



Wind Integration/Ancillary Services Requirements Study

Warren Lasher
System Assessment

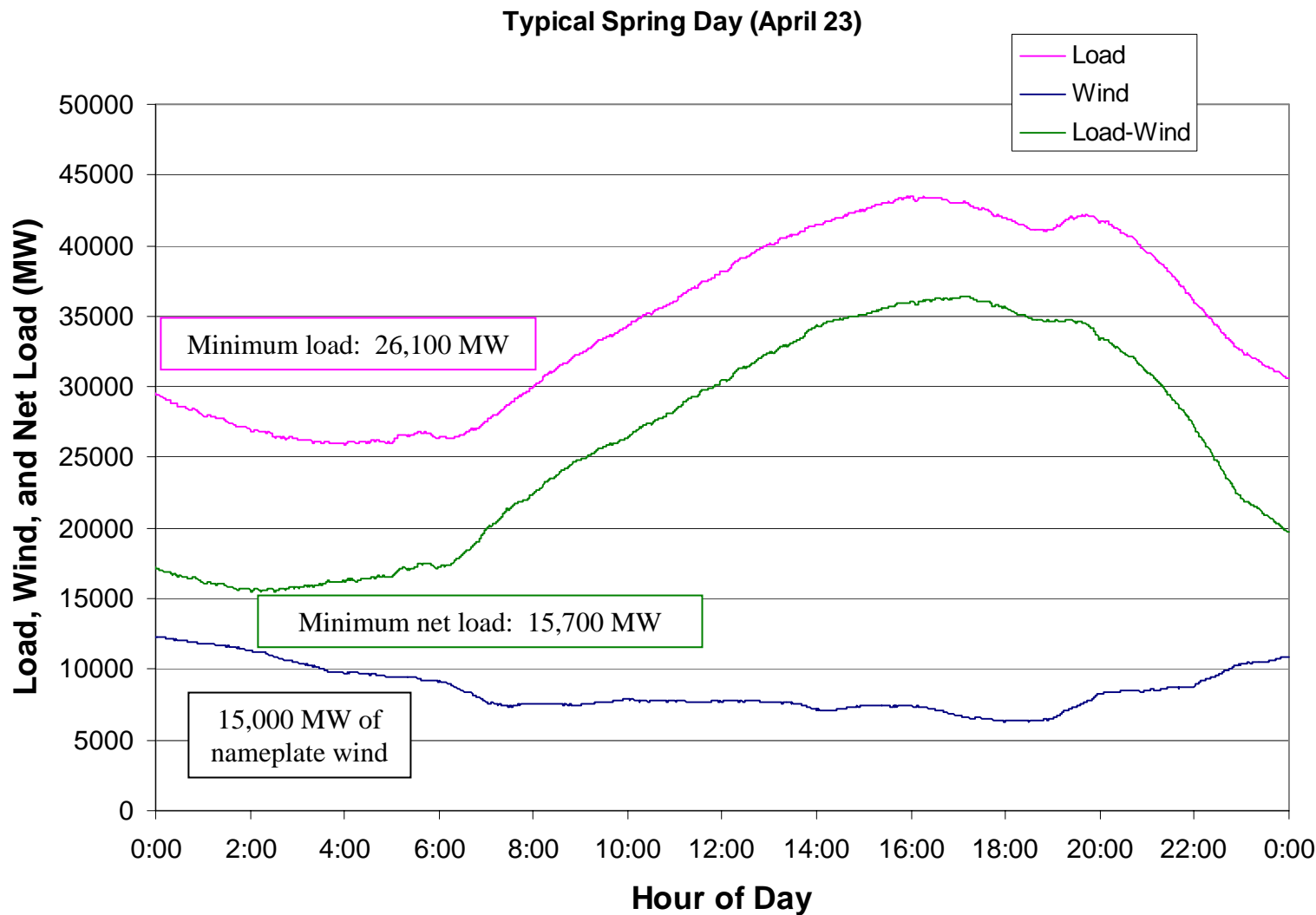
DSWG

03/07/2008

Wind Ancillary Services Study

- **Performed by General Electric consulting group with input from ERCOT Staff and a task force of stakeholders from the Reliability and Operations Subcommittee (ROS)**
- **Studied need for additional or modified ancillary services to meet reliability requirements, based on:**
 - 2008 load level and installed thermal generation
 - Four scenarios of installed wind generation, distributed among potential CREZ areas
 - 5,000 MW; 10,000 MW; 10,000 MW with different geographic distribution; and 15,000 MW
 - Used actual 2006 load pattern and used 2006 weather patterns to drive simulation of wind generation that would occur if these amounts of wind generation were installed

“Net-Load” Calculation – An Operators Viewpoint



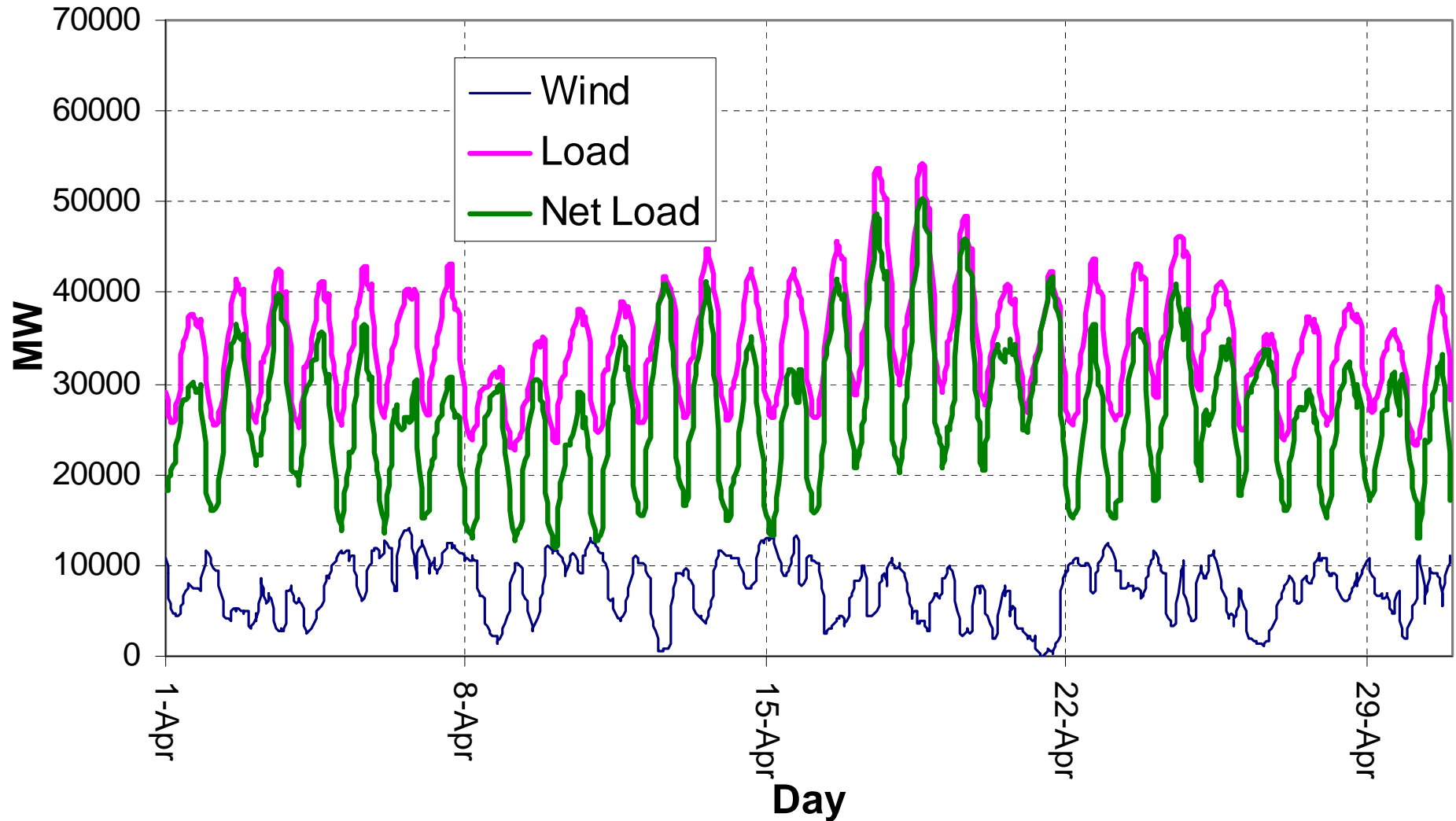
Similar to load, operator can't control wind generation availability

Net load predictability is key to reliable operations

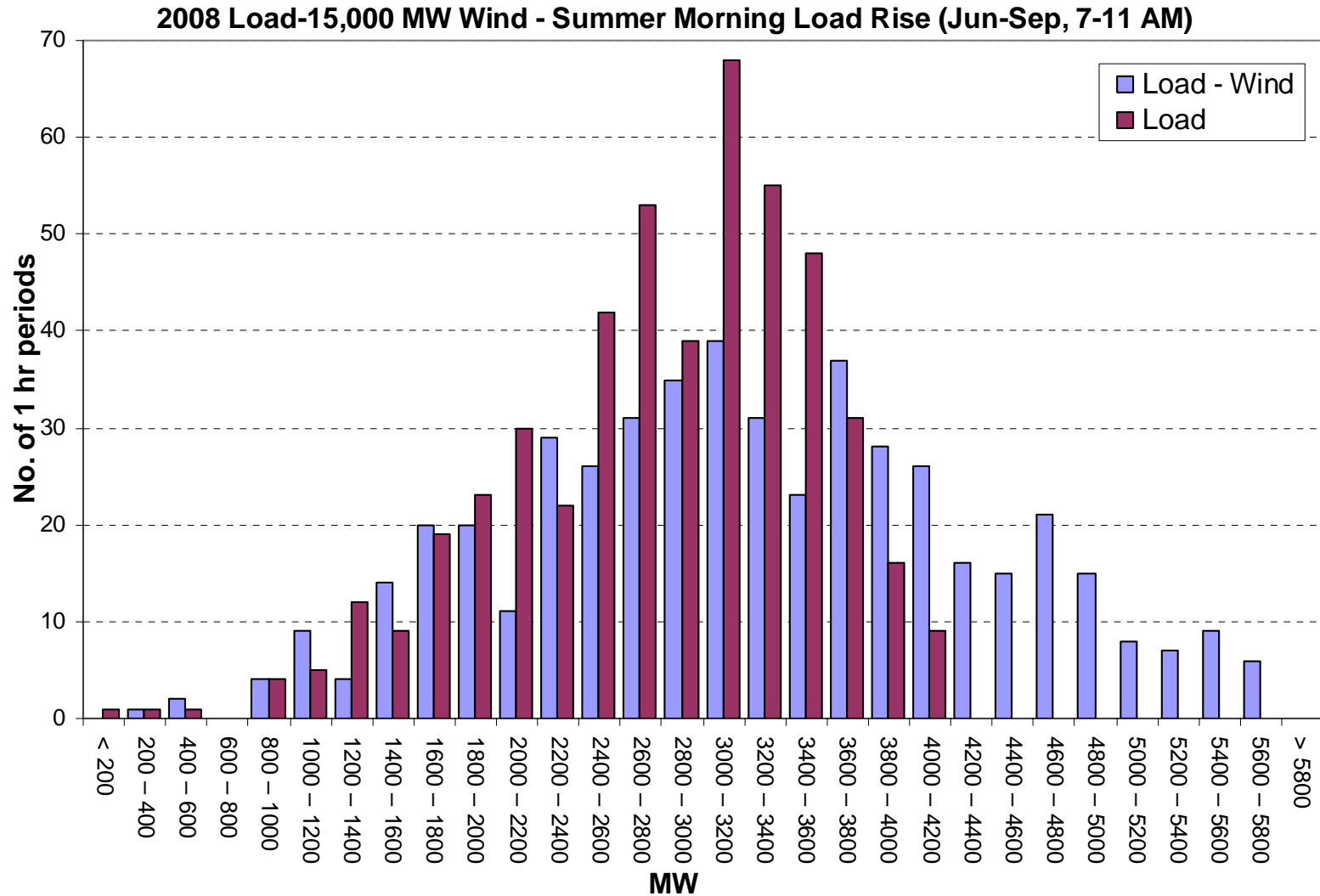
Additional large increases in wind generation will change the typical load shape

Wind Integration Alters Net Load Shape

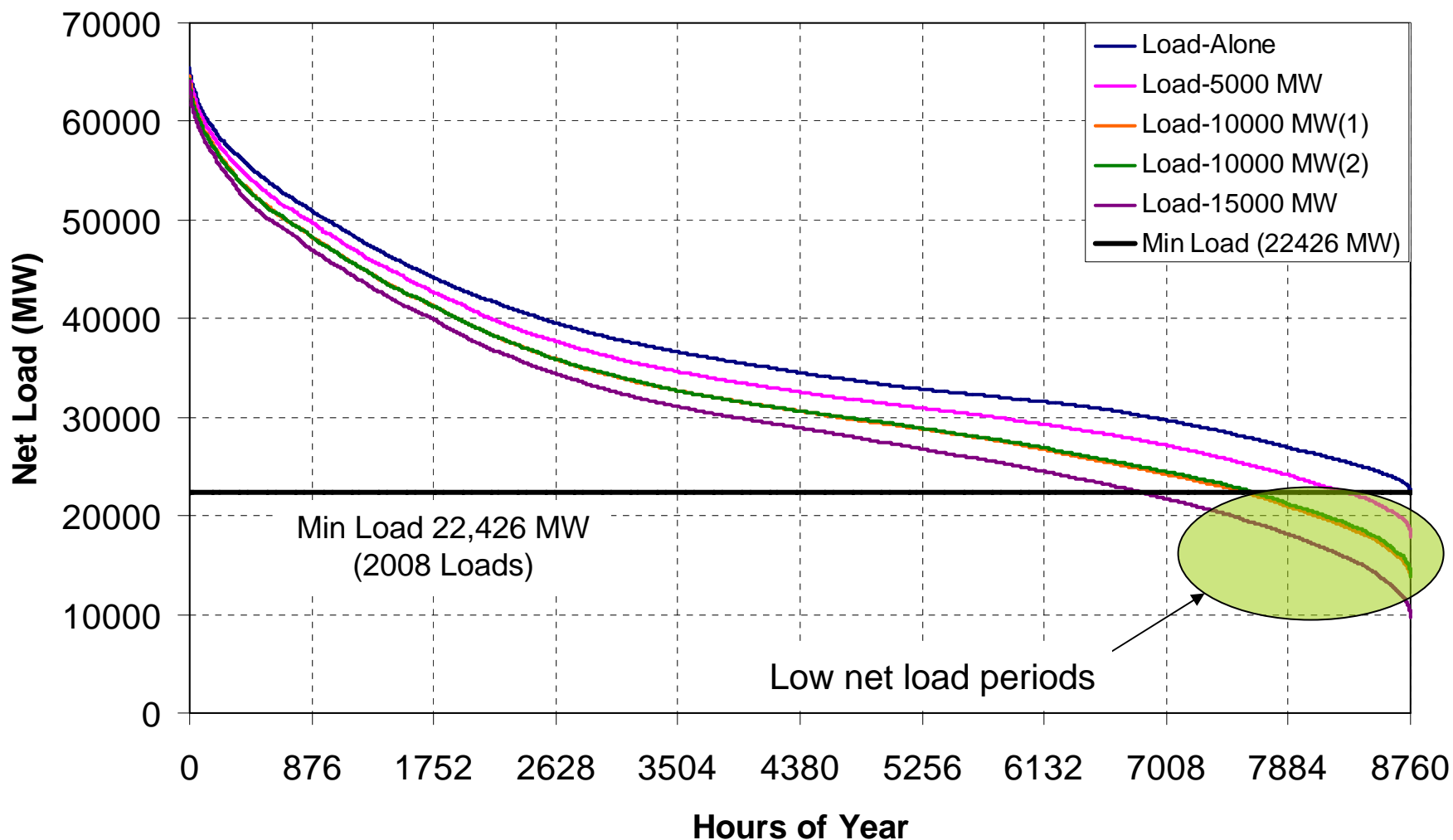
Load-15,000 MW Wind - April Time Series Plot



Wind Impact Ancillary Services Study - Example



Net Load Duration Curves for Various Wind Scenarios



Compounding the low growth in ERCOT minimum load, wind capacity has a significant impact on net load.

A/S Study Findings - Regulation

- **Need to implement state-of-the-art wind power production forecast**
 - Protects against under-commitment due to predictable changes in wind (reliability issue)
 - Protects against over-commitment (economic issue)
 - Acceleration of nodal project on wind forecasting
- **Present ERCOT methodology for determining regulation requirement remains effective if adjusted for increasing installed wind capacity (increase is linear)**
- **Regulation requirements (average, annual) increase linearly with increase in installed wind generation, up to 20-23% for 15,000MW**
 - Requirements vary by season and time of day

Additional A/S Study Findings

- **Daily swings in net load (load-wind) increase significantly with increasing wind**
- **Occasional down regulation exhaustion will occur for >5000MW of wind generation**
 - Several alternatives to resolve this issue, including wind curtailment
 - Increased flexibility in operating parameters of future generation
- **Extreme wind power increases and decreases will occur infrequently (up to 20% within 30 mins), but are predictable with wind forecast**
 - Increase responsive and/or non-spin reserves
- **Localized convective events are less predictable; large concentrations of wind increases vulnerability but CREZ geographic diversity helps**

A/S Study Events

- **GE presented results to ERCOT stakeholders on 2/27/2008**
- **Draft final written report due to ERCOT in mid March**
- **Stakeholder comment period on draft report**
- **GE will prepare final report**
- **ERCOT will file final report with PUCT in Docket 33672**

- **Wind Workshop to be held 3/17/2008**

Questions or Comments?

