

A photograph of three wind turbines on a grassy hillside under a cloudy sky. The image is overlaid with a semi-transparent purple filter. A thick red curved line separates the top image from the bottom text area.

RESEARCH REPORT

Vol 2017 No 83

Green Investment Diagnostics for Africa: What are the Binding Constraints to Investment in Renewables in Kenya and Ghana?

Ana Pueyo, Stephen Spratt, Simon Bawakyillenuo and Helen Hoka Osiolo

June 2017

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Photo caption: Kenya Nairobi: Wind turbines on the Ngong Hills.

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Summary

The vast potential of renewable energy is failing to be realised in many African countries, in spite of the many pledges made by donors and international financiers. This is not due to a lack of policies supporting investment. Many African countries have renewable energy targets, feed-in-tariffs (FiT), or import duty exemptions for renewable energy technologies. In some cases these policies are not fully implemented. In others they are implemented but, put in the language of this report, they are not targeting the most binding constraints to investment. Whatever the reason for their lack of success, it is clear that simply introducing formal policies is not enough.

This Research Report presents the Green Investment Diagnostics methodology that aims at supporting policymakers to better target policies for the promotion of renewable energy investment. Our approach draws from the original Growth Diagnostics developed by Hausmann, Rodrik and Velasco (2004) to identify the most binding constraints to economic growth in developing countries. We adapt that approach to the particular case of the energy sector, so that we can identify the main bottlenecks faced by renewable energy investors in a particular country.

We start by asking: for this particular country, at this particular time, what is preventing higher levels of investment in renewable energy generation technologies for which there is an economic rationale? To answer this question we follow a systematic approach, which starts with a decision tree analysis and continues with the cumulative building of evidence to back up potentially binding constraints. We apply the new methodology to two Sub-Saharan African countries, Kenya and Ghana, but this exercise could be replicated in any other context.

In Ghana, we look for the reasons for underinvestment in renewable generation capacity. We find that renewable energy investments provide low returns in the country, disproportionate with the very high risks coming from an unreliable off-taker, poor regulation, macroeconomic imbalances and corruption. Furthermore, there is insufficient access to finance due to scarce domestic finance and high returns expectation for short-term loans.

In Kenya, we first look for factors behind the successful attraction of investment for large-scale renewables, mainly wind and geothermal. We then focus on the constraints to future investment, particularly in flexible, smaller-scale technologies more appropriate for increasing electrification rates in rural areas. Kenya offers generous returns to investment in renewables and least cost generation from geothermal and wind. However, it faces high system costs due to a lack of networking infrastructure and an inflexible generation mix. It also presents regulatory constraints at the planning and procurement stages and serious problems of social acceptance. Social problems are exacerbated by uncertain land property rights and consultation processes, inequality in access to services, and the rent-seeking behaviour of local elites.

At the heart of each country's constraints there is a stable status quo in each country: the over-borrowing state in Ghana, and a rent-capturing elite in Kenya.

Keywords: renewable energy; investment; development; Africa.

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Data publication

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Abbreviations and acronyms

ACWI	All Country World Index
AREI	Africa Renewable Energy Initiative
BMI	Broad Market Index
CPIA	Country Policy and Institution Assessment
DFI	development finance institution
DFID	Department for International Development
EBIT	Earnings Before Interest and Tax
EBITDA	Earnings Before Interest, Tax, Depreciation and Amortisation
EC	Energy Commission
ECG	Electricity Company of Ghana
EPA	Environmental Protection Agency
EPC	engineering, procurement and construction
EPP	emergency power plant
EPSRC	Engineering and Physical Sciences Research Council
ERC	Energy Regulatory Commission
FDI	foreign direct investment
FiT	feed-in tariff/s
GDP	gross domestic product
GHG	greenhouse gas
GIPC	Ghana Investment Promotion Center
GNI	gross national income (per capita)
GRIDCo	Ghana Grid Company Ltd
GWh	gigawatt hour/s
HFO	heavy fuel oil
HRV	Hausmann, Rodrik and Velasco (2004) – see References
ICT	information and communications technology
IEA	International Energy Agency
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
IPP	independent power producer

IRE	intermittent renewable energy
IRR	internal rate of return
KNUST	Kwame Nkrumah University of Science and Technology
kWh	kilowatt hour/s
LCOE	levelised cost of energy
LCPDP	Least Cost Power Development Plan
LMI	lower middle-income [country]
LNG	liquefied natural gas
LPG	liquefied petroleum gas
MiDA	Millennium Development Authority
MIGA	Multilateral Investment Guarantee Agency
MW	megawatt/s
NEDCO	Northern Electricity Distribution Company
OandM	operations and maintenance
ODA	Overseas Development Assistance
OECD	Organisation for Economic Co-operation and Development
PPA	Power Purchase Agreement
PRG	partial risk guarantee
PURC	Public Utilities Regulatory Commission
PV	photovoltaics
RE	renewable energy
REA	Rural Electrification Authority
REIPPP	Renewable Energy Independent Power Producer Procurement
SDG	Sustainable Development Goal
SE4All	Sustainable Energy for All
SSA	Sub-Saharan Africa
USES	Understanding Sustainable Energy Solutions in Developing Countries
VRA	Volta River Authority

Contents

Summary, keywords and author notes	3
Acknowledgements	5
Abbreviations and acronyms	7
1 Introduction	11
2 Background of renewable energy investment in Kenya and Ghana	14
2.1 Ghana	14
2.2 Kenya	17
2.3 Summary	19
3 The Green Investment Diagnostics methodology	20
3.1 Are renewable energy investments attractive enough?	22
3.2 Is appropriate finance available?	32
3.3 Narrowing down constraints and positing a syndrome	36
4 Green Investment Diagnostics – Ghana	41
4.1 Are renewable energy investments attractive?	41
4.2 Is appropriate finance available?	52
4.3 Narrowing down constraints and positing a syndrome	54
5 Green Investment Diagnostics – Kenya	57
5.1 Are renewable energy investments attractive?	57
5.2 Is appropriate finance available?	69
5.3 Narrowing down constraints and positing a syndrome	72
6 Discussion	76
7 Conclusions	78
Appendix A – Key informants	79
Appendix B – Comparison of indicators from Ghana and Kenya	80
References	88
Tables and figures	
Table 3.1 Indicators of constraints related to low returns	24
Table 3.2 Indicators of constraints related to power sector regulatory risk	27
Table 3.3 Indicators of constraints related to the creditworthiness of the off-taker	29
Table 3.4 Indicators of constraints related to resource supply, technology, macroeconomic, social and governance risks	30
Table 3.5 Indicators of constraints related to inadequate supply of savings	34
Table 3.6 Indicators of constraints related to poor intermediation	35
Table 3.7 Examples of movements in constraints producing changes in outcome	37
Table 3.8 Examples of behaviours to bypass constraints to renewable energy investment	38

Table 3.9 Examples of those likely to thrive given particular constraints	39
Table 4.1 Rates of return of several investment indices in 2014 and as an average of the period 2009–14	42
Appendix Table A1 Interviewees	79
Appendix Table B1 Levelised cost of energy in Kenya and Ghana	80
Appendix Table B2 Returns on equity for investment in renewables in Kenya and Ghana	80
Appendix Table B3 Indicators of system costs in Kenya and Ghana	81
Appendix Table B4 Indicators of demand in Kenya, Ghana, SSA and LMI countries	81
Appendix Table B5 Average capacity factors of renewables in Kenya, Ghana, SSA and internationally	83
Appendix Table B6 Indicators of regulatory risk in Kenya and Ghana	83
Appendix Table B7 Indicators of off-taker risk in Kenya and Ghana	84
Appendix Table B8 Indicators of resource and technology risks in Kenya, Ghana and LMI countries	84
Appendix Table B9 Indicators of macroeconomic risks in Kenya and Ghana	85
Appendix Table B10 Indicators of social and reputational risks in Kenya and Ghana	85
Appendix Table B11 Indicators of governance risks in Kenya, Ghana, SSA and LMI countries	85
Appendix Table B12 Indicators of supply of domestic finance in Kenya, Ghana, SSA and LMI countries	86
Appendix Table B13 Indicators of supply of international finance in Kenya, Ghana, SSA and LMI countries	86
Appendix Table B14 Indicators of financial intermediation in Kenya, Ghana, SSA and LMI countries	87
Figure 3.1 First nodes of the Green Investment Diagnostics decision tree	21
Figure 3.2 Unattractive investments due to low returns	22
Figure 3.3 Unattractive investments due to high risks	25
Figure 3.4 Insufficient finance due to inadequate supply of savings	33
Figure 3.5 Insufficient finance due to poor intermediation	34
Figure 4.1 Ghana's constraints decision tree	54
Figure 5.1 Levelised cost of energy at 10 per cent discount rate for several generation candidates in Kenya	58
Figure 5.2 Kenya's constraints decision tree	72
Appendix Figure B1 Average electricity end-user tariffs and FiT in Kenya and Ghana	82

1 Introduction

Access to reliable and affordable electricity is an essential condition for human development. Electricity provides services such as lighting, the refrigeration of food and medicines, and pumping of water for consumption and irrigation. It powers information and communications technologies (ICTs) and drives motors in lifts, cranes, mills, pumps, compressors and other machine tools. Industrial development is unimaginable without electricity. On the other hand, electricity generation is a major contributor to local air pollution and a key source of the greenhouse gas (GHG) emissions responsible for climate change due to a heavy reliance on fossil fuels. According to the Fifth Assessment report of the Intergovernmental Panel on Climate Change (IPCC), electricity generation contributed a quarter of total anthropogenic GHG emissions in 2010 (IPCC 2014).

The international development community increasingly recognises the need to achieve universal access to modern energy without jeopardising climate stability. Several initiatives demonstrate this. The Sustainable Energy for All (SE4All) programme launched by the United Nations in 2011, for example, set three targets to be achieved by 2030: universal access to modern energy, doubling of renewables in the energy mix, and doubling the global rate of improvement in energy efficiency. These targets are reflected in the seventh goal of the Sustainable Development Goals (SDGs). Many other initiatives embrace similar goals, particularly for Africa. Examples include: the New Energy Deal for Africa, from the African Development Bank; the Africa Renewable Energy Initiative (AREI), under the mandate of the African Union; Power Africa, sponsored by the United States; and the UK Energy Africa campaign.

The reason for the focus on Sub-Saharan Africa (SSA) is clear. The region has the lowest access to modern energy in the world, but is also set to be hit hardest by the effects of climate change. Of the 1.2 billion people without access to electricity worldwide, 53 per cent live in SSA, where the average electrification rate is 35 per cent. Rural electrification rates are well below this average figure, at under 10 per cent in many countries (IEA 2017). Furthermore, the number of people lacking electricity is set to increase, as population growth outpaces efforts to promote electrification. SSA will struggle to meet energy-related SDGs by 2030, when 645 million Africans could still lack access to electricity (IEA 2014).

Africa's deficit in electricity infrastructure not only keeps connection rates low but also delivers a substandard service for those who are connected. This is costly for the economy: power outages cause losses equivalent to between 3 and 7 per cent of the sales of enterprises (Eifert, Gelb and Ramachandran 2008) and the lack of reliable electricity is often rated as the highest constraint to enterprise growth (Goedhuys and Sleuwaegen 2010). This poor performance is the result of insufficient investment in the three components of the electricity system: generation, transmission and distribution (Eberhard *et al.* 2016; Pueyo, Orraca and Godfrey-Woods 2015). As a result of underinvestment, Africa's abundant energy resources remain unutilised.

SSA is rich in both fossil fuels and renewable energy. Today, the case for investment in renewable energy is increasingly strong and not only for environmental reasons. The economics of renewable energy in Africa is becoming compelling as costs

have fallen dramatically in recent years. Energy security is also a strong motivation in many countries, not least because of the size and volatility of fossil fuel imports. The narrative of renewables as a luxury only affordable to high-income countries is increasingly falling apart. For the first time, in 2015 developing countries invested more than developed countries in renewable energy (Frankfurt School–UNEP Centre/BNEF 2016).¹ In the same year, more renewable than fossil fuel-based capacity was added to the global generation mix (REN21 2016). Despite undoubted progress, most developing country investment in renewable energy is concentrated in a small number of economies, particularly China, India, South Africa and Mexico. Excluding South Africa, SSA still struggles to attract investment for generation capacity in general, and renewables in particular.

The literature is replete with attempts to understand why this situation persists. Most broadly, previous research suggests that shortages of capital, skills and governance capacity prevent Africa from using its plentiful renewable energy resources (Collier and Venables 2012). A long list of more specific problems affecting all types of generation technologies can also be found. These include: underpricing, financial weakness of electric utilities, corruption and patronage, flawed and uncertain regulation, low savings rates, poorly developed financial markets, low and dispersed demand, high transmission losses, constricted power generation planning, or lack of technological knowledge (Gratwick and Eberhard 2008; Collier and Venables 2012; Suberu *et al.* 2013).

As well as highlighting a multitude of constraints, academics and practitioners have proposed a commensurate amount of policies to address them. From the 1990s, development finance institutions (DFIs) promoted the standard model of power sector reform to deal with the failures of Africa's centralised power utilities and to raise private finance for capacity expansion. The key elements of this model were unbundling, privatisation, competition and independent regulatory oversight (Malgas and Eberhard 2011). To date, the standard model has not been fully implemented by any African country. What has emerged instead are hybrid power systems, where incumbent state-owned utilities remain dominant but independent power producers (IPPs) are used to fill financing gaps (Gratwick and Eberhard 2008). These hybrid systems tend to be very inefficient and have failed to attract private investment at anything like the levels needed.

A more recent wave of reform targets renewable energy investment specifically. Renewable energy investments face additional problems in Africa as they require large upfront investments and project viability is dependent on maintaining stable, long-term revenues. They are therefore very vulnerable to both the high financing costs and uncertain regulatory environment prevalent in the region. To address these problems, donors have promoted feed-in tariffs (FiT) as a cornerstone instrument to guarantee long-term, fixed-price electricity purchase agreements and grid access. FiT have been successfully implemented in many Northern and Southern countries, such as Germany and China, where they have contributed to the widespread deployment and dramatic cost reduction of wind and solar photovoltaics (PV) (Hoppmann, Huenteler and Girod 2014). As of 2016, ten African countries had approved FiT: Ghana, Kenya, Rwanda, Uganda, Senegal, Tanzania, Egypt, Algeria,

1 Excluding large hydro.

Nigeria and Mauritius (REN21 2016). Despite this, FiT have not attracted significant investment in renewables to these countries. In many of them there is not a single project benefiting from FiT several years after they were approved.

The examples of comprehensive power sector reform and FiT illustrate how policies that work wonders in some countries can be ineffective in others. Reflecting on the demise of the standard model of power sector reform, Besant-Jones (2006) underlined the need to adapt reform to the national conditions. No African country had anything like the conditions of the UK, USA, Chile and Norway, whose power sector reform they tried to emulate. These countries had excess capacity, near universal electricity access and financially healthy utilities. African power systems had none of those characteristics and their systems were too small to enable efficient competition (Gratwick and Eberhard 2008). The success of FiT in Germany and China also built in characteristics that are absent in SSA, such as large markets, low financing costs and confidence that the governments would honour the commitments made.

This research starts from the position that simply attempting to replicate successful policies from other countries is unlikely to bring much needed investment for Africa's renewable electricity generation. Worse, attempting to do so will see scarce political and financial resources wasted. The same resources could achieve more if they targeted the most important constraints to investment in each country at a particular time. If this is so, the key task is to find a way to prioritise between the many problems that can usually be identified.

This rationale underpins the development of the Green Investment Diagnostics methodology, which seeks to systematically identify the 'binding' constraints to investment in renewable energy. Our method is an adaptation of the Growth Diagnostics framework developed by Hausmann, Rodrik and Velasco (HRV) (2004) to identify the key constraints holding back economic growth. Their approach was driven by the needs of policymakers facing multiple causes, but lacking the ability to tackle all of them at once, or to prioritise between them. The solution proposed was to identify and concentrate limited resources on the 'binding constraint' which would be identified with a tool conceptualised as a decision tree.

Growth Diagnostics have been widely applied by multilateral organisations to better target support for growth promotion. Our Green Investment Diagnostics approach seeks to support policymakers targeting the promotion of investment in renewable energy. We contribute to the original Growth Diagnostics by adapting the HRV decision tree to a sectoral, not national, analysis and by incorporating political economy, macroeconomic modelling and energy system elements.² We pilot this new methodology in two African countries: Kenya and Ghana. These countries are the research hubs of East and West Africa and showcase the choices SSA faces as it aims to provide universal access to affordable energy, foster economic growth and reduce the vulnerability to imported fuels and erratic hydrological resources. They offer an interesting comparison as their power systems face very different challenges. Kenya's power system is financially sound and there is a large share of renewable energy, but demand is low and access rates are among the lowest in Africa. The share of renewables other than

2 All these are included in separate documents.

large hydro in Ghana is negligible, and its power system is struggling financially. However, Ghana has reached one of the largest connection rates in SSA, even if the quality of that access has fast deteriorated.

This report describes our methodology and findings in Kenya and Ghana. While the focus is predominantly on grid-connected facilities, we acknowledge the importance of investment in smaller-scale off-grid systems in both countries and appreciate that the constraints will be very different to those for larger facilities. The report starts by providing some background about investment in renewable electricity in Kenya and Ghana. Section 3 describes the Green Investment Diagnostics methodology. Section 4 and Section 5 apply the methodology to our target countries. Section 6 discusses the results of the analysis and the challenges that arise when applying the Green Investment Diagnostics approach to small and complex energy systems. Section 7 concludes by inviting policymakers and donors to replicate the approach in other countries and regions.

2 Background of renewable energy investment in Kenya and Ghana

This section introduces the context of investment in renewable energy in Kenya and Ghana. It shows the status of energy access in the countries, generation capacity needs, the types of generation technologies that have been prioritised so far, and the role of renewables in the generation mix. This background helps to focus the question that the diagnostics should answer: is there a shortage of investment in generation capacity? If so, does it affect all types of technologies, or just renewable energy, and which specific renewable energy technologies? If current demand can easily be met with existing capacity, what types of plants have been prioritised? This section also reviews the previous literature about obstacles to investment in renewables in Kenya and Ghana. It finalises by comparing the departing situations of both countries and suggesting the focus of each diagnosis.

2.1 Ghana

Ghana performs relatively well on access to electricity with a 72 per cent access rate, compared to an average of 35 per cent in SSA (IEA 2016).³ The quality of this access is poor, however, with very low consumption levels and prevalent power outages. Insufficient power generation is the major cause of this situation. At the end of 2014 Ghana had an official capacity of 2,831 megawatts (MW), but only 1,482MW were available. The gross electricity supplied in the same year was 12,906GWh against requirements of 14,571–15,351GWh (EC 2015a). And the situation is getting worse. Electricity demand is growing at 6–7 per cent per year but capacity is not growing at a similar pace. As a result, rolling blackouts have been part of Ghanaians' everyday life since 2012.⁴

3 Here access is understood as connection to electricity.

4 Rolling blackouts or load shedding is the practice of temporarily reducing the supply of electricity to an area to avoid overloading the generators.

In the World Bank's 2013 Enterprise Surveys, firms reported an average of 8.4 power outages per month, resulting in the loss of 11.5 per cent of sales (World Bank 2013b). Both figures are significantly above the average for SSA, and far above the average for lower middle-income (LMI) countries. Electricity supply is identified as the main obstacle to growth by 20 per cent of Ghanaian firms. The 2015 Energy Outlook prepared by the Energy Commission (EC) estimates that the total installed capacity needs to increase by some 800–1,000MW to eliminate load shedding. This would raise consumption per capita to 600kWh, more in line with the average for LMI countries (EC 2015a).

Ghana's power crisis has been caused by a mixture of underinvestment in new generation capacity, low hydrological resources due to a shift in rainfall patterns and poor management of reservoir levels, and disruptions in natural gas supply from Nigeria. Hydropower provided 56 per cent of Ghana's installed capacity in 2014 and generated 65 per cent of electricity. The remaining 46 per cent of capacity comes from oil and natural gas thermal power plants, which generate 35 per cent of power in the country.

The government has signed contentious contracts with four IPPs for 1,370MW of oil and gas emergency power plants to provide a short-term solution to the crisis. The new plants are likely to run on oil due to challenges in securing an adequate gas supply (EC 2015a). The cost of electricity from emergency oil plants was estimated in the Energy Outlook at 19 USD cents per kWh and that from gas plants at 13 USD cents per kWh, while Ghana's composite tariff for hydro and thermal plants was 6.3 USD cents per kWh in June 2015 (PURC 2015). Emergency generation is hence a very expensive and carbon intensive option in comparison to the current generation mix.

The new contracted power plants have quickly become operational, which is part of their appeal of course. Two plants with a combined capacity of 480MW started operations in February 2016 and the rest are scheduled to be ready in under two years. Greenfield baseload plants such as large hydropower, combined liquefied natural gas- (LNG) fired and coal power facilities would take between five and seven years to construct (EC 2015a).⁵ New emergency plants are hence justified as a quick way to buy time for hydropower dams to recover sustainable water levels, thermal plants to undergo major maintenance, new greenfield baseload plants such as large hydropower, combined LNG-fired and coal power facilities to be constructed, and for the power sector to undergo reform processes. An important factor, however, is that the government has signed ten-year contracts, which means the country could be locked in expensive and carbon-intensive electricity for the next decade.

Despite this, both the Ghanaian government and the World Bank see 'clean and affordable' natural gas as the long-term solution to the power crisis solution in Ghana (EC 2015a; World Bank 2013a, 2015b). For example, the World Bank has provided USD700 million in guarantees for the upstream natural gas sector to supply fuel to 1,000MW of power generation capacity. The increase of gas supplies for domestic generation will require a diversification of the sources of imported

5 The baseload on a grid is the minimum level of demand on an electrical grid over 24 hours. Baseload power sources are power stations which can consistently generate the electrical power needed to satisfy this minimum demand.

gas, however, as well as investments in LNG and the exploitation of indigenous offshore natural gas resources. The long-term generation plan also considers the use of imported coal, which will contribute to significantly increasing Ghana's grid emission factor, currently at 0.56tCO₂/MWh (Republic of Ghana 2015).

Apart from large hydro, renewable energy plants are not seen as part of the solution to the energy crisis in national planning documents (EC 2015a; Ministry of Energy 2010). Although the government has committed to increasing their share to 10 per cent, renewables are presented as too expensive to be competitive (Ministry of Energy 2010) or not feasible due to lack of experience with these technologies (Fritsch and Poudineh 2016).

The Renewable Energy Law adopted in 2011 provided fiscal incentives and a regulatory framework for private investment but progress towards the 10 per cent target has been very slow. Of the 82 projects totalling nearly 6,600MW of capacity that had obtained provisional wholesale supply and generation licences by May 2016, only one 20MW solar PV plant has been built (EC 2016b).

Rooftop solar PV energy has enjoyed more political support than other renewable alternatives and is expected to reduce the daily national peak load by 200MW.⁶ Households and businesses receive incentives to invest through capital subsidies and net metering, which give consumers the option to trade their excess generation for grid electricity when they are in deficit (EC 2015c).⁷ At the moment, net metering is a weak incentive as consumers cannot trust that grid electricity will be available when they need it, and the scheme does not consider monetary compensation for excess sales of electricity.⁸ Energy efficiency is also a key element of the solution to the energy crisis. Ghana was the first country in SSA to develop an energy efficiency standards and labelling programme for household appliances. Energy performance standards have delivered considerable energy savings and have been particularly successful in promoting efficient lighting (IEA 2015).

Ghana has good renewable energy resources (Gyamfi, Modjinou and Djordjevic 2015). It is particularly rich in hydropower resources, which have been harnessed to a large extent, but substantial potential is still untapped for small hydropower plants. Wind energy potential is estimated to be about 2,000MW and is located in the coastal areas and along the border with Togo.⁹ Solar energy resources are particularly good in the northern regions, with a mean annual Global Horizontal Irradiation (GHI) of 5.74kWh/m²/day (Ecreee/Ecowrex 2015). There are currently no wind, mini-hydro or biomass plants connected to the grid and just two solar PV plants totalling 22.5MW. Planned capacity additions by the national generation utility Volta River Authority (VRA) until 2020 are predominantly fossil fuel based.

6 Peak load is a period in which electrical power is expected to be provided for a sustained period at a significantly higher than average supply level.

7 Net metering is a billing mechanism that credits solar PV energy system owners for the energy they feed to the grid when their system generates more electricity than the home uses during daylight hours.

8 Excess sales of electricity take place when rooftop solar PV panels generate more electricity than the household needs and this is sold to the grid.

9 www.unep.org/Documents/Multilingual/Default.asp?DocumentID=430&ArticleID=4771&lang=en (accessed 11 November 2015).

They include a 700MW supercritical coal power plant with a planned extension to reach 2,000MW, in partnership with the Chinese company Shenzen Energy. VRA would also add nearly 600MW of gas power plants in addition to 400MW from IPPs. Renewables play a marginal role, with 150MW of wind power and 12MW of solar PV planned by VRA (EC 2015a). It therefore seems inevitable that Ghana's fossil fuel-based pathway to address its energy crisis will compromise climate change mitigation goals and energy security. Furthermore, reliance on expensive fossil fuel imports will be a drain on Ghana's finances.

The most frequently reported constraints to renewable energy investment in Ghana are regulatory. The literature refers to creditworthiness of the national distribution company Electricity Company of Ghana (ECG), low electricity tariffs, access to finance and technical and capabilities shortages (Malgas and Eberhard 2011; IRENA 2015b; Fritsch and Poudineh 2016; CEPA 2015; World Bank 2013a; Gyamfi *et al.* 2015). The Ghanaian government has taken some measures to address these constraints. For example, it approved a renewable energy FiT policy and more recently initiated a competitive tender for 20MW of solar PV.¹⁰ It has initiated the partial privatisation of ECG with the support of the US Millennium Development Authority (MiDA). In December 2015, a 59 per cent increase in residential end-user electricity tariffs was approved (PURC 2015). The government has also established a Renewable Energy Fund to mobilise financial resources for the promotion, development, sustainable management and utilisation of renewable energy resources (IRENA 2015b).

These policies have not always been effective. For example, the FiT that was announced in 2013 had not been used at the time of writing. The solar PV auction announced in December 2015 had still not delivered any result by September 2016. The privatisation of ECG is also dragging behind schedule. The Renewable Energy Fund has not delivered any significant outcome either. This raises the question of whether these policies were targeting the most important constraints, and if they were politically viable.

2.2 Kenya

Kenya is positively perceived by donors and investors as a target country for renewable energy investments because of its market-friendly approach to development (Newell and Phillips 2016). Kenya initiated power sector reform processes in 1996 which saw the establishment of an independent regulator and the unbundling and liberalisation of the electricity sector. It was the first country in SSA to attract a significant number of IPPs through international competitive bids (Eberhard *et al.* 2016). The national distribution and generation utilities, Kenya Power (KPLC) and Kengen, were partially privatised and are now profitable. The off-taker (i.e. purchaser of electricity), Kenya Power, has never defaulted on a Power Purchase Agreement (PPA) and has developed the capacity to effectively negotiate with the private sector. Electricity tariffs are cost-reflective and efficient, and there is an affordable lifeline tariff for consumption below 50kWh per month.

10 Press advertisement for Government of Ghana invitation for prequalification for 20MWp Solar PV IPP Project (GOG/MOP/20MWSP/2015/01), December 2015, www.dgmarket.com/tenders/np-notice.do?noticeId=13529510.

The licensing process is transparent and key responsibilities for planning, tendering and contracting are well defined (Kapika and Eberhard 2013).

Kenya has shown commitment and consistency in planning processes, both to increase electrification rates and the expansion of renewable energy (World Bank 2014). As opposed to many other countries in SSA, electricity supply is not considered the main constraint to business growth by Kenyan firms, which are more concerned by issues like informality, corruption and political instability (World Bank 2013c).

Despite all these positive features and sentiments from investors and donors, Kenya has one of the lowest rates of access to electricity in SSA. In 2013, 35 million Kenyans, i.e. 80 per cent of the population, did not have access to electricity (IEA 2015). The access rate in rural areas was as low as 7 per cent. The situation has improved in recent years and connectivity rates had increased to 50 per cent by the end of 2015, according to data by the national distribution utility Kenya Power (KPLC 2015). Kenya Power has set a target to connect over one million new customers every year to achieve 70 per cent electrification by 2017 and universal access by 2020 (Lahmeyer International 2016). Grid extension is the preferred approach to provide access to electricity in Kenya because more than 90 per cent of the population live within reach of the grid (KPLC 2015; Parshall *et al.* 2009). However, only a small share of households within the proximity of distribution lines are connected (Lee *et al.* 2016).

Significant problems to increasing connectivity are that grid connection costs are too high relative to rural incomes, and consumption levels remain very low even when connections are made. These problems have been addressed to some extent by small stand-alone solar PV systems that provide a basic electricity service at a low cost (Pueyo 2015; IED 2013; Zeyringer *et al.* 2015). These systems have proliferated in rural communities and Kenya is now the largest market for solar PV home systems in SSA, and the second largest for small solar lighting systems, after Tanzania (REN21 2016). More recently, donors have been interested in mini-grids because they enable more energy services and hence more income-generation opportunities.¹¹ However, unsubsidised private mini-grids are unaffordable for most of the rural population (Carbon Africa *et al.* 2015).

The Kenyan electricity system is very small, with only 2,404MW of installed capacity to serve a population of 46 million in 2015. In the past, over-reliance on hydropower combined with poor hydrology put the system under severe stress. To open up the sector to new technologies and sources of finance, Kenya embarked in a power sector reform process in the mid-1990s. Five thermal plants mainly running with heavy fuel oil (HFO) were commissioned (four remain today), which led to significant price increases. Additionally, two geothermal plants were commissioned in the early 2000s (Eberhard *et al.* 2016). Severe drought affected the country in the 2000s and the government commissioned up to 200MW of expensive emergency power plants (EPPs), but these have now been reduced to 30MW. Besides, Kenya put in place a long-term programme for the development of geothermal power and is now the largest producer of geothermal energy in Africa.

11 See for example DFID's 'Green Mini-Grids Africa' <https://devtracker.dfid.gov.uk/projects/GB-1-203990> or GIZ's 'Promotion of solar-hybrid minigrids' www.giz.de/en/worldwide/25332.html.

Since 2014, the Kenyan system has added significant geothermal and HFO thermal capacity and plans to dramatically increase the share of wind power, mainly through a new 300MW wind power farm in the Lake Turkana area. The development of this and three smaller wind farms would increase the share of variable renewable energy generation capacity in Kenya's grid from 1 per cent in 2015 to 18 per cent by 2019. This may pose problems to the stability of the power system, mainly due to inexperience in managing large shares of intermittent generation.

The national development strategy approved in 2008 (known as Vision 2030) placed electricity at the centre of industrial and social development (Republic of Kenya 2007). The programme 5000+MW was launched in 2013 with the aim of bringing 5,000MW of capacity online within 40 months. The strategy prioritised indigenous resources, mainly geothermal, but also wind and coal, and potentially gas. The approval of FiT and Vision 2030 in 2008 saw an explosion in unsolicited proposals for wind power plants approved for development, with 510MW committed until 2022, but implementation has been slow. Since then, only 700MW out of the promised 5,000MW have been added to the system. While this falls short of the government's ambition, it is considered sufficient to meet Kenya's current demand. In effect, the most recent generation and transmission Master Plan describes a situation of overcapacity: 'Kenya is one of the few African countries with sufficient available generation capacity to meet demand and plenty of projects in the planning stage' (Lahmeyer International 2016: 3).

In spite of having sufficient capacity at the current time, the quality of the electricity provided by the national grid is poor and consumption levels are very low. Transmission and distribution networks are weak and overloaded, and electrical outages are common. In the last World Bank Enterprise Surveys (World Bank 2013c), for example, Kenyan firms reported an average of 6.3 electrical outages in a typical month, lasting an average of 5.6 hours and causing a 5.6 per cent loss in annual sales. Interestingly, 57.4 per cent of firms own a generator, which indicates the inability of the grid to provide electricity when it is needed. Besides, the fast penetration of large-scale wind power plants in the system and an inflexible interconnection with Ethiopia may pose further stability challenges. This could require reserve capacity from hydro, gas, medium speed diesel or flexible interconnections with neighbouring countries (Lahmeyer International 2016).

Kenya has therefore implemented successful policies to attract investment in green generation capacity but still faces two major challenges: low connectivity rates and poor quality of access. Through our diagnostics we seek to identify successful elements of Kenya's landscape for investment in renewable energy as well as constraints to a more inclusive, scalable supply of renewable electricity. These would include a more diversified renewable generation mix (geographically and technologically) which is adapted to the characteristics of demand (affordable and scalable as demand grows).

2.3 Summary

The electricity sectors of Kenya and Ghana represent the many challenges that countries in SSA encounter as they try to build green and inclusive economies. Both countries aim at providing universal access to affordable electricity, fostering

economic growth and reducing the vulnerability of their power systems to erratic rainfall patterns and imported fuels. Climate change commitments also require cleaner generation technologies. Renewable energy can jointly contribute to energy security and environmental sustainability.

Both Kenya and Ghana have looked for a least cost, local, long-term way out of hydropower dependence. Kenya has championed geothermal power as a secure, least cost and clean energy source. It is now the leading geothermal power supplier in Africa. Ghana has instead sought to develop its domestic gas resources to fuel its power plants, while renewables have been relegated to a minor role. However, gas exploitation has been slow and local gas will not be adequate to meet the country's gas requirements for the medium-to-long term. In the short term, to deal with power supply crises, both countries have locked themselves into contracts with private thermal plants using imported fuel. This has proved expensive and vulnerable to the volatility of fossil fuel prices and unreliable supply, such as in the case of Ghana's dependence on Nigerian gas.

The focus of diagnostics in Ghana is first to understand constraints to investment in all types of generation technologies, given the large deficit of capacity in the country; and then to understand what prevents renewables from being a key element of Ghana's energy security strategy.

In Kenya, the focus is to understand the constraints to a more flexible electricity system that includes different types of renewable energy diversified geographically, as well as constraints that prevent further access to electricity.

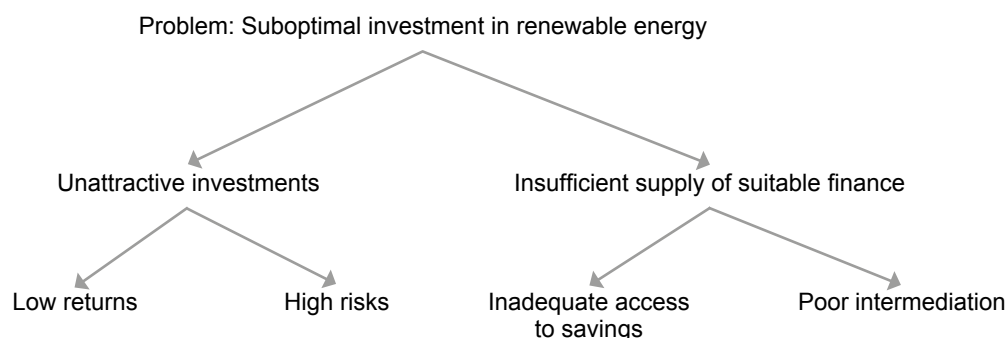
The current situation of both countries shows, in the end, tensions between the universality of access to electricity and its financial viability between the short-term relief of electricity supply crises and sustainable long-term solutions.

3 The Green Investment Diagnostics methodology

The evolution from the original Growth Diagnostics to the Green Investment Diagnostics approach is described in our previous publication (Spratt *et al.* 2016). In this section we describe the logical decision tree framework and the four diagnostic signals we use to identify the key areas of policy intervention most likely to remove obstacles to investment in renewable technologies.

The Green Investment Diagnostics approach starts with a clear understanding of the state of investment in renewable energy in the target countries. Is there a lack of investment in the power sector as a whole or only in renewable generation? Are there periods of intense activity or stagnation? Is the country investing in least cost generation or taking suboptimal decisions? Answering these questions points at technologies where investment is less than would be expected given the country context and relative economic and financial attractiveness.

Having identified renewable energy technologies where investment has been historically low in the country, but potential is high, we ask: for this country, at this

Figure 3.1 First nodes of the Green Investment Diagnostics decision tree

Source: Author's own; drawing from Hausmann *et al.* (2004).

particular time, what is preventing higher levels of investment in renewable generation technologies for which there is an economic rationale? Our decision tree then offers several alternatives, or branches, to explain low levels of investment. Three different sources underpin the branches of our decision tree: (i) the original Growth Diagnostics decision tree (Hausmann *et al.* 2004); (ii) a review of the literature about constraints to investment in renewable energy in developed and developing countries (Pueyo *et al.* 2015); and (iii) interviews with investors, regulators, representatives of the financial sector, academics and practitioners (a list of interviewees is provided in Appendix A).

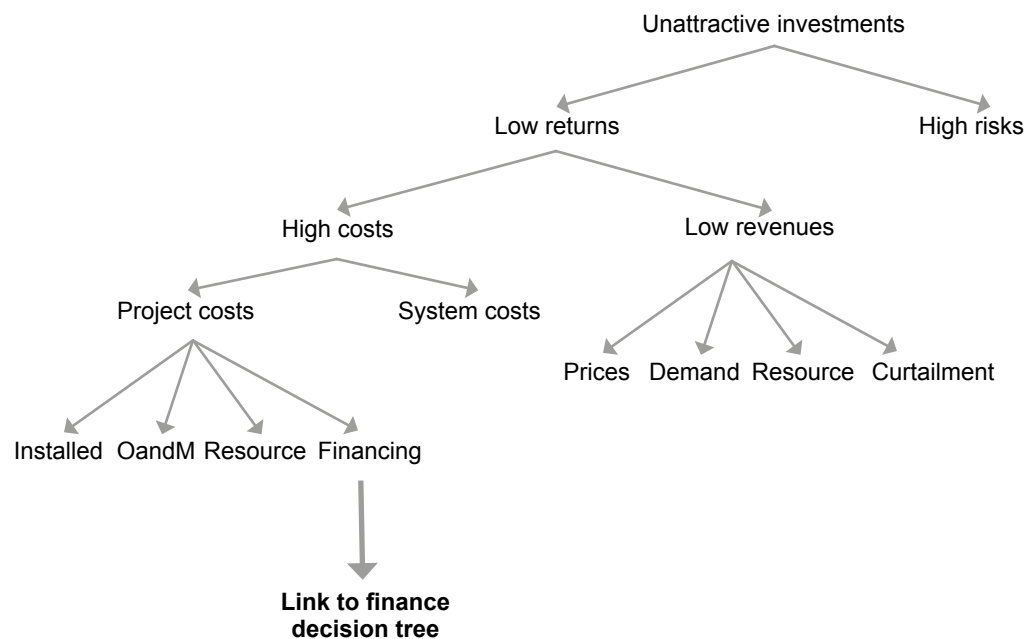
The two initial branches to explain the low level of investment are: (i) investment returns are not attractive enough relative to alternatives; or (ii) the sorts of finance needed are not available. Of course, it is possible that both these problems exist, or that they are interconnected. Investments may be unattractive if profits are too low after high interest rates are paid. On the other side, debt financiers may require high interest rates if the project's risks are very high. This is the main explanation for why our approach may result in more than one 'binding constraint'.

We look at project attractiveness and finance availability separately in the next level of the decision tree. Projects may be considered unattractive for two reasons: returns are too low or risks are too high. Finance supply (long-term, low-cost debt finance) may be low because there is not enough capital available, or capital is potentially available but is not allocated efficiently by the financial system. Figure 3.1 illustrates these initial nodes of the Green Investment Diagnostics decision tree.

Decisions about which constraint to investigate further at each node are informed by the country's performance in several related indicators as compared to other countries or to international benchmarks. As well as direct quantitative comparisons, we also rely on interviews to interpret these indicators.¹² Qualitative methods are particularly useful to identify the relationships between different constraints, and their relative importance from the perspective of investors and other stakeholders such as regulators or financiers.

As potential problem areas are ruled out, we are left with a small number of areas which the evidence suggests may be the most important constraint, and a growing

¹² See list of interviewees in Appendix A.

Figure 3.2 Unattractive investments due to low returns

Source: Authors' own.

understanding of why. Section 3.1 and Section 3.2 look in detail at the possibilities open at each side of the decision tree: project attractiveness and finance availabilities. We identify indicators to assess the importance of different constraints.

3.1 Are renewable energy investments attractive enough?

As described above, investments could be unattractive if they provide insufficient returns or if their risks are too high (or both).

We start by looking at the returns branch of the decision tree. To assess the sufficiency of returns we compare the equity internal rate of return (IRR) of renewable energy generation projects to the opportunity cost of funds.¹³ The opportunity cost is the return yield of potential investment alternatives. For an unconstrained international investor, this would be the returns obtainable in the global equity and bond markets. For investors with a regional or sectoral scope, their opportunity costs would be the return of investments in these markets.

If we see that returns are not competitive with alternatives, the next question is why this is. Moving down the decision tree to the next level, we again face two possible explanations: returns may be insufficient because project costs are too high or revenues too low. Figure 3.2 shows the different sub-branches following signs of low returns in the project. Low returns may result from high costs of renewable energy generation or from low revenues.

High costs of renewable energy generation plants could relate to either the plant itself or the system. To capture project-level costs, we use the levelised cost

¹³ The methodology to estimate equity IRR of renewable energy projects is described in Pueyo, Bawakyillenuo and Osiolo (2016).

of energy (LCOE) of renewable energy plants and compare it to international benchmarks for renewable energy and to the LCOE of fossil fuel-based plants in the country.¹⁴ If the LCOE appears high as compared to international benchmarks, we will investigate further. Is the problem with operations and maintenance (OandM) and resource supply costs, or is the cost of financing the issue? When financing costs are driving up the cost of renewables, we will also investigate what is causing them, through the financial branch of the decision tree, which will be further analysed in Section 3.2

System costs are those that a single generation plant imposes on the electricity system as a whole (IEA 2010). These include the costs of transmission and distribution infrastructure required for grid connection and the cost of operating and planning reserve for intermittent renewables.¹⁵ To assess this we look at the following parameters:

- i The generation share of intermittent renewable energy projects in the country (it is often stated that if renewable penetration is higher than 20 per cent by energy it may pose challenges to the system);¹⁶
- ii the geographic and technology diversification of existing renewable energy (more diversification reduces system costs);
- iii the availability of dispatchable backup capacity and storage in the country (mainly hydro reserves and gas turbines);
- iv the availability of interconnections with neighbouring countries;
- v the reach of the grid infrastructure compared to the location of renewable resources; and
- vi the responsibility for paying the transmission costs of a specific project.¹⁷

If the analysis suggests that high costs are not the cause of low returns, the explanation must be that revenues are too low. There are a number of possible explanations for this, each of which would require a very different policy solution. Renewable resources available in the country may not be of high enough quality, or the technologies used may be inefficient. Prices could be too low to generate sufficient revenues, or demand could be insufficient. The risk of curtailment of intermittent renewable energy could also be jeopardising revenue generation.

14 The concept of LCOE and the methodology to calculate it is described in Pueyo *et al.* (2016).

15 Reserve capacity is a measure of available capacity over and above the capacity needed to meet normal peak demand levels. The reserve capacity should be available to the system operator within a short interval of time to meet demand in case a generator goes down or there is another disruption to the supply.

16 Countries in Europe such as Denmark, Ireland or Spain have achieved much larger shares than this 20 per cent by energy, stabilising the grid with trade with neighbouring countries or with flexible generation sources (IRENA 2015a).

17 For example, in Germany the costs of transmission are borne by the transmission system operators and charged to the federal grid agency of Germany (Klessmann, Nabe and Burges 2008). In many other countries, grid connectivity to the nearest substation needs to be borne by the project developer and grid access is not always guaranteed, which can significantly increase the cost of a project.

Table 3.1 Indicators of constraints related to low returns

Constraint	Indicator	Source of data
Returns	Equity IRR	Individual project data, or information in national generation planning documents
	Country government bond yields	National banks
	Several investment indices	FTSE, SandP, MSCI, Bloomberg
Project costs	LCOE of the project/technology in the country (USD cents/kWh)	Individual project data, or information in national generation planning documents
	International LCOE benchmarks (USD cents/kWh)	IRENA (2015c)
	LCOE of fossil fuel-based generation in the target country (USD cents/kWh)	National generation planning documents
Installed costs	Unit investment costs (USD/kW)	Individual project data, or information in national generation planning documents
	International benchmarks of unit investment costs	IRENA (2015c)
OandM costs	OandM as a share of capital costs	Individual project data, or information in national generation planning documents
Resource costs	Cost of biomass or geothermal resource, when the generator has to pay to a supplier	Individual project data
Financing costs	Cost of debt	Individual project data, national banks, international debt suppliers
System costs	Share of intermittent renewable energy in the country (% capacity)	National generation planning documents
	Geographic and technological diversification of IRE in the country	National generation planning documents
	Share of dispatchable generation – % generation from natural gas, hydropower, HFO and biomass	National generation planning documents
	Connectivity – % of population connected to the grid	National distribution utility or IEA energy access statistics (OECD/IEA 2015)
	Responsibility for transmission costs	National energy regulator
Prices	Regulated tariffs	National energy regulator
	Directly negotiated PPAs	National energy regulator
	Feed-in tariffs	National energy regulator
Demand	GDP growth (%)	World Development Indicators
	Standard deviation of GDP growth (2006–14)	Calculation with data from World Development Indicators
	Poverty headcount ratio at USD1.90 per day (2013)	World Development Indicators
	Poverty growth (2006–13)	Calculation with data from World Development Indicators
	Interconnections exist	National transmission utility
	Exports/total generation (2015)	National energy statistics

Table 3.1 Indicators of constraints related to low returns (cont.)

Constraint	Indicator	Source of data
Quality of RE resource	National RE resource potential	
	Capacity factors of RE plants*	Individual project data, or information in national generation planning documents
Risk of curtailment	Baseload consumption	National energy statistics
	Transmission capacity	National transmission planning documents
	Flexibility of generation mix	As in indicators of system costs

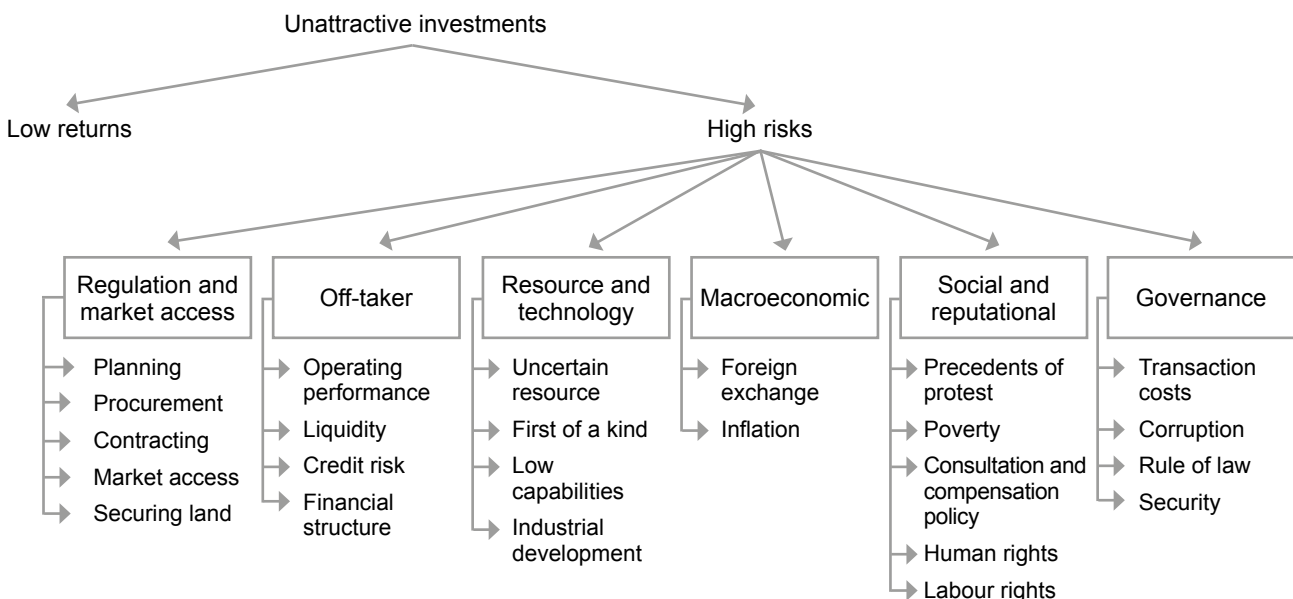
* Low capacity factors show that power plants are not operational for a large share of the time and hence cannot sell a lot of power.

Source: Authors' own.

This refers to the possibility that all the electricity produced by intermittent generators cannot be fed into the system. The risk of curtailment is higher in systems with low baseload consumption of electricity, insufficient transmission capacity, low interconnection and an inflexible generation mix. In each case, indicators are derived to measure and compare performance. Table 3.1 presents the indicators used to measure and compare the performance of projects or countries related to the returns of renewable energy.

Projects with high returns could still be unattractive if they face high risks. Investment in renewable energy technologies is particularly vulnerable to a risky environment because they tend to be very capital intensive. Therefore they require a long-run, assured revenue stream. A number of risks can jeopardise the future revenue stream, including: regulatory risks; off-taker risks; resource and technology risks; macroeconomic risks; social and reputational risks and governance risks. Figure 3.3 shows the ramifications of the decision tree that relate

Figure 3.3 Unattractive investments due to high risks



Source: Authors' own.

to high risks. This illustrates the process through which the decision tree approach is operationalised. If there is evidence suggesting that off-taker risk is particularly important, we look more closely to assess what is undermining the financial viability of the company. Is it mainly a liquidity issue, for example, or is it a more fundamental problem of operating performance? The policy response would clearly be very different depending on the answer to this question. The remainder of this section describes the diagnostic process for assessing the relative importance of investment risks.

Power sector regulation and market access

Well-designed, transparent and enforceable regulation is required at every stage of the development of a renewable energy generation project, particularly if it is connected to the national grid. Electricity providers need predictable plans for the extension of the national system and enforceable regulation that protects: (i) their property rights; (ii) their right to feed the power they produce to the national grid; (iii) their ability to sell electricity at a predictable price that allows for cost recovery; and (iv) them from the risk of non-payment. Challenges in all these areas are widespread in SSA.

Constraints at the planning stage arise when the government is unable to predict the generation, transmission and distribution capacity and interconnections that will be needed to meet future demand. Further potential problems arise when grid expansion and off-grid initiatives are not coordinated and if there are no clear links between the capacity needs highlighted in national generation expansion plans and what is actually procured. Effective planning requires adequate systems, human resources and institutional capacity, and is best undertaken with an integrated resource planning framework.¹⁸ Traditional planning systems need to take into account issues that are particular to renewables, such as the intermittency of supply in some cases, the time it takes to build renewable energy plants or the time required to obtain finance. Demand forecasting also needs to be drastically improved through bottom-up approaches that take into account how the demand of customers in different rural locations will evolve (Chattopadhyay, Kitchlu and Jordan 2014).

Constraints at the procurement stage arise from a lack of competition among suppliers; unclear procurement responsibilities; and lengthy and opaque permitting processes. Opportunities for corruption are reduced when: procurement is linked to national planning; PPAs are granted by a unique transparent authority; and when the permitting process is streamlined, keeping the number of permits required and the time needed to grant them to the minimum. A recent source of transaction costs for utilities and regulators in Africa has been the increase in unsolicited proposals from private developers to build renewable energy generation plans. As opposed to competitive tenders, unsolicited proposals occur when private developers take the lead in proposing new generation plants to the national utility or the government agency in charge of issuing PPAs. Individual company

¹⁸ Integrated resource planning is defined as a 'utility plan for meeting forecasted annual peak and energy demand, plus some established reserve margin, through a combination of supply-side and demand-side resources over a specified future period' (Wilson and Biewald 2013: 4).

Table 3.2 Indicators of constraints related to power sector regulatory risk

Constraint	Indicator	Source of data
Planning	Number of RE projects in the pipeline (waiting for permits, or with permits but waiting for PPAs)	National energy regulator
	Comparison of required capacity in past planning documents and projects that have actually been built	Past national generation capacity planning document and current electricity generation statistics
Procurement	Number of projects and MW procured through competitive bids	National energy regulator
	Number of steps and licences required to generate electricity from renewable sources	National energy regulator
Contracting	Length of RE price guarantee	Individual PPA or FiT policy
	Adjustments for exchange rate and inflation risk	Individual PPA or FiT policy
	Access to grid guaranteed by law	Individual PPA or FiT policy
	Connection cost covered by utility	National energy regulator and individual project data
Market access	Per cent of generation capacity controlled by the state	National electricity generation statistics, or planning documents with ownership data for each power plant

Source: Authors' own.

decisions typically determine system expansion in market-based decentralised power systems. However, in small African power systems, an increase of unsolicited proposals can clog the permitting and contracting functions and lead to a long list of projects in the pipeline waiting for approval. An obvious solution is to procure plants through organised tendering (Eberhard *et al.* 2016).

Constraints at the contracting stage arise when PPAs do not reassure investors that they will be able to recover their investment and obtain a reasonable profit. Some attractive clauses that may help in this regard include: long-term price guarantees; foreign currency denomination;¹⁹ guaranteed access to the national grid; priority dispatch;²⁰ and take-or-pay clauses (OPIC *et al.* n.d.).²¹ At the same time, regulators and off-takers need to ensure that contracts do not become so generous that they undermine least cost electricity supply.

Negotiating renewable energy contracts is complex and requires a great deal of expertise from both the government side and private sponsors. African

19 Payments in foreign currency protect the investor against the devaluation of the local currency. This is important because debt and equity usually need to be returned in foreign currency.

20 Priority dispatch ensures that renewables are fed before fossil fuels when demand is lower than supply.

21 Take-or-pay clauses oblige the off-taker (or purchaser of electricity) to purchase all power agreed in the contract or otherwise provide a compensation.

governments often lack this expertise. Some symptoms of constraint at the contracting stage include precedents of PPAs not having been honoured; PPAs that do not ensure 'bankability' of projects; frequent changes to electricity tariffs; and a wide spread between FiT and national electricity retail tariffs, which would point at political pressures to keep prices low.

Constraints to access the power market arise when the sector is highly concentrated in the hands of state-owned utilities and there is no clear criteria for allocation of investment opportunities between private and public actors (Malgas and Eberhard 2011). Even if the legal framework allows for access to the grid for private generators, long delays in obtaining permits and grid connection may effectively prevent entry.

To summarise, regulatory risk is an extremely important issue in the power sector, given the importance of regulation in shaping markets and ensuring that they function properly. Table 3.2 shows the indicators we use to recognise the most important potential constraints. The fact that renewable energy may require public financial support for the life-time of a project complicates things further. The credibility of the government in the eyes of investors is therefore crucial.

Creditworthiness of the off-taker

The off-taker is the purchaser of electricity from power generation plants. National distribution companies typically play this role in Africa. When off-takers are not financially sound, generators face a high risk of not being paid and financiers are reasonably reluctant to back their projects. Several financial challenges make African electricity distribution companies unreliable payers. Retail electricity prices are often lower than the wholesale price of electricity charged by generators, for example. In addition, customer default rates are often high, billing processes may be ineffective, while large losses can result from poor network system maintenance.

The annual reports and financial statements of electricity utilities provide detail on their financial health as well as insights into the reasons for poor performance. A first sign of trouble, for example, is the lack of recent, audited accounts with a positive opinion from the auditors. Table 3.3 describes several indicators that can be extracted from utilities' annual reports to identify potential constraints.

Firstly, operational performance refers to the process of purchasing, delivering and invoicing electricity, as well as collecting bills to pay salaries and electricity providers. The goal of a company is to maximise the surplus of receipts over disbursements and the speed of the cycle. EBITDA or EBIT margins (EBITDA or EBIT/sales) are indicators of the operating financial performance of the company and allow for a comparison between companies.²² While a negative EBITDA is a strong indication of financial distress, a positive EBITDA is not a guarantor of financial sustainability, as additional cash is needed to cover financing costs and reinvestment. The EBITDA margin observed for public service companies

22 EBIT is Earnings Before Interest and Tax; EBITDA is Earnings Before Interest, Tax, Depreciation and Amortisation. Calculated as revenue minus expenses excluding interest and tax, depreciation and amortisation.

Table 3.3 Indicators of constraints related to the creditworthiness of the off-taker

Constraint	Indicator	Source of data
Operational performance	EBIT (if positive, EBIT margin)	Annual reports of distribution utilities
	System losses	
Liquidity	Current liabilities/current assets	
	Cash and cash equivalents/ accounts payable and short-term borrowing	
Credit risk	Revenue collection to sales	
	Trade receivables past due by more than a year	
	Receivables from public institutions	
Financial structure	Short-term debt/equity and long-term debt	

Source: Authors' own.

in Europe is 20 per cent (Fritsch 2011). A study of EBIT margins for electricity and gas retailers in Organisation for Economic Co-operation and Development (OECD) countries shows lower values, between 1 and 22 per cent, with a median EBIT margin of 12 per cent (London Economics 2012). We take these values as benchmarks to assess the operating sustainability of the off-taker.

System losses, where power billed to consumers is lower than power purchased from generators, are an important cause of low operating margins. For example, the 2013 financial statements of Ghana's distribution utility ECG present an operating loss and high system losses of 23 per cent of total power purchased contribute to this poor performance (ECG 2013a: 49).

Secondly, liquidity risk is high when current liabilities are higher than current assets and the amount of cash and cash equivalents is low as compared to accounts payable and short-term borrowing. This may create liquidity problems and delays in payments to suppliers.

Finally, credit risk arises when customers are unable to pay their bills in full. Financial statements usually show the aging of accounts receivable. A large share of receivables past their due date and in particular a large share of receivables due for over a year would point at a high credit risk. Some financial statements show the profile of customers whose bills are overdue. Often the state and state-owned companies fail to comply with their payment obligations, contributing to the precarious state of national electric utilities.

The financial structure of a company provides additional clues about its financial health. A large share of short-term debt relative to equity and long-term debt suggests financial stress.

Resource supply and technology risk

Resource supply risks can arise from inaccurate assessments of renewable energy resources (Waissbein *et al.* 2013) or from unreliable resource suppliers, in the case of biomass or geothermal, for example. To mitigate these risks, public dissemination of robust resource assessments for each technology may be helpful. Suppliers of geothermal steam and biomass feedstock must be contractually obliged to provide a certain quantity and quality of resource and be financially and technically sound.

Table 3.4 Indicators of constraints related to resource supply, technology, macroeconomic, social and governance risks

Constraint	Indicator	Source of data
Resource	Resource assessments available	National or international energy thinktanks, or national regulator
Technology	Gross enrolment ratio in tertiary education	World Development Indicators
	Competitive Industrial Performance Index	UNIDO Competitive Industrial Performance Reports
	Grid capacity – enough transmission capacity to transmit projected generation	National transmission planning documents
Macroeconomic	Currency risk – change in exchange rate (USD per local currency)	National banks
	Inflation – Consumer Price Index year-on-year	National banks
	Current account deficit	National banks
	Fiscal deficit	National banks
Social	Precedents of social discontent in renewable energy projects	Press
	Clear social consultation guidelines	National regulation on Environmental and Social Impact Assessment
	CIRI empowerment rights index (2011 is latest value)	CIRI Human Rights Dataset
Governance	CPIA transparency, accountability and corruption in the public sector index (1 low – 6 high)	World Development Indicators
	CPIA property rights and rule-based governance index 2015	World Development Indicators
	Transparency International Corruption Perception Index (rank)	Transparency International
	Percentage of firms expected to give gifts to secure a government contract	World Bank Enterprise Surveys
	Percentage of firms expected to give gifts to obtain a construction permit	World Bank Enterprise Surveys
	Intentional homicides per 100,000	World Development Indicators
	Threat of terrorism	Foreign Office country reports

Source: Authors' own.

Technology risks are likely to be high when the country has no previous experience in a particular technology, when its industry is not sufficiently developed to provide spare parts and knowledge, and when its workforce has not got the required skills.

Table 3.4 shows the indicators used to identify constraints related to resource supply and technology risks, jointly with other types of constraints.

Macroeconomic risks

The scale of capital requirements for power generation projects, compared to the immature or absent capital markets in many developing countries means that finance needs to be obtained internationally.²³ As a result, debt and equity are usually denominated in foreign currency. In contrast, project revenues are usually denominated in local currency, creating significant currency risk. Large currency devaluations and/or high rates of inflation thus damage the viability of renewable energy projects as they diminish the real value of future revenues relative to liabilities to debt and equity investors. To capture these risks we use two indicators with direct impact on the returns to investment: inflation rates and annual changes in the official exchange rate of the local currency to USD.

Social opposition and reputational risk

Due to its positive environmental connotations, public support for renewables is usually high in most countries. However, problems arise when moving from national to local acceptance. Community acceptance has proven to be a real block to the completion of renewable energy projects, as evidenced by projects experiencing delays or being abandoned due to conflict with local communities. In Kenya, for example, a 60MW wind power project recently had to halt construction as local farmers took to the streets and the court, making the site unsafe (Waruru 2016). Social opposition has delayed or stopped wind farm development in other developed and developing countries, such as Mexico (Juarez-Hernandez and Leon 2014) and the UK (Cass and Walker 2009).

Some particularities of renewable energy projects make them more exposed in this regard. They are smaller per project than fossil fuel plants, hence requiring more location decisions for an equivalent capacity. Their visual impact per unit of output (kWh) is also larger, and there is much less flexibility on where they can be located as they need to be where the best resources are (Wüstenhagen, Wolsink and Bürer 2007).²⁴

Questions of community acceptance and compensation are complicated when the current users of the land do not hold formal land titles, as is often the case in SSA. The lack of clarity over land rights also creates the possibility of rent seeking from local communities pursuing compensation for land they do not use. Project developers negotiating compensations to local stakeholders claiming cultural or

23 Interviews with Aldwych International and GCP, 2015.

24 There are interesting differences between social acceptance in developed and developing context. For example, opposition to wind farms in developed countries mostly derives from their negative landscape impact. In developing countries the main concern is the impact to livelihoods of changes in access to land (Juárez-Hernandez and León 2014).

livelihood-related entitlement to the land are often unable to differentiate legitimate from illegitimate claims.²⁵

The evidence suggests that community acceptance of projects depends on distributional justice (who bears costs and reaps benefits), procedural justice (opportunities for the local community to participate in decision-making) and trust in the project developers (Wüstenhagen *et al.* 2007).²⁶ It is therefore very important that foreign project developers understand the local context if they are to avoid damaging relationships (Wüstenhagen *et al.* 2007; Hammami, Chtourou and Triki 2016).

Table 3.4 shows some indicators of potential social opposition risks that can be used at the national level. However, the risk of social opposition is better assessed at the project than the national level, as it depends on the characteristics of the local community, the project and the project developer.

Project developers also need to be cautious of the potential reputational damages of bad practices by their contractors. Reputational risks are higher in those regions with questionable human and labour rights records. We measure these through human rights and labour rights indices.

Governance risk

Many of the risks identified above are intimately related to governance. As a further piece of evidence on these areas, we also look at governance directly, using the World Bank's 'Doing Business' indicators in the following areas: corruption; security; conflict; property rights; and rule-based governance ratings.

Table 3.4 summarises all the indicators used to identify constraints in the areas of resource supply, technology, macroeconomic, social and governance risks.

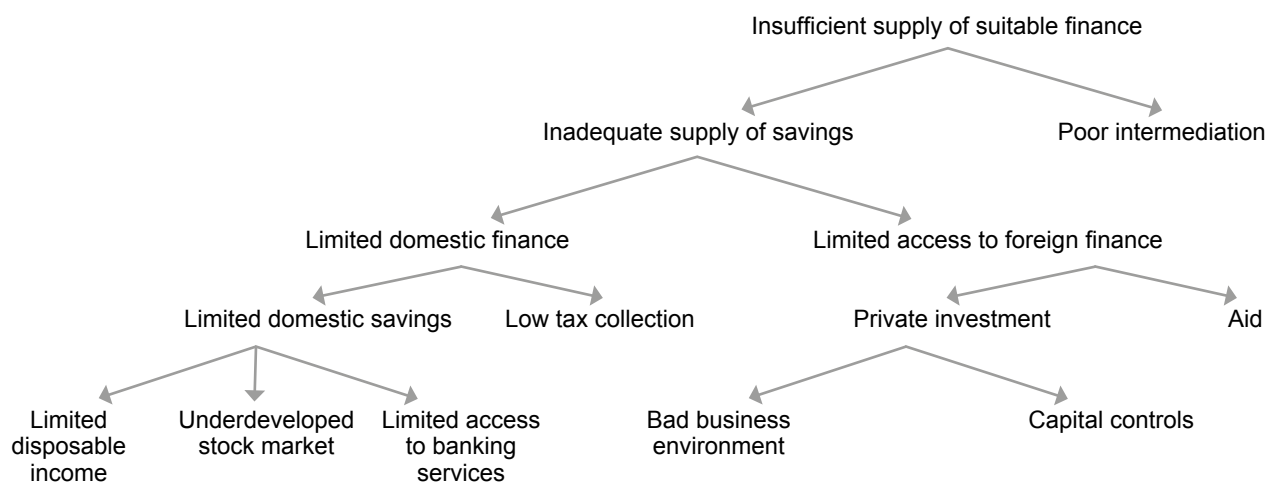
Having considered potential constraints relating to the relative attractiveness of particular projects, the next section turns to the supply of finance.

3.2 Is appropriate finance available?

It may be the case that even attractive renewable energy projects are unable to obtain the finance they need. Many firm surveys identify access to finance as a major constraint to investment. At the national level a low share of credit to the private sector and high financing costs may provide further evidence of financial constraints. At their heart, financial supply constraints result from either a lack of savings (domestic or external) or a failure of the financial system to allocate those savings (Hausmann *et al.* 2004).

25 Interviews with International EPC contractor and Aldwych International, 2015.

26 Communities are more favourable to projects when they are given full information about their costs and benefits and when they are involved in consultation and decision-making processes. Benefit-sharing mechanisms such as revenue sharing, jobs, lower electricity tariffs, investments in local infrastructure and public services also improve the chances of local acceptance. Clear policy frameworks detailing compensation requirements consulted with the local population also improve acceptance and reduce transaction costs for both parties.

Figure 3.4 Insufficient finance due to inadequate supply of savings

Source: Authors' own.

We start by looking at the decision tree branch related to an inadequate access to savings. Its ramifications are illustrated in Figure 3.4. As we did when looking at project attractiveness, a process of elimination results in some areas being ruled out. Where there is evidence to suggest that an area may be an important constraint, we engage in further investigation at more detailed levels of the decision tree.

In principle, renewable energy projects can use domestic and foreign finance. In practice, foreign sources are essential in most developing countries, as domestic sources are insufficient for the level of investment required (Bazilian *et al.* 2011). We look in particular at the availability of two sources of foreign finance: foreign direct investment (FDI) and foreign aid for reasons of scale and data availability. Foreign aid can both provide funds directly and leverage private finance through blended finance-type models and political 'insurance' for private investors. Aid also shields the sector from the volatility of private investment and targets countries and technologies avoided or under-served by the private sector (Pueyo *et al.* 2015). While aid will remain crucial, however, the scale of the funding gap can only be addressed by a large increase in private investment. Causes for insufficient FDI include a bad business environment or direct restrictions through capital controls (Hausmann *et al.* 2004).

As well as a shortage of external finance, problems may exist in terms of insufficient domestic finance. High domestic interest rates are a symptom of insufficient domestic finance, as they indicate a scarcity of supply relative to demand. As summarised in Figure 3.4, potential explanations range from limited domestic savings to a low level of tax collection, preventing public investment in infrastructure. In this regard, the low level of tax collection in SSA is considered as one of the greatest barriers to the transformation of the power sector (Africa Progress Panel 2015).

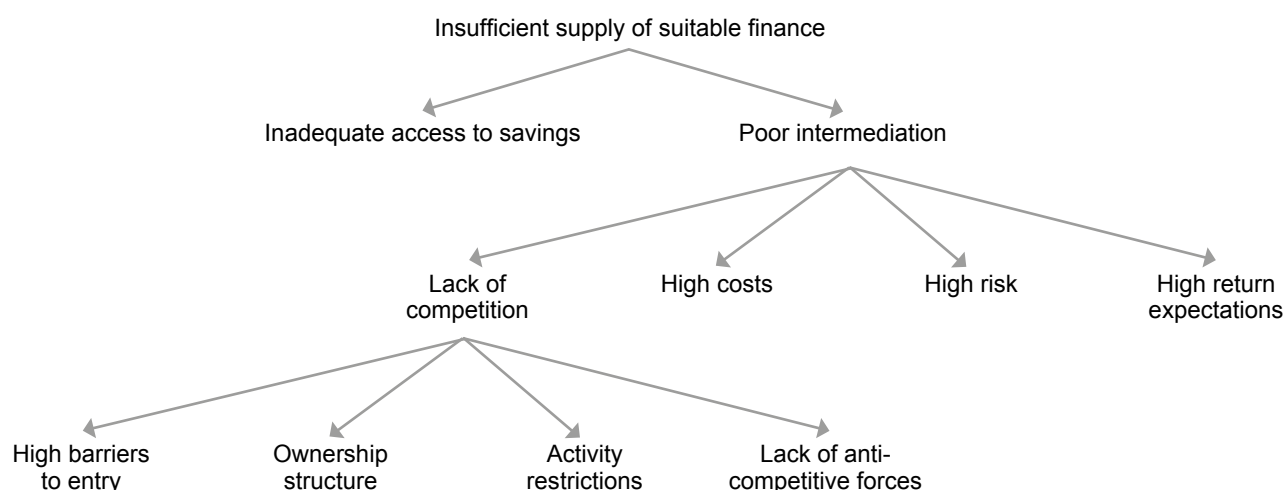
Table 3.5 summarises the indicators used to identify constraints related to the insufficient supply of savings, both national and international.

Table 3.5 Indicators of constraints related to inadequate supply of savings

Constraint	Indicator	Source of data
Access to domestic savings	Gross domestic savings (% GDP)	World Development Indicators
	Gross capital formation (% GDP)	World Development Indicators
	Private credit by deposit money banks to GDP (%)	<i>Little Data Book on Financial Development 2015–16</i> (World Bank 2015c)
	Stock market capitalisation to GDP (%)	<i>Little Data Book on Financial Development 2015–16</i> (<i>ibid.</i>)
Low disposable income	GDP per capita (constant 2010 USD)	World Development Indicators
Access to banking services	Commercial bank branches per 100,000 people	<i>Little Data Book on Financial Development 2015–16</i> (<i>ibid.</i>)
	Bank accounts per 1,000 adults	<i>Little Data Book on Financial Development 2015–16</i> (<i>ibid.</i>)
Tax collection	Tax revenue (% GDP) average last 5 years	World Development Indicators
Foreign investment	FDI, net inflows (% GDP) 2014	World Development Indicators
	Ease of Doing Business (2016 rank)	World Development Indicators
	Portfolio equity, net inflows (% GDP) 2009	World Development Indicators
Aid	Aid inflows, net ODA (% GNI) annual average 2010–14	World Development Indicators
	Net ODA received per capita (current USD) average 2010–14	World Development Indicators

Source: Authors' own.

Figure 3.5 Insufficient finance due to poor intermediation



Source: Authors' own.

Table 3.6 Indicators of constraints related to poor intermediation

Constraint	Indicator	Source of data
Poor intermediation	Bank lending–deposit spread 2015	<i>Little Data Book on Financial Development 2015–16</i> (World Bank 2015c)
Competition	Bank concentration (%) 2013 Boone indicator (2013)	
Cost	Bank overhead costs to total assets (%)	
Risk and returns expectations	Bank return on equity (% after tax) 2013	
	Bank non-performing loans to gross loans (%)	
	Stock market returns (% year-on-year)	
Short-termism	Syndicated loan average maturity (years) 2013	World Development Indicators
	Average maturity on new external debt commitments (2014)	

Source: Authors' own.

Rather than the underlying supply of finance, the inability to access finance on suitable terms may be a problem of financial intermediation. Well-functioning banks are competitive and stable, and able to provide long-term finance to promote investment and economic growth. Figure 3.5 summarises the issues of financial intermediation in decision tree form, illustrating the main categories and their more detailed potential causes, which will be further developed in this section.

A key indicator of intermediation problems is a wide spread between deposit and lending rates (Hausmann, Klinger and Wagner 2008). Wide spreads could be caused by lack of competition, high costs and bank-specific factors influencing risk preferences, and encouraging short-termism.²⁷ Another important influence on banks' willingness to lend long term at affordable rates is their own alternatives. Where banks can earn very high returns from short-term lending to the government, for example, it is not difficult to understand why they might be reluctant to lend for longer maturities with considerably higher risks.

Low bank branch penetration and high sector concentration signal a problem of low competition. Bank pricing behaviour or market power indicators include the H-statistic, the Lerner index and the Boone indicator.²⁸ All three indicators can be summarised as a composite measure of the competitiveness of the banking sector as described in Table 3.6. If competition appears to be a problem, we explore potential causes through indicators of barriers to entry, ownership structure, activity restrictions and regulation.

27 See World Bank article, 'Banking Competition': www.worldbank.org/en/publication/gfdr/background/banking-competition.

28 The H-Statistic captures the elasticity of bank interest revenues to input prices. The Lerner index measures markups in banking, defined as the difference between output prices and marginal costs. The Boone indicator shows the elasticity of profits to marginal costs (www.worldbank.org/en/publication/gfdr/background/banking-competition).

If the problem is more an issue of banking efficiency than market competitiveness, we would expect to see this reflected in costs. Indicators include overhead costs to assets, and bank cost to income ratio.

Finally, the question of a potential short-term bias or high returns expectations is assessed through indicators of opportunities for short-term returns, as shown by liquid assets to deposits and short-term funding, short-term real interest rates, government bond yields, and short-term money market rates.

3.3 Narrowing down constraints and positing a syndrome

The diagnostic processes described thus far are designed to highlight areas of potential concern by comparing performance in different areas with international peers and benchmarks. However, even if an area is identified as potentially problematic, this does not mean it is necessarily 'binding'. A country may perform extremely badly in a particular area, but this may have little impact on investment incentives. It could also be the case that a country scores badly in many, or even most aspects. Which of them should be targeted first?

As pointed out in Hausmann *et al.*, '[I]t is seldom helpful to provide governments with a long list of reforms, many of which may not be targeted at the most binding constraints on economic growth' (2004: 2). Governments could achieve more with less if they deploy their limited policymaking capital to relieve binding constraints. Prioritisation is therefore key to effectiveness and efficiency in policymaking.

In order to assess how binding the first identified set of problems are, we gathered insights from actual investors, regulators and suppliers in the renewable energy value chain of the relevant country. We attempted a similar approach to that of Hausmann *et al. (ibid.)*, according to which the presence of binding constraints would generate the following observable 'symptoms':

- i The price (or shadow price) of the constraint should be high.
- ii Historical movements in the constraint should have produced significant changes in the desired outcome.
- iii Agents in the economy should be attempting to overcome or bypass the constraint.
- iv Agents less affected by the constraint are more likely to survive and thrive, and vice versa.

The (shadow) price of the constraint should be high

When the constraint to investment is a shortage of supply – for example, finance, infrastructure, skills, confidence, stability – we would expect the price (whether market or shadow price) to be high. If the constraint is an insufficient supply of general finance, for example, we would expect to see very high real interest rates. If the problem was restricted to long-term finance, then interest rates for this type of finance should be high. If a lack of supporting infrastructure was binding, we would expect the infrastructure that did exist to generate high returns. If the issue was political risk, then premiums for political risk insurance would be likely to be very high.

Table 3.7 Examples of movements in constraints producing changes in outcome

If the constraint is...	We would expect an increase in investment when...
Low electricity tariffs	<ul style="list-style-type: none"> • Approval of FiT with premium prices • Approval of cost-reflective tariffs
Uncertain procurement processes	Credible international competitive bids
Creditworthiness of the off-taker	<ul style="list-style-type: none"> • Improvement of the financial health of the purchasing utility • Government or World Bank provide guarantees to cover for risk of non-payment
Uncertain planning	Publication of credible power sector plans
Long and opaque permitting and contracting procedures	Approval of regulations streamlining permitting procedures, standardisation of PPAs
Lack of demand	Fast GDP growth, interconnections with importing countries
Corruption	Observable improvement in governance
Social opposition	Peaceful periods, approval of laws and procedures that guarantee the rights of indigenous communities
High cost of finance	Periods of lower real interest rates
Lack of international finance	Periods of relatively high foreign capital inflows
Lack of foreign aid	Periods of increased ODA influx
Lack of competition between banks	Periods of greater competition
Lack of political will	Government commits to (credible) renewable energy targets
Lack of political credibility	Government adopts binding targets and provides guarantees

Source: Authors' own.

This is not restricted to constraints with market prices. The problem may be a lack of skilled workers, a symptom of which would be high wages in relevant sectors. If the issue is excessive risk, we would expect to see this reflected in mitigation instruments like insurance premiums, sovereign guarantees or exchange rate hedging tools.

In practice, as noted by other practitioners (Felipe and Usui 2008) it was difficult to measure shadow prices and other evidence was required for judging the scarcity of resources.

Movements in the constraint should produce significant change in the desired outcome

We would expect to see significant impacts on renewable energy investments when a binding constraint is relaxed. Table 3.7 shows examples of interventions targeting particular constraints that would be likely to lead to an increase in renewable energy investment.

In each case, observation of a relationship between increases in the rate of investment and the factors in the right hand column would provide some evidence of potentially binding constraints.

In practice, however, it was difficult to analyse the impact of relaxing constraints on actual investments. Data on investments in electricity generation in general

Table 3.8 Examples of behaviours to bypass constraints to renewable energy investment

Constraint	Potential behaviour
Poor regulation for grid-connected generators	<ul style="list-style-type: none"> • Explosion of non-regulated off-grid small-scale generation, even in locations within reach of the national grid • Self-generators do not sell excess to the grid
Electricity prices below cost recovery	<ul style="list-style-type: none"> • Self-generators do not sell excess generation to the grid • Off-grid generators charge higher prices • Electricity generators sell power directly to consumers
Unreliable off-taker	<ul style="list-style-type: none"> • Requirement of sovereign guarantees or partial risk guarantees (PRG) to back up PPAs • Self-generators do not sell excess generation to the grid
Customers non-payment	Prepayment schemes established by distribution company
Demand uncertainty	Financiers demand take-or-pay clauses in PPAs
Political interference/vested interests/lack of political will	Financiers and EPC contractors prefer government-backed (or state-owned) projects
Macroeconomic risk	<ul style="list-style-type: none"> • Foreign currency denominated PPAs • PRG to cover for foreign exchange risk
Social opposition	Significant expenses in social engagement plans and private security in sites
Lack of skilled technicians	<ul style="list-style-type: none"> • Least sophisticated projects are implemented (i.e. solar PV plants, diesel gensets) • Large share of foreign staff in EPC and OandM
Lack of domestic savings	Investors look for finance in international markets
Lack of infrastructure	Projects located in areas next to transport and transmission infrastructure, even if they don't have the best renewable resource
Lack of long-term finance	High prices are charged to allow for a fast payback period

Source: Authors' own.

and renewable generation in particular are very lumpy because in small electricity systems investments in generation capacity are few and far between. Sometimes investments are under preparation for a long time before they actually take place. The large size of projects requires a variety of equity and debt investors, in addition to risk mitigation mechanisms such as partial risk guarantees provided by multilateral development banks. Getting all financial stakeholders on board takes time and financial closure cannot be attributed to the relaxation of a single constraint. After financial closure, it can take time for projects to start operations if they must wait for transmission lines to be finalised or to solve land property disputes, for example. For this reason, it would be impossible to attribute a peak in investment, which could be caused by a single project, to changes in a single specific constraint. We carried these tests by looking at the dates when projects became operational and comparing them to the performance of several indicators of constraints, but the results were not conclusive.

Agents in the economy should be attempting to overcome or bypass the constraint

Where problems are serious, we would expect to observe firms trying to overcome them. For example, as noted in Hausmann *et al.* (2008) firms in India invest heavily in self-generation to bypass constraints in the national supply of electricity. Countries

Table 3.9 Examples of those likely to thrive given particular constraints

Constraint	Potential winners
Political interference/vested interests/lack of political will/corruption	State-owned enterprises, investors with strong links to the government or the ruling elite
Social opposition	Cooperatives, community-managed mini-grids, projects with a strong social component
Macroeconomic risks	Suppliers being paid in foreign currency
Unreliable off-taker	<ul style="list-style-type: none"> • Off-grid suppliers • Suppliers with guaranteed income through sovereign guarantees or multilateral bank guarantees
Lack of capabilities	Technologies that are simple to install and operate
Prices below cost recovery	Power suppliers not subject to regulated tariffs
Lack of grid capacity	Projects directly connected to the distribution network
Short-termism of finance supply	<ul style="list-style-type: none"> • Technologies with low upfront investment and high running costs (i.e. fossil fuel-based generation) • Projects with a fast payback period
Lack of cheap and long-term finance	<ul style="list-style-type: none"> • Agents with easy access to affordable and long-term finance succeed in bringing projects to implementation (i.e. Chinese investors with access to Chinese development finance) • Government-backed projects obtaining cheap finance from multilateral banks

Source: Authors' own.

where labour market regulations are a binding constraint are likely to see higher than normal levels of informal employment. Countries where appropriability is low due to high taxes might see greater use of cash for business transactions, while a lack of capital from the financial system could cause firms to use more of their internal resources. For constraints specifically related to investment in the power sector, we detail some potential behaviours to bypass constraints in Table 3.8.

We were able to apply this type of non-price-related signals more naturally than the previous shadow prices and movements of constraints. Following up signals of actors bypassing constraints required in-depth knowledge of the countries' power sectors, as well as creativity from the researcher. One of the main criticisms towards the Growth Diagnostics approach has been the absence of a scientific formula in its procedural application, which can lead to arbitrary choices of constraints by practitioners (Habermann and Padrutt 2011). In our case, we introduced a more systematic approach in the navigation of the decision tree but appreciated the freedom to test plausible stories through non-price signals.

Agents less intensive in the constraint more likely to survive and thrive, and vice versa

While the presence of a constraint should encourage agents to avoid it, advantages will also be conferred on businesses that are less reliant upon it, and vice versa. Hausmann *et al.* describe this with an evocative metaphor:

What is the binding constraint to animals thriving in the Sahara desert? This is not unlike the question of what limits economic growth in a country. However,

in the Sahara, it is instructive to note that of those few animals that do thrive in that environment, a very large proportion are camels and a very small proportion are hippopotamus. The fact that the animals most intensive in the use of water, hippopotamus, are scarce while the animals least intensive in the use of water, camels, are thriving suggests that the supply of water may be a binding constraint to the spread of animals in the Sahara.

Hausmann *et al.* (2008: 43–4)

Table 3.9 sketches what this might mean specifically for investment in renewable energy generation.

We were also able to apply this test in our analysis of Kenya and Ghana, but as with actors bypassing constraints, it required in-depth knowledge of winners and losers in each country and the discretion of the researchers.

To summarise, our Green Investment Diagnostics approach first provides a reduced list of potential constraints to investment through the analysis of indicators following a decision tree. It then looks for symptoms that indicate they are binding. Some of the approaches to look for symptoms of constraint according to HRV are difficult to apply to small and complex energy systems (i.e. impact of movements in constraints or shadow prices). We look for symptoms mainly by observing how actors try to bypass constraints and what types of investments survive or perish. As the different tools are worked through, evidence supporting particular constraints builds cumulatively. The fact that this evidence comes from different sources provides further confidence. However, we were not able to reduce our focus to a single binding constraint as suggested in the original diagnostics. Links between different constraints are endless and singling one out is a challenging task. In fact, one important criticism of the Growth Diagnostics approach is the idea that an economy has a single most binding constraint that has to be addressed first (Habermann and Padrutt 2011). It might be better to reduce several constraints to some extent instead of focusing entirely on one, especially when there are so many interconnections between them.

In our analysis, we highlight a group of key obstacles to investment in renewables in each country, show their interrelationships and propose a theory or explanation for the existence of those particular constraints, what in Growth Diagnostics terminology is called a syndrome. In the next subsection, we explain our approach to recognise symptoms of binding constraints and to posit a syndrome that accounts for what we observed.

Positing a syndrome

In Growth Diagnostics, a syndrome is a theory or an explanation for the existence of the particular constraints we observe. It is about understanding the root causes of the constraints. Hausmann *et al.* (2008) propose a non-exhaustive list of six syndromes that explain constraints to growth. Their proposed syndromes include four stories of government failure, in which an overburdened state may over-borrow, over-tax, underinvest or under-protect. Over-borrowing leads to a fiscal deficit that pushes interest rates up and where government borrowing crowds out the financial markets, causing low private investment at a high financial cost. Over-taxing reduces private returns discouraging investment. Underinvestment by

the state reduces the demand for investment even with low interest rates. In an under-protecting state, law and order collapses and investment risk is too high. Two additional syndromes describe external pressures that disrupt the export sector, jointly with the inability of the country to move to alternative products due to coordination and self-discovery obstacles. Finally, a syndrome of barriers to entry refers to situations where economic activity is reserved from some incumbents.

All these syndromes are relevant to our analysis. An over-borrowing state could subsidise electricity tariffs or fossil fuels damaging the financial viability of power utilities and the competitiveness of renewables, or crowding out private investment. An over-taxing state could reduce private returns to investment in renewables. Underinvestment in transmission and distribution infrastructure, for example, could discourage investment in generation. The uncertain future revenue streams will deter investors in an under-protecting state. External shocks and self-discovery problems could reduce the demand for electricity in the country, and hence investment needs. Finally, barriers to entry are clearly relevant in countries that have not abandoned the traditional centrally managed approach to power supply, and where state-owned utilities dominate the market.

4 Green Investment Diagnostics – Ghana

Section 2 described Ghana's problem as one of underinvestment in all types of generation capacity, but particularly in renewable energy. The country has adopted a Renewable Energy Law, but it has not been duly implemented. Our diagnostics look for the main constraints to renewable energy investment by first asking if there is a shortage of attractive investments or instead a shortage of suitable finance for them. Further evidence is then accumulated to point at the main causes for one or another constraint.

4.1 Are renewable energy investments attractive?

Our previous research on costs and returns of hydro, wind and solar PV in Ghana showed low returns for wind and utility-scale solar PV in comparison to alternatives (Pueyo *et al.* 2016). Utility-scale solar PV is expected to deliver returns on equity of 9 per cent, based on the price per kWh set in the FiT and a 7.5 per cent debt interest rate (based on data provided by the EC).²⁹ We estimated that a combination of low-cost debt from development banks (at around 4 per cent interest rate as enjoyed in other developing countries, such as Kenya) and low installed costs, such as those claimed by BXC solar, could allow equity rates of return of close to 22 per cent for solar PV.³⁰

29 Based on a FiT price of 17 USD cents per kWh guaranteed for a period of ten years, after which we assume a price of 13 USD cents per kWh, which is the cost of new gas power plants as provided in EC (2015a).

30 BXC solar is a 20MW solar PV plant financed with Chinese capital and developed by Chinese contractors.

Table 4.1 Rates of return of several investment indices in 2014 and as an average of the period 2009–14

Indices	Value 2014	Value 2009–14
MSCI All Country World Index (ACWI)	2.47%	11.41%
SandP listed private equity	-	16.54%
SandP Broad Market Index (BMI)	2.33%	12.11%
MSCI Frontier markets	1.84%	4.57%
SandP Pan Africa	-14.74%	2.66%
FTSE/JSE All Africa	8.14%	15.23%
FTS/JSE Africa venture capital		42.64%
SandP Global oil and gas	-30.32%	13.7%
SandP Global alternative energy	-3.14%	-2.2%
SandP Global clean energy	-5.09	-9.68%
NYSE Bloomberg global solar	7.09	-1.53
NYSE Global wind	6.84	-1.13

Source: Authors' own.

Wind power plants could deliver equity rates of return of around 14 per cent but higher returns would be possible if installed costs were closer to lower international benchmarks (IRENA 2015c).³¹ Cost reductions could be achieved through learning effects and economies of scale. Hydropower, in contrast, would be expected to deliver very high returns, over 30 per cent, but the availability of hydrological resources in Ghana is highly uncertain.

The rates of return of wind and solar PV are relatively low compared to potential alternatives. Interviewed stakeholders suggested that projects in the telecommunications sector, or even treasury bills and bonds are more profitable than investments in renewable energy.³² For investors targeting the Ghanaian electricity sector, gas power plants are more profitable alternatives.³³

Table 4.1 shows the rates of return of several investment indices, from more general to more specific geographic and sectoral indices. The table shows rates for both 2014 and the annual average for the period 2009–14, but average figures are more useful due to the volatility of these sectors.

Ghana's government (GOG) bond yields, considered less risky than investing in a greenfield renewable energy project provide interest rates of 25.28 per cent, 25.93 per cent and 23.49 per cent on the 91-day, 182-day bills and the three-year fixed bond as of the end of September 2015. Interest rates on the one-year, two-year note, three-year note, the five-year GOG bond and seven-year fixed

31 At a FIT price of 15 USD cents per kWh guaranteed for ten years, after which it goes down to 13 USD cents per kWh.

32 Interview with Executive Director of KITE, 2015.

33 Interview with Project Manager, Aldwych International, 2015.

bonds were 22.50 per cent, 23.00 per cent, 23.49 per cent, 21.00 per cent and 18.00 per cent. These figures show that it is possible for investors to get good returns with lower risk than a greenfield renewable energy project in Ghana in broad diversified sectors, or very high returns with high risk as well for investments with Africa exposure. For investors with a focus on renewable energy, however, investments in Ghana are competitive with global alternatives.

Costs

Our estimates of LCOE for renewable power plants show hydropower is the least cost technology in Ghana, at 7.9 USD cents per kWh (Pueyo *et al.* 2016). The LCOE of generic wind power is 14.3 USD cents per kWh and that of solar PV 18.7 USD cents per kWh. These estimates use a social discount rate of 12 per cent as provided by national documents (EC 2015a). The Energy Commission has estimated that a 20MW solar PV plant recently developed by Chinese company BXC would require a price of 16.8 USD cents per kWh to break even, assuming a project life of 20 years, a discount rate of 10 per cent and a 15 per cent capacity factor (EC 2016a).

The cost of a generic wind power plant in Ghana is higher than international benchmarks. Chinese wind projects reported 6 USD cents per kWh in 2014 and African projects around 10 USD cents per kWh (IRENA 2015c). Estimated costs of solar PV in Ghana are in line with 2014 international benchmarks for Africa, but far from the most competitive figures of around 6 USD cents per kWh reported in the latest South African renewable energy auctions (Eberhard and Kaberger 2016). These costs are still below the commissioned oil-based thermal plants to deal with the electricity supply crisis, at a LCOE of 19 USD cents per kWh (EC 2015a).

The high costs of finance, high capital costs due to lack of experience and economies of scale and capacity factors below the international average appear to be behind the relatively high cost of wind power in Ghana compared to international benchmarks. Relatively high solar PV costs are also caused by high financing costs. Although these plants are lower cost than fossil fuel-based plants, there is a perception that 'the economy needs cheap power from fossil fuels to develop'.³⁴

System costs are not a key constraint in Ghana at the present time. Although the Ghanaian system is very small, the penetration of intermittent renewables is negligible at the moment and is not expected to increase to a level that threatens system stability. The Ghanaian government's target is to generate 10 per cent of electricity from renewable energy (excluding large hydro) by 2020. Only 4 per cent of that would be variable renewable energy that could raise system cost issues. The government has also shown a preference for solar PV below 20MW, which will allow geographic diversification. At the moment, nearly all generation comes from dispatchable hydro and fossil fuel-based thermal plants, the transmission network covers most of the country and there are good interconnections with neighbouring countries. These characteristics would provide system stability in the event of an increase in the share of variable renewable energy.

34 Interview with Head of Strategic Planning and Policy, Energy Commission 2015.

Having looked at the cost of renewables in Ghana in comparison to fossil fuel alternatives and international benchmarks, we conclude that renewables can be competitive with the thermal plants that are being commissioned in the country. However, costs are above international benchmarks, mainly due to high financing costs. We now turn to look at the revenues.

Revenues

Revenues depend on the size of the demand, the price of electricity and the amount of electricity that can be generated and fed to the grid.

First we look at demand for electricity, as a function of the rate of growth in the country, levels of poverty and inequality, as well as any external demand from other countries. Indicators for all these and a comparison with Kenya and international benchmarks are presented in Appendix B. Ghana's GDP growth rate is higher than the average for SSA and for LMI countries, but it is much more volatile. Poverty rates are significantly lower than the average for SSA and have been falling. Households from all per centiles have benefited from growth in Ghana between 2005 and 2013, with the richest and poorest per centiles benefiting the most (GSS 2014). Finally, with regard to external demand, interconnections with neighbouring countries are available through the West African Power Pool. Ghana is currently a net electricity exporter to neighbouring countries Togo, Benin and Burkina Faso. Therefore, demand does not appear to be an important constraint to investment in renewable electricity.

Prices could well be an important obstacle to investment in all types of generation technologies, as Ghanaian retail tariffs are among the lowest in Africa. Figure B5 in Appendix B compares electricity tariffs in Kenya and Ghana, both retail tariffs and FiT. Ghanaian consumers, regulators and politicians are used to very low costs due to its traditional reliance on old – but cheap – hydroelectric plants. As a result, price rises tend to be met with strong social opposition.³⁵ Although price rises are essential for financial sustainability, the government appears to have prioritised popular support over the financial viability of the electricity sector, frustrating efforts by the regulator to raise tariffs. In any case, price increases were granted recently to avoid the collapse of electricity utilities. In addition to low tariffs, the rapid fall in the value of the local currency, which has lost more than 50 per cent of its value against the US dollar in the last few years, makes it difficult for the distribution company to pay IPPs whose prices are dollar denominated (ECG 2013b).

The government supports a subsidy to residential consumers in the lowest electricity consumption band. The scheme is effectively a cross-subsidy from non-residential and wealthier residential consumers to poorer residential consumers. This has raised opposition among large consumers of the national distribution company Electricity Company of Ghana (ECG), which feel unfairly treated compared to industrial customers which are directly connected to the transmission network. To retain these high revenue-yielding industrial consumers ECG has negotiated lower tariffs, further damaging the financial sustainability of the tariff scheme (these issues are further discussed in the 'Off-taker risks' subsection).

35 Interview with CEO of GCP, 2015.

As a result of these tensions to keep prices low, there is a wide divergence between generation costs (average market cost and spot market price) and final prices (so-called composite bulk generation charge in Ghanaian regulation). The current transmission and distribution charges are also insufficient to allow the transmission company GRIDCo (Ghana Grid Company Ltd) and the distribution company ECG to recover their costs and both utilities have requested the regulator Public Utilities Regulatory Commission (PURC) an upward review of their tariffs (ECG 2013b).³⁶

Ghana has approved a FiT scheme for renewable energy generation that offers fees at least twice as high as retail tariffs guaranteed for ten years. However, FiT offer a poor reassurance to investors as the time guarantee is just for ten years and they denominated in local currency. They do not offer investor protection against foreign exchange risks or inflation, which have escalated in the last years (PURC 2014). Besides, ECG's poor credit record makes investors wonder if it is capable of honouring the guarantee.

The third element influencing revenues is the amount of electricity that can be generated by each renewable energy project. This is reflected by the capacity factors of the plants, which measure the share of the time when plants are generating electricity. Capacity factors for wind and solar PV in Ghana are below African and international average values. Average wind power plants capacity factors are 25 per cent in Ghana (according to information provided by the EC), as compared to 32 per cent in Africa and 30 per cent internationally. Average capacity factors for solar PV are 15 per cent as compared to 22 per cent in Africa and 20 per cent internationally (Pueyo *et al.* 2016).

The final element that determines the revenues of intermittent renewable generation projects is the risk of curtailment. This is considered low in Ghana because the FiT scheme includes a renewable energy purchase obligation, there is a high share of flexible generation in the Ghanaian system, and sufficient transmission capacity and interconnections.

Having looked at the returns of renewable energy in Ghana, we conclude that these are not high enough compared to alternatives in other sectors and regions. However, they would be acceptable for investors focused on the renewable energy sector. High financing costs, low prices and low capacity factors explain low returns.

We now look at the risks that renewable energy investors face in Ghana, including regulatory, off-taker, resources and technology, macroeconomic, social and governance risks.

Regulatory risks

We start by looking at the planning stage of the regulatory process. Ghanaian strategic energy plans have been unrealistic in the past, and have often not been implemented,

36 GRIDCo advert: *Proposed Transmission Service Charge for 2015 Major Tariff Review*; see www.gridcogh.com/en/posts/gridco-advert---2015-tariff-proposal-summary-51.php.

increasing uncertainty for investors.³⁷ A symptom of the inefficiency of the planning process is the large number of plants that are awaiting permits or finance. In 2016, 82 unsolicited renewable energy projects totalling nearly 6,600MW of capacity had obtained provisional wholesale supply and generation licences.³⁸ These include very large flagship projects, such as the 155MW Nzema solar PV plant, which are unlikely to be built any time soon. Renewable energy plants in the pipeline more than double the current capacity of the Ghanaian system and broadly exceed the caps and targets set for renewables in the Renewable Energy Act. They evidence the lack of coordination between the planning and procurement functions in the country.

The permitting procedures are also inefficient and opaque. Project developers need to engage with a number of institutions to get licences, clearances, assurances and incentives.³⁹ Each of these steps increases transaction costs and gives opportunities for rent seeking, an issue that came up strongly in our interviewees to Ghanaian stakeholders:

At every step there are officials trying to get personal advantage out of the project and if you do not meet their demands the project is delayed and delayed and delayed.

(Managing Director, Upwind, 2015)

To get a PPA in Ghana you need to know a politician or a big person to take you through the process.

(Deputy Executive Director, ACEP, 2015)

Our regulators are in the taking business not in the giving business.

(Founder, Solar Light Company, 2015)

As well as the sheer number of licences and permits, many expire after a year, but it takes much longer than this to secure financing, so investors need to pay a high fee to renew their licences and are only allowed to do so once.⁴⁰

In addition to bureaucratic difficulties, there are problems with institutional design and the division of responsibility. For example, the role of the technical and

37 For example, the 2006 plan by the EC forecasted supply requirements of 14,150–14,828GWh. Gross electricity supplied in 2014 was just 12,906GWh. It also anticipated that by 2013–15 there would be 200MW of wind, 80MW of municipal solid waste, 10MW of biomass, solar PV and mini-hydro and 4MW of landfill gas capacity, none of which is available today (EC 2006, 2015b).

38 EC website, accessed November 2016.

39 The following licences, approvals, agreements and clearances are required from different institutions (EC 2012; IRENA 2015b): (1) Site clearance by the Environmental Protection Agency (EPA) and the Energy Commission; (2) Environmental permit from EPA; (3) No-objection in principle from the PURC; (4) Memorandum of understanding with the off-taker (e.g. ECG); (5) Provisional wholesale electricity supply licence, by the EC (17 submissions are required to obtain this); (6) Construction work permit (authorisation to construct), by the EC (six submissions are required to obtain this); (7) Operational licence (authorisation to operate), by the EC (six submissions are required for this); (8) Wholesale electricity supply licence to generate electricity from renewable energy source, by the EC; (9) Relevant approvals from governmental agencies, such as Ghana Investment Promotion Center (GIPC), Ministry of Power and Ministry of Finance and Economic Planning; (10) PPA with off-taker; and (11) Electrical connection agreement with GRIDCo.

40 Interview with Biomass representative, EC, 2015.

financial regulator has been split into two institutions: the PURC and the Energy Commission. This has created contradictions in procuring new power, as one agency is responsible for providing licences to new generation plants while the other is responsible for approving the tariffs in the PPA. This implies that one institution could be providing market access while the other blocks it.

We now look at the contracting stage. As with permitting, there are problems with institutional design. PPAs are in theory the competence of distribution utilities ECG or Northern Electricity Distribution Company (NEDCO), but the Ministry of Energy, VRA and ECG have all separately signed or undertaken commitments to enter into PPAs with private generators, each of them following different procedures. Other contractual risks include the solvency of the off-taker, currency devaluation, inflation and the short period of price guarantees by FiT.

Pricing has been previously discussed in the 'Revenues' subsection, but it is worth highlighting here the political interference in price setting and the tensions to keep prices low as a regulatory risk. Further regulatory uncertainty comes from ambiguous support to FiT. Policymakers perceive FiT as an expensive instrument and there is a will to replace them with competitive bids, following the successful experience of South Africa.⁴¹ Still, no clear regulation has been approved that provides transparent guidelines and the government has not announced its intentions publicly.⁴²

An additional regulatory constraint comes from the uncertain roles of private and public actors. The national generation utility controls 73 per cent of generation capacity and can use its existing power to influence the negotiating process for new generation capacity to the detriment of private investors. The government has openly invited private sector participation as a way out of the energy crisis and as of December 2015 there were three IPPs in the country. However, in practice the national utility is reluctant to accept an increasing role of the private sector in the provision of infrastructure services, as it would diminish control and patronage (Malgas and Eberhard 2011). Privatisation of utilities does not have popular domestic support either.⁴³

Regulatory risks therefore come out as an important constraint to investment in renewable energy, in all its dimensions: planning, procurement, contracting and market access. The next subsection considers the issue of the off-taker, which is crucial to understanding how the Ghanaian power system functions – and sometimes does not.

Off-taker risks

We focus our analysis on the main off-taker in the Ghanaian electricity system, the Electricity Company of Ghana (ECG). There is a second distribution company, NEDCO, which is part of VRA and is the sole distributor in the north. The regions covered by ECG represent approximately 36 per cent of the territory surface but 72 per cent of total demand in Ghana (ECG 2013a).

41 Interviews with representatives of EC and GCP, 2015.

42 Interviews with the Energy Commission and GCP, 2015.

43 Interview with CEPA, 2015.

In 2016, as we prepared this report, ECG's last published financial statements were for 2013. Although they contained a favourable opinion by the auditors, the inability to publish up-to-date statements is a leading indicator of difficulties. This is supported by the fact that the ECG has carried an operating loss for the last three years, and is currently unable to pay suppliers in time due to insufficient cash flow, or to pay down its debt liabilities.

Current liabilities are significantly higher than current assets and the amount of cash and cash equivalents is very low compared to accounts payable and short-term borrowing. ECG has 45 per cent short-term debt as compared to equity and long-term debt, suggesting very high finance costs.

System losses are such that almost a quarter of the power purchased from generators is not billed, with losses equally attributed to technical and commercial reasons. The ratio of revenue collection to sales is 90 per cent, which shows that some of the power that is billed is not paid for by consumers. Of the total amount of trade receivables, 49 per cent are not overdue and 13 per cent are overdue by more than a year. All these indicators are included in Table B8 as part of Appendix B and compared to those of the Kenyan off-taker.

As a result of these imbalances, ECG is unable to cover its costs and finance critical investment projects (ECG 2013a). The main causes can be summarised as follows:

- Low tariffs set below cost recovery for distribution and retailing.
- Macroeconomic imbalances. ECG must pay IPPs in foreign currency, as their PPAs are dollar denominated but it is not compensated for the severe depreciation of the cedi.
- Cost increases. Prices of imported materials, tools and spare parts have soared as the currency has fallen, as has the costs of finance. Furthermore, the costs of maintaining and operating rural networks are much higher than the revenues they yield, but ECG is not compensated for the highest cost.
- Regular load shedding damages the company's network assets, which need to be replaced more frequently.
- Poor revenue collection and billing. About 65 per cent of ECG's debt consists of arrears accrued from government and public institutions.
- Increase of distributed generation to directly serve some industrial consumers, bypassing ECG. As a consequence, ECG has lost some high revenue-yielding consumers. Besides, the power they consume is transported through ECG's distribution network, which imposes certain costs for which the company is not reimbursed.

All these make ECG unable to absorb the higher cost of FIT. Even if it signs PPAs with potential generators, these do not provide assurance to financiers that they will recoup their investments. Through our interviews, off-taker risks were repeatedly highlighted and often singled out as the most important constraint to investment in electricity generation:

The biggest challenge that we have is getting a credible off-taker.
(Executive Director, KITE, 2015)

If the one who buys and sells electricity is not credible, that is the biggest obstacle.
(Deputy Executive Director, ACEP, 2015)

ECG is bankrupt. They are not reliable. They can sign PPAs but they will not fulfil them because they don't have any money.
(Managing Director, Upwind, 2015)

The Ghanaian utility is broke, so the question is will it pay?
(Chief Executive Officer, Ghana Capital Partners, 2015)

There are two main approaches to mitigating off-taker risk. First, guarantees can be obtained from the Ghanaian government or international development agencies that bills will be paid in case of default by the national utility. In the past, private IPPs in Ghana have relied on the provision of guarantees by the Ghanaian government. However, the Ministry of Power has declared that it does not want to be involved with guarantees to IPPs, due to the financial difficulties that the government is facing. It has recommended instead the use of partial risk guarantees such as those provided by the Multilateral Investment Guarantee Agency (MIGA) of the World Bank.⁴⁴

A second approach is to improve the creditworthiness of the off-taker. This would require the reduction of technical and commercial losses, the improvement of revenue collection and the professionalisation of ECG management. These are key aims of the US Power Africa initiative that provides financial support to Ghana's electricity sector jointly with the Millennium Challenge Corporation through the Compact II agreement. US support is conditioned to an increased participation of the private sector and, specifically to the concession of ECG for private sector management (Power Africa 2015).

To summarise, it seems clear that the performance of the ECG is a major obstacle to investment in the power sector in Ghana. While opinions may differ on the best way to resolve this issue, there is little prospect of significantly increasing investment until it is resolved.

Resources and technology

While resolving problems with the off-taker is a crucial precondition to investment, it is not the only thing that matters. The viability and attractiveness of renewable energy projects will also be strongly affected by the underlying potential of renewable resources, and the availability and suitability of technology and expertise to exploit these resources.

For resource potential, the Ghana Meteorological Services Agency has collected data on solar radiation and sunshine hours for over 50 years. Kumasi's Kwame Nkrumah University of Science and Technology (KNUST) measures hourly global and diffuse irradiance and has also collected wind speed and biomass resources data. Hydropower potential has been investigated for many years in Ghana and

44 Interviews with Executive Director, KITE and Head of Strategic Planning, EC.

many potential mini-hydro sites have been identified (IRENA 2015b). We consider that there is enough information about the quality of renewable energy resources in Ghana and therefore uncertainty is not a significant constraint to investment.

In contrast, there is institutional inexperience, technological immaturity and a lack of skilled managerial and technical manpower to oversee and maintain renewable energy projects and to manage distribution companies (Gyamfi *et al.* 2015; Fritsch and Poudineh 2016). There is very little experience with renewable energy in Ghana apart from hydro, and the country's higher education rates are well below the average for LMI countries. Industrial competitiveness is also very low for the country's income level.

For grid capacity, GRIDCo's latest annual report declares that the transmission network has just enough capacity to transmit electricity generated from the plants to the load centres, but it is unable to withstand contingencies (GRIDCo 2014). However, other authors understand that the Ghanaian grid code is not yet ready to incorporate intermittent generation (IRENA 2015b).

Even if there is a lack of capabilities in the country, technology risks do not worry our interviewees as a stumbling block in the development of the renewable energy sector. Besides, the lack of capabilities does not differ from that of other countries without significant experience in the implementation of renewable energy projects. We now follow our analysis by looking at macroeconomic risks.

Macroeconomic risk

As has been mentioned at various points, Ghana faces major macroeconomic challenges, including a sharp currency depreciation, high inflation and interest rates and large current account and fiscal deficits. The Ghanaian cedi lost 65 per cent of its value against the US dollar between 2011 and 2015 and 18 per cent during just 2015. The country faces persistently high inflation, which was 18.5 per cent by February 2016.⁴⁵ Ghana's increasingly unsustainable fiscal and current account imbalances required a bailout from the International Monetary Fund (IMF) in 2015. While Ghana's fiscal position improved in 2015, the high level of its budget deficit and debt still is likely to require further fiscal consolidation (World Bank 2016a).

These issues affect the sustainability of project revenues, the government's capacity to provide guarantees or to sustain subsidised electricity tariffs, and hence the creditworthiness of the off-taker. Macroeconomic risks are therefore of fundamental importance to international investors. Currency volatility is not unique to the country, but has been worse in Ghana than in many comparable countries. The same is true for its persistently high inflation. International investors will look very carefully at these issues, knowing that they can profoundly affect the core economic viability of large-scale infrastructure projects.

45 Inflation data taken from the Bank of Ghana website, www.bog.gov.gh/ (accessed 28 February 2016).

Social and reputational risk

As well as the financial risk created by macroeconomic problems, investors may also be concerned about social and reputational risk. The development of liquid biofuels, for example, has raised social concerns in Ghana, with several reported cases of 'land grab' (ActionAid 2012).⁴⁶ In general, technologies requiring large areas of land such as solar PV and hydropower have greater potential to create conflicts with land users. This is exacerbated by the process for obtaining land in Ghana not being transparent enough, with many properties not holding valid title documents. Somewhat worryingly, we were unable to find clear guidelines on consultation processes required with local communities to develop renewable energy projects.

Despite these issues, Ghana's human and labour rights record is generally better than in other countries in the region. Ghana scores 11 out of a maximum value of 14 in the empowerment rights index, for example, which looks at government respect for seven rights: foreign movement, domestic movement, freedom of speech, freedom of assembly and association, workers' rights, electoral self-determination and freedom of religion (CIRI Human Rights Dataset 2016).

Although there are precedents of land grabs in biofuel projects, and uncertainty with regard to land ownership, the issue of social discontent did not come up in any of our interviews with stakeholders. We did not find cases of discontent with planned renewable electricity generation projects in the press, either. For this reason, we will not consider social opposition among our reduced number of constraints to be analysed further.

Governance risk

Finally, we look at governance as another potential source of risk. Although corruption in Ghana is an issue, it appears to be lower than in many SSA and LMI countries according to some indicators such as the CPIA (Country Policy and Institution Assessment) transparency, accountability and corruption in the public sector index, or the Transparency International Corruption Perception Index (CPI). The World Bank Enterprise Surveys, however, show that as much as 35 per cent of companies declare to be expected to give gifts to secure a government contract or to obtain a construction permit (World Bank 2013b). This compares to 32 per cent to secure a government contract in the SSA region, or 29.5 per cent to obtain a construction permit. Corruption at this level is particularly relevant in Ghana given the large number of permits and clearances required to be able to develop a renewable energy project, as previously described.

Security is better than in the average LMI and SSA country. In 2011, Ghana had 1.7 intentional homicides per 100,000 people as compared to 5.9 in LMI countries and 14.4 in SSA one year later (data for 2011 not available for country groupings).

⁴⁶ Land grabbing is the contentious issue of large-scale land acquisitions in developing countries by domestic and transnational companies, governments, and individuals, for the purpose of industrial food or biofuels production.

Having reviewed the relative importance of different risks in Ghana, the combined evidence – from the indicators in the decision tree and stakeholder interviews – suggests that the following are the most important:

- Low returns as compared to alternatives
- High financing costs
- Low prices
- Low capacity factors
- Regulatory risk
- Off-taker risk
- Macroeconomic risk
- Corruption.

The following section turns to the other set of potential investment constraints – those caused by a lack of available finance.

4.2 Is appropriate finance available?

According to surveys, access to finance is considered a major obstacle to growth by 62 per cent of enterprises in Ghana, compared to 37 per cent in the SSA region (World Bank 2013b). The results of a previous Growth Diagnostics exercise for Ghana concluded that credit is a binding constraint for private investment, noting that credit to the private sector is low compared with other countries, short term in nature and costly (United States Government and Government of Ghana 2011).

Our analysis of the cost of renewables has also shown that the LCOE of renewable energy projects is driven up by high financing costs and returns on investment are low due to the high cost of debt (Pueyo *et al.* 2016). At face value, it therefore appears that finance is an important constraint to investment in renewable energy projects which require large upfront investment. In this section we dig deeper to analyse the reasons behind poor access to finance for renewables in Ghana.

Supply of savings

We first look at the supply of savings in Ghana, both national and international. High domestic interest rates in Ghana show a high willingness to remunerate savings, which may indicate a shortage of underlying finance. Treasury bills have rates higher than 22 per cent and the average lending rate was 29 per cent as of September 2015 (Bank of Ghana 2016). At the same time, gross domestic savings, private credit and stock market capitalisation as a percentage of GDP are significantly lower than in the average LMI country. The fact that scarce capital is combined with high interest rates suggests access to credit as a significant constraint. Our interviews confirm that banks do not have enough capital of the right form for renewable projects, which makes it necessary for investors to look for finance abroad.⁴⁷

47 Interviews with Deputy Director, ACEP, and CEO, GCP, 2015.

For external finance, Ghana shows better access to FDI than their income and regional group peers. Ghana has also been able to tap the global capital markets by issuing bonds or attracting foreign investment in its stock market, as shown by relatively high figures of portfolio equity investment inflows. Inflows of Overseas Development Aid (ODA) are higher in Ghana than for the average SSA country, but its graduation from low-income country to LMI country will limit its access to concessional finance in the long run.

While the evidence overall suggests that access to international finance is not a major constraint in Ghana, and that Ghana attracts more ODA than might be expected, this is less clear for the electricity sector. Here, ODA to Ghana is much lower than the average amount going to either low- or middle-income countries. The former attract ODA flows to the electricity sector at an average of 0.24 per cent of GDP, while the average figure for the latter is 0.21 per cent. ODA flows to the electricity sector in Ghana, however, are 0.19 per cent. The fact that Ghana is not short of aid finance in general, but this does not flow to the power sector, points at constraints to the sector attractiveness for donors, not to the availability of donor finance.

Intermediation

In addition to the low supply of domestic savings, it could be the case that this is poorly allocated. A wide spread between bank deposit and lending rates in Ghana in fact suggests that there are intermediation problems in the financial sector.⁴⁸ The spread is much wider than in Ghana's regional and income groupings, as shown in the tables of indicators in Appendix B.

One possible explanation is a lack of competition in the sector. Bank concentration, however, is lower in Ghana than in SSA and is in line with the average for comparable LMI countries. The Boone indicator is also lower than for the other groups, suggesting a higher level of competition in Ghana. Concentration and competition do not seem to be a significant problem in Ghana in comparison with other countries in its region or income group.

Ghana's banking sector is more risky, however, as measured by non-performing loans and commensurate large return expectations compared to its peers. Banks have a relatively small amount of capital and cannot provide large long-term loans, as their businesses would be jeopardised in the event of a default. Local banks, perhaps unsurprisingly, prefer to focus on lucrative short-term loans with very high interest rates of up to 35 per cent.⁴⁹

The main constraints identified at the finance side of the decision tree are therefore: the insufficient supply of domestic savings and poor intermediation due to a risky lending environment, and the availability of lucrative short-term investment alternatives.

48 The average three-month time bank deposit rate in Ghana was 13 per cent and the average lending rate was 28.98 per cent at the end of September 2015 (www.bog.gov.gh/, accessed 28 February 2016).

49 Interviews with Deputy Executive Director of ACEP, 2016 and Executive Director of KITE, 2015.

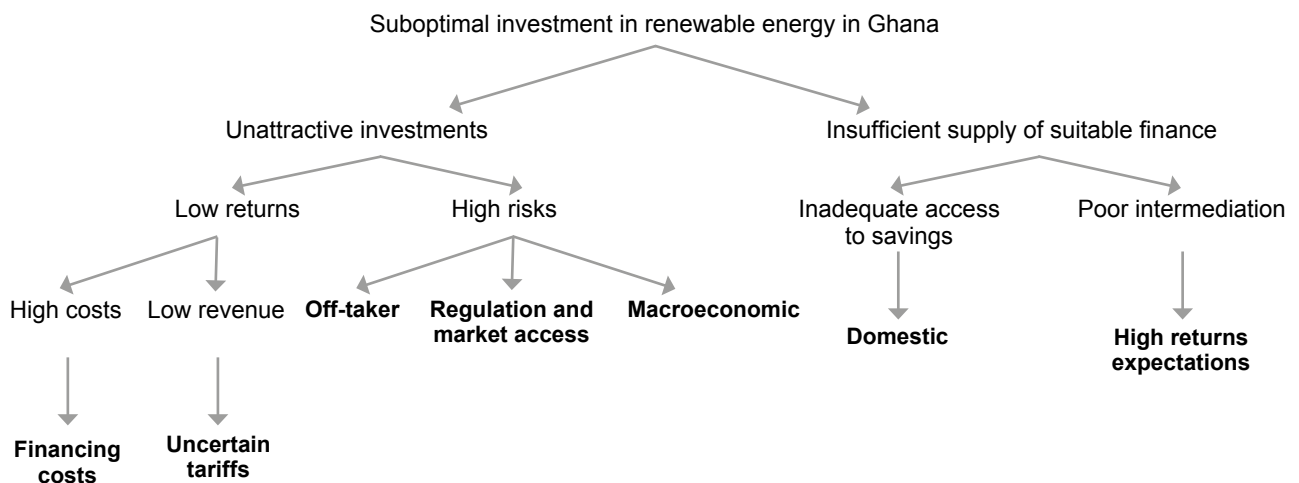
4.3 Narrowing down constraints and positing a syndrome

To summarise, we have examined potential investment constraints in Ghana from the perspective of the supply of finance and the relative attractiveness of particular projects. A number of possible constraints have been ruled out, but others have emerged as possible ‘binding’ constraints. These are highlighted in bold in Figure 4.1. As we can see, these arise in both branches of the decision tree: project attractiveness and access to finance. In the analysis, we include financing costs, which appear in the ‘project attractiveness’ side of our decision tree, as part of the financing constraints. This delivers a total of seven potentially binding constraints.

The next step of the analysis looks for further evidence to prioritise constraints through a number of tests adapted from the Growth Diagnostics framework. Specifically, we look at shadow prices, and at evidence that actors are trying to bypass identified constraints and that those actors less exposed to a particular constraint are more likely to survive and thrive. Shadow prices are only relevant for constraints that relate to the scarcity of a particular resource, such as domestic savings or good governance in the case of Ghana.

The evidence of the binding character of **domestic savings** is clear. As we have seen, Ghanaian banks and the government are willing to remunerate savings with high interest rates for deposits and bonds. We have also observed high foreign debt and a high current account deficit, much higher than in the rest of SSA or other LMI countries. This signals that Ghana has used up its access to foreign savings to the limit, given the lack of domestic savings. In the particular case of investments in electricity generation projects, all IPPs are fully financed internationally (except for the first IPP in the country, Tadoradi 2, which was structured as a joint venture with 10 per cent participation of the national utility VRA). There is a significant influx of Chinese capital in Ghanaian IPPs, with more than 30 per cent of IPP capacity relying on Chinese investment. There is also a significant share of United States’ equity investors. Publicly owned plants are financed internationally, with concessional loans from international development agencies as well as from commercial lenders (VRA 2014). Another symptom of the

Figure 4.1 Ghana’s constraints decision tree



Source: Authors’ own.

constraining character of insufficient savings is that power plants with low upfront costs but high operational costs, hence less vulnerable to high financing costs, are more likely to thrive. Such is the case of the recently commissioned oil and gas power barges, which are extremely expensive to run but cheap to build.

There is also clear evidence of **problems of intermediation**, from the wide spread between deposits and lending rates, the evidence of a more risky environment (with more defaults than in similar countries), and a tendency to provide short-term finance with high returns expectations.

Macroeconomic and off-taker risks are partly related. They reflect the government's accumulation of obligations that it cannot meet, either increasing foreign debt to unsustainable levels, or selling electricity for less than it costs. External imbalances have translated into rapid currency depreciation that damages the returns for investors. On the other side, imbalances at the level of the off-taker put electricity generators on the brink of bankruptcy. For example, the national generation utility VRA is currently struggling to raise finance for new projects due to its poor financial health, caused by low tariffs and the poor payment record of ECG (VRA 2014).

Constraints related to the creditworthiness of the off-taker have been addressed in the past through mitigation instruments such as sovereign guarantees and PRG, but these are getting harder to obtain, as we have seen. Another way of bypassing off-taker risks is selling directly to consumers. This has long been allowed in theory but until recently all domestic generation was sold to the national distribution companies and surpluses were exported (Kapika and Eberhard 2013). VRA has prevented direct contracts between generators and consumers in the past (Malgas and Eberhard 2011).⁵⁰ However, distributed (or embedded) generation is rising in Ghana (EC 2016a). For example, a new private 30MW dual fuel coal power plant started direct power supply to the mining industry in 2016 and a 5MW LPG-fired (liquefied petroleum gas) power plant supplies electricity to industrial customers in Tema. The plant uses diesel-generating sets and is wholly owned by Ghanaian investors. There are also several biomass power plants that do not feed their power to the grid (IRENA 2015b) and the use of generators for self-supply is pervasive in Ghana. Fifty-two per cent of firms own a generator, a much larger percentage than in the rest of SSA (World Bank 2013b).

The accumulation of unsustainable obligations is also related to **corruption and patronage**, which were highlighted as another potentially binding constraint. **Low prices** also reflect the use of public services to win political support. There is an understanding of electricity as public service and a desire to provide universal access to electricity, even for those that cannot afford it. Ghana's electrification model based on geographically equitable coverage has in fact achieved higher access rates than any other country in SSA except South Africa (IEG 2008).

A clear symptom of **regulatory problems** is, as we have seen, the large number of projects awaiting permits to get built and start operations. As evidenced by the solar PV plant BXC, even when finance is readily available, and construction is speedy, it is extremely difficult for renewable energy projects to start commercial

50 www.gasandoil.com/news/1998/03/cna81072

operations. At the moment of finalising this research, the plant was still carrying tests to obtain an operational licence, even though it has been built since October 2015.⁵¹ The Energy Commission has indicated that one of the major problems that limit the operation of the plant is that 'it cannot inject power to the grid when there is a problem of curtailment' (EC 2016a: 4).

The government is reluctant to fast-track renewables. However, it is much more ready to take risks when it comes to fossil fuel plants. Karpowership and Ameri oil and gas emergency plants got their required licences and started operation in record time as the government facilitated their deployment on a fast-track basis. Besides, the Ameri gas power plant benefits from a take-or-pay clause in its PPA, which imposes a heavy cost for the Ghanaian economy when gas supply is interrupted.

Our interviewees point at regulators' lack of expertise in renewables and misinformation with regard to their cost. One of our informants explained that 'the Minister's approach to energy security is fossil fuels. He thinks we should buy coal and bring oil and gas power barges, but does not realise that imported fossil fuels will drive up costs and insecurity'.⁵² Even though gas will be a key part of Ghana's power sector improvement, at the moment gas supply shortages are very costly as the government is tied to payments to generators through take-or-pay clauses even when they cannot produce. Oil-based generators have so far enjoyed low oil prices, but the government has signed ten-year contracts with them, and the price of oil is likely to rise over that period.

We are unable to single out a single constraint as being the most binding, because all the identified constraints are highly interrelated and show symptoms to back them up. We find, however, many indications of a syndrome that comprehends the malaise of renewable electricity in Ghana. We call this the **syndrome of the over-borrowing state**. The Ghanaian government has assumed a number of commitments that it is unable to meet with its own resources: for example affordable electricity tariffs, high rates of rural electrification and cheap fossil fuels. The Ghanaian state is also prone to patronage, increasing civil servant salaries or providing benefits to gain political support. These tendencies were exacerbated by the fall of commodity prices in recent years, which forced the government to borrow heavily from international markets and eventually led to a bailout by the IMF in 2015. To sustain its high fiscal deficit, the government offers higher bond rates than the private returns to investment in the real economy, hence crowding out private financial markets. The new government has made promises that might put the power sector under further stress, such as an aggressive industrialisation and universal electrification.

51 <http://bxcghana.com/index.php/building-of-40-megawatts-solar-energy-plant-at-mangoadze/> (accessed 6 October 2016).

52 Interview ACEP, 2015.

5 Green Investment Diagnostics – Kenya

Section 2 showed that Kenya has been able to attract investment in renewable energy, mainly large-scale geothermal and wind. However, access levels remain small and there are threats to the stability of the system as a result of technological choices made for capacity expansion. Our diagnosis will look at both the factors behind success to attract investment in some technologies, and the remaining constraints that prevent investment in a more flexible and inclusive electricity system.

5.1 Are renewable energy projects attractive?

Our previous research on costs and returns of utility-scale hydro, solar PV, wind and geothermal power in Kenya showed very healthy returns on equity (ROE) for geothermal power at a FiT of 8.8 USD cents per kWh (Pueyo *et al.* 2016). The ROE for geothermal could reach 30 per cent at the low costs of debt (3 per cent) enjoyed by publicly owned plants and 17 per cent at higher debt interest rates around 8 per cent (*ibid.*). However, none of the existing geothermal plants have used FiT and hence we cannot assume that they benefit from such prices. On the other hand, private investors would be unlikely to access finance as cheap as the Kenyan public geothermal plants did. Therefore actual returns of plants in the past may have been lower than our estimates, but very high returns are feasible under FiT prices and low cost of debt.

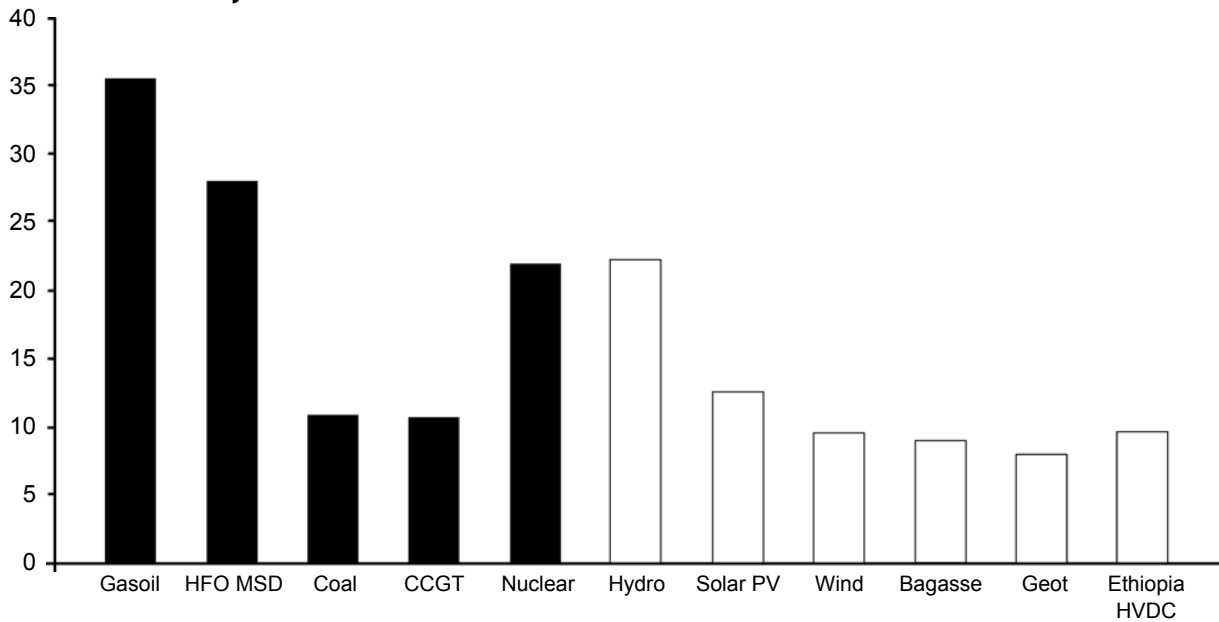
Wind power plants can also deliver high returns of between 14 and 20 per cent depending on access to concessional finance, at a FiT of 11 USD cents per kWh. Solar PV and hydropower offer modest returns of between 5 and 9 per cent depending on the cost of finance, at FiT of 12 USD cents per kWh for solar PV and 8.2 USD cents per kWh for hydro (*ibid.*).

Expected returns for wind and geothermal power are very competitive with other investment alternatives in Kenya. For example, treasury bills pay nominal rates of 8.8 per cent as per December 2015 and equity investors require returns of between 16 and 20 per cent (*ibid.*). Solar PV would require higher FiT, close to 18 USD cents per kWh to deliver competitive returns. Low FiT for hydropower also means that only the projects with the best resource and lower investment cost are financially viable.

Privately owned mini-grids would typically require a 20 per cent return on equity investment in Kenya (Pueyo 2015; Carbon Africa *et al.* 2015). A study of the potential of mini-grids in Kenya indicates that tariffs required for cost recovery given this level of required return would only be affordable to around 5–10 per cent of the rural population (Carbon Africa *et al.* 2015). Although the government has approved a FiT for off-grid solar PV, at 20 USD cents per kWh it is insufficient to cover the costs of private off-grid generators (Ministry of Energy 2012).

Lower return on equity requirements could therefore increase the size of the viable market for mini-grids. This could be achieved through, for example, capital subsidies, community ownership, or further public participation through the Rural

Figure 5.1 Levelised cost of energy at 10 per cent discount rate for several generation candidates in Kenya



Note: LCOE for coal, hydro and wind estimated as an average of different plants.

Source: Author's own with data from Lahmeyer International (2016).

Electrification Authority (REA) or Kenya Power. On the other hand, subsidised tariffs could improve affordability for consumers but risk creating long-term financial dependence.

Returns of geothermal and wind are therefore considered very attractive when compared to alternatives in the global investment market, as presented in Table 4.1 included as part of Section 4.1 about project attractiveness in Ghana. However, returns of utility-scale solar PV are still not high enough as compared to potential alternatives.

Costs

Our previous work on cost and returns of renewables shows that grid-connected geothermal and wind power offer least cost, affordable electricity in Kenya. Using a social discount rate of 10 per cent, we estimated a LCOE of geothermal power of 7.3 USD cents per kWh. Geothermal plants in Kenya have actually been able to obtain much cheaper finance from development banks and donors, enabling a LCOE of 5 USD per kWh or lower. The LCOE of a generic wind power plant using a 10 per cent discount rate is 10.3 USD cents per kWh. However, sites with exceptional wind resources, such as that of Lake Turkana Wind Power Project (LTWP), can reach a LCOE of 7.5 USD cents per kWh. In our previous study of costs, we estimated a LCOE of 14.8 USD cents per kWh for solar PV using a 10 per cent discount rate, but the latest generation expansion plan suggest a lower cost of 12.54 USD cents per kWh (Lahmeyer International 2016).

Figure 5.1 shows the LCOE for different generation alternatives in Kenya using a 10 per cent social discount rate, as presented in the most recent generation expansion plan. Wind, bagasse cogeneration and geothermal power are clearly competitive with

fossil fuel alternatives.⁵³ Also, because renewables are able to attract least cost finance from development banks, the competitiveness gap may be wider than depicted.

Even if project costs are competitive, however, system costs could be an important constraint for the further penetration of renewables in Kenya. The fast introduction of a large share of wind power in a single location, as will happen with the 300MW LTWP, could destabilise the system as it will not allow the grid manager to learn gradually how to integrate intermittent renewables. Flexibility could be provided by hydropower, pumped storage, natural gas and diesel engines, or by flexible interconnections with neighbouring countries. Planned interconnections with Ethiopia do not introduce much flexibility, however, because they commit Kenya to purchase a fixed amount of electricity (Lahmeyer International 2016).

With regard to transmission costs, the standardised PPAs published by the Energy Regulatory Commission (ERC) require the seller of electricity to cover the 'shallow' connection cost (the required infrastructure as far as the existing network). Because the national transmission and distribution network does not cover a large share of the country, costs to the existing network could be very high in many locations. New transmission lines are covered by KETRACO, but there can be considerable delays in their implementation, which could add to the costs of renewable energy projects. Appendix B includes further indicators of system costs in Kenya.

Unsubsidised mini-grids are not affordable for most of the population. Their cost is significantly higher than that of electricity from the grid, at a LCOE of between 65 and 80 USD cents per kWh. This assumes a 6 per cent cost for concessional debt and a 20 per cent cost of equity (Carbon Africa *et al.* 2015).

In summary, electricity from renewable energy sources is cost competitive in Kenya. However, the variable generation from wind and solar resources could significantly increase system costs, if it is not properly planned.

Revenues

We look at four elements of revenues for a renewable energy project: demand, price, quality of the renewable energy resource and risk of curtailment.

Healthy returns are only possible when there is enough demand for the electricity generated. This is particularly problematic for intermittent generation like wind, which sometimes produces power when demand is low, such as in the middle of the night. Intermittent generators thus need to be able to sell the electricity they produce to be financially viable. To ensure this, financiers often require a take-or-pay clause in wind power PPAs that commits the off-taker to purchase all their power or otherwise pay for it. The risk of curtailment is an important constraint for intermittent generators but take-or-pay clauses to mitigate it can be very onerous for the off-taker. Such concerns drove the World Bank to withdraw guarantees it had agreed to provide to the large 300MW LTWP currently under construction in North Kenya. The Bank deemed that low demand, lack of experience of the grid operator to manage such a large share of wind power

53 Bagasse is dry pulpy residue left after the extraction of juice from sugar cane. Bagasse is utilised as a biofuel for cogeneration of heat and power and for the manufacture of pulp and building materials.

concentrated in a single site, and constraints in transmission capacity could expose Kenya Power to unacceptably large financial risks (*Business Daily Africa* 2012).

Several indicators show that demand in Kenya is growing more rapidly than in the rest of Sub-Saharan African countries, and LMI countries as a whole. However, growth is still below the very optimistic 10 per cent aspiration of Kenya's Vision 2030 strategy which guided much of the country's generation expansion plans. This high level of growth is considered unrealistic in the most recent power generation and transmission plan (Lahmeyer International 2016).

More broadly, economic growth in Kenya is very volatile, which makes it harder to predict energy demand. A high poverty incidence and low income per capita indicate a low ability to pay for electricity at the household level. External demand is small at the moment. Although there are interconnections with Uganda and Tanzania via 132Kv transmission lines, international trade is minimal.

We consider that there is a risk of curtailment of intermittent renewable energy in Kenya at the moment due to low demand, low transmission capacity and low external trade. However, there are plans to increase interconnections with other countries as well as transmission capacity, which may mitigate this risk.⁵⁴

The small size of Kenya's demand was highlighted by our interviewees as a particular problem for intermittent generators.⁵⁵ Poverty rates in Kenya are higher than in SSA as a whole and demand in rural areas is particularly small, which makes it financially unviable to extend the grid.

Productive uses are very small, and most people do not have energy-intensive appliances in their homes. Electricity is primarily used to charge mobile phones, which does not allow the recovery of generation, transmission and distribution costs.

(Director of Quality and Environment, EPC contractor)

For off-grid alternatives, some approaches to reduce the risk of low demand are modular mini-grids, which can grow as demand builds up; hybrid mini-grids that can use diesel generation to provide power during peak hours or demand management approaches which distribute the load over the day to avoid overcapacity.

Electricity tariffs in Kenya are set by the ERC. Kenya has made a significant effort to design cost-reflective tariffs that enable all the operators in the electricity system to maintain their financial integrity, attract capital, operate efficiently and fully compensate investors for the risks assumed (ERC 2010). This has met some opposition from large industrial consumers, which represent a small share of connections but more than 70 per cent of the total consumption. These actors argue that Kenya's electricity tariffs are significantly higher than in other regions, damaging their competitiveness, and exert strong pressure on the government to reduce tariffs to a more competitive level.

Tariffs comprise of a fixed charge, a demand charge and an energy charge. The fixed charge is set to recover the customer-related costs of metering, meter reading,

54 For example, the planned use of the interconnection with Uganda to transmit power to Rwanda would increase external demand (Lahmeyer International 2016).

55 Interview with Project Manager, Aldwych International and Director of Research and Policy, KBA, 2015.

inspection, maintenance billing and customer accounting. These charges remain constant but vary with the customer category, being higher for larger consumers. The demand charge recovers the costs associated with the transmission and distribution network. It is derived directly from the long run marginal cost related to the transmission and distribution network. Domestic consumers and the smallest commercial consumers are not required to pay a demand charge and hence transmission and distribution costs are fully covered by the industry. They remain constant but are smaller for larger consumers. The energy charge per kWh is set on the long run marginal cost of electricity and is progressive for residential consumers, with the lowest consumers paying less than wealthier, more intensive consumers.

Commercial and industrial tariffs work the other way, with the largest consumers paying less per kWh. Energy charges for commercial consumers are lower than those for residential consumers, but commercial consumers are subject to higher monthly fixed charges and demand charges.

A key feature of Kenya's tariff schedule is the automatic monthly pass-through of generation fuel costs and exchange rate fluctuations through fuel cost charges and the foreign exchange rates fluctuation adjustment, as well as inflation adjustments every six months. Additionally, consumers pay a water levy for the use of hydro resources at 5 UDS\$ cents per kWh, an Energy Regulatory Commission levy at 3 cents per kWh, Rural Electrification Programme Levy at 5 per cent of the base rate and VAT at 16 per cent on everything except the water levy, the regulator and rural electrification levies and inflation adjustment (ERC 2013).

Kenya has approved FiT to promote investment in renewable energy generation. The policy was first published in 2008, and has since been revised twice to include additional technologies, and change capacity limits and tariffs when they were not deemed attractive enough for investors. The last revision was in December 2012.

The main elements of the FiT are guaranteed tariffs, a connection obligation for the transmission company and a purchase obligation for the off-taker. The FiT includes an allowance for interconnection costs, which must be borne by the developer. The off-taker must guarantee priority purchase, transmission and distribution for small renewable energy projects and comply with the terms of a negotiated PPA for large-scale renewable energy projects. The off-taker can pass through the costs of the FiT to the final consumer (Ministry of Energy 2012).

FiT are denominated in USD or other selected foreign currency and guaranteed for 20 years. They have a fixed value and an indexed component related to OandM costs, which are the only costs that will vary during the 20-year guaranteed period. Because retail tariffs are set at cost recovery levels, they are not much lower than the FiT.

Only renewable energy projects below a maximum cumulative capacity can benefit from FiT, whereas larger generators must seek direct negotiation with the off-taker Kenya Power. In the short term, it is expected that Kenya will approve a competitive bidding scheme for these larger generators.⁵⁶ Capacity limits for FiT are 50MW for wind, 40MW for solar PV and biomass, 70MW for geothermal and 20MW for hydro. Larger projects need to negotiate their PPAs and related tariffs

56 Discussions with Mott MacDonald, technical advisor to the Kenyan government, December 2015.

directly with Kenya Power. Small renewable energy projects, with capacities under 10MW, benefit from a technology-neutral, standardised PPA and they are approved on a first-come, first-served basis. Projects larger than 10MW have to negotiate with Kenya Power some of the clauses of the PPA.

The third element for revenue generation are renewable energy resources. Kenya enjoys very rich renewable energy resources, hence renewable energy projects benefit from high capacity factors. Certain regions (such as Marsabit, Turkana, Ngong and the coastal region) enjoy world class wind resources, with average speeds ranging from 8–14m/s, allowing for capacity factors above 40 per cent (Kiplagat, Wang and Li 2011). The LTWP, in particular, claims a capacity factor of 62 per cent in corporate presentations (Aldwych International 2014). Kenya's solar resource is also vast and geothermal resources, located in the volcanic centres around the Rift Valley are unique in Africa.

In summary, whereas renewable energy resources are world class and prices are about right, a small demand and the risk of curtailment could pose some challenges for revenue generation by large-scale renewable energy plants in Kenya.

Having analysed the returns of renewable energy in Kenya, we continue the assessment of project attractiveness by looking at the associated risks, starting with regulatory risk.

Regulatory risks

Responsibilities for planning, procurement, contracting and permitting of power generation capacity in Kenya are generally well defined and efficient. As a result, Kenya has been one of the most successful countries in SSA in attracting IPPs (Eberhard *et al.* 2016). The Kenyan energy sector was restructured after 1996 from a state monopoly towards unbundling of generation, transmission and distribution responsibilities, introduction of IPPs, and private participation in state-owned utilities. The energy policy of 2004 created a new independent regulator for the energy sector: the Energy Regulatory Commission (ERC). Its functions include planning, at the front-end of the procurement process, and permitting at the back-end, as well as tariff setting and oversight, monitoring and enforcement of sector regulations (Ministry of Energy and Petroleum 2014).

Planning processes in Kenya are considered generally good. They are updated regularly to respond to changes in decision parameters; are based on solid analysis from independent technical advisors; and are linked to procurement processes. However, they also have important weaknesses. Until recently, for example, demand forecasts were based on unrealistically fast growth expectations (Lahmeyer International 2016). Consequently, expansion plans focused on large-scale generation infrastructure, including coal, gas and wind.

Another issue is that plans have failed to address the challenges posed by increasing shares of intermittent generation capacity. As a result, there have been significant delays in the implementation of several committed projects, particularly those developed by the private sector. Only LTWP, among four committed wind power plants featured in the 2011 Least Cost Power Development Plan (LCPDP) had started construction in 2016, for example. The most recent plan still includes

four committed wind power plants for a total of 210MW to be commissioned in 2017 and 2018, in addition to LTWP. Besides, one large 980MW coal power plant would be commissioned between 2020 and 2022.

Planning for rural electrification is the responsibility of the Rural Electrification Authority (REA), established by the Energy Act of 2006. While we could not find a rural electrification master plan on the websites of the REA or any other institution, Kenya Power contracted an international engineering firm to prepare a Distribution Master Plan that forecasts electricity demand for all Kenyan counties and identifies the distribution infrastructure required (Parsons Brinckerhoff 2013).

The Distribution Master Plan acknowledges several limitations. Firstly, information about the coverage of the national grid and the implementation of private mini-grids is very limited, even for the consultants preparing the plan. The capacity of mini-grids is growing in Kenya as more donors and private investors become interested in decentralised alternatives to electrification, but there is not an integrated on- and off-grid approach to planning. This creates uncertainty, not only for the planners but also for private sector developers looking to invest in off-grid solutions.

Another weakness of current planning approaches is that demand forecasts are too top-down, based on aspirations rather than objective expectations (for example, for GDP growth, population growth rates, urbanisation, electrification targets and consumption). There appears to be significant scope to improve demand forecasts through bottom-up approaches that integrate network planning with demographic data (for example, on income level and location) using geographic information systems (Chattopadhyay *et al.* 2014).

Finally, there is no learning from previous electrification programmes, with regard to connection rates and consumption growth after connection.

A representative from an international EPC contractor with operations in the Kenyan electricity sector offered the following perspective about the weaknesses of the planning processes:

Planning is the single most important aspect that needs to be addressed to improve the prospects of RE investment in Kenya. There has to be a clearer perspective from the government. If the priority is industrialisation, then they have to build large-scale infrastructure. If the priority is to extend access, then they need to combine off-grid and on-grid infrastructure. A good distribution network is what determines the prosperity of a country. Having all the generation infrastructure connected provides reliability and supports growth.
(Director of Quality and Environment, International EPC contractor)

We now describe issues related to procurement. Responsibilities for procurement are not explicitly defined, but typically when Kengen is unable to finance the new investments required in the expansion plan, the private sector is invited to participate. Kenya Power, the distribution utility and grid operator, is usually in charge of opening competitive bidding processes to select the best private supplier. Kenya has a strong track record of procurement through international competitive bids run by Kenya Power. Up to seven IPPs have been procured this way since 1996. As a consequence, Kenya Power has accumulated considerable capabilities and bidders have been reassured of a trustworthy system, which

reflects in an increase in interested bidders in the most recent rounds. However, there have been a few cases when procurement has been handled by the government directly or when Kengen, the national power generation utility, has been appointed by the government to procure new plants. There have also been some instances where the government has considered unsolicited bids, most notably in the case of the large LTWP (Eberhard *et al.* 2016).

Generators feeding to the grid must sell their electricity to Kenya Power, which is therefore in charge of contracting through PPAs. PPAs stipulate the price, technical specifications, risk allocation, rights and obligations of the parties. The ERC needs to approve the PPA before it can be signed by the parties, taking into account the fairness of consumer and capacity prices and the amount of energy provided. IPPs must obtain a number of permits and clearances from different institutions before their PPAs are approved and they are granted an Electricity Generation licence.

The ERC has developed a renewable energy portal to guide investors through permitting processes.⁵⁷ The portal clearly shows the number and sequence of permits required to build and operate a renewable generation plant, the institutions responsible for each permit, the amount of time each clearance should take and the application fee, when applicable. All developers of plants connected to the grid would need to obtain seven permits and approvals.⁵⁸ Off-grid plants larger than 1MW need the same number of permits, but if they are not benefiting from a FiT scheme they do not need to agree a PPA with Kenya Power.

The Kenyan government introduced a FiT scheme in 2008 to promote private investment in renewable energy, as described in the 'Revenues' subsection previously. The scheme has, however, not been very successful in leading to operational projects. There is a long pipeline of unsolicited projects under the FiT scheme undergoing PPA negotiations, including more than 500MW of solar PV power, distributed amongst 15 projects and 550MW of wind power distributed amongst 13 projects (Lahmeyer International 2016). Several projects have approved PPAs through the FiT scheme, including three large wind farms, one biomass cogeneration plant and 21 small hydropower projects for an overall capacity of 89MW. At the time of writing, only the biomass plant was operational and using a FiT. The large LTWP is outside the capacity cap set for projects using FiT and was initiated as an unsolicited bid negotiated directly with the Government of Kenya. The private geothermal plant Orpower was initially awarded through a competitive bid and subsequently extended in direct negotiations with Kenya Power (Eberhard *et al.* 2016). The fact that the FiT policy has hardly been used raises questions about its usefulness, especially considering the good track record that Kenya already had

57 www.renewableenergy.go.ke/.

58 The following permits are required in Kenya to operate a renewable energy plant: (1) Approval of an Expression of Interest and Detailed Feasibility Study – granted by the Ministry of Energy and Petroleum; (2) Environmental Impact Assessment – granted by the National Environment Management Authority; (3) Approval of Change of User – granted by the County Authority to control land use and development; (4) Power Purchase Agreement – agreed with Kenya Power. The PPA can be either capacity based or FiT based. Standardised PPAs are available on the ERC website; (5) Approval of PPA – provided by ERC, to guarantee fairness of prices and the quantity of electricity provided; (6) Electricity Generation, Distribution and (or) Supply licence – granted by ERC when there is compliance with the Energy Act and Electricity Licensing Regulations; and (7) Development permit – granted by the county government to ensure safety of buildings and control planning.

with competitive bids. The government has therefore manifested a preference for the competitive procurement of large renewable energy projects and has contracted an international consultancy to design renewable energy auctions.⁵⁹

Existing private mini-grids in Kenya are smaller than 1MW, but there is not a clear regulatory framework for such small plants outside the national grid. While this provides freedom for developers to locate where they want and charge the fees they need, it also increases uncertainty (ECA *et al.* 2014). Private developers of mini-grids would benefit from regulation that provides certainty to their business model when the grid reaches their site, for example through concessions or private delivery models working jointly with the grid (for example, mini-grid developers are required to use grid-compatible systems that provide grid stability support or help with densification of connections or increasing new connections).

With regard to market access, even though Kengen dominates the generation market, with more than 72 per cent of assets, public and private procurement is seen as complementary, not competitive. Private sector players have been more successful in developing fossil fuel-based plants and cogeneration, while Kengen dominates hydro and geothermal power generation.

In summary, the main regulatory constraints in the Kenyan system come from planning processes that have overestimated demand and so far have not integrated on- and off-grid generation alternatives; a large number of unsolicited renewable energy proposals; and uncertain regulation for private mini-grids.

Off-taker risks

Kenya Power is the off-taker in Kenya's electricity system. It owns and operates most of the transmission and distribution system in the country and is also in charge of retailing. It is partially privatised, but the government holds a majority stake. Kenya Power has a good track record in paying private electricity suppliers and honouring PPAs. The company has been profitable since 2004, after emerging from a period of sustained loss-making.

The operating income or EBIT has been positive for over a decade and the EBIT margin, at 12 per cent in 2015, is at the level of the median observed for electricity and gas retailers in OECD countries. There is sufficient liquidity, with current assets higher than current liabilities at a 60 per cent ratio, and cash and cash deposits accounting for 91 per cent of accounts payable.

The financial structure is solid with short-term debt representing a small share of equity and long-term debt. The company has well-established credit control procedures to ensure payment by customers and has installed a large amount of prepaid and automatic meters to minimise the risk of non-collection.

Kenya Power is therefore a creditworthy off-taker that does not pose major constraints to investment in the Kenyan electricity sector. However, there is concern about how the financial strength of Kenya Power will be affected by the overcapacity that could result from recently signed PPAs (Eberhard *et al.* 2016).

59 Discussions with Mott MacDonald, technical advisor to the Kenyan government, December 2015.

Resources and technology

Kenya enjoys vast renewable energy resources. There is a potential for 8,000–12,000MW of geothermal power, or more than four times the current capacity of the Kenyan electricity system. Geothermal resources are assessed by the state-owned Geothermal Development Corporation (GDC). GDC announced in 2015 a new specific master plan for geothermal development, co-funded with the Japanese International Development Agency (JICA) that will provide the most recent status of geothermal resource potential in Kenya.

Hydropower potential is assessed in the National Water Resources Management Strategy (NWRMS). Even though hydro has been used extensively in Kenya, there is still substantial potential, as reflected by current plans to develop a large project for over 800MW of capacity.

High-level wind and solar PV energy resource assessments were carried out in 2008, with more recent assessments in 2013 also showing a large potential of about 4,600MW for wind. More detailed resource assessments are required for biomass, as there are no specific surveys of agro residues for energy use.

The reliability of geothermal and biomass resources could be a constraint for their further development, however. GDC, which holds steam mining rights in Kenya, for example, has not been able to source as much steam as required, and its perceived technical and financial weakness could prevent private investment. Recent geothermal projects at the Menengai site, for example, required PRG from the African Development Bank to cover the steam supply risk and the risk of payment default by Kenya Power (Eberhard *et al.* 2016). Biomass resource supply has also been problematic in the sugar industry.⁶⁰

With regard to capabilities in the country, statistics show a lower level of tertiary education than would be expected for a middle-income country. The Competitive Industrial Performance Index is also low, with Kenya ranked 108th among 140 countries globally and in the ninth position among 25 Sub-Saharan African countries. This lack of local skills increases the cost of projects, as they must rely on external staff, and may prevent technology transfer.⁶¹

A lack of infrastructure (mainly roads and transmission lines) also increases costs and risks for more geographically remote projects.⁶² Transmission and distribution networks are weak. The latest power generation and transmission master plan highlights the need for considerable expansion, reinforcement and rehabilitation measures to allow the stable transport of energy from power plants to load centres (Lahmeyer International 2016). Besides, the grid code provides limited operational rules for managing variable renewable energy and there are no clear rules defining the share of curtailment costs and wheeling charges of transmission and distribution networks (World Bank 2014).

In summary, Kenya faces resource supply risks for geothermal and biomass, a low level of local skills and a lack of transmission and distribution infrastructure, which can increase project costs or delay construction.

60 Interview with Andrew Barnett, the Policy Practice.

61 Interview with the Director of QandE, International EPC contractor, 2015.

62 Interview with Project Manager, Aldwych International, 2015.

Macroeconomic risk

Kenya's macroeconomic indicators are stable in comparison to other SSA countries. Currency devaluation is moderate with a 13 per cent devaluation of the KSh against the USD since 2011, and year-on-year inflation of 6.6 per cent in December 2015 (Central Bank of Kenya 2015).

Kenya's current account balance has been significantly in deficit since 2004, however, as a consequence of a fast growth in imports of machinery and transport equipment, manufactured goods and oil. Exports are concentrated in a small basket of agricultural products, mainly tea, coffee and horticulture. Recent low oil prices have allowed the current account deficit to contract from 10.4 per cent of GDP in 2014 to 7.1 per cent of GDP in 2015, but falling global tea prices and a fall in tourism revenues as a result of terror threats have introduced new pressures. The government's fiscal deficit is also relatively high.

Social and reputational risk

Several renewable energy generation projects have experienced distress as a consequence of disputes with local communities. These include the geothermal plant Olkaria IV and the wind power plants Kinangop and LTWP.

The development of geothermal fields in the Naivasha area, where Olkaria IV is located, triggered a long-term land conflict, complaints to the European Investment Bank (EIB) and World Bank, and a court dispute. A section of the Maasai tribe raised concerns in 2014 about increased impoverishment, intra-community disputes, health concerns and stress. Local dwellers had several complaints about the resettlement plan, including: increased transportation cost to their cultural centre; the construction of fewer houses than promised; compensations only given to some households; and impact on sacred and cultural sites in Hells Gate National Park.⁶³ Kengen incurred resettlement costs of over KSh850 million (USD9.3 million) to satisfy local communities.

The 60MW Kinangop Wind Farm, in Kajjado, which would have been Kenya's first FiT project, was halted in 2015 after a series of protests and hostilities from the local community. Kinangop had already reached financial close and was ready to start construction, but increasing compensation requests from landowners ignited a conflict with developers which could not be resolved.⁶⁴

The 300MW LTWP has started construction but is facing a court case about illegal land acquisition brought forward by local communities. On the other hand, the LTWP consortium claims that local host communities are in full support of the project and do not feel the plaintiffs represent them.⁶⁵

Several interviewees raised social opposition as an important risk to their projects. They considered that while some local tribes have legitimate claims, many others

63 <https://communitylegalresources.wordpress.com/2015/05/22/maasai-issues-regarding-olkaria-iv-geothermal-power-generation-project/>.

64 Interview with QandE Director, EPC Contractor, 2015.

65 Interview with Project Manager, Aldwych International, 2015.

seek illegitimate payouts and it is difficult to distinguish one from the other. There is a lot of uncertainty about the acceptable distance between wind generators and communities, as there is no specific legislation about it. There is also uncertainty about how to secure land and way leaves. The interviewed EPC contractor estimates that there is a much smaller risk of conflict with local land users when projects are developed by the government or local investors, which is why they prefer to work on local projects or those that are not 100 per cent private.

Community issues are a major problem in Kenya. They can kill a project. Protests scare investors and they are a massive reputational issue. This was particularly a problem for the transmission line of more than 400km.
(Project Manager, Aldwych International, 2015)

Communities see it as the opportunity of a lifetime to get a payoff. Resettlements are a big issue and we have to budget for it... Negotiations have to be fast. Otherwise it becomes a snowball as the news spreads and more and more actors seek a payout.
(Director of Quality and Environment, International EPC contractor, 2015)

The main barriers to investment are associated to the sociopolitical challenges linked to securing land and way leaves.
(Chairman, KERECA, 2015)

Behind these conflicts there is the issue of unclear land property rights in Kenya and unclear social consultation guidelines that can provide certainty to both developers and affected communities. Besides, there are issues of unbalanced costs and benefits from large power generation infrastructure for rural communities, when these projects feed power directly to the transmission grid leaving local communities unconnected.

Kenya has a poor record of human and labour rights, according to the empowerment rights index developed by CIRI, where it scores four out of a maximum value of 14. The index looks at the government performance for seven rights: foreign movement, domestic movement, freedom of speech, freedom of assembly and association, workers' rights, electoral self-determination and freedom of religion (CIRI Human Rights Dataset 2016). Human Rights Watch denounces serious human rights violations by Kenyan security forces and widespread impunity at all levels of government. Security sector reforms, land reform and stronger accountability mechanisms have not been fully implemented.⁶⁶

Social and reputational risks therefore emerge as a significant constraint in Kenya, with the potential to block renewable energy investments. We finalise the analysis of risks by looking at governance in Kenya.

Governance risk

Kenya performs poorly in the Corruption Perception Index, where it ranks 139th among 167 countries. The percentage of firms that declare having to provide gifts to obtain construction permits or secure government contracts is higher

66 www.hrw.org/africa/kenya.

than in the SSA region as a whole. In contrast, Kenya's record with regard to the transparency, accountability and corruption of the public sector is better than in LMI countries of the SSA region as a whole, according to the CPIA index.

Corruption and political interference were mentioned as important constraints in our interviews. This is in spite of safeguards, such as the severe due diligences required by development banks as a requirement for financing, which require a paper trail for every expense. However, when projects are big enough, there is government support to avoid corruption.⁶⁷ There is a view that 'it is good to be on the side of the government for projects to be successful'.⁶⁸

Security levels are better than elsewhere in the SSA region when looking at rates of homicides, but terrorist violence has been on the rise since 2011.

To summarise, renewable energy projects in Kenya are attractive in terms of high potential returns and competitive costs. However, concerns arise from low levels of demand that are incompatible with the traditional approach to electrification through large-scale grid-connected generation projects; the risk of curtailment for intermittent generation; a deficit in transmission and distribution infrastructure; regulatory limitations with regard to planning and a large number of unsolicited proposals which may lead to a situation of overcapacity; low local skills and high social and reputational risks, and governance, linked to corruption and the government's interference.

5.2 Is appropriate finance available?

Even if returns of renewable energy projects in Kenya are potentially high, finance needs to be available for these projects to get built. The Kenyan financial sector is the third largest in SSA and has been resilient to domestic and foreign shocks in the last decade (World Bank 2015a). Access to finance is only considered as a major constraint to growth by 17 per cent of enterprises, as compared to 62 per cent of enterprises in Ghana, or 37 per cent in the SSA region (World Bank 2013c). In the analysis of financial constraints, we will first look at the supply of savings, and then at potential problems in the banking system.

Access to external savings does not seem to be a problem. Kenya has long been a preferred country by donors, with higher levels of ODA per capita and per GDP than its regional and income level peers. This is also the case with the electricity sector, where – unlike Ghana – Kenya has attracted far more ODA as a proportion of GDP than the average LMI country. This is just short of 1 per cent of GDP in Kenya, compared to 0.24 per cent and 0.21 per cent in low-income and middle-income countries respectively, and less than this in Ghana. Consequently, Kenya has been able to attract low-cost finance from international donors for the development of electricity generation infrastructure, mainly geothermal. For example, public geothermal plants Olkaria I and IV pay average interest rates of 1.05 per cent and 2.05 per cent for their debt, with average maturities of 23 years and 13.4 years and grace periods of between three and six years (Pueyo *et al.* 2016).

67 Interview with Project Manager, Aldwych International, 2015.

68 Director of Quality and Environment, International EPC contractor, 2015.

Kenya shows lower access to FDI inflows than its peers (see Table B14 in Appendix B). However, Kenya has been able to tap the global capital markets by issuing bonds to finance infrastructure projects and with a high participation of foreign investors in the Nairobi stock exchange.

In spite of its ability to attract foreign finance, the Kenyan financial system faces new challenges to raise long-term funding as it consolidates its middle-income status and fills its vast infrastructure gap (World Bank 2015a). Funding is also required for small-scale off-grid infrastructure which will be part of the solution to low connectivity among the rural population, but traditional bank and donor funding for infrastructure may bypass these smaller projects due to their high transaction costs. Financiers complain of a lack of bankable projects in Kenya that are large enough for long-term financing.⁶⁹

The situation is different with domestic finance, where there is a lack of savings and very few domestic equity providers.⁷⁰ Reliable local equity partners are important to attract foreign capital, as well as to ensure that there is a transfer of technology to the host country. Thus, Kenya's weakness in this area could provide a major constraint for the future development of the sector.

Despite these issues, Kenya has a relatively high level of stock market capitalisation compared to its peers, which may point to the importance of foreign capital and public investment for asset formation in the Kenyan market, and also suggests that even a relatively developed stock market is not generating the type of domestic equity investments needed to support renewable energy projects.

Low levels of income per capita may be behind the low observed domestic savings. Access to banking services in Kenya is very high – reflecting the growth of the mobile sector – and tax revenue collection is in line with other SSA countries (see tables of indicators in Appendix B).

In line with these findings, there was agreement among our interviewees that access to international finance is not a major problem in Kenya.

There is no shortage of finance. Not generally. Generally there is enough finance, with more and more equity investors pursuing the high returns of the African continent.

(Project Manager, Aldwych International)

The World Bank and the European Investment Bank are important sources of investment. International EPC contractors prefer to bid for projects financed by international banks, as they perceive a high risk of not being paid when projects are financed by local banks.⁷¹

Most respondents agreed that there is a positive bias towards renewables among international financial institutions, compared to fossil fuels.

69 Interview with Senior Investment Officer, African Development Bank, 2015.

70 Interviews with Director of Research and Policy, KBA; and country economist, African Development Bank, 2015.

71 Interview with Director of QandE, International EPC contractor, 2015.

It is much easier for renewable energy projects to raise finance than for fossil fuel projects... All the investors are interested in renewables and they can access different kinds of subsidies that the fossil fuel projects cannot get... The lending community is very biased towards renewables.
(Project Manager, Aldwych International)

Funding options for fossil fuels are limited compared to renewable energy.
(Director of Research and Policy, Kenya Bankers Association)

Interviewees also point at different financing models for fossil fuel-based or large hydro and renewable energy.

Renewable energy projects change hands very frequently. They are sold and acquired frequently. Large fossil fuel-based plants usually stay with the same owner for their whole life. Fossil fuel plants are often financed with the balance sheet of utilities. They don't need to look for investors. It could be the case that large utilities are not very competitive to finance and operate smaller renewables and this is better done by smaller investors.
(Director of Quality and Environment, International EPC contractor)

Interviewees pointed in particular at the difficulties of getting finance for coal power plants 'because they have very bad press',⁷² highlighting that 'only the Chinese are financing coal at the moment'.⁷³

However, there are advantages in financing fossil fuel-based generation.

There are a lot of diesel generators because they are very fast to install and individually have very low capital cost.
(Project Manager, Aldwych International)

Because of experience and familiarity, it is easier to structure, price and finance fossil fuels.
(Senior Investment Officer, African Development Bank)

We now look at the performance of the financial sector. Commercial bank lending rates were 16 per cent in December 2015 and treasury bill rates were 9 per cent. Interest rate spread in the banking sector is quite high, at 8.7 per cent but is comparable to the average spread for the SSA region. Bank concentration is significantly lower than in the SSA region and the LMI grouping. The Boone indicator also shows a higher level of competition between Kenyan banks than in other countries.

Kenyan banks are less efficient than those in LMI countries as a whole, but more efficient than those in SSA, measured by their overhead costs to total assets. A low percentage of non-performing loans to gross loans in comparison to Kenya's peers suggests the banking sector has been resilient to shocks and that risks are lower than in other countries. The system also shows the capacity to provide long-term funding, with high maturities of syndicated loans and external debt.

In summary, access to external finance and intermediation do not pose significant constraints to investment. If anything, there has been an excessive flow of

72 Interview with Director of QandE, International EPC contractor, 2015.

73 Interview with Project Manager, Aldwych International, 2015.

concessional finance to Kenya, in particular to geothermal energy – a profitable and least cost generation technology. Concessional finance could have targeted other priorities, such as much needed transmission and distribution infrastructure, technologies to add flexibility to the Kenyan electricity system, off-grid systems of remote rural communities, or less mature technologies such as wind and solar PV. However, a lack of domestic savings could be an obstacle to investment.

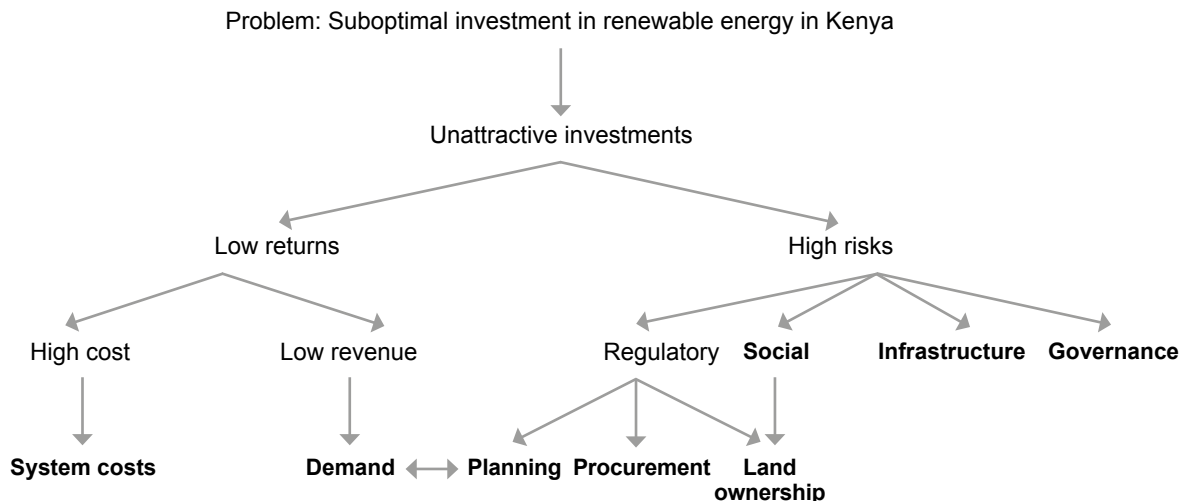
5.3 Narrowing down constraints and positing a syndrome

The decision tree analysis for Kenya has pointed at many positive developments in Kenya that facilitate investment in renewable energy. These were summarised by one of our interviewees:

Kenya is far ahead from the rest of Africa. They have a great track record. They have invested a lot in capacity building. They have got good advisors, strong political support and solid commercial relationships. I have a great opinion of Kenya Power. Their regulatory reform has worked. They are rapidly increasing electrification rates. The FiT are close to right. Solar could be higher. What reassures investors is to see that their competitors are being paid and are getting their investment back. That is why Kenya will go well.
(Project Manager, Aldwych International)

However, some constraints remain. These come mainly from the ‘project attractiveness’ branch of the decision tree. Although we identified a shortage of domestic savings on the finance side of the decision tree, in this section we could not find enough evidence of its binding character. The final constraints refer to: high system costs coming from a large share of intermittent renewables and poor transmission infrastructure; low demand due to low ability to pay of population without access, economic growth below projections and low international trade of electricity; regulatory constraints at the planning and procurement stages, and uncertain land ownership; social opposition linked to land disputes; infrastructure deficits and poor governance. These are highlighted in bold in Figure 5.2.

Figure 5.2 Kenya’s constraints decision tree



Source: Authors’ own.

As in the previous case study, the next step of the analysis looks for further evidence of the binding character of constraints through a number of tests adapted from the Growth Diagnostics framework. We look specifically at the behaviour of actors trying to bypass each constraint and at evidence that those actors less intense in a particular constraint are more likely to survive and thrive.

Firstly, evidence of binding constraints related to **system costs** comes from the behaviour of the off-taker and financiers. According to our interviewees, Kenya Power 'is not in a hurry' to agree more PPAs with wind power IPPs because they are unsure that the system will be able to cope with a larger share of wind power. Additionally, the World Bank withdrew support to the large LTWP on the basis of the high costs of a take-or-pay clause for Kenya Power given the high risks of curtailment, and the delays in completing the transmission line. The lack of system flexibility may therefore be an important constraint to further development of wind power plants. This could be addressed through interconnections with neighbouring countries that provide reserve power, management of hydropower resources, implementation of pumped storage in hydropower plants or diversification of renewable energy geographically and technologically. However, many of these solutions are expensive and the issue remains that the speed at which Kenya is trying to roll out wind is fundamentally difficult, and would be so in any country.

Agents have tried to bypass this constraint through strong political support. For example, the LTWP is considered as a flagship project for the whole of Africa and became a priority for both the Kenyan government and the African Development Bank. To reach financial closure, the project required several risk mitigation instruments, including: a take-or-pay clause in the PPA; Euro-denominated PPA; and a partial risk guarantee to cover the risk of completion of the transmission line and commercial risks.

Second, the explosion of solar lighting and solar PV home systems and the large number of individual firms that own diesel generators in Kenya (57 per cent of firms according to the World Bank Enterprise Surveys) refute the hypothesis of **low demand**. Instead, the grid extension business model has not been appropriate for poor rural consumers. Poor rural consumers cannot pay for the large upfront costs required to connect to the national grid, and their daily consumption is too low for the national utility to get back their investment on grid extension. Off-grid solutions are providing poor rural consumers with a basic service and are able to bypass the constraint of upfront investments through pay-as-you-go schemes. These allow consumers to pay for the electricity they use and eventually own individual systems after a certain amount of payments. Ownership can also remain in the providers of the systems, who would also be in charge of maintenance and replacement. In this model, the energy supplier becomes the financier of the consumer. It thus requires access to corporate finance or working capital, which is expensive and hard to get for small companies operating in risky markets. The fact that many enterprises are purchasing generators, which are much more expensive than electricity from the grid, also shows that low demand is not the only problem.

Constraints at the **planning stage** are evidenced by low electricity access rates in the country, in spite of sufficient capacity in the system. This shows that there has not been an effective rural electrification process in the past. Actors have bypassed this constraint by adopting off-grid systems beyond the national planning sphere.

However, new grid extension plans are constraining further investment in mini-grids, whose business model is jeopardised by the cheaper tariffs of the national grid. The coordination of off-grid and on-grid solutions in energy planning could further facilitate private investment in mini-grids. With regard to overrated expectations of economic growth, these may have led to overcapacity, which could become a future constraint to investment if it damages the financial sustainability of the off-taker.

A high number of unsolicited proposals for renewable energy generation point to constraints at the **procurement** stage. The government is taking action to address this by limiting the FiT to small-scale projects and implementing a competitive bidding scheme for larger renewables, following Kenya's previous successful experience with competitive bids for fossil fuels.

Several signals point at the severity of **social acceptance** constraints. The shadow price of social acceptance is high, as shown by the high cost of resettlement plans, compensations, and court cases in several projects. The cost of abandoning a project after financial closure and once equipment has been shipped to the project is also very high. Actors more able to deal with social acceptance issues – such as the state – are more likely to survive and thrive. Large hydro dams or geothermal projects requiring sensitive negotiations for land acquisition from local communities have been undertaken by the state, or the sites have been previously de-risked for the private sector. For example Orpower, the only operational IPP in Kenya, became feasible when the Government of Kenya donated some wellheads to the private developer (it also removed exploration risks from the private investor). Fossil fuel-based thermal projects with a quicker turnaround and relatively more flexible in their location, have been typically developed by the private sector. This may also be related to lower vulnerability to financing costs.

Expansion of **transmission infrastructure** is required so that the power generated in new plants can be transported to the load centres. The Treasury must give approval for new transmission lines and projects are mainly funded with development aid. Transmission infrastructure requires patient capital from investors but often this is allocated to other development priorities. A key hindrance to new transmission lines is the time-consuming process of acquiring way leaves and land for substations. The government is in charge of this process. We could not find evidence of shadow prices for transmission. However, we find evidence of actors trying to mitigate the risk of slow construction of transmission infrastructure. For example, the LTWP required a partial risk guarantee to cover the risk of completion of the transmission line in order to reach financial closure.

We find several symptoms of a **governance** constraint. Renewable energy projects requiring heavy infrastructure investments in Kenya (mainly geothermal and hydro) are more likely to thrive if they are publicly owned and funded. Projects can bypass important constraints when they have strong political support. This is mainly granted to large-scale, flagship projects that are very visible to the public, or to short-term visible solutions to power crises like emergency diesel generation. For example, the LTWP became a political priority which facilitated the inclusion of several clauses in the PPA, which may prove risky for the off-taker: a take-or-pay clause; a payment security from Kenya Power through an escrow account raised via a tariff increase; a euro-denominated PPA; and a partial risk guarantee to cover the risk of completion of the transmission line.

A lack of **domestic savings** could be an obstacle to investment, but we do not find strong signals about the severity of this constraint. The supply of private credit by deposit money banks is very high in comparison to other countries in SSA and close to that in LMI countries. Stock market capitalisation is also high. Interest rates offered by 90-day Treasury bills were 8.6 per cent as per December 2015, which is lower than the returns offered by renewable energy projects. Hence there is no clear evidence of the government crowding out the financial markets, as happened in Ghana. On the other hand, there is a heavy dependence on aid finance, which means donors have a strong influence on Kenya's energy agenda. Also, there is a concern that lack of finance could become a severe constraint in the future because Kenya's borrowing has escalated in recent times.

We provide a theory to explain the prevalence of the constraints observed, which we call the **syndrome of the rent-capturing elite**. Kenya has had access to a large flow of foreign aid, but this has been mainly channelled towards the priorities of urban and political elites. Priorities have mainly consisted in highly visible, large-scale generation projects, such as government-sponsored geothermal plants or large wind power plants, feeding their energy directly to Nairobi and other large cities. It is questionable that financing geothermal power at nearly zero interest rates should be a priority for donors, as these plants are profitable and provide least cost electricity. Other investments, less visible and profitable, would have the potential to bring higher benefits for the poor. For example, improvements of the transmission and distribution network or the implementation of small-scale distributed generation for dispersed rural communities could improve the rates of access to electricity for the rural poor, but have been historically neglected by the elite.

There may be a rent-seeking dimension that explains the preference for large-scale projects, in terms of the ability of government officials to maintain control over access to sites, infrastructures and profits more easily (Newell *et al.* 2014). Large-scale projects are also a source of pride for ruling politicians, and are aligned with the ambitions set up in Kenya's national strategy Vision 2030.

Donor influence manifests not only in the flows of foreign aid but also in the choice of renewable energy support policies. For example, FiT were very much supported by donors, in spite of Kenya's previous track record of competitive bids. FiT effectiveness to attract investment has been underwhelming and Kenya is now moving towards renewable energy auctions.

The Government of Kenya has opened several fronts to address the constraints identified. These include a mini-grids regulatory framework, the geospatial mapping of the country for integrated grid and off-grid planning; and an auctioning scheme for renewables. If they are properly implemented, these could be game changers for the sector.

6 Discussion

The Green Investment Diagnostics framework has been effective to reduce a large number of potential constraints to investment in renewables to a manageable number in Kenya and Ghana. The decision tree tool has been particularly useful, but we have found some challenges to apply the original Growth Diagnostics tests. For example, we have not been able to look at the effect of movements in the constraint on the level of investment in the power sector. Investments in generation capacity in small national systems do not happen continuously, but are very large and infrequent. Also, data on shadow prices are unavailable for many constraints. Unlike the original Growth Diagnostics, we do not finish with the identification of a single most binding constraint, but propose instead a small group of interrelated constraints and a 'syndrome' to explain their root causes.

Before applying our diagnostics tool, we explained the context for investment in renewables in both countries. We found some similarities, such as the tension of preserving the financial sustainability of electric utilities while aiming for universal access. We also found a similar renewable energy policy portfolio, with renewable energy targets and FiT in both countries.

In reality, Kenya and Ghana depart from very different circumstances. Ghana has been immersed in a power sector crisis for several years, with frequent blackouts and national power utilities on the brink of bankruptcy. Renewable energy does not feature as a key solution to energy security problems in the country. Ghana has instead emphasised the role of domestic gas resources to fuel its power plants. However, gas exploitation has been slow and local gas will not be adequate to meet the country's gas requirements for the medium-to-long term. In the short term, to deal with a power supply crisis, Ghana has locked itself into expensive contracts with private thermal plants using imported fuel.

Kenya instead has enough generation capacity to meet its current needs and may exceed capacity needs in the medium term. Its power utilities are financially sanitised, prices are set at cost-recovery level, there is a good track record of international competitive bids to procure generation capacity and a good history of honouring PPAs signed with IPPs. Kenya has decisively supported renewable energy, through a long-term geothermal plan and the approval of several wind power projects. The other side of the story is a large share of population without access to electricity and a level of social discontent that can halt infrastructure projects. Kenya's electricity system also faces stability problems due to the fast penetration of intermittent renewables and the inflexibility of the current system.

Our analysis then questions if potential constraints to investment in Kenya and Ghana come from a lack of attractive projects or instead from a lack of appropriate finance. A decision tree, informed by indicators (included in Appendix B) and interviews with stakeholders (detailed in Appendix A) points at constraints in the project attractiveness side for Kenya, and in both project attractiveness and finance availability for Ghana.

With regard to project attractiveness, the returns for renewable energy in Kenya appear higher than in Ghana, due to very good quality renewable energy

resources (mainly wind and geothermal) and access to lower cost finance. The LCOE for renewables is lower in Kenya than in Ghana but in both countries, electricity from renewables can offer lower costs than some of the procured fossil fuel-based plants. A potential weakness in Kenya is that intermittent renewables could impose considerable costs for the electricity system unless further flexibility is added through interconnections, storage or more flexible generation capacity.

The risks of investing in renewable energy are higher in Ghana than in Kenya. At the core of Ghana's risks there is an off-taker that cannot afford to pay the agreed FiT because its financial health has been damaged by prices below cost-recovery; system losses; poor metering and billing; unpaid bills; inflation and currency devaluation, in addition to poor management and political patronage. Kenya's risks are mainly social, infrastructural and political.

Both Kenya and Ghana present regulatory constraints to investment in renewables, but again these are more acute in Ghana. Both countries have experienced an explosion of unsolicited proposals following their approval of FiT. Ghana's management of the issue has been contradictory: the regulator set caps to the total renewable energy capacity while at the same time provided provisional licences to projects exceeding those caps by far. Kenya's FiT policy only applies to projects below a certain capacity and larger projects need to directly negotiate PPAs with Kenya Power. Both countries have recently manifested a preference for auctions instead of FiT, trying to emulate the success of South Africa's Renewable Energy Independent Power Producer Procurement (REIPPP) auctioning scheme. Kenya's position is clearer, as it will maintain FiT for small-scale projects, while pursuing auctions for large projects. Ghana announced a competitive bid for 20MW of solar PV at the end of 2015 but there has not yet been an awardee.

Ghana's financial constraints are also more acute than Kenya's. There is a lack of domestic savings, and an excess of debt by the state, which has caused currency devaluation, fast inflation and fiscal imbalances. Government bonds offer higher returns than investment in renewable energy and there is overall a shortage of the long-term, low-cost finance needed for electricity generation projects. Even though Kenya has a shortage of domestic savings, it has benefited from substantial inflows of foreign aid. Foreign aid has, for example, provided debt at near-zero interest rates to geothermal plants, even though these are profitable and offer least cost electricity.

Ultimately, Kenya presents a more fertile ground for investment in renewable energy but must redistribute rents for the provision of electricity to the rural poor and to tackle its deficit on transmission and distribution infrastructure. Ghana is in dire need of long-term affordable finance to achieve a sustainable solution to its generation capacity deficit. The growth of renewables in Ghana will also need fully functioning utilities and a reliable policy framework. All in all, policy should target different priorities in Kenya and Ghana, and FiT or renewable energy targets are hardly the most appropriate instruments for both. Two subsequent studies on the political economy of investment in renewable energy in Kenya and Ghana propose a set of policies to address the specific constraints identified in each country, and analyse their political feasibility by looking at the political sources of support and opposition and their relative power.⁷⁴

74 To be published in *IDS Bulletin* 48.5 (2017 forthcoming).

7 Conclusions

The vast potential of renewable energy is failing to be realised in many African countries, in spite of the many pledges made by donors and international financiers. This is not due to a lack of policies supporting investment. Many African countries have renewable energy targets, FiT, or import duty exemptions for renewable energy technologies. In some cases these policies are not fully implemented. In others they are implemented but, put in the language of this report, they are not targeting the most binding constraints to investment. Whatever the reason for their lack of success, it is clear that simply introducing formal policies is not enough.

In the research described in this report, we have developed and tested an approach to identify what these constraints might be. The Green Investment Diagnostics methodology is designed to help policymakers identify the most important obstacles to investment in the renewable energy technologies most suited to their countries, and deliver effective reforms to remove these obstacles.

Constraints could arise from the lack of attractive projects, the lack of appropriate finance, or both. In many cases, there are a large number of issues that may be holding back investment. An important characteristic of our framework is that it helps to narrow down the hundreds of potential constraints to a handful of the most pressing. The method for achieving this relies on robust international comparisons of data drawn from a diverse set of credible sources. We triangulate the evidence with interviews with stakeholders and with diagnostic signals to assess the importance of each constraint.

While constraints are likely to be country-specific, there are commonalities. As our analysis of Kenya and Ghana has shown, for example, FiT that provide a guaranteed income to generators for a period of time will only succeed when there is a reliable off-taker that can pay those fees, or a solvent state that can take responsibility through sovereign guarantees. Previous successful FiT also had a market large enough to make it worth the effort of calculating an appropriate tariff. Incentive mechanisms open to everyone, without total capacity caps or a procedure to prioritise proposals, are likely to clog small African power systems. When there is not a deficit in generation capacity, strategies to mobilise foreign aid would be best addressed to the electrification of the last mile or the improvement of transmission and distribution networks, instead of to already profitable renewable energy generation technologies.

While there are commonalities, they will manifest themselves in very different ways in different contexts. An approach that targets support to the needs of each particular country is therefore likely to be more effective than simply importing policies that have enjoyed success elsewhere. Given this, we invite donors and national policymakers to replicate this exercise to better target their support to green growth in developing countries.

Appendix A Key informants

The names of informants are anonymised at their request and only their position in their organisation is disclosed. One particular company also requested that its name is not disclosed.

Appendix Table A1 Interviewees

Role of interviewee	Organisation	Country of operations	Type of stakeholder	Date
Founder and Managing Director	Upwind	Ghana	RE industry (wind)	21 October 2015
Chief Executive Officer	Ghana Capital Partners	Ghana	RE industry (solar PV)	19 September 2015
Agency Director for RE and energy efficiency	Energy Commission Ghana (EC)	Ghana	Regulator	19 September 2015
Deputy Executive Director	Africa Center for Energy Policy (ACEP)	Ghana	Thinktank	1 October 2015
Executive Director	Kumasi Institute of Technology and Environment (KITE)	Ghana	Academia	16 October 2015
Programme Assistant of Biomass, Renewable Energy Division	EC	Ghana	Regulator	1 October 2015
Head of Strategic Planning and Policy	EC	Ghana	Regulator	1 October 2015
Executive Director	Solar Light Company Limited	Ghana	RE industry (solar PV)	28 October 2015
Head of Research Division	UT Bank	Ghana	Finance	2 October 2015
Director of Research	Ghana Investment Promotion Centre (GIPC)	Ghana	Government	2 October 2015
Project Director	Aldwych International	Kenya	RE industry (wind)	11 September 2015
Quality and Environment Director	International EPC contractor*	Kenya	RE industry (wind)	2 October 2015
Senior Investment Officer Infrastructure Finance and PPP	African Development Bank	Kenya	Finance	30 September 2015
Country economist	African Development Bank	Kenya	Finance	30 September 2015
Director of Research and Policy	Kenya Bankers Association (KBA)	Kenya	Finance	28 September 2015
Chairman	Kenya Renewable Energy Association (KEREAA)	Kenya	RE industry	21 September 2015
Two staff members	Kenya Investment Promotion Agency (KENINVEST)	Kenya	Government	23 September 2015
Managing Director	Integral Advisory	Kenya	RE industry (consultancy)	4 August 2016
Partner	Garrigues Advisory	Spain – International	RE industry (consultancy)	1 October 2015

* The name of the company is not disclosed at the request of the interviewee.

Source: Authors' own.

Appendix B Comparison of indicators from Ghana and Kenya

Appendix Table B1 Levelised cost of energy in Kenya and Ghana

LCOE (USD cents per kWh)		
Technology	Ghana	Kenya
Wind	14.3	10.3
Solar	18.7	14.8
Hydro	7.9	10.7
Geothermal		7.3

Note: Using social discount rates.
Source: Pueyo *et al.* (2016).

Appendix Table B2 Returns on equity for investment in renewables in Kenya and Ghana

Returns (per cent)		
Technology	Ghana	Kenya
Wind	6.9	14.3
Solar	Close to 0	5.3
Hydro	33.5	5.3
Geothermal		16.8

Note: Using commercial cost of debt and prices at FiT.
Source: Pueyo *et al.* (2016).

Appendix Table B3 Indicators of system costs in Kenya and Ghana

System costs			
Topic	Indicator	Ghana	Kenya
Share of IRE	% IRE capacity	6% (2020 target)	18% in 2019, from 1% in 2016
Diversification of IRE	High or low with regard to technology and geography	High (geographically diversified solar PV below 20MW and wind)	Low (only wind and more than 50% in a single location)
Share of dispatchable generation	% generation from hydro (natural gas, hydropower, HFO and biomass plants as a share of the total)	100%	Around 44% in 2016, but with a small share of gas turbines and a large share of unreliable hydro and dirty diesel engines
Connectivity	% of population connected to the grid	72%	47%
Transmission costs	Responsibility for transmission costs	Cost to metering point borne by generator	Project developer covers shallow costs, but delays in building new transmission lines can add to the cost of the project

Source: OECD/IEA (2015); Ghana: EC (2015b), GRIDCo (2014); Kenya: Lahmeyer International (2016), KPLC (2015).

Appendix Table B4 Indicators of demand in Kenya, Ghana, SSA and LMI countries

Demand					
Topic	Indicator	Ghana	Kenya	SSA	LMI
Growth	GDP growth (%)	3.5% (2015)	5.6% (2015)	3.4% (2015)	2.6% (2015)
		4.5% (2016p)	6% (2016p)	3% (2016p)	2.5% (2016p)
		7.7% (2017p)	6.1% (2017p)	4% (2017p)	3.4% (2017p)
Growth volatility	Standard deviation of GDP growth (2006–14)	3.15	2.22	1.24	1.22
Poverty	Poverty headcount ratio at USD1.9 per day (2013)	24.2% (2012 according to national poverty line)	50% (2012 based on national poverty line)	42.7% (2012)	n.a.
	Poverty growth (2006–13)	-7.7%	+4%	n.a.	n.a.
External sales of power	Interconnections exist	Yes	Yes and more being built		
	Exports/total generation (2015)	4%	0.4%		

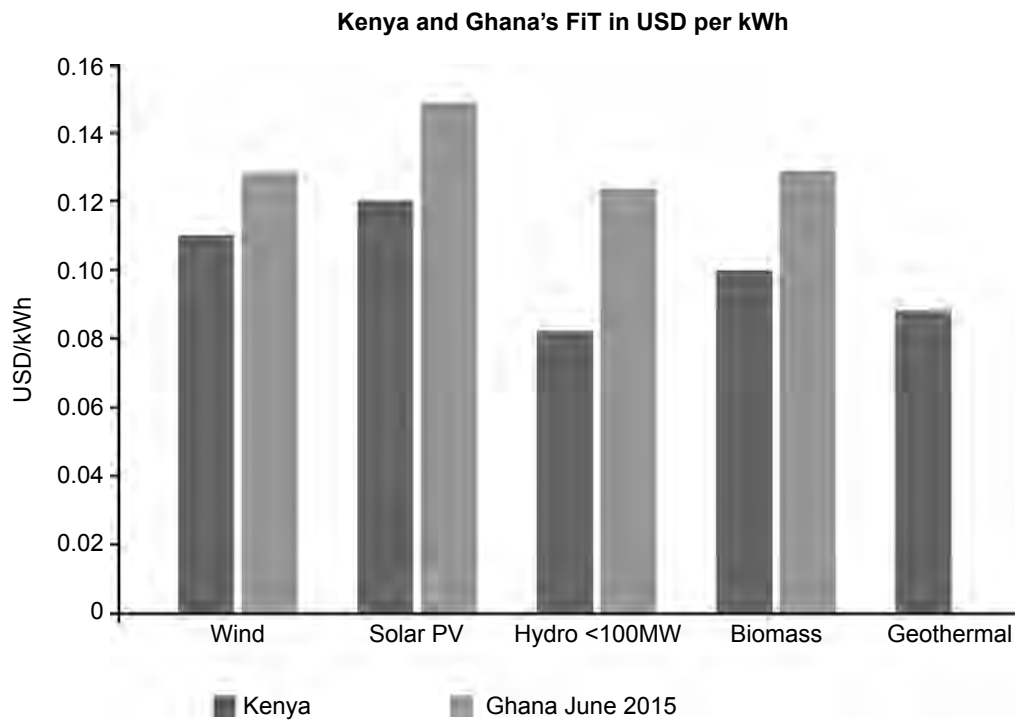
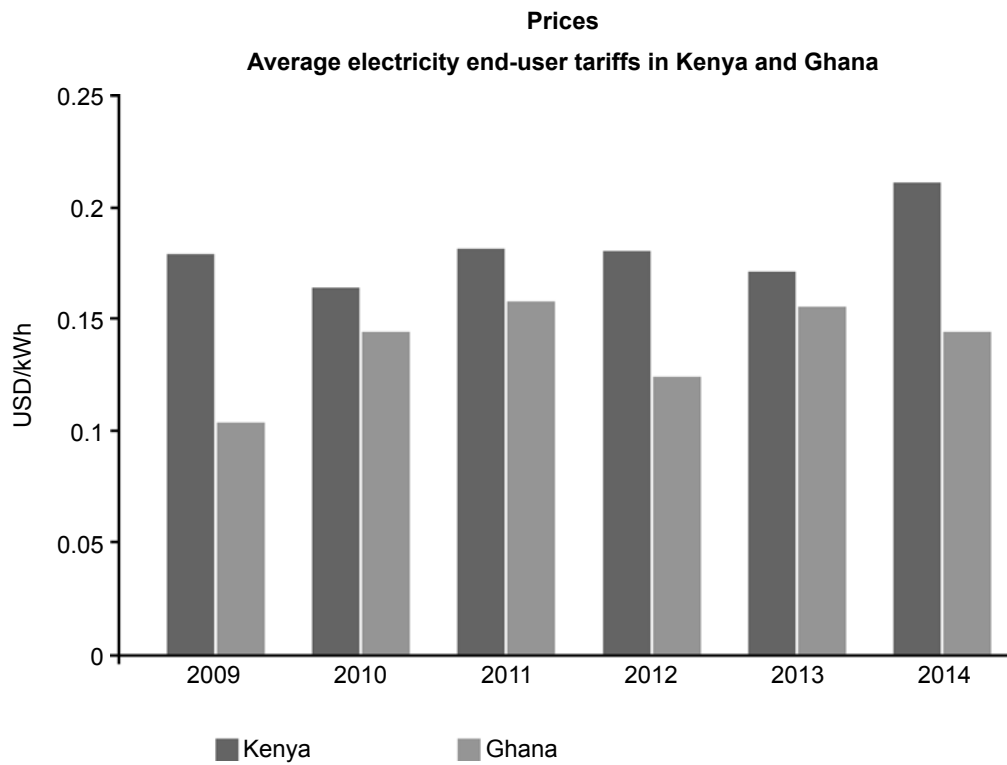
Note: p = predicted.

Source: 'Growth' and 'Growth volatility': World Bank (2016b).

'Poverty': Ghana: GSS (2014); Kenya: KIPPRA (2013); SSA: World Bank (2016b).

'External sales of power': Ghana: EC (2015b); Kenya: KPLC (2015).

Appendix Figure B1 Average electricity end-user tariffs and FiT in Kenya and Ghana



Note: Ghana's tariff converted to USD at the exchange rate in June 2015.

Source: Pueyo *et al.* (2016).

Appendix Table B5 Average capacity factors of renewables in Kenya, Ghana, SSA and internationally

Average capacity factors				
Technology	Ghana	Kenya	Africa	International
Wind onshore	25%	45%	32%	30%
Solar PV	17%	20%	22%	20%
Hydro	50%	55%		50%

Source: Pueyo *et al.* (2016).

Appendix Table B6 Indicators of regulatory risk in Kenya and Ghana

Regulatory risks			
Topic	Indicator	Ghana	Kenya
Planning	Number of RE projects in the pipeline (with provisional licence)	82	50 projects for 1,139MW in the pipeline
	Projects that have been built	2 (22.5MW)	All planned except 360MW coal and 110MW wind
Procurement	Number of projects and MW procured through competitive bids	1 solar PV project, 20MW (bid announced but not awarded)	7 fossil fuel projects for 512MW
	Number of steps and licences required to generate electricity	11	10–12, depending on the technology
Contracting and market access	Length of RE price guarantee	10 years	20 years
	Exchange rate and inflation risk	Not covered	Yes (tariff denominated in foreign currency)
	Access to grid guaranteed by law	Yes	Yes
	Connection cost covered by utility	No	No
	% of generation capacity controlled by the state	73%	70% of capacity 80% of total electricity produced
	CPIA property rights and rule-based governance index 2015	4	3

Source: World Bank (2016b); Energy Commission of Ghana (www.energycom.gov.gh); Energy Regulatory Commission of Kenya (<http://erc.go.ke/>).

Appendix Table B7 Indicators of off-taker risk in Kenya and Ghana

Off-taker risk			
Topic	Indicator	Ghana	Kenya
Operational performance	EBIT (if positive, EBIT margin)	-123 million cedis	12%
Liquidity	Current liabilities/current assets	154%	60%
	Cash and cash equivalents/accounts payable and short-term borrowing	8%	91%
Financial structure	Short-term debt/equity and long-term debt	45%	19%
System losses	System losses (as % purchases)	23%	17.5%
Credit risk	Revenue collection to sales	89.9%	
	Trade receivables past due by more than a year	13%	3% (over a year) 11% (plus impairment)
	Receivables from public institutions	55%	

Source: KPLC (2015); ECG (2013a).

Appendix Table B8 Indicators of resource and technology risks in Kenya, Ghana and LMI countries

Resource and technology risk				
Topic	Indicator	Ghana	Kenya	LMI
Resource risk	Resource assessments available	Yes	Yes (except biomass)	
Human resources	Gross enrolment ratio in tertiary education	14.3%	4%	23%
Industrial development	Competitive Industrial Performance Index	0.074 (119 out of 140)	0.01 (108 of 140)	
Grid capacity	Enough transmission capacity to transmit projected generation	Yes	Not at the moment, but planned	

Source: World Bank (2016b); UNIDO Competitive Industrial Performance Reports website (www.unido.org/data1/Statistics/Research/cip.html); UNIDO (2014); GRIDCo (2014); Lahmeyer International (2016).

Appendix Table B9 Indicators of macroeconomic risks in Kenya and Ghana

Macroeconomic risk			
Topic	Indicator	Ghana	Kenya
Currency risk	Change in exchange rate (USD per local currency)	-65% (2011–15) -18% (2015)	-13% (2011–15) -10% (2015)
Inflation	Consumer Price Index year-on-year December 2015	17.7% (2015)	6.6%
Fiscal stability	Current account deficit	-9.2% (2014)	-7.1%
	Fiscal deficit	-10.4% (2014)	-7.3% (2015)

Source: Bank of Ghana website (www.bog.gov.gh/); Central Bank of Kenya website (www.centralbank.go.ke/).

Appendix Table B10 Indicators of social and reputational risks in Kenya and Ghana

Social and reputational risk			
Topic	Indicator	Ghana	Kenya
Social discontent	Precedents of social discontent in renewable energy projects	Land grabs for growing biofuels	Yes
	Clear social consultation guidelines	No	No
Human and workers rights	CIRI empowerment rights index (2011 is latest value)	11 (out of 14)	4

Source: ActionAid (2012); *Danwatch* (2016); McGovern (2016); CIRI Human Rights Dataset (2016).

Appendix Table B11 Indicators of governance risks in Kenya, Ghana, SSA and LMI countries

Governance risk					
Topic	Indicator	Ghana	Kenya	SSA	LMI
Corruption	CPIA transparency, accountability and corruption in the public sector index (1 low – 6 high)	3.5	3	2.74	2.97
	Transparency International Corruption Perception Index (rank)	56 out of 167 global 7 out of 47 SSA	139		
	Percentage of firms expected to give gifts to secure a government contract	35.2%	33.4%	31.7%	
	Percentage of firms expected to give gifts to obtain a construction permit	35.1%	34.6%	29.5%	
Security	Intentional homicides per 100,000	1.7	7	14.4	5.9
	Threat of terrorism	Low	High		

Source: World Bank (2016b, 2013b, 2013c).

Appendix Table B12 Indicators of supply of domestic finance in Kenya, Ghana, SSA and LMI countries

		Domestic savings			
Topic	Indicator	Ghana	Kenya	SSA	LMI
Access to domestic savings	Gross domestic savings (% GDP) 2014	17.73	5.2	17.84	23.23
	Gross capital formation (% GDP) 2014	26.24	22	21.31	25.11
	Private credit by deposit money banks to GDP (%) 2013	14.2	29.1	16.7	32.2
	Stock market capitalisation to GDP (%) 2013	7.5	25.4	22.2	16.6
Low disposable income	GDP per capita (constant 2010 USD)	1,670.7	1,101.2	1,162.1	1,969.5
Access to banking services	Commercial bank branches per 100,000 people 2013	6.0	5.6	3.9	8.2
	Bank accounts per 1,000 adults	470	652	166	396
Tax collection	Tax revenue (% GDP) average last 5 years	13.723	15.81	15.25	10.98

Source: World Bank (2016b, 2015c).

Appendix Table B13 Indicators of supply of international finance in Kenya, Ghana, SSA and LMI countries

		Foreign savings			
Topic	Indicator	Ghana	Kenya	SSA	LMI
Foreign investment	FDI, net inflows (% of GDP) 2014	8.7%	1.5%	2.5%	2.1%
	Ease of Doing Business (2016 rank)	114 (11th SSA)	108 (9th in SSA)		
	Portfolio equity, net inflows (% GDP) 2009	2.1%		1.1%	0.8%
Aid	Aid inflows, net ODA (% GNI) annual average 2010–14	4.1%	5.14%	3.1%	0.9%
	Net ODA received per capita (current USD) average 2010–14	61	59.5	50.2	16.4

Source: World Bank (2016b).

Appendix Table B14 Indicators of financial intermediation in Kenya, Ghana, SSA and LMI countries

		Intermediation			
Topic	Indicator	Ghana	Kenya	SSA	LMI
Poor intermediation	Bank lending–deposit spread 2015	16	8.7	8.8	6.8
Competition	Bank concentration (%) 2013	70.1	51.6	75.4	70.1
	Boone indicator (2013)	-0.13	-0.09	-0.05	-0.05
Cost	Bank overhead costs to total assets (%)	5.7	4.7	5.2	3.4
Performance	Bank return on equity (% after tax) 2013	31.8	15.5	15.5	11.2
	Bank non-performing loans to gross loans (%)	12	5	5.6	5.6
	Stock market returns (% year-on-year)	74.4	50		
Short-termism	Syndicated loan average maturity (years) 2013	1.1	9.5	4.5	5
	Average maturity on new external debt commitments (2014)	12.1 (2014) 18 (2010–14)	16.7 (2014) 28 (2010–14)		

Source: World Bank (2016b, 2015c).

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