

**Modelling****TECNALIA****Optical, thermal and mechanical modelling of PV and BIPV modules****Location of the infrastructure:**

San Sebastian, Spain

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[oihana.zubillaga@tecnalia.com](mailto:oihana.zubillaga@tecnalia.com)**Objectives:**

Optical, thermal and mechanical design of PV and BIPV modules.

**Main features:**

This infrastructure is directed to the application of available software and the development of new theoretical methods and software tools in the field of computational modelling for the optical, thermal and mechanical design of PV and BIPV modules, as follows:

## i) Optical properties:

- Design of optical interference systems: transfer matrix method-based software for optical design and characterization of thin film stacks. Design of selective, multipurpose coatings. Calculation of spectral and integrated transmittance and reflectances of the coating plus substrate system, colorimetric coordinates, effective refraction index. Additionally, coating equipment for samples fabrication is available.
- Optical models for complex multilayer glazing systems: internally developed theoretical methods and software tools for the optical characterization of complex laminates (including embedded coatings and solar cells), from the optical properties of each component (glass, polymeric films, coatings, solar cells, etc.). Calculation of spectral and integrated spectrophotometric magnitudes of the whole system, colorimetric properties, vision through glazing.
- Lens design for PV concentration systems: ray-tracing based software for Fresnel lenses or any other lens array. Determination of geometrical optics parameters.

## ii) Thermal properties:

- Analytical method and implementation for the calculation of temperature profiles in PV modules with user defined environmental conditions.
- FEM based software for thermal simulation of one-dimensional and two-dimensional heat transfer at PV modules and BIPV elements.

## iii) Mechanical properties:

- FEM based software for the simulation of mechanical behaviour of plates. Optimization of the thickness of plates for building integration complying to legal regulations.

**Limitations or constraints:**

No

**Typical services or results:**

- Analysis of directives and standards applicable to BIPV and building codes
- Analytical and FEM calculation of service loads (wind and snow) and overloading due to manipulation and maintenance of PV elements.
- Analytical calculation of the transmittance and reflectance of the element for different thicknesses and configurations.
- FEM calculation of thermal transmittance (U values) for different thicknesses and configurations.

**Examples of research projects:**

- Design of façade BIPV elements made of composite materials.
- Design of a greenhouse incorporating low concentration PV modules and lenses.