

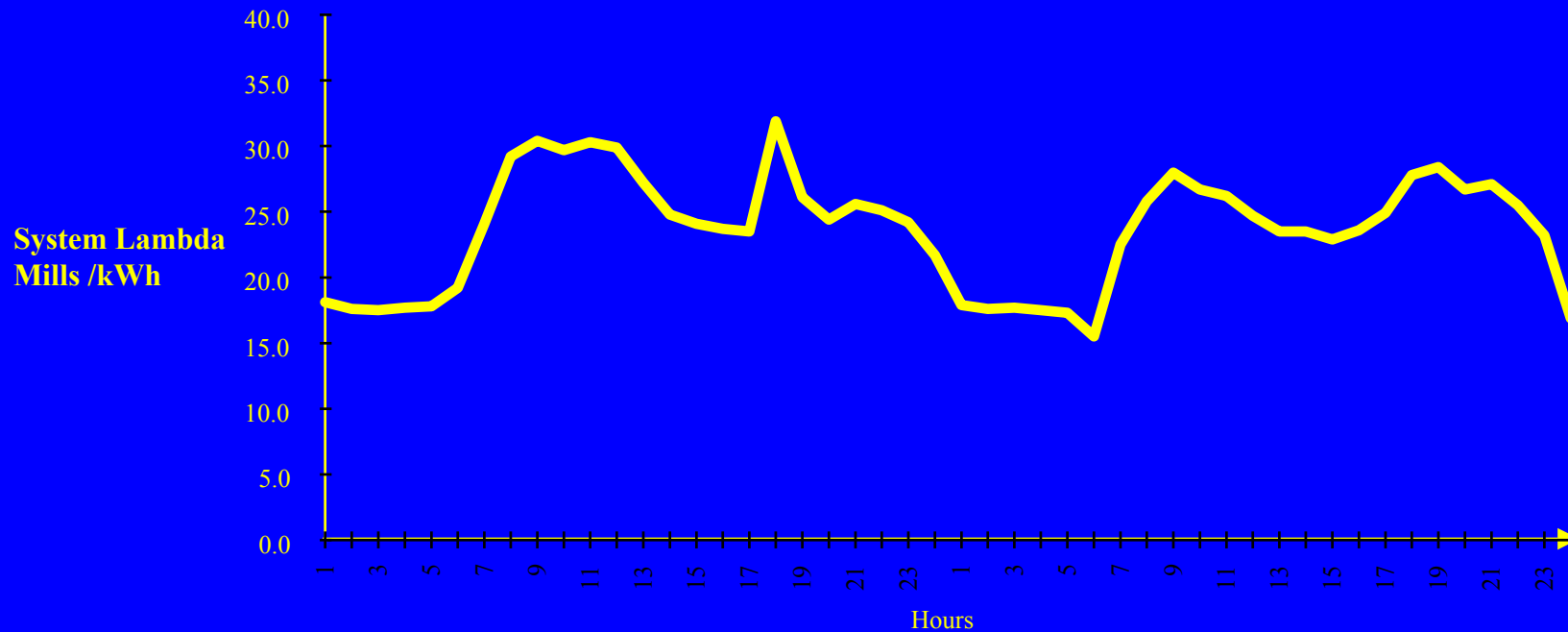
ESD 126

***ESD 126: Mercados
económicos de la energía***

***Características de la
demanda de energía eléctrica***

Two Days in January, 1993 Hourly Marginal Costs

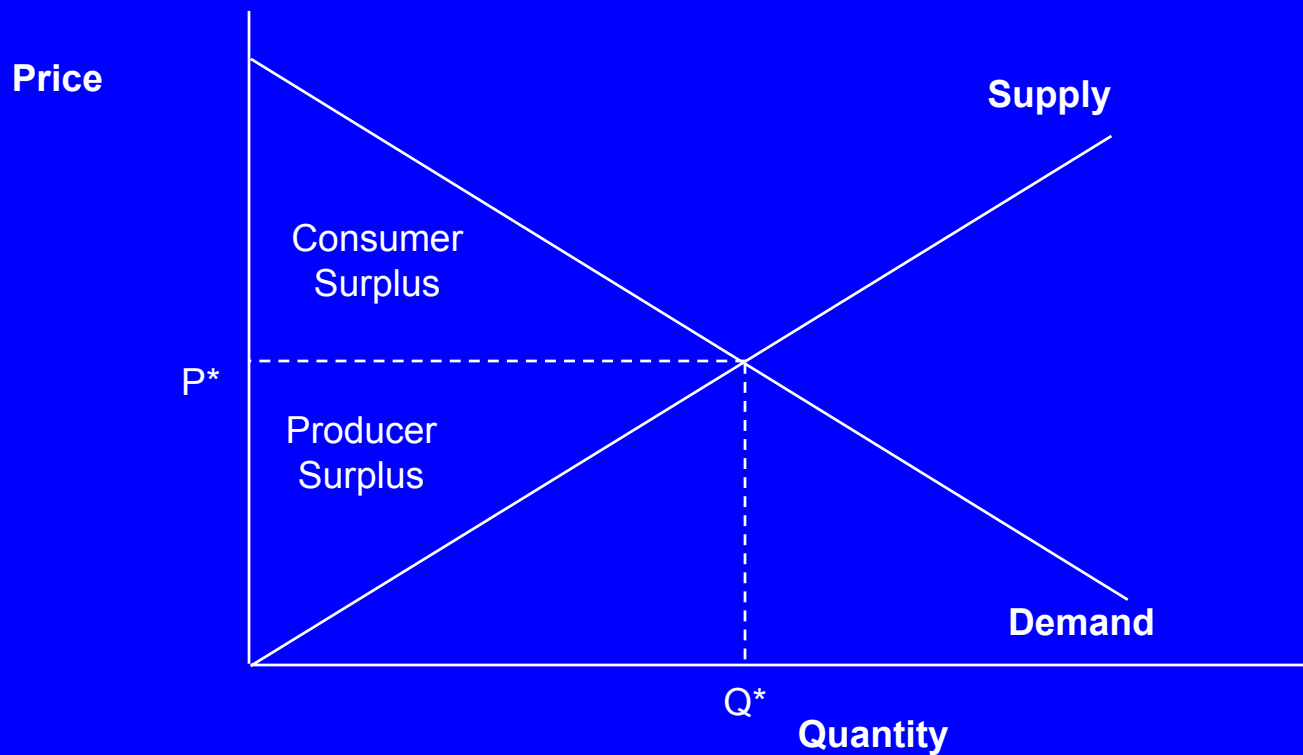
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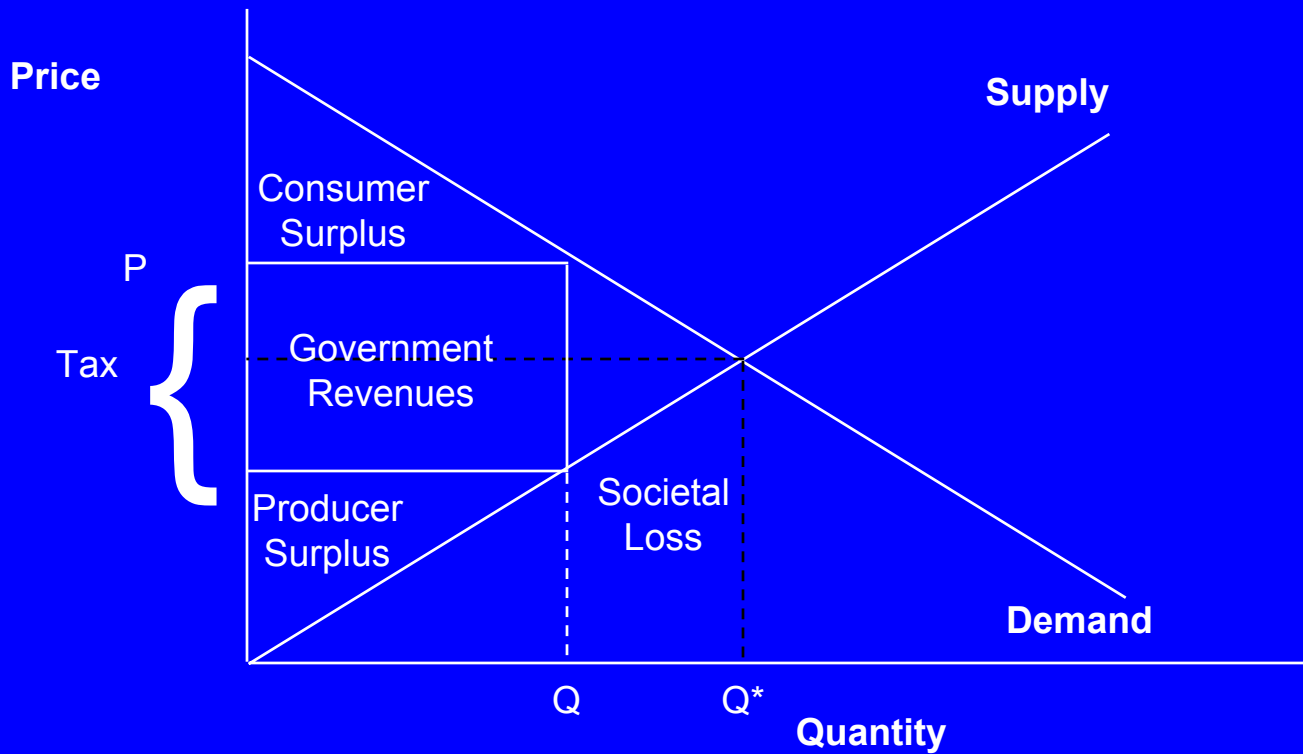
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***Power System Economics
and Electric Markets***

Competitive Conditions



Conditions under Taxation



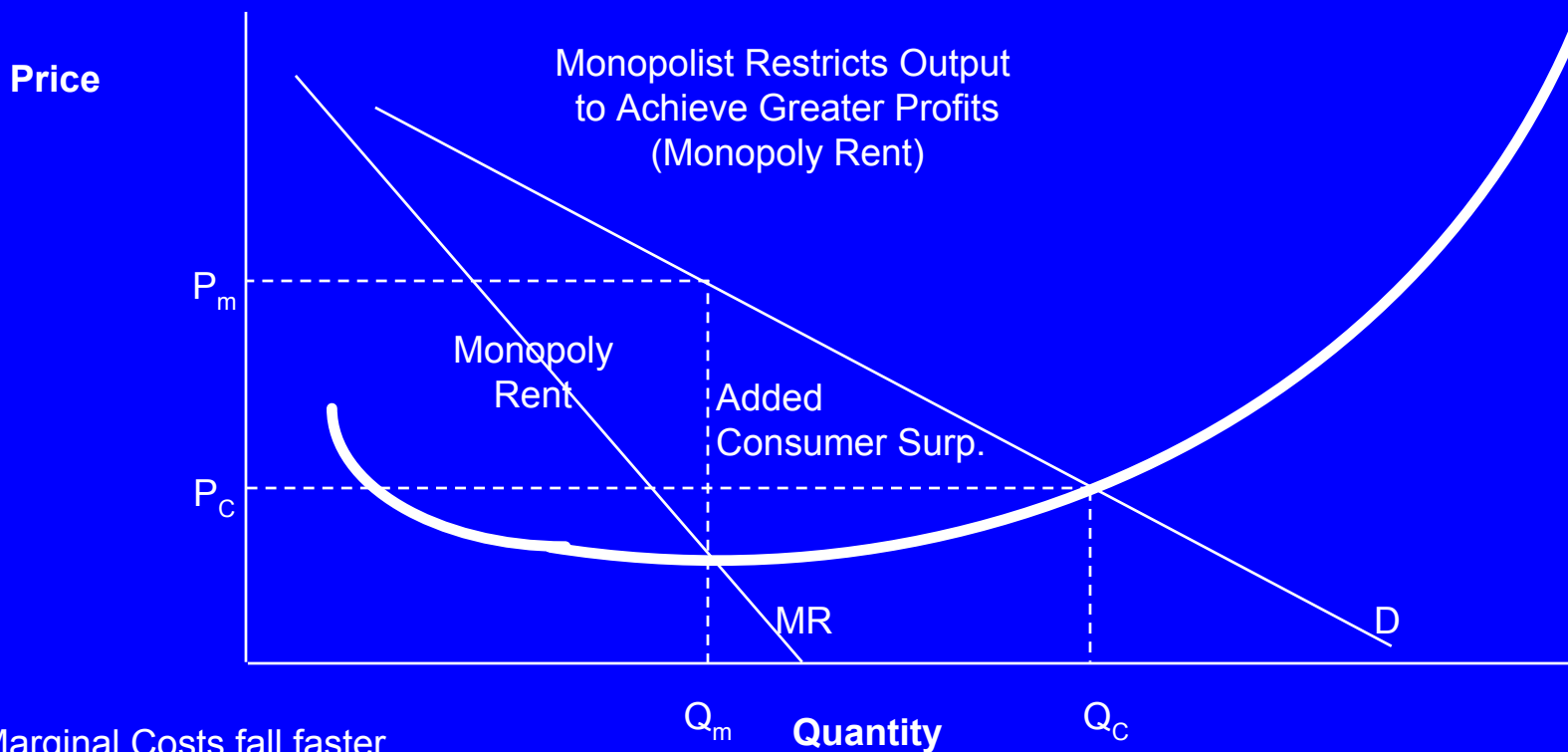
Profit Maximizing Firm



Monopoly Pricing

- *Objective is to capture benefits of economies of scale and at the same time providing those benefits to customers by charging as close to marginal cost as possible.*
- *Given that Marginal Cost < Average Cost alternative pricing structures are used*
 - Ramsey, or second best pricing
 - Provide form of marginal cost pricing while allowing firms to recover costs

Monopoly Pricing



Marginal Costs fall faster than average costs thus if marginal costs are used as price, firm loses money

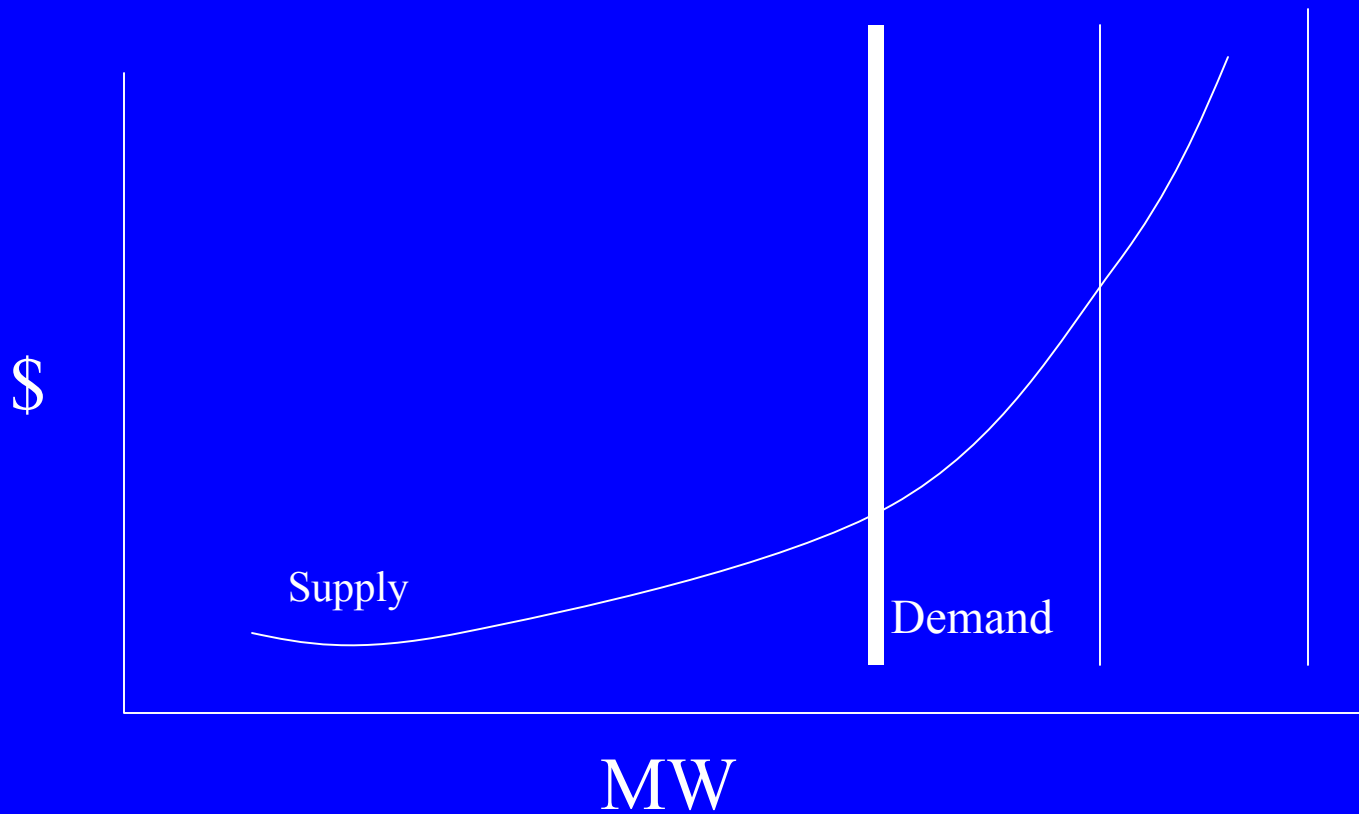
Marginal Revenue falls faster than price as output increases

Pricing Structures

- *Short Run Marginal Cost (SRMC)*
 - In general under recovers because $MC < AC$
- *Long Run Marginal Cost (LRMC)*
- *Average Cost Pricing*
- *Ramsey Pricing*
 - Charge customers a price that is inversely proportional to their elasticity of demand
 - Time of use (TOU)
 - Real Time Pricing (RTP)

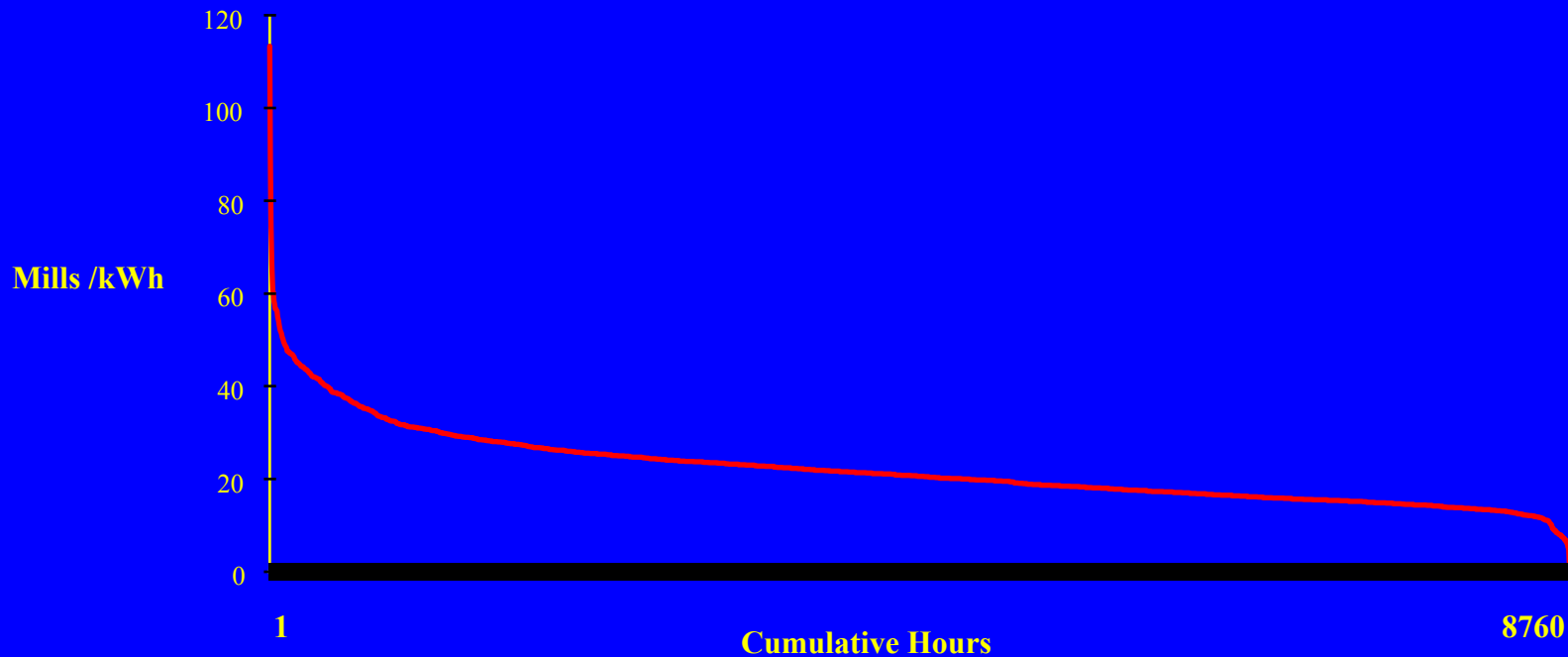
Electric Markets

ESD 126

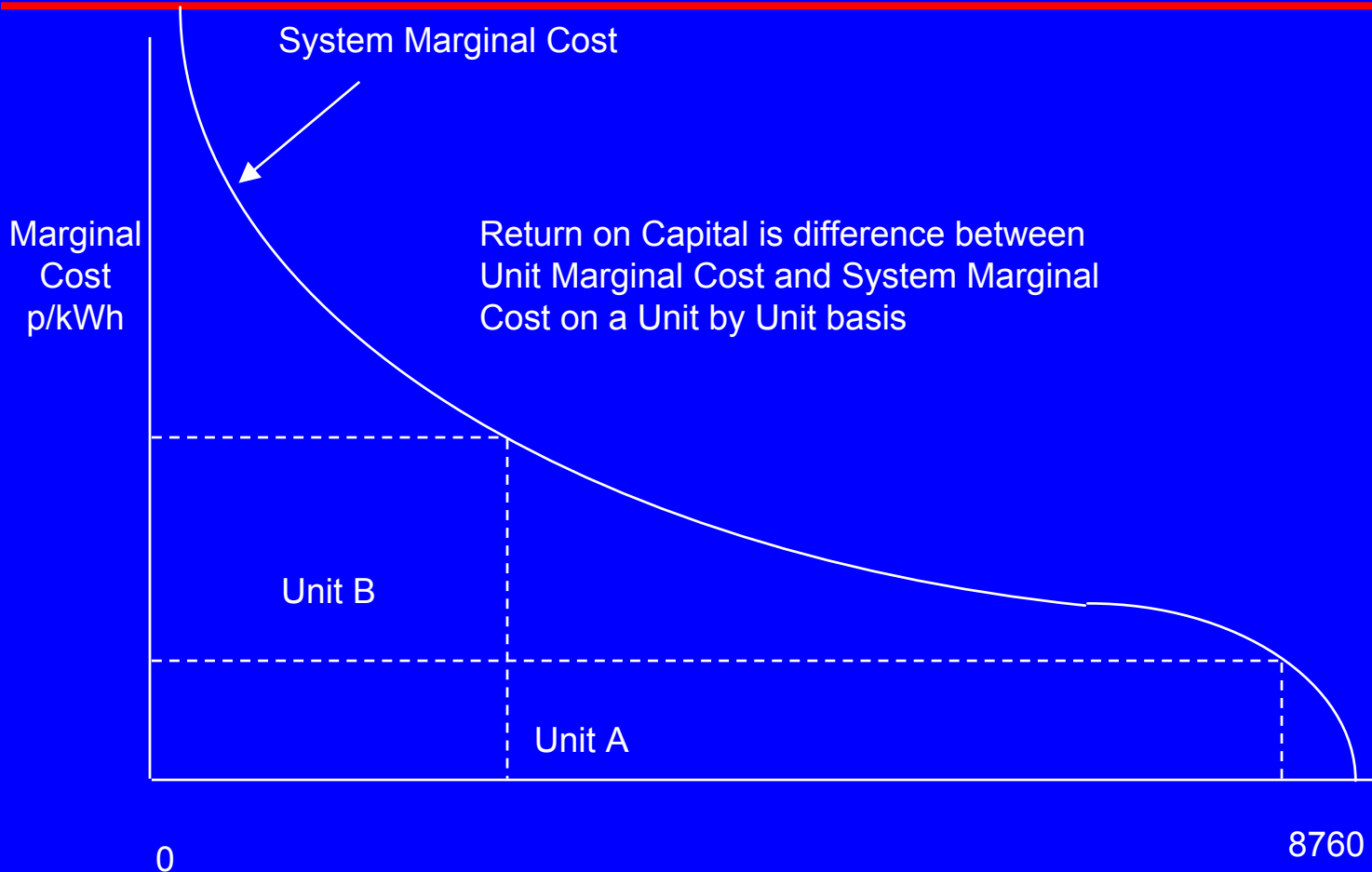


Cost Duration Curve: Sorted by Marginal Cost

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Individual Unit Economics



What is a Market?

- *Rules for the ideal market:*
 - A Homogeneous product
 - Buyers and sellers can find one another
 - Perfect information is available
 - Entry and exit is free
- *Vocabulary of the imperfect market*
 - Market power
 - Imperfect measure of the imperfect market = HHI
- *In general:*
 - “A place where an independent buyer and an independent seller can exchange goods at an agreed upon *PRICE*”
- *The Key: PRICE not COST*

Players

- *Generators*
- *Transmitters*
- *Distributors*
- *System Operator(s)*
- *Markets*
- *Brokers*
- *Consumers*

Players Roles: Generators

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- *Strategies*
 - Multiple facilities
 - Geographic dispersion
 - Same fuel, same type units
 - Geographic contiguity
 - Diverse fuel, diverse units
 - Single facility
 - Niche supplier
 - Peaking ?

Player's Roles: Marketers / Brokers

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- ***Market Maker (Grease)***
 - Identify spreads
 - Buy Low
 - Sell High
 - Reduce risk to buyers and sellers
 - Buy forward to reduce producer risk and/or assure market for future capacity
 - Sell forward to reduce (eliminate) price risk to consumer
 - Fuel Swap
 - Gas for Electricity
 - Tolling
- ***Brokers: Match Maker only***

Products in the Electric Market

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- ***Capacity (short ==> long term)***
- ***Energy (time and location specific)***
- ***Transportation (Transmission)***
- ***Ancillary Services***
 - Loss Compensation
 - Constraint Mitigation
 - Spinning Reserves / Energy Imbalances
 - VAR Support
 - Black Start
 - System Protection
- ***Energy Services***
 - Cost packages
 - Value packages
 - The MCI and Sprint of Electricity

Products: Energy and Capacity

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- *Energy*
- *Capacity*
 - Installed (Long Term)
 - Operable (Short Term)
 - Reserve
- *Separability and Timing are Critical Issues*
 - Multiple Products
 - Short time periods for trading and clearing
 - Minimize the role of the ISO in the market

Prices (Costs)

- *For Energy and Capacity*
 - Bilateral Market Based
 - Swaps (contracts for differences)
 - Spot Market Based
- *Ancillary Services*
 - ? Regulation because of localized monopoly conditions
 - Independent System Operator
 - Call Contracts
 - Reservation
 - Strike

Markets and Market Instruments

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- ***Forward (Futures) Markets***
 - Price lock-in
 - Information for future investments
 - “Referent to”
 - Spot Market
 - Expectation of change
- ***Spot Markets***
 - High variability / uncertainty
- ***Ancillary Services Market***
 - Operating requirements
- ***Clearing Markets***
 - After the fact trading by buyers and suppliers

Markets and Market Instruments

ESD 126

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Prices in the Electric Market: Functions

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- ***Provides signals to buyers***
 - Operations: how much to demand given value of end product
 - Investment: trade-off between
 - Fuels
 - Efficiency
- ***Provides signals to suppliers***
 - Operations: how much, when and where
 - Investment: when, what kind, and where

Price Discovery Mechanisms in the Electric Market *ESD 126*

- ***Regulated requirement***
 - (Avoided Costs) PURPA in the US
- ***Required bidding through regulated entity***
 - Mandatory Pool as in the UK
- ***Coordinated Bidding***
 - Voluntary PoolCo (Transactions may go “around” the pool)
 - NordPool ?
- ***Open market***
 - Bilateral Contracts

How is price discovered in a Competitive Market?

- *Supermarket and “Auto Mile”*
- *Industry knowledge / Word of Mouth*
 - The Natural Gas Model
 - Henry Hub plus basis points
- *Brokers and Marketers*
 - For complex markets / products
 - When information and contact failures occur
- *Electronic Bulletin Board (EBB)*

Information Required by the buyer

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- *Define the product needed*
 - amount
 - delivery point
 - timing
 - reliability
- *Prices of delivered energy available in the market*
- *Who will sell (marketers and/or primary suppliers)*
- *Conditions of the offers to sell*
- *Credibility of the suppliers*

Information Required by ESD 126 the Marketer

- *Their sources and conditions of supply*
- *Their costs of energy*
- *Their costs of transmission (and distribution)*
- *Their ability to reliably deliver*
 - Hedged in energy and or \$

Contract is written against ESD 126 specific terms:

- *Cost of Energy*
- *Cost of Transmission*
- *Quantity*
- *Duration*
- *Reliability*
- *Delivery points*
- *Contingencies*

What institutions and / or ESD 126 functions are necessary?

- ***ISO***
 - Balancing
 - Responsible only for ISO's activities
- ***Billing***
 - handled on the basis of individual players.
 - Significant opportunity for additional specialization in the market -- firms established to provide metering and billing services as well as firms to do the actual billing

Summary

- *Financial Markets Critical*
- *Restructuring will bring about:*
 - *Winners*
 - *Losers*
- *New entities will emerge*
- *New financial instruments will emerge*
- *New physical and service products will emerge*

What are the markets that will develop and what will be sold?

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- *Spot Market*

- Energy
- Ancillary Services?

- *Futures Market*

- Energy
- Capacity?

- *Reliability Market*

- Capacity
 - Installed
 - Operable
 - Reserve
- Ancillary Services



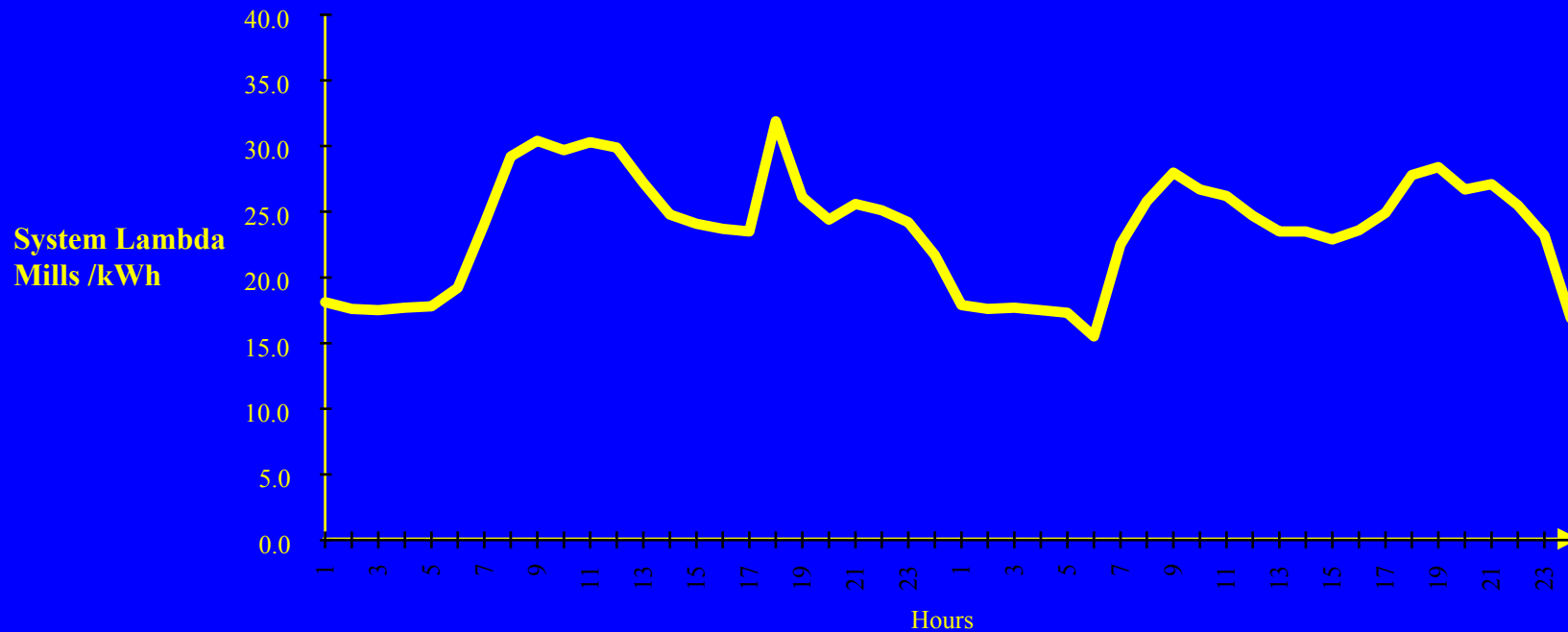
**Must be Closely
Related in the
Market**

SRMC

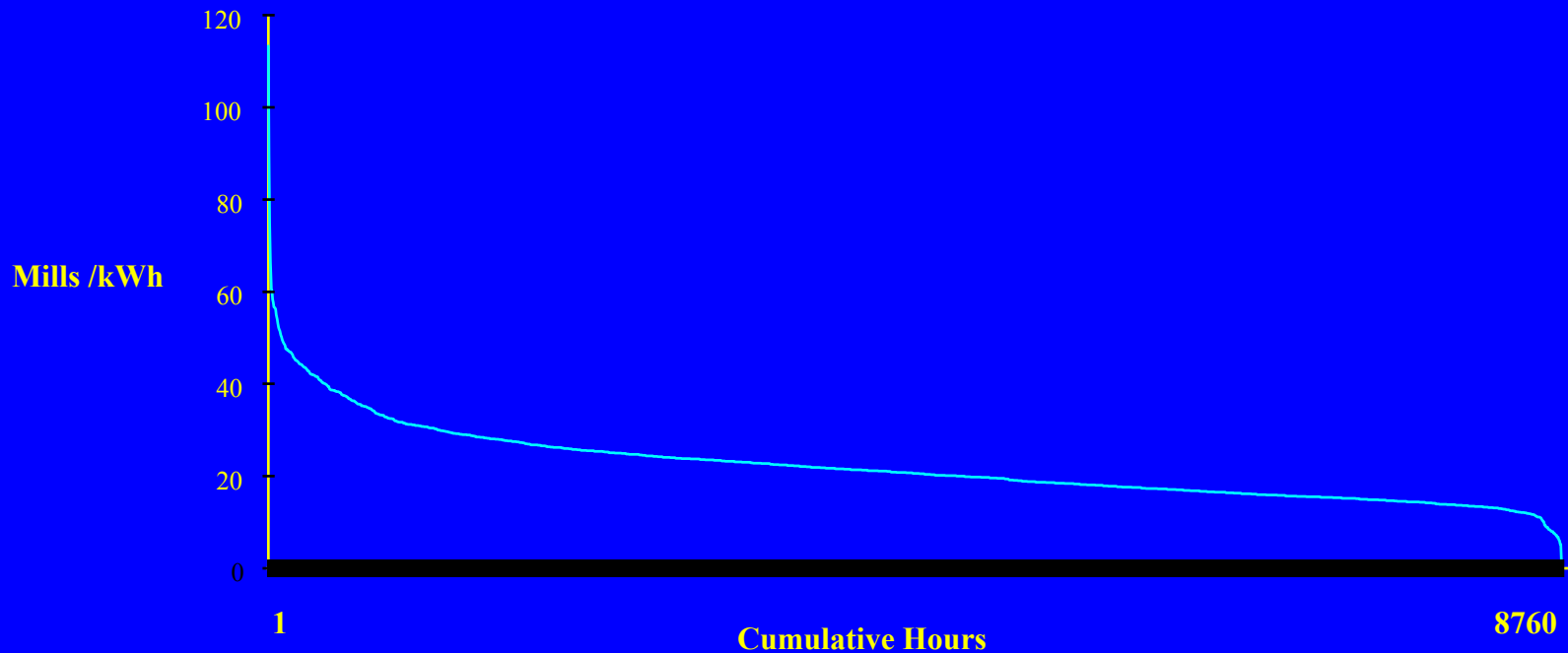
- *Operating Cost (Variable Cost) Based*
 - Fuel, O&M ...
- *Spot Price / PIP or POP*
- *Economically efficient operating rules*
- *Best when operating costs dominate*
 - Electricity

Two Days in January, 1993 Hourly Marginal Costs

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Cost Duration Curve: Sorted by Marginal Cost *ESD 126*

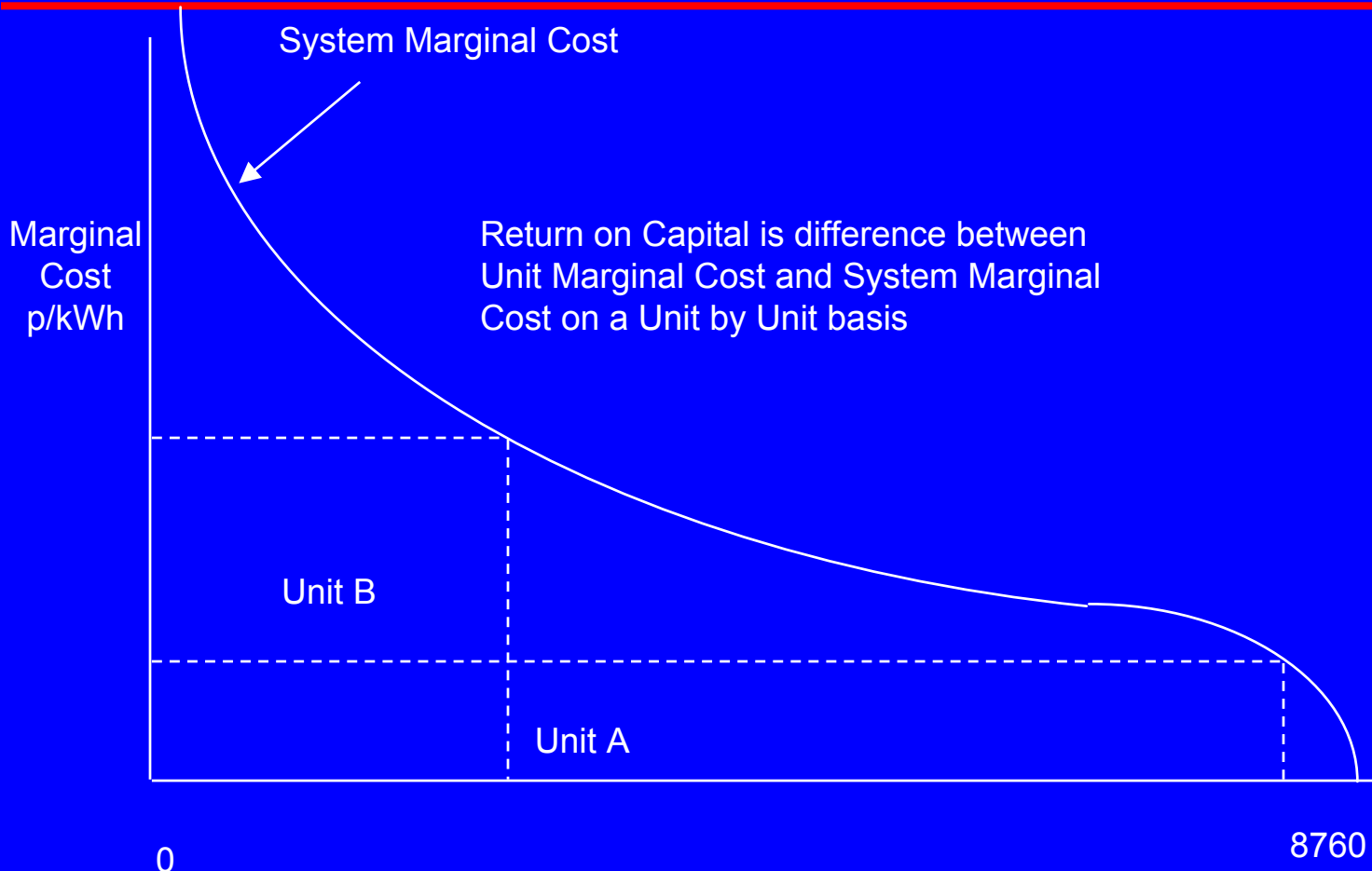


Ramsey version of SRMC *ESD 126*

Rate: RTP (US) or ...

$$\begin{aligned} MC_{GEN}(t) = & \text{System Lambda (t) or System} \\ & \text{Marginal Costs} \\ & + \\ & \text{Marginal Generation and Maintenance Cost (t)} \\ & + \\ & \text{Marginal Cost of Reserves and Contingencies (t)} \\ & + \\ & \text{Marginal Shortage Costs(t) (VOLL/LOLP or other} \\ & \text{approximation method)} \\ & + \\ & \text{Revenue Recovery Adjustment (US)} \end{aligned}$$

Individual Unit Economics



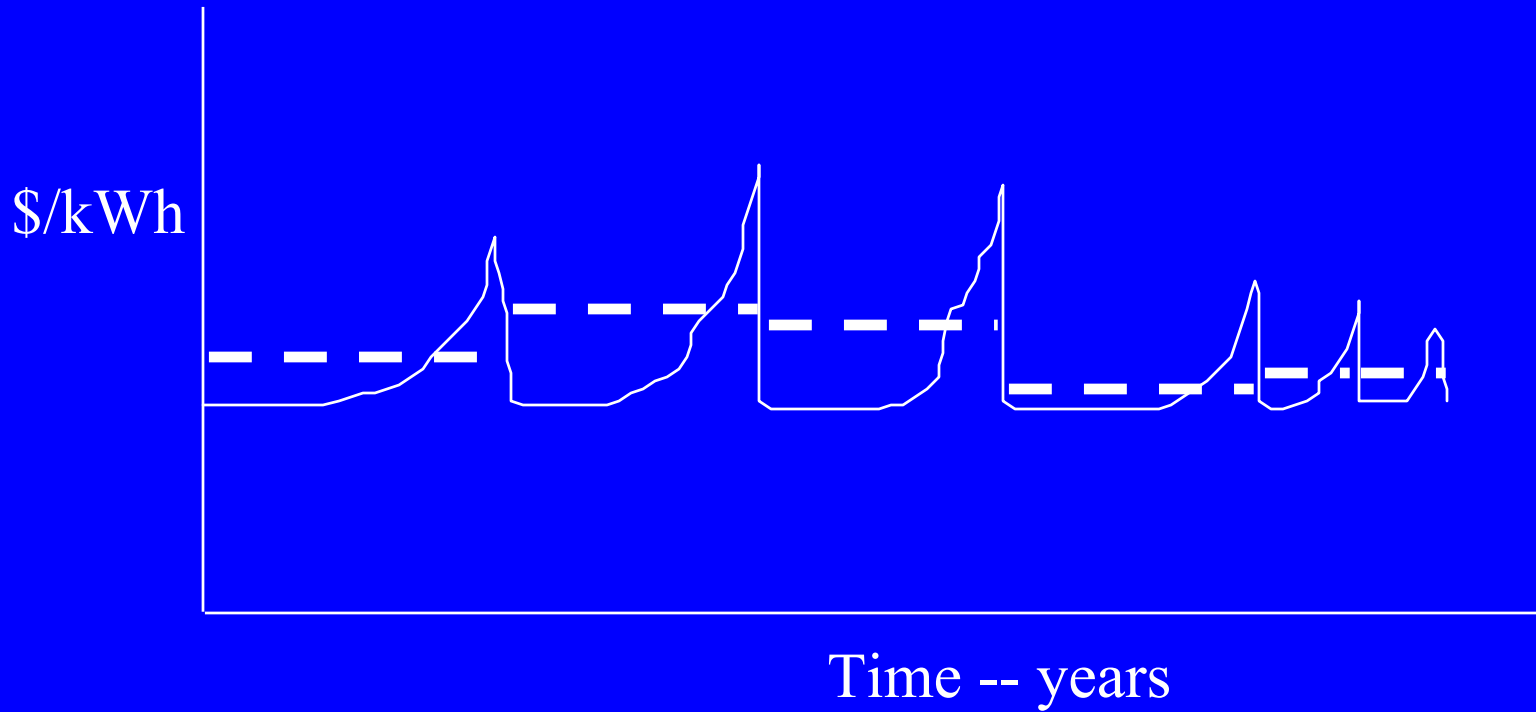
Revenue Recovery

- *Objective: to match the financial calculation of required revenues to the economic earnings of marginal costs*
 - In general the earnings from $MC < AC$
 - In theory, when you include Capacity Shortage Costs, and are in equilibrium, sufficient revenue will be generated with SRMC pricing.
 - Methods of recovery for difference between MC and AC
 - Adder (per kWh)
 - Lump Sum (connection charge)
 - Multiplier (per kWh)

LRMC

- *Forward looking to the next investment*
- *Includes expected operating costs*
- *“Saw toothed” behavior*
- *Best for infrastructure with little operating cost and high capital cost*
 - Water and Sewer

LRMC



Summary of Pricing Rules and Realities: The Devil is in the Details *ESD 126*

- *What role will the regulator play?*
- *How quickly will “deep” markets emerge?*
- *Who will benefit and who will be hurt in the transition?*
- *How many products are there?*
 - *Who will decide?*
- *How will the futures market develop to provide for hedges on price?*
- *Can the regulator remain aloof -- in the UK the regulator has stepped in because of poor initial rules?*

Swaps / Contracts for Differences

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