



Contents lists available at ScienceDirect

Renewable and Sustainable Energy Reviews

journal homepage: www.elsevier.com/locate/rser

Demonstrating sustainable energy: A review based model of sustainable energy demonstration projects

Bart A.G. Bossink

Vrije Universiteit Amsterdam, Faculty of Sciences, Section Science, Business & Innovation, De Boelelaan 1081-1087, 1081 HV Amsterdam, The Netherlands

ARTICLE INFO

Keywords:
demonstration
innovation
learning
prototyping
sustainability
energy

ABSTRACT

This article develops a model of sustainable energy demonstration projects, based on a review of 229 scientific publications on demonstrations in renewable and sustainable energy. The model addresses the basic organizational characteristics (aim, cooperative form, and physical location) and learning effects (technical, organizational, policy and market learning) of sustainable energy demonstration projects (prototyping, organizing, and market demonstrations). This article concludes that a main effect of the reviewed demonstrations is that these projects enable people to learn to further develop, apply and commercialize sustainable, renewable and clean energy technologies. They provide four specific learning opportunities; they 1) enable scientists and technicians to learn how to technically develop sustainable energy prototypes; 2) facilitate technicians and managers to learn to build an organization that produces these sustainable energy prototypes on a large(r) scale; 3) help public policy officers to learn to develop public policy that stimulates the commercialization process of these sustainable energy prototypes; and 4) support commercial professionals to learn how to bring sustainable energy prototypes to the market.

1. Introduction

Demonstration projects in sustainable energy are often proposed to be the settings wherein the authorities cooperate with academia and commercial firms to further test, understand and improve new sustainable energy technologies [63] before they grow large and can be commercially exploited. Research identifies several key characteristics of demonstration projects in sustainable energy. The literature claims that demonstration projects stimulate sustainable energy innovation via ‘learning-by-doing’ [18,70,91], ‘trial-and-observe’ [63], ‘learning-by-searching’ [70], ‘learning-by-replication’ [157], and ‘learning-by-interacting’ [70]. Participants in sustainable energy demonstration projects - like producers, suppliers and users - learn, and by putting what they have learnt into practice, they serve as role models for others to follow [72]. In general, the literature supports the proposition that demonstration projects help to commercialize new sustainable energy technologies [15]. But the literature also addresses the need for a more fine-grained insight into *how* these demonstration projects help to commercialize new sustainable energy technologies. Frishammar et al. [52] conclude that future research should opt for a “more in-depth understanding of the actor networks surrounding pilot and demonstration project plants as well as the roles of innovation management and public policy in addressing different conflicts of interest” (p. 14). In the same line of reasoning, Bossink [15] argues

that: “an interesting question for technical, organizational and market demonstration projects can be how certain conditions and contingencies influence a clean demonstration project’s innovativeness” (p. 15).

There still is insight and knowledge to gain about the characteristics of sustainable energy demonstration projects, their learning effects on business, markets and society, and their contribution to energy research and practice. The objective of this review study is to develop a model of sustainable energy demonstration projects that identifies distinctive types of demonstration projects, and for each type classifies what its basic organizational characteristics and learning effects are. Considering this objective, the central research question that is addressed in this review article is: *What are the basic organizational characteristics and learning effects of distinctive types of demonstration projects in sustainable energy?* This article aims to give answers to this question by reviewing 229 peer-reviewed academic publications on sustainable energy demonstration projects. Based on this, it develops a model of sustainable energy demonstration projects’ aims, organizational forms, and learning effects. This article argues that demonstration projects in sustainable energy have a pronounced innovative effect: they enable technical, organizational, policy, and market learning of the people who participate, and by this contribute to the active body of applied knowledge that forms the basis of the development, production, marketing and use of renewable and sustainable energy in business, markets and society. The past 40 years many studies about

E-mail address: b.a.g.bossink@vu.nl.

<http://dx.doi.org/10.1016/j.rser.2017.02.002>

Received 22 April 2016; Received in revised form 28 November 2016; Accepted 1 February 2017

1364-0321/ © 2017 The Author(s). Published by Elsevier Ltd. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

one demonstration project, several demonstration projects, or a program of demonstration projects in sustainable energy have been conducted and published. Recently, studies that review several of these sustainable energy and other clean technology demonstration projects [15,52], were added to this research stream. These studies develop an agenda for future sustainable technology demonstration project research, based on an analysis of the practical characteristics of sustainable technology demonstration projects [15], and on an analysis [15,52] and synthesis [52] of several theoretical approaches in demonstration project research. To date, no review study has been conducted that synthesizes the sustainable energy demonstration literature into a model that for several distinctive types of sustainable energy demonstration projects classifies what their basic organizational characteristics and learning effects are. This review study aims to fill this gap and to contribute to a deeper understanding of the organizational characteristics and learning effects of the sustainable and renewable energy demonstration project.

This article is organized in four sections, of which this first section is introductory. Section 2 presents the research method that is applied to organize the review. Section 3 provides an overview of the main results of the review, and analyzes and synthesizes this into a model of sustainable energy demonstration projects. It ends with an overview of the contribution of the article to research and practice, the limitations of the study, and avenues for further research. Finally, concluding Section 4 summarizes the main outcomes and conclusions of this research.

2. Review method and methodology for model development

In total, 229 publications are collected, analyzed and synthesized into a model of demonstration projects in sustainable energy.

2.1. Collection of publications

A literature review is conducted to gain insights into the characteristics and effects of demonstration projects in sustainable energy. The literature review method consists of three subsequent steps (see [129,201]).

The first step of this method is the making of a list of relevant publication titles in scientific journals. For this purpose the database 'PiCarta Online Contents' (www.picarta.nl) is consulted. PiCarta contains articles from approximately 15,000 journals and periodicals, from 1992 to date. The combination of keywords that is used to search for publications is: 'demonstration' AND 'project'. This combination of keywords is sought for in the title of publications. Complementary, the 'Google Scholar' database is used to search for the most recent publications about demonstration projects in sustainable energy in 2013, 2014, 2015 and 2016, using the keywords 'demonstration' AND 'project' AND 'energy'. Titles are collected, read and rejected or adopted. The criteria for adopting a publication are that these have to be peer-reviewed, published in an academic journal or series, and contain empirical results about demonstration projects in sustainable energy.

The second step in the method is the search for publications where to the articles in the first list refer. This search is done by means of analyzing the titles in the reference lists of the publications that are selected in the first step. These publication titles are collected, read and rejected or adopted. The criteria for adopting publications that are traced are that these have to be peer-reviewed, published in an academic journal or series, and contain empirical results about demonstration projects in sustainable energy. The titles that are selected in this second step are added to the titles of the first step, and together form a second version of the list of publications.

In the third step of the search method, publications are sought in the 'Google Scholar' database that refer to the publications from the second version of the list. Publications are collected, read and rejected

or adopted. Again, the criteria for adopting publications are that these have to be peer-reviewed, published in an academic journal or series, and contain empirical results about demonstration projects in sustainable energy. The selected publications are added to the second version of the list, resulting in a third version. All publications of this third version of the list are read completely. Publications that primarily focus on demonstration projects in sustainable energy are chosen to be subject of the literature review and other publications are left aside. This results in a fourth and final version of the list.

In total 220 empirical publications are selected to be subject of the analytical review (see Table 2), and the remaining 9, mainly conceptual and theoretical publications about demonstration projects [4,15,52,91,108,122,125,170,195], are used as supporting references in this review study. The study of 229 publications is dedicated completely to demonstration projects in sustainable energy; all these publications report original empirical data/insights about sustainable energy demonstration projects. The 229 publications are published in the period 1976–2016. The starting year 1976 is chosen because this year can be considered as the year wherein a "first major study" ([72]: 458) - a study by Baer et al. [4] about the effect of demonstration projects - is published. The distribution of the complete collection of 229 publications among the following four consecutive decades, and the start of the fifth decade, is as follows: 1976–1985: 2 publications (0.9%); 1986–1995: 5 publications (2.2%); 1996–2005: 32 publications (14.0%); 2006–2015: 128 publications (55.9%); and 2016: 62 publications (27.1%). This indicates that demonstration projects in sustainable energy receive an increasingly growing attention of academic researchers. The vast majority of the publications in this review study is published in the past ten years and represents recent research into sustainable energy demonstration projects.

2.2. Analysis of publications

For each empirical publication the aims, organizational forms, and learning effects of the demonstration projects that are presented by this publication, are analyzed.

First, the aim of the demonstration projects is recorded by means of using the categorization of Macey and Brown [122]. Macey and Brown [122] distinguish three types of consecutive demonstration projects, each with its own specific aim:

- Prototyping demonstration projects: to develop new prototypes and turn-prototypes-into-products;
- Organizing demonstration projects: to develop a production organization that is capable of producing large(r) quantities of the prototypes-turned-into-products;
- Market demonstration projects: to find and explore (a) market(s) for the new prototype-based products.

Secondly, the organizational form of the demonstration projects is established, using Markusson et al.'s (2011) three types of cooperation in demonstration projects:

- Cooperating private organizations;
- Cooperating public organizations;
- Cooperating public and private organizations.

Thirdly, the effect of each demonstration project is identified by means of using a classification of four learning effects, based on [52]: 5):

- Technical learning effects: learning to develop and produce new prototypes in sustainable energy;
- Organizational learning effects: learning to cooperatively organize the improvement and commercialization process of new prototypes in sustainable energy;

Download English Version:

<https://daneshyari.com/en/article/5483014>

Download Persian Version:

<https://daneshyari.com/article/5483014>

[Daneshyari.com](https://daneshyari.com)