

Load Following: Some Economic Thoughts

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February 2006

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What is Load Following?

- Load regulation v. load following
- Load following definitions:
 - Hirst/Kirby (2000): difference (MW) between maximum and minimum values within each hour of the 30-minute rolling average of two-minute load data
 - Hirst/Kirby (2001): use of online generation equipment to track intra- and inter-hour changes in customer loads
 - ISAB (2005): flow interruption or inconstant flows, broadly understood
 - Krich/Milligan (2005): change in total load from one hour to the next

Load Following v. Regulation

- LF: longer time interval
- LF: patterns of individual customers are highly correlated with each other
- LF: changes are often predictable (e.g., because of the weather dependence of many loads) and have similar day-to-day patterns

Limitations on Load Following Capability

- Supply-side
 - Environmental: restrictions on changes in flows of water over relatively small increments of time, such as hour-to-hour
 - Limitations on “ramp rates” on generators
- Demand-side
 - Integration of renewable resources that require “generation following” or other services
 - Changes in characteristics of loads

Snake River Drawdown Studies

Late '90s

- Proposal: removal of four Lower Snake hydro projects
- Transmission impacts
 - Loss of reactive (voltage) support to transmission system
 - Need to run Lower Snake generators as synchronous condensers
 - Shift in location of generation => possible new transmission constraints or congestion somewhere else in the system (examples)
- Generation impacts
 - Replacement of generation (quantified)
 - Replacement of operating reserves (quantified)
 - Replacement of load following capacity (overlooked)
 - Replacement of daily load factoring capability (overlooked)

Consequences of Limitations on Load Following

- Need for new generation capacity
 - Load growth
 - Integration of new resources (e.g., wind)
 - Operating reserves
- Changes in transmission capacity
 - Cutplane-specific impacts (see map at end)
 - Implications for redispatch patterns
 - Reactive support
- Implications for pricing of LF service

Pricing of Ancillary Services

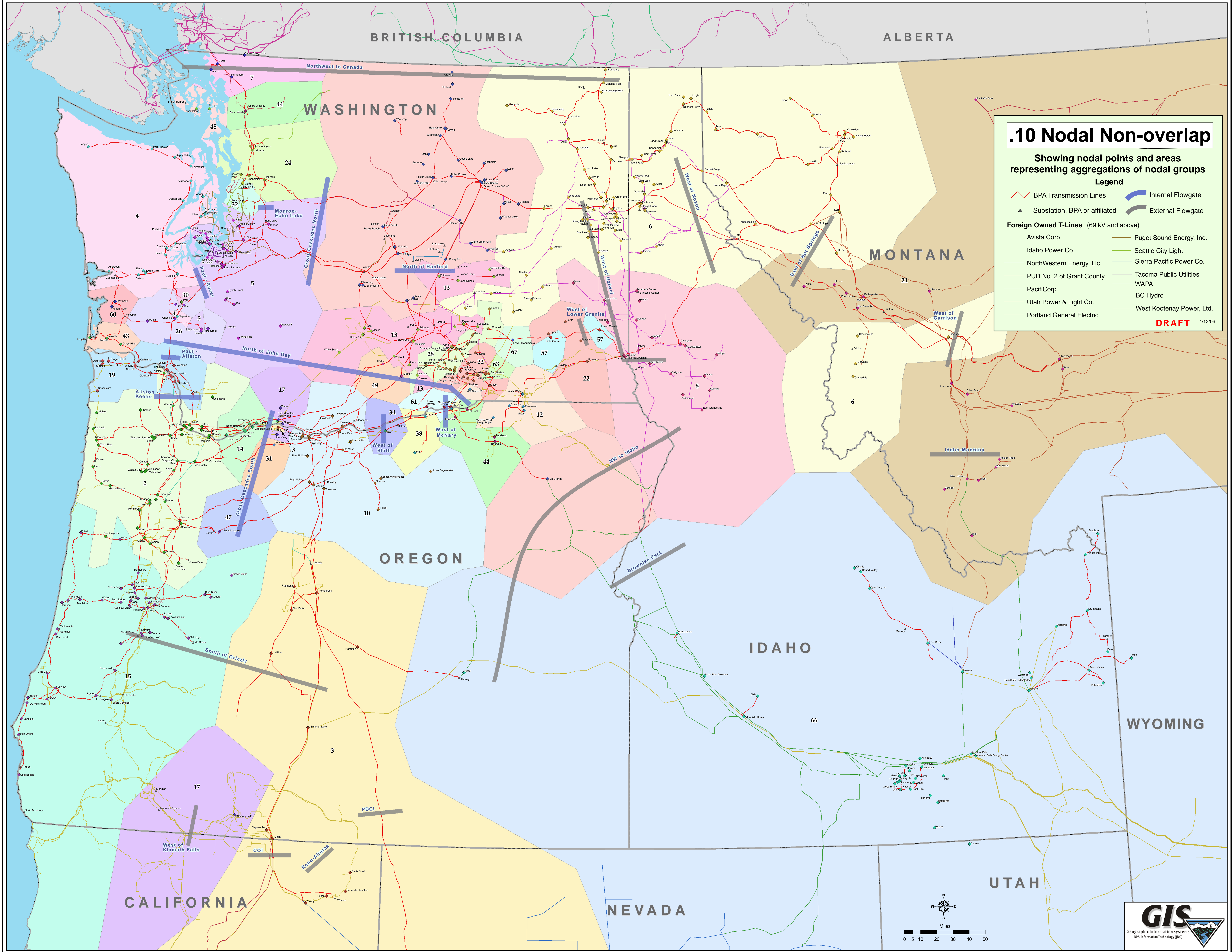
- What are “ancillary services”?
- Current methods
 - Load following not a FERC-defined ancillary service, so no explicit prices or costing approaches exist
- Future methods
 - Load following may have to be separated from other ancillary services
 - Pricing should follow certain principles
 - Cost-based if market conditions not competitive
 - Market-based if market conditions are competitive
 - Cost causation principles

Pricing of Load Following

- Basic principles
 - Assume cost-based due to lack of competitive markets
 - Charge those who use the service
 - Charge a price that covers the cost of service
- Application issues
 - Measurement of load following (see definitions), including use by individual customers or customer classes
 - In a thermal system, costs measured by identifying the marginal units that provide the service: incremental operating costs plus perhaps opportunity costs if generation withheld from energy markets to be able to provide load following
 - In a hydro system, costs measured generally by opportunity cost of holding capacity withheld from energy markets; may vary greatly depending on market conditions

Conclusions

- Load following (and other uses of hydro capacity) will likely become a more important issue over the next several years
- Utilities should prepare to add generation, implement demand-side management programs, and investigate pricing of load-following and generation-following services to meet the needs of both customers and new generators



.10 Nodal Non-overlap

Showing nodal points and areas representing aggregations of nodal groups

- Legend**
- BPA Transmission Lines
 - Substation, BPA or affiliated
 - Internal Flowgate
 - External Flowgate
- Foreign Owned T-Lines (69 kV and above)**
- Avista Corp
 - Idaho Power Co.
 - NorthWestern Energy, Llc
 - PUD No. 2 of Grant County
 - PacifiCorp
 - Utah Power & Light Co.
 - Portland General Electric
 - Puget Sound Energy, Inc.
 - Seattle City Light
 - Sierra Pacific Power Co.
 - Tacoma Public Utilities
 - WAPA
 - BC Hydro
 - West Kootenay Power, Ltd.

DRAFT 1/13/06

