Cost-reflective prices and charges: from theory to implementation

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The future of electricity distribution network and tariff policy
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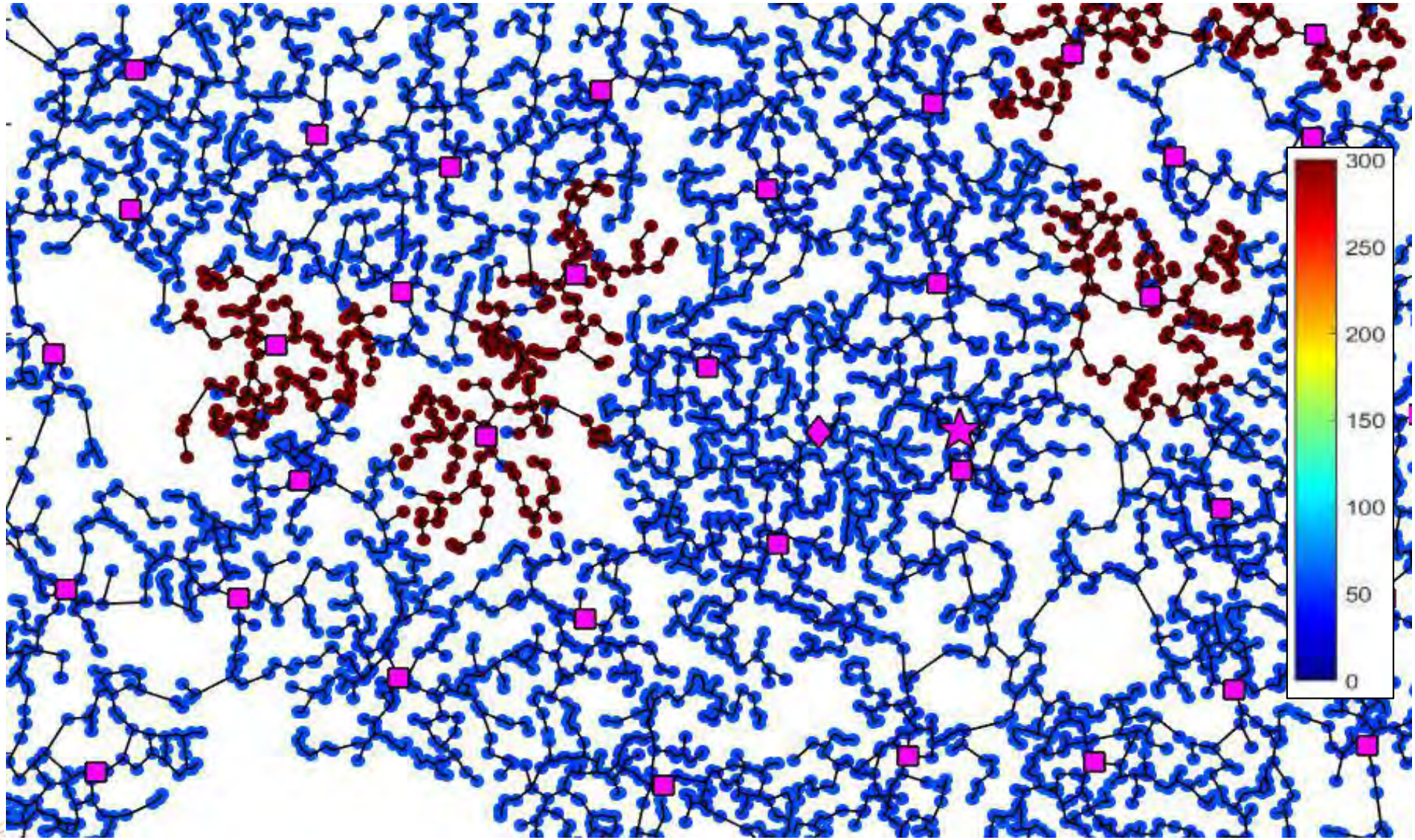
Well-known introductory facts*

* Already, or sooner or later in the theater near you…

Insights on the Economics of DERs

Distribution-level active power LMPs

- **Caused by network congestion**

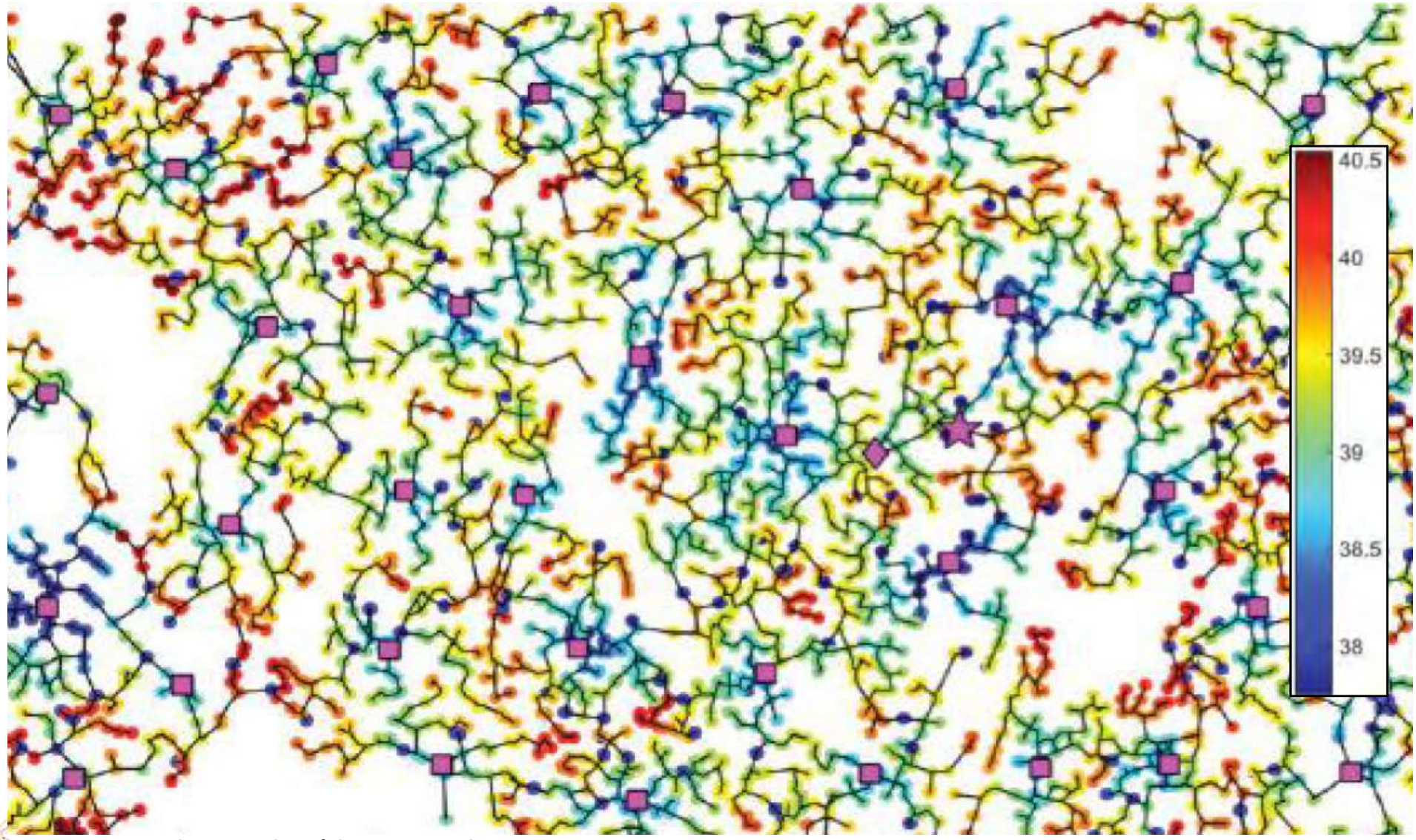


Source: The MIT Utility of the Future Study

Insights on the Economics of DERs

Distribution-level active power LMPs

- **Caused by network losses**



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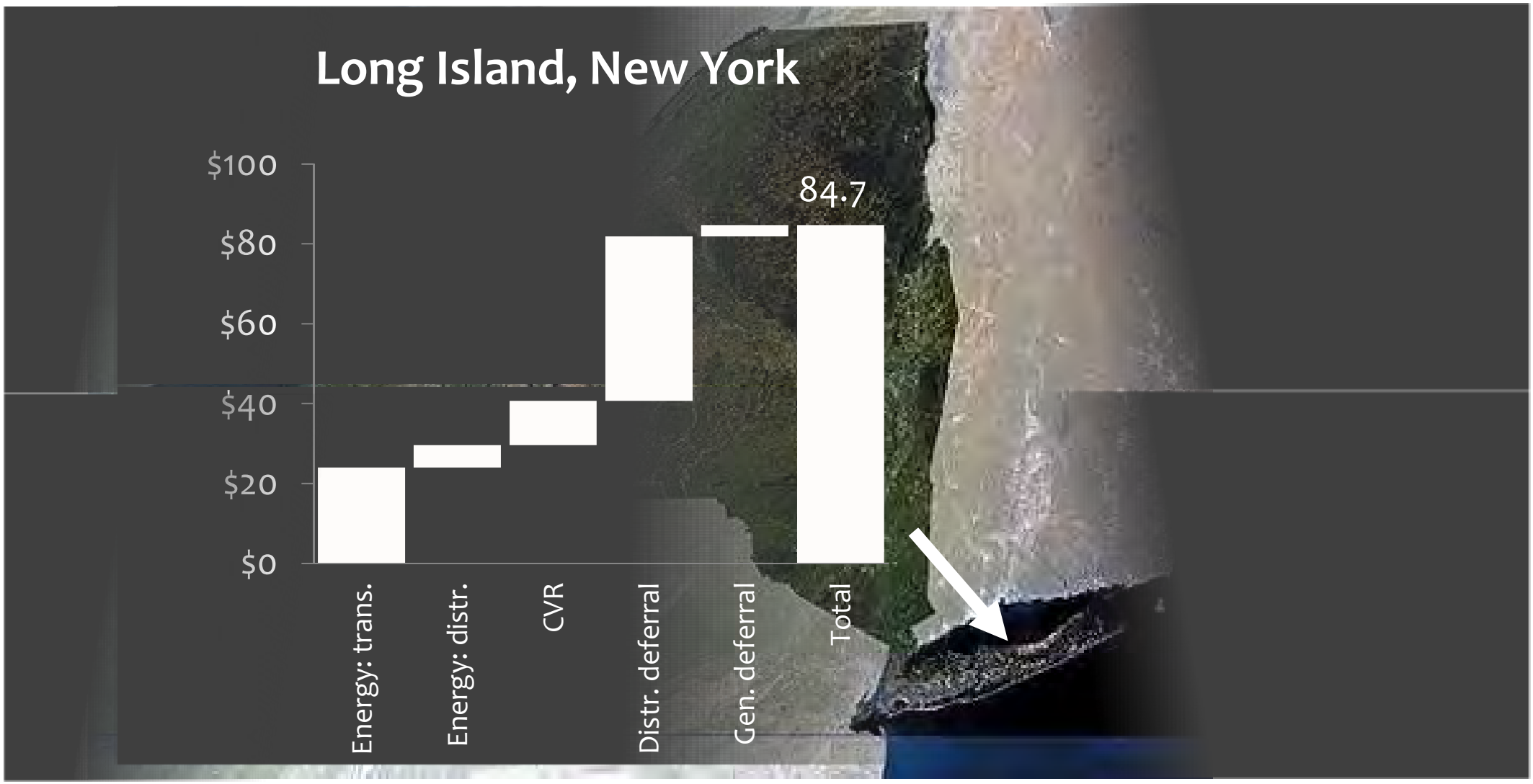
Insights on the Economics of DERs

Average locational value per MWh

- **Distributed Solar PV (High-Value Example)**



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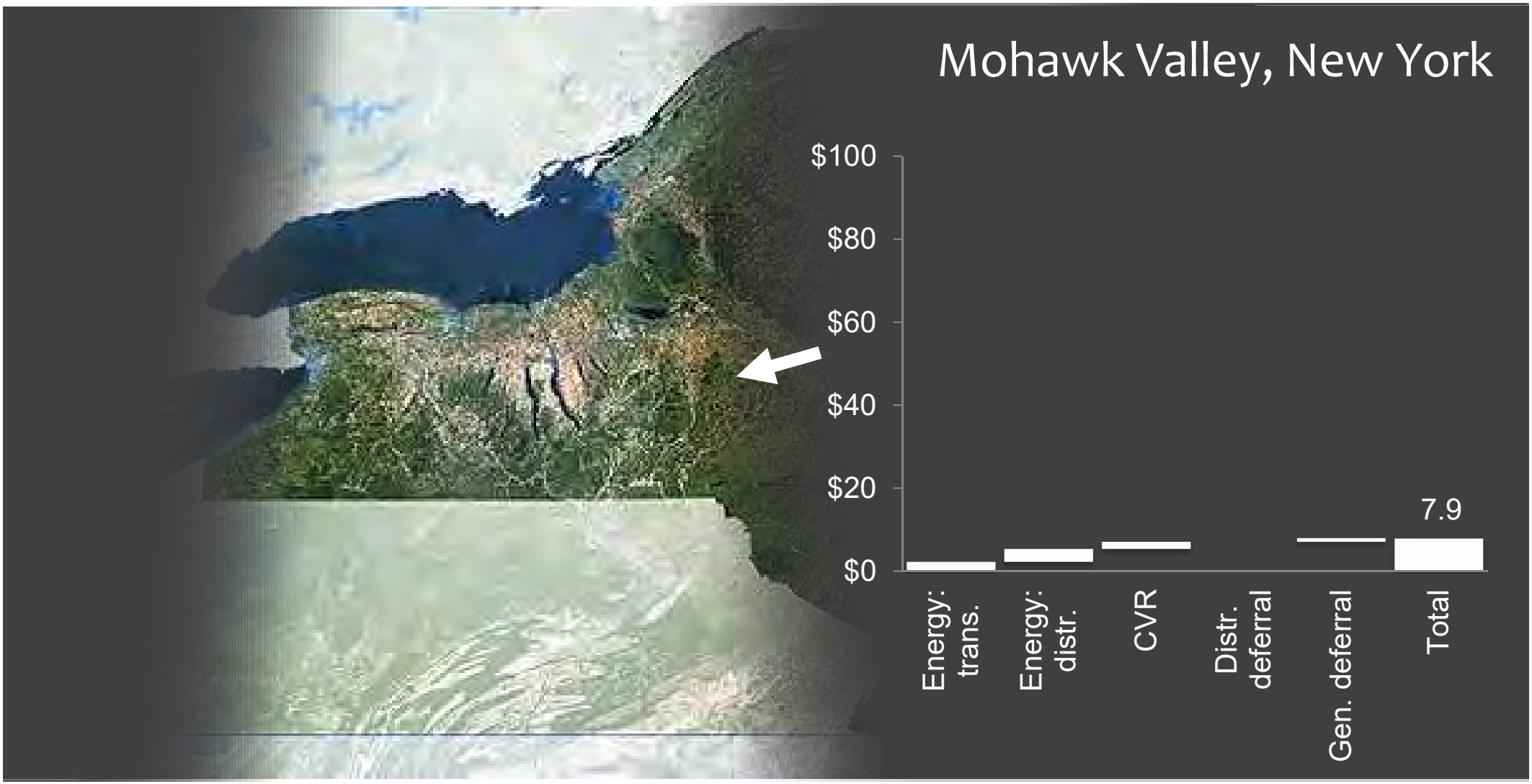
Insights on the Economics of DERs

Average locational value per MWh

- **Distributed Solar PV (Low-Value Example)**



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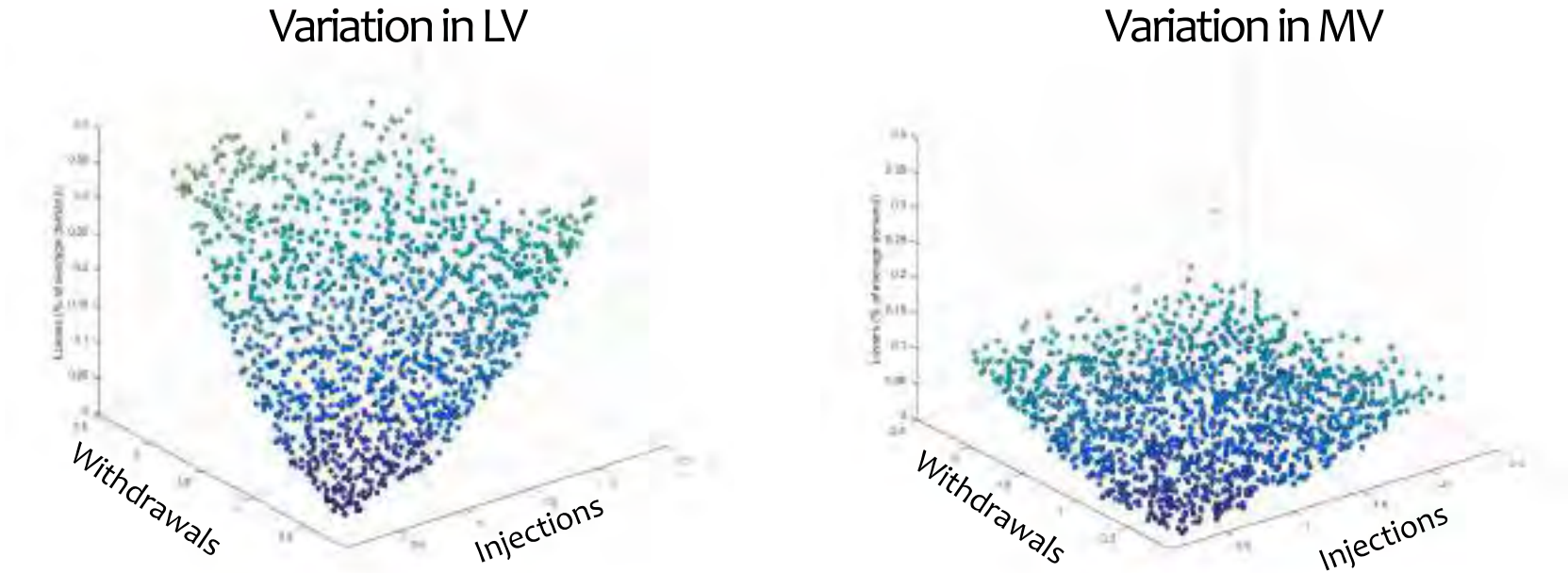
Insights on the Economics of DERs

Drivers of locational value

- **Losses**
- **Capacity constraints and upgrade costs**
- **Local reliability costs**
- **User premium value?**



Semi-urban network results

Source: Jenkins (MIT), forthcoming

From theory…

Basic principles of rate design

- **Two key objectives that prices and charges should accomplish**

  (1) Send efficient economic signals to the agents in the system, and

  (2) Recover the regulated costs

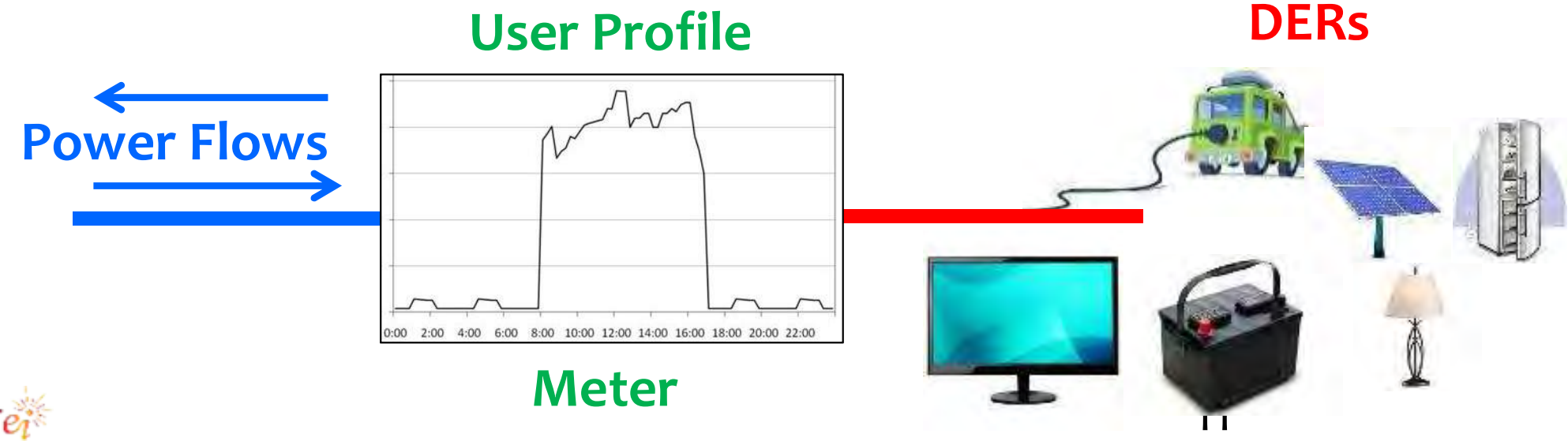
The traditional world

		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

Economic efficiency

Based on the individual network use

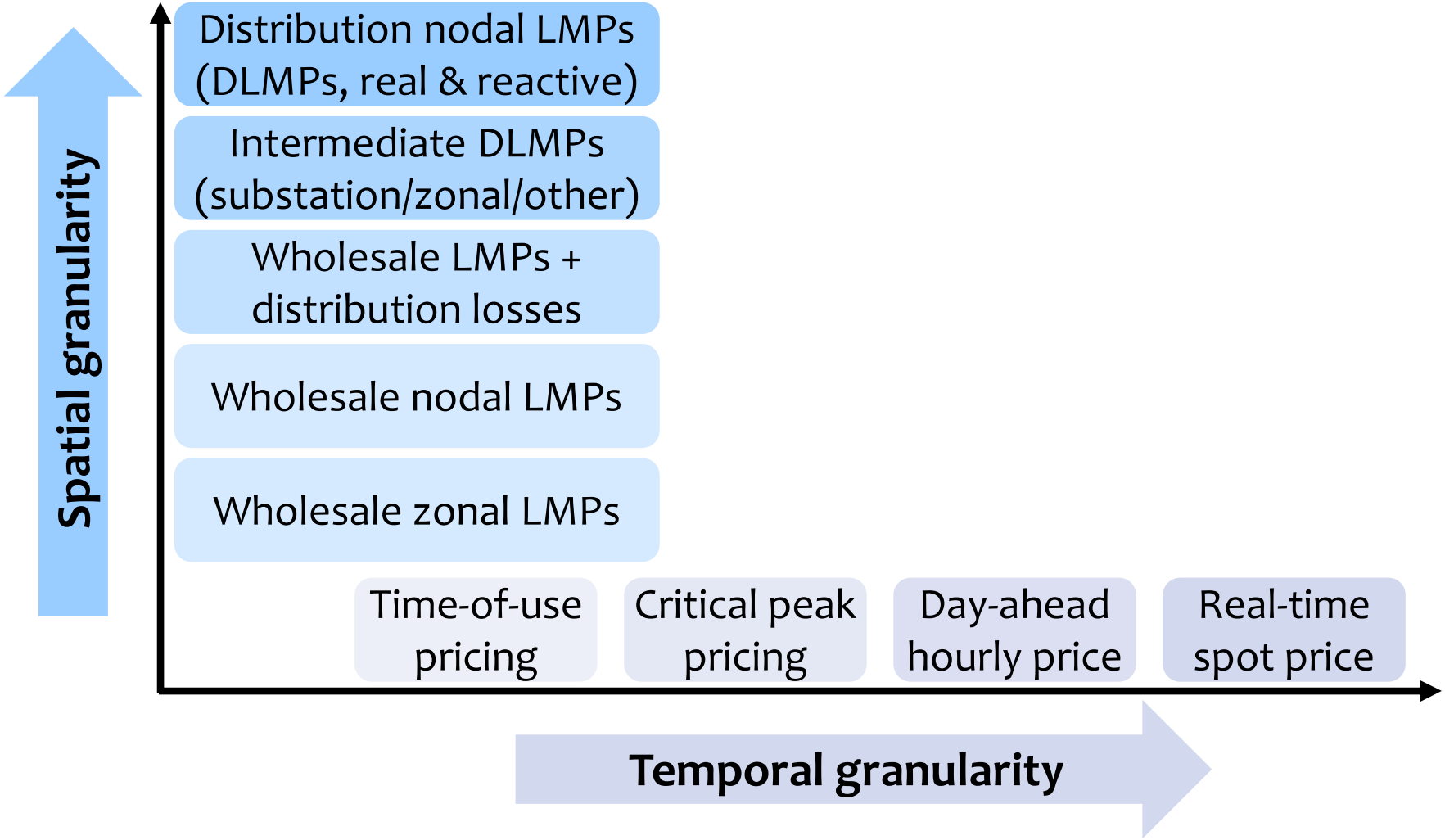
- **Individual injection and withdrawal profiles**
  - Avoiding going behind the meter
- **Symmetrical (at a given time and place)**
  - Compensating injections at the same rate as that charged for withdrawals



(1) Send efficient economic signals efficiency

Temporal and spatial granularity

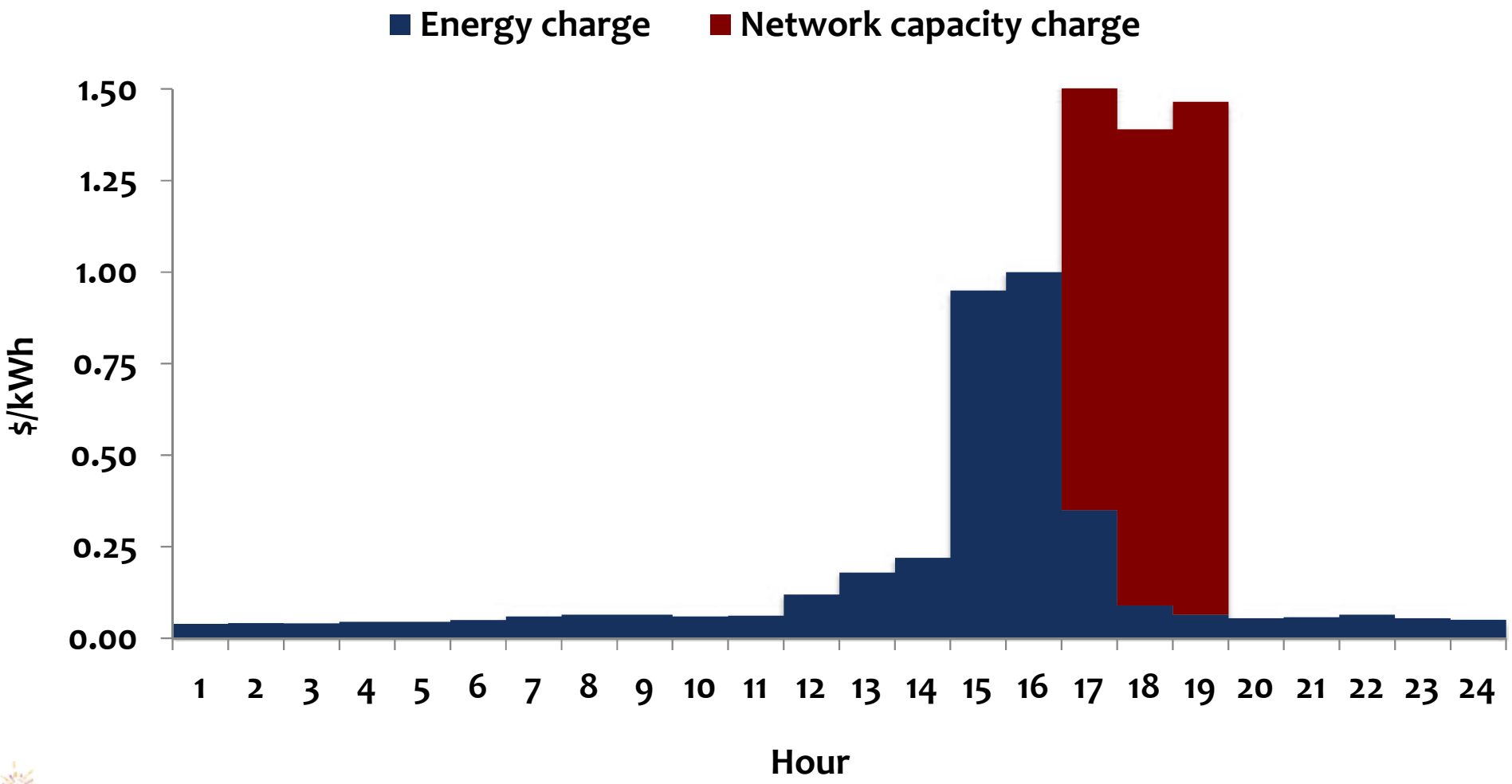
- **Optimize the granularity of price signals with respect to both time and location**



(1) Send efficient economic signals efficiency

Temporal granularity

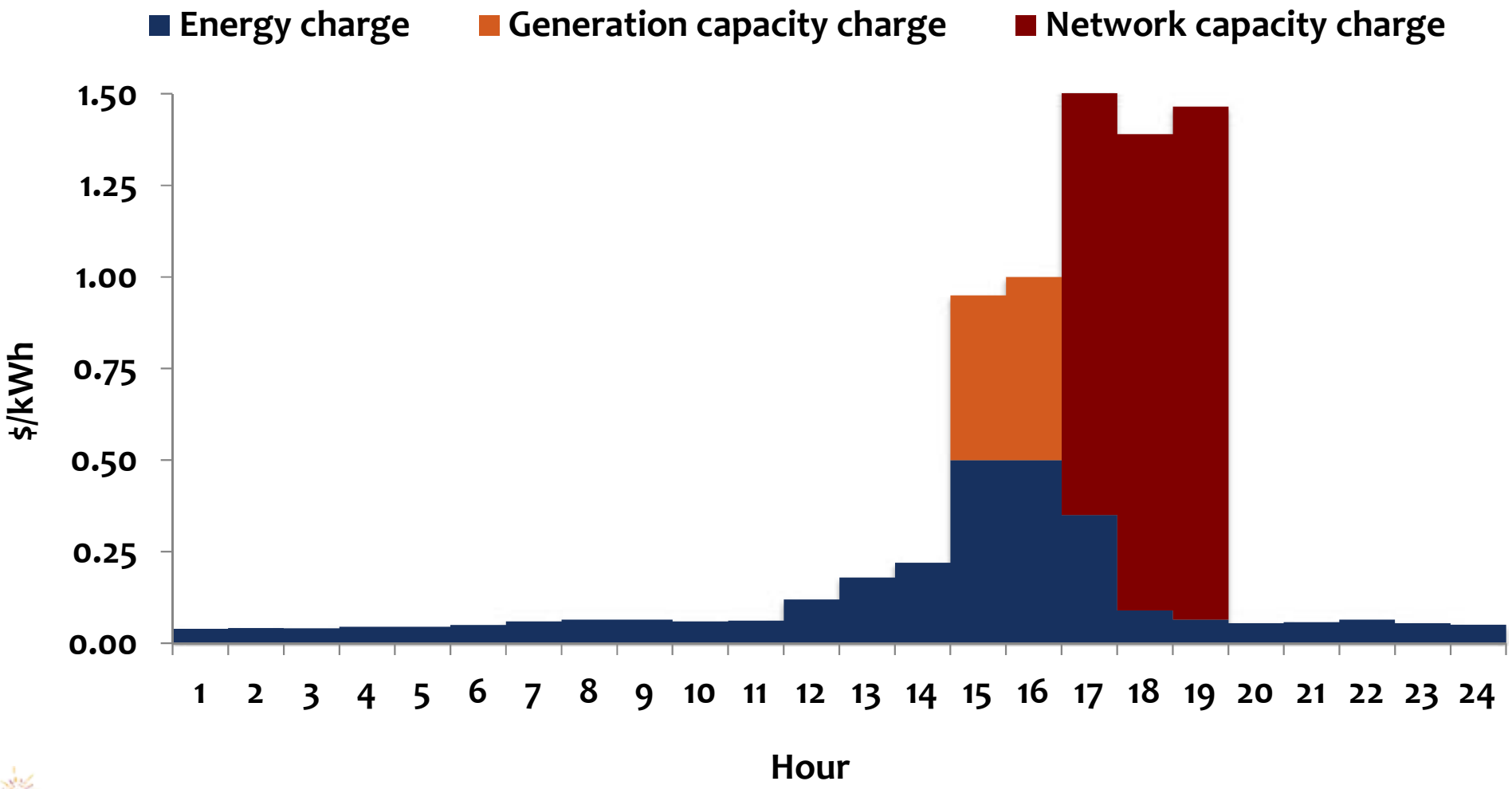
- **Forward-looking peak-coincident network capacity charges**



(1) Send efficient economic signals efficiency

Temporal granularity

- … and scarcity-coincident generation capacity charges



(2) Recover the regulated costs

Allocation of residual regulated costs

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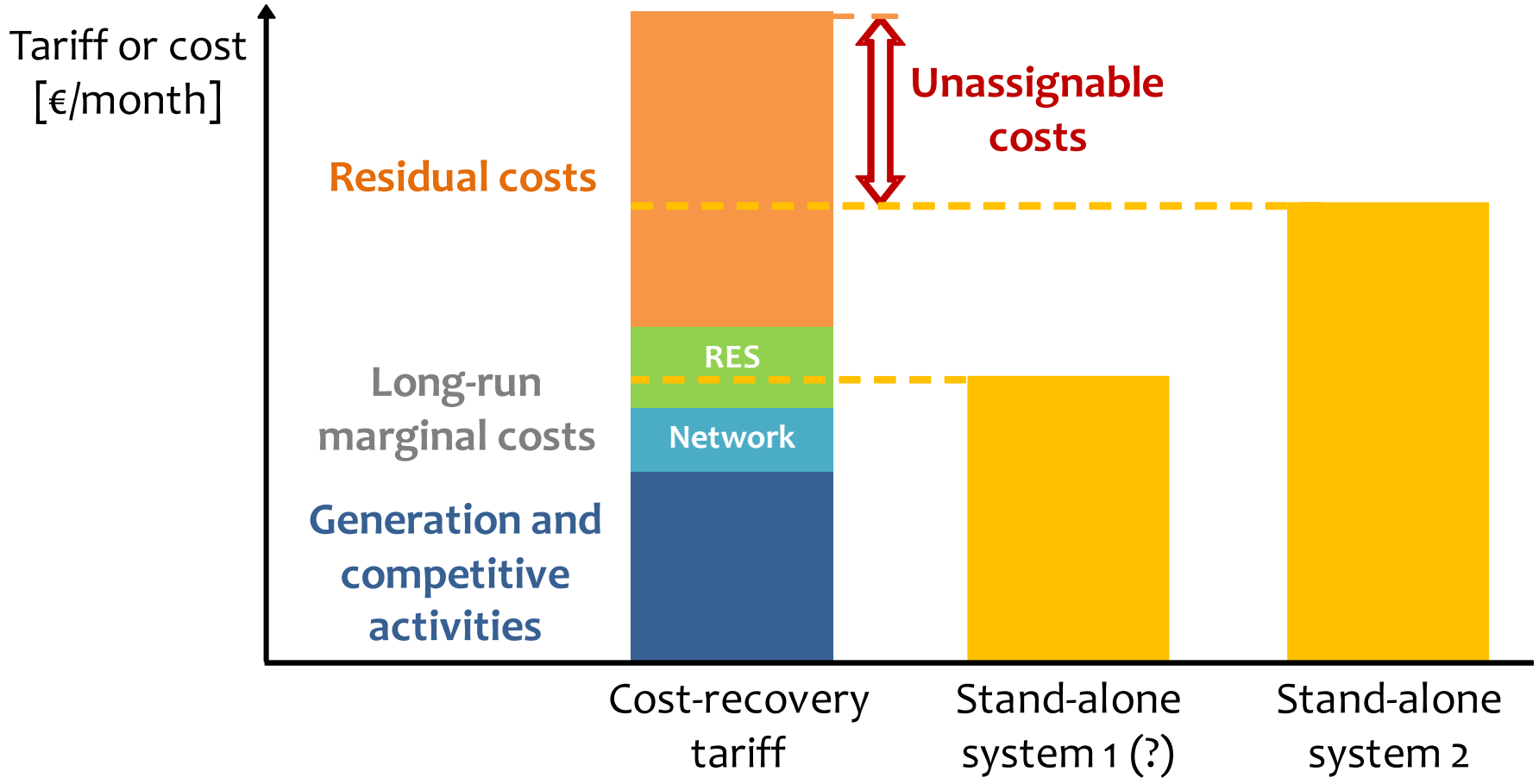
Allocation of residual regulated costs

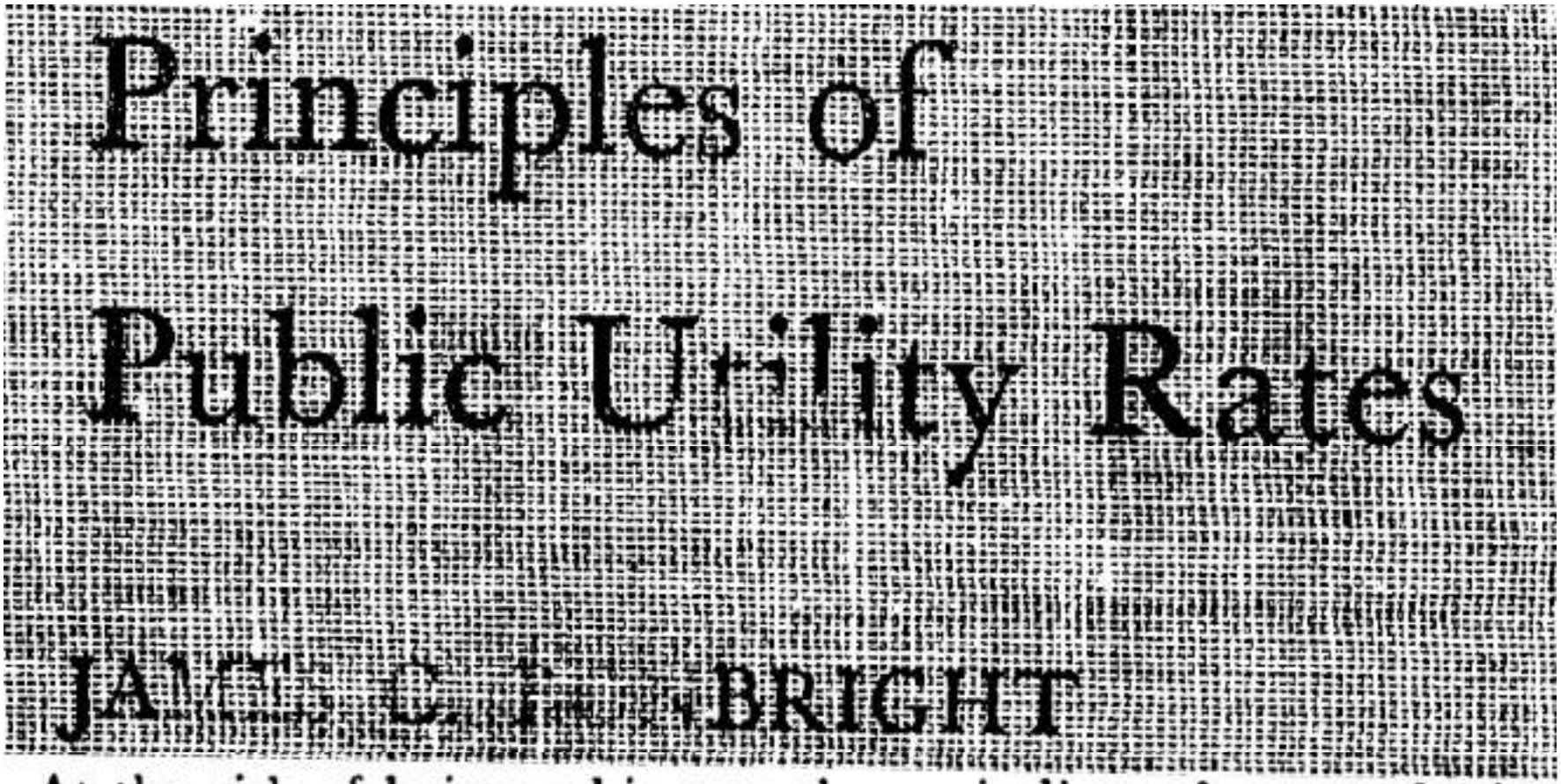
- **Network and policy costs without distorting efficient incentives**



Batlle, C. et al., 2016. "Regulated Charges and Electricity Bills for a Distributed Future: Efficient Price Signals for Increasingly Elastic End-Users". November, 2016

…to practical implementation

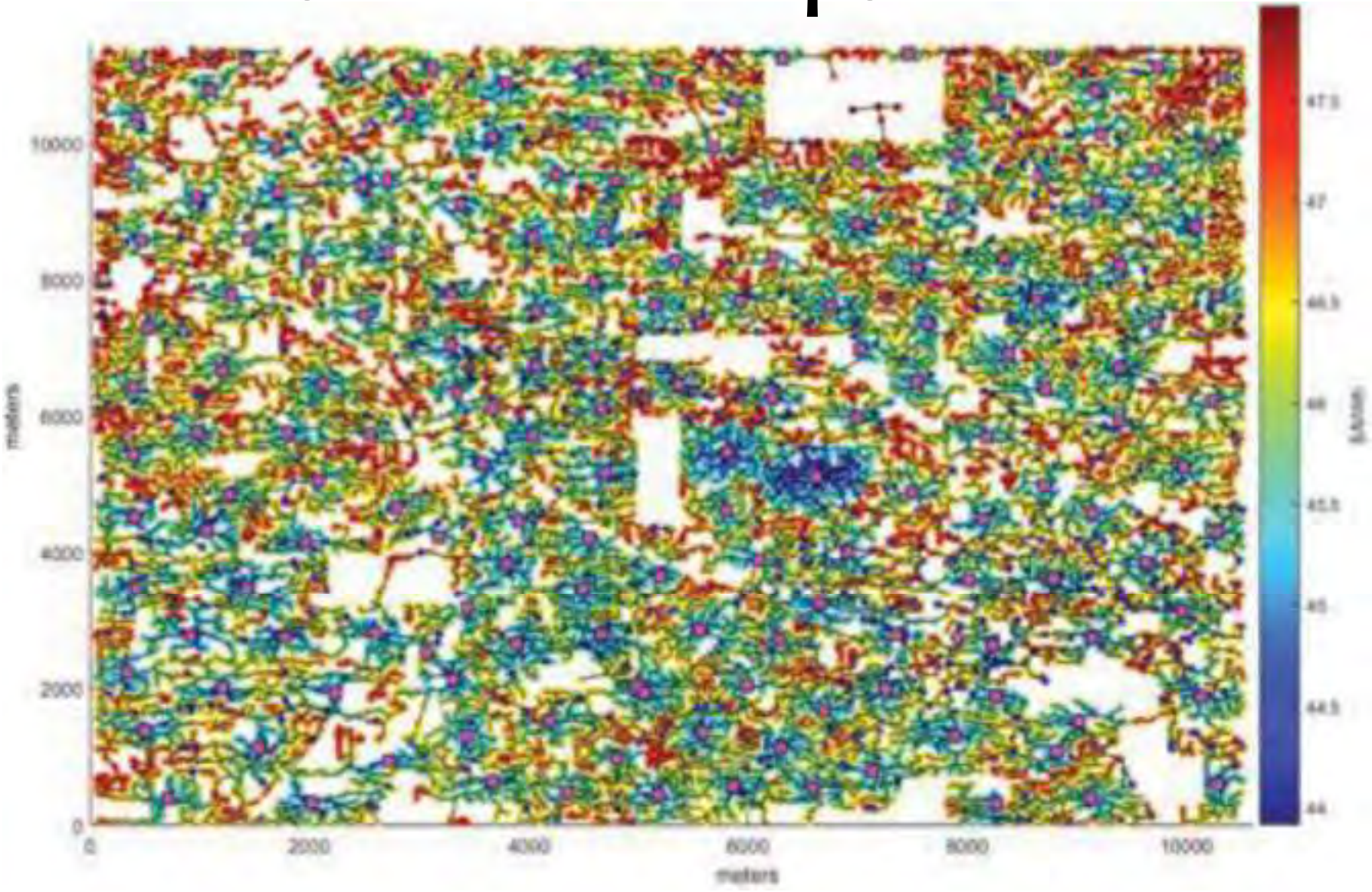
From theory to implementation



At the risk of being subject to the prejudices of my profession, I am convinced that the modern tendency to view fairness criteria of reasonable rates as secondary criteria, to be accepted primarily as constraints on the application of the so-called economic criteria, is a mark of progress in the development of rate-making policies designed to serve the public interest.

From theory to implementation

- **Distribution-level active power LMPs**



Source: The MIT Utility of the Future Study

From theory to implementation

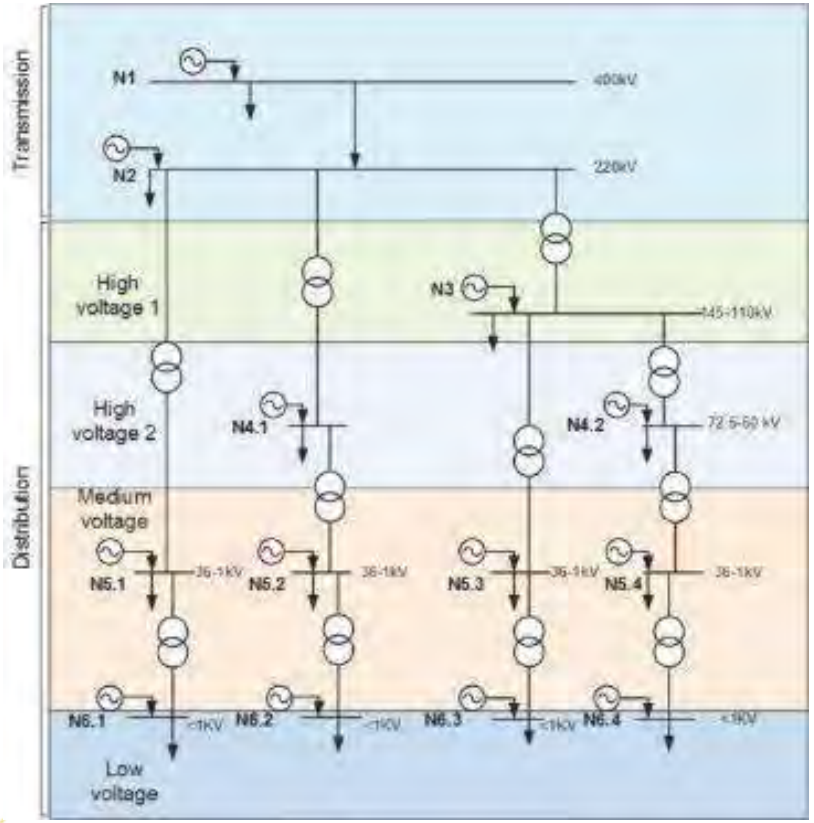
- **Today's prices and charges do not enable efficient investment and operations**
- **BUT implementable proposals must account for:**
  - Regulatory objectives
    - Economic efficiency, revenue adequacy, gradualism
  - Other public policy objectives
    - Decarbonization, social and political acceptance, low income and technology support…
  - Implementation costs
    - Computational capacity, metering costs, etc.

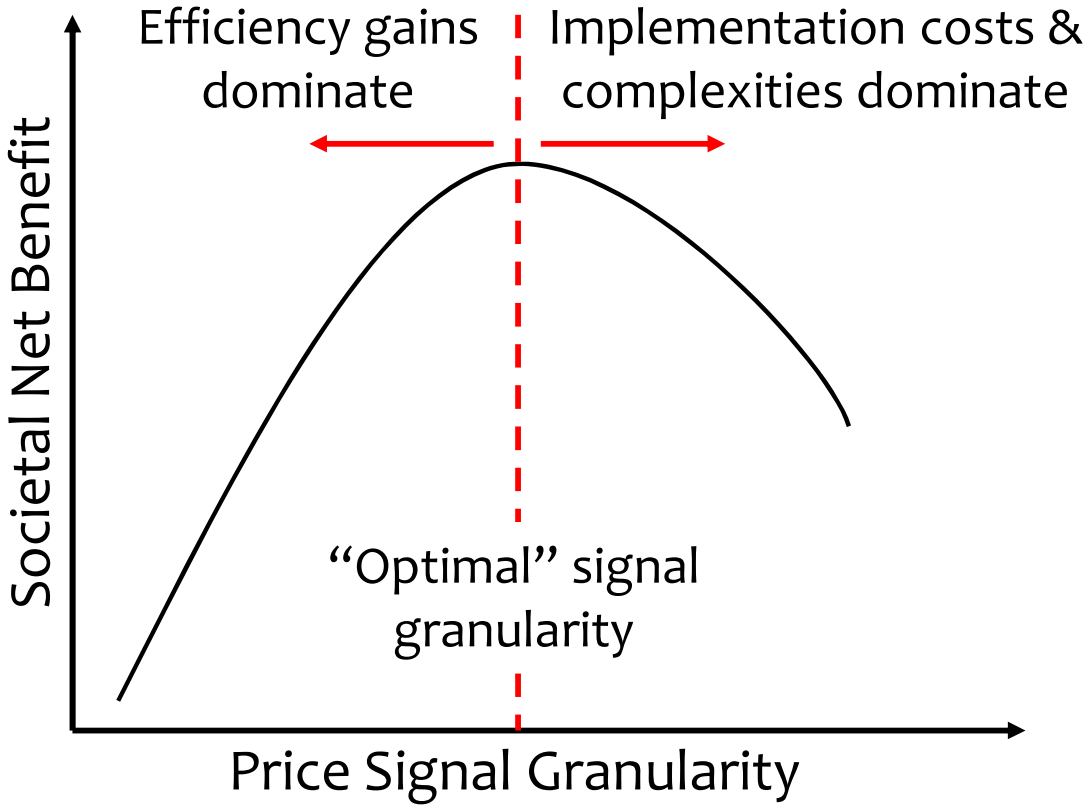
Address distributional concerns without sacrificing efficient incentives

- **Efficient pricing would unwind cross-subsidies and result in greater variability in charges**
  - Lump-sum bill credits or surcharges can restore desired cross-subsidies if desired
  - Lump-sum pre-payments or hedging arrangements can address monthly bill variability
  - Means-tested low-income assistance can replace implicit subsidy due to volumetric charges

How good is good enough for pricing granularity?

- **Tradeoffs in granular rate design: system efficiency gains vs. implementation costs**

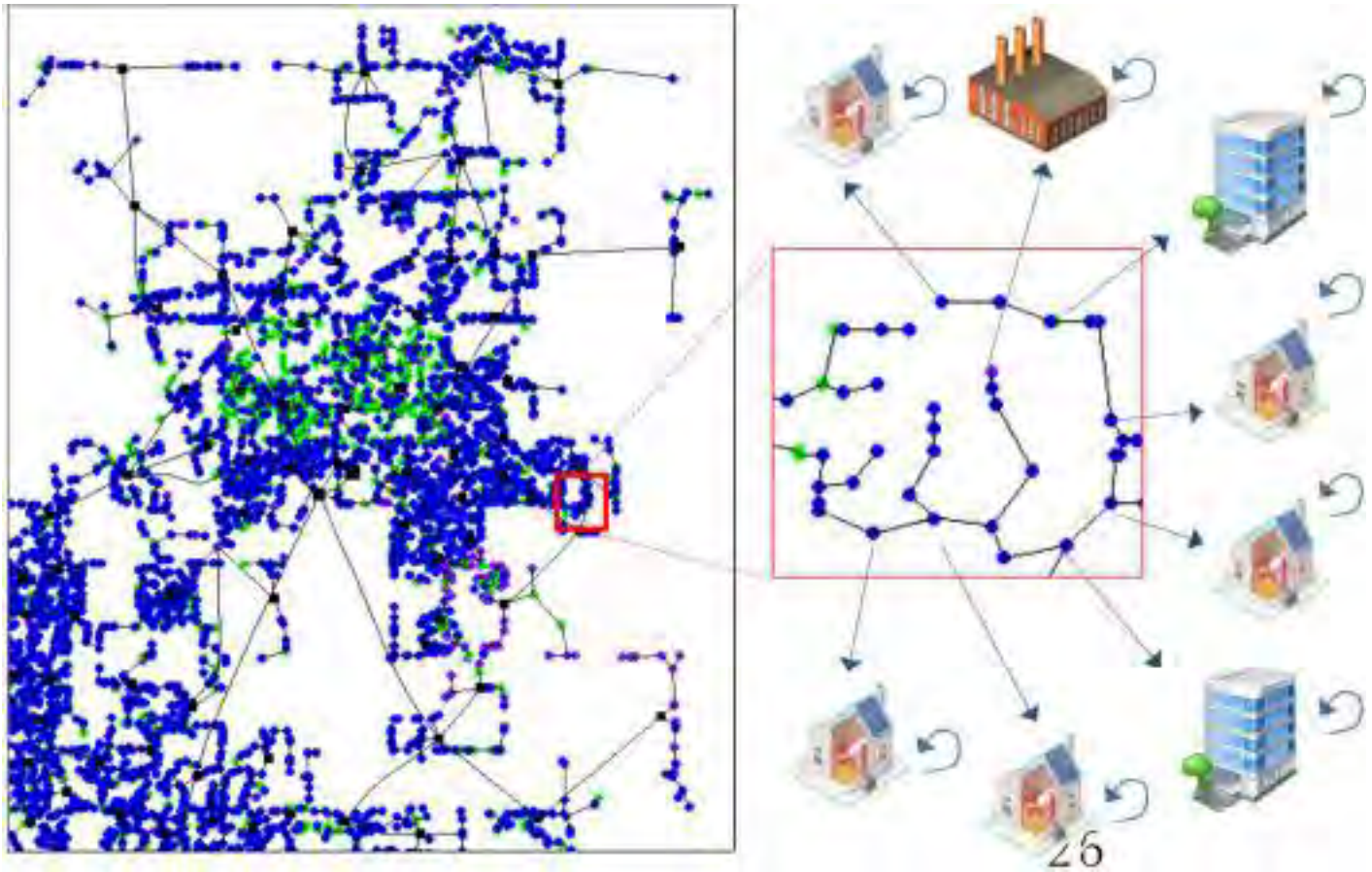




Mitigating distributional impacts of efficient pricing

- **Empirically and analytically exploring practical solutions to meet regulatory tariff objectives**

Figure: DRE-D-SIM snapshot. Proprietary modeling tools enable us to explore consumer response to tariffs in detail and at realistic scales



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