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# Transmission Pricing

Donald Hertzmark  
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## Topics

1. Key Issues in Transmission Pricing
2. Experiences in Other Systems
3. Pricing Alternatives
4. Electricity Market Structure and Transmission Services Pricing





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## Other Pools of Interest to Tariff Council Include:

- ☐ EU - Open Access Tariff
- ☐ PJM - tight pool with growing role of market
- ☐ Eskom - transition from vertically integrated monopoly to ?



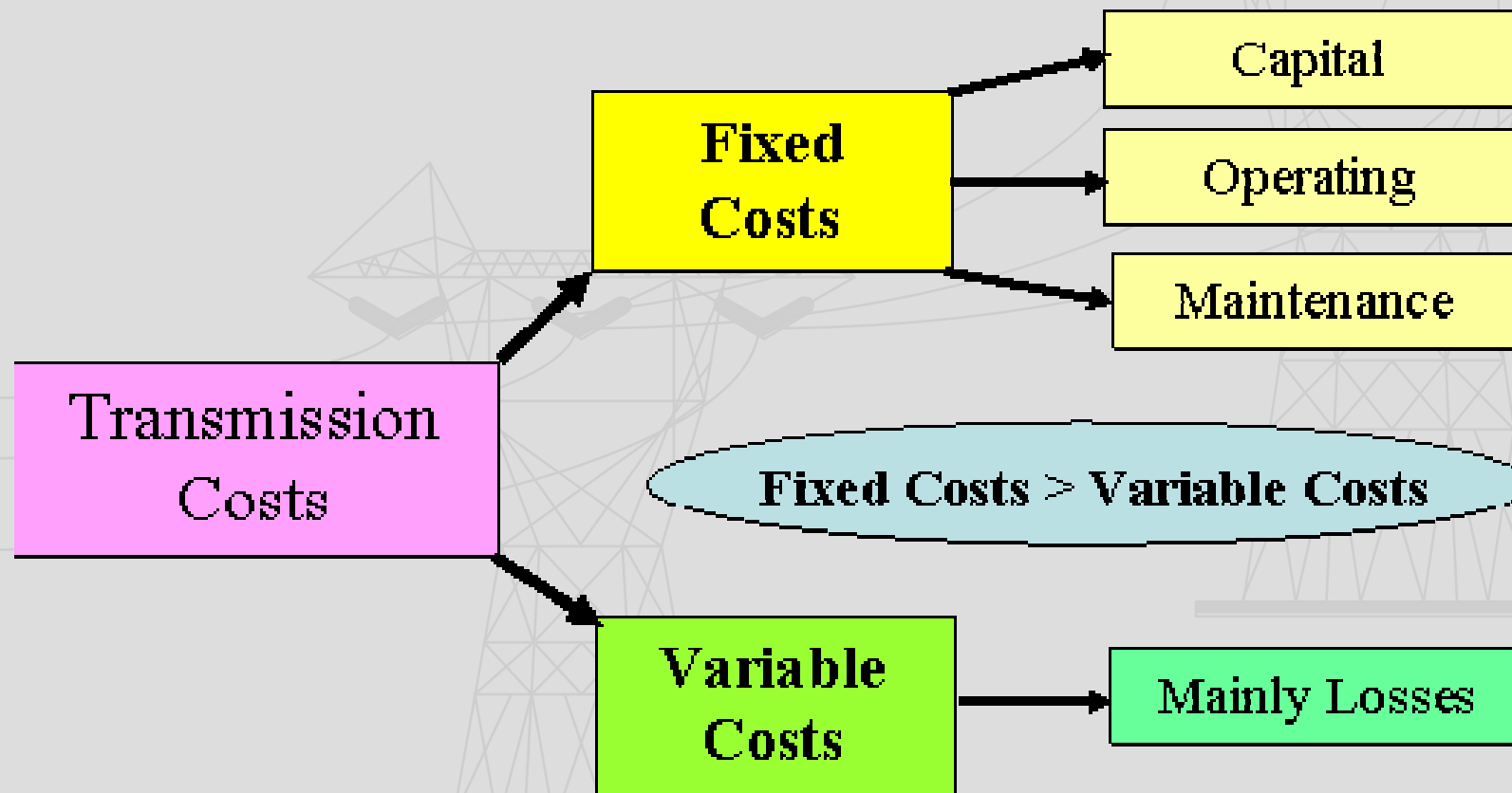


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## General Structure of Transmission Cost





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## Key Issues for Tariff Council

- ☐ Cover costs
- ☐ Avoid discrimination among customer classes
- ☐ Provide incentives for efficient use of transmission system
- ☐ Remain competitive for supply of electricity to Indian market



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## The direct pricing components of transmission service include the following cost elements:

- ☐ Fixed Investments in capacity
- ☐ Losses
- ☐ Maintenance and operation



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## The indirect pricing components of transmission service include the following cost elements:

- ☐ Levies
- ☐ Cost arising from regulatory review
- ☐ Public service obligation
- ☐ Stranded investments



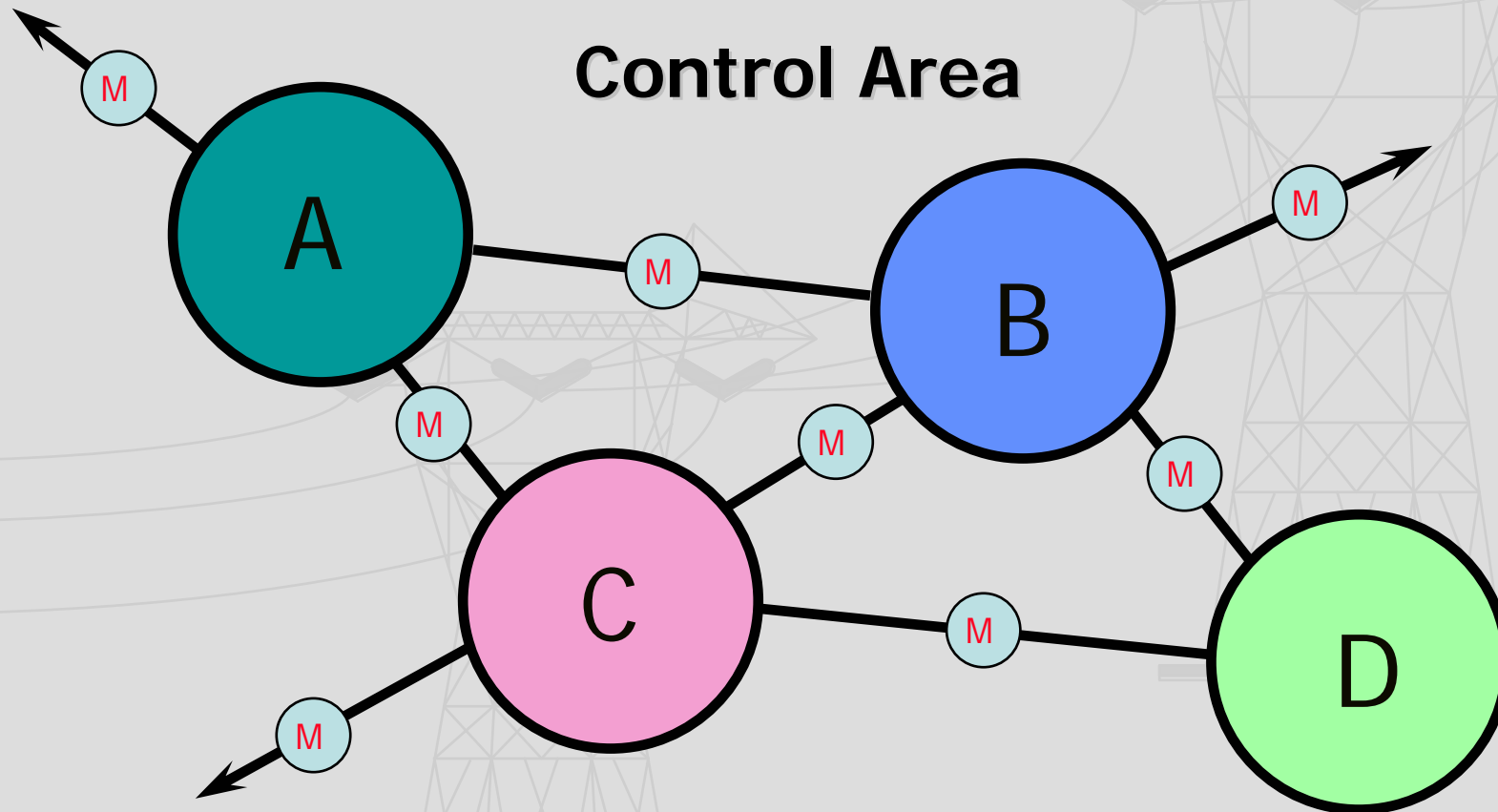


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## Control Area





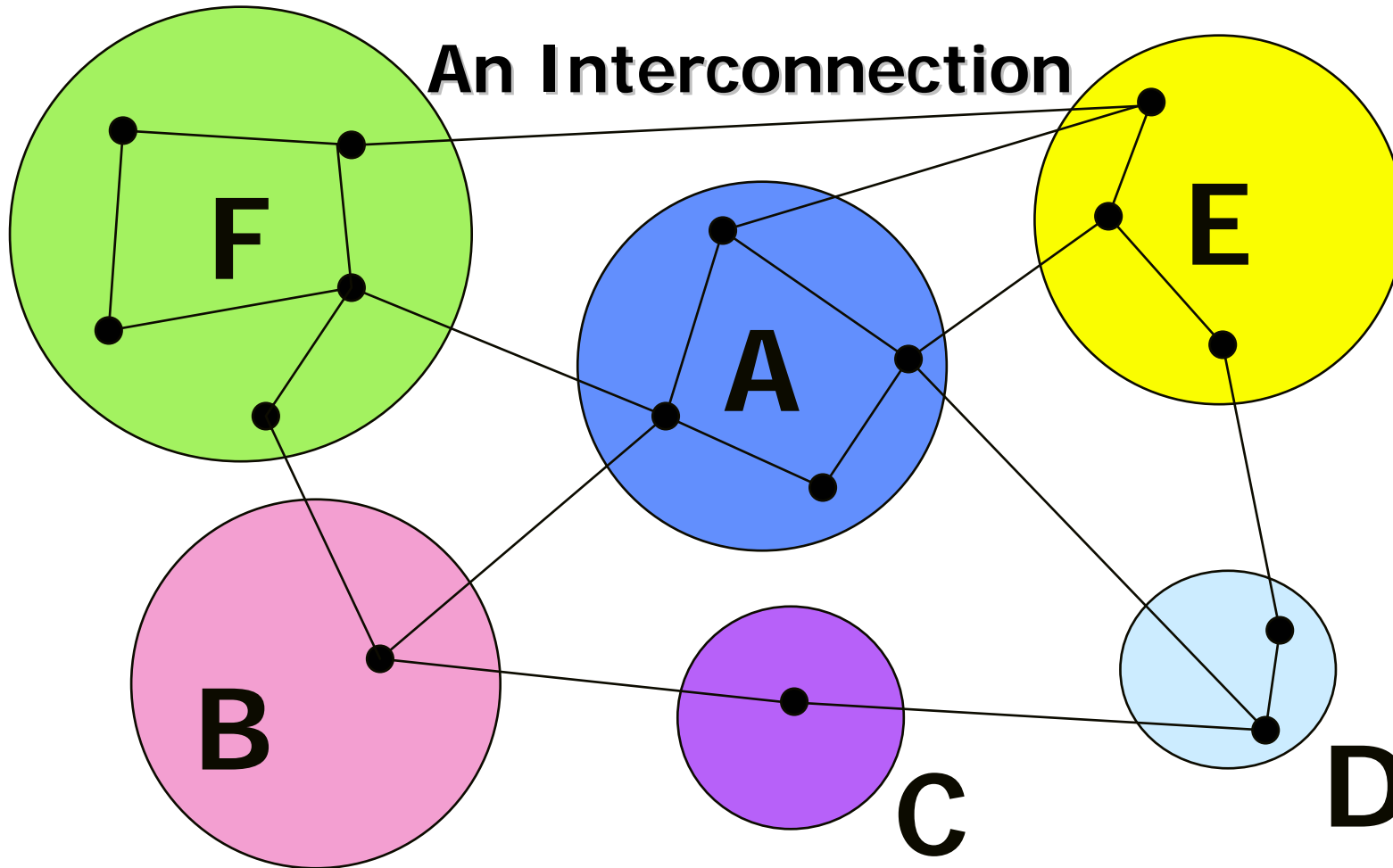


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## An Interconnection



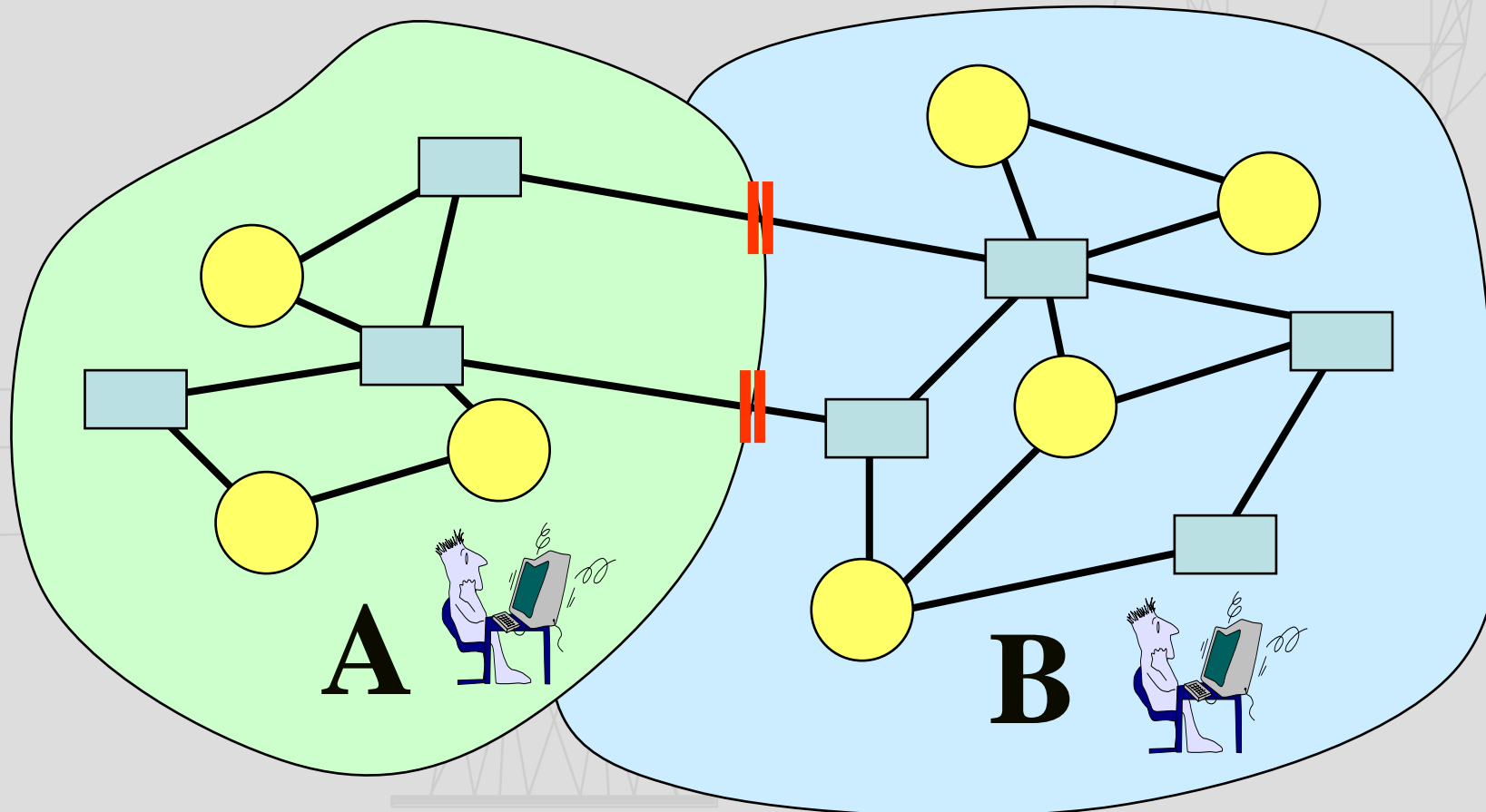


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## Interchange - Plain and Simple



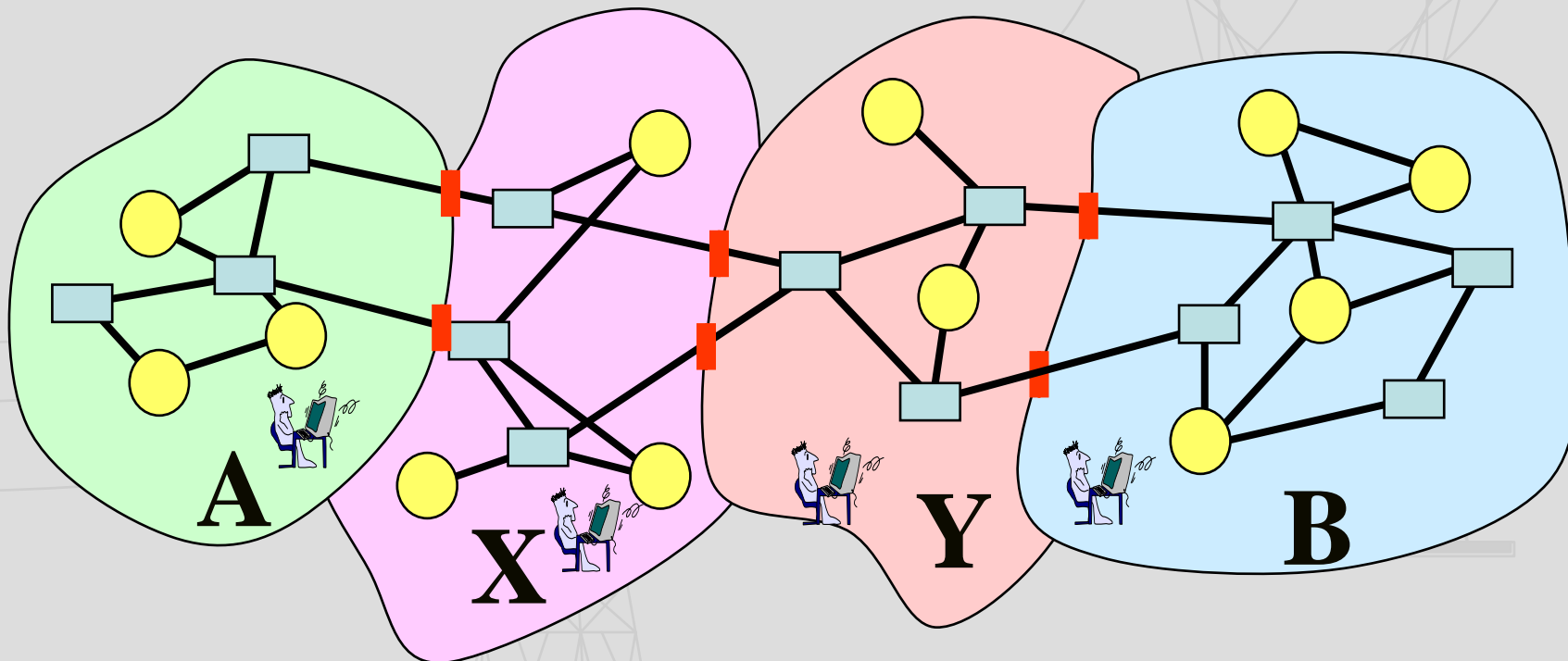


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## Interchange - With Wheeling





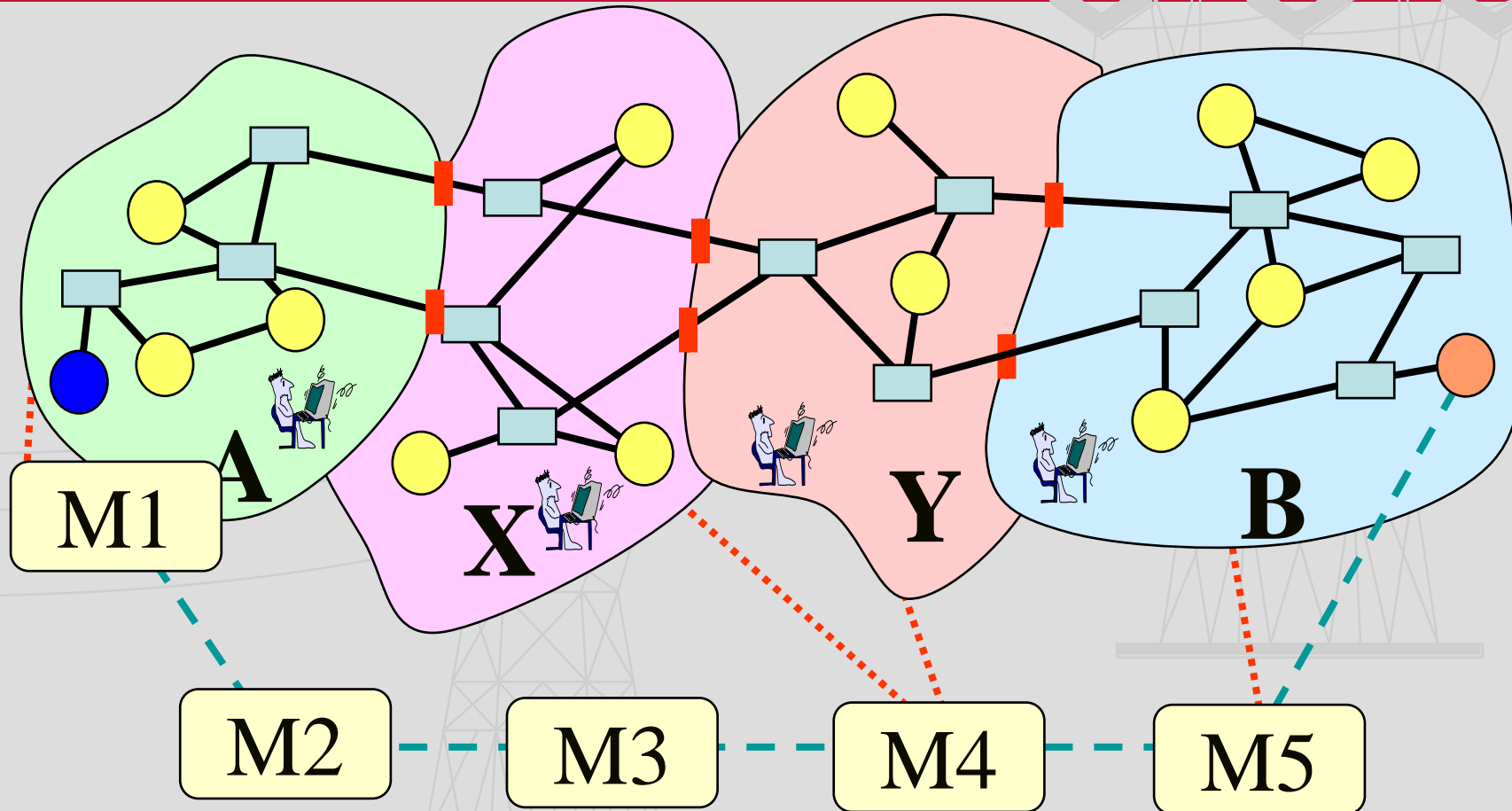
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## Interchange - Open Access





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## Criteria for Pricing Transmission Services

1. Technical feasibility -- How much can services be unbundled without posing a risk to the power system operations?
2. Management feasibility -- Assessments and analyses of management resources needed by each control area operator
3. Economic feasibility: -- Cost/Benefit analysis and trade offs of different pricing options



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### Allocation of Ancillary Service Responsibility in Typical Systems

Service	Covering What Ancillary Service Elements	Who Controls	Who Pays
Scheduling, Control & Dispatch	Control of generating stations, load following	Control area system operator	Members of intra-control area
Reactive Power & Voltage Control	Maintaining voltage within prescribed bands	Control area system operator	Generators receive, may be market allocated within control area
Regulation & Frequency Control	Maintaining appropriate Hz across system and at transfer points using AGC, load following	Control area system operator	Transmission system users
Energy Imbalance	Energy over or under supply in inter-control area transactions	System operator (since they tax generators to pay for AGC)	May be purchased from other control areas or internal generators
Reserves (spinning & supplemental)	Required share of various reserve categories apportioned by system load responsibility	Generators	Generators may allocate from own plants or purchase





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## EU Open Access Rules

- ❑ What major requirements are there for adopting or joining the TPA system in the EU?
  - Common Rules
  - Commercial operation standards
  - Unbundling and transparency of accounts
  - Access to the transmission system
  - Open markets
  - Timing of adoption





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## Component Costs Approach to Ancillary Services - Recommended by EU Regulators

Disaggregate the following transmission costs:

- ☐ Reliable access to grid for generators and consumers
- ☐ Transport to/from the borders and through transit countries
- ☐ Interconnections outside the region
- ☐ Congestion
- ☐ Losses



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## EU Open Access Approach: Component Cost Pricing Method

- Include only costs specific to transit
- Price transit transactions based solely on their incremental costs
- Identify explicit and detailed costs of transactions
- Assumes that transit transactions are secondary in volume and value to domestic transactions



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## EU Open Access Rules – cont'd

- ☐ How effective are the EU's open access rules? The main reasons for slow realization of TPA in EU are:
  - Different approaches and institutional set-up of the national regulatory institutions
  - Uneven unbundling level in different EU countries
  - Significant electricity price differentials within and among countries and consumer groups
  - Different taxation levels among countries
  - Grossly inadequate transmission interconnections
  - Low overall trade volume relative to potentials



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## EU Open Access Rules – cont'd

- ☐ How applicable are these EU rules to Azerbaijan? Key provisions relevant to domestic & international pricing:
  - Protective measures for members – *force majeure* provisions
  - Interoperability of the transmission system
  - Access to the transmission system by members
  - Flexible restructuring schedule.



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## **EU Open Access Rules – cont'd**

How applicable are these EU rules to Azerbaijan? Key provisions relevant to domestic & international pricing:

- Non-discrimination
- One TSO or ISO to make decisions for each control area
- Transparency in cost calculations
- Cost coverage on transmission and services



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## PJM -- The Pennsylvania, New Jersey, Maryland Pool

### At a Glance

Population - 51 million

Generating sources -  
1,271

w/diverse fuel types

Generating capacity -  
164,905 MW

Peak demand - 144,644  
MW

Annual energy delivery -  
729 million MWh

Transmission lines -  
56,250 miles

Members/customers -  
500+

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TIFF (Uncompressed) decompressor  
are needed to see this picture.



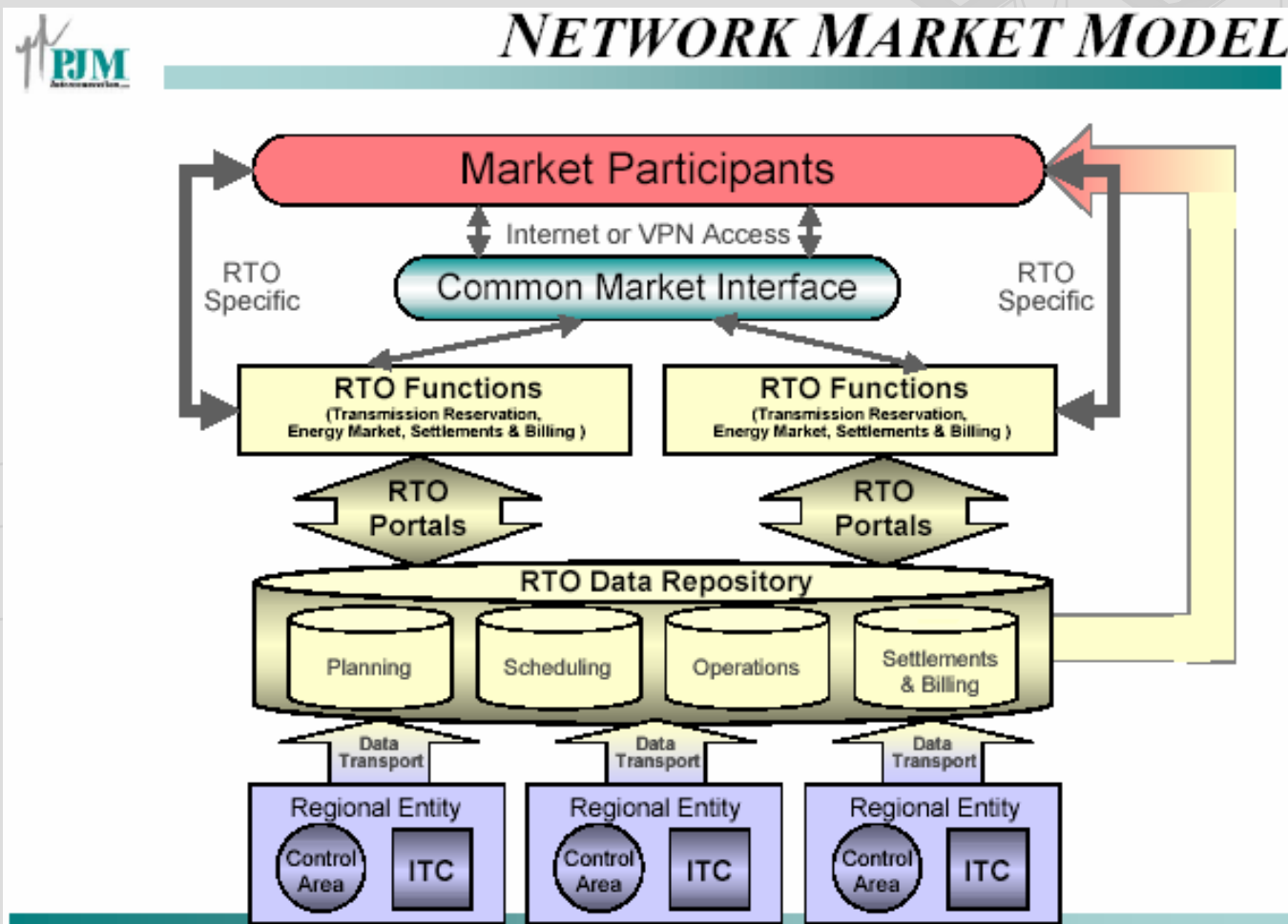


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## PJM -- The Pennsylvania, New Jersey, Maryland Pool







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## How are transmission services handled in a tight pool?

- ☐ The pool uses formulas and bids rather than fixed charges to provide the following services:
  - Scheduling, Control and Dispatch and capacity reservation
  - Ancillary Services, including:
    - Reactive Supply and Voltage Control from Generation Sources Service
    - Regulation and Frequency Response Service
    - Energy Imbalance Service
    - Operating Reserve - Spinning and Supplemental Reserve Service



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## Since 1997 the PJM system has put an increasing number of products out for market allocation:

- ☐ Real time cost-based energy market (April, 1997)
- ☐ Daily capacity markets (January, 1999)
- ☐ Monthly and multi-monthly capacity markets (January, 1999)
- ☐ Real time competitive energy market (April, 1999)
- ☐ Transmission Rights Auction (June, 1999)
- ☐ Day-ahead market for energy (June, 2000)
- ☐ Regulation market (June, 2000)
- ☐ Spinning Reserve market (2001)
- ☐ Reliability Market Model (2008)



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## Charges for Firm Point-to-Point Transmission:

- ☐ Annual capacity reservation charge in \$/kW, based on:
  - ☐ Delivery point
  - ☐ Peak v. off-peak delivery
- ☐ Redispatch costs (\$/kWh), based on congestion in system
- ☐ Energy losses (\$/kWh), based on system averages
- ☐ Current capacity reservation charges vary from \$15-35/kW/year
- ☐ Pricing formula is based on actual embedded costs ÷ reserved peak load



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## Breakdown of PJM A/S Charges

Charge	How Computed	Geographical Unit
<b>Scheduling, System Control and Dispatch Service Charges</b>		
<b>PJM Charges</b>	Monthly \$/MWh rate calculated as PJM's Control Area Administrative Service expense divided by total PJM transmission use, plus PJM's Market Support Service rate for transmission customers.	System wide
<b>Transmission Owner</b>	Monthly \$/MWh rate for each zone as filed in the PJM Open Access Transmission Tariff.	Zonal
<b>Regulation Charges</b>	Hourly \$/MWh rates calculated as total cost of Regulation in applicable East or West regulation market divided by total real-time load in that market	Region
<b>Reactive Power</b>	Monthly revenue to generators based on capacity reserved for that service. Annual truing up & recalculation of next year's requirements	Zonal
<b>Spinning Reserve Charges</b>	Daily \$/MWh rates calculated as total cost of Spinning Reserve in the applicable reserve zone divided by the total real-time load in that zone	Zonal
<b>Transmission Loss Credits</b>	Hourly \$/MWh rate calculated as total point-to-point transmission loss revenues divided by total PJM real-time load	System wide
<i>Source: PJM Website</i>		



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## Applicability to Azerbaijan

- ☐ Each control area operator, and not the individual member, has the obligation to ensure the reliable operation of the intra-area control system
- ☐ PJM has developed mechanisms for the accurate pricing, as well as the proper allocation of the costs and compensation
- ☐ PJM has maintained a mix of “community services” for some services and market allocation for others





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## Applicability to Azerbaijan – cont'd

- ☐ Certain services are aggregated, managed, and deployed under the control of the central operating authority.
- ☐ A full and accurate unbundling permits transmission costs to be calculated and adjusted equitably, including truing-up for A/S
- ☐ PJM uses formulas instead of fixed charges for all cost-based services



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## Eskom

- ☐ Has embarked in restructuring and unbundling
- ☐ Has started publishing proposed overall regulations for its own system
- ☐ Has started publishing transmission services and cost allocation proposals





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## Transmission Services in the Context of South African Restructuring

- ❑ At the present time -- all of the transmission services are going to be directed and allocated by the SO
- ❑ The direction of system restructuring in South Africa points toward a Nordpool type of option
  - most electricity sales accomplished through bilateral contracts
  - bid pool used for imbalances and for purposes of establishing reference prices
  - Transmission services, including A/S, provided by contract and bidding, rather than by central direction



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## Applicability to Azerbaijan of Eskom Service Rules and Tariffs

- ❑ Eskom is *de facto* system area controller for the largest SAPP control area - treatment of transmission pricing must be harmonious, transparent and fair
- ❑ The key issues towards an unbundled and transparent system are the following:
  - Whose costs count?
  - Who has standing to appeal for redress with the regulator?
  - How will information from the ISO be made available to SAPP members?
  - How to avoid “pancaking” of transmission charges for point-to-point transactions?
  - How will stranded costs be resolved?



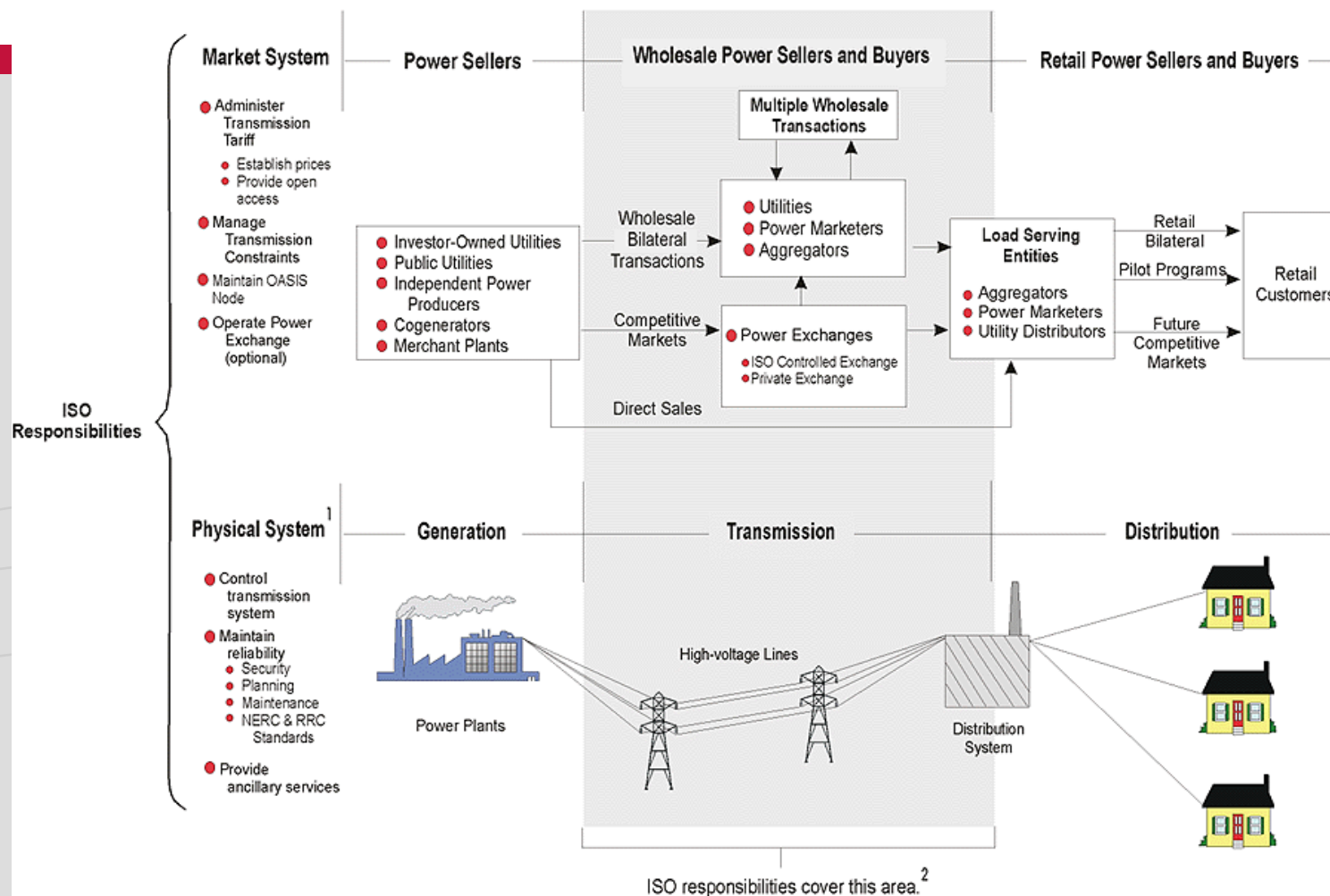
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Figure 14. Overview of an Independent System Operator's Responsibilities

# ISO's Responsibilities



<sup>1</sup> In some instances, transmission owners, not ISO employees, will physically operate portions of the transmission system. Details vary among ISO proposals. In addition, the type of facilities controlled by an ISO vary by region.

<sup>2</sup> An ISO also affects unit power generation through energy balancing, management of congestion, and responding to emergency conditions.

Source: Energy Information Administration, Office of Coal, Nuclear, Electric and Alternate Fuels.



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Service	How Treated in SAPP	How Treated by Eskom (future)	Notes
<b>Scheduling, System Control and Dispatch Service Charges</b>			
<b>Control Area Service Charges</b>	Monthly rate calculated as SAPP's Control Area Administrative Service expense divided by total Control Area transmission use.	Monthly rate for transmission customers as filed in applicable tariff.	System wide in SAPP, country-wide in Eskom
<b>Transmission Owner</b>	N/A	N/A	No system of purchased transmission rights yet established
<b>Regulation Charges</b>	Responsibility of each member	Hourly \$/MWh rates calculated as total cost of Regulation in applicable regulation market divided by total real-time load in that market	National in SAPP, Country-wide in Eskom
<b>Reactive Power</b>	Responsibility of each member	Monthly revenue to generators based on capacity reserved for that service. Annual truing up & recalculation of next year's requirements	National in SAPP, Zonal in Eskom
<b>Spinning Reserve Charges</b>	Responsibility of each member	Daily \$/MWh rates calculated as total cost of Spinning Reserve divided by the total real-time load	National in both systems

**Source:** Eskom, Sections on Ancillary Services from Draft Grid Code version 5.06

Note: Eskom charges not yet completely established and likely to subject to considerable changes before final versions published.





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## **Applicability to Azerbaijan of Eskom Service Rules and Tariffs – cont'd**

- ☐ The particular issues that need to be addressed:
  - How many system operators – does the SA ISO control the SAPP control area as well?
  - How many TS owners and operators within SA?
  - What will be the procedure for the allocation of costs, including losses, between SA and SAPP control area members?
  - What transition mechanisms exist for improving SAPP control area services?



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## **Towards a Workable Transmission Tariff**

- ❑ Key Issues, Questions, & Recommendations for Azerbaijan
  - Cover costs
  - Avoid discrimination among customer classes
  - Provide incentives for efficient use of transmission system
  - Supply electricity competitively to Indian market



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## **Towards a Workable Transmission Tariff**

- ☐ Key Issues, Questions, & Recommendations for Azerbaijan (cont)
  - Uniform v. zonal transmission prices
  - Which A/S are essential to the proper control of quality in the system?
  - Who provides them?
  - What are the tradeoffs, if any, among different services?
  - Is there a free riding ("leaning") issue?





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## ❑ Cover Costs:

- Price determination must be transparent
- Unbundle just enough services – too many vs. too few
- Don't get ahead of yourself

*Both the NY ISO and PJM OI have a mix of centrally provided and bid out ancillary services; on the contrary, the CAISO went to bid-based services before it had much experience with administered services*

*Nordpool has bid-based services, but it is also very sophisticated and decentralized, probably not a good short term model for Azerbaijan*



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- ❑ Avoid discrimination among customer classes:
  - Price determination must be transparent
  - Give legal standing to customers
  - Do not treat same demand profile differently if cost of service is equivalent



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- ❑ Competitive supply of electricity to external markets:
  - Price level is reasonable - below all-in cost of supply to a given demand node
  - Congestion charges are minimized
  - Capacity reservation charges are competitive with new transmission capacity costs in trading partners



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# Electricity Market Structure and Transmission Services Pricing

Transmission pricing must allow for evolution of market structure

- More transactions through markets
- More participants & new contract instruments
- Changing industry structure in region
- Other regional issues (e.g., SA power pool)



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## Pricing Alternatives for Azerbaijan Transmission Services

- ❑ Proposed services to be priced on cost basis:
  - Capacity reservation and control area operations
  - Reactive Power & Voltage Control
  - Regulation & Frequency Control
- ❑ Proposed services to be priced on value base:
  - Energy Imbalance
  - Reserves (spinning & supplemental)





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## Basis for Pricing

### ❑ Cost-based services – *Control area service including dispatch*

- Embedded Costs (*lagged by one month and allocated across all energy*), including
  - ✓ ISO costs, including Market Administration, Control Area Services, Market Power Monitoring Program & General & Administrative expense
  - ✓ System Scheduling, Control, & Dispatch costs
  - ✓ System Operator startup costs
  - ✓ Transmission System Studies, Engineering & Planning
  - ✓ Transmission System Capacity





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## Basis for Pricing

- ❑ Cost-based services – ***Control area service including dispatch*** – cont'd
  - Uplift Charges (*billed hourly and allocated by responsibility factor - % of load*), including:
    - ✓ Transmission Service Market Administration
    - ✓ Transmission Service Billing & Accounting
    - ✓ Miscellaneous Adjustments (including stranded costs, if any + excess regulation, excess residual energy)



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## Basis for Pricing

### ☐ Cost-based services – *Reactive power*

- For a small control area the reactive power charge can be uniform throughout the system while in larger control areas it is appropriate to use locational or zonal pricing
- The costs of the service should be computed monthly with an annual or monthly true up
- Payment for the service should be no less than the energy+capacity charge as negotiated and no more than the marginal transaction price ruling at a given time



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## Basis for Pricing

- ❑ **Cost-based services – *Regulation and frequency control*** – Associated types of transactions and costs:
  - Cost of load monitoring & regulation (an embedded cost)
  - And for each individual generator - value of lost generation sales and cost of additional generation

*Costs of the embedded regulation services and the payments to generators are summed and added to the transmission energy charge*



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## Basis for Pricing

### ❑ Value-based services – *Imbalance and Reserves*

- The bidding out of reserves is an example of “performance-based regulation” (PBR)
  - ❖ Under PBR the generators will initially receive the relevant marginal energy charge for providing a spinning reserve
- For other categories of reserves, bidders will offer capacity reservation bids and will be compensated based on the lowest bid level still sufficient to meet the requirements for that reserve category



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## Basis for Pricing

- ❑ Will these pricing proposals work and will they provide essential capabilities and characteristics?
  - Transparency, cost separability, and fairness
  - Cost coverage for transmission, and
  - Incentives for efficient performance?





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## Basis for Pricing

- ❑ Proposals for pricing transmission can promote efficiency if the following conditions hold:
  - Data collection is accurate, frequent and appropriate
  - Simulation modeling work is done frequently and in a transparent manner
  - Adjustment intervals for formulas and tariffs are specified and are sufficiently small initially to overcome errors, omissions and changes
  - Costs included in various ancillary services formulas contain only those items applicable to Azeri Energy's transactions