Malawi Sustainable Energy Investment Study

October 2019

UN-OHRLLS

GOVERNMENT OF MALAWI
Ministry of Natural Resources, Energy and Mining

ROCKY MOUNTAIN INSTITUTE

Foreword

[*Photo to be added, pending validation*]

Malawi has committed to achieving “Sustainable Energy for All”, as enshrined in Sustainable Development Goal (SDG) number 7. Energy is a means to an end; it provides a platform for social and economic development, and a pathway for achieving many of the other SDGs. The third Malawian Growth and Development Strategy (MGDS III) recognises this central role of energy, citing it as “the lifeblood of the economy”, and laying out a goal to “provide sufficient sustainable energy for industrial and socio-economic development”. Improved access to reliable and sustainable energy supply is one of the core outcomes the MGDS III seeks to achieve.

In response to these commitments, the Ministry of Natural Resources, Energy and Mining (MoNREM), acting through the Department of Energy Affairs (DoEA) and Malawi Energy Regulatory Authority (MERA), has worked to put in place policies, regulations and a framework that will allow increased investment and rapid growth in the power sector. The National Energy Policy (2018) and the Malawi Renewable Energy Strategy (2017) build on the targets laid out in the Sustainable Energy for All Action Agenda (2017) and provide high-level policy direction, complemented by detailed technical analysis made available in the most recent Integrated Resource Plan (2017).

To translate these goals into reality, the Ministry will rely on clear plans to move key investments forward, based on transparent funding arrangements that aim to provide reliable and sustainable energy for Malawians at the lowest possible cost. In this context, this Malawi Sustainable Energy Investment Study, a partnership between DoEA, the UN-OHRLLS and Rocky Mountain Institute, is timely and essential.

This document outlines a clear vision of what is needed and how, together, we can make it happen. The way forward for Malawi represents a significant investment over the coming decades, of up to $3 billion, but this investment will create enormous benefits for the country.

The study will help government, development partners, investors and the private sector converge on a shared agenda. Concentrating on a clear set of short-term actions, the study’s recommendations can unlock investment and help the sector grow rapidly, as proven in other countries across Africa.

I call on all actors in the energy space to work alongside Government as we look to implement the recommendations of this study and accelerate progress towards sustainable energy for all Malawians.

[*To be signed, pending validation*]

Patrick Matanda

Secretary for Natural Resources, Energy and Mining

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Contents

BACKGROUND

Rocky Mountain Institute and UN-OHRLLS are working with the government of Malawi to overcome barriers and meet targets for energy investment in the country

Malawi Sustainable Energy Investment Study aims to:

- Provide a clear and specific **investment prospectus** for meeting Sustainable Development Goals (SDG), and improve power sector financial health and service
- Identify **immediate** and **near-term opportunities** to make progress and **unlock investment** in Malawi
- Support Malawi to **secure** the right **finance** at the right time
- Build on extensive work carried out by Malawi government and development partners over the past years, to build a **shared vision**

Government of Malawi

The Department of Energy Affairs (DoEA) is one of the constituent departments of Malawi's Ministry of Natural Resources Energy and Mining. It coordinates formulation of energy policies, planning, and ICT; the provision of rural electrification services; and the provision of alternative energy and energy conservation services

UN-OHRLLS

United Nations Office of the High Representative for Least Developed Countries, Landlocked Developing Countries and Small Island Developing States (UN-OHRLLS) helps coordinate and implement programmes of action which assist vulnerable countries in areas including economic growth, poverty reduction and meeting targets laid out in the SDG.

Rocky Mountain Institute (RMI)—an independent nonprofit founded in 1982—transforms global energy use to create a clean, prosperous, and secure low-carbon future. It engages businesses, communities, institutions, and entrepreneurs to accelerate the adoption of market-based solutions that cost-effectively shift from fossil fuels to efficiency and renewables.

Through 2019, this study worked to gather information from a range of actors, to work towards an integrated approach for analyzing power sector investment needs

Public sector entities

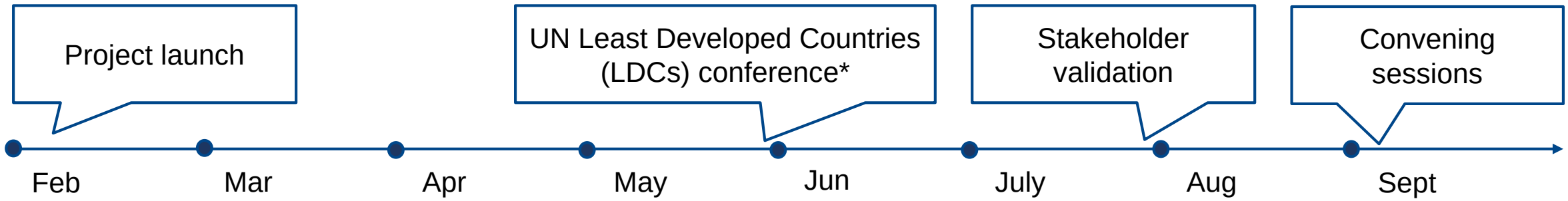
Department of Energy Affairs (lead)	Malawi Investment & Trade Centre	ESCOM
Department for Economic Planning & Development	Department of Forestry	EGENCO
Treasury	Department of Agricultural Planning	MERA

Development partners

- Technical assistance (UNDP, GIZ, USAID, DFID)
- DFIs (World Bank, AfDB)
- NGOs and CSOs

Private sector

- Private developers
- Commercial banks
- Investors



*http://unohrlls.org/scaling-energy-access-finance-least-developed-countries-30-31-may-2019-beijing-china/

Malawi's challenges are recognizable to many other LDCs, who can learn from this experience

	Unit	Malawi	Mali	Sierra Leone	Zambia	Mozambique	Madagascar
Electrification	*(% of population)*	12%	35%	20%	27%	24%	23%
Rural grid electrification	*(% of population)*	**4%**	**2%**	**3%**	**3%**	**5%**	17%
Electricity price	*(US cent/kWh)*	**11.3***	16.2	16.9	**8.1**	**8.8**	19.5
Installed capacity	*(On-grid MW)*	**395**	**471**	**171**	2,906	2,893	768
Availability of finance	*Low: 0 High: 2.5***	**0.25**	1.75	**0.25**	1	0.75	**0.25**

Other LDCs in sub-Saharan Africa face **similar challenges** and can apply similar approaches.

*Electricity price from Malawi Energy Regulatory Authority (MERA) website as of May 2019; MK 88.02/kWh converted using 775 MK to USD.

**Availability of Finance score reflects whether or not existing projects have been able to secure concessional or commercial finance from domestic and international sources. Sources: Climatescope Bloomberg BNEF 2018, WB World Development Indicators

INTRODUCTION

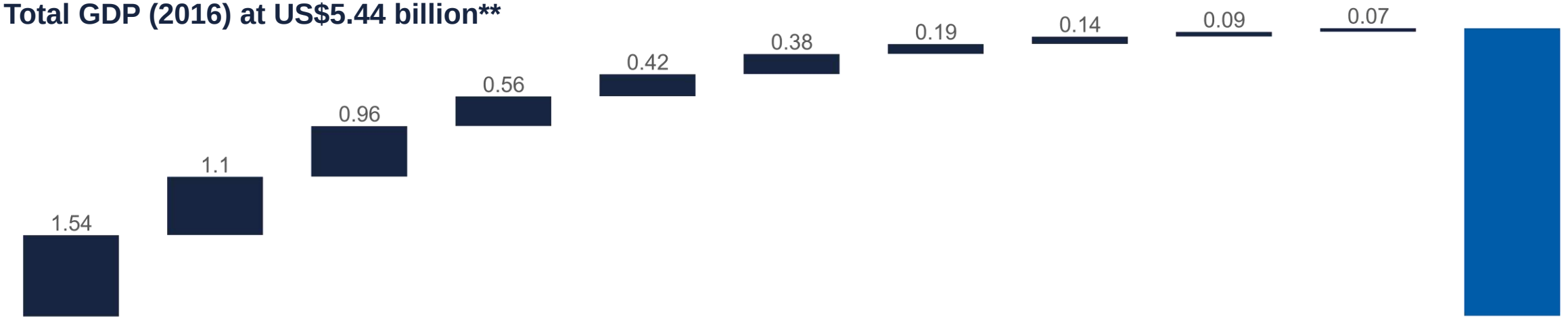
Current conditions show significant potential and sustained demand for increased energy access in Malawi

Population 18 million
- **19% in Urban Areas**
- **81% in Rural Areas**

National electricity access: 12%
- 3.9% in rural areas
- 48.7% in urban areas

In 2017 **system-wide load shedding** occurred as low rainfall left the system unable to meet demand. In 2019, the peak available capacity of **285MW** (including 55MW of emergency diesel generation) is still well below the peak demand.*

Total GDP (2016) at US$5.44 billion**



Source: Southern Africa Energy Program (SAEP) Market Entry Info Pack–Malawi

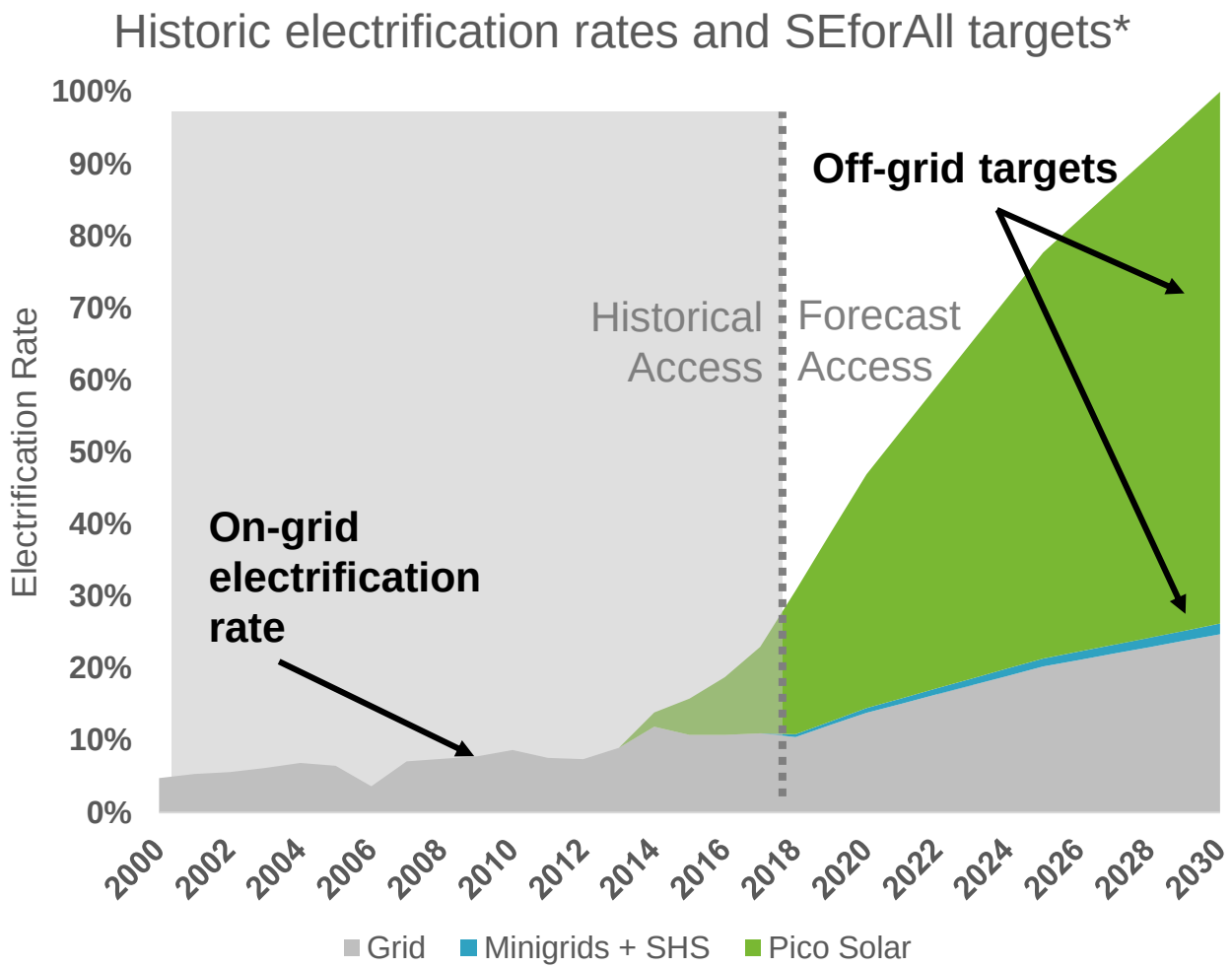
*Electricity Supply Corporation of Malawi (ESCOM) Power Gen Info 2019 factsheet. **GDP was approximately $316 per capita in 2016.

Increasing the supply of and access to reliable, affordable energy is therefore at the core of Malawi's development goals

Malawi Growth and Development Strategy III (2017) aims to:
"Provide sufficient sustainable energy for industrial and socio-economic development."

Malawi's Sustainable Energy for All (SEforAll) Action Agenda (2017) intends to:
"Provide access to modern energy services for all by 2030, through on- and off-grid electrification and improved cookstoves."

The goal of the Malawi Energy Policy (2018) is to:
"Increase access to affordable, reliable, sustainable, efficient and modern energy for every person in the country."



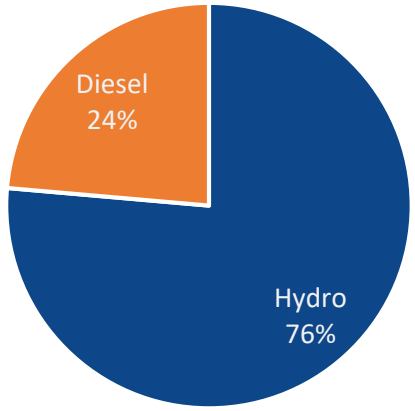
*Targets taken from the 2017 SEforAll Action Agenda

Recognizing this, the government and its partners have set ambitious targets to unlock the generation potential, and undertaken numerous pieces of sector reform

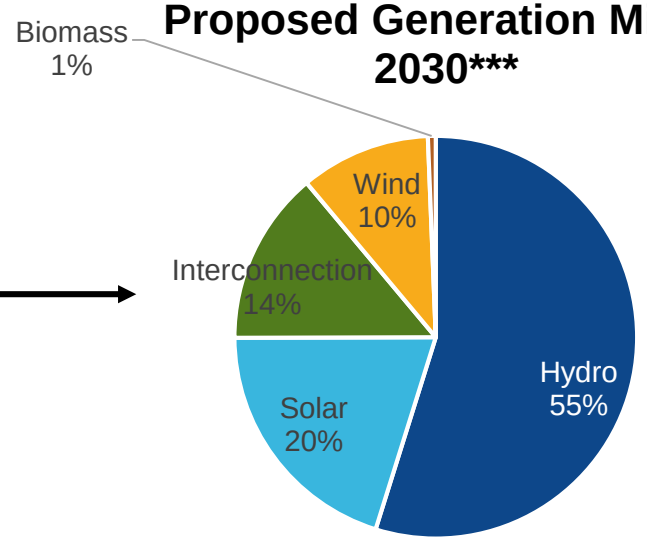
Numerous Reforms and Stakeholder commitments have been undertaken to help realize access targets*

- **2003:** Malawi approves Power Sector Reform Strategy to foster private sector involvement
- **2013:** Malawi enters US$350 million compact with Millennium Challenge Corporation to help fund infrastructure projects, especially to increase transmission and distribution capacity.
- **2017**: ESCOM unbundled to act solely as dispatcher (and in the interim as single buyer), and EGENCO formed to handle generation

Generation Mix in 2018**



Proposed Generation Mix in 2030***



Malawi has rich renewable generation potential, including hydropower, solar, wind and biomass.

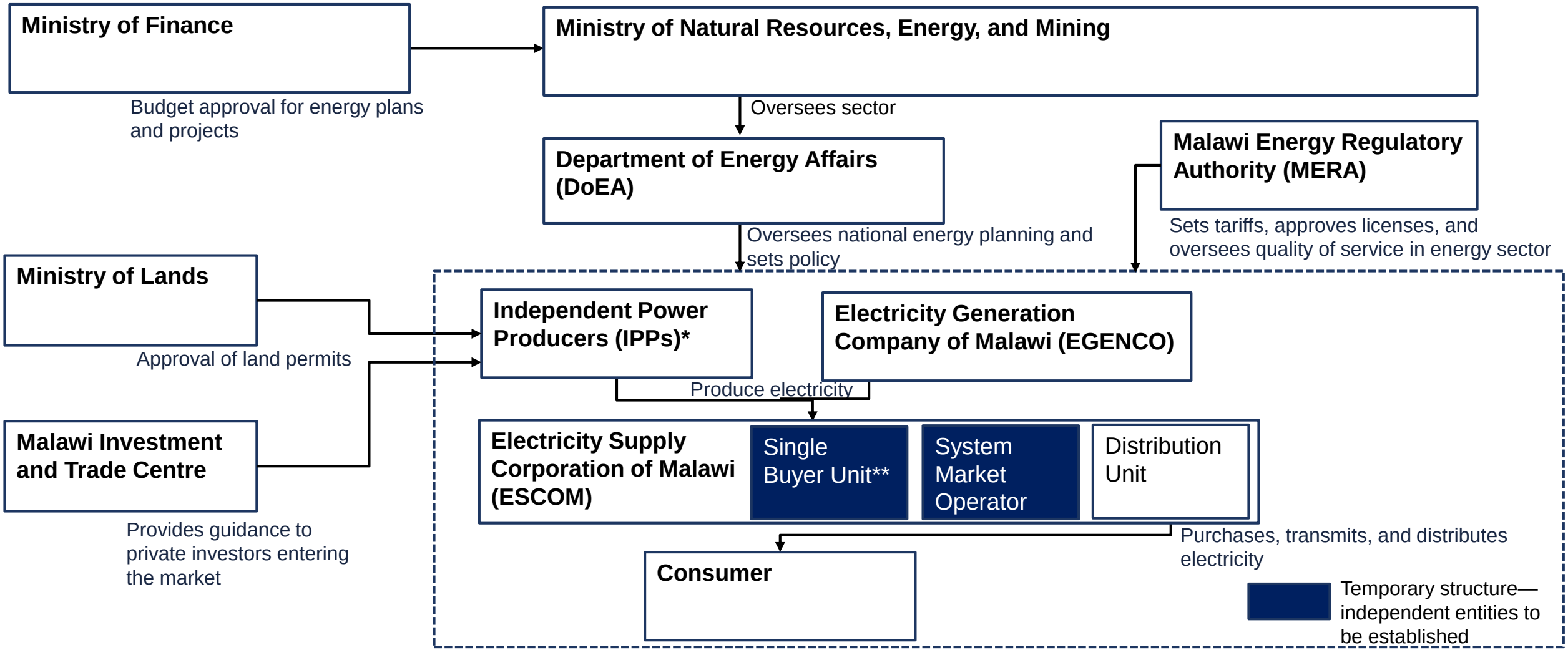
Those resources have not been well utilized yet, and if unlocked, could provide a diverse portfolio of resources that produce cheap, reliable services through bulk power systems.

* SAEP Market Entry info Pack

** Current generation mix is based on the existing project information through the Department of Energy Affairs (DoEA).

*** Proposed generation mix is based on RMI's analysis.

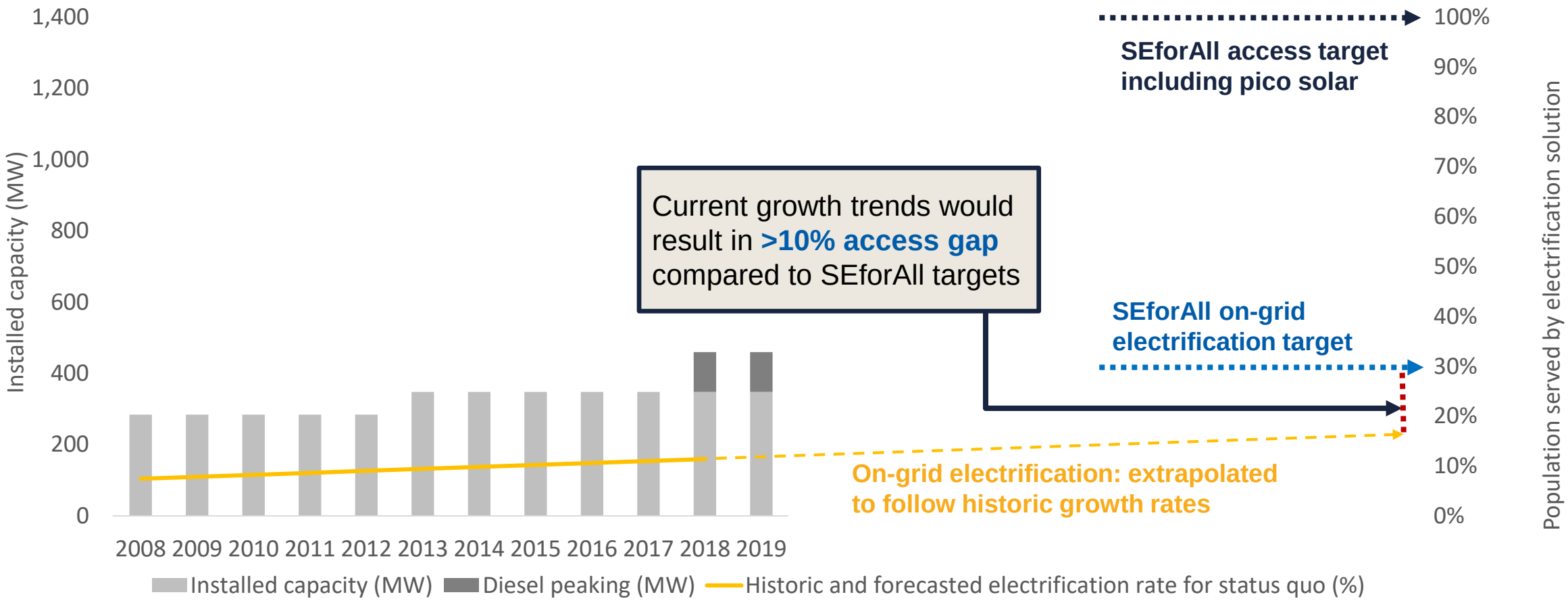
Malawi has made efforts to establish an institutional framework that can govern a privatized energy sector and catalyze investment



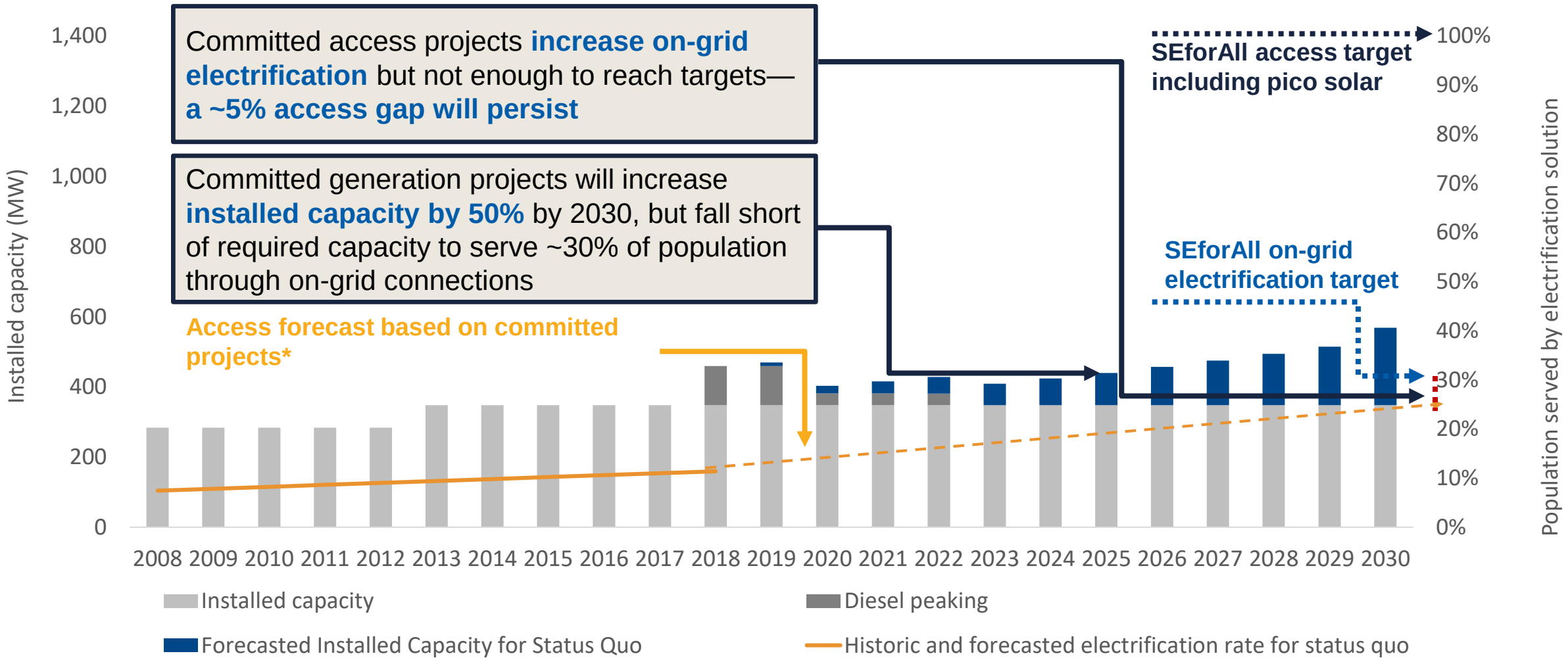
*No IPPs are currently operating with the exception of Aggreko

**At the time of writing, Power Markets Ltd has been established outside of ESCOM, but has yet to be staffed

On current trends, Malawi would only reach around 20% electrification in 2030 and fail to reach targets for serving the population

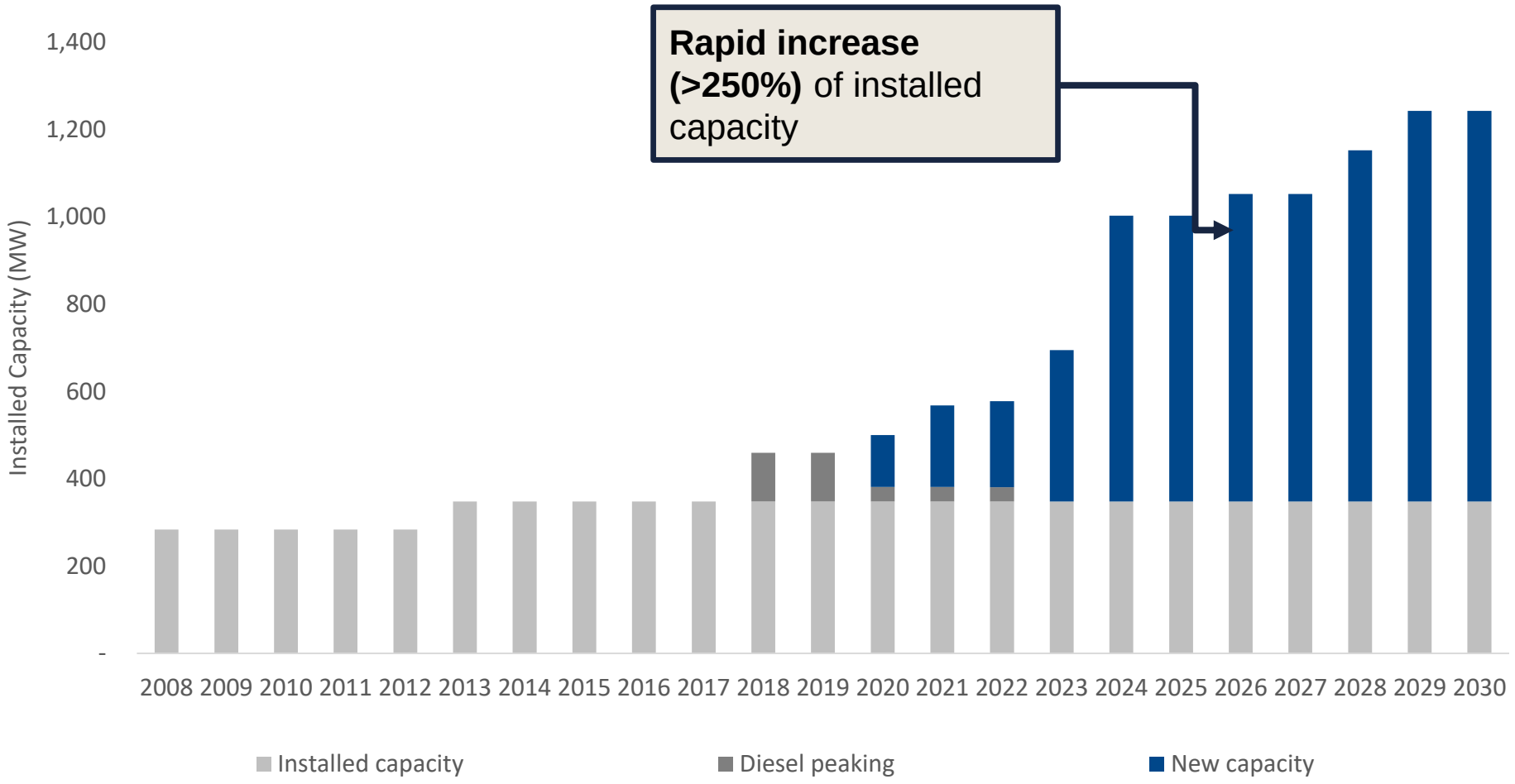


Ongoing programs and current proposals will improve this outcome, but still fall far short of Malawi's goals

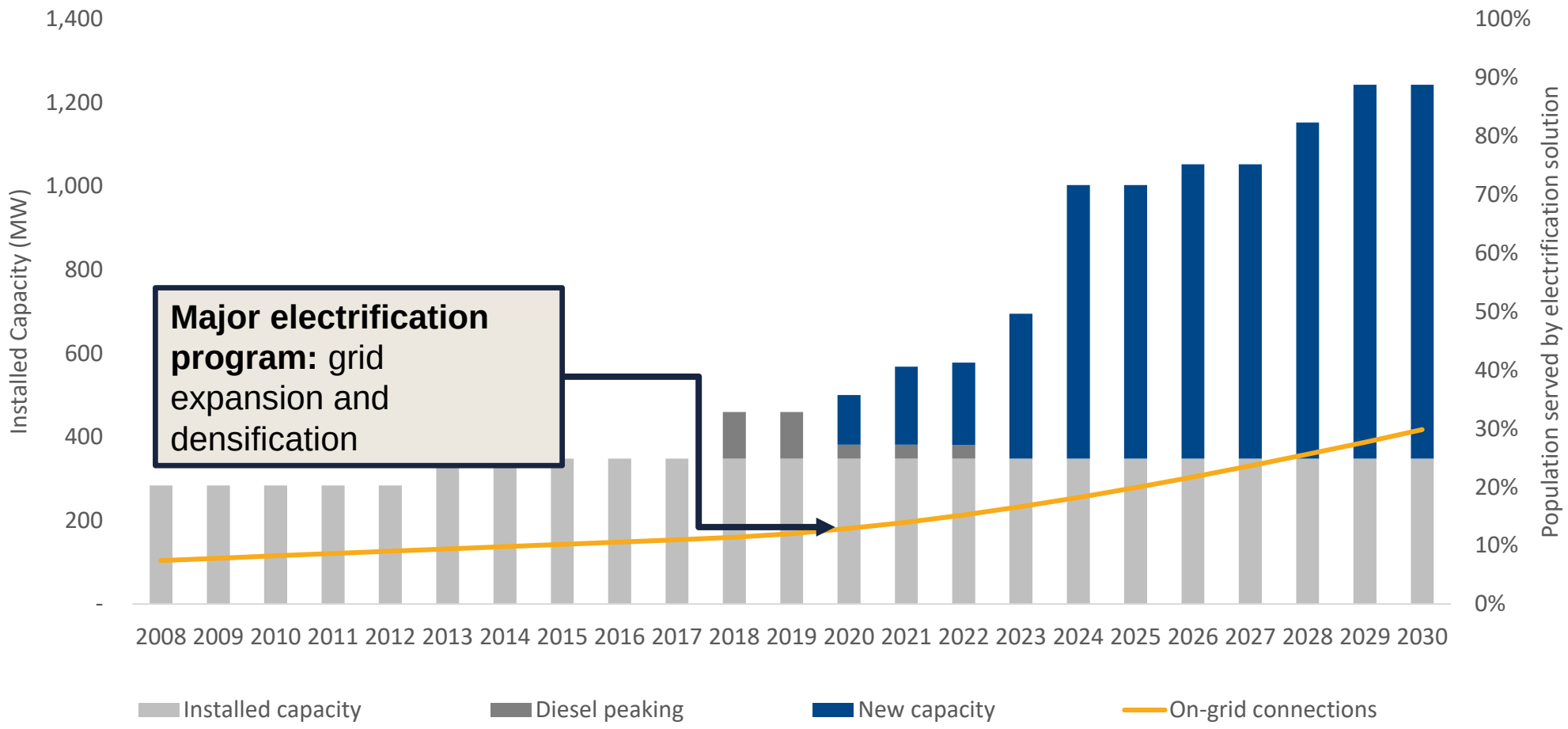


*World Bank Electricity Access Project and USAID's Southern Africa Energy Program (SAEP) together are estimated to provide around 450K connections, which when combined with forecasted electrification under the status quo would increase access to around 25% by 2030.

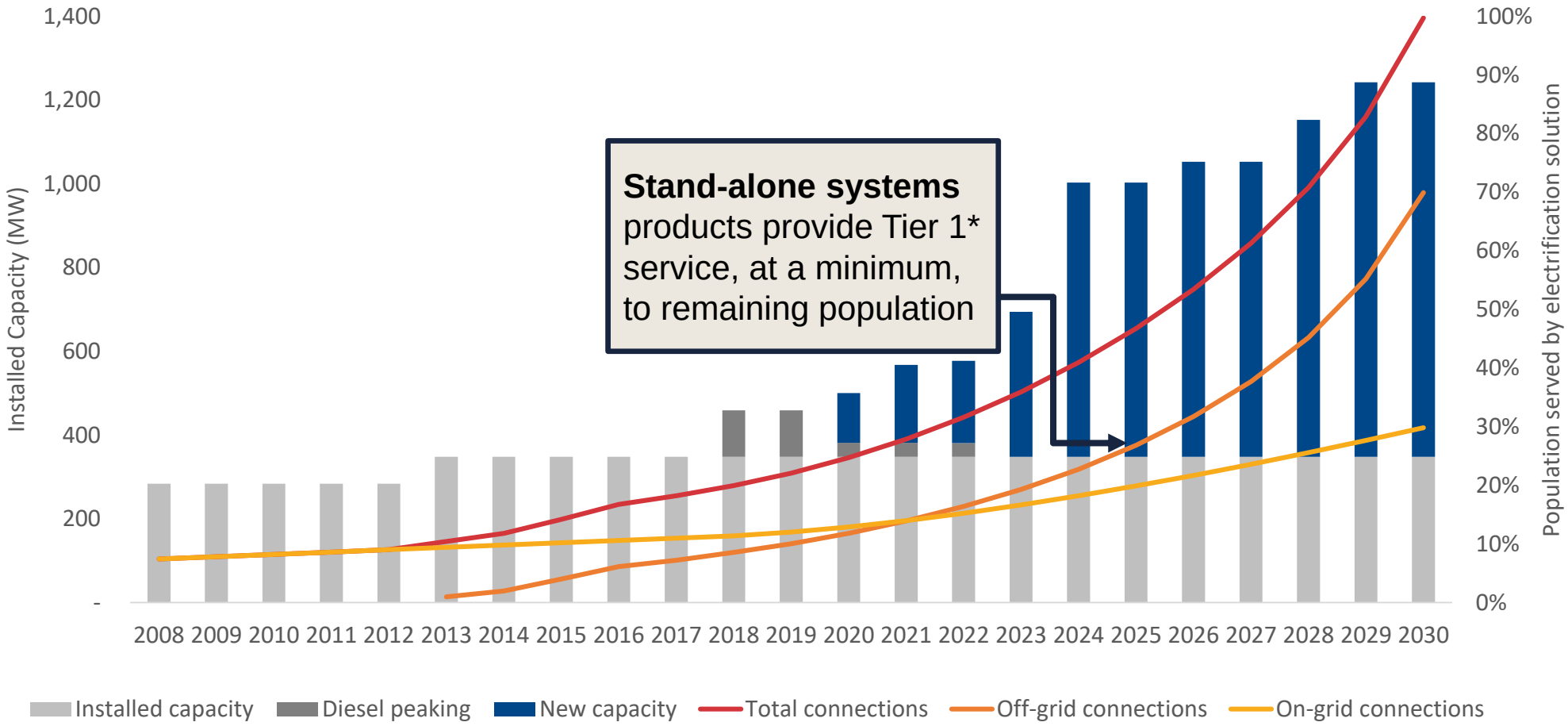
But by removing barriers and driving rapid growth in the sector, Malawi can scale up the power sector to provide generation capacity for expanding connections



Combining grid strengthening with an increased pace of rural electrification, Malawi can reach the goal of nearly 30% on-grid energy access by 2030



And by complementing on-grid access with a rollout of off-grid connections, Malawi can provide some level of electricity access to all by 2030



Meeting Malawi's energy needs requires a **step change** compared to historic progress.

Malawi must act quickly to:

- De-risk **immediate projects**
- Disseminate success to create **positive feedback loops** and **scale investment**

* The World Bank and SEforAll multi-tier framework is used for measuring levels of energy access - https://www.esmap.org/node/55526

This optimal investment pathway can only be achieved through a concerted effort from all key stakeholders

Government

- Support the **right projects**, in the **right order**, using an optimal mix of financial instruments to **de-risk and attract additional financing**
- Implement **supportive policies** to de-risk investment
- Ensure that a whole-system, **least-cost** solution is reached, to provide reliable and affordable electricity access

Investors

- Increase **awareness and knowledge** of approved frameworks and processes
- **Target investment** at priority project areas identified by government
- Use available **climate finance** to reduce overall financing costs

Development Partners

- **Simplify financing structures** and increase ease of access to climate finance
- **Support a least-cost pathway** through financial instruments for de-risking
- Provide technical assistance to identify facilities, package projects and structure finance, and complete applications to **obtain climate finance**

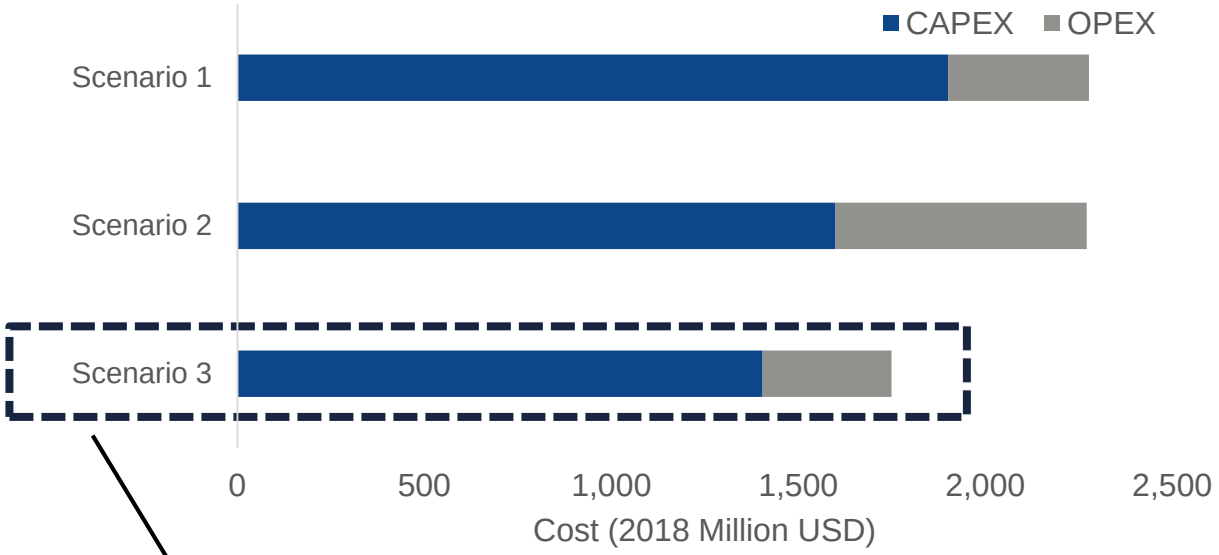
A flexible power system with generation infrastructure that prioritizes renewables and demand management is the lowest-cost option for meeting Malawi's targets

Scenario 1 represents the recommended portfolio included in the national planning document for the generation segment (the Integrated Resource Plan [IRP]) with a foundation of large coal and hydro plants

Scenario 2 represents the ESCOM Investment Plan, with various solar photovoltaic (PV) and small hydro projects implemented in the near term

Scenario 3 represents the optimized scenario developed in this study: a diverse portfolio with energy efficiency (EE) and modular renewable energy (RE) resources that allow dynamic adjustment over the years

Generation infrastructure net present value (NPV)* to 2030

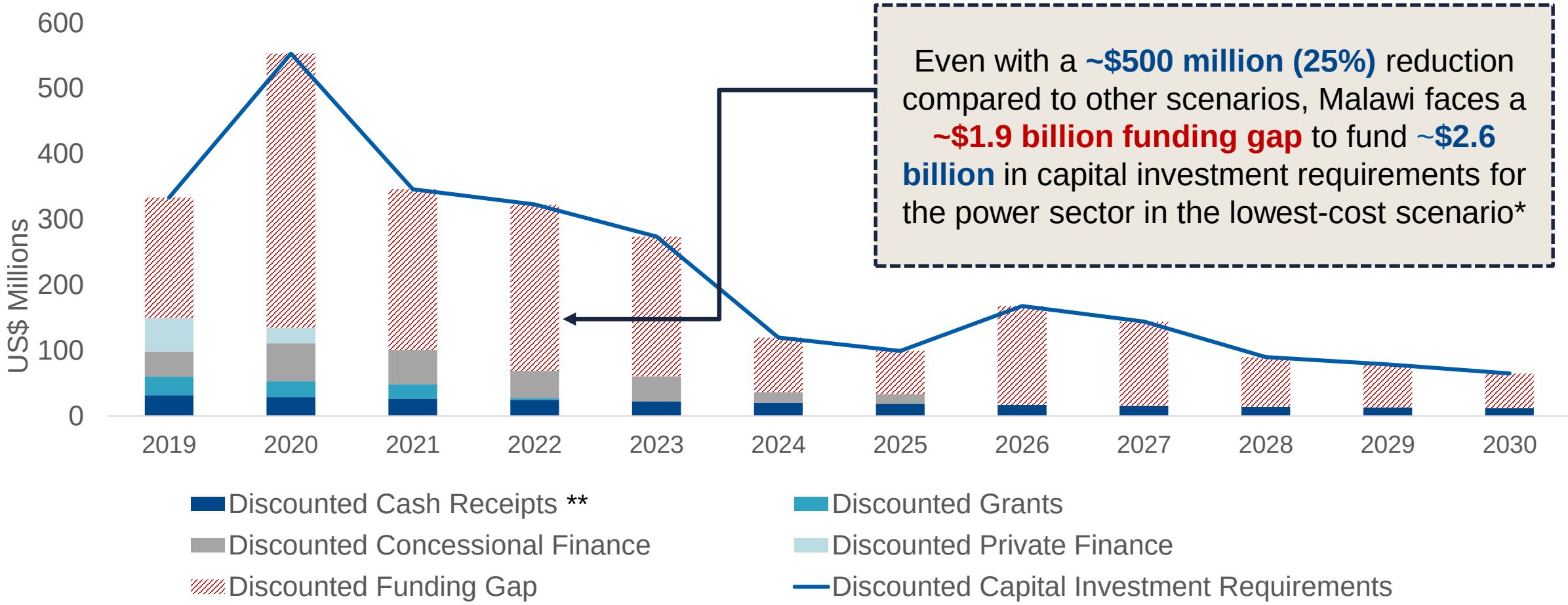


Scenario 3 provides a **least-cost, reliable, and diversified solution, saving ~$500 million (25%) and avoiding ~19 million tons of CO_2 emissions** with the potential to dynamically adjust investment based on demand forecasts

*NPV is calculated applying a 9% discount rate and including capital needs and operating expenses for the system to meet generation needs through to 2030.

The level of investment required to meet these targets and cover the $1.8 billion funding gap for the power sector represents a rapid increase in activity

Capital investment requirements and committed funding

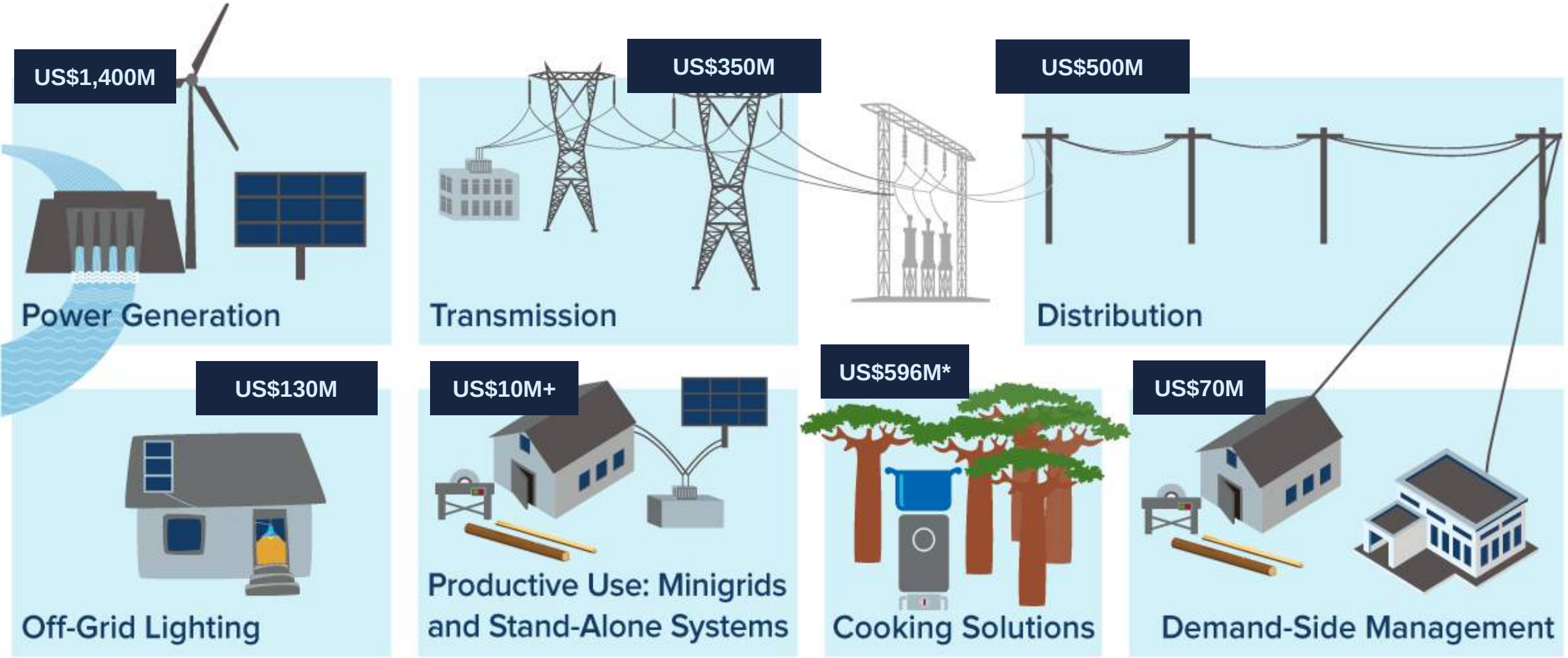


Even with a **~$500 million (25%)** reduction compared to other scenarios, Malawi faces a **~$1.9 billion funding gap** to fund **~$2.6 billion** in capital investment requirements for the power sector in the lowest-cost scenario*

*All costs are calculated at NPV, discounted at 9%. Investment requirements do not include cooking solutions.

**Cash receipts refers to budget allocations for the energy sector, based on historical trends. This includes budgets earmarked for ESCOM-led electrification efforts and MAREP-led electrification.

Capital must be provided to meet funding needs across all the major areas of Malawi's energy system, both on- and off-grid



Capital investment requirements are discounted at 9% *Cooking investment needs are analyzed separately (and excluded from the previous graph), as they will need to be refined with development of an updated national strategy for forestry and alternative cooking solutions.

Investment to fill this gap will need to come from a range of private, public, and concessional sources, complemented by government support

No subsidy required

Requires Subsidy

Lower risk commercial activities (no subsidy)	Stand-alone systems for productive use and pico solar for mid to high socio-economic brackets
Higher risk commercial activities (in need of temporary subsidy)	Generation
Not fully commercially viable activities (in need of temporary subsidy)	Minigrids targeting productive use
Not fully commercially viable activities (in need of long-term or permanent subsidy)	T&D, EE/demand-side management (DSM), cooking solutions, and pico solar for low socio-economic brackets

Government role is to **de-risk** investment in segments that can be commercially viable by reducing perceived risks and supporting economically viable projects that lack commercial returns

Guarantees, subordinate capital, first-loss capital

Donor capital (grants) and **some concessional financing**

Malawi can immediately begin closing the funding gap and unlocking the necessary capital to meet national goals and enable development

1. Plan and prioritize projects

Priority: Use in-depth demand & reliability assessments to update project planning

2. Blend finance to reduce costs and implement quick-win projects

Priority: Get quick-win IPPs commissioned
Priority: Install climate finance expertise

3. Drive cost reductions and de-risking across the sector

Priority: Align government agencies and demonstrate de-risking

4. Unlock additional finance

Priority: Centralize communication with investors and provide clarity on needs

5. Strengthen institutional frameworks to develop the market and support implementation

Priorities:
- On-grid: Establish independent single buyer unit; improve off-taker financial health
- Off-grid: Improve implementation and awareness of product standards

The following sections of this document build out the project needs and the available finance for Malawi's energy sector

Section	Description
Project prioritization	Evaluates each key area of the energy system, to map: • **Challenges** and current status • **Opportunities** for improving economics and developing the market • **Priority activities**—criteria for project selection and programming • **Investment** needs for the sector
Finance for development	Maps project needs to appropriate types of finance, identifies funding sources, and provides recommendations to obtain financing
De-risking projects	Identifies key sector-wide risks and provides recommendations to reduce perceived and existing risks to attract appropriate, low-cost, private investment
Recommended actions	Provides key next steps for government, private sector, and development partners, to unlock finance and reach Malawi's goals

PROJECT PRIORITIZATION

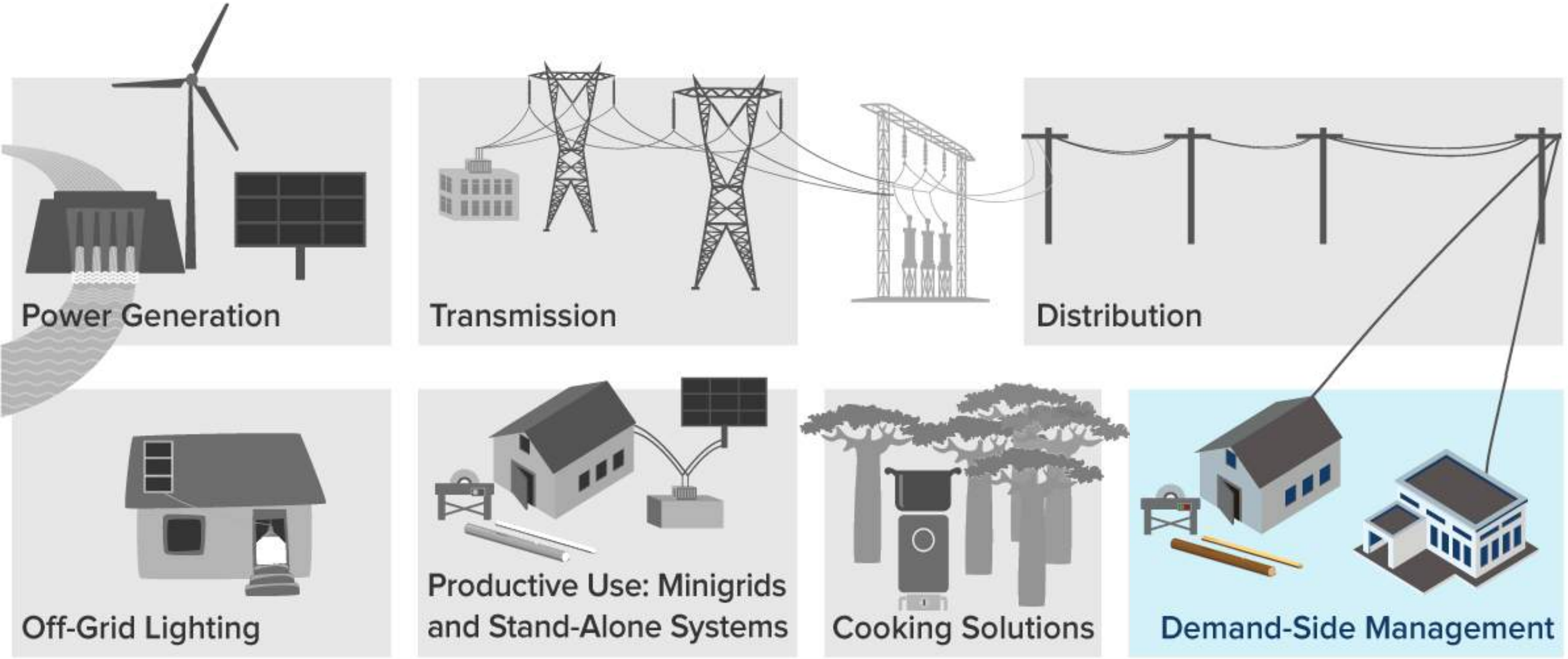
Project prioritization is essential for ensuring that available funding is spent in the most effective and impactful manner

Tier 1: "Quick win" projects that can/should be supported immediately with funding at hand	"Quick wins" are defined as projects that can: • Reduce perceived risks of financiers/developers • Improve future project economics • Prove viable business models to unlock funding opportunities for future projects* • Support other quick win infrastructure projects
Tier 2: Projects that should be prioritized in the near-term	Criteria used to establish near-term (2019–2023) priorities include: • Enable additional connections • Enable economic growth • Support other near-term key infrastructure projects
Tier 3: Projects that should be prioritized in the mid-term to achieve the 2030 goals	Mid-term (2024–2030) priorities are established based on the SEforAll, National Energy Policy and National Electrification Plan targets

*For the off-grid sector the approach used divides between types of projects that can generate commercial returns in the future and can attract private financing (off-grid productive use) and those that cannot. It doesn't prioritize between these two types of projects but proposes different financing mechanisms, and assumes that both types of projects need to be supported to meet access targets.

To meet Malawi's energy goals, an integrated understanding of project needs must be developed, covering seven key sectors

DEMAND-SIDE MANAGEMENT (DSM)



Malawi should capture near-term opportunities in EE programs while building long-term capacity, to ensure dynamic demand planning

~$70 million

investment required by 2030 to establish robust DSM throughout the system*

Top priorities for Malawi are:

- Improve demand planning and forecasting
- Develop a comprehensive EE program covering key sectors

To move forward, the next steps are:

- Update and calibrate existing **demand forecasts** for sector planning
- Accelerate progress with planned efficiency programs

*Capital investment requirements discounted using 9% discount rate

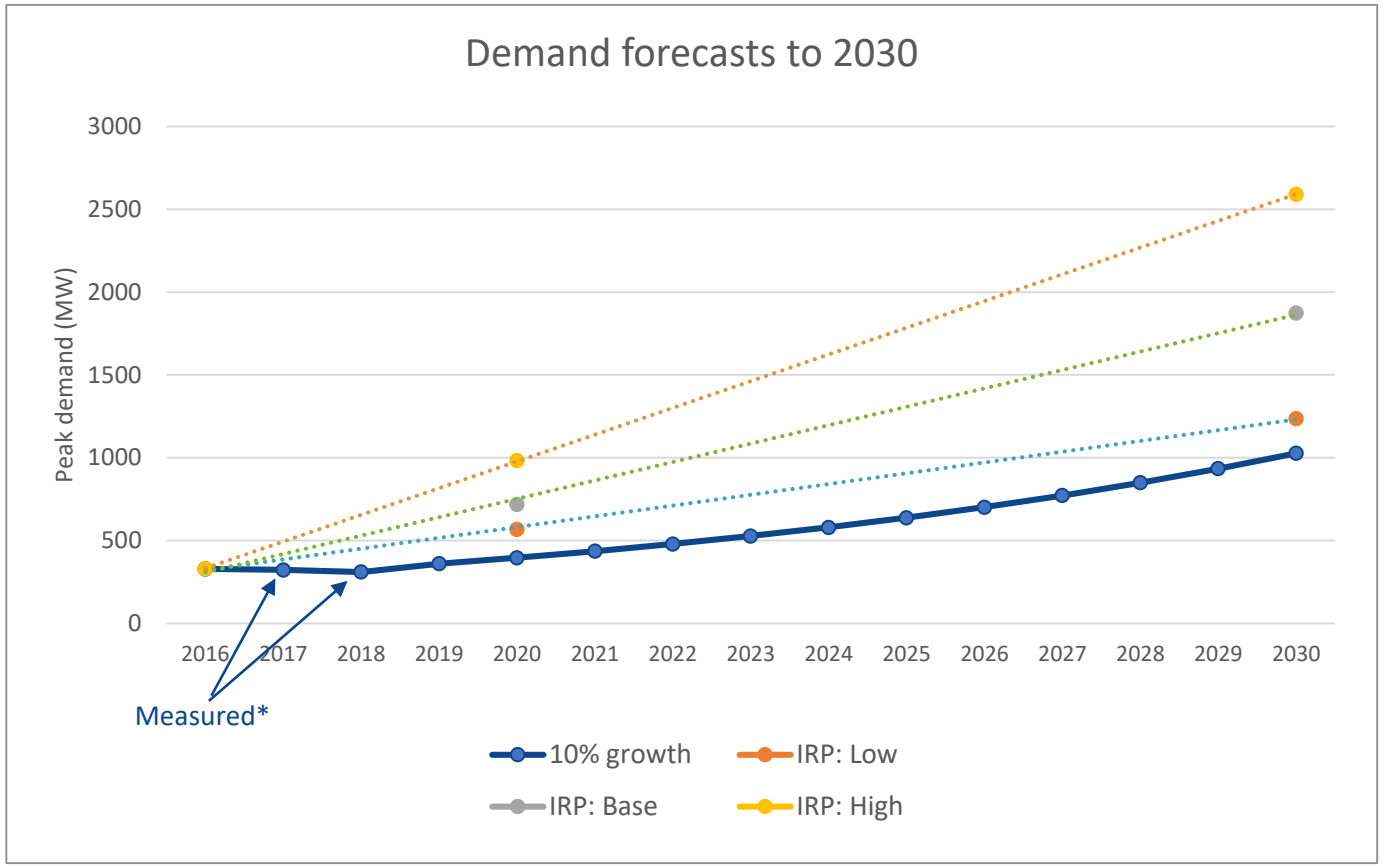
DSM must focus on the challenges of improving planning while capturing the available benefits from efficiency programs

Challenges	Description
1. Demand planning is not updated	• Current sector plans go into detail on energy generation scenarios, but provide limited analysis of expected energy needs* • The role of DSM in optimizing energy planning and reducing costs is not explicitly discussed, while changing demand patterns following widespread outages in 2017 are not considered • **This risks leading to supply-demand imbalance, as Malawi signs inflexible agreements to purchase electricity from independent power producers and cross-border interconnectors****
2. EE potential is not being captured	• **Low awareness:** lack of consumer information translates to limited demand for EE products and an immature market without significant availability • **Limited consumer information:** the benefits and options available are not clearly communicated to the general public • **Lack of technical expertise:** to go beyond existing programs, there is a need for trained professionals • **Funding deficit:** as EE has not been prioritized, there has been limited power sector funding allocated to the sector

*ESCOM has been provided with the E-Terra Platform by USAID and the Plexos software by the World Bank, which should facilitate the regular development of updated demand estimates.

**Currently, demand significantly outstrips supply, but if all the project pipeline were to be built out, the situation would be rapidly reversed.

Demand forecasts must account for rapid changes in the power sector



Changing conditions mean the most comprehensive demand forecasts (2017 IRP**) are already outdated

- Economic growth differs from 2016 forecast data
- Self-generation (principally PV + battery) is becoming a significant cause of grid defection
- Tariffs increased by 32% in 2018, likely depressing demand
- Some point loads identified in the IRP (e.g., major mining developments) may not have materialized on schedule

Improving demand management and forecasting is vital for informing investment decisions

- Different demand scenarios have radically different impacts on investment needs to 2030 and beyond
- Overestimated demand forecasts could lead to excess capacity and generation
- Historic growth rates are low (4%), although suppressed demand plays a role in this
- **DSM** projects will have a significant impact on demand forecasts

*The 2016–2018 data was the measured value based on the maximum demand history provided by ESCOM. The flattening/reduction in 2017/2018 was due to the suppressed demand. **IRP for Malawi, Norconsult, Economic Consulting Associates and Energy Exemplar. Final report, May 2017.

Efficiency projects already ongoing and committed can offer 94MW of demand saving by 2023, representing up to 18% of projected demand

DSM can play an important role in making Malawi's power system more cost effective

Programs to improve EE and demand response show significant benefits:

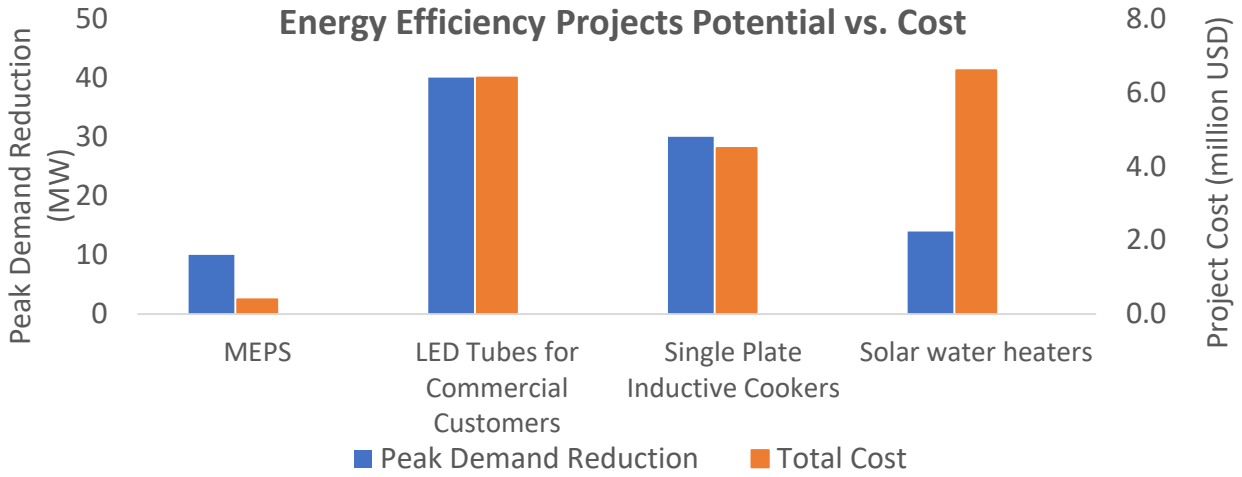
- Lower cost alternative to capacity expansion
- Reduce or postpone grid investments, freeing up capacity for new connections
- Help customers avoid the impacts of increasing energy prices
- Improve system cost recovery through loss reduction

Highlight: success of previous efficiency projects

2011–2013 Energy Efficient Lighting Program: distributed 2 million compact fluorescent lamps to residential customers, small enterprises and public buildings.

This lowered demand by **51MW** (15%) during the evening peak period and 65MW during the morning peak period.*

Committed and planned programs** can capture 94MW of additional demand saving by 2023



- Provide 2 million free or subsidized light emitting diode (LED) lightbulbs to commercial and industrial customers
- Introduce Minimum Energy Efficient Performance Standards (MEPS) for some energy using systems
- Provide 140,000 free or subsidized inductive cookers
- Support installation of 16,000 solar water heaters

*Source: Project Completion Report: Energy Efficient Lighting Program; prepared by Evidence on Demand on behalf of DFID, November 2013.
**Source: ESCOM investment plan, 2017 IRP

A comprehensive EE program can help meet Malawi's energy needs at a lower cost

Key opportunities from EE can be captured through a few, simple steps:

1. **Align with international activities on EE**—benefit from economies of scale and lower program costs
2. **Introduce MEPS**—ensure lowest lifecycle cost for consumers; focus on high-priority energy-consuming systems
3. **Provide subsidies for highly efficient equipment**—develop the market through targeted financial support
4. **Support local industry**—assembly of some energy efficient systems and products can happen in Malawi
5. **Build capacity and expertise in efficiency**—train energy auditors and energy managers for buildings and industry
6. **Develop an EE Fund**—ensure funding is available for implementation of cost-effective projects

Major energy consuming systems		
All	**Lighting**	← Initially, focus performance standards and efficiency programs in areas of largest demand, where they can have rapid, significant impact
Industrial	**Electric motors**	←
	Industrial loads	
	Pumps & fans	
Residential	**Cooking**	←
	Water heating	←
	Domestic appliances	
Commercial	Air conditioning	
	Office equipment	
	Commercial appliances	

Highlight: Ujala LED program for market transformation in India*
Distribution of 770M LEDs at low up-front cost, with repayment on user electricity bills

- Grew domestic market for LED lighting from 0.1% to **25% in two years**
- Retail market **price of LEDs dropped 75%** over four years
- Local assembly and manufacture expanded rapidly

*Source: Energy Efficiency Services Limited, India

Better forecasting and improved efficiency can drive down costs across the power sector

Improve demand forecasting

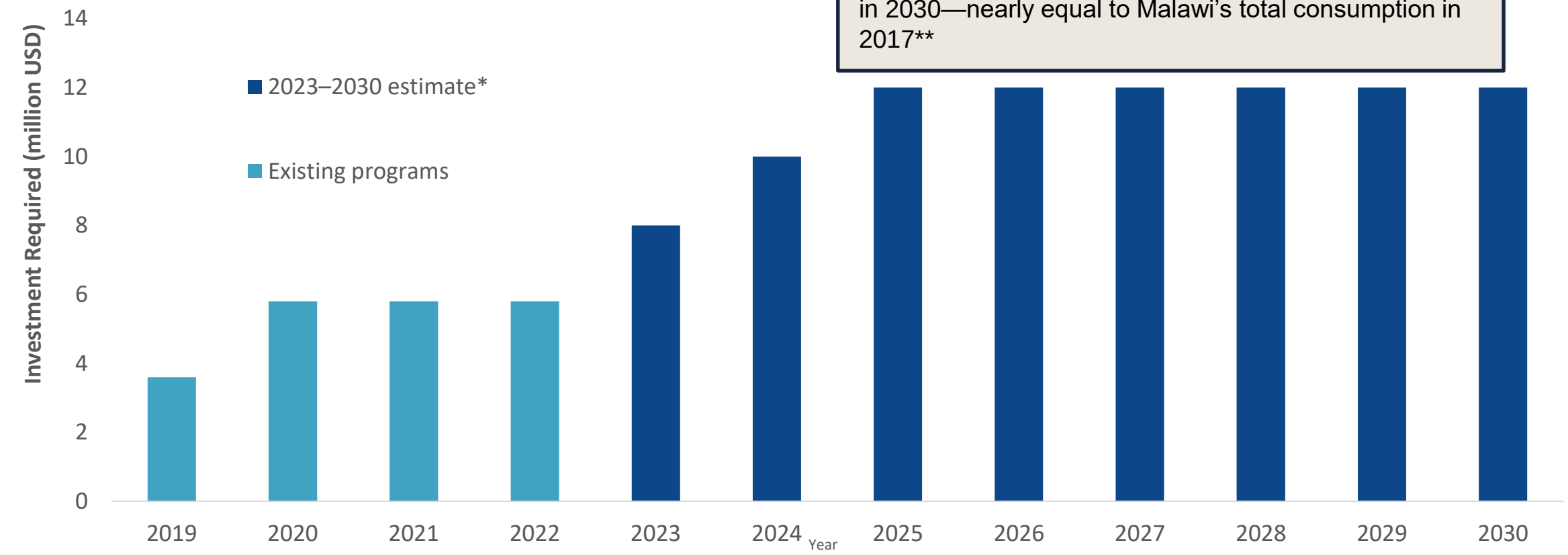
- **Carry out regular updates of demand forecasts, based on metered consumer data and stakeholder input**
- Incorporate the impacts of distributed generation, EE and technology change into forecasts

Scale up the use of EE

- Accelerate implementation of planned “quick win” projects: LED lighting and the first minimum energy performance standards
- Develop a comprehensive efficiency program, spearheaded by public procurement and focused on priority energy systems
- Build capacity, train professionals and provide structured funding to put efficiency at the heart of power sector development

Malawi can begin with cost-effective projects now that have been prioritized to unlock additional EE potential and develop the market

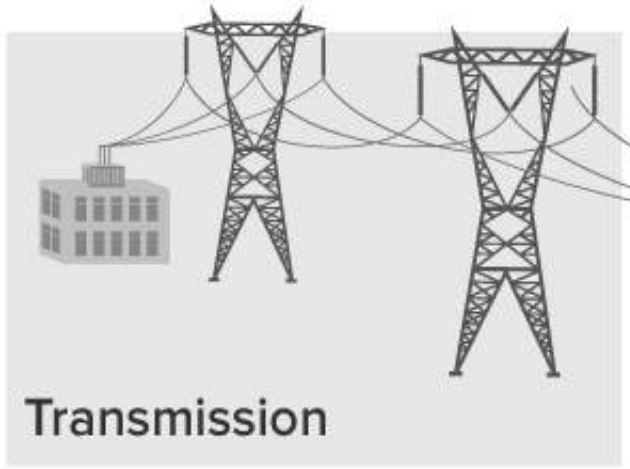
Staged increase to an **annual investment of $12M**, to achieve total potential savings of up to 1.6TWh per year in 2030—nearly equal to Malawi's total consumption in 2017**

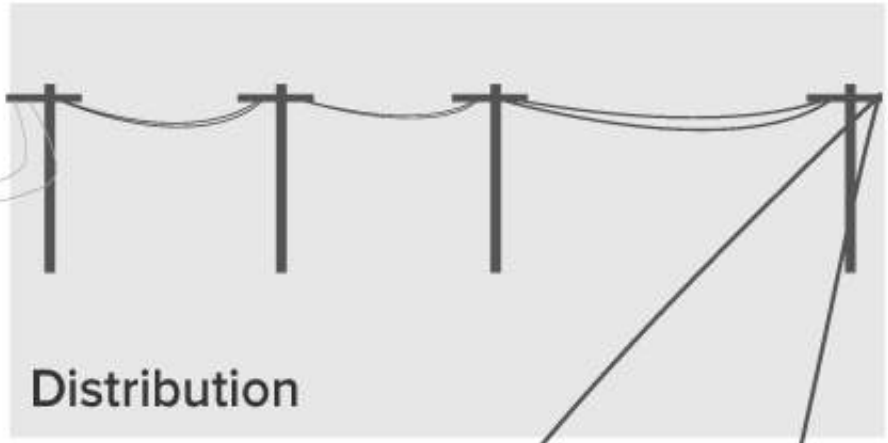


*Costs ramp up to $12M annually, assuming implementation of an EE fund, ongoing subsidies, and a comprehensive capacity building program, as well as M&V, program administration and ongoing improvement of energy performance standards.

**Based on mean savings cost of $0.069/kWh, which is 50% higher than mean US utility efficiency program saving costs of $0.046/kWh

POWER GENERATION





Malawi could pursue a least-cost, reliable, and diversified solution to save ~$500 million on investment and operating expenses by 2030 while meeting NDC emissions targets

~$1,400 million

investment required by 2030 to meet the growing demand*

Top priorities for Malawi are:

- Solar projects, including some with storage, to unlock the markets
- Modular renewable projects to diversify the portfolio and reduce whole-system costs
- Interconnection projects to secure reliability

To move forward, the next steps are:

- Implement a set of **quick win projects** (principally solar PV) to demonstrate market readiness
- Conduct comprehensive **integrated planning** on a regular basis to adjust investment based on demand forecasts**

*Capital investment requirement discounted with 9% discount rate

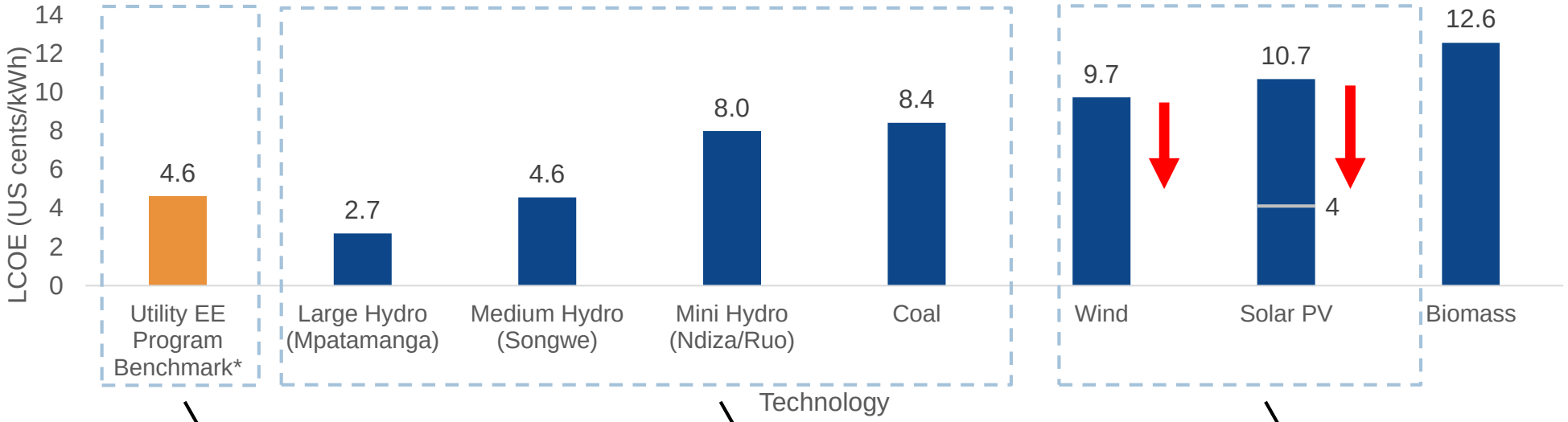
**Plexos modelling tools can be used for the integrated planning

The major challenge for generation is a lack of current and future power supplies to meet growing demand

Challenges	Description
1. Diminishing capacity and reliability of hydro resources	• Existing generation fleet is dominated by hydro run-of-river plants, on the Shire river • Deforestation is causing flooding and increasing siltation of reservoirs and blockages of the turbines, posing reliability and resilience risks to the system • Low rainfall and dropping water levels in Lake Malawi caused significant power shortages in 2017 • Long-term climate models predict higher frequency of droughts, which could significantly impact production capacity
2. Delayed generation capacity expansion	• Different entities have set generation capacity targets, but there is no overall agreement on the implementation plans • Generation projects are scheduled to be built, but progress has been slow due to lack of financing without government guarantee of credit worthiness

Malawi has a range of available energy sources, from which the most cost-effective portfolio can be developed

Estimated Levelized Cost of Electricity (LCOE) from different power generation sources (2017 IRP)**



LCOE is commonly used compare the economics of individual generation sources. It demonstrates the cost of generation across the lifetime of projects

Energy savings from EE program can cost less than generating electricity, therefore should be considered the **"first fuel"**

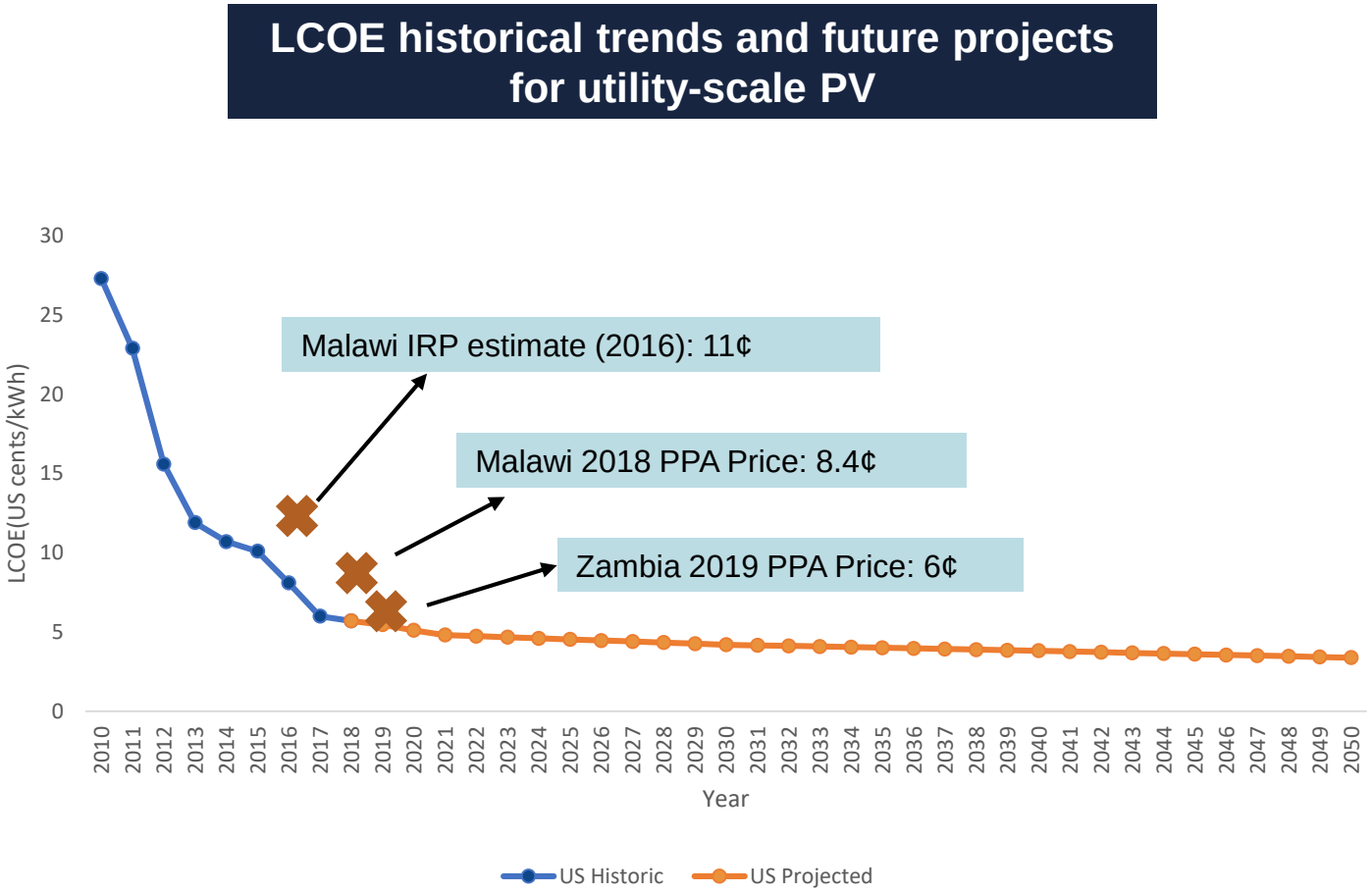
Based on the 2017 IRP assumptions, hydro and coal resources are cost-competitive. However, they could potentially raise **reliability and environmental issues**

Renewables (wind and solar PV) are becoming competitive with traditional generation and are also undergoing rapid **cost reduction**, making them even more attractive as technology evolves in the coming years **(already seen in contracts signed in 2018/2019)**

*The efficiency cost is an average cost across all utility efficiency programs in the United States. Source: https://emp.lbl.gov/sites/all/files/total-cost-of-saved-energy.pdf

**LCOE source: RMI's calculation based on the 2017 IRP.

Ongoing cost reductions in renewables and storage are likely to change the least-cost pathway



- Recently signed solar Power Purchase Agreements (PPAs) in Malawi have pricing of 8.4¢/kWh, already significantly lower than the 2016 IRP estimates (11¢/kWh), but is still significantly higher than US costs (4¢/kWh in 2016)
- With the maturing of the market and ongoing hardware cost reduction, Malawi is highly likely to follow the international trends for cost reduction in solar PV and other renewables
- A recently commissioned PV plant in Zambia is already providing power at 6¢/kWh. As of April 2019, bids have been awarded for new plants in Zambia at below 4¢/kWh
- In the de-risking section of this document, we will discuss in detail recommended actions to remove financing and implementation barriers to materialize the cost reduction

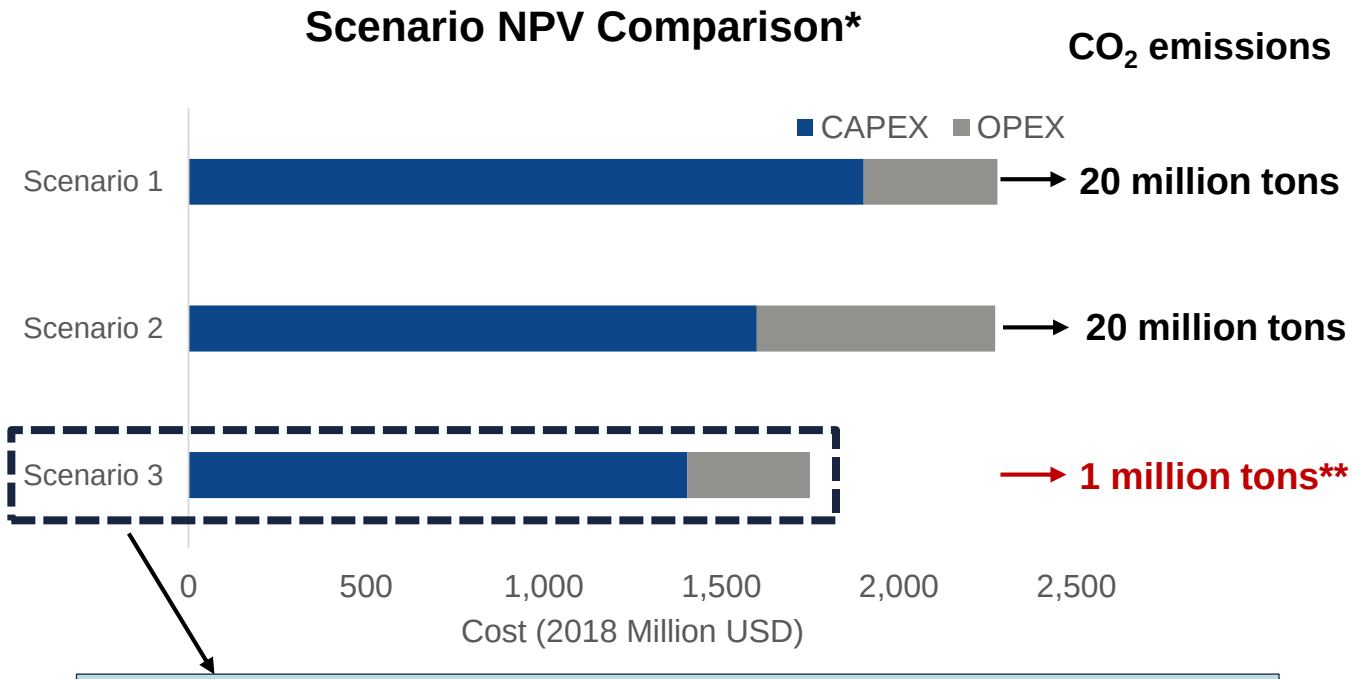
Data Sources: Malawi cost: RMI's calculation based on the 2017 IRP; Malawi PPA price: MERA and ESCOM; Zambia PPA price: https://www.afrik21.africa/en/zambia-bangweulus-solar-park-54-mw-recently-delivered-by-neoen-and-idc/; US cost and PPA price: NREL Annual Technology Baseline. https://atb.nrel.gov/

Coordinated assessment and prioritization over a set of candidate generation projects can optimize the use of financial resources and reduce system costs

Scenario 1 represents the recommended portfolio included in the national planning document for the generation segment (the IRP), dependent on large coal and hydro plants

Scenario 2 represents the ESCOM Investment Plan, with various solar PV and small hydro projects implemented in the near term

Scenario 3 represents a proposed least-cost scenario: a diverse portfolio with EE and modular RE resources that allow dynamic adjustment over the years



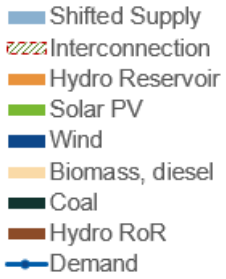
Scenario 3 provides a **least-cost, reliable, and diversified solution, saving ~$500 million (25%) and ~19 million tons of avoided CO_2 emission** with the potential to dynamically adjust investment based on demand forecasts

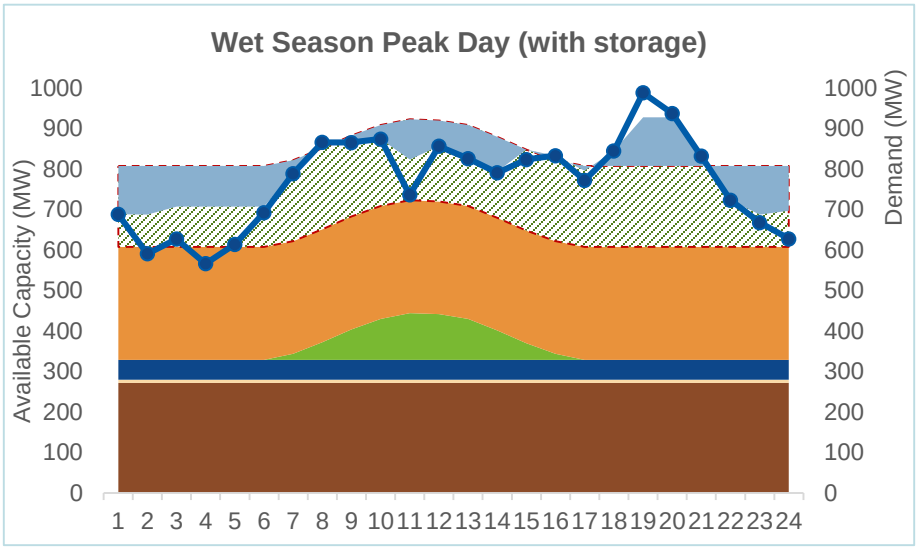
See **Appendix A** for detailed analyses of these three scenarios

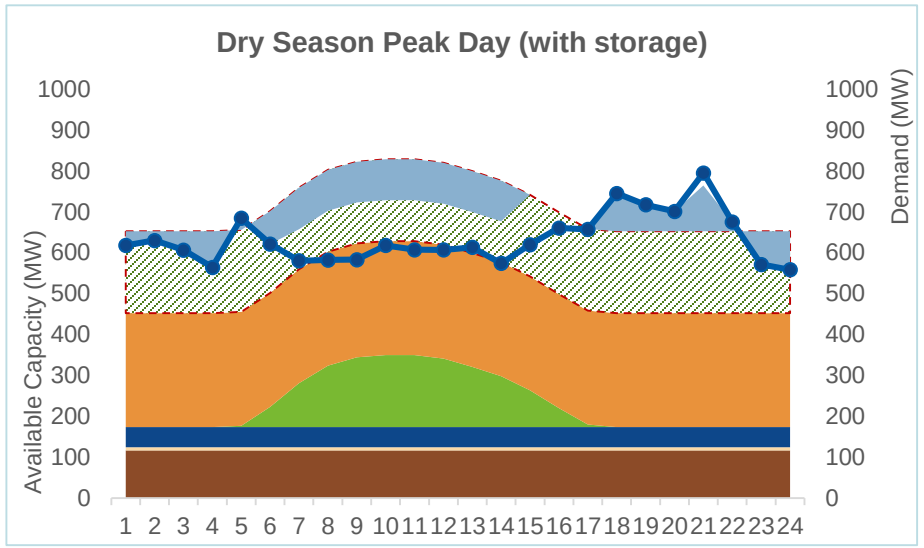
*Cost calculation assumes 9% discount rate.

** Lower emissions projections could be used in the revisions of Malawi's Nationally Determined Contributions (NDCs)

Hourly dispatch analysis shows that an optimized solution using renewables and storage can meet projected demand







Scenario Setting	Peak Demand Day in the Wet Season (March) in 2030	Peak Demand Day in the Dry Season (October) in 2030
Scenario Impact	• Scenario 3 generation mix • Projected generation without storage can meet projected demand* 70% of the time on the peak day • Storage (battery and reservoir) can help improve hour-by-hour availability	• Scenario 3 generation mix • Lower availability from hydro run-of-river, but also 20% lower peak load, mainly due to seasonal difference in agriculture processing load • The demand gap in the evening (5pm to 11pm) can be significantly mitigated by storage (battery and reservoir) capacity

Several countries reach high penetration of renewables without experiencing reliability issues.

For example:**

Denmark

More than **40%** of the electricity generation comes from wind energy

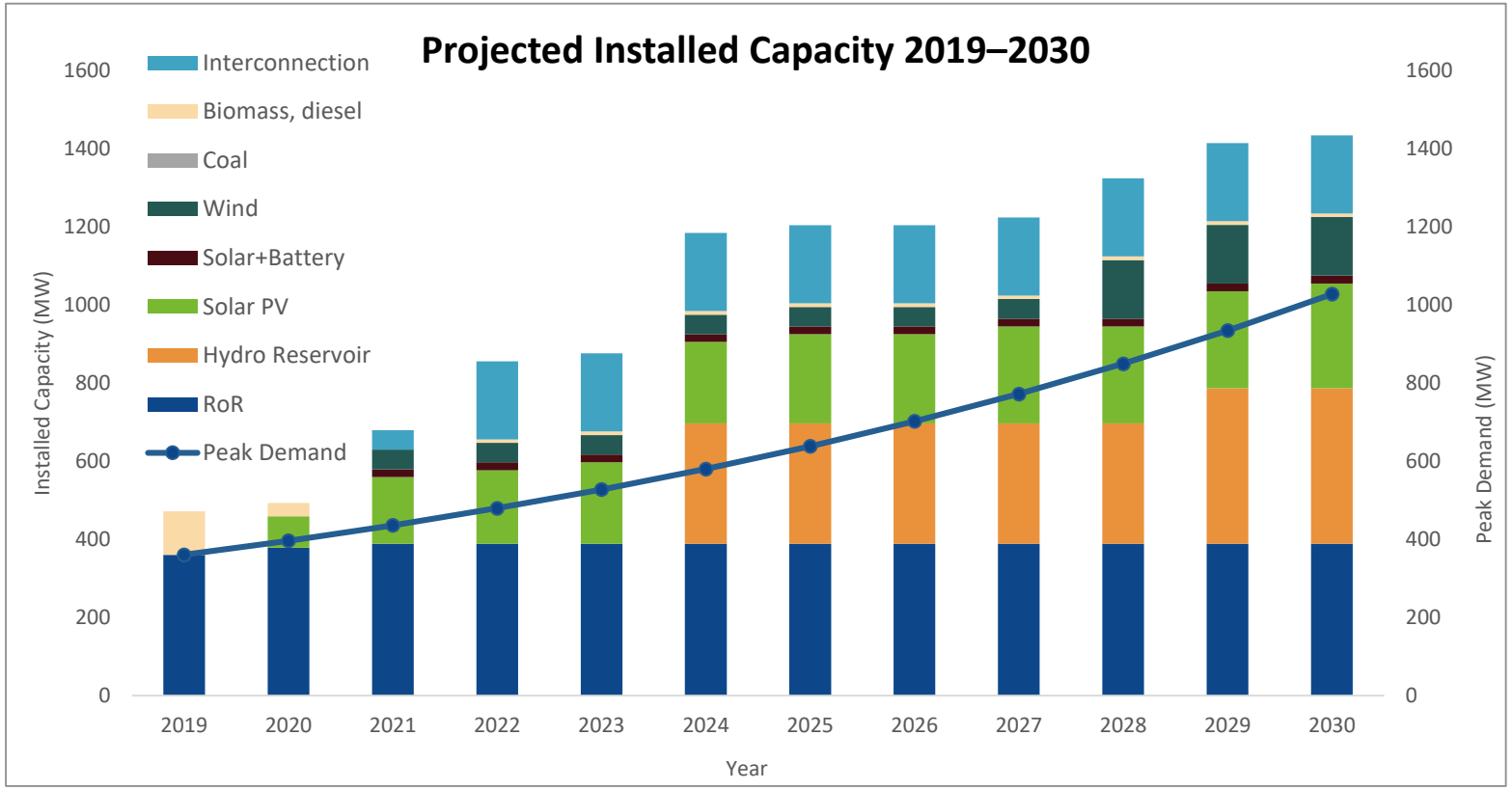
Hawaii

Fully dispatchable solar+storage systems are supporting the Island of Hawaii to achieve more than **10%** generation from solar and **36%** from renewables

*Load is assumed to follow the same hourly pattern as in 2017, with 10% annual growth from 2019 to 2030. More details about the methodology and assumptions can be found in the annexes.

**Example source: https://cleanenergysolutions.org/sites/default/files/documents/flexibility-case-studies.pdf

Malawi can follow a dynamic, least-cost capacity expansion plan to meet system reliability needs



Tier 1: Quick Win

- **Multiple solar PV projects** (Salima by JCM, Nkhotakota by Phanes, etc.) can demonstrate benefits and reduce perceived risks
- **PV+battery** can demonstrate the ability to firm power

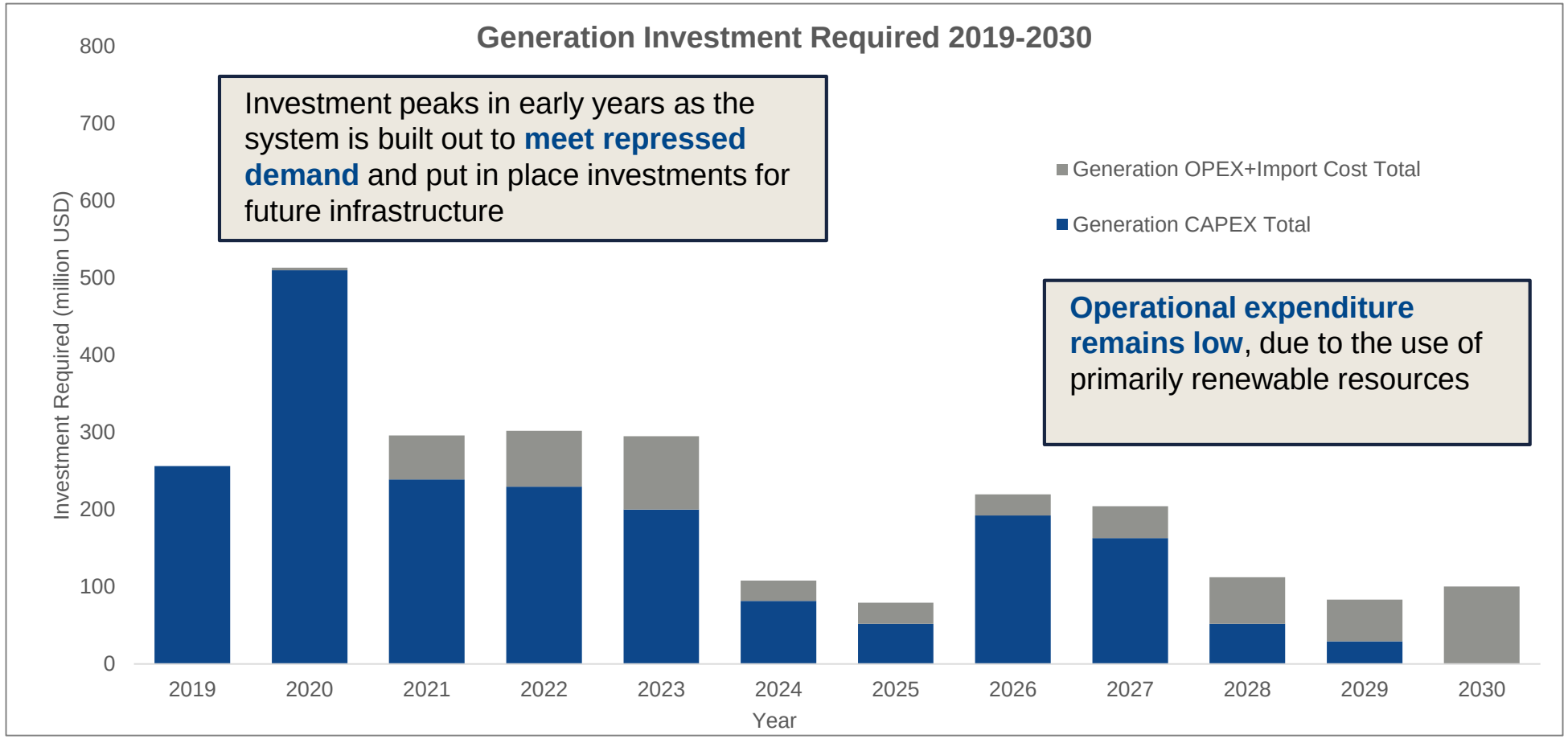
Tier 2: Near-term (2019–2023)

- **Tedzani hydro upgrade** and **Ndiza/Ruo mini hydro** will improve the run-of-river system
- **Waste to energy project** can capture environmental synergy
- **More solar projects** will become more cost-effective and provide clean power
- **Mozambique Interconnection** will provide reliable power from Mozambique and Southern Africa Power Pool (SAPP) market
- **Mzimba wind** will provide additional power

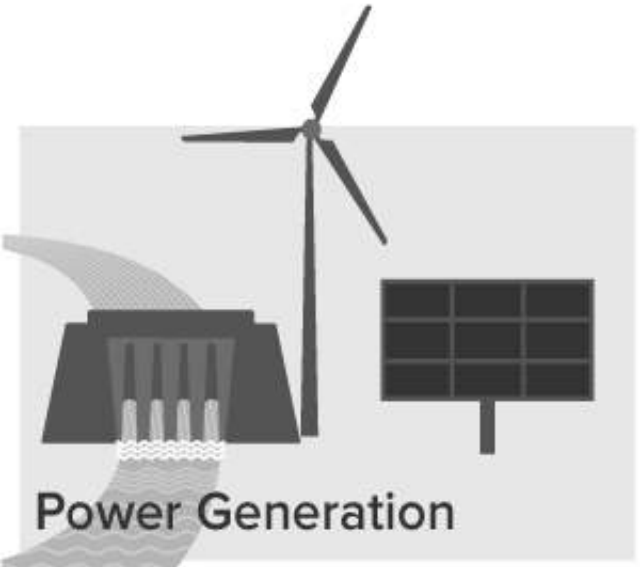
Tier 3: Mid-term (2024–2030)

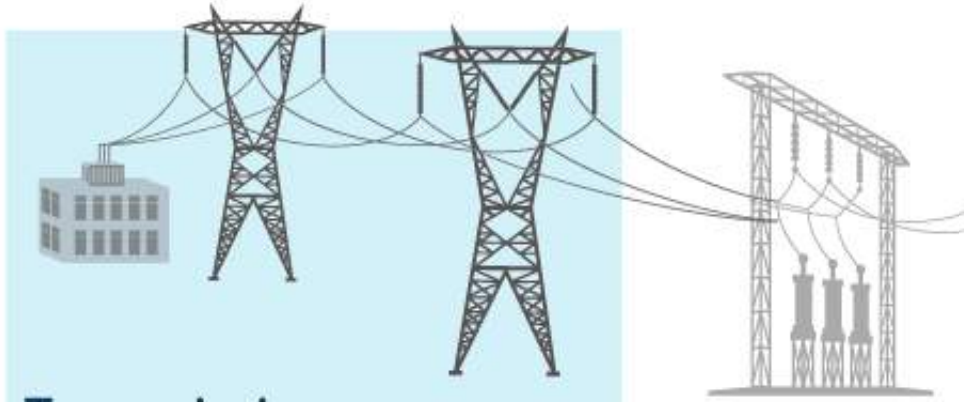
- **Mpatamanga and Lower Songwe hydro** will provide flexibility through reservoir storage
- **Additional wind and solar capacity** will provide additional clean supply to meet demand

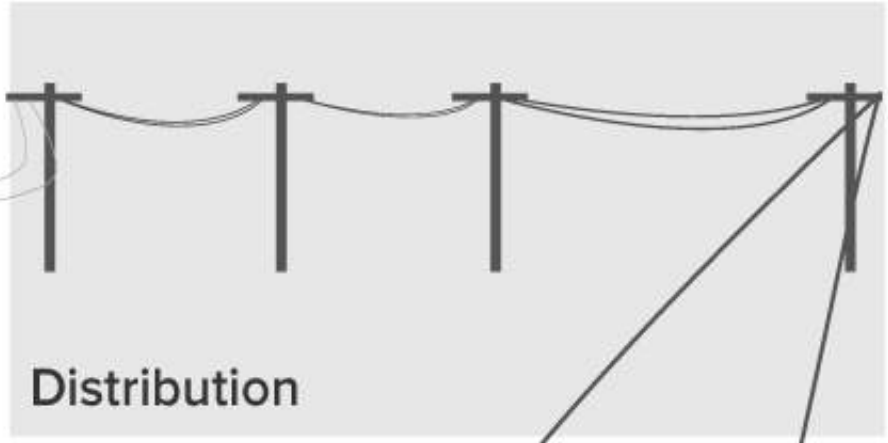
Large capital investment is needed in the near-term, while the operation cost will vary, driven mainly by the need for importing power

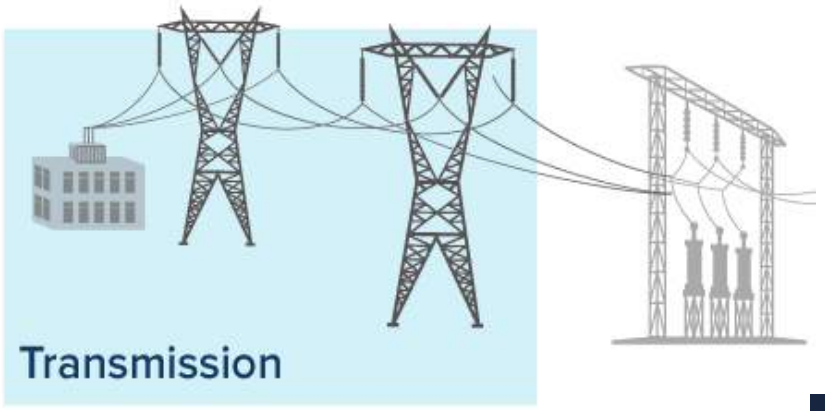


TRANSMISSION









Malawi should balance the near-term import and long-term capacity expansion through a coordinated transmission build-out plan

~$350 million

investment required by 2030 to provide adequate infrastructure support for capacity expansion*

Top priorities for Malawi are:

- Key transmission lines and substations to support integration of renewables
- Transmission backbone and interconnection projects to meet both near-term and long-term needs strategically

To move forward, the next steps are:

- Complete interconnection with Mozambique
- Conduct comprehensive **integrated planning** regularly to ensure transmission investments coordinate with generation

*Capital investment requirement discounted with 9% discount factor

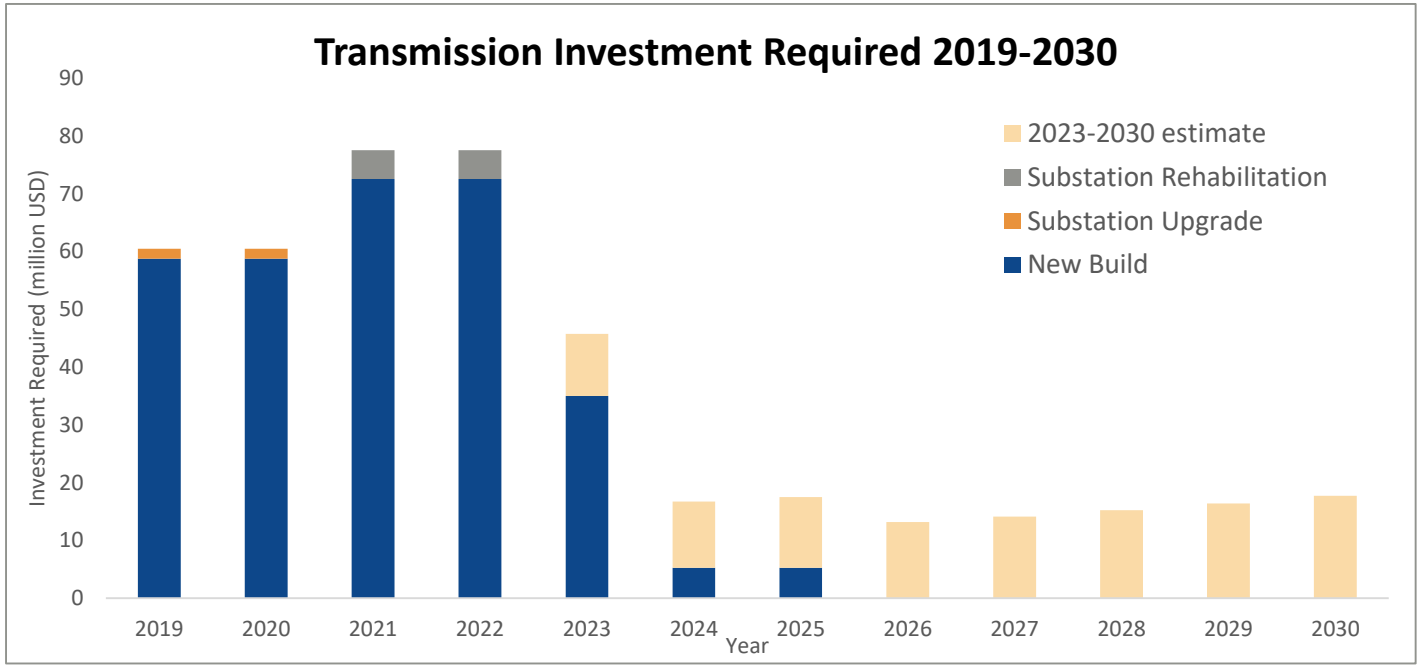
Transmission system in Malawi are dependent on aging infrastructure that cannot meet the growing needs for renewable integration

Challenges	Description
Aging infrastructure	• Existing transmission infrastructure has operated for decades without proper maintenance • The growing demand has put lots of transmission lines and substations into overloaded status, increasing outages and posing threats to sustained economic growth
Growing need for RE integration	• There is a lack of clear understanding of how to optimally integrate intermittent renewables (solar and wind) onto the grid, without running risks of outages • A 2016 grid capacity study suggested that only 70MW solar could be integrated, which added to the perception of risks of solar integration among decision makers, grid operators and investors

There are opportunities to leverage resources from neighboring countries to solve near-term power shortage, and strategically upgrading the system backbone for further system expansion

Opportunities	Description
Interconnectors with neighboring countries	• Interconnection projects with Mozambique, Zambia, etc. could help Malawi meet short-term power need without having to spend capital investment in generation projects • Interconnection contracts could potentially secure a relatively low price for a certain period of time to hedge power price risk • Interconnection lines could also used for market transaction at the SAPP
Transmission backbone project	• Transmission backbone project involves high-voltage transmission lines and substations alongside to improve system reliability to key regions • The enhanced transmission capability could allow additional intermittent renewable resources to be integrated without (or with minor) impact to the system

Malawi can follow an initial transmission project plan to support system expansion and upgrade



The Central to North Backbone-Western Transmission Line was estimated to cost $175 million. Once completed, it would support interconnections and serve as main highway across the country. The model assumes ongoing transmission investment for upgrades beyond 2023, at a lower level of investment than the backbone project.

Tier 1: Quick Win

- **Nanjoka and Dwangwa Transmission Lines & Substations** projects are supporting Salima and Nkhotakota PV projects

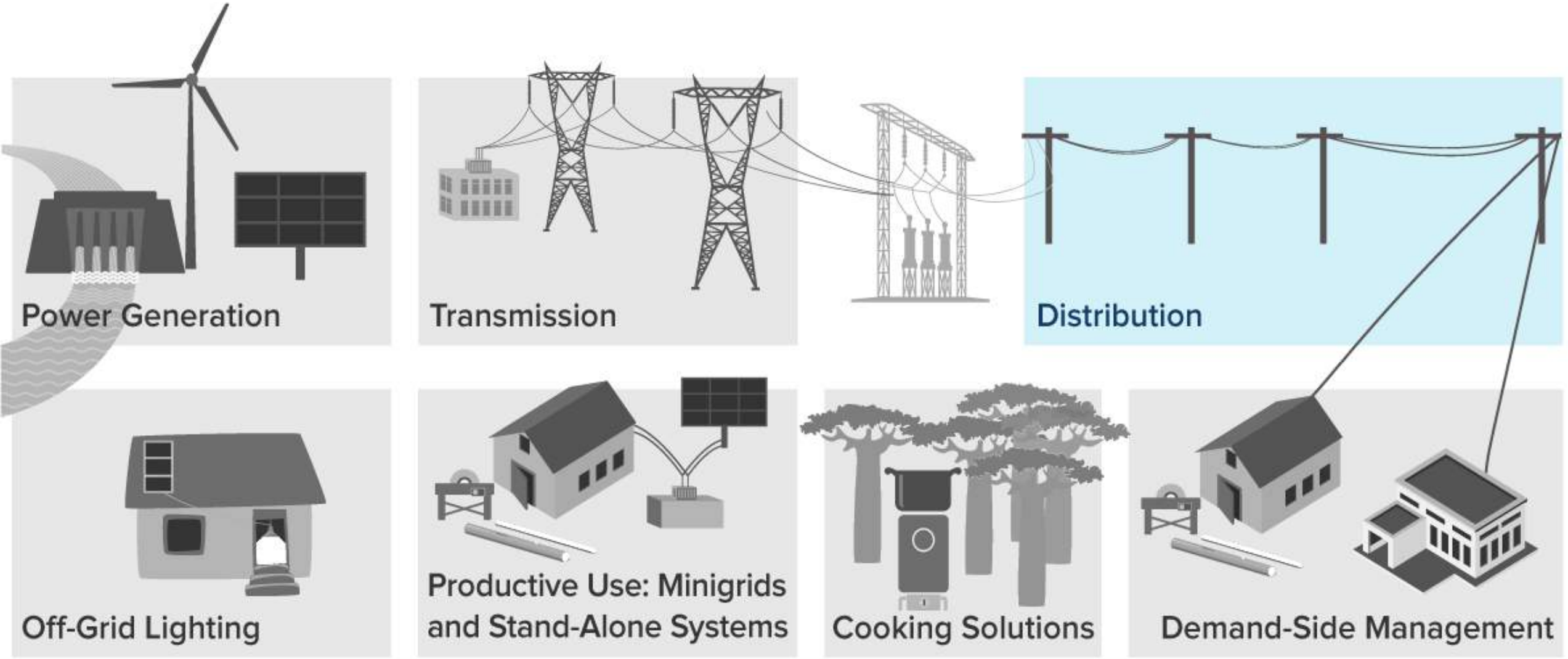
Tier 2: Near-term (2019–2023)

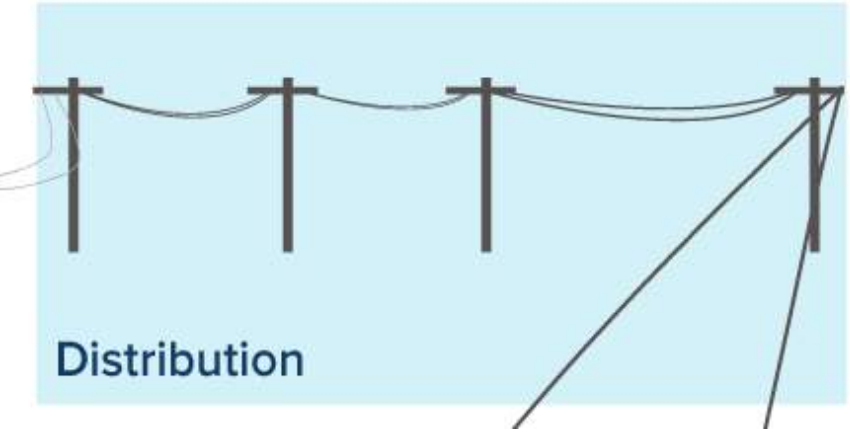
- **Phombeya-Zomba-New Blantyre Transmission Line & Substation** is supporting Mozambique interconnection, as well as Mpatamanga hydro when it's built
- **Central to Northern Backbone-Western Transmission Line** is supporting Mozambique line, as well as Songwe hydro when it's built, and will be critical for transferring power between Central and Northern regions*
- **New Blantyre Station, Chichiri Substation upgrade and Eastern Transmission Line** are supporting critical areas

Tier 3: Mid-term (2024–2030)

- **Chintheche—Chikangawa (Raiply) 132kV Transmission Line and Substation Upgrade** is supporting Mzimba wind plant
- Estimate additional **$11–18 million** per year to keep up with the generation expansion and system upgrade
- Suggest further analysis to evaluate the prioritization

DISTRIBUTION





Malawi should coordinate the on-grid and off-grid planning to achieve a systematic, optimized solution that achieve access targets

~$500 million

investment required by 2030 to enable a robust grid densification*

Top priorities for Malawi are:

- Distribution upgrades to sustain economic growth
- Cost optimization for rolling out electrification programs

To move forward, the next steps are:

- Build crucial substations
- Conduct analysis to further prioritize among least-cost grid densification areas
- Conduct integrated, on-grid and off-grid planning on a regular basis to coordinate investment decisions

Capital investment requirement discounted with 9%

Existing distribution system is facing the challenging of aging and overloading, with power quality being a major concern

Challenges	Description
Low levels of electrification	• Over **60%** of the country's people (~12 million) reside within 2.5km of existing grid, and more than **80%** (~15 million) reside within 5km • An estimated 1.1 million households reside within 500m of existing ESCOM transformers and 1.5 million within 1km • However, only 20–30% of this population is connected to the grid
Power quality issue for existing customers	• Existing distribution lines and substations are overloaded, especially in the areas with rapid urbanization • Customers started to install off-grid back-up generations and provide threats to utilities (potential grid defection and utility death spiral)

Source: Millenium Promise Interim First Order Geospatial Least Cost Electrification Plan

Grid densification and expansion coordinated with off-grid electrification are the most cost-effective ways of bringing electricity access to new communities

Generation capacity expansion

- Reduce reliance on large scale generation, instead use distributed energy resources (such as connected microgrids) for grid expansion to avoid stranded assets issues

Productive use and demand stimulation

- Electrifying productive use increases capacity utilization to reduce per-unit costs and improve system viability
- Need to provide financial support for acquiring appliances and wiring houses, to increase uptake (e.g., ESCOM Ndawala program could be ramped up)

A more robust, cheaper, more sustainable grid

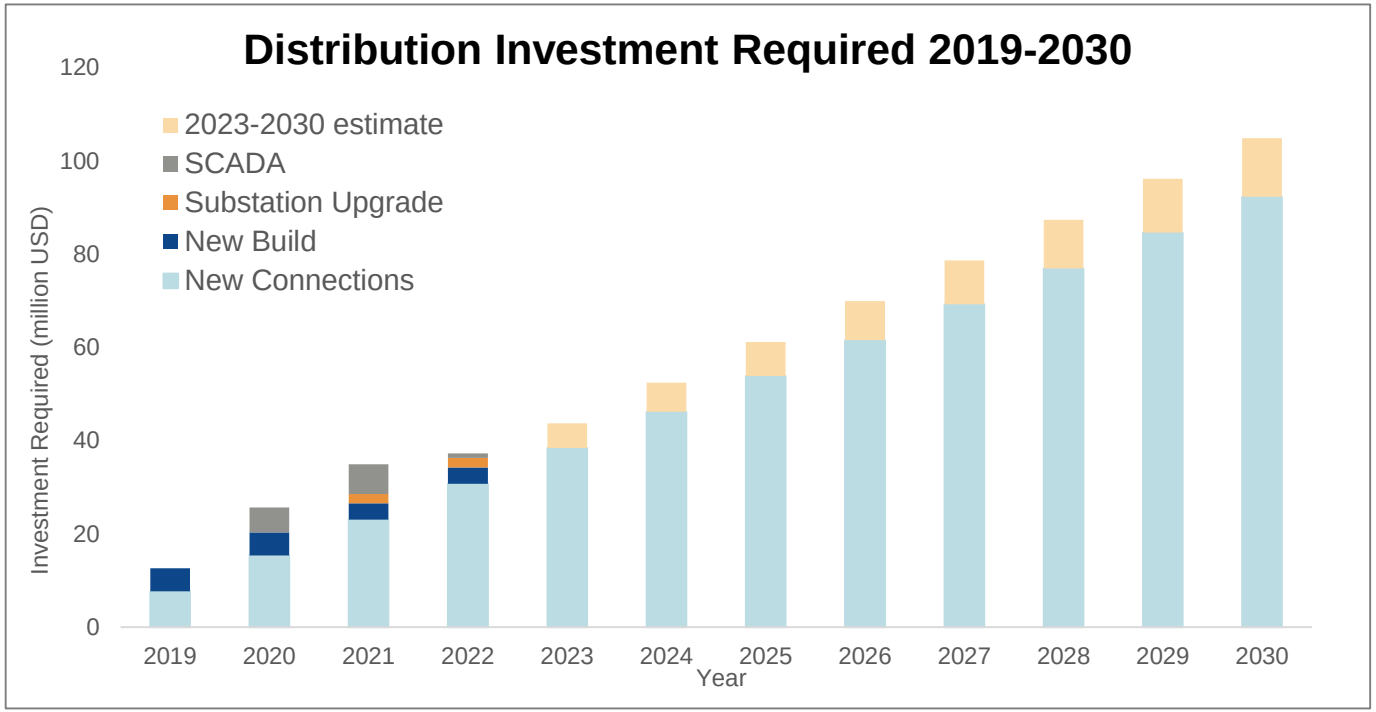
Least-cost grid densification

- Customers within 500m–1km of ESCOM transformers can be connected to existing transformers with little to no additional medium voltage line

Off-grid electrification

- Solar home systems and minigrids can meet power needs in areas that grid extension hasn't reached, and help increase demand to achieve better economics when the main grid does arrive

Capturing the low-hanging fruit of least-cost grid densification through continued investment in the distribution network is essential for achieving targets



Supervisory Control and Data Acquisition (SCADA) is the computer system used for operation and control of the transmission and/or distribution networks. ESCOM has been using SCADA for transmission for a long time, and started to implement it in the distribution network to increase the real-time visibility of the distribution network, increase speed in execution of operational commands and availability of quality distribution system data that can be used for planning purposes. We estimate a staged development of implementation from the Southern region to Central and Northern regions, based on the ESCOM plan.*

Tier 1: Quick Win

- **Blantyre West to Chileka Line, Lilongwe Area 49 Substation and KIA Substation** can achieve quick wins by supporting areas in the Central region with highest population density

Tier 2: Near-term (2019-2023)

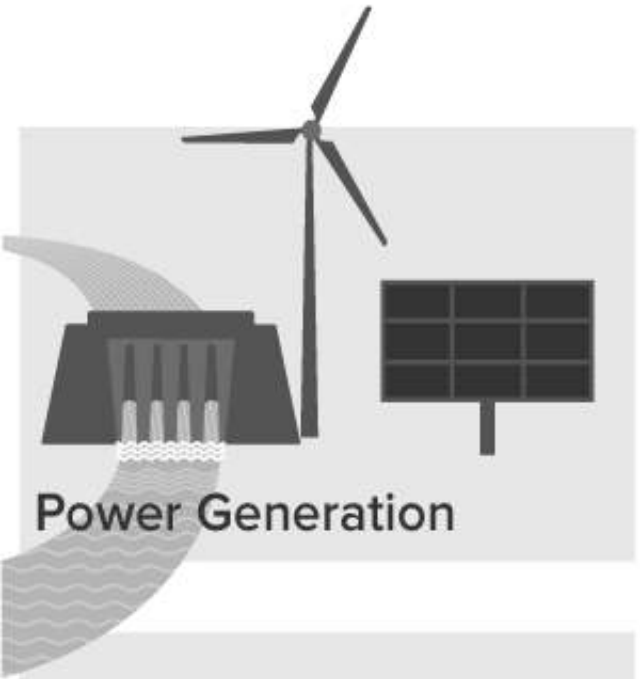
- **Staged SCADA projects, Thyolo C, Malosa and Senga Bay Substations and Monkey Bay-Maldeco Line** can improve power quality in critical regions
- Suggest further analysis into the 109 "high" and "very high" priority locations with over 100,000 households identified by GIS study

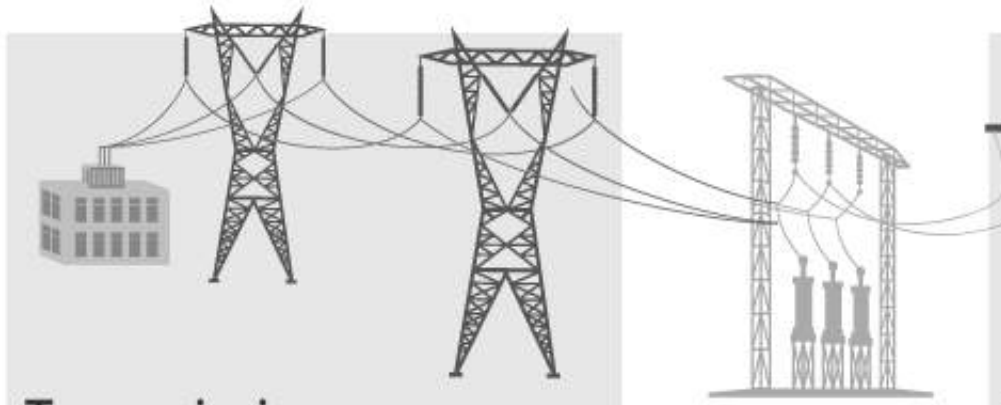
Tier 3: Near-term and Mid-term (2019–2030)

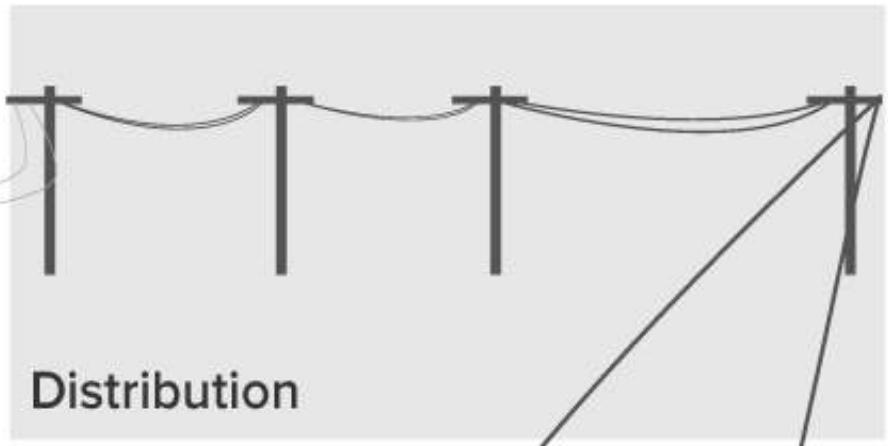
- Connecting **800,000 homes** within 500m would bring the electrification rate to **28% nationwide**
- Follow the best practice of grid connections to reduce capital expenditure (CAPEX) (US$450–500 per connection); total estimated cost is **$400 million**
- For 2024–2030: estimate spending of **$5–13 million** to maintain/improve power quality. Suggest further analysis to evaluate the prioritization

*Information source: ESCOM 5-year Investment Plan.

PRODUCTIVE USE: MINIGRIDS AND STAND-ALONE SYSTEMS







Malawi should identify and support productive use to enable sustainable business models in the minigrid sector

>$10 million

investment required by 2030 to develop the minigrid market*

Top priorities for Malawi are:

Couple minigrid development with agriculture-based productive use to **reduce electricity costs** and promote localized **economic growth**

To move forward, the next steps are:

- Assess value chains in **irrigation, horticulture,** and **dairy farming** to identify potential for minigrid growth

*Development and construction cost estimated based on policy targets for minigrid sector. With additional information on agricultural value chains, a more realistic market estimate can be produced. Capital investment requirements discounted with 9% discount rate.

Major challenges for off-grid productive use include lack of sustainable business models and poor collaboration between productive sectors and electrification efforts

Challenges	Description
1. Lack of proven business models	• Mismatch in demand and supply due to low affordability, seasonal incomes, and limited anchor loads • Poor cost recovery and lack of skilled technicians lead to inadequate repair and maintenance and inability to ensure long term sustainability of systems. Out of more than 17 projects developed, only 4 projects remain in operation today* • Lack of training and financing to develop the business case, identify the right productive use equipment, and overcome upfront costs • Lack of awareness on equipment standards to identify the right equipment for meeting user needs and system constraints
2. Poor collaboration productive & electricity sectors	• Lack of collaboration between agriculture sector and electricity providers makes planning and budgeting for productive use in project design difficult • For example: value addition centers to process crops financed by the Ministry of Agriculture faced 3-year delays to get electricity
3. Costs too high	• Equipment costs, balance of system, and limited penetration of mobile money drive up minigrid costs in Malawi*** • Solar powered minigrids in Malawi incur estimated all-inclusive costs from $1.33 to $2.44/kWh** compared to benchmarks for regional projects of $0.60/kWh

Sources: *Power Sector Assessment Report pg 20; **Eales et al Feasibility Study for a Solar PV Microgrid, 2018; ***Eales, Minigrids in Malawi: Status, Opportunities, and Barriers, 2018

Supporting productive use requires testing new business models and collaborating with agriculture programs

Opportunity	Description
1. Test new business models	• Include productive use in siting decisions, design, and execution of projects to ensure projects include realistic demand estimates; earmark resources to support demand growth • Target underserved communities under the grid with latent productive use opportunities and feed surplus power to the grid, helping address the grid's generation deficit in the short to medium term • Build on lessons learned from early efforts, including EnDev's PURE incubator/accelerator that will support new businesses engaged in productive uses of energy to enter markets and increase sales*
2. Establish linkages with agriculture sector	• Develop cross-sector programs to develop and power productive use facilities in agriculture hubs • Apply lessons learned by Road Authority and Ministry of Agriculture to coordinate road projects with needs of agriculture hubs
3. Increase capacity utilization to bring down unit costs	• Design productive use components to reduce minigrid costs by around 20%, adding daytime and variable loads and more kWh on the system to spread fixed costs over more consumption (e.g., pre-development costs, fixed operation costs)

*Feedback provided by GIZ En Dev Team on August 2019.

Off-grid productive use is already taking place in Malawi and learning from exemplar projects can be applied to accelerate progress

Examples of productive use in Malawi

	Productive use intervention	Context
Coffee and agro-processing with minigrid electricity in Usingini*	• Electrification of coffee processing with minigrids • Expansion into macadamia processing to address seasonality of coffee crop	• Large village: 1,500 households • 10km from medium voltage (MV) lines, grid offers unreliable service • High ability to pay—high income generating activity of coffee production • Presence of Airtel tower to provide anchor load
Small-scale irrigation with stand alone solar pumps in Mudumuka**	• Irrigation serving smallholder farmers • Expansion into cash crops (tomato, beans) with stand alone irrigation pumps	• Larger peri-urban community • Main irrigation site at Mudumuka, with 2,000 households in a 2km radius • >1km from MV lines, unreliable service and lines do not run to irrigation site • Low ability to pay due to prevalence of subsistence farming and limited income generating activities

Examples **range** from **larger-scale projects** that generate sufficient revenues to justify installing a **minigrid**, to **smaller, more scattered opportunities** that are best served through **stand-alone systems**

Productive use is already happening, but for examples like this to become the norm, Malawi needs to **understand where opportunities for productive use lie** to inform the design of cross-sector support structures that will enable localized productive use interventions

See **Appendix B** for additional detail on productive use case studies

Sources: *Usingini Feasibility Study and author calculations; **Interviews with Malawi Fruits and author calculations

Understanding the opportunities for productive use will inform which intervention activities Malawi should pursue going forward

Productive use intervention activities		
Intervention category		**Intervention scale**
Needs assessment	Value chain evaluation	National
Business development services (training and education)	Identification of optimal equipment	National and Local
	Business case assessment	Local
	Enterprise development & training	Local
Equipment provision and consumer finance	Local appliance availability and affordability	National and Local
	Information on optimal appliances	Local
Larger scale demand stimulation projects	Larger scale productive use interventions	Local
	Cross-sector development partnerships	National
Electricity service	Electricity cost and pricing	Local
	Tariff structure	Local
	Service quality	Local

Interventions across the value chain can support productive use efforts:

- ***Value chain analysis*** to understand gaps where targeted interventions can grow local economies
- ***Business development*** to help developers & customers get the most from new appliances and equipment
- ***Equipment provision & finance*** to develop and help customers access the right appliances and equipment
- ***Large scale projects*** to promote productive uses and economic growth by targeting larger ventures and new markets
- ***Electricity service models*** create the right conditions to increase the rate of uptake

The key next step is for national and local actors to conduct needs assessments to better understand productive use opportunities

Productive use intervention activities

Intervention category		Intervention scale
Needs assessment	**Value chain evaluation**	National
Business development services (training and education)	**Identification of optimal equipment**	National and Local
	Business case assessment	Local
	Enterprise development & training	Local
Equipment provision and consumer finance	Local appliance availability and affordability	National and Local
	Information on optimal appliances	Local
Larger scale demand stimulation projects	Larger scale productive use interventions	Local
	Cross-sector development partnerships	National
Electricity service	Electricity cost and pricing	Local
	Tariff structure	Local
	Service quality	Local

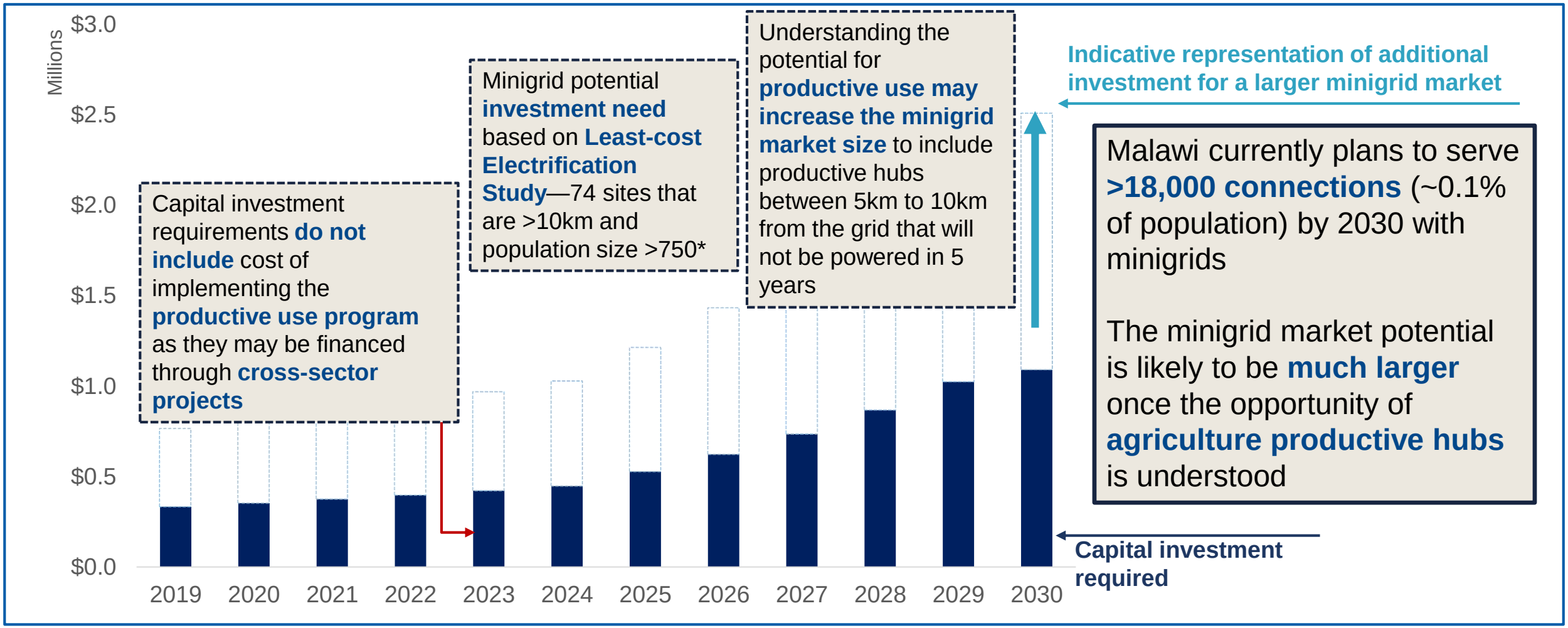
National Actors

Size market & opportunity: Assess productive hubs in **irrigation, dairy, and horticulture** to identify and assess feasibility of electrifying potential value addition facilities and design cross-sector partnerships

Local Actors

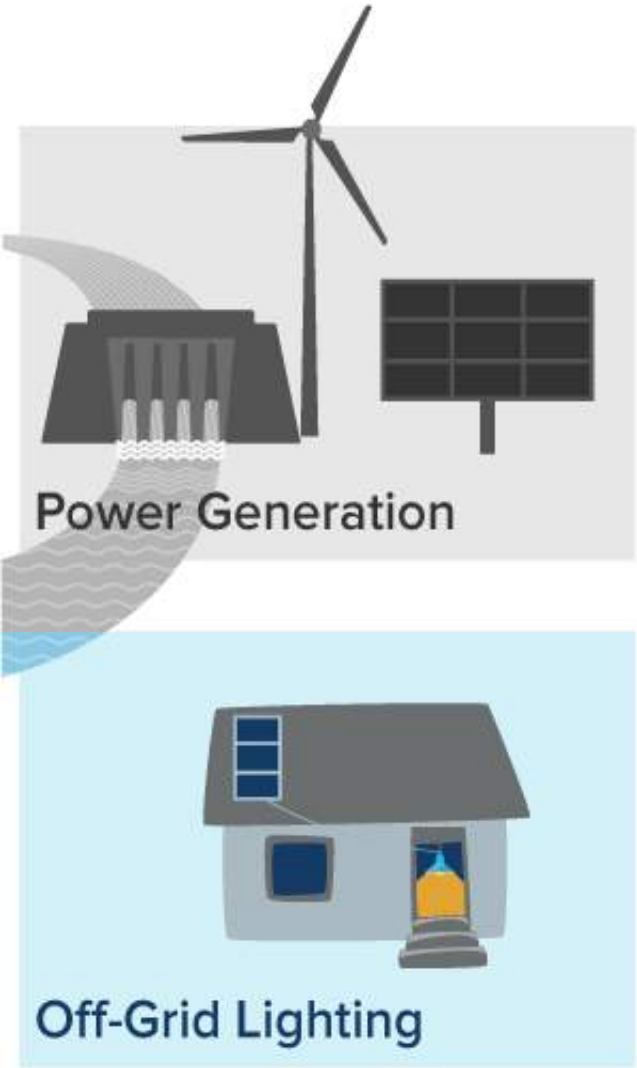
Conduct market surveys to understand customer needs, appliance availability, and identify barriers preventing customer uptake

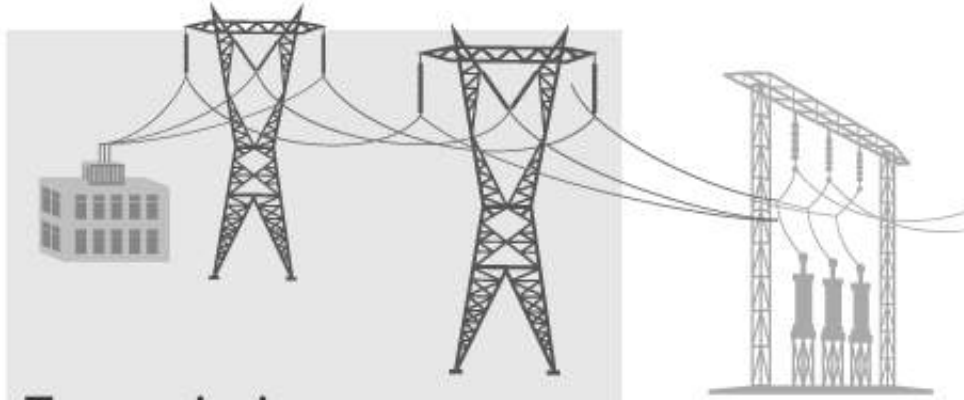
Prioritizing productive use, Malawi can move the off-grid sector towards financial viability, enabling it to take on a more significant role in the country's power sector

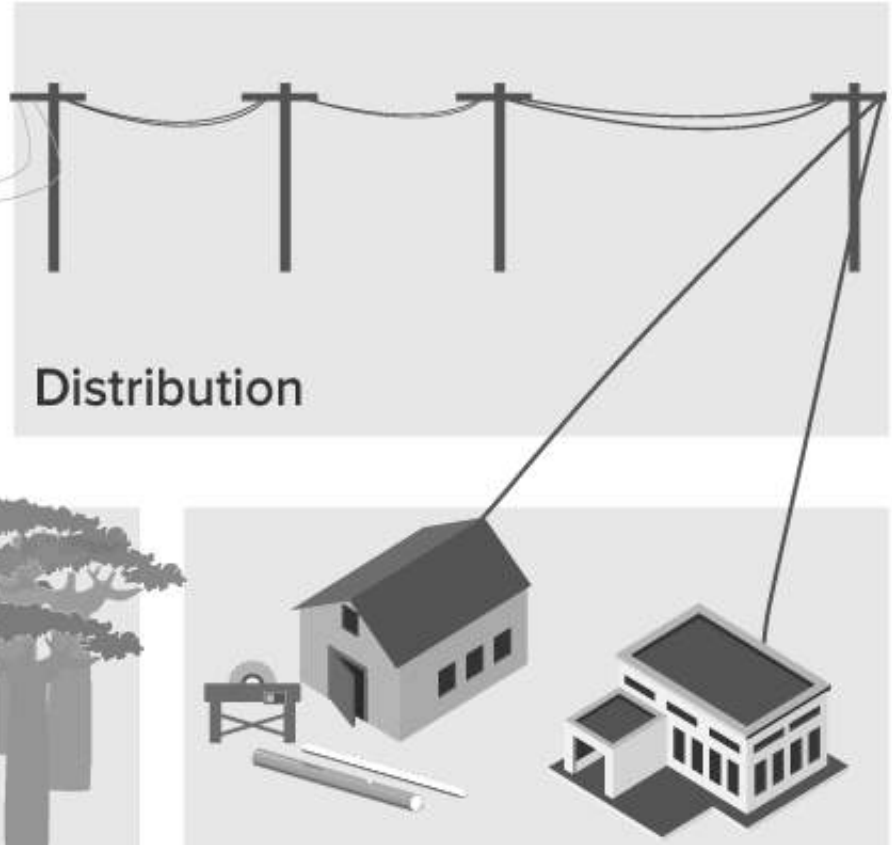


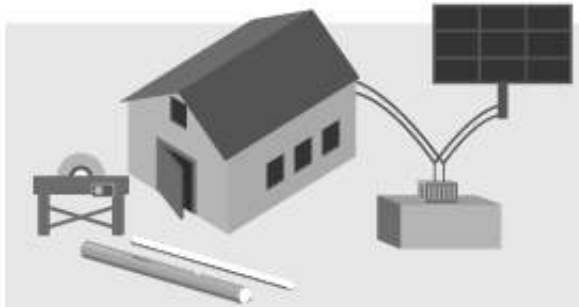
*Capital investment requirements discounted using 9% discount factor. Market size based on Least-cost Electrification study, but a deeper understanding of value chains in Malawi is required to size the market for minigrids targeting productive use.

OFF-GRID LIGHTING









Malawi should enable private sector participation to grow the off-grid lighting market, while subsidizing the poorest to meet its access targets

$130 million

investment required by 2030 to meet off-grid connection targets*

Top priorities for Malawi are:

- Understand **demand**
- Build **consumer awareness** on product quality
- **Subsidize** the poorest

To move forward, the next steps are:

- **Collect information** on performance of different service options to tailor **program design** to market needs

Capital investment requirements only include the portion of the market that cannot afford the full cost of pico solar products and require subsidies. Capital investment requirements discounted at 9%.

The major challenges the pico solar sector faces include information asymmetries, poor quality, and low affordability

Challenge	Description
1. Poor information and nascent market	• Poor information on demand characteristics challenge matching technical and financial solutions to target population's ability to pay (ATP) and preferences • Few distributors in rural areas. Distributors face high upfront costs to establish supply chains to serve an unproven market (current sales <2000 units a year). USAID's Solar Home System Kickstarter Program is addressing this barrier by providing results-based financing (RBF), linkages to creditors, and consumer awareness as a market development tool*
2. Poor product quality	• Limited consumer awareness to distinguish between products and make tradeoffs between quality, value, and price** • Difficulty in controlling supply of counterfeit goods imported through uncharted routes. Institutional arrangements for enforcing technical standards can only address formal supply chains • Outdated quality standards, although Malawi Renewable Energy Strategy 2017 sets out a plan to adopt Lighting Global Standards
3. Low affordability	• Around 3.5M households cannot afford to pay for pico solar products*** • Value-added tax (VAT) and duties (on some products) combined with inflation and foreign exchange (FOREX) volatility drive up local prices, reducing affordability

Sources: *SAEP Market Entry Pack; Oxfam America Evaluation Report: RE Access and Socio-economic Development: The case of small-holder farmers in Mchinji and Rumphi districts in Malawi; *** Author calculations based on following study: Business Innovation Facility. "Off-grid lighting and phone charging study," August 2016

The largest opportunities for pico solar include leveraging program flexibility, community organizations, and potential for scale

Opportunity	Description
1. Leverage multi-stage program design to understand market needs	• Conduct a trial-based implementation model that feeds back lessons learned into program design to improve likelihood of success • Provide a range of options in payment models, subsidies, and product choice during early stages until characteristics of demand are better understood to ensure that demand can drive supply • Improve coordination across ongoing efforts, such as with GIZ EnDev's market development efforts supporting suppliers, promoting one-stop shops for sales and service of products, and organizing market participants to push for better regulation*
2. Build consumer awareness of quality products	• Leverage USAID and GIZ EnDev awareness campaigns to develop consumer knowledge on distinguishing quality products from counterfeit goods • Use village Savings and Loans institutions as entry points to identify and understand market needs, provide consumer awareness training, and fund repairs for low-cost pico solar products after warranty period expires
3. Overcome affordability barrier	• High population density, significant potential size of market (over 30K units sold in Jul-Dec 2018),** and proximity to larger markets can enable providers to achieve scale and lower costs • Support market scale by removing VAT and providing viability gap funding—3.5M households that would need viability gap funding to cover difference between cost and ATP

*Feedback provided by GIZ En Dev Team on August 2019.

**Gogla, "Global Off-grid Solar Market Report: Semi-Annual Sales and Impact Data," 2018

Malawi has a unique opportunity to test and refine to design the right approach to meet the country's needs

Two projects aim to support the development of the off-grid lighting market in Malawi:

- Phase 1: USAID Solar Home System Kickstarter Program (**US$1.5M**) *under implementation*
- Phase 2: World Bank Electricity Access Project (**US$20M***) *approved*

Malawi can test a range of design options and collect information on their performance to refine the design of the larger Phase 2

Preliminary Data Collection List	
Supply chain	Number of providers operating per district
Sales	Number of connections per provider
Product preferences	Number of units sold per product category**
Repair and Maintenance	Number of repairs Types of repairs Consumer preference for coverage options under warranties
ATP	Loan Repayment, default rates of various payment models
	Loan Repayment, default rates at different price points

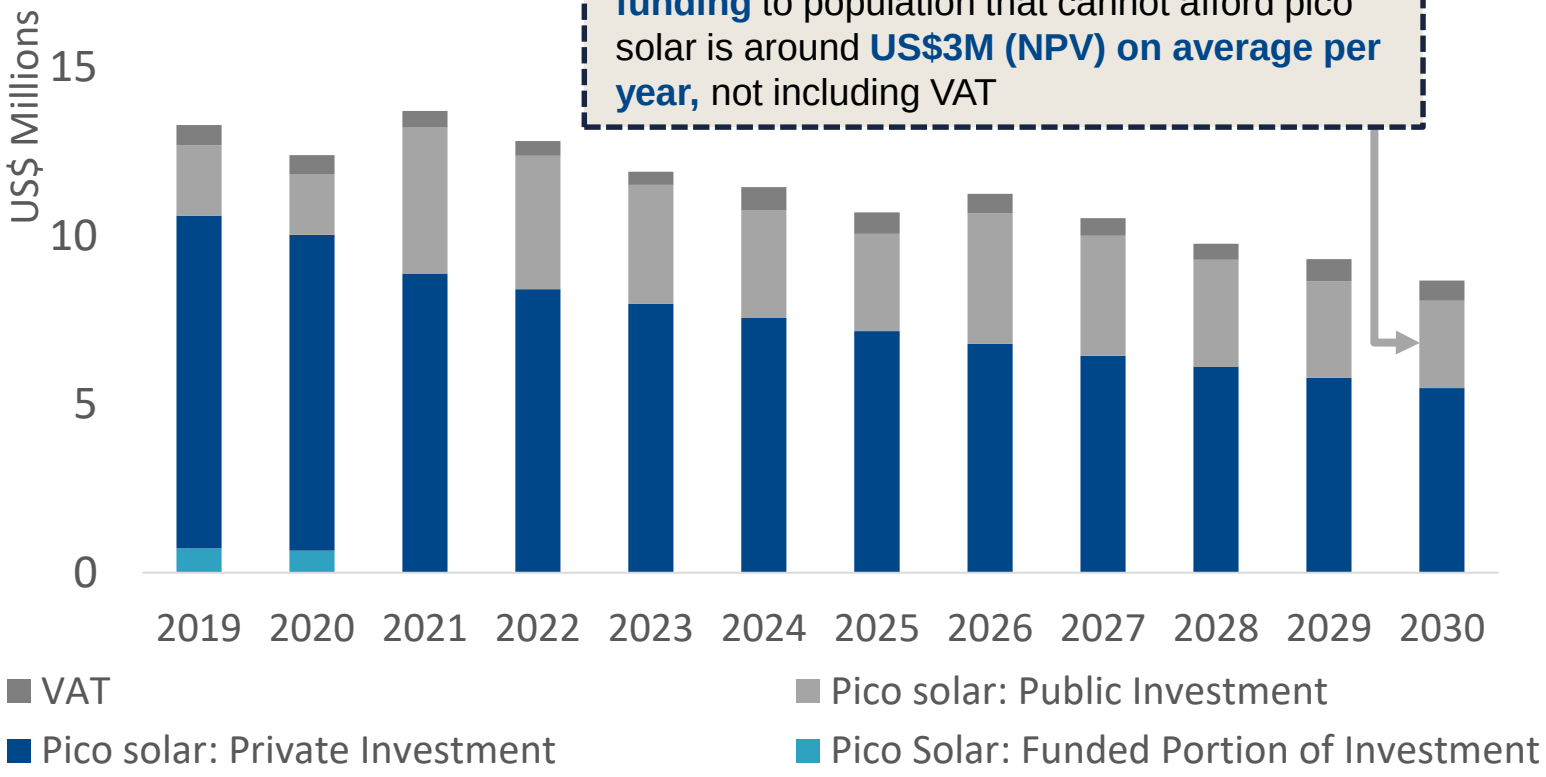
*Twenty million refers to the off-grid component of the project supporting the development of the market for stand alone systems, total project size is US$150 million, which also includes a component developing minigrids (US$10M).

**Product category refers to a group of products providing a given tier of service.

To reach universal access, Malawi can complement grid development with ~3.5M off-grid connections by 2030 (around 60% of households), subsidizing the poorest

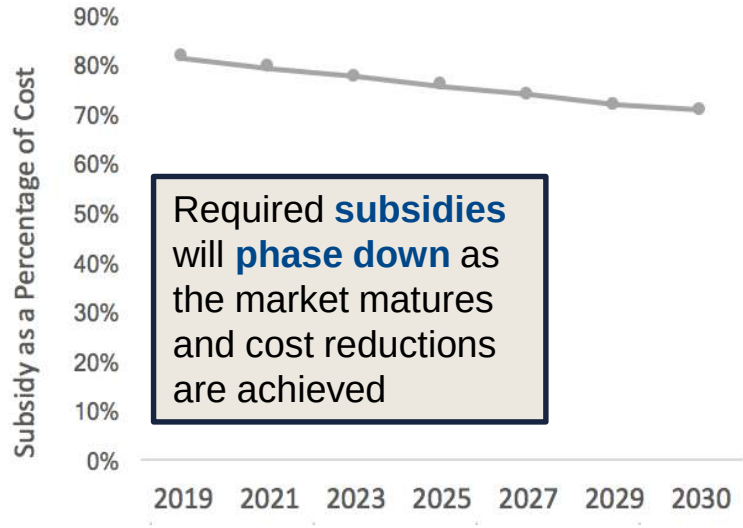
Investment requirements to subsidize population that cannot afford pico solar

Total estimated cost of providing **viability gap funding** to population that cannot afford pico solar is around **US$3M (NPV) on average per year,** not including VAT



Due to the short lifetime of units, **additional investment costs** to cover replacement costs will be needed going forward*

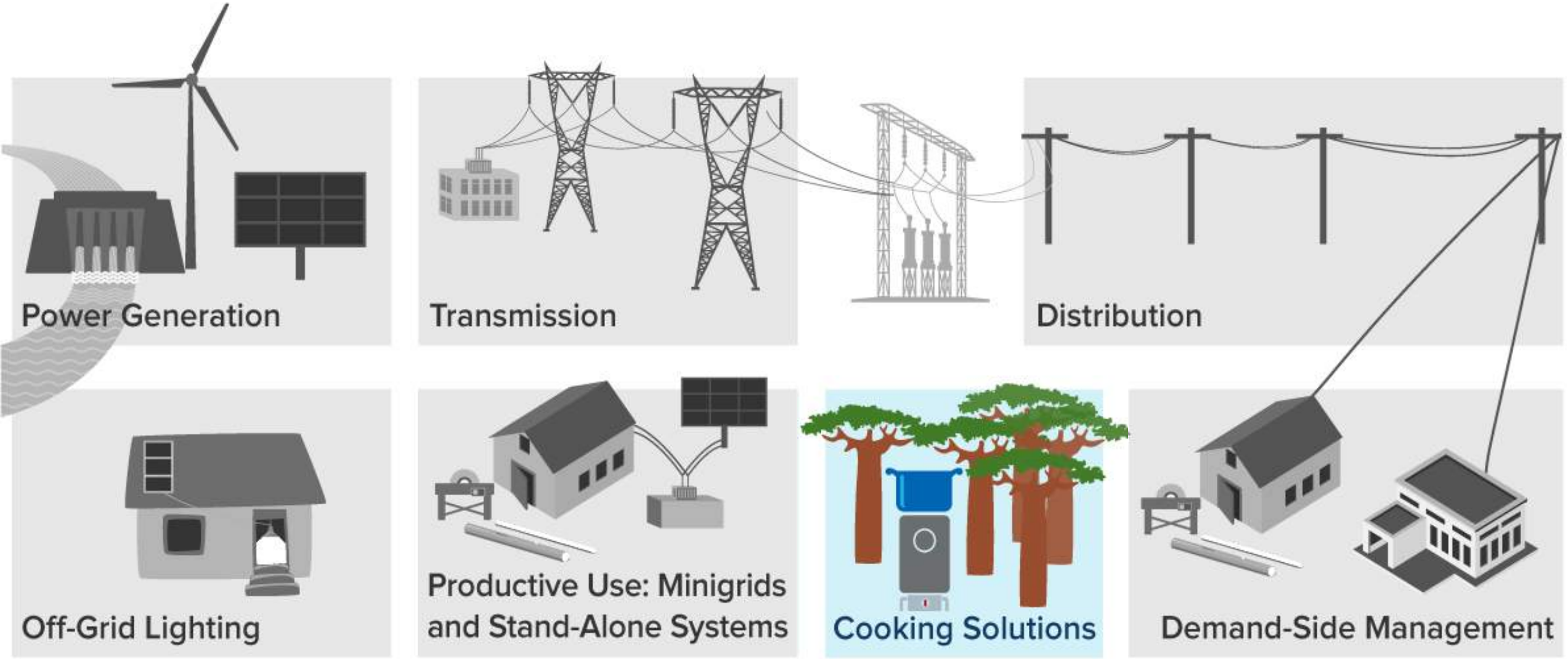
Required subsidy to cost per unit



Required **subsidies** will **phase down** as the market matures and cost reductions are achieved

*The investment costs include replacement costs for units expiring during period of analysis (assuming a 5-year lifetime of units). However, replacement costs of units that expire beyond year 2030 are not included. Capital investment requirements discounted using a 9% discount rate

COOKING SOLUTIONS



Malawi must develop a long-term clean cooking strategy to drive a sectoral transformation and avoid major deforestation in the coming years

$510 million

Investment required in:

Supply side, to increase biomass availability

Demand side, to increase efficiency

New technologies and infrastructure to drive sectoral transformation

Top priorities for Malawi are:

- Drive a sectoral transformation of the cooking sector to reduce biomass demand, increase health and provide sustainable cooking solutions

To move forward, the next steps are:

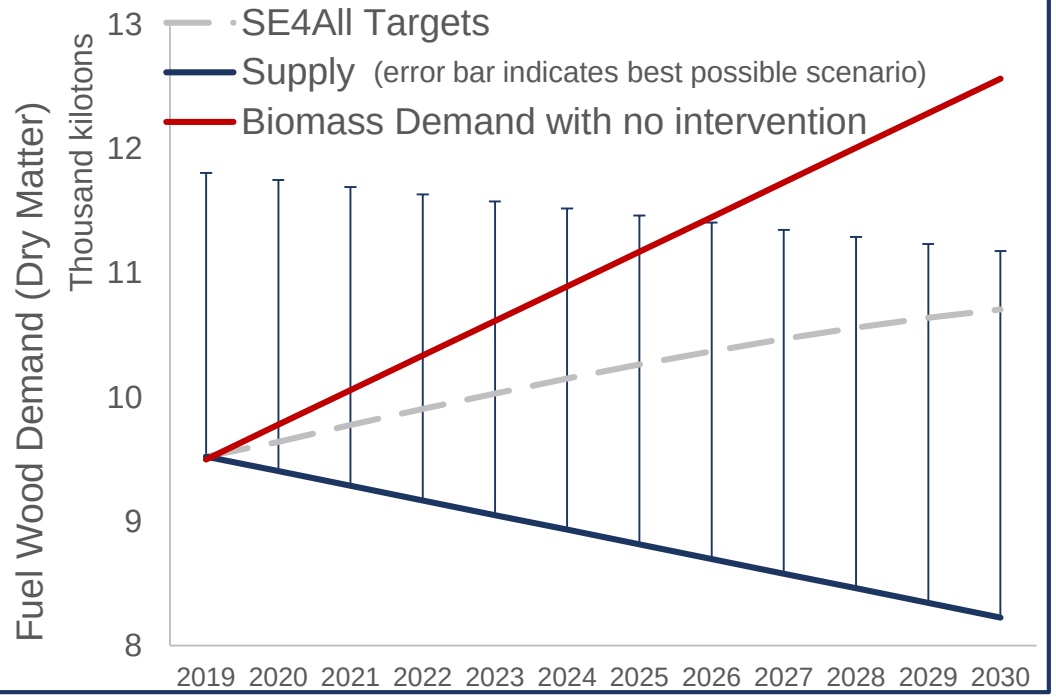
- **Conduct an inter-ministerial planning process** to augment improved cookstove strategy and set a long-term vision for clean cooking with non-biomass technologies
- Apply targets and mobilize investment with innovative business models

The current trajectory of high biomass dependence is unsustainable for Malawi

Supply/Demand

Conventional demand will exceed supply potential between now and 2027

SEforAll Action Agenda cooking targets will only make a slight dent in the impending supply/demand imbalance*



Environment & Resilience

Trees and forests play a disproportionately large role in energy security, but also serve several other key functions:

- **Soil erosion control** to enhance energy security (especially for hydropower energy generation), plus food security, and increase resilience to weather shocks
- Regulation of local and regional climate
- Providing the foundation of ecosystems and ensuring food security from agroforestry and pollination systems
- Limiting of soil, water, and air pollution

Gender Equality

- A significantly higher proportion of women than men collect fuelwood—a time-consuming activity that could be otherwise spent on productive uses

Health

- The large volumes of concentrated exhaust emitted by current cooking methods is a significant concern for individual health—especially for cooking in enclosed areas

**SE4All Cooking Targets for 2030 (Percentage of Population): electric cookstoves, 4%; liquefied petroleum gas (LPG) stoves, 1.6%; advanced woodstoves, 100%; biogas, <1%.* Source: SE4All Action Agenda; Role of Trees and Forests in Building Resilience in Malawi, Magombo, L.K.; WISDOM Malawi Final Workshop 2019; National Charcoal Strategy 2017-2027.

Forest and landscape restoration instruments can help optimize biomass supply, but would have to be prioritized and and scoped to before implementing

Instrument	Scoping Potential	Overall Cost	Description	
Natural Forest Management and Watershed Protection	16% of the country 1.52 million hectares	195.6 million	Increase resources available; provide seedlings, materials, and training to encourage planning and actions (e.g. tree planting) that can help limit soil erosion, strengthen stream-banks, increase food security and restore biodiversity	These initiatives typically require public and philanthropic funding
Conservation Agriculture	2% of country 200,000 hectares	13.4 million		
Farmer Managed Natural Regeneration	19% of country 1.8 million hectares	15.4 million		
Community Plantations and Private Woodlots	6% of country 580,000 hectares	80.3 million	Relieve pressure on and *protect* forested areas through increased access to local Community Plantations for fuelwood reserves Establish private, managed woodlots in order to maintain sustainable fuelwood demand and supply	**There is potential to incentivize the private sector to fund these initiatives**
Intercropping and non-forestry fuel reserves	To be determined	Low	Support use of non-forestry fuels in improved cookstoves[1], including alternative crops and agricultural residues	Funding needs to be determined

Source: Forest and Landscape Restoration Opportunities Assessment for Malawi (2017)

[1] Initial research suggests that use of residues from plants such as pigeon peas can be burnt in improved cookstoves, reducing total demand by up to 80%. Intercropping and "climate-smart agriculture" can increase the availability of these non-traditional fuels, helping drive down demand for fuel wood. (Christa Roth, 2017 & 2019)

A range of cooking solutions can be deployed to meet needs and reduce biomass demand, without increasing cost for households that already use charcoal

Cooking Tech	5-year Discounted HH[1] Cost (USD)	Equipment Cost[2] (USD)	Current Usage Rate[3]	State of Market
LPG	787	50	0.2%	- LPG distribution mechanisms still nascent - LPG tank ownership is expensive - LPG imports do not improve Malawi's balance of payments
Electricity	1044	70	2%	- Electric cooking presents a significant peak load for Malawi's electric grid, which is still building capacity
Charcoal	743	37	16%	- Charcoal cookstoves don't address biomass demand, emissions, or health concerns
Biogas	171	62.5	0.001%	- High initial cost of digestor is cost-prohibitive for farmers - Lack of local successful technology pilots has stinted awareness and perpetuated social distrust of the technology - Limited skilled labor supply for scale-up and maintenance
Ethanol	426	48	~	- Could potentially strain ethanol supply for fuel and other uses
Advanced Woodstove	0 – 96[4]	3	23.8%	- Advanced cookstoves don't fully address biomass demand, emissions, or health concerns[6]
3-Stone Stove	0 – 363[4]		58%	- Baseline for most of the population

As of 2016, non-biomass cooker deployment was as follows:

- **6800 LPG Cookers**
- **84,000 Electric Cookers**
- **50 Biogas Cookers**
- **0 Ethanol Cookers**

As of 2019 **1,079,876 Advanced Woodstoves** have been sold in Malawi[5]

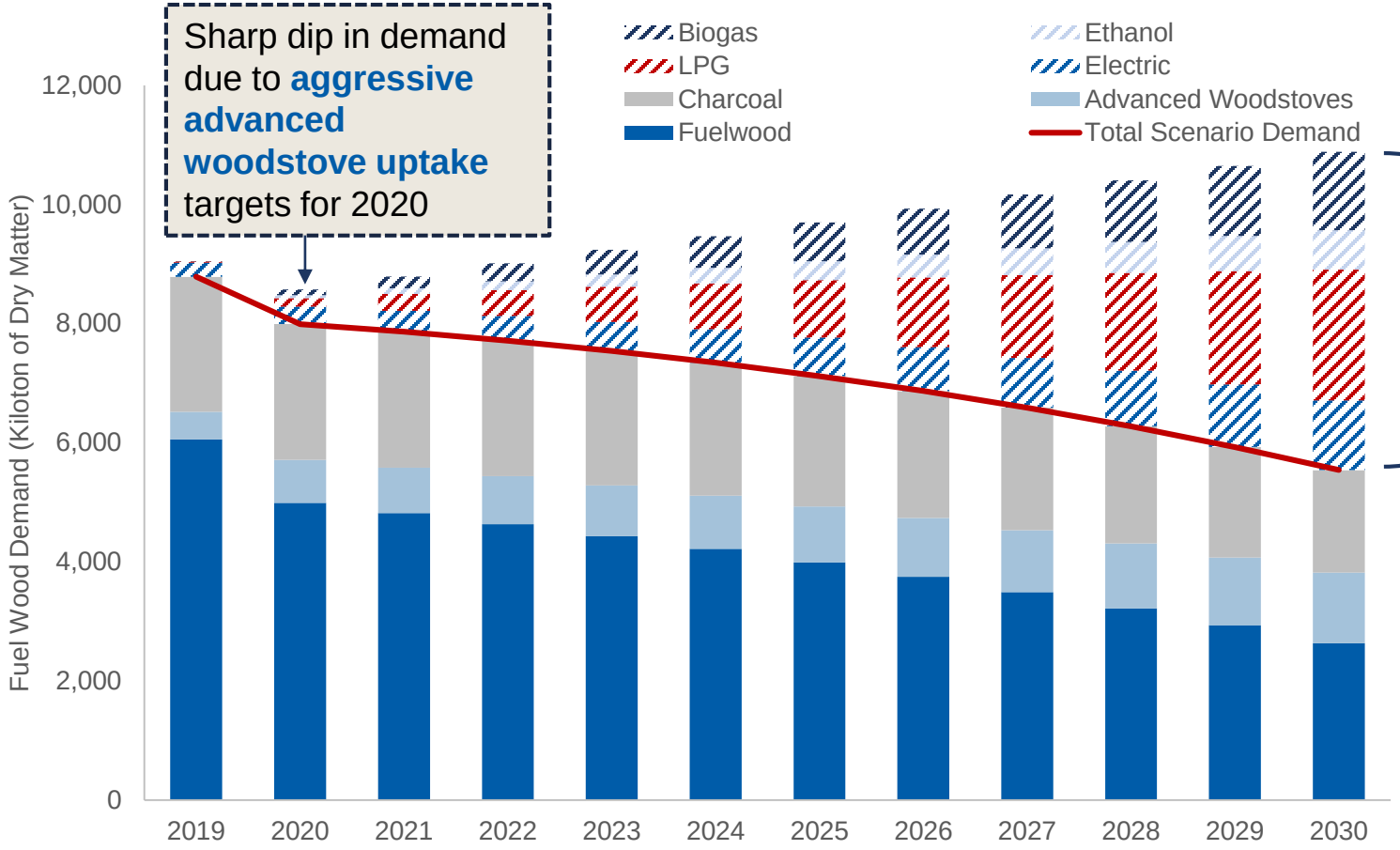
1. HH = Households
2. Clean Cooking Alliance Cookstove Catalog
3. Percentage of Population (2016)

4. Overall cost could drop to 0 USD if fuelwood is harvested without being paid for 5. https://energypedia.info/wiki/Malawi_Cookstove_DB
6. However, preliminary research indicates that portable, improved cookstoves are increasingly used outside the homes, reducing the health impacts of smoke in households (Christa Roth, 2019).

Sources: SE4All Action Agenda; Quantitative Study on Cooking Fuels in Malawi; National Cookstove Steering Committee 2018-20 Strategy

More ambitious targets for non-biomass cooking technologies could more significantly reduce biomass demand

Sharp dip in demand due to **aggressive advanced woodstove uptake** targets for 2020



Government of Malawi identifies the need for more ambitious targets than set by the **SE4All Action Agenda.** Pillars 1 and 2 of the **National Charcoal Strategy 2017-2027** call for the promotion of **alternative cooking fuel uptake,** and **fuel efficient cooking technologies** respectively**.** The **2018 National Energy Policy, National Cookstove Steering Committee 2018-20 Strategy** and other documents can guide new targets

Avoided biomass demand[2] from biogas, electric, ethanol, and LPG cooker uptake

	Possible Targets (2030)	
Technology	Number of Units	Population Uptake
Advanced Woodstoves	2.2M	37%
Charcoal	300k	5%
Biogas	596k	10%
LPG	893k	15%
Electric	477k	8%
Ethanol	298k	5%

Biomass demand[1] *by technology uptake for charcoal, advanced woodstoves, plus fuelwood usage, and* ***biomass demand mitigated[2]***

1. Demand forecast shown reflects SE4All Action Agenda and 2018 National Energy Policy cooking targets
2. Biomass demand mitigated is measured by demand saved from households that would otherwise using fuelwood for cooking

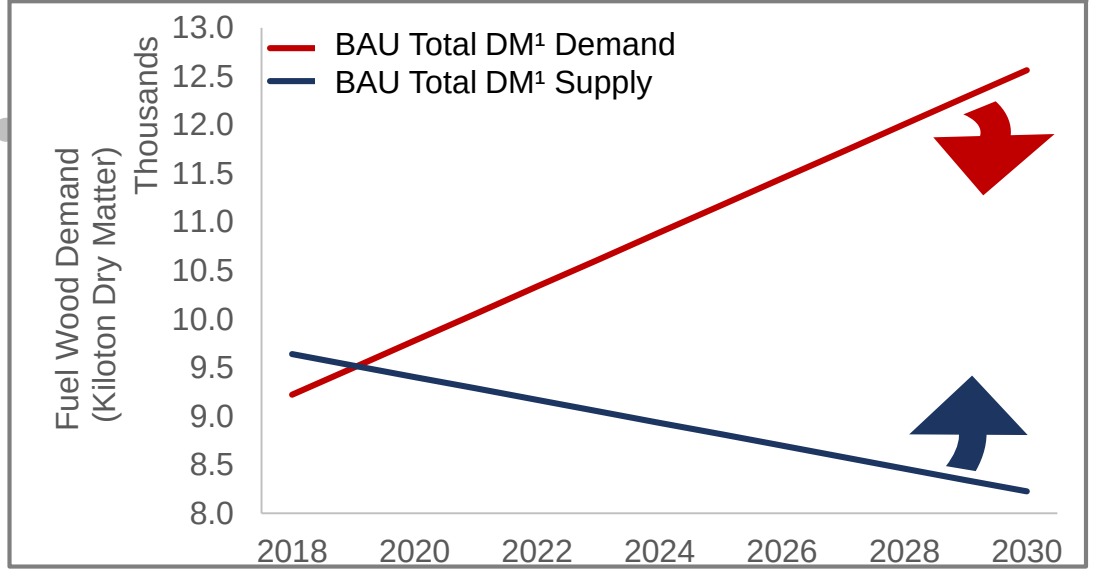
Source: National Cookstoves Programme Roadmap; National Cookstove Steering Committee Strategy 2018-2020

Malawi should develop an integrated approach to clean cooking in order to address urgent national needs and an unsustainable biomass supply–demand balance

Cooking options
LPG
Electricity
Charcoal
Biogas
Ethanol
Advanced cookstove
3-Stone Stove

Sector	Key Questions to answer
Biomass Demand	- How does this solution affect overall biomass demand?
Health & Wellness	- What are the health effects of household use?
Effects on Environment	- What is the emissions potential of this solution?
Cost & Financing	- What is the capital investment needed to deploy this technology? - What is the funding landscape? - Is there a business case for external investment?

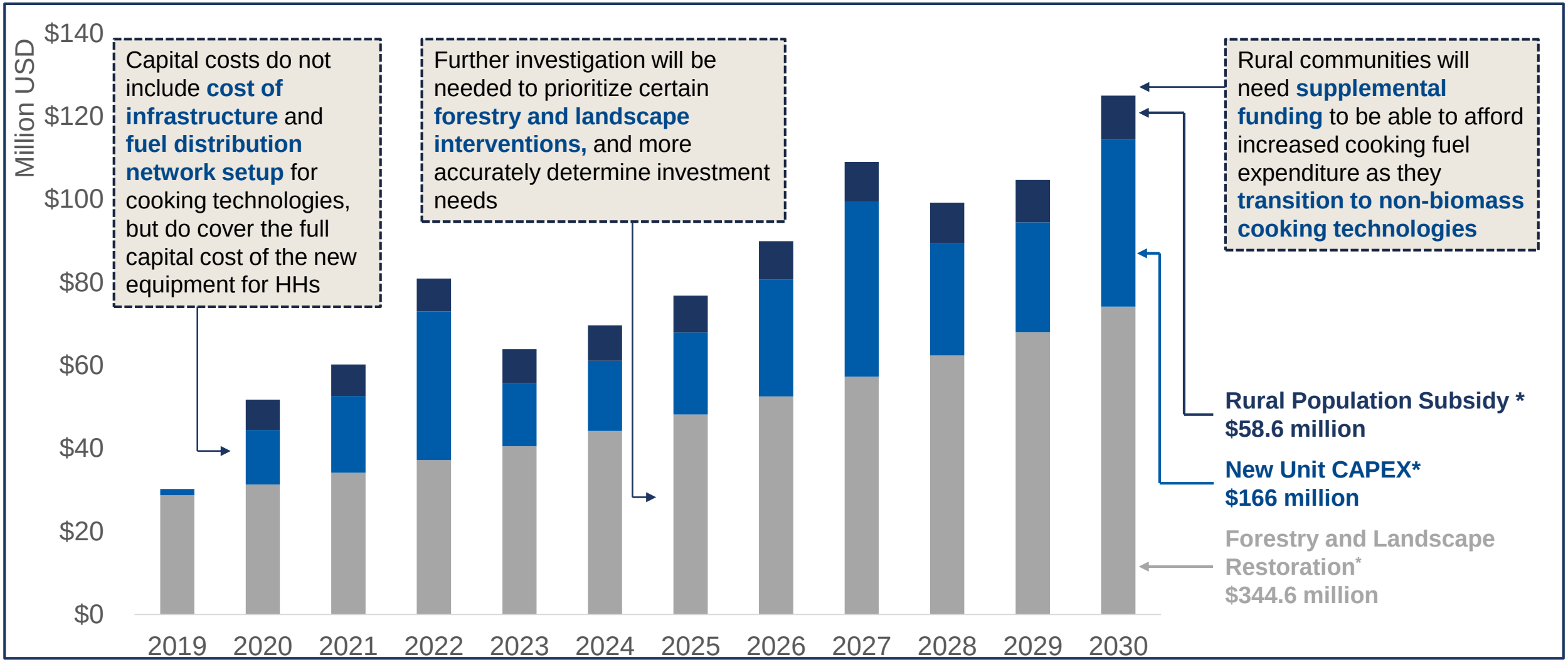
Realistic targets must be locally designed and driven



<u>Next step:</u> Given the complexity of the sector, and interactions with several non-energy sectors, it is recommended that an **inter-ministerial planning process** be carried out to develop quantitative targets for a comprehensive clean cooking strategy to 2030

Source: Malawi WISDOM analysis
¹Dry Matter (DM).

Improving Malawi's cooking practices and restoring biomass supply will require continued and targeted investment

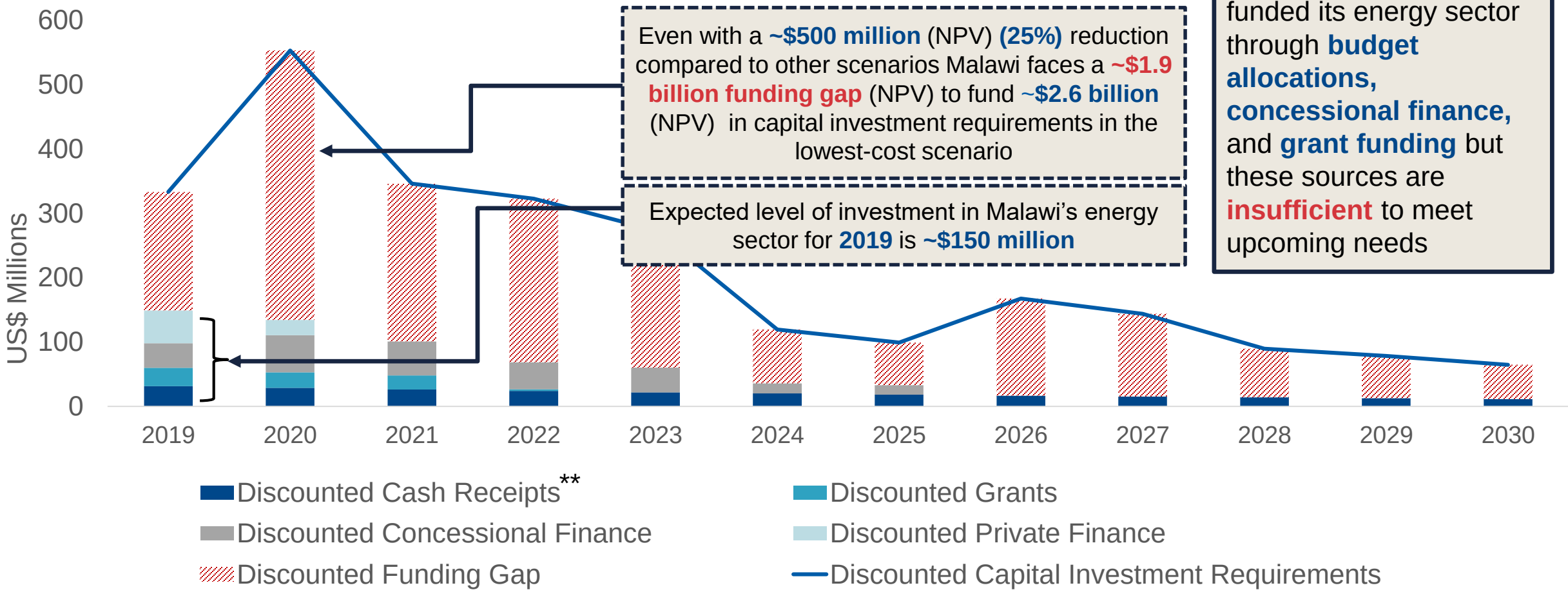


* Cumulative Costs discounted with 9% discount rate

FINANCE FOR DEVELOPMENT

Malawi has some funding in place and the prioritization framework reduces costs but the funding gap for the power sector remains large

Capital investment requirements and committed funding for the power sector through to 2030*

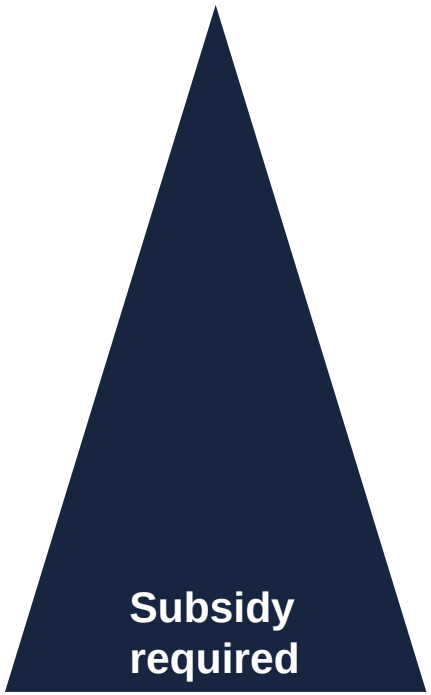


Malawi has historically funded its energy sector through **budget allocations, concessional finance,** and **grant funding** but these sources are **insufficient** to meet upcoming needs

*Investment requirements do not include cooking solutions but include development and construction costs. All values are NPV, calculated with a discount factor of 9%

**"Cash Receipts" refer to budget allocations for the energy sector, based on historical trends. This includes budgets earmarked for ESCOM-led electrification efforts and MAREP-led electrification.

Blending finance to reduce perceived risks and dedicating limited public finance to economically viable projects can catalyze private investment



Uses of Finance		Sources of Finance
Lower risk commercial activities (no subsidy)	Stand-alone systems for productive use and pico solar for mid to high socio-economic brackets	**Market-based financing** Commercial Investors
Higher risk commercial activities (in need of temporary subsidy)	Generation	**Guarantees, subordinate capital, first loss capital** Development Finance Institutions (DFIs), government
Not fully commercially viable activities (in need of temporary subsidy)	Minigrids targeting productive use	
Not fully commercially viable activities (in need of long-term or permanent subsidy)	Transmission, distribution, DSM, cooking solutions, and pico solar for low socio-economic brackets	**Donor capital, grants and some concessional financing** Government, NGOs, DFIs

Malawi has already taken important steps to encourage investment by reducing investment risks

The standardized template of the **implementation agreement** includes **safeguards to protect investors,** including:

- Providing protections for **moving funds in US dollars** out of the country
- Ensuring tariff ramp-ups to protect against **currency volatility**

- Providing **credit guarantees** on off-taker payments

40. Foreign Currency Exchange and Transfer of Funds

40.1 Foreign Exchange Regulation

The exchange and transfer abroad of all Dollars related to the Project shall be governed by the Laws of Malawi as amended from time to time, provided that the GoM shall permit the Company to make or receive any payments in relation to the Project in Dollars.

40.2 Free Transfer and Repatriation of Necessary Funds

The GoM shall permit the free transfer of all funds and financial settlements in Dollars necessary to implement and carry out the Project or as contemplated by this Agreement.

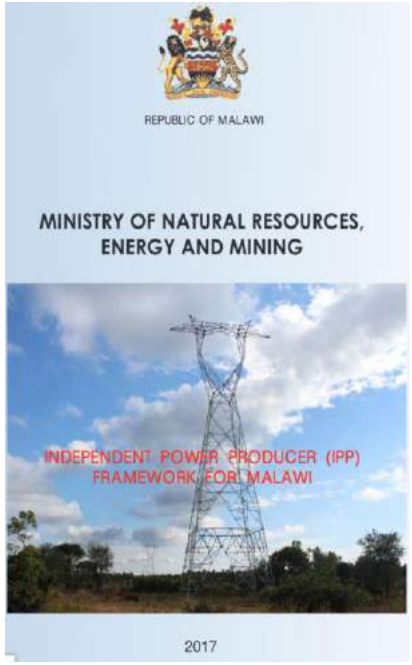
40.3 Tariff Increased in line with Exchange Risks

[The GoM shall approve any increase to the Tariff that is necessary to address exchange risks between Kwacha and US Dollar.]

43 GoM Guarantee

43.1 Guarantee

In consideration of the Company entering into the Power Purchase Agreement with the Power Purchaser, the GoM hereby irrevocably and unconditionally guarantees and promises to pay the Company the amount of [ ] when due in accordance with the terms of the Power Purchase Agreement, which obligation of the GoM shall include monetary damages arising out of any failure by the Power Purchaser to perform its obligations under the Power Purchase Agreement to the extent that any failure to perform such obligations gives rise to monetary damages.



Source: Independent Power Producer Framework for Malawi, Ministry of Natural Resources, Energy and Mining, 2017

Malawi's proposed financial strategy builds on this approach to leverage 3x in private financing

Use **first-loss** and **subordinate capital** early on to attract **commercial sources** of financing and demonstrate the viability of investing in generation in Malawi

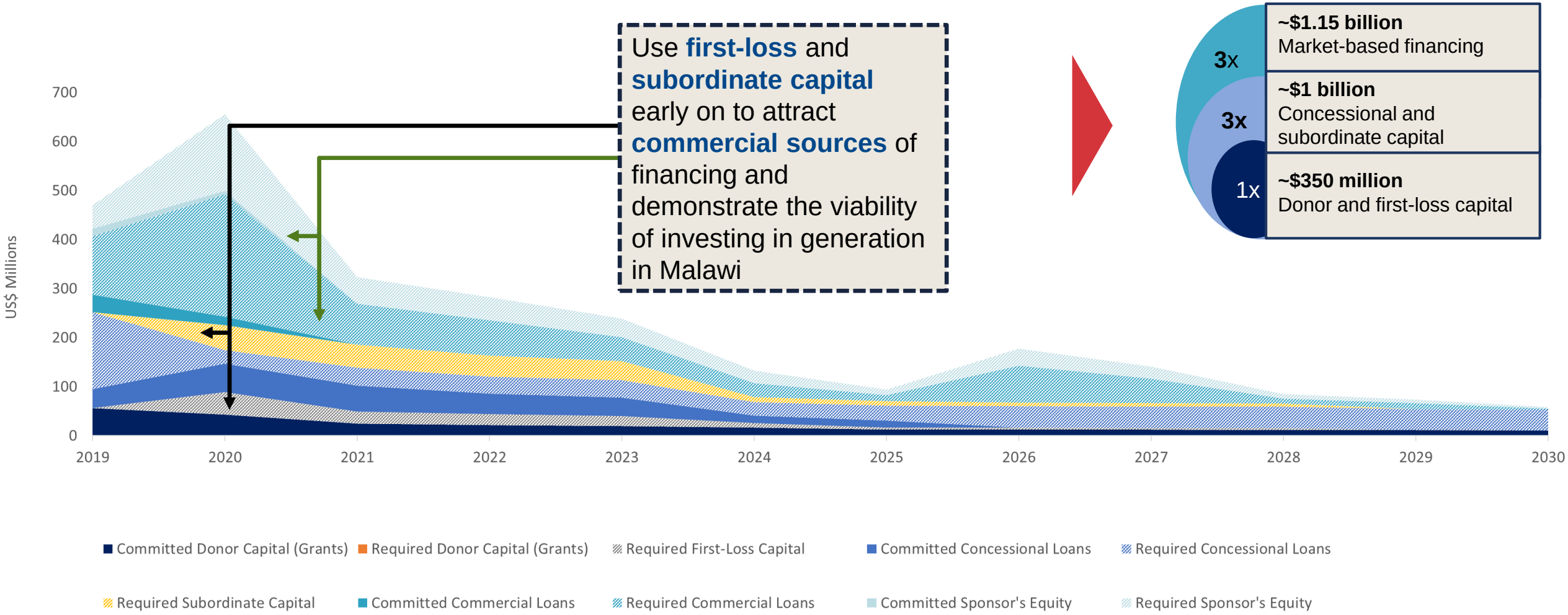


Chart does not include financing costs or cooking solutions investment requirements. Investment requirements includes development and construction costs, discounted using a 9% discount rate

The prioritization framework unlocks commercial financing by disproving perceived risks and increasing investor comfort

Identify and implement Quick-win Projects

Criteria for **Quick Win Projects**	Effects of **Quick Win Projects**
Demand-side management—improve **system economics** and **reduce system costs**	Improve **off-taker finances**
Generation—improve **reliability** of system and **quick turnarounds**	Reduce perception of risk through **demonstration effects**
Transmission—ensure ability to **deploy power** and benefit from new supply	**Balanced** system growth
Distribution—ensure new supply can connect to **largest load centers**	
Mini-grids—ensure **cost recover**y by targeting **productive use**	Prove **viable business models**

Provide a **track record** to give credibility to ESCOM as an **off-taker**

Show pathway for **mitigating risks**

Prove **viable business models**

Unlock commercial financing

To develop this pipeline Malawi should start with public sources of green climate finance to blend, de-risk, and attract private investment

Green climate finance is a **good fit** for Malawi's needs

Pipeline qualifies for green climate finance	Low liquidity requirements	Low return requirements	Long-term investment horizon	Flexible supply of products to de-risk private finance
✓	✓	✓	✓	✓

Green climate finance refers to financial resources that **support climate change mitigation and adaptation**, and are deployed through **grants and non-grant mechanisms**, including market-based and concessional debt and equity and de-risking products.*

*Not all sources of green climate finance have these qualities but the sample of facilities assessed for this study included options that provided financing with these characteristics.

Several green climate facilities can provide funding to de-risk more commercial sources of financing now

Fund	Trustee	Best Fit with Investment Needs
Access to Energy Fund (AEF)*	FMO Netherlands Development Bank	• Early stage investment and de-risking of commercially viable projects (Gen) • Lighting and Productive Use in off-grid sector
InfraCo Africa—Sub Sahara Infrastructure Fund*	Private Infrastructure Development Group	De-risk commercially viable projects
Interact Climate Change Facility	European Development Finance Institution	De-risk commercially viable projects
International Financial Corporation-Canada Climate Change Program	International Finance Corporation	• Early stage investment and de-risking of commercially viable projects (Gen) early in pipeline • Offer second tier financing to increase local investor comfort
Clean Technology Fund of Climate Investment Funds	World Bank	Early stage investment and de-risking of commercially viable projects (Gen)
Energy and Environment Partnership in Southern and East Africa (EEP)	Nordic Development Fund	Various**
Green Bonds Program	AfDB	De-risk commercially viable projects

Some of the trustees are **already investing in Malawi**

See Appendix C for a **deep dive** on a selection of facilities assessing their fit with Malawi's investment needs and a broader list of financing facilities Malawi can explore further

* FMO and InfraCo already invested in Malawi—JCM Salima UK Ltd, which owns 75% of SPV JCM Matswani Solar Corp, other 25% owned by InfraCo.

** EEP supports projects in all sectors of clean energy, including solar PV, wind power, clean cookstoves, hydro energy, biomass, among others.

The following investors could provide more commercial sources of financing to blend with green climate finance

International & Regional Financial Institutions

- AFC
- OPIC
- Export-Import Bank of the United States
- China EXIM Bank
- International Finance Corporation (IFC)

International & Regional Private Investors

- Myra
- Blue Haven
- Lion's Head Global Partners
- Helios
- Triodos Bank
- Next Energy Capital
- responsAbility

Local Banks

- National Bank of Malawi Plc.
- Standard Bank Malawi Ltd.
- FDH Bank Ltd.
- New Finance Bank
- First Capital Bank Ltd.
- CDH Investment Bank Ltd.
- Ecobank Ltd.
- NBS Bank Ltd.
- Nedbank Malawi Ltd.

MITC can play a **key role in centralizing outreach** with these entities.

Some of these investors are **already investing** in Malawi while others can be brought in with de-risking and awareness campaigns.

Note that this slide does not present a comprehensive list but provides a few examples of active or potential investors in the sector.

Malawi needs in-house capacity to navigate the complex international financial architecture, secure green climate funds, and structure financing

Capacity Requirements

Malawi must **develop capacity** in several areas:

- Knowledge of **climate finance landscape** to identify sources and instruments for delivering climate finance
- **Financial expertise** to structure financing for and de-risk investments
- Establishing **relationships** with climate finance providers

Solutions

Existing programs can be **implemented quickly** to address capacity gaps:

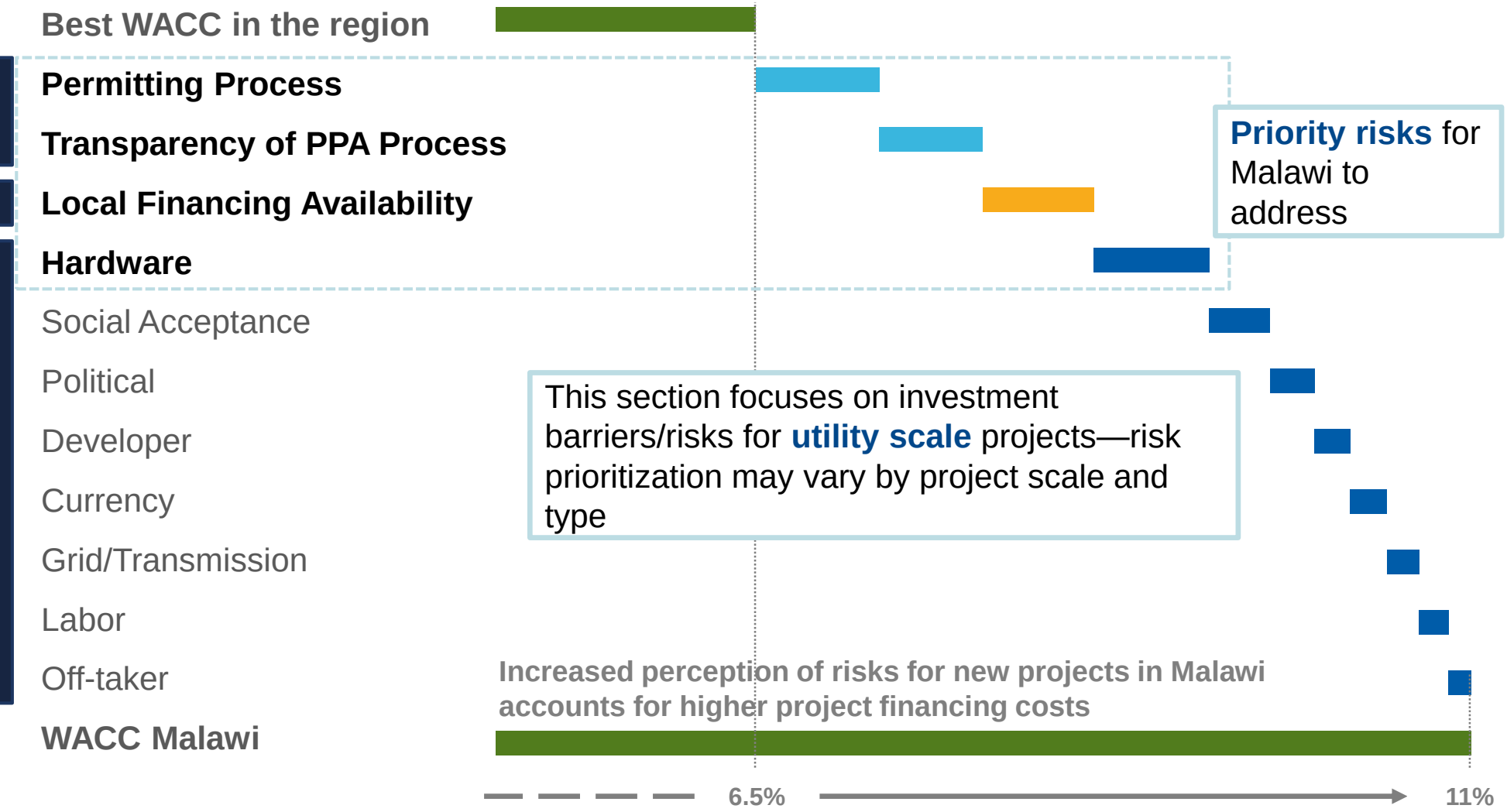
- The **Commonwealth Climate Finance Access Hub** and **Climate Finance Access Service** (in development)—both programs provide subsidized **in-country advisors** for a period of 1 to 3 years to identify and secure climate financing and build local capacity
- In-house capacity embedded in local ministries enables a **comprehensive skills transfer**, by providing longer-term support and vantage into the issues that surface and how to resolve them throughout the **full project development lifecycle**

Outcome: Build **in-house capacity** to identify pathways to **access green climate financing**

DE-RISKING PROJECTS

There are a set of real and perceived risks that make access to capital difficult and expensive for Malawi

1. Contracts and Licensing
2. Access to Finance
3. Implementation Costs



- Weighted Average Cost of Capital (WACC) calculated assuming a 70% debt, 30% equity split
- Incremental impact of risks on cost of project collected by a sample (12 respondents) of local financiers, foreign investors, government officials and IPP's engaged in utility scale solar generation projects. Analysis was undertaken following methodology of UN De-risking Renewable Energy Investment Study (2018)

Critical risks must be addressed to attract investment and grow the sector beyond "quick win" projects

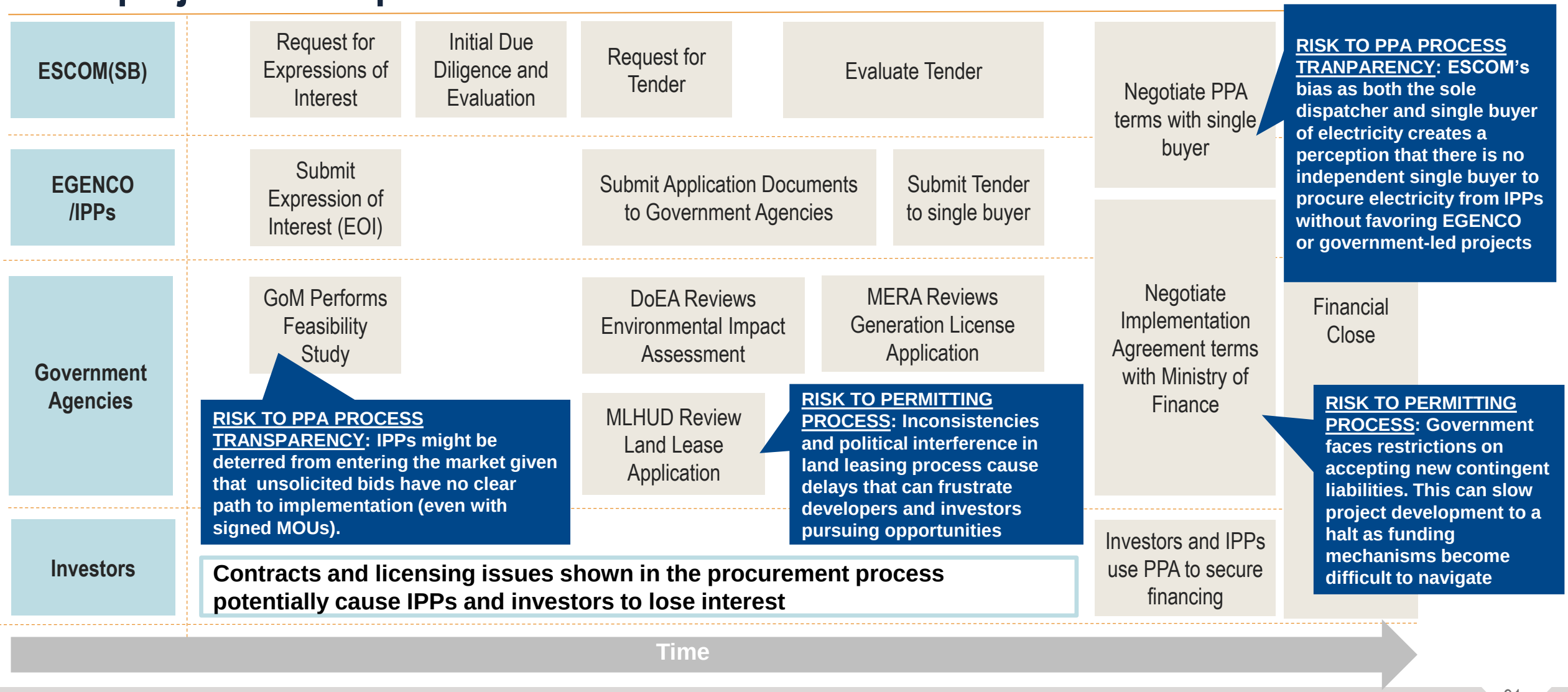
Category	Prioritized risks
Contracts and Licensing	Permitting process Transparency of PPA process
Access to finance	Local financing availability
Implementation costs	Hardware costs

In the following slides, each high-priority risk area will be addressed using the following layout:

1. **Challenges**
   What are the conditions that cause or magnify this risk?
2. **Current Status**
   What steps have already been taken to address risk?
3. **Opportunities**
   What are the potential interventions that can be taken to address risk?

1. Contracts and Licensing

Perceived and real risks around a lengthy and uncoordinated procurement process slow project development



Lack of expertise and experience in financing projects limits funding for project development

Concessional Funding

Limited expertise within government to identify sources and instruments for delivering finance

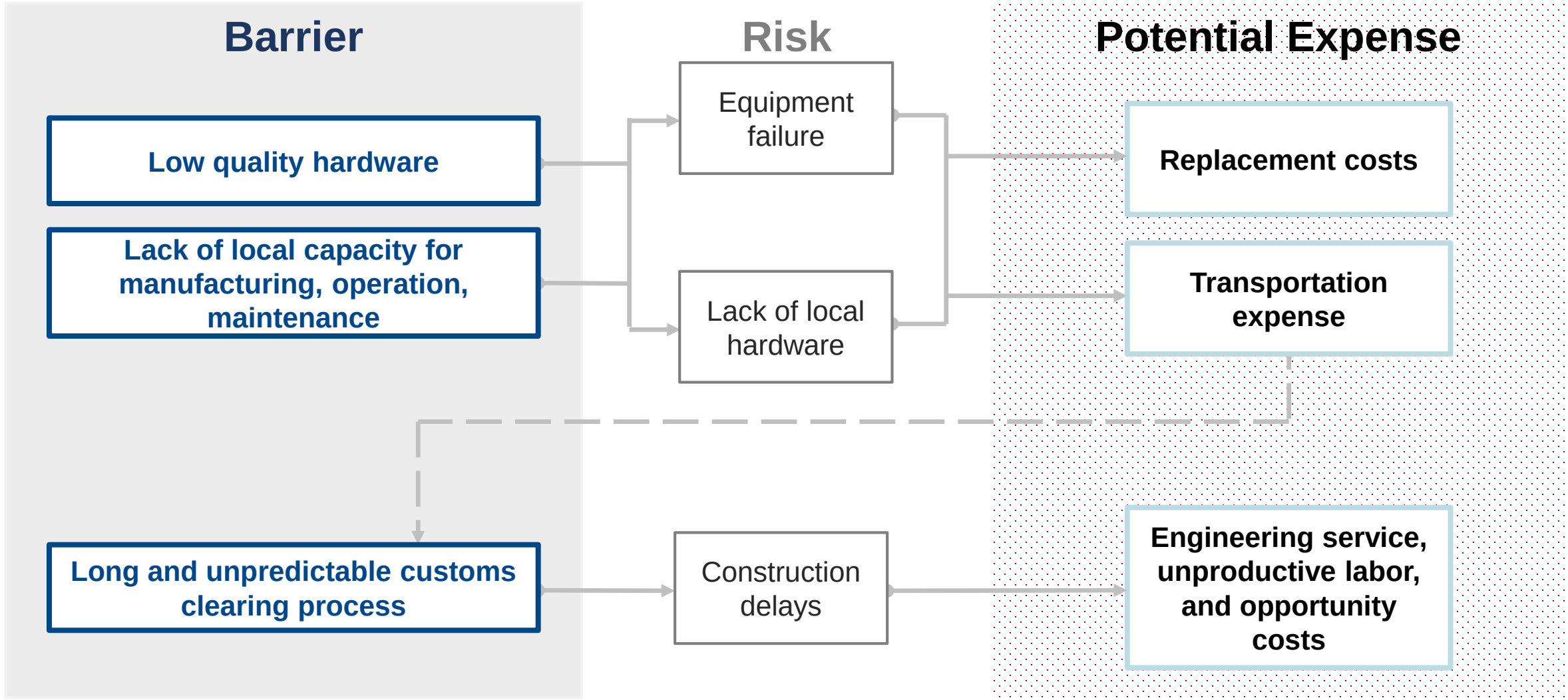
BARRIERS TO FUNDING

Private Capital

- **Few successful projects** to demonstrate bankability
- **Limited financial expertise** to structure financing to de-risk investments

Funding for Projects

Perceived and real difficulty of accessing hardware locally increases overall project costs



Malawi has adopted policy and regulatory measures to address some of the key risks and issues but needs to communicate with investors to dispel perceived risks

1. Contracts and Licensing

The government is committed to a strategic market vision, with systematic planning and clear procedures in place to guide project development

2018 **National Electrification Strategy:** Provides policy and regulatory strategies—plus technical, planning, and financial tools—for increasing private sector engagement

National Energy Policy: Establishes guiding frameworks to increase engagement with private sector (IPP), and enable increased RE deployment

2017 **National Renewable Energy Strategy:** Discusses feasibility and necessary action steps to achieve targets for on and off-grid RE electrification, plus for clean cooking

ESCOM T&D Capital Investment Projects: Shows five-year T&D pipeline to increase grid capacity

Integrated Resource Plan: Proposes project pipeline to align private sector with national priorities

2. Access to Finance

Opened its energy market to external investors to attract additional investment

- **Unbundling of the sector,** and the **IPP framework (2017)** lay the groundwork to attract international IPPs

3. Hardware Costs

Implemented tax exemptions to reduce hardware costs and established the institutional framework to ensure quality of equipment

- Mandated import duty exemptions for critical energy equipment for construction (cranes, lorries, tractors, etc.); electricity generation (fuses, transformers, electricity supply meters, solar PV panels, etc.); solar lamps, and chargers*
- Assigned MERA responsibility for enforcing local RE quality standards, with support from Mzuzu University to test technologies and develop standards

* Malawi Revenue Authority (MRA) Customs and Excise Tax Incentives

Opportunities exist to address the priority risks and issues through a few, simple actions that can improve finance flows to the sector

1. Contracts and Licensing

- **Streamline permitting process** by publicizing action steps
- Expedite **establishment of external single buyer unit** to help promote a more well-regulated energy market
- Help expedite and **strengthen solicited bid process** by sharing resources with developers

2. Access to Finance

- **Recruit specific program staff** to develop local structures and capacity to pursue pathways for obtaining public sources of green climate finance
- **Use blended financing**—funding projects with both concessional green climate funding and private finance—to make projects bankable and attractive for investors
- **Disseminate results** of bankable projects to build local investor confidence (for future investments)

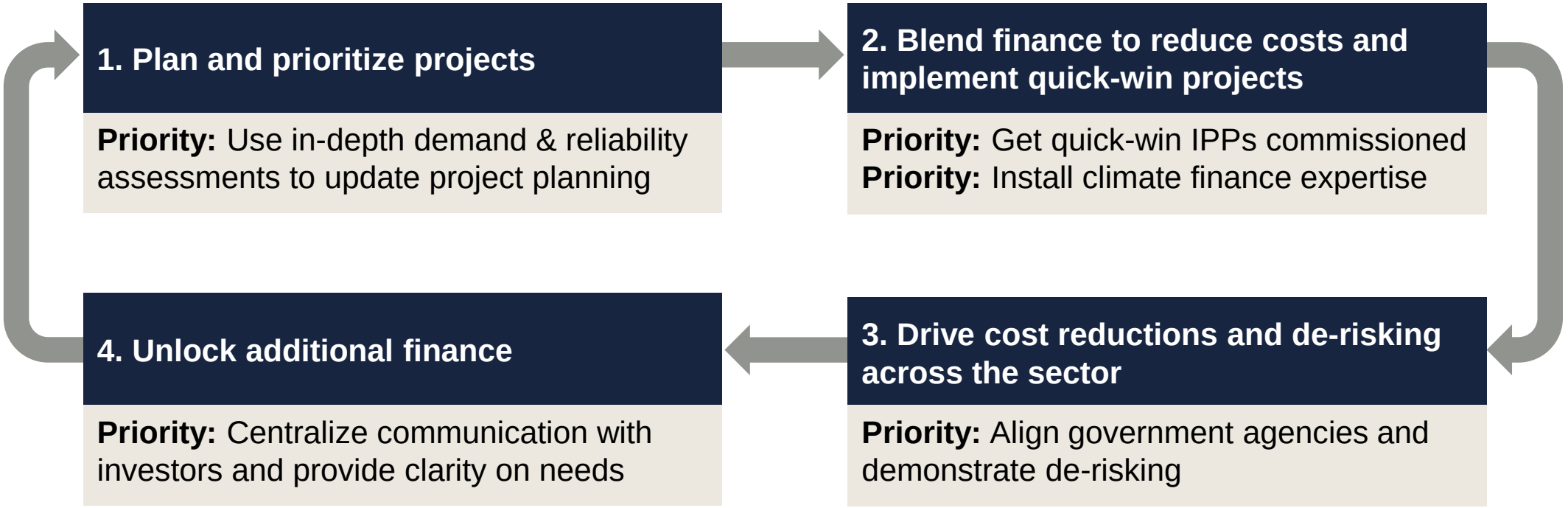
3. Hardware Costs

- Enforce **consistent and expedited customs clearing procedures** for energy project equipment by addressing staffing and other internal customs division challenges
- **Provide cost-effective pathways for accessing hardware locally** by facilitating bulk purchasing and connecting developers with retailers

See **Appendix D** for a detailed description of these de-risking actions

RECOMMENDED ACTIONS

A few key actions can unlock the funding Malawi needs in a positive feedback loop that can help the country develop rapidly, sustainably, and at the lowest cost



5. Strengthen institutional frameworks to develop the market and support implementation

Priorities:
- On-grid: Establish independent single buyer unit; improve off-taker financial health
- Off-grid: Improve implementation and awareness of product standards

Plan and prioritize projects:
Use in-depth demand and reliability assessments to update project planning

Actions

I. Review current demand and update demand estimates for the next five years, including the impacts of distributed generation, EE, and tariff increases

II. Update the project list to ensure it meets this demand, while maintaining life-cycle least-cost, meeting SAPP reliability guidelines and following other prioritization criteria identified for specific sectors

III. Use Scenario 3 as a starting point, and conduct analysis on an ongoing basis to study risks and mitigation strategies associated with generation projects, particularly, intermittent renewables, while fully incorporating the flexibility value from battery storage

Resources for implementation

- Use the project prioritization criteria in this report*, along with existing IRPs and additional sector-specific convening and analysis
- Ensure that ESCOM and DoEA have dedicated teams in place, with internal capacity for planning
- Define the planning role of the single buyer unit and its interaction with other agencies
- See Appendix A (page 106) for reliability analysis needed for renewable project planning and implementation

Outcomes

- The pipeline of generation projects can be optimized to meet true demand, saving at least $200 million and reducing the risk of supply-demand imbalance.
- Government agencies improve capacity for implementing and updating integrated energy plans.

*See pages 27-75

Blend finance to de-risk and implement quick-win projects: Get quick-win IPP projects installed and commissioned

Actions

I. Drive forward the final approvals for the small group of solar (and solar + battery) IPPs that already have signed PPAs and are nearing final approvals of their implementation agreements

II. Support the project developers to get them implemented and commissioned as quickly as possible, to demonstrate the viability of the sector

Resources for implementation

- Ongoing support from the relevant ministries and government departments may require centralized coordination from DoEA

Outcomes

- Having 2-3 projects installed, commissioned and selling electricity to ESCOM provides a clear message to investors: it demonstrates the viability of the sector, reduces the perceived risk and contributes to Malawi sending the message that the power sector is “open for business”

Blend finance to de-risk and implement quick-win projects: Install in-country climate finance expertise

Actions

I. Put in place a dedicated climate finance expert to help identify climate finance opportunities and drive the application processes for these funds

II. Ensure alignment with the treasury and the department for economic planning and development as finance opportunities are identified

Resources for implementation

- Services like the Commonwealth Climate Finance Access Hub and the Climate Finance Access Service (under development) can provide dedicated, in-country advisors for periods of 1–3 years

Outcomes

- There is increased availability of climate finance to support high-priority projects, reducing financing costs and helping projects to get off the ground quickly

Drive cost reductions and de-risking across the sector: Align government agencies and demonstrate de-risking

Actions

I. Bring together government agencies (DoEA, MERA, ESCOM, Ministry of Lands, Ministry of Finance, MRA, MITC) to carry out the comprehensive de-risking process outlined in this report

II. Communicate the implementation and results of this de-risking process to investors, through MITC's channels and outreach

Resources for implementation

- Actions are identified in Appendix D of this report (p 134)
- The UNDP de-risking RE investments methodology* provides a guide for implementation
- IFC's Scaling Solar program** has worked to do this specifically for the solar energy sector.

Outcomes

- Institutional investors are made aware of the investment landscape in Malawi
- Financing costs are reduced and there is increased availability of competitive commercial finance

* www.undp.org/drei

** https://www.scalingsolar.org/

Unlock additional finance:
Centralize communication with investors and provide clarity on project needs

Actions

I. Implement a coordinated strategy to communicate project needs, pipeline, and government priorities in a clear, transparent manner*

II. Issue clear guidance on the roles, responsibilities, and contact points for government agencies involved in approvals for the energy sector

Resources for implementation

- Malawi Investment and Trade Centre (MITC) can act as a single contact point for communicating with investors
- The development partners' working group provides a central contact for alignment among members, in close coordination with DoEA

Outcomes

- Investors, development partners, and other actors are able to direct their activities appropriately
- Project approvals happen more quickly, the reasons for delays are given, and perceptions of corruption or inefficiency are reduced

*This study provides a basis for communication with investors and development partners. Showing clear government buy-in for a transparent set of objectives and projects is the key, as other actors can then rally around this set of needs. MITC and the development partners' working group can develop further materials and communication guidelines.

Strengthen institutional frameworks (on-grid):
Put in place a single buyer unit and improve the utility's financial health

Actions

I. Accelerate the implementation of a fully staffed single buyer unit and ensure it is provided with capacity, support, and oversight to fulfil its role

II. Focus on ESCOM's financial situation: increase revenues (including customer retention and overdue payment collection from the public sector) to improve the viability and bankability of the off-taker

Resources for implementation

- DoEA already has plans in place for implementing the single buyer unit – the government should move forward rapidly with staffing and operationalizing the unit
- ESCOM's management team is working to improve its financial situation*

Outcomes

- Off-taker risk is reduced and projects move faster, as clear payment processes for PPAs are in place
- Over time, investors reduce their needs for sovereign guarantees, increasing the availability of capital and helping financing costs to drop further

*Through the MIS billing system provided by MCC, among other things.

Strengthen institutional frameworks (off-grid): Apply product standards and increase awareness

Actions

I. Ensure that appropriate standards are in place and enforced, to ensure availability of high-quality products in the off-grid solar market*

II. Carry out awareness programs to develop consumer knowledge and leverage financial support to scale up the market for high-quality products

Resources for implementation

- IFC provides lighting global standards, which are being widely adopted for off-grid lighting in the region

Outcomes

- Increased readiness of consumers to invest in off-grid lighting solutions drives up private capital flows
- Increased equipment lifetimes translates to consumer saving on replacement costs
- Over time, significant reductions are made in the cost of high-quality systems, as the market grows and matures

*Coordinating standards with neighboring countries and focusing on a few import ports significantly reduces the challenges of enforcement across porous land borders. Using shared infrastructure and systems such as pre-export verification of compliance (adopted in Uganda) reduces the need for expensive testing infrastructure.

Implementing these recommendations successfully will require government leadership, improved communications, and collaboration between stakeholders

Three agencies will be at the core of implementing these recommendations, working with **government**, **investors,** and **development partners**:

Department of Energy Affairs	Malawi Investment and Trade Centre	Development partners working group
Take the lead in national planning Set goals, define targets, and drive implementation of recommended actions Coordinate activities among government agencies and ministries	**Centralize contacts with the investment community** Provide a single point of contact, facilitating the flow of information to and from investors Communicate DoEA's activities and updates	**Coordinate support to the government** Ensure development partners are providing the right support to enable implementation of this report's recommendations Align within the DP group

APPENDICES AND SUPPORTING DOCUMENTS

Appendices to this report

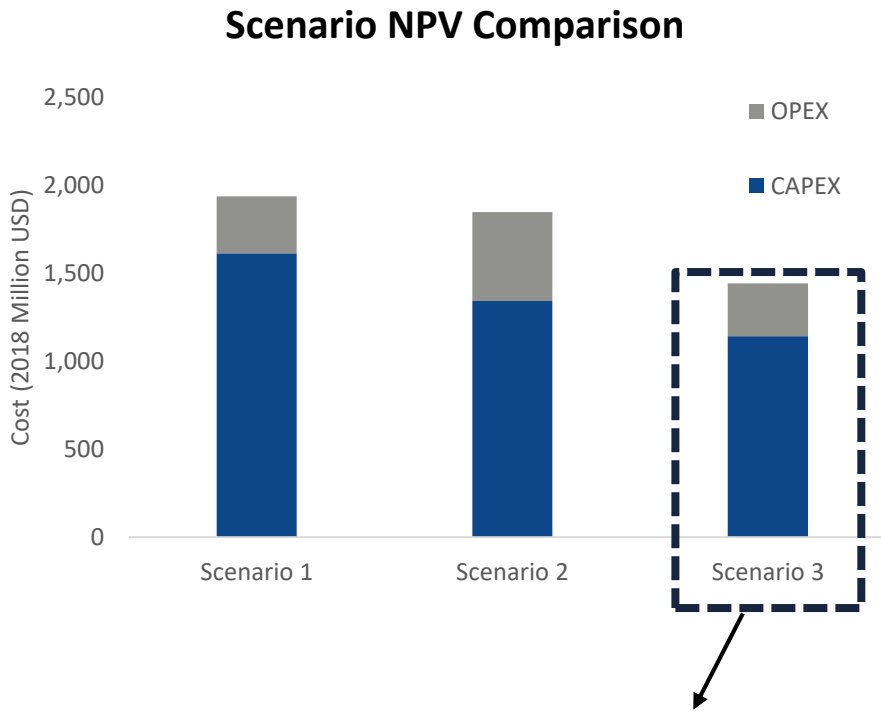
Supporting documents

1. **Executive summary**
2. **Methodological notes,** including a list of programs and projects
3. **Project prioritization model** (excel)

Appendix A:
Generation scenario details

Scenario Overview

	Scenario 1	Scenario 2	Scenario 3
Generation Mix	• Follows the IRP recommended portfolio up to 2026 • Large coal plants, large hydro	• Follows the ESCOM investment plan up to 2023 • Large coal, large hydro, solar	• Proposed plan • Hydro, wind, and solar
Reliability Impact	• Firm capacity from coal • Fuel risk, vulnerable to drought	• Firm capacity from coal • High dependency to power imports	• Intermittent resources with firm capacity from battery and hydro storage
Risks	• Dependent on coal price and national/ international policies on carbon pricing	• Coal-price and carbon-price risks • Imported power-price risks	• Imported power-price risks, mitigated by wind and solar cost reduction
Modularity	• Exclusive large-scale generation could have stranded asset issue	• Diverse portfolio could provide synergy, but large coal and hydro could have stranded asset issue	• Diverse portfolio with small-scale generation making it easier to adjust based on demand



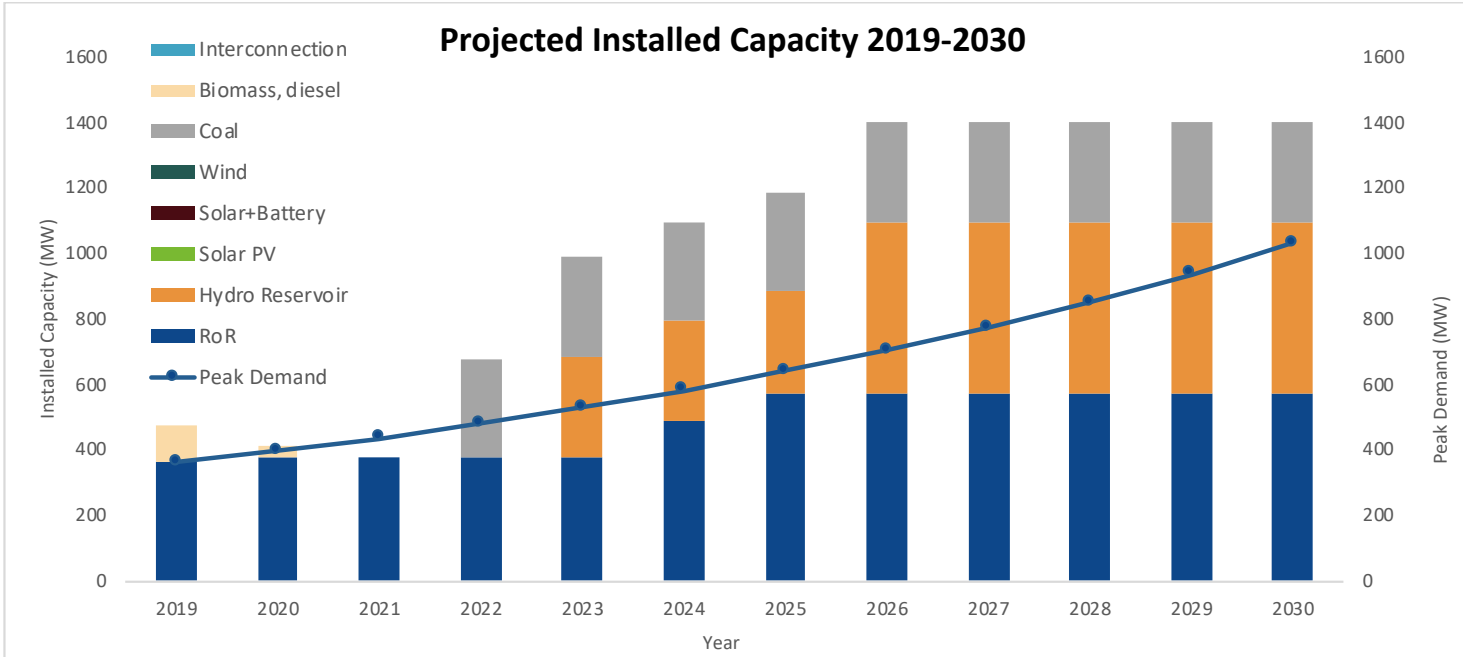
Scenario 3 provides a **least-cost, reliable, and diversified solution, saving ~$500 million (25%)** with the potential to dynamically adjust investment based on demand forecasts

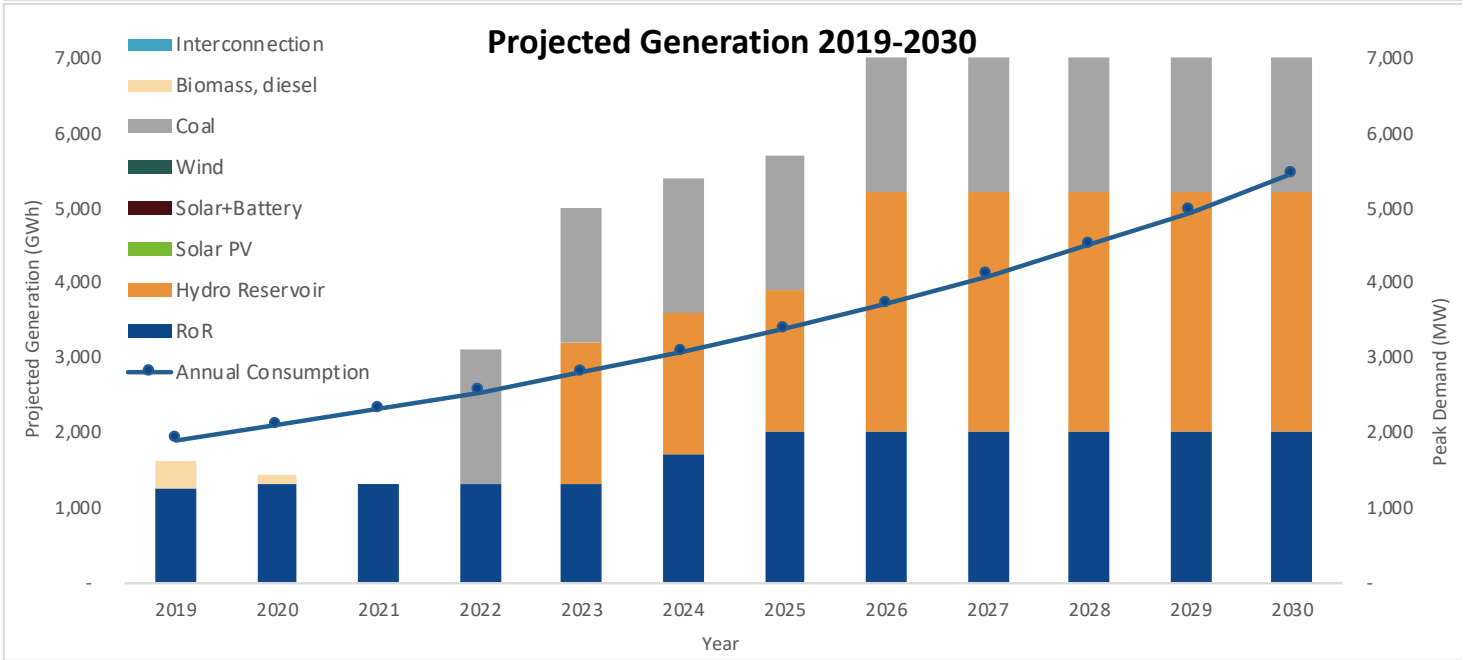
Capacity and Generation Expansion

Scenario 1

Project	Commissioning year	Capacity
Tedzani IV	2020	18
Kam'mwamba Coal	2021	300
Mpatamanga Hydro	2023	308
Kapichira III	2024	110
Hamilton Falls	2025	87
Kholombizo Hydro	2026	213

- Scenario 1 follows the IRP-recommended portfolio, with exclusively large coal and hydro plants.
- The portfolio is able to meet the peak capacity and annual generation constraints for most of the years except the first two (2019–2020).





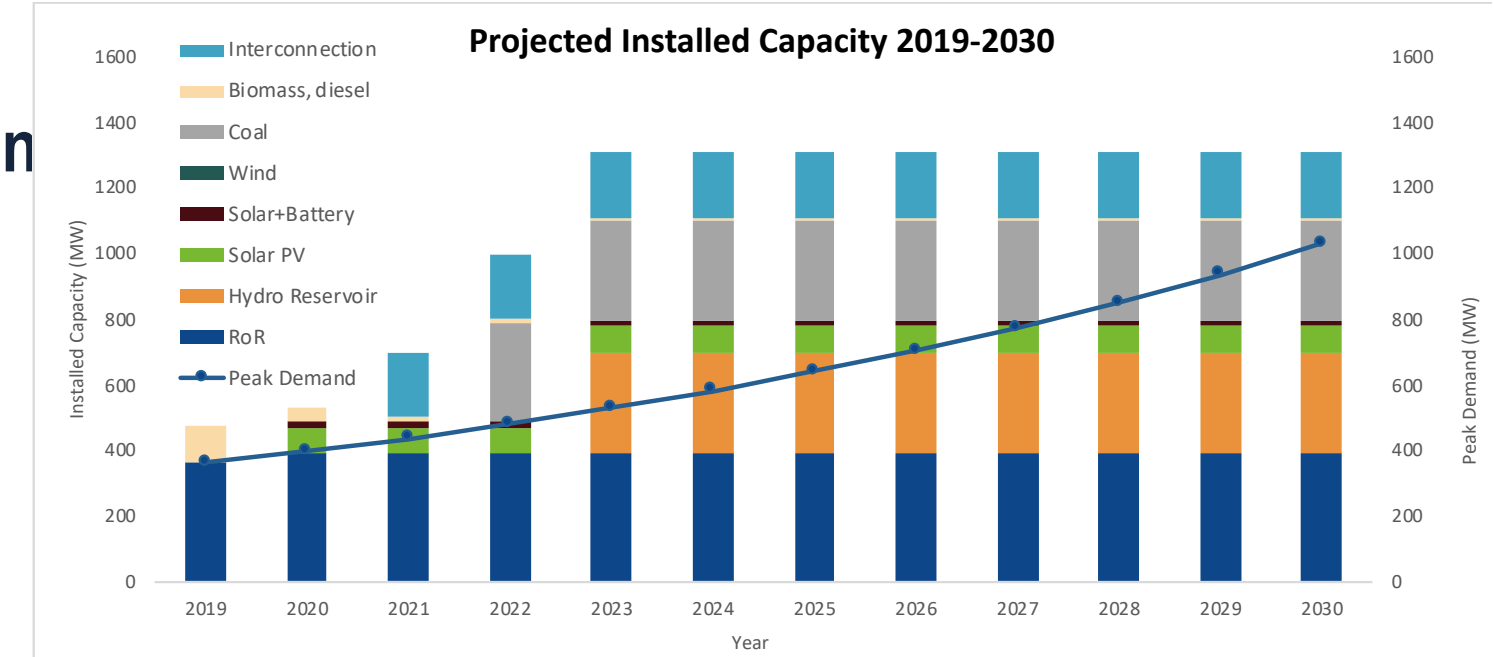
Note: Projected 10% demand growth.
Based on the Norconsult Integrated Resource Plan (IRP) for Malawi, Final Report May 2017

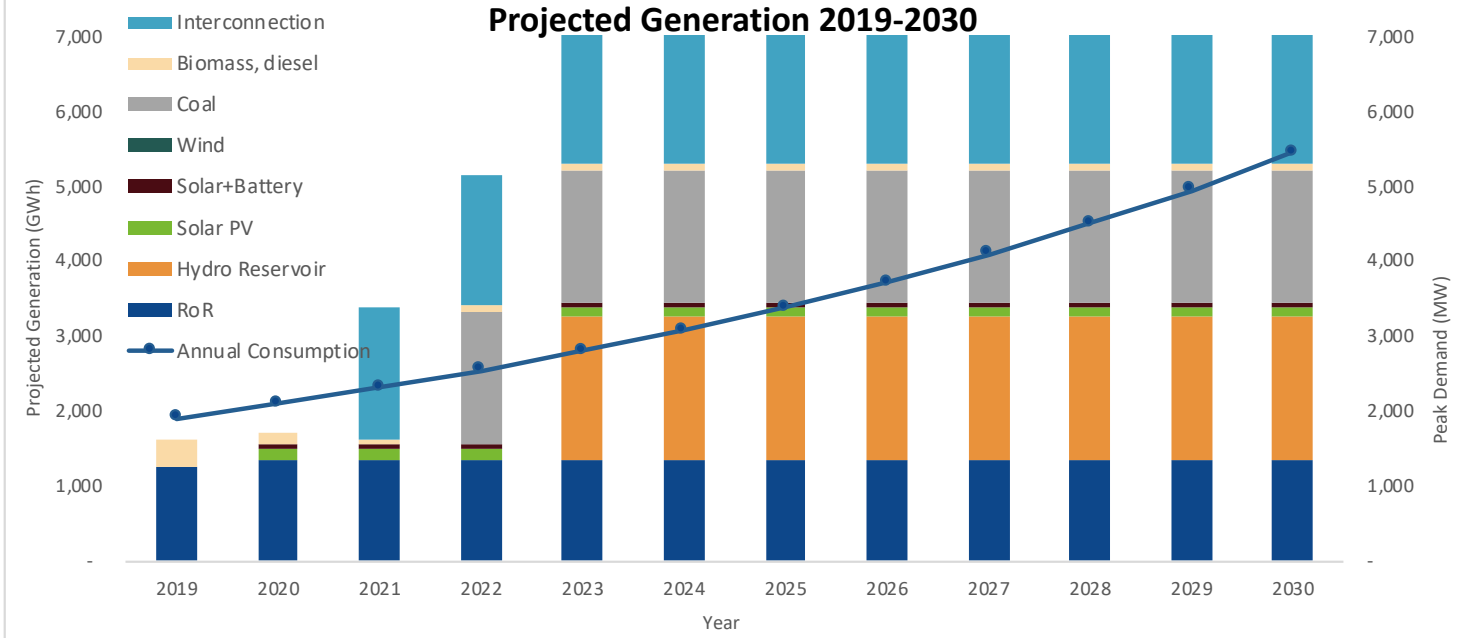
Capacity and Generation Expansion

Scenario 2

Project	Commissioning Year	Capacity
Tedzani IV	2020	18
Solar IPP—Salima	2020	60
Solar IPP—Nkhotakota	2020	21
LLW PV/Battery (Kanengo)	2020	20
Ndiza/Ruo Mini Hydro	2020	8
Waste to energy project (Blantyre)	2020	10
Kam'mwamba Coal	2021	300
Malawi/Mozambique Interconnection	2021	200
Mpatamanga Hydro	2023	308

- Scenario 2 follows the ESCOM investment plan, with various solar PV and small hydro projects implemented in the near term.
- The portfolio is able to meet the annual peak capacity constraints, with generation shortage for the first two years and surplus once the coal plants and interconnection projects are completed.





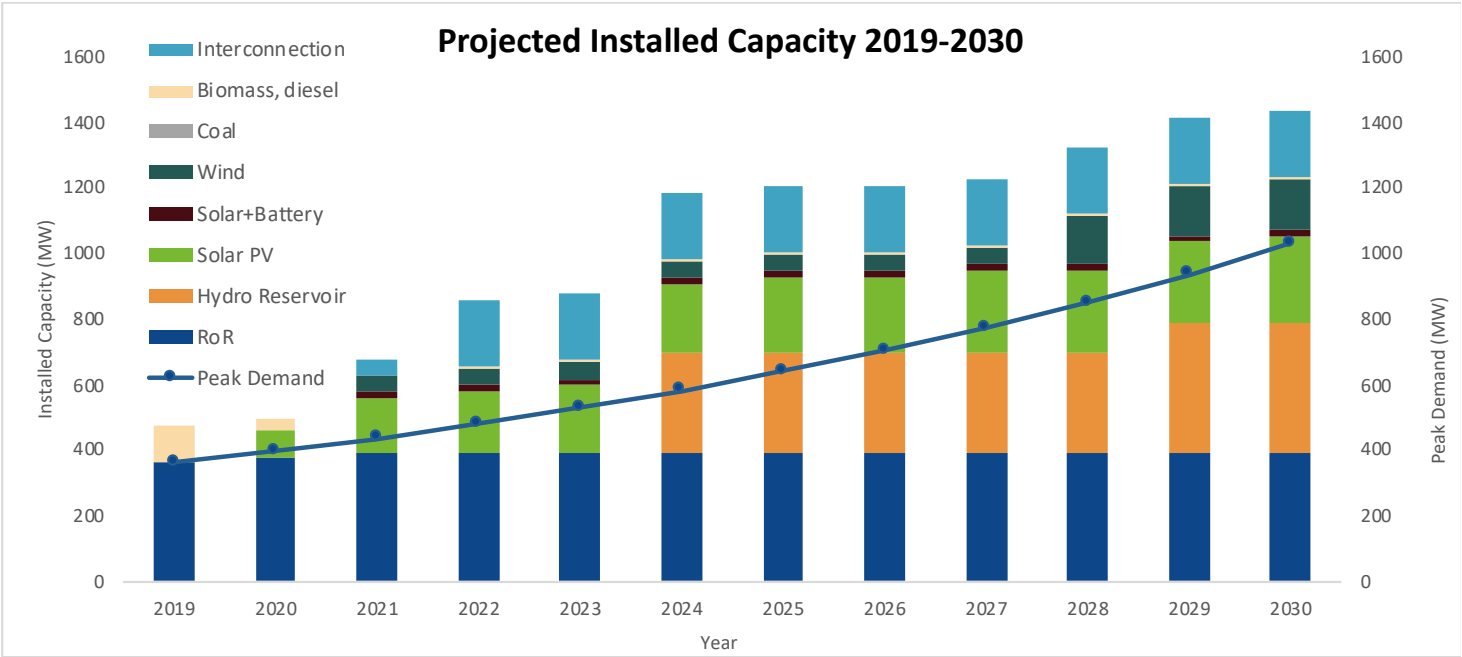
Note: Projected 10% demand growth.
Based on the ESCOM Investment Strategy 2018-2023, published February 2018

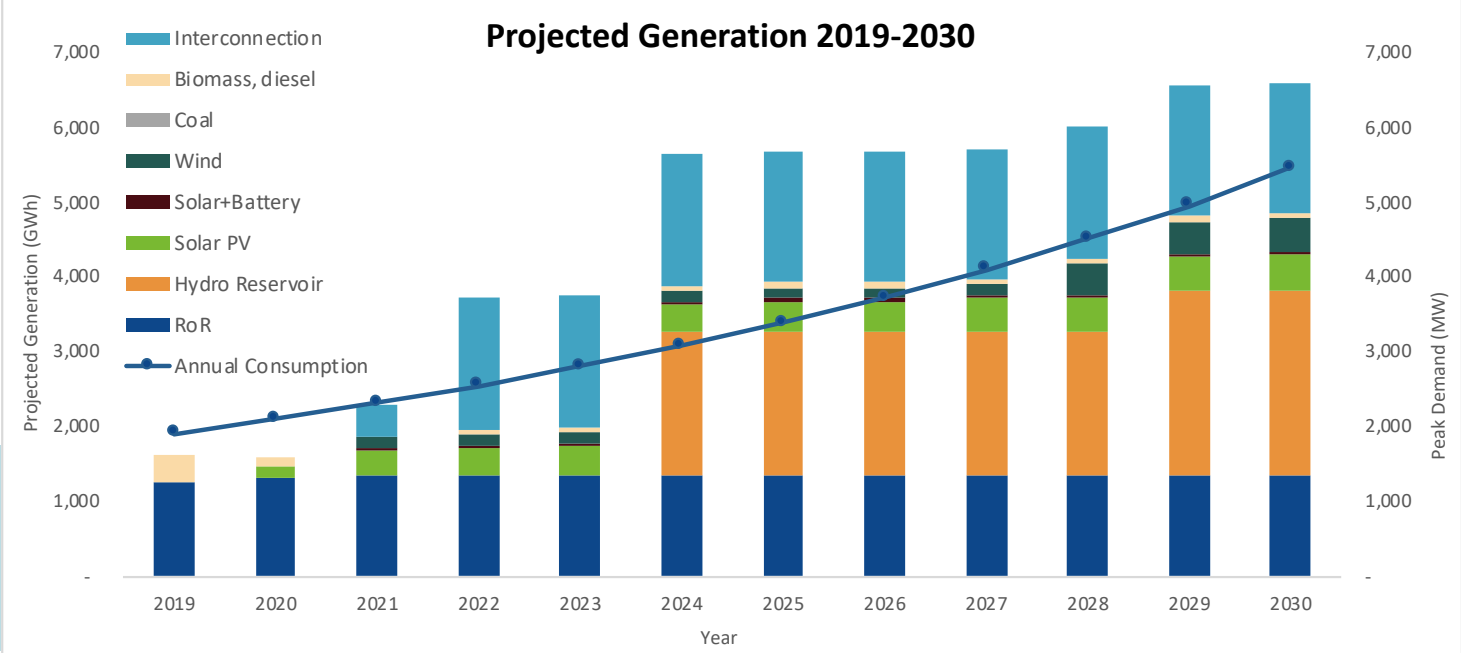
Capacity and Generation Expansion

Scenario 3

Project	Commissioning Year	Capacity
Tedzani IV	2020	18
Solar IPP—Salima	2020	60
Solar IPP—Nkhotakota	2020	21
LLW PV/Battery (Kanengo)	2021	20
Golomoti Solar	2021	20
Monkey Bay Solar	2021	20
Bwengu Solar	2021	50
Malawi/Mozambique Interconnection Phase I	2021	50
Mzimba Wind Phase I	2021	50
Ndiza/Ruo Mini Hydro	2021	8
Cogeneration with IIIlvo	2022	9
Solar IPP—Kanengo(Lilongwe)	2022	18
Malawi/SAPP Interconnection Phase II	2022	150
Representative Solar I	2023	20
Mpatamanga Hydro	2024	308
Representative Solar II	2025	20
Representative Solar III	2027	20
Mzimba Wind Phase II	2028	100
Lower Songwe Hydro	2029	90
Representative Solar IV	2030	20

- Scenario 3 is the optimized proposal developed during this study, with diverse portfolio to allow dynamic adjustment over the years.
- The portfolio is able to meet the annual peak capacity constraints, with generation shortage for the first two years and surplus from hydro in the mid-term and interconnection for the majority of the time.

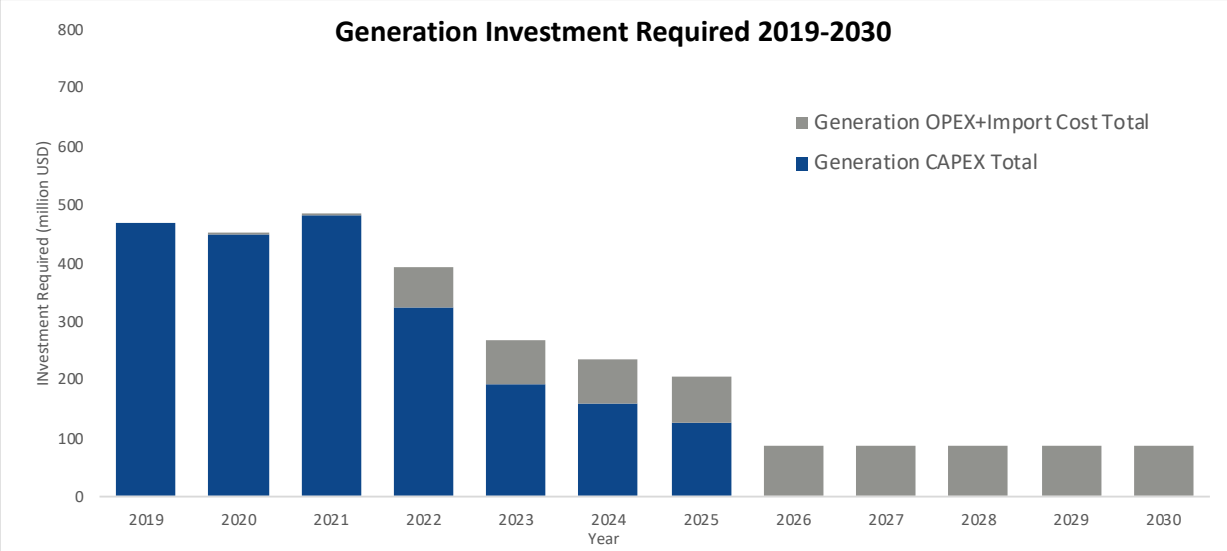




Note: Projected 10% demand growth.

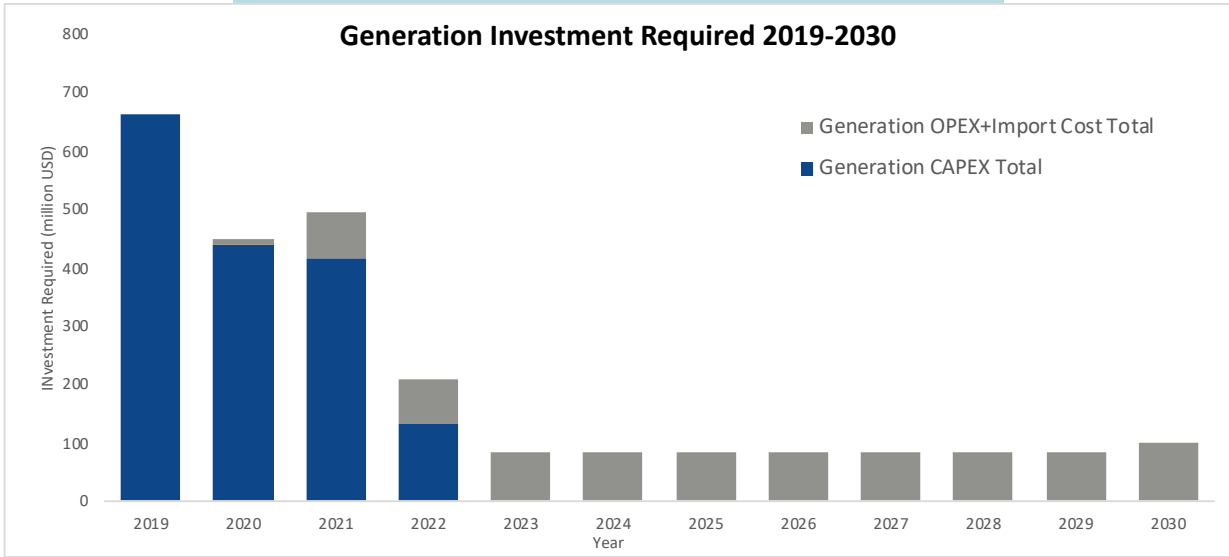
Investment Required

Scenario 1

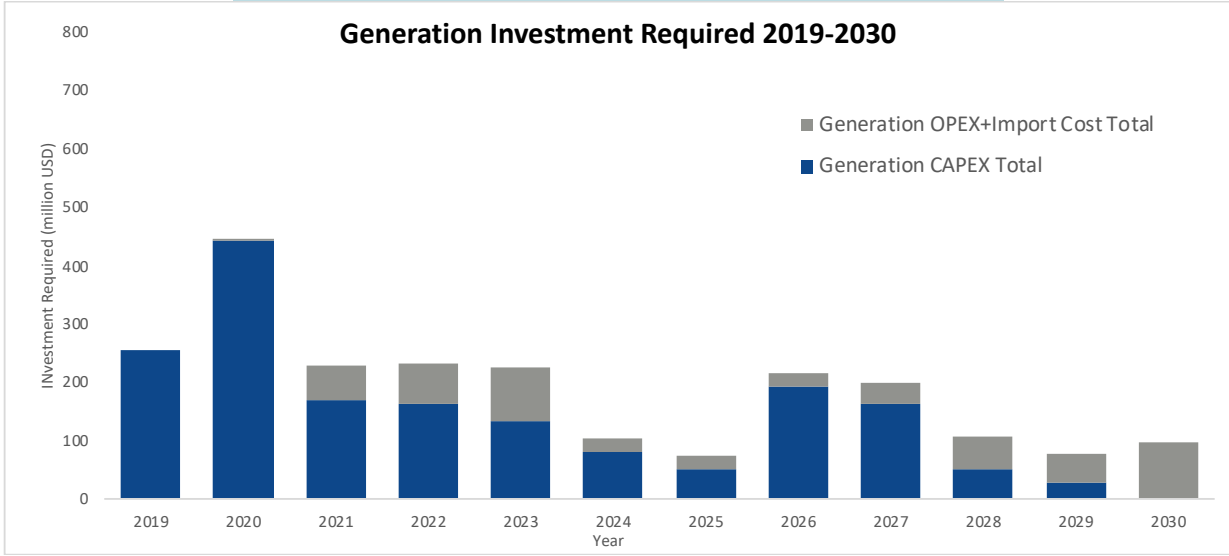


- Scenarios 1 and 2 have high upfront capital costs, followed by sizable operation cost over the years.
- Scenario 3 spreads out the capital cost across the years, and has lower operation costs due to reduced fuel demand.

Scenario 2

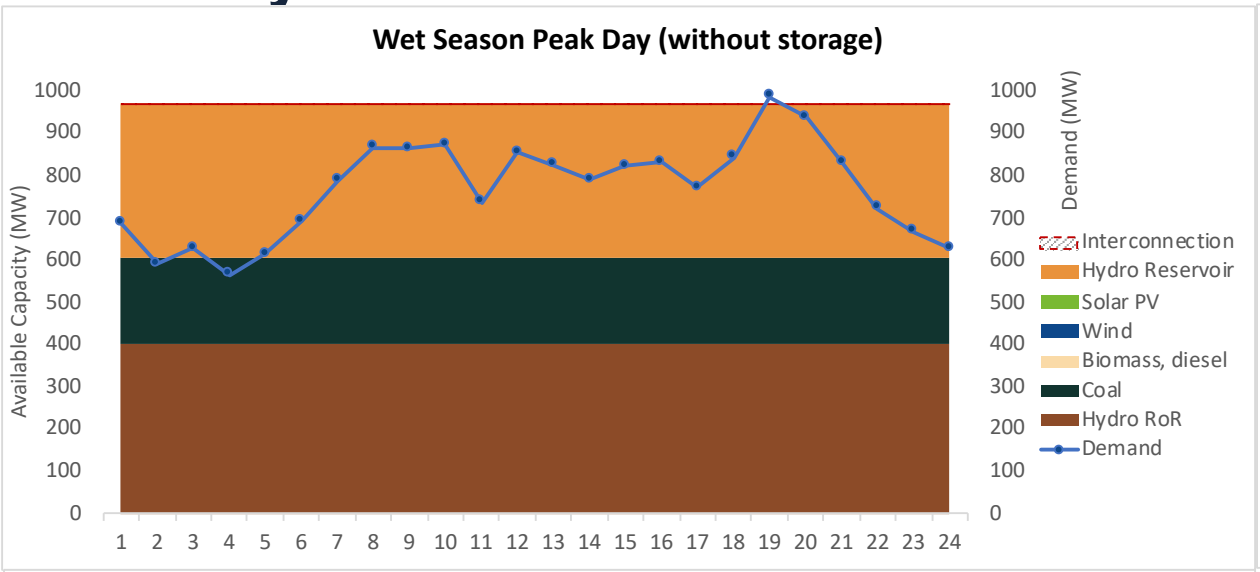


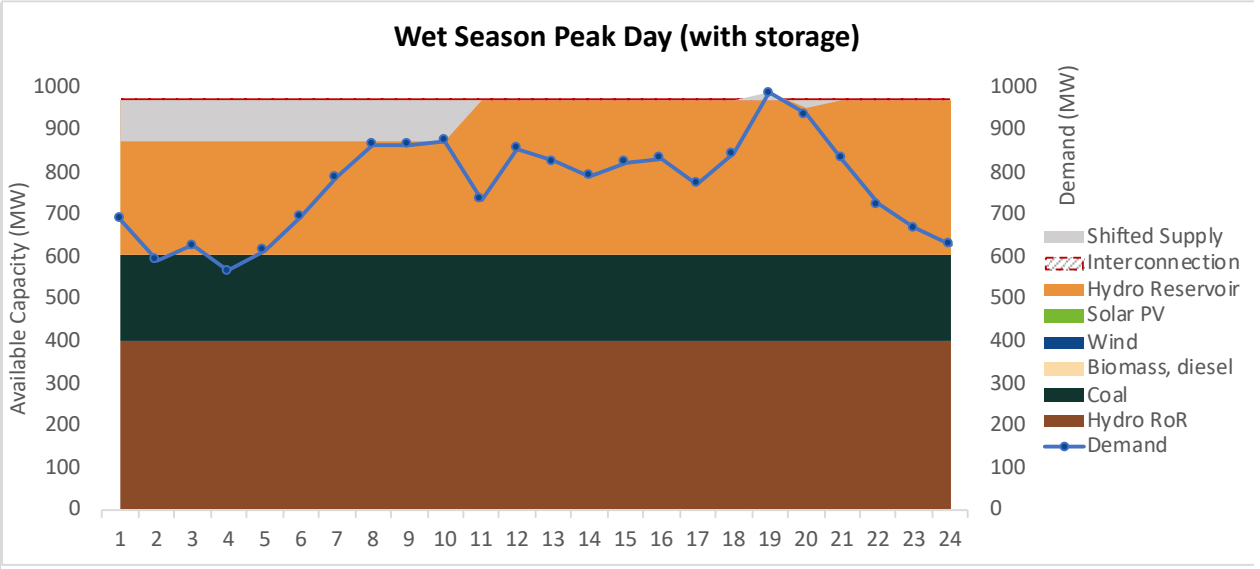
Scenario 3

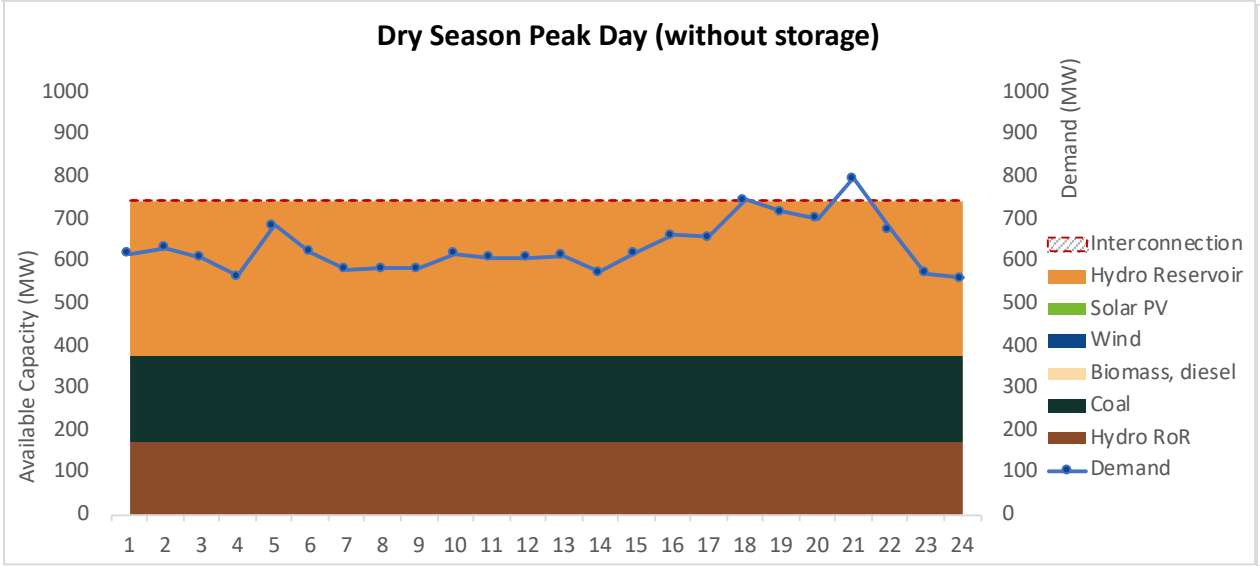


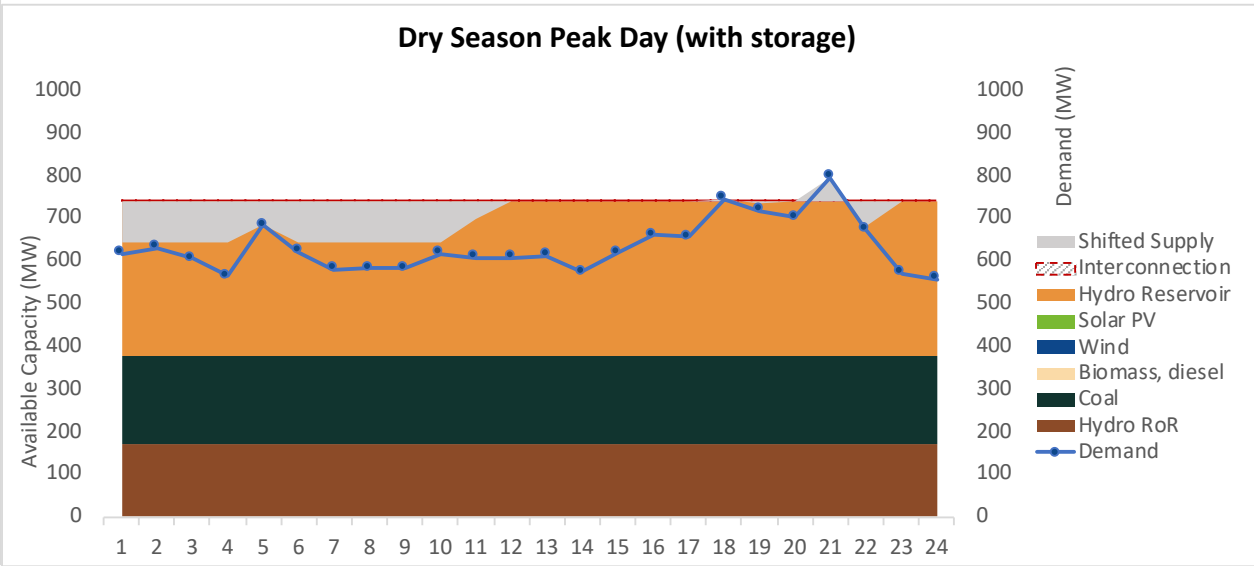
Reliability Check

Scenario 1*





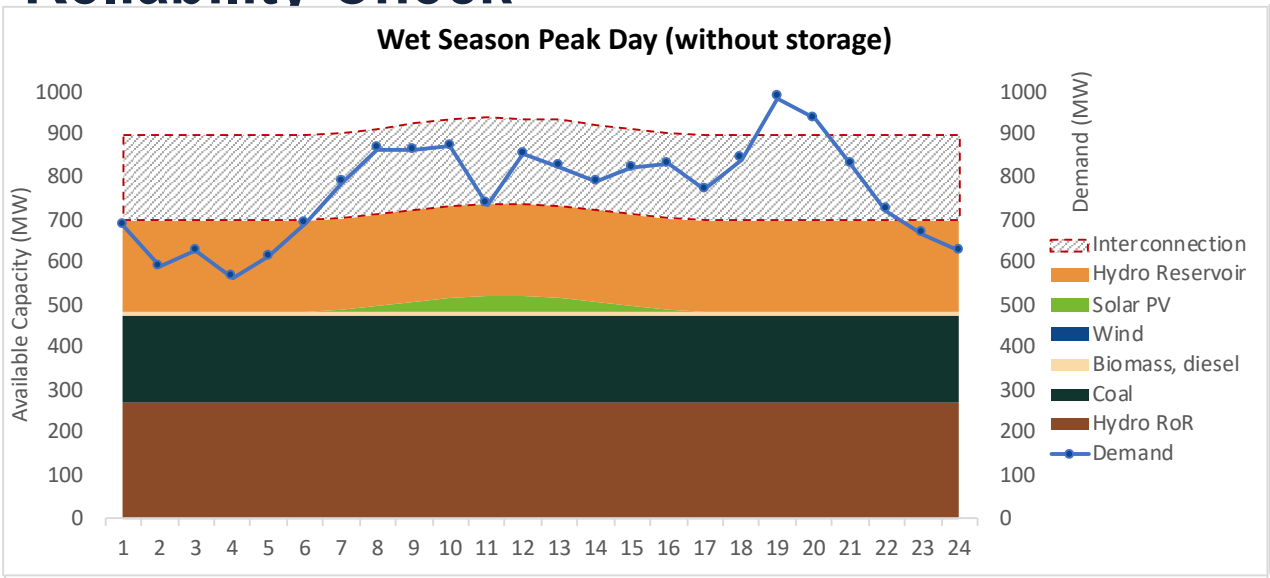


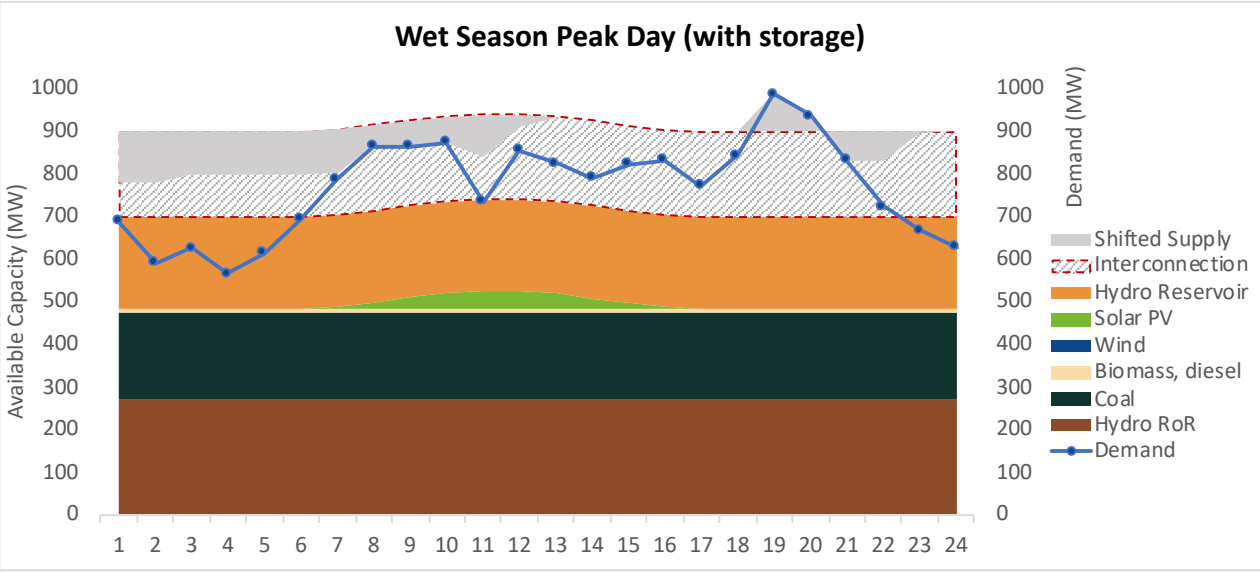


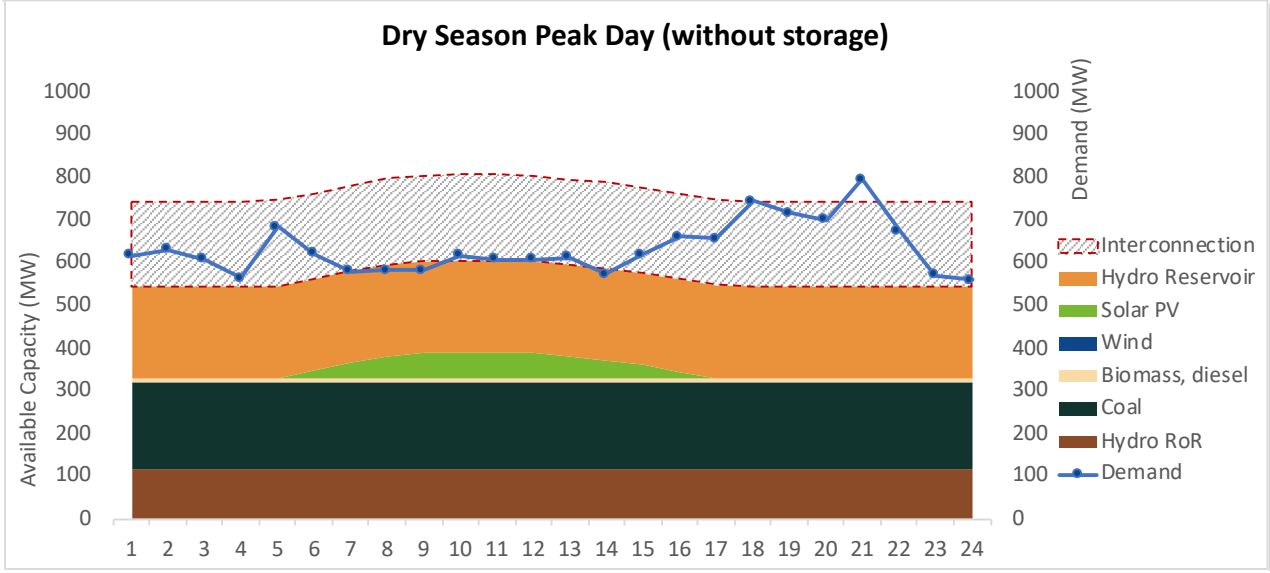
* The reliability check analysis chooses two representative days in 2030 when monthly peak demand occurs, one in the wet season and one in the dry season, and illustrates whether stacked generation capacity is able to meet hourly peak demand, either with or without the help of reservoir and battery storage capacities.

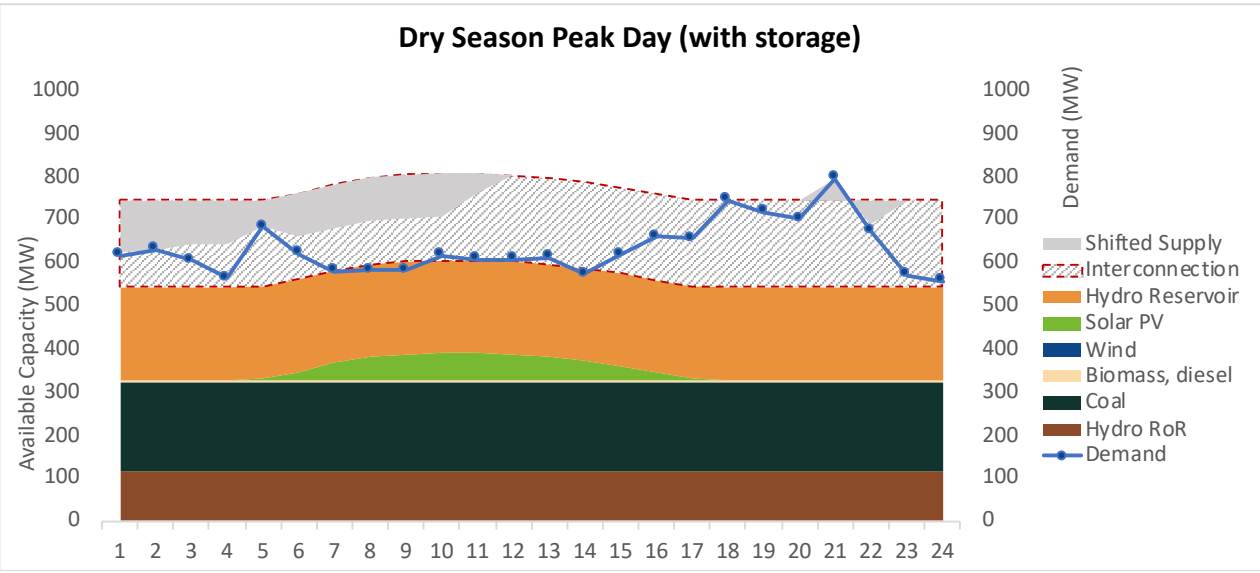
Reliability Check

Scenario 2*





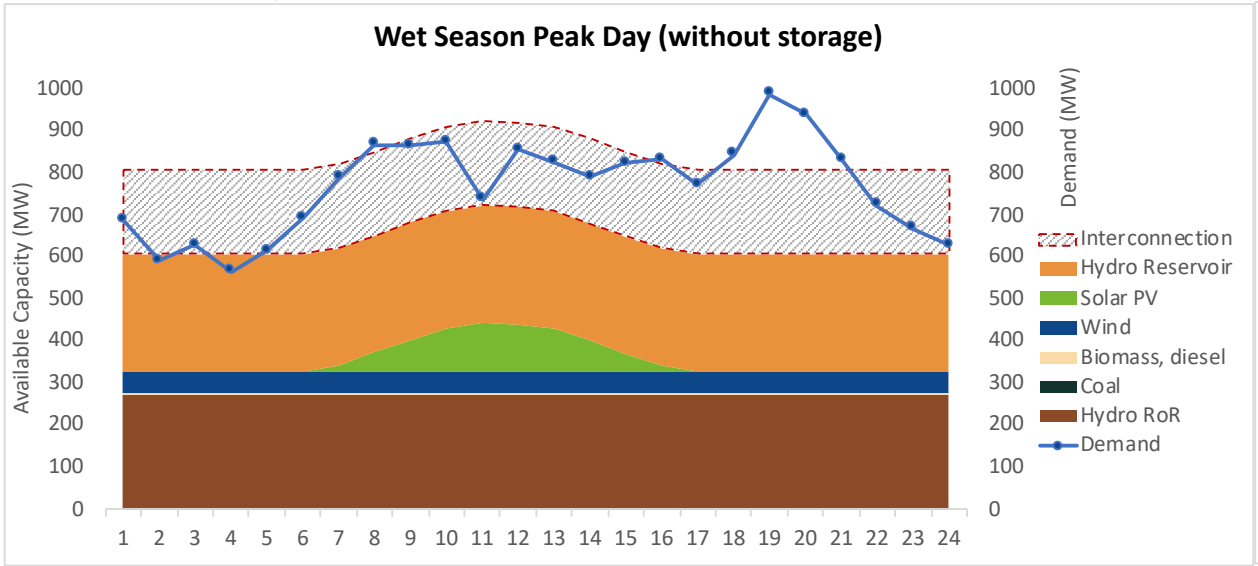


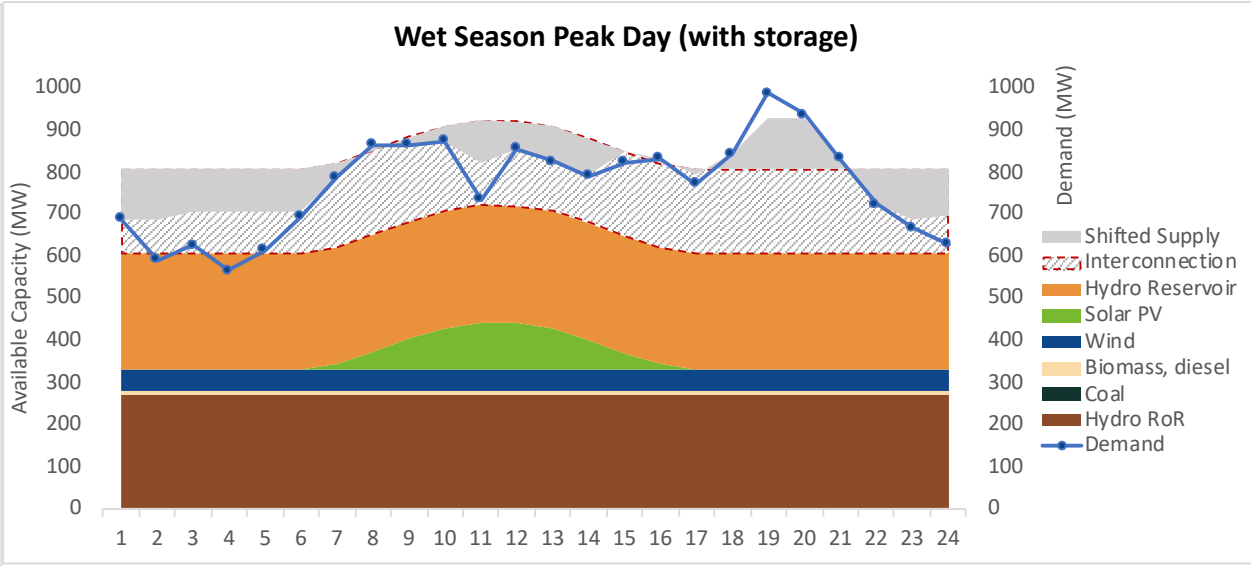


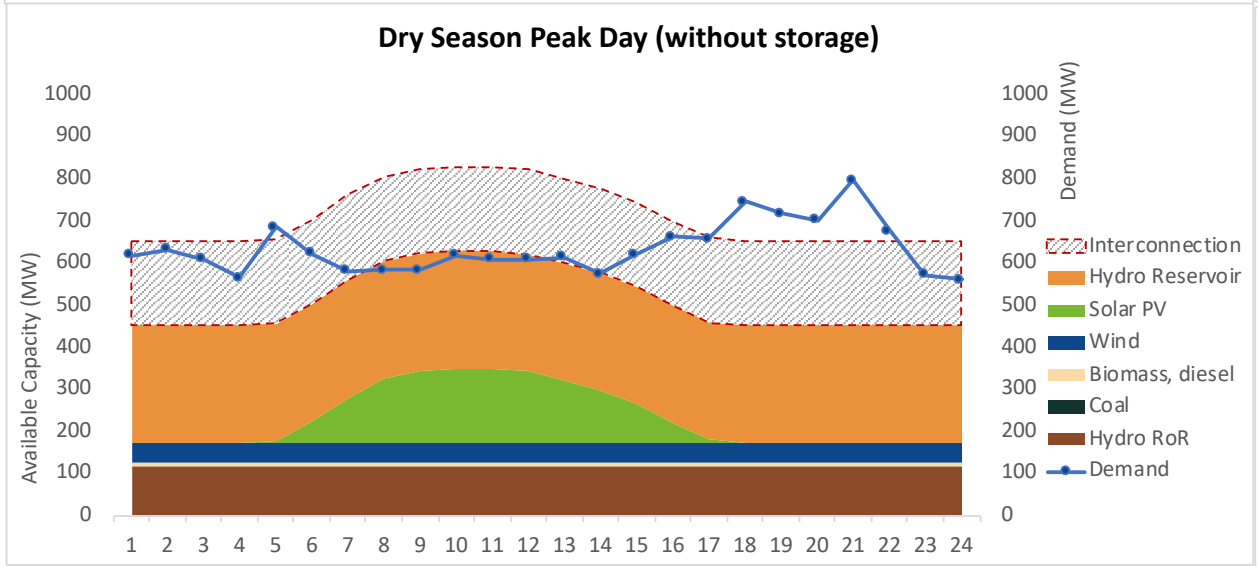
* The reliability check analysis chooses two representative days in 2030 when monthly peak demand occurs, one in the wet season and one in the dry season, and illustrates whether stacked generation capacity is able to meet hourly peak demand, either with or without the help of reservoir and battery storage capacities.

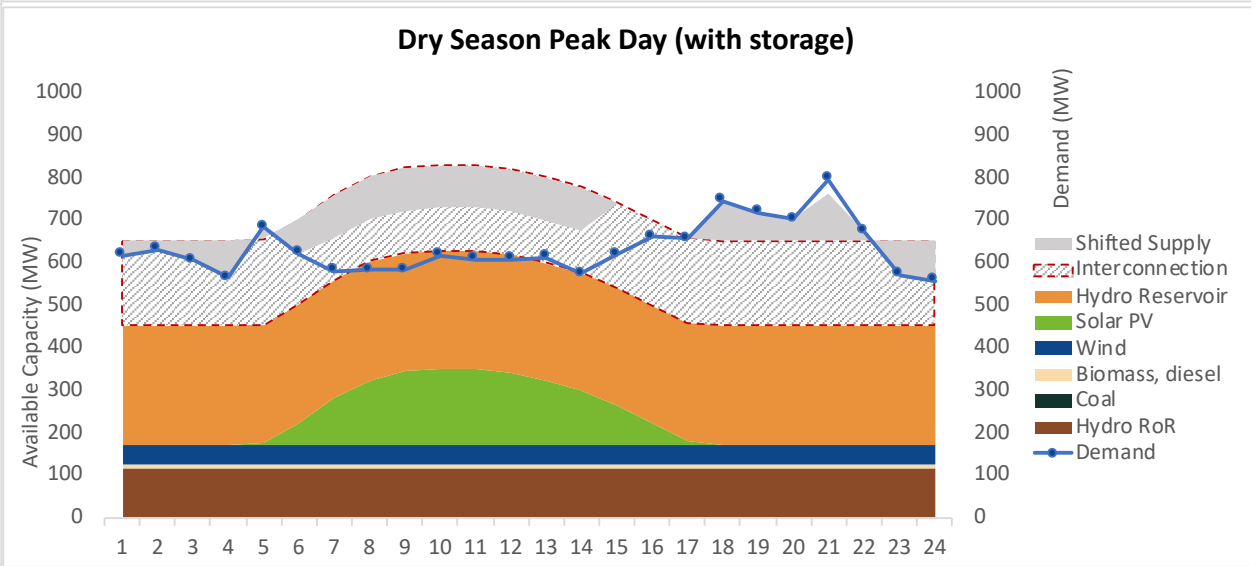
Reliability Check

Scenario 3*









* The reliability check analysis chooses two representative days in 2030 when monthly peak demand occurs, one in the wet season and one in the dry season, and illustrates whether stacked generation capacity is able to meet hourly peak demand, either with or without the help of reservoir and battery storage capacities.

Ongoing analysis should continue to study risks and mitigation strategies associated with generation projects, particularly, variable renewables

Feeder-level reliability assessment should be conducted

- Revisit grid configuration, explore opportunities to revise from radial to loop systems
- Identify areas for transmission upgrades (e.g. larger transformers, conductors)
- Explore storage at strategic locations
- Identify opportunities for grid-connected microgrids to enable more renewables

Comprehensive studies are needed before integrating solar PV projects

These may include:

- Power flow analysis
- Transient stability analysis
- Fault ride through studies
- Dispatch analysis
- Dynamic studies for solar+storage projects

Scenario 3 provides a starting point for the project planning process. With declining costs of renewables and storage, IRP and scenario analysis should be revisited regularly.

Appendix B:
Productive use detailed analyses and case studies

Detailed Options Space of Productive Use Interventions (1 of 2)

Intervention Category		Supply-Side Options	Demand-Side Options
Value Chain Analysis	Value Chain Evaluation	• **Market Surveys** map economic activities and identify barriers and opportunities. These could include partnership with rural development programs to identify additional barriers hindering access to markets or raw materials, and opportunities to integrate demand stimulation and productive use into broader socio-economic development efforts. • A **Catalogue of Actors** defines institutions participating in the space for easy identification.	
Business Development Services (Training and Education)	Identify the Right Equipment	• **Equipment List for Consumer Segments** involves understanding customer needs, testing equipment reliability, validating manufacturer specifications, and identifying the right equipment. • **Awareness Campaigns** create awareness among suppliers about the right appliances, their impact, required after-sale services, and how to source them.	• **Customer Surveys** help to identify customer needs and barriers preventing appliance uptake. • **Awareness Campaigns** create awareness among customers about the right appliances, where to source, and how to use them.
	Assess Business Case	• **Credit Evaluation Training** instructs appliance providers on the business case of equipment investment and how to evaluate customer credit through non-traditional means.	• **Business Plan Development Training** helps customers estimate cash flows, returns, and payback plans for new appliances.
	Enterprise Development & Training	• **Commercial and Technical Training** assists developers and other parties assess opportunities for providing electricity-based services through training to attract new entrants.	• **Enterprise Development Support Services** support commercial and technical skills for existing and new businesses.
Equipment Provision and Consumer Finance	Local Appliance Availability and Affordability	• **Concessional Finance Funds** finance equipment provision programs, for example through revolving funds. • **Risk Guarantees** reduce the risk of such programs. • **Bulk Purchasing** increase appliance availability and affordable by taking advantage of economies of scale; procurement can take place through different mechanisms, including 3rd-party procurement, developer coordination and aggregation of demand, or individual developer efforts. • **Matchmaking between Suppliers and Market** attracts suppliers of productive use equipment and connect international suppliers to the local market. • **Local Production of Appliances** increases availability of the right appliances in local markets.	• **Appliance Financing** helps customers afford the up-front cost of accessing appliances. • **Appliance Subsidy and Customer Rebates** help customers access appliances and could be tied to electricity prepay service. • **Diesel Conversion Buyback** remove diesel appliances from the market and help customers finance new appliances. • **Tax Incentives** help customers access the right appliances.
	Information on Right Appliances	• A **Centralized Database** with information relevant for different stakeholder groups, including on demand, willingness to pay, and where to source equipment will help both suppliers and customers identify the correct appliances to introduce in different contexts.	

Detailed Option Space of Productive Use Interventions (2 of 2)

Intervention Category		Supply-Side Options	Demand-Side Options
Larger Scale Demand Stimulation Projects	Larger Scale Productive Use Interventions	• **Larger Scale Productive Use Projects** increase electricity usage and, therefore, economic development by increasing the reach of services such as electric mills, carpentry tools, and water purification. • **Matchmaking with Commercial Providers** facilitates additional service offerings, such as cell towers and internet services from the private sector.	• **Market Access Facilitation Support** provides support to develop markets and supply chains for the outputs of productive uses.
	Cross-sector Development Partnerships	• An **Electrification Component in Multi-sector Rural Development Efforts** shares responsibility for demand stimulation with other ongoing efforts, such as health or rural agro-industrial programs. • A **Brochure of Electricity Benefits** shares information with sector agencies, NGOs, and other stakeholders.	
Electricity Service	Electricity Cost and Pricing	• **Demand Projections based on Existing Load Data** assist developers in accurately sizing new systems. • **Development of Deferrable Loads**, such as water pumping, can be scheduled when the cost of electricity is low, effectively storing that energy for other times of the day. • **Modularity of Supply** prevents oversized systems by enabling system growth as demand increases.	• **DSM** includes the use of energy efficient appliances to reduce consumption. • **Tariff Subsidies or Connection Subsidies** assist customers in affording electricity.
	Tariff Structure	• **Time of Use Tariffs** charge different rates at different times of day, which can stimulate consumption during the day when PV production is greatest. • **Tariff Classes** distinguish customers by class to enable greater productive use of electricity. • **Seasonal Payment Reserves** allow customers to prepay for electricity during seasons of higher production and income, enabling more consistent year-round consumption.	• **Awareness Campaigns on Tariff Structure** help developers understand customer perception around pricing models and drive customer awareness on tariff structure.
	Service quality	• **Special Access Zones** provide higher quality service and reduce the distribution costs and special amenities for consumers who are currently far away from productive use activities. • **Customer Agreements** enable providers to commit to specific service levels in exchange for a committed level of demand.	
Policy and Regulation	Regulatory Framework	• A **Quality Assurance Framework** helps to ensure consistent quality and performance of minigrid resources, improving customer perception and willingness to pay. This framework could also include specifications on demand stimulation.	

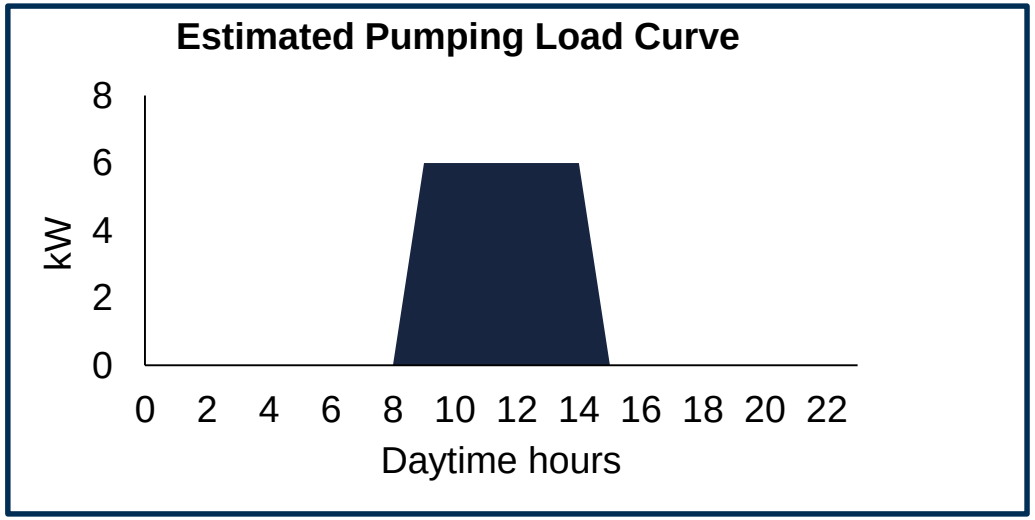
Stand-alone irrigation case study: Futurepumps in Mudumuka

Key takeaways

- Solar based stand-alone systems present a **commercially viable solution** for small dispersed farmers
- **Small and seasonal load from irrigation** and lack of other productive use activities in the area limit the financial viability of a larger grid-based system

Context

- Grid <1km away, but does not reach areas that require irrigation
- Small community: <2,000 households
- Limited ability to pay: subsistence farming represents principle economic activity
- Small market: 3 stand-alone pumps in use, potential market size of 50 pumps



Source: Interviews with Kevin Simpson, Malawi Fruits Ltd.
Photo Credit: Futurepump Kenya Limited

Stand-alone irrigation Case Study: Futurepumps in Mudumuka

Techno-Economic Information

Return Information:*
- Internal Rate of Return (IRR)>350%
- NPV ~$US3,500

Payment models: Rent to own, ~US$200 per year for ~ 4years

Cost: ~US$800 investment

System characteristics: up to 120W of solar DC solar pump, sufficient to irrigate ½ to 1 acre of land

Maintenance: Futurepump provides 3-year guarantee and maintenance of equipment

Takeaways

Benefits of Productive Use
- Early analysis suggests revenue increases of ~150%, when farmers expand into growing cash crops (tomato, paprika, beans)

Key Success Factors
- Access to finance to surmount upfront cost of systems
- Maintenance services to ensure longevity of investments
- Capacity building to improve productivity of small holder farms and increase irrigation impact (identification and growing cash crops, soil analysis to increase productivity)

*Assumptions: 10 year lifespan; 4.5% discount rate; 5% annual cost factor; 1% annual yield factor. Other studies have also found favorable returns for solar based irrigation in Malawi: Eales et al 2017, Productive Use of Solar PV in Malawi finds that solar based irrigation systems have payback periods ~3 years and present the highest returns of the five most commonly found productive uses in Malawi

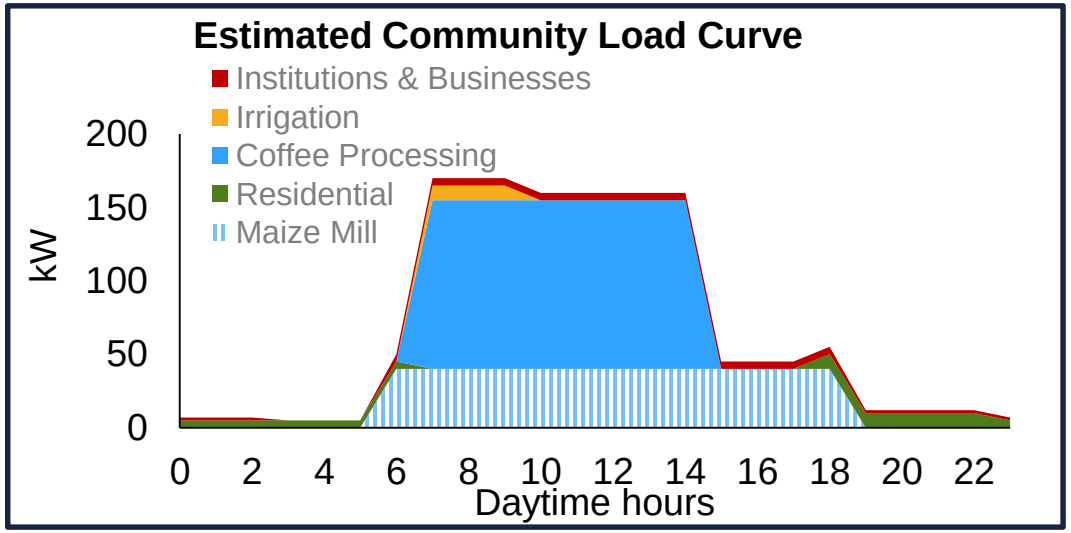
Minigrid case study: Coffee processing and irrigation in Usingini

Key takeaways

- **Large and year-round loads from coffee processing, macadamia industry, and maize mill** increase the financial viability of minigrid systems and provide a sufficient load to justify a larger grid-based system

Context

- 1,000 households in community (5,000 residents within surrounding areas)
- HH loads expected to increase from 100W to 200-300W
- Small business loads from irrigation, maize mills, grocers, carpenter
- Cash crops: coffee, macadamia, other agricultural farms
- Subsistence crops: maize, cassava, fishing



Source: Usingini Feasibility Study

Minigrid case study: Coffee processing and irrigation in Usingini

Techno-Economic Information

Cost

- CAPEX: ($879,000 GRANT)
- Operational Expenditure (OPEX): $58,516/yr*
- Initial Tariff:
  - Anchor (Coffee) $0.27
  - Residential $0.09
  - Business $0.17
- IRR: 10%[2]

Cost Recovery Scenario

- CAPEX: $879,000***
- OPEX: $58,516/yr
- Tariff ($/kWh):**
  - Anchor (Coffee) $0.32
  - Residential $0.11
  - Business $0.20

ENW: ** -- is it 10 year IRR or 10 year payback?

Takeaways

Benefits of Productive Use

Increased power supply and production may promote local economic growth and employment opportunities. Increased employment may attract a larger population, which in turn may attract other services that can further promote local economic growth (e.g., Airtel network expansion).

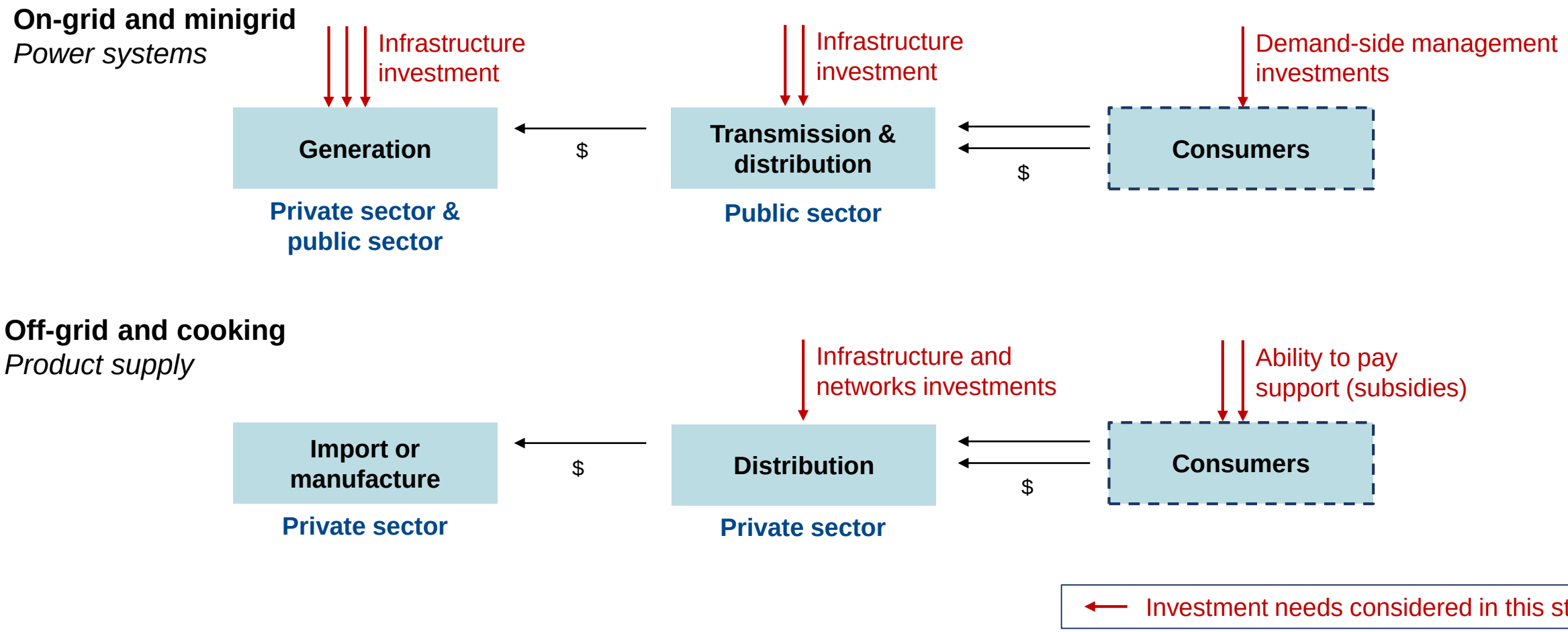
Key Success Factors

- The tariff structure would need to reflect the capital investment to prove the commercial viability of the business model, attract private sector investment, and scale this model to other communities
- The project can only achieve cost-recovery with forecasted loads from coffee processing and macadamia nut production, illustrating the importance of productive use in ...eving commercially viable business models for minigrid ...ems in Malawi

* Average for first five years
** Ten-year IRR
*** 70%/30% debt-equity split; Source: Usingini Feasibility Study

Appendix C:
Finance options analysis

This study identifies a range of funding needs, that will accrue at different stages of the value chain and may be linked to different actors



Various facilities and funders provide climate finance to support prepare and implement projects in sub-Saharan Africa (1 of 3)

Fund[1]	Trustee	Financial Instruments	Investment Focus
Africa Renewable Energy Initiative[2]	AfDB	Grants, concessional loans, guarantees, in-kind contributions	Project and Program implementation
Climate Change Technical Assistance Facility[3]	European Investment Bank	Contingent grants	Scoping and project preparation
Access Energy Fund (AEF)[4]	FMO Netherlands Development Bank on behalf of the Ministry of Foreign Affairs	Grants, concessional loans, equity	Project and program implementation
Global Climate Partnership Fund (GCPF)[5]	Programme Office of the International Climate Initiative	Market rate loans	Project and program implementation
Green Bonds Program[6]	AfDB	Concessional loans	Project and program implementation
Interact Climate Change Facility[7]	European Development Finance Institution	Market-rate loans, guarantees	Project and program implementation
InfraCo Africa—Sub Sahara Infrastructure Fund[8]	Private Infrastructure Development Group	Grants, equity	Project and program implementation
International Finance Corporation (IFC)—Canada Climate Change Program[9]	IFC	Concessional loans and guarantees	Project and program implementation

Sources: 1) NDC Climate Finance Explorer http://ndcpartnership.org/content/climate-finance-explorer; 2) http://www.arei.org/ 3)http://www.eib.org/projects/documents/cctaf_guidelines_public.htm 4) https://www.fmo.nl/aef 5) http://www.gcpf.lu 6) https://www.afdb.org/en/topics-and-sectors/initiatives-partnerships/green-bond-program/ 7) https://www.edfi.eu/facility/iccf/ 8) http://www.infracoafrica.com 9) http://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/cb_home/mobilizing+climate+finance/blendedfinance_ifccanada

Various facilities and funders provide climate finance to support prepare and implement projects in sub-Saharan Africa (2 of 3)

Fund[1]	Trustee	Financial Instruments	Investment Focus
Global Environment Facility (GEF)—Support for Programming through National Dialogues[2]	World Bank	Grants	Scoping and project preparation
Green Climate Fund (GCF)—Readiness Programme[3]	World Bank	Grants, in-kind contributions	Scoping and project preparation, creating enabling environments and building institutional capacity, complying with reporting requirements
The Carbon Fund—The Carbon Initiative for Development[4]	World Bank	Results-based finance	Project and program implementation
The Nordic Development Fund[5]	Governments of Denmark, Finland, Iceland, Norway and Sweden	Grants	Project and program implementation
NAMA Facility[6]	Various	Grants, concessional loans, guarantees	Creating enabling environments and building institutional capacity, project and program implementation
Clean Technology Fund of Climate Investment Funds[7]	World Bank	Grants, concessional loans, subordinated debt, market-rate loans, equity, guarantees	Project and program implementation

Source: 1) NDC Climate Finance Explorer http://ndcpartnership.org/content/climate-finance-explorer 2) http://www.thegef.org/gef/ 3) https://www.greenclimate.fund 4) https://www.ci-dev.org/ 5) http://www.ndf.fi 6) http://www.nama-facility.org 7) https://www.climateinvestmentfunds.org/topics/clean-technologies

Various facilities and funders provide climate finance to support prepare and implement projects in sub-Saharan Africa (3 of 3)

Fund[1]	Trustee	Financial Instruments	Investment Focus
Le Fonds Français pour l'Environnement Mondial[2]	Agence Française de Développement - French Development Bank (AFD)	Grants	Project and program implementation
New Partnership for Africa's Development (NEPAD) Climate Change Fund[3]	Africa Union's NEPAD	Grants	Project and program implementation
LDC Fund[4]	World Bank	Grants	Project and program implementation
Green Building EDGE Program[5]	IFC	In-kind contributions	Scoping and project preparation, creating enabling environments and building institutional capacity
TerrAfrica[6]	NEPAD	Grants	Project and program implementation
Special Climate Change Fund[7]	World Bank	Grants, concessional loans, equity, guarantees	Project and program implementation
Energy and Environment Partnership in Southern and East Africa[8]	Nordic Development Fund	Grants, market-rate loans, guarantees	Project and program implementation

Source: 1) NDC Climate Finance Explorer http://ndcpartnership.org/content/climate-finance-explorer 2) http://www.ffem.fr/ 3) http://www.nepad.org/resource/nepad-climate-change-fund 4) https://www.thegef.org/topics/least-developed-countries-fund-ldcf 5) https://www.edgebuildings.com/ 6) http://terrafrica.org/ 7) https://www.thegef.org/topics/special-climate-change-fund-sccf 8) http://eepafrica.org/

A deep dive in a selection of climate finance facilities identifies a close fit with Malawi's needs (1 of 4)

Fund	Best Fit	Who applies	Flexible instruments	Application Timeframe	Additional Considerations	Overall Fit
AEF	• Early stage investment and de-risking of commercially viable projects (Gen) • Lighting and Productive Use in off-grid sector	Private sector	Yes: grants, concessional loans, subordinate capital	Open*	**+** Higher ease of use**	
GCPF	• EE or off-grid lighting through second tier financing to increase local investor comfort • Small-scale (>30MW) RE projects in late development stage	Private sector (financial intermediary)	No: market-rate loans (senior debt)	Open*	**–** Prioritizes high emitters and countries with significant potential for EE gains	

*Could not find evidence that the funds were not open to accept applications

** FROM already invested in Malawi

 Strong fit

 Weak fit

A deep dive in a selection of climate finance facilities identifies a close fit with Malawi's needs (2 of 4)

Fund	Best Fit	Who applies	Flexible instruments	Application Timeframe	Additional Considerations	Overall Fit
Clean Technology Fund of Climate Investment Funds	Early stage investment and de-risking of commercially viable projects (Gen)	Public and/or private sector, first step taken by MDB	Yes: grants, concessional loans, subordinated debt, market-rate loans, equity, guarantees	Open*	– Longer timeline, application process may take up to 4 years;	
IFC-Canada Climate Change Program	• Early stage investment and de-risking of commercially viable projects (Gen) early in pipeline • Offer second tier financing to increase local investor comfort	Private sector	Yes, fund only offers concessional loans and guarantees, but option to blend alongside other IFC funds	Open	– Track-record of investment in emerging economies** + Reasonable timeline 6 months to 2 years	

* Could not find evidence that the funds were not open to accept applications

** Track-record of investments has been in emerging middle income economies. In Africa, has only invested in the larger economies: Nigeria, Ghana, Uganda

 Strong fit

 Weak fit

A deep dive in a selection of climate finance facilities identifies a close fit with Malawi's needs (3 of 4)

Fund	Best Fit	Who applies	Flexible instruments	Application Timeframe	Additional Considerations	Overall Fit
Interact Climate Change Facility	• De-risk commercially viable projects	Private sector	No, market rate loans, guarantees	Open	+ Efficient two step process	
InfraCo Africa—Sub Sahara Infrastructure Fund	• De-risk commercially viable projects	Private sector	No: grants, equity, but can be blended with other sources	Open	+ Higher ease of use*	
Energy and Environment Partnership in Southern and East Africa	Various**	Public sector	Yes: grants, market-rate loans, guarantees	Can only apply during call for proposals, currently closed.	– Timelines and eligibility criteria specific to each call for proposal, need to assess fit with each call	

* InfraCo already invested in Malawi

** EEP supports projects in all sectors of clean energy, including solar PV, wind power, clean cookstoves, hydro energy, biomass, among others.

 Strong fit

 Weak fit

A deep dive in a selection of climate finance facilities identifies a close fit with Malawi's needs (4 of 4)

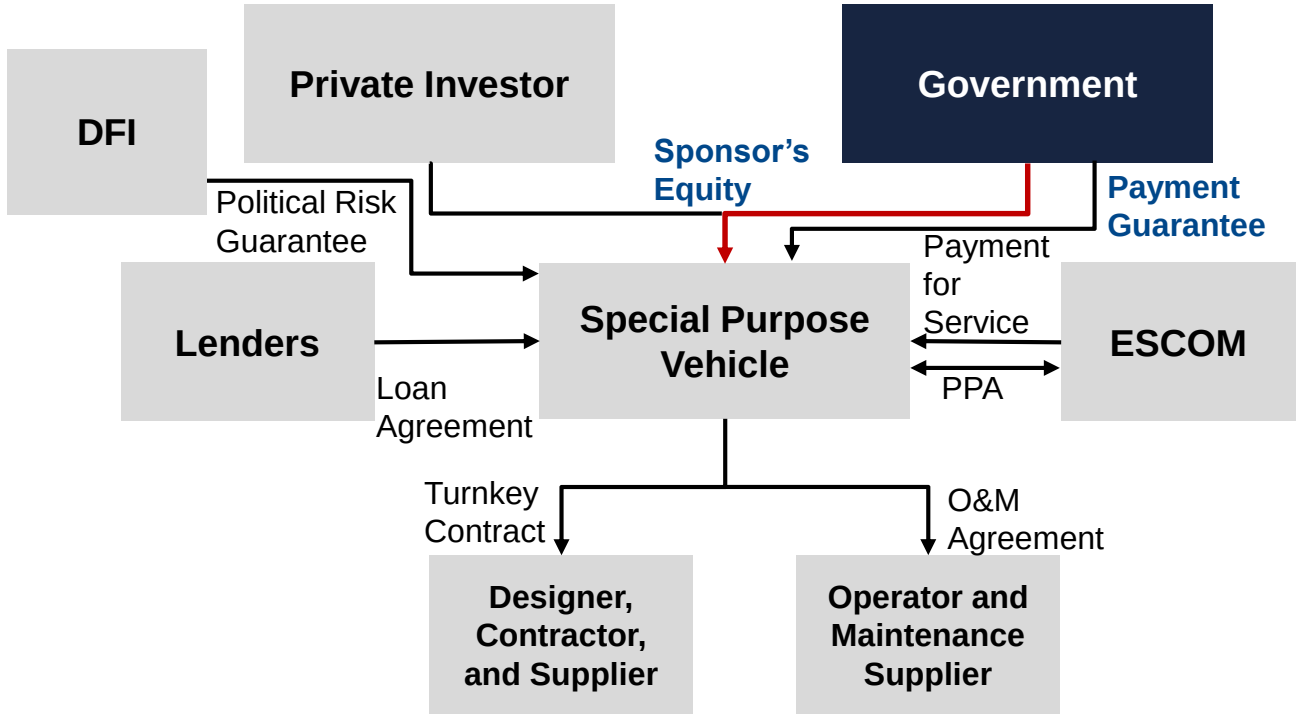
Fund	Best Fit	Who applies	Flexible instruments	Application Timeframe	Additional Considerations	Overall Fit
GEF—Support for Programming through National Dialogues	Early stage identification and scoping of projects, through national multi-stakeholder convening	Public sector	N/A	Rolling basis	– Does not provide support across the project development cycle	
GCF—Readiness Programme	Readiness funding to help countries access GCF funding and/or comply with Fund requirements	Public sector	N/A	For readiness support can only apply during application windows	+ Aims for at least 50% of readiness financing to go to LDCs; up to US$1 million per country per year may be provided under the readiness program	

 Strong fit

 Weak fit

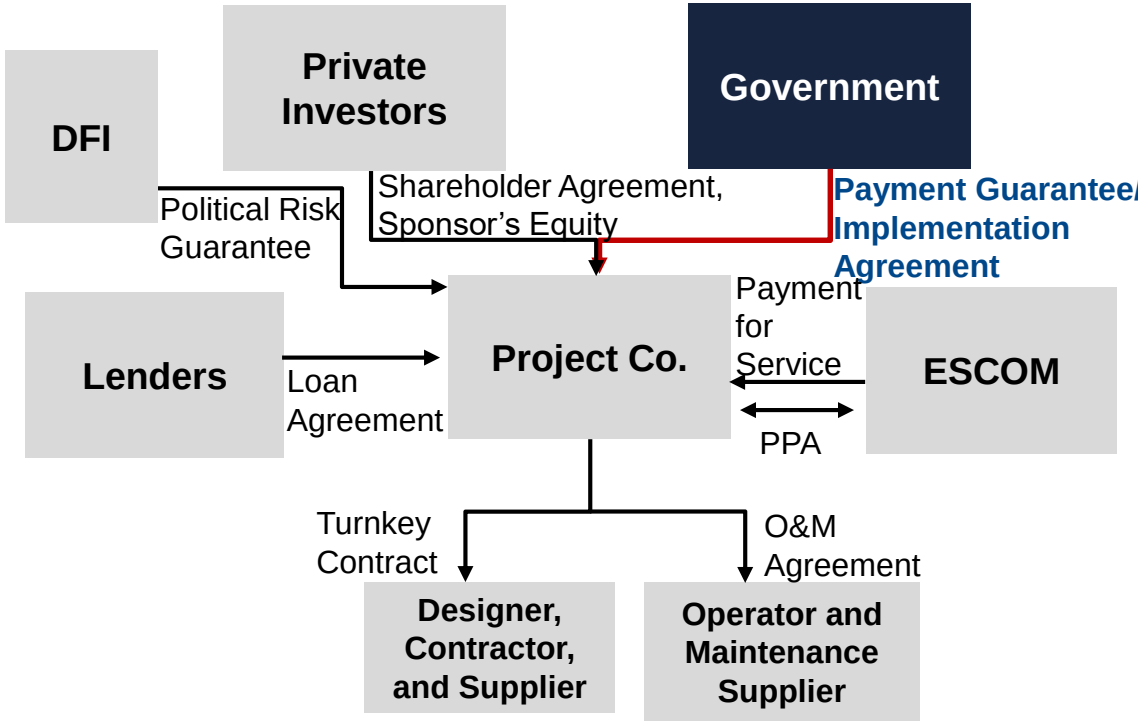
To attract private sources of financing Malawi needs to implement new ownership structures

Build Own Operate Transfer (BOOT) ownership structure allow Malawi to **retain ownership** in critical assets while **bringing in additional financing**



Mpatamanga, Lower Songwe Hydro, Lower Fufu Hydro

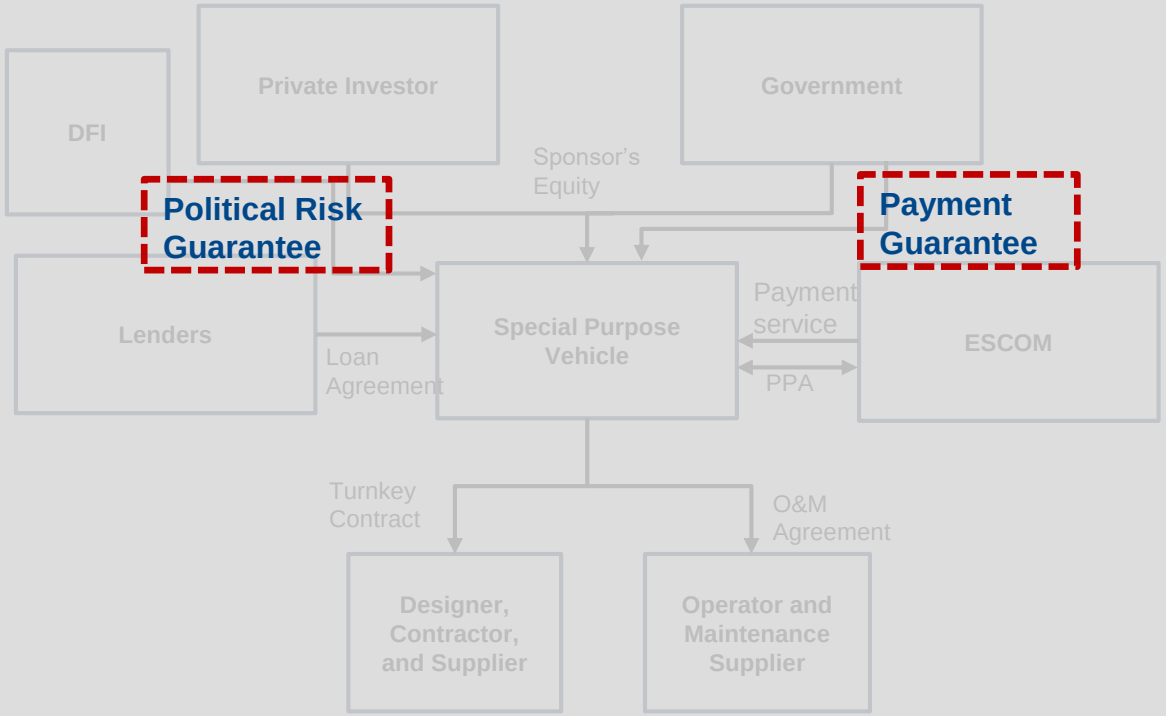
IPP ownership structure allows Malawi to **access additional financing and expertise** in non-critical assets



Various, including: Solar IPP—Salima, Solar IPP—Nkhotakota, Kanengo PV/Battery

Guarantees serve an important role in these new ownership structures to reduce political and off-taker risk and unlock commercial investment

*Financial guarantees **transfer the risk** of noncompliance by one of two sides in a transaction to a third external party.*
Developmental guarantees** back projects that promote the development and welfare of developing countries and **provide security needed to attract private capital.

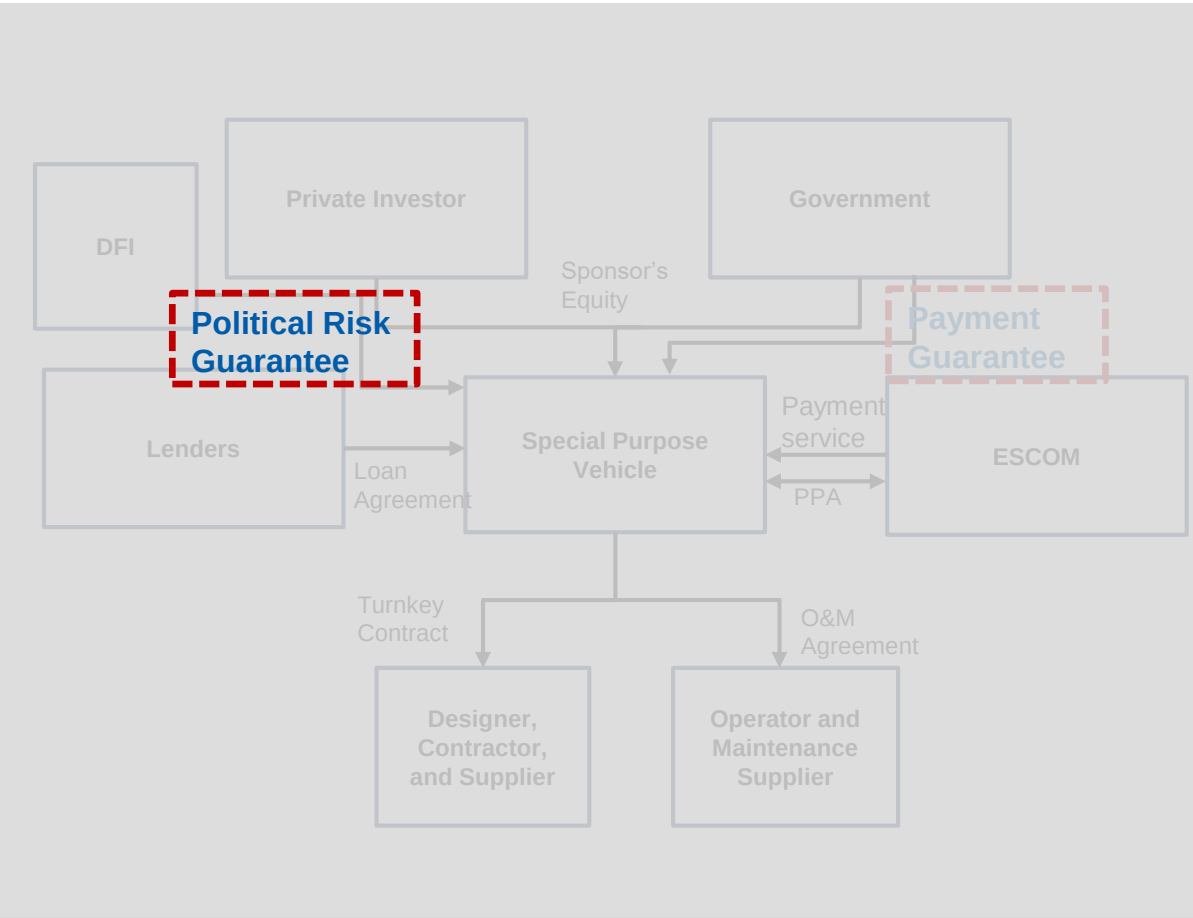


In practice, risk is separated and guarantees will **only cover one of** or **portions of** the following risks:

- **Political Risk**—any action or inaction by a government that impacts the ability of a party to uphold its end of an agreed financial transaction. For example—nationalizations, expropriations, war or civil unrest, restrictions on access to FOREX, regulatory changes, failure of government to meet contractual obligations
- **Credit Risk**—nonpayment or late payment of a financial obligation, no matter the cause (political or commercial).

Political Risk Guarantees

*These guarantees cover all or a portion of the amount of a financial transaction and are **triggered only if the (political) risk** specified by the guarantee is the reason why the debtor does not pay.*



When

Common in infrastructure projects where the govt. plays an important role. The investor will borrow from a commercial bank to fund the project. The PRGs **backstop debt** against specified **actions taken by the local govt**. that could impact repayment of the loan

Who

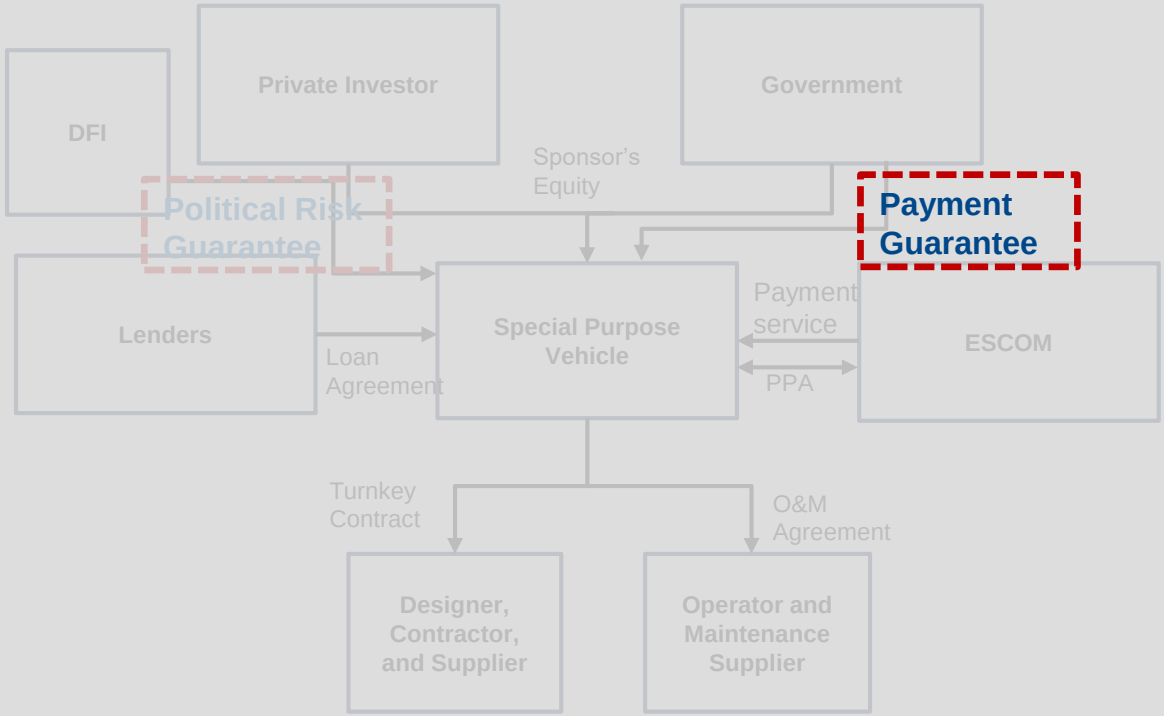
- International Bank for Reconstruction and Development (IBRD) and International Development Association (IDA)
- Multilateral Investment Guarantee Agency
- AfDB

Government Role

IBRD, IDA, and AfDB require government to provide a sovereign counter-guarantee.

Payment Guarantees

Backstops ongoing payment obligations *of state-owned enterprises for infrastructure projects*



When

A payment guarantee is used to backstop off-taker payments and reduce payment risk when the **off-taker is not bankable.**

Who

Local government and/or international and regional financial organizations such as OPIC or multilateral development banks

Options

In early stages of market development:

- **Sovereign guarantee***—government guarantees off-taker payments; this guarantee may be included in country balance sheet

In more mature markets with track-records of successful projects, options may include:

- **Put Call Options**—replaces a sovereign guarantee by backstopping payment obligations with a contingent real estate transaction, in the event of non-payment. Does not appear on country balance sheet
- **Revolving Letter of Credit** issued by a commercial bank; this letter can be drawn by the project special purpose vehicle up to an agreed amount, should the off-taker fail to honor its payment obligations. Does not appear on country balance sheet

*Sovereign guarantees may cover a broader range of risks beyond payment risk, including currency risk and political risk.

Appendix D:
Implementation guides for project de-risking

Opportunities to improve permitting and other procurement processes to increase external stakeholder participation

Priority next step

Goal	*Actions*
Streamline permitting process	**Summarize existing IPP framework into quick reference document to highlight process steps, timelines, highlight the go-to authority offices for various steps, and reference where to find additional information on requirements, timelines, and other relevant information in the larger text** – Coordinating Agency: MERA, DoEA **Enforce a standardized process for land leasing** – Coordinating Agency: Ministry of Lands; DoEA

Additional actions

Goal	*Actions*
Establish a well-regulated energy market	**Accelerate process for establishing single buyer unit** – Coordinating Agency: DoEA, ESCOM
Help expedite and strengthen solicited bid process by sharing resources with developers	**Manage and share database of potential sites** – Coordinating Agency: MITC, DoEA

Opportunities to increase access to finance in order to fund and implement projects

Priority next step

Goal	*Actions*
Increase availability of long term, affordable, flexible financing that can be used to de-risk early investment and attract additional sources of commercial financing to Malawi's energy sector	**Develop local structure and capacity to establish and pursue pathways for obtaining public sources of green climate finance that can be used early on to de-risk investment and attract additional sources of commercial financing, including local financing. Specifically, build local capacity to identify climate financing that meets Malawi's project needs, establish relationships among climate funding providers and co-investors, structure finance, and lead process to move project through funding pipeline.** – Coordinating Agency: Ministry of Finance; DoEA **Disseminate results of bankable projects to build local investor comfort with future investments. This includes sharing information to establish a proven track record of bankable projects. It also includes sharing lessons learned related to successful financing and business models and a pathway to mitigate key risks.** – Coordinating Agency: Ministry of Finance; DoEA; MITC

3. Hardware Costs

Opportunities to reduce hardware costs to make project implementation more cost effective

Priority next step

Goal	*Actions*
Expedite hardware importation process for new energy projects	**Enforce consistent and expedited customs procedures for energy project equipment** – Coordinating Agency: MRA Customs and Excise

Additional actions

Goal	*Actions*
Increase cost-effective pathways to access hardware locally	**Maintain and share a database of component trends, OEMs and retailers** – Coordinating Agency: DoEA, Developers, MITC, Trade Division **Communicate with developers to help facilitate bulk importation for optimal technology pricing** – Coordinating Agency: Single Buyer Unit, DoEA, MITC

Appendix E:
Acronyms and abbreviations

List of acronyms and abbreviations

AfDB	-	African Development Bank
ATP	-	Ability to pay
BAU	-	Business as usual
BOOT	-	Build Own Operate and Transfer
CAPEX	-	Capital expenditure
CSO	-	Civil society organization
DFI	-	Development Finance Institution
DFID	-	Department for International Development
DM	-	Dry matter (biomass)
DP	-	Development Partner
DoEA	-	Department of Energy Affairs
DREI	-	De-risking renewable energy investment
DSM	-	Demand-side management
EE	-	Energy efficiency
EGENCO	-	Electricity Generation Company (Malawi)
EOI	-	Expression of interest
ESCOM	-	Electricity Supply Corporation of Malawi
FOREX	-	Foreign exchange (foreign currency)
GIS	-	Geographic Information System
GIZ	-	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
GoM	-	Government of Malawi
HH	-	Households
IBRD	-	International Bank for Reconstruction and Development
ICT	-	Information and Communications Technology
IDA	-	International Development Association—World Bank
IFC	-	International Finance Corporation
INDC	-	Intended Nationally Determined Contributions
IPP	-	Independent Power Producer
IRP	-	Integrated resource plan
IRR	-	Internal rate of return
LCOE	-	Levelized cost of energy
LDC	-	Least developed country
LPG	-	Liquefied petroleum gas
MAREP	-	Malawi Rural Electrification Programme
MEPS	-	Minimum energy performance standard
MERA	-	Malawi Energy Regulatory Authority
MLHUD	-	Ministry of Lands, Housing, and Urban Development
MITC	-	Malawi Investment and Trade Centre
MRA	-	Malawi Revenue Authority
MV	-	Medium voltage
M&V	-	Measurement and Verification
NAMA	-	Nationally Appropriate Mitigation Actions
NDC	-	Nationally Determined Contributions (to reduce emissions and adapt to climate change)
NGO	-	Non-governmental organization
NPV	-	Net present value
O&M	-	Operation and maintenance
OPEX	-	Operational expenditure

List of acronyms and abbreviations

PV	-	Photovoltaics
PPA	-	Power purchase agreement
RBF	-	Results-based finance
RE	-	Renewable Energy
RMI	-	Rocky Mountain Institute
SAEP	-	Southern Africa Energy Program
SAPP	-	Southern Africa Power Pool
SCADA	-	Supervisory control and data acquisition
SDG	-	Sustainable Development Goals
SEforAll	-	Sustainable Energy for All
T&D	-	Transmission and Distribution
UNDP	-	United Nations Development Program
USAID	-	United States Agency for International Development
UN-OHRLLS	-	United Nations Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States
VAT	-	Value-added tax
WACC	-	Weighted average cost of capital

Appendix F:
Interviews and experts consulted

Interviews conducted and experts consulted

Thanks are due to the many experts and specialists who kindly gave up their time to participate in questionnaires and interviews, or to support the development and review of this study. In particular, the authors would like to recognize contributions from the following people:

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- Bill Rustrick and Austin Ngwira (Clinton Development Initiative)
- Charles Kagona and Michael Gondwe (ESCOM)
- Daniel Kloser (MEGA)
- David Putin (DFID)
- Devine Matare (RENAMA)
- Berias Unholo (Community Energy Malawi)
- Emmanuel Mjimapemba (UNDP)
- Etta M'mangisa (UNDP)
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- Teddie Kamoto and Frank Chilimampunga (Forestry)

Off-grid sites visited

Thanks are also due to the developers and communities in the following sites, who provided vital information on minigrid development and productive uses of energy during the team's site visits:

Mulanje Electricity Generation Authority micro-hydro project
District: Mulanje
Chief Area: Bondo
Village: Kundi and Niwade
Run of river minigrid system in operation

Community Energy Malawi
District: Mchinji
Chief Area: Mloonyein
Village: Sitolo
Solar PV minigrid system currently under development

Chikondi Community
District: Lilongwe
Chief Area: Palawo
Village: Chikondi
Unelectrified village 8km from the grid. Population uses stand-alone systems (mostly pico solar) for energy needs. Economic activity based on agriculture—subsistence farming and cash crops mainly tobacco, maize, and soybeans.