International Energy Agency

Theme presentation: Policies and Regulations to support Reliable, Sustainable and Efficient Power Systems: the case of Digital Management of Distributed PV

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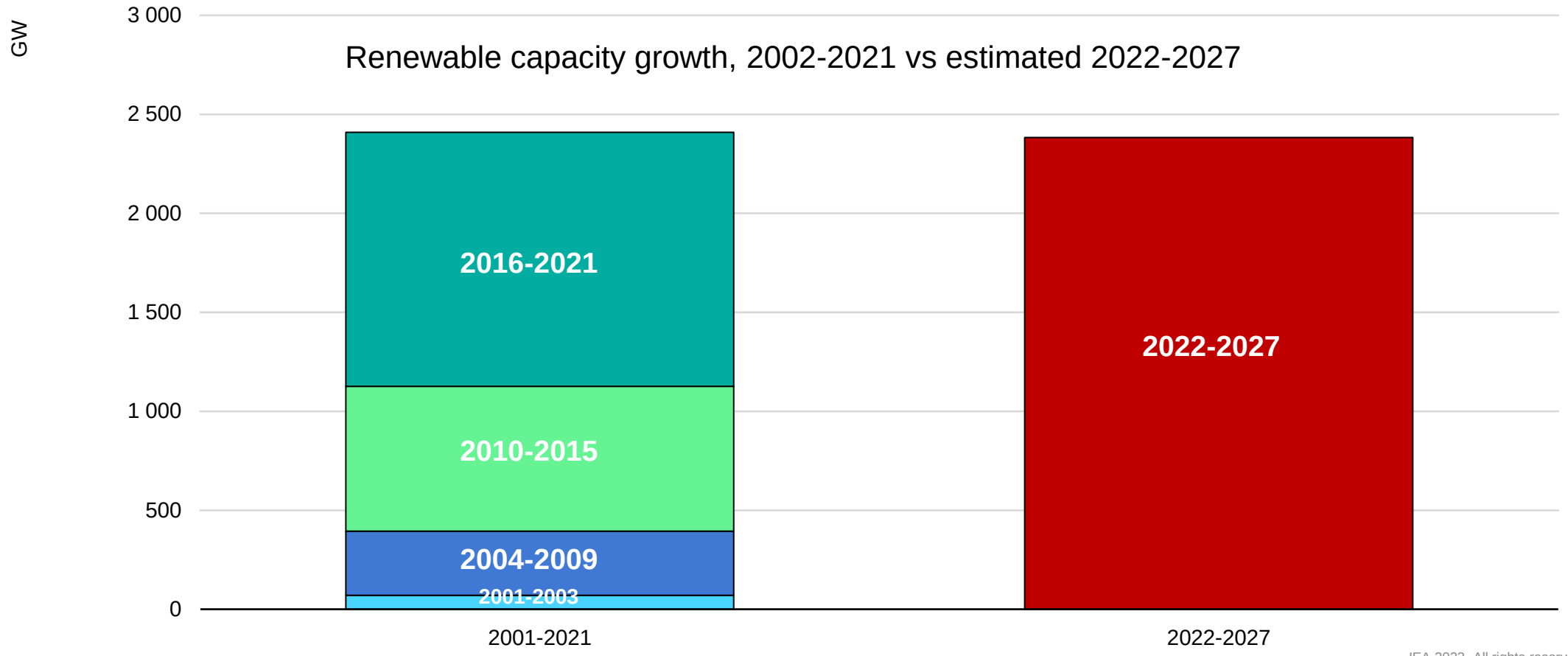
India Smart Utility Week, Theme E: Session-7:

Policies and Regulations to Promote Digital Management of Distributed Solar PV (In Collaboration with IEA)

Speaker : *Vida Rozite, Policy Analyst and Project Manager - Digital Demand Driven Electricity Networks Initiative, IEA*

It took 20 years to achieve the same level of renewables growth as forecast in the next 5 years



Renewables will expand by an additional 2400 GW by 2027, equal to the entire installed capacity of China.

India SMART UTILITY Week 2023

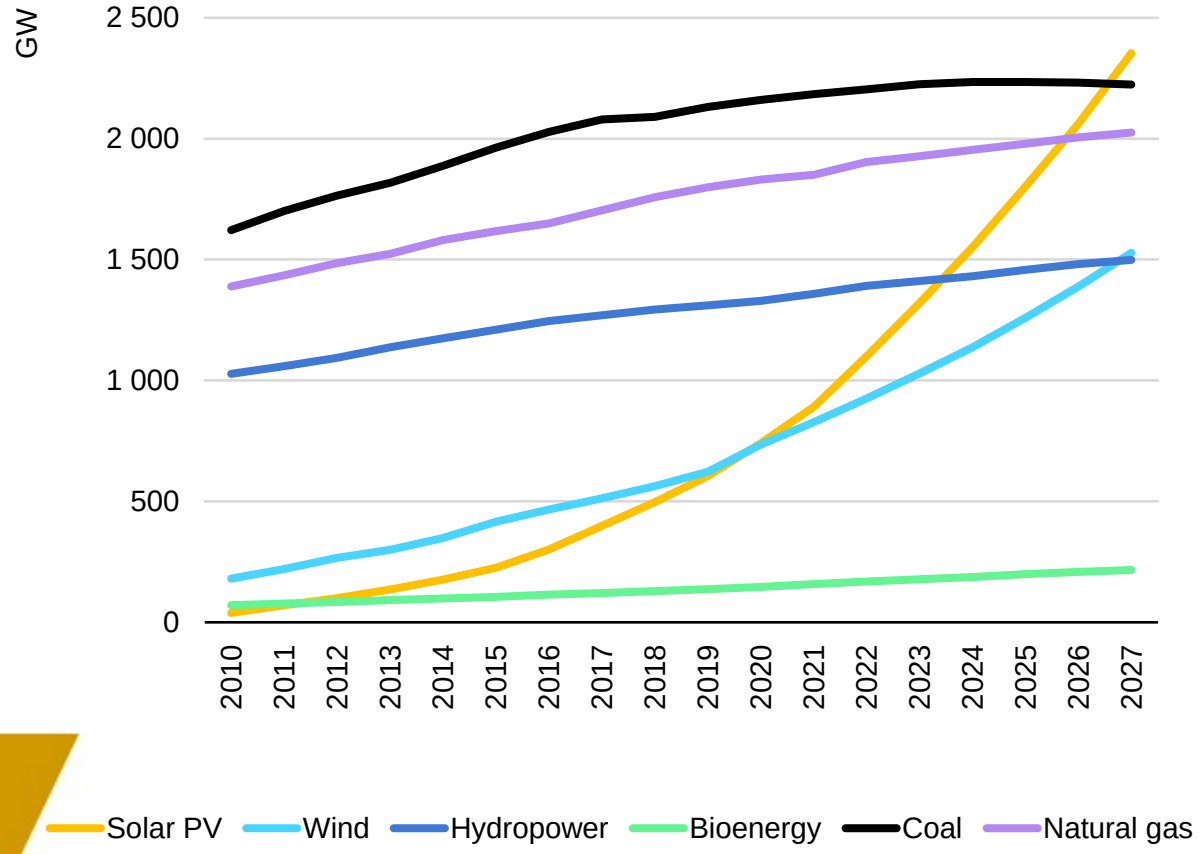
28 Feb – 04 March 2023 | New Delhi

Solar PV becomes the largest global installed capacity surpassing coal by 2027

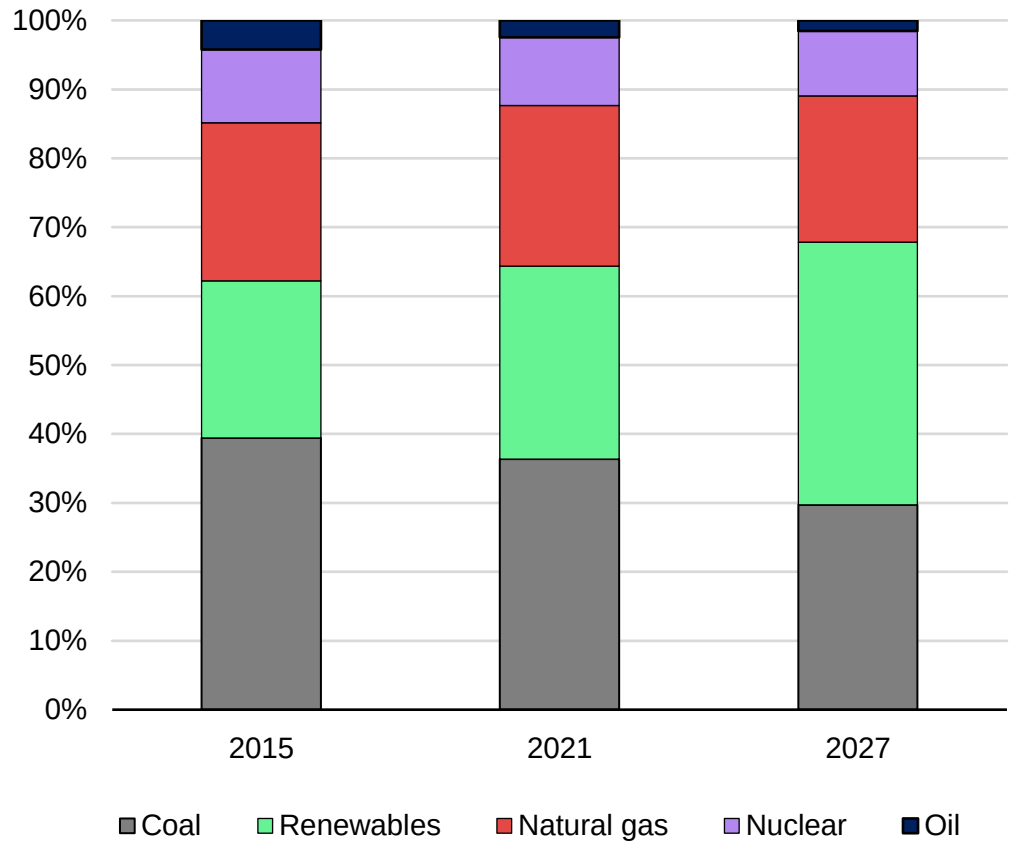
ORGANIZER

ISGF India Smart Grid Forum

Cumulative global installed capacity by technology, 2010-2027

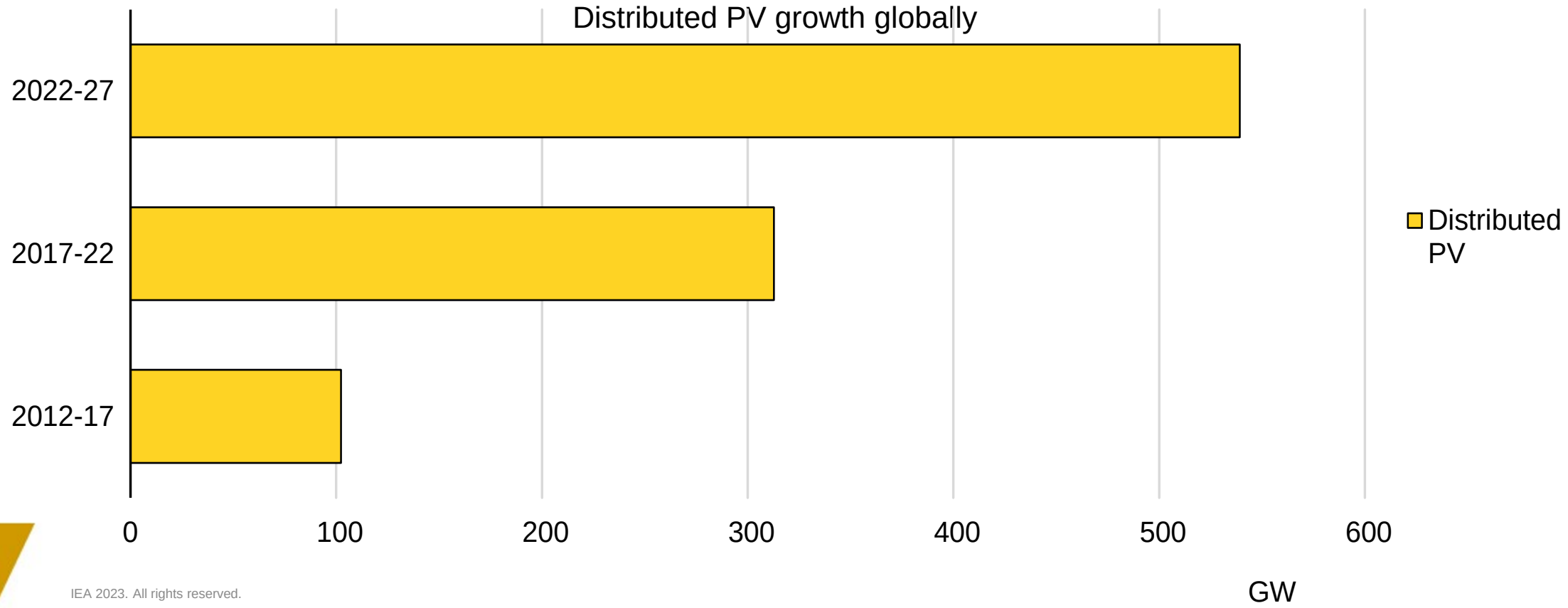


Electricity generation by technology, 2015, 2021, 2027



Cumulative solar PV capacity almost triples surpassing natural gas by 2026 and coal by 2027
And renewable electricity generation surpass coal by early 2025

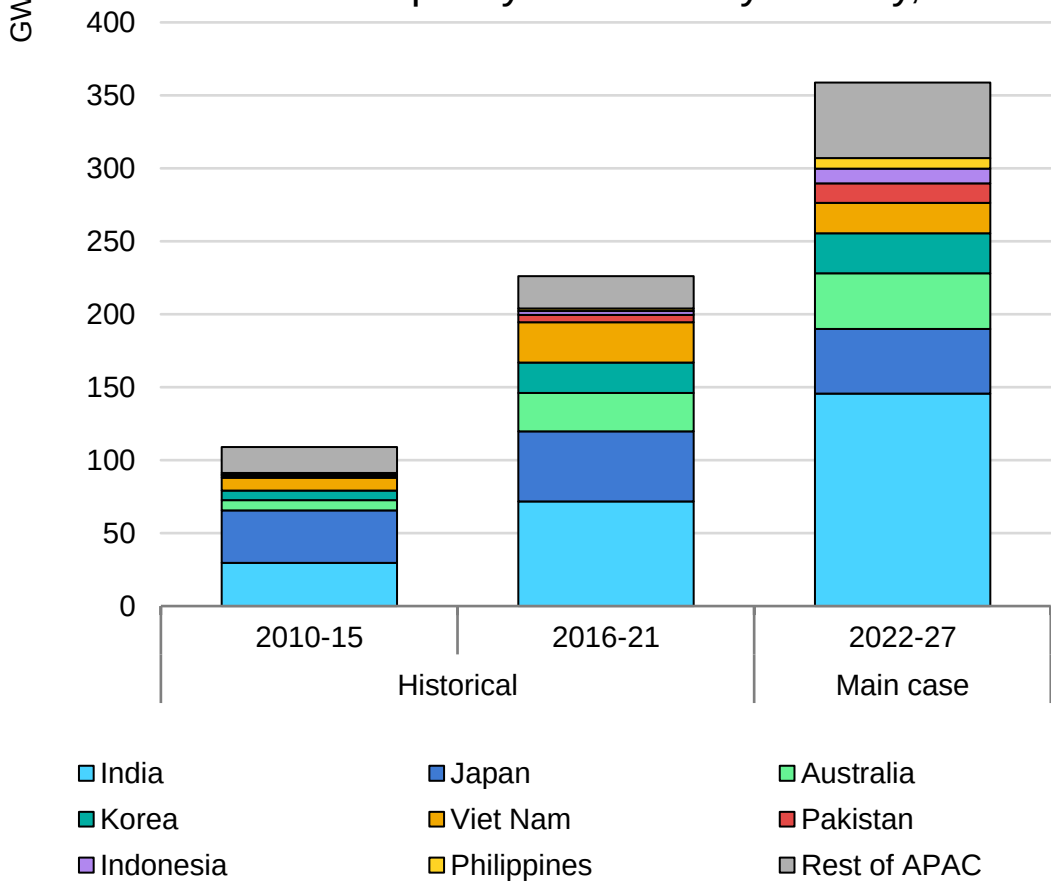
DPV growth forecast in next five years is more than in last decade



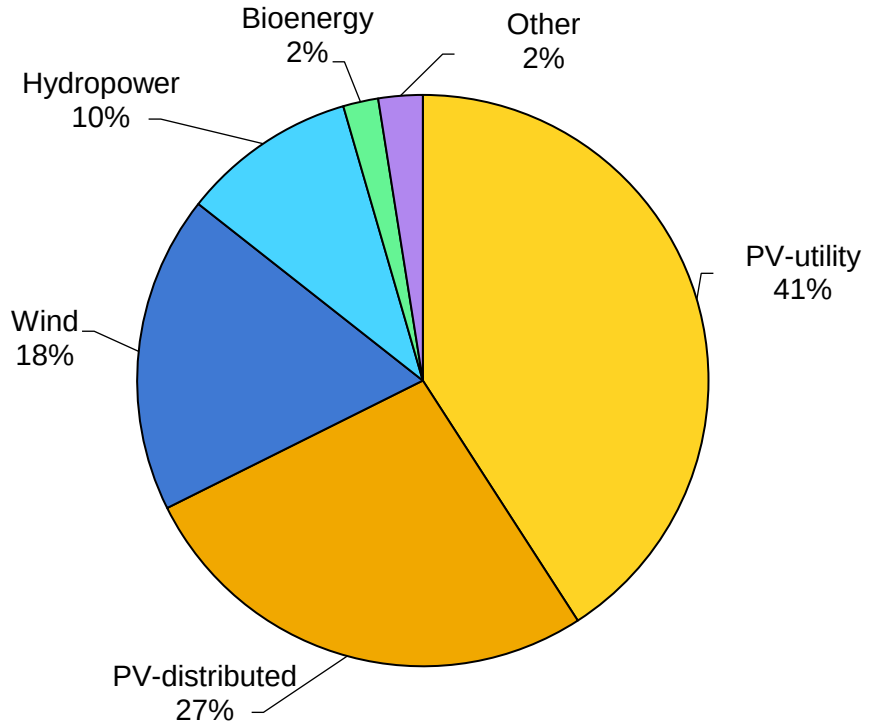
Over the next five years, China leads the distributed PV capacity expansion, large growth expected in EU and USA, and other countries such as India emerge as new growing markets

APAC: Low costs, security and climate goals drive solar PV boom

APAC renewable capacity additions by country, 2010-2027



APAC capacity additions by technology, 2022-2027



In the next 5 years, capacity installed in wind and PV is expected to double. However, growth in APAC remains uneven, with India, Japan, Australia and Korea responsible for almost three-quarters of deployment.

Net Zero pathways mean power systems will become much more complex

Select Global Net Zero Emissions by 2050 Scenario (NZE) milestones:

- **Yearly wind and solar PV capacity** additions **> 1 000 GW** by 2030
- **100 million buildings** with residential PV by 2030
- **All new buildings zero-carbon-ready** by 2030
- **Electric car fleet of over 300 million** in 2030 and electric cars accounting for 60% of new car sales

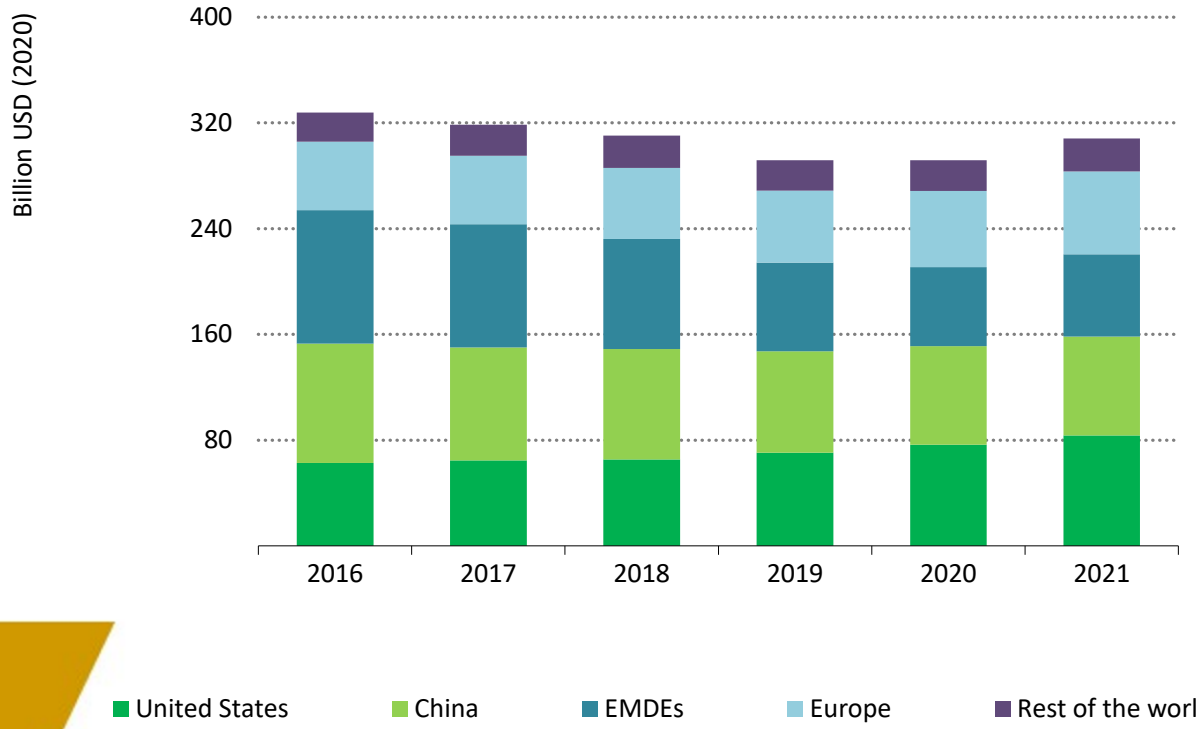
These massive changes will require more flexibility. In the NZE:

- **> 500 GW** of demand response brought to market by 2030
- **Tenfold increase** in global inventory of **flexible assets** by 2030

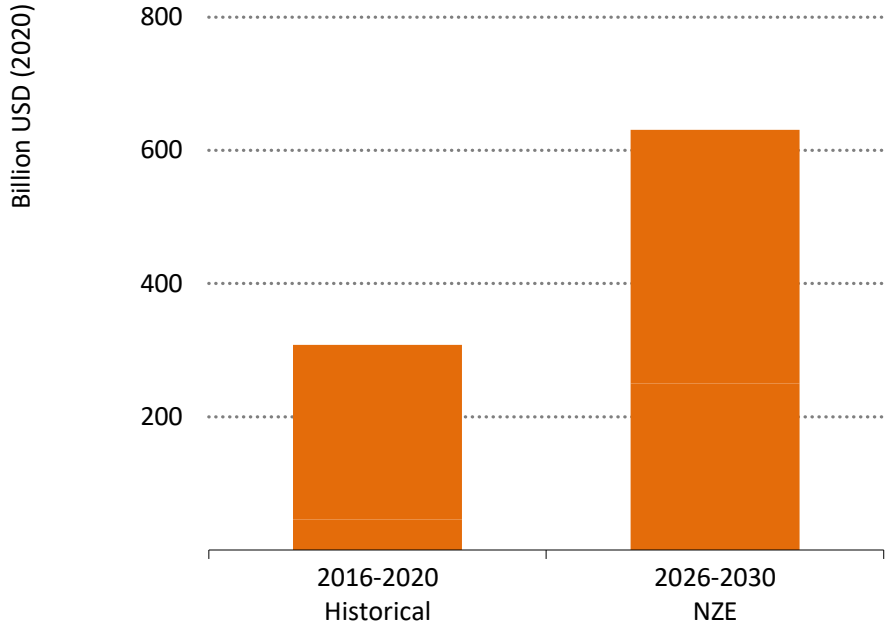
https://www.iea.org/reports/demand-response
https://www.iea.org/reports/world-energy-outlook-2021
https://www.iea.org/reports/net-zero-by-2050

Significant increase in investments needed for electricity networks and digital assets

Investment spending in electricity networks, 2016-2021

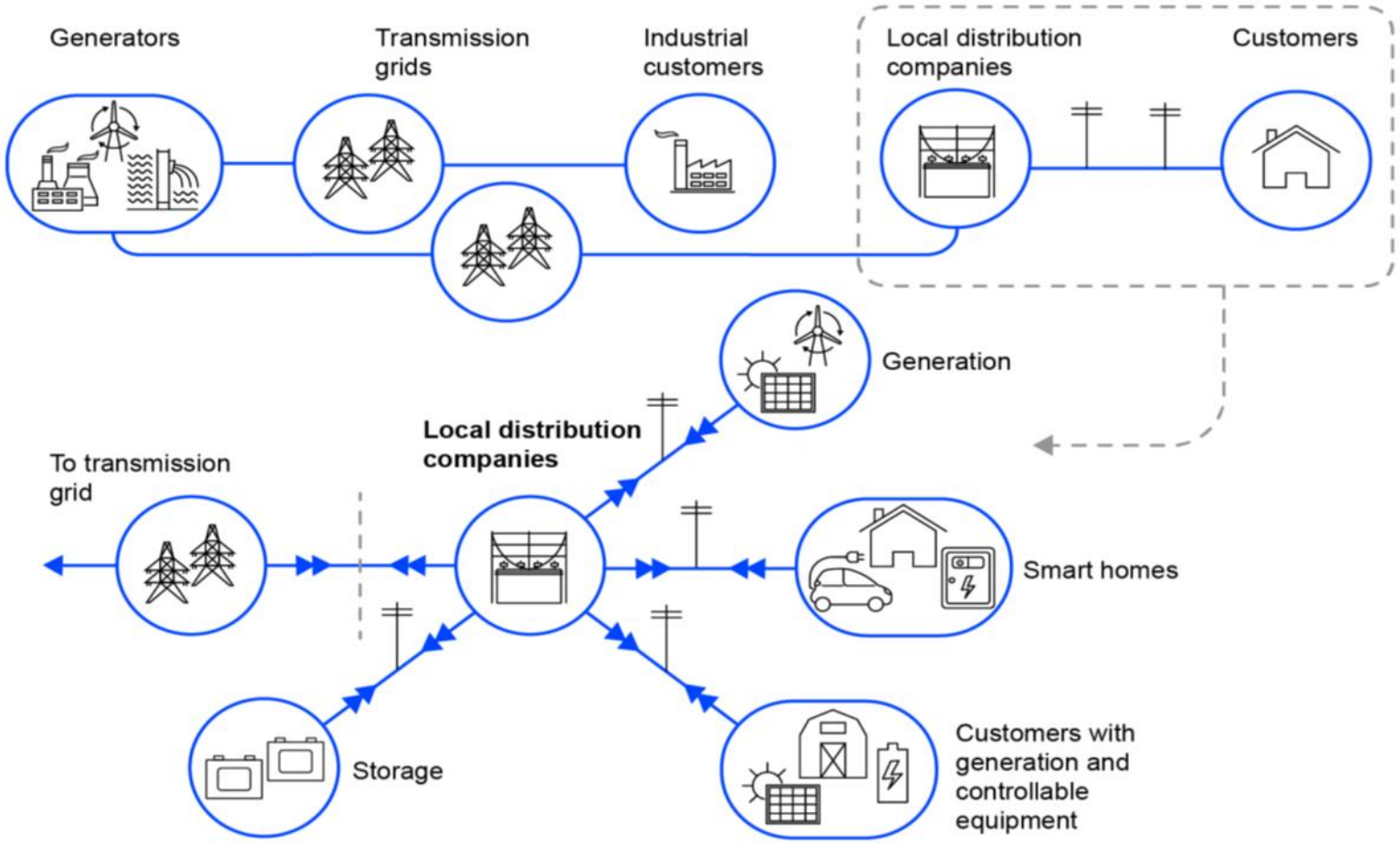


Investment spending in electricity networks, 2016-2020 (historical) and 2026-2030 (Net Zero Emissions Scenario)



In the NZE Scenario, annual electricity network investments doubles, reaching more than USD 600 billion per year by 2026-2030
Investments in digital assets must increase almost sixfold in the same period.

Power systems are radically changing and digitalisation is becoming increasingly central

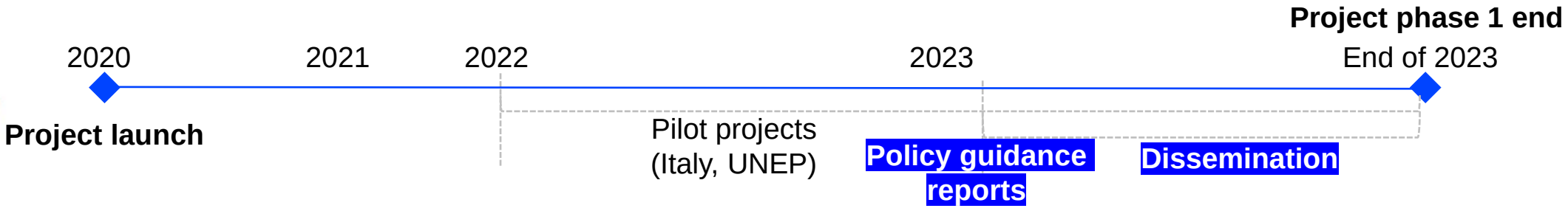


Data, analytics, advanced controls are all becoming essential for planning, operation, maintenance, and markets orchestration

Digital Demand-Driven Electricity Networks Initiative (3DEN)

- **Aim of the Project** - providing **actionable guidance** to policy makers on the policy, regulatory, technology and investment context needed to accelerate **power system decarbonisation and modernisation** and **effective utilisation of demand side resources**
- **Project phase 1 timeline: 2020 - 2023**
- **Global scope, geographic focus** including but not limited to **Brazil, Colombia, India, Indonesia, Morocco, South Africa, Tunisia**, and **Latin America, Africa, Southeast Asia** regions. Ongoing engagement with a **Consultative Group of Experts** (37 members from 14 countries)
- Italy / UNEP are supporting **pilot projects** that will be implemented **in 2022** to test new approaches on demand side and distributed energy resources in (1) Urban contexts, (2) Islanded systems, (3) Existing grid assets – **learnings will feed into 3DEN analysis**.

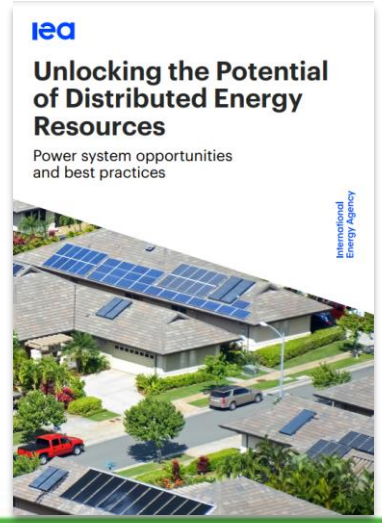
Project timeline



Digital Demand-Driven Electricity Networks Initiative (3DEN)

- Upcoming policy guidance documents
  - **Smart grids in emerging markets and developing economies**
    - How investments in physical and digital infrastructure in the sort to medium term can bring multiple benefits such as grid resilience and improved financial standing
  - **Grids of the future**
    - The twin transitions of the digital and energy transition, to achieve a higher power system efficiency
- Previously published reports
  - **G20 Report - Empowering Cities toward Net Zero Emissions**
    - Resilient, smart and sustainable cities towards a sustainable energy future
  - **Unlocking the potential of distributed energy resources**
    - Lessons to help policy makers, regulators and system operators for electricity market design
  - **Towards net-zero: Interoperability of technologies to transform the energy system**
    - OECD Going Digital Series to provide policy makers with the tools they need to help their economies and societies thrive in an increasingly digital and data-driven world

Link



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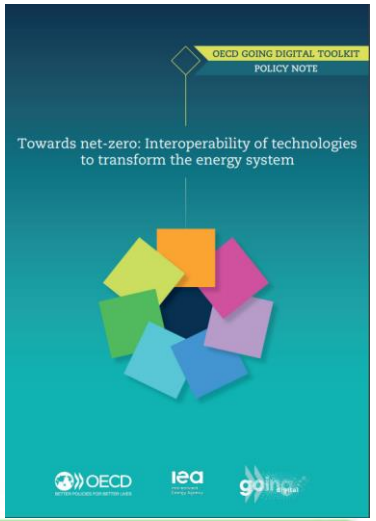

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Distributed PV and digitalisation Key considerations

- Distributed PV growth requires policies that find the best compromise between attracting investment, securing enough revenues for grids and ensuring a fair allocation of grid costs for all consumers. Digitalisation can play a key role in this.
- Rapid deployment of distributed PV must be managed. It shows the importance of integrating upfront the visibility and controllability of resources, e.g. tracking and monitoring deployment and performance of distributed energy resources for timing and location of DPV production with customers' electricity consumption.
- Digital tools can help system operators analyse real time data and include DPV generation in forecasting, integrated energy planning, scheduling and dispatching procedures.
- Combined with fast electrification of end uses, these trends converge to make digitalisation more central than ever: i.e. optimising the efficiency of homes, deployment of distributed PV, as well as wider systems like distribution grids and cities to manage and match the time and location of demand and supply thereby reducing the need to oversize the grid.

Thank You

For discussions/suggestions/queries email:

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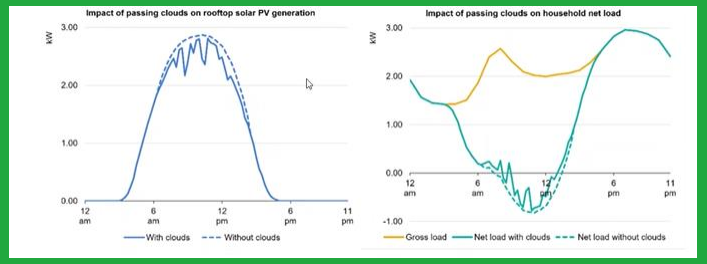
Introduction: four key areas to study DPV integration and some examples

Technical

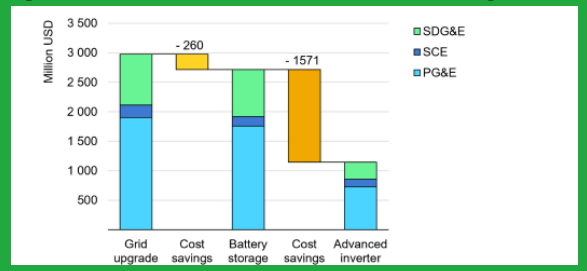
Impact of passing clouds on DPV generation and on household net load



Source IEA with data from EPRI, Distributed PV Monitoring and Feeder Analysis.

Economic

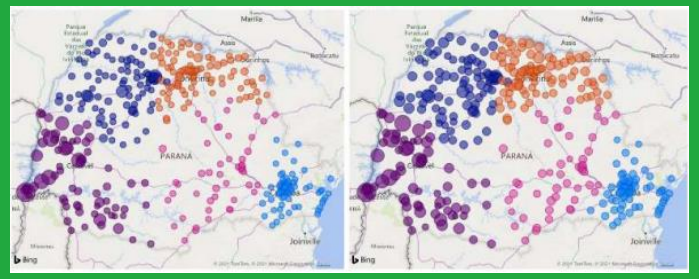
Cost savings from using advanced inverters and customer battery storage to integrate DPV into California's distribution grid in 2026



Source: IEA based on DNV GL (2020), Customer Distributed Energy Resources Grid Integration Study: DER Grid Impacts Analysis

Planning

DPV adoption forecasts in Paraná (Brazil) for grid planning



Source: Benitez et al. (2022) Planejamento a partir de redes representativas do sistema de distribuição considerando a penetração de DERs

Registry / Tracking

Statistics of DPV capacity per postcode in Australia

Source: Australian PV Institute

Many DPV integration challenges and opportunities can be addressed with digital solutions

Objective

Introduce high-level international experiences around digital solutions for DPV integration

1. What problems can DPV create?
2. What digital solutions may exist?
3. What policy recommendations may make sense?

Technical problems & digital solutions

Problems

- **At distribution level**
  - Low visibility & controllability of DPV (geo- and time-granular)
  - Uncertain (net) demand & feed-ins
  - Grid issues (e.g. V increases, reverse flows)
  - Low quality DPV installations
- **At transmission level**
  - Mass DPV disconnection if grid disturbances
  - Need to consider the role of DPV in providing services at wholesale level

Digital solutions

- Smart meters
- Smart inverters
- (Smart) storage
- Advanced distr. management systems
- Solar forecasting (with geo- granularity)
- TSO-DSO data exchange & coordination
- Apps easing prosumer's involvement (e.g. in aggregators)

Technical problems & digital solutions: possible policies

Possible policies

- Mandates (at least for DPV adopters)
- Grants/financing/central purchasing (reduce cost barrier)
- Data use / Privacy / cybersec. policies (smart meter acceptance, data monetisation)
- DisCo regulation (e.g. performance-based regulation, profit-sharing, TOTEX)
- Grid codes
- Flexible grid connection
- Enable, and remunerate, DERs providing services
- Digital-oriented processes and skills in utilities

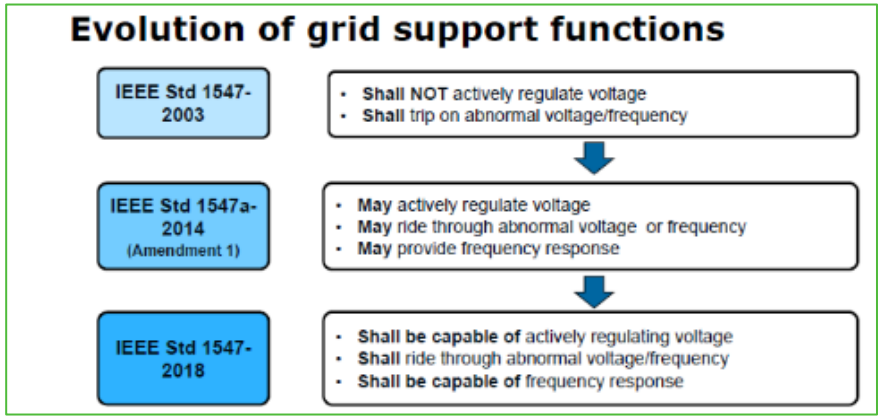
Technical problems & digital solutions: focus on Smart Inverters

Survive grid issues

- Small disturbance (voltage / frequency) ride through
  - Before: 49.7 – 50.3 Hz
  - Now: 47.5 - 51.5 Hz for at least 30 minutes

Solve grid issues

- Autonomous or Remotely controlled:
  - Voltage and frequency control
  - Loss reduction
  - Anti-islanding and/or microgrid management
  - Regulation of exported energy
  - DER-enhanced fault location isolation & service restoration



Source: NREL and IEEE

Before, inverters just "fed energy into the grid", now they "dynamically work with the grid"

Digitally-enabled DPV registries & deployment tracking

Problems

- Lack of visibility of DPV installations, location, capacities, etc.
- Undetected economic impacts (e.g. income lost) and difficulty to design tariffs (e.g. calculate real energy being consumed)
- Hinders effective sectoral planning, unknown needs etc.
- Safety issues (e.g. utility workers don't know if DPV energising a feeder)
- Hinders efficient DPV adoption (e.g. lack of updated info for prospective adopters)

Digital solutions

- Digital registry based on apps, webs, etc
- Data management
- Data analytics for use cases
- Smart meters
- GIS integrating registry data
- Aerial recognition, bill analysis or other sensors to track DPV registered & unreg.
- Ex-ante simulations (e.g. site feasibility, expected generation)
- Track data from DPV providers' apps

Digitally-enabled DPV registries & deployment tracking

Possible policies

- Mandate and implement digital centralised (e.g. national?) registries
- Certified lists of vendors / installers? (for Q assurance before registry)
- Promote information sharing and use cases (e.g. data analytics, new business models)
- Disclosure of grid info (e.g. DER hosting capacities).

Digitally-enabled DPV registries & deployment tracking: some examples

Category*	South Africa Today	South Africa Proposed SAGEN	INDIA	United Kingdom	Australia	California
Basic Customer Information		X	X	X	X	X
Geographic Information		X	X	X	X	X
Basic DPV Information		X	X	X	X	X
Complementary DPV Information		X	X	X	X	X
Solar Installer Information & Equipment			X	X	X	X
Utility / Billing Characteristics			X			X
Smart Meter Capabilities						X
Over-Time Smart Meter Data					X	X
Specific Grid Connect. Info.				X		
Instantaneous Smart Meter Data						X
Publicly Available Information						X

Think about registries "during deployment" to make your life easier "during integration"

Thank You

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