry Association, Belgium
33. KIC SE, KIC Innoenergy SE, Netherlands
34. Alma Consulting Group SAS, France

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