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INSTITUTO DE INVESTIGACIÓN TECNOLÓGICA

CRMs design elements
International experiences

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I-SEM Stakeholder Forum
Dublin, June the 17th, 2014

CRMs design elements
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- The security of supply problem
  - Classic reasons behind the need for CRMs
  - What do stakeholders seek with a CRM?
  - CRMs mechanisms design elements

- Design elements of CRM
  - The product
  - Targeted market (buying side and the selling side)
  - Price vs Quantity (defining the requirements)
  - Trading mechanism

- Advanced design of the RO mechanism

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The security of supply problem
Classic reasons behind the market failure (i)

- Ideally generators can fully recover their long-term costs
  - Even although prices are based solely on operating short-term costs

- Hypotheses marginal pricing theory under perfect competition
  - **An efficient short-term market**
    - Competitive demand participation

    - Competitive generation participation

    - Efficient pricing rule

  - **An efficient long-term market**
    - Risk is allocated efficiently among market agents (supply and demand)

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The security of supply problem
Classic reasons behind the market failure (i)

- Ideally generators can fully recover their long-term costs
  - Even although prices are based solely on operating short-term costs

- Hypotheses marginal pricing theory under perfect competition
  - **An efficient short-term market**
  ✗ • Competitive demand participation
    - Demand does not set prices: lack of participation, caps, OS intervention
  ✗ • Competitive generation participation
    - Offer caps, entry barriers (vertical integration), etc.
  ✗ • Efficient pricing rule
    - Costs are not convex and pricing rules are not optimal in some cases
  - **An efficient long-term market**
  ✗ • Risk is allocated efficiently among market agents (supply and demand)
    - Generators are risk averse and most consumers are not
 - **Others: continuous investment and no economies of scale**

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The security of supply problem
Classic reasons behind the market failure (ii)

- The problem is long-term uncertainty not short-term volatility risk
  - Short-term volatility is not a problem for system adequacy
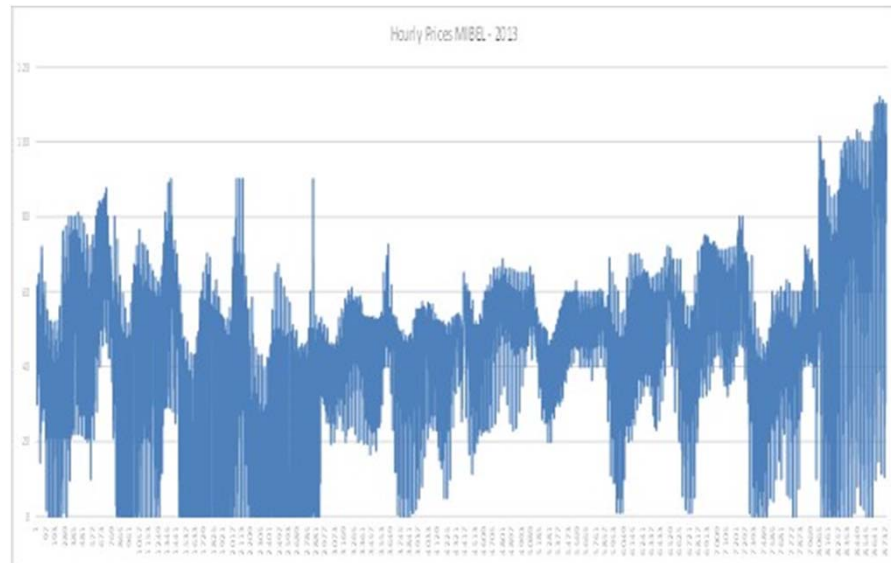
vs
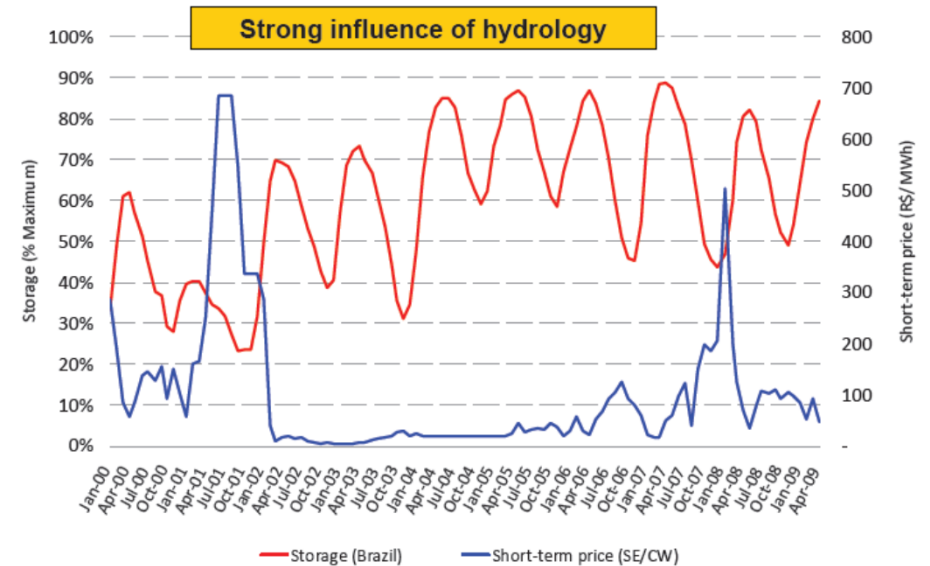
Source: L.A. Barroso. Power Sector Deregulation In Brazil.
Ensuring Supply Adequacy Through Energy Auctions.

  - *The "missing planning" problem*: low carbon policies have boosted the regulator intervention in the system capacity expansion

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The security of supply problem
What do regulators and generators seek with a CRM?

- What does the regulator seek?
  - Secure the electricity supply
    - Attract capacity & guarantee an efficient resource management
  - Hedge the consumers risk (stabilize prices)
  - A tertiary objective: enhance competition
    - Open the market to new entrants (national or cross border)
    - Some products help mitigating market power

- What do generators want?
  - A major objective: hedge their risk
    - Hedge price risk (stable signal)
    - Have the hedge or additional income defined before the plant is built
  - If short-term signal is not optimal (price cap, pricing rules, etc.)…
  … an additional source of income may be needed

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The security of supply problem
CRMs design elements

- Main design elements of CRMs

Capacity Markets

Bilat. Capacity Markets

Capacity Payments

Long term energy auctions

Reliability options

Strategic reserves

Purchasing mechanism
Centralisation — Auction or Bilateral

Targeted Market
Selling Side
Buying Side

Product
-Physical (E/C) and/or financial
-Lead time
-Contract duration
-Indexation
-Penalties

Firm supply

P vs Q

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CRMs design elements
Product

- The most important design element
    - Its acquisition should lead the system to the efficient scenario
- Three main components that can combine in the definition

Financial contract
(forward, option, …)

PRODUCT

Physical energy delivery
(penalties)
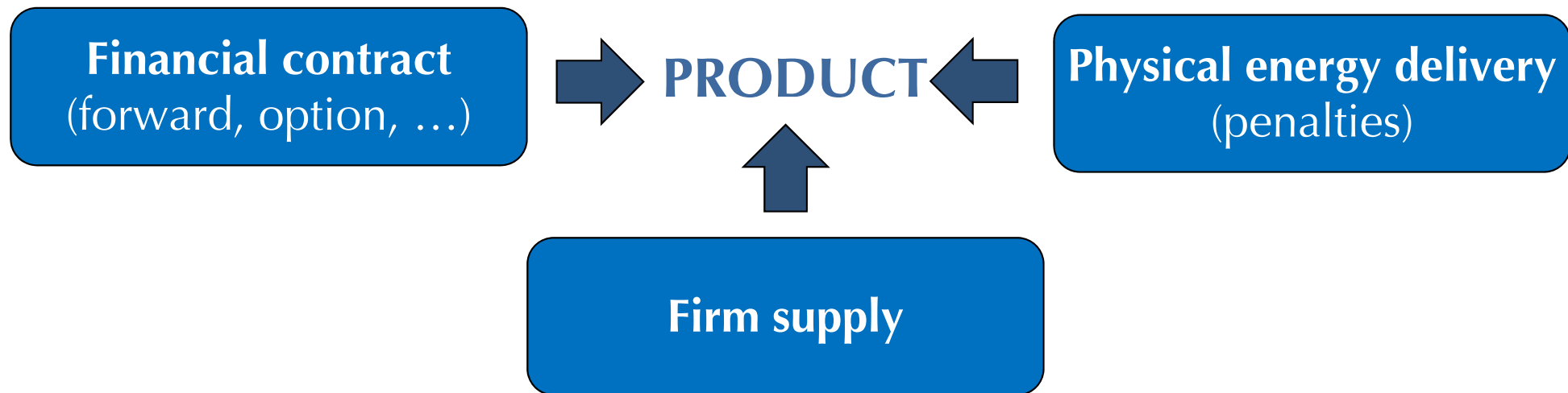
Firm supply

- Examples of products:
    - Purely financial contract
    - Firm supply
    - Financial + firm supply
    - Financial contract + physical delivery + physical back up

CRMs design elements
Product: Reliability Option (i)
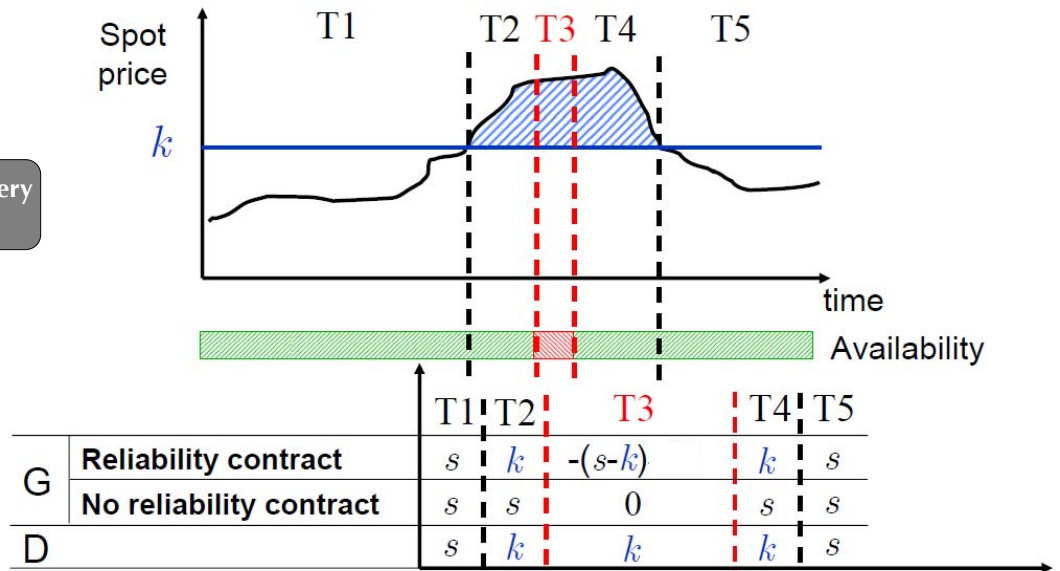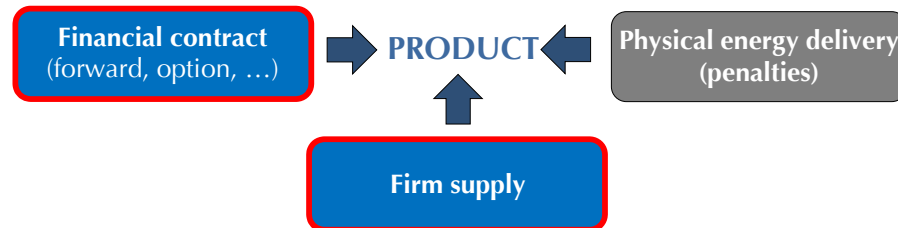
- The (financial) Reliability Option
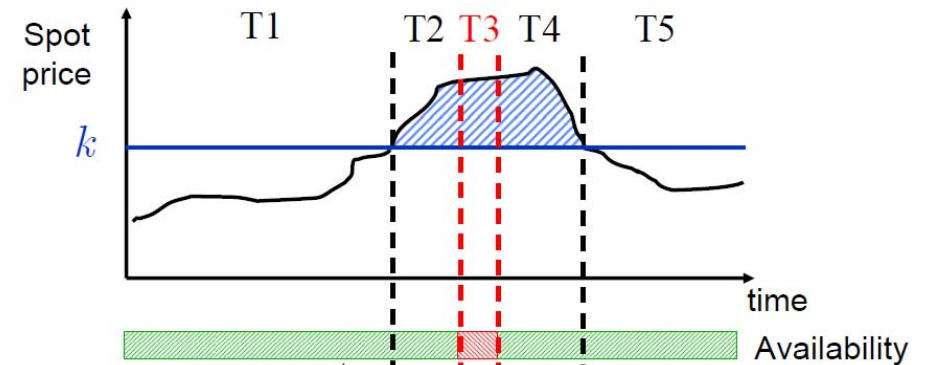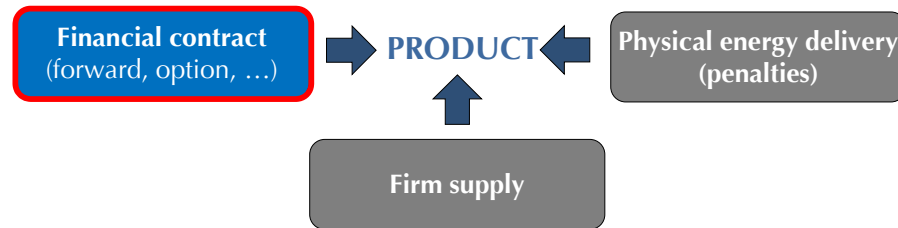
		T1	T2	T3	T4	T5
G	Reliability contract	s	k	$-(s-k)$	k	s
	No reliability contract	s	s	0	s	s
D		s	k	k	k	s

- Purely financial (no firm supply, no penalties) -> no experience
  - Hedges price risk (both for demand and generation)
  - Financial entities can ideally sell this product
  - Physical delivery is not guaranteed

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CRMs design elements
Product: Reliability Option (ii)
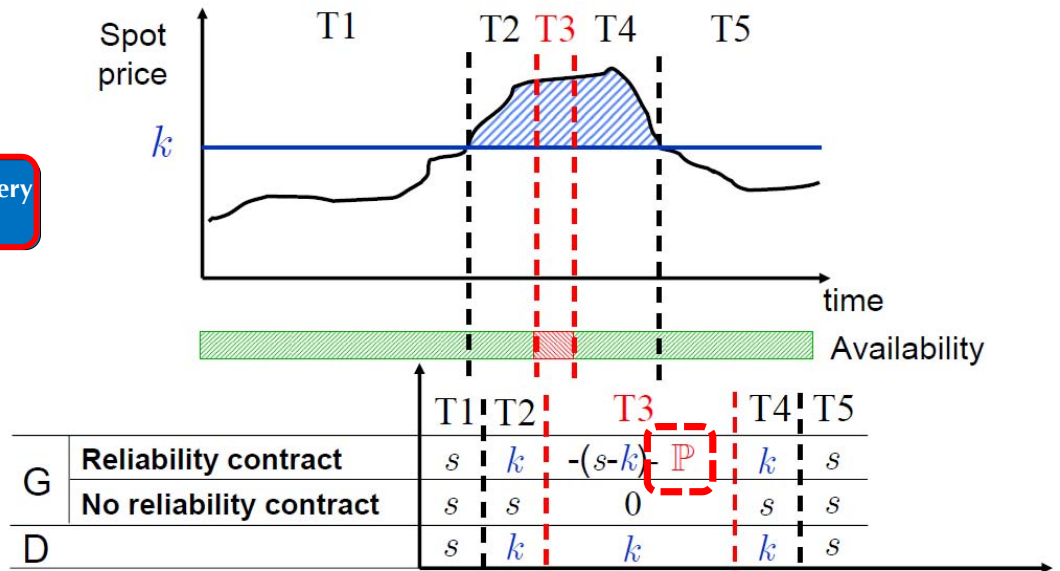
- The (financial) Reliability Option

- Purely financial (firm supply but no penalties) -> Colombia
  - Hedges price risk (generator and the regulator)
  - A physical back up is required
    - The price of the RO can be higher than the value of the financial product
  - Physical delivery is more likely to be delivered

CRMs design elements
Product: Reliability Option (iii)
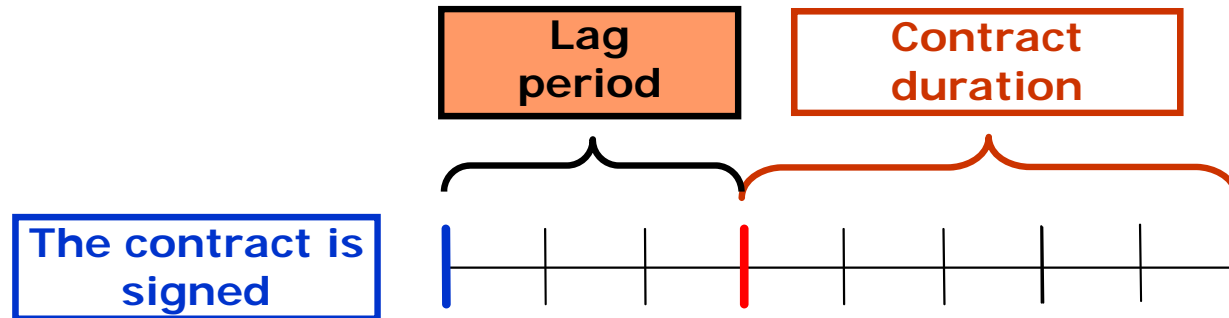
- The (physical) Reliability Option

- Physical Reliability option -> New England
- The penalty increases the incentive for physical delivery
  - The downside of the penalty
    - Increases the investor's risk (increases the premium asked for the RO)

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CRMs design elements
Product

- Time terms of the contract

- Lag period: allows to fix the conditions before installing the plant
- Contract duration: sufficient durations reduce the investor's risk

  – Optimal value for these parameters are technology-dependent

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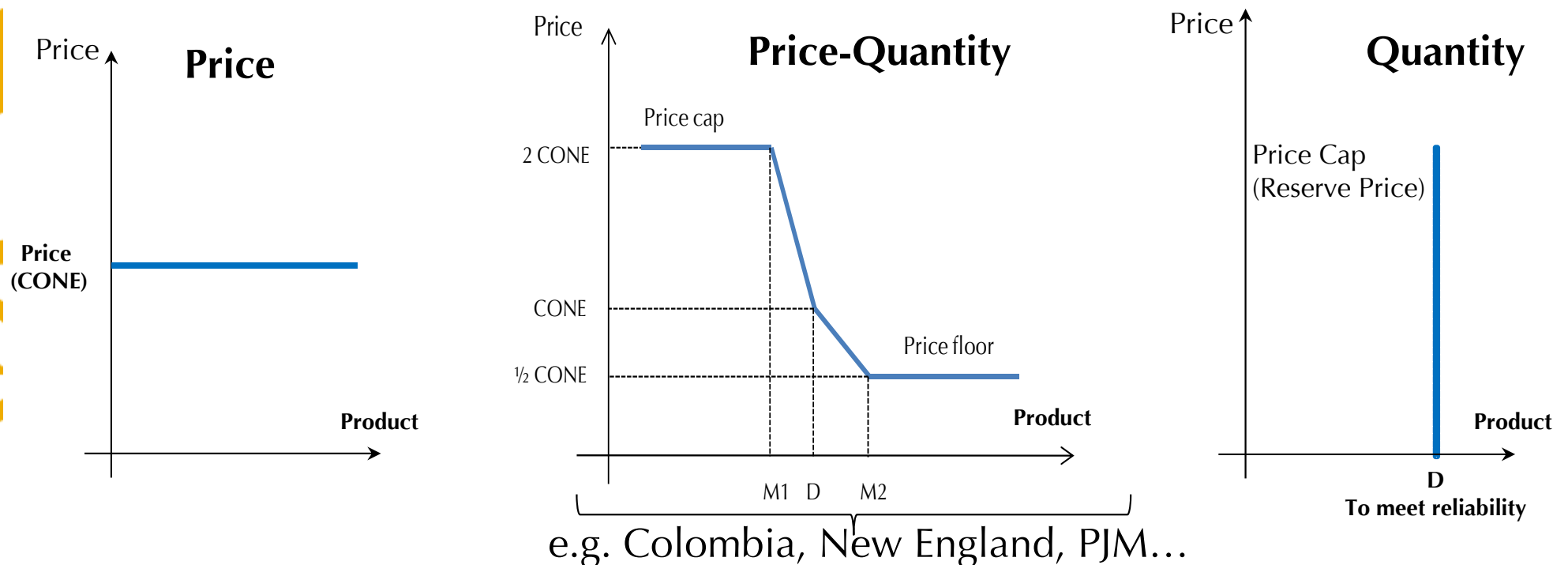
CRMs design elements
Targeted market

- <u>Buyers</u>: demand represented by the regulator
  - All the demand
    - Who should pay? -> All demand (avoid cross subsidies)
  - Only a segment of the demand
    - Important to define products that are enjoyed by the segment of the demand buying the product (avoid free riding)
    - Who should pay? -> The segment of the demand represented

- <u>Seller</u>: who can sell the product?
  - All technologies or just some (or one) technology
  - How can demand response participate?
  - Only new investments or all units?
    - Usually different conditions apply to new investments and existing units

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CRMs design elements
Quantity vs Price: defining the requirements

- Market-based mechanisms
  - Price: the regulator fixes the price (market forces decide the quantity)
  - Quantity: the regulator fixes the quantity (market forces the price)
  - Price-Quantity curve

Price

Price

Price (CONE)

Product

Price-Quantity

Price

Price cap

2 CONE

CONE

½ CONE

Price floor

Product

M1   D   M2

e.g. Colombia, New England, PJM...

Quantity

Price

Price Cap (Reserve Price)

Product

D
To meet reliability

- Need to convert a reliability standard into a requirement

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CRMs design elements
Mechanism to purchase the product

- **Bilateral vs. auction**
  - Auctions are more transparent
  - Enhance liquidity

- **Centralized vs. decentralized**
  - Centralizing the acquisition
    - allows exploiting economies of scale
    - at least does not add barriers to new entrants (vertical integration)
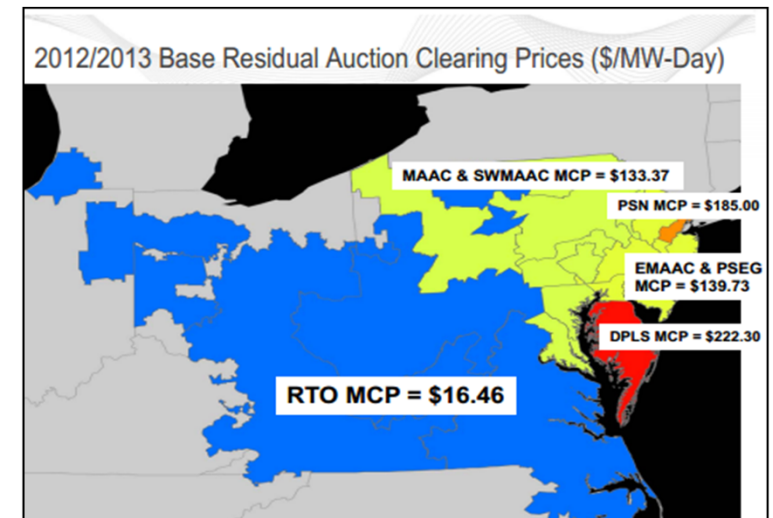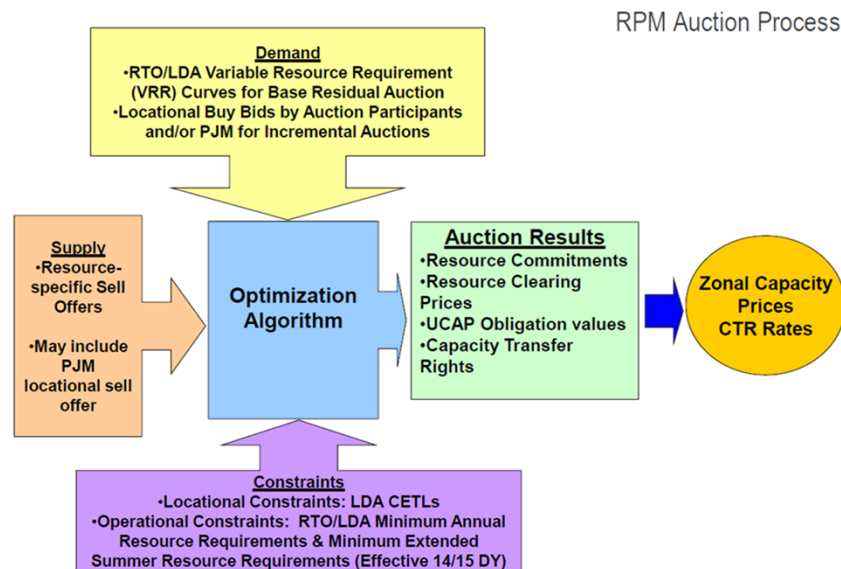   - minimizes free riding

- **Single node or zonal**
  - Liquidity versus efficiency

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CRMs design elements
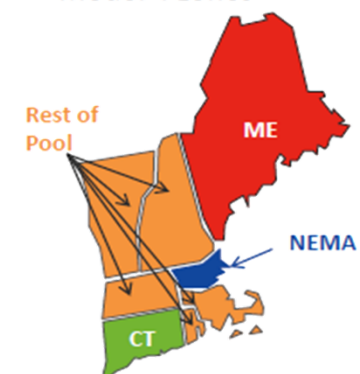# Mechanism to purchase the product

- Zonal auctions
  - In PJM's RPM the clearing price for each Locational Deliverability Area (LDA, import constrained zones) is determined using an optimization-based algorithm

RPM Auction Process

Demand
- RTO/LDA Variable Resource Requirement (VRR) Curves for Base Residual Auction
- Locational Buy Bids by Auction Participants and/or PJM for Incremental Auctions

Supply
- Resource-specific Sell Offers
- May include PJM locational sell offer

Optimization Algorithm

Auction Results
- Resource Commitments
- Resource Clearing Prices
- UCAP Obligation values
- Capacity Transfer Rights

Zonal Capacity Prices CTR Rates

Constraints
- Locational Constraints: LDA CETLs
- Operational Constraints: RTO/LDA Minimum Annual Resource Requirements & Minimum Extended Summer Resource Requirements (Effective 14/15 DY)

2012/2013 Base Residual Auction Clearing Prices ($/MW-Day)

MAAC & SWMAAC MCP = $133.37
PSN MCP = $185.00
EMAAC & PSEG MCP = $139.73
DPLS MCP = $222.30
RTO MCP = $16.46

- Model 4 zones

Source: PJM and ISONE
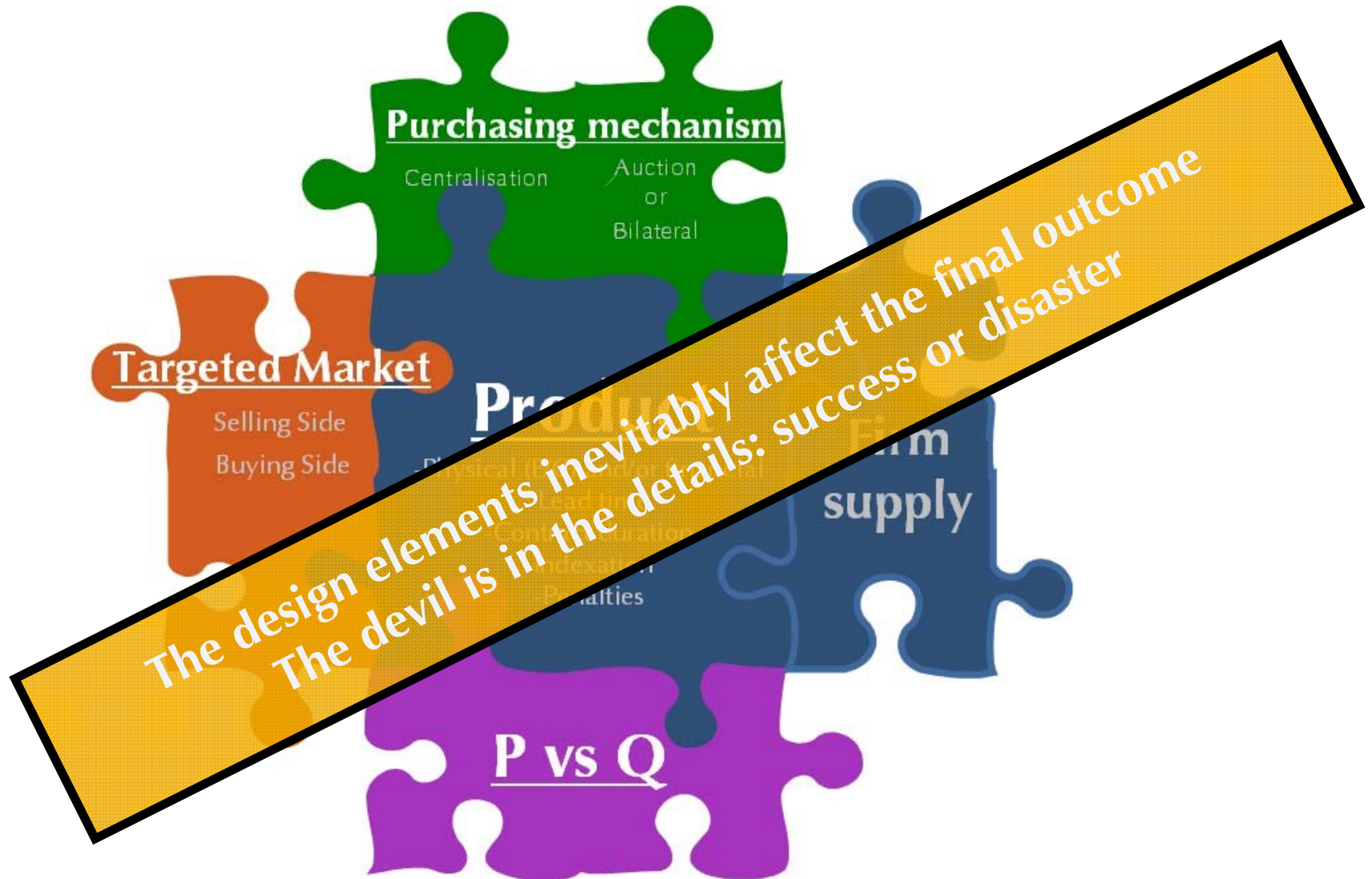

Rest of Pool
ME
NEMA
CT

  - In ISO-NE's FCM a simplified clearing algorithm
    - Capacity zones are designated in advance
    - FCA begins with a single zone

The security of supply problem
CRMs design elements

- Main design elements of CRMs

The design elements inevitably affect the final outcome
The devil is in the details: success or disaster

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The regulatory mechanisms
The reliability option mechanism

- Implementing a CRM mechanism is never easy

- In the reliability option mechanism
  - How to set the strike price
  - The reference market
    - When is a scarcity detected? (real-time, hour-ahead, day-ahead)
    - What if there is not market? What if there are multiple markets?
  - Consideration of previous bilateral contracts
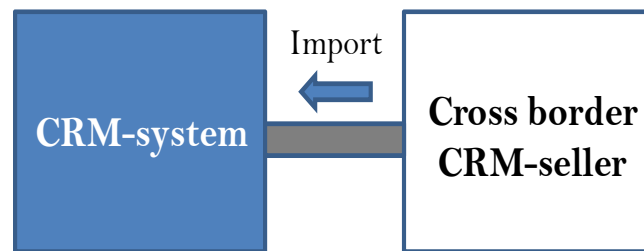 - How to avoid the "wait for the tender effect"?
  - How do we take into account the interconnections?

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The regulatory mechanisms
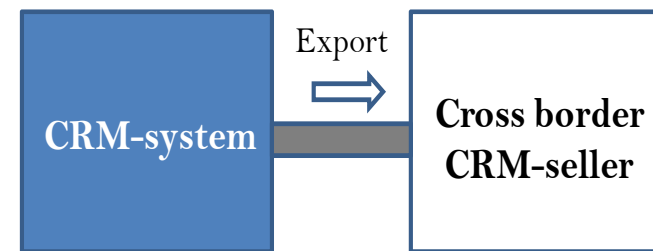# The reliability option mechanism

- The problem in the regional context
  - Physical commitments are important in the adequacy problem
  - Let us imagine that the CRM-system has contracted physical reliability options from neighbouring country…
  - … and the PCR allocates all transmission capacity in the short-term

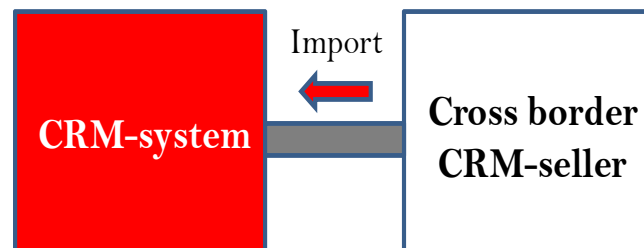NS -> No Scarcity   I -> Import
S -> Scarcity   E -> Export
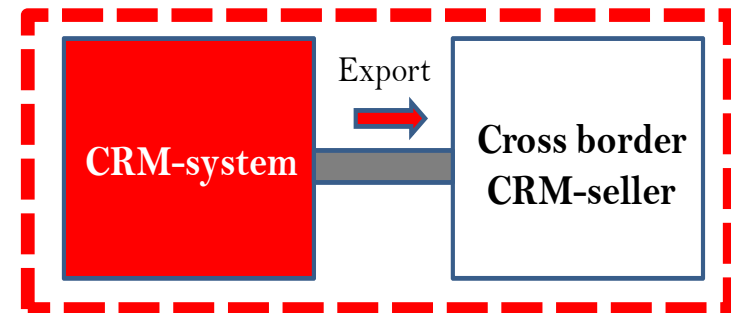
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