**Addressing Variable Renewables in**

**Long-Term Energy Planning (AVRIL)**

**Expert workshop**

**Resume for Day 2 discussion**

**Main topics to discuss**

Structure of the report, how to present, messages, communication bottle neck

**Structure of the report**

**Introduction:**

* + problem definition, scope, objective of the report

**Part I: Identification of the VRE impacts on reliability of power system**

[To associate the RE impacts on reliability with different time horizon -> use matrix to establish a common framework for communication]

* + To define a framework to discuss the reliability issues (generation/gird; adequacy/security)
  + How properties of VRE impact each reliability issues (under each 4 category)
  + What are the time resolution of these impacts (under each 4 category)
  + What are the significance of the impacts for a system in developing countries (under each 4 category)
  + What are the measures to address these issues (under each 4 category)

**Part II: Planning time horizon and tools**

* + To define 4 types of planning tools to support power sector infrastructure development
* Capacity expansion (planning time horizon: 15-30 years)
* Transmission expansion (planning time horizon: 5-15 years)
* Dispatch planning (planning time horizon: < 1 years)
* Network study (planning time horizon: milliseconds to hours)
  + For capacity expansion planning, why the coordination is more important with high RE shares
* Coordination with transmission expansion planning
* Coordination with dispatch planning
* Coordination with network study
  + Discuss the needs for reduced form models for the coordination
  + What needs to be represented in capacity expansion model
* [Generation adequacy] capacity credit needs to be represented, it requires good resource data; and temporal matching of the resource with load need to be assessed through dispatch models, or other support tools
* [Generation security] flexibility measures to be represented and this can be directly represented in the capacity expansion model or reduced form representation of flexibility measures can be drawn from a dispatch model, or other support tools
* [Generation security/stability] either technical solution to be modelled, or technical limits of penetration due to the lack of inertia and governor response may be drawn from network studies, or other support tools
* [T&D adequacy] costs linked with the new investment needs to be reflected; cost estimate maybe drawn from GIS based transmission expansion models, or other support tools
* [T&D security] costs linked with the new investment may need to be reflected; however the costs linked to such investments are known to be relatively marginal

**Part III: Catalogue of modelling methodologies that address various reliability aspects in the long-term planning**

* + Capacity credit [Generation/Adequacy issue]
* Evaluation of the capacity credit of VRE, and use it in the reserve margin constraints in the capacity expansion model
* Establishing an empirical relationship between capacity credit and RE share
* Data needs: resource data, load
* Supporting tools
  + Flexibility issues [Generation security]
* Increasing time resolution
* Restructuring time
* Using a production cost model – iteration/validation
* Using constraints drawn from a separate tool
* Data needs: costs for deploying different flexibility products
* Supporting tools
  + Inertia/governor response [Generation security/stability]
* Rule of thumb for inclusion/exclusion
* Model technical solutions as add-on costs
* Implement technical limits drawn from a separate study
* Data needs: detailed network map
* Supporting tools
  + Transmission investment [Network/adequacy]
* Model technical solutions as add-on costs
* Incorporation of site specific project info
* Data needs: Generic cost data, GIS based data
* Supporting tools
  + Transmission investment [Network/security]
* Model technical solutions as add-on costs
* Data needs: Generic cost data, GIS based data
* Supporting tools

**Part IV Special chapter on island systems**

**What could be included in addition?**

* Hydro production – dry year vs wet year
* Analytical results themselves (as an application example in association with different methodologies)
* How improved methodology may change the results
* Assessment of the relative importance of different modeling methodologies
* Catalogue of tools
* Evaluation of the existing tools
* Regional planning
* Link to the energy sector planning
* High level policy message
* developing country specific planning challenge
* planning time horizon

**Next steps**

* + North Africa consultation
  + Latin America consultation

**The role of IRENA**

* + Advisory service
  + Linking policy makers and academics