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Global Energy Alliance for People and Planet

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EXECUTIVE SUMMARY

Powering Social Infrastructure in Sierra Leone:

Market Assessment and Roadmap for Schools

Acknowledgements

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Objectives, Scope and Approach

Rationale

- Data on powering social infrastructure (healthcare facilities and schools) is sparse, outdated, and stored in multiple locations.
- There is limited coordination between energy and health and education sector actors (e.g., choice of locations for interventions, maintenance of installed infrastructure, appliances and investments in social infrastructure).
- There is a need to understand the investment need to bridge the energy access gap in schools.
- There is a lot of duplication happening across multiple interventions (e.g., needs assessment tools, system design, research on medical appliances, testing sustainable delivery models).

Roadmap objectives

01 Provide the government and its development partners with market intelligence and the evidence base for advancing electrification of healthcare facilities and schools in Sierra Leone

02 Provide the strategic information and implementation guide needed by governments and their partners to increase investment on powering social infrastructure and efforts on the their sustainability.

03 Provide practical recommendations targeted at the government and its development partners in terms of the planning and coordination of electrification efforts for schools and healthcare facilities in Sierra Leone.

02 | Market Assessment

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Access to electricity could transform challenges into opportunities for improved education service delivery

Access to improved education infrastructure and services will lead to improved outcomes on education

Unreliable energy access leads to poor education services and outcomes

- 74% of population do not have access to electricity
- ~45% of senior secondary schools have no access to electricity
- Absence of electronic/digital learning gadgets and systems to facilitate e-learning
- 36% of school age children who should be senior secondary school are out of school.
- Inadequate funding and financing of education institutions and delivery systems
- Operational and infrastructural challenges continue to impede service delivery of educational institutions countrywide
- Completion rates remain very low throughout the country; 22% for senior secondary school; 44%; junior secondary school and 64% for primary school.

Demand challenges

- The electrification gap is still very large. Although access to electricity is improving, the rate of electrification is still slow as the demand for electricity continues to grow rapidly.
- Lack of access to financing mechanisms for providers and end users
- Inadequate access to electricity for social/public services such as healthcare facilities

Education financing and donor funding

- GoSL is strengthening partnerships with Ips to increase funding for improved education service delivery and outcomes
- GoSL has shown strong leadership, determination and political will to increase spending on education
- GoSL is tracking donor commitments and channeling resources to schools in need of sustained attention to achieve quality education outcomes.

Key Policy Actions

GoSL remains committed to:

- Improving governance at all levels and ensuring rural electrification is done through engagement and involvement of key stakeholders, including the private sector.
- Improving policy and regulatory environment – e.g., Government unbundled the power sector in 2015 and created new state utilities.
- Continuing to explore renewable energy sources, especially solar and hydro-power and increase investment for off-grid locations.

- Implementing the FQSE initiative on providing free tuition to all children in government-approved schools.
- Strengthening digital learning systems to ensure schools and learners are equipped with connectivity and the learning devices they need.
- Maintain the share of education budget to the total national budget at 15-20%, which is the largest national share per sector compared to other development sectors.

Improved energy access will lead to improved quality of education services and better outcomes

- GoSL plans to increase installed electricity capacity from 160 MW (in 2022) to 850 MW by 2030and restore electricity in all district headquarters and cities.
- GoSL plans to increase renewable energy contribution to 80% by 2030 – at least twenty villages and eight towns in each district connected to the national grid or off-grid standalone schemes.
- Together with increased budgetary spending on education, these electrification plans could help transform the education sector from an under-resourced, ill-equipped, underperforming delivery system into a well resourced and functioning education system that is accessible for all school going children throughout the country.

Source: MoE. Energy transformation. Sector goals and Development partner alignment. June 2022

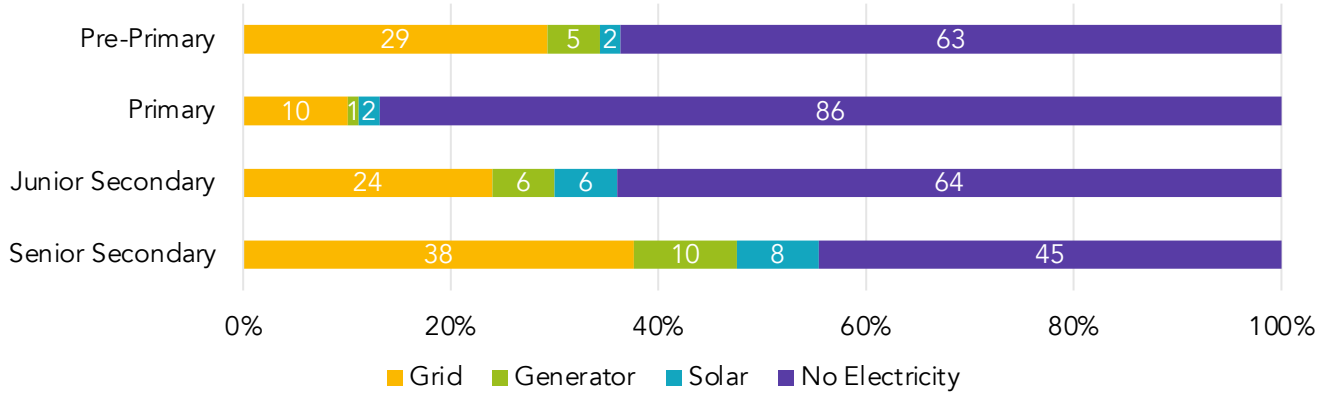
Inter-sectoral coordination on powering social infrastructure

- There is currently no formal inter-ministerial coordination platform that focuses on electrification of social infrastructure such as healthcare facilities and schools. Therefore, coordination between MoHS and MoE or MBSSE and MoE is ad-hoc and driven by emerging needs. Also, there is currently no mechanism for coordination between ministries and stakeholders specifically on powering healthcare or schools.
- However, several coordination mechanisms exist to facilitate discussions on intervention among key players in the sectors. For instance, the Health Sector Coordinating Committee (HSSC) is the highest coordinating body for the MoHS and its development partners. Similarly, the Health Development Partners (HDP) forum and Health NGOs forum both meet monthly. Both are occasionally attended by government stakeholders in order to brief the partners on various activities and issues.
- MoHS is currently examining the issue: senior advisers to the Ministers are currently working through the office of the Deputy Minister to coordinate all interventions related to health facility electrification, with proposed plans to establish a maintenance unit within MoHS that will be responsible for O&M of installed solar PV systems at healthcare facilities countrywide. It is expected that this unit will coordinate with officials at MoE. No such plans are currently envisaged for MBSSE in the education sector.
- Informal discussions are currently ongoing for a multistakeholder platform on powering social infrastructure (incl. civil society, donors, private sector and government stakeholders). Virtual and in-person meetings have been held to discuss key issues related to powering social infrastructure in Sierra Leone, such as the sustainability of solar PV technology after installations and the related O&M issues.

School electrification status: general overview and analysis

1 Access to power is still very low

- The Annual School Census (ASC) captures data on school infrastructure including electricity access. Access rates at all school levels combined have remained very low (22.5%) compared to 2019 (22.0%): Out of a total of 11,034 schools, only 1,845 schools are connected to the national grid.
- 63% of pre-primary schools, 86% of primary schools, 64% of junior secondary schools and 45% of senior secondary schools have no electricity (ASC, 2020).
- Access rates in 2019/2020 remained static for all school levels compared to the 2018/2019 census, i.e., 63%, 87%, 65%, 45% for pre-primary, primary, junior secondary and senior secondary, respectively.



Source: The Annual School Census (ASC), 2020; *rounded figures*

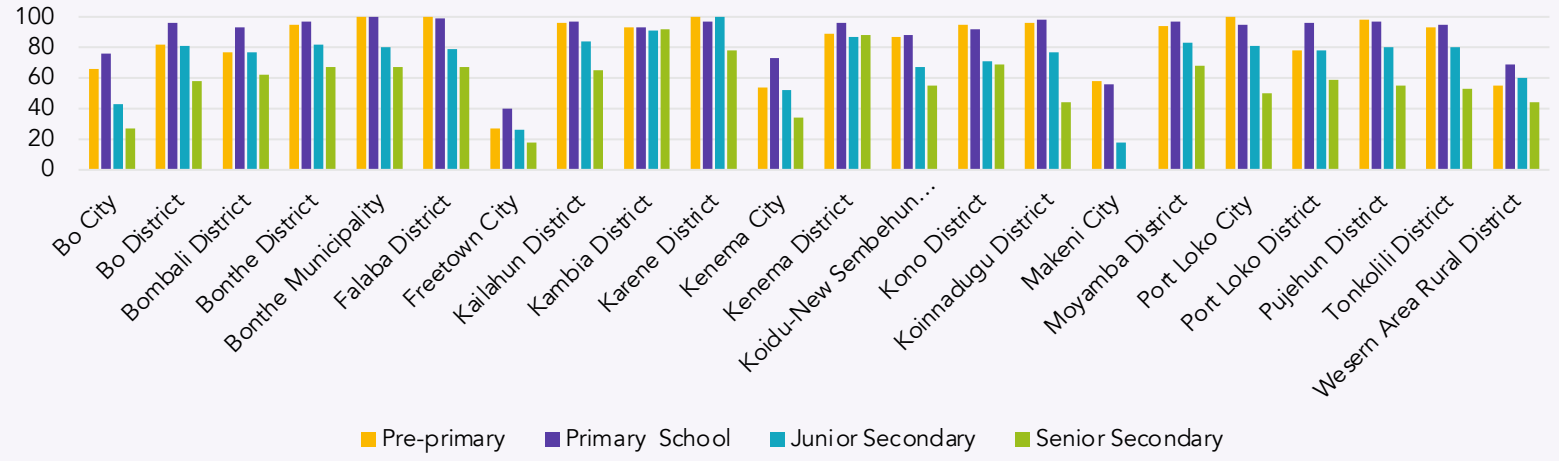
2 Access rates are significantly low for primary schools

- More than half (7,020) of the schools in Sierra Leone (63.6%) are primary schools, which is also the school level with the lowest electricity access rate on average. Pre-primary schools account for 15.9% (1,756), while junior secondary schools and senior secondary schools account for 14.5% (1600) and 6.0% (658), respectively. Senior secondary schools have the highest access rates, with 56% (368) of schools at this level having some access to electricity.
- The main source of electricity is connectivity to the national grid. Only a few schools (1-10%) have gensets or solar PV power solutions (2-8% primarily from stand-alone systems or connection to a mini-grid).

3 Access rates for schools vary significantly among districts and between urban and rural settings

- Access rates are generally higher for schools located in urban settings. These are typically city municipalities/district headquarter towns connected to the national grid (e.g., Bo, Kenema, Makeni and Western Urban/Rural where the capital Freetown is located).
- Access rates drop significantly with remoteness from a large town/city connected to the national grid. Electricity access is very low for schools located in rural settings - reflecting the generally low electricity access rate for rural areas.
- Some progress has been made to improve access for schools in rural areas with solar PV solutions. Nevertheless, very few schools have larger-scale solar stand-alone systems or mini-grid connections.
- With the rollout and scaling of mini-grids and stand-alone solar systems in off-grid communities, it is expected that electricity access will gradually improve.

Education facilities (%) without access to power



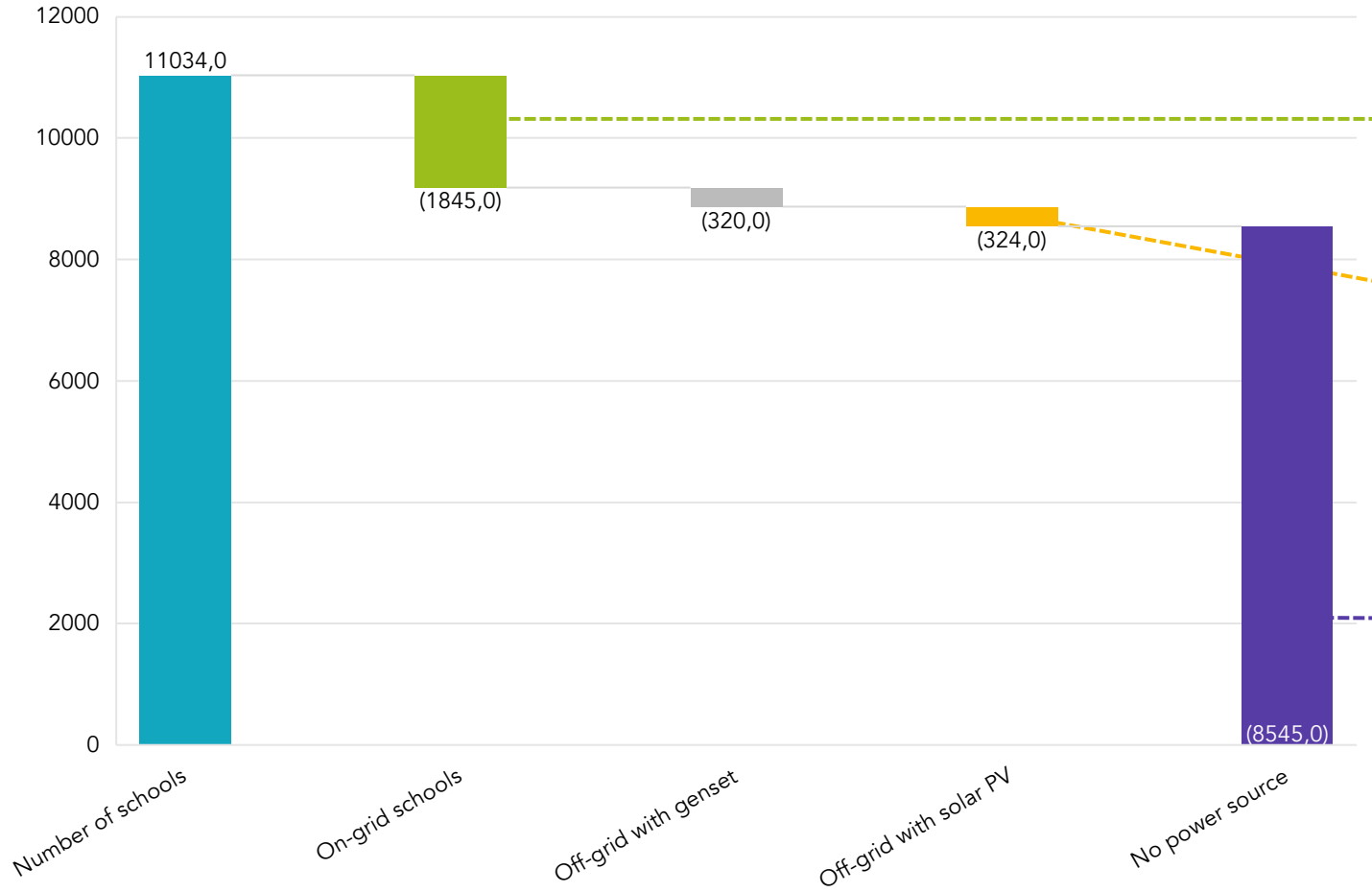
4 Electrification data for schools is binary with gaps in reliability

- Available data on school electrification status is binary, with very little information on duration or quality of access. Some schools in urban settings are connected to the national grid, but they suffer from frequent power outages and require backup solutions.
- A noticeable key challenge of solar PV systems is the lack of long-term operation and maintenance regimes or sustainability plans, leading to declining performance of the equipment, e.g., faulty wirings, dysfunctional batteries, or broken light bulbs.

Source: The Annual School Census (ASC), 2020

Sizing the access gap - market opportunity for solar PV systems

School electrification (all levels): sizing the gap



Solar PV back-up systems can be provided to address frequent outages and quality of access for schools **connected to the national grid.**

→ **25% of on-grid schools and all schools powered by a genset require a robust power solution = 781 schools**

+

Schools with stand-alone solar PV solutions tend to be **under-electrified**, as they mostly only have power for lighting some rooms and/or powering small equipment.

→ **Est. 75% of schools with solar PV still require a robust power solution = 243 schools**

+

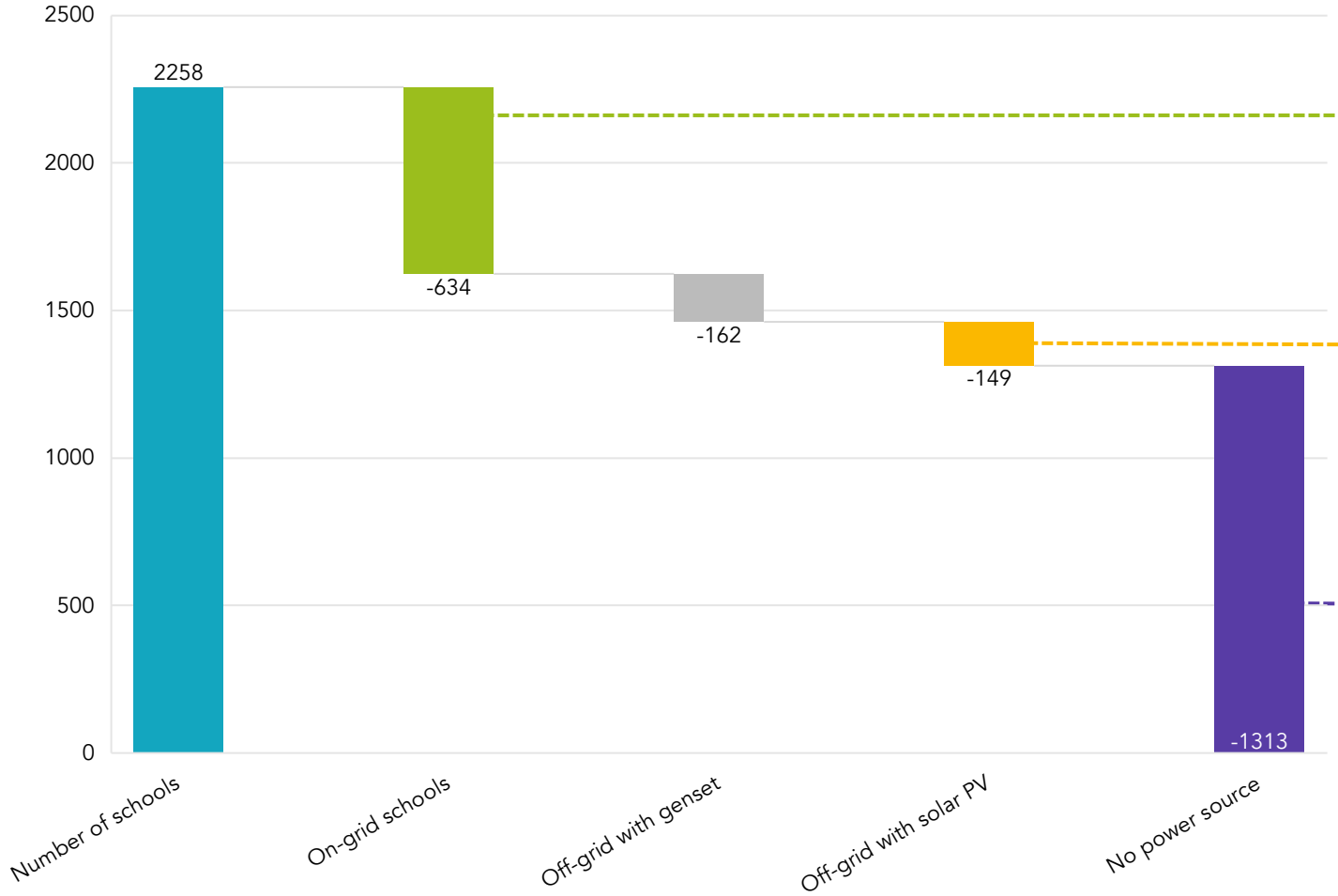
Most of the schools **without access** to any source of electricity supply are in communities, typically small towns and villages in off-grid districts located further away from large towns/cities.

→ **All schools in this category require a robust power solution = 8,545 schools**

Total market opportunity:
9,596 schools

Sizing the access gap - market opportunity for solar PV systems

Secondary school electrification: sizing the gap



For **on-grid** schools solar PV systems can be provided as back-up systems to address frequent outages and quality of access.

→ **25% of on-grid schools and all genset-powered schools = 320 secondary schools**

+

The fraction of secondary schools with stand-alone solar PV solutions tend to be **under-electrified**, as they mostly only have power for lighting some rooms and/or powering small equipment.

→ **75% of solar powered schools require a robust solution = 112 secondary schools**

+

The schools **without access** to any source of electricity supply are mostly in communities (small towns and villages) in off-grid districts.

→ **All unpowered schools require a robust solution = 1,313 secondary schools**

Total market opportunity:
1,745 secondary schools

Recommended solar PV system sizes for secondary schools

Solar PV array	Storage	Ideal school (size, # shifts)	Additional services	CapEx*	OpEx*
1.5 kWp	3 kWh	Small, single	WASSCE center	$ 18,500	$ 320 / year $ 1,120 at year 10
3 kWp	6 kWh	Medium, single Small, double	Computer lab; dormitory for 100 students	$ 25,000	$ 330 / year $ 2,240 at year 10
4.5 kWp	9 kWh	Large, single Medium, double		$ 32,400	$ 350 / year $ 3,440 at year 10
6 kWp	12 kWh	Large, double		$ 39,700	$ 380 / year $ 4,560 at year 10

**CapEx costs include: design, PV system components, balance of systems, internal rewiring, energy efficiency improvements, civil works, and transportation*

**OpEx costs include: component maintenance, basic preventative maintenance; battery replacement assumed at year 10*

Average CapEx: $ 8.6 / Wp

Financing Need to Electrify all Secondary Schools

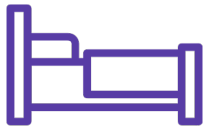
1,745 Secondary Schools
in need of a reliable energy solution

1,745 schools
requiring av. 3 kWp

$45m in CapEx
$12.5m in OpEx

436 comp labs
requiring av. 3 kWp

$11.3m in CapEx
$3.1m in OpEx



436 dormitories
requiring av. 3 kWp

$11.3m in CapEx
$3.1m in OpEx

175 WASSCE
centers requiring
av. 1.5 kWp

$2.2m in CapEx
$1m in OpEx

- *OpEx costs include regular O&M for 15 years + battery replacement after 10 years*

Total CapEx required: $70m

Total OpEx required: $20m

Installed Capacity to be added:
8 MWp

Delivery model	Description	Biggest drawbacks
Traditional equipment ownership model	Describes a model where a donor agency either directly provides grant funding and commissions an NGO or private sector actor, or grants a public agency funding to commission an NGO or private sector actor to design, purchase and install solar PV systems at a public institution e.g. school. The asset is typically owned by the public institution or agency. This has been the predominant model for most electrification interventions in the education sector implemented in Sierra Leone.	Limited opportunities for long-term sustainability.
Service-based model	Describes a model where a public agency selects a service provider (private sector or NGO) to provide electricity services (design, procure, install, operate and maintain solar PV systems) to public institutions e.g. school, typically over a 10- to 15-year period. The service provider raises investment capital (debt or equity) from investors and may also get subsidies and guarantees from donors. The service provider ensures that service levels are met for the contract period. The government pays the provider on a regular basis, as it would with other utilities directly or through a financial institution once a 3rd party verifies that the services have been rendered accordingly.	Difficult to set up a long-term service-based model between public sector actors and service providers. Several critical risks need to be addressed to ensure that willingness and ability to pay is appropriately addressed.
Hybrid model	This combines elements of the traditional equipment ownership model and the service-based model, where it is not fully commercially market driven and yet not fully dependent on donor funding and public agency ownership and management. Given compliance management and procurement management capacity challenges in most settings, it however proposes a Program Management Unit (PMU) or Compliance Management Entity (or similar) through which service contracts and repayments for energy services are managed with the private sector ESCO. The role of donors in this model could be to provide grant funds in the form of (partial) subsidies for e.g. aggregated procurement of energy efficiency upgrades or supply side subsidies to cover portions of system CAPEX. The private sector ESCO raises additional concessional funding through impact investors, DFIs, corporates or philanthropies, but with an assumed lower risk profile given partial subsidies/grants.	Not enough incentive currently exists to make schools entry points/anchors for community electrification. Consistency of contributions from public agency is required for sustainability and building confidence of private sector ESCOs and investors

Traditional Equipment Ownership Approach

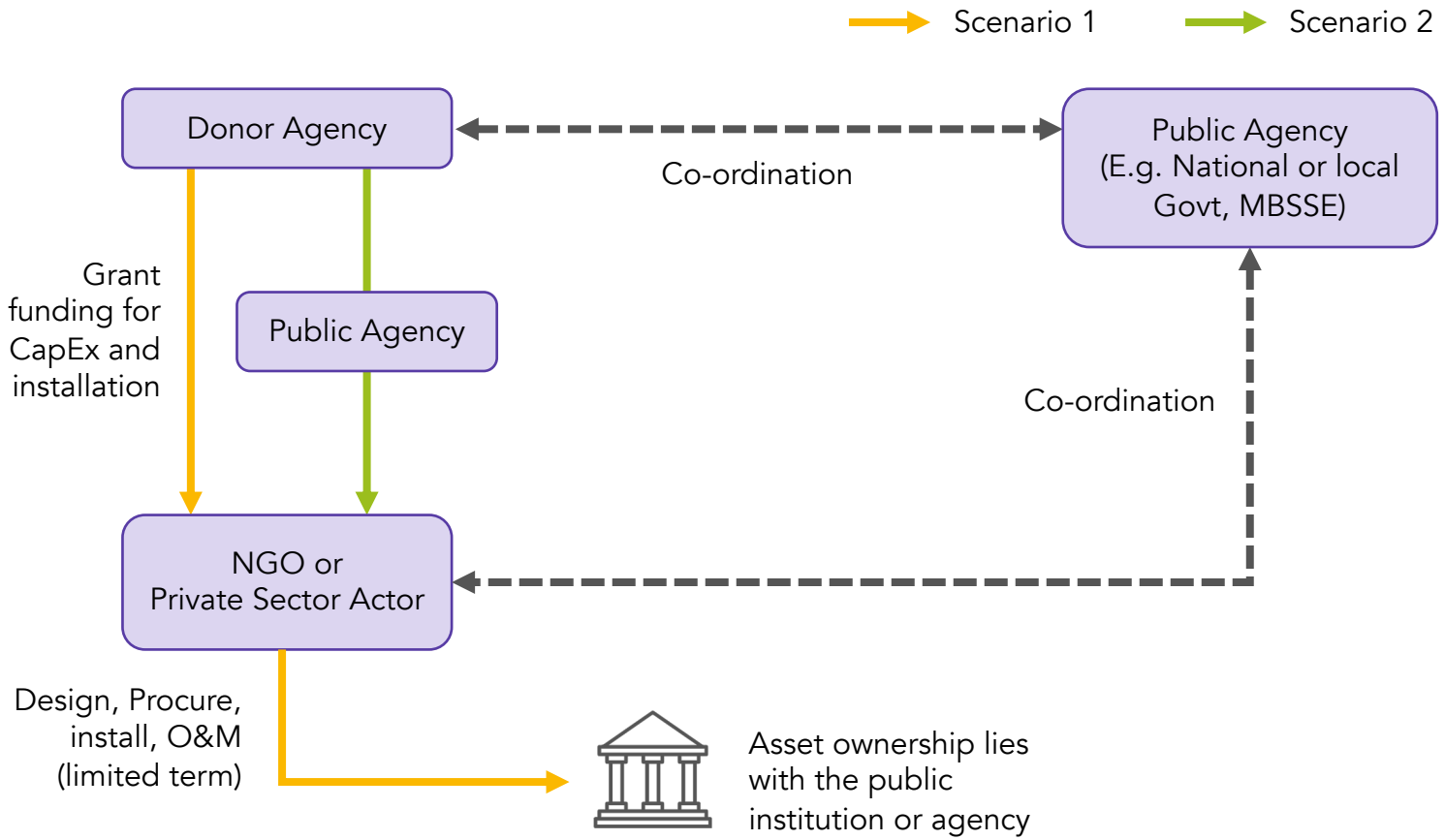
Scenario 1

A donor(s) directly provides grant funding and commissions an NGO or Private sector developer to design, purchase and install RE systems at a school.

Scenario 2

A donor(s) provides grant funding directly to an implementing public agency who commissions an NGO or Private sector developer to design, procure and install RE systems to a school.

In both instances, a public agency plays a co-ordination role, and the asset is owned by the public institution or agency



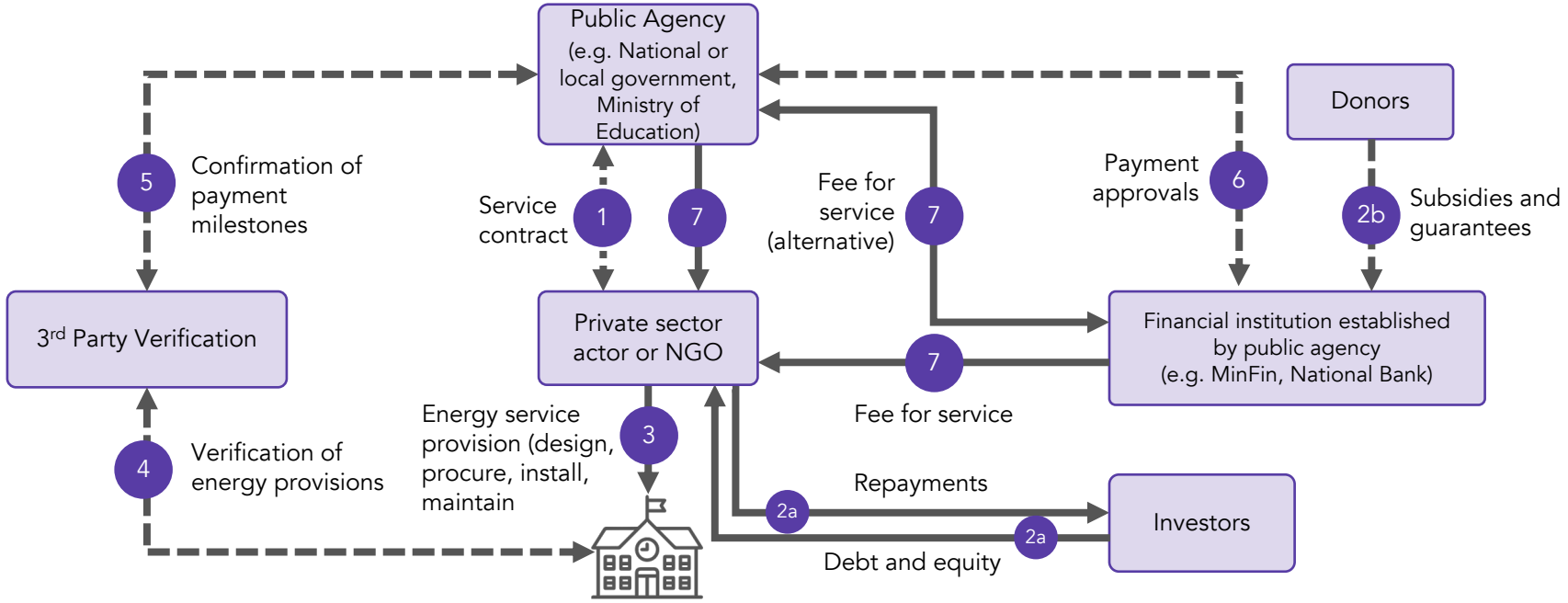
Note: illustration from SEforALL, WB, ESMAP (2021) 'From Procurement to Performance'.

Service-based Model Approach

01 A service contract is signed between the service provider and the public agency

2a The service provider raises capital from investors; direct grants to the investors (for e.g., RBF) are not included in this figure

2b Subsidies and guarantees are deployed; these are in addition to existing funds and finance going to public health, public education, etc.



03 An energy solution is deployed, and the facility starts using power as a service

04 A third party verifies that energy is being provided and consumed, including through remote monitoring technologies

05 The third-party verifier sends confirmation that payment milestones have been met to the public agency

06 The public agency sends payment approval to the financial institution

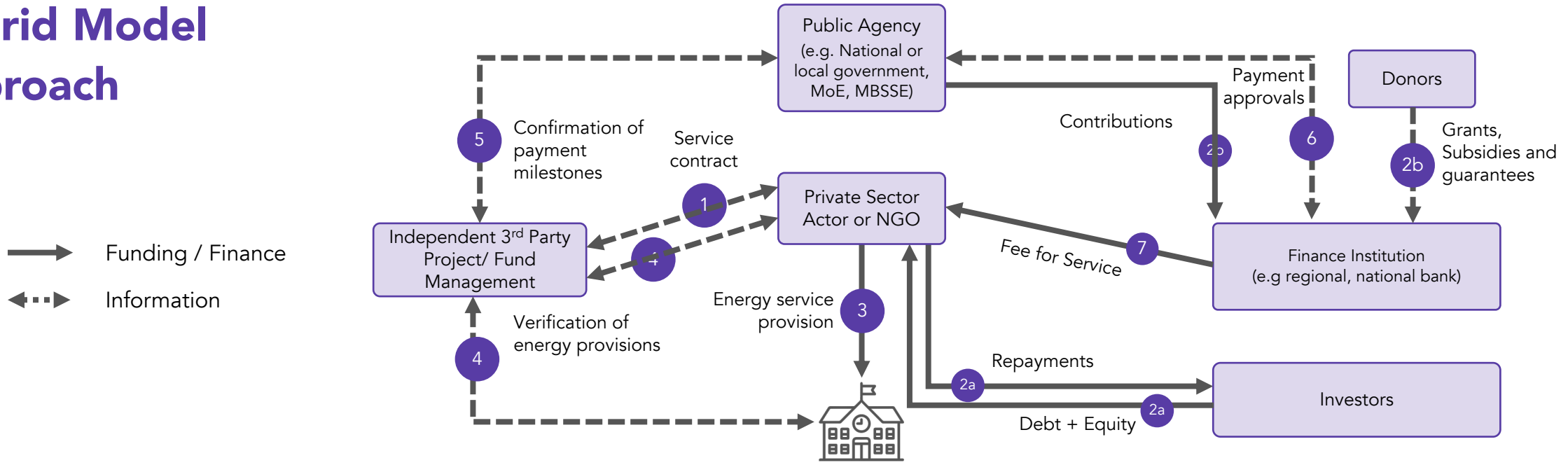
07 The financial institution (e.g., fund manager) issues payment in accordance with the contract and the service delivered

7 alt The financial institution releases funds, which the public agency uses to pay the service provider. Note: these funds can be provided up front.

→ Funding/ Finance

↔ Information

Hybrid Model Approach



01 A service contract is signed between the service provider and the public agency e.g MBSSE, SLA Unit, PPP Unit

2a The service provider raises capital from investors; direct grants to the investors (for e.g., RBF) are not included in this figure

2b Public health and education electrification specific subsidies, guarantees and contributions from donors and government

03 An energy solution is deployed, and the end user starts using energy as a service

04 A third party manages the project contract, verifies that energy is being provided and consumed, including through remote monitoring technologies

05 The third-party verifier sends confirmation that payment milestones have been met to the public agency and financial institution

06 The public agency sends payment approval to the financial institution

07 The financial institution issues payment in accordance with the contract and the service delivered

03 | Roadmap: Powering Schools

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Next steps for phased implementation

Phase 1: Structuring and feasibility (2023 - 2024)

- Engagements initiated between GoSL, IPs and other stakeholders to plan framework for coordination and support for projects on powering social infrastructure (PSI), including the establishment of a dedicated Project Management Unit (PMU) for PSI.
- Commit and provide funds to establish PMU, as well as undertake energy-education ecosystem mapping and energy audits/assessment.
- Undertake comprehensive energy-education ecosystem mapping, energy audits/assessments and electrification needs of schools.
- Commit and provide resources for technical assistance and programmatic support to MBSSE & MoE for developing proof-of-concept on school electrification.
- Strengthening of the ASC into central and dynamic database with real time application commences at MBSSE.
- PMU commences and begin to provide technical assistance, leads school electrification plan and engage all stakeholders, including GoSL, IPs, private sector, etc.

Phase 2: Development and demonstration (2024 – 2026)

- Implement pilots on school electrification with different financing, ownership and operating models/practices; gather lessons learnt through MEL.
- PMU use initial MEL outputs to refine investment and aggregation of school electrification plans, as well as MEL plans.
- Launch school electrification programme and engage donors, GoSL, IPs and the private sector (EPCs) to activate school electrification programme
- Funding and financing mechanisms are secured and electrification (including design, procurement and installation) of 2,500 schools commences in partnership with relevant parties (GoSL, donors, private sector and IPs and impact investors.
- MEL performance management framework developed and activated on ownership and operation and maintenance regimes .

Phase 3: Scale up (2026 – 2029)

- Refine and elaborate on implementation plans and delivery models on financing and ownership models from Phase 2.
- Scale-up and complete electrification of additional 7,069 schools, including a complete and functional O&M/MEL framework
- Data on O&M/MEL framework feeding directly into central and dynamic database in real time for impact evaluation.

01	**Data and digitalization**	Invest in data collection, management, and analysis
02	**Funding and financing mix**	Unlock appropriate financing and risk mitigation vehicles
03	**Technology, standards and energy efficiency**	Adopt minimum technical quality standards and invest in energy efficient appliances
04	**Sustainability and delivery approach**	Analyze different delivery models and preconditions for sustainability
05	**Coordination and information exchange**	Strengthen coordination between health and energy stakeholders, through linkages with existing national energy and health sector strategies

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About SEforALL

Sustainable Energy for All (SEforALL) is an international organization that works in partnership with the United Nations and leaders in government, the private sector, financial institutions, civil society and philanthropies to drive faster action towards the achievement of Sustainable Development Goal 7 (SDG7) – access to affordable, reliable, sustainable and modern energy for all by 2030 – in line with the Paris Agreement on climate.

We work to ensure a clean energy transition that leaves no one behind and brings new opportunities for everyone to fulfil their potential.

Contact us to learn more

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