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Session II: Technical feasibility of a 100% renewable power system by 2050

Electricity Systems, Status and prospective in selected LAC countries

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Which are the objectives of the Renewables development?

Perform a Diagnosis, propose Scenarios and Guidelines to reach them

Introduction of detailed infrastructure planning processes. Perform technical and economic analysis to evaluate impacts and anticipate adaptation requirements:

- From: energy costs -supply
- To: Tariffs Evaluate remuneration schemes, including new value elements
- Rest of needed resources: personnel, modelling, forecasting, dispatching requirements, among many others

note: tables presented below were initially developed within undergoing tasks between FB and ECLAC, in the context of the Renewables Observatory Sustainable Energy (ROSE)
https://www.cepal.org/es/noticias/cepal-lanzo-observatorio-regional-energias-sostenibles

Current situation of VRE (Variable Renewable Energy) in selected electricity interconnected systems

Country:	Electricity matrix characteristics (2017-2019)							Proyections (2025-2030)
	Capacity (GW)			RVEs in the interconnec-ted system				VRE insertion objective in the interconnected system (% power)
	Instaled	Max	neighbor countries (GW)	(% energy)	(% capacity)	(GW)	neighbor countries (GW)	
Argentina	38.5	26.3	204	1.1%	2.4%	0.9	22.9	27% (mostly ERV)
Bolivia	2.1	1.5	251	2.5%	4%	0.1	22.4	6%
Colombia	16.9	10.1	201	0.0%	0.2%	0.0	17.6	17%
Panama	3.3	1.7	32	8%	11%	0.4	0.4	16% (reference esc) 29% (renewables esc)
Brazil	165.7	90.0	112	8%	10%	17.1	3.2	16% (reference esc)
Chile	23.5	10.5	55	11%	17%	4.0	1.4	40% (reference)
Uruguay	4.2	1.9	204	33%	40%	1.7	18.0	50%

- Current % VRE is very low in Argentina, Bolivia and Colombia; intermedia in Panama, Brazil and Chile; and high in Uruguay.
- Projected participation of VRE in the interconnected system is low in Bolivia, intemedia en Colombia and Brazil, and significative in Uruguay, Argentina, Chile y Panama.

Variable renewable resources and their interconnection potential - Current situation

Country:	Variable renewable resourses		Renewable energy, evacuation possibilities (2017-2019)	
	Renewable resources (significant potential relative to total installed capacity)	Geographical dispersion of variable renewable resources	Transport capacity available to evacuate resources (relative to renewables' potential)	Average distance to load centers
Argentina	Wind (> tens GW) Solar (> tens GW)	High	Low	Medium-High High
Bolivia	Solar (decenas de GW) Wind	Medium (Altiplano) Medium (Valley y Plain)	Low Medium	Low Medium
Colombia	Solar Wind (30 GW)	Medium (North - N.East) Low (Guajira)	Low	Low
Panama	Wind (1.9 GW) Solar (1 GW)	Medium Medium	Low	Low
Brazil	Wind Solar	High	Low	Medium-High
Chile	Wind Solar	High	Medium	Medium-High High
Uruguay	Wind Solar	Meddium to Low		Low

- Significant variable renewable resources potential (wind and solar)
- Geographic dispersion of resources - medium to low (greater impact of variability), except Chile, Argentina Brazil
- Low to medium available transport capacity and variable distance to load centers
- Strong challenge in terms of expanding transportation infrastructure to be able to exploit these resources in a meaningful way
- The installed capacity in bordering countries is an order of magnitude higher than the maximum power of each country (mainly due to the weight of Brazil).

Preliminary evaluation: availability of flexible resources for compensating variability (2017/18)

Country:	Interconnection (GW, relative to maximum power)	Plants that could respond quickly to variations in VREs (% of installed capacity): **open cycle TurboGas, reservoir hydro**	Power plants that could complement predictable variations (e.g. solar) (% of installed power): **Combined Cycle** CCGT	Energy storage systems (% of installed power) (e.g. pumped storage plants)
Argentina	36%	35%	29%	1.9%
Bolivia	6%	29%	15%	0.0%
Colombia	10%	69%	14%	0.0%
Panama	18%	18%	10%	0.0%
Brazil	19%	64%	4%	0.0%
Chile	6%	25%	8%	0.1%
Uruguay	209%	12%	13%	0.0%

- interconnection with **bordering countries** variable, only partially synchronized significant magnitude: Uruguay 176% - allowing high insertion of wind - and Argentina13%
- installed capacity in **flexible power plants** is very variable, with a high percentage in Colombia and Brazil (mainly hydro), intermediate in Argentina, Chile and Bolivia and medium to low in Panama and Uruguay.

Note: the proposed stylized typology is necessarily a simplification, more national dispatch specific info is needed for assessing the exact profile of some power plants, e.g. Uruguay's Salto Grande is currently used for partially coupling with wind variations

Preliminary evaluation of **planned** flexible resources for compensating variability (2025 – 2030)

Country:	Capacity (GW)		VRE insertion objective in the interconnected system		
	Installed	Max	(% power)	(% energy)	(GW)
Argentina	68.5	46.8	27% (mostly ERV)	25% (mostly VRE)	10
Bolivia	5.0	3.6	6%	5%	0.3
Colombia	24.3	13.0	17%		4.1
Panama	6.1 (ref Scen) 7.3 (renew Esc)	3.5	16% (ref Scen) 29% (renew Scen)	11% (ref Scen) 22% (renew Scen)	2.1
Brazil	216.3	130.0	16% (reference esc)	13%	35.3
Chile	32.0	14.3	40% (reference)	26% (ref Scen) 42% (Esc medium AG)	8.8 - 16
Uruguay	5.9	2.7	50%	42%	3.0

Preliminary evaluation of **planned** flexible resources for compensating variability (2025 – 2035)

Country	Interconnection (GW, relative to maximum power)	Plants that could respond quickly to variations in VREs (% of installed capacity): **open cycle TurboGas, hydro reservoir**	Power plants that could complement predictable variations (e.g. solar) (% of installed power): **Combined Cycle CCGT**	Energy storage systems (% of installed power) (e.g. **pumped storage** plants)
Argentina	24%	25%	19%	1%
Bolivia	263%	66%	6%	0%
Colombia	24%	53%	10%	0%
Panama	26%	15%	24%	0%
Brazil	19%	53%	<15%	0.5% (Ref Scen) 3% (Alternat Scen)
Chile	10%	23%	8%	0.1%
Uruguay	148%	9%	12%	0.0%

- **Interconnections:** new situation in Bolivia, reduction in Uruguay
- Colombia, Brazil, Bolivia: increase in their VRE's **quickly** responding plans
- Reductions for nearly all in VRE's **complementing** resources plans

CHALLENGES

- Find a balance between VREs penetration & achievement of national objectives - energy security and access to energy (cost of energy)
- Anticipate impacts and bottlenecks in the transformation of hydro-thermal systems into hydro -wind –solar -thermal.
- Investment and joint planning of infrastructure expansion (VRE + T&D)
- Identify cost-effective tools to balance or level VREs, and minimize renewable energy curtailments:

  i. Demand side management

  ii. EE storage (pumping hydro, CSP, etc.)

  iii. Interconnection (with neighboring countries or national subsystems)

  iv. Dispatch of existing plants (modification of the commercialization rules of electric power and dispatch operations).Change in the role of thermoelectric plants.

  v. Improve solar and wind forecasting + linkage to the dispatch (modeling + regionalized database)

  vi. Etc.

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