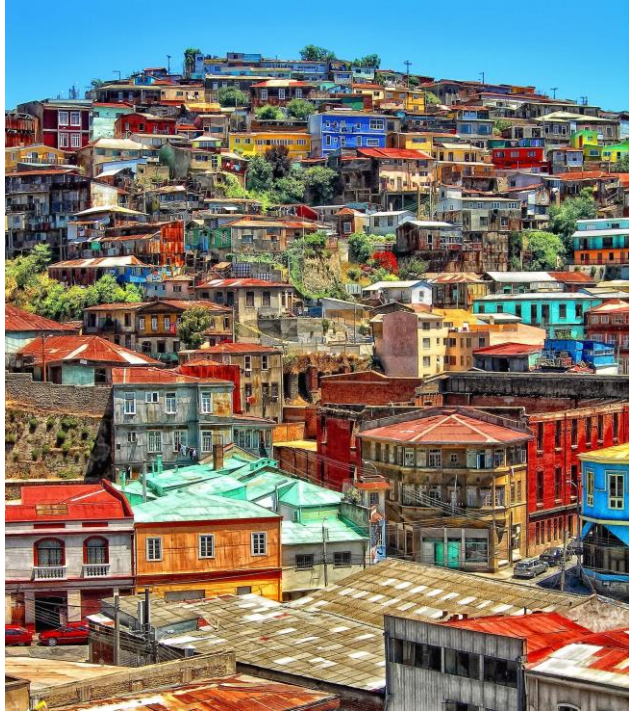
A few slides about me, my research, and of course, about my cat



From Chile to Finland

EX UMBRA IN SOLEM

TECHNISCHE UNIVERSITÄT MÜNCHEN

Colbun
MEJOR ENERGÍA

Bachelor in Electrical Engineering and MSc. in Electrical Engineering with a mention in Power Systems.

Erasmus student and research assistant in the high voltage laboratory.

Internship: data mining and renewable generation forecasting.

AC3E

Centro Avanzado de Ingeniería Eléctrica y Electrónica

Support engineer in Ministry of Energy project to incentivize the distributed energy resources.

inodú

energy & sustainability

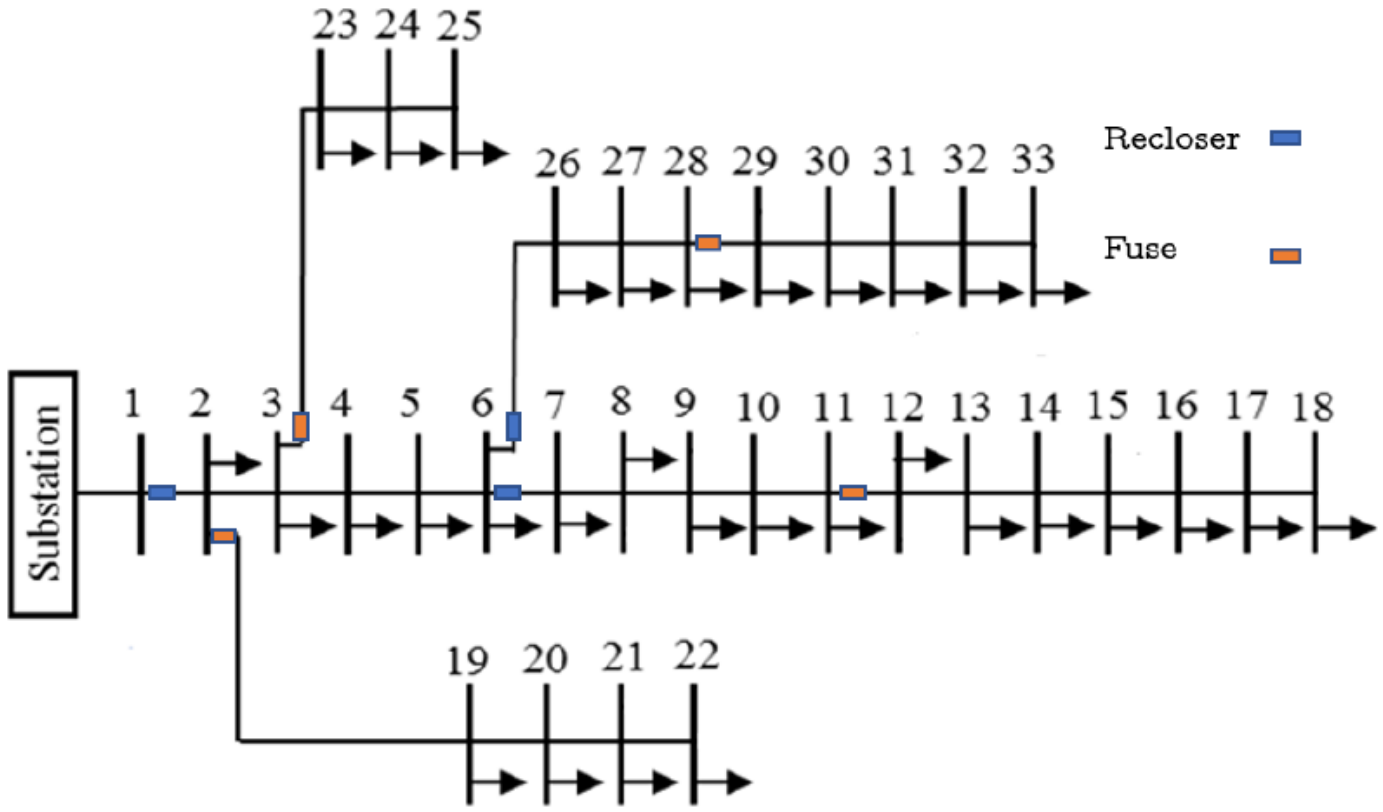
Energy and Sustainability Analyst.

Aalto University

Doctoral student.

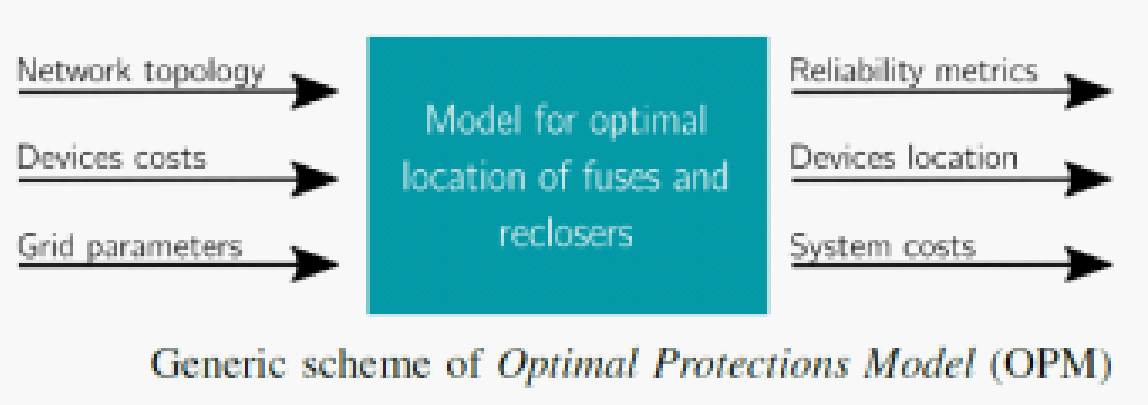
Distribution systems reliability

- How to measure the reliability of the grids?
- How to increase it?
- How much are we willing to pay to increase it?

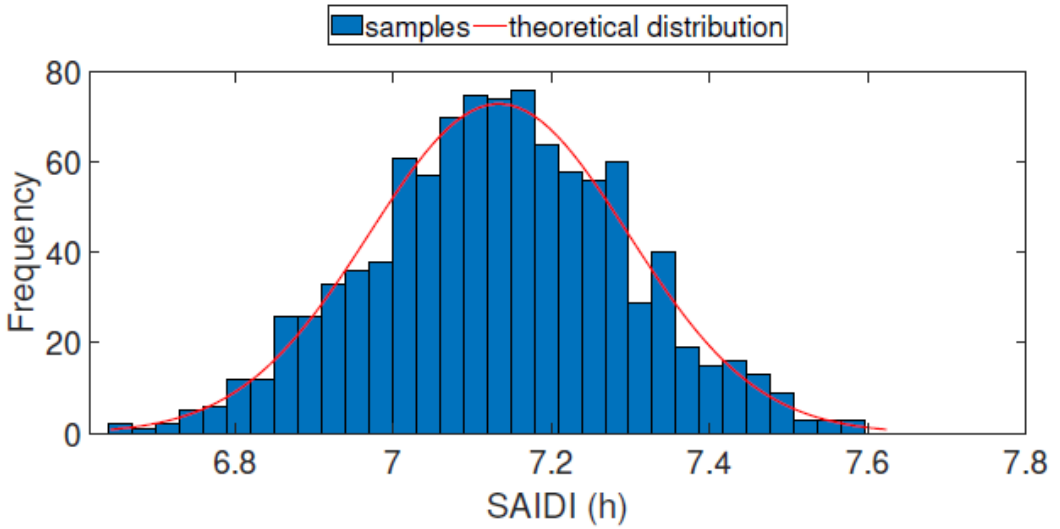


How to measure reliability?

- Reliability indices are defined in common standards. (IEEE; NERC)
- Load (generation) growth uncertainty.
- Outages of electrical devices are not deterministic.
- Poor data.

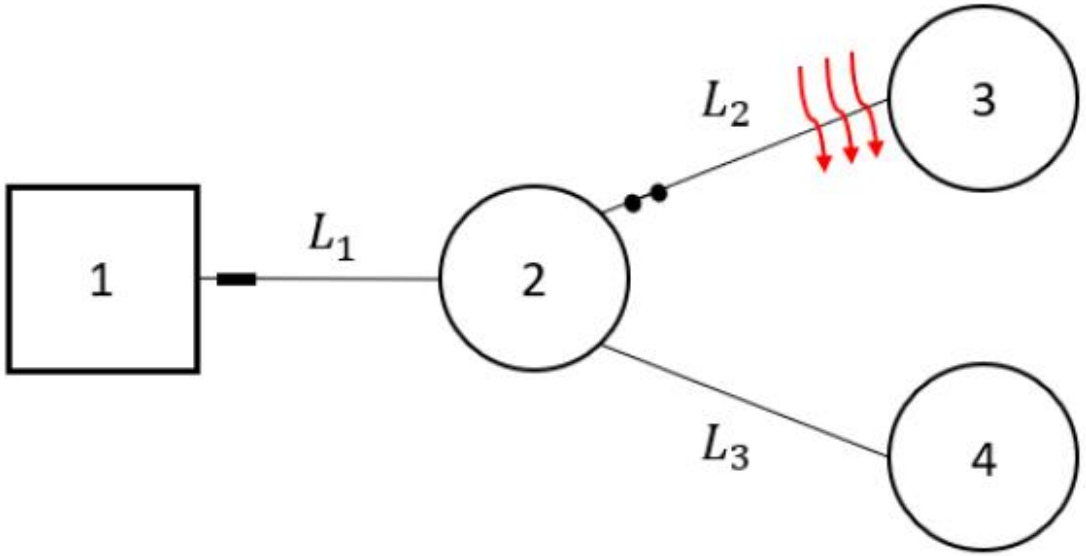


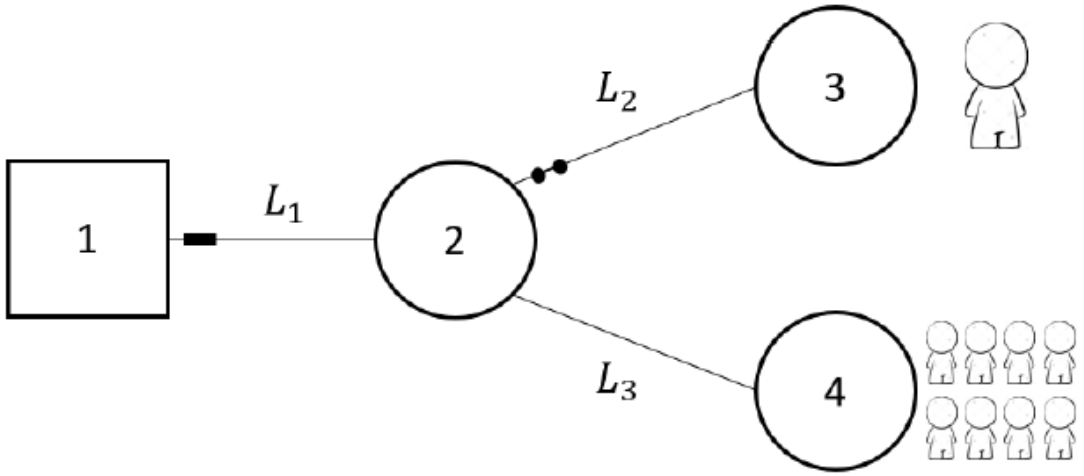
Generic scheme of *Optimal Protections Model* (OPM)



How to increase the reliability?

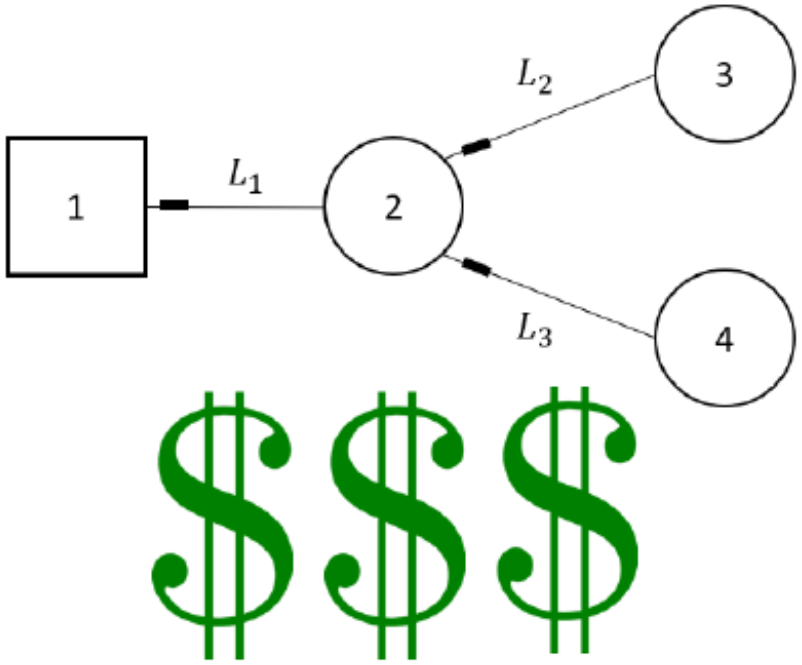
- Can we locate protective devices to isolate faults?
- Which devices and where?

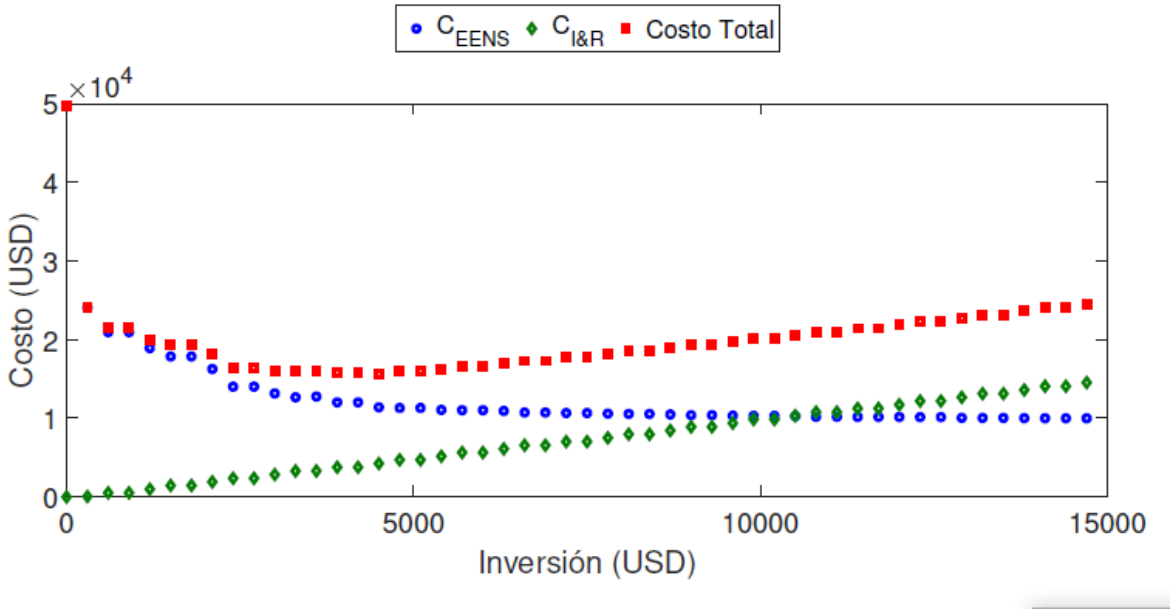




How much are we willing to pay to increase it?

- Protective devices are expensive.
- The rate of reliability improvement when adding additional devices tends to decrease.



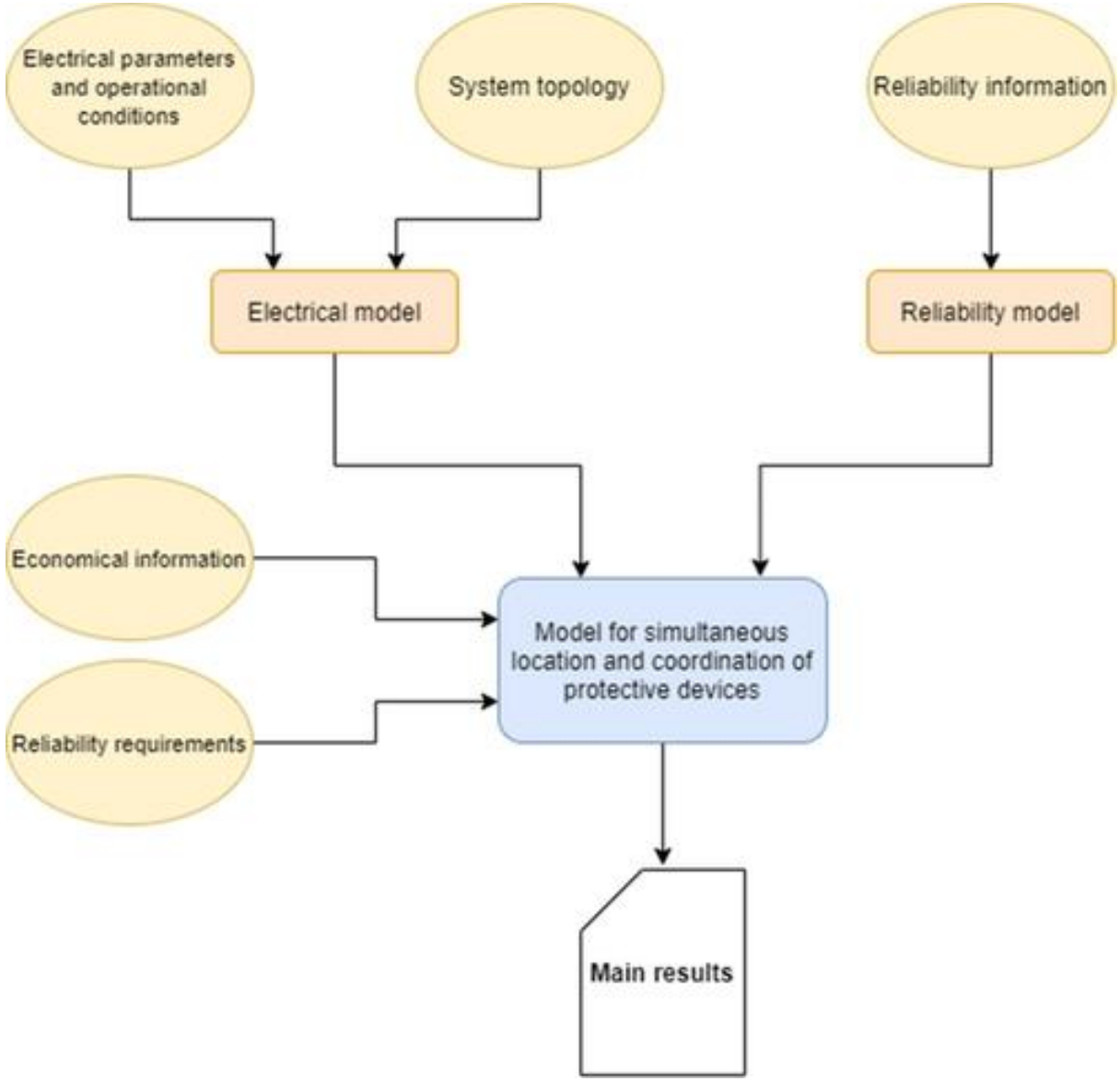


As reliable as required ≠ As reliable as possible

Proposal

A mixed-integer linear program model for the simultaneous selection, localization, and coordination of protective devices (reclosers and fuses), considering the fuses' rescue schemes based on electrical criteria. Local reliability indices and economic penalties for violating minimum standards are integrated into the model, thereby providing new decision-making elements.

10.1049/gtd2.12211



Decarbonization policies

- When is it safe to retire the coal units? Drought!
- Social impact of the operating and social impact of retirement.
- Carbon tax policies and their economic impacts.
- Green policies. How will the early decision impact the system planning?

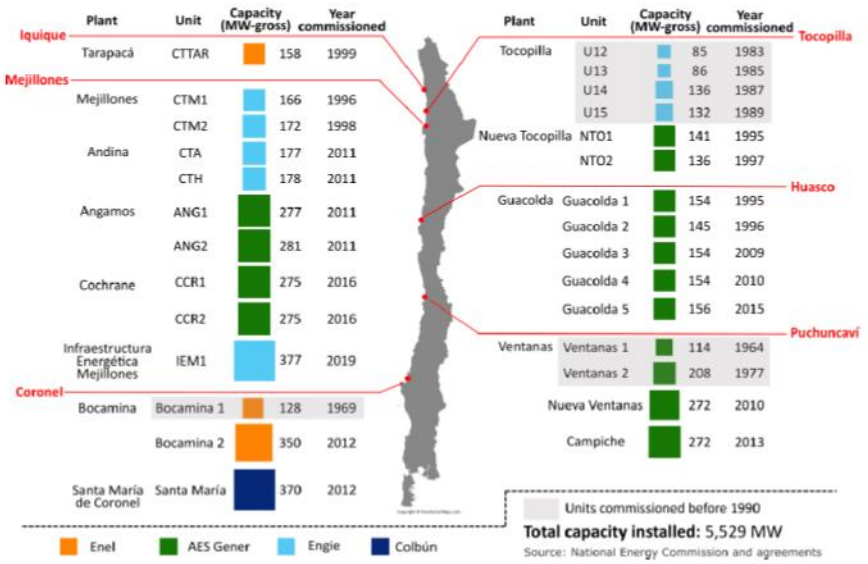
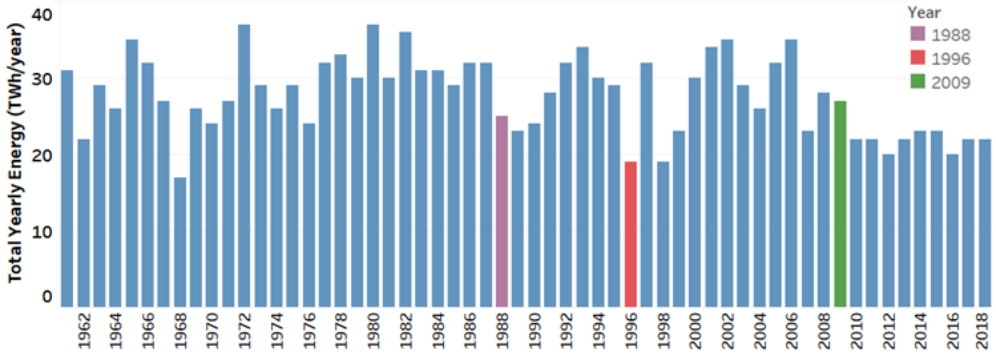
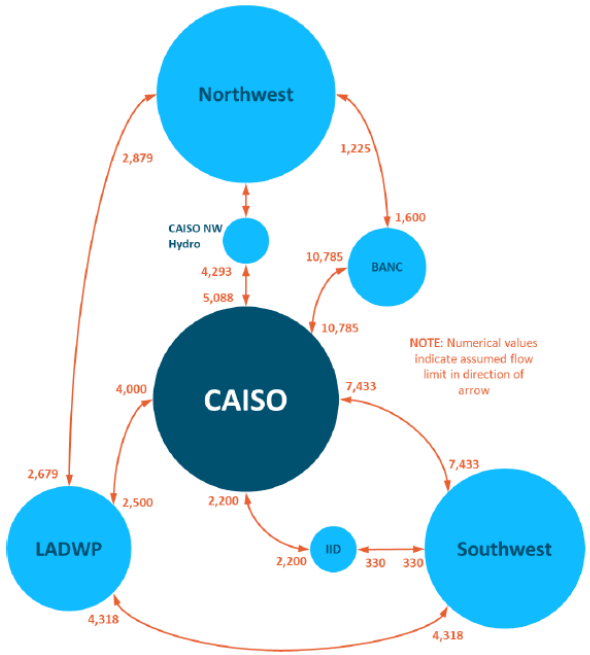


Figure 2: Coal-fired plants installed (Source: inodú)

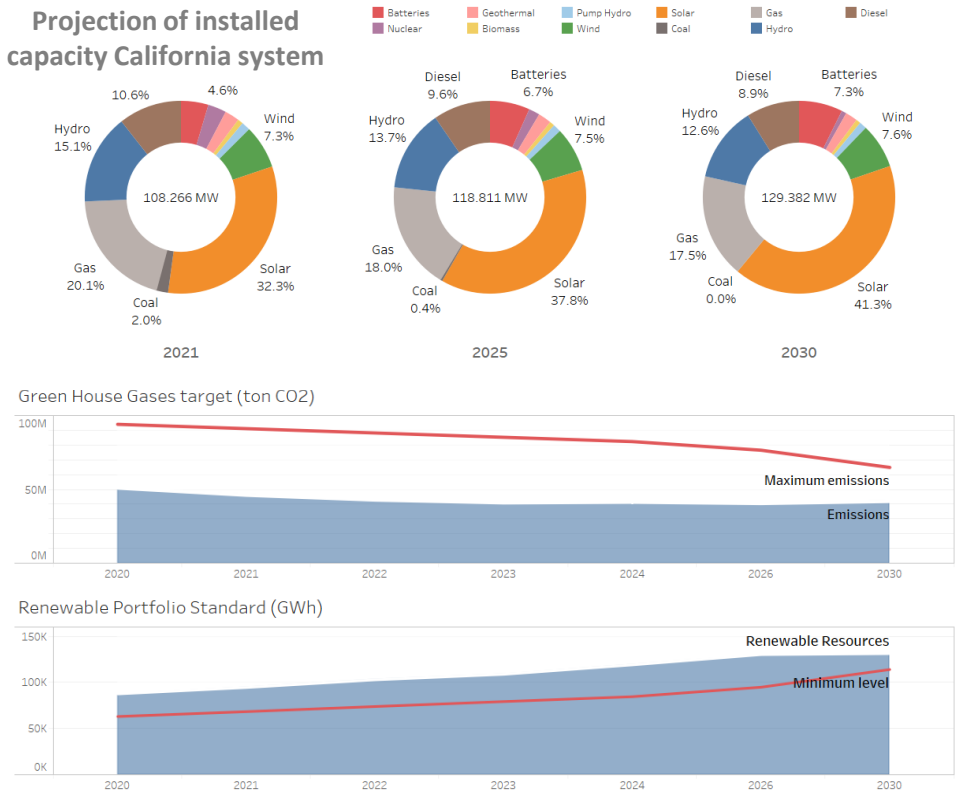


Hydrological conditions in the SEN.

Decarbonization path in California



Transmission topology used in RESOLVE.
Source: IRP 2019-2020

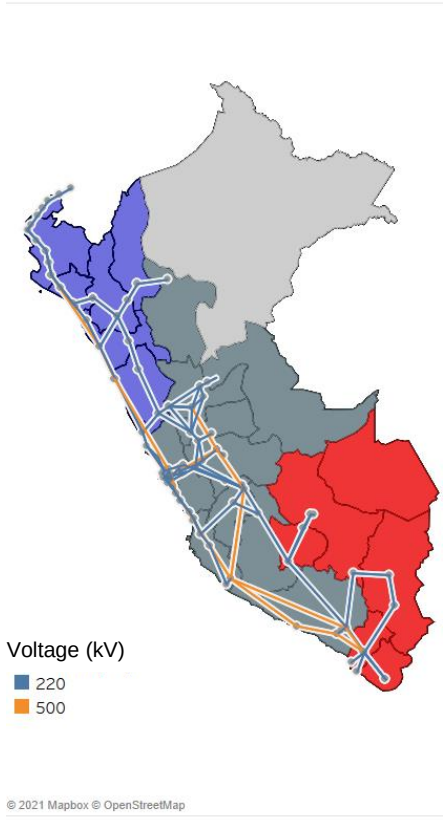


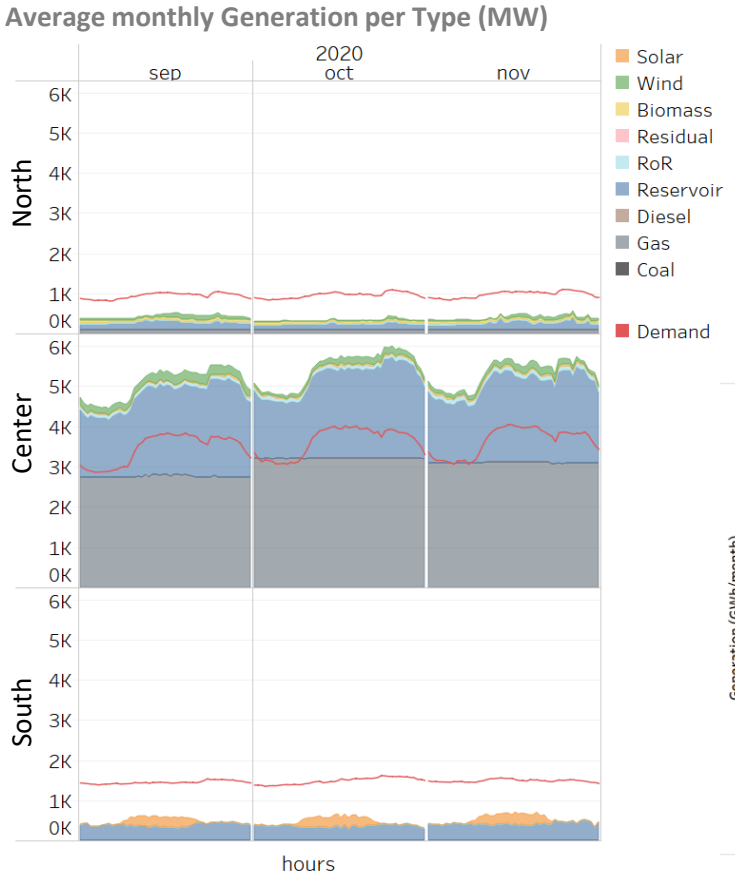
[1] Retail sales estimation for PLEXOS based on IRP 2019-2020.

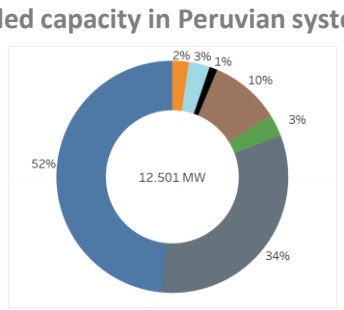
[2] California considers BANC, CAISO, IID, LDWP, and CAISO_NW_Hydro zones defined on IRP 2020. SW and NW are not considered part of California.

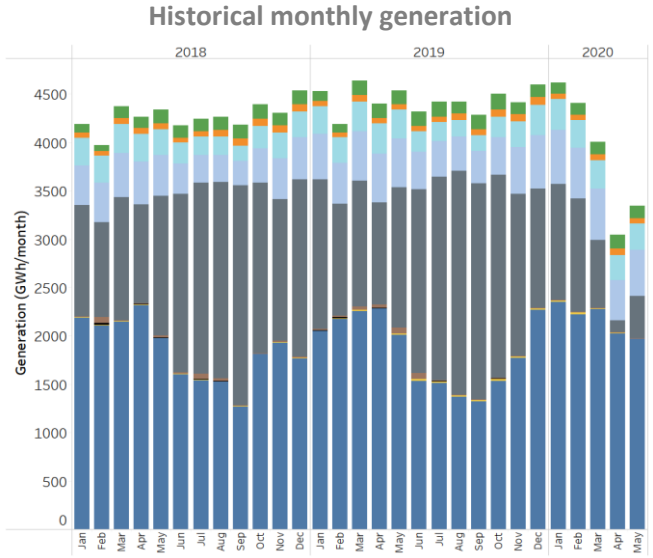
Renewable Portfolio Standard is defined on *SB 100* with the following targets[1] of retail sales per year: 44 % in 2024, 52 % in 2027, and 60 % in 2030. Finally, a 100% renewable energy requirement is defined for 2045.

Renewable integration challenges in Perú

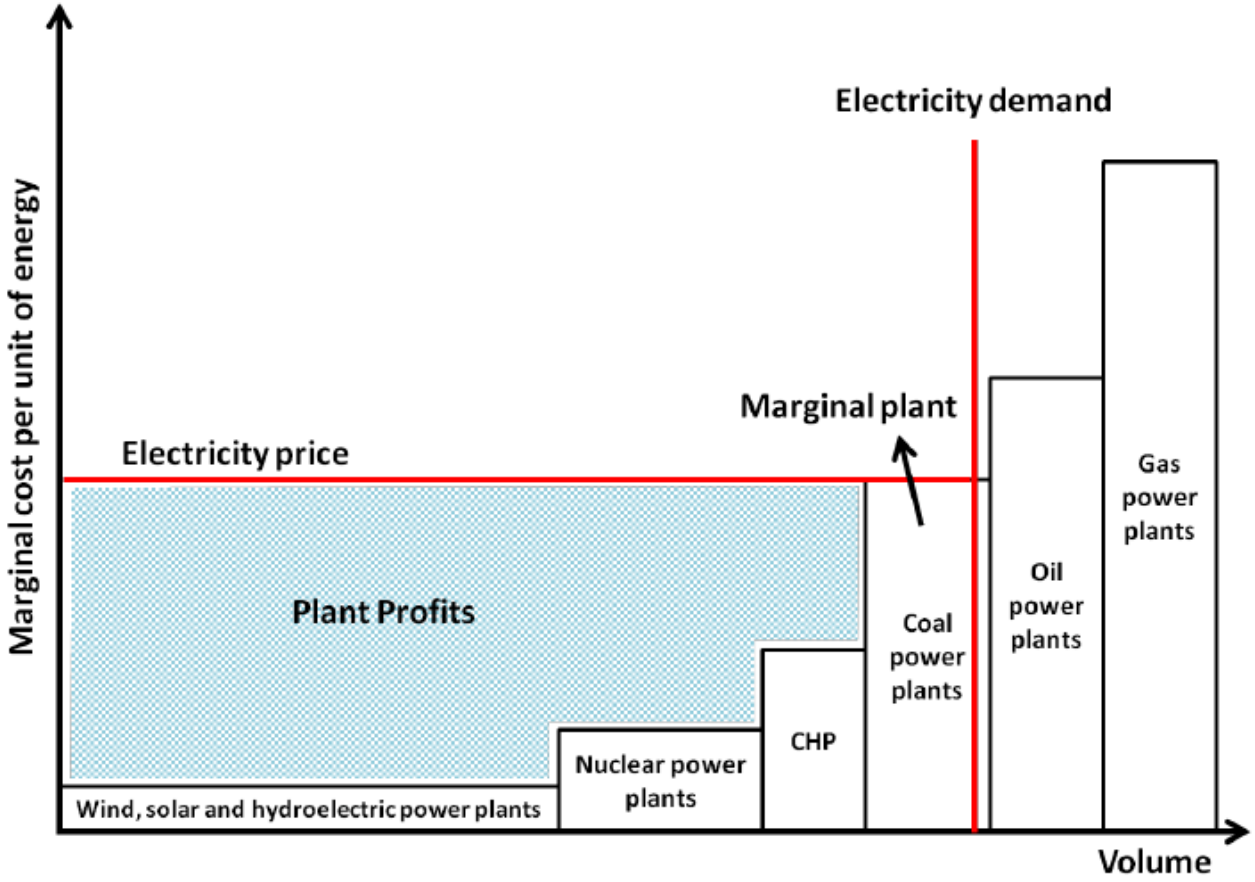








Energy and capacity markets



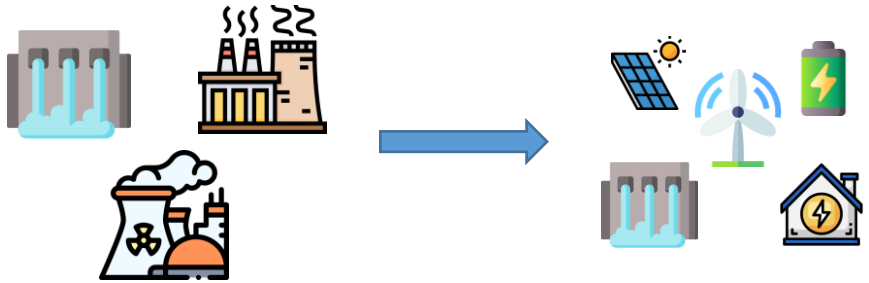
Cross-Border Trade in Electricity and the Development of Renewables-Based Electric Power: Lessons from Europe. DOI: 10.1787/5k4869cdwnzr-en

https://www.texasmonthly.com/news-politics/texas-electric-grid-failure-warm-up/

Different approaches to quantify the contribution to system reliability

Regulators, system operators, and utilities need to understand future reliability challenges in order to define the right market signals to create the conditions to deploy the infrastructure needed.

The structure of power systems is changing

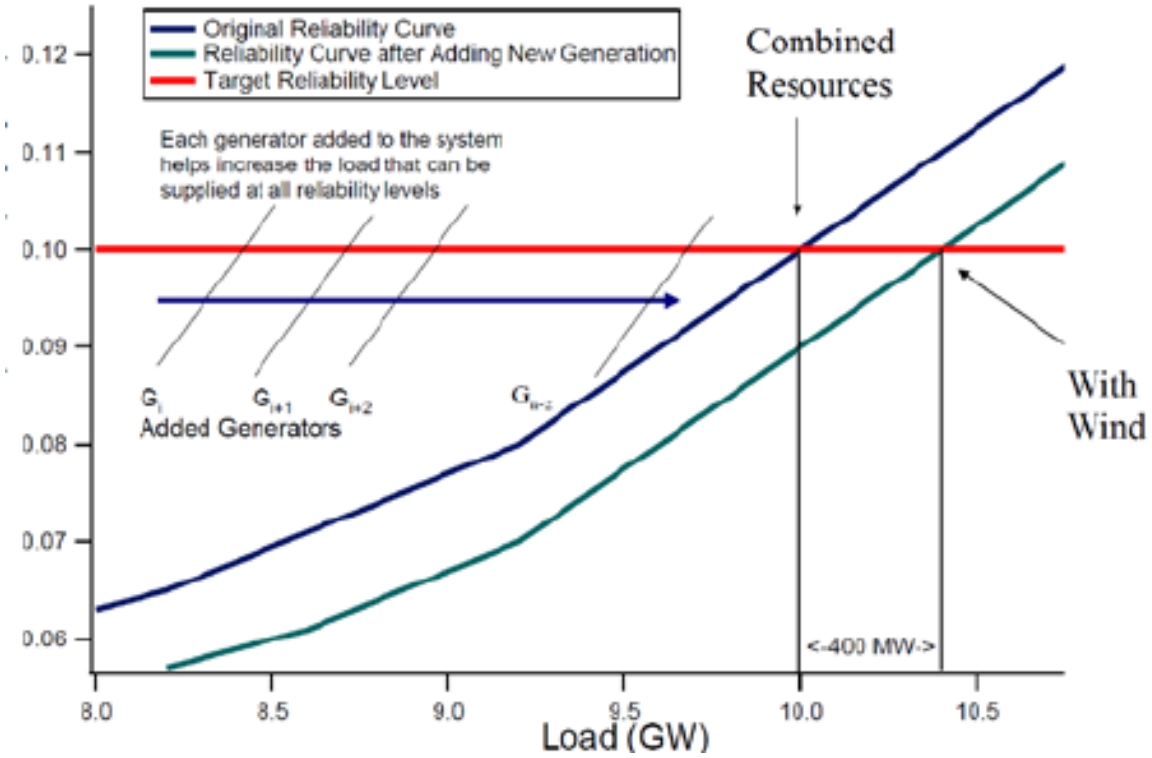


How can capacity contributions to the system reliability be quantified?

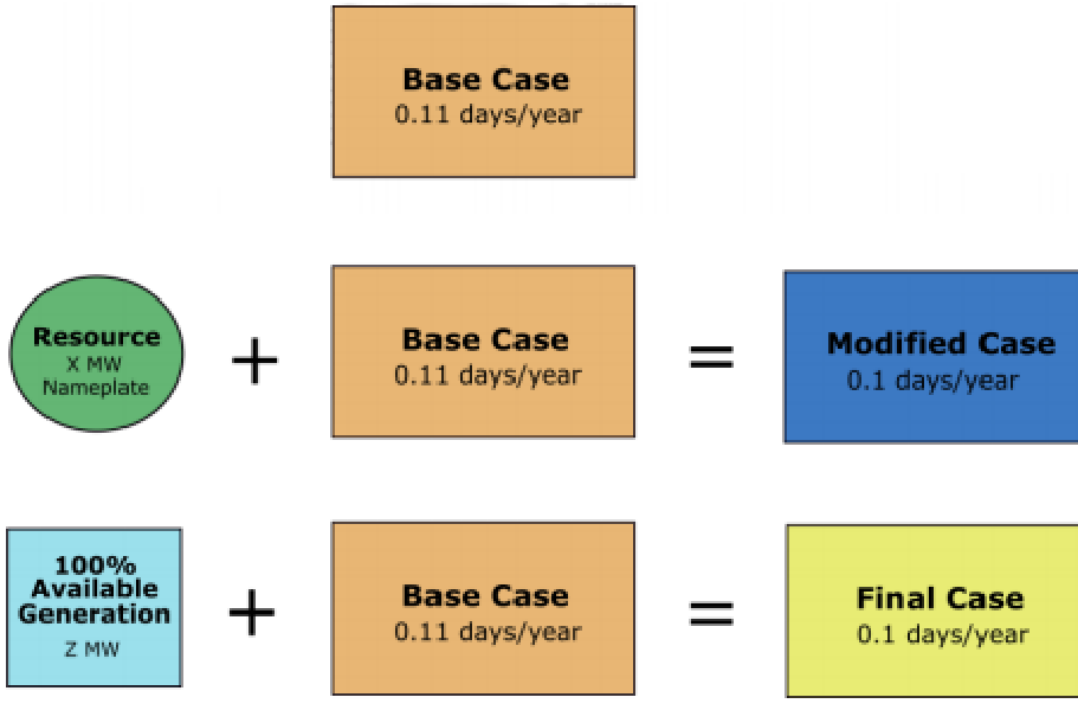
One approach is to use the
Effective Load Carrying Capability (ELCC)

How much capacity do we need?

- What scenarios are we going to consider?
- How do we account for the capacity contribution?
- How do we distribute the payments in a highly related system?



https://www.nyiso.com/documents/20142/24172725/NYISO%20ELCC_210820_August%2030%20Presentation.pdf



https://energia.gob.cl/sites/default/files/documentos/informe_final_-_determinacion_psuf_via_elcc_y_ecp_-_isci.pdf

Next?

- Portfolio decision analysis applied to the energy sector.
- Mitigation of financial risks in PPAs.
- Efficient energy policy design.
- Sauna, kahvit ja pullat!

I am happy to collaborate!

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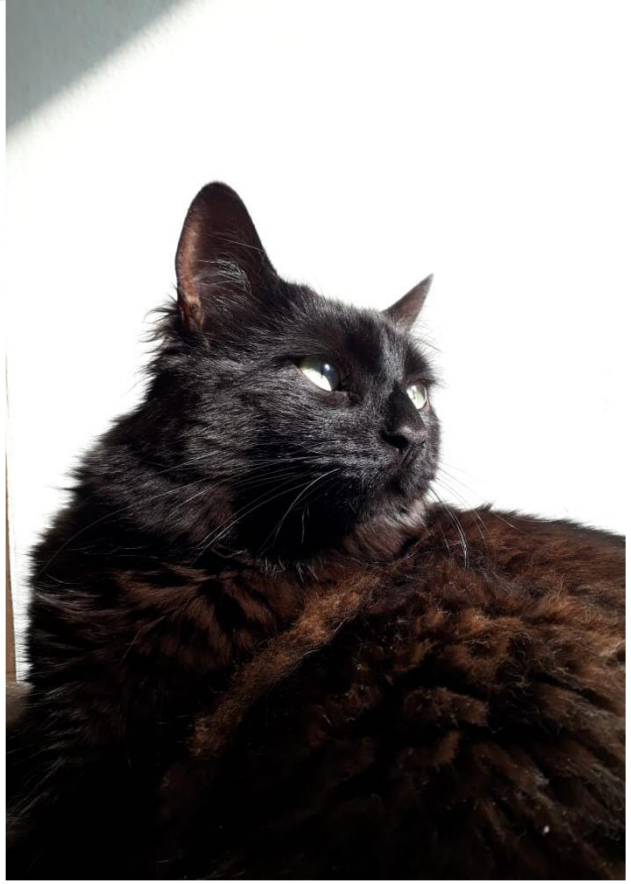
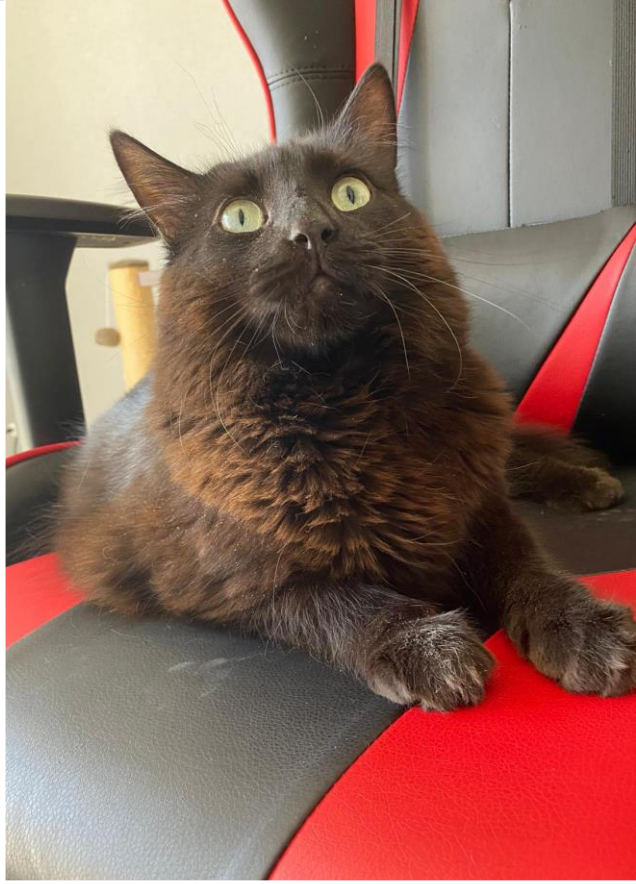
- Room Y223





Thanks for your attention!