



IAEA

International Atomic Energy Agency

Department of Nuclear Energy
Division of Planning, Information and Knowledge Management
Planning and Economic Studies Section

IAEA CRP on the *Economic Appraisal of Small Modular Reactor (SMR) Projects: Methodologies and Applications*

Technical Meeting on Back End of the Fuel Cycle Considerations
for Small Modular Reactors, 20-23 September 2022.

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New CRP: Economic Appraisal of Small Modular Reactor (SMR) Projects: Methodologies and Applications (I12007)

The IAEA is launching a 3-year, Coordinated Research Project (CRP) focusing on the economics of SMRs, including micro-reactors, by providing Member States with an economic appraisal framework for their development and deployment.

New Coordinated Research Project

Saied Dardour, IAEA Department of Nuclear Energy
Frederik Reitsma, IAEA Department of Nuclear Energy

MAR 25 2020



Significant advances have been made on Small Modular Reactors, some of which will use pre-fabricated systems and components to reduce construction costs and shorten delivery schedules.

Small Modular Reactors (SMRs), with electrical power up to 300MW per module, have specific design, safety and siting features, as well as a wide range of applications. In response to increased interest, the IAEA is launching a 3-year, Coordinated Research Project (CRP) focusing on the economics of

Related Stories

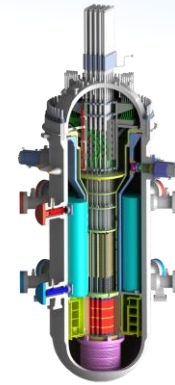
-  IAEA Launches Technical Working Group on Small, Medium Sized or Modular Nuclear Reactors
-  IAEA SMR Regulators' Forum Shares Experiences on New Reactors
-  New IAEA Self-Assessment Methodology and Enhancing SMR Licensing Discussed at Regulatory Cooperation Forum

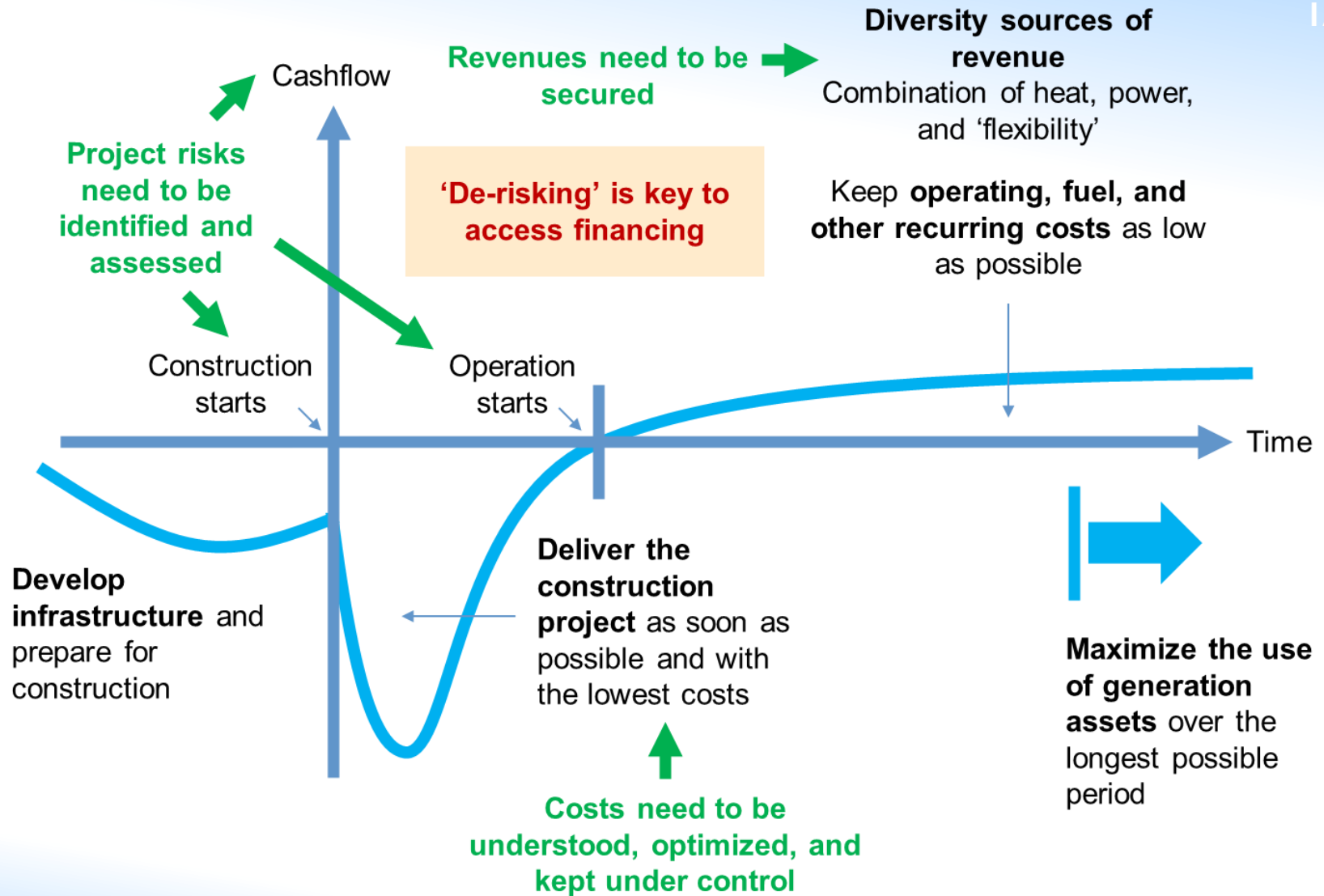
Related Resources

-  [Small modular reactors](#)
-  [Small Modular Reactor \(SMR\) Regulators' Forum](#)
-  [Nuclear Power Technology Development Section](#)
-  [Planning and Economic Studies Section](#)

Presentation of the CRP

- Initiated in December 2020, the IAEA CRP entitled ‘Economic Appraisal of Small Modular Reactor (SMR) Projects: Methodologies and Applications’ aims at providing Member States with a canvas and a framework (the *COOSMR Framework*) for the economic appraisal of Micro- and Small Modular Reactors development and deployment.
- Participating Institutions (47):
 - CNEA, Argentina; ANSTO, Australia; TRACTEBEL, Belgium; EPE, Brazil; KOZLODUY, Bulgaria; CNL, Canada; CNPE, China; SNERDI, China; SPIC, China; U-ZAGREB, Croatia; UJV, Czech Rep.; CREN-K, DRC; FERMI, Estonia; FORTUM, Finland; VTT, Finland; CEA, France; FPL, France; GAEC, Ghana; BATAN, Indonesia; POLIMI, Italy; CRIEPI, Japan; JAEA, Japan; JAEC, Jordan; KISR, Kuwait; CNESTEN, Morocco; SN13, Netherlands; PAEC, Pakistan; NCBJ, Poland; ROSATOM, Russian Fed.; MOZWELI, S. Africa; KAERI, S. Korea; IDOM, Spain; SLAEB, Sri Lanka; CNSTN, Tunisia; U-CARTHAGE, Tunisia; U-ISTANBUL, Turkey; MENR, Turkey; PERIHELION, UK; U-LEEDS, UK; ARC, US; INL, US; KAIROS, US; NECG, US; NINE, US; NUSCALE, US; PILLSBURY, US; TAMU, US.
- Observers (5):
 - BEIS (UK); NREL (US); GIF EMWG; OECD NEA; ASEAN Centre for Energy.
- Secretariat (IAEA):
 - S. Dardour and D. Subbotnitskiy (PESS), M. H. Subki (NPTDS).



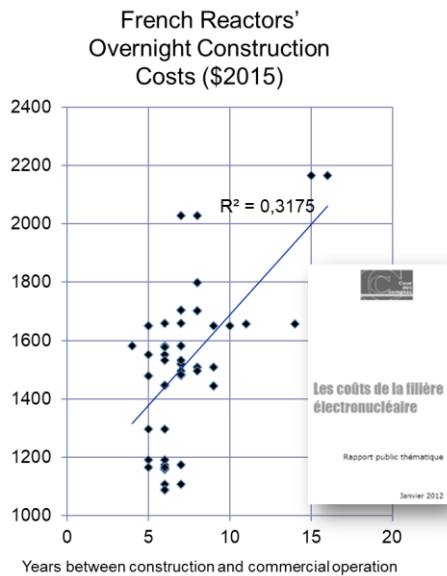


Past

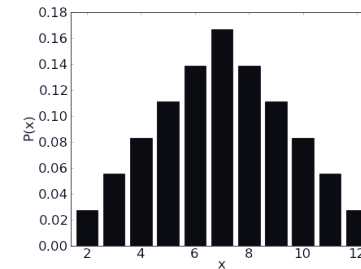
Future

Costs

Known / Certain



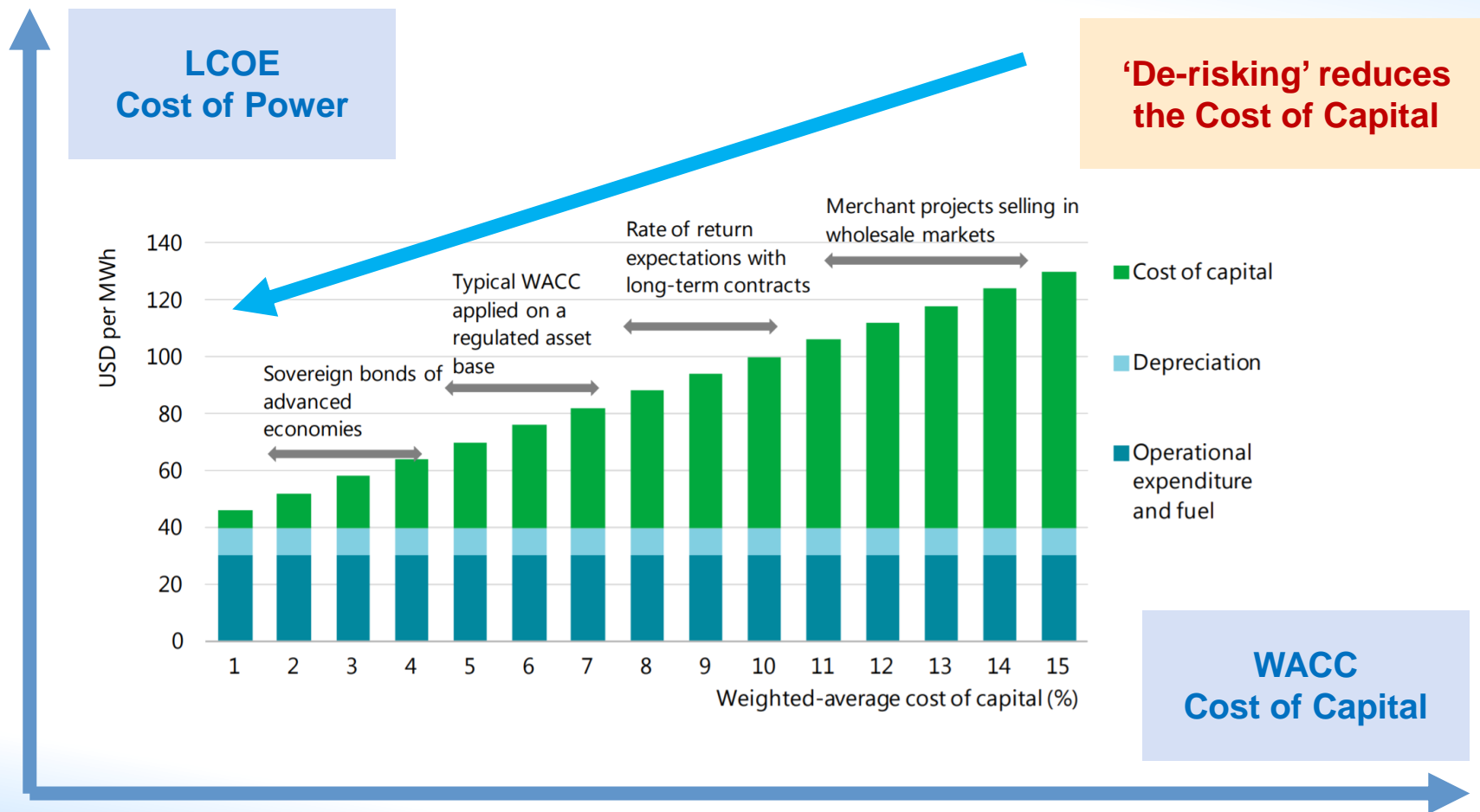
Unknown / Uncertain



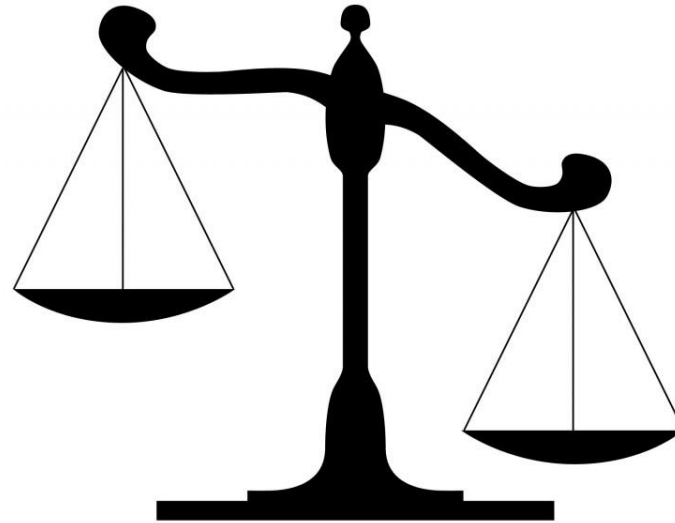
We can only approximate the **probable** cost of a program, project, system, equipment, part or task.



Access to cheap capital makes a huge difference to the cost of producing electricity for a new nuclear power project *



* IEA, Nuclear Power in a Clean Energy System (2019) <https://www.iea.org/reports/nuclear-power-in-a-clean-energy-system>



Costs have to be balanced against **Benefits**

Investments in SMR are driven by specific challenges:

Affordable energy prices for consumers

Growing penetration of power generation from variable renewable energy (VRE) sources (increasing need to balance VRE)

Global concerns for climate change (need of progressively substituting fossil-based energy fuels with more sustainable sources)

Security and reliability of supply

Cost-benefit analysis: A method to evaluate the net economic impact of a project. Expected benefits are estimated and monetised with inflation accounted for, and offset against project costs. The approach is most commonly used to inform in major infrastructure investment in both developed and developing countries.

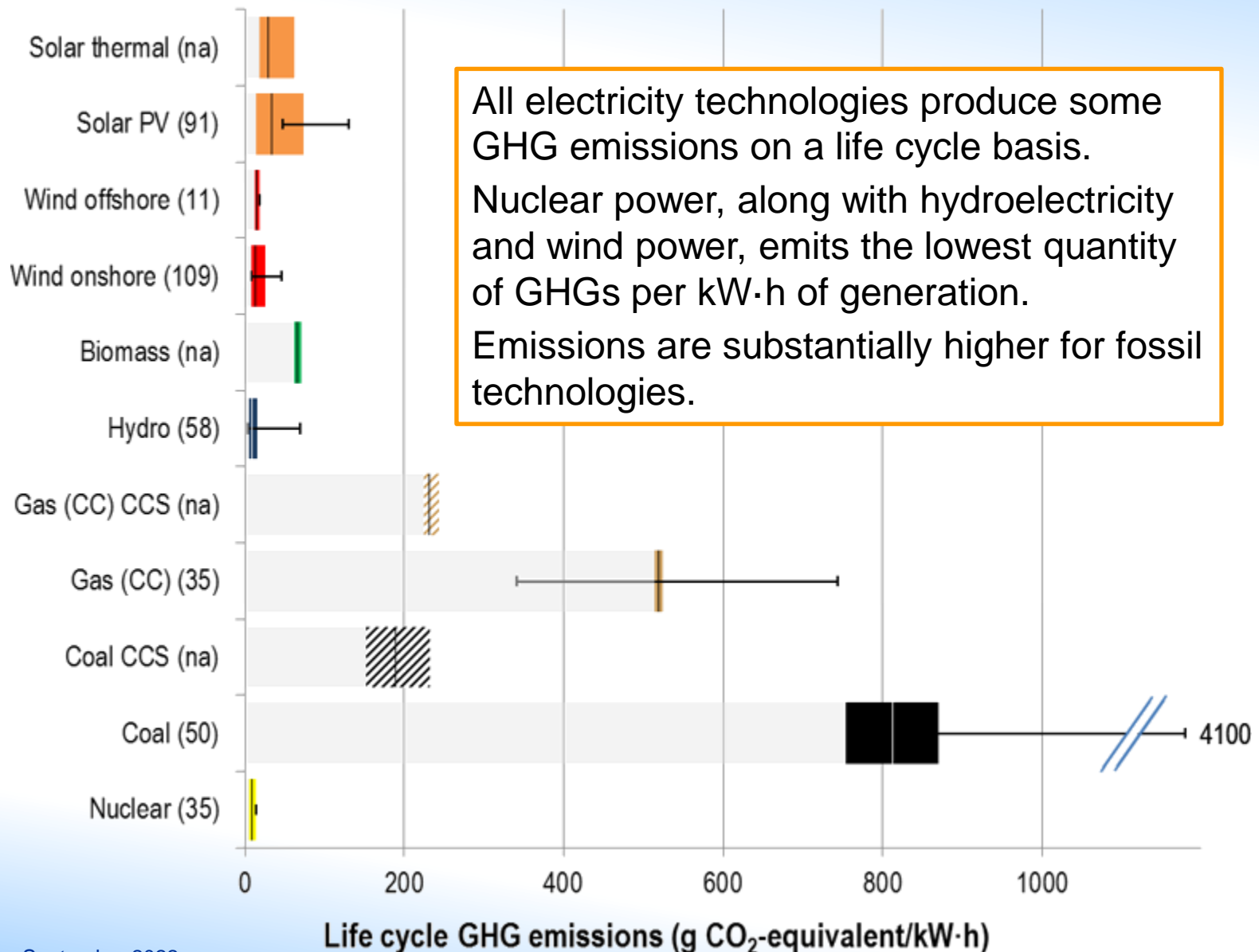
Cost-effectiveness analysis: This method is used where monetising outcomes is not possible or appropriate, most commonly in health. Common measures include “quality-adjusted life years”.

Value for money and international development: Deconstructing myths to promote a more constructive discussion
Penny Jackson, OECD Development Co-operation Directorate.

<https://www.oecd.org/development/effectiveness/49652541.pdf>

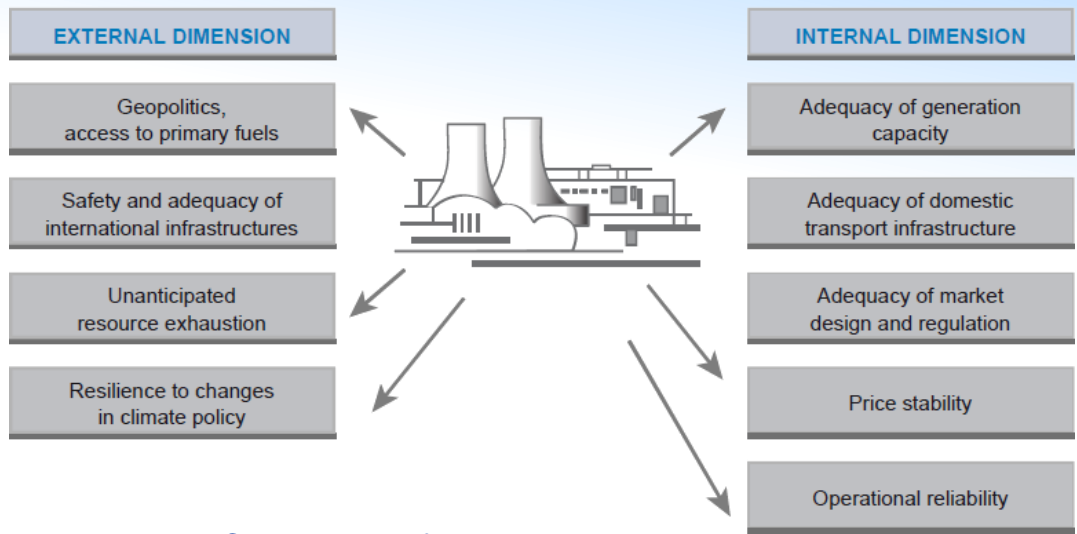
Life cycle GHG emissions

Source: IAEA, Climate Change and Nuclear Power 2018.



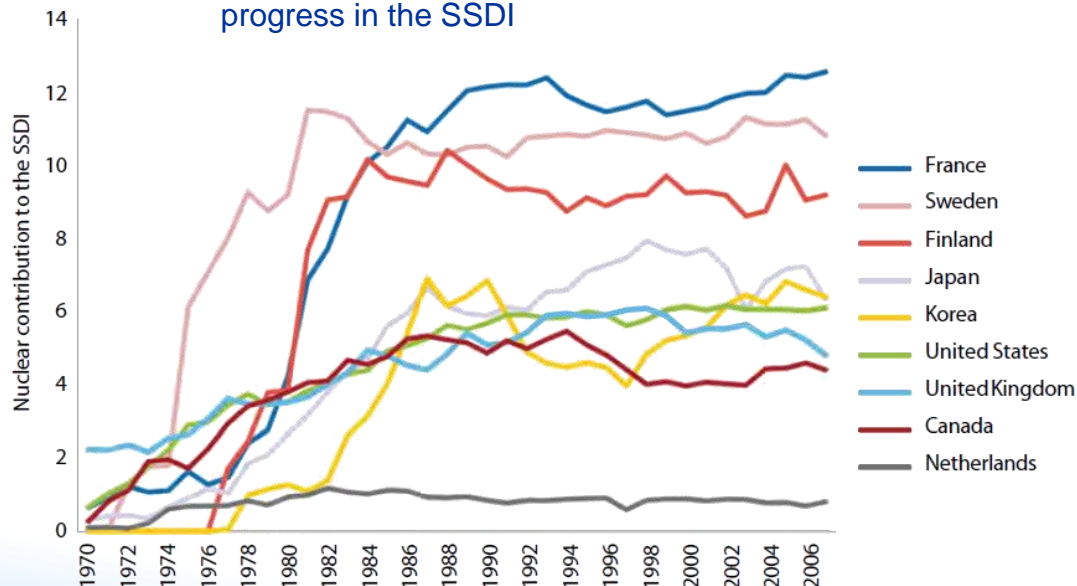
Security of supply Source: NEA, 2018.

SECURITY OF ENERGY SUPPLY



- NEA's indicator of the security of supply for OECD countries: the simplified supply and demand index or SSDI.
- The SSDI shows a remarkable improvement for the great majority of OECD countries over the 40-year time frame of the study: Australia, Canada, Finland, France, Japan, the Netherlands, Sweden, the United Kingdom and the United States.
- This improvement resulted from the introduction of nuclear power for electricity generation, decreasing energy intensity and increased diversification of imported fuels such as coal, oil and gas.

Source: NEA, 2010. Contribution of nuclear power to progress in the SSDI



Source: NEA, 2010.

Multi-billion investments in multi-billion infrastructure projects in general, and SMR newbuilds in particular, are a synonym of **economic growth and job creation** over many decades.

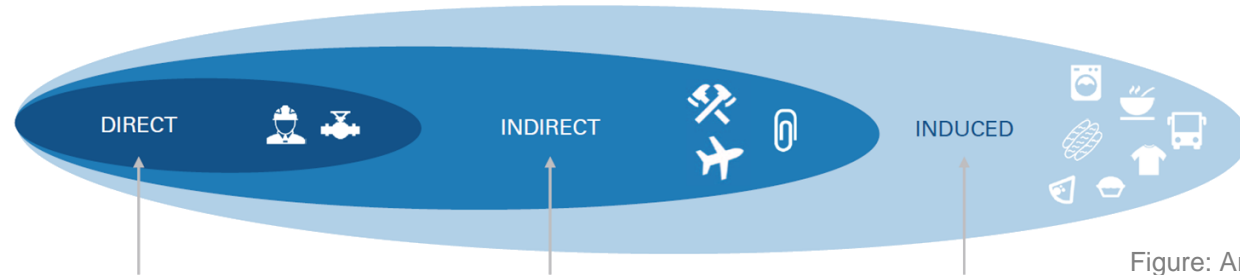
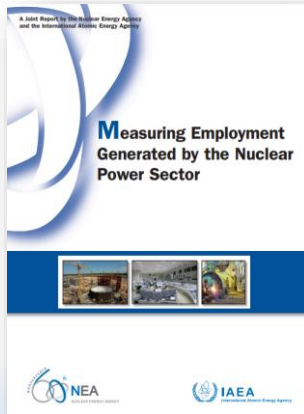


Figure: Arthur D. Little

- All activities related to the project itself: construction, engineering, permitting, surveys, etc.
- Providers of raw materials and services to the direct contributors to the project
- Household spending by direct and indirect contributors to the project



Investments in energy infrastructures tend to stimulate construction, manufacturing, engineering services, generating economic growth across a wide range of economic sectors, beyond the energy sector.

The labour market is also impacted by direct and indirect (or “spillover”) effects, which can be estimated and quantified.

Macroeconomic impact



Who we are

Careers

Helping Britain achieve Net Zero

Hinkley Point C

29 Sep 21

Hinkley Point C

Five years on, 22,000 workers in Britain are at work on Hinkley Point C



The first reactor unit and the blue steel columns of the turbine building illuminated against the Somerset skyline.

[View](#) | [Download](#) (20.05 MB)

- Contracts provide work for 3,600 British companies
- Spending with businesses in North of England tops £1.2bn
- Number of workers to grow as pandemic pressures ease
- New photos and video show progress on the Somerset site



There is a positive relationship between the growth of transport and electricity infrastructure and economic growth.

Policies that promote spending in these areas have a positive impact on growth, provided they do not create excess capacity.

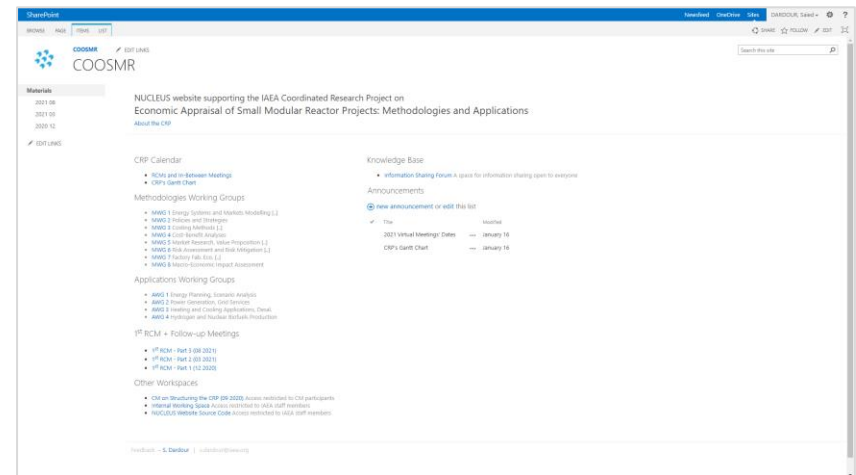
Project Deliverables

- Project deliverables:
 - D1: A generic framework (the COOSMR Framework) for the economic appraisal of SMR.
 - D2: Supporting methods, tools, and datasets.
 - D3: Country cases and other case studies, focusing on SMR applications, and illustrating the application of the *COOSMR Framework*.
 - D4: The CRP report, documenting D1-D3 deliverables, to be published at the end of the project.

Project NUCEUS



<https://nucleus.iaea.org/sites/coosmr>



Perspective matters...

Project Developer

Project developers rely on standard financial appraisals focusing on *returns to shareholders*.

Public Sector Decision-Maker

Economic appraisal takes a broader view to include *benefits and costs to society*.



Illustration: huffpost.com
https://www.huffpost.com/entry/its-all-perspective_b_11688054

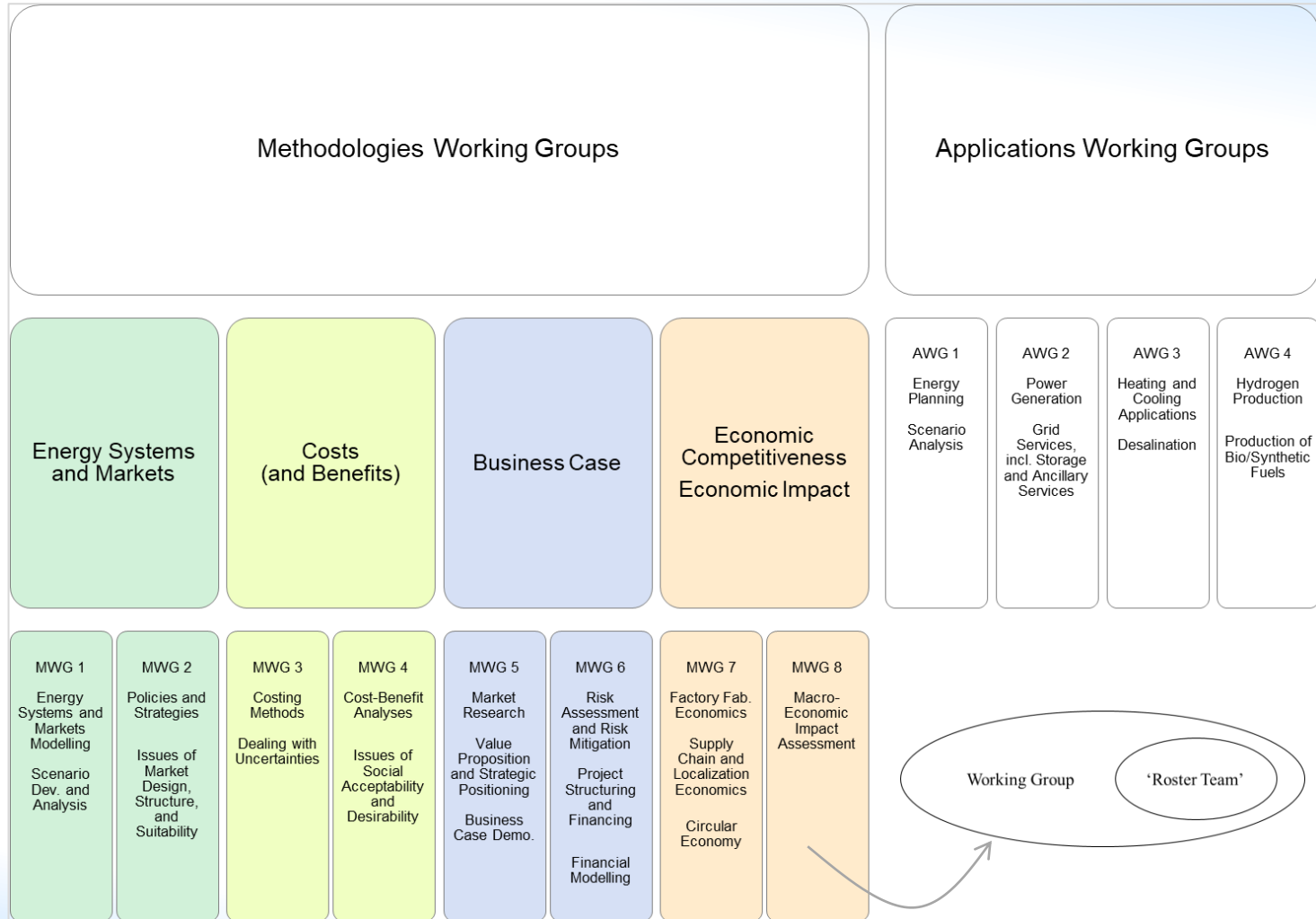
The COOSMR Framework

- The *COOSMR Framework* is intended to support two distinct segments of end-users, with different needs and expectations:
 - *Public sector decision-makers*, investigating the relevance of the SMR option in a province, country, or region.
 - *Project designers and developers*, aiming at demonstrating the business case for SMR, securing funding and financing, and public support for the project.

	Public sector decision-makers	Project designers and developers
Perspective		
	Investigate the relevance of the SMR option in a province, country, or region.	Demonstrate the business case for SMR, secure funding and financing, and public support for the project.
Objective		
	Formulation of strategic objectives and requirements Demand and supply analysis Option analysis Cost-benefits, or cost-effectiveness, analysis Macroeconomic impact assessment Policy design and validation	Market research and analysis of the competitive landscape Development of a unique value proposition and a strategic positioning Planning, cost forecasting and analysis Business planning and business case demonstration Project structuring and risk allocation Securing funding and financing, and public support for the project.
Key Steps Analyses to Conduct Supporting Methodologies		

- The main objective assigned to the **8 Methodologies Working Groups (MWGs)** is the development of the COOSMR Framework.
- The framework would suggest a generic process, or a procedure, for investigating the relevance of the SMR option in a given context and for demonstrating the business case for SMR.
- cf. Details of the topics covered by MWGs in the next slide.
- The applications considered in the context of the CRP include:
 - Power generation (and the provision of ancillary and other services to the grid);
 - Process heat production (for desalination and residential heating and cooling, among other applications);
 - Hydrogen production.
- The **4 Applications Working Groups (AWGs)** will work towards developing country cases and other case studies, focusing on SMR applications, and illustrating the application of the *COOSMR Framework*.

CRP Working Groups and 'Roster Teams'



Methodologies Working Groups (MWGs)

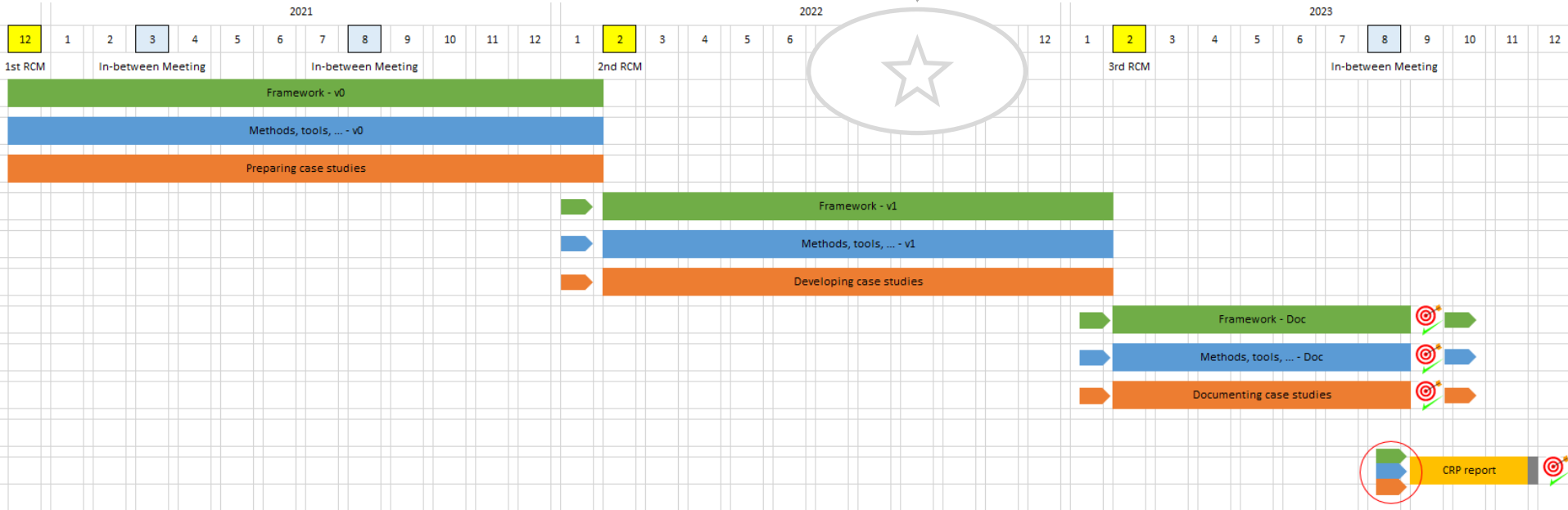
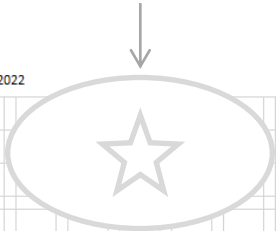


- Energy Systems and Markets
 - The first key area of investigation targets *public sector decision-makers* and covers approaches and methodologies for:
 - **MWG 1:** Investigating the (economic) relevance of the SMR option in evolving power systems (relying increasingly on variable generation from renewables) and energy markets
 - **MWG 2:** Developing policies and strategies that set out what needs to be done to create an (economically) enabling environment for SMR development and deployment.
- Costs (and Benefits)
 - The second topic to be addressed by MWGs covers:
 - **MWG 3:** Approaches to cost forecasting and analysis under uncertainty.
 - **MWG 4:** Cost-benefit, or cost-effectiveness, analysis.
 - The methodologies would benefit both segments of end-users, i.e., *public sector decision-makers*, and *project designers and developers*.
- Business Case
 - The ‘Business Case’ covers two sets of topics:
 - **MWG 5:** Business planning and business case demonstration.
 - **MWG 6:** Enabling access to financing – and ‘cheap capital’ – for SMR projects.
 - The methodologies developed in the context of this activity would serve primarily the *project designers and developers* end-users’ segment. They might also be of interest to *public sector decision-makers*.
- Economic Competitiveness, Economic Impact
 - The fourth key area of investigation, ‘Economics’, targets *public sector decision-makers* and covers two main topics:
 - **MWG 7:** Factory Fabrication Economics, Supply Chain and Localization Economics, and Circular Economy.
 - **MWG 8:** Macro-Economic Impact Assessment.

CRP Development Plan



YOU ARE HERE



thank you!