Applied Energy xxx (2013) xxx–xxx

Contents lists available at ScienceDirect

Applied Energy

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

Strategic policy to select suitable intermediaries for innovation to promote PV solar energy industry in China

Hsing Hung Chen [a], Amy H.I. Lee [b,*], Silu Chen [c]

[a] Faculty of Management and Administration, Macau University of Science and Technology, Wei Long Avenue, Taipa, Macau
[b] Department of Technology Management, Chung Hua University, No. 707, Sec. 2, Wu Fu Rd., Hsinchu 300, Taiwan
[c] School of Management, Wuhan University of Technology, Wuhan, Hubei, China

HIGHLIGHTS

- China is under pressure to prosper the photovoltaic (PV) solar energy industry.
- An interactive learning platform for knowledge management is essential.
- The paper proposes some conceptual assumptions.
- Suitable intermediaries at different stages of PV energy industry are found.

ARTICLE INFO

Article history:
Received 18 September 2012
Received in revised form 17 August 2013
Accepted 13 October 2013
Available online xxxx

Keywords:
Strategic policy
Intermediaries for innovation
Sustainable competitive advantage
An interactive learning and communicating platform

ABSTRACT

Ever since its commitment to the Copenhagen Accord of 2009 to lower its carbon emissions by 2020 to a level that will be 40% below those of 2005, China has been aiming to develop its photovoltaic (PV) solar energy industry. Because knowledge is a critical factor for obtaining a sustainable competitive advantage in a knowledge-intensive industry, it is essential to build up an interactive learning and communicating platform as a facilitator to absorb, distribute and create knowledge within a firm and among its suppliers and customers. However, relevant literature has, hitherto, never discussed such an intermediary platform for innovation. Therefore, this paper proposes some conceptual assumptions to solve this problem. After a practical investigation, this paper seeks to find suitable intermediaries for innovation at different levels of the PV solar energy supply chain in China.

1. Introduction

As a result of an increase in environmental awareness and the support of governments, grid-connected photovoltaic (PV) solar power industry has grown rapidly to deal with emerging energy and environmental problems. The two major groups of PV solar cells are wafer-type cells and thin film cells. Wafer-type PV solar cells are made from wafers that are cut from a silicon ingot, while thin-film PV solar cells are deposited directly on a substrate like glass, plastic or steel [1]. Presently crystalline silicon is the most commonly used material. However, because PV silicon thin-film solar cells have a greater potential to reduce energy payback time, material use, production costs and energy consumption, such cells have become the main choice in the energy industry [2]. With the consistently growing demand for PV solar cell systems, an exponential growth in PV solar energy industry can be expected in the near future. In order to promote this emerging industry, it is necessary to consider the issue from the perspective of an integrated PV system to make PV energy industry economically acceptable [3]. An integrated PV system is an integration of a variety of parties including academic researchers, governments, system integrators and equipment suppliers with a mutual goal of supplying stable electricity by converting abundant sunlight. However, the use of PV solar energy has not been examined comprehensively due to the following reasons: (a) academic researchers have limited experience and data on PV solar energy industry; (b) many governments are not that desperate to encourage renewable energy at the present time; (c) system integrators prefer to adopt existing ordinary solutions to reduce the investment risk and the construction period; (d) equipment suppliers in different supply chains are often only interested in the equipment itself, and do not consider the perspective of an integrated system. For the purpose of solving aforementioned issues in a knowledge-intensive industry, it may be essential to build up an interactive learning

* Corresponding author. Tel.: +886 13876789091, +886 3 5186582; fax: +886 3 518 6575.
E-mail address: amylee@chu.edu.tw (A.H.I. Lee).

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http://dx.doi.org/10.1016/j.apenergy.2013.10.034

and communicating platform as a facilitator to absorb, distribute and create knowledge within a firm and among suppliers and customers. Intermediaries for innovation, as facilitators, may connect demand and supply to support innovation to overcome market failures and system failures, and integrate different levels of systematic aggregation. Then, the target of this paper is to find suitable intermediaries for innovation to promote different levels of the PV solar energy supply chain in China.

Extensible capabilities in the semiconductor and flat panel display (FPD) industry, such as market, manufacture and global logistics, provide the basic infrastructures for developing the emerging industry in China. With the gradual cost reduction in semiconductors and FPDs, the consumer market of this emerging industry looks promising. On the supply side, the chemistry and process technologies in chip and FPD, including photolithography, deposition and etching, are directly applicable to mass producing PV solar cells. These companies can also employ their existing R&D experiences to improve and upgrade technologies for extensive solar technology development. The expansion of production is a result of booming investment in China. Manufacturing experiences and R&D experiences will give rise to learning curve effects and then result in the subsequent cost reduction in major PV solar products like solar cells, solar modules and solar systems [4]. Nevertheless, suppliers of major PV solar products must be flexible enough to customize their characteristics to satisfy individual demands and application requirements flexibly and to compete on price and performance [5]. To summarize, the economics of an integrated system or systematic application locally close to the users at the downstream supply chain must involve customer-oriented learning effects at the upstream supply chain [6]. In addition, China is aiming to hastily develop its PV energy industry because its current technologies are still behind many western nations like USA and those in Europe and its strategic policy is to reduce its carbon emission intensity by 2020 to a level that will be 40% below that of 2005 [7]. Accordingly, it will be helpful for a knowledge-intensive industry to build up an interactive learning platform to create, share and absorb knowledge within a firm or among its suppliers and customers.

Different people create, enrich, share and use knowledge in social interactions [8]. The majority of decision making occurs in groups, and motivation and action of individual members in an organization are affected by the social context [9]. Social networks are employed to obtain resources, knowledge, and information, and they can be used to explain personal relationships or personal ties [10]. Social networks are also recognized as an important intangible asset to facilitate innovative activities from the perspectives of individual positions, relations and operations [11,12]. Previous studies have stressed that social networks are critical in a wide range of social contexts including inter-firm relations and intra-firm relations [13], family relations [14], and other social relationships [15]. Chen and Wang employed trust to modulate the relationships in social networks with innovative capability from the perspectives of external social networks and internal social networks [16]. Recently, Karamanos [17] examined the interaction between the alliance network structure in an industry (the macro-level) and the alliance portfolio structure in a firm (the micro-level). The results show that firms with exploratory activities have limited and indirect access to other firms (micro-level) and firms

Part 1: Questions related to the importance of characteristic factors to sustainable advantage
Please evaluate the importance of the following 38 characteristic factors:
compatible cultures, long-term orientation, relationship, compromise, attitude, service, trust, centrality of certain members, staff change, preexisting knowledge, overlapping knowledge bases, complexity knowledge, skill complementarities, structural ties, social cohesion, support in product simplification, support in design for manufacturing activities, strong R&D support in component selection, knowledge transfer and diffusion, motivation correspondence, keen competition, risk taking policy, optimize knowledge flow, market opportunity, consistency, reliability, availability, quality, regulation change, technology risk, market uncertainty, inventory, cost, return of asset, earning per share, economic value of knowledge stocks, flexibility, closeness.

How important is each characteristic factor in order for your firm to reach sustainable advantages?

Characteristic factors of social network	Degree of importance				
Extremely unimportant (1) to Extremely important (5)	1	2	3	4	5
Compatible cultures					
Long-term orientation					

⋮

Part 2: Questions related to the importance of intermediary to knowledge distribution, absorption and creation
Please evaluate what are the suitable intermediaries for innovation under each characteristic factor. The intermediaries include: innovation consultants aimed at individual entrepreneurs, innovation consultants aimed at collectives of entrepreneurs, brokerage organizations that forge peer networks, system instruments for the support of innovation at higher level, and Internet-based portals and database.

Do you recommend the intermediary for innovation under each characteristic factor (like *compatible cultures* as an example)?

Intermediaries for innovation	Degree of recommendation				
Not highly recommended (1) to Highly recommended (5)	1	2	3	4	5
Innovation consultants aimed at individual entrepreneurs					
Innovation consultants aimed at collectives of entrepreneurs					
Brokerage organizations that forge peer networks					
System instruments for the support of innovation at higher level					
Internet-based portals and database					

⋮

Fig. 1. Partial content of the questionnaire.

Please cite this article in press as: Chen HH et al. Strategic policy to select suitable intermediaries for innovation to promote PV solar energy industry in China. Appl Energy (2013), http://dx.doi.org/10.1016/j.apenergy.2013.10.034