A RESEARCH SUMMARY FOR ENTREPRENEURS, POLICY MAKERS AND TECHNOLOGY FIRMS

Creating Distributed Generation: How Solar Financing Ventures are Built

By HARALD OVERHOLM

University of Cambridge, Institute for Manufacturing

How can innovative sustainable technologies be spread to make an impact on global warming and resource scarcity? Much research addresses this topic by focusing on end customer awareness, or on conditions for technology innovation. This research project instead analyses the potential for business model innovation to contribute to sustainable technology diffusion.

The focus of this research is on how upfront costs for customers of solar modules are removed through financing and services by third parties. This has been achieved through a business model whereby firms build, own and maintain solar panels on the premises of end-customers, only selling the electricity to the customer. Solar power is effectively offered as a service, rather than as a product, hence

the firms creating such offerings are called solar service firms in this report.

A large set of clean technologies in for example heating, electricity generation and water treatment could be sold through similar business models. Such technologies, including solar panels, typically share some basic traits. In the words of two academic experts on these markets, *"a wide range of environmentally sound products are characterized not simply by higher total cost but rather by a different investment profile, namely higher initial cost versus lower operating cost"*[1].

Hardware, installation and learning costs make the investment expensive, even when operating costs are low. The requirement for a large effort and cash investment upfront deters most customer types. The solar service business model solves this problem and creates customer value in a number of ways:

- By removing customers' upfront investment cost
- By taking on the initial efforts of selecting, installing and securing permits for the technology
- By taking full responsibility for the long-term operation and maintenance of the solar panel

The customer gets green electricity, typically at a cheaper rate than electricity from the grid, and with long-term guaranteed price stability. The main potential drawback for the customer is that, due to financing costs, the project may become more expensive over its entire life-span than it would have been if the customer had paid for it upfront.

As a part of this research a database of US solar service firms was created (see graphical representation below) based on cross-examination of government, industry and news sources. No pre-existing comprehensive database of US solar service actors was identified.

EXECUTIVE SUMMARY

Business model innovation can help spread clean technologies. This work uses the market for small-scale solar financing, in which firms build, own and maintain solar panels for end-customers, as an empirical example. These "solar service" ventures have an intermediary role between panel manufacturers and end-customers, and have opened up new solar markets. In other burgeoning markets the business model is applied to new technologies. This research provides insights for new ventures seeking to use the business model, manufacturers looking to sell to similar markets, and policy-makers encouraging their growth.

[1] Kaenzig, J. & Wüstenhagen, R., 2010. The Effect of Life Cycle Cost Information on Consumer Investment Decisions Regarding Eco-Innovation. *Journal of Industrial Ecology*, 14(1), p2

All early solar service firms in the US were new ventures, started with the specific purpose of creating solar service offerings. They took an intermediary role, and did not own or manufacture the solar technologies they were using.

Intermediary ventures with business models similar to the solar service firms have emerged in other sustainable technology industries, using technologies such as:

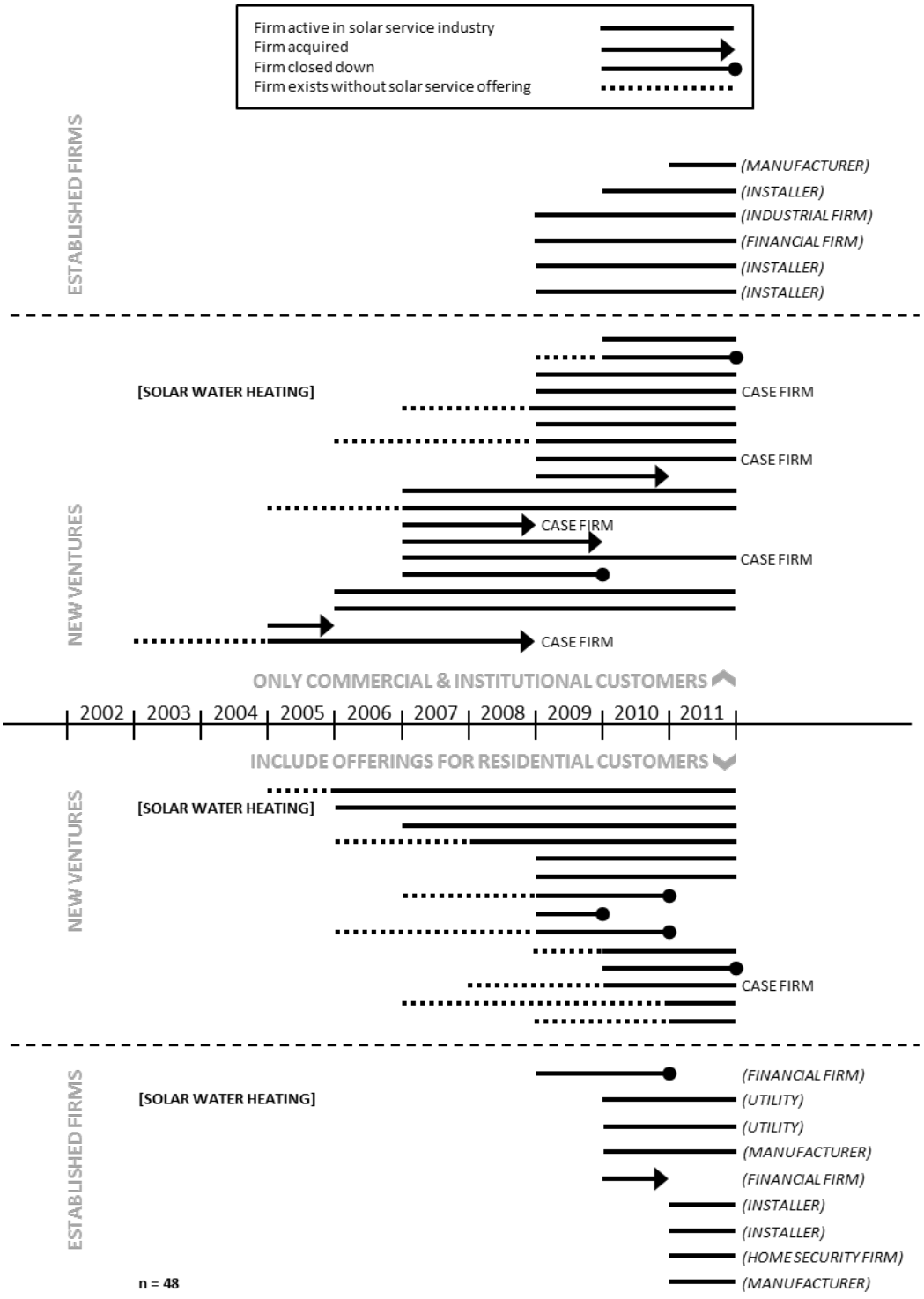
- *Ground-source heat pumps (Eco2 Energy, Sweden)*
- *Methane combustions from landfills (Vireo Energy, EU)*
- *Solar heating (Skyline Innovations, US)*
- *Water treatment (Water Capital, Mexico)*
- *Greenhouses for local food production (Brightfarms, US)*
- *Car sharing of electric vehicles (MoveAbout, Norway)*

Two firms, SunEdison and Renewable Ventures, pioneered the business model in the US in around 2005, and laid the foundation for a market that rapidly grew. New incentives for solar power installations, in particular the California Solar Initiative (started in 2007), helped motivate early entrants. Later, the collapse of solar panel prices and a rapid decline in installation costs may have provided an important impulse for new actors to join in – especially for the surge of established firms entering the market after 2008.

This research also points to growing familiarity with the business model among the firms' networks (consisting of finance providers, insurers, installers and end-customers) as an important driving force in itself, increasing the velocity with which solar service actors could sell, finance and build portfolios of solar installations.

Although the US solar service market is by far the largest, similar firms have emerged in the UK[2], The Netherlands[3] and Singapore[4].

[2] For example: Engensa, http://www.engensa.com/
[3] Zonline, http://www.zonline.nu/
[4] Sunseap, http://www.sunseap-leasing.com/



Entrants in the US solar service market for photovoltaic and heating panels (studied firms marked as "CASE FIRM")

The solar service market has spread solar technology to new groups of end customers. According to researchers at the US National Renewable Energy Laboratory, the firms using solar service business models *"have enticed a new demographic to adopt PV, likely by reducing or removing several adoption barriers, [...] repackaging PV value into a simple monthly bill savings rather than a payback time on the order of decades"*[5].

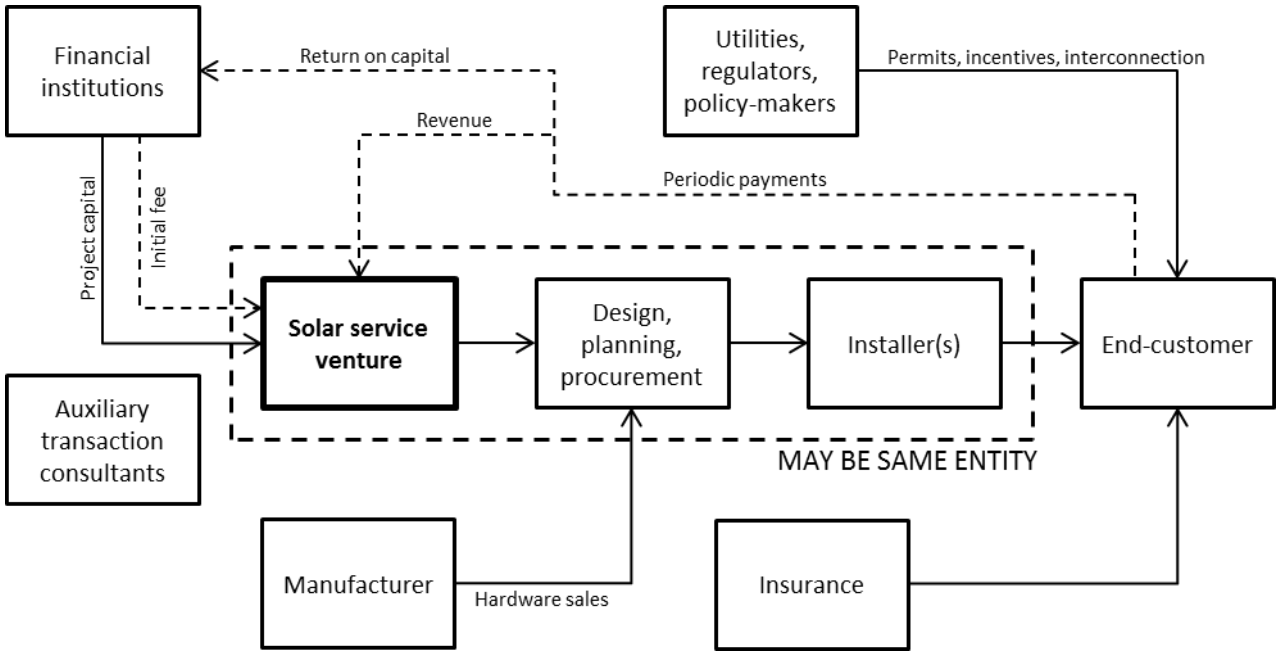
What is the bottleneck to growth for this kind of intermediary service market? This research points clearly to the entrepreneurial effort required to build intermediary service companies as a major constraining factor. The intermediary ventures pioneering these markets undertake a monumental entrepreneurial task – to bring all parties needed for the offering together simultaneously within strict financial boundaries. As the ventures provide a full solution to the end customer, they have to arrange financing, insurance and permits for the installation, contract installers, oversee procurement and design, and negotiate interconnection with utilities to be able to sell surplus solar electricity to the grid. Not until all this is in place do the ventures see a cash flow, which then comes in the form of an initial fee from financial project partners and later from back office and O&M services to existing installations.

The initial creation of an intermediary service offering is a taxing process, and one that demands a high degree of entrepreneurial skill. The reward for taking on that task can be a fast-growing company once all the pieces of the service offering are in place. SolarCity, a solar service firm that launched its service offering in 2008, was the largest US installer of residential solar installations in 2011[6]. SunEdison, one of the pioneering firms, built solar projects between 2005 and 2012 with a combined generating capacity of almost a gigawatt, using a total $ 3 bn in project financing[7].

[5] Drury, E. et al., 2012. The transformation of southern California's residential photovoltaics market through third-party ownership. *Energy Policy*, 42, p689

[6] Krulewitz, A., 2012. *Who Reigns Supreme in Residential Solar?*, Greentech Solar [http://www.greentechmedia.com/articles/read/who-reigns-supreme-in-residential-solar]

[7] http://www.sunedison.com/wps/portal/memc/aboutus/whoweare/ourexperience/



Key parties and resource flows needed to create a solar service installation (not illustrating underlying financial / legal structures)

My research set out to understand the process through which the early solar service entrepreneurs created their customer offerings by bringing all necessary counterparties together, thereby kick starting the solar service market. It is my hope that this work may provide insights of use to new ventures and their counterparties wherever the business model is applied again.

For an in-depth look at how the solar service offering works once in place, rather than the process of creating it, please refer to the suggested further reading on the last page of this report.

My main method of research was an in-depth study of 6 US ventures, selected from the database above. Five were active in the solar photovoltaic industry, and one in the solar heating industry. The bulk of my research was made up of interviews with the founding teams, and with their early financial or installation counterparties. In addition, I made extensive use of documents on the firms from themselves and from third parties, visited trade fairs where the firms were represented, and interviewed industry experts, policy makers and regulators.

	SunPioneer	SunPath	SunBuilder	SunFinance	SolarPrivate	SolarHeat
Relative market entry	Pioneer	Follower	Follower	Late follower	Follower	Pioneer
Customer niche	Commercial / institutional	Commercial / institutional	Commercial / institutional	Commercial / institutional	Residential	Commercial / institutional
Technology used	Solar electric	Solar electric	Solar electric	Solar electric	Solar electric	Solar heating
Additional business models	(Equity-only installations before bank financing)	No	No	No	Direct cash sales of solar installations	(Equity-only installations before bank financing)
Installed MW first 3 years	2006-2009: <100	2008: 1 2009: 1 2010: <5	2007: <5 2008: >10 2009: >15	2010: <1 2011: >1 2012: >5	2010: <5 2011: >5 2012: >10	2010: <1 2011: >1 2012: >5
Exit	Sold in 2009	No	Sold in 2011	No	No	No
Location of early value creation	California, other US states	California, New Jersey	California	Washington, DC, other US states	California	Washington, DC

Studied US solar service firms (anonymized)

FINDINGS OF RELEVANCE TO NEW SERVICE VENTURES

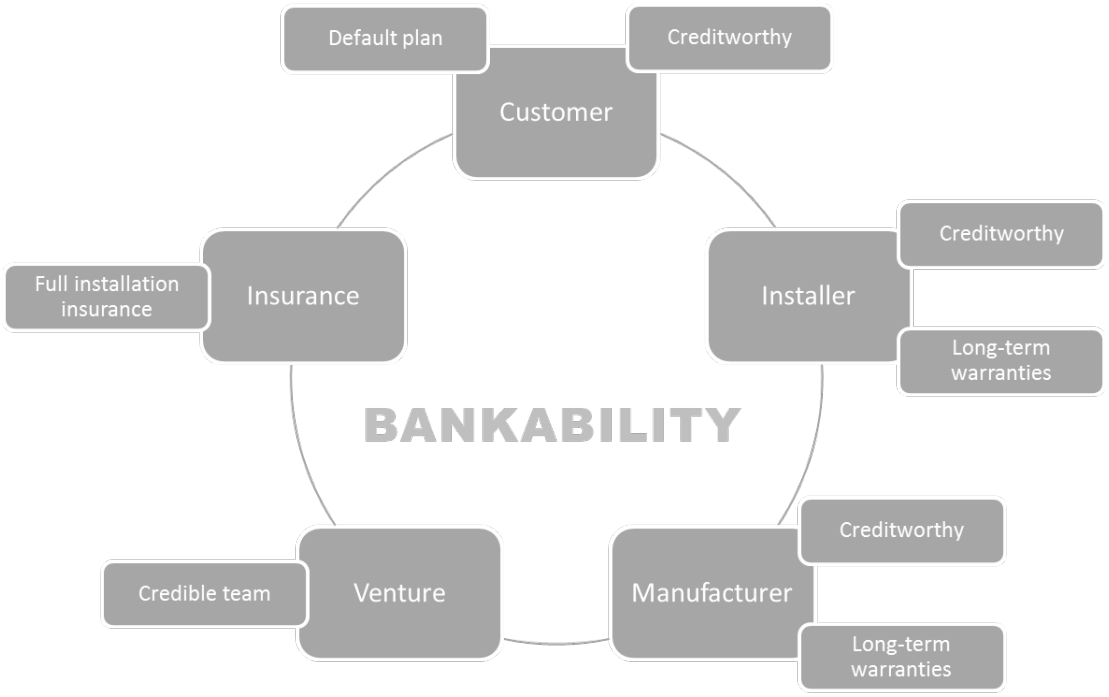
How are solar service ventures built? The firms analyzed in this research project typically lacked significant intellectual property or other proprietary assets. This meant that the new value they created mainly was a product of the ecosystem they created through bringing together other actors in a network, and the way in which they structured interactions in that network. They differed from the vast majority of new ventures in other industries by the number of partnerships they needed and the time-critical way in which those ties had to be formed and sequenced.

Of all their connections, those related to financing were by far the most difficult to obtain. In contrast, end customers were often seen as abundant, and not the main concern for any of the solar electric ventures. This was different for the solar heating venture, which had a smaller potential customer base to choose from.

	SunPioneer	**SunPath**	**SunBuilder**	**SunFinance**	**SolarHeat**	**SolarPrivate**
Non-commercial relationships	State regulators State policy makers Utilities	State regulators Utilities	Utilities	State policy makers Utilities	State regulators Local regulators	State regulators Local regulators Utilities
Installers	Vertically integrated	3-6	3-6	3-6	2	Many
Financial partners	2 banks	1 bank	2 banks	1 bank, Aggregated individuals	Aggregated individuals	1 bank
Insurance firms or agents	1 insurer, 1 broker	1 broker	1 insurer	1 insurer, 1 agent	1 insurer	2 insurers
End customers	3-6	3-6	3-6	3-6	3-6	Many

Type and number of counterparties during first 1-2 years of value creation

Called "bankability" in the sector, the ability to finance a portfolio of installations through banks was a pivotal skill developed by the ventures. Bankability followed from minute attention to how and with whom the ventures' other relationships were formed, so that all demands of the financial partners were accommodated. Only creditworthy end-customers could be involved; only well-proven equipment from large and reliable manufacturers with strong warranties could be installed; and installers had to be reputable and provide warranties for their work. Insurance had to be procured.



Key aspects of "bankability" – the ability to secure bank financing for a solar installation

In order to form these partnerships simultaneously while achieving bankability, the ventures relied strongly on two strategic processes:

- Tutoring of counterparties – extensive information transfer on areas counterparties needed to understand in order to work with the venture
- Constant cycling between multiple negotiations, in order to form all partnerships simultaneously on identical terms

Compared to product ventures, reliant on processes for internal product development and product sales to end-customers, these key strategic processes of the solar service ventures mark a different kind of entrepreneurship.

Tutoring, the transfer of large amounts of information to counterparties in order to establish a common knowledge base on which the partnership could operate, was critical. In the case of financial and insurance partners, tutoring focused on the solar installation and the ventures' business model; for installers, tutoring centered on how to create quality standards, detailed budgeting and other traits of a professional growth market that many solar installers were initially unused to.

Tutoring was often combined with two other knowledge management processes: screening of counterparties to find those with most pre-existing knowledge before entering into tutoring; and carefully coordinated co-learning with partners when new knowledge had to be acquired by both parties (for example on legal details or new policy) in order to close negotiations.

Cycling in-between counterparties was a central strategic process, not only due to the time-critical character of the value creation, but also as different partners often made requests on which other partners the venture had to work with, or expected other partnership discussions of the venture to be closed before committing to joint value creation. This often created chicken-and-egg situations for the ventures, only to be solved by rapid and constant cycling between negotiations and tutoring processes.

The critical nature of these two strategic processes is in contrast to other strategies that were expected from prior research literature to be important. For example, risk reduction by creating redundant ties with many similar partners was a strategy seldom used, mainly as the venture teams had little bandwidth left beyond negotiations they needed to pursue. Building on the venture teams' previous contacts was typically not a prominent strategy to access partners, as the partnerships needed for value creation were so specific that they were unlikely to overlap with any pre-existing network of entrepreneurs. Typical sales processes, involving symbolic or visionary communication and elaborate rapport-building, may have

occasionally mattered but were very much subordinate to the essential processes of knowledge transfer and cycling.

The ventures often had to influence and rely on non-commercial partnerships using the same strategic processes as for their commercial partners. Several firms closely interacted with and tutored state energy boards, local zoning departments, and the interconnection departments of utilities, for example.

Variation among the ventures

The ventures were cross-compared to identify differences in process related to market entry, business model or technology.

Use of a different technology did not alter the processes described above. SolarHeat, which created a service solution around solar heating rather than photovoltaic panels, did not depart from the partnering patterns of other ventures.

The number of end-customers a firm worked with seemed clearly linked to the structure of its partnering processes. SolarPrivate, which worked with a large number of small residential end-customers, had to standardize and formalize its process of negotiating with customers, local permitting authorities and installers to a much higher extent than the other ventures.

Being a pioneer of the service business model, as SunPioneer was in the solar electric market and SolarHeat was in the solar heating panel market, meant relying on even more extensive tutoring and cycling, as counterparties were less knowledgeable and more risk concerned than they would be when they were later contacted by followers. Both firms found that they had to start their business slowly by creating pilot installations with their own funds, rather than with bank financing, to demonstrate business model viability to prospective partners.

The negative externality of building a solar service venture

When a venture used tutoring and cycling to reach value creation it left partners with a roadmap for how to carry out further similar

work – with or without the same solar service venture. An ecosystem was created that could be entered by other actors focused on similar value creation. Conversely, all the follower ventures reported benefitting from the work of other solar service firms.

Several of the firms described trying to protect the value they created through their education and binding together of networks, yet failing to find reliable ways to do so, at least beyond the temporary protection that the personal relationships to partners might offer. In this sense, the establishment of an ecosystem of partners through tutoring and cycling was a negative externality for the solar service firms, limiting the entrepreneurial rent they could extract from their actions.

Transfer of conclusions to other industries / countries

To what extent would the strategic processes described above be critical to intermediary service ventures in other sustainable technology industries?

Ventures aiming to build intermediary service solutions are likely to encounter fairly similar conditions, irrespective of their industry. The strategic importance of efficient cycling between negotiations with potential partners is likely to apply widely, as anyone attempting to use this business model has to complete its full portfolio of partnerships simultaneously. However, in an industry where fewer partners are needed, cycling may become less taxing. For example, intermediary service ventures in car sharing do not rely on installers, and hence one degree of complexity is removed from their portfolio.

Tutoring of counterparties is likely to be important in all cases where partners that do not share the industry knowledge of the venture are needed. To use the car sharing example again, such a venture may rely on financing from car leasing firms, which are used to analyze risks in the car industry, something that would lessen the need for information transfer. In the case of most other technologies, it is unlikely that financial partners and insurers will know the technology well, or that installation partners will be used

to the sort of highly structured construction processes needed for third party financed installations.

To what extent can ventures from outside the US use the findings? For entrepreneurs in developed markets, the particularities of the US market – such as certain types of regulations or financial vehicles – may be a reason for concern. Yet the critical strategic processes were mainly related to ties formed with commercial parties, likely to be similar to those in other developed countries.

For entrepreneurs in developing markets, issues of trust and underlying infrastructure (such as the ability to obtain credit ratings for end customers) may be pressing issues to clarify before being able to use these partnering processes successfully.

FINDINGS OF RELEVANCE TO POLICY MAKERS

Facilitating the emergence of intermediary service ventures in sustainable technology industries can benefit the goals of policy makers with a green or resource-conserving agenda. For the solar service area, it has been concluded that:

Policies that enable third-party PV products [i.e., solar service firms] to enter new markets, or policies that target similar barriers to PV adoption, represent strong opportunities for stimulating PV demand in concert with traditional incentives that reduce system costs or increase revenues. These opportunities frequently represent low-cost or cost-neutral policies that have the potential to dramatically increase PV demand by enticing new customers to adopt PV that are associated with a significantly larger population demographic.[8]

The research summarized in this paper provides additional observations that may be of help to policy makers wishing to see the success of the solar service firms repeated in new geographies or industries.

[8] Drury, E. et al., 2012. The transformation of southern California's residential photovoltaics market through third-party ownership. *Energy Policy*, 42, p689

The commercial front is far behind the technology innovation front

A general observation is that the commercial front of the solar market is far behind the front of new solar technology, due to the bankability phenomenon. In order for banks to finance a technology, for insurers to provide full insurance coverage, and for manufacturers and installers to feel comfortable providing warranties, a robust and time-tested technology must be used by the intermediary service ventures that launch these services.

Understanding of bankability deserves more focus when energy R&D is planned, and calls for innovative policy making when helping to commercialize new energy innovations. One topic for policy makers to explore may be aid to commercialization through the compiling and publishing of performance data on new technologies, which would provide information critical to bankability.

Incentives to support entrepreneurs are different from those supporting end-customers

An intermediary service industry works differently from a product market, and the ultimate aim of supportive policy for such a market should be to attract entrepreneurs into developing firms, rather than to push customers to make one-off purchases. To nudge entrepreneurs into creating intermediary service ventures, stable and well-defined policy instruments are needed. For example, the tradable Renewable Energy Certificates issued by some US states – albeit initially very generous – were unpredictable and widely disliked by the entrepreneurs. For those entrepreneurs that expanded into markets with RECs, the instability of the instrument created severe problems. On the other hand, the robust and century-old concept of tax equity, a policy instrument providing tax breaks to investors in infrastructure assets, was simple in terms of benefits, had been used widely in other sectors, and was typically seen as a positive and important policy instrument by entrepreneurs once it extended into the solar market. It had clear end-dates and could not change significantly during its active period. It was occasionally difficult to find suitable tax equity investors, but that was ultimately a question of a market imbalance

that could be solved by skillful entrepreneurs in co-operation with their financial partners.

Helping remove practical barriers may be more powerful than creating incentives

Standardized and transparent regulation of technology installation and maintenance procedures can be a great help to entrepreneurs. The devil was in the details for the solar service ventures: to ensure a profitable operation, it was critical for them to sort out how to successfully manage building regulations, utility interconnections, and access to installations in the case of customer default, to name but a few regulatory areas. In addition to battling with the vastly more powerful utilities, this demanded interaction with a number of institutions unrelated to the energy area, such as tax authorities, fire authorities, and zoning departments. Clear and homogenous guidelines for such regulatory bodies and common industry standards applied to different cities and regions can help reduce costs and be a great aid to the growth of intermediary service markets.

FINDINGS OF RELEVANCE TO TECHNOLOGY FIRMS

This research shows how the requirements of intermediary service firms, rather than end-customer preferences, may shape demand for sustainable technology products. Technology managers at manufacturing firms can benefit from three observations:

- Technology bankability is pivotal to intermediary markets. To be bankable, a technology needs long-term performance data validated by third parties, and strong warranties made by a creditworthy firm. This means that the prospects of intermediary service markets for novel technologies, or for small manufacturers without credit ratings, are limited.
- For technology markets in which installation services are needed, installers influence the viability of intermediary business models. If installers cannot install a technology cost-efficiently, or if there are too few installers to scale up

the market, it is difficult for entrepreneurs to create intermediary ventures. Again, this limits the prospects of intermediary service markets for novel technologies.

- Intermediary service ventures can act as lead users and contribute significantly to product innovation – they are often among the most sophisticated and experienced customers of the technology they are using.

Finally, manufacturers may also want to use the findings on how new ventures create the business model to evaluate whether they could apply this business model themselves. As was clear from the industry database, several manufacturers have entered the solar service markets since the beginning of 2009.

Suggested further reading on the solar service market

Coughlin, J. & Cory, K., 2009. *Solar Photovoltaic Financing: Residential Sector Deployment*, Golden, Colorado: National Renewable Energy Laboratory

Kollins, K., Speer, B. & Cory, K., 2010. *Solar PV Project Financing: Regulatory and Legislative Challenges for Third-Party PPA System Owners*, Golden, Colorado: National Renewable Energy Laboratory

Acknowledgements

This research could not have been written without the support of a large number of people. I am indebted to all informants of the studied ventures and their financial and installation partners who were more than kind to share their memories of the early solar service industry. In addition, I wish to thank Dr Elizabeth Garnsey (University of Cambridge), Dr Damian Miller (Orb Energy), Richard Kaufmann (DoE), David Feldman (NREL), Dan Oros (KPCB), Professor Kathleen M. Eisenhardt (Stanford University), Reinhard Reicher (IFC) and Dr Johann Napp (Bain) for their generosity in aiding this work. Finally, the research could not have been conducted without kind financial support from RADMA, SWECO and Churchill College, and the encouragement of my previous employers at Sustainable Technologies Fund (Stockholm).

Source of this research summary

Overholm, H., 2013. *Genesis of an Ecosystem: Alliance Initiation by Technology-Intermediary Ventures*, Unpublished PhD thesis submitted for examination to the University of Cambridge

Contact

Harald Overholm
Institute for Manufacturing
17 Charles Babbage Road
Cambridge, CB3 0FS, UK
E-mail: haraldoverholm@gmail.com