Wholesale Electricity Concepts

A. David Cormie P. Eng.
Division Manager Power Sales and Operations
Manitoba Hydro
May 2010

Topics

- Electricity Accounting
- Losses
- Firm
- Capacity
- Energy
- Reserves
- Products

Electricity Accounting

For each moment in time

- Supply = Demand
- Generation = MB Load + Net Metered Exports
- MB Demand = Generation - Net Metered Exports
- MB Demand = Customer Metered Demand + TX Losses + Distribution Losses + Transformation Losses + HVDC Conversion Losses

Reporting Periods

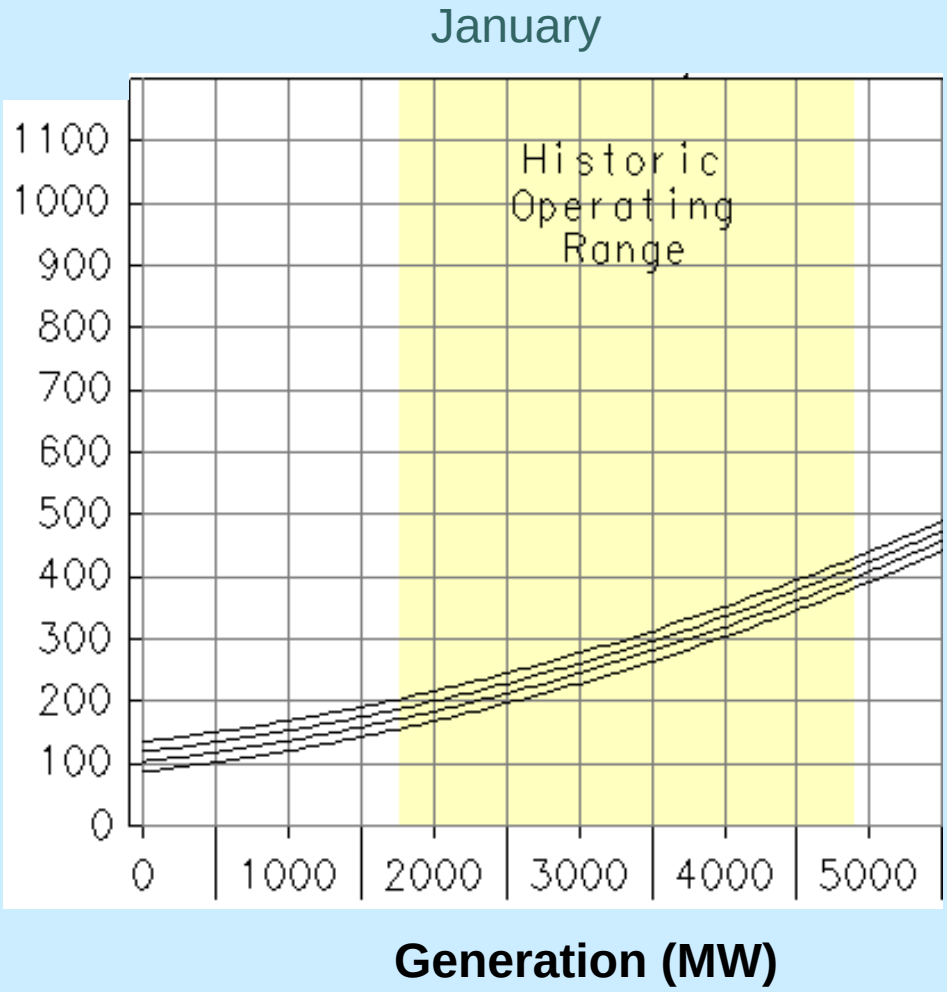
- **Hourly**
- **Monthly**
- **Yearly**

Transmission Losses and HVDC Conversion Losses

Losses are dependant upon

- Generation
- Air Temperature
- VG Outages

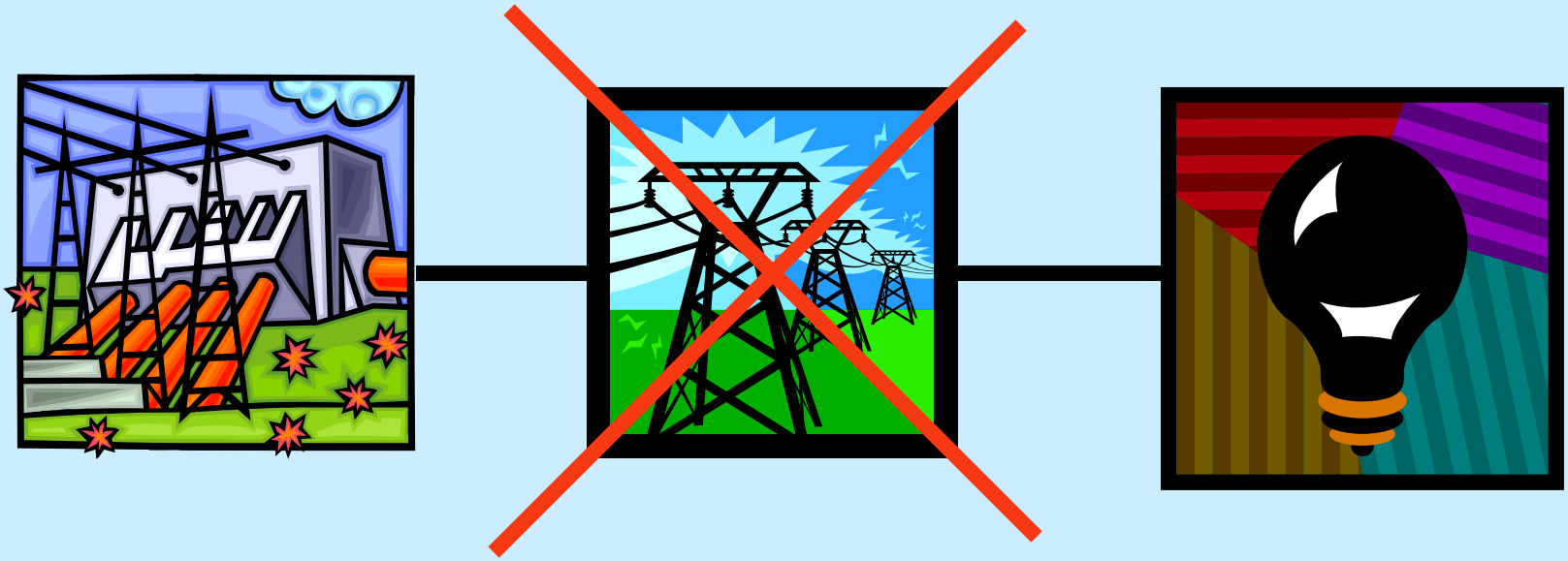
Average 7% - 8%



What does “Firm” mean?

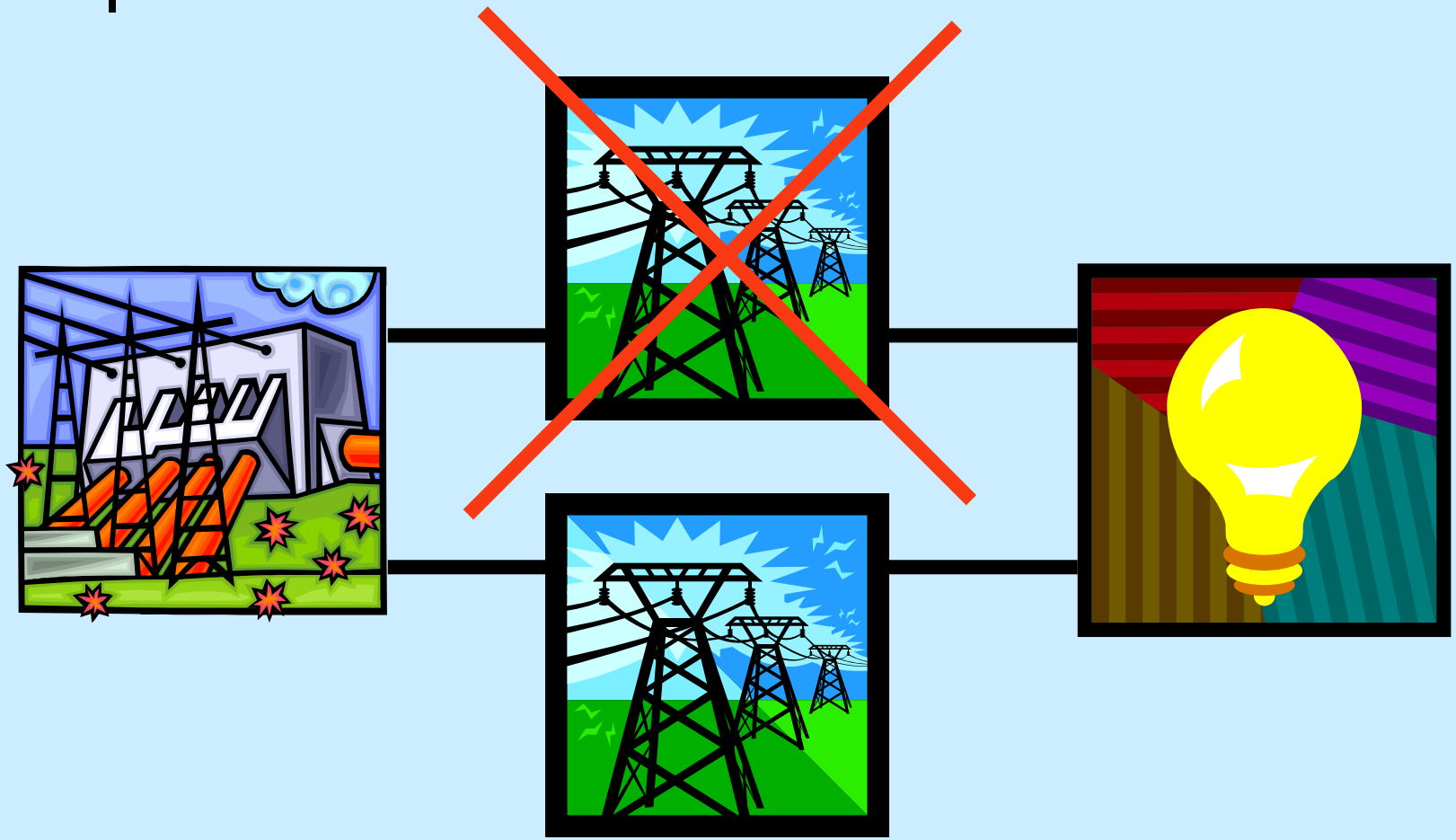
- Physically Firm
  - Capacity
    - Generation
    - Transmission
- Financially Firm
  - Liquidated Damages (LD)
    - Buyer is kept financially whole
    - Force Majeure exclusion

Physically Firm

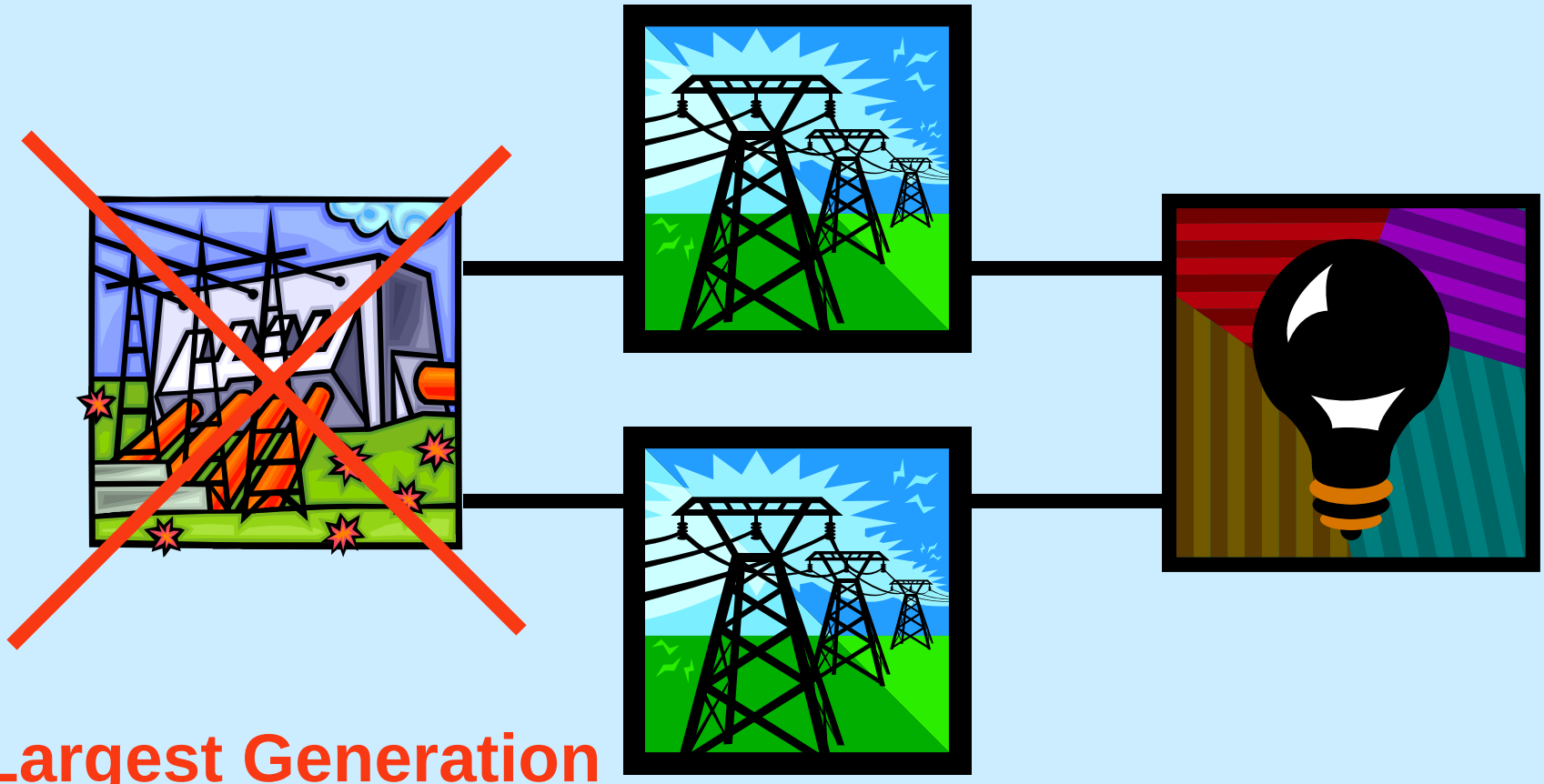


Largest TX Contingency

Firm Transmission



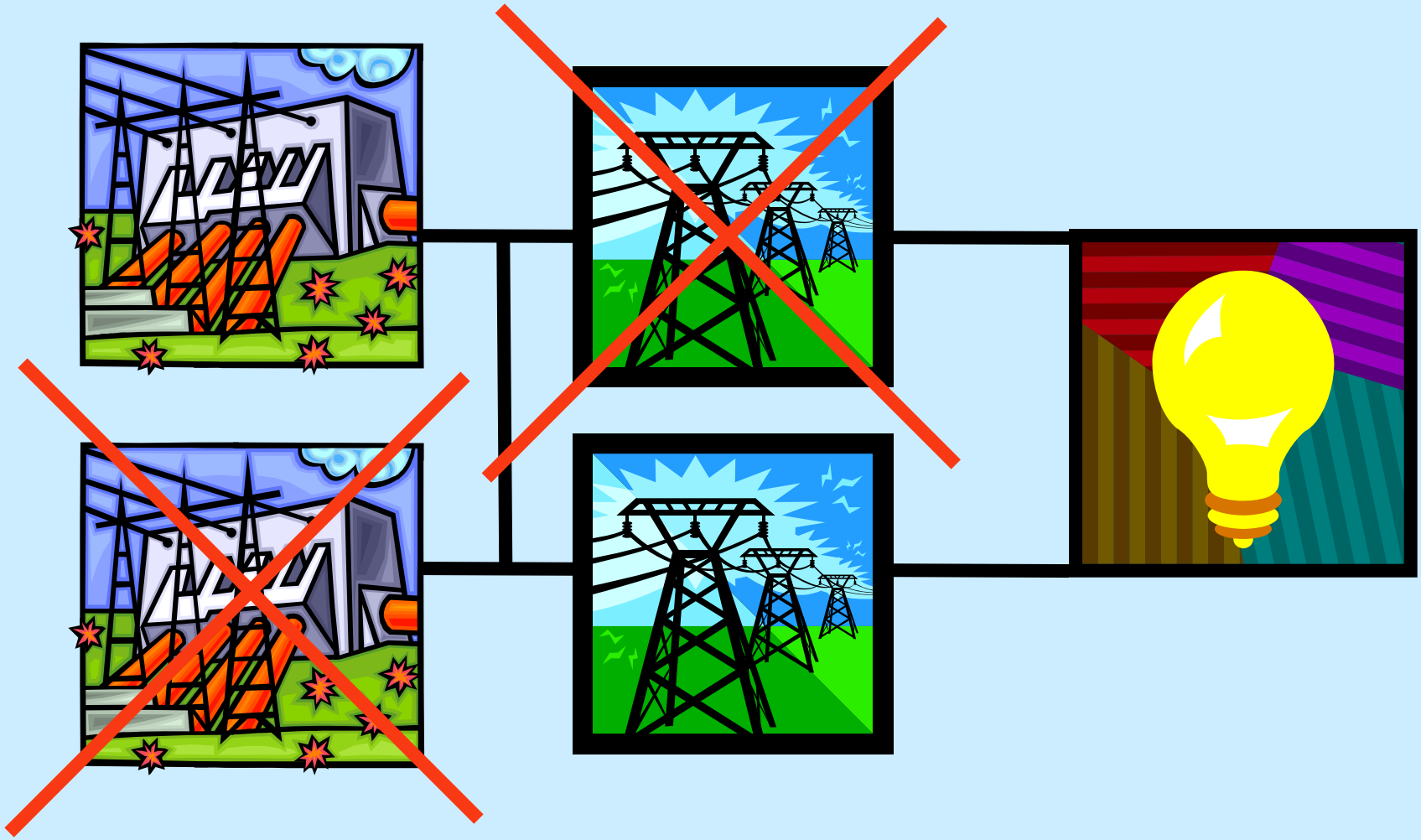
Firm Generation



Largest Generation Contingency

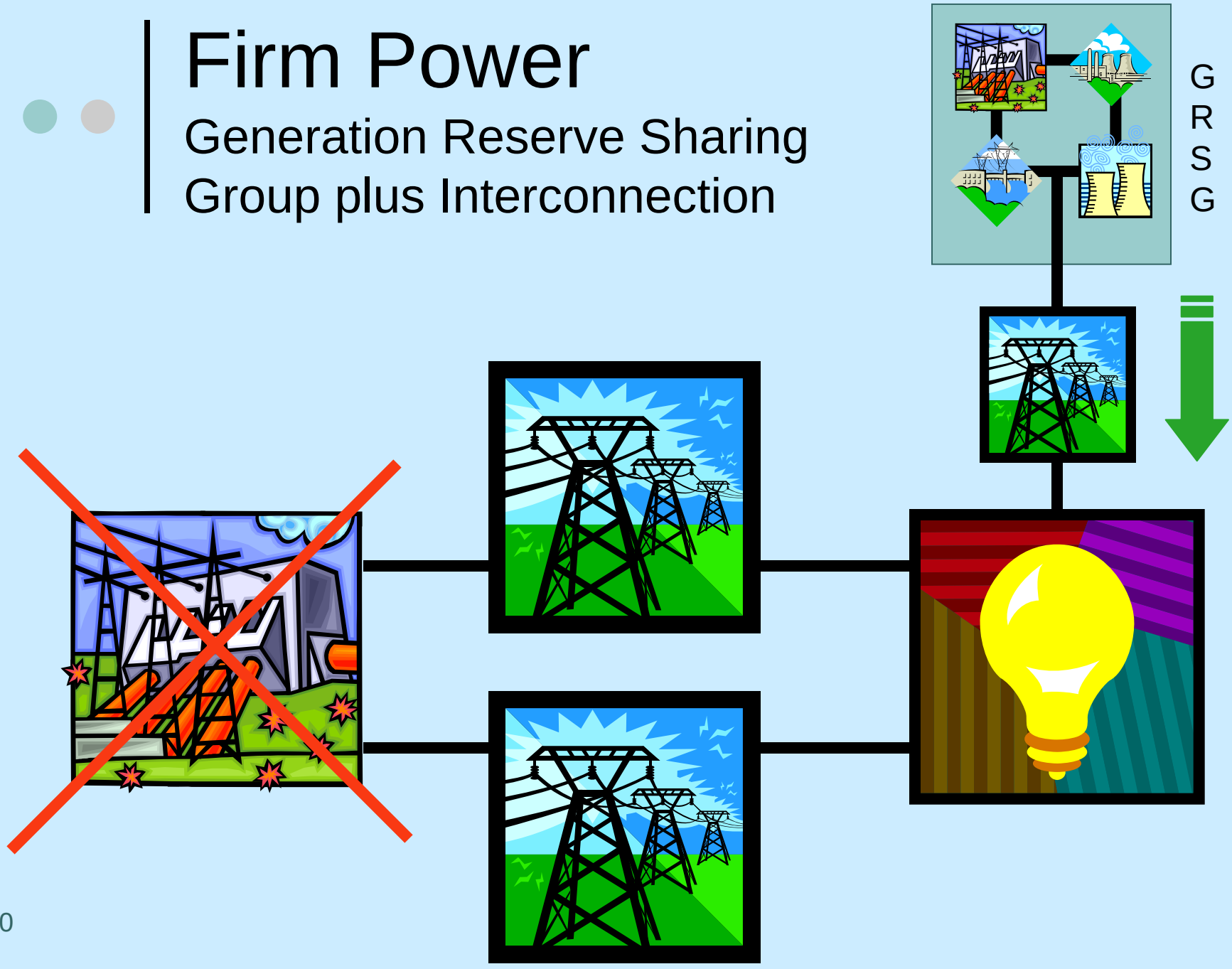
Firm Power

Generation and Transmission Reserves

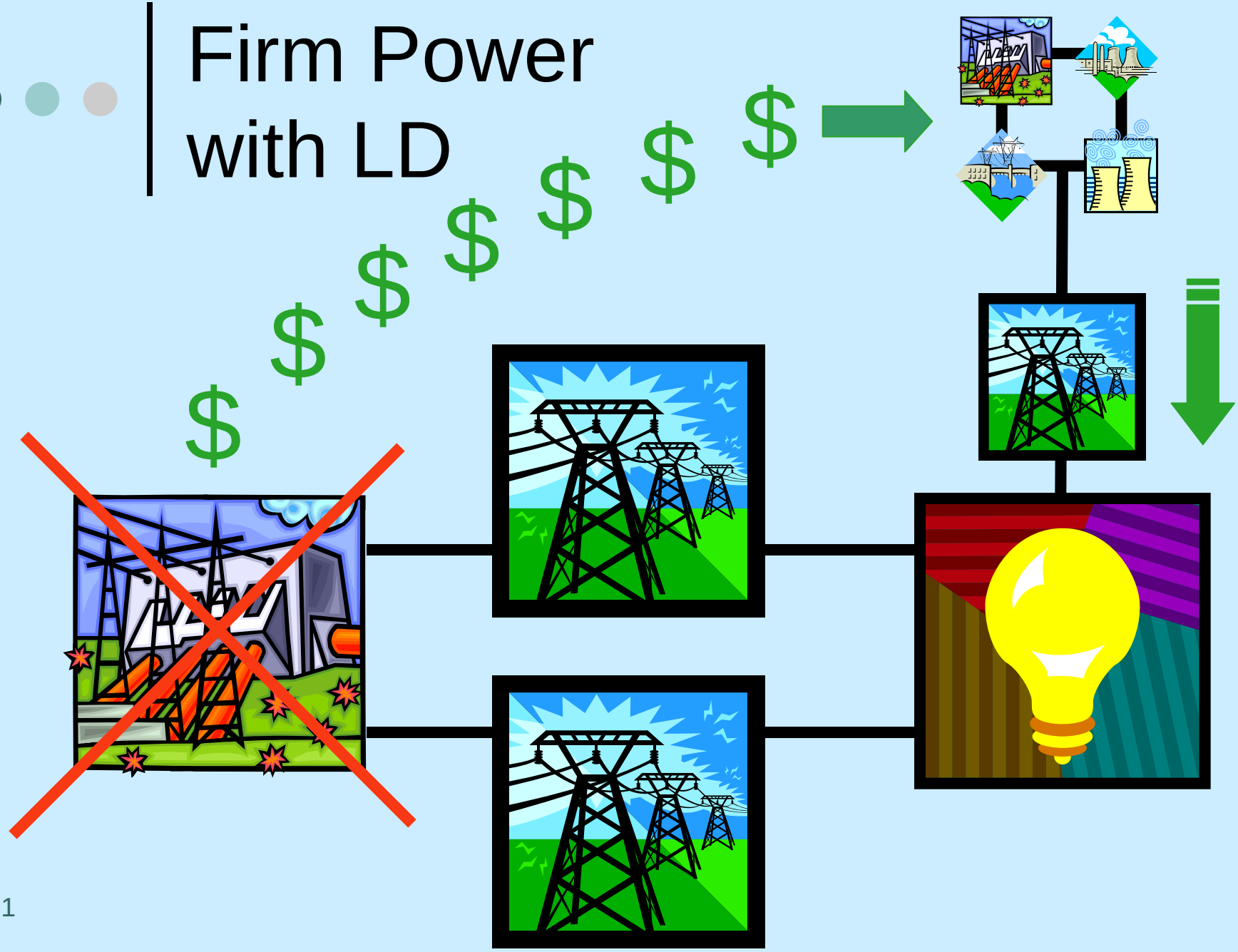


Firm Power

Generation Reserve Sharing Group plus Interconnection



Firm Power with LD



Capacity - MW

- The capability to produce power
  - Generator
    - Driven by a turbine
      - Hydraulic, steam, gas, air
    - Fueled by water, coal, gas, wind
  - Load reduction
    - Virtual generator
    - Curtailable load
- “Dispatchable” capacity
  - Produce power as required

125,000 HP

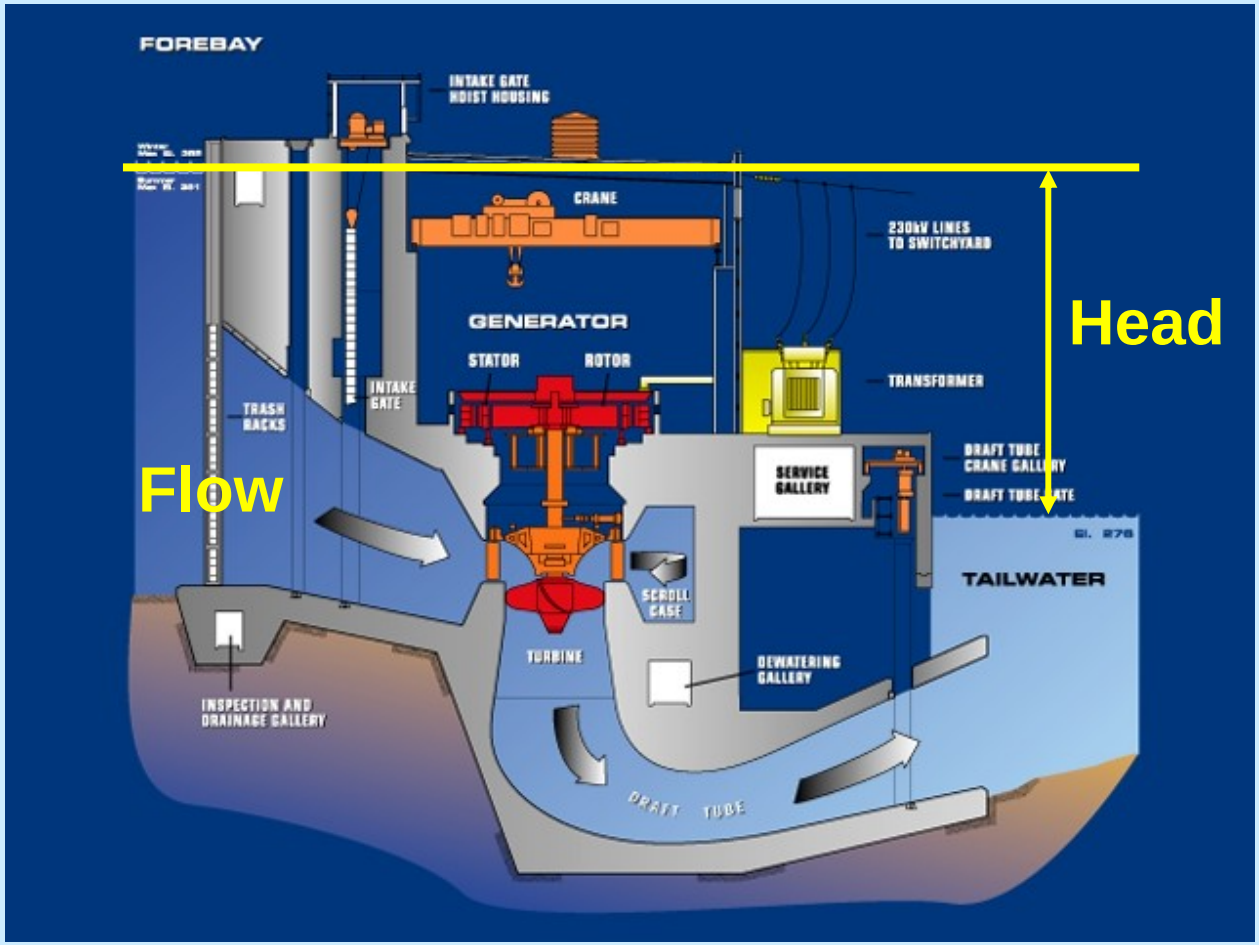
Energy - MWh

- Output x time
- Long Spruce:
  - 1 hour: 1010 MW x 1 hr = 1010 MWh
  - 1 day: 1010 MW x 24 hr = 24,240 MWh
  - 1 year: 24,240 MWh/d x 365 d = 8.8 TWh
  - Annual average = 6.4 TWh
- Average Capacity Factor: 6.4/8.8 = 72%
  - Annual capacity factor will vary with water conditions

Hydraulic Power

Power = Flow x Head x k

101 MW = 16.6 x 80 x 0.076



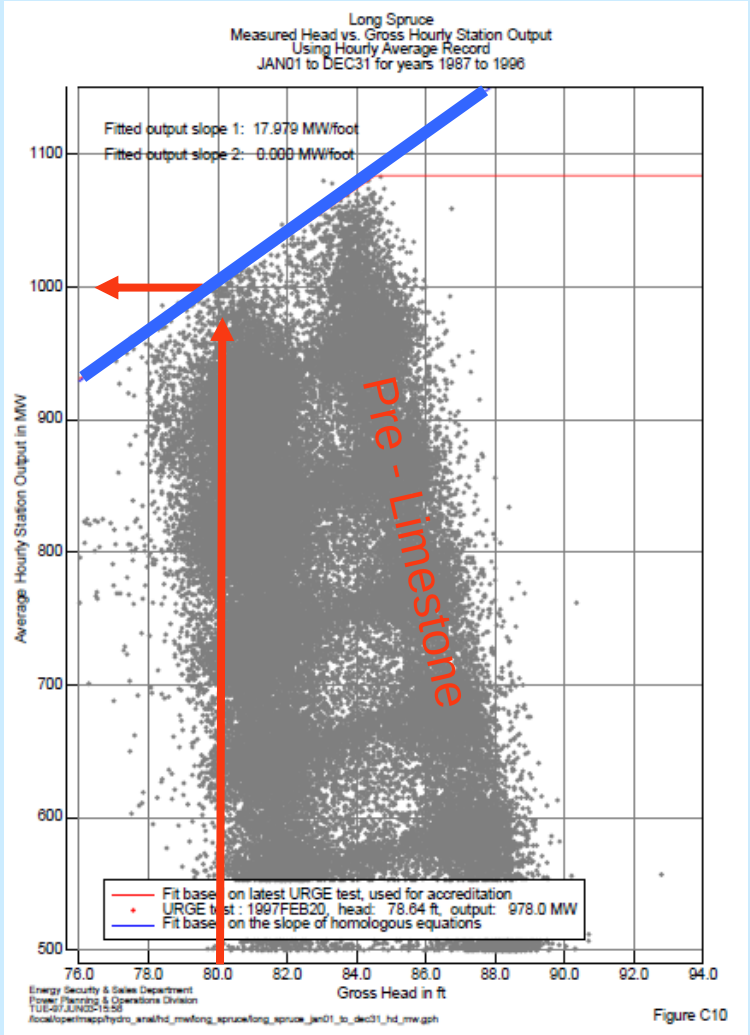
Long
Spruce
10 units
1010 MW

Accredited Capacity

- Capacity rated according to a uniform standard
  - Regional Reliability Organization
    - Was MAPP
    - Now MISO
- Backed by verified performance tests
  - Normalized for operating conditions
- Backed by adequate fuel resources
  - 4 continuous hours at time of peak

Long Spruce G.S.

- Maximum Capacity is dependant upon head
  - River flow,
  - Upstream levels
    - Trash, ice
  - Downstream levels
    - Ice jams
    - Forebay
- Rated at 1010 MW



Output (MW)

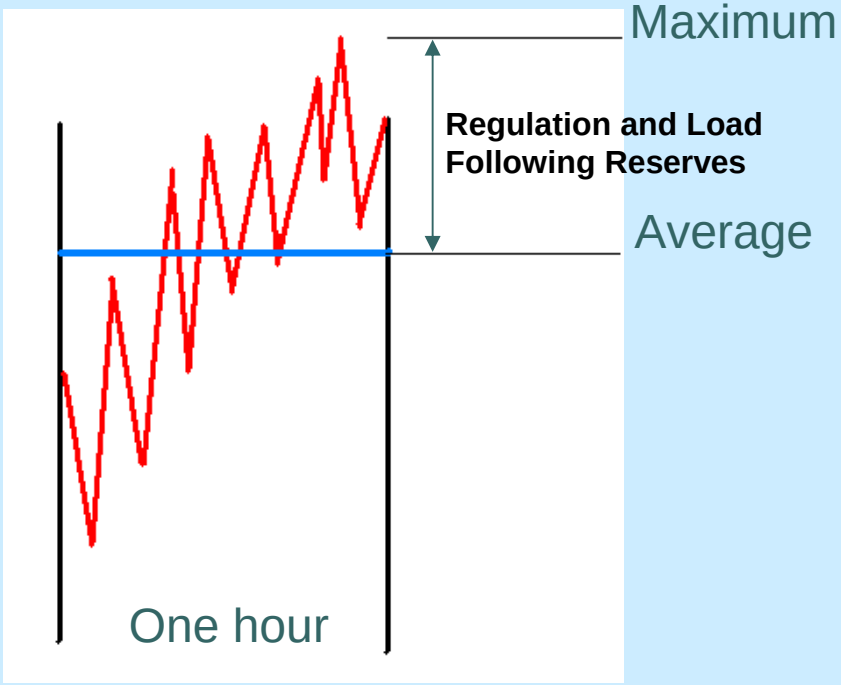
Head (ft)

Operating Reserves

- Generating capacity reserved to maintain
  - reliable supply to load
  - control of imports and exports
    - Inadvertent flows
- Types
  - Regulation
  - Load Following
  - Contingency
- Capacity not available for commercial use

Regulation and Load Following Reserves

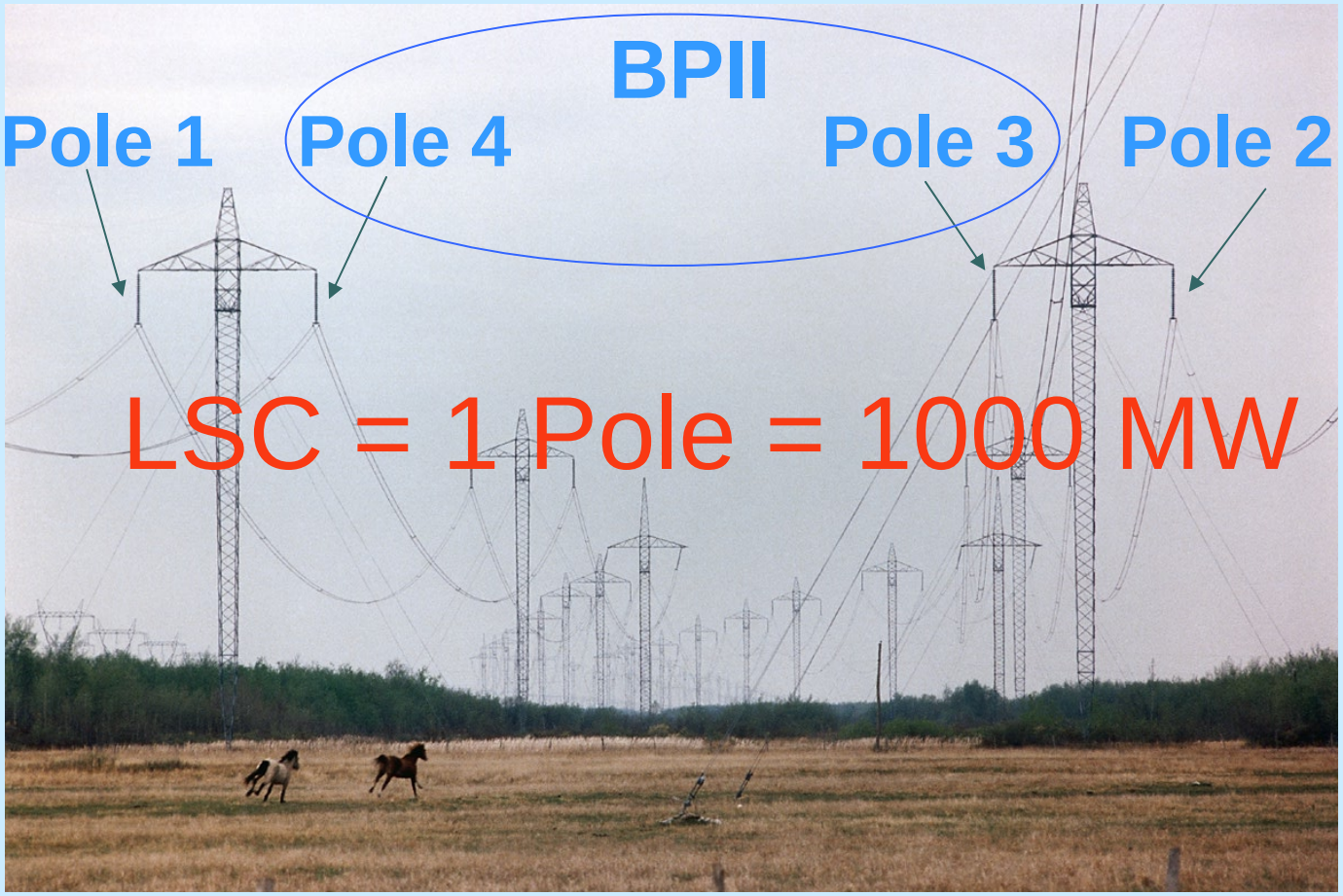
- Generating capacity reserved to follow MB load up and down on a moment by moment and over the hour basis
- MH maintains
  - minimum of 50 MW
  - Up to 250 MW
- Regulation reserves will increase as more wind generation is added to system



Contingency Reserves

- NERC Standard
  - Mandatory for interconnected systems
- Contingency
  - Reserves for largest single loss **1000 MW**
  - Spinning – 40% **400 MW**
  - Supplemental – 60% **600 MW**
    - Generation **550 MW**
    - Curtailable load ‘Option R’ **50 MW**
- Re-establish in 105 minutes
- Options
    - Start up generation
    - Curtail ‘Option A’ load
    - Buy down sales

Contingency Loss of HVDC



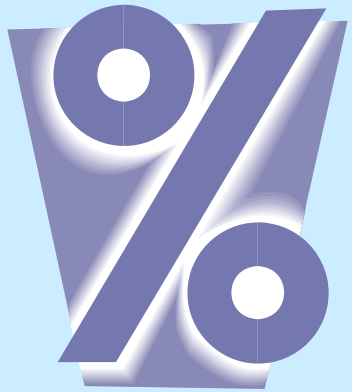
Reserve Sharing Group

- MISO – MB Hydro CRSG Agreement
  - Effective Jan 1, 2010
  - Largest Shared Contingency 1500 MW
    - MISO Share 1350 MW
    - MH Share 150 MW
      - Spinning – 40% 60 MW
      - Supplemental – 60% 90 MW
        - Generation 40 MW
        - Curtailable load ‘Option R’ 50 MW
- MH by itself 950 MW
- MH in CRSG 100 MW
- Net Benefit 850 MW

$100 million/yr

The Need for Planning Reserves

- Additional Generation Capacity
  - Load forecast variations
    - Weather
    - Load growth uncertainty
  - Outages
  - Operating reserves
- MH Planning Criteria
  - 12% of forecast annual peak load plus any required for committed export sales



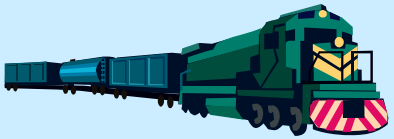
Capacity Products

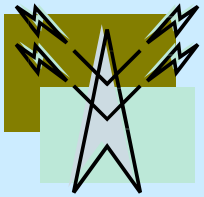
- MH only sells system power
  - Provided from entire system of resources
  - No specific station/source
- Firm Power
  - Seller responsible for reserves
  - Backed by dependable energy and firm TX
  - Sold to Manitoba Customers
- System Participation Power
  - Buyer shares in system risk
    - responsible for own reserves
    - MH has curtailment rights
  - Backed by dependable energy
  - Sold on the export market

Generation Costs
(Incremental $/MWh)

- Hydro
  - Water rentals — $3.41/MWh
  - O and M — $0.15/MWh
  - Total — $3.56/MWh
  - At Border — **$3.92/MWh**
- Gas Thermal
  - Fuel (@$5/MBTU) — **$64/MWh**
- Gas CT
  - Fuel (@$5/MBTU) — $65/MWh
  - Start ($15,000 each)
    - 24 hour run — $5/MWh
    - 1 hour run — $77/MWh
  - Total — **$70 - $142/MWh**

Fuel and Power Purchases

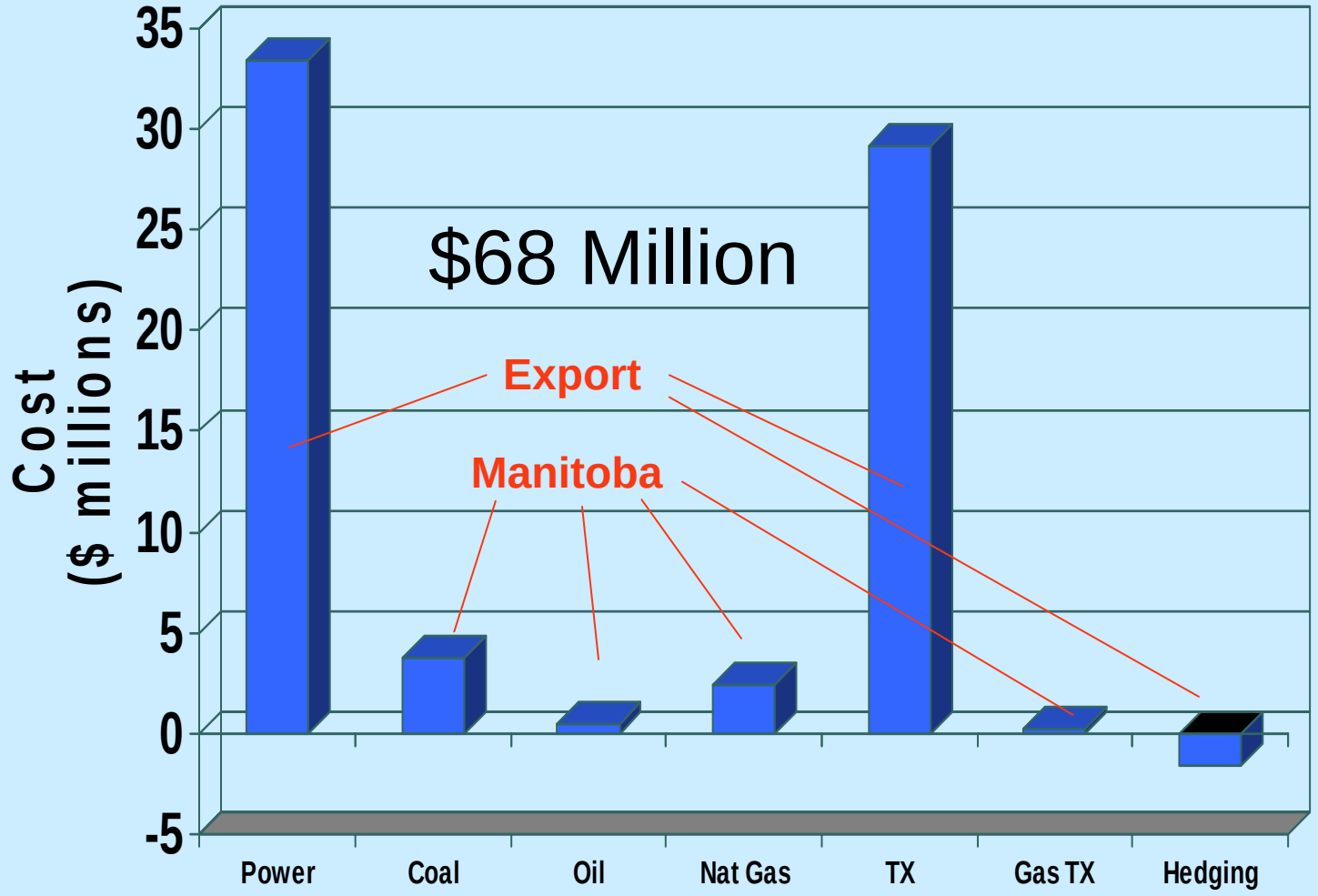




- Purchases necessary to serve
  - Manitoba load
    - On/off peak arbitrage
  - Export commitments
- Includes
  - Power
  - Coal and Freight
  - Fuel Oil
  - Natural Gas
  - Transmission Service
  - Natural Gas Storage and Transport
  - Hedging Products

Fuel and Power Purchases

Includes both fixed and variable costs (2009/10)



The End

Thank You !