United States Energy Association
Energy Bar Association
"Energizer"

Integrating Intermittent Generation in Southeast Europe: Lessons Learned

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Overview of USEA

- Not for Profit voluntary membership association
- 150 members covering the breadth of the U.S. energy industry
  - Utilities, regulatory agencies, oil & gas, nuclear, finance, research universities, consultancies
- U.S. member committee of the World Energy Council
- Educational & information dissemination mission
  - Annual State of the Energy Industry; Energy Efficiency Forum; Energy Supply Forum; weekly briefings
- 25 years of cooperation with USAID

ETAG Objectives

Plan for robust, reliable cross border transmission interconnections as the backbone infrastructure for cross border trade and exchange of electricity generated by clean & innovative energy technologies

Develop technical rules, guidelines and network infrastructure assessments to accelerate integration of clean & innovative energy technologies

Improve security of supply in distribution systems by supporting: optimization planning; line loss reduction; asset management programs; smart grid technology; and region wide disaster preparedness and emergency response programs

Support utility commercialization, privatization and market transformation to improve overall network efficiency and support clean energy market development

Project Goals: SECI & BSTP

Promote National & Regional Transmission Planning Among TSOs

Harmonize Transmission Planning Principles, Methods and Methodologies

Identify Priority Investments in Transmission Systems & Interconnections

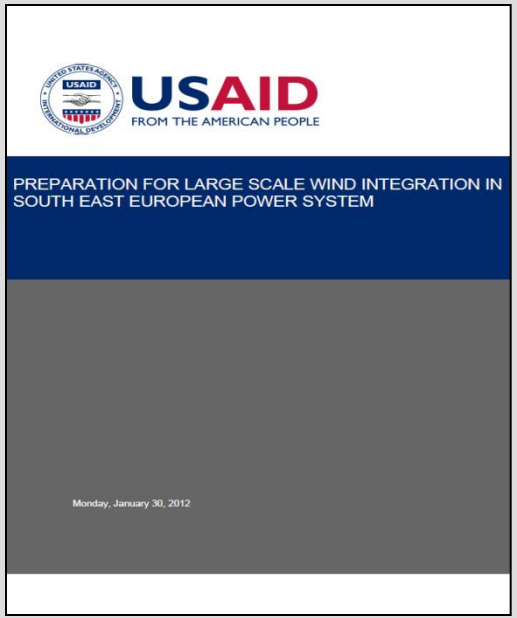
SECI Project Participants

- Albania – Transmission System and Market Operator
- Bosnia and Herzegovina – Independent System Operator in BiH
- Bosnia and Herzegovina – Electricity Transmission Company of BiH
- Bulgaria – NEK EAD, National Electricity Company
- Croatia – HEP Transmission System Operator LLC
- Kosovo – Transmission System and Market Operator (KOSTT)
- Macedonia – Macedonia Transmission System Operator
- Montenegro – AD Prenos
- Romania – Transelectrica
- Serbia – JP Elektromereza Srbjie (EMS)
- Turkey – Turkish Electricity Transmission Company
- Italy – TERNA (observer)
- Slovenia – Elektro Slovenia (observer)

Model Characteristics

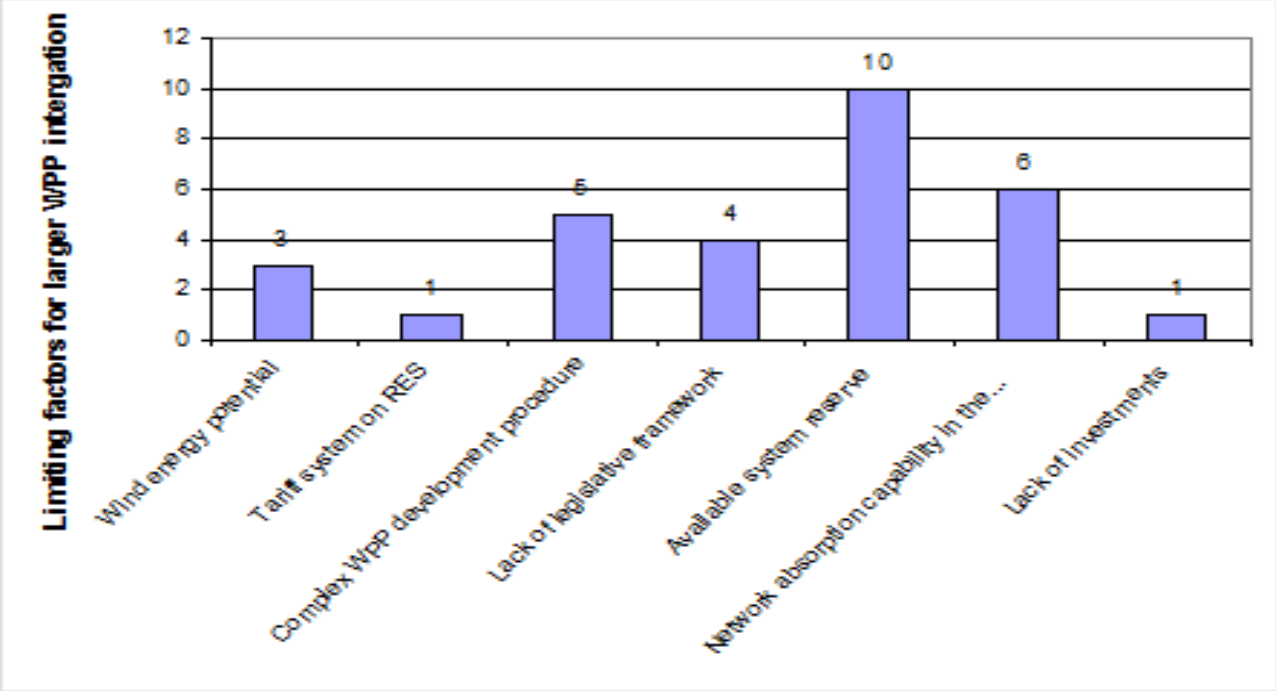
SECI & BSTP			
Common Database of Network Elements in Siemens PSS/E	2010, 2015, 2020, 2025 & 2030 for Winter Max, Summer Min & Summer Max Regimes – LF & Dynamic	2015 & 2020 Optimal Power Flow Models (BSTP Only)	Quarterly Working Group Meetings & Model Updates

SECI: Preparation for Large Scale Wind Integration in Southeast European Power System

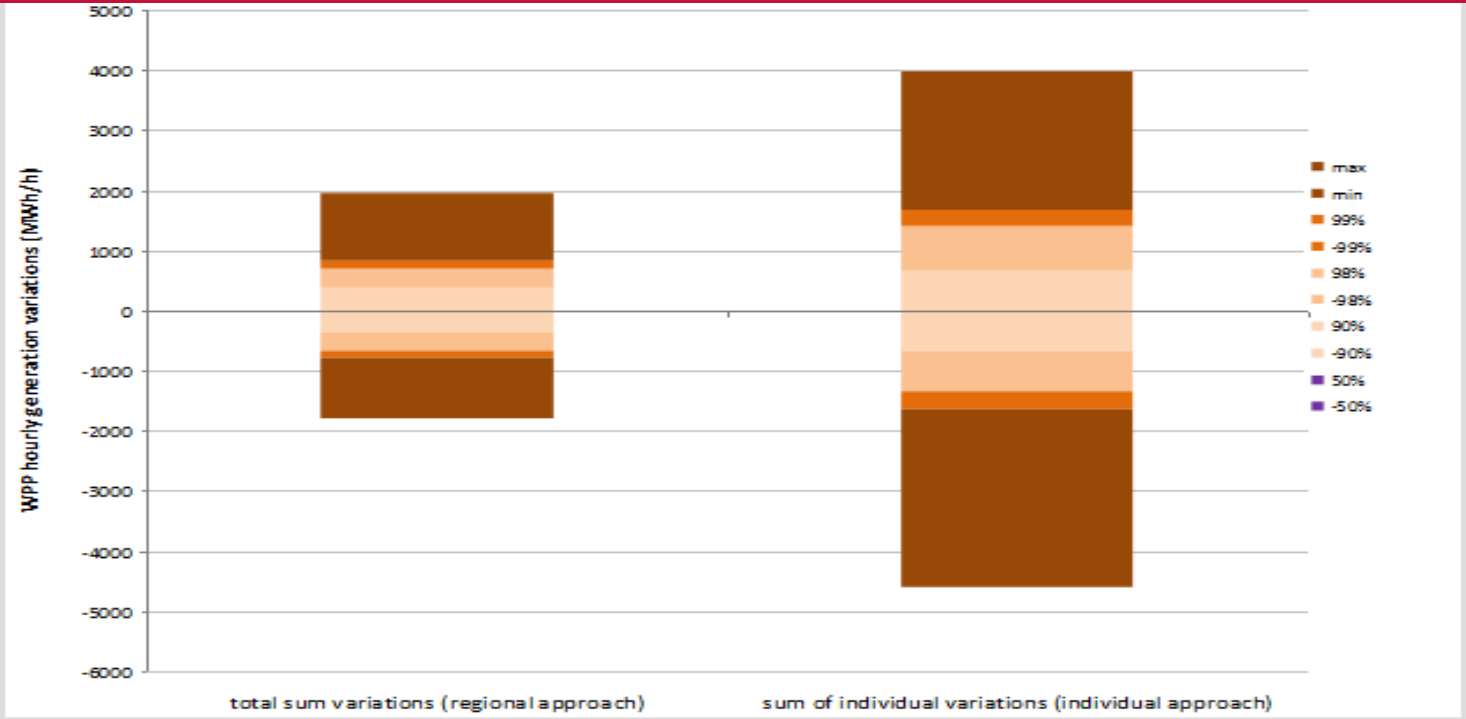


- Ambitious Renewable Energy Supply (RES) Targets in SEE, especially wind generation
- Study Reviewed RES: Targets, Existing Wind Studies, Legal/Regulatory Framework, Technical Standards for each SECI Country
- Conducted Regional Network Load Flow Analysis Assuming Large Scale Penetration of Wind Generation

SECI: Impediments to Large Scale Wind Integration

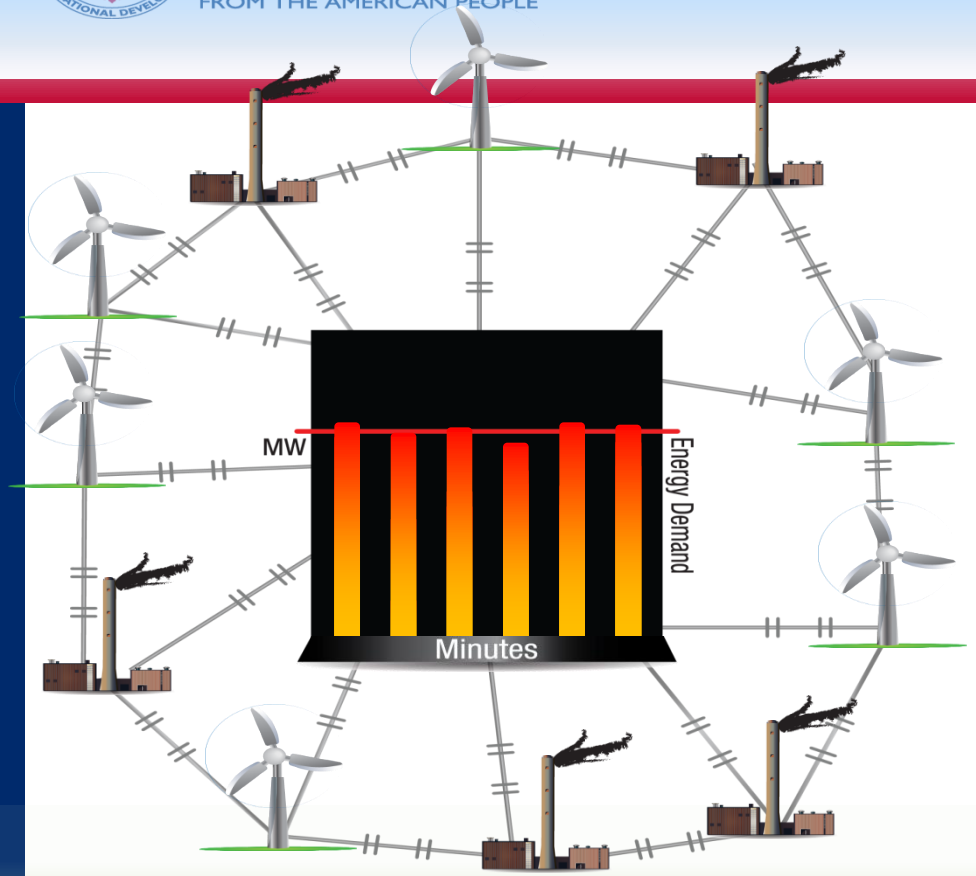


SECI: Impediments to Large Scale Wind Integration

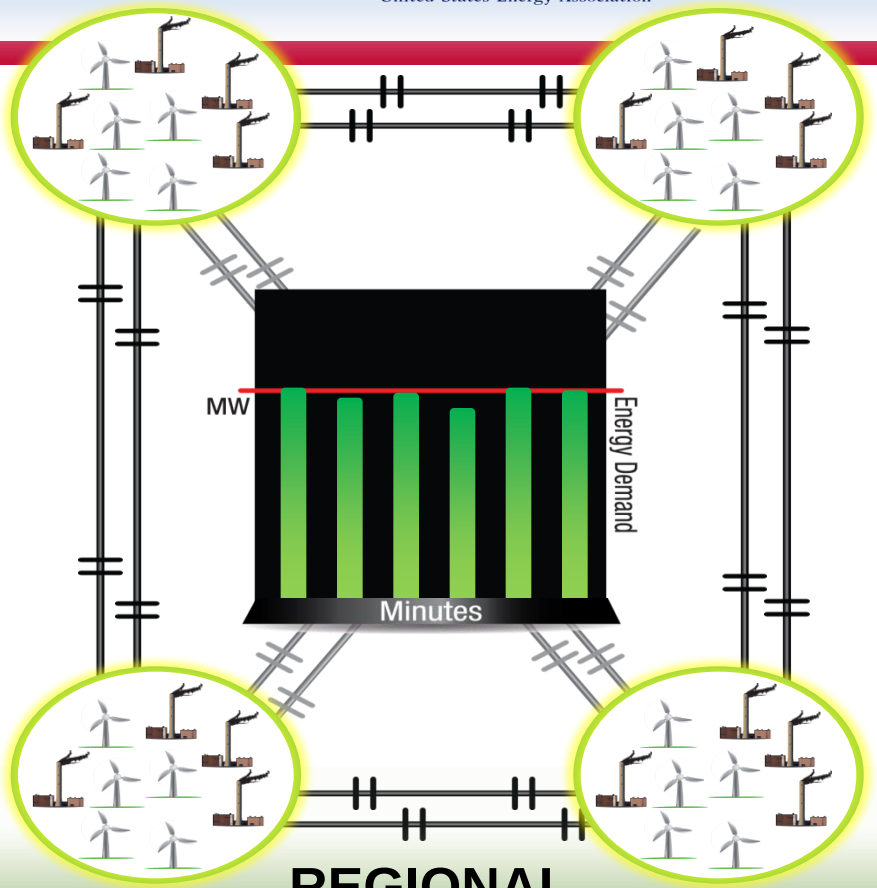


SECI: Critical Findings of Large Scale Wind Integration in Southeast European Power System Study

- Technical Standards for Balancing Reserves can be an Impediment to Wind Generation Development at the National Level
- Regional Provision of Balancing Reserves Requires 50% less Reserves than National Provision of Reserves
- Regional Provision of Balancing Reserves Opens 2,000 MW of Generating Capacity for Market Activities
- Regional Balancing Reserve Sharing Mitigates a Significant Technical Impediment to Wind Generation Development at the National Level



COUNTRY

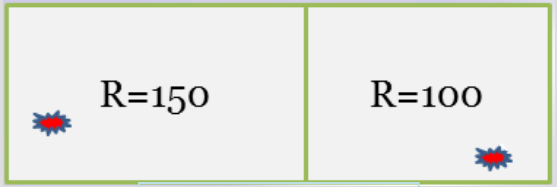


REGIONAL

Wind Turbine
Thermal Plant
Transmission Line

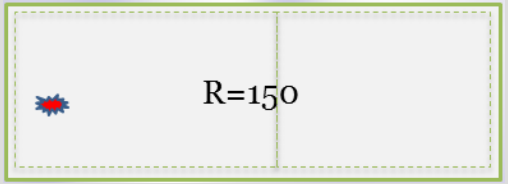
ENTSO-E Approved Reserve Sharing Mechanisms

Individual Dimensioning



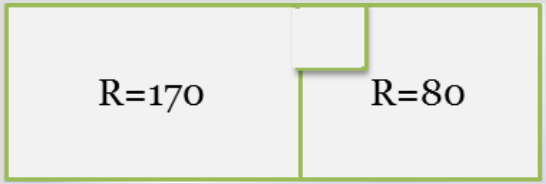
∑ = 250 MW

Common Dimensioning



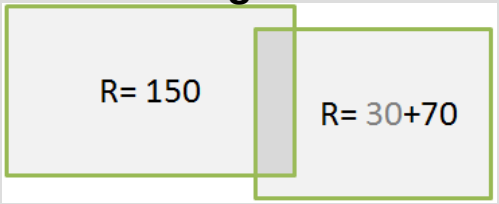
∑ = 150 MW

Exchange of Reserves



∑ = 250 MW

Sharing Reserves



∑ = 220 MW

Dealing with Seams

- Sufficient cross-border transmission capacity for energy & balancing markets
- Seams create opportunities for gaming
- Coordinated Auction Office
- Regulatory Action

Other Issues

- Impact on Tariffs – Social Stability
- Queue Management
- Complex Connection Procedures
- Interaction with Distribution Networks
- Energy Security

Germany

March 24, 2018 6:50 PM

Carbon Intensity	Low-carbon	Renewable
603g	26%	2%

(gCO_2eq/kWh)

Electricity production | Carbon emissions by source