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Adding a new analysis framework to support large scale electrification financing plans in countries lacking universal electricity access

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“What is the most important thing in life?

God and family”

To them

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1. Introduction

Less than half of the population in Sub-Saharan Africa (SSA) still live without access to electricity: 47% total electricity access rate and only 28% rural access rate as of 2019 due to both demand and supply constraints (World Bank, 2021b) and the number of people without access in SSA increased in 2020 for the first time since 2013 (IEA, 2021). Worldwide and accounting for population growth, 940 million people will have to gain access to electricity by 2030 to comply with United Nations (UN) Sustainable Development Goal (SDG) 7.1 (SDG7.1)[1]. According to studies consulted by The Rockefeller Foundation, global investments are not on track to achieve this goal (The Rockefeller Foundation, 2020) and, with the current and planned policies, more than 670 million people worldwide may still lack access by 2030 (IEA, 2021), electricity access rate in SSA will only reach 60% by the end of the decade and reaching universal access to affordable electricity would require tripling the electricity access rate of recent years (IEA, 2022).

The overall under electrification conundrum has been covered and confirmed by literature from different perspectives. As expected, its crucial importance and diagnosis have been well documented both generally and for specific regions such as Uganda (Eder et al., 2015), highly relevant for the purposes of this work. Some authors have tried to summarise existing literature on the challenges to achieve a holistic solution to the electrification problem and on the reasons behind actual electricity underdevelopment. On this line of research, Gregory and Sovacool (2019) start with a sample of three African countries with a notable body of academic literature (Kenya, Mozambique and Tanzania) and then undertake a systematic review of 815 peer reviewed papers on the topic of electricity infrastructure, analysing how this literature has evaluated the problem as well as its main methodological, conceptual, and empirical characterization. Another subset of studies aimed at discussing solutions and required changes from different fields (technical, political, regulatory or financial among others), adopting a global top-down perspective and analysing rural electrification initiatives in specific developing countries (Almeshqab and Ustun, 2019). Similarly, Fontaine et al. (2016) explain how one particular business, technical and financial initiative (the Awango project, led and sponsored by Total and now under deployment in over 30 countries) achieved significant benefits through the sale of solar lanterns. In addition, most development partners/financial institutions (DPs/DFIs) such as the World Bank, the African Development Bank or the European Bank for Reconstruction and Development have published, sponsored or supported relevant research studies highlighting the gravity of the situation and its severe social, economic and educational consequences (African Development Bank, 2014) as well as including practical workshops organised among others by the Africa Electrification Initiative (AEI). As an indicative example, working papers sponsored by the World Bank have summarised different institutional approaches to electrification, leveraging on the experiences of rural energy agencies and rural energy funds across SSA on ground-level implementation (World Bank, 2012; World Bank, 2017).

While there are several worldwide initiatives, working groups at all levels and both financing and industrial sponsorships aiming at, at least partially and progressively, addressing such tremendous hurdle for African social, economic and cultural development, structuring and raising the required financing appears to be a critical requirement for the actual implementation of any of these investment programs. The lack of required financing as the main obstacle to execute the electricity distribution build-out in SSA is widely covered by literature, and several papers suggest different (partial) solutions from either industrial or

[1] UN Sustainable Development Goal 7.1: by 2030, universal access to affordable, reliable and modern energy services. This target has two indicators. Indicator 7.1.1: Proportion of population with access to electricity. Indicator 7.1.2: Proportion of population with primary reliance on clean fuels and technology.

financial perspectives: Harris and Ehsani (2017) highlight the importance of more complex and viable financial models, presenting a model village as a case study where innovative technologies and financing were introduced; Berahab (2020) suggests the pay as you go scheme for customers as an option to facilitate electricity off-grid systems investing and financing (using Kenya as the pilot case); Troost (2018) highlights the need to increase investment attractiveness in general and investments in mini-grid operating companies in particular as the specific path to achieve financial sustainability; Abdullah and Markandya (2012) find the electricity connection payments by potential new customers as the problem and suggest the need for governments to change the existing set of subsidies and financial support in order to reach underpenetrated areas. In summary, capital remains up to seven-times more expensive in developing and emerging markets than in advanced economies (IEA, 2021) and neither the large pool of private capital nor the leading utility corporates are seriously considering the required level of investments.

A working group, the MIT/Comillas Universal Access Laboratory with funding from the Rockefeller Foundation (the Research Team), has been aiming at addressing such low rate of electrification by developing an innovative techno-economic model. Pillars of this new electrification research approach, the Integrated Distribution Framework (IDF), include: (i) focus on electricity distribution as the main bottleneck to achieve universal access (vs generation and/or transmission), (ii) design of a holistic solution for an entire country (vs specific territories) taking into consideration its public funding status and limitations, (iii) the combination of different technical alternatives on-grid and off-grid (both mini-grids and stand-alone systems) to deliver the optimal solution to each particular situation and (iv) the concession legal structure as the best business and financial model to achieve its targets. Integrating the financial approach into the overall model is a key feature of the IDF which, for any implementation at a country level, incorporates an integrated techno-economic model, an integrated vision of the regulatory and business model and an integrated financial plan.

I have been working with the Research Team since December 2019, contributing my almost 30 years investment banking experience to the overall development of both a business plan that incorporates the techno-economic model and a financial plan to fund and support its implementation (initially applied to the specific countries we have been working with and aspiring to develop a wider framework that could be applied to similar situations). A key part of my role within the Research Team has then been to ensure that technical and business electrification plans can be funded and would be acceptable to all potential financing providers under current market terms and conditions. This DBA thesis incorporates the result of my collaboration with the Research Team that has materialized in two working papers: “A business plan to achieve full electrification in Rwanda under the Integrated Distribution Framework (IDF) (de Abajo et al., 2020)” and “The electricity access index methodology and preliminary findings (Pérez-Arriaga et al., 2022b)”. In addition to these two papers, this DBA thesis also includes a section named “A framework for analysing the feasibility of electricity access investments, the required financing plan and the equity raising in SSA countries: the case of electrification in Uganda”.

While lack of both electrification and financing in SSA are widely covered by research, the contribution of this thesis consists of: (i) the development of business and financial models, built alongside the execution of various Research Team assignments in different countries, ready to be actionable and to support raising the required financing under current market conditions; (ii) this real work experience has allowed us to build a more generic analysis framework which could eventually be applied to other SSA countries or even to other developing regions, although, as the Research Team has learnt by working on different situations (Uganda, Rwanda, Ecuador, Panamá), the application to other countries will be heavily conditioned by their local characteristics and challenges; (iii) finally, a broader analytical risk-return-impact framework to overcome potential capital raising difficulties which includes traditional financial criteria as well as more innovative financial and non-financial considerations consistent with a holistic approach to the overall financing decision-making process.

The methodology behind the research presented in this DBA thesis shows some similarities to action research (AR), the generic term used to describe research in action or the collaboration between researchers and practitioners (Mathiassen, 2002) in terms of work methodology, implementation process and ability to generate knowledge. Based on the assumption that academic and professional knowledge represent very different but related domains, AR is introduced as a method for correcting positive science deficiencies (Susman and Evered, 1978) as well as a rigorous approach that aims to contribute both to the practical concerns of people in an immediate problematic situation and to the goals of social science by joint collaboration within a mutually acceptable ethical framework (Rapoport, 1970). Some general review papers (Coughlan and Coghlan, 2002) that summarize AR theoretical and practical approach have also been consulted to validate my overall working approach. Additionally, other authors (McKay and Marshall, 2001; McNiff and Whitehead 2010) have opted for a more detailed description of how a proper AR model should work, accommodating both a problem-solving methodological approach and a full theoretical research framework. Despite not following all formal AR criteria set forth by these authors, the Research Team has effectively followed the most commonly used circular approach (see section 4.1) suggested by Coughlan and Coghlan (2002).

My DBA thesis includes the following sections presented in the chronological order they have been elaborated. Section 2 reproduces the first paper ("A business plan to achieve full electrification in Rwanda under the Integrated Distribution Framework (IDF) (de Abajo et al., 2020)") which effectively represents my first opportunity to develop a business and financial model on a real Research Team assignment (my main contribution was precisely the compilation of all IDF related inputs and the elaboration of both a business plan confirming the IDF suitability to achieve SDG7.1 targets and a financial plan confirming its actionability). Section 3 reproduces the second paper ("The electricity access index methodology and preliminary findings (Pérez-Arriaga et al, 2022b)") on which we opt to step back, develop a wider and comparable analytical framework (by building an electricity access index) and show the gap in the electrification financial effort to be filled by different countries (my main contribution focused on the definition and actual implementation of the sufficiency component of the index, by, firstly, analysing all relevant financial information and developing the business and financial plans to allow the comparison between the trajectory of actual financial efforts towards universal access and the path that a country should follow to achieve SDG7.1 and, secondly, evaluating the financial viability of the SDG7.1-compliant plan for each considered country). Section 4 includes the third part of my DBA thesis ("A framework for analysing the feasibility of electricity access investments, the required financing plan and the equity raising in SSA countries: the case of electrification in Uganda") which, based on the works undertaken for the Government of Uganda, develops an integrated analysis framework, including a traditional financial risk-return approach as well as other risk mitigators and return enhancement models that could facilitate the financing process in general and equity raising in particular, aiming at the full electrification of Uganda by 2030 (this section includes and develops in full the thesis contribution described above). Section 5 closes the thesis with the conclusions of my overall work, summarising its main results, contributions, limitations and areas of future potential work.

(i) A business plan to achieve full electrification in Rwanda under the Integrated Distribution Framework (IDF) (de Abajo et al., 2020)

The first paper includes our attempt to build a full and comprehensive business plan to reflect how the overall capital and operating expenditure required to achieve full electrification in Rwanda by 2030 using the IDF model could be executed and financed as part of an ongoing business operation.

Preliminary conversations with key stakeholders in Rwanda about potential adoption of the IDF were initiated by some members of the Research Team, taking advantage of their contribution to the elaboration of the Master Electrification Plan for Rwanda. These conversations continued afterwards, allowing the Research Team to further develop the effort, to examine the potential of the IDF for Rwanda in more detail and to bring some quantification into the proposed approach (both from an operating and from a financial perspective).

Rwanda was considered a very adequate country for a potential implementation of the IDF, as suitable conditions exist for each of the described four IDF pillars and progress has been made in every one of them. Rwanda is also in a good situation, from the perspective of the criteria of the international development banking community, to embark in a significant infrastructure project like the full electrification plan.

The Research Team prepared a detailed template (in excel spreadsheet format) of a business plan that accounted only for the pending electrification effort (i.e., all that at that time was not electrified yet), but that could be expanded to include the complete electricity sector of the country. The template was initially meant to be an instrument for discussion and clarification of the potential of the IDF, in Rwanda and elsewhere.

This first paper, after providing some background to the electrification situation in Rwanda, focuses on the description of the template and its application in Rwanda as well as on preliminary financing considerations and actionable funding alternatives to allow its implementation on the non-electrified regions of Rwanda.

(ii) The electricity access index methodology and preliminary findings (Pérez-Arriaga et al., 2022b).

The second paper explains our initiative to build an electricity access index (EAI) to evaluate the electrification progress in a country by examining the current level of effort in the distribution segment of the electricity supply chain (both on- and off-grid) to achieve universal electricity access by 2030.[2] This electrification progress evaluation includes the assessment of two separate perspectives. Firstly, the sufficiency of the volume of effort, in economic terms, by comparing the volume of the current financial effort made by the country with that necessary to achieve universal electricity access in this decade, while also verifying if such necessary effort would be financially viable. Secondly, the effectiveness in the allocation and utilisation of the current expenditure, by examining the compliance of the present effort to sound electrification principles: universality, conformity with an integral plan, economic viability, and focused on development.

The main goal of the EAI was not to provide a country ranking on universal access, but rather to stress which aspects of the electrification strategy should be improved in each country and to show the gap in the financial effort that should be filled, while also indicating how difficult will be to comply with SDG7.1 at

[2] The index (EAI) described in this report only addressed access to electricity, although in principle it could be extended to clean cooking, heating and other energy uses.

individual country scale. This working paper presents in detail the methodology to compute all the components of this multi-dimensional index. The methodology has already been tested on several countries that have not achieved full electrification yet and some preliminary findings were drawn: (i) without detailed and reliable data to track electrification efforts (both on and off-grid) at country scale, it is not possible to follow progress, set achievable milestones, or identify areas where efforts must be urgently enhanced to achieve SDG7.1 globally (this aspect should be urgently improved, and focus must be placed on every country individually, making use of the expertise and information available); (ii) as underlined by other reports, the current financial effort devoted to electrification is not sufficient to achieve universal access by 2030 (actually, with the financial instruments and current market and regulatory constraints, a significant number of countries simply cannot have a financially viable electrification plan compatible with SDG7.1.); (iii) regardless of the effort currently being devoted to universal access, the electrification strategies of several countries fail to comply with sound principles (this may result in suboptimal electrification solutions and hamper the economic efficiency of the interventions that are being deployed); (iv) aggregated assessments on universal electricity access, which condense information at a regional scale (e.g., Central America, East Africa), miss key aspects of the electrification effort that can be only identified at national scale (countries belonging to the same region may face very different conditions and the EAI represents a powerful tool to policymakers, development agencies, donors, NGOs and investors involved in universal access).

In summary, the EAI (developed by the Research Team) assesses at country level whether the electrification effort is on track to reach universal access by 2030 from a quantitative perspective (the sufficiency component) and from its conformity to sound principles of electrification (the effectiveness component). The EAI is meant to detect the need to intensify electrification efforts, to warn about the insufficiency of the present financing instruments and institutions to attain universal electricity access in many countries, and to point out to possible deviations in the present electrification strategies in a country with respect to broadly accepted best international practices. The outcome of the Electricity Access Index is not a static description of the current degree of electricity access in a country, but rather a comparison between the trajectory of actual financial efforts towards universal access and the path that a country should follow to achieve SDG7.1.

(iii) A framework for analysing the feasibility of electricity access investments, the required financing plan and the equity raising in SSA countries: the case of electrification in Uganda

The third part of my thesis intends to close the loop and further detail how an electrification business plan could be realistically financed under current market conditions. As explained above, the overall research objective focuses on providing actionable solutions to address the lack of electrification in developing countries and structuring the required financing is a critical component for the actual implementation of any investment program that intends to remedy such handicap at a country level by 2030. Integrating the financial approach into the overall model is a key feature of the IDF which, for any implementation at a country level, incorporates an integrated techno-economic model, an integrated vision of the regulatory and business model and an integrated financial plan. It intends to leverage on the IDF and further detail how an electrification business plan could be realistically financed under current market conditions. Structuring and eventually raising the required financing are critical components of the actual implementation of any investment program that intends to remedy the lack of electrification in developing geographies at a country level by 2030. We aim at contributing to this generally accepted financing challenge by developing the foundations that, based on a real country pilot case (Uganda), will describe the framework necessary to structure and potentially raise the necessary financing in general and the equity in particular, to fund the investment required to achieve full coverage of non-electrified SSA countries.

Addressing this funding constraint will rely, among others, on the overall financing plan, on the specific government ability to provide some country and regulatory support at different levels to all financing providers, on the commitment by some DFIs or DPs who are expected to provide a significant portion of the required debt program (Debt Providers), and on the critical involvement of either a single or several equity capital providers. This section presents a model built under the assumption that the presence of a leading industrial or strategic partner (Equity Investor) will be required at some point to support a long-term sustainable financing structure in countries similar to Uganda where the Equity Investor will be expected to: (i) lead the industrial and operating electrification plan, (ii) provide the local business with the best-in-class business expertise and, most importantly, (iii) provide the final equity component that should result in a fully financed business plan, i.e., commit and link the highest risk component of the capital structure to the execution of such plan.

Focusing on an actual pilot case, we have built a strategic, technical and financial model, also reflected on a detailed business plan, on how the non-electrified areas of the selected country could be fully covered by 2030 to comply with SDG7.1 and how that business plan would be financed and executed. The selected country for our initial analysis is Uganda due to several reasons including size, political and economic stability, suitability for capital raising and, very importantly, access to data and information: a key requirement to select the country is the full involvement and cooperation of its government, relevant officials and management of the local electricity company. In addition, a critical part of our pilot case relates to the expiry and hence required renegotiation of the concession of one of Uganda's key sector players which opened-up the possibility to consider different alternatives around the design of the regulatory and business models. We have been working with the Government of Uganda (GoU) since 2020 as part of a mission to perform an assessment of the electricity distribution sector in Uganda (Uganda Assignment) led by Ignacio Pérez-Arriaga as a component of The European Union Global Technical Assistance Facility for Sustainable Energy, which resulted in an initial report issued in 2021 and a revised and updated version in 2022 (Final Report, Pérez-Arriaga, 2022a).

The combination of work carried out on recent assignments and relevant professional experience seems to indicate that the execution of a business plan for such an ambitious target as the electrification of SSA countries will depend heavily on the right financing strategy and on the right selection of and commitment from both Debt Providers and the Equity Investor. Putting together the entire capital structure would be challenging, its different providers are expected to request some level of inter-conditionality and the ultimate equity component is expected to be a critical financing cornerstone. As mentioned above, the Equity Investor commitment would be key both to lead the strategic and business plan and to provide either partially or in full the remaining financing required, and based on prevailing market practice, we assume it would require, on the one hand, some necessary but not sufficient conditions including: (1) a sound and viable technical plan built to effectively develop a network for each specific situation, (2) the respective government support (critical to bring concessional capital, to provide the necessary comfort both to the Debt Providers and to the Equity Investor and to maximize, as the main stakeholder in the resulting business, the expected social and economic benefits for the population), (3) an appropriate and efficient capital structure to ensure that the business plan will be fully funded and (4) a satisfactory consideration of other political and cultural factors (either at the country – e.g., political regime, cultural heritage – or at the corporate level).

On the other hand, and assuming all these conditions are in place, financial returns delivered by the business plan to the Equity Investor are likely to be just fair and may not be attractive enough to compensate for the required time and effort as well as the reputational and financial risks associated to investing in these countries, especially if large investment amounts are required. Thus, the Equity Investor is highly likely to demand some additional investment levers to positively consider the financial and non-financial benefits expected from its participation and leadership.

These additional investment levers shall include some financial return enhancement by adding a real options framework to expand the traditional financial risk-return analysis as well as an innovative risk-return-impact approach that we would expect the Equity Investor to consider so that their internal decision-making bodies would support the necessary financial, technical, human capital and reputational investment. The overall investment case for the Equity Investor can still admit various alternatives depending on the final capital structure (potentially including equity, equity-like or hybrid instruments) as well as the specific Equity Investor plan and objectives. Thus, it would be fair to assume that, initially, a financial risk-return approach should be articulated, including both some risk reduction by potential credit enhancement (designing more favourable or tailor-made Equity Investor structure terms) and some return enhancement by adding less visible option value linked to their pioneering presence in this type of geographies. This option value could theoretically result from either capturing potential growth in other markets or having the right to abandon the project under well-defined circumstances, but the latter is expected to be a critical Equity Investor request (i.e., a must have condition) rather than a value addition and its related option value has not been valued or added to the base case return. Therefore, the only real option value included in the analysis is the Equity Investor option to grow or expand into other countries, having indicatively selected the neighbouring country of Rwanda as explained in section 4.5.

In addition, a project of this nature would represent a very compelling ESG (Environmental, Social, and Governance) proposition, increasingly critical in current corporate and financing markets: Environmental (given predominance of renewable energy sources), Social (given the notorious social benefits brought by the network development program) and Governance (ensuring that the overall business plan execution and the alignment of interests among all stakeholders comply with best corporate governance standards). Both Environmental and Social reasons appear to be widely accepted to defend an investment in electricity in SSA developing countries, but the overall corporate governance and investment structure discussion is expected to also play a critical role. Beyond a typical ESG approach we have analysed both Social and Environmental angles under a deeper impact investing perspective (Impact) by following the risk-return-impact model suggested by Cohen (2020), we have measured the social and environmental benefits electricity access would bring using various quantifiable metrics, and we have attempted to value these benefits so a dollar amount can be added to the overall investment case. Therefore, we have added a more innovative Impact investment proposition to the traditional financial analysis framework, hence developing an integrated risk-return-impact model which we would expect to be critically important for the Equity Investor's decision-making bodies and procedures. On this last point, we briefly suggest how to overcome the potential corporate governance controversy around companies' ultimate purpose (maximising shareholders value vs acting in the interest of all stakeholders including current or future potential Impact beneficiaries).

As explained in chapter 4, the Uganda Assignment has allowed us to understand the country industry dynamics and to select the potentially best placed sector player where some Equity Investor interest could be raised. Financial projections built under the same Uganda Assignment produce some base case Equity Investor returns in the region of 13% by 2030 or 12% by 2040, clearly insufficient to satisfy the expected cost of equity (estimated at 14.5%) and the additional business, financial and reputational challenges to be faced by an Equity Investor. The overall investment case would be significantly improved by mitigating the risk through market standard investment structure features and related agreements, by enhancing the expected returns up to the region of 20% (by 2030) to 17% (by 2040) with the real option value associated to expanding into Rwanda and by adding an Impact related SROI (Social Return on Investments) in excess of 30%, reflecting the Impact value directly attributable to the Equity Investor.

As a result, the overall investment proposal to the Equity Investor is significantly improved after the consideration of both risk mitigation measures and the financial return improvement resulting from the addition of real options value and the Impact model. In addition to identifying these key areas as relevant to the Equity Investor and as potential sources of hidden value on a real and actionable situation, our model provides the tools to quantify this generic improvement. The investment return increase may not be a transforming decision-making criterium on its own, but it will certainly help to enhance the Equity Investor case in situations like the Uganda Assignment. Thus, main results of our work include: (i) the actual confirmation of the initial challenge to raise new equity to fund the electrification of the least profitable regions in SSA (S&P[3] B rating) countries; (ii) the value added brought by the real options model and the quantification of the commonly accepted "strategic premium" by most industrial investors; (iii) the adoption of an Impact model that measures the different impact areas and can then be added into a full and revised investment proposal for the Equity Investor and (iv) the multiple benefits deriving from developing a business plan both to model the operating scenarios and to analyse financing alternatives on other situations where lessons learnt from the Uganda Assignment may be applicable.

[3] S&P refers to financing ratings issued by Standard & Poor's Ratings Services

2. A business plan to achieve full electrification in Rwanda under the Integrated Distribution Framework (IDF) (de Abajo et al., 2020)

This chapter reproduces the contents of the article “A business plan to achieve full electrification in Rwanda under the Integrated Distribution Framework (IDF)” published in July 2020 with co-authors Díaz-Pastor, S., González, A. and Pérez-Arriaga, I. by the Global Commission to End Energy Poverty (Working Paper Series) as part of the MIT Energy Initiative.

2.1. The General Context

The Government of Rwanda (GoR) has established an ambitious and comprehensive National Energy Sector Strategic Plan (ESSP)[4], which includes a 100% electrification target by 2024, meant to contributing to economic growth and poverty alleviation. With the support of multiple development partners, Rwanda has successfully accelerated the rate of access to electricity during the last decade, which has increased from 10% in 2010 to 43% in 2018[5], almost exclusively by grid extension. But the pace of grid extension is insufficient to achieve the established access target, and there are less expensive off-grid solutions to meet the estimated demand of many of the still non-electrified customers.

The MIT/Comillas Universal Access Laboratory, using its electrification planning software REM and with funding from the World Bank, has contributed to the electrification effort by developing a Master Electrification Plan for the entire country. This plan is the least cost option to meet the GoR target, subject to some constraints that were necessary to ensure technical viability and consistency with the priorities set up by the ESSP. In addition to a sound estimation of the investment and operation costs, the results obtained make possible to inform prospective off-grid investors about what areas are not contemplated for grid extension for the temporal scope of the plan (now to 2024). The detailed results of this study will also inform the implementation of the National Electrification Strategy (NES) and the preparation of the National Electrification Plan (NEP).

Preliminary conversations with key stakeholders in Rwanda about potential adoption of the Integrated Distribution Framework (IDF)[6] were initiated by members of the GCEEP Research Team, taking advantage of the partial overlap in time of the present Rockefeller Foundation project that is promoting the IDF approach and the end of the elaboration of the Master Electrification Plan. These conversations have continued afterwards, in Rwanda and elsewhere, including also some GCEEP members. All those contacted have encouraged the Research Team to continue the effort, to examine the potential of IDF for Rwanda in more detail and to bring some quantification into the proposed approach. This is the objective of the present Working Paper.

The results of the MIT/Comillas least cost electrification plan can be the basis for the development of a business plan to check the financial viability of a potential distribution concession in Rwanda. From an objective viewpoint, Rwanda appears to be a very adequate country for a potential implementation of the IDF, as suitable conditions exist for each of the four IDF pillars and progress has been made in every one of

[4] National Energy Sector Strategic Plan (ESSP), September 2018.
http://mininfra.gov.rw/fileadmin/user_upload/new_tender/Energy_Sector_Strategic_Plan.pdf
[5] Sources: MININFRA and ESMAP et al. report “Rwanda: Beyond connections. Energy access diagnostic report based on the multi-tier framework”, June 2018.
[6] I. Pérez-Arriaga, R. Stoner, D. Nagpal and G. Jacquot. “Global Commission to End Energy Poverty: Inception Report”, September 2019. https://www.endenergypoverty.org/reports

them[7]. Rwanda is also in a good situation – from the perspective of the criteria of the international development banking community – to embark in a significant infrastructure project like the full electrification plan.

The GCEEP Research Team has prepared a detailed template – in excel spreadsheet format – of a business plan that accounts only for the electrification plan (i.e., all that presently is not electrified yet), but that could be expanded to include the complete electrification segment of REG[8]. For the time being this template is just meant to be an instrument for discussion and clarification of the potential of the IDF, in Rwanda and elsewhere. The present Working Paper, after providing some background to the electrification situation in Rwanda, focuses on the description of the template and its application in Rwanda.

The GCEEP Research Team is ready to continue conversations with all interested stakeholders, investigate the open issues, and perform its role as convener to achieve a potential consensus on the implementation of the IDF in Rwanda.

2.2. Background on the Rwandan Power Sector

The Gross Domestic Product per capita in Rwanda was $826 in 2018, which is equivalent to just 7% of the world's average. This low level of economic development can be partly attributed to infrastructure shortcomings, linked to high electricity costs that hinder socio-economic development and to lack of access that limits the transformation from an economy based on subsistence agriculture to a knowledge economy. Developing the energy sector is key to develop other sectors, such as manufacturing, agro-processing, housing, mining, tourism and IT services.

The electrification rate in Rwanda primarily reflects grid-connected users in urban areas and remains largely concentrated in the two top quintiles, with almost negligible coverage in the bottom 40 percent of the population. Electrification is primarily a rural challenge: 77 percent of the urban population is electrified, and their access is concentrated in the higher levels of service. By contrast, 84 percent of the rural population has no access to electricity and only very few are in the top levels. Off-grid solutions are more common in rural areas and they typically provide low levels of access.

Rwanda is a small, densely populated country that will ultimately be fully electrified through the national grid. However, grid extension to reach clusters with very low total demand is too expensive. Off-grid solutions, which provide lower-tier service but are more affordable, can provide an important interim solution for these households. The affordability challenge and the steep cost reductions in off-grid solar solutions have made the Government reconsider its strategy for access expansion and put more emphasis on off-grid solar for households that have basic electricity needs and would have difficulties affording even a subsidized grid connection fee. To implement the new targets, the Government has launched least cost electrification planning efforts – of which the MIT/Comillas study is the last example – and has put in place new procedures for simplified procurement of small mini-grids.[9]

[7] I. Pérez-Arriaga, D. Nagpal, G. Jacquot and R. Stoner. "Integrated Distribution Framework: Guiding principles for universal electricity access". GCEEP Working Paper. May 2020. https://www.endenergypoverty.org/reports

[8] The detailed cost estimates provided by the MIT/Comillas electrification plan refer only to what remains to be electrified, but not to what has to be done in the existing distribution network. The business plan can only be completed once this information is included in the financial analysis of the distribution concession business model, which must comprise the entire Rwandan distribution system.

[9] IRENA (2019). Policies and regulations for renewable energy mini-grids.

At present, tariff revenues collected by the Rwanda Energy Group (REG, the national energy company) are insufficient to recover the operating costs of service provision to its customers. Rwanda's electricity supply is expensive due to limited domestic energy resources and noncompetitively procured generation capacity. Tariffs are among the highest in the region, but they are below cost recovery because the low incomes limit the consumers' ability to pay for electricity services. The gap is covered by budget transfers to REG. Even at a subsidized rate, firms pay a higher price of electricity compared to neighbouring countries, making access to electricity among the main constraints to scaling up private investment flows.

Absent a vigorous increment of demand as a result of an acceleration of the electrification plan, the estimated surplus of generation capacity after 2020 will create pressure on the tariff and – if the tariff remains below costs – on the need for Governmental subsidies. To increase the affordability of electricity for low-income households, a new tariff regime was put in place from January 2017. A number of important changes were made. First, the price of electricity was reduced by 51 percent for households with monthly consumption up to 15 kWh (the average monthly consumption of households in Rwanda was an estimated 35 kWh per month in 2016/17). Second, a new connection policy aims to make connections affordable for all consumer categories and introduces new payment options for the connection fee, including one with zero down payment targeted at low-income households. Tariffs for selected non-household consumers that are not exposed to international competition—commercial customers, broadcasters, telecom towers and health facilities—have been brought closer to cost recovery.

The governance of Rwanda's power sector has historically been highly concentrated in the Government, with relatively little independent decision making, for example, in the utility. This favours reform coordination and can speed up program implementation. However, with limited separation of commercial, regulatory, and political objectives in decision making, it carries risks of inefficiencies and nonadherence to business plans or regulatory mandates. To mitigate such risks, in 2013, with the support of the World Bank and other development partners, the Government restructured the key energy sector institutions, aiming at achieving regulatory independence, financial sustainability, and increased private sector engagement. REG was created to take over the electricity utility functions as well as carry out power sector planning and development. While the Government retains ownership of REG, its affiliated companies are governed under company law as opposed to public service law. RURA is the sector regulator with a track record of independent tariffs decisions and utility performance reviews.

Rwanda has been a leading reformer among African economies in Doing Business indicators[10], ranking second in Africa only after Mauritius in the business enabling environment. According to recent reports by the World Bank, overall, while risks remain, Rwanda's macroeconomic policy framework is considered adequate by World Bank reviews and rating institutions. Rwanda's prudent macroeconomic policy has enabled the country to achieve high economic growth and macroeconomic stability in the past decade. Both monetary and fiscal policies have been implemented in a prudent manner. The World Bank/International Monetary Fund assessment of Rwanda's DSA indicates continuation of low risk of debt distress. Rwanda's public sector debt has increased with an investment push in recent years but remains comfortable in absolute terms. Rwanda's domestic public debt has also increased to develop a broader domestic market in recent years but also remains low in absolute terms.

Support from development financial institutions (DFIs) will be necessary to make the electrification plan financially viable. The core elements of the proposed electrification planning strategy rest upon not just

[10] http://www.doingbusiness.org/data/exploreeconomies/rwanda#getting-electricity

putting in place an adequate plan and a decision-making framework but mostly on finding consensus among stakeholders, including the Government, development partners and private sector, on how to address fiscal risks and payment guarantees.

2.3. The Electrification Plan

Based in the report developed by the MIT-IIT Universal Energy Access Laboratory in 2019 for the National Electrification Plan of Rwanda 2020-2024 (NEP 202-2024)[11], the Rwandan Energy Group and the Government of Rwanda have established the roadmap to rapidly achieve universal electrification in 2024, with a least-cost mix of grid and off-grid technologies. This First Roll-out Wave will supply 100% of the expected residential, community and industrial loads in 2024 assuming a demand trend projected from the, still very small, values in 2019.

In this business plan we assume that this initial electrification push will lead out to a more stable period until 2030, where the large investments developed from 2020 to 2024 will require limited network reinforcements. Additional connections to the backbones designed for 2024 and any necessary upgrades in the off-grid and on-grid generation will continue to accommodate later demand growth. During the period 2031-2040 we expect that increased development rates, accompanied by larger demand growth, as well as lower generation costs will drive the network connectivity further, reducing the weight of stand-alone systems from 40% in 2030 to 20% in 2040.

This Second Roll-out Wave will require significant investments to accommodate this new demand, and to allow the transition of the present infrastructure to a future smarter network capable of meeting the expectations of quality of service, sustainability, integration of renewable energies with distributed characteristics and management of flexible energy demand.

2.3.1. NEP 2020-2024. First Roll-out Wave

The National Electrification Plan of Rwanda 2024 details at village level the least-cost areas where the national grid needs to be extended at the end of this period, the location of least-cost mini-grid villages, and the areas where DC solar kits and other AC standalone systems should be supplied as a first, temporary, solution.

NEP 2024 included the detailed design of the power systems required to supply each one of the 2.9 million new customers of the Rwandan power sector in 2024. NEP also detailed the 931 individual grid extension and 1,973 mini-grid projects, scheduled for their implementation from 2020 to 2024 according to the priorities for electrification of community and industrial loads, and the budget and operative constraints specified by EDCL.

Our detailed computer-based analysis with the REM model has been limited to the electrification of those customers which required to be supplied by grid extension that needed new MV distribution lines, with any necessary MV/LV transformers and LV lines to reach the end residential and C&I customers and to the off-grid solutions for customers located beyond the already electrified areas in service by the current MV central network. Customers to be connected by just densification, i.e., wired to existing nearby LV lines in

[11] MIT&IIT-Comillas UEA Lab 2019. TASK 2 Report. Design of the National Electrification Plan in Rwanda. https://www.reg.rw/fileadmin/user_upload/Report_of_the_Design_of_the_National_Electrification_Plan_in_Rwanda.pdf

already electrified villages and customers close to the existing MV lines, did not need of the REM analysis to determine their least cost electrification mode as grid extension. NEP 2024 has provided an initial rough estimation of the cost of the densification effort based on EDCL estimations. However, an additional densification plan – still to be done – is required to analogously provide detail down to customer level of the implementation of these new connections and of the associated upstream reinforcements required in the existing distribution grid, and their potential impact at transmission and generation levels.

In agreement with EDCL indications, the demand profiles and quality of service requirements for all grid-standard customers (either connected to the central network or to decentralized generation in mini-grids) are equivalent, targeting a reliability as close to 100% as possible, which will allow the development of productive and commercial activities, as well as the provision of appropriate public services, mainly education and health.

The National Electrification Plan aims at the end of 2024 for a share of grid extension of 56.1% for all of Rwanda, bearing the larger investment effort in this period. Around 750 thousand connections will be required for 4,700 villages within the reach of the existing grid, requiring an estimated investment cost of $448 million[12]. Additionally, the extension of the MV and LV grid to 2,400 new villages, designed in detail by the Reference Electrification Model REM for over 430 thousand new customers, will require an overnight investment cost of $316 million. A very significant, and innovative, effort will also be devoted to developing mini-grids for around 320 thousand customers in 2600 villages, with a total investment of $200 million. Grid and off-grid high-quality standard solutions by 2024 will have reached 2.5 million (64.2%) of the customer base.

The remaining 5100 villages in this First Roll-out wave, almost 1.4 million customers, will be electrified with a DC solar kit, while a few thousand of community and productive loads will also remain isolated and supplied by standalone AC systems, adding $59 million in overnight investment. Considering together fill-in, new extensions, mini-grids and standalone systems, the total investment effort for the First Roll-out wave reaches $1,023 billion.

NEP also establishes for this period the corresponding total annual O&M (operating and maintenance) costs of $23.7 million/year for densification ($10 million/year), grid extension ($7 million/year), mini-grids ($6 million/year) and standalone systems ($0.7 million/year) at the end of 2024. The densification investment and O&M costs have been roughly estimated from known per-household connection costs[13] and estimated new connection needs. It is also important to highlight here again that the CAPEX (capital expenditure) and OPEX (operating expenditure) associated to the growth of demand of customers already connected to the already existing network are not included within the scope of NEP 2024.

2.3.2. 2031-2040. Second Roll-out Wave

Reducing the share of customers supplied with a standalone system from 40% to 20% between 2031 and 2040 will require an investment close to $1.3 billion throughout this period. Almost $900 million will be devoted to reaching most of the 5,100 isolated villages in non-risk areas with grid extensions adequate to

[12] MIT&IIT-Comillas UEA Lab 2020. TASK 3b Report. Institutional and Regulatory Recommendations for the National Electrification Plan in Rwanda

[13] These average connection costs encompass many different situations, ranging from cases where only a drop line to the closest LV line is needed, to cases where a new MV/LV transformer is also necessary, plus the meter and protections in all cases.

their demand in those years. $290 million will still be required for further densification in areas with connection to the main grid, also considering that most of the mini-grids created by 2024 will probably be embedded into the central grid at the end of this Second Roll-out wave. Finally, the cost of new solar kits and replacements within these 10 years will still account for another $100 million; this is a rough estimation, representing the CAPEX deployed to deal with population and consumption growth and the replacement of the kits that have been amortized during the 2031-2040 period.

2.4. Models of Private Sector Participation in the Distribution Sector[14]

Distribution companies in most low-access countries are faced with a deteriorating financing situation as a result of a combination of factors: limited cost-recovery due to tariff structures and high cost of wholesale power supply, along with large technical and commercial losses. This has resulted in under-investments in the distribution segment, including infrastructure and network expansion, affecting accessibility, quality and reliability of supply. In turn, commercial and industrial consumers that traditionally have been the important sources of revenue for discos are increasingly investing in captive generation based on diesel and renewable energy.

Addressing the structural challenges and long-term financial-sustainability concerns of discos will be crucial for mobilising investments towards the urgently needed infrastructure in distribution, as well as meeting the universal electricity access objectives. With a heavy involvement of the state in the ownership and management of discos, greater private sector participation in distribution is seen as an important catalyst for improving internal management and operation with a view to improve operational viability. Importantly, it is also a means to attract the substantial levels of investments needed for the development and strengthening of infrastructure to improve quality and reliability of service and add new connections.

Figure 1 illustrates different models of private sector participation in the distribution sector. The models are assessed from the perspective of meeting the two pre-requisites for strengthening the distribution sector in low-access countries: nature and extent of private sector involvement and the potential for mobilising substantial private capital.

[14] D. Nagpal, I.J. Pérez-Arriaga. "How is the distribution sector in low-access countries attracting private sector participation and capital?". GCEEP Working Paper. May 2020. https://www.endenergypoverty.org/reports

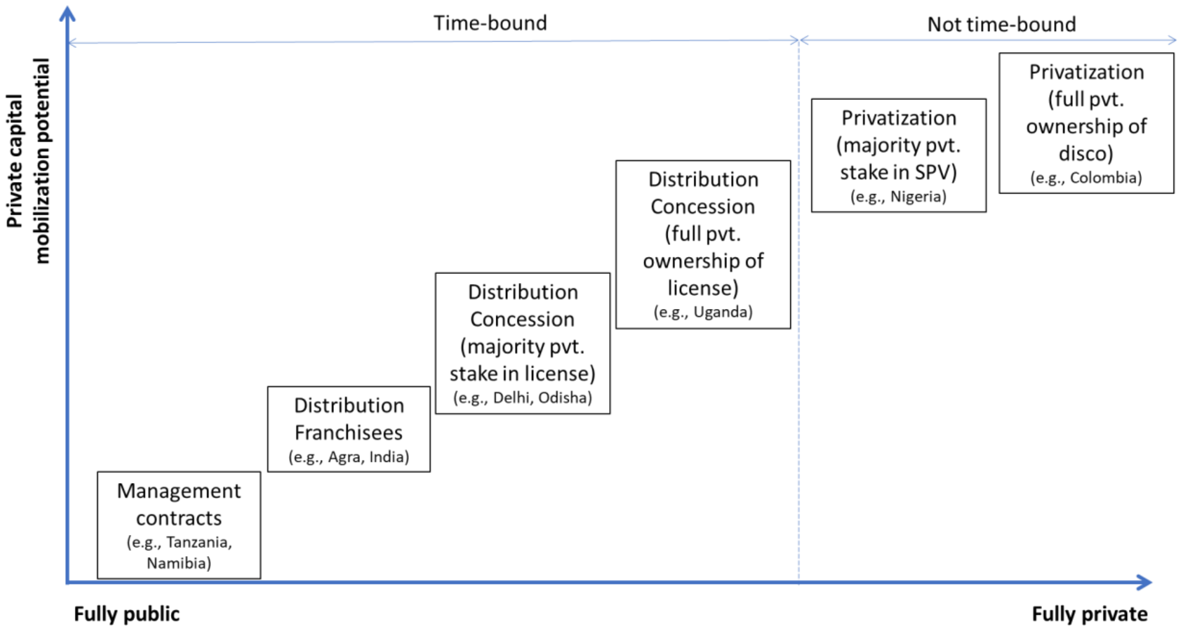

Figure 1. Different modes of privatisation of distribution sector in developing countries

Private sector involvement in the distribution sector can be designed to be time-bound or indefinite. Time-bound measures for participation of the private sector are for a specific period of time, after which the operational and economic rights of distribution reverts back to the government/public sector control. Examples of such measures include:

- Management contracts wherein private sector involvement is short-term (5-10 years) and largely limited to improving internal management and reducing aggregate technical and commercial (AT&C) losses through higher collections and tariff reforms. The large-scale mobilisation of private capital is often not the focus of such measures.
- Distribution franchisees are usually short- and medium-term (5-15 year) agreements between existing distribution licensees and private entities to carry out activities related to supply, billing and collection, customer engagement, reduce technical losses and undertake capital expenditures needed to meet prescribed performance objectives.
- Distribution concessions wherein an entity, which is majority or completely privately-owned, is provided a long-term (20-25 years) distribution license to service a certain territory. In such cases, the entity has full operational and investment rights over the duration of the concession while the extent of economic rights vary, depending on whether the government retains total (this is the case in a pure concession contract) or partial ownership in the entity. Here, the objective is usually to mobilise private capital for investments into the infrastructure and operations.

Indefinite privatization measures essentially involve transfer of operational and economic rights of distribution to the private sector with the intention that at no time does the control revert back to the government/public sector. The entity taking over the distribution licensee under such a privatization model may either be entirely owned by the private sector (*e.g.,* as is the case in Colombia) or majority-owned (as is the case in Nigeria).

The distribution concession model

A Distribution Concession (DC) engages the private sector to mobilise investments in the distribution sector and is usually long-term (20-25 years). Compared to management contracts, the level of private sector engagement increases under such concessions as they assume a greater risk in anticipation of a return. Strict concessions require the private lessor to operate, maintain, and expand the asset, and, at the end of the concession period, return the asset, with all improvements, to the owner, and receive a payment for the residual value of the investments made[15].

The DC is a more complex regulatory and legal construct than the distribution franchise (DF). The major difference with the DF is the need for substantial investments, therefore requiring additional regulations regarding the remuneration in order to reduce the risk of the concessionaire (of not having its investment and operation costs properly remunerated) and the risk of the consumer paying too much for the service (or too little, rendering the distribution activity insolvent). As in the case of the DF, regardless whether the incumbent power company is vertically integrated or not, the concession only refers to the activities and assets corresponding to the distribution segment.

The concessionaire is a company, which in general would be established as a special purpose vehicle (SPV), i.e. with several participating entities, just for the purpose of managing the concession, possibly with non-recourse. The ownership of the SPV may be structured in different ways. In the case of Uganda, for instance, the SPV is owned entirely by the private sector. Meanwhile, in Delhi or Odisha (India), the private sector owns a majority controlling stake in the SPV, while the remainder of the equity stake is held by the government. At the end of the concession all the assets are returned to the incumbent utility.

As with the DF, the SPV will take over the entire management of the distribution company. However, in this case all investments will be made entirely by the SPV, in line with an agreed capital expenditure plan and following approvals by the regulator and/or the ministry for any major investments.

The distribution assets will be split into two categories for regulatory and business model purposes: i) the new investments "A" made by the SPV during the duration of the concession, and ii) the assets "B" that existed at the moment of awarding the concession.

In the case of a DC, the concession contract is signed between the SPV and some governmental entity, acting on behalf of the customers, and it will be supervised by the regulator or some ministerial department or public agency. It follows a description of the general characteristics of this kind of contract, illustrated by some examples.

Treatment of assets A

The regulator computes the revenue requirement RRA to be paid to the SPV for the cost of service associated with the new investments. The RRA comprises capital costs CAPEXA and administrative, operation and management costs OPEXA.

Regarding CAPEXA, the regulator must follow the usual procedure to determine the regulatory asset base of the new investments (RABA), and the corresponding cost of capital to be paid every year to the SPV on this concept. The usual separate remuneration of debt and equity resulting in the WACC to be applied to

[15] Hoseir et al. (2017) and Jacquot (2019) provide a comprehensive overview of the different types of concessions supported by country examples.

the entire RABA would be followed. The return on equity might be established from the outset for the entire period (this is the case of the 20% of Umeme, or the 16% of Tata Power Delhi. Alternatively, it could be adapted to the capital market conditions. The cost of amortization of the assets will be computed on the basis of the economic lives of each one.[16]

Guaranteed return on equity incentivizes much-needed investment in distribution. In the decade between 2002 and 2013, Tata Power Delhi incurred capital expenditures of over INR 3000 crores (or USD 418 million at current rates) [17]. Meanwhile, Umeme in Uganda has invested over USD 600 million since 2005 in the distribution system (Umeme, 2019)[18]. Where other investment risks may be prevalent, de-risking measures have been introduced such as the setting up of an escrow fund to ensure payments from the government to the concessionaire and political risk insurance from MIGA as has been the case in Uganda (World Bank, 2015)[19].

One important issue is what assets the regulator considers that can be included in the RAB. For instance, in the concession contract of Tata Power in Odisha, investments in generation or storage, either on- or off-grid, that might be used to reinforce the end of long feeders where reliability and quality of service may be poor, will not be included in the RAB.[20]

The concession contract of Tata Power in Odisha establishes that the CAPEXA annuity will be updated every year to account for the new investments, while the annual value of OPEX is reviewed every three years. This incentivizes Tata Power to improve the efficiency of O&M, as well as gold plating (regulator permitting) its new investments.[21]

At the end of the concession period (20 or 25 years are typical values), if the concession is not renewed the residual value of the A assets must be paid to the owners of the SPV, which is terminated. The Government retains the full ownership of the distribution company.

Treatment of assets B

Assets B, that existed at the time of awarding the concession, require administration and operation and maintenance. Therefore, CAPEXB must be included in the revenue requirement, as it is done with CAPEXA.

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[16] The actual composition of the capital of the company will consist of a mix of debt and equity, where debt may have return periods much shorter than the economic lives of the power systems assets. The business plan of the SPV must provide a solution to this mismatch, by making use of a suitable financial strategy.
[17] Tata Power – DDL (), https://www.tatapower-ddl.com/Editor_UploadedDocuments/Content/FAQ's.pdf
[18] Umeme (2019), https://www.umeme.co.ug/umeme_api/wp-content/uploads/2019/07/UMEME_Power_Book_web.pdf
[19] World Bank (2015), http://documents.worldbank.org/curated/en/354661498163378835/pdf/116661-WP-P150241-PUBLIC-53p-Detailed-Case-Study-Uganda.pdf
[20] This creates an interesting dilemma. If the SPV is not mandated to improve reliability and quality of service in these areas, or it does not have the economic incentives to do it, then a potential market opportunity opens in using off-grid solutions – either mini-grids or standalone systems – to offer an alternative reliable and high-quality supply to those customers that might be interested in paying extra for it – typically commercial, industrial and well-off residential customers. Since Tata Power is also in the off-grid business, this may create some conflict of interest. There might be some better approach to incentivize the adoption of societal least cost solution in each case.
[21] This is the classical regulatory dilemma concerning the incentives created by any specific regulation on the relationship between CAPEX and OPEX for any Disco. In fact, often the same goal in reliability or quality of service can be achieved by capital investment or by increasing AO&M activities. The specific regulation determines in which direction the distribution company will be incentivized to perform.

The issue to be addressed now is what to do with the capital cost associated with Assets B. First, it is to be expected that a rigorous accounting of the value of the existing distribution assets has not taken place, and therefore the value of CAPEXB is not known precisely. Second, in most developing countries with access deficit, governments do not want to apply cost reflective tariffs because of a diversity of reasons, including that a large fraction of the population cannot afford the costs, that customers may not want to pay for a service of poor quality, and that is popular to maintain the tariffs low, even if this means that the government has to spend money in bailing out the Discos instead of using it for other purposes, while condemning the discos to permanent underperformance.

In a concession agreement, the Government can fix a value of RABB for the B assets well below what should be in reality. This has the effect of creating a low value for the corresponding CAPEXB annuity, resulting in a low tariff, as desired, but one that is cost-reflective, if the “tuned” value of RABB is accepted as the true value of the assets. Although the tariff in this case is cost-reflective, the ad-hoc declaration of a low value for the RABB is actually a tariff subsidy for the end customers.

In the concessions of Delhi and Odisha it has been agreed that the concessionaire will own 51% of the company during the duration of the concession, while the Government of Delhi or the Government of Odisha, respectively, will own the remaining 49%. This seems to imply (to be verified) that the amount paid by the concessionaire in the auction will entitle it to an initial 51% of the rights to the revenues of the company as well as to the control of the board. The amount paid also determines the value of the initial RAB (which is RABB, since RABA is zero at the outset).

The economic terms of the concession

The concession is awarded by means of an auction, where several concepts are evaluated. First, the key economic component of the auction is the bid on the amount to pay to the Government to get the concession. The regulator announces a minimum value for this amount, and the bidders will equal or better the minimum value, or they will quit the auction.[22] This minimum value set by the regulator can be interpreted as the value RABB of the existing distribution assets that the concessionaire will be able to use while their physical lives last and only until the end of the concession[23]. Note, however, that the concessionaire will just manage but not own the assets B, for which no compensation will be given at the end of the concession. On the other hand, at the termination of the concession, if it is not renewed, the concessionaire will receive the residual value of all the assets A that have been included in the RABA (and of any investment associated to the assets B and allowed to be included in the RAB). This completely ends the relationship between the concessionaire and the Government.

The second economic component of the auction may be a detailed business plan, whose soundness will be evaluated in addition to the other two components. This has been the case in the auction for the concession in Odisha that was awarded to Tata Power.

And the third and final component are commitments to meet performance targets, such as loss reduction, reliability metrics, or number of new connections, whose level of realization will be subject to penalties or

[22] In the case of Uganda, the concessionaire Umeme pays an annual fee for the use of the existing distribution network (assets B).

[23] Therefore, this value is NOT exactly the RABB, but the economic value of leasing these assets for all purposes of economic and managerial control of the company for the duration of the concession. Subtle point.

credits. In the case of the Odisha only a loss reduction commitment was required. In the case of Delhi, year-on-year reduction in AT&C losses were sought for a 5-year period.

To provide certainty to the private investors, in Delhi's case the government issued policy directions to provide clarity on bidding criteria, availability of assured returns and tariff fixation criteria, among other parameters. For instance, prior to the bidding, the bulk supply tariff order was issued by the regulator from 2002 until the end of 2006-07 to provide clarity on revenue/expense outlook[24].

Revenue requirement, tariffs and subsidies

The regulator will compute the tariffs that will allow to recover the established total revenue requirement, including now the A and B assets. The initial tariffs must take into account the present value of total losses, either technical or commercial, so that the estimated revenues to be collected allow the recovery of this revenue requirement. The tariffs in the following years will be computed on the basis of the prescribed trajectory of losses. Therefore, the SPV has the incentive of reducing the total losses as much as possible, while it is cost effective, taking also any incentive regulation into account.

Note the conceptual difference between the revenue requirement, which needs to be cost reflective, since otherwise no private investor would be willing to participate in a concession agreement, and the estimated revenue collected from the tariffs that are determined by the regulator. If the tariffs are designed to be cost-reflective, both quantities will be equal. If the amount to be collected by the tariffs is below the cost of supply, then a subsidy is needed to make the distribution activity whole. This subsidy can be deployed in different ways: for instance, a direct individual subsidy to some categories of customers; an annual lump sum to the concessionaire to make it whole; or a reduction in the wholesale price of the electricity that is purchased by the SPV to meet the demand of its customers.

If the concession covers a rural territory that has not been electrified yet, or that has been electrified for a minimum demand level that could grow substantially under a more robust supply of electricity, or where there is connection, but of poor reliability and quality, then the necessary investment to achieve a satisfactory electricity supply can be substantial. If the physical condition of the B assets is poor, significant investment may be needed to achieve the levels of performance required in the concession contract. Proper metering and customer attention may require additional investment and O&M costs. Even if the tariffs prior to the concession contract were cost reflective, they will be probably insufficient to cover these new high costs, and therefore an additional subsidy might be needed to make the concessionaire whole. As a hypothetical example, this would be the case of Umeme, the only distribution company in sub-Saharan Africa (with Seychelles) where tariffs are cost reflective, in case a new concession – for a new term starting 2025 – is negotiated that includes the obligation of universal electrification in some territory (perhaps the entire country), which mostly consists of rural electrification. Then, a distribution activity that was initially financially viable without subsidies will now need to be subsidized.

2.5. The Business Plan

As indicated in the introduction section, the business plan to be presented here accounts only for the electrification plan (i.e. all that presently is not electrified yet), but not the existing distribution network –

[24] https://www.tatapower-ddl.com/Editor_UploadedDocuments/Content/TPDDL%20Case%20Study_COMPLETION%20OF%2010%20YRS.pdf

i.e. the assets A but not the assets B, as in the discussion in the previous section 4.[25] Should information on assets B be made available, the business model could be extended to include both the existing and future distribution system, including off-grid solutions. For the time being this template is just meant to be an instrument for discussion and clarification of the potential of the IDF, in Rwanda and elsewhere.

2.5.1. Scope of Work

The purpose of this preliminary business plan is to facilitate a consensus among the main stakeholders that could be involved in making possible a concession agreement to achieve full electrification in Rwanda. Each one of these main stakeholders has different business, financial and social objectives:

- The GoR wants a plan where everyone gets electricity within a reasonable but short-term timeframe, with an entity with the financial and technical resources to deliver reliable supply, and with the cost of periodic bailouts to the disco being replaced by a financially manageable amount of subsidies. We have assumed these subsidies would include both yearly amounts to complement the tariff income and some financing/equity-like support (whether acting as principal or most likely facilitating some DFI funding, "GoR Subsidized Financing") to complement initial equity and debt financing.
- The incumbent distribution company seeks the improvement of the existing network and its extension to connect new customers, plus the development of off-grid solutions, with a satisfactory level of reliability and quality of service, and in an integrated way – although separate accounting might be needed for each one. This can be accomplished by turning the management of the company to the concessionaire for a period of time.
- The regulator will oversee both current and new developments to ensure the regulatory framework is fully respected by all industry players and to provide the required stability and confidence to the industrial partner and the financing providers.
- The different financing providers are all assumed to seek some level of balance between achieving their respective financial targets and contributing to the economic and social development of Rwanda.
- Finally, the new industrial partner will play a critical role as equity provider and, most importantly, new business operator to contribute their industrial expertise and to assume ultimate responsibility on the execution of the business plan.

The business plan has been prepared and this document has been written from the Government standpoint, i.e. with the main purpose of aligning the interests of the other key stakeholders around the DC implementation.

As discussed above we have assumed that, in a first approximation, the Government is indifferent to, from a pure financial perspective, whether the grid extension, the development of mini-grids and the provision of services with standalone systems are done by a single entity or by separate ones. Therefore, and for simplicity purposes, the financial model:

[25] The detailed cost estimates provided by the MIT/Comillas electrification plan refer only to what remains to be electrified, but not to what has to be done in the existing distribution network. The business plan can only be completed once this information is included in the financial analysis of the distribution concession business model, which must comprise the entire Rwandan distribution system.

- Limits itself to provide an indicative quantification of the total required investment, the operational management and potential financing plan for the non-electrified customers during the 2021-2040 period.
- Assumes that a single entity will be responsible for investing, operating and managing these future distribution assets, while being compatible and adaptable to other structure scenarios.
- Provides a useful platform to, upon completing appropriate diligence, eventually incorporate the existing distribution business so the full system and its key business drivers could be further analyzed.
- Incorporates the key business and financial assumptions required to evaluate and articulate the implementation of the DC model explained above (assuming that is the finally selected alternative).

2.5.2. Financial Model Structure

The economic and financial model is built around four modules: the new distribution network roll-out plan, the expected/required operating income to support the network investment, the working plan associated with such business development and the overall financing plan to make it all possible:

- As stated in the description of the electrification plan in section 3, the new network investments will be rolled-out in two stages: (i) during the period 2021-2025, where there will be an optimal mix between grid extension, fill-in consumers, mini-grids and stand-alone systems in order to achieve full population coverage by the end of period ("First Roll-out Wave" – as described in section 3 and corresponding to the Master Electrification Plan), and (ii) during the period 2031-2040, where the objective will be to improve the population connectivity to the grid by reducing the weight of stand-alone systems from 40% in 2030 to 20% by 2040 ("Second Roll-out Wave" – with its basic parameters defined in this section), together the "Roll-out Waves". During the Roll-out Waves, some amount of CAPEX is also deployed to deal with population and consumption growth. In addition, we have obviously assumed and modelled that all capital expenditure incurred will be replaced once amortized considering the different network components, employed technologies and respective life expectancy periods.
- Therefore, our revenue stream will be mostly generated by the revenues coming from the different types of customers paying for their consumption at the corresponding tariff for each customer class as detailed in section 5.3. Additionally, we have assumed the following revenues:
    i. connections and other non-energy sales (including revenue from works and other expenses initially incurred by the company but ultimately born by and invoiced to clients),
    ii. grants linked to the GoR Subsidized Financing and recognized in the P&L account as the proportionate capital expenditure is being rolled-out, and
    iii. subsidies from the Government (representing amounts not received under the tariff setting methodology and declining over time as they become non-essential to support initial business development).

The operating cost structure includes the cost of energy upstream (cost of sales), operation and maintenance costs (including all operating/yearly expenditure) and administrative expenses (split between direct customer billing/service and other overheads), in addition to the provisioning of some expected bad debt from customers.

- Working capital has been modelled including the ordinary trade receivables, inventory and trade payables required to launch and operate the business. The tax schedule has also been modelled, anticipating a 4 years tax holidays period which, together with the expected significant tax shield the business would generate, would avoid any tax payments during the First Roll-out Wave.
- Financing has been structured considering three main sources to fund the initial network roll-out as well as the expected initial operating losses:
    i. commercial/corporate debt, estimating the structure, amount, tenor and terms at or close to market conditions (potentially structuring a syndicated bank loan in which, for instance, some DFI related institution could participate),
    ii. GoR Subsidized Financing (again, some subsidized/concessional debt to be eventually provided by the Government, most likely utilizing totally or partially some DFI/World Bank facility) to be raised as required by the business plan funding (see section 2.5.3) and recognized as “grants” on a yearly basis (as the funded CAPEX is being invested),
    iii. and the required equity injection to be provided by the critical industrial partner mentioned above (although the model would allow some dividend pay-out, no distribution to shareholders has been assumed in the forecasted period to reduce financial leverage/risk and to avoid the need for any subsequent equity contribution).

Financing has also been structured taking into consideration both Roll-out Waves, which require new funding and linked debt refinancing to support the network roll-out strategy explained above.

2.5.3. Financial Model Main Assumptions

The table below in column 3 presents the key assumptions used in building the economic and financial model. Consequences of these assumptions can be found in columns 4 and 5.

Key Category	Key Metric	Key Assumption	Compound Annual Growth Rate ("CAGR") 2021/2030	CAGR 2031/2040
Macro	GDP (real growth)	9%		
	Inflation USD	2%		
	Inflation RWF	5%		
CAPEX	The network roll-out, the associated investment costs incurred in any given year and the connection of all consumers are assumed to take place proportionally throughout the year, so a mid-year convention is assumed for every year additional CAPEX and new customers (same assumption is considered for the Upstream Energy Cost, O&M and Administrative Expenses). - Period 2021/2025.- Network deployment to connect the remaining additional customers so that Universal Access can be achieved by the end of 2025 - Period 2026/2030.- CAPEX to cope with population and consumption growth and replacement CAPEX as required by specific D&A schedule - Period 2030/2040.- CAPEX focused to connect Stand Alone Systems to the grid (reducing SAS from 40% in 2031 to 20% by 2040) and cover population growth			
	- Period 2021/2025	USD 1,023 million		
	- Period 2026/2030	USD 245 million		
	- Period 2031/2040	USD 1,277 million		
	- Total CAPEX (2021/2040) of which:	USD 2,545 million		
	- Extension	49%		
	- Fill-in	26%		
	- Mini-grids	16%		
	- Standalone Systems	9%		
Depreciation and Amortization	Extension	100% CAPEX: 25 years		
	Fill-in	100% CAPEX: 25 years		
	Mini-grids	82% CAPEX: 25 years 15% CAPEX: 5 years 3% CAPEX: 10 years		
	Standalone Systems	100% CAPEX: 5 years		
	Population increase	2021/2025: The electrification plan is being implemented under the assumption of the expected population in 2025. 2031/2040: progressive reduction from 3% to 2% per year.		

	Demand increase per customer	2021/2025: The electrification plan is being implemented under the assumption of the expected demand per customer in 2025. 2026/2040: 6% per year		
Revenues	Tariffs (pass-through of wholesale energy costs)	In addition to inflation, tariffs are subject to a pass-through scheme of the cost of energy reduction for all end customers tariffs for the 2031/2040 period (the pass-through reduction linearly evolves from 5% in 2031 to 50% of the total energy cost reduction in 2040)		
	Number of C&I Consumers	Airport Cell office Coffee washing station Irrigation pumping Markets Milk collection center Mining Sector Office Tea Factory Telecom Tower Water Pumping Stations	3.4%	2.4%
	C&I Tariff	2021 - initial 25% increase on current regulated tariff (to be compensated by the 2031/2040 pass-through evolution)	1.1%	-0.6%
	Number of non-C&I Customers	Health center Health post IDP Model Village (avg.) Preprimary school Primary school Secondary school Technical Schools VTC Residential 10W Residential 50W	13.2%	2.4%
	Non-C&I Tariff	2021 - no increase on current regulated tariff	1%	-0.2%

	Connections/Other income	2021/2040 period: 5% of tariff income	11.9%	8.1%
	Grants	Grant revenues (for a total of USD 400 million, equal to the GoR Subsidized Financing) recognized in the P&L proportionally to the percentage of annual CAPEX over total CAPEX		
	Subsidies from Government	2021/2030 period: 10% of tariff income 2031/2040 period: progressive/linear decrease from 10% (2031) down to 0 (2040)	10.6%	-100%
Operating Costs	Cost of Sales (Upstream Energy Cost)	Upstream energy cost equivalent rate ($/kWh) per energy consumed/year Period 2021/2024: decrease from $20 (cents/kWh) in 2021 to $12 (cents/kWh) in 2024 in line with the NEP energy cost forecast. Period 2025/2040: linear decrease until it reaches $7 (cents/kWh) by 2040.	2.4%	5.8%
	Other Distribution Cost (O&M)	Estimated as a percentage of CAPEX incurred: - Extension: 5.30% CAPEX until 2030, being reduced from 2031 to 3% by 2040 due to efficiencies and economies of scale - Fill in – 5.30% CAPEX - Mini-grids: 0.87% CAPEX - SAS – 0% CAPEX	16.5%	4.4%
	Bad Debt Provision	3% from tariff income	11.9%	8.1%
	Administrative Expenses (Customers/Billing)	9 USD/year/client to increase with inflation	18.1%	3.8%
	Other Administrative Expenses (Overheads)	2020/2039 period: 5% from tariff income	11.9%	8.1%
	Concession Agreement	Not applicable (at this stage)		
Working Capital	Trade receivables (as #days of Revenues)	45 days		
	Inventories (as #days of COGS/Distribution costs)	30 days		

	Trade payables (as #days of COGS/Distribution costs)	60 days
Financing – Equity	Amount	2021: 150 USD million 2022: 150 USD million
	Total	300 USD million
	% Total financing (First Roll-out Wave)	30%
	Dividend (Pay-Out Policy)	0% (no pay-out indicatively assumed)
Financing - GoR Subsidized Financing	Amount	2021: 150 USD million 2022: 150 USD million 2031: 100 USD million
	Total	400 USD million
	% Total financing (First Roll-out Wave)	30%
	Drawdown/Repayment schedule	Drawdown as above, P&L recognition as per Grants schedule, no repayment assumed
	Cost	Interest Rate: 0%
Financing - Commercial Debt (linked to First Roll-out Wave)	Amount	2024: 200 USD million 2025: 200 USD million 2026: 100 USD million
	Total	500 USD million
	% Total financing (First Roll-out Wave)	40%
	Drawdown period	3 years
	Principal grace period	2 years
	Repayment schedule	2026: 10 USD million 2027: 20 USD million 2028: 20 USD million 2029: 20 USD million 2030: 20 USD million 2031: 410 USD million
	Cost	Interest Rate: 7%
Financing - Commercial Debt (linked to Second Roll-out Wave)	Amount	2031: 500 USD million
	Drawdown period	1 year
	Principal grace period	2 years
	Repayment schedule	2033: 10 USD million 2034: 10 USD million 2035: 10 USD million 2036: 10 USD million 2037: 10 USD million 2038: 450 USD million
	Cost	Interest Rate: 7%
	Refinancing/Amount	2038: 500 USD million

Figure 2. Rwanda: Financial Model Main Assumptions

2.5.4. Financial Model Main Results

Key results deriving from the financial model are analyzed following the same structure as in the tables of the previous sections.

Capital Expenditure Plan

The CAPEX plan has been elaborated aiming at reaching full population coverage with acceptable reliability by the end of 2025 (First Roll-out Wave) while maximizing population connectivity to the grid by reducing the weight of stand-alone systems from 40% in 2030 to 20% by 2040 (Second Roll-out Wave). To satisfy this goal and as per the assumptions detailed in 5.3 above, all required investments shall be completed in two distinctive stages allowing the business growing operations to address a significant – albeit non-unusual – execution and financing challenge.

As shown in Figure 3, First Roll-out Wave CAPEX for the mix of technologies is deployed in parallel for all of them throughout the 2021-2025 period as directed by the prior Master Electrification Plan. Between 2026 and 2030 both the replacement CAPEX and the additional investments to address expected population growth (maintaining same quality of service) require annual CAPEX in the region of 20% of total revenues. In 2031 the Second Roll-out Wave CAPEX starts to be deployed, requiring a decreasing percentage of revenues (from 30% in 2031 down to 20% in 2040) while delivering a significant reduction of stand-alone systems (only 20% of total expected population by 2040).

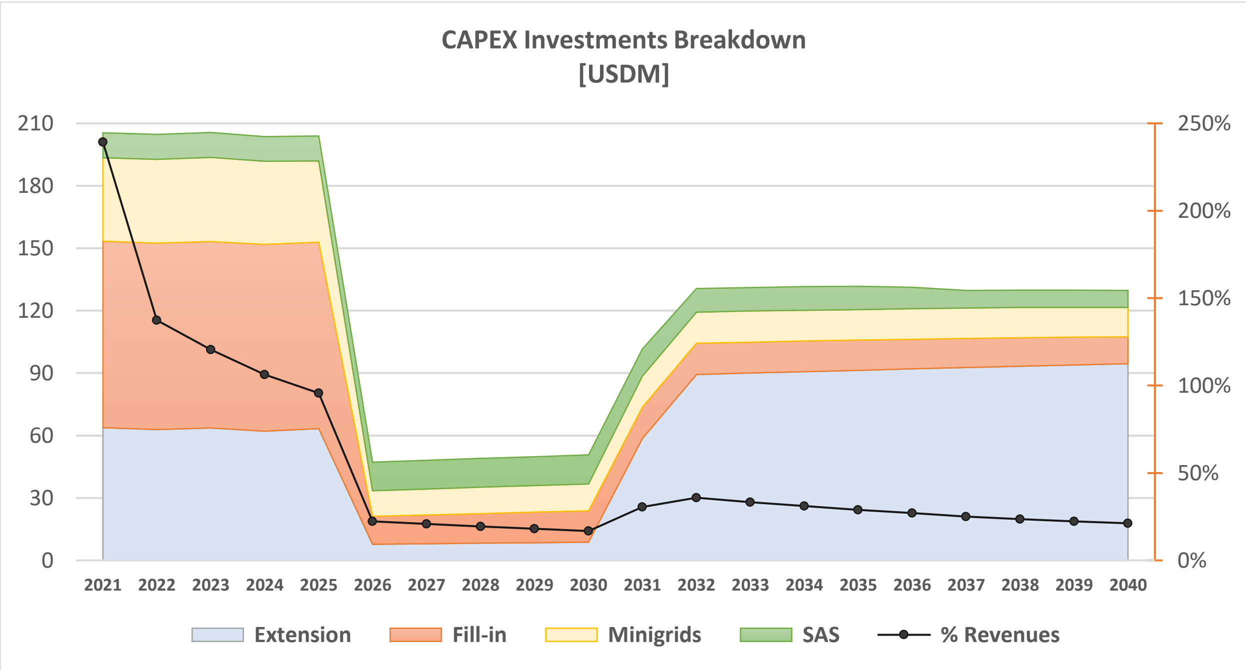

Figure 3. Rwanda: CAPEX investments breakdown

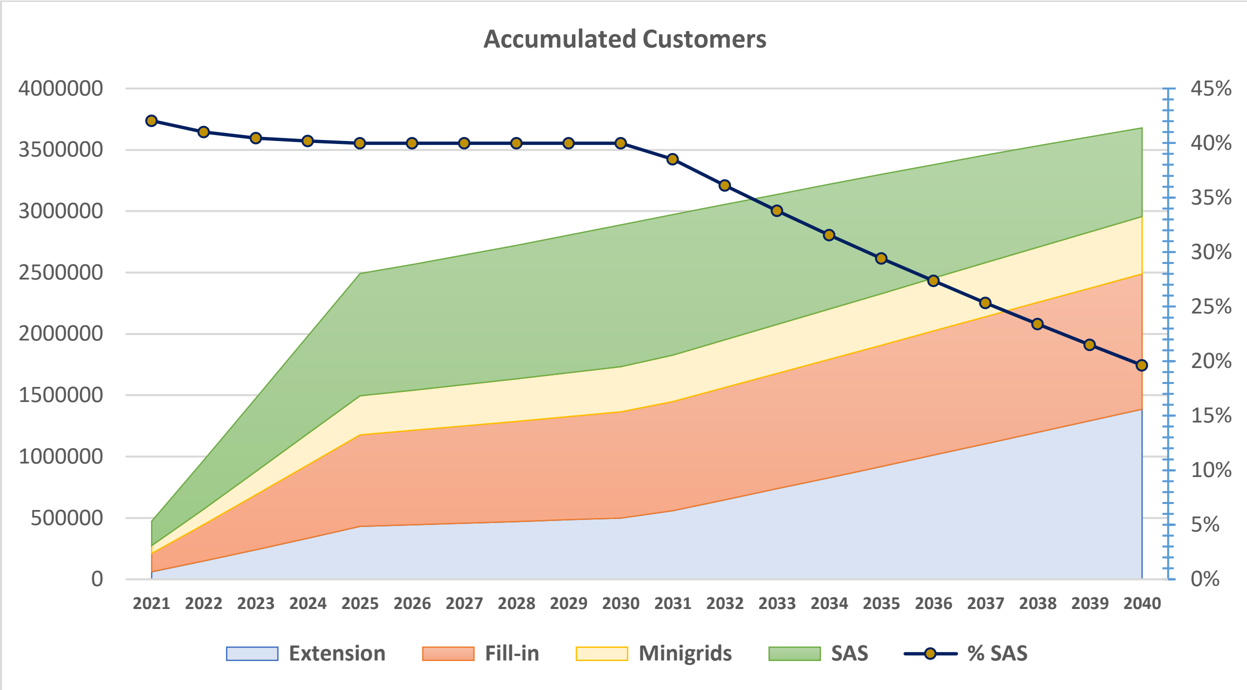

Figure 4. Rwanda: Accumulated number of customers

Revenue Model

Total revenues grow at a 2021-2030 CAGR over 9% and at a 2031-2040 CAGR around 7%, from over 80 USD million the first full year of operations up to over 600 USD million by the end of the projections period. Tariff income (growing as % of total revenues from about 55% in 2021 to about 90% by 2040) and connection income follow a similar pattern, while Government subsidies (required during the network deployment years to support business roll-out) progressively reduce their weight until they could be completely eliminated by 2040 (see Figure 5). Grants evolve in line with CAPEX deployment further to the GoR Subsidized Financing terms, which explains some accounting (non-cash) revenues decrease in 2026 when the First Roll-out Wave is completed.

Most tariff income growth comes from non-C&I customers, increasing from just over 20% the first year of operation up to just over 50% by 2040, reflecting the significant increase in the number of non-C&I customers (over 13% 2021/30 CAGR in customers electrified for the first time), despite C&A higher estimated tariffs (25% initial increase on the Regulated Tariff) and higher expected consumption increase.

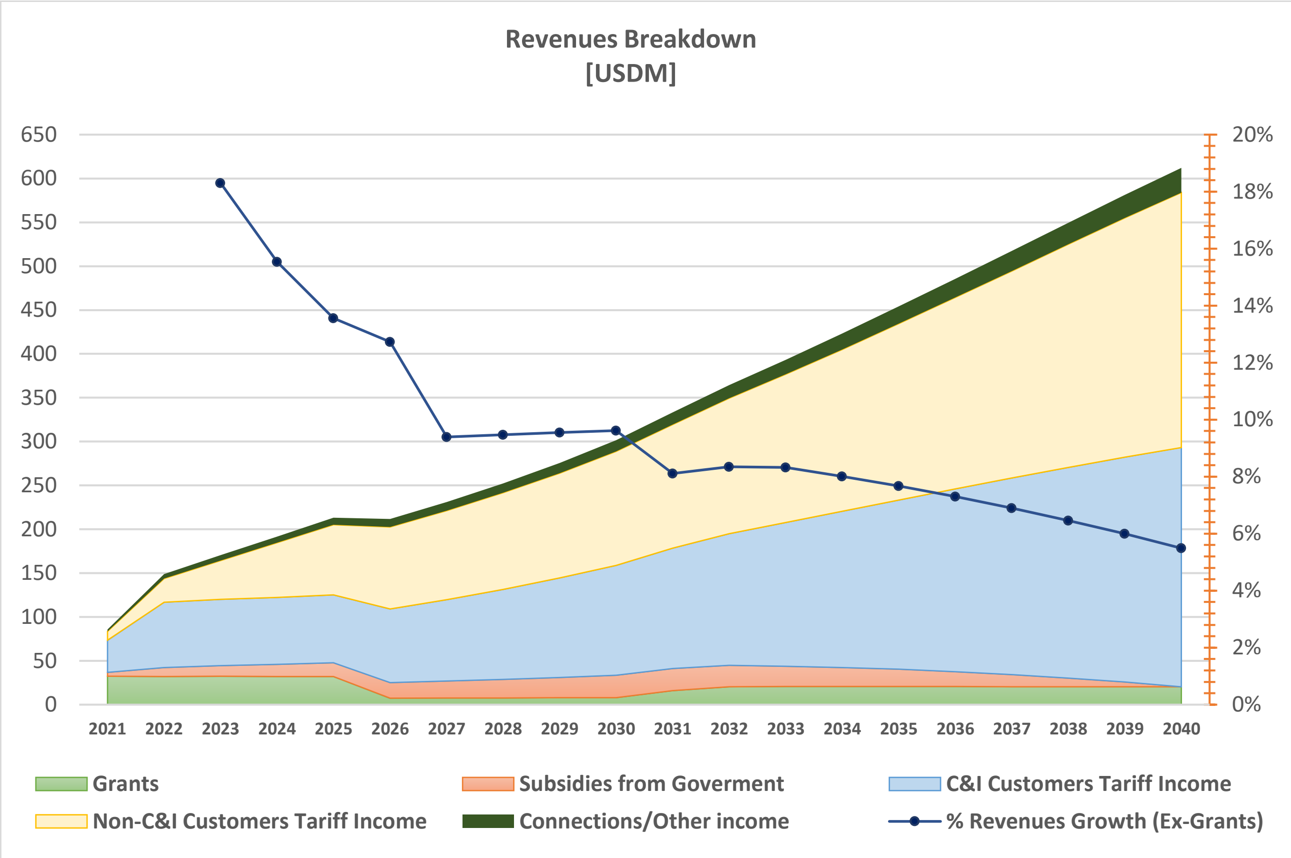

Figure 5. Rwanda: Revenues breakdown

Operating Cost Model Cost Model

Total operating costs start growing at a slightly lower pace than revenues (2021-2030 CAGR about 7%) and then benefit from operating leverage (2031-2040 CAGR just over 5%), evolving from about 90% down to about 55% of ex-grants revenues by the end of the projections period, with the following cost breakdown (see Figure 6):

- As upstream energy cost moves alongside energy consumption and inflation, its relative lower growth (2021-2030 CAGR over 2% and 2031-2040 CAGR over 4%) reduce weight from over 50% down to about 30% of total revenues by 2040.
- Distribution costs, as they grow with the capital expenditure, remain between 15% and 20% of total revenues in the 2021-2030 period and between 10% and 15% of total revenues thereafter.
- Bad debt is expected to be provisioned at 3% of tariff income (no provision write-up has been assumed).
- Administrative expenses include customer/billing services (relatively stable around 7% - 10% of total revenues resulting in a 2021-2030 CAGR around 18% and a 2030-2039 CAGR of about 4% and other general overheads (estimated to be around 5% of total tariff income).

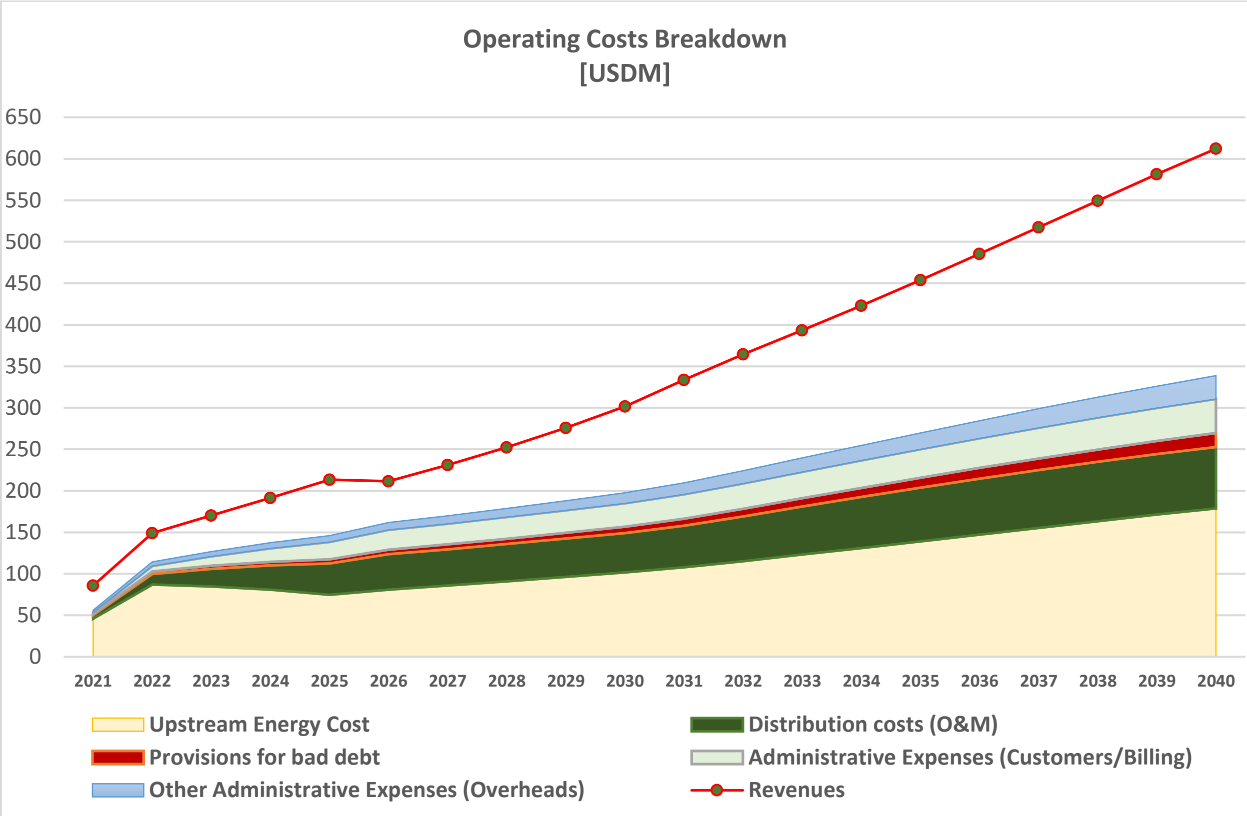

Figure 6. Rwanda: Operating costs breakdown

Operating Margins

Our estimate of revenues and cost structure produces the following operating margins (see Figure 7):

- EBITDA margin (calculated "ex-Grants" to avoid volatility brought by the GoR Subsidized Financing revenues recognition criteria) increases up to the 30/35% region by the end of the 2021-2030 period, showing some optimistic margin expansion up to the 40% area by the end of the projections period.
- As expected, EBIT margin shows a more volatile evolution linked to the network D&A schedule, starting below 10% during the first few years and growing thereafter to around 30% by the end of the projections period.

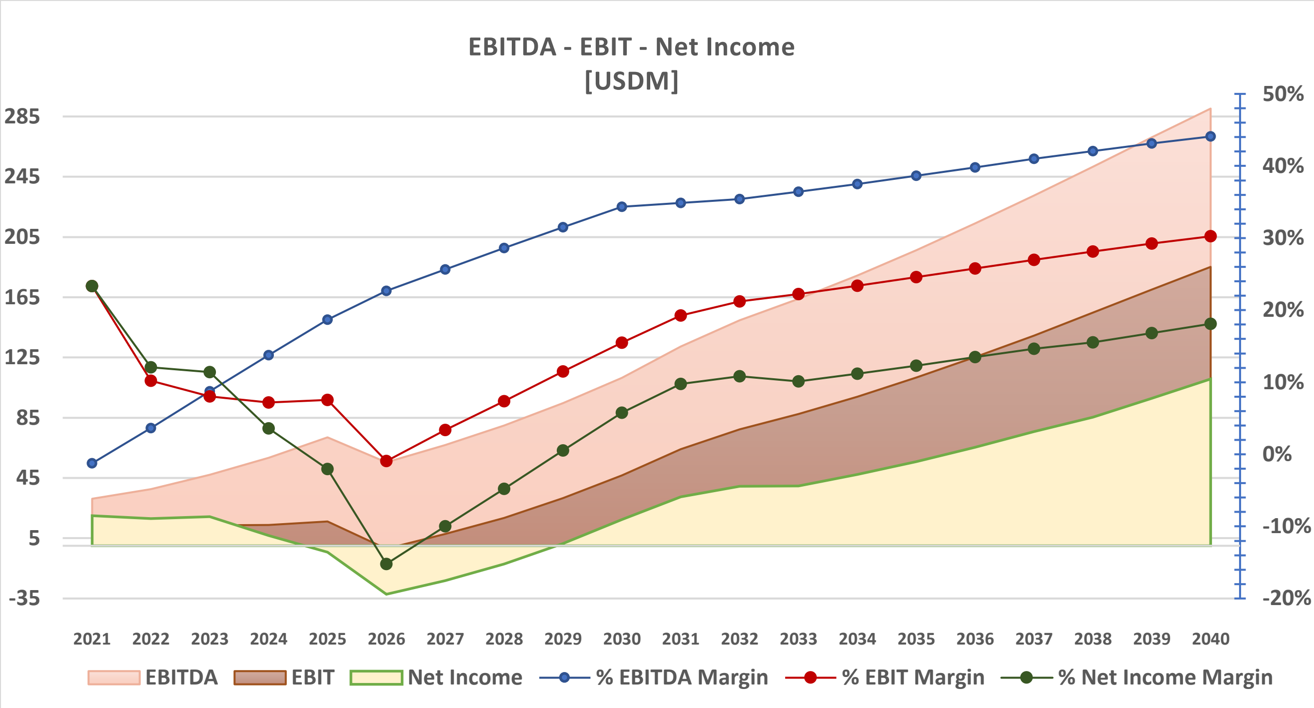

Figure 7. Rwanda: EBITDA - EBIT - Net income

Figure 7 above also shows the evolution of EBITDA (2021-2030 CAGR around 15% and 2031-2040 CAGR over 9%), EBIT (2021-2030 CAGR around 17% and a 2031-2040 CAGR over 12%) and net income (very low and even negative for a few years in the 2021-2030 period but showing a healthy 2031-2040 CAGR over 15%), whereas Figure 8 below adds the evolution of revenues to provide a full overview of the business and operating model evolution.

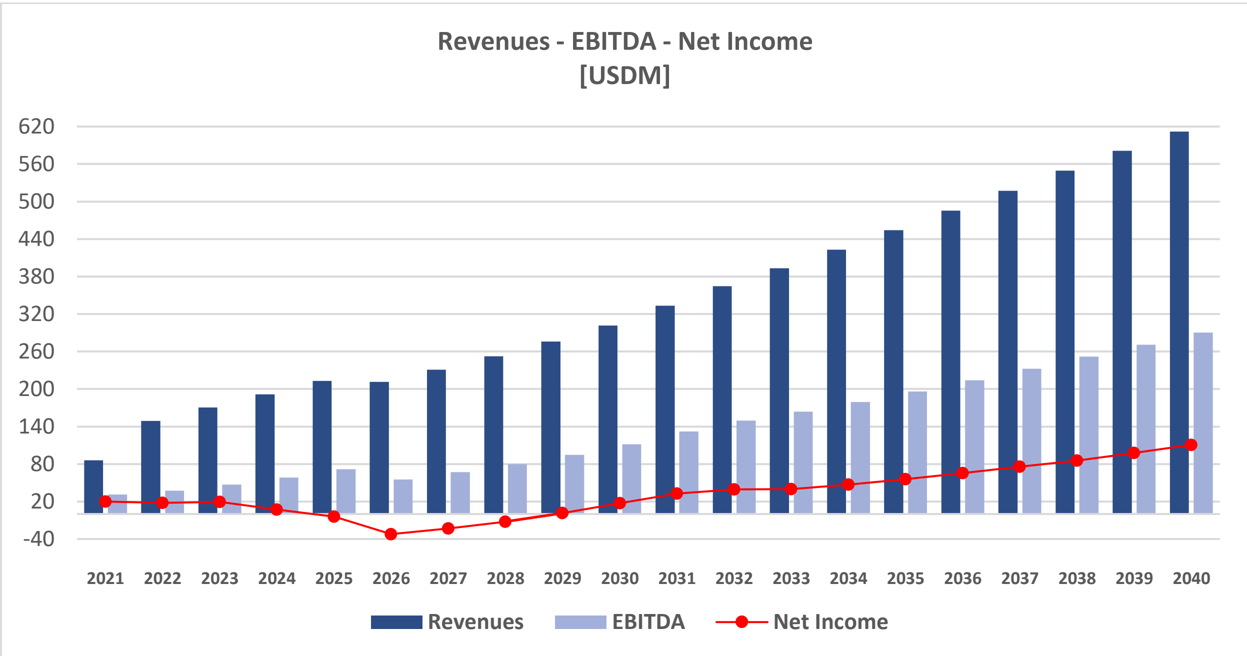

Figure 8. Rwanda: Revenues - EBITDA - Net income

Financing Plan

In summary terms, to fund the required USD 3.0 billion over the full 2021/2040 projections period (USD 2.5 billion CAPEX and USD 0.5 billion net financial expense), the following financing structure (see Figure 8) has been assumed:

- Initial equity injection of USD 300 million in 2021/22 (around 10% of the total), anticipating the new industrial partner (either on its own or alongside other investors) will have to frontload a significant amount of the initial CAPEX program subject to confirming funding commitments for the full program. No additional equity would be required to support the Second Roll-out Wave (as indicated above and consistent with limiting equity contributions, no dividend pay-out has been assumed during the entire projections period).
- GoR Subsidized Financing of (i) USD 300 million in 2021/22 (around 10% of the total), i.e., similar amount and timing than the initial equity contribution as both financing providers would seek mutual comfort by agreeing to provide equivalent financing support and (ii) additional USD 100 million in 2031 (around 3% of the total) to support the development of the Second Roll-out Wave (anticipating the significant social and economic benefits brought by the increase in connectivity to the grid). This subsidized debt has been assumed to be provided by the GoR linked to and conditioned to the network roll-out program at terms (cost, long tenor, covenants) below market, eventually channeling funds from DFIs (such as the World Bank or the AfDB).
- Commercial debt including: (i) USD 500 million in 2024/26, contingent on the previous equity and GoR Subsidized Financing being disbursed, arranged at market terms (amount, cost – 7% coupon assumed considering some spread on the 6.625% GoR USD financing, tenor, repayment schedule and financial covenants) and thus acceptable by commercial debt financing providers (indicatively, we believe an IFC led syndicate could bring significant structuring and execution benefits but other funding sources could also be contemplated); (ii) USD 500 million commercial debt refinancing has been scheduled in 2031 (linked to the second GoR Subsidized Financing USD 100 million payment) and (iii) another USD 500 million commercial debt refinancing could be arranged in 2038 (when both business and capital structure have been stabilized so best terms could be achieved). Net debt (and so net financing inflows into the business) is estimated to be around USD 300 million by 2040 (around 10% of the total, including USD 400 million commercial debt and USD 100 cash/equivalents).
- Operating cash flow of USD 2.0 billion generated by the business over the 2021/2040 period (around 67% of the total).

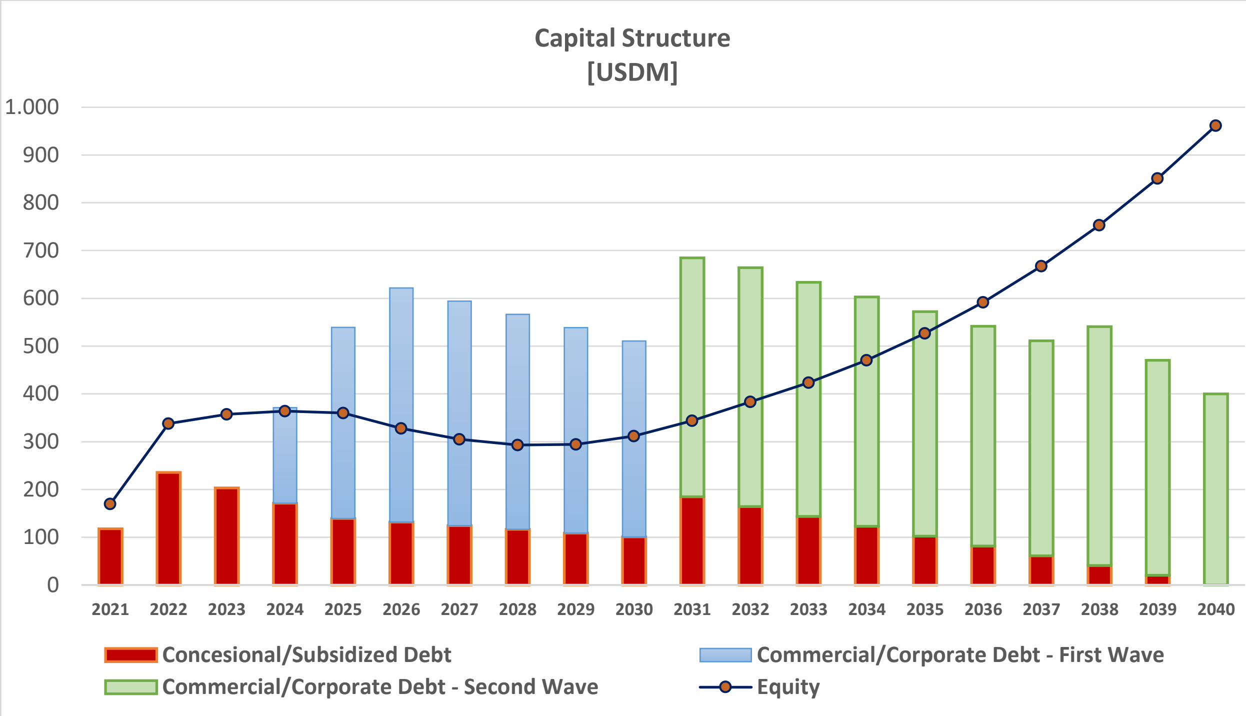

Figure 9. Rwanda: Capital structure

Some key leverage ratios (see Figure 10) support the capital structure sustainability, with DSCR (EBITDA/debt related payments) over 1.4x except in 2026 (1.3x) and 2027 (1.2x), Net Debt / EBITDA peaking at 9.0x in 2026 but quickly deleveraging afterwards (down to 1.2x by 2040), Total Debt / PP&E around 60%/70% until it peaks at 75% by 2032 (progressively declining afterwards) or Interest Cover (EBIT/interest expense) consistently above 2.0x during the Second Roll-out Wave.

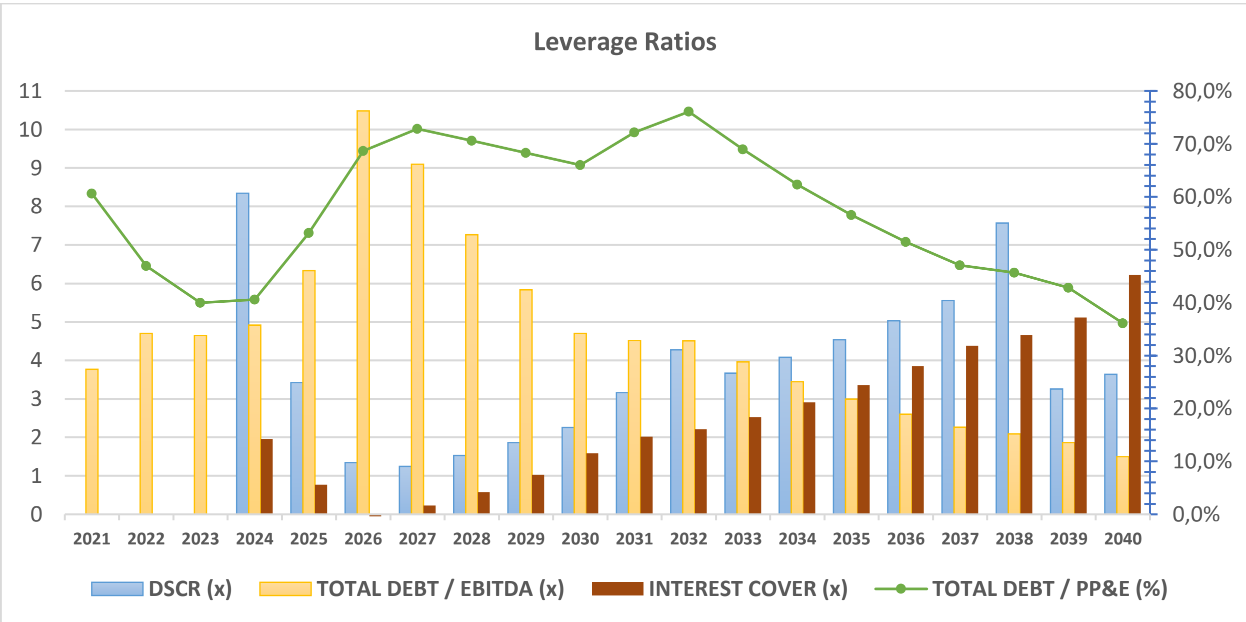

Figure 10. Rwanda: Leverage ratios

Business Plan Returns

The business plan produces the following returns (see Figure 11 below):

- ROCE, calculated as EBIT/(Equity + Net Debt), below 7% during the 2021 – 2030 period, but growing from 8% in 2031 up to 15% by 2040.
- Net ROCE, calculated as NOPAT/(Equity + Net Debt), below 5% during the 2021 – 2030 period, but growing from 5% in 2031 up to 10% by 2040.
- Given expected cost of debt, tax impact (estimated at 30% but, as discussed, non-applicable during the First Roll-out Wave) and lack of extraordinary cash distributions back to shareholders, return on equity (ROE, calculated as Net Income/Equity) grows from 10% to 12% in the 2031-2040 period.

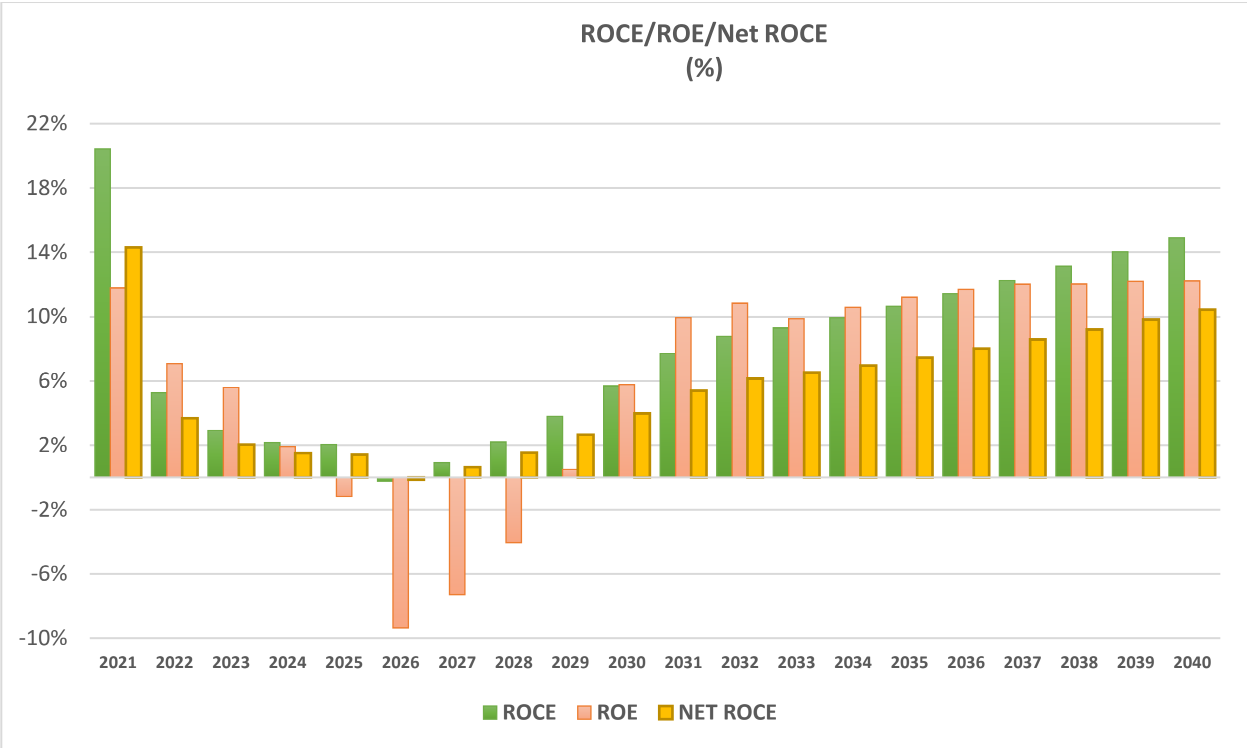

Figure 11. Rwanda: ROCE/ROE

Finally, equity internal rate of return (IRR), calculated under several holding/exit horizons and some estimated market value multiple of 10x EBITDA by 2031, 2036 or 2040 (in line with some recent and relevant transactions), result in 11% / 12% over 10, 15 or 20 years (see Figure 12 below).

Figure 12. Rwanda: Equity IRR (%)

2.6. Conclusions

To complement the key results explained above, some final comments are presented on the key conclusions and implementation challenges as well as the opportunities that have become apparent while building the business plan:

- The overall Integrated Distribution Framework (IDF), with the adoption of a Distribution Concession (DC) model, are the keystones of the business plan. As explained, rolling out the network (as per the explained Roll-out Waves) and hence developing the CAPEX program are the primary drivers behind the operating model.
- The Government's role will also be critical from several standpoints: as current owner of the existing distribution business (and thus counterparty to the potential concession agreement – see comment below), as potential support to the development of the new/early business via incentivizing subsidies, as facilitator of the GoR Subsidized Financing and as ultimate guarantor of the regulatory environment (including tariffs or taxes, among other instruments). The Government participation would be key to provide the necessary comfort both to the debt and equity providers as well as to maximize, as the key stakeholder in the resulting business, the expected social and economic benefits that the execution of the electrification program would bring to the country as a whole.
- Designing the best possible capital structure (negotiating and aligning the different capital providers) is also paramount, not only to achieve a fully funded business plan but also to provide the equity partner with the appropriate financial certainty to fund the equity investment.
- The overall investment case for the new industrial partner should be further articulated on the basis of financial arguments (both in the base case and through additional scenario analysis), strategic value and, of high relevance in current corporate and financing markets, a very compelling ESG proposition: Environmental (given sector "green" status), Social (given the notorious social benefits brought by the

network development program) and Governance (ensuring that the overall business plan execution and the alignment of interests among all stakeholders comply with best corporate governance standards).

Finally, it is necessary to conclude with the scope of work “not-performed“ in the economic and financial model built at this stage and presented in this document. Focus has been given to the network roll-out plan for the non-electrified customers in Rwanda but, in order to provide a fully comprehensive business plan of the country entire distribution system, a complete analysis should be carried-out around the existing distribution network/business plus the new distribution network/business, as a single integrated entity within a single concession, but with separated accounting and remuneration approaches, as indicated in section 4. Completing this integrated analysis and incorporating it into the business plan for the non-electrified customers should further confirm the overall model operating and financial feasibility as well as the social and economic benefits it would bring to all the stakeholders.

3. The electricity access index methodology and preliminary findings (Pérez-Arriaga et al., 2022b)

This chapter reproduces the contents of the article "The electricity access index methodology and preliminary findings (Pérez-Arriaga et al., 2022b)" published in May 2022 with co-authors Pérez-Arriaga, I., Díaz-Pastor, S. and Mastropietro, P. by the Global Commission to End Energy Poverty (Working Paper Series) as part of the MIT Energy Initiative.

3.1. What is the goal of the Electricity Access Index?

As recognised by the United Nations through its inclusion as the seventh Sustainable Development Goal (or SDG7) of its 2030 Agenda, access to sustainable, reliable and affordable energy is a key element for the development of the economy and the society as a whole and an essential facilitator for all the rest of SDGs (UN, 2021). Between 2010 and 2019, 1.1 billion people gained access to electricity worldwide, bringing the global access rate from 83% to 90% (WB, 2021). The annual rate of growth reached 130 million people in the period 2017-2019, outpacing population growth globally, although not in every region. And preliminary data show that the global number of people without access was broadly stuck or increased in the period 2019-2021, mainly due to the impact of the Covid-19 pandemic, which hampered electrification efforts and amplified affordability issues (IEA, 2021).

In the world, 759 million people lacked electricity access in 2019, with Sub-Saharan Africa accounting for three-quarters of the global population without access. Worldwide, there is a significant urban-rural divide, with 84% of the global population without access living in rural areas. Accounting for population growth, 940 million people will have to gain access to electricity by 2030 in order to comply with SDG7.1.[26] According to all consulted studies, global investments are not on track to achieve this goal (The Rockefeller Foundation, 2020) and, with the current and planned policies, more than 670 million people may still lack access by 2030 (IEA, 2021). New instruments are required to assess progress towards SDG7.1, signalling the main hurdles to electrification and the regions and countries that require an enhanced effort.

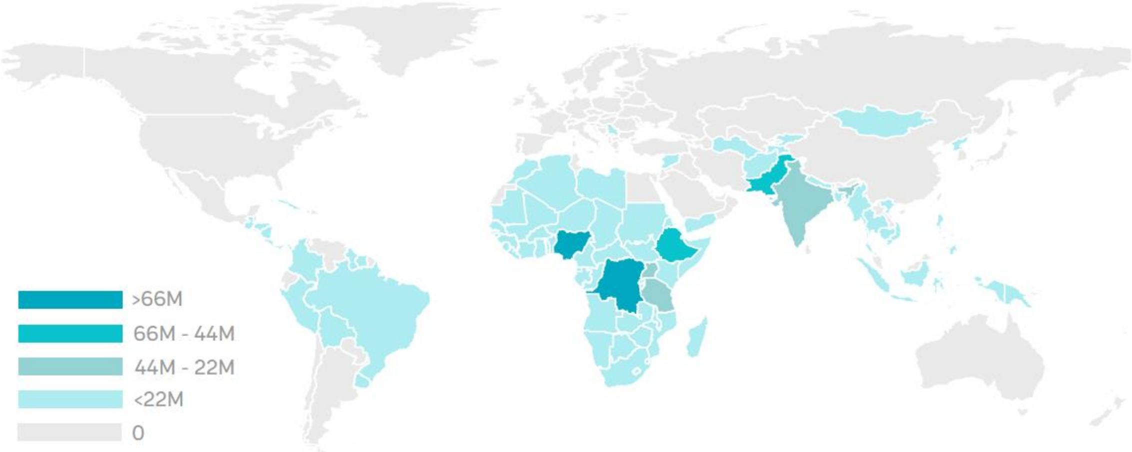

Figure 13. Population without Access to Electricity, millions of people (total), chart from WB (2021)

[26] "Ensure universal access to affordable, reliable and modern energy services by 2030". This includes electricity and clean fuels. This document only addresses the target on electricity access.

The Electricity Access Index, developed by the MIT-Comillas Universal Energy Access Lab for the Global Commission to End Energy Poverty, assesses at country level, whether the electrification effort is on track to reach universal access by 2030 from a quantitative perspective (the sufficiency component) and from its conformity to sound principles of electrification (the effectiveness component).

The Electricity Access Index is meant to detect the need to intensify electrification efforts, to warn about the insufficiency of the present financing instruments and institutions to attain universal electricity access in many countries, and to point out to possible deviations in the present electrification strategies in a country with respect to broadly accepted best international practices. The outcome of the Electricity Access Index is not a static description of the current degree of electricity access in a country, but rather a comparison between the trajectory of actual financial efforts towards universal access and the path that a country should follow to achieve SDG7.1, plus an objective assessment of the financial viability of the SDG7.1-compatible path.

3.2. What is the scope of the Electricity Access Index?

The scope of the Electricity Access Index is defined based on the assumption, corroborated by many real-world experiences, that the distribution segment is the critical bottleneck to achieve universal access. In the context of this study, distribution is meant to encompass all those "last-mile" activities to supply electricity to end-users, including not only conventional on-grid distribution and retailing tasks, but also off-grid solutions (minigrids and stand-alone systems) that involve assets, as generation and storage, that commonly exceed the scope of distribution.

Distribution has historically attracted a very little share of private investments in the electricity sector of those countries that have not yet achieved universal access. This is especially true in Sub-Saharan Africa, where private capital flows into transmission and distribution sectors (T&D) are virtually zero (RES4Africa, 2021), as presented in Figure 14. Other reports (SEforALL, 2021) show how T&D receive a very minor share of electricity investments, and this minor share commonly targets large transmission projects.

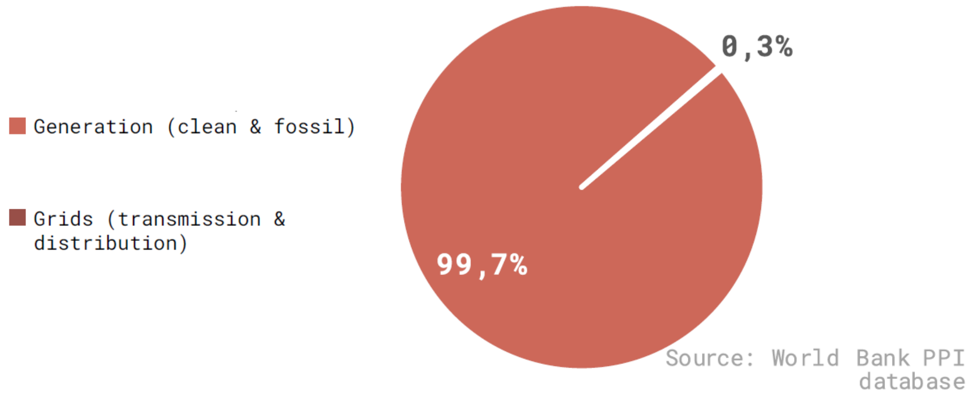

Figure 14. Private Investments in the Electricity Sector of Ten Focus Countries in Africa (Algeria, Ethiopia, Ghana, Kenya, Morocco, South Africa, Tanzania, Uganda, and Zambia) in the period 2010-2020 (RES4Africa, 2021)

Failures in the distribution segment of many low-access countries are dramatically hampering universal access to electricity. Distribution companies commonly face significant financial distress, and this provokes viability challenges that hinder the mobilisation of the substantial public and private investment needed to expand grid-based electricity access. The lack of a proper regulatory framework, encompassing the distribution activity, has a negative impact also on off-grid solutions, and recent growth of minigrids and stand-alone systems has occurred largely in silos. To reach universal access by 2030, new business models for distribution must be defined that leave no one behind, ensure permanence of supply, integrate the various electrification modes (on-grid and off-grid), and align with a vision for the long-term, sustainable development of the power sector and the economy.

The Electricity Access Index, therefore, focuses on the distribution activity. In its *sufficiency* component, it compares the financial effort that is presently dedicated to achieving universal electricity access in the distribution segment with the one required to reach SDG7.1. But sufficiency must also examine if the country would be able to financially sustain the level of effort compatible with full electrification by 2030. Here, effort is not defined only in terms of investments, but also of operational costs; the latter are usually ignored in most assessments on universal access, although they are of paramount importance to guarantee the permanence of the service. The financial effort must be defined in terms of TOTEX (total expenditures) in on- and off-grid distribution, as the summation of CAPEX (capital expenditures) and OPEX (operational expenditures). The *effectiveness* component of the index also focuses on the distribution activity, but now comparing the current practice of the electrification activities with the sound principles for universal access mentioned above and to be described in detail later (GCEEP, 2021).

3.3. Why a new index?

Electricity access cannot be assessed through simple quantitative metrics, such as the percentage of the population being provided with the service. Most of the experts nowadays agree that a multi-dimensional approach is necessary, and several institutions have made contributions in this direction. Excellent indexes have been developed in the last decades to measure energy access through this multi-dimensional perspective. The best example is probably the well-known Multi-Tier Framework, or MTF, developed by the Energy Sector Management Assistance Program (ESMAP) of the World Bank. As regards electricity, the MTF evaluates access in a country using the following attributes: i) capacity, ii) duration, iii) reliability, iv) quality, v) affordability, vi) legality, and vii) health and safety. Based on these attributes, tiers from zero to five are defined through the definition of thresholds (ESMAP, 2015) and they are studied in different contexts (e.g., urban vs. rural; households, business, and community facilities). This approach allows a more accurate characterisation of electricity access in a country, which goes well beyond the simple percentage of electrified households, as it can be observed in Figure 15 for Ethiopia.

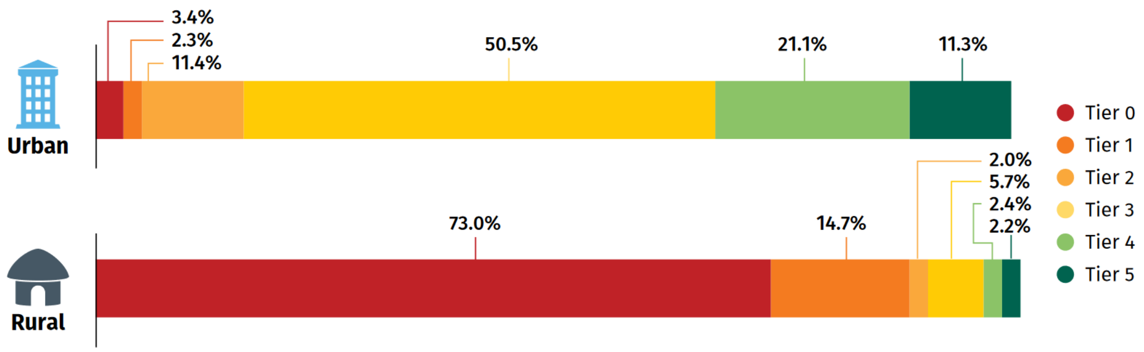

Figure 15. Electricity access in Ethiopia through the lens of the MTF approach (ESMAP, 2018a)

Other reports[27] by several institutions working on this topic track investments in universal access and, in some cases, compare these expenditures with the ones required to achieve SDG7.1 (SEforALL, 2021; WB, 2021). Nonetheless, in these documents, data are commonly aggregated for very wide regions, without a country-by-country granularity, or across the different activities within the power sector (generation, transmission, and distribution). However, these activities have a very diverse impact on granting access to new end-users and are subject to different conditions in terms of regulation and risk for the agents. Furthermore, as already mentioned, the vast majority of these studies focuses on capital expenditures, while electrification projects require large operational expenditures to provide the permanence of the service and a total-expenditure approach is necessary when analysing project financing.

With this background, and taking advantage of all these relevant studies, the Electricity Access Index follows a novel multi-dimensional approach to achieve the following objectives, which are not covered by any existing index on universal access.

- The index focuses on the distribution activity, both on- and off-grid, which has revealed to be the critical bottleneck to achieve universal access to electricity.
- The index has a country-level granularity, since countries, although located in the same region, may have very different conditions from the perspective of universal energy access, in terms of access gap, soundness of energy policy and regulation, financial viability of the distribution sector, or access to finance.
- The index is based on a TOTEX (CAPEX + OPEX) approach, considering all the costs that need to be covered to achieve full electrification and to maintain it over time.
- The index does not limit the analysis to the identification of the total costs required to achieve SDG7.1, but it also assesses how these costs should be financed, based on a financial plan tailored to the conditions in each country.
- The index goes beyond the current picture on the status of electricity access in a country and delves into the reasons behind such a status, assessing the major hurdles that are hindering a faster development of universal access and the elements of the electrification strategy that should be improved.

3.4. The design of the Electricity Access Index

In order to achieve the above-listed objectives, the Electricity Access Index has been structured around two main components:

- The sufficiency component measures the volume of financial effort currently being devoted in a country to universal access and compares it with the effort that would be required according to a sound and SDG7.1-compliant electrification strategy; furthermore, the sufficiency component also evaluates the viability of that SDG7.1-compliant plan from a financial perspective for the considered country.
- The effectiveness component assesses whether the present volume of financial effort devoted to electrification at distribution level is being deployed so that it can produce the desired results in the

[27] A comprehensive review of other indices related to universal access can be found in Annex II.

best possible way. This assessment is made by analysing the compliance of the national electrification strategy with sound electrification principles.

The two components depict very different but complementary aspects of the electrification process in a country. While the sufficiency ratio compares the present volume of effort with what would be necessary to attain universal access by 2030 – but also verifying if that necessary effort would be financially viable – the effectiveness evaluation indicates whether this current effort is well employed, with an implementation according to sound principles. Note that the sufficiency component not only evaluates if the present level of expenditure is enough to achieve the desired SDG7 target, it also examines the financial viability of a hypothetical electrification plan that would attain universal electricity access by 2030, assessing whether this plan would be financially easy, challenging, or impossible to accomplish.

The following subsections provide a more detailed description of each component. Further information, together with the detailed methodology, can be found in Annex III.

3.4.1. The sufficiency component

As explained before, the sufficiency component examines the situation of the electrification process in a country from a double perspective. First, it is computed how much of the expenditure that would be needed to achieve universal access is actually covered by the present effort in the considered country (see Figure 16. Graphical representation of the sufficiency component of the Electricity Access Index). The comparison is made in annual terms, and it includes all the costs that must be incurred to meet SDG7.1.

The present financial effort devoted to universal access is obtained from data in publicly available sources[28] about existing projects of grid extension, minigrids, and stand-alone systems in each country (primarily from publicly available financial statements from relevant distribution companies and complemented with available reports on private investments deployed per country). The volume of annual expenditure goes to the numerator of the fraction in Figure 16. Graphical representation of the sufficiency component of the Electricity Access Index and the amount in the denominator is obtained by developing the best possible financial plan for a techno-economic electrification plan that achieves universal electricity access in 2030 in the country[29]. Therefore, for every country a detailed financial plan has been built, with a horizon of 20 years into the future, using the total cost annual values from the techno-economic electrification plan, the estimated income from regulated tariffs, and the best possible blended finance that would allow to meet common indicators for a business plan to be acceptable. The percentage x in Figure 16. Graphical representation of the sufficiency component of the Electricity Access Index can now be determined, but not the colour in the circle yet.

[28] These values are extracted from the OECD/DAC Creditor Reporting System. The OECD consolidates and categorizes the public financial support that donors (as the sum of official loans, grants, and equity investments) provide to developing countries for on- and off-grid projects. For details, see: https://stats.oecd.org/Index.aspx?DataSetCode=crs1

[29] These values are obtained from National Electrification Strategies (when they exist and are SDG.7 compatible) or standard electrification plans such as the World Bank's Global Electrification Platform using the OnSSET model (https://electrifynow.energydata.info) – or our own analysis using the Reference Electrification model (REM) (https://universalaccess.mit.edu/#/main).

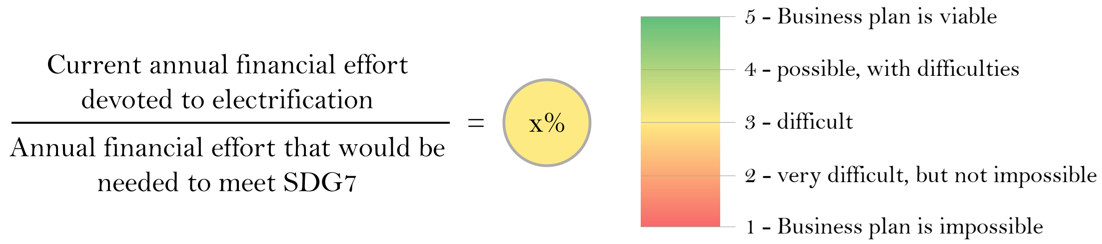

Figure 16. Graphical representation of the sufficiency component of the Electricity Access Index

The second perspective focuses on the financial viability of the hypothetical business plan that has been used to compute the denominator in the fraction of Figure 16. Graphical representation of the sufficiency component of the Electricity Access Index. The design of the business plan has been tested with some industry experts in infrastructures financing. These experts must assess whether the business plan for each considered individual country is financially viable or not, with the present institutions, criteria, and financial instruments. Financing an electrification plan that is technically viable may be impossible from a financial point of view for some countries, while it might be perfectly feasible for others. Experts must classify the financial viability of the business plan for each country into one the following categories: i) impossible; ii) very difficult, but not impossible; iii) difficult; iv) possible, with some difficulties; or v) viable. Such score is translated in a colour code (see Figure 16. Graphical representation of the sufficiency component of the Electricity Access Index that, together with the percentage computed in the previous step, represents the sufficiency component of the index). Further details are presented in the Annex.

3.4.2. The effectiveness component

The effectiveness component is meant to qualitatively assess the compliance of the electrification strategy of a country with sound principles. These principles have been classified in four pillars[30], defined hereunder and presented graphically in Figure 17. Graphical representation of IDF principles (GCEEP, 2021), which may look deceptively simple in theory, but they are very difficult to implement fully, and they are rarely applied in conjunction.

- A commitment to universal access that leaves no one behind. This requires permanence of supply and the existence of a utility-like entity with ultimate responsibility for providing access in a defined territory.
- Efficient and coordinated integration of on- and off-grid solutions (i.e., grid extensions, mini-grids and stand-alone systems). This requires integrated planning and appropriate business models to reach all types of consumers in the defined service territory.
- A financially viable business model for distribution. This will typically require some form of concession to provide legal security and ensure the participation of external and mostly private investors, as well as subsidies to cover the potential viability gap.

[30] These principles were condensed in the Integrated Distribution Framework (IDF), an approach to electrification proposed by the UEA Lab and applied in several projects in the context of the Global Commission to End Energy Poverty funded by the Rockefeller Foundations; for details, see https://www.endenergypoverty.org/.

- A focus on development to ensure that electrification produces broad socio-economic benefits. This principle links expanded access to the delivery of critical public services (e.g. health, education) and productive uses and to the promotion of gender equality.

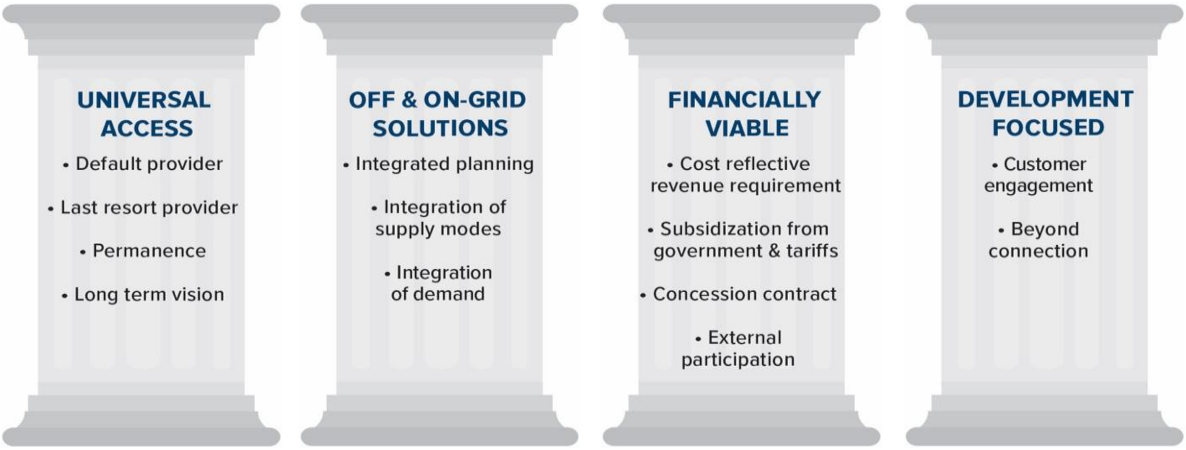

Figure 17. Graphical representation of IDF principles (GCEEP, 2021)

In the literature, it is possible to find renowned and reliable studies that aim to assess one or more of these aspects. The Regulatory Indicators for Sustainable Energy (RISE) computed by ESMAP (2020) encompass one pillar devoted to electrification planning, which assesses, through surveys with country experts, relevant topics as the framework for grid electrification, mini-grids, and stand-alone systems, or utility transparency and creditworthiness. Other indexes and reports that do not focus on universal access, contain relevant information on the electrification strategy and the conditions that project developers have to face. The Electricity Regulatory Index (ERI) computed by the African Development Bank (AfDB, 2021) provides valuable information regarding the governance and the overall effectiveness of the regulatory frameworks of African countries. The well-known Doing Business report (WB, 2020) and the Global Competitiveness Report (WEF, 2020) present a clear picture of the private sector participation challenges.

However, none of the above-mentioned reports and surveys addresses the electrification strategy from the perspective required for the Electricity Access Index and the information they provide is not sufficient to evaluate all the principles outlined in Figure 17. Graphical representation of IDF principles (GCEEP, 2021) Therefore, a specific 34-item questionnaire has been developed for the effectiveness component of the index. The questionnaire is sent to country experts, who are required to assign a score, from one to five, to each item. Items are divided among the four pillars presented above and this allows to compute, for each country being surveyed, a score for each pillar and the overall compliance with sound electrification principles. A colour code is also applied here to provide an intuitive graphical representation of the scores.

3.5. Presentation of the outcomes and preliminary findings

3.5.1. Representative case studies

The sufficiency and the effectiveness components provide two different perspectives on the electrification process in every considered country, which are presented to the user without further aggregation. In fact, he main goal of the Electricity Access Index is not to provide a country ranking on universal access[31], but rather to stress which aspects of the electrification strategy are to be improved in each country and to show the gap in the financial effort that should be filled, while also indicating how difficult will be to comply with SDG7.1 at individual country scale. A possible presentation of the outcomes for three hypothetical countries is shown in Figure 18. These case studies do not reflect the reality of any specific country, but they represent a set of conditions that can be found in several jurisdictions that have not yet achieved full electrification.

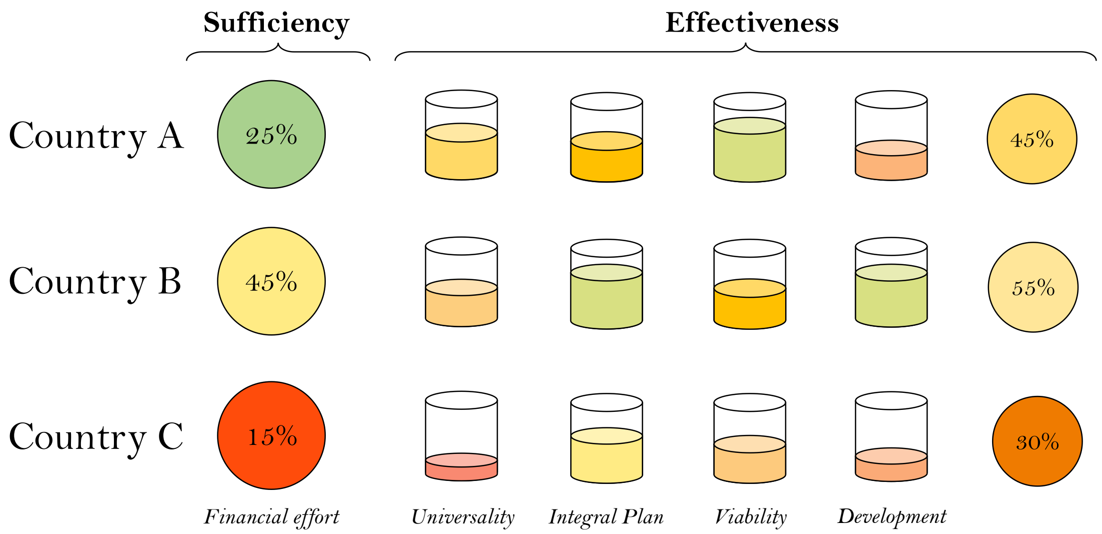

Figure 18. Possible presentation of the Electricity Access Index for three hypothetical countries

Country A may represent countries in Latin America or, more in general, middle-income countries, which are only a few percent from reaching universal access, with the unelectrified population living in remote rural areas. The financial effort for this hypothetical country to achieve SDG7.1 is not large in absolute terms and it could easily be covered through a minor increase in the tariffs of connected end-users (green colour in the sufficiency component); however, the lack of political consensus to build and implement a viable financial plan results in a very slow-paced progress. The regulatory framework may assign clear responsibilities to the entities involved in electricity supply, but this role is not actually enforced. Sound electrification plans, integrating different modes, have been developed and approved, but they are not being implemented. Electrification efforts are mainly driven by the intermittent or project-specific funding from donors. Electrification policies do not pay sufficient attention to productive and community uses.

Country B reflects the situation of many developing countries that still have a significant electricity access gap, but where large electrification investments are being registered. Although the financial challenge is considerable, if initial support from development finance institutions is provided and the regulation defines a robust business model for private investors, a large part of the costs can progressively be covered through demand growth and a slow increase in electricity tariffs. The universality of electricity access is not strictly guaranteed, since the electrification plan from the government focuses on grid extension, while the deployment of minigrids and stand-alone systems is left to the private sector. Overall, the plan may be financially viable, but the lack of coordination among different electrification modes may challenge some

[31] Given the multi-dimensional nature of the Electricity Access Index, it is not possible to generate a ranking, since a specific country may be well-positioned on a certain aspect, but it may perform poorly on another aspect of the electrification strategy.

business model. On the other hand, the electrification strategy as a strong focus on productive uses and incorporates a gender perspective.

Country C may reflect the situation of several countries that present a very small electricity access and would require a huge financial effort to achieve full electrification by 2030. Constraints on the sovereign debt impedes the country to absorb this financial cost, donor can only cover a small portion of it, and private actors perceive a high risk due to the lack of a viable plan. The country will not be able to achieve SDG7.1 and the target should be moved forward. It is not possible to define a business model that allows to guarantee the universality of the service. Some of the business models being developed may be viable, but they can only be implemented on a small scale. Not enough attention is being paid to productive uses, which could foster demand and improve cost recovery.

These are only three examples of the different situations that could be outlined by the Electricity Access Index; their goal is only to reflect that the multi-dimensional design of the Index may result in very diverse combinations of sufficiency and effectiveness scores.

3.5.2. Preliminary findings

Beyond defining the methodology to compute the Electricity Access Index as presented in this report, the MIT-Comillas Universal Energy Access Lab has also applied this methodology and calculated the multi-dimensional index for a small number of countries that are diverse enough to cover a wide spectrum of values for the index components. A future report will present the results of this analysis once a sufficient large number of countries have been evaluated. However, the assessment carried out so far permits to present some preliminary findings.

The first message is not a finding itself, but rather a warning bell for the community working on universal access. It is extremely hard to track electrification efforts in the distribution segment at the country level and to find reliable data to populate the model behind the Electricity Access Index. No global database is available and most of the relevant reports present these data at regional level. National institutions and private companies, when committed with transparency, may provide relevant information for on-grid electrification, but off-grid solutions may be implemented by other entities and go unrecorded. This data dispersion may look intrinsic to the complex and multi-actor framework of universal access. However, without a proper tracking of electrification efforts at the country level, it is not possible to follow progress, set achievable milestones, or identify areas where endeavours must be urgently enhanced to achieve SDG7.1.

Beyond this initial consideration, the following preliminary findings can be drawn from the assessment that is being carried out:

- As underlined by other reports, the current financial effort devoted to electrification, considering both capital and operational expenditures, is not sufficient to achieve universal access by 2030 in most of not-yet-fully-electrified countries. Actually, with the financial instruments and rules in place now, a significant number of countries simply cannot have a financially viable electrification plan compatible with SDG7.1. Not only is the current financial effort insufficient, but there is also no viable financial plan able to cover the required effort.
- Regardless of the volume of effort currently being devoted to universal access, the electrification strategies of several countries fail to comply with robust theoretical principles. This may result in

suboptimal electrification solutions and hamper the economic efficiency of the interventions that are being deployed. Even if the volume of expenditure is aligned with the actual requirements of a country, this effort may fail if it is poorly implemented.

- Aggregated assessments on universal electricity access, which condense information at a regional scale, miss key aspects of the electrification effort. The starting point of any assessment should be represented by national techno-economic and financial plans developed at individual country level, reflecting all the peculiarities of the national context, in terms of electrification status, financial constraints, or regulatory environment. Countries belonging to the same region may face very different conditions; two neighbouring countries may have very similar electricity access gaps, but one of them may be unable to achieve universal access due to, for instance, constraints on the public debt or an inadequate regulatory environment.

These findings are just a preview of the overall picture that can be obtained through the Electricity Access Index. If computed for all the countries that have not yet achieved universal access, it is expected that more finding and insights will be attained and made available to policymakers, development agencies, donors, NGOs and investors.

4. A framework for analysing the feasibility of electricity access investments, the required financing plan and the equity raising in SSA countries: the case of electrification in Uganda

4.1. Introduction[32]

Less than half of the population in SSA still live without access to electricity: 47% total electricity access rate and only 28% rural access rate as of 2019 due to both demand and supply constraints (World Bank, 2021b) and the number of people without access in SSA increased in 2020 for the first time since 2013 (IEA, 2021). Worldwide and accounting for population growth, 940 million people will have to gain access to electricity by 2030 to comply with UN SDG7.1. According to studies consulted by The Rockefeller Foundation, global investments are not on track to achieve this goal (The Rockefeller Foundation, 2020) and, with the current and planned policies, more than 670 million people worldwide may still lack access by 2030 (IEA, 2021), electricity access rate in SSA will only reach 60% by the end of the decade and reaching universal access to affordable electricity would require tripling the electricity access rate of recent years (IEA, 2022).

The overall under electrification conundrum has been covered and confirmed by literature from different perspectives. As expected, its crucial importance and diagnosis have been well documented both generally and for specific regions such as Uganda (Eder et al., 2015), highly relevant for the purposes of this work. Some authors have tried to summarise existing literature on the challenges to achieve a holistic solution to the electrification problem and on the reasons behind actual electricity underdevelopment. On this line of research, Gregory and Sovacool (2019) start with a sample of three African countries with a notable body of academic literature (Kenya, Mozambique and Tanzania) and then undertake a systematic review of 815 peer reviewed papers on the topic of electricity infrastructure, analysing how this literature has evaluated the problem as well as its main methodological, conceptual, and empirical characterization. Another subset of studies aimed at discussing solutions and required changes from different fields (technical, political, regulatory or financial among others), adopting a global top-down perspective and analysing rural electrification initiatives in specific developing countries (Almeshqab and Ustun, 2019). Similarly, Fontaine et al. (2016) explain how one particular business, technical and financial initiative (the Awango project, led and sponsored by Total and now under deployment in over 30 countries) achieved significant benefits through the sale of solar lanterns. In addition, most DPs or DFIs such as the World Bank, the African Development Bank or the European Bank for Reconstruction and Development have published, sponsored or supported relevant research studies highlighting the gravity of the situation and its severe social, economic and educational consequences (African Development Bank, 2014) as well as including practical workshops organised among others by the Africa Electrification Initiative (AEI). As an indicative example, working papers sponsored by the World Bank have summarised different institutional approaches to electrification, leveraging on the experiences of rural energy agencies and rural energy funds across SSA on ground-level implementation (World Bank, 2012; World Bank, 2017).

While there are several worldwide initiatives, working groups at all levels and both financing and industrial sponsorships aiming at, at least partially and progressively, addressing such tremendous hurdle for African social, economic and cultural development, structuring and raising the required financing appears to be a critical requirement for the actual implementation of any of these investment programs. The lack of

[32] Section 4.1 reproduces parts of section 1 given thesis structure and its applicability to the rest of section 4.

required financing as the main obstacle to execute the electricity distribution build-out in SSA is widely covered by literature, and several papers suggest different (partial) solutions from either industrial or financial perspectives: Harris and Ehsani (2017) highlight the importance of more complex and viable financial models, presenting a model village as a case study where innovative technologies and financing were introduced; Berahab (2020) suggests the pay as you go scheme for customers as an option to facilitate electricity off-grid systems investing and financing (using Kenya as the pilot case); Troost (2018) highlights the need to increase investment attractiveness in general and investments in mini-grid operating companies in particular as the specific path to achieve financial sustainability; Abdullah and Markandya (2012) find the electricity connection payments by potential new customers as the problem and suggest the need for governments to change the existing set of subsidies and financial support in order to reach underpenetrated areas. In summary, capital remains up to seven-times more expensive in developing and emerging markets than in advanced economies (IEA, 2021) and neither the large pool of private capital nor the leading utility corporates are seriously considering the required level of investments.

The Research Team has been aiming at addressing such low rate of electrification by developing an innovative techno-economic model. Pillars of this new electrification research approach (IDF) include: (i) focus on electricity distribution as the main bottleneck to achieve universal access (vs generation and/or transmission), (ii) design of a holistic solution for an entire country (vs specific territories) taking into consideration its public funding status and limitations, (iii) the combination of different technical alternatives on-grid and off-grid (both mini-grids and stand-alone systems) to deliver the optimal solution to each particular situation and (iv) the concession legal structure as the best business and financial model to achieve its targets. Integrating the financial approach into the overall model is a key feature of the IDF which, for any implementation at a country level, incorporates an integrated techno-economic model, an integrated vision of the regulatory and business model and an integrated financial plan.

This section intends to leverage on the IDF and further detail how an electrification business plan could be realistically financed under current market conditions. Structuring and eventually raising the required financing are critical components of the actual implementation of any investment program that intends to remedy the lack of electrification in developing geographies at a country level by 2030. We will aim at contributing to this generally accepted financing challenge by developing the foundations that, based on a real country pilot case (Uganda), will describe the framework necessary to structure and potentially raise the necessary financing in general and the equity in particular, to fund the investment required to achieve full coverage of non-electrified SSA countries.

Addressing this funding constraint will rely, among others, on the overall financing plan, on the specific government ability to provide some country and regulatory support at different levels to all financing providers, on the commitment by some DFIs or DPs who are expected to play a significant role among the Debt Providers, and on the critical involvement of the Equity Investor. This section presents a model built under the assumption that the Equity Investor presence will be required at some point to support a long-term sustainable financing structure in countries similar to Uganda, and it will be expected to: (i) lead the industrial and operating electrification plan, (ii) provide the local business with the best-in-class business expertise and, most importantly, (iii) provide the final equity component that should result in a fully financed business plan, i.e., commit and link the highest risk component of the capital structure to the execution of such plan.

Focusing on an actual pilot case, we have built a strategic, technical and financial model, also reflected on a detailed business plan, on how the non-electrified areas of the selected country could be fully covered by

2030 to comply with SDG7.1 and how that business plan would be financed and executed. The selected country for our initial analysis is Uganda due to several reasons including size, political and economic stability, suitability for capital raising and, very importantly, access to data and information: a key requirement to select the country is the full involvement and cooperation of its government, relevant officials and management of the local electricity company. In addition, a critical part of our pilot case relates to the expiry and hence required renegotiation of the concession of one of Uganda's key sector players which opened-up the possibility to consider different alternatives around the design of the regulatory and business models. We have been working with the GoU since 2020 as part of the Uganda Assignment led by Ignacio Pérez-Arriaga as a component of The European Union Global Technical Assistance Facility for Sustainable Energy, which resulted in an initial report issued in 2021 and a revised and updated version in 2022 (Final Report, Pérez-Arriaga, 2022a).

Research work start with an overview of the country's electricity distribution subsector to be used for our pilot case, including the proposed sector reform to reach full electrification in Uganda by 2030. A business plan for the country to comply with SDG7.1 has been prepared further to the Uganda Assignment under the supervision of some relevant GoU officials and it has served as the basis to develop a potential full financing plan. Expected business and financial risk-return analysis for the latter leads into the discussion of alternatives to mitigate the Equity Investor risk and to enhance the expected financial return by including real options value. Finally, we have included an attempt to quantify and measure the expected Impact brought be the investment and have added all building blocks to complete the full investment case.

The methodology behind the research presented in this DBA thesis shows some similarities to AR, the generic term used to describe research in action or the collaboration between researchers and practitioners (Mathiassen, 2002) in terms of work methodology, implementation process and ability to generate knowledge. Based on the assumption that academic and professional knowledge represent very different but related domains, AR is introduced as a method for correcting positive science deficiencies (Susman and Evered, 1978) as well as a rigorous approach that aims to contribute both to the practical concerns of people in an immediate problematic situation and to the goals of social science by joint collaboration within a mutually acceptable ethical framework (Rapoport, 1970). Some general review papers (Coughlan and Coghlan, 2002) that summarize AR theoretical and practical approach have also been consulted to validate my overall working approach as follows below. Additionally, other authors (McKay and Marshall, 2001; McNiff and Whitehead 2010) have opted for a more detailed description of how a proper AR model should work, accommodating both a problem-solving methodological approach and a full theoretical research framework. Despite not following all formal AR criteria set forth by these authors, the Research Team has effectively followed the most commonly used circular approach suggested by Coughlan and Coghlan (2002).

The circular approach started by diagnosing the electrification challenge (how the non-electrified areas of the selected country could be fully covered by 2030 to comply with SDG7.1), followed by planning the key working tasks (need to build the techno-economic model to assess the investments required to achieve that goal and need to build a business plan reflecting how the required CAPEX and OPEX could be executed and financed), effectively taking the actions required not only to deliver our work plan but to ensure we would incorporate GoU officials, Ugandan regulator and key sector players feedback into our work (by exchanging emails, having phone calls and working sessions ahead of an actual working field trip) and finally evaluating our action by iterating internally (within the Research Team) and externally (with the referred key stakeholders and other industry experts consulted to cross-check our main conclusions). Among other highly relevant content, the Final Report incorporates the result of our research work, includes its main business and financial conclusions and has also become the inspiration and starting point of our thesis.

The combination of work carried out on recent assignments and relevant professional experience seems to indicate that the execution of a business plan for such an ambitious target as the electrification of SSA countries will depend heavily on the right financing strategy and on the right selection of and commitment from both Debt Providers and the Equity Investor. Putting together the entire capital structure would be challenging, its different providers are expected to request some level of inter-conditionality and the ultimate equity component is expected to be a critical financing cornerstone. As mentioned above, the Equity Investor commitment would be key both to lead the strategic and business plan and to provide either partially or in full the remaining financing required, and based on prevailing market practice, we assume it would require, on the one hand, some necessary but not sufficient conditions including: (1) a sound and viable technical plan built to effectively develop a network for each specific situation, (2) the respective government support (critical to bring concessional capital, to provide the necessary comfort both to the Debt Providers and to the Equity Investor and to maximize, as the main stakeholder in the resulting business, the expected social and economic benefits for the population), (3) an appropriate and efficient capital structure to ensure that the business plan will be fully funded and (4) a satisfactory consideration of other political and cultural factors (either at the country – e.g., political regime, cultural heritage – or at the corporate level).

On the other hand, and assuming all these conditions are in place, financial returns delivered by the business plan to the Equity Investor are likely to be just fair and may not be attractive enough to compensate for the required time and effort as well as the reputational and financial risks associated to investing in these countries, especially if large investment amounts are required. Thus, the Equity Investor is highly likely to demand some additional investment levers to positively consider the financial and non-financial benefits expected from its participation and leadership.

These additional investment levers shall include some financial return enhancement by adding a real options framework to expand the traditional financial risk-return analysis as well as an innovative risk-return-impact approach that we would expect the Equity Investor to consider so that their internal decision-making bodies would support the necessary financial, technical, human capital and reputational investment. The overall investment case for the Equity Investor can still admit various alternatives depending on the final capital structure (potentially including equity, equity-like or hybrid instruments) as well as the specific Equity Investor plan and objectives. Thus, it would be fair to assume that, initially, a financial risk-return approach should be articulated, including both some risk reduction by potential credit enhancement (designing more favourable or tailor-made Equity Investor structure terms) and some return enhancement by adding less visible option value linked to their pioneering presence in this type of geographies. This option value could theoretically result from either capturing potential growth in other markets or having the right to abandon the project under well-defined circumstances, but the latter is expected to be a critical Equity Investor request (i.e., a must have condition) rather than a value addition and its related option value has not been valued or added to the base case return. Therefore, the only real option value included in the analysis is the Equity Investor option to grow or expand into other countries, having indicatively selected the neighbouring country of Rwanda as explained in section 4.5. (which also includes relevant real options related literature references).

In addition, a project of this nature would represent a very compelling ESG proposition, increasingly critical in current corporate and financing markets: Environmental (given predominance of renewable energy sources), Social (given the notorious social benefits brought by the network development program) and Governance (ensuring that the overall business plan execution and the alignment of interests among all stakeholders comply with best corporate governance standards). Both Environmental and Social reasons appear to be widely accepted to defend an investment in electricity in SSA developing countries, but the overall corporate governance and investment structure discussion is expected to also play a critical role. Beyond a typical ESG approach we have analysed both Social and Environmental angles under a deeper Impact perspective by following the risk-return-impact model suggested by Cohen (2020), we have measured the social and environmental benefits electricity access would bring using various quantifiable metrics, and we have attempted to value these benefits so a dollar amount can be added to the overall investment case. Therefore, we have added a more innovative Impact investment proposition to the traditional financial analysis framework, hence developing an integrated risk-return-impact model which we would expect to be critically important for the Equity Investor's decision-making bodies and procedures. On this last point, we briefly suggest how to overcome the potential corporate governance controversy around companies' ultimate purpose (maximising shareholders value vs acting in the interest of all stakeholders including current or future potential Impact beneficiaries). There is abundant literature both on ESG, including literature review papers (Daugaard, 2020), and on Impact investing, either describing its overall innovative investment approach (Cohen, 2020) or focusing on its implementation in and the benefits brought to Africa (Avigdor, 2019). Alongside the Impact model exposition, some relevant literature references are included in chapter 4.6.

As explained below, the Uganda Assignment has allowed us to understand the country industry dynamics and to select the potentially best placed sector player where some Equity Investor interest could be raised. Financial projections built under the same Uganda Assignment produce some base case Equity Investor returns in the region of 13% by 2030 or 12% by 2040, clearly insufficient to satisfy the expected cost of equity (estimated at 14.5%) and the additional business, financial and reputational challenges to be faced by an Equity Investor. The overall investment case would be significantly improved by mitigating the risk through market standard investment structure features and related agreements, by enhancing the expected returns up to the region of 20% (by 2030) to 17% (by 2040) with the real option value associated to expanding into Rwanda and by adding an Impact related SROI in excess of 30%, reflecting the Impact value directly attributable to the Equity Investor.

4.2. The Uganda Assignment: Final Report (Pérez-Arriaga, 2022a) and Proposed Sector Reform

The Final Report started by developing some strong features of the Ugandan power sector and the propitious opportunity of international funding mobilization to overcome some existing weaknesses in the sector and to promote an ambitious path to the provision of a reliable, affordable, and sustainable supply of electricity for all households, industries and businesses in Uganda in a reasonable timeframe – with an expected positive impact on job creation, demand augmentation, and lower tariffs – with the ultimate goal of increasing the wellbeing of the population and enabling economic growth.

In order to achieve these goals, initial assessment in 2021 already anticipated the need for an eventual reform of the electricity distribution sector in Uganda (Proposed Reform). This reform should include a solution to the future of the concession agreements – specially Umeme's concession agreement, the leading distribution and current concession holder – and should also specify the means of accelerating the pace of electrification and improving the reliability and quality of supply in the country, in particular in rural areas. Moreover, it should identify opportunities for possible engagement with the European Union (EU) and for support alternatives to the Ugandan power sector.

As it has been the case for the overall Uganda Assignment, the Proposed Reform has been presented to and elaborated with and cooperation of the GoU, including relevant officials at various ministries and

Umeme's management, upon the following fundamental tenets: (i) consider electricity distribution in its entirety i.e., the supply of power to all end customers by a suitable combination of all electrification modes, either grid extension, mini-grids, or standalone systems and design a sound business model for each mode, under a common strategy of financing, tariffs, and cross subsidization; (ii) adopt a single distribution company for the main connected grid in the entire country; (iii) preserve the existing managerial capability in grid-connected electricity distribution, under a concession business model with a private company approach, as a valuable asset of the Ugandan power sector that is almost unique in SSA countries; (iv) set the desired goal now – a sound distribution sub-sector and full electrification by 2030 – and design a viable plan to achieve it – technical, economical, regulatory, business, and financial – to make sure that the adequate means and resources are employed from the outset and, most importantly, (v) reach a broad agreement on these principles among all the relevant stakeholders, pooling their resources together, with strong political support and the guidance of a local champion institution (which seems to correspond to the Ugandan Ministry of Energy and Mineral Development or MEMD).

In addition, the Proposed Reform should be built following these main principles:

- The business and regulatory approaches that are proposed for all the electrification modes, either on- or off-grid, share common criteria and are considered in an integrated fashion, since they are all developed in the best interest of Ugandan customers, although the specific business models and supply technologies must be adapted to each situation.
- On-grid distribution will continue under a concession model, with a new format and contracting conditions. The new concessionaire, here termed NewCo, will preserve the existing managerial capability in Umeme, with a private company approach, and will be the distribution operator for the connected grid in the entire country. NewCo's shareholding structure is assumed to also be the same as Umeme's but it would be open to any levels of direct or indirect public participation in the ownership of the firm and, most importantly for the purposes of this document, it should also allow the possibility to raise new equity at market terms (i.e., it should allow the entrance of an Equity Investor). NewCo's territorial scope will cover the entire national territory, but it will have different responsibilities in Umeme's present footprint and the rest of the territory. NewCo will continue current activities in Umeme's footprint, but it will have limited responsibilities in the rest of the country: only administration, operation and maintenance (AO&M) of all the new assets, plus a small fraction of the new investments that may be considered critical, to be authorized by the Electricity Regulatory Authority (ERA), and responsibility for contracting the engineering, procurement and construction (EPC) of all distribution network investments. Finally, NewCo's return on investment shall be negotiated reflecting current national and global macroeconomic conditions, while maintaining a reasonable profitability in relation to the risks under a regulated cost-reflective remuneration that incentivises efficiency.
- A financial intermediary (FinanceCo), newly incorporated and owned by the GoU, will serve as a hub of all the financing sources and will extend financing to NewCo and the off-grid developers. An upgraded Uganda Energy Credit Capitalisation Company (UECCC) is a possible option to implement FinanceCo without creating additional organizations. NewCo will bill and collect the revenues from the application of regulated tariffs to all grid-connected customers (since the collected revenues will exceed the regulated NewCo's costs, there will be a surplus to be delivered to FinanceCo and therefore NewCo will not need public subsidies).

- The GoU via its publicly owned electric utility will, at least initially, own all the assets, present and future, of the main grid, since the proposed business model is a concession and not a privatization. A buyout of the residual value of the assets that have been invested by Umeme until the scheduled end of the present concession will not be necessary assuming Umeme's shareholders agree to transfer to NewCo the rights to use these assets under the new concession conditions specified above. The Final Report also assumes that the rebundling of Ugandan public generation, transmission and distribution companies will take place, and Uganda Electricity Distribution Company Limited (UEDCL) would become the on-grid division of the distribution department of the Uganda National Electricity Company, who will own all the on-grid distribution assets.
- A cost-reflective remuneration, a "regulated revenue requirement", must be established for each mini-grid deployed according to the National Electrification Strategy (NES) and this remuneration will be collected from two sources: i) regulated tariffs, which will be the same for all mini-grid customers and grid-connected ones; and ii) direct subsidies to the mini-grid developers provided by FinanceCo. A minimum level of demand to be supplied at household level shall be defined (as explained below we have considered both the 3W solar kits base case targeted in the NES and an alternative 10W solar kits scenario for all 5.5 million rural residential households) whereas a cost-reflective remuneration shall also be established for the supply of electricity with solar kits (this remuneration will be collected from two sources: i) a regulated stream of payments by the households and collected by NewCo; and ii) direct subsidies to the minigrid developers by FinanceCo).
- NewCo will be required by the new concession contract to participate in a new off-grid company (a special purpose vehicle, Off Grid SPV) that will also be the default and last resort provider of off-grid solutions in the designated areas in the NES, without interfering with the existing off-grid market activities (this measure is necessary to ensure that nobody will be left behind in the electrification process in Uganda). Current electrification initiatives by DPs and private investors, although undoubtedly beneficial, are inadequate both in funding volume and coordination level for the challenge of achieving universal access in Uganda in this decade (achieving full electrification in a reasonable time requires joining forces to reach the necessary funding level around a comprehensive plan that makes political, financial, regulatory and technical sense).
- Finally, the Final Report expects the GoU to lead the distribution reforms and the electrification process, attracting support and establishing the required confidence from DPs and other investors, on the basis that reliable, affordable, and sustainable power supply is a key enabler of population well-being and economic growth.

The Proposed Reform is summarized below by explaining, sequentially, its techno-economic, business and regulatory, institutional, and financial layers.

4.2.1. The techno-economic layer

Electricity distribution must expand to meet demand growth, to complete densification and to improve performance in areas already electrified, as well as to ensure the electrification of areas that do not have access yet, using a mix of grid extension, mini-grids and standalone systems. A distribution reform proposal must include a comprehensive electrification plan and, despite its shortcomings,[33] the NES is the best electrification plan currently available in Uganda, so it will be used as the reference scenario to build the business and financial model. The NES integrates on-grid and off-grid solutions (mini-grids and standalone systems) and provides an estimation of the costs that would be incurred in providing the service with a reasonably high level of detail.

According to the NES, the overall cost of the electrification plan is USD 4.68 billion.[34] This plan should enable 10.4 million additional connections in the next 10 years. On-grid initiatives (3.4 million connections by densification and 1.2 million connections by grid extension) will account for the larger amount totalling USD 3.9 billion or 84%, with the remaining 16% dedicated to mini-grids (7% of the budget for 0.23 million connections) and stand-alone systems (9% of the budget for 5.5 million households). The implementation period covers 10 years from 2021 to 2030 and targets an overall access of 100% considering the minimum service level of a 3W solar kit per household (most commonly known as Tier 1 service level). Since this level is too low to be compliant with SDG7.1, an additional financial scenario has been analysed considering that a 10W solar kit is the minimum level of service for households and that extra effort is made in supplying electricity to productive and community uses in the clusters of population to be electrified, with an increment of 11% (USD 5.2 billion) in the investment cost.

4.2.2. The business model and regulatory layer

The business and regulatory approaches that are proposed for all the electrification modes, either on- or off-grid, share key common criteria and are considered in an integrated manner, since they have all been specifically designed for Ugandan customers, although the specific business models and supply technologies must have been adapted to each situation and supply zone.

Figure 19 shows the proposed business model for each of the four supply zones comprising the entire territory of Uganda, which will evolve dynamically with time: the current footprint of Umeme (Zone A), the rest of the territory to be supplied by grid extension (Zone B), the demand clusters supplied by mini-grids, and the customers that will be initially assigned standalone systems.[35]

The same principles of regulated cost-reflective revenue requirement and regulated tariff cross subsidization across-the-board apply to these four business models. There is freedom of installation for all companies in the off-grid space (respecting the territorial allocation defined by the NES) and there would also be a transitory adaptation period for all existing mini-grids and the suppliers of standalone systems.

[33] The adopted Geographical Information System (GIS) model lacks precision to properly identify the least-cost electrification mode in each circumstance. The massive deployment of 3W solar kits planned in most rural areas (for 5.5 million households) should not qualify as proper access.

[34] This figure only includes overnight investment costs. Financial costs and AO&M costs must be included to obtain the total cost of electrification.

[35] Regulation must be ready to facilitate the smooth transition between electrification modes, while preserving the rights of the developers of off-grid solutions, the incumbent on-grid distribution company and the customers.

NewCo in zone A	NewCo in zone B	Minigrids	Standalone systems
FULL CONCESSION Investment + EPC + O&M	MANAGEMENT CONCESSION EPC + O&M + some critical investments to be approved by ERA	MULTIPLE PRIVATE COMPANIES One of which is a SPV with NewCo participation that is Last resort & Default provider	MULTIPLE PRIVATE COMPANIES One of which is a SPV (same as for minigrids) with NewCo participation that is Last resort & Default provider

Figure 19. Breakdown of unelectrified demand according to electrification mode and business model approach

Electricity supply with the main grid (Zone A and Zone B)

As explained above, on-grid distribution will continue being provided by NewCo under a concession model, with a new format and contract conditions. NewCo shall preserve the existing managerial capability in Umeme and will become the distribution operator for the connected grid in the entire country, although with different responsibilities in Umeme's current footprint and in the rest of the territory. Its ownership structure may also vary with public participation in Umeme, currently at 24% via the National Social Security Fund, potentially increasing either by acquiring shares from other partners or by subscribing a cash and/or in-kind capital increase.

In Zone A (Umeme's current footprint), NewCo will keep the same functions that Umeme has now, planning, investment, responsibility for contracting the EPC of all new network assets, plus the AO&M of all assets, but it will have a substantially lower rate-of-return (still to be negotiated) and redefined targets (reliability, losses, customer service) with economic implications associated to performance. In Zone B (the rest of the country), NewCo will have more limited responsibilities, planning, responsibility for contracting EPC and the AO&M of all new assets, which will be sourced with public funds (only a minor fraction of the new assets shall eventually be funded by NewCo, if and when proposed and justified by NewCo and authorized by ERA after consulting UEDCL - see section on the institutional layer).

NewCo will bill and collect the revenues from the application of the regulated tariffs to all grid-connected customers. The revenues collected by NewCo will exceed its regulated revenue requirement, since NewCo will only incur, at most, a small fraction of the investments in zone B, therefore generating a surplus, whose use will be discussed in the section on the financial layer.[36] Therefore, NewCo will avoid depending on direct monetary public subsidies, which will limit potential risks and reduce its cost of capital.

The GoU (via its publicly owned electric utility) will own all, current and future, assets of the main grid, since the proposed business model is a concession and would not imply a privatization (see section on the financial layer). A buyout of the residual value of the assets that have been invested by Umeme until the

[36] It is important to make sure that NewCo is incentivized to bill all grid-connected customers and collect the corresponding revenues from the application of the regulated tariffs, since the surplus of NewCo – after retaining its regulated revenue requirement – is delivered to another entity (this entity is FinanceCo, see the financial layer). The right incentive scheme can be achieved by calculating a priori the surplus that NewCo must deliver to FinanceCo, as the difference between the regulated annual revenue requirement of NewCo as calculated by ERA for a given year minus the total revenue that NewCo could collect from application of the tariffs, assuming a stringent collection rate target. NewCo must deliver this surplus to FinanceCo, regardless of the actual collection rate.

scheduled end of the present concession will not be necessary if the shareholders of Umeme agree to transfer to NewCo the rights to use these assets under the new conditions specified above.

Electricity supply with mini-grids

As far as the supply zone to be covered by mini-grids is concerned, the proposed business and regulatory approach will target to achieve full electrification by 2030 as described in the NES (i.e., requiring the deployment of all the mini-grids included in the NES, so that not a single potential customer in Uganda is left behind), to encourage private initiative (already present in the country with several companies) while minimizing the interference with the existing mini-grids in operation, to guarantee the sustainability of the mini-grids (i.e., the permanence of a reliable and affordable electricity supply from all of existing and new mini-grids) and to make it possible for all customers connected to the main grid or to any of the mini-grids to pay the same regulated tariff regardless of the differences in the incurred supply costs (uniform tariffs at utility or national level is a generalized international practice, with implicit cross-subsidization among urban, peri-urban, and rural customers).

Meeting all these objectives will require the GoU to intervene by establishing a number of key regulatory measures: (i) a cost-reflective remuneration (a "regulated revenue requirement") for each mini-grid deployed according to the NES which shall be collected from two sources: the regulated tariffs and direct subsidies to the mini-grid developers; (ii) all new mini-grids must abide by these rules: compatibility with the NES, regulated end-customer tariffs (equal to the tariffs for grid-connected customers) and reception of subsidies to top up the cost-reflective revenue requirement (existing mini-grids must be given a deadline to meet these new requirements); (iii) ideally, a cost-reflective remuneration should suffice to attract mini-grid developers to deploy all mini-grids included in the NES and to guarantee their sustainability, but in practice some intervention is likely to be required to guarantee that some "default and last resort provider" will be present where others do not want to operate and will take control where others quit supplying; (iv) as a result, an additional condition in the NewCo concession agreement will be the creation, jointly with some off-grid solutions developer(s), of a Special Purpose Vehicle (SPV) company that will play the role of "default and last resort provider". The SPV will be a normal off-grid solutions company for all purposes, except for the mandate to build and operate the mini-grids in the NES that others do not build and to take charge of any mini-grid business that disappears. The participation of NewCo in the SPV facilitates the future transfer of mini-grid customers to the main grid "when the grid arrives", which eventually must happen for most or even all mini-grids, given the high population density in Uganda and the absence of major geographical impediments to grid expansion (but it might take one or two decades). The mandate for NewCo to participate in the SPV should be included in the negotiation package of the new concession.

Electricity supply with standalone systems

As with mini-grids, the proposed business and regulatory approach will target to achieve full electrification by 2030 as described in the NES (which requires the provision of all the standalone systems – mostly solar kits, but also systems to supply commercial and industrial loads – included in the NES, so that not a single potential customer in Uganda is left behind), to encourage private initiative (already present in the country with several companies) while minimizing the interference with existing standalone assets in operation, to guarantee the sustainability of this electrification mode (i.e., the permanence of a reliable and affordable electricity supply to all customers to whom NES assigns standalone systems) and to make it possible for all customers that are assigned standalone systems to afford them.

Meeting all these objectives will require the GoU to intervene by establishing a number of key regulatory measures: (i) definition of a minimum level of demand to be supplied at household level, which must be compatible with the energy needs of the specific population (e.g., cooling or heating depending on weather conditions, refrigeration for perishable agricultural or fishing products – and the economic capability to purchase appliances such as a TV, a blender or a small fridge). As mentioned above the NES has opted for a 3W solar kit per household and although we follow the NES as the base case we do not accept this minimum level of supply as compliant with the UN SDG 7.1.[37] (see section on the financial layer for a discussion of alternatives); (ii) a cost-reflective remuneration (a "regulated revenue requirement") for the supply of electricity with solar kits according to the NES which shall be collected from two sources: a regulated stream of payments and direct subsidies to the mini-grid developers (see section on the financial layer for the source of these subsidies);[38] (iii) all new deliveries of solar home systems (SHS) under the proposed business and regulatory model must abide by these rules: meet the established minimum demand level, regulated end-customer payment for the basic SHS compatible with the minimum demand, and regulated subsidy to the SHS supplier for each delivered system to top up the cost-reflective revenue requirement for the supplier, including the costs of maintenance and customer attention (existing SHS suppliers must be given a deadline to meet these new requirements); (iv) ideally, a cost-reflective remuneration should suffice to attract SHS suppliers to offer their solutions in the locations established by the NES and to guarantee their sustainability, but in practice some intervention is likely to be required to guarantee that some "default and last resort provider" will be present where others do not want to operate and will take control where others quit supplying (as with mini-grids, tenders may be considered as a last resource solution in the zones where suppliers would not go, despite the incentives); (v) an additional condition in the NewCo concession agreement shall be required: the SPV (defined before for mini-grids as the "default and last resort provider") will also commit to this same role for the standalone systems. As indicated above, the SPV will be a normal off-grid solutions company for all purposes, except for the mandate to deliver standalone systems in the areas defined by the NES for this type of supply where other companies do not want to go and to take charge of the customers of any SHS business that disappears. The interference between the suppliers of SHS with a market-based approach and the subsidized supply of SHS

[37] "By 2030, ensure universal access to affordable, reliable and modern energy services." In the case of poor rural areas in Uganda, after consultation with several stakeholders, it could be concluded that the minimum demand should include a residential solar kit of at least 10W – enough for two or three lights, phone charging, and a radio – plus electricity supply for productive and community use of electricity, as the only way to promote human and economic development. The financial analysis of this report includes a sensitivity analysis of a scenario with a minimum residential demand of a 10W solar kit, plus at least one community and one productive electrical supply at every village.

[38] The sustainability of electricity supply with SHS can be guaranteed if the business model of the supplier is defined as a "utility-like" business. This is easier under a fee-for-service kind of arrangement, whereby the supplier is responsible to guarantee the continuity of service indefinitely – maintaining and replacing the SHS as needed – in exchange for a regulated monthly fee, which is the usual payment system of the customers connected to mini-grids or the main grid. However, the prevalent business model for SHS in Uganda is rent-to-own, whereby the residential customer pays an initial amount plus weekly or monthly instalments during two or three years, until which the solar kit becomes the customer's property, perhaps including some maintenance obligation by the supplier. Under the rent-to-own model, a new subsidy to the supplier will be needed each time the customer needs to replace the SHS. Hopefully, with time, most households will become grid-connected and the stream of explicit subsidies for the purchase of SHS will almost disappear. Under a fee-for-service scheme, the regulated tariff would be part of a broad tariff cross-subsidization scheme, including all customers in the country.

under regulated tariffs can be minimized, so that subsidies are not wasted with those customers that do not need them.[39] The participation of NewCo in the SPV facilitates the future transfer of standalone customers to mini-grids or to the main grid "when the grid arrives". As indicated previously, the mandate for NewCo to participate in the SPV should be included in the negotiation package of the new concession.

4.2.3. The institutional layer

The definition of the governance of the distribution segment, and the electrification plan in particular, is the responsibility of the MEMD, in coordination with the Ministry of Finance, Planning and Economic Development (MoFPED). The main goal of the MEMD is to meet the energy needs of Uganda's population for social and economic development, in an environmentally sustainable manner.

The Ugandan Cabinet Decision of 22 February 2021 on "Merging and Consolidating Government Agencies, Commissions, Authorities and Public Expenditure" was made with the overall objective of eliminating structural functional duplications and wasteful expenditure. It has already led to amending the Rural Electrification Agency (REA) Statutory Instrument to include REA as a department of MEMD and it also seems that Uganda Electricity Generation Company Limited (UEGCL), Uganda Electricity Transmission Company Limited (UETCL) and UEDCL would be reintegrated in one publicly owned company called the Uganda Electricity Company (UEC).

This report will assume that the re-bundling of UEGCL, UETCL, and UEDCL will take place, despite the fact that this decision has not been formally stated and that it has not been clarified how it would be implemented. So far it has created much uncertainty among the stakeholders and, if carried out, it will complicate matters under a regulatory perspective, with small (if any) benefit. The impact will be different for the transmission, generation, and distribution segments of electricity supply.

Re-bundling generation and cancelling the present concession to operate and maintain the publicly owned power plants, would require transferring these functions to a "generation department" within the newly created UEC and no major problem is expected on this front.

Merging transmission will amount to transferring the responsibilities of UETCL to another department within the UEC. However, in this case, since the system operation function is included in UETCL, special measures will be needed to guarantee the independence of the system operator, since it will be managing a power system with a mix of privately and publicly owned power plants.[40]

Distribution would become another department of the UEC. An integral perspective of distribution would require this department to comprise two divisions, one for on-grid supply and the other for off-grid solutions (i.e., mini-grids and standalone systems), under a common Department Head. UEDCL would become the on-grid division, overseeing the activities of NewCo, and supporting ERA from a technical perspective in the on-grid space, which is expected to eventually dominate distribution. The off-grid division could integrate most of the staff from the former REA, who are presently in the MEMD. All the on-grid

[39] This can be achieved in several ways; for instance, directly providing a subsidy to help purchasing the minimum demand SHS only to the low-income households.

[40] There is ample jurisprudence on this topic in the "Acquis Communautaire" of the Internal Electricity Market of the EU, where measures to mitigate the negative implications of this kind of integration of activities has been thoroughly debated.

distribution assets will be owned by the UEC. On the contrary, the physical assets of mini-grids and standalone systems will be owned by the private suppliers.

The role of the distribution companies, NewCo and the suppliers of off-grid solutions, must be reconsidered, so that the potential of electricity access can be fully exploited. While the aim of digitization and decentralization in developed countries focuses on *demand response*, developing power systems needs *demand growth*, associated to economic development and, more broadly, human development, especially in rural areas. This asks for an in-depth revision of the role of distribution companies as active retailers, promoting development via residential electricity utilization, productive, and community uses.

Two other organizations play a major institutional role in the distribution segment: ERA and FinanceCo. ERA must continue its role as the independent regulatory authority, supported by the distribution department of the UEC for technical matters and the supervision regarding the on- and off-grid activities of the distribution activity. Financing the capacity expansion, administration, operation, and maintenance of the entire distribution, including the electrification plan, is a major undertaking. The MEMD in coordination with the MoFPED is in the driving seat of this undertaking, but it is managed by a specialized company that as discussed will be named FinanceCo. It will be a financial intermediary owned by the GoU that will serve as a hub of all the financing sources and will extend financing to NewCo and the off-grid developers. An upgraded UECCC is a possible option to implement FinanceCo without creating additional organizations.

An operation of this dimension needs the coordinated support of all the DPs presently operating in Uganda. Proper supervision and control of the electrification plan require that, in addition to the GoU represented by the MEMD and the MoFPED, the DPs with a significant contribution to the project must participate in the governance of FinanceCo, which is likely to raise the possibility to acquire some stake in the equity of FinanceCo.

Figure 20 represents the structure of the proposed institutional layer for the distribution subsector in Uganda, with a depiction of the most important functions of each entity, and how they will evolve in time.

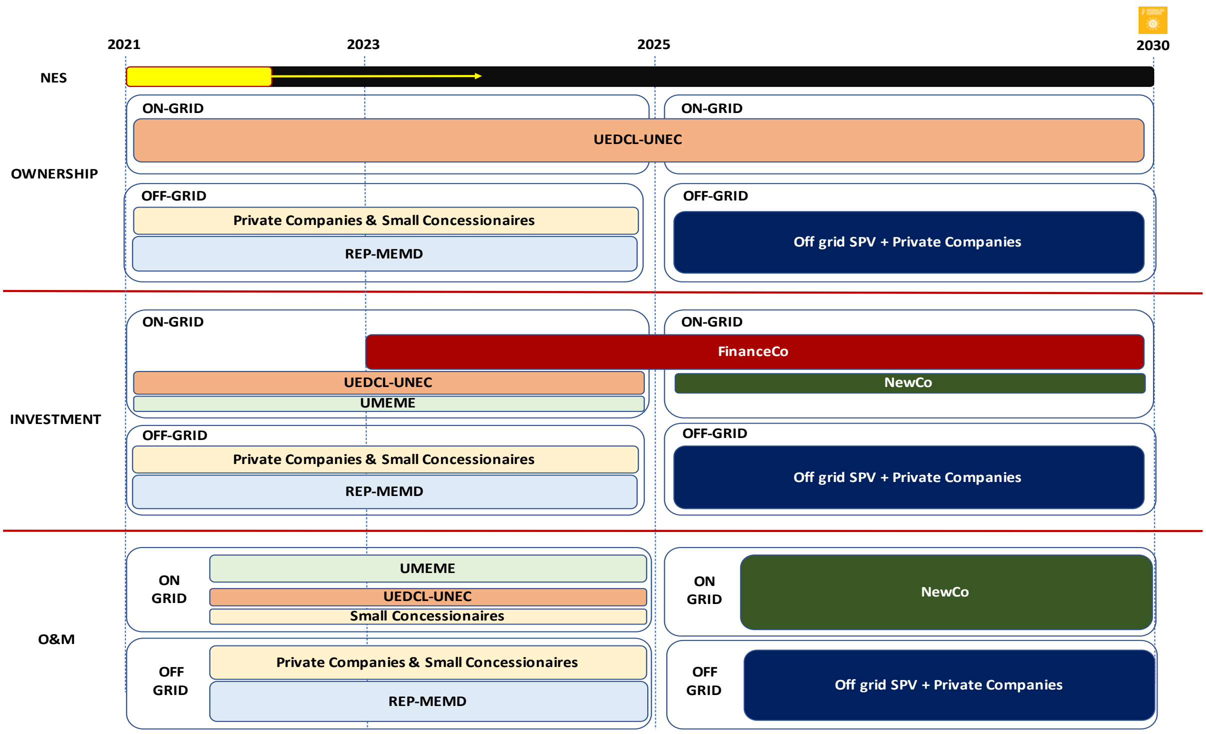

Figure 20. The institutional layer: relevant organizations for distribution reform and their evolution in time

4.2.4. The financial layer

FinanceCo is the hub in charge of coordinating, raising, and channelling the capital flows for the entire process of reform of the distribution sector and the electrification plan. FinanceCo should facilitate and optimize all financing and investment related to the key NES targets, including the financial contributions of the GoU, the DPs, and the surplus of NewCo, which jointly finance investments in Zone B of NewCo and the subsidies to the off-grid companies.

FinanceCo financial model can be better understood by listing its cash sources and uses (represented in Figure 21). Cash flows into FinanceCo will include the surplus of NewCo after collecting revenues from tariffs and retaining a cost-reflective revenue requirement and, depending on its final capital and shareholding structure, equity injections from the GoU as required (also potentially open to private investors) and grants and concessional loans from the DPs (and/or other third parties external financing should additional funding be required). Cash flows out of FinanceCo will include investments in assets of NewCo (starting in 2023) on the new on-grid connections required by the NES, subsidies to mini-grids to top up their cost of service beyond the revenues from the regulated tariffs, subsidies to developers of SHS to top up their cost of service beyond the regulated payments of rent-to-own schemes and financing repayment and/or refinancing, including satisfaction of cost of capital of debt and equity.

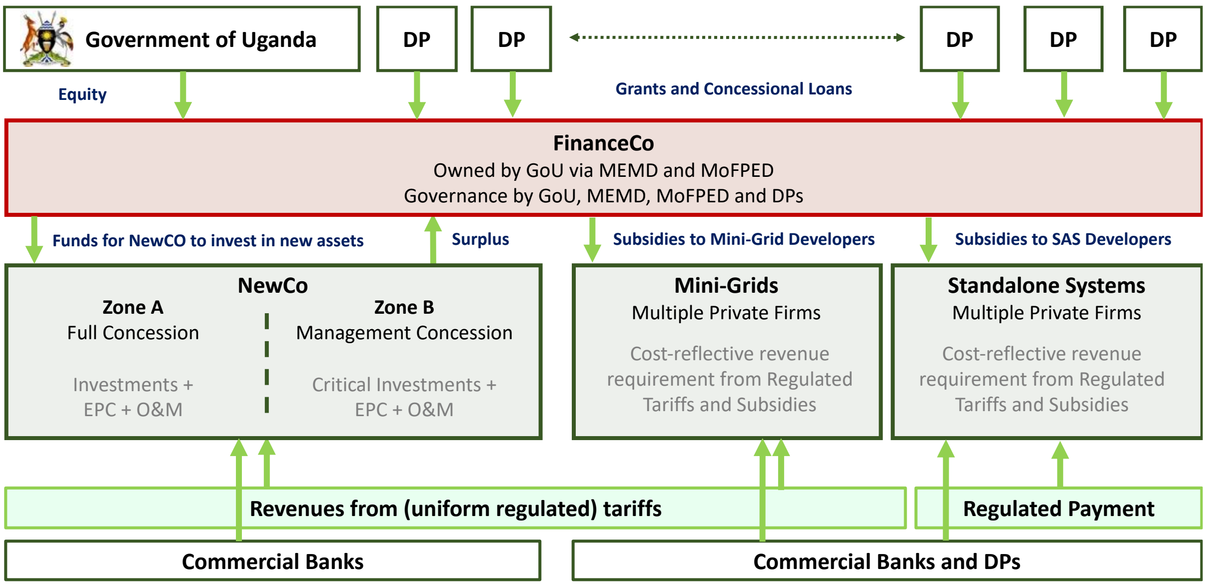

Figure 21. The financial layer: map of economic flows

The centralized role played by FinanceCo implies an across-the-board implicit cross-subsidization among all customers, rural or urban, supplied on- or off-grid. The electrification plan can be considered financially viable if, after a reasonable period of time, the revenues collected from the regulated tariffs will be able to repay the debt incurred during the electrification process, while also remunerating the equity during the considered period, and will be sufficient to cover the total annual costs of electricity supply in the future. This happens to be the case for the NES in Uganda, as shown by our detailed financial analysis (as described in the next section).

4.3. The Uganda Assignment: Reference Business Plan and main results

4.3.1. Financial analysis of the NES: Reference Business Plan

A detailed business and financial plan (Reference Business Plan) has been built by developing the assumptions and conditions under which it is viable to implement and finance the Proposed Reform, including the electrification plan according to the NES to achieve universal access to electricity in Uganda by 2030. The detailed Reference Business Plan model is described in Annex I of this document, including its main assumptions and key criteria supporting decisions on financing alternatives.

The Reference Business Plan is substantially different from the very basic financial analysis included in the NES, which appears to have several serious flaws. In the first place, the financial analysis in the NES is "static", while an electrification financial plan must include yearly financial projections, which on the one hand reflect how the Reference Business Plan execution evolves over time and on the other hand portray the evolving relationship in time between the operating and the financial variables: the country starts borrowing money to achieve full electrification in a few years and it also may need some grants from the GoU and from the DPs; because of the electrification process the demand grows quickly as well as the revenues from application of regulated tariffs; once the electrification is complete, the revenues from all end customers may make it possible to pay back the debt and to stabilize the financial situation of distribution in the future. If this is the case, then the financial plan is viable. This dynamic process is entirely absent from the financial analysis in the NES. Secondly, the financial analysis in the NES only includes investment (Capital Expenditures or CAPEX), while the electrification process requires to also incur administration, operation, and maintenance costs, which are significant and do impact the overall financing strategy. Finally, the financial analysis in the NES includes a contribution of the revenues from the tariffs to cover 10% of the total investment costs. However, in a sound dynamic plan, the tariff revenues are the key contributor that ends up paying for the incurred debt and stabilizes the sector financially.

The term Reference Business Plan is used to refer to a version of our electrification business plan that strictly follows the results of the NES.[41] The main conclusion that can be derived from the Reference Business Plan is that it is possible to finance the NES with a blended mix of financial resources, showing that the NES would be financially viable if our recommendations are followed. However, it will be challenging, since the current level of expenditure in the distribution segment of the Ugandan power sector is much lower than what the viable financial model for the NES requires.

The result is particularly significant as the Reference Business Plan assumes that the tariffs to end customers are constant in nominal value (i.e., the value is not adjusted for inflation) over the entire 2021 to 2040 period. The viability of the plan hinges on the brisk demand growth due to electrification, a significant amount of concessional loans, and some volume of grants. Cross-subsidization across the board makes it possible for all electrification modes to receive a remuneration capable to attract private capital. Note, however, that the NES only includes extremely basic solar kits of 3W for 5.5 million households during the entire considered period until 2040. This cannot be considered an adequate level of electricity access compatible with the SDG 7.1.

[41] Other versions of the electrification business plan can be easily developed with the same analytical tool, for instance replacing the 3W solar kits for more capable SHSs and adding more electrical supply for productive and community uses in the rural villages.

Main financial conclusions drawn out of the full Reference Business Plan (see the summary in Figure 22) include:

- Over the period from 2022 until 2030, when all customers in Uganda must have access to electricity, FinanceCo must receive a total amount of USD 3,800 million of funding, broken down as USD 2,800 million of concessional debt (74% of the total amount; six years of grace period; 2% interest rate), USD 600 million in grants, and USD 400 million in equity provided by the GoU.
- This financial effort is concentrated over the period until 2030, when the major investments associated to electrification of the entire country have to be made (the investment is not uniform over the years, with an average investment per year of USD 470 million).
- Analysing FinanceCo's cash inflows and outflows, given the Return on Investment (ROI) adjustment payment from NewCo to FinanceCo, this amount over the 2022-2030 period rises to USD 834 million (on the other hand, the subsidies required to guarantee 12% ROI to private off-grid companies reach USD 827 million over the same period)[42].
- FinanceCo's cash inflows derived from the surplus of NewCo generate a positive operating cash flow which allows FinanceCo to fund 5% of its investment needs during the 2023-2030 period, in addition to grants (20%), concession debt (65%), and government equity (10%).
- In the case of NewCo, in the 2025-2030 period, with the new ROI adjustment, the revenue requirement and the estimated cash reserves can account for 86% of its investment needs, which allows NewCo to raise commercial debt (10%) and equity (5%).
- During the same time interval (2025-2030) the ensemble of private off-grid companies, which receive subsidies and collect regulated tariffs that allow them to receive a cost-reflective revenue requirement, can cover 68% of their investment needs, leverage commercial debt for 22% and raise equity for the remaining 10%.

FinanceCo		
Positive Operating Cash Flow	USD 219 million	5%
Grants based on DFIs funds to Government linked to the deployment of the CAPEX	USD 800 million	20%
Concessional Debt from DFIs	USD 2.600 million	65%
Equity	USD 400 million	10%
Total	**USD 4.019 million**	

NewCo		
Net Cash Variation	USD 57 million	6%
Positive Operating Cash Flow	USD 815 million	80%
Commercial debt with potential implications on sovereign debt	USD 100 million	10%
Equity	USD 50 million	5%
Total	**USD 1.022 million**	

Off-grid SPV&PC		
Positive Operating Cash Flow	USD 697 million	69%
Commercial debt directly channeled through the Government.	USD 220 million	22%
Equity	USD 100 million	10%
Total	**USD 1.017 million**	

Figure 22. The proposed financing: summary of the period 2021-2030

[42] The value of the new ROI for NewCo would result from a negotiation between the GoU and NewCo. Therefore, 12% is a placeholder to be replaced by other tentative numbers during the negotiation process, until an agreement is reached eventually.

In summary, over a long period of time – since the proposed financial plan covers the period from 2021 to 2040 – the total distribution costs (CAPEX plus Operating Expenses or OPEX) are paid by grants (from the GoU and the DPs) during the electrification phase plus the tariffs from the end customers. Financial stability is achieved at the end of the considered period. We mean by financial stability that the regulated tariffs – including a fair amount of cross-subsidization – are sufficient to cover the total regulated costs (the "revenue requirement") of the distribution business, including both off- and off-grid supply.

4.3.2. Financial analysis of a scenario not contemplated in the NES (minimum supply of 10W): Alternative Business Plan

There is no universally-adopted definition of what "access to electricity" means in reference to the UN SDG7.1 ("*by 2030, ensure universal access to affordable, reliable and modern energy services*"). The NES has adopted the target of deploying 3W solar kits for 5.5 million households in rural Uganda. These systems may not even meet the minimum threshold of what could be considered access – being able to charge a phone and supply one LED light or a radio for four hours a day.

The Final Report also examines the impact that a small enhancement in the capacity of solar kits has on the financial viability of the electrification plan. We have chosen a popular product - much in demand among the low-income rural population In Uganda – 10 W solar kits with a cost of USD 170, which can supply two or three lights, phone charging, and a radio for a longer time. In addition, it has been assumed at least one productive and one community use in each village or population cluster of a minimum size.[43]

We have developed a sensitivity analysis of the Reference Business Plan for the NES (Alternative Business Plan), including a scenario where the 5.5 million rural residential households have 10W solar kits instead of the 3W solar kits in the NES. The rest of the operating assumptions of the business model from 2021 to 2040 have not been modified, therefore ensuring that 100% electrification is achieved by 2030.

The CAPEX of investment in solar kits now increases from USD 418 million in the NES to USD 935 million whereas the total CAPEX of the NES increases from USD 4.68 billion to USD 5.2 billion (up 11%).

The volume of subsidies coming from FinanceCo towards the standalone solar systems companies (with a specified ROI of 12%) must cover the increase in the cost of the solar kits. A new capital structure has been designed for the Alternative Business Plan to address this temporary mismatch between subsidies and higher investment needs. In order to comply with the limits of the financial ratios of the aggregated off-grid companies, the commercial debt requirements must increase from USD 220 million in the Refence Business Plan to USD 510 million.

The increase in subsidies needed to guarantee the 12% ROI to the aggregated off-grid companies (Off-grid SPV and private companies, SPV&PC) generates a deficit in FinanceCo that must be financed. The increment in subsidies that FinanceCo must provide must come from an increase in concessional debt, grants, and equity, leaving a percentage of 12% equity, 22% grants, and 66% debt. Debt restructuring was carried out by analysing the debt limit through financial ratios, always making sure that all debt will be repaid by 2040.

[43] From a quantitative viewpoint, the relevance of this additional amount of community and productive use of electricity has been found to be much smaller than the assumed increment in residential use.

Figure 23 sums up the key figures of the Alternative Business Plan, which we also consider to be financially viable. Please note the Alternative Business Plan only relates to the Off Grid SPV and does not impact NewCo financial projections.

Our Proposed Financing (Summary 2021-2030)		
External Funds - DFIs		
Concessional Debt	USD 2.700 million	66%
Grants (based on DFIs funds to Government linked to the deployment of the On-grid CAPEX)	USD 900 million	22%
	USD 3.600 million	
Internal Funds - GoU		
Equity FinanceCo	**USD 500 million**	12%
Total	**USD 4.100 million**	
Commercial debt with potential implications on sovereign debt	*USD 610 million*	*16% NewCo* *84% Off-grid SPV&PC*

Figure 23. Financing proposal for the Alternative Business Plan (summary for 2021-2030 period)

4.3.3. Reference Business Plan for NewCo: Model structure, key assumptions and main results

As discussed above we consider both Reference Business Plan and Alternative Business Plan to be financially viable under the assumption that Debt Providers will be led by DPs (at market terms under their specific business idiosyncrasy and working approach) whereas additional equity required will be provided respectively by the GoU (in the case of FinanceCo), by individual private investors (in the case of Off Grid SPV) and, in the case of NewCo, by current Umeme's shareholders since the Final Report assumes NewCo will maintain Umeme's current concession holders as part of the concession renewal terms.

There is however a clear market consensus on the expected request of additional equity investments that financing providers will pose at some point to SSA countries in general and to Uganda in particular, in order to jointly contribute to reaching the electrification targets. This financing providers request is assumed to be well received and even also actively supported by the GoU due to anticipated public financing constraints and budget limitations over the next few years. For the purposes of our analysis, should the GoU agree to bring in new equity into one of the main electricity industry participants, NewCo has initially been selected as the most obvious sector player where the entrance of an Equity Investor seems easier to be completed due to its concessional nature, its existing mature operations, the profile of its financial results and forecasts and its listed status among other reasons (other sector players described above as part of the Proposed Reform could be part of subsequent analysis and research)[44]. Please also note that for the purposes of this analysis only the Reference Business Plan has been used since the Alternative Business Plan only relates to the Off Grid SPV.

NewCo's economic and financial model structure can be explained around four modules: the new distribution network roll-out plan (*Capital expenditure plan)*, the revenue regime reflecting NewCo's concession terms (*Revenue model*), the resulting operating income, required to support the network investment (*Operating cost and income model*) and the overall financing plan, including the working capital

[44] Should NewCo become the selected vehicle to channel equity investments into Uganda, the entrance of an Equity Investor could be indicatively implemented, with GoU support, either by a capital increase at NewCo or by a secondary trade of NewCo´s shares currently owned by the National Social Security Fund (quasi-Government agency).

evolution, associated with such business development to make it all possible (*Financing plan*). As stated in the description of the Uganda Assignment, the new network investments will be rolled-out in two stages: (i) during the period 2022-2030, where there will be an optimal mix between grid extension, fill-in consumers, mini-grids and stand-alone systems in order to achieve full population coverage by the end of period, and (ii) during the period 2031-2040, where some additional CAPEX will deployed to cope with population and consumption growth. In addition, we have obviously assumed and modelled that all capital expenditure incurred will be replaced once amortized considering the different network components, employed technologies and respective life expectancy periods. Therefore, our revenues will be generated by the income coming from the different types of customers paying for their consumption at the corresponding tariff for each customer class in Zones A and B. The operating cost structure includes the cost of energy upstream (cost of sales), operation and maintenance costs (including all operating/yearly expenditure) and administrative expenses (split between direct customer billing/service and other overheads), in addition to the provisioning of some expected bad debt from customers. Revenues collected by NewCo will exceed its regulated revenue requirement, since NewCo only incurs at most a small fraction of the investments in zone B, hence generating a surplus. Therefore, a new ROI adjustment cost would be computed to evidence the cash outflow from NewCo that must be delivered to FinanceCo. Working capital has been modelled including the ordinary trade receivables, inventory and trade payables required to launch and operate the business. In addition, the tax schedule has also been modelled. Financing has been structured considering three main sources to fund the initial network roll-out as well as the expected initial operating losses: Umeme's existing commercial debt considering amounts and terms currently in place (debt is modelled to be fully amortized by 2025 as customary at the end of a concession period), new commercial/corporate debt, estimating the structure, amount, tenor and terms at or close to market conditions (potentially structuring a syndicated bank loan led or participated by some DFI), and the required equity injection to be eventually provided by Umeme's current shareholders once the new concession contract has been signed in 2025 (or eventually by an Equity Investor).

Capital expenditure plan

The investment plan has been developed with the objective of reaching full population coverage with acceptable reliability by the end of 2030, and due to regulatory changes expected to take place in this timeframe, investments are organized in different periods (initial situation 2021/2022, electrification effort 2023-2030, and financial stabilization 2031-2040) as shown in Figure 24 and in Figure 25.

As discussed above and according to the NES, the overall cost of the electrification plan (to be completed by 2030) is USD 4.68 billion, split among the various industry players as follows: FinanceCo (USD 3.54 billion), UEDCL-UEC (USD 104 million), Off Grid SPV and private off-grid companies (USD 774 million) and NewCo (USD 271 million).

As for the initial situation (2021/2022) and based on the current investment levels presented in the financial statements, we have estimated that only 20% of the NES target has been or will be fulfilled in both years. Therefore, we have allocated the rest of the necessary connections evenly over the rest of the period, so that 100% electrification is achieved by 2030. This means a step change from approximately 190,000 new connections in 2022 to 1.14 million connections in 2023.

For the electrification effort (2023-2030), FinanceCo is assumed to provide the required financing to Umeme until the end of the current concession (2025), and to NewCo afterwards (2025-2030) to execute the EPC of the new on-grid connections dictated by the NES within Umeme's footprint (since Umeme cannot invest by political decision during this time interval in its current footprint). After 2025, NewCo will be able to make a small fraction of the on-grid investments established by the NES, which correspond to critical network infrastructures requested by NewCo and approved by ERA after consultation with UEDCL-UEC, requiring then a decreasing percentage of revenues (from 11% in 2025 down to 6% in 2040). Additionally, in 2025, UEDCL-UEC will transfer all consumers under its operation to NewCo so it will then operate and maintain the consumers and assets under UEDCL-UEC in 2025 until the end of the new concession.

For the financial stabilization (2031-2040) and once 100% electrification is achieved, new investments are only necessary to address population and consumption growth, plus CAPEX replacement according to the specific D&A (depreciation and amortization) schedule, requiring a decreasing percentage of revenues (from 4% in 2031 down to 2% in 2040).

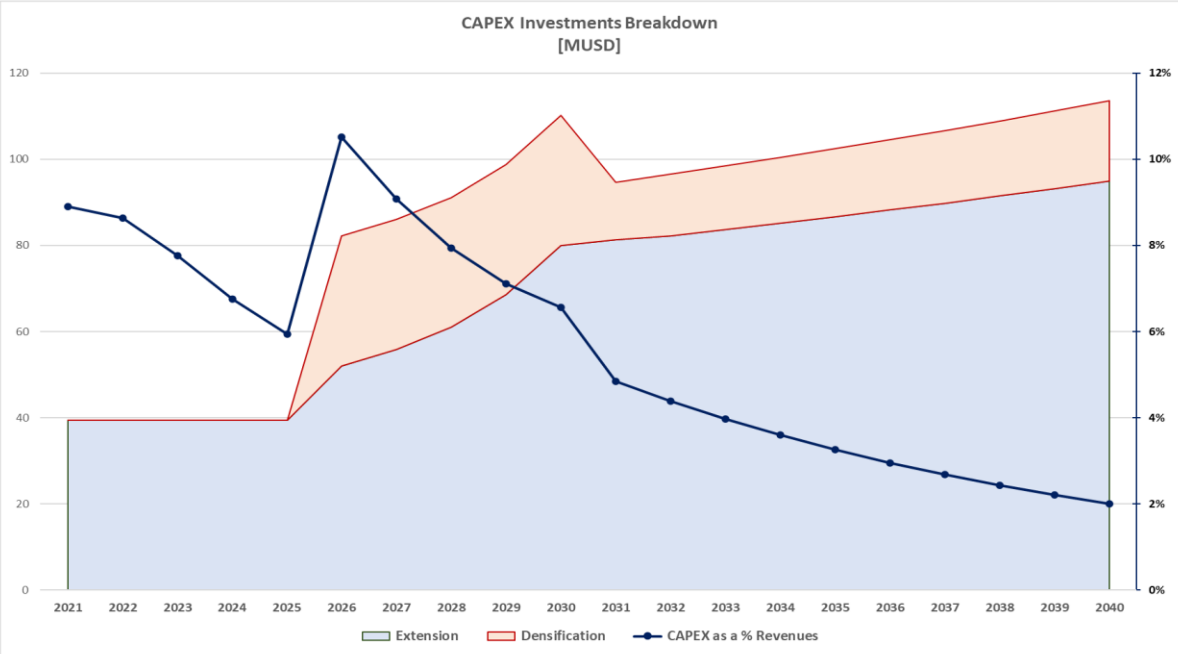

Figure 24. Uganda: CAPEX investments breakdown

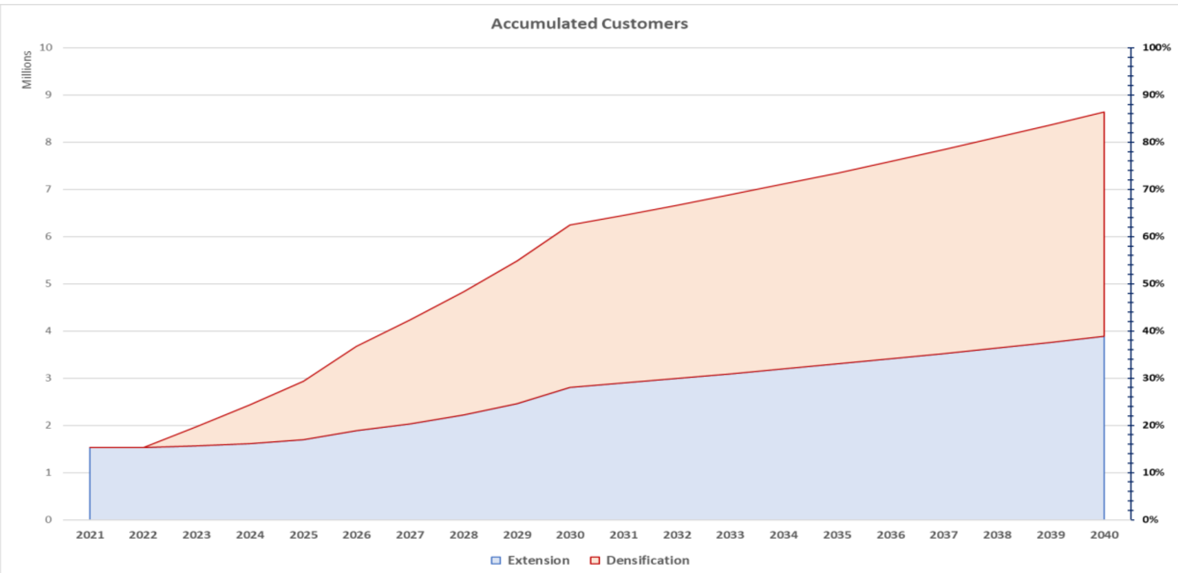

Figure 25. Uganda: Accumulated number of customers

Revenue model

NewCo will bill and collect revenues from the application of regulated tariffs to all customers connected to the grid. The revenue requirement has been calculated using a 20% ROI until 2025, when, after the concession's renegotiation, the return rate is expected to be reduced to 12% for zones A and B.

The revenues collected by NewCo will exceed its regulated revenue requirement, as NewCo will only incur, at most, a small fraction of the investments in zone B, thus generating a surplus (as seen in Figure 26, this difference will increase as more consumers are connected in Zone B). Total revenues from the tariff collection (100% of total revenues) grow at a 2021-2030 CAGR around 16% and at a 2031-2040 CAGR over 12%, from over 444 USD million in 2021 – still Umeme– up to over USD 5.6 billion by the end of the projections period.

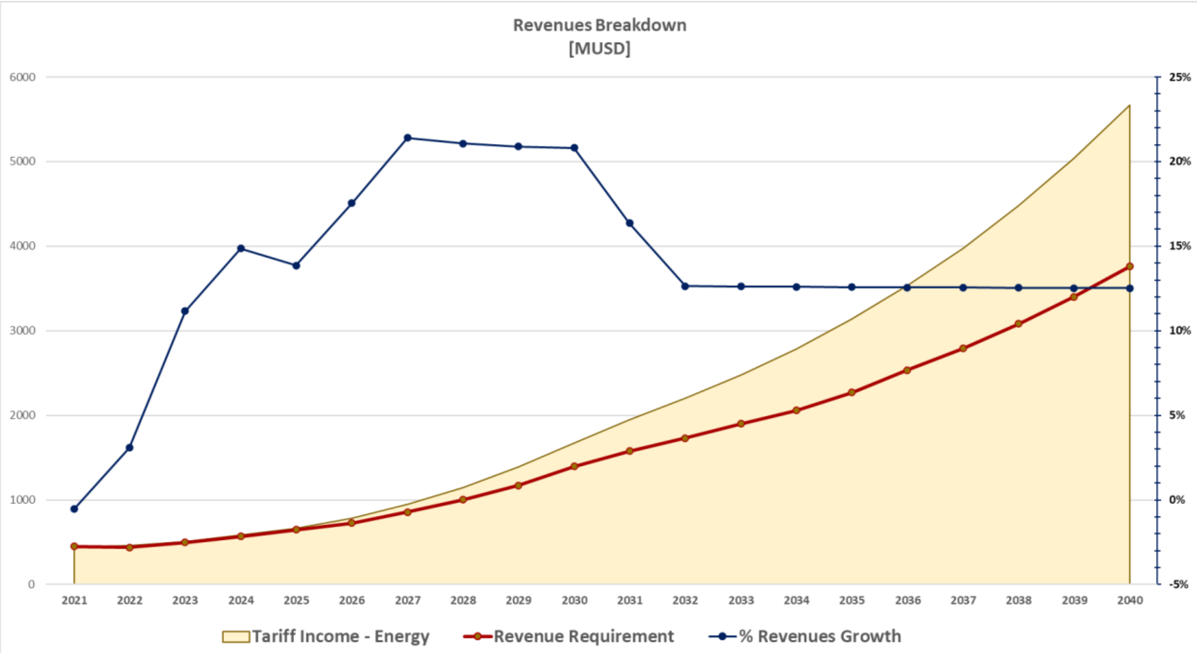

Figure 26. Uganda: Revenues breakdown

Operating cost and income model

Total operating costs start growing at a slightly slower pace than revenues (2021-2030 CAGR about 17%) and then benefit from operating leverage (2031-2040 CAGR just over 13%), evolving from about 90% down to about 55% of ex-grants revenues by the end of the projections period, with the following cost breakdown (see Figure 27): (i) as upstream energy cost moves alongside energy consumption, its relative lower growth (2021-2030 CAGR over 12,8% and 2031-2040 CAGR over 12,4%) reduce weight from over 67% down to about 51% of total revenues by 2040; (ii) distribution costs grow alongside capital expenditure and remain between 3% and 9% of total revenues in the 2021-2030 period and between 9% and 5% of total revenues thereafter; (iii) bad debt is expected to be provisioned around 1% of tariff income (no provision write-up has been assumed); (iv) administrative expenses include customer/billing services (relatively stable around 7% - 15% of total revenues resulting in a 2021-2030 CAGR around 19% and a 2030-2039 CAGR of about 5% and (v) post-2023 and especially once the concession is renegotiated in 2025, revenues collected by NewCo will exceed its regulated revenue requirement, creating a surplus that will be delivered to FinanceCo (this cash outflow will be computed as a cost, named ROI Adjustment Payment, resulting in initially 2% of the revenues, which will grow, as shown in Figure 27, up to 33% of the total revenues).

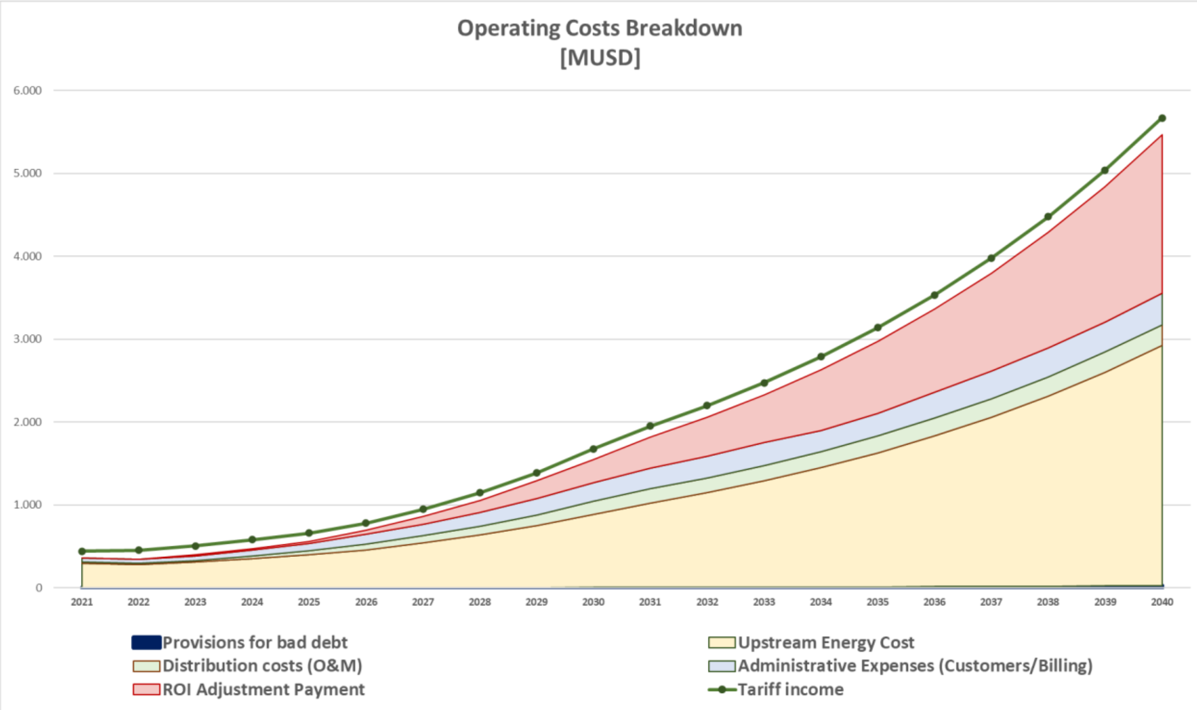

Figure 27. Uganda: Operating costs breakdown

Our estimate of revenues and cost structure produces the following operating margins (see Figure 28): EBITDA margin decreases to the 8% region by the end of the 2021-2030 period, due to the renegotiation of the concession ROI from 20% to 12% after 2025 and, as expected, EBIT margin shows a more volatile evolution linked to the network D&A schedule, starting below 15% during the first few years and decreasing after 2025 to around 3% by the end of the projections period.

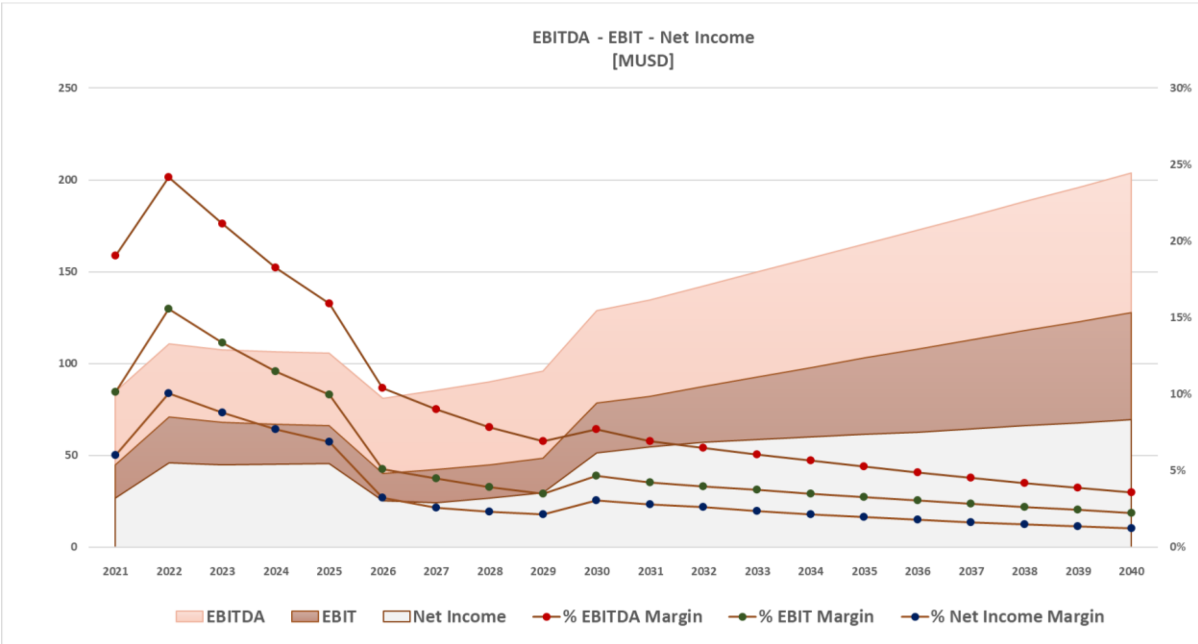

Figure 28. Uganda: EBITDA - EBIT - Net income

Figure 28 also shows the evolution of EBITDA (2021-2030 CAGR around 4.8% and 2031-2040 CAGR over 4.7%), EBIT (2021-2030 CAGR around 6.4% and a 2031-2040 CAGR over 5%) and net income (always positive – secured by the regulated revenue requirement - in the 2021-2030 and 2030-2040 periods with CAGRs over 7% and 3% respectively). In contrast, Figure 29 below adds the evolution of revenues to provide a complete overview of the business and operating model evolution (having sliced EBITDA at USD 1 billion to see more accurately the evolution of EBITDA and Net Income).

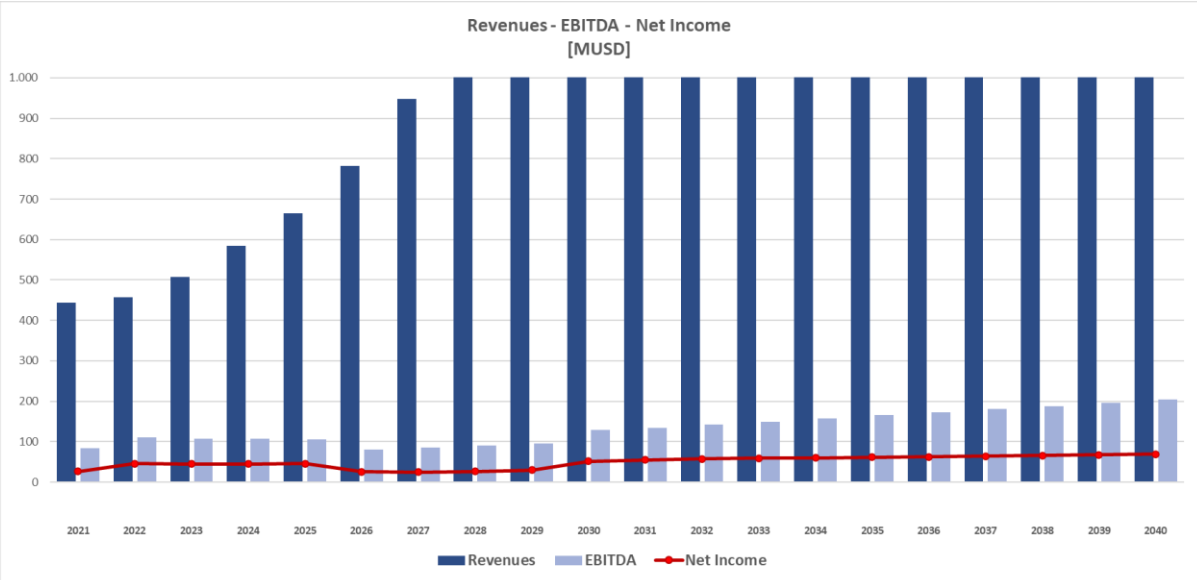

Figure 29. Uganda: Revenues - EBITDA - Net income

Financing plan

In summary terms, to fund the required USD 2.7 billion over the full 2021/2040 projections period (USD 1.7 billion CAPEX and USD 213 million net financial expense), the following financing structure (see Figure 30) has been assumed: (i) initial equity injection of USD 50 million in 2026 (around 5% of the total) as part of the concession renewal, to be injected either by the existing investors or by a potential new partner since they will have to frontload a significant amount of the CAPEX financing subject to confirming funding commitments for the full program (in addition, a dividend pay-out has been assumed at 50% during the entire projections period); (ii) current commercial debt, around USD 80 million, is expected to be fully amortized by the end of 2024/25 as the current concession contract is expected to be terminated; (iii) new commercial debt shall be raised, including USD 100 million in 2026 contingent to the equity injection, arranged with an 8% coupon and with tenor, repayment schedule and financial covenants at market terms and thus acceptable by commercial debt financing providers (indicatively, we believe an IFC led syndicate could bring significant structuring and execution benefits but other funding sources could also be contemplated) and some estimated USD 50 million per year starting in 2032 (to finance the required replacement of assets expected as per the D&A schedule and the increase in population and electricity consumption) resulting in USD 450 million over the 2032-2040 period and net debt around USD 270 million by 2040 (around 10% of the total, including USD 370 million commercial debt and USD 100 cash/equivalents) and (iv) operating cash flow of USD 2.0 billion generated by the business over the 2021/2040 period (around 75% of the total).

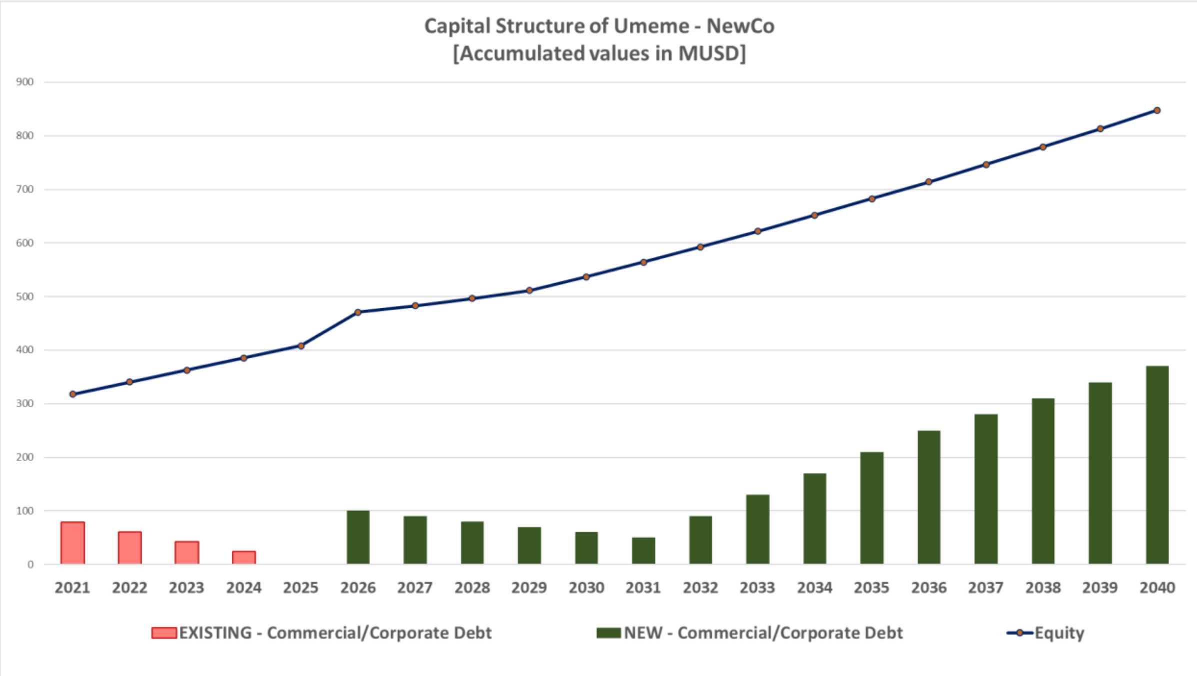

Figure 30. Uganda: Capital structure

Some key leverage ratios (see Figure 31) support the capital structure sustainability, with DSCR (EBITDA/debt related payments) over 3.5x, Total Debt / EBITDA peaking at 1.8x in 2040, Total Debt / PP&E fluctuating due to varying capital requirements, spread out over the two concession periods until it peaks at 38% by 2040 or Interest Cover (EBIT/interest expense) consistently above 4.5x through the different investment periods.

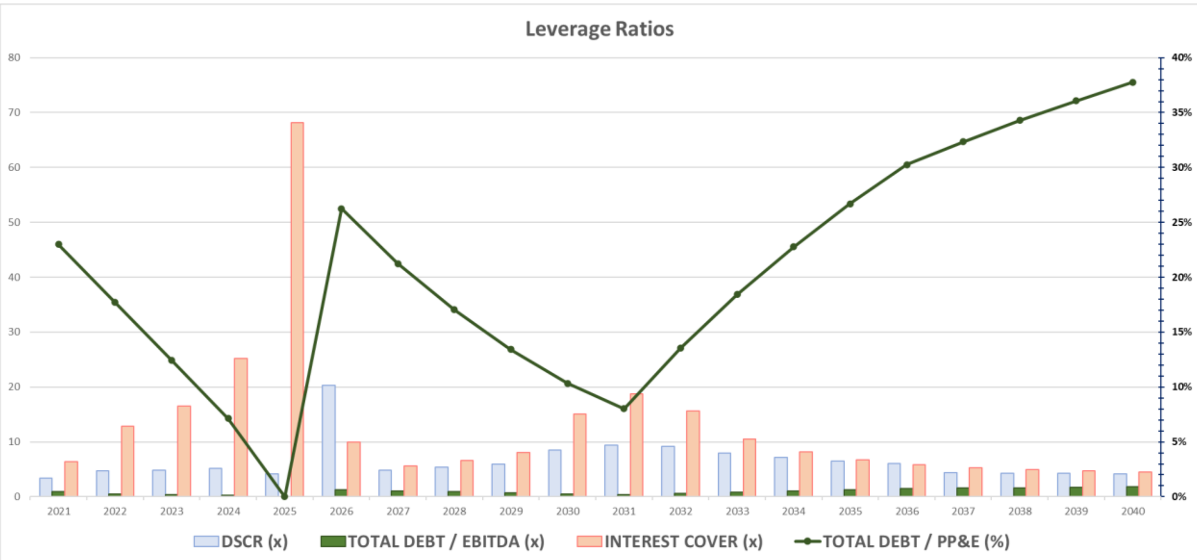

Figure 31. Uganda: Leverage ratios

Reference Business Plan returns

The Reference Business Plan produces the following returns (see Figure 32 below): ROCE (calculated as EBIT / (Equity + Net Debt)) over 18% during the 2021-2025 period, decreasing in the new concession agreement below 10% during the 2026 – 2030 period, but growing to an average of 11% in the 2031 – 2040 period; net ROCE (calculated as NOPAT / (Equity + Net Debt)), reaches its peak in 2021 at 18% and decreases down to 7.7 % in 2040 and, given expected cost of debt, tax impact (estimated at 30%) and the cash distributions back to shareholders, annual return on equity or ROE (calculated as Net Income/Equity) fluctuates with the returns stipulated for each concession period, growing from 5% to 8% in the 2026-2040 period.

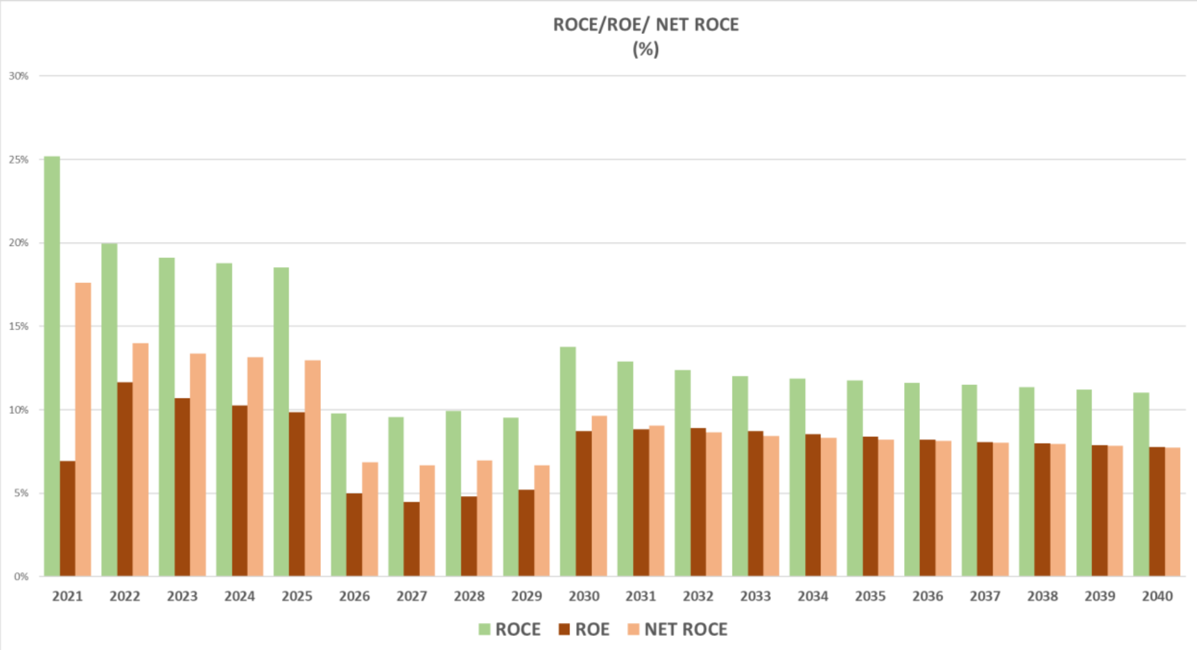

Figure 32. Uganda: ROCE/ROE

We anticipate the Equity Investor will focus on the Reference Business Plan IRR to quantitively assess the potential investment attractiveness under different scenarios. Figure 33 and Figure 34 summarize the key NewCo valuation assumptions and the expected Equity Investor IRR respectively assuming a 2023-2030 investment horizon whereas Figure 35 and Figure 36 summarize similar inputs and outputs for a 2023-2040 investment period.

To calculate NewCo equity value we have used a discounted cash flows methodology (DCF) because it best reflects the fundamental company value, it is the most relevant for an Equity Investor and there are no relevant comparable listed companies or transactions. For the terminal value we have used the NOPAT/WACC (Weighted Average Cost of Capital) approach because we believe that its implicit assumption (overtime return on capital will equal cost of capital) is the most appropriate to assess NewCo terminal value. Indicatively, Umeme's trading multiple is 1.9x EV/EBITDA as of 31 October 2022 (calculated as enterprise value or market capitalisation plus net debt over annualised EBITDA) which we disregard for the purposes of our analysis due to the stock lack of liquidity.

Resulting IRRs confirm the challenging base case returns scenario for the Equity Investor: IRRs below the cost of equity 14.5% with returns declining as investment period increases (12.8% IRR for the 2023-2030 period and 11.8% IRR for the 2023-2040 period) due to NewCo also declining regulated return on capital (down from 20% up to 2025 to 12% from 2025 onwards) as well as capital structure and reinvestment assumptions used to elaborate the Reference Business Plan.

NewCo Equity Value	**2022**	**2030**	**WACC calculation**			
FCF 2023-2030	68.3		Risk-free rate	8.5%	Equity	50%
NOPAT		55.0	Beta (unlevered)	0.59	Debt	50%
TV (NOPAT/WACC)	257.9	536.4	Beta (levered)	1.00		
TV (Equity Value)		505.2	Equity premium	6.0%	Cost of debt (pre-tax)	8.6%
Enterprise Value	326.2		Cost of equity	14.5%	Cost of debt (post-tax)	6.0%
Net Debt	73.6					
NewCo Equity Value	**252.7**		**WACC**	**10.3%**		

Figures in USD million. WACC calculation key assumptions:

Risk-free rate: yield average from selected USD sovereign issues by 31.12.2021 (pre-crisis) https://www.bondsupermart.com/bsm/bond-selector

List of comparable African countries (ratings B-/B/B+) with selected USD sovereign issues: Kenya, Senegal, Nigeria, Zambia, Cameroon, Rwanda

Beta (unlevered): 0,59 (utilities/general from https://pages.stern.nyu.edu/~adamodar/New_Home_Page/datafile/Betas.html)

Equity premium: KPMG Research (https://indialogue.io/clients/reports/public/5d9da61986db2894649a7ef2/5d9da63386db2894649a7ef5)

FCF: Free Cash-Flow. TV: Terminal Value

Figure 33. NewCo Equity Value key assumptions (2023-2030)

Equity Investor	2022	2023	2024	2025	2026	2027	2028	2029	2030
Equity Value	-252.7								505.2
Value Addition	-								
Capital Increase					-50.0				
Dividends		22.3	22.5	22.8	12.6	12.2	13.4	14.8	25.7
Net CF/Value	-252.7	22.3	22.5	22.8	-37.4	12.2	13.4	14.8	530.9
Equity Investor IRR	**12.8%**								

Figures in USD million.

Figure 34. Equity Investor IRR (2023-2030)

NewCo Equity Value	**2022**	**2040**	**WACC calculation**			
FCF 2023-2040	128.8		Risk-free rate	8.5%	Equity	50%
NOPAT	0.0	89.4	Beta (unlevered)	0.59	Debt	50%
TV (NOPAT/WACC)	157.8	871.3	Beta (levered)	1.00		
TV (Equity Value)		597.9	Equity premium	6.0%	Cost of debt (pre-tax)	8.6%
Enterprise Value	286.6		Cost of equity	14.5%	Cost of debt (post-tax)	6.0%
Net Debt	73.6					
NewCo Equity Value	**213.0**		**WACC**	**10.3%**		

Figures in USD million. WACC calculation key assumptions:

Risk-free rate: yield average from selected USD sovereign issues by 31.12.2021 (pre-crisis) https://www.bondsupermart.com/bsm/bond-selector

List of comparable African countries (ratings B-/B/B+) with selected USD sovereign issues: Kenya, Senegal, Nigeria, Zambia, Cameroon, Rwanda

Beta (unlevered): 0,59 (utilities/general from https://pages.stern.nyu.edu/~adamodar/New_Home_Page/datafile/Betas.html)

Equity premium: KPMG Research (https://indialogue.io/clients/reports/public/5d9da61986db2894649a7ef2/5d9da63386db2894649a7ef5)

FCF: Free Cash-Flow. TV: Terminal Value

Figure 35. NewCo Equity Value key assumptions (2023-2040)

Equity Investor	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**
Equity Value	-213																		597.9
Value Addition	-																		
Capital Increase					-50														
Dividends		22.3	22.5	22.8	12.6	12.2	13.4	14.8	25.7	27.2	28.7	29.4	30.1	30.7	31.4	32.1	33	33.9	34.7
Net CF/Value	-213	22.3	22.5	22.8	-37.4	12.2	13.4	14.8	25.7	27.2	28.7	29.4	30.1	30.7	31.4	32.1	33	33.9	632.7
Equity Investor IRR	**11.80%**																		

Figures in USD million

Figure 36. Equity Investor IRR (2023-2040)

Despite the referred arguments supporting the selection of NewCo as the most obvious sector player to attract the interest of an Equity Investor, we anticipate the stand-alone risk-return investment proposition may not be attractive enough due to both quantitative and qualitative reasons. On the one hand, expected returns (Equity Investor IRR in the region of 13% by 2030 or 12% by 2040) below the cost of equity (14.5%) are unlikely to initially get meaningful internal traction. On the other hand, the investment case is likely to be definitely rejected because of the early stage of NewCo's additional business development, the inherent risk of the new investment roll-out plan, the lack of successful precedents in SSA and, very importantly, the relevant size of the required equity ticket to eventually acquire NewCo's entire share capital (USD 253 million in the 2023-2030 case and USD 213 million in the 2023-2040 case).

This preliminary conclusion has been discussed with and confirmed by some senior industry executives from potential Equity Investors, who admit their internal decision-making bodies are highly likely to turn down this investment proposition.

We could then infer that, following a traditional investment analysis approach, the investment proposition should then need to be further developed and improved, including both some risk reduction by potential credit enhancement (designing more favourable or tailor-made structure terms for the Equity Investor, see section 4.4) and some expected financial return improvement by adding real options value (resulting from either capturing potential growth in other markets or having the right to abandon the project under well-defined circumstances, see section 4.5).

4.4. Risk mitigation measures

This chapter focuses on the specific risk mitigation measures that should improve the investment risk proposition by enhancing its credit risk profile, without ignoring the critical corporate governance implications (the Equity Investor is expected to play a critical industrial role beyond the mere financial investment). These may include the reduction of the equity ticket size (most likely through the inclusion of other equity providers into some type of syndicated investment structure), the introduction of preferred economic rights (either some preferential dividend or equivalent financial return and/or some preferential liquidation rights), the potential addition of preferred political rights (i.e., some privileged corporate governance rights associated either to the full syndicate or, most likely, disproportionately to the Equity Investor) and some special exit provisions, as part of the concession agreement and/or included in a separate shareholder agreement (SHA).

As discussed, the investment amount required from the Equity Investor in absolute terms to reach the required control over NewCo is expected to be substantial (see Figure 34 and Figure 36 above). Given the relevance of potential investor concerns, the Equity Investor is expected to look for structure alternatives to minimize the size of its equity ticket while preserving its corporate governance status. The reduction of equity ticket size could firstly be achieved by seeking the minimum control guaranteeing stake (consistent with common corporate governance practice, Uganda 2012 Companies Act assumes control either controlling the Board composition or by exercising or controlling more than one half of the total share capital) and/or combining that equity size reduction with a SHA to be signed with the other NewCo shareholders.

Hence, under the Reference Business Plan the Equity Investor could limit the full equity investment to USD 127 million (2030 case) or USD 107 million (2040 case) in case direct control of NewCo share capital (just above 50%) is required and allow other financial investors to own directly the rest of shares or, should this become a primary concern, reduce the ticket even further by controlling NewCo through a syndicated vehicle which, while owning a similar 50.1% stake, would allow the Equity Investor to exercise the required control through a SHA with the other financial investors (i.e., the Equity Investor could reduce the ticket to 50.1% of the syndicated vehicle investment or just around USD 64 million or USD 54 million for the 2030 case or the 2040 case respectively).

The Equity Investor could alternatively structure its investment, either totally or partially, through some type of non-ordinary stock that grants either preferred economic rights and/or the potential addition of preferred political rights. We would expect the Equity Investor to be more focused on the latter and seek a similar set of privileged corporate governance rights by channelling all or part of the investment through some privileged securities, either tailor-made or provided for under Ugandan regulation, with super-voting rights, reserved areas of corporate governance or favourable deadlock resolution mechanisms. We would also expect the other Equity Investor partners, especially if they are financial investors, to seek compensation through preferred economic rights and maximise financial returns, so some compromise among the different partners could be achieved.

Despite corporate and operating control remains a top Equity Investor priority, we shall expect them to also actively pursue capital preservation and financial investment protection measures, especially in front of the GoU or GoU related entities. Final corporate governance regime will obviously result from each specific negotiation process but, given the highlighted potential investment concerns, the Equity Investor is likely to seek the best of both industrial and financial worlds before committing the initial investment. Other potential capital preservation measures such as DFIs capital invested guarantees or country insurances policies could be pursued but a detailed analysis of these alternatives, as mentioned in section 5, has been left outside the scope of this work.

The Equity Investor will also try to impose some favourable exit status both in the SHA (to be signed with the financial partners) and, primarily, in the concession terms (to be signed with the GoU) where under some unfavourable regulatory, business, financial or political scenarios, the Equity Investor could be granted a favourable divestment in timing and in economic terms. Assurances of a well-defined, non-controversial and finically favourable investment exit is expected to be a critical Equity Investor decision-making bodies requirement. This favourable exit regime may include, among others, the return of the initial investment (potentially plus some pre-agreed financial return), some market standard provisions including, as an indicative example, the option to drag the other NewCo shareholders and drive a full NewCo sale (in case this alternative is perceived to maximise Equity Investor proceeds) and a clear path to get international legal arbitration or protection should an amicable exit is not achieved.

4.5. Real options model: the Rwanda case

We focus next on how the expected financial return could be improved by adding real options value that could theoretically derive from either capturing potential growth in other markets or having the right to abandon the project under well-defined circumstances. For the purposes of our analysis we assume that the latter would not so much be a potential investment return enhancement but a critical Equity Investor request at the time of negotiating NewCo's concession terms. As a result, the option to abandon is assumed to be an investment necessary condition rather than a value addition and its related option value has not been valued or added to the base case returns.

We have then exclusively focused on applying the real options theory to the real option to grow (Growth Real Option) and selected Rwanda as a neighbour country to Uganda with a similar electrification challenge (in terms of non-electrified geography, required investment and financing raising complexity) but behind Uganda on the adoption of the concession model and the attraction of foreign capital. We also take advantage of the financial model built by the Research Team as part of our work on Rwanda prior to the Uganda Assignment – see de Abajo et al. (2020) – so a real options model can be tested on a comparable situation for which a set of relevant financial projections is available. For the avoidance of doubt, the Growth Real Option calculated on Rwanda (Growth Real Option on Rwanda) is purely indicative, although we believe that the approach can be applied to other countries where the Uganda (and eventually also the Rwanda) experience and credentials could become relevant.

4.5.1. Introduction to real options approach

The real options approach was developed from Myers (1977) proposal to overcome some of the limitations of conventional DCF valuations. Real options capture the value of managerial flexibility (i.e. the capacity to actively manage a business investment) as well as non-monetary or intangible results that could generate future growth opportunities.

Conventional investment valuation models (DCF based) only consider the actual flows generated by said project which are discounted at a rate that reflects the risk of the investment. Net present value (NPV) and IRR criteria, widely used in business practice, are the main applications of the DCF approach. In these models, although risk is considered through the discount rate, the investor's position is passive, waiting for uncertainty to be resolved but not being able to act on it. This vision is static and does not allow any interaction with the business context nor any adjustment to the changing circumstances that may arise. In summary, what these traditional models imply is that today´s decisions regarding the investment in a project are taken without considering the possible changes in the business environment that may exist and the ability to adapt to this environment. To overcome this static position, it is necessary to recognize that the company has flexibility to react to the different situations that may arise.

If this is the case, flexibility (decision-making rights) may be an important source of value in business investments that is consistently ignored by conventional valuation methods. The real options approach allows us to assess this ability that company managers have to adapt to the different scenarios that may arise with the information available at any given time. While conventional DCF based models only take into account the risk-return trade-off, the real options approach adds managerial flexibility to these parameters or the ability to adapt and respond to future uncertainty. We need to stress that the option value comes from the possibility to react to uncertainty, not from uncertainty itself (Mascareñas, et al., 2003).

In real options valuation, the following variables are considered: i) the underlying asset (or asset on which the value of the decision right depends) and its volatility, ii) the strike or exercise price, iii) the expiration date, iv) the risk-free interest rate and v) the cash flows generated by the project while the option is not exercised and which are waived by keeping the right alive (similar to dividends in financial stock options). A basic criterium for classifying options is the moment of exercise, which distinguishes between European options if the option can only be exercised at a specific moment (the expiration date), and American options if it can be exercised any time before up to and including the expiration date. Valuing American options is more complex, as reflected in many of the existing real options valuation methods. This greater complexity is due to the fact that not only must the option be valued on its expiration date and discounted to the present time (like a European option), but the right must be valued on each date on which exercise is possible by comparing the value to exercise and the value of keeping the option alive until the next period. Therefore, a backward induction process is required to value the option recursively: valuation begins on the expiration date and moves backwards in time, determining the optimal exercise policy.

Based on the nature of the right that they grant to their holder, real options can also be classified into the following types: options to delay an investment and growth options (these two categories are associated with financial call options) and options to abandon or options to reduce (which are associated with financial put options). Additionally, we can find compound options (options on options) or change options (right to choose between options) among others that involve greater complexity. As discussed, only the Growth Real Option on Rwanda will be analysed and valued.

One of the most relevant considerations when approaching the valuation of a real option is the nature of the underlying asset. In real options, the underlying asset is a real asset, whether it is an investment project, an intangible asset or a business unit. These real assets are characterized by their specificity, since each project has features and properties that make it unique and generate value only to the holder of the right, therefore affecting the ability to negotiate with the asset or with the option in the market. In order to value real options, like their financial counterparts, it is necessary to assume that markets are complete and all assets can be traded. This assumption is quite reasonable in the case of financial options, but not so much when we try to value managerial flexibility and business decision rights. Many real option models accept this assumption without further consideration, based on the fact that the real option underlying asset, even if not traded, can be valued on the basis of its expected cash flows (Trigeorgis, 1996). Copeland and Antikarov (2001) try to correct this dissonance in some way and consider that the present value of the project cash flows is a good estimator of market value in situations in which the underlying asset is not traded.

Despite these difficulties, there are numerous scientific references in the literature that corroborate the effectiveness and suitability of the real options approach when valuing investment projects (Boyer et al., 2003, Lander and Pinches 1998, Tamara and Aristizábal 2012, Graham and Harvey 2001, Reuer and Tong 2007). Many of the case studies carried out are focused on the natural resources sector (Kulatilaka, 1993; Laughton and Jacoby, 1991; Smit, 1997; Moel and Tufano, 2000; Rocha et al., 2006), biotechnology companies (Micalizzi; 1999, Amram and Kulatilaka, 1999; Kellogg and Charnes, 2000; Stark, 2001; León and Piñeiro, 2004; Rubio and Lamothe, 2006; Brandão et al., 2018), internet (Schwartz and Moon, 2001; Sáenz-Diez et al., 2008), real estate investment and climate change adaptation (Rocha et al., 2007; Kim et al., 2017;

Gómez-Cunya et al., 2020), and, more recently, renewable energy (Fernandes et al., 2011; Kallio et al., 2012; Santos et al., 2014; Guedes and Santos, 2016; Miranda et al., 2017; Moon and Baran, 2018; Schachter and Mancarella, 2019; Byungil et al., 2020).

However, there is still a large gap between the academic contribution to real option models and its application in business practice. The reality is that those who make decisions and estimate the value of new projects are still reluctant to incorporate models based on the real option approach and keep using other more traditional techniques to guide their decision-making processes. In my experience, both professionals and decision-making bodies frequently consider unquantified terms such as strategic premium or market entry premium which do represent real option value but fail to develop specific and actionable valuation models. Reasons behind it can be summarized, as Myers (1996) suggests, in the lack of knowledge and skills of the professionals, together with an inadequate presentation of the models by the academics. We can therefore conclude that very often in business practice the models used are unable to properly capture all the sources of value in an investment project, and we need to encourage the application of more suitable models for such purpose that have already been repeatedly proven effective in academic works.

In this sense, although many real option valuation models were developed since the beginning of the eighties, they present a paradoxical lack of flexibility in their application (Alonso et al., 2007) sometimes due to restrictive mathematical assumptions that limit their applicability (Lander and Pinches, 1998). Lander (1997) reviewed the most common assumptions underlying real option models up to the mid-1990s, concluding they related to the valuation of one single right, at a certain moment, with only one source of uncertainty that follows a Geometric Brownian Motion. Clearly these assumptions give little room for maneuver and real cases rarely adjust to them.

With such a wide variety of models, we need to question which one is best suited for the valuation at hand. Several of the most relevant models proposed (among others Copeland and Antikarov, 2001; Cortazar, 2001; Schwartz and Moon, 2001; Miltersen and Schwartz, 2004) rely on the use of Monte Carlo simulation. The advantages of using simulations are the diversity of uncertain variables that can be incorporated into the model as well as the wide range of real options that can be evaluated. However, the implementation of valuation proposals based on Monte Carlo simulation requires a high volume of calculations that can only be performed by using a software package.

Searching for and eventually applying a more accurate valuation proposal is only justified as long as the benefits obtained compensate the cost of developing and implementing such proposal. Therefore, the choice of which real option valuation model will be used becomes a relevant issue, since we need to reach a balance between the efficiency in capturing the value of the real option and the costs involved in the implementation of the model (Amram and Kulatilaka, 1999).

Taking all this into consideration, an interesting alternative would be to use the model presented by Copeland and Antikarov (2001). It proposes reducing multiple sources of uncertainty affecting the underlying asset to a single one: the variability of the project value over time. Based on Samuelson's (1965) theorem, Copeland and Antikarov maintain that the rate of return of the underlying project will evolve over time according to a normal random walk with constant volatility. The stochastic evolution of the variability of the project is estimated with a Monte Carlo simulation generating a large number of trajectories in the discrete field. Their model allows the use of a binomial model to value any investment and its options, regardless of the evolution of the sources of uncertainty and this is precisely the proposed valuation model that will be used to evaluate the Growth Real Option on Rwanda or the real option (associated to the expansion into Rwanda) embedded in the initial investment in NewCo.

4.5.2. Valuation of a Growth Real Option

To properly assess the full value of investing in NewCo, we need to analyse the sources of value contingent on the evolution of some circumstances that may make managers adjust their decisions. Based on this, we can differentiate between the cash flows coming directly from NewCo, assuming a potential Equity Investor passive investment strategy, and the decision rights linked to the growth options provided by such an investment.

The valuation of each of these components requires a set of tools best suited to the features of the income stream evaluated. The present value of NewCo´s cash flows is obtained by discounting the expected value of these cash flows at a risk adjusted discount rate (see section 4.3), while the valuation of the decision rights on future growth opportunities requires the use of the concepts and models related to the real options approach. Thus, this section aims at elucidating whether the value of the growth real option associated with investing in NewCo helps to justify the decision to undertake such an investment. The growth opportunity identified refers to the potential investment in the electrification of only one specific country (Rwanda, a neighbour country to Uganda, for the reasons mentioned above).

This decision right entails the possibility of its exercise in different moments in the future, which makes it difficult to apply conventional option valuation processes. A comparative analysis between the advantages of valuing the option and the cost associated with the implementation of the model (in terms of time and effort) recommends the use of the Copeland and Antikarov (2001) model, specifically the improved version by Brandão et al. (2012). The proposed method estimates first the project rate of return with a Monte Carlo simulation, and then uses a binomial model with dynamic programming to determine the optimal exercise policy. The model implementation has been done in Matlab, which runs the simulation of 100,000 trajectories of the ultimate sources of uncertainty behind NewCo´s cash flows. This allows the estimation of the rate of return of the project value that, on the basis of Samuelson's Theorem (1965), will follow a random walk. From the parameters of the stochastic process resulting for the project rate of return, the use of the binomial model is proposed in an Excel spreadsheet.

The remaining of the chapter is structured as follows: in the first section, the model by Copeland and Antikarov (2001) and Brandão et al. (2012) is presented; in the second section, the investment opportunity is analysed in order to estimate the parameters required to undertake the valuation analysis and, in the third section, we apply the proposed model to assess the Growth Real Option on Rwanda value, in light of which the investment decision shall be evaluated.

4.5.2.1. Copeland and Antikarov (C&A) model

C&A's model is based on the conventional project value without flexibility (present value of project cash flows without flexibility before incorporating the value of embedded real options or Conventional PV) and, uses simulation techniques to model uncertainty. It reduces all sources of uncertainty affecting the cash flows to a single one: the rate of return of the project, which permits the subsequent use of the binomial model, widely used in options valuation, to calculate the expanded NPV (including the option value).

Thus, the key to this approach is the estimation of the volatility underlying the investment opportunity and how to use that volatility to build a binomial tree. This is a fundamental insight in C&A proposal, on which subsequent literature allows to improve the volatility estimation of the underlying asset (Brandão et al., 2005a; Smith, 2005; Brandão et al., 2005b) and which will be specifically addressed below.

The initial assumption used by C&A refers to the existence of complete markets, which implies there is a sufficient number of assets in the markets that can be combined to cover any investor preference, without restrictions on short sales and without friction (e.g., transaction costs or divisibility) or arbitrage in the market and, also, that a twin security or a replica portfolio of the underlying asset can be found. Full verification of the complete market assumption is difficult, but in most valuation models we can assume the degree of verification is quite high. However, compliance with this hypothesis in the case of real options becomes more difficult due to the very nature of these decision rights, as will be discussed later.

Trying to get closer to reality and in order to allow a greater adaptability to real investment projects, C&A include two additional assumptions which are the main contribution of their model:

- They rely on Samuelson's Theorem (1965) to unify all sources of uncertainty of the problem into a single one –the return on the project value– that changes over time according to a random walk. Samuelson's Theorem (1965) establishes that the rate of return of any asset will follow a random walk (regardless of the evolution of cash flows that are expected to be generated in the future) as long as investors have complete information about those cash flows. This implies that asset returns will not be cyclical, even when cash flows are. This is the case because it is understood that all information about expected cash flows is included in the market value of the company or the project and, therefore, investors have complete information (the market value of the stock accurately reflects present and future information about the company). Thus, the investor's return coincides with the cost of capital and based on this theorem, C&A consider that all uncertainty sources affecting the cash flows can be summarized into the rate of return of the project value, which permits the use of the binomial model as presented by Cox et al. (1979). The random walk is not affected by the different stochastic processes that the sources of uncertainty may follow, the only disturbances that may have an effect on the rate of return will be those arising from random events.
- They introduce the Marketed Asset Disclaimer method (MAD), according to which the Conventional PV is the best estimate of the market value of the project. This assumption allows the use of risk-neutral probabilities or portfolio replication in the subsequent valuation of real options. The MAD overcomes the difficulties involved in applying the valuation principles of financial derivatives to real option valuation, since the underlying asset is usually not a traded asset, unlike the underlying of financial options. Again, the valuation models of financial options rely on the assumption that their underlying assets are traded, and that there are no arbitrage opportunities in the market, which allows the valuation of the derivative replicating its payoffs with synthetic portfolios or estimating risk-neutral probabilities. But investment projects, which constitute the underlying of the decision rights, are assets with features and properties that make them unique. In addition, they are generally inserted within a company and are inseparable from it, so only the company can exploit the generation of those cash flows. As a result, real assets have little negotiability and fail to comply with the assumption of complete markets (even so, this assumption is still considered since it is not just included in the option valuation but in the overall project assessment).

In summary, based on Samuelson's Theorem, C&A propose to use the Conventional PV as the best estimate of the "possible" market value to be generated by the project if it was actually traded in the market and hence consider that the Conventional PV is the current value of the underlying asset when applying the real options approach.

Based on these assumptions, the C&A model uses Monte Carlo simulation to estimate the sources of uncertainty. The generation of a high volume of trajectories for the uncertainty sources makes it possible to determine the cash flows and, based on these, the Conventional PV at any given time. If the value of the project, without options, follows a Geometric Brownian motion stochastic process, then the real options defined on the project can be valued with traditional valuation methods, such as the binomial model. Using this information and relying on Samuelson's Theorem, C&A generate the project rate of return (z_i)and, out of its evolution, the volatility needed to estimate the underlying binomial tree (starting from the Conventional PV as determined by the MAD). Thus, according to the C&A model the valuation process is structured in four stages:

Stage 1: Calculation of Conventional PV using the DCF model.

Stage 2: Modelling of uncertain variables, which entails estimating the stochastic pattern of the uncertainty sources future evolution. At this point, the autocorrelations of each variable over time and the correlations between the variables (two by two), if any, are introduced. Once the sources of uncertainty have been modelled, Monte Carlo simulation is used to generate the distribution of the underlying project value over time and to estimate the standard deviation of its rate of return. Based on this volatility, a binomial tree will be built showing the values of the underlying project value before introducing the real options. C&A model most important contribution is precisely the estimation of the underlying asset volatility and how to use it to create the binomial tree.

Stage 3: Construction of the tree showing the evolution of the underlying asset following a binomial framework. This will allow us to subsequently identify and introduce flexibility and additional decision-making possibilities.

Stage 4: Completion of the real option valuation, assessing the returns of the decision tree using the replication and arbitrage techniques (Black and Scholes model) or the risk-neutral probabilities (Merton model).

We should then focus on estimating the volatility of the underlying asset. Prior to C&A work, not much had been written about the problems of estimating it other than stating that the volatility of an investment project is not the volatility of any of the variables used as inputs (e.g. the price or quantity of a certain product), nor is it the volatility of the company's financing resources. Focusing on the identification of the stochastic behaviour of the uncertainty sources, C&A use Monte Carlo simulation, which allows the use of auto-correlations and correlations between variables as well as time series properties. Further to the C&A process, the steps to estimate the volatility of the underlying asset would therefore be:

- Estimate the Conventional PV, i.e. the present value of the underlying project, by discounting the expected future cash flows of the project at the appropriate risk-adjusted discount rate (to obtain the expected value of future cash flows, the average value of the inputs estimated by the company would be used).
- Model uncertain variables considering auto-correlation (including mean reversion) and correlation between variables and deciding how confidence intervals change over time.
- Use of Monte Carlo simulation to generate future values of the state variables and thereby calculate both the cash flows ($CF_{i,t}$ or CF_t^i) and the present value ($PV_{i,t}$) for each trajectory considering all the state variables where $i=1,2,\dots,m$ refers to the set of simulated trajectories and $t=1,2,\dots,n$ refers to the time subperiods). This way, C&A can calculate the project's profitability rates for each simulated trajectory with the following formula:

$$z_i = ln\frac{(CF_{i,1} + PV_{i,1})}{PV_0}$$

where z_i represents the rate of return of project value between period 1 and 0 and *i* is the number of simulations.

Note that in the previous expression the variable PV_0 remains constant and represents the Conventional PV, while $PV_{i,1}$ is calculated as:

$$PV_{i,1} = \sum_{t=2}^{n} \frac{CF_t}{(1 + WACC)^{t-1}}$$

Later works (see Brandão et al., 2005a and 2005b, Smith, 2005, and Brandão et al., 2012) have shown that the underlying volatility resulting from C&A model is overvalued, so it is advisable to incorporate the formula suggested by Brandão et al. (2012):

$$z_i = ln\frac{(CF_{i,1} + PV_1)}{PV_0}$$

The difference with the previous expression is that PV_1 remains constant and represents the project value *t=1* from the original estimations prior to the generation of the simulated trajectories.

- Construct the underlying project tree with the values of the investment project without flexibility. From the rate of return values obtained in the *m* simulated trajectories, the standard deviation is estimated and will be used as volatility parameter in the construction of the binomial tree. More specifically, this volatility parameter allows the estimation of the multipliers that determine the upward (*u*) and downward (*d*) movements, and from these the risk-neutral probabilities that we need for the final decision tree (*q* and (*1-q*)).

4.5.2.2. Growth Real Option on Rwanda

As mentioned at the beginning of the chapter, this section analyses the decision rights associated to a potential investment by the Equity Investor in NewCo using the concepts and tools provided by the real options approach and Rwanda has been selected as the ideal scenario to have the option to extend the business model developed in Uganda, since Rwanda is a neighbour country to Uganda with a similar electrification challenge (in terms of non-electrified geography, required investment and financing raising complexity) but behind Uganda on the adoption of the concession model and the attraction of foreign capital.

Given the limited investment capacity of the local authorities and existing companies, the involvement of foreign private capital is likely to be required when undertaking projects that could guarantee full access to electricity. Additionally, we have assumed that, due to Rwanda´s market size and local dynamics, a single operator could be selected to lead the electrification of the entire country (i.e., the Equity Investor could be chosen by the Government of Rwanda (GoR) due to its credentials and acquired expertise in Uganda). To be more precise and in anticipation of limited competition in a potential auction process, rather than a bidding process we have assumed a negotiation process with the Rwandan authorities to determine the investment key terms and conditions out of which two possible results could be expected: favourable or unfavourable to the Equity Investor. Thus, the possibility (not the obligation) to negotiate and eventually reach an agreement with the GoR constitutes the main growth opportunity available to the Equity Investor.

This opportunity falls under the category of investment option, the exercise of which, in the event of an agreement with the GoR being reached, involves the roll-out of the electricity access network to supply electricity in Rwanda (strike price of the Growth Real Option on Rwanda).

At the valuation date, the precise moment in which the negotiation process with the GoR may be closed is unknown. However, we believe some time must elapse between the beginning of the electrification process in Uganda and the promotion of a similar electrification process in Rwanda. Thus, a period of two years seems to be required both for the GoR to initiate its electrification process and for the Equity Investor to build its reputation in front of the GoR and to conduct a bilateral negotiation process. From that moment on, a period opens in which it is possible to reach an agreement between the Equity Investor and the GoR, the duration of which should not extend beyond three years in order to realistically meet the goal set by the UN to electrify the whole country by 2030 (the Equity Investor should them aim at determining the optimum moment to try to reach that agreement with the GoR). The challenge is therefore to value an investment opportunity that could be exercised on more than one future date throughout the three-year period which, in options terminology, is equivalent to valuing a call option of pseudo-American nature, also called Bermuda option.

After having thus determined the nature of the investment opportunity behind the Growth Real Option on Rwanda, we need to estimate the necessary parameters required for its valuation, analysing both the stream of cash flows of the underlying asset and the exercise price (total investment amount) of the Growth Real Option on Rwanda should it be exercised.

Exercise of the investment option

It is important to stress that, in this case, the effective exercise of the option depends not only on the Equity Investor decision to participate or not in the negotiation process with the GoR –based on how a series of contingencies evolve– but also and most importantly on the potentially favourable outcome of that negotiation process with the GoR. To account for this circumstance, the net value derived from the exercise of the option is weighted by the estimated probability of a successful bid. This follows the model by Smit (1997) for the valuation of investments in oil concessions, when the exercise value of the option to drill the reserve is conditioned by the probability of success of the exploration activities. Additionally, in Alonso et al., (2009), a similar approach is proposed to value an option to invest in the electricity distribution business in Brazil, since its exercise is conditioned by the probability to be awarded further to a competitive bidding process. In our model, the weighting of the net value resulting from the investment opportunity by the probability of success requires considering that the presence of other competitors interested in the business is very limited. Therefore, only two possible outcomes of the trading process are considered, success and failure and the value of the growth option is weighted by a probability of 50%.

Exercise price of the investment option

As per the Rwanda business plan (see section 2 and note some updates to the business plan built in 2020, in particular to First Roll-out Wave CAPEX and GoR grants), the outlay required for the full Rwanda electrification project would amount to USD 1,360 million. This amount is supposed to be rolled-out throughout several periods, depending on the intensity of the investment from the moment in which the project execution begins, and the roll-out process shall be terminated by 2030. However, and in order to simplify the valuation of the American option, we have assumed that the whole amount of the investment would be funded in one go when the agreement with the GoR is reached and, simultaneously, some USD 500 million grants are provided by the World Bank and committed through the GoR, which effectively lowers the exercise price of the Growth Real Option on Rwanda to USD 860 million [45].

Underlying asset of the investment option

To determine the cash flows associated to electrifying Rwanda, we need to identify the main sources of uncertainty on which they depend, as well as the estimation of the parameters that determine their future behaviour pattern. The Equity Investor will be responsible for the installation, operation and maintenance of the network, and will receive in exchange a fee as remuneration (its eventual non-compliance would be a breach of contract), so the project cash flows will result from supplying the energy demanded in the electrified area. As discussed, we have assumed that if the project is awarded, and given its relatively small size, the Equity Investor would provide energy to the entire market.

To model the behaviour of the electricity demand and its future evolution, it is not possible to use the historical evolution of this variable, since electrifying Rwanda (around 50% of the country) will represent a significant change in the volume of electricity currently consumed (it almost makes no sense to talk about prior energy consumption volumes). To overcome these difficulties and in line with market practice, we assume demand for electricity shall fluctuate in line with the evolution of the Gross Domestic Product. We use annual changes in Rwanda's GDP according to available records to describe the future evolution of the electricity demand, which follows a lognormal diffusion process. Therefore, the stochastic behaviour pattern of the uncertain variable presents a continuous variation represented by a Geometric Brownian Motion. The stochastic differential equation for the evolution of the state variable (S_t) is as follows:

$$dS_t = \alpha_s S_t dt + \sigma_s S_t dz$$

where α_s and σ_s symbolize, respectively, the average variation rate and volatility of the continuous movement; and *dz* represents a Wiener stochastic process with the expression:

$$dz = \xi \cdot \sqrt{dt}, \xi \rightarrow N(0,1)$$

The best alternative to use Monte Carlo simulation for the evolution of this uncertain variable is to use the logarithmic transformation of the process, $x_t = ln(S_t)$ applying Itô's Lemma to the resulting stochastic differential equation. As a result, the logarithm of the value of the asset behaves according to a Brownian Arithmetic motion, normally distributed and with less operational complexity:

$$dx_t = d[ln(S_t)] = [\alpha_s - 0.5{\sigma_s}^2]dt + \sigma_s dz$$

Then, we take a time interval of amplitude Δt:

$$x_{t+\Delta t} - x_t = ln(S_{t+\Delta t}) - ln(S_t) = (\alpha_s - 0.5{\sigma_s}^2)\Delta t + \sigma_s Z\sqrt{\Delta t}$$

reaching the following expression to simulate the Geometric Brownian motion:

$$S_{t+\Delta t} = S_t \, exp\left[(\alpha_s - 0.5{\sigma_s}^2)\Delta t + \sigma_s Z\sqrt{\Delta t}\right]$$

where *Z* is the standardized Normal (0,1) variable of the diffusion process.

[45] The original Rwanda business plan, as stated in section 2.5, assumed USD 300 million grants in 2021/2022 and USD 100 million in 2031 whereas the updated Rwanda business plan assumes USD 500 million in 2023/2027.

The simulation of the Geometric Brownian motion (S_t) only requires obtaining a set of sample values from the standard normal distribution and its substitution in the previous expression. Since it is an exact simulation, small increments of time (Δt) are not required to get a good approximation. Figure 37 shows the initial values of energy demand by technical electrification alternative and by type of consumer that is expected to be channelled through the country's electric grid at the valuation date (2023).

Energy (kwh/year/customer)	**2023**
Extension	
Residential	190
Industrial	8,336,351
Commercial	2,958
Total	**8,339,499**
Densification	
Residential	190
Industrial	0
Commercial	0
Total	**190**
Minigrids	
Residential	190
Industrial	0
Commercial	0
Total	**190**

Figure 37. Energy by type of consumer that is expected to be channelled through the country's electric grid

As discussed, we use annual values of Rwanda's GDP (expressed in constant 2010 values) to estimate the stochastic behaviour of the energy demand evolution. Data was taken from the World Bank information portal, and the graphical representation of the series used is shown in Figure 38.

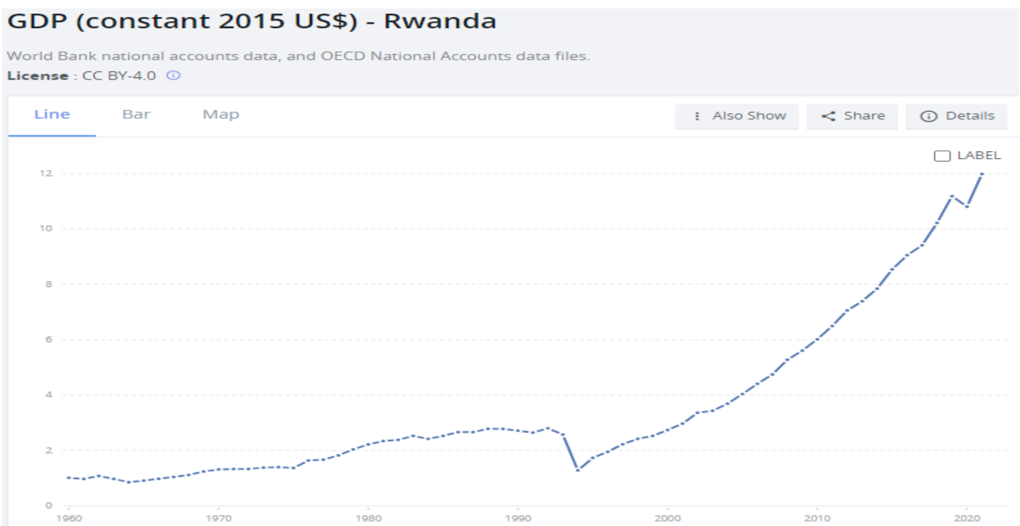

Figure 38. Evolution of Rwanda's GDP (at constant USD prices, from 2015)

https://datos.bancomundial.org/indicador/NY.GDP.MKTP.KD?locations=RW&name_desc=true

Figure 38 shows a continuous growth path since the late 1990s. However, trying to keep a conservative approach, we have opted to consider the country's evolution for the last 40 years, so the analysis of the probabilistic behaviour of the variable is based on the period between 1980-2021. From the variation of the logarithmic transformation of the original series, we verified that there is not enough empirical evidence to reject of the null hypothesis of normality from the Shapiro Wilk[46] test with a p-value of 0.101. The descriptive statistics of the variation of the logarithmic transformation show an average annual relative variation of 5.06% (α_s) and a standard deviation of 10.84% (σ_s).

Rwanda´s electrification FCF are defined and have otherwise been estimated similarly to the Reference Business Plan (see section 4.3).

$$FCF_t(S_t) = f(S_t) = EBITDA + Taxes \pm Var\,WC - CAPEX$$

$$EBITDA = f(S_t)$$

Following this approach, annual cash flows have been estimated for the full duration of the electrification project (2023-2040) so 18 annual cash flows have been projected using the mid-year convention of cash-flow generation. Although the investment required for the Rwanda electrification project (i.e., the option exercise price) would be distributed linearly between the number of periods remaining from the moment the option is exercised until the year 2030, we will assume, as previously mentioned, that the project entails a single outlay paid once the agreement with the GoR is reached. This way, when estimating the current value of the underlying asset as per Copeland and Antikarov (2001), we shall take CAPEX equal to zero up to 2030 and positive CAPEX values as from 2030 (reflecting the required maintenance or recurring CAPEX). FCF have been discounted at the same 10.3% WACC (similar CAPM assumptions used for NewCo can be now applied in Rwanda[47]) following the same valuation methodology explained in section 4.3. Resulting present value for the Growth Real Option underlying asset is USD 740.6 million, which represents the starting point in the build-up of the binomial tree of the underlying asset and a very relevant output to estimate the overall investment return. Similarly, and following proposal from Brandão et al. (2012) to improve our estimate of the underlying asset volatility, we have calculated its value at *t=1* (USD 833.9 million).

4.5.2.3. Valuation results for the Growth Real Option on Rwanda

After having estimated the aforementioned variables, the process for the valuation of the Growth Real Option on Rwanda is presented in this section.

First, we perform the simulation of the electricity volume that will be supplied to consumers through the installed network. In order to do this, a Matlab routine was developed and, starting from the initial value of the electricity demand volume, generates 100,000 simulated trajectories of the Geometric Brownian motion (as shown in Figure 39).

[46] The Shapiro-Wilks test states the null hypothesis that a sample of data follows a normal distribution. Its use is recommended when the size of the series is less than 50. If a significance level of 5% is assumed, for a higher p-value the null hypothesis cannot be rejected. It is considered one of the most powerful tests for contrasting normality (Saphiro and Wilk, 1965).

[47] Same WACC can be used given Rwanda risk-free rate at 31.12.2021 (8.5%) is equal to the basket of African countries with S&P B rating used for Uganda and all other WACC assumptions also apply.

$$
\begin{array}{lllllll}
S_0 \rightarrow & S_\tau^1 \longrightarrow & S_{2\tau}^1 \longrightarrow & \cdots \longrightarrow & S_{T-2\tau}^1 \longrightarrow & S_{T-\tau}^1 \longrightarrow & S_T^1 \\
\searrow & S_\tau^2 \longrightarrow & S_{2\tau}^2 \longrightarrow & \cdots \longrightarrow & S_{T-2\tau}^2 \longrightarrow & S_{T-\tau}^2 \longrightarrow & S_T^2 \\
 & \cdots & & & & & \\
\searrow & S_\tau^{100.000} \longrightarrow & S_{2\tau}^{100.000} \longrightarrow & \cdots \longrightarrow & S_{T-2\tau}^{100.000} \rightarrow & S_{T-\tau}^{100.000} \rightarrow & S_T^{100.000}
\end{array}
$$

Figure 39. Real options: Simulation of energy volumes

where τ is the length, in annual terms, of the sub-intervals into which stream of cash flows is divided, so that in one year there are $1/\tau$ periods (we have assumed an annual duration of the sub-intervals).

The simulated values for the state variables allow us to estimate $CF_{i,t}$ or CF_t^i (as per Figure 40) in each subinterval, according to the previously defined functional relationship between the variables and $CF_{i,t}$ or CF_t^i, as well as to project the FCF for the 2023-2040 period (see Figure 41).

$$
\begin{array}{lllllll}
CF_0 \rightarrow & CF_\tau^1 \longrightarrow & CF_{2\tau}^1 \longrightarrow & \cdots \longrightarrow & CF_{T-2\tau}^1 \longrightarrow & CF_{T-\tau}^1 \longrightarrow & CF_T^1 \\
\searrow & CF_\tau^2 \longrightarrow & CF_{2\tau}^2 \longrightarrow & \cdots \longrightarrow & CF_{T-2\tau}^2 \longrightarrow & CF_{T-\tau}^2 \longrightarrow & CF_T^2 \\
 & \cdots & & & & & \\
\searrow & CF_\tau^{100.000} \rightarrow & CF_{2\tau}^{100.000} \rightarrow & \cdots \longrightarrow & CF_{T-2\tau}^{100.000} \rightarrow & CF_{T-\tau}^{100.000} \rightarrow & CF_T^{100.000}
\end{array}
$$

Figure 40. Real options: CF_t^i scheme

Year	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**
Mid Year	0.5	1.5	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10.5
FCF	**-15.41**	**- 4.33**	**-34.9**	**5.06**	**17.01**	**45.41**	**96.18**	**180.63**	**154.59**	**203.29**	**186.62**

Year	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**
Mid Year	11.5	12.5	13.5	14.5	15.5	16.5	17.5
FCF	**191.76**	**199.16**	**217.15**	**214.08**	**240.93**	**271.59**	**310.64**

Figure 41. Real options: FCF estimates

It is important to note that, based on the simulated value of the cash flows, it is possible to get the value of the underlying at any given moment *t*, by following a backward induction process for each trajectory –from the future moment when the investment expires until the early moment when its acceptance is considered– so the cash flows are successively discounted with the WACC and accumulated in the value of the project. Therefore, the value of the underlying project at any moment *t* and for a given trajectory *i* is calculated from the following expression:

$$V_t^i(S_t^i) = \sum_{s=t+\tau}^{T} \frac{CF_s^i(S_s^i)}{(1+WACC)^{s-t}}$$

From these values generated in each simulated trajectory, the profitability rates of the project are calculated following the improved proposal of Brandão et al. (2012):

$$z_i = ln\frac{(CF_{i,1} + PV_1)}{PV_0}$$

where, as we know, z_i represents the rate of return of the project value between period 1 and 0; and *i* is the number of simulations. Note that in this expression the variables PV_0 and PV_1 remain constant; representing the values of the project at *t=0* and *t=1* obtained from the original financial estimations (i.e., prior to the generation of the simulated trajectories).

The average value (from all the simulated trajectories) for the variable z_i is 9.90% and its standard deviation is 9.07% (σ_z). This volatility is used for the construction of the recombining binomial tree for the underlying project without flexibility. More specifically, we need the volatility to estimate the multipliers for the upward (u) and downward (d) movements as follows:

$$u = e^{\sigma_z\sqrt{\Delta t}} = 1.06623 \text{ and } d = e^{-\sigma_z\sqrt{\Delta t}} = \frac{1}{u} = 0.9378$$

We consider a semi-annual periodicity, which is the frequency used to evaluate the investment decision in Rwanda. These calculations are based on a risk-free interest rate of 8.5%[48] equivalent to a semi-annual rate of 4.163%.

Figure 42 shows the binomial event tree of the underlying project representing the value of the investment without flexibility or the Growth Real Option on Rwanda.

Tree of the underlying project value (ex- Growth Real Option on Rwanda)

	Jul-23	Dec-23	Jul-24	Dec-24	Jul-25	Dec-25	Jul-26	Dec-26	Jul-27	Dec-27
740.61	789.67	841.97	897.74	957.21	1020.61	1088.21	1160.29	1237.14	1319.08	1406.45
	694.61	740.61	789.67	841.97	897.74	957.21	1020.61	1088.21	1160.29	1237.14
		651.46	694.61	740.61	789.67	841.97	897.74	957.21	1020.61	1088.21
			610.99	651.46	694.61	740.61	789.67	841.97	897.74	957.21
				573.03	610.99	651.46	694.61	740.61	789.67	841.97
					537.43	573.03	610.99	651.46	694.61	740.61
						504.05	537.43	573.03	610.99	651.46
							472.74	504.05	537.43	573.03
								443.37	472.74	504.05
									415.83	443.37
										389.99

Figure 42. Binomial event tree for the underlying project value with no real options

[48] Calculated as Rwanda USD sovereign yield by 31.12.2021 (pre-crisis) and, as discussed in section 4.3, it is also equal to the average of selected/comparable USD sovereign yields at that date. List of selected/comparable African countries (with S&P ratings B-/B/B+): Kenya, Senegal, Nigeria, Zambia, Cameroon, Rwanda. https://www.bondsupermart.com/bsm/bond-selector.

The original model by Copeland and Antikarov (2001), risk adjustment involved in option valuation is carried out by estimating the intermediate cashflows generated by the underlying project. As discussed, at this point we follow Brandão et al. (2005a), who improve C&A proposal, estimating the cash flow generation rate δ_t as:

$$\delta_t = \frac{E(CF_t)}{PV_t}$$

where $E(CF_t)$ is the average value of the cash flow at time t from the 100,000 simulated trajectories and the denominator is the value of the underlying project in t prior to the incorporation of uncertainty. The rate δ_t is estimated in annual terms for the first five periods, resulting in a null value for the first three, since the cash flows are negative, and a positive value for the last two periods, as seen in the following table:

Year	2023	2024	2025	2026	2027
δ_t	0	0	0	0.00419	0.01295

Figure 43. Cash flow generation rate estimate

It is precisely for the periods in which δ_t has a positive value when the early exercise of the option can take place. In these cases, since the option valuation is considered on a semi-annual basis, we assume the value of the parameter remains constant during the year.

The product of tree the underlying project value (Figure 42) by the value of δ_t (Figure 43), produces the tree of the intermediate project cash flows (Figure 44).

Tree of the intermediate project cash flows

Jul-23	Dec-23	Jul-24	Dec-24	Jul-25	Dec-25	Jul-26	Dec-26	Jul-27	Dec-27
0.00	0.00	0.00	0.00	0.00	0.00	4.87	5.19	17.08	18.21
0.00	0.00	0.00	0.00	0.00	0.00	4.28	4.56	15.03	16.02
	0.00	0.00	0.00	0.00	0.00	3.76	4.01	13.22	14.09
		0.00	0.00	0.00	0.00	3.31	3.53	11.63	12.40
			0.00	0.00	0.00	2.91	3.11	10.23	10.90
				0.00	0.00	2.56	2.73	9.00	9.59
					0.00	2.25	2.40	7.91	8.44
						1.98	2.11	6.96	7.42
							1.86	6.12	6.53
								5.38	5.74
									5.05

Figure 44. Tree for the intermediate project cash flows

Subtracting the value of these intermediate project cash flows (Figure 44) from the underlying project value (Figure 42), we obtain the underlying project value ex-dividend (Figure 45).

Tree of the underlying project value (ex-dividend)

	Jul-23	Dec-23	Jul-24	Dec-24	Jul-25	Dec-25	Jul-26	Dec-26	Jul-27	Dec-27
740.61	789.67	841.97	897.74	957.21	1020.61	1088.21	1155.42	1231.95	1302	1388.24
	694.61	740.61	789.67	841.97	897.74	957.21	1016.33	1083.64	1145.26	1221.12
		651.46	694.61	740.61	789.67	841.97	893.98	953.19	1007.39	1074.12
			610.99	651.46	694.61	740.61	786.36	838.44	886.12	944.81
				573.03	610.99	651.46	691.69	737.51	779.44	831.07
					537.43	573.03	608.42	648.72	685.61	731.02
						504.05	535.18	570.63	603.07	643.02
							470.75	501.93	530.47	565.61
								441.51	466.61	497.52
									410.44	437.63
										384.94

Figure 45. Tree of the underlying project ex-dividend

Once we have the underlying project value tree, we can incorporate the Growth Real Option on Rwanda or the possibility of extending the business model developed in Uganda to the electrification of Rwanda. As already mentioned, the exercise of the option is considered in 2025, 2026 and 2027, since a grace period of two years is necessary between the launch of the Uganda Assignment and the possibility of extending the model to Rwanda.

Now we just need to calculate the value of the risk-neutral probabilities from which the semi-annual valuation of the option is carried out:

$$q = \frac{e^{r\Delta t} - d}{u - d} = 0{,}8083 \text{ and } 1 - q = \frac{u - e^{r\Delta t}}{u - d} = 0{,}1916$$

The valuation of the Growth Real Option on Rwanda is presented in Figure 46. As already discussed, it is equivalent to a pseudo-American a call option. By applying options value theory, the valuation exercise begins at the expiration date and follows a recursive backwards induction process going back in time. At the expiration date, the valuation of the American option simply involves comparing the value of the underlying ex-dividend and the outlay required by the investment, so that if the difference is positive the investment is accepted and otherwise it is rejected:

$$OInv_T = Max(Underlying_T - Investment\ Outlay;\ 0)$$

Before the expiration date, the valuation of the American option requires comparing the value of immediately exercising the option and the value of keeping it alive until the following period:

$$OInv_t = Max(Underlying_t - Investment\ Outlay;\ Value\ to\ Continue_t)$$

$$Value\ to\ Continue_t = e^{-r}\left[q \cdot\ OInv_{u,t+1} + (1-q) \cdot\ OInvC_{d,t+1}\right]$$

Values resulting from this valuation exercise are shown in Figure 46.

Tree of the Growth Real Option on Rwanda value

	Jul-23	Dec-23	Jul-24	Dec-24	Jul-25	Dec-25	Jul-26	Dec-26	Jul-27	Dec-27
163.31	186.49	212.23	240.66	271.94	306.21	343.62	384.31	428.49	476.37	528.24
	101.01	118.47	138.40	161.01	186.49	214.99	246.62	281.49	319.63	361.12
		49.32	60.14	73.11	88.55	106.82	128.25	153.16	181.76	214.12
			14.37	18.52	23.87	30.76	39.63	51.07	65.81	84.81
				0.00	0.00	0.00	0.00	0.00	0.00	0.00
					0.00	0.00	0.00	0.00	0.00	0.00
						0.00	0.00	0.00	0.00	0.00
							0.00	0.00	0.00	0.00
								0.00	0.00	0.00
									0.00	0.00
										0.00

Figure 46. Tree of Growth Real Option on Rwanda value

Finally, we just need to weigh the option value obtained in Figure 46 (USD 163.3 million) by the 50% probability of success (or failure) expected from the negotiation process with the GoR, resulting a Growth Real Option on Rwanda value of USD 81.6 million.

4.6. Impact model

As discussed, we have also added the Impact perspective and measured the social benefits electricity access would bring using various quantifiable metrics.

Before developing this chapter and as anticipated in Section 1, it is fair to admit that the corporate governance controversy on whether companies' ultimate purpose should be maximising shareholders value versus acting in the interest of all stakeholders (including and most importantly current stakeholders or future potential Impact beneficiaries) exceeds the scope of our work. We shall however briefly comment and suggest a relatively straight forward, at least in theory, way to overcome this concern. Following Hart (2022), not only scholars but even shareholders on high profile recent situations confront the traditional shareholders value maximization (SVM) paradigm and, when externalities and social considerations are relevant, it could be argued that shareholders will push companies and management teams to seek shareholders welfare maximization (SWM) rather than SVM. These high-profile recent situations show that Friedman separation theorem (shareholders can replicate on their own any Impact corporates could pursue) does not hold and that SVM is not unanimously favoured by shareholders and, most importantly, does not achieve a socially efficient outcome among the group of shareholders as a whole. Hart (2022) suggests then SWM as an updated and more comprehensive alternative to define corporates ultimate goals and a shareholder vote in this type of situations to avoid the risk of misalignment between management and the majority of shareholders. This is precisely what we believe the Equity Investor should do: even if their internal regulations allow them to agree an investment of this size (especially if some of the size reductions included in Section 5.2 have been followed) without seeking specific shareholders support, a favourable, and ideally broad, shareholder vote would be highly beneficiary not only to reduce potential legal contingencies but to align interest with management and to indicate an attractive area for business expansion.

Our scope of work is based and focused on social impact (Social Impact) with environmental impact (Environmental Impact) consequences also being also included as part of the overall Impact evaluation and quantification process. Some controversy around Environmental Impact appears on similar studies, where social benefits to the citizens or to the wider community are being evaluated and defining the specific group of directly affected stakeholders is not easy. Most academics understand Social Impact as the generation of “social value”, “social return” or “social performance” (Rawhouser et al., 2019) but recent research also seeks to understand the social dimension of the environmental challenges and recent studies link both, including Environmental Impact as a fundamental component of Social Impact. For example, Stephan et al. (2016, p.1252) defines social impact as: “the process of transforming patterns of thought, behaviour, social relationships, institutions, and social structure to generate beneficial outcomes for individuals, communities, organizations, society, and/or the environment beyond the benefits for the instigators of such transformations”. This can be considered a humanistic view of Environmental Impact, where the effects of climate change on people and society matter the most. From a practical standpoint, several studies with an environmental focus have considered Social Impact as a critical element of Environmental Impact, both being totally interrelated. For example, some studies on the Impact of the energy transition and the new circular economy models connect the positive effect on the environment as well as on employment or people's quality of life (Vanhuyse et al., 2021).

This discussion is also linked to the potentially negative Environmental Impact derived from electricity production. As we will explain later, some of the additional electricity production to be generated due to the Proposed Reform will generate CO2 emissions into the atmosphere, which raises a dilemma around some negative Impact derived from the increase in electricity access (which as we will explain should produce multiple social benefits). On the one hand, this potential concern can be easily addressed by justifying how additional CO2 emitted through the generation of electric energy shall be offset by the substitution of kerosene. As we will explain, kerosene related CO2 emissions are much higher and produce a more direct pollution, because they are concentrated in homes and directly breathed by people. On the other hand, we cannot ignore the ethical perspective of countries development (Drydyk and Keleher, 2019), which requires a holistic ethical assessment of these developing processes consequences and of the medium and long-term effects on the different dimensions of human beings (Boylan, 2022). Thus, in energy transition processes, some adverse environmental effects can be found, which are important to consider and should be appropriately addressed, but these potentially negative effects would be much greater if these development and industrialization processes were not carried out.

Additional literature covers the overall electrification Impact and how it can influence socioeconomic and environmental progress. Sociologist Marcos Valdés defines impact assessment as an evaluation that focuses on the secondary or collateral effects of an activity (Valdés, 2009). Social Impact, a term that has historically been totally unrelated to the traditional risk-return financial analysis, has gradually become more popular in business management with a clear focus on measuring and quantifying its concrete social benefits (despite its novelty and constant evolution, several methodologies can already be used to measure Social Impact).

Our Impact model is limited to the assessment and measurement of the acceleration of the electrification of Uganda within NewCo’s areas of operation. On the one hand, we assume the country would be 100% electrified by 2040 should it continue with its current and expected electrification growth rate, around 3%

annual access growth in the 2010/20 period (World Bank, 2022b), which refers to the Deadweight scenario explained below or the Impact that would have been created if NewCo's activities did not happen, and we are therefore just evaluating the marginal Impact brought by anticipating ten years the full electrification of the country from 2040 to 2030. This assumption may make sense in terms of grid expansion and densification, but it is unrealistic in terms of off-grid connections, as the growth of electrification increases at a much higher rate up to electrifying 90% of the population than when accessing the last 10% (being realistic the challenge of electrifying the last mile for the last 10% is unlikely to be accomplished outside the Uganda Assignment). On the other hand, to maintain the most direct investment Impact attribution, our analysis will be limited to NewCo's areas of operation, including grid extension and grid densification (the scope of this analysis could be further expanded beyond NewCo to the rest of the country).

As discussed, we have built an Impact model to assess Social Impact by using an Impact monetization metric. A recent study suggests that new methods of Impact measurement should be implemented and designed to allow a comparative and quantitative evaluation of progress towards sustainability (Diaz-Sarachaga, 2021). If quantification and monetization techniques are combined when assessing Impact to evaluate their net contribution to society, this will provide more objectivity as well as standardized data that allow a comparison between the different Impact areas or between the Impact generated by different activities.

The Social Return of Investment or SROI is our selected metric for identifying, managing, and measuring the generated Social and/or Environmental Impact. It assigns a monetary value to Impact that could eventually be compared or even added to the traditional risk-return analysis. Some commonly accepted guidelines (Civis, Grupo., 2012 and Pava Rincón, 2022) have been used as key references to support our SROI based model. SROI implementation is developed in sequential steps or stages (involve stakeholders, understand key changes, value the important aspects, include only what is essential, do not claim too much, be transparent and check the results), which we have followed to build our SROI model:

Stage 1: Scoping and stakeholder identification

- 1.1 Establish the scope of work
- 1.2 Identify key stakeholders
- 1.3 Decide how to engage key stakeholders

Stage 2: Creating outcomes map

- 2.1 Start Impact mapping
- 2.2 Identify and assess main inputs
- 2.3 Clarify outputs
- 2.4 Describe outcomes

Stage 3: Evidencing the outcomes and giving them value

- 3.1 Develop indicators for outcomes
- 3.2 Collect information on outcomes
- 3.3 Establish how long outcomes last
- 3.4 Place a value on the outcome

Stage 4: Establishing Impact

4.1 Assess attribution

4.2 Evaluate deadweight

Stage 5: Calculating the SROI

5.1 Calculate the net present value

5.2 Calculate the ratio

Stage 6: Reporting, using and certifying the results

SROI analysis could be conducted either retrospectively (based on actual outcomes that have already have already taken place) or prospectively (predicting how much social value may be created if expected outcomes are actually achieved). Our SROI model has been built prospectively, using the Reference Business Plan as well as other relevant market assumptions as appropriate, hence leaving Stage 6 out of the scope of this work. Additionally, we have consistently taken a conservative approach, intending to avoid overestimating Impact value, without assigning specific value unless a reliable metric (objectively supported) is available thus leaving some potential Impact areas outside our SROI quantification.

Stage 1: Scoping and stakeholder identification

1.1 Establish the scope of work

Establishing the scope of our work starts by defining its purpose (to quantify Impact by using the SROI tool in order to complement the risk-return approach and replace it by a risk-return-Impact framework), its audience (potential Equity Investors, especially industrial or strategic, who are potentially interested in financing NewCo), and the background: it is worth reminding, for the purposes of evaluating Impact, that the Uganda Assignment should strongly contribute to the development of SDG7 in general and SDG7.1 in particular, key to achieve the other 17 SDGs as electricity is a fundamental element for health (SDG3), education, (SDG4) and socio-economic progress (SDG8), which also includes, at a secondary level, the eradication of poverty and hunger (SDG1 and SDG2), the provision of clean water and sanitation (SDG6) and gender equality (SDG 10). In terms of resources, some actual stakeholders have been involved as part of the Uganda Assignment and some literature review has been carried out, mostly using meta search engines (such as Google Scholar) and non-bibliographic sources (databases, articles and reports from consulting firms and international organizations such as the World Bank).

The analysis will generally focus on evaluating the Impact brought by the network expansion and densification in Uganda, and, more specifically, on the Social Impact expected to be created in NewCo's area of influence. Out of the approximately 10.4 million connections planned for the entire country, with each connection estimated to include five people or the average household size in Uganda (UBOS , 2021) or a total of approximately 52 million people, 45% is planned to be covered by grid expansion and densification with the rest being off-grid connections (either isolated photovoltaic sources or mini grids). Therefore, around 23.4 million people will be electrified under NewCo's concession area where as discussed NewCo will be responsible for financing 10% of the required investments but fully responsible for the operation and maintenance of the entire grid. Both areas of NewCo's (10%) and FinanceCo's (90%) investment responsibility shall be covered by our model since a common development strategy has been followed, there shall be tariffs cross-subsidization and NewCo will run the entire AO&M operation (Impact would be significantly reduced without the required maintenance) but we assume Impact attribution to NewCo should and will be evaluated differently in either scenario.

Impact associated to maintaining the area that was already electrified will not be analysed and hence excluded from the scope of our work. An extension of our model could be further developed considering that part of the proceeds resulting from the collection of grid tariffs are invested in the creation of mini-grids or isolated PV sources to electrify the remaining population of Uganda, so that some indirect electrification could be partly attributed to NewCo's actions.

SROI model period will run from 2023 to 2030 (to evaluate direct Impact value creation) but, as we will explain, deadweight evaluation (what would happen if the Proposed Reform was not executed) requires extending our analysis until 2040.

1.2 Identify key stakeholders

Key stakeholders (those who could affect or be affected, direct or indirectly, positive or negatively by NewCo's activities) have been obtained from the Global Commission to End Energy Poverty (Lee, 2020) and the National Electrification Strategy for Uganda (NES, 2021) and include GoU, grid extension and densification workers, households to be electrified (men, women, and children), communities to be electrified, community uses (schools, health centres, street lighting, electrification of businesses, other industries), affected community (electrification of businesses, other industries) and NewCo itself. Again, other potential stakeholders have been left outside the scope of our work (people who are already electrified or those whose electrification is going to be based on mini-grids or off-grid photovoltaic sources).

1.3 Decide how to engage key stakeholders

As this is a prospective analysis, required external information to build our forecasts in general and the Reference Business Plan in particular, has been obtained from existing studies as well as additional analysis carried out with some key identified stakeholders, either directly or through some representatives. In addition, a weekly dialogue has been maintained during part of the Uganda Assignment (to confirm the feasibility of the Proposed Reform) with a representative based in Uganda who was in contact with both the GoU and the communities to be electrified.

Stage 2: Creating outcomes map

To support our Impact thesis and to build the Impact model, we have followed the theory of change in order to study how the organization's resources (inputs, investments) are used to carry out different activities (outputs, electricity) that ultimately translate into actual outputs (results) for the benefit of the stakeholders (e.g., turning on the lights, having a refrigerator, being able to study, clean cooking).

2.1. Start Impact mapping

Impact mapping is the overall model that includes both raw data and the analysis of all these data. It connects the stakeholders to the main model inputs (usually time or money) and to the main outputs and outcomes in order to analyse and calculate the value created to them. Outputs and outcomes are treated indifferently in some Impact assessment approaches, but we differentiate the specific output (the electrification of the country resulting from executing the specific business activity, same for all stakeholders) from the wider range of potential outcomes (the changes that the development of the activity ultimately brings to each stakeholder, different and potentially several per stakeholder). In this model stage of development, we restrict all potentially affected stakeholders down to those included in the scope of our Impact model.

2.2. Identify and assess main inputs

Main model input consists of the total investment required to carry out NewCo's business activity (i.e., NewCo planned CAPEX). As per the Reference Business Plan, total input value (CAPEX to be deployed by NewCo in grid extension and grid densification by 2030) is estimated to be USD 271 million. We have opted not to include OPEX as an input for simplification purposes (it represents an intrinsic part of and is financed by ongoing business operations once the initial investment has been committed plus total OPEX under both 2023-2030 and 2023-2040 periods is very similar and its minimal impact on the total input value can be disregarded). Other relevant inputs on which the activity may be dependent on (mostly natural ecosystems related) have not been considered for the purposes of calculating the SROI.

2.3. Clarifying outputs

Figure 47 shows the connections expected to be reached every year, and therefore the people to be connected within NewCo's reach. As mentioned in the scope of work, average household size (5 persons per connection) in Uganda (UBOS , 2021) has been considered to estimate total population to be electrified.

Number of new connections	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Grid Extension	31,301	53,849	80,645	107,181	140,176	183,347	248,028	344,864
Densification	412,636	412,636	412,636	412,636	412,636	412,636	412,636	412,636
TOTAL	443,937	466,485	493,281	519,817	552,812	595,983	660,664	757,5
People connected	**2,219,685**	**2,332,425**	**2,466,405**	**2,599,085**	**2,764,060**	**2,979,915**	**3,303,320**	**3,787,500**

Figure 47. Uganda: Connections per year (2023-2030)

2.4. Describing outcomes

Key outcomes have been derived from UN SDGs review and confirmed with relevant literature review (Mpholo, 2018 and Khellaf, 2018) and stakeholder representatives as part of the Uganda Assignment. As discussed, Uganda electrification shall directly contribute to the development of SDG7 ("ensure access to affordable, secure, sustainable and modern energy for all") which should result in five interrelated goals, all to be achieved by 2030: universal access to modern energy (target 7.1), increase global percentage of renewable energy (target 7.2), double the improvement in energy efficiency (target 7.3), promote access to research, technology and investments in clean energy (target 7.4) and expand and upgrade energy services for developing countries (target 7.5). Uganda electrification should mainly contribute to SDG7.1, which is key to achieving the other SDGs as electricity is a fundamental element for health (SDG3), education (SDG4), and socio-economic progress (SDG8), which also includes, on a secondary level, the eradication of poverty and hunger (SDGs1/2), the provision of clean water and sanitation (SDG6), and gender equality (SDG10).

To better assess potential outcomes and what changes may occur, it is necessary to underline that main source of energy for non-electrified African population is based on combustion, either firewood or vegetal carbon, both fuels emitting toxic and unhealthy gases and contributing to deforestation. In any case, the transition path to electricity as well as the process to change life habits such as cooking patterns is not always easy as confirmed by recent experiences in similar geographies (MMB, 2021).

Main outcomes arising from the electrification of the country should impact socio-economic progress, health, and education (Mpholo, 2018).

Expected outcomes within the socio-economic progress include the employments to be generated by the business development (either by hiring operators or engineers), the employments to be potentially destroyed by each activity development (e.g., the kerosene lamp industry or the jobs generated by firewood and charcoal) and the businesses or trades that will be installed thanks to the electrification. We have assumed that the employments generated by the electricity expansion shall compensate the number of jobs that will be negatively affected by the substitution of electricity as the main source of energy, including any biomass combustion industry jobs. In addition, changes that may affect the way Ugandans socialize or community security is organized as a society should also be considered part of the socio-economic progress outcome.

As previously mentioned, biomass combustion is a relevant cause behind the spread of diseases such as respiratory infections, strokes, and lung cancer among others. Women and children, who spend most time inside homes (usually poorly ventilated) are mostly affected. The electrification of the households should allow the introduction of access to clean and modern energy, thus eliminating the need for the traditional use of biomass and allowing the development of clean cooking. Therefore, pollution inside the houses should decrease, significantly improving general health and women and children well-being. In addition, access to clean energy can significantly improve health care services: reliability and functionality of medical devices, access to vaccination, laboratory testing, general hygiene, prolonged opening hours, communication and records management or training and staff retention among others (WHO , s.f.).

In terms of education, 12.5% of African countries have less than 5% of schools electrified (Khellaf, 2018). On the one hand, the excuse frequently used in some forums (it is not necessary to electrify since school takes place during the day) is not valid since homework and class preparations take place when there is no natural light and current school schedule could be extended beyond daylight hours. On the other hand, light is not the only electrical resource needed for education: schools also need electricity for equipment, be it computers, ventilation or laboratory equipment (it is unthinkable to run a European school without computers, but somehow it is not considered essential for the education of African children). High quality education is not a priority, which results in a high number of students dropping out of school and in the rejection of some high-quality teachers. Positive outcomes in the education field include: (i) light and study time: as previously mentioned, current school attendance is limited to natural light and kerosene lamps are used to study and prepare classes, which is detrimental to the health of teachers and students (C. Kirubi, 2009); (ii) school performance: higher attendance increases number of graduates with studies in Sudan Tanzania and Kenya confirming this intuitive correlation (M.P. Bacolod, 2006) while electricity improves overall academic performance (B.K. Sovacool S. R., 2016); (iii) education tools: information and communication technologies (ICT) such as telephone, radio, television, audio, and video devices pose opportunities to increase the quality of education in addition to e-learning (UNESCO, 2011) and (iv) teacher commitment: good teachers usually try to work for a school where quality teaching is as high as possible so an electrified school would be preferred over an unelectrified one (B.K. Sovacool S. C., 2013).

In addition, electrification related Impact can be classified due to the type of affected stakeholder (Figure 48 below): there are outcomes related to the electrified community and others more directly related to households. Up to 72% of total public institutions and 76% of schools are currently not electrified, out of which by 2030 a total of 57% of those non-electrified institutions will be electrified by grid extension and densification and the remaining 43% by off-grid intervention (NES, 2021).

NES (target by 2030)	Health Centres	Schools	Total
Electrified	1,265	4,025	6,446
Electrified (%)	37	24	28
Non electrified	2,127	12,903	16,184
Non electrified (%)	63	76	72
Targeted by densification	526	3.196	4.121
Targeted by densification (%)	25	25	25
Targeted by grid extension	672	4,058	5,054
Targeted by grid extension (%)	32	32	32
Total	**1,198**	**7,254**	**9,175**

Figure 48. Uganda: Public institutions to be electrified by grid extension and grid densification by 2030

Energy for community facilities is fundamental to socioeconomic development because it drives improvements in general health, human capital (education), small businesses or street lighting. Access to energy in health centres improves access to these essential services, energy access in educational facilities increases the time students spend in school and improves the experience for children and teachers improved communications and energy services in community buildings enable the use of these institutions during evening hours while street lighting can improve mobility and safety and foster economic and social activity.

Most relevant negative potential outcome appears to affect Environmental Impact, since the electrification of the country is expected to drive an increase in demand, which would imply an increase in energy generation and it would lead to an increase in CO2 emissions. Although our model is mostly focused on Social Impact, some Environmental Impact related outcomes have been also analysed and discussed in Stage 3.2.

Stage 3: Evidencing the outcomes and giving them value

3.1 Develop indicators for outcomes

Aiming at providing values to the outcomes explained above, indicators below (Impact Indicators) have been developed for the different outcome areas, also considering whether they result from the electrification of households or community areas (Figure 49).

HEALTH	**Community areas**	Access to vaccination
		Diagnostic and treatment capabilities
		Emergency care
	Households	Reduction of kerosene use
		Health improvements
		PM2.5 exposure

EDUCATION	**Community areas**	School performance
		Increased quality of education
	Households	Increased study hours

SOCIO-ECONOMIC PROGRESS	**Community areas**	Road lighting
		Street crime
		Income generation
	Households	Over-indebtedness
		Changes in perception of safety
		Gender inclusion
		Access to media and information

Figure 49. Uganda: Impact Indicators by Outcome Area

A detailed table of Impact Indicators is presented below (Figure 50), indicating both the most direct expected Impact as well some commentary on additional benefits brought by each outcome.

Outcome	Indicator	Impact	Derived Impact
Health centres can have vaccine refrigerators, thus increasing access to vaccination for the population (especially children)	Access to vaccination	Reduction of deaths and hospital admissions, DALYs (Disability Adjusted Life Years)	Increase life expectancy of the country, lower sickness levels and higher work attendance
Having specialized medical equipment (supported by electricity) helps in the correct execution of diagnosis and treatment	Diagnostic and treatment capabilities	New equipment improves the quality of healthcare and prevents deaths	Increase of interest and commitment of physicians
Health centres can open without natural light,	Emergency care	Possible emergency service, increasing staff	More sick people are cared for, reducing the

increasing the quality of medical care. And improving the recording of patient information and patients and staff sense of security		morale and ease of recruitment, training, and retention	number of deaths and DALYs
Non-electrified population uses kerosene lamps for household lighting, producing gases that are harmful to health	Reduction of kerosene use	Reduction in the consumption of kerosene as a resource for lighting	Improved health and reduced PM2.5 exposure.
Use of biomass and kerosene combustion produces toxic gas emissions in the home, which induces cardiorespiratory diseases	Health improvements	Decreased indoor pollution in homes, reducing the likelihood of contracting cardio-respiratory diseases	General health improvement at home (48% of those surveyed confirm family health improvements)
Use of biomass and kerosene combustion produces toxic gas emissions in the home, which induces cardiorespiratory diseases	PM2.5 exposure	Exposure to PM2.5 particles (particles with a diameter of 2.5 micrometres) is reduced by 73% for school children and 50% for adults	Exposure to these particles can cause negative effects on respiratory health
Extension of school day beyond daylight hours	School performance	Electrification of school's results in higher attendance and increased graduation rates	Increase in years of schooling for children (and labour income due to access to better jobs)
Electricity required for school equipment (computers, ventilation, or laboratory equipment)	Increased quality of education	Electrification allows access to ICT tools, information, and communication technologies	Increase in children's grades by 10%
Electricity to allow students to study beyond daylight hours	Increased study hours	Daily increase of 20 minutes per child, allowing better absorption of knowledge	Increase in children's commitment to education, number of university graduates and better jobs
Electrification of community areas	Road lighting	Street and road lighting	Decrease in traffic fatalities by 30%
Electrification of community areas	Street crime	Street and road lighting	Decrease in crime rate by 36%

Electrification of small and medium business	Income generation	Increases business efficiency	Income increases by USD 13 per week
Electrification of households	Over-indebtedness	Consumers may generate needs and raise excessive debt to fund them.	Stress generated in this population by excessive debt
Electrification of households	Changes in perception of safety	Reduction of domestic accidents (burns and fires)	Increase in home safety (86% of families reported feeling safer at home due to access to electricity)
Electrification of households	Gender inclusion	Reduction of time women spend on household work, access to information and entertainment	Increase women participation in politics, in decision-making at the household and in the labour market
Electrification of households	Access to media and information	Access to electrical equipment such as telephones, radios, or televisions	Increase in digital communication and information which translates into improved health and education

Figure 50. Uganda: Impact Indicators and Derived Impact

3.2 Collect information on outcomes

To assess the value of these Impact Indicators, our Impact model is based on the expected electrified population (as per the Reference Business Plan) on which each Impact Indicator is then calculated based on the affected population and some specific assumptions to support each of them. Most of data supporting these assumptions has been obtained from an Impact report written by the company 60dB (Kat Harrison, 2020), in which almost 35.000 interviews were conducted with energy consumers in 17 countries, where the most represented area is SSA. It should be noted that 51% of the consumers surveyed continue to use other fuels and therefore only 49% of the population benefits from electricity generated Impact: despite having access to electricity, the immense poverty limits the acquisition of electricity powered products such as electric stoves or induction hobs to perform basic functions. To maintain a conservative approach, this restriction will be applied to all Impact Indicators linked to household electrification. The main source of energy for the non-electrified African population is still based on combustion (either wood or vegetal carbon, both emitting toxic gases as well as contributing to deforestation) while the main source of lighting is kerosene lamps.

- Follows most relevant information collected for each Impact Indicator, which has in turn been used for ulterior Impact assessment and quantification:
- Access to vaccination: among others, rotavirus vaccines have the potential to prevent several deadly gastroenteritis. As per the study "Cost-effectiveness of rotavirus vaccination in Kenya and Uganda" (Charles Sigei, 2015), the vaccination schedule is two doses and it is an orally administered vaccine that

requires a cold chain for distribution and storage. From 2016 to 2035 rotavirus vaccination may prevent 70,236 deaths in Uganda and 329,779 hospital admissions in children under 5 years of age in Uganda so, assuming a linear evolution, around 3,512 deaths and 16,489 hospital admissions per year would be averted. In order to limit potential Impact assessment to the scope of affected population, we should adjust these data by the percentage of health centres not electrified yet (76% of the total) and to those health centres to be covered by grid expansion and densification (57%) (NES, 2021). Lack of accurate, concrete, and contrasted information on other vaccines has prevented us from evaluating and quantifying their Impact, although some indicative qualitative assessment lead us to anticipate a highly significant number of lives to be potentially and additionally saved.

- Diagnostic and treatment capabilities: centres to be electrified are expected to improve their customer service hence benefitting those with access to a health centre and currently 71.73% of Ugandans have access to level II health facilities within one-hour walking distance (Dowhaniuk, 2021). Despite obvious difficulties in gathering and managing reliable information, actual Impact is expected to be highly relevant and even further reinforced by the SDG3 target for 2030 ("ensure healthy lives and promote well-being for all at all ages").
- Health care hours: thanks to electricity health centres can open when there is no natural light, increasing the quality of medical care and improving the recording of patient information, the sense of security of patients and staff, the staff morale and their ease of recruitment, training, and retention. The emergency department utilization rates were lowest in low-income non-electrified countries with a median of 8 visits per 1000 population (Chang CY, 2016).
- Reduction of kerosene use and CO_2 net emissions: this indicator measures the percentage of households that either reduce or eliminate the use of kerosene lamps, replacing them with electric technologies. According to surveys, 53% of the population of East Africa use kerosene lamps as their main source of lighting while with access to electricity 87% stopped using kerosene altogether (Kat Harrison, 2020), which should produce significant Social Impact as exposure to kerosene is highly detrimental to cardiorespiratory health.
- Additionally, any electrification process increases national electricity demand, leading to more emissions from electricity generation. Based on the expected electricity demand and the country's current energy mix, we have calculated that the grid emission factor is 138.24 gCO_2/kWh (Aqachmar, 2022). Assuming that this energy mix is maintained, we can estimate the expected level of CO_2 emissions, although this is a very conservative assumption, since the momentum of renewable energies in underdeveloped countries is very strong. Therefore, computing the CO_2 emissions trajectories under both the Reference Business Plan and the Deadweight scenario, Figure 51 shows the increase in CO_2 emissions when accelerating an electrification plan (see details in Annex IV).

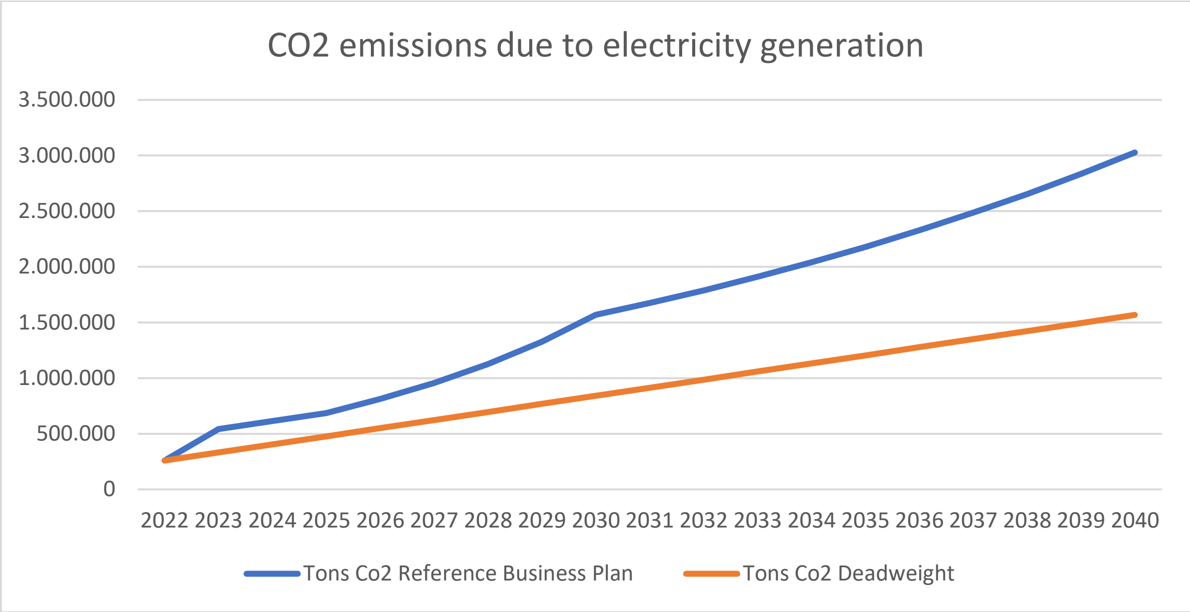

Figure 51. Uganda: Expected CO2 Emissions due to electricity generation

This acceleration would lead to an annual increase of, on average, around 90 kgCO2 more per connection. However, annual CO2 emissions associated with the use of kerosene lamps range from 90 kg to 900 kg per house (Lighting Africa, 2010). Additionally, new research has shown that kerosene lamps are significant sources of atmospheric black carbon and emit 20 times more than previous estimates, with 7-9% of fuel burned converted into black carbon particles[49]. Therefore, replacing kerosene lamps with electricity has lasting positive impacts on quality of life, economic development, education, and health. As the electrification benefits clearly outweigh potential environmental harm, we have decided not to quantify this potential negative Environmental Impact.

- Health improvements: out of those surveyed by 60dB, 48% of consumers have noticed improvements in their health and that of their family members due to access to electricity (Kat Harrison, 2020). As previously mentioned, biomass combustion is the cause of the spread of diseases such as respiratory infections, strokes, and lung cancer, among others. Those who suffer the most are women and children since they spend most time at home (usually with poor ventilation). The electrification of these people allows the introduction of access to clean and modern energy, thus eliminating the need for the traditional use of biomass, decreasing indoor pollution and related health problems.
- PM2.5 exposure: as per the 60dB study, exposure to PM2.5 particles (particles with a diameter of 2.5 micrometres that can cause negative effects on respiratory health) is reduced by 73% in school children and 50% for adults thanks to electrification (Kat Harrison, 2020).
- School performance: electrification is expected to reduce school dropouts and increase the number of years of schooling by 0.72 years per student (YÉO, 2020), affecting those children who experience all the advantages associated with full electrification. We have then adjusted full population to those with access to electricity, to children of school age or 15,537,266 children between 5 and 14 years by 2030, which is 26.14% of the total population (United Nations, 2019) and have further adjusted its actual

[49] Nicholas L. Lam et al., “Household Light Makes Global Heat: High Black Carbon Emissions from Kerosene Wick Lamps,” Environmental Science & Technology 46 (2012): 13531–13538.

repercussion considering that literacy rate within the targeted universe was 89% in 2018 (World Bank, 2020) even though the number of schoolchildren is increasing every year with SDG4 implementation.

- Increased quality of education: as per the 60dB study, children's grades increase by 10% once they get full access to electricity (Kat Harrison, 2020), which should then be applied to the adjusted share of beneficiary children calculated above.
- Increased study hours: according to the 60dB paper, children increase their study time by 20 minutes per day per child during their overall school time, which appears to have a critical influence in the acquisition of knowledge and subsequent professional development (same potentially affected children population shall be considered).
- Road lighting: cities lighting results in an increase in safety for vehicles and pedestrians. Data published by the WHO in 2020 indicates that Uganda ranks 6th in the world in deaths caused by traffic accidents (6.27% of all deaths) considering an overall 53.6 per 100,000 population or 0.0536% death rate (WHO, 2020). Former chairman of the International Lighting Committee (Wout Van Bommel) indicated that "the implementation of a correct street lighting system in cities as well as on roads can contribute to reducing the rate of traffic accidents by up to 30%" (León, 2006).
- Street crime: according to a New York based study, street lighting can reduce crime rate (intentional homicide rate) up to 36% by increasing street safety (Chalfin, 2022) and World bank data indicates that Uganda's crime rate in 2022 was 10 per 100,000 population (World Bank , 2022a).
- Income generation: the 60dB study indicates that 18% of consumers use energy for professional activities (most commonly being small businesses in SSA).
- Over-indebtedness: the percentage of consumers reporting difficulties in paying energy bills in Uganda is 4% and since the Reference Business Plan assumes tariffs are adjusted to the previous expenditure on fuel or kerosene, over-indebtedness associated with the acquisition of electrical equipment is disregarded.
- Changes in perception of safety: mostly due to the reduction of domestic accidents in homes (burns and fires), 86% of families reported feeling safer in their homes because of access to electricity (Kat Harrison, 2020).
- Gender inclusion: generic increase in empowerment and reduction of time spent by women on domestic work are found to occur in the 49% of households that have access to electricity. (Eberhard, 2020) highly relevant considering that female population in Uganda is 50.7% (World Bank, 2021a).
- Access to media and information: with the help of devices such as radios, televisions, or cell phones, communication between families, access to information and entertainment increases. A study conducted in Uganda in 2001 linked access to a television or a radio device to a reduction of malaria catching rates since access to information favoured the use of mosquito nets and reduced the spread of the disease (Nuwaha, 2001). According to the World Bank, in 2020 only 20% of Uganda's total population or 47.5% of the electrified population had internet access (Laia Ferrer-Martí, 2012).

3.3 Establish how long outcomes last

To establish the duration of outcomes, it is necessary to differentiate between Impact Indicators with a one-time effect over population to be electrified and those with continued (albeit decreasing over time)

Impact once electricity is deployed. For example, the vaccination effects are assumed to only last one year, considering that this Impact Indicator measures the number of lives saved annually. Despite no specific duration has been assigned to those Impact Indicators for which no financial proxy will be assigned (and hence no specific Impact value will be added), we should note that Impact in general shall last for as long as good electric service is provided, which further reinforces the relevance of NewCo's operation and maintenance services.

For school performance related Impact Indicators, duration is assumed to be one year since the Impact generated on students shall only affect them once in their schooling time. As for the other socioeconomic Impact Indicators (road lighting, street crime or income generation related), population affected will grow with the electrification rate and the related Impact will not remain beyond the actual year of electrification.

3.4 Place a value on the outcome

Next step consists of identifying and allocating appropriate financial values to the Impact Indicators, as these allow calculating the relative importance brought be electrification to all stakeholders. In this section and consistent with our conservative approach, value is exclusively given to outcomes for which sufficient and relevant information is available (full list of outcomes reinforces the highly relevant Impact associated to electrification, but they have not been included in out Impact valuation analysis unless directly applicable data is available).

Selected outcomes to which a financial proxy has been assigned are those measured by the following Impact Indicators: access to vaccination, school performance, road lighting, street crime and income generation. Details on how the different proxies have been applied are explained below:

- According to the study "Cost-effectiveness of rotavirus vaccination in Kenya and Uganda" (Charles Sigei, 2015), from 2016 to 2035 rotavirus vaccination can prevent 70,236 deaths in Uganda and 329,779 hospital admissions in children under 5 years of age. Over this 20-year period the cost of the vaccines would be USD 62 million, the avoided healthcare costs should total USD 18 million (including household costs) and dividing vaccines net costs (USD 44 million) over the estimated 1.5 million averted DALY (years lost due to premature death or years lived with severe disability), the study estimates the cost per year of life in Uganda to be USD 29. Considering that life expectancy in Uganda is 66.7 years (according to the WHO) and applying the USD 29 estimate (given rotavirus vaccine are applied to children within the first months of life), we derive that the proxy of value in Uganda is approximately USD 1,934 per life (we acknowledge such a surprisingly low value for a human life). Assuming the vaccination Impact takes place linearly, 3,512 deaths and 16,489 hospital admissions would be avoided per year (we have only applied the proxy of value per life to expected number of deaths avoided due to lack of information on type and relevance of hospital admissions).
- For lives saved due to street and road lighting (accidents averted and crimes avoided), the previously explained proxy of value per year of life (USD 29) has been applied to the estimated 31.7 averted DALY assuming 66.7 life expectancy minus 35 years or the average age of traffic accidents and crimes (Uganda Police, 2020) and to the expected number of lives saved per year as explained above (30% reduction on 0.0536% death rate on traffic accidents and 36% reduction on 10 per 100,000 population death rate on street crimes).
- Consumers using energy for income generation gained an additional USD 13.36 per week (Kat Harrison, 2020) which results in some annual income increase of USD695 per consumer dedicated to professional

activities. As expected and as table 52 below shows, in economic terms this is the clear largest contributor to the total expected value of benefits.

- Electrification of education results in an increase in the number of years of schooling by 0.72 years (YÉO, 2020). In low-income countries, each additional year of schooling adds 10% to each person's future average income which, discounting the opportunity cost or income they could be earning while in education (Lobos, 2018) and considering the average income per capita of Ugandans is USD 856 per year (World Bank, 2021b), the total financial proxy with respect to school performance has been estimated at USD 61.6 per affected child per year (calculated using 10% of the annual salary, multiplying it by the 0.72 years of increase in schooling time).

Having calculated the population affected and the economic value per person for each Impact Indicators to be monetized, the annual value of the outcomes produced by electrification is summarized in Figure 52 below.

Outcome Value	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Access to vaccination	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
School performance	15.6	16.4	17.3	18.3	19.4	20.9	23.2	26.6
Road lighting	0.3	0.7	1	1.4	1.8	2.3	2.8	3.3
Street crime	0.1	0.2	0.2	0.3	0.4	0.5	0.6	0.7
Income generation	136	278.9	430	589.3	758.7	941.3	1.143.7	1.375.7
Total Outcome Benefit	**154.9**	**299.1**	**451.6**	**612.3**	**783.3**	**968**	**1,173.2**	**1,409.4**

Figures in USD million.

Figure 52. Uganda: Annual Outcome Benefit Base Scenario (2023-2030)

Stage 4: Establishing impact

4.1 Assess Attribution

The next step is to assess the extent to which the outcomes that have been analysed do result from the business activity (NewCo) by estimating what proportion of the outcome can be considered as directly added by the activity (Attribution) and how much of the outcome would have occurred in any case without NewCo's activity (Deadweight). Within the attribution rate it is established what specific percentage of the outcome corresponds to the electrification brought by NewCo and what percentage corresponds to other factors.

Access to vaccination is increased because vaccines need to be kept cold, and therefore electrification is critical for refrigerators, but their implementation would not be possible either without some investment carried out by the Ministry of Health. Therefore, we have estimated that the attribution percentage corresponding to electrification should be 50%.

The rest of Impact Indicators have been calculated exclusively considering electrification as their direct cause (for example, in the case of traffic accidents, we have only considered the reduction of accidents due to lighting and not due to the improvement of roads or other factors), so the change is assumed to entirely due to electrification. The same rationale applies to the rest of quantified Impact Indicators, crime reduction, school performance, and income generation.

Once the percentage of general attribution that corresponds to electrification has been established, we estimate that one third of this attribution corresponds to electrification financing and two thirds to electrification operation and maintenance, since we believe an appropriate network AO&M is critical and deserves twice the level of attribution granted to network investment. As mentioned above, infrastructure development is financed by NewCo (10%) and by FinanceCo (90%), but NewCo is responsible for the entire network operation and maintenance. In summary and to correctly reflect this attribution split, Impact Indicators have then been adjusted so that 10% of the electrified population corresponds entirely to NewCo and 90% to FinanceCo, NewCo also receiving final attribution for two thirds on the AO&M carried out over FinanceCo 90% investment.

Resulting annual Impact benefits (Impact Benefits) obtained by applying these attribution rates are summarized in Figure 53 below.

Attribution Adjusted Benefits	2023	2024	2025	2026	2027	2028	2029	2030
Access to vaccination	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
School performance	10.9	11.5	12.1	12.8	13.6	14.7	16.2	18.6
Road lighting	0.2	0.5	0.7	1.0	1.3	1.6	2.0	2.3
Street crime	0.1	0.1	0.2	0.2	0.3	0.4	0.4	0.5
Income generation	95.2	195.2	301.0	412.5	531.0	658.9	800.6	963.0
Impact Benefit	**107.4**	**208.3**	**315.1**	**427.5**	**547.3**	**676.5**	**820.2**	**985.5**

Figures in USD million.

Figure 53. Uganda: Annual Impact Benefits Adjusted by Attribution (2023-2030)

4.2 Evaluate Deadweight

To measure the net impact generated by NewCo, Deadweight must be subtracted from the Attribution adjusted Impact Benefits. Deadweight represents an estimate of the Impact that would have been created if the NewCo's activities did not happen and shall be determined by evaluating whether the Impact Benefits could have been achieved without the Proposed Reform and due to other external factors. The Proposed Reform and its associated 2030 electrification plan have two main consequences: firstly, it accelerates the electrification of the country (without it we assume the 2030 deadline would not be met) and, secondly, it guarantees full (100%) country electrification (getting to the last 10% has proven to be highly challenging in countries under similar circumstances). The last 10% of the electrified population is known as the last mile and it usually refers to the population whose electrification is either very difficult or very expensive to be accomplished.

Keeping our conservative approach, only the acceleration of the country's electrification will be evaluated, thus if NewCo's activity did not take place, the total electrification of the in-scope population (or a similar effect) would still be achieved but a later stage. To develop this alternative "slower" scenario (i.e., what would happen if the Proposed Reform was not carried out), it has been considered that from 2010 to 2020 Uganda electricity covered population experienced a 3% growth per year and this trend could be reasonably maintained (World Bank, 2022b) achieving full electrification by 2040.

Accordingly, we have developed a Deadweight scenario in which a similar Impact is achieved but at a later date (2040): the Reference Business Plan implies an electricity covered market average growth of 5.79%

per year until 2030 (assuming linear evolution to get to 100%) versus the 3% annual growth used for the Deadweight scenario until 2040. This Deadweight scenario produces the numbers for the 2023-2030 period shown in Figure 54 below.

Deadweight	2023	2024	2025	2026	2027	2028	2029	2030
Annual Impact Benefit	79.5	154.2	233.2	316.5	405.1	500.8	607.1	729.5

Figures in USD million.

Figure 54. Uganda: Annual Deadweight (2023-2030)

Under the Deadweight scenario, final Impact shall be the same than in the Reference Business Plan scenario, so we could calculate the Deadweight Impact to be generated between 2030 and 2040 by taking the total Reference Business Plan Impact and subtracting the Deadweight Impact to be achieved by 2030. For simplification purposes, Deadweight Impact has been assumed to follow a linear pattern over the 2030-2040 period as shown in Figure 55 below.

Deadweight	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Annual Impact Benefit	106.2	106.2	106.2	106.2	106.2	106.2	106.2	106.2	106.2	106.2

Figures in USD million.

Figure 55. Uganda: Annual Deadweight (2030-2040)

Due to the nature of our Deadweight Impact scenario, we are nor calculating the net resulting Impact but rather evaluating separately Impact Benefits (Attribution adjusted) and Deadweight as per the SROI model in the next section.

Stage 5: Calculating the SROI

Calculate the NPV

Once both Impact Benefits (Attribution adjusted) and the alternative Deadweight Impact scenario have been calculated, their NPV can be obtained by discounting expected Impact values at the WACC (same discount rate applied to the Reference Business Plan for easier comparison and relative analysis). This results in an Impact Benefits present value under the Reference Business Plan (2023-2030) of USD 2,615 million or USD 113 implied value per capita versus Uganda's income per capita being of USD 856 (World Bank, 2021a) and a Deadweight Impact present value under the Deadweight scenario (2023-2040) of USD 2,261 million. Subtracting the Deadweight Impact, we obtain a net present value for the expected Impact Benefits under the Reference Business Plan of USD 353 million.

Calculate the ratio

As previously mentioned, the purpose of the SROI approach is to incorporate the expected Social Impact value into the traditional risk-return analysis, producing a ratio between the Impact Net Present Value and the Investment Value (USD 271 million for NewCo under the Reference Business Plan)**:**

$$SROI = \frac{Impact\ Net\ Present\ Value}{Investment\ Value} = \frac{353\ MUSD}{271\ MUSD} = 1.303$$

Therefore, we can conclude that Social Impact generated by NewCo's business activity is USD 353 million, 1.3 USD per USD invested or 30.3%.

4.7. Main results

The final step of our working process and our model consists of consolidating the value enhancement brought by the Growth Real Option on Rwanda value and the Impact models into the Equity Investor analysis framework resulting from the Reference Business Plan under both the 2023-2030 and 2023-2040 scenarios. It is fair to acknowledge that these value additions may not have the same direct cash flow visibility than the Reference Business Plan is expected to deliver, but they do add highly relevant and quantified information on the investment consequences.

As explained above, our overall model approach is predicated on the inclusion of both financial and Impact considerations into the decision-making process, but it is fair to differentiate the expected Equity Investor IRR including the Growth Real Option on Rwanda (Expanded IRR) from the SROI. The Expanded IRR indicates the expected return to be generated, either directly from the Reference Business Plan or from the Growth Real Option on Rwanda, for the direct benefit of NewCo's shareholders, while the SROI represents the overall Impact related return that NewCo is expected to deliver to a wider group of potential stakeholders.

On the one hand, Figures 56 and 57 summarize the Expanded IRR or expected Equity Investor IRR including the USD 81.6 million value addition brought by the Growth Real Option on Rwanda assuming a 2023-2030 and a 2023-2040 investment period respectively and we can appreciate the significant IRR increase from 12.8% to 19.5% and from 11.8% to 16.7% under both timeframes.

On the other hand, Figures 58 and 59 below display, side by side, all relevant returns produced by our model: Reference Business Plan IRRs and the Expanded IRR (under both 2023-2030 and a 2023-2040 investment periods) as well as the SROI (30.3%).

Equity Investor	2022	2023	2024	2025	2026	2027	2028	2029	2030
Equity Value	-252.7								505.2
Value Addition	81.6								
Capital Increase					-50.0				
Dividends		22.3	22.5	22.8	12.6	12.2	13.4	14.8	25.7
Net CF/Value	-171.1	22.3	22.5	22.8	-37.4	12.2	13.4	14.8	530.9
Expanded IRR	**19.5%**								

Figures in USD million.

Figure 56. Equity Investor Expanded IRR (2023-2030)

Equity Investor	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**
Equity Value	-213.0																		597.9
Value Addition	81.6																		
Capital Increase					-50														
Dividends		22.3	22.5	22.8	12.6	12.2	13.4	14.8	25.7	27.2	28.7	29.4	30.1	30.7	31.4	32.1	33	33.9	34.7
Net CF/Value	-131.4	22.3	22.5	22.8	-37.4	12.2	13.4	14.8	25.7	27.2	28.7	29.4	30.1	30.7	31.4	32.1	33	33.9	632.7
Expanded IRR	**16.7%**																		

Figures in USD million.

Figure 57. Equity Investor Expanded IRR (2023-2040)

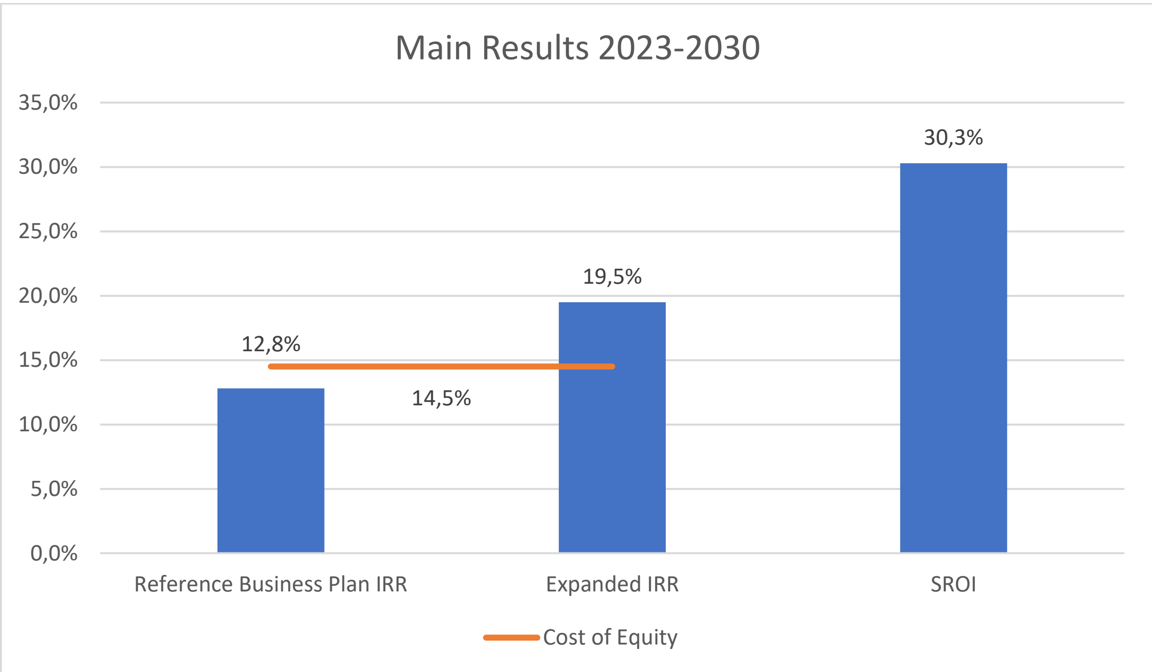

Figure 58. Summary of financial and Impact returns (2023-2030)

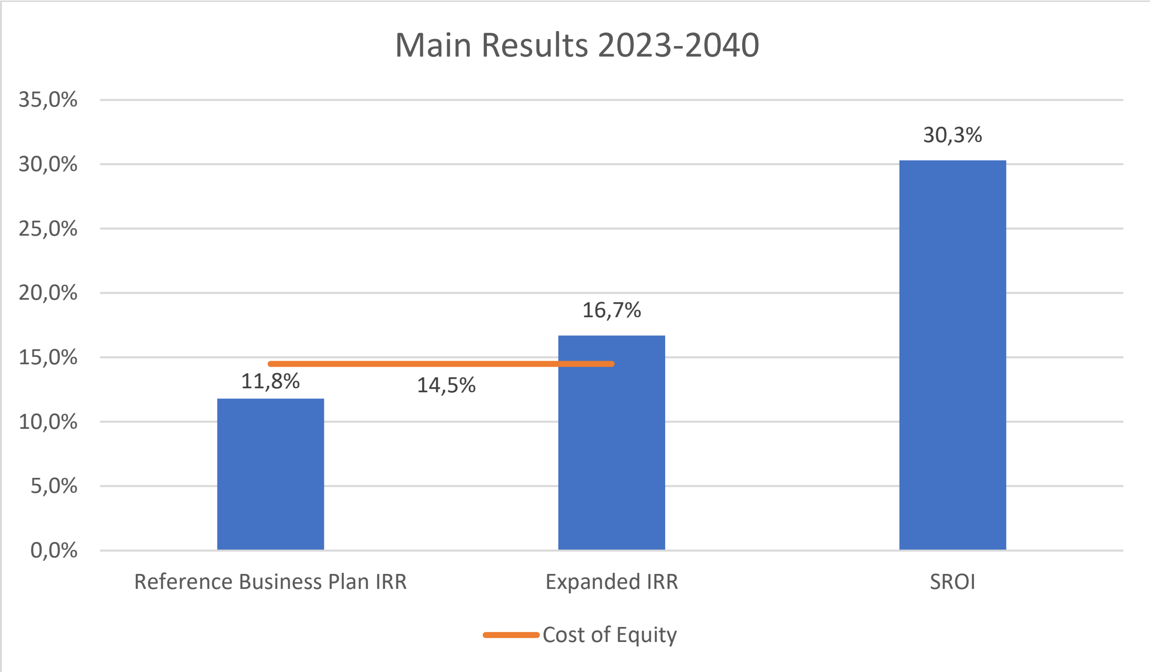

Figure 59. Summary of financial and Impact returns (2023-2040)

These Expanded IRRs and SROI are obviously expected to be well received by the Equity Investor decision-making bodies. But beyond the magnitude of the returns increase and the potential investment decision they could lead to (in both scenarios Expanded IRRs are above the cost of equity pre-SROI), they indicate areas of potential hidden shareholder and/or stakeholder value creation. These areas of hidden value may be of different relevance to different potential Equity Investors and the underlying assumptions used to measure both real options and Impact value additions may also be differently assessed, but we believe neither their existence nor their direct link to the Reference Business Plan and the investment in NewCo could be disputed, so they should at least be analysed and considered by any rational Equity Investor.

5. Conclusions

5.1. Main results and original contributions

There are several worldwide initiatives, working groups at all levels and both financing and industrial sponsorships aiming at, at least partially and progressively, addressing the tremendous consequences brought by the lack of electrification to African social, economic and cultural development. Structuring and raising the required financing appear to be critical requirements for the actual implementation of any of these investment programs and work conducted by the Research Team (and reflected in this thesis) confirms the currently unsatisfactory speed of electricity networks roll-out as well as the magnitude of the challenge ahead of us to achieve full electrification by 2030. The Research Team has been aiming at contributing to such problem by developing the IDF (based on the following pillars: focus on electricity distribution as the main bottleneck, design of a holistic solution for an entire country, combine different technical on-grid and off-grid alternatives and implement the concession legal structure as the best model to achieve its targets) and by incorporating a financial approach into the overall model, consolidating a techno-economic model, an integrated vision of the regulatory and business model as well as a financing plan.

Based on this approach and throughout the work carried out over the last few years on different real assignments, we have confirmed the relevance of the lack of electrification for their overall social, economic and human development, the appropriateness of the IDF as a useful model to deal with such problem, the importance of structuring and raising the required financing to fund the electrification investments and the expected difficulty of this capital raising in most situations. Indeed, these recent real and actionable situations have reaffirmed the challenge to put together a holistic financing plan in general and to raise new equity in particular to fund the electrification of the least profitable regions in SSA (S&P B rating) countries, the multiple benefits deriving from developing a business plan both to model the operating scenarios and to analyse financing alternatives on situations where lessons learnt from the Uganda Assignment may be applicable, the value added brought by the real options model (partly quantifying the commonly accepted "strategic premium" by most industrial investors) and the adoption of an Impact model that measures the different Impact areas and can then be added into a full and revised investment proposal for the Equity Investor.

The combination of this recent work and my professional experience seems to indicate that the execution of a business plan for such an ambitious target as the electrification of SSA countries by 2030 will heavily depend on the right financing strategy and on the right selection of and commitment from both Debt Providers and the Equity Investor. The various capital providers are expected to request some level of inter-conditionality and the ultimate equity component is expected to be a critical financing cornerstone. As mentioned above, the Equity Investor commitment would be key both to lead the strategic and business plan and to provide either partially or in full the remaining financing required. Based on prevailing market practice and on work summarised in this document, financial returns expected to be delivered by the case business plan to the Equity Investor are unlikely to compensate for the required time and effort as well as the reputational and financial risks associated to investing in these countries, especially if large investment amounts are required. Thus, the Equity Investor is highly likely to demand some additional investment levers and the overall investment proposition to the Equity Investor is significantly improved after the consideration of both risk mitigation measures and financial return improvement resulting from the addition of real options value and the Impact model. Returns enhancement from 12-13% (Reference

Business Plan IRRs) to 17-20% (Expanded IRRs) plus SROI over 30% may not be transforming decision-making criteria on their own but they will certainly help to improve the Equity Investor case in similar situations to the Uganda Assignment.

In summary, the contribution of this thesis consists of: (i) the development of integrated business and financial models, built alongside the execution of various Research Team assignments in different countries (especially the opportunity to work on the Uganda Assignment with relevant GoU representatives and hence to build the Reference Business Plan), ready to be actionable and to support raising the required financing under current market conditions; (ii) this real work experience has allowed us to build a more generic analysis framework which could eventually be applied to other SSA countries or even to other developing regions, although, as the Research Team has learnt by working on different situations (Uganda, Rwanda, Ecuador, Panamá), the application to other countries will be heavily conditioned by their local characteristics and challenges; (iii) finally, a broader analytical risk-return-impact framework to overcome potential capital raising difficulties which includes traditional financial criteria as well as more innovative financial and non-financial considerations consistent with a holistic approach to the overall financing decision-making process.

By developing this integrated framework, we hope to have contributed to open future research avenues on how current financial markets and leading corporates in general can get closer to some developing countries and can contribute to their economic and social development.

5.2. Limitations and future work

Due to the practical and multidisciplinary approach of our work, we have faced the following main limitations which do also signal potential areas of future research:

- Elaboration of all financial projections used on the various sections and more specifically in the case of Rwanda (where limited traction with relevant GoR or corporate representatives was obtained at the time of building the financial projections) but even in the case of Uganda given the relevance of the Reference Business Plan, has faced the ordinary limitations associated to the selection of forward-looking operating and financial assumptions. Additional refinement of business plan assumptions should improve the overall level of accuracy delivered by the various models.
- Similarly, the elaboration of the EAI would benefit from the refinement of the underlying financial models and from additional specific expertise on each local financial market to validate some of the conclusions reached, mostly on the sufficiency side (see section 2). Additional refinement of business plan and financing assumptions should improve the overall level of confidence delivered by the various models and the overall EAI value added would increase by enlarging the sample of countries being analysed.
- Involvement from relevant Government and corporate officials has varied across countries. Additional participation of local stakeholders on subsequent iterations would increase our confidence on the results produced by our work being conformant with the local authorities´ plans and on the potential implementation of our models in these countries.
- Analysis related to the Uganda Assignment has been focused on NewCo for the various reasons explained above. A similar analysis could be undertaken on other Ugandan sector players in general

and on FinanceCo in particular, given its potentially relevant role in the Proposed Reform implementation.

- The real options model also face all typical limitations associated to such financial analysis tool (related to either the underlying asset value or the key option structure and assumptions). In addition, our model validity could increase by: (i) considering the model sensitivity to variables other than Rwanda electricity demand growth evolution as potential volatility drivers (on the Growth Real Option on Rwanda), (ii) adding and explicitly valuing the option to abandon (in our model considered to be a "must have" condition by the Equity Investor) and (iii) adding other countries in addition to Rwanda as potential source of value to the Growth Real Option on Rwanda.
- Our Impact analysis model is also affected by multiple limitations, on the identification of potential Impact outcomes, on the selection of those to be eventually quantified and on their actual measurement. More reliable and accessible data should increase the number of Impact outcomes being assessed, the confidence behind some of our assumptions and the overall SROI result (which, as discussed, we believe is highly conservative).
- Additional contrast with relevant DFIs officials and with potential Equity Investors should not affect the main conclusions of the thesis but would clearly increase its practical validation. Some relevant judgments rely on my professional experience and on some limited conversations and work sessions held with each category of potential capital providers, thus increasing the sample of both DFIs and Equity Investors would clearly contribute to future research.
- Our research model and conclusions rely on the work carried out on Rwanda and, more importantly, around the Uganda Assignment. Expanding the sample of countries being analysed and validating our conclusions in other geographies would also be a clear area of future potential work.
- As discussed, there are some highly relevant considerations for the Equity Investor overall investment case that have neither been quantified nor explored in detail. Political risk, regulatory certainty and stability, reputational risk or capital markets reception of a potential investment in Uganda or Rwanda have not been analysed and are expected to play a critical role in the Equity Investor decision-making process. Future research could explore some of these potential concerns either from a qualitative or even a quantitative standpoint as well as how to cover or mitigate some of these potential sources of risk (e.g., emerging markets and country risk analysis, political risk insurance or potential evaluation of the growth decline risk).
- Finally, when analyzing the overall investment case for the Equity Investor, I have not discussed the potentially positive impact that an investment in NewCo could have on the Equity Investor cost of capital. Current ESG and Impact market sentiment could lower the cost of capital and increase the value creation potential for the Equity Investor, which could clearly be further analysed by future research.

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Annex I: Detailed Reference Business Plan assumptions

The business plan that is presented in this report has been developed using a "financial model", i.e., an analytical tool to support this kind of exercise. This tool has been built using an Excel spreadsheet, representing the financing strategy for the distribution segment of the Ugandan power sector during the period 2021 to 2040, with the complete electrification of the country by 2030 as described in the NES. Developing scenarios based on this tool requires some external assumptions/inputs – e.g., demand growth, cost of solar panels or batteries, or price of wholesale energy – and also needs the provision of some strategic inputs – e.g., the trajectory of annual CAPEX and OPEX in the electrification plan, the evolution of tariffs to the end customers, or the proposed blend of grants, equity, and debt to finance distribution during the period. Then the tool delivers the corresponding financial statements and the key outputs, which the financial planner must use to evaluate the viability of the financial plan and to adjust the strategic inputs in an iterative process, trying to achieve the best possible outcome, hopefully a viable business plan.

The business plan presented in this report ("Reference Business Plan") and its conclusions hence depend on these external and strategic assumptions. Sensitivity analysis can be performed to understand the impact of inputs and assumptions on the viability of the financial plan.

Storyline and assumptions

It follows a description of the key assumptions used to build the Reference Business Plan. They are embedded in the storyline of the proposed regulatory and business model approach, and they are organized by time periods (initial situation 2021-2022, electrification effort 2023-2030, and financial stabilization 2031-2040) and by topic: investment, ownership, and operation and maintenance.

Investment

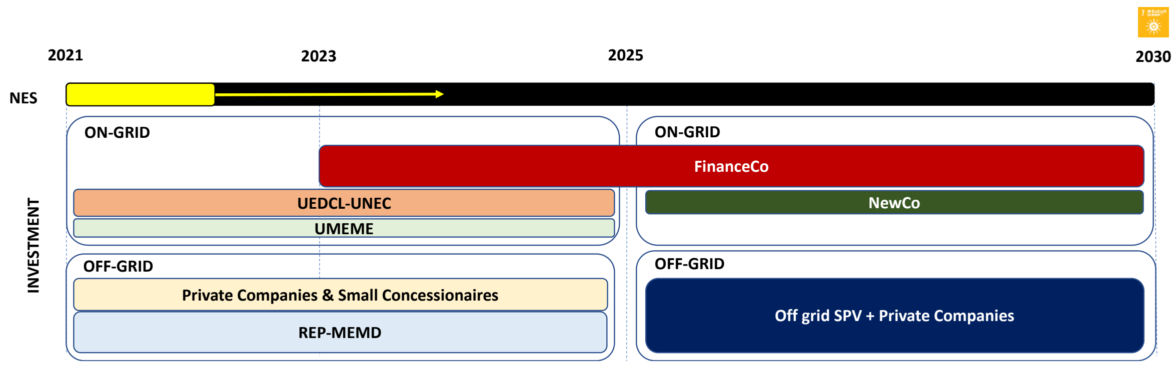


Figure 60. The institutional and business model layers: the investment perspective

2021-2022

We have assumed that although the national target is to meet the levels of investment and necessary connections set by the NES, this target has not been reached in 2021, nor does it appear that it will be met in 2022. Based on the current investment levels presented in the financial statements, we have estimated that only 20% of the NES target has been or will be fulfilled in both years. Therefore, we have allocated the rest of the necessary connections evenly over the rest of the period, so that 100% electrification is achieved by 2030. This means a step change from approximately 190,000 new connections in 2022 to 1.14 million connections in 2023.

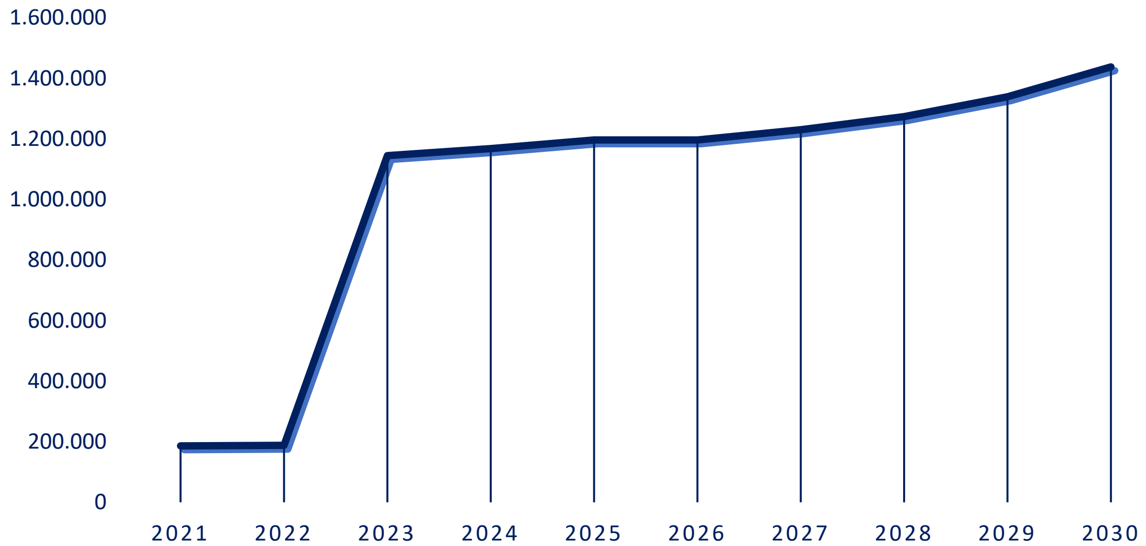


Figure 61. Number of new connections per year following the NES

2023-2030

From 2023 until the end of the current concession, FinanceCo is assumed to provide the financing to Umeme (and after 2025, to NewCo) to make the EPC of the new on-grid connections dictated by the NES within Umeme's footprint (since Umeme cannot invest by political decision during this time interval in its current footprint).

After 2025, NewCo will be able to make a small fraction of the on-grid investments established by the NES. These investments correspond to critical network infrastructures requested by NewCo and approved by ERA after consultation with UEDCL-UEC.

UEDCL (probably a department within the vertically integrated public company UEC) will be responsible for inspecting and verifying the activities and compliance with the objectives imposed on NewCo and providing technical advice to MEMD. It will have no legal personality or consumers.

Investments in off-grid solutions will be made by the aggregate of private companies and small concessionaires and the REP within MEMD (until 2025). Subsequently the off-grid space will be filled by private companies, including the newly SPV which, in its role of off-grid default provider and last resort provider, will ensure full compliance with the NES objectives.

2031-2040

Once 100% electrification is achieved, new investments are only necessary to address population and consumption growth, plus CAPEX replacement according to the specific D&A (depreciation and amortization) schedule.

Ownership

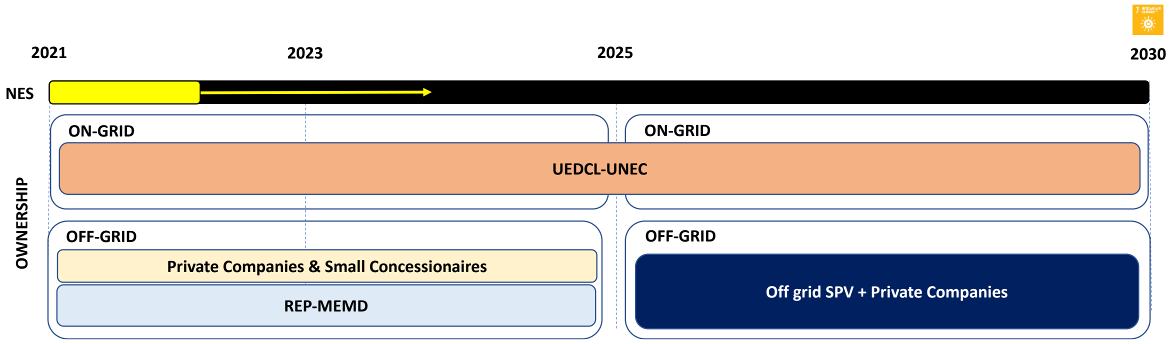


Figure 62. The institutional and business model layers: ownership of the assets

2021-2040

Existing and new on-grid assets will belong to UEDCL initially. With the rebundling, all of them would belong to the vertically integrated company UEC. In addition, UEC would inherit the on-grid assets and customers of the small concessionaires as their license expires. After 2025, NewCo will operate and maintain these assets and will inherit the customers.

Because we assume on-grid distribution will continue under a concession model, with a new format and contracting conditions but in principle with the same company shareholders, the buy-out of Umeme's investments residual value will not be required. Neither the concessionaire, NewCo, nor FinanceCo would own any physical distribution assets, as UEC would own them.

New off-grid assets will belong to private companies. Any existing publicly owned off-grid assets will be transferred to private companies under conditions to be specified.

Operation and Maintenance

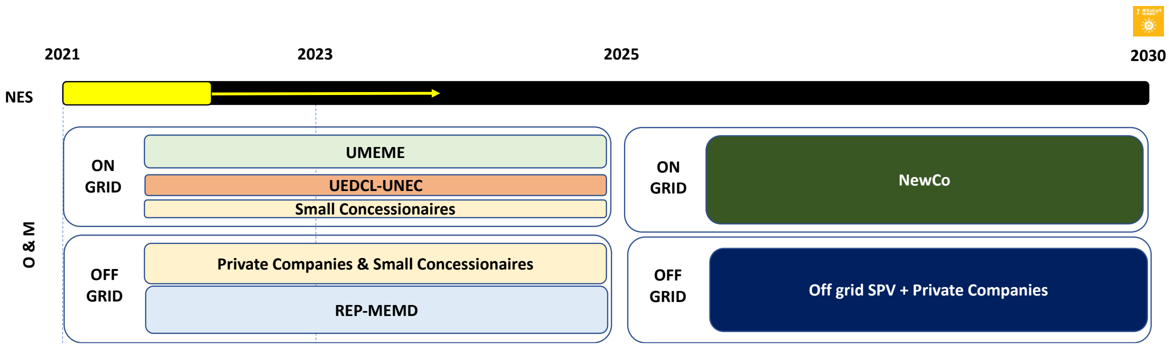


Figure 63. The institutional and business model layers: Operation and Maintenance

2021-2024

During this period, the AO&M of on-grid consumers will be carried out by Umeme, UEDCL, and the small concessionaires, as a continuation of the present situation. Off-grid activities and customers will also continue as they are now.

2025-2040

In 2025, UEDCL-UEC will transfer all consumers under its operation to NewCo. Therefore, NewCo will operate and maintain the consumers and assets under UEDCL-UEC in 2025 until the end of the new concession.

- In addition to the assumptions concerning the construction of the model, we have made estimates of external inputs based on market information:
    - Based on the most up-to-date information from the IMF, we have obtained GDP's growth and USD and USh inflation trajectories for the 2021-2040 period. Additionally, we have obtained the corporate taxes and population and demand growth projections from market reports by contrasting them with the different companies in the sector.
    - Cross-checking with the information provided within the NES, we have obtained the AO&M cost data for each technology, the depreciation and amortization schedule of the assets, and finally, the technical losses and bad debt provisions.
    - The value of the upstream cost of energy obtained from the NES and Umeme's financial statements has been verified with the Regulatory Authority, and the most recent tariff schedule has been obtained.
- The following key strategic inputs have been assumed:
    - The NES has set the annual investment and new connections targets as we have described above. We have respected the CAPEX and OPEX values specified in that document, and the decision to deploy 3W solar kits in the reference scenario.
    - Our baseline scenario involves inputs to be negotiated, such as the ROI for NewCo - Zone A, ROI for NewCo - Zone B, and the ROI for off-grid solutions. Until 2025, Umeme's ROI is 20%, but we have introduced 12% for NewCo in the reference scenario after 2025 and for the aggregated off-grid developers. Sensitivity analysis can be made, and the effect on the business plan of different values of ROI can be evaluated.
    - Additionally, a procurement fee (%) of the NES to be paid to Umeme and then to NewCo has been introduced, equivalent to 5% for all the investments to be made in zone B, the cost of which is paid by FinanceCo.
    - The tariffs remain at their current value, i.e., they are not adjusted for inflation during the period 2021-2040.
    - All the concessional debt and associated interests are repaid in full by 2040, as shown in Figure 64. The capital structure will consist entirely of equity at that time, as it is typical at the end of the concession contract periods.

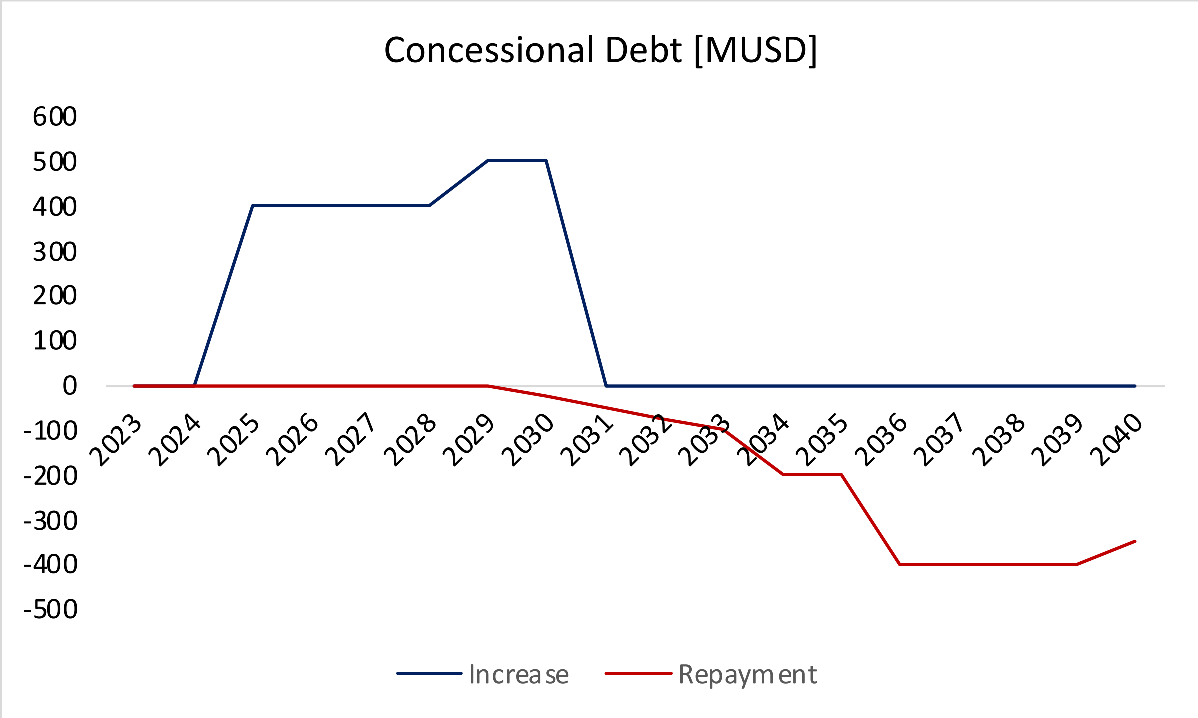


Figure 64. Use and repayment of the concessional debt

Main data

Key strategic inputs

CAPEX trajectory

The network roll-out, the associated investment costs incurred in any given year, and the connection of all consumers are assumed to take place proportionally throughout the year. A mid-year convention is adopted for additional CAPEX and new customers (the same assumption is considered for the upstream energy cost and AO&M expenses).

- Period 2021/2030 - Network deployment to connect the remaining additional customers so that universal access can be achieved by the end of 2030 following the NES;
- Period 2031/2040 - CAPEX to cope with population and consumption growth and replacement CAPEX as required by specific D&A schedule.

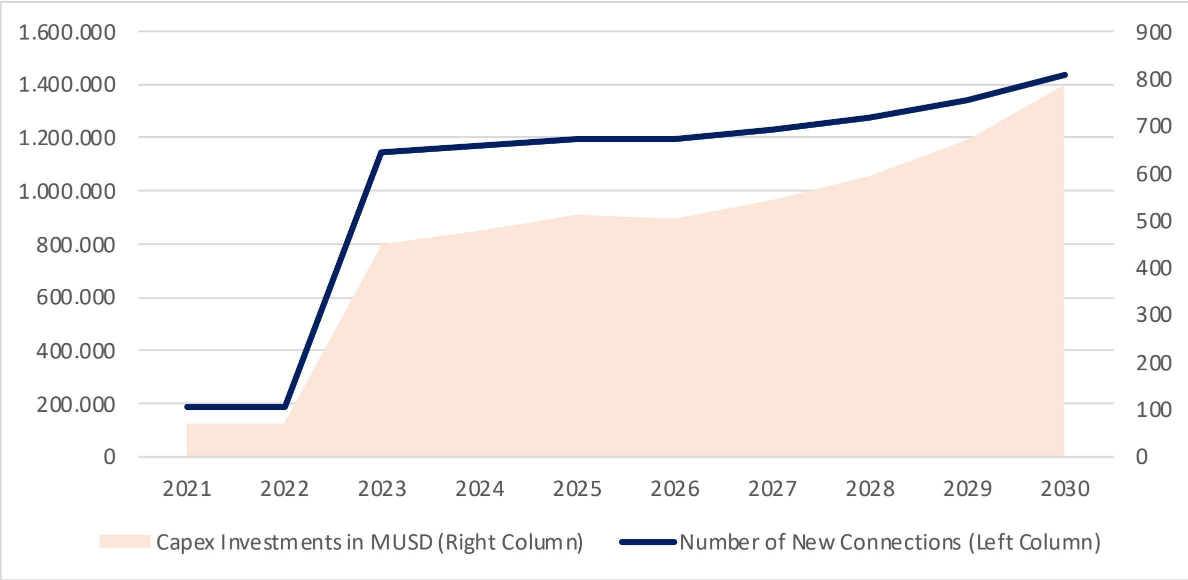


Figure 65. CAPEX and new connections trajectory

Tariffs

The current tariffs set by the regulator for each type of customer (residential, commercial, or industrial) are used. Mini-grid customers are charged at the same tariff as grid consumers. Isolated system users are charged the average rural household energy consumption equivalent (USD 12/year).

- Commercial and Industrial customers Tariff: No increase on the currently regulated tariff;
- Non-C&I Tariff: No increase on the currently regulated tariff;
- Pass-through of wholesale energy costs: In addition to inflation, tariffs could be subject to a pass-through scheme of the cost of energy reduction for all end customers tariffs for the 2031/2040 period. Due to the lack of data, there is no trajectory for the energy cost (it is the same value for the whole period). Therefore, tariffs do not decrease in value due to a reduction in the cost of energy.

Grid Extension/Densification	Residential Tariff	*INPUT*	**747,50**	*Q1 2022 values in USHs/kWh*
	Lifeline - First 15 Units (Ush/kWh)		*250,00*	*Q1 2022 values in USHs/kWh*
	Energy units between 16 – 80 (Ush/kWh)		*747,50*	*Q1 2022 values in USHs/kWh*
	Energy units between 81 – 150 (Ush/kWh)		*412,00*	*Q1 2022 values in USHs/kWh*
	Energy Units above 150 (Ush/kWh)		*747,50*	*Q1 2022 values in USHs/kWh*
	Industrial Tariff	*INPUT*	**400,00**	*Q1 2022 values in USHs/kWh*
	Commercial Tariff	*INPUT*	**597,10**	*Q1 2022 values in USHs/kWh*
Minigrids	Residential Tariff	*INPUT*	**747,50**	*Same as On-grid Customers*
	Industrial Tariff	*INPUT*	-	
	Commercial Tariff	*INPUT*	-	
SAS	Type A	*INPUT*	**12,00**	*Rural Household Energy Consumption USD*
	Type B	*INPUT*	-	

Figure 66. Value of the tariffs applied in the model

Financing characteristics and constraints

- Grants: Grant revenues are based on DFIs funds to the Government linked to the deployment of the CAPEX. Recognized in the P&L proportionally to the percentage of annual CAPEX over total CAPEX. No repayment of the Grants is introduced in the model
- Concessional debt: Six years of grace period; 2% interest rate
- Commercial debt: No grace period; 8% interest rate

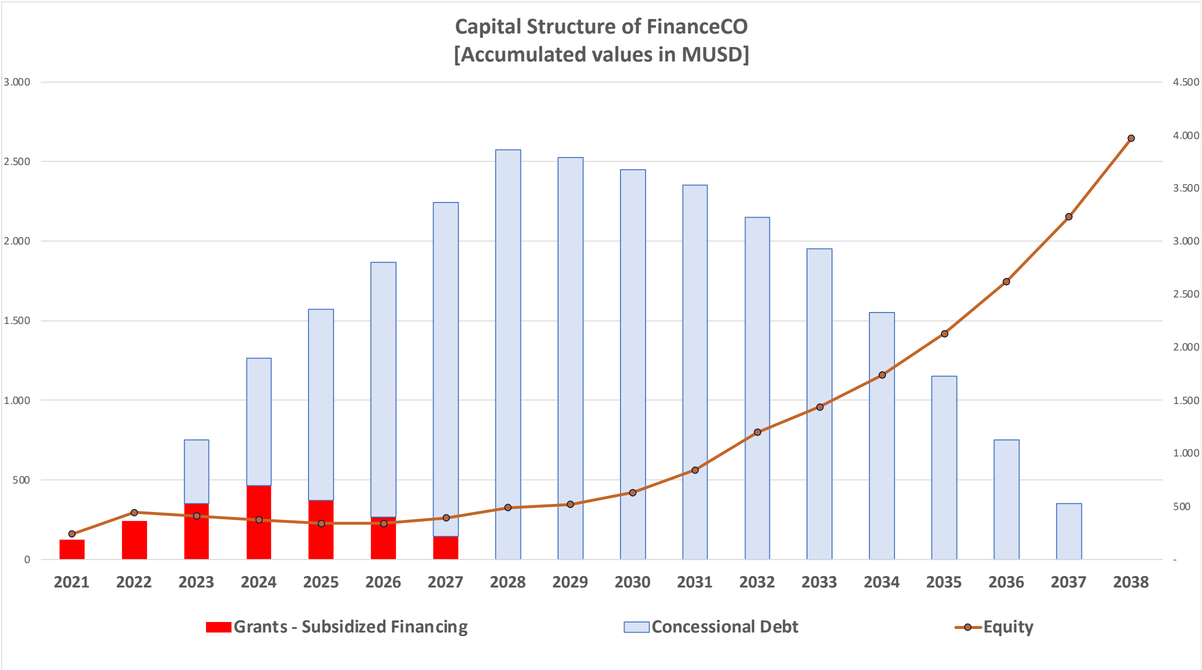


Figure 67. FinanceCo capital structure evolution

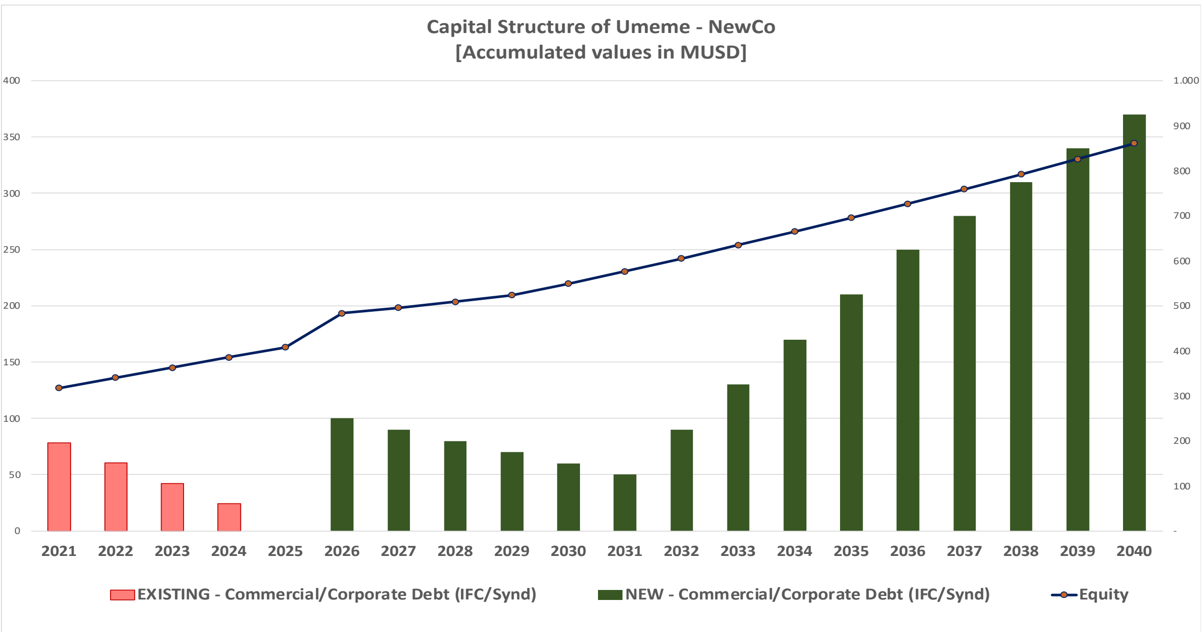


Figure 68. Umeme – NewCo capital structure evolution

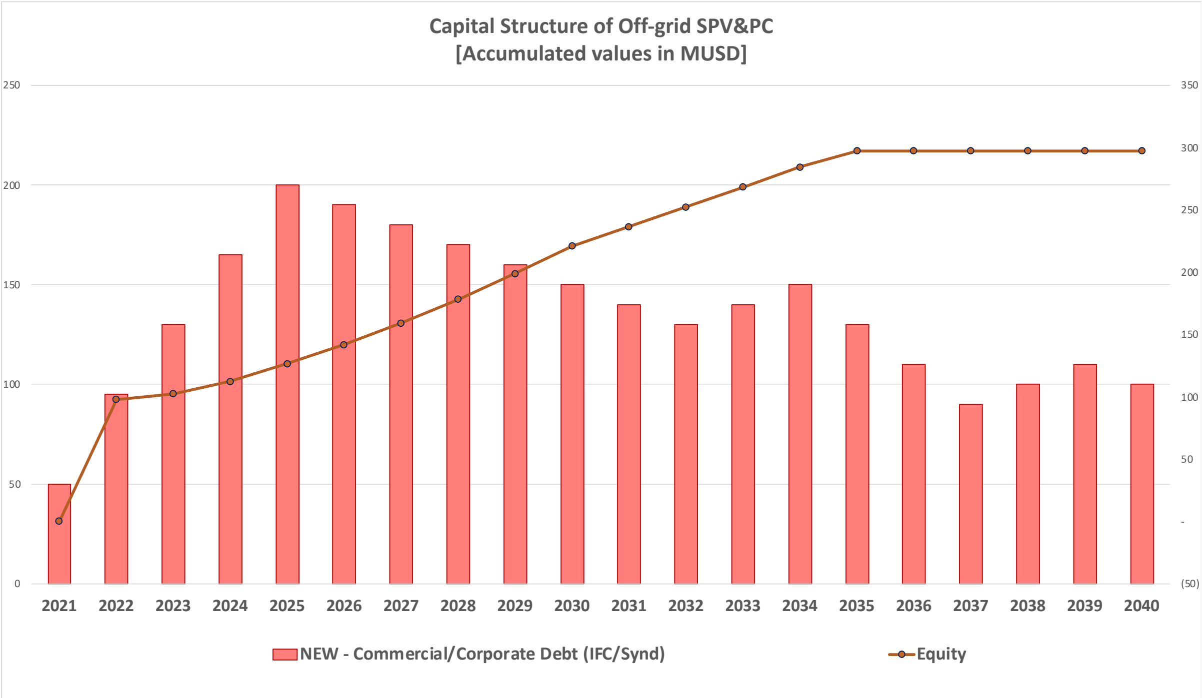


Figure 69. Off-grid SPV&PC capital structure evolution

External inputs based on market information

Market inputs

- Corporate tax rate: 30%
- Figure 70 shows the trajectories of the expected values of GDP growth, USD inflation and USH according to IMF data.

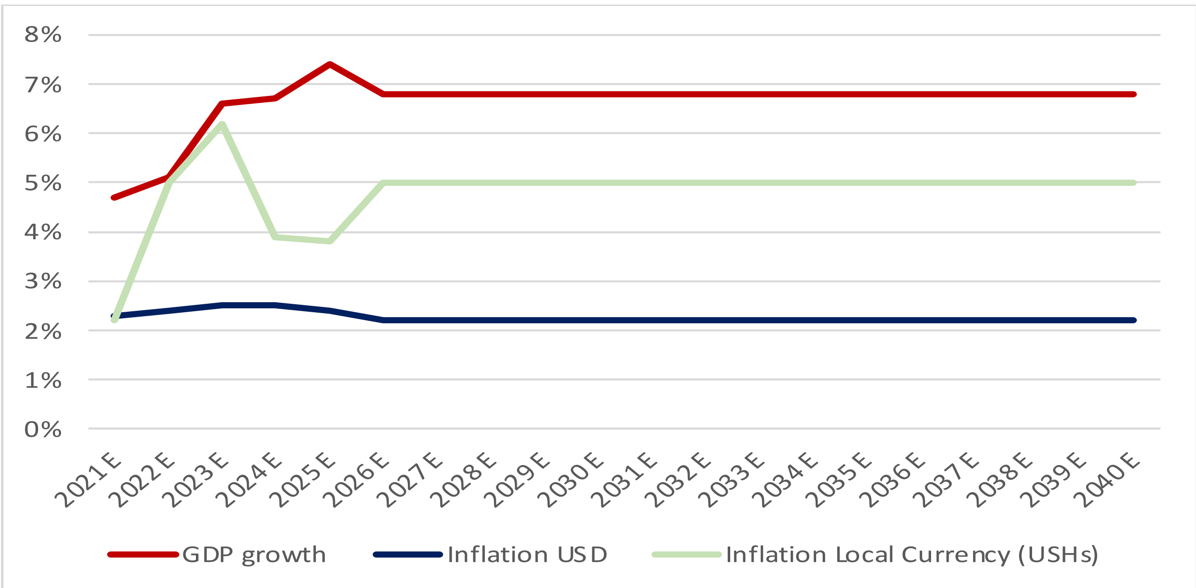


Figure 70. Expected GDP, USD inflation and USH inflation trajectories

Population increase

- 2021-2030: The electrification plan is being implemented under the expected population in 2030;
- 2031-2040: Both rural and urban rates of growth are 3.3%.

Demand increase per customer

- Increasing current demands (from UMEME and UEDCL) with GDP+2% until 2025 and interpolating to match domestic and commercial consumers with the NES projection in 2030. There is no projection of industrial consumer demand for 2030 and is therefore projected following GDP+2%;
- After 2030 it continues to increase with growth equal to GDP+2%.

Depreciation and amortization

The depreciation expenses regarding CAPEX A (the existing distribution network) are introduced to the model and depreciated according to the values established in the financial statements. CAPEX B (corresponding to the electrification plan) has the depreciation periods. In both cases, the asset is replaced with its consequent investment at the end of its life period.

- Extension:
    - 100% CAPEX: 25 years
- Densification:
    - 100% CAPEX: 25 years
- Mini-grids:
    - 70% CAPEX: 25 years
    - 12% CAPEX: 15 years
    - 18% CAPEX: 10 years
- Standalone systems:
    - 100% CAPEX: five years

Operating Costs

- Upstream energy cost is equivalent to USD 0,084 /kWh per energy consumed/year for the full period. Provided by the regulator or the financial statements;
- The AO&M cost is estimated as a percentage of CAPEX incurred;
- Bad Debt provision is estimated as a percentage of tariff income (2%);
- The administrative expenses (customers/billing) are estimated as a specific value USD/year/client increased with inflation.

Model overview

In the remaining pages of this annex, we provide the financial statements of the companies that compose the proposed structure of the sector. The companies are:

- FinanceCo.
- The aggregated Off-grid SPV and private companies (mini-grids and standalone systems).
- Umeme first and then NewCo.

The following financial statements are attached for each of the companies:

- Profit and loss (P&L): The P&L statement refers to a financial statement that summarizes the revenues, costs, and expenses incurred during a specified period. These records provide information about a company's ability or inability to generate profit by increasing revenue, reducing costs, or both;
- Balance sheet: The balance sheet refers to a financial statement that reports a company's assets, liabilities, and shareholder equity at a specific point in time. Balance sheets provide the basis for computing rates of return for investors and evaluating a company's capital structure. In short, the balance sheet is a financial statement that provides a snapshot of what a company owns and owes, and the amount invested by shareholders;
- Cash flow statement: A cash flow statement is a financial statement that provides aggregate data regarding all cash inflows a company receives from its ongoing operations and external investment sources. It also includes all cash outflows that pay for business activities and investments during a given period;
- Financial projections: We provide the expected projections during 2021-2040 for the CAPEX, depreciation, equity, working capital, and debt repayment.

FINANCIAL STATEMENTS

FinanceCo

P&L

			FinanceCo			New Concession Agreement														
P&L			2023 E	2024 E	2025 E	2026 E	2027 E	2028 E	2029 E	2030 E	2031 E	2032 E	2033 E	2034 E	2035 E	2036 E	2037 E	2038 E	2039 E	2040 E
	Revenues	mUSD	88	99	107	142	186	251	337	424	375	467	574	728	869	1.000	1.185	1.396	1.635	1.908
	% Growth	%	0,0%	12,1%	8,7%	32,1%	31,1%	35,2%	34,4%	25,6%	(11,6)%	24,8%	22,9%	26,8%	19,4%	15,0%	18,5%	17,8%	17,2%	16,7%
	Revenues (exGrants)	mUSD	12	16	18	55	91	146	217	280	375	467	574	728	869	1.000	1.185	1.396	1.635	1.908
	% Growth	%	0,0%	39,9%	8,8%	208,8%	66,1%	60,5%	48,6%	29,2%	33,7%	24,8%	22,9%	26,8%	19,4%	15,0%	18,5%	17,8%	17,2%	16,7%
REVENUES	ROI Adjustment Payment	mUSD	12	16	18	55	91	146	217	280	375	467	574	728	869	1.000	1.185	1.396	1.635	1.908
	% Growth	%	0,0%	39,9%	8,8%	208,8%	66,1%	60,5%	48,6%	29,2%	33,7%	24,8%	22,9%	26,8%	19,4%	15,0%	18,5%	17,8%	17,2%	16,7%
	Other revenues	mUSD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	% Revenues	%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
	% Growth	%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
	Grants	mUSD	76,5	82,5	89,6	87,0	94,9	105,2	120,7	143,8	-	-	-	-	-	-	-	-	-	-
	% Revenues	%	86,8%	83,5%	83,5%	61,4%	51,1%	41,9%	35,8%	33,9%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
	% Growth	%	0,0%	7,8%	8,6%	(2,9)%	9,1%	10,9%	14,7%	19,2%	(100,0)%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
COST OF SALES	Provisions for bad debt	mUSD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	% Growth	%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
	% Revenues	%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
	Gross margin	mUSD	88	99	107	142	186	251	337	424	375	467	574	728	869	1.000	1.185	1.396	1.635	1.908
	Growth	%	0,0%	12,1%	8,7%	32,1%	31,1%	35,2%	34,4%	25,6%	(11,6)%	24,8%	22,9%	26,8%	19,4%	15,0%	18,5%	17,8%	17,2%	16,7%
	% Revenues	%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%
	Subsidies for the Off-grid SPV&PC	mUSD	(37)	(65)	(93)	(108,8)	(122,1)	(127,5)	(133,3)	(139,7)	(145,7)	(150,4)	(156,1)	(162,1)	(168,0)	(170,6)	(173,0)	(176,4)	(180,2)	(184,1)
	Growth	%	0,0%	77,3%	42,7%	16,9%	12,3%	4,4%	4,5%	4,8%	4,3%	3,3%	3,8%	3,8%	3,6%	1,6%	1,4%	2,0%	2,2%	2,2%
	% Revenues	%	(41,8)%	(66,1)%	(86,7)%	(76,8)%	(65,8)%	(50,8)%	(39,5)%	(33,0)%	(38,9)%	(32,2)%	(27,2)%	(22,3)%	(19,3)%	(17,1)%	(14,6)%	(12,6)%	(11,0)%	(9,6)%
	EBITDA	mUSD	51	34	14	33	64	124	204	284	229	317	418	566	702	830	1.012	1.219	1.455	1.724
	EBITDA (ex-Grants)	mUSD	(25)	(49)	(75)	(54)	(31)	18	83	140	229	317	418	566	702	830	1.012	1.219	1.455	1.724
	% Revenues	%	58,2%	33,9%	13,3%	23,2%	34,2%	49,2%	60,5%	67,0%	61,1%	67,8%	72,8%	77,7%	80,7%	82,9%	85,4%	87,4%	89,0%	90,4%
	% Revenues (exGrants)	%	(216,1)%	(300,6)%	(425,1)%	(98,7)%	(34,4)%	12,6%	38,5%	50,1%	61,1%	67,8%	72,8%	77,7%	80,7%	82,9%	85,4%	87,4%	89,0%	90,4%
	D&A	mUSD	(14)	(28)	(44)	(59)	(76)	(95)	(116)	(141)	(147)	(154)	(160)	(167)	(174)	(181)	(188)	(195)	(203)	(211)
	% Revenues	%	(15,3)%	(28,5)%	(40,9)%	(41,9)%	(41,0)%	(37,7)%	(34,4)%	(33,4)%	(39,4)%	(32,9)%	(27,9)%	(22,9)%	(20,0)%	(18,1)%	(15,9)%	(14,0)%	(12,4)%	(11,1)%
	EBIT	mUSD	38	5	(30)	(26)	(12)	29	88	143	82	163	258	400	528	649	824	1.024	1.252	1.513
	% Revenues	%	42,9%	5,5%	(27,7)%	(18,6)%	(6,7)%	11,5%	26,1%	33,7%	21,8%	35,0%	45,0%	54,9%	60,7%	64,9%	69,5%	73,4%	76,6%	79,3%
	Financial Income	mUSD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Financial Expense	mUSD	-	-	(4)	(12)	(20)	(28)	(37)	(47)	(51)	(50)	(48)	(45)	(41)	(35)	(27)	(19)	(11)	(4)
	EBT	mUSD	38	5	(34)	(38)	(32)	1	51	96	31	114	210	355	487	614	797	1.005	1.241	1.509
	EBT (ex-Subsidies, ex-Grants)	mUSD	(39)	(77)	(123)	(125)	(127)	(104)	(70)	(48)	31	114	210	355	487	614	797	1.005	1.241	1.509
	% Tax rate	%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
	Taxes	mUSD	-	-	-	-	-	-	-	-	-	-	-	-	(145)	(184)	(239)	(301)	(372)	(453)
	Cumulative tax losses	mUSD	(39)	(116)	(239)	(364)	(492)	(596)	(666)	(713)	(683)	(569)	(359)	(4)	-	-	-	-	-	-
	Net Income	mUSD	38	5	(34)	(38)	(32)	1	51	96	31	114	210	355	342	430	558	703	869	1.057
	% Revenues	%	42,9%	5,5%	(31,4)%	(27,1)%	(17,5)%	0,4%	15,1%	22,7%	8,2%	24,3%	36,6%	48,7%	39,3%	43,0%	47,1%	50,4%	53,1%	55,4%

Balance sheet and cash flow statement

BS		2023 E	2024 E	2025 E	2026 E	2027 E	2028 E	2029 E	2030 E	2031 E	2032 E	2033 E	2034 E	2035 E	2036 E	2037 E	2038 E	2039 E	2040 E
Non-current assets	mUSD	324,5	660,9	1.012,9	1.338,0	1.681,2	2.051,5	2.468,8	2.963,1	2.965,8	2.967,2	2.967,4	2.966,2	2.963,6	2.959,7	2.954,2	2.947,2	2.938,7	2.928,5
PP&E	mUSD																		
Intangibles	mUSD	324,5	660,9	1.012,9	1.338,0	1.681,2	2.051,5	2.468,8	2.963,1	2.965,8	2.967,2	2.967,4	2.966,2	2.963,6	2.959,7	2.954,2	2.947,2	2.938,7	2.928,5
Other fixed assets	mUSD																		
Current assets	mUSD	36,8	23,4	148,1	297,6	227,1	152,5	165,6	98,6	76,5	113,7	223,9	379,7	421,7	326,6	322,6	421,9	638,5	1.038,2
Cash and equivalents	mUSD	35,4	21,4	145,9	290,9	215,9	134,5	138,9	64,1	30,3	56,1	153,1	289,9	314,5	203,3	176,5	249,8	436,9	803,0
Other financial assets	mUSD																		
Trade receivables	mUSD	1,4	2,0	2,2	6,7	11,2	18,0	26,7	34,5	46,2	57,6	70,8	89,8	107,2	123,3	146,1	172,0	201,6	235,3
Inventories	mUSD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other current tax assets	mUSD																		
Total Assets	mUSD	361,3	684,3	1.161,0	1.635,6	1.908,3	2.204,0	2.634,5	3.061,7	3.042,3	3.080,9	3.191,3	3.345,9	3.385,4	3.286,3	3.276,8	3.369,1	3.577,2	3.966,8
Total Shareholders' Equity	mUSD	237,8	443,2	409,5	371,1	338,6	339,5	390,6	486,7	517,3	630,9	841,3	1.195,9	1.435,4	1.736,3	2.126,8	2.619,1	3.227,2	3.966,8
Share capital & treasury shares	mUSD	200,0	400,0	400,0	400,0	400,0	400,0	400,0	400,0	400,0	400,0	400,0	400,0	400,0	400,0	400,0	400,0	400,0	400,0
Share premium	mUSD																		
Retained earnings	mUSD	37,8	5,4	(33,7)	(38,4)	(32,5)	0,9	51,1	96,1	30,6	113,6	210,3	354,6	239,5	300,9	390,5	492,3	608,1	739,6
Reserves	mUSD	-	37,8	43,2	9,5	(28,9)	(61,4)	(60,5)	(9,4)	86,7	117,3	230,9	441,3	795,9	1.035,4	1.336,3	1.726,8	2.219,1	2.827,2
Long term liabilities	mUSD	123,5	241,1	751,5	1.264,5	1.569,7	1.864,5	2.243,8	2.575,0	2.525,0	2.450,0	2.350,0	2.150,0	1.950,0	1.550,0	1.150,0	750,0	350,0	-
Deferred tax liabilities	mUSD																		
Grants	mUSD	123,5	241,1	351,5	464,5	369,7	264,5	143,8	-	-	-	-	-	-	-	-	-	-	-
LT financial liabilities	mUSD	-	-	400,0	800,0	1.200,0	1.600,0	2.100,0	2.575,0	2.525,0	2.450,0	2.350,0	2.150,0	1.950,0	1.550,0	1.150,0	750,0	350,0	-
Short term liabilities	mUSD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trade payables	mUSD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other short term liabilities	mUSD																		
Other tax liabilities	mUSD																		
ST financial liabilities	mUSD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Provisions	mUSD																		
Total Liabilities	mUSD	361,3	684,3	1.161,0	1.635,6	1.908,3	2.204,0	2.634,5	3.061,7	3.042,3	3.080,9	3.191,3	3.345,9	3.385,4	3.286,3	3.276,8	3.369,1	3.577,2	3.966,8
Check		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Cash Flow		2023 E	2024 E	2025 E	2026 E	2027 E	2028 E	2029 E	2030 E	2031 E	2032 E	2033 E	2034 E	2035 E	2036 E	2037 E	2038 E	2039 E	2040 E
EBITDA (ex-Grants)	mUSD	(25,2)	(49,0)	(75,4)	(54,0)	(31,2)	18,4	83,5	140,4	229,0	317,1	418,4	566,3	701,5	829,7	1.011,9	1.219,1	1.455,2	1.724,1
- Taxes	mUSD	-	-	-	-	-	-	-	-	-	-	-	-	(144,9)	(184,2)	(239,1)	(301,4)	(372,3)	(452,8)
+/- Change in WC	mUSD	(1,4)	(0,6)	(0,2)	(4,6)	(4,5)	(6,8)	(8,7)	(7,8)	(11,7)	(11,4)	(13,2)	(19,0)	(17,4)	(16,1)	(22,8)	(26,0)	(29,6)	(33,6)
Operating Cash Flow	mUSD	(26,6)	(49,5)	(75,5)	(58,6)	(35,7)	11,6	74,7	132,6	217,4	305,6	405,2	547,3	539,3	629,3	750,1	891,7	1.053,3	1.237,7
Capex	mUSD	(338,0)	(364,5)	(396,0)	(384,4)	(419,3)	(465,0)	(533,3)	(635,7)	(150,1)	(155,1)	(160,2)	(165,5)	(171,0)	(176,6)	(182,4)	(188,5)	(194,7)	(201,1)
Investing Cash Flow	mUSD	(338,0)	(364,5)	(396,0)	(384,4)	(419,3)	(465,0)	(533,3)	(635,7)	(150,1)	(155,1)	(160,2)	(165,5)	(171,0)	(176,6)	(182,4)	(188,5)	(194,7)	(201,1)
Cash Flow from Assets	mUSD	(364,6)	(414,0)	(471,5)	(443,0)	(455,0)	(453,3)	(458,6)	(503,1)	67,2	150,5	245,0	381,8	368,3	452,7	567,6	703,3	858,6	1.036,6
Financial Income	mUSD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Financial Expense	mUSD	-	-	(4,0)	(12,0)	(20,0)	(28,0)	(37,0)	(46,8)	(51,0)	(49,8)	(48,0)	(45,0)	(41,0)	(35,0)	(27,0)	(19,0)	(11,0)	(3,5)
Debt repayment	mUSD	-	-	-	-	-	-	-	(25,0)	(50,0)	(75,0)	(100,0)	(200,0)	(200,0)	(400,0)	(400,0)	(400,0)	(400,0)	(350,0)
Debt increase	mUSD	-	-	400,0	400,0	400,0	400,0	500,0	500,0	-	-	-	-	-	-	-	-	-	-
Grants/Sub-debt financing	mUSD	200,0	200,0	200,0	200,0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dividends	mUSD	-	-	-	-	-	-	-	-	-	-	-	-	(102,6)	(129,0)	(167,4)	(211,0)	(260,6)	(317,0)
+/- Capital Increase/Reduction	mUSD	200,0	200,0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Financing Cash Flow	mUSD	400,0	400,0	596,0	588,0	380,0	372,0	463,0	428,3	(101,0)	(124,8)	(148,0)	(245,0)	(343,6)	(564,0)	(594,4)	(630,0)	(671,6)	(670,5)
Cash movement	mUSD	35,4	(14,0)	124,5	145,0	(75,0)	(81,3)	4,4	(74,9)	(33,8)	25,8	97,0	136,8	24,7	(111,2)	(26,8)	73,3	187,0	366,1
		-																	
Cash BoP	mUSD		35,4	21,4	145,9	290,9	215,9	134,5	138,9	64,1	30,3	56,1	153,1	289,9	314,5	203,3	176,5	249,8	436,9
Cash movement	mUSD	35,4	(14,0)	124,5	145,0	(75,0)	(81,3)	4,4	(74,9)	(33,8)	25,8	97,0	136,8	24,7	(111,2)	(26,8)	73,3	187,0	366,1
Cash EoP	mUSD	35,4	21,4	145,9	290,9	215,9	134,5	138,9	64,1	30,3	56,1	153,1	289,9	314,5	203,3	176,5	249,8	436,9	803,0

Financial projections

Projections		2023 E	2024 E	2025 E	2026 E	2027 E	2028 E	2029 E	2030 E	2031 E	2032 E	2033 E	2034 E	2035 E	2036 E	2037 E	2038 E	2039 E	2040 E
PP&E - Capex																			
Capex investments from Annual Accounts	mUSD																		
Impairments - acelerated D&A	mUSD																		
Capex investments from OECD	mUSD																		
Capex	mUSD	338	364	396	384	419	465	533	636	150	155	160	166	171	177	182	188	195	201
% Revenues	%	*383,6%*	*369,1%*	*369,0%*	*271,3%*	*225,7%*	*185,2%*	*158,1%*	*149,9%*	*40,1%*	*33,2%*	*27,9%*	*22,7%*	*19,7%*	*17,7%*	*15,4%*	*13,5%*	*11,9%*	*10,5%*
PP&E - BoP	mUSD	-	324,5	660,9	1.012,9	1.338,0	1.681,2	2.051,5	2.468,8	2.963	2.966	2.967	2.967	2.966	2.964	2.960	2.954	2.947	2.939
+ Capex	mUSD	338,0	364,5	396,0	384,4	419,3	465,0	533,3	635,7	150	155	160	166	171	177	182	188	195	201
- Divestiture	mUSD																		
- D&A	mUSD	(13,5)	(28,1)	(43,9)	(59,3)	(76,1)	(94,7)	(116,0)	(141,4)	(147)	(154)	(160)	(167)	(174)	(181)	(188)	(195)	(203)	(211)
PP&E - EoP		324,5	660,9	1.012,9	1.338,0	1.681,2	2.051,5	2.468,8	2.963,1	2.966	2.967	2.967	2.966	2.964	2.960	2.954	2.947	2.939	2.929
Working Capital Calculations																			
Working Capital																			
+ Trade receivables	mUSD	1	2	2	7	11	18	27	35	46	58	71	90	107	123	146	172	202	235
+ Inventories	mUSD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
- Trade payables	mUSD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Working Capital	mUSD	1	2	2	7	11	18	27	35	46	58	71	90	107	123	146	172	202	235
Variation	mUSD	***1***	***1***	***0***	***5***	***4***	***7***	***9***	***8***	***12***	***11***	***13***	***19***	***17***	***16***	***23***	***26***	***30***	***34***
Working Capital Days																			
Trade receivables - Days of revenues	Days	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45
Inventories - Days of COGS/Distrib costs	Days	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Trade payables - Days of COGS/Distrib costs	Days	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
Equity Schedule																			
Equity - BoP	mUSD	-	238	443	409	371	339	340	391	487	517	631	841	1.196	1.435	1.736	2.127	2.619	3.227
+/- Capital Increase/Reduction	mUSD	200	200		-	-	-	-	-	-	-	-	-	-	-				
+/- Change in Equity/Net income	mUSD	38	5	(34)	(38)	(32)	1	51	96	31	114	210	355	342	430	558	703	869	1.057
- Dividends (% Net Income)	mUSD	-	-	-	-	-	-	-	-	-	-	-	-	103	129	167	211	261	317
Equity - EoP	mUSD	238	443	409	371	339	340	391	487	517	631	841	1.196	1.435	1.736	2.127	2.619	3.227	3.967
Financial debt repayment																			
1. Calculation of Long Term financial debt																			
Grants - Subsidized Financing																			
BoP	mUSD	-	123,5	241,1	351,5	464,5	369,7	264,5	143,8	-	-	-	-	-	-	-	-	-	-
+ Increase	mUSD	200,0	200,0	200,0	200,0	-	-	-	-				-	-	-				
- Realisation (% capex)	%	9,6%	10,3%	11,2%	10,9%	11,9%	13,1%	15,1%	18,0%										
- Realisation	mUSD	(76,5)	(82,5)	(89,6)	(87,0)	(94,9)	(105,2)	(120,7)	(143,8)										
EoP	mUSD	123,5	241,1	351,5	464,5	369,7	264,5	143,8	-	-	-	-	-	-	-	-	-	-	-
Interest rate LT	0%																		
LT Financial expense	mUSD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Concessional Debt																			
BoP	mUSD	-	-	-	400,0	800,0	1.200,0	1.600,0	2.100,0	2.575,0	2.525,0	2.450,0	2.350,0	2.150,0	1.950,0	1.550,0	1.150,0	750,0	350,0
+ Increase	mUSD	-	-	400,0	400,0	400,0	400,0	500,0	500,0	-	-	-	-	-	-	-	-	-	-
- Repayment	mUSD	-	-	-	-	-	-	-	(25,0)	(50,0)	(75,0)	(100,0)	(200,0)	(200,0)	(400,0)	(400,0)	(400,0)	(400,0)	(350,0)
EoP	mUSD	-	-	400,0	800,0	1.200,0	1.600,0	2.100,0	2.575,0	2.525,0	2.450,0	2.350,0	2.150,0	1.950,0	1.550,0	1.150,0	750,0	350,0	-
Interest rate LT	2%																		
LT Financial expense	mUSD	-	-	4,0	12,0	20,0	28,0	37,0	46,8	51,0	49,8	48,0	45,0	41,0	35,0	27,0	19,0	11,0	3,5

The aggregated Off-grid SPV and private companies

P&L

	P&L				FinanceCo			New Concession Agreement														
			2021 E	2022 E	2023 E	2024 E	2025 E	2026 E	2027 E	2028 E	2029 E	2030 E	2031 E	2032 E	2033 E	2034 E	2035 E	2036 E	2037 E	2038 E	2039 E	2040 E
	Revenues	mUSD	5	11	44	80	116	140	162	176	190	204	216	224	233	242	252	259	265	274	282	292
	% Growth	%	0,0%	112,0%	288,1%	84,1%	45,0%	20,6%	15,4%	8,4%	8,0%	7,8%	5,7%	3,6%	4,0%	4,1%	4,0%	2,7%	2,6%	3,1%	3,2%	3,3%
	Revenues (exGrants)	mUSD	5	11	44	80	116	140	162	176	190	204	216	224	233	242	252	259	265	274	282	292
	% Growth	%	0,0%	112,0%	288,1%	84,1%	45,0%	20,6%	15,4%	8,4%	8,0%	7,8%	5,7%	3,6%	4,0%	4,1%	4,0%	2,7%	2,6%	3,1%	3,2%	3,3%
REVENUES	Tariff Income - Energy	mUSD	1	2	7	15	23	32	40	48	56	65	70	73	77	80	84	88	92	97	102	108
	% Growth	%	0,0%	50,1%	234,3%	120,6%	55,1%	35,3%	25,9%	20,7%	17,2%	14,8%	8,7%	4,3%	4,6%	4,7%	4,8%	4,9%	5,0%	5,1%	5,2%	5,3%
	Average residential Tariff	USD/kWh	0,208	0,208	0,208	0,208	0,208	0,208	0,208	0,208	0,208	0,208	0,208	0,208	0,208	0,208	0,208	0,208	0,208	0,208	0,208	0,208
	% Growth	%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
	nº Residential Customers	million	0,1	0,2	0,9	1,6	2,3	3,0	3,7	4,4	5,1	5,7	5,9	6,1	6,3	6,5	6,7	7,0	7,2	7,4	7,7	7,9
	% Growth	%	0,0%	99,6%	300,5%	75,1%	43,0%	28,9%	22,5%	18,4%	15,5%	13,5%	3,3%	3,3%	3,3%	3,3%	3,3%	3,3%	3,3%	3,3%	3,3%	3,3%
	Subsidies	mUSD	4	9	37	65	93	109	122	128	133	140	146	150	156	162	168	171	173	176	180	184
	% Growth	%	0,0%	133,4%	300,1%	77,3%	42,7%	16,9%	12,3%	4,4%	4,5%	4,8%	4,3%	3,3%	3,8%	3,8%	3,6%	1,6%	1,4%	2,0%	2,2%	2,2%
COST OF SALES	Upstream Cost of Energy	mUSD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	%Growth	%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
	% Revenues	%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
	Distribution costs (O&M)	mUSD	(1)	(3)	(10)	(23)	(36)	(48)	(58)	(68)	(79)	(91)	(99)	(103)	(108)	(114)	(120)	(126)	(133)	(139)	(147)	(155)
	% Growth	%	0,0%	198,9%	239,2%	123,5%	57,5%	32,2%	20,8%	17,9%	15,8%	14,3%	8,8%	4,6%	5,0%	5,4%	5,4%	5,1%	4,9%	5,1%	5,3%	5,3%
	% Revenues	%	19,2%	27,1%	23,7%	28,8%	31,2%	34,2%	35,8%	39,0%	41,8%	44,3%	45,6%	46,1%	46,5%	47,1%	47,7%	48,9%	49,9%	50,9%	52,0%	52,9%
	Provisions for bad debt	mUSD	(0)	(0)	(0)	(0)	(0)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	% Growth	%	0,0%	50,1%	234,3%	120,6%	55,1%	(100,0)%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
	% Revenues	%	(0,5)%	(0,4)%	(0,3)%	(0,4)%	(0,4)%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
	Gross margin	mUSD	4	8	33	57	80	92	104	107	110	114	117	121	124	128	132	132	133	134	136	137
	Growth	%	0,0%	91,6%	306,7%	71,6%	39,9%	16,0%	12,5%	3,1%	3,0%	3,1%	3,1%	2,8%	3,2%	3,0%	2,8%	0,4%	0,5%	1,0%	1,1%	1,2%
	% Revenues	%	80,3%	72,5%	76,0%	70,9%	68,4%	65,8%	64,2%	61,0%	58,2%	55,7%	54,4%	53,9%	53,5%	52,9%	52,3%	51,1%	50,1%	49,1%	48,0%	47,1%
ADM COSTS	Administrative Expenses (Customers/Billing)	mUSD	(0)	(0)	(0)	(1)	(1)	(1,5)	(1,7)	(1,9)	(2,2)	(2,4)	(2,7)	(2,8)	(3,0)	(3,1)	(3,3)	(3,5)	(3,7)	(3,9)	(4,1)	(4,3)
	Growth	%	0,0%	197,9%	245,3%	127,1%	60,5%	28,6%	14,3%	13,3%	12,6%	12,2%	8,7%	5,6%	5,6%	5,6%	5,6%	5,6%	5,6%	5,6%	5,6%	5,6%
	% Revenues	%	(0,6)%	(0,8)%	(0,7)%	(0,9)%	(1,0)%	(1,1)%	(1,1)%	(1,1)%	(1,2)%	(1,2)%	(1,2)%	(1,3)%	(1,3)%	(1,3)%	(1,3)%	(1,3)%	(1,4)%	(1,4)%	(1,5)%	(1,5)%
	EBITDA	mUSD	4	8	33	56	78	91	102	105	108	111	115	118	121	125	128	129	129	130	132	133
	EBITDA (ex-Grants)	mUSD	4	8	33	56	78	91	102	105	108	111	115	118	121	125	128	129	129	130	132	133
	% Revenues	%	79,7%	71,7%	75,3%	70,0%	67,4%	64,7%	63,1%	59,9%	57,0%	54,5%	53,1%	52,7%	52,2%	51,6%	51,0%	49,8%	48,7%	47,6%	46,6%	45,6%
	% Revenues (exGrants)	%	79,7%	71,7%	75,3%	70,0%	67,4%	64,7%	63,1%	59,9%	57,0%	54,5%	53,1%	52,7%	52,2%	51,6%	51,0%	49,8%	48,7%	47,6%	46,6%	45,6%
	D&A	mUSD	(2)	(4)	(18)	(31)	(45)	(55)	(64)	(66)	(67)	(69)	(72)	(75)	(78)	(81)	(85)	(85)	(86)	(87)	(88)	(89)
	% Revenues	%	(42,1)%	(39,4)%	(40,8)%	(38,9)%	(38,5)%	(38,9)%	(39,8)%	(37,5)%	(35,6)%	(33,8)%	(33,5)%	(33,7)%	(33,7)%	(33,6)%	(33,6)%	(33,0)%	(32,5)%	(31,8)%	(31,1)%	(30,3)%
	EBIT	mUSD	2	4	15	25	34	36	38	39	41	42	42	42	43	44	44	43	43	43	44	44
	% Revenues	%	37,6%	32,4%	34,5%	31,1%	28,9%	25,8%	23,3%	22,4%	21,5%	20,7%	19,7%	18,9%	18,5%	18,0%	17,4%	16,8%	16,2%	15,9%	15,5%	15,2%
	Financial Income	mUSD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Financial Expense	mUSD	(2)	(6)	(9)	(12)	(15)	(16)	(15)	(14)	(13)	(12)	(12)	(11)	(11)	(12)	(11)	(10)	(8)	(8)	(8)	(8)
	EBT	mUSD	(0)	(2)	6	13	19	21	23	25	28	30	31	32	32	32	33	34	35	36	35	36
	EBT (ex-Subsidies, ex-Grants)	mUSD	(4)	(11)	(31)	(52)	(74)	(88)	(99)	(102)	(106)	(110)	(115)	(119)	(124)	(130)	(135)	(137)	(138)	(141)	(145)	(148)
	% Tax rate	%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
	Taxes	mUSD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Cumulative tax losses	mUSD	(4)	(15)	(46)	(98)	(172)	(260)	(360)	(462)	(568)	(678)	(792)	(911)	(1.035)	(1.165)	(1.301)	(1.437)	(1.575)	(1.716)	(1.861)	(2.009)
	Net Income	mUSD	(0)	(2)	6	13	19	21	23	25	28	30	31	32	32	32	33	34	35	36	35	36
	% Revenues	%	(0,1)%	(19,3)%	13,8%	16,4%	16,3%	14,7%	14,2%	14,4%	14,5%	14,6%	14,3%	14,1%	13,9%	13,2%	12,9%	13,1%	13,2%	13,1%	12,6%	12,3%

Balance sheet and cash flow statement

BS		2021 E	2022 E	2023 E	2024 E	2025 E	2026 E	2027 E	2028 E	2029 E	2030 E	2031 E	2032 E	2033 E	2034 E	2035 E	2036 E	2037 E	2038 E	2039 E	2040 E
Non-current assets	mUSD	16,6	30,3	125,3	207,9	280,1	302,0	314,8	327,3	339,2	351,7	353,6	352,8	358,8	362,8	365,0	361,6	358,4	361,7	365,5	370,3
PP&E	mUSD																				
Intangibles	mUSD	16,6	30,3	125,3	207,9	280,1	302,0	314,8	327,3	339,2	351,7	353,6	352,8	358,8	362,8	365,0	361,6	358,4	361,7	365,5	370,3
Other fixed assets	mUSD																				
Current assets	mUSD	33,6	163,0	108,7	73,1	52,4	37,9	33,9	32,1	32,6	34,3	39,2	46,5	67,4	90,3	82,2	66,6	50,9	58,6	66,0	52,6
Cash and equivalents	mUSD	33,3	162,5	107,0	69,4	46,5	30,0	24,2	20,6	19,2	18,9	22,4	29,0	49,0	71,1	62,0	45,3	28,6	35,2	41,4	26,6
Other financial assets	mUSD																				
Trade receivables	mUSD	0,2	0,3	0,8	1,9	2,9	3,9	4,9	5,9	6,9	8,0	8,7	9,0	9,4	9,9	10,4	10,9	11,4	12,0	12,6	13,3
Inventories	mUSD	0,1	0,3	0,8	1,9	3,0	3,9	4,8	5,6	6,5	7,4	8,1	8,5	8,9	9,4	9,9	10,4	10,9	11,5	12,1	12,7
Other current tax assets	mUSD																				
Total Assets	mUSD	50,2	193,3	234,1	281,0	332,5	339,8	348,7	359,4	371,8	386,0	392,7	399,2	426,2	453,2	447,2	428,2	409,2	420,3	431,6	422,8
Total Shareholders' Equity	mUSD	(0,0)	97,8	102,4	112,2	126,5	142,0	159,2	178,1	198,8	221,1	236,5	252,3	268,4	284,4	297,4	297,4	297,4	297,4	297,4	297,4
Share capital & treasury shares	mUSD	-	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0
Share premium	mUSD																				
Retained earnings	mUSD	(0,0)	(2,2)	4,5	9,9	14,3	15,5	17,2	19,0	20,6	22,4	15,4	15,8	16,1	16,0	13,0	-	-	-	-	-
Reserves	mUSD	-	(0,0)	(2,2)	2,4	12,2	26,5	42,0	59,2	78,1	98,8	121,1	136,5	152,3	168,4	184,4	197,4	197,4	197,4	197,4	197,4
Long term liabilities	mUSD	50,0	95,0	130,0	165,0	200,0	190,0	180,0	170,0	160,0	150,0	140,0	130,0	140,0	150,0	130,0	110,0	90,0	100,0	110,0	100,0
Deferred tax liabilities	mUSD																				
Grants	mUSD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LT financial liabilities	mUSD	50,0	95,0	130,0	165,0	200,0	190,0	180,0	170,0	160,0	150,0	140,0	130,0	140,0	150,0	130,0	110,0	90,0	100,0	110,0	100,0
Short term liabilities	mUSD	0,2	0,5	1,7	3,8	6,0	7,9	9,5	11,2	13,0	14,9	16,2	16,9	17,8	18,8	19,8	20,8	21,8	22,9	24,1	25,4
Trade payables	mUSD	0,2	0,5	1,7	3,8	6,0	7,9	9,5	11,2	13,0	14,9	16,2	16,9	17,8	18,8	19,8	20,8	21,8	22,9	24,1	25,4
Other short term liabilities	mUSD																				
Other tax liabilities	mUSD																				
ST financial liabilities	mUSD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Provisions	mUSD																				
Total Liabilities	mUSD	50,2	193,3	234,1	281,0	332,5	339,8	348,7	359,4	371,8	386,0	392,7	399,2	426,2	453,2	447,2	428,2	409,2	420,3	431,6	422,8
Check		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Cash Flow		2021 E	2022 E	2023 E	2024 E	2025 E	2026 E	2027 E	2028 E	2029 E	2030 E	2031 E	2032 E	2033 E	2034 E	2035 E	2036 E	2037 E	2038 E	2039 E	2040 E
EBITDA (ex-Grants)	mUSD	4,2	8,1	32,8	56,2	78,4	90,8	102,2	105,2	108,2	111,3	114,7	117,8	121,5	125,0	128,4	128,8	129,2	130,3	131,6	133,0
- Taxes	mUSD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
+/- Change in WC	mUSD	(0,1)	0,1	0,0	0,0	0,1	(0,1)	(0,2)	(0,2)	(0,1)	(0,1)	(0,0)	(0,0)	0,0	0,0	0,0	0,0	(0,0)	(0,0)	(0,0)	(0,0)
Operating Cash Flow	mUSD	4,1	8,1	32,8	56,2	78,5	90,8	102,0	105,0	108,0	111,2	114,7	117,8	121,5	125,0	128,4	128,8	129,1	130,3	131,6	132,9
Capex	mUSD	(18,8)	(18,1)	(112,8)	(113,8)	(117,0)	(76,5)	(77,3)	(78,3)	(79,4)	(81,7)	(74,1)	(74,7)	(84,5)	(85,4)	(86,8)	(82,0)	(82,9)	(90,3)	(91,5)	(93,2)
Investing Cash Flow	mUSD	(18,8)	(18,1)	(112,8)	(113,8)	(117,0)	(76,5)	(77,3)	(78,3)	(79,4)	(81,7)	(74,1)	(74,7)	(84,5)	(85,4)	(86,8)	(82,0)	(82,9)	(90,3)	(91,5)	(93,2)
Cash Flow from Assets	mUSD	(14,7)	(10,0)	(80,0)	(57,6)	(38,5)	14,3	24,7	26,7	28,6	29,6	40,5	43,1	37,0	39,6	41,6	46,8	46,3	40,0	40,0	39,7
Financial Income	mUSD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Financial Expense	mUSD	(2,0)	(5,8)	(9,0)	(11,8)	(14,6)	(15,6)	(14,8)	(14,0)	(13,2)	(12,4)	(11,6)	(10,8)	(10,8)	(11,6)	(11,2)	(9,6)	(8,0)	(7,6)	(8,4)	(8,4)
Debt repayment	mUSD	-	(5,0)	(5,0)	(5,0)	(5,0)	(10,0)	(10,0)	(10,0)	(10,0)	(10,0)	(10,0)	(10,0)	(10,0)	(10,0)	(20,0)	(20,0)	(20,0)	(10,0)	(10,0)	(10,0)
Debt increase	mUSD	50,0	50,0	40,0	40,0	40,0	-	-	-	-	-	-	-	20,0	20,0	-	-	-	20,0	20,0	-
Grants/Sub-debt financing	mUSD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dividends	mUSD	-	-	(1,5)	(3,3)	(4,8)	(5,2)	(5,7)	(6,3)	(6,9)	(7,5)	(15,4)	(15,8)	(16,1)	(16,0)	(19,6)	(33,8)	(35,0)	(35,8)	(35,5)	(36,0)
+/- Capital Increase/Reduction	mUSD	-	100,0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Financing Cash Flow	mUSD	48,0	139,2	24,5	19,9	15,6	(30,8)	(30,5)	(30,3)	(30,1)	(29,9)	(37,0)	(36,6)	(16,9)	(17,6)	(50,8)	(63,4)	(63,0)	(33,4)	(33,9)	(54,4)
Cash movement	mUSD	33,3	129,2	(55,5)	(37,7)	(22,8)	(16,5)	(5,8)	(3,6)	(1,4)	(0,3)	3,5	6,5	20,1	22,0	(9,1)	(16,6)	(16,7)	6,6	6,2	(14,8)
Cash BoP	mUSD	-	33,3	162,5	107,0	69,4	46,5	30,0	24,2	20,6	19,2	18,9	22,4	29,0	49,0	71,1	62,0	45,3	28,6	35,2	41,4
Cash movement	mUSD	33,3	129,2	(55,5)	(37,7)	(22,8)	(16,5)	(5,8)	(3,6)	(1,4)	(0,3)	3,5	6,5	20,1	22,0	(9,1)	(16,6)	(16,7)	6,6	6,2	(14,8)
Cash EoP	mUSD	33,3	162,5	107,0	69,4	46,5	30,0	24,2	20,6	19,2	18,9	22,4	29,0	49,0	71,1	62,0	45,3	28,6	35,2	41,4	26,6

Financial projections

Projections		2021 E	2022 E	2023 E	2024 E	2025 E	2026 E	2027 E	2028 E	2029 E	2030 E	2031 E	2032 E	2033 E	2034 E	2035 E	2036 E	2037 E	2038 E	2039 E	2040 E
PP&E - Capex																					
Capex investments from Annual Accounts	mUSD																				
Impairments - acelerated D&A	mUSD																				
Capex investments from OECD	mUSD																				
Capex	mUSD	19	18	113	114	117	76	77	78	79	82	74	75	84	85	87	82	83	90	92	93
% Revenues	%	*355,4%*	*161,3%*	*258,6%*	*141,8%*	*100,5%*	*54,5%*	*47,7%*	*44,6%*	*41,9%*	*40,0%*	*34,3%*	*33,4%*	*36,3%*	*35,3%*	*34,4%*	*31,7%*	*31,2%*	*33,0%*	*32,4%*	*32,0%*
PP&E - BoP	mUSD	-	16,6	30,3	125,3	207,9	280,1	302,0	314,8	327,3	339,2	352	354	353	359	363	365	362	358	362	366
+ Capex	mUSD	18,8	18,1	112,8	113,8	117,0	76,5	77,3	78,3	79,4	81,7	74	75	84	85	87	82	83	90	92	93
- Divestiture	mUSD																				
- D&A	mUSD	(2,2)	(4,4)	(17,8)	(31,2)	(44,8)	(54,6)	(64,4)	(65,9)	(67,5)	(69,1)	(72)	(75)	(78)	(81)	(85)	(85)	(86)	(87)	(88)	(89)
PP&E - EoP		16,6	30,3	125,3	207,9	280,1	302,0	314,8	327,3	339,2	351,7	354	353	359	363	365	362	358	362	366	370
Working Capital Calculations																					
<u>Working Capital</u>																					
+ Trade receivables	mUSD	0	0	1	2	3	4	5	6	7	8	9	9	9	10	10	11	11	12	13	13
+ Inventories	mUSD	0	0	1	2	3	4	5	6	7	7	8	8	9	9	10	10	11	11	12	13
- Trade payables	mUSD	(0)	(1)	(2)	(4)	(6)	(8)	(10)	(11)	(13)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)
Working Capital	mUSD	0	0	(0)	(0)	(0)	(0)	0	0	0	1	1	1	1	1	0	0	1	1	1	1
Variation	mUSD	***0***	***(0)***	***(0)***	***(0)***	***(0)***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***(0)***	***(0)***	***(0)***	***(0)***	***0***	***0***	***0***	***0***
<u>Working Capital Days</u>																					
Trade receivables - Days of revenues	Days	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45
Inventories - Days of COGS/Distrib costs	Days	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Trade payables - Days of COGS/Distrib costs	Days	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
Equity Schedule																					
Equity - BoP	mUSD	-	(0)	98	102	112	126	142	159	178	199	221	237	252	268	284	297	297	297	297	297
+/- Capital Increase/Reduction	mUSD	-	100	-			-	-	-	-	-	-	-	-	-	-	-				
+/- Change in Equity/Net income	mUSD	(0)	(2)	6	13	19	21	23	25	28	30	31	32	32	32	33	34	35	36	35	36
- Dividends (% Net Income)	mUSD	-	-	2	3	5	5	6	6	7	7	15	16	16	16	20	34	35	36	35	36
Equity - EoP	mUSD	(0)	98	102	112	126	142	159	178	199	221	237	252	268	284	297	297	297	297	297	297
Financial debt repayment																					
<u>1. Calculation of Long Term financial debt</u>																					
<u>NEW - Commercial/Corporate Debt (IFC/Synd)</u>																					
BoP	mUSD	-	50,0	95,0	130,0	165,0	200,0	190,0	180,0	170,0	160,0	150,0	140,0	130,0	140,0	150,0	130,0	110,0	90,0	100,0	110,0
+ Increase	mUSD	50,0	50,0	40,0	40,0	40,0	-	-	-	-	-			20,0	20,0	-	-	-	20,0	20,0	-
- Repayment	mUSD		(5,0)	(5,0)	(5,0)	(5,0)	(10,0)	(10,0)	(10,0)	(10,0)	(10,0)	(10,0)	(10,0)	(10,0)	(10,0)	(20,0)	(20,0)	(20,0)	(10,0)	(10,0)	(10,0)
EoP	mUSD	50,0	95,0	130,0	165,0	200,0	190,0	180,0	170,0	160,0	150,0	140,0	130,0	140,0	150,0	130,0	110,0	90,0	100,0	110,0	100,0
Interest rate LT	8%																				
LT Financial expense	mUSD	2,0	5,8	9,0	11,8	14,6	15,6	14,8	14,0	13,2	12,4	11,6	10,8	10,8	11,6	11,2	9,6	8,0	7,6	8,4	8,4

Umeme - NewCo

P&L

	P&L		Historical Data					FinanceCo		
			2018 H	2019 H	2020 H	2021 E	2022 E	2023 E	2024 E	2025 E
	Revenues	mUSD	400	479	446	444	457	508	584	665
	% Growth	%	0,0%	19,7%	(6,9)%	-0,5%	3,1%	11,2%	14,9%	13,9%
	Revenues (exGrants)	mUSD	400	479	446	444	457	508	584	665
	% Growth	%	0,0%	19,7%	(6,9)%	-0,5%	3,1%	11,2%	14,9%	13,9%
REVENUES	Tariff Income - Energy	mUSD	400	479	446	444	457	508	584	665
	% Growth	%	0,0%	19,7%	(6,9)%	-0,5%	3,1%	11,2%	14,9%	13,9%
	Average residential Tariff	USD/kWh				0,208	0,208	0,208	0,208	0,208
	% Growth	%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
	nº Residential Customers	million			-	1,4	1,4	1,9	2,4	2,8
	% Growth	%	0,0%	0,0%	0,0%	0,0%	0,0%	30,8%	24,8%	21,0%
COST OF SALES	Upstream Cost of Energy	mUSD	(244)	(319)	(317)	(296)	(284)	(311)	(351)	(395)
	%Growth	%	0,0%	30,5%	(0,5)%	(6,6)%	(4,3)%	9,5%	13,1%	12,5%
	% Revenues	%	(61,1)%	(66,6)%	(71,2)%	66,8%	62,0%	61,1%	60,2%	59,4%
	Distribution costs (O&M)	mUSD	(12)	(8)	(12)	(12)	(12)	(18)	(33)	(50)
	% Growth	%	0,0%	(31,9)%	47,4%	(2,3)%	(2,4)%	57,7%	76,1%	54,9%
	% Revenues	%	0,0%	(0,1)%	0,1%	2,7%	2,6%	3,6%	5,6%	7,6%
	ROI Adjustment Payment	mUSD	-	-	-	-	-	(12)	(16)	(18)
	% Growth	%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	39,9%	8,8%
	% Revenues	%	0,0%	0,0%	0,0%	0,0%	0,0%	2,3%	2,8%	2,7%
	Provisions for bad debt	mUSD	-	-	-	(2)	(2)	(3)	(3)	(3)
	% Growth	%	0,0%	0,0%	0,0%	0,0%	3,1%	11,2%	14,9%	13,9%
	% Revenues	%	0,0%	0,0%	0,0%	0,5%	0,5%	0,5%	0,5%	0,5%
	Gross margin	mUSD	143	152	116	133	160	165	181	198
	Growth	%	0,0%	5,8%	(23,4)%	14,2%	20,1%	3,4%	9,6%	9,7%
	% Revenues	%	35,9%	31,7%	26,1%	29,9%	34,9%	32,4%	30,9%	29,8%
ADM COSTS	Administrative Expenses (Customers/Billing)	mUSD	(46)	(49)	(48)	(48)	(49)	(57)	(74)	(92)
	Growth	%	0,0%	6,3%	(2,1)%	0,0%	1,2%	17,5%	29,1%	24,7%
	% Revenues	%	(11,6)%	(10,3)%	(10,8)%	(10,9)%	(10,7)%	(11,3)%	(12,7)%	(13,9)%
	EBITDA	mUSD	97	103	68,0	85	111	107	107	106
	EBITDA (ex-Grants)	mUSD	97	103	68	85	111	107	107	106
	% Revenues	%	24,3%	21,4%	15,3%	19,1%	24,2%	21,1%	18,2%	15,9%
	% Revenues (exGrants)	%	24,3%	21,4%	15,3%	19,1%	24,2%	21,1%	18,2%	15,9%
	D&A	mUSD	(28)	(33)	(38)	(40)	(40)	(40)	(40)	(40)
	% Revenues	%	(7,0)%	(6,9)%	(8,5)%	(8,9)%	(8,6)%	(7,8)%	(6,8)%	(5,9)%
	EBIT	mUSD	69	69	30	45	71	68	67	66
	% Revenues	%	17,3%	14,5%	6,7%	10,1%	15,6%	13,4%	11,5%	10,0%
	Financial Income	mUSD	4,6	4,8	5,1	-	-	-	-	-
	Financial Expense	mUSD	(18)	(16)	(13)	(7)	(6)	(4)	(3)	(1)
	EBT	mUSD	56	58	22	38	66	64	64	65
	EBT (ex-Subsidies, ex-Grants)	mUSD	56	58	22	38	66	64	64	65
	% Tax rate	%	30%	30%	30%	30%	30%	30%	30%	30%
	Taxes	mUSD	(17)	(17)	(7)	(11)	(20)	(19)	(19)	(20)
	Cumulative tax losses	mUSD	-	-	-	-	-	-	-	-
	Net Income	mUSD	39	41	15	27	46	45	45	46
	% Revenues	%	9,8%	8,5%	3,5%	6,0%	10,0%	8,8%	7,7%	6,9%

P&L	New Concession Agreement														
	2026 E	2027 E	2028 E	2029 E	2030 E	2031 E	2032 E	2033 E	2034 E	2035 E	2036 E	2037 E	2038 E	2039 E	2040 E
Revenues	781	949	1.149	1.389	1.678	1.952	2.199	2.476	2.788	3.139	3.534	3.977	4.476	5.037	5.667
% Growth	17,6%	21,4%	21,1%	20,9%	20,8%	16,4%	12,6%	12,6%	12,6%	12,6%	12,6%	12,6%	12,5%	12,5%	12,5%
Revenues (exGrants)	781	949	1.149	1.389	1.678	1.952	2.199	2.476	2.788	3.139	3.534	3.977	4.476	5.037	5.667
% Growth	17,6%	21,4%	21,1%	20,9%	20,8%	16,4%	12,6%	12,6%	12,6%	12,6%	12,6%	12,6%	12,5%	12,5%	12,5%
Tariff Income - Energy	781	949	1.149	1.389	1.678	1.952	2.199	2.476	2.788	3.139	3.534	3.977	4.476	5.037	5.667
% Growth	17,6%	21,4%	21,1%	20,9%	20,8%	16,4%	12,6%	12,6%	12,6%	12,6%	12,6%	12,6%	12,5%	12,5%	12,5%
Average residential Tariff	0,208	0,208	0,208	0,208	0,208	0,208	0,208	0,208	0,208	0,208	0,208	0,208	0,208	0,208	0,208
% Growth	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
nº Residential Customers	3,6	4,1	4,7	5,4	6,2	6,4	6,6	6,8	7,0	7,2	7,5	7,7	8,0	8,2	8,5
% Growth	26,2%	15,4%	14,4%	14,0%	14,0%	3,3%	3,3%	3,3%	3,3%	3,3%	3,3%	3,3%	3,3%	3,3%	3,3%
Upstream Cost of Energy	(456)	(538)	(633)	(746)	(880)	(1.012)	(1.137)	(1.278)	(1.436)	(1.614)	(1.814)	(2.039)	(2.292)	(2.576)	(2.895)
%Growth	15,3%	18,0%	17,7%	17,8%	18,0%	15,0%	12,4%	12,4%	12,4%	12,4%	12,4%	12,4%	12,4%	12,4%	12,4%
% Revenues	58,3%	56,7%	55,1%	53,7%	52,4%	51,8%	51,7%	51,6%	51,5%	51,4%	51,3%	51,3%	51,2%	51,1%	51,1%
Distribution costs (O&M)	(70)	(87)	(107)	(129)	(155)	(173)	(181)	(189)	(198)	(206)	(215)	(224)	(234)	(243)	(253)
% Growth	38,0%	25,8%	22,5%	20,6%	20,0%	11,6%	4,7%	4,6%	4,5%	4,4%	4,3%	4,2%	4,1%	4,1%	4,0%
% Revenues	8,9%	9,2%	9,3%	9,3%	9,2%	8,9%	8,2%	7,6%	7,1%	6,6%	6,1%	5,6%	5,2%	4,8%	4,5%
ROI Adjustment Payment	(55)	(91)	(146)	(217)	(280)	(375)	(467)	(574)	(728)	(869)	(1.000)	(1.185)	(1.396)	(1.635)	(1.908)
% Growth	208,8%	66,1%	60,5%	48,6%	29,2%	33,7%	24,8%	22,9%	26,8%	19,4%	15,0%	18,5%	17,8%	17,2%	16,7%
% Revenues	7,0%	9,6%	12,7%	15,6%	16,7%	19,2%	21,3%	23,2%	26,1%	27,7%	28,3%	29,8%	31,2%	32,5%	33,7%
Provisions for bad debt	(4)	(5)	(6)	(7)	(8)	(10)	(11)	(12)	(14)	(16)	(18)	(20)	(22)	(25)	(28)
% Growth	17,6%	21,4%	21,1%	20,9%	20,8%	16,4%	12,6%	12,6%	12,6%	12,6%	12,6%	12,6%	12,5%	12,5%	12,5%
% Revenues	0,5%	0,5%	0,5%	0,5%	0,5%	0,5%	0,5%	0,5%	0,5%	0,5%	0,5%	0,5%	0,5%	0,5%	0,5%
Gross margin	198	228	257	290	354	383	402	422	412	433	486	509	533	557	583
Growth	(0,3)%	15,2%	12,7%	12,9%	22,3%	8,1%	5,1%	5,0%	(2,4)%	5,2%	12,2%	4,7%	4,7%	4,6%	4,6%
% Revenues	25,3%	24,0%	22,3%	20,9%	21,1%	19,6%	18,3%	17,0%	14,8%	13,8%	13,8%	12,8%	11,9%	11,1%	10,3%
Administrative Expenses (Customers/Billing)	(116)	(142)	(167)	(194)	(225)	(248)	(260)	(272)	(254)	(268)	(313)	(329)	(345)	(361)	(379)
Growth	25,9%	22,2%	17,0%	16,4%	16,2%	10,1%	4,8%	4,8%	(6,5)%	5,4%	16,9%	4,9%	4,9%	4,9%	4,9%
% Revenues	(14,9)%	(15,0)%	(14,5)%	(14,0)%	(13,4)%	(12,7)%	(11,8)%	(11,0)%	(9,1)%	(8,5)%	(8,9)%	(8,3)%	(7,7)%	(7,2)%	(6,7)%
EBITDA	81	85	90	96	129	135	142	150	158	165	173	180	188	196	204
EBITDA (ex-Grants)	81	85	90	96	129	135	142	150	158	165	173	180	188	196	204
% Revenues	10,4%	9,0%	7,8%	6,9%	7,7%	6,9%	6,5%	6,1%	5,6%	5,3%	4,9%	4,5%	4,2%	3,9%	3,6%
% Revenues (exGrants)	10,4%	9,0%	7,8%	6,9%	7,7%	6,9%	6,5%	6,1%	5,6%	5,3%	4,9%	4,5%	4,2%	3,9%	3,6%
D&A	(41)	(43)	(45)	(48)	(50)	(53)	(55)	(57)	(60)	(62)	(65)	(67)	(70)	(73)	(76)
% Revenues	(5,3)%	(4,5)%	(3,9)%	(3,4)%	(3,0)%	(2,7)%	(2,5)%	(2,3)%	(2,1)%	(2,0)%	(1,8)%	(1,7)%	(1,6)%	(1,5)%	(1,3)%
EBIT	40	42	45	48	79	82	88	93	98	103	108	113	118	123	128
% Revenues	5,1%	4,5%	3,9%	3,5%	4,7%	4,2%	4,0%	3,7%	3,5%	3,3%	3,1%	2,8%	2,6%	2,4%	2,3%
Financial Income	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Financial Expense	(4)	(8)	(7)	(6)	(5)	(4)	(6)	(9)	(12)	(15)	(18)	(21)	(24)	(26)	(28)
EBT	36	35	38	42	73	78	82	84	86	88	90	92	94	97	99
EBT (ex-Subsidies, ex-Grants)	36	35	38	42	73	78	82	84	86	88	90	92	94	97	99
% Tax rate	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
Taxes	(11)	(10)	(11)	(13)	(22)	(23)	(25)	(25)	(26)	(26)	(27)	(28)	(28)	(29)	(30)
Cumulative tax losses	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Net Income	25	24	27	30	51	54	57	59	60	61	63	64	66	68	69
% Revenues	3,2%	2,6%	2,3%	2,1%	3,1%	2,8%	2,6%	2,4%	2,2%	2,0%	1,8%	1,6%	1,5%	1,3%	1,2%

Balance sheet and cash flow statement

BS		2018 H	2019 H	2020 H	2021 E	2022 E	2023 E	2024 E	2025 E	2026 E	2027 E	2028 E
Non-current assets	mUSD	308,3	303,4	340,3	340,2	340,2	340,1	340,0	340,0	380,9	423,9	469,8
PP&E	mUSD											
Intangibles	mUSD	308,3	303,4	340,3	340,2	340,2	340,1	340,0	340,0	380,9	423,9	469,8
Other fixed assets	mUSD											
Current assets	mUSD	140,1	219,9	180,0	171,9	174,7	184,7	198,3	207,0	354,4	330,0	306,4
Cash and equivalents	mUSD	69,7	133,9	97,9	110,1	112,9	115,9	118,7	115,8	247,0	200,7	151,1
Other financial assets	mUSD											
Trade receivables	mUSD	49,3	59,1	55,0	36,5	37,6	41,8	48,0	54,6	64,2	78,0	94,4
Inventories	mUSD	21,1	26,9	27,1	25,4	24,3	27,1	31,6	36,6	43,2	51,4	60,8
Other current tax assets	mUSD											
Total Assets	mUSD	448,4	523,2	520,3	512,1	514,9	524,8	538,3	547,0	735,3	753,9	776,2
Total Shareholders' Equity	mUSD	313,7	354,4	369,8	383,1	406,1	428,4	450,9	473,8	549,0	561,1	574,5
Share capital & treasury shares	mUSD	-	-	-	-	-	-	-	-	50,0	50,0	50,0
Share premium	mUSD											
Retained earnings	mUSD	39,3	40,8	15,4	13,3	22,9	22,3	22,5	22,8	25,2	12,2	13,4
Reserves	mUSD	274,3	313,7	354,4	369,8	383,1	406,1	428,4	450,9	473,8	499,0	511,1
Long term liabilities	mUSD	92,5	115,1	96,3	78,3	60,3	42,3	24,3	-	100,0	90,0	80,0
Deferred tax liabilities	mUSD											
Grants	mUSD	-	-	-	-	-	-	-	-	-	-	-
LT financial liabilities	mUSD	92,5	115,1	96,3	78,3	60,3	42,3	24,3	-	100,0	90,0	80,0
Short term liabilities	mUSD	42,2	53,8	54,2	50,7	48,6	54,1	63,1	73,2	86,3	102,8	121,7
Trade payables	mUSD	42,2	53,8	54,2	50,7	48,6	54,1	63,1	73,2	86,3	102,8	121,7
Other short term liabilities	mUSD											
Other tax liabilities	mUSD											
ST financial liabilities	mUSD	-	-	-	-	-	-	-	-	-	-	-
Provisions	mUSD											
Total Liabilities	mUSD	448,4	523,2	520,3	512,1	514,9	524,8	538,3	547,0	735,3	753,9	776,2
Check		-	-	-	-	-	-	-	-	-	-	-

BS		2029 E	2030 E	2031 E	2032 E	2033 E	2034 E	2035 E	2036 E	2037 E	2038 E	2039 E	2040 E
Non-current assets	mUSD	521,0	580,8	622,8	664,6	705,8	746,6	786,9	826,6	865,8	904,4	942,5	980,0
PP&E	mUSD												
Intangibles	mUSD	521,0	580,8	622,8	664,6	705,8	746,6	786,9	826,6	865,8	904,4	942,5	980,0
Other fixed assets	mUSD												
Current assets	mUSD	282,2	264,4	264,2	313,1	365,7	422,4	483,5	549,5	610,9	678,3	752,4	833,7
Cash and equivalents	mUSD	96,1	41,4	6,4	24,0	41,5	58,9	75,8	92,2	97,9	102,8	106,7	109,2
Other financial assets	mUSD												
Trade receivables	mUSD	114,1	137,9	160,4	180,7	203,5	229,2	258,0	290,5	326,9	367,9	414,0	465,8
Inventories	mUSD	71,9	85,1	97,4	108,3	120,6	134,3	149,7	166,8	186,0	207,6	231,7	258,7
Other current tax assets	mUSD												
Total Assets	mUSD	803,2	845,1	887,0	977,6	1.071,5	1.169,0	1.270,4	1.376,1	1.476,7	1.582,8	1.694,9	1.813,7
Total Shareholders' Equity	mUSD	589,3	615,0	642,3	670,9	700,3	730,4	761,1	792,4	824,6	857,6	891,5	926,2
Share capital & treasury shares	mUSD	50,0	50,0	50,0	50,0	50,0	50,0	50,0	50,0	50,0	50,0	50,0	50,0
Share premium	mUSD												
Retained earnings	mUSD	14,8	25,7	27,2	28,7	29,4	30,1	30,7	31,4	32,1	33,0	33,9	34,7
Reserves	mUSD	524,5	539,3	565,0	592,3	620,9	650,3	680,4	711,1	742,4	774,6	807,6	841,5
Long term liabilities	mUSD	70,0	60,0	50,0	90,0	130,0	170,0	210,0	250,0	280,0	310,0	340,0	370,0
Deferred tax liabilities	mUSD												
Grants	mUSD	-	-	-	-	-	-	-	-	-	-	-	-
LT financial liabilities	mUSD	70,0	60,0	50,0	90,0	130,0	170,0	210,0	250,0	280,0	310,0	340,0	370,0
Short term liabilities	mUSD	143,9	170,1	194,8	216,7	241,2	268,6	299,3	333,6	372,1	415,2	463,4	517,5
Trade payables	mUSD	143,9	170,1	194,8	216,7	241,2	268,6	299,3	333,6	372,1	415,2	463,4	517,5
Other short term liabilities	mUSD												
Other tax liabilities	mUSD												
ST financial liabilities	mUSD	-	-	-	-	-	-	-	-	-	-	-	-
Provisions	mUSD												
Total Liabilities	mUSD	803,2	845,1	887,0	977,6	1.071,5	1.169,0	1.270,4	1.376,1	1.476,7	1.582,8	1.694,9	1.813,7
Check		-	-	-	-	-	-	-	-	-	-	-	-

Cash Flow		2018 H	2019 H	2020 H	2021 E	2022 E	2023 E	2024 E	2025 E	2026 E	2027 E	2028 E
EBITDA (ex-Grants)	mUSD	97,1	102,5	68,0	84,5	110,6	107,4	106,5	105,7	81,2	85,5	90,1
- Taxes	mUSD	(16,9)	(17,5)	(6,6)	(11,4)	(19,7)	(19,1)	(19,3)	(19,6)	(10,8)	(10,4)	(11,5)
+/- Change in WC	mUSD	(28,2)	(3,9)	4,3	16,8	(2,2)	(1,4)	(1,7)	(1,6)	(3,0)	(5,5)	(7,0)
Operating Cash Flow	mUSD	52,0	81,1	65,7	89,9	88,7	86,9	85,5	84,5	67,4	69,5	71,7
Capex	mUSD	(61,8)	(28,3)	(74,9)	(39,5)	(39,5)	(39,5)	(39,5)	(39,5)	(82,2)	(86,0)	(91,1)
Investing Cash Flow	mUSD	(61,8)	(28,3)	(74,9)	(39,5)	(39,5)	(39,5)	(39,5)	(39,5)	(82,2)	(86,0)	(91,1)
Cash Flow from Assets	mUSD	(9,8)	52,8	(9,2)	50,4	49,3	47,4	46,1	45,1	(14,8)	(16,5)	(19,4)
Financial Income	mUSD	4,6	4,8	5,1	-	-	-	-	-	-	-	-
Financial Expense	mUSD	(17,67)	(15,9)	(13,1)	(7,0)	(5,5)	(4,1)	(2,7)	(1,0)	(4,0)	(7,6)	(6,8)
Debt repayment	mUSD	-	-	(18,8)	(18,0)	(18,0)	(18,0)	(18,0)	(24,3)	-	(10,0)	(10,0)
Debt increase	mUSD	92,5	22,5	-	-	-	-	-	-	100,0	-	-
Grants/Sub-debt financing	mUSD	-	-	-	-	-	-	-	-	-	-	-
Dividends	mUSD	-	-	-	(13,3)	(22,9)	(22,3)	(22,5)	(22,8)	-	(12,2)	(13,4)
+/- Capital Increase/Reduction	mUSD	-	-	-	-	-	-	-	-	50,0	-	-
Financing Cash Flow	mUSD	79,5	11,4	(26,8)	(38,3)	(46,5)	(44,4)	(43,2)	(48,1)	146,0	(29,8)	(30,2)
Cash movement	mUSD	69,7	64,3	(36,0)	12,2	2,8	3,0	2,9	(3,0)	131,2	(46,3)	(49,6)
Cash BoP	mUSD	-	69,7	133,9	97,9	110,1	112,9	115,9	118,7	115,8	247,0	200,7
Cash movement	mUSD	69,7	64,3	(36,0)	12,2	2,8	3,0	2,9	(3,0)	131,2	(46,3)	(49,6)
Cash EoP	mUSD	69,7	133,9	97,9	110,1	112,9	115,9	118,7	115,8	247,0	200,7	151,1

Cash Flow		2029 E	2030 E	2031 E	2032 E	2033 E	2034 E	2035 E	2036 E	2037 E	2038 E	2039 E	2040 E
EBITDA (ex-Grants)	mUSD	95,9	128,9	134,8	142,3	149,9	157,5	165,1	172,8	180,5	188,2	195,9	203,7
- Taxes	mUSD	(12,7)	(22,0)	(23,4)	(24,6)	(25,2)	(25,8)	(26,3)	(26,9)	(27,5)	(28,3)	(29,0)	(29,8)
+/- Change in WC	mUSD	(8,6)	(10,6)	(10,2)	(9,3)	(10,6)	(11,9)	(13,5)	(15,3)	(17,2)	(19,5)	(22,0)	(24,8)
Operating Cash Flow	mUSD	74,6	96,3	101,2	108,5	114,2	119,8	125,3	130,6	135,7	140,4	144,9	149,1
Capex	mUSD	(98,7)	(110,1)	(94,6)	(96,6)	(98,5)	(100,4)	(102,4)	(104,5)	(106,6)	(108,9)	(111,2)	(113,5)
Investing Cash Flow	mUSD	(98,7)	(110,1)	(94,6)	(96,6)	(98,5)	(100,4)	(102,4)	(104,5)	(106,6)	(108,9)	(111,2)	(113,5)
Cash Flow from Assets	mUSD	(24,2)	(13,8)	6,6	11,9	15,7	19,4	22,9	26,1	29,0	31,5	33,8	35,6
Financial Income	mUSD	-	-	-	-	-	-	-	-	-	-	-	-
Financial Expense	mUSD	(6,0)	(5,2)	(4,4)	(5,6)	(8,8)	(12,0)	(15,2)	(18,4)	(21,2)	(23,6)	(26,0)	(28,4)
Debt repayment	mUSD	(10,0)	(10,0)	(10,0)	(10,0)	(10,0)	(10,0)	(10,0)	(10,0)	(20,0)	(20,0)	(20,0)	(20,0)
Debt increase	mUSD	-	-	-	50,0	50,0	50,0	50,0	50,0	50,0	50,0	50,0	50,0
Grants/Sub-debt financing	mUSD	-	-	-	-	-	-	-	-	-	-	-	-
Dividends	mUSD	(14,8)	(25,7)	(27,2)	(28,7)	(29,4)	(30,1)	(30,7)	(31,4)	(32,1)	(33,0)	(33,9)	(34,7)
+/- Capital Increase/Reduction	mUSD	-	-	-	-	-	-	-	-	-	-	-	-
Financing Cash Flow	mUSD	(30,8)	(40,9)	(41,6)	5,7	1,8	(2,1)	(5,9)	(9,8)	(23,3)	(26,6)	(29,9)	(33,1)
Cash movement	mUSD	(55,0)	(54,7)	(35,0)	17,6	17,6	17,3	17,0	16,4	5,7	4,9	3,9	2,5
Cash BoP	mUSD	151,1	96,1	41,4	6,4	24,0	41,5	58,9	75,8	92,2	97,9	102,8	106,7
Cash movement	mUSD	(55,0)	(54,7)	(35,0)	17,6	17,6	17,3	17,0	16,4	5,7	4,9	3,9	2,5
Cash EoP	mUSD	96,1	41,4	6,4	24,0	41,5	58,9	75,8	92,2	97,9	102,8	106,7	109,2

Financial projections

Projections		2018 H	2019 H	2020 H	2021 E	2022 E	2023 E	2024 E	2025 E
PP&E - Capex									
Capex investments from Annual Accounts	mUSD	61,8	28,3	74,9					
Impairments - acelerated D&A	mUSD	0,0	0,0						
Capex investments from OECD	mUSD	0,0	0,0						
Capex	mUSD	61,8	28,3	74,9	39	39	39	39	39
% Revenues	%	*15,4%*	*5,9%*	*16,8%*	*8,9%*	*8,6%*	*7,8%*	*6,8%*	*5,9%*
PP&E - BoP	mUSD	274,3	308,3	303,4	340,3	340,2	340,2	340,1	340,0
+ Capex	mUSD	61,8	28,3	74,9	39,5	39,5	39,5	39,5	39,5
- Divestiture	mUSD								
- D&A	mUSD	(27,9)	(33,2)	(37,9)	(39,5)	(39,5)	(39,5)	(39,5)	(39,5)
PP&E - EoP		308,3	303,4	340,3	340,2	340,2	340,1	340,0	340,0
Working Capital Calculations									
<u>Working Capital</u>									
+ Trade receivables	mUSD	49	59	55	36	38	42	48	55
+ Inventories	mUSD	21	27	27	25	24	27	32	37
- Trade payables	mUSD	(42)	(54)	(54)	(51)	(49)	(54)	(63)	(73)
Working Capital	mUSD	28	32	28	11	13	15	16	18
Variation	mUSD	***28***	***4***	***(4)***	***(17)***	***2***	***1***	***2***	***2***
<u>Working Capital Days</u>									
Trade receivables - Days of revenues	Days	45	45	45	30	30	30	30	30
Inventories - Days of COGS/Distrib costs	Days	30	30	30	30	30	30	30	30
Trade payables - Days of COGS/Distrib costs	Days	60	60	60	60	60	60	60	60
Equity Schedule									
Equity - BoP	mUSD	209	248	289	304	317	340	363	385
+/- Capital Increase/Reduction	mUSD				-	-	-		
+/- Change in Equity/Net income	mUSD	39	41	15	27	46	45	45	46
- Dividends (% Net Income)	mUSD	-	-	-	13	23	22	23	23
Equity - EoP	mUSD	248	289	304	317	340	363	385	408
Financial debt repayment									
<u>1. Calculation of Long Term financial debt</u>									
<u>EXISTING - Commercial/Corporate Debt (IFC/Synd)</u>									
BoP	mUSD	-	92,5	115,1	96,3	78,3	60,3	42,3	24,3
+ Increase	mUSD	92,5	22,5	0	-	-			
- Repayment	mUSD		-	(18,8)	(18,0)	(18,0)	(18,0)	(18,0)	(24,3)
EoP	mUSD	92,5	115,1	96,3	78,3	60,3	42,3	24,3	-
Interest rate LT	8%								
LT Financial expense	mUSD	17,67	15,9	13,1	7,0	5,5	4,1	2,7	1,0
<u>NEW - Commercial/Corporate Debt (IFC/Synd)</u>		19,10%	13,79%						
BoP	mUSD				-	-	-	-	-
+ Increase	mUSD					-	-	-	-
- Repayment	mUSD						-	-	-
EoP	mUSD	-	-	-	-	-	-	-	-
Interest rate LT	8%								
LT Financial expense	mUSD	-	-	-	-	-	-	-	-

Projections		2026 E	2027 E	2028 E	2029 E	2030 E	2031 E	2032 E	2033 E	2034 E	2035 E	2036 E	2037 E	2038 E	2039 E	2040 E
PP&E - Capex																
Capex investments from Annual Accounts	mUSD															
Impairments - acelerated D&A	mUSD															
Capex investments from OECD	mUSD															
Capex	mUSD	82	86	91	99	110	95	97	98	100	102	104	107	109	111	114
% Revenues	%	*10,5%*	*9,1%*	*7,9%*	*7,1%*	*6,6%*	*4,8%*	*4,4%*	*4,0%*	*3,6%*	*3,3%*	*3,0%*	*2,7%*	*2,4%*	*2,2%*	*2,0%*
PP&E - BoP	mUSD	340,0	380,9	423,9	469,8	521,0	581	623	665	706	747	787	827	866	904	942
+ Capex	mUSD	82,2	86,0	91,1	98,7	110,1	95	97	98	100	102	104	107	109	111	114
- Divestiture	mUSD															
- D&A	mUSD	(41,2)	(43,1)	(45,2)	(47,5)	(50,3)	(53)	(55)	(57)	(60)	(62)	(65)	(67)	(70)	(73)	(76)
PP&E - EoP		380,9	423,9	469,8	521,0	580,8	623	665	706	747	787	827	866	904	942	980
Working Capital Calculations																
<u>Working Capital</u>																
+ Trade receivables	mUSD	64	78	94	114	138	160	181	204	229	258	290	327	368	414	466
+ Inventories	mUSD	43	51	61	72	85	97	108	121	134	150	167	186	208	232	259
- Trade payables	mUSD	(86)	(103)	(122)	(144)	(170)	(195)	(217)	(241)	(269)	(299)	(334)	(372)	(415)	(463)	(517)
Working Capital	mUSD	21	27	34	42	53	63	72	83	95	108	124	141	160	182	207
Variation	mUSD	***3***	***6***	***7***	***9***	***11***	***10***	***9***	***11***	***12***	***14***	***15***	***17***	***19***	***22***	***25***
<u>Working Capital Days</u>																
Trade receivables - Days of revenues	Days	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Inventories - Days of COGS/Distrib costs	Days	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Trade payables - Days of COGS/Distrib costs	Days	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
Equity Schedule																
Equity - BoP	mUSD	408	483	495	509	524	549	577	605	635	665	695	727	759	792	826
+/- Capital Increase/Reduction	mUSD	50	-			-										
+/- Change in Equity/Net income	mUSD	25	24	27	30	51	54	57	59	60	61	63	64	66	68	69
- Dividends (% Net Income)	mUSD	-	12	13	15	26	27	29	29	30	31	31	32	33	34	35
Equity - EoP	mUSD	483	495	509	524	549	577	605	635	665	695	727	759	792	826	861
Financial debt repayment																
<u>1. Calculation of Long Term financial debt</u>																
<u>EXISTING - Commercial/Corporate Debt (IFC/Synd)</u>																
BoP	mUSD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
+ Increase	mUSD	-														
- Repayment	mUSD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EoP	mUSD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Interest rate LT	8%															
LT Financial expense	mUSD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<u>NEW - Commercial/Corporate Debt (IFC/Synd)</u>																
BoP	mUSD	-	100,0	90,0	80,0	70,0	60,0	50,0	90,0	130,0	170,0	210,0	250,0	280,0	310,0	340,0
+ Increase	mUSD	100,0				-	-	50,0	50,0	50,0	50,0	50,0	50,0	50,0	50,0	50,0
- Repayment	mUSD	-	(10,0)	(10,0)	(10,0)	(10,0)	(10,0)	(10,0)	(10,0)	(10,0)	(10,0)	(10,0)	(20,0)	(20,0)	(20,0)	(20,0)
EoP	mUSD	100,0	90,0	80,0	70,0	60,0	50,0	90,0	130,0	170,0	210,0	250,0	280,0	310,0	340,0	370,0
Interest rate LT	8%															
LT Financial expense	mUSD	4,0	7,6	6,8	6,0	5,2	4,4	5,6	8,8	12,0	15,2	18,4	21,2	23,6	26,0	28,4

Annex II: Review of indexes relevant for universal access

This annex reviews some indexes and metrics directly focusing on universal access and rural electrification or that can be relevant for the topic. The justification of why a new index is needed has been discussed in section 3.3; this section only provides an overview of existing indexes and metrics.

Tracking SDG7

The "Tracking SDG7: The Energy Progress Report" is a joint effort by the Custodian Agencies for Sustainable Development Goal 7 (SDG7) – IRENA, IEA, WB, UN, WHO – which provides the most comprehensive look available at the world's situation regarding global energy targets on access to electricity, clean cooking, renewable energy and energy efficiency.

The report gives the international community a global dashboard to register progress on three key targets:

- Ensuring universal energy access.
- Doubling progress on energy efficiency.
- Substantially increasing the share of renewable energy by 2030.

It assesses the progress made by each country on these targets and provides a snapshot of how far the world from achieving SDG7 is. Since the report is issued every year and the metrics used are consistent over time, it provides a measure of the progress being made. The same information is available per country and broken down into rural and urban populations. Figure 13 shows a world map based on the results of the Tracking SDG7 report.

The Multi-Tier Framework (MTF)

The ESMAP report "Beyond connections. Energy access redefined" proposes a multi-tier framework that can be used for measuring and goal-setting, investment prioritization, and tracking progress. This index captures the multiple modes of delivering energy access from grid to off-grid, including the wide range of cooking stoves and fuels. It also helps reflect the contributions of various programs, agencies, and national governments toward electrification. Energy use is divided among three so-called locales which are studied separately. ESMAP (2015) define locales of energy use as the broad locations of end use of energy for availing energy services; locales of energy use include households, community institutions, and productive enterprises.

For the household locale, the proposed multi-tier framework examines i) access to electricity, ii) access to energy for cooking solutions, and iii) access to energy for space-heating solutions as three separate sub-locales. Separate multi-tier frameworks are defined for each of these components. Separate indices of energy access are calculated for each of the components, defined as the average tier rating across households in the given area adjusted to a scale of 100. The overall index of household access to energy may be calculated as the average of the three sub-locale indices. A graphical representation of the outcomes of this assessment was presented in Figure 15.

For the productive engagement locale, the proposed multi-tier framework examines the energy supply vis-à-vis critical energy applications. Measuring energy needs for productive uses is a complex challenge. There are multiple types of productive enterprises, encompassing different scales of operation, varying degrees of mechanization, a multitude of energy applications, and a variety of energy supplies. Further, it is not possible to set norms of energy needs for different enterprises or applications to measure energy access deficits. Also, lack of adequate energy access may not be the only constraint to functioning and expansion of the productive enterprise, which may be constrained by raw materials, capital, land, skilled manpower, markets, transportation, government licenses, or other inputs. Specifying minimum energy needs of different types of enterprises would be a very cumbersome approach. Also, it is important to capture energy needs of small and micro enterprises and productive engagements in the informal sector, which are often not reflected in enterprise surveys that tend to focus on large enterprises. To address these challenges, an approach based on surveys of individuals for their key productive engagements and energy needs is proposed. Under this approach, energy access for productive engagements is aggregated across individuals, thus eliminating the need for reflecting the relative scale of operations of different enterprises. An index of access to energy for productive uses for any given geographical area can be calculated as the average tier level across all individual respondents in that area, adjusted to a scale of 100. In addition, sub-indices can also be calculated for various productive activities (e.g., small shops, artisans, or agriculture) by taking the average of tier levels across respondents engaged in those activities.

For the community facilities locale, five sub-locales need to be considered: i) health facilities, ii) educational facilities, iii) street lighting, iv) government buildings, and v) public buildings. Access to energy for each sub-locale can be determined based on surveys of either the users of the facility or the providers of the facility. The former requires a survey of households, whereas the latter requires a survey of the relevant community institutions. Whereas the former can only yield subjective and limited information, more detailed information can be obtained from the latter. Multi-tier frameworks are defined for each of the sub-locales, and separate indices are calculated based on the average tier rating for each sub-locale, adjusted to a scale of 100. The overall index of access to energy for community facilities is calculated as the average of indices across the five sub-locales.

For any geographical area, an overarching index of access to energy can be calculated as the average of the indices across the three locales—households, productive uses, and community facilities.

IIASA improved approach to measure energy access

According to IIASA (International Institute for Applied Systems Analysis), while the MTF is a significant enhancement to the earlier binary formulations of energy access, it is now too complex and conceptually muddled to track access at a global scale (Pachauri and Rao, 2020). A new framework is built based on the Multi-Tier Framework (Figure 71), which simplifies and advances the approach to identify the energy poor more accurately.

AF Measurement of Household Access to Electric Services	Tier 0	Tier 1	Tier 2	Tier 3
Energy Supply Poverty				
Availability	None	<8hrs	8-16hrs	>16hrs
Cost of supply^	NA	NA	NA	NA
Energy Service Poverty				
Service level	None	*Minimal* (Lighting/ phone charging)	*Decent* + (TV | fridge| cooling)	*Affluent* + (other appliances)
Affordability (budget share)	NA	>10%	5-10%	<5%

Note: ^ The cost of supply is context specific

MTF Measurement of Household Access to Electric Services*	Tier 0	Tier 1	Tier 2	Tier 3	Tier 4	Tier 5
Duration – Day Evening		≥ 4hrs	≥ 4hrs	≥ 8hrs	≥ 16 hrs ≥ 4hrs	≥ 23 hrs ≥ 4hrs
Quality					Voltage problems do not affect use of desired appliances	
Reliability Disruptions per week					≤ 14	≤ 3 of total duration < 2hrs
Capacity		≥ 3W	≥ 50W	≥ 200W	≥ 800W	≥ 2kW
Consumption levels, in Wh/day	<12	≥ 12	≥ 200	≥ 1,000	≥ 3,425	≥ 8,219
Affordability				Cost of standard consumption package of 365 kWh per annum is < than 5% of household income		

Note: * The MTF also includes dimensions - "Legality" & "Health and Safety"

Figure 71. A simplified alternative framework compared to the multi-tier framework for energy access measurement (Pachauri and Rao, 2020)

The framework distinguishes between two aspects of access: the quality of power supply and the circumstance of the end-user. This distinction is important to better direct policy efforts where they are most needed, i.e., to energy suppliers and/or to households. It also reduces the number of dimensions and tiers to simplify the MTF.

Instead of correlating energy consumption with energy access, a key advancement of the new framework is using ownership of different types of appliances as a proxy for measuring household amenities and services derived from the use of these appliances to improve wellbeing. Electricity consumption is a misleading measure of energy service, because for those who use inefficient appliances, more consumption does not translate into more service. For instance, a household using six inefficient light bulbs is not better off than one that uses three efficient high-luminosity light points and an efficient fan that provides comfort from the summer heat. The framework also improves on how affordability is measured to consider appliance purchase costs in addition to recurrent electricity expenditures in assessing the budget share spent on electric services.

When applied to real data, the framework suggests that the energy poor are more segmented than what is reflected by existing binary or MTF indicators. The categorisation of households according to electricity consumption differs markedly from that according to energy services and using appliance ownership, revealing greater heterogeneity among the energy poor than what is reflected in the MTF consumption-based indicator.

In addition, the new framework shows that affordability is even more of a constraint to gaining access to modern electric services for households in Ethiopia, India, and Rwanda than reflected by the MTF. According to the MTF indicator of affordability, practically no one in Ethiopia or India would be considered unable to afford electricity access. However, if one includes the discounted cost of appliances needed to consume electricity in the indicator, about a third of the population in India and Ethiopia might be categorized as facing issues with affordability. In Rwanda, even without considering the discounted cost of appliances, most electricity consuming households are faced with affordability constraints to using basic electric services at home.

The Modern Energy Minimum

The Modern Energy Minimum is a new global electricity consumption threshold proposed by the Energy for Growth Hub. The analysis is performed at country level. In simplified terms, the reasoning is mostly based on two empirical relationships:

- A "quasi-linear" relationship between national GNI per capita and national average electricity consumption (kWh per capita).
- A frequent national ratio of 30% residential consumption vs 70% non-household consumption (industrial, commercial, agriculture and transport) consumption.

The conclusion is drawn that for a country to get to a low-middle income status ($2511 per capita) the annual per capita consumption level must be 1000 kWh and 300 kWh per capita should be the Modern Energy Minimum to be set as an objective of electrification (Figure 72).

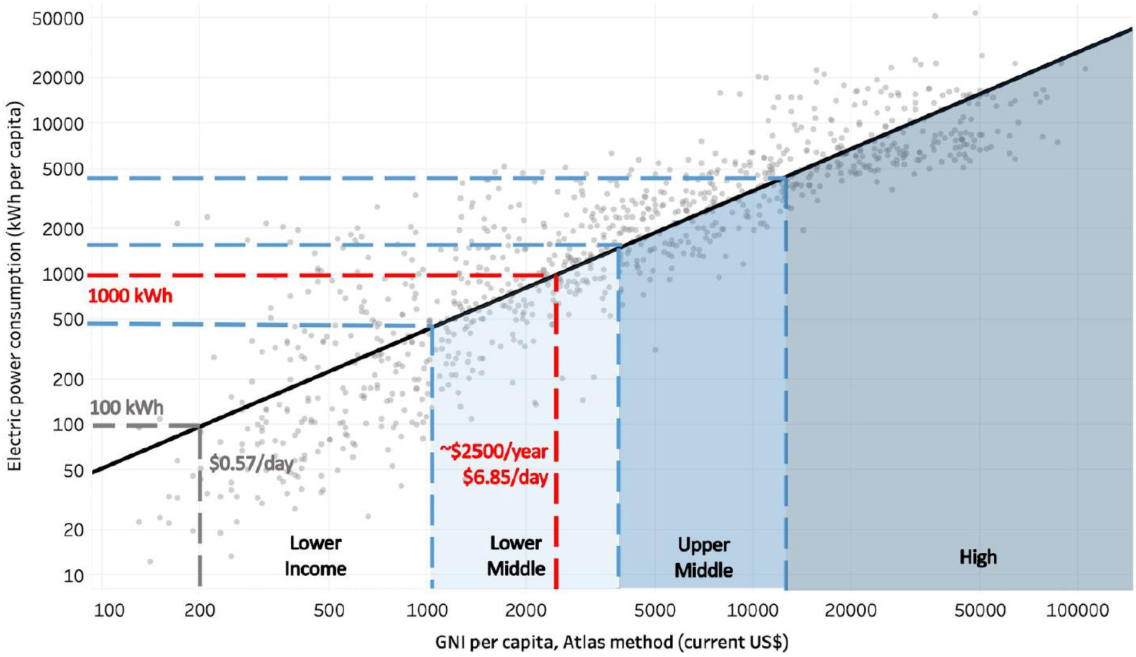


Figure 72. Electricity consumptions and income level through the lens of the Modern Energy Minimum (Energy for Growth Hub, 2020)

It is therefore suggested to count people that have achieved electricity access as those that: i) consume at least 300 kWh/year at home and ii) live and work in an economy with average non-residential consumption above 700 kWh per capita.

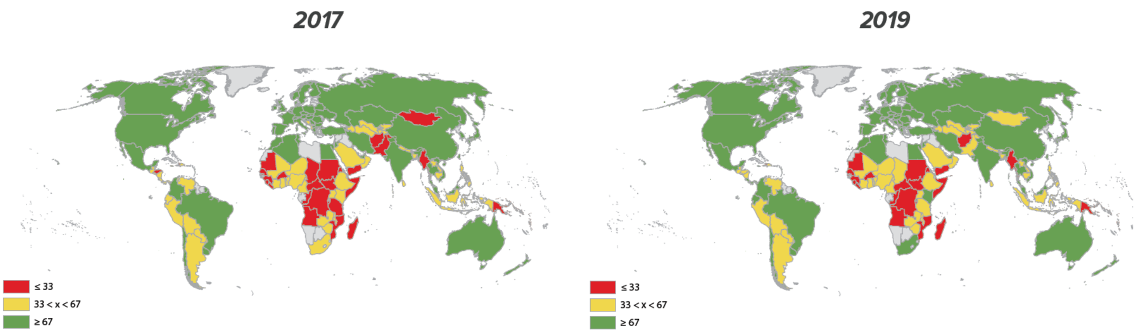
Regulatory Indicators for Sustainable Energy (RISE)

RISE is a set of indicators to help compare national policy and regulatory frameworks for sustainable energy. RISE assesses countries' policy and regulatory support for each of the four pillars of sustainable energy, i.e., i) access to electricity, ii) access to clean cooking (for 55 access-deficit countries), iii) energy efficiency, and iv) renewable energy. With over 30 indicators (Figure 73) covering 138 countries and representing over 98 percent of the world population, RISE provides a reference point to help policymakers benchmark their sector policy and regulatory framework against those of regional and global peers, and a powerful tool to help develop policies and regulations that advance sustainable energy goals. Each indicator targets an element of the policy or regulatory regime important to mobilising investment, such as establishing planning processes and institutions, introducing dedicated incentives or support programs, and ensuring financially sound utilities. Together, they provide a comprehensive picture of the strength and breadth of government support for sustainable energy and the actions they have taken to turn that support into reality.

ELECTRICITY ACCESS	• Electrification plan • Grid electrification framework	• Framework for standalone systems • Utility transparency and monitoring	• Scope of the electrification plan • Framework for mini grids	• Consumer affordability • Utility creditworthiness
CLEAN COOKING	• Planning	• Scope of planning	• Standards and labeling	• Incentives for clean cooking solutions
RENEWABLE ENERGY	• Legal framework for renewable energy • Incentives and regulatory support for renewable energy	• Network connection and use • Carbon pricing and monitoring	• Planning for renewable energy expansion • Attributes of financial and regulatory incentives	• Counterparty risk
ENERGY EFFICIENCY	• National energy efficiency plannin • Incentives and mandates: Public sector • Minimum energy performance standards	• Transport sector • Energy efficiency entities • Incentives and mandates: Utilities	• Energy labeling system • Carbon pricing and monitoring • Incentives and mandates: Industrial and commercial end users	• Financing mechanisms for energy efficiency • Building energy codes

Figure 73. RISE pillars and indicators (ESMAP, 2020)

RISE classifies countries into a green zone of strong performers in the top third of the 0-100 score range, a yellow zone of middle third performers, and a red zone of weaker performers in the bottom third (Figure 74).



Source: World Bank, RISE 2020.

Figure 74. Evolution of RISE scores worldwide (ESMAP, 2020)

The Electricity Regulatory Index (ERI)

The Electricity Regulatory Index measures the level of development of electricity sector regulatory frameworks in 43 African countries and the capacity of regulatory authorities to effectively carry out their relevant functions and duties. The ERI is made up of three pillars or sub-indices: the Regulatory Governance Index (RGI); the Regulatory Substance Index (RSI); and the Regulatory Outcome Index (ROI).

The ERI scores are calculated based on responses to comprehensive surveys distributed to electricity sector regulatory institutions, and utilities in African countries with confirmed regulatory authorities. Based on the responses to the surveys, each indicator in the sub-indices is assigned a score between 0 and 1. Figure 75 shows the result of such assessment for 2021, with the colour code specified in the legend.

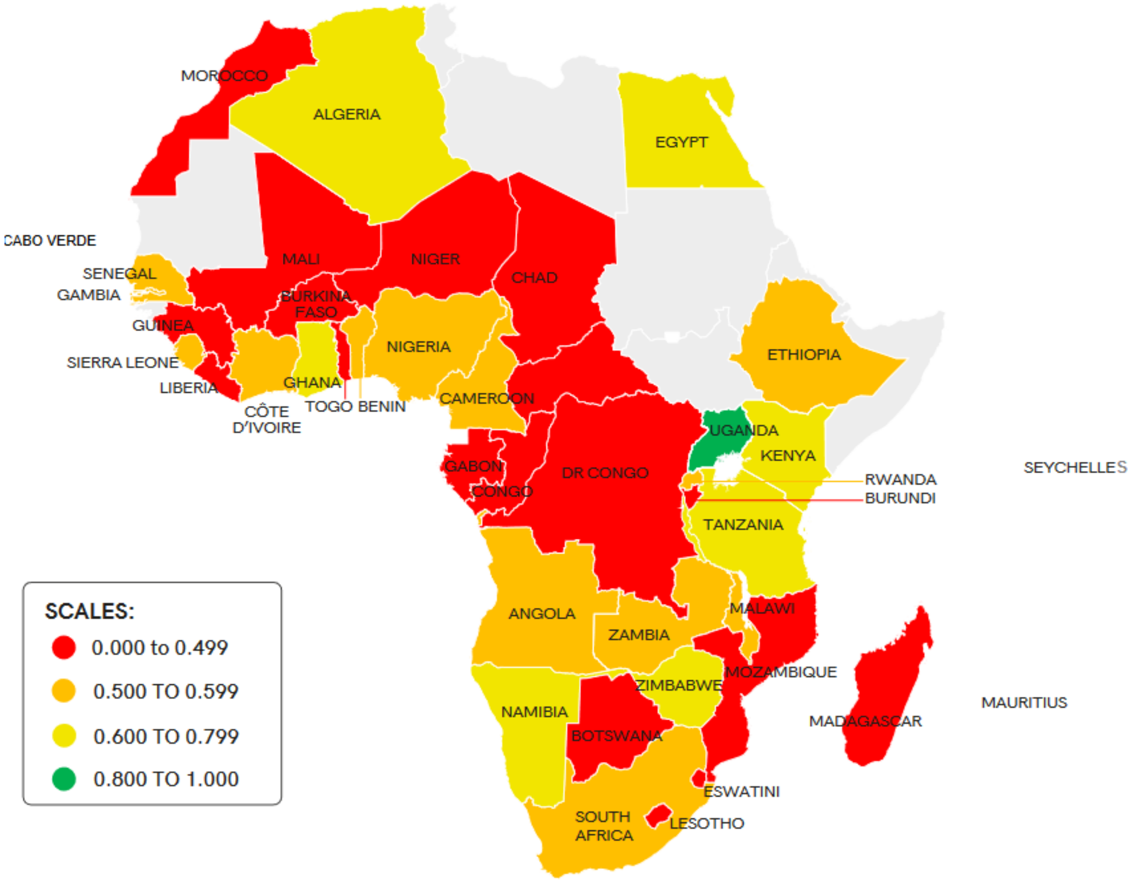


Figure 75. ERI index for African countries (AfDB, 2021)

Annex III: Detailed design of the Electricity Access Index

The body of this report only presents the main elements of the methodology used to compute the Electricity Access Index. This Annex provides all the details required to replicate or scale up this exercise.

Sufficiency component

As explained in section 3, the elaboration of the index requires the development of a business plan to finance the electrification plan that can achieve universal access in the country by 2030. In some countries the electrification plan corresponds to an existing national electrification strategy, in other cases it has been obtained from publicly available studies performed by development organizations – such as the World Bank's Global Electrification Platform using the OnSSET model – or our own analysis using the Reference Electrification model (REM).[50]

The critical importance of the business plan stems from the fact that, in an electrification process that aims to achieve full electrification in less than a decade starting from a large access gap, very substantial investments in assets with long economic lives are necessary during a relatively short period of time. On the other hand, regulated tariffs, even when designed according to orthodox regulatory principles of cost-reflective revenue requirements, recover the costs slowly, especially when the access rate is low and so is the customer base. This lack of synchronism or time offset between costs and revenues creates financial needs. When the tariffs are not cost reflective, or the revenue collection has significant gaps, the business model is stressed and becomes non-viable in some countries. This is a key indicator that the business plan can detect. On the other hand, the business plan for other countries can handle this time offset without much difficulty, returning to a balance situation a few years after 2030, with a cost-reflective revenue requirement and a progressive stabilization of the capital structure at sustainable leverage levels/ratios.

For the sake of homogeneity, so that the results could be comparable, some common criteria have been adopted for all the techno-economic plans and business plans:

- Adopt the viewpoint of the government, as the ultimate responsible entity in the electrification process.
- Consider the entire distribution system, both on- and off-grid, existing and new. The techno-economic electrification plan should correspond as much as possible to the least cost mix of the three electrification modes.
- All residential customers are supplied at least tier 2, and all commercial and industrial customers receive reliable power.
- The business plan considers all costs (including the costs of maintenance and replacement of assets) and all revenues of the distribution activity.
- When the latest financial statements of the distribution utilities are available, this becomes a primary information source of the business plan.

[50] See the MIT/Comillas Universal Energy Access Lab E https://universalaccess.mit.edu

- As the business plan expands over a long period of time (in principle until 2040), all assets must be replaced at the end of their economic lives.
- The current regulated tariff structure (i.e., breakdown into consumer types) of grid-connected customers is assumed to continue over the entire horizon of the business plan, although the numerical values can evolve over time. Mini-grid customers are charged the same tariff as grid consumers. Standalone-system users are charged the average Rural Household Energy Consumption equivalent.
- Grants from DFIs to governments are linked to the deployment of CAPEX and recognized in the profit and loss account as revenues, whereas subsidies from the Government can be used without restrictions.
- The time horizon of the business plan has been divided into two periods. The first one covers the interval from the present time to 2030, when universal access is assumed to be achieved. This is a period of heavy investment and with the revenues from the tariffs gradually growing, as more people are supplied with electricity. During the second period, from 2030 to 2040, investments are only needed to cope with the increment in demand due to population and demand growth, as well as to replace assets that reach the end of their economic lives.
- The design of the financial plan must carefully balance multiple factors, such as the distribution of the investments during the first period (until 2030), which customers to supply first, the evolution of the tariffs during the entire horizon of the plan, the limits that might be imposed by the sovereign debt of the country, the blend of financial resources and the parameters that define each financial instrument. The business plan must maintain acceptable values of the key financial ratios so that it is possible to raise the capital necessary for the electrification plan until 2030. Finally, the business plan must attain a stable financial condition by 2040 or earlier, whereby the annual expenditures, the regulated revenue requirement from all the distribution activities and the revenues from the regulated tariffs tend to converge.
- The total amount to be financed must be calculated over the financial projections period. It includes the operating cash flow (until the business plan becomes cash flow positive and starts contributing to the electrification CAPEX roll-out), the investment plan up to 2030 and the cash outflows (financial interest and taxes) associated to the suggested capital structure, computed as shown in Figure 76.

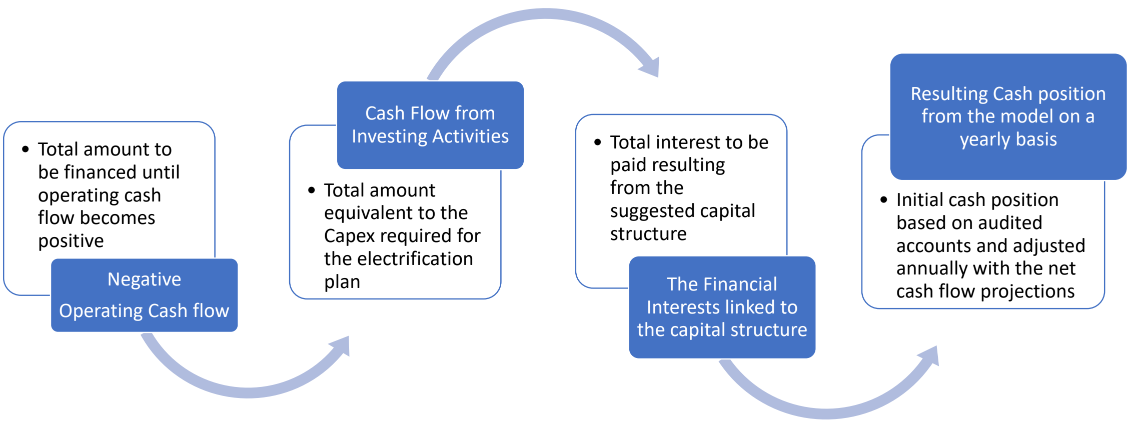


Figure 76. Term-by-term determination of the total amount to be financed.

Other more technical aspects in the elaboration of the financial plan are:

- The iterative adjustment of parameters in the financial plan must be carried out noticing that the different components (Debt/Equity/Grants) are interrelated and conditioned to each other. In each iteration, some key financial ratios are analyzed to make a first assessment of the optimal capital structure and maximum amount of debt (corporate/commercial) that the BP can tolerate.
- Government support is critical for several reasons – support and respect for the regulatory framework, subsidies if they exist, grants, and channeling DFIs financing – for both equity and debt, so the overall impact on and expected support from the Government is also analyzed.
- The most challenging component of the capital structure, both to structure and potentially to raise, is the equity (rate/governance/return and exit, if any). Additionally, both the dividend (as per market practice) and the overall return on equity are modeled and computed.

Once the business plan has been developed, it can provide two key pieces of information. In the first place, the plan shows how much annual expenditure is presently needed to be in the right path to meet the SDG7.1 target. This is the amount that goes into the denominator in Figure 16. Graphical representation of the sufficiency component of the Electricity Access Index

In the second place, the business plan can be presented to experts in evaluating large infrastructure projects in developing countries to get their assessment about the overall viability of the plan. After examining the plan and any additional information provided, each expert is asked to classify the financial viability of the business plan for the considered country into one the following categories: (1) impossible; (2) very difficult, but not impossible; (3) difficult; (4) possible, with some difficulties; or (5) the plan is viable.

It follows the enumeration of the information that must be provided to the experts for them to carry out the evaluation.

Information that is provided to the expert evaluators

For each considered country, the following information is provided in a separate file:

- Relevant general information on the country:
  - Total population, broken down into urban and rural. National electrification rate, and the individual rates for rural and urban populations.
  - Average electric consumption per household and per capita.
  - GDP present value and rate of growth, inflation rate, and sovereign credit ratings, as well as the World Bank's *Ease of Doing Business* ratio.
  - Total value of the assets of the power distribution segment.

- The ratio (in percentage) of the present electrification effort to the effort that would be needed.51
- Summary Table of Financing Sources and Uses:
  - Internal sources of financing:
    - Collected revenue from the regulated tariffs, which may include cross subsidization among categories of consumers.
  - External sources of financing:
    - Grants based on DFIs funds to Government, typically linked to the deployment of the CAPEX of the electrification plan.
    - Concessional Debt from DFIs.
    - Subsidies from the Government (bailouts to the distribution segment).
    - Commercial debt.
    - Equity.

  The information provided must differentiate two periods: i) the first one covers the initial years, until the operating cash flow becomes positive; ii) the second one covers the subsequent period until 2030, when the heavy investments necessary to achieve the universal access goal stop and are followed by a period where the need for financing new investments is significantly reduced.
- Key financial ratios of the business plan:

  From a financial perspective, the evolution of the ratios has most interest until 2030, when the heavy investments associated to the electrification plan stop. However, the period 2030-2040 has also interest to understand how the financial situation evolves towards a state of equilibrium between the annual revenues from regulated tariffs and the annual incurred costs. The provided ratios are:
  - EBITDA / (Interest + repayment)
  - (EBITDA + CAPEX) / (Interest + repayment)
  - Subsidized & concessional debt / EBITDA
  - Commercial & corporate debt / EBITDA
  - Total debt / EBITDA
  - Net debt / EBITDA
  - EBIT / Financial interest
  - EBIT / (Equity + Net debt)

[51] This is the first element that is needed to compute the sufficiency component of the index. For each country, the numerator is computed from actual data in the annual reports of the utilities, complemented with other data bases with information on off-grid solutions. The denominator is obtained from national electrification strategies (when they exist and are SDG.7 compatible) or standard electrification plans in the World Bank data bases.

- Net Operating Profit After Tax / (Equity + Net debt)
    - Net income / Equity
    - Total debt / Property, Plant, and Equipment (in %)
- Other information from the business plan
    - Total CAPEX of the electrification plan over Property, Plant and Equipment (PP&E) at the Beginning of the considered period (2021). Same over Average Cash Flow during the 2021-2030 period.
    - Period until EBITDAs become positive (both timing and quantum). Same for the cash flow.

Effectiveness component

The effectiveness component is computed via the results of a questionnaire, based on 34 items, which are divided among the four pillars of the Integrated Distribution Framework: universality, integral plan, viability, and focus on development. For each country, the questionnaire is sent to several country experts, looking for a balance of the different perspectives that may be present in the country by engaging experts from public institutions, utilities and the private sector. Experts are asked to evaluate the institutional and regulatory framework in the country, assigning a score from one to five to each item.

The scores from different experts are averaged to define a final score for each item. Items are all given the same weight, thus the score for each pillar is obtained by simply averaging the scores of the items corresponding to that pillar. Finally, the overall compliance with sound electrification principles is obtained by averaging the scores of the four pillars and translating the score from one to five into a percentage, as shown in Figure 77.

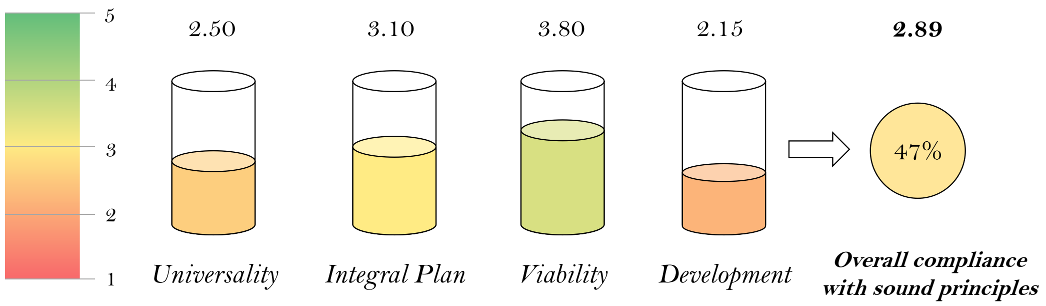


Figure 77. Example of the results of the effectiveness component of the Electricity Access Index

This annex starts with a presentation and justification of the importance and comprehensiveness of the principles of the Integrated Distribution Framework (IDF). Then it presents the 34-item questionnaire that country experts must fill in. Each item of the questionnaire has an introductory statement defining the topic, and a set of sub-questions. The experts can also provide comments for any of the topics.

Universal access

The principle of universal access requires that some entity, or combination of entities, makes sure that all customers in a considered territory will be supplied with at least a minimum level of service[52] and reliability through a combination of on- and off-grid solutions. Some entity must accept the role of default supplier (that is, being responsible for ensuring that nobody is left without service) and last-resort supplier (being responsible for providing the service in the event some previously existing supplier fails to do so). If these roles and responsibilities are not clearly defined, as it often happens, the electrification initiative may become inactive after a few years because of the absence of proper maintenance, funding, or management, or when demand grows and equipment needs to be repaired, replaced, or upgraded.

In practical terms, guaranteeing the universality conditions laid out above will require some kind of long-term agreement, as a concession, that ensures the permanence of supply. These long-term contracts can be established though a tender or via direct negotiation between the government and the potential project developers. The selected company (or companies) would commit to supply some prescribed level of electricity access to all customers and should also accept the role of last resort provider in the assigned area, being paid the corresponding cost for this service.

These agreements should encompass all areas where population without electricity access live and this requires a strong commitment from the government, who should also pursue the engagement of local communities to properly define the service level and characteristics. This commitment must be further backed by key development partners and embedded in a lead ministry or public agency that can guide the efforts of the many stakeholders and participants who will be involved.

Integration of on- and off-grid solutions

Within the population lacking electricity access in a certain country, very different conditions can be found, in terms of distance from the network, geography of the territory, or economic development. Therefore, a sound electrification plan must consider different electrification modes (grid extension, minigrids, and standalone systems) that could best fit each one of these conditions. The most efficient equilibrium of these electrification modes should be determined with a GIS-based optimisation tool, which should be able to internalise preferences or constraints that go beyond economic aspects, as those that could be raised by local communities or public institutions.

The outcome of this exercise should be a techno-economic plan providing: i) a roadmap for investments and project implementation that meets electrification targets at least cost and ii) estimates of the cost of supply (including both capital and operational expenditures), which are needed as an input of the financial plan, in order to calculate regulated tariffs and assess the need for subsidies. These costs should be expressed with a yearly granularity.

An efficient integration of different integration modes also requires a certain degree of coordination among them, especially at the regulatory level. Decisions should be taken on the boundaries of each electrification mode and what happen when two modes meet, as when the

[52] There are different methodologies to define service level in electrification programmes (ESMAP, 2015). In any case, the level of electricity demand should reflect a basket of basic services (which are context-dependent), but it should also consider affordability issues.

main grid eventually reaches an area covered by a minigrid (ESMAP, 2018b). A lack of clarity on these aspects may increase the risk perceived by the actors involved and hamper investments.

Turning a geospatial plan into reality requires addressing additional challenges with respect to the design of mode-specific regulations for remuneration, the management of interfaces between modes, provisions for default and last-resort service, and the dynamic integration of different supply modes with changing demand over time.

Financial viability

A sound electrification plan should be able to attract private partners who can mobilise investment capital, take advantage of advanced technologies, and bring technical and managerial expertise. These actors will show interest only if the financial viability is ensured for all the electrification modes considered by the plan. This requires the signature of long-term agreements based on regulated revenue requirement that encompasses all the costs faced by these companies. The revenue requirement should be computed through the cost-of-service method commonly used in monopoly regulation, with the application of some performance incentives[53]. Deviating from this basic regulatory approach increases the cost of capital, deters investment, and compromises the quality of service.

While the regulated revenue requirement should include all costs, the same is not true for end-user tariffs, which could internalise any sort of consumption subsidy. For instance, in some contexts, the regulation imposes the application of uniform tariffs in the entire national territory, and this would apply also to the new connections resulting from the electrification plan, regardless of the costs actually incurred. While the application of consumption subsidies is totally legitimate and, in many cases, essential to overcome affordability issues, it is of utmost importance that any difference between the revenue requirement and the amount to be collected through tariffs is covered through a specific subsidy budget and paid to the company in charge of electrification. This budget may come from the government or international institutions, or it can be raised through cross-subsidies.

Focus on development

The ultimate goal of universal access is not to connect consumers, but rather to provide electricity as a facilitator of social and economic development. For the electrification plan to bring socio-economic benefits, a top-down approach has to be complemented by the bottom-up participation of electricity end-users. Entities such as non-governmental organisations (NGOs), foundations, and cross-sector agencies have important roles to play in the definition of the electrification plan (Batidzirai et al., 2021), which should reflect the priorities of local communities. Public institutions should promote these customer-engagement activities through specific participation processes or including dedicated clauses in the long-term agreements.

There are several aspects that could help align the electrification plan with the social development of the newly-connected territory. The mere access to electricity does not unlock by itself the potential of productive end-uses in rural communities (IIED, 2019; WB, 2021). The

[53] These performance incentives may focus on service quality, customer services, or billing efficiency.

electrification strategy should include specific initiatives to facilitate the purchase of efficient appliances, foster the creation of small enterprises, or promote capacity building. The electrification plan should also include community services, as providing electricity to schools, hospitals, or water treatment facilities. Finally, the electrification strategy must consider a gender perspective. Beyond the common narrative according to which women are disproportionately affected by a lack of access to electricity or energy poverty, there is a growing awareness that women can also play an essential role in the effectiveness of the electrification plan, maximising its social impact (ESMAP, 2017; Winther et al., 2020). This could be reflected in the electrification strategy through specific assessments or initiatives targeting, for instance, female-led households.

Full questionnaire sent to country experts

The questionnaire is displayed in the following pages. Each item of the questionnaire has an introductory statement defining the topic, and a set of sub-questions. Experts can also provide further comments beyond raw scores.

Universal access

Do the existing policy, regulation, institutions, and business models make sure that everyone will have an adequate electricity supply on a sustainable basis?

nº	Question	Score (1 to 5)
1	*Priority from a political perspective*. Is universal electricity access a **political priority**, as compared with other important needs of the power sector and other economic sectors? Other needs of the power sector may include electricity supply for industrialization, improvement of the quality of service in urban centers, transmission interconnections, and the development of large generation plants for exports.”	
2	*A sufficient level of access, which may be context dependent, will be guaranteed for all*. Is there a **national electrification strategy** with a **minimum access target** that at least: meets some reliability and quality requirements, is being followed or at least somehow enforced, used as a guide, and updated as needed? These targets may be context-adapted (e.g., tailored for urban, rural, and isolated communities, etc.).	
3	*Attention paid to specific categories of consumers*. Does the national electrification strategy include special provisions for informal settlements, vulnerable households, and female-headed families?	
4	*Existence of a competent local entity in charge of achieving universal access, i.e., nobody is left behind.* Is there a **national champion** institution that has been given the responsibility to **achieve universal access**, with executive power and the technical competency to accomplish this mission, and the technological, human, and financial resources to do it?	
5	*The business model for grid extension is adequate for discos to do their part of the electrification plan.* Is the existing regulatory and **business model *for grid extension* adequate to supply demand for everyone** according to an electrification strategy as defined previously, on a permanent basis (i.e., in a financially sustainable regime)?	
6	*The business model for mini-grids is adequate for mini-grids to do their part of the electrification plan.* Is the existing regulatory and **business model *for mini-grids*** adequate to supply demand for everyone according to an electrification strategy as defined previously, on a permanent basis (i.e., in an economically sustainable regime)?	

7	*The business model for stand-alone systems is adequate to do their part of the electrification plan*. Is the existing regulatory and **business model *for stand-alone systems*** adequate to supply demand for everyone according to an electrification strategy as defined previously, on a permanent basis (i.e., in an economically sustainable regime)?	
8	*Full electrification needs a default provider: one that must supply where others would not – and a last resort provider: one that will take over supply where others have failed or quit.* Does the regulation explicitly include the roles of **default provider** and **last resort provider**?	
9	*The adopted regulation and business models must avoid resulting in a disorganized multiplicity of suppliers, technical standards, and contractual arrangements that will be difficult to coordinate in the future.* Are the present power sector structure and regulation and the national electrification strategy consistent with a **sound long-term vision** of the power sector in the considered country? Is electricity supply in the hands of "utility-like" entities?	

Comments:	

Integration of on- and off-grid solutions

Is there a national electrification strategy to be followed by an actionable plan that integrates all electrification models in an efficient manner, is supported by adequate regulation and business models, and is accepted by decision-makers?

nº	Question	Score (1 to 5)
1	*Existence of a competent local entity in charge of taking responsibility for the development and implementation of the national electrification plan.* Is there one or more institutions responsible for the **development and the implementation of a national electrification plan**? Is this institution technically able to manage the implementation of the plan, with executive power to accomplish this mission, and with the technical, human, and financial resources to do it? It is permissible that this institution consults third parties when developing the national electrification plan.	
2	*The plan must be based on least-cost principles and therefore must integrate the three modes of electrification.* Has the electrification plan been established following a **least-cost criterion**, employing GIS-based approaches, **considering all electrification modes** and the future transitions among them, subject to clearly specified objectives and constraints?	
3	*The development of the distribution segment must be consistent with other actions in the other segments of the power sector to achieve an efficient and reliable electrification target.* Is the electrification plan aligned with a **comprehensive power system development strategy** including generation, transmission, distribution, and off-grid development?	
4	*The electrification strategy and/or plan must be followed to be effective.* Is there a formal procedure of **monitoring and enforcing** targets concerning the **mix of electrification modes** that results from the electrification plan or strategy? Are these targets legally binding? Are electrification development partners' endeavours coordinated under the guidance of the national electrification strategy and/or plan?	

5	*The regulatory and financial environment should be able to attract mini-grid developers*. Are private developers of mini-grids **allowed to install, charge for, and operate** their facilities? Are there national programs which aim to develop mini-grids or support the development of mini-grids? Are there **licensing or authorization procedures for mini-grid operators**? Is there any regulation establishing the tariffs – or limits to the tariffs – for customers of mini-grids? Does the regulation consider any capacity thresholds or simplified procedures (e.g., depending on the technology or size of the mini-grid, etc.)? Are the procedures streamlined to facilitate the deployment of off-grid solutions, reduce administrative waiting times, and facilitate the procurement process?	
6	*The regulatory and financial environment should be able to attract stand-alone system developers*. Is there regulation requiring minimum quality standards for stand-alone systems? Are there national programs which aim to deploy stand-alone systems or **support the development of stand-alone systems**?	
7	*Regulation should exist that facilitates transfers between electrification modes.* Is there regulation ensuring that **future transitions among electrification modes happen smoothly** for customers and for the electricity suppliers? Specifically: Are there technical standards (i.e., a section of the distribution grid code) detailing the requirements for installing and operating mini-grids? Does regulation exist establishing when and what will occur if the main grid reaches a mini-grid or an area with a concession to deploy solar kits? Is the interaction between interconnected mini-grids and the main grid regulated? Is there any requirement to facilitate common access (or transfer of access) of consumer data?	
Comments:		

Financial viability

Are the present institutional, political, social, policy, legal, and regulatory conditions adequate to do business in the country, attracting substantial private investment in the distribution segment of the power sector?

nº	Question	Score (1 to 5)
1	*Substantial private investment in a country will only happen if some fundamental conditions exist.* How **easy is it to do business** in the country? Categories that can be considered are: starting a business, getting credit, protecting minority investors, paying taxes, and enforcing contracts.	
2	*One of the critical conditions to attract private investment into the power sector of a country is legal security, which must be based on a solid record of sound regulation, both the content of the regulation itself as well as the quality of the regulatory institutions*. How sound is the **regulatory framework** in the country? Categories that can be considered are: existence of a legal mandate, clarity of roles and objectives, independency of the regulator, transparency of decisions, and predictability of the regulatory framework.	
3	*The appetite for private investment in the distribution segment should be comparable with that for other power sector investment opportunities in the country.* Is the distribution segment obtaining a **share of the total amount of funding** that the power sector presently receives that can be considered adequate, given the typical distribution of investment expenditures into generation, transmission, and distribution, as well as the lack of access to electricity in the country?	
4	*Not only the volume of investment matters; how the funds are utilized is also important.* Are current expenditures on electrification within the distribution segment of the power sector **well-employed?** The answer to this question must consider whether funds have been employed in some electrification mode when they could had been used better in a different mode, the efficiency of procurement and operation activities, the choice of minimum levels of access, the adopted minimum reliability requirements, and the incurred level of public indebtedness, among other criteria.	

5	*Private investment in the distribution segment of the power sector can only happen if it is facilitated by the country's energy policy and regulation*. Is the distribution segment **unbundled** (at least on an accounting basis) from other segments of the power supply chain? **Is some form of PSP** (private sector participation, in property, management, or outsourcing of activities) **allowed in the distribution segment**?	
6	*A distribution concession model can be a plausible approach to attracting private investment and improving overall distribution performance in a country. Are conditions in the country suitable for the implementation of a distribution concession model?.* Can the adoption of a **distribution concession model** come in the form of a PPP (public private partnership) in the considered country? Do laws governing PPP exist? Are there clear processes and institutional responsibilities for selecting PPPs? Are defined PPP models available for distribution? Are unsolicited proposals, solicited proposals, or competitive tenders for power sector infrastructure investments possible?	
7	*A SDG7.1 compliant techno-economic business plan may be wishful thinking and fail to attract investment in the absence of a business plan specifying how the electrification process can be financed in a credible way.* **Does a business plan (financial plan) exist** that makes sure that the techno-economic electrification plan of any national electrification strategy can be viable? Are the present or envisioned funding mechanisms sufficient to cover the activities specified in the electrification plan?	
8	*Many developing countries are seriously indebted, and this may pose serious limitations to procuring loans necessary for executing electrification plans.* Could issues related to **sovereign debt** constrain the amount of financing that the country can get for its electrification plan? Are financial instruments available to distribution companies that could mitigate these financial constraints, such as DFI guarantees, escrow agreements for private distribution investors, or concessional lending not limited to government-owned companies?	
9	*Private investor confidence is possible only if cost recovery is expected, either through cost-reflective tariffs or through grants and subsidies.* Is the present business model for the **grid-connected distribution** segment financially viable? Is the annual revenue collected from end customer tariffs (reduced by the amount of theft and non-paid bills) able to recover the annual total cost of supply as determined by the cost-reflective regulatory revenue requirement? Are there publicly funded mechanisms to secure viability gap funding for grid extension in rural areas (i.e., the difference between the cost reflective annual revenue requirement and the estimated actual revenue collection from end customer tariffs)?	

10	*Private investor confidence in the mini-grid activity is possible only if cost recovery is expected, either through cost-reflective tariffs or through grants and subsidies.* Is the present business model for mini-grids financially viable? Is there an established revenue requirement calculation method for mini-grids? Are mini-grid tariffs regulated under a national uniform tariff approach? In case a viability gap exists, are there publicly funded mechanisms to secure viability gap funding for operators of mini-grids everywhere they are needed?	
11	*Private investor confidence in stand-alone systems is possible only if cost recovery is expected, either through cost-reflective tariffs or through grants and subsidies.* Is the present business model for stand-alone systems financially viable? Is there an established procedure to determine the revenue requirement for electricity supply with stand-alone systems? In case a viability gap exists, are there publicly funded mechanisms to secure viability gap funding for operators of stand-alone systems everywhere they are needed? Are there regulated tariffs under a national uniform tariff approach for subsidized customers supplied by stand-alone systems?	
12	*Is there sound regulation for expanding distribution through grid extension?* Do rules exist that mandate providing connection by the DSO (distribution system operator) where it has a concession or a license to operate? Are there rules imposing penalties or the removal of distribution licenses in case of noncompliance? Is there a grid code defining system operation rules for distribution? Regarding transparency and availability of data: are the balance sheets of public utilities publicly available? Is data regarding distribution grid operations and quality publicly available? Is there a clear and publicly available procedure to get the distribution authorization/license?	
Comments:		

Focus on development

Do the electrification plans contemplate "beyond electric supply" dimensions that facilitate human development?

nº	Question	Score (1 to 5)
1	*The economic and human development of non-electrified communities can only be achieved with electrification strategies that go beyond the supply of residential demand.* Does the plan include **productive uses** (e.g., agricultural, commercial, industrial activities, etc.)? Are the resources devoted to productive uses included in the national electrification plan sufficient in volume and tailored to the economic activity in the country/area?	
2	*The economic and human development of non-electrified communities can only be achieved with electrification strategies that go beyond the supply of residential demand.* Does the plan include **community facilities** (e.g., health centers, schools, administrative buildings, etc.)? Are the resources devoted to community uses included in the national electrification plan sufficient in volume and are they properly addressing the needs of the communities?	
3	*Most economic and community activities that are enabled by electricity access are only possible if the electricity supply meets acceptable standards of reliability and quality of service.* Does the business model for each electrification mode include incentives to provide an adequate level of reliability so that productive and community uses can happen?	
4	*Residential, commercial, and industrial customers may need some commercial and financial support and capacity building to make use of the opportunities that electricity access can provide.* Does the business model for each electrification mode include incentives to promote demand growth or to support the acquisition of appliances for residential, commercial, and industrial utilization (e.g., through microfinancing schemes, etc.)?	
5	*Careful regulatory design is needed for companies in charge of each electrification mode to experience the right incentives to perform well in terms of the elimination of "commercial" losses and other aspects related to customer engagement, even if these aspects are not directly related to electricity supply (e.g., participation of women in revenue collection activities, literacy or handicraft schools, financing social activities, etc.).* Does the business model for each electrification mode include incentives to	

	promote best practices in billing, revenue collection, and customer engagement regarding complaints and any other issues?	
6	*Universal access should promote the development of the entire society and it should pursue gender equality and the empowerment of women*. Does the electrification plan or strategy include a gender perspective? Does it consider specific instruments to provide access to female-headed households?	

Comments:	

Annex IV: Detailed Calculation of CO_2 Emissions

Under the Reference Business Plan, expected electricity demand from 2023 to 2030 to reach the total electrification of the country by 2030 is shown in Figure 78 below.

Reference Business Plan	2023	2024	2025	2026	2027	2028	2029	2030
Expected Demand (GWh)	3.925	4.442	4.967	5.881	6.923	8.153	9.607	11.342

Figure 78. Expected Demand Reference Business Plan (2023-2030)

Based on the expected electricity demand and the current country energy mix, we have obtained that the emission factor of the grid is 138.24 gCO_2/kWh (Aqachmar, 2022). Assuming this energy mix is maintained we can estimate the expected level of CO_2 emissions, although this is a very conservative assumption since the drive for renewable energies in underdeveloped countries is very strong. But since only grid expansion and densification are being evaluated within NewCo scope of business activity, we have decided not to alter current country energy mix and to assume that renewable energy will drive future on-grid investments and the mini-grids and off-grid PV sources.

Using the 138.24 gCO_2/kWh emission factor, the expected levels of annual CO_2 tons for the 2023-2030 period has been calculated and shown in Figure 79 below.

Reference Business Plan	2023	2024	2025	2026	2027	2028	2029	2030
Expected CO2 (Tons)	542.592	614.062	686.638	812.989	957.036	1.127.071	1.328.072	1.567.918

Figure 79. Emissions Reference Business Plan (2023-2030)

For the 2030 to 2040 period we have followed a similar approach assuming emissions factor will remain stable and electricity demand will increase alongside GDP as summarized in Figure 80 below.

Reference Business Plan	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Expected Demand (GWh)	12.113	12.937	13.817	14.756	15.760	16.831	17.976	19.198	20.504	21.898
Expected CO2 (K Tons)	1.675	1.788	1.910	2.040	2.179	2.327	2.485	2.654	2.834	3.027

Figure 80. Emissions Reference Business Plan (2031-2040)

Applying the same Deadweight rationale explained above (i.e., total electrification shall take place without the Proposed Reform by 2040) and building a simple regression to estimate a linear increase in demand between 2031 and 2040, the emissions Deadweight Figures 81 and 82 are obtained for the 2023-2030 and the 2031-2040 periods respectively.

Deadweight	2023	2024	2025	2026	2027	2028	2029	2030
Expected Demand (GWh)	2.401	2.927	3.453	3.979	4.505	5.031	5.557	6.083
Expected CO2 (Tons)	331.906	404.613	477.319	550.026	622.732	695.439	768.145	840.852

Figure 81. Expected Demand and Emissions Deadweight (2023-2030)

Deadweight	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Expected Demand (GWh)	6.608	7.134	7.660	8.186	8.712	9.238	9.764	10.290	10.816	11.342
Expected CO2 (K Tons)	914	986	1.059	1.132	1.204	1.277	1.350	1.423	1.495	1.568

Figure 82. Expected Demand and Emissions Deadweight (2031-2040)

As expected under an accelerated electrification plan scenario, Environmental Impact in terms of CO2 emissions due to power generation is expected to be negative since CO2 emissions from 2023 to 2040 would be higher if the Proposed Reform and the Reference Business Plan are implemented.

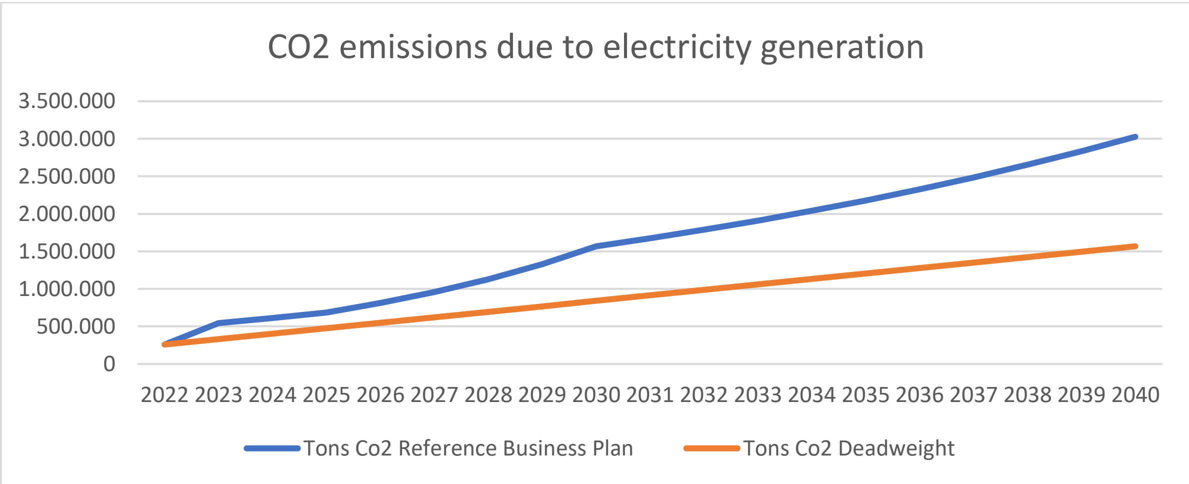


Figure 83. Expected CO2 Emissions due to electricity generation

If we subtract the expected tons of our reference scenario from the expected tons of the deadweight scenario, the result, year by year, is as follows:

	2023	2024	2025	2026	2027	2028	2029	2030
Expected CO2 (Tons)	210,686	209,449	209,319	262,963	334,304	431,632	559,927	727,066

Figure 84. Expectations of CO2 emissions

And then dividing it by the current connected population, year by year, we get an average of 90 kg of CO2 per connection point during the 2023-2030 period.

Kerosene CO2 emissions assumptions.

Analyzing the World Bank and IFC document "Solar Lighting for the Base of the Pyramid - Overview of an Emerging Market" we observe the following Figure 85.

Kerosene CO^2 emissions assumptions and methodology

Our assumptions appear below to facilitate comparison with estimates in the literature:

- Kerosene CO^2 emissions factor – according to commonly accepted estimates kerosene emits approximately 2.5kg of CO^2 per liter
- Kerosene use per household – we assume an average of 5 liters monthly per BOP household leading to 150kg of household CO2 emissions a year. The actual range on household kerosne use is wide with a review of 28 surveys from across the globe showing a variation from 3 to 30 liters per month of lighting fuel use. Our estimate draws on Lighting Africa market research on off-grid populations in five African countries and equates to the use of one kerosene wick lamp or two relatively more efficient kerosene hurricane lamps for 3-4 hours daily.
- Number of households – we estimate 110 million African off-grid households and 20 million on-grid households with very poor-quality grid connections and consequent reliance on fuel-based lighting

Figure 85. Kerosene CO2 emissions assumptions and methodology

Based on an emission factor of 2.5 kg of CO2 per liter of kerosene, and a range of consumption of 3 to 30 liters per month (as average consumption of a household in SSA), the direct annual emissions in a household range from 90 (3x2.5x12) to 900 (30x3.5x12) kg of CO2 per household.