DEPARTMENT OF ELECTRICITY AND ENERGY

Role of Nuclear In South Africa's Energy Mix

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DDG: Nuclear Energy and Regulation Management

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Presidential Climate Commission's Energy Dialogue

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- Supply of flexible or baseload Energy
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Government Policy

Nuclear Energy Policy of 2008

- Attainment of global leadership and self-sufficiency in the nuclear energy sector in the long term;
- *Nuclear Energy shall be used as part of South Africa's **diversification** of primary energy sources and to ensure security of energy supply*
- *Nuclear Energy shall contribute to **economic growth** and **technology development** in South Africa through investment in infrastructure, creation of jobs and the further development of skilled workers.*
- *Nuclear Energy shall form part of South Africa's strategy to **mitigate climate change**.*

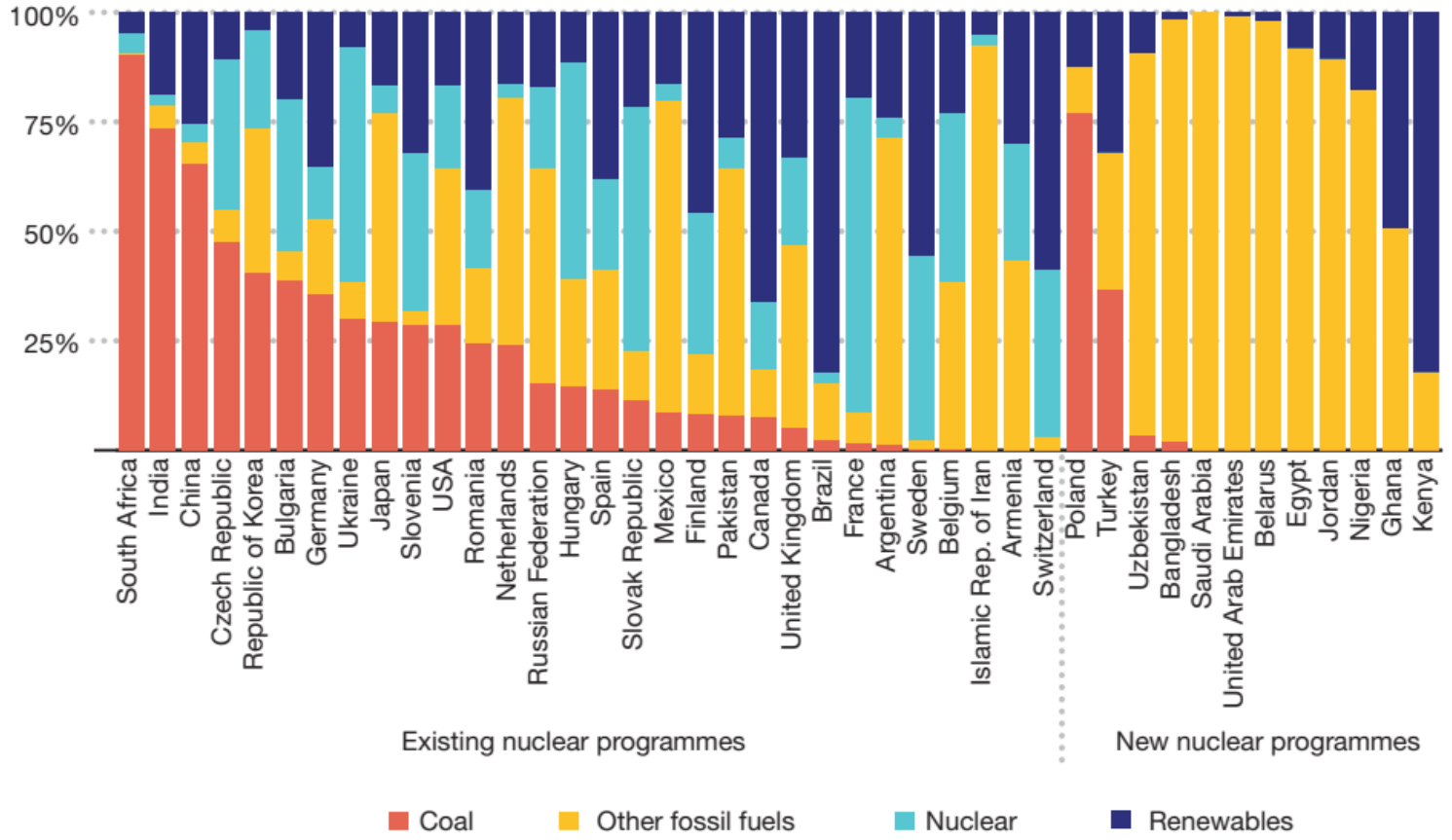
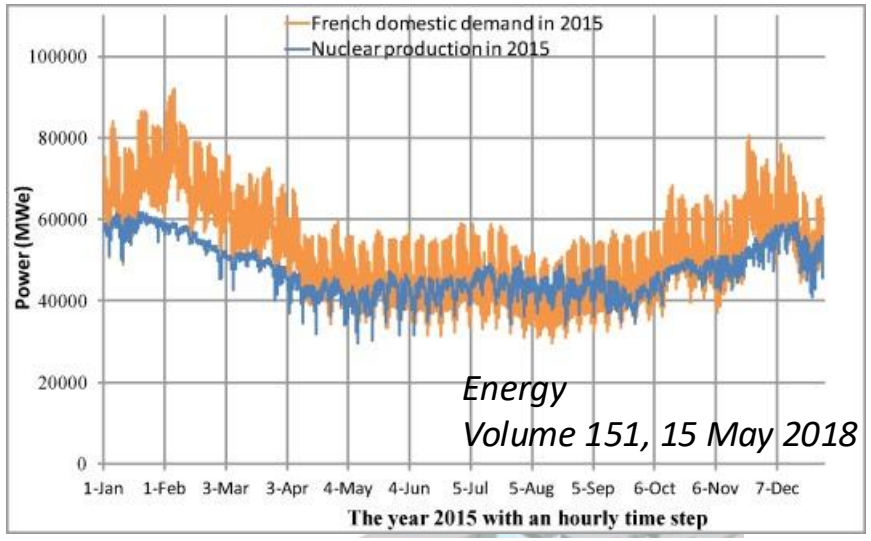


Figure 4. Electricity generation mix (2018) in countries with or planning nuclear power programmes [27].

Source: IEA, World Energy Statistics and Balances, Paris, 2021.

Supply of Flexible or Baseload Electricity

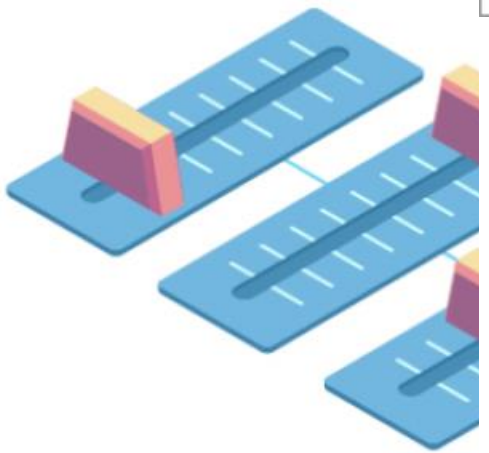
- Conventional Nuclear Power Plants have flexibility in design to follow load twice a day
- Newer designs are even more flexible and can match mid-merit plants
- When coupled with processes can produce a net output that is completely flexible

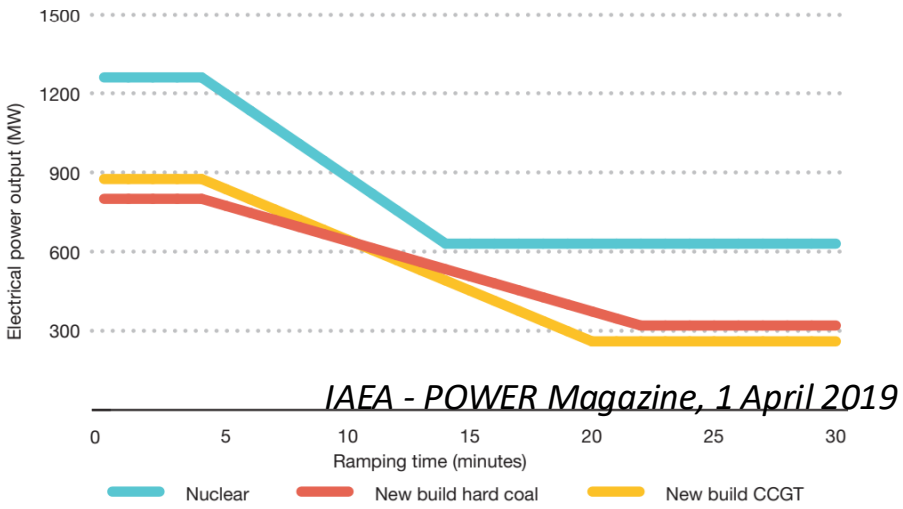


Energy
Volume 151, 15 May 2018

OPERATIONS

Current and new reactor designs can ramp power output **up or down** to match or balance grid demand.





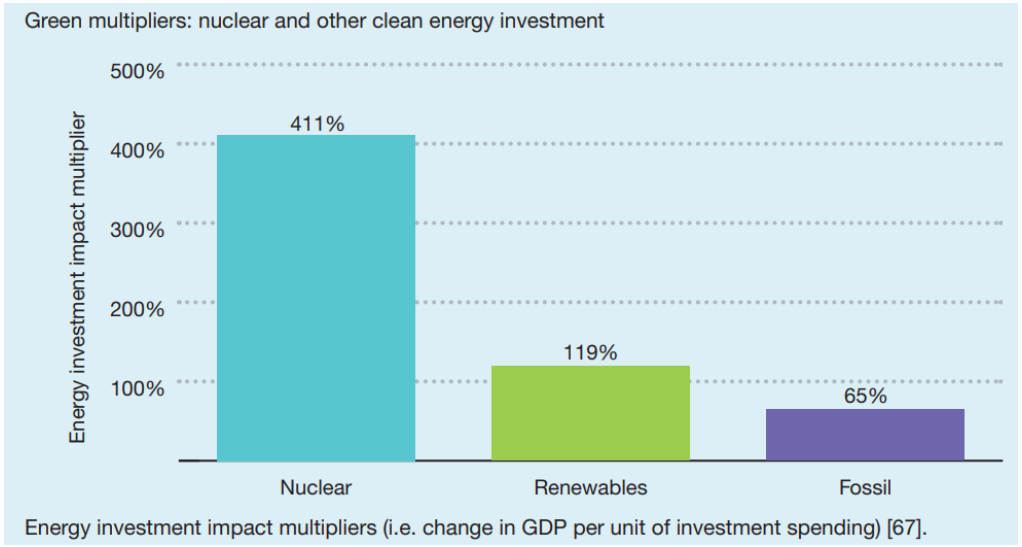
IAEA - POWER Magazine, 1 April 2019

Figure 5. Ramping capabilities of nuclear, coal fired and gas fired generation [28].

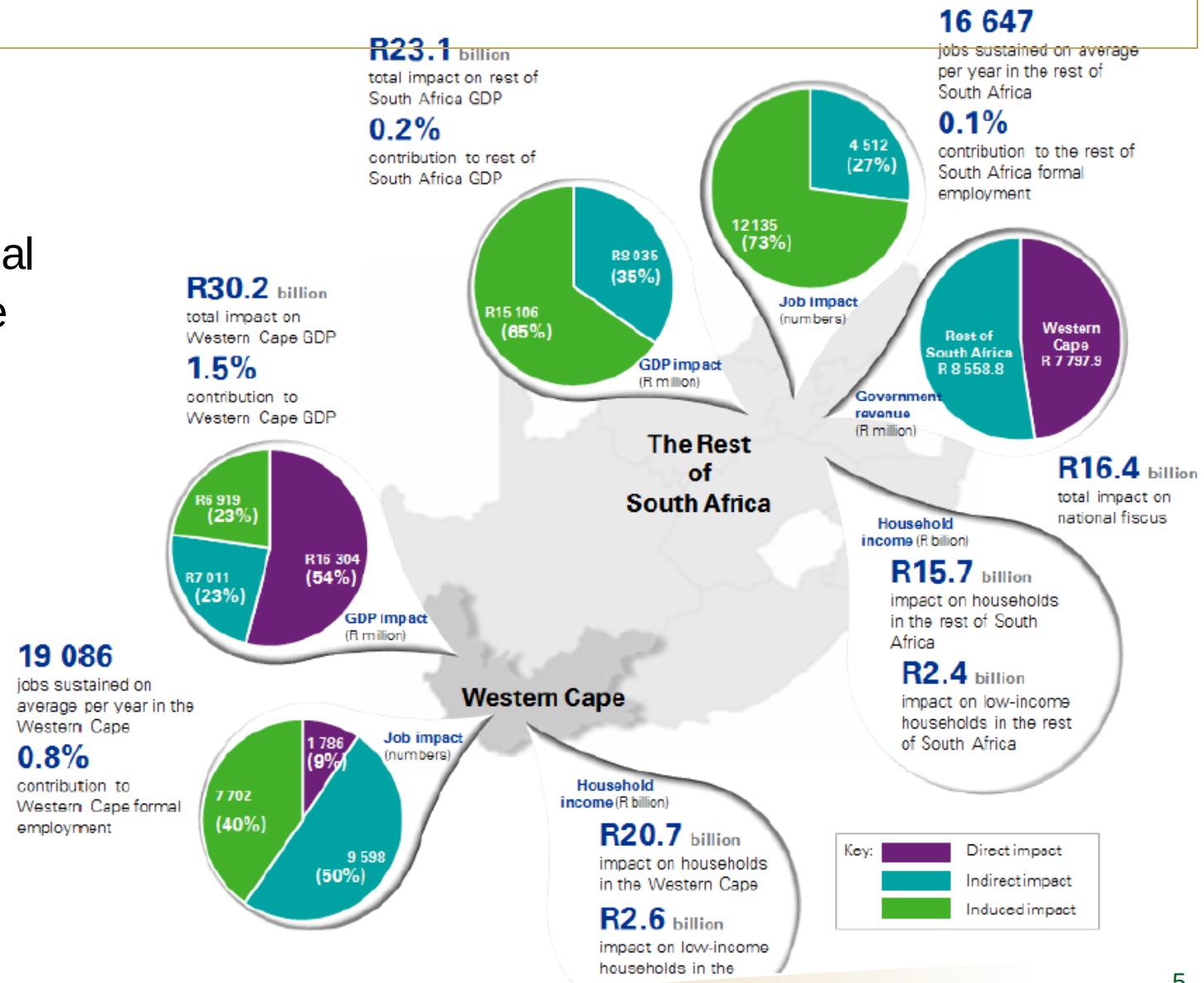
Source: US DOE

Create Sustainable Long-Term Jobs

- Nuclear Power plants have a 60 year + lifetime, long-term job stability.
- Construction stage jobs over an additional 10 year period before and after there are decommissioning jobs for a further 10 years.

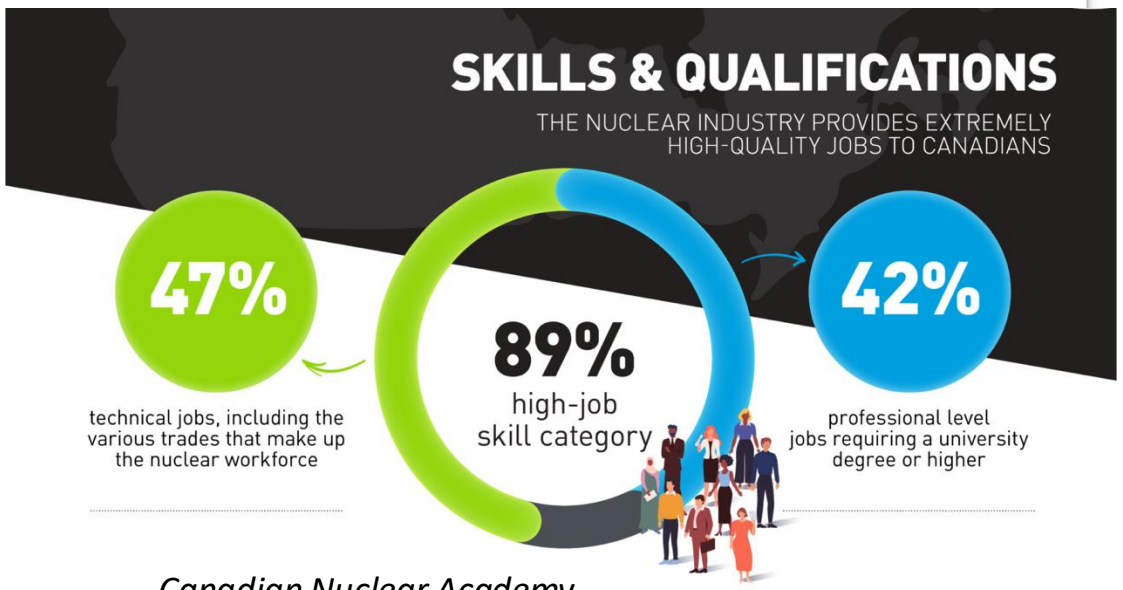


Source : *IMF Working Paper WP/21/87, International Monetary Fund, Washington, DC, 2021*

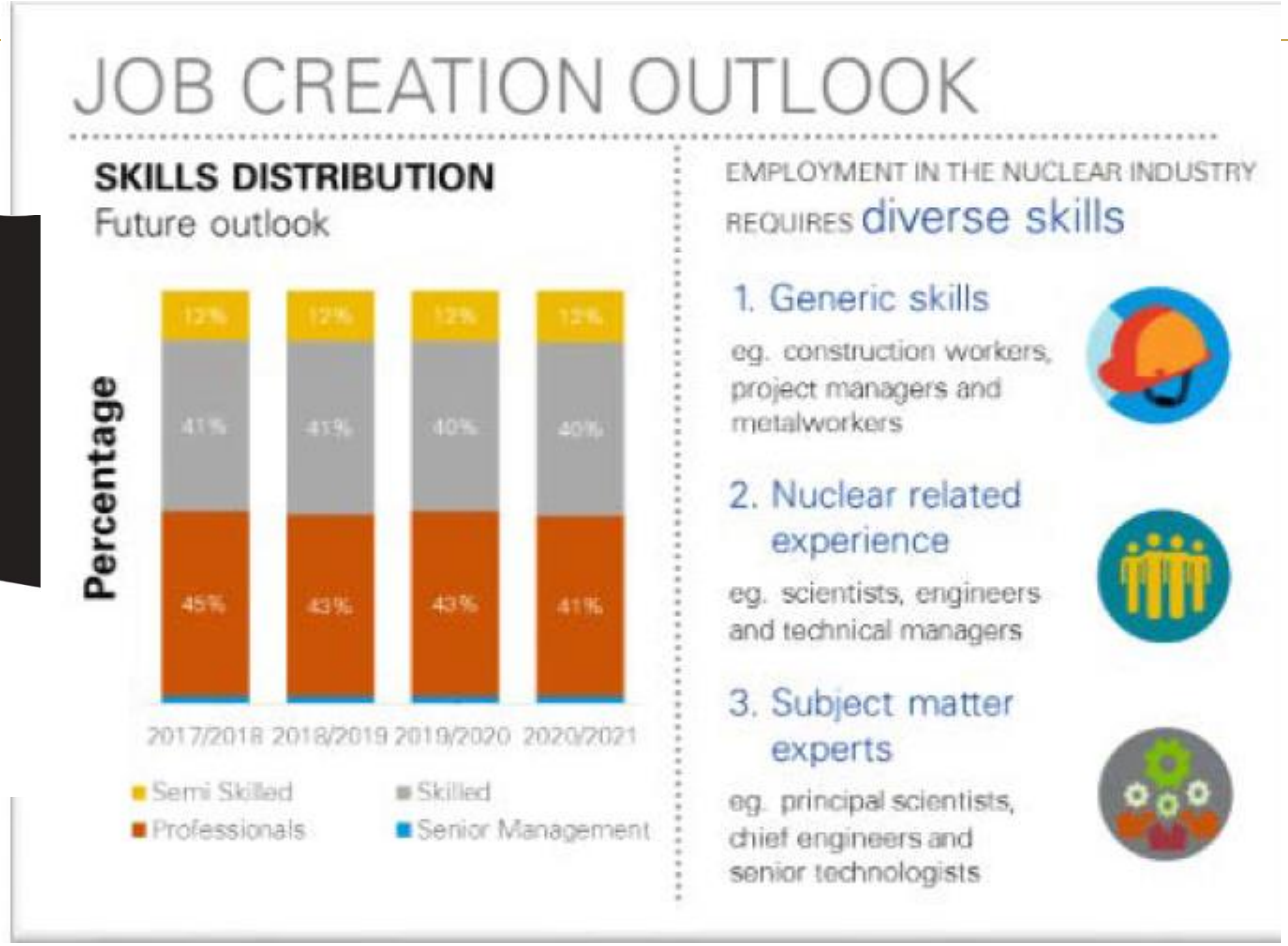


Source: KPMG analysis from 2014 Social Accounting Matrix for South Africa and Western Cape

Highly Skilled Workers



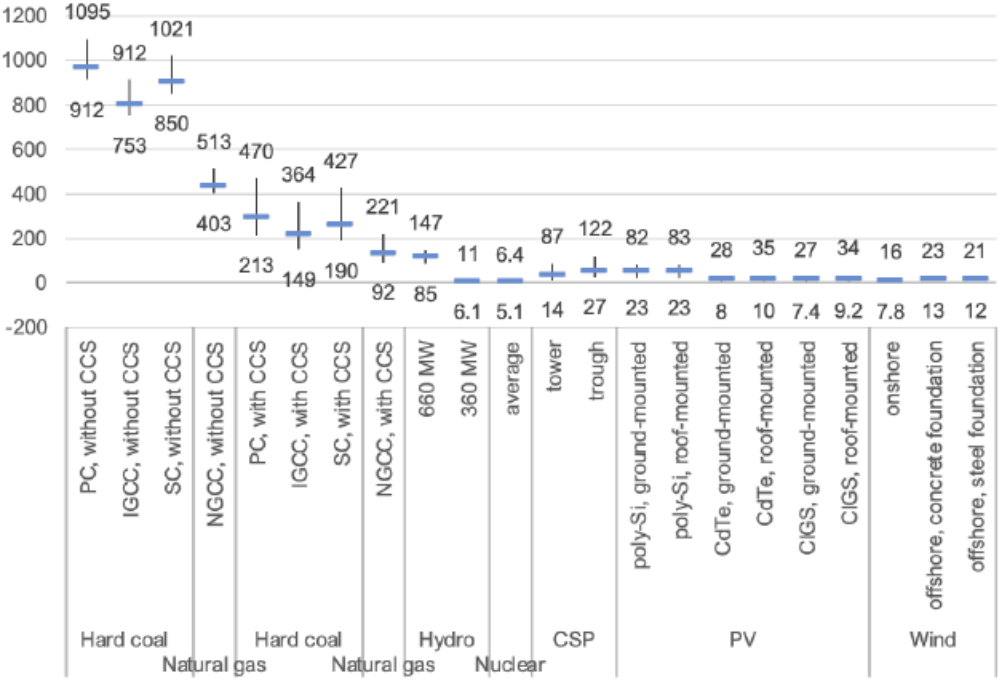
Canadian Nuclear Academy



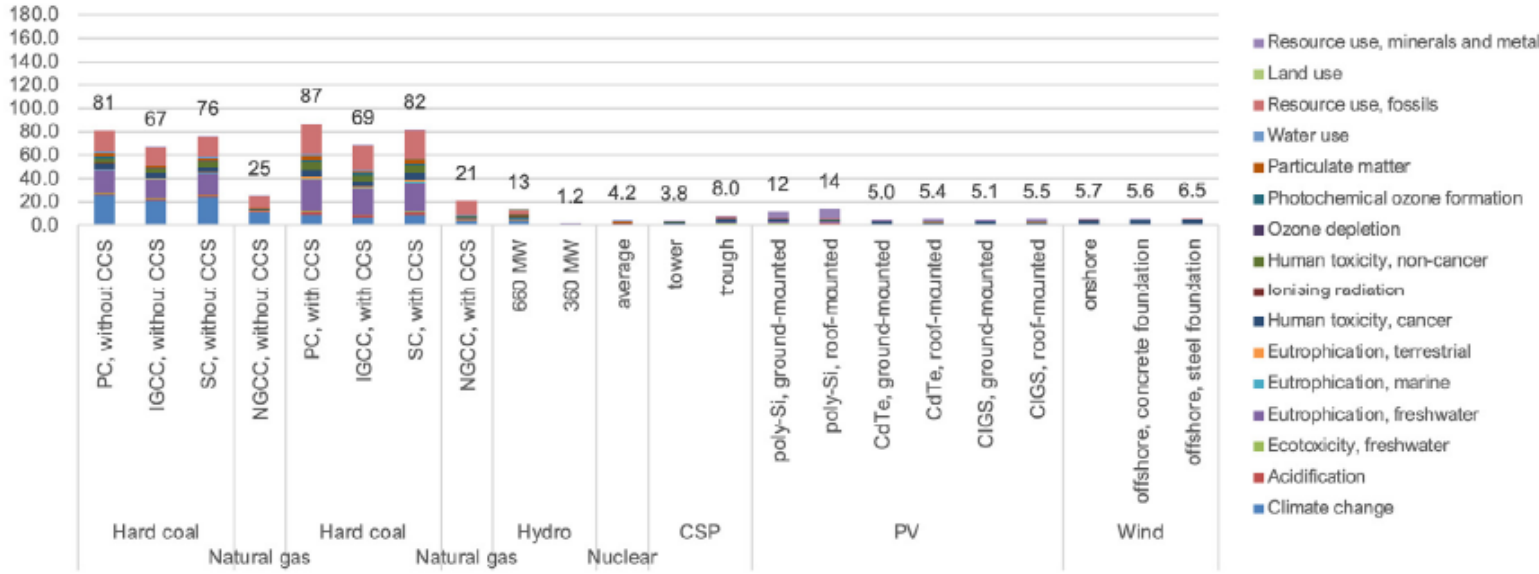
Source: KPMG analysis from 2014 Social Accounting Matrix for South Africa and Western Cape

Mitigation of Climate Change and Environmental Damage

Lifecycle GHG emissions, in g CO_2 eq. per kWh, regional variation, 2020

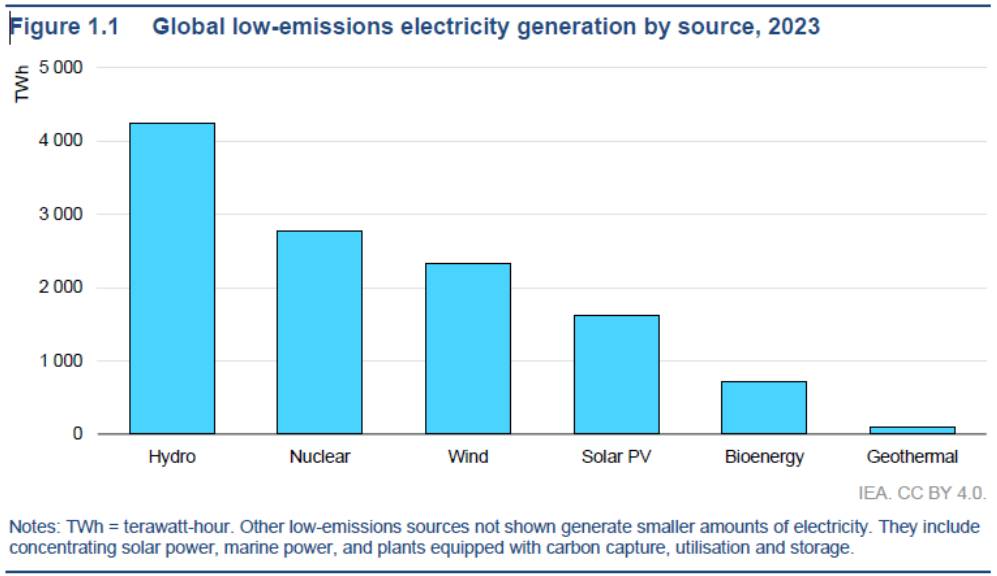


Normalised lifecycle impacts, weighted, of the production of 1 TWh, per technology, Europe, 2020



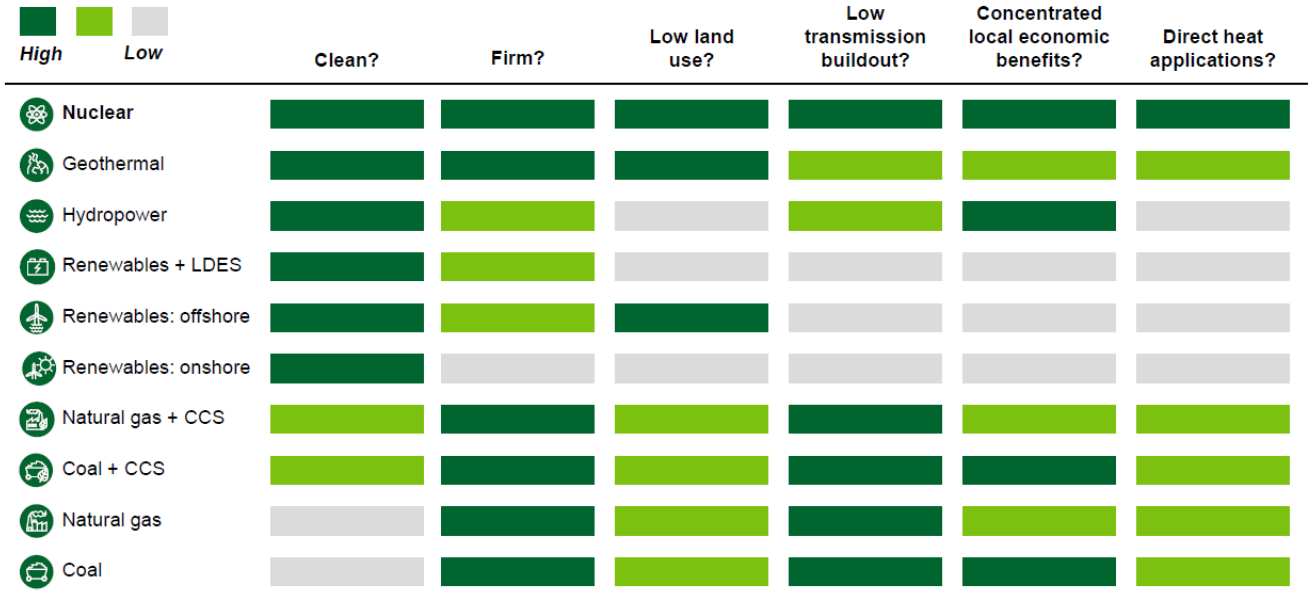
United Nations Economic Commission of Europe

Mitigation of Climate Change and Environmental Damage



International Energy Agency Report, The Path to a New Era for Nuclear Energy

Nuclear offers a unique value proposition for a net zero grid

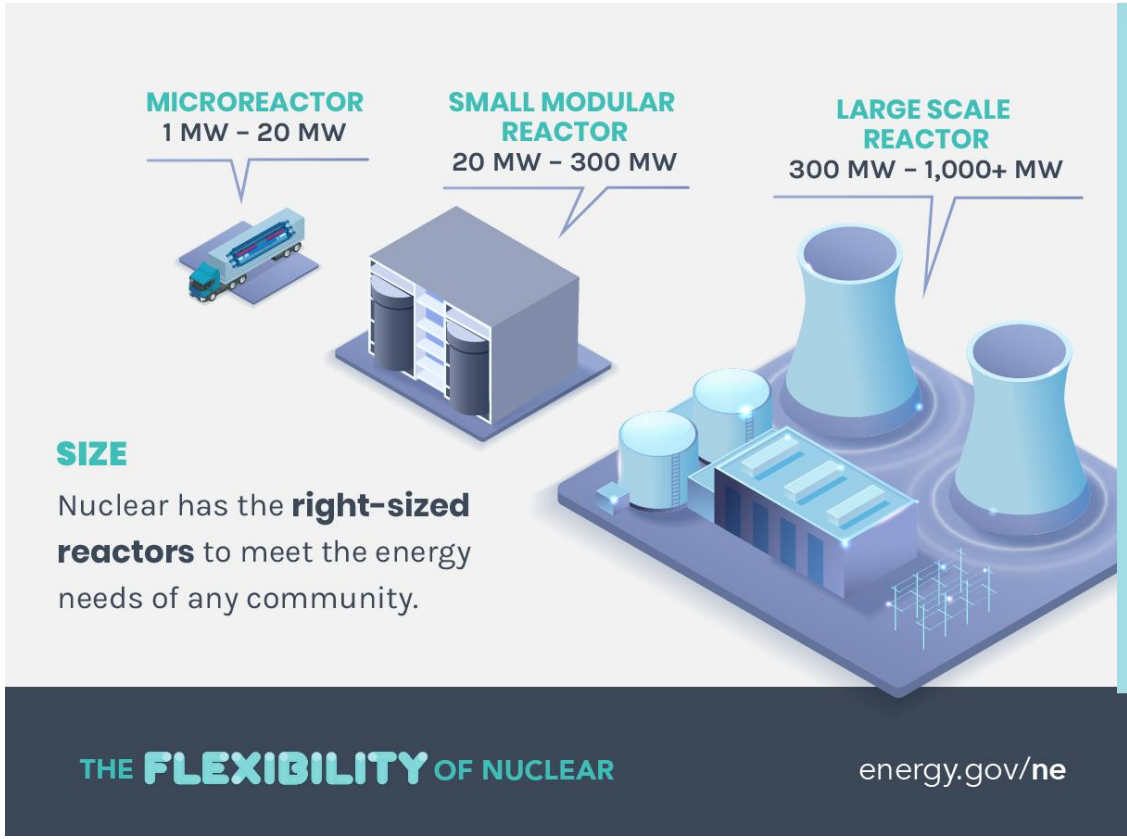


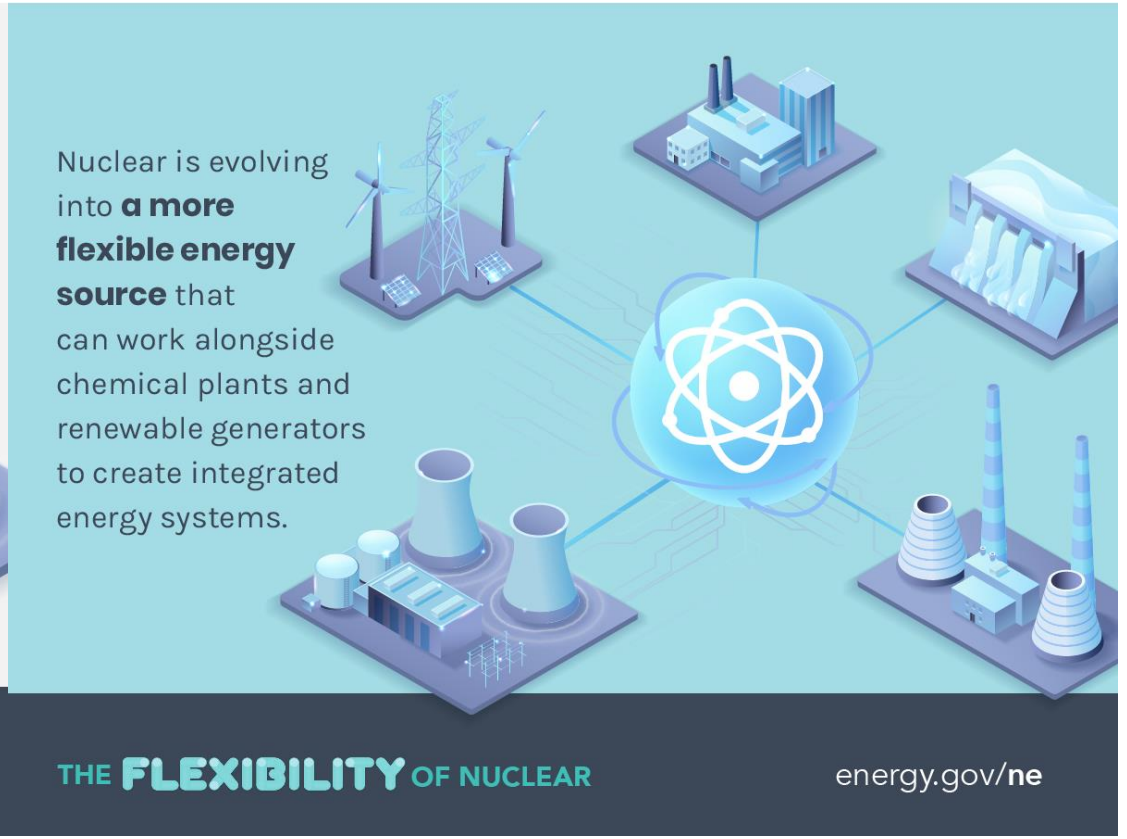
US Department of Energy Presentation, Advanced Nuclear Pathways to Commercial Liftoff

Cheap, Affordable Energy

- The decommissioned coal fleet can be repurposed for nuclear power plants, saving Trillions of rands on new grid infrastructure
- Repurposing of coal plants can also save 30% of the capital cost.
- Koeberg currently produces the lowest cost of electricity on the South African grid.
- Nuclear power cost are relatively high during the first 20 years of operation due to capital and investment costs needed to be paid back, after that for 40+ years the cost is very cheap as in the case of Koeberg.
- Countries with high penetration of nuclear power usually have much lower electricity costs than surrounding neighbours.
- Nuclear Power can produce one of the cheapest forms of clean hydrogen.

Size and Location Flexibility





Hybrid Production Flexibility

Nuclear is highly suited to cheap hydrogen production

Nuclear reactor design	Plant output: Electricity	Plant output: Low temperature heat (300°C) (district heat, industry, H_2)	Plant output: High temperature heat (600-700°C) (industry, H_2)	Coal replacement applications	Technological and commercial maturity
Large water cooled	✓	✓		Multi-unit power plant	Mature; more than 300 units in operation
SMR, water cooled	✓	✓		Single unit, power or CHP	Demonstration; pre-commercial; conventional nuclear licensing process widely applicable
SMR, advanced (gas/sodium cooled)	✓	✓	✓	Single unit, power, CHP, industrial boiler, H_2	Design phase; demonstrated technology; pre-commercial
SMR, advanced (salt or lead cooling; micro-reactors)	✓	✓	✓	Single unit, power, CHP, industrial boiler, H_2	Research, development and demonstration

Table 1. Categorizing selected nuclear technologies suitable for replacing coal.

Source: IAEA : Nuclear For a Net-Zero World, 2018

Conclusions

A realization in the global community has firmly emerged that Nuclear Energy has a critical role to play in achieving NetZero2050 targets as well as commitments made in the Paris Agreement.

- According to the IEA, in 2021, 44 countries and the European Union have pledged to meet a net-zero emissions target.
- At its peak in the early 2030s, global nuclear capacity additions reach 30 GW per year, five-times the rate of the past decade.
- The 28th Conference of the Parties (COP-28) Agreement recognizes accelerating nuclear energy as part of the solution, where 198 signatory countries to the UN Framework Convention on Climate Change (UNFCCC) officially called for hastening the deployment of nuclear.
- The 28th Conference of Parties (COP-28) had 25 countries pledging to triple nuclear capacity by 2050 as part of efforts to mitigate climate change, providing sustainable and reliable energy security. At COP-29 this increased to 31 countries and 14 of the world's largest and influential financial institutions endorsed the Declaration to Triple Nuclear Energy.
- Nuclear Power has a significant role to play in the South African Energy Mix with Small Modular Reactors (SMRs) adding a fresh alternative on scale, cost and timelines.

Recommendations

The Department of Energy and Electricity recommends that:

- South Africa should accelerate the deployment of nuclear energy to ensure security of energy supply, contribute to **economic growth** and **technology development** in South Africa through investment in infrastructure, creation of jobs and the further development of skilled workers.
- The Just Energy Transition Framework should consider including nuclear energy and align with global developments (COP and IEA) on nuclear.
- South Africa should consider joining international initiatives to support the role of nuclear energy in achieving NetZero2050.
- Nuclear Energy should be considered for inclusion in the Green Taxonomy to enable investment into nuclear projects.

THANK YOU