THE ELECTRICITY ACCESS INDEX

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Two countries can report the same electricity access rate and yet face entirely different problems—one short of investment, another lacking a financeable business model and credible cost-recovery rules, a third needing only the political decision to allocate an affordable cost across its consumer base. The access rate alone hides these differences, and so do the electrification plans built on it. The Electricity Access Index (EAI) is a country-level diagnostic designed to expose them: it assesses whether the current electrification effort, and the policies and regulations under which it is deployed, are adequate to a financeable path to universal access. Applied to four contrasting cases—Rwanda, Malawi, Bangladesh, and Ecuador—it shows that countries fall behind for very different reasons even when they pursue the same goal. Some face a demanding but financeable scale-up. Some combine an investment gap with weak business models and limited regulatory credibility. Others are close to universal access and can readily finance the last mile through internal cross-subsidies, but lack the political commitment to decide how that cost is recovered. By making these differences explicit, the EAI shifts the assessment from how many people are connected to the binding constraint on delivery in each case.

1 INTRODUCTION

Universal electrification is not a single delivery problem. The scale of the remaining gap, the strength of the existing power system, the spatial distribution of demand, and the credibility of sector institutions all change what the "electrification effort" means in practice. Access metrics such as SDG7.1 and the Multi-Tier Framework (MTF) are essential for describing outcomes. SDG7.1 tracks the share of the population with access to electricity, while the MTF goes further and characterizes the quality of that access—capacity, availability, reliability, affordability, and safety—along a graded scale. Both are indispensable for measuring where a country stands. But both are outcome metrics: they describe the state of access at a point in time, not whether the current level of effort and the prevailing policies and regulations can actually deliver and sustain universal access. They do not by themselves show whether a given electrification pathway can be achieved under the fiscal, regulatory, institutional, and financial constraints a country actually faces. These differences matter because they shape what can be built, who can finance it, how costs can be recovered, and which regulatory arrangements can sustain the service over time.

Electrification must therefore be analyzed through the boundary conditions that shape it, rather than through a single generic model. A least-cost plan may be technically correct in very different

contexts, yet the implementation challenge will not be the same. A handful of conditions recur across comparative work[1] and repeatedly alter the delivery problem in material ways: the stage of electrification, the strength of the national backbone, the credibility of institutional, regulatory, and fiscal arrangements, and the trajectory of demand and revenue after connection. Together they determine the cost and timing of the rollout, the feasible mix of grid, mini-grid, and stand-alone solutions, and the tariff and subsidy architecture needed to sustain service over time. The stage of electrification sets who remains unserved and how costly they are to reach: low-access systems must expand service at scale, while high-access systems must close a smaller but harder residual gap. The strength of the national backbone determines whether electrification is mainly a distribution problem or whether generation and distribution must be planned together because the interconnected system does not reliably reach the territory. Institutional, regulatory, and fiscal credibility governs whether tariff reviews, subsidy settlement, and transition rules between grid and off-grid service are dependable enough to support investment. And the trajectory of demand and revenue after connection decides whether new customers can sustain the system, since a connection only creates value if consumption grows and payment can be maintained.

This contrast is visible at the regional level. In Sub-Saharan Africa, electricity access reached 53.3 percent in 2023, and the region accounted for most of the global population still without electricity. In Latin America and the Caribbean, access had already reached 98.4 percent. Central and Southern Asia sit between these poles but have moved fast in recent years, narrowing their access gap from 414 million people in 2010 to just 27 million in 2023. These figures point to fundamentally different implementation settings. In the first case, the central question is how to scale rollout under weak systems and limited fiscal space. In the second, the central question is how to reach the remaining population when those left behind are often the most expensive users to serve (IEA et al., 2025).

A high access rate is easy to mistake for a solved problem. When a country is close to full access, the people still without electricity are usually rural, poor, and isolated, and they consume little demand. Reaching them often means extending the grid over long distances or installing stand-alone systems, both of which cost more per user than the rest of the network. The difficulty is not only technical. It is also regulatory, fiscal, and political, because the system has to decide how that extra cost is recognized and who pays for it—a decision that remains even when the country can afford it.

These boundary conditions clarify the type of electrification problem a country faces, but they do not yet show whether its current response is adequate to that problem. Answering that question requires a diagnostic step. The purpose of this paper is to provide one. It introduces the Electricity Access Index (EAI) as a way to assess whether the present level of sector effort and the prevailing policies and regulations are adequate to those conditions, and then applies it to four countries—Rwanda, Malawi, Bangladesh, and Ecuador—that represent different classes of electrification problem. Throughout, the EAI is a conditional measure: it evaluates a given level of effort against a fixed target year—universal access by 2030—and asks how far that effort goes toward meeting it. The target year is itself part of the diagnostic rather than a fixed external assumption. Extending

[1] This comparative work draws on research developed within the MIT / IIT-Comillas Universal Energy Access Laboratory and on its application to universal electrification in Africa through the African School of Regulation (ASR). Related publications are available at https://universalaccess.mit.edu and https://africanschoolregulation.org

the target year, for example to 2040, would lower the required annual effort and change the resulting score; the index measures progress toward a specific deadline, so the resulting score reflects the chosen timeframe and should not be read as a fixed characteristic of the country.

2 THE ELECTRICITY ACCESS INDEX[2]

As set out in the introduction, boundary conditions explain why electrification problems differ across countries. They do not yet show whether the current response is adequate. For that purpose, this paper introduces the Electricity Access Index (EAI) (Pérez-Arriaga et al., 2022). The aim of the EAI is not to rank countries. It is a country-level diagnostic. Its role is to assess whether the present effort in the distribution segment is aligned with a credible path to universal access, and whether that effort is being deployed under rules and institutions that can sustain service over time.

The EAI focuses on the distribution segment because this is where universal access most often stalls. Here, distribution is understood broadly. It includes conventional on-grid distribution and retailing, but also mini-grids and stand-alone systems when they perform the last-mile function. This focus is deliberate. Standard access metrics such as SDG7.1 and the Multi-Tier Framework remain essential for describing outcomes, but they do not show whether the current effort is large enough, whether the rollout is financeable, or whether current regulations support implementation at the scale needed. The EAI was designed to address that gap by working at country level, using a total-expenditure perspective, and linking the engineering pathway to a country-specific financial plan.

2.1 CONCEPT AND SCOPE

The EAI has two components: sufficiency and effectiveness. Sufficiency asks whether the scale of current effort is close to the scale required for universal access, and whether the corresponding plan is financially viable. Effectiveness asks whether that effort is being allocated, governed, and regulated in a way that can plausibly deliver sustainable electrification. Here, "sustainable" means a utility-like service: supply that is reliable, professionally operated, and financially and institutionally able to endure over the long term rather than to degrade once initial support is withdrawn.

This distinction is important for the argument developed here. A country may be underperforming because the volume of effort is too low. It may also be underperforming because the effort is poorly organized, weakly targeted, or not supported by credible business models, tariff rules, or

[2] This paper builds on and extends the methodology introduced in:

- Pérez-Arriaga, I.J., Díaz-Pastor, S.J., Mastropietro, P., de Abajo, C. (2022). The electricity access index methodology and preliminary findings. MIT / Global Commission to End Energy Poverty working paper. Available at:

  https://www.iit.comillas.edu/publicacion/workingpaper/es/456/The_electricity_access_index_methodology_and_preliminary_findings

subsidy arrangements. The policy response is not the same in both cases. One points to an effort gap. The other points to an implementation gap.

Read in this way, the EAI sits between standard access measurement and full regulatory-financial design. It does not replace SDG7.1 or the Multi-Tier Framework. It complements them by asking a different question: whether the existing delivery system is organizing and financing electrification in a way that can plausibly sustain universal access.

2.2 SUFFICIENCY

The first component of the EAI is sufficiency. It compares the current annual financial effort devoted to universal electrification in the distribution segment with the annual effort required by a financially sound electrification strategy consistent with SDG7.1. The comparison is made in annual terms, and the relevant variable is total expenditure rather than investment alone. The metric therefore uses TOTEX, defined as CAPEX plus OPEX.

This choice matters because electrification does not end at connection. Sustainable service also requires operation, maintenance, repair, and future asset replacement. A metric that tracks only new investment can therefore overstate progress by ignoring the cost of keeping systems in service over time. This TOTEX perspective is one of the main differences between the EAI and more conventional investment-based exercises.

The numerator of the sufficiency ratio captures the present annual financial effort. It is built from observed expenditure on grid extension, mini-grids, and stand-alone systems, using publicly available country-level information from utilities and other investment sources, including financial statements and international reporting databases such as the OECD/DAC Creditor Reporting System.

The denominator is more demanding. It is not a simple engineering estimate. It is obtained from a country-specific techno-economic electrification plan and the associated financial plan required to achieve universal access by 2030. For each country, this denominator is based on a detailed business plan built over a 20-year horizon. The plan combines the annual TOTEX profile of the electrification pathway with expected revenues from regulated tariffs and the best feasible mix of public support, concessional instruments, and commercial finance. The EAI therefore does not stop at asking how much universal electrification would cost. It also asks whether those costs can be financed through a credible implementation plan under the tariff structure, subsidy mechanisms, institutions, and financing instruments actually available.

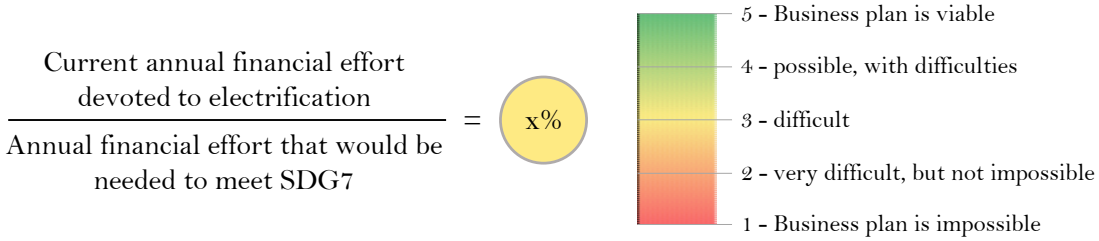

Figure 1. Graphical representation of the sufficiency component of the Electricity Access Index. Source (Pérez-Arriaga et al., 2022).

For that reason, sufficiency in the EAI has two dimensions, as shown in Figure 1. The first is the ratio between present effort and required effort. The second is the financial viability of the business plan used to compute the denominator. This second dimension is essential. A country may still be making less effort than required, but the remaining gap may nevertheless be financeable under credible public support and blended finance. In other cases, the deeper problem is that no plausible business plan can sustain the required rollout under prevailing regulatory, fiscal, and market conditions.

This viability dimension is assessed against practical infrastructure-finance criteria and is informed by consultation with experts in infrastructure finance, who review whether the country-specific business plan would be financeable under the prevailing institutional setting, risk profile, and available financial instruments. The result is then classified on a five-level scale, from impossible to viable, and translated into the color code shown in Figure 1. The index therefore captures not only whether the annual effort is large enough, but also whether the underlying universal-access plan is financially credible. Further methodological detail is provided in the Annex.

This component is especially relevant for the broader argument developed here, which is concerned not only with least-cost pathways, but with the missing step between least-cost planning and implementable delivery. The sufficiency component moves in that direction because it translates an electrification pathway into an annual financial requirement and then asks whether that requirement can be supported by a credible business plan. In that sense, it is much closer to the feasibility problem that motivates this analysis than a simple access-rate indicator.

2.3 EFFECTIVENESS

The second component of the EAI is effectiveness. If sufficiency asks whether enough effort is being made, effectiveness asks whether the current electrification strategy is structured and governed in a way that can plausibly deliver universal access. The focus is therefore not only on the volume of effort, but also on the quality of the institutional and regulatory environment in which that effort is deployed.

This component of the index is organized around four principles derived from the Integrated Distribution Framework[3]. The first is universal access. Electrification should leave no one behind and should assign clear responsibility for service in a defined territory. The second is the integration of on- and off-grid solutions. Grid extension, mini-grids, and stand-alone systems should be planned and coordinated as parts of one strategy rather than as separate programs. The third is financial viability. Distribution must rest on a business model that can sustain service over time, often through some form of concession or other long-term arrangement that provides legal security, supports external investment, and covers any remaining viability gap. The fourth is a focus

[3] The Integrated Distribution Framework (IDF), as introduced in the original EAI working paper, is the outcome of a collective research effort developed within the MIT / IIT-Comillas Universal Energy Access Laboratory over several years. The work was initially supported by the Shell Foundation and later developed in collaboration with the Global Commission to End Energy Poverty (GCEEP), with support from The Rockefeller Foundation. In this paper, the term Integrated Framework for Electrification (IFE) is used to refer to the broader and updated formulation of that framework. The approach has also been championed by the African School of Regulation (ASR) in the context of universal electrification in Africa. Additional related publications are available at: https://universalaccess.mit.edu.

on development. Electrification should support productive use, critical public services, and broader social and economic gains (GCEEP, 2020).

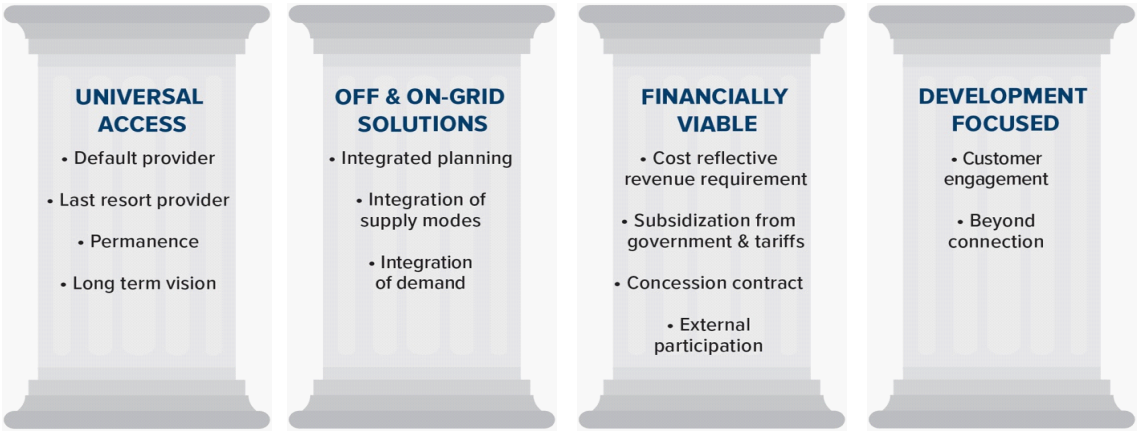

Figure 2. Graphical representation of IDF principles. Source (GCEEP, 2020).

This is also the point at which regulation becomes central in the analysis. The effectiveness component does not treat regulation as background context. It examines whether the regulatory and institutional environment is consistent with durable electrification. The assessment therefore asks whether adequate business models exist for grid extension, mini-grids, and stand-alone systems; whether planning is integrated across electrification modes; whether transition rules are clear when the grid reaches an area already served by a mini-grid or a stand-alone system; whether cost recovery or viability-gap support is available; and whether the sector provides enough legal and regulatory certainty to attract external capital. Regulation is therefore not outside the EAI. It is embedded most directly in the effectiveness assessment.

The effectiveness score is constructed through a 34-item questionnaire completed by country experts. Each item is scored from one to five. Items are grouped under the four pillars, which allows the calculation of both pillar-specific scores and an overall score for each country. A color code is then used to provide an intuitive graphical representation of the results. This is an important methodological choice. Existing instruments such as RISE and the Electricity Regulatory Index, together with broader business-climate references such as Doing Business and the Global Competitiveness Report, provide useful information on parts of the enabling environment, but they do not assess electrification strategy from the perspective required by the EAI. The specific questionnaire was designed to fill that gap (African Development Bank, 2021; Schwab and Zahidi, 2020; World Bank, 2020a, 2020b).

This component is especially valuable here because it separates two problems that are often mixed. A country may be underperforming because the volume of effort is too low. But it may also be underperforming because the effort is poorly structured, weakly coordinated, or not supported by credible regulatory and fiscal arrangements. The policy response is not the same in each case. A sufficiency gap calls for more resources or a different financing envelope. An effectiveness gap calls for changes in planning, regulation, implementation, or governance. The EAI makes that distinction visible and provides the diagnostic bridge to the country evidence that follows.

3 RESULTS: FOUR COUNTRIES, FOUR DIFFERENT FEASIBILITY PROBLEMS

All figures in this section refer to the 2022 baseline datasets used in the first EAI country applications. The purpose is not to rank countries. It is to show that the same universal-access target can correspond to very different feasibility problems once the analysis moves beyond access outcomes and considers financeability, implementation rules, and the time profile of the rollout. This is the central reason for using the EAI here. The index is useful not because it produces one more score, but because it shows which parts of the electrification strategy need to improve in each country and how difficult compliance with SDG7.1 may be at country level.

3.1 HOW THE RESULTS SHOULD BE READ

Before turning to the four country applications, it is useful to clarify how the EAI is meant to be read. The original EAI working paper makes this point with three stylized country profiles, as represented in Figure 3.

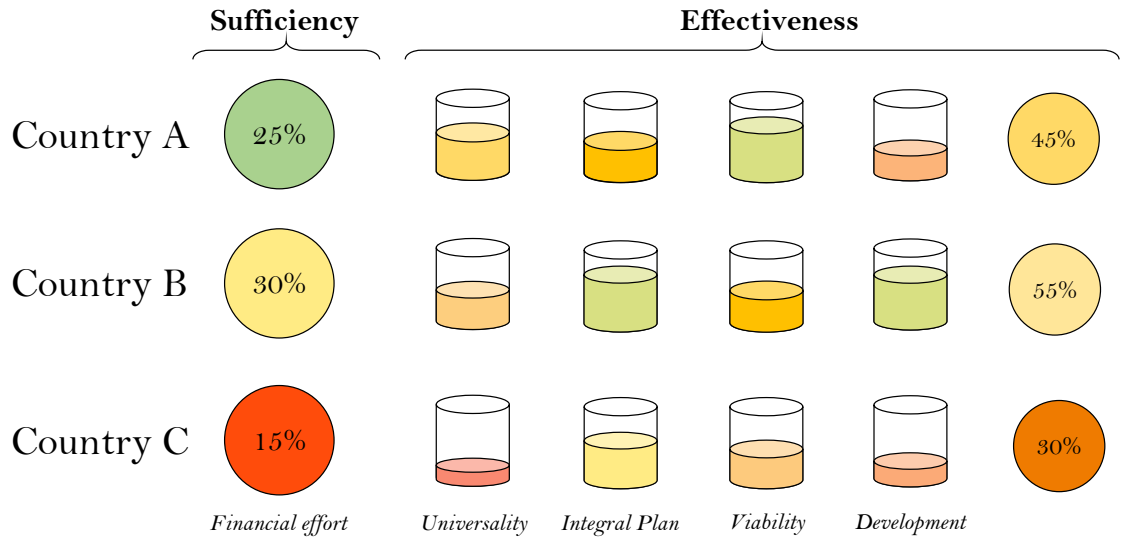

Figure 3. Possible presentation of the Electricity Access Index for three hypothetical countries. Source (Pérez-Arriaga et al., 2022).

The first is a country close to universal access, where the absolute financing need is not large, but progress remains slow because there is no political agreement to build and implement a credible financial plan. The second is a country that is investing and may even have a potentially viable business plan, but where progress is still too slow because the electrification strategy is incomplete, especially when grid and off-grid solutions are not properly integrated. The third is a country with a very large access gap, severe fiscal constraints, and no viable business model capable of supporting universal access under current conditions. The purpose of those stylized examples is not to replace real country analysis. It is to show that low sufficiency can mean very different things, and that the same universal-access target can fail for very different reasons.

For the same reason, the index is not meant to be collapsed into a single ranking: similar access outcomes can rest on very different feasibility problems, and those differences are sharp even between neighboring countries in the same region. The four real cases below make this concrete.

A final note on interpretation is necessary. The sufficiency component has two dimensions: the ratio between current effort and required effort, and the financial viability of the business plan behind the denominator. That denominator is always the country-specific business plan required to reach universal access by 2030. The sufficiency results are therefore conditional on that target year. If the horizon were extended, the annual effort requirement and the financing profile would change. The depth of the available evidence also differs across the four countries. The effectiveness component was assessed in full only for Malawi, drawing on a complete expert questionnaire; for Rwanda, Bangladesh, and Ecuador the assessment rests on the sufficiency component and on the structure of the underlying business plan, and the summary table reports effectiveness as not available for these three. The five-level viability rating of the business plan is likewise available on a fully comparable basis only for part of the sample. For that reason, the second dimension is read here through the structure of the business plan itself: the balance between internal cash generation and external finance, the use of tariff support and cross-subsidies, the period of negative operating cash flow, and the overall dependence on grants and subsidies. This is also consistent with the feedback received from infrastructure-finance review. The general approach was judged sensible and intuitive, but the reviewers stressed that viability depends strongly on the technology mix and on the predictability of cash flows, including remuneration rules and the treatment of losses and theft.

Table 1. Summary of the four country applications [4].

Country	***2022 access rate (national / rural)***	***Sufficiency***	**Effectiveness**	***CAPEX to 2030 (USD million)***	***Net operating cash flow to 2030 (USD million)***	***Main external financing (USD million)***	***Explicit tariff support***
Rwanda	35% / 23%	62%	n/a	1,462	1,427 *	Grants 300; commercial debt 240; equity 200	Indexation + 10% over inflation for commercial and industrial consumers
Malawi	18% / 10%	11%	32%	4,059	788 *	Grants 1,600; commercial debt 1,620; equity 800	Indexation only; no explicit cross-subsidy
Bangladesh	85% / 78%	72%	n/a	4,409	10,789	Grants 200; commercial debt 210; equity 150	Indexation + 50% over inflation for commercial and industrial consumers, declining to zero by 2030

[4] * For Rwanda and Malawi, net operating cash flow includes external subsidies to the distribution segment. Effectiveness was assessed in full only for Malawi; "n/a" indicates that a comparable effectiveness score is not available for the other countries.

Ecuador	97% / 90%	45%	n/a	525	348	Concessional debt 220	Indexation + 5% over inflation for highest-consumption users

3.2 RWANDA: LOW ACCESS ALONGSIDE A BROADLY FEASIBLE FINANCING PATH

Rwanda is the clearest example in the sample of a low-access country whose financing problem is still difficult, but not structurally broken. National access is only 35%, and rural access is just 23%. The population is mostly rural, and average electricity consumption remains very low at 55 kWh per capita per year. On a simple access reading, Rwanda would appear very far from universal access. The EAI gives a more nuanced picture. Its sufficiency score reaches 62%, which is high relative to its access level and clearly above the weaker African case in the sample.

The business plan explains why. The electrification path requires about USD 1.46 billion of CAPEX up to 2030. This is still a major effort. It is equivalent to seven times the opening value of the distribution asset base and ten times average operating cash flow during 2021–2030. Yet the plan is not built on grants alone. Net operating cash flow reaches USD 1.427 billion by 2030. Grants add USD 300 million, commercial debt adds USD 240 million, and equity adds USD 200 million. The transition is also relatively short: operating cash flow turns positive after only two years, and the cumulative funding gap to be bridged before that point is only USD 30 million. A short and shallow negative-cash-flow phase matters because it limits the working-capital and bridge-financing burden the sector must carry before revenues can cover ongoing costs. As the next paragraph makes clear, however, that early turn to positive cash flow rests in part on subsidies to the distribution segment, so it should be read as conditional support for feasibility rather than evidence of stand-alone bankability.

Rwanda also shows clearly that tariff design is part of the financing architecture, not a secondary detail. The plan assumes tariff indexation for all users and an additional increase of 10% over inflation for commercial and industrial consumers. In other words, part of the rollout is supported through an explicit redistribution inside the tariff system. At the same time, the plan still relies on subsidies to the distribution segment, which are included in the operating cash flow. The important point is therefore not that Rwanda can electrify without public support. The important point is that support, internal cash generation, debt, and tariff design are combined in a way that makes the scale-up challenge look conditionally workable.

Rwanda is therefore a useful benchmark. It shows that low access does not automatically imply financial impossibility. A country can still face a large rollout challenge and yet present a financing structure that is much closer to feasibility than the headline access rate would suggest. That is one of the main reasons why access rates alone are too crude for these purposes.

3.3 MALAWI: INSUFFICIENT EFFORT AND A PLAN THAT IS NOT FINANCEABLE

Malawi sits at the opposite end of the spectrum. It is also a scale-up case, but here both the effort gap and the implementation problem are much more severe. National access is 18%, rural access is only 10%, GDP per capita is USD 395, and inflation is 9.5%. The country therefore enters the analysis not only with a large access gap, but also with a much weaker macro-fiscal base than Rwanda.

The sufficiency result captures that weakness immediately; the score is 11%. The current effort is far below the level that would be required for a plan to reach universal access by 2030.

The financing structure confirms that conclusion. Up to 2030, the business plan requires about USD 4.06 billion of CAPEX, but internal net operating cash flow contributes only USD 788 million. The plan therefore relies heavily on external support: grants of USD 1.6 billion, commercial debt of USD 1.62 billion, and equity of USD 800 million. Cash flow only turns positive after five years, and cumulative negative operating cash flow reaches USD 564 million before that point. CAPEX is forty-six times the opening value of the distribution asset base and fifty-one times average operating cash flow during 2021–2030. This is a much more stressed financing profile than Rwanda's.

What makes Malawi especially important is that the problem goes beyond the ratio itself. The fuller country application shows that an EAI-compatible plan for Malawi would require 6.3 million new connections and about USD 5.9 billion of investment, whereas the national strategy envisaged only 1.5 million connections and about USD 930 million. The gap is therefore not a small modelling adjustment. It is a large mismatch between the scale of the stated objective and the scale of the financing problem that must be solved.

The financing side is equally stark. Grants and subsidies together cover more than 60% of total financing needs. By ordinary infrastructure-finance standards a plan that depends on concessional and grant funding for the majority of its capital base is not bankable: it cannot raise commercial debt or equity at scale, because the system-wide revenue requirement is not expected to be recovered—whether through tariffs, structured cross-subsidies, or credibly settled public support—under the prevailing remuneration and cost-recovery rules. This is the clearest case in the sample where the first and second dimensions of sufficiency point in the same direction. Malawi is not only spending too little. Under current conditions, the implied plan to reach universal access by 2030 is also not financeable.

Malawi is also the only case in this section for which the effectiveness side is available in full, and it changes the interpretation in an important way. The overall effectiveness score is 32%. The weakest pillar is development focus. The strategy does not set clear requirements for the quality and reliability of supply needed for productive uses, and it does not provide strong incentives for demand growth. The score on financial viability is also poor because there is no robust business model for any of the three electrification modes and no proper business plan with adequate funding mechanisms. On universality and on the integration of on- and off-grid solutions, the picture is

mixed: Malawi performs better on the existence of a least-cost plan and some elements of governance, but worse on permanence of supply, last-resort provision, monitoring and enforcement, coordination with broader power-sector planning, and the regulation of transitions between electrification modes.

The broader sector context helps explain why. The transmission and distribution utility, ESCOM, has been in financial hardship, tariffs are not cost-reflective, and the off-grid sector was historically constrained by regulation. Merchant mini-grids were allowed to operate only under regulated tariffs that did not match the underlying risk, which helps explain why mini-grid development depended mainly on donor-funded projects. Malawi is therefore not only a case of insufficient effort. It is a case where insufficient effort, weak business models, and weak regulatory credibility reinforce each other.

3.4 BANGLADESH: A STRONG REVENUE BASE SUPPORTS FEASIBILITY

Bangladesh is the strongest case in the sample from the point of view of sufficiency. National access is already 85%, with rural access at 78%, but the country still faces a large absolute challenge because of its population size. The relevant point is therefore not that the remaining gap is small. It is that the financing structure supporting the path to universal access is much stronger than in the other cases. The sufficiency score reaches 72%, the highest in the group.

The main reason is the revenue base. CAPEX to 2030 reaches USD 4.409 billion, but operating cash flow reaches USD 10.789 billion. External support is comparatively small: USD 200 million of grants, USD 210 million of commercial debt, and USD 150 million of equity. The plan has no period of negative operating cash flow. CAPEX is only 0.4 times the opening value of the existing assets (PP&E) and four times average operating cash flow during 2021–2030. In practical terms, Bangladesh is the case where internally generated cash flow, rather than external support, carries most of the financing requirement—the configuration that makes a plan self-sustaining and readily bankable.

The tariff assumptions reinforce that result. The plan includes tariff indexation for all users and a strong cross-subsidy from commercial and industrial consumers: an additional increase of 50% over inflation at the start of the period, which then declines gradually to zero by 2030. This is the strongest tariff redistribution mechanism in the sample. It shows how a broader and stronger connected base can make a material difference to feasibility.

Bangladesh is therefore a key comparator. It shows that electrification stage does not determine sufficiency mechanically. Bangladesh does not have the highest access rate in the sample. Ecuador does. But Bangladesh has the strongest sufficiency outcome because its business plan rests on much stronger internal cash generation and a tariff structure with greater redistributive capacity. This is exactly the kind of difference that a simple access metric cannot reveal.

A note of caution is still needed. The current evidence provides a strong view of the financing side, but not a fully comparable effectiveness score like the one available for Malawi. The right

conclusion is therefore narrower. One can say with confidence that Bangladesh's business-plan side is much stronger than in the other cases. One cannot say, on the basis of the evidence used here, that every aspect of its broader implementation environment is equally strong.

3.5 ECUADOR: NEAR-UNIVERSAL ACCESS, WHERE THE LAST MILE IS A POLITICAL RATHER THAN A FINANCIAL CONSTRAINT

Ecuador is the clearest residual-gap case in the sample. National access is already 97%, urban access is 100%, rural access is 90%, and average electricity consumption is much higher than in the other cases, at 1,376 kWh per capita per year. On a conventional access reading, Ecuador looks almost complete. The EAI shows why that reading is incomplete. Its sufficiency score is only 45%, which is well below Bangladesh and also below Rwanda, despite Ecuador's far higher access rate.

The reason is not that Ecuador faces the same type of challenge as Malawi or Rwanda. It does not. The remaining cost is modest in absolute terms and well within the sector's means: CAPEX to 2030 reaches only USD 525 million, net operating cash flow already contributes USD 348 million, and the residual gap—around USD 220 million—is covered through concessional debt, with no grants, equity, or commercial debt required in the baseline plan. Operating cash flow is positive from the outset. The high ratio of CAPEX to operating cash flow (about fifteen times the 2021–2030 average) reflects the low remuneration of the remaining users rather than any system-level financing shortfall. In other words, the last mile is readily financeable; what it requires is a deliberate decision about how its costs are recovered.

Tariff policy again forms part of the financing architecture. Ecuador's plan assumes tariff indexation for all users and an additional increase of 5% over inflation for the highest-consumption categories. This is a smaller redistributive effort than in Rwanda or Bangladesh, but it is also the key to the case: Ecuador's large, high-consumption connected base gives it ample room to recover the residual cost through internal cross-subsidies without straining any individual consumer group. The financing instrument is therefore available; the binding question is whether the system chooses to deploy it. The last mile does not pay for itself simply because most of the country is already connected—but in Ecuador it can comfortably be paid for by the rest of the system.

This is the key lesson from Ecuador. High access does not remove the financing problem. It changes its form. The remaining users are fewer, but they are harder to reach and less remunerative, and their costs can no longer be absorbed unnoticed within a large-scale expansion of the system. The challenge therefore shifts from financing capacity, which Ecuador has, to cost recognition and the political management of who pays for the final connections—the explicit allocation of those costs across the connected base. That is precisely why residual-gap electrification deserves separate treatment.

4 DISCUSSION

Taken together, the four applications make the value of the EAI much clearer than a single country narrative can.

The first result is direct: none of the four countries is yet on a sufficient effort path to achieve universal access by 2030. Bangladesh is the strongest case, but even there the score reaches only 72%. Rwanda reaches 62%. Ecuador reaches 45% and Malawi obtains 11%. This confirms the broader warning in the EAI work that current electrification effort is often insufficient once the analysis is done in TOTEX terms and at country level.

The second result is that access rates do not translate mechanically into financeability. Ecuador has by far the highest access rate in the sample, yet its sufficiency score is below Rwanda's and far below Bangladesh's. Bangladesh has a lower access rate than Ecuador, but a much stronger business plan because internal cash generation is much stronger. Rwanda and Malawi are both low-access African countries, but their financing structures differ sharply. The distance to 100% access matters, but it does not by itself identify the real delivery problem.

The third result is that tariff architecture and financing mix are part of the diagnosis, not technical detail. Rwanda and Bangladesh rely on explicit cross-subsidies from commercial and industrial consumers. Ecuador applies the same logic, but on a smaller scale and only to high-consumption users. Bangladesh stands out because internally generated cash flow carries most of the financing requirement. Rwanda combines internal cash generation with grants to CAPEX, equity, debt, and subsidies. Ecuador has the means to finance its residual gap internally—its high-consumption base leaves room for cross-subsidy—so its lower score reflects an unresolved choice about cost allocation rather than a shortage of financing. Malawi, by contrast, depends heavily on granted assets, debt, and external subsidies to recover the revenue requirement while internal cash generation remains weak. These are not side notes. They are the mechanisms that determine whether the same access goal can be financed at all.

The fourth result is that the time profile of the plan matters greatly. Bangladesh and Ecuador start with positive operating cash flow. Rwanda reaches that point after two years. Malawi needs five. A long negative-cash-flow period makes a rollout plan more fragile, more dependent on credible settlement, and more exposed to regulatory reversal or fiscal stress. This is another reason why the EAI is useful: it brings time and financing structure into the assessment instead of leaving them hidden behind access outcomes.

The fifth result comes from the only country where the effectiveness component is available in full. Malawi shows that low sufficiency and low effectiveness are not the same problem, but they can reinforce each other. The country is not only underinvesting relative to need. It also lacks robust business models, clear incentives for demand growth, strong transition rules across electrification modes, and a funding structure that can support permanence of supply. This is why Malawi is the strongest illustration in the sample of a country facing both an effort gap and a governance gap.

The broader conclusion is therefore straightforward. These countries do not differ only in how many people remain unserved. They differ in the structure of the feasibility problem that must be solved. Some face mainly a last-mile problem in which financing capacity exists and the binding question is the political allocation of cost. Some face a scale-up problem with a potentially workable financing path. Some face a scale-up problem under much weaker fiscal and regulatory conditions. That is the main empirical result. It shows why access metrics alone are not enough and why a serious assessment must move from diagnosis to differentiated regulatory and financing design.

5 CONCLUSION

This analysis has shown that the electricity access deficit is not a single delivery problem. Countries with similar access gaps may face very different feasibility conditions once the analysis moves beyond headline access rates and considers financing structure, revenue capacity, regulatory credibility, and the time profile of the rollout. This is the main value of the Electricity Access Index. The EAI does not add one more country ranking. It helps distinguish different implementation problems that would otherwise remain hidden behind similar access outcomes.

The country evidence points to three main conclusions. First, current electrification effort is often insufficient once both capital and operating expenditures are considered relative to a path to universal access by 2030. Second, the nature of the constraint differs across countries: in some, under prevailing rules and financial instruments, a universal-access plan compatible with SDG7.1 is not financially viable at all; in others, the financing capacity exists and the binding constraint is instead a political decision about how the residual cost is recognized and allocated across the connected base. Third, weak implementation environments can reinforce the financing problem. Even when the required expenditure can be identified, the strategy may still fail if business models are weak, coordination across delivery modes is poor, tariff and subsidy rules are not credible, or transition rules between grid and off-grid systems remain unclear.

These findings also show why effectiveness, and sufficiency should not be collapsed into a single measure. A country may underperform because the scale of the effort is too small. But it may also underperform because the effort is poorly structured or not supported by credible institutional, regulatory, and fiscal arrangements. The policy response is not the same in each case. A sufficiency gap calls for more resources or a different financing envelope. An effectiveness gap calls for changes in planning, regulation, implementation, or governance. In several countries, both constraints are present at the same time.

A methodological warning follows directly from this exercise. It remains extremely difficult to track electrification effort at country level, especially in the distribution segment and especially for off-grid activities and operational expenditure. No global database provides a complete picture, and even relatively transparent national institutions rarely record on-grid and off-grid effort in a comparable way. This data fragmentation may partly reflect the multi-actor nature of universal access, but it has serious consequences. Without consistent country-level tracking, it is difficult to follow progress, set realistic milestones, or identify where effort and reform must be strengthened most urgently.

The broader implication is that aggregated regional assessments are not enough. The starting point of any serious assessment should be a country-specific techno-economic and financial plan, interpreted together with the institutional and regulatory conditions under which it must be implemented. Countries in the same region may face very different combinations of access gaps, fiscal constraints, and governance weaknesses. Two neighboring countries may appear similar in access terms and yet differ sharply in their ability to finance and sustain universal access.

The EAI does not by itself provide a final regulatory-financial solution. What it does provide is a disciplined diagnosis of the type of feasibility problem each country faces. That diagnosis is the necessary starting point for the differentiated regulatory and financing design that durable universal electrification requires, which must be developed separately for each class of boundary-condition setting.

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ANNEX

DETAILED DESIGN OF THE ELECTRICITY ACCESS INDEX

1 SUFFICIENCY COMPONENT

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).[5]

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.

[5] See the MIT / IIT-Comillas Universal Energy Access Laboratory: https://universalaccess.mit.edu

- 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.
- As the business plan expands over a 20-year horizon, 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, the decade following the universal-access target year, 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 the end of that second period 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 4.

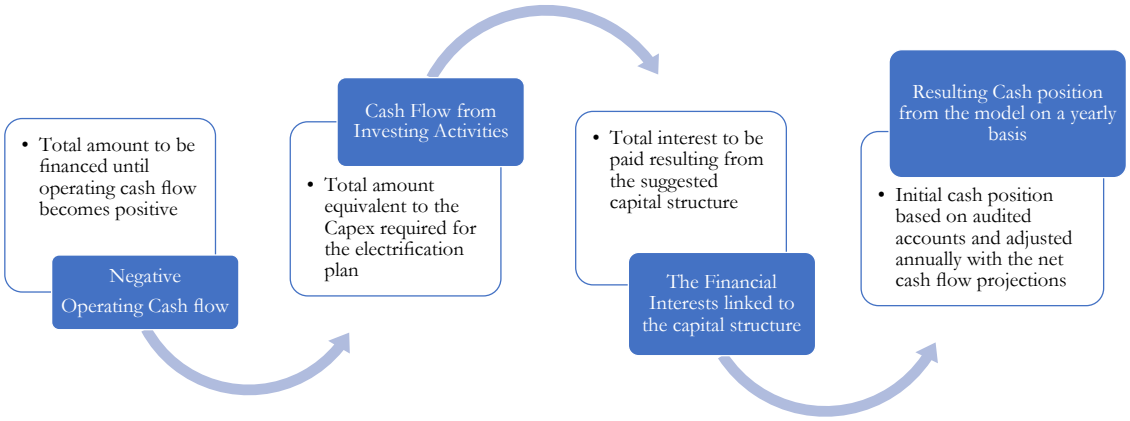

Figure 4. Term-by-term determination of the total amount to be financed.

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 1.

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.[6]
- 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

[6] 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.

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 second period, after the heavy investment phase, is also of 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)
  - 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.

2 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: universal access, integration of on- and off-grid solutions, financial 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 5.

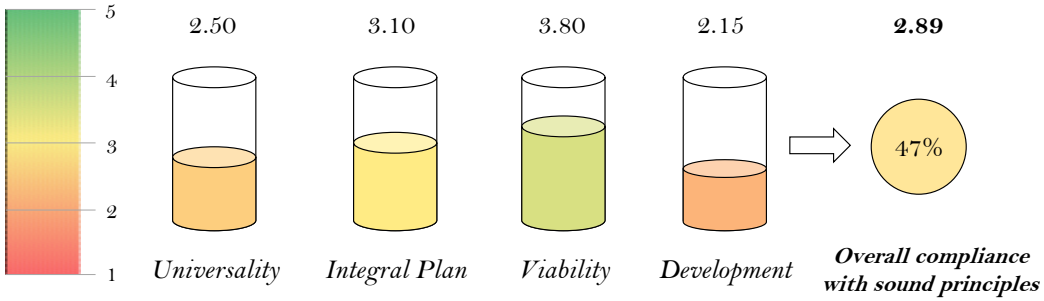

Figure 5. Example of the results of the effectiveness component of the Electricity Access Index.

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.

2.1 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[7] 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

[7] There are different methodologies to define service level in electrification programmes (Bhatia and Angelou, 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.

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.

2.2 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 main grid eventually reaches an area covered by a minigrid ((Tenenbaum et al., 2018)). 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.

2.3 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[8]. 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.

2.4 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 (IEA et al., 2025; Johnstone, 2019). The 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 (Dutta et al., 2017; Winther et al., 2020). This could be reflected in the electrification strategy through specific assessments or initiatives targeting, for instance, female-led households.

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

3 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.

3.1 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:		

3.2 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:	

3.3 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:		

3.4 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:		