IAEA
International Atomic Energy Agency
Atoms for Peace and Development

Nuclear Energy:

Securing Clean Energy for Climate Resilient Transitions

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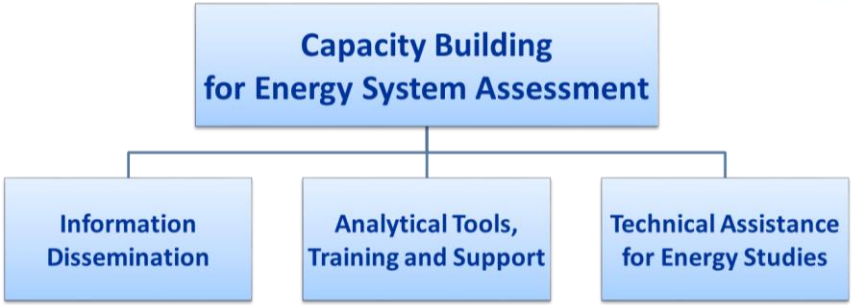
Outline

- Overview of PESS
- Capacity Building in Energy Planning
- Nuclear and Net Zero
  - IAEA's annual projections to 2050
  - Why nuclear's contribution to NZ transitions is important:
    - Low Carbon and Sustainability credentials
    - Enabling integration of large shares of renewables
    - Security of supply and climate resilience
    - Decarbonization beyond electricity
    - Macroeconomic impacts of nuclear investment / Just Transition
    - Deployment challenges are being addressed

Planning and Economic Studies Section

1. **Energy Planning support to Member States**
2. **Nuclear in clean energy transitions**
   - Energy modelling net zero scenarios, Nuclear power projections to 2050
   - Nuclear and Sustainable development
   - Role of H2 in energy transitions
   - Climate resilience
3. **Technical and economic analysis of nuclear power** (large reactors, LTO, SMRs, advanced reactors)
   - Cost analysis, system costs, financing
   - Macroeconomics

Energy Planning and Capacity Building Tools

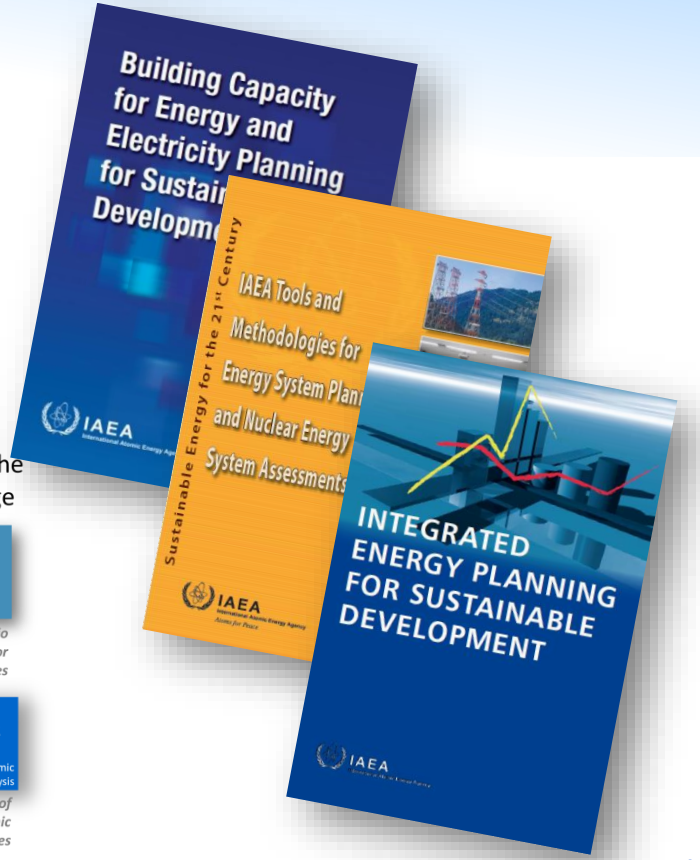


[Technologically-neutral approaches and tools:]

Energy Assessment Tools distributed to
150+ Member States
21 Regional & International Organizations

Some MS expressing interest in nuclear (→ support through IAEA Milestones approach)

- Set of own energy system assessment tools covering the whole energy planning process, available free of charge

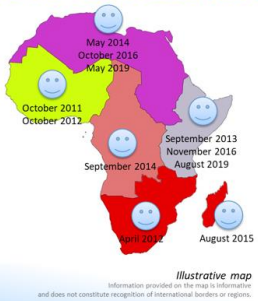


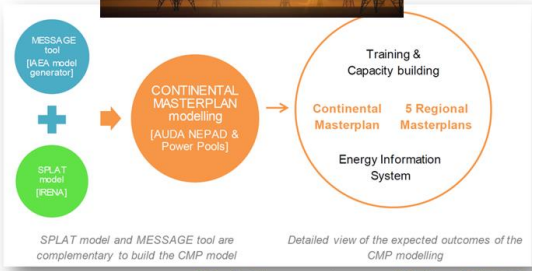
Examples of capacity-building in energy planning:

Development of Africa's Continental Power System Masterplan (African Union Development Agency)

Africa

Development of Sub-regional Power Pool Models (using MESSAGE tool)



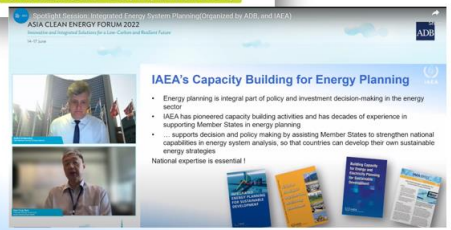


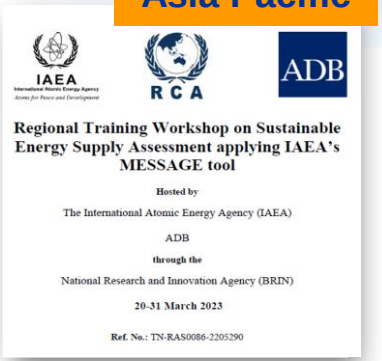
Modelling partners: IAEA + IRENA

https://www.nepad.org/news/high-level-eu-and-auda-nepad-officers-report-progress-africas-continental-power-master

Regional capacity building for sustainable energy planning (with ADB and RCA)

Asia Pacific





https://asiacleanenergyforum.adb.org/spotlight-session-integrated-energy-system-planning/

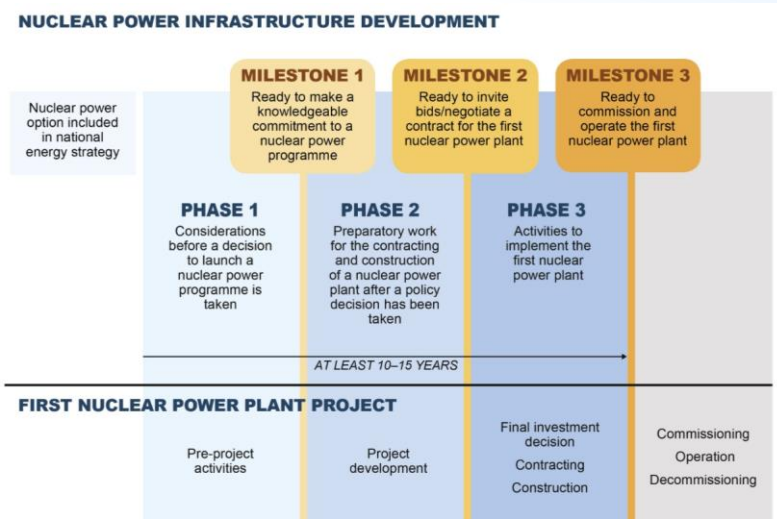
In 2022

354 Professionals

60 Member States

51 Events

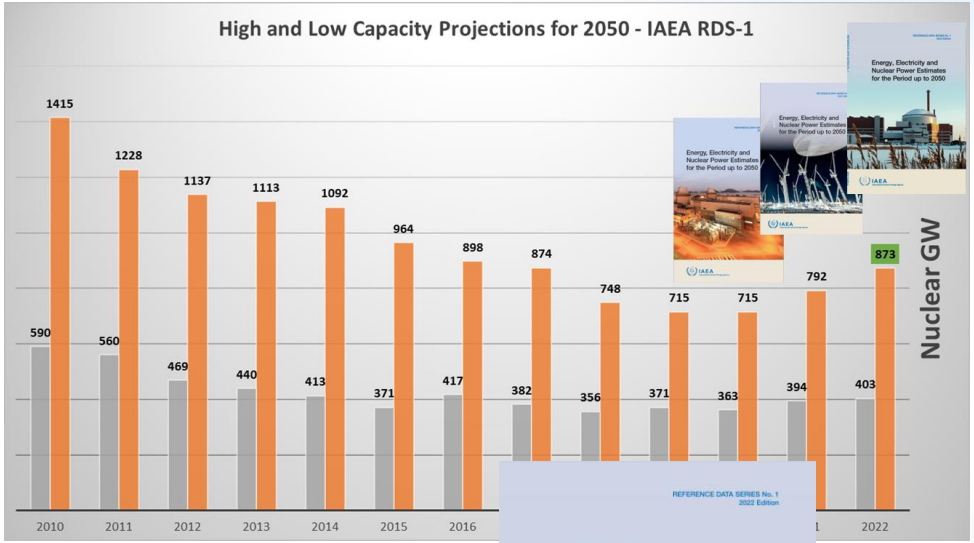
IAEA Milestones Approach (for newcomer countries)



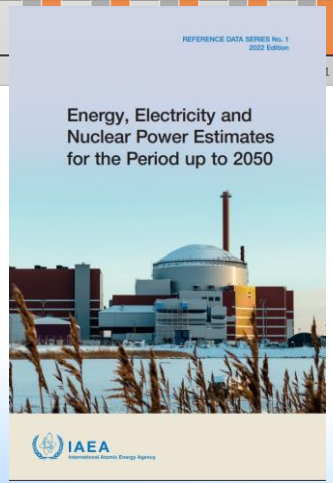
The Milestones Approach includes 19 nuclear infrastructure issues, requiring specific actions during each of the three phases.

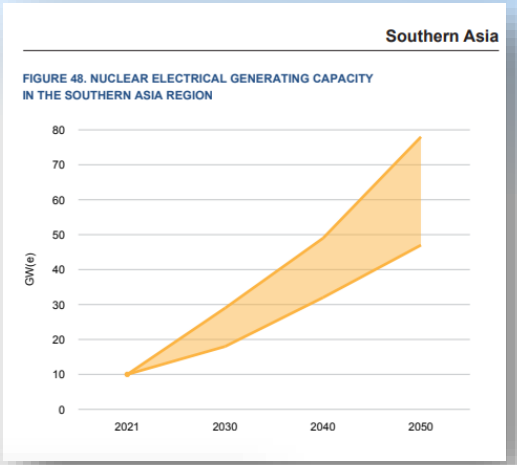
7 out of 26 newcomer countries are ESCAP MS

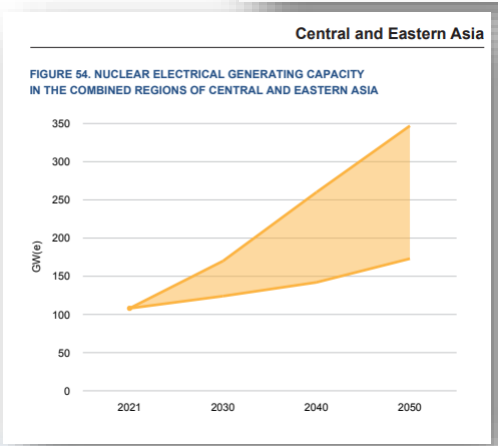
IAEA nuclear projections to 2050 (2022 edition)



High case (2022) 873 GW by 2050, corresponds to ambitious LTO + about **588 GW** of new build in 3 decades

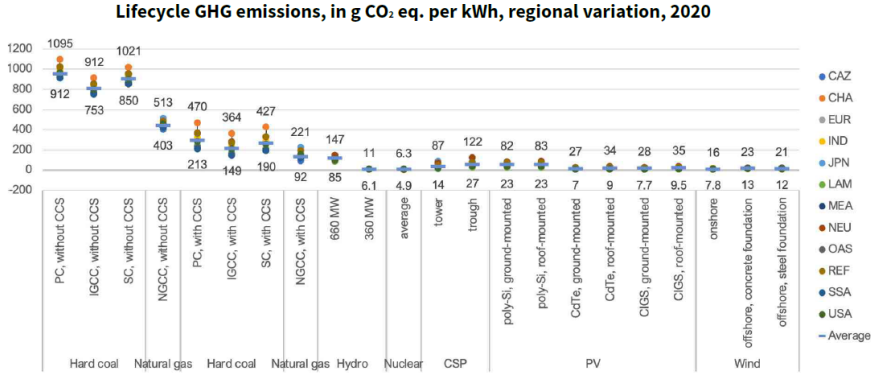






Low carbon and sustainability

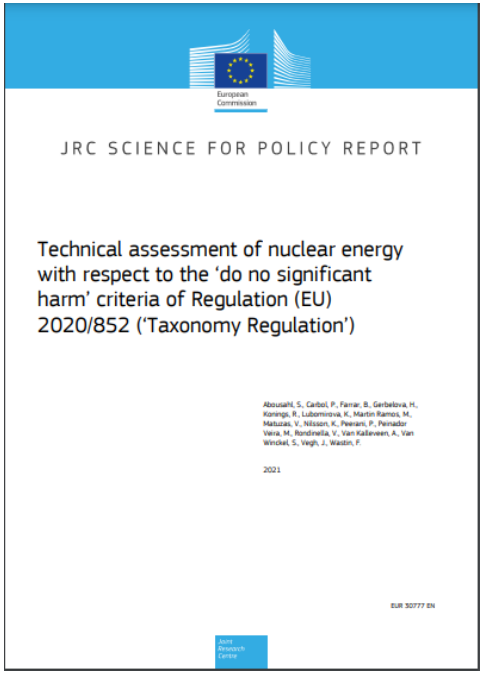
Figure 37 Lifecycle greenhouse gas emissions' regional variations for year 2020. Variability is explained by several factors: electricity mix (all regions), methane leakage rates (fossil fuels), load factors (renewables). Nuclear power is modelled as a global average except for back-end.

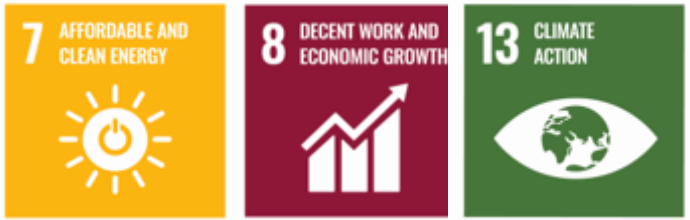


Smallest carbon footprint among low C technologies

(2022)

*IAEA estimates that over the last 5 decades, about **70Gt CO_2** have been avoided thanks to NP*



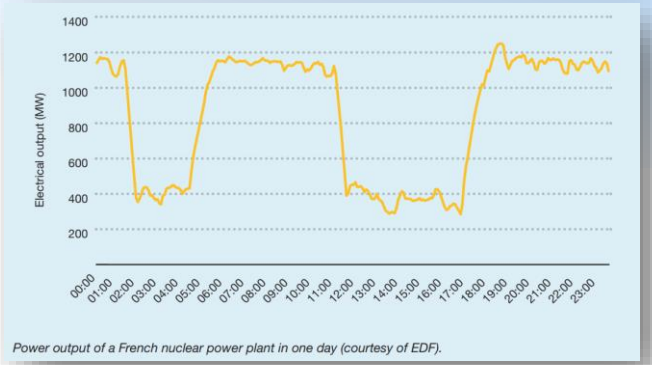


IAEA: Nuclear Energy for a Net Zero World (2021)

Enabling integration of large % renewables

- Nuclear is a **dispatchable and flexible** source of low C power that can support the deployment of large shares of variable renewables such as solar PV and wind.
- Without nuclear, even more renewable capacities and energy storage technologies would need to be deployed.
- Analysis of overall (system) costs of energy transitions show that **transitions with nuclear are less costly** than transitions without nuclear, even if nuclear is more expensive than wind/solar (LCOE).
- It's also a question of **risk** for transitions

Flexibility of nuclear generation



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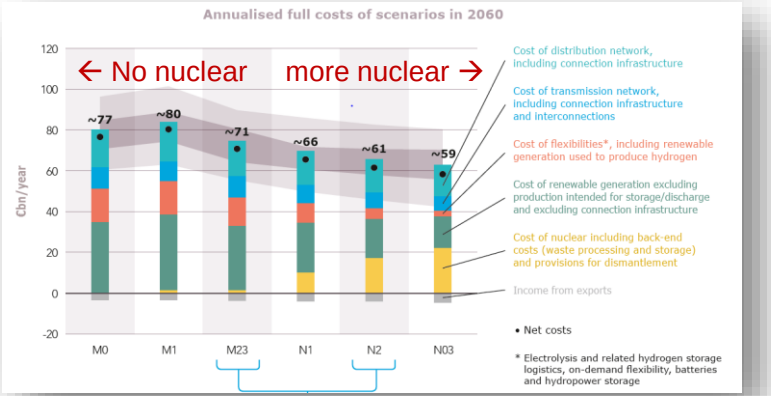
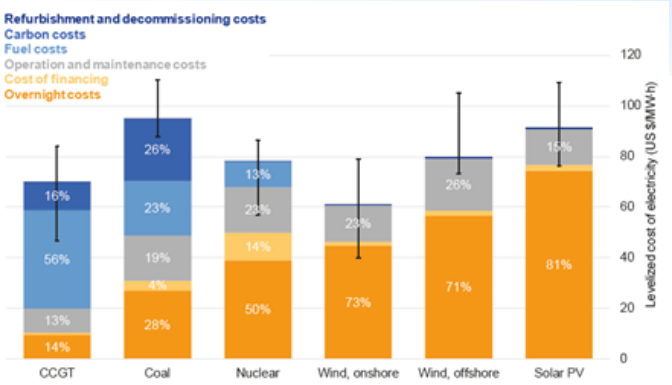


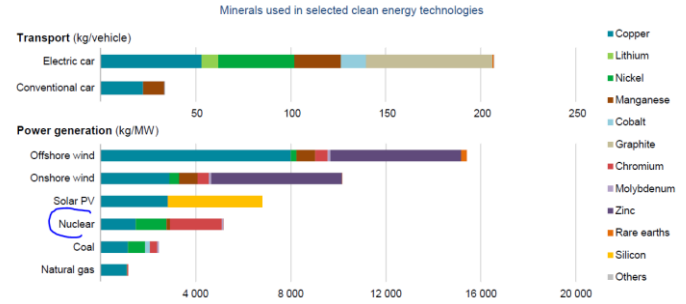
French grid operator RTE report "Energy Pathways to 2050" (2021)

Security of energy supply

- Cost of nuclear generation is **not very sensitive to the cost of fuel** (contrary to coal and gas generation)
- **Uranium resources are widely available** globally.
- Nuclear fuel can easily be **stored on site**
- Nuclear generation is among the low C technologies **least dependent on critical minerals** – *IEA report on Critical Minerals (2021)*
- Climate Change / Extreme weather can impact all technologies – and energy systems. IAEA operational data suggests that nuclear power is resilient – and adaption measures can be deployed to reduce vulnerabilities.

Adapted from IEA/NEA Projected Costs of Electricity Generation (2020)

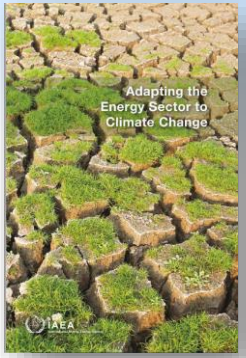


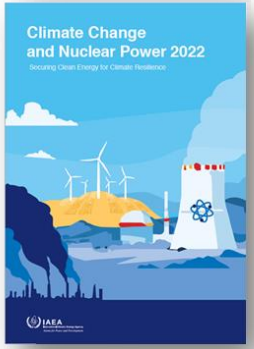


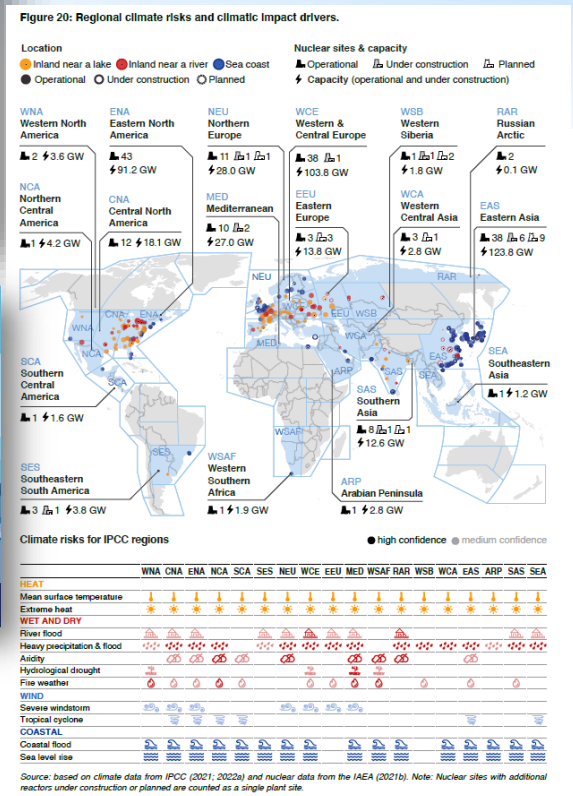
IEA, The Role of Critical Minerals in Clean Energy Transitions (2021)

Climate resilience

- **Climate Change / extreme weather can impact all technologies**, including nuclear power– and affect the resilience of energy systems.
- Investment needed in **climate resilient energy infrastructures**
- IAEA operational data (PRIS) suggests that nuclear is resilient – and adaption measures can be deployed to reduce vulnerabilities.
- **Nuclear power can contribute to increase the resilience of energy systems**:
  - Resilience to extreme weather events
  - Adaptation, preparedness of nuclear industry – to maintain safety and improve efficiency
- Another aspect of Security of Energy Supply





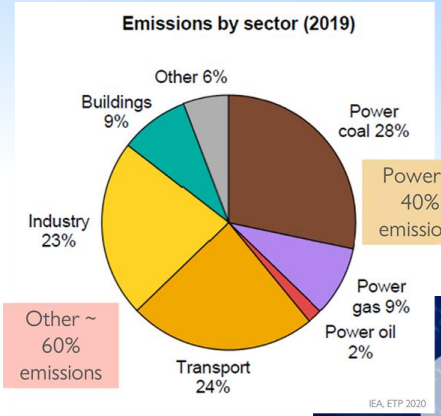


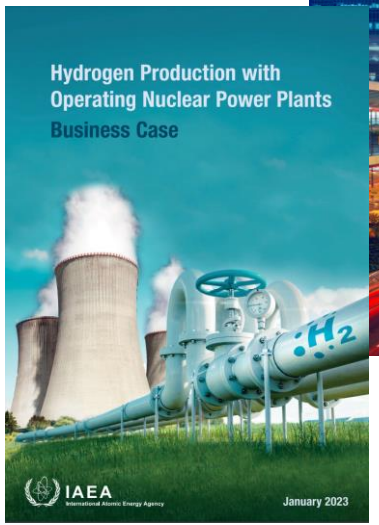
Decarbonization beyond electricity

- Nuclear energy = **source of low carbon heat, electricity and hydrogen**

- Nuclear heat supply:
  - Long experience of District Heating
  - Advanced reactors can also deliver high temperature steam for industrial applications

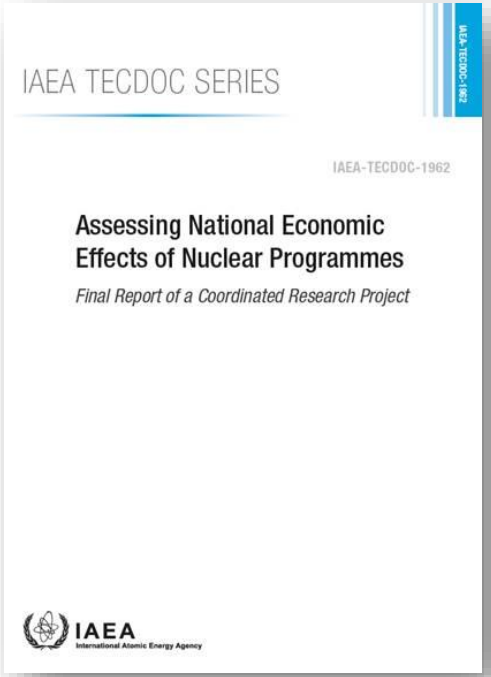
- Growing interest in hydrogen as an enabler of the transition to NZ (storage, flexibility, heat, etc). Nuclear can produce low C H2
  - Through electrolysis like other low C technologies
  - Through thermal splitting processes (more efficient)

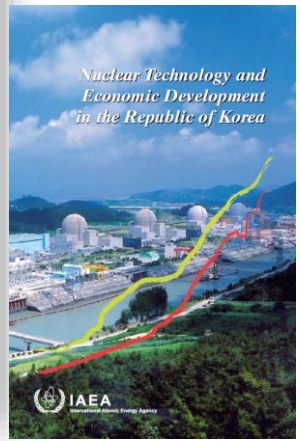


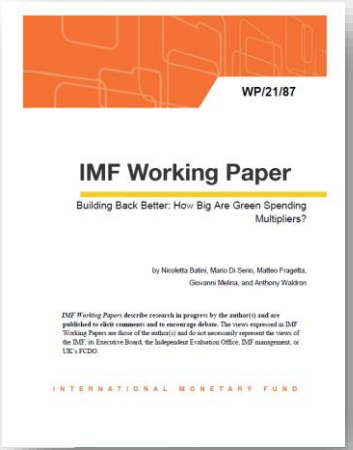


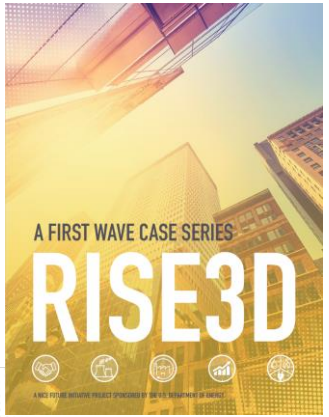
Macroeconomic impacts of nuclear investments / Just Transition

- Can clean energy investments compensate for the economic losses associated with the transition away from fossil fuel activities?
- Analyses (including from IMF) suggests that **“green investments” can have positive impacts – and nuclear investments can have the highest GDP multipliers**
- Level of supply chain localization is an important consideration.









Research teams from 10 IAEA MSs (Croatia, Indonesia, Korea, Malaysia, Poland, RF, South Africa, Tunisia, Uruguay, Viet Nam) applied the new macroeconomic model (EMPOWER) to estimate economy-wide effects from construction and operation of a nuclear plant

Deployment challenges are being addressed

- **Policies:**
  - Energy and climate crises → renewed interest in nuclear
- **Public acceptance:**
  - More open discussion of nuclear option in different fora (including COP, G20, CEM)
  - On safety, waste management, costs
- **Costs and access to finance:**
  - Cost reductions from FOAK Gen III to NOAK
  - Supply Chain improvements
  - New financing models are being developed, inclusion of nuclear in sustainable finance being discussed
- **New technologies and initiatives:**
  - SMRs
  - Standardization of designs and harmonization of regulatory requirements


IAEA Initiative Sets Ambitious Goals to Support the Safe and Secure Deployment of SMRs

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Thank you!

Contact: h.paillere@iaea.org