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PV MODULE LIFE TIME FORECAST AND EVALUATION

Photovoltaic Life Time Forecast and Evaluation
A Marie Sklodowska Curie (MSCA) Project SOLAR-TRAIN

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INTRODUCTION

- SOLAR-TRAIN is a Marie Sklodowska-Curie (MSCA) Innovative Training Network (ITN)
- It brings together 14 international, multi-disciplinary early stage researchers (ESR) to work towards the common goal of "Photovoltaic Life Time Forecast and Evaluation"
- ESRs are hosted by a consortium of eight research institutions, universities and companies with the support of 10 partner organizations
- More information on the project and results: www.solar-train.eu

PHOTOVOLTAIC LIFE TIME FORECAST AND EVALUATION

Motivation

- Enhance quality assurance in the photovoltaic industry by underpinning science and trained personnel
- Gain a profound understanding of degradation factors and their implication on energy yield over life time
- Reduce costs of energy

Objectives

- Develop novel and validated models for service life time and energy prediction of PV modules and systems
- Enable a scientific assessment of the triangle quality, durability and costs

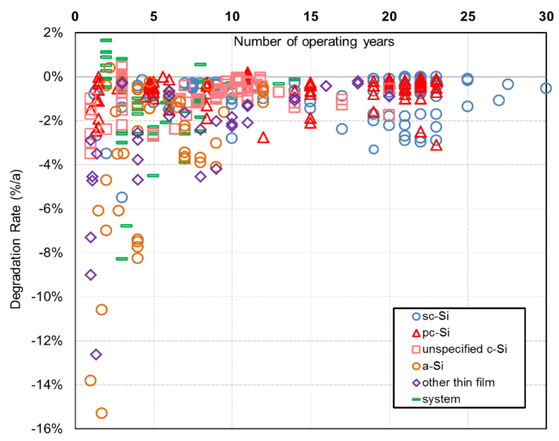

Fig. 1: Annual degradation rates of different PV technologies. Source: Loughborough University

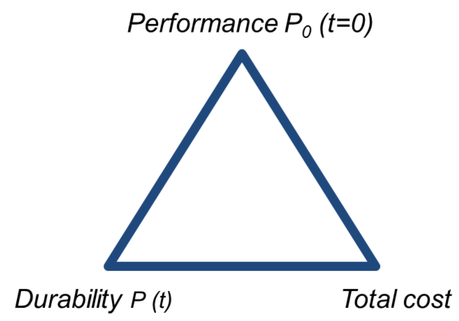

Fig. 2: Interdependency quaility, cost, durability

DIFFERENT TOPICS BEING ADDRESSED

SOLAR-TRAIN approach

- To achieve the main objective of the project "photovoltaic life time forecast and evaluation ", different topics are being addressed;

(1) Climatic degradation factors
(2) Analysis of degradation and failure modes of PV modules
(3) Evaluation of polymeric materials in PV modules
(4) Service lifetime prediction for PV modules and systems and related economic impact

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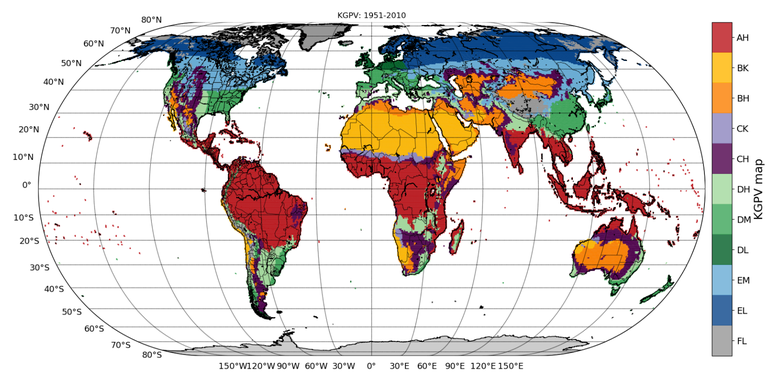
FIRST RESULTS

Work is progressing in all the different addressed sub-topics of the project. For example:

Climatic classification

- A new global climate classification is being developed by integrating Köppen-Geiger classification and irradiation maps



Legend Map

Main Climates
Arid (A), Desert (B), Steppe (C), Temperate (D), Snow (E), Polar (F)

Irradiation levels
Very High (K), High (H), Medium (M), Low (L)

Fig. 3: Proposed Solar-train classification

Encapsulant analysis

- Influence of EVA thickness on the photodegradation process after UV radiation tests
- Evaluation of the encapsulant discoloration and optical properties
- Investigation of hydrolysis kinetics of the polymeric layers after Damp Heat

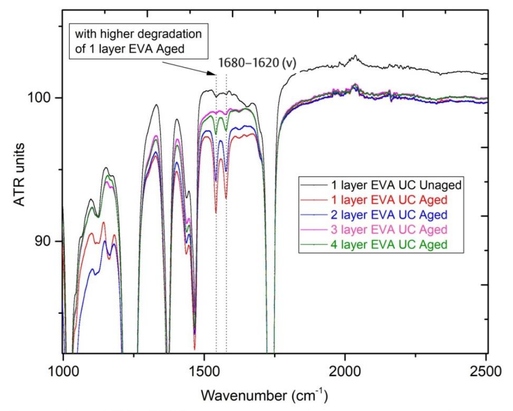


Fig. 4 : ATR-FTIR spectra of bottom surface of EVAs (in Glass-BSF configuration) before and after short time exposure upon pure UV radiation (75 kWh/cm2)

Service lifetime prediction

- Application of statistical analysis methods to extract reliable long-term performance loss indicators
- PR, P, I_{mpp} and V_{mpp} of 26 PV systems (8 technologies), in operation since 2010, was investigated
- Interdependencies between parameters

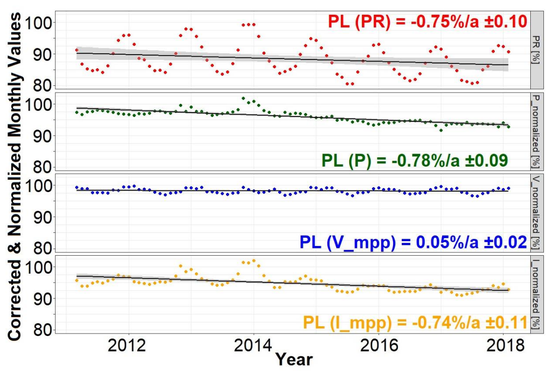


Fig. 5 : Corrected & normalized monthly mean values of a mc-Si-system with regression line of STL (seasonal-trend decompositon using LOESS) trend

- A power-output analytical degradation model is being developed at module level and on long term degradation modes

Climatic Zones	Degration rate (%/year)	Failure time (years)
Negev	0.10193	9.3
Gran Canaria	0.03983	17.0
Freiburg	0.02974	20.5

Table.1 : Shows the degradation rates and failure time of a PV module simulated for three climatic zones

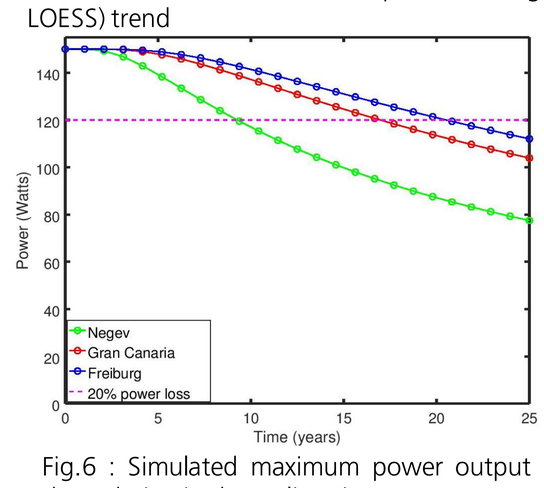


Fig.6 : Simulated maximum power output degradation in three climatic zones

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