Chair of Renewable and Sustainable Energy Systems
TUM School of Engineering and Design
Technical University of Munich

Long-term investment in low-carbon energy systems resilient to climate change

Case study for Colombia and Peru

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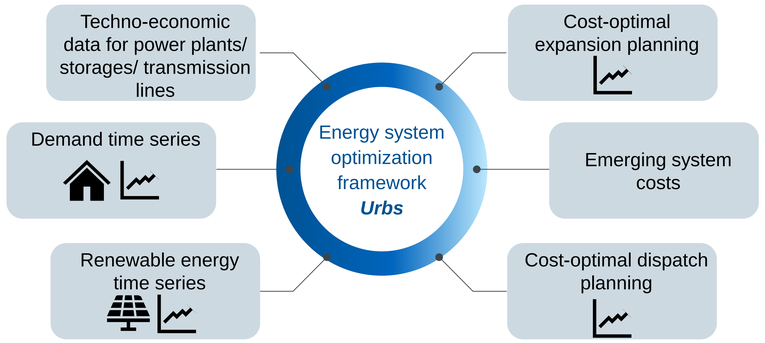
Background

- Peru and Colombia aim to continue developing towards a lower-carbon energy mix
- Both countries have great potential in renewable energy generation, evident specially in photovoltaics and hydropower
- Increasing effects on rainfall variability adversely affect hydroelectric power generation, responsible of >50% of total current electricity generation

Questions for a sustainable future:

- What is the **cost-optimal investment** in renewable energy technologies to achieve a low-carbon energy system **(-95% CO2 emissions)** from 2019 to 2050?
- How does the **climate variability affect** the transition to renewable energies due its effect on hydroelectric power?

Long-term investment planning with *urbs*



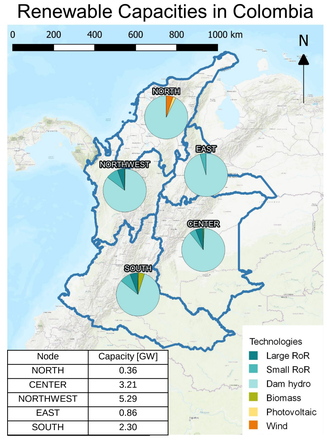
Model overview

Modeling method	Linear programming
Time scope	30 years (2019-2050)
Time steps	hourly
Spatial scope	Multi-regional
Optimization goal	Minimal costs

Model Nodes Colombia

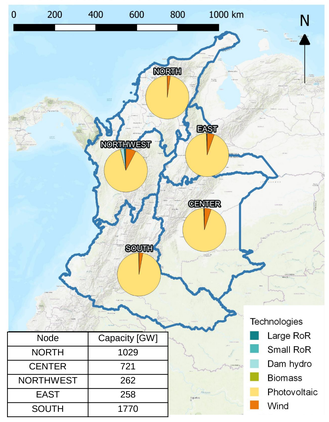
Model Nodes Peru

Renewable Capacities in Colombia



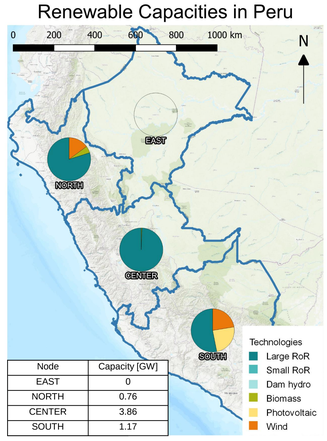
Node	Capacity [GW]
NORTH	0.36
CENTER	3.21
NORTHWEST	5.29
EAST	0.86
SOUTH	2.30

Renewable Potentials in Colombia



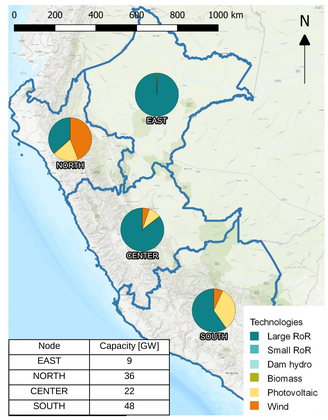
Node	Capacity [GW]
NORTH	1029
CENTER	721
NORTHWEST	262
EAST	258
SOUTH	1770

Renewable Capacities in Peru



Node	Capacity [GW]
EAST	0
NORTH	0.76
CENTER	3.86
SOUTH	1.17

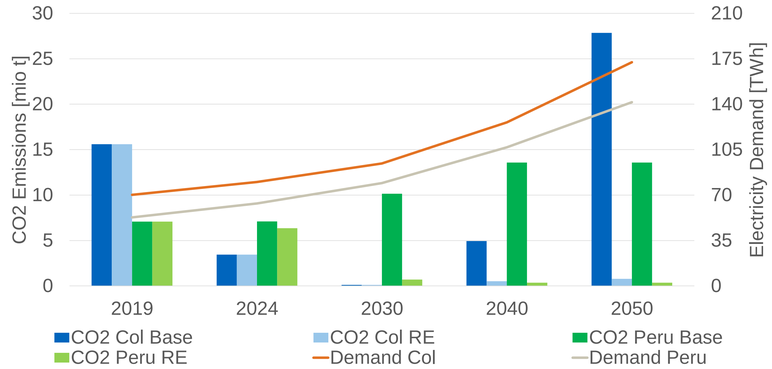
Renewable Potentials in Peru



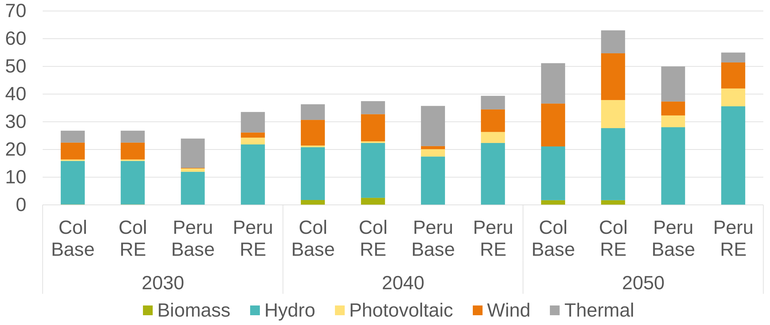
Node	Capacity [GW]
EAST	9
NORTH	36
CENTER	22
SOUTH	48

Scenario	Description
Base	Cost-optimal investment planning for timeframe 2019 - 2050
RE	CO2 emissions are reduced by 90% for 2030, 95% for 2040 and 2050
Niña	Variability in hydroelectric power generation due to climate pattern ‘La Niña‘
Niña	Variability in hydroelectric power generation due to climate pattern ‘El Niño‘

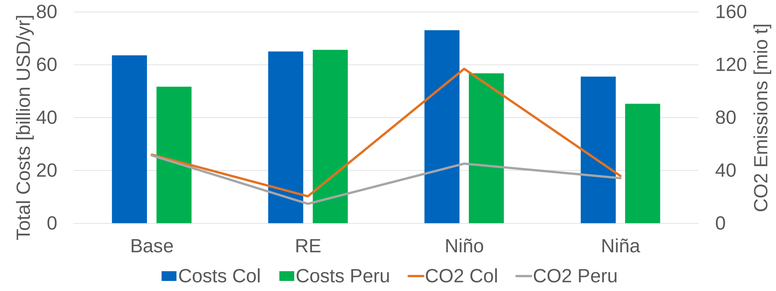
Results: CO2 Emissions [mio t] and Electricity Demand [TWh]



Results: Installed Capacity [GW]



Results: Total Costs [billion USD/yr] and CO2 Emissions [mio t]



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