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interfaces

Assessment and Demonstration 5.2

How can we define a methodological assessment framework?

This common methodology aims to define terms, to prescribe common assumptions and input values like energy prices, future price developments, assessment periods, impact calculation methods, and system boundaries, and to provide a basis for optimizing possible BIPV solutions.

To achieve as much consistency and comparability as possible among the different projects and work packages within ACTIVE INTERFACES and beyond, a common assessment methodology was developed and outlined. This methodology was the basis for the assessment of energy, greenhouse gas and economic impacts of Building-integrated photovoltaic solutions (BIPV solutions), as well as for comparing BIPV solutions with non-BIPV renovation options.

Keywords: Energy; Greenhouse gas; Cost assessment; Impact analysis; BIPV in building renovation.
Target audience: Architects & engineers; Suppliers & companies.

The impacts of Building-integrated photovoltaic (BIPV) solutions on energy generation and consumption, greenhouse gas emissions (GHG), and costs have to be assessed on the basis of a common methodology, which defines common terms and system boundaries, outlines calculation methods for the impact assessments, and proposes common input values (eg. life spans or energy prices and their future development) [1].

Scope
The impacts of BIPV solutions are assessed for the subsequent impact categories and indicators: Total and non-renewable primary energy use, comprising operational primary energy use (heating, ventilation, air conditioning, domestic hot water and auxiliary energy use), primary energy use for operation and maintenance, and embodied primary energy use for BIPV and renovation measures, including replacements during the assessment period if needed.

Greenhouse gas emissions of energy consumed as well as of embodied energy use (LCA)
Life cycle costs (LCC) during the assessment period comprising costs for interest and amortization during the life cycle or the assessment period and maintenance costs.

System boundaries
The boundary for on-site generation of renewable energy and for the energy consumed by the building (net delivered energy) is the building lot.

Approach for impact assessment of building renovation with BIPV solutions
It is assumed that BIPV solutions are part of a renovation project which might also comprise further energy related and non-energy related measures. To correctly determine the (net) impacts of BIPV solutions assessed on costs, primary energy use and carbon emissions, a common reference renovation option is defined, as it would be carried out if BIPV was not part of the package of renovation measures (“reference renovation” in Fig.1). Net impacts of the renovation solution with BIPV result as the difference between the impacts of the BIPV renovation solution minus the impacts of the renovation option without BIPV. Both solutions will provide a building which is renovated in compliance with existing regulations and which is supposed to be functionally viable for at least the next 20 years.

These factors are determined by LCA and take into account upstream energy use and related emissions for extraction, processing, transportation and distribution of various energy carriers. Primary energy (PE) conversion factors and GHG emission factors of electricity savings due to BIPV depend on the way electricity deliveries from the grid which are replaced by BIPV electricity were generated. We propose to apply the conversion factors of the current national mix of electricity consumed.

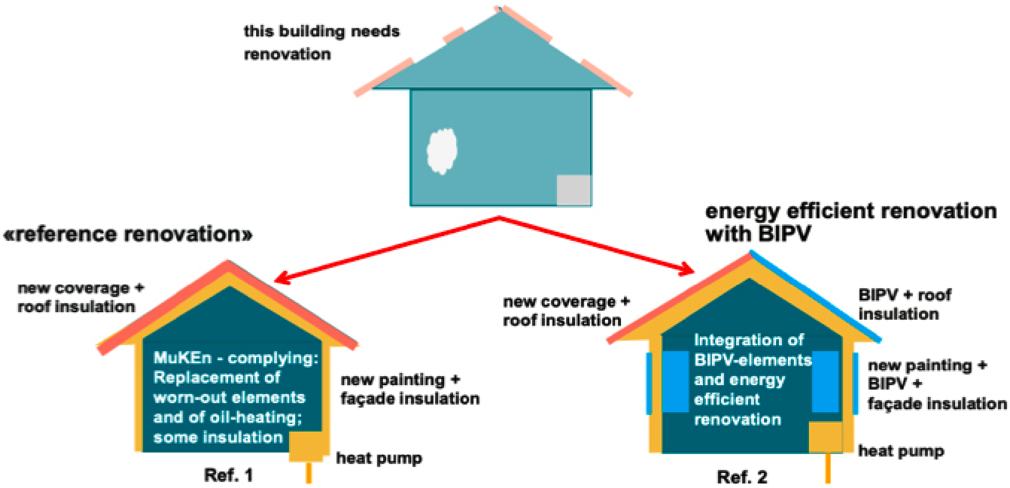

Fig. 1 Definition of a common "reference renovation" versus an energy efficient renovation with BIPV (©econcept).

The conversion factors of energy delivered by district heating and cooling systems depend on the input share of the energy carriers needed to generate district heat or cold, and on the corresponding PE and emission factors.

Cost assessment

The cost assessment is based on a life cycle cost approach, determining global costs: the sum of the present values of the initial investment costs, plus present values of running costs, plus present values of operational, maintenance and replacement costs during the calculation or life cycle period.

Economic valuation of on-site generated BIPV electricity

In the current Swiss situation, determination of the value of BIPV electricity fed into the grid depends on the way BIPV is installed and subsidized: either the feed-in remuneration at cost model (RPC) or the self-consumption model with remuneration for excess electricity fed into the grid. Since RPC remuneration is not available any more, fed-back electricity is valued according to current Swiss energy law, which requires utilities to make market-anchored payments corresponding to the resulting cost savings for the particular utility.

Overall assessment procedure to determine the impacts of BIPV renovation solutions [1]

1. Collection of building data which is needed for the assessment
2. Definition of the necessary reference renovation solution (reference case without BIPV)
3. Definition of the renovation solution with BIPV
4. Determination of system boundaries, general input values (energy prices, interest rates, life spans, assessment period, possible subsidies and remuneration rates for fed-back electricity)
5. Collection/calculation of energy, emission and cost data to determine impacts of the BIPV renovation solution
6. Impact calculation for the reference renovation and for the BIPV renovation case (e.g. with the INSPIRE-tool).
7. Option 1: Further calculations to determine impacts on revenues for the building owner, return on equity, rent increases, etc.
8. Option 2: Sensitivity calculations for different energy prices.

References

[1] W. Ott, M. Lehmann. "Common methodological framework to assess energy, climate and economic impacts of BIPV"; Report 1/3, National Research Programme “Energy Turnaround” (NRP 70) ACTIVE INTERFACES – Holistic strategy to simplify standards, assessments and certification for building integrated photovoltaics. SNF project 153849, 2016.

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