Mitigating Climate Change:
IAEA assistance to interested Member States

H-Holger Rogner

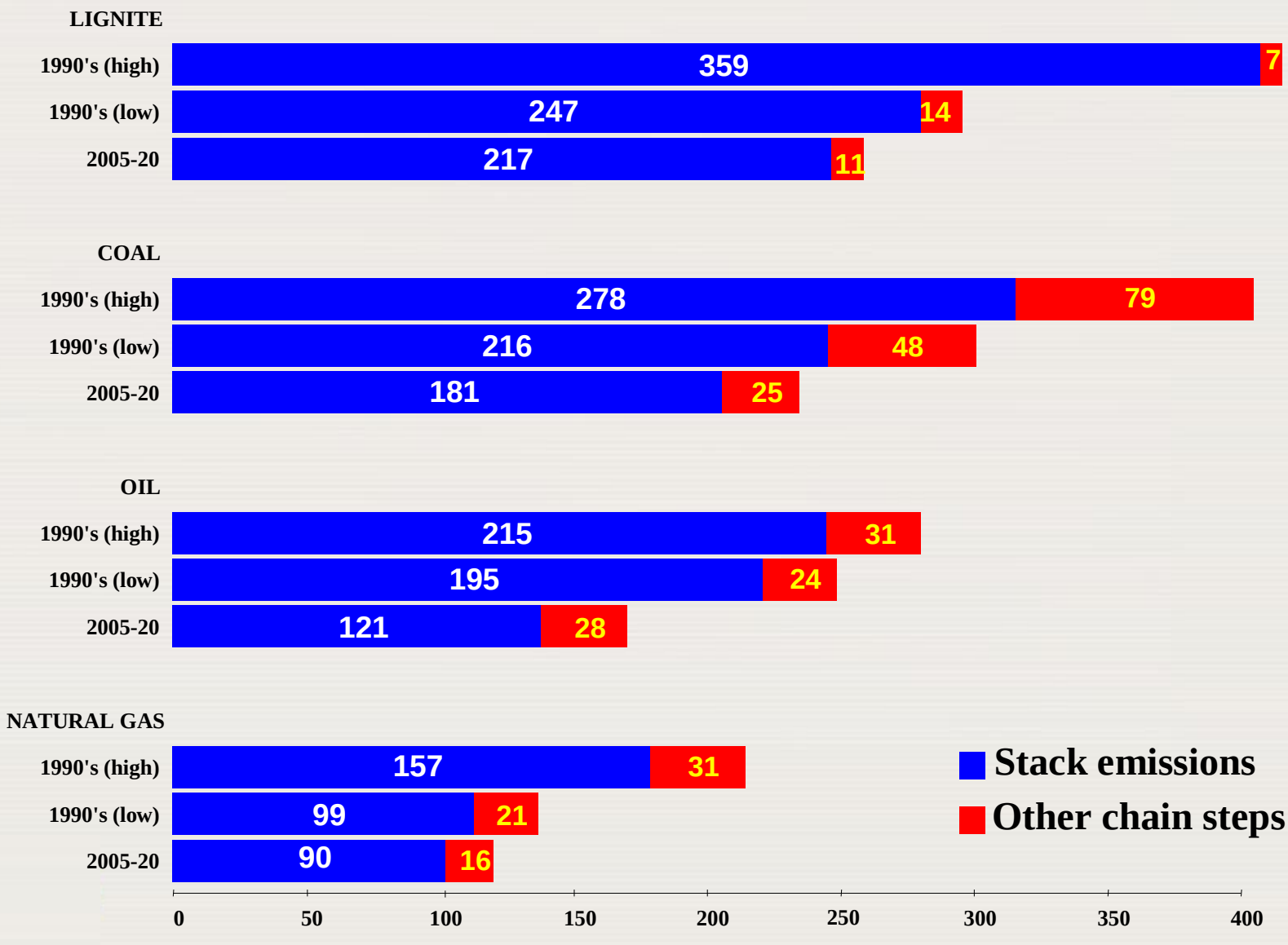
Planning & Economic Studies Section (PESS)

Department of Nuclear Energy

Three take-away messages

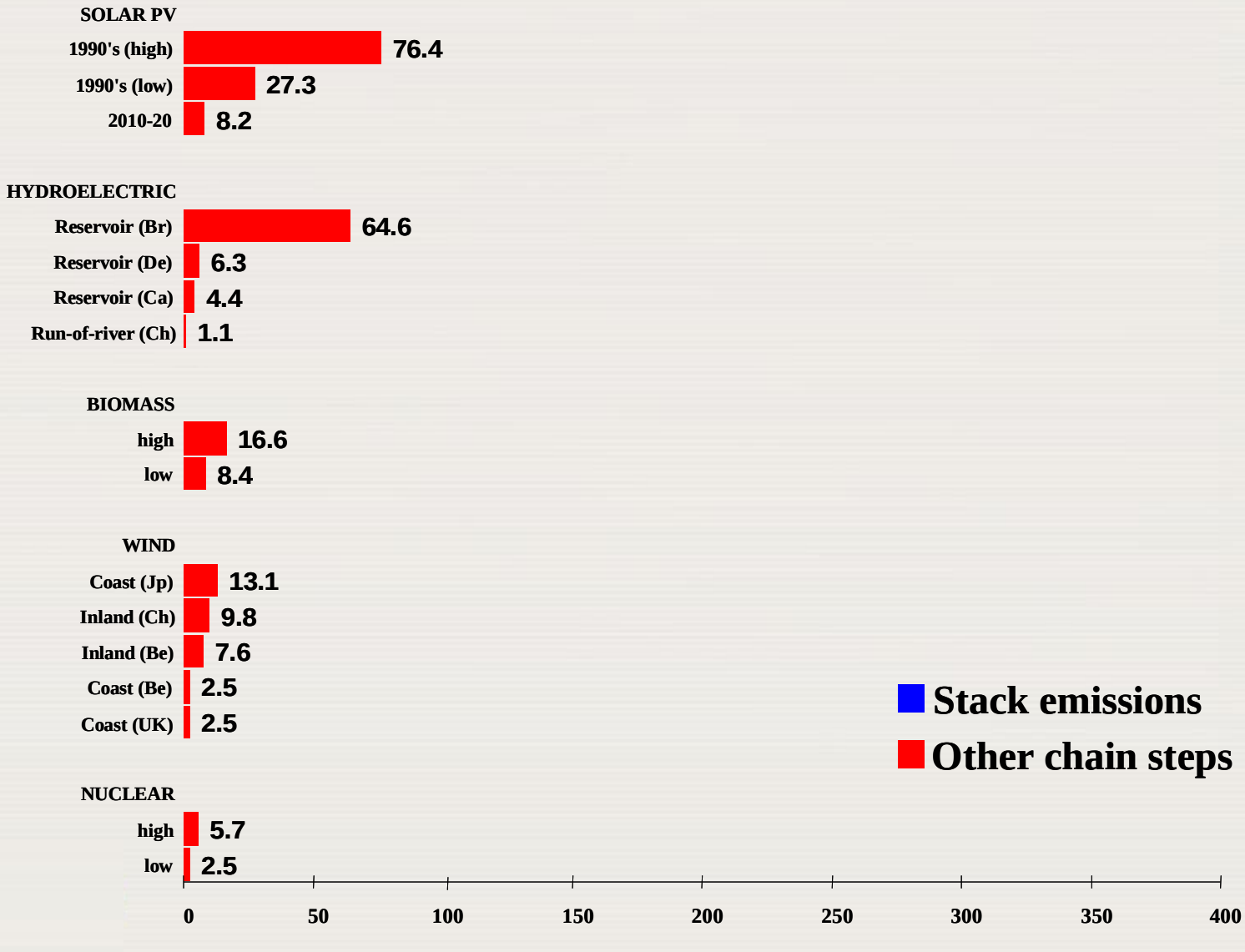
- Nuclear power is good for the climate
- Nuclear power is not a quick-fix mitigation option
- Nuclear power can make a substantial mitigation contribution in any serious long-term mitigation strategy

Full Chain Greenhouse Gas Emissions, g C / kWh



IAEA

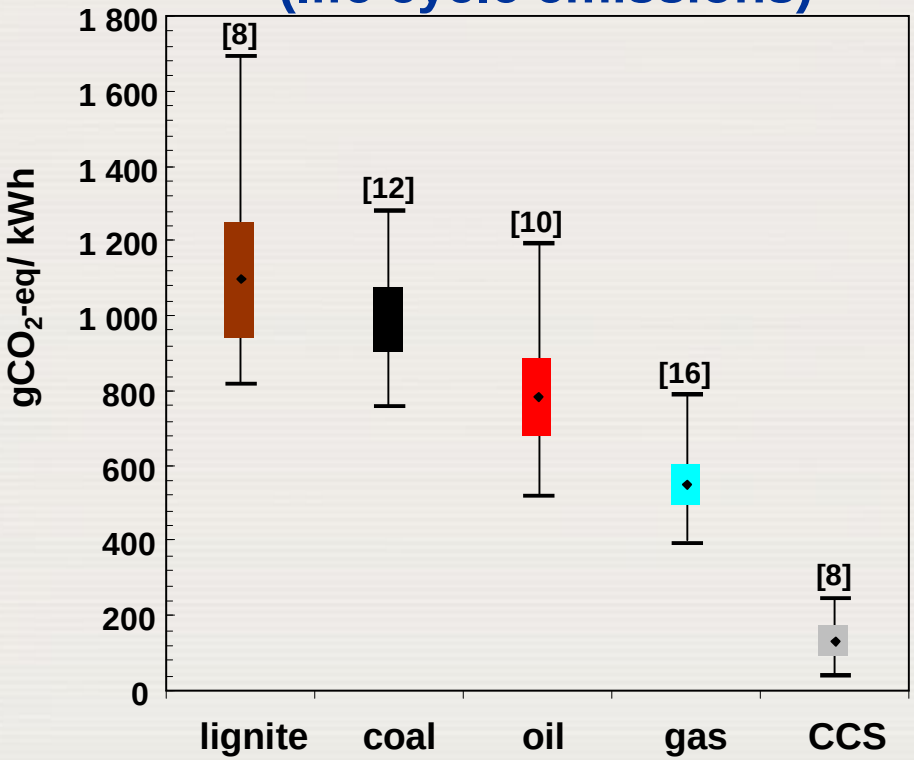
Full Chain Greenhouse Gas Emissions, g C / kWh



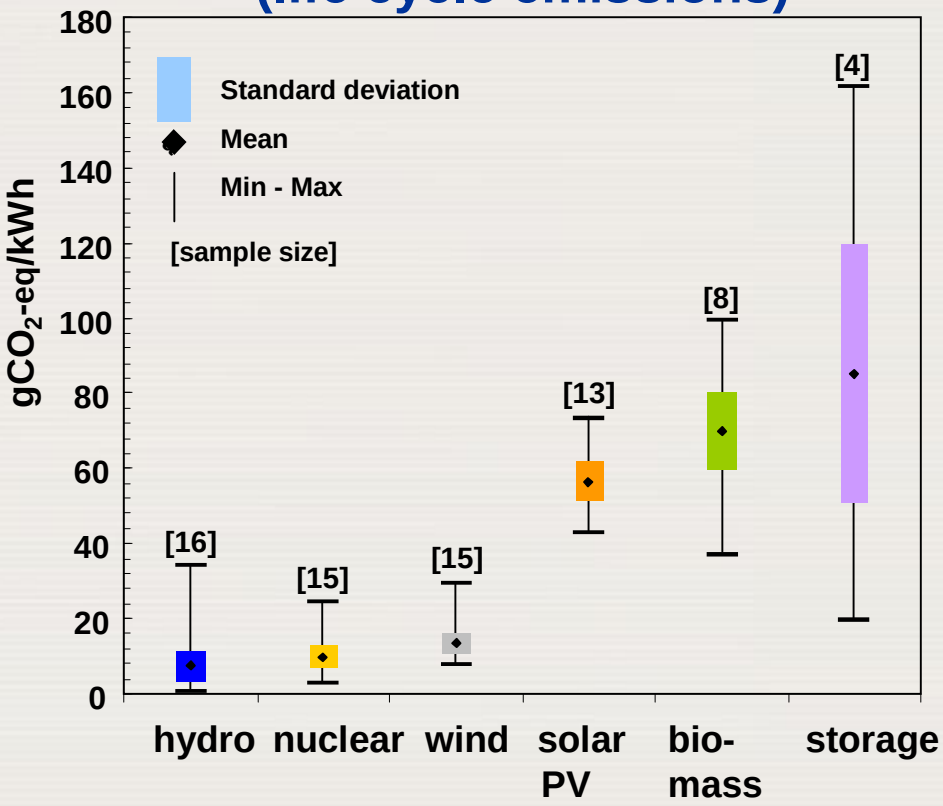
IAEA

Nuclear power is good for the climate

Fossil electricity generation (life cycle emissions)



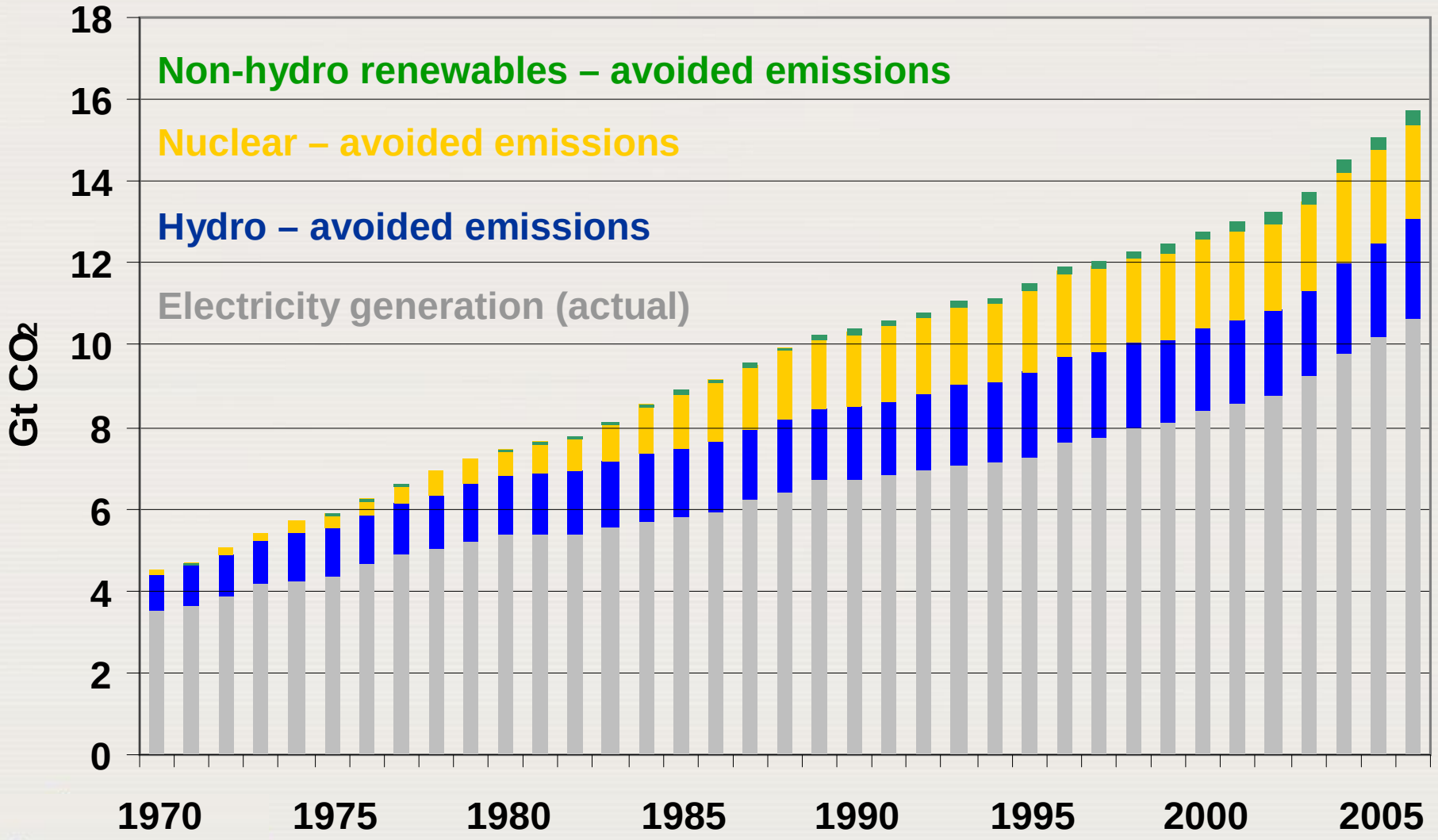
Non-fossil electricity generation (life cycle emissions)



Nuclear power: Very low lifecycle GHG emissions make the technology a potent climate change mitigation option

IAEA

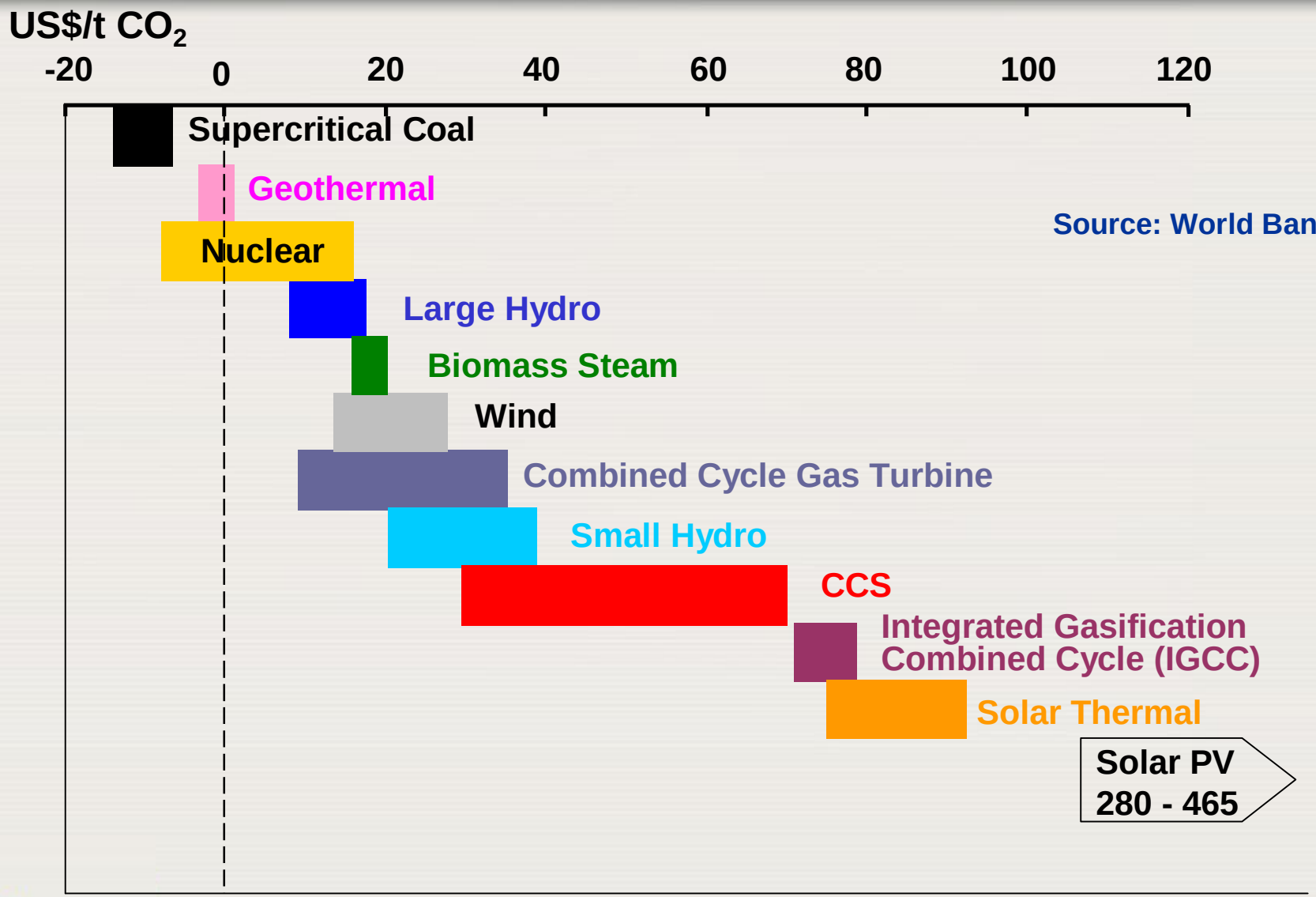
Global CO2 emissions from electricity generation & emissions avoided by hydro, nuclear & renewables



IAEA

Source: IAEA calculations based on IEA data

Range of carbon dioxide reduction costs for electricity technologies

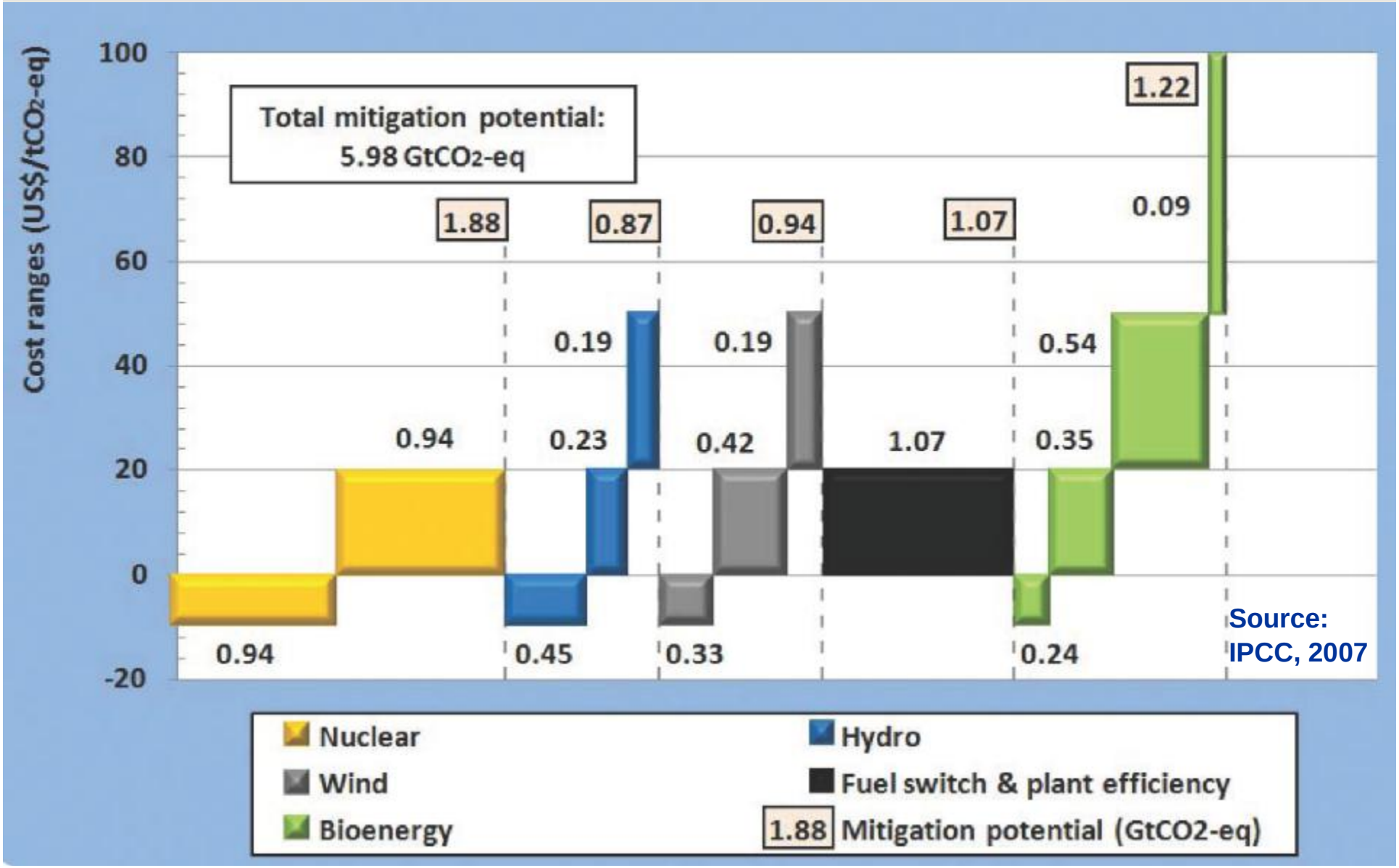


Source: World Bank

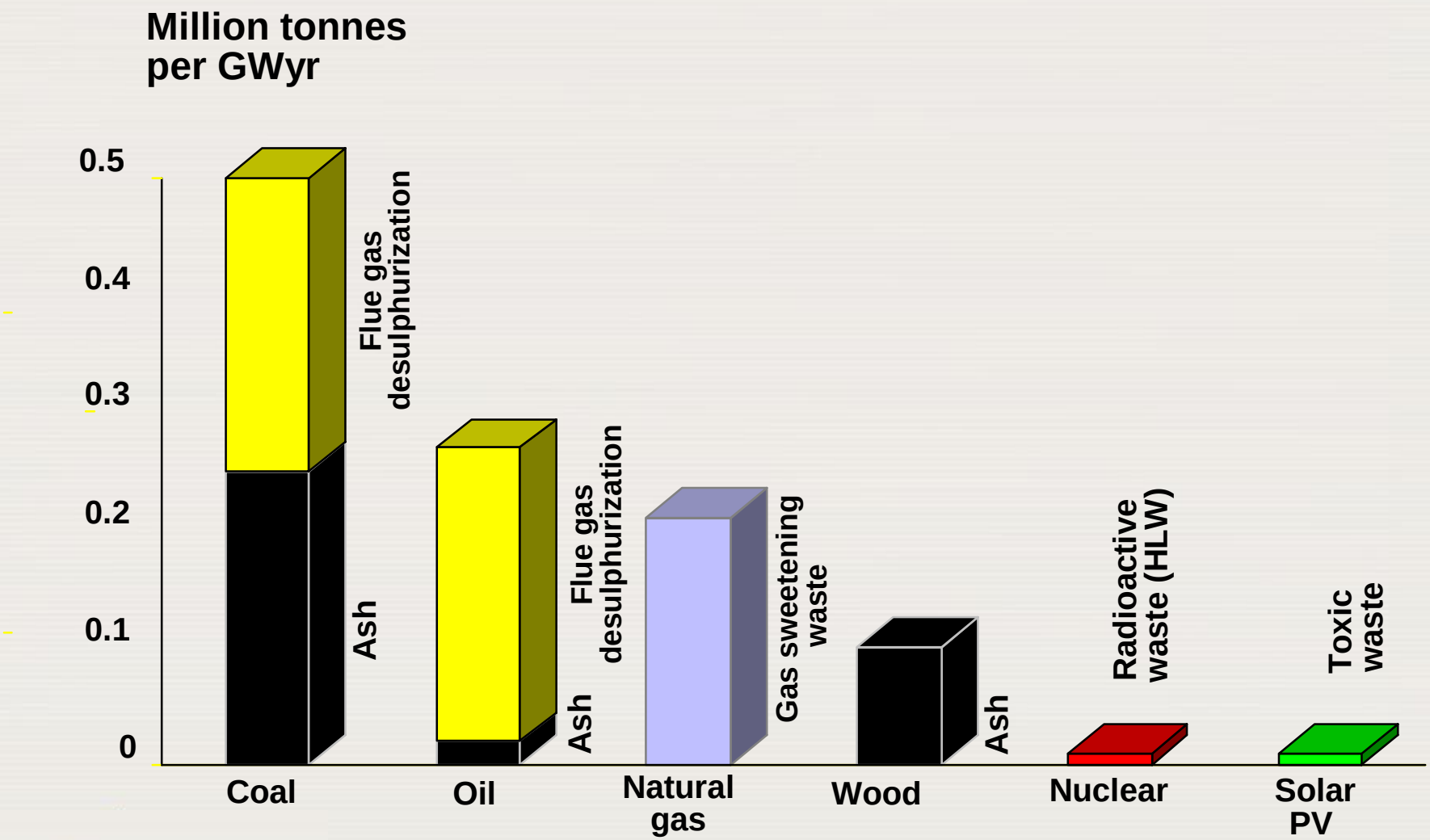
IAEA

Note: This graph is for illustrative purposes only, actual costs are site specific

Mitigation potential of selected electricity generation technologies in different cost ranges



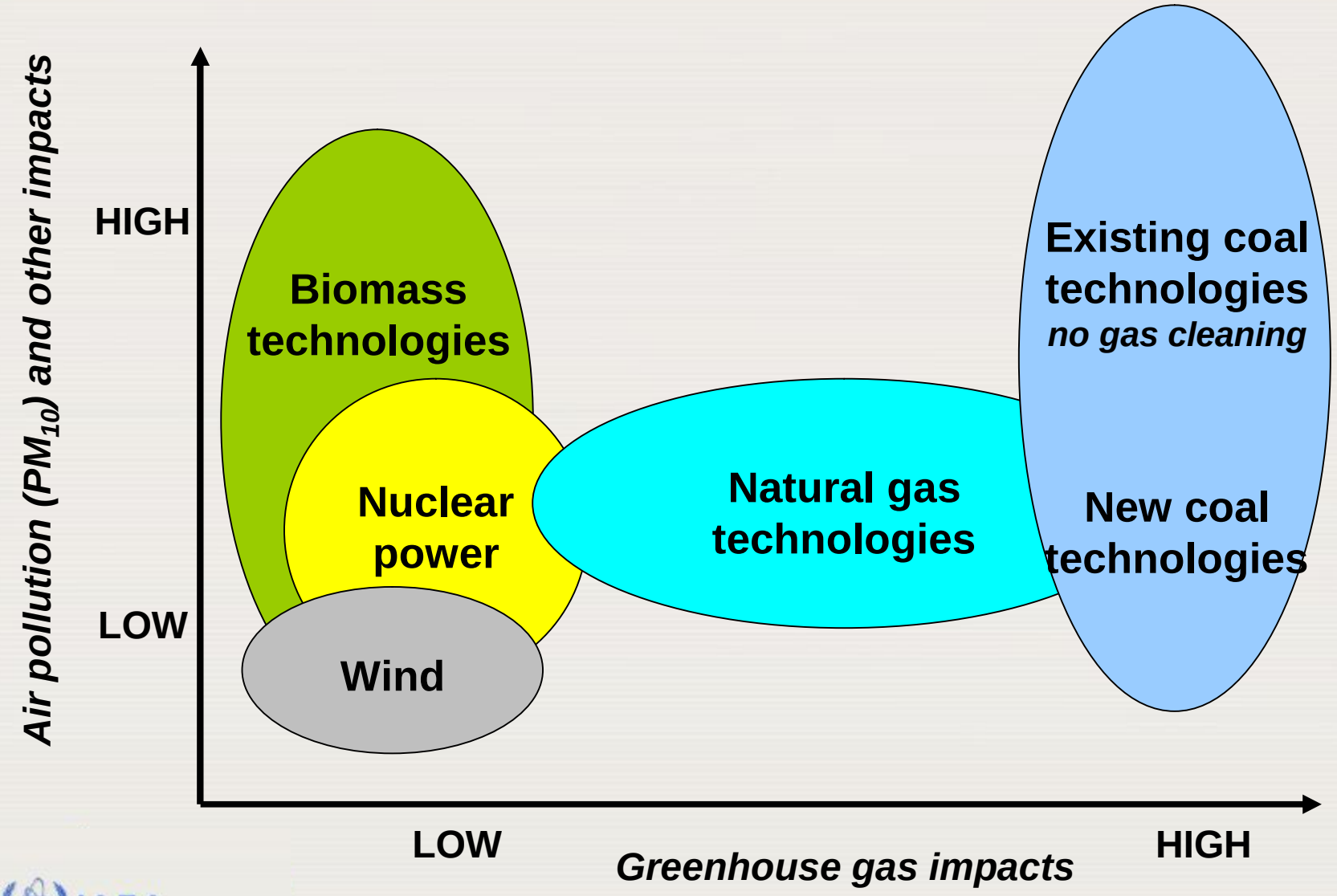
Wastes in Fuel Preparation and Plant Operation



IAEA

Source: IAEA, 1997

Externalities of different electricity generating options



IAEA

Source: EU-EUR 20198, 2003

No such thing as a perfect technology

- There is no technology without risks and interaction with the environment.
- Do not discuss a particular technology in isolation.
- Compare a particular technology with alternatives in a system context and on a life cycle (LCA) basis.

One size does not fit all

- Countries differ with respect to
  - energy demand growth
  - alternatives
  - financing options
  - weighing/preferences
    - accident risks (nuclear, mining, oil spills, LNG…), cheap electricity, air pollution, jobs, import dependence, climate change
- All countries use a mix. All are different.
- Nuclear power per se is not “the solution” to the world’s energy problems, climate change and energy security
- It surely can be an integral part of the solution!

IAEA assistance to interested Member States

IAEA responds to Member State requests !

- **Energy planning and capacity building**
  - **Mitigation options throughout the energy system**
  - **CDM, JI and emission trading**
- **Infrastructure planning for starting nuclear power programmes**

Why is IAEA involved in system energy planning?

- Many developing countries lack the capability and/or capacity for integrated resource planning
- Sequential stop-gap measures instead of long-term development planning
- Only UN organization which is promoting energy planning and assists Member States since the mid-1970s

Objective is to build energy planning capacity in developing countries

IAEA

Why energy system planning?

- A prerequisite for informed decision making
- Supply and demand side options
- Financial viability and capability
- Social/public/political commitment & acceptance
- Economic development & environmental protection including mitigating climate change
- Regional approaches, infrastructure sharing & energy trade (interconnections)
- Testing effectiveness of policy measures

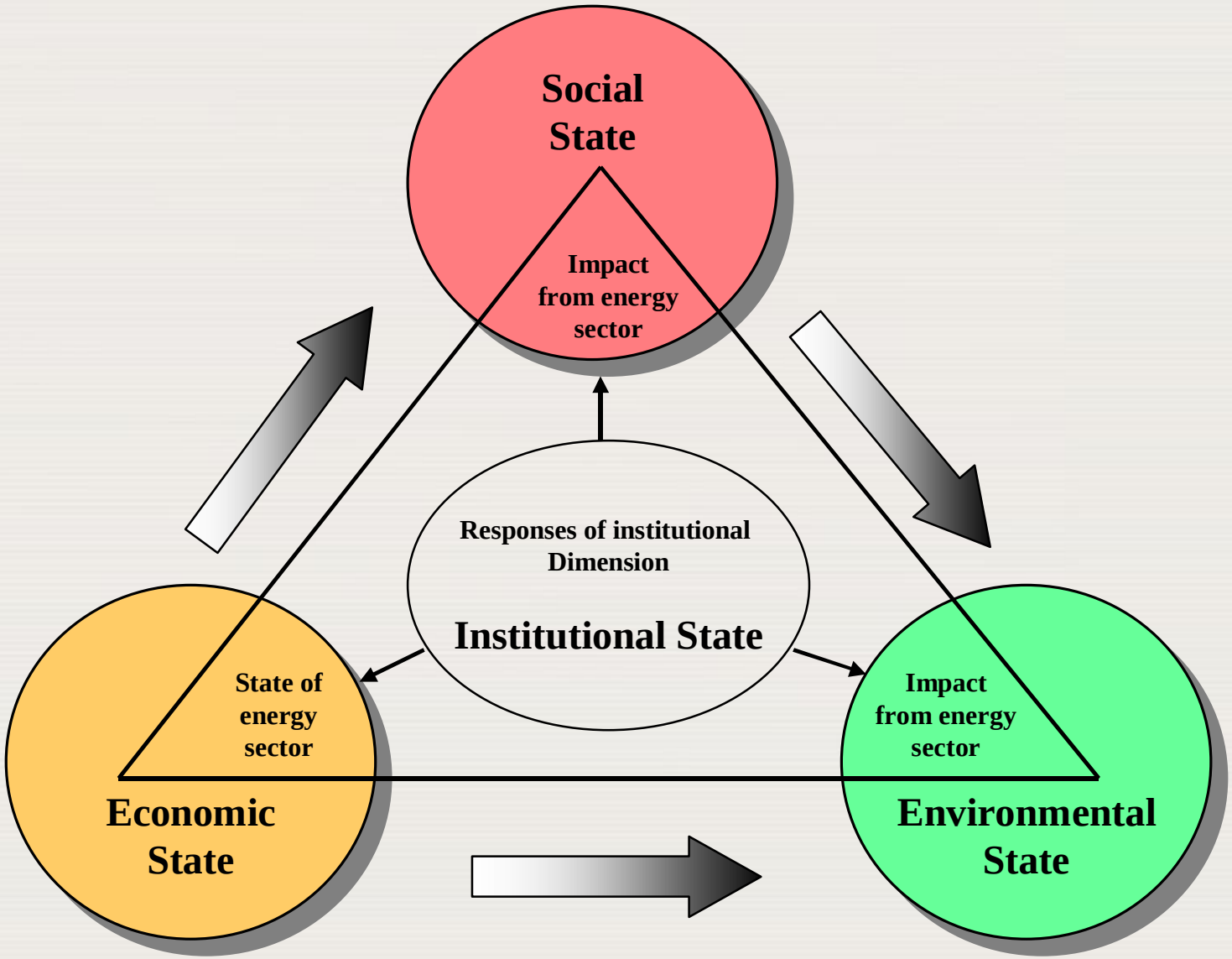
Capacity building: Energy for Development

- Transfer planning models tailored to developing countries
- Transfer data on technologies, resources and economics
- Train local experts
- Jointly analyze national options
- Help establish continuing local expertise

IAEA

IAEA Analytical Tools for Sustainable Energy Development

- MAED
- WASP
- ENPEP
- MESSAGE
- FINPLAN
- SIMPACTS
- ISED



IAEA

IAEA energy analysis models

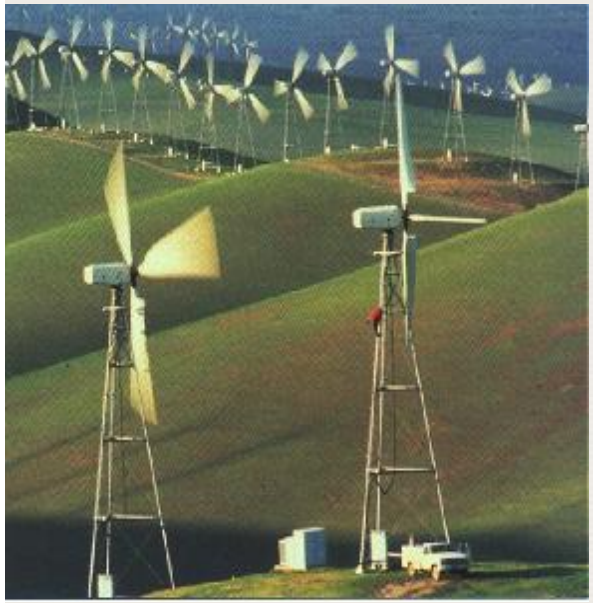
- Model for the Analysis of Energy Demand

- Model for Energy Supply System Alternatives and their General Environmental impacts

- Financial Analysis of Electric Sector Expansion Plans

- Simplified Approach for Estimating Impacts of Electricity Generation

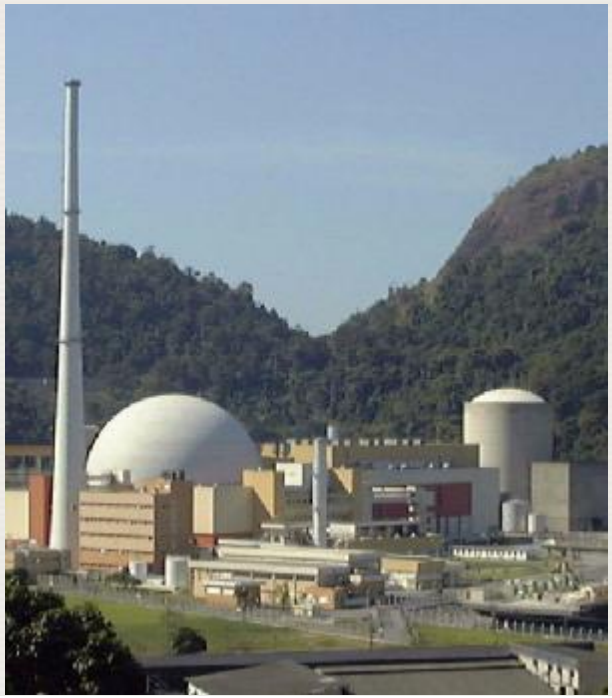
Energy Planning



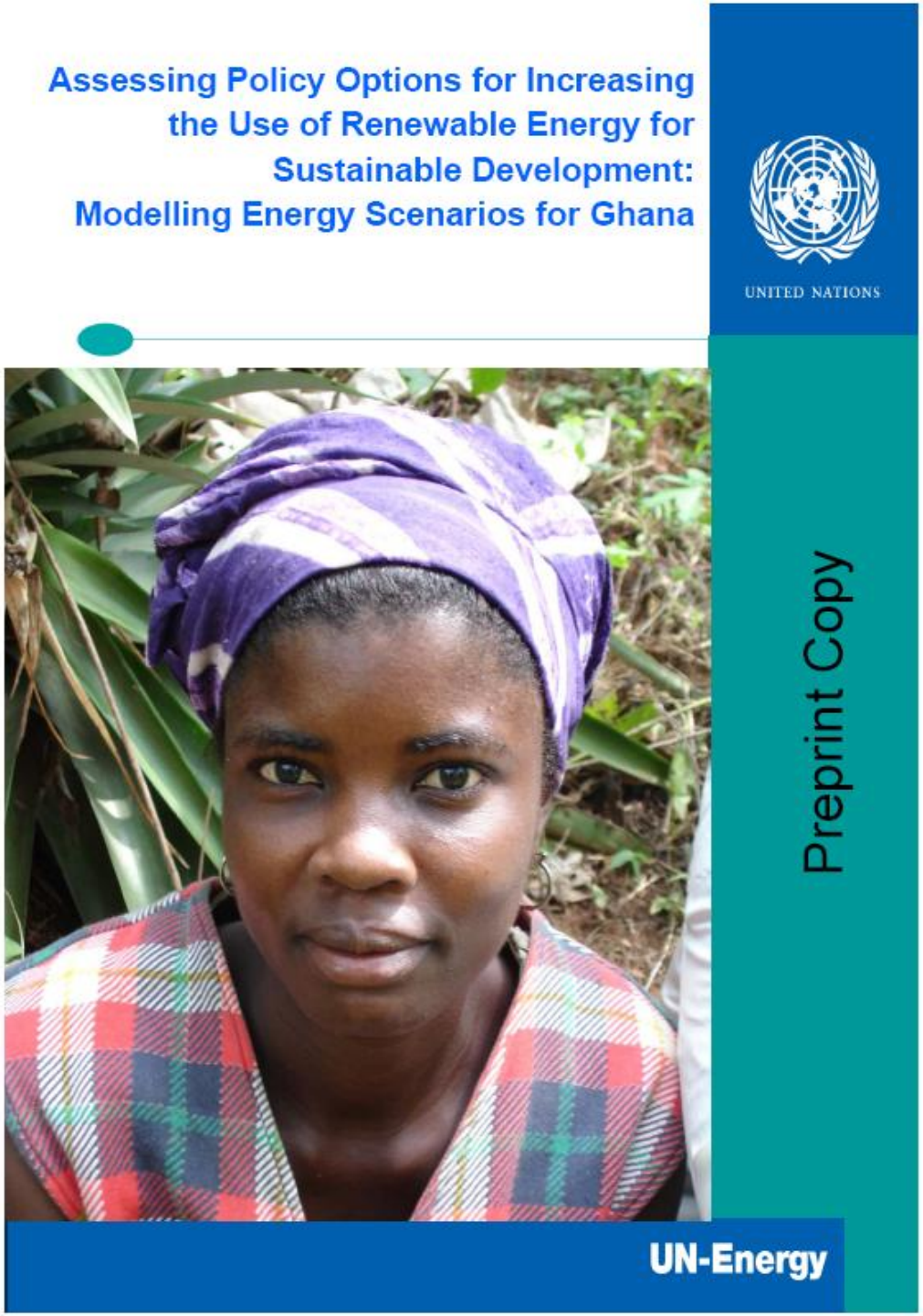
Outputs

- A national plan towards sustainable energy development

- A tool for benchmarking status, defining strategies for, and monitoring progress towards, a sustainable energy future



IAEA



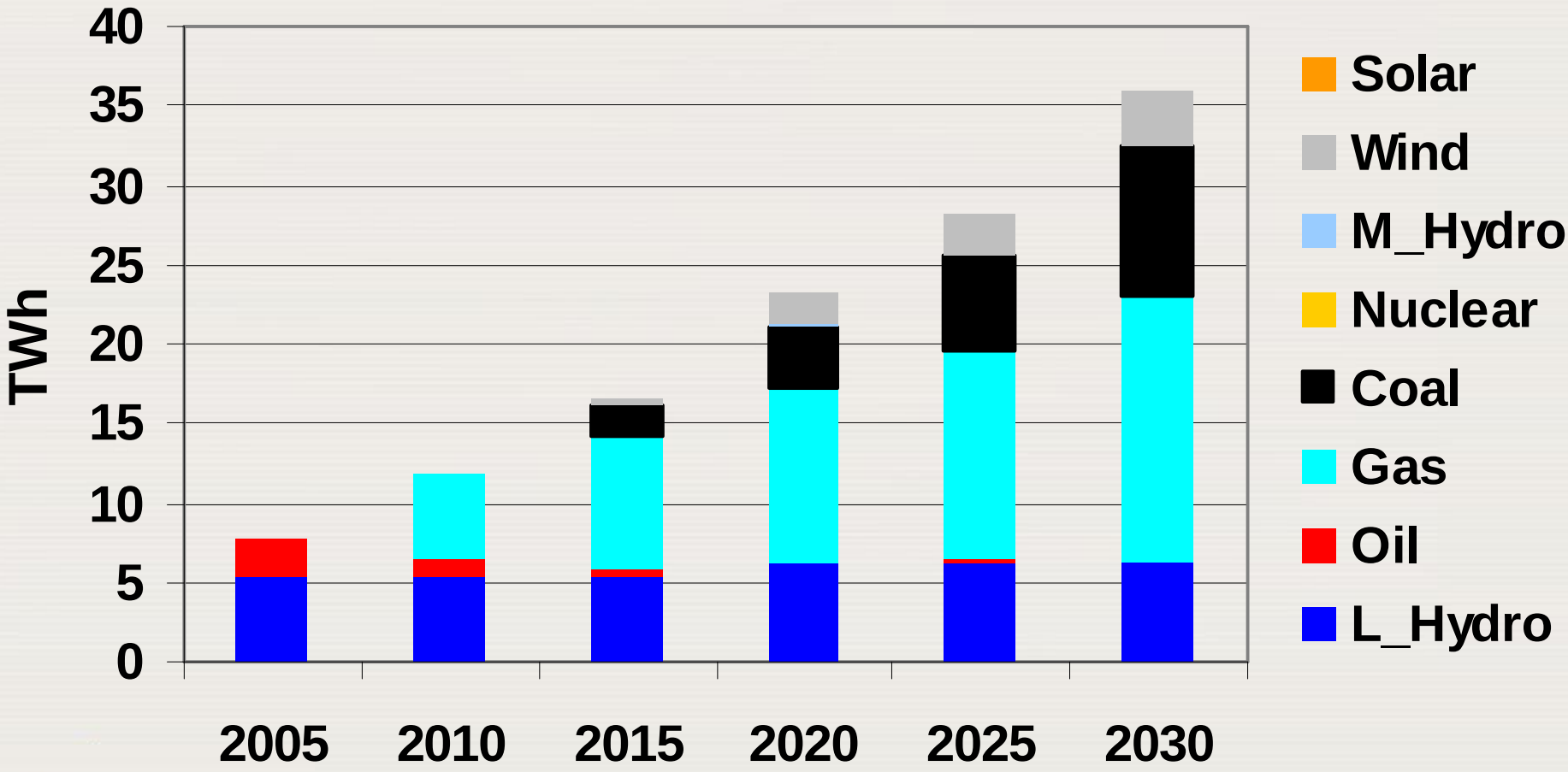
A UN-ENERGY Demonstration Study

conducted by

- **Department of Economic and Social Affairs (DESA)**
- **Food and Agriculture Organization (FAO)**
- **International Atomic Energy Agency (IAEA)**
- **United Nations Environment Programme (UNEP)**
- **United Nations Industrial Development Organization (UNIDO)**

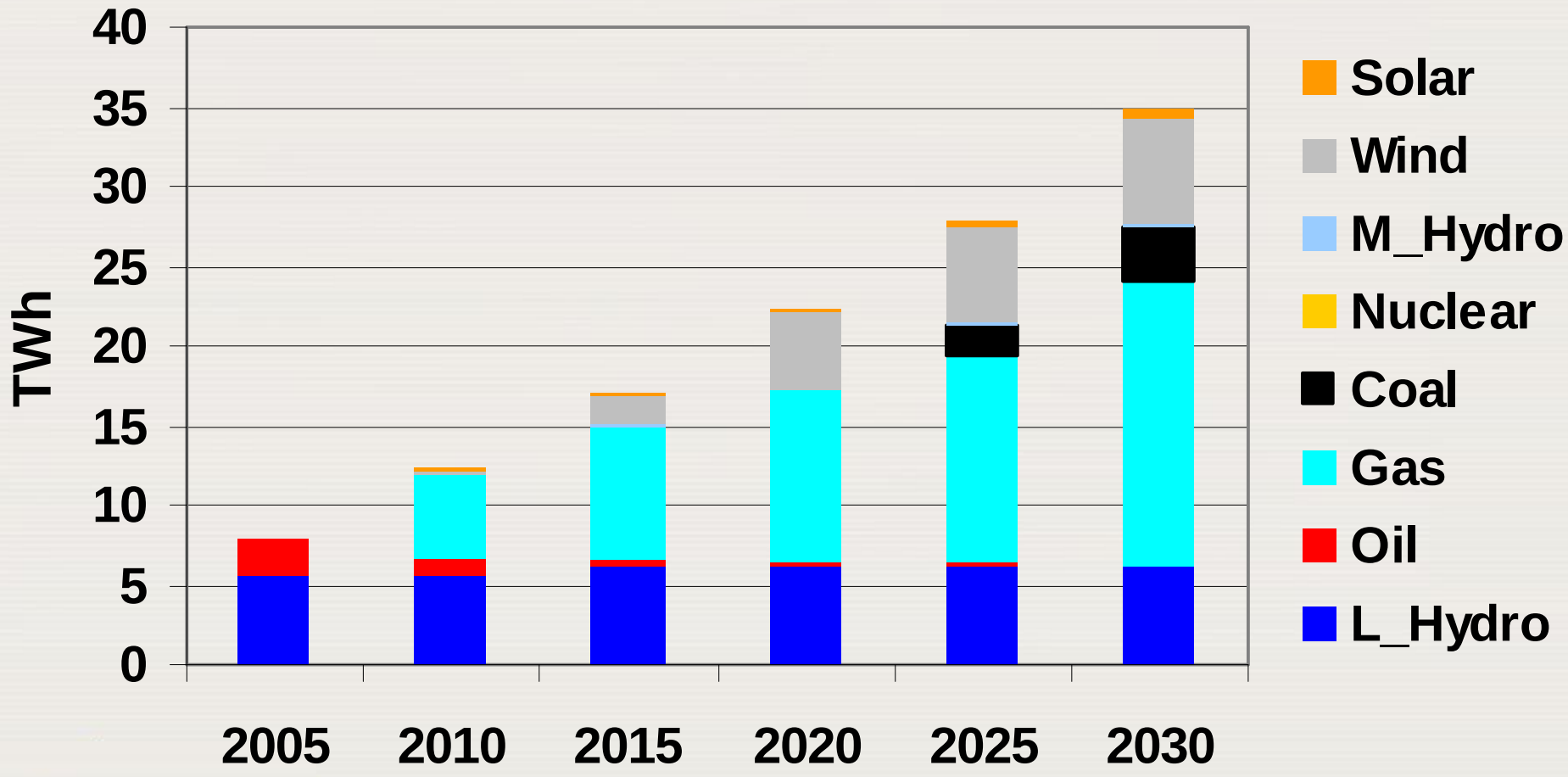
with assistance form the Ghana Energy Commission

Electricity generation: Base case



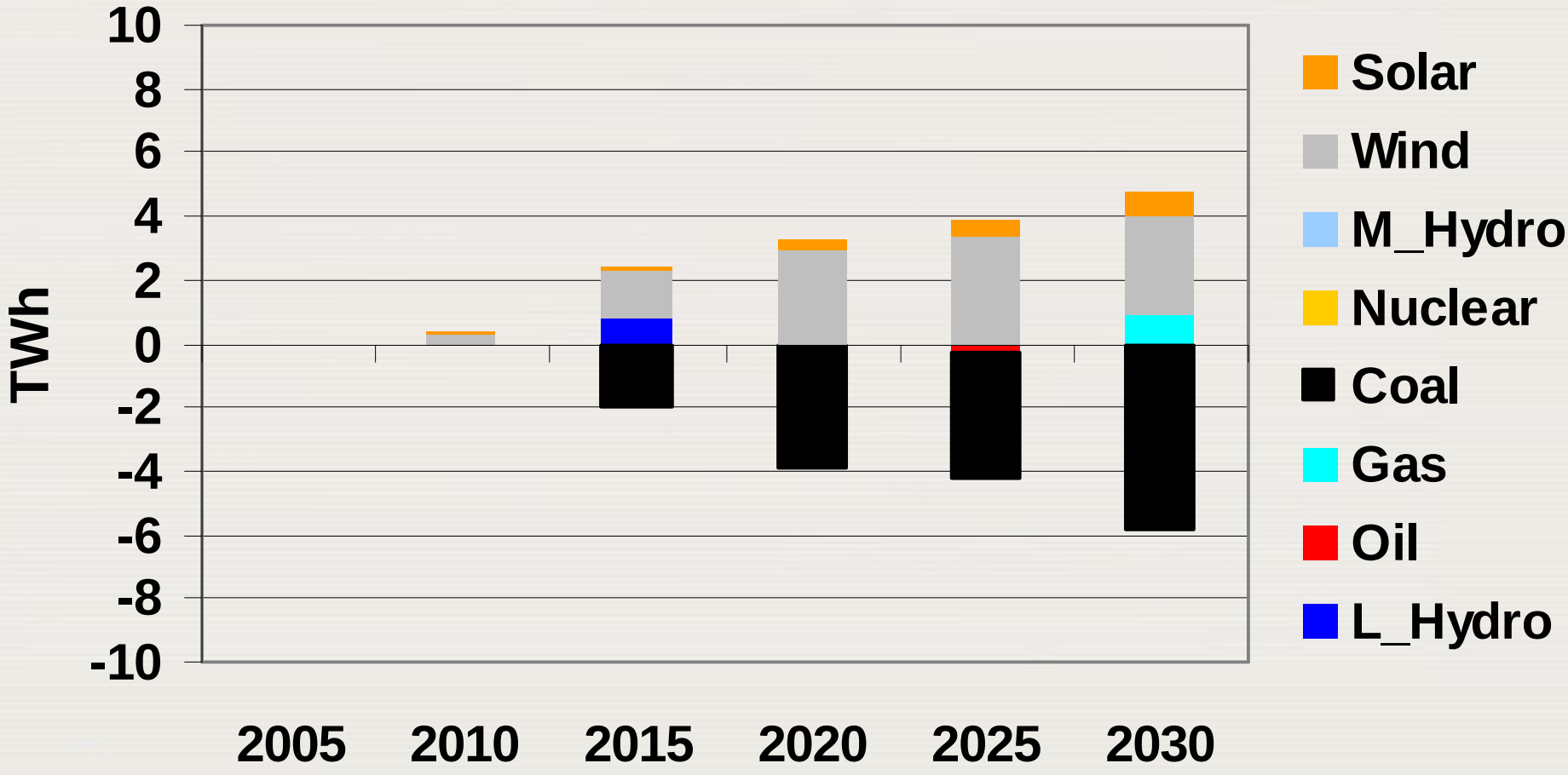
IAEA

Electricity generation: CDM at $25/tCO$_2$



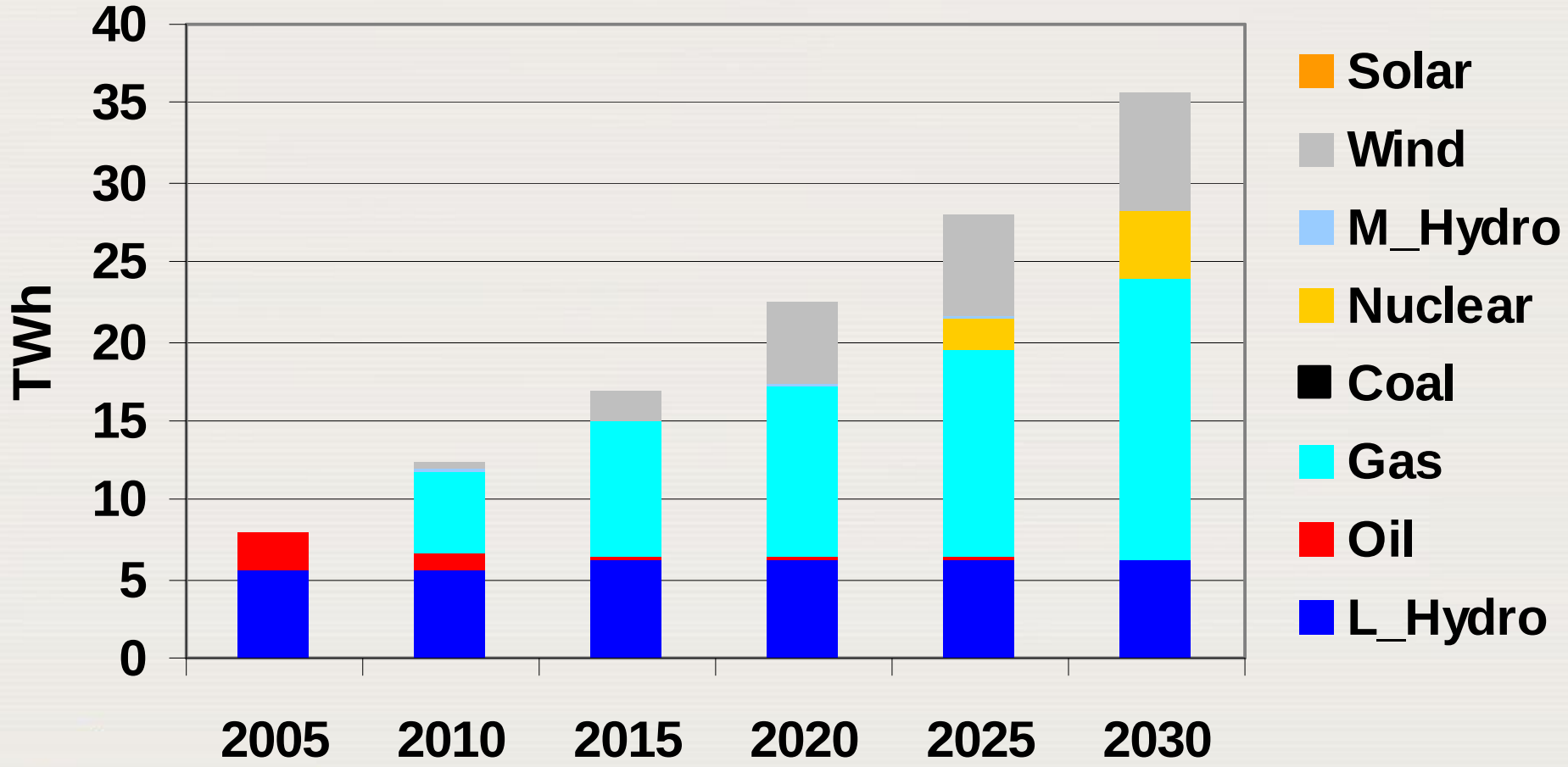
IAEA

Electricity generation: CDM vs BC



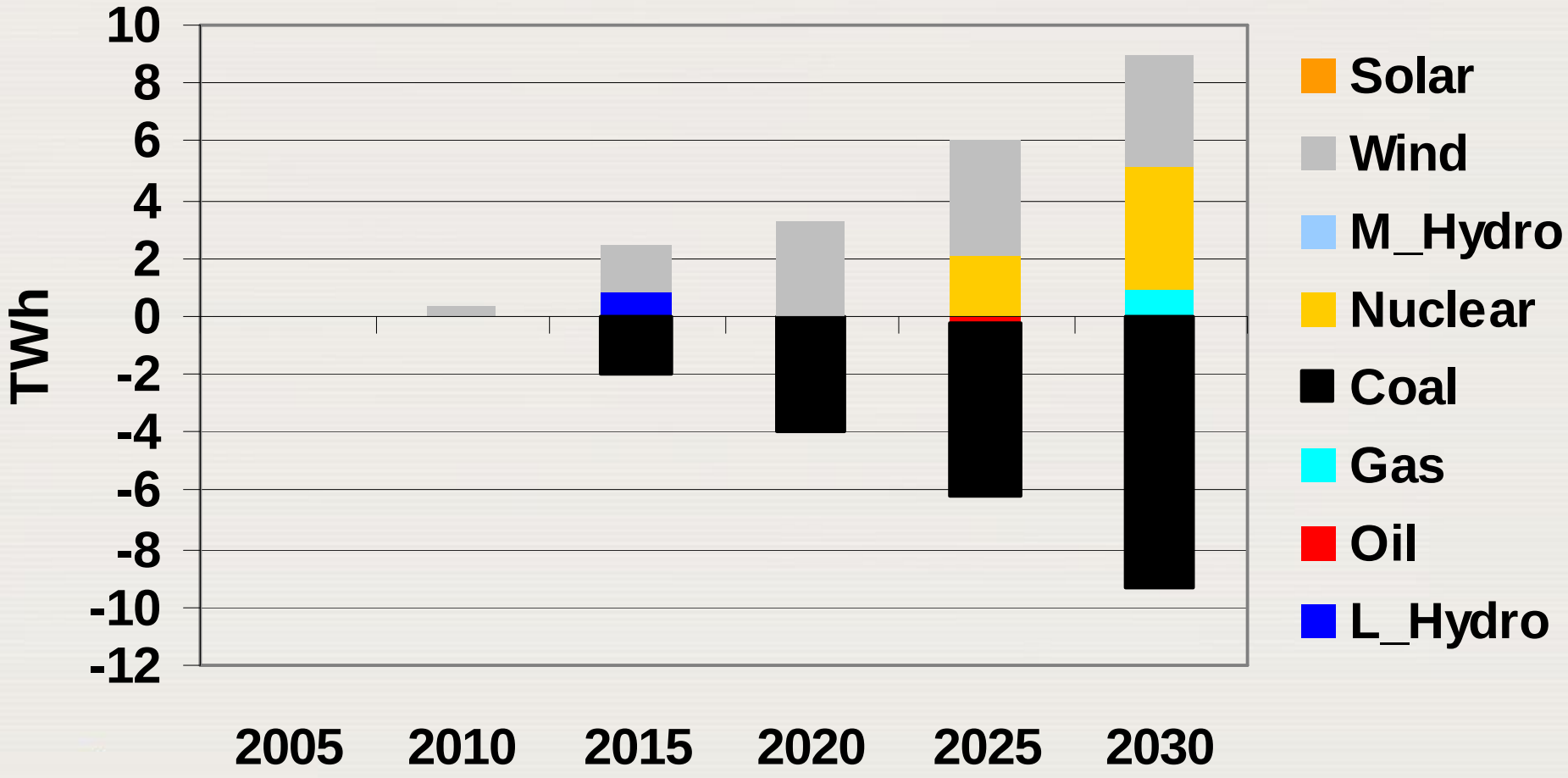
IAEA

Electricity generation: CDM at $25/tCO$_2$ with nuclear as CDM option



IAEA

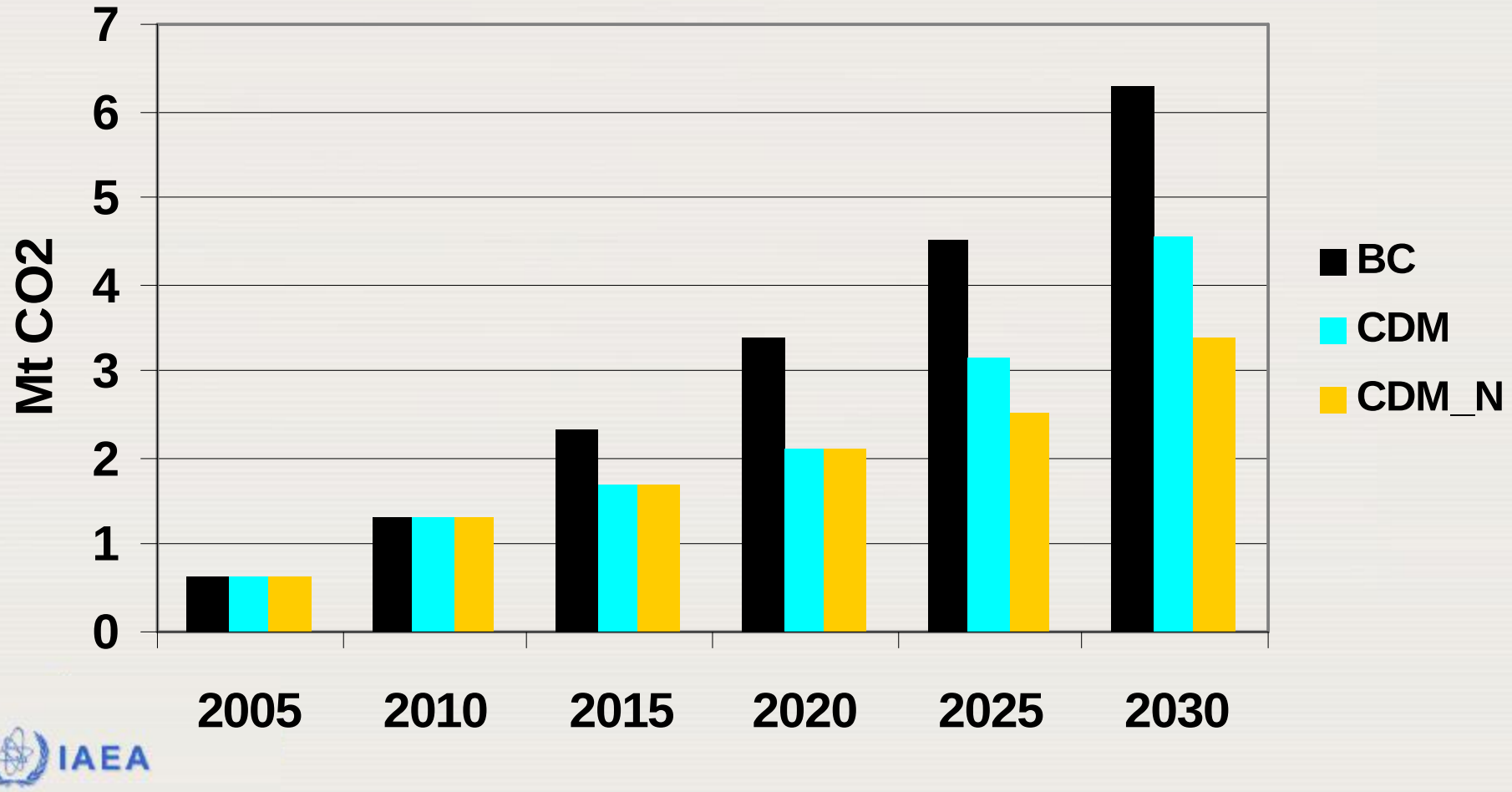
Electricity generation: CDM_N vs BC



IAEA

Impact of different CDM schemes

CO2 emissions from electricity generation



IAEA

Energy Planning – An ongoing process

- No analysis is perfect
- Many more “what if” questions need to be explored
- New information
- Previously plausible assumptions no longer stand the test of time
- Energy planning never ends…..

Energy planning and nuclear power

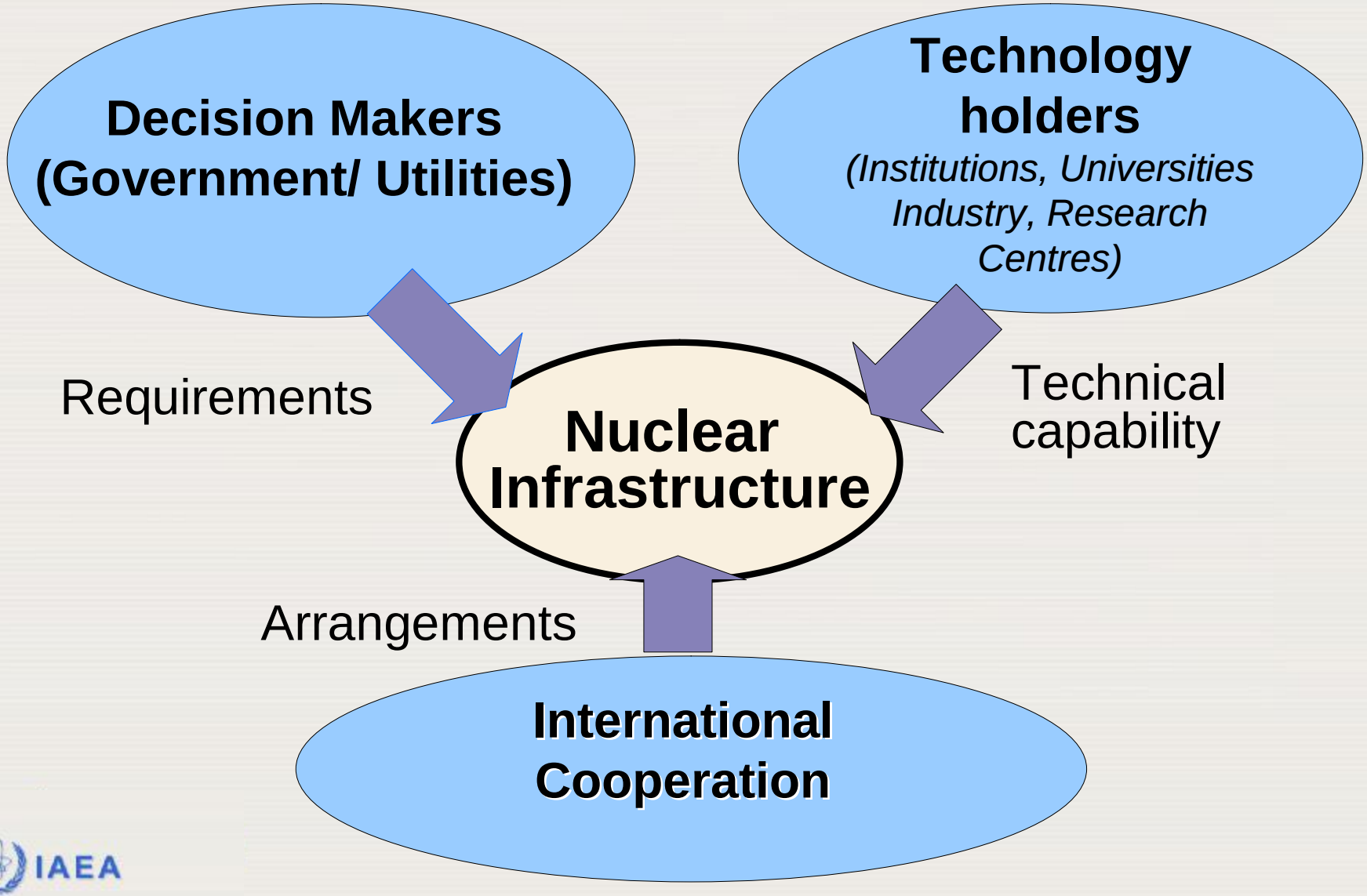
- If nuclear power is integral part of the optimal supply mix under several potential futures (scenarios), the next logic step concerns:

Understanding the issues involved with the implementation of a nuclear power programme

Unlike many large industrial projects, nuclear power has certain unique characteristics

- Risk of severe accidents and possible target of sabotage, i.e. concerns inherent with nuclear material and radiation
- Public awareness of nuclear risks seems to outweigh its awareness of the benefits, e.g. climate change
- Importance of public trust
- Safety, security and proliferation issues
- Start up phase is significant in length and effort, some 10-15 years before the shovel hits the ground
- Requires a “100 year +” commitment
- Long term waste issues

Infrastructure requirements



IAEA

Issues: Expected preparedness and competency in key areas of

1. National position
2. Legislative framework
3. Nuclear safety
4. Regulatory framework
5. Human Resource Development
6. Safeguards
7. Security and physical protection
8. Management
9. Financing
10. Stakeholder involvement
11. Emergency planning
12. Radiation protection
13. Nuclear fuel cycle
14. Nuclear waste
15. Environmental protection
16. Site and supporting facilities
17. Industrial involvement
18. Procurement
19. Electric grid

ISSUES	MILE-STONE 1	MILE-STONE 2	MILE-STONE 3
1. National position			
2. Legislative framework			
3. Nuclear safety			
4. Regulatory framework			
5. Human resource development			
6. Safeguards			
7. Security and physical protection			
8. Management			
9. Financing			
10. Stakeholder involvement			
11. Emergency planning			
12. Radiation protection			
13. Nuclear fuel cycle			
14. Nuclear waste			
……			
19. Electric grid			

ACTIONS

ACTIONS

ACTIONS

Nuclear Safety Infrastructure

Nuclear Safety is integral part of all aspects of a nuclear power programme

- Legal Framework, regulators, operators
- Technical competence, skills and attitudes
- Leadership and management, and safety culture
- Financial strength and stability for the entire programme
- Life cycle: pre-operation, operation, decommissioning and waste management
- Openness and transparency
- Emergency preparedness and response capabilities
- International connectivity

Reference: Considerations Document - GOV/INF/2007/2

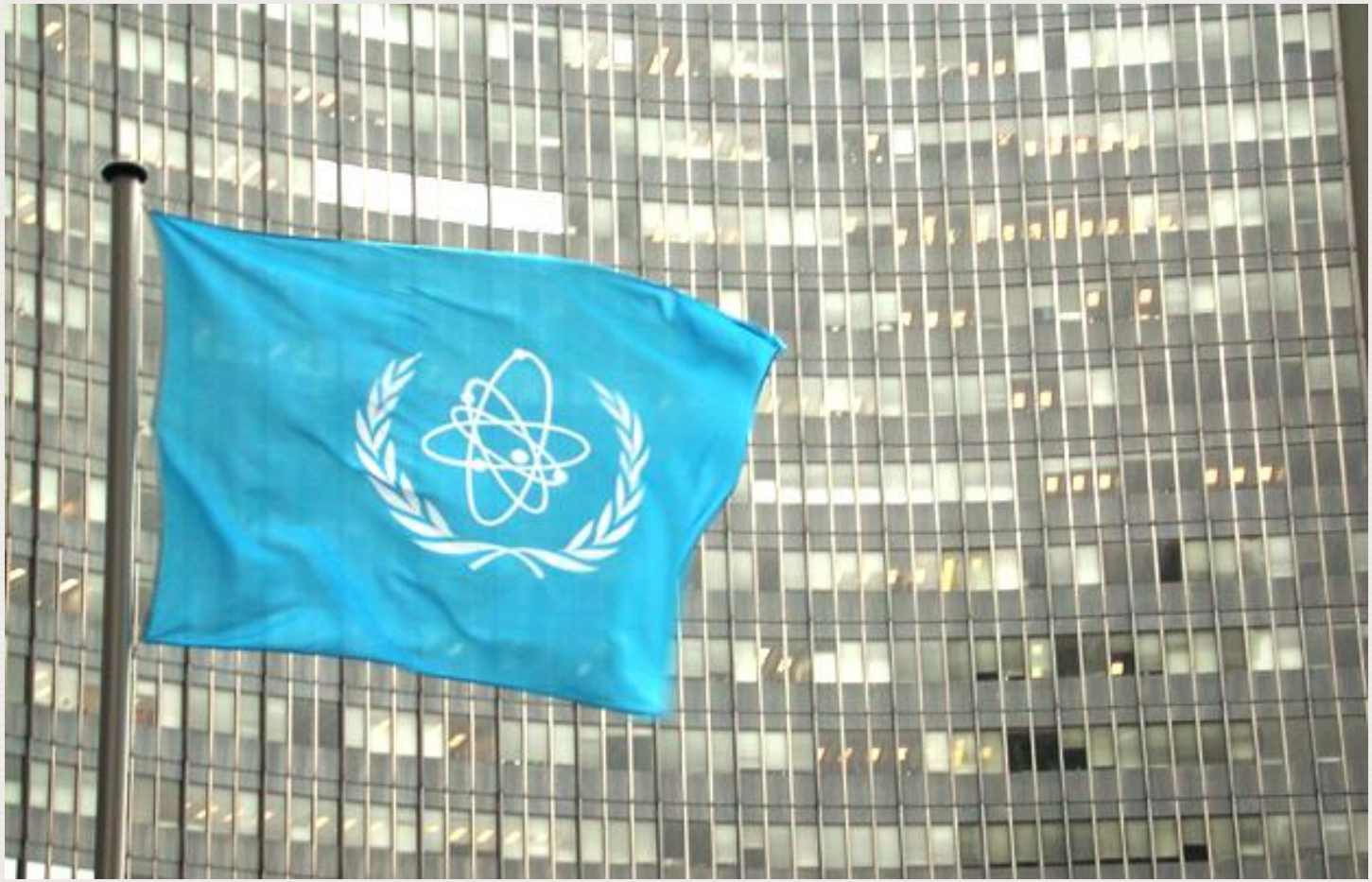
IAEA

Nuclear Energy and Society

Bjorn Wahlström

IAEA

IAEA



…atoms for peace.

Economics – Nuclear power

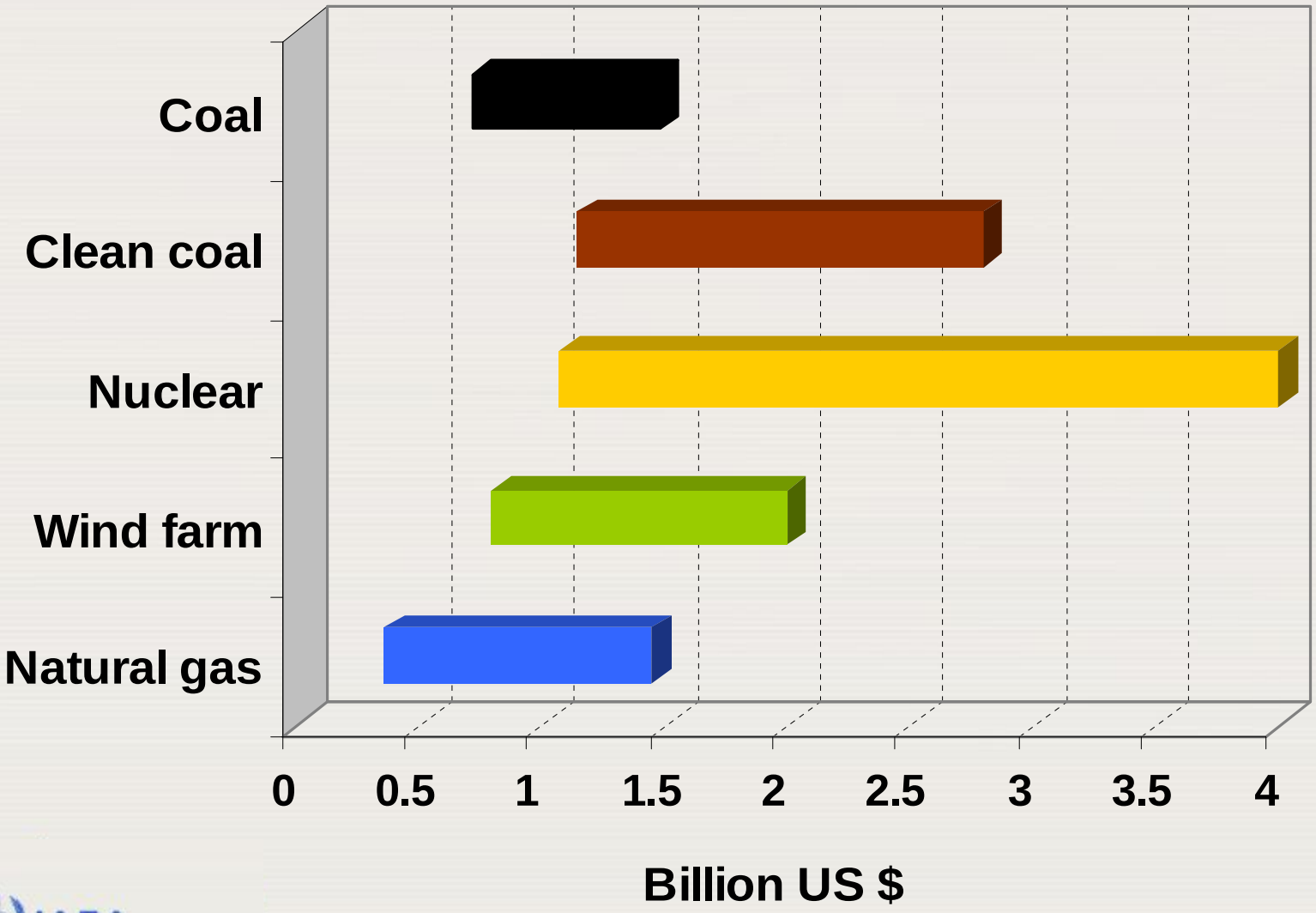
Advantages

- Nuclear power plants are cheap to operate
- Stable & predictable generating costs
- Long life time
- Supply security (insurance premium)
- Low external costs (so far no credit applied)

But…

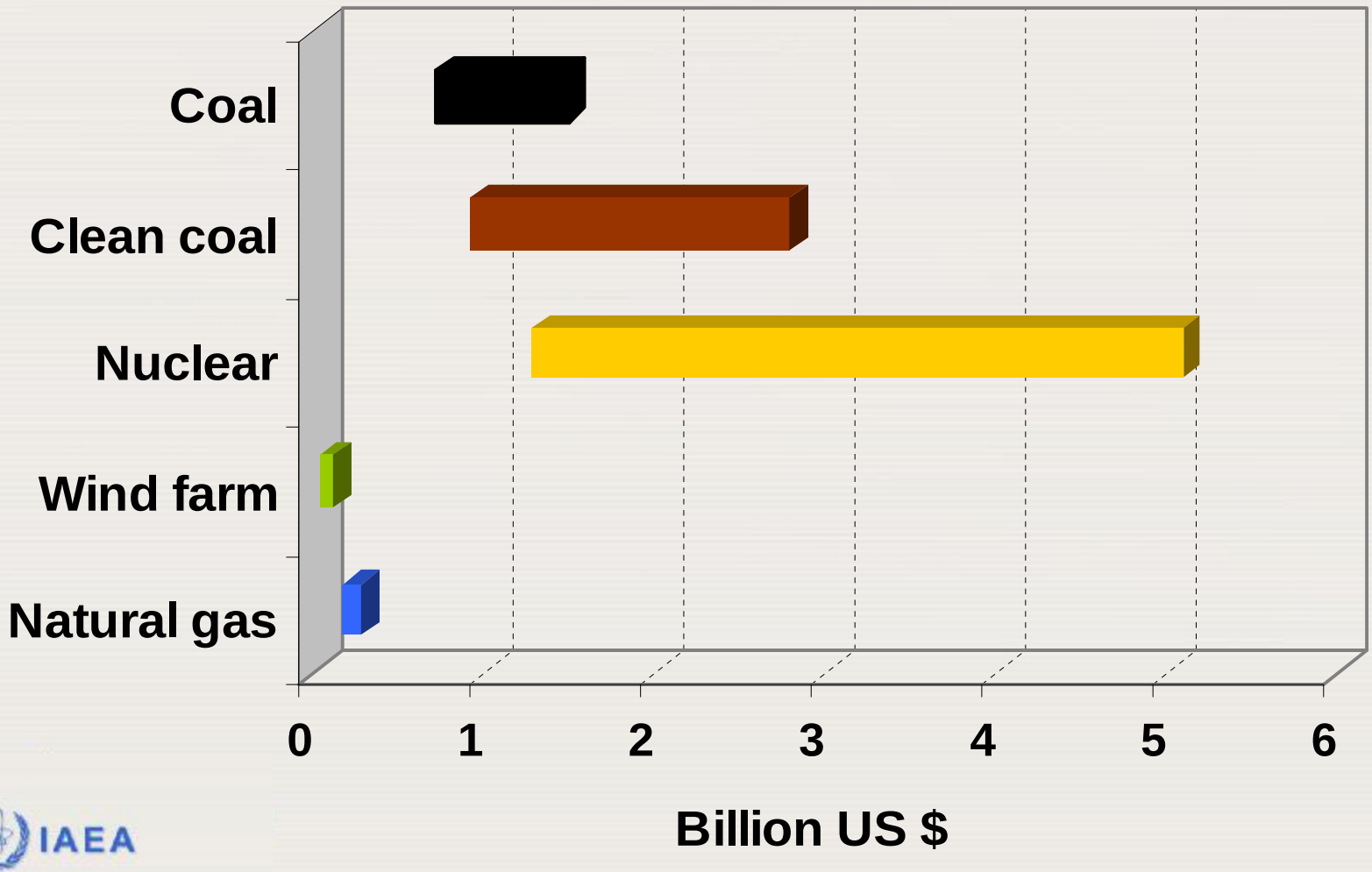
- High upfront capital costs can be difficult to finance
- Sensitive to interest rates
- Long lead times (planning, construction, etc)
- Long payback periods
- Regulatory/policy risks
- Market risks

Overnight investment cost ranges for 1 000 MW generating capacity



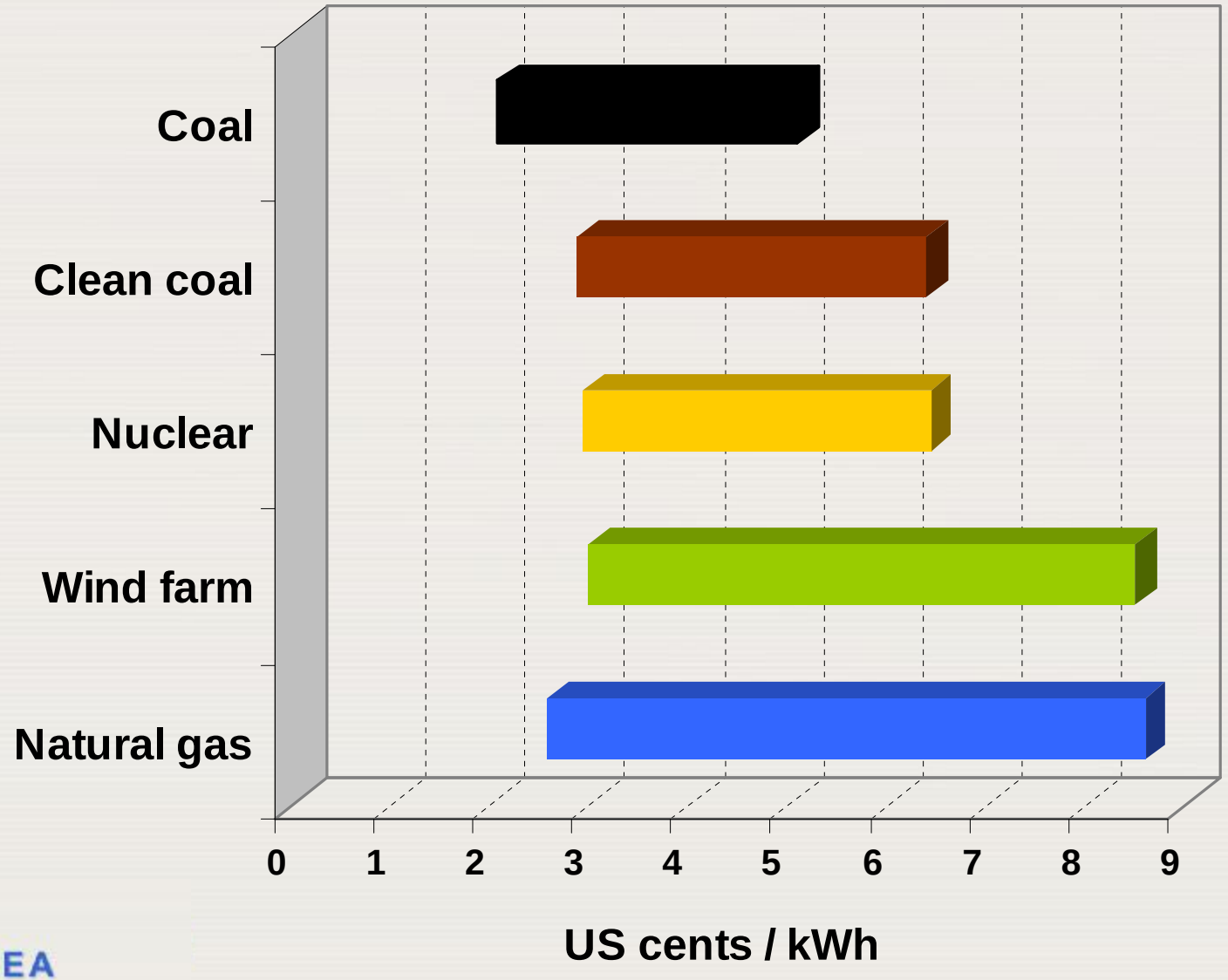
IAEA

Overnight investment cost ranges for typical unit sizes



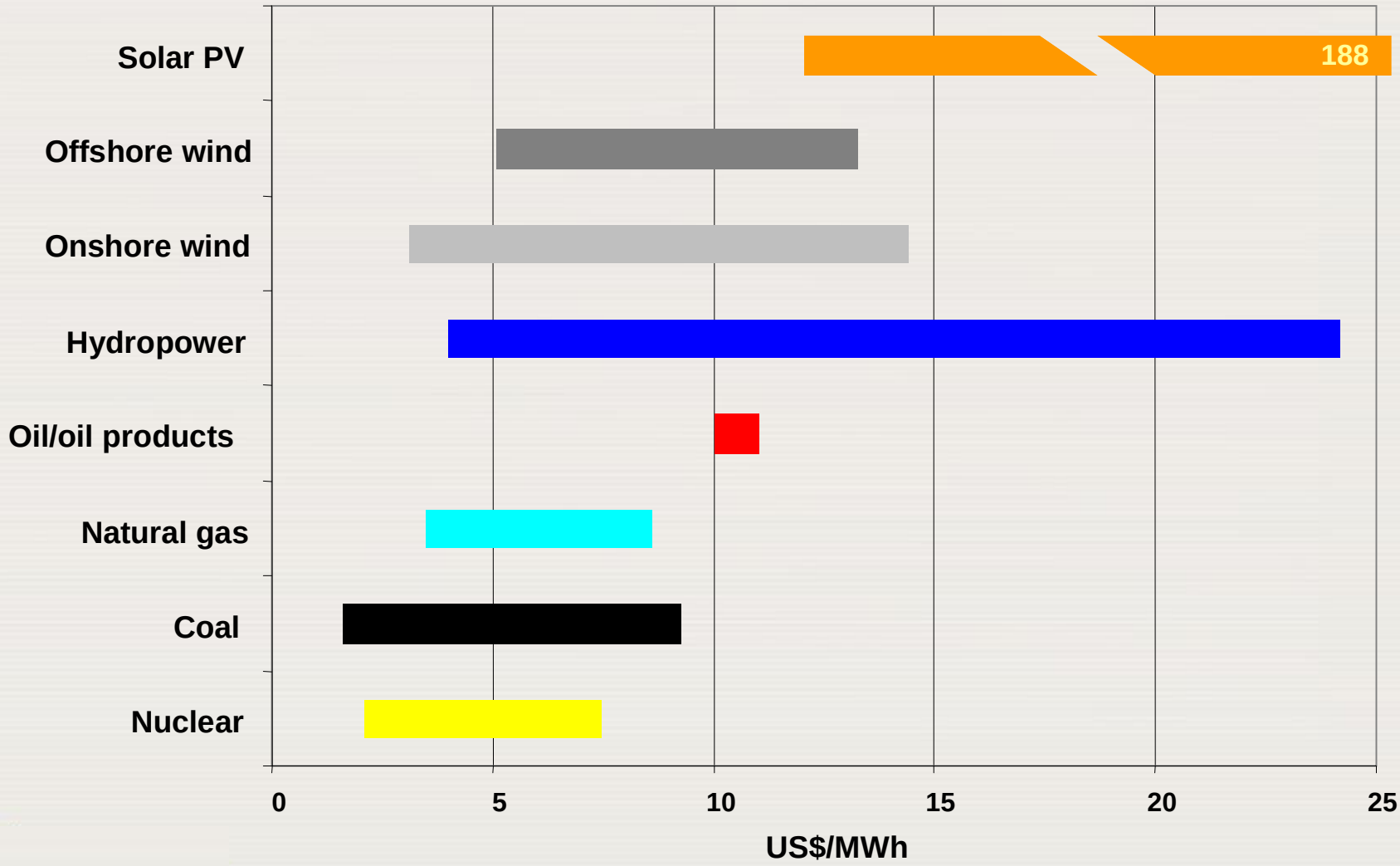
IAEA

But what matters really are the generating cost ranges (capital, O&M, fuel)



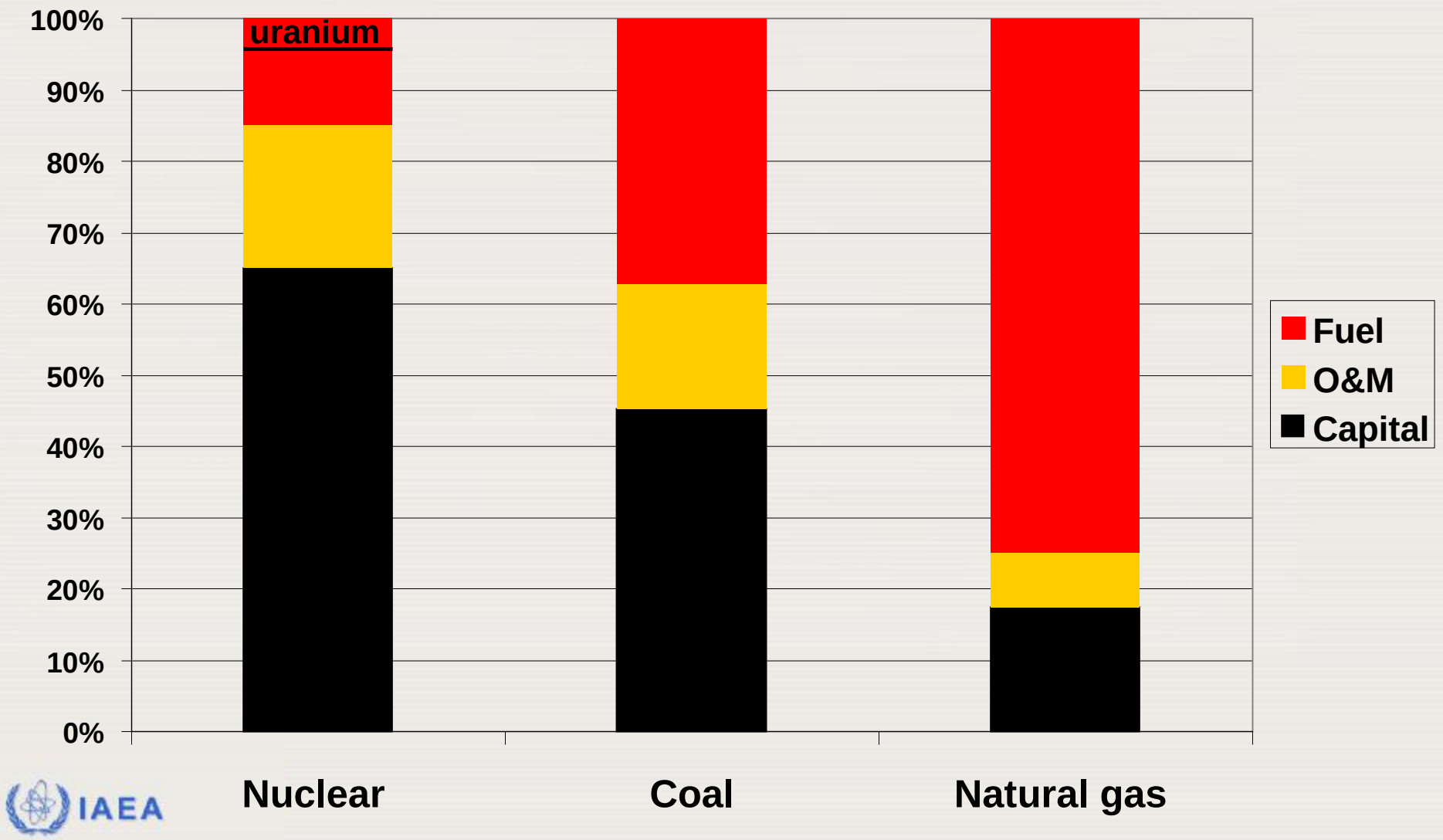
IAEA

Range of levelized generating costs of new electricity generating capacities

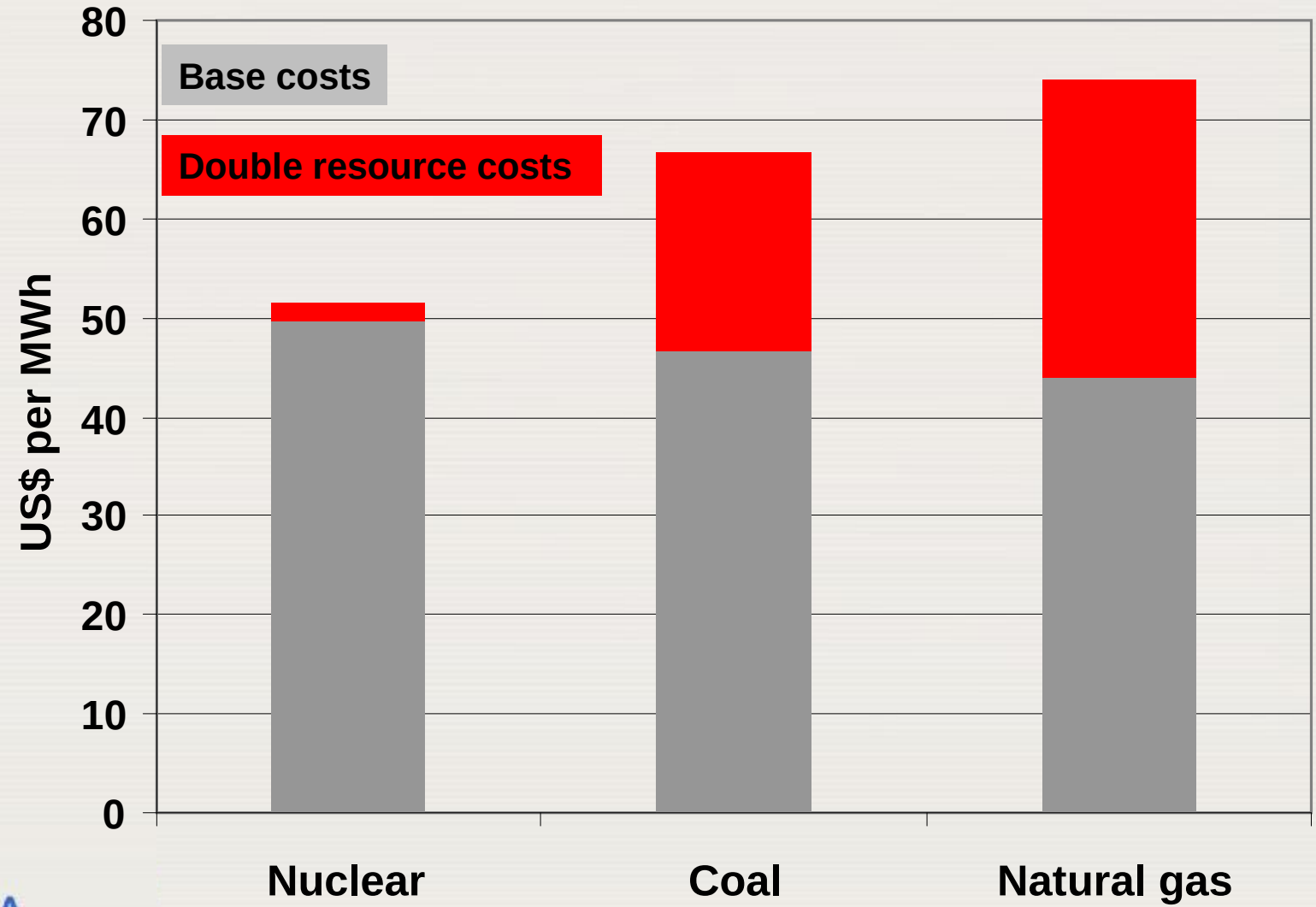


Source: Adapted from eight recent studies

Cost structures of different generating options



Impact of a doubling of resource prices



IAEA

One size does not fit all

- Countries differ with respect to
  - energy demand growth
  - alternatives
  - financing options including subsidies
  - weighing/preferences
    - accident risks (nuclear, mining, oil spills, LNG…), cheap electricity, air pollution, jobs, import dependence, climate change
- All countries use a mix. All are different.
- Nuclear power per se is not “the solution” to the world’s energy problems, climate change and energy security
- It surely can be an integral part of the solution!

IAEA