MITei
MIT Energy Initiative

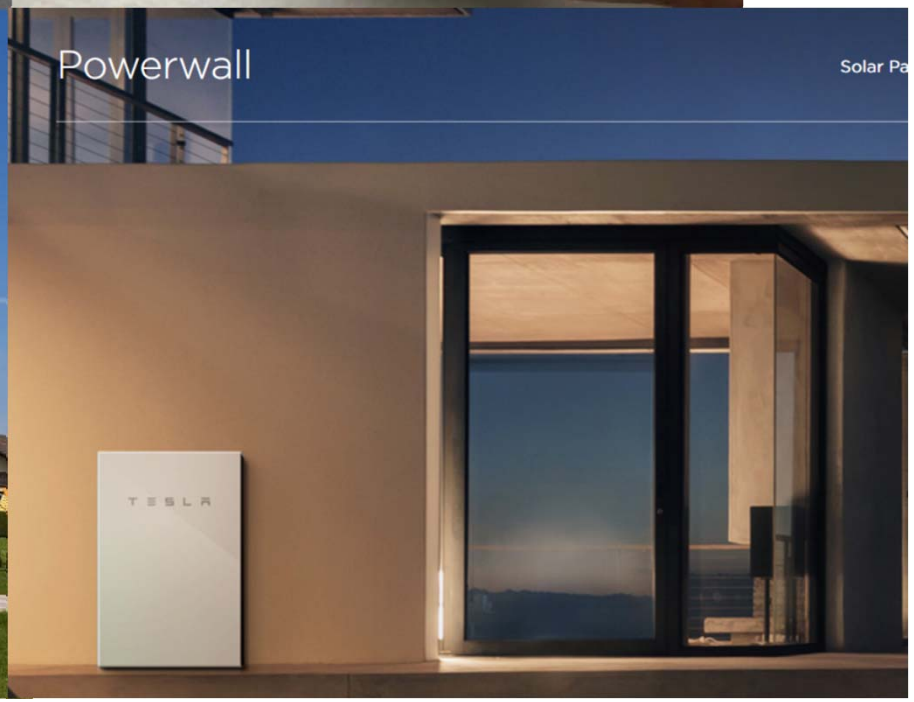
UTILITY OF THE FUTURE

An MIT Energy Initiative response to an industry in transition

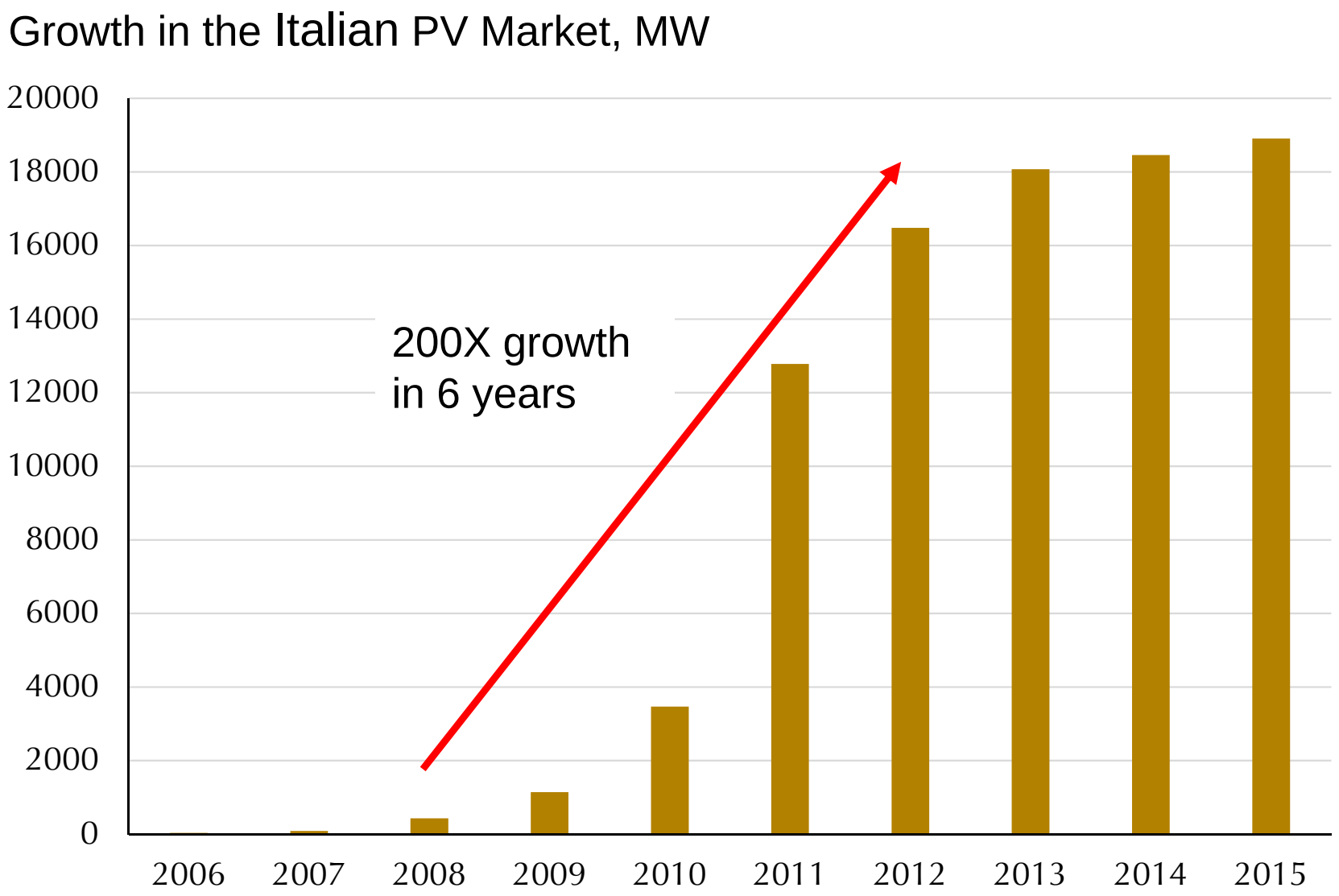
In collaboration with IIT-Comillas

Universidad Pontificia ICAI ICADE Comillas Madrid
Instituto de Investigación Tecnológica

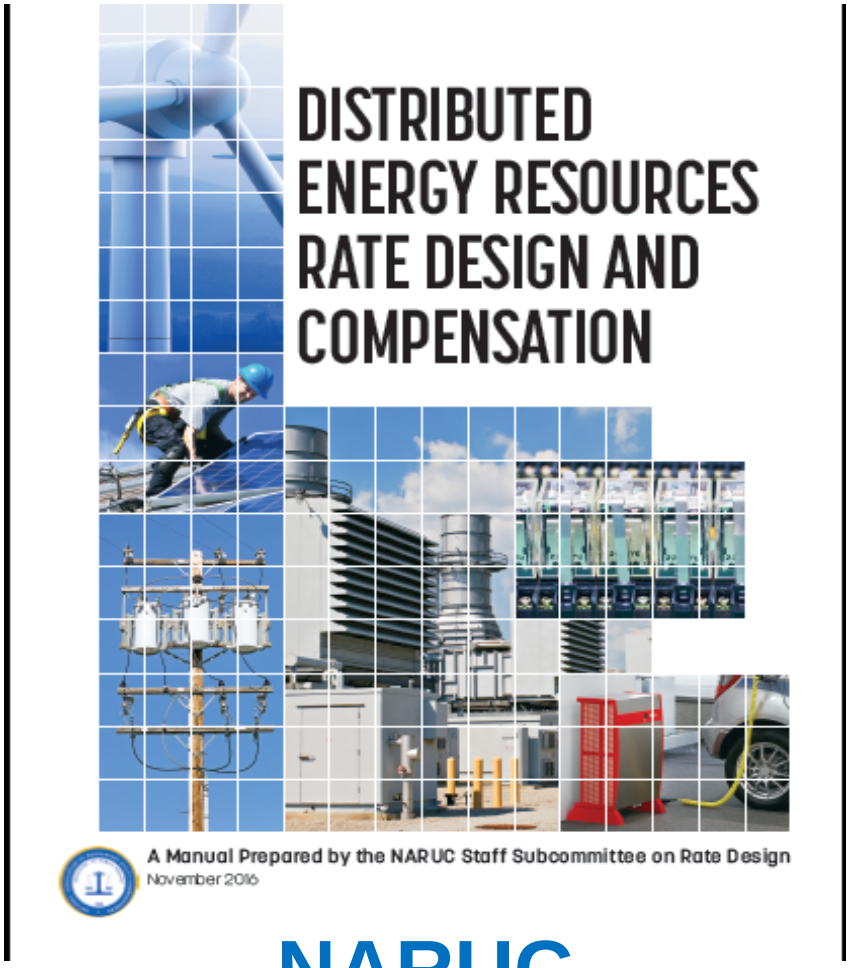
Technologies are ready for the agents to decide how to manage their energy



Customers/investors respond to signals – and can act very fast!



When the report was about to be published



NARUC

NOVEMBER 10

EU COMMISSION

NOVEMBER 30

Two preliminary clarifications

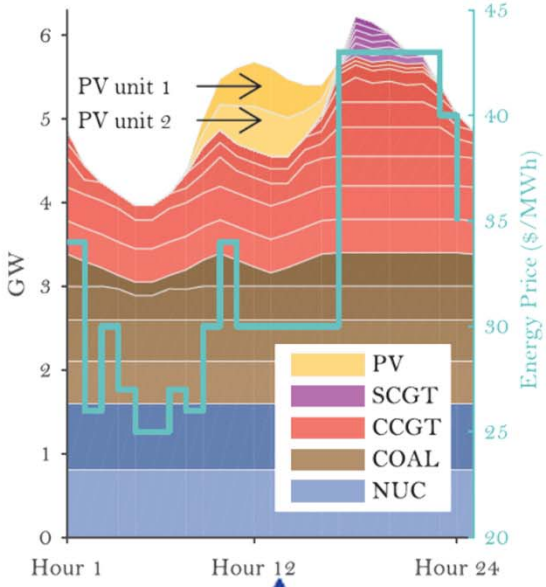
The study is about the future of the provision of electricity services

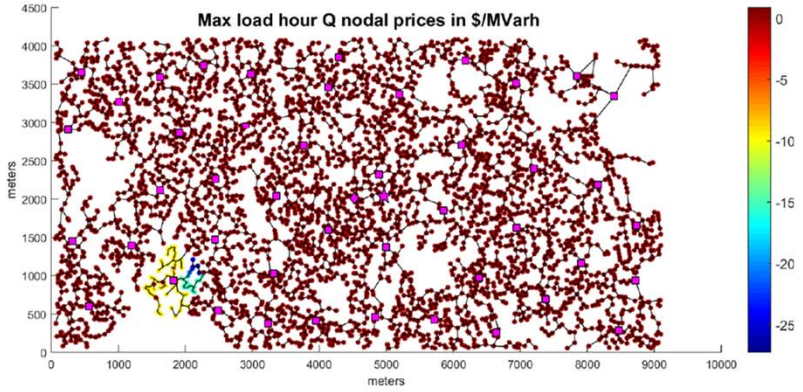
"L'avenir, tu n'as point à le prévoir mais à le permettre"
Citadelle, Antoine de Saint-Exupéry, 1948

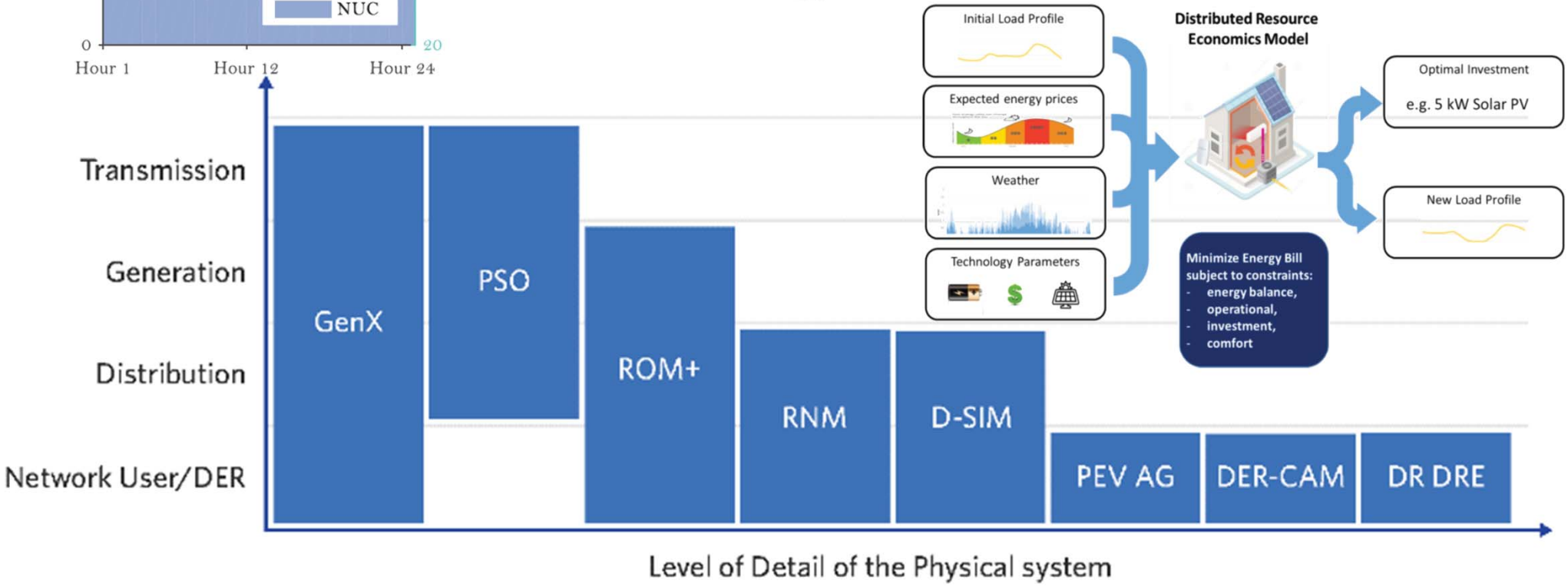
"The future, you do not have to foresee it, but to enable it"

Tools and contributors

The approach: the modeling tools







The Research Team

Principal Investigators

Ignacio Pérez-Arriaga, Professor, Electrical Engineering, Institute for Research in Technology Comillas Pontifical University; Visiting Professor, MIT Energy Initiative

Christopher Knittel, George P. Shultz Professor of Applied Economics, Sloan School of Management, MIT; Director, CEEPR, MIT

Project Directors

Raanan Miller, Executive Director, Utility of the Future Study, MIT Energy Initiative

Richard Tabors, Visiting Scholar, MIT Energy Initiative

Research Team

Carlos Batlle, Research Scholar, MIT Energy Initiative; Professor, Comillas Pontifical University

Ashwini Bharatkumar, PhD Student, Institute for Data, Systems, and Society, MIT

Michael Birk, SM, Technology and Policy Program, MIT

Scott Burger, PhD Student, Institute for Data, Systems, and Society, MIT

José Pablo Chaves, Research Scientist, Institute for Research in Technology, Comillas Pontifical University

Research Team (continued)

Pablo Duenas-Martinez, Postdoctoral Associate, MIT Energy Initiative

Tomás Gómez, Professor, Director of the Institute for Research in Technology, Comillas Pontifical University

Ignacio Herrero, Research Assistant, Institute for Research in Technology Comillas Pontifical University

Sam Huntington, SM, Technology and Policy Program ('16), MIT

Jesse Jenkins, PhD Candidate, Institute for Data, Systems and Society, MIT

Max Luke, SM, Technology and Policy Program ('16), MIT

Raanan Miller, Executive Director, Utility of the Future Study MIT Energy Initiative

Pablo Rodilla, Research Scientist, Institute for Research in Technology Comillas Pontifical University

Richard Tabors, Visiting Scholar, MIT Energy Initiative

Karen Tapia-Ahumada, Research Scientist, MIT Energy Initiative

Claudio Vergara, Postdoctoral Associate, MIT Energy Initiative

Nora Xu, SM, Technology and Policy Program ('16), MIT

Faculty Committee

Robert Armstrong, Director, MIT Energy Initiative

Carlos Batlle, Research Scholar, MIT Energy Initiative; Professor, Institute for Research in Technology, Comillas Pontifical University

Michael Caramanis, Professor of Mechanical Engineering and Systems Engineering, Boston University

John Deutch, Institute Professor, Department of Chemistry, MIT

Tomás Gómez, Professor, Director of the Institute for Research in Technology, Comillas Pontifical University

William Hogan, Raymond Plank Professor of Global Energy Policy, John F. Kennedy School of Government, Harvard University

Steven Leeb, Professor, Electrical Engineering & Computer Science and Mechanical Engineering, MIT

Richard Lester, Associate Provost and Japan Steel Industry Professor of Nuclear Science and Engineering, Office of the Provost, MIT

Leslie Norford, Professor, Department of Architecture, MIT

John Parsons, Senior Lecturer, Sloan School of Management, MIT

Richard Schmalensee, Howard W. Johnson Professor of Economics and Management, Emeritus
Dean, Emeritus, Sloan School of Management, MIT

Research and Project Advisors

Lou Carranza, Associate Director, MIT Energy Initiative

Stephen Connors, Director, Analysis Group for Regional Energy Alternatives, MIT Energy Initiative

Cyril Draffin, Project Advisor, MIT Energy Initiative

Paul McManus, Master Lecturer, Questrom School of Business, Boston University

Álvaro Sánchez Miralles, Senior Associate Professor, Institute for Research in Technology, Comillas Pontifical University

Francis O'Sullivan, Research Director, MIT Energy Initiative

Robert Stoner, Deputy Director for Science and Technology, MIT Energy Initiative

Advisory Committee

Chair: Phil Sharp, President, Resources for the Future

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Alain Burtin, Director, Energy Management, EDF R&D

Paul Centolella, President, Paul Centolella & Associates LC, Senior Consultant, Tabors Caramanis Rudkevich

Martin Crouch, Head of Profession for Economists and Senior Partner, Improving Regulation, Ofgem

Elizabeth Endler, Research Program Manager, Shell International Exploration & Production (US) Inc.

Phil Giuidice, CEO, President, and Board Member, Ambri Inc.

Timothy Healy, CEO, Chairman and Co-founder, EnerNOC

Mariana Heinrich, Manager, Climate & Energy, World Business Council for Sustainable Development

Paul Joskow, President and CEO, Alfred P. Sloan Foundation, MIT Professor Emeritus

Melanie Kenderdine, Director of the Office of Energy Policy and Systems Analysis and Energy Counselor to the Secretary, U.S. Department of Energy

Christina La Marca, Head of Innovation, Global Thermal Generation, Enel

Alex Laskey, President & Founder, Opower

Andrew Levitt, Sr. Market Strategist, PJM Interconnection

Luca Lo Schiavo Deputy Director, Infrastructure Regulation, Italian Regulatory Authority for Electricity, Gas and Water (AEEGSI)

Gary Rahl, Executive Vice President, Booz Allen Hamilton

Mark Ruth, Principal Project Lead, Strategic Energy Analysis Center, National Renewable Energy Laboratory

Miguel Sánchez-Fornie, Director, Global Smart Grids, Iberdrola

Manuel Sánchez-Jiménez, Team Leader, Smart Grids, European Commission

Laurent Yana, Director Advisor of Global Bus, Group Strategy Division, Engie

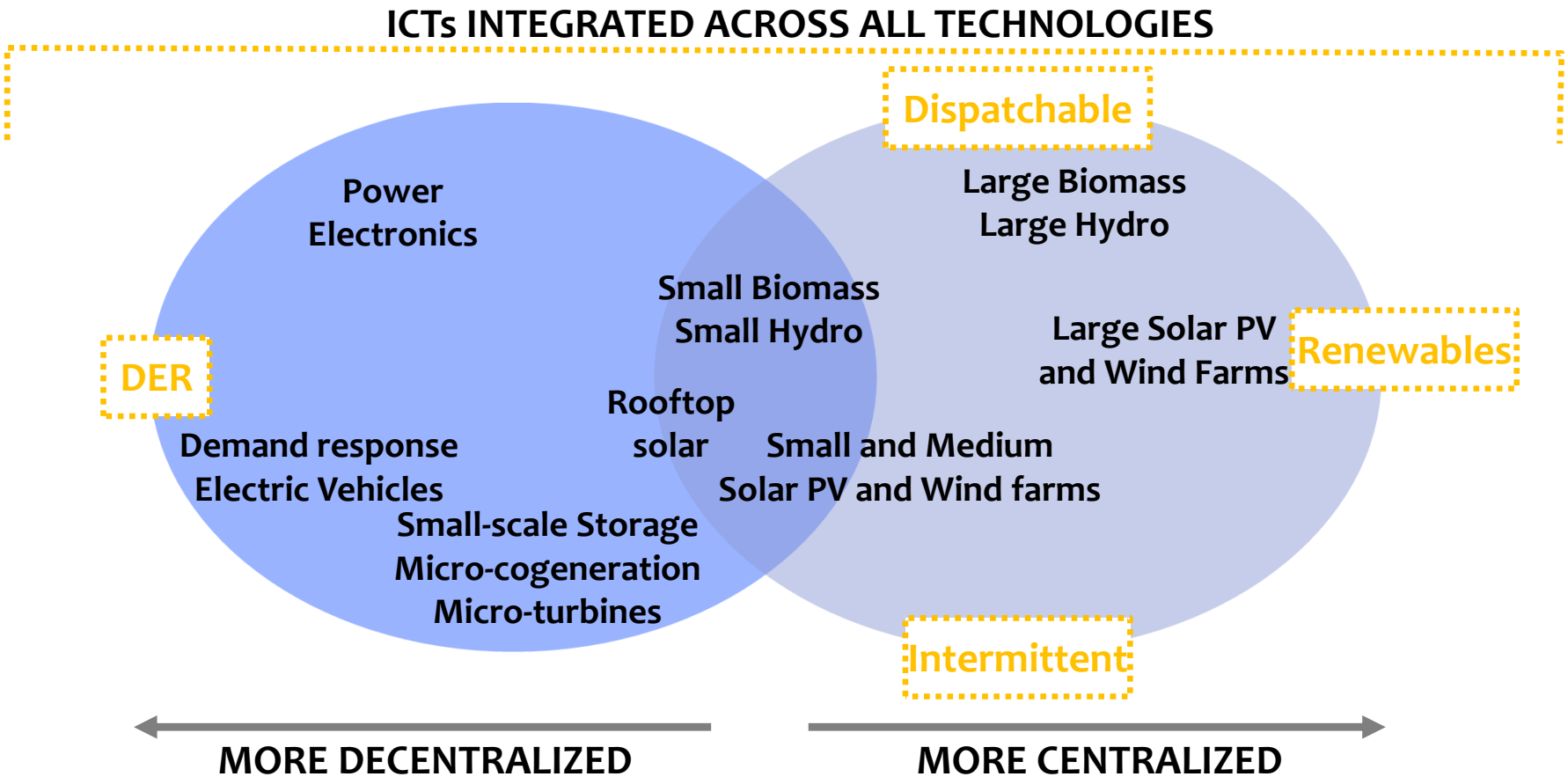
Audrey Zibelman, Chair, New York State Public Service Commission

Consortium members

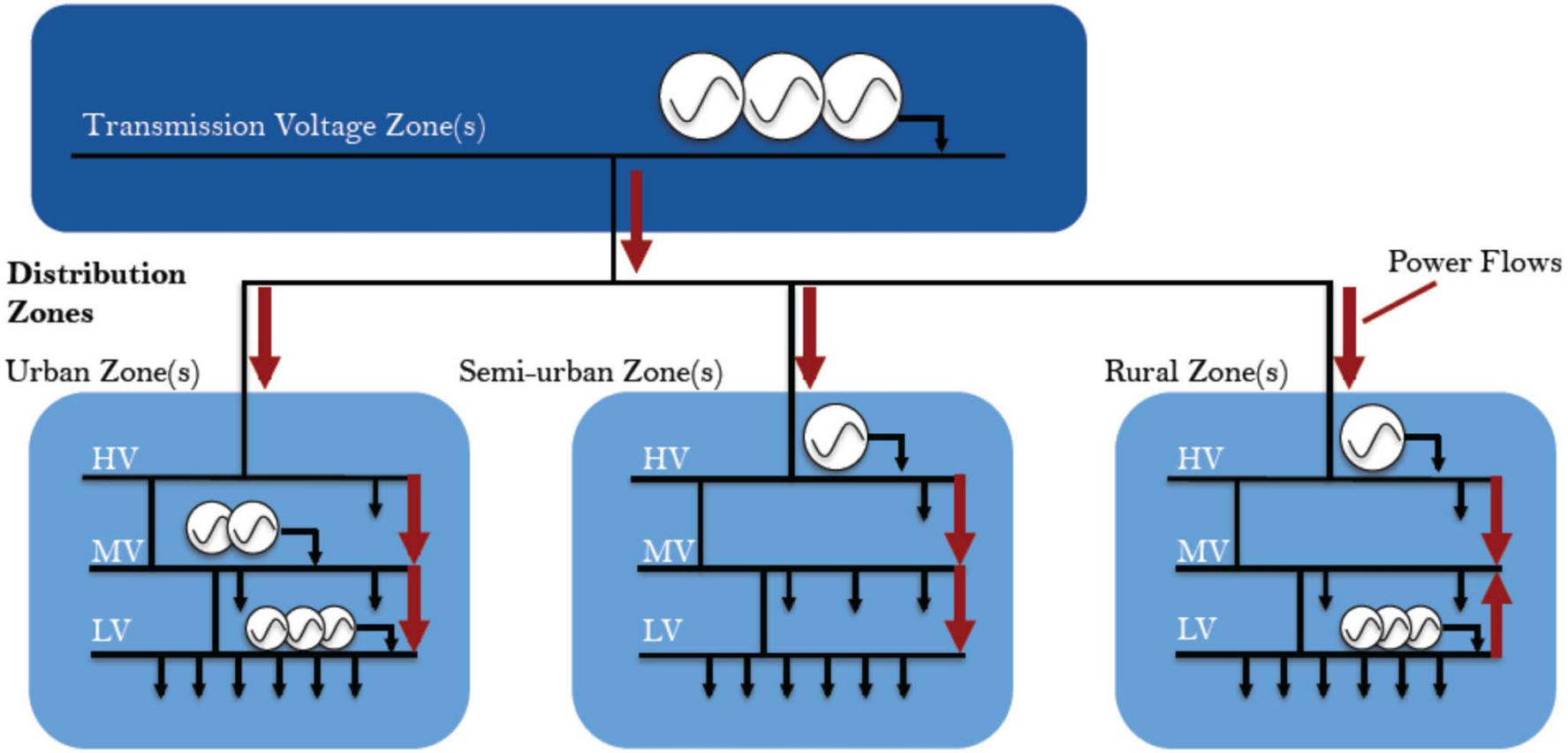
Paul & Matthew Mashikian

Scope & key recommendations

Understanding Electricity Services and How DERs Affect the Design and Operation of Power Systems



Insights on the Economics of DERs and the Competition between Centralized and DERs



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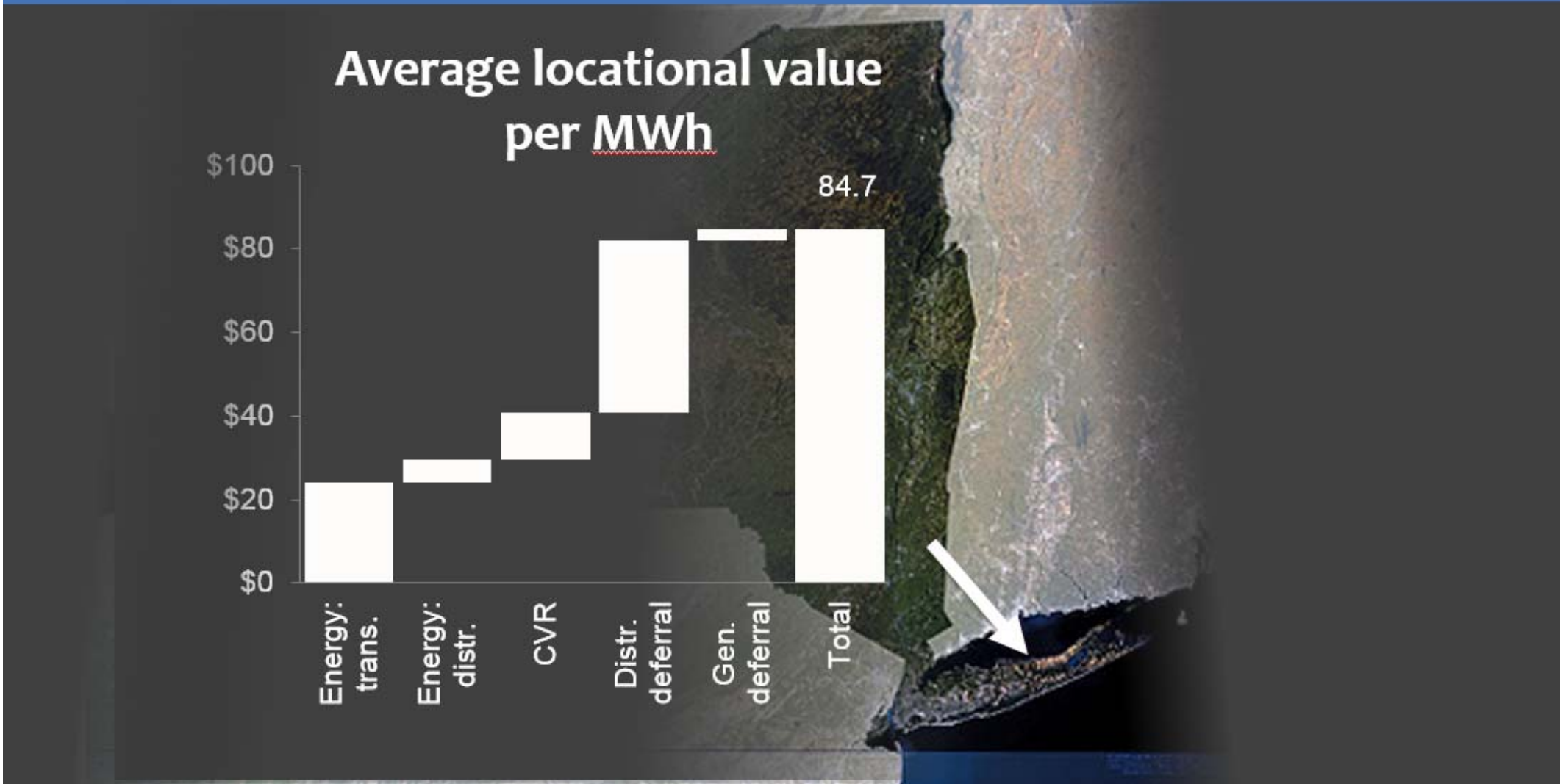

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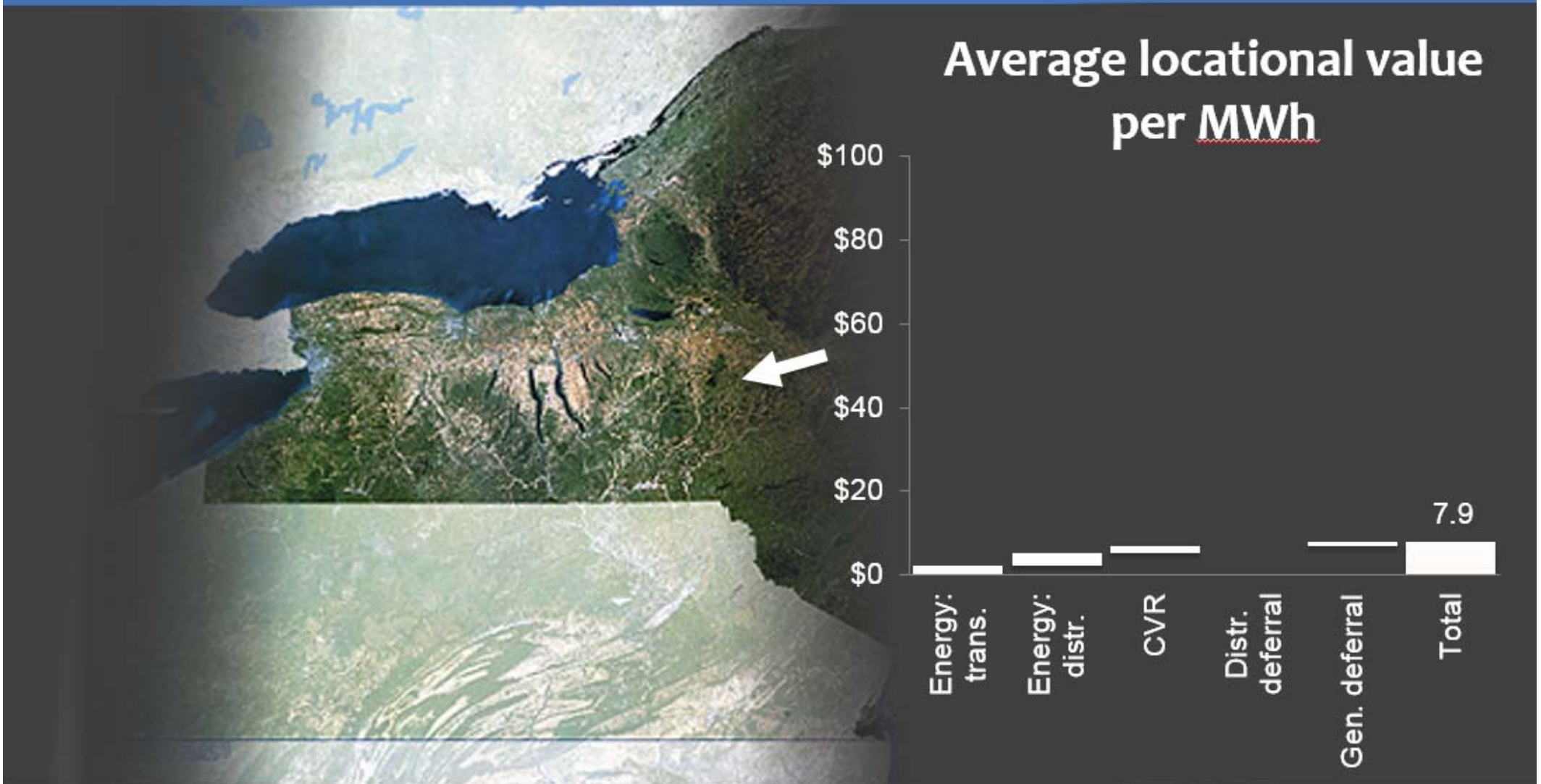


Is the future distributed?

The future is integrated

Regulation & markets

Creating a level playing field

A framework for an efficient and evolving power system

4. A Comprehensive and Efficient **System of Prices and Regulated Charges** for Electricity Services

5. The Future of the **Regulated Network Utility Business Model**

6. Restructuring Revisited: Electricity **Industry Structure** in a More Distributed Future

7. The **Re-Evolution** of Short- and Long-Term Electricity **Market Design**

KEY RECOMMENDATIONS

1. Cost-reflective prices and charges

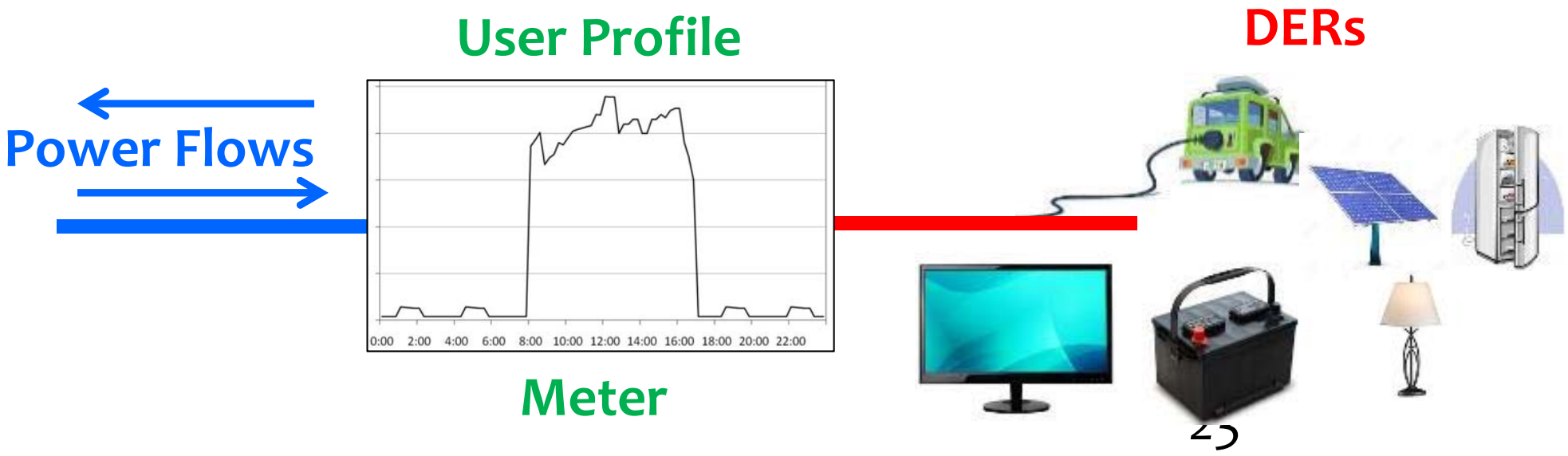
Power rates

The traditional world

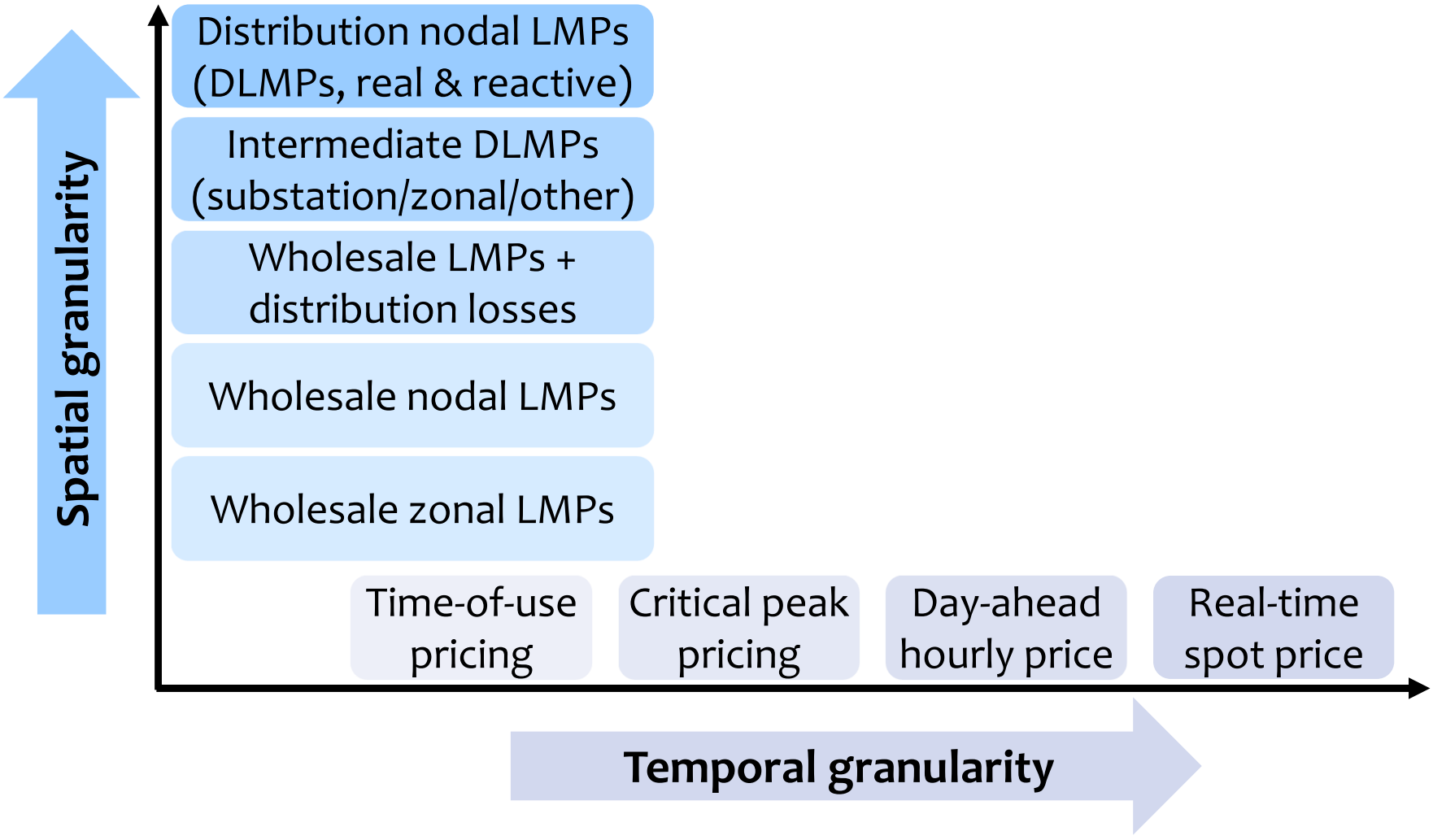
		Winter			Summer		
		Peak	Intermediate	OFF-peak	Peak	Intermediate	Off-peak
LV <1kV	1 tz.	€/kW €/kWh €/customer					
	2 tz.	€/kW €/kWh €/customer			€/kW €/kWh €/customer		
	3 tz.	€/kW €/kWh €/customer		€/kW €/kWh €/customer		€/kW €/kWh €/customer	
MV >1kV y <33kV	3 tz.	€/kW €/kWh €/customer		€/kW €/kWh €/customer		€/kW €/kWh €/custom	
	6 tz.	€/kW €/kWh €/customer	€/kW €/kWh €/customer	€/kW €/kWh €/customer	€/kW €/kWh €/customer	€/kW €/kWh €/customer	€/kW €/kWh €/customer
HV >33kV y <72kV	6 tz.	€/kW €/kWh €/customer	€/kW €/kWh €/customer	€/kW €/kWh €/customer	€/kW €/kWh €/customer	€/kW €/kWh €/customer	€/kW €/kWh €/customer
VHV >72kV y <220kV	6 tz.	€/kW €/kWh €/customer	€/kW €/kWh €/customer	€/kW €/kWh €/customer	€/kW €/kWh €/customer	€/kW €/kWh €/customer	€/kW €/kWh €/customer

Prices and charges

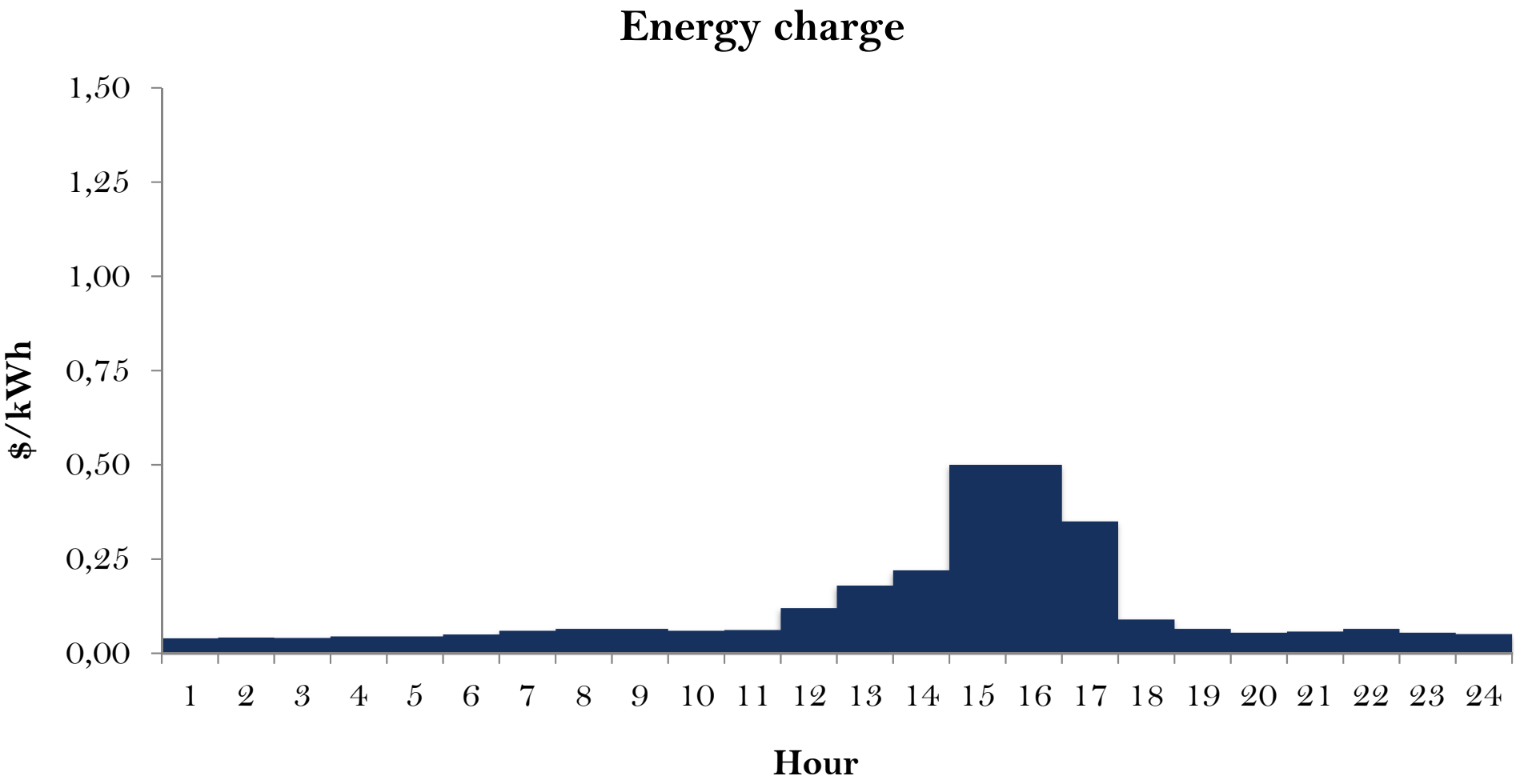
- Based on the individual injection & withdrawal profiles
  - Symmetrical
  - Avoiding going behind the meter



Optimize the granularity of price signals with respect to both time and location



Forward-looking peak-coincident charges: networks and firm capacity



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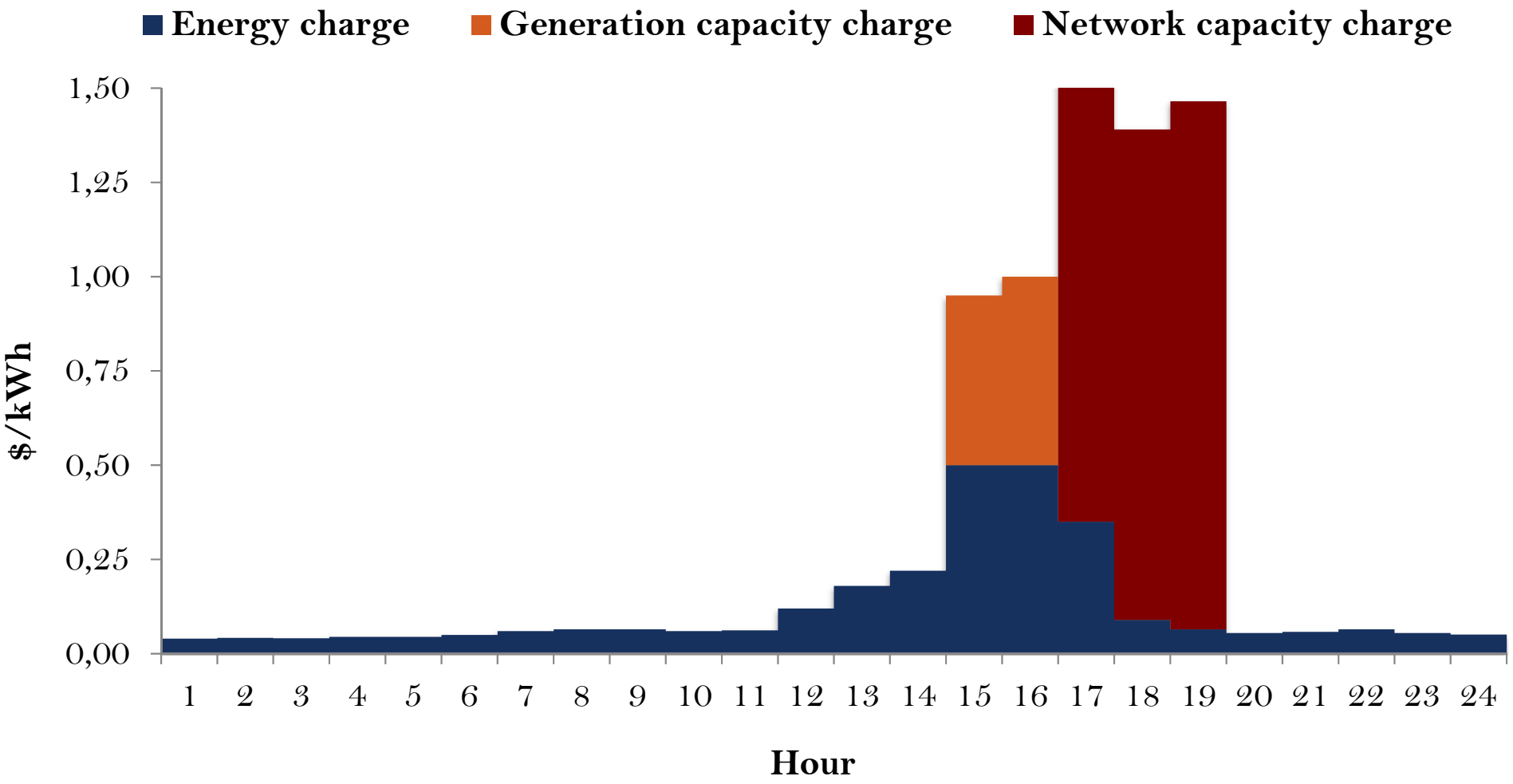
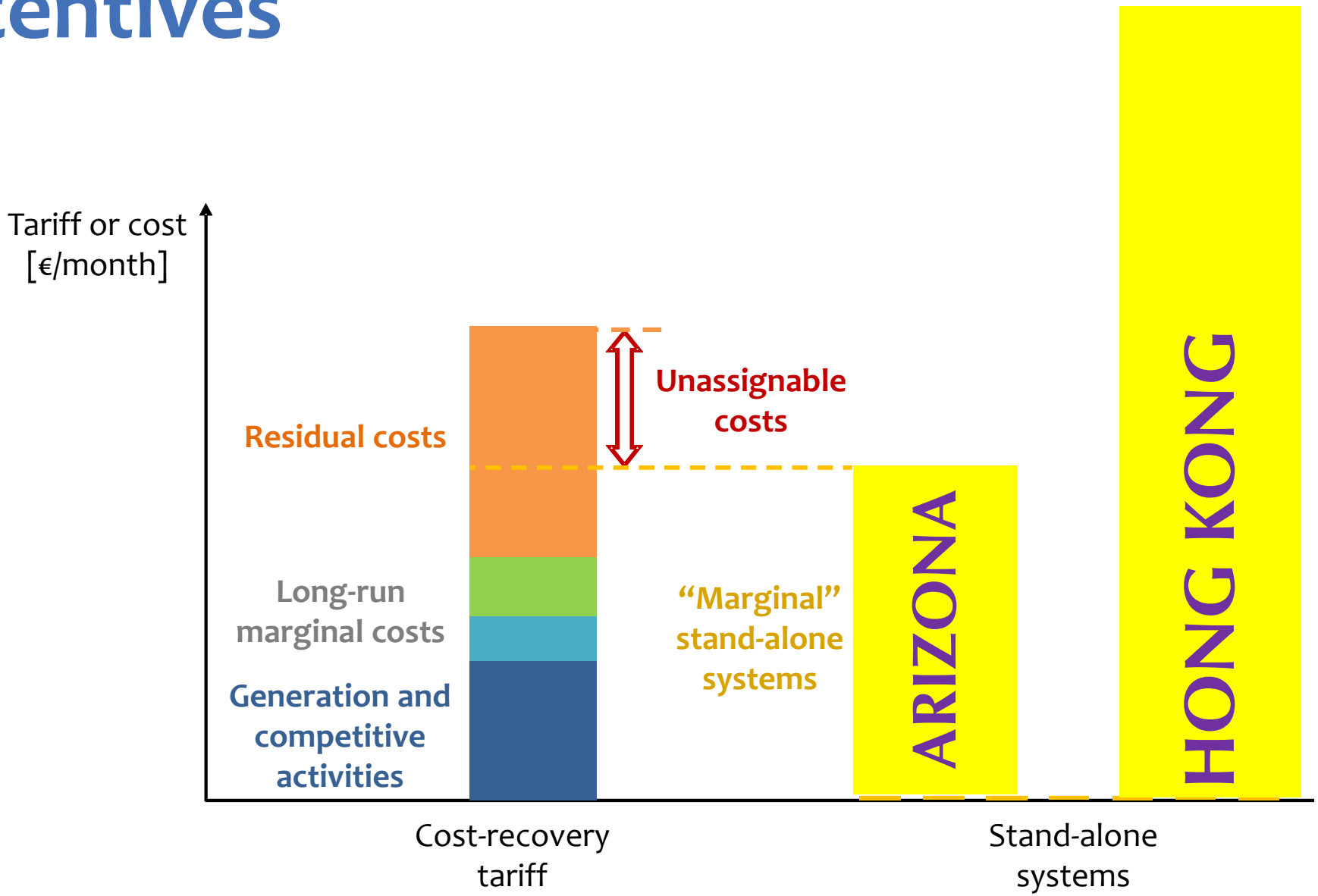


Allocate residual network and policy costs without distorting efficient incentives



2. Improved network regulation

State of the art regulatory tools to reduce information asymmetry & manage uncertainty

Incentive-compatible menu of contracts

- to induce accurate utility forecasts and minimize strategy behavior

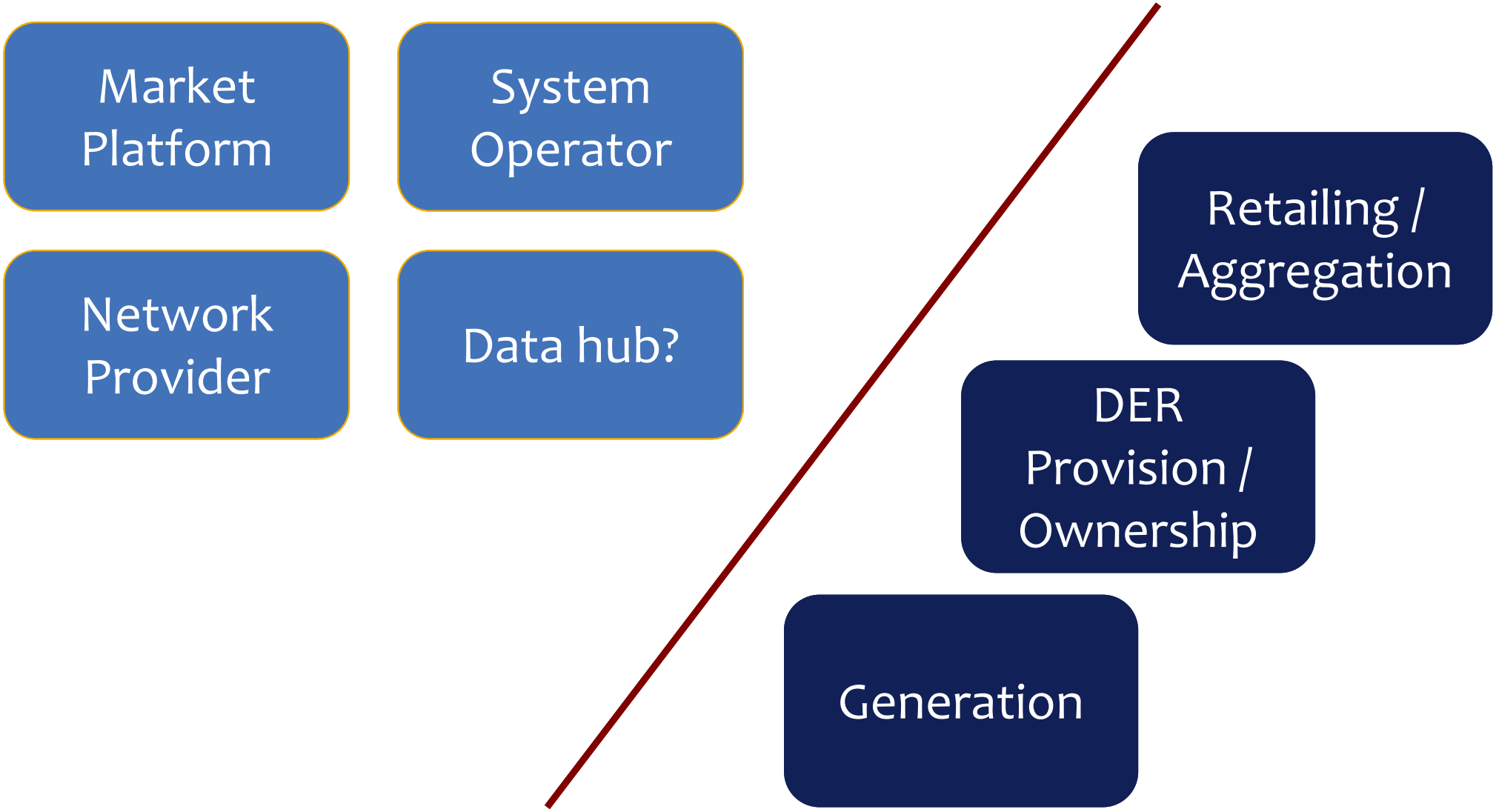
Engineering-based reference network models

- to equip regulators for forward-looking benchmarks and analyze uncertainty scenarios

See Jenkins & Pérez-Arriaga (2017), "Improved Regulatory Approaches for the Remuneration of Electricity Distribution Utilities with High Penetrations of Distributed Energy Resources," *The Energy Journal* 38(3): 63-91

3. Revisit industry structure

Carefully assign responsibility to minimize potential conflicts of interest




4. Update electricity markets

Enable new resources to play in existing and emerging markets

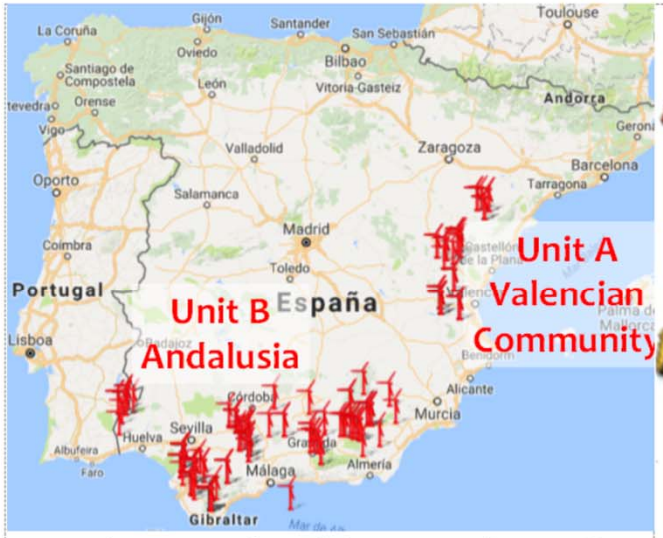
Update wholesale **market rules** (such as bidding formats and products) to reflect the operational constraints of new resources

- Long-term
- Spot
- Reserves

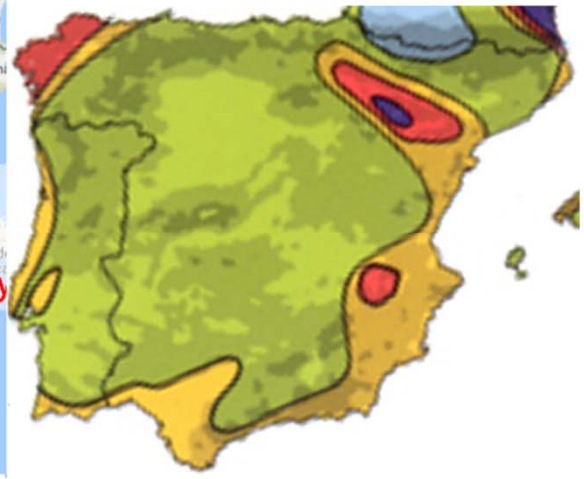
US vs EU best practices

Minimize the interference of support mechanisms for clean technologies in electricity markets

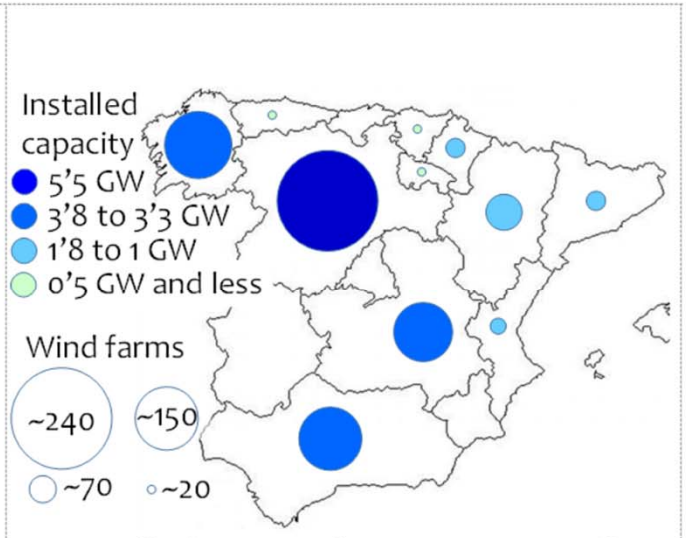
Auctioned **capacity-based subsidies** complemented with ex-post compensations defined for reference benchmark plants



A. Valencia and Andalusia wind maps[10]



B. Iberian Peninsula wind atlas[11]



C. Installed capacity by regions in 2015[12]

A Policy and Regulatory Toolkit for the Future Power System

IN SUMMARY, WHAT THE STUDY PROPOSES

- **can be gradually implemented** with existing technology and reasonable regulatory measures
- **sets a level playing field** for competition of centralized and distributed resources
- **enabling an efficient outcome** regardless of the future development of technologies or policy objectives

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