

APEC Expert Group on New and Renewable Energy Technologies and US Grid/Renewable Energy Research Programs

Cary N. Bloyd, Ph.D.
Senior International Research Advisor
Energy and Efficiency Division
Pacific Northwest National Laboratory
Richland, Washington, USA

**Workshop on Addressing Grid-
interconnection Issues in Order to
Maximize the Utilization of New and
Renewable Energy Resources**

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What is APEC?

- Asia-Pacific Economic Cooperation (APEC) was created in 1989
- Objective: Promote trade liberalization, trade facilitation and technical assistance
- APEC Economies account for more than one third of the world's population, 60% of world GNP and 50% of world trade
- Implements its activities through 11 working groups including the Energy Working Group

(<http://www.apec.org>)



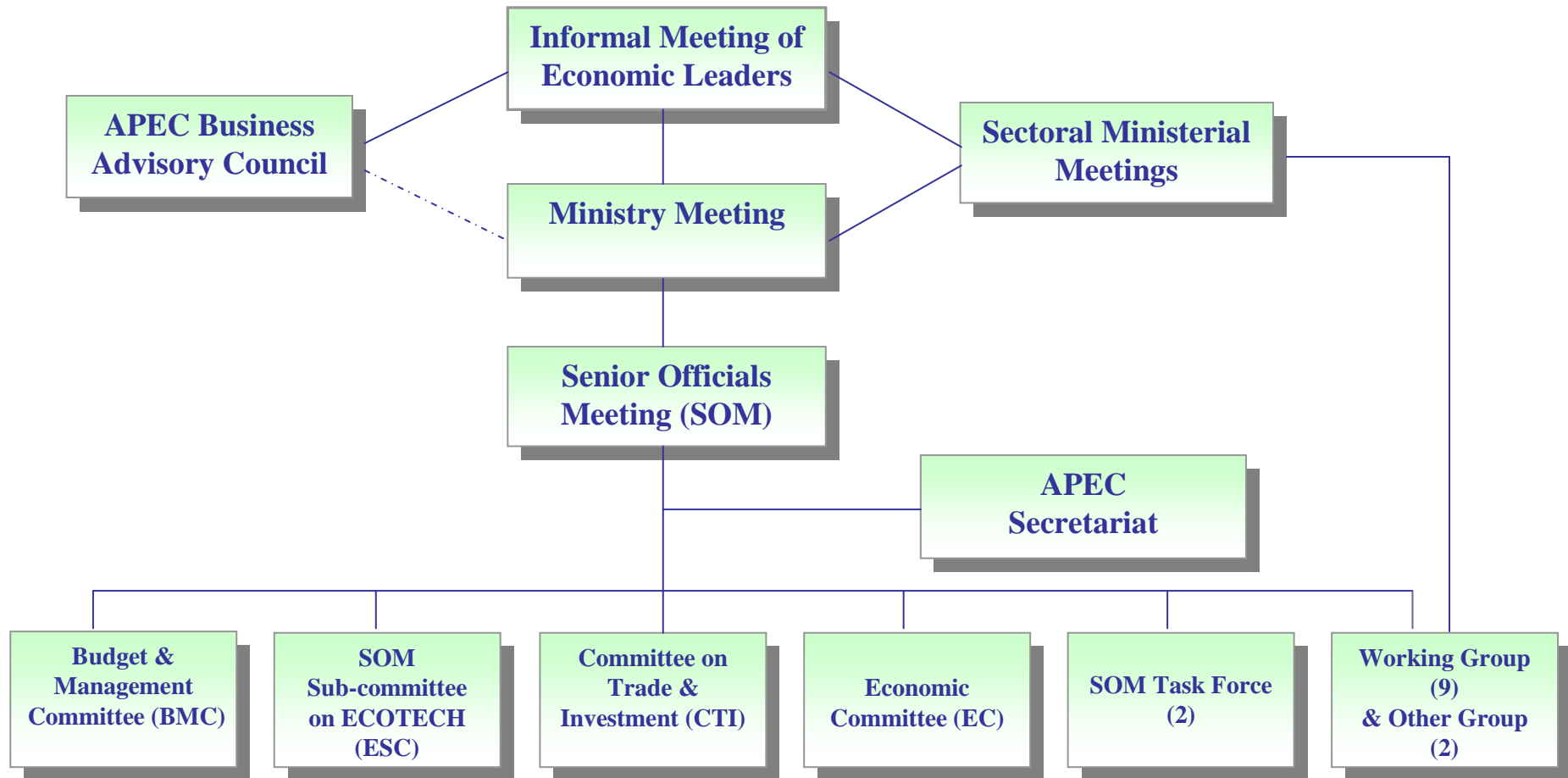
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APEC Member Economies span the Pacific

- ▶ **Australia**
- ▶ **Brunei Darussalam**
- ▶ **Canada**
- ▶ **Chile**
- ▶ **Peoples Republic of China**
- ▶ **Hong Kong China**
- ▶ **Indonesia**
- ▶ **Japan**
- ▶ **Republic of Korea**
- ▶ **Malaysia**
- ▶ **Mexico**
- ▶ **New Zealand**
- ▶ **Papua New Guinea**
- ▶ **Peru**
- ▶ **Republic of the Philippines**
- ▶ **Russia**
- ▶ **Singapore**
- ▶ **Chinese Taipei**
- ▶ **Thailand**
- ▶ **United States**
- ▶ **Vietnam**

Asia Pacific Economic Cooperation



The eleven APEC working groups support economic and technical cooperation

- ▶ Agricultural Technical Cooperation Working Group
- ▶ Energy Working Group
- ▶ Fisheries Working Group
- ▶ Health Working Group
- ▶ Human Resources Development Working Group
- ▶ Industrial Science and Technology Working Group
- ▶ Marine Resource Conservation Working Group
- ▶ Small and Medium Enterprises Working Group
- ▶ Telecommunications and Information Working Group
- ▶ Tourism Working Group
- ▶ Transportation Working Group



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APEC Energy Working Group (EWG)

- ▶ The EWG was launched in 1990
- ▶ The EWG seeks to maximize the energy sector's contribution to the region's economic and social well-being, while mitigating the environmental effects of energy supply and use
- ▶ Australia was the EWG Lead Shepherd from its inception until 2009. The United States is the current Lead Shepherd
- ▶ The Energy Security Initiative (ESI) is the principal mechanism through which the EWG addresses the short and long term energy security challenges in APEC in a sustainable manner
- ▶ The APEC Energy Ministers (EMM9) last met in Fukui, Japan in June 2010 under the theme of “Low Carbon Paths to Energy Security—Cooperative Energy Solutions for a Sustainable APEC”

(www.ewg.apec.org)


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The Energy Working Group is supported by 7 sub-fora groups

- Expert Group on Clean Fossil Energy (EGCFE) – Chair: USA
(www.egcfe.ewg.apec.org)
- Expert Group on Energy Efficiency & Conservation (EGEEEC) – Chair: New Zealand (www.egeec.apec.org)
- Expert Group on Energy Data & Analysis (EGEDA) – Chair: Japan
(www.iecej.or.jp/egeda/)
- Expert Group on New and Renewable Energy Technologies (EGNRET) – Chair: USA (www.egnret.ewg.apec.org)
- APEC Biofuels Task Force- Chair: USA
(www.biofuels.apec.org)
- Asia Pacific Research Center (APERC)
(www.iecej.or.jp/aperc/)
- Energy Business Network- Chair: New Zealand
(www.ewg.apec.org)

EGNRET's Renewable Energy Activities are Diverse and Complementary

- ▶ Lead and work with EWG major initiatives
 - APEC 21st Century Renewable Energy Development Initiative
 - EWG led Energy Security Initiative (2001)
 - Ministerial Level Financing Initiative (2004)
 - Ministerial Level Hydrogen Initiative (2004)
 - Ministerial Level Biofuels Initiative (2006)
- ▶ Organize workshops
- ▶ Conduct research projects
 - 50 have been completed since 1992
 - 2 are being implemented in 2010-2011

EGNRET Renewables/Grid-Integration Projects

- ▶ Using Smart Grids to Enhance Use of Energy Efficiency and Renewable Energy Technologies (EWG 01,2009S) USA
- ▶ Addressing Grid Interconnection Issues in Order to Maximize the Utilization of New and Renewable Energy Sources (EWG 02/2009) Japan
- ▶ APEC Workshop on Grid Integration of Renewable Energy (USA Self funded, January 12-15, 2009)
<http://www.sandia.gov/regis/>
- ▶ 2008 APEC Photovoltaic Conference (EWG Self funded Chinese Taipei, October 7-8, 2008)
<http://www.apecpv.itri.org.tw>



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High Penetration Solar Energy Challenges

- ▶ For high distributed PV penetration
 - Significant fluctuations in electricity output requires other grid assets to compensate for it
 - Ramping issues (morning and evening) require other generators to ramp up or down
 - Potential issues when feeding electricity back into the grid (circuit breaker protection schemes are designed for uni-directional power flow)
- ▶ For solar thermal power plants
 - Operate on the principal of a steam turbine plant
 - No ramping issues because of large thermal storage
 - BUT: significant water requirements for cooling the water/steam medium of steam turbine plant

Research and Development

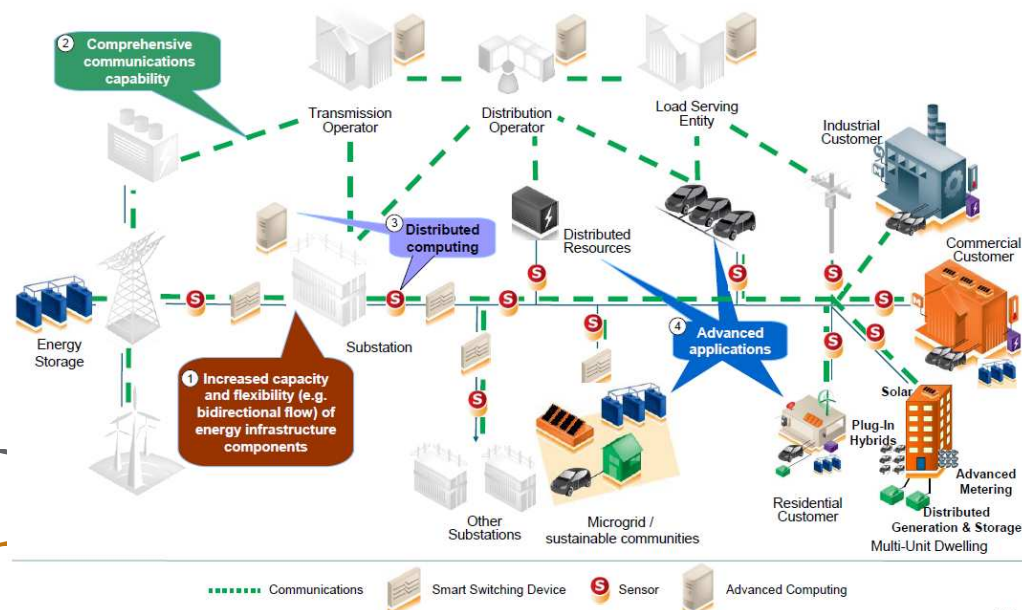
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- The diagram illustrates a Smart Grid architecture with the following components and interactions:
- 1 Increased capacity and flexibility (e.g. bidirectional flow) of energy infrastructure components:** Represented by a brown callout pointing to the main power lines.
 - 2 Comprehensive communications capability:** Represented by a green callout pointing to the communication network (dashed green lines).
 - 3 Distributed computing:** Represented by a purple callout pointing to the Substation and Distributed Resources.
 - 4 Advanced applications:** Represented by a blue callout pointing to the various end-users and resources.
- Key Components and Interactions:**
- Transmission Operator:** Manages the high-voltage transmission network.
 - Distribution Operator:** Manages the distribution network.
 - Load Serving Entity:** Provides electricity to end-users.
 - Substation:** A central hub for power distribution and control.
 - Distributed Resources:** Includes solar, wind, and other renewable energy sources.
 - Advanced Computing:** Provides the computational power for smart grid operations.
 - Smart Switching Device:** Enables precise control of power flow.
 - Sensor:** Monitors the grid's health and performance.
 - Communications:** Facilitates data exchange between all components.
- End-Users and Resources:**
- Industrial Customer:** Large-scale commercial and industrial users.
 - Commercial Customer:** Medium-scale commercial users.
 - Residential Customer:** Individual households.
 - Plug-In Hybrids:** Vehicles that can be charged from the grid.
 - Solar:** Residential solar panels.
 - Advanced Metering:** Smart meters for monitoring energy usage.
 - Distributed Generation & Storage Multi-Unit Dwelling:** Buildings with integrated energy storage and generation.
 - Microgrid / sustainable communities:** Self-sufficient energy systems.
 - Other Substations:** Additional power distribution points.
 - Energy Storage:** Large-scale storage facilities.
- Legend:**
- Communications
 - Smart Switching Device
 - Sensor
 - Advanced Computing

DOE Programs Addressing High Penetration PV Challenges--Office of Energy Efficiency and Renewable Energy (<http://www.eere.doe.gov>)

Systems Integration

(within Solar Energy Technologies Program)

- Solar Energy Grid Integration systems (SEGIS) to develop inverters/converters with EMS interfaces for integrating solar energy with smart grid applications
- Solar system modeling & benchmarking
- Resource & Safety R&D



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US DOE Smart Grid Information Clearinghouse (<http://www.sgiclearinghouse.org/>)

Goal is to “make data from smart grid demonstration projects and other sources available to the public”

- Competitive award to Virginia Tech (Lead)/EnerNex/IEEE Team to establish Web-based public info clearinghouse
 - Serving as a central repository for smart grid information, including all Recovery Act smart grid projects
 - Sharing and dissemination of information on knowledge gained, lessons learned, and best practices
 - Supporting decision making by both State/Federal Regulators
- Responded to high priority identified by NARUC/FERC Smart Grid Collaborative & Electricity Advisory Committee
- Clearinghouse User Group comprising key stakeholder groups assembled to guide collaborative development



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US DOE Outreach grid integration activities

► GridWeek 2010

- Washington, DC, October 18-21, 2010
- <http://gridweek.com/2010/>
- Associated US-EU workshop on Energy Storage

► 4th International Conference on Integration of Renewable and Distributed Energy Resources

- Albuquerque, New Mexico, December 6-10, 2010
- <http://4thintegrationconference.com/>

Thank you for your attention!

Cary Bloyd@pnl.gov



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