
“El papel de Fraunhofer Chile en la escena fotovoltaica”

Fraunhofer Center for Solar Energy Technologies CSET

- Challenges and Solutions for PV Plants



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9 November 2018

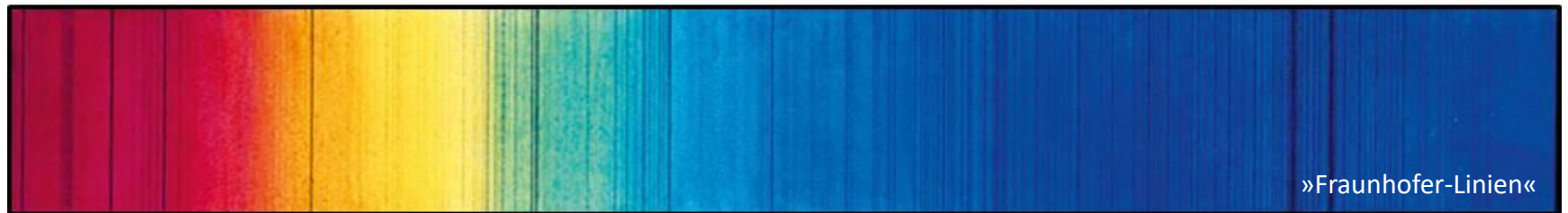
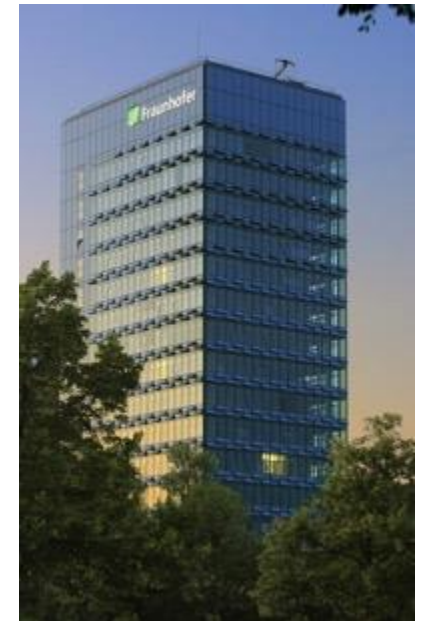
Florianópolis, Brazil

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The Fraunhofer-Gesellschaft

Largest Organization for Applied Research in Europe

- 67 institutes and research units
- Staff of more than 23 000
- € 2 billion annual research budget totaling
 - Roughly two thirds of this sum is generated through contract research on behalf of industry and publicly funded research projects
 - Roughly one third is contributed by the German federal and state governments in the form of base funding
- International co-operations
- In Chile since 2010



Proyecto apoyado por



Fraunhofer in a Nutshell



University



- strong integration with academia
 - demand driven research combined with scientific excellence
 - professional R&D services for industry

Center for Solar Energy Technology - CSET

Objective and Associates

Generate **innovations** to achieve large scale implementation of solar energy in Chile for **main industrial** and **commercial/residential** sectors

- **Subsidiary of FRAUNHOFER ISE** / Freiburg
- Based on the existing infrastructure of Fraunhofer Chile Research Foundation (FCR)
- **Co-Executor:** Pontificia Universidad Católica de Chile and located in UC Innovation Center
- Since 2015 operating in Chile
- **Team** of more than 60 people in FCR & UC



Fraunhofer Chile Research (FCR) Foundation

Center for Solar Energy Technologies (CSET)

- **Center of Excellence**, co-funded by CORFO
- 2013: Application for CEI
- 2015: Operational Start of CSET
- Location: Innovation Center / Campus San Joaquín UC
- **Application oriented R&D and Support**
 1. PV Systems
 2. Solar Thermal Systems
 3. Transversal projects
- Adaption of Technologies for Chile
- Quality Assurance, Standards and Advising



Solutions for Photovoltaic Plants

Questions of Operators and Financiers

- Is the location a good location for my PV plant?
- Which panel technology is best for my PV plant?
- How often should I clean the modules for not losing money?
- Does the cleaning system damage my modules?
- Is the operator of my PV plant complying with the agreed performance ratio?
- **Is my PV plant underperforming?**



Solutions for Photovoltaic Plants

Is the location a good location for my PV plant?

- To determine the best location of a PV plant, it is necessary to know the solar irradiance and climatic conditions of the location
- CSET has experience in installation, maintenance and evaluation of meteorological stations to determine the best location for your PV plant
- CSET carries out periodic maintenance of the station and permanent remote monitoring of the following environmental conditions:
 - Solar irradiance
 - Wind speed
 - Temperature
 - Humidity
 - Pressure



Toco measuring station

Solutions for Photovoltaic Plants

Which panel technology is best for my PV plant?

- There are different technologies of PV modules and each can present different behavior according to the location
- CSET has experience comparing different technologies on site evaluating the efficiency, degradation and soiling of different technologies
 - Monocrystalline
 - Polycristaline
 - Thin film
 - Bifacial
 - etc.
- I-V curve tracing, measurement of electrical parameters, solar irradiance and environmental conditions



CODESSER measuring station

Solutions for Photovoltaic Plants

How often should I clean the modules for not losing money?

- Soiling of PV modules leads to lower energy production and decreasing profits
- Cleaning processes have associated costs. Necessary analysis of costs and gained profits
- CSET has experience in determining the optimal cleaning strategy for your PV plant taking into account:
 - Level of soiling
 - Rainy seasons
 - Generating losses
 - and **cost of cleaning**
- CSET has a soiling management software for optimizing the output of PV plants (365 days)



Dirty and clean modules



Automatic cleaning mechanism for dirty modules

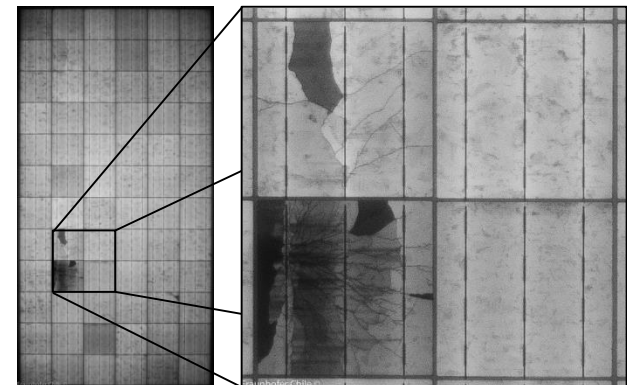
Solutions for Photovoltaic Plants

Does the cleaning system damage my modules?

- Periodic cleaning of the PV modules is necessary in order to maintain optimum production
- Unsuitable cleaning systems can cause damages of PV modules, leading to accelerated degradation
- CSET is doing damage assessments through electroluminescence studies on your site
- Forward-bias electroluminescence is a non-destructive test that provides necessary information to e.g. evaluate modules before and after cleaning processes
- Research & Development of suitable cleaning systems



Cleaning mechanism for dirty modules

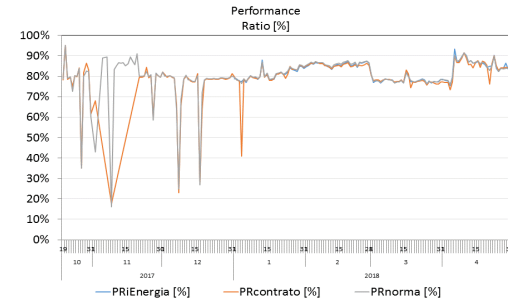


PV module evaluated with electroluminescence

Solutions for Photovoltaic Plants

Is the operator of my PV plant complying with the agreed performance ratio?

- The performance ratio (PR) shows the effectiveness of a PV plant
- PV plant operators must comply with a minimum PR stipulated by contract
- PV plants with dirty or uncalibrated pyranometers will deliver wrong PR
- CSET determines the real PR to be compared with the one delivered by the PV plant
- CSET performs the PR calculation through the different options of data collection:
 - Plant irradiance sensor data
 - Own irradiance sensor data
 - Satellite irradiance data



Own pyranometer mounting



Solutions for Photovoltaic Plants

Is my PV plant underperforming?

- The performance of your PV plant directly influences your profits
- CSET can determine underperformance of your PV plant and solve the problems
- Check of underperformance through:
 - I-V curve tracing and analysis
 - Performance ratio calculations
- Determine causes of underperformance through:
 - Visual inspection
 - Electroluminescence
 - Soiling analysis
 - Checking of solar tracker
 - Pyranometer verification



Verification of solar tracker angle



Dirty modules



Visual inspection of combiner box

For a Solar Future of Chile

**We have best solutions
for your PV plant**

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