

# Financing the DESCO S-Curve: What are we waiting for?



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## Introduction

In a paper published last year (“How a New Breed of Energy Services Companies can Reach 500 million Energy Poor Customers within a Decade”) we introduced the distributed energy services company, or DESCO, as a commercially viable business model to reach many of the world’s 1.1 billion off-grid people with access to clean, affordable energy services by 2030. Over the past year, DESCOs have grown as we predicted. However, despite increasing evidence of profitability of market innovators and increased attention from governments and development partners in their potential to be part of the solution, all but the leading DESCOs continue to face major challenges in raising capital. Meanwhile, with money to support climate-friendly and energy access initiatives growing, investors lament that they simply do not have sufficient deal pipeline. The issue lies in the mismatch between the nature of financing available and the nature of financing needed to grow a robust, truly investible sector. In this article we assess the state of the market and attempt to forecast the amount and types of capital needed, focusing on the stages of growth of a DESCO and the potential macro market demand. We conclude with some prescriptions of how to keep adequate capital flowing into the DESCO sector.

## 1. Moving from Isolated Success Story to Robust Sector

The role of business in improving access to modern energy services has been contemplated for some time now. Recognizing that public funding will be insufficient to meet the needs of the billions of people at the base of the energy ladder, there have been calls dating back at least a decade for the private sector to come up with interventions to close the “access gap”. While the business rationale for serving the energy poor was not always made clear by early proponents, recent analysis suggests that there is a \$40 billion market opportunity<sup>1</sup> for modern energy services, of which about a half is for lighting and phone charging alone.

In a paper<sup>2</sup> published in 2014 we introduced the terminology of “distributed energy services companies” or “DESCOs”, to describe businesses that have begun to capture this opportunity at scale.

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<sup>1</sup> From Gap to Opportunity: Business Models for Scaling Up Energy Access. International Finance Corporation, 2012.

<sup>2</sup> “How a New Breed of Energy Services Companies can Reach 500 million Energy Poor Customers within a Decade”, Pepukaye Bardouille and Dirk Muench, June 2014. <http://persistentnrg.com/analysis/>

Over the past year, DESCOs have grown as fast as we predicted, reaching an estimated 500,000 households and offgrid businesses. By our estimates, DESCOs collectively raised an estimated \$200 million in equity and debt by the end of 2014. As DESCOs approach 1 million connections in 2016, their capital needs continue to increase.

However, despite the achievement of profitability by market leaders in the DESCO sector and increased attention from governments and development partners in DESCOs' potential to be a major part of the energy access solution, all but a small group of the largest DESCOs continue to face significant challenges in raising capital. This seems particularly illogical as one realizes that there are increasing, largely donor-based, financial commitments to support energy access initiatives around the World.

**Why are companies that have a sustainable, potentially profitable energy access solution unable to secure financing? Why are investors beginning to lament that they do not have sufficient viable deal flow to justify the initial buzz of the DESCO sector?**

The answer lies in the mismatch between the nature of financing available and the nature of the financing needed to grow a robust, scalable, investible sector.

This article assesses the state of the market and attempts to forecast the amount and types of capital needed, focusing on macro market demand and the kinds of capital needed at various stages of growth of a DESCO. We conclude with some prescriptions of how to keep adequate capital flowing into the DESCO sector.

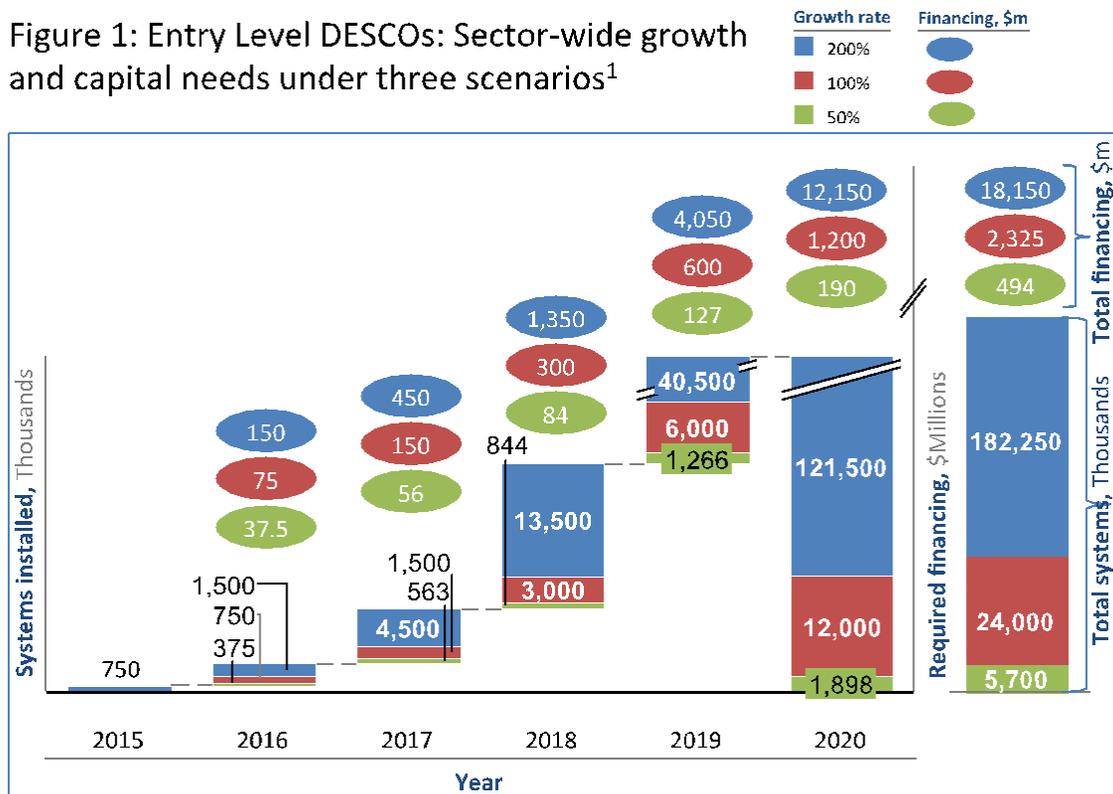
## **2. How Much Capital is Needed?**

Let's look at sector-wide capital needs of DESCOs providing two types of product or service levels: those providing entry level energy services of lighting and mobile phone charging and those providing higher level energy services that can include radios, fans and televisions in addition to lighting and mobile phone charging. These products or services could be provided with individual rooftop systems or efficient mini-grids. We look at both entry level and larger offerings under three overall sector growth rates: 50%, 100% and 200% per year.

Figure 1 illustrates growth scenarios assuming that DESCOs reach 750,000 customers in 2015, and offer only entry-level rooftop solar systems. At a 50% annual growth rate, 5.7 million households and small businesses would be connected to a modern off grid system by 2020. The capital needed to achieve this would be approximately \$500 million. At a 100% annual growth rate, 24 million households and small businesses could be reached by 2020. This would require capital of approximately \$2.3 billion.

At a 200% annual growth rate, 182 million connections could be made by 2020.<sup>3</sup> The capital needed to achieve this number would be approximately \$18 billion.

Figure 1: Entry Level DESCOs: Sector-wide growth and capital needs under three scenarios<sup>1</sup>



<sup>1</sup> Assuming \$100 cost per connection of inventory and installation to DESCO

Of course there are several factors independent of the amount of capital available that will determine whether any of these scenarios can be reached, including:

<sup>3</sup> This is the larger than the current estimate of approximately 130 million off grid households and businesses in sub-Saharan Africa. Of course, current estimates will increase as population grows, as population growth is generally not absorbed by increased grid capacity.

- **Can DESCOs grow quickly enough to reach, say 182 million customers?** This requires building stable and robust business organizations capable of servicing millions of small users while maintaining an almost frenetic rate of growth. It also requires stable governments where doing business is practical and regulatory barriers are protective of consumers but are not barriers to development.
- **Can DESCOs operate cost effectively?** The illustrations above assume DESCOs manage costs well. Inefficiencies as well as mid-term setbacks that can occur in any growth business will increase the amount of capital needed to achieve that company's share of the growth illustrated above.
- **Will the grid or other energy access solutions reach a large portion of these potential customers first?** This begs the question: how big is the market for DESCO products?
- **Will customers be satisfied with entry-level systems?** All the evidence collected by DESCOs to date confirms that they will not. At a minimum, nearly everyone wants to be connected to the world, whether via TV, tablet or some other media device. Technology solutions that can provide entertainment and communication using very low wattage systems exist, and are growing in scope. But customers want productive power, too, for refrigeration, milling, water pumping and other income-generating activities.
- **What portion of the target market will be able to afford larger systems?** This is also an unknown. What is known is that DESCOs offering larger than entry level products are not having trouble selling them.

When evaluating how much capital is needed, it is also important keep in mind that much of the capital put to work can be "recycled". Capital invested to install 750,000 entry-level systems in 2015 will typically be recovered in 12-18 months and, if lenders do not demand repayment, can be reinvested. Our simple forecast treats this reinvestment as new lending. In addition, once a business becomes profitable, its net earnings can be reinvested into growth of the business. At a certain point – beyond the sophistication of our model – a business can finance not only its growth of staff, stores and operations with its profits, but it can also finance its receivables and inventory.

We expect that, as more consumers gain access to entry-level energy services, demand for greater levels of service will increase. Even though there is no demographic data that shows the percentage of customers able to afford larger

systems and the appliances powered by those systems, there is both investor and government confidence that, in at least some sub-Saharan countries, both income and demand is large enough to support growth of a “higher powered” DESCO sector.

Let’s look at what capital requirements might be in the higher-powered segment of the DESCO sector.

Figure 2 shows growth scenarios for a reasonably priced higher level rooftop solar system. Let’s assume that this reflects the average cost required by DESCOs to offer customers TVs and other appliances at a modest level.

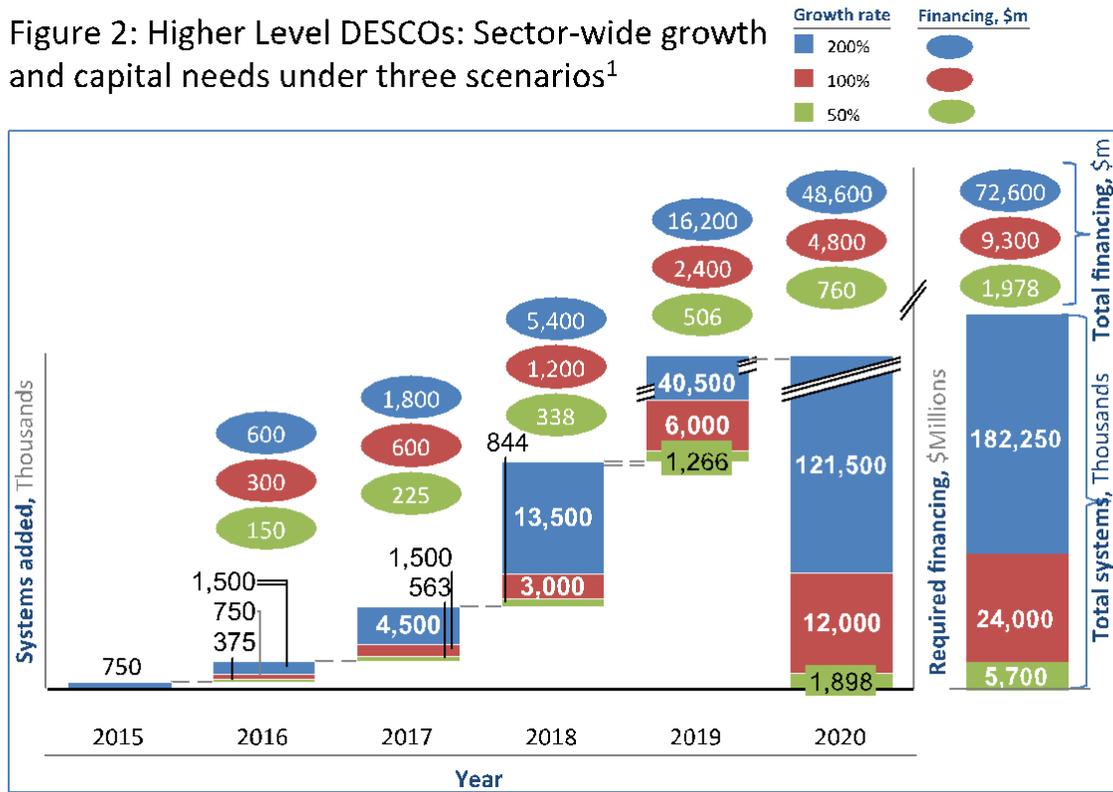
If all DESCOs offered modestly priced larger systems, at a 50% annual growth rate (reaching approximately 5.7 million households and businesses by 2020), the capital required to achieve this goal would be approximately \$2 billion.

At a 100% annual growth rate, \$9.3 billion would be required to reach 24 million households and businesses by 2020.

At a 200% annual growth rate, \$72.6 billion would be required to reach 182 million households and businesses by 2020.

Note that although, as with the entry-level systems discussed above, the capital invested can be “recycled” when customers repay the cost of the system, because these larger systems are more expensive, the period of cost recovery is longer, ranging from 3 to 5 years.

Figure 2: Higher Level DESCOS: Sector-wide growth and capital needs under three scenarios<sup>1</sup>



<sup>1</sup> Assuming \$400 cost per connection of inventory and installation to DESCO

While it is difficult to forecast a definitive capital need for the DESCO sector over the next five years, it seems likely that a minimum of \$1 billion could be put to work. That number could easily exceed \$10 billion if sufficient capital is available and DESCOS overcome other growth hurdles.

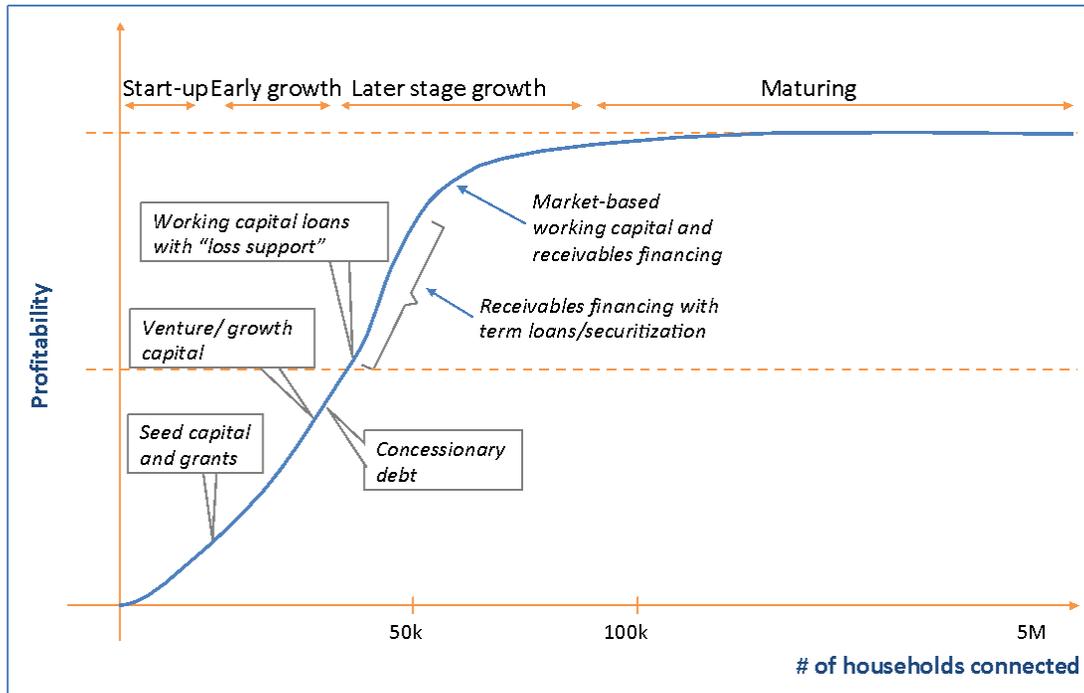
### 3. Financing Along a DESCO's S-Curve

Figure 3 depicts the life cycle of a successful DESCO along the "S" curve. This DESCO offers its customers entry-level rooftop systems or utilizes a mini grid with sufficient capacity to provide customers with entry-level services. With this product offering, a DESCO can breakeven at 25,000 - 50,000 customers, turning profitable thereafter. Of course, a DESCO offering larger systems or services to its customers would need far fewer customers to achieve breakeven.

Moving along the graph (left to right), we illustrate the kind of capital a DESCO needs to grow, achieve profitability, and maintain that profitability as a mature enterprise. We divide the growth of a DESCO in 4 stages: start-up-, early

growth-, late growth- and maturing stage. Capital requirements over each stage are discussed below.

Figure 3: Capital needs over the life-cycle of a DESCO



### Start-up Stage

Virtually all DESCOS have financed their start-up stage with a combination of grants and seed equity. The founders have contributed by taking no salaries and/or highly concessionary salaries and often have made investments of their own capital or capital raised from families and friends, as is common for most new businesses.

A DESCO with the ability to license a product and operating platform from a third party should generally need between approximately \$1.5-2 million to get through the startup stage.<sup>4</sup> Small amounts of capital are required to set up the business and begin assembling staff. Most of the capital is expended near the end of the cycle as the company pilots its products and begins building a customer base, resolving initial operating problems and challenges.

<sup>4</sup> If the DESCO also needs to design its own product and create its own operating platform (i.e., the software to operate systems remotely), substantially more capital would be required (perhaps \$2-4 million).

At the end of the start-up phase, a DESCO offering entry-level systems/services would have approximately 1-2,000 customers, a solid product and a stable operating platform. It will have worked out most of its customer payment issues. The DESCO will be ready for larger amounts of capital to enter the early growth stage.

### **Early Growth Stage**

In the early growth stage a DESCO starts to grow with the core operating team it has built during the start-up stage.

During this stage the DESCO may encounter “bugs” with integration of its operating platform with mobile phone and mobile money providers, or with operation of the hardware, supply chain or recruiting a large staff or agent network. These challenges will get worked out by a successful company and help it build a resilient operating business.

A DESCO offering entry-level products/services could be expected to need \$3-6 million over approximately 24 months and reach 15-25,000 customers during the early growth stage. Most of the capital needed would come from venture capital investors and concessionary impact investors. Some concessionary impact investors invest in early growth stage DESCOs in the form of debt but, given the risk profile of these loans, these are essentially equity investments with a debt-like yield. There is also some grant capital available, usually in the form of “soft” loans that are only repayable if and when the company has the financial capability to do so.

### **Later Growth Stage**

A DESCO’s growth accelerates in the later growth stage. Its cost structure is now almost entirely driven by the number of customers it has – driving operating costs – while its growth rate drives its demand for investment in new systems. The DESCO will start to focus on its efficiency of operations and should achieve operational breakeven 24 – 36 months into this phase. A DESCO will need approximately \$20 million of capital by the end of the Later Growth Stage.

In the later growth stage the DESCO should begin to focus on building a stable capital structure for enduring growth. These simple building blocks are:

- A sufficient equity base

- Short term, revolving debt to finance current assets (i.e., inventory)
- Term debt to finance customer payments (whether loan repayments or rental payments)
- The possibility of a layer “quasi-equity” between the true debt and equity of the company. This can increase equity investor returns because it is nondilutive.

At the beginning of the later growth stage, the DESCO will primarily have access only to equity and perhaps concessionary debt that takes an equity-like risk to finance its growth. As a result, as the DESCO approaches breakeven, it should have a large equity base with little leverage.

As it approaches breakeven, however, a DESCO should be able to attract lenders to finance the two distinct parts of its balance sheet that can be leveraged: 1) inventory – which can be financed with working capital loans, and 2) customer receivables – which can be financed with working capital loans if receivables are short term in nature, or with term loans if the customer receivables are long term in nature. Financing these two parts of a DESCO’s balance sheet is discussed in the following section.

### **Maturing Stage**

As a DESCO achieves profitability it should be able to leverage its equity and finance its growth primarily with debt.<sup>5</sup> To provide returns its equity investors seek, the DESCO will have to continue to drive growth and will need substantial debt capital to do so.

A DESCO offering entry-level products/services should need approximately \$75 million in total capital (from start-up) and approximately 5 years to reach 250,000 customers. While this DESCO could be considered “mature” in the sense that it is providing equity investors with an attractive return on capital, the market opportunity will be anything but mature for many years. Opportunities for rapid growth will continue so long as portions of the World’s off grid population remain without an energy access solution.

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<sup>5</sup> Generally a DESCO should have a sufficient equity base at this point to support a debt-based growth model. See Persistent Energy Capital’s *Borrowing Capacity Model*, which enables the user to calculate working capital borrowing capabilities of DESCOS. The model allows the user to set assumptions on cost, margin, sales level, lender criteria and other factors to determine borrowing potential. “Financing DESCOS – A Framework”, Chris Aidun and Dirk Muench, March 2015. <http://persistentnrg.com/analysis/>

## 4. What Kinds of Capital Are Right for the DESCO Sector?

The prior section illustrated what kinds of capital a typical DESCO would need. Looking at the capital needed and the capital available in the DESCO sector on a macro basis, there is a mismatch between what investors want to invest in and what the sector needs. Moreover, as shown in Figures 1 and 2, the sector will need somewhere between \$2 and \$70 billion over the next 5 - 10 years to achieve the kind of rapid growth that both businesses and policy makers seek.

Let's say we want to mobilize \$10 billion of capital over the next five years. Where should it be invested?

### **Equity - \$3 billion**

The DESCO sector should be able to put \$3 billion of that \$10 billion to work as equity.

The critical need will be in early stage equity to launch and grow new businesses in currently unserved markets. This early stage equity has the highest return potential.

As DESCO's mature and turn profitable, many will have the ability to grow their equity base by retaining earnings. Accordingly, we would expect some of the \$3 billion in equity to come from internally generated earnings.

### **Debt - \$7 billion**

As DESCOs near breakeven they become candidates for conventional commercial lending.

Perhaps the best way to analyze the borrowing needs of the growing DESCO sector is to think of a DESCO as two businesses in one: a *marketing and distribution company* that sells solar assets or the services those assets can provide, and a *finance company* that finances the purchase or lease of the solar assets for its customers. The latter is analogous to consumer finance companies that all large automobile companies have used to finance their customer car purchases. In the immature DESCO sector, however, the finance function has not yet been spun off into separate entities.<sup>6</sup>

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<sup>6</sup> Similarly, the US solar company SolarCity describes itself as two companies – a solar development company and a power company. The two sides of SolarCity are similar to a DESCO's two sides. [http://www.greentechmedia.com/articles/read/SolarCity-Reports-Record-PV-Bookings-and-Installs-in-Q2?utm\\_source=Daily&utm\\_medium=Headline&utm\\_campaign=GTMDaily](http://www.greentechmedia.com/articles/read/SolarCity-Reports-Record-PV-Bookings-and-Installs-in-Q2?utm_source=Daily&utm_medium=Headline&utm_campaign=GTMDaily)

In this context, we would expect inventory financing to constitute approximately \$3 billion of the total \$7 billion of debt needed and receivables financing to constitute \$4 billion of the total ticket. Both types of financing can take many forms, ranging from revolving lines of credit to securitization of receivables.

## **From Here Up the S Curve – A Prescription for More Capital**

Many things may constrain development of the DESCO sector. Lack of capital is high on the list. It is of course not the only issue facing companies, but access to capital is a challenge we can analyze and solve. Here is our prescription to keep capital from being the barrier to development of the DESCO sector:

### **Provide Equity for Start-ups and Early Growth Companies**

In a dream world of public-private sector cooperation in development, there would be a pool of capital set aside for diversified investing in start-ups.

*A \$500 million pool of seed and early stage equity invested in start up DESCOs could take **years**, perhaps **decades**, off the achievement of energy access.*

One attractive approach is to follow the model the Israeli government used to develop its high tech sector. After several experiments beginning in the late 1980s, Israel launched its Yozma Fund in 1993 with an initial capitalization of \$100mm. Yozma made investments in ten venture capital funds managed by independent managers. These ten funds, plus Yozma directly investing, made seed and early stage investments in start-up Israeli businesses that could not otherwise attract capital.

While many individual businesses invested in with Yozma funds failed, the Yozma program is widely viewed in government, business and academic circles as the critical catalyst that created not only Israel's high tech company sector, but also spawned its venture capital sector.<sup>7</sup>

A similar initiative to support the DESCO sector would almost certainly have a significant impact on achieving energy access goals.

## **Private Sector Investment Sophistication**

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<sup>7</sup> For more background see [this research paper](#)

Donors and development institutions know painfully well that commitments to spend money on donor programs does not ensure successful development. The challenges in using donor funds for investment are even more substantial.

Experience in the sector has taught us that *investing* (in contrast to granting) most of the capital used to develop commercial businesses imposes a market discipline on both the investor and the company. In the case of the energy access challenge, this private sector, profit driven, discipline will drive the growth of customers. And that means increased energy access as we have outlined in this and our prior papers.

Experience has also taught us that knowledgeable, sophisticated private investors – not local government agencies, social development experts, part timers or amateurs – are required to put the DESCO sector’s needed capital to work. Investing \$500 million to launch and support 25-35 DESCOS will most effectively be done by experienced incubators, seed equity investors and later stage private equity funds. Similarly, other programs to promote local financial institutions to enter the DESCO debt markets should be designed with commercial principles in mind.

### **Promote Local Bank Revolving Lending**

Bringing local commercial banks into the DESCO sector as revolving lenders should be a critical focus of development institutions, impact investors, donors or others. This could be done in several ways:

- **Demonstration:** Even though there are mechanical challenges,<sup>8</sup> impact investors and donors that wish to lend to growth DESCOS on a concessionary basis should do so in revolving loan facilities. These facilities should replicate conventional commercial banking structures. DESCOS using such facilities will be able to establish a track record of successful loan and inventory management. This should make them more attractive to local commercial banks as potential borrowers.

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<sup>8</sup> Debt investment funds are accustomed to lending term loans and will likely have logistical challenges lending, accepting repayment and relending on a revolving basis. A revolving loan structure can be replicated by hiring a local commercial bank to handle cash management, but the procedure is more expensive than a conventional revolving lending arrangement.

- **Funding:** Local development banks and commercial banks in DESCO markets may be encouraged to provide revolving loans to DESCOs through international development institution funding programs. Bangladesh provides an important example of how highly concessional loans from the World Bank and KfW, channeled through the State-owned Industrial Development Corporation (IDCOL), helped to spur the installation of over 2 million solar home systems in off grid parts of the country. Similarly, in Ethiopia, a World Bank credit, which the Government on-lent to state-owned Development Bank of Ethiopia to provide local currency financing to SMEs, resulted in over 200,000 solar products entering the market in under a year.
- **Underwriting Risk:** Commercial banks may be induced to enter the DESCO sector as revolving lenders if there is a first loss layer supporting their transactions. Donors and development institutions could support commercial banks by providing this “encouragement layer” to their initial lending in the sector.

### **Promote Asset Securitization in the DESCO sector**

Promoting asset securitization in the DESCO sector will have dual benefits: not only will it create a standardized, accessible source of capital for DESCOs, but it may open frontier capital markets to asset backed securities as an instrument to finance other assets.<sup>9</sup>

Bringing debt investors into the asset securitization market for DESCOs should not be as difficult as bringing local commercial banks into the revolving loan market. As asset securitizations become more common, asset pools in any offering can be tranching. In tranching of an asset pool, the “A” or more senior asset-backed securities have first priority in payment and “B”, “C” or lower tranches have. The higher tranche securities bear the lowest interest rates and lower tranches higher rates. This reflects pricing of the relative risks to investors in each tranche. This tiering of risk has the salutary effect of offering something for every interested investor.

The development of a securitization market to support the DESCO sector could be accelerated if development institutions and other concessionary lenders invested in junior tranches of asset securitization notes to reduce risk to more nervous but interested new investors that would buy senior tranches.

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<sup>9</sup> For example Kenya has a law that provides a framework for public sales of asset-backed securities but it is currently not being actively utilized. Kenya Capital Markets Act, Section 485A.

Alternatively, development institutions could provide direct first loss credit support to new investors in securitized notes. These could be effective techniques to encourage local financial institutions to become investors in DESCO securitizations.

### **Promote Foreign Exchange Risk Mitigation Tools**

DESCOs do business in local currencies while buying product in hard currencies (such as US dollars). Most DESCO lenders to date have lent in dollars or Euros. Every CEO and CFO of a DESCO – and most investors – are aware of large and largely unpredictable foreign exchange risk associated with these loans.

Large companies in Western markets routinely hedge their foreign exchange risk. They have sophisticated financial products (such as foreign currency swaps) available to them to do this. In frontier markets these products do not exist. They desperately need to be developed.<sup>10</sup>

### **Assist with Market Preparation**

As we have said, many factors may constrain the development of the DESCO sector. Starting a DESCO in any market and bringing it successfully to scale is a daunting challenge. Among the many hurdles are:

- Developing a distribution network of agents in regions with poor roads and logistics support;
- Overcoming customer perceptions in many regions that solar products are shoddy because of “market spoilage”;
- Achieving customer acceptance of solar as a solution to their aspirations to have grid-connected, ‘first world’ electricity services;
- Managing unstable or arbitrary political systems that make doing business unpredictable;
- Working in regulatory environments that place artificial constraints on businesses, or that insist on universal tariffs measured in \$/kWh when what people really want is reasonably priced, dependable energy services;
- Coordinating with grid utilities in a DESCO’s market so that grid roll-out and off grid energy access complement each other; and

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<sup>10</sup> TCX, a global fund created by development finance institutions, will provide currency hedges. See <https://www.tcxfund.com/>. An important first step, there is currently only limited access to this fund by participating investors in TCX, their counterparties and others they sponsor.

- Operating in countries where fossil fuels like diesel are subsidized for consumers and/or where solar products are subjected to heavy VAT or customs duties.

While these non-financial barriers are beyond the scope of this paper, they are squarely in the view of any entrepreneur, CEO, investor or lender in the DESCO sector. The DESCO sector will develop faster if these challenges can be removed or lessened. In particular, programs that focus on easing restrictive regulations, lower or exempt solar products from VAT and customs duties and educate consumers on the value of solar products (and how to distinguish between quality and shoddy products) will accelerate sector growth. Governments and their development partners could provide critical assistance in this regard.<sup>11</sup>

## 5. Conclusion: It is Time to Throw Money at a Solution

The quest for successful development of energy access is haunted by past failures of many different kinds of efforts in off-grid areas of the World. Remembering these wounds of the past, donor governments, development institutions and impact investors have shown great caution investing in the DESCO sector.

Yet, the DESCO model and the technological advances that are making it possible have already shown tremendous success in a relatively short period of time. DESCOs promise to revolutionize energy access the way mobile communications did in frontier markets.

Track records of the leading DESCOs provide clear evidence that, finally, the energy access challenge has a very real solution that **we should throw money at**. In parallel, governments and development partners should push very hard for the implementation of a handful of strategic supportive measures that will give them tangible results: energy access for millions of people who would otherwise be waiting for many more years for the grid to arrive.

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<sup>11</sup> An example of success in this regard was the work of the World Bank with the Tanzanian utility regulatory authority to exempt low power minigrids from regulation as utilities. See “THE ELECTRICITY (DEVELOPMENT OF SMALL POWER PROJECTS) RULES, 2013”, Tanzania Energy and Water Utilities Regulatory Authority. In contrast, the Government of Ghana, in spite of widespread interest at various levels of government, refused to clarify that such minigrids would be exempt from utility regulation, effectively shutting down a nascent effort to pursue a DESCO minigrid model in Ghana.

We are not suggesting imprudent investing or lending. We are suggesting taking risks; large risks.

Many, many businesses should be launched. Lots of capital – both investment and grant capital – should flow into (even flood) the DESCO sector; the sooner the better.

There is no doubt that many of these businesses will fail – some investments will be lost and some grants will be for naught. However, if enough capital is mobilized, the failures will be irrelevant. Instead, just like the Israeli technology sector, the success of thriving businesses that will make major contributions to solving the energy access challenge will eclipse these failures.

As an ancillary benefit, the DESCO sector provides the opportunity for growth of the financial sector in frontier markets: working capital, term debt (including securitized assets), venture capital, and demand for currency hedging instruments can all drive the financial sector. Several billion dollars of local currency lending could be triggered over the next five years. So too can the financial inclusion of a group of newly electrified consumers – some of whom will create their first mobile money accounts with the help of a DESCO – driving the banking sector in frontier markets.

What are we waiting for?

## **About the authors:**

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**Pepukaye Bardouille**, Senior Operations Officer with the International Finance Corporation (IFC), part of the World Bank Group. Pepukaye has worked for over 15 years in management consulting and development finance. She currently leads much of IFC's global activities on energy access, focusing on scaling-up commercially-viable models for off-grid energy access. The views expressed in this paper are her own.

**Dirk Muench**, Co-founder and a Managing Director of Persistent Energy has over 12 years' experience as an investor and financial advisor, and has worked in the energy access sector for over five years. Dirk co-founded Persistent Energy with Chris Aidun in 2012.