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The Key to Resolving Transmission Gridlock: The Case for Implementing Power Electronics Control Technologies

by

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Power Electronics Control Technologies

FACTS & HVDC Systems

Strategic solutions to upgrading the Nation's electrical transmission system infrastructure by:

- Increasing Capacity
- Enhancing Reliability
- Improving Controllability
- Eliminating System Constraints
- Reducing T-Line Construction
- Preserving the Environment
- Value: Saving Time & Money, and Enabling Profitability

Kii Channel HVDC Transmission - 2000

SDG&E Talega STATCOM/BTB - 2002

Electrical Transmission System Issues

- **Deregulation Issues**
  - **Deregulation requires open-access power delivery system**
    - Enable power delivery within and between regions
    - Facilitate access to interconnected competitive generation
    - Provide market-based incentives for transmission investment
- **Reliability & System Issues**
  - **Transmission reliability -- a national security issue**
    - Existing system not designed for open-access power delivery
    - System capacity has not kept pace with supply and demand
    - Higher levels of power quality required for “digital society”
    - New transmission line permitting, siting, & construction is difficult, expensive, time-consuming, and controversial

Electrical Transmission System Solutions

REQUIREMENTS

Upgrade Transmission System Infrastructure

to provide enhanced system capacity, operation, and control in order to maintain a stable, secure, and reliable electric supply network

SOLUTIONS

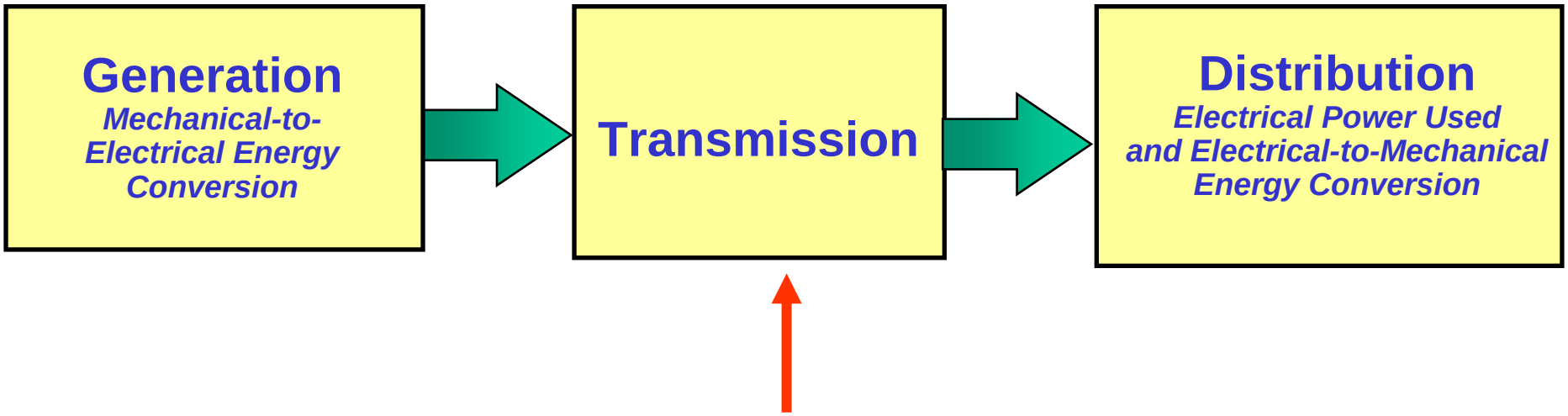
Comprehensive expansion strategy including:

- **New Transmission Lines & Conventional Equip't**

- **Power Electronics Based Control Technologies**

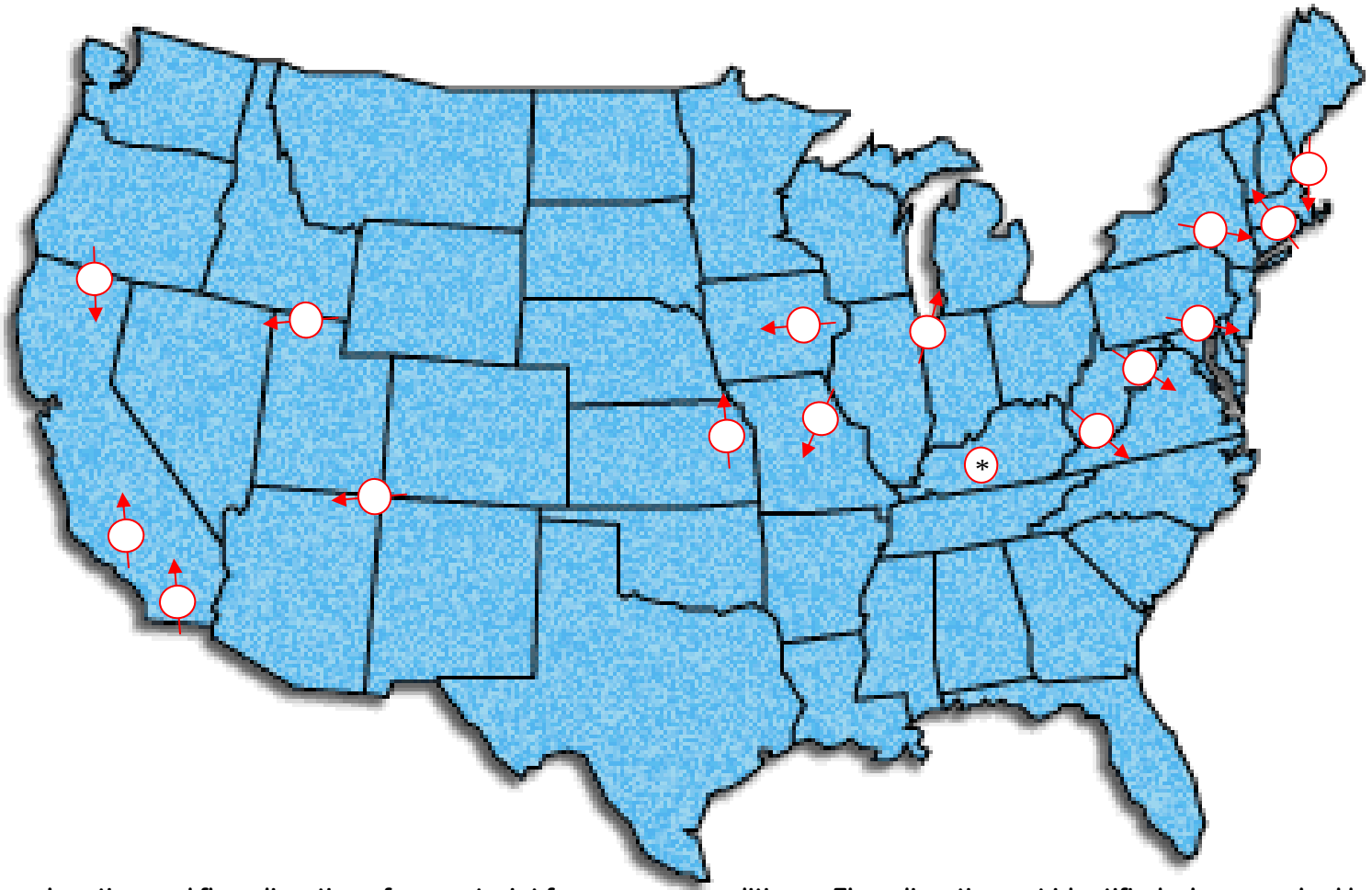
Basic Control of Power Systems

Power Generation, Transmission and Distribution



Power Delivery Constraints, Bottlenecks, & Losses Occur Here

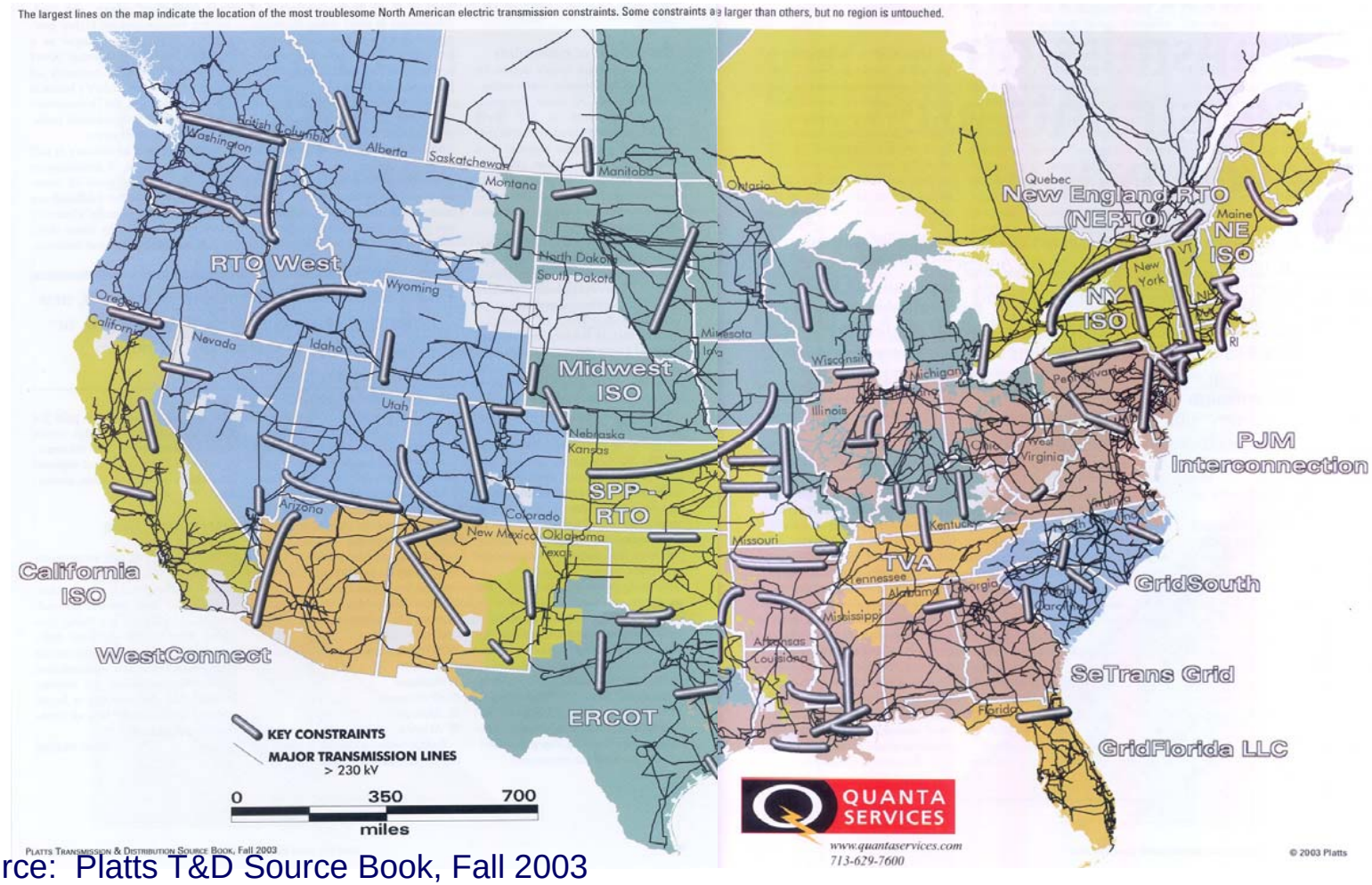
National Transmission System Bottlenecks



Indicates a location and flow direction of a constraint for summer conditions. Flow direction not identified where marked by *

Source: The Wall Street Journal, Transmission Flaws Boost Power Costs," December 20, 2001. Original source: FERC

National Transmission System Constraints



Source: Platts T&D Source Book, Fall 2003

Power Electronics Technologies

Power Electronics Definitions

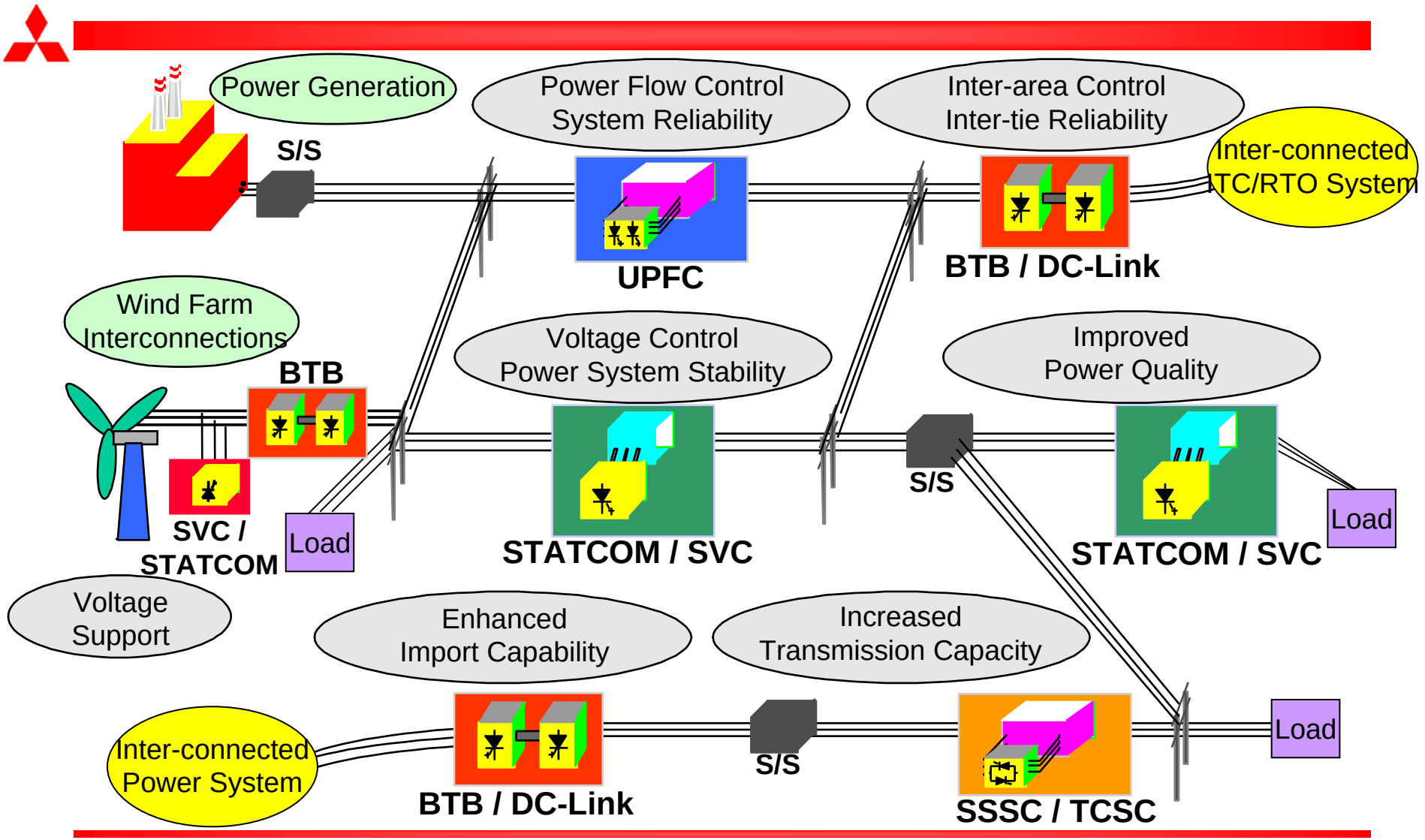
FACTS Technologies

- Engineered systems consisting of:
  - power semi-conductor based converters / valves;
  - information and control technologies (software);
  - and interconnecting conventional equipment
- that build intelligence into the grid by providing enhanced power system performance, optimization, and control.

HVDC Technologies

- Engineered systems consisting of:
  - thyristor-based converter technology;
  - control and protection systems (software);
  - and interconnecting conventional equipment
- that provide power transfer and control capability for power system interconnections and transmission delivery requirements

Power Electronics Technologies



Power Electronics Applications

- **Utilization/Expansion of Existing Transmission Grids**
  - **Enhanced Transmission System Reliability & Control**
    - Higher Level of Power Quality and Security
    - Enhanced Voltage Control and Stability
    - Improved Power System Stabilization
    - Increased Power Flow Control
  - **Power Transfer & Control**
    - DC-Links for “seamless” interconnection
  - **Improved Inter-tie Reliability & Control**
    - Efficient Interconnection of ITC/RTO-type Systems
  - **Increased Transmission System Capacity**
    - Up to 40% increase in capacity can be realized
  - **Optimized Transmission System Control & Operation**

Value Proposition and Policy Aspects of Power Electronics Technology

Value Proposition of Power Electronics

- **Economic Advantages**
  - Financially sound investments for grid enhancement
  - Transfer more power reliably across existing networks
  - Fraction of expense associated w/ conventional solutions
- **Positive Environmental Impact**
  - Significantly reduces or defers the need for new t-lines
  - Implemented at existing substations w/in property bounds
  - Eliminates right-of-way purchases / eminent domain issues
  - Stabilizes interconnection of renewables (e.g., wind)
  - Allows greater flexibility in siting new generation
- **Efficient Implementation**
  - Turnkey projects completed in 12 to 18 months
  - Years less than siting, permitting, & constructing new lines

Value Proposition of Power Electronics

- **Proven Reliability**
  - 30+ years of successful worldwide operating experience
  - Reliabilities leading to enhanced quality of power delivery
  - Results in increased power delivery availability
- **More Efficient Utilization/Expansion of Grid Assets**
  - Increases real power capacity of existing systems
  - Integrates intelligence-based control of networks
  - Provides dynamic response to system contingencies
  - Facilitates non-synchronous grid interconnections
  - Enhances necessary grid expansion where required
- **Control of Power Flow**
  - Changing the “laws of physics” on the power system
  - Directing power delivery for maximum operating efficiency

Policy and Value Proposition

- **Power Electronics Equivalent Value**
  - FACTS are “generators” of Vars (Reactive Power)
    - Vars are needed to maintain system voltage and stability
  - DC Links are “controllers” of Mega-Watts (Real Power)
    - Controllable Mega-Watts are needed to regulate operation
- **Policy Must Allow Incentive to Realize this Value**
  - “Merchant Plant” approach to transmission technologies
  - Place value on generated Vars and controllable Mega-Watts
- **Effective Policy will lead to System Improvements**
  - Wide-scale power electronics will enhance grid reliability
  - Necessary grid expansions will be better facilitated

Policy Recommendations

- **Accelerated Depreciation of Technology Investments**
  - Accelerated depreciation for investments in technologies that are, from a public policy and technical perspective, clear alternatives to the protracted process of transmission line construction.
- **Increased Rate-of-Return on Technology Investments**
  - Increased rate of return on investment in transmission assets should be commensurate with the value to the system of having adequate transmission capacity. Compared to the costs of outages, congestion and lack of access to low-cost electricity, the cost of this upgrade is minimal.
- **Value of Technology Recognized through Incentives**
  - Consistency between the regulations and incentives that have been established for generator interconnections (merchant plants & IPPs) with respect to generated Vars and controllable Mega-Watt values.