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# Modeling Decarbonization Pathways in the Power Sector in Developing Countries: The case of Colombia



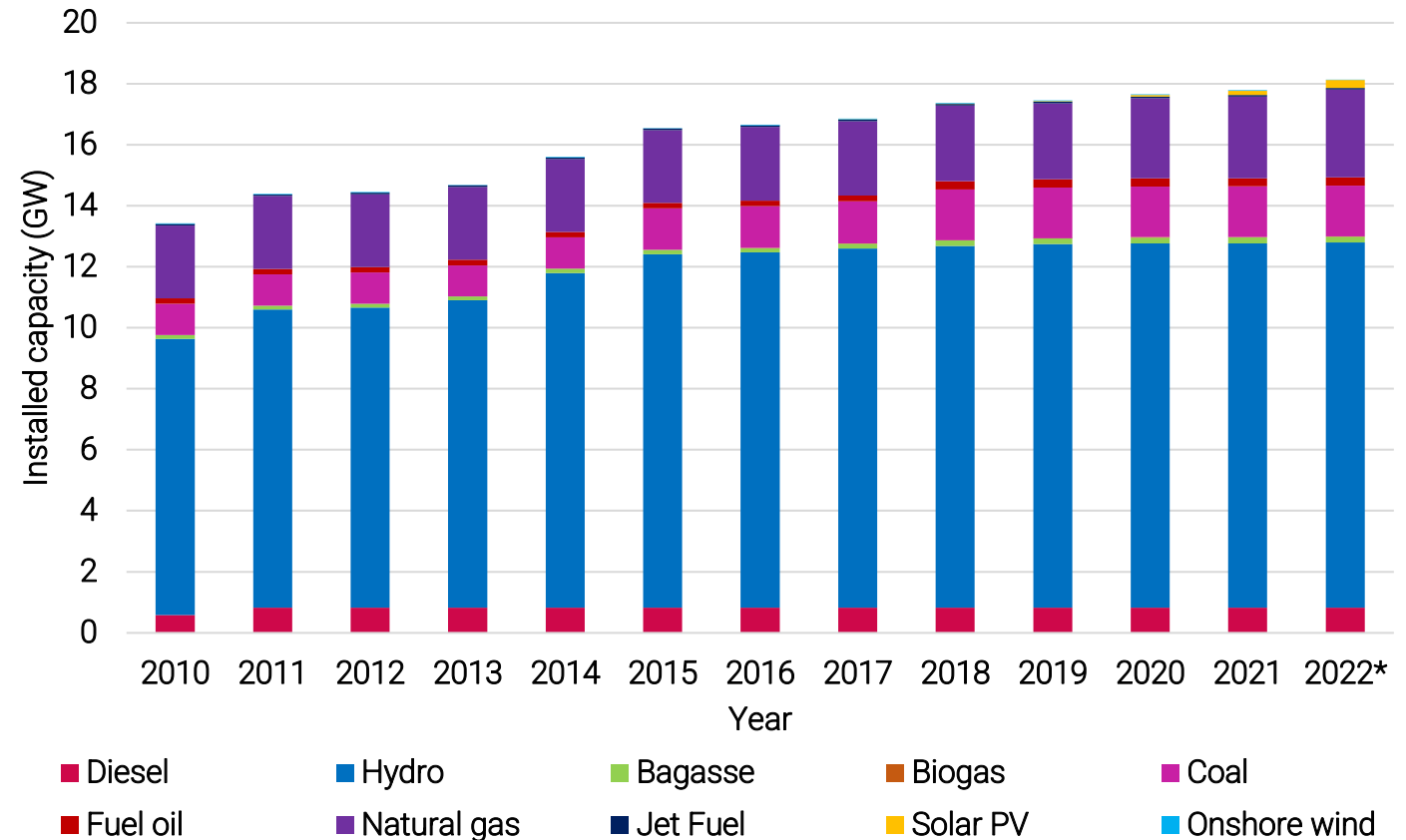
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Energy Modelling Platform Latin America and The Caribbean (EMP-LAC)

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# Context

- National Determined Contribution (Gobierno de Colombia, 2020): 51% GHG reduction by 2030 and carbon neutrality by 2050
- Electricity consumption should grow five times at the same time that the power system is decarbonized fully by 2050 (Plazas, 2022)
- Colombia is highly vulnerable to the effects of global warming and climate change (Gobierno de Colombia, 2021a; Portafolio, 2021; UNODC, 2008)



Source: XM, 2022

## Research questions:

- **How will the Colombian power mix evolve under a full decarbonization target by 2050?**
- **What is the effect of a progressive drought regime in the performance of a decarbonized power system in Colombia?**

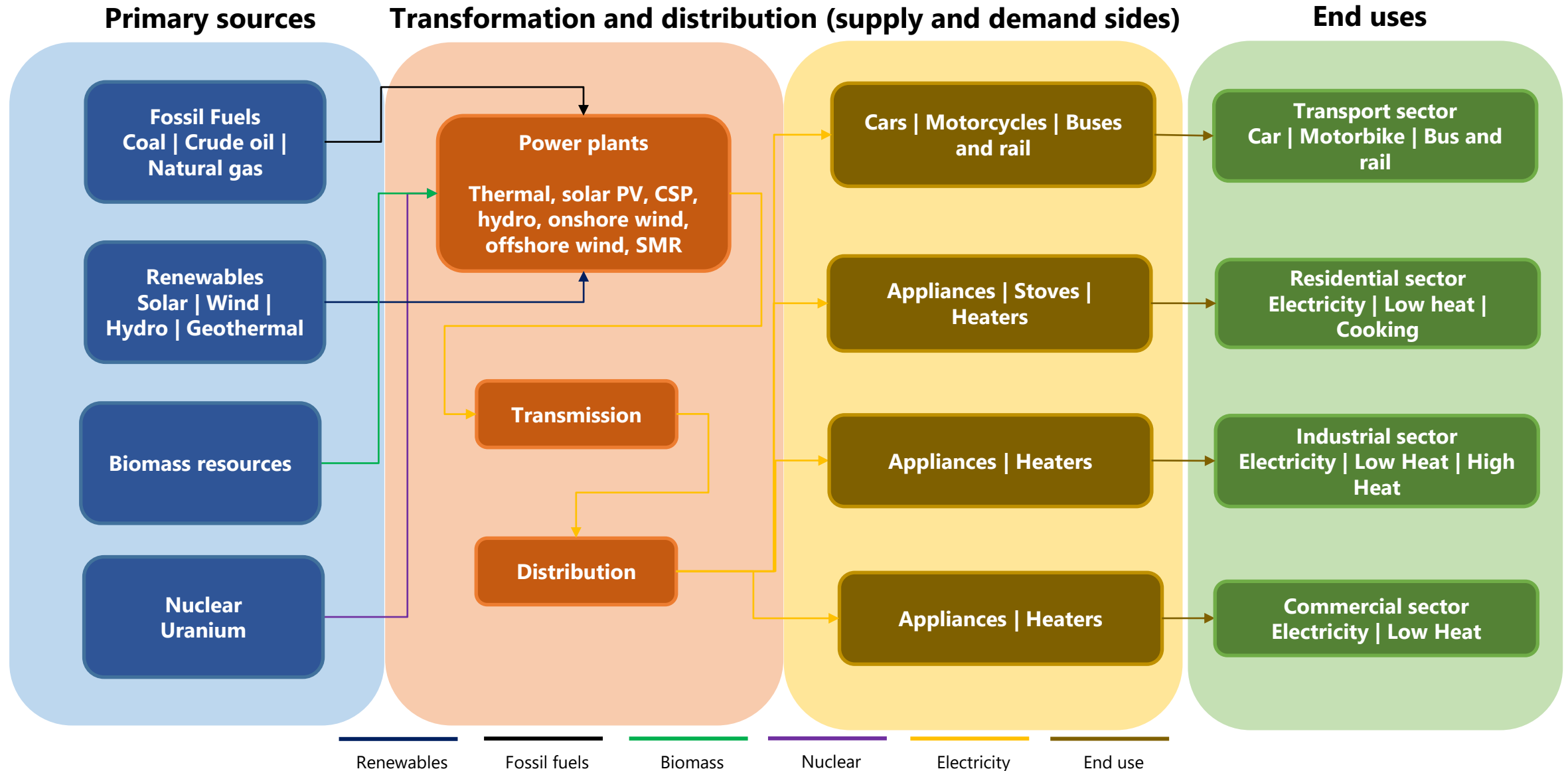
# Methodology

**Reference energy  
system and data  
gathering**

**Modeling and  
scenario analysis  
(OSeMOSYS)**

**Result analysis  
and policy  
insights**

# Energy Reference System



# Scenarios

## Baseline (BAU)

**No carbon target**

**Historical trends remain with limited penetration of non-conventional renewable technologies**

## GHG Cap (NDC)

**Full decarbonization by 2050**

**Renewable technologies are fully available (PV, wind, CSP, geothermal)**

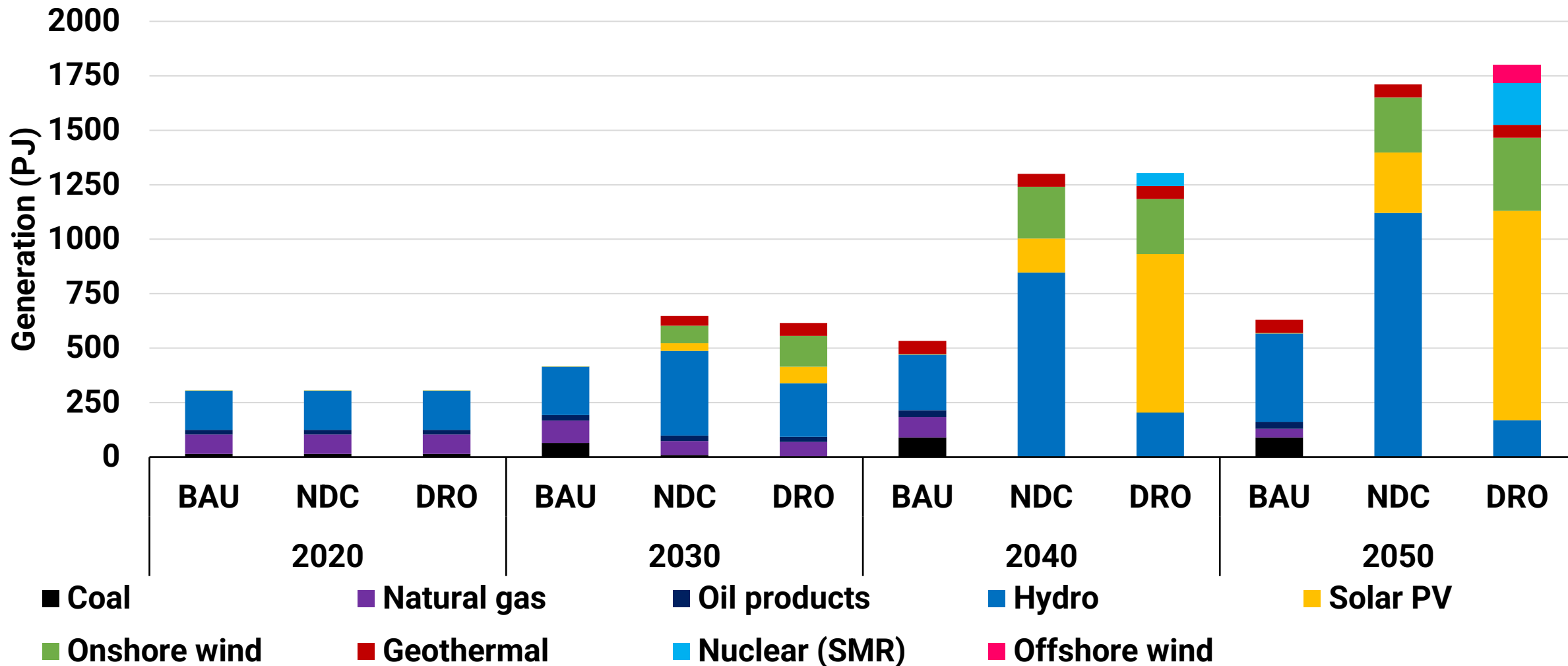
## Drought (DRO)

**Full decarbonization by 2050**

**Reduction in 50% of capacity factor for hydro-based technologies (Mekonnen et al., 2022)**

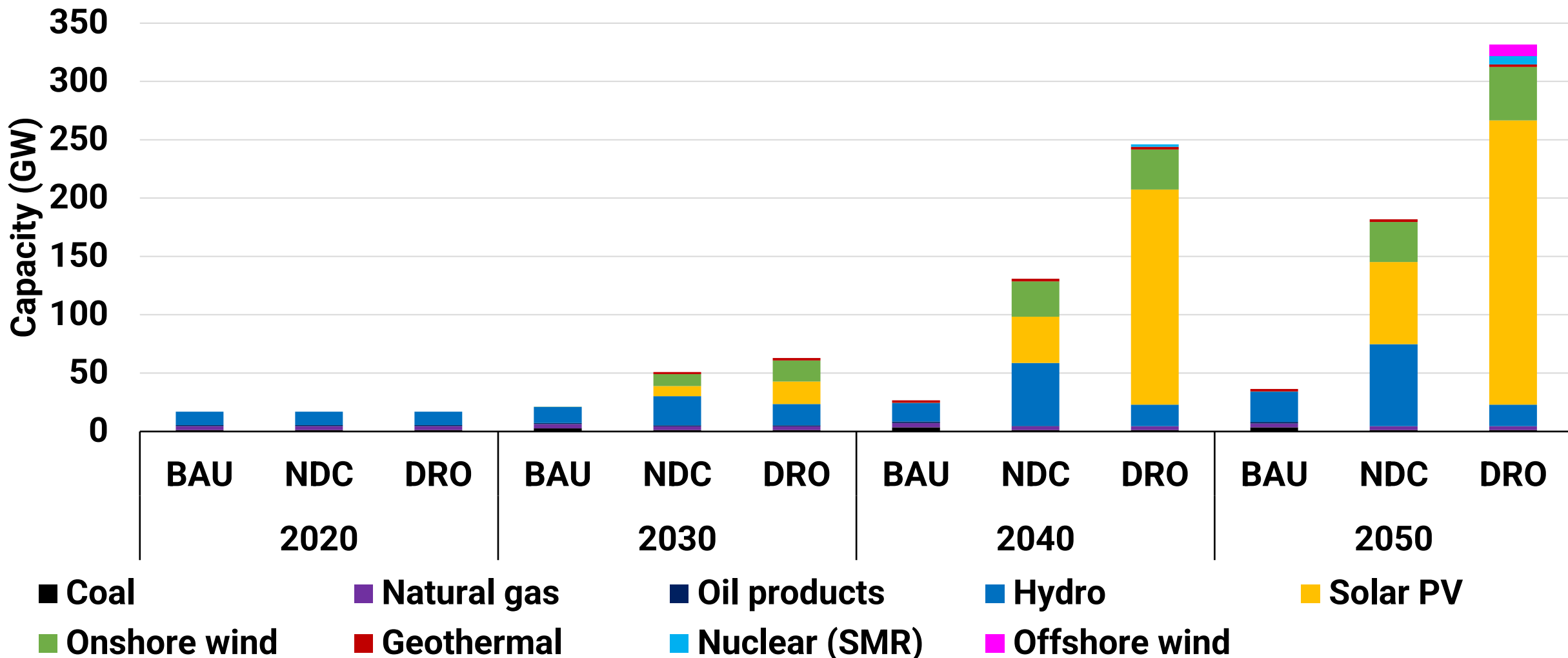
# Results (1/4)

## Electricity Annual Generation



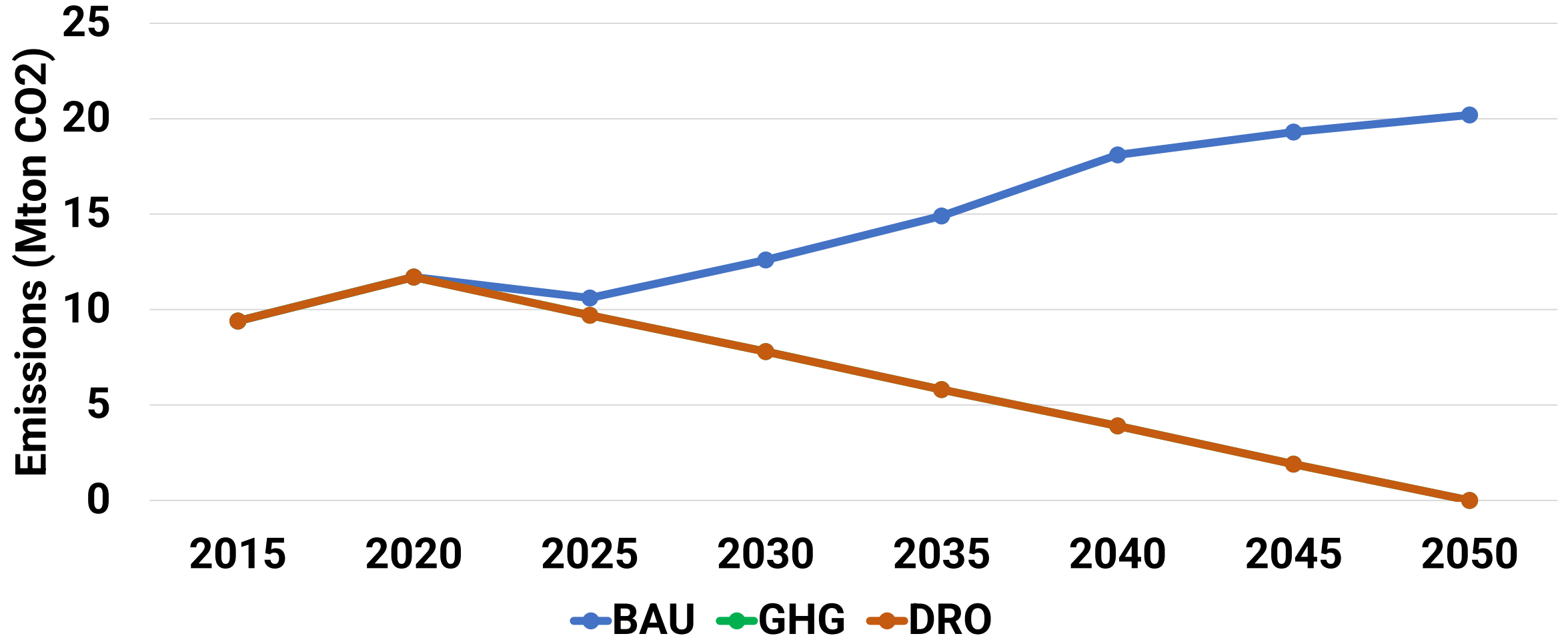
# Results (2/4)

## Total Installed Capacity



# Results (3/4)

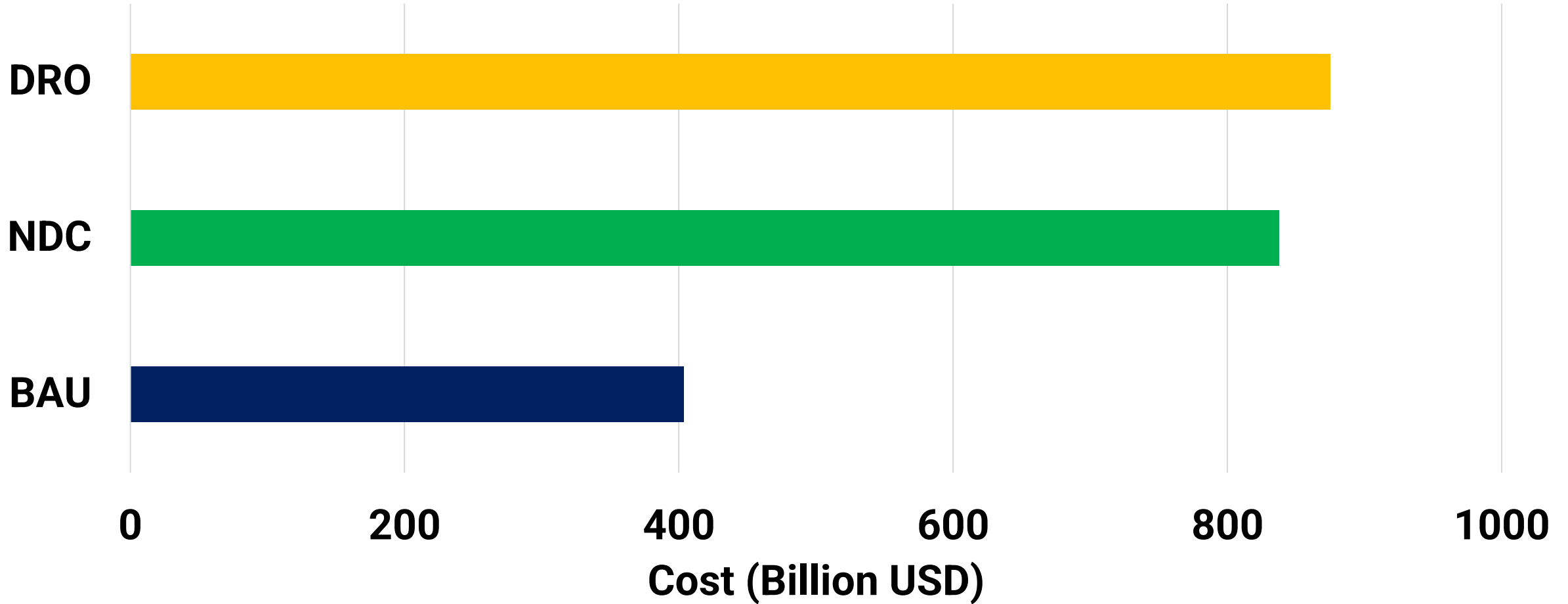
## Annual emissions





# Results (4/4)

## Total discounted cost



# Conclusion and Policy Insights



**The current energy mix will not enable the accomplishment of the NDC and GHG emissions could double by 2050**

**Carbon neutrality requires the electrification of end-uses demanding between three and six more electricity, essentially hydro, solar PV and onshore wind**

**Under drought conditions, solar PV is required to replace hydro and a more diversified portfolio could work with the deployment of nuclear (SMR) and offshore wind**

# Future Work

**Flexibility assessment**

**Data review and update**

**Storage modeling implementation**

**Robustness analysis**

# Acknowledgments

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*Thank You!*

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