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A review of the Dutch ecosystem for building integrated photovoltaics

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Abstract

Building integrated photovoltaics (BIPV) is one of the most promising solutions to generate renewable electricity in the built environment. BIPV applications can replace regular building components into prefab integrated components that at the same time generate electricity, contributing to the aesthetics in the built environment. In this paper we thoroughly review the existing BIPV stakeholders, the BIPV ecosystem and policy and legislation for BIPV in the Netherlands. The information that is provided throughout this research and the conclusions that were drawn should be taken into account by the government, academia and the BIPV industry when further designing the BIPV (export) strategy for the Netherlands.

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Keywords: Building Integrated Photovoltaics; BIPV; photovoltaics; aesthetics; built environment; renewable energy; solar energy; the Netherlands

1. Introduction

Generating renewable electricity in the built environment increasingly is done by means of building integrated photovoltaics (BIPV) applications that replace regular building components [1]. Prefab integrated components that at the same time generate electricity contribute to the aesthetic value of a building, and allow architects to design (near) zero energy buildings. The concept is distinctive from regular solar energy applications, since the PV function is integrated into the building envelope instead of placing the solar module on the roof (Building Added (or Adapted) PV, BAPV).

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BIPV is currently positioned primarily as a niche-product, making up about 1-3% of the total PV market with a total installed capacity worldwide of 1.0 GWp [1]. In this study, BIPV is referred to as a system that includes at least one functionality in the building envelope in addition to electricity generation [2].

Three common building elements that are suitable for state-of-the-art BIPV are pitched and sloped roofs, flat and curved roofs, and façades [3]. Today, the most preferred location for BIPV elements or systems is usually the rooftop due to less shadowing and therefore generally more solar radiation and higher power generation, but façades become more and more popular from an aesthetic point of view [4]. Flexibility in shape, size and colour are important characteristics of BIPV [2]. The BIPV applications that are generally used are 1) BIPV foil or thin film (high flexibility and light weight), 2) BIPV tiles (concerning 57.8% of BIPV roofing systems [5]), 3) BIPV modules (similar to BAPV, but weather proofing and in-roof), and 4) solar glazing (e.g. transparent BIPV roofs at train stations of Utrecht and Rotterdam) [6].

2. Structure of the research

2.1. Stakeholder analysis (methodology)

The stakeholder analysis consisted of the following phases [7]:

1. Inventory of involved parties: The inventory was made at the sectoral level and parties were identified according to the Triple Helix (Government, Industry and Academia) [8].
2. Define interest of each stakeholder: For the stakeholders found in phase 1, market parties were identified and their interests as well as perspective on BIPV were defined. Information was acquired from desk research.
3. Determine relationship(s) between involved parties and their position within the ecosystem: This step visualizes how the stakeholders are related to each other within the BIPV sector. Points of differentiation for primary stakeholders, secondary and tertiary stakeholders were used as a guidance.

2.2. DESTEP-analysis (methodology)

A DESTEP (demographic, ecological, socio-cultural, technological, economic and political-legal) analysis gives an idea of the environment the BIPV sector is operating in and what developments, trends and uncertainties it faces. It provides a systematic analysis of the external factors the sector is subjected to [9]. Each category was qualitatively described by means of desk research on all impacts that are applicable to the BIPV sector. Main sources for the desk research were the statistical databases of CBS, the World Bank and Eurostat, as well as scientific literature and reports from the International Energy Agency (IEA).

3. Results

3.1. Stakeholder analysis

1. Inventory of involved parties

The identified parties are presented in Table 1 and checked with the preference of SMEs that are active in the BIPV sector of the Netherlands [10].

Table 1. Inventory of parties that are involved in the BIPV sector, classified according to the Triple Helix model [8]

Triple Helix parties	BIPV stakeholders
Government	European Union; Dutch government; Provinces & Municipalities; Federation spatial quality & Design Review Committees
Industry	BIPV manufacturers / suppliers / wholesale; Construction industry (contractors, material suppliers; PV-module installation; architects); Industry associations
Academia	Research institutes; Universities
End Users	Housing associations and their tenants; Business Rental (office spaces); Private homeowners