SmartSenseCom
INCORPORATED

IMPROVING DATA METRICS:

Developing Tools to Ensure Electricity Market Effectiveness and Efficiency In An Era of Fundamental Change

FERC TECHNICAL CONFERENCE
Docket No: AD10-12-004
June 2013

The Need

- Electricity market assessment and management requires
- Understanding the operating constraints of the Grid, being able to realistically forecast its ability to respond to changing circumstances and requirements, which
- Enables efficient allocation of generation and transmission resources

The Challenge

- The Grid has a decreasing tolerance for error, which means a lower tolerance for poor data quality both in terms of
    - Measurement Error
    - Timeliness (Speed)
- Since Public Policy and Regulation are key drivers of the changes which are lowering tolerances, regulation needs to pay attention to and begin to establish metrics for data quality

- **Era of Fundamental Change**
  - **Technology**
  - **Market Structure**
  - **Regulation**
- **Change Impacts Markets**
- **Framework for Managing Change**
  - **Identify market impacts**
  - **Isolate variables that capture market impact**
  - **Deploy tools to drive performance**
- **Case Studies**
  - **CPS Standards**

The Grid is Undergoing Fundamental Change

- Every aspect of the electrical grid is undergoing fundamental change
  - Changes in technological makeup
  - Changes in industry structure
  - Changes in Public Policy
  - Changes to regulatory authority
- Public Policy and Regulation in particular are driving Grid operating changes, placing sometimes conflicting requirements on operators
- Due to long lead times in system design and implementation, only beginning to see these changes
- Needed: A framework to ensure that all of the regulatory tools available can be deployed to ensure market effectiveness and efficiency during era of change

Technologists Recognize the New Data Quality Need

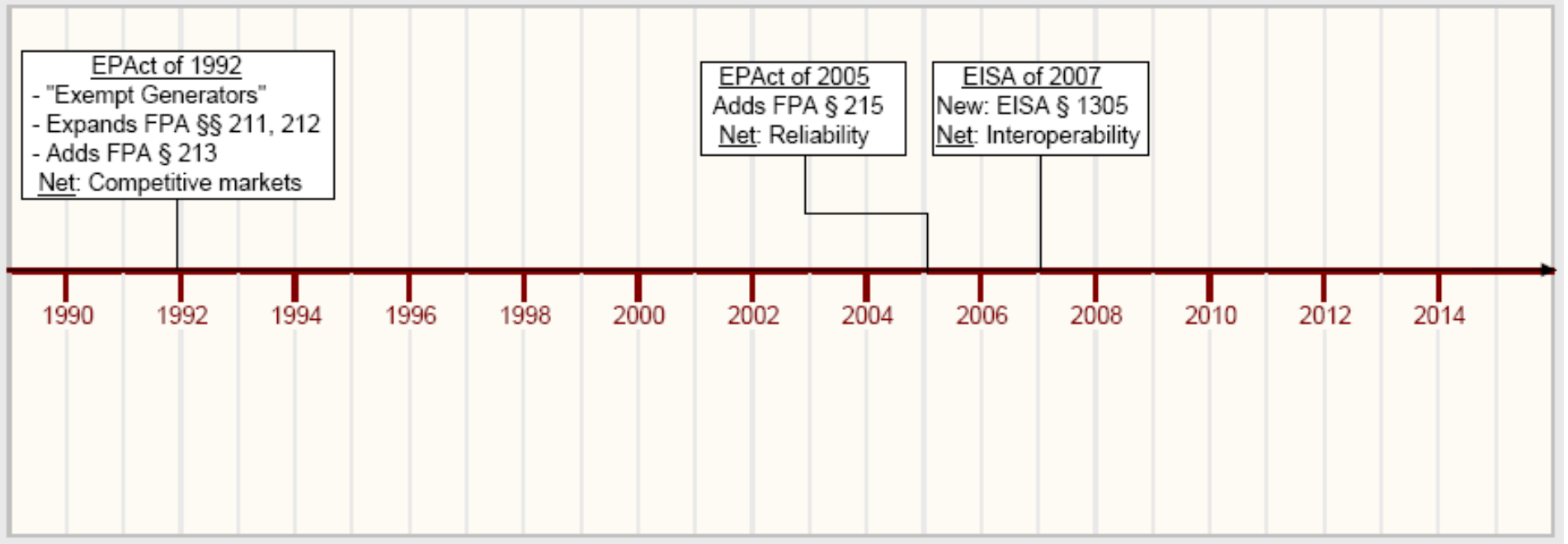
Existing Electrical and Physical Measurement Techniques for Electric Power Will Not Meet the Engineering Requirements of the Future

Source: EPRI, BPA

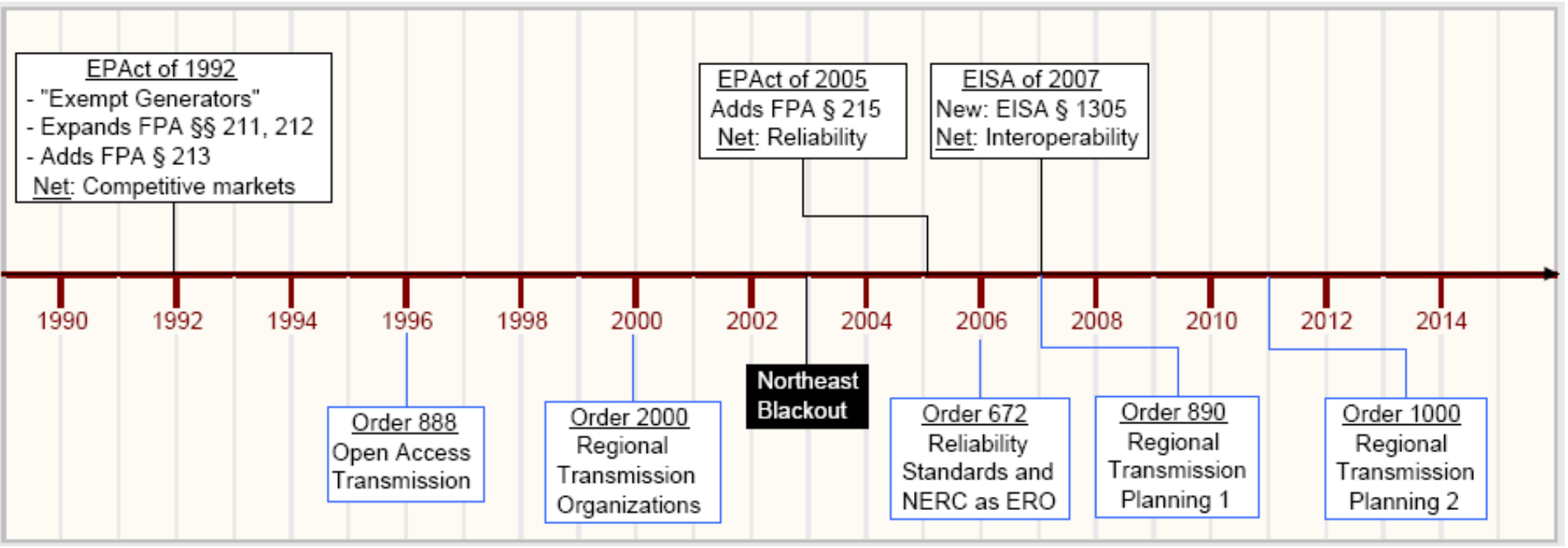
- ***Electrically, the next generation of monitoring & measurement must be:***
  - Reliable throughout all potential events and not be subject to saturation
  - Broadband and provide information across a much wider harmonic spectrum
  - Able to detect DC phenomena
  - Safe and sufficiently inexpensive to deploy throughout the HV and MV grid
  - Continuously accurate across a broad range of load without excessive recalibration

- ***Physically, the next generation of monitoring & measurement should:***
  - Provide direct measurements that do not require complex extrapolation/interpolation
  - Provide continuous information of condition vs. electrical load
  - Be robust and reliable over the long term without excessive maintenance

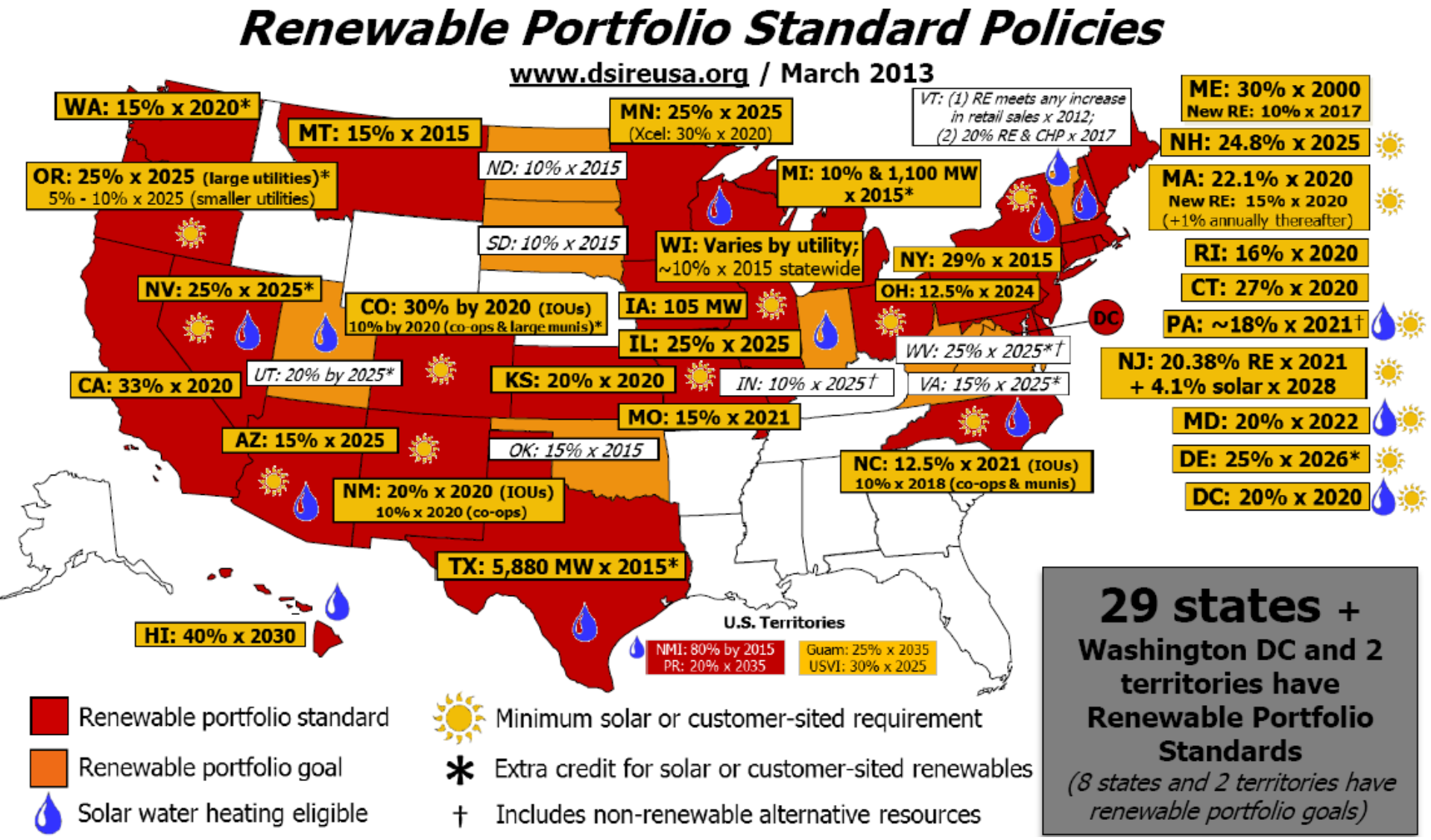
Evolution of FERC Authority



Evolution of FERC Authority



Ongoing Evolution in Response to Changes



Source: Database of State Incentives for Renewables & Efficiency

Converging Changes: Consequences

- Reduced system tolerances
  - Ability to absorb problems while continuing to meet needs and account for growing list of requirements
    - Requirements include those imposed by reliability, renewables integration, *etc*.
  - Exacerbated by increased uncertainty and variability
- Net: Lower margin for error
- Need for increased system control to ensure proper market function
- Example: Market impacts of transmission loading relief
  - Use more expensive local energy rather than imported energy
  - FERC, Electric Transmission Constraint Study (2001)
  - CERTS, National Transmission Grid Study (2002)
  - DOE, National Electric Transmission Congestion Studies (2006, 2009)

The Challenge: Lower tolerances, higher variability

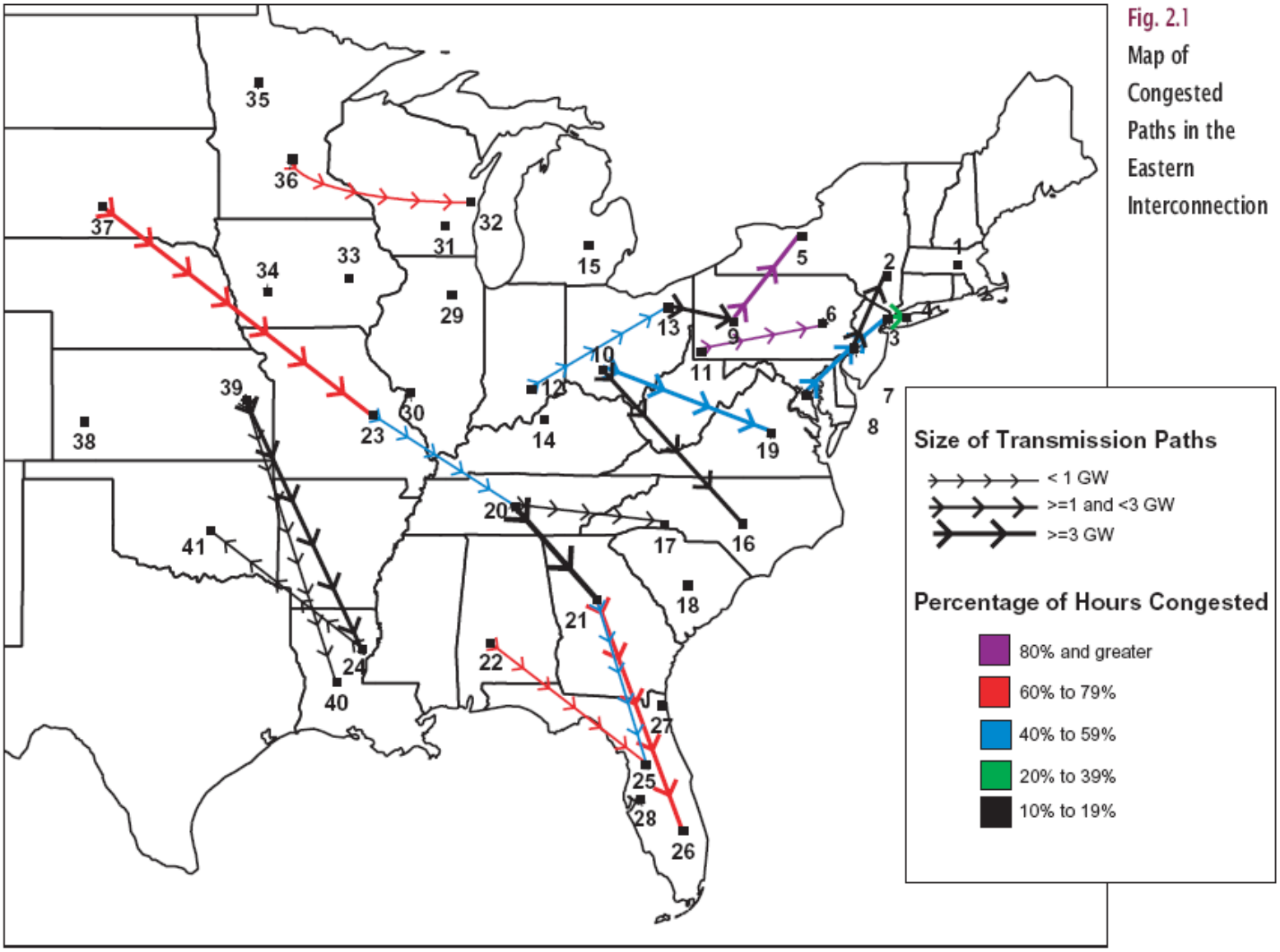
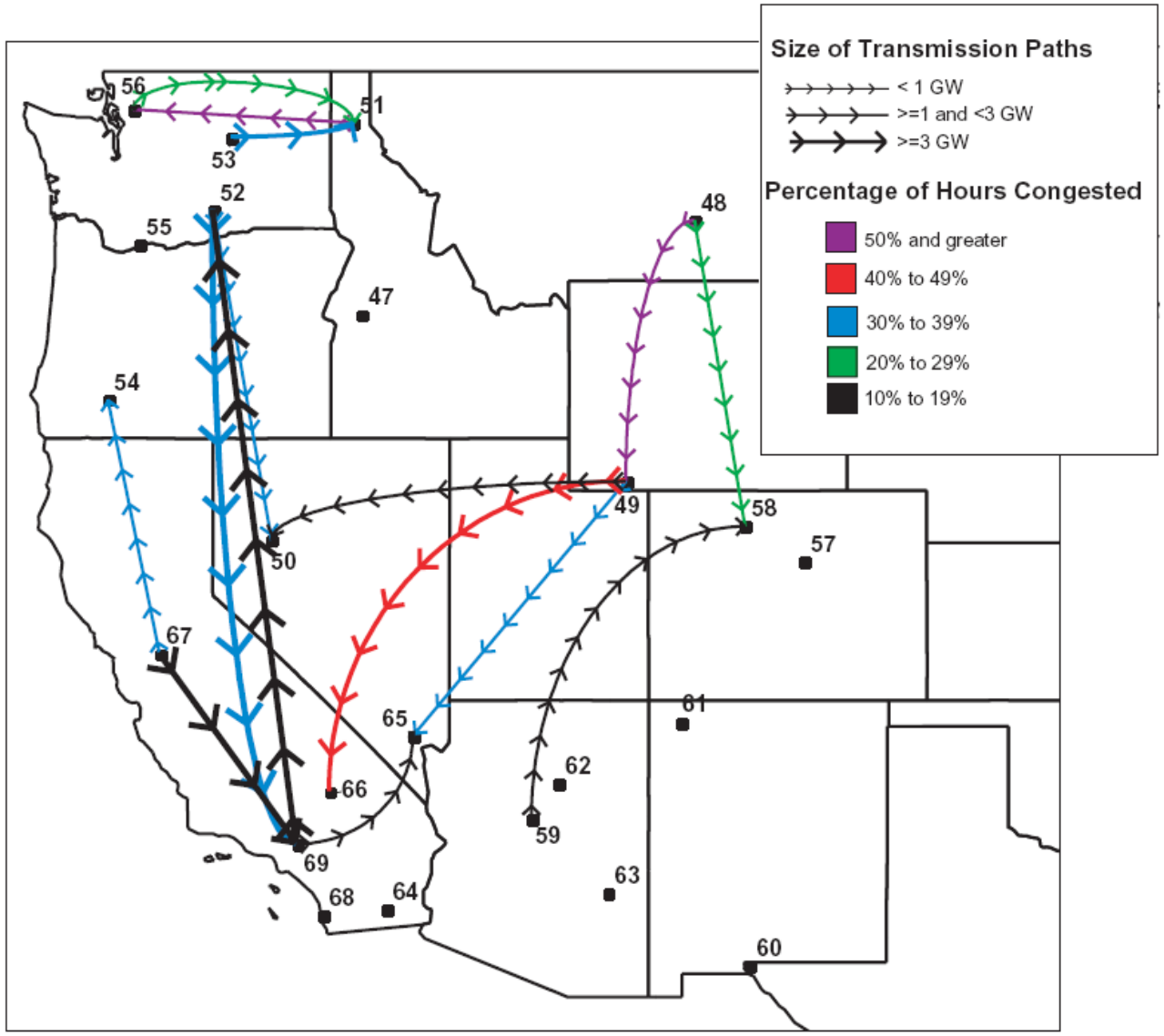


Fig. 2.1 Map of Congested Paths in the Eastern Interconnection

Source: CERTS, National Transmission Grid Study, Chapter 2

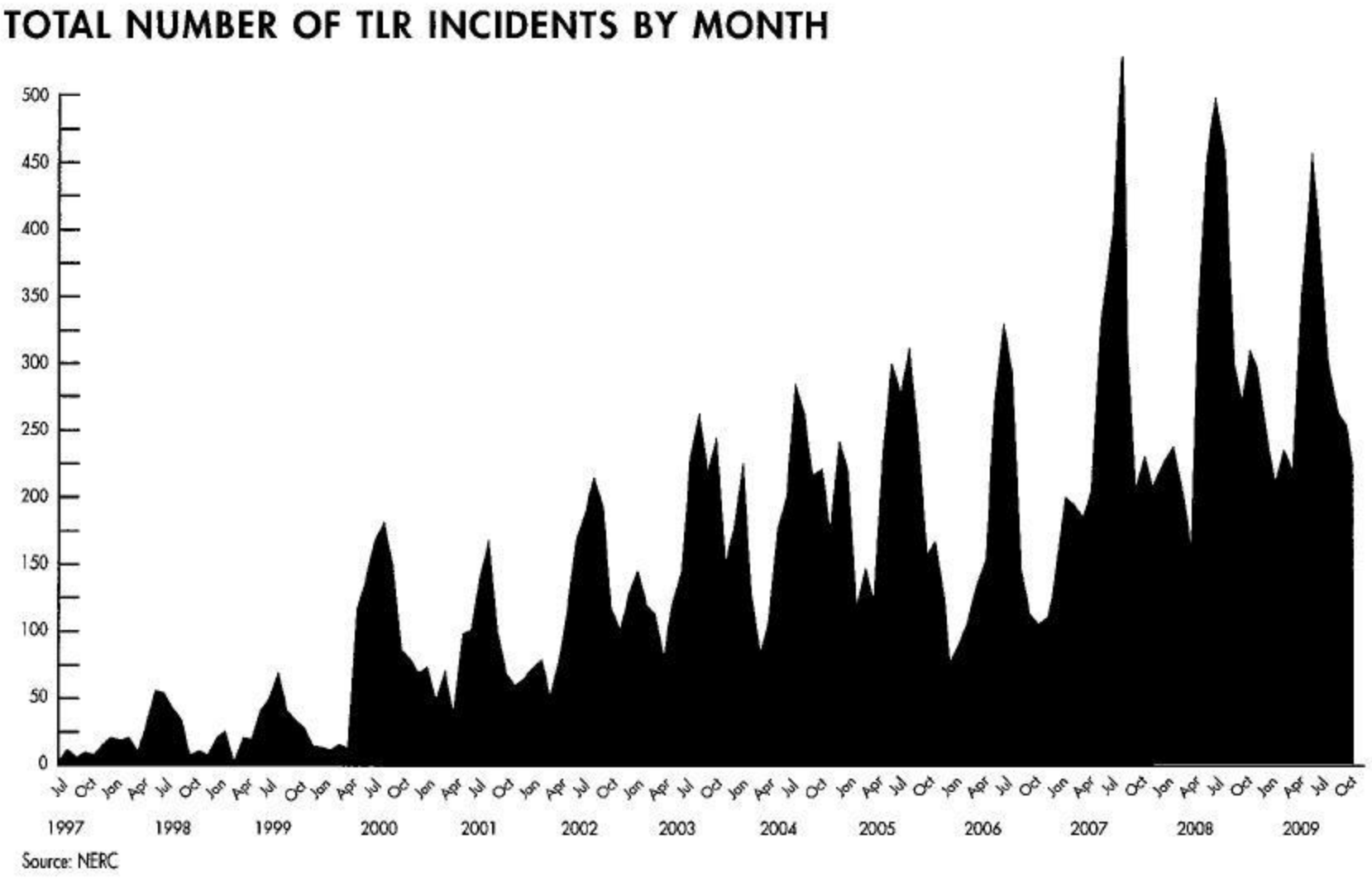
The Challenge: Lower tolerances, higher variability

Fig. 2.2
Map of
Congested
Paths in the
Western
Interconnection



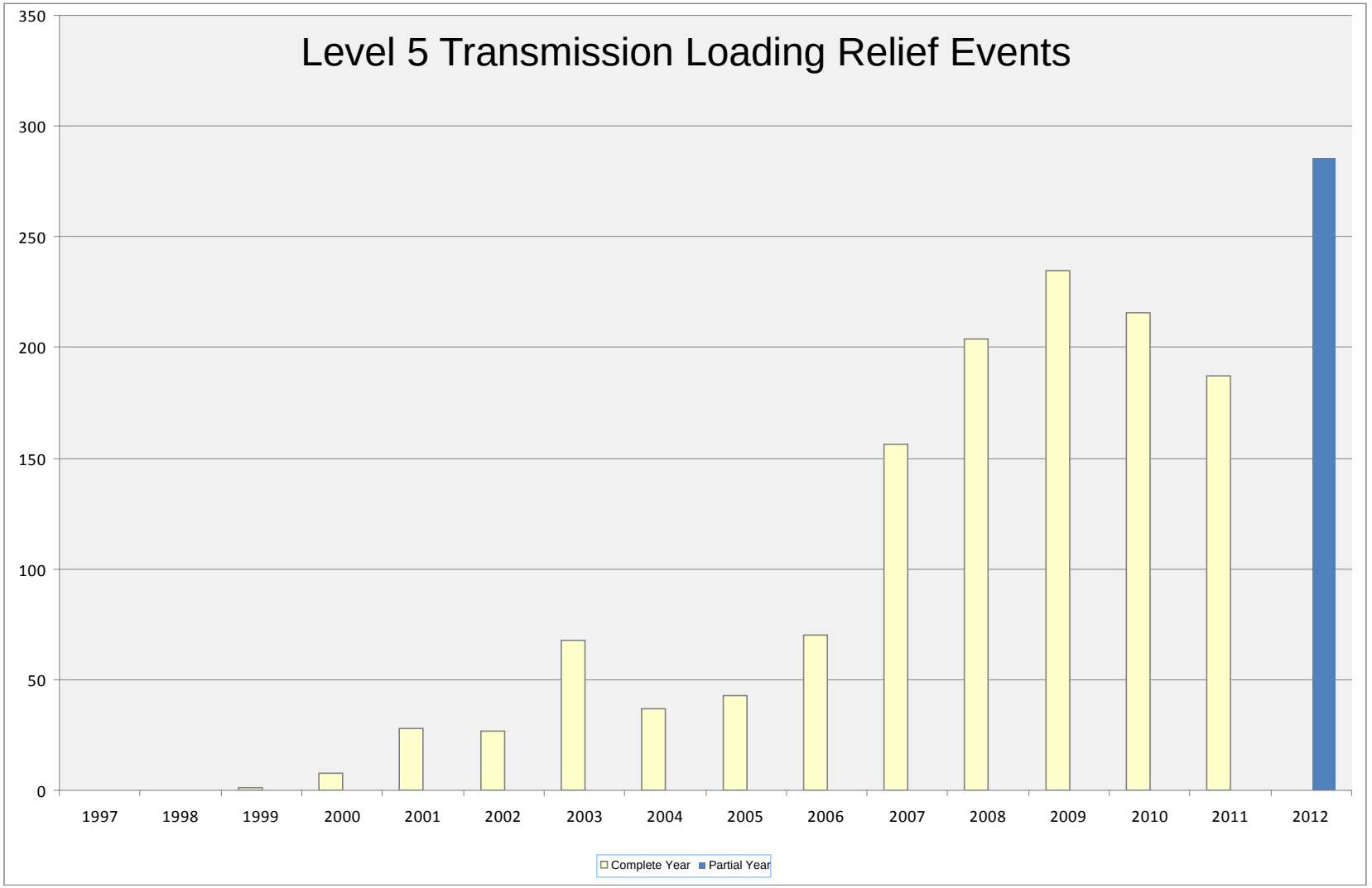
Source: CERTS, National Transmission Grid Study, Chapter 2

The Challenge: Lower tolerances, higher variability



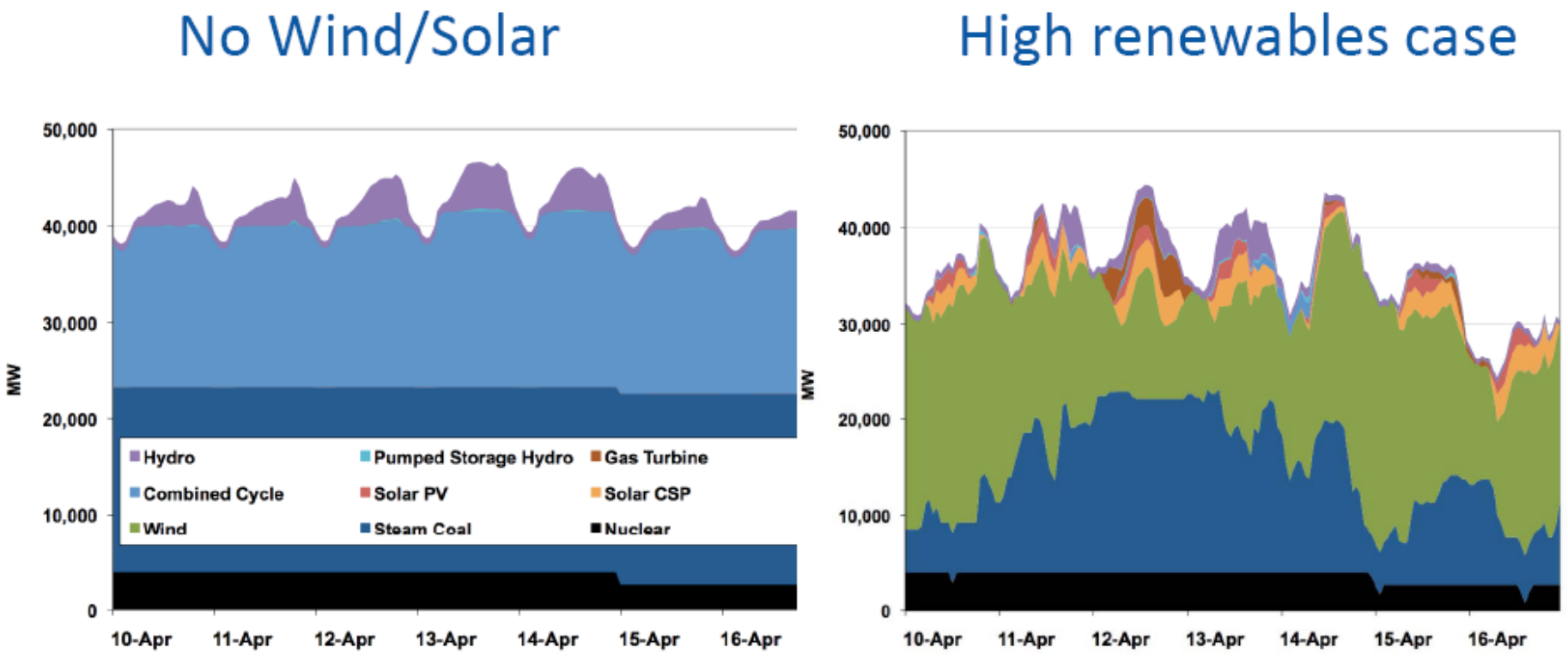
Source: NERC, graph from Shively and Ferrare, *Understanding Today's Electricity Business*

The Challenge: Lower tolerances, higher variability



Source: NERC, TLR Logs

The Challenge: Lower tolerances, higher variability



Source: NREL, *Western Wind and Solar Integration Study* at 15 (2010)

Importance of Identifying Market Impacts

- Understanding market impacts of changes increasingly important:
  - Systems are operated closer to capacity
  - Variability and uncertainty in generation mix increases
  - Margin for error decreases

- Best possible information critical:
  - Identify key variables that have market impact
  - Understand the dynamics of market impacts (i.e. – who bears burdens?) of the changes
  - Design performance metrics to address impacts

- In absence of standard metrics, allocation of burden is an irrational one
  - Creating disincentives for desired performance
  - Increasing margin of error, not reducing

Improved System Assessment and Management Tools Critical to Identify & Address Impacts

- Reduced tolerances and lower margin for error require system awareness and management
  - Allows recognition and mitigation of market impacts
- The questions FERC asks and addresses to mitigate market impact must be understood in terms of the technical, structural, and regulatory trends
- Software-based systems allow FERC to assess the market impacts of these changes
  - Beyond providing market planning and efficiency tools for operators
  - Example: DOE's Policy Office Electricity Modeling System
- Software-based systems allow FERC to evaluate what actions to take to ensure proper market function
  - Reliable, efficient operation of system at low cost to consumers

Identifying Market Impacts

- Goal: Understand system dynamics to ensure that no artificial barriers are present or are created

- Can be achieved by identifying where technology or structure may cause significant market dysfunction

- Once these areas are identified, burdens to market participants can be assessed and made explicit

- Absence of data standards along certain performance metrics acts as an effective barrier because:
  - No means to measure performance
  - Implicit burden-shifting under *ad hoc* allocation

Established Metrics Empower Management and Forecasting Tools

- "The quality of information supplied by these tools depends upon the quality of telemetry and other real-time data…" *NERC 2011 Operating Committee Report*

- Once information needs are established (i.e. – what variables are critical), software based-tools assist in modeling and operations
  - But inherently dependent upon underlying data and its accuracy

- Uniformity regarding the variables to be measured and targets to be achieved reduces range of error and permits increased control

- Examples
  - Integration of real-time load data with transmission line rating software
  - Design, tune, and update operating and planning models to minimize error around different metrics, including variable generator output
  - Optimize transmission switching while accounting for the stability impacts of distributed generation

Sources: NERC, Real-Time Application of Synchrophasors for Improving Reliability (2010)
NERC, Special Report, Potential Bulk Reliability Impacts of Distributed Resources (2011)
NERC, Comments in Response to FERC VER NOI, Docket No. RM-10-11 (Apr. 2010)

Establishing Performance Metrics

- Case Study: CPS Standards (BAL 001-0.1a)

- Open access led to concerns regarding the operational reliability and efficiency of the interconnections
  - Increased need for established control criteria
  - Desire to allocate control burden equitably among all participants

- Critical metric identified: Frequency

- Performance metrics:
  - Balancing area contribution to control frequency error
  - Bound unscheduled flows between balancing areas

Source: Electric Power Research Institute (Jaleeli and VanSlyck), *Control performance standards and procedures for interconnected operation*, TR-107813 at iv (1997)

Establishing Performance Metrics

- Case Study: CPS Standards (BAL 001-0.1a), cont.

- Performance measured over short term and long term
  - Penalties for underperformance

- Uniform rules reduce range of error, allocate burdens explicitly among market participants

- Questions:
  - Is frequency the only metric that can or should be measured in a similar manner? Can a similar approach work with other metrics?
  - Are penalties the best means to achieve objectives? Would market-based alternative incent better performance?

Source: Electric Power Research Institute (Jaleeli and VanSlyck), *Control performance standards and procedures for interconnected operation*, TR-107813 at iv (1997)

Conclusion

- 20th Century: Static, centralized, command and control model for Grid engineering and operations

- 21st Century: “Transactional” power system – dynamic, distributed, network-based model for engineering and operations

To successfully manage (whether in operational or market terms)… need improved data quality and metrics:

Reduce Error

Improve Timeliness

Questions?

cvizas@smartsensecom.com

SmartSenseCom, Inc.

126 C Street NW

Lower Level
Washington, DC 20001