Next Generation Policy Instruments for Electricity Generation from Renewable Sources (RES-E-NEXT)

Kristian Petrick
Acting for the IEA-RETD Operating Agent

20 November 2014, Tokyo, Japan

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The mission of IEA-RETD is to accelerate the large-scale deployment of renewable energies

RETD stands for "Renewable Energy Technology Deployment"

IEA-RETD provides a **policy-focused, technology cross-cutting platform** ("Implementing Agreement") under the legal framework of the International Energy Agency

- Created in 2005, currently **8 member countries**: Canada, Denmark, France, Germany, Ireland, Japan, Norway, UK
- IEA-RETD commissions annually **5-7 studies** bringing together the experience of some of the world's leading countries in RE with the expertise of renowned consulting firms and academia
- Reports and handbooks are freely available at www.iea-retd.org
- IEA-RETD organizes **workshops** and presents at international events

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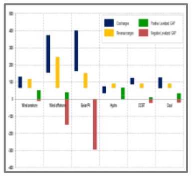
Key challenges for an accelerated RE deployment and IEA-RETD Project Examples

Key Challenges	IEA-RETD Project Examples
▪ Economic / societal justification for RE ▪ Jobs & economy ▪ Externalities & co-benefits ▪ Innovation	Employment and Innovation through Renewable Energies (EMPLOY, 2009-12) 
▪ Financing RE deployment ▪ Business cases ▪ Costs and policy instrument design	Cost and Business Case Comparisons of RE vs. non-RE Technologies (RE-COST, 2013) 
▪ Communication / public acceptance ▪ Lack of understanding ▪ Misleading information	Communication of best practices for RE (RE-COMMUNICATE, 2013)
▪ System integration ▪ High variable RES-E shares ▪ Market design	Next generation RES-E policy instruments (RES-E-NEXT, 2013) 

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Agenda

- Introduction and Objectives

1.Securing RES-E Generation

2.Securing Grid Infrastructure

3.Enhancing System Flexibility

4.Securing Generation Adequacy

- Synthesis and Discussion
- Concluding Remarks

Next Generation RES-E Policy Instruments

Project Steering Group:	Michael Paunescu (CA, chair), Kjell Sand (NO), Simon Müller (IEA RED), Georgina Grenon (FR), Henriette Schweizerhof (DE).
Implementing Body:	NREL (USA), Ecar (Ireland), DIW Berlin (Germany)
Execution:	September 2012 – July 2013
Objective:	To provide an overview and analysis of next generation RES-E policy instruments in the light of changing electricity systems and markets with high shares of RES-E
Status:	Completed, downloadable at RES-E-NEXT, 2013

RES-E = Electricity from Renewable Energy Sources

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Characteristics of next generation RES-E policy

With increasing penetration, variable RES-E integration increasingly affects power system planning and operation.

As a consequence:

- System-wide impacts will grow, requiring more complex system-wide analysis
- Expert and stakeholder communities are growing more diverse, increasing disagreement on best pathways
- Magic bullet solutions are less and less likely
- Solution-sets are increasingly likely to vary by jurisdiction
- Across jurisdictions, strong policy leadership required and policy coordination is key

Active, sustained, and coordinated evolution is central to next-generation RES-E policy.

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Challenges include ensuring predictable revenue streams and stable grids—policies can address both

- **Grid-Related Challenges**
  - Non-dispatchable RES-E adds supply-side variability, increasing balancing needs
  - RES-E generators may need to increasingly provide grid support services
  - Congestion on transmission lines from wind, distribution feeders from distributed PV
- **Revenue-Related Challenges**
  Operational requirements could reduce revenues, especially via:
  - Prevalence of energy imbalance penalties
  - Requirements for RES-E to provide increased grid services
  - Greater curtailment of RES-E resources

Next Generation Policies can meet these challenges by being "cost, market and grid aware"

1. Maintain investment certainty for RES-E and minimise the cost of incentives ("cost aware")
   - e.g. FiTs with flexible adjustment

2. Encourage positive interplay with markets ("market aware")
   - e.g. proactive consideration of revenue impacts of curtailment practices and energy imbalance penalties

3. Respond proactively to changing grid needs ("grid aware")
   - e.g. linking price supports to requirements for RES-E to provide grid support services

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Overview of RES-E grid infrastructure issues

Development of grid is necessary

- Connecting generation to load
- Energy and price arbitrage
- Facilitates competition and reduces gaming
- Provides security and reliability
- Reduces aggregate variability and uncertainty of variable renewables
- Enables access to flexibility

But is also problematic

- High-quality RES-E can be far away from main load centres
- Planning conundrum: what first, grid or generation?
- Lumpy expansion
- Public acceptance

Solutions to Address the Challenges of Grid Development

- Centralised planning
- Addressing public acceptance issues
  - Active stakeholder management and public consultation
  - Undergrounding or partial undergrounding
  - Submarine HVDC cables ("bootstrapping")
- Technological solutions
  - e.g. Dynamic Line Rating (DLR)
- Congestion management
  - e.g. Locational Marginal Pricing (LMP)

Dynamic Line Rating instrumentation, ERCOT West Texas

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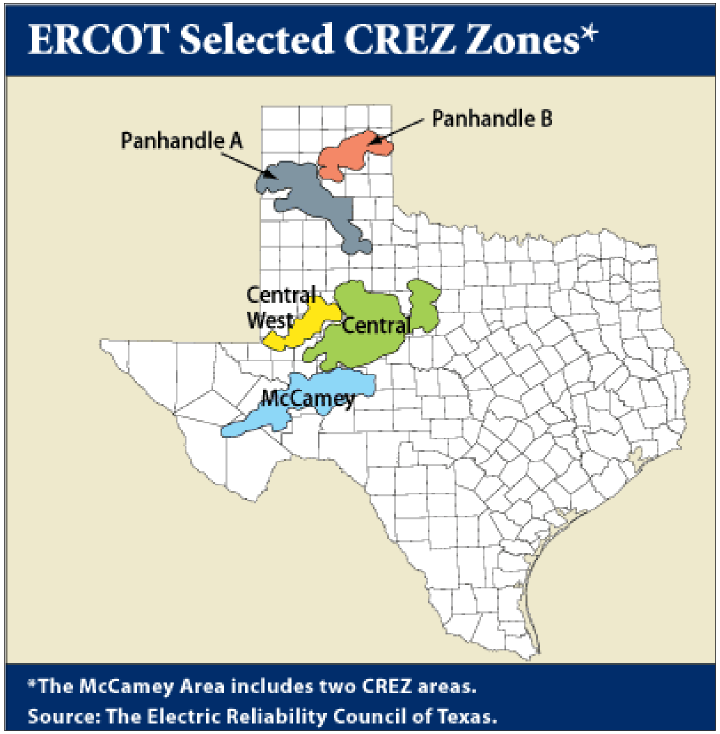
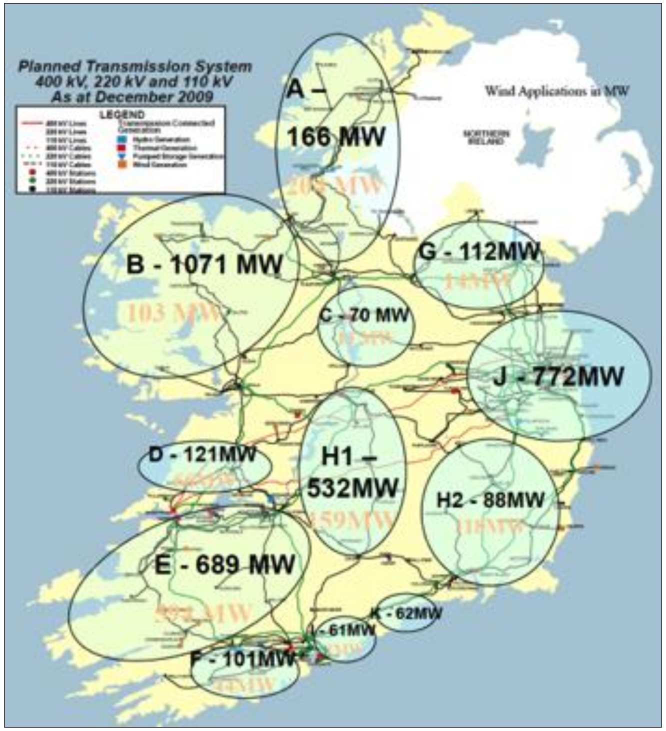
Centralised planning approaches have been effective mechanisms for transmission network development

Competitive Renewable Energy Zones (CREZ) in Texas have seen grid for 18.5 GW of wind built in 4 years

Group Processing in Ireland sets out rules for development of grid to support tranches of RES-E projects





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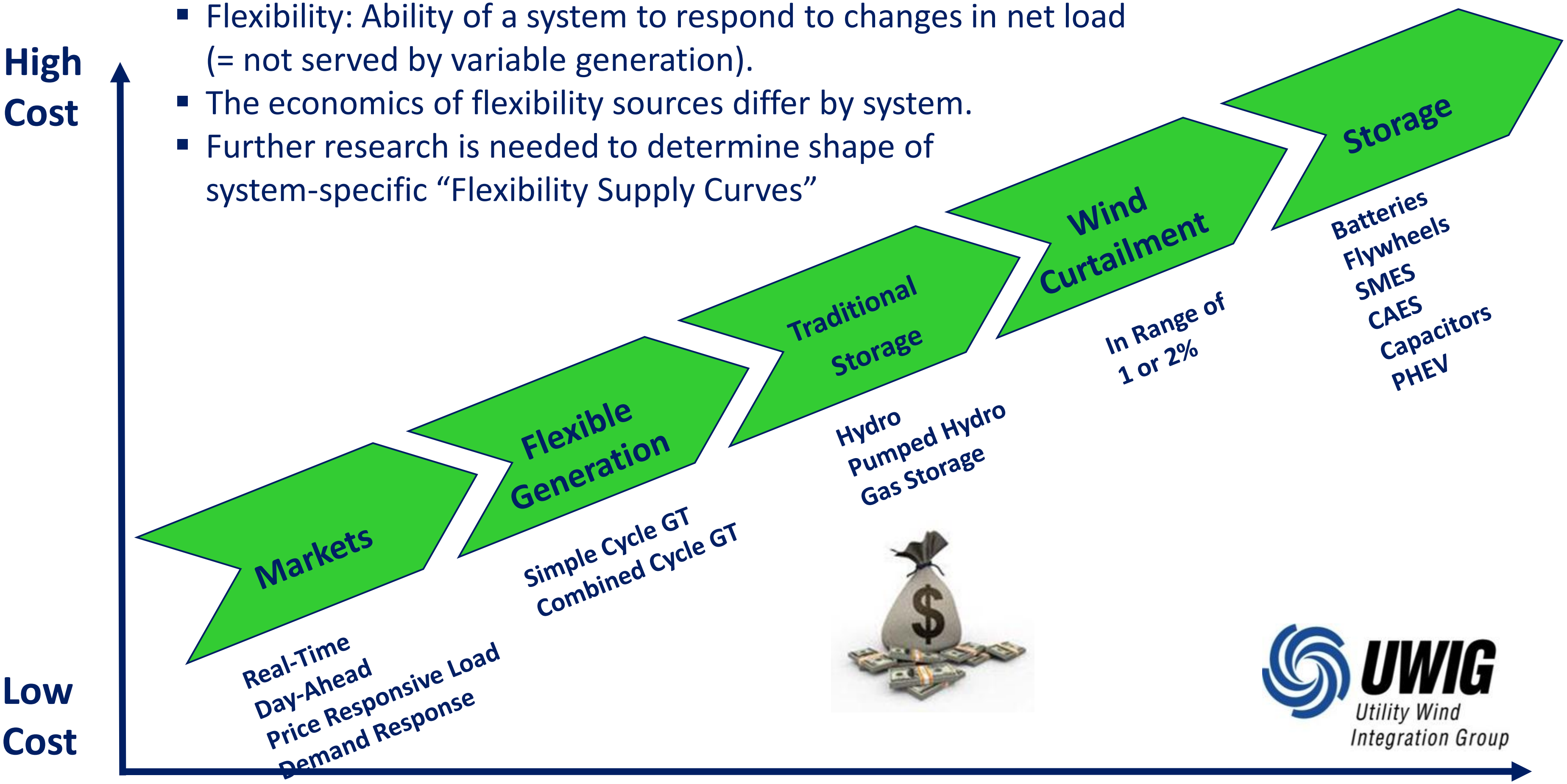
Flexibility options vary in cost

- Flexibility: Ability of a system to respond to changes in net load (= not served by variable generation).
- The economics of flexibility sources differ by system.
- Further research is needed to determine shape of system-specific "Flexibility Supply Curves"



How to incentivize and reward flexibility

- There are contrasting perspectives on the best path towards incentivization of flexibility
  - Some observers suggest that “capability-based” mechanisms are likely to be a key part of evolution towards high RES-E futures.
  - Another perspective is that continued evolution in market design, e.g. very fast energy-only markets, widespread nodal pricing, and demand-side bidding, will be sufficient to reward flexibility
  - Some systems are in the process of designing and implementing specific flexibility incentivisation products (e.g. California Independent System Operator)
- The optimal path will vary by context, but the need to incentivize capability will be increasingly acute in high variable RES-E futures.

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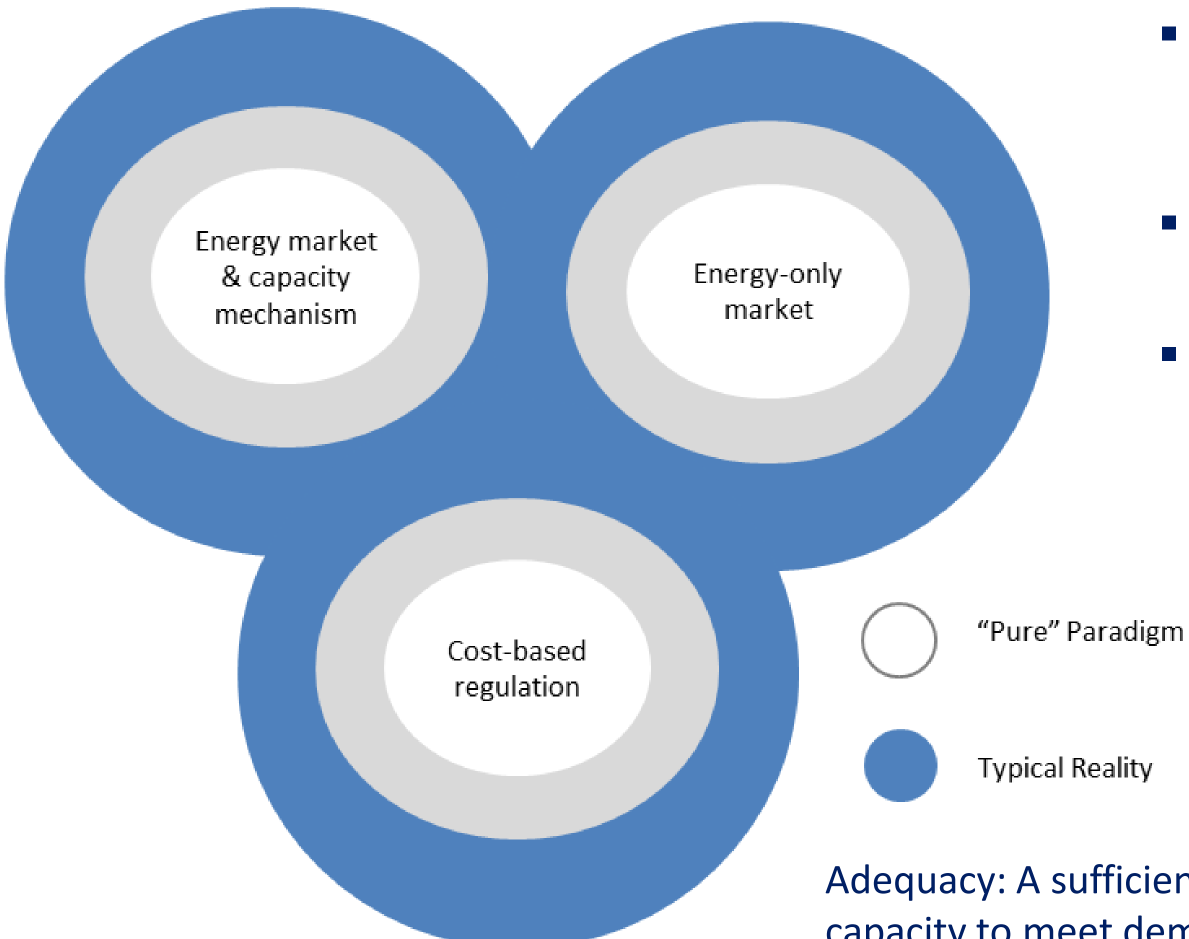
Capacity adequacy is addressed differently under the three dominant power market paradigms



- Electricity prices are key to conventional generator revenues
- Rules vary significantly by market structure.
- Real-world power markets rarely conform to ideal or "pure" paradigms.

Adequacy: A sufficient level of generating capacity to meet demand at some future date

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Several options exist to securing generation adequacy in high RES-E futures

- **Capacity Payments**

  In Ireland, the cost of peaking generation units is offered on a fixed basis to all generation that provides power during peak periods.

- **Capacity Markets**

  Some entities are made responsible to contract sufficient (equivalent) firm capacity to meet peak demand. Capacity resources typically include new or existing generation, imports, or demand response.

- **Strategic Reserves**.

  - TSO or other entity contracts on behalf of regulator for peaking capacity or demand resources. Resources only are entered into market above a predefined strike price —difficult to finance in energy markets.

- **Measures to Strengthen Energy-Only Markets.**

  - Example: Support for longer-term energy contracting to level annual variation of energy revenue . Contracts in Europe are 1-3 years ahead of power sale.

Securing generation adequacy in high RES-E futures requires coordination

Each of these leading options implies:

- Some level of administrative intervention into energy markets
- Medium or high risk to power plant investors
- Complex implications for demand-side resources and inter-regional trade.

All above imply that administrative coordination of energy markets is likely to increase into the future

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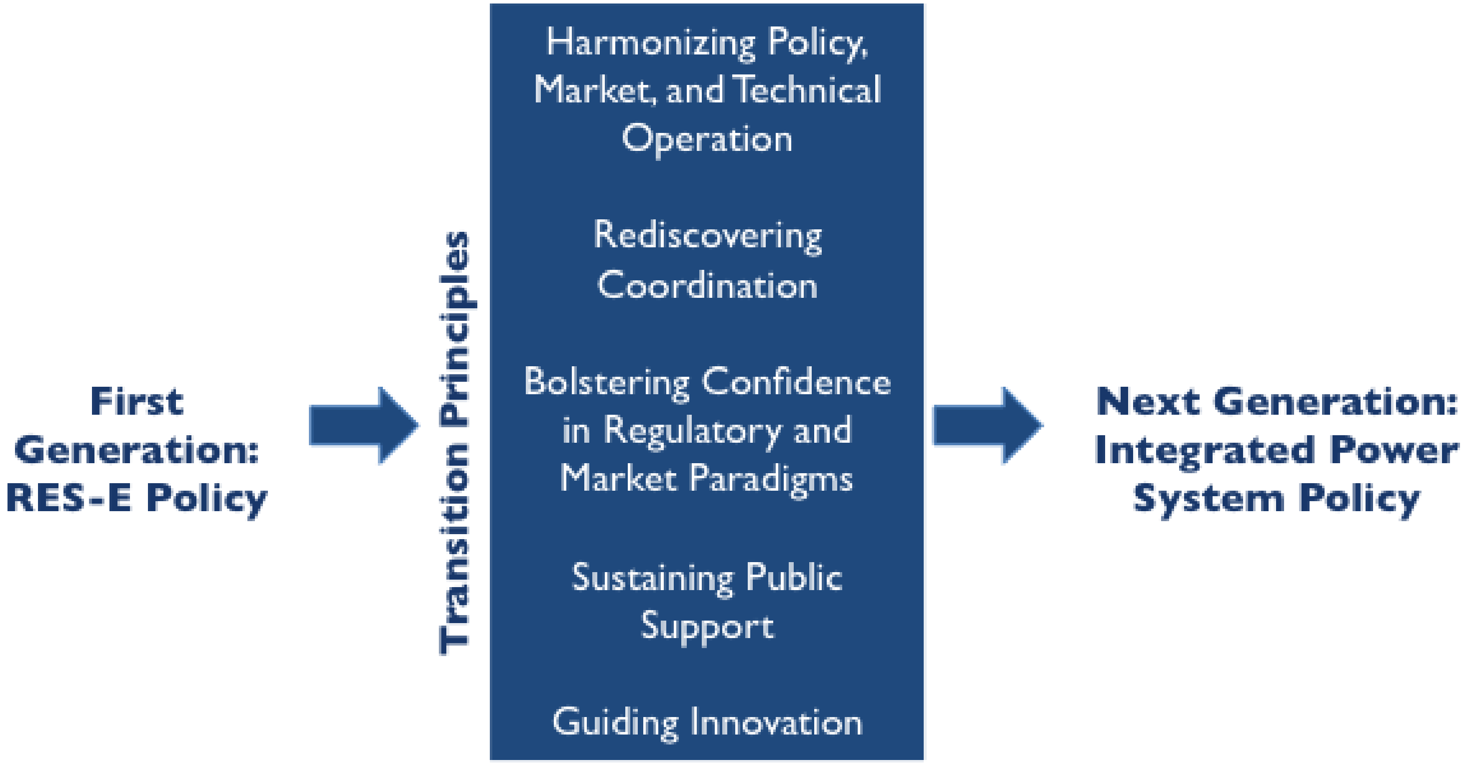
The path to power system transformation will not require policy or technology revolutions, but…

… an active, sustained, and coordinated evolution is central to next-generation RES-E policy.

Five principles that can guide this evolution are:



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Technical and policy options can make it work

- **Securing RES-E generation**
  - Incentives can be designed to encourage positive interplay with markets and systems operations
  - Incentives can be designed to be responsive to changing market conditions
- **Securing grid infrastructure**
  - Centralized coordination has a role in transmission-network development
  - Various policy and technology approaches help reduce public acceptance risk
  - Improved congestion-management practices (e.g. locational pricing) are important complements to grid extension
  - Deferral of grid investment creates value (e.g. through dynamic line rating technology)

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Technical and policy options can make it work

- **Enhancing flexibility**
  - Flexibility requirements and solutions are highly dependent on system characteristics
  - Further progress in market design could unlock flexibility (e.g. locational pricing, demand side bidding)
  - Mechanisms rewarding flexible capabilities will be a key part of enhancing flexibility
  - Methods of quantifying flexibility needs require further development
- **Securing generation adequacy**
  - Administrative intervention to achieve adequacy in energy markets is unlikely to diminish in the near term
  - Adequacy solutions will have complex and significant impacts on various power stakeholders

Strategy sets reflect penetration levels, and grow more interdependent at high penetrations

Example policy evolution through stages of RES-E penetration.

	Securing RES-E Generation	Securing Grid Infrastructure	Short-Term Security of Supply: *Flexibility*	Long-Term Security of Supply: *Adequacy*
Low Variable RES-E	Establish basic RES-E support mechanisms (e.g., Feed-in tariffs, targets, tenders)	Evaluate grid infrastructure needs in light of RES-E resources	Evaluate system flexibility levels; determine binding flexibility constraints	Evaluate functioning of adequacy mechanisms
Moderate Variable RES-E	Integrate RES-E into dispatch optimisation	Establish RES-E grid codes and designated transmission zones	Improve forecasting Broaden balancing-area footprints	Initiate capacity-adequacy studies
High Variable RES-E	Influence location of RES-E on grid to lessen distribution or bulk grid impacts Encourage RES-E production ⇔	Employ low-visibility transmission technologies Employ active network management ⇔	Employ advanced system operation (e.g., advanced unit comfvise storage and/or additional flexible generation) ⇔	Improve adequacy mechanism in accordance with predominant paradigm

Integration of RES-E policies in energy market policies

- At relatively **low levels of generation, few operational issues** arise due to RES-E.
- In high-RES-E systems around the world, next-generation RES-E policies increasingly **are shaped by broader systemic considerations.**
- It is evident that RES-E will **impact all parts of power-system policy**.
- **RES-E considerations are becoming a fundamental component** of next-generation “power-system policy.”

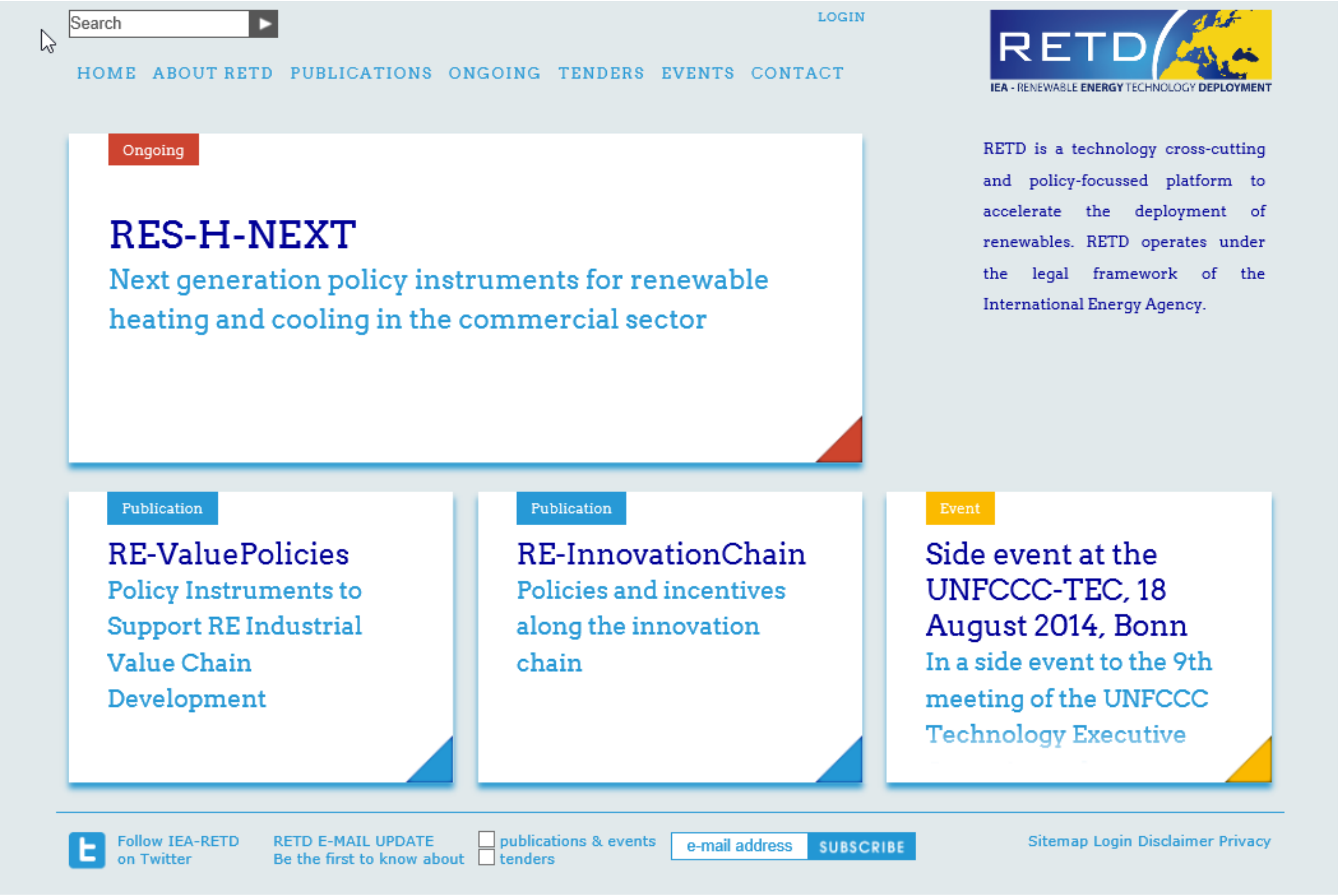
Evolution vs. Revolution

No technical or policy revolutions are necessary to achieve high-RES-E futures, but…

- … anticipating and **managing policy interactions** and policy debates will be key
- … as RES-E graduates into more central role in power-system operation, **policy harmonisation** will help maintain RES-E growth in an evolving power systems.
- **… coordinated evolution** is crucial, guided by **sustained, active leadership** to establish transition pathways**.**

Contact

Website: www.iea-retd.org
Contact: info@iea-retd.org, kristian.petrick@iea-retd.org



THANK YOU!

For additional information on RETD

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