Turning up the volume

Financial aggregation for off-grid energy

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The last decade has seen rapid growth among enterprises seeking to deliver decentralised renewable energy products to the more than one billion people who still lack access to electricity – but this sector is still at an early stage. The challenge is matching the scale of finance offered by investors with the finance needs of small-scale energy opportunities for poor households. Financial aggregation, however, bundles together energy opportunities, lowering costs and risk for investors. This paper gives an overview of innovation in financial aggregation and how it tackles barriers as well as insights into the implications of design choices.

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Summary

Over the last decade there has been rapid growth in the number of enterprises seeking to deliver decentralised renewable energy products and services to the more than one billion people who still lack access to electricity. Yet – while headway has been made in closing the energy access gap through products such as solar lanterns, solar home systems and mini-grids – the decentralised renewable energy sector in developing countries is still at an early stage. And investing in this sector presents the significant challenge of matching the type and scale of finance offered by investors with the finance needs of small-scale energy access for unelectrified households. In response to this challenge, innovative forms of 'financial aggregation' are emerging – bundling together energy opportunities to lower transaction costs, risks, and the cost of capital.[1]

This paper seeks to give an overview of experience and innovation in financial aggregation, highlighting how aggregation models tackle barriers to reaching scale in the decentralised small-scale renewable energy sector to provide electricity to those who lack access.

What is financial aggregation?

In the decentralised renewables sector, aggregation is not limited to finance:

- **Aggregating finance**: bundling financial products into a platform that offers scale and diversified risk for investors.
- **Aggregating demand**: such as communities joining up in energy cooperatives to aggregate their energy demand and access finance for a mini-grid,[2] or pooling demand in a region and bulk-procuring services to deliver household solar systems.
- **Aggregating enterprises or projects**: such as a portfolio of enterprises or projects delivering decentralised renewable energy services with similar technologies or business models.
- **Aggregating information**: such as platforms that seek to improve access to finance for decentralised renewable energy enterprises, through standardising the information that enterprises provide to investors: risk, returns and impact, or the credit-worthiness of the target population.

Challenges to accessing finance ...

Decentralised renewable energy finance comes with higher actual and perceived risk, increasing its costs. This includes market barriers, such as countries with significant off-grid populations having low scores on ease of doing business; technology and business model risk; lack of co-ordination between small-scale suppliers and enterprises; small deal sizes; young enterprises lacking historical performance data and proven track records; capital intensive businesses – and investors' belief that cash-poor household borrowers with no credit history are risky bets.

... and how aggregation can overcome them

Aggregating finance can overcome some of these challenges, reducing both risk and the cost of finance, and tackling market barriers. Financial aggregators can bring together enterprises or their assets into portfolios, diversifying risk across a number of investments and making the sector more attractive for investors. They can also play a role in reducing perceived risk by pooling together anonymised consumer credit information to prove the consumers credit worthiness in countries where consumers typically do not have established credit ratings. Bundling together smaller loans and assets from relatively small-scale decentralised renewable energy projects and enterprises can create investment products that meet the larger-scale needs of institutional investors. Finance aggregators can also

tackle some of the market barriers creating risk, such as policy, tax and regulatory barriers through having a single platform for investors and government to discuss challenges.

Different approaches to aggregation

Successful aggregation requires a pipeline of sufficient size, quality and common characteristics to be aggregated. To stimulate this young market, the aggregators we looked at did this either through specialising in aggregating renewable energy enterprises in a particular country, or specialising in enterprises using a particular technology or business model. Whilst the focus of this paper is on financial aggregation, a few models in the decentralised renewable energy sector seek to broker enterprises with investors through standardising project data.

By narrowing the focus of the aggregation platform, the aggregator reduces the technical knowledge it needs to make good investment decisions, providing assurance to investors of their understanding of a key element of risk. Financial aggregation largely focuses on the supply of finance, through a finance vehicle that bundles together many small-ticket deals with energy enterprises. But those platforms focusing on a geography were effectively aggregating demand, through bringing end users together to offer investors assurance of sufficient scale. Given the nascent nature of the market, many aggregators also offer business development services and/or training to the enterprises they support financially.

In a sector characterised by many small individual investments, **standardising** the investment process can reduce transaction costs. And the **financial instruments** used by the aggregators varied depending on the type of investors, the design of the instrument and the financial products being offered. Our **aggregator case studies** show the variety of aggregation characteristics across this developing market:

- **The Infrastructure Development Company Limited (IDCOL)** aggregates public investment for renewable energy development within Bangladesh.
- **The Alternative Energy Promotion Centre (AEPC)** is the parastatal agency in Nepal responsible for promoting small-scale renewable energy.
- **SunFunder** is a solar finance business that aggregates capital through private debt funds and deploys it into an aggregated portfolio of solar loans in developing countries.
- **Ignite Power** acts as an originating entity, selling solar home systems both directly and indirectly in Rwanda, Tanzania and Sierra Leone, aggregating demand and finance as well as procurement and operations.
- **E+Co** was a non-governmental organisation based in the US that made clean energy investments in developing countries from 1994 until it was restructured in 2012.

We also looked at other examples including the Ground_Up Project, an online investment platform, Climate Investor One, The Green Finance Catalyzing Facility, the MicroGrid Investment Accelerator, and the Climate Aggregation Platform.

Understanding aggregators' impact

The aggregator's bottom line is consistent **financial returns** – but donors and investors also have a strong interest in understanding the **social and environmental impact** of investing in this market. The primary non-financial indicator of success in this sector is the number of households that have gained **access to electricity**; for instance, IDCOL is credited with helping 4.5 million households in Bangladesh achieve basic electricity access through solar home systems. However, there is a risk that focusing entirely on the number of new connections could lead to perverse incentives – where the focus on getting new customers through expanding geographical coverage is of more importance than investing in the post-sales customer relationship through good maintenance and high-quality products.[9]

Emerging lessons

It is still an early-stage market. The aggregators explored in this paper are pioneers in that market, and future approaches to aggregation will need to learn from their challenges and successes, as well as adapt to a growing market. Some lessons that have emerged from our study are:

- **The value of hand-holding:** it is vital to support early-stage entrepreneurs to build the investment pipeline, as proving their business case is a prerequisite for achieving scale. There is also a case for public finance to support these services, given the public benefit arising from capacity building, and that the challenge of funding this support reduces the expected rate of return to investors (in the short term – patient capital is also needed).

- **Stimulating the market:** Building shared platforms between governments, donors, enterprises, NGOs and aggregators has helped tackle policy and regulatory barriers to the market. Governments can create certainty for investors by explicitly integrating decentralised energy into their energy planning processes. And despite increasing private investment, donors' support is still needed for market stimulation across multiple new geographies.
- **Long-term commercial sustainability**: This needs to be prioritised by investors, including by measuring the potential for future returns through indicators such as the retention of customers, management of defaults and average return per user. This will maximise market activation, not just market expansion through new connections.
- **Bespoke support enables innovation:** Even the most mature businesses in the market are still relatively young, creating continuing need for bespoke, flexible and adaptable support. And while standardisation is a key element of aggregation, reducing costs and increasing assurance to all parties, aggregation models also need to be flexible enough to encourage innovation and evolve with the changing market.
- **Structuring aggregation:** Aggregation models operate at different points of the value chain and they have different strengths as a result. Understanding these choices should improve the design of aggregators so they are clearer on the fundamental model by which they will operate their business, and where they should partner with other organisations. A key element is deciding where they can standardise to achieve scale and reduce costs, and where they can offer bespoke support to help grow renewable energy enterprises.
- **Exploring further financial innovation** in how aggregators are structured is likely to have value – where for instance donors support advice to businesses behind investor platforms and underwrite expansion finance.

There are many lessons to be learnt from existing aggregators and further experimentation will be needed. At the very core of the challenge is for aggregators to structure investment so they reward enterprises who offer strong customer care that drives word-of-mouth referrals, who expand products to meet consumer demand, and who enable increasing productive use by their customers.

Introduction

1

Investing in decentralised renewable energy in developing countries presents a significant challenge: matching the scale of finance offered by investors with the finance needs of small-scale energy access opportunities for poor households (such as solar lanterns, solar home systems and mini-grids).[1] Yet out of this challenge have emerged innovative forms of 'financial aggregation' – bundling together energy opportunities to lower transaction costs, risk, and the costs of capital. And through increasing access to capital and lowering its costs, aggregation can accelerate the expansion of energy services to the poorest.

In this early stage of the market, we are seeing active experimentation; and entities have developed different ways of aggregating energy opportunities. This has meant different approaches - for investment processes; for the information collected to capture project risk-return and impact; for which technologies are invested in; the business models considered; or how consumer demand is aggregated. Yet they all have the same goal – to tap into capital markets and improve the flow of cheaper finance to decentralised renewable energy deployment.

This paper seeks to give an overview of approaches to financial aggregation, highlighting how aggregation models tackle barriers to reaching scale in the decentralised small-scale renewable energy sector. Through examining five case studies – the Infrastructure Development Company Limited (IDCOL), the Alternative Energy Promotion Centre (AEPC), Ignite Power, SunFunder and E+Co – interviews with experts and a review of the literature, we offer thoughts on the characteristics of the emerging approaches and seek to understand what is driving success and where challenges remain.

What is financial aggregation?

The OECD defines financial aggregation as bundling together similar small projects "to reach a scale where they become attractive to large investors, for investment, on-sale or for securitisation through issuing a bond".[3] The Climate Aggregation Platform (CAP) defines it as "the aggregation, or bundling together, of small loans and assets… to create investment products that meet the large-scale needs of institutional investors including global pension funds and insurance funds".[4] In our research, we have found aggregation in the decentralised renewables sector is not limited to bundling financial products into a platform, but includes:

- **Aggregating demand**: such as communities joining up in energy cooperatives to aggregate their energy demand and access finance for a mini-grid,[5] or pooling demand in a region and bulk-procuring services to deliver household solar systems (see Ignite in Section 6)
- **Aggregating enterprises or projects**: such as a portfolio of enterprises or projects delivering decentralised renewable energy services with similar technologies or similar business models
- **Aggregating information**: such as platforms that seek to improve access to finance for decentralised renewable energy enterprises, through standardising the information that enterprises provide to investors: risk, returns and impact, or the credit-worthiness of the target population.

The simplest definition of financial aggregation is any mechanism that aggregates capital around particular characteristics of investments. As one expert has noted, this is quite common – any fund structure is an aggregation model. However, a wider range of aggregation approaches for the decentralised renewable energy sector has been developing to tackle the challenges of the emerging decentralised renewables market. These include small-scale and distributed opportunities with high upfront capital needs; particularly capital-intensive business models, such as enterprises offering pay-as-you-go (PayGo) solar household systems[8]. And as stated above, by bundling together many small-scale decentralised renewable energy assets, aggregators have the potential to tap into new sources of finance and investor bases, which can offer large volumes of financing at lower costs.[5] Sustainable Energy for All (SEforAll) estimate that "developing structures to aggregate small-scale projects could catalyse USD25 billion" of investment for decentralised renewable energy.[6]

Based on this research, the following definition captures the common characteristics of financial aggregators for decentralised renewable energy:

An aggregator is an entity which distributes finance, or facilitates the distribution of finance, to decentralised energy projects and enterprises through:

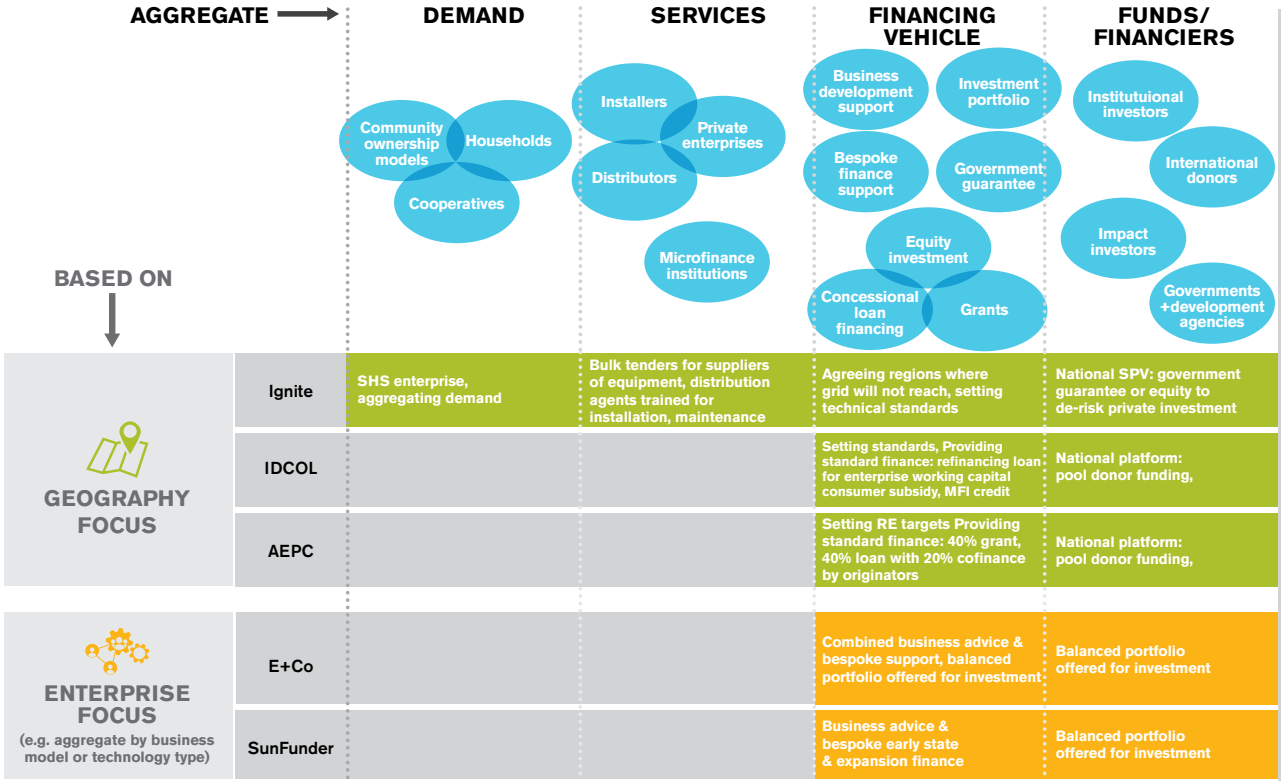
1. Bundling together projects, enterprises, information, or products, usually with a defined scope such as:
   - Enterprises or projects within a geographical area
   - Enterprises or projects employing a particular technology, eg hydro mini-grids or solar home systems (SHS)
   - Demand across a geographical area, eg through agreement with government where the grid will not expand for five years
   - Business models, eg mini-grid or PayGo SHS
   - Data, eg consumer payment performance

- Funds, through a portfolio that balances the risk to investors.

2. Applying standardised approaches to achieve economies of scale, such as:
   - Equipment standards
   - Investment processes, eg standard project forms, standard finance products
   - Special purpose vehicle (SPV) structures that either standardise risk or provide a portfolio of diversified risk
   - Standard templates for record-keeping, eg standard indicators of impact, consumer credit data.
3. Deploying financial instruments and services required to channel finance and data between enterprises and investors, such as:
   - Bulk tendering
   - Bespoke or standard debt products
   - Business advice services
   - Refinancing, eg securitisation of assets, consumer receivables.

See Figure 1 for how our case study aggregators take different approaches to aggregation.

Figure 1: Snapshot of five different financial aggregators



Why is aggregation important for decentralised energy financing?

Over the last decade there has been rapid growth in the number of enterprises seeking to deliver decentralised renewable energy products to the more than one billion people who still lack access to electricity. While headway has been made in closing the energy access gap, through products such as solar lanterns, SHS and mini-grids, the decentralised renewable energy sector in developing countries is still nascent; it can be characterised by many small-scale enterprises in poorly understood markets with young business models.

The potential size of the market is significant. Hystra recently updated estimates of the market, suggesting that there are still 240 million households living beyond the grid and 200 million poor households on the grid but not needing grid-level energy services.[7] Together they spend USD20 billion each year on electricity for lighting and charging phones. Based on an analysis of population density and energy intensity, this market is likely to be served by solar lanterns (130–150 million households), SHS (130–150 million) and micro-grids (50–60 million). Hystra estimates also suggest further innovation will be needed, as 30–50 million extreme poor and 100–120 million isolated households would still be unreached with current systems. Innovation in consumer financing is looking promising, but is still at an early stage. For example, the PayGo market is only 10–15 per cent of solar household system sales – but offers huge potential to deepen access to poorer households, with the additional benefit of expanding access to finance in the future through providing credit ratings for these households.

To date, 70 per cent of solar lantern sales have occurred in five East African countries and India, which only make up 35 per cent of the global off-grid population.[8] Even in these top-performing countries, expansion is concentrated in better-off and more densely populated regions. Many of the remaining countries with high off-grid populations are more complex markets, with lower population density – for instance, Zambia has a third of Tanzania's average population density – or with greater policy uncertainty, in such areas as value-added tax (VAT) exemption, import tariffs, standards, and significant local currency fluctuation risks.

The uncertainties of these markets translate into risk aversion by the private sector to invest in decentralised renewable energy access. On top of this, reaching poorer households has its own challenges, creating perceived or real risks that increase the costs of capital. Poorer households are risk-averse, and therefore slow to take up a product that they don't know, but are also prepared to pay more to reduce risk.[8,9] They require high-quality contact with off-grid enterprises to build trust in the technology before buying. This – alongside the remoteness of many off-grid communities – means distribution costs are high. Thus, a business needs high market penetration or higher value products to absorb these costs.

However, the pioneers in decentralised renewables are showing how bundling energy systems with other products (radio, phone charging or loans for other equipment) can offer greater returns per customer. As the energy systems open the door to other services, they are highly valued by the poor, addressing one of the fundamental challenges of services to the poor. Even lanterns can now charge mobile phones, which lead to life-changing access. Through integrating maintenance into the package with warranties or PayGo, post-sales support builds trust further, leading to peer-to-peer product promotion. These pioneers are proving that poor consumers are prepared to pay for quality energy services.

Despite this success, there are still significant challenges to accessing finance to support the stimulation and growth of these markets. While the cost of renewable energy technologies – particularly solar – has fallen dramatically in recent years, financing costs for decentralised renewable energy remain prohibitive. A few early leaders have attracted significant expansion finance over the last year or so, but fewer deals are being reported overall[10] and experts interviewed noted the lack of a second wave of enterprises attracting expansion finance.

Overcoming the challenges to accessing finance

2

This section sets out the challenges that lead to higher actual and perceived risk for decentralised renewable energy finance, increasing the costs of finance. It then explores how aggregating finance can overcome these challenges, reducing both risk and the cost of finance, and tackling market barriers.

The challenges

Market barriers

Many countries with a significant off-grid population are challenging places to do business, with inherent risks.[11] Concerns include corruption, volatile markets, exchange rate fluctuation and political and regulatory uncertainty – such as the likelihood of rules governing the repatriation of proceeds being changed, or the persistence of import tax holidays. A weak enabling environment increases the cost of capital.[12] An investor in the market recently expressed concerns that the off-grid sector is operating in a regulatory grey area,[13] and others have expressed concerns over the treatment of defaulting consumers, highlighting at least that there is a poorly developed understanding of effective regulation in this young sector.

Technology and business model risks

Customers only pay if they are receiving a good service. This requires ongoing service and maintenance by off-grid enterprises to respond to and fix customer problems, and technology to activate/deactivate PayGo systems that cannot be hacked. The lender must therefore understand and take on the risk relating to the enterprise's technology and operational performance.

There are concerns that as competition increases among off-grid enterprises, companies will relax their credit requirements to win customers, or attempt to steal each other's customers, impacting returns from the market. There are also concerns that to demonstrate growth and impact to investors, businesses will focus more on connecting customers than retaining them. The right financial structure for the different business models of off-grid enterprises is still being refined, as shown by the recent restructuring of some relatively mature enterprises. All this highlights that it is still early days in a newly developing industry. The impact of increased competition is not certain, but challenges should lead to better regulation. It is likely that consumers will ultimately win through better offers, while businesses unable to compete will fail.

Lack of co-ordination

The decentralised renewable energy market in developing countries is made up of small-to-medium scale suppliers, distributors and installers, domestic banks, local cooperatives and micro-finance institutions (MFIs) with limited access to foreign donor capital and even less foreign direct investment. Without aggregation, investments are made in a fragmented manner on a business-by-business basis, without specialist expertise leading to diverse approaches to contracts, installation, operations and maintenance.[5] This lack of coordination leads to high transaction costs, higher financing costs and shorter-term loans.

Coordination to standardise investment in certified technologies with proven business models could reduce the costs of capital. Businesses could also coordinate to demonstrate their value proposition at scale by harmonising their reporting indicators, such as the PayGo key performance indicator framework.[14]

Greater coordination could also reduce operational costs. Businesses could coordinate to share the costs of providing maintenance in a geographical area. A central buying platform, such as for solar lanterns, could enable existing distribution networks to carry quality products, and provide them with technical advice and working capital.[8] Ignite is demonstrating aggregation around such a platform for SHS (see Section 6).

Lack of historical data

To offset real and perceived risk, lenders need to justify their decisions about pricing their finance based on performance data. For example, an enterprise offering an 18-month payment schedule will need to have 18 months of records to demonstrate their historical performance when seeking finance. This is challenging in a growing market made up of mostly young enterprises. Given that many enterprises are still refining their business models, it would also be likely that later customer cohorts of the same enterprise show better returns thanks to learning from earlier customer cohorts – but the business will need the full data of the later cohort of customers' repayment rates before they can borrow against that performance.

In addition, collecting the social and environmental impact data as typically required by investors is expensive and difficult for many enterprises. While there has been some progress, such as through Acumen's lean data approach, it takes time to build such systems, seek donor buy-in and implement data systems. Historically, money to assist in this reporting has not been available.

Deal size

Institutional investors with larger, cheaper finance are not interested in investment vehicles until they reach a minimum level of, say, USD60–100 million;[15,16] and collect years of data to de-risk investment decisions, since the transaction costs are otherwise deemed too high. Yet experts note that in this market even the larger enterprises are still relatively small – and many would struggle to absorb investments of USD10–20 million in one go (though this may be slowly changing, with one of the largest African enterprises – M-Kopa – recently closing a USD55 million deal). This shows a clear disparity between the interests of institutional investors and the needs and capacities of enterprises; it has been called the 'missing middle' or 'bankability gap'.[17,11]

Asset-heavy businesses

Enterprises delivering decentralised renewables have significant debt requirements to maintain inventory, servicing, operations and funding expansion of geographies or products, and for those providing consumer financing, this increases dramatically.[12] Consumer finance such as PayGo or micro-loans enables poor households to pay in small, regular instalments, but result in a delayed return for enterprises and MFIs, who are financing "customer purchases of otherwise unaffordable solar home systems", and requires larger working capital pools for those providers.[18] Longer contracts and lower down payments or deposits increase the affordability for those with low incomes – and has been incentivised by using connection rates as an indicator of success for financiers. However, this could lead to higher default rates, when the falling price of solar means new SHSs come onto the market that are cheaper than the ones consumers are still paying for (see the example of IDCOL in Section 6). Businesses that offer shorter contracts, but with follow-up products, could reduce the need for capital for growth[8] and help households to climb the energy ladder or acquire other assets.

Consumer receivables

In the PayGo and mini-grid markets, businesses are borrowing against future payments from consumers for a small asset or electricity services. These payments are consumer receivables and in a more established market, could be aggregated to reach an adequate deal size for the bond market (greater than USD60 million) and then securitised, or in other words sold as an asset-backed security – increasing liquidity for the company at low cost.[17] However, in the PayGo market, enterprises are providing loans to consumers with no credit history and no formal income, and where there is relatively poor legal recourse in case of default.

Initial PayGo statistics demonstrate solid repayment records from poor households, but greater evidence appears to be needed to tackle the deep belief by investors that cash-poor household borrowers are risky bets. While legal recourse can be challenging in these geographies, a lack of legal recourse in PayGo solar home systems is replaced by the ability to turn off the solar kit in response to non-payment. For mini-grids, the assets remain in the ownership of the operator; but operators face the risk that if the grid does reach a community, they will not get the expected returns on the costs of installation and this is made more challenging when limited demand from communities means that it takes a long time to recover the costs of installation.

How aggregation can overcome these challenges

Reducing risk and the cost of finance

Decentralised renewable energy enterprises in developing countries largely lack any credit scoring and have limited data on enterprise performance.[16] Given that the decentralised energy sector is a relatively new industry with few proven business models, and many enterprises are still in the stage of experimenting to find successful approaches, investors have little evidence on which to base their decisions – leading to higher costs of capital to the enterprises.

Aggregation can offer investors ways to spread this risk. In the housing and car loan markets in developed countries, aggregation is used to pool together small loans or investments and issue bonds in portfolios of investments. This has the effect of spreading the risk of each individual investment over thousands of assets, both for the bonds investor and for the aggregator that issues the bonds.[19] In a similar way, aggregation in the decentralised energy sector can bring together enterprises or their assets into portfolios, spreading risk and making the sector more attractive for investors (although to build the pipeline of investment, ready enterprise is a significant investment in itself).

Aggregators can also play a role in reducing perceived risk. Aggregators can pool together consumer credit information in countries where consumers typically do not have established credit ratings to build the track record. The Ground_Up Project pools standardised information on decentralised energy enterprises to enable investors to make informed decisions about investments that meet their goals and risk criteria. Aggregation platforms like Ignite and SunFunder are working to bring in local banks and educate them on the opportunities and the risks of this new market to increase their confidence in lending to the sector –

and by accessing local debt, reducing exposure to currency fluctuations. In this way, aggregation platforms offer the opportunity to innovate with instruments that unlock debt finance at scale, mitigate currency risk and encourage local financing – all of which could help tackle the financing gap.[8]

Matching Deal Size

Bundling together smaller loans and assets from relatively small-scale decentralised renewable energy projects and enterprises can create investment products that meet the larger-scale needs of institutional investors.[5] And aggregating end-user demand likewise enables finance to flow to the local level.[6]

The transaction costs of investing individually in each energy enterprise or end user at the local level then lies with the aggregation platform, minimising these costs for investors but nonetheless representing a significant cost. E+Co's experience as an aggregator suggests that if the business advice required to ensure an enterprise is investment-ready is part of the transaction costs for investors, the returns are in single digits. If this business development support is funded by public finance, the returns are in double digits (see Section 6).[20] In this early market, business advice is essential to building the pipeline for investment (i.e. essential to making projects 'bankable').

Aggregators like SunFunder bundle together small deals into an investment vehicle, providing the financial 'plumbing' to unlock investment for enterprises previously deemed too small or too risky.[16] But, given the early stage of most enterprises, hand-holding and bespoke support is required to help get local enterprises ready for expansion. Aggregators of loans like E+Co and SunFunder have therefore had to provide business advice services to help local enterprises develop their basic systems, at least on occasion. While these approaches to early-stage technical support was integral to the E+Co aggregation model, it could be provided through a third party, as long as there were close links to the financial aggregators. For example, Energy for Impact and Private Advisory Finance Network (PFAN) seek to address the barriers to success for small and medium decentralised energy enterprises by sourcing projects from the private sector, screening the business plans for investment readiness and financability, providing technical assistance to support project development and building capacity.

Tackling market barriers

Financial aggregators can tackle some of the markets barriers that relate to risk, such as policy, tax and regulatory issues; or driving up costs, such as servicing remote, small and isolated markets. National aggregation platforms like IDCOL in Bangladesh and AEPC in Nepal bring governments and donors together as co-investors in stimulating the decentralised energy market, providing a forum to tackle policy barriers such as product standards. Aggregator Ignite partners with the government in Rwanda to address several market barriers, including product standards and requesting the government to clarify where the grid will expand in the next years, providing certainty to the off-grid market. For aggregators without a country focus this dialogue is more challenging, suggesting the need for others – donors, non-governmental organisations (NGOs) and business associations – to create national platforms to support governments in addressing market barriers like high VAT and import tariffs or taxes on mobile money transactions. Equally, this national focus is needed to support innovation to reach underserved areas, such as through results-based finance or other incentives and to work with local banks to build their confidence in lending.[8,21]

Choices in aggregation design

3

Successful aggregation requires a pipeline of sufficient size and common characteristics to be aggregated. To stimulate this young market, the aggregators we looked at did this either through specialising in aggregating renewable energy enterprises in a particular country, or specialising in enterprises using a particular technology or business model.

By narrowing the focus of the aggregation platform, the aggregator reduces the technical knowledge it needs to make good investment decisions, providing assurance to investors of their understanding of a key element of risk. Financial aggregation largely focuses on the supply of finance, through a finance vehicle that bundles many small-ticket deals with energy enterprises. But those platforms focusing on a geography were effectively aggregating demand, through bringing end users together to offer investors assurance of sufficient scale.

Standardisation

In a sector characterised by many small individual investments, standardising the investment process can reduce transaction costs.[22,4] This can occur in any part of the aggregator's model. For example, IDCOL provides technology and standardised financial products, so entrepreneurs are clear about what their offer to consumers needs to be in order to get the financing, as well as what working capital and consumer subsidies they can access, providing certainty when developing their business model.

In a young market however, standard financial products can limit entrepreneurs' ability to innovate in business models. So SunFunder, by contrast, offers a bespoke, business-by-business approach to structuring loans. It has also developed different fund structures for investors as it learns from early approaches.

The Climate Aggregation Platform focuses heavily on the value of standardisation in its approach to building "pipelines of high-quality, standardised, small-scale low-carbon energy assets". It aims to facilitate the standardisation of contracts, key performance indicators, data sets, and due diligence. And it notes the importance of the structure and terms in the design of a special purpose vehicle for a successful aggregation transaction: "to bring eventual liquidity to markets in financial aggregation assets, there needs to be standardisation and transparency across SPV [special purpose vehicle] structures".[5] But in the case studies we examined, while each aggregator was seeking to reduce costs through standardisation where they could, it was clear that this requires balance with enabling experimentation until this decentralised energy market has reached greater maturity.

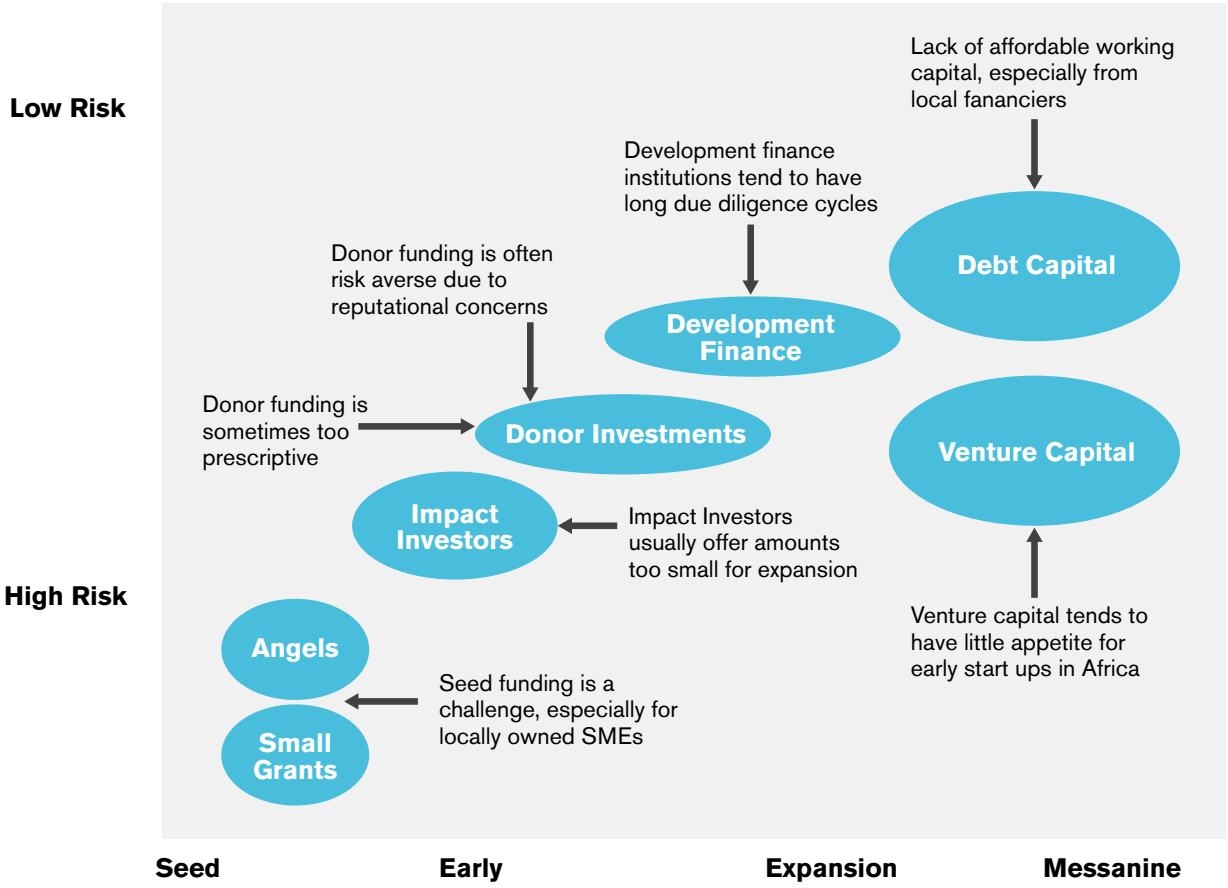
Financial instruments

Many of the financial aggregators we looked at used an SPV as the instrument in which to bundle consumer receivables (eg E+Co, to a lesser extent SunFunder) or demand for investors (eg Ignite, IDCOL). An SPV is a legal entity; often a company structured for profit, but it can also be a non-profit organisation, created to achieve an objective or project and enabling investors to take different layers of risk. SPVs seek to provide a clear offer on risk-returns through consistency in describing the projects, giving assurance to the investor – and the bundling is either of similar projects to narrow the risk set or a portfolio to spread risk.[23,4]

Pooled debt facilities are used (eg SunFunder) to offer inventory and working capital loans to a range of enterprises. These loans can be bundled with the SPVs to create debt funds of sufficient size to attract investors. Whilst donor and development finance can also be pooled in funds in a variation on SPVs, set up as a shared account with a delivery partner with an agreed governance structure, set of objectives and delivery approach (eg AEPC).

The financial instruments used by the aggregators varied depending on the type of investors, the design of the instrument and the financial products being offered (see Figure 2).

Figure 2. Sources of funding and their value to off-grid energy



Source: Bertha Centre and WWF (2016) Switching on finance for off-grid energy. https://www.gsb.uct.ac.za/files/BerthaOffGridEnergy.pdf

1. Types of investors

The decentralised energy market has raised funds from a variety of sources, including government, international donors and development finance, private philanthropists, angel investors, impact investors, venture capital, institutional investors and crowd funding. Each source of funding will have different implications with respect to scale, and the types of projects they are willing to fund. Targeting the right investor for the risk profile of the opportunity is critical. Angel investors, for example, are (generally speaking) smaller-scale investors offering small, one-off deals, including early-stage, higher-risk investments, and tend to offer equity. By contrast, institutional investors look for large proven investments, more suitable for mature enterprises, but with lower cost of capital.[12,13] As noted in the introduction, the purpose of aggregation has been to attract lower-cost finance, particularly working capital, into the decentralised energy market to enable faster expansion. Ignite has mobilised institutional investment and local debt finance from banks on the back of a sovereign guarantee in Rwanda and a government investment of equity in Sierra Leone.

2. Financial instrument design

The structuring of special purpose vehicles and pooled funds in this market have a number of variations, as shown in the case studies in Section 6. SPV models appear to have three usual types – originator-specific SPVs for single businesses, and either co-mingled or standardised SPVs for portfolios.[5] SunFunder offers to its investors portfolios of loans made to solar enterprises, in the form of pooled debt funds. SunFunder's loan products offered to solar enterprises include working capital loans, inventory loans and also structured finance solutions which take the form of SPVs where receivables of a solar enterprise's end-users are bundled. By contrast, Lendable has a standardised SPV model that develops a separate SPV portfolio for each investor, with the aim of replicating hundreds of these SPVs to achieve liquidity in the market. IDCOL and AEPC both have pooled funds with multiple donors and some government funding. E+Co was a US non-profit that blended philanthropic, development and private grant and loans to support its offerings of enterprise development services and investment. Ignite, however,

has structured an SPV that pools consumer demand and then tenders out to equipment manufacturers and distributors – breaking up the vertically integrated business model of off-grid enterprises, with the intent of enabling specialisation in the delivery chain.

3. Financial products provided to enterprises

The financial products offered by aggregators to enterprises have largely been to support the expansion of early-stage enterprises and so have mostly been debt for early stage roll-out and working capital. But IDCOL and AEPC included debt combined with grants or subsidies. For example, AEPC offers a standard product of 40 per cent subsidies and 40 per cent loans with 20 per cent co-finance by the enterprise. SunFunder and E+Co have both offered debt structured to suit the enterprise. New off-grid energy funds are being set up by impact investors with public climate finance providing subordinated debt, and are expected to offer standard debt products to enterprises. Ignite provides contracts to the product manufacturing and distribution enterprises. Further innovation can be expected as the market grows – and aggregators reach sufficient scale for the securitisation of assets for the bond markets.

Figure 2 summarises the range of approaches to aggregation found in the case studies. As illustrated, there are numerous approaches aggregators can take to each of the elements of aggregation, each with their own challenges as well as strengths. As the market grows and aggregators develop and evolve, new approaches can be expected. The detailed case studies on each of the models summarised in Figure 2 are in Section 6.

Measuring success in aggregators

4

Aggregators use a range of criteria to measure success and understand their impact. Overall, the aggregators explored have successfully channelled finance from donors and investors to small enterprises, enabling them to provide energy services to consumers who would otherwise have not had access. The aggregator's bottom line has to be consistent financial returns, but donors and investors also have a strong interest in understanding the social and environmental impact of investing in this market.

Financial returns

Whether aggregators see themselves as a social enterprise or for-profit, they must achieve a financial return for their investors. As noted above, the cost of building the pipeline of new enterprises through early business advice is significant – with E+Co experience showing a negative impact on their rate of returns for investors.

The commercial viability of financial returns from off-grid enterprises is still relatively unproven. Larger businesses have only been breaking even, but this is because they are investing in rapid expansion so are not yet offering clear dividends. Aggregation platforms have however largely offered consistent performance – for example, Ignite has consistently made a profit since first breaking even two months after beginning operations in June 2016. E+Co also offered single digit return to its lenders, which – given the investment in building the early pipeline – was impressive. However, IDCOL has seen a steady drop in performance since 2013 after several years of 53 per cent compound growth. This has been explained by the arrival of generics supplied at a lower cost, undercutting consumer trust and therefore repayments, and the subsidies provided through IDCOL creating dependency in the (largely not-for-profit) partners rather than stimulating competitive innovation.[29]

For the innovative PayGo sector, it has been harder for businesses to communicate their success when so much of their capital is tied up in consumer loans. The Global Off-Grid Lighting Association (GOGLA) and Lighting Global have proposed a key performance indicator framework to capture the financial sustainability of the PayGo industry's unique structure, and include repayment rates and the proportion of their portfolio at risk due to consumer finance.[15]

The financial model for mini-grids requires long pay-back periods, creating greater exposure to regulatory uncertainty, risk of grid expansion and unstable consumption. This has created a focus on quick returns through acquiring customers, rather than on the sustainability of returns through stimulating demand.

Energy access

The primary non-financial indicator of success in this sector is the number of households that have gained access to electricity. IDCOL is credited with helping 4.5 million households in Bangladesh achieve basic electricity access through SHS,[24] while Ignite is six months ahead of schedule in its planned electrification of 250,000 Rwandan households.[25] GOGLA suggests three criteria to measure household access:

1. Improved energy access, historically – the cumulative number of people who live in a household with an improved energy source such as solar
2. Improved energy access, currently – the number of people who currently live in households with an improved source of energy such as solar
3. Energy needs met – the number of people who have achieved Tier 1 and Tier 2 energy access, based on the SEforAll multi-tiered framework.[12]

However, there is a risk that focusing entirely on the number of households connected could lead to perverse incentives, as off-grid enterprises race to install SHS and mini-grids rather than investing in the post-sales customer relationship through good maintenance and offering high-quality products.[8] This suggests that metrics should also capture sales practices, customer retention and the management of defaults. With strong post-sales services, including additional products, customers are more likely to recommend the product to their neighbours, which in a bottom-of-the-pyramid market can be a more effective sales technique.[11] Likewise, mini-grid success criteria should focus on demand stimulation, measured by average revenue per user, to increase sustainable returns on investments over the long term.

SEforAll has led the development of a framework to recognise that different technologies offer very different levels of energy – the 'energy ladder'. The higher up the ladder, the more productive potential the energy offers, and therefore the greater the likely social benefits, such as poverty reduction. There is only limited recognition of the fact that not all energy access is equal in creating impact. However, AEPC has quantitative targets for the number of units and kilowatt hours to be achieved by each renewable energy technology, which provides another way of capturing overall progress in enabling productive uses of energy.[26]

Social and environmental returns

Standardising indicators for social impact has been challenging, not least due to the costs of collecting data. Five impact areas are shown to benefit from off-grid electrification:

1. Health: replacing candles, kerosene and diesel and so reducing respiratory illness
2. Financial inclusion: having an asset for collateral and credit history
3. Poverty: enabling households to save through spending less on lighting from renewables than on kerosene, candles and torches, enabling longer work days and through enabling processing and other productive uses
4. Access to services: charging phones provides access to climate and market information, children making more use of education through being able to study at night
5. Climate change: reduction in the emission of greenhouse gases through replacing kerosene.

GOGLA's list of impact metrics sets out to capture social impacts, such as the number of livelihoods supported, household change in the available hours of light, household savings on energy-related expenditure, and greenhouse gas emissions reduced.[12] AEPC includes targets relating to increased employment and increases in income-generating activities. E+Co launched a Triple Bottom Line reporting system in the early 2000s which tracked over 35 social, environmental and financial indicators, providing major inputs to the design and launch of other initiatives such as the Global Impact Investing Network.

In its 2016 annual review, SunFunder claims to have reached 2.7 million people, amounting to 222,000 tonnes of carbon dioxide-equivalent emissions mitigated each year (this has since risen to 240,000), or 50,000 cars taken off US roads.[27] IDCOL also tracks a series of actions to mitigate local environmental damage from SHS, solar irrigation, mini-grids, cookstoves and biogas.

What drives success? What are the challenges?

5

Our exploration of the five case studies and other examples in this paper has revealed some insights into success in aggregation, the top factor being to first focus and define the aggregator's core competency, and then make sure to attract the right type of capital and partners to implement this. It should be noted, however, that some are mutually exclusive. For example, a strong offer to governments requires limiting the geographical spread of an aggregation platform, while learning across businesses might be best supported through a wide geographical spread. So the success factors set out below highlight some choices in the design of financial aggregation platforms.

Factors leading to success

Ensuring a strong offer to consumers by supporting businesses with good customer service:

- The products of the enterprise being invested in need to be good quality and meet user needs – provided through clear technical specifications and product standards.
- Payment methods should be easy, including innovation in consumer finance such as PayGo or microfinance.
- Post-sales support should be excellent, including follow-on products and good maintenance practices. Given the associated costs, rewarding cost-effective approaches is essential, such as clustering mini-grids or sharing maintenance services with competitors.

A strong offer to businesses creates the pipeline for sustainable returns in the long term:

- Loan management and servicing is expensive for aggregators so standardised processes are key to reducing costs and give investors greater assurance of the consistency of the assets, therefore reducing the cost of capital to the business. However, this favours relatively capable businesses.
- In contrast, flexible, bespoke support to enterprises to suit their needs and business models helps build the pipeline – and while more expensive now, is likely to offer returns in the longer term.
- Providing business advice for early-stage entrepreneurs with a clear line of sight to capital investment is more effective than entirely separating business support and investment.
- Incentivise commercial sustainability through measuring success in indicators that will promote long-term commercial sustainability – such as retention of customers and average return per user.
- Working with a range of projects enables the aggregators to share lessons across businesses and across geographies, speeding up the replication of effective innovation.

A strong offer to investors improves their confidence in the sector and so reduces the cost of capital:

- Working with local banks and other national financial intermediaries reduces the aggregation platforms' exposure to currency risk. Providing guarantees and first loss investments can incentivise lending from banks while they build their understanding of the sector, recognising that building understanding in the financial sector is a multi-year learning process that requires patience.
- Aggregating enterprises into an investment portfolio and targeting a range of investors – from government and donors' concessional finance to commercially oriented capital – spreads risk and brings together the range of stakeholders required to stimulate the market.

A strong offer to partner governments to meet their energy targets builds goodwill to tackle market barriers:

- Bringing government and donors together, through joint approaches to stimulate the decentralised renewable energy market and achieve shared electrification targets, improves coordination in financing and in tackling market barriers.
- Bringing in concessional finance that is prepared to take greater risk speeds up the stimulation of the market – for example, through offering small grants and concessional loans for start-up and early expansion phase enterprises; subordinated debt and guarantees to aggregation platforms; as well as grants for the business support services. This reduces the cost of capital to the entrepreneurs for proving their business model and, in the competitive market that is already emerging, savings would be passed on to consumers.
- Agreeing how to meet electrification targets – where the grid will expand and where off-grid offers are needed – provides greater certainty in the size of the potential market, effectively aggregating demand.

Emerging challenges

Our research also revealed a number of challenges faced by aggregators. Many of these relate to the early stage of supporting this rapidly growing market, and so can be solved over time with good coordination. Others represent an opportunity for learning how to structure investment effectively, to improve liquidity and avoid perverse incentives, including from the role of aggregators themselves. Learning rapidly from these early experiences is critical to improve the performance of the sector.

The early stage of the market means that understanding and standardisation are low, increasing transaction costs:

- **Lack of track record:** There is insufficient data on the credit-worthiness of customers and high diversity in approaches to contracts, installation and maintenance, as well as SPV structures themselves.
- **Cheap generics spoil the market:** Competition from poor-quality generic products spoils the market through reducing consumers' confidence in renewables overall. While efforts are being made to certify quality products eg in IDCOL, campaigns to raise awareness among consumers are required to ensure they make informed choices.
- **Limited capability and understanding:** The first movers in the market are devoting significant resources to nurture young enterprises who are still experimenting in their business models, as well as educating investors in the risk-return profiles of the market.

Structuring the finance effectively to stimulate the market is still evolving:

- **New business models require innovation in investment:** Market actors are still developing effective financial structures for investing in this capital-intensive and asset-heavy sector, with limited experience, for example, in securitisation of the assets.
- **Lack of patient capital:** Despite the potential size of the market and the growth of the market leaders, there is limited willingness by investors to fund intermediaries like aggregators to build the pipeline for long-term returns – they are themselves 'start-up' enterprises and need to prove their potential. The hype around the off-grid energy market may have created unrealistic expectations of immediate returns.
- **Attracting the right mix of finance:** This early market has started to create a buzz, and the market leaders have attracted substantial investment for expansion recently. But these businesses need the right mix of equity and working capital. Observers have suggested that the market has a disproportionate amount of venture capital and impact equity investors, and too few investors who offer working and inventory capital.
- **Currency fluctuation:** This represents real risk, as the assets are paid for in foreign currency but consumers pay in local currencies. So accessing debt from local banks and other financial institutions will be important, but again requires devoting resources to educate them and build their confidence in the market.
- **Subsidies can distort the market:** Early donor support may have offered enterprises subsidies that are too high, creating over-dependence on these grants and disincentivising innovation by enterprises and MFIs. And in some cases, the administration of subsidies was so cumbersome that they were challenging to access, reducing their effectiveness in supporting poor consumers in accessing renewable energy products.

Does aggregation itself risk distorting markets?

- **Can aggregators limit competition?** There is some concern that aggregators themselves have the potential to distort markets – particularly where they are focused geographically on a country. The experience in Bangladesh when the cost of solar fell rapidly, changing the market dynamics, suggests that new market players can disrupt the status quo. However, the subsidies provided by the aggregator may have prevented the established players reacting fast enough. There is therefore some credibility to the concern that aggregation can limit competition through capturing the market, setting technical standards and favouring a certain business model. And this suggests the need for careful observation of the market as whole, tracking indicators beyond the immediate objectives of the aggregation model itself, to understand market performance.

Emerging lessons

Despite the successes of the leading enterprises in this market, it is still early days. For a start, the eight or so SHS enterprises that are the current market leaders in their field are still relatively small and a second wave of SHS enterprises has yet to follow them. The recent financial restructuring of a couple of these leaders suggests that the market is still experimenting in the basics. And most of the activity in the market is concentrated in densely populated areas of a few countries. The aggregators explored in this paper are pioneers in an early-stage market, and future approaches to aggregation will need to learn from their challenges and successes, as well as adapt to a growing market.

Value of early-stage hand-holding

- Given the need for rapid expansion in the young decentralised energy market in developing countries, support to early-stage local entrepreneurs is vital to build the investment pipeline and reach the scale required for achieving energy access.
- Given the challenge to attract investors willing to accept a lower rate of return due to the provision of business development services, there is a case for public finance to support these services. Experience does show, however, the value of advisory services provided in partnership with investors, so there is a line of sight to the investors' expectations.
- SunFunder is exploring partnerships with business advisory firms or NGOs to carry out this function. Ignite is providing training for its distribution and sales agents in Rwanda, Tanzania and Sierra Leone, seeing this as an integral part of their model's success in enabling enterprises to specialise in kit design and manufacture while delivering distribution and post-sales support themselves.
- To increase the patience of capital in funding this early-stage support, aggregators noted the need to communicate not just the successes of returns on current investments, but also the continuing challenges of the market. This would help avoid giving investors the impression the problem is 'solved', which has led to expectations of full commercial rates of return.

Stimulating the market

- Building shared platforms between governments, donors, enterprises, NGOs and aggregators has helped tackle policy and regulatory barriers to the market. Essential to this is agreeing common objectives through targets for decentralised energy access, but experience also suggests that the targets should also create incentives for strong post-sales support, not just for acquiring new customers. National aggregation platforms with governments investing alongside donors or private investors are proving to have value in strengthening the shared commitment to stimulating the market, and so deliver the reforms needed.
- Governments can attract greater private investment to the decentralised energy enterprises operating in their country through creating certainty for investors, by explicitly integrating decentralised energy into their energy planning processes and ensuring clarity of investment guidelines and regulations. Creating thresholds for grid expansion, or being transparent about where the grid will and will not expand in the medium-term, increases much needed certainty for returns from household energy and mini-grid markets.
- Despite increasing private investment, donors' support is still needed for market activation. Grant support and concessional finance enable the provision of business advice and start-up finance. Underwriting expansion, through instruments such as guarantees or subordinated debt, brings in private investors with low risk appetites but cheaper finance. Mechanisms like results-based financing may offer a more effective model to incentivise businesses to reach the poorest and most remote regions, rather than direct subsidies. But donors need to further innovate in incentivising reach to the remote and poor households, given that the capital-hungry nature of these enterprises means they struggle with payment on results. Donor support in improving the enabling environment, strengthening institutions and the establishment of national industry associations, for example, are also vital to help the market take off.
- Donors can also play a key role in supporting data collection, as there is a continuing need for data to evidence the impact of aggregation models as well as the impacts of the decentralised renewable energy businesses that they are investing in.
- Businesses themselves could explore greater coordination to reduce some of the cost drivers, such as post-sales maintenance or even, for the distribution-focused enterprises, tendering for equipment together to reduce unit costs.
- NGOs can support market development through educating consumers, setting up suitable micro-finance products for accessing energy products, and stimulating energy demand through micro-loans for productive uses of energy. Donors, in turn, need to support NGOs to undertake this work.

Long term commercial sustainability

- Investors (both public and private) need to prioritise long-term commercial sustainability, by measuring the potential for future returns through indicators such as the retention of customers, management of defaults and average return per user. This will maximise market activation, not just market expansion through new connections.

Bespoke support enables innovation

- Even the most mature businesses in the market are still relatively young, creating continuing need for bespoke, flexible and adaptable support. In the mini-grid and SHS sectors, even relatively mature enterprises have had to restructure their financing model. The most effective models for financing off-grid renewable energy technology may not yet have been developed. And financial tools used in similar, asset-heavy markets, like securitisation for the bond market, are yet to be tested.
- Standardisation is a key element of aggregation, reducing costs and increasing assurance to all parties. Agreeing common indicators and reporting formats across the businesses and the SPVs themselves could help increase investment flows and reduce the cost of capital. But aggregation models also need to be flexible enough to encourage innovation and evolve with the changing market, or they risk creating perverse incentives.

Structuring aggregation

- Aggregation models operate at different points of the value chain and they have different strengths as a result. Understanding these choices should improve the design of aggregators so they are clearer on the fundamental model by which they will operate their business, and where they should partner with other organisations. A key element in this is deciding where they can standardise to achieve scale and reduce costs, and where they can offer bespoke support to help grow renewable energy enterprises.
- Exploring further financial innovation in how aggregrators are structured is likely to have value – where donors support advice to businesses behind investor platforms and underwrite expansion finance, and investors test approaches to increase liquidity in the asset-heavy business models, such as PayGo and mini-grids, through securities and so on.
- A critical lesson for aggregators and their investors is to learn from recent experiences in other aggregators and remain flexible and innovative, experimenting with new approaches as the market grows and changes.

In conclusion

This paper has attempted to develop a framework to help investors, enterprises and other aggregators understand how aggregation works and the benefits of aggregation for renewable energy in developing countries. However, to thrive in this growing market, it is also important for aggregators to remain flexible and consider new, innovative ways of offering standardised approaches, financial instruments and mechanisms, and other functions appropriate to the positions in the aggregation value chain that they occupy. There are many lessons to be learned from existing aggregators, and while it is important for aggregators to be able to continue operating in a stable, secure manner and offer a competitive return on investment, experimentation and novel approaches are also important to help shape the market into the future. And at the very core of this mission, aggregators need to structure investment to stimulate and reward enterprises who offer strong customer care that drives word-of-mouth referrals, who expand products to meet consumer demand, and who enable increasing productive use by their customers.

Aggregator case studies

6

We chose five aggregators to reflect early pioneers like E+Co, IDCOL and AEPC and more recent entrants such as SunFunder and Ignite. They were chosen to reflect both maturity and geographical and business-led approaches. During investigation, additional examples emerged, that due to time could not be fully explored but are referenced here.

The Infrastructure Development Company Limited (IDCOL)

Aggregation characteristics

IDCOL aggregates public investment for renewable energy development within Bangladesh. It originally focused on solar home systems but has since expanded into solar irrigation and other technologies. It works through accrediting partner organisations that buy and distribute the products, with microfinance to extend consumer credit, and incentives for battery recycling. It channels funds in the form of subsidies and credits to its partner organisations.[28,29]

Standardisation

IDCOL quality assures its consumer products and provides standard finance products to partner organisations that meet its eligibility criteria. IDCOL certifies SHS products that meet its technical specifications, including batteries that can be recycled. It provides working capital loans and consumer subsidies to partner organisations, and partners with microfinance institutions to extend consumer credit to poor households so they can pay for products.[31]

Financial structure

1. Financial instrument and source of funding

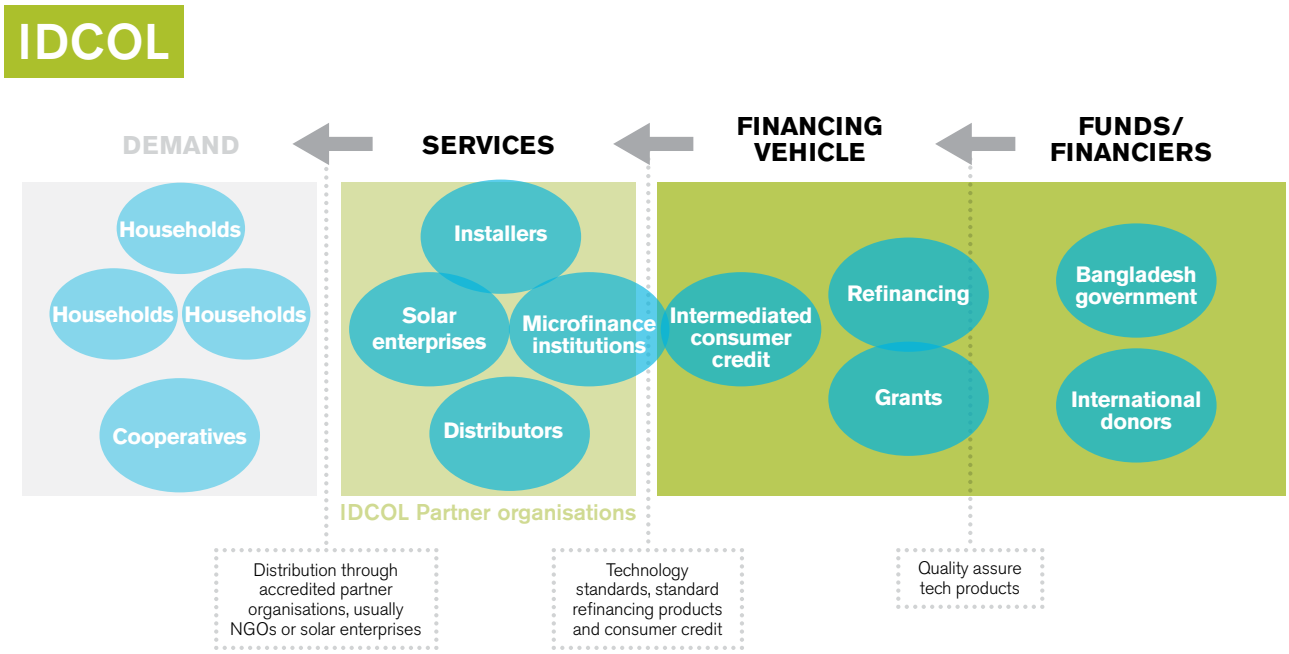
IDCOL receives grants and concessional loans from the Bangladesh government and international donors. IDCOL pools finance within a governance structure that includes the donors and the government.

2. Finance provided to enterprises

IDCOL provides support to its partner organisations through a combination of grants and refinancing of loans. Households provide a 10 per cent down payment on their solar home systems and pay for the rest through a micro-credit scheme, at a rate of 15–20 per cent per annum. After installing the SHS, the partner organisation applies to IDCOL for a grant and refinancing of their loan. IDCOL then disburses loan and grant to partner organisations, with funds sourced from donors. The combination of the grant and the refinancing at a lower interest rate lowers the cost of supplying SHS for the partner organisation, enabling it to pass on these savings to consumers in the form of cheaper prices.[30]

Successes

IDCOL has demonstrated significant success, having "unified an otherwise fragmented market, standardising technology, finance and policy" with 4.5 million systems installed by IDCOL customers, 70,000 new customers connected each month and 12–15 per cent of Bangladesh's rural population now using solar.[22] According to Rai, "IDCOL's feat in



providing decentralised energy access in off-grid areas can be largely credited to the creation of effective working partnerships with different actors in the supply chain".[28] For example, IDCOL innovated in engaging MFIs to offer credit prior to the advent of PayGo, making solar home systems more accessible by enabling poorer households to pay for them incrementally.

Underlying cost drivers and challenges

However, while IDCOL was successful in stimulating the decentralised market, sales have declined since 2013 due to uneven competition from cheap generic products from China. Products sold by IDCOL partner organisations must be approved by IDCOL's technical standards, but there are no comparable standards for products on the open market, making it easier for low-quality generics to undercut partner organisations' approved products.[30] Analysis by Bloomberg New Energy Finance suggests that IDCOL's generous subsidies could be partly responsible, by disincentivising innovation among partner organisations and supporting inefficient organisations that are now unable to adapt to competition in the market. There are suggestions that customers are defaulting on their payments as they see cheaper products being sold to their neighbours.

The Alternative Energy Promotion Centre (AEPC)

Aggregation characteristics

The Alternative Energy Promotion Centre (AEPC) is the parastatal agency in Nepal responsible for promoting small-scale renewable energy. AEPC acts as a 'financial intermediary' for the National Rural and Renewable Energy Programme (NRREP), pooling donor and government funding to stimulate the decentralised energy market.[30]

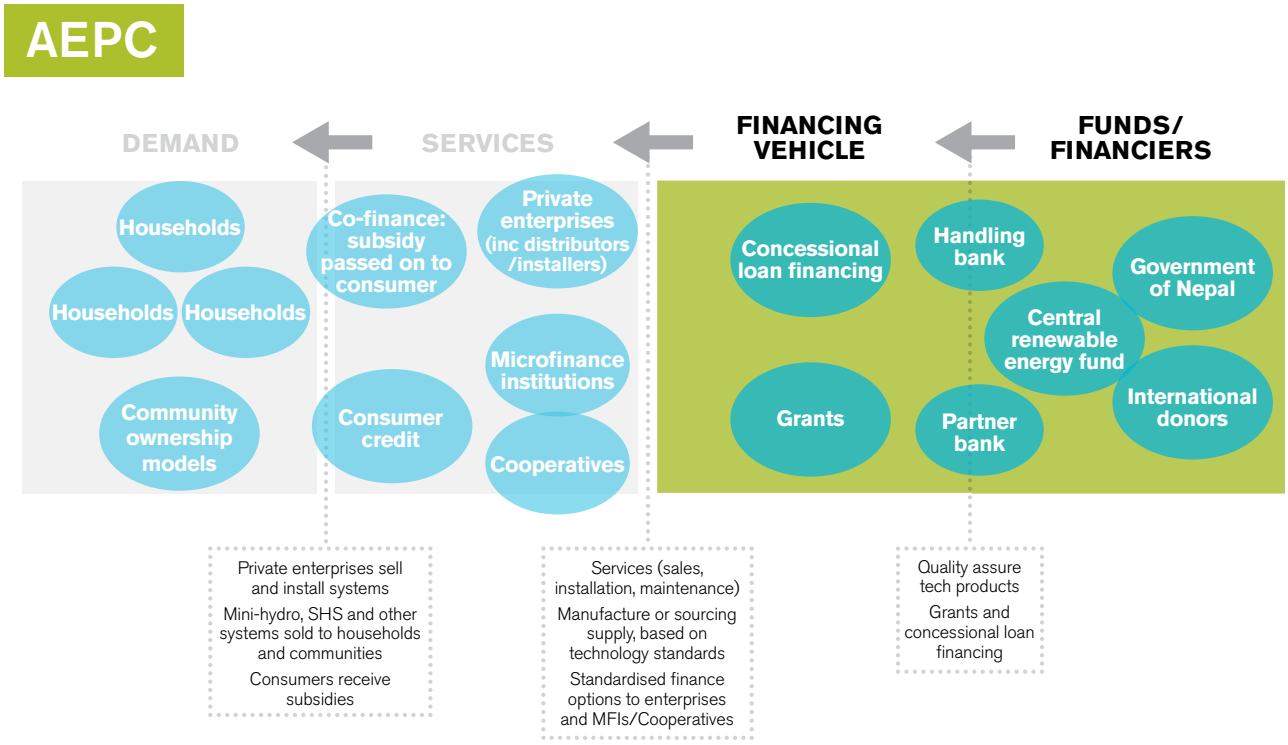
Standardisation

Enterprises follow standardised procedures to apply for funding.

Financial structure

1. Financial instrument and source of funding

Like IDCOL, AEPC was created to pool finance from donors and the government and directs these funds to financial intermediaries, such as banks, MFIs, private technology providers, NGOs and District or Village Development Committees.[31]



Initially AEPC channelled finance to intermediaries through project-based approvals; however, this led to fragmented outcomes.[29] In 2012, NRREP was launched in an effort to bring all renewable energy financing into a programmatic approach.29 This involved setting up several new financial intermediaries, including:

- The Central Renewable Energy Fund (CREF), which manages all NRREP funds, using both subsidies and credit to fund renewable energy installations
- The Global IME Bank, a private bank that houses the CREF Secretariat
- Seven partner banks
- MFIs and cooperatives, which provide finance to end consumers to fund SHS and micro-hydro installations.

2. Finance provided to enterprises

The National Rural and Renewable Energy Programme standard financial product provides 40 per cent subsidies and 40 per cent loans, with 20 per cent co-finance expected to be mobilised by the project partner. NRREP is considered to have improved coordination of finance delivery. According to Steinbach, actors also believe that NRREP's use of financial intermediaries and concessional loans will incentivise mobilising finance from banks and from District Development Committees (DDCs) and Village Development Committees (VDCs). However, beneficiaries expressed concern that the co-financing requirement will reduce access by poorer communities to renewable energy installations.[30] NRREP concludes this year and is currently under review.

Underlying cost drivers and challenges

Challenges faced by NRREP include the limited capacity within many partner organisations and within AEPC itself. There have been claims of irregularities in procuring energy technologies and appliances, and cumbersome subsidy administration.[32] With the government's zero-tolerance policy for mismanagement, every case of potential irregularity is investigated, and funding halted until issues are resolved, causing significant delays. A new safeguard mechanism has been put in place to rectify this.

A former AEPC employee has argued that the energy sector is over-dependent on subsidies and continued donor support, to the point that the system is unable to handle reductions in the level of subsidies. It is argued that other mechanisms also need to be considered, such as concessional loans, tax waivers, feed-in tariffs or guarantees.[33]

SunFunder

Aggregation criteria

SunFunder provide inventory, construction, and structured asset finance loans for solar lighting, home systems, mini-grids and commercial solar projects. SunFunder is a solar finance business that raises and aggregates capital to drive the growth of solar power in developing countries through private debt funds. SunFunder finances solar product distributors and manufacturers, solar companies and project developers in East Africa, West Africa and Asia.[34]

Standardisation

SunFunder has a nuanced approach to standardisation. While they have developed a set of standard credit procedures, they are quite flexible on the form of loan structure in order to tailor loans to the needs of companies at different stages of growth. This is in recognition of the early stage of the sector overall and that companies are developing a range of different business models. It sees value in entrepreneurs being entrepreneurial, and provides flexibility in investment models to enable their offer of bespoke and tailored support to new enterprises. On the other hand, SunFunder has also sought to standardise new lending products, such as its Structured Asset Finance Instrument for PayGo receivables finance, to make them easier to understand for new investors.

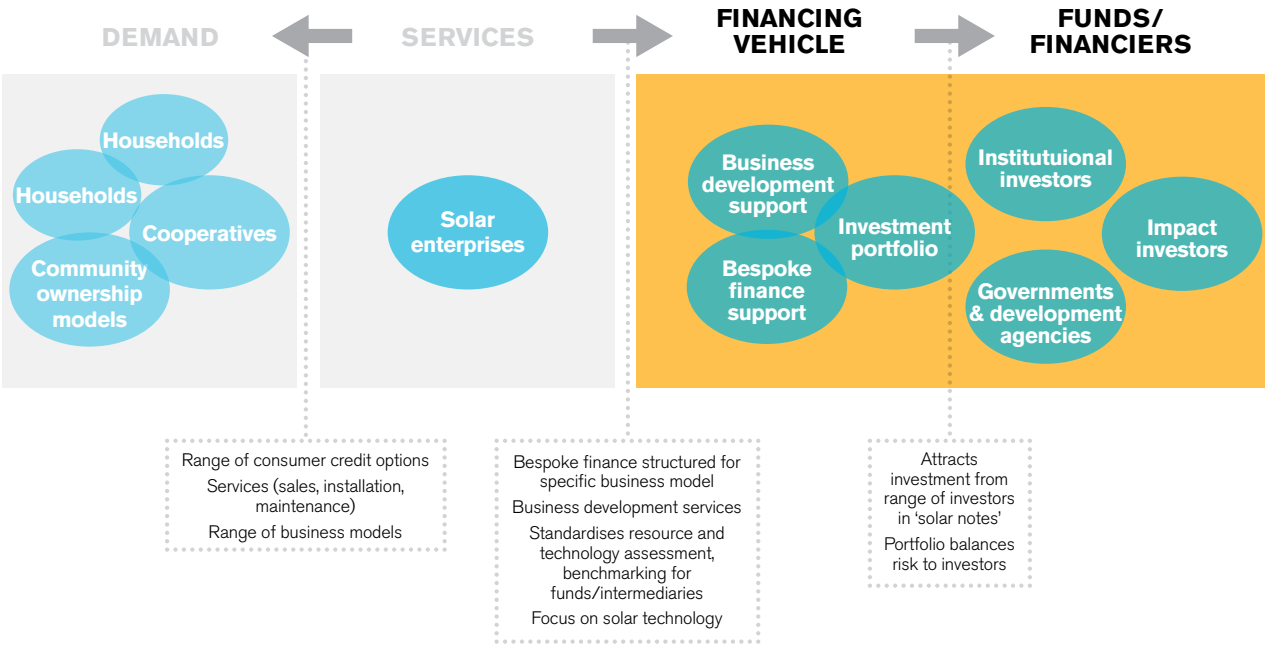
Financial structure

1. Financial instrument and source of funding

SunFunder sources commercial finance from private investors, including development finance investors, like OPIC and FMO and impact investors such as MCE Social Capital and Calvert Foundation. SunFunder offers investors a diversified portfolio of solar enterprises and projects, enabling investors both to make larger investments than would otherwise be possible and to spread their risk across a portfolio of projects. SunFunder then uses the capital raised to tailor loans for enterprises in the sector, including for working capital, inventory finance and specialised SPVs.[25,4] SunFunder also has the capacity to syndicate co-investors together into its SAFI loan structures.

SunFunder began as a crowdfunding platform, but soon realised that it could not reach the scale of investment needed to fund its beneficiaries. It transitioned to offering investors the opportunity to invest in 'Solar Notes',[35] beginning with Notes of around USD100,000 and together reaching a total amount of USD15 million. In 2016, SunFunder launched a 5 year debt fund – it has since reached first close and is rapidly reaching a full-close value of USD65 million.

SunFunder



SunFunder is reaching out to and educating local banks with the intention of attracting local currency debt investment into the sector. SunFunder sees aggregators having a role advocating for investment into renewable energy and setting up benchmarks to help scale the sector.

2. Finance provided to enterprises

SunFunder provides a range of lending products for solar enterprises, ranging from straightforward inventory financing and working capital to structured finance facilities. Of the latter, it has recently launched SAFI, a forward-looking instrument that provides financing for solar enterprises to acquire new customers, rather than providing finance for customers already acquired. This is particularly useful for PayGo enterprises, which face high capital costs upfront, but typically enter into one to three-year repayment contracts with customers.

Successes

In 2016 SunFunder's portfolio of solar loans nearly tripled. Since 2013, it has unlocked USD55 million for off-grid solar, including USD40 million in its current USD65 million Beyond The Grid fund. SunFunder states that it has completed more transactions than any other debt provider in the market. Their successes include completing 100 transactions with a total value of over USD30 million, launching more than 30 solar customer relationships across Asia, Africa and the Pacific, and maintaining a loss rate on their portfolio of solar loans of below 1 per cent. In April 2017, Bloomberg New Energy Finance chose SunFunder as one of its top ten New Energy Pioneers.[36]

Underlying cost drivers and challenges

SunFunder has developed their aggregator platform because they believe there are strong commercial prospects in the renewable energy sector in developing countries, and that the risk perception does not match the reality. As a first mover, they argue they have founded the approaches to assessing risk in the sector, but have also come up against the challenges cited by conventional investors.

For instance, SunFunder spends significant time on 'small-ticket' loans for early stage enterprises – resulting in proportionately higher transaction costs for small investments. While this is difficult, it is also seen as an opportunity to build relationships that will grow the sector. SunFunder noted that some of those transaction costs represent business advice and other services that could be supported by public finance but still needs to be linked to investment platforms. They are exploring partnerships to outsource business development services to increase efficiency.

Another challenge is the availability of sufficient debt financing. Currently the off-grid energy sector is largely supported by impact investors and equity investors, but while equity is important in the start-up phase to innovate and prove business models, entrepreneurs prefer working and inventory capital as debt rather than equity to avoid diluting their ownership and control too far when they scale up.

Ignite Power

Aggregation criteria

Unlike intermediaries such as IDCOL or SunFunder who provide financing but take no operational role, Ignite provides a platform to finance solar home systems by breaking up the vertically integrated SHS enterprises. It aims to encourage businesses to specialise in either suppliers of the technology (ie experts in design and manufacture of the kit) or in distribution (ie experts in sales and service). It acts as a capital and service provider, selling SHS both directly and indirectly. Ignite operates in Rwanda, Tanzania, Sierra Leone and is setting up operations in four more countries, focused on the in-country part of the value chain, aggregating demand and finance as well as procurement and operations. Ignite approached its goal of electrifying Rwandan households in a similar manner to developing a large infrastructure project "in terms of structure, financing and incorporation into national energy planning".[23]

Standardisation

Ignite agrees a set of product standards with partner governments that suppliers must meet before it will sell their SHS systems. As an aggregation entity, Ignite has also developed standardised payment models, including offering PayGo, and seeks to deliver a high-quality service to consumers through service providers and its own staff.

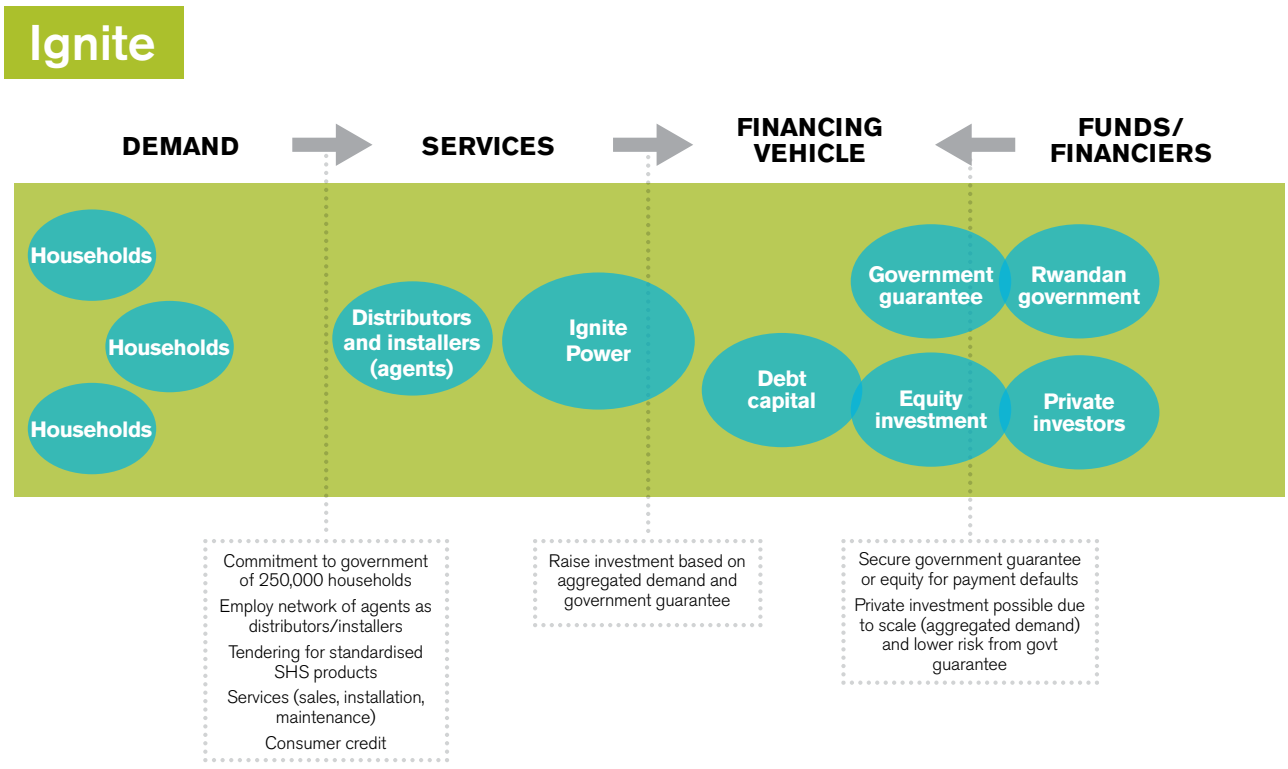
Financial structure

1. Financial instrument and source of funding

Ignite secured financing to execute a USD38 million project in Rwanda following an implementation agreement with the government. It has signed a second agreement with the government of Sierra Leone. So far it has had no support from development agencies, but has explored a capital facility to match contributions of funds and some grant for technical support, to speed up the model's scale of expansion.

As an aggregator that specialises in the customer side of the value chain, Ignite argues that there are three consecutive steps to successful aggregation: 1) aggregating demand, 2) aggregating procurement and 3) aggregating finance.

While SunFunder and E+Co fund enterprises but do not take an operational role in the underlying assets, Ignite manages the distribution, service and credit collection itself, leaving sales to be done through distributors. In this way, Ignite is aggregating demand through a vast network of agents that it trains to sell, install and maintain SHS. All systems are serviced by Ignite teams, ensuring long-term quality and level of service. This has allowed Ignite to achieve scale and rapidly electrify thousands of households.[23,37] Ensuring large-scale demand then enables Ignite to tender for bulk purchases of SHS products, buying in large volumes at a low wholesale price. And this price reduction has been passed on to the customer, which



combined with there being no deposits required, they also appear to reach poorer customers.

Ignite argues that once this volume is guaranteed, raising the scale of demand in each country from a few thousand to hundreds of thousands, it can begin to attract finance from large investors that are not currently in the impact space. Ignite has entered into a range of financial arrangements, including equity investment, debt investment and grants.

2. Finance provided to enterprises

Ignite tenders for the suppliers of SHS kit that meet the standard – reducing the cost per unit through bulk orders. It also identifies, trains and employs a network of entrepreneurs who act as agents, selling, installing and maintaining SHS within their local area.

Successes

By the end of 2016, Ignite had the largest market share of SHS in Rwanda[38] and was offering the most affordable systems in East Africa.[35,39] It has ensured each government is a partner in the endeavour, through having 'skin in the game' in the form of a guarantee or equity investment. This has allowed it to get clarity from the government about where the grid will not expand and to agree product standards. And it has attracted multi-million local currency debt financing for its operation in Rwanda. It has expanded to Sierra Leone and Tanzania and is finding it easier to attract capital now that it has a proven track record.

Underlying cost drivers and challenges

When Ignite first began in Rwanda the investors put in the initial equity investment themselves and quickly raised local currency debt. However, when they expanded to Sierra Leone sourcing capital was a slow process, partly due to delays caused by pursuing local debt financing, which is much lower cost but more difficult to obtain than foreign currency in countries with less developed investment ecosystems. Ignite has found it easier to secure investment in some countries than others.

There have been some concerns that because Ignite has such a large market share in Rwanda it could reduce competition. However, Ignite's market share is divided between three major suppliers, creating competition on both cost and quality between them that would not otherwise happen in a small market like Rwanda. Taking on the responsibility for a quality distribution and sales role itself means Ignite sees training its agent entrepreneurs as a part of its business model. It is not offering an investment portfolio so much as an aggregator that conducts the sales and distribution process itself.

E+Co

Aggregation criteria

E+Co (pronounced 'E and Co') was a non-governmental organisation based in the US that made clean energy investments in developing countries from 1994 until it was restructured in 2012. E+Co provided patient capital and business development services to sustainable energy entrepreneurs across Southeast Asia, Central America and sub-Saharan Africa, aiming to develop an investment platform that mobilised private finance behind a balanced portfolio of investments, which together offered financial sustainability as well as environmental and social impact.

Standardisation

Like SunFunder, E+Co opted for little standardisation in their services to the businesses – instead their approach was offering bespoke debt and close hand-holding support and business advice in the very early days of this market. E+Co did standardise its capital raising through the launch of its People and Planet note in 2008, one of the first instruments to raise small loans from accredited investors in the US. A major driver was to standardise reporting requirements across its debt providers. This approach was a precursor to note products offered by other aggregators, such as SunFunder.

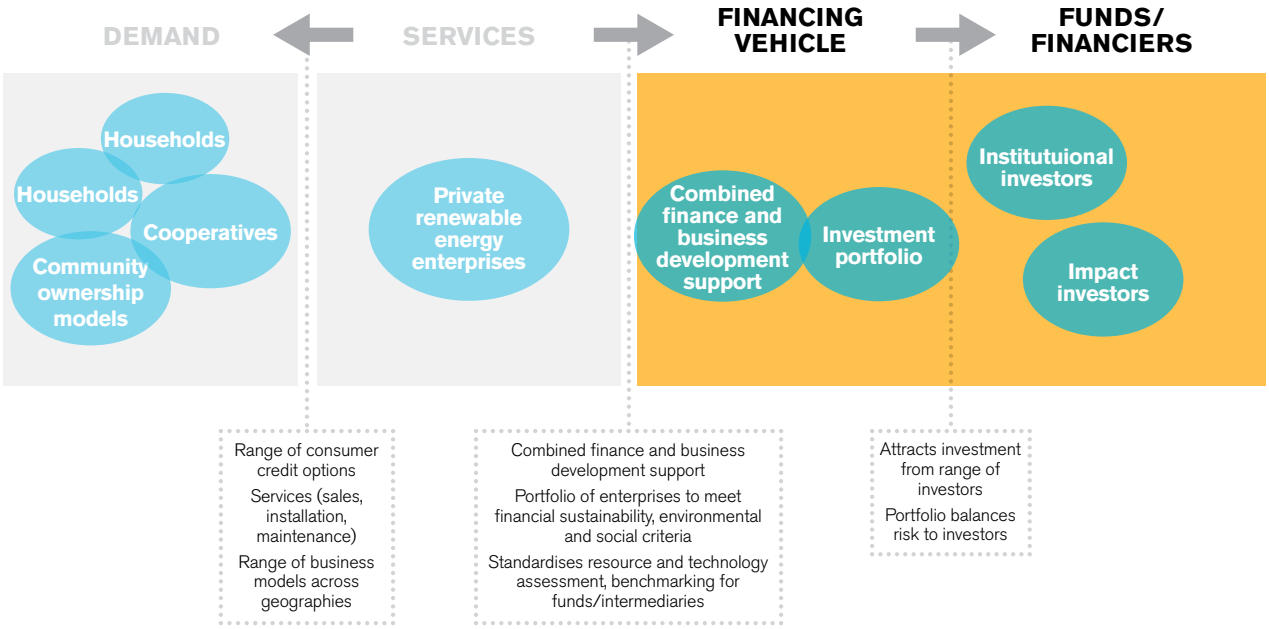
Financial structure

1. Financial instrument and source of funding

E+Co was a non-profit that sought finance from a range of investors, seeking to build a sufficiently large portfolio of investments with a balance of risks, to attract cheaper debt finance from institutional investors. It was aiming to stimulate the market so was seeking patient capital from investors prepared to invest today for greater returns in the future.

E+Co's model was born out of the experience of its founding staff, who started their careers working for the Port Authority of New York and New Jersey. As a public body, port authorities aim to make investments with public capital that stimulate private investment in infrastructure and economic development. Typically, some of these investments will succeed in bringing a profitable return, and some will not, but across the entire portfolio of investment the authority can be successful in making enough return to meet its fiduciary duties while also serving the public good. E+Co developed three interlinking criteria – financial sustainability, environmental benefits and social impacts – and realising that it would not always be possible to find enterprises that satisfy all three, built up a portfolio of projects and enterprises that together would meet these criteria.[18]

E+Co



2. Finance provided to enterprises

E+Co adopted a model which focused on both business development assistance to energy entrepreneurs, and early-stage, patient capital; one of the first entities to combine both of these activities into a single services-delivery model.[18] E+Co explained that business development services are vital, and helping a business develop in its early phases is the number one risk mitigation strategy and an integral part of E+Co's model. However, business development services alone are not enough; they point out that providing business services to young renewable energy companies with no line of sight to capital is like providing job training without jobs – so the investment portfolio is a vital part of their model.

Successes and lessons learned

E+Co found that the benefit of having a portfolio of investment across geographies was the ability to develop and share learning between them. For example, E+Co had extensive experience in mini-hydro development in central America, so when Tanzania began looking at its mini-hydro process, E+Co brought the expertise of its investment staff to Tanzania.

E+Co was ground-breaking for its time and delivered effectively on two critical criteria. First, it demonstrated the ability to blend capital and deliver single digit returns from clean energy enterprises through a portfolio; and second, it demonstrated the viability (and potential) of the energy enterprise sector. SELCO Solar in India is an example of this (E+Co was an early equity investor in SELCO, in 1996). SELCO has now been operating sustainably and providing renewable energy electrification options to the energy poor for over 25 years. It has also stimulated a whole ecosystem of activity around its solar retail operation, including a foundation, a fund to provide early-stage capital to local entrepreneurs, and an incubator.

Underlying cost drivers and challenges

The major challenge E+Co faced was simply a lack of the right mix of capital. And particularly, in that even earlier stage of the market, investors were not prepared to provide sufficiently patient capital to enable an intermediary such as E+Co to prove the model over time. Because E+Co's focus was not solely on making a fast return, but also providing business advice to start up clean energy enterprises to build the sector, its ability to offer double digit returns was reduced to single digits. Experts noted that E+Co's portfolio approach would work over time if there had been sufficient grant capital to fund the provision of mandatory business development and monitoring and evaluation services. The fact that E+Co was a non-profit added to this challenge as it was unable to raise equity.

E+Co also faced increased risk through providing largely early-stage funding. A lot of E+Co's work went into helping enterprises build the financial and management systems they needed to expand. However, E+Co found that while the public sector was interested

in capacity building through business development services, the private sector was focused on investment-ready opportunities, and few investors were interested in both.[18] Experts state that even now, the renewable energy sector is a nascent market, with need for a lot of hand-holding for early-stage businesses, particularly local businesses, which was a core focus of E+Co's investment approach. One development since E+Co was operational is the proliferation of business advisory services (eg PFAN) in developing countries that can take on some of this role, rather than the aggregator incorporating it as an integral part of their fund management structure.

Other examples

The Ground_Up Project provides an online investment platform that aggregates environmental companies and projects under USD10 million. As well as establishing portfolios of investments, the Ground_Up Project aggregates information through its Value Compass algorithm. This algorithm scores information about projects on six criteria – management, operations, social, country, financials and environmental – and uses these scores to help match investors and funders to their preferences.[40] The Ground_Up Project's approach is therefore about facilitating investments, not making them.

Climate Investor One focuses on providing a 'whole-of-life' investment solution, which provides a financing source to enterprises for each stage of a project's lifecycle. It also provides technical assistance and risk-reduction services to projects, with the aim of accelerating projects and preventing developers from getting 'stuck' without adequate or appropriate capital at the different phases of the project's lifecycle.

The Green Finance Catalyzing Facility is proposed by the Asian Development Bank to catalyse private sector finance and help green infrastructure projects cross the 'bankability gap'. The Facility will use a blended finance approach with concessional and commercial finance. It will focus on actively creating project pipelines, and outlines a range of financial instruments and mechanisms that it may utilise, including guarantee-based support, equity co-investment and revenue support. The Facility will aggregate infrastructure projects through the creation of a Pooled Projects Vehicle for Institutional Access to Finance.

The United Nations Development Programme's (UNDP) proposed **Climate Aggregation Platform** (CAP) is aiming to leverage over USD100 million in co-financing from different partners, including the Inter-American Development Bank, to build pipelines of standardised, low-carbon energy assets and develop low-cost financing options for these assets. The Platform will be implemented by UNDP and the Climate Bonds Initiative. CAP will undertake three core activities:

1. Promote coordination among finance and industry stakeholders, through a global working group
2. Promote standardisation
3. In-country demonstrations and technical support for pilot transactions.[41,3]

The **MicroGrid Investment Accelerator** was launched at the SEforALL forum in April 2017, receiving core investments from Facebook and Microsoft. Its goal is to standardise the procurement of micro-grids specifically for household use. The accelerator is only operating in certain countries to begin with, narrowing the level of country risk they are willing to take on, and have gone to market in these countries with proposals for mini-grid developers that meet certain characteristics. The aim is to raise USD25 million at first close through a combination of grant and equity finance.[20]

Endnotes and references

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Acronyms

AEPC	Alternative Energy Promotion Centre
CAP	Climate Aggregation Platform
CREF	Central Renewable Energy Fund
IDCOL	Infrastructure Development Company Limited
GOGLA	Global Off-Grid Lighting Association
MFI	micro-finance institution
NGO	non-governmental organisation
NRREP	National Rural and Renewable Energy Programme
PayGo	pay-as-you-go
PFAN	Private Advisory Finance Network
SEforALL	Sustainable Energy for All
SHS	solar home system
SPV	special purpose vehicle
UNDP	United Nations Development Programme
VAT	value-added tax

The last decade has seen rapid growth among enterprises seeking to deliver decentralised renewable energy products to the more than one billion people who still lack access to electricity – but this sector is still at an early stage. The challenge is matching the scale of finance offered by investors with the finance needs of small-scale energy opportunities for poor households. Financial aggregation, however, bundles together energy opportunities, lowering costs and risk for investors. This paper gives an overview of innovation in financial aggregation and how it tackles barriers as well as insights into the implications of design choices.

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