Tunisian Electricity System: Energy Transition

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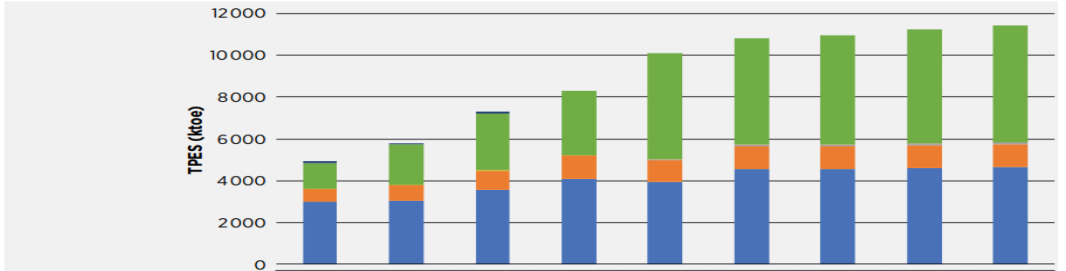
Context, Challenges, and Main Findings

- Tunisia heavily depends on Oil & Gas Power Production.
- A positive trend is the electrification increasing from **21% in 1962 to 99.8% in 2022**.
- Tunisia is committed to its nationally determined contribution (NDC). The aim is to reduce **45% GHG emissions by 2030** and net zero by 2050.
- Adoption of the TSP (Tunisian Solar Plan), integrating **30% of the capacity with RES by 2030**.
- Challenges include – import dependency, aged grid infrastructure, system flexibility & resilience issues, land availability & access, topographical constraints and limitations.
- ***The main challenge proposed to be investigated with the model is to highlight the impact of Tunisia's Energy Transition.***

Figure 1. Total primary energy supply (TPES) by source, Tunisia, 1990-2018



	1990	1995	2000	2005	2010	2015	2016	2017	2018
Coal	82	71	79	0	0	0	0	0	0
Natural Gas	1 234	1 924	2 732	3 091	5 083	5 055	5 209	5 436	5 569
Nuclear	0	0	0	0	0	0	0	0	0
Hydro	4	3	6	12	4	6	4	2	1
Geothermal, solar, wind	0	0	2	4	39	89	100	103	103
Biofuels and waste	638	750	934	1 121	1 058	1 076	1 081	1 082	1 090
Primary and secondary oil	2 989	3 053	3 554	4 087	3 933	4 573	4 552	4 612	4 665

Sources: INS (2018a), MISME (2019a).

Figure 2. Energy import dependency, Tunisia. 2010-2018

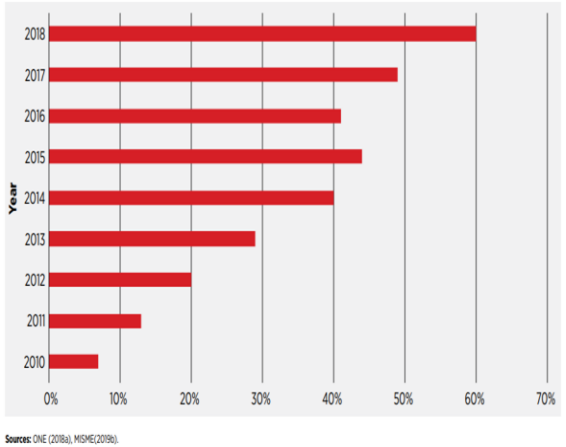
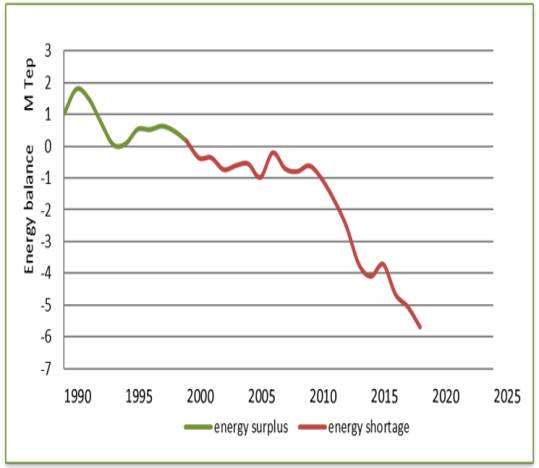


Figure 3. Tunisian Energy Balance.



Source: ONME, 2020

Scenarios

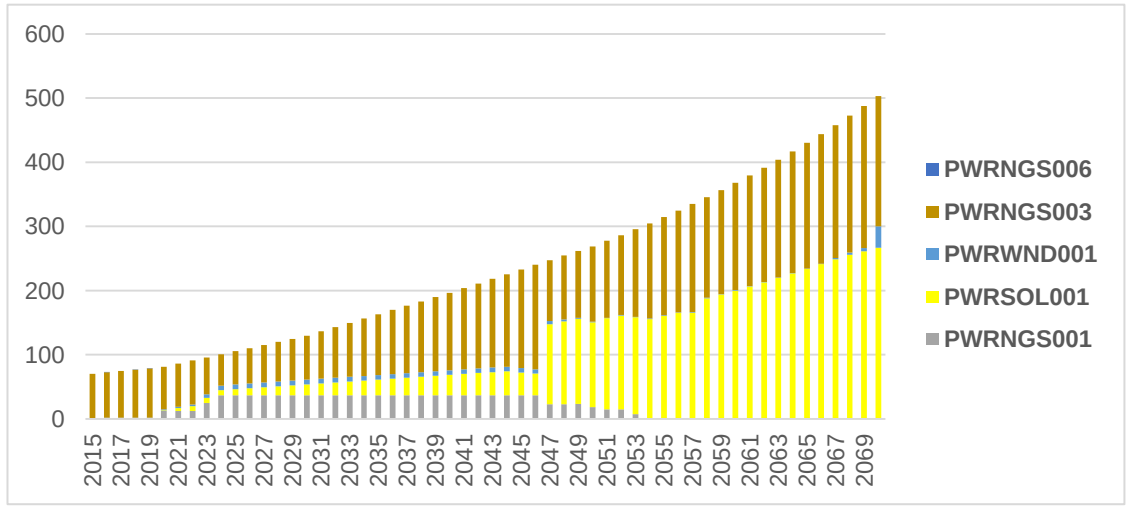
Using Osemosys the following scenarios were investigated:

Scenario Label	Scenario Description	Key Assumptions
BAU	Assume existing demand growth and supply continues.	Current energy situation 97% fossils & 3% RE (Hydro, PV and Wind)
RE 2030	Integrate 30% capacity with RES by 2030.	Activity constraint applied on a fictious RE technology
Net Zero	Develop energy mix to achieve reduction of 45% GHG emissions by 2030 and net zero GHG emissions to “0” by 2050.	Emission constraint applied on the electricity production

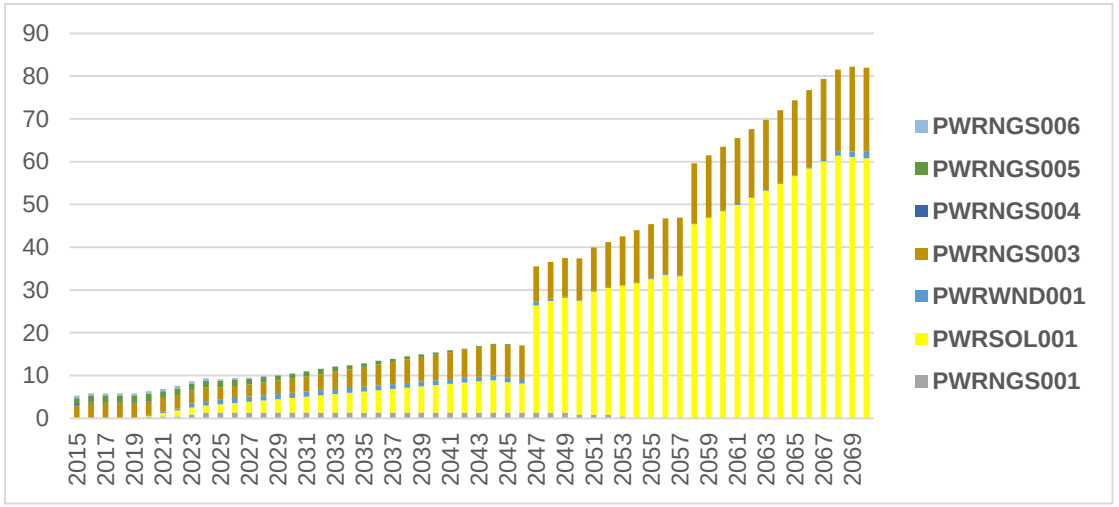
Results: Scenario 1 – Business As Usual

- Currently Primary fuel used for Electricity production is Oil & Gas.
- **Assumptions** – Minimum capital investment, no annual emission limit and import of natural gas is available as the demand grows.

Annual Electricity Production (PJ)



Total Annual Capacity (GW)



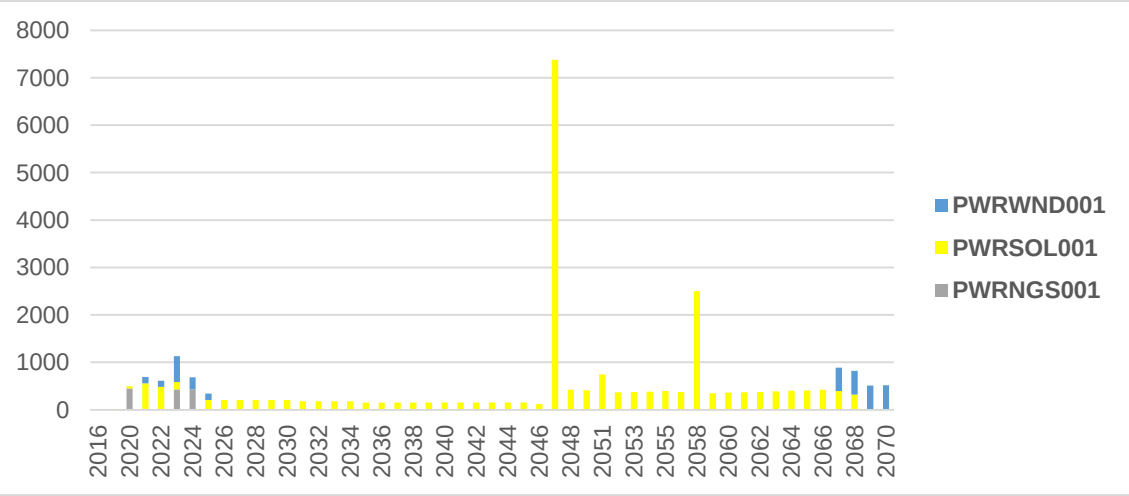
Observations:
- *Natural Gas dominates production generally with RES share (mainly solar) increasing significantly from 2055 onwards.*
- *Some wind technology in use between 2023-2047.*

Observations:
- *Considering Natural gas as primary fuel for electricity production, least cost RES technologies to contribute.*

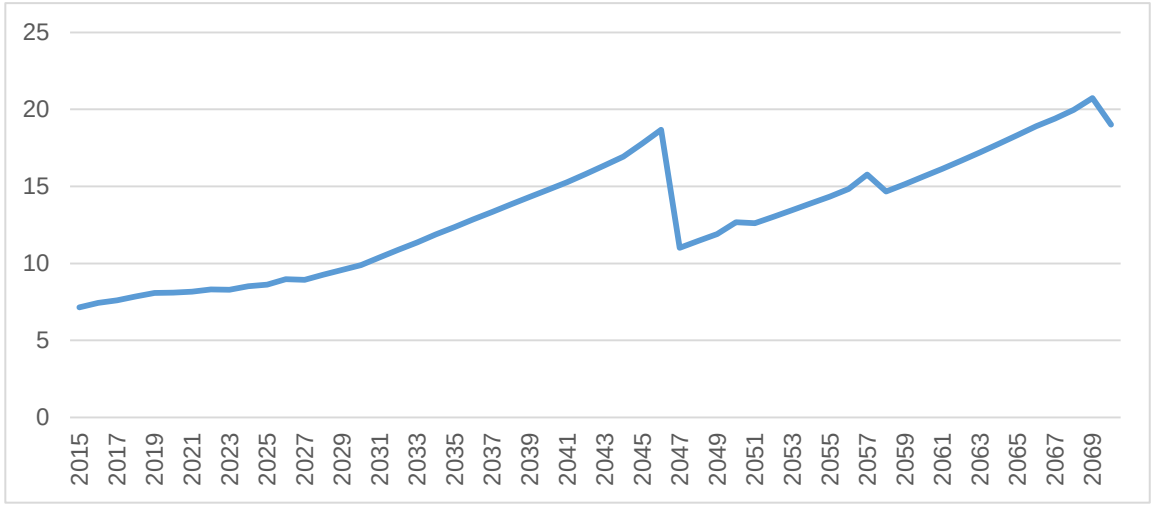
Observations:
- *Total Annual Capacity increases gradually except in 2047 and 2063 due to investments in least cost technology at the time.*
- *RES share increases gradually from 2023 onwards with step increments at 2047 & 2063.*

Results: Scenario 1 – Business As Usual

Capital Investment (Million USD)



Annual CO2 (Kton)



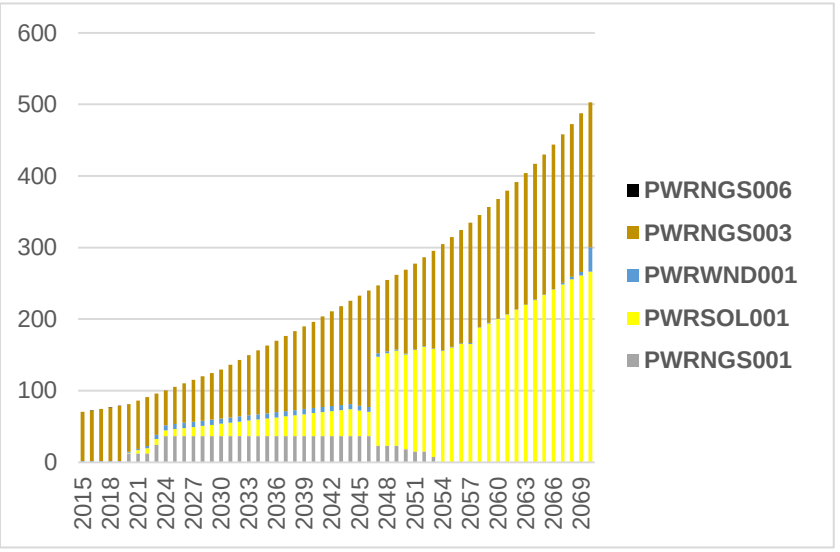
Observations:
- *Significant investment required in least cost RES in 2046.*
- *No major investment until 2046 and 2057.*
- *No targeted investment for emission reduction.*

Observations:
- *Annual CO2 increases gradually with slight drop around in 2047 due to potential capital investments in RES.*
- *As the demand grows the share of RES then reduces between 2050-2070, hence emissions continues to increase gradually from 2050 onwards.*

Observations:
- *Mainly NG is causing CO2 emissions. As the RES are developed from 2047 the emissions reduces slightly but then again increases beyond 2050.*

Results - Annual Electricity Production (PJ)

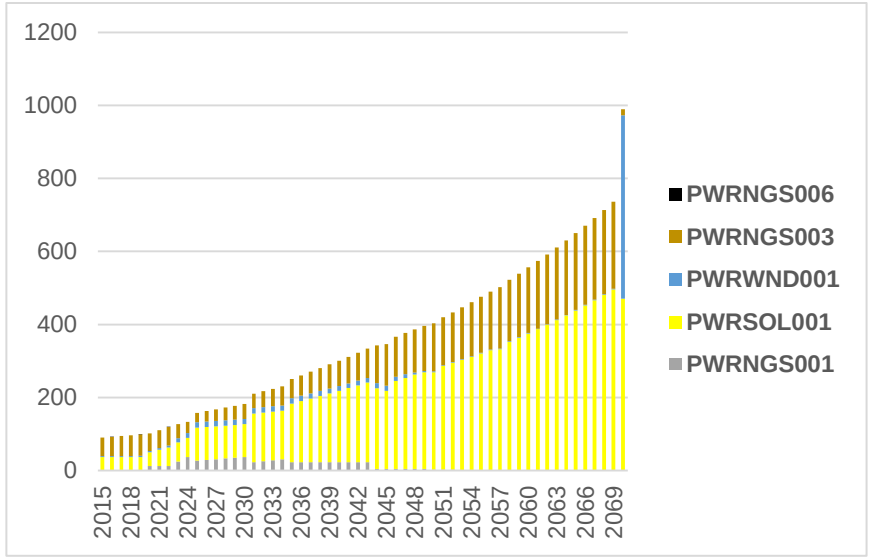
Scenario 1 - BAU



Observations:

- *Natural Gas dominates production generally with RES share (mainly solar) increasing significantly from 2055 onwards.*
- *Some wind technology in use between 2023-2047.*

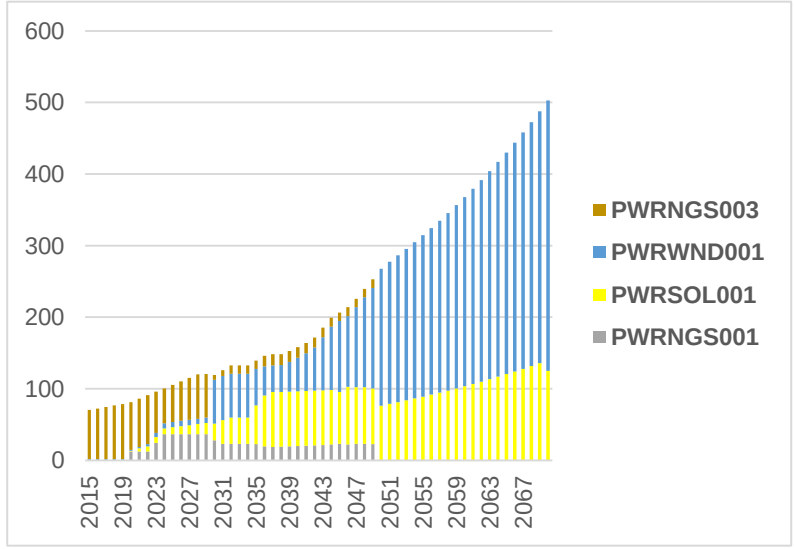
Scenario 2- RE 2030



Observations:

- *Development of Solar Generation from 2015 onwards.*
- *Solar Power dominates the production generally, wind& NG contributes to fulfil remaining demand.*

Scenario 3 – Net Zero 2050



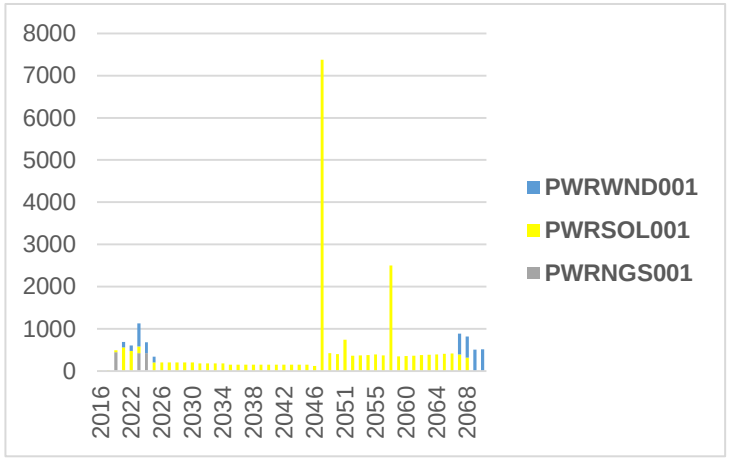
Observations:

- *Natural Gas dominates production till 2025.*
- *Solar and Wind Technologies develops gradually from 2023 to 2049.*
- *Solar Energy Provides sufficient & affordable production to support Net Zero from 2051 onwards.*

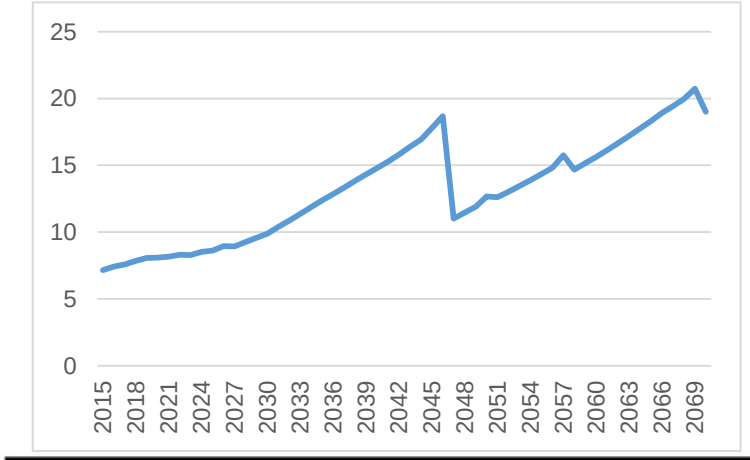
Results – Cost Benefit Analysis

Scenario 1 - BAU

Capital Investment

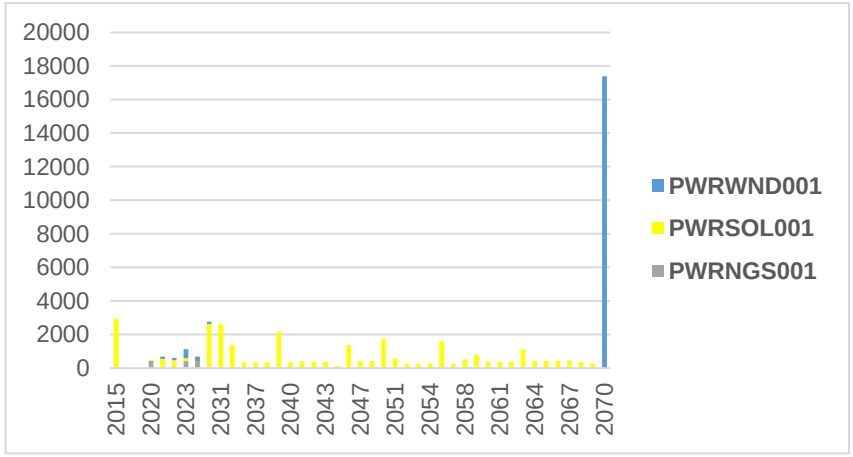


Annual Co2

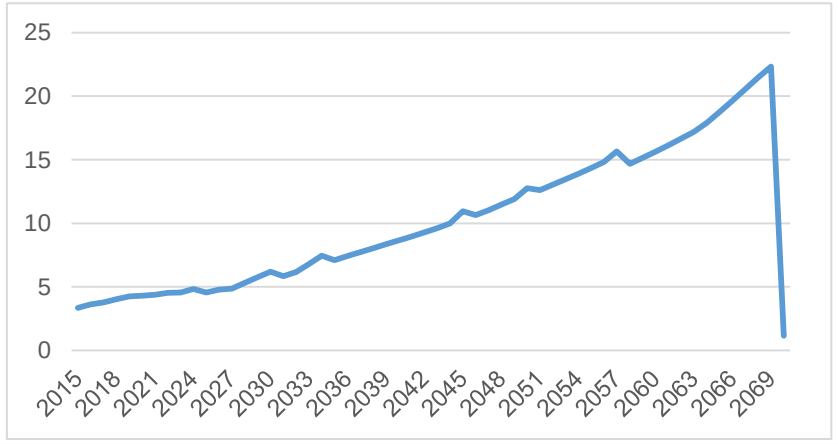


Scenario 2- RE 2030

Capital Investment

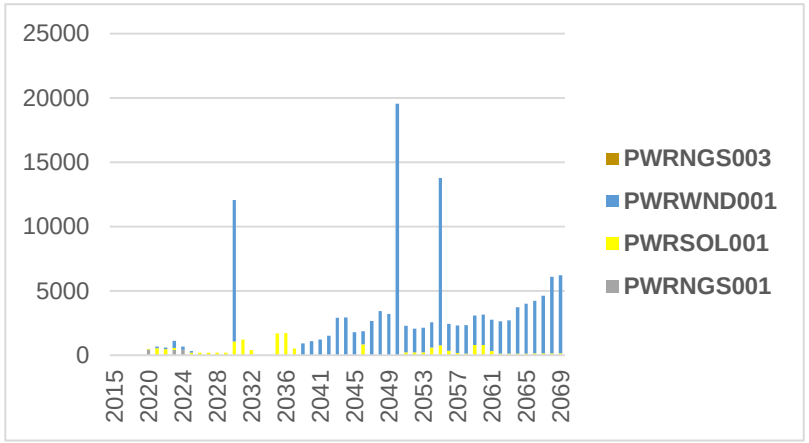


Annual Co2

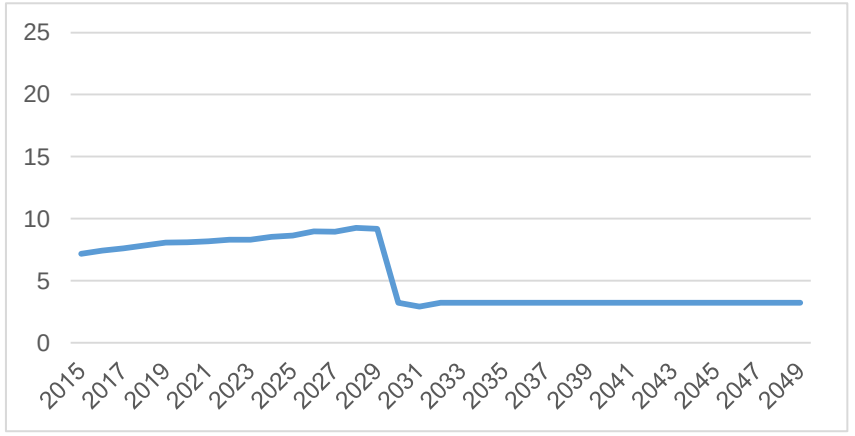


Scenario 3 – Net Zero 2050

Capital Investment



Annual Co2



Conclusion and Policy Insights

Conclusions

- To achieve net zero Tunisia will require to strategically invest in RES development across the country and minimise the reliance on natural gas as soon as possible.
- Reliance on single technology (such as shown in scenaio 2), is not as effective as diversification of RES source deployment.
- Natural Gas will remain as a supporting fuel to serve the remaining demand, system stability and eliminating RES intermittency issues for grid. This will minimise the grid investment and allows more RES investments.

Policy Insights

- Efforts undertaken to strengthen energy sector – adoption of the TSP (Tunisian Solar Plan), Creation of independent regulatory authority, develop financing tools, strengthen FTE (Energy Transition Fund).
- Following the above strategic measures, the electricity & gas network requires reinforcement and significant RES deployment. This requires stable & resilient network with adequate flexibility and storage provisions.

Future Work

- Integrate Biogas in the model and assess impact on emissions & investments.
- Consider Carbon tax and apply stricter annual emission limits to assess the impact on possible generation mix and investments.

References

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