ENERGY USAGE AND PAY BACK TIME FOR BIPV

The graphs show ranges of solar coverage, self-consumption and pay back time for BIPV in given Framework. With a PV installed area ranging from 1/3 to full roof area, a solar coverage rate between 5 % to 45 % and a self-consumption rate of 70 % to 100 % can be reached. These high self-consumption rates assure low pay back times of 7 years to 13 years for roof installed PV and 17 years to 30 years for façade integrated PV.

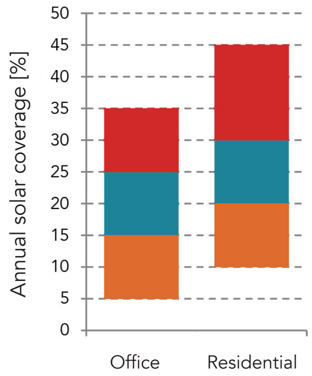


Fig.1 Elec tricity demand that can be covered with 200 m²-600 m² PV[1] for office and residential buildings[2]

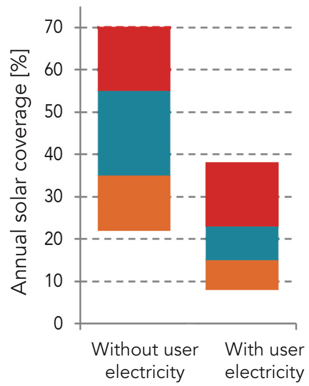


Fig.2 Building[2] energy demand with and without user electricity that can be covered with 200 m²-600 m² PV[1]

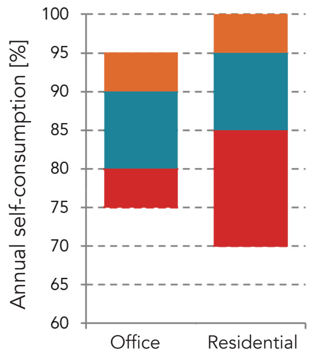


Fig.3 Ratio of self-consumed to total PV yield for 200 m²-600 m² PV[1] for office or residential buildings[2]

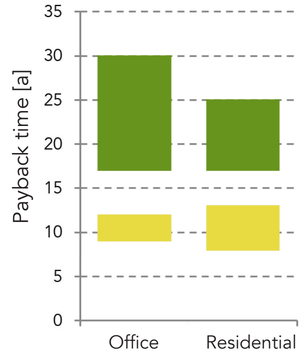


Fig.4 Period to recover PV investment[3] for roof installed or facade integrated PV for office or residential buildings[2]

- Small coverage 200 m² PV
- Medium coverage 400 m² PV
- Full coverage 600 m² PV
- Roof integrated PV
- Façade integrated PV

Photovoltaics[1] :
- Oriented horizontal, east, south or west.
- Tilted from 0° to 90°.
- Polycrystalline PV.

Building[2] :
- 3.000 m² GFA
- 5 Floors
- Standard Building Quality
- Electrical Heating, hot water production and cooling

Economy[3] :
- 200 €/m² roof installed PV
- 310 €/m² façade integrated PV
- 0,18 €/kWs Grid consumption
- 0,04 €/kWh Feed in tariff

DESIGN RULES FOR PV SYSTEMS

:: Highest Yield

FULL 30° SOUTH

:: High yield, balanced daily energy

FULL <20° SOUTH or EAST&WEST

:: High yield in the morning and evening

FULL >30° EAST & WEST

:: High yield in the morning or evening

FULL >30° EAST or WEST

:: Yield in the early morning and late evening

EAST & WEST

:: Balanced yield with high production in transition period

SOUTH

:: High balanced yearly yield

:: Economic design

FULL <20° SOUTH, EAST, WEST

UPPER FLOORS SOUTH

UPPER FLOORS EAST & WEST

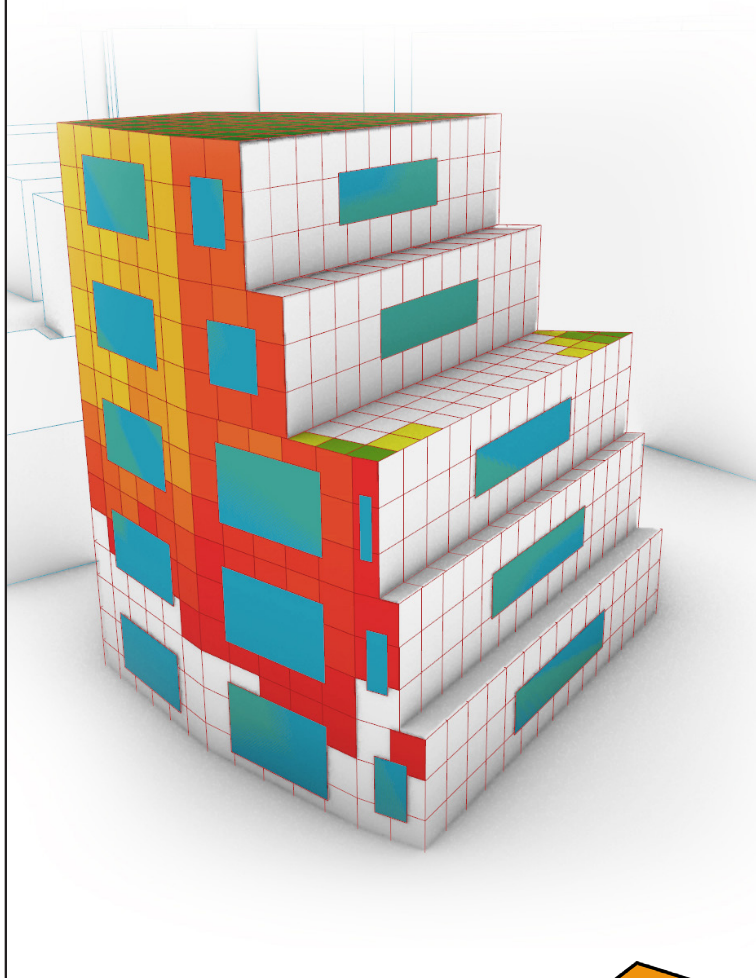
:: FACADE INTEGRATED

:: ROOF MOUNTED

:: COVERAGE

:: INCLINATION

:: ORIENTATION



VITALITY

Design rules in the early planning phase of building-integrated photovoltaics

In the planning process of buildings, an early and integral planning guideline is required to successfully implement Building-Integrated Photovoltaics (BIPV). However tools are missing and there is a lack of design rules that could be easily applied in order to support especially those planners at an early stage who are not experienced in photovoltaics.
VITALITY offers design rules and parametric tools in order to bridge this gap.

VITALITY TOOL

In the planning process of buildings, an integral planning guideline is required to successfully implement Building-Integrated Photovoltaics (BIPV).
Advantages of BIPV systems are that PV can cover more building's surfaces and replace some of the traditional building components (e.g. façade cladding), but even though BIPV can completely cover the building's skin, in reality only partial coverage would make sense in terms of economics efficiency.

However, the lack of digital tools and easy to use design rules for planning makes it difficult for non-PV specialist to integrate BIPV in the early planning stage of design.

VITALITY project addresses the elaboration of tools for an integrative planning process. The results of the project are a set of numerical but simplified rules that allow a refined BIPV planning already during the early design stage. The project analyses design criteria and standardization and transforms them into simplified models. Case stories of buildings are investigated in parametric studies, simulated in terms of thermal performance, and they are examined with regards to their thermal, electrical and BIPV expert planning.

The simplification is the key also in terms of to digital modeling where relatively simple parametric model is enough to analyze its solar potential within its urban location and placement of PV panels. This enables fast massing studies and quick design changes.

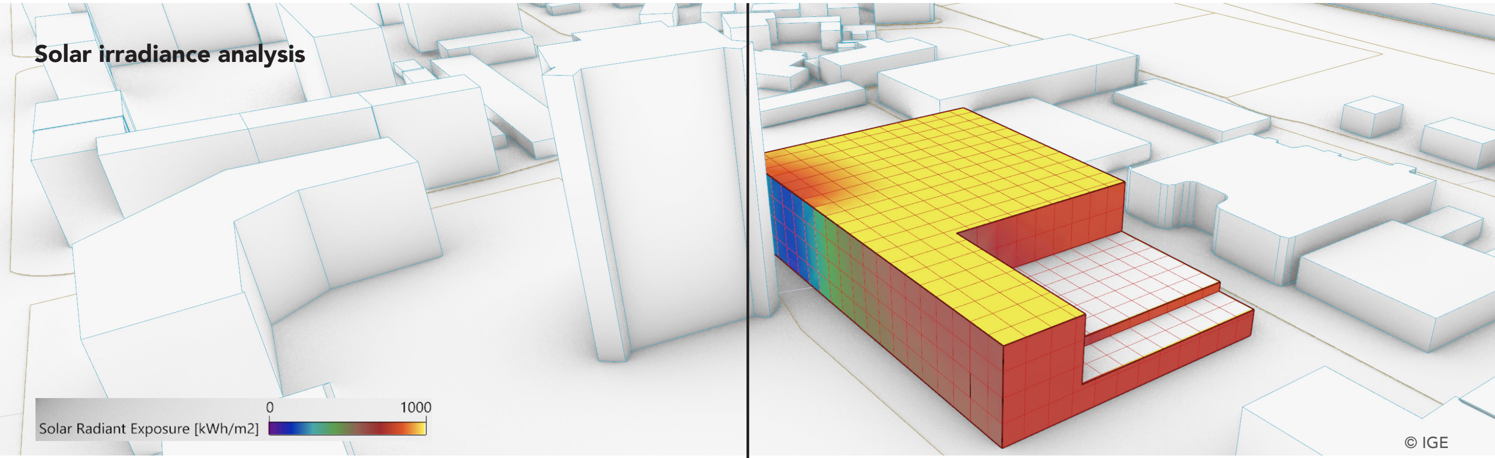
VITALITY project also developed library of tools for Rhino/ Grasshopper® platform that are free to download

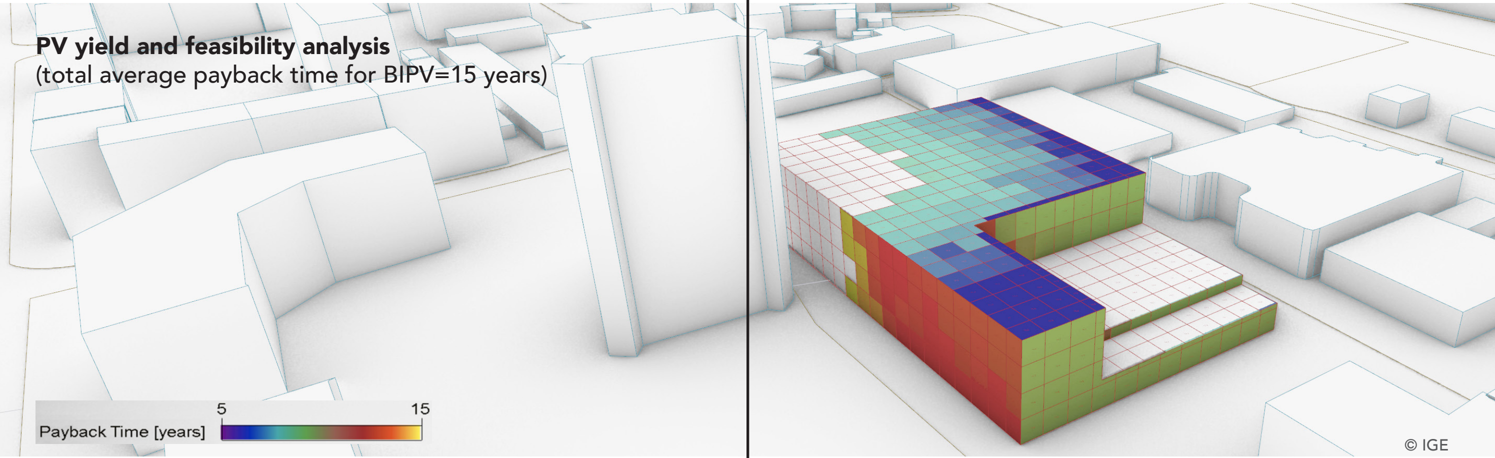
https://www.food4rhino.com/app/vitality

The VITALITY library can be connected to other existing tools, e.g. DIVA for the calculation of hourly solar radiation and ARCHSIM for getting the energy demand problem of the building.

PV YIELD Component

Fast calculation of the yield values (kWh/m²). The drop down menus enable to select the mounting type of the photovoltaics module (roof vs. façade). and the type of PV cell (e.g. monocrystalline, polycrystalline, etc.)





PVYield [kWh/m²] **=** EPV ηPV ηInv (1 + αP (θM – 25 °C))
EPV [kWh/m²] irradiance in plane of the PV modules
θM [°C] module temperature
ηPV [%] module efficiency
ηIN [%] inverter efficiency
αP [%/K] temperature coefficient

VITALITY Component

Provides the feasible amount and positions of PV panels by comparing the hourly electricity production of the allocated roof + façade surfaces with the electric energy demand of the building. The selection of the panels is taking in account contribution to the building's energy demand vs selling the exceeded electricity to the grid. The tool provides the estimation of payback time for each panel plus the total average payback time can be used as a threshold to output the only feasible PV panels within this average range.

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