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

Techno-economic data for power plants/ storages/ transmission lines

Demand time series

Renewable energy time series

Energy system optimization framework, Urbs

Cost-optimal expansion planning

Emerging system costs

Cost-optimal dispatch planning

Model overview

Modeling method: Linear programming

Time scope: 30 years (2019-2050)

Time steps: Hourly

Spatial scope: Multi-regional

Optimization goal: Minimal costs

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

Results: Installed Capacity [GW]

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

Scenario Description

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