

ROOFTOP SOLAR SOLUTIONS

GHANA MARKET ASSESSMENT



Build ● Compete ● Grow



IFC

**International
Finance Corporation**
WORLD BANK GROUP

Creating Markets, Creating Opportunities

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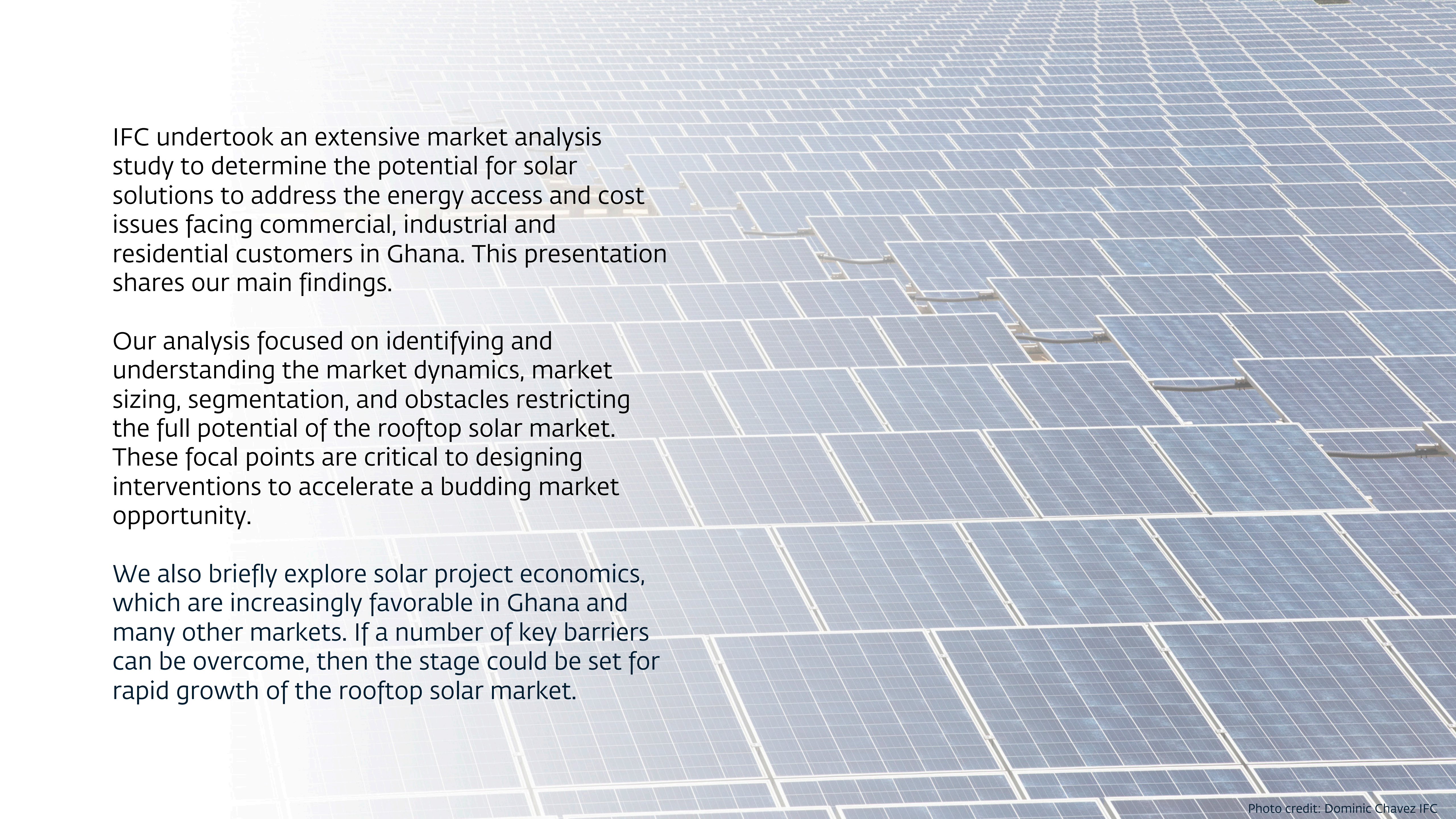
Ministry of Foreign Affairs of the
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INTRODUCTION & METHODOLOGY



IFC undertook an extensive market analysis study to determine the potential for solar solutions to address the energy access and cost issues facing commercial, industrial and residential customers in Ghana. This presentation shares our main findings.

Our analysis focused on identifying and understanding the market dynamics, market sizing, segmentation, and obstacles restricting the full potential of the rooftop solar market. These focal points are critical to designing interventions to accelerate a budding market opportunity.

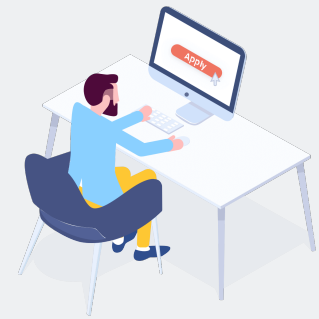
We also briefly explore solar project economics, which are increasingly favorable in Ghana and many other markets. If a number of key barriers can be overcome, then the stage could be set for rapid growth of the rooftop solar market.

We deployed four main research activates to provide a holistic view of the market

APPROACH

KEY ACTIVITIES

OUTCOMES



Desk Research

An extensive search for relevant information via secondary sources was conducted

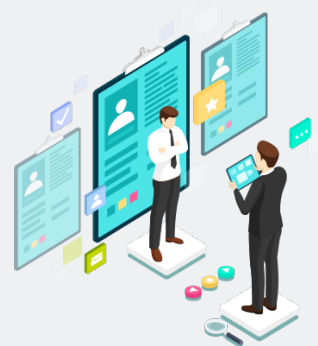
An understanding of the relevant macro and sectoral trends impacting demand and supply of solar solutions



Marketplace Discussion

Marketplace discussions with the key stakeholders across the value chain

Sourced insights not available via secondary sources and cross validated desk research findings



Consumer Analysis

Survey with existing and potential customers of solar solutions in residential and commercial segments

Purchase decision making process, factors influencing their purchase decision making, satisfaction level with the existing products and identification of gap areas between demand and supply



Analysis

Corroborated, synthesized and analysed information sourced from desk and primary research

Findings on key factors impacting the market, estimation of future growth, detailed need gap analysis

PRIMARY RESEARCH: WHO DID WE TALK TO?

- Accra • Kumasi • Takoradi

RESIDENTIAL SECTOR

78%



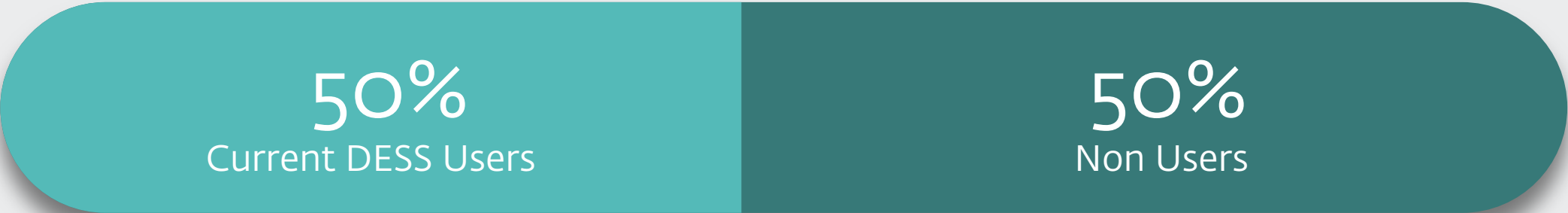
Male

22%



Female

Split of Residential users



COMMERCIAL & INDUSTRIAL SECTOR



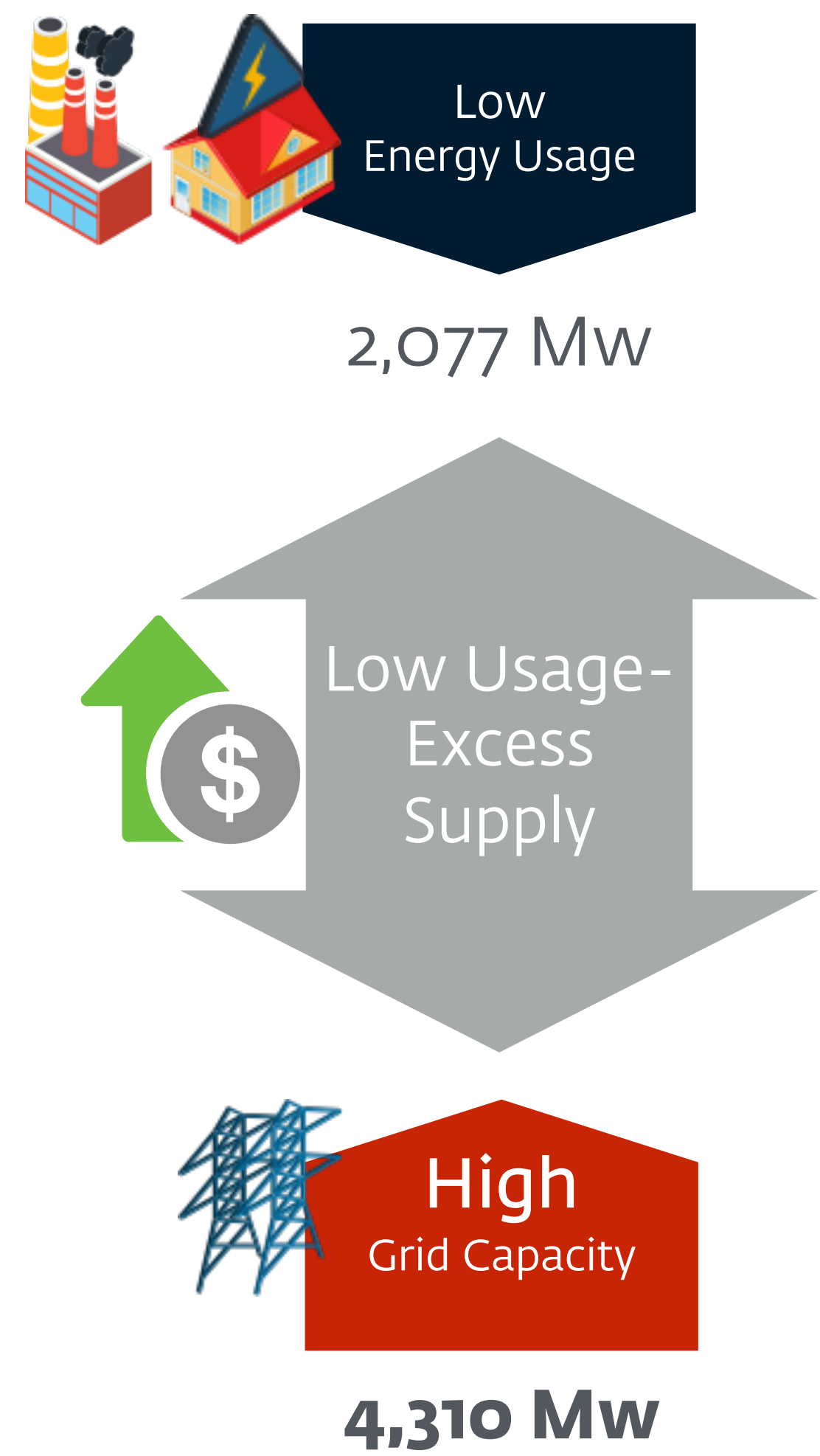
Decision Makers with responsibilities within their Organisation in regards to



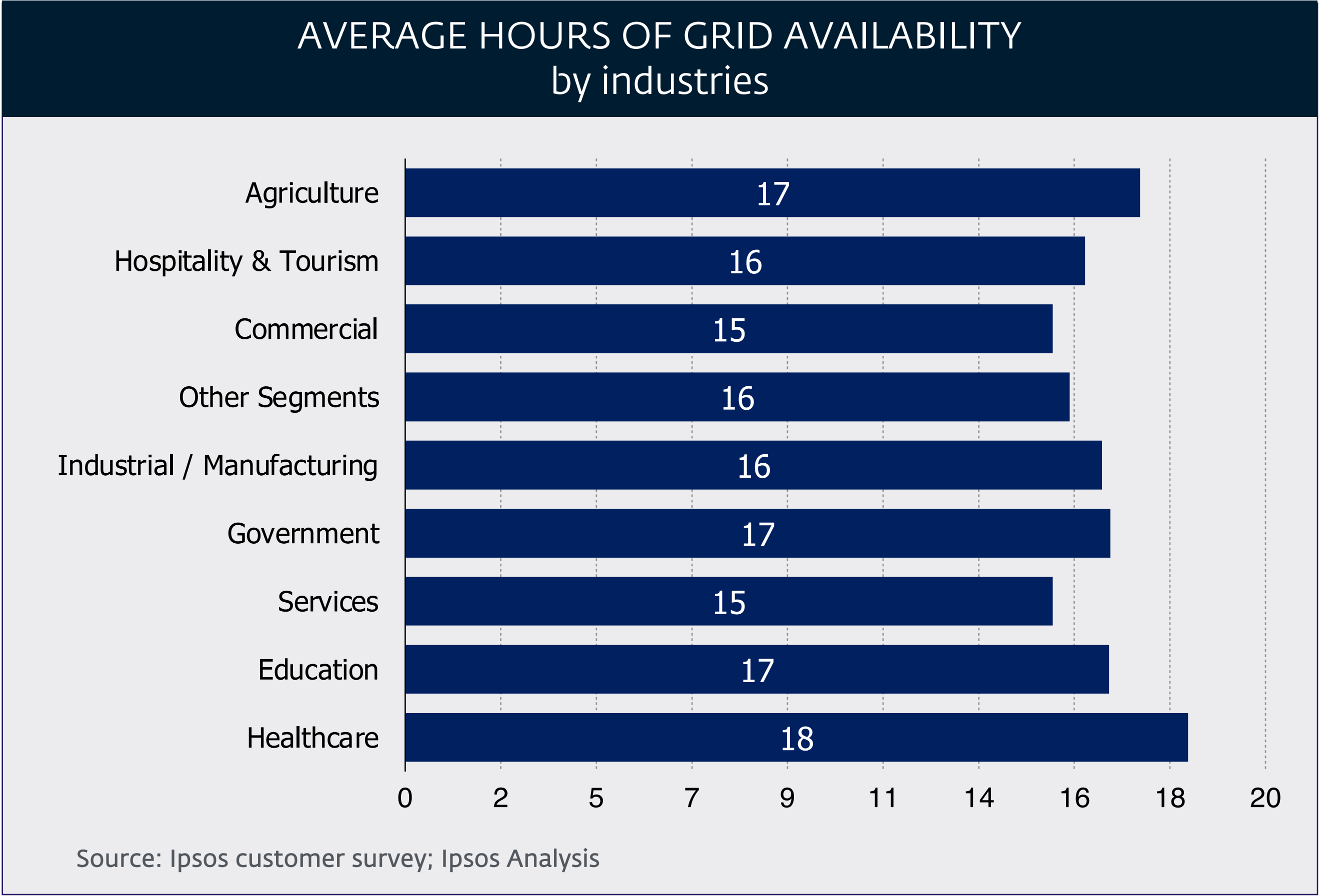


ENERGY SECTOR IN GHANA

THE CURRENT ENERGY SCENARIO
IN GHANA IS CHARACTERIZED BY
SURPLUS



WHILE THERE IS BETTER RELIABILITY IN
MAJOR METROS LIKE ACCRA, SURVEY
RESULTS SUGGEST SHORTAGES REMAIN



| Consumption | Residential (Domestic Usage) | | | Non-Residential (Commercial usage less than 100kVA) | | | Industries (SLT usage)* | | |
|--|---------------------------------|-------|-------|--|--------|--------|----------------------------|--------|--------|
| | Ghp / kWh | | | Ghp / kWh | | | Ghp / kWh | | |
| | 2016-17 | 2018 | 2019 | 2016-17 | 2018 | 2019 | 2016 | 2018 | 2019 |
| (R)51-300 / (C)100-301 | 67.33 | 55.55 | 61.75 | 96.79 | 67.75 | 75.32 | | | |
| 301 - 600 | 87.38 | 72.09 | 80.14 | 102.99 | 72.10 | 80.15 | | | |
| 601+ | 97.09 | 80.10 | 89.04 | 162.51 | 133.76 | 126.47 | | | |
| SLT - LV | | | | | | | 100.89 | 75.66 | 98.86 |
| SLT - MV | | | | | | | 78.09 | 58.57 | 75.06 |
| SLT - HV | | | | | | | 71.76 | 53.82 | 78.77 |
| SLT-HV Mines | | | | | | | 113.97 | 102.57 | 249.17 |
| ● *SLT is Special Load Tariff for energy usage for industrial purposes; supply voltages LV–Low Voltage (400V); MV- Medium Voltage (11,000 V) and HV-High Voltage (33,000 V). | | | | | | | | | |

High electricity tariffs remain a challenge.

To reduce electricity shortages experienced prior to 2014, the government fast-tracked private power plants that have led to excess generating capacity and high costs, along with increased tariffs. In March 2018 the government announced significant tariff reductions, but in July 2019 they were raised again.

With utilities in financial strain and concerns around sustainability, Ghanaian customers likely face high tariffs and potentially further increases in the future.

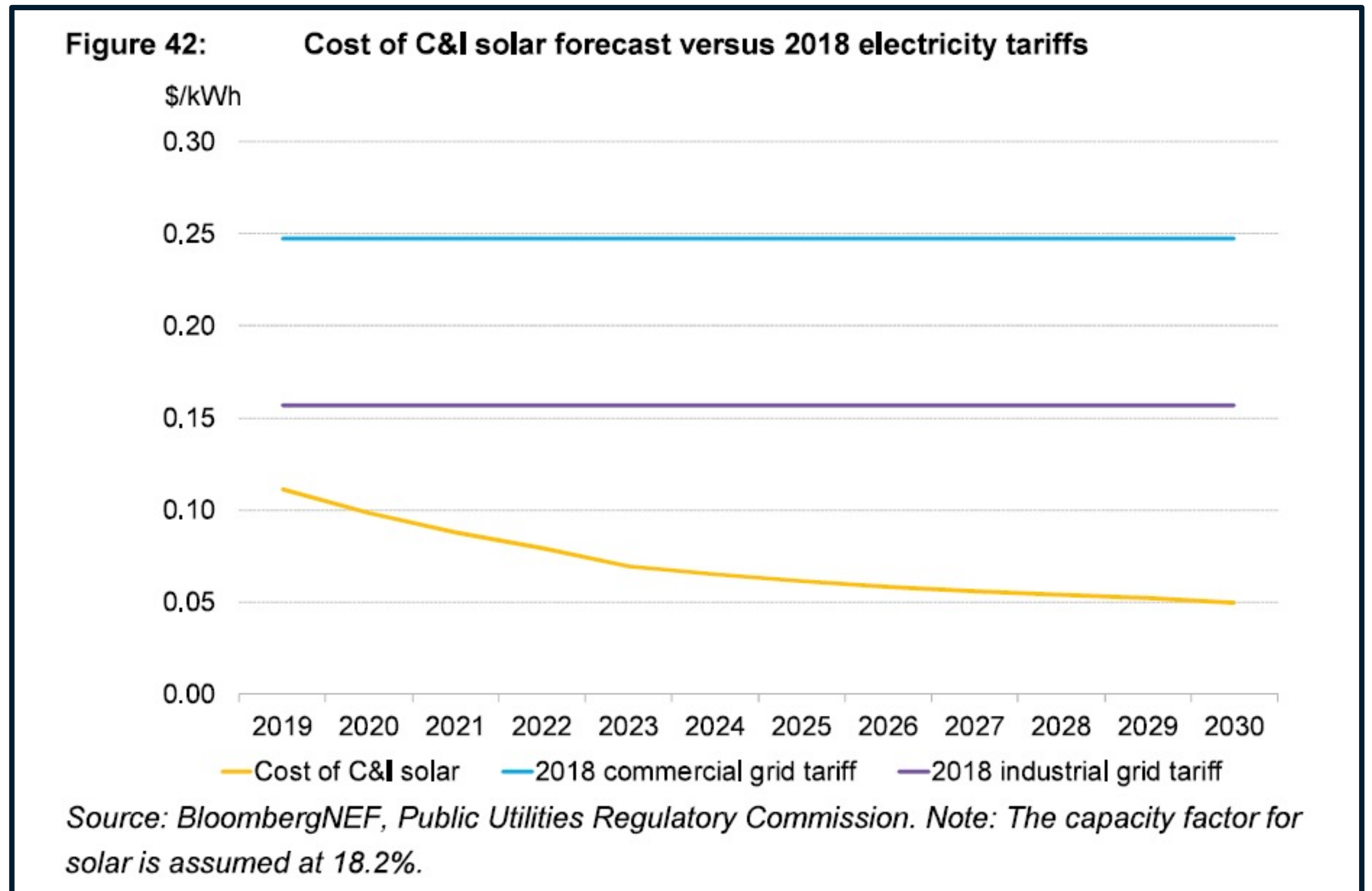


SOLAR PROJECT ECONOMICS

Ghana solar and electricity tariff projections to 2030

Solar offers an economical proposition to commercial and industrial customers in Ghana to mitigate current and future energy costs. In 2019, tariffs increased 11.17% from the 2018 rates.

Solar offers Ghanaian C&I customers a strong value proposition by allowing them to lock in cheaper energy prices through 10-15 year PPAs provided by IPP solar developers.



*This model demonstrates a grid-tariff plateau, while the likelihood of tariffs increasing is high

IPP Economics

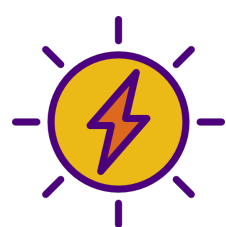
Case Study – Brewery

Power solutions comparison:
Case demonstrates a 20% Solar and 80% Grid configuration vs. 100% Grid

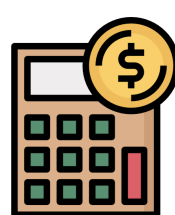
On a 1,480,000 kWh monthly power consumption.

Financials for Independent Power Producer (IPP) Solar Provider

- Convenient monthly payment for the customer to the IPP provider.
- No up-front cost – IPP offers 10 year power purchase agreement (PPA).
- 10-year contract includes investment, installation and maintenance costs.
- \$ 143,000 USD in annual savings.



Average Tariff



Total per Month

20% Solar

8 cents/ kWh

\$ 23,680

**80%
On-grid**

12 cents/ kWh

\$ 142,000

Net Delta

\$11,920

On-Grid only

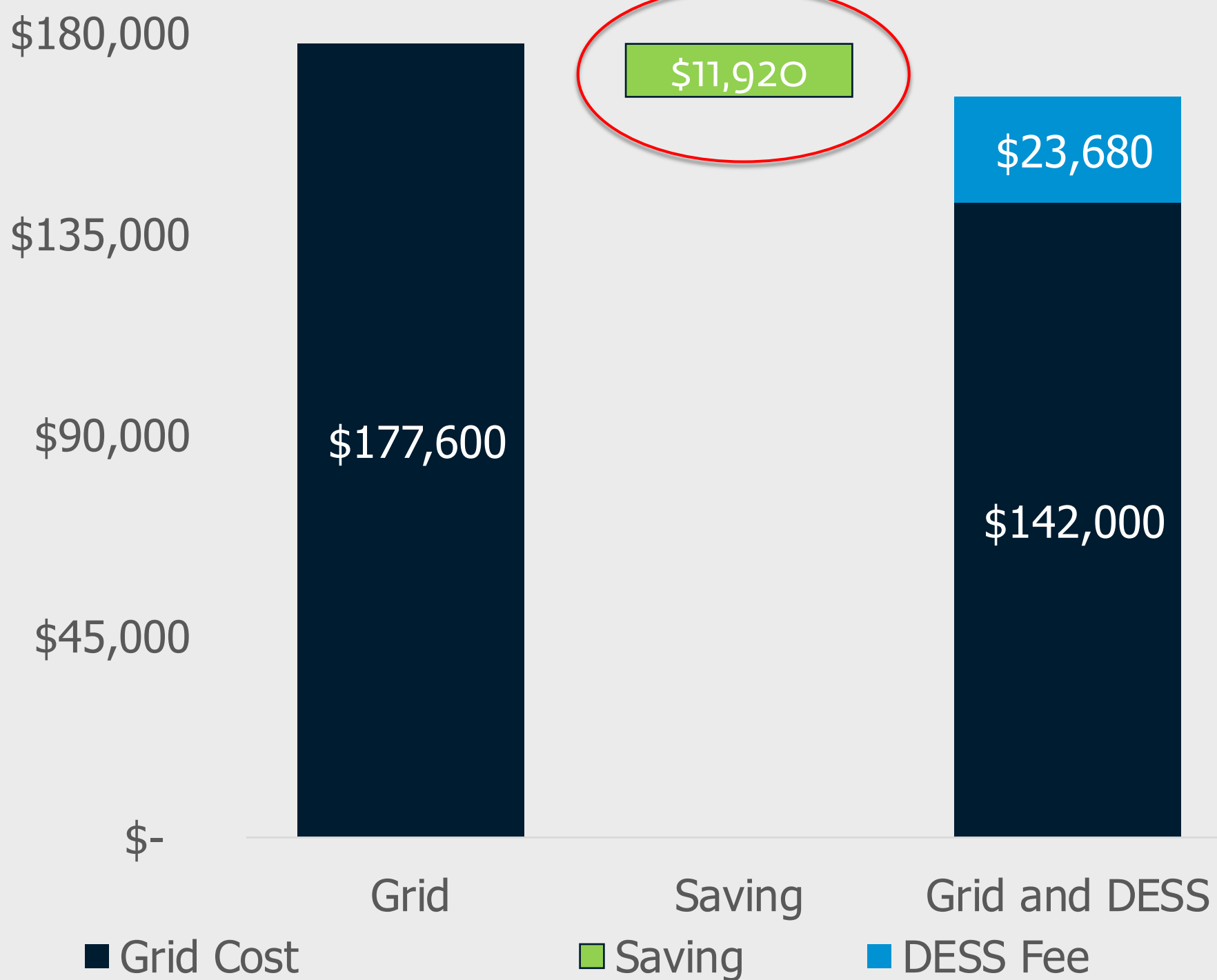
**100%
On-grid**

12 cents/ kWh

\$ 177,600

**Data provided by 3rd party and reflects financials cited within the case*

Monthly Cost Comparison
Grid vs. 20% Solar and 80% Grid



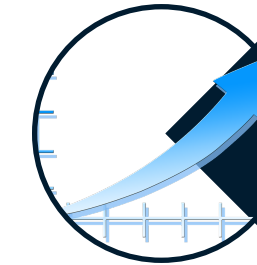
10 year contract yields ~ USD \$1.43 MN saved over the contract period.

Overview of Solar Economics

Solar project economics vary across developer offerings and customer segments and are best suited for a separate, dedicated analysis. On-balance sheet acquisition remains at present a challenging proposition at scale given national interest rates, but is already compelling if financed through affordable hard currency loans. If interest rates can be kept in check, the ever decreasing component costs of solar continually increases the value proposition year by year.

IPP models that offer pure OPEX savings to customers are the prevailing option today, realizing 20+% in energy savings. Still, developers face the risk of currency devaluation if accessing hard currency loans, as well as tariff volatility. Tariff hedging facilities are one option to mitigate this risk.

Sample Solar Economic Drivers



Provider economies of scale and related procurement and commissioning advantages



Capital interest rates secured by both developer and off-taker



Site location, transport and related O&M cost



Available roof / land vis a vis site load profile



System configuration (eg. Pure pv solar, solar / generator / grid hybrid, and storage sizing)



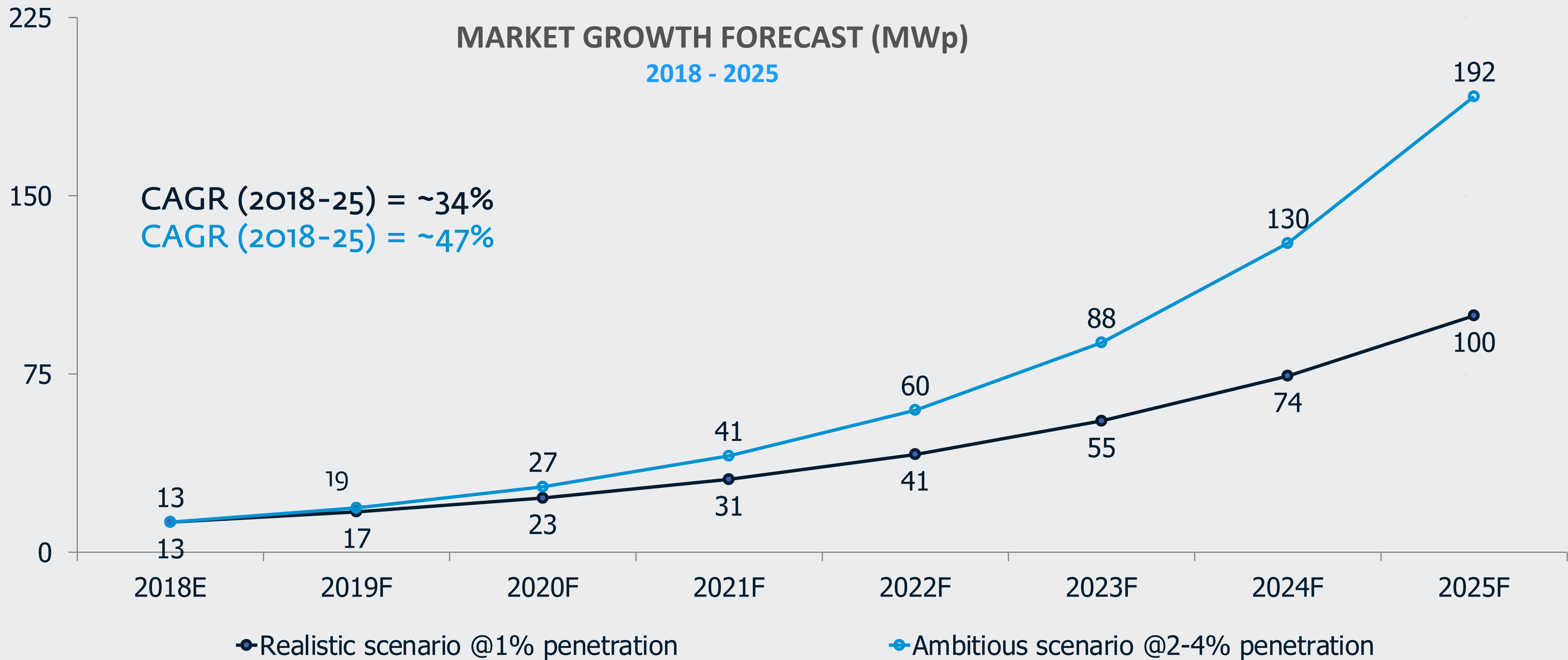
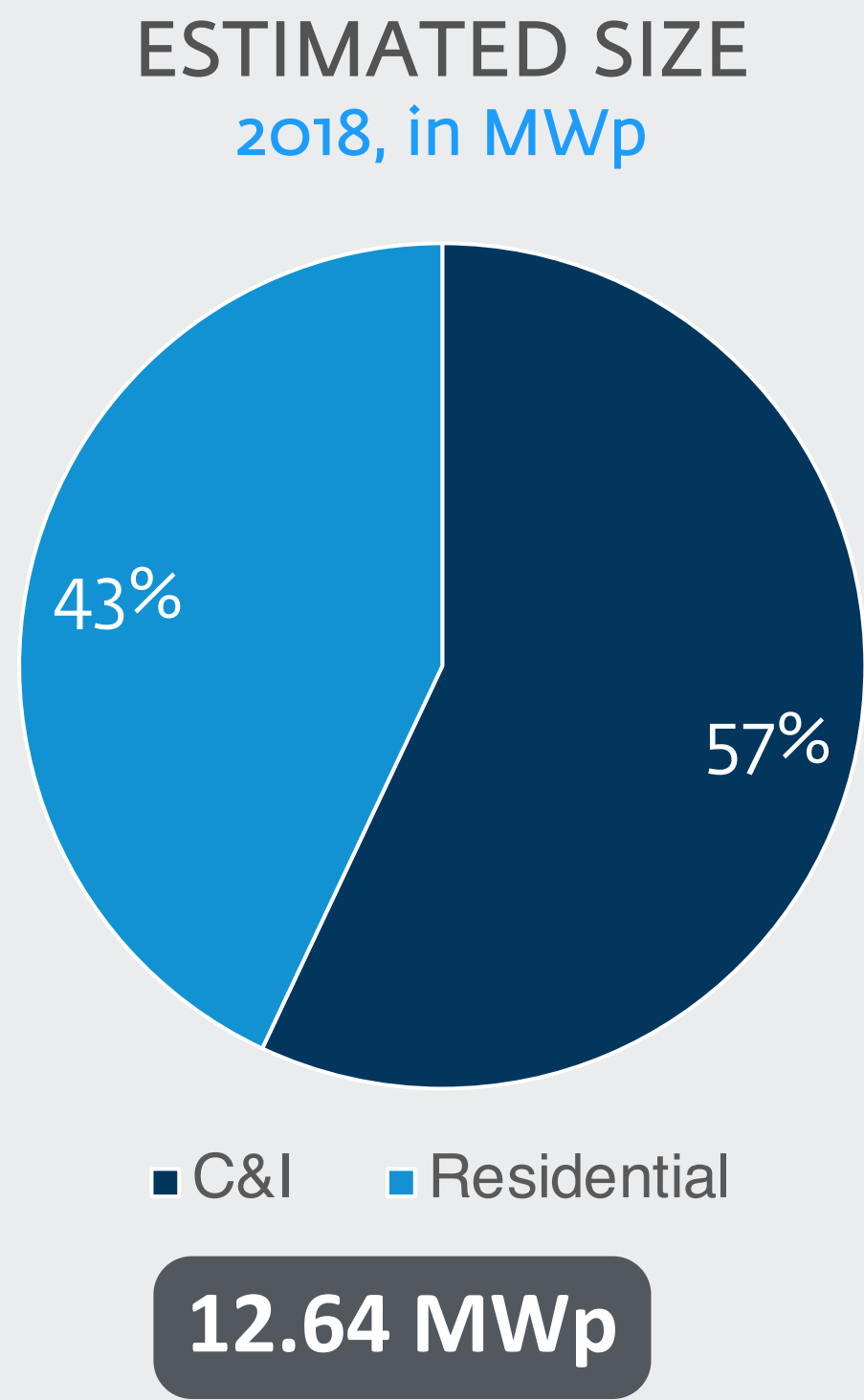
Quality of solution components



COMMERCIAL & INDUSTRIAL

DEMAND SIDE ANALYSIS






As of 2018 nearly ~13 MWp (valued at USD 30 Mn) of solar was installed.
Projections suggest installations to reach between 100 and ~192 MWp (USD219-224 Mn) by 2025.



Notes: Penetration rate for Ambitious scenario based on Govt.'s renewable energy vision for the year 2025—with penetration ranging from 2-4% depending on market segment.

In Ghana, there are several attractive customer segments with compelling segment valuations.



| SEGMENTS | DESS Installed base, 2018 | Sector Value 2018 | Share of Total Installed Base (DESS), 2018 | Market Potential (Volume), 2025 | Market Potential (Value), 2025 |
|---|---------------------------|-------------------|--|---------------------------------|--------------------------------|
|  Commercial | 2.78 MWp | \$ 7 Million | 22% | 21.3 – 38.7 MWp | \$45 – 47 Mn |
|  Hospitality & Tourism | 0.25 MWp | \$ 1 Million | 2% | 1.8 – 3.6 MWp | \$4 Mn |
|  Healthcare | 0.04 MWp | \$ 0.1 Million | 0.3% | 0.3 – 1.0 MWp | \$0.6 – 1.2 Mn |
|  Education | 0.11 MWp | \$ 0.2 Million | 0.8% | 0.8 – 3.0 MWp | \$1.7 – 3.5 Mn |
|  Agriculture | 0.01 MWp | \$ 0.03 Million | 0.1% | 0.1 – 0.4 MWp | \$0.2 – 0.5Mn |
|  Government | 0.08 MWp | \$ 0.2 Million | 0.7% | 0.6 – 1.2 MWp | \$1 Mn |
|  Industrial | 3.94 MWp | \$ 9 Million | 31.2% | 28.2 -56.3 MWp | \$62 - 66 Mn |
|  Residential | 5.44 MWp | \$ 13 Million | 43% | 46.5 – 87.6 MWp | ~\$102 Mn |
| TOTAL | 12.64 MWp | ~\$30 Mn | | ~100 – 192 MWp | \$219– 224 Mn |

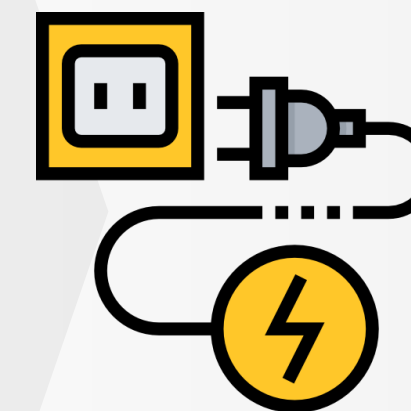


COMMERCIAL / SERVICES

Estimated installed base of 2.78 MWp and \$7 Mn in 2018. Potential to reach upto \$47 Mn by 2025

| Number of establishments | | | | | | |
|--------------------------|----------------------------|-------|-------------------------|----------------------------|---------------------|----------------|
| Banking | | | Petrol filling stations | Trade / Wholesale & Retail | Transport & Storage | Telecom Towers |
| Commercial bank branches | Microfinance bank branches | ATMs | | | | |
| 1,377 banks | 484 | 2,044 | 3,500 | 27,063 | 1,459 | 5,583 |
| Penetration | | | 2% | | 4% | |

Typical Electricity Requirement



3.5 to 200 kWp

DESS installed Base, 2018



2.78 MWp

DESS potential, 2025



Penetration

@1%

21.3 MW

@2-4%

38.7 MWp

SECTOR VALUE

\$7 Mn

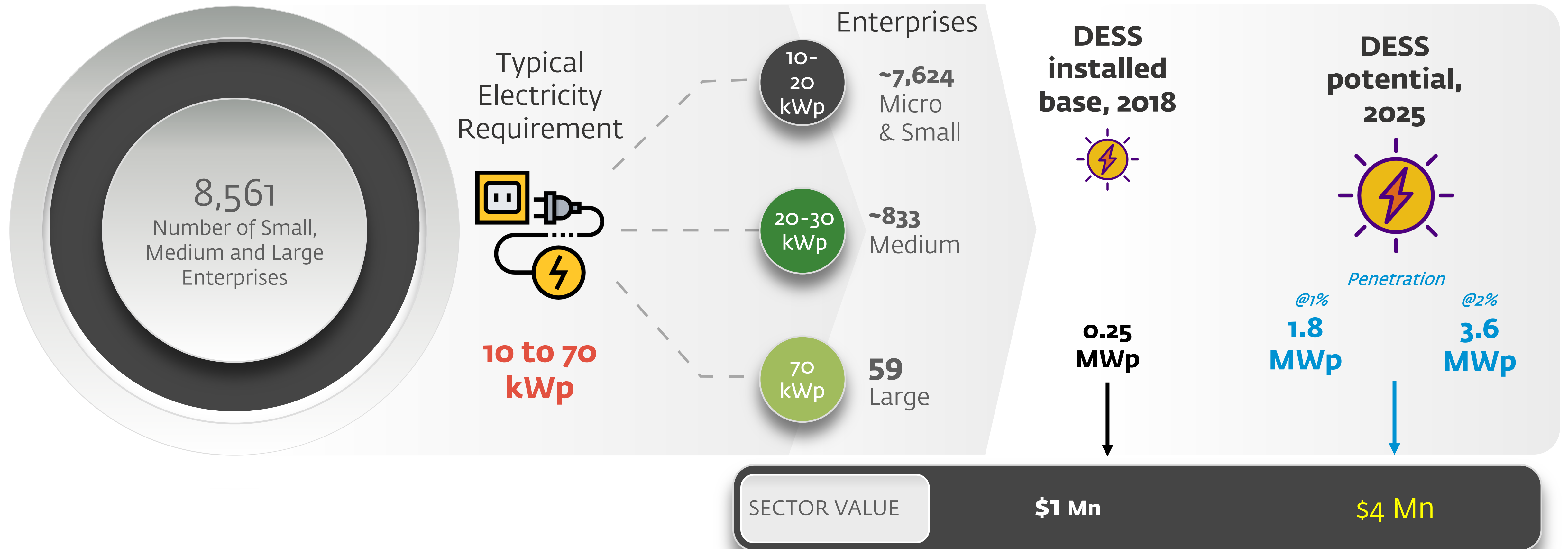
\$45 – 47 Mn

Sources: Market Place Discussions; Ipsos Analysis; Ghana Electricity Supply Plan 2017; Ghana Renewable Energy Master Plan;
<https://allafrica.com/stories/201705290958.html>
https://www.bog.gov.gh/privatecontent/MPC_Press_Releases/Banking%20Sector%20Report%20%20-%20July%202017.pdf
https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2014/01/1.-GPM-Presentation_Nigeria+Ghana-WG_Jan-2014-v1.pdf
<https://www.bog.gov.gh/privatecontent/Payment%20Systems/Payment%20Systems%20Annual%20Report%202017.pdf>



HOSPITALITY & TOURISM

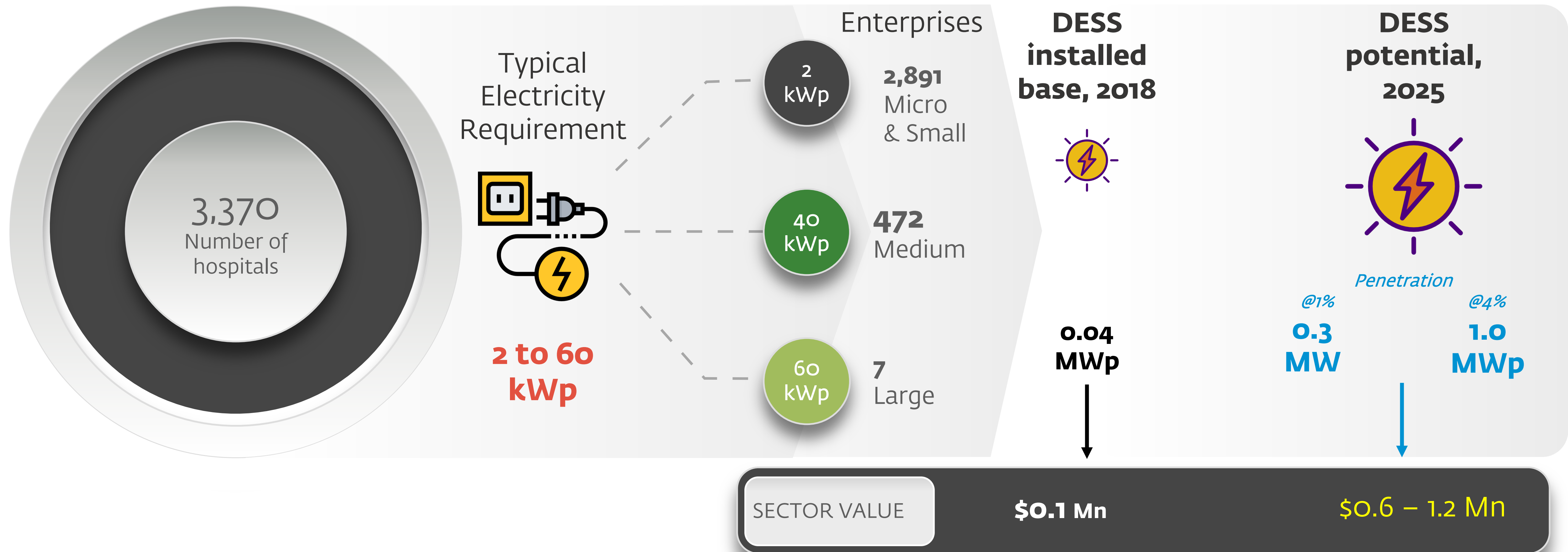
Estimated installed base of 0.25 MWp and valued at \$1 Mn in 2018. Potential to reach upto \$4 Mn by 2025





HEALTHCARE

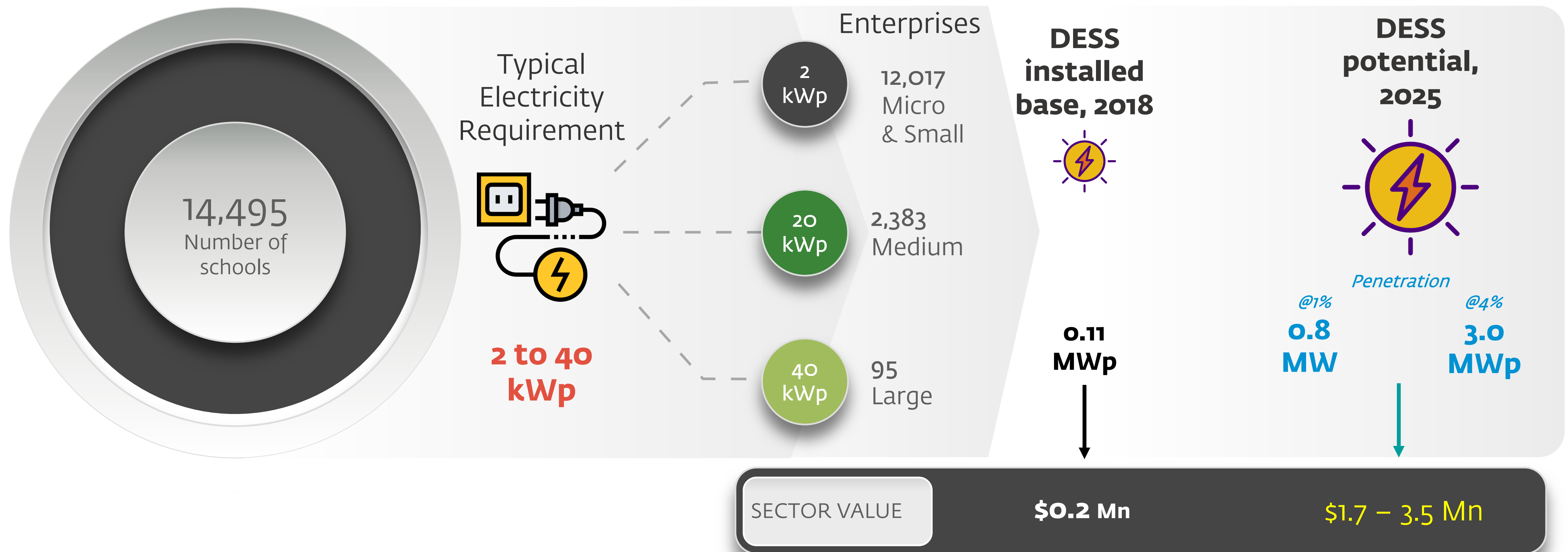
Estimated installed base of 0.04 MWp and valued at \$0.1 Mn in 2018. Potential to reach upto \$1.2 Mn by 2025

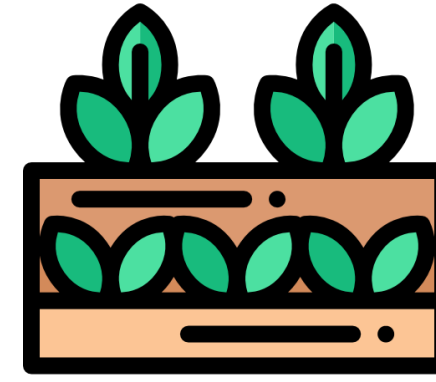




EDUCATION

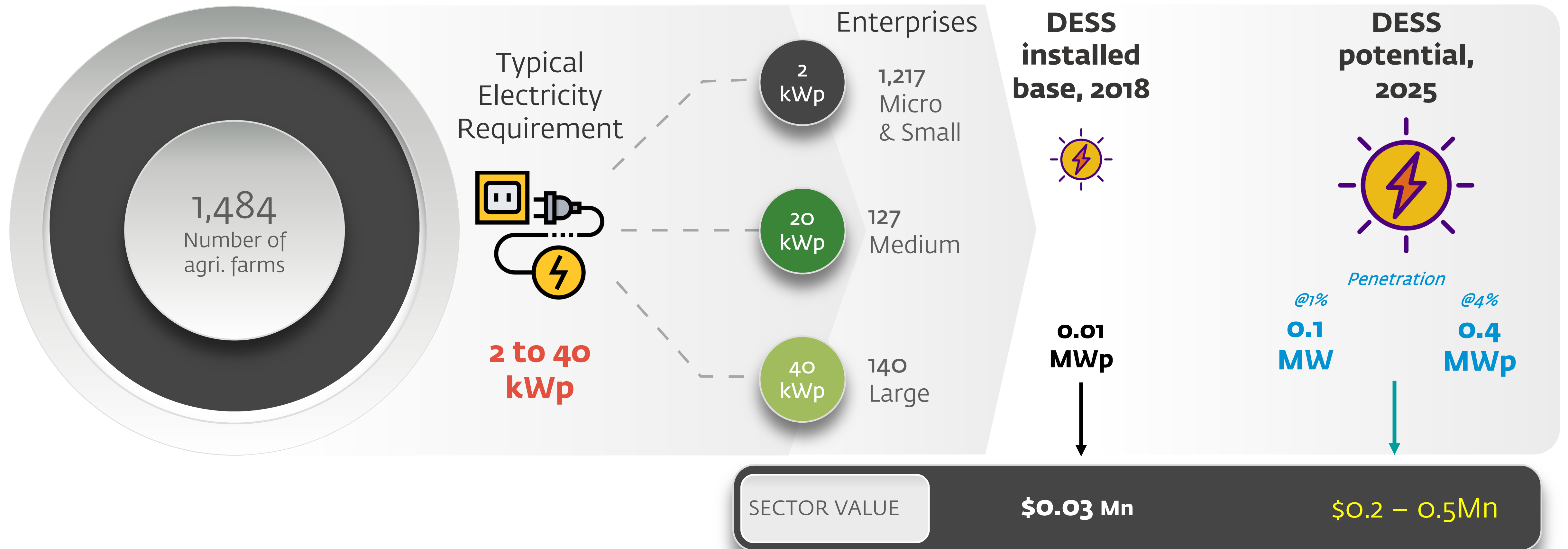
Estimated installed base of 0.11 MWp and valued at \$0.2 Mn in 2018. Potential to reach upto \$3.5 Mn by 2025

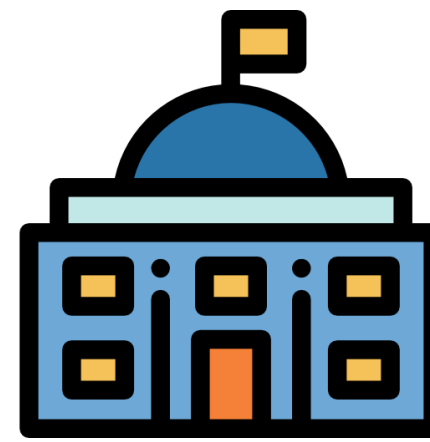




AGRICULTURE

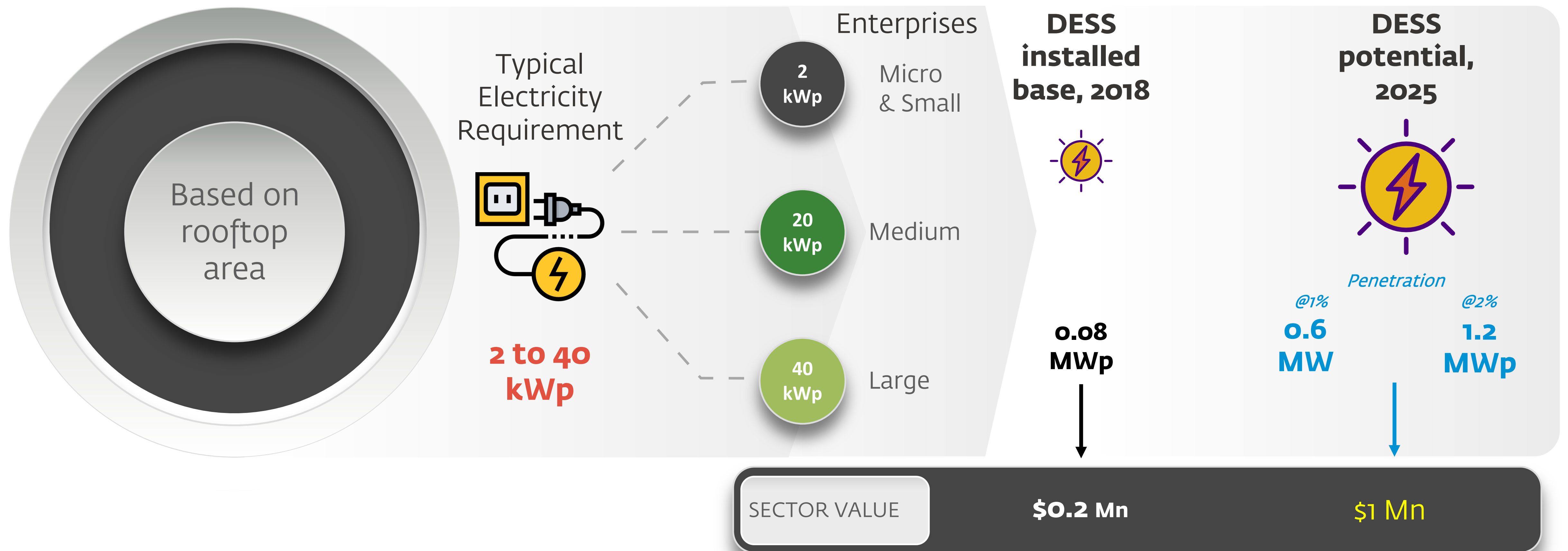
Estimated installed base of 0.01 MWp and valued at \$0.03 Mn in 2018. Potential to reach upto \$0.5 Mn by 2025





GOVERNMENT

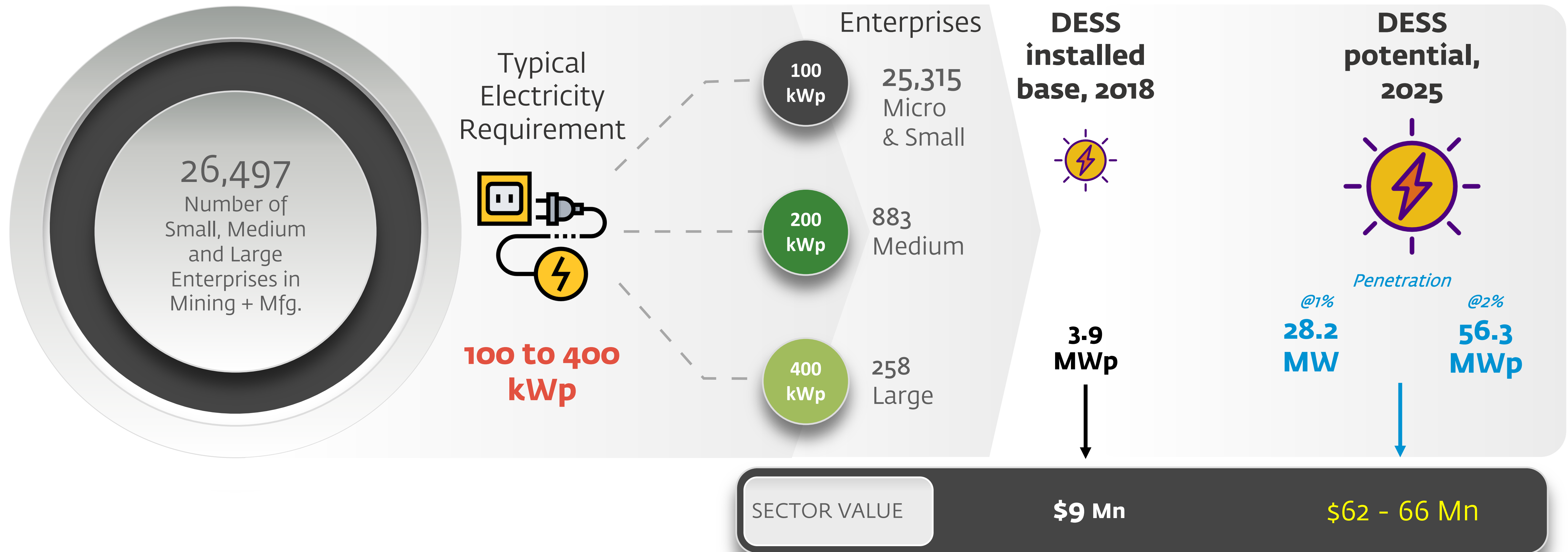
Estimated installed base of 0.08 MWp and valued at \$0.2 Mn in 2018. Potential to reach upto \$1 Mn by 2025





INDUSTRIAL

Estimated installed base of 3.9 MWp and valued at \$9 Mn in 2018. Potential to reach upto \$66 Mn by 2025

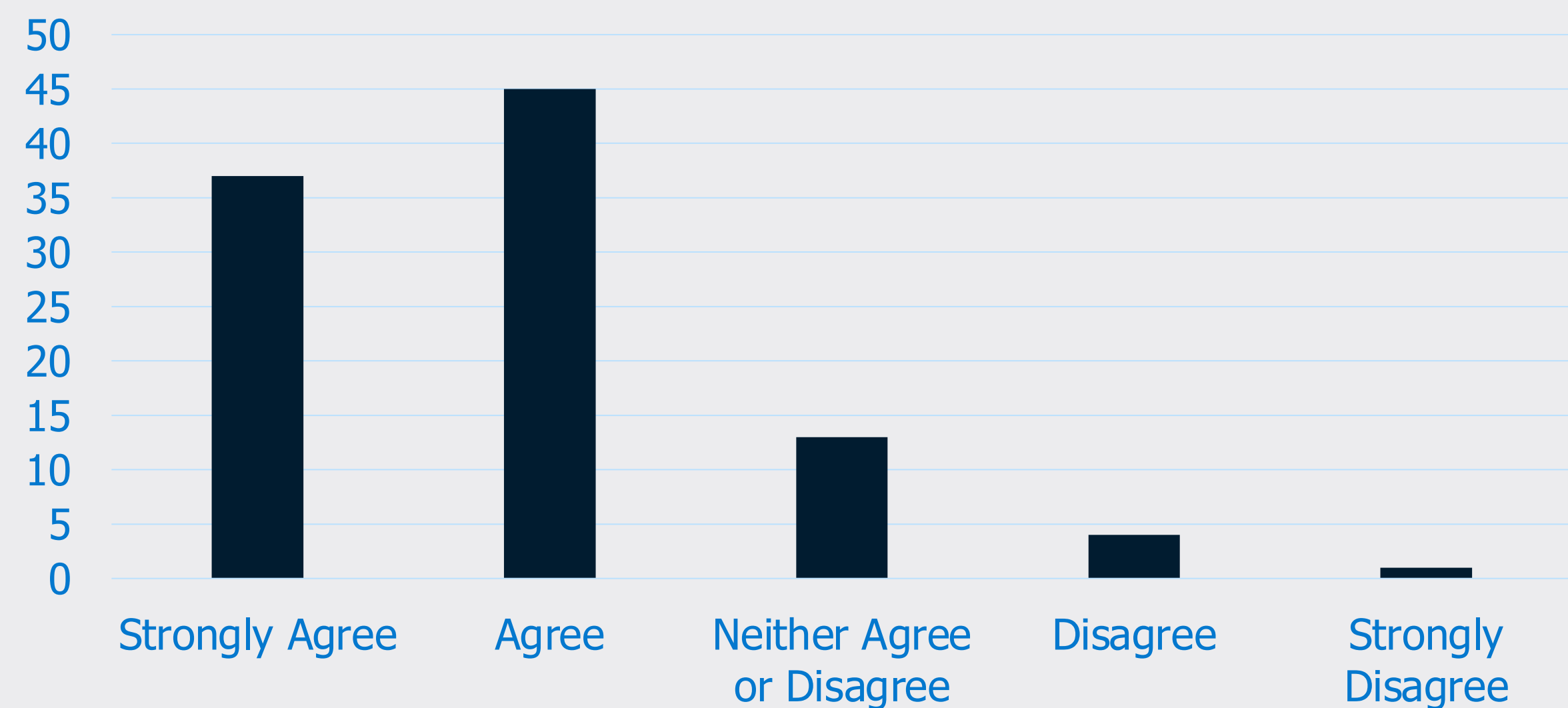


Despite the existing base of users holding mostly positive experiences per our survey, and the market outlook seeing fair commercial opportunities, the market is constricted by several barriers.

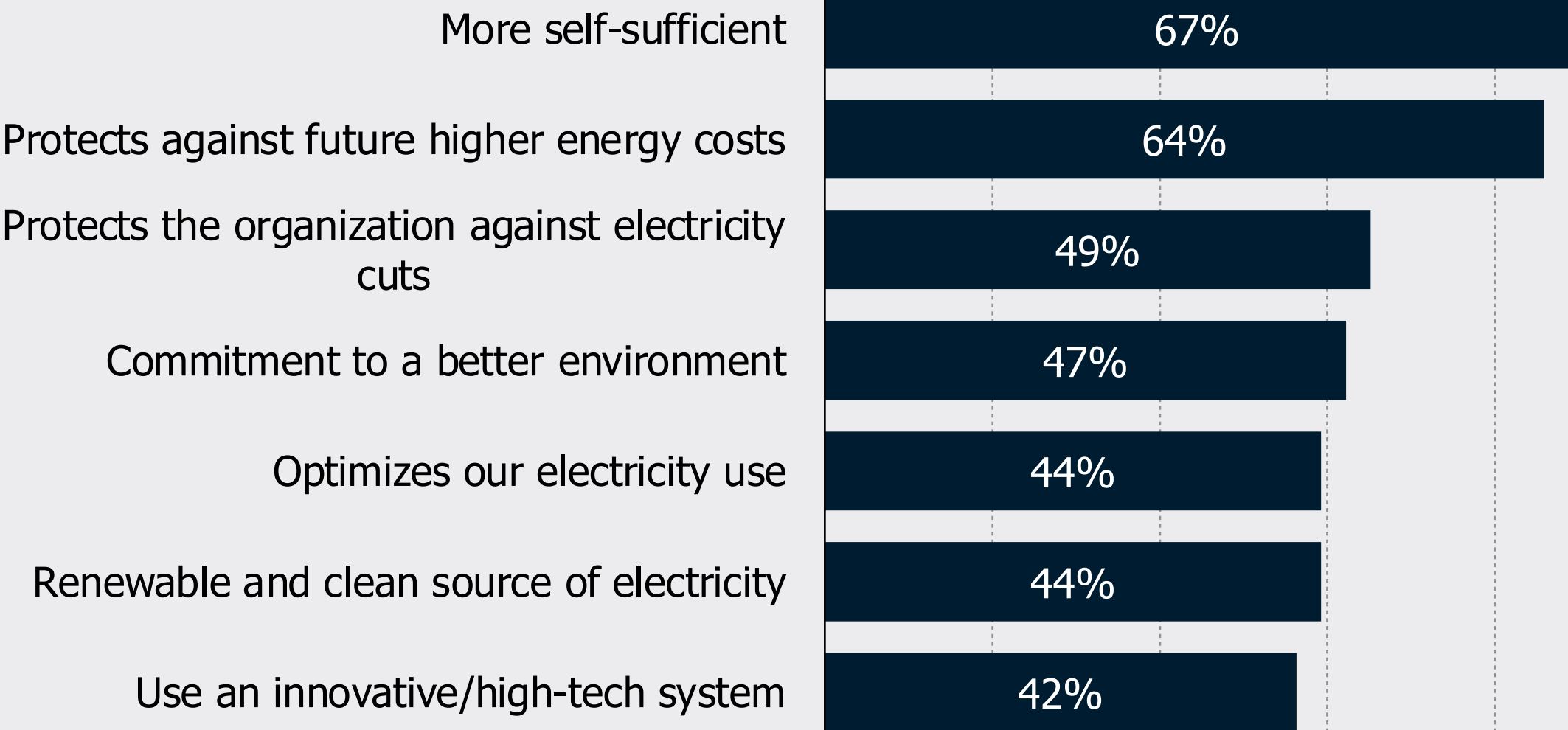


Existing Solar users are satisfied.
Many non-users indicate willingness to adopt solar solutions.

USERS OF SOLAR PV AND ENERGY STORAGE SOLUTIONS
Value for Money



DRIVERS FOR ADOPTION
Solar Solution Non-Users



LIKELIHOOD FOR ADOPTION

About 67% of commercial and industrial businesses in Ghana who do not currently use Rooftop solar PV and energy storage solutions are willing to give the solution a try.


18%
Definitely will try it


49%
Will try it


33%
Might or might not try it

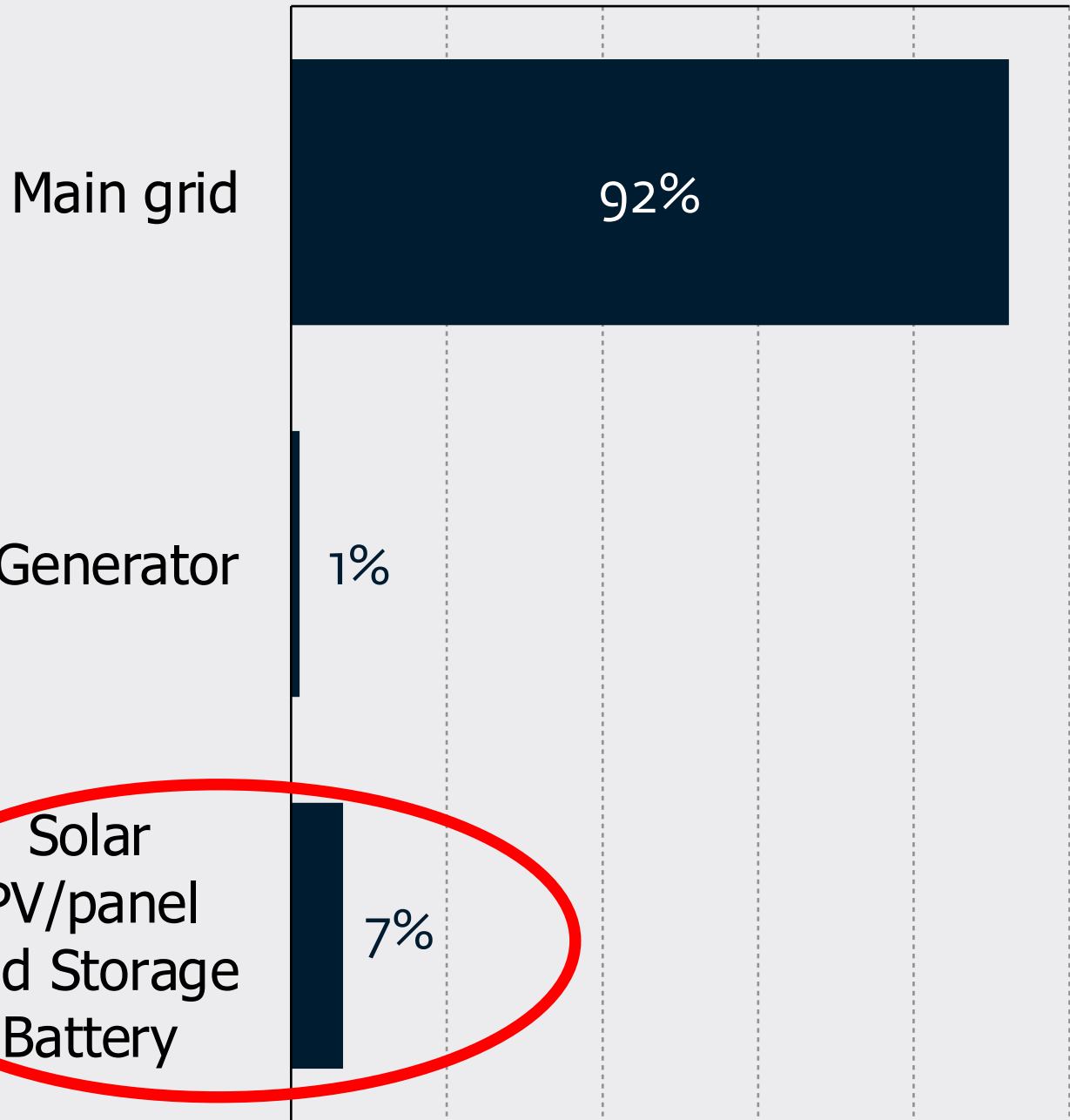

0%
Will not try it


0%
Definitely will not try it

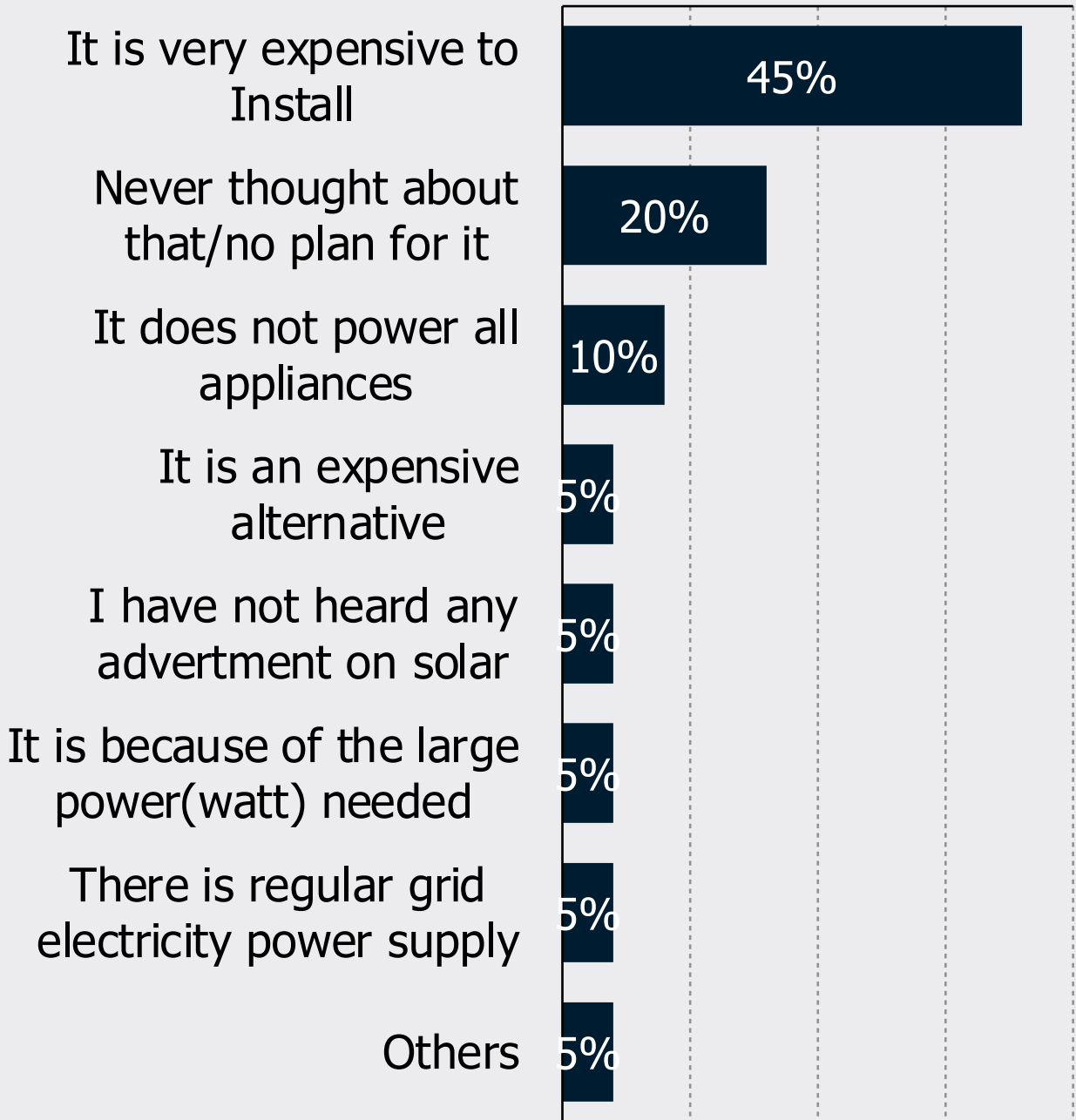
However, a low awareness & perceived cost of solar solutions are core barriers to adoption.

LOW-AWARENESS AND PERCEPTION OF SOLAR SOLUTIONS FROM NON-USERS

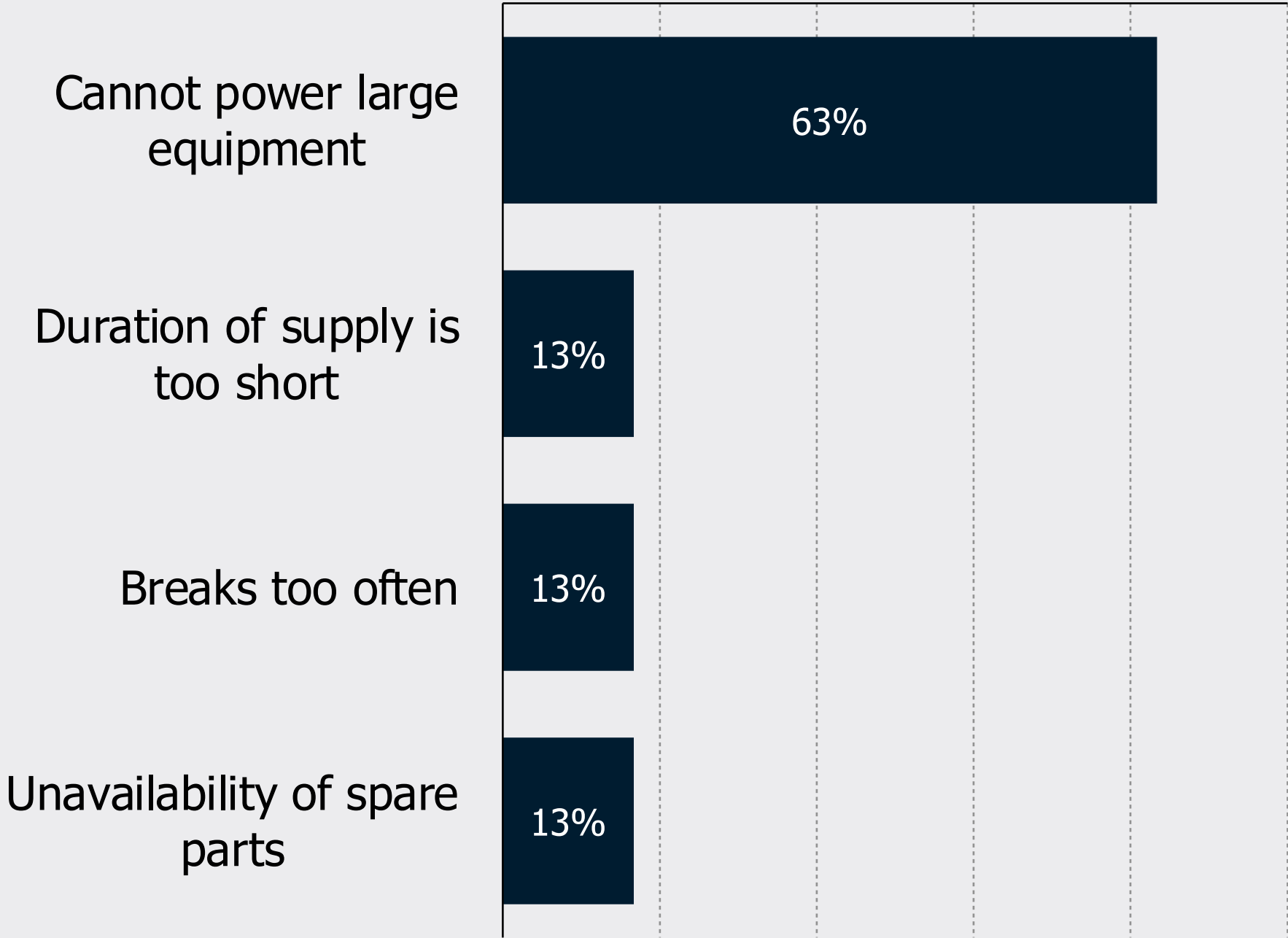
Top of the mind responses for where non-solar users primarily access electricity



Top of the mind responses from non-users on perceptions of solar technology



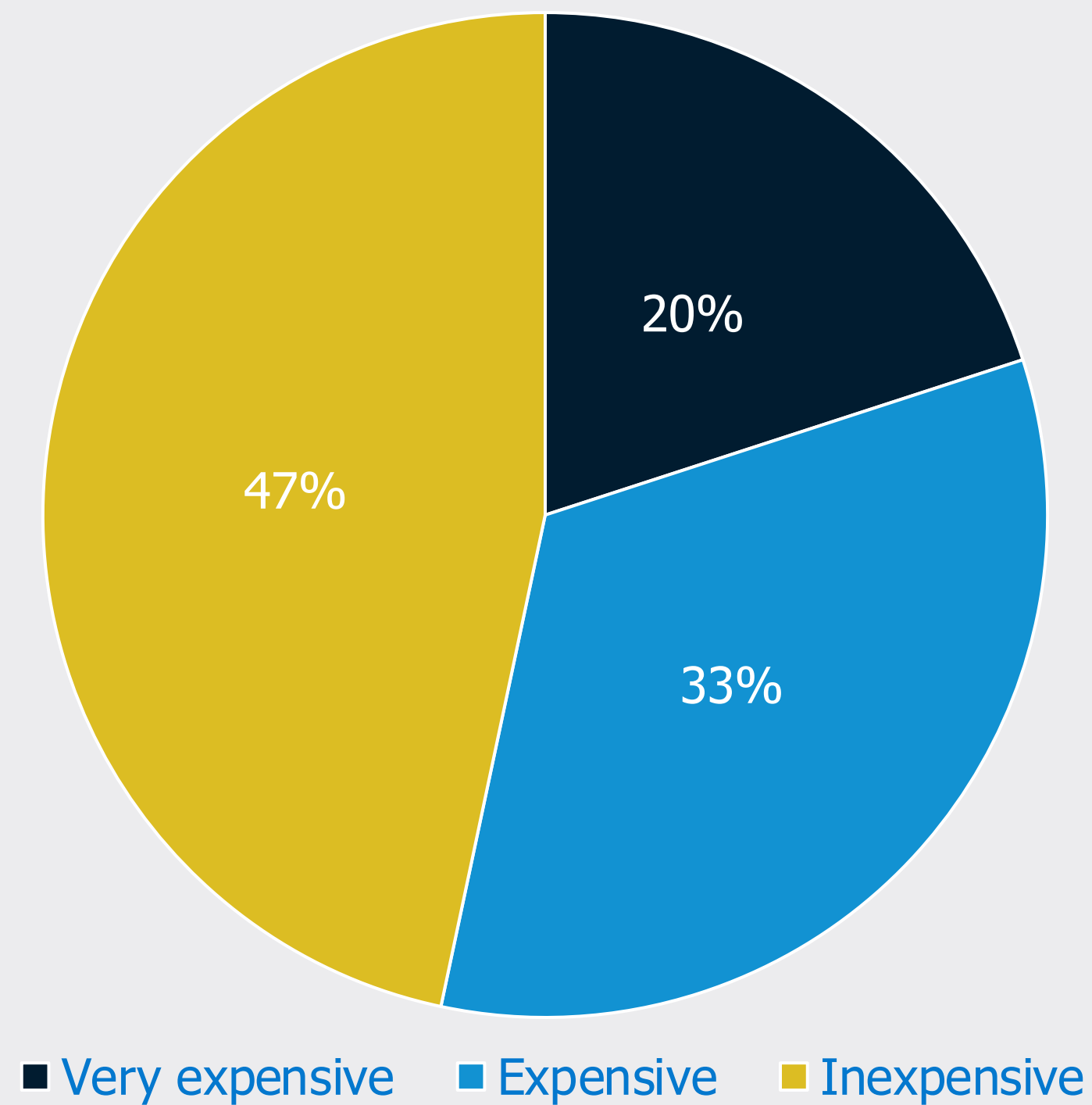
KEY CHALLENGES FACED BY USERS
Experience using solar PV / panel & storage batteries



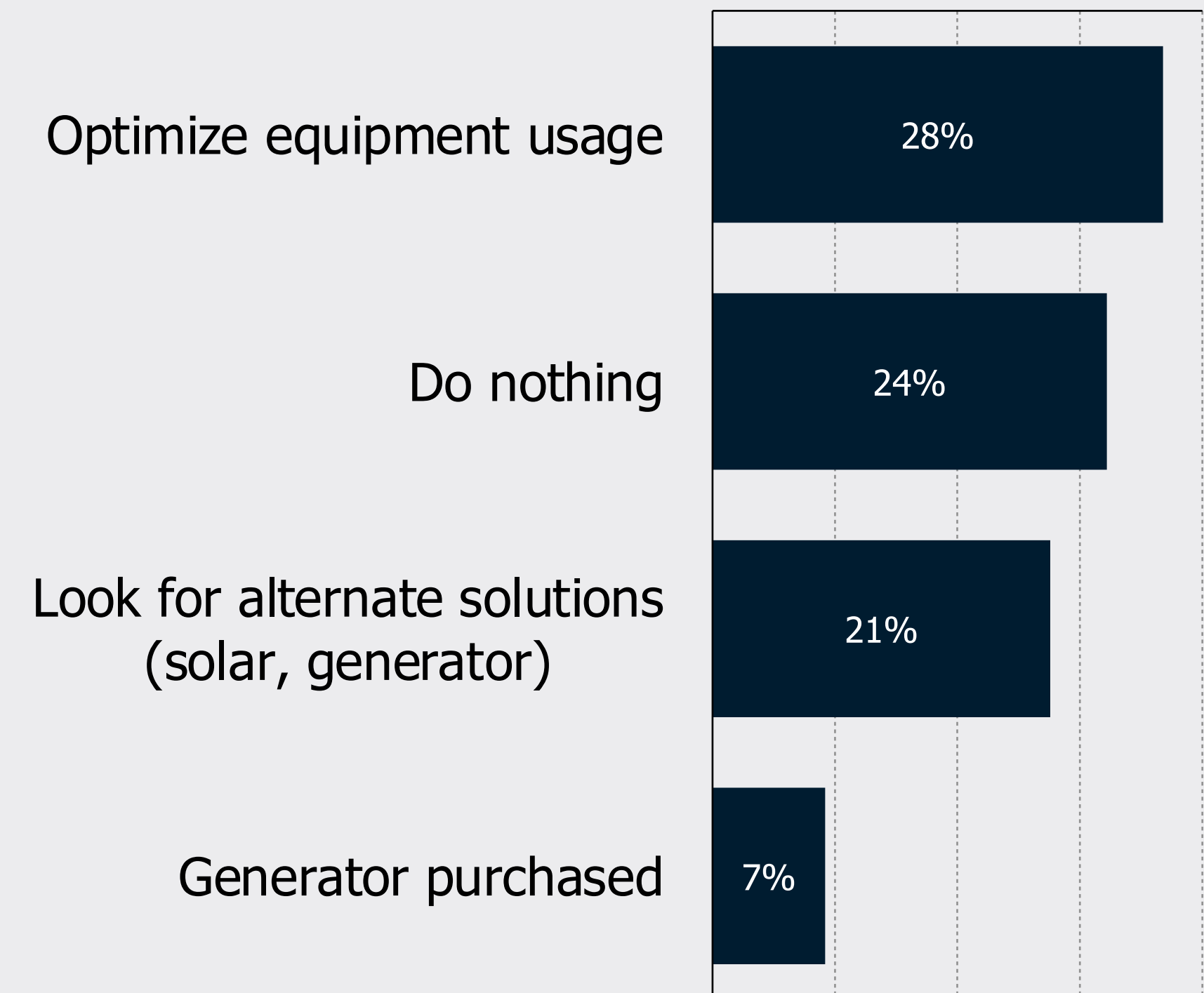
The strongest drivers to adopt the solution are demonstrating cost-saving and reliability of the solution to meet needs.

53% of C&I customers surveyed reported their current electricity supply was expensive to very expensive, where as the remainder of customers seem to have devised strategies to manage energy spend.*

SPENDS ON ALL SOURCES OF ELECTRICAL ENERGY
C&I customer's perception at country level



PLAN TO MANAGE SPENDS ON ELECTRICAL ENERGY



*Survey results could be explained from the fact that the survey was carried out shortly after reductions in tariffs. Customers are possibly viewing tariffs within the 2018' context and not in historically higher terms. These results do not reflect the 2019' increase.

Our research suggests that, prior to the 2018 tariff reductions, C&I customers powered operations from the grid until reaching consumption thresholds that triggered higher prices.

To mitigate charges, many C&I customers turned to on-site generators to power operations during these periods. This practice could resume, and potentially scale, if the underlying drivers to energy costs are not addressed, and tariffs continue to increase as expected.



RESIDENTIAL



The residential market segment in Ghana is the most lucrative opportunity for solar developers based on modeled and projected value.

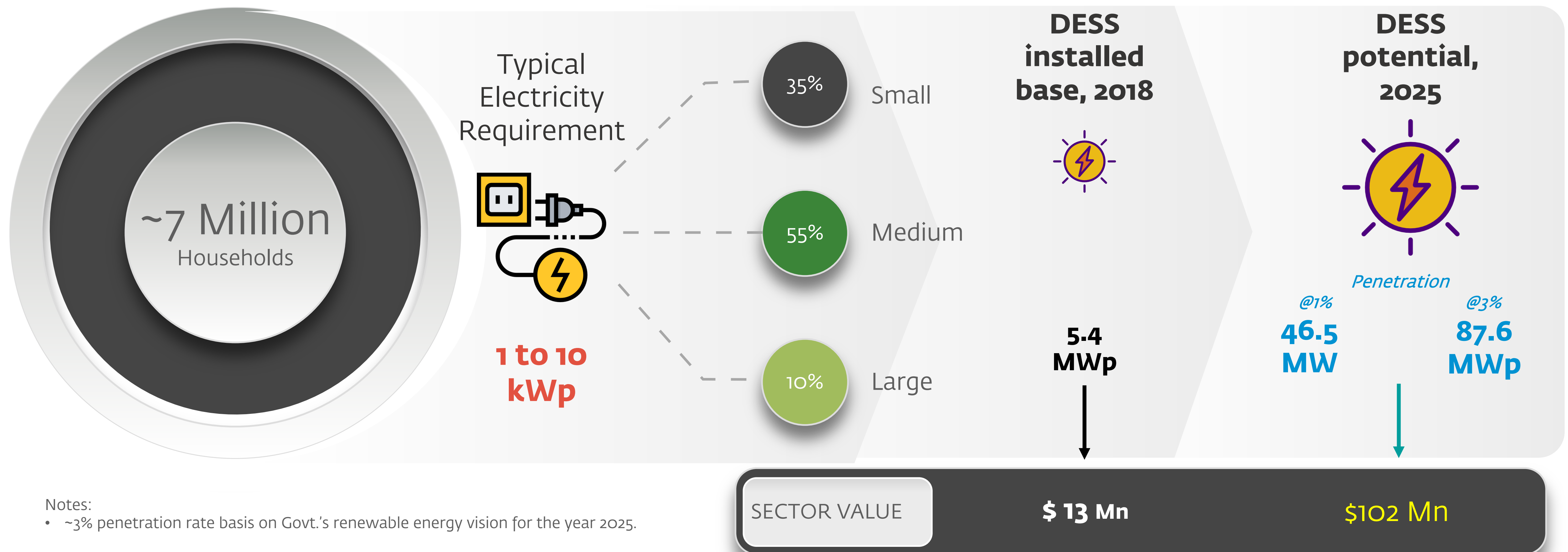
Residential customers in Ghana reported they still experience unpredictable load shedding despite an excess supply, albeit for much shorter durations and frequencies than in the past.

Potential and existing customers of solar solutions expressed that “dependable and affordable service” ranges from “important to very important,” suggesting that home solar solutions could meet a market demand. However, financing solutions are key.



RESIDENTIAL

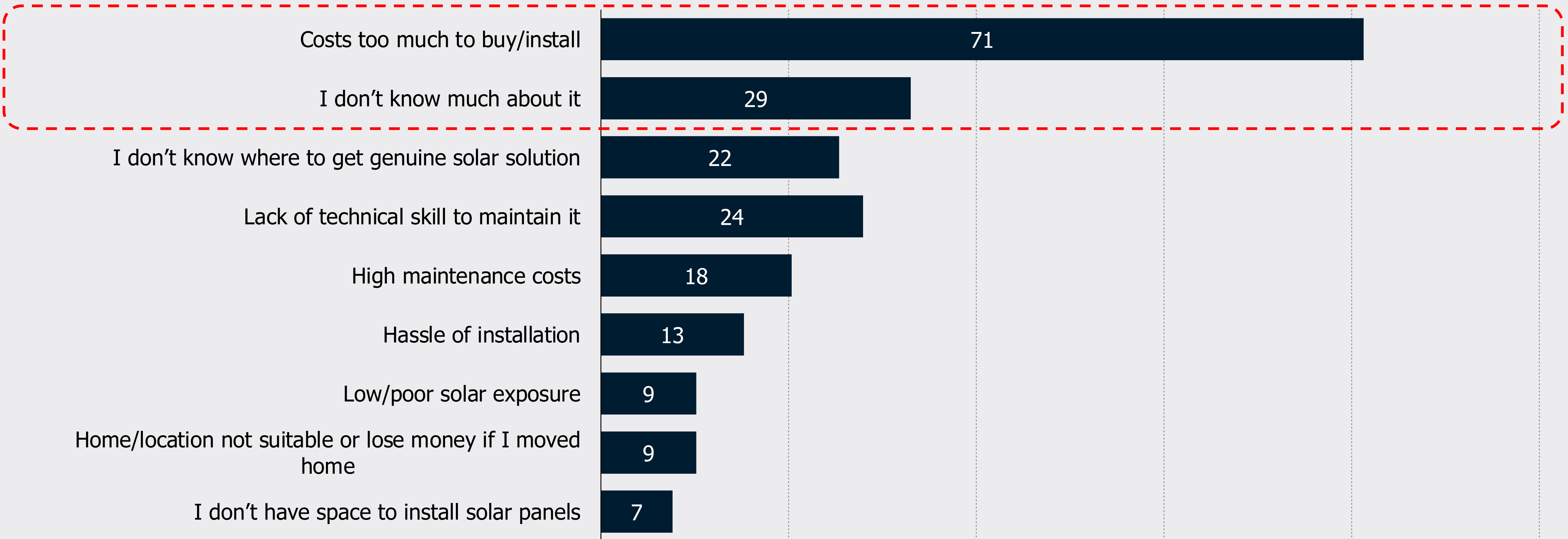
Estimated installed base of 5.4 MWp and valued at \$13 Mn in 2018. Potential to reach upto \$102 Mn by 2025



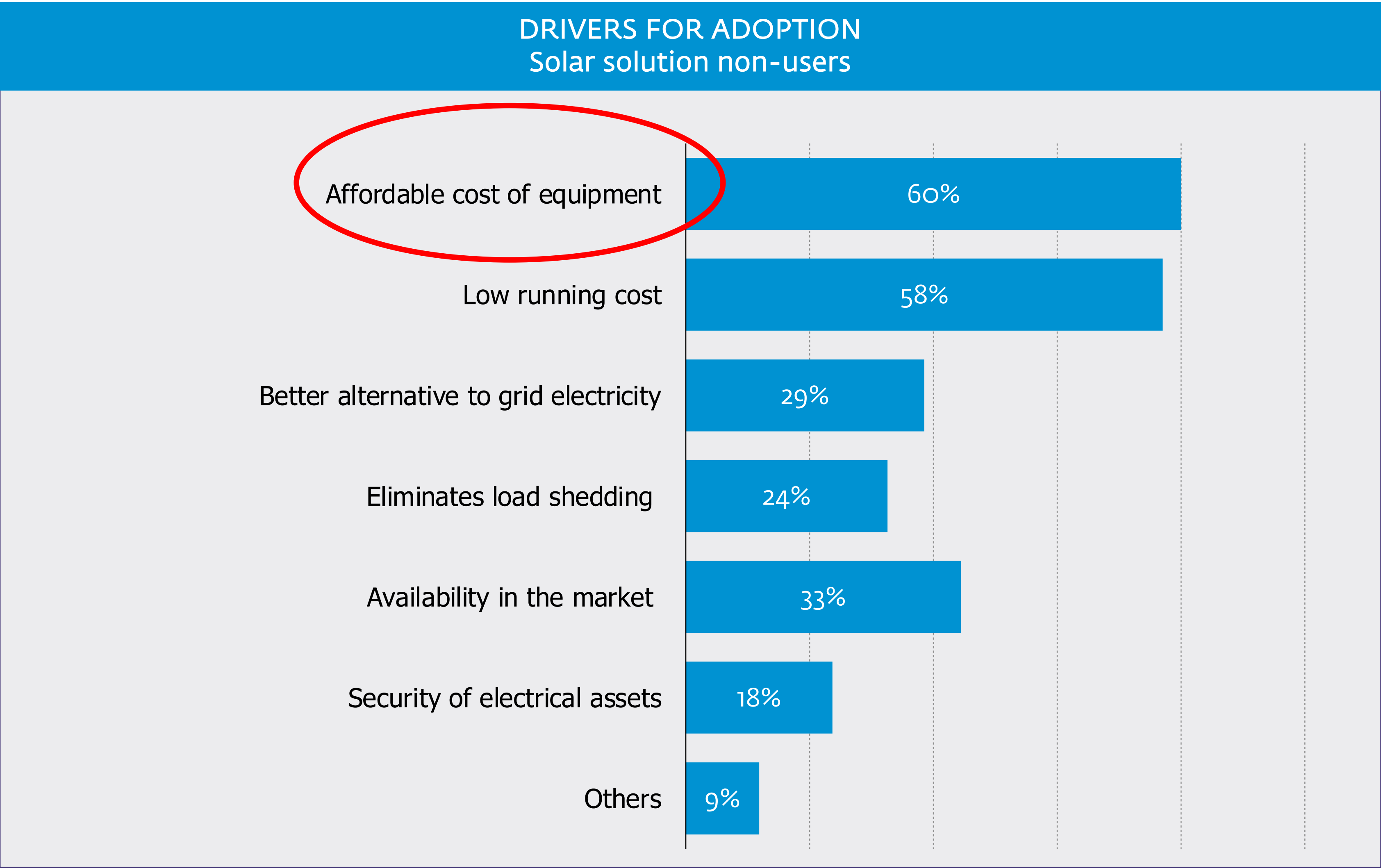
Despite an attractive market size and opportunity for developers, the residential customer segment faces market barriers.

BARRIERS TO ADOPTION

The majority of the survey respondents indicated that initial investment & installation costs were barriers to adoption; cost and lack of awareness are the key issues.



Potential users might be willing to consider solar solutions if the cost of equipment is affordable.



LIKELIHOOD FOR ADOPTION

About 40% of home owners who do not currently use Rooftop solar PV and energy storage solutions are willing to give the solution a try.



40%

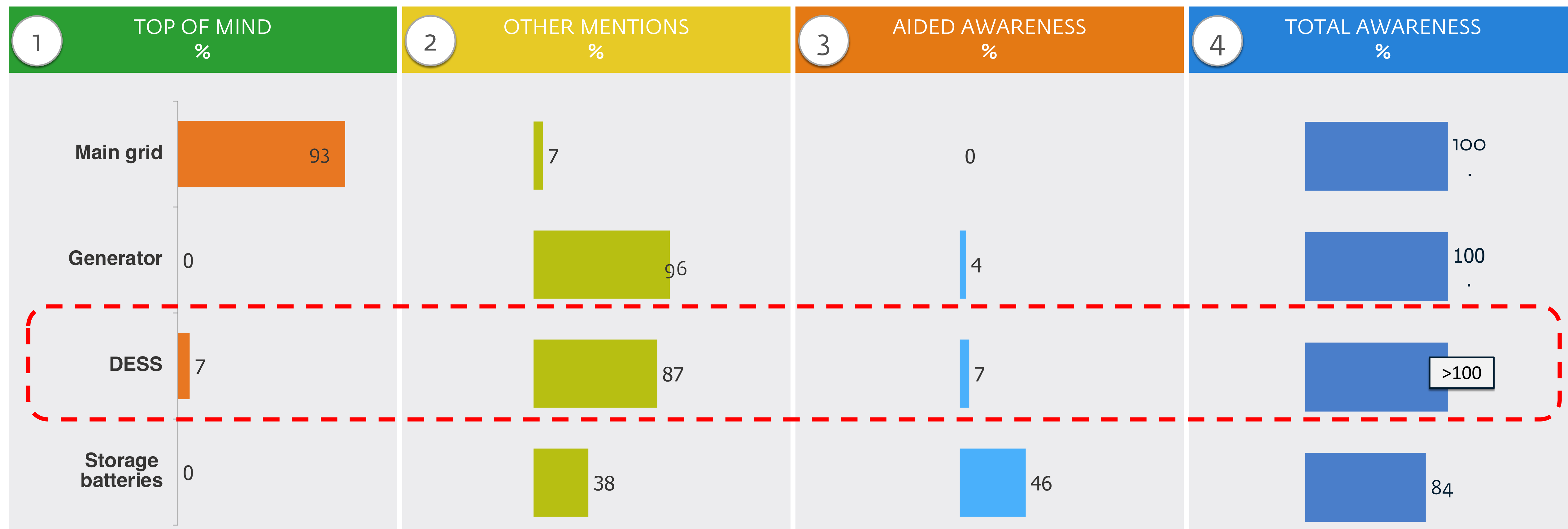
Open to solar purchase



60%

Not considering solar purchase

Awareness of Solar solutions is not top of mind to residential non-users, but were recognized as an option to power the home after further inquiry.



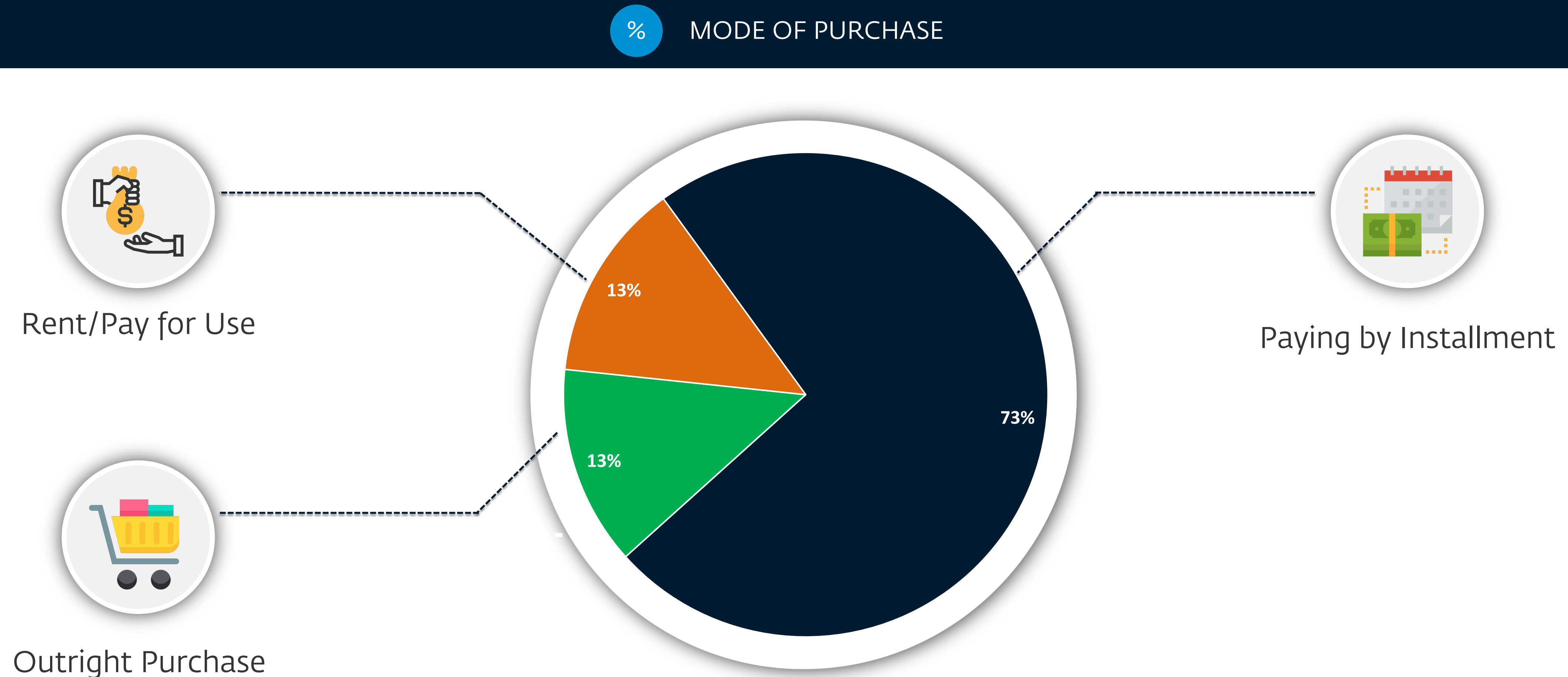
- 1.1. Based on the different types of electrical energy sources available in Ghana that your household could possibly use, which source of electrical energy comes first to your mind?
1.2. Again based on the different types of electrical energy sources available in that your household could possibly use, are there any other source(s) of electrical energy that you are aware of?
1.3. Are you aware of these other sources of electrical energy?

Source: Ipsos customer survey; Ipsos Analysis

* Some answers exceed 100% due to the total number of answer choices selected for a question were greater than the number of respondents that answered the question

Residential customers have a strong, preferred mode of procurement of Solar: Installments

Residential buyers would prefer to purchase through installment payment plans.
Only 13% would consider an outright purchase.



2.5. If solar energy solutions such as Distributed Energy and Storage Solutions were to be made available through a solar energy provider, how would you like to pay for the solution?

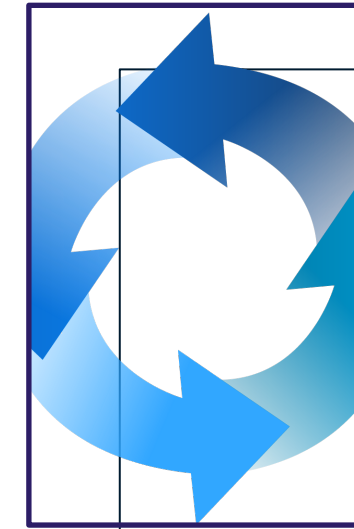


ISSUES AND CHALLENGES FACING SOLAR SUPPLIERS

There are key, early-stage issues that are hampering the growth of solar firms.



Large Demand for Capital
But Low Supply



Long Sales Cycles Tying
Up Liquidity, Providers
Forced to Offer Short-
Term Loans of 3-6 Months



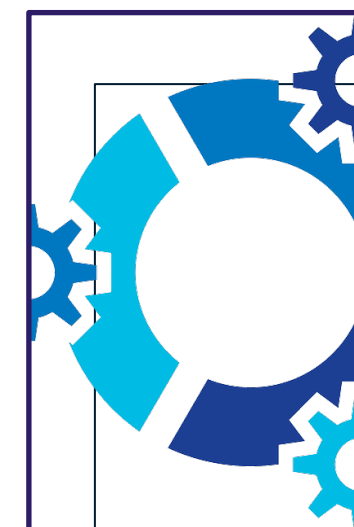
Absence of
Standardization of
Solution Designs to Fit
Each Customer Segment



Challenges Prioritizing
Customer Segments



Lack of Universal Quality
Standards.



Lack of Standard
Operations &
Maintenance Practices,
and Service Level
Agreements

Large Demand for Capital But Low Supply



Many start-up firms interviewed reported struggling to meet growing demand due to the inability to tap local currency debt. Sales pipeline was reported to be strong across many providers, but debt and / or project finance were scarce. Asset collateral and client lending history were the two top reasons reported for inability to access loans from local financial institutions.

A handful of firms sought to reconcile domestic shortages by tapping foreign sources, such as crowd sourcing platforms, and early stage venture capital.

While interest rates from European crowd sourced debt were favorable, averaging between 9-11%, FX risk still remains.

Companies struggle to meet growth aspirations due to a limited supply of local currency debt.

Large Demand for Capital But Low Supply



Ghanaian solar solution providers express why building a solar industry in Ghana is so difficult:

“IT’S NEARLY IMPOSSIBLE TO BUILD A BUSINESS WITH LOCAL CAPITAL. BUSINESSES DOING WELL IN GHANA ALL HAVE ACCESS TO INTERNATIONAL HARD CURRENCY LOANS.”

“RUNNING A BUSINESS IN GHANA, YOU MUST TAKE IT SLOWLY, RATHER THAN LEAP FROGGING – BECAUSE THERE IS NO ACCESS TO CAPITAL.”

“MOST LOCAL BUSINESSES ‘CHICKEN OUT’ AND JUST STAY AT STEADY STATE ...THEY DON’T GROW DUE TO COST OF CAPITAL OR NO ACCESS TO CAPITAL.”

Long Sales Cycles Tying Up Liquidity, Providers Forced to Offer Short-Term Loans of 3-6 Months



Without local currency debt, many firms take consumer financing into their own hands – but at a cost.

Many firms reported offering 3-6 month loan tenors on a percentage of the overall asset value (after a down payment) to broaden their residential sales and support the need for consumer financing. But performing customer credit checks, managing repayment performance and mitigating customer loan delinquency were said to be activities that were both expensive and inefficient for the solar company to perform.

Further, siphoning off sales margin to cover consumer financing instead of circulating back into procurement was reported by firms to have a negative impact on expanding their customer base. This in turn led many firms to restrict customer financing to both a limited amount of customers, as well as skewing tenors closer to 3 months instead of 6.



Challenges Prioritizing Customer Segments



Few companies articulated a clear and strategic prioritization of customer segments mapped to corresponding value propositions and firm-level strategic advantage(s).

The majority of companies interviewed struggled to articulate how they have strategically prioritized customer segments, and in turn, have not developed compelling value propositions to both meet customer objectives and out-perform competitors.

While these symptoms are indicative of any early stage market, where the focus is on capturing early adopters and rotating capital, there is a lot of room for companies to grow their market strategy.

Prioritizing where and how a firm competes, including clear value propositions to customers and barriers to entry for competitors, would help many firms distinguish themselves in the market. These strategies would create cost efficiencies as well as reduce opportunity cost derived from a fractured sales approach.

Absence of Standardization of Solution Designs to Fit Each Customer Segment

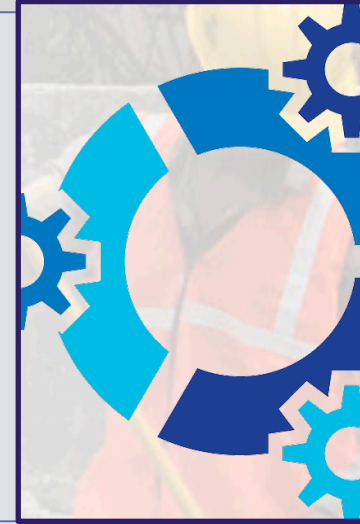


Few companies reported a standardized approach for system design, configuration, and sales to meet demand from targeted customer segments.

Many companies would benefit from a stream-lined, standardized approach to their procurement, engineering and sales strategies. By prioritizing customer segments, and narrowing the configuration options for customers with less variation in load profile (e.g. petrol stations, franchised enterprises, bank branches), companies could leverage economies of scale in procurement, and create cost and performance efficiencies for asset commissioning.

Most companies interviewed deployed a more ad-hoc approach to procuring, sizing, selling and commissioning rooftop solar assets. The lack of standards likely increase the overall solution cost to both the provider and customer.

Lack of Standard Operations & Maintenance Practices and Service Level Agreements



Both at the firm level and market level, there is a lack of standards for operating and maintaining rooftop solar assets that restricts market growth.

Interviews with firms reveal there is a wide range of practices deployed for supporting solar asset operations and maintenance (O&M). The inconsistency of O&M practices jeopardizes the rapid uptake of solar due to impacts to customer perceptions when O&M practices are subpar, and customer experiences are poor.

Further, interviews with firms reveal there is also a wide variance of Service Level Agreements (SLAs) for rooftop solar solutions, adding to the already wide variation of potential customer experiences and overall asset performance.

By agreeing to industry level standards for O&M and SLA, all solar firms will benefit from a more uniform customer experience from rooftop solar.

Companies & customers alike would benefit from market level universal quality standards.



Lack of Universal Quality Standards.

To build a solar industry that offers a consistent, quality user experience, the industry needs to adopt and abide by procurement, sizing, and installation quality standards.

These standards will ensure that customer experiences and perceptions are positively reinforced through uniform and predictable asset performance. In turn, asset performance predictability will drive the development of local bank lending as the risks associated with the asset and customer repayment discipline are decreased.



SUMMARY

Ghana presents a modest commercial and industrial opportunity, with an equally modest residential market potential for solar solutions based on overall market value.

For C&I segments, locking in energy prices with solar through 10-15 year PPAs from IPP models, or on-balance sheet acquisition of solutions with favorable interest rates presents a compelling case to mitigate future tariff increases and/or volatility.

The residential segment presents a compelling opportunity for developers to tap the mass-market.

However, across segments financing issues, risk of currency devaluation, and other market barriers persists. Barriers will need to be rectified for Ghana to reach a mature solar market.





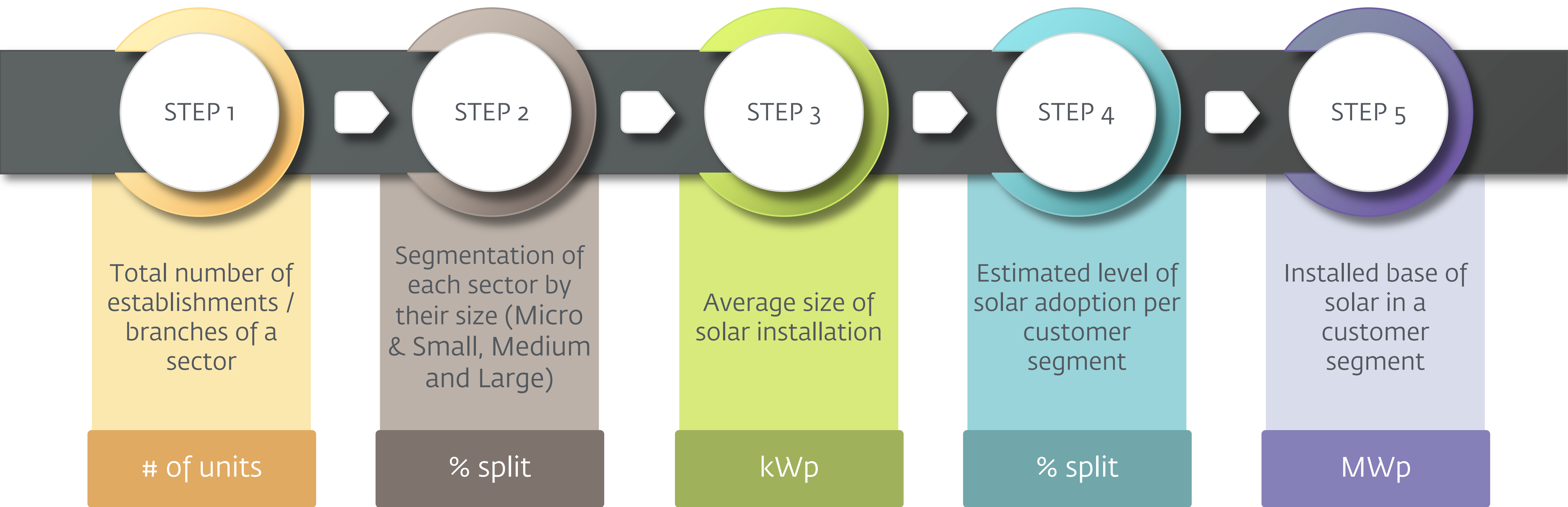
ANNEXES

Glossary

| | | | | | |
|---|------|--|----|----------------|---|
| 1 | DESS | Distributed Energy & Storage Solutions | 7 | SHS | Solar Home Systems |
| 2 | kWp | Kilo Watt Peak | 8 | EPC | Engineering, Procurement, and Construction |
| 3 | MW | Megawatt | 9 | NREAP | National Renewable Energy Action Plan |
| 4 | MWp | Megawatt Peak | 10 | SLAP | Solar Lantern Promotion Programme |
| 5 | IPP | Independent Power Producer | 11 | SLT | Special Load Tariff |
| 6 | TWh | TeraWatt Hour(s) | 12 | NREAP | National Renewable Energy Action Plan |
| | | | 13 | LV MV HV | Low Voltage (400 V) Medium Voltage (11,000 V) High Voltage (33,000 V) |

APPROACH FOR MARKET SIZING (1/2)

A five-step approach was taken to estimate the installed base of the solar market across sectors gleaning inputs from both in-depth desk research as well as key stakeholders



APPROACH FOR MARKET SIZING (2/2)

However, for estimating installed base for offices segment we used an alternative approach based on number of office-going workforce and proportion of rooftop space on which Solar can be deployed

APPROACH FOR ESTIMATING SOLAR INSTALLED BASE FOR OFFICE SEGMENT



7.2 Mn
Total
workforce



0.5 Mn
Workforce
going to
office

X



14 m²
Avg. space/
employee

=



7.4Mn m²
Gross office
floor area

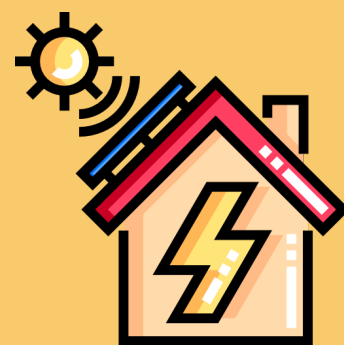
%



2.2Mn m²
Gross
rooftop
area (exc.
large
buildings)

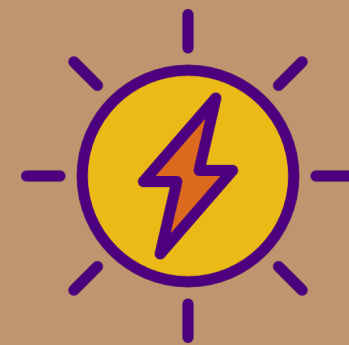


30%
Solar suitable
rooftop area



10 m²
Area required
to generate
1kWp

=



1.4-2.8MWp
Solar energy
potential
*(assuming a
maximum
penetration rate of
2-4%)*

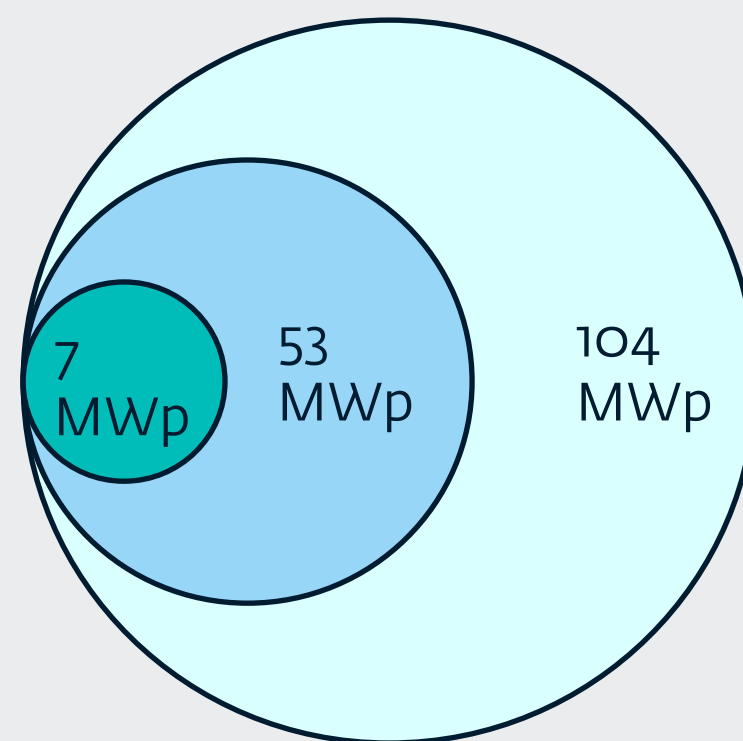
- Given an average solar radiation level of about 5.5 KWh/m²/day around 10m² of solar panel area is required to generate 1KW of electricity. Using this assumption total generation potential is ~70MWp per annum.
- Once we arrived at total deployable size, i.e. 70MWp, a ball-park percentage of adoption rate was used to estimate installed base of 2018.
- Foreseeable challenge to implementation are:
 - Adjacent buildings likely to limit efficiency of solar panels
 - Limited rooftop space is likely to put a cap on the amount of energy generated per site

DEMAND SIDE ANALYSIS – INCLUDING MSMEs

Size of Market

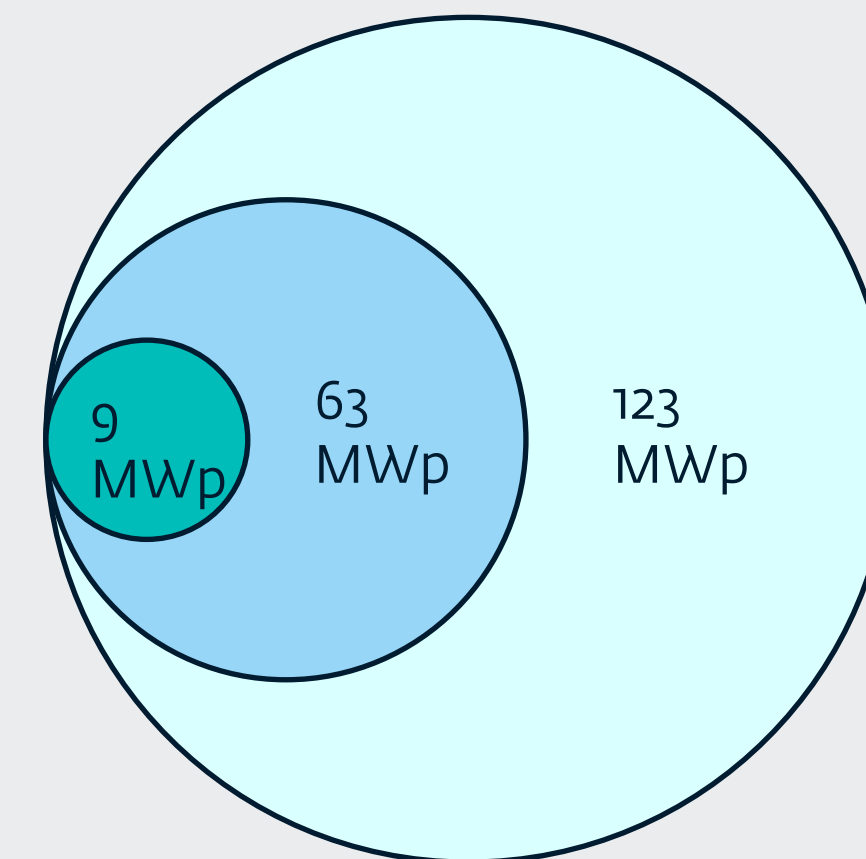
If we include micro enterprises as well in the overall universe of DESS, total addressable market of C&I segment is expected to reach 63 – 123 MWp; valued at USD138 – 144 Mn by 2025.

Scenario considering only SMEs
2025, in MWp



- Installed base in 2018
- Installed base in 2025 @1% penetration
- Installed base in 2025 @2-4% penetration



Scenario considering MSMEs
2025, in MWp



- Installed base in 2018
- Installed base in 2025 @1% penetration
- Installed base in 2025 @2-4% penetration

Notes:

- ~2-4% penetration rate basis on Govt.'s renewable energy vision for the year 2025.
- Typical installation size of Micro enterprises ranges between 0.1 to 3 kWp across Commercial; upto 5kWp in Industrial customer segment.
- As per the latest census available for Ghana, number of Micro enterprises across customer segments are: Wholesale & Retail: 209460; Transport and Storage: 74,142; hotels / accommodation: 55,667 ; health service: 50,900 ; Education: 28,532 ; Mining: 9,562 and manufacturing: 173,213

| SEGMENTS | SMEs | | | MSMEs | |
|---|----------------------|-----------------------|----------------------|-----------------------|----------------------|
| | Installed base, 2018 | Market (Volume), 2025 | Market (Value), 2025 | Market (Volume), 2025 | Market (Value), 2025 |
|  Commercial | 2.78 MWp | 21.3 – 38.7 MWp | \$45 – 47 Mn | 26.6 – 49.1 MWp | \$57 – 58 Mn |
|  Hospitality & Tourism | 0.25 MWp | 1.8 – 3.6 MWp | \$4 Mn | 2.2 – 4.3 MWp | \$5 Mn |
|  Healthcare | 0.04 MWp | 0.3 – 1.0 MWp | \$0.6 – 1.2 Mn | 0.3 – 1.2 MWp | \$0.6 – 1.3 Mn |
|  Education | 0.11 MWp | 0.8 – 3.0 MWp | \$1.7 – 3.5 Mn | 0.8 – 3 MWp | \$1.7 – 3.5 Mn |
|  Agriculture | 0.01 MWp | 0.8 – 3.0 MWp | \$0.2 – 0.5Mn | 0.1 – 0.4 MWp | \$0.2 – 0.5Mn |
|  Government | 0.08 MWp | 0.6 – 1.2 MWp | \$1.4 Mn | 0.8 – 1.5 MWp | \$2 Mn |
|  Industrial | 3.94 MWp | 28.2 -56.3 MWp | \$62 - 66 Mn | 31.9 – 63.8 MWp | \$70 – 74Mn |
|  Residential | 5.44 MWp | 46.5 – 87.6 MWp | ~\$102 Mn | 46.5 – 87.6 MWp | ~\$102 Mn |
| TOTAL | 12.64 MWp | ~100 – 192 MWp | \$219– 224 Mn | 109 – 211 MWp | \$ 240 – 246 Mn |

Renewable Energy Act 2011

The renewable energy act of 2011 requires an electricity distribution utility or bulk customer to procure a specified percentage of its total purchase of electricity from renewable energy sources and provides incentives, a guaranteed Feed-in-Tariff to renewable energy producers

**5
MW**

TOTAL EXISTING INSTALLED
CAPACITY

**3.3
MW**

GRID
CONNECTED
SYSTEMS.

As a contribution towards the attainment of the 10% renewable energy target in the electricity mix by 2020 and to pursue the SE4ALL Action Agenda by 2020, the following solar programs and activities have been initiated:

- I. The Energy Commission has issued site clearance permits for 15 independent power producers (IPPs) for utility-scale power projects;
- II. The Ministry of Power and the Energy Commission are developing a new private-led framework to promote the installation of about 200,000 solar home systems (SHS) through net metering; National Renewable Energy Action Plan (NREAP) of Ghana
- III. There is also the Solar Lantern Promotion Programme (SLAP). This programme aims to promote the distribution of 2,000,000 high-quality solar lanterns in deprived and remote off-grid communities by 2020. Since 2013, 80,000 have been procured, and over 50,000 of them sold with a 50% subsidy.

The government of Ghana has developed a draft of the Net Metering Code.

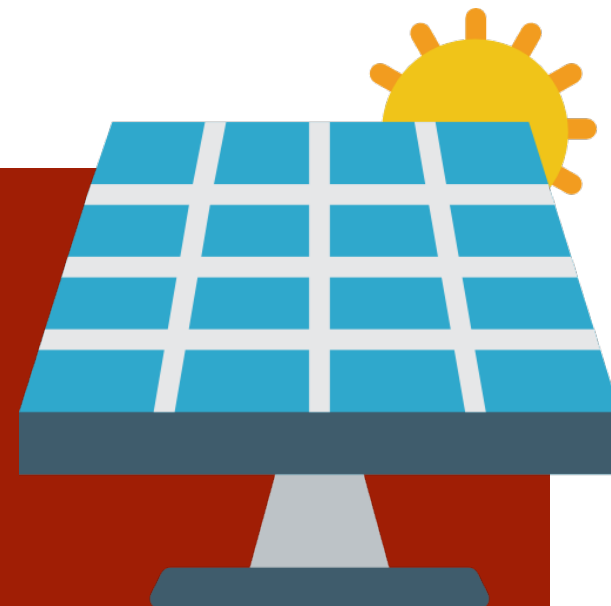
- Net metering is designed for applications where the renewable energy generation is not being used as a back-up to the main source of power supply. Instead, the excess energy is supplied to the Distribution Utility, on the assumption that the amount of energy supplied to the grid will not exceed the amount purchased over an annual tracking period.
- It is planned, that only renewable energy generators with capacity up to 200 kW will be able to benefit from the net metering support.

The National Rooftop Solar PV Program

It is a capital subsidy scheme under which beneficiaries are given a capital subsidy to cover the cost of the solar panel component of the system.

FREE Solar PV Panels

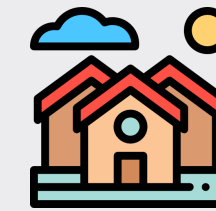
Up to a maximum of
500Wp ~ USD 396



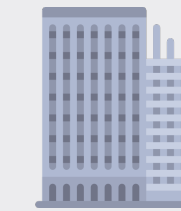
OBJECTIVE

To **INSTALL 200,000 solar PV systems** on rooftops in the country to reduce peak load up to **200 MW** in the medium term.

BENEFICIARIES



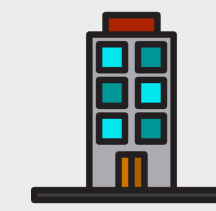
Homes



Offices



Hospitality



SMEs

Phase 1: Target 20,000 installations in residential facilities

CRITERIA FOR PARTICIPATION

APPLICANTS MUST

- Change all lamps at his/her facility to LED lamps.
- Purchase the Balance of System (BoS) components such as inverter, batteries, charge controllers, changeover switch and wires, etc.
- Use only solar PV installers licensed by the Energy Commission for all the installation works. The government of Ghana has developed a draft of the Net Metering Code.