Modelling Low-carbon and Affordable Energy Pathways for Egypt

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Outline

- Context, challenges & Research Question
- Egypt's Reference Energy System
- Scenarios
- Results
- Conclusions, Policy insights, & Future Work

Figure 1. Map of Egypt. Sourced: https://www.worldatlas.com/maps/egypt

Context, Challenges, and Main Findings

- Population 102.3 million, GDP: 365.1 bn USD (2020) (World Bank, 2020).
- Hosting COP 27 in Sharm el-Sheikh (November 2022), but is yet to set quantifiable emissions reduction targets or update its NDC.
- ISES 2035 report states a target of 20% of Egypt's electricity to be sourced from renewables by 2022, and 42% by 2035.
- Egypt has previously struggled with energy affordability, leading to sector reforms in 2014

Research questions :

- 1) What technologies will enable Egypt's electricity sector to reach net zero by 2050?
- 2) What is the most affordable pathway for Egypt's electricity sector?

Investigated using OSeMOSYS (Howells et al., 2011).

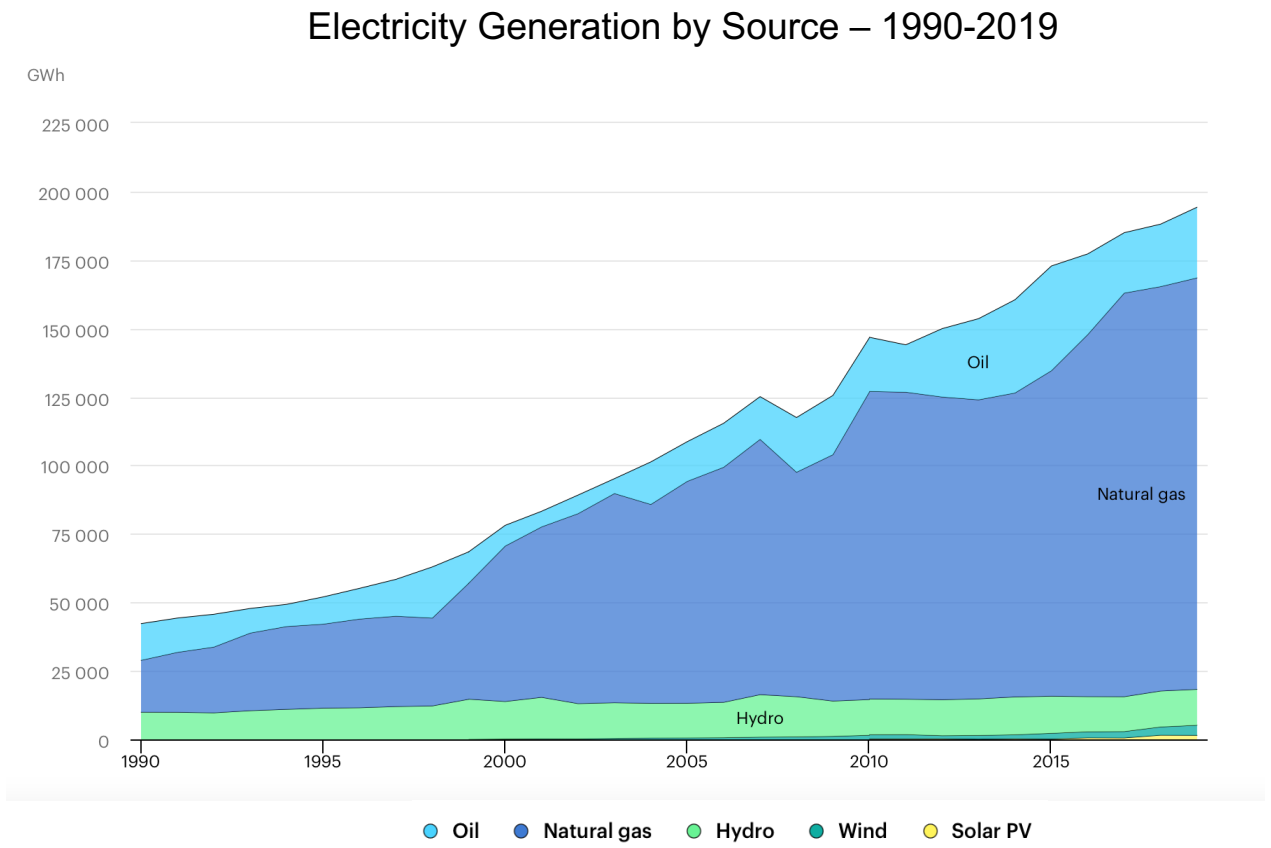


Figure 2. Electricity Generation by Source. Sourced: IEA (2022) https://www.iea.org/countries/egypt

Egypt's Reference Energy System

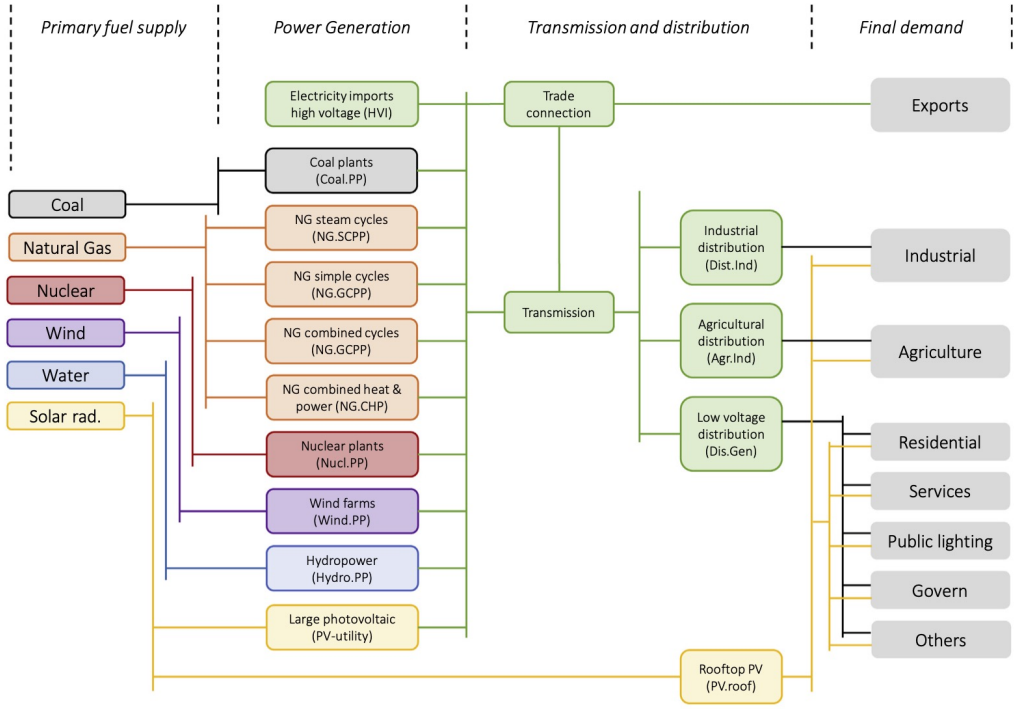


Figure 3. A simplified RES for Egypt. Sourced: Rady et al., 2018

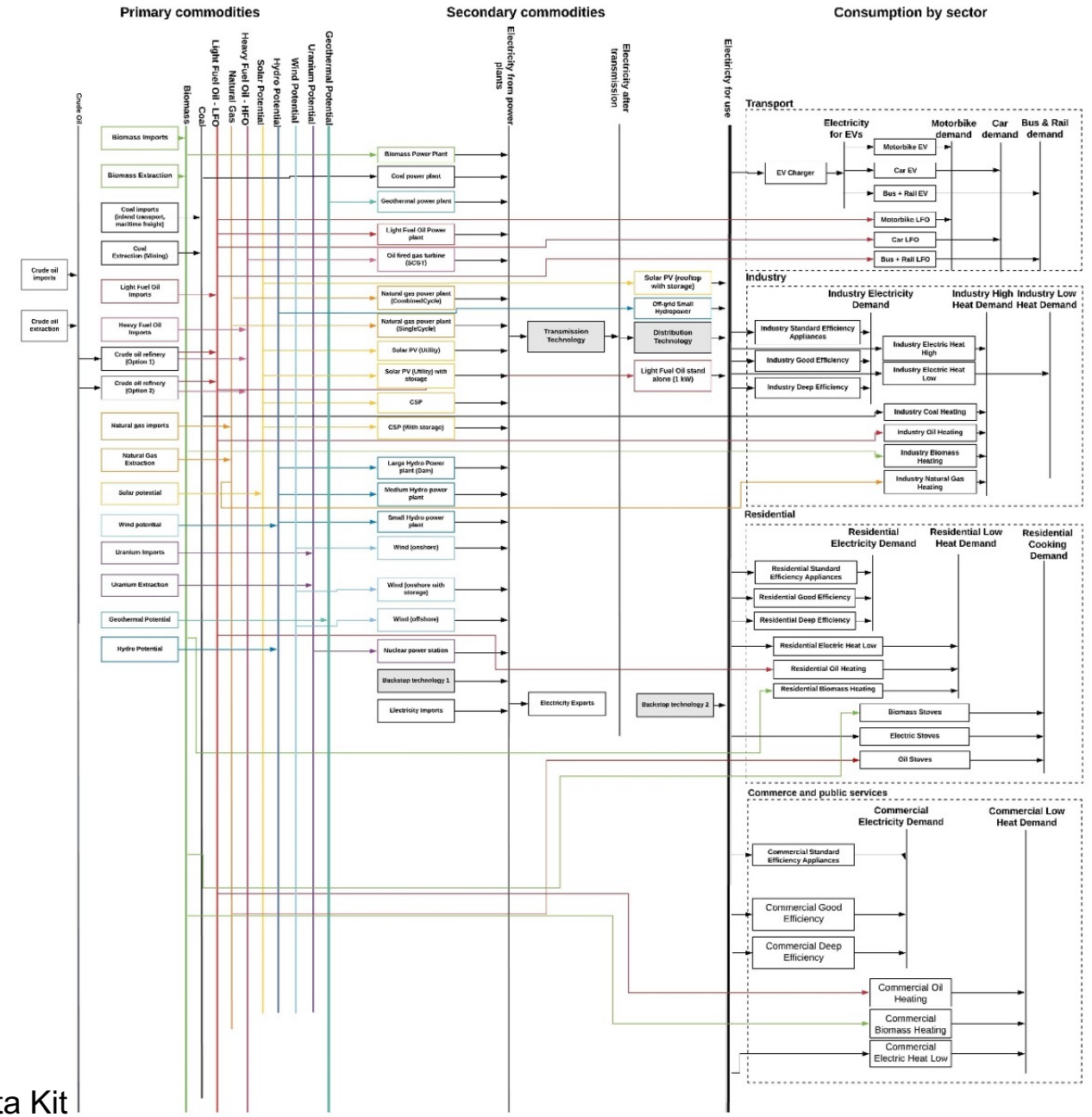


Figure 4. Detailed RES from the appendix of the Starter Data Kit

Scenarios

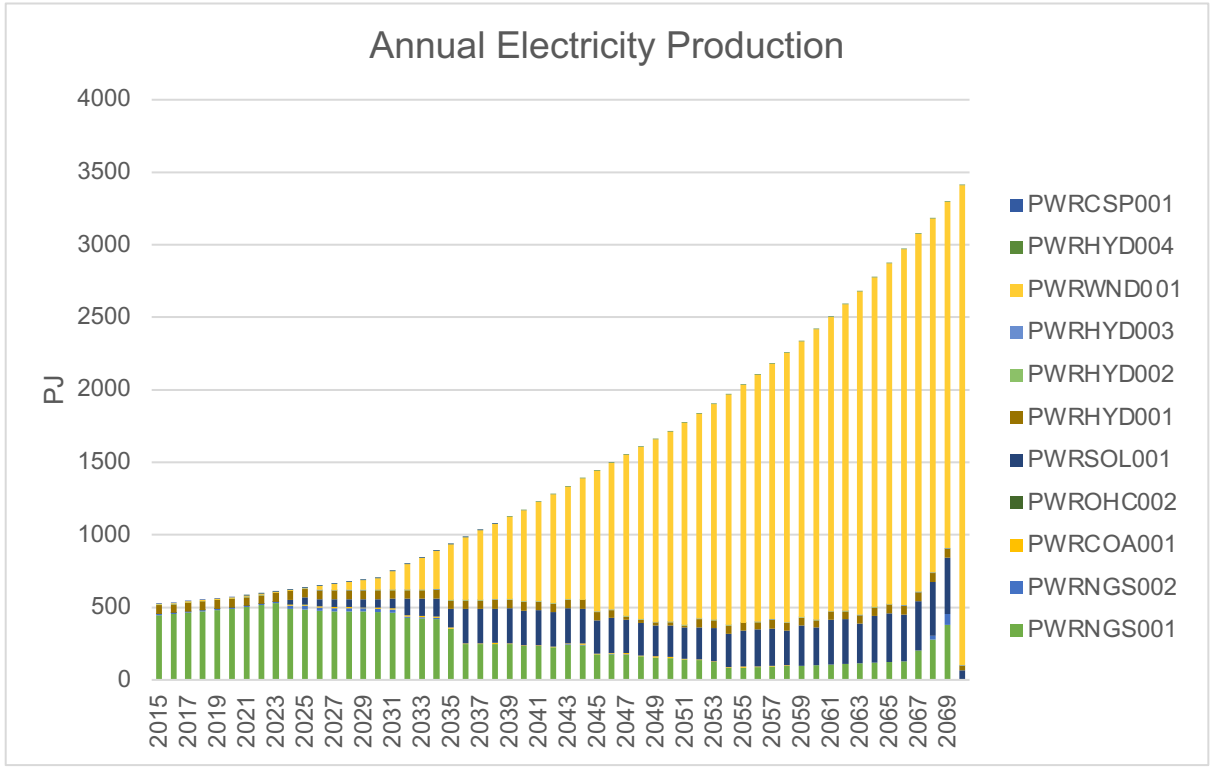
Using OSeMOSYS the following scenarios hope to be investigated:

Scenario Label	Scenario Description	Key Assumptions
Least Cost (BAU)	The OSeMOSYS default scenario to determine the technologies needed for the most inexpensive pathway. Timeslices reduced to 8 and transport demand removed.	This scenario may be dominated by fossil fuel technologies, alongside solar PV, which most likely will not reach net zero by 2050.
Net Zero	This scenario will determine the combination and proportions of technologies needed to reach net zero by 2050. Timeslices reduced to 8, transport removed and annual emissions limit reduced to 0 between 2050 and 2070.	This scenario will not contain any fossil fuel technologies, therefore, renewable capacity will need to be increased. Net zero by 2050 may not be achievable – later date such as 2060 may be concluded

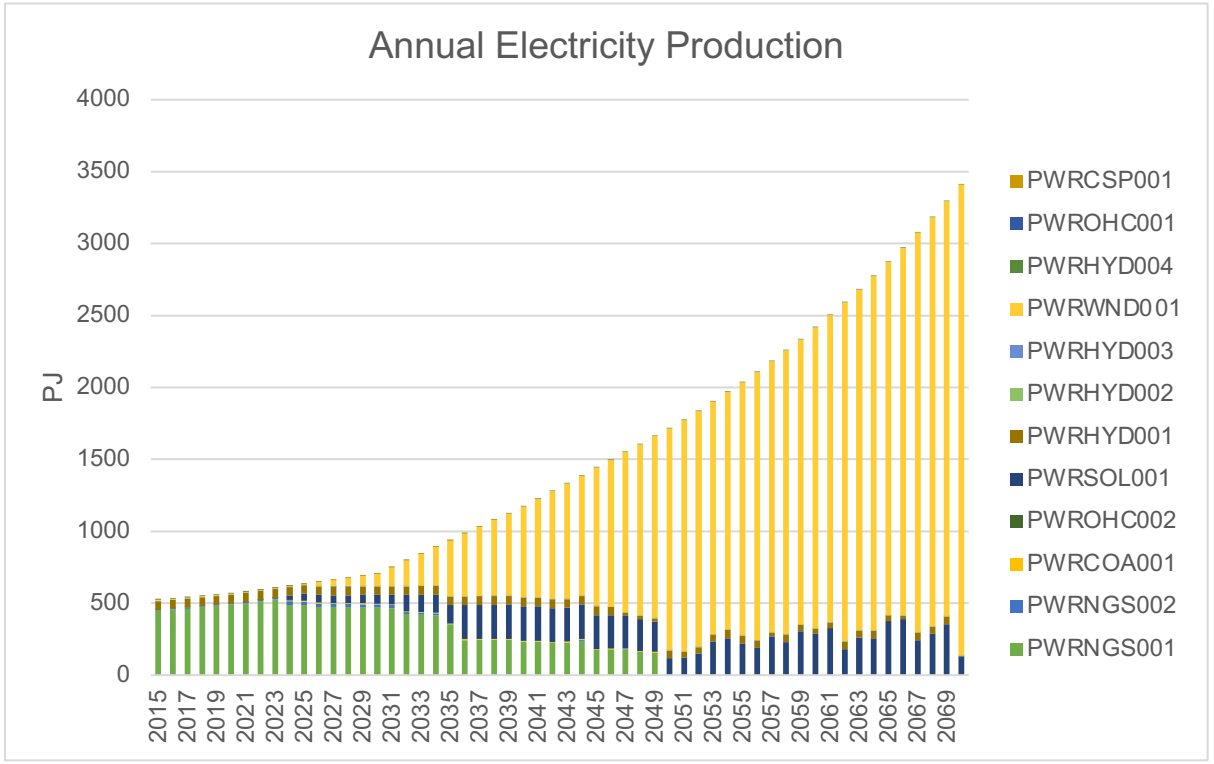
Results

Annual Electricity Production

Base Scenario – BAU (without including transport technologies)

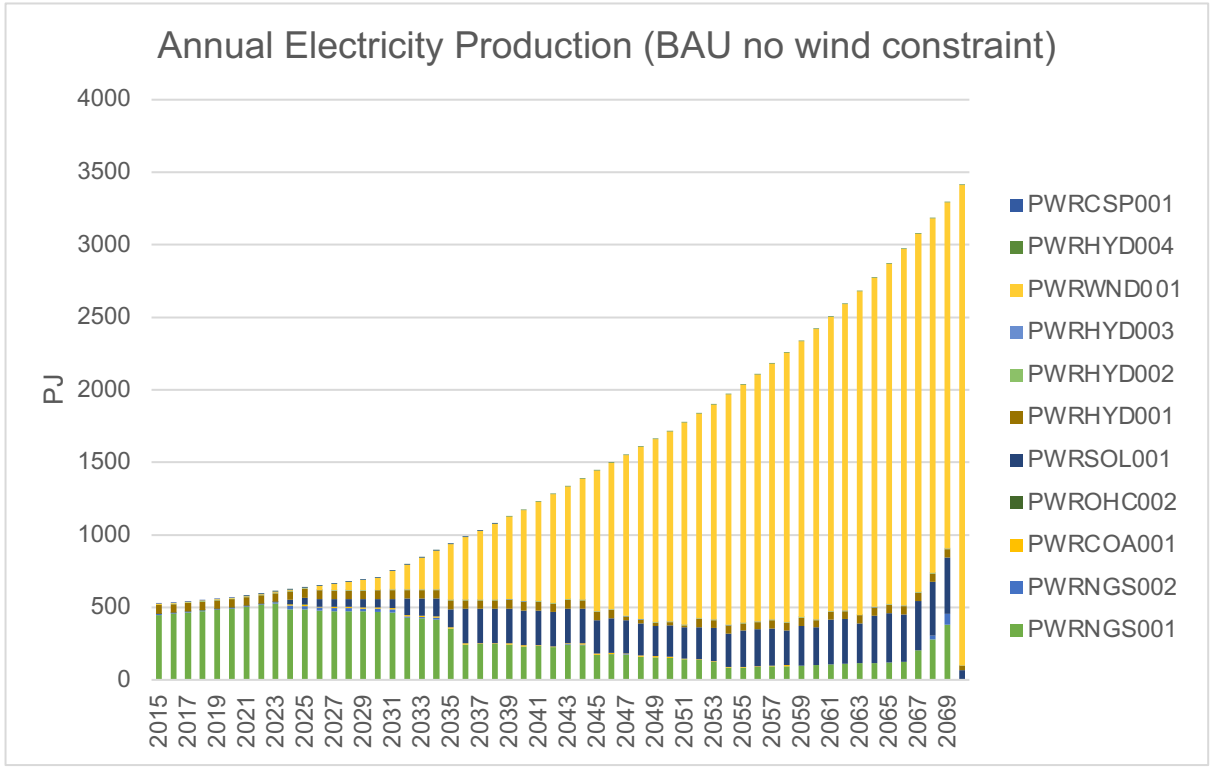


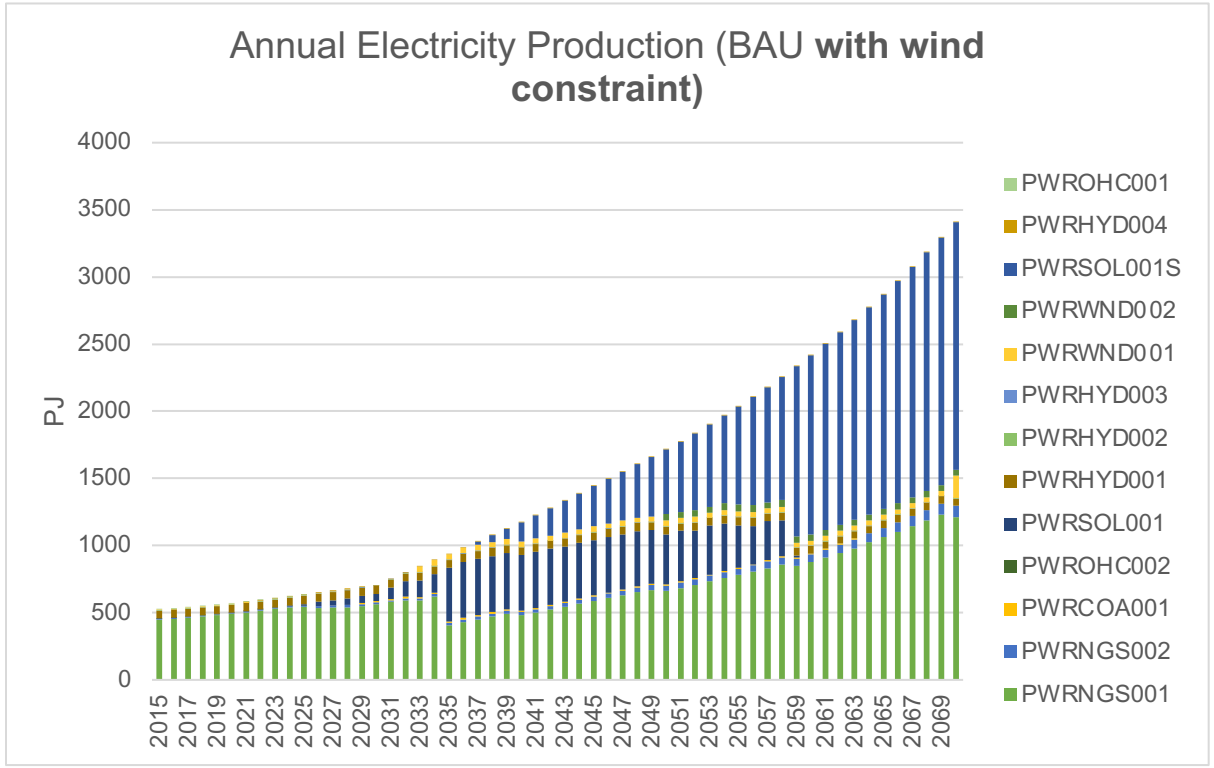
Net Zero (without including transport technologies)



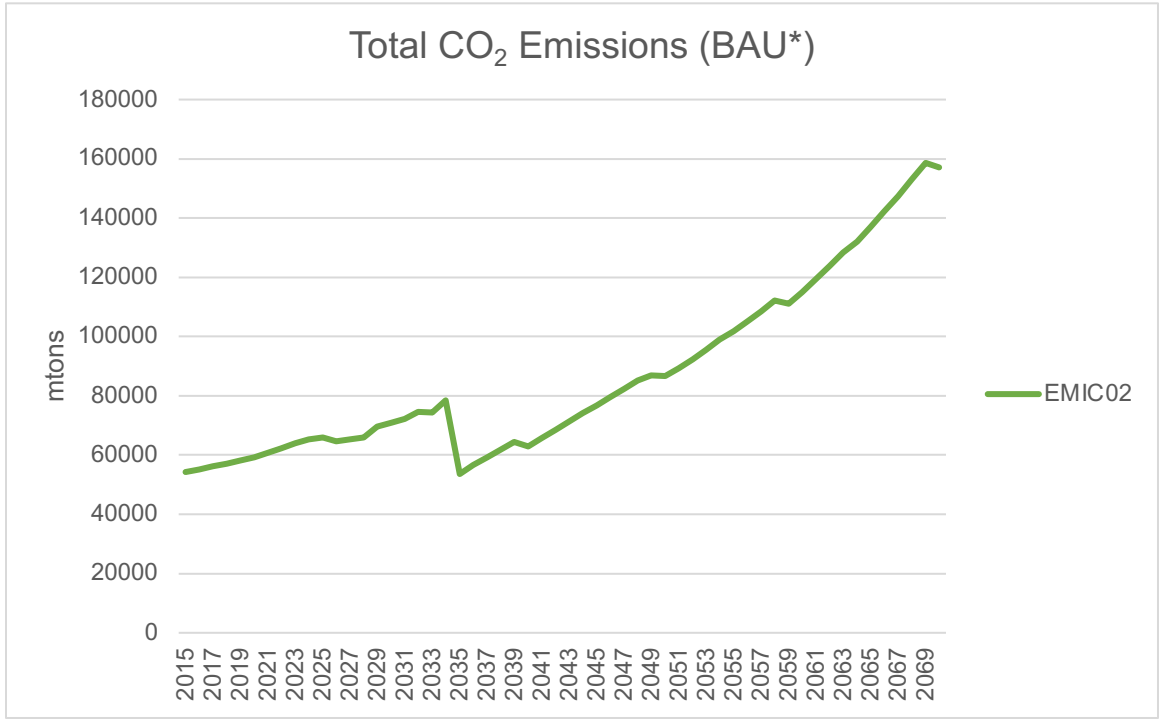
Adding additional realistic constraints

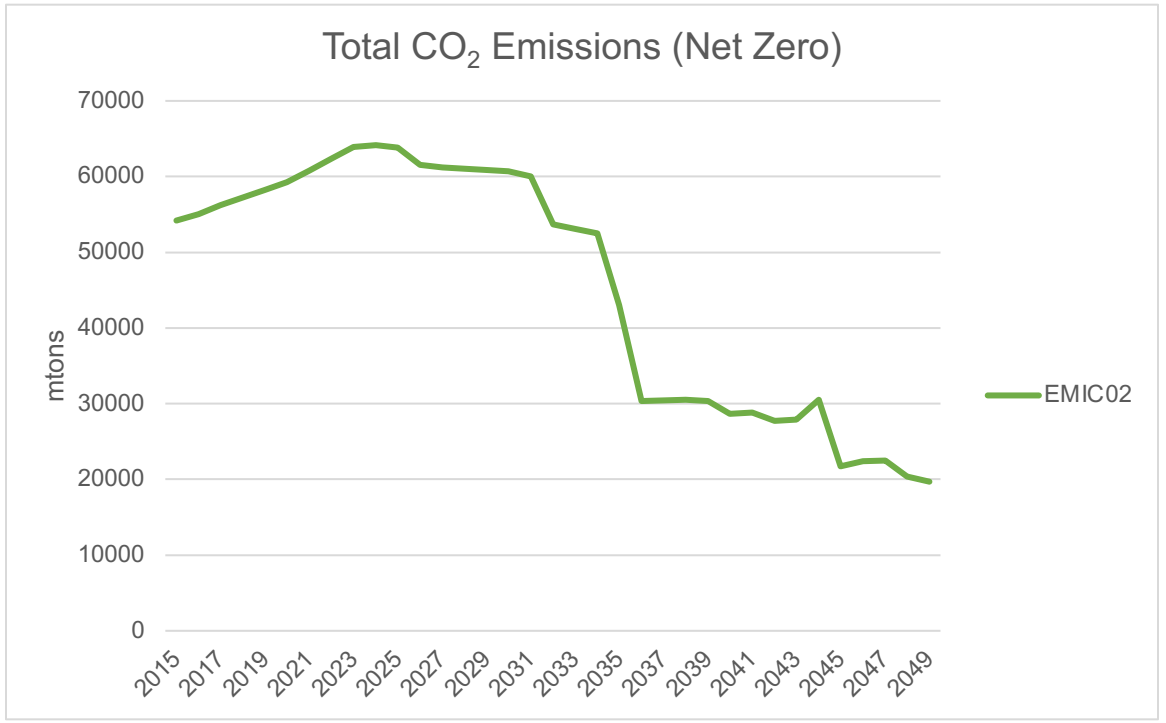
- World Bank estimate of 7.2 GW of potential wind capacity in the Gulf of Suez – extrapolated and assumed to be 10GW nationwide





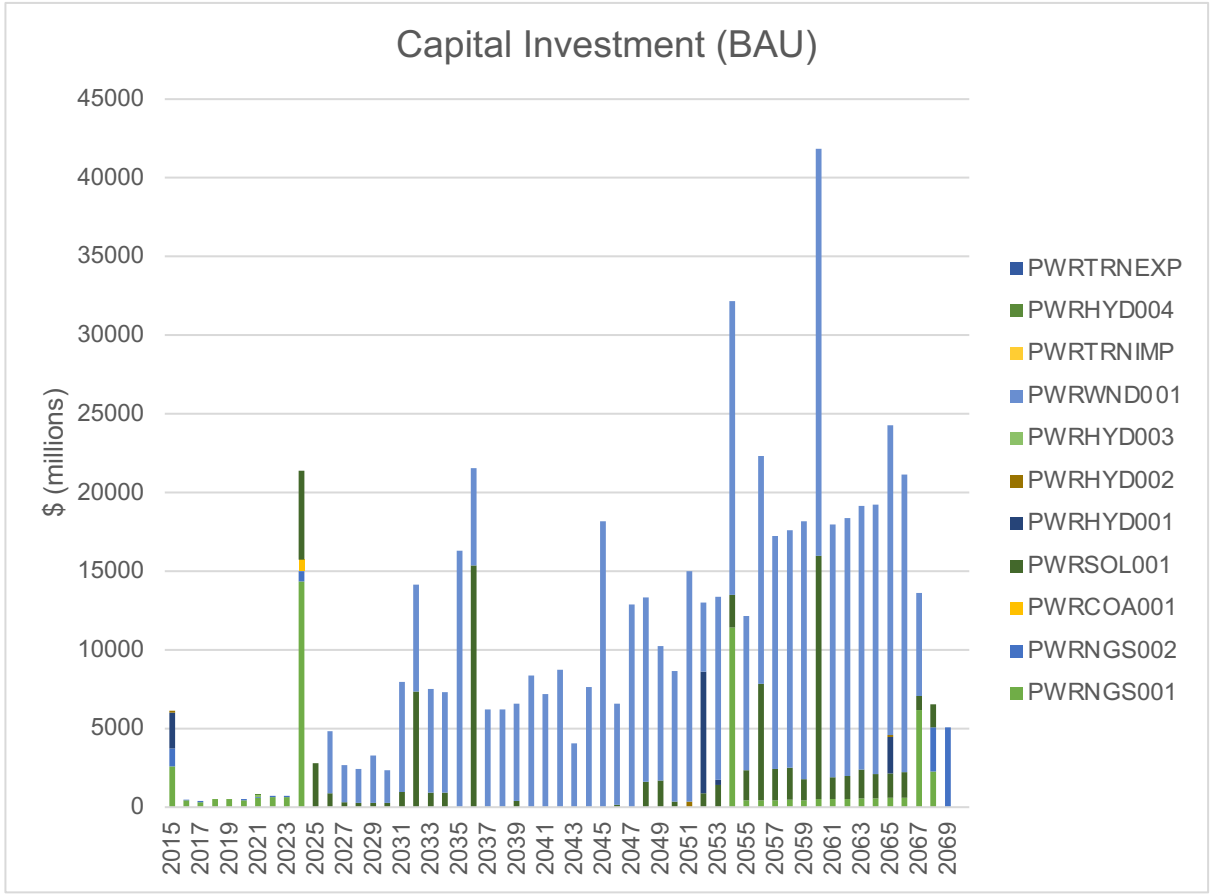
Results

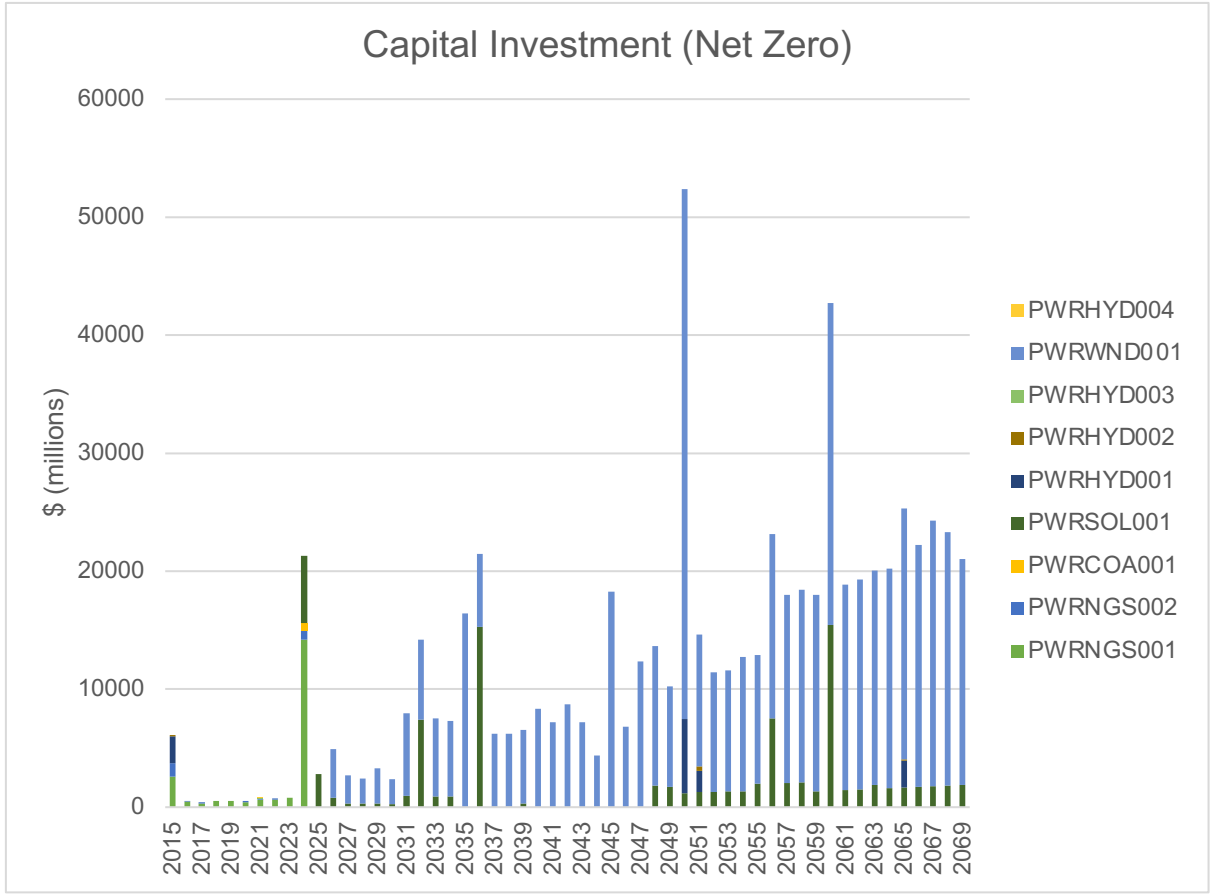




* with wind constraint

Cost-Benefit Analysis





Conclusion and Policy Insights

Conclusion

- Although the Net Zero scenario has environmental benefits of reducing CO_2 emissions, the investment required is extremely large
- Q 1 – Hydropower, solar and wind will be needed to reach net zero
- Q 2 – BAU is more affordable than Net Zero
- An affordable, low carbon energy pathway for Egypt will likely fall between the two.

Policy Insights

- Net Zero will require large capital investment – financial mechanisms are needed
- Fossil fuel reductions needed more quickly to reach zero carbon dioxide emissions by 2050

Future Work

- Additional Constraints to Net Zero (e.g. solar) to make it more realistic
- Electricity Scenario - Incorporate the 20% by 2022, 42% by 2035 electricity from renewables target
- Fossil Fuel Scenario

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Thank you for listening!