Beyond Energy: Load Following and Ancillary Services on the Mid-C – An Operational Perspective

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Purpose

- The major goals of today's presentation are:
  - Bring awareness to a critical but opaque area of power system operations.
  - To enable you to appreciate the challenges the system operators face in balancing the diverse demands placed on the Mid-C.

Ancillary Service Basics

- Services defined:
  - Load Following – a service related to following relatively predictable load trends over short time intervals (e.g. 10 minute windows).
  - Load Regulation – a service related to balancing the random moment to moment fluctuations in demand (4 second windows).
  - Contingency Reserve – capacity held in reserve to ensure a significant loss of supply can be accommodated without adverse impacts to the grid.

Significance of Ancillary Services

- While not exhaustive, the services to be considered are particularly important on the Mid-C and for safe reliable grid operations.
- Each of these are directly related to keeping load and generation matched at all times.
- The constant matching of load and generation is extremely important due to its direct relationship with system frequency.
- Significant deviations from 60 Hz can result in serious impacts to grid reliability.

Importance of Matching Load and Gen

- Less generation than load results in a frequency decrease.
- More generation than load results in a frequency increase.
- Decreased frequency can lead to loss of plant equipment and system (grid) collapse.
- Increased frequency can lead to equipment damage and voltage excursions.
- The economic and social consequences of poor frequency control can be very significant.

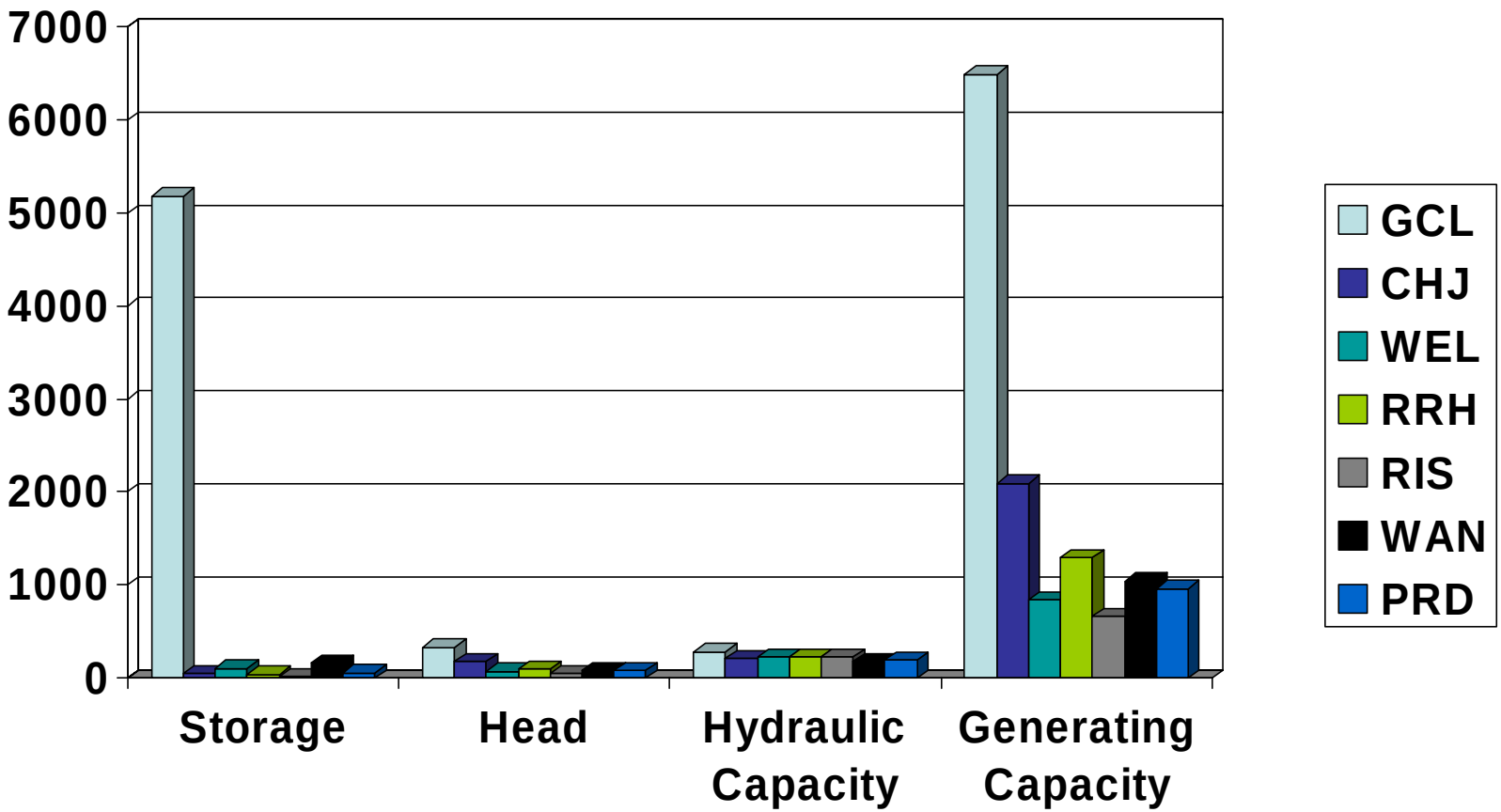
Impacts of Ancillary Services (A/S)

- Adequate supply of these A/S is critical to a safe reliable interconnected power system.
- The benefits of interconnected operation are tremendous – decreased long run costs and increased flexibility.
- There is a cost. These A/S, like any reserve quantity, do constrain operating flexibility.
- Non-power constraints add to the challenges faced by system operators.

Introduction of the MC System

- The MC system consists of 7 multi-purpose projects located on the Columbia River.
- The projects include: Grand Coulee, Chief Joseph, Wells, Rocky Reach, Rock Island, Wanapum, and Priest Rapids.
- The projects are located in the middle of the FCRPS.
- Projects are in close proximity but “lagging” effects are important.

The MC System Projects - All



Introduction of MC Parties

- Parties to the MC include government agencies, tribal entities, public utilities, and private utilities.
- The MC parties represent various interests from across the NW Region.
- A very large proportion of NWPP-US system is served by the Mid-C projects.

The MC System - Roles

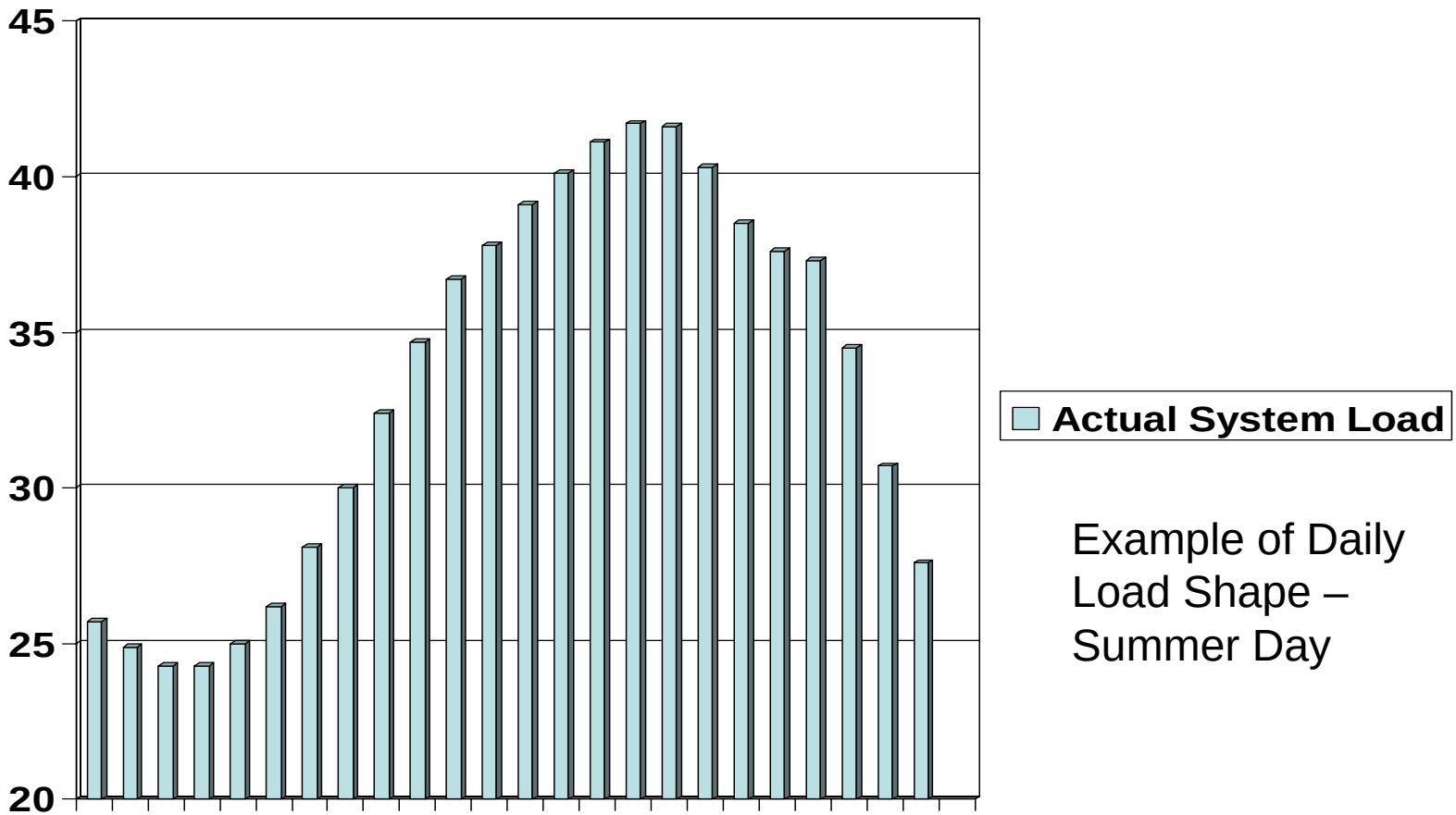
- The MC system projects are relied upon to provide the following services:
  - Support for Biological Activities
  - Recreation
  - Power Supply
    - Energy production
    - Load Following
    - Peak Shaving
    - Regulation
    - Contingency Reserves

Introduction to the NW Grid

- Dramatic fluctuations in the need for electricity occur across seasons, weekdays, and hours.

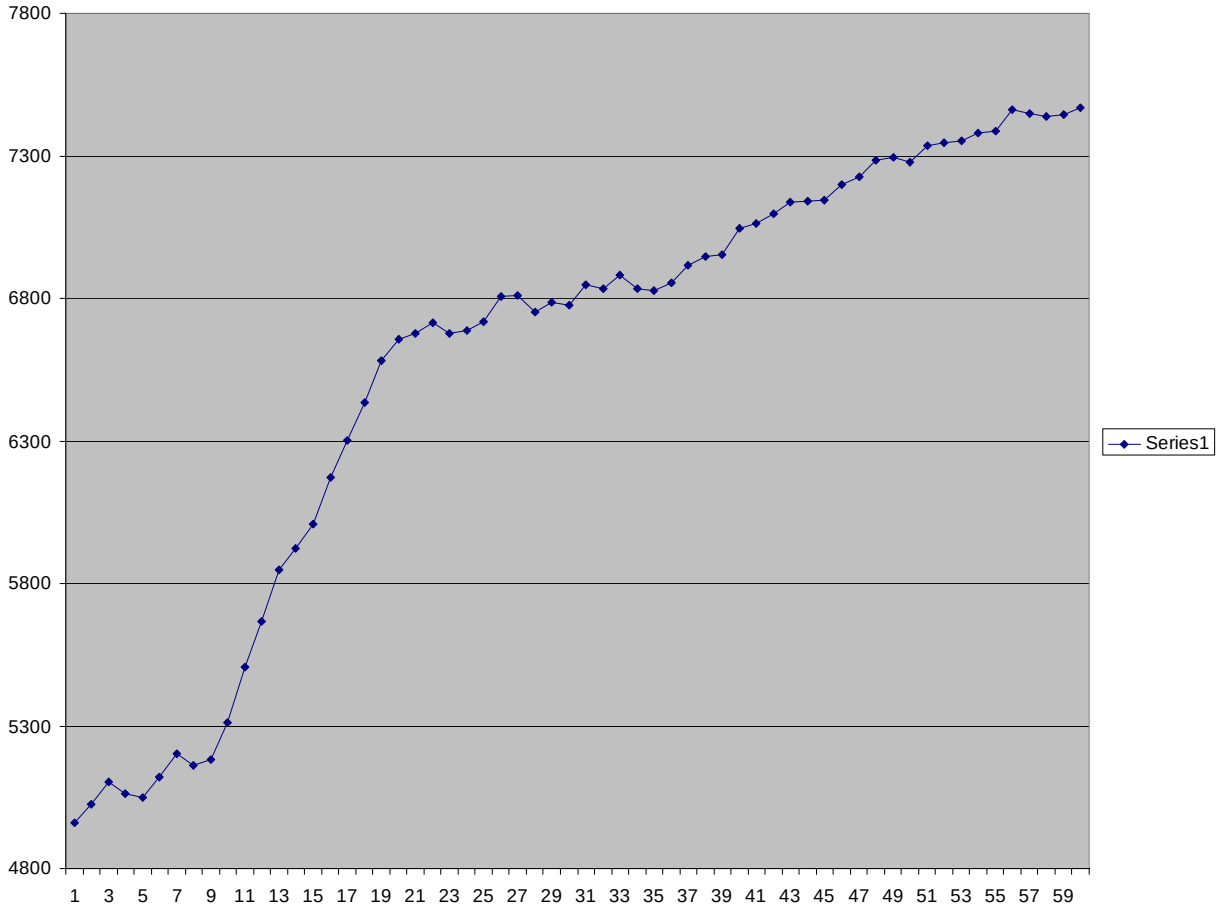
- For example, WECC peak demand is on the order of 146,000 MW and annual average energy demand is approximately 96,000 MWa.

Introduction to the Western Grid

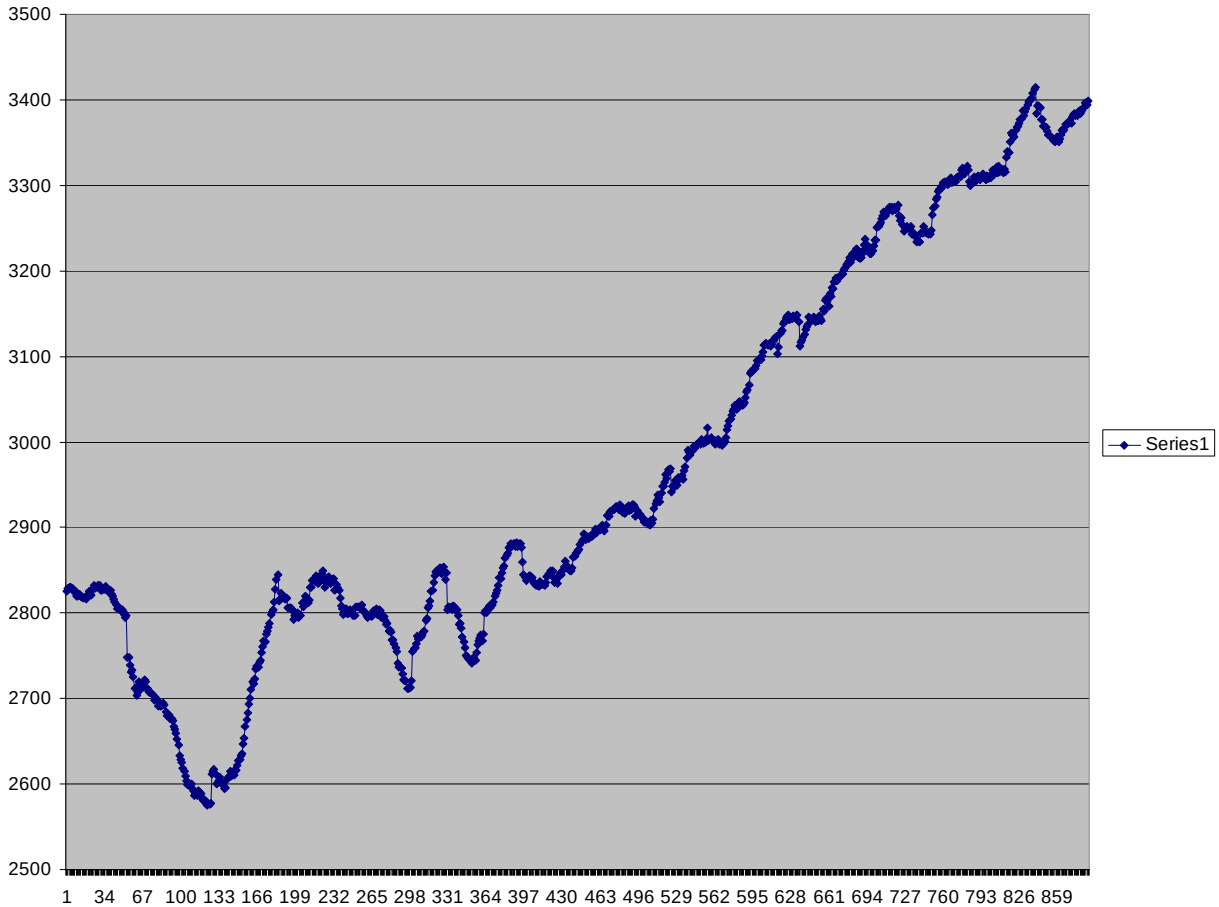


Example of Daily Load Shape – Summer Day

Typical NW Winter 1 Hr AM Load Pick-up



Typical Winter NW* 1 Hr AM Load Pickup (w/ reg)



Introduction to NW Grid

Regional Energy Sources

- Coal – Base load energy
- Nuclear – Base load energy
- CCCT – Baseload / Intermediate energy
- CT – Peak Energy
- Wind – Intermittent / base load affecting
- Hydro – Base load energy, peak shaving energy, spinning reserve, non-spinning reserve, regulation (AGC), and load following.

Operational Challenges

- Major issues faced:
  - Balancing A/S against efficient production
  - Effects of Non-power constraints
    - Biological requirements
    - Recreational requirements
  - Increasing impacts from transmission system ops
  - Future load growth & renewable resource integration

Operational Challenges

- Examples of specific challenges:
  - Balancing A/S needs against production cost impacts
    - Reservoir space / head impacts
    - Impacts to unit loading / efficiency
  - Tradeoff between a desire for high and stable ponds for recreation with need to follow load and supply contingency reserve upon demand.
  - Tension w/ requirements of Biological and Power systems.
    - Operating to minimize fish stranding by limiting flow fluctuations while load following.

Operational Challenges

- Examples of specific challenges:
  - Tension w/ requirements of Biological and Power systems.
    - Impacts of maintaining increased minimum discharge requirements on load following.
    - Impacts of managing fish spill programs while attempting to load follow (especially with instantaneous spill %s, relation to stranding)
    - Impacts of managing many simultaneous constraints leading to project “scheduling” and potential burden shifting
    - Impacts to other regional resources leading to a concentration of burden on Mid-C.

Operational Challenges

- Examples of specific challenges:
  - Effects of regional load growth against a “fixed” resource base.
  - Operating to assist in mitigating (or not exacerbating) transmission system problems.
  - Operating under significant uncertainties (load, streamflow, off-system resource contingencies) and strict power and non-power constraints.
  - Figuring all this out in real-time