Making Light Work

The report has been produced as part of the Making Light Work Project at the Smith School of Enterprise and Environment, University of Oxford. Making Light Work analyses a new programme developed by the World Bank which aims to rapidly increase the amount of energy that is generated through solar power in developing countries. The project was awarded through the British Academy's Sustainable Development Programme, funded by the Global Challenges Research Fund. Dr Alex Money is the Principal Investigator.

The future of renewable energy infrastructure financing – Aligning development opportunities with investor preferences

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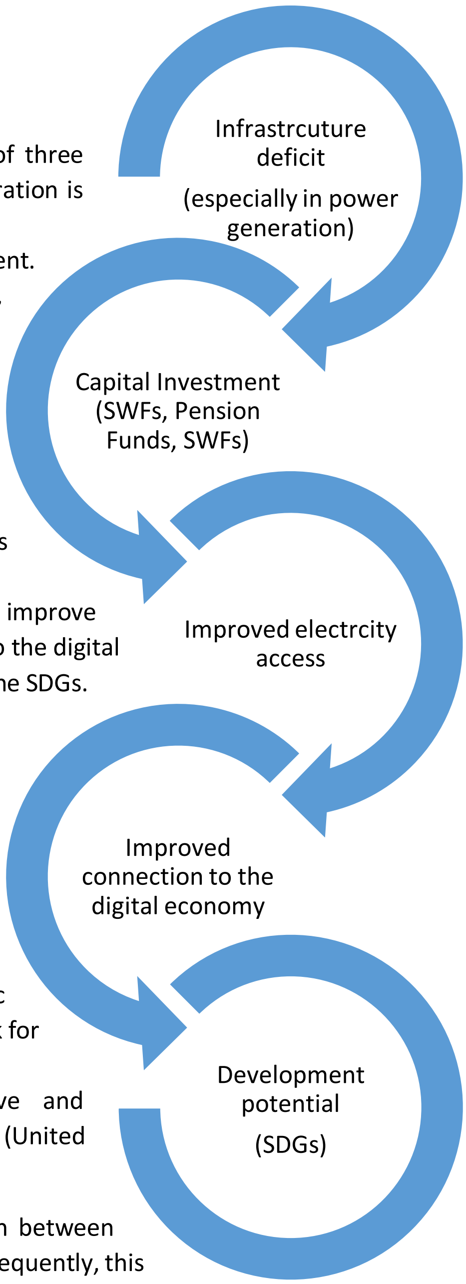

Summary

1. Infrastructure deficits have been growing for the best part of three decades across much of Sub-Sharan Africa (SSA). Power generation is the sector where these deficits are most prominent.
2. Reducing this deficit will require substantial capital investment. Due to the illiquid nature of infrastructure as an asset class, institutional investors such as Sovereign Wealth Funds (SWFs) with longer-term investment horizons are particularly well suited to invest in SSA power infrastructure.
3. Given vast supplies of solar radiation, solar PV is the optimal renewable energy generation option in SSA.
4. Improved power infrastructure will lead to increased rates of electricity access for urban and rural populations as well as industry.
5. Improved electricity access has the potential to significantly improve internet penetration rates and open up the African continent to the digital economy. In turn this will aid in the progress towards meeting the SDGs.

Closing the infrastructure deficit

The positive outcomes from reducing the infrastructure deficit in SSA would contribute towards meeting a number of the Sustainable Development Goals (SDGs). Most, notably SDGs **7**, **8**, and **9**:

- **7** – Ensure access to affordable, reliable, sustainable and modern energy for all
- **8** – Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.
- **9** – Build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation (United Nations, 2015)

In addition, we hypothesize that there is a strong positive correlation between improved power infrastructure and increased internet penetration. Subsequently, this has the potential to substantially improve inclusion in the digital economy which major parts of SSA remain excluded from. This has been extensively documented by the Oxford Internet Institute (OII) in the ongoing GEONET project.

The current scenario

In 2016, the population of SSA totalled 1.033 billion (The World Bank Group, 2017) and by 2050, current projections suggest that the population will have expanded to over 2.1 billion (United Nations Department of Economics and Social Affairs Population Division, 2015). This trend will be coupled with a threefold increase in the urban population from 360 million – 1,137 million and a rural population increase of 58% over the next 33 years (Cleland and Machiyama, 2017). Urbanisation and population growth will inevitably result in increased electricity demand. Despite this, generation capacity across SSA has remained almost static since 1974. Consequently, there have been severe power deficits resulting in regular load shedding on a rotational basis throughout the day in varying locations across the region. Indeed, as Arezki and Sy (2016) note, out of all sectors, power is by far SSAs biggest infrastructure challenge given that thirty countries currently face regular blackouts. The scale of the current infrastructure deficit in SSA is clearly alarming, and a 2009 World Bank Report estimated that $93 billion of infrastructure investment is needed each year in SSA across all sectors (Foster and Biceno-Garmendia, 2009).

The potential for SWFs

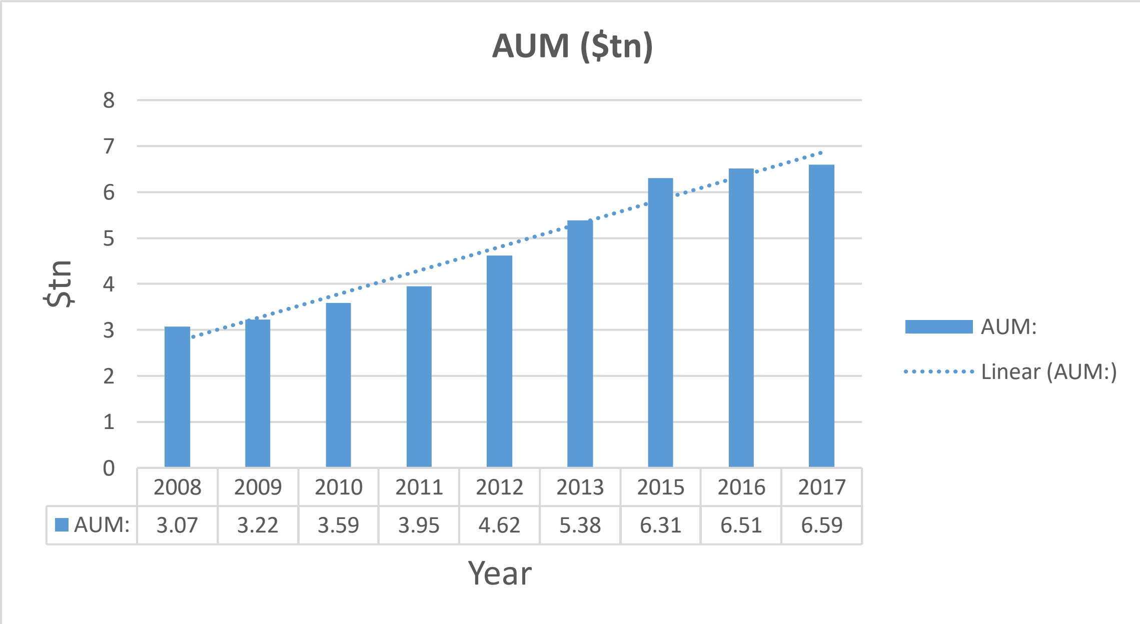

Figure 1: Sovereign Wealth Fund Growth (Source: Preqin, 2017)

This short report posits that SWFs can be major contributors to reducing the current infrastructure deficit. Since the start of the 21st Century, SWFs in multiple geographies have been rapidly accumulating assets (Figure 1) and it will be argued that their size, coupled with their investment mandate, makes them ideal infrastructure investors.

Infrastructure assets are a significantly more attractive investment option for longer term investors. Because SWFs have investment horizons that span multiple decades they are able to absorb the predominantly large investment amounts that infrastructure commands and they are less concerned about holding illiquid assets (Clark *et al.*, 2011). Inderst (2010), takes these arguments further highlighting that infrastructure also meets a number of the desires of SWFs including economies of scale, inelastic demand, stable cash flows and the ability to generate uncorrelated returns, inflation linkage and downside protection.

Despite the potential congruity of SWFs and infrastructure investments, they are not predominant investors in the sector. Indeed, the vast majority of SWFs remain underweight in infrastructure assets – currently, they only allocate 3.3% of their portfolio to this asset class (PwC, 2017). For example, the Norwegian SWF, which is currently the largest in the world, is still not permitted to invest in unlisted infrastructure (Reuters, 2017).

Case study – Zambia

Zambia, a landlocked nation situated in SSA is home to a population of 14.5 million (Table 1). For a number of years, the Zambian economy has been growing rapidly – GDP increased year-on-year by 6.4% between 2010 and 2014. However, this bullish growth rate is faltering and currently annual GDP growth is 4% (World Bank, 2015).

Zambia - Energy sector overview		Energy Type	Installed Capacity (MW)	% of Total
Population	14.5 million	**Hydro:**	2,255	94.1128%
Current production	13,000 GWh	**Thermal**	80	3.3388%
Current demand	16,000GWh	**Diesel**	11	0.4591%
Installed generation capacity	2, 411 MW	**Heavy fuel oil**	50	2.0868%
Electricity demand increase	3%/year	**Solar**	0.06	0.0025%
		Total:	**2,396**	**100%**

Table 1: Zambia - Energy sector overview (Source: Energy Regulation Board Zambia, 2015; World Bank, 2015)

In 2015 , the Energy Regulation Board (ERB) estimated that hydropower was providing 95% of total generation capacity (Energy Regulation Board Zambia, 2015). Drought conditions since 2015 have resulted in discharge in the rivers feeding the main generation sites being significantly lower than is necessary to meet Zambia's electricity needs. In addition, economic growth has resulted in electricity demand rising 3% per annum as well as an increase in peak-time electricity demand of between 150 and 200 MW a year (Energy Regulation Board, 2014; Johnson *et al.*, 2017). The gap between supply and demand has thus widened. In August 2015 the deficit stood at 560 MW and had increased to 1,000 MW by February 2016 (Mfula, 2016).

In order to reverse the growing deficit, a number of initiatives have been introduced aiming to reduce Zambia's reliance on hydroelectric power. Examples of such schemes include Scaling Solar. Led by the World Bank Group, Scaling Solar includes advisory services, standardised contracts, stapled offer of financing and guarantees of insurance for solar PV projects (Kruger, 2017). This assistance sets up a platform through which solar developers can bid for certain solar projects. The bidding process operates through reverse auction in which developers bid for the price at which they are able to generate electricity (for overview of Scaling Solar, see Kruger, 2017). Given that a number of countries in SSA receive in excess of 2,000 hours of sunlight per annum (SOLARGIS, 2017), solar PV installation remains the most viable long term and sustainable energy source. Scaling Solar aims to supply 50MW to the Zambian grid within the next two years.

Figure 2 shows the positive correlation between access to electricity and the percentage of the population with access to the internet. Access to the internet has the potential to connect a number of individuals to the digital economy which can have a number of positive development outcomes including employment opportunities. Initiatives like Scaling Solar have the potential to drive this change.

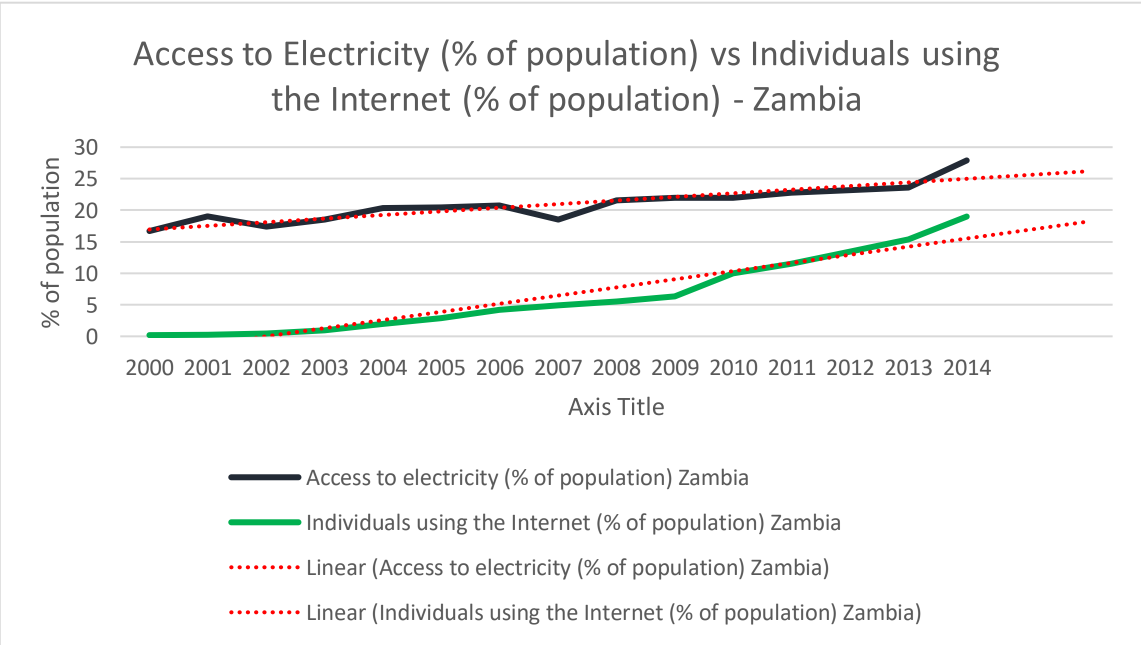

Figure 2: Access to electricity (% of population) vs Individuals using the Internet (% of population) - Zambia (Source: (ITU, 2017; SE4All, 2017))

Despite this correlation and the plethora of existing literature examining the potential development outcomes that can be garnered through increased digital inclusion, internet penetration rates in SSA remain far behind other world regions (Figure 3). In order for this to be overcome, greater engagement by longer term institutional investors is required.

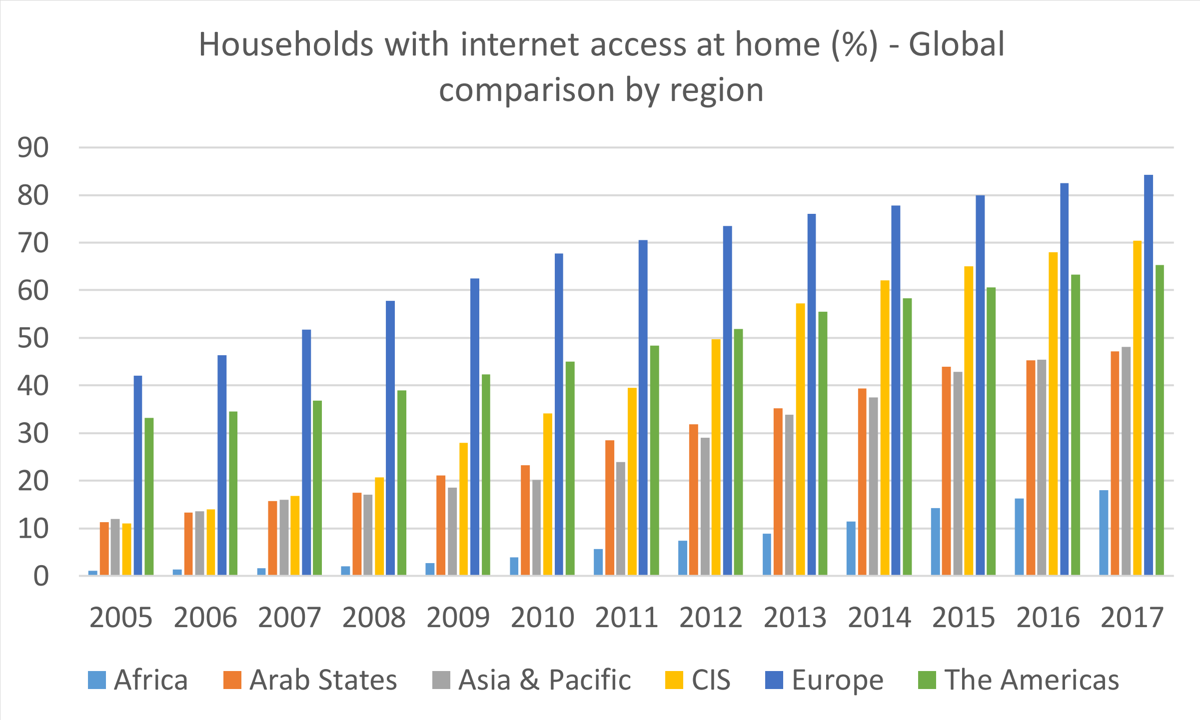

Figure 3: Households with internet access at home (%) - Global comparison by region (Source: ITU, 2017)

Conclusion

This summary report has highlighted the following:

- Infrastructure deficits are growing in a number of nations – and this trend is particularly prevalent in SSA in the power sector
- With ongoing processes such as urbanisation and population growth, electricity demand will continue to rise.
- SWFs are growing in size and are aligned particularly well to illiquid infrastructure assets
- With improved infrastructure and electricity access, internet access rates are likely to increase. This has the potential to connect individuals to the digital economy who are currently excluded.

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