A2E ACCESS TO ENERGY INSTITUTE I

Dalberg

Putting an End to Nigeria's Generator Crisis: The Path Forward

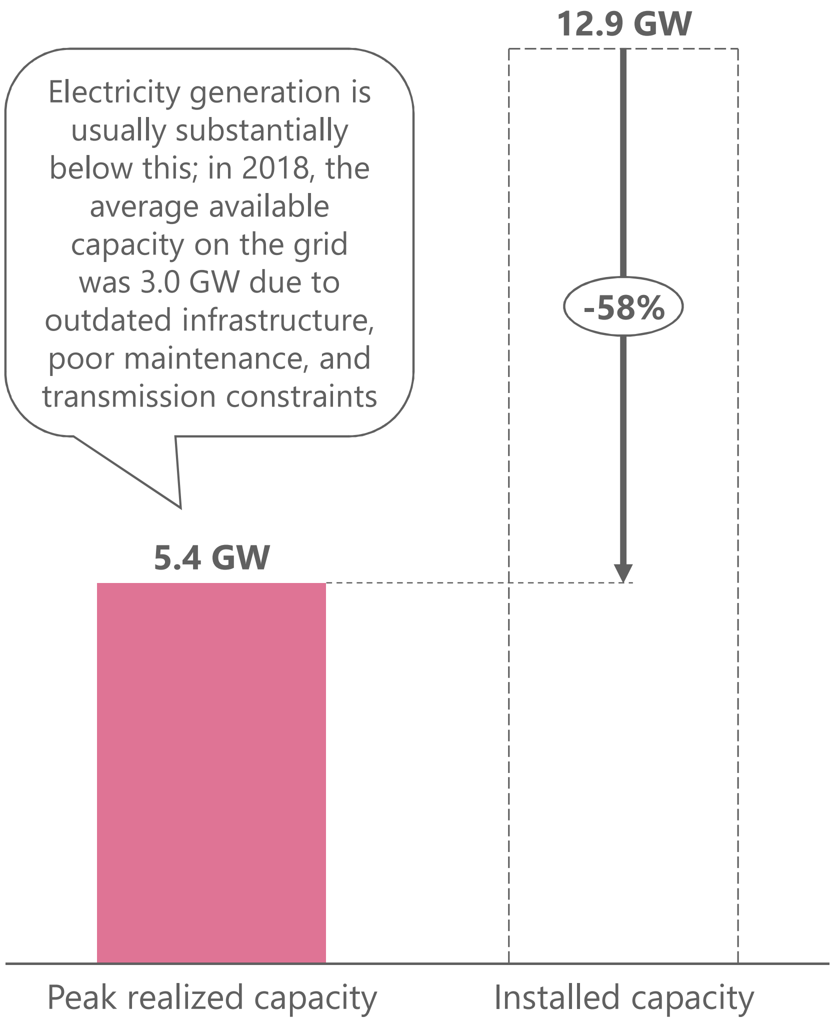
JUNE 2019

THE SITUATION

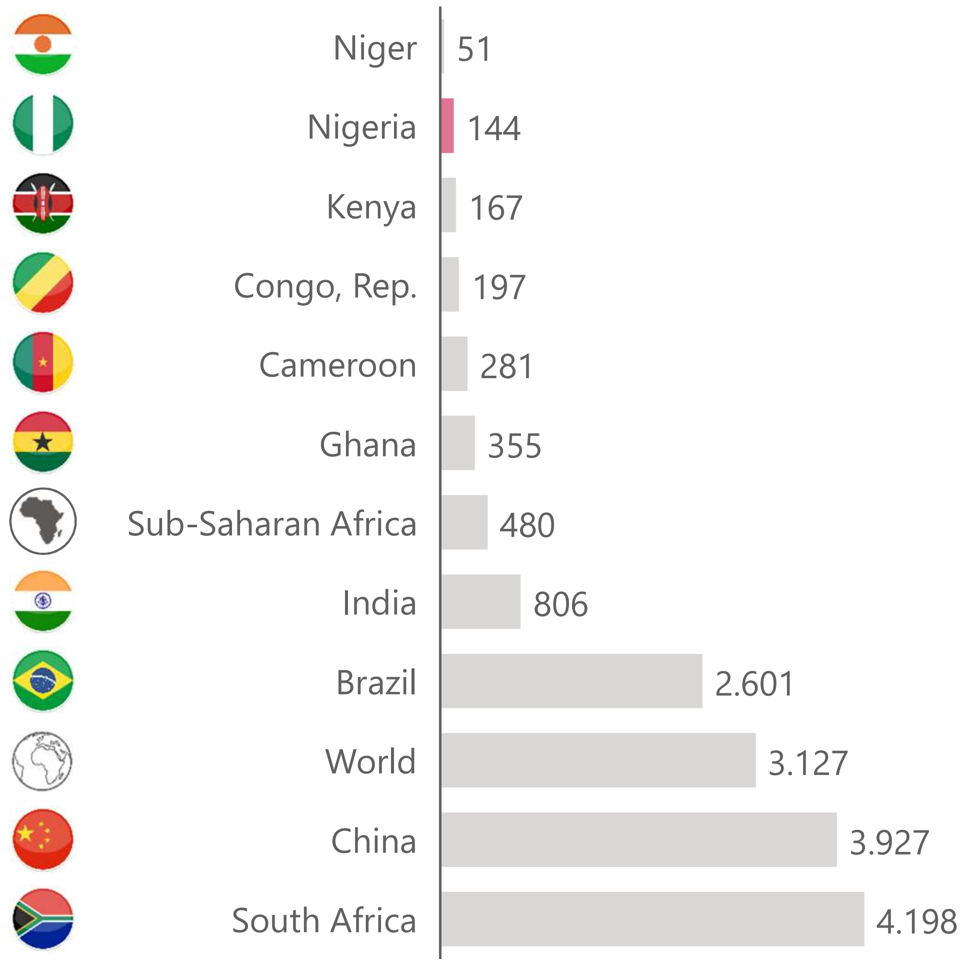
Nigeria’s economy depends heavily on small gasoline generators; their collective capacity is eight times more than Nigeria’s entire national grid

At its peak, the available capacity of Nigeria's grid is ~5.4 GW, which is insufficient for current consumption needs

Grid electricity production capacity
GW, 2018



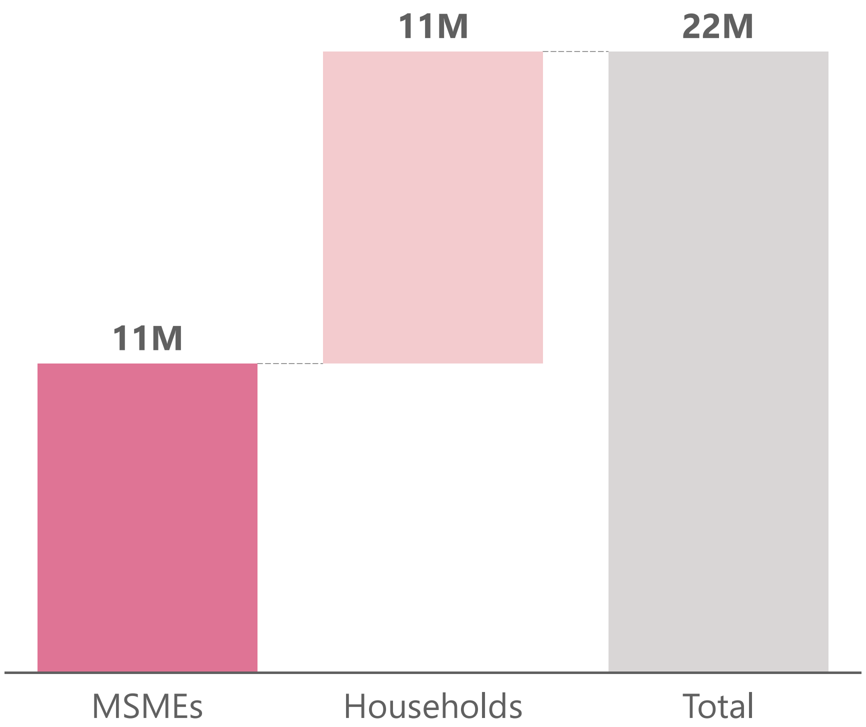
Electricity consumption per capita in selected countries
kWh per capita, 2016



Sources: Nigeria Electricity System Operator: Operational Reports, 2019; Nextier Power, The Power Sector's Market Performance: 2018 Overview; World Bank Development Indicators; Non-OECD Energy Statistics

Given poor grid access, 22M small gasoline generators are being used to power households and small businesses

Number of households and MSMEs in Nigeria relying on small gasoline generators (0-4 kVA)[1]
millions, %, 2018



% of total with generators	*27%*	*29%*

Official statistics on the number of small gasoline generators in Nigeria are difficult to find. The ban on the bulk import of small generators, which came into effect in Nov 2015, means that the real number of generators is often under-reported[2]

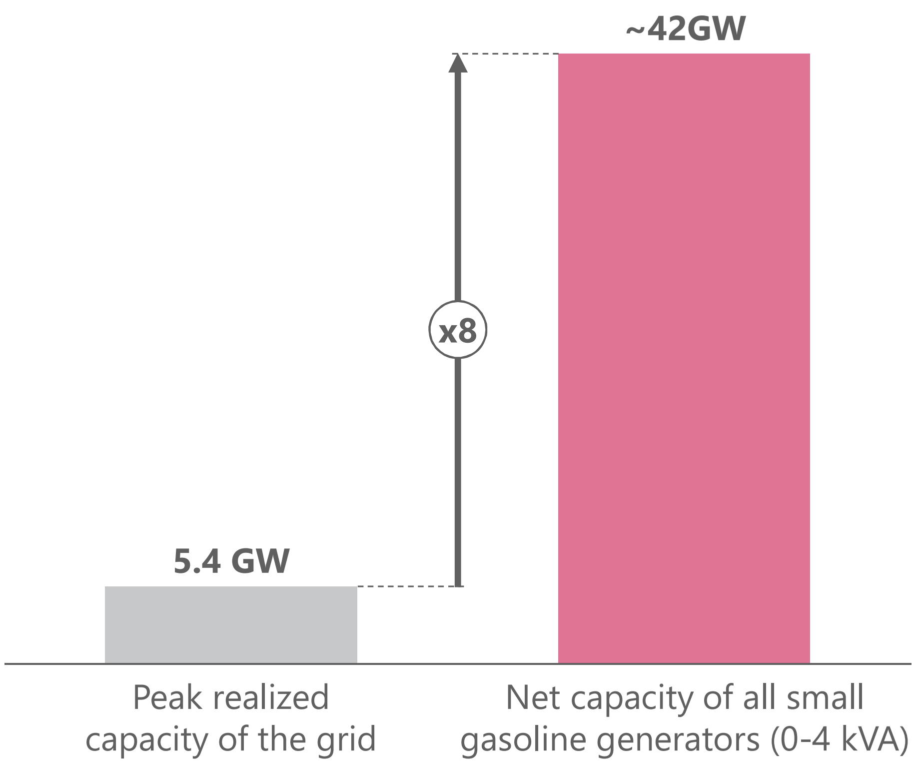
Our estimate reflects a bottom-up approach based on household-level surveys and covers the market for small gasoline generators.[3] Other estimates of the number of small gasoline generators in Nigeria range from 17-60 million

Alternative estimates of generator estimates

Note: [1] Throughout the rest of this document, "small gasoline generators" refer to those with a 0-4 kVA capacity. [2] While bulk-imports are illegal, the import of individual generators is legal. [3] Households and businesses with higher energy needs typically use larger, diesel-powered generators which are not included in this estimation. Sources: World Bank Data; Afro-Barometer; UN Demographic and Health Surveys; Nigerian National Bureau of Statistics; Household and SME surveys (n=910); Nigeria Ministry of Industry, Trade, and Investment; Dalberg analysis

Despite the ban on the import of small gasoline generators, their capacity is 8x larger than the grid's peak capacity

Electricity production capacity by source, grid vs. gasoline generators
GW, 2018



Sources: Nigeria Electricity System Operator: Operational Reports, 2019; Nextier Power, The Power Sector's Market Performance: 2018 Overview; Household and SME surveys (n=910); Nigeria Ministry of Industry, Trade, and Investment; Dalberg analysis

THE PROBLEM

The prolific use of small gasoline generators has wide-ranging negative impacts on the environment, public health, and government budgets

The prolific use of small gasoline generators is in stark contrast with Nigeria's ability to achieve the SDGs

Gasoline generators have direct impacts on …

Toxic fumes released by generators lead to illness and death

The continued consumption of fossil fuels for generators directly conflicts with the shift towards renewable energy sources

Continued use of gasoline generators will prevent Nigeria from achieving its emissions reductions targets under the Paris Agreement

Gasoline generators have indirect, but substantial, impacts on …

High lifetime energy expenditures

Unsafe work environments

Environmentally unsustainable infrastructure

Poor air quality in urban areas

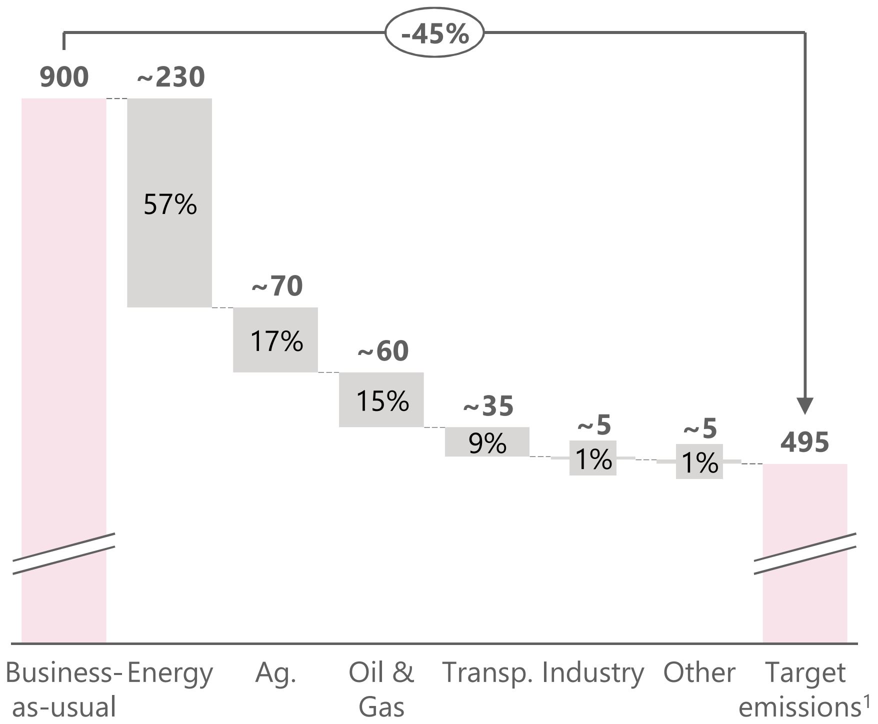
Continued reliance on fossil fuels

Source: UN Sustainable Development Goals (SDGs)

Eliminating Nigeria's 22M gasoline generators could make a substantial contribution to its commitment to cut emissions

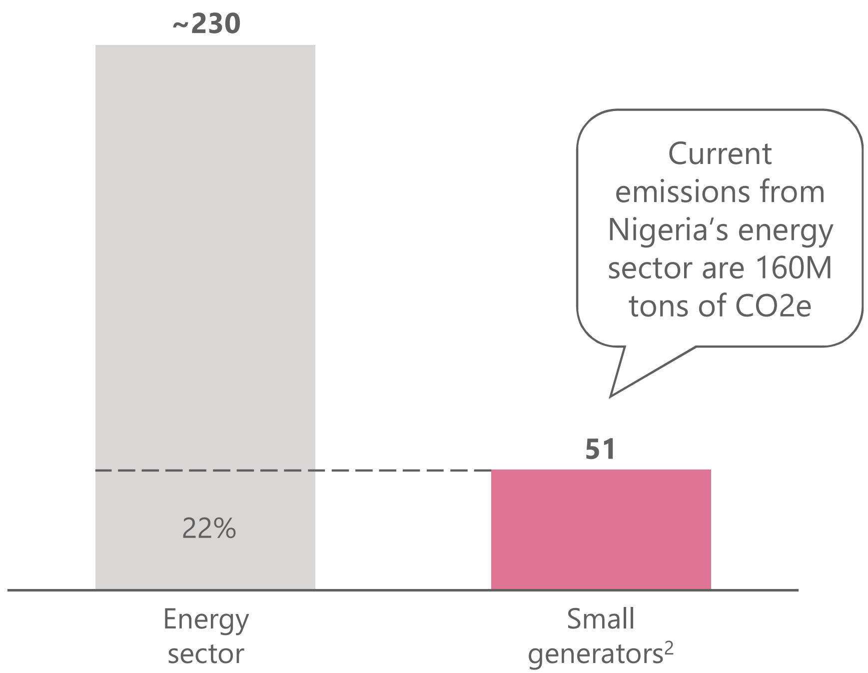
Nigeria has committed to cutting its GHG emissions by 45% by 2030, primarily from the energy sector

Projected emissions in Nigeria in 2030 and proposed sources of reductions, by sector
Million of tons of carbon dioxide equivalent, % of reduced emissions, 2030



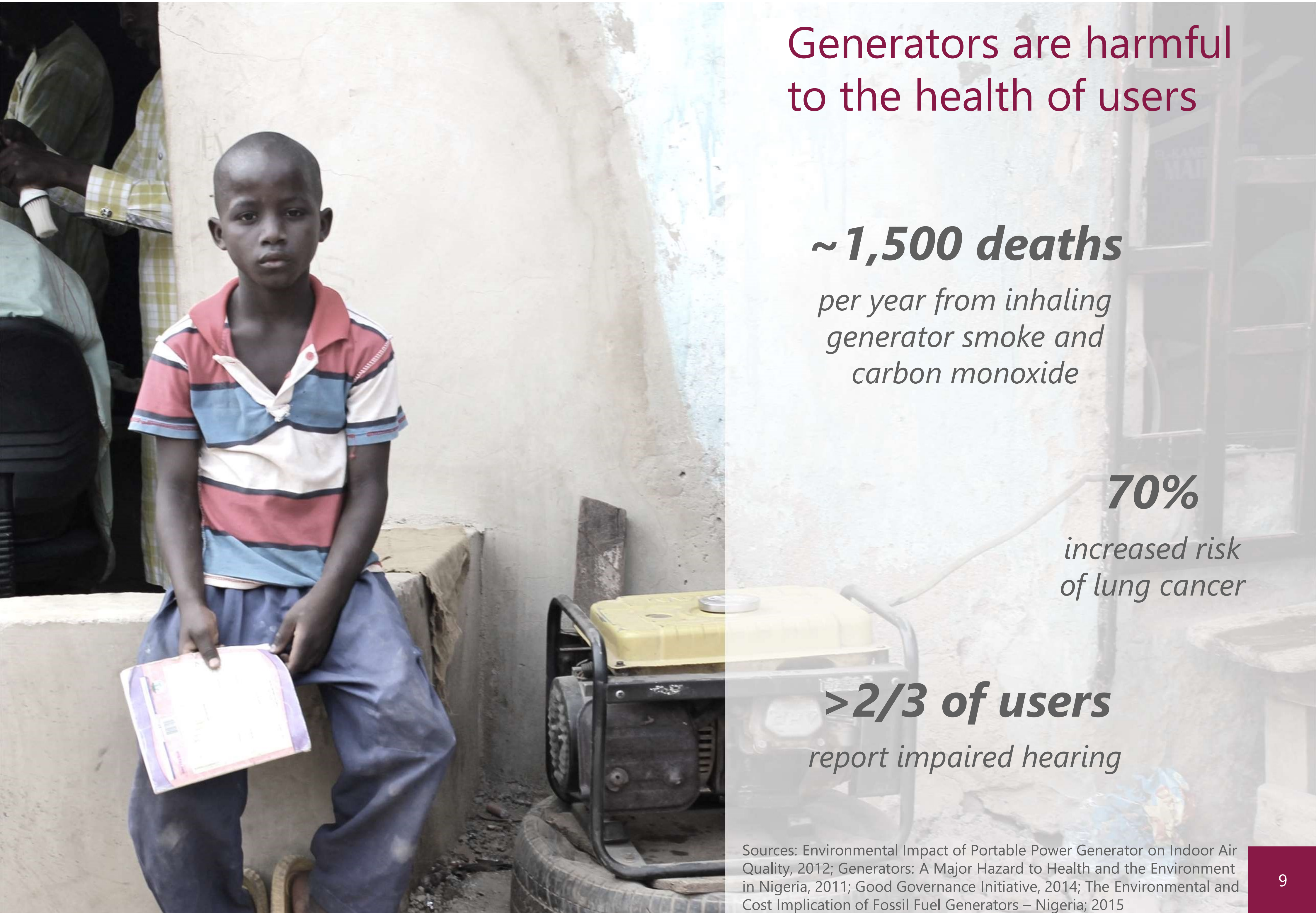
Replacing gasoline generators presents a big opportunity as they will produce 22% of targeted reductions from the energy sector in 2030

Comparison of gasoline generator emissions vs. proposed reduction in energy sector emissions
Million of tons of carbon dioxide equivalent, 2030



Note: [1] Target emissions are the "conditional" contributions that Nigeria aims to achieve with international support in the form of "finance and investment, technology and capacity building". [2] Other sources have estimated similar CO2e emissions at 82M tons and 100M tons.
Sources: Nigeria's Intended Nationally Determined Contribution (INDC), 2014; Climate Watch; Carbon Trust, Conversion Factors

Dalberg A2EI



Generators are harmful to the health of users

~1,500 deaths

per year from inhaling generator smoke and carbon monoxide

70%

increased risk of lung cancer

>2/3 of users

report impaired hearing

Sources: Environmental Impact of Portable Power Generator on Indoor Air Quality, 2012; Generators: A Major Hazard to Health and the Environment in Nigeria, 2011; Good Governance Initiative, 2014; The Environmental and Cost Implication of Fossil Fuel Generators – Nigeria; 2015

Nigeria subsidizes gasoline consumption to the tune of $1.6-2.2 billion each year for small gasoline generators alone

Nigeria's subsidy policies

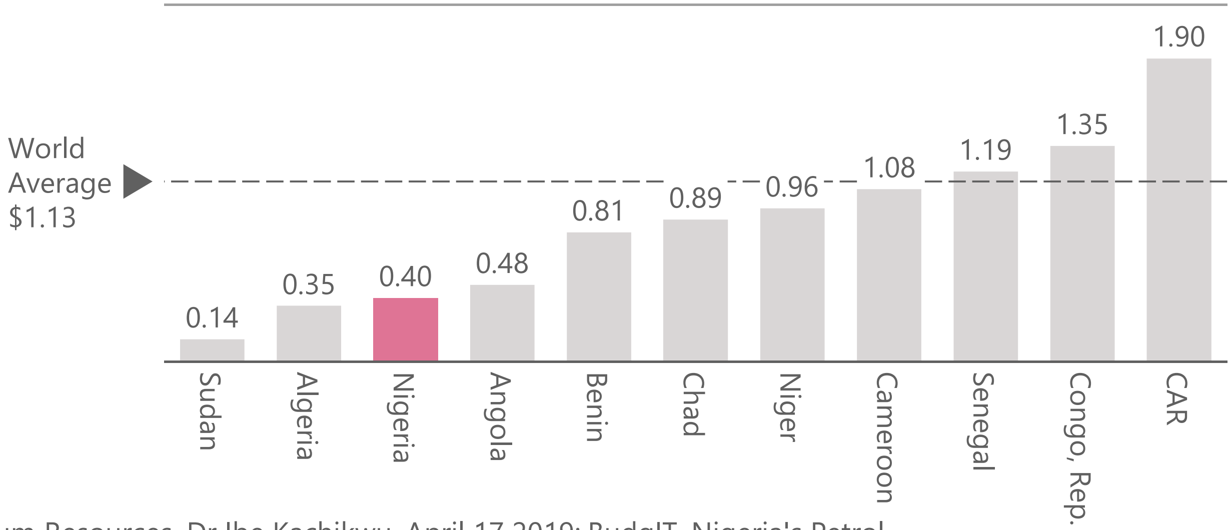
- The Government of Nigeria subsidizes the cost of gasoline so that consumers pay a fixed price at the pump
- In 2018, the fixed price of gasoline was ₦145 ($0.40) per liter, with the government subsidy fluctuating from ₦35-₦50 ($0.10-$0.14) per liter depending on the landing cost of gasoline
- Volatility in global crude oil prices has led to substantial volatility in subsidy payments and associated fiscal pressures. In 2018, the subsidies for gasoline used in generators amounted to 3-5% of total government expenditures

$1.6B - $2.2B

per year in gasoline subsidies for generators

Resulting in the 3rd cheapest fuel in Africa . . .

Price of gasoline per liter in selected African countries
USD, June 2019



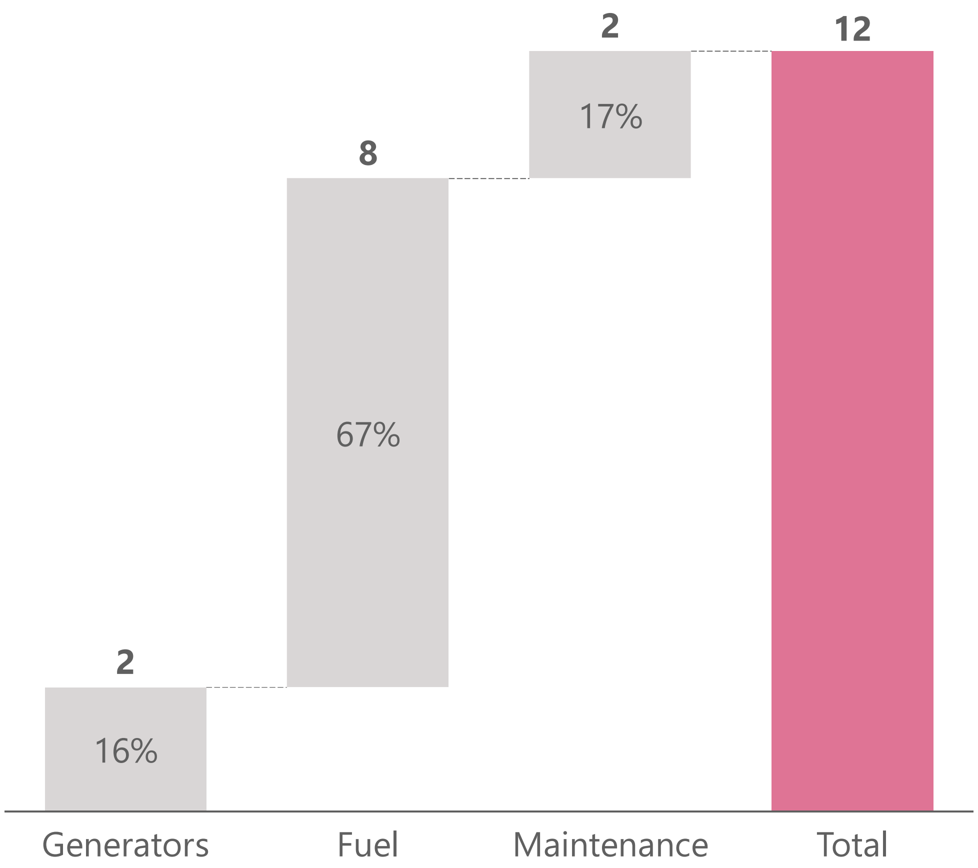
Sources: Punch, Quote from Minister of State for Petroleum Resources, Dr Ibe Kachikwu, April 17 2019; BudgIT, Nigeria's Petrol Subsidy Regime, 2019; The Africa Report, The Rising Cost of Nigeria's Petroleum Subsidy, January 15 2019; International Monetary Fund - World Economic Outlook

THE OPPORTUNITY

An effective substitute for small gasoline generators, such as solar systems, can tap into a $12 billion-a-year market in Nigeria alone

Nigerians spend $12 billion each year on buying and operating small gasoline generators

Total expenditure on small gasoline generators
USD billions, 2018



Note: Expenditure on generators is annualized based on average lifespan
Source: Dalberg analysis

Solar alternatives to gasoline generators exist in Nigeria, but are currently 15-20x more expensive

Why do people use gasoline generators?

Small gasoline generators are ubiquitous across Nigeria's markets and households. They are used to power many appliances including fans, TVs, refrigerators, and lights

Given that ~50% of Nigerians are not connected to the grid, and those that are face unreliable electricity access, many people have no choice but to use small gasoline generators

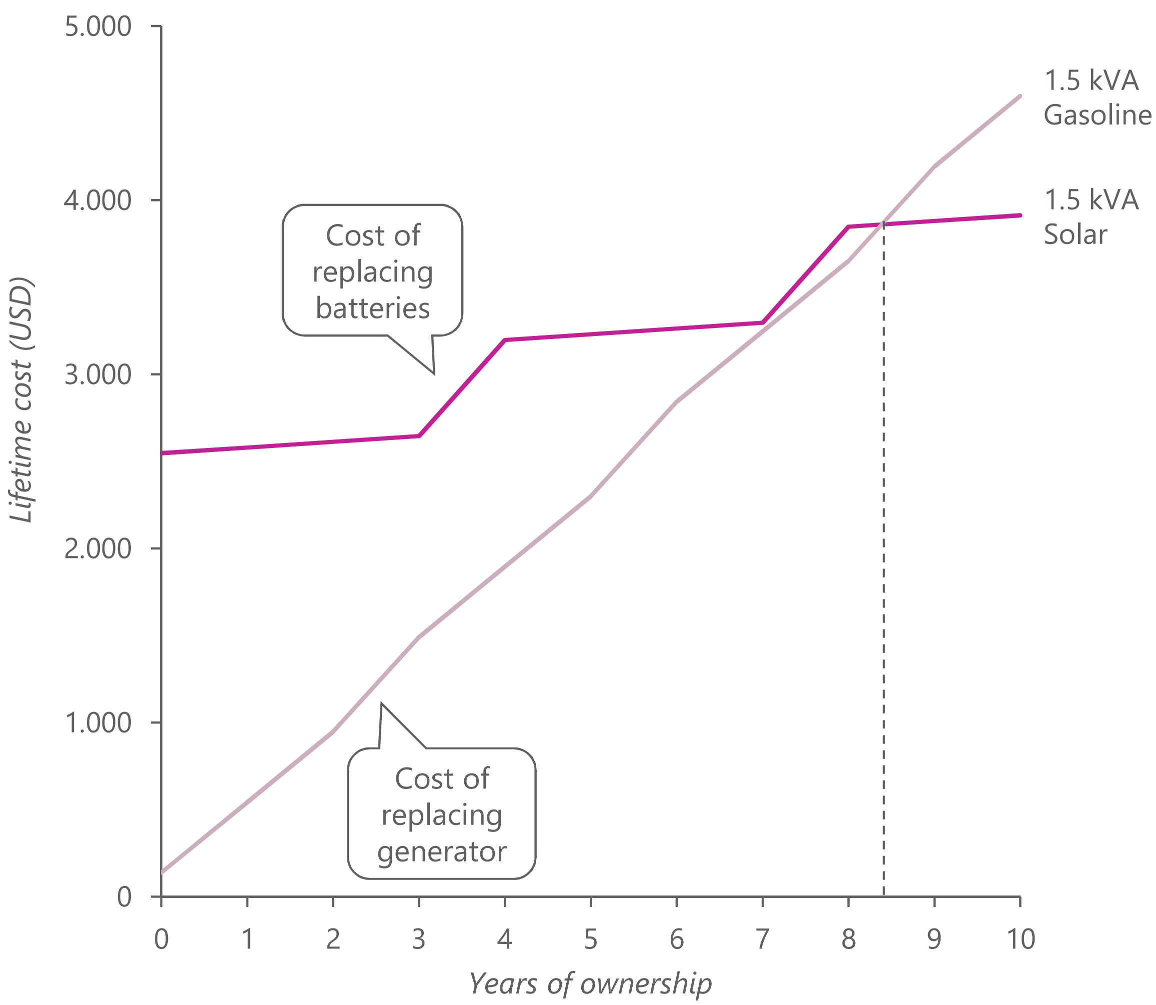
What are the alternatives?

Technically viable solar products that meet these needs do exist. They can be used to run the same appliances. And given that gasoline generators typically run far below 100% load, they can be replaced by relatively smaller solar systems

However, they are currently a lot more expensive, which means they are not available at scale. A typical 1.5 kVA gasoline generator costs $150, while a 1.5 kVA solar system costs $2,500

Given high upfront costs, it currently takes 8-9 years before the total costs of a solar system fall below those of generators

Total lifetime cost of generators, by type of generator
USD, 2019



Key insights

Three factors affect the total lifetime cost of a generator:

- **Upfront purchase:** While the upfront costs for solar systems are expected to fall sharply in the near future, they are still 15-20x the price of a gasoline generator
- **Fuel:** The cost of gasoline for generators is typically $20-40 per month depending on generator size. Solar systems, by comparison, have no ongoing fuel costs
- **Maintenance and repair:** Small gasoline generators, at best, have a lifetime of 5 years. Solar systems, however, have a lifespan of ~20 years with certain elements such as batteries needing to be replaced every ~5 years

These cost patterns are similar across 0-4 kVA generators

Sources: Consistent Energy Limited; Senwei; Elepaq; Sumec; Firman; Nigeria Data Portal; Household and SME surveys (n=910); Dalberg analysis

A2EI is contributing to the development of a more affordable solar system, for example, by gathering and sharing new data

What is A2EI doing?

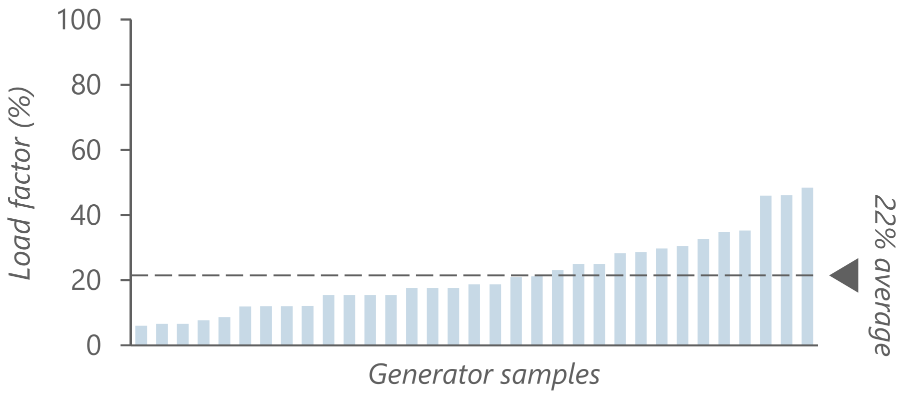
The Access to Energy Institute (A2EI) is a non-profit R&D institute dedicated to supporting the transition from fossil fuels to cheaper, cleaner, effective solar substitutes

In Nigeria, A2EI has already installed more than 150 smart data meters on gasoline generators to collect data and build reliable evidence on generator usage patterns (e.g., load, hours of use, fuel consumption, noise levels, air quality). This data will inform several pilot projects

A2EI will also make this data available freely online, for example through its dashboard, to spark further discussion and innovation

First A2EI data findings

Load factor of gasoline generators (May 2019)

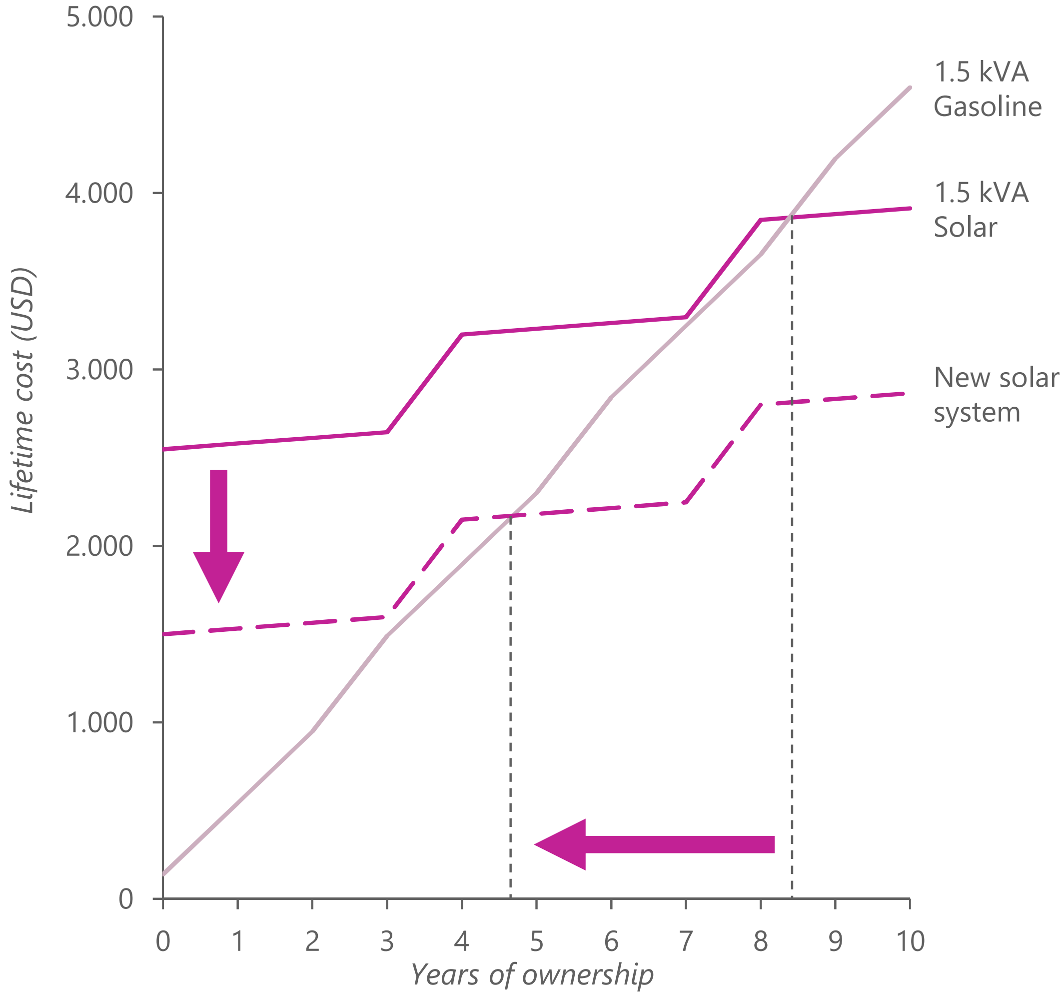


One metric measured by the smart data meters is the average load of gasoline generators. Preliminary data indicates the average generator load factor is 22%, implying that gasoline generators could be replaced with smaller solar systems that can still effectively power the same appliances

Note: A2EI data can be found at https://a2ei.org/data. A2EI's preliminary load factor data of 22% is substantially lower than currently available estimates.
Source: A2EI Smart Data Meters

If upfront costs of solar systems can be reduced to ~$1,500, they will become cheaper than generators after 4-5 years

Total lifetime cost of generators, by type of generator
USD, 2019



- The high upfront cost of solar products, currently ~$2,500 for a 1.5 kVA system, is a major barrier to getting users to switch from gasoline generators
- Reducing this upfront cost to $1,500 - both through better product design and by being able to replace generators with smaller solar systems given the average generator load factor is less than 100% - would reduce the breakeven point from 8-9 years to 4-5 years
- Such a change could be a key driving force in accelerating the mass-substitution of Nigeria's 22 million gasoline generators for cleaner, healthier solar alternatives

THE PATH FORWARD

Accelerating the switch to solar systems requires improved affordability, concessional financing for emergent players, and an enabling policy and regulatory environment

Accelerating the switch to solar systems requires a coalition of partners working together beyond R&D

Research and development can contribute to reductions in the retail price of solar systems. However, alone, this will not be enough to spark the mass transition from gasoline generators to alternative solar systems

A collaborative effort among different actors - including researchers, solar players, financing institutions, and regulators - is needed across three key activities:

1. **Improving user affordability through reduced costs and better access to finance**
2. **Supporting emergent firms with the concessional capital needed to jump-start the sector**
3. **Creating the right policy and regulatory environment to enable the sector to grow**

Improve user affordability through reduced costs and better access to finance

The high upfront costs of solar systems as well as some negative perceptions of solar products in Nigeria are barriers to a rapid and mass transition from gasoline generators to solar for many users

To facilitate the switch, lower costs and improved access to finance is needed, for example by:

- Gathering data on current generator use to better understand usage patterns, including average load
- Developing new solar systems, informed by this new data, that can be manufactured and therefore sold at a lower upfront cost
- Reducing the upfront cost barrier by providing incentives and subsidies (e.g., low-interest loans, results-based financing, carbon credits)
- Investigating the applicability of Pay-As-You-Go (PAYG) mechanisms[1] to spread the upfront cost burden over time

Note: [1] See the PAYG financing model agreed between Consistent Energy Limited (a solar distributor), Sterling Bank, and members of the Barbers Association of Nigeria

Support emergent firms with the concessional capital needed to jump-start the sector

At this pre-commercial and relatively high-risk stage of the solar industry's trajectory in Nigeria, substantial amounts of concessional financing is crucial for jump-starting the sector.

Concessional financing is needed to support emergent firms that can supply, finance and maintain solar systems, for example by:

- Identifying current sources of funding for off-grid, energy transition, and climate mitigation that could be directed towards the sector
- Identifying new sources of funding that could be directed towards the sector e.g., Green Climate Fund, Clean Development Mechanism (CDM) projects, carbon taxes, etc.
- Repurposing fuel subsidies, essentially shifting them from fossil to solar energy
- Fostering connections between funders and developers/distributors of solar technology to stimulate the flow of financing

Create the right policy and regulatory environment to enable the sector to grow

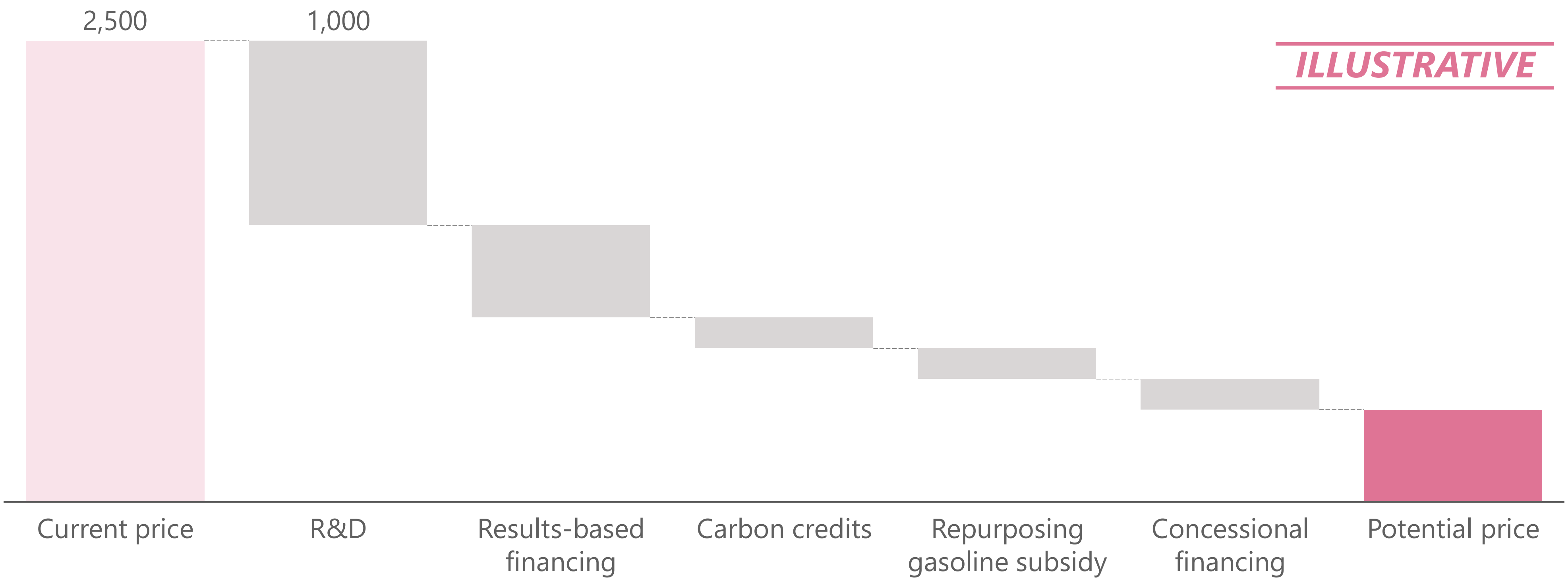
Nigeria needs to create the right policy and regulatory environment and broader ecosystem to enable the sector to grow, for example by:

- Creating attractive financial incentives such as reduced import duties on solar equipment, solar investment tax credits, and rebates for buying solar technology. For example, in February 2018, the Nigerian Customs Services (NCS) increased tariffs on the import of solar panels from 5% to 10%
- Supporting the growth of domestic solar manufacturing e.g., through capital cost subsidies
- Designing and enforcing a clear and consistent regulatory framework, including enforcing the ban on the bulk import of low-cost generators
- Identifying existing players in the generator and solar industry that can become champions in this new industry

Source: TechPoint Africa, 8 Months After Import Tariff Hike, Nigeria's Renewable Energy Situation is Not Looking Up, September 6 2018

The path forward: Combining these actions through a coalition of partners could transform Nigeria's energy sector

Potential reductions in upfront costs of solar system, by source
USD

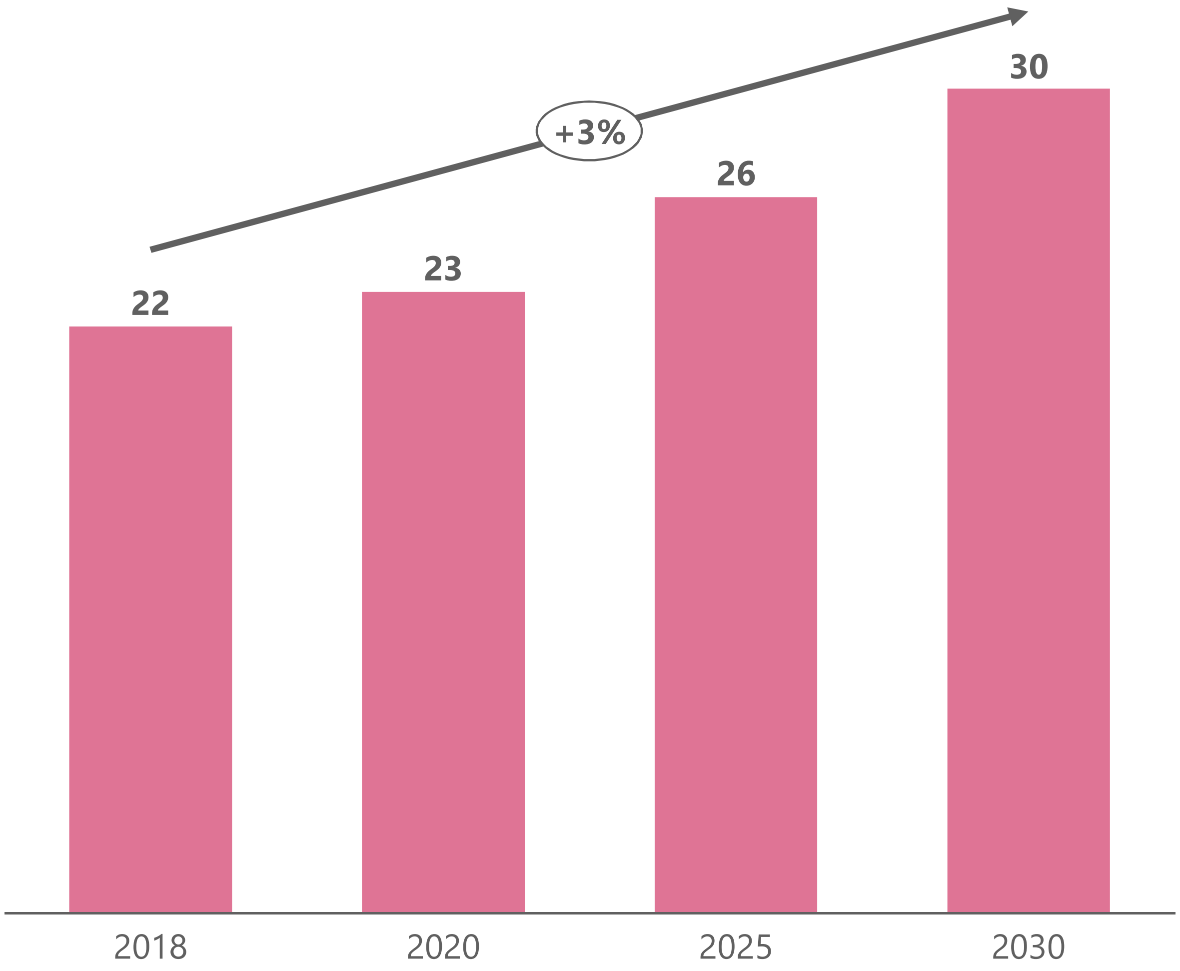


By working together, a strong coalition of partners could reduce the potential price of solar systems to the point required to move the needle in the transition away from gasoline generators

ANNEX

The small generator market is expected to increase by 3% p.a. to 2030 to service a growing population and economy

Estimated growth of the gasoline generator market (0-4 kVA)
Millions of generators, 2018-2030



Under reasonable assumptions, the demand for small gasoline generators is expected to increase by 8 million units by 2030 primarily due to:

- **Population growth** of 2.5% per year will see demand from households and small businesses increase
- **Rising incomes** which will enable more people to buy generators, either for the first time or as a back-up for existing generators

Sources: UN Population Division; UN Demographic and Health Surveys; World Bank database; Afro-Barometer; Knoema; Global Market Insights; Nigerian National Bureau of Statistics; Household and SME surveys (n=910); Nigeria Ministry of Industry, Trade, and Investment; Dalberg analysis.

Spotlight: The Nigerian Rural Electrification Agency (REA)

The **Rural Electrification Agency** (REA) is an implementation agency of the Federal Government of Nigeria

They are a leader in the movement to eliminate fuel-powered generators and replace them with more solar-powered systems. Existing projects that could help to support this transition include:

- **Energizing Education Program:** Develops off-grid power solutions for Nigerian universities, and has already replaced 860 diesel generators
- **Nigeria Electrification Project:** Catalyzes off-grid development in Nigeria and aims to deploy solar home systems to 1.5 million households, with support from the World Bank and the African Development Bank
- **Nigeria Energy Database:** As part of its commitment to data-driven decision making, REA is collating energy statistics and making them publicly available to help private sector developers make informed decisions on the development and financing of off-grid projects

REA

RURAL ELECTRIFICATION AGENCY

ENERGY=EMPOWERMENT=EFFICIENCY

Source: REA, Highlighting the Rural Electrification Agency's Impact, 2019

Methodology: Number of households and MSMEs in Nigeria relying on small gasoline generators

Number of households relying on 0-4 kVA gasoline generators

- **Number of households:** We combined World Bank population projections and UN Demographic and Health Survey data on household size to estimate the number of households in Nigeria in 2015. Extrapolation to 2018 was based on the CAGR of household size growth from 2003 to 2015.
- **Proportion of households owning generators:** Households were segmented by income band (<₦5,000; ₦5,000-₦9,999; ₦10,000-₦19,999; ₦20,000-₦49,999; ₦50,000-79,999; >₦80,000)[1] according to data from the Nigerian National Bureau of Statistics and Dalberg's Household and SME surveys. We estimated the number of households in each group that owned a 0-4 kVA gasoline generator in 2018 based on the proportion of households within each income band that stated they owned a small gasoline generator. We then summed generator ownership numbers across the income bands to obtain national level figures. Key variables such as grid expansion and growth in GDP per capita were used to calibrate figures. Final estimates were triangulated in expert interviews and cross-checked against a variety of sources, including World Bank and emerge85 research papers.

Number of MSMEs relying on 0-4 kVA gasoline generators

- **Number of MSMEs:** We used data from the Nigerian Ministry of Industry, Trade and Investment to establish the total number of MSMEs in Nigeria in 2019.
- **Proportion of MSMEs owning generators:** MSMEs were segmented by income band according to the proportion of respondents in Dalberg's survey database that stated that self-employment (e.g. in small business, trade, or manufacturing) was one of their top three income sources. We used the proportion of MSMEs that stated they owned a small gasoline generator by income group and aggregated to obtain national level figures. Final estimates were triangulated in interviews and cross-checked against a variety of sources, including SMEDAN and NBS research.

Notes: [1] All references to 'income band' within the methodology section refer to the income bands listed here.

Methodology: Electricity production capacity of gasoline generators

Electricity production capacity of Nigeria's generator base

- **Proportion of generator base, by capacity:** Based on insights from Global Market Insight's report on gasoline gensets in Nigeria, we assumed that ~30% of the market for 0-4 kVA gasoline gensets is comprised of generators between 0-2 kVA, and ~70% is comprised of generators with a capacity of 2-4 kVA.
- **Capacity used in calculations:** To establish the average generator capacity within the two 0-2 kVA and 2-4 kVA capacity brackets, we used Dalberg's Household and SME survey data. The average capacity within the 0-2 kVA bracket equated to 1.28 kVA. The average capacity within the 2-4 kVA bracket equated to 3.01 kVA.
- **Overall production capacity:** The production capacity of the generator base was extrapolated based on the aggregate number of generators in Nigeria's household and SME markets in 2018.

Source: Global Market Insight's report on Global Gasoline Gensets Market Size By Power Rating, By End-Use, Phase and Region (2019– 2025)

Methodology: Estimated growth of the 0-4 kVA gasoline generator market to 2030 (1/2)

Estimated growth of the 0-4 kVA gasoline generator market to 2030

- **Growth in # of households:**
  - Population size: We used World Bank population projections, which estimate that Nigeria's population will grow at ~2.54% CAGR between 2016 to 2030.
  - Household size: We projected changes in household size based on the UN Demographic and Health Survey of Nigeria, using the CAGR from 2003 to 2015.
- **Growth in # of MSMEs:**
  - Growth in MSMEs: MSMEs were segmented by income band based on the proportion of households in Dalberg's Household and SME survey that stated self-employment as one of their top three income sources. We used these proportions and data from the Ministry of Industry, Trade and Investment on the total number of MSMEs to estimate the number of MSMEs by income band. Growth in the number of MSMEs by income band was projected to 2030 based on the CAGR of Nigeria's real GDP per capita growth between 2007 and 2017.
- **Grid expansion:**
  - Grid expansion: World Bank figures on access to electricity were used to chart historic grid access from 2010 to 2015. The CAGR from this period was used to project grid access from 2016 to 2030.
  - Improvements in grid reliability: Afrobarometer data on the proportion of the population with access to the grid between 2011 and 2018 was used to calculate the proportion of those with grid access able to obtain an average of <4 hours of grid electricity per day.

Note: Any duplication between sources of growth was eliminated during the modelling process (e.g., population growth feeding into income expansion).

Methodology: Estimated growth of the 0-4 kVA gasoline generator market to 2030 (2/2)

- **Income expansion:**
  - Utilising population growth and real GDP per capita data, we calculated the proportion of households moving between income bands from 2018 to 2030. The proportion of households owning a generator in each income band (based on Dalberg's Household and SME survey) was used to project income-driven increases in small gasoline generator ownership.

Note: Any duplication between sources of growth was eliminated during the modelling process (e.g., population growth feeding into income expansion).

Methodology: Market value in 2018 (1/2)

Valuation of generator sales

- **Value of individual generator units:** We used data from Jumia, a pan-African e-commerce platform, to establish the cost of gasoline generators in the 0-2 kVA and 2-4 kVA segments. In the 0-2 kVA segment, the estimated cost of purchase was based on 1 kVA gasoline generator models. In the 2-4 kVA segment, estimates were based on 3 kVA models. In each category, an average cost of purchase was calculated across multiple generators.
- **Scaling to estimate market value:** Based on insights from Global Market Insight's report on gasoline gensets in Nigeria, we assumed that ~30% of the market for 0-4 kVA gasoline gensets is comprised of generators between 0-2 kVA, and ~70% is comprised of generators with a capacity of 2-4 kVA.[1] In line with this estimate, we multiplied household and SME generator ownership by the average cost of purchase in each generator capacity segment to obtain the market value of the installed base (if new).
- **Adjustment for replacement rates:** Based on interviews and desk research focused on the lifetime of small gasoline generators in Nigeria, we assumed an average replacement rate of 3 years. The market value of the installed base, if new, was then divided by the replacement rate to obtain an annualized figure of the expenditure on small gasoline generators in 2018.

Source: [1] Global Market Insight's report on Global Gasoline Gensets Market Size By Power Rating, By End-Use, Phase and Region (2019– 2025)

Methodology: Market value in 2018 (2/2)

Valuation of maintenance costs

- **Cost of maintenance per year:** Expert interviews undertaken by A2EI suggest that maintenance on small gasoline generators is ~20% of overall OPEX costs.
- **Scaling to estimate market value:** In line with the above 30:70 split of the generator market by capacity segment (i.e., 0-2 kVA and 2-4 kVA), we multiplied the number of generators owned by households and MSMEs by the average maintenance cost for each generator capacity segment to obtain the cost of maintenance per year for the small gasoline generator market.

Valuation of fuel use

- **Fuel use in 2018 (liters):** Data from Dalberg's Household and SME surveys was used to establish fuel use per year for households and MSMEs owning gasoline generators with a capacity of <4 kVA. Separate estimates were calculated for both the 0-2 kVA and 2-4 kVA segments, and for households and MSMEs.
  - Fuel use per year (USD): Fuel prices in Nigeria were calculated based on an average price over the past year, using information from the Nigeria Data Portal's Petrol Price Watch.
  - Emissions from small gasoline generators (2030): Based on the estimate of the installed generator base by 2030 and the fuel use associated with this base, we utilized the Carbon Trust's estimate of CO2e per liter of gasoline used (2.3117 kg of CO2e) to calculate the carbon dioxide equivalent from small generators in 2030.
  - Fuel generator subsidies (2018): We estimated gasoline subsidies per liter based on quotes from interviews with the Minister of State for Petroleum Resources, Dr IbeKachikwu, and changes in distribution margins. These estimates were triangulated with data on gasoline subsidies from previous years that were tracked by BudgIT's Nigeria's Petrol Subsidy Regime

Methodology: Total lifetime cost by generator type

Lifetime cost of 1.5 kVA gasoline generator

- **Upfront purchase:** We used data from Jumia, a pan-African e-commerce platform, to establish the cost of purchase for a selection of 1.5 kVA generators.
- **Fuel use:** Data from Dalberg's Household and SME surveys was used to establish fuel use per year for households and MSMEs owning gasoline generators with a capacity of <2 kVA. This information was cross-checked with the run-times of 0-4 kVA generators at 50% load capacity for sale on Jumia.
- **Maintenance and repair:** Based on expert interviews and A2EI insights, we estimated that small gasoline generators have a lifetime of five years, at best.

Lifetime cost of 1.5 kVA solar system

- **Upfront purchase:** We used data from Consistent Energy, a Nigerian solar energy company, and expert interviews to establish the cost of purchase for a selection of 1KW (1.3 kVA) solar systems.
- **Fuel use:** Solar systems do not require fuel.
- **Maintenance and repair:** According to expert interviews, the batteries of solar systems typically need to be replaced on average every 5 years and inverters typically need to be replaced every 5-10 years.

Methodology: Dalberg's Nigeria Household and SME survey (1/2)

<u>Survey size and profile</u>

- Household and SME sample: Dalberg's households sample included c.300-305 households in each of the three Nigerian focus states (Bayelsa, Delta, and Rivers) for a total of 910 household surveys. Dalberg's SME sample included 50-65 SMEs per each of the three focus states for a total of 165 SMEs surveys.
- Areas surveyed provide a representative view of the diversity of demographic profiles in Nigeria's Delta region:

State	LGA[1]	Urbanisation	Terrain	Income	Size	Commerce/ occupation	Housing	Road access	Ethnic Groups
Bayelsa	**Brass**	Semi-urban	Riverine	L-M	c.233k	- Mostly retail	Cement	None; travel by boat	Ijaw, Igbo, Yoruba
Bayelsa	**Nembe**	Rural	Riverine	L	c.166k	- Retail - Some factories	Cement	Some tarred, more under construction	Ijaw + Delta Igbo and Yoruba
Bayelsa	**Yenagoa**	Urban	Upland	L-M	c.446k	- Mostly retail	Cement	Under construction; also boat	Epie, some Yoruba, Igbo/Delta Igbo, Hausa
Rivers	**Bonny**	Semi-urban	Riverine	L-M	c.278k	- Fishing - Some retail - Oil businesses	Mostly cement, mud with zinc roof	Fairly good network	- Kalabari tribe dominate, some Igbo
Rivers	**Ahoada East**	Semi-urban	Upland	L	c.215k	- Trading - Farming - Retail	Mostly cement, some mud	Good access but repairs needed	Ekpeye dominate
Rivers	**Obia Akpor**	Urban	Upland	L-M	c.597k	- Trading - Fishing - Civil service	Cement, aluminum and zinc roofs	Fairly good road network	Ikwerre + Igbos and Yorubas
Delta	**Uvwie**	Urban	Upland	L-M	c.242k	- Trading - Civil service	Mostly cement brick and zinc roof	Access roads, but poor conditions	Urhobos + Itsekiris and Igbos
Delta	**Warri SW**	Semi-urban	Riverine and upland	L-M	c.149k	- Retail	Cement brick and zinc roof Some mud	Access roads, but poor conditions	Urhobos and Isekiris
Delta	**Bomadi**	Semi-urban	Riverine	L	c.110k	- Trading - Fishing - Farming	Mostly mud with some cement	Access roads, but few water bridges	Ijaw

Note: [1] LGA = Local Government Area.

Methodology: Dalberg's Nigeria Household and SME survey (2/2)

Research methodology

To ensure a representative understanding of the three focus states, Dalberg used a rigorous approach to primary data collection:

1. Selected states were stratified into senatorial districts, local government areas (LGAs) by urbanization (urban, rural, semi-urban), and enumeration areas[1], from which 10 households were selected using systematic random sampling.[2]

2. Eligible respondents were at least 18 years-old, and a Kish grid[3] was used to determine whether male or female respondents was selected.

3. A systematic random sampling technique was used to interview business leaders in targeted states drawn from national and local SME registries such as NASME.

4. Particularly responsive respondents amongst SME and household surveys were invited to participate in focus group discussions, after sorting by socio-economic class, gender, age, and language spoken.

Notes: [1] Urbanization classification, enumeration areas, focus states and district lists are from NBS. [2] In cases where randomly selected respondents were not available, three attempts were made at different times of the day; otherwise the household was replaced with a different respondent. [3] A system that forces random sampling of household members so that responses do not skew to certain types (e.g., male-only heads of households).

The A2EI thanks its funders for their continuing support, which is enabling this research

FMO
Entrepreneurial
Development
Bank

STICHTING
DOEN
NATIONALE POSTCODE LOTERIJ

IKEA Foundation
IKEA

Good Energies
POWER FOR A BETTER WORLD