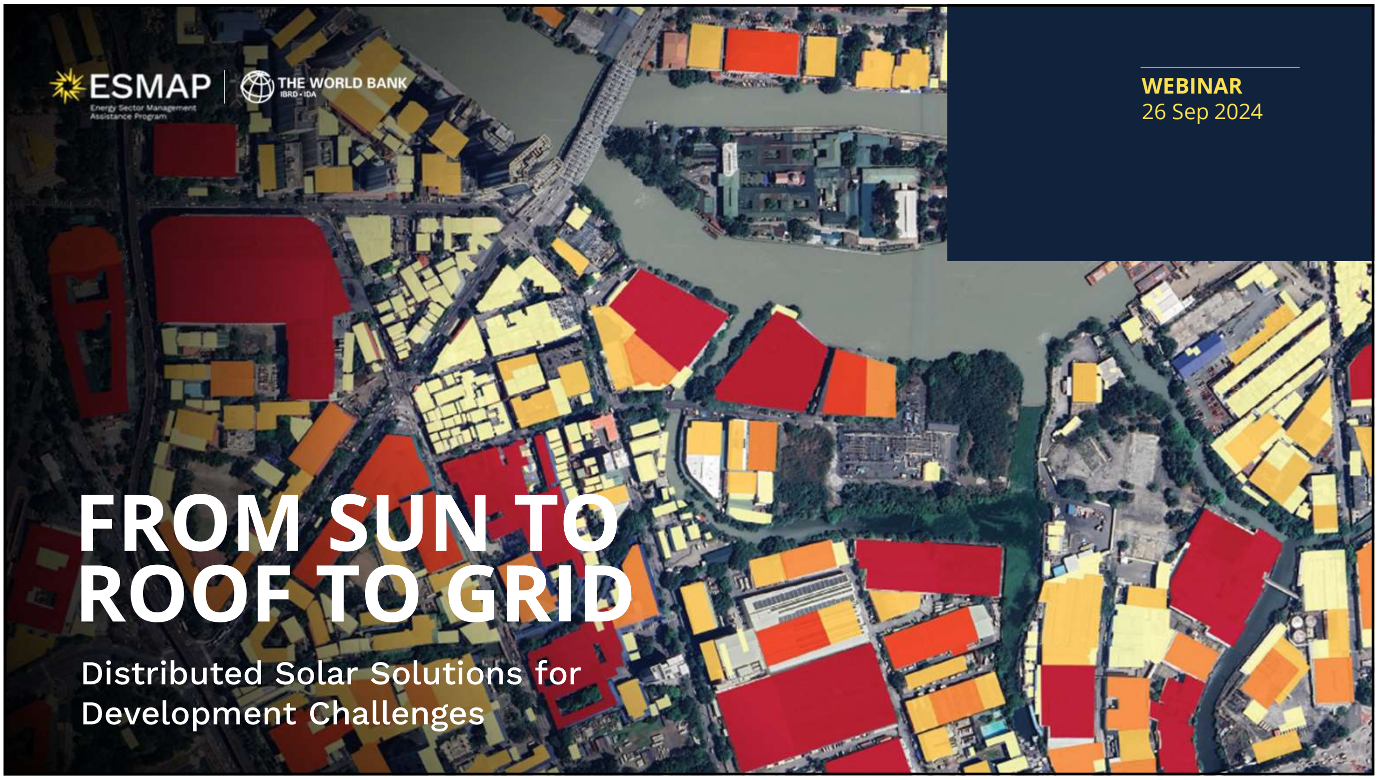

Distributed PV: From Sun to Roof to Grid

ESMAP Webinar

Agenda: Reports overview | Panel Discussion | Q&A | Next steps

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Practice Manager · ESMAP, World Bank

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Senior Energy Specialist · World Bank

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Mfundi Songo
Chairperson Distribution Steering Committee of Technology · ESKOM

Julieta Giraldez
Director of Integrated Grid Planning · Electric Power Engineers

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1

MEET THE PRESENTERS

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ALAN LEE
Senior Energy Specialist, World Bank
Türkiye
Alan has over 19 years experience in energy, climate and sustainability programs, with the World Bank since 2013 including for major investments in Türkiye, China, and Myanmar, as well as global analysis on DPV and carbon pricing. He previously worked for the Australian Government. He holds a Master of Studies with economics at Australian National University.

THOMAS FLOCHEL
Senior Energy Economist, World Bank
Senegal
Thomas leads World Bank energy engagements in Senegal. Since joining the World Bank in 2013, Thomas has led investment and advisory projects across regions focusing on electricity access, utility reform, and energy transition, and authored several ESMAP reports. He holds a PhD in Economics from the University of Edinburgh.

‘Key Messages on Distributed PV

OVERVIEW

Address different stakeholder interests and awareness levels

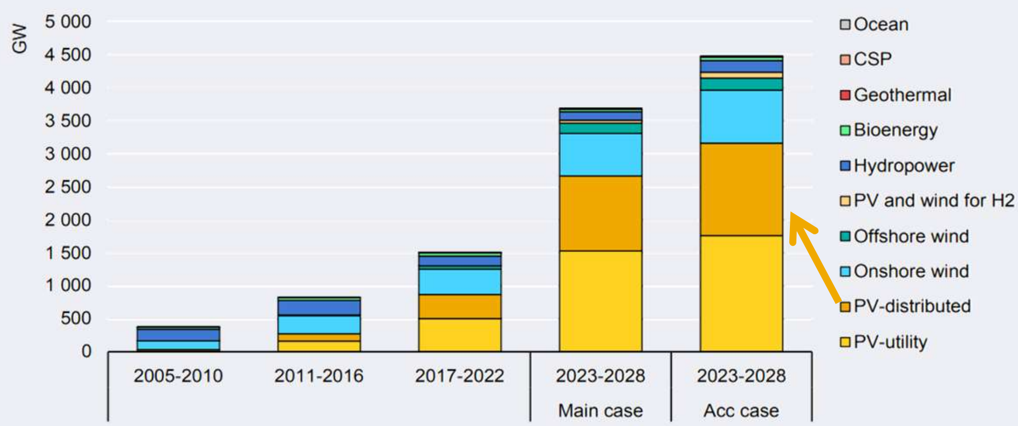
Myths	Realities with smart program design
× Distributed PV (DPV) can benefit only a lucky few customers	✓ **DPV can benefit many actors in various ways** including utilities, and customers without means to buy or host their own DPV system (community schemes).
× DPV must be capped at X% of load for safety or technical concerns	✓ **DPV can be grid-friendly at high levels** Anticipate rising penetration with grid codes for inverter programming, inverter-PV ratio, strategic siting, digitized control and coordination, etc.
× DPV causes a ‘death spiral’ for electric utilities	✓ **DPV can be designed for win-win outcomes** Price electricity and remunerate feed-in to fairly share costs and reflect value. Consider use cases that support utility financial viability (bootstrap, loss reduction).

OVERVIEW

Fastest-growing local energy technology

DPV may reach one-third of all renewable capacity additions

Renewable capacity growth by technology, 2005-2028



Notes: CSP = concentrated solar power. Capacity additions refer to net additions.

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https://www.iea.org/reports/renewables-2023

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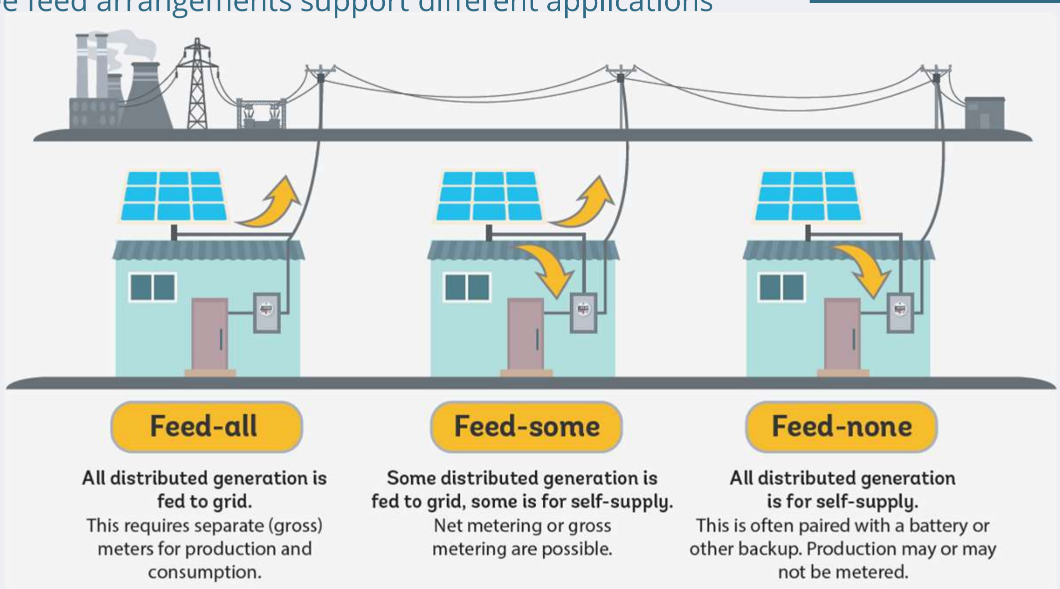
OVERVIEW

DPV can feed all, some or none to grid

Three feed arrangements support different applications



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https://www.esmap.org/from_sun_to_grid_to_solar_power_systems

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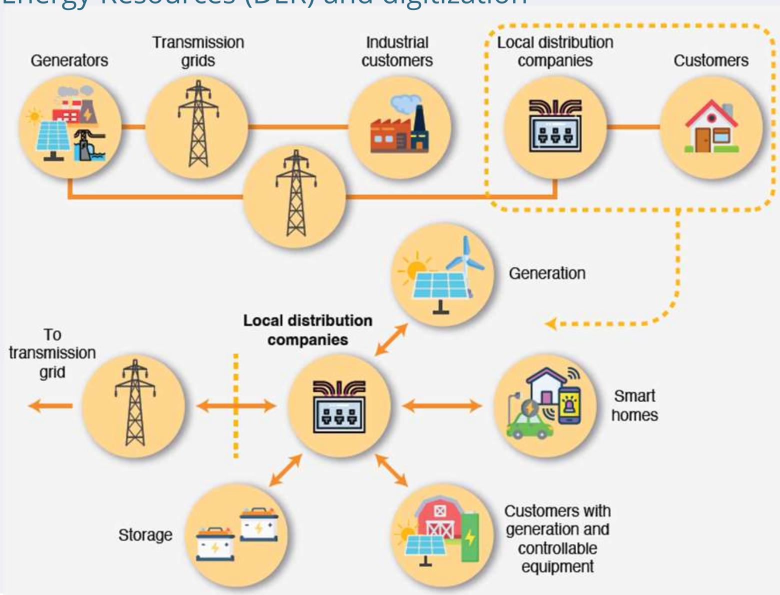
OVERVIEW

Power systems undergoing radical changes

with Distributed Energy Resources (DER) and digitization



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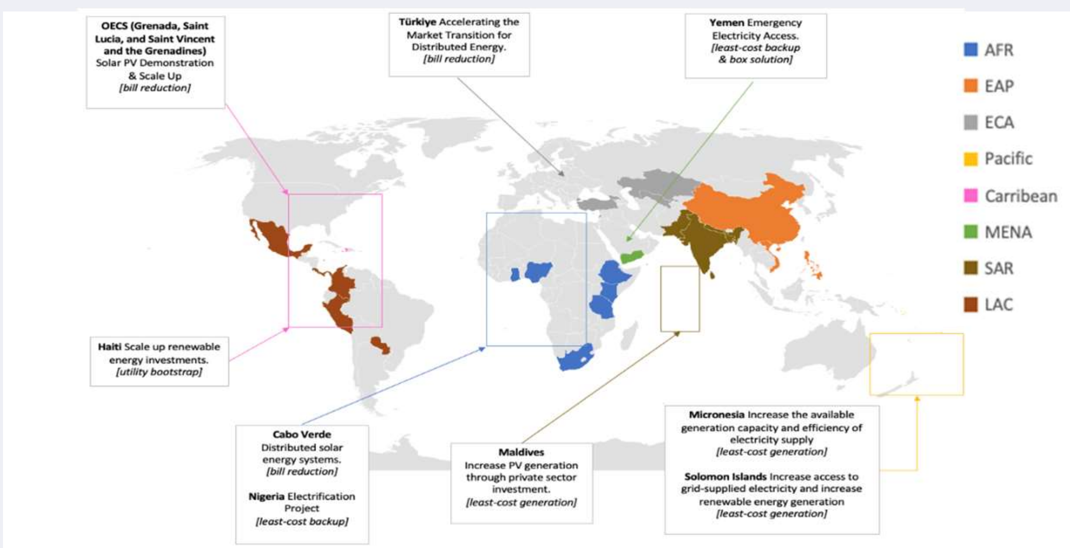
Based on IEA (2022)

OVERVIEW

DPV is growing in countries the world over

Many with World Bank finance and ESMAP technical assistance



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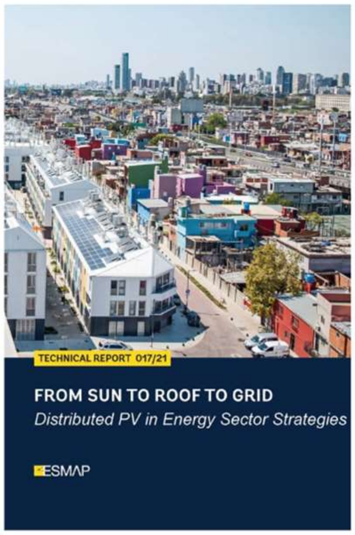
Recent DPV Investments and Technical Assistance financed by WB

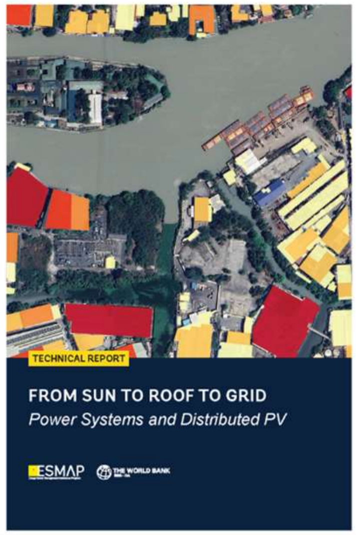
https://projects.worldbank.org/

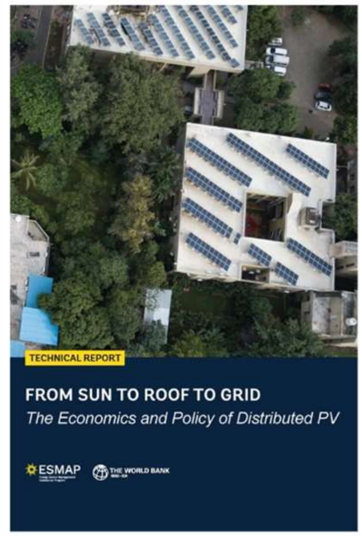
OVERVIEW

New ESMAP reports offer a menu of ideas

Approaches for strategy, power systems, and policy packages



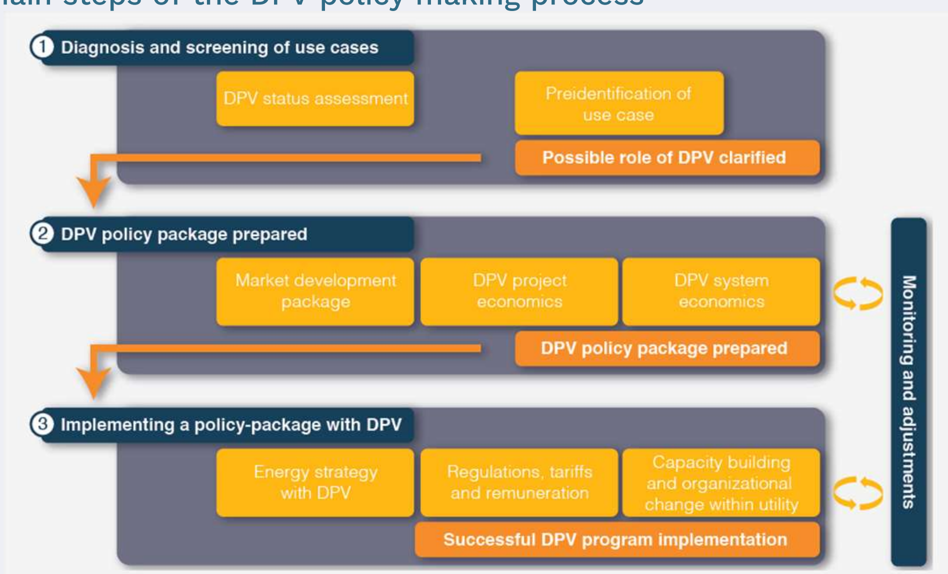




OVERVIEW

Economics & Policy of Distributed PV

Three main steps of the DPV policy making process



OVERVIEW

Distinct use cases for DPV strategy

Can be combined and include battery or other technologies

1. **Bill reduction**
2. **Least-cost backup**
3. **Least-cost generation**
4. **Alternative to Transmission & Distribution** investment
5. **Utility bootstrap** – improve service & bill collections
6. **Ancillary services** – such as voltage support to the grid
7. **Community social support** – benefit those with less means
8. **Financial loss reduction** – for customers whose payments don't cover costs
9. **Box solution** – meet urgent power needs

OVERVIEW

DPV use cases, benefits and challenges

T&D = Transmission and Distribution

DPV use cases, benefits and challenges

OVERVIEW

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Report 1 www.esmap.org/esmap-from-sun-to-roof-to-grid-distributed-pv 12

DPV use cases, benefits and challenges

OVERVIEW

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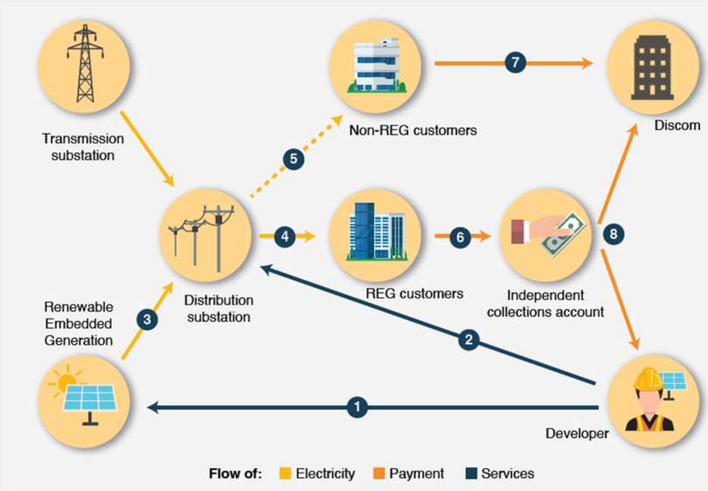
OVERVIEW

Utility 'bootstrap' use case: Nigeria

Undergrid microgrid with renewable-embedded generation (REG)



Note: Discom = distribution company; REG = renewable-embedded generation.

Wuse market, Abuja, Nigeria

Credit: Green Village Electricity (GVE) Projects. Used with permission

OVERVIEW

Systems for grid-friendly DPV

Anticipate power system issues with long-term least-cost solutions

Grid codes are key

Power system risks from DPV at rising levels	Solutions Menu 1: Balance local load with supply	Solutions Menu 2: Enhance hosting capacity
<u>Low DPV penetration</u> • Breach of voltage limits <u>Medium DPV penetration</u> • Disruption to fault protection scheme • Breach of transformer capacities and conductor thermal ratings • Increased variability and uncertainty of net load • Poor response to grid disturbances	<u>Supply-demand coordination</u> • Promote efficient demand ahead of designing DPV • Analyze hosting capacity and grid congestion to inform strategic sites and DPV design • Favor large DPV close to substations • Use digital technologies to monitor & control DERs • Aggregate DERs into virtual power plants <u>Supply-side adjustments</u> • Calibrate PV sizes and angles to serve local peak loads and diversify production time • Optimize DPV systems with high DC:AC ratio • Size DPV to match efficient local energy demand • Limit feed-in dynamically or statically <u>Demand-side adjustments</u> • Demand response and energy storage	<u>DPV inverter programming</u> • Voltage management • Cope with grid disturbances <u>Grid equipment adjustment or upgrade</u> • Voltage compensation equipment • On-load tap changing transformers • Protection scheme settings <u>Enhance power system flexibility</u> • Improve forecasts • Automate operations • Expand balancing areas • Shorten dispatch intervals and schedule updates

For high penetration issues and solutions, mostly relevant for small power systems, and rarely a constraint for large systems, see Report 2 (Figure 1)

MEET THE PANELISTS

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JULIETA GIRALDEZ

Director of Integrated Grid Planning, Electric Power Engineers
USA

Julieta is an internationally recognized subject matter expert in distributed energy resource (DER) grid integration with extensive expertise in distribution system modeling. She brings a holistic view to grid integration and planning.

ABHISHEK RANJAN

Partner, EY-Parthenon
India

With over 23 years of industry experience in utility and information technology sectors, Abhishek is a business professional who is passionate about accelerating energy transition and decarbonization.

MFUNDI SONGO

Senior Manager and Chair of Distribution Steering Committee of Technology, ESKOM
South Africa

Mfundi is an expert in power systems planning, engineering, and analysis, specializing in the integration of power stations and network developments within South Africa including for renewable energy.

YAVUZ UNAL

Deputy CEO, Solarçatı
Türkiye

Yavuz is the Deputy CEO of Solarcati and has over twenty years of experience in the energy and corporate finance sector. He has held senior positions in many national and international companies.

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16

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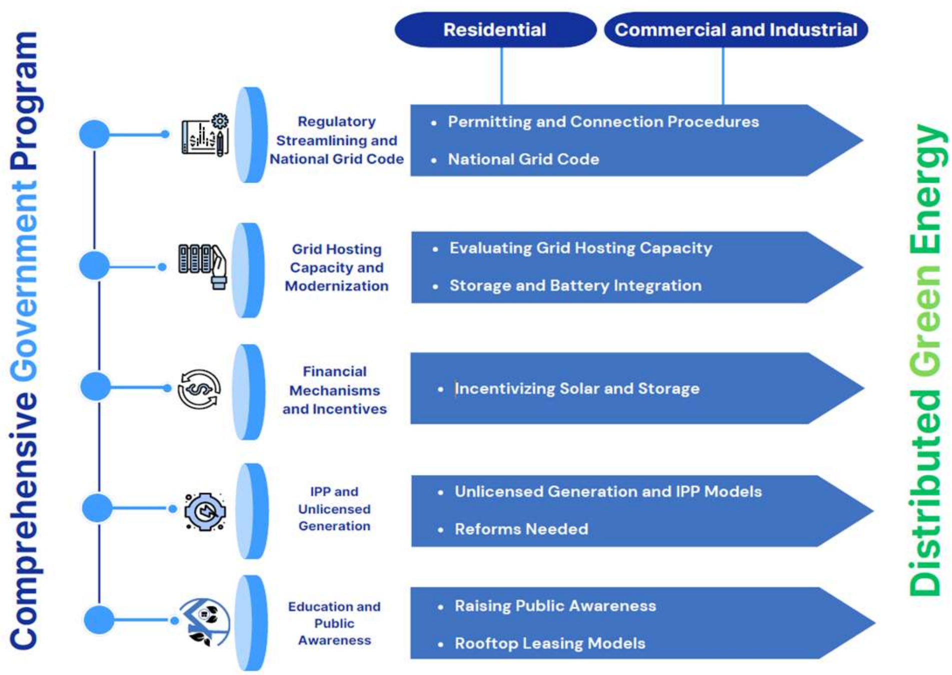
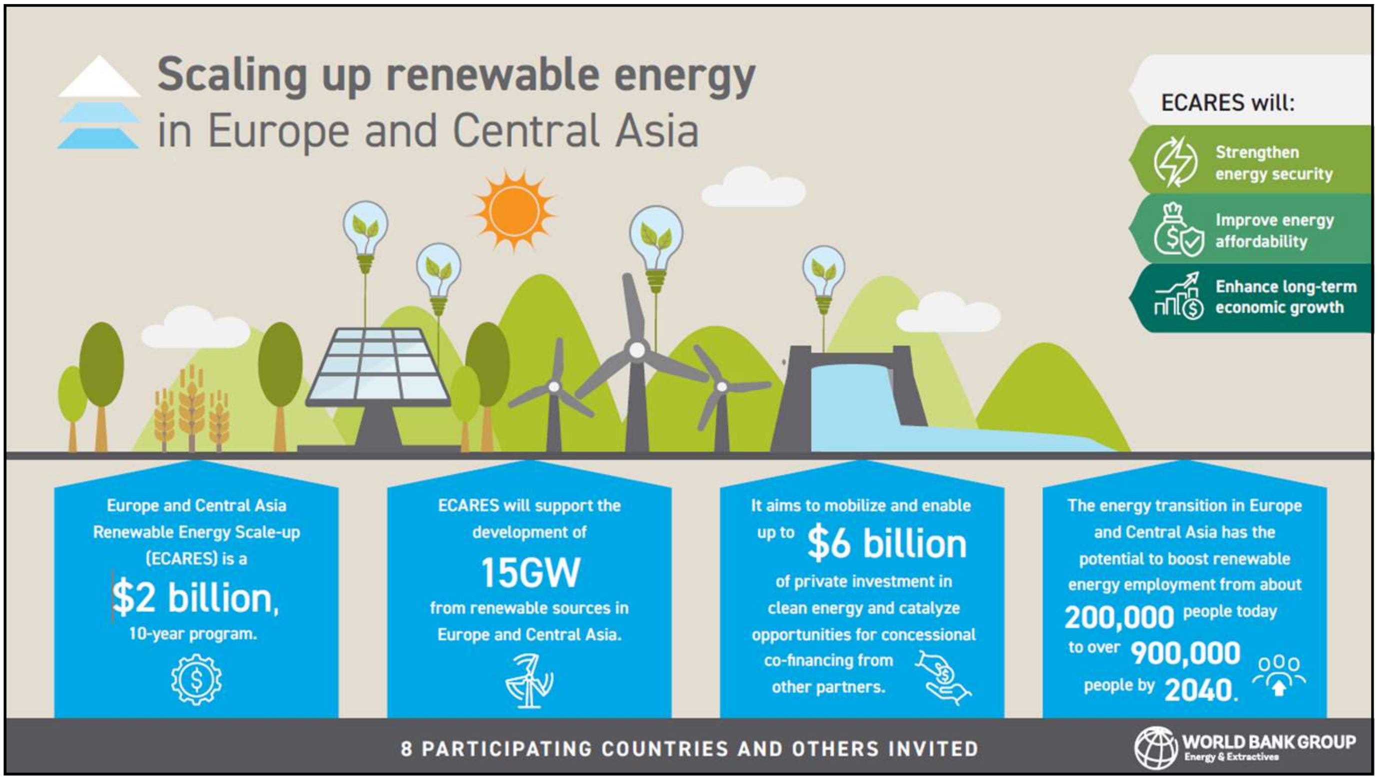


www.solarcati.com

17


Scaling up renewable energy
in Europe and Central Asia
ECARES will:
Strengthen energy security
Improve energy affordability
Enhance long-term economic growth
Europe and Central Asia Renewable Energy Scale-up (ECARES) is a
$2 billion,
10-year program.
ECARES will support the development of
15GW
from renewable sources in Europe and Central Asia.
It aims to mobilize and enable up to
$6 billion
of private investment in clean energy and catalyze opportunities for concessional co-financing from other partners.
The energy transition in Europe and Central Asia has the potential to boost renewable energy employment from about
200,000 people today
to over 900,000
people by 2040.
8 PARTICIPATING COUNTRIES AND OTHERS INVITED
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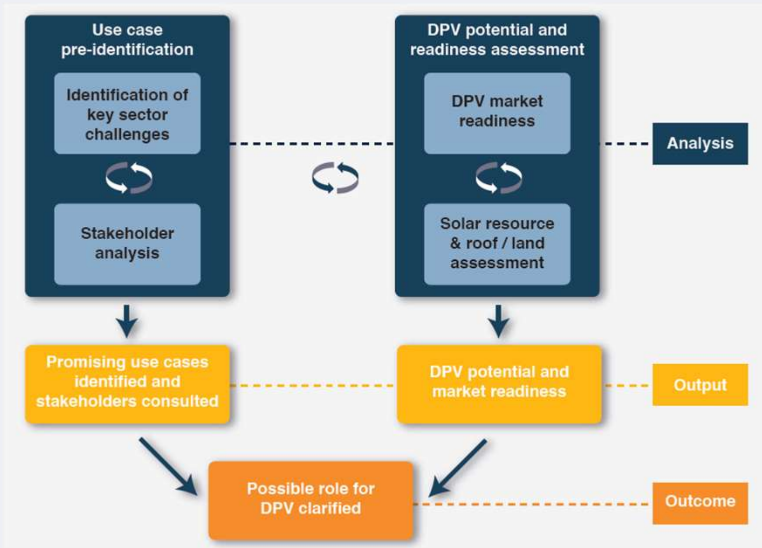
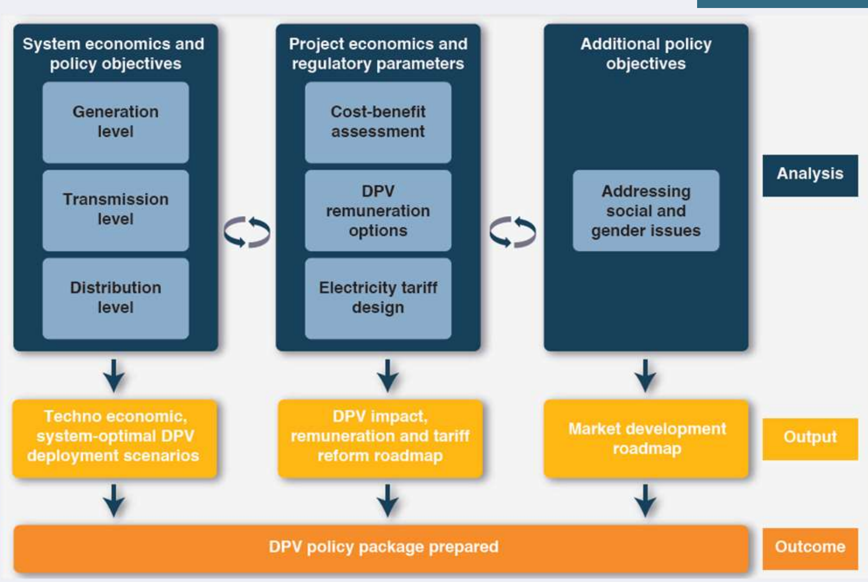
POLICY PACKAGES

Step 1: Diagnosis and use case screening



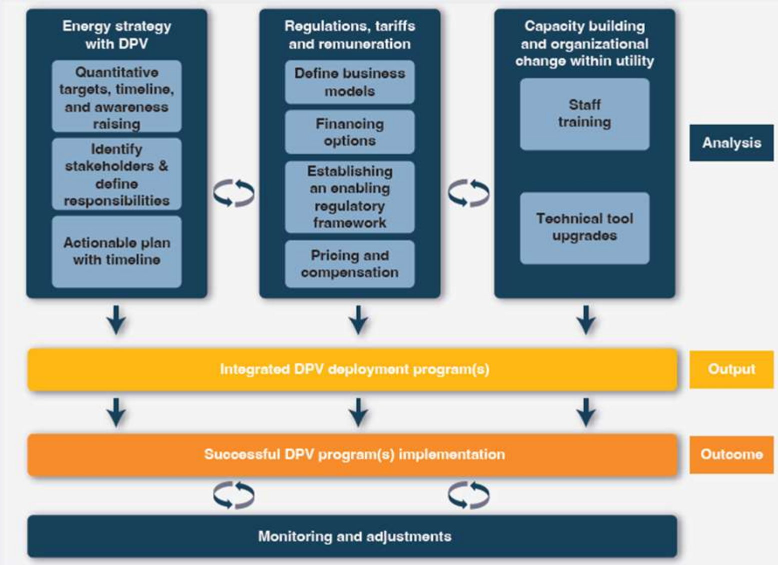
POLICY PACKAGES

Step 2: DPV policy package prepared



POLICY PACKAGES

Step 3: Implementing a policy package with DPV



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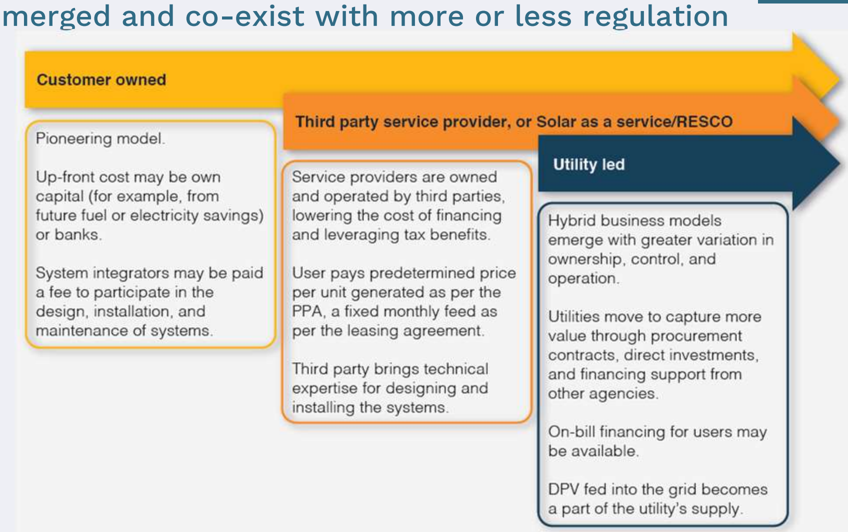
22

POLICY PACKAGES

3 main types of business model

have emerged and co-exist with more or less regulation



Source: Adapted from IFC (2014): Singh, Sethi, and Mazumdar (2019): and CPI (2018), Note: DPV=Distributed Photovalvics; PPA = Power Purchase Agreement; RESCO= Renewable Energy Service Company.

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23