3rd Global Regulatory Perspective Program for Commissioners of Electricity Regulatory Commissions

IIT Kanpur, March 4th, 2021

Design of Distribution and Retail Consumer's Tariff

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Two complementary tasks

Determine the **size** of the pie:
Setting the remuneration

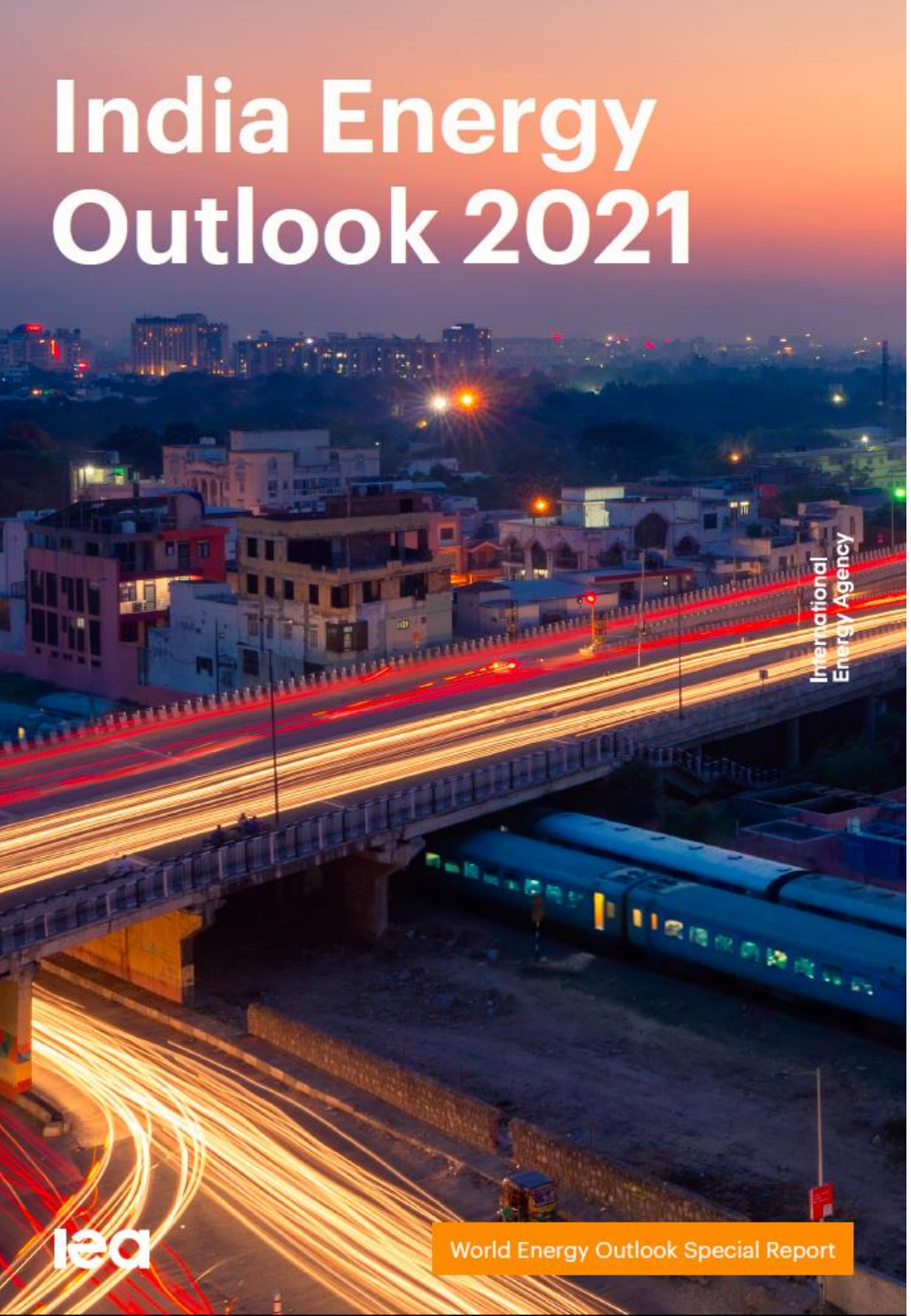
Sharing the pie:
Tariff design

Allowed costs and tariffs

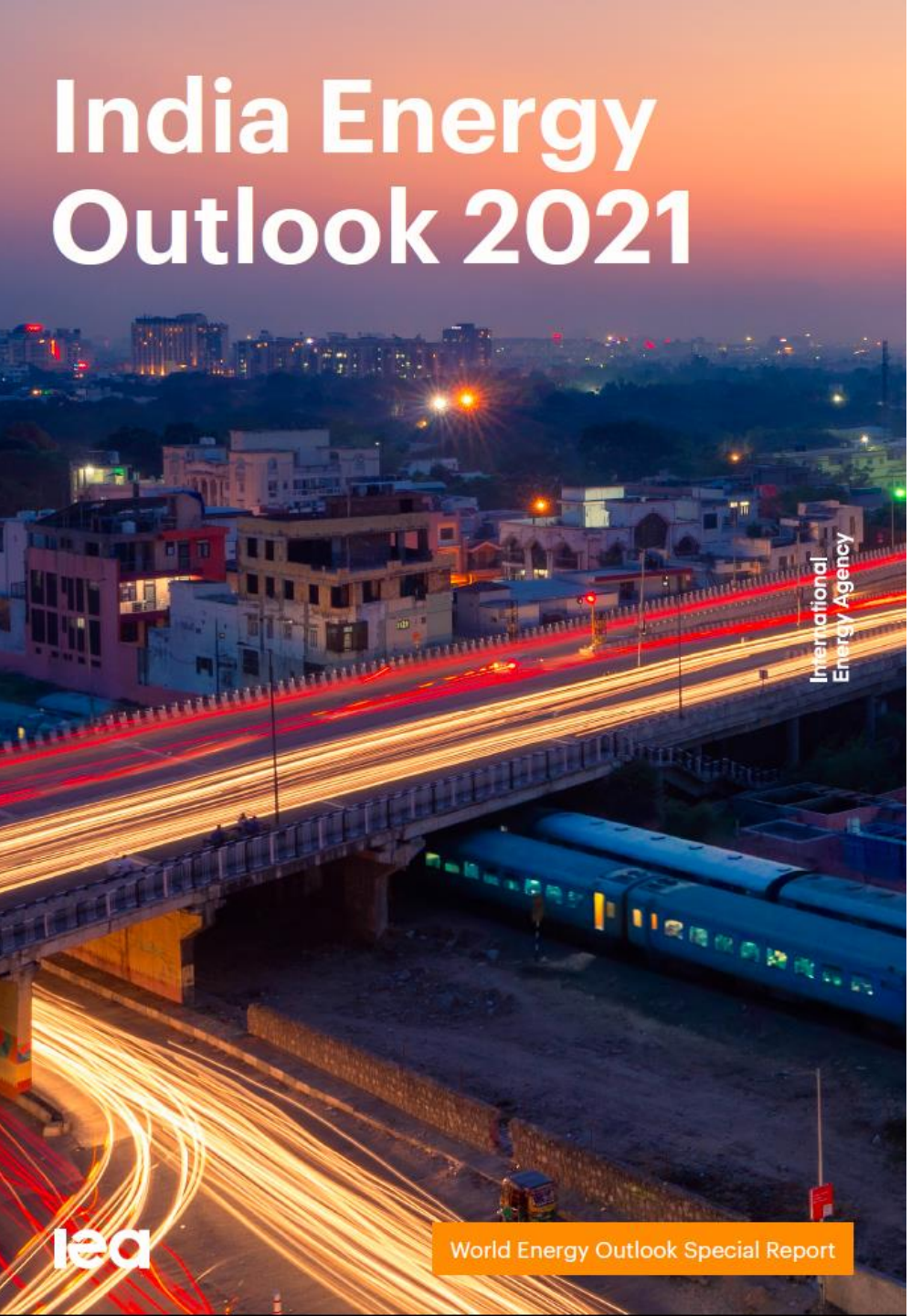
- Regulators have **two basic tasks** related to "tariffs"
  - Determine **how much revenue** a utility will be allowed to earn during the next award period *(the 'revenue requirement')*
  - Determine the **'rate structure**' or end customer tariff that will yield the required revenue *(i.e., the prices that different classes of customers will be charged)*

Outline

1. The context
2. Challenges determining the size of the pie
3. Challenges slicing the pie
4. The role of regulators

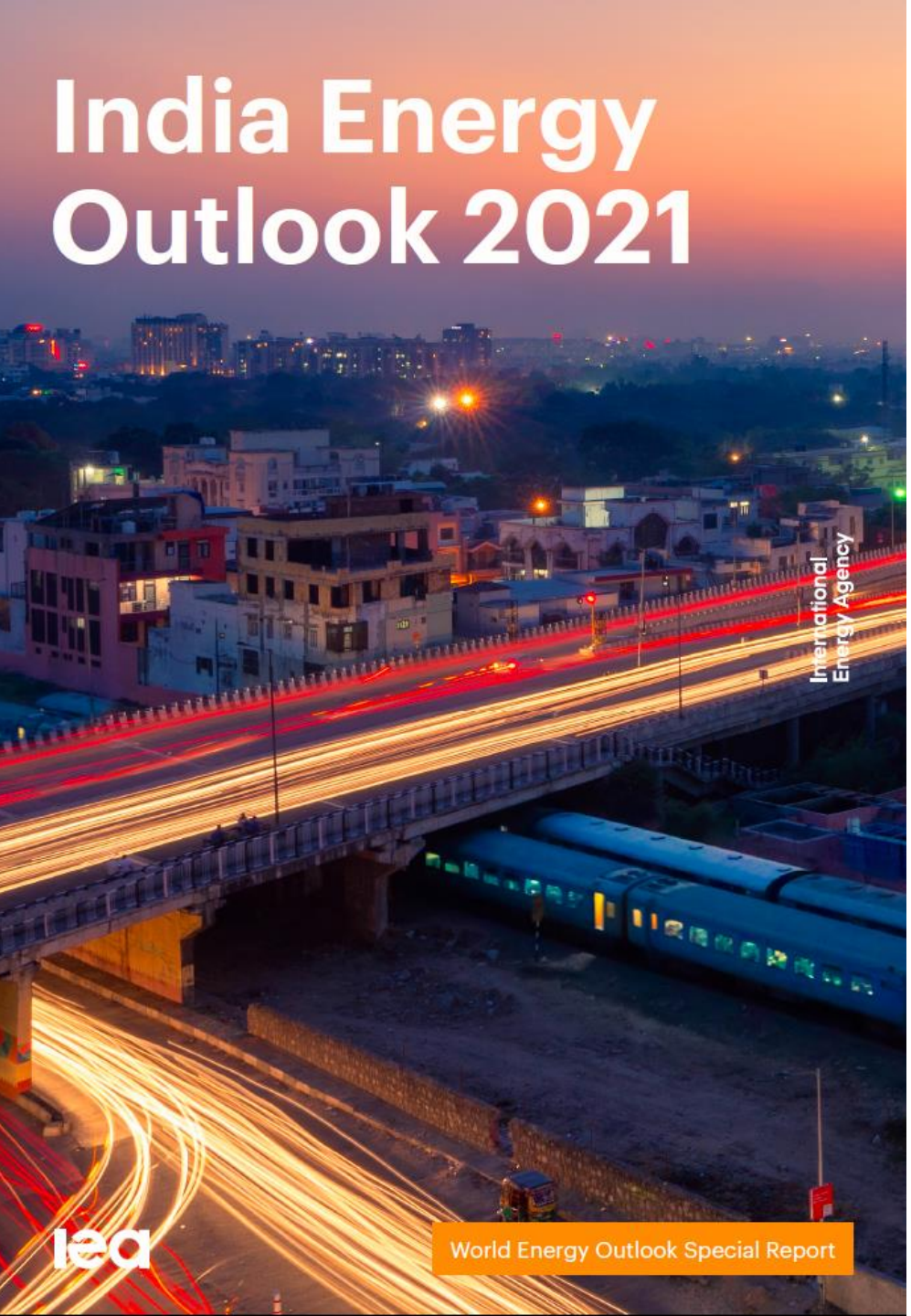


1. The context



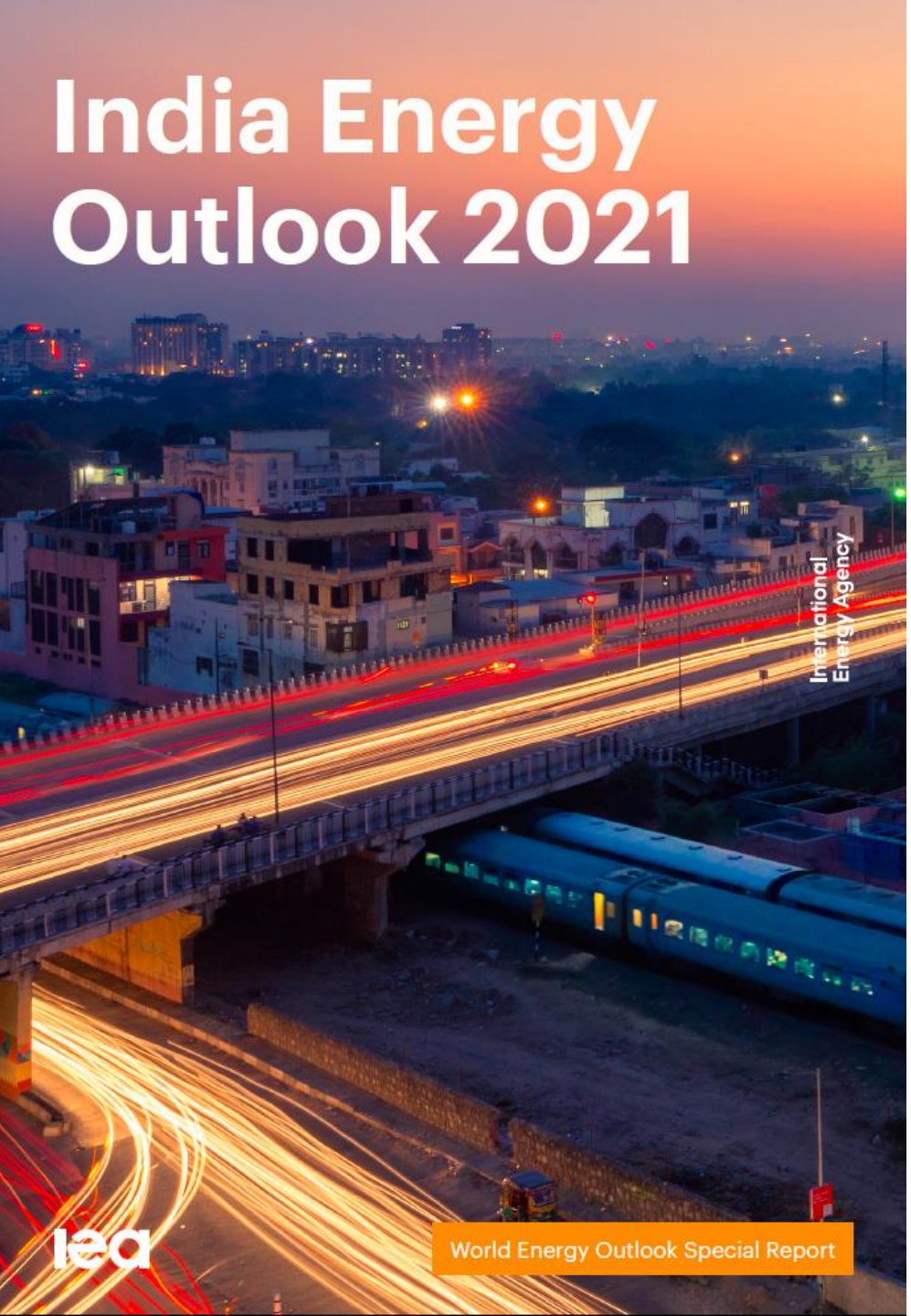
"Electricity demand grows much faster than overall energy demand in all of the scenarios examined, putting electricity at the center of India's modernization."

Electrification of the economy



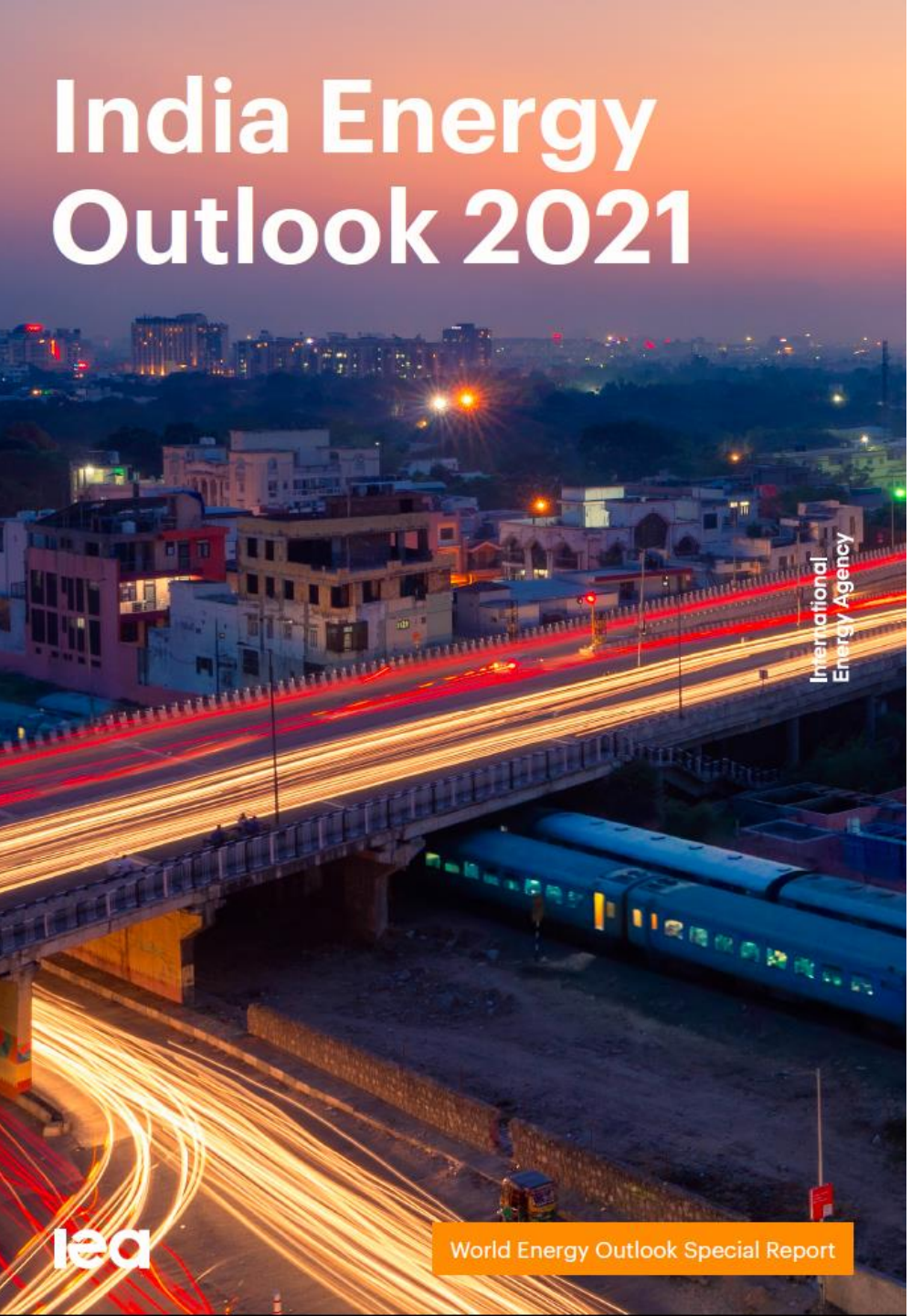
"The growth of India's renewable energy sector has been highly impressive – and India is set to lead the world in areas like solar power and batteries in the coming decades."

Based on renewables & storage



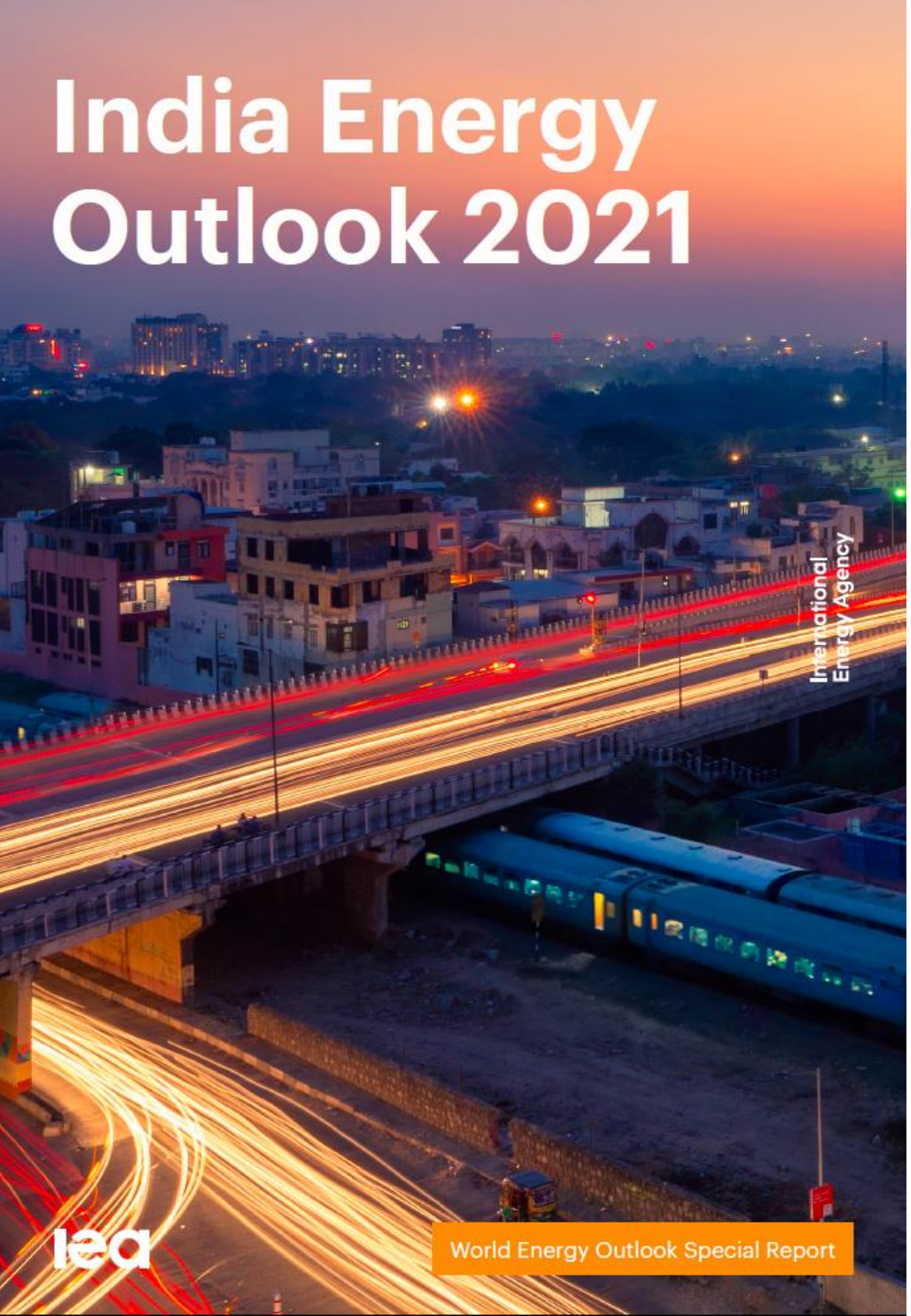
"A defining feature of the outlook is a sharp rise in variability – both in electricity
output, from solar PV and wind, and in daily consumption."

Variability will be a challenge



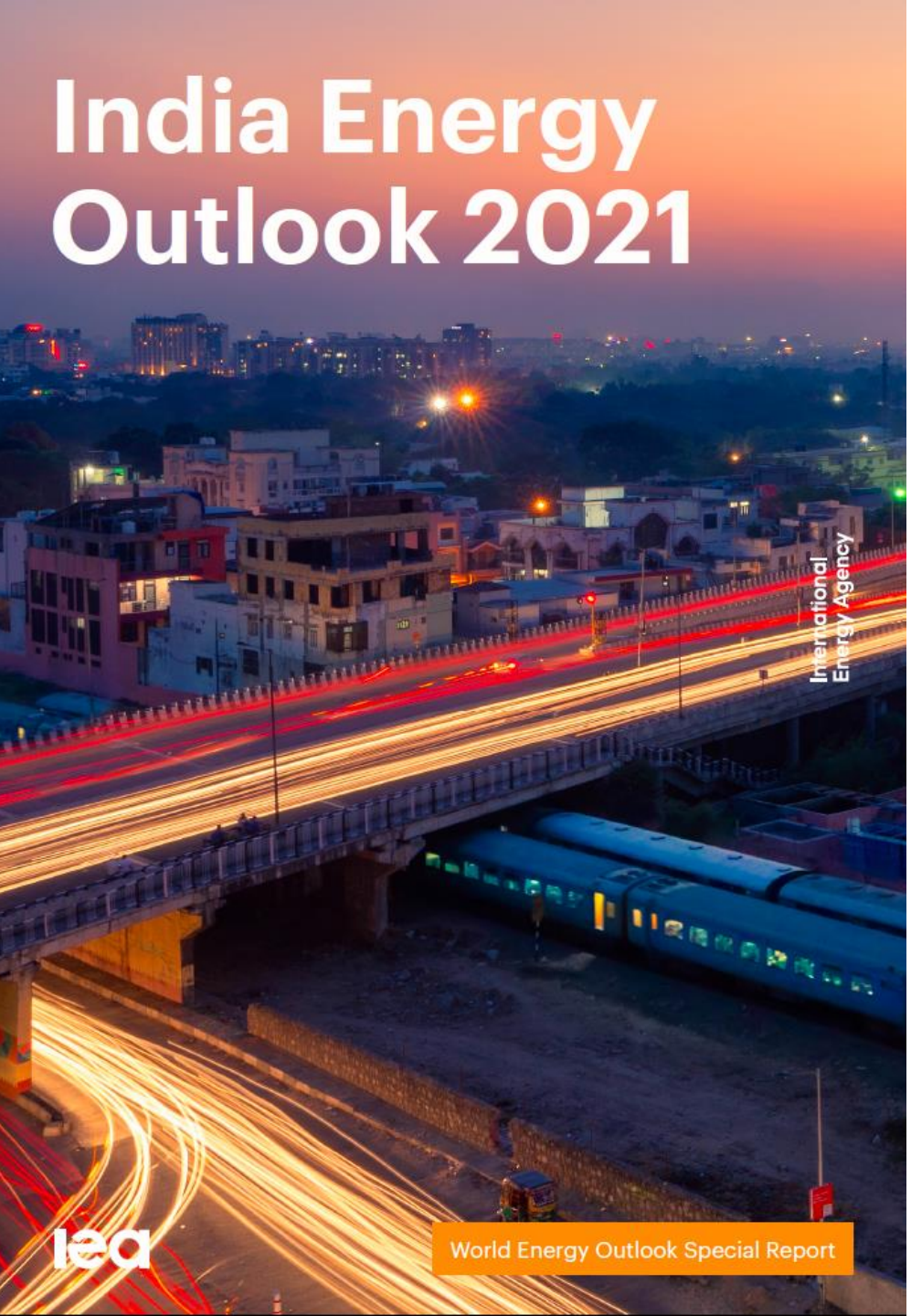
"The pace of change in the electricity sector puts a huge premium on robust grids and other sources of flexibility.
India has a higher requirement for flexibility in its power system operation than almost any other country in the world."

Flexibility will be the solution



"India's success in bringing electricity connections to hundreds of millions of its citizens in recent years. This is a monumental achievement that has improved the material well-being of a huge number of people."

Great achievement in electrification



There are several challenges ahead. A key issue is the fragile financial health of state-owned electricity distribution companies ("discoms").

Still much work to do in the last mile

2. Challenges determining the size of the pie

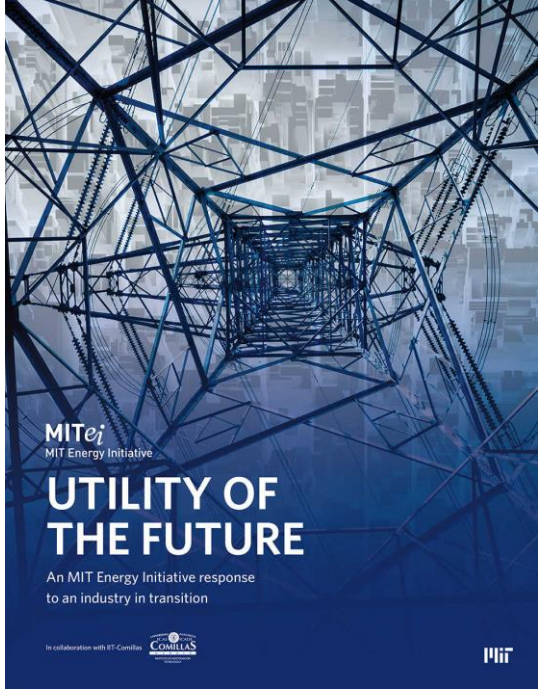
I shall bring here some of the key recommendations of the MIT "Utility of the future" study

http://energy.mit.edu/research/utility-future-study/

Recommendation

"Enhance distribution regulation"

The **regulation of distribution utilities must be improved** to enable the development of more efficient & innovative distribution utility business models



An enhanced distribution business model

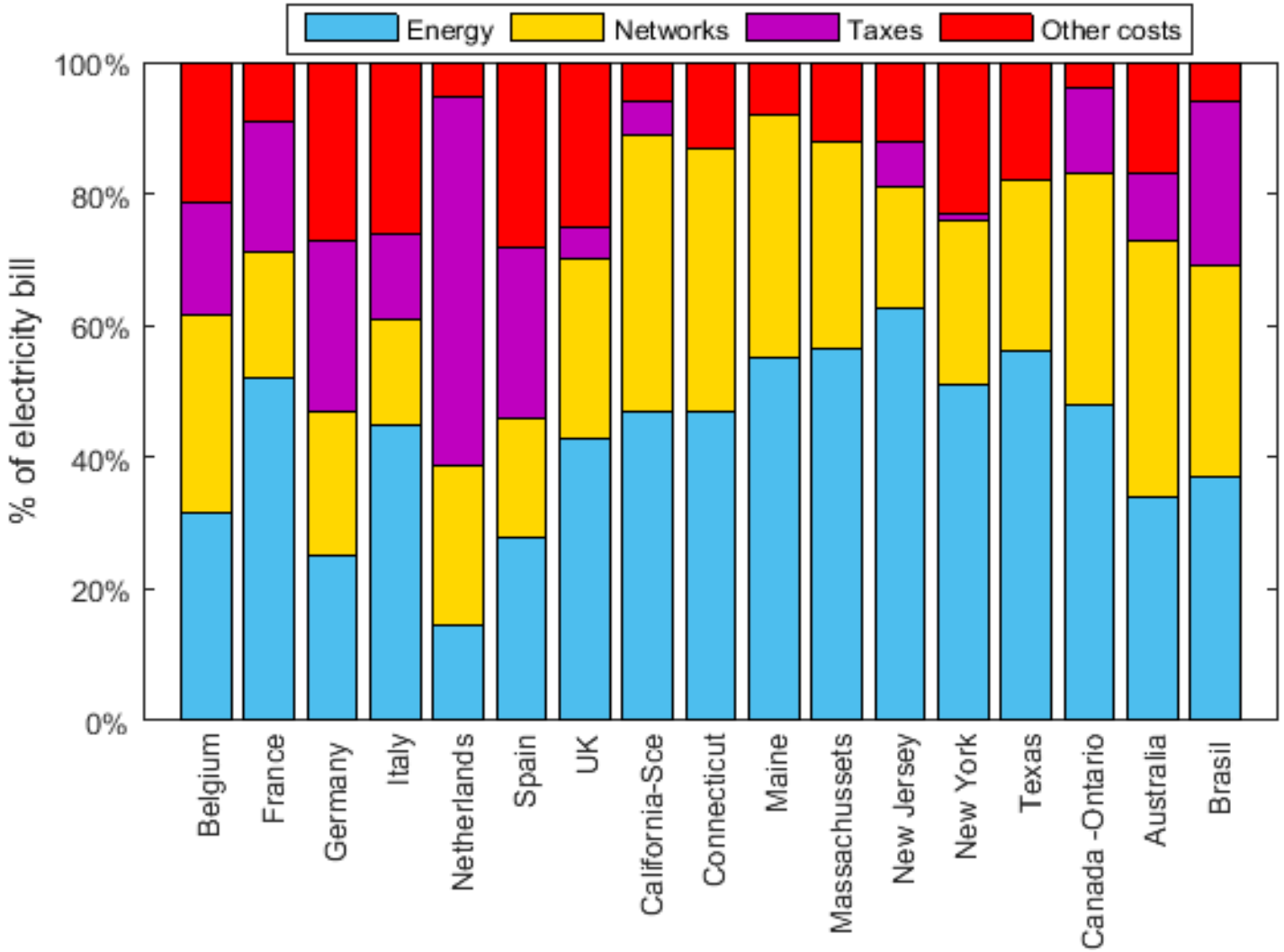
- Forward-looking, **multi-year revenue trajectory** with **profit sharing** mechanisms
- “State of the art” regulatory tools to **manage uncertainty**
- **Outcomes-based** performance incentives
- Incentives for long-term **innovation**

Cost reflective revenue requirement
(the “Aggregate Revenue Requirement” or ARR)

The costs of electricity supply

- **Network costs**
  - Distribution *(Capex & Opex)*
  - Transmission *(Capex & Opex)*
- **Generation costs**
  - If regulated under cost-of-service *(Capex & Opex)*
  - If under market conditions: price of energy
- **Retailing costs** *(small & typically merged with distribution costs)*
- **Regulated charges**
  - System Operator, Regulator, & any subsidized programs *(efficiency, renewables, domestic fuels, stranded costs, social tariffs, etc.)*
- **Taxes**

Components of the end consumer tariff in some countries



Breakdown of residential electricity bills in different jurisdictions in 2014-2015

The revenue requirement

- **All incurred costs** to supply electricity **must be included**
  - Networks, generation, retailing, other regulated charges, & taxes
  - **Generation** costs may result from energy prices; **retail** (commercialization) costs may result from retailers' competition
  - **Network** costs are regulated directly, under some form of cost-of-service & typically include some performance-based incentives
- The revenue requirement for each activity **must be cost reflective**
  - Needed for **sustainability** of the companies providing the activity
  - Needed to **attract investment**
  - If end customer tariffs are subsidized, **subsidies** to suppliers or to the end customers will be needed, but **the revenue requirement must be cost reflective always.**

In some countries the revenue requirement is not cost reflective…

Making Power Affordable for Africa and Viable for Its Utilities

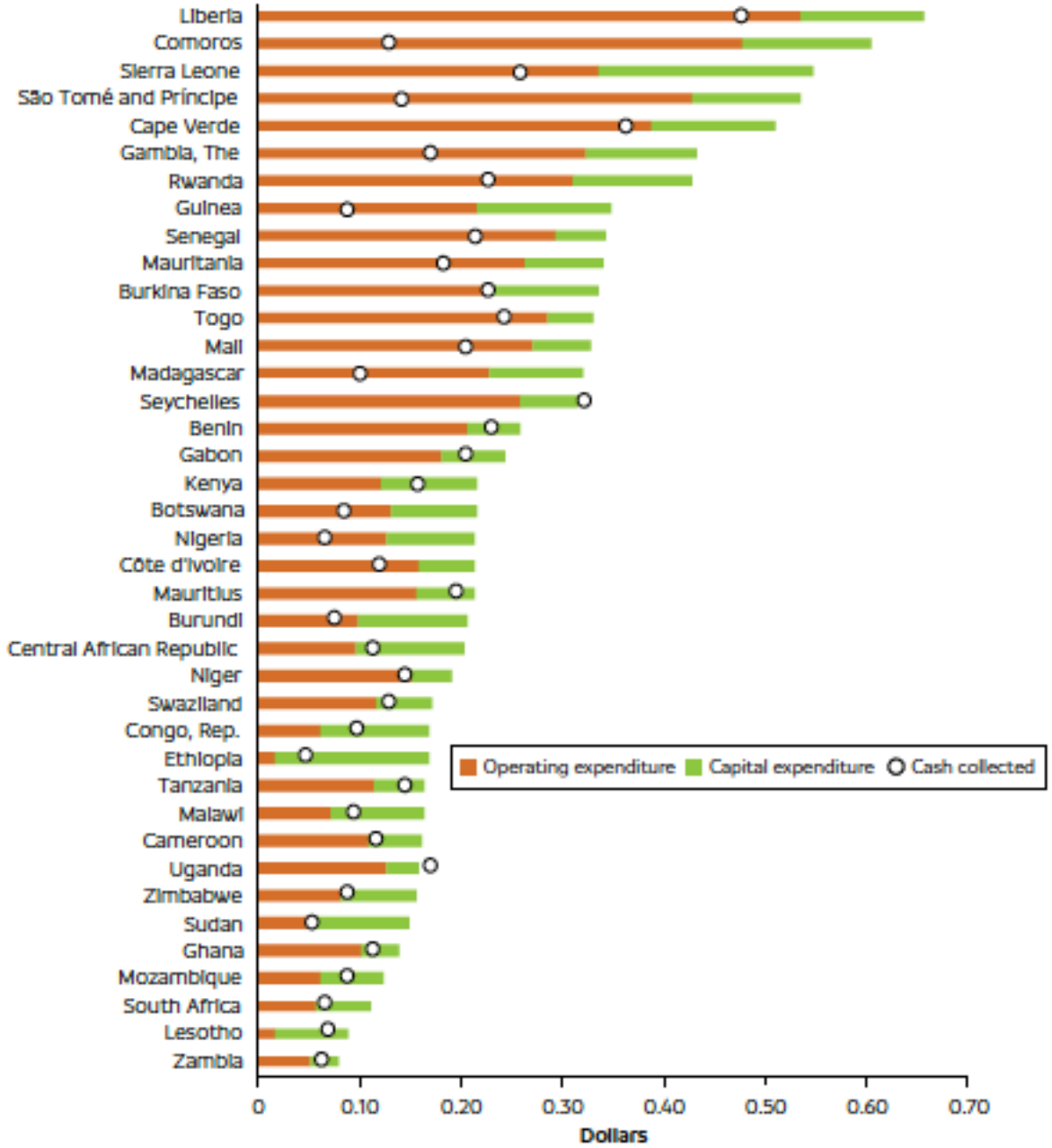
WORLD BANK GROUP

Africa Renewable Energy and Access Program (AFREA)

ESMAP

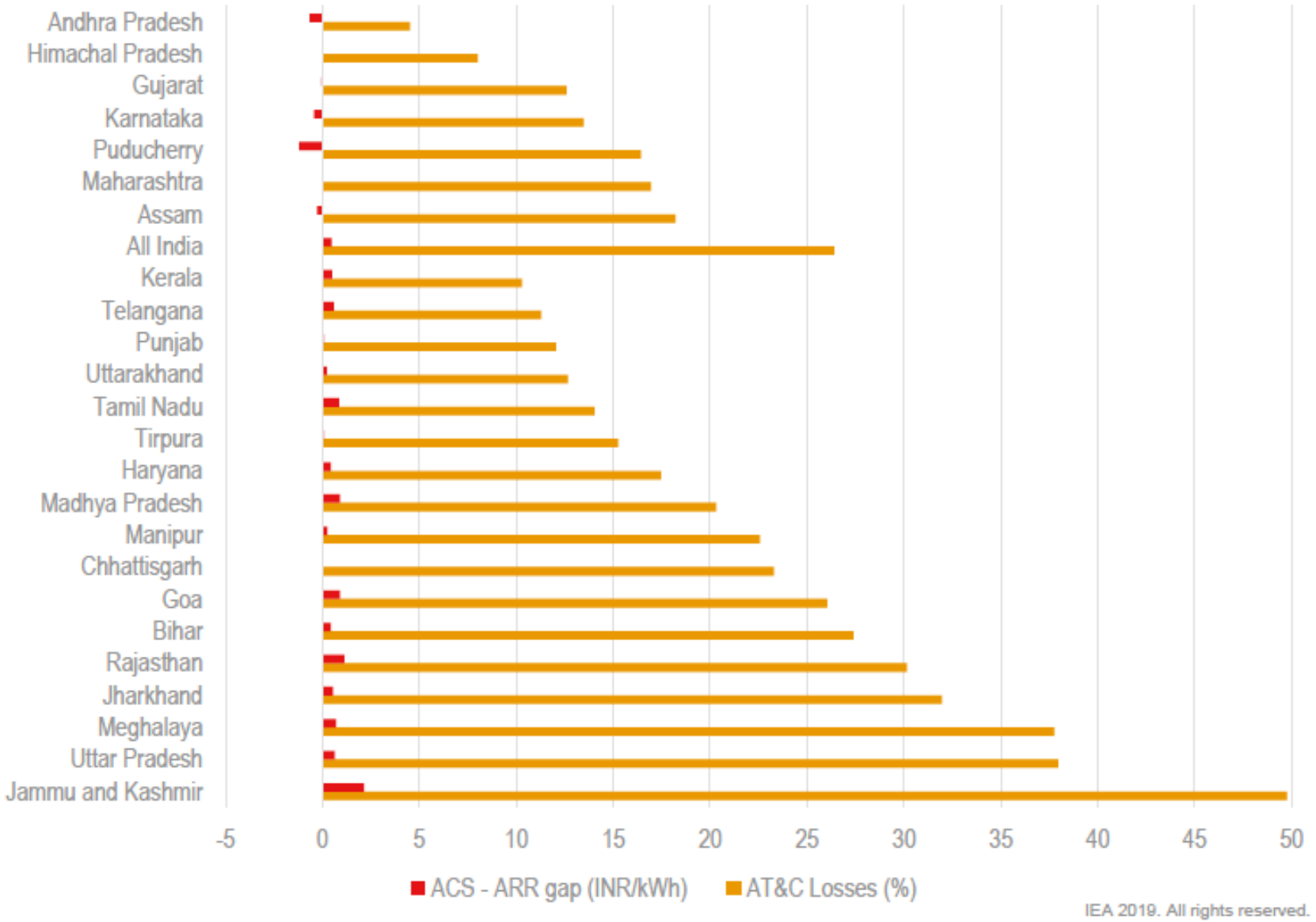
2016

Figure 2 Comparison of electric supply costs with cash collected in 2014 U.S. dollars per kWh billed



Source: Trimble et al. 2016.

Figure 7.16 Performance of India's DISCOMs



Notes: ACS = average cost of supply; ATC = aggregate technical and commercial; ARR = average revenue realised.

Source: UDAY (2019), *Dashboard*, https://www.uday.gov.in/home.php.

What are the implications?

Implications of non-cost-reflective tariffs

- Non financially viable disco, resulting in poor O&M, inadequate investment, & poor customer attention
- Lack of progress in electrification: reliability & quality of service, C&I customers, technical & commercial losses, demand growth
- Risk of insufficient payment to generation & transmission
- Non creditworthy off-taker, impairing generation investment
- Same for transmission investment
- Customers do not perceive the true cost of electricity => inefficient use of electricity

How to incentivize efficiency?

All regulations result in incentives…

- Any regulatory scheme implies incentives for the regulated firm
  - E.g., strict cost-of-service regulation leads to
    - The Averch-Johnson effect
    - Lack of interest in efficiency gains
  - Cost-of-service based on standard costs or some other scheme not based on the actual costs & performance of the firm leads to
    - Strong stimulus to improvements of efficiency, but no benefit for consumers & poor quality of service

RPI-X or the Multi Year Tariff (MYT)

- A formalized regulatory lag between price reviews gives companies an incentive to operate efficiently in the interval between reviews
  - “Revenue cap”, also called revenue-yield control: the trajectory of maximum revenues of the company is established for the review period.
    - Once all the future costs of the firm for the control period have been somehow estimated, the value of X must be such that the net present value of the stream of estimated costs and revenues for the entire control period are equal

The calculation of X

- TC_{PV} is the present value (PV) of the estimated total incurred cost at the initial year t of the 4 year price control period
- Revenue cap trajectory & calculation of X: Match the NPV of costs & revenues R(t) for the control period

$$TC_{PV} = R(t).d + R(t).(RPI-X).d^2 + R(t).(RPI-X)^2.d^3 + R(t).(RPI-X)^3.d^4$$

  - d is the discount factor *(to move money in time)*
  - NOTE (key issue): The effect of the expected change in the cost drivers (such as the supplied demand) is already included in TC_{PV}

How to estimate the trajectory of costs in an uncertain future with DER penetration?

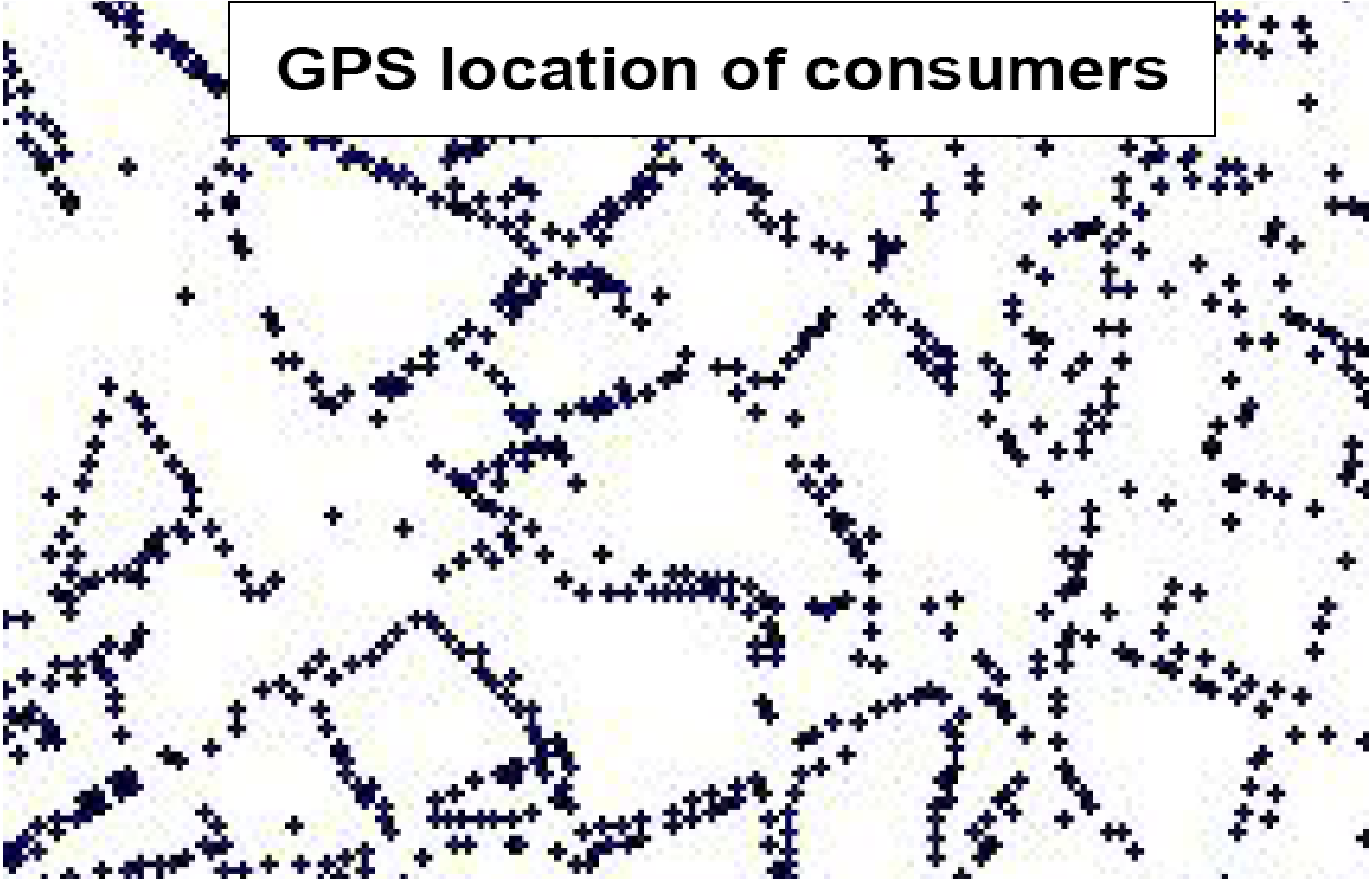
Computer-aided tools can help to estimate efficient distribution costs

Approaches to estimate future distribution costs

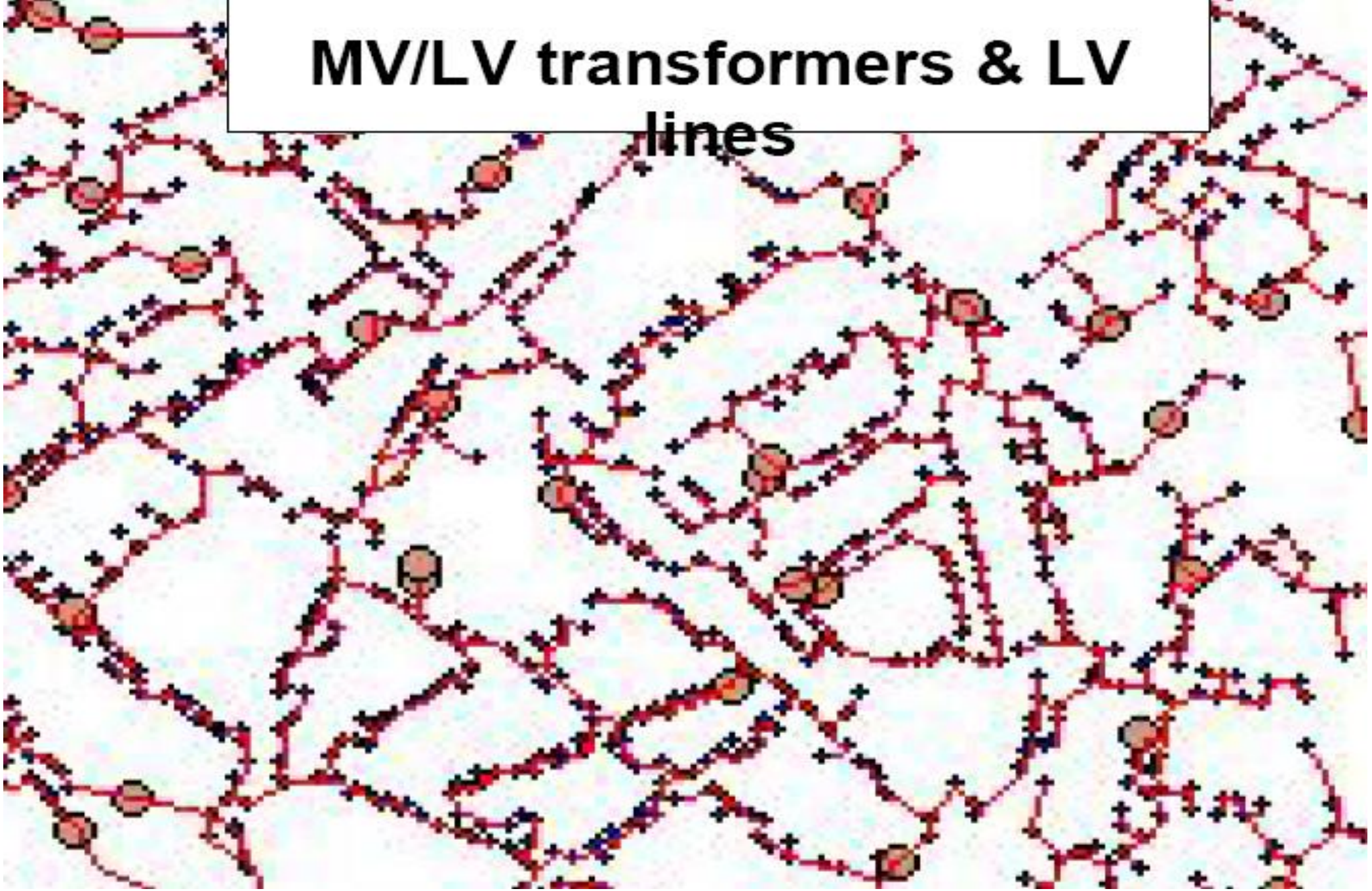
- Extrapolation
  - The future will not resemble the past
- Benchmarking
  - Lack of a data base of comparable situations
- Reference network models
  - Realistic approximation to the estimated future scenarios with computer-based engineering optimization models

Results shown below have been obtained with the model RNM ”Reference Network Model”, IIT Comillas University

GPS location of consumers

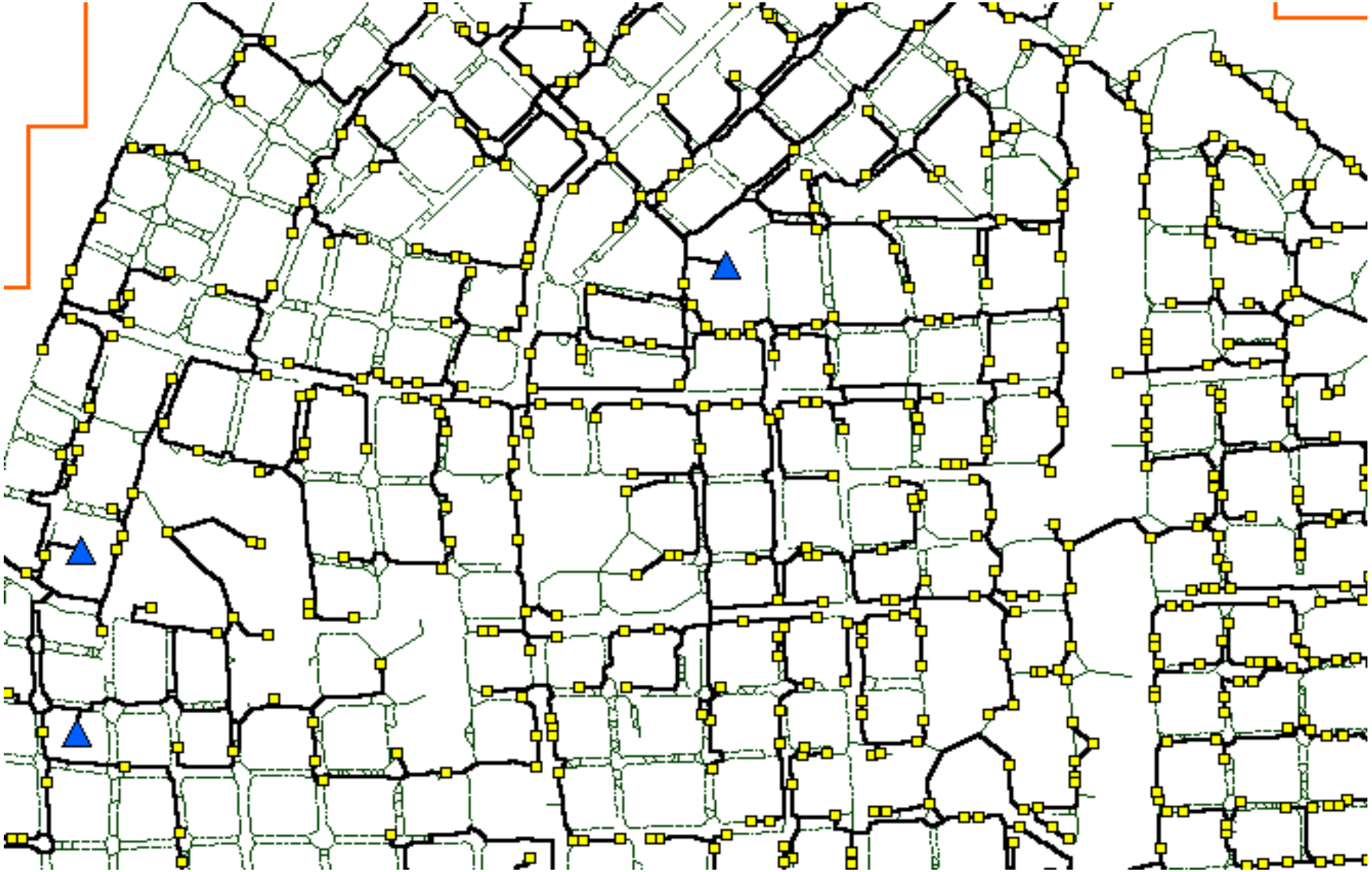


SOURCE: RNM model, IIT Comillas University



SOURCE: RNM model, IIT Comillas University

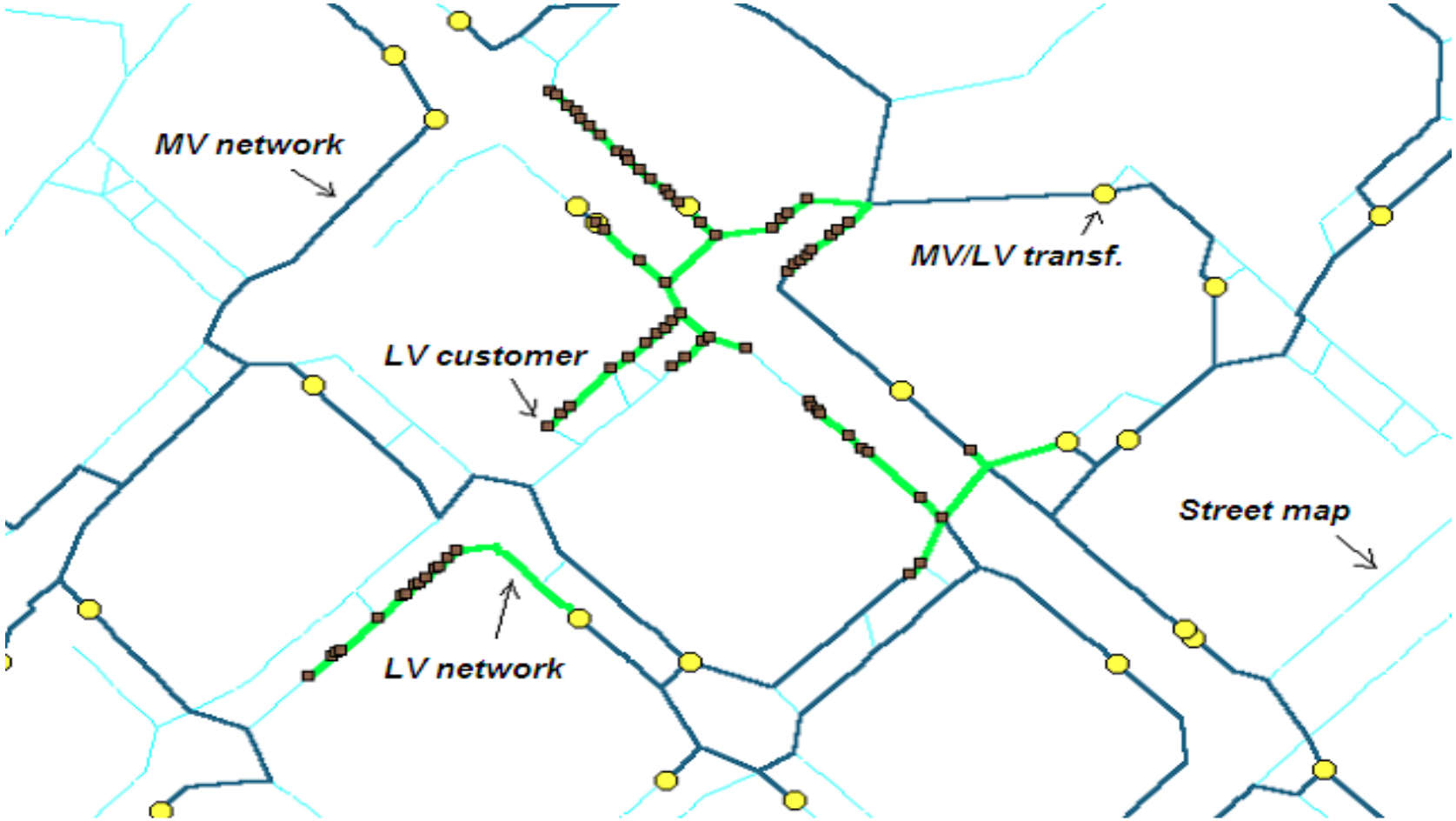
MV urban network



SOURCE: RNM model, IIT Comillas University

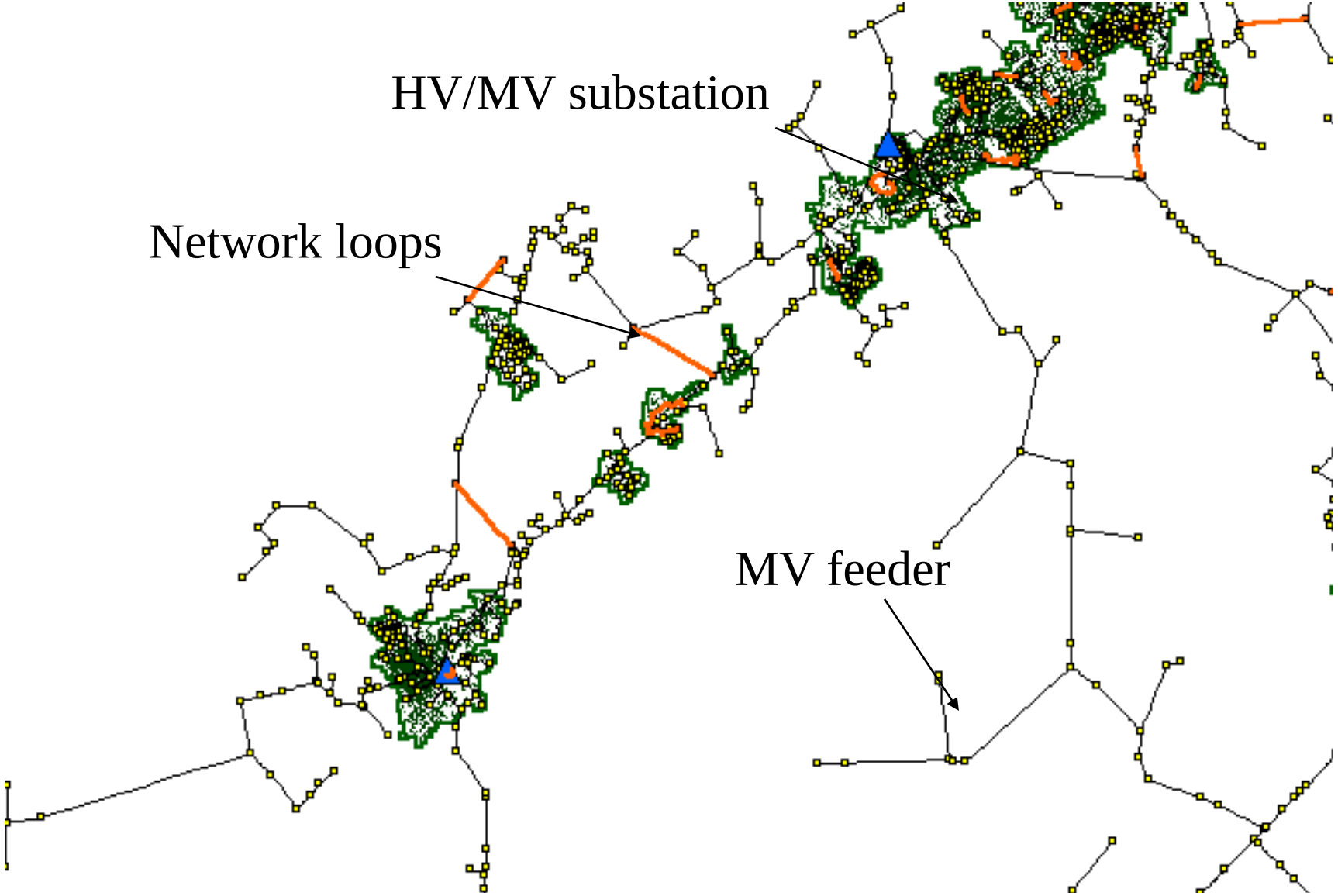
MV urban network (zoom)

Street map, LV and MV network, LV customers and MV/LV transformers



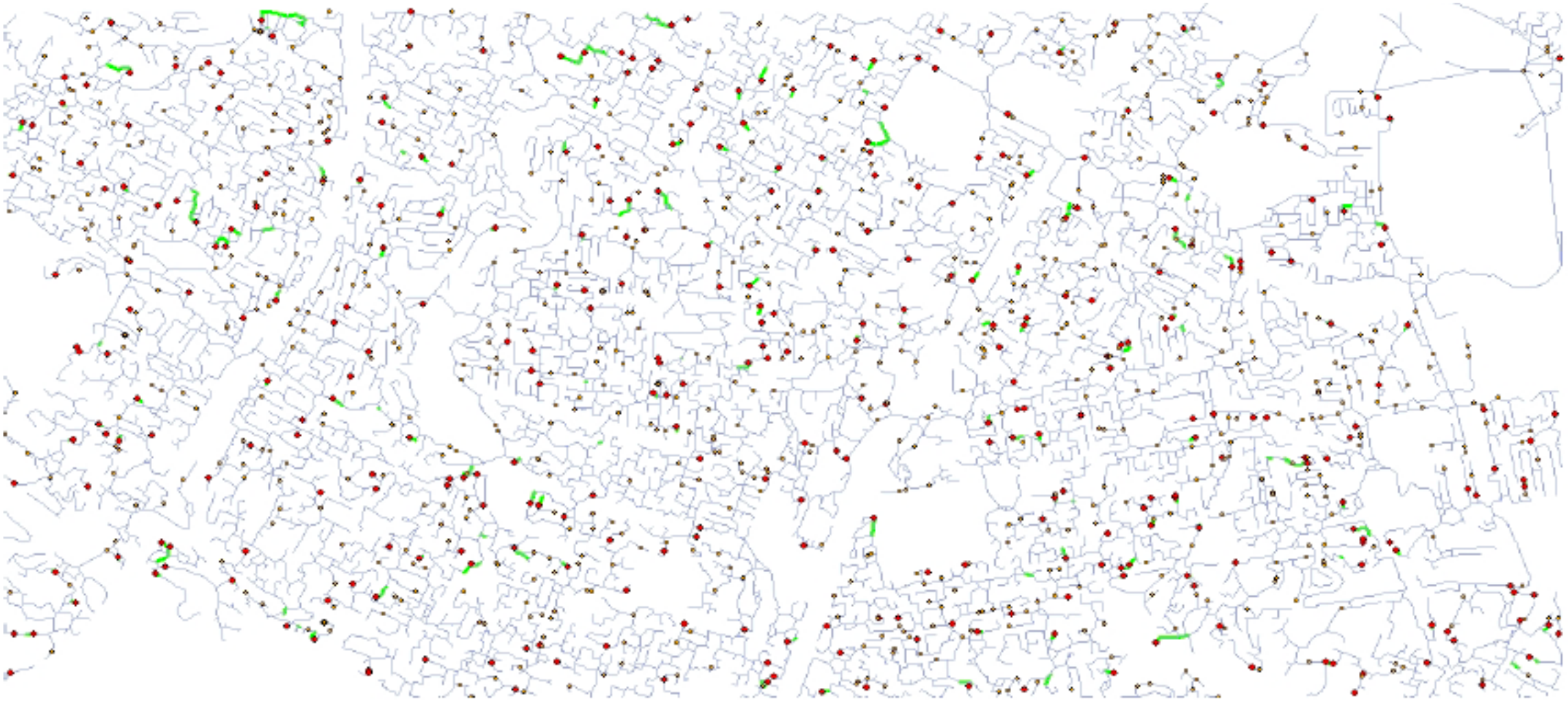
SOURCE: RNM model, IIT Comillas University

MV urban/rural network



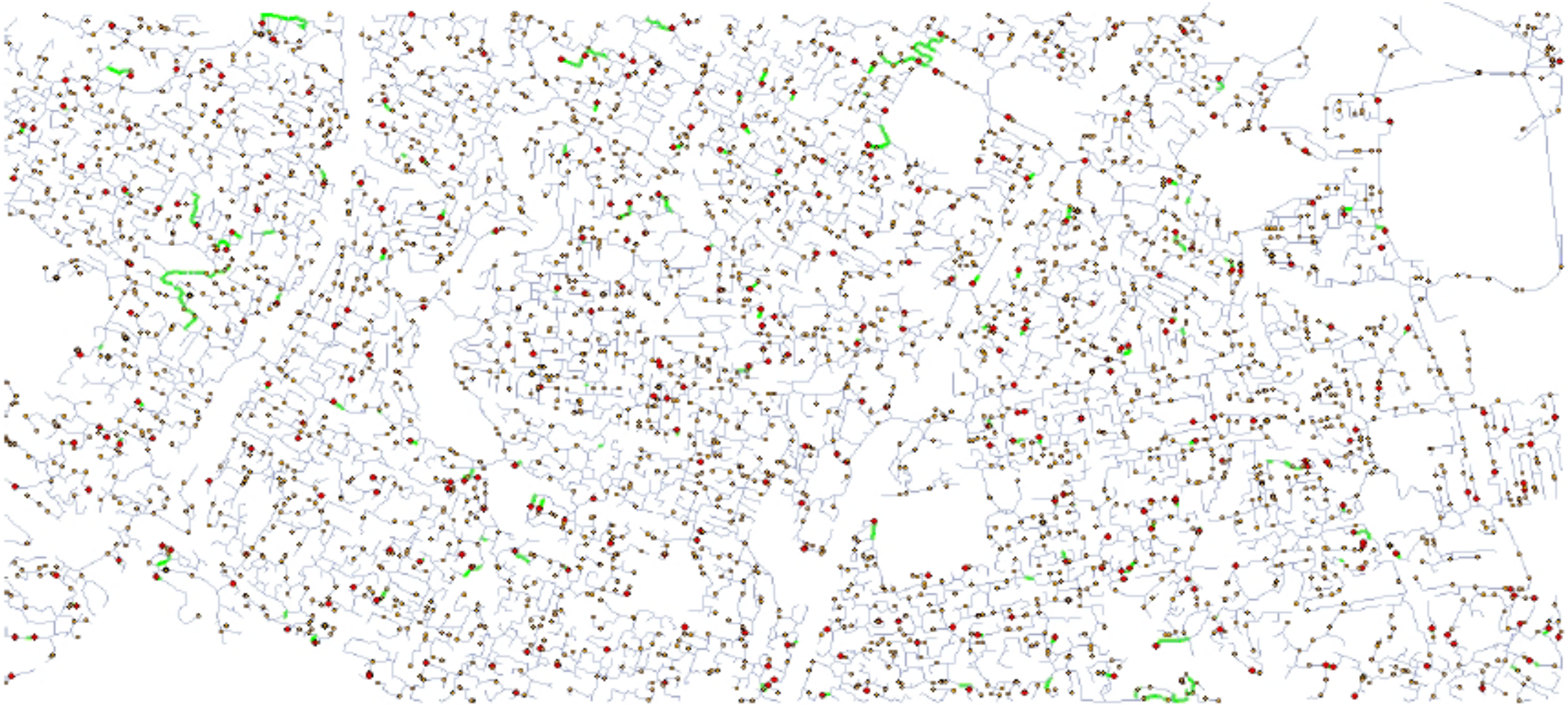
SOURCE: RNM model, IIT Comillas University

Increasing levels of rooftop solar penetration -1



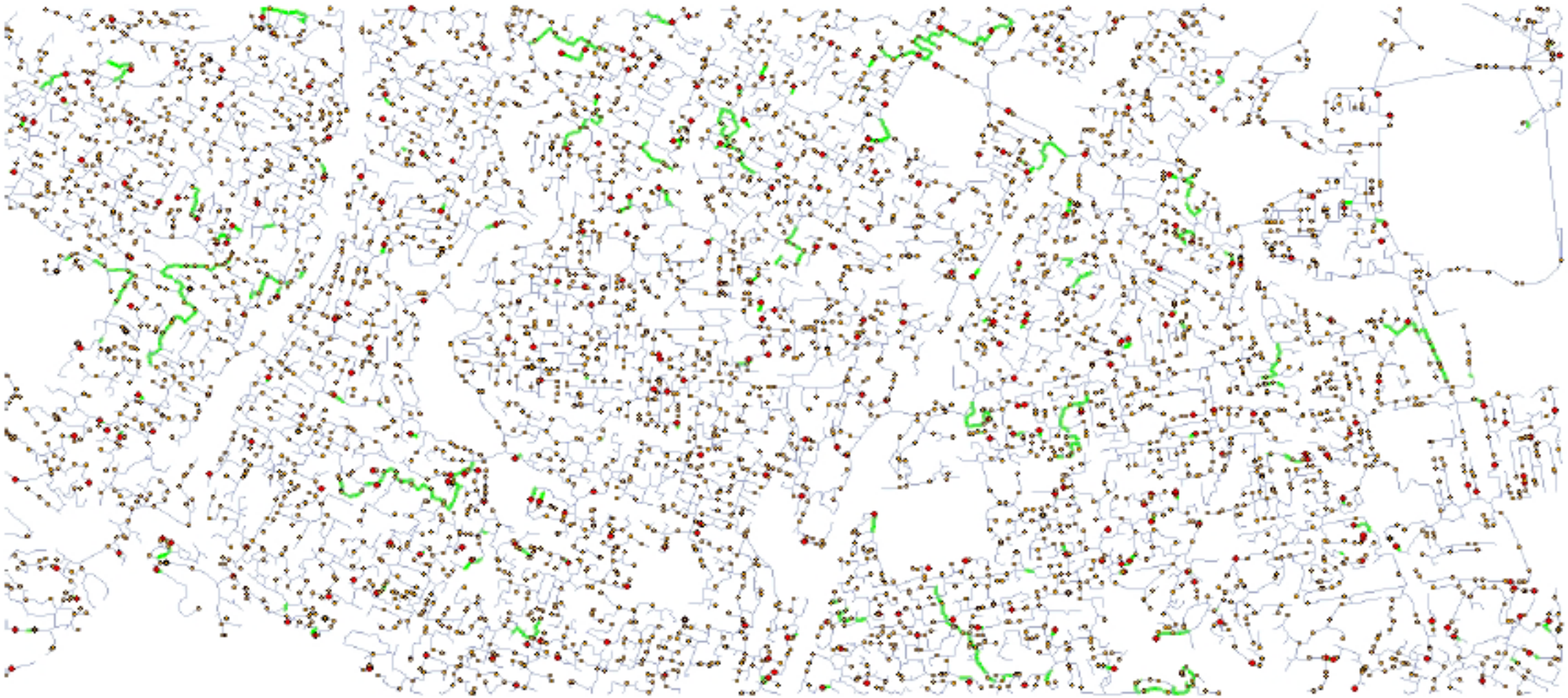
RNM Model, from the MIT "Future of solar" study

Increasing levels of rooftop solar penetration -2



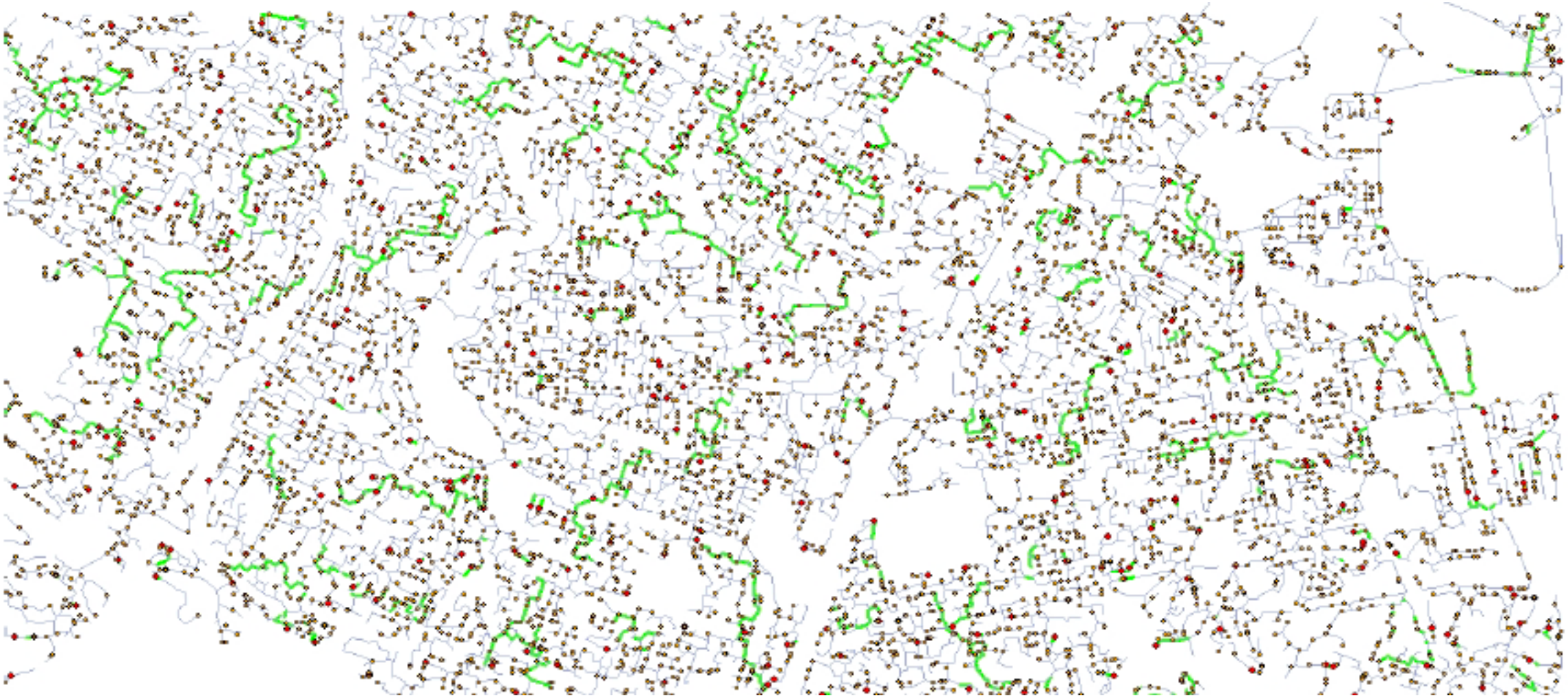
RNM Model, from the MIT "Future of solar" study

Increasing levels of rooftop solar penetration -3



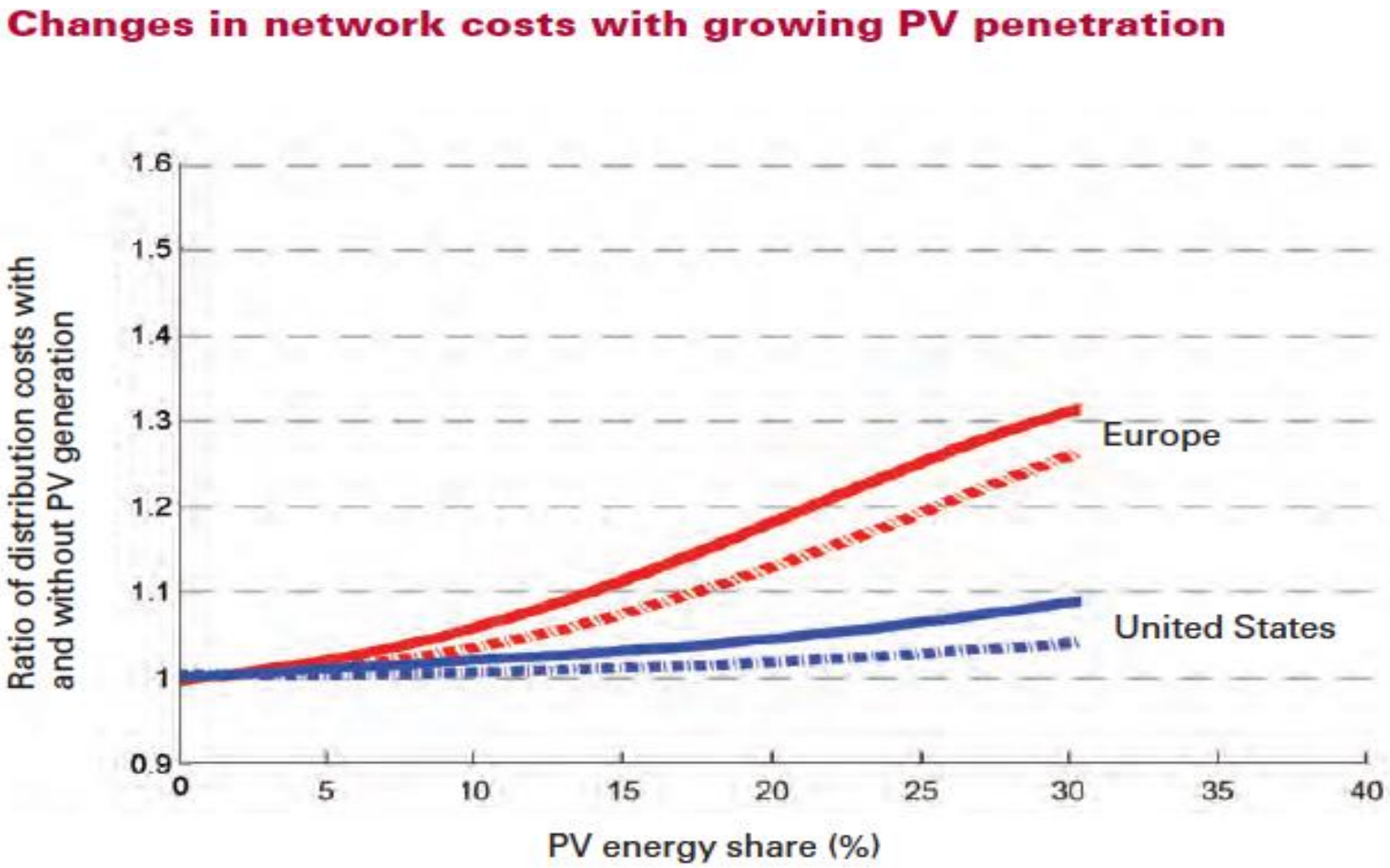
RNM Model, from the MIT "Future of solar" study

Increasing levels of rooftop solar penetration -4



RNM Model, from the MIT "Future of solar" study

From the MIT "Future of Solar Study"




Between reviews, the regulator has nothing to do…

How about deviations from forecasts in the key parameters determining the future costs?

- The basic control formula for the total revenue of the firm is (all amounts in t):

$$\text{Total regulated revenue } (t+1) =$$
$$= \text{Total regulated revenue } (t) \times (1+RPI-X) \times$$
$$\times \left(1 + \Sigma_k \left(\Delta\text{revenue driver } k \times \text{weighing factor } k\right)\right)$$

where

- a typical revenue driver is the total volume (physical, not monetary) of sales
- Δrevenue driver k is the ***deviation*** **with respect to the estimate of change of revenue driver k** that has been already included in the cost estimate for the entire price control period
- Then Δrevenue driver k = 0 if the value of the revenue driver k during the price control period has been estimated correctly

Other improvements on RPI-X or MYT

- Add ad hoc incentives for reliability, loss reduction, revenue collection, or innovation (RIIO, by OFGEM)
- "Incentive compatibility" to make the firm truthfully reveal their best cost estimates *("menu of contracts" method)*
- Improve the efficient cost estimates of the regulator
  - to reduce its **information disadvantage** *(the "adverse selection problem")*
  - not endangering the **viability of the regulated firm** (the "budget constraint")
  - while encouraging **managerial effort of the firm** *(to be as efficient as possible, while preserving quality of service & low losses)* by allowing it to capture rents that cannot be clawed back *(the "moral hazard" problem)*

Readings -1

- "**Regulation of monopolies**" , by T. Gómez. Chapter 4 of the textbook "Regulation of the electric power sector", Springer Verlag 2013, edited by Ignacio Pérez-Arriaga.

- "**The Remuneration Challenge: New Solutions for the Regulation of Electricity Distribution Utilities Under High Penetrations of Distributed Energy Resources and Smart Grid Technologies**." Jesse D. Jenkins and Ignacio Pérez-Arriaga, September 2014. MIT's CEEPR working paper series (No. 2014-005). http://ceepr.mit.edu/working-papers/

  (for details go to the Master thesis of Jesse Jenkins, MIT TPP ESD, May 2014)

Readings -2

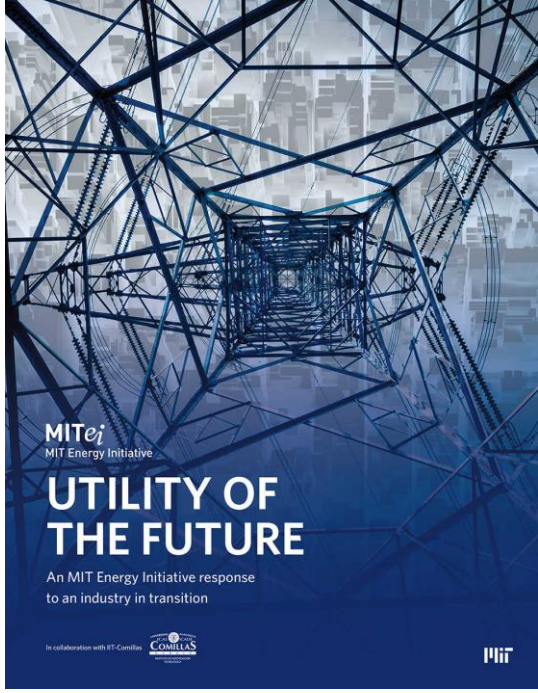
- **OFGEM** revisions to their RPI-X system http://www.ofgem.gov.uk/Networks/rpix20/ConsultDocs/Documents1/RPI-X@Recommendations.pdf

- R. Cossent & T. Gómez. "**Implementing incentive compatible menus of contracts to regulate electricity distribution investments**". Utilities Policy 27 (2013) 28-38.

Recommendation

"Rethink industry structure to minimize conflicts of interest"

The **structure** of the electricity industry should be carefully evaluated to minimize potential conflicts of interest



Establish independence between the Distribution System Operator and the agents performing activities in markets
and
if independence is legal or functional, apply significant regulatory oversight and transparent mechanisms to provide services

2. Challenges slicing the pie

Tariff design principles

The Gazette of India

EXTRAORDINARY
PART I - Section 1
PUBLISHED BY AUTHORITY
Ministry of Power

New Delhi,
Dated the 6th January, 2006

RESOLUTION

No.23/2/2005-R&R(Vol.III)

TARIFF POLICY

1.0 INTRODUCTION

1.1. In compliance with section 3 of the Electricity Act 2003 the Central Government hereby notifies the Tariff policy in continuation of the National Electricity Policy (NEP) notified on 12th February 2005.

1.2. The National Electricity Policy has set the goal of adding new generation capacity of more than one lakh MW during the 10th and 11th Plan periods to have per capita availability of over 1000 units of electricity per year and to not only eliminate energy and peaking shortages but to also have a spinning reserve of 5% in the system. Development of the power sector has also to meet the challenge of providing access for electricity to all households in next five years.

1.3. It is therefore essential to attract adequate investments in the power sector by providing appropriate return on investment as budgetary resources of the Central and State Governments are incapable of providing the requisite funds. It is equally necessary to ensure availability of electricity to different categories of consumers at reasonable rates for achieving the objectives of rapid economic development of the country and improvement in the living standards of the people.

1.4. Balancing the requirement of attracting adequate investments to the sector and that of ensuring reasonability of user charges for the consumers is the critical challenge for the regulatory process. Accelerated development of the power sector and its ability to attract necessary investments calls for, inter alia, consistent regulatory approach across the country. Consistency in

FORUM OF REGULATORS

NEW DELHI

Model Regulations for Multi Year Distribution Tariff

Assisted by CRISIL INFRASTUCTURE ADVISORY

Regulatory principles in the Tariff Policy (2006)

4.0 OBJECTIVES OF THE POLICY

The objectives of this tariff policy are to:

(a) Ensure availability of electricity to consumers at reasonable and competitive rates;

(b) Ensure financial viability of the sector and attract investments;

(c) Promote transparency, consistency and predictability in regulatory approaches across jurisdictions and minimise perceptions of regulatory risks;

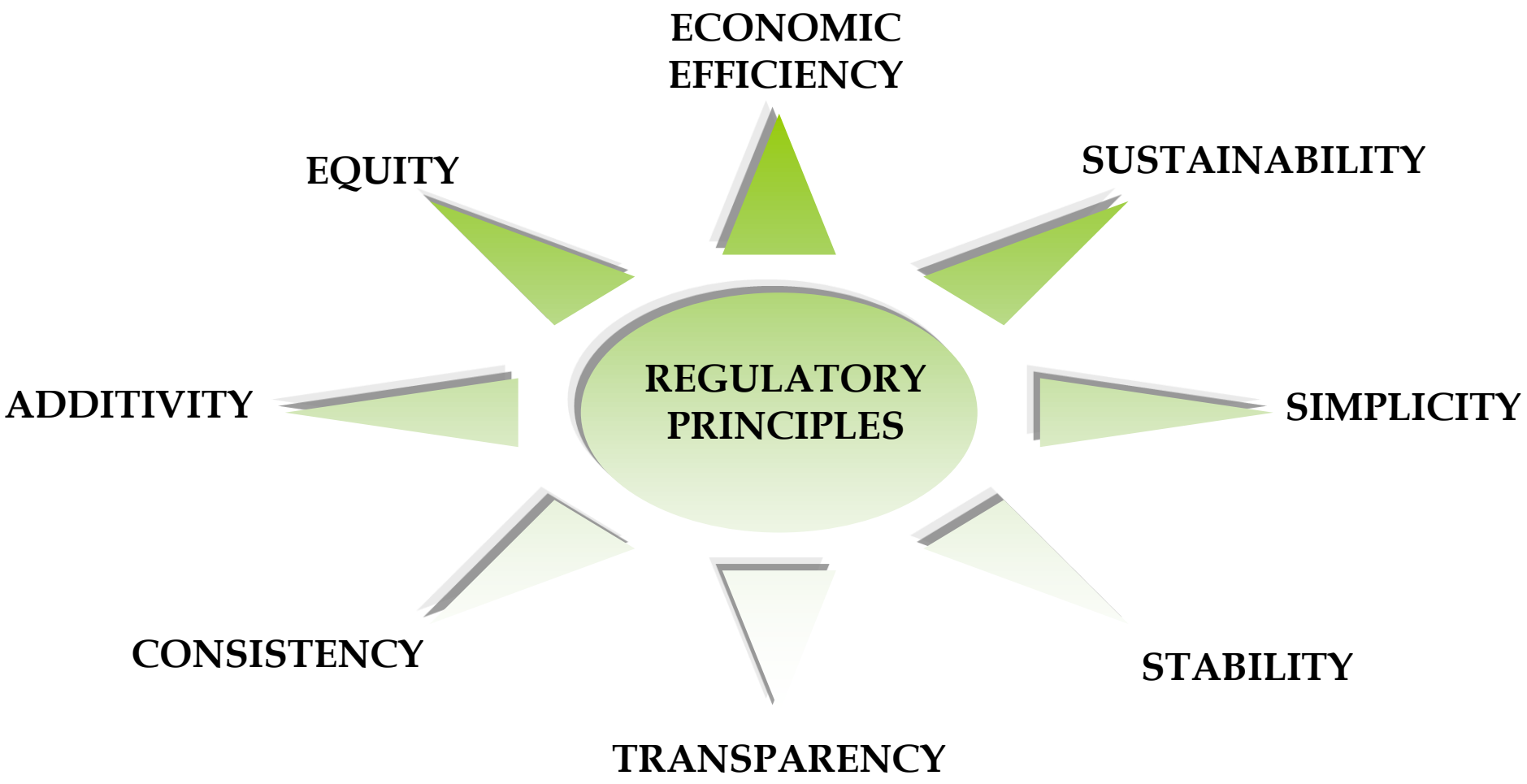
(d) Promote competition, efficiency in operations and improvement in quality of supply.

PRINCIPLES OF TARIFF DESIGN

1. Effectiveness of yielding total revenue
2. Stability and predictability of revenue
3. Stability and predictability of rates
4. Discouraging wasteful use of services
5. Understanding of present and future private and social costs and benefits of service provided
6. Fairness of rates in the apportionment of total costs of service among different consumers
7. Avoidance of discrimination in rates
8. Promotion of innovation and cost-effectiveness in the face of changing demand and supply patterns
9. Simplicity, understandability, public acceptability, and feasibility
10. Freedom from controversies as to proper interpretation

SOURCE: Slide presentation by ISMAIL ALI KHAN, Chairman TSERC

Regulatory principles for tariff design



Regulatory principles

- (economic) **Sustainability:** guarantee of recovery of all regulated costs so that the electrical power sector is economically viable
- **Equity or Non Discrimination** in the allocation of costs to consumers: Same charge should apply to the same provision of a service, regardless the end use of the electricity.
  - This would be in line with a cost allocation procedure based on cost causality

Regulatory principles

- **Economic efficiency:** Tariffs must sent economic signals that **promote efficient consumption** of the good in the short & long term *(allocative efficiency)*, leading to efficient operation & investment. This requires that **costs should be assigned to those who are responsible for them** *(*criterion of ***cost causality****)*
  - Then, use marginal costs / prices whenever possible
  - And, if there are still costs to be assigned
    - apply "cost causality" as far as it is possible
    - &, finally, try to minimize any inevitable distortion in the economic decisions of the consumers

Regulatory principles

- **Transparency:** in the methodology, so that all employed criteria & procedures are made public
- **Stability:** in the adopted methodology, so that the concerned agents have the least possible regulatory uncertainty. Stability is compatible with a gradual process of adaptation of the present tariffs to the new system
- **Simplicity:** in the methodology & its implementation, as far as possible

Regulatory principles

- **Additivity:** derived from the principles of efficiency & sustainability. End user tariffs must be the outcome of adding all applicable cost concepts
- **Consistency:** with the specific regulatory process of each country
- **Other principles:**
  - **Protection** of low-income / vulnerable consumers
  - **Protection** of the environment *(include in the tariffs the environmental costs)*

Regulatory principles
A pragmatic summary

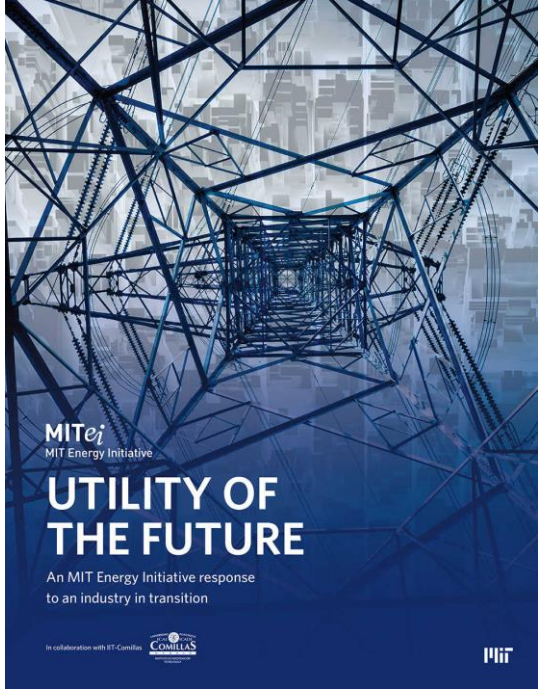
- Tariffs *(the size of the pie & sharing it)* must comply with the accepted regulatory principles. At least they should:
  - **Guarantee recovery** of the total regulated cost for each activity
  - Be **additive**
  - Be reasonably **efficient**
    - Send adequate economic signals both in the short & the long term
  - Be **simple & transparent**

After examining how **distributed energy resources (DERs)** will be **changing the provision of electricity services,** over the next decade & beyond, our first recommendation was…

Recommendation #1

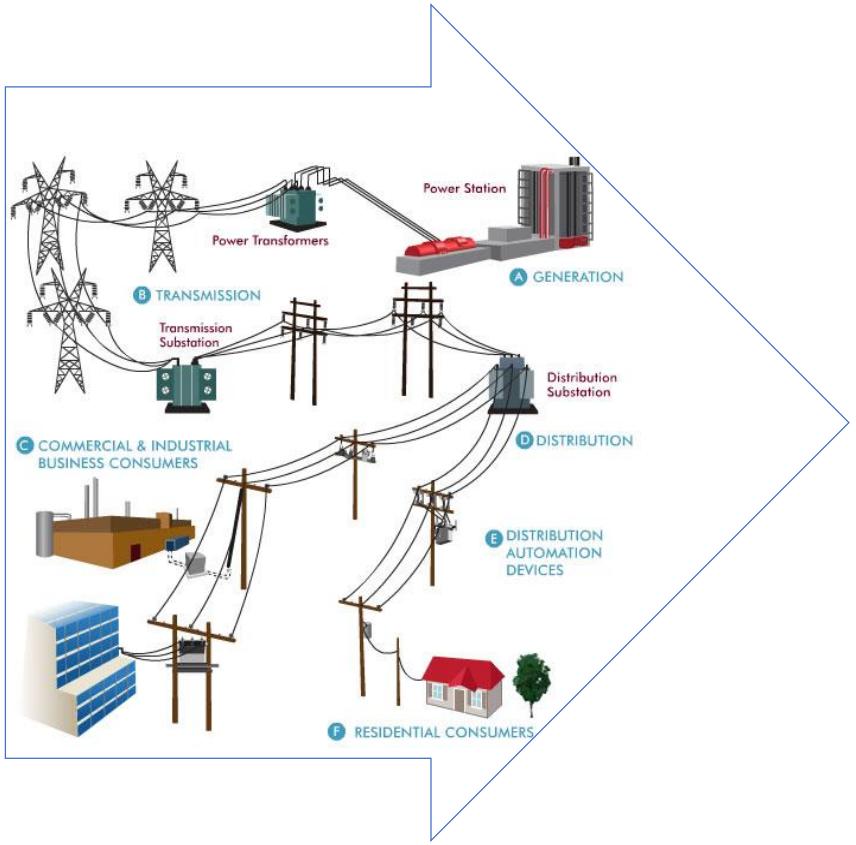
"Create a comprehensive & efficient system of prices & charges"

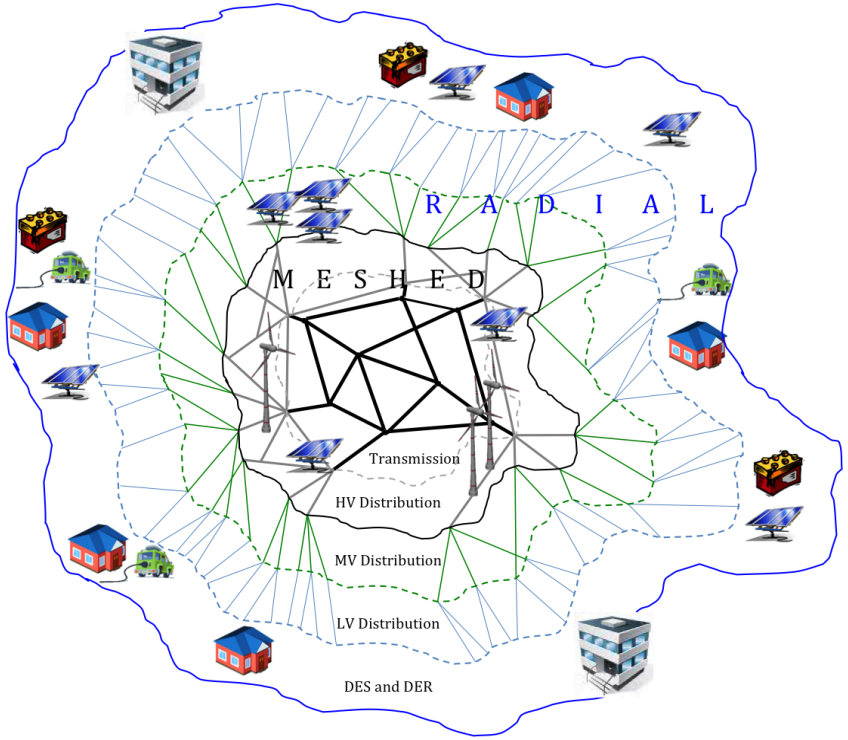
The only way to put all resources – **centralized & distributed**– on a **level playing field** and achieve efficient operation and planning in the power system is to **dramatically improve prices and regulated charges** for electricity services.



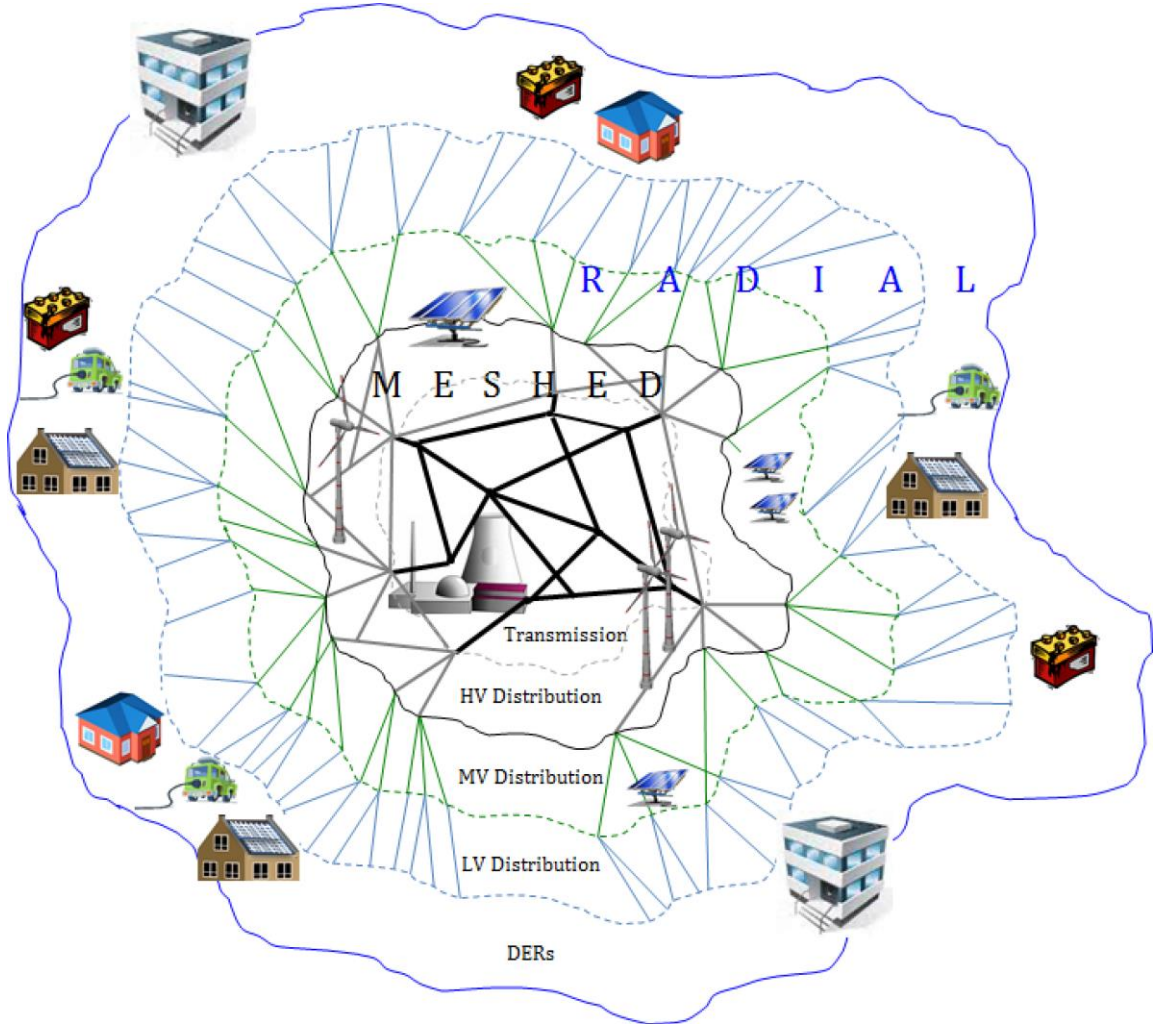

Prices & charges are
the nervous system
of the electricity sector,
reaching everywhere

A mindset change





Create a comprehensive & efficient system of prices & charges *(Like a nervous system, reaching every corner of the power system)*



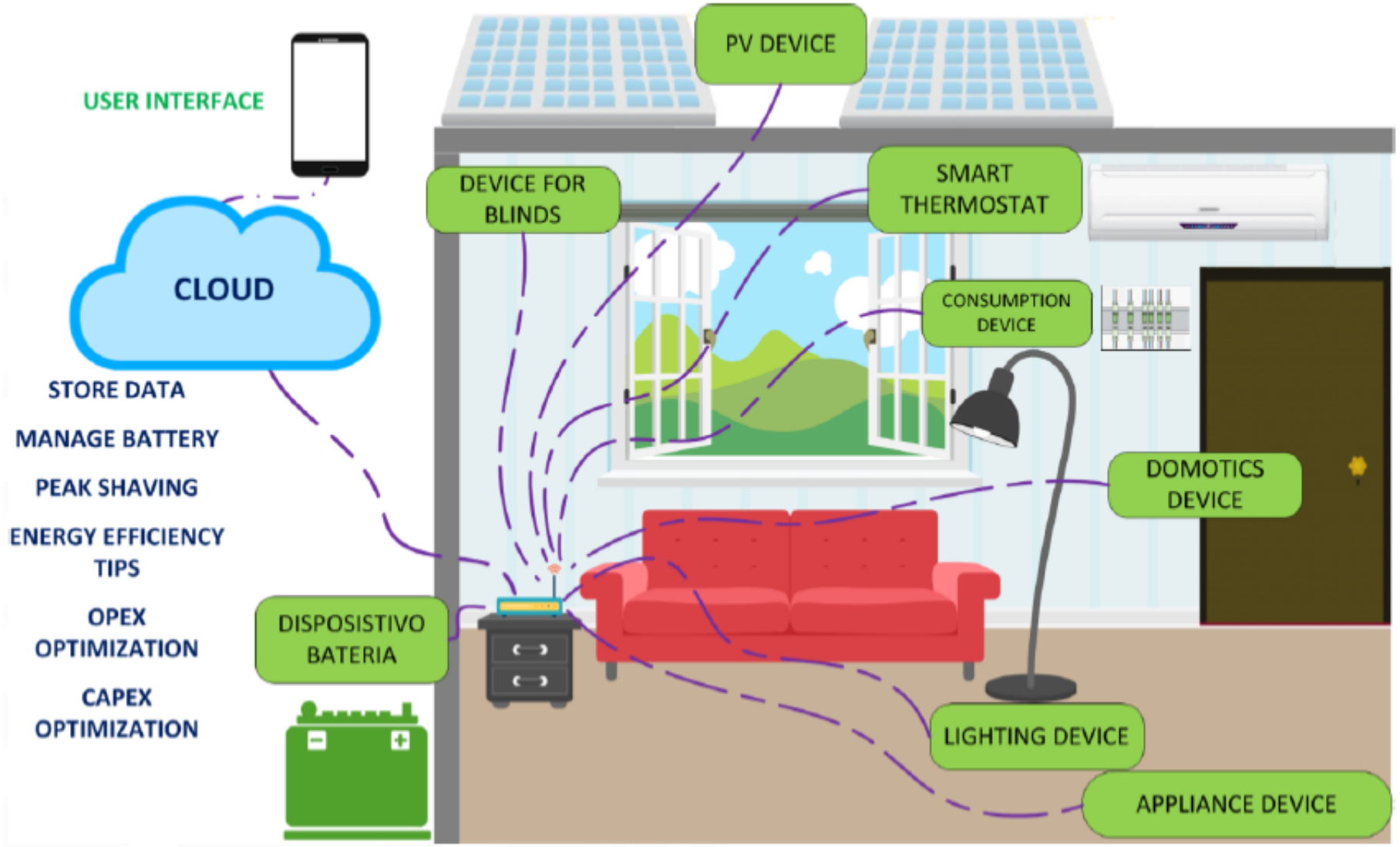
DERs could deliver large savings by improving the utilization of electricity infrastructure,

but many opportunities to deliver greater value are left untapped

without a comprehensive system of efficient prices & regulated charges for electricity services

Consumers (will) have unprecedented choice regarding how to manage their power supply…

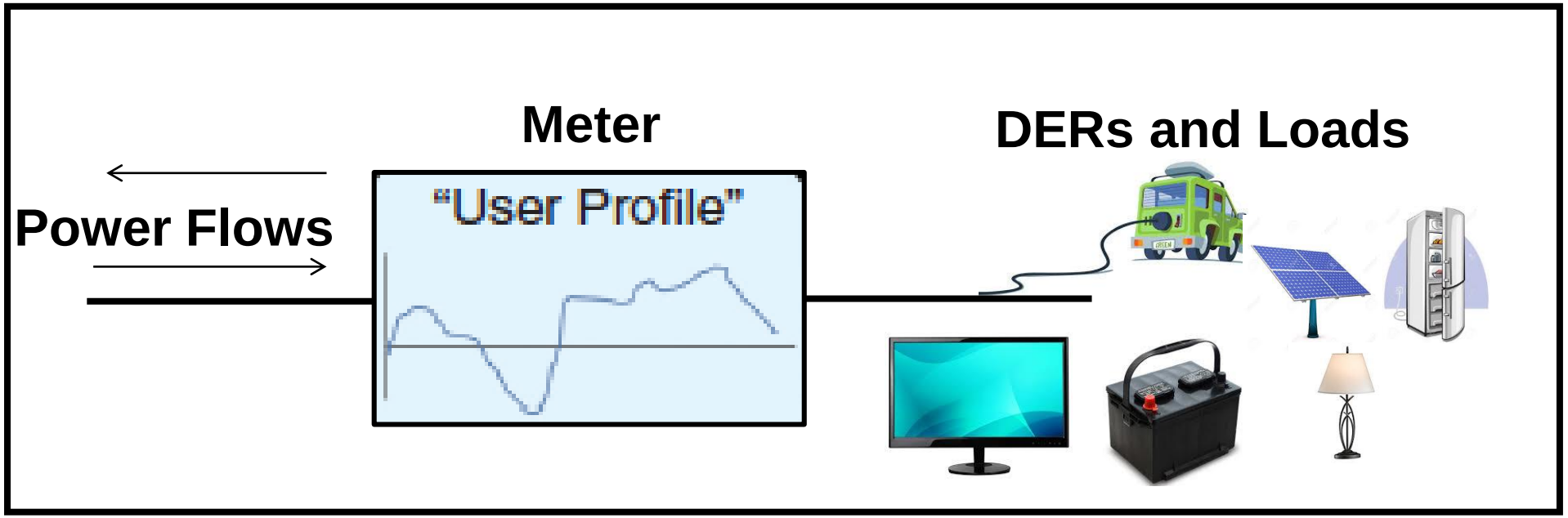
… & the technologies are ready for the agents to decide how to manage their energy



Implications of a rigorous adherence to the principles

Any **cost-reflective** component of prices & charges should be exclusively based on the **individual injection & withdrawal profiles** at the network connection point & should be **symmetrical**.

This requires the use of **advanced meters**



Challenge: In principle, no discrimination between prices of kWh under same conditions of time, voltage & location

End-user prices in India are categorized by consumption group and there is a large variety of tariffs in each state, with cross-subsidy between industrial and residential users.

Retail prices at state level show a wide range of tariff structures and methodologies, leading to a wide spread of categories.

Table shows average end-user prices in INR/kWh for the fiscal year 2015/16 for four types of customers: domestic, commercial (non-domestic), agricultural and industrial (average of both high-tension and low-tension type).

Agriculture (around 22% of total sales) is charged a flat tariff with a monthly fee and unmetered power for water pumping.

Table 7.4 Consumer average revenue per unit (INR/kwh), 2015/16

Region	State	Domestic avg.	Commercial avg.	Agricultural avg.	Industrial avg.
Eastern	Bihar	3.32	6.73	3.61	6.86
	Jharkhand	1.38	7.41	0.55	6.10
	Odissa	3.67	6.48	1.58	6.28
	Sikkim	2.64	4.94	0	5.96
	West Bengal	5.47	7.43	4.07	3.75
North-eastern	Arunachal Pradesh	3.78	4.91	0	3.85
	Assam	3.82	7.33	6.31	6.36
	Manipur	3.10	3.53	0.73	2.29
	Meghalaya	3.85	5.92	3.33	6.12
	Mizoram	3.60	6.63	2.00	6.19
	Nagaland	1.93	1.93	0	0.86
	Tripura	0	0	0	0
Northern	Delhi	6.40	11.60	3.82	10.2
	Haryana	5.60	7.69	0.34	7.36
	Himachal Pradesh	4.02	5.71	7.29	5.70
	Jammu & Kashmir	1.77	3.21	1.74	1.43
	Punjab	4.54	6.95	0	6.99
	Rajasthan	4.54	7.03	4.80	6.50
	Uttar Pradesh	3.62	9.22	1.63	8.35
	Uttarakhand	3.24	5.14	2.52	4.97
Southern	Andhra Pradesh	3.23	11.42	0.30	6.56
	Karnataka	4.43	8.34	0.98	6.68
	Kerala	3.76	12.73	2.29	6.83
	Puducherry	2.39	5.28	0.26	5.35
	Tamil Nadu	2.82	8.84	0	10.77
	Telangana	2.73	9.23	0.43	7.98
Western	Chattisgarh	3.71	4.89	3.76	7.09
	Goa	2.06	4.82	1.59	4.52
	Gujarat	5.15	5.65	2.67	6.88
	Madhya Pradesh	5.04	6.59	1.09	7.09
	Maharashtra	5.80	0	2.61	6.66

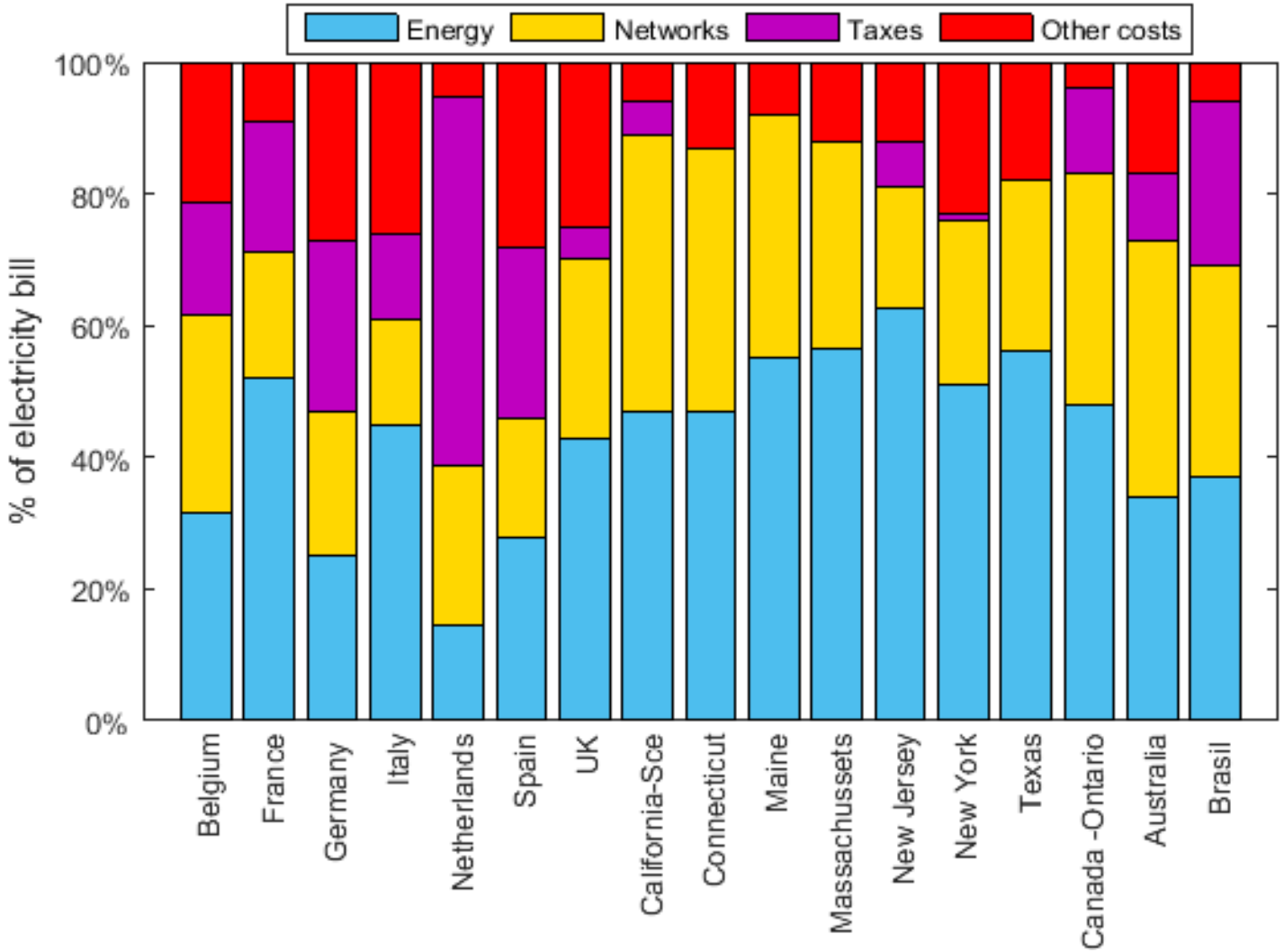
We want to create a comprehensive and efficient system of prices & charges

How to do it? First, remember…

The costs of electricity supply

- **Network costs**
  - Distribution *(Capex & Opex)*
  - Transmission *(Capex & Opex)*
- **Generation costs**
  - If regulated under cost-of-service *(Capex & Opex)*
  - If under market conditions: price of energy
- **Retailing costs** *(small & typically merged with distribution costs)*
- **Regulated charges**
  - System Operator, Regulator, & any subsidized programs *(efficiency, renewables, domestic fuels, stranded costs, social tariffs, etc.)*
- **Taxes**

The basic components of the end consumer tariff



Breakdown of residential electricity bills in different jurisdictions in 2014-2015

Tariffs are applied with a structure *(Time zones & voltage levels)*

<table>
<tr><th colspan="2" rowspan="2"></th><th colspan="3">Winter</th><th colspan="3">Summer</th></tr>
<tr><th>Peak</th><th>Intermediate</th><th>OFF-peak</th><th>Off-Peak</th><th>Intermediate</th><th>Peak</th></tr>
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€/customer</td></tr>
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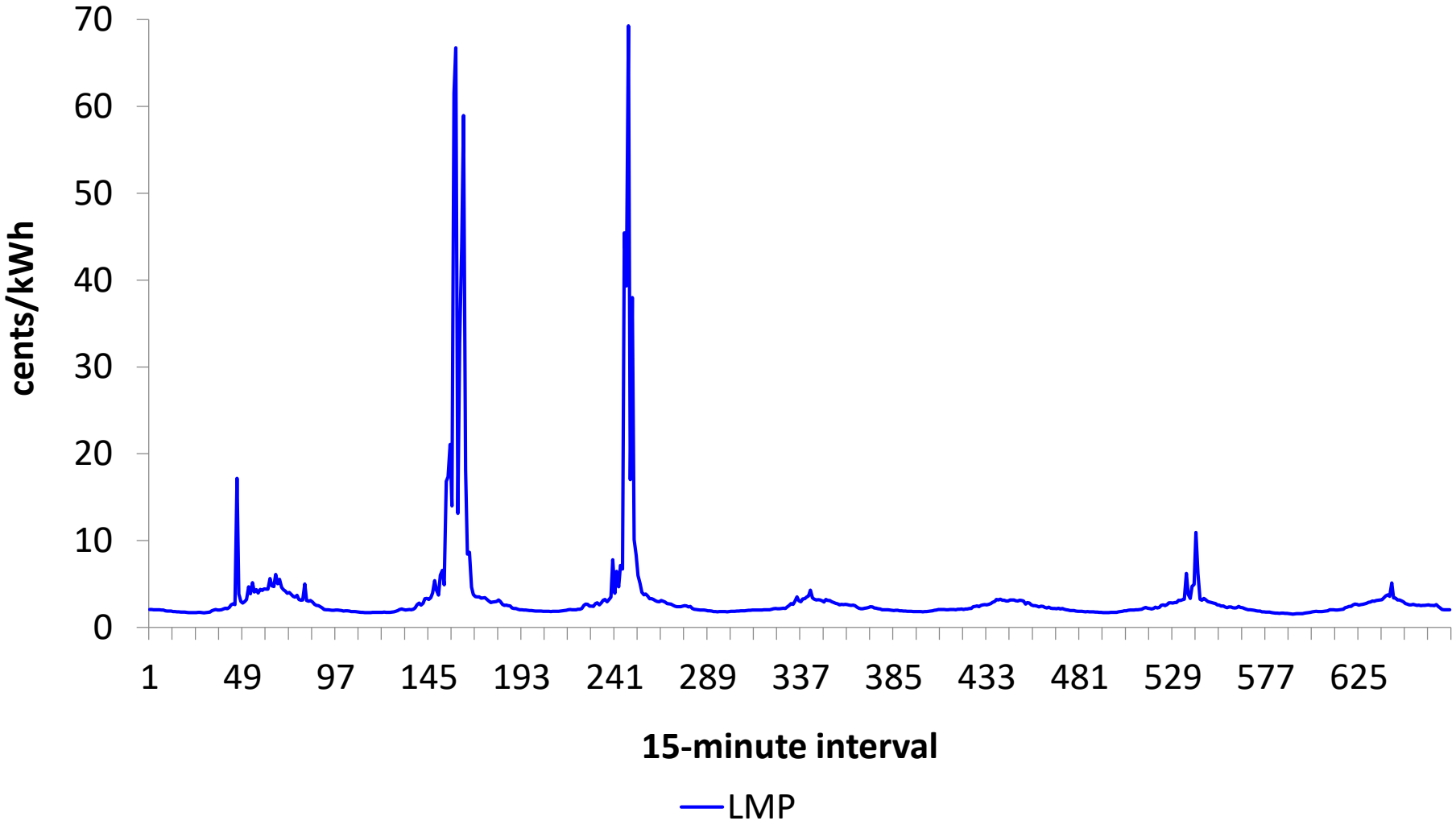
</table>

Let's do it one step at a time…

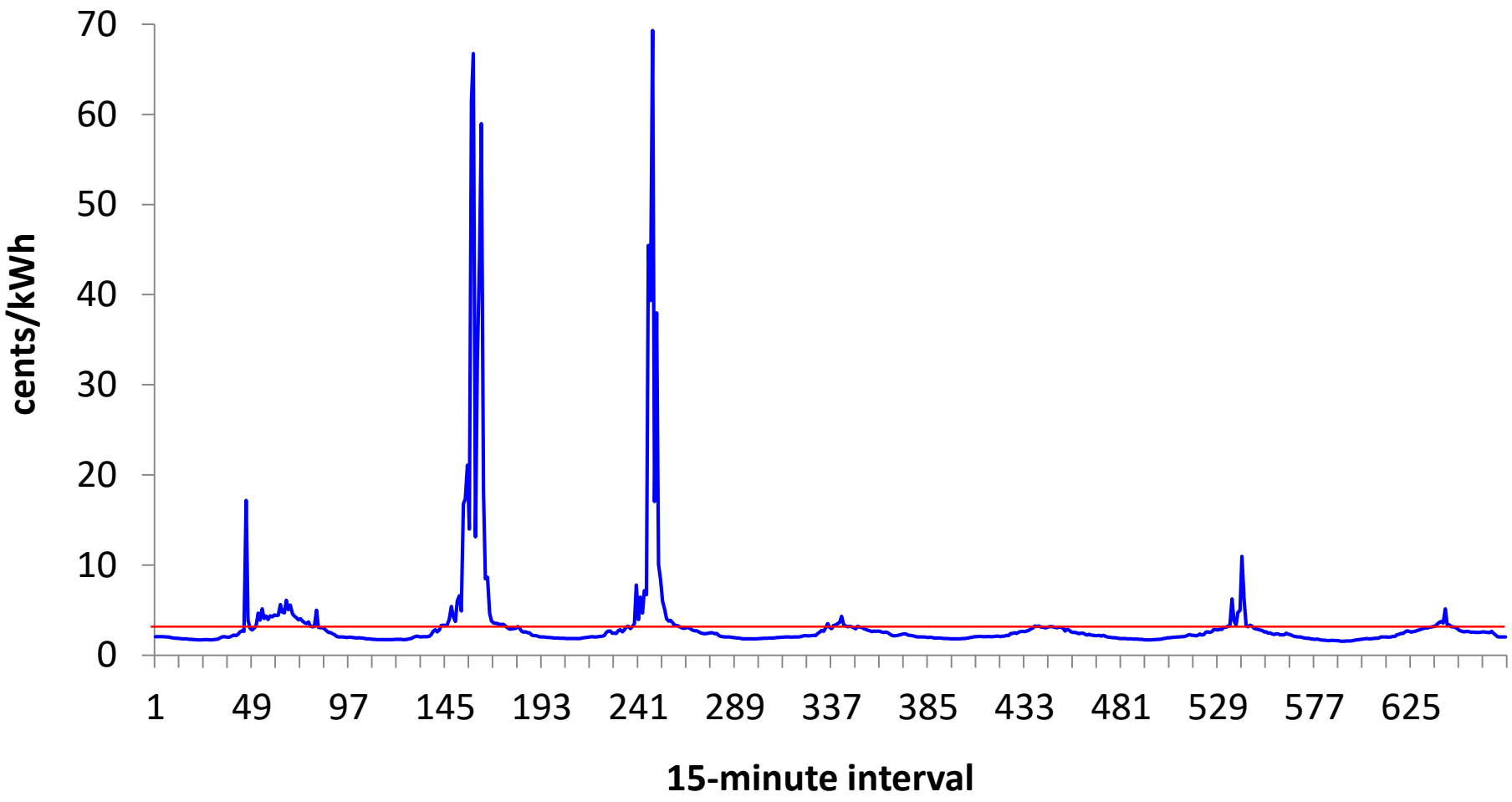
- **STEP 1**: Reflect **time differentiation** in the energy charges

Capture the wholesale energy price evolution in time



(one week in July 2015 in Austin, ERCOT)

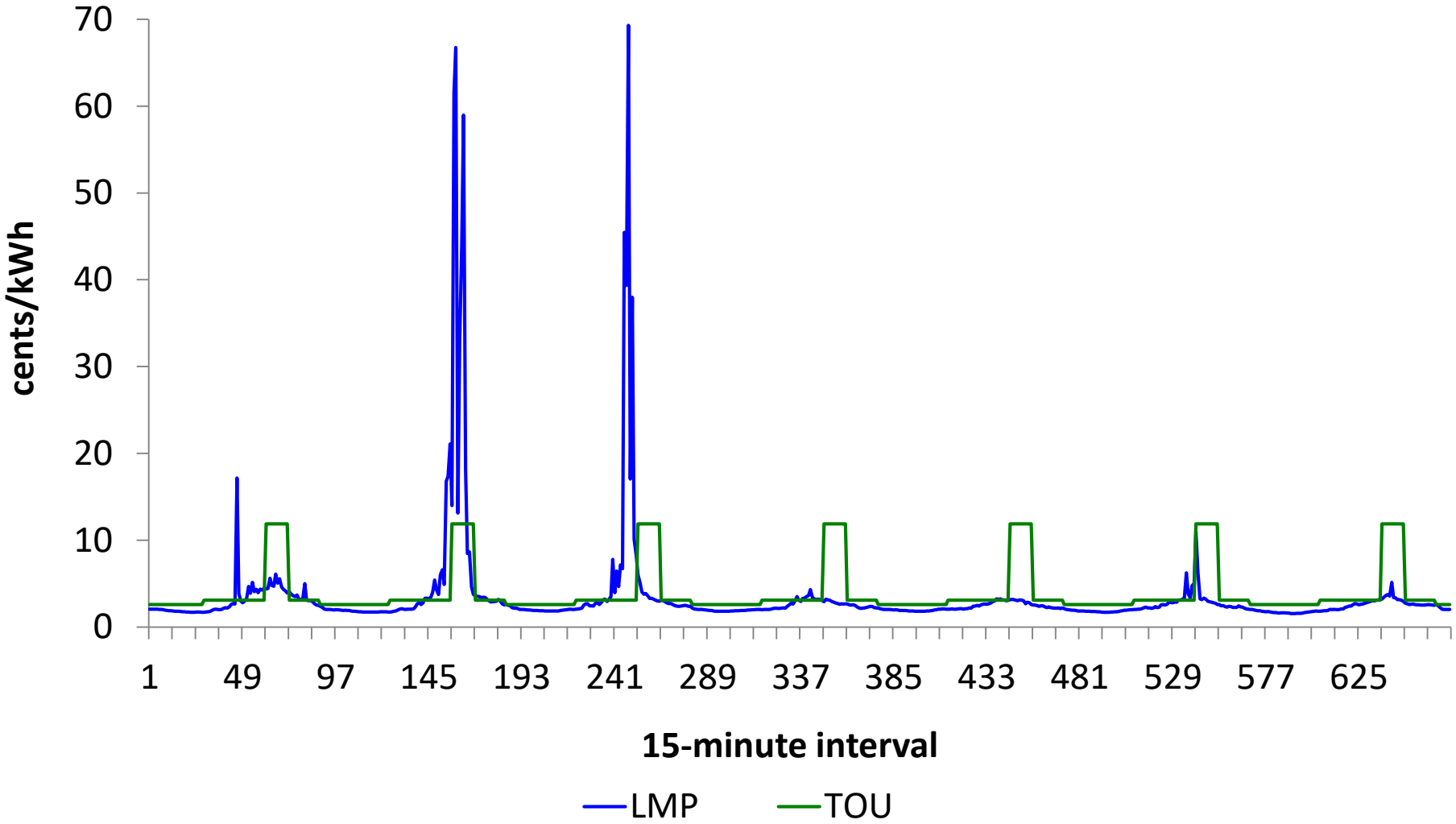
… compared to the usual constant rate…



(one week in July 2015 in Austin, ERCOT)

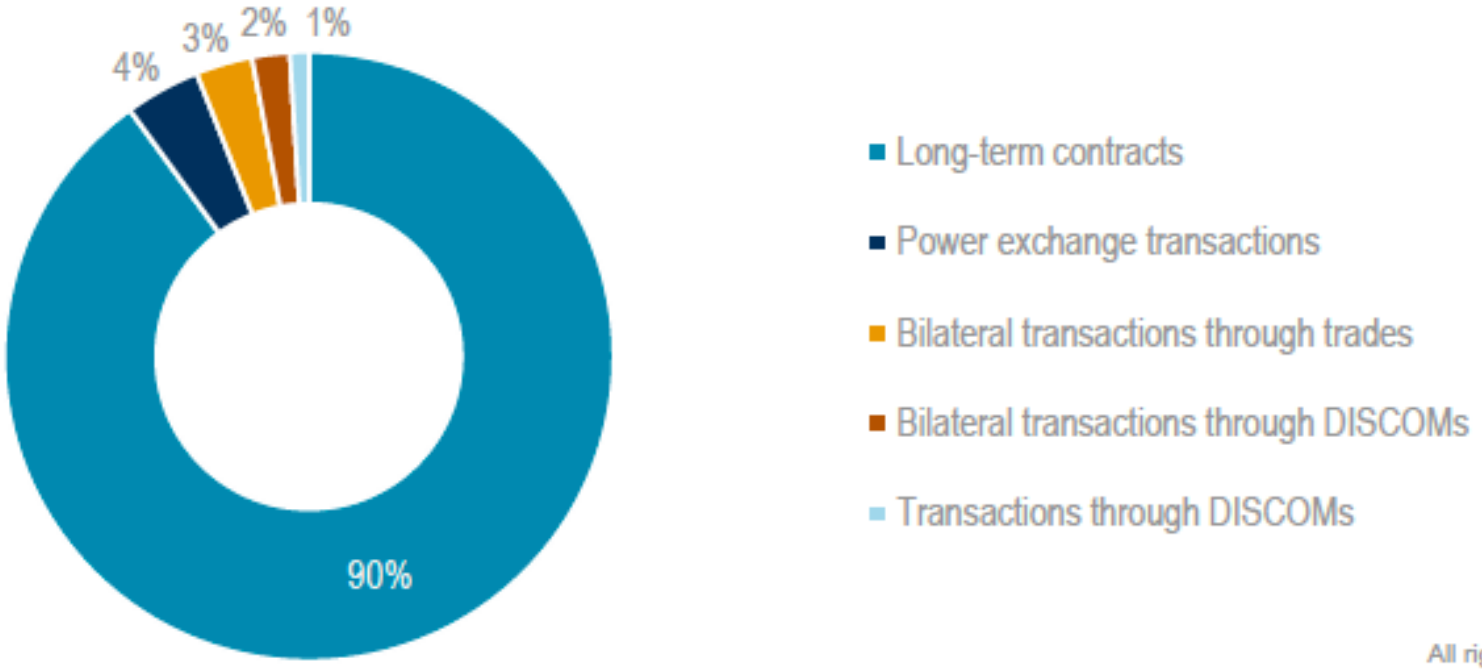
… or to Time of Use (ToU) pricing

(one week in July 2015 in Austin, ERCOT)



(one week in July 2015 in Austin, ERCOT)

Challenge: Small volume of energy traded in the Indian wholesale market (despite progress being made & CERC's efforts)



90% of all generation was priced through regulated long-term contracts, with only 4% through the exchange.

Source: CERC (2018a), *Report on Short-Term Power Markets, MMC Report 2017-18*; www.cercind.gov.in/2018/MMC/AR18.pdf.

End customers do not see the real time energy price

- Most generators are remunerated based on the traditional classification of
  - fixed (capital) costs, which go to the demand component of the tariff
  - & variable (production) costs, which go to the energy component of the tariff

  & this is how discos purchase most power & reflect it in the tariffs

End customers do not see the real time energy price

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  - fixed (capital) costs, which go to the demand component of the tariff
  - & variable (production) costs, which go to the energy component of the tariff

  & this is how discos purchase most power & reflect it in the tariffs
- On the other hand, in well-developed wholesale markets the marginal price of energy pays for the total cost of power plants & this is the energy component reflected in the end customer tariff
  - In some markets there is an additional (minor) capacity payment to encourage investment & plant availability under system stressful conditions

Challenge: Smart meters & tariff structures must go beyond prepayment & time-of-use pricing

Bihar's 'smart prepaid meter scheme' to be extended nationwide

The 'smart prepaid meter' scheme implemented in Bihar will now be extended nationwide. Union Finance Minister Nirmala Sitharaman proposed to introduce the meter throughout the country in the Budget presented in Parliament on Monday.

February 03, 2021, 08:22 IST

TARIFF ORDER

True-up of the FY 2018-19, Annual Performance Review of the FY 2019-20, Aggregate Revenue Requirement (ARR) and Determination of Retail Tariff for the FY 2020-21

Petition No. 17/2019

For

Electricity Wing of Engineering Department, Chandigarh (EWEDC)

19th May 2020

JOINT ELECTRICITY REGULATORY COMMISSION
For the State of Goa and Union Territories,
3rd and 4th Floor, Plot No. 55-56, Sector -18, Udyog Vihar-Phase IV
Gurugram, (122015) Haryana
Telephone : +91(124) 4684705 Telefax: +91(124) 4684706
Website: www.jercuts.gov.in
E-mail: secy-jerc@nic.in

9.1. Tariff Schedule

Table 148: Tariff Schedule

S. No.	Consumer Category	Fixed Charge INR/kW/month	Energy Charge INR/kWh
1.	**DOMESTIC SUPPLY (DS)**		
I.	**LT Domestic**		
a.	0-150 kWh per month	10.00	2.75
b.	151-400 kWh per month		4.80
c.	Above 400 kWh per month		5.20
II.	**HT Domestic**	10.00	4.80
2.	**COMMERCIAL/ NON RESIDENTIAL (NRS)**		
I.	**LT Commercial**		
a.	0-150 kWh per month	INR. 20/kW/Month for Single Phase INR. 100/kW/Month for Three Phase	5.00
b.	151-400 kWh per month		5.30
c.	Above 400 kWh per month		5.60
II.	**HT Commercial**	100.00	5.30
3.	**INDUSTRY**		
I	Large Industrial Power Supply (LS)	200.00	5.00
II	Medium Industrial Power Supply (MS)	200.00	4.70
III	Small Industrial Power Supply (SP)	30.00	4.80
4.	**AGRICULTURAL PUMPING SUPPLY (AR)**	-	2.90
5.	**PUBLIC LIGHTING (PL)**		
I	Public Lighting system managed by Municipal Corporation, Panchayat and Street Lights maintained / outsourced to an external agency	100.00	5.35
II	Advertisement/ Neon-sign Boards Advertisement boards, billboards (apart from advertisement boards installed on commercial establishments and charged under commercial tariff)	100.00	7.10
6.	**BULK SUPPLY (BS)**	200.00	4.90
7.	**TEMPORARY SUPPLY**	Tariff shall be Fixed/ Demand charges (if any) plus energy charges (for relevant slab, if any) under corresponding permanent supply category plus 50% of both.	
		For multi activity pursuit, applicable Tariff for temporary connection shall be with reference to that of commercial category for permanent supply.	
8.	**ELECTRIC VEHICLE CHARGING STATION**	-	3.80

ODISHA ELECTRICITY REGULATORY COMMISSION
BIDYUT NIYAMAK BHAWAN
PLOT NO. 4, CHUNOKOLI,
SHAILASHREE VIHAR, CHANDRASEKHARPUR,
BHUBANESWAR-751021
****

CASE NOs.70, 74,75, 76, 77, 78, 79 & 80 of 2019/ 1098
Date.23.09.2020

To

The Authorized Officer,
NESCO Utility,
At/Po : Januganj
Dist : Balasore

The Authorized Officer,
WESCO Utility,
At/Po: Burla
Dist : Sambalpur

The Authorized Officer,
SOUTHCO Utility,
At/Po: Courtpeta, Berhampur
Dist : Ganjam

The Chief Executive Officer,
TPCODL, 2nd floor, IDCO Tower
Bhubaneswar-22

Sub: **Publication of Retail Supply Tariff Notification for FY 2020-21 w.e.f. 1st October, 2020 under Regulation 57 of OERC (Conduct of Business) Regulations, 2004.**

Sir,

I am directed to inform that you are required to publish the matter as attached to this letter in English language in one issue each of a daily English and Odia newspaper and in Odia language in one issue of daily Odia newspaper, having wide circulation in your area of supply. The publication shall be made on or before **24.09.2020** positively.

The proof of the above publications shall be furnished to the Commission within seven days of such publication.

You are also requested to keep the detailed order of the Commission and the attached notification in your website.

Yours faithfully,

A N Parida
23/09/2020
SECRETARY

Encl : As above

Copy to the Administrator WESCO, NESCO & SOUTHCO Utilities-cum-Chairman, GRIDCO Ltd., Janpath, Bhubaneswar-751022.

RETAIL SUPPLY TARIFF EFFECTIVE FROM 1ST OCTOBER, 2020

Sl. No.	Category of Consumers	Voltage of Supply	Demand Charge (Rs./KW/ Month)/ (Rs./KVA/ Month)	Energy Charge (P/kWh)	Customer Service Charge (Rs./Month)	Monthly Minimum Fixed Charge for first KW or part (Rs.)	Monthly Fixed Charge for any additional KW or part (Rs.)	Rebate (P/kWh)/ DPS
	LT Category							
1	Domestic							
1.a	Kutir Jyoti <= 30 Units/month	LT	FIXED MONTHLY CHARGE-->			80		
1.b	Others							10
	(Consumption <= 50 units/month)	LT		**270.00**				
	(Consumption >50, <=200 units/month)	LT		**450.00**		20	20	
	(Consumption >200, <=400 units/month)	LT		**550.00**				
	Consumption >400 units/month)	LT		**590.00**				
2	General Purpose < 110 KVA							10
	Consumption <=100 units/month	LT		**560.00**				
	Consumption >100, <=300 units/month	LT		**670.00**		30	30	
	(Consumption >300 units/month)	LT		**730.00**				
3	Irrigation Pumping and Agriculture	LT		**150.00**		20	10	10
4	Allied Agricultural Activities	LT		**160.00**		20	10	10
5	Allied Agro-Industrial Activities	LT		**440.00**		80	50	DPS/Rebate
6	Public Lighting	LT		**590.00**		20	15	DPS/Rebate
7	L.T. Industrial (S) Supply <22 KVA	LT		**590.00**		80	35	10
8	L.T. Industrial (M) Supply >=22 KVA <110 KVA	LT		**590.00**		100	80	DPS/Rebate
9	Specified Public Purpose	LT		**590.00**		50	50	DPS/Rebate
10	Public Water Works and Sewerage Pumping <110 KVA	LT		**590.00**		50	50	10
11	Public Water Works and Sewerage Pumping >=110 KVA	LT	200	**590.00**	30			10
12	General Purpose >= 110 KVA	LT	200	**590.00**	30			DPS/Rebate
13	Large Industry	LT	200	**590.00**	30			DPS/Rebate
	HT Category							
14	Bulk Supply - Domestic	HT	20	**460.00**	250			10
15	Irrigation Pumping and Agriculture	HT	30	**140.00**	250			10
16	Allied Agricultural Activities	HT	30	**150.00**	250			10
17	Allied Agro-Industrial Activities	HT	50	**430.00**	250			DPS/Rebate
18	Specified Public Purpose	HT	250		250			DPS/Rebate
19	General Purpose >70 KVA < 110 KVA	HT	250		250			10
20	H.T Industrial (M) Supply	HT	150		250			DPS/Rebate
21	General Purpose >= 110 KVA	HT	250	**As indicated in the notes below**	250			DPS/Rebate
22	Public Water Works & Sewerage Pumping	HT	250		250			10
23	Large Industry	HT	250		250			DPS/Rebate
24	Power Intensive Industry	HT	250		250			DPS/Rebate
25	Mini Steel Plant	HT	250		250			DPS/Rebate
26	Railway Traction	HT	250		250			DPS/Rebate
27	Emergency Supply to CGP	HT	0	**750.00**	250			DPS/Rebate
28	Colony Consumption (Both SPP & Industrial)	HT	0	**460.00**	0			DPS/Rebate
	EHT Category							
29	General Purpose	EHT	250		700			DPS/Rebate
30	Large Industry	EHT	250	**As indicated in the notes below**	700			DPS/Rebate
31	Railway Traction	EHT	250		700			DPS/Rebate
32	Heavy Industry	EHT	250		700			DPS/Rebate
33	Power Intensive Industry	EHT	250		700			DPS/Rebate
34	Mini Steel Plant	EHT	250		700			DPS/Rebate
35	Emergency Supply to CGP	EHT	0	**740.00**	700			DPS/Rebate
36	Colony Consumption	EHT	0	**455.00**	0			DPS/Rebate

Let's do it one step at a time…

- Reflect **time differentiation** in the energy charges
- **STEP 2**: Apply forward-looking peak-coincident capacity charges for networks & firm generation capacity *(if applicable)*

Challenge: Very diverse demand charges & having to deal with residual charges

- Strict application of this principle would result in
  - high demand charges to customers connected in areas with networks close to present or near future congestion & contributing to the congestion peak
    - No charges if no contribution to the peak
    - Credits if contribution to reduce the congestion at the peak
  - zero demand charges to customers connected in areas where networks are not close to present or near future congestion at any time
- Implication: The costs of the non-congested networks must be recovered by some other non-cost-reflective method => **residual charges**

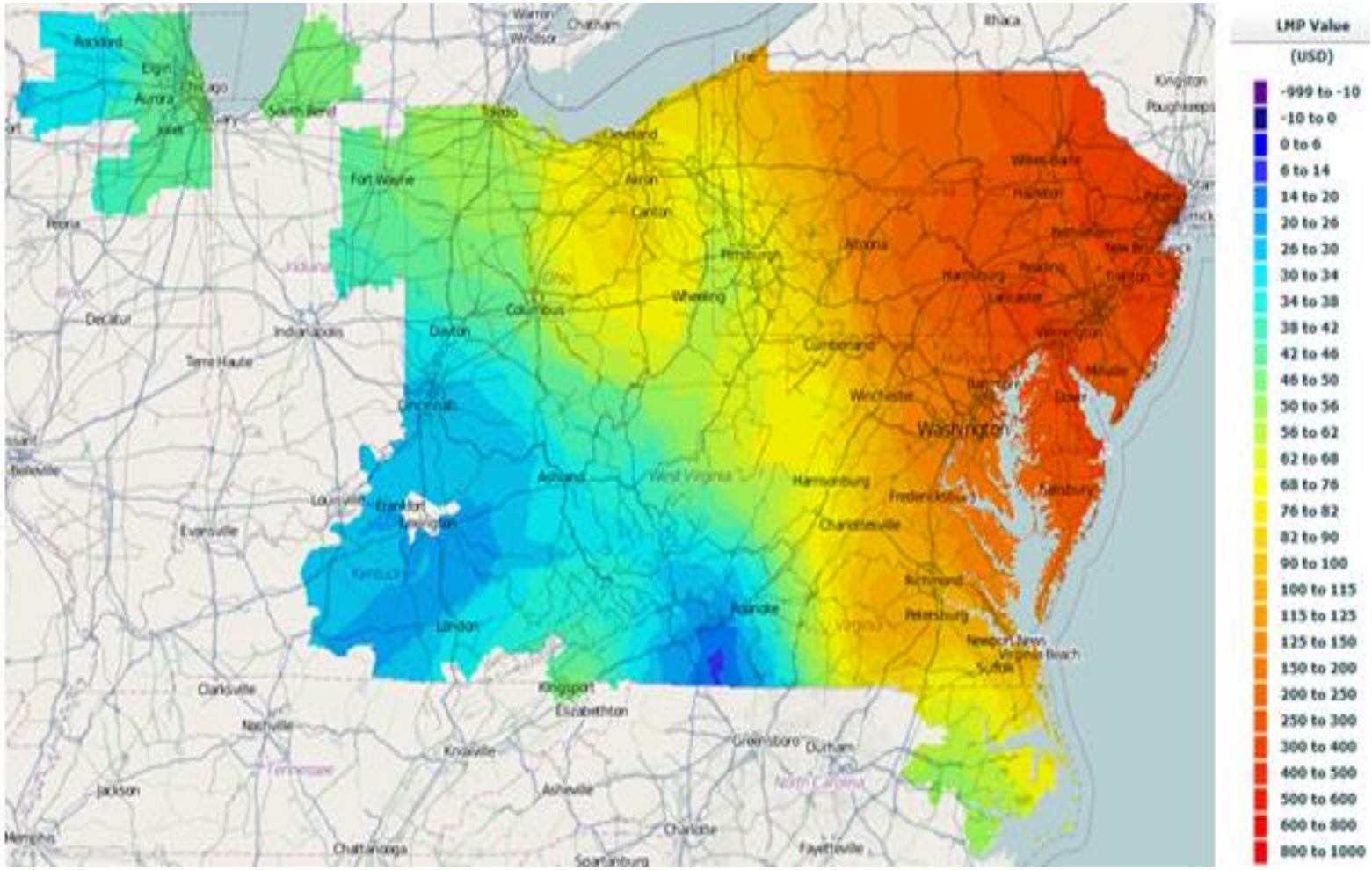
Relevant tariff design principles for the allocation of network costs

- **Sustainability**: Network charges should fully recover the cost-of-service determined by regulator
- **Economic efficiency**: Contribution of the tariff to maximization of social welfare ➔
  - Do not overdo the signal: Use "**cost causality**" ("responsibility in incurred network costs") just for those assets whose existence is a direct consequence of the behavior of the network users
  - Allocate any "leftover costs" ("residual network costs") with Ramsey-like criteria

Let's do it one step at a time…

- **STEP 1**: Reflect **time differentiation** in the energy charges
- **STEP 2**: Apply forward-looking peak-coincident capacity charges for networks & firm generation capacity *(if applicable)*
- **STEP 3**: Progressively increase the **locational component** of prices & charges

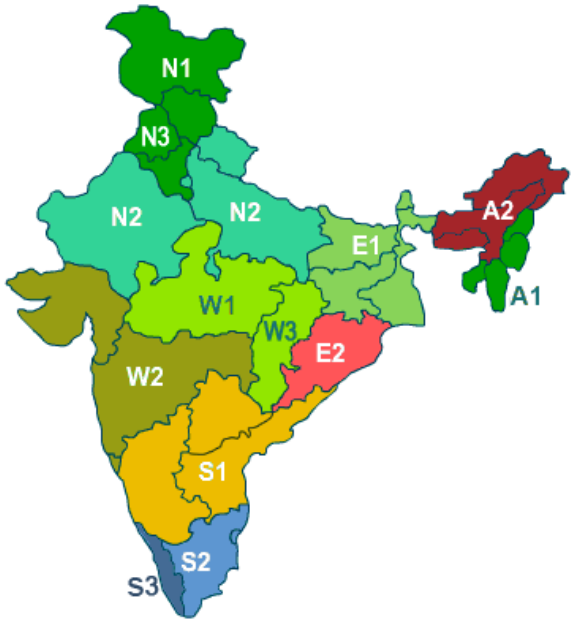
Energy prices at transmission level may vary significantly if there are binding network constraints

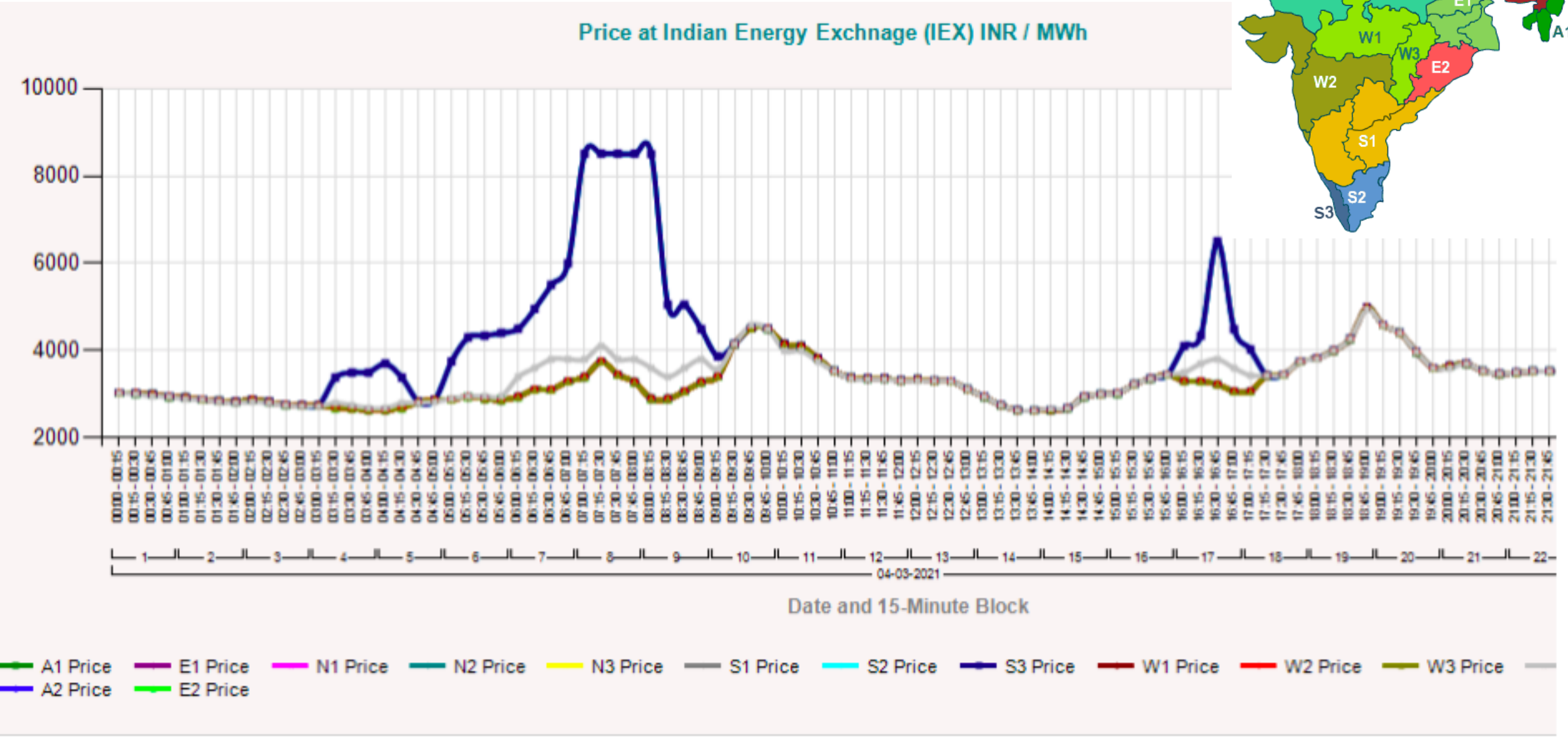


Wholesale LMP variation across more than 11,000 PJM nodes on July 19, 2015, at 4:05 pm

Bidding zones in European market coupling

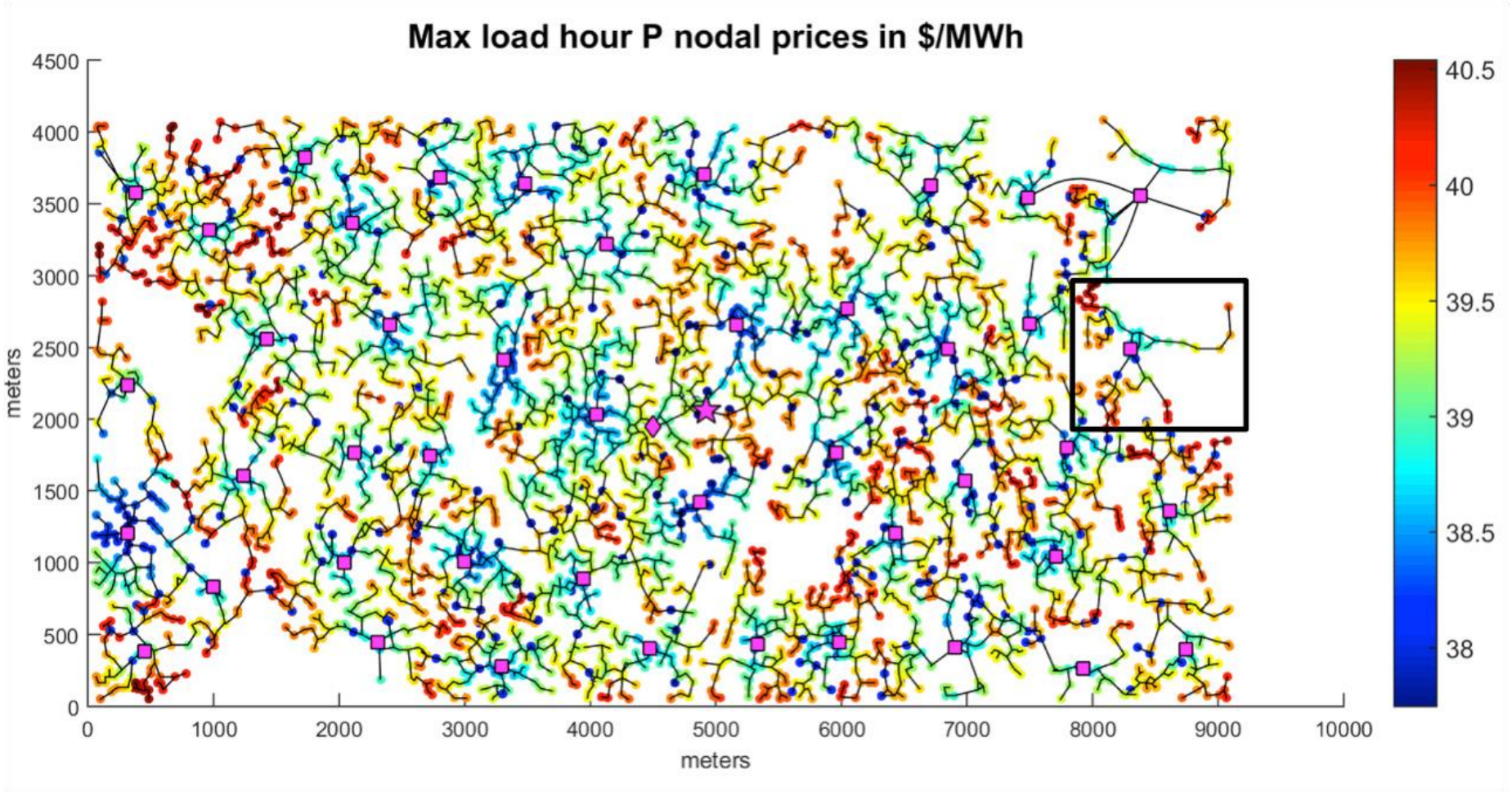
Bidding zones & prices at IEX



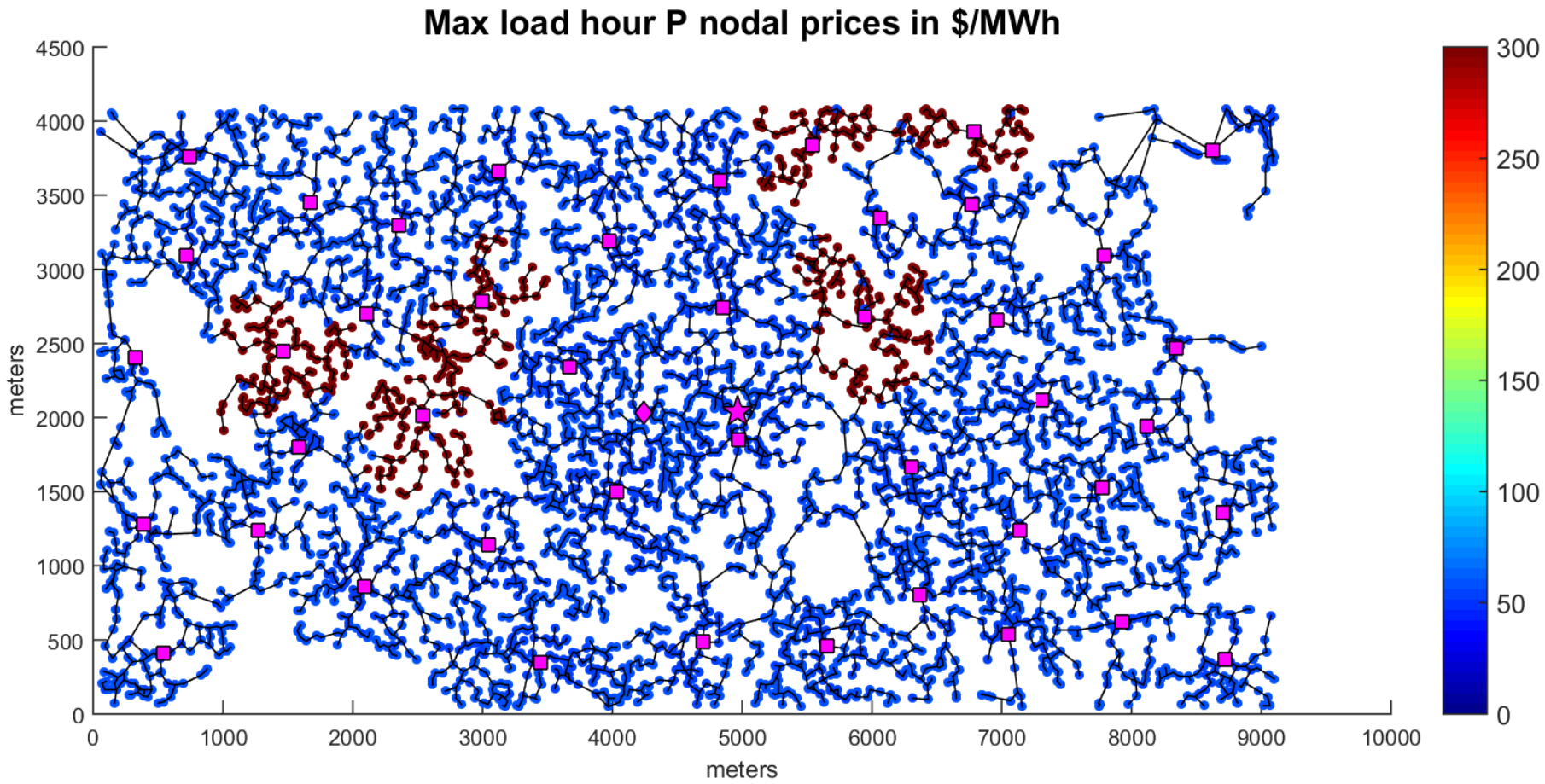


There is locational differentiation in energy prices also at distribution level

Getting deep into distribution
(just losses)



Getting deep into distribution
(losses & network constraints)



Locational differentiation of prices has important policy implications,

since the value of the services provided by DERs may depend on their location

Some DERs can only be deployed at a specific scale level…

… while others can be deployed at different scales

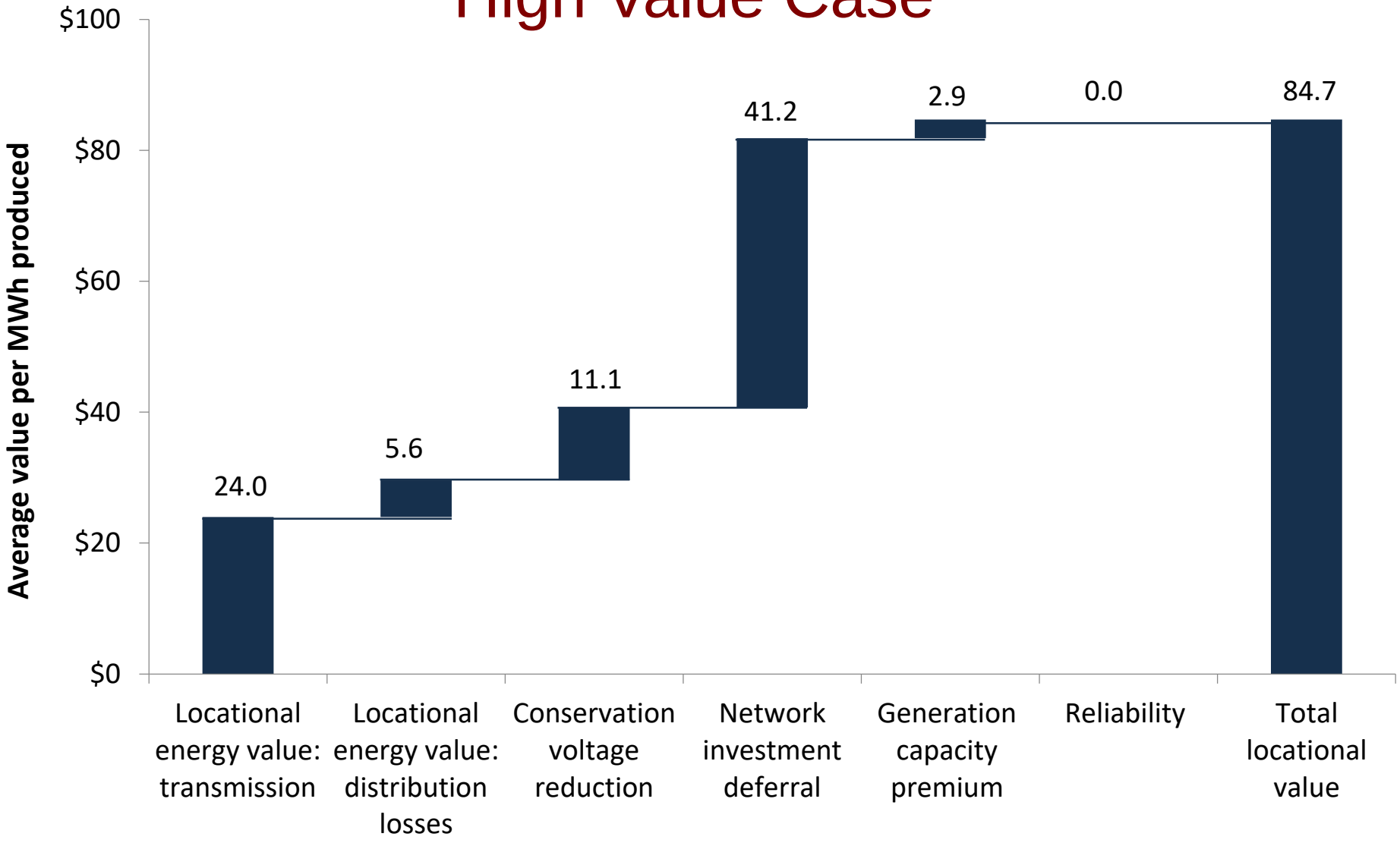
Utility Scale

C&I Scale

Residential Scale

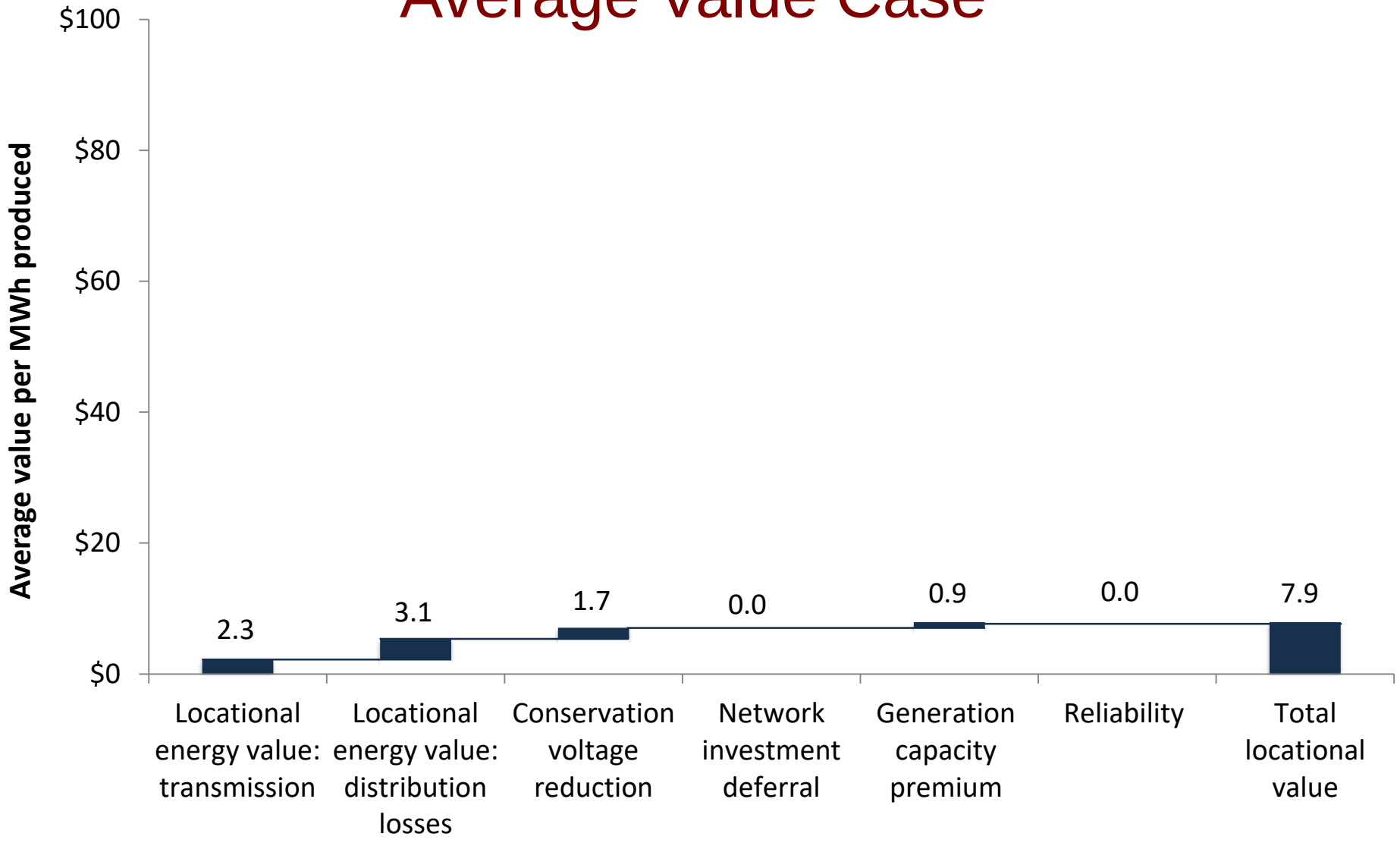
Locational Value of Distributed Solar PV: Long Island, New York Example

High Value Case



Locational Value of Distributed Solar PV: Mohawk Valley, New York Example

Average Value Case

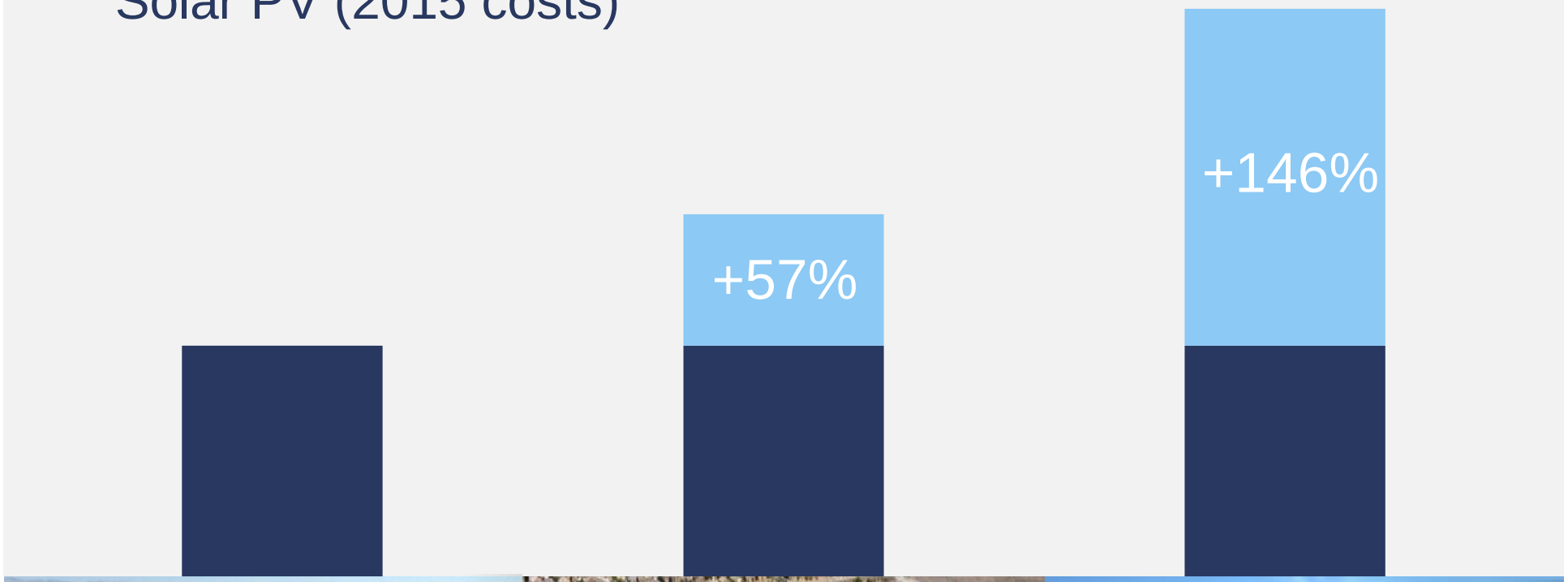


For DERs that can be deployed at different scales (e.g., solar PV, storage)…

Locational value competes with economies of scale

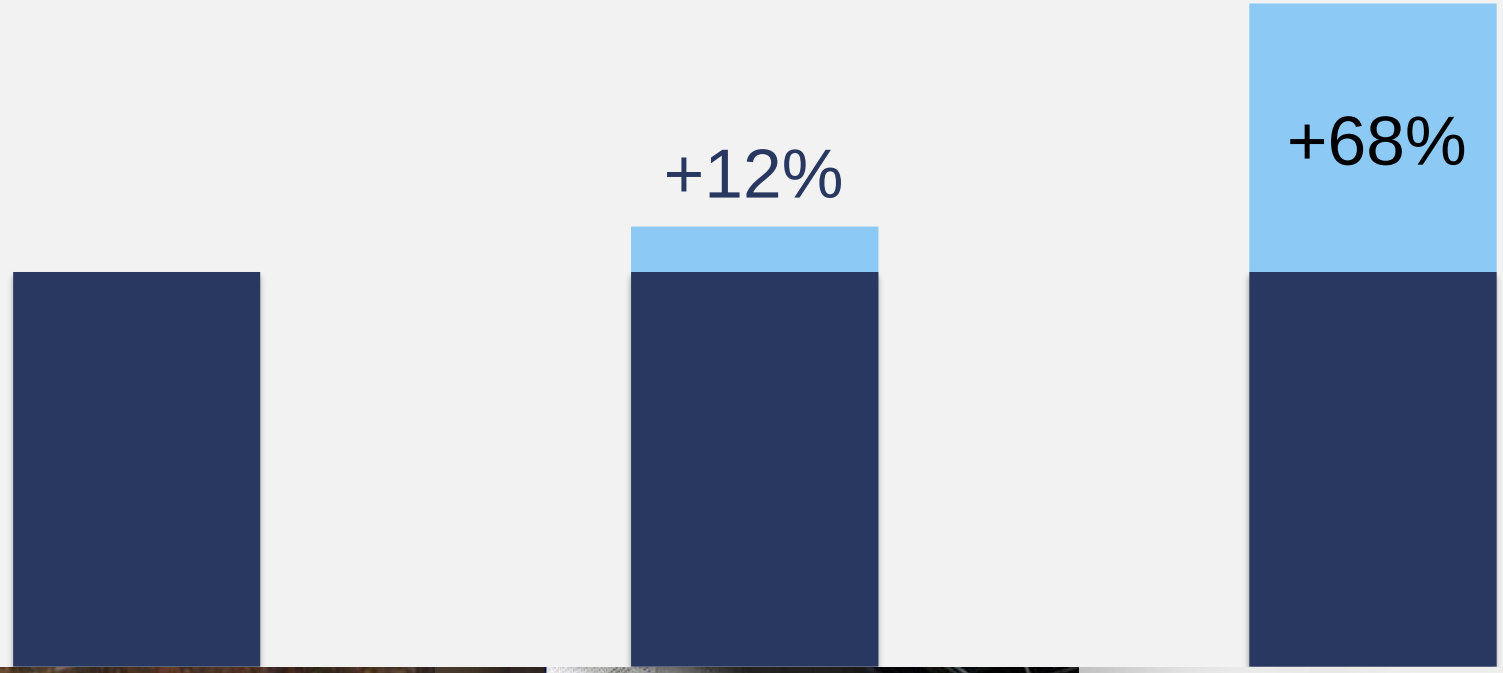
Economies of Unit Scale Still Matter

Solar PV (2015 costs)



Economies of Unit Scale Still Matter

Lithium-ion Energy Storage (2015 costs)



10-20 MW

100-200 kW

0 kW

Distributed or centralized?

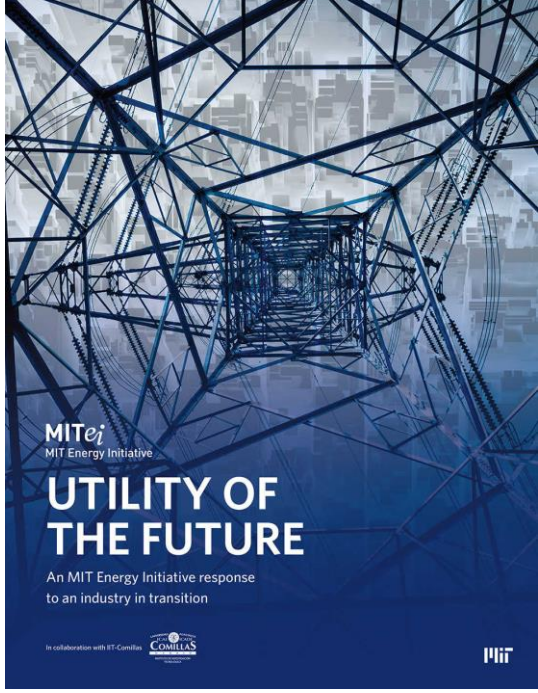
- From a **societal viewpoint**, the locational value *versus* the incremental cost due to loss of economies of scale determines the best option
- From the **customer viewpoint**, *the locational value enhances the economic viability of the distributed resource*, which will be a factor among others to make a decision

Recommendation

"Carefully evaluate the economic opportunities and costs of DERs"

Better utilization of **existing assets** and smarter energy consumption hold great potential for cost savings.

Economies of scale still matter, and the distributed deployment of **solar PV** or energy **storage** is not cost-effective in all contexts and locations

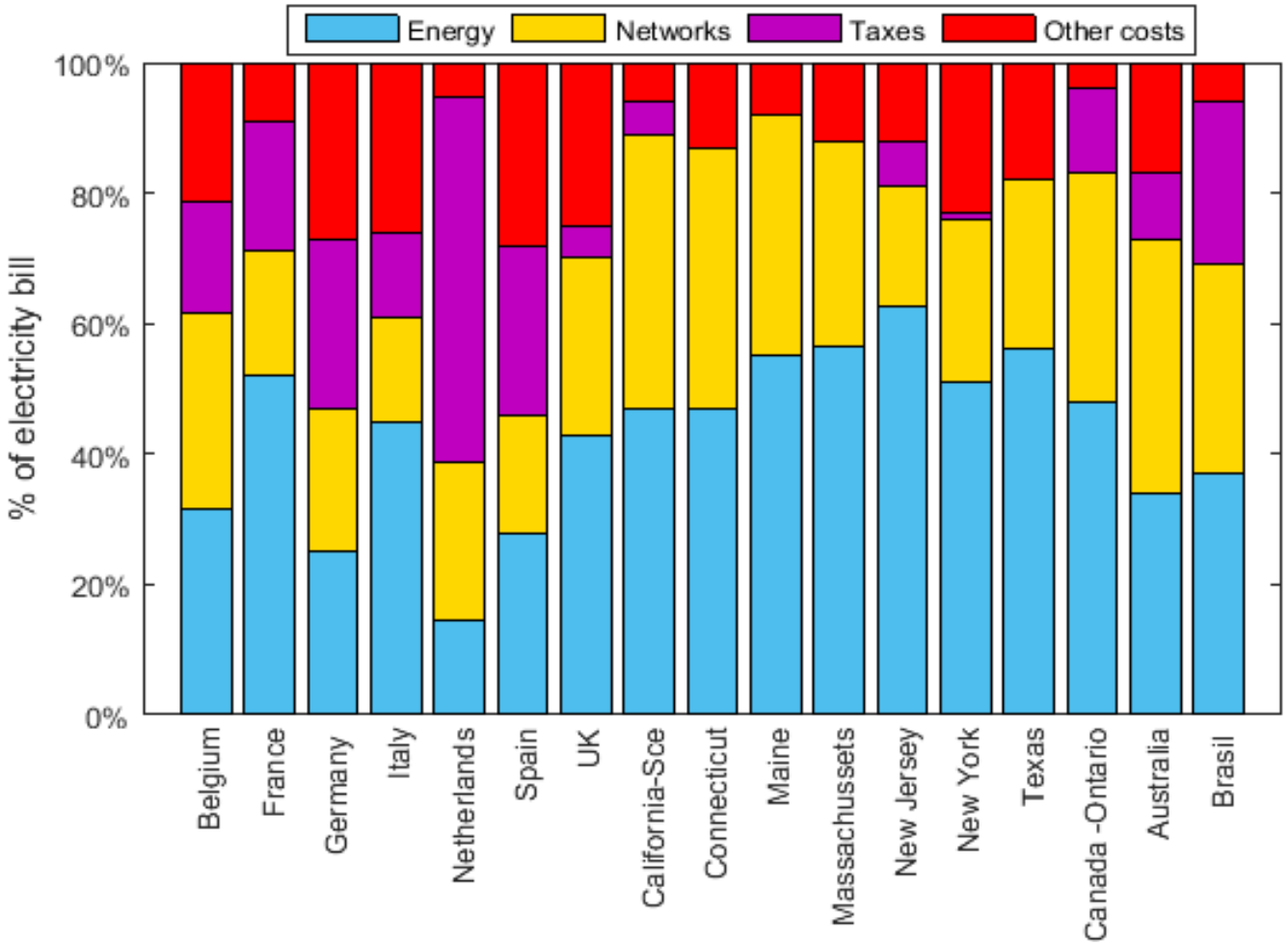


Perhaps the most important step…

Let's do it one step at a time…

- **STEP 1**: Reflect **time differentiation** in the energy charges
- **STEP 2**: Apply forward-looking peak-coincident capacity charges for networks & firm generation capacity (if this is the case)
- **STEP 3**: Progressively increase the **locational component** of prices & charges
- **STEP 4: Policy & residual network costs** should be charged **minimizing distortion** of cost-reflective signals

Policy costs & residual network costs **should not be recovered with volumetric charges** ($/kWh). We recommend a **fixed annual charge** distributed in monthly installments.



Breakdown of residential electricity bills in different jurisdictions in 2014-2015

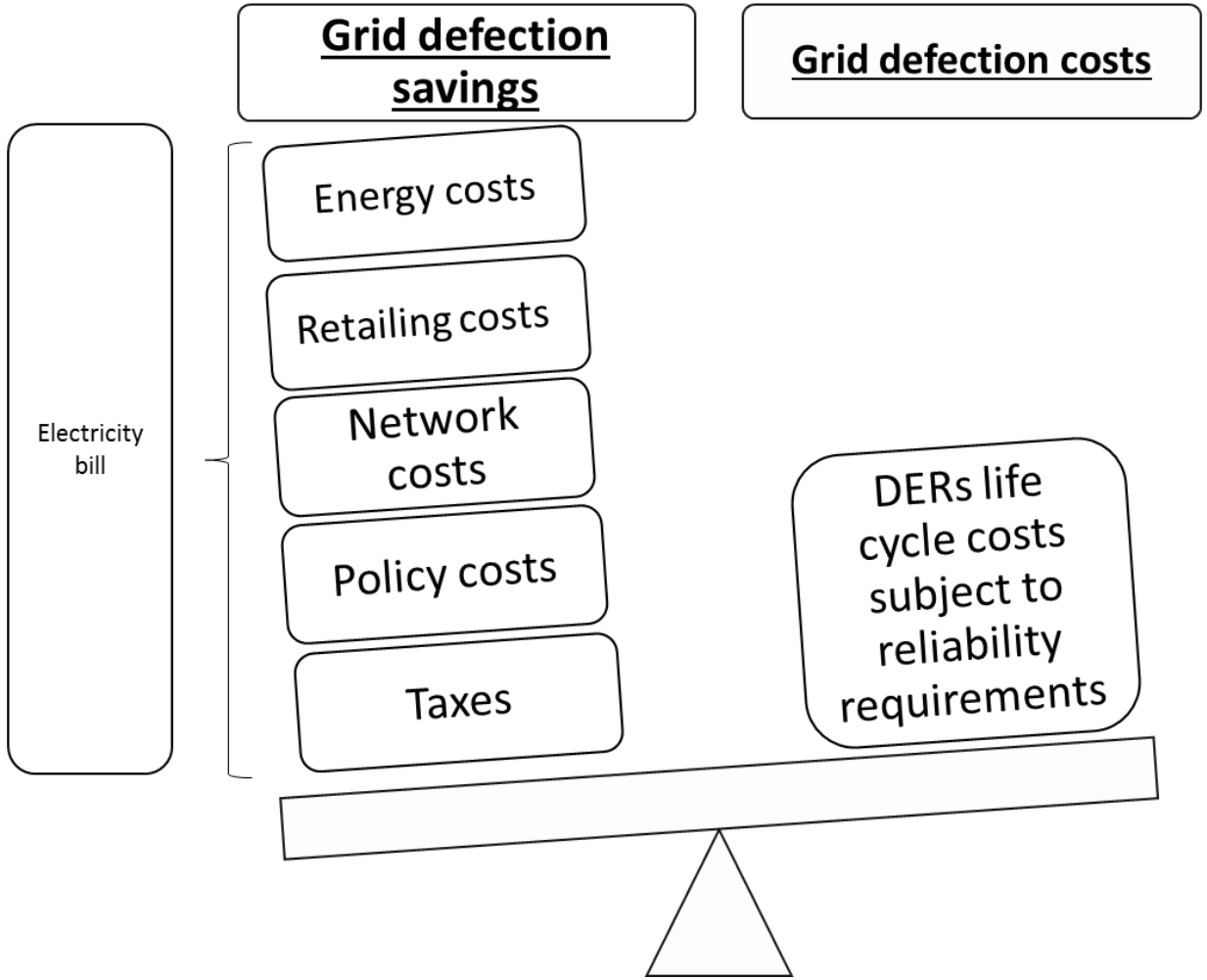
Implementation

- Policy costs & residual network costs **should be removed from the volumetric ($/kWh) component of the tariff** & charged differently. How?
  - Preferably as an **annual lump sum** (conveniently distributed in monthly installments), with the magnitude of each customer charge depending upon **some proxy metric of lack of price elasticity or some measure of wealth**, such as the property tax or the size of the system user's dwelling, or just via ordinary taxes.
- The seriousness of the **threat of grid defection** must be carefully considered in determining which costs are included in the electricity tariff.

Let's do it one step at a time…

- **STEP 1**: Reflect **time differentiation** in the energy charges
- **STEP 2**: Apply forward-looking peak-coincident capacity charges for networks & firm generation capacity *(if applicable)*
- **STEP 3**: Progressively increase the **locational component** of prices & charges
- **STEP 4: Policy & residual network costs** should be charged **minimizing distortion** of cost-reflective signals
- **STEP 5**: Reconsider **which costs are included** in the electricity tariff if inefficient **grid defection** is a serious threat

Depending on the seriousness of the **threat of grid defection**, which costs are included in the electricity tariff must be carefully considered



Remember…

Challenge: In principle, no discrimination between prices of kWh under same conditions of time, voltage & location

End-user prices in India are categorized by consumption group and there is a large variety of tariffs in each state, with cross-subsidy between industrial and residential users.

Retail prices at state level show a wide range of tariff structures and methodologies, leading to a wide spread of categories.

Table shows average end-user prices in INR/kWh for the fiscal year 2015/16 for four types of customers: domestic, commercial (non-domestic), agricultural and industrial (average of both high-tension and low-tension type).

Agriculture (around 22% of total sales) is charged a flat tariff with a monthly fee and unmetered power for water pumping.

Table 7.4 Consumer average revenue per unit (INR/kwh), 2015/16

Region	State	Domestic avg.	Commercial avg.	Agricultural avg.	Industrial avg.
Eastern	Bihar	3.32	6.73	3.61	6.86
	Jharkhand	1.38	7.41	0.55	6.10
	Odissa	3.67	6.48	1.58	6.28
	Sikkim	2.64	4.94	0	5.96
	West Bengal	5.47	7.43	4.07	3.75
North-eastern	Arunachal Pradesh	3.78	4.91	0	3.85
	Assam	3.82	7.33	6.31	6.36
	Manipur	3.10	3.53	0.73	2.29
	Meghalaya	3.85	5.92	3.33	6.12
	Mizoram	3.60	6.63	2.00	6.19
	Nagaland	1.93	1.93	0	0.86
	Tripura	0	0	0	0
Northern	Delhi	6.40	11.60	3.82	10.2
	Haryana	5.60	7.69	0.34	7.36
	Himachal Pradesh	4.02	5.71	7.29	5.70
	Jammu & Kashmir	1.77	3.21	1.74	1.43
	Punjab	4.54	6.95	0	6.99
	Rajasthan	4.54	7.03	4.80	6.50
	Uttar Pradesh	3.62	9.22	1.63	8.35
	Uttarakhand	3.24	5.14	2.52	4.97
Southern	Andhra Pradesh	3.23	11.42	0.30	6.56
	Karnataka	4.43	8.34	0.98	6.68
	Kerala	3.76	12.73	2.29	6.83
	Puducherry	2.39	5.28	0.26	5.35
	Tamil Nadu	2.82	8.84	0	10.77
	Telangana	2.73	9.23	0.43	7.98
Western	Chattisgarh	3.71	4.89	3.76	7.09
	Goa	2.06	4.82	1.59	4.52
	Gujarat	5.15	5.65	2.67	6.88
	Madhya Pradesh	5.04	6.59	1.09	7.09
	Maharashtra	5.80	0	2.61	6.66

Challenge: Captive producers

- High industrial tariffs & unreliable supply have led to a gradual transition towards industry generating power itself (captive generation) or purchasing it from dedicated generators (open access).
- Around 18% of grid-connected capacity stems from so-called captive power plants, which satisfy 71% of India's industrial electricity consumption
- India has around 80 GW of installed capacity in the form of captive power plants owned by industrial customers for localized production and use
- The captive plants run on coal (54 GW or 68% of the total), natural gas (9.5 GW or 12%), diesel/fuel oil (3.5 GW or 4%) and renewables (bagasse, biomass, wind and solar) (15 GW or 16%).

Readings

- Pérez-Arriaga, I.J., et al., **Utility of the Future: An MIT Energy Initiative response to an industry in transition**, Cambridge, MA: MIT Energy Initiative, December, 2016.
- Pérez-Arriaga, I., Jenkins, J.D., and Batlle, C. "**A regulatory framework for an evolving electricity sector: highlights of the MIT Utility of the Future study**" *Economics of Energy and Environmental Policy* 6(1), 2017.
- Visit: http://energy.mit.edu/research/utility-future-study/

A new frontier in regulation

Economic signals at the “last mile” & the interface on- & off-grid

The “last mile” & the interface on- and off-grid

From information available on the **Draft Electricity (Amendment) Bill, 2020**

Inclusion of Distribution Sub-licensee and Franchisee:

“To ease the burden of distribution licensees and in order to promote some form of demographic specialization, the distribution licensees, can appoint another entity for distribution of electricity on its behalf, within its area of supply. This entity can be either a distribution sub-license appointed with prior permission of the State Commission or it may be a franchisee appointed by merely informing the State Commission. This move could possibly give more leeway to power generators and licensed distributors sub-contract the obligations and allot risk to specific parties, where they belong.”

However, there is no addition of further clauses which specifically govern either of these newly introduced entities, wherein the extent of statutory obligation of each of the entities is co-extensive with one another.

Open issues -1

- Generation & storage “behind the meter”: is net metering a sound regulation?
  - Yes, if netting is done in “real time” & just for the energy component of the tariff, & network charges are applied to the real time injection or withdrawal
  - No, if netting is done over a long time period (standard meters) including all tariff components & network charges are not determined correctly

Open issues -2

- After the outstanding electrification effort of the last few years in India, some discoms still have serious problems at the last mile, where non-discoms organizations have deployed or are deploying off-grid solutions
- Approaches are needed to establish a collaborative framework benefiting customers, discoms, & off-grid developers
  - “Microgrids under the grid”, better connected than not
  - Recapturing C&I customers, either defected or with expensive & dirty backups
  - Outsourcing metering, billing, revenue collection, retailing, network O&M, or promotion of electricity services & efficient appliances

Open issues -3

- Is “all-connected” the least cost option?
  - In a future electrified economy grid connection appears to be the obvious model except for exceptional situations
  - However, perhaps grid extension has gone too far in some cases, & presently, disconnection from the main grid & supply with local generation can be the least cost solution, at least until demand grows much more
  - Could the Direct Benefit Transfer (DBT) apply to non-grid-connected customers if supply meets some required minimum conditions?
  - Could regulated cost-of-service remuneration apply to collaborative schemes between discoms & off-grid providers?

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THE COUNCIL

India Residential Energy Survey (IRES) 2020

Design and data quality

Shalu Agrawal, Sunil Mani, Abhishek Jain, Karthik Ganesan, and Johannes Urpelainen

Technical Document | October 2020

MINI-GRIDS IN UTTAR PRADESH

POLICY LESSONS

A Centre for Science and Environment report

India Case Study: Moving "Beyond Access"

Since 2017, Power for All has been working in India, by engaging with the decentralized renewable energy (DRE) sector to facilitate a shift in narrative that goes "beyond access", and by establishing a unified voice that communicates the co-benefits of DRE solutions in achieving the Indian government's non-energy related development goals, i.e. universal healthcare, doubling farmers' income, creating green jobs, clean cooking, and others.

CHALLENGE

The Government of India declared in 2019 that its grid extension program (known as Saubhagya) had achieved 100% household electrification. However, millions of homes and businesses, especially in rural India, still lack power, or suffer from significant quality and reliability issues, in part because state-owned utilities, already struggling financially, deprioritize servicing poorer rural communities! Clearly there is a need for private-sector decentralized renewable energy (DRE) companies, including solar home systems and mini-grids, to be integrated into India's energy infrastructure to address this gap. But talking about "energy access" is no longer relevant in a country where, on paper at least, everyone has access. A new narrative was needed.

SOLUTION

Using its integrated, evidence-based campaign approach, Power for All used communications and data to re-orient the perspective of key decision-makers (nationally and at the state level) on the importance of mainstreaming DRE, and worked with local partners to shift the sector narrative to go "beyond access". This unified sector voice spotlighted the value that DRE adds to achieving the Indian government's non-energy related development goals (i.e. "co-benefits"): universal healthcare, doubling farmer income, creating green jobs, clean cooking, etc.

RESULTS

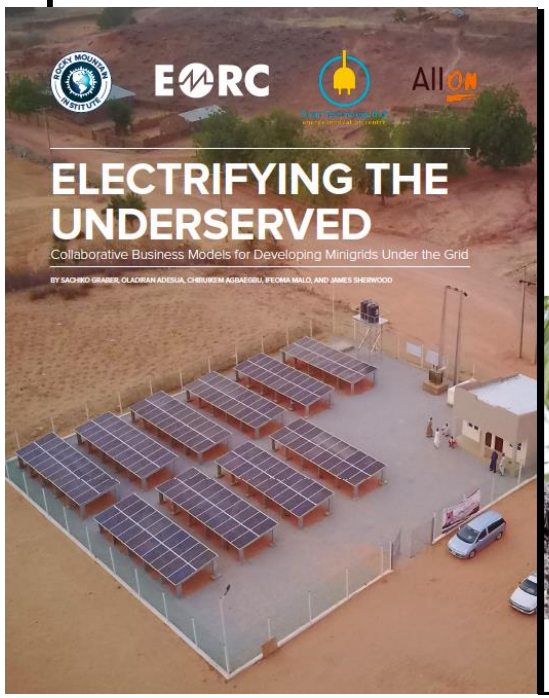
- In 2019, Power for All kicked off an editorial partnership with ET Energy World, part of leading national media outlet Economic Times, to create a dedicated platform called "Energizing Rural India", publishing regular content focused on the "beyond access" theme. It has so far worked with over 40 DRE companies and research organizations to spotlight their work on healthcare, agriculture, education, micro-enterprise, innovation, jobs and finance. **In addition, Power for All has secured media coverage in other leading national and global publications, including a story in The Economist that highlighted the** success of

Global Commission to End Energy Poverty

2020 REPORT ELECTRICITY ACCESS

MITei MIT Energy Initiative

MIT



ELECTRIFYING THE UNDERSERVED

Collaborative Business Models for Developing Minigrids Under the Grid

BY SACHIKO GRABER, OLADIRAN ADESUA, CHIBUIKEM AGBAEGBU, IFEOMA MALO, AND JAMES SHERWOOD

Energy and Economic Growth
Applied Research Programme

The nexus of grids, mini-grids and off-grid options for expanding electricity access

State of knowledge paper

Subhes Bhattacharyya and Debajit Palit

November 2019

Oxford Policy Management

UKaid

POWER SECTOR

PROF (DR.) ANIL KUMAR, HEAD OF DEPARTMENT OF POWER AND INFRASTRUCTURE MANAGEMENT; UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
MR. YASHASWI GYANPURI, UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

Retail Supply Business in Power Distribution

The last stage or the logical end point of power reforms in India is full retail competition, because it avoids the potential conflicts and inefficiencies of the competitive wholesale electricity market.

The Indian Power sector is undergoing important transitional changes after the introduction of reforms and restructuring in trade, industry and commerce. With the introduction of reforms and restructuring in the power sector, the generation of power, which was a State monopoly, was thrown open to private sector in order to bring in private investment.

Power supply and operation of network are two separate businesses in several developed countries. However, the Indian Electricity Act 2003 does not have any explicit provisions to this effect. Though there are enabling provisions for multiple players setting up separate networks in the same circle to supply power, there are few takers for such intra-circle competition with the exception of Mumbai distribution.

To promote competition, the Electricity Act 2003 has laid down a roadmap for utilities to transform from vertically integrated monopolies to unbundled autonomous entities (for profit). It has supported private participation in electricity distribution by providing for multiple distribution licensees and non-discriminatory open access for consumers. Moreover, the business in distribution wires should be optimized to avoid duplication of assets; retail supply can be open to competition.

Stages of Transition of Retail Competition

- Vertically Integrated Monopoly
- Competition in Generation
- Partial Wholesale Competition
- Partial Retail Competition
- Full Retail Competition

The stages above shows Indian Power Sector scenario, till now sector achieved upto third stage, i.e. partial wholesale competition. As the sector is also in the transition stage as it was in many countries, Indian power sector will also move towards in the retail competition. As an initiative, few states started working on retail competition model, in Mumbai. Even though multiple licenses were given to BSES and Tata Power, it is still an initiation to the retail competition.

The Indian Electricity industry is moving towards a multi buyer model characterized by multiple players and bilateral contracting wherein there is a need for separation of wires and supply business thereby introducing competition in the retail supply which is the final stage of the reform process.

Separation of carriage and content (bringing retail supply concept) can definitely bring about transparency in the ATS&C losses in the distribution segment. If the responsibilities of the wires [carrier] business and supply business are separated and given to two distinct entities, the existing perverse tendency of camouflaging theft of electricity (commercial losses) under the overall distribution losses would be discouraged. Also it will create a new class of power retailers adept at buying and selling power without owning the infrastructure.

The retail competition permits all consumers to choose their generator, either directly or through their retailer's choice. Generation is deregulated and regulation does not impose capacity requirements on generators.

Similar to other sectors; power retailers buy electricity in the wholesale exchange and sell it to meet customer need of electricity. Their sustainability and profits depend on their capability to satisfy consumer preferences, consequently promoting low prices and the development of new products to increase efficiency.

The retail model require open access to all wires, whether is high voltage transmission line or low voltage distribution line. This model separates the providing of wires from power service. Customers may purchase their power either directly from the spot market or from one or several competing power retailers. Therefore, open access regulation to wires need to be well established.

Power retail and power distribution is two separate functions. Power retail is the business of buying power from generators or in the spot market and reselling it to final customers. Distribution is the service of carrying electricity from the transmission and distribution network to the consumer.

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Article

Location and Sizing of Micro-Grids to Improve Continuity of Supply in Radial Distribution Networks

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Abstract: The steady decline in the prices of distributed energy resources (DERs), such as distributed renewable generation and storage systems, together with more sophisticated monitoring and control strategies allow power distribution companies to enhance the performance of the distribution network, for instance improving voltage control, congestion management, or reliability. The latter will be the subject of this paper. This paper addresses the improvement of continuity of supply in radial distribution grids in rural areas, where traditional reinforcements cannot be carried out because they are located in secluded areas or in naturally protected zones, where the permits to build new lines are difficult to obtain. When a contingency occurs in such a feeder, protection systems isolate it, and all downstream users suffer an interruption until the service is restored. This paper proposes a novel methodology to determine the optimal location and size of micro-grid systems (MGs) used to reduce non-served energy, considering reliability and investment costs. The proposed model additionally determines the most suitable combination of DER technologies. The resulting set of MGs would be used to supply consumers located in the isolated area while the upstream fault is being repaired. The proposed methodology is validated through its application to a case study of an actual rural feeder which suffers from reliability issues due to the difficulties in obtaining the necessary permissions to undertake conventional grid reinforcements.

Keywords: Micro-grids; continuity of supply; power distribution; power system planning

1. Introduction

The digitalization of the energy industry represents a turning point in the sector development [1]. In the case of electricity network planning [2], until the end of the 20th century, networks were mainly composed of a set of passive assets governed by electromechanical protection elements. With the sector digitalization, a wide range of possibilities enabling an increase in global social welfare has been opened. Regarding system planning and operation, these possibilities are translated into new management strategies that allow optimizing the performance of the system.

Nowadays, the levels of monitoring and control of transmission grids are fairly high; however, transmission only accounts for 3% of the total length of the European electricity network [3]. The remaining 97% corresponds to the distribution system [4], whose monitoring levels are significantly lower, especially in the case of rural networks [5]. These grids are mostly radial. Consequently, a failure in any of the network elements usually implies the loss of supply for all customers located

Distribution Utilities Forum

RURAL ELECTRIFICATION: IMPACT ON DISTRIBUTION COMPANIES IN INDIA

A study to highlight the real and perceived implications on power distribution companies due to the large-scale intensification of rural electrification in India.

Bigsna Gill | Astha Gupta | Debajit Palit

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4. The role of regulators

“As for the future, your role is not to foresee, but to enable it”

Antoine de Saint Éxupéry

Thank you

MITei

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