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Business Models for Sustainable Energy Development

By Ans Kolk & Daniel van den Buuse

Business-led approaches to accessing energy in development countries are becoming key factors to sustainable market development. Given the major challenges in this market, companies will blend commercial and donor-funded activities, while simultaneously finding innovative ways to bring renewable energy technologies beyond the energy grid. Collaborative approaches by companies and public actors focused on private sector development seem crucial at this stage to further upscale emerging business models in this market.

The global pathway towards a more sustainable energy future has widely been recognised as a key challenge for the 21st century. Especially access to energy is crucial as 1.3 billion people in developing countries lack access to electricity, while the United Nations (UN) aim at universal access to modern energy services by 2030.1 The issue has gained real momentum in recent years, also because 2012 was labelled as the international year of ‘Sustainable Energy for All’ by the UN. At the same time, international interest in the role of business in furthering development has increased over the past decade, with the importance of business-based, sustainable approaches being emphasised by academics and practitioners. To contribute insights, this article explores the role of business in establishing access to sustainable energy in developing countries, given the lack of insight into the ‘whether and how’ of viable business models in economic, social and environmental terms. It starts by outlining the main challenges and opportunities, to subsequently introduce a business model perspective, using illustrative cases from our own research,2 while also offering some broader reflections on dilemmas and modalities.

Sustainable energy development: What is the problem?

Energy, often characterised as the ‘life-blood of modern societies’, is seen as fundamental for economic and social progress in developing countries. Energy can act as an incubator of economic activity and have an important impact on long-term poverty reduction. It increases livelihood options by allowing households to engage in a more diverse range of income-generating activities, and can make pre-existing activities more efficient. Energy is directly linked to increased income and productivity, and indirectly to enhanced levels of health, education, quality of life, and human development in general. Given the centrality of energy for sustainable development, wider and greater access to energy services is critical for achieving all of the Millennium Development Goals.3

In many developing countries, it is financially, technologically and organizationally almost impossible to extend the central grid to all remote and rural parts of the country.
RETs are not yet widely adopted in developing countries due to a lack of available infrastructure for RETs, which creates high initial capital costs for RET-based electrification projects, and limits the possibilities for a wider, sustained market development.

Considering that approximately 80% of the people in developing countries who lack access to electricity live in rural areas beyond the reach of the electricity grid, rural electrification is a crucial issue in access to energy. The conventional approach to electrification has been to extend the electricity grid powered by centralised fossil fuel-based power plants operated by the national utility. This is based on the model adopted in developed countries, where national governments had traditionally created such systems. In many developing countries, however, it is financially, technologically and organizationally almost impossible to extend the central grid to all remote and rural parts of the country. Grid-connected electricity is often only available in urban areas, because of high costs for connection and subsequent power transmission losses resulting from the large distances that need to be bridged. Given this situation, the best way to still create access to energy is the application of off-grid and decentralised solutions for energy provision, either based on existing technologies such as diesel generators, or on emerging renewable energy technologies (RETs), widely regarded as potentially most sustainable.

A diverse range of RET-based applications for decentralised off-grid electrification including solar, wind, hydro and hybrid systems has become available in recent years. Main applications include solar home systems applied to individual homes, schools or hospitals, village-scale mini-grids powered by solar, wind or hybrid technologies, small-scale biomass gasifiers with gas engines, and hydropower installations on a pico-scale, micro-scale or small-scale. In addition, solar photovoltaic based products and solutions, including solar lanterns primarily for lighting, have found their way to the market. Selecting the best technological configuration for rural electrification from the available options should be done on a case-to-case basis, as the specific conditions in a geographical area determine the most effective solution. Several general characteristics of RET-based approaches, including the efficiency, adaptability, repairability, and ease of use of the technology, are rather context-specific and dependent on the needs of the end consumer. Furthermore, reliability and affordability are seen as crucial aspects in this respect as well.

Given this wide spectrum of renewables-based electrification options, one could argue that there is potentially a major unexploited market out there for companies marketing renewables-based electrification solutions in areas beyond the grid, using innovative business models. However, reality is somewhat different. While decentralised RET-based electrification offers clear benefits from an environmental and social perspective, it also has major challenges that fuel the debate on whether RETs have economic viability in developing counties. Many technologies developed to date with the intention to be implemented in developing countries did not achieve commercial viability, or remained limited to charitable distribution programmes by donor organisations. In addition to challenges related to financing and upscaling beyond pilot projects, RETs are not yet widely adopted in developing countries due to a lack of available infrastructure for RETs, which creates high initial capital costs for RET-based electrification projects, and limits the possibilities for a wider, sustained market development. As a result, creating the right kind of incentives to step up investments in off-grid energy solutions and designing long-term viable business models to sustain rural electrification has been very difficult for for-profit companies.

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Models for RET-based electrification

While the range of models for RET-based electrification is rather diverse in the studies that we reviewed, the basic mechanisms involved in both delivery and financing are rather comparable. Elsewhere we have positioned existing approaches on two dimensions: the extent to which subsidies are included in the models in question, and the nature of the actors involved. Below we will discuss some key elements as background for the further discussion.

At one extreme, there is the traditional philanthropic model, a donor-driven approach in which developed countries provide funding to developing countries on a project basis, and government organisations are fully in charge of all aspects related to the RET-based electrification system. This does not provide a basis for establishing a viable market, and organisations such as the World Bank are emphasising the need to move beyond this model. The other end of the spectrum consists of a commercially-led delivery model based on cash sales, with zero subsidies. This resembles a classic market-based model in which private organisations and/or individuals are end users of the electricity, own and finance the system and are fully responsible for installation and maintenance – roles all fulfilled by a government organisation in the previous model. This variant only works for households with sufficient purchasing power, which excludes the (poorest of the) poor.
Table 1: Six questions that underlie a business model

<table>
<thead>
<tr>
<th>Question</th>
<th>Some subcomponents</th>
</tr>
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<tbody>
<tr>
<td>How will the firm create value?</td>
<td>• Peculiarities of the offering</td>
</tr>
<tr>
<td>For whom will the firm create value?</td>
<td>• Market factors such as business-to-business or business-to-consumer, local-international, value-chain position of customer, market segments</td>
</tr>
<tr>
<td>What is the firm’s internal source of competitive advantage?</td>
<td>• Internal capability factors including production, sales, technology, finance, supply chain management, leveraging of networks and resources</td>
</tr>
<tr>
<td>How will the firm position itself in the marketplace?</td>
<td>• Competitive strategy factors such as operational excellence, product/service quality, innovation/cost leadership, customer relationship/experience</td>
</tr>
<tr>
<td>How will the firm make money?</td>
<td>• Economic factors such as pricing and revenue sources, operating leverage, volumes and margins</td>
</tr>
<tr>
<td>What are the entrepreneur’s time, scope, and size ambitions?</td>
<td>• Type of investment model (e.g. subsistence, income, growth, speculation)</td>
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In between these two, we find several other models including a multi-stakeholder approach, in which private entities are still end user of the electricity and have ownership over the installation, but financing in is provided by a donor, financial institution or dealer through a low to medium-size investment in the overall project. Micro-financing is additionally mentioned as a possibility as well, although this instrument in general has not been without criticism. Fee-for-service model models, in which a national utility or energy service company owns, finances and maintains the installation, and is responsible for maintenance while periodically charging a fee to households based on usage may be combined with an affordability payment scheme or specific subsidy. There are also other models in which subsidies are integrated, such as a regulated purchase tariff with subsidies that complement tariffs paid by consumers, or fund electricity producers either for the number of connections established. Also, financing via power purchase agreements that guarantee producers a specific price and a minimum purchase to stimulate investments.

In the past decade, international governmental and non-governmental organisations have been key actors in RET-based electrification through different kinds of partnerships and financing schemes. Interestingly, views on the most appropriate delivery and financing models, and the role for public and private actors, have shifted over the years, however. The desirability of models carried out by private actors, either through public-private partnerships or without subsidies at all, is the most recent phenomenon in a field that has traditionally relied on donation-based, ‘donor-driven’ projects. As such, there is an increasing recognition of the importance of private sector involvement for long-term sustainability in establishing energy markets in developing countries. The emphasis on private sector approaches is also reflected in the United Nation’s ‘Framework for Action’: “In many off-grid situations, small-scale sustainable energy solutions for productive uses of energy are not only affordable under the right business models, but cheaper than current sources of energy. This creates opportunities for local business development consistent with all the objectives of Sustainable Energy for All”.

Still, key here is gaining insight in how and to what extent RET business models can become viable and thus sustainable in both economic and social/environmental terms. To shed some light on these aspects, we examined three illustrative cases of bottom-up business initiatives of local companies.

There is an increasing recognition of the importance of private sector involvement for long-term sustainability in establishing energy markets in developing countries.

A business model perspective with three illustrative cases

We explored many publications on business models in search of the most suitable framework for examining the issues outlined above. The most appropriate model appears to be an open set of questions at the foundation level, as summarised in Table 1, coupled with a proprietary level that considers the unique innovation of the specific venture.

Considering these questions, we examined local companies in off-grid energy solutions in Asia, which include Kamworks (Cambodia), Sunlabob (Laos), and Husk Power Systems (India) (see Table 2). Primary and secondary data was collected during a field research trip to Asia, through semi-structured interviews with entrepreneurs and experts in the field, and from public sources.

Overall, local companies in off-grid rural electrification offer a portfolio of energy ‘solutions’, generally consisting of different renewable-energy technologies to various customers: business-to-business and/or business-to-consumer, in a range from individual-level to village-level products and services. End-consumers vary in their ability to pay as many are poor which means that there is often financial support via donor organizations, in which case these organizations can be argued to resemble, in a sense, a ‘business’ customer (as end-consumers are beneficiaries).

The three companies exhibit some differences in terms of size, product-service solutions and customers. All three are locally-focused in their respective home countries; only Sunlabob has started some activities on a project basis in other countries as an outflow of their international recognition and contacts. Husk Power Systems is unique for its...
Table 2: Some characteristics of the three local companies included in this article

<table>
<thead>
<tr>
<th></th>
<th>Husk Power Systems (HSP)</th>
<th>Kanworks</th>
<th>Sunlabob</th>
</tr>
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<tbody>
<tr>
<td><strong>Year of creation</strong></td>
<td>2008</td>
<td>2006</td>
<td>2000</td>
</tr>
<tr>
<td><strong>Country of origin</strong></td>
<td>India</td>
<td>Cambodia</td>
<td>Laos</td>
</tr>
<tr>
<td><strong>Countries/(sub) regions of activity</strong></td>
<td>Main market is India’s Bihar state</td>
<td>Main market is Cambodia</td>
<td>Main market is Laos, also international activities on project basis in Thailand, Cambodia, Uganda, Sierra Leone, Mozambique, Liberia, and Afghanistan (some starting from 2012 onwards)</td>
</tr>
<tr>
<td><strong>Main products/technologies</strong></td>
<td>Biomass gasifier running on rice husk, distributed by village grid</td>
<td>Grid-connected and off-grid solar systems, water systems (pump), solar home systems (sizes 20W to 320W), Moonlight solar lantern, solar-powered cooling</td>
<td>Grid-connected solar systems, village grid systems (technologies: hybrid, solar, hydro, wind), solar home systems (sizes 20W to 150W), solar lanterns, water systems (pump, purification, treatment, heater), solar-powered cooling</td>
</tr>
<tr>
<td><strong>Main services</strong></td>
<td>Installation and maintenance, training programmes through Husk Power University</td>
<td>Installation and maintenance, awareness raising and demonstration, rental scheme on solar lantern</td>
<td>Installation and maintenance, consultancy on electrification and energy efficiency, project management, training programmes, awareness raising and demonstration, rental schemes on energy systems and solar lanterns</td>
</tr>
<tr>
<td><strong>Types of customers</strong></td>
<td>b-to-c, predominantly low-income customers in rural India</td>
<td>B-to-b and b-to-c, broad customer base from organisations/business to middle- and low-income customers in rural Cambodia</td>
<td>B-to-b and b-to-c, broad customer base from organisations/business to middle- and low-income customers in rural/urban Laos</td>
</tr>
<tr>
<td><strong>Size</strong></td>
<td>350 employees (6 executive management)</td>
<td>Not specified (estimated 15-25 employees)</td>
<td>Around 70 employees</td>
</tr>
<tr>
<td><strong>Subsidies obtained</strong></td>
<td>Investments from a number of organisations including international organisations, foundations, venture capital firms, and non-profit venture funds</td>
<td>From international (development) organisations for supplying and installing RET-based energy solutions on project-basis, which includes the World Bank and Energy &amp; Environmental Partnership Mekong</td>
<td>From international (development) organisations for supplying and installing RET-based energy solutions on project-basis, which includes the World Bank, Asian Development Bank, and United Nations/UNIDO</td>
</tr>
<tr>
<td><strong>Partnerships within private sector</strong></td>
<td>Investors include Shell Foundation, Draper Fisher Jurvetson (DFJ), LGT Venture Philanthropy, Bamboo Finance (Oasis Capital), and Cisco</td>
<td>Includes private sector partners for supply of products (organisations not specified)</td>
<td>Includes private sector partners for supply of products (21 organisations), projects &amp; implementation (11 organisations), and business strategy development (3 organisations)</td>
</tr>
<tr>
<td><strong>Partnerships with governmental actors</strong></td>
<td>Includes The Ministry of New and Renewable Energy (MNRE), Govt. of India and World Bank/IFC</td>
<td>Includes Agentschap NL (Netherlands) and GIZ (Germany)</td>
<td>Includes United Nations/UNESCAP, World Bank/IFC, GIZ (Germany), SES (Germany), Lao Institute for Renewable Energy (URE)</td>
</tr>
<tr>
<td><strong>Partnerships with non-governmental actors</strong></td>
<td>Includes the Acumen Fund</td>
<td>Includes Energy &amp; Environmental Partnership (EEP) Mekong, PicoSol Cambodia, CIIC/Crédit Mutuel Kampuchea, the Delft University of Technology (Netherlands), the University Twente (Netherlands), and Kofi Annan Business School (Netherlands)</td>
<td>Includes The Asia Foundation, Engineers Without Borders Australia, FK Norway, Cambodia Rural Development Team, World Volunteer</td>
</tr>
<tr>
<td><strong>Key achievements/statements</strong></td>
<td>(1) “The company designs, installs and operates biomass-based power plants. Each plant uses proprietary gasification technology to convert abundant agricultural residue (procured from local farmers) into electricity, which is distributed to rural households and micro-enterprises through a micro-grid system - providing a better quality, cheaper way to meet energy needs” (2) “Consumers pre-pay a fixed monthly fee ranging from US$2 to US$2.50 to light up two fluorescent lamps and one mobile charging station. This offers consumers savings of at least 30% over kerosene and diesel energy sources” (3) “Since 2008, HPS has successfully installed more than 80 plants in Bihar, providing electricity to over 200,000 people across 300 villages”</td>
<td>(1) “Kanworks tries to introduce the so-called energy ladder: for the lowest income household we have the Moonlight (a solar-powered lantern), and for the medium and higher income households we have solar home systems in 20 watt, 40 watt and 80 watt” (2) “In the first place Kanworks sells and installs solar electricity systems for professional end-users that have a need for electricity in the rural areas (high-end). In the second place, the company imports, develops, produces and sells products based on solar electricity for the consumer market (low-end)” (3) ”International experience shows that the biggest problems with battery operated solar systems are usually related to the quality of the product and lack of a functioning local service network”</td>
<td>(1) “Sunlabob operates as a profitable, full-service renewable energy provider, providing commercially-viable energy services” (2) “Sunlabob believes that responsible, long-term oriented entrepreneurship is the driving force for sustainable economic development and for providing managerial, technical, and financial resources needed to meet social and environmental challenges” (3) “Sunlabob installed more than 10,000 systems in over 500 villages and locations in Laos” (4) “Sunlabob has successfully initiated a rental service for energy systems and a Solar Lantern Rental System that allows households and villages to afford electricity”</td>
</tr>
</tbody>
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Source: Derived from A. Kolk & D. van den Busee (2012). In search of viable business models for development: Sustainable energy in developing countries.

cost-effective electricity generation through a biomass gasifier running on discarded rice husk, abundantly available in rural India, which is subsequently distributed through a village grid. This is a specific business model and technology developed by Husk Power Systems aligned to local conditions. Although based in two different countries, Kamworks and Sunlabob are rather similar in many respects, considering their main products/services, types of consumers and the fact that they are run by an entrepreneur strongly embedded in the local/regional context. One dissimilarity is Kamworks’ primary orientation at solar energy, which means that it is more focused in the type of renewable energy than Sunlabob. Different from Husk Power Systems, which predominantly cater to low-income (end) consumers only, Kamworks and Sunlabob serve a broader mix of customers, including local business on a fully commercial basis as well as end-consumers, villages and/or individuals, who pay themselves or are (partly) funded via international donor projects. This relates directly to the economic factors and types of investment models of the local companies.

All companies strongly advocate market-oriented approaches and entrepreneurship. At the same time, they generally have a variety of (non-)governmental partners with which they collaborate. Often these serve to gain, for example, access to subsidies or other types of support from international organizations to service the real poor and/or start up a business in renewable off-grid energy. There are differences in the degree to which the local companies rely on such external sources. Kamworks and Sunlabob have a mixture of self-sustaining commercial activities alongside subsidized projects based on donor funding. The latter type is focused at reaching the poorest consumers while commercial activities target business markets or middle-class consumers. Husk Power Systems has designed an innovative for-profit model based on specific local circumstances, which has potential to be scaled up. Still, the company has several socially-oriented investors, including the Shell Foundation.

While commercial activities are undertaken by all case companies, there needs to be funding for poor people to be able to get access to energy either via an arrangement like this or another type of (external) support.

Key findings
Some key strengths of these local companies as private sector based entities in this market include:

- **Blending commercial and donor-funded activities** - While commercial activities are undertaken by all case companies, there needs to be funding for poor people to be able to get access to energy either via an arrangement like this or another type of (external) support, with a clear role for governments, international governmental and non-governmental organisations, corporate philanthropy or social venture capital. Reliance on micro-finance ‘soft credit’ schemes or developing rental schemes in conjunction with micro-finance institutions and donors (as Sunlabob and Kamworks do), can be crucial in terms of affordability for end-consumers. Funding is also necessary for covering upfront investment and operating costs because it is relatively expensive to set up and maintain a stable system of electricity provision in remote rural areas – those locations where the true challenge of ‘sustainable energy for all’ lies.

- **Adaptability to local conditions** - A major strength of these companies is their adaptability to local conditions, as opposed to more generic one-size-fits-all electrification solutions. As these companies are, almost by nature, embedded in local communities and possess in-depth knowledge of the distinct characteristics of markets and consumers, they seem better able to develop context-specific solutions which also creates legitimacy for their approach. Kamworks in Cambodia and Sunlabob in Laos follow a model with segmentation based on income levels and energy needs, thereby providing the appropriate technological solution that suits consumers best. Taking Kamworks as an example, the company emphasizes its commitment to introducing an energy ladder based on this need- and income-segmentation, whereby the lowest-income households have the opportunity to purchase a Moonlight solar-powered lantern (through a rental scheme, which reduces the upfront costs of buying a Moonlight and makes it more accessible), while those with higher purchasing power (individuals or companies) can buy somewhat more expensive systems.

- **Beyond pilot projects** - Funding for pilots and the start and set-up of the whole system is needed, requiring donors and/or socially-oriented investors with a longer-term orientation. With declining (relative) costs of renewable energy, possibilities to undertake more activities for less funding might increase, depending on local costs of buying a Moonlight and makes it more accessible), while those with higher purchasing power (individuals or companies) can buy somewhat more expensive systems.

Kamworks and Sunlabob have a mixture of self-sustaining commercial activities alongside subsidized projects based on donor funding. The latter type is focused at reaching the poorest consumers while commercial activities target business markets or middle-class consumers.
Private enterprises do not exclusively build their business model on market mechanisms, but rather combine commercial sales with donor-funded projects, thereby enhancing the importance of collaborative approaches by public and private actors in this market.

weather and geographical conditions, but a long-run commitment to a specific approach is necessary given the complexities of operating and building networks of suppliers. These types of support often run counter to donor approaches of funding for larger-scale one-off projects, competitive ‘bidding’ for grants, or shifting from one location/partner to another to cover multiple countries, satisfy diverse constituencies or jump on the bandwagon of a successful venture elsewhere.

- **Learning by doing approach** - There is also the issue, noted by interviewees, that ‘theoretically’ the role of the private sector is widely accepted, also by international (development) organisations, but that an understanding of the practical side of how business operates and what it requires to realise a profitable approach is something different. It is, for example in the case of sustainable energy, relatively easy to underline the importance of the ‘right’ business models, but the road to building and then supporting such bottom-up entrepreneurial activity to sufficient scale is complex and protracted. Large, stand-alone donor programmes can distort local markets if they do not relate to local companies that need to play a role in longer-term solutions – especially in the case of rural electrification, small-scale rather than large business will be actively involved.

**Concluding remarks**

The emergence of market-based approaches generally does not diminish the role of other (non-)governmental actors as the challenges of ‘sustainable energy for all’ are tremendous, and economic viability has been a real issue. A clear and increased recognition on an international scale of involving private sector actors at the local level to further longer-term sustainable development in this market is evident from our research. Private enterprises do not exclusively build their business model on market mechanisms, but rather combine commercial sales with donor-funded projects, thereby enhancing the importance of collaborative approaches by public and private actors in this market. This is worthwhile to consider in shaping the (future) involvement of companies in establishing long-term sustainable markets in combination with support from governments and donor organisations, where applicable. Some issues, such as renewable, rural off-grid electrification, may need a form of collaboration by public, private and non-profit actors who subscribe to trajectories that become economically viable in the longer run or that rely on mixed forms of funding or partnership arrangements. The specifics may differ depending on local circumstances, as some business models seem to have the potential for economic viability, provided that there is sustained commitment based on in-depth, local knowledge of markets, consumers and products/services.

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**Ans Kolk** is full professor at the University of Amsterdam Business School, The Netherlands. Her research areas are in corporate social responsibility and sustainability, especially in relation to international business and policy. Specific topics have included poverty and development; climate change and energy; bottom of the pyramid and subsistence markets; partnerships; codes of conduct and non-financial reporting; stakeholders and governance. Professor Kolk has published numerous articles in international journals (see [http://ssrn.com/author=105013](http://ssrn.com/author=105013)). In 2009, she received the EABIS/Aspen Institute Faculty Pioneer European Award (Lifetime Achievement Award) ([akolk@uva.nl](mailto:akolk@uva.nl); [http://www.abs.uva.nl/pp/akolk](http://www.abs.uva.nl/pp/akolk)).

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**References**

5. See the article included in note 2. The two dimensions ranged from fully subsidised to non-subsidised, on the one hand; and public or private actors, on the other hand.