Manufacturing Africa

The opportunity for Commercial & Industrial solar in Senegal

March 2022

This study has been funded by UK aid from the UK Government; however, the views expressed do not necessarily reflect the UK government's official policies

Contents

Key Messages

Issue

- **Industrial energy users face some of the highest tariffs in Africa.** High dependency on the use of liquid fuels for power generation means that electricity tariffs are ~5 $c/kWh (~25%) higher than in peer countries such as Ghana or Cote d'Ivoire. The availability of domestic gas resource may not provide much relief unless international commodity prices fall back from their current highs.

Trends

- **Falling solar costs offer the potential for industrial customers to better manage their energy costs.** Solar PV costs have fallen rapidly in recent years and many commentators expect costs to continue falling. For many businesses, especially those with 7-days-a-week operations, solar would lower energy costs.
- **Corporates are increasingly paying close attention to the emissions from their energy consumption.** An increasing number of companies are setting ambitious emissions reduction targets. The ability to implement measures such as C&I solar is likely to be increasingly important in deciding where to invest.

Potential

- **No major issues with grid stability have been attributed to C&I solar in other countries,** including in countries such as South Africa, where C&I solar is ~1.5% of the capacity mix. In Senegal, several initiatives (such as OMVG, and development of battery storage projects) will improve resilience of the grid.
- **It is estimated that the market potential for C&I solar in Senegal is >200 MW,** and that this could increase to 380-500 MW by 2030 as electricity demand continues to grow.

Unlocking the potential for C&I solar

- **Technical decrees being drafted to implement the energy code could define a clear regulatory framework for supporting C&I solar. .** Specifically:
  - **Removal of restrictions on ownership** of C&I projects, allowing for the implementation of projects using lease or PPA business models.
  - **Clarity over licencing.** Ideally this should allow for smaller projects to be implemented without a full generation licence. Where licences are required it is critical that the process and requirements for securing a licence are simple and unambiguous.
  - **Review of off-peak retail energy tariffs**, to ensure that these tariffs are cost reflective and do not unintentionally undermine the business case for C&I solar.
  - **Clear arrangements for the export of surplus energy**, which can greatly improve the business case for C&I solar projects. Clarity is required over any eligibility criteria for projects to be able to export surplus energy, and the commercial arrangements (i.e., the tariff and the means by which this is contractually secured) for selling that surplus.
  - **Regulatory framework for wheeling power.** Clearly defined and predictable wheeling tariffs could act as an enabler for more ambitious, larger C&I solar projects that are not co-located with customer loads.

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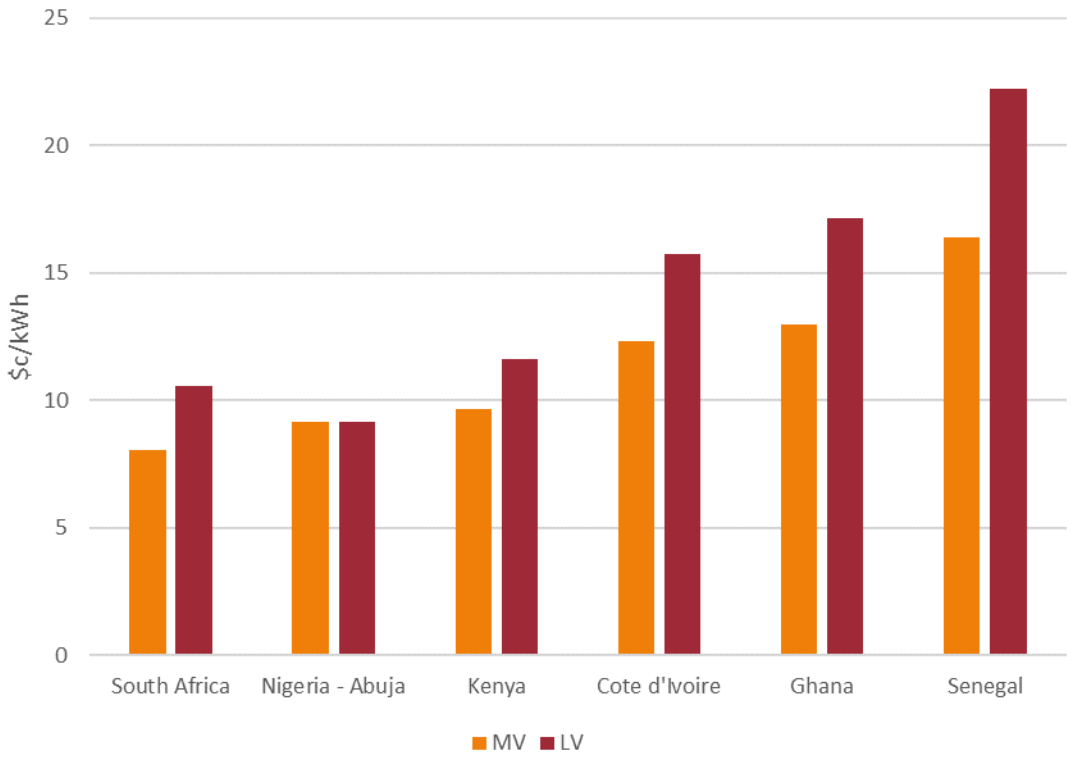
C&I energy users in Senegal face some of the highest energy costs in Africa

Electricity tariffs for industrial energy users

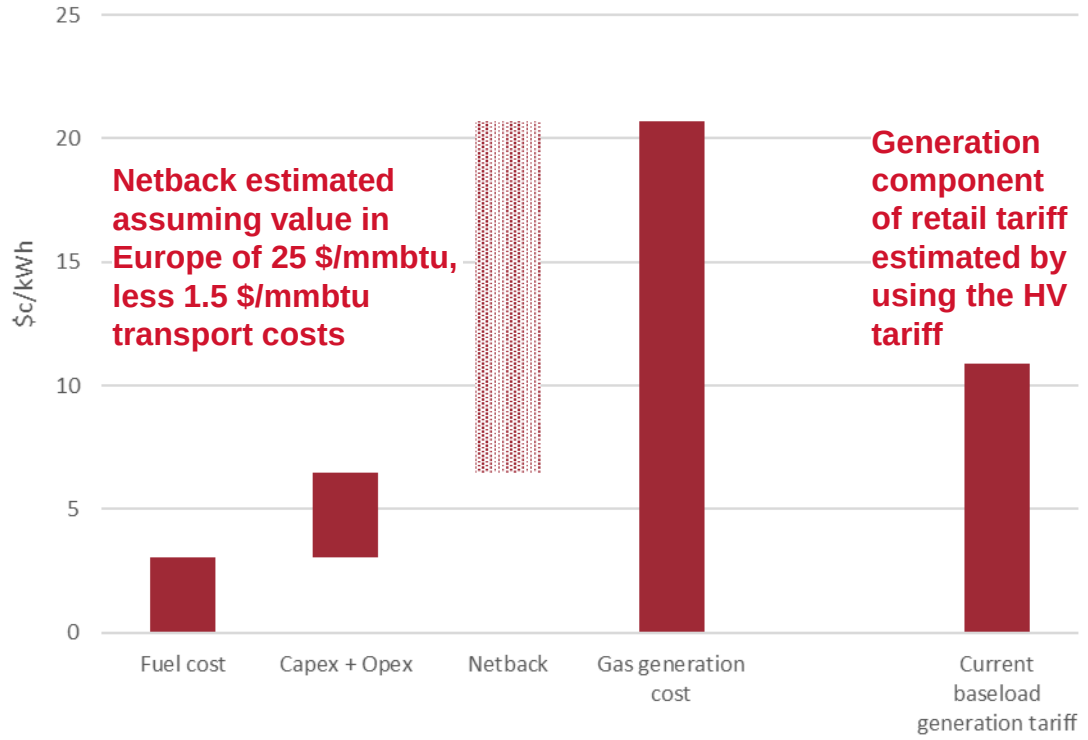
Senegal is highly dependent on expensive liquid fuels for power generation. Largely as a result, retail electricity tariffs for industrial customers are ~5 $c/kWh higher than in either Ghana or Cote d'Ivoire.



Source: *Analysis of data from Senelec, and other utility and regulator websites*

Cost of natural gas

Soaring commodity prices mean that domestic natural gas production may provide little relief to electricity prices. Gas prices are likely to reflect the value of the commodity in international markets, not only the raw cost of production.



Source: *Analysis of news articles*

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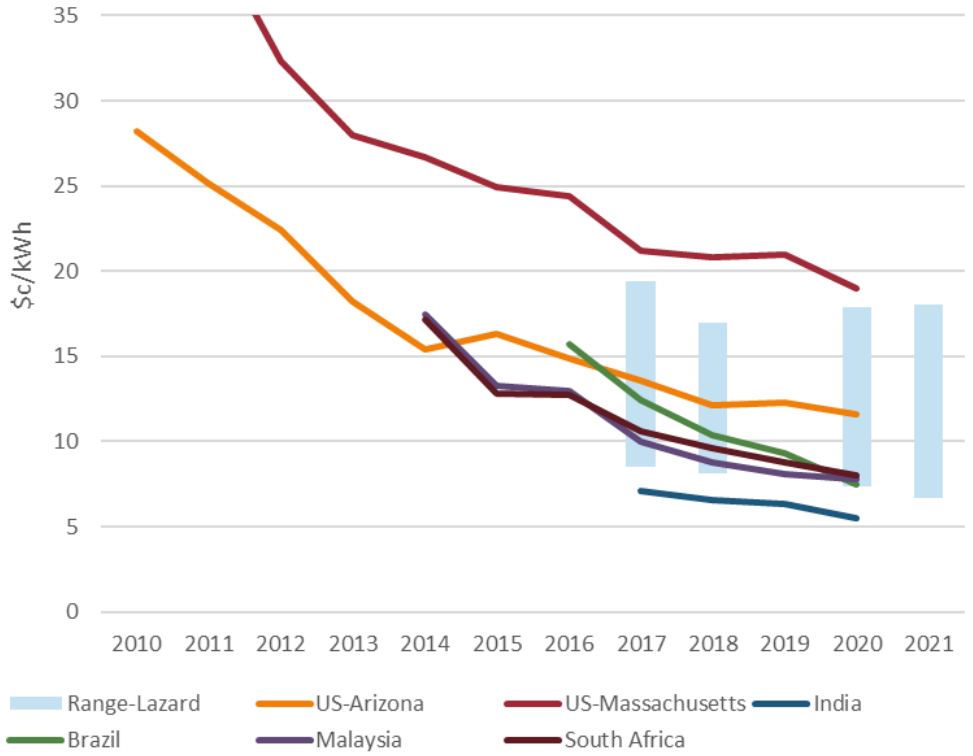
Falling solar costs mean that C&I energy consumers can use on-site energy to cut costs

Levelised cost of solar

Solar capital costs have fallen rapidly in recent years. Levelised cost (the average cost of generating a unit of electricity over the lifetime of a project) has therefore also fallen.



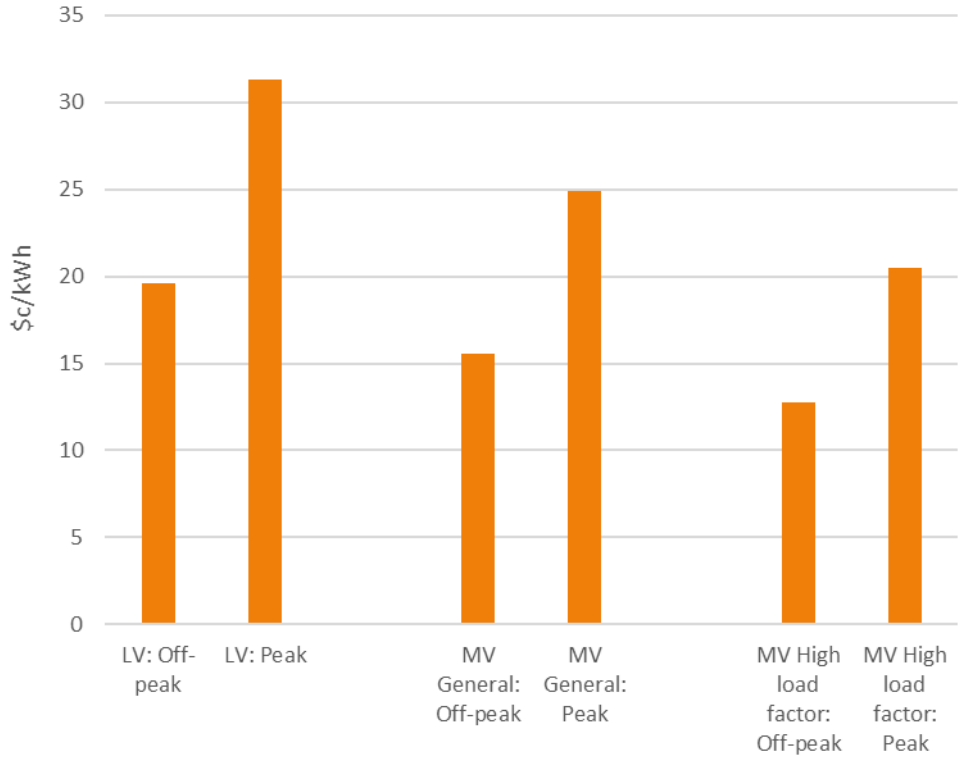
Source: *Analysis of data for C&I scale solar PV projects from Lazard, IRENA*

Senelec C&I unit rates

Lower solar costs means that the cost of on-site solar compares well against the marginal unit cost of retail electricity. Note that these unit costs are lower than the all-in tariff shown on the prior slide, which includes fixed costs.

C&I solar is always likely to be cheaper than Senelec during peak hours

Solar still likely to save costs for most energy users during off-peak hours



Source: *Analysis of data from Senelec*

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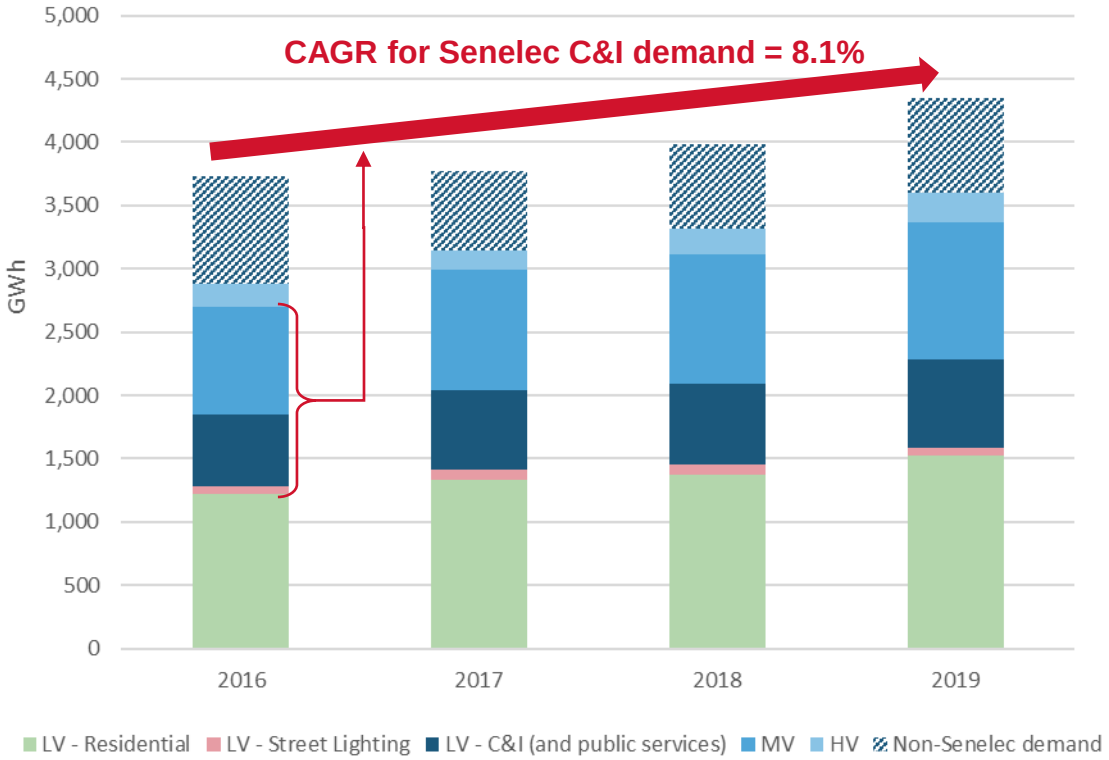
The C&I solar sector in Senegal could reach ~500 MW by 2030 if existing regulatory barriers are removed

Growth in industrial electricity demand

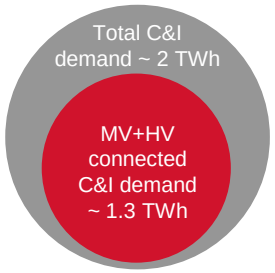
High GDP growth has driven growth in commercial and industrial demand for electricity in recent years. Demand has grown at a CAGR of 8.1% p.a., with just over 2 TWh of demand connected to the Senelec network in 2019.



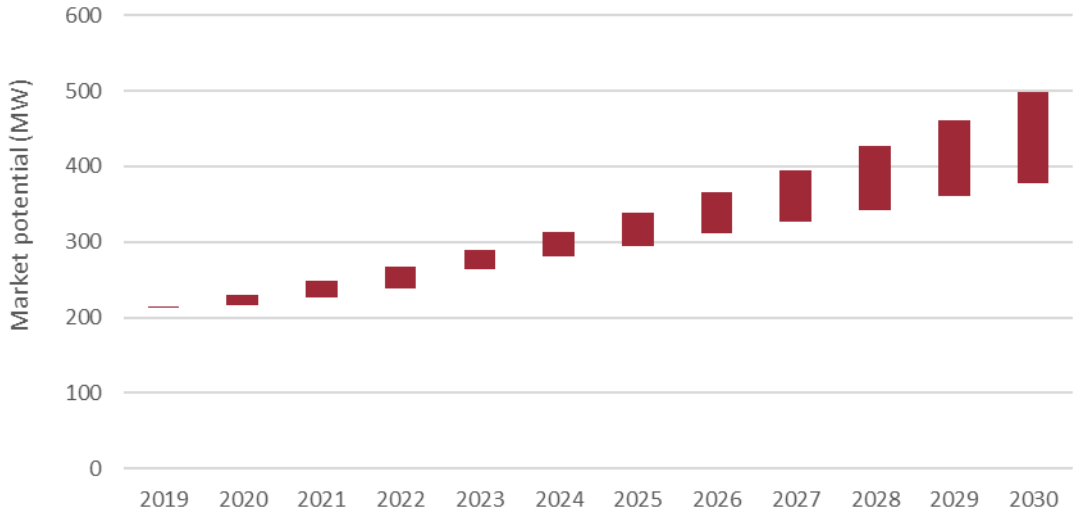
Source: *Analysis of data from CRSE, IEA*

Market potential for C&I solar

High utility costs and business demand for low carbon power means that solar could be an attractive option for many of these energy users. The C&I solar opportunity could be as high as 500 MW by 2030.



- If the main market opportunity is MV and HV connected loads, this is equivalent to ~1.3 TWh.
- Assuming an all-day (24/7) energy consumption profile, this equates to ~150 MW.
- Taking an average solar profile for Senegal, this could likely accommodate ~210 MW of solar, which could grow to 380-500 MW by 2030 as demand grows.



- See Section B of the detailed evidence base (page 62) for detailed analysis on the market potential described above.

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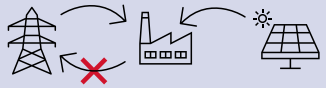
Several countries in Africa have a better enabling environment for C&I solar than Senegal (for example, through more clearly defined permitting / licencing requirements and in one country (South Africa) some scope for exporting surplus generated electricity

Country	C&I solar market size* (MW)	Behind the meter *Energy is generated and used exclusively onsite by the C&I energy consumer. No energy is sold back to the grid.*			Exports *Most energy is used onsite, but excess energy generated can be sold to the grid.*		Wheeling *Solar energy is transported across the grid from a separate solar generation location.*	
								
		No restriction	Declaration only	Full licence	Legally allowed	Implemented	Legally allowed	Implemented
Senegal	9	Undefined	Undefined	Undefined	✓	×	✓	×
Kenya	28	< 1 MW	NA	> 1 MW	✓	×	✓	×
Morocco	4	20 kW	20 kW – 2 MW	> 2 MW	✓	×	✓	×
South Africa	805	100 kW	100 kW – 100 MW	> 100 MW	✓	~	✓	~
Nigeria	55	< 1 MW	NA	> 1 MW	✓	~	✓	~
Côte d'Ivoire	<1	500 W	500 W – 20 kW	> 20 kW	✓	×	✓	×
UK	>1,000s	Most C&I projects	NA	Exporting >50 MW	✓	✓	✓	✓
France	>1,000s	<50 MW	NA	>50 MW	✓	✓	✓	✓

** Market size analysis is based on aggregation of a wide range of primary data sources, mostly from AfSIA (Link) and BP (Link)*

- Other countries have a more favourable enabling environment for C&I solar:
  - Licensing thresholds and requirements are often clearly defined.
  - In many markets, the threshold for a full licence is high.
  - Some markets allow C&I energy consumers to export and even wheel energy. However, only a small number of countries (e.g., South Africa) allow for this in practice. More countries have a legal framework for supporting the export of surplus energy in place, but have not implemented this in practice.
- C&I energy consumers in countries with favourable regulatory regimes are better able to manage their energy supply to optimise their cost base and to ensure they meet security of supply requirements.
- Increasingly, companies are also demanding the flexibility to manage their carbon footprint and gain access to low or zero emissions power.

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The new Electricity Code creates barriers to investment in C&I solar that need to be urgently resolved

- The techical decrees currently being drafted should provide clarity on a number of articles in the new law. While the previous legal framework was not optimal for C&I solar, it is now unclear whether many projects that were possible under the previous law would be possible under the new Code.
- The lack of clarity in some transition clauses in the Electricity Code means that projects are on hold until these issues are resolved.

#	Issue	Description
Level 1 – Issues that affect all projects		
1A	Restrictions on ownership and business model	The new Code does not allow third party owned assets to elect for the "declaration regime", which removes the need for a licence. Therefore, a third party owned project would be required to secure a licence.
1B	Licensing threshold or process not defined	The new Code states that auto-producers with capacity over some capacity threshold, or any auto-producer wishing to export power, will be required to secure a licence. The quantum of the threshold is not defined. No process for securing a licence has been defined so it is unclear how mechanistic this will be.
1C	Tariff design	Most C&I customers are on a time-of-use tariff with Senelec, which charges a much lower tariff during off-peak hours (i.e., when solar is generating). Given the prevalence of oil-based generation on the grid, it is unclear whether this tariff structure truly reflect the marginal economics of the generation sub-sector.
Level 2 – Issues restricting export potential		
2A	Eligibility for export	A previous decree, issued under the now repealed Renewable Energy law, stated that C&I customers would be able to export up to 10% of onsite power generation. The new Code states that a threshold shall apply, but this threshold is not defined.
2B	Commercial arrangements for export unclear	There is no route-to-market for exporting surplus energy from C&I solar projects.
Level 3 – Issues restricting wheeling of power		
3A	No commercial framework for wheeling	The new Code allows for third party access to the transmission and distribution networks. However, the market arrangements and wheeling fees that would allow for such access to become a reality are not defined.

- See Section A of the detailed evidence base for detailed analysis of the specific Electricity Code references that result in the issues described above.

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A tactical approach is required: focusing on regulatory detail that will be defined through upcoming decrees

Issue	Suggested actions	Next steps	Timing	Priority
Issue 1A: Restrictions on ownership and business model	Requirement that C&I solar projects should be owned by the user should be removed.	Legal advice suggests that *Law 2021/31* could be 'interpreted' favourably by CRSE decision.	No existing process or plan to initiate one.	High – legal opinion suggests that CRSE should be engaged now so that they can issue a formal decision to favourably interpret the Code.
Issue 1B: Licensing threshold and process	Thresholds / eligibility requirements for licensing should be defined. The process for applying for a licence should be clearly defined.	Decree consultation coordinated by MCA.	Second half of January 2022.	**High** – these details will be defined through decrees to be drafted over the coming weeks. Now is the time to engage with this process.
Issue 1C: Design of electricity tariffs for C&I energy consumers	Methodology for calculation of ToU tariffs should be published. This should reflect the marginal cost of power generation.	CRSE oversee tariff regulation.	Ongoing.	**Low** – no immediate time sensitivity. Until the methodology is published, it is unclear how far the methodology deviates from best practice.
Issue 2A: Eligibility for exporting surplus power	Exports of surplus power should not be restricted through regulation.	Decree consultation coordinated by MCA.	Second half of January 2022.	**High** – these details will also be defined through the drafting of decrees.
Issue 2B: Arrangements for exporting surplus power	A clear route-to-market should be defined for exporting surplus power.	Decree will delegate definition of this route-to-market to CRSE.	After finalisation of the decrees.	**Medium** – this cannot be taken forward until responsibility has been formally delegated to CRSE.
Issue 3A: Commercial framework for wheeling power	Arrangements should be implemented, including definition of wheeling tariffs.	Implementation of the Electricity Code, being overseen by MCA.	Not a priority decree, but must be implemented by late 2023.	**Medium** – likely to be an area tackled by MCA and others during 2022.
	Engage with WAPP to establish a meaningful regional electricity market.	Existing three phase plan.	Progress has stalled.	**Low** – progress has stalled and requires consensus across all ECOWAS member states.

See Section A of the detailed evidence base for detailed analysis of the specific Electricity Code references that result in the issues described above.

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A 3-phase plan is proposed, focusing on barriers to be addressed through the decrees during early 2022

Short-term

- In the short-term, the focus should be on policy decisions that can be tackled through the drafting of decrees over the coming months.
- The decree to implement *Articles 29, 30* of the Electricity Code will define the thresholds and eligibility requirements for the licensing and/or declaration of generation facilities and the process for securing a licence where applicable.
- The decree to implement *Article 25* will define when it is possible to export surplus power from auto-producer sites.
- MCA plans to have both decrees ready for review during Q1 of 2022.
- Alongside addressing regulatory barriers, an office (possibly resident in APIX) could be established to help solar companies engage with the market and catalyse project opportunities.

Medium-term

- Decision making processes relating to other priority actions will unfold over longer timescales.
- Removing restrictions on third party involvement in C&I projects will require a CRSE decision that favourably 'interprets' the Code. If this is not forthcoming, primary legislation may be required to remove these restrictions.
- Definition of a dependable route-to-market for the sale of surplus energy can only take place after the decree to implement *Article 25* has been approved.
- Other parts of the Code, such as implementation of third party access, are lower down MCA's priority list and are less important to most C&I solar projects.

Long-term

- In the longer-term, the enabling environment for more ambitious cross-border C&I solar projects could be improved by engaging in implementation of a meaningful regional electricity market through WAPP.
- Transparency concerning the setting of ToU tariffs could also be improved to ensure that these reflect international best practice.

Detailed evidence base: Appendix A

Policy and regulatory analysis

Key energy sector institutions

Senegal's electricity sector remains dominated by state-controlled actors

- Ministry of Petroleum and Energy (MPE) has overall responsibility for energy sector policy in Senegal.
- The Minister also has ultimate responsibility for licensing; licenses and concessions are issued by decree.

- A sector regulator, CSRE, was formed by Law 98-29, in April 1998.
- CSRE's responsibilities are focused primarily on tariff regulation.

- Senelec is the incumbent vertically integrated utility.
- Senelec operates under a 'concession' agreement dated 1999 with the Government of Senegal, which was intended to lay the path to privatisation. 34% of shares were sold to Hydro-Quebec and Elyo, but the deal was annulled by President Wade in 2000.
- Senelec now remains 100% state-owned. It is the offtaker for IPPs.

- The sector remains dependent on subsidy through Ministry of Finance.
- This is administered through a separately managed energy sector support fund, FSE.

- The Rural Electrification Agency, ASER, was created in 1999 and is responsible for coordinating and tendering for electrification projects.
- Where required, this draws on funding from Ministry of Finance.

- ANER was created in 2013 to promote the use of renewable energy.

- AEME was created in 2011 to promote energy efficiency.
- Both ANER and AEME are operational agencies within the Ministry of Petroleum and Energy.

Other stakeholders relevant to C&I solar

Because C&I solar can help catalyse industrial growth, not only energy sector stakeholders are interested

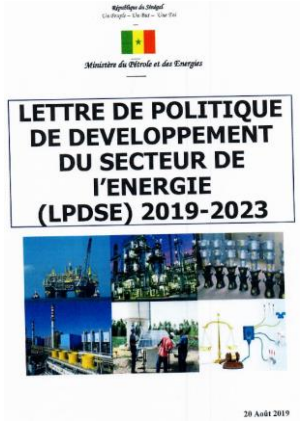
- Ministries beyond MPE are relevant to the promotion of C&I solar.
- The flagship *Plan Senegal Emergent (PSE)* aims to grow key sectors including energy, industry, agriculture and food, and health and pharmaceuticals.
- Ministry of Industrial Development and Small and Medium Industries (MIPMI) oversees implementation of the plan and notes that high energy costs are a major barrier to its success.
- The Operational Unit for delivery of the PSE oversees implementation of Green PSE, as well as overseeing the contribution of policy actions to reaching NDC targets.

- Bureau de Mise a Niveau is supervised by MIPMI and is charged with assisting companies in 'upgrading' or 'modernising' to improve the competitiveness of Senegalese industry.
- One of BMN's focus areas is energy, and it has assisted a number of companies in improving energy efficiency.
- BMN, which is supported by multiple donors including GIZ and AFD, often funds 30-40% of the capex for these projects.
- This has included a few small-scale C&I projects.

- The Union des Prestataires des Industriels et des Commerçants du Sénégal is affiliated to the National Employer's Council (CNP) and represents the interests of industry in Senegal.
- The issue of high energy costs means that it too is focused on any solutions that can help to manage these costs.
- UPIC is currently benefiting from funding from the Institut Francophone du Developpement Durable (IFDD) to support an energy audit of 15 companies that UPIC works with.

The context of electricity sector reform in Senegal

The current process of implementing the Electricity Code is largely driven by the Electricity Sector Roadmap



- The LPDSE sets the overall policy direction for the energy sector for the period 2019-2023.
- The document sets overall targets, such as achieving universal access to electricity by 2025 and growing electricity generation capacity.
- Reference is made to growing role for renewable energy, but no specific target is defined.

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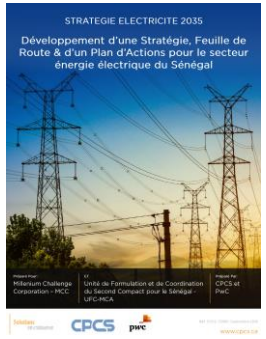
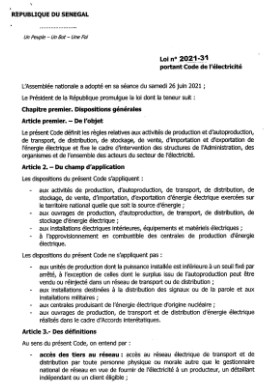
- MCC is working closely with the Government of Senegal to spur economic growth by reducing the cost of power.
- It has been leading many of the initiatives to reform Senegal's electricity sector to achieve these objectives.



- The Electricity Sector Roadmap was prepared in 2018 with MCC funding, through the local MCA (Millennium Challenge Account) office, and it sets out the plan for reforming the sector.
- At its heart, this involves the unbundling of Senelec, and introducing competition across the value chain.
- The role of the regulator, CRSE, is also strengthened in the oil and gas sector.

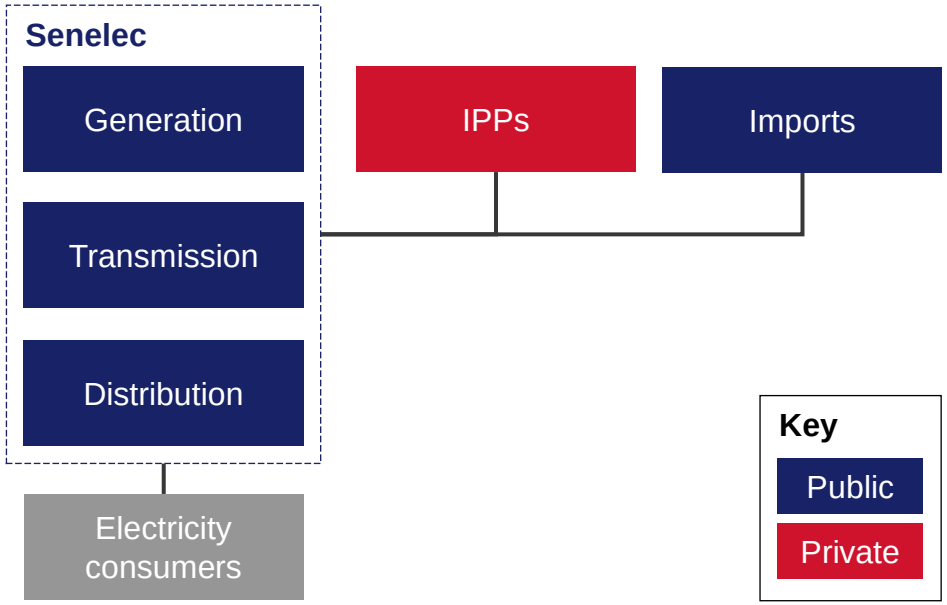


- The MCA office was also instrumental in drafting the *Law 2021/31*, the new Electricity Code, which replaces the Electricity Act of 1998 and puts in place the primary legislation to start implementation of the Roadmap.
- However, because the law is a complete re-write of the previous policy framework it also affects areas not covered by the Roadmap, including C&I solar projects.
- Some of the effects are negative and/or result in ambiguity until implementing regulations are defined, as described further over the following slides.
- *Law 2021/31* will be implemented primarily through decrees, which will provide further detail where this is not provided by the law. MCA is also leading work on drafting these decrees.

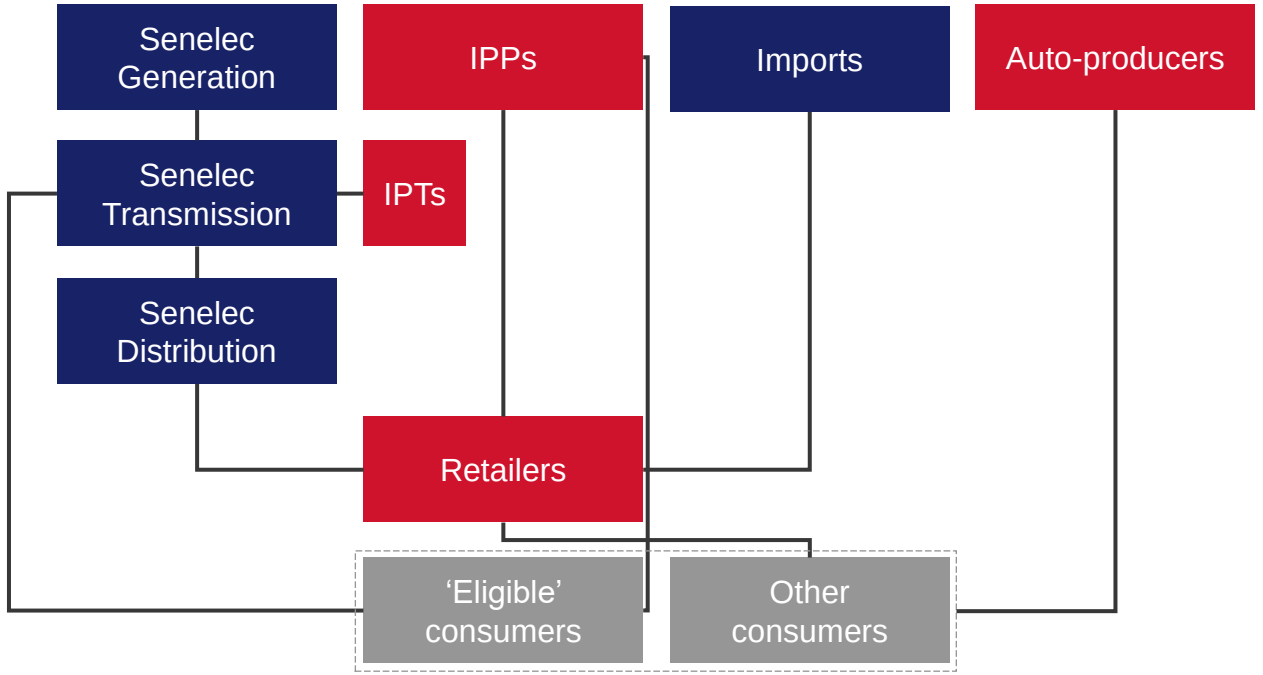
Organisation of the electricity sector

Implementation of the Roadmap will allow more competition in the sector

Status Quo



Implemented Roadmap – 2035



- The simplified schematics illustrate how more private sector entities will be involved in the electricity sector after implementation of the Roadmap is complete. This could involve private sector involvement in the transmission and retail of electricity, in addition to the involvement in generation, which already exists through IPPs.
- Eligible consumers (initially only a sub-set of HV-connected customers) will be able to procure their power directly from IPPs and other parties, which will require the implementation of third party access to the electricity network.
- The roadmap also suggests a role for the private sector in transmission, with IPT (Independent Power Transmission) projects.

Overview of regulatory barriers to C&I solar

The new Electricity Code creates uncertainty where there was previously clarity

- Many articles in the new law lack clarity.
- While the previous legal framework was not optimal for C&I solar, it is now unclear whether many projects that were possible under the previous law would be possible under the new Code.
- The lack of clarity in transition clauses in the Electricity Code means that projects are on hold until these issues are resolved.

#	Issue	Description	Pre-existing or new issue?	Reference
Level 1 – Issues that affect all projects				
1A	Restrictions on ownership and business model	The previous Electricity Act (now repealed) clearly stated that Senelec alone was able to engage in wholesale activities. This was interpreted by many in the sector as prohibiting the use of a PPA model for C&I projects. The new Code states clearly that self-production is not “une mission de service public” (Art. 14) which appears to exclude the sector from many regulatory provisions of the Code. However, some stakeholders have suggested that the new Code prohibits ownership of a C&I project by a third party, which would be terminal for many leasing and financing solutions. Our reading is more nuanced: the new Code does not allow third party owned assets to elect for the “declaration regime”, which removes the need for a licence. Therefore, a third party owned project would be required to secure a licence.	Pre-existing, although the nature of the restriction has now changed.	Law 1998/29, Art. 19 Law 2021/31, Art. 14, 29, 30
1B	Licensing threshold or process not defined	The new Code states that auto-producers with capacity over some capacity threshold, or any auto-producer wishing to export power, will be required to secure a licence. The quantum of the threshold is not defined. No process for securing a licence has been defined so it is unclear how mechanistic this will be. Auto-producers are not identified as an operation actor in the sector in the Code.	New – previous Electricity Act (1998/29) was unambiguous that projects <50 kVA did not require a licence.	Law 2021/31, Art. 30; Chapter II, Section II

Overview of regulatory barriers to C&I solar

The new Electricity Code creates uncertainty where there was previously clarity

#	Issue	Description	Pre-existing or new issue?	Reference
1C	Tariff design	Most C&I customers are on a time-of-use tariff with Senelec, which charges a much lower tariff during off-peak hours (i.e., when solar is generating). Given the prevalence of oil-based generation on the grid, it is unclear whether this tariff structure truly reflect the marginal economics of the generation sub-sector.	Pre-existing.	Senelec tariff schedule
Level 2 – Issues restricting export potential				
2A	Eligibility for export	A previous decree, issued under the now repealed Renewable Energy law, stated that C&I customers would be able to export up to 10% of onsite power generation. The new Code states that a threshold shall apply, but this threshold is not defined.	New – the previous legal framework was clear; this clarity has now been lost.	Decree 2011/2014 (issued under Law 2010/21), Art. 3 Law 2021/31, Art. 25
2B	Commercial arrangements for export unclear	A previous regulatory decision defined a tariff for the export of energy. A draft contract for the sale of export was also drafted, but never implemented. The contract would appear to require an onerous bilateral negotiation, unlikely to be worthwhile for small-scale projects. The status of these arrangements, never implemented, is unclear. General statements on tariff setting are made in the Code, but these do not cover auto-producers.	Pre-existing, but worsened by the new Code, which repeals the laws under which the previous arrangements were defined.	Decision 2018/09 (issued under Law 2010/21 and Decree 2011/2014) Law 2021/31, Art. 61
Level 3 – Issues restricting wheeling of power				
3A	No commercial framework for wheeling	The new Code allows for third party access to the transmission and distribution networks. However, the market arrangements and wheeling fees that would allow for such access to become a reality are not defined.	Pre-existing – third party access was not permitted prior to the new Code.	Law 2021/31, Art. 16

Issue 1A: Restrictions on ownership and business model

Companies using solar for their energy consumption are required to own the project i.e. both fund it and operate it themselves

Situation prior to Law 2021/31	Impact of Law 2021/31	Types of project impacted	Experience from other countries	Recommendations	Enabling institutions
Only Senelec was allowed to engage in wholesale activities and thus sign a PPA. There were no restrictions on the ownership of C&I energy production installations under the previous framework, other than a requirement to declare the installation under *Law 1998/29, Art. 24*.	Senelec's exclusivity in signing PPAs no longer applies. *Law 2021/31, Art. 29* introduces the concept of a 'declaration regime', alongside the licencing regime presented in *Art. 30*. However, little about this regime is defined; it is left to the energy sector regulator, CRSE, to define what the regime is and who should be eligible for this. *Art. 29* suggests that auto-production facilities should not be owned by a third party. This is a barrier to lease / SaaS business models.	Any project owned by a third party, i.e., contracted through a lease / SaaS type business model. In particular, any project that would otherwise have qualified for the 'declaration regime' (as yet undefined) may be restricted in its choice of business model.	In Kenya, adoption of a PPA model would require a C&I developer to acquire a license. This has led to wider adoption of leasing, instead of using PPAs. We are not aware of any countries requiring C&I solar projects to be owned by the energy user, or placing any restrictions of this sort on access to fast-track declaration or registration.	Requirements for the 'declaration regime' referred to in *Art. 29* need to be defined, and the thresholds associated with this should also be defined. The wording in *Art. 29* is ambiguous. Ideally this article should be amended so that there is no restriction on business models involving third party ownership. There is no rational justification for such a prohibition and leasing can be a useful business model for companies who would prefer to allocate capital to their core business. It might be possible to secure this clarification through a favourable CRSE decision. However, if this is not forthcoming, a change in primary legislation (i.e., the Code) may be required.	MCA-led committee issuing draft decrees covering Art. 29/30 during Q1 2022. *Art. 29* specifically mentions CRSE role for defining 'declaration regime'.

Issue 1B: Licensing threshold and process

It is unclear which projects will be required to obtain a license under the new regulatory framework

Situation prior to Law 2021/31	Impact of Law 2021/31	Types of project impacted	Experience from other countries	Recommendations	Enabling institutions
Projects less than 50 kVA in size did not require a license *(Law 1998/29, Ch 1, Art. 1).* For example, we are aware of several small projects installed on Ecobank premises by Daystar, making use of this exemption. Developers of larger projects (e.g., CrossBoundary) are proceeding on the basis that the size of their project would anyway require a license.	*Law 2021/31* lists the various actors engaged in the electricity sector, but does not identify auto-producers in this list *(Ch 2, Sec 2)*. *Law 2021/31, Art. 30*, which covers licensing, states that the licensing regime is applicable to auto-production above a certain threshold (not defined), and to all auto-production that intends to sell surplus energy. *Art. 29* paves the way for a 'declaration regime' for some auto-producers, although there are additional issues with the drafting of this article (see Issue 1A). The process for licensing is also not defined in *Art. 30*.	Most project types have a lack of clarity over whether they need a licence until the threshold mentioned in *Law 2021/31, Art. 30* has been defined. Many developers have paused projects as a result, although we are aware of at least one developer constructing a behind-the-meter project (without a licence) regardless. Arguably, larger projects that have always required a licence and might reasonably expect to need a licence in future are less impacted. Projects intending to export are impacted by a clear requirement for them to secure a licence, although in practice this has little impact because a route-to-market for exporting surplus energy has not yet been implemented.	Many countries have introduced a two-tier approach to licensing. Smaller projects (e.g. up to 1 MW in Kenya, up to 2 MW in Morocco) are subject to a lighter touch 'declaration' regime. These projects might be required to submit certain information to energy sector institutions, but do not require a licence to operate. There may be a lower threshold below which even declaration of the facility is unnecessary (e.g., 20 kW in Morocco). South Africa has recently updated its regulatory framework such that no registration is required below 100 kW, and installations between 100 kW and 100 MW are subject to registration, but not licensing requirements.	The licensing threshold in *Art. 30* should be defined. Ideally there should be two thresholds: (a) one below which even declaration is not required; and (b) and one (e.g., 2 MW as in Morocco) below which a lighter touch regime (*Art. 29*), applies. The article should also be amended such that the same thresholds apply to all types of project, including projects that export. Issues relating to the export of surplus should be handled separately (see Issues 2A, 2B). The process for granting of licences needs to be defined clearly, so that the requirements are unambiguous. In practice this can be difficult, which is why lighter-touch 'declaration' regimes can be useful.	MCA-led committee issuing draft decrees covering Art. 29/30 during Q1 2022.

Issue 1C: Design of electricity tariffs for industrial energy consumers

It is not clear whether peak/off-peak tariff differentials are strictly cost reflective

Description of the situation (note this is unaffected by the promulgation of Law 2021/31)	Types of project impacted	Experience from other countries	Recommendations	Enabling institutions
Senelec adopts a time-of-use (ToU) tariff structure again, charging a higher tariff during peak hours (19h to 23h) compared to off-peak hours. We understand that this tariff structure was adopted in response to advice from another donor programme, focused on energy efficiency, to shift energy consumption away from peak hours. As a generic recommendation, this makes sense. But there is no transparency over how the ToU tariff is calculated, for example, through publication of a clear methodology. Further, such a tariff structure should reflect time-of-day variations in the marginal cost of power generation. In the context of Senegal, recent modelling by our team suggests that the marginal generation will be expensive thermal generation (at least until substantial gas-fired capacity is commissioned) at all times of day. Economic theory therefore suggests that the difference between peak and off-peak tariffs should be much smaller than is currently the case, although some stakeholders have suggested that supply shortfalls during peak hours mean that the Value of Lost Load (VoLL) might be considered in calculating the peak price. Solar projects will only generate power during periods that are defined as 'off-peak' by Senelec. The lower price of power for industrial energy consumers during these hours reduces the cost reduction potential of solar energy.	All C&I projects whose primary purpose is to offset retailed electricity tariffs.	Other countries, such as South Africa and Namibia, also have ToU tariffs. The spread between peak and off-peak prices is generally quite large in these markets, but there is also greater variation in the marginal cost of power generation in these markets. A larger number of markets have a demand tariff, which charges a per kVA amount, levied on peak demand and/or connection size.	A transparent tariff methodology describing the calculation of peak and off-peak energy tariffs for industrial energy consumers should be published. This methodology should reflect the actual difference in the marginal generation cost during these time periods (if this is not already the case).	Senelec and CRSE. CRSE has overall responsibility for tariff regulation. The regulator would typically publish the methodology used for setting retail electricity tariffs.

Issue 2A: Eligibility for exporting surplus power

Senegal has enabled the export of surplus power in theory, but not in practice

Situation prior to Law 2021/31	Impact of Law 2021/31	Types of project impacted	Experience from other countries	Recommendations	Enabling institutions
In theory, *Decree 2011/2014* allowed for C&I power generation facilities to export up to 10% of onsite power generation. In practice, the absence of a guaranteed route-to-market for this power (see Issue 2B) means that this has not been implemented.	*Law 2010/21* (under which *Decree 2011/2014* was issued) is repealed. *Art. 25* of the new Code states that the injection of surplus energy into the transmission or distribution network shall be permitted (a) within a certain threshold, and (b) as determined by a purchase contract. The threshold is not defined. Further, *Art. 30* requires that any auto-producer intending to sell surplus energy should be licensed, regardless of the project size.	All C&I solar projects intending to sell surplus energy. This would affect projects for which it is economically optimal to over-size the generation facility. It would also affect C&I energy users who only have substantial energy needs on weekdays (and who therefore might have surplus energy to sell at the weekend).	Across Sub-Saharan Africa, very few countries systematically allow for the sale of surplus energy in practice. Many countries have enacted legislation to support policies such as net metering in theory, but in practice these are rarely implemented. Some municipalities in South Africa do have a feed-in tariff, although even within South Africa this varies substantially depending on location.	It is understood that Senelec, CRSE, and others are concerned that allowing the export of surplus energy will facilitate IPPs by the back door. Not unreasonably, they suggest that such projects should be procured competitively. However, a modest over-sizing of solar projects can frequently materially benefit the economics, helping to lower energy costs for C&I energy users. The concerns raised can be addressed without an outright ban, ideally through setting tariffs at an appropriate level (see Issue 2B), and if not, through setting a cap such as that introduced by *Decree 2011/2014* and as suggested by *Art. 25* of the Code.	MCA-led committee issuing draft decree covering Art. 25 during Q1 2022.

Issue 2B: Commercial arrangements for exporting surplus power

A route-to-market will need to be defined and made available if export of surplus is to be possible in practice

Situation prior to Law 2021/31	Impact of Law 2021/31	Types of project impacted	Experience from other countries	Recommendations	Enabling institutions
CRSE's *Decision 2018/09* published tariffs to be paid for the export of surplus power from auto-producer facilities. CRSE also prepared a draft contract that was intended to be used for such sales. In practice, these arrangements were not implemented.	*Art. 25* notes that the terms and conditions of the sale of any surplus shall be defined by decree. It is understood that decisions regarding the pricing for such sales will be delegated to CRSE by the decree.	All C&I solar projects intending to sell surplus energy.	As noted previously, very few countries in Sub-Saharan Africa have in fact implemented a route-to-market for surplus energy from C&I projects. Kenya is an example of a country that has committed to net metering in primary legislation, but has not yet implemented this policy. In South Africa, while feed-in tariffs do exist, the arrangements vary by municipality. Tariffs for surplus power are typically ~5 $c/kWh in South Africa, below the levelised cost of C&I scale solar. This encourages the 'right-sizing' of projects and provides a 'win-win' outcome: cheap power for the utility, while allowing companies to optimise the design of projects.	Where it is permitted to export surplus power from C&I solar sites (see Issue 2A), a clear route-to-market for these exports needs to be defined. This should ideally be defined in the decree to implement *Art. 25* of the Code. The route-to-market should ideally establish a fixed tariff, or at least a fixed methodology by which tariffs are calculated, paid for exported energy. South Africa provides some useful benchmarks that can be considered in determining an appropriate level for these tariffs.	MCA-led committee issuing draft decree covering Art. 25 during Q1 2022. It is understood that at least the quantification of export tariffs will be delegated to CRSE.

Issue 3A: Commercial framework for wheeling power

Further market liberalisation could allow for more ambitious C&I solar projects

Situation prior to Law 2021/31	Impact of Law 2021/31	Types of project impacted	Experience from other countries	Recommendations	Enabling institutions
As noted previously, the old Electricity Act establishes Senelec as having exclusivity in the wholesale trade of electricity, meaning that it was impossible to wheel power across the transmission or distribution network.	*Art. 26* requires that third parties have access to electricity network infrastructure under non-discriminatory conditions. *Art. 82* covers transitional measures and provides 30 months from passing the law to implementation of the third-party access regime. This would require such access to be operationalised by late 2023. The West African Power Pool (WAPP) is also implementing a three-phase liberalisation plan. WAPP remains in Phase 1 of that process: a standardised transmission pricing methodology has been adopted. Phase 2 involves the introduction of a standardised approach to bilateral trades, and Phase 3 would involve a liquid unified regional wholesale market. Implementation is delayed, but might be catalysed by imminent completion of major regional transmission lines.	Projects currently being developed are on-site and therefore unaffected. For corporate electricity consumers to buy renewable power from another location, implementation of third party access would be required, including clearly defined commercial arrangements and tariffs for wheeling power over the network. In the longer term, if customers were to procure power cross-border, this would also require implementation of third party access across the wider WAPP system.	In Africa, there are limited examples of regulatory regimes having been liberalised to the extent that wheeling is possible for a wide range of market participants. One exception is South Africa, where wheeling tariffs have been implemented on the main Eskom network and in some municipalities. In more liberalised markets (across Europe and North America) corporates increasingly procure large volumes of renewable power to meet their energy needs. This is common, for example, for data centre projects. We are aware of early stage attempts to implement this for similar projects in another country in West Africa.	Third party access should be implemented in line with the requirements of *Law 2021/31*. For this to be effective, wheeling tariffs will need to be set and access to these arrangements should be mechanistic.	MCA-led committee working on implementation of the Electricity Code. CRSE involvement likely to be critical in setting wheeling tariffs. Interaction with WAPP executive in Cotonou for cross-border trading.

Implementation of the Electricity Code

MCA have informed us that the time to provide input on the draft decrees will be Q1 2022

June 2021

Electricity Code (Law 2021/31) passed by Parliament. Uncertainty has resulted in many projects being paused, although we are aware of at least one project that has proceeded to construction regardless.

Early Dec 2021

MCA convened committee to work on drafting of decrees to implement the Code. The committee is composed of MPE, implementing agencies (ASER, ANER, AEME), and CRSE.

The committee is focusing initially on decrees concerning CRSE's role and the regulatory regime, followed by decrees relating to least cost sector planning. After these decrees have been completed, the committee will turn to two decrees relevant to C&I solar:

- One will address implementation of *Articles 29, 30*, i.e., licencing requirements, thresholds, and processes.
- Another will address *Article 25*, i.e., arrangements for auto-producers and, specifically, for the export of surplus energy.

Q1 2022

During Q1 2022, MCA plans to have advanced drafts of both of these decrees, approved by the committee (a highly ambitious timetable). These will then be subject to a 10 day consultation period. It is unclear how widely the decrees will disseminated, but MCA has promised that the Manufacturing Africa programme will receive copies of these decrees.

End Q1 2022

After this period the final decree will be reviewed by the Minister of Energy, the Secretary-General of the Government. Finally, the decrees will be approved by the Government Council.

The decrees do not need to return to the National Assembly as they are simply implementing previously passed primary legislation.

The committee will continue to work on other decrees beyond this period, including longer-term projects such as implementing of unbundling and third party access.

Process for addressing existing regulatory issues and prioritisation

A tactical approach is required when engaging with processes that will shape the regulatory outcome

Issue	Suggested actions	Next steps	Timing	Priority
Issue 1A: Restrictions on ownership and business model	Requirement that C&I solar projects should be owned by the user should be removed.	Legal advice suggests that *Law 2021/31* could be 'interpreted' favourably by CRSE decision.	No existing process or plan to initiate one.	**Medium** – legal opinion suggests that CRSE should be engaged now so that they can issue a formal decision to favourably interpret the Code. If this cannot be secured, primary legislation to amend the Code would be required.
Issue 1B: Licensing threshold and process	Thresholds and eligibility requirements for 'declaration' and 'licensing' regimes should be clearly and unambiguously defined. The process for applying for and securing a license, where required, should be clearly defined. This should be as mechanistic as possible.	Decree consultation coordinated by MCA.	Second half of January 2022.	**High** – these details will be defined through decrees to be drafted over the coming weeks. Now is the time to engage with this process.
Issue 1C: Design of electricity tariffs for C&I energy consumers	Methodology for calculation of ToU tariffs should be published. This should reflect time-of-day changes in the marginal cost of power generation if not already the case.	CRSE oversee tariff regulation.	Ongoing.	**Low** – no immediate time sensitivity; CRSE can be approached at any time. Until the methodology is published, it is unclear how far the methodology deviates from best practice.
Issue 2A: Eligibility for exporting surplus power	Exports of surplus power should not be restricted through regulation.	Decree consultation coordinated by MCA.	Second half of January 2022.	**High** – these details will also be defined through the drafting of decrees.

Process for addressing existing regulatory issues and prioritisation

A tactical approach is required when engaging with processes that will shape the regulatory outcome

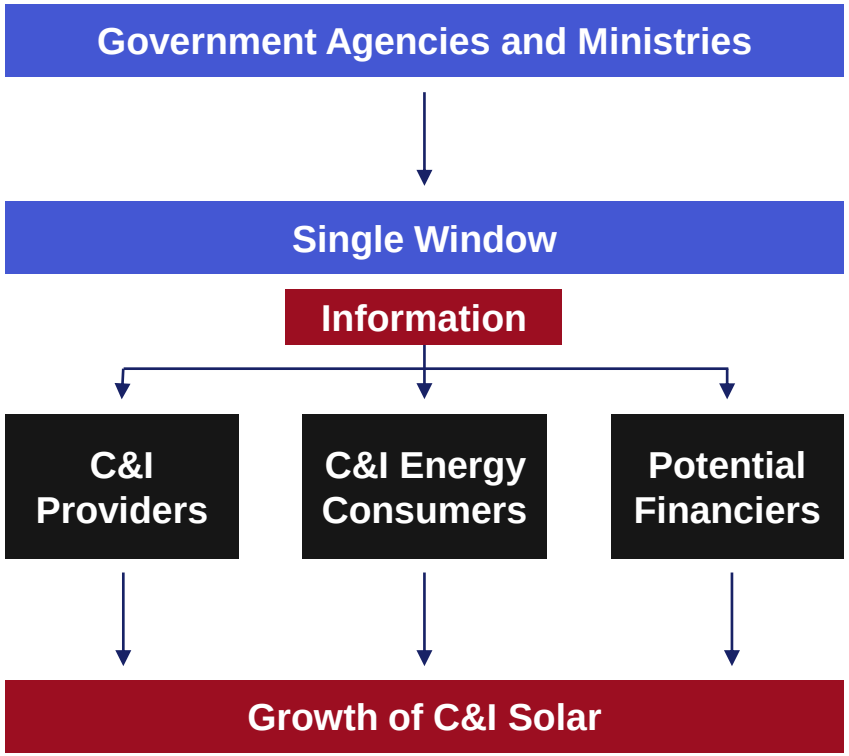
Issue	Suggested actions	Next steps	Timing	Priority
Issue 2B: Commercial arrangements for exporting surplus power	A clear route-to-market should be defined for exporting surplus power. A fixed tariff, or a predictable methodology for calculating tariffs, should be established.	Decree to be finalised during Q1-2022 will delegate definition of this route-to-market to CRSE.	After finalisation of the decrees.	**Medium** – this cannot be taken forward until responsibility has been formally delegated to CRSE.
Issue 3A: Commercial framework for wheeling power	Arrangements to support third party access, in line with the Electricity Code, should be implemented. This will include the definition of wheeling tariffs.	Implementation of the Electricity Code, being overseen by MCA.	Not understood to be one of the priority decrees for January, but must be implemented by late 2023.	**Medium** – likely to be an area tackled by MCA and others during 2022.
	Senegal should engage with WAPP to encourage further liberalisation in establishing a meaningful regional electricity market.	Implementation of the regional electricity market in line with existing three phase plan.	WAPP originally planned for fully liberalised market to be established, but progress has stalled.	**Low** – progress has stalled and requires consensus across all ECOWAS member states.

A one-stop shop for C&I solar

In addition to addressing regulatory barriers, an office (possibly resident in APIX) to help solar companies engage with the market could help catalyse project opportunities

- The single window would be a single point of engagement for the private sector, specifically C&I solar providers, potential financiers and industrial energy consumers, providing signposting and access to information.
- It will also engage relevant ministries and agencies, ensuring the information provided to the market (policies and incentives) is up to date.
- It's objectives would be to:
  - Provide clarity to C&I developers on the legislation relevant to C&I solar
  - Provide potential financiers with information on the C&I solar market and its legal and regulatory framework
  - Provide industrial energy customers with relevant information on opportunities, incentives and the benefits to developing a C&I solar project.

  With the ultimate aim of facilitating increased investment and growth in the C&I solar market in Senegal.



Action plan for addressing barriers to C&I solar

Action should focus on barriers that can be addressed through the drafting of decrees during early 2022

Short-term

- In the short-term, the focus should be on policy decisions that can be tackled through the drafting of decrees over the coming months.
- The decree to implement *Articles 29, 30* of the Electricity Code will define the thresholds and eligibility requirements for the licensing and/or declaration of generation facilities and the process for securing a licence where applicable. To the extent allowed by the primary legislation, this should minimise restriction on business models involving third parties, such as leasing.
- The decree to implement *Article 25* will define when it is possible to export surplus power from auto-producer sites.
- MCA plans to have both decrees ready for review during Q1 of 2022.
- Alongside addressing regulatory barriers, an office (possibly resident in APIX) could be established to help solar companies engage with the market and catalyse project opportunities.

Medium-term

- Decision making processes relating to other priority actions will unfold over longer timescales.
- Removing restrictions on third party involvement in C&I projects will review a CRSE decision that favourably 'interprets' the Code. If this is not forthcoming, primary legislation may be required to remove these restrictions.
- Definition of a dependable route-to-market for the sale of surplus energy can only take place after the decree to implement *Article 25* has been approved.
- Other parts of the Code, such as implementation of third party access, are lower down MCA's priority list and are less important to most C&I solar projects.

Long-term

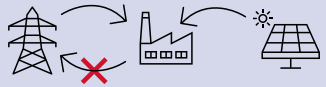
- In the longer-term, the enabling environment for more ambitious cross-border C&I solar projects could be improved by engaging in implementation of a meaningful regional electricity market through WAPP.
- Transparency concerning the setting of ToU tariffs could also be improved to ensure that these reflect international best practice.

Detailed evidence base: Appendix B

Regulatory case studies

Comparison of policy framework in other countries

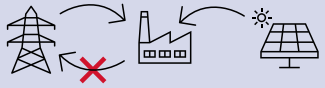
There are several countries, including in Africa, with a better enabling environment for C&I solar than Senegal

Country	Behind the meter			Exports		Wheeling	
							
	No restriction	Declaration only	Full licence	Legally allowed	Implemented	Legally allowed	Implemented
Senegal	Undefined	Undefined	Undefined	✓	×	✓	×
Kenya	< 1 MW	NA	> 1 MW	✓	×	✓	×
Morocco	20 kW	20 kW – 2 MW	> 2 MW	✓	×	✓	×
South Africa	100 kW	100 kW – 100 MW	> 100 MW	✓	~	✓	~
Nigeria	< 1 MW	NA	> 1 MW	✓	~	✓	~
Côte d'Ivoire	500 W	500 W – 20 kW	> 20 kW	✓	×	✓	×
UK	Most C&I projects	NA	Exporting >50 MW	✓	✓	✓	✓
France	<50 MW	NA	>50 MW	✓	✓	✓	✓

- Each of the countries included in the review above clearly define thresholds for licensing generation projects.
- In many countries these thresholds are quite high. South Africa recently increased its threshold for a generation licence to 100 MW. Only Cote d'Ivoire requires projects < 1 MW to obtain a generation licence.

Case study – Kenya

Kenya has reduced licencing requirements for small-scale behind-the-meter C&I solar



No restriction	Declaration only	Full licence	Legally allowed	Implemented	Legally allowed	Implemented
< 1 MW	NA	> 1 MW	✓	×	✓	×

Policy framework

National Strategies
- Vision2030

Energy Policies and Laws
- Energy Bill
- National Energy Policy

Implementing Regulations
- Energy Solar Photovoltaics System Regulations
- Energy Act

Policy details

- **Vision2030**
  - Aims to transform Kenya into a newly industrialised, middle-income country providing a high quality of life to all its citizens in a clean and secure environment.
  - The vision lays out the aim to increase power generation and efficiency. Increased generation from geothermal, coal, renewables and energy imports were explicitly targeted.
- **Energy Bill**
  - Broadly the Bill covers all aspects of energy regulation except for the discovery, development and production of petroleum.
  - The bill laid out proposals for net-metering which would allow consumers that own power generators to sell excess electricity to the grid.
- **National Energy Policy**
  - A sector wide review looking at ensuring a sustainable, adequate, affordable, and reliable supply of energy.
  - Together the National Energy Policy and the Energy Bill guide the specific implementing regulations.

Case study – Kenya

Kenya has a predictable and transparent process for permitting small generation projects

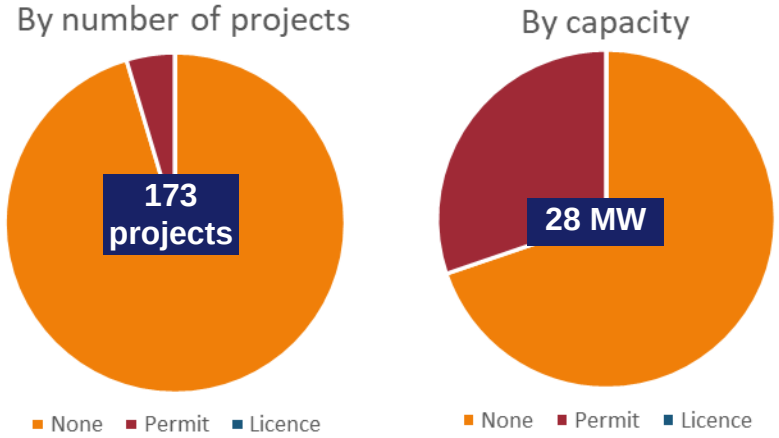
Policy details

The Energy Solar Photovoltaics Systems Regulations define the requirements for licencing of behind-the-meter solar in Kenya.

- A capacity below 1 MW requires no licence or permit. However, the developer requires:
  - A permit from the National Construction Authority,
  - Submission of an Environmental Impact Assessment to NEMA, and
  - Local county approval.
- These procedures are required for projects of all sizes
- Grid codes are specified, and installation must be carried out by a licenced technician.
- Small projects are therefore able to go ahead without informing either the energy regulator or utility, but this only applies to pure behind-the-meter projects.
- Analysis of data from AfSIA and Bhamidipati, P. L., & Gregersen, L. E. (2020) suggests that ~95% of projects commissioned so far have been less than 1 MW in capacity.

Key policy drivers

- Capacity between 1 MW and 3 MW requires a permit from the regulator.
- A licence is required for capacity of 3 MW and higher.
- The difference between applying for a licence and a permit is a fee of 10,000 Kenyan shillings for a licence.
- According to the regulator the entire application process takes up to 90 days and is generally completed within 60.
- Developers report the application process to be predictable and transparent.
- Analysis of data from BloombergNEF, Bhamidipati, P. L., & Gregersen, L. E. (2020) and AfSIA suggests so far no C&I solar of greater than 3 MW capacity has been developed.
- The same sources indicate ~10 projects between 1 and 3 MW have been commissioned.



Source: Bhamidipati, P. L., & Gregersen, L. E. (2020)

Case study – Kenya

Export of energy from self generators is not yet implemented

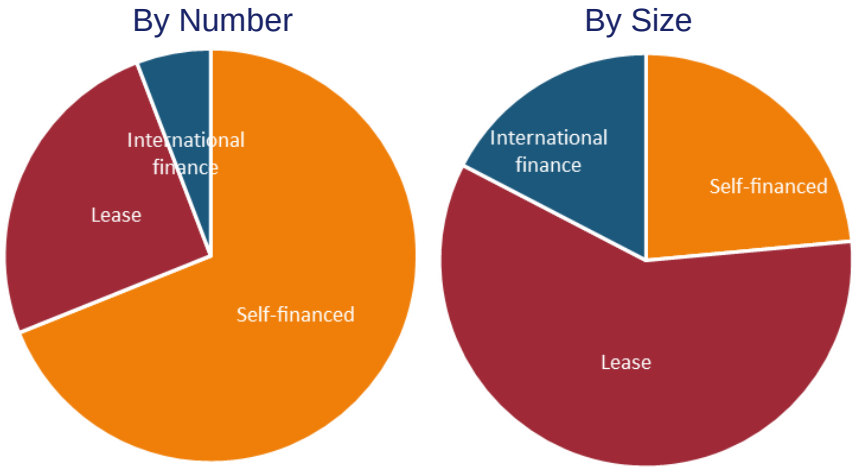
Policy details

- The **Energy Act, 2019** provides legislative support for net-metering and the ability to sell excess energy to the grid.
  - This legislative support came from adoption of the proposals in the 2017 Energy Bill regarding net-metering.
  - The act was informed by the national energy review under the direction of the Energy Bill.
  - A maximum capacity of 1 MW was legislated for net-metering.
  - As it stands net-metering has yet to be implemented and so a pathway to sell surplus supply of electricity to the market does not yet exist.

Bhamidipati, P. L., & Gregersen, L. E. (2020) conducted interviews with companies in Kenya and found two key policy interventions were frequently mentioned as being positive for C&I energy projects:

- Statutory Energy Audits:
  - The energy management regulation gazetted in 2012 subjected commercial, industrial and institutional energy users to mandatory energy audits. Audits increased consumer awareness of energy efficiency and need to increase renewable fuel uptake.
- Investment deductions:
  - Tax incentives for businesses on construction and equipment purchases. Solar equipment capital expenditure counts within this and entitles companies to tax benefits. The exact magnitude of these benefits is unclear, but they provide an incentive to install C&I solar.

Key policy drivers



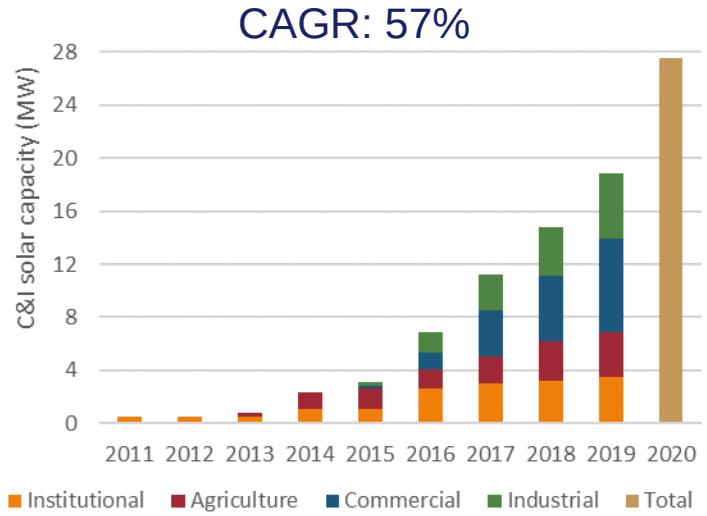
Source: Bhamidipati, P. L., & Gregersen, L. E. (2020)

- 70% of the projects in Kenya have been self-financed. However, these have generally been quite small and only make up 25% of C&I solar capacity.
- PPA models in Kenya would require the developer to be licenced to sell electricity. As a result of this all developer financed projects have used a lease model.
- 25% of projects have used lease models, these tend to be larger and make up 60% of C&I solar capacity.
- The remaining 5% of projects have been financed by international finance, often by funding from development funds. These projects are generally larger in size and make up 15% of capacity.

Case study – Kenya

Sustained growth in C&I solar is likely

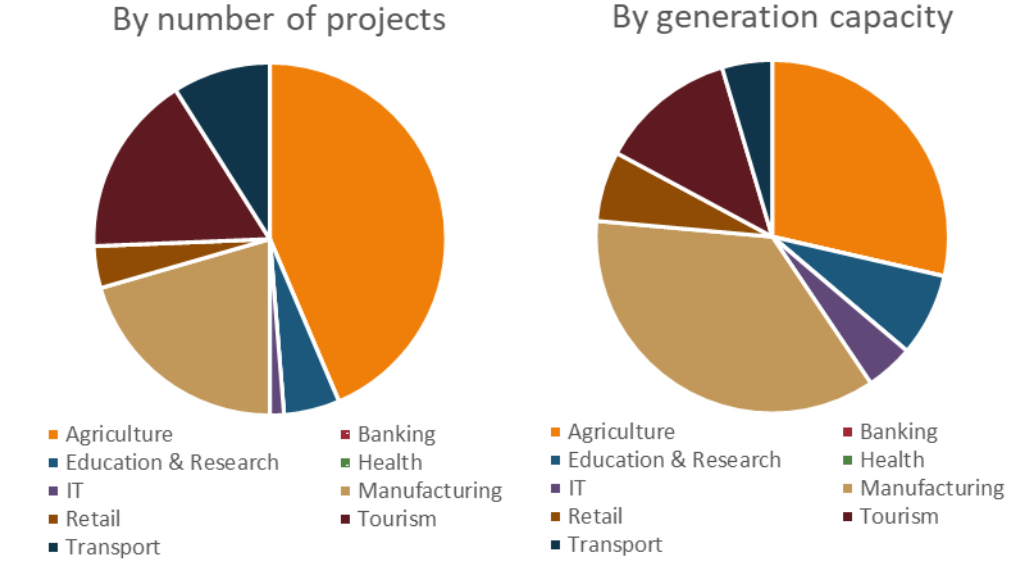
Results of policy



Source: Bhamidipati, P. L., & Gregersen, L. E. (2020) and AFSIA 2021

- Kenya has seen sustained growth in C&I solar at a CAGR of 57% with ~28 MW capacity installed by the end of 2020 (AFSIA, 2021).
- The transparent, predictable and relatively fast (~2 months) process to obtain a permit for C&I solar is thought to have enabled this growth.
- Rising tariffs provide motivation for C&I companies to invest in self generation.
- Export of surplus energy by self-generators is not yet possible as net metering has not been implemented.
- We are not aware of any grid stability issues in Kenya that have been attributed to this growth in solar.

Sub-sectors using C&I solar

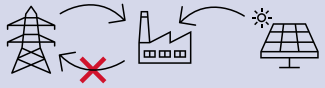
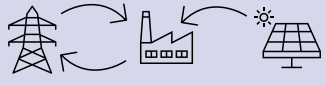


Source: AFSIA 2021

- Agriculture (mainly flower farms) accounts for 44% of C&I solar projects (by number). These projects are relatively small and only represent 29% of MW capacity.
- Manufacturing projects at 36% of MW capacity are biggest contributor to capacity. These are relatively large, making up only 21% of projects by number.
- Tourism (mainly hotels and safari lodges) is the third largest sub-sector, accounting for 17% of projects by number and 13% by capacity.
- Kenya has 1 MW of C&I solar installed at a datacentre (a sector that is particularly focused on securing electricity from renewable sources), suggesting the relatively friendly regulatory framework is attracting new industrial loads.

Case study – Morocco

The regulatory framework in Morocco has failed to provide sufficient clarity to self-generators.

						
No restriction	Declaration only	Full licence	Legally allowed	Implemented	Legally allowed	Implemented
20 kW	20 kW – 2 MW	> 2 MW	✓	×	✓	×

Policy framework

National Strategies
- 1963 Dahir

Energy Policies and Laws
- Law 13-09

Implementing Regulations
- Bill no.82.21

Key policies

- **Article 2-2 of the 1963 Dahir** (a royal decree) sets out the right of individuals or legal entities to produce electricity for own use. Projects are subject to prior approval by MEM (Ministry of Energy and Mining) and must meet the following criteria:
  - All independent production must be less than 50 MW.
  - Production must be exclusively for the consumers needs.
  - Production must not have any impact on the grid. This requirement is not clearly defined and in effect has acted as a barrier to C&I solar.
- **Law 13-09** opened the market for C&I renewables, reducing the regulatory burden for smaller-scale projects. Split into three categories:
  - No restrictions below 20 kW,
  - Declaration regime between 20 kW and 2 MW.
    - Requirement to provide MEM with a declaration on technical details of the project.
  - Authorisation regime, which appears to be analogous to a license, above 2 MW.
    - Two-stage application to MEM both before construction and upon commissioning.

Case study – Morocco

The regulatory framework in Morocco has failed to provide sufficient clarity to self-generators

Challenges for C&I solar

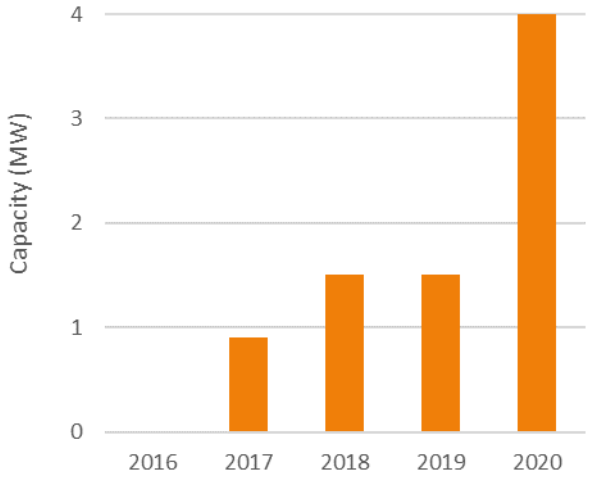
- All industrial projects are subject to environmental and urban regulations and can require: an environmental impact assessment, building permits, conformity certificates.
- From the existing policies the sector faces a few key challenges:
  - Self-generators lack clear legal status.
  - Law 13-09 does not provide clear guidance on the requirements for C&I solar, e.g., how/whether surplus power can be exported, or how impact on the grid should be assessed to comply with the 1963 Dahir.
  - Route-to-market for the sale of excess electricity is not clearly defined and has not been implemented.

- **Bill no. 82.21** aims to resolve these challenges. Bill no. 82.21 adjusts the legislative and regulatory framework governing the self-generation of electricity.
  - It defines the right of any individual or legal entity to self-produce electricity.
  - Currently the bill is passing through parliament, but it is hoped it will provide clarity to the sector.
  - The bill is expected to lay out the application process for self-generation so that the process is non-discriminatory and transparent.
  - It will define technical requirements to ensure grid stability.

Case study – Morocco

C&I solar has a very small market presence in Morocco because of the regulatory barriers to development

C&I Solar trends in Morocco



Source: Analysis of IRENA,2021 and AFSIA, 2021 data

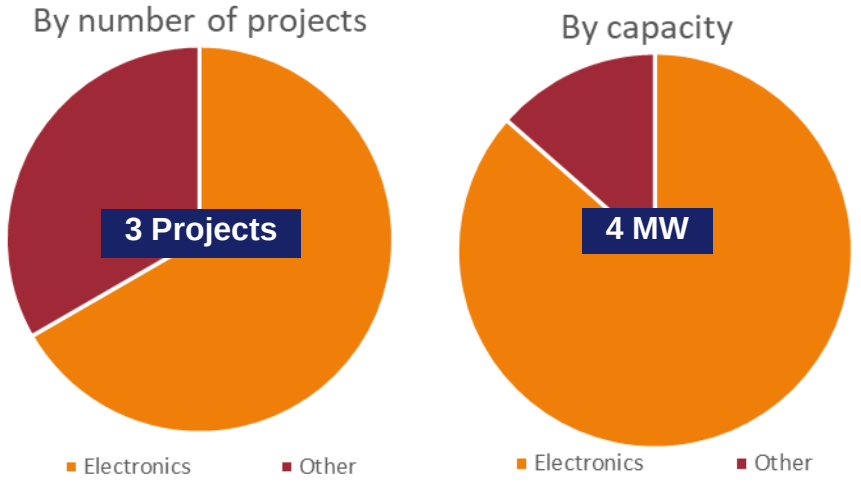
- In 2020 the total solar PV capacity in Morocco was 322 MW.
- Despite this capacity, solar was only responsible for ~1% of electricity generation in Morocco.
- Morocco does also have CSP (Concentrated Solar Power) and onshore wind power generation capacity.
- C&I solar makes up only ~1-2% of total solar PV capacity, while off-grid residential solar makes up 6 times more at ~3% (these projects typically being well below the 20 kW threshold).

C&I solar projects to date

Company	Developer	Sub-Sector	Capacity (MW)
Nexus Factor	Engie	Electronics	2.5
ST Microelectronics	GreenYellow	Electronics	0.7
Other	Other	Other	0.8

Source: AFSIA, 2021

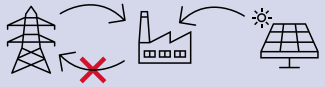
- C&I solar is Morocco made up of a few medium-sized projects (> 500 kW).
- The low thresholds for ministerial approval mean that projects need to have critical mass before it is worthwhile for a company to commit the effort for a project to seek these approvals.



Source: AFSIA, 2021

Case study – South Africa

South Africa has recently increased the threshold for requiring a generation licence to 100 MW



No restriction	Declaration only	Full licence	Legally allowed	Implemented	Legally allowed	Implemented
100 kW	100 kW – 100 MW	> 100 MW	✓	~	✓	~

Policy framework

National Strategies
- Integrated Energy Plan (2016)

Energy Policies and Laws
- Electricity Regulations Act (ERA, 2006)
- National Energy Act (2008)
- Amendment to Schedule 2 of the ERA (2021)

Implementing Regulations
- Integrated Resource Plan (2019)

Policy details

- **Schedule 2 of the Electricity Regulation Act (ERA)**, guides the issuance of licences for generators and transmitters, wheelers and distributors of electricity. There have been several amendments, but prior to a recent amendment to Schedule 2, it was generally accepted that a licence was not required when generation is for:
  - Own use (although this was lacking a clear definition),
  - Not connected to the grid, or
  - Under 1 MW in size.
- **The National Energy Act 34, 2008** aims to ensure a diverse and sustainable energy mix, which provides electricity at affordable prices supporting economic growth and poverty alleviation.
- This act saw the development of the **Integrated Energy Plan (IEP), 2016.**
- The **IEP** considers South Africa's energy needs and considers the whole energy sector in the context of supporting economic growth and poverty alleviation. It aims to ensure supply and security of energy and informs the **Integrated Resource Plan (IRP)**.

Case study – South Africa

The recent amendment to the ERA greatly increases the market potential for C&I solar

Self-generation

- **The Integrated Resource Plan, 2019** was developed following the IEP and provides guidance on future energy investments in order to meet demand for electricity. The IRP is used to guide the energy mix.
- **The Amendment to Schedule 2 of the ERA, 2021** has relaxed the requirements for licencing of power generation capacity in South Africa.
  - A capacity below 100 kW requires no licence or registration with the regulator.
  - Between 100 kW and 100 MW requires registration with the regulator but no generation licence.
  - Generation plants with a capacity >100 MW require a licence and must be part of a national procurement.
- The licensing threshold is particularly important, because when considering whether a licence is awarded, the regulator will consider a project's alignment with the IRP, acting as a barrier to project development.
- All generation connected to a municipal network is required to register with the relevant municipal utility.
- The requirements from these policies are summaries is the table below:

Capacity (MW)	<0.1	0.1-100	>100
Registration with municipality	✓	✓	✓
Registration with regulator	×	✓	✓
Licence from regulator	×	×	✓

Energy exports and wheeling

- Some municipalities have defined feed-in tariffs for the purchase of surplus power generation from C&I projects.
- Feed-in-tariffs for exports are typically low, vary between municipality, and have no guarantee of structure or value from year to year.
- Municipalities are gradually moving towards consistent and predictable mechanisms to facilitate the export of electricity. They are also gradually moving towards time-of-use based tariffs that reflect the value of generation displaced by the project.
- In Western Cape municipal the average variable portion of the tariff is 0.75 R/kWh, which is equivalent to ~ 5 $c/kWh.
- An additional 0.25 R/kWh is offered in the first year of connection.
- This is below the levelized cost of electricity, so business cases are based on the self-consumption of electricity.
- Feed-in tariffs in South Africa are generally set below the levelised cost of small-scale C&I projects. This provides C&I project with some compensation for exported energy, while also incentivising developers to size projects to primarily meet onsite loads.

Case study – South Africa

South Africa's more advanced market for C&I energy projects also extends to the wheeling of power

Wheeling and energy trading

- **Electricity wheeling** up to 100 MW is allowed by the 2021 amendment to schedule 2 of the ERA.
  - Distributors are currently implementing the mechanisms to allow for this and fixing tariffs for wheeling. Some distributors (e.g. Cape Town municipality) are more advanced in defining these tariffs than others.
  - The aim is that wheeling should be possible from sellers to buyers in any part of the country.
- **Electricity trading** is allowed by the 2021 amendment to schedule 2 of the ERA.
  - Currently a number of companies are applying to the regulator to be licenced as energy traders.
  - They would purchase energy from a generator and transport across the grid to a consumer.
  - This requires purchase of electricity via a PPA and a wheeling agreement with the transmission and/or distribution utilities as applicable.
- The ability to wheel power across the network provides an opportunity to C&I consumers who cannot install solar onsite to explore alternative ways to reduce their energy tariffs and CO_2 emissions.

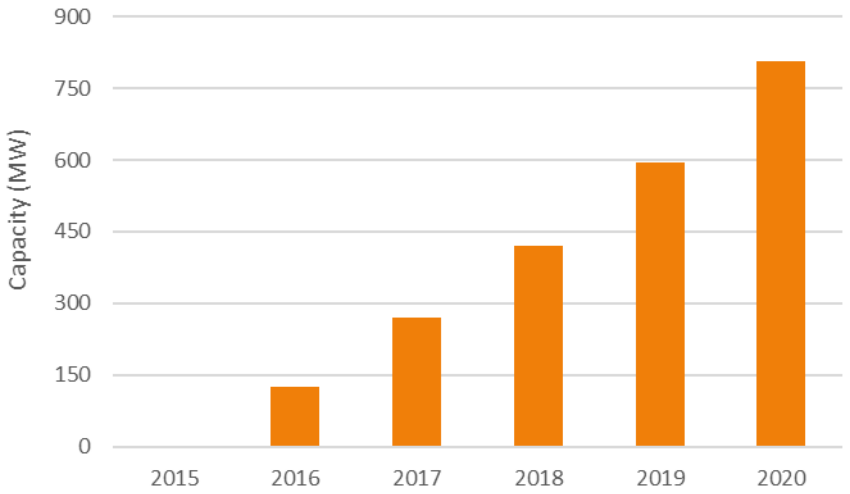
Financing

- **Power Purchase Agreements (PPAs)** now account for ~30-40% of new C&I projects in South Africa. This proportion is expected to grow as consumers become more familiar with these contracts.
- PPA contracts are most popular with large corporate clients who want:
  - A clear indication of electricity cost.
  - Cash flow stability.
  - No system performance risk.
- **Commercial loans** from local banks are taking a growing interest in financing C&I projects in South Africa.
  - In the last two years tailored mechanisms for solar equipment have been developed.
  - Banks typically provide ~70-80% of the finance with a five-to-ten-year repayment period.
  - Energy audits and EPCs enable banks to ensure the loan repayments are less than the savings from solar installation.
  - As the amount of financing for solar has increased, the perceived risk has decreased and more favourable financing conditions have been offered by banks.

Case study – South Africa

South Africa's C&I market has grown rapidly; this is expected to accelerate because of the licensing changes

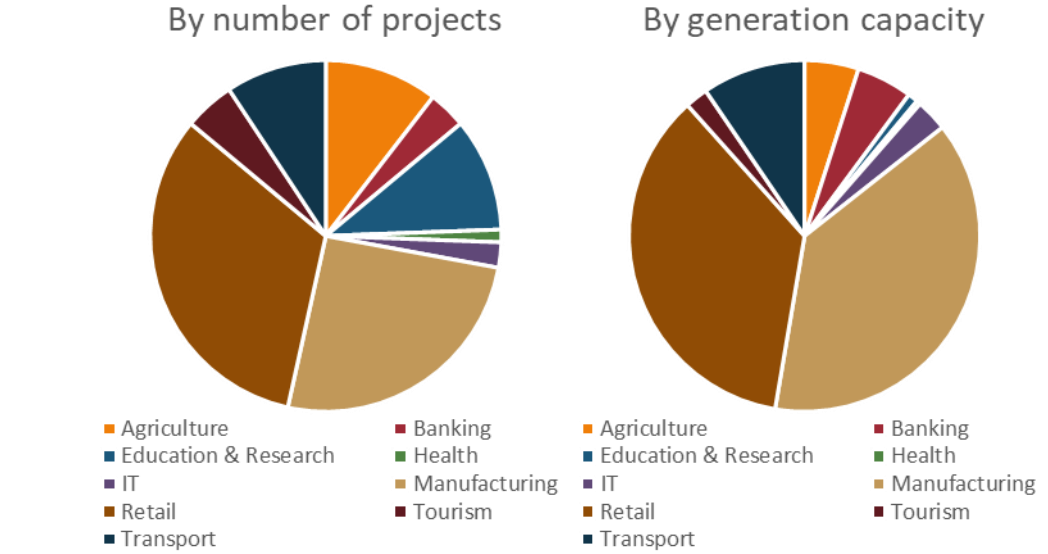
C&I Solar growth



Source: GreenCape Energy Services, 2020, BP Statistical Review of World Energy, 2021

- Since 2016 C&I solar has grown at a CAGR of ~60%. This is higher than the overall growth of solar in South Africa, which has grown at ~30%.
- This high growth is likely to be due to:
  - A favourable policy environment for C&I solar.
  - Above inflation rises in retail electricity tariffs.
  - Extensive load shedding in 2019 and 2020, which is expected to last for the next 3-5 years.

Sub-sectors using C&I solar



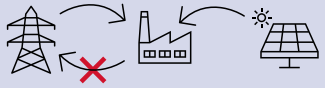
*Source: AFSIA 2021**

- The above analysis does not cover the complete population of C&I projects in South Africa, but is believed to be representative.
- Retail projects (e.g., malls) are the largest by number of projects (33%) and second largest by capacity (36%).
  - These projects include several large malls such as the Mall of Africa (4.8 MW) and Clearwater Mall (2.9 MW).
- Manufacturing represents 26% of projects by number and 38% by capacity.
  - This comes from a range of sources including pharmaceuticals, food processing, electronics and chemical industries.

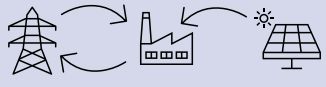
* *Note that the breakdown shown in the pie chart is not for the full population of projects shown in the left chart, because the data is collected from a range of sources.*

Case study – Nigeria

The private sector is involved across Nigeria's electricity sector



No restriction	Declaration only	Full licence
<1 MW	NA	>1 MW



Legally allowed	Implemented
✓	~

Legally allowed	Implemented
✓	~

Policy framework

National Strategies

- Vision 20:2020 (2010)

Energy Policies and Laws

- The National Electric Power Policy (2001)

Implementing Regulations

- Permits for Captive Power Generation (2008)
- Mini-Grid Regulations (2016)
- Independent Electricity Distribution Network Regulations (2012)
- Application for Licences (2010)

Policy details

- **Vision 20:2020** sets out the vision for economic growth in Nigeria.
  - The vision highlights the importance of using Nigeria's renewable energy resources in meeting the country's targets for adding new generation capacity.
  - Solar receives a specific target of 1% of generation capacity by 2020.
  - Solar is also highlighted as having a key role in helping Nigeria to achieve energy access targets.
- **The National Electric Power Policy** was developed aiming to tackle the poor service, low availability and high frequency of outages within the grid-based electricity system.
  - This was to be achieved through creating an investor friendly environment with low government involvement. The distribution sector was privatised, but the lack of cost reflective tariffs means that this has not been a success.
  - The policy required licencing procedures for any electricity generator of 1 MW or more.

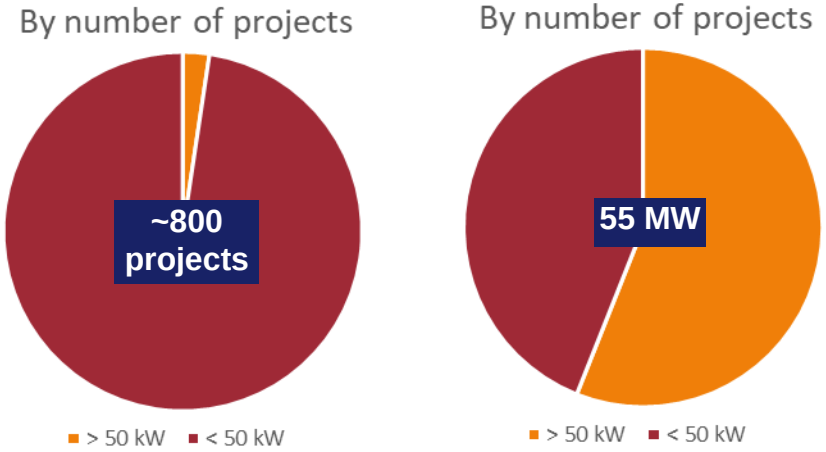
Case study – Nigeria

Poor reliability of the electricity grid means that captive power generation is widespread in Nigeria

Self generation

- **Pure behind-the-meter projects of less than 1 MW require no permit or licence**.
- **A permit for captive power generation (2008)** is required for a pure behind-the-meter project of greater than 1MW capacity.
  - These applications are reported to be relatively simple.
  - They take ~5 months.
  - The applicant must submit an environmental impact assessment, an audited financial statement, a building permit, a detailed business plan and they must pay a licence fee.
  - The permit is valid for 5 years at which point a renewal fee is charged.
- If a project is between 100 kW and 1 MW and provides power directly to two or more neighbouring businesses **a mini-grid distribution licence** is required.
- For projects greater than 1 MW and providing energy to neighbouring businesses an **Independent Electricity Distribution Network licence** is required.
- Projects wishing to export power directly to the grid need a generation licence.
  - According to the regulator the process should not exceed six months.
  - However, as far as can be determined there are no cases of C&I solar which have completed this licencing to export power.

C&I solar projects in Nigeria



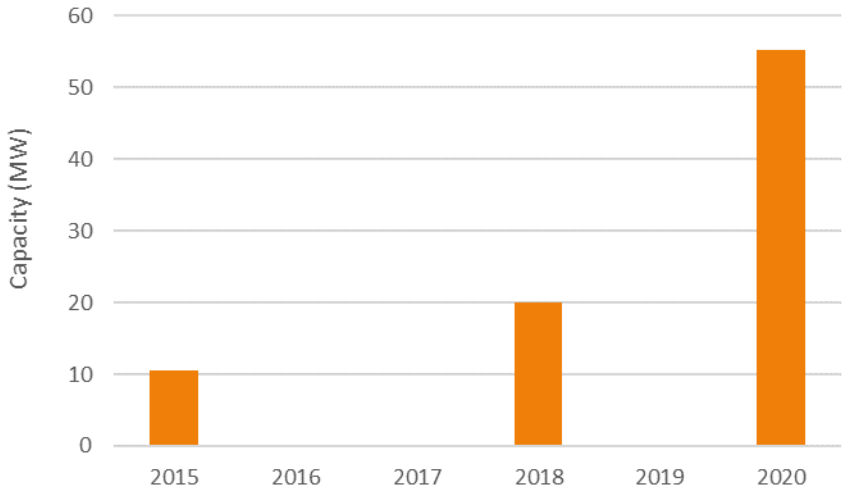
Source: Analysis of AFSIA 2021 and BloombergNEF data.

- Stability of electricity supply is a significant problem within Nigeria
- This means that most substantial businesses have their own power generation equipment.
- C&I solar is therefore often replacing expensive diesel generators, helping to reduce costs and emissions.
- ~45% of C&I solar capacity is from many small projects of < 50 kW.
- There is less visibility on the number, sub-sectors and total installed capacity of the smaller projects.

Case study – Nigeria

C&I solar has been growing rapidly in Nigeria in recent years

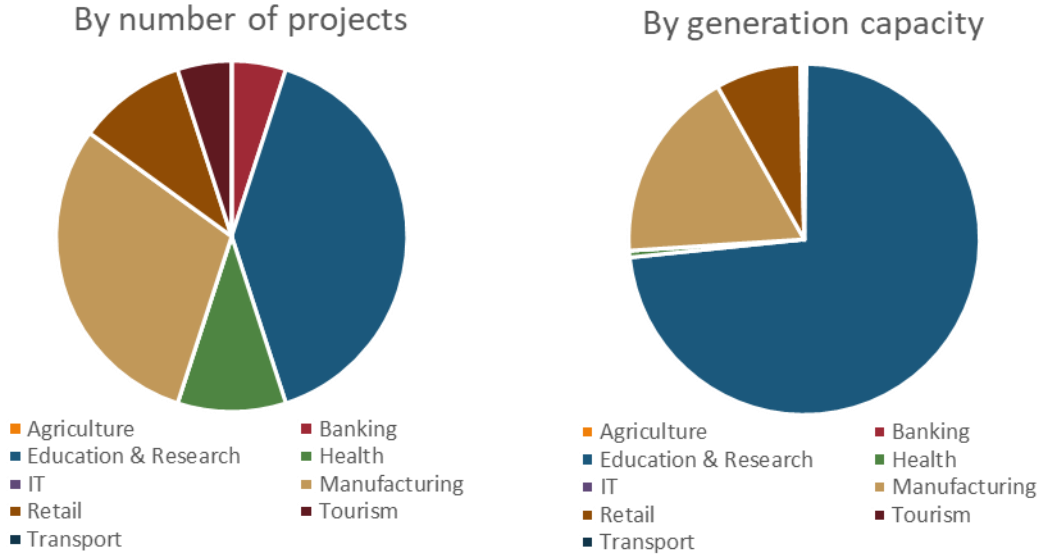
C&I Solar growth



Source: Analysis of data from RECP, BloomberdNEF and AfSIA.

- As a result of roughly half the capacity being distributed across a large number of small projects, there is little data on the exact installed capacity.
- Since 2015 C&I solar has grown at a CAGR of ~30% and this rate has increased to ~65% between 2018 and 2020.
- A significant amount (~20 MW) of this growth in the last few years has come from private universities commissioning solar through the energizing education program.

Sub-sectors using C&I solar



*Source: Analysis of AFSIA 2021 and BloombergNEF data**

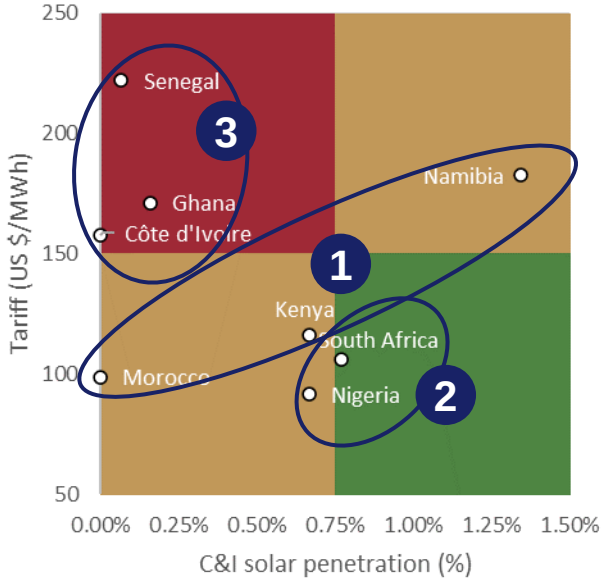
- For companies with more than 50 kW of installed capacity a breakdown by sector is provided above.
- ~40% of these by number and ~75% by capacity comes from private universities that have added solar through the energizing education program.
- At ~30% of the remaining projects and ~20% of capacity, manufacturing projects make up most of the remaining larger C&I solar projects.

* *Note that the breakdown shown in the pie chart is not for the full population of projects shown in the left chart, because the data is collected from a range of sources.*

Case study – Summary

Senegal's C&I solar sector is held back by regulatory barriers

Comparison of C&I penetration



Source: Analysis of BloombergNEF data and utility/regulator tariff information
Note: *Solar penetration figures are presented for 2018 as we have consistent data across all countries for this year*

1. In the absence of other factors, it is expected that the opportunity for C&I solar will be highest for countries with high retail electricity tariffs for C&I electricity consumers.
2. Countries such as South Africa and Nigeria have growing C&I sectors in spite of low tariffs, partly because of poor grid reliability.
3. Some countries – of which Senegal is an example – have a small C&I sector in spite of high tariffs, highlighting the impact of regulatory barriers.

C&I solar impact on the grid

- The impact of C&I solar on grid stability is limited and can be managed.
- No major issues have been reported in South Africa, which by end of 2020 had >800 MW of installed C&I solar capacity (~1.5% of total installed capacity), in addition to large volumes of utility-scale intermittent renewables. South Africa's regulatory framework facilitates export of surplus energy and wheeling of solar across the network to C&I sites.
- By requiring C&I developers to declare projects, the regulator/utility can monitor where C&I capacity is growing, so that this can be accounted for in network planning.
- Indeed, allowing for the export of surplus energy can be beneficial to other customers connected to the grid. Exported power can be purchased at a tariff that is mutually beneficial, improving the economics of a C&I solar project, while reducing bulk power generation costs.
- It also seems highly unlikely that grid-based C&I electricity demand would be adversely impacted by allowing the C&I solar sector to grow: South Africa's grid-based C&I electricity demand is 14x higher than Senegal's.
- Several initiatives currently underway (commissioning of the OMVG interconnector, development of utility-scale battery storage projects) will also help improve power quality on the grid, further mitigating any small risks that need to be managed.

Detailed evidence base: Appendix C

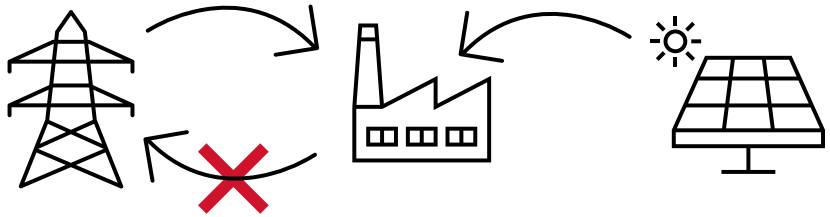
C&I solar market analysis

Introduction to C&I use of solar

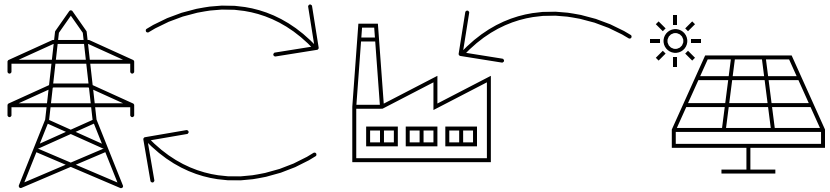
C&I solar opportunities can be split into three main types of project, each with different characteristics

C&I solar can be split into three broad types:

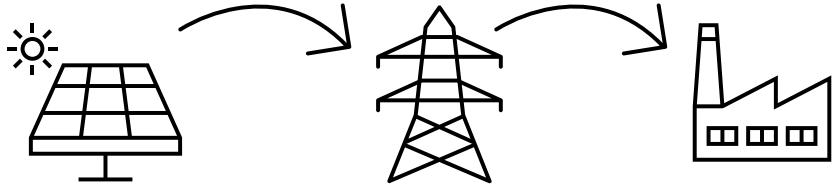
1. **Pure behind the meter** – this is where energy is generated and used exclusively within the company, and none can be sold back to the grid.

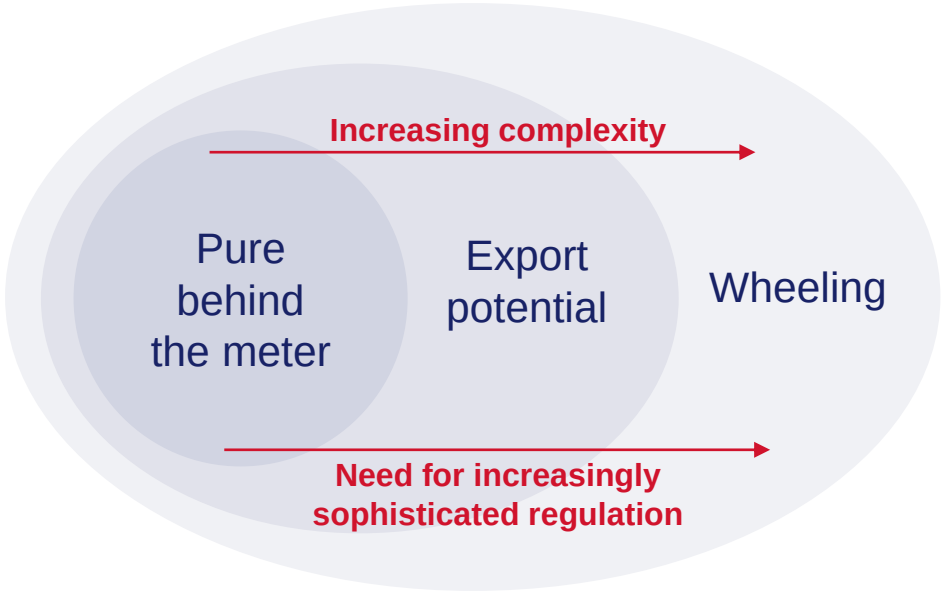


2. **Export potential** – this is where excess energy generated can be sold to the grid.



3. **Wheeling** – Solar energy is transported across the grid from a separate solar generation location.





These three types have different regulatory challenges (explored further in Section 4):

- Pure behind the meter is the simplest with any excess generation curtailed and so no effect upon the grid.
- Exports potentially allow for more renewable energy within the energy mix and improved optimisation of energy costs for a C&I energy consumer. Additional regulatory consideration include the tariffs that can be charged for the export of surplus energy.
- Wheeling requires all the energy generated to be transported by the grid and so has most effect upon the grid. For this model, tariffs need to be defined for use of the transmission and distribution system.

Introduction to C&I use of solar

Different business models are used to define the relationship between solar companies and C&I energy users

Outright purchase of solar equipment

Payment: Energy consumer pays up-front for the cost and installation of the solar equipment.

Ownership: Energy consumer owns the solar equipment and assumes responsibility for maintenance (subject to warranties, etc.).

Pros: Simple, single transaction.

Cons: Substantial investment in non-core operations which many businesses will not want to commit capital to. Energy consumer assumes more risks and responsibilities associated with operating the asset.

PPA for solar

Payment: Energy consumer pays for kWh generated by the solar installation.

Ownership: Solar assets remain owned by the solar company, who essentially provides an energy service to the company. Assets may transfer to energy user at end of contract, depending on agreed terms.

Pros: Easy for companies to understand, like-for-like comparison with existing energy bills. Many operational risks normally remain with the solar company. No need for energy consumer to directly arrange finance or allocate substantial capital.

Cons: More complex commercial terms.

Lease for solar equipment

Payment: Energy consumers leases the solar assets from the solar company, paying a fixed monthly/ annual amount and spreading the cost over multiple years.

Ownership: Solar assets remain owned by solar company, often with asset transfer or an option for the energy consumer to buy the assets at the end of the contract term.

Pros: Many operational risks normally remain with the solar company. No need for energy consumer to directly arrange finance or allocate substantial capital.

Cons: More complex commercial arrangements. Yield/output risk often transfers to energy consumer, less intuitive business case

These business models can sometimes be referred to as solar-as-a-service (SaaS)

Financing C&I solar projects

Financing of projects provides a barrier to small companies with less capital and developed credit ratings.

Contract structures

- The table below analyses the main business models for C&I solar introduced earlier.

	Outright purchase	Lease	PPA
Description	Consumer purchases the solar equipment outright	Equipment is rented by the customer from the developer	Power produced purchased at a fixed price per kWh
Solar as a Service (SaaS)	×	✓	✓
Typical scale	Small < 1MW	Larger > 100 kW	Larger > 100 kW
Performance risk	Consumer	Developer	Developer
Maintenance responsibility	Consumer	Developer	Developer
Financing responsibility	Consumer	Developer	Developer
Key attraction	Similar concept to owning a diesel generator	Consumer benefits from no up-front costs	Consumer benefits from no up-front costs

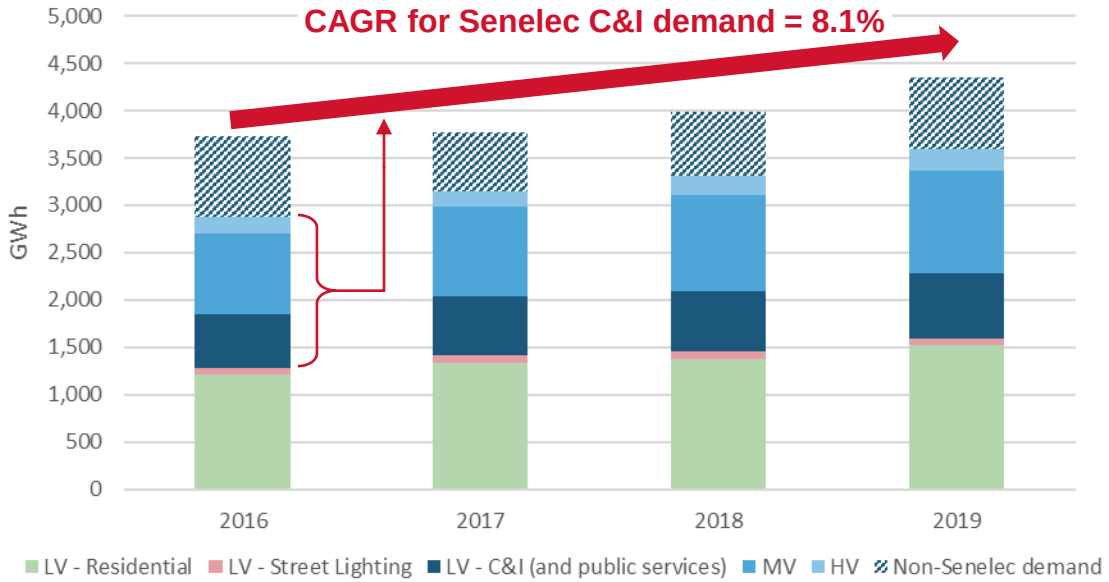
Financing

- Rental and PPA agreements are sometimes referred to as solar as a service (SaaS) models.
- So far, there has been limited penetration of more sophisticated SaaS business models in Senegal. Many stakeholders raise financing as a barrier for the sector.
- Many of the local solar companies only engage in small-scale equipment sales.
- However, this limits market penetration as consumers generally want to prioritise capital allocation towards their core business.
- In the region access to finance is a challenge for small businesses, with local currency loans often expensive or simply not available apart from short tenors (which are not suitable for solar project).
- These challenges extend to local solar companies who can find it difficult to compete with international players who have access international pools of capital, can benefit from the CFA Franc's € peg, and can offer SaaS contracts (subject to regulatory constraints).
- Improving access to low interest, local currently, long-term loans for local C&I solar companies would support local developers in providing SaaS contracts and would open up solar to a wider range of C&I energy consumers.

C&I energy demand in Senegal

C&I demand for electricity has grown at 8.1% p.a. in recent years and is likely to continue increasing

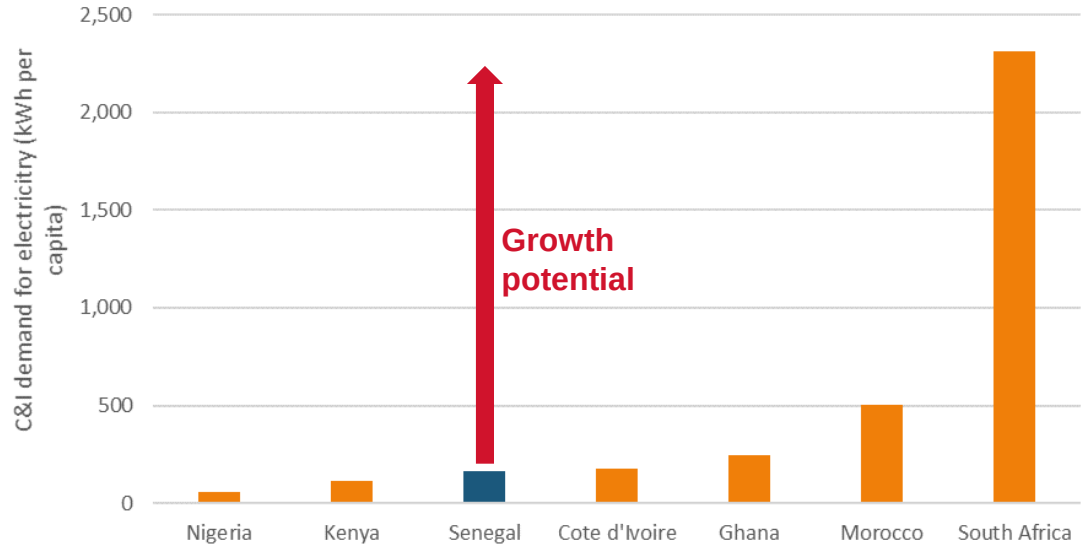
Demand for electricity



Source: *Analysis of data from CRSE, IEA*

- Over the period 2015-2019, Senegal's economy grew at an average rate of 6.1% p.a. While the Covid-19 pandemic has taken a hit, the IMF still expects average GDP growth of 5.6% p.a. over the period 2020-2026, with growth reaching 10.8% p.a. in 2023.
- This growth in GDP has driven higher demand for electricity. C&I demand for electricity has grown at a CAGR of 8.1% p.a. in recent years, with just over 2 TWh of C&I demand connected to the Senelec network in 2019.

C&I demand per capita



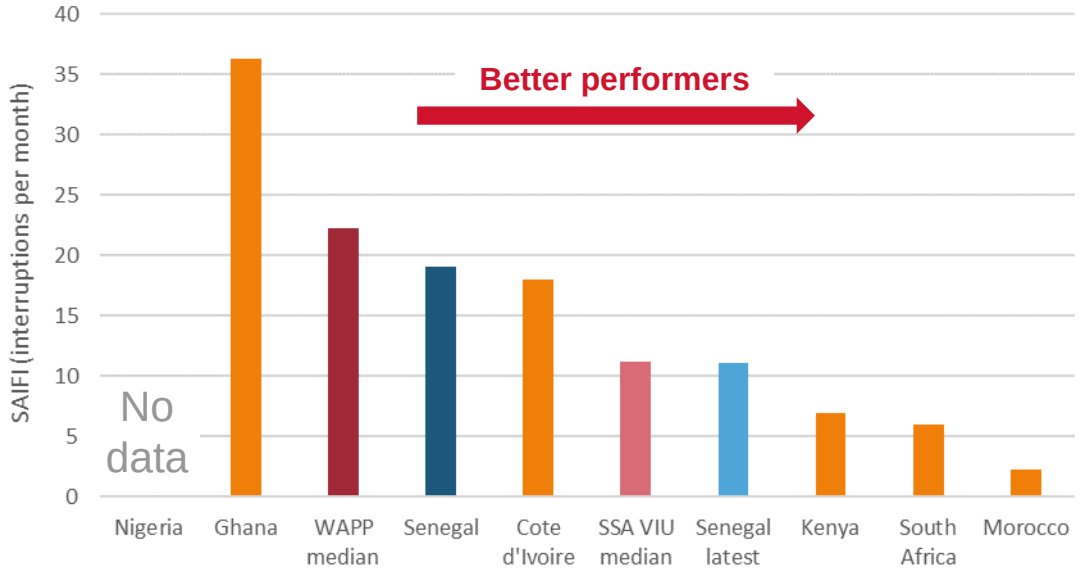
Source: *Analysis of data from IEA, World Bank*

- Senegal's C&I demand for electricity compares well with its peers. Demand is higher than in some countries across Sub-Saharan Africa (SSA), such as in Nigeria, where the poor quality of grid-based power supply is well documented.
- However, demand per capita remains well below levels seen in some other countries across Africa, and especially an upper-middle-income country such as South Africa.
- As Senegal's economy continues to grow, C&I demand for electricity is therefore likely to grow substantially.

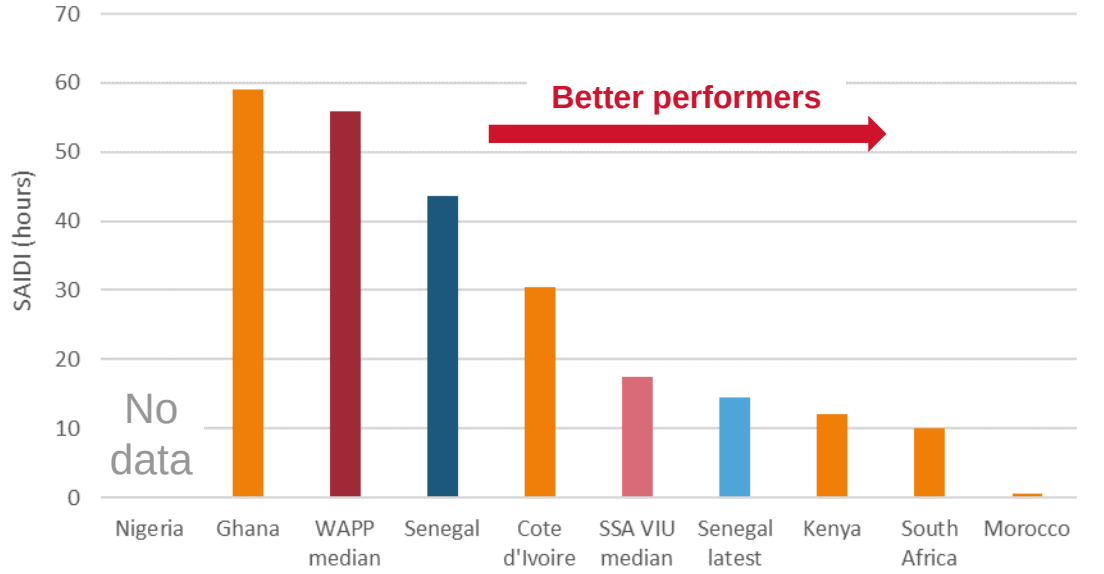
Drivers for C&I solar – grid reliability

The performance of Senelec's network ranks well against its regional peers but reliability remains a challenge

SAIFI – Frequency of outages



SAIDI – Duration of outages



Source: *Analysis of data from CRSE, World Bank GovData360 database, World Bank UPBEAT database*

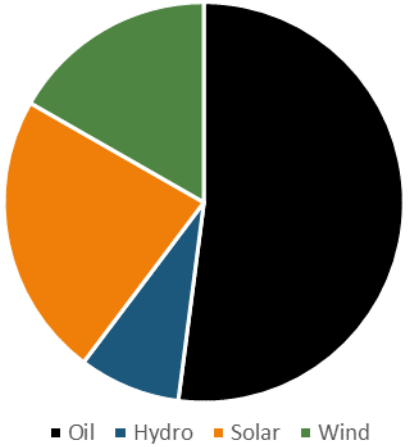
- The above data compared technical performance of the Senelec grid against the same peer group. SAIFI is a measure of the frequency of outages for end users of electricity; SAIDI is a measure of the duration of those outages. Note that data is not available for Nigeria, where it is well documented that the reliability of electricity supply is extremely poor.
- The graphs include median values for utilities in the West African Power Pool and for vertically-integrated utilities across Sub-Saharan Africa. These median values are taken from the World Bank's recent study, "Utility Performance and Behaviour in Africa Today", UPBEAT. The graph also shows the latest values from CRSE, which show improved performance since the 2019 data from the World Bank's GovData360 database, which allows for like-for-like cross-country comparison.
- Senelec performs better than many other utilities in West Africa, and CRSE's latest numbers compare well against an average for the continent. But outages remain frequent, and will often remain a factor for C&I loads in considering whether to invest in onsite generation.

Drivers for C&I solar – cost of energy

Senelec's electricity is some of the most expensive on the continent, deterring business investment

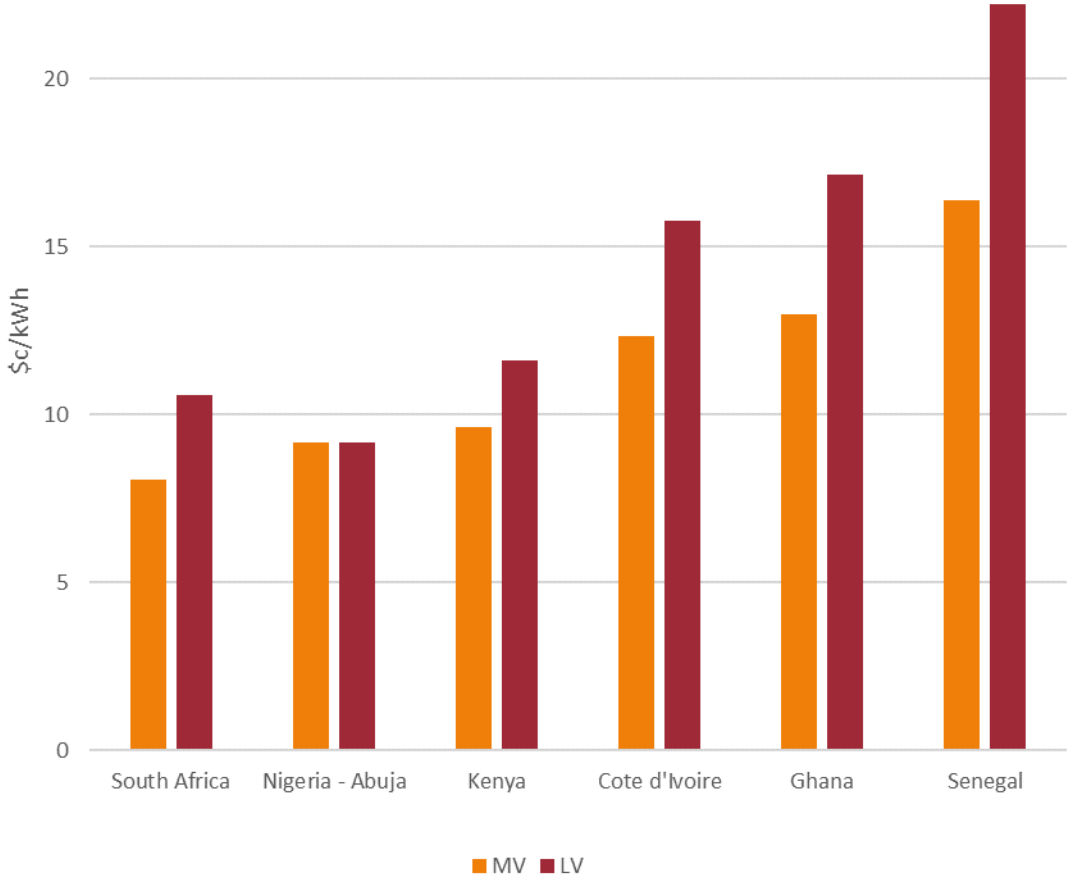
- Senegal's electricity generation mix is heavily dependent on oil-based fuels (see below).
- This reliance on expensive oil is the main driver of high electricity tariffs.
- Industrial electricity tariffs are amongst the highest in Africa, being ~5 $c/kWh higher than either Ghana or Cote d'Ivoire when comparing similar tariff classes.
- The tariffs on the rights are analysed for a baseload demand profile of 100 kW (LV) and 2 MW (MV).
- The high costs of power in Senegal is a barrier to FDI and the expansion of energy-intensive industries.

Electricity capacity mix in Senegal, 2021



Source: *Analysis of data from Senelec, Cross-border Information*

Retail electricity tariffs for industrial consumers

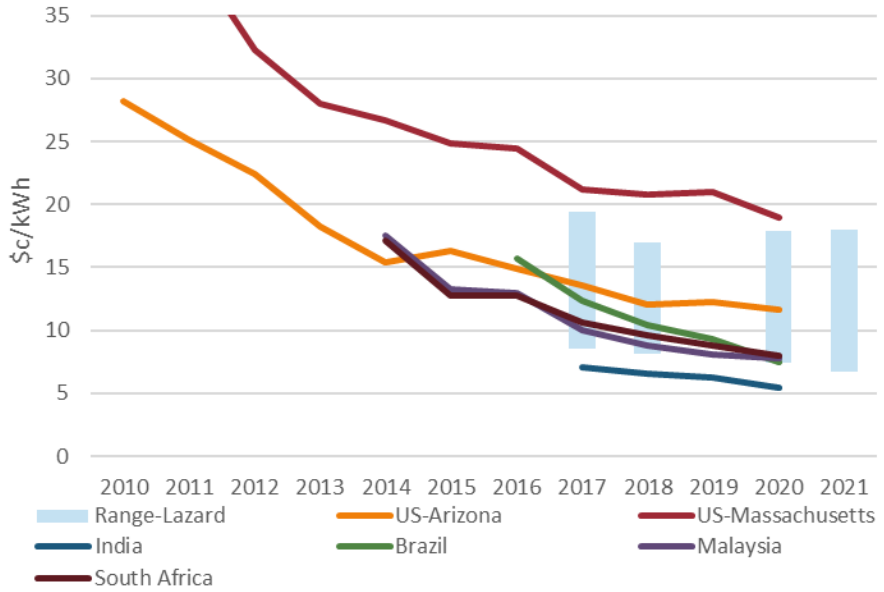


Source: *Analysis of data from Senelec, and other utility and regulator websites*

The falling cost of solar

Solar costs have fallen rapidly in recent years and are often lower than electricity tariffs in Senegal

Levelised cost of solar

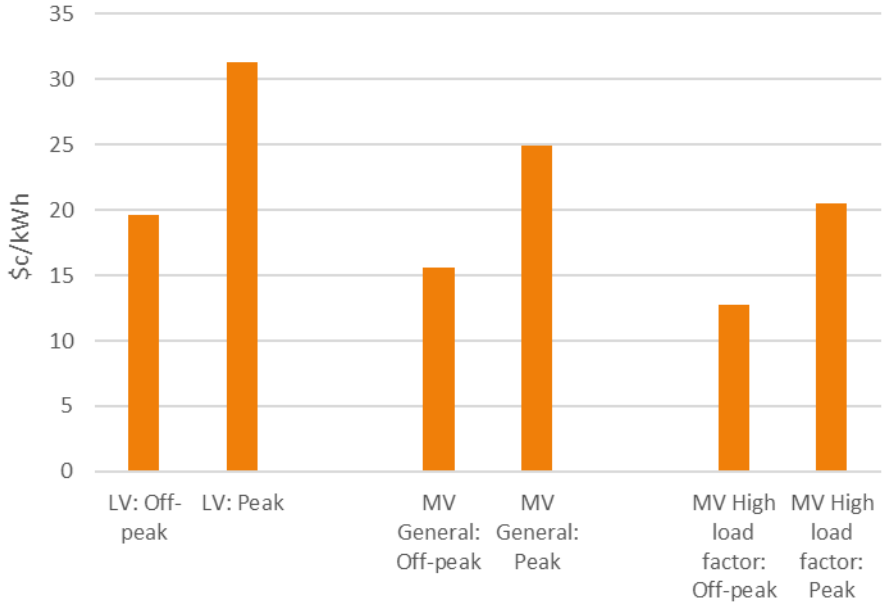


Source: *Analysis of data for C&I scale solar PV projects from Lazard, IRENA*

Senelec C&I unit rates

C&I solar is always likely to be cheaper than Senelec during peak hours

Solar still likely to save costs for most energy users during off-peak hours



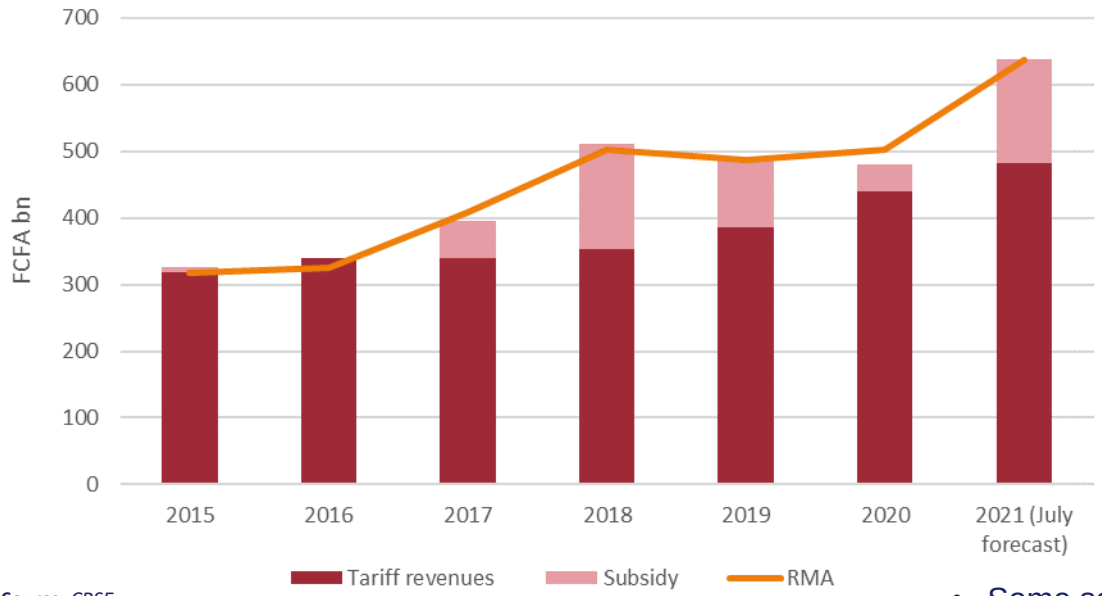
Source: *Analysis of data from Senelec*

- Solar capital costs have fallen rapidly in recent years across the globe. This has translated to falling levelised costs (levelised cost is a measure of the cost of generating a unit of electricity measured over the economic life of the project).
- As shown by the graph on the left above, the levelised cost varies according to the quality of the solar resource available, and with local installation costs.
- The graph on the right shows the most relevant energy charges from Senelec's tariff schedule. Most industrial customers are subject time-of-use charging; a higher peak charge applies during the hours 7pm-11pm, with an off-peak charge being applied outside of these hours.
- The cost of energy from a C&I solar installation typically compares well against Senelec's tariffs. The business case is finely balanced, but still likely to be positive for many energy users during off-peak hours, which is when solar PV installations will be generating electricity.

Drivers for C&I solar – the impact of natural gas on the cost of energy

The use of natural gas in the electricity sector is unlikely to result in a substantial reduction in tariffs

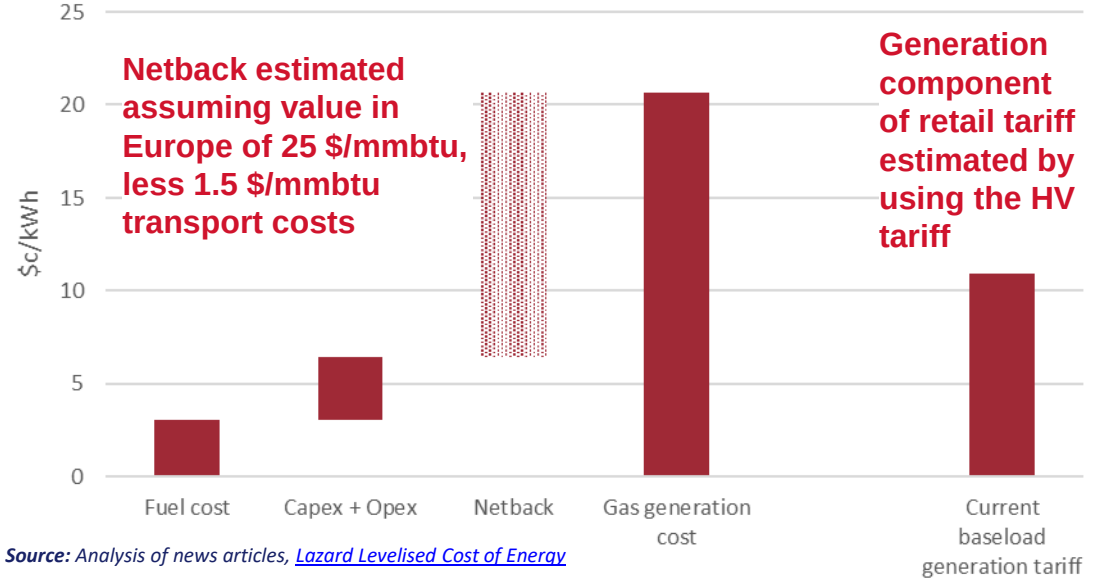
Impact of tariff subsidies



Source: *CRSE*

- CRSE permits Senelec to collect a Maximum Authorised Income (RMA). When tariffs are not adjusted such that this RMA is recovered, subsidies are used to plug the gap.
- This gap has increased in recent years and is forecast to rise further in 2021 as a result of higher commodity prices.
- To the extent that natural gas results in lower generation costs, this is likely to be used to reduce the subsidy burden on Ministry of Finance before end-user tariffs benefit.

Cost of natural gas



Source: *Analysis of news articles, Lazard Levelised Cost of Energy*

- Some sources have suggested that gas from Greater Tortue and other fields will cost ~4 $/mmbtu, and there are expectations that domestic gas reserves will result in lower gas prices.
- However, very high global prices mean that the netback value of the gas (the price it could be sold for if transported to other markets) is currently much higher. Gas imported to Europe currently costs ~25 $/mmbtu.
- It seems likely that domestic gas would be sold for somewhere between these price points (an implicit fossil fuel subsidy), but even with lower international gas prices it is unclear whether natural gas will result in any significant reduction in electricity tariff.
- Capex (1,200 $/kW) and opex (3 $/MWh) for gas-fired power generation are added to the cost of gas itself, based on numbers from Lazard's annual Levelised Cost of Energy publications.

While new gas-fired power might reduce the cost of power generation slightly, it seems unlikely that this will feed through into lower tariffs for C&I consumers of electricity in the near future

Contribution to Senegal's Nationally Determined Contribution (NDC)

C&I solar could make a contribution towards Senegal achieving its NDC

- Senegal NDC was updated in 2020, and includes emissions reduction targets from both the energy and industrial sectors.
- Senegal aims to reduce emissions from the energy sector by up to 41.2% compared to a business-as-usual scenario.
- Catalysing C&I investment in solar PV could help to reduce Senegal's reliance on fossil fuels for power generation.
- These projects would be funded by the private sector, they would not require capital to be allocated directly by government or SOEs.

Sector	2010 emissions ($GgCO_{2eq}$)	2020 emissions ($GgCO_{2eq}$)	BAU 2030 ($GgCO_{2eq}$)	Unconditional target	Conditional target
Energy	6,165	~10,000	23,927	10.0%	41.2%
Industrial processes	1,412	~3,200	3,953	0.0%	8.1%

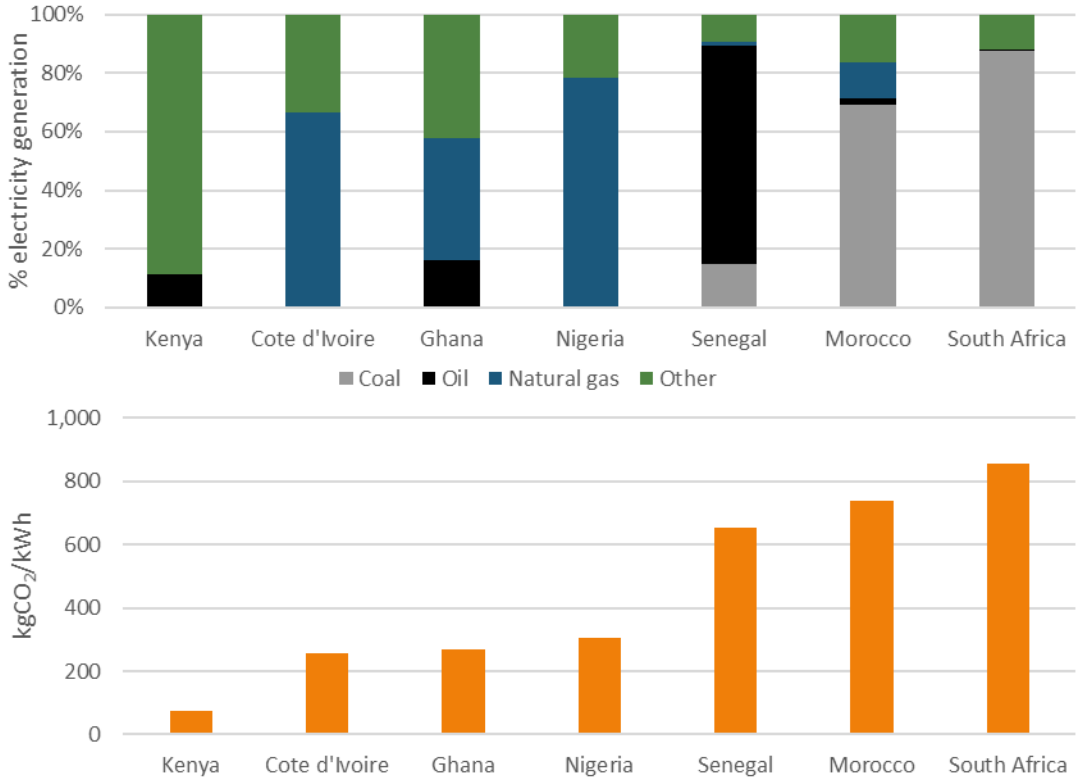
Potential contribution of C&I solar to achieving NDCs

- Every 1 MW of oil-based capacity electricity generation capacity operating at full load that is displaced would contribute a reduction in emissions of ~6 $GgCO_{2eq}$.
- 100 MW of C&I solar operating at an average capacity factor of 20% would displace ~175 GWh of oil-fired power generation accounting for 118 $GgCO_{2eq}$.

Private sector focus on low emissions

High emissions in Senegal's electricity sector may prevent companies from investing in the country

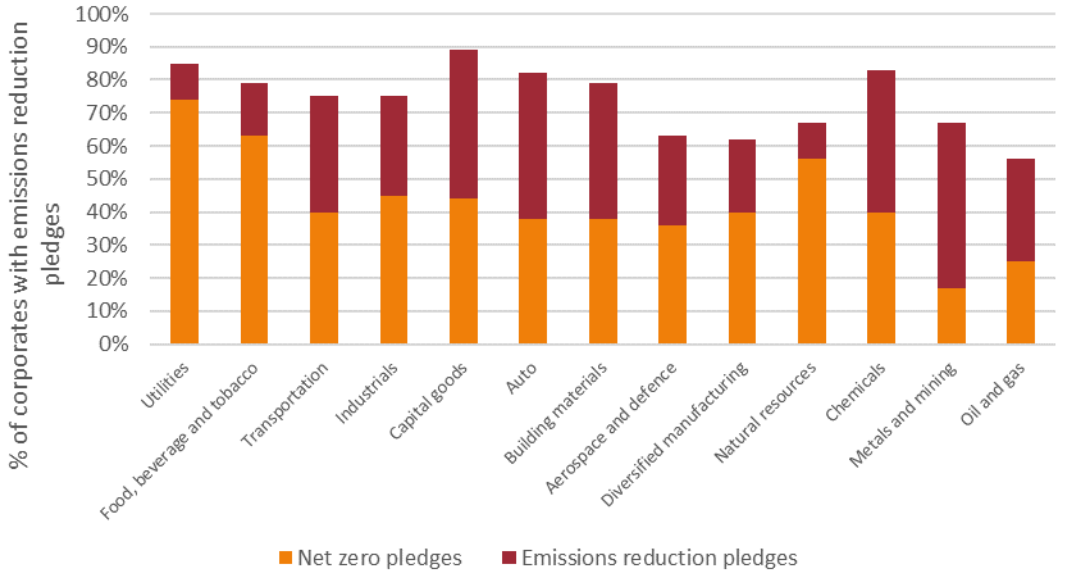
Emissions intensity of electricity ($kgCO_2/kWh$)



Source: *Analysis of data from IEA*

- Senegal's electricity generation mix has a much higher emissions intensity than most other countries.
- African countries with a higher emissions intensity (South Africa, Morocco) have a much more permissive environment for C&I solar, so that companies can reduce their carbon footprint.

Corporate pledges to cut emissions



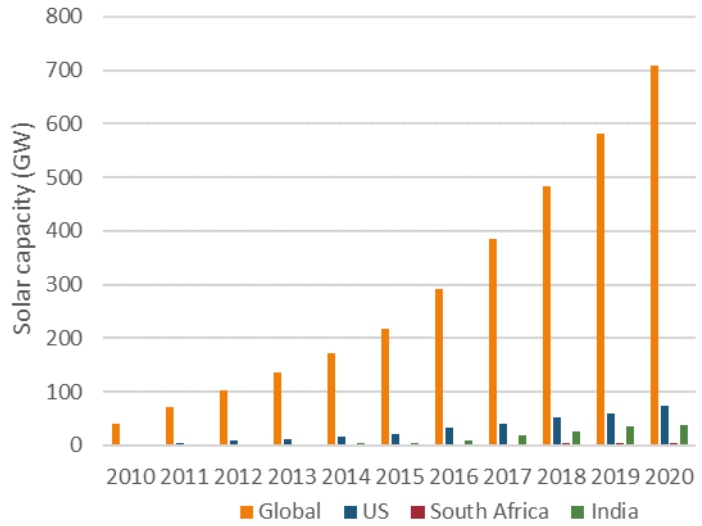
Source: *Fitch Ratings*

- Where government action falls short, corporates are increasingly imposing their own emissions reduction targets. This increasingly has a meaningful impact on the allocation of capital.
- The above chart shows the proportion of corporates in Western Europe with emissions reduction targets.
- To attract FDI in future, Senegal will need to enact policies that enable companies to meet these targets. If energy intensive industries are unable to source their electricity from renewable sources, they are increasingly unlikely to invest.

Global growth of C&I solar

Globally solar, and specifically C&I solar, has seen high growth in recent years

Global solar capacity

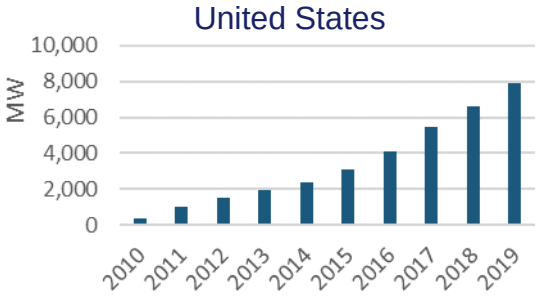


Country	Solar CAGR
World	33%
US	43%
South Africa	32%
India	48%

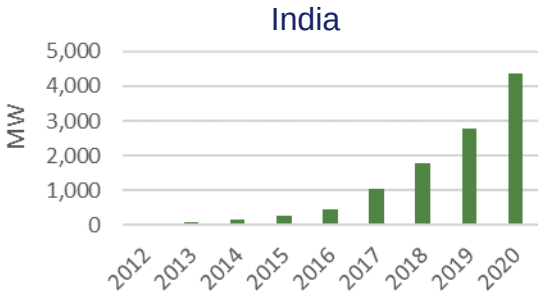
Source: BP Statistical Review of World Energy, 2021

- Globally solar capacity has grown rapidly over the last ten years with a CAGR of 30%.
- This has been driven by falling costs of solar capacity and a motivation to move towards net-zero.

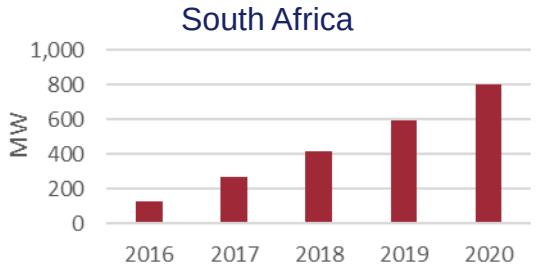
C&I solar capacity



Source: Solar Energy Industries Association, 2020



Source: BloombergNEF, IEEFA, 2020



Source: GreenCape Energy Services, 2020

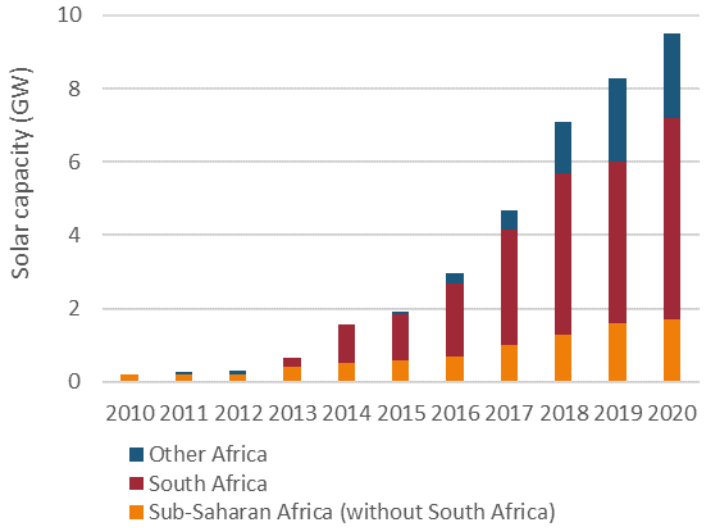
Country	C&I Solar CAGR
US	39%
South Africa	59%
India	69%

- C&I solar is a significant and growing market. In the US, South Africa and India C&I solar is more than 10% of the total solar generation capacity.
- C&I solar is a rapidly growing market. In many countries C&I solar capacity is growing at a higher CAGR than overall solar capacity.
- This is driven by falling solar costs, but also growing CSR requirements for companies to source their energy from renewable sources.

Global and regional context

In Sub-Saharan Africa the use of solar is growing, but remains behind progress in other regions

Africa solar capacity

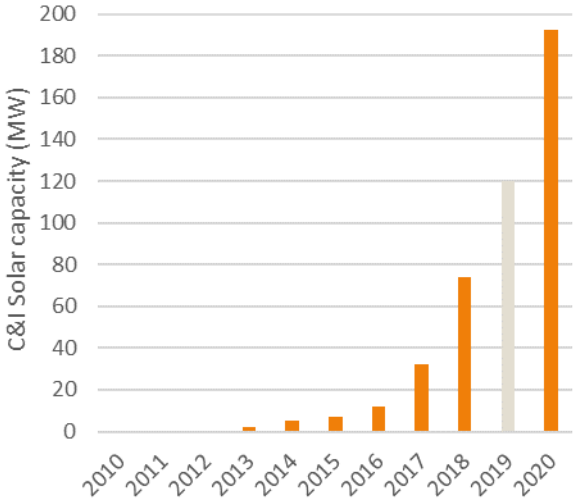


Country	Solar CAGR
World	33%
Africa	48%
South Africa	32%
Sub-Saharan Africa (without South Africa)	24%

Source: BP Statistical Review of World Energy, 2021

- Across the whole of Africa solar capacity has grown rapidly with a CAGR of ~50% between 2010 and 2020.
- This growth has not occurred uniformly and in Sub-Saharan Africa (excluding South Africa) this growth has only been at a CAGR of 24% over the same period.
- By the end of 2019 Senegal had 134 MW of installed solar capacity, the majority of which is utility scale (*Source: Senegal introduces VAT exemptions for off-grid solar products, PV magazine).*
- This total has continued to grow as new projects are commissioned, with total installed capacity now totalling ~200 MW.

Sub-Saharan Africa C&I solar capacity



Country	C&I Solar (MW) 2018	2020
Sub-Saharan Africa (without South Africa)	74	194
Nigeria	20	55
Kenya	15	27
Burkina Faso	15	15
Eritrea	8	8
Ghana	7	11
Namibia	7	28
Ghana	7	11
Zimbabwe	1	14
Senegal	1	9

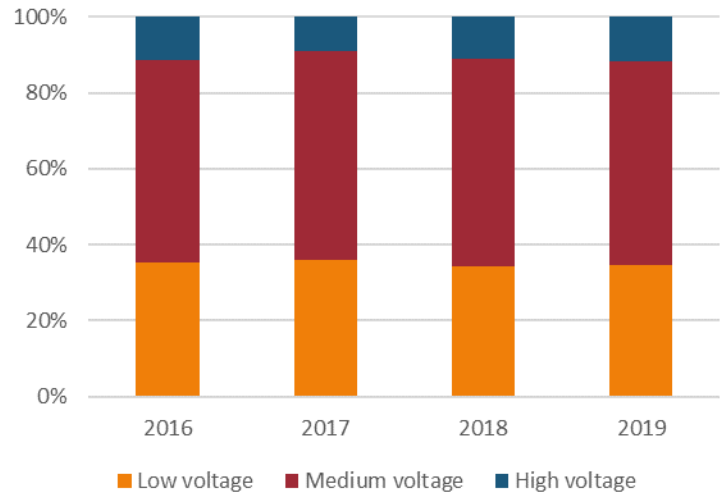
Source: Analysis of BloombergNEF, 2019 and AFSIA 2021 data, excluding South Africa

- C&I solar represented only 4% of solar capacity in Sub-Saharan Africa (excluding South Africa) in 2018.
- Significant growth in C&I solar capacity only began in 2017, as solar costs became competitive with utility electricity tariffs. So far, growth of this market varies greatly by country, as shown in the table above.
- In 2018 ~2/3rds of the C&I solar capacity was in only 3 countries – Nigeria, Kenya and Burkina Faso (note that in Burkina Faso, this total is the result of one single gold mine project).
- C&I growth continued through 2020, despite the impact of Covid restrictions.

C&I solar potential in Senegal

There is substantial potential for C&I solar to reduce energy costs for job-generating businesses in Senegal

Industrial demand for electricity in Senegal



Source: *Analysis of data from CRSE*

- In 2019 total industrial demand for electricity in Senegal was 2,016 GW.
- This demand for electricity is split across low, medium and high voltage connections, with the % of load at each voltage level shown in the above figure.
- This demand comes from a range of sources including retail spaces, manufacturing, fertiliser, cement and mining sites.
- It is likely that industrial demand for electricity will increase substantially as Senegal's economy grows.

High Voltage Consumers

Company	Sub-Sector	2018 Sales (GWh)
SOCOCIM	Cement	82.3
ICS	Fertiliser	62.5
SOMETA	Mining	53.8
OLAM	Food systems	5.1

Source: *Analysis of data from Senelec*

- Senelec provides power for the above high voltage consumers.
- These consumers engage in measures to reduce their CO_2 emissions:
  - SOCOCIM has planted 500 hectares of crops for biofuels and also has a 8 MW_p solar PV project to contribute towards its energy needs.
  - This demonstrates the demand that exists for companies to take action to cut energy costs and reduce carbon emissions.

C&I Solar projects under development

Company	Developer	Sub-Sector	Capacity (MW)	Storage (MW)
Senico	GreenYellow	Food processing	1.6	0.0
Eramet	Crossboundary	Mining	13.0	8.0

Source: *Analysis of news articles*

- In addition to the SOCOCIM project, only 0.8 MW_p of C&I solar has been installed in Senegal.
- Some new C&I solar projects are under development (examples in table above).
- The carbon intensity of grid electricity generation and high energy tariffs mean that C&I solar presents an opportunity to drive cost reduction and carbpn emissions for businesses in Senegal.

Solar generation profiles

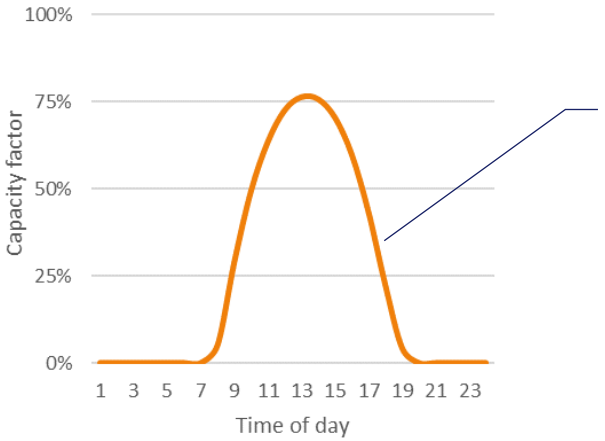
Diurnal variation in solar generation limits its contribution to C&I loads in the absence of being able to export

Solar profiles

Monthly solar intensity

Some seasonality in solar resource, with greatest generation during December to April dry season.

Hourly solar intensity



Regular daily profile in output

Source: *Renewables Ninja, 2019*

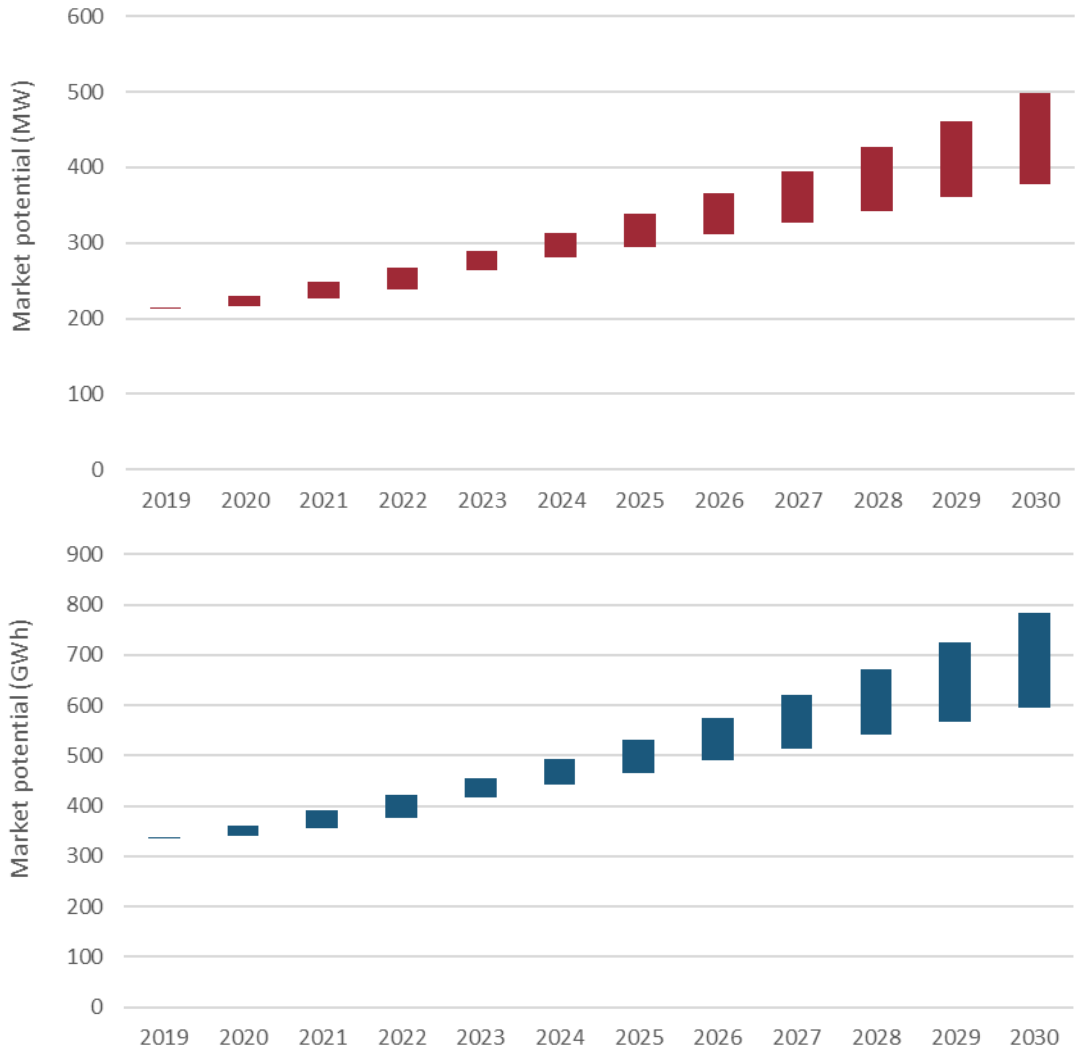
The impact of solar profiles on C&I solar

- The solar resource in Senegal does vary seasonally, with output greatest during the December to April dry season.
- C&I companies with demand that is broadly constant through the year will aim to size installed capacity so there are no times of year where they are curtailing significant amounts of unused energy.
- Companies will also typically size the installed capacity of their solar installation to avoid significant curtailment in the middle of the day (unless they also install a battery – see later slide).
- Companies that only operate on weekdays would curtail most of the energy generated at weekends (unless it is possible to export surplus energy). This may also impact how much solar capacity an energy consumer installs.
- The shape of solar output means that in the absence of a regulation supportive of energy exports, companies / developers need to trade off the additional savings that they might achieve by over-sizing a solar installation against the losses associated with energy curtailment.

Estimated market potential

The market for C&I solar could grow to 380-500 MW by 2030

Market potential projections (MW and GWh)



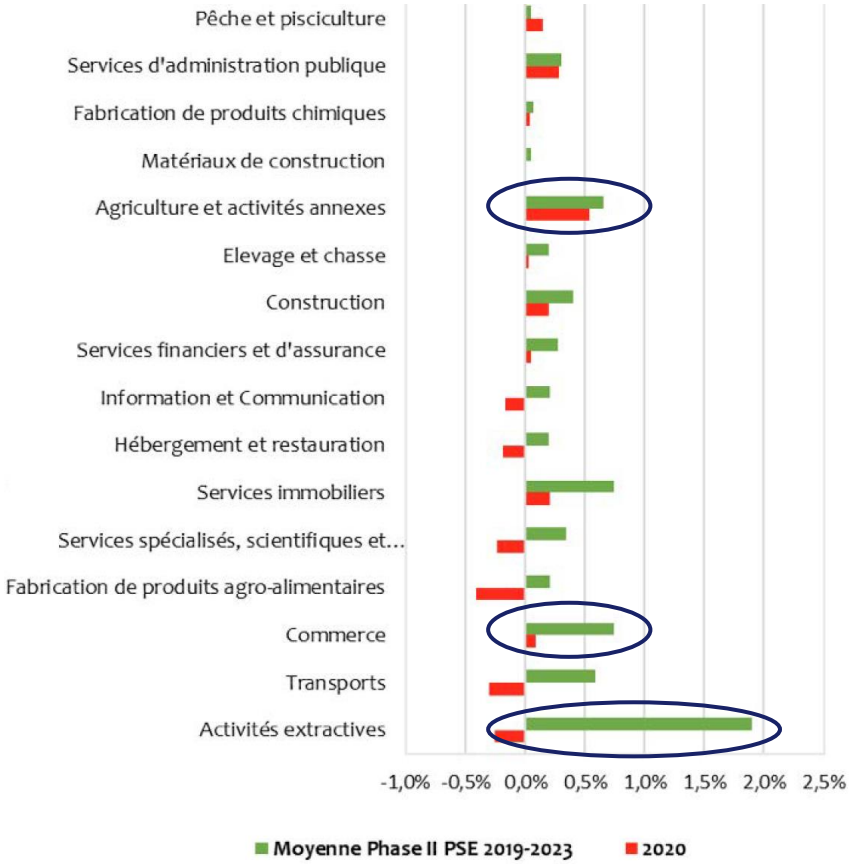
Drivers of growth in market opportunity

To estimate the potential market size, the following assumptions can be made:

- We have assumed that HV and MV-connected demand is operating 7 days a week, to give ~150MW of hourly demand for C&I solar.
- If companies instal enough solar PV capacity to meet demand in the middle of the day in the sunniest month (March), this gives a potential market size of ~210 MW installed solar capacity (in 2019).
- If C&I demand continues to grow at a CAGR of 8.1% this would give a potential market size of ~500 MW by 2030. The top panel (which shows MW market potential) also shows a lower growth rate, which is aligned with the IMF's latest GDP projections for Senegal.
- Growth could be even higher; for example, if the use of C&I solar helps to attract incremental C&I investment to Senegal.
- The lower panel shows the market potential in GWh terms, assuming an average capacity factor of 18%. The 2019 addressable market of 335 GWh is ~17% of Senelec's C&I load.
- Unlike in some other West African markets (e.g., Nigeria), there is a small market potential in Senegal for displacing the role of backup generators. While backup generators are used by some businesses, they typically only operate for short periods of time. This is evident in the IEA's energy balance database, which shows limited use of oil products directly by industrial sectors.

Key sectors for C&I energy demand

Senegal's plans for growing industry focus on several energy intensive sectors



Source: *Plan Senegal Emergent, 2019-2023*

- The largest industries in Senegal are agricultural and fish processing, phosphate mining, fertilizer production, petroleum refining, mining, and construction materials.
- These industrial activities all require substantial energy inputs.
- The fastest growing parts of the economy (see left) also include energy intensive sectors, such as extractives.
- Elements of the PSE could also drive growth in electricity demand from C&I:
  - Growth of sector of sectors identified as priorities for job creation, such as agribusiness, aquaculture, pharmaceuticals, and digital industries. Particular focus is placed on growing small and medium sized enterprises.
  - Development of agropoles and Special Economic Zones (SEZs) to accelerate the growth of certain industries.
- The PSE's action plan commits to spending ~1bn FCFA on these initiatives over the 2019-2023 period.

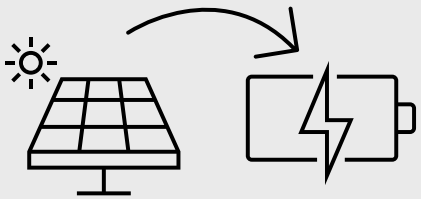
Market size – further factors

Energy exports and battery storage increase potential for C&I solar. C&I solar could drive job creation

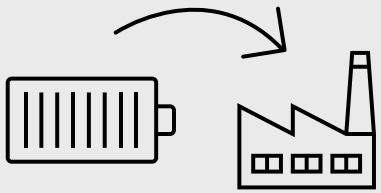
Other considerations in sizing solar C&I projects

- **Energy exports** from the consumer site:
  - Exports would allow more C&I solar to be installed as excess generation would no longer be being curtailed but fed back into the grid.
  - This would improve the business case for C&I solar, especially for companies operating primarily on weekdays.
  - By displacing oil-based generation, C&I solar projects would push down the cost of electricity generation, benefiting all electricity consumers.
  - However, exporting surplus energy requires a supportive regulatory framework.
- **Battery storage**:
  - Battery storage would allow for excess generation during the daytime to be stored, which would then be used overnight.
  - This would increase the amount of C&I solar that could be installed.
  - Battery storage increases the market size for pure behind-the-meter projects, so requires fewer changes to the regulatory framework.
  - However, battery storage increases the upfront capital cost of the project, exacerbating the challenge of financing the project.

Day: battery charging



Night: battery discharging



Wider economic benefits

- C&I solar provides low-cost electricity for industrial consumers.
- In 2017 the Private Infrastructure Development Group (PIDG) evaluated the link between investment in the power sector and job creation in Senegal.
- This research found that a 6.3% reduction in end-user electricity costs would result in 68,500 jobs being created.
- In other research, the price elasticity of demand for electricity in Senegal has been estimated as -0.9 (Atalla, Bigerna, and Bollino, 2016). This would imply that a 1% decrease in price leads to a 0.9% increase in electricity consumption.
- Taken together these suggest C&I solar may have two effects:
  1. The potential for C&I solar reducing energy costs may attract additional industrial loads which would not have otherwise been invested in Senegal.
  2. Reductions in grid tariffs due to C&I solar (the benefit of exported surplus energy and/or the displacement of thermal generators) could stimulate more grid demand.
- Both would likely drive job creation.

Glossary

AEME	Agence pour l'Economie et la Maîtrise de l'Energie - Agency for the Economy and Energy Management
AFD	African Development Bank
AfSIA	Africa Solar Industry Association
ANER	Agence Nationale pour les Energies Renouvelables - National Agency for Renewable Energies
ASER	The Rural Electrification Agency
BMN	Bureau de Mise a Niveau - Upgrading Office
C&I	Commercial and Industrial
CAGR	Compound Annual Growth Rate
CNP	National Employer's Council
CSRE	Commission de Régulation du Secteur de l'Energie - Energy Sector Regulatory Commission
ECOWAS	Economic Community of West African States
EPC	Energy Performance Certificate
ERA	Electricity Regulation Act
ESR	Energy Sector Roadmap
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit - German Development Agency
HV	High Voltage
IEA	International Energy Agency
IEP	Integrated Energy Plan
IFDD	Institut Francophone du Développement Durable - Francophone Institute of Sustainable Development
IPP	Independent Power Producer
IPT	Independent Power Transmission
IRENA	International Renewable Energy Agency
IRP	Integrated Resource Plan
LPDSE	Lettre De Politique De Développement Du Secteur De L'Energie - Energy Sector Development Policy Letter
LV	Low Voltage
MCA	Millennium Challenge Account

Glossary

MCC	Millennium Challenge Corporation
MEM	Ministry of Energy and Mining of Morocco
MIPMI	Ministry of Industrial Development and Small and Medium Industries
mmbtu	Metric Million British Thermal Unit
MPE	Ministry of Petroleum and Energy
MV	Medium Voltage
MW	Megawatt
NDC	Nationally Determined Contribution
NEMA	National Environment Management Authority of Kenya
PSE	Plan Senegal Emergent
PV	Photovoltaic
RMA	Maximum authorised income for Senelec
SaaS	Solar-as-a-Service
SAIDI	The System Average Interruption Duration Index
SAIFI	The System Average Interruption Frequency Index
Senelec	Société nationale d'électricité du Sénégal - National Electricity Company of Senegal
SEZ	Special Economic Zone
SOE	State-Owned Enterprise
ToU	Time-of-Use
UPIC	Union des Prestataires des Industriels et des Commerçants du Sénégal - Union of Service Providers of Industrialists and Traders of Senegal
VoLL	Value of Lost Load
WAPP	West African Power Pool