



GHANA'S ENERGY TRANSITION

– THE ROLE OF NUCLEAR IN THE ENERGY MIX

Presentation By

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**25TH INPRO DIALOGUE FORUM ON NUCLEAR ENERGY
DEVELOPMENT IN EMBARKING COUNTRIES**

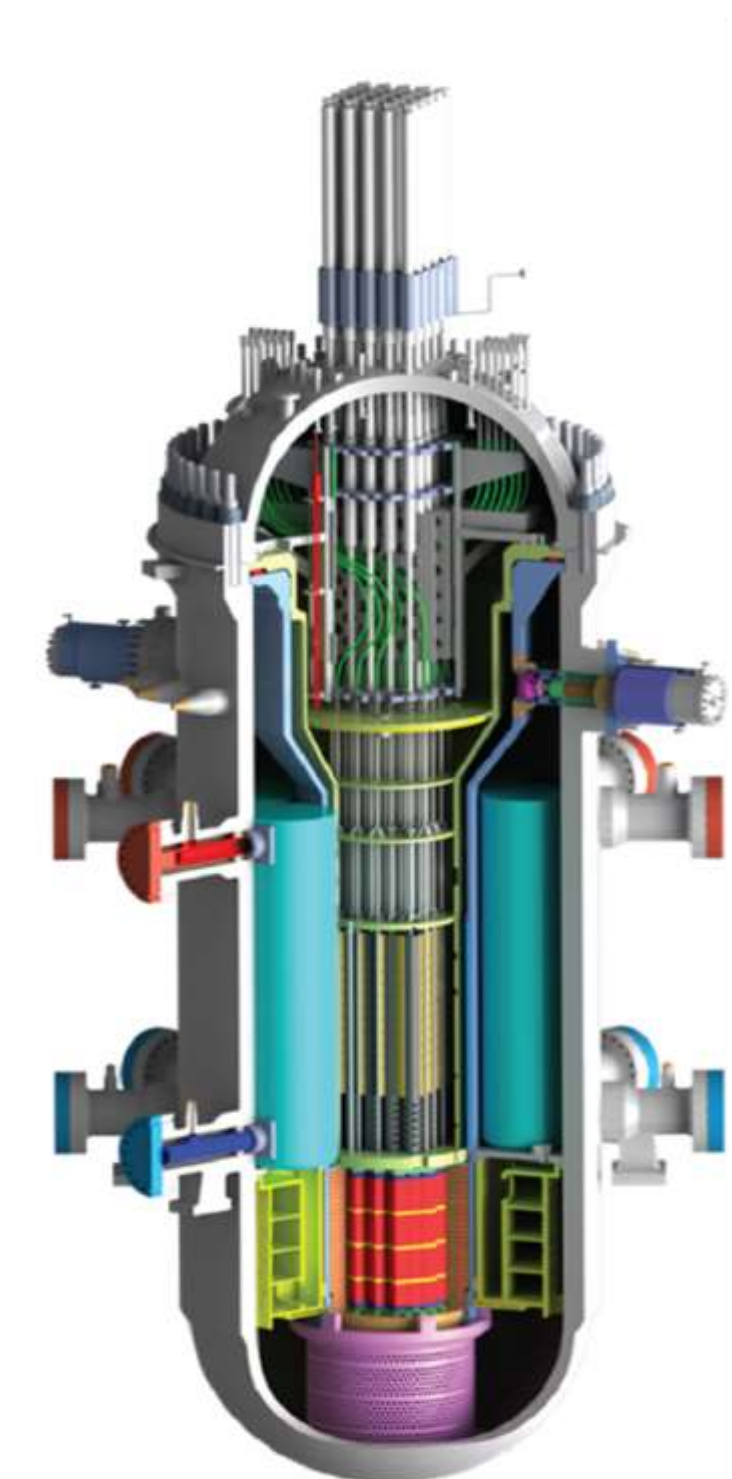
THE EDGE CONVENTION, NAIROBI, KENYA

18TH NOVEMBER, 2025



INPRO

International Project on
Innovative Nuclear Reactors
and Fuel Cycles



REPUBLIC OF GHANA



Republic of Ghana, is a country in West Africa.

It covers an area of 238,535 km² (92,099 sq mi), with about 35 million inhabitants (according to 2024 census)

Produces Cocoa, Timber, Gold, Bauxite, Oil & Gas

Electricity access of 89.05% and an install capacity of 5.4GW

GRID INFRASTRUCTURE

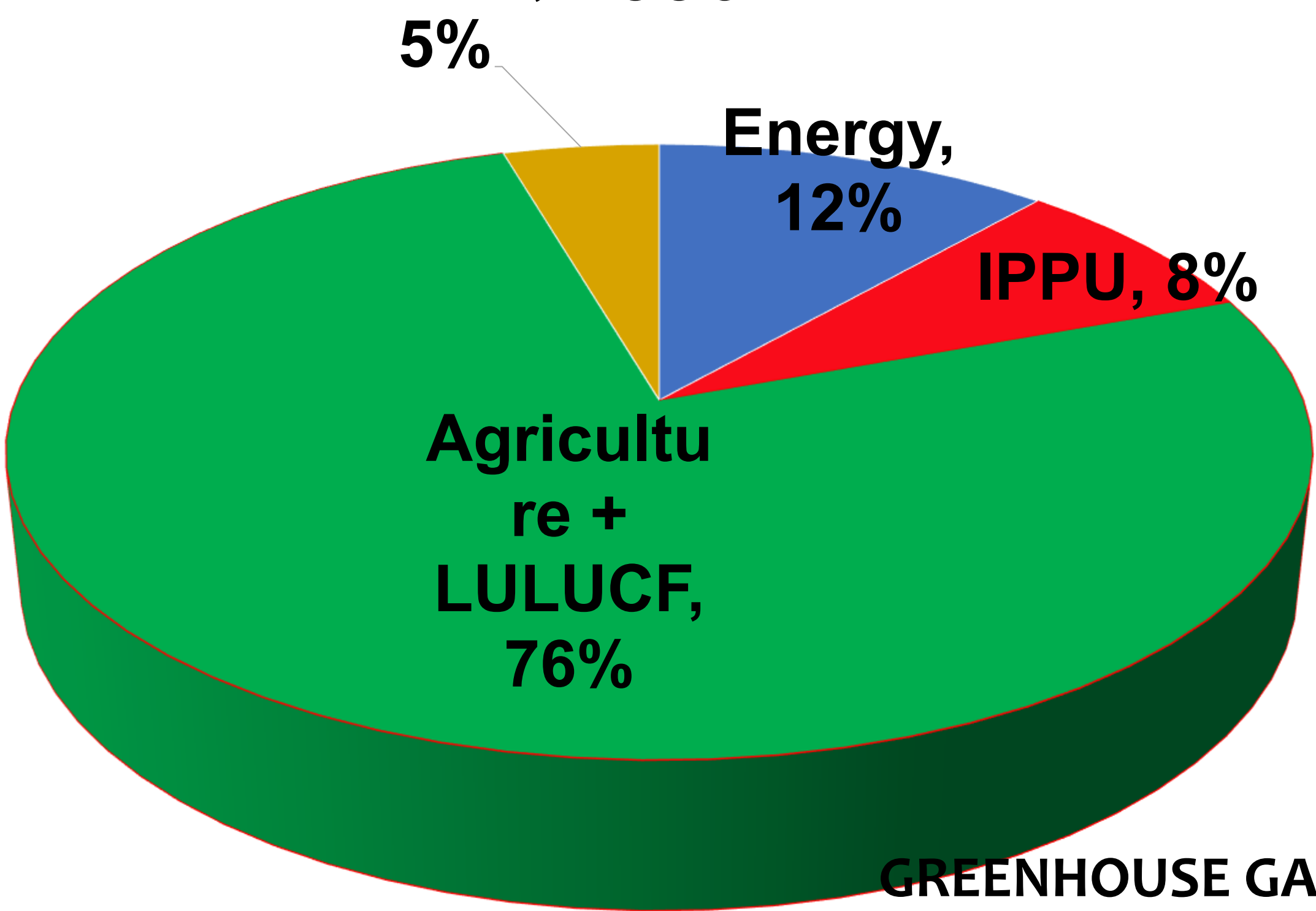
- GRIDCo is responsible for construction and operation of substations and high voltage transmission lines i.e., 69-330 kV lines.
- The Electricity Company of Ghana (ECG) and Northern Electricity Company (NEDCo) are responsible for construction and operation of transmission lines smaller than this.
- Ghana's grid consist of a total of 6,472 km (2021) of transmission lines of which some 90% are 161 kV lines.
- Ghana's grid code is regulated by the Energy Commission



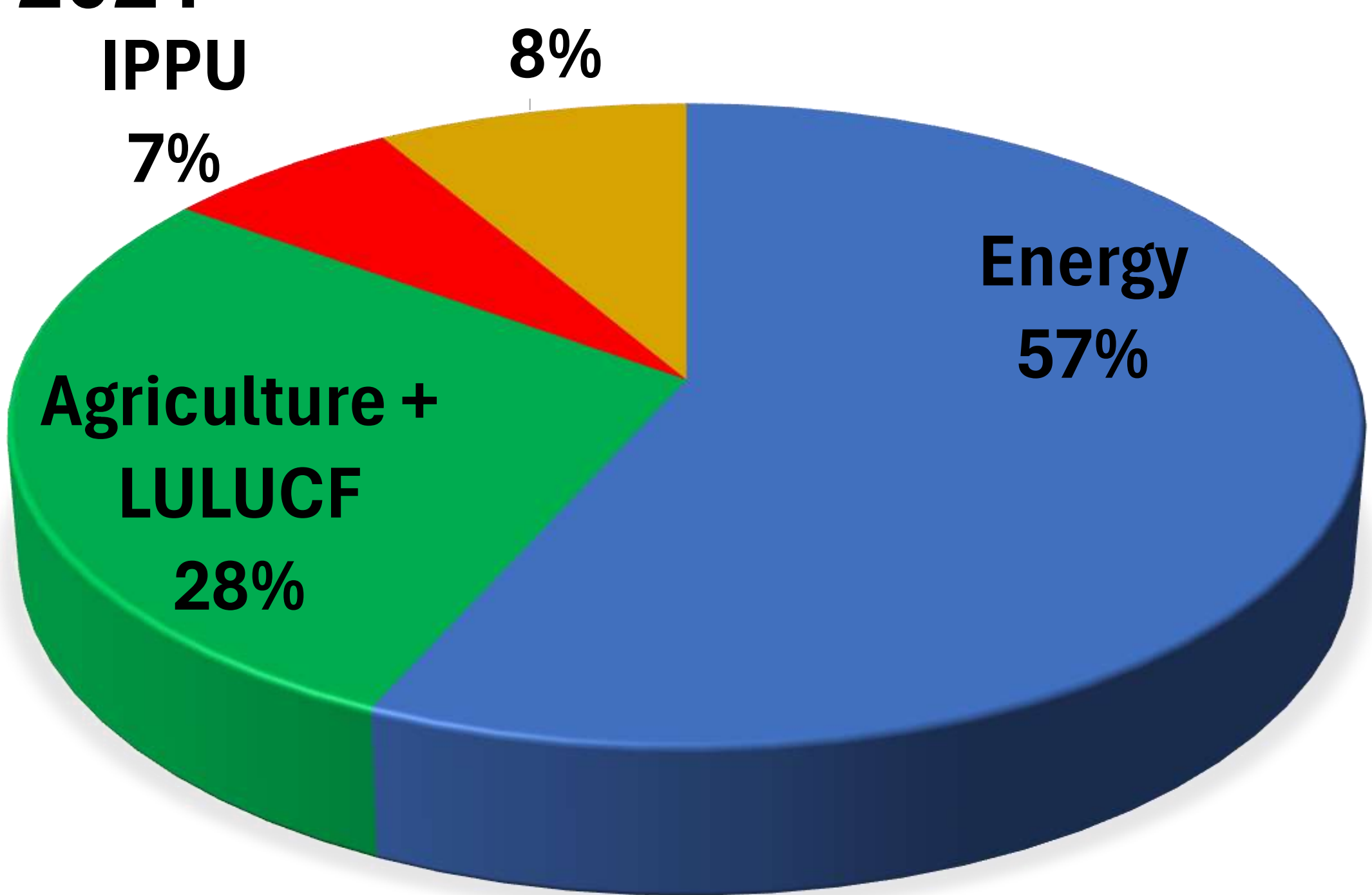
GHANA'S GREEN HOUSE GAS EMISSION SOURCES

CHANGE IN GREENHOUSE GAS EMISSION BY SECTOR

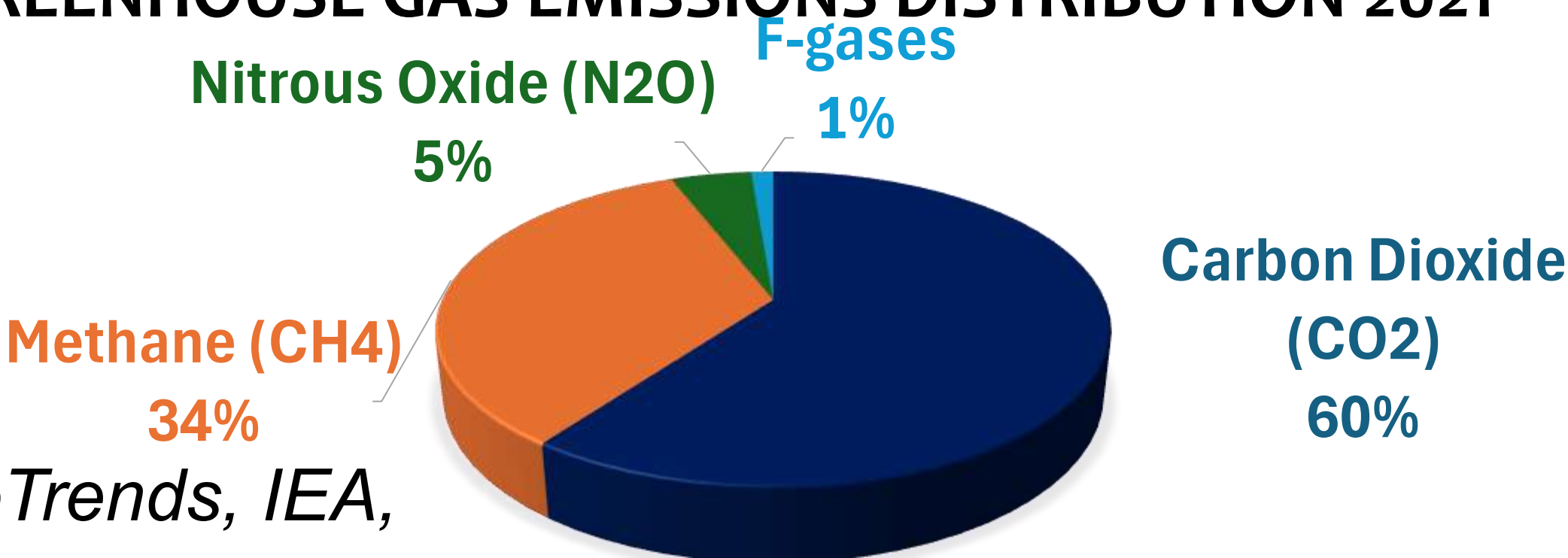
Total Emissions by Sector in
Waste, 1990



Total Emissions by Sector in
2021

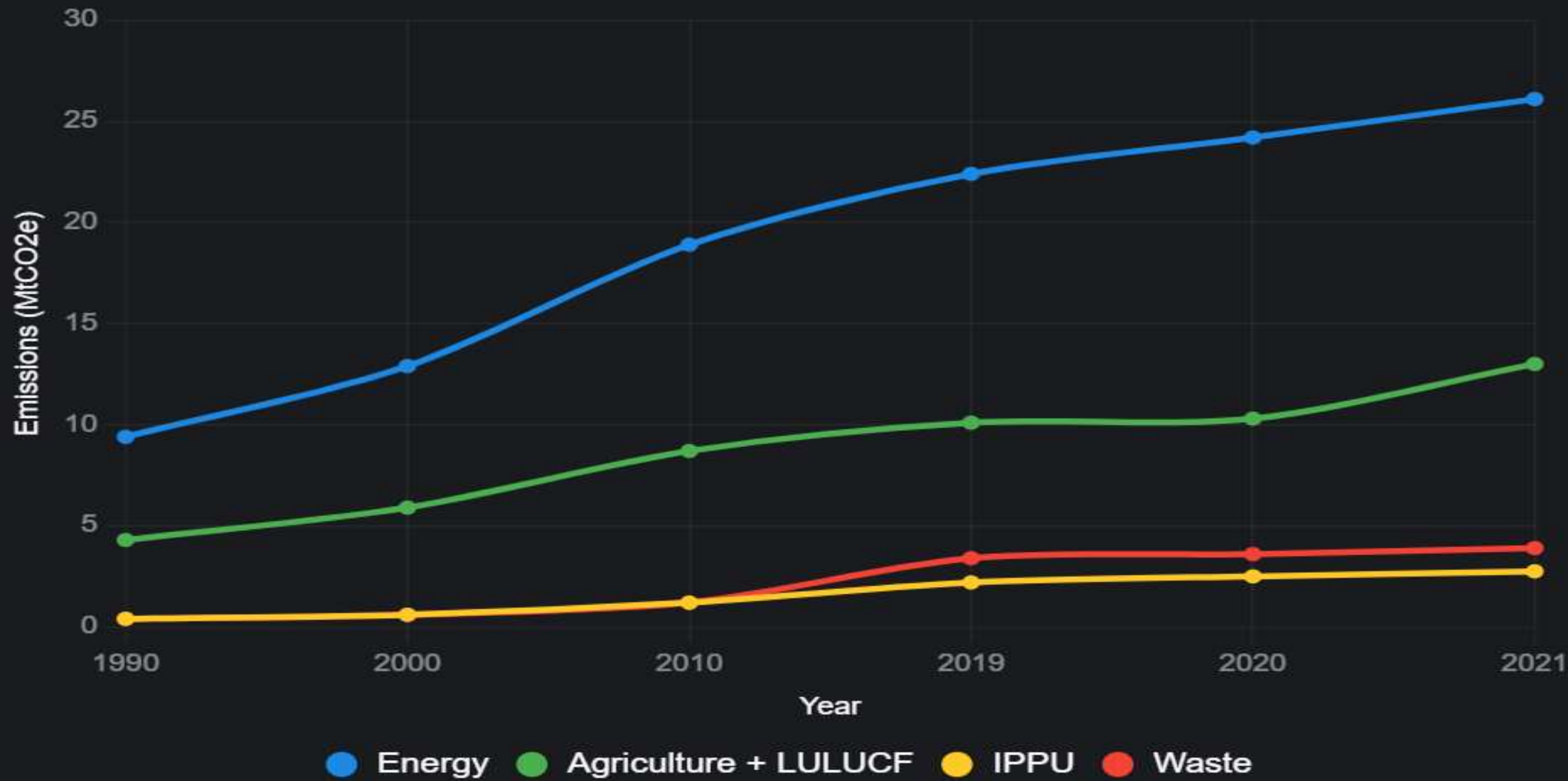


GREENHOUSE GAS EMISSIONS DISTRIBUTION 2021



Data Sources: Climate Watch, MacroTrends, IEA,

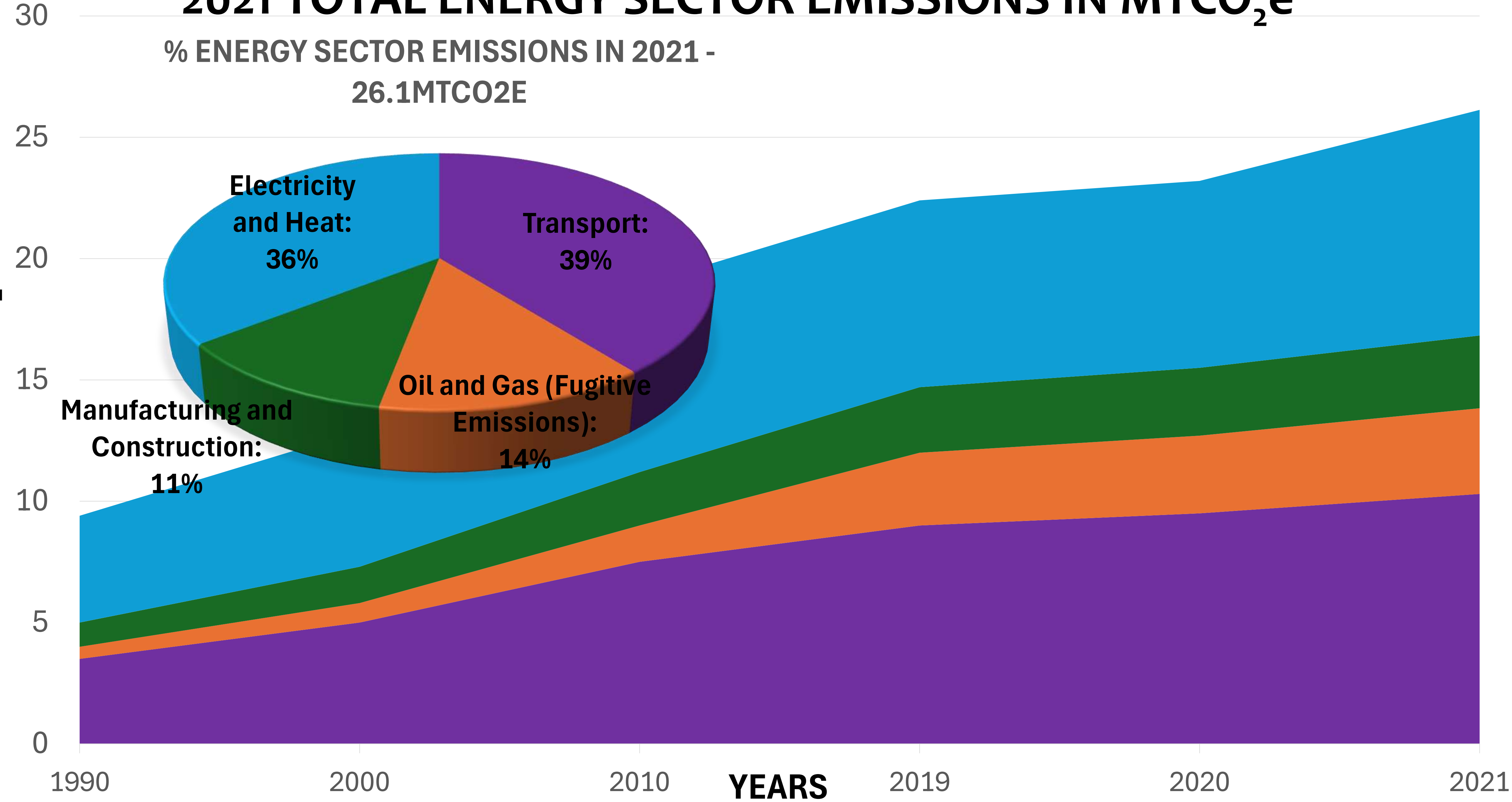
Ghana's GHG Emissions by Sector (1990–2021, MtCO2e)



2021 TOTAL ENERGY SECTOR EMISSIONS IN MTCO₂e

% ENERGY SECTOR EMISSIONS IN 2021 -
26.1MTCO₂E

EMISSIONS IN MTCO₂e



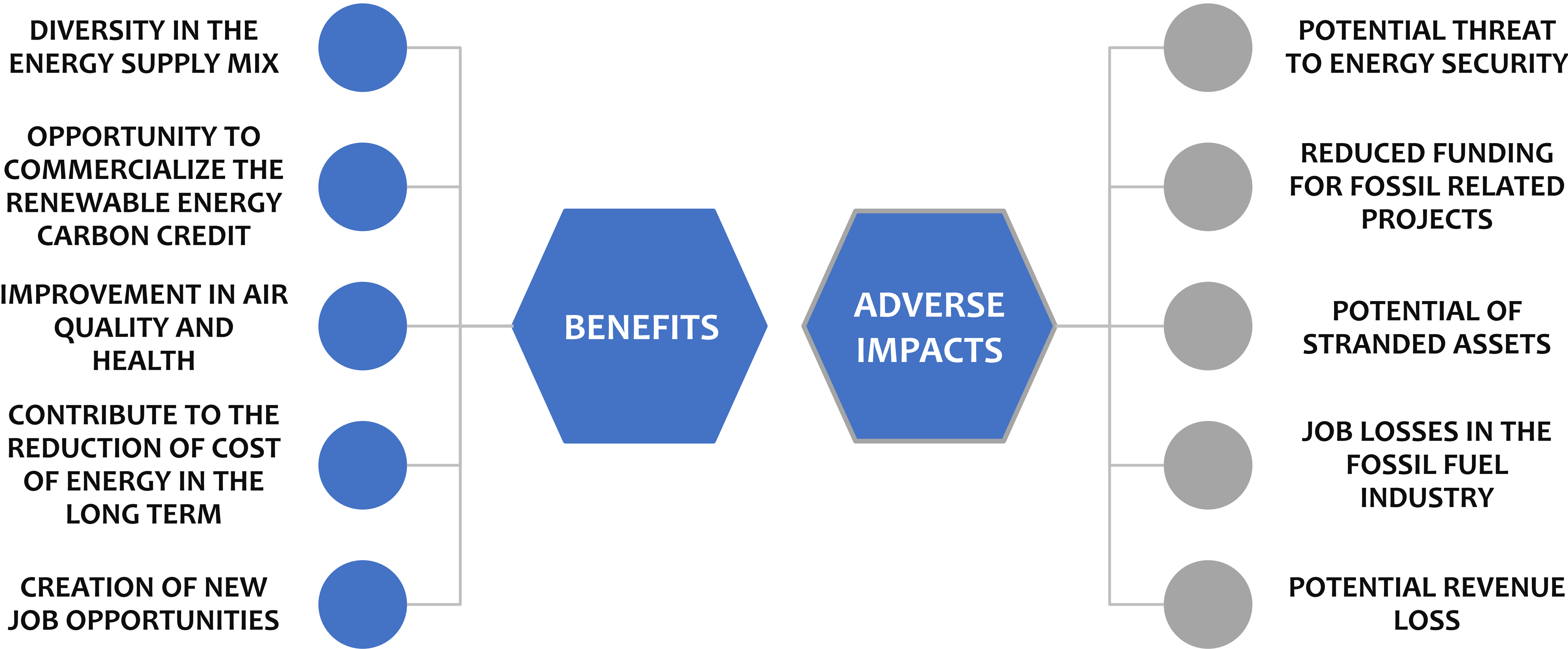
Transport Oil and Gas (Fugitive Emissions): Manufacturing and Construction: Electricity and Heat



GHANA'S JUST ENERGY TRANSITION PATHWAY

NET-ZERO ENERGY TRANSITION

BENEFITS & ADVERSE IMPACT



CHALLENGES OF ENERGY TRANSITION

Geopolitical challenges:

- There is a spur for fossil fuel producing **nations to resist** this change as Energy transition is likely to shift control from these fossil fuel producing nations to nations with an abundance of rare earth minerals.

Financial challenges:

- Huge capital investment needed
- Difficulty in accessing cheap and ready funding by developing countries to build essential clean energy infrastructure.



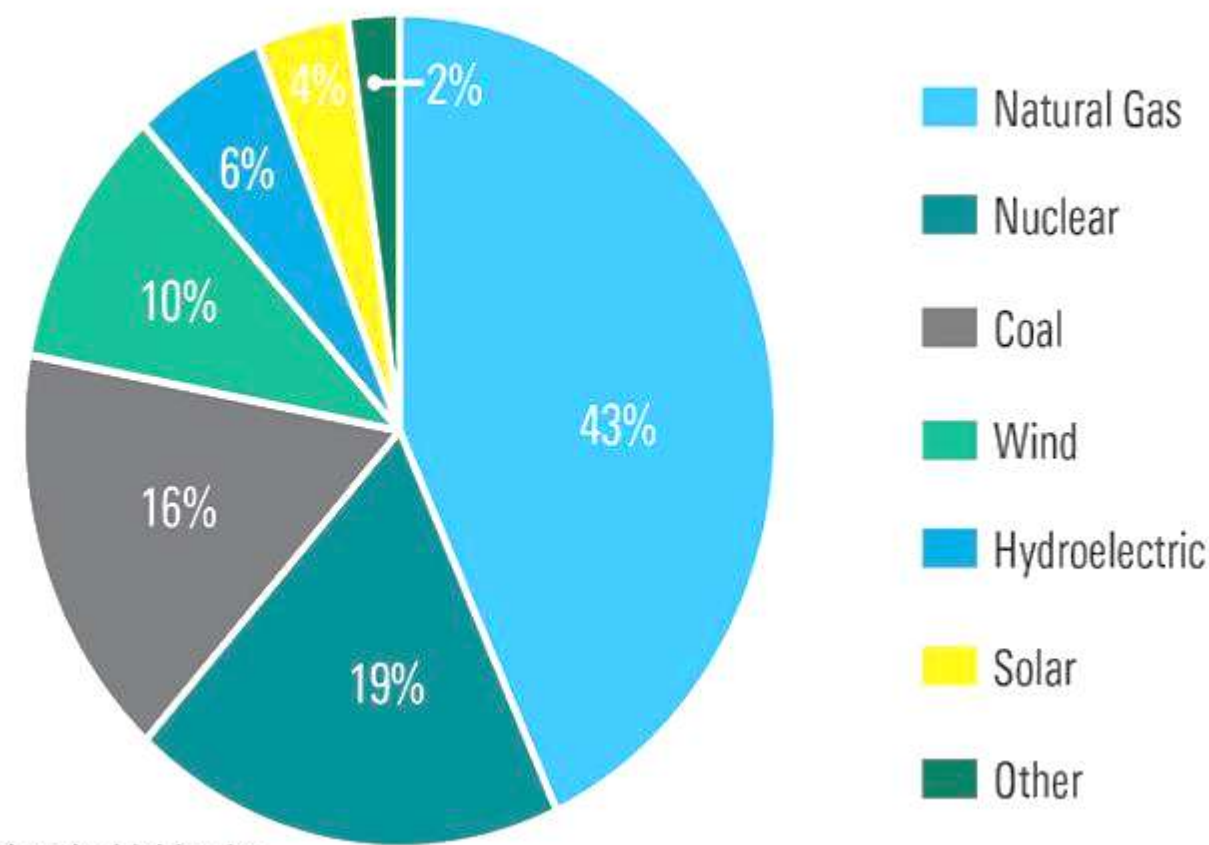
Technology challenges:

- Low availability factor of modern renewable energy technology.
- Battery storage technology is still inefficient and less economical – performance still being improved.
- Advancement in Nuclear Reactors, though promising are still on the drawing board. Small and Modular and Gen IV reactors

GHANA'S AVAILABLE ENERGY RESOURCES

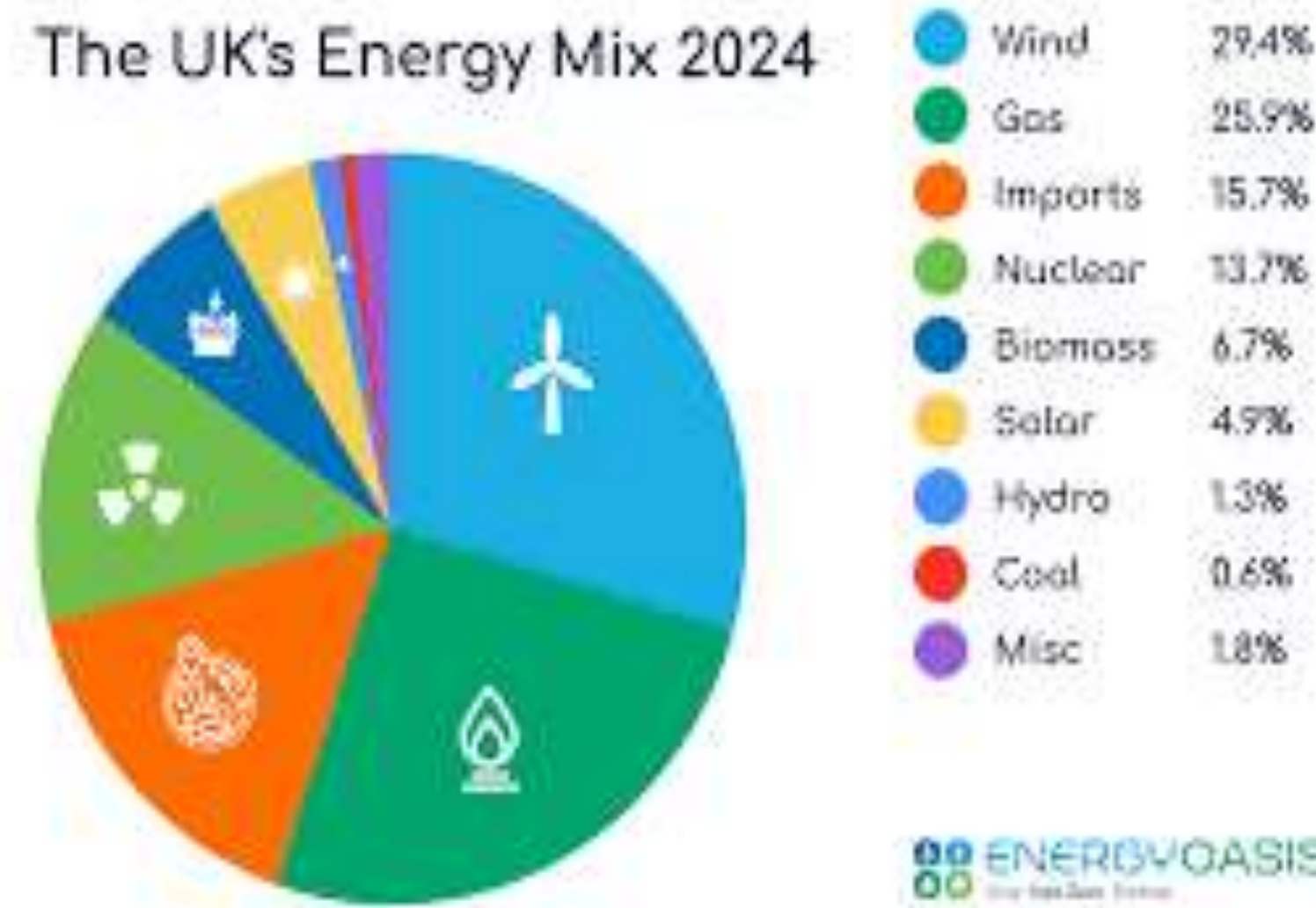
ALTERNATIVE BASE-LOAD ENERGY FOR INDUSTRIALIZATION

U.S. POWER GENERATION MIX, 2023



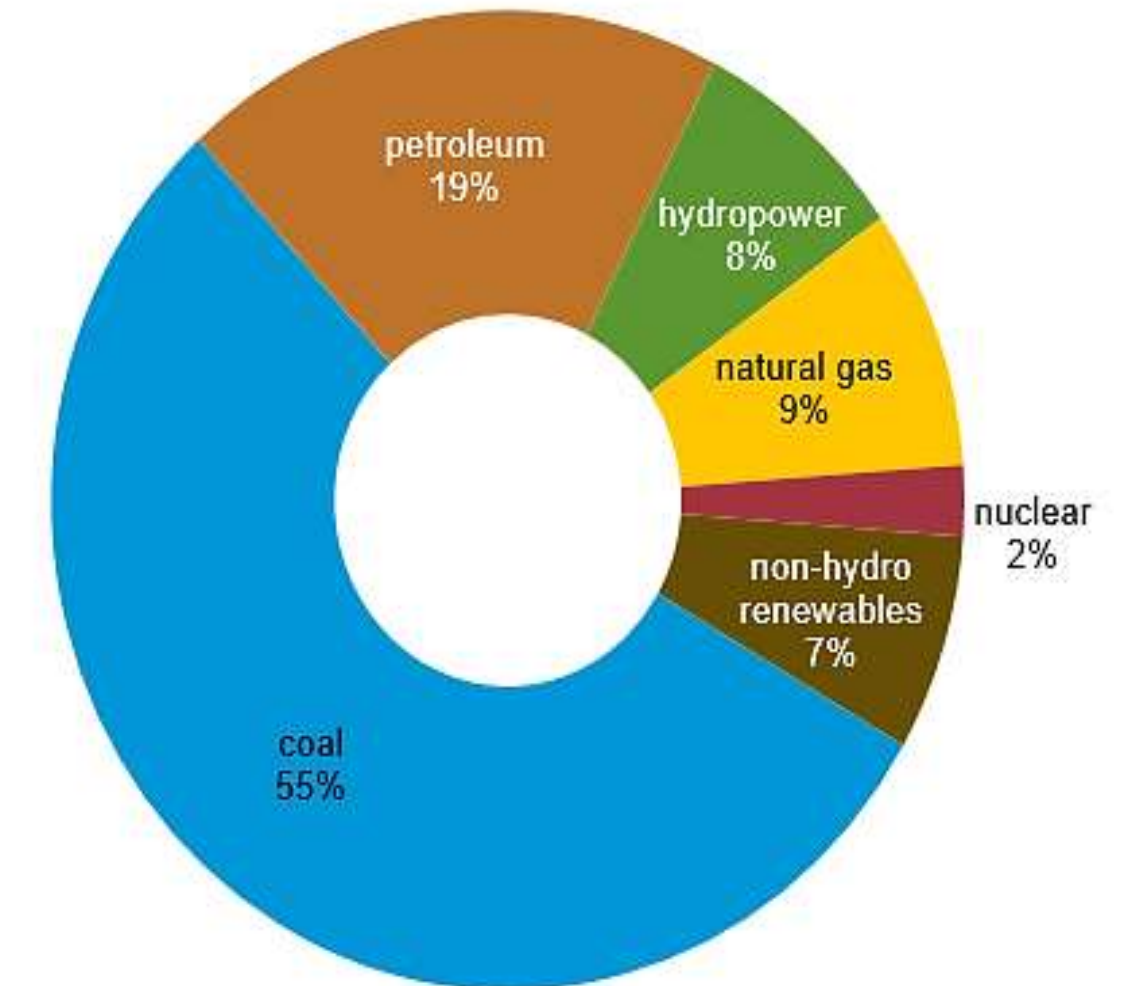
Source: U.S. Energy Information Administration

The UK's Energy Mix 2024



ENERGYVOASIS

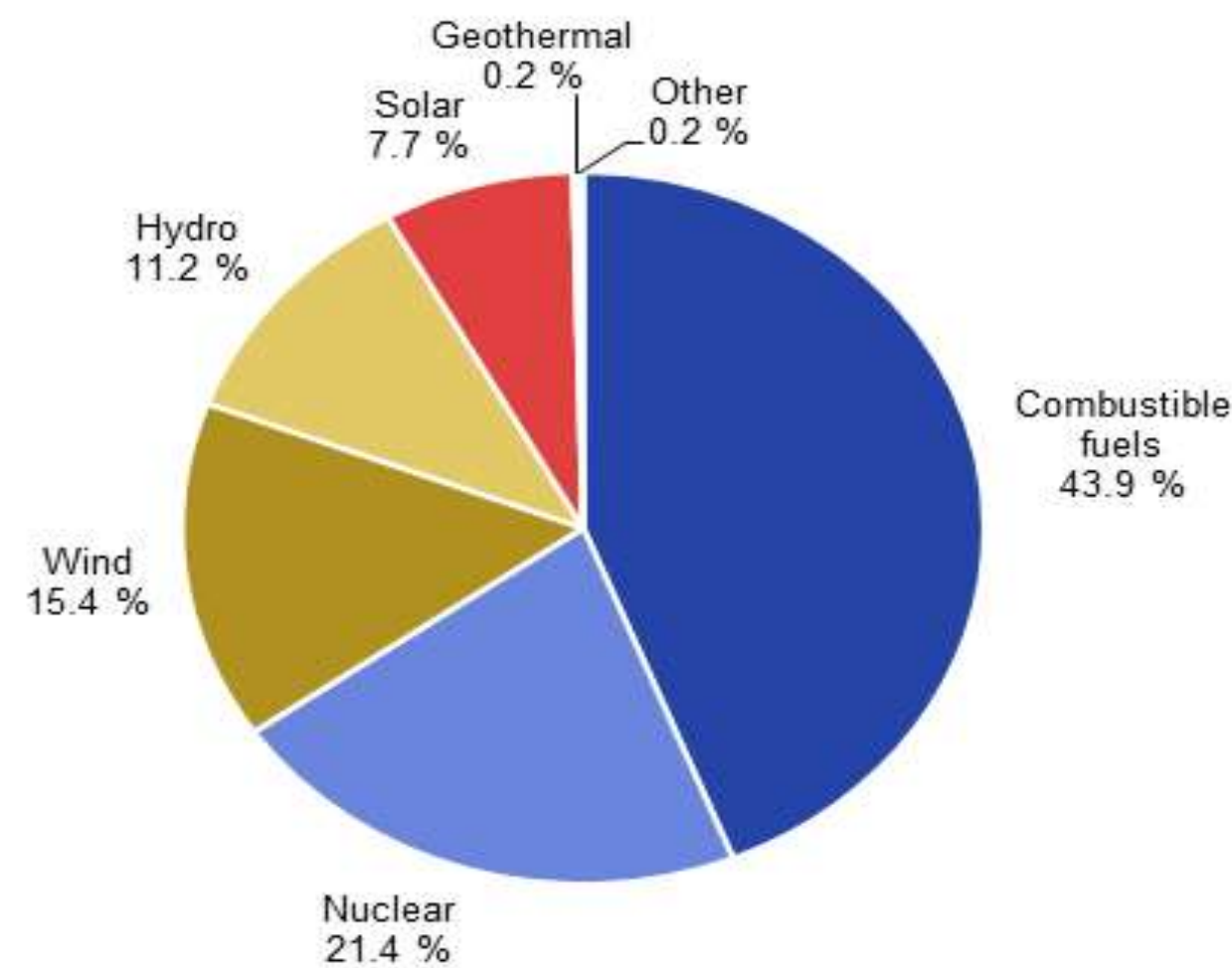
Figure 1. Total primary energy consumption in China by fuel type, 2021



Data source: BP Statistical Review of World Energy 2022
Note: Total may not equal 100% because of independent rounding. Includes only commercial fuel sources and does not account for biomass used outside of power generation.

Net electricity generation, EU, 2022

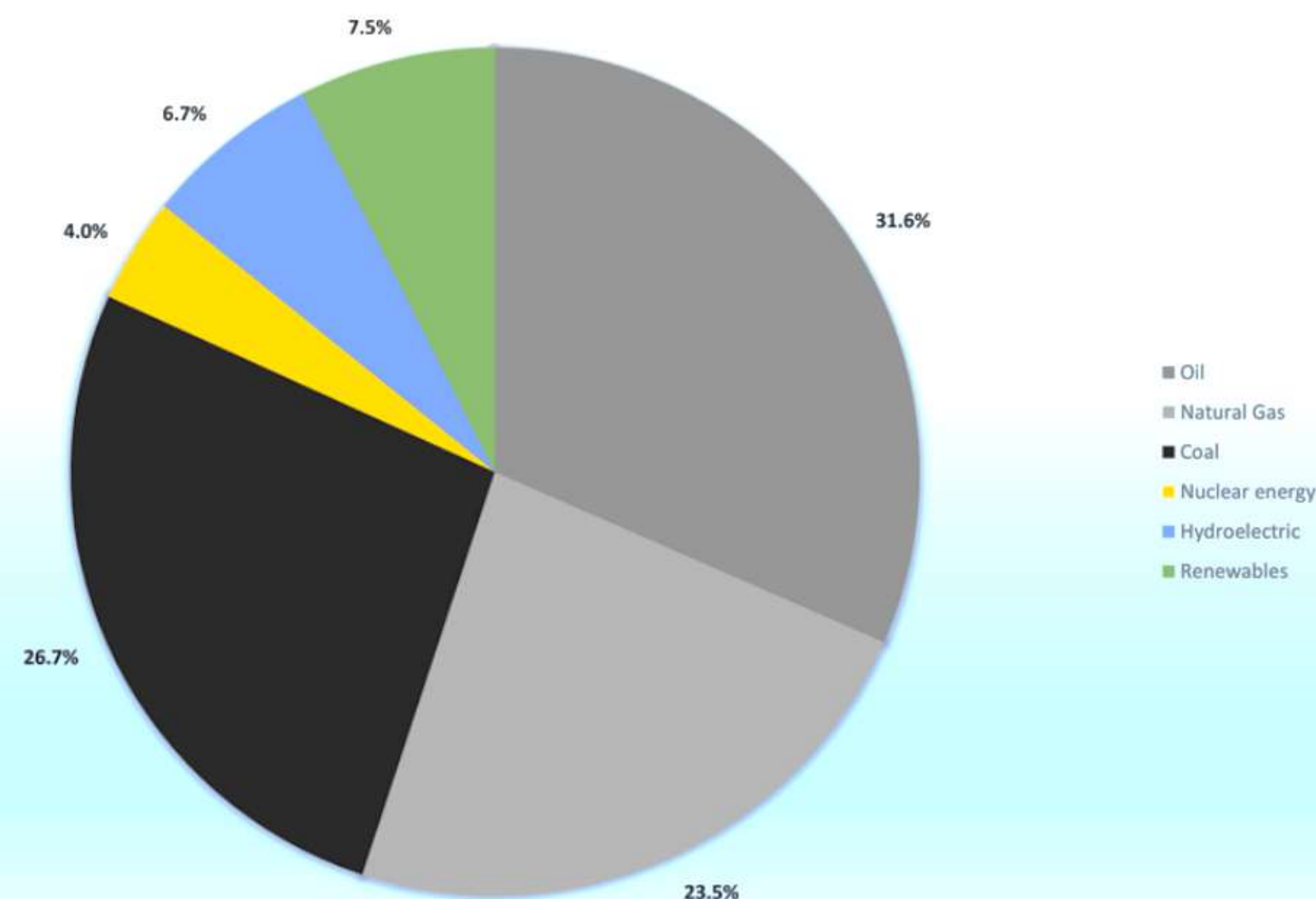
(%, based on GWh)



Source: Eurostat (online data code: nrg_ind_peh)

eurostat

PRIMARY GLOBAL ENERGY CONSUMPTION 2022



Data source: 2023 Statistical Review of World Energy

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- Ghana's energy policy is geared towards our commitment to the Paris Agreement on Climate change and the Nationally Determined Contributions
- We need to plan for future clean base-load energy for industrial growth

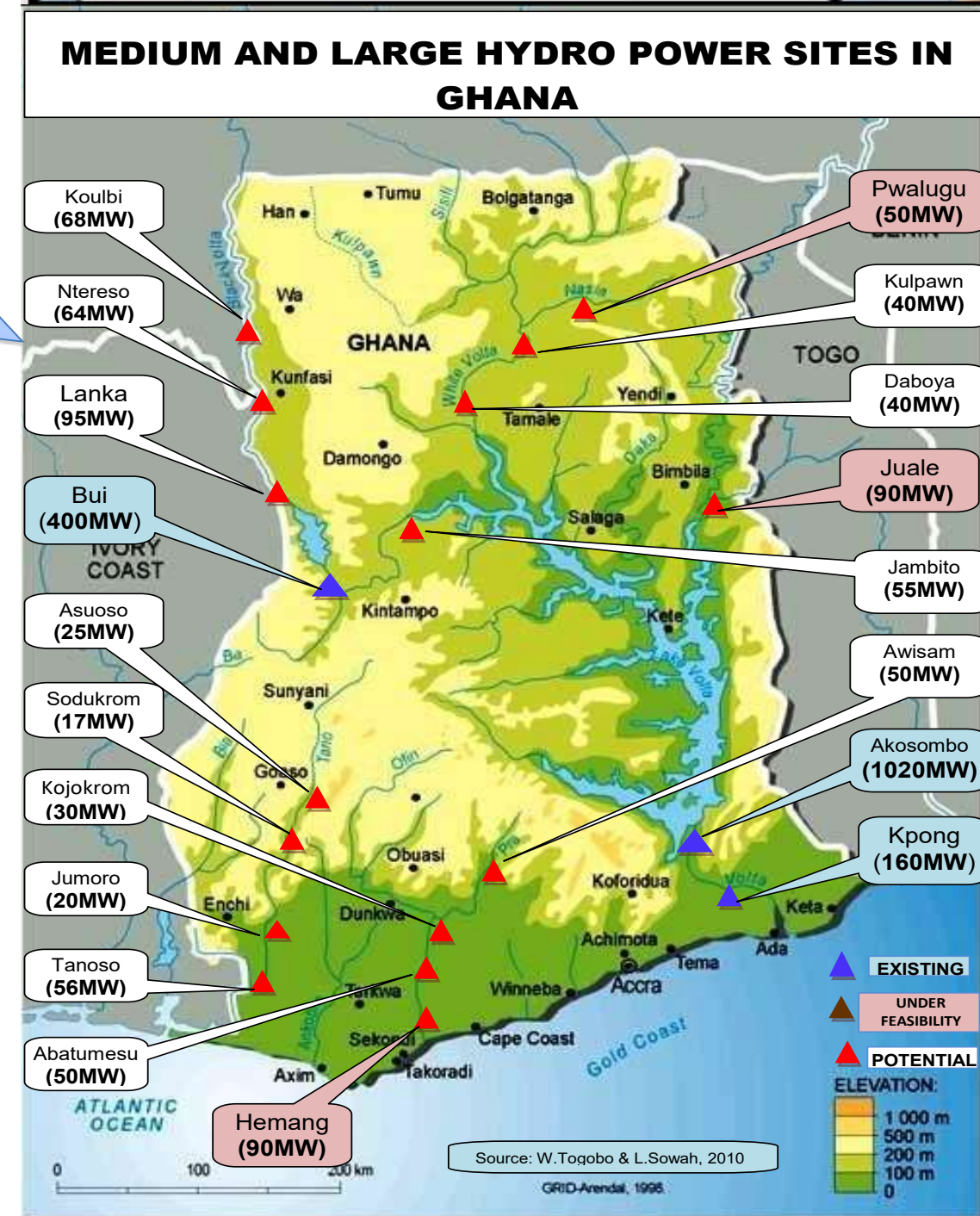
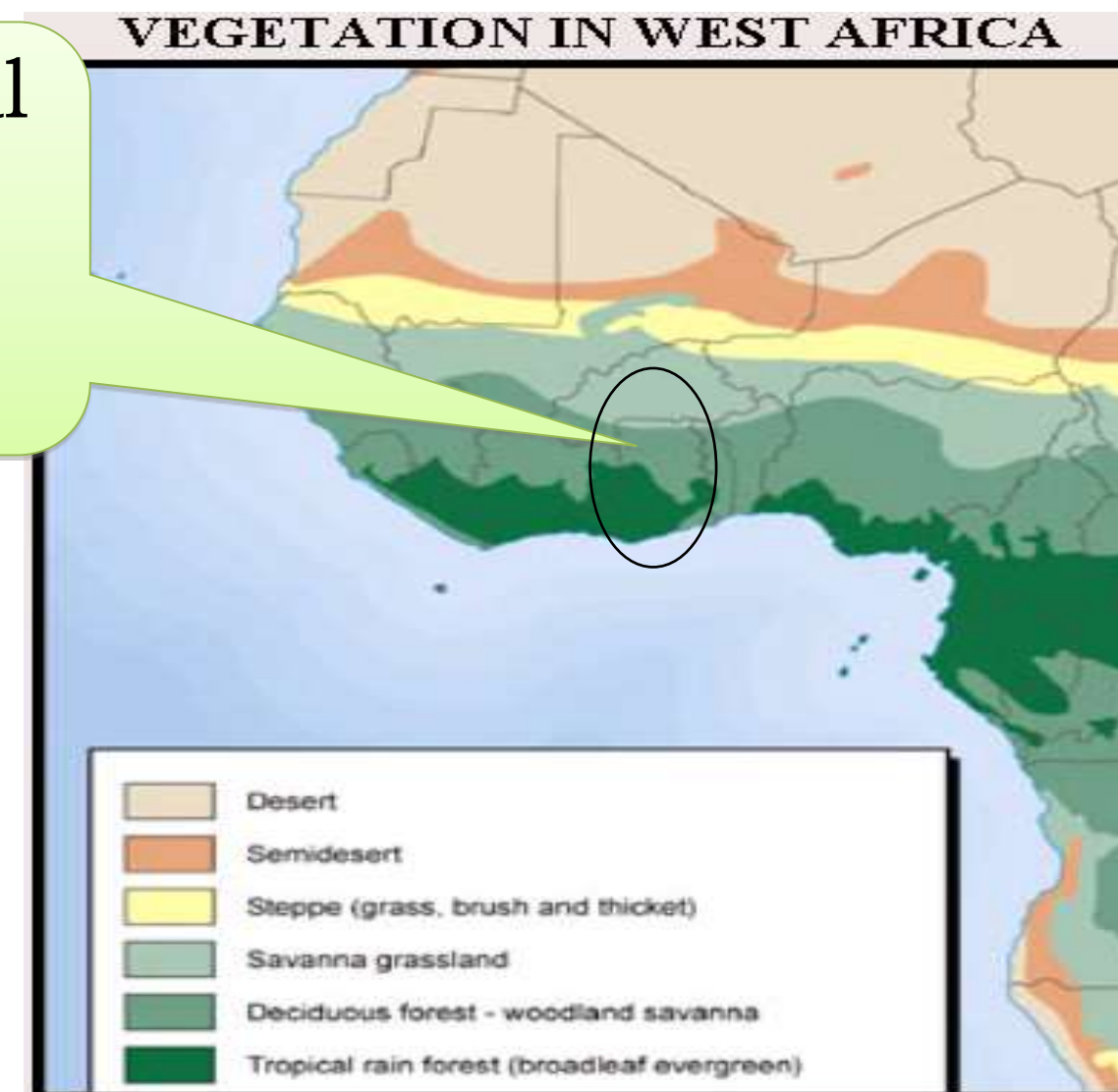
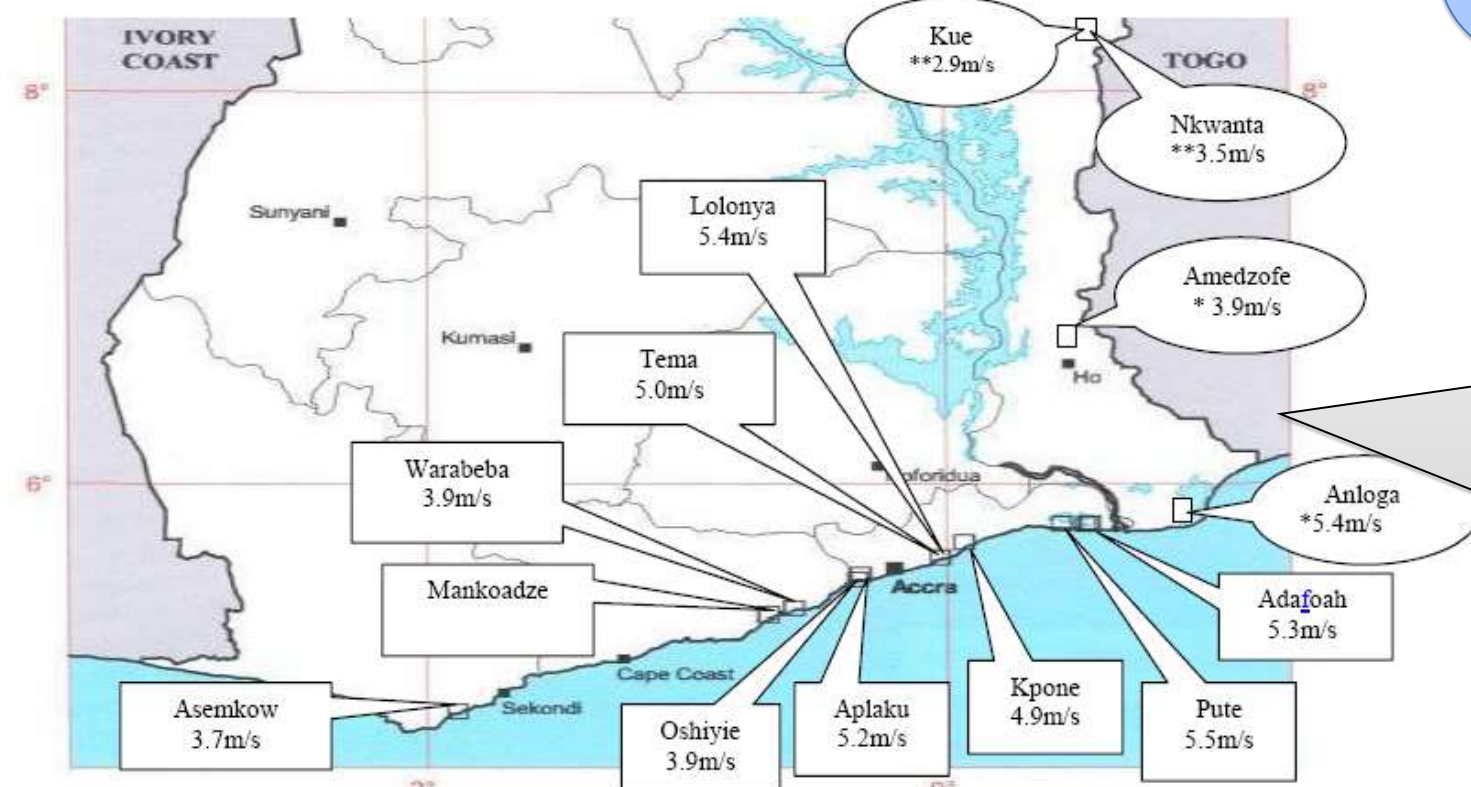
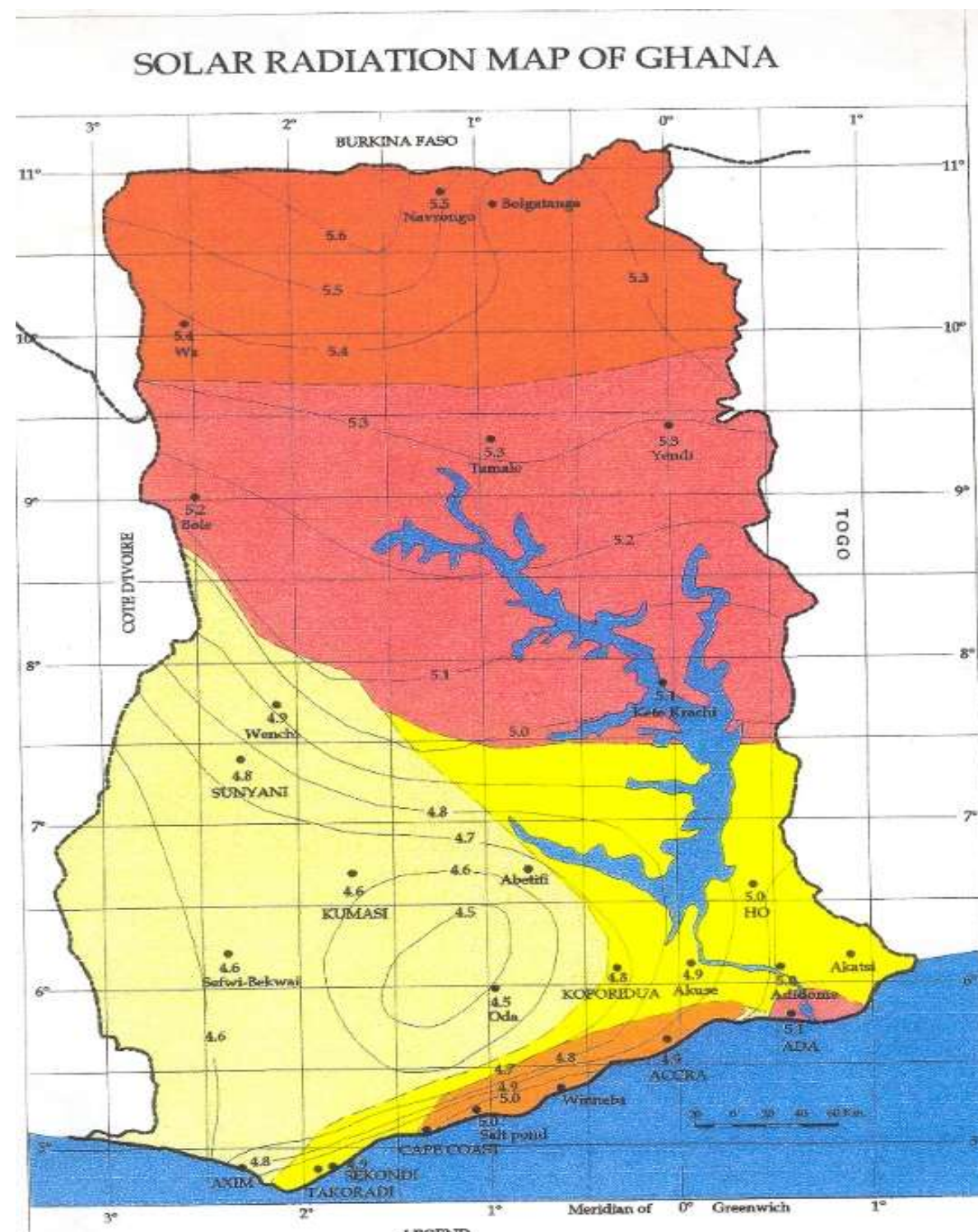
Energy Resource Potential in Ghana

Ghana has high potential for energy crops, forest and crop residue for electricity generation

High solar irradiation 4-6 kWh/m²/day to support grid and off-grid electrification

Ghana has over 14 potential hydro sites with total capacity of 740MW yet to be exploited.

High Wind power potential along coast. Data collection at 60m & 80m height underway in 13 sites.



- Until the late 1980s, renewable energy in the form of hydro power accounted for more than 90% of Ghana's total electricity generation
- As at December 2024, the contribution of hydro and other renewable energies in the energy mix had declined to about 28% of total installed electricity generation capacity.

ALTERNATIVE BASE-LOAD ENERGY FOR INDUSTRIALIZATION

- SDG goal 7
- The Paris agreement
- We need to plan for future clean base-load energy for industrial growth using clean energy technologies.
- Variable renewable energy (solar and wind) will continue to play a role in Ghana's energy mix based on a robust grid and reliable baseload energy
- Gas-Power as basedload electricity?

Figure 34: Base case: Supply/Demand balance, bcf per year

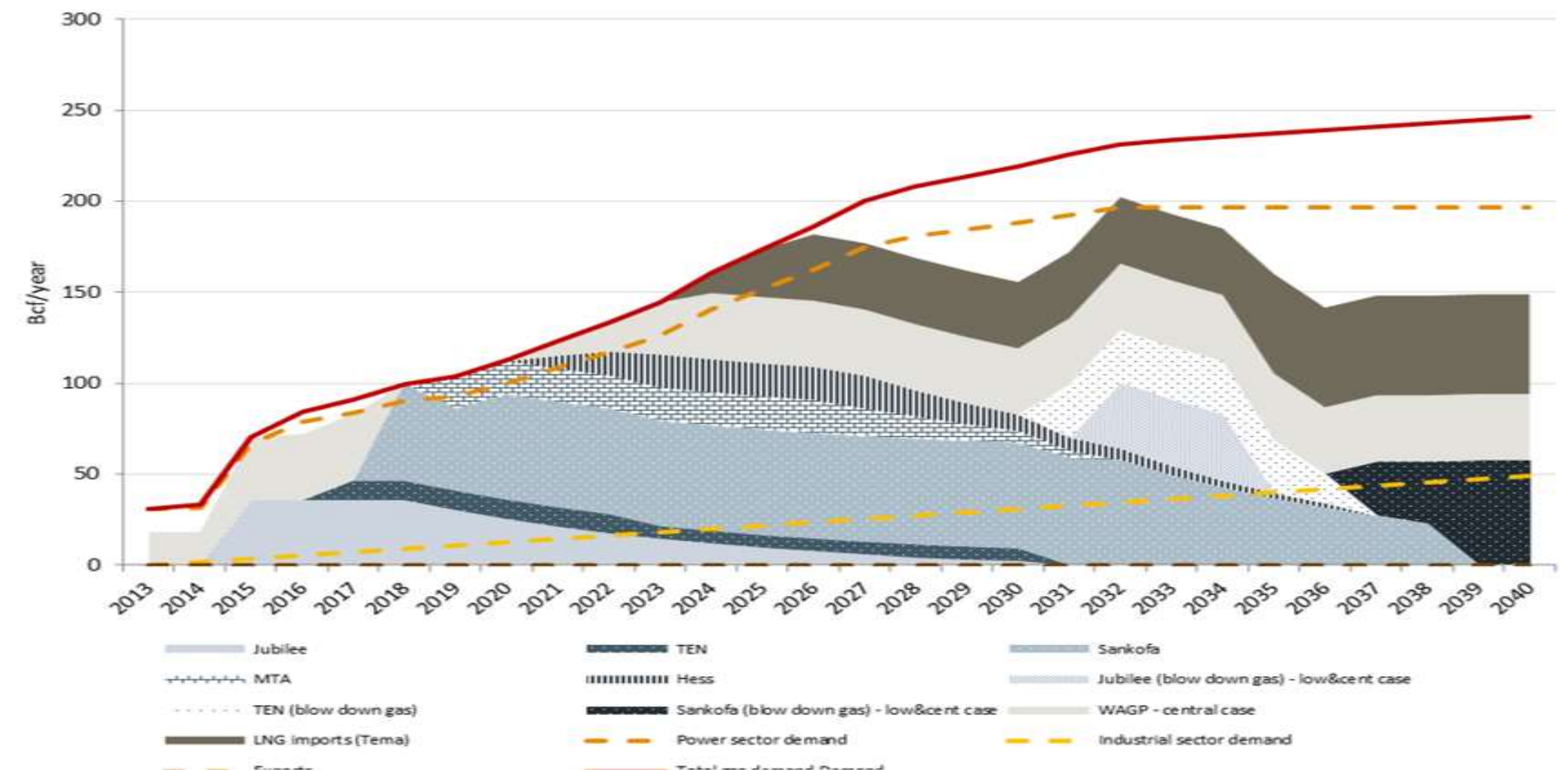
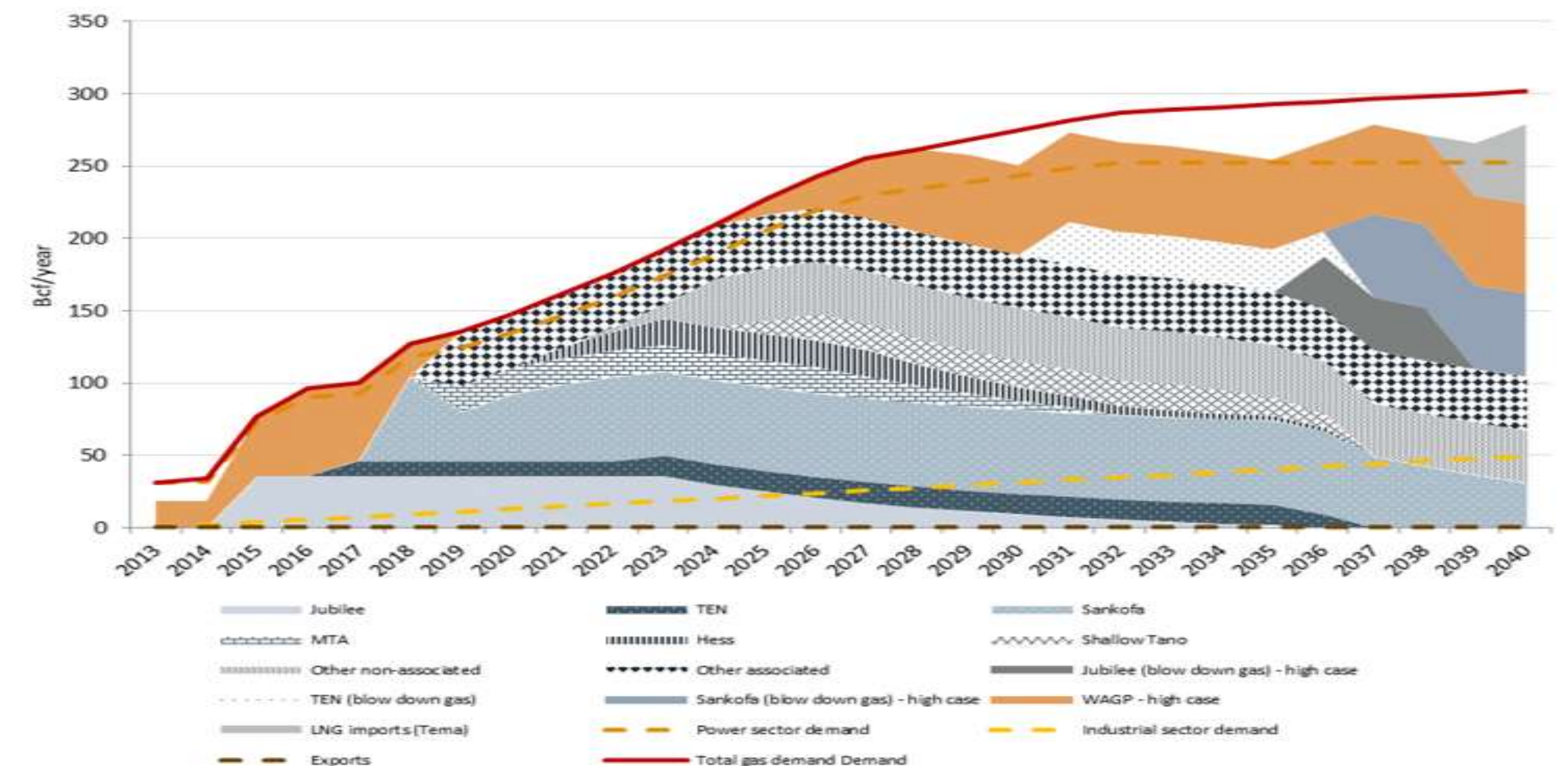


Figure 36: High case: Supply/Demand balance, bcf per year



ENERGY MODELLING FOR ENERGY TRANSITION USING LOW EMISSIONS ANALYSIS PLATFORM (LEAP)

PRELIMINARY ASSUMPTIONS

Main assumptions		2021	2070	Avg. Annual Growth Rate
GDP(\$billion)		79.1	863.7	5%
Population(million)		30.8	72.2	2%
Urban share (%)		56.0	85.0	1%
Electricity access	National		99.8% (by 2030)	
	Rural Savannah*	57.3	99.8% (by 2030)	12%
	Rural Forest**	60.1	99.8% (by 2028)	14%
	Rural Coastal***	76.9	99.8% (by 2030)	4%

Ghana: Gross domestic product (GDP) in current prices from 1987 to 2027 (in billion U.S. dollars)



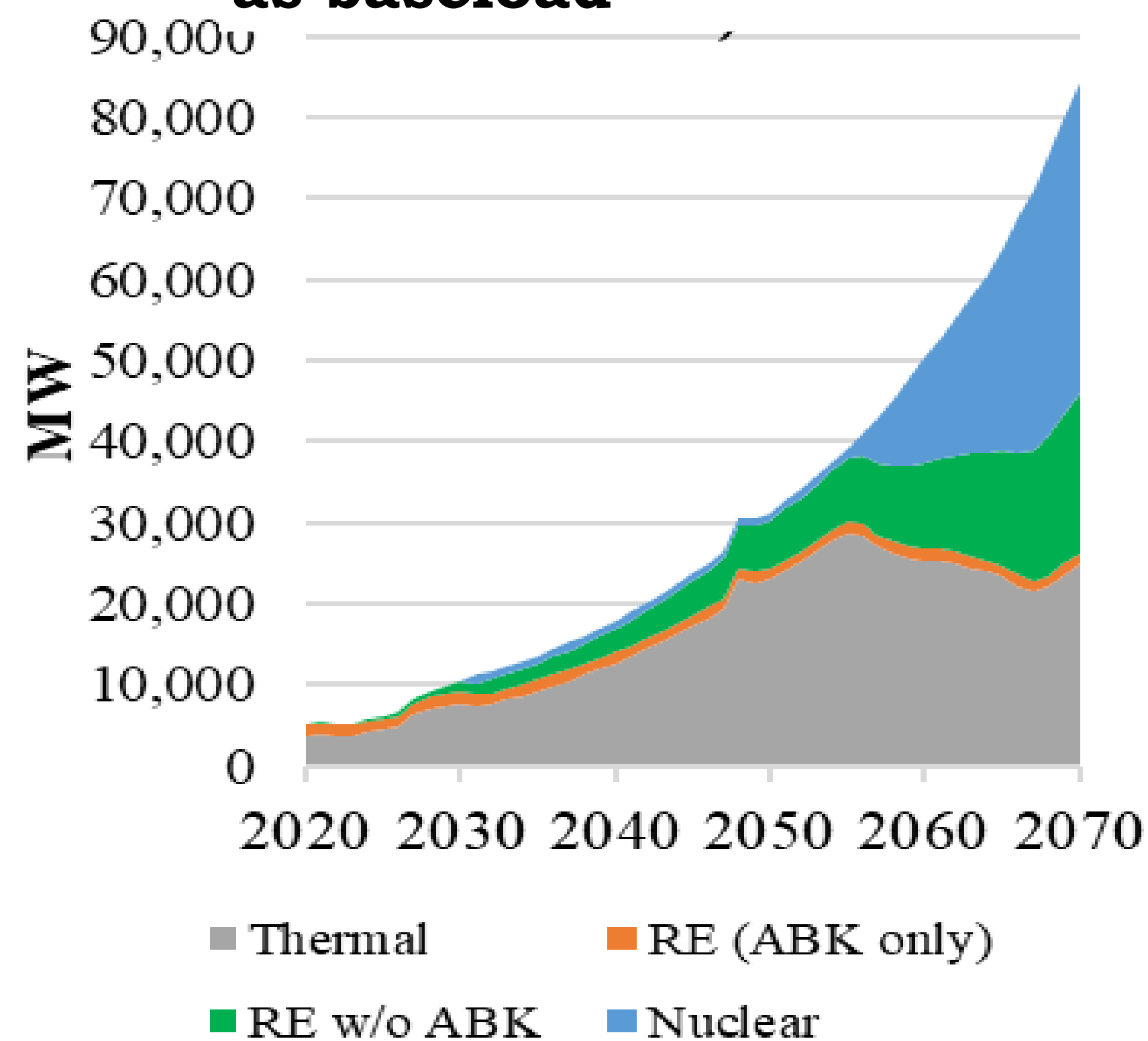


DEMAND MODELLING AND ASSOCIATED EMISSION SCENARIOS

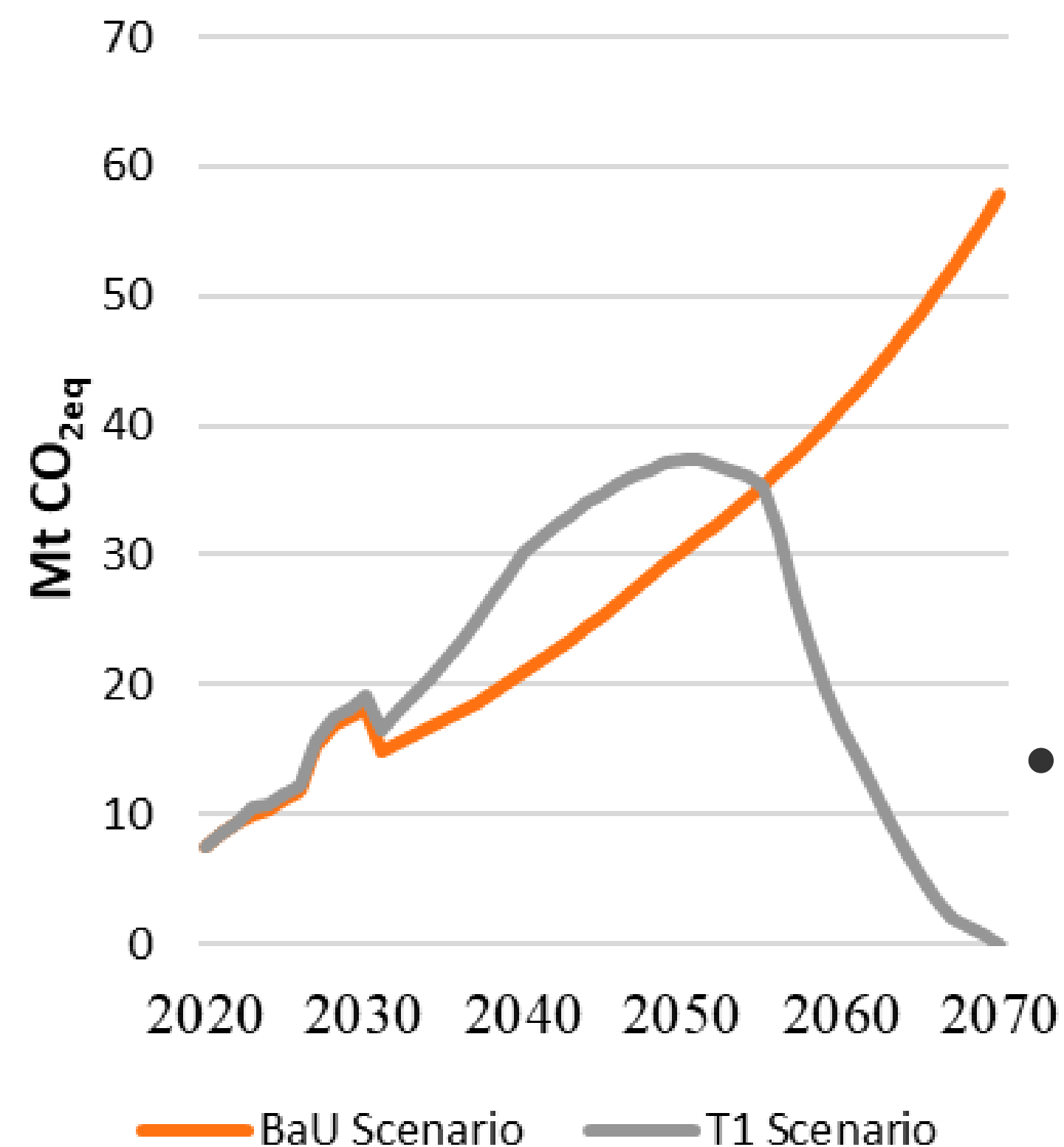
- TRANSITION SCENARIO 1 (T1)

This scenario includes the use of nuclear for power generation; use of Carbon Capture, Utilization and Storage (CCUS) technology; use of compressed natural gas, electric, hydrogen fuel cell vehicles; sustainable aviation fuel; efficient energy transformation processes; and efficient end-use appliances.

T1 Scenario (Nuclear as baseload)



NPI Vs TI Emissions



Advantages

- High energy security due to a diversified based load fuel mix
- Access to future green trade market
- Lower cost of electricity generation
- Meet future electricity demand due to fuel switch

Associated Risk

- High investment cost – introduction of CCUS and Nuclear
- Human resource and industrial capacity of new technologies

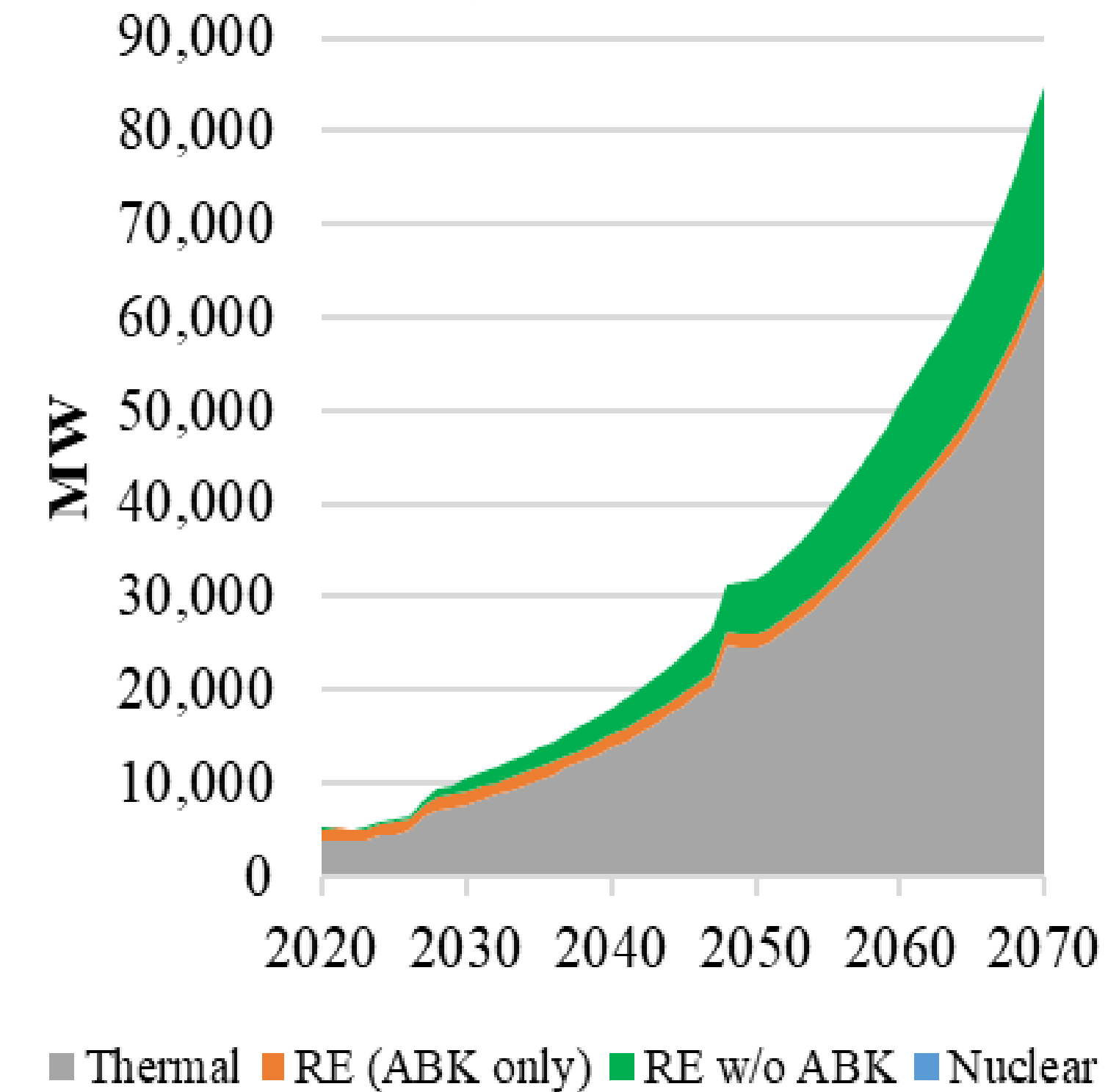


DEMAND MODELLING AND ASSOCIATED EMISSION SCENARIOS

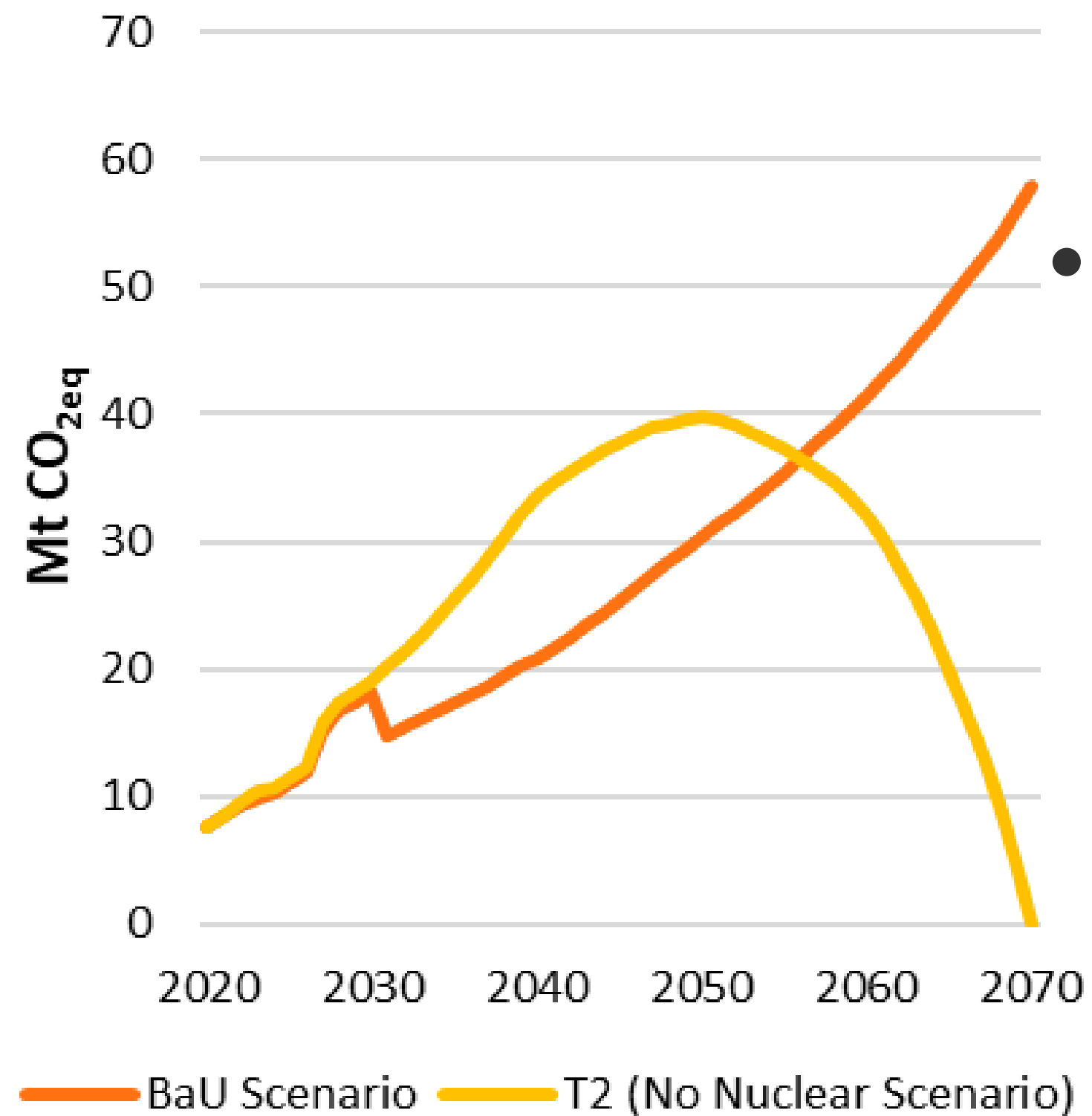
- TRANSITION SCENARIO 2 (T2)

This considers everything under Transition Scenario 1 but excludes the use of nuclear for power generation. This scenario was considered with the assumption that there would be constant supply of indigenous natural gas.

T2 Scenario (Gas as baseload)



NPI Vs T2 Emissions



• Advantages

- Access to future green trade market
- Meet future electricity demand due to fuel switch

• Associated Risk

- Low energy security due to non-diversified baseload fuel mix
- High investment cost – introduction of CCUS
- No guarantee of constant availability and supply of domestic natural gas
- Price volatility of imported gas (LNG)
- High cost of electricity generation due to production cost



DEMAND MODELLING AND ASSOCIATED EMISSION SCENARIOS

- TRANSITION SCENARIO 3 (T3)

This considers everything under Transition Scenario 1 but excludes the use of nuclear for power generation and CCUS. This scenario was considered with the assumption that there would be constant supply of indigenous natural gas.

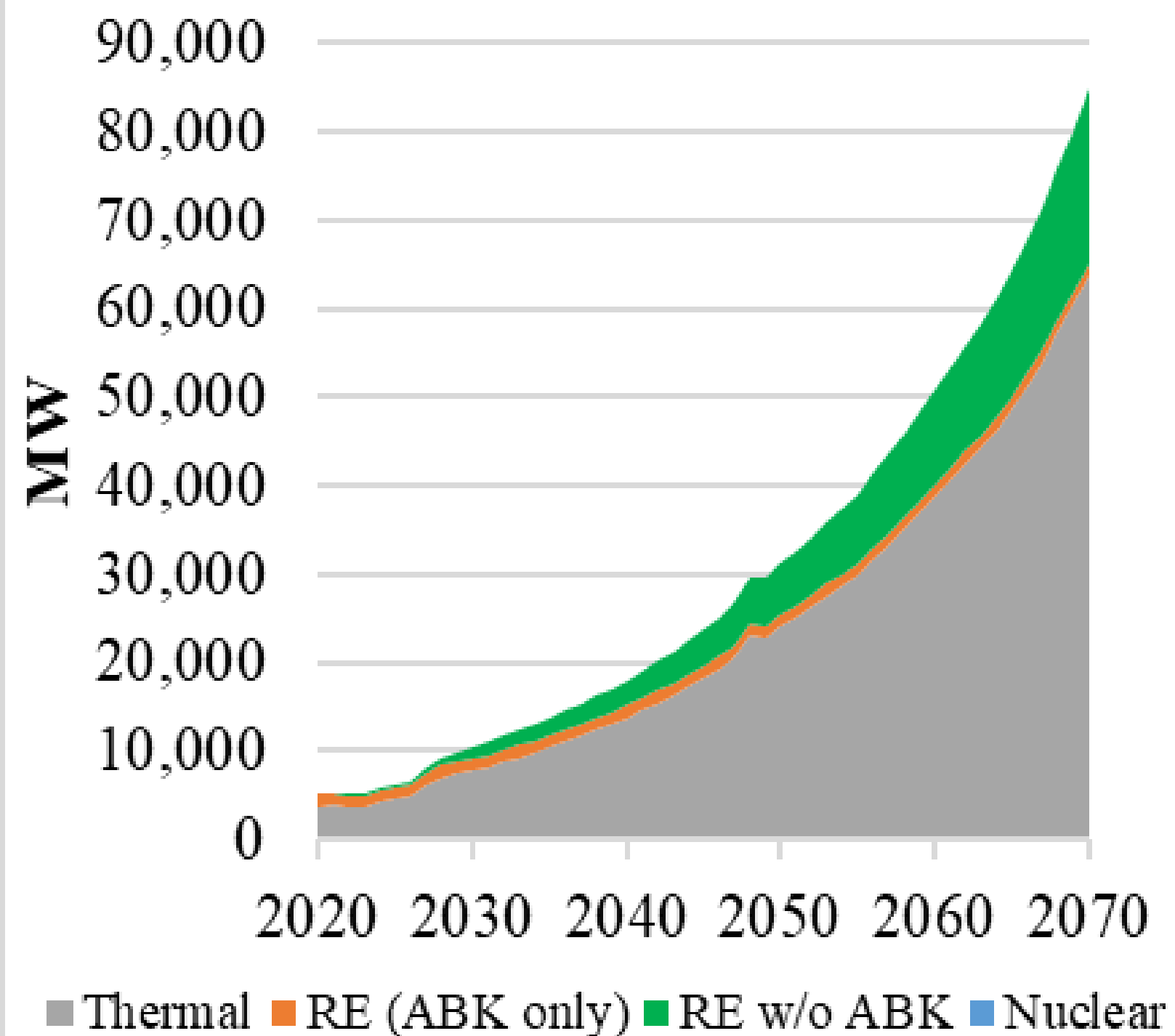
• Advantages

- Meet future electricity demand due to fuel switch
- Low investment cost

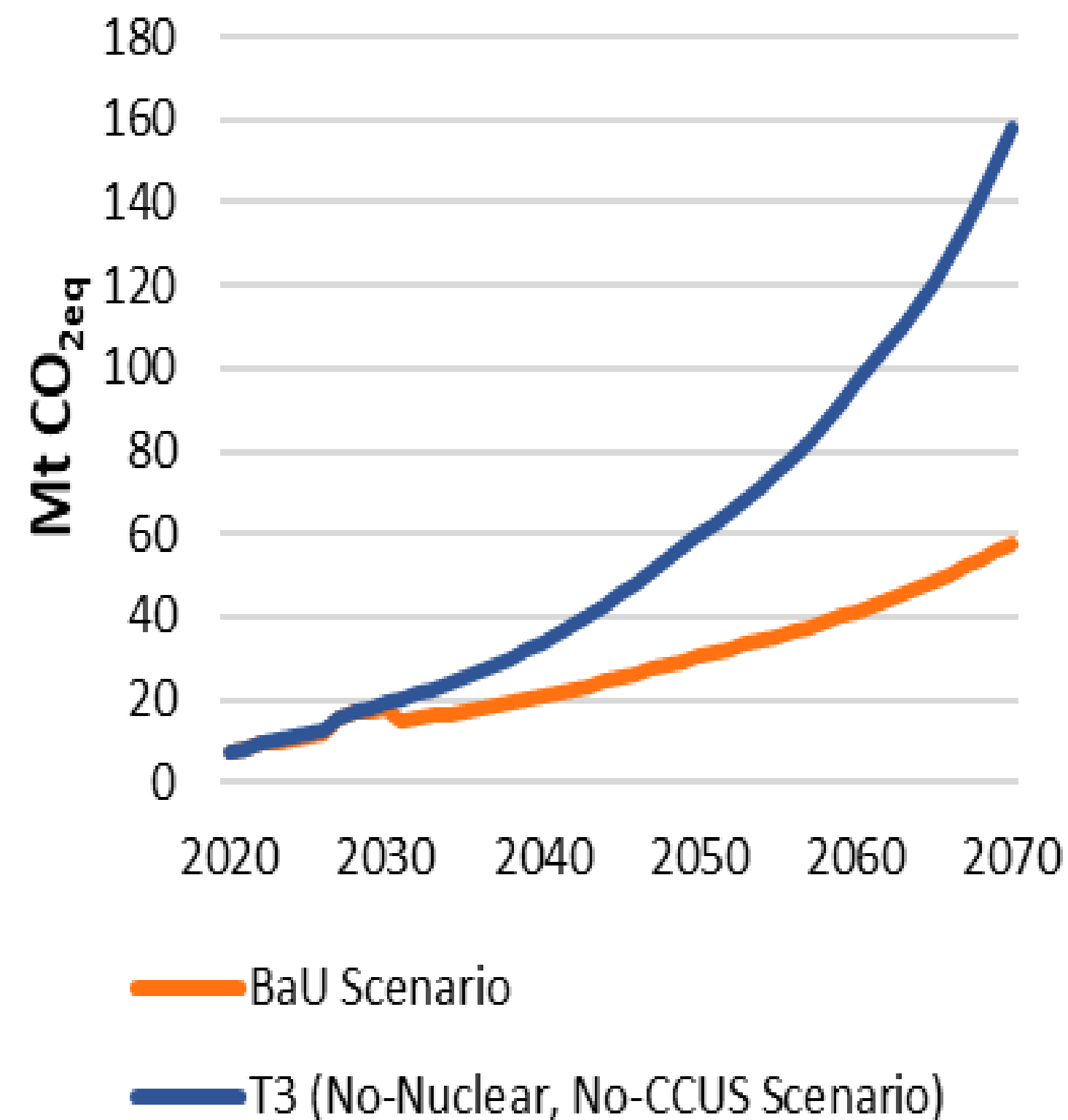
Associated Risk

- Low energy security due to non-diversified baseload fuel mix
- No guarantee of constant availability and supply of domestic natural gas
- Price volatility of imported gas (LNG)
- GHG emission levels rises with associated health concerns
- No access to future green trade market

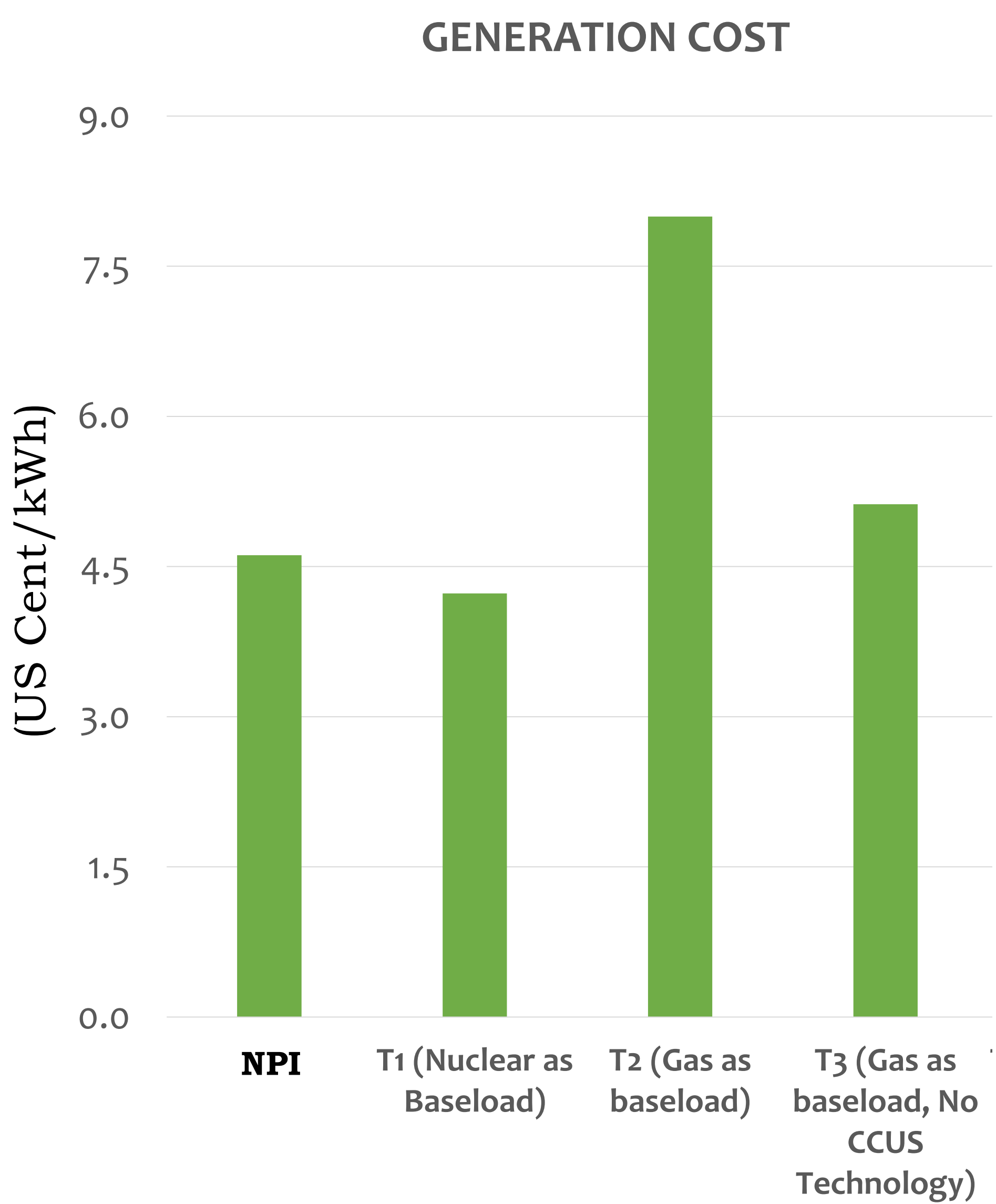
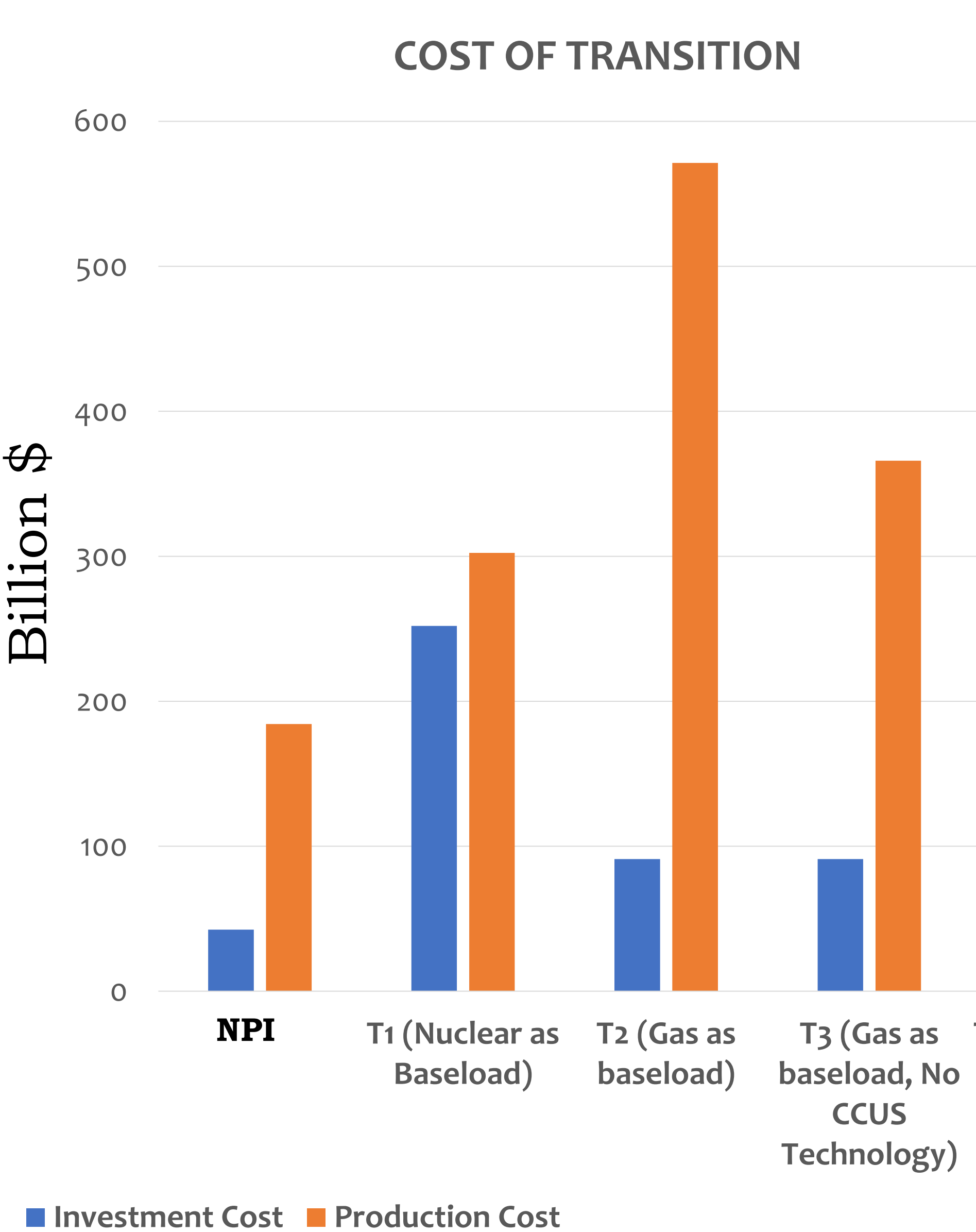
T3 Scenario (Gas w/o CCUS)



NPI Vs T3 Emissions



CUMMULATIVE ELECTRICITY COSTS

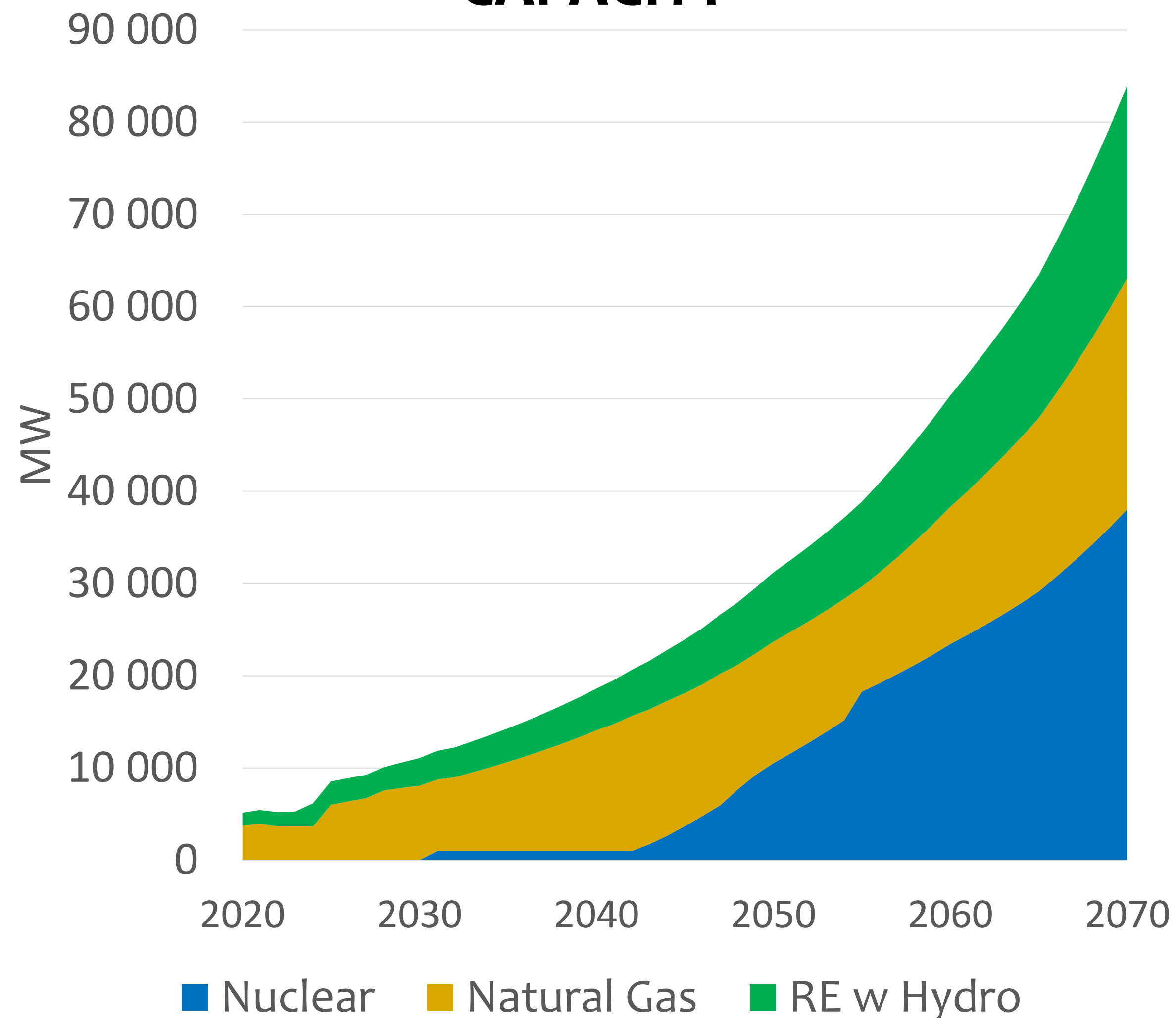




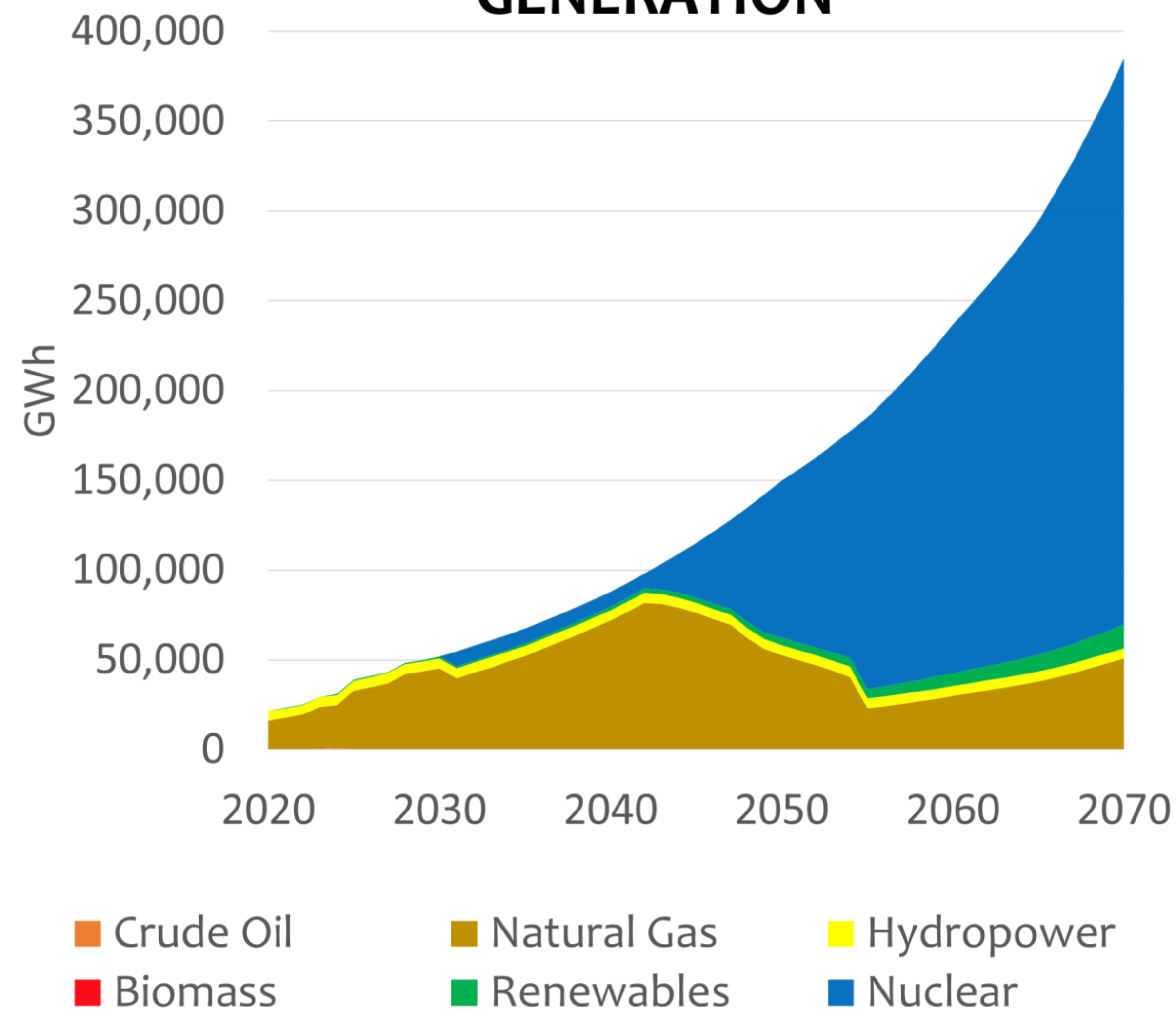
ENERGY TRANSITION ENERGY MIX

Nuclear and Gas as baseload

CAPACITY



GENERATION



Ghana Roadmap



POLICIES TOWARDS ACHIEVING NET ZERO

DECARBONIZATION

- GHG emitting industries shall be required to establish tree plantations to offset emissions.
- Natural Gas shall be a transition fuel for electricity production, industrial heating and transport
- Aggressively promote afforestation as carbon sinks.
- Establish a regulatory framework to minimise GHG emissions from industries.
- Legislate and develop rules for carbon finance and trade
- Promote and encourage non-motorized transportation
- Promote and encourage the use of electric vehicles

- Phase-out fossil-fuelled ICE vehicles
- Introduce Carbon Capture, Utilisation and Storage (CCUS) technology in applicable thermal power plants and industries
- Increase the share of renewable in the energy generation mix
- **Introduce and increase the share of nuclear in the energy generation mix**
- Introduce and promote biofuel as a transition fuel
- Reduce the use of bulk road vehicles for transportation of goods
- Promote the use of hydrogen fuel

***ADOPTION OF SMALL MODULAR
REACTORS IN THE ENERGY MIX***

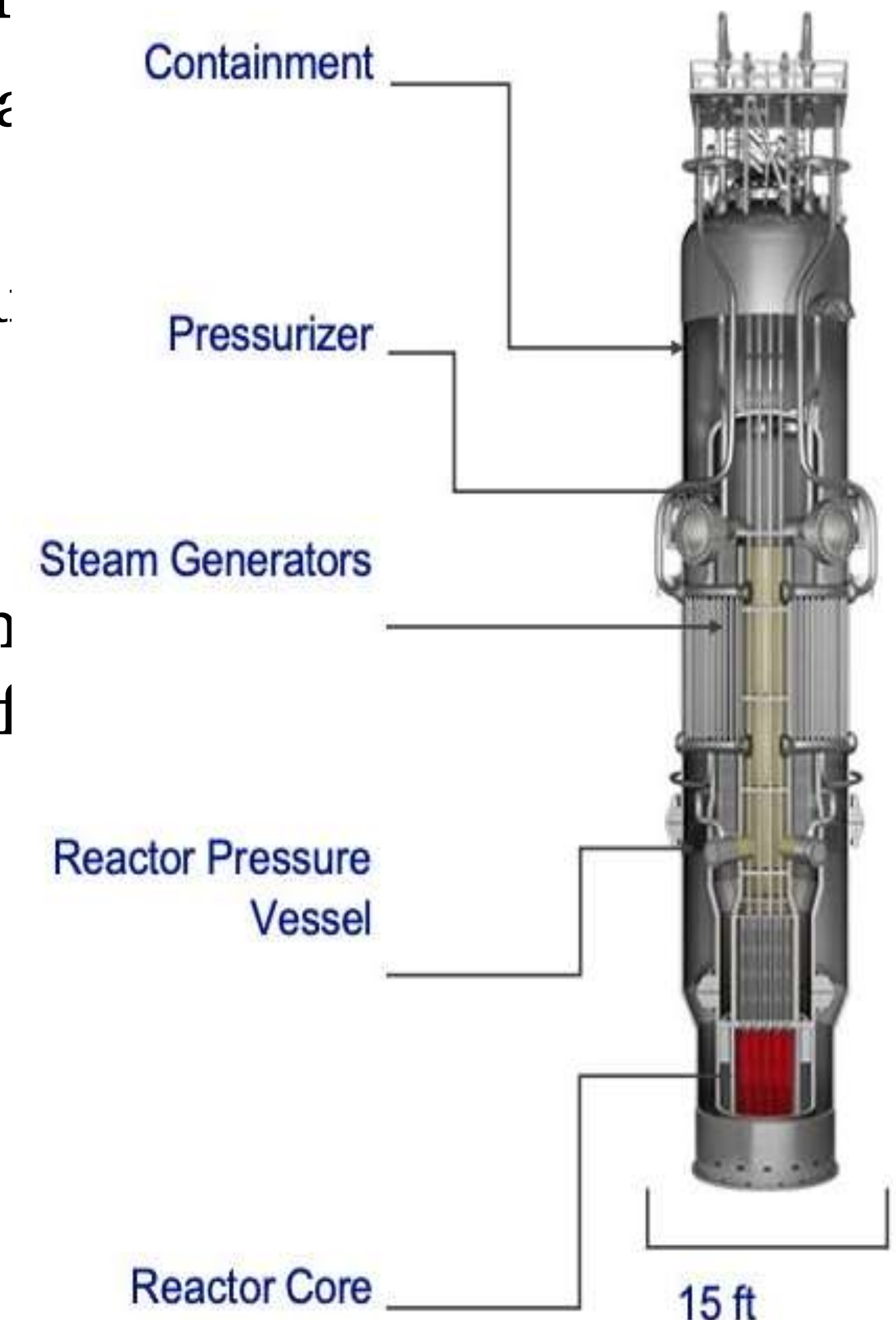
CONSIDERATION OF SMR IN GHANA'S ENERGY MIX

ANALYSIS

- SMRs could provide a stable, low-carbon energy source to complement Ghana's existing hydropower and thermal generation
- Has the potential to meet 10-15% of the nation's electricity demand by 2040.
- SMR is adaptability to Ghana's grid size due capacity and modularity
- Suitability for coastal and inland regions.
- Ability to be integrated in an industrial enclave
- Economic analysis indicates lower upfront investment with levelized cost of electricity (LCOE) competitive with fossil fuel alternatives but more expensive than large nuclear power plants

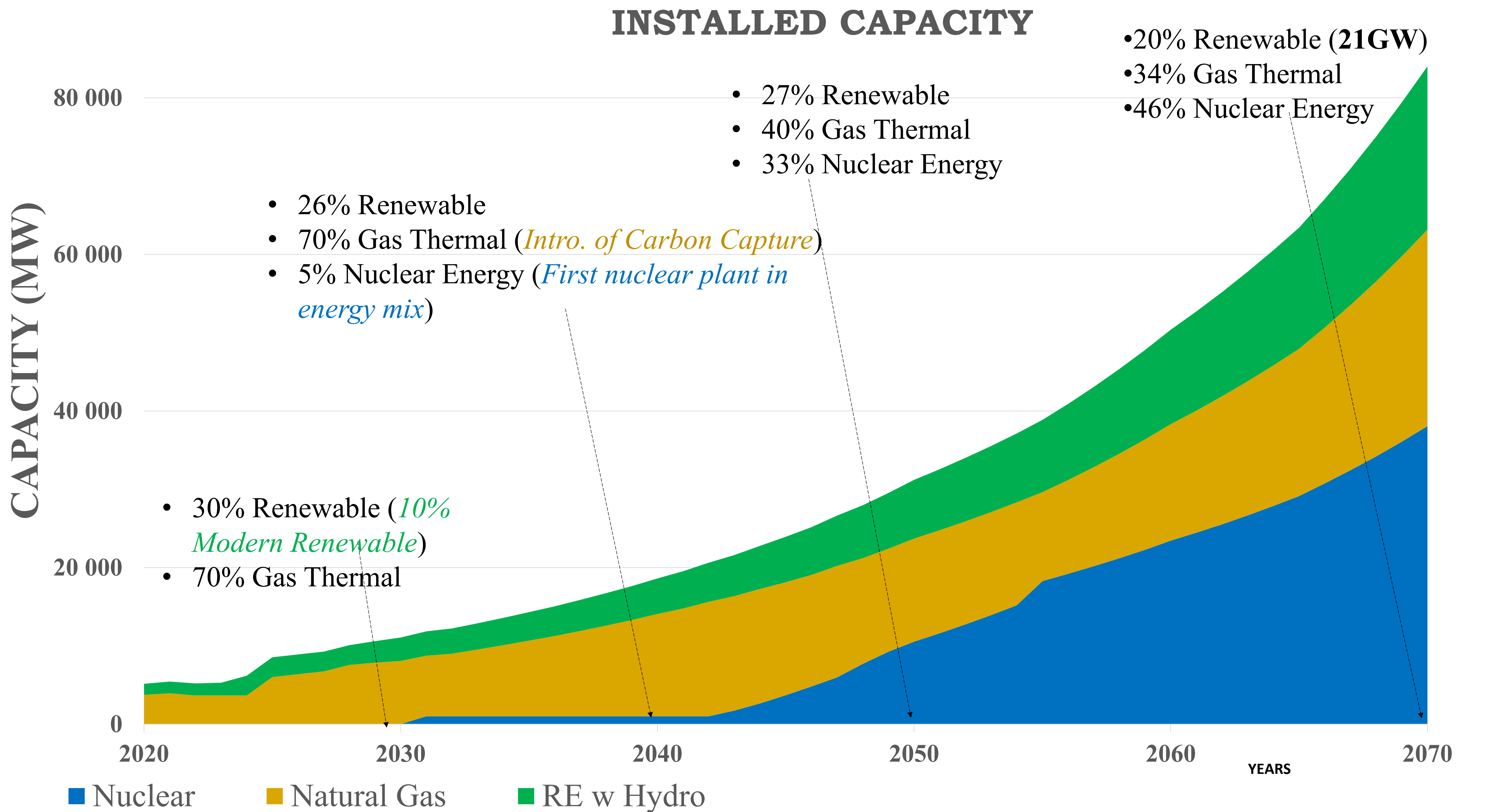
STEPS UNDERTAKEN TOWARDS SMR INTEGRATION

- In 2022, Ghana issued a Request for Information (RFI), of which 15 vendors participated with 4 SMR vendors technology
- In 2024, Nuscale technology was selected for adoption in an industrial enclave



*A cutaway view of NuScale's 77-MWe Power Module -
Courtesy: NuScale*

SMR TECHNOLOGY IN GHANA'S ENERGY TRANSITION PROJECTED ENERGY MIX



COST AND INVESTMENT REQUIREMENTS OF THE TRANSITION

Energy Cost

- **US\$76 billion** is estimated for electricity Trans. & Dist.
- Electricity generation capacity is estimated at **US\$266 billion**.
- Additional gas infrastructure, including T&D networks, sum up to **US\$14.5 billion**.

Transport Cost

The cost of replacing or switching fuel at the transportation sector is estimated at **US\$12.3 billion**.

Residential Cost

The main residential appliances considered include cooking, lighting, refrigeration, space cooling, water heating, cloth washing and dish washing. The total cost is estimated at **US\$148.2 billion**.

Industrial and Service Cost

- The total cost estimate for industry is **US\$7.4 billion**.
- the cost of replacing less efficient ACs and refrigerators with more efficient ones is estimated at **US\$14.5 billion**.



Total Cost

The total cost of the transition is therefore estimated at **US\$561.8 billion**

ECONOMIC IMPACT

Revenues and Contribution to GDP

- Projected Net Cashflows for Oil and Gas **US\$35 billion** & **US\$1.3 billion** respectively
- Electricity Sales **US\$140 billion** (16% GDP) by 2070



Agriculture and Food Security

The transition framework's impact on land use is insignificant (0.17% of arable land)

Jobs

The transition will have positive implications on jobs.

Total : 1.405 million Jobs

Fuel: 36, 808 Jobs

Electricity: 1.4 million Jobs

Energy Access and Security

Universal access to electricity and high access to modern cooking fuels. Increase in industrial and socioeconomic development

Productive Use of Energy

With universal electrification, households will have access to electricity for other productive uses such as running cold stores, hairdressing saloons, dressmaking and local eateries.

CHALLENGES AND RECOMMENDATIONS

Challenges

- Limited industrial capacity in the development of nuclear programme.
- Inadequate funding and financing mechanism for the nuclear programme.
- Public concerns about the risks and safety of nuclear power plants

Recommendations

- Establish strategic bilateral partnerships with more advanced nuclear power countries and international Institutions.
- Encourage Public-Private Partnership (PPP)
- Educate and sensitize the public (policy makers, legislators, media, educational Institutions, chiefs and opinion leaders) to address their concerns
- Continuously develop regulatory frameworks to address issues of safety, security and safeguards in accordance with international best practices.
- Ensure that all activities of the nuclear programme are transparent, technically sound, clear, accurate, reliable and understandable to the public and provide for appropriate public involvement in a timely manner.

CONCLUSION

SOCIAL IMPACTS

GENDER

The extensive use of biomass especially for cooking disproportionately affect women and children who are the gatherers of these solid fuels. An improvement in access to energy both for cooking and for lighting would lead to a total **avoided time loss of 30.05 million hours** for firewood collection.

New job opportunities to be created is estimated at 1,404,702 due to the introduction of new technologies such as CCUS, Nuclear, Hydrogen, EV charging stations, etc.



HEALTH

Minimising energy-related indoor air pollution could avoid **48,218** number of premature deaths. The reduction in fine particulate matter will prolong the lives of people in communities.

Meets future electricity demand of 380,000 GWh
(83GW install capacity) due to
fuel switch

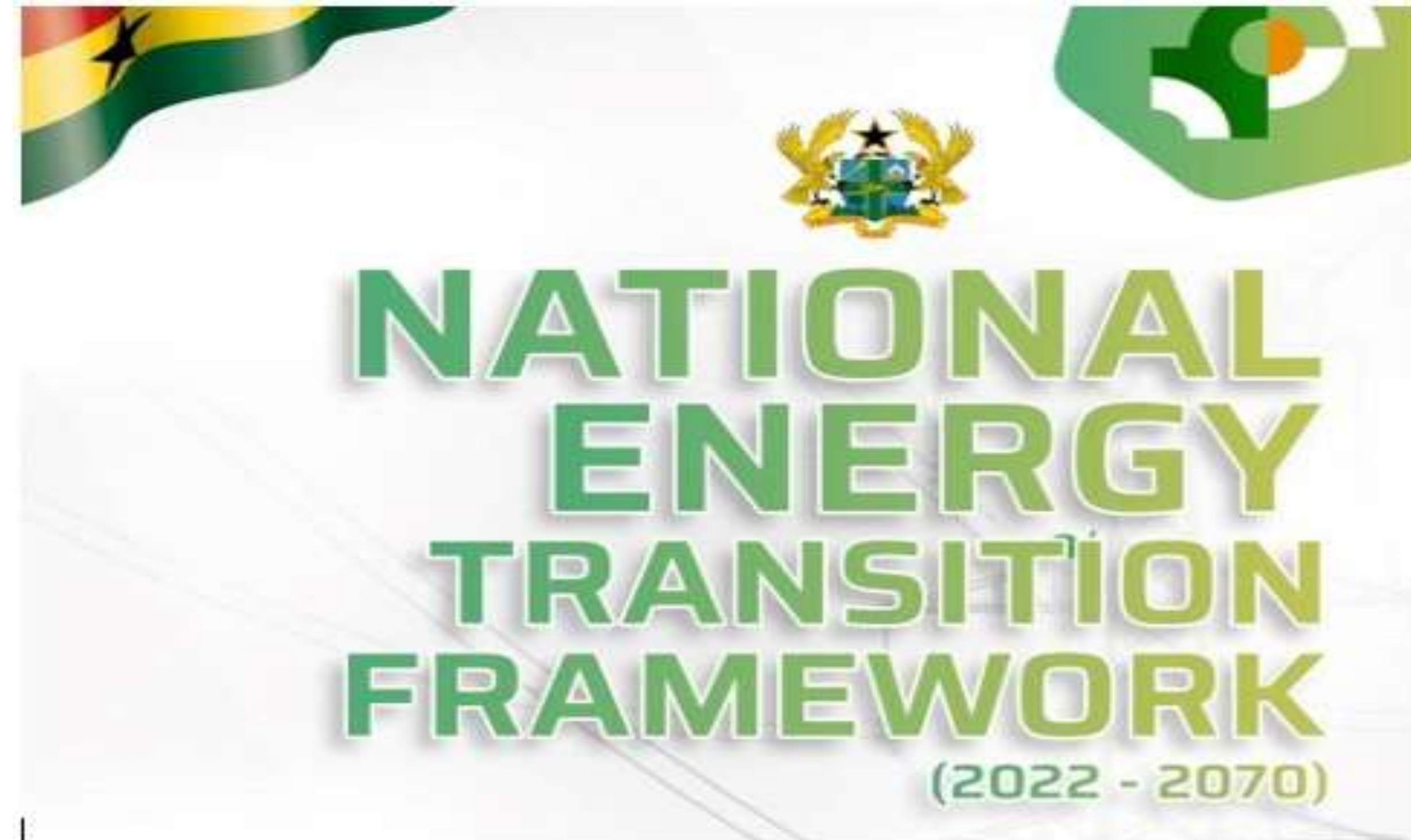
..Moving Towards Net-Zero

THANK YOU





SCAN TO DOWNLOAD



SCAN TO DOWNLOAD