Desafíos en la transición energética y los pasos para resolverlos

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Nuevas Tecnologías para la Red del Futuro en Chile

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New challenges arising

- When synchronous power plants are displaced by others, multiple aspects have to be taken into consideration:
  - Energy balance ⇒ MWh per year
  - System adequacy ⇒ power plants, MW and MWh availability in the next hours and days
  - Short term power system stability ⇒ several difficult physical phenomena have to remain under control

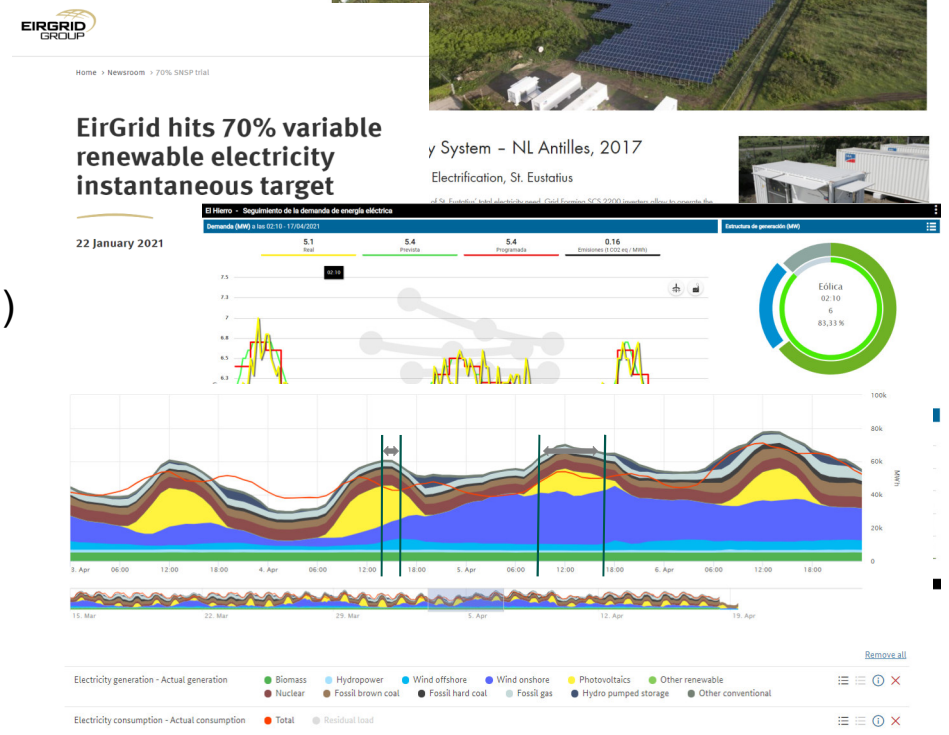
    mi único tema de hoy
  - Cost, timeline, sector coupling, grid topology, import & export,

    pricing schemes, flexibilities, legal framework, local acceptance, …

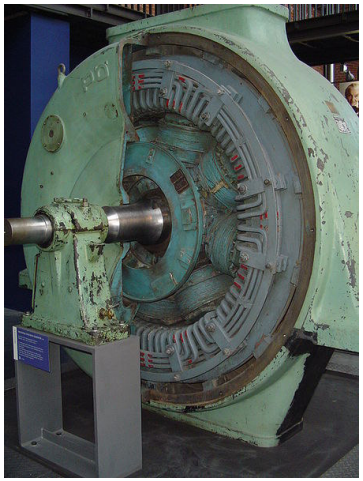
New challenges arising

- Technically very high instantaneous penetration with RES are possible, examples
  - St. Eustatius 100% Island
  - Ireland 70% (meshed grid)
  - El Hierro 100% Island (Canarias)
  - (Germany >100% but: part of EU grid!!)

- The challenge is not “renewable”, but it is
  - Inverter-based connected to AC grid
  - Volatile source
  - (decentral)



Looking ahead: What might become relevant in future?



- Mitigation of RES volatility and power gradients
- Inertia and/or fast frequency response
- Mitigation of negative sequence voltages
- Damping of low-order harmonics
- Damping of power system oscillations
- Resynchronization and black start
- Protection systems dealing with lower (?) short-circuit currents
- Models and tools to assess all the phenomena
- ...

When, where, to what extent will which subject become critical for the power system?

Research and collaboration is needed!

"RES means: power electronics"

* IET publication Jan 2015 "Power system needs – How grid codes should look ahead"

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Scope of the classic Ancillary Services Schemes:

? • Frequency control

? • Voltage control

• Black start

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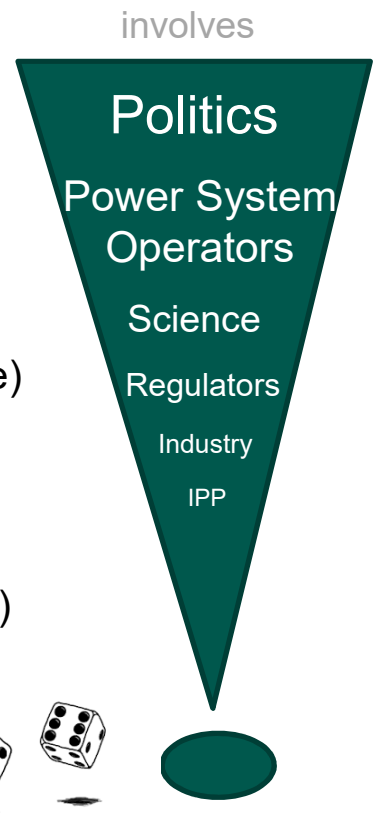
Several potentially critical topics need to be 1st assessed and 2nd addressed somehow.

Top – Down approach to quantify system needs + services

1. Define target system (sources, loads, RES-penetration in P and E…)
   Definir el sistema de destino
2. Define dimensioning disturbance (EU: -3 GW, so far not system split …)
   Definir las perturbaciones dimensiónates
3. Study to determine the system needs (incl. urgency of different needs)
   Estudio para determinar las necesidades técnicas del sistema
4. Technical formulation of requirements (system needs => tec. performance)
   Expresar las necesidades técnicamente
5. Determine the economically optimal form of provision & performance
   Determinar la versión económicamente óptima para obtener los servicios técnicos necesarios
6. Define technical benchmarking and organizational form (AS or Grid Code)
   Definir criterios técnicos de cumplimiento y la organización del suministro (SSCC o exigencia mínima en código de red)
7. Realization (adapt Anc.Service schemes and Grid Codes)
   Implementación



or:

Top – Down approach to quantify system needs + services

1. Define target system	The electrical target system is to be defined in terms of energy quantities, as well as the expected shares of the different power sources (RES, conventional, storage) and sinks (loads, e-mobility, storage). If necessary, different scenarios for several points in time with key data are to be politically specified.	Definir el sistema de destino
2. Define dimensioning disturbance	System faults have to be defined, which the network specified under 1. should survive without blackout, or which maximum supply restrictions should be permitted (e.g. load shedding). This is a political decision.	Definir las perturbaciones dimensiónates
3. Study to determine the system needs	Independent studies determine the type and scope of the minimum **power system supporting functionalities**; overall for the electrical system, as well as regional and local, in order to be able to operate under the conditions given in 1. and 2. in steady state conditions and in the event of faults, as well as with the desired voltage and frequency quality.	Estudio para determinar las necesidades técnicas del sistema
4. Technical formulation of requirements	Describe the necessary global/regional/local power system supporting functionalities identified under 3. in a technology-neutral manner. These system needs are to be translated into quantifiable contributions, which in principle can be provided by individual network participants or groups of network participants. Objective: To enable as many network participants as possible to provide system-supportive behavior.	Expresar las necesidades técnicamente
5. Determine the econo-mically optimal form of provision	For each of the network service functions identified under point 3, decide specifically how to meet the demand in the most economically advantageous way through contributions of network participants (or groups of them). a. market-based provision b. Mandatory capability and/or provision	Determinar la versión económicamente óptima para obtener los servicios técnicos necesarios
6. Define technical benchmarking and organizational form	For a. and b. define detailed technical benchmarking For a. additionally define organizational and remuneration form (tender, bid invitation, pricing regulated or free, payment based on capability and/or provision, ...)	Definir criterios técnicos de cumplimiento y la organización del suministro
7. Realization	To a.: Execute tender or other selected market forms for the procurement of non-frequency ancillary services. To b.: Determine date of application for new grid codes, if necessary define transitional arrangements	Implementación


Thank you
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