



Can energy and innovation drive new growth in India?

Legacy, Sanguinity, Prosperity

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Energy Access



Renewables



Power Sector



Industrial Sustainability & Competitiveness



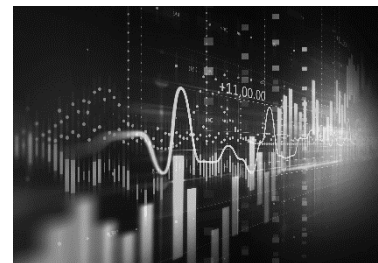
Low-Carbon Pathways



Risks & Adaptation



Technology, Finance, & Trade



Centre for Energy Finance

Four energy transitions

Traditional to modern

Rural to urban

Deeper integration into global energy markets

Growth to sustainable growth



Legacy

Facing the oil headwinds head on



India and global energy markets

Energy security is not energy self-sufficiency

A complex quest for **adequate quantities** of energy resources, at prices that are **affordable and predictable**, while minimising the risk of overseas **supply disruptions** and ensuring **sustainability** of the environment and of the energy system for future generations.

Focus areas for India

ASSURED SUPPLY

Developing capacity for energy diplomacy
Critically evaluate overseas investments

SAFE PASSAGE

Invest in building fleet capacity
Strengthen security partnerships in IOR

SECURE STORAGE

Build domestic storage capacity
Cooperative arrangements for storage
Institutional capacity to manage reserves

FUNCTIONAL INSTITUTIONS

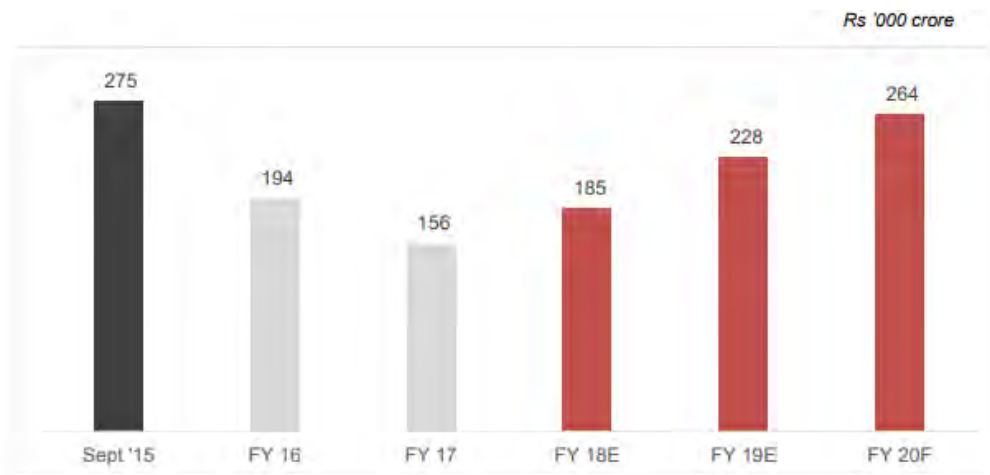
Transparency; dealing with supply shocks;
collective security; arbitrate disputes;
pooling resources; sharing best practices

EXPLOITING MARKET POWER

Moving from a price taker to price influencer.

Without fixing the power sector, the future looks uncertain

- Total outstanding debt of discoms: ₹4.3 lakh crore (as on March 2015)
- High loss states: Rajasthan, Tamil Nadu, Uttar Pradesh
- Bonds (for 16 states)
 - Bonds to be issued: ₹2,69,056.35 crore
 - Bonds issued: ₹2,32,163 crore (approx. 86%)
- AT&C Losses (for 26 states)
 - Target: 15%
 - As of March 2019: 18.29%
- ACS – ARR Gap (for 16 states)
 - Target: ₹0 / unit (zero)
 - As of March 2019: ₹0.26 / unit
- Tariff Revision (for 27 states)
 - As of March 2019: 25 states



Sanguinity

Ending energy poverty?



ACCESS 2015 & ACCESS 2018

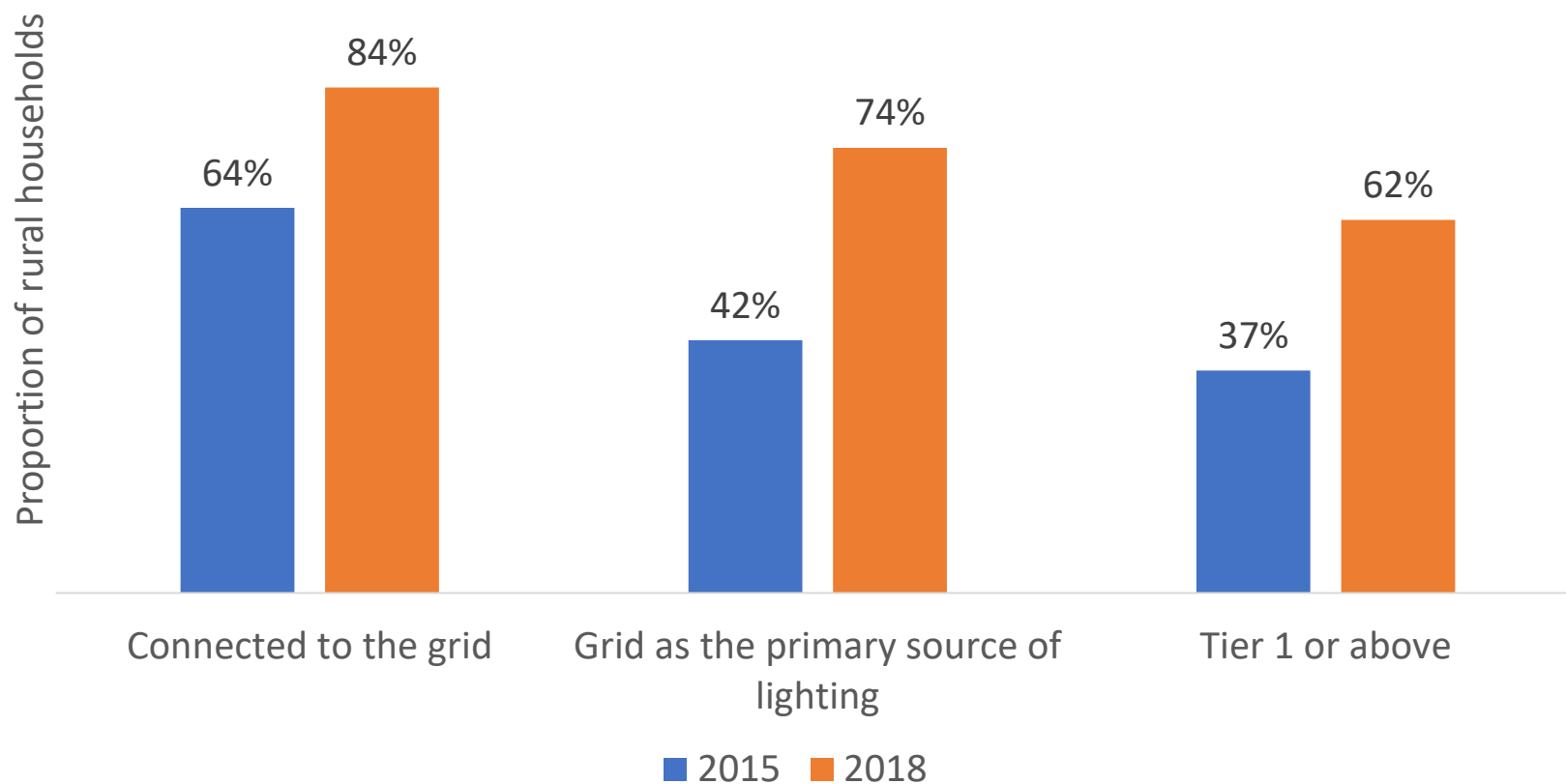
- **2015:** First ever use of the **multidimensional framework** to evaluate energy access in India
 - Bihar
 - Jharkhand
 - Madhya Pradesh
 - Odisha
 - Uttar Pradesh
 - West Bengal
- **2018:** **Largest panel-data** on multidimensional energy access in the world



6 States | 54 Districts | 756 Villages | 9,072 Households | 5 million Data points

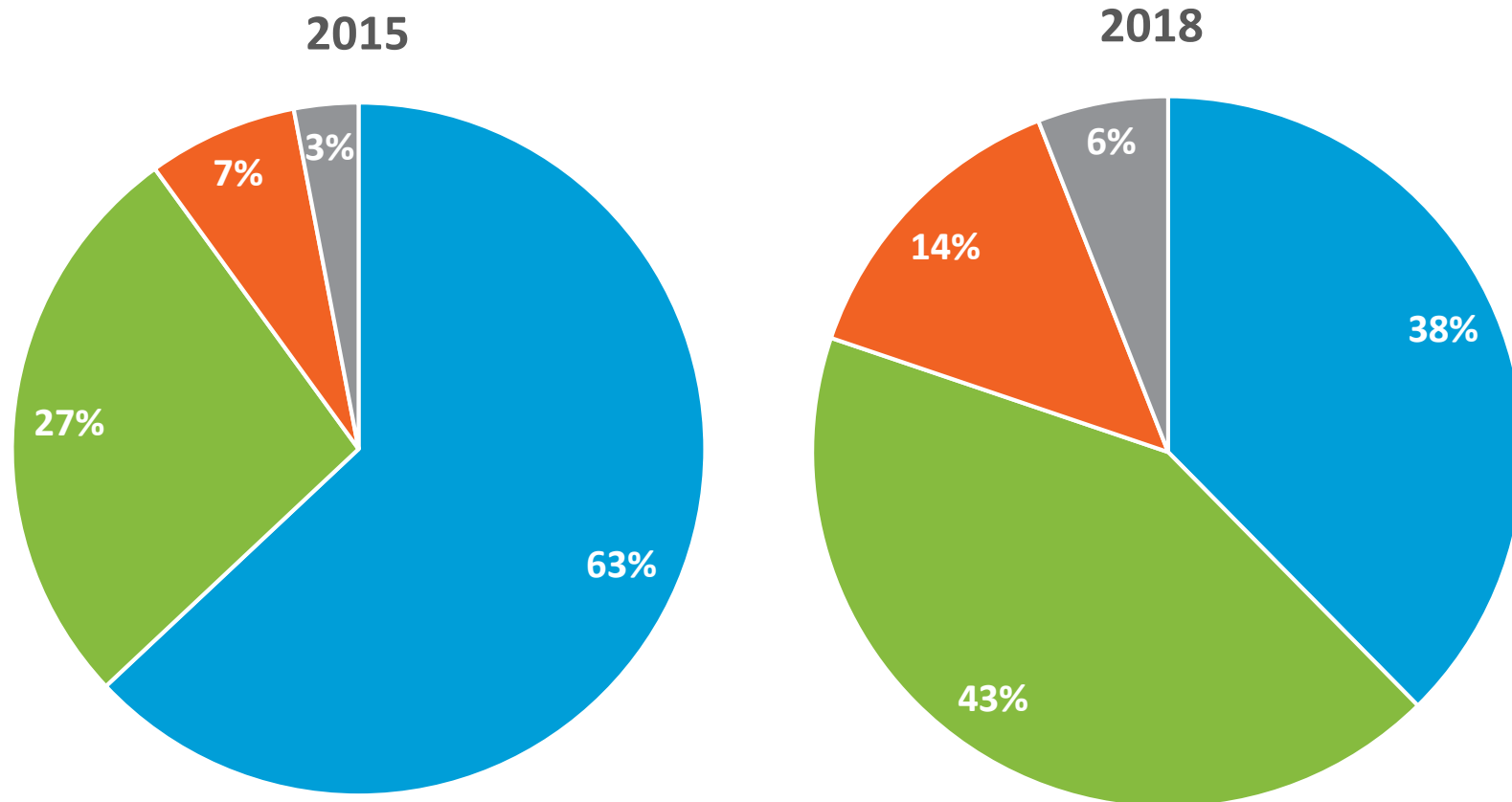
118 million have moved out of absolute electricity poverty

Access to electricity in six states



But long way to go, as only 20% of rural households are in top-two tiers

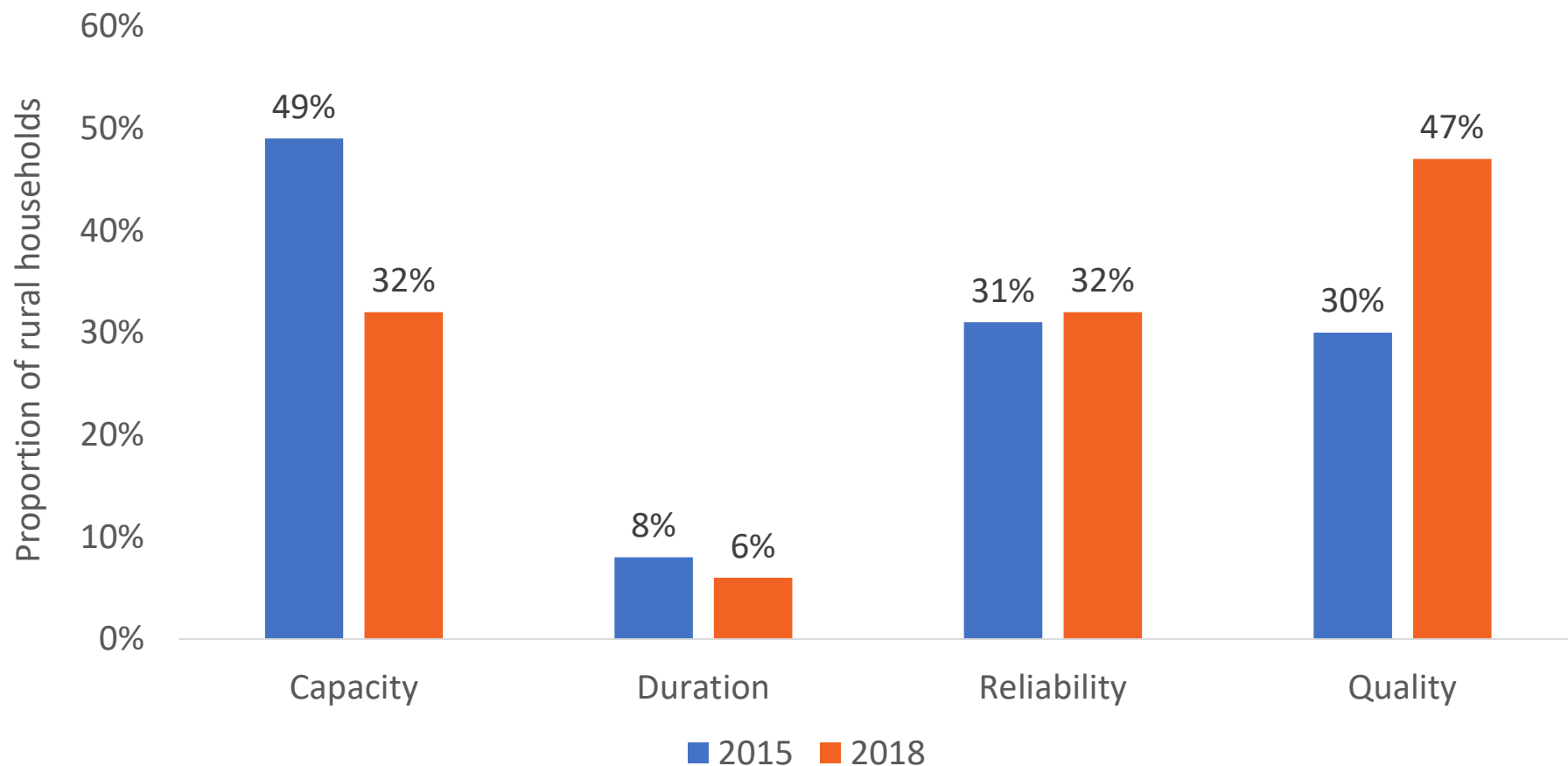
Electricity Access Evolution



■ Tier 0 ■ Tier 1 ■ Tier 2 ■ Tier 3

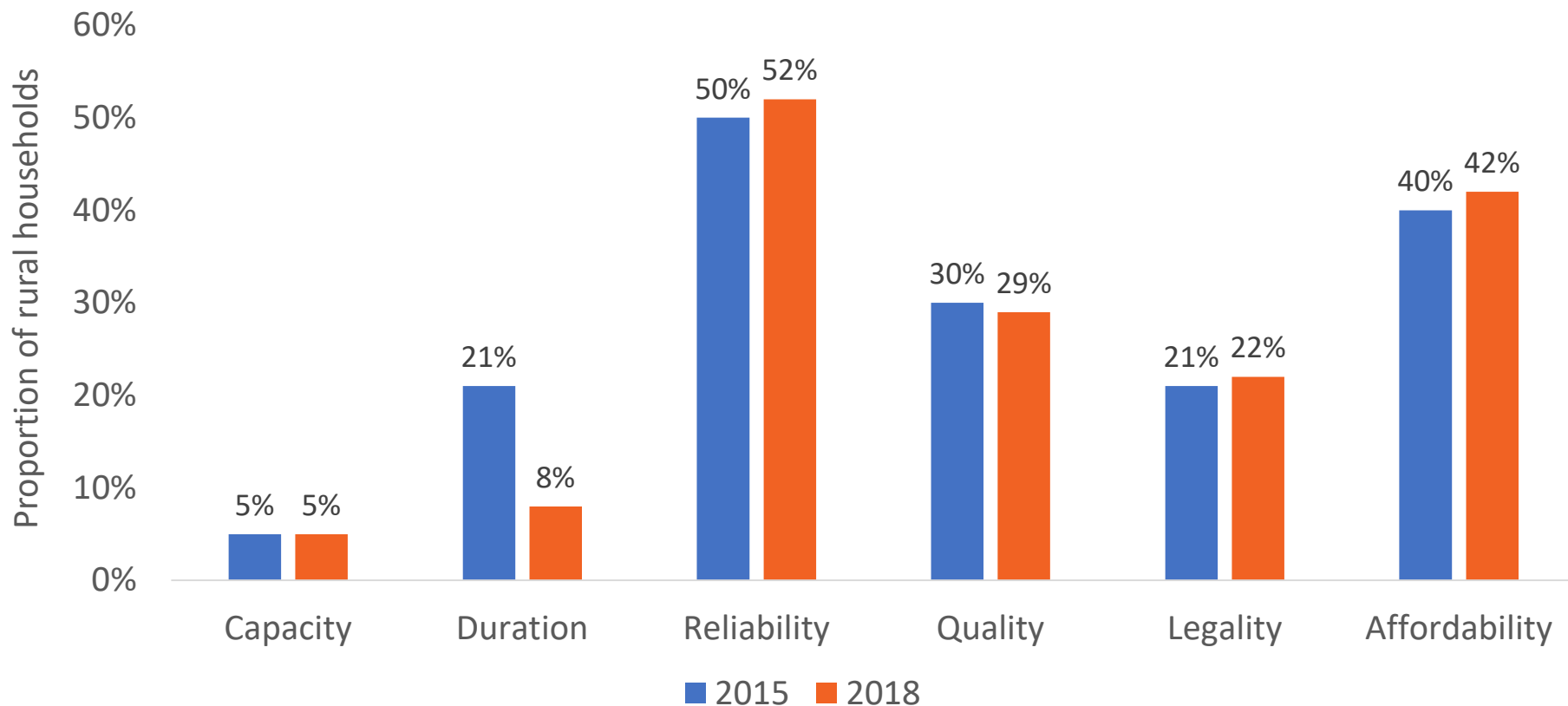
Quality and reliability of supply remain main issues for Tier 0 HHs

Bottlenecks in electricity access faced by Tier 0 households

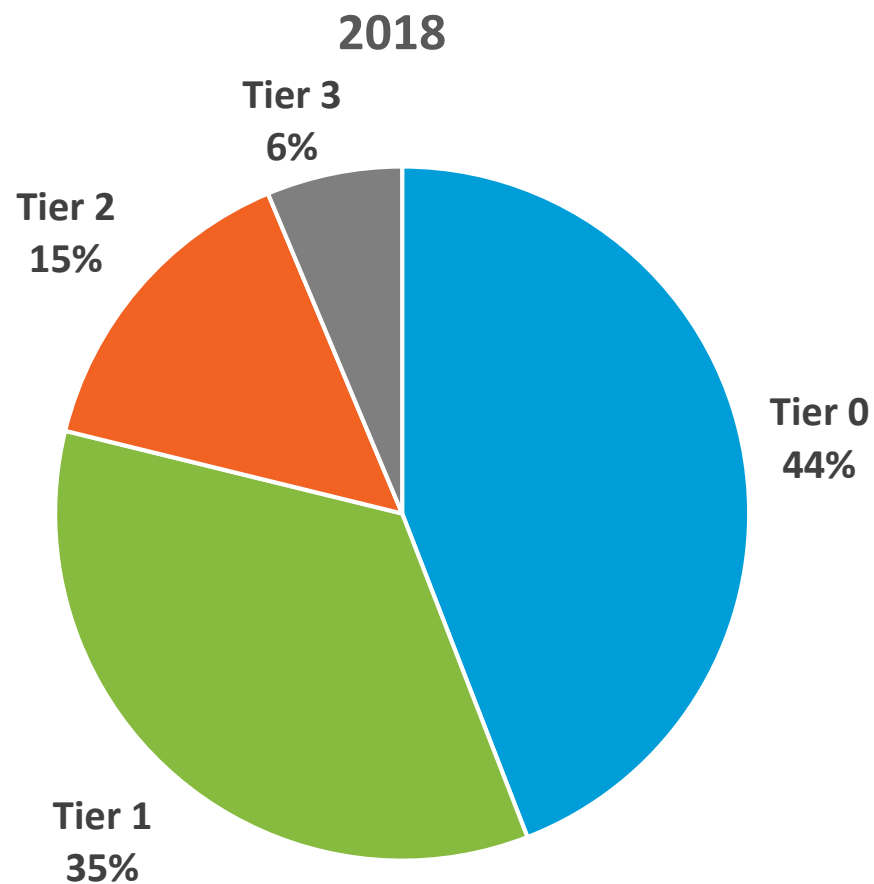
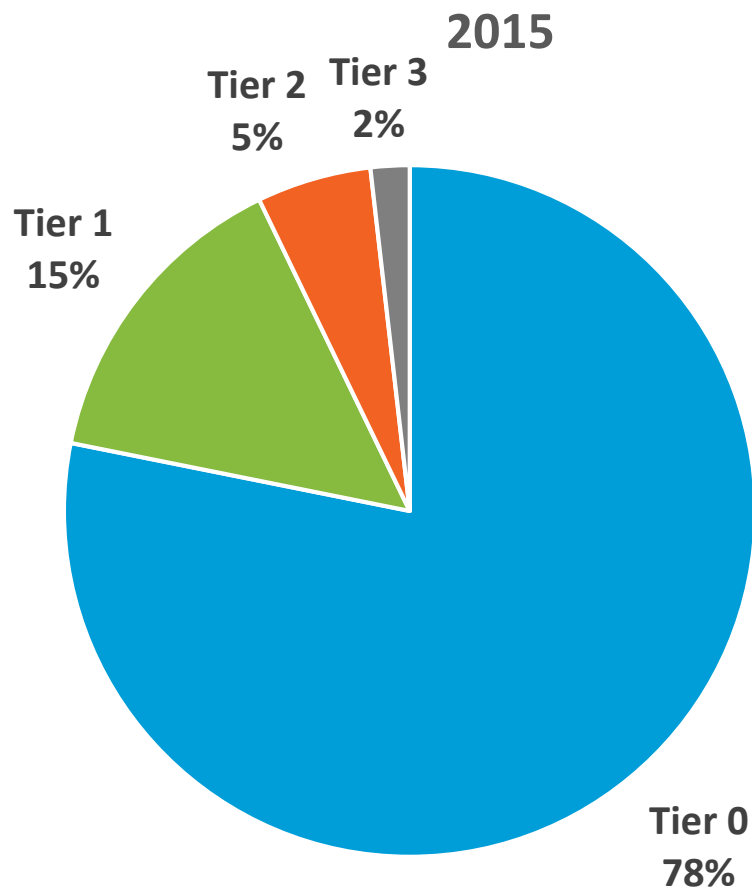


Duration of supply has improved, but reliability remains a concern

Bottlenecks in electricity access faced by Tier 1 households



160 million have gained access to clean cooking energy

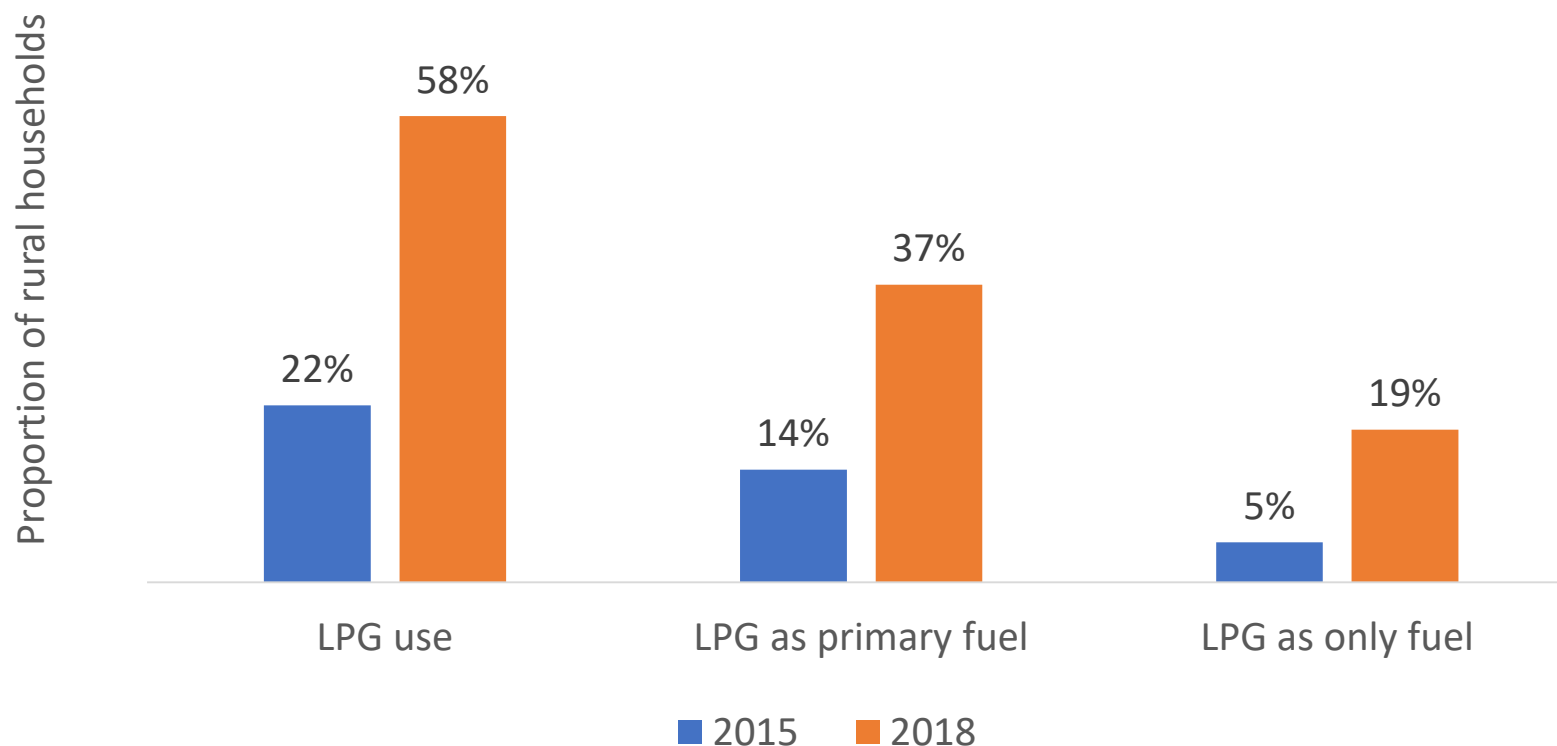


■ Tier 0 ■ Tier 1 ■ Tier 2 ■ Tier 3

LPG is the driver for all the change, but a long way to go

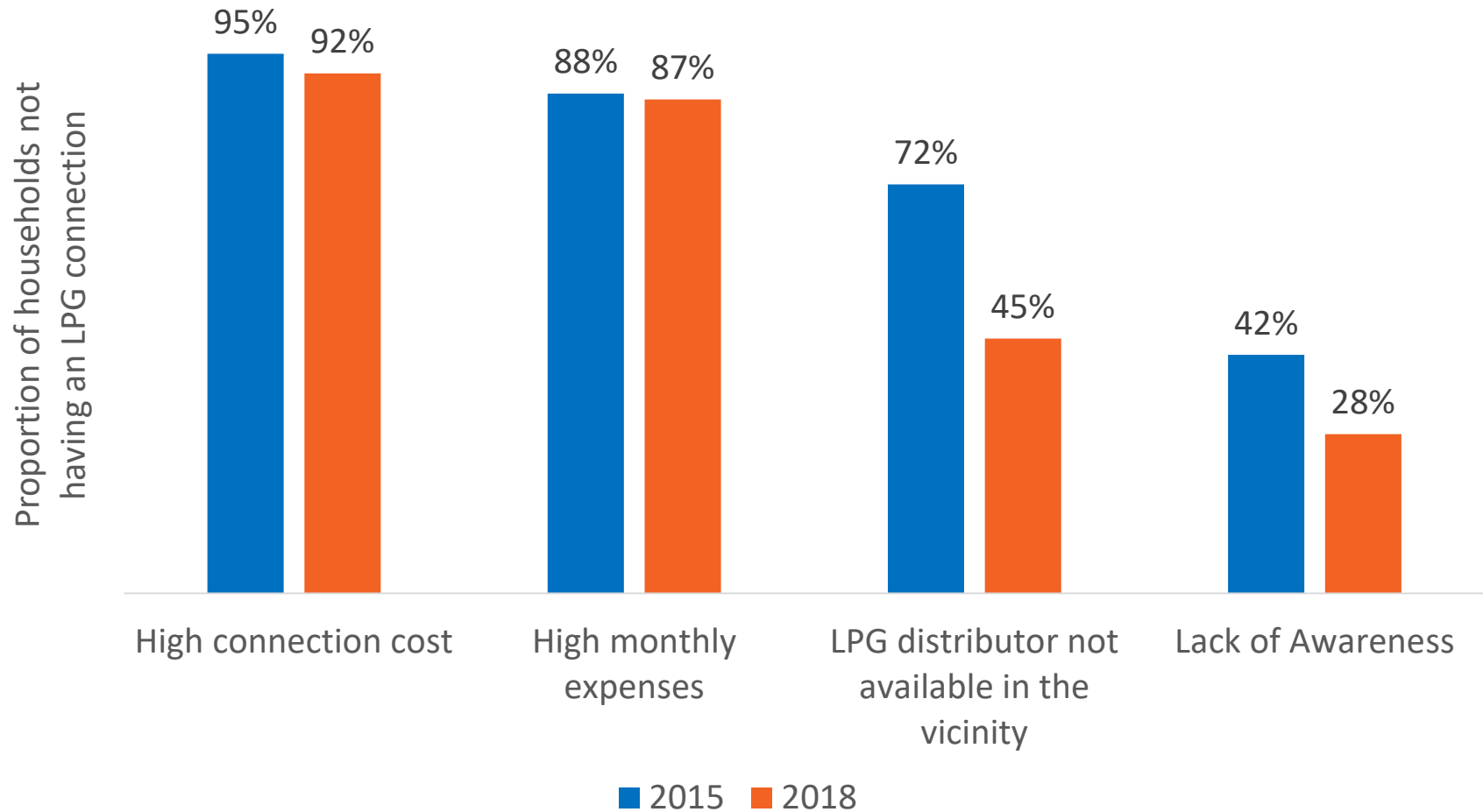
LPG connection and its use as a primary fuel has increased two-fold

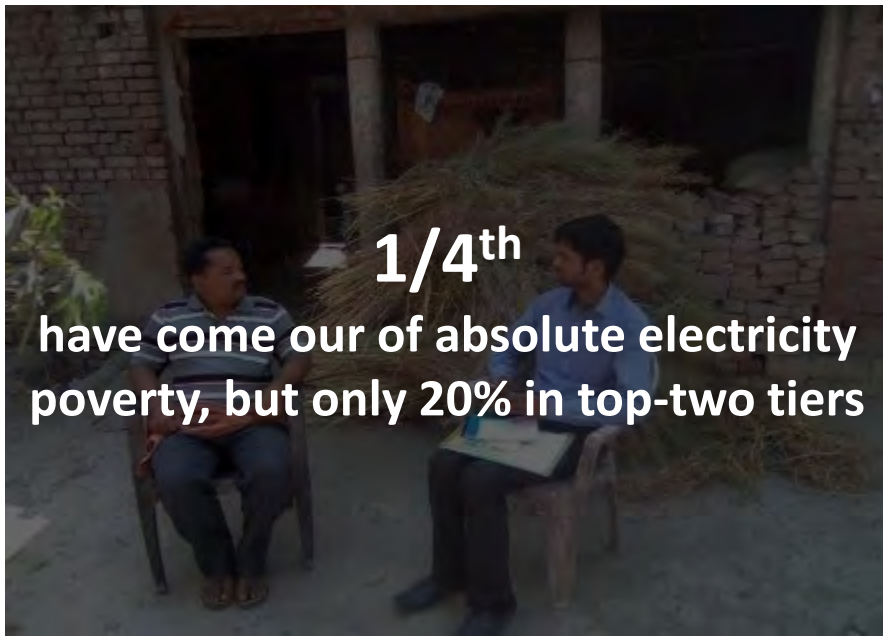
LPG adoption and use in rural areas of six major states



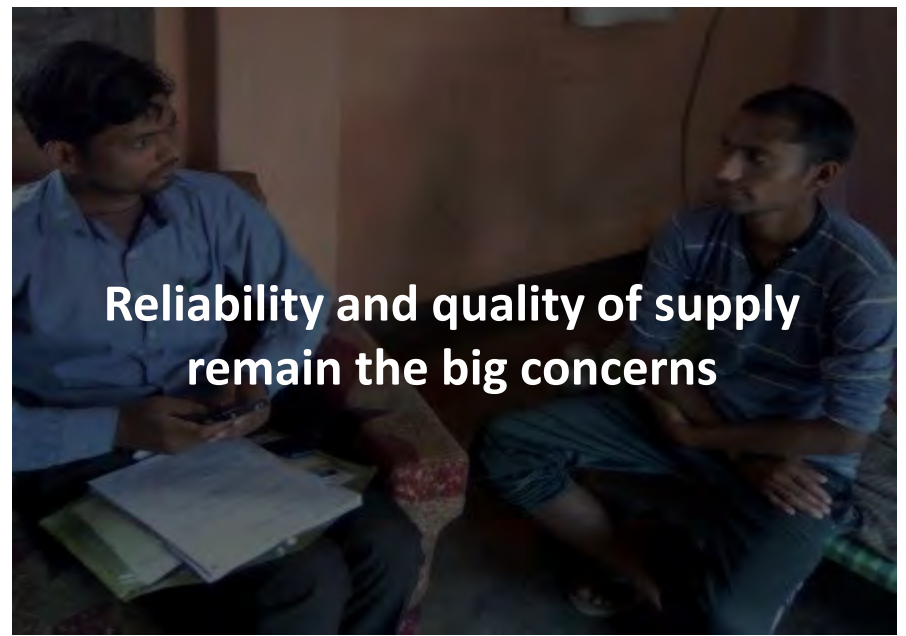
Affordability remains the biggest challenge to adopt and use LPG

Reasons for not having an LPG connection in 2015 and 2018

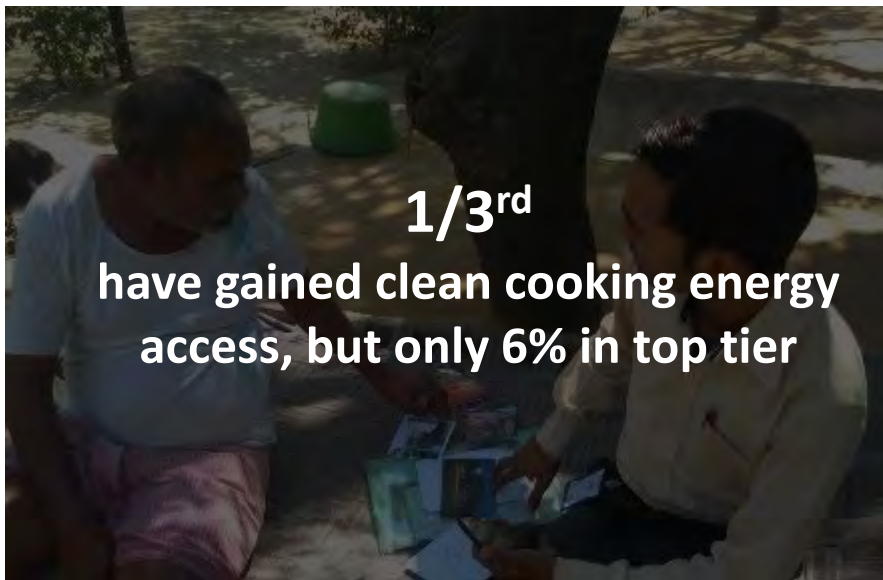




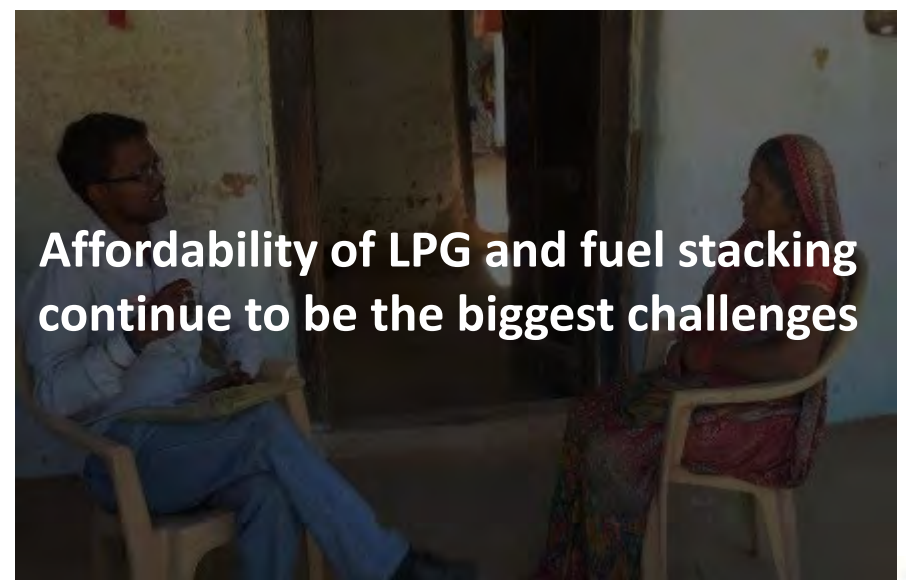
1/4th
have come out of absolute electricity
poverty, but only 20% in top-two tiers



**Reliability and quality of supply
remain the big concerns**



1/3rd
have gained clean cooking energy
access, but only 6% in top tier



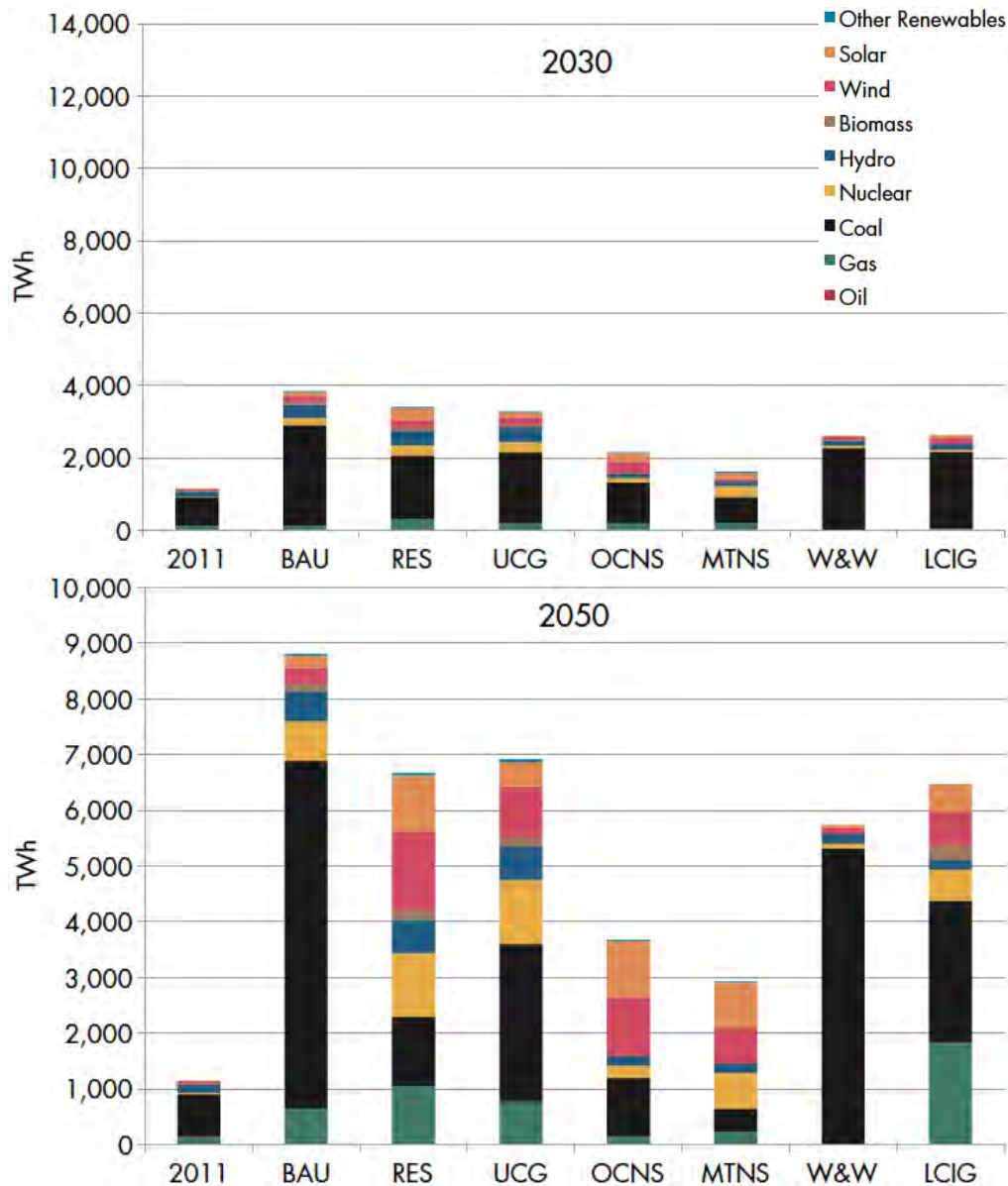
**Affordability of LPG and fuel stacking
continue to be the biggest challenges**

Tapping every ray of the sun?



Image: Abhishek Jain/ CEEW

Electrification to increase energy system resilience



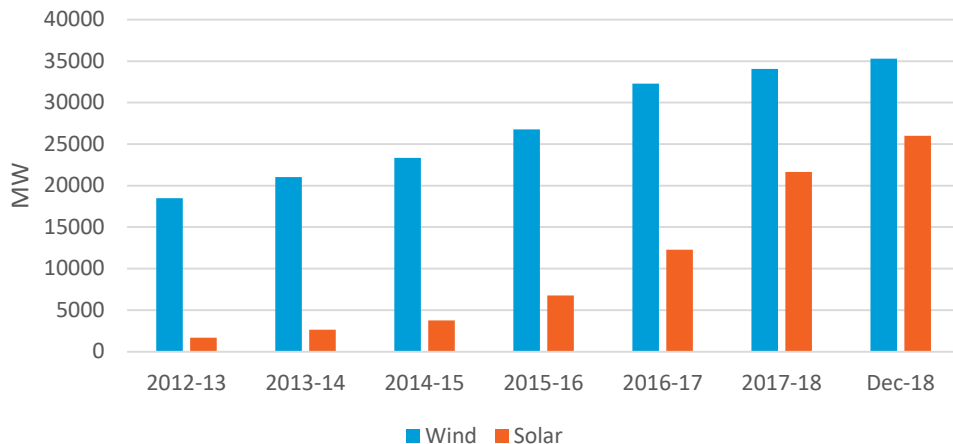
- A range of generation options are required, whichever scenario is followed
- **Five of the seven scenarios show significant future generation coming from renewables (wind and solar)**

Electricity mix today and tomorrow

Source	2010	2015	2020	2025	2030	2035	2040
Biomass	1%	0.5%	0.2%	0.2%	0.4%	0.4%	0.3%
Coal	67%	77.0%	72.1%	66.5%	59.7%	53.1%	47.1%
CSP	0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.3%
Gas	12%	4.1%	5.9%	4.2%	3.2%	2.4%	1.7%
Geothermal	0%	0.0%	0.3%	0.5%	0.4%	0.4%	0.3%
Hydro	14%	10.5%	8.3%	6.5%	5.1%	4.1%	3.5%
Nuclear	3%	3.1%	5.0%	5.5%	5.5%	5.3%	5.1%
Oil	0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
PV	0%	1.0%	4.5%	10.4%	16.9%	23.4%	29.7%
Wind	3%	3.8%	3.8%	6.1%	8.8%	10.8%	12.1%
TOTAL	100%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

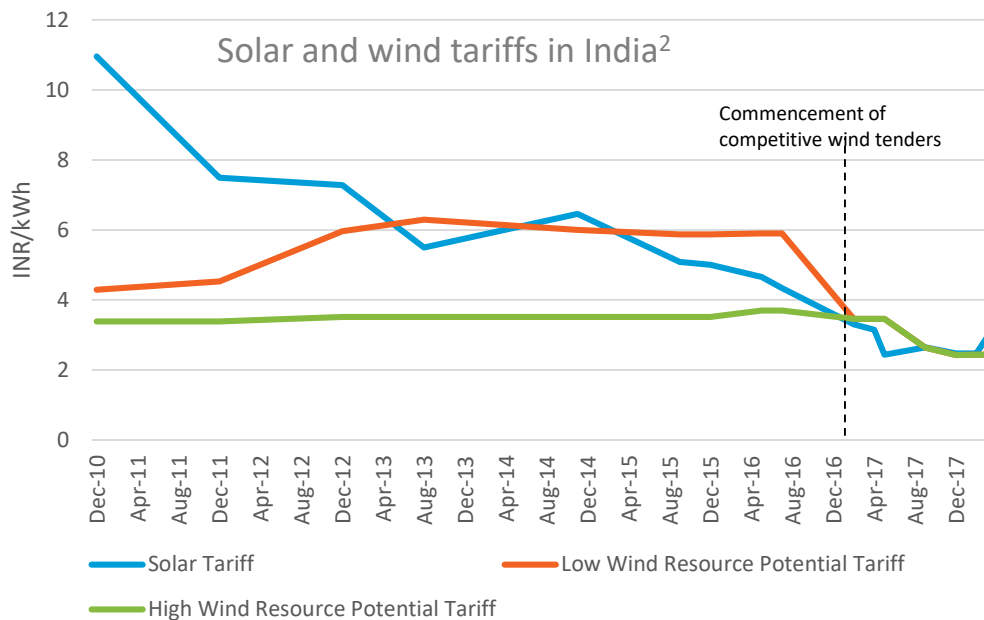
India's renewable energy journey

India's solar and wind installed capacity¹



- Policy push on solar since 2014-15 has driven sharp increase in solar installed capacity

Solar and wind tariffs in India²



- Solar and wind tariffs have stabilised below USD c 4/kWh

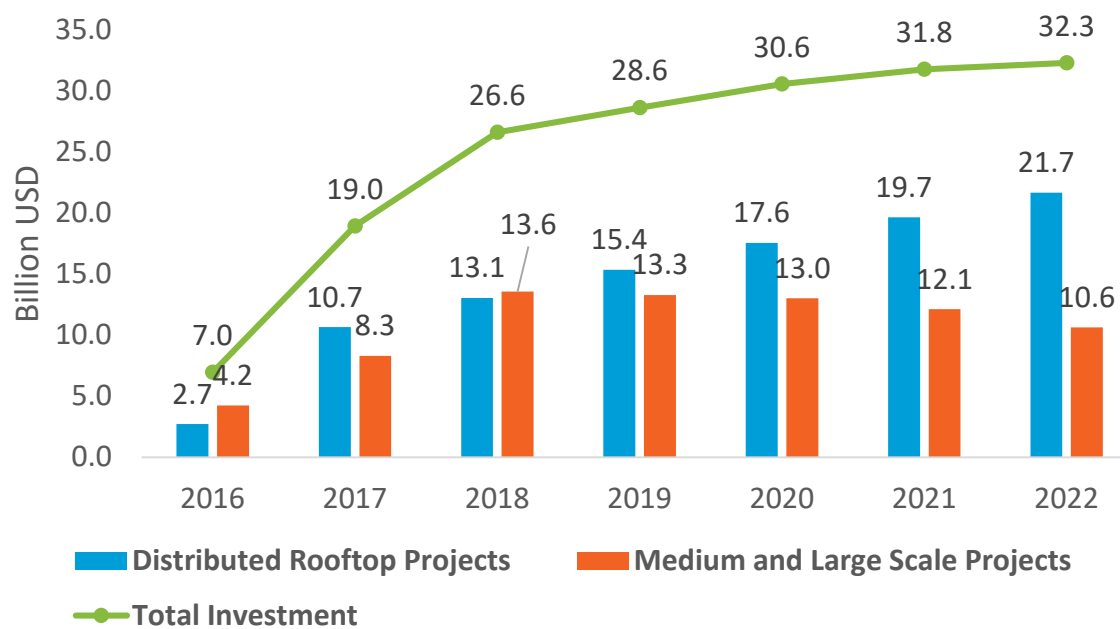
1 Source: Central Electricity Authority & Ministry of New & Renewable Energy

2 Source: CEEW Analysis

Investment requirements to fund a revolution

RE Investment Flows	Average 2013-2017 (USD Billion)	2017 (USD Billion)
India ¹	10.0	10.9
Global ²	321	334

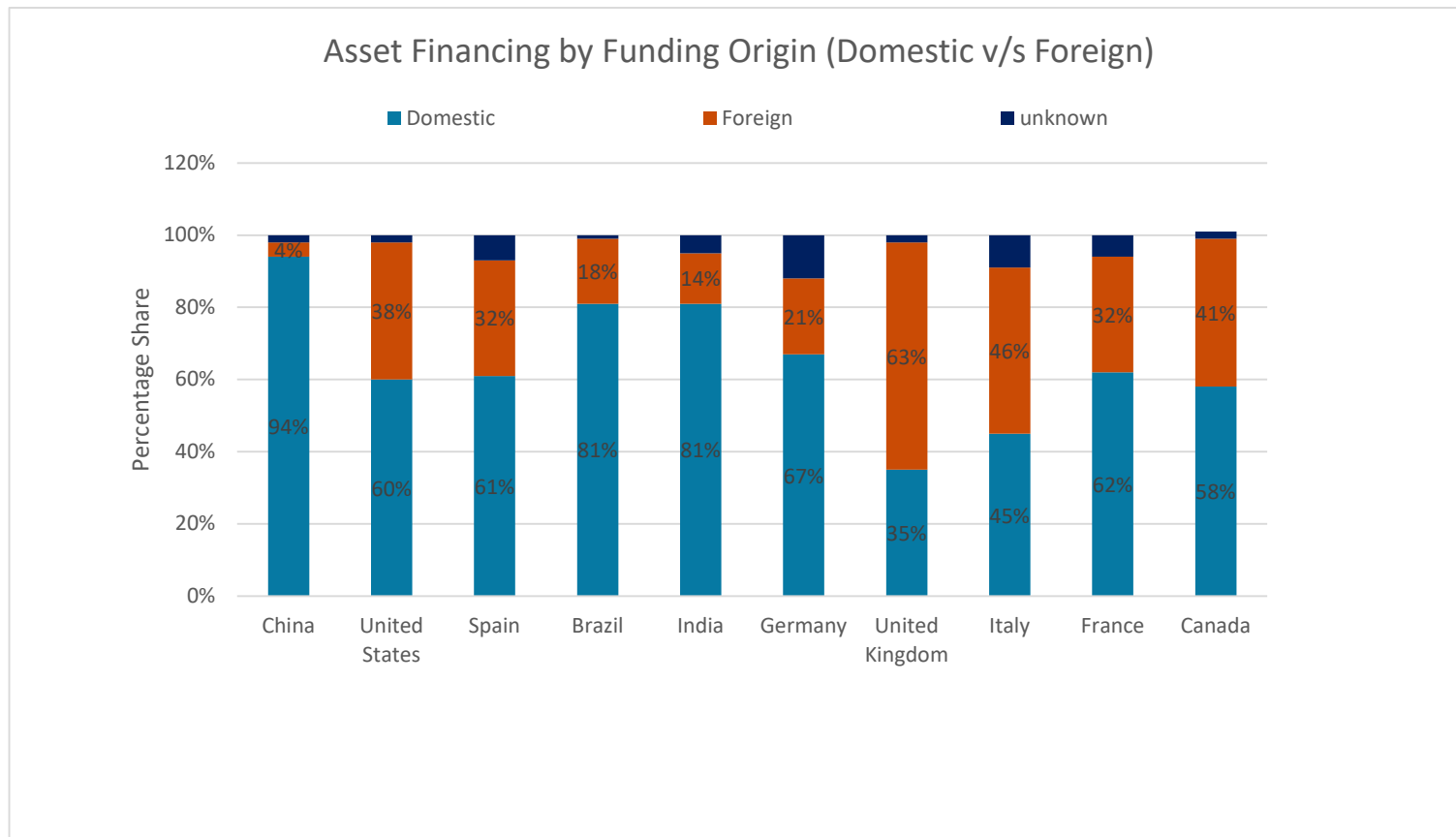
Annual investment needed in India's solar sector



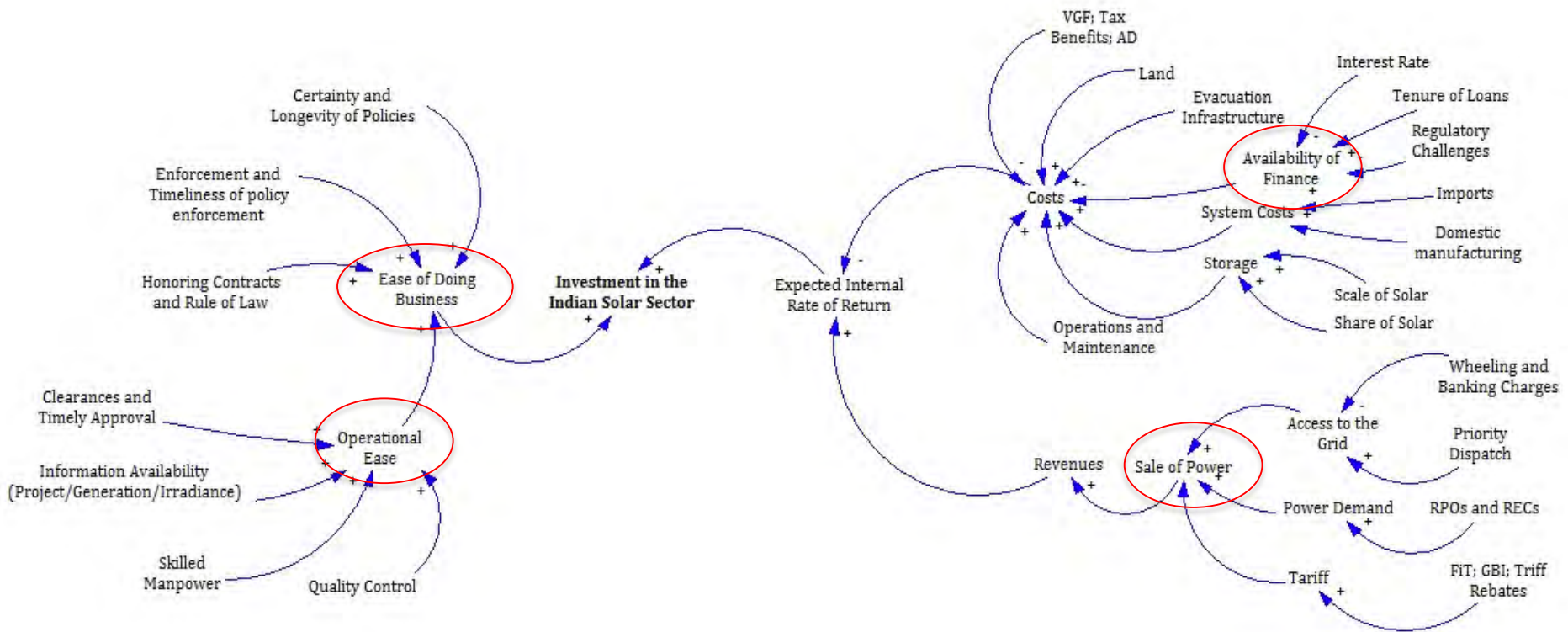
23 | 1 Source: BNEF (2018); Chawla (2016)

2 Includes large hydro investments

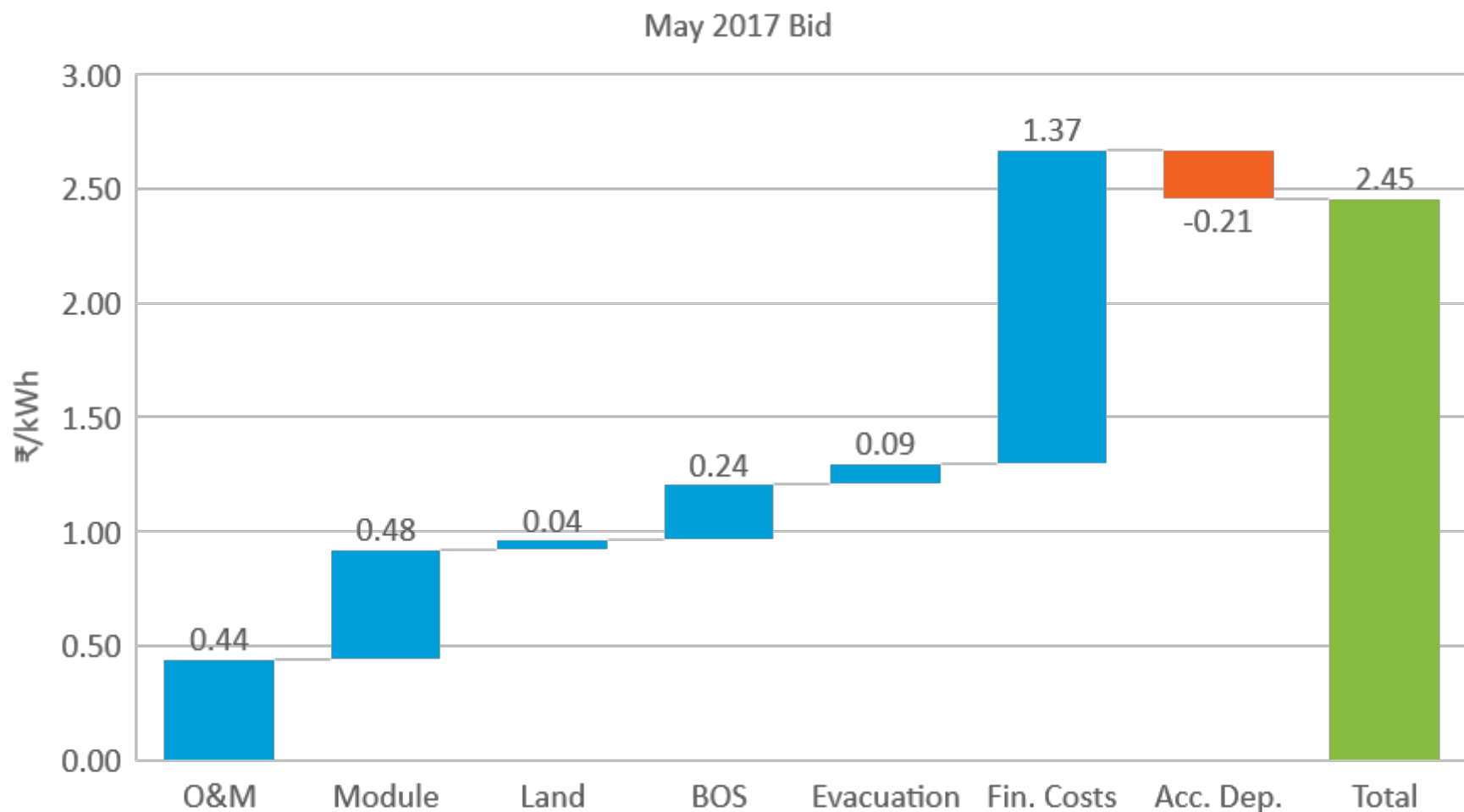
Emerging economies receive only a small share of foreign funding



Factors determining returns on RE investments

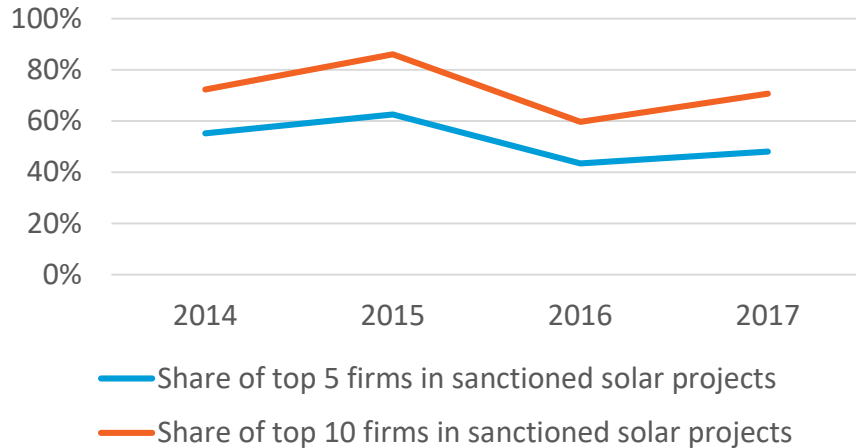


Anatomy of an RE tariff: risk perceptions determine costs of finance

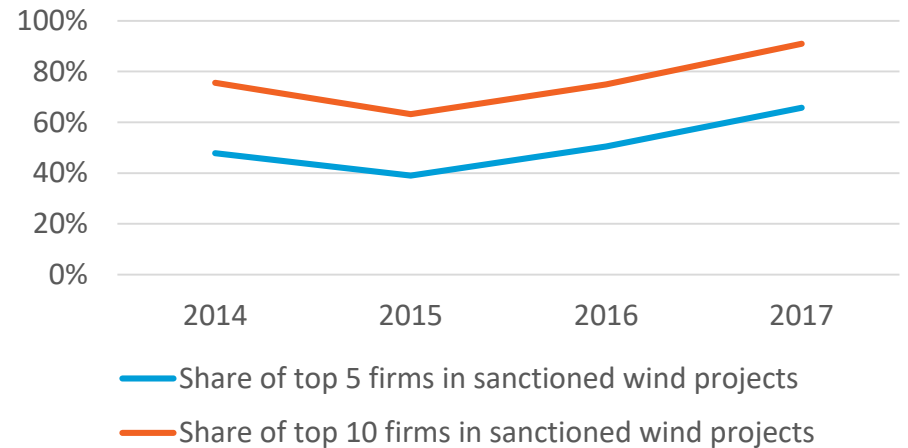


Greater market concentration; solar parks become attractive

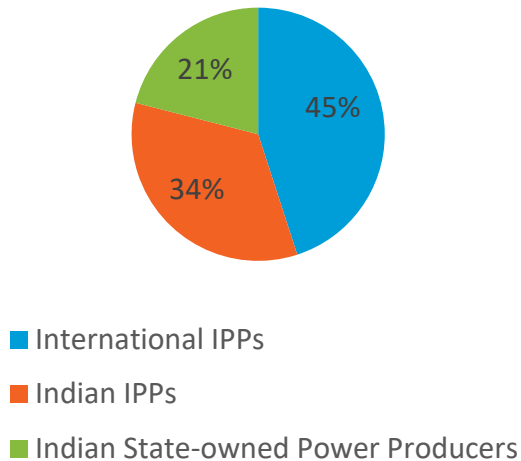
Market concentration in solar energy generation



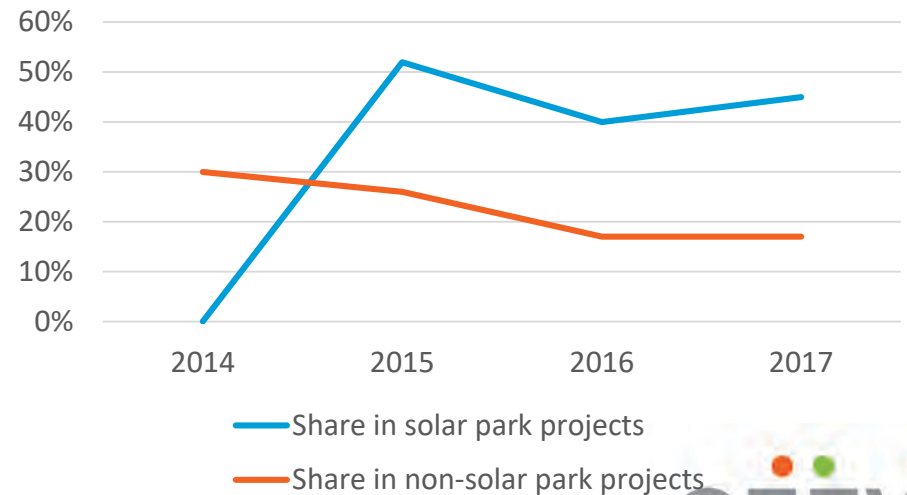
Market concentration in wind energy generation



Share of projects at solar parks (2014-2017)



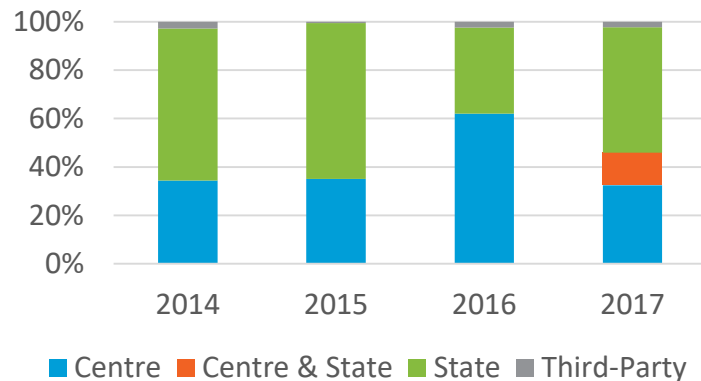
Solar investments by international IPPs



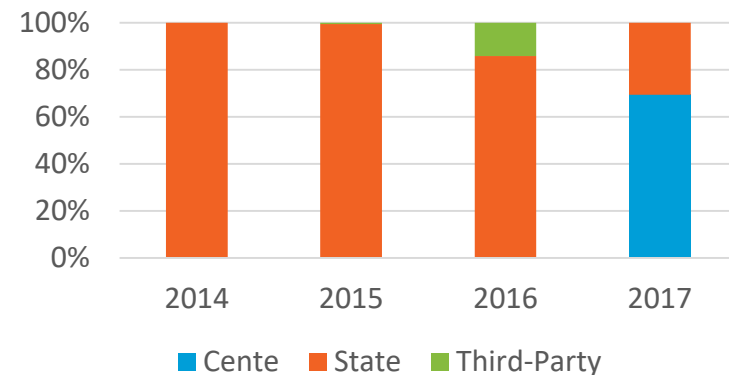
Creditworthiness of oftakers strongly impacts investment

- Preference for creditworthy central oftakers for solar and wind projects
- Creditworthy state DISCOMS account for the majority of state oftakers

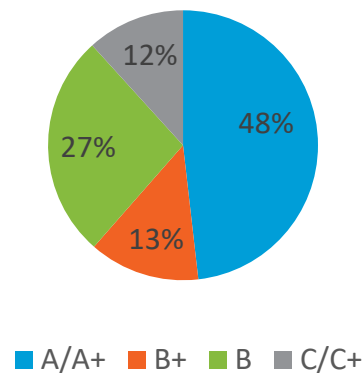
Share of solar projects by oftakers



Share of wind projects by oftakers

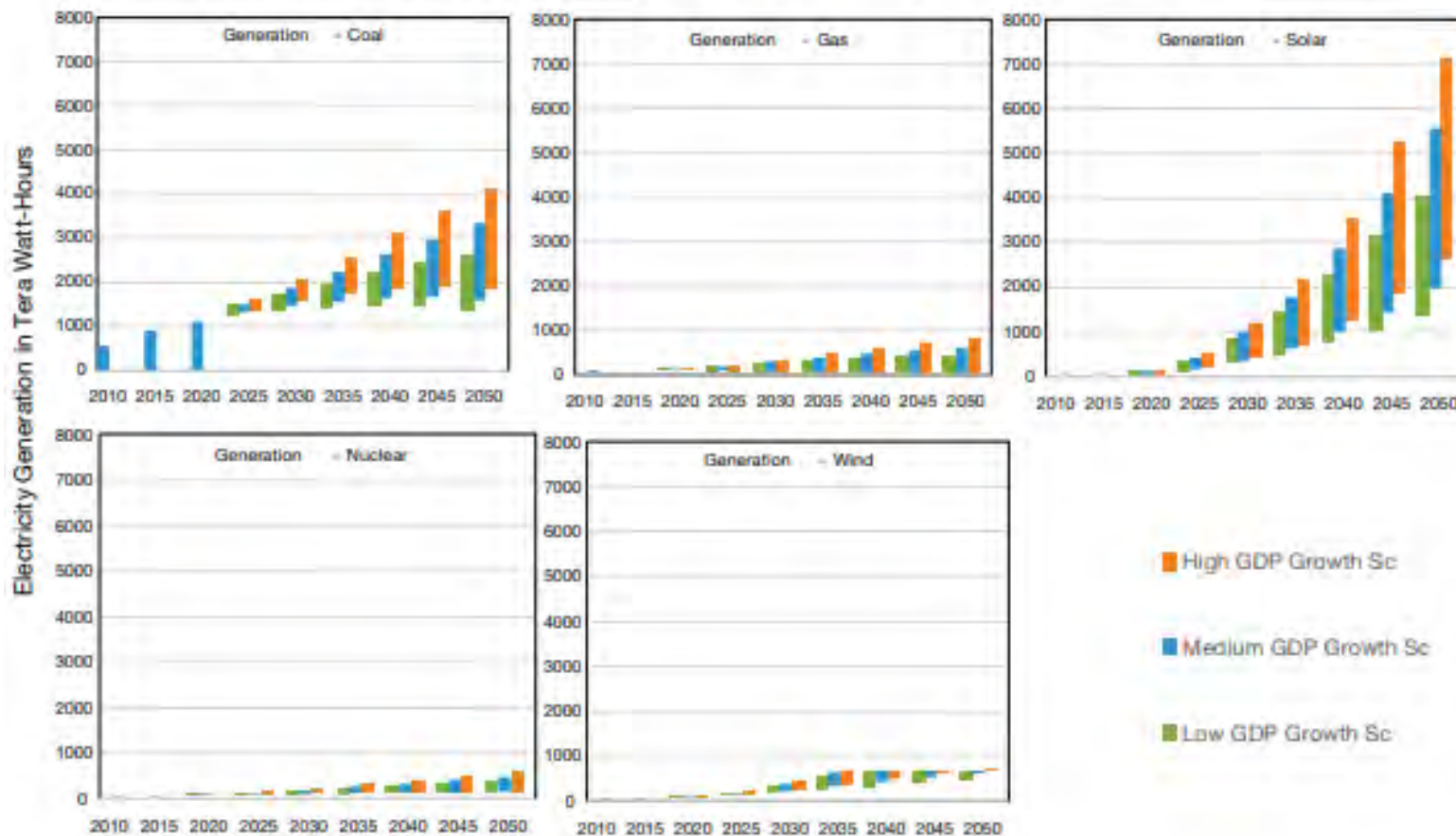


Share of sanctioned projects with state distribution companies by utility grade



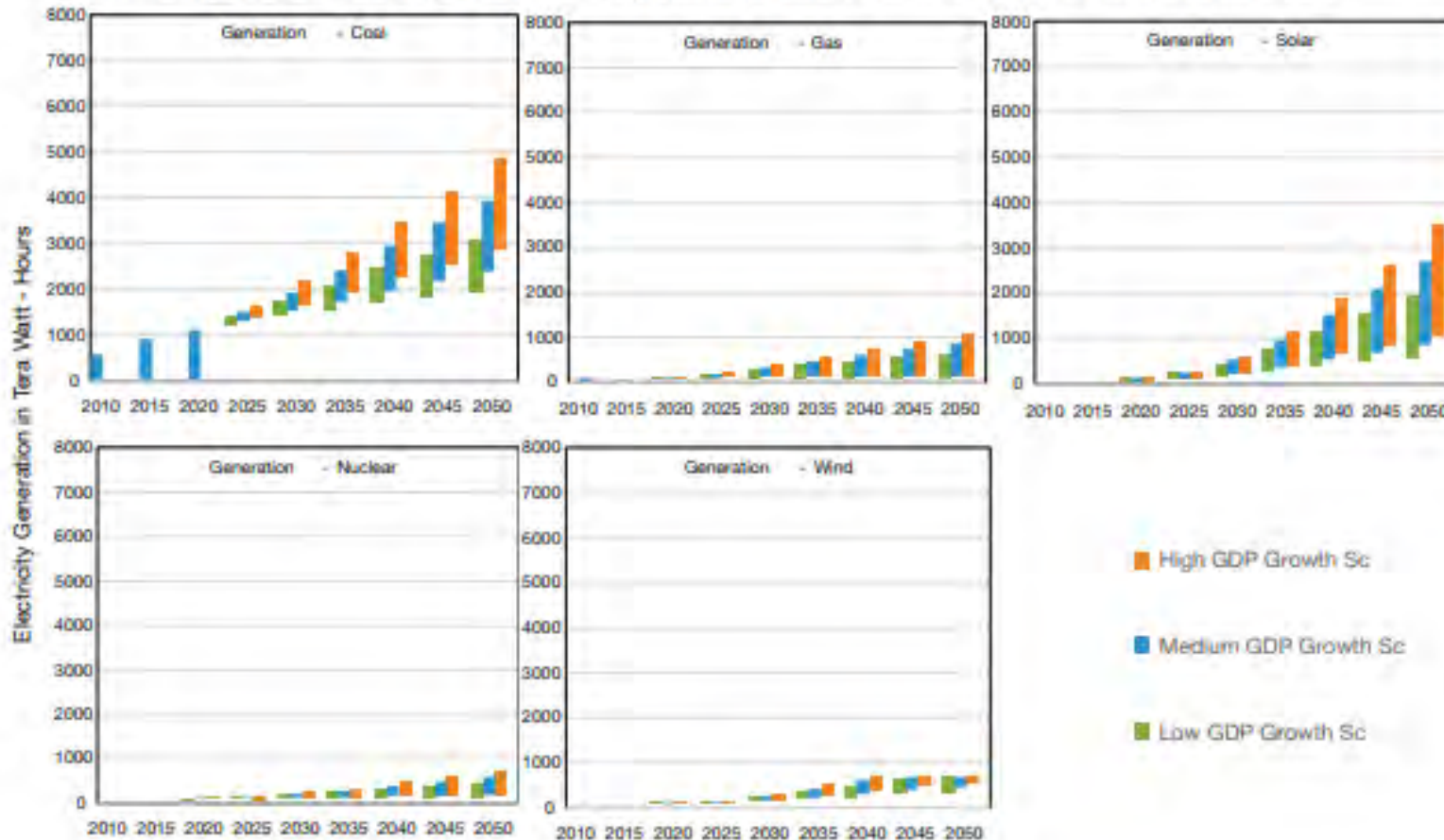
What gets built and used: who bears integration costs?

a) Electricity generation range by technology WITHOUT grid integration cost levied on VRE producers

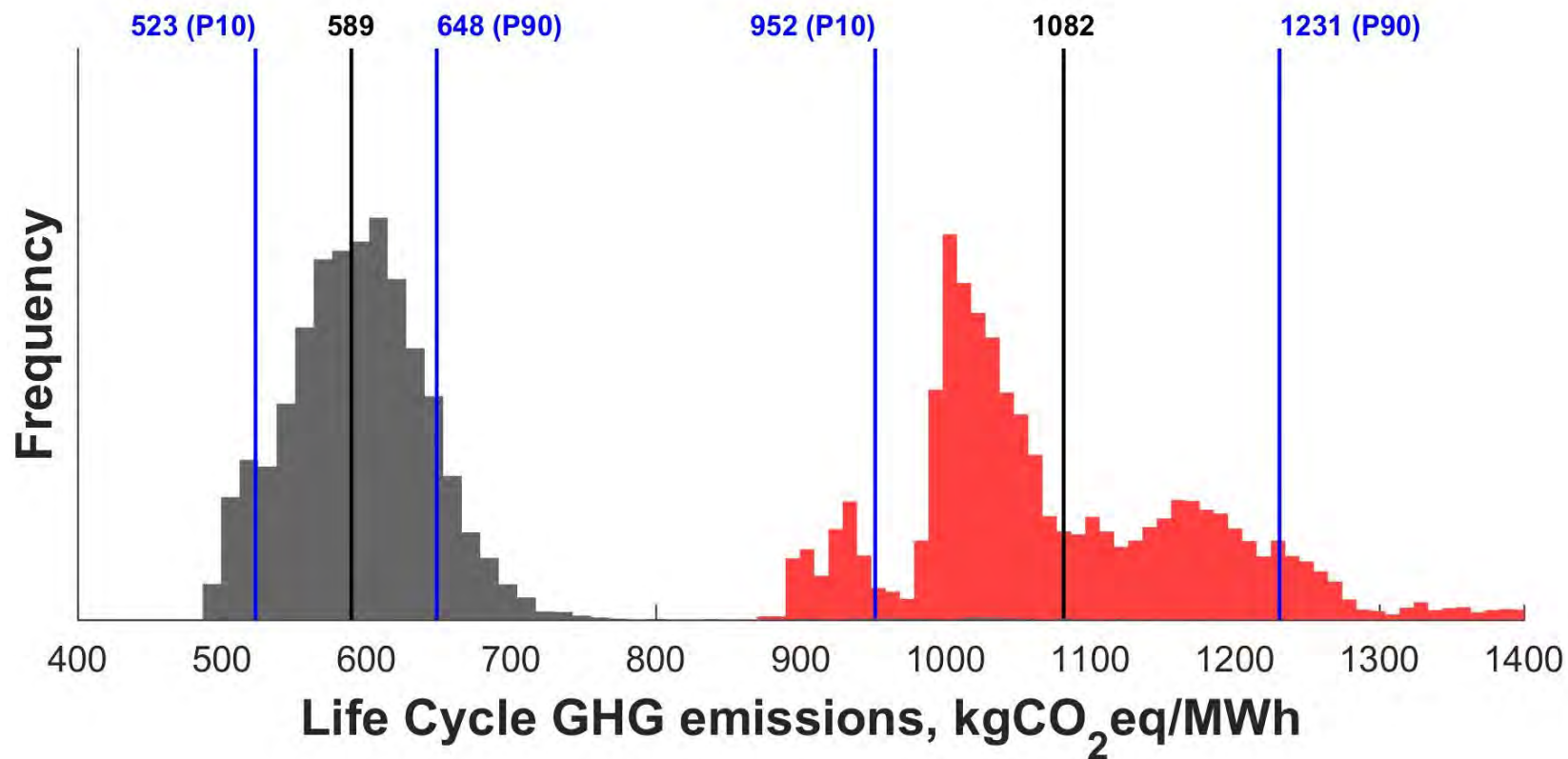


What gets built and used: who bears integration costs?

b) Electricity generation range by technology WITH grid integration cost levied on VRE producers



Indian coal power has ~2X GHG emissions of gas-based generation



Renewing our vows on renewables

No backsliding

- Continue raising ambition

No failed contracts

- Tackle risk perceptions

No lost electrons

- Focus on integration

No false binaries

- Manufacturing versus deployment
- Coal vs RE OR Efficient TPPs + RE



Prosperity

Using our roofs?

Image: Unsplash



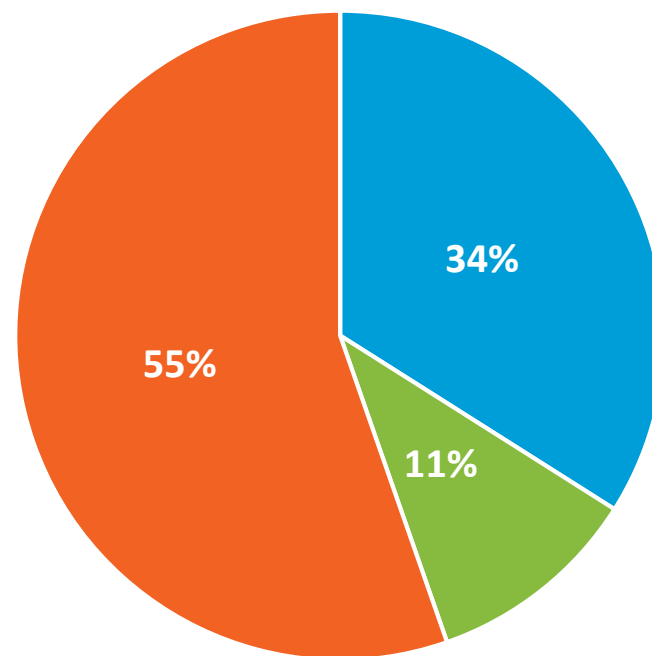
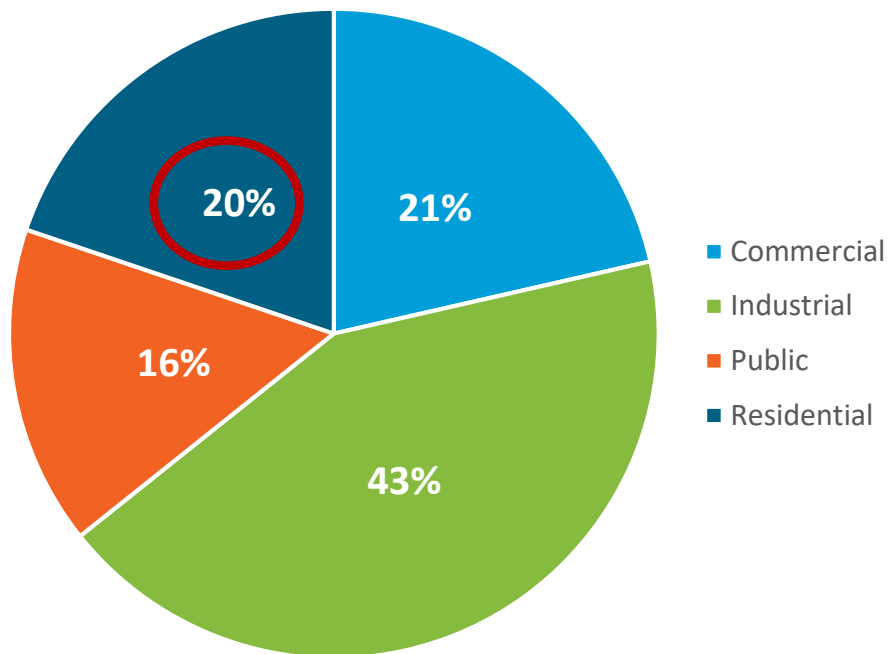
State of the rooftop solar sector

Total rooftop capacity installed in India:

2.5 GW

Total rooftop capacity installed in Delhi:

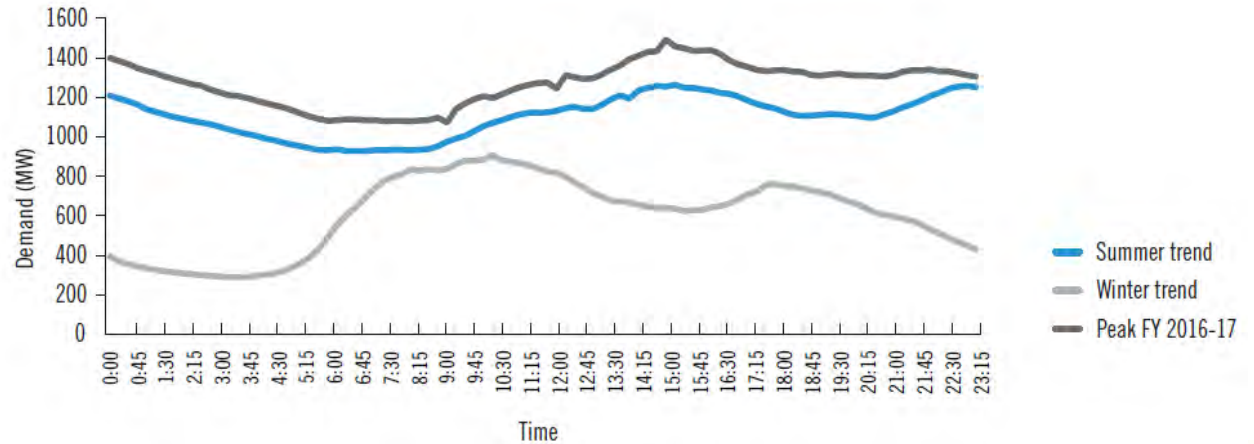
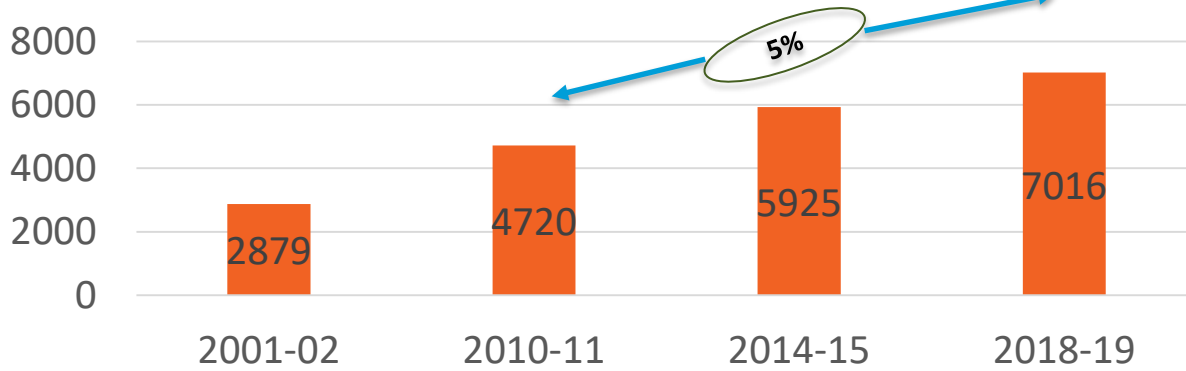
103 MW



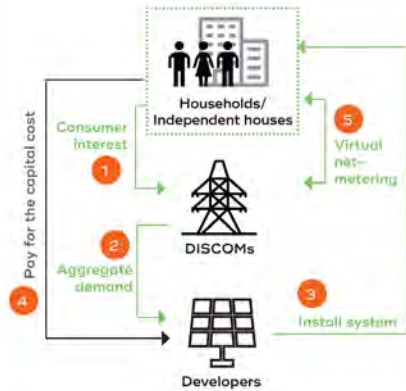
Low adoption in the residential sector despite the availability of significant technical potential

Why rooftop solar – Prospect for Delhi

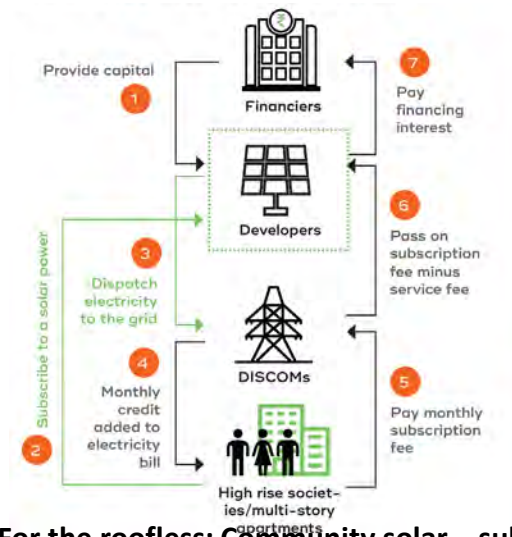
Peak Demand (MW)



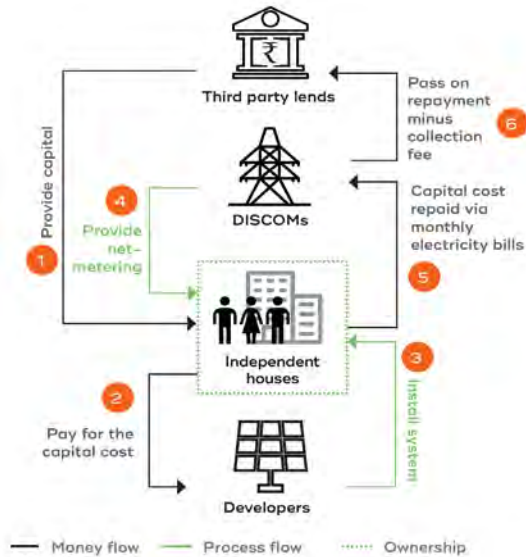
New DISCOM-led business models



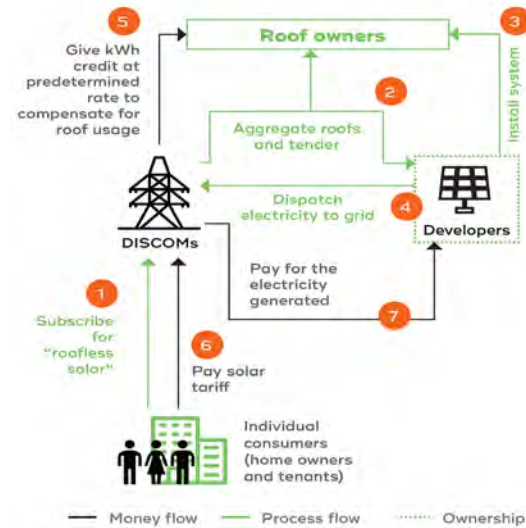
1.a For the roofless: Community solar – upfront payment



1.b For the roofless: Community solar – subscription mode



2. For the creditless: On-bill financing model



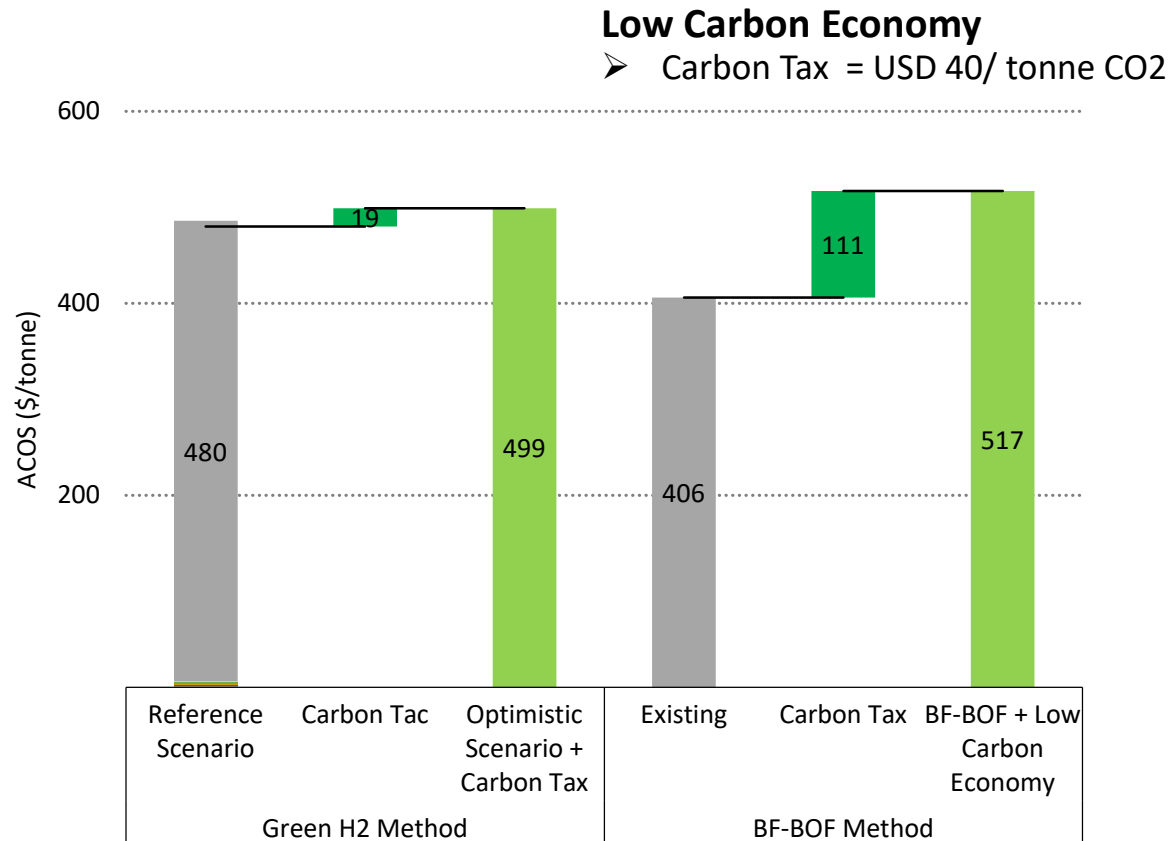
3. For all: Solar partners model

Low-carbon industrialisation for the fastest growing major economy?



Favourable renewable profiles, low electrolyser CAPEX, and low power costs could make “green steel” commercially competitive

- Optimistic scenario
 - Electrolyser CAPEX = \$ 615/KW
 - Solar LCOE = \$ 0.029/KWh
 - Wind LCOE = \$ 0.043/KWh
- Under the optimistic scenario the Green H2 based production is 18% higher than the conventional method



Sustainable mobility for a country on the move?



Avoid, shift, improve...



- Metro + bus vs bus: 12-35 minutes saved at peak hours for > 10 km journey
- But each minute saved could cost between ₹0.5 and ₹2

Where did we lose out?



Resource efficiency to make in India?

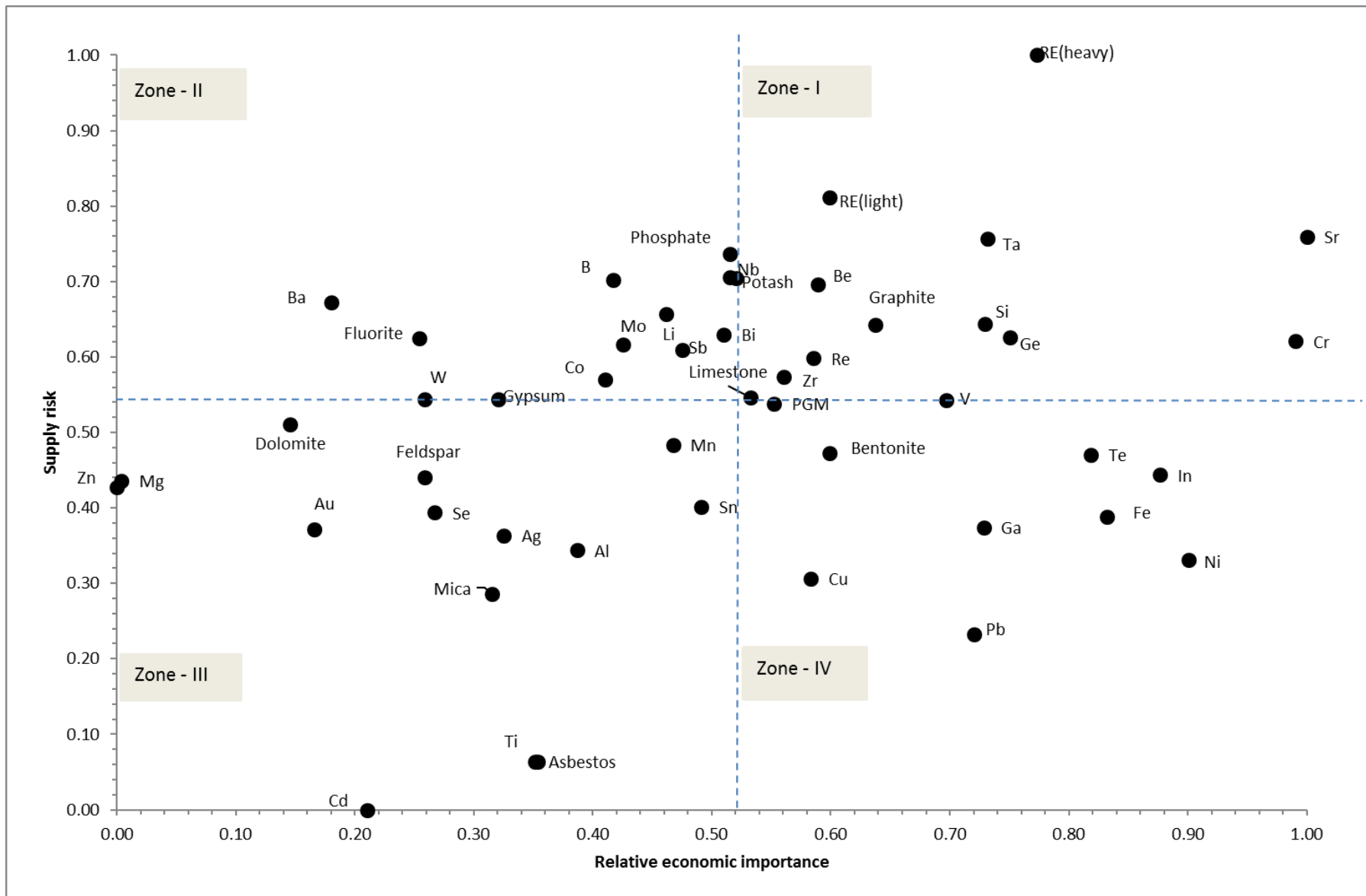


Image: istock

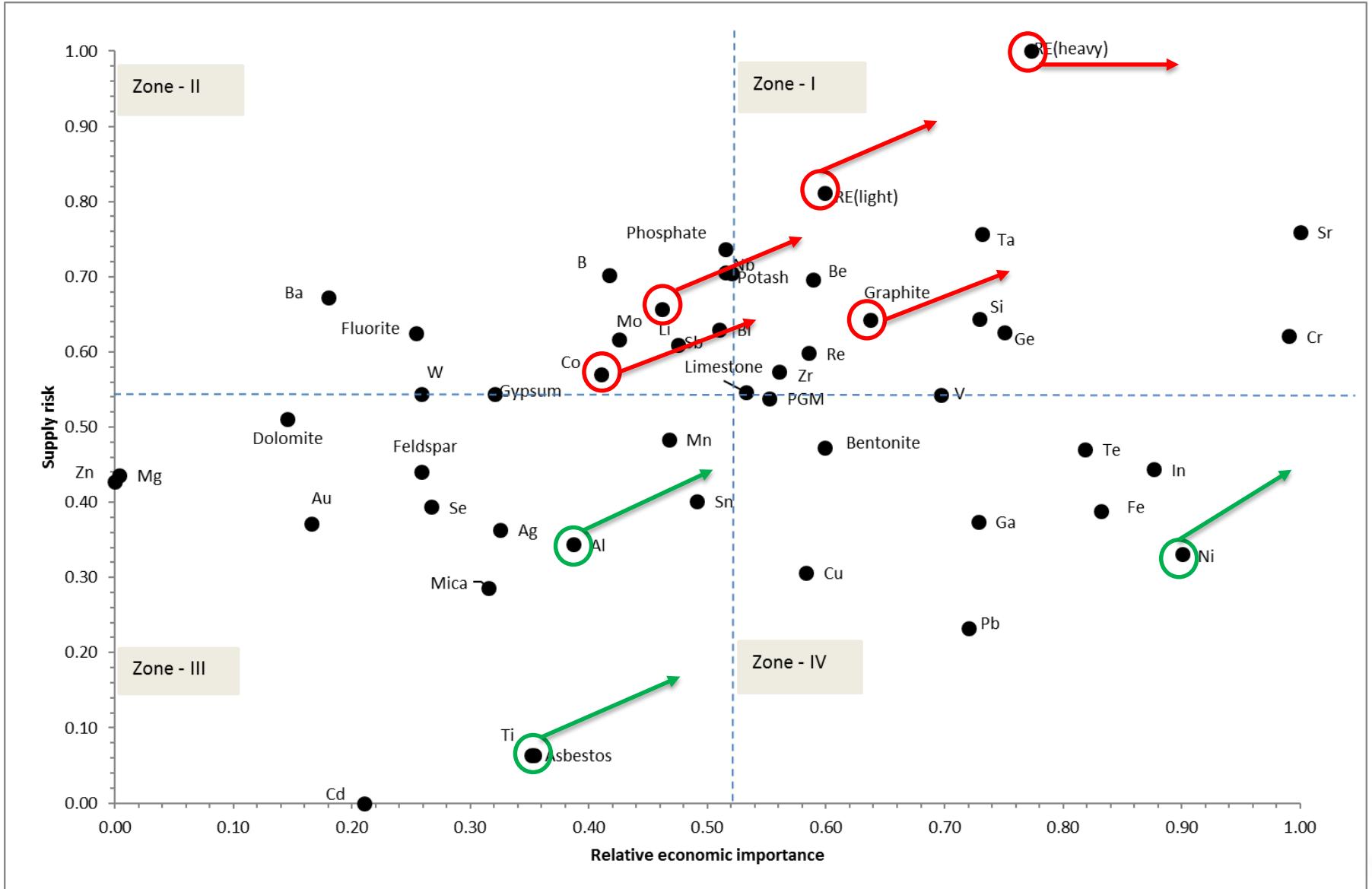


Image: CC Wikipedia

Critical minerals: CEEW scenario_2030



Critical minerals: Potential impact of recent ambitious EV targets

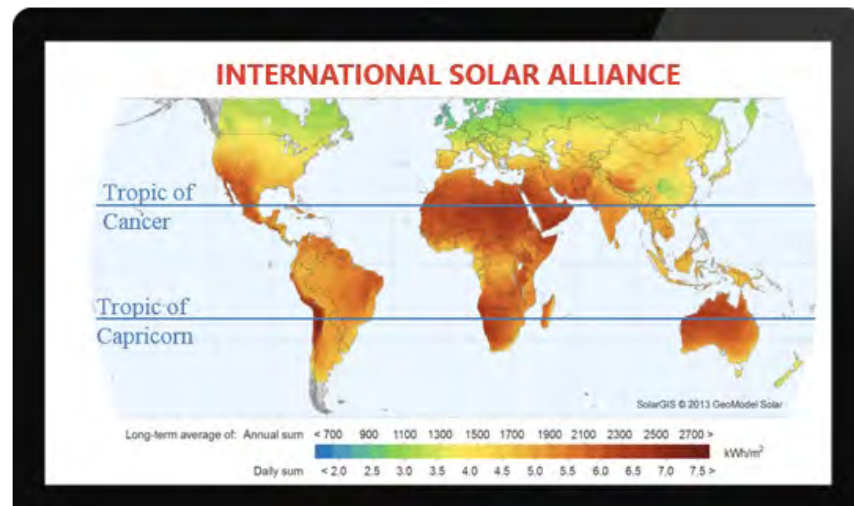


Can India lead?

Confronting our demons

- Legacy
 - Resilience in international energy markets
 - Reform in domestic power markets
- Sangunity
 - Energy access will demand attention to detail to improve consumer experience
 - Renewables is a risk and reward game now; need to renew our vows on renewables
- Prosperity
 - Untapped sources of growth on the back of India's multiple energy transitions
 - Hard-to-abate industrial sectors need bets on new energy technologies
 - Understand global supply chains to design indigenisation policies
 - Urbanisation presents opportunities to integrate residential, commercial and transport
 - Resource efficiency has to be at the core
- **Innovation is needed not only in technology but also in policy, markets and behaviour**

International Solar Alliance: A new kind of energy partnership



Recognizing that sustainable development, universal energy access, and energy security are critical to the shared prosperity and future of our planet, and acknowledging that clean and renewable energy needs to be made affordable for all, we do hereby declare our intention to support India's proposal to launch an international solar alliance as a common platform for cooperation among solar resource rich countries lying fully or practically between the Tropics of Cancer and Capricorn.

Imagine



Image: Wikimedia

Thank you

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