SUSTAINABLE LEAST-COST SOLAR DEPLOYMENT

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Desire to deploy renewables but at least-cost

Objective:
690 GW of solar PV additional installed capacity by 2025 in developing countries*

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** IEA, World Energy Outlook 2018 / Sustainable Development Scenario*

Targets for solar deployment stalled due to key challenges

LAND AVAILABILITY

IPP ATTRACTABILITY

PROJECT FINANCING

VARIABILITY

INTEGRATION IN THE GRID

POLITICAL RISK

FOREIGN EXCHANGE RISK

LEAST-COST GENERATION

IRRADIATION

- Lack of enabling environment
- Weak procurement process
- Difficult access to risk mitigation coverage

CURTAILMENT

LEGAL FRAMEWORK

DISPATCH CONSTRAINTS

UTILITY BANKABILITY

TIMING

CONTRACT TERMINATION

WEAK PROCUREMENT

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Key questions that need to be answered to ensure sustainability

1. **How much solar PV can I integrate** in my grid?
2. **How much solar PV** do I need?
3. **Where** do I need it?
4. **When** do I need it?

→ **Sustainable Solar Targets**

5. **Who** should be investing in the solar projects?
6. **How to procure** the projects?
7. Under what **risk allocation**?

→ **Deployment Framework**

8. **How to mitigate risks** in a sustainable manner?

→ **Risk Mitigation Coverage**

COUNTRY LEVEL STRATEGY

Country Level Strategy

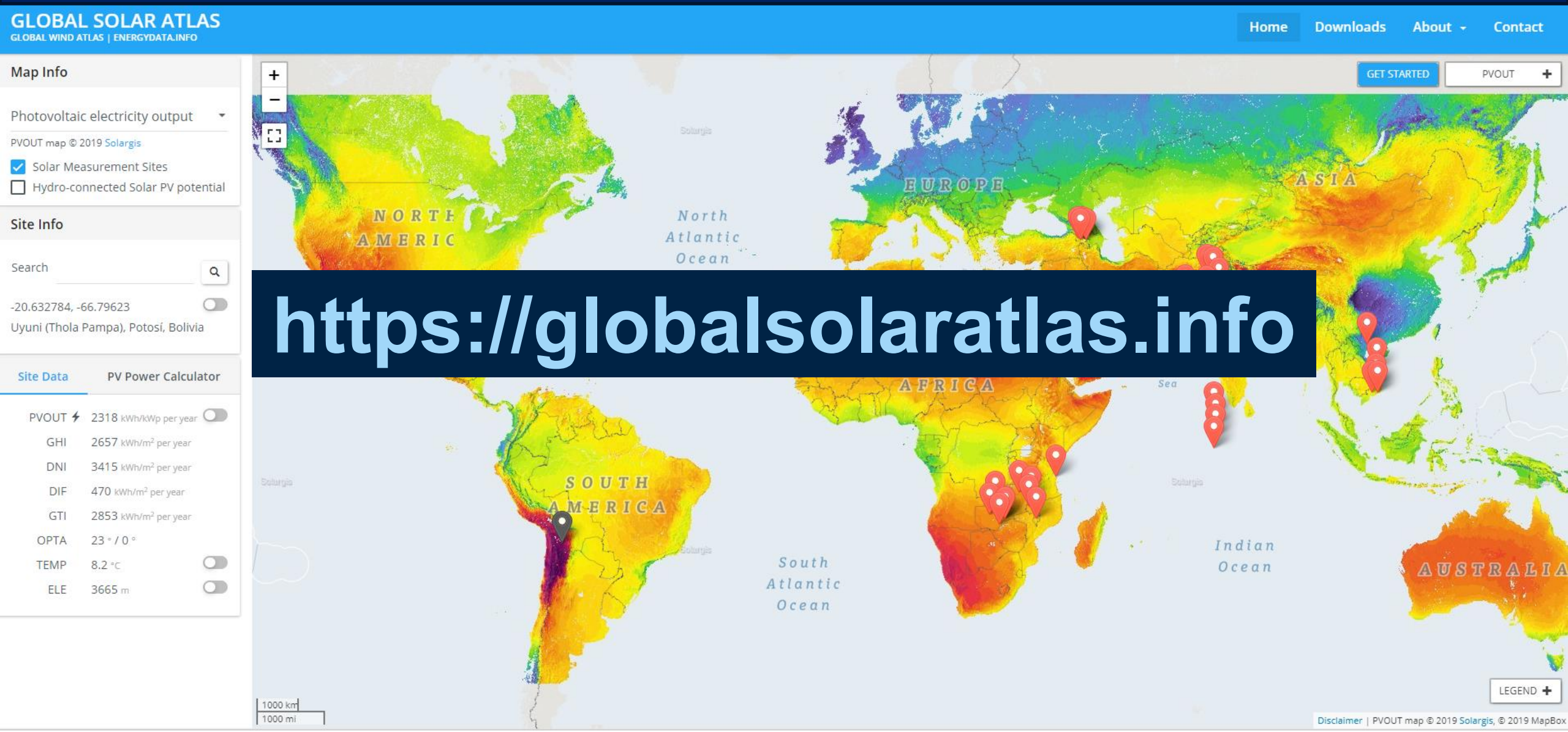
SUSTAINABLE SOLAR TARGETS	DEPLOYMENT FRAMEWORK
Dispatch & Transmission upgrade plan	Financing Strategy (IPP/PPP/Public)
Least-cost planning exercise	Procurement Strategy
Optimum solar PV technology selection (rooftop, floating etc.)	Legal Framework

Articuled with the overall Power Sector Framework (utility reform, electrification strategy, energy efficiency, subsidies etc.)

Medium-term solar targets with clear deployment timeline

How much solar can be integrated and where?	Grid Integration Analysis / Dispatch Diagnosis	To identify the technical and commercial constraints in the grid that would inhibit the deployment of VRE and assess where it is the most optimum to locate
What type of solar PV technology?	Targets per type of technology	To decide on different targets between ground-mounted PV, rooftop PV, floating/co-located with hydro
How much solar needed in the system and when?	Least-cost generation planning	To identify the optimal generation options considering the national targets and constraints identified under the grid integration analysis

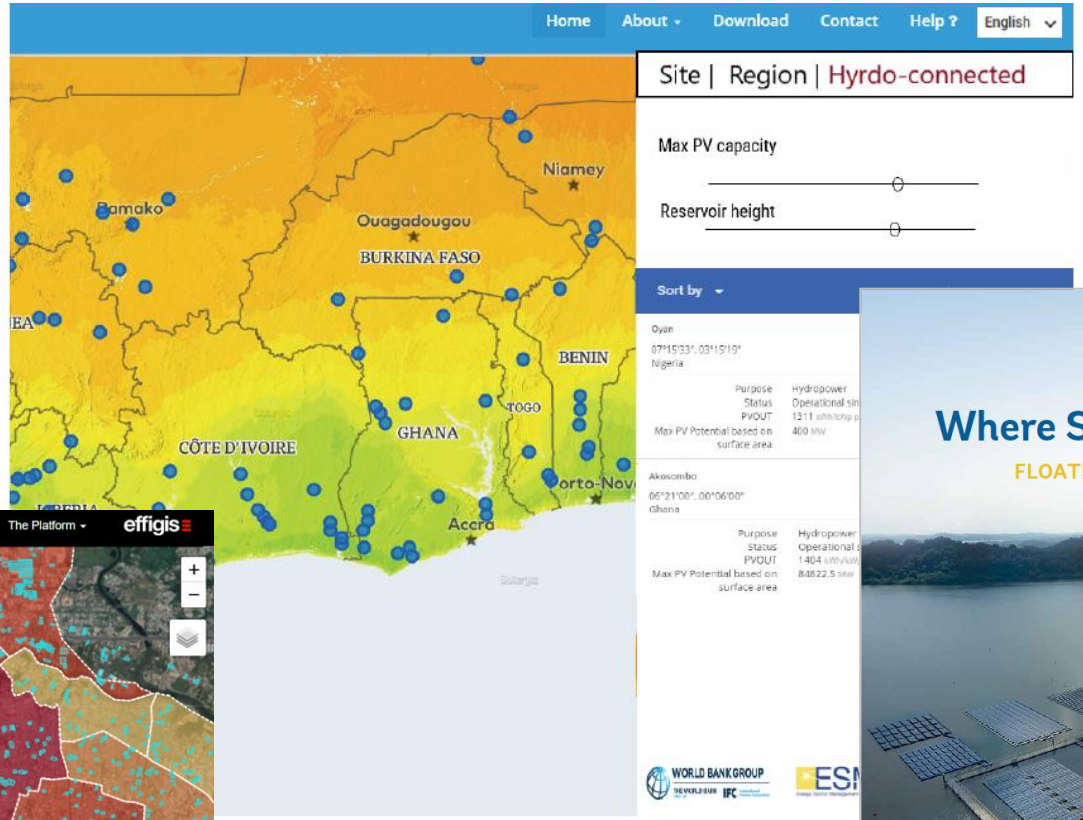
WBG Global Solar Atlas



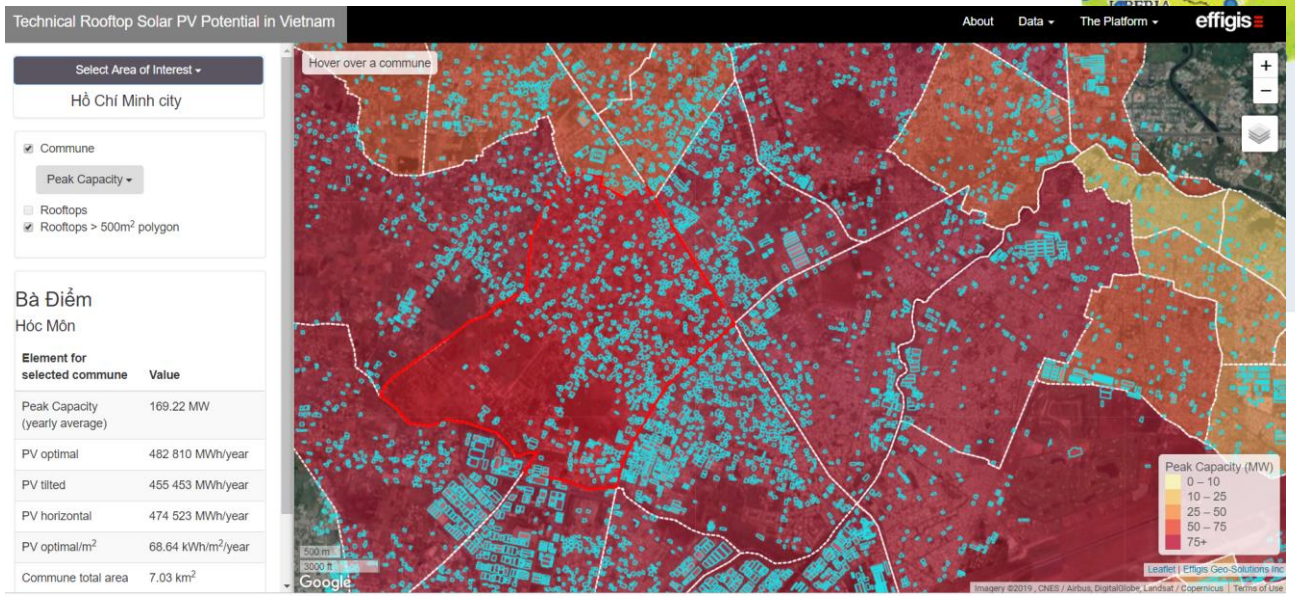
Solar PV Technology Optimum

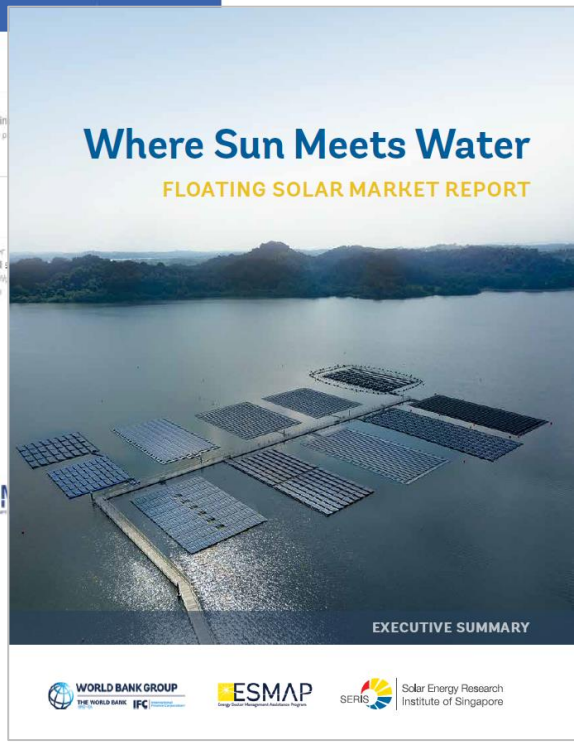
- Ground-mounted
- Floating PV
- Collocated with hydro power
- Rooftop PV

ESMAP Hydro-connected PV tool*



Technical rooftop PV potential*



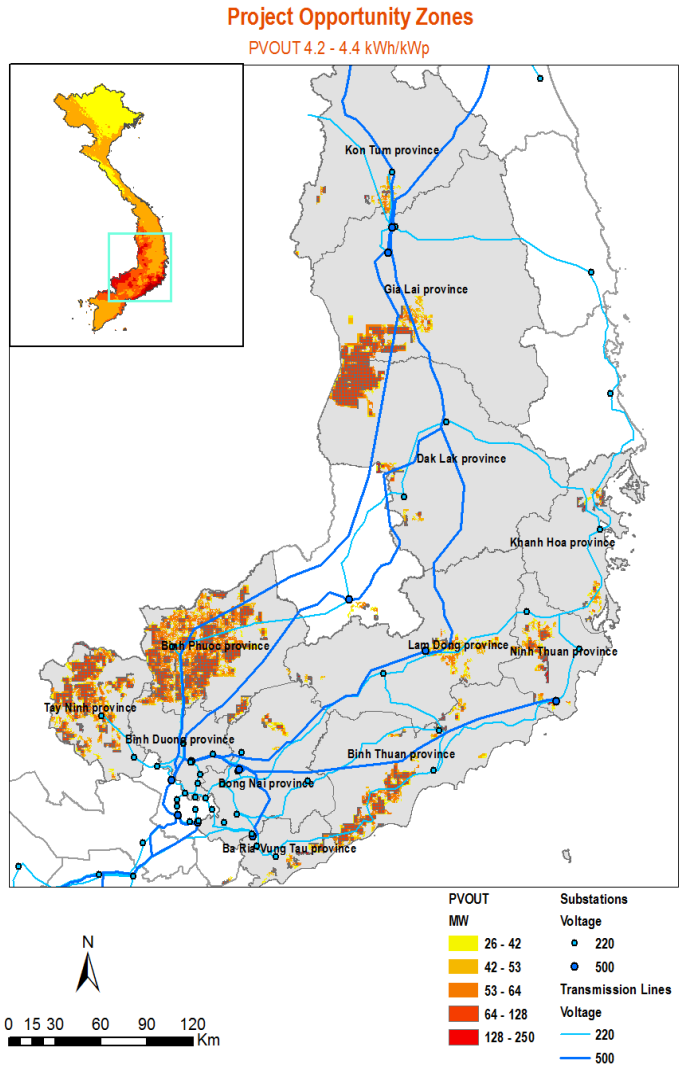


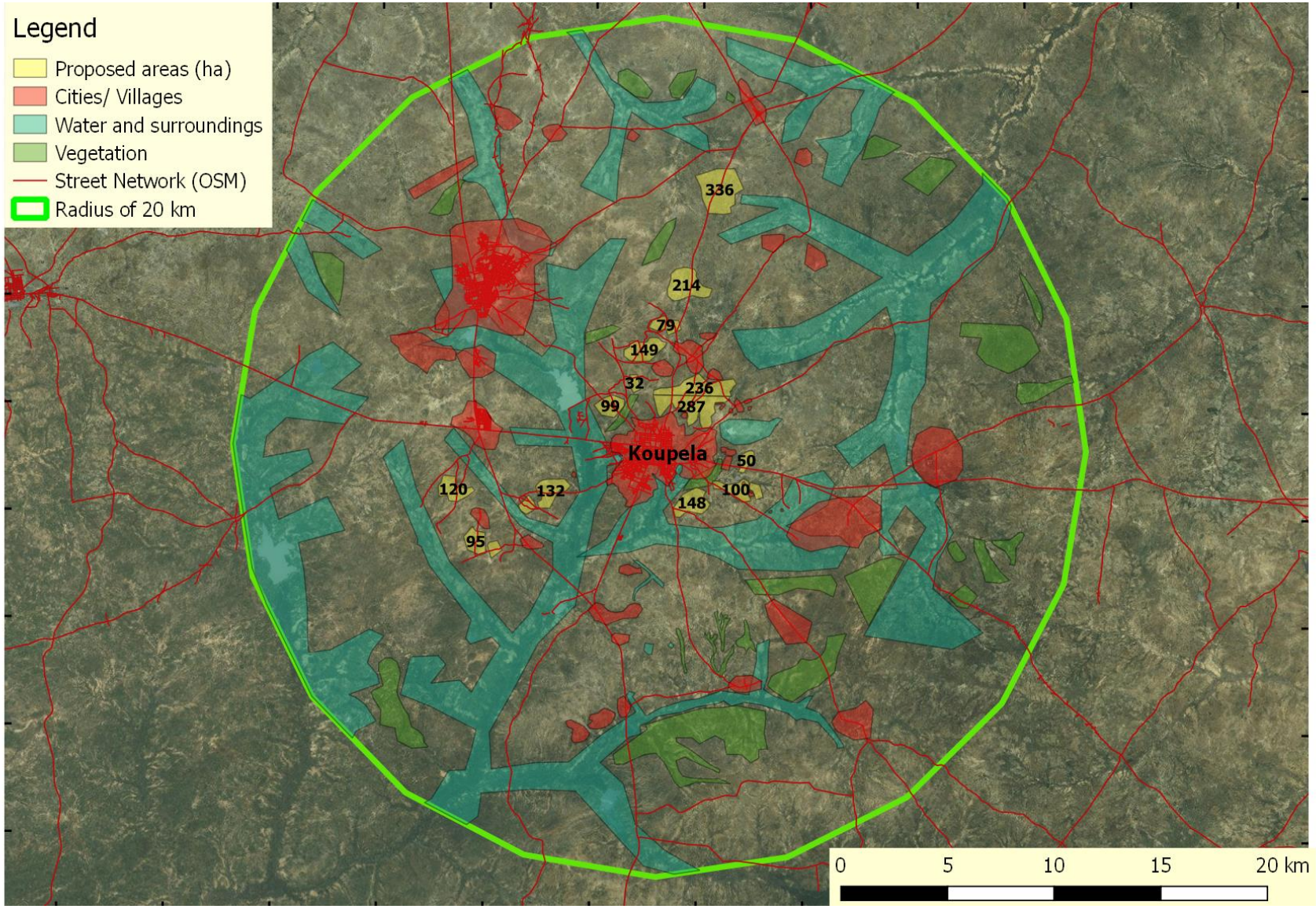
** The technical rooftop PV potential is under development and the hydro-connected PV tool is currently only for West Africa and India*

Deployment Framework

Where do I have space in my grid & land?	Locational Study	To identify the optimal location for solar PV projects looking at (i) grid availability, (ii) solar resource and (iii) land availability
How to finance and procure the projects?	Procurement Plan	For the Government to decide how much investment it wants to put into the future solar projects and how to procure IPPs (e.g. substation based auctions, solar parks etc.) under what risk allocation
What legal framework to procure it?	Suitable regulatory framework	To allow for the development of IPP/PPP projects and attract private investors

Planning by the utility to reduce cost and integration constraints





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How to Procure IPPs & Mitigate Risks ?

Auction Models

Location Agnostic auctions

- Government auctions a predetermined capacity (MW), allowing **the developer the choice of project location without limitations**

Substation auctions

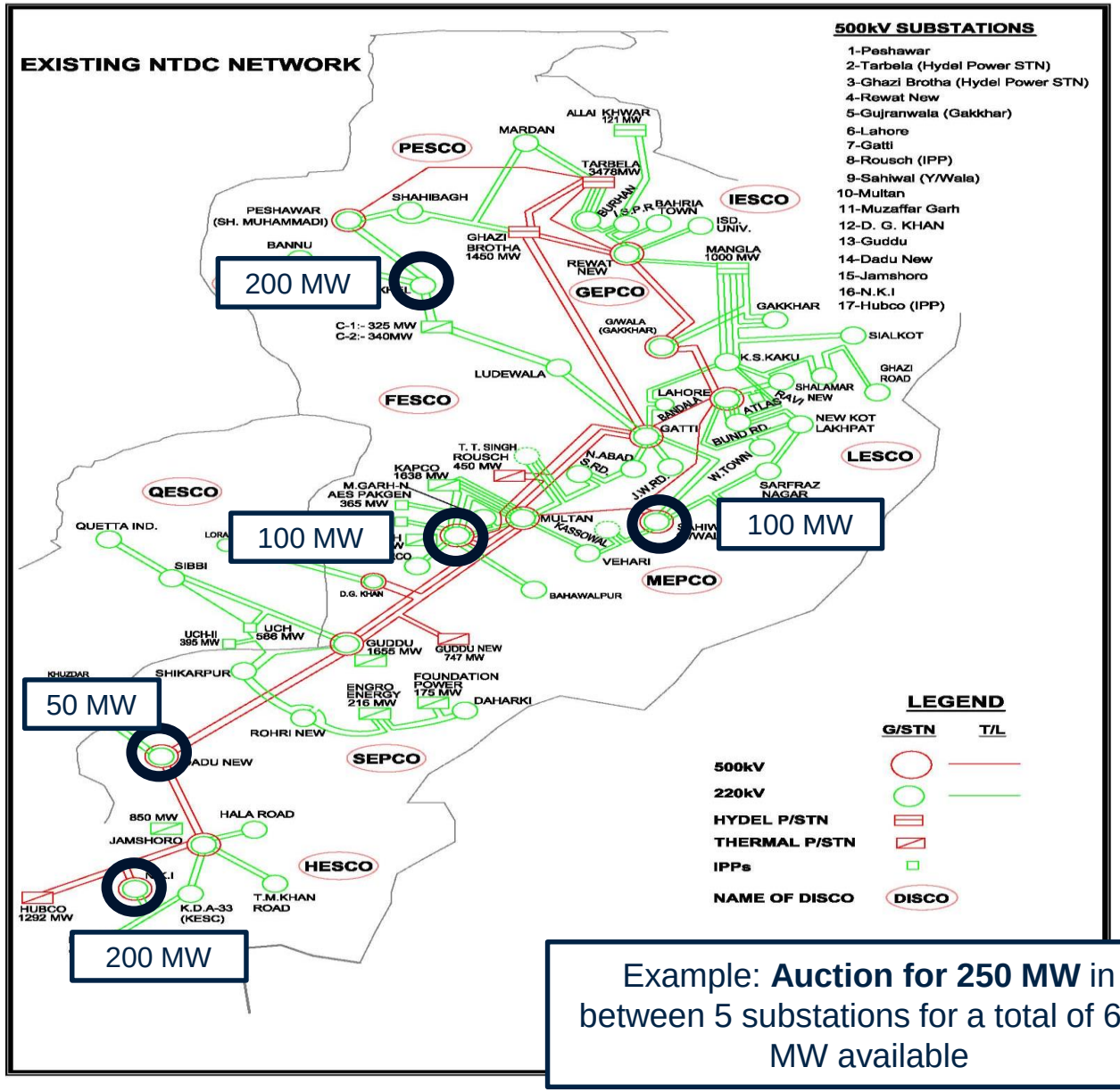
- Government auctions a capacity (MW) at **identified substations** up to a level capped by grid interconnection limits

Solar Park auctions

- The **Government identifies and develops the Solar Park and its infrastructure**, gets the key permits, and auctions the site

Substation and Solar Park schemes enable a **reduction in curtailment risk**
Solar Parks enable a reduction in development risks (land, safeguards) from the IPP's perspective

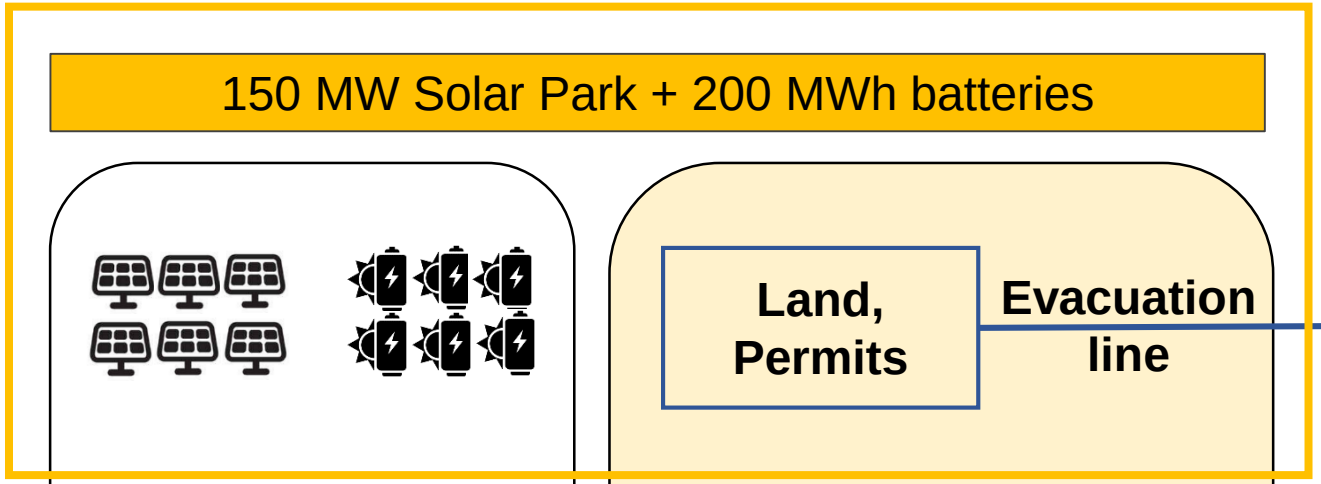
Substation-linked auction: Example of Pakistan (under discussion)



Example: **Auction for 250 MW** in between 5 substations for a total of 650 MW available

- Developer is **free to choose any site location** but must connect to the grid at specified substations
- Developer identifies land and secures required licence/permits as per applicable law near the identified substation(s)
- All eligible substations (and their capacity available) are identified by the bidding agency and listed for auction
- Supply power at auctioned tariff through Power Purchase Agreement

Solar Park Structure: Example in Burkina Faso (under discussion)



SONABEL grid network

Land, Permits

Evacuation line

IPPs (private investments > $200m)

- Solar Plant (PV modules, inverters, DC/AC transformer etc.)
- Batteries

Government of Burkina Faso (World Bank loan of ~$15 m and land contribution of BF)

- Acquisition of land+ permits needed before auction
- Evacuation line to the SONABEL grid

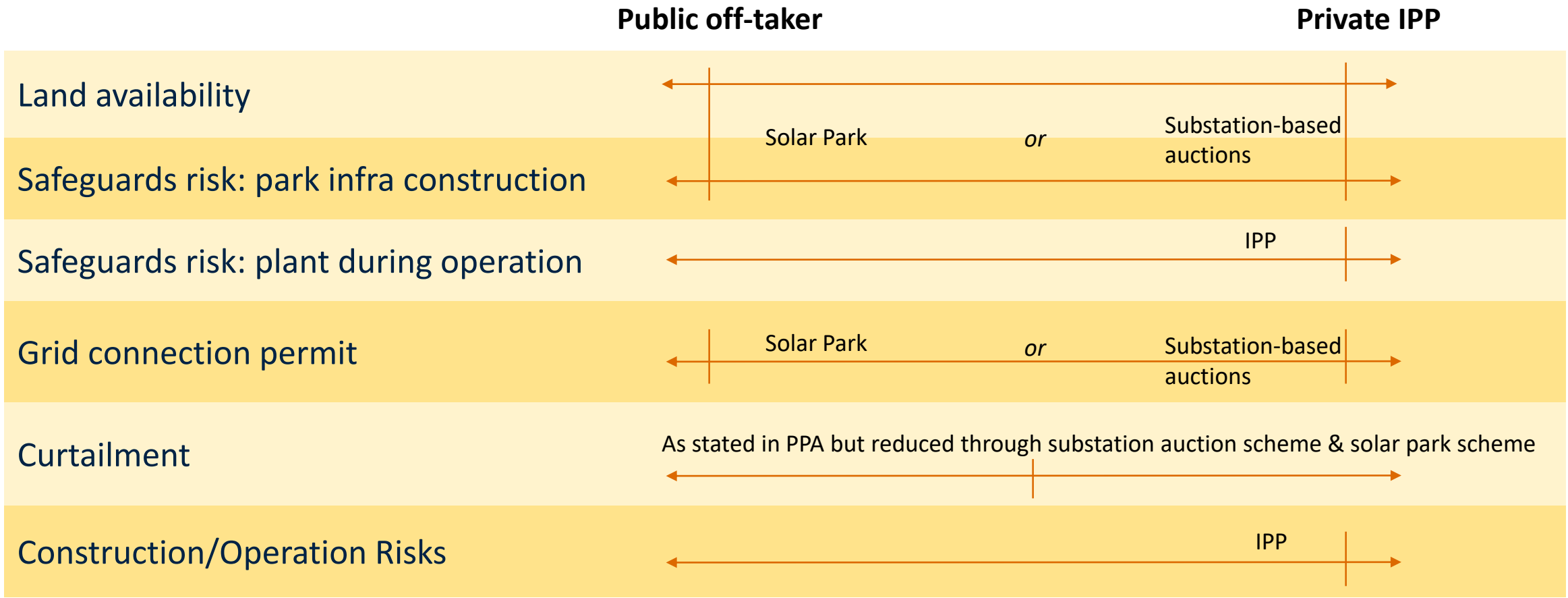
Government of Burkina Faso (World Bank loan of ~$50m, depending on needs)

- Reinforcement of dispatch and network of SONABEL to facilitate PV grid integration
- Capacity building

IPPs pays annual payments for utilization of Solar Park infrastructures to the Government

Why the selection of an auction scheme is so important?

Development/Operation Risk Allocation: Trade off between Price and Risks



PROCUREMENT & RISK ALLOCATION

Streamlined and Transparent Procurement

- Scaling Solar **or private transaction advisors** depending on the government and the source of financing

- **Market sounding** to test the high level risk allocation with the private sector

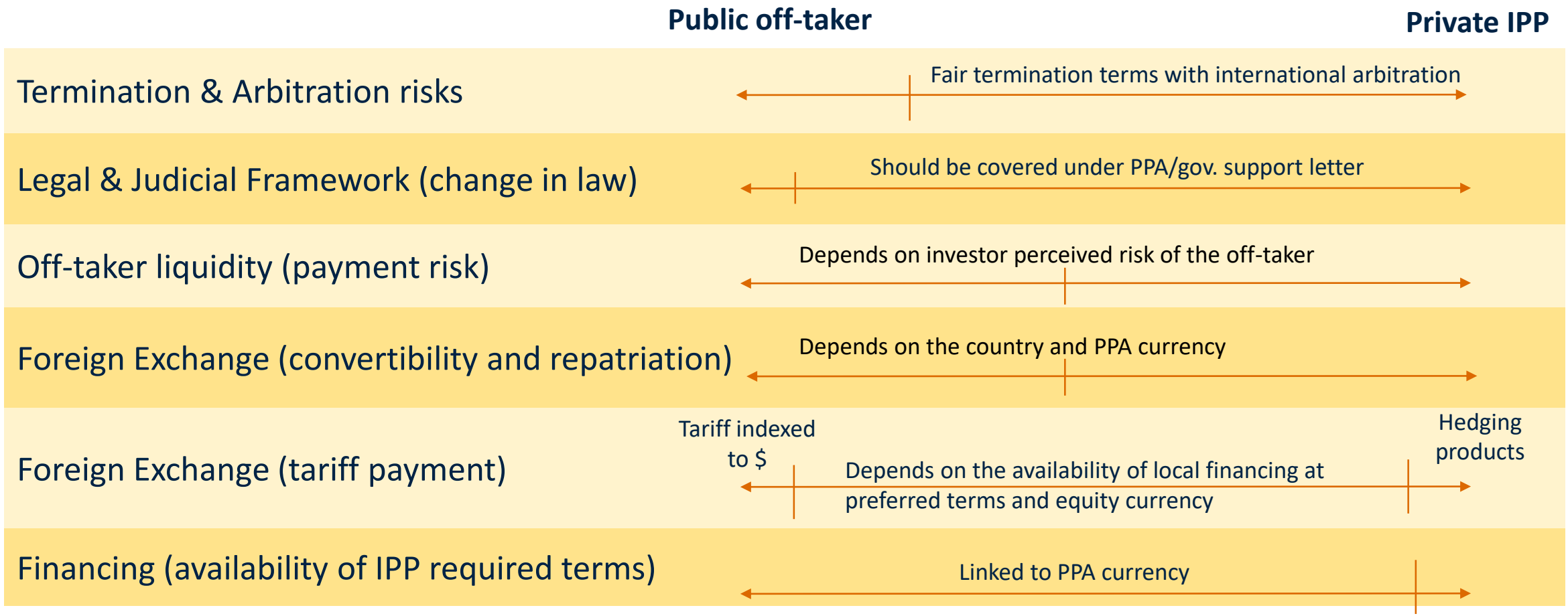
- **Risk allocation, including**:
  - ✓ PPA currency linked to debt availability / foreign exchange risk
  - ✓ Off-taker viability / liquidity and termination risk
  - ✓ Change in law / change in tax regime

- **Risk mitigation instruments (guarantees)** potentially leveraging **climate finance**

- Under-development **global e-tendering platform** **energy-auction Platform**

Risk Allocation in the PPA / Support Government in taking risks in can sustain

Investment & Termination Key Risk Allocation: Trade off between Price and Risks



Utility / Country Risk: Mitigation?

KEY RISKS

- Utility liquidity risk / inability to pay the monthly payments
- Creditworthiness of the utility and risk of bankruptcy
- Risk of contract termination / inability to pay termination amounts
- Change in law

SHORT TERM MITIGATION

- Ensure the PPA price is as low as possible so financially it is sustainable for the utility
- Liquidity constraints: escrow accounts for 6 months/ LC – WB liquidity guarantee
- WB loan guarantee for termination
- MIGA political risk insurance
- Strong PPA covering change in law (Government letter of support)

MEDIUM TERM MITIGATION

- Support utilities in improving service and collecting payments
- Improve grid quality to reduce system losses
- Subsidy reform

Foreign Exchange Risk: Mitigation?

KEY RISKS

- The IPP cannot access project finance non-recourse long-term financing in local currency
- If PPA currency is in local currency but indexed to USD, risk of convertibility
- Risk for the utility when covering the FX risk to weaken its balance sheet

SHORT TERM MITIGATION

- Guarantee for repatriation and convertibility risks

MEDIUM TERM MITIGATION

- Support development of non-recourse financing in local currency by improving the domestic lending sector

For sustainable and least-cost PV deployment

- When developing solar projects, it needs to be thought as part of an ecosystem looking among others at the grid capacity, the land availability and procurement capabilities
- The selection of the right procurement scheme is key in reducing risks
- Risk allocation between the private IPP and the public off-taker/Government has to be well balanced for bankable projects mobilizing the private sector (investors and lenders)