European Commission

Leadership in renewables

Solar photovoltaic (PV): the impact of EU R&D funding

Bioenergy | Biofuels | Geothermal | Hydropower | Ocean | **Solar PV** | Solar thermal | Wind

OBJECTIVES

A comprehensive study of solar PV research and development (R&D) support within the EU over the past 20 years

1. Identify the impact of EU R&D support of the solar PV sector
2. Understand how the solar PV sector has developed

METHODOLOGY

EFFECTIVE DATA COLLECTION ACTIVITIES USING A RANGE OF METHODS

- DATA FROM EXISTING DATABASES
- STAKEHOLDER QUESTIONNAIRE
- CASE STUDIES
- EXPERT INTERVIEWS
- LITERATURE REVIEW

KEY FIGURES: FUNDING OF R&D

EU Framework Programmes funding

- **462** solar PV projects funded through the Framework Programmes (FP5-Horizon 2020) for solar PV
- **€800 m** EU funding through the Framework Programmes (FP5-Horizon 2020) for solar PV
- **21 %** of funding to thin film technologies, making it the most funded solar PV energy R&D topic

Member State funding

- **€200 m** R&D budget grew from an average of €100 m per year (1995-2004) to over €200 m per year (2011-2016)
- **Top 5** 1. Germany 2. France 3. Netherlands 4. Italy 5. UK
- **79 %** of Member State solar PV funding is from the top 5 Member States

International funding

Funding from the EU region for solar PV technologies is larger than that in other countries, with spending at an average of €180 m per year between 1998 and 2015. The USA provided €123 m on average between 1995 and 2015, followed by Japan which provided €83 m on average.

IMPACT ON KNOWLEDGE GENERATION

Patents

EU share of global patents has declined from 17 % in 2000 to 4 % in 2014

The number of EU patents filed grew from less than 500 per year in the early 2000s to approximately 1 800 per year between 2009 and 2011

From 2012 onwards, EU patents average 1 100 per year

Publications

EU-based authors were involved in 25 % of the global publications between 1995 and 2017, making it the global leader (followed closely by China and the USA)

Additional impacts

EU funding contributed to the development of several new technologies (e.g. organic PV, multi-junction cells and concentrated photovoltaics (CPV)).

EU funding contributed to cost reductions of crystalline silicon and thin-film technologies through the exploration of new materials and improved manufacturing processes

IMPACT ON SECTOR DEVELOPMENT

- **107 000 MW** installed capacity for electricity in 2017, growing from 600 MW in 2003 — Installed capacity
- **3.6 %** net electricity production from solar PV in 2017 — EU electricity
- **€5 billion** average exports per year (2011-2015) to the rest of the world — Exports
- **€11 billion** EU solar PV industry turnover in 2016 — Turnover
- **100 000** people employed in the EU solar PV sector in 2016 — Jobs
- Less than **€1 000** per kW in 2017, reducing from €3 000 in 2008 (capital expenditure (capex) – utility scale) — Solar PV cost

EXAMPLES OF IMPACT FROM R&D PROJECTS

High efficiency rear contact solar cells and ultra-powerful modules (HERCULES)

- An FP7 project that made significant advances in PV technologies to reach ultra-high efficiencies with industrially relevant processes
- The project developed large-area, bifacial silicon-heterojunction (SHJ) and interdigitated back contact (IBC) solar cells with 23 % and 24 % efficiencies (respectively) at laboratory scale. The project partners, CEA and Meyer Burger, built SHJ pilot lines with a production capacity of 2 400 wafers per hour, demonstrating the feasibility to reach industrial-scale production. The project also demonstrated important cost reductions (at the time down to EUR 0.4/W) for both technologies, showing that ultra-high efficiency devices were cost-competitive
- The project paved the way for the next generation of crystalline silicon-based PV technology. The key results are being brought towards industrial production, supported by H2020 projects AMPERE and Next-Base, with high expectations of regaining large-scale PV manufacturing in Europe

Production technology to achieve low Cost and Highly Efficient phOtovoltaic Perovskite Solar cells (CHEOPS)

- An ongoing H2020 project developing very high-performance/low-cost PV devices based on emerging perovskite technology
- The project has achieved an efficiency of 25.2 % with silicon and perovskite-based tandem cells and demonstrated how the efficiency could increase to over 30 %. It developed a cost-efficient and simple production process – compatible with existing manufacturing lines – integrating a perovskite cell directly on top of a standard silicon-based cell. It also introduced a unified standard for measuring and testing perovskite-based PV devices to strengthen reliability and comparability
- The project partner, Oxford PV, and its subsidiary, Oxford PV Germany, received €15 million financing from the European Investment Bank in 2017. This is to support the transfer of the perovskite technology from laboratory to industrial-scale manufacturing, fostering the EU technology leadership in the field