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Assessment of the economical & societal impact of the development of next-generation nuclear reactors

An approach to uncover and evaluate wider benefits

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Chiel provides evidence-based advice for strategy and policy at the interface of technology and society. He has delivered various studies, analyses, and strategic support in the field of nuclear technology for mainly (semi) public clients across the EU.

Technopolis Group

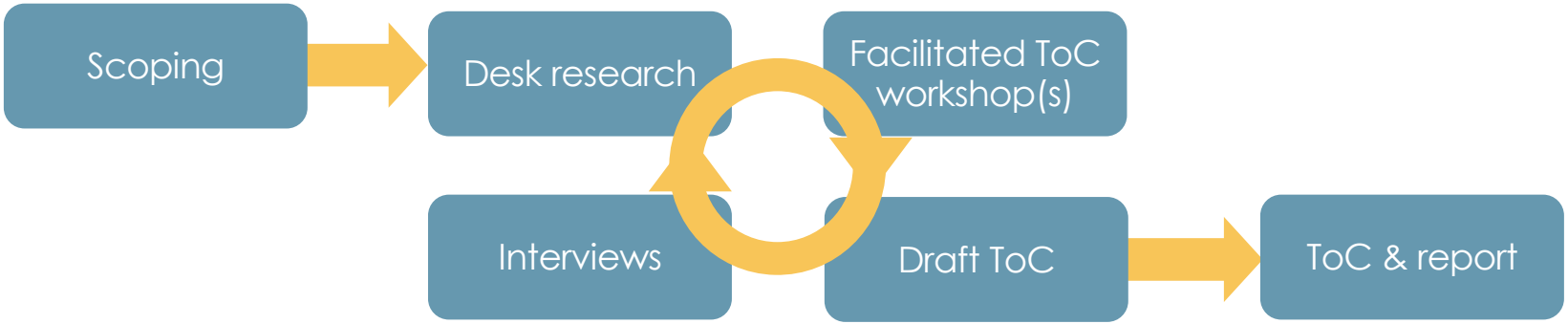
Technopolis Group is an international consultancy firm that provides research and advisory services in science, technology and innovation policy and strategy to (semi) public clients across the globe. We have ~300 consultants based in 12 offices across Europe, Africa and Latin America. We bridge the gap between science, technology and society, and help organisations to uncover the societal impact and value of their activities. In the field of nuclear technology we have worked for EU, national and regional governments, sector organisations, waste management organisations, campuses and reactor development programmes on topics related to nuclear medicine, medical isotopes, nuclear infrastructure, radioactive waste, radiation protection, human capital, ecosystems, security of supply, nuclear fuels and novel reactor concepts (Gen IV).

“We need to assess our potential economic and societal impact, can you help us?”

- Governments have set ambitious goals to address climate change and to progress in the energy/green transition
  - Paris Agreement: limit global warming to no more than 2°C/35.600°F
  - Dutch government: a CO_2-free electricity sector by 2035
- Nuclear energy, and the development of next-generation nuclear reactors, can contribute to these ambitious goals
- At the same time governments want to see how investments contribute to structural economic change and address societal concerns

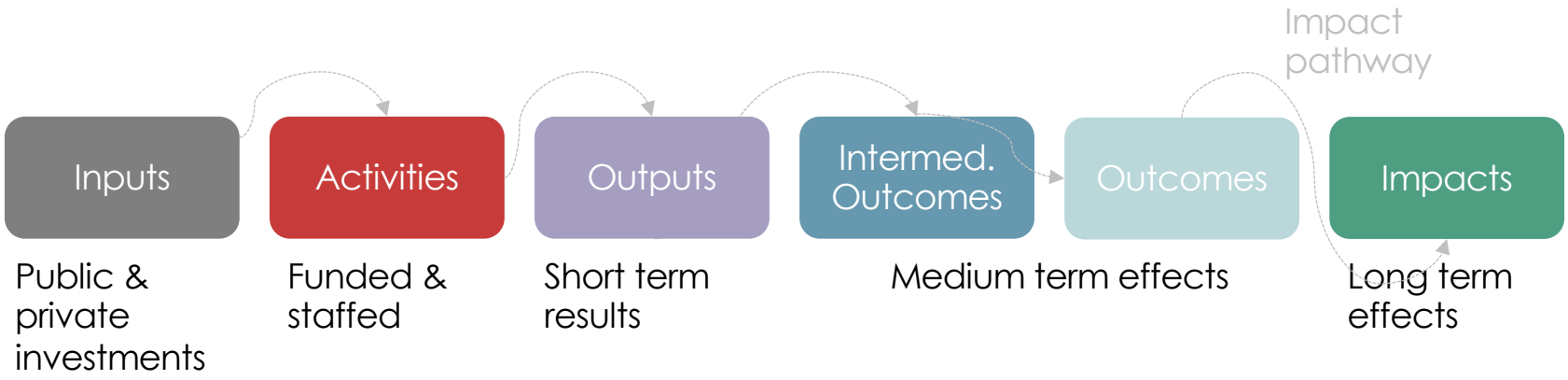
Process to uncover societal and economic impact

- Building a theory of change requires discussion, and benefits from outsider perspectives to challenge internal views and beliefs
- Substantiating impacts requires research and analysis



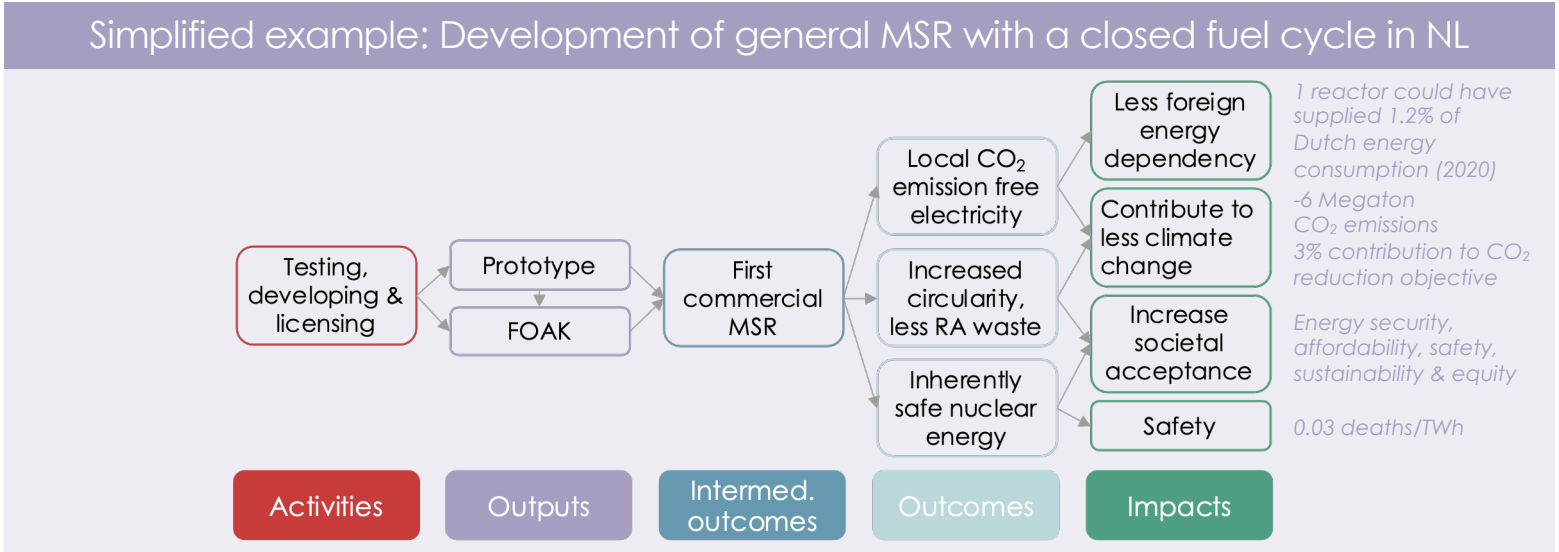
A Theory of Change to analyse impact

- An analytical tool: a structure to interpret, show and communicate expected effects of a given investment
- A programming tool: a structure to identify potential gaps and missing links to reach intended impacts with your programme or proposal convincingly



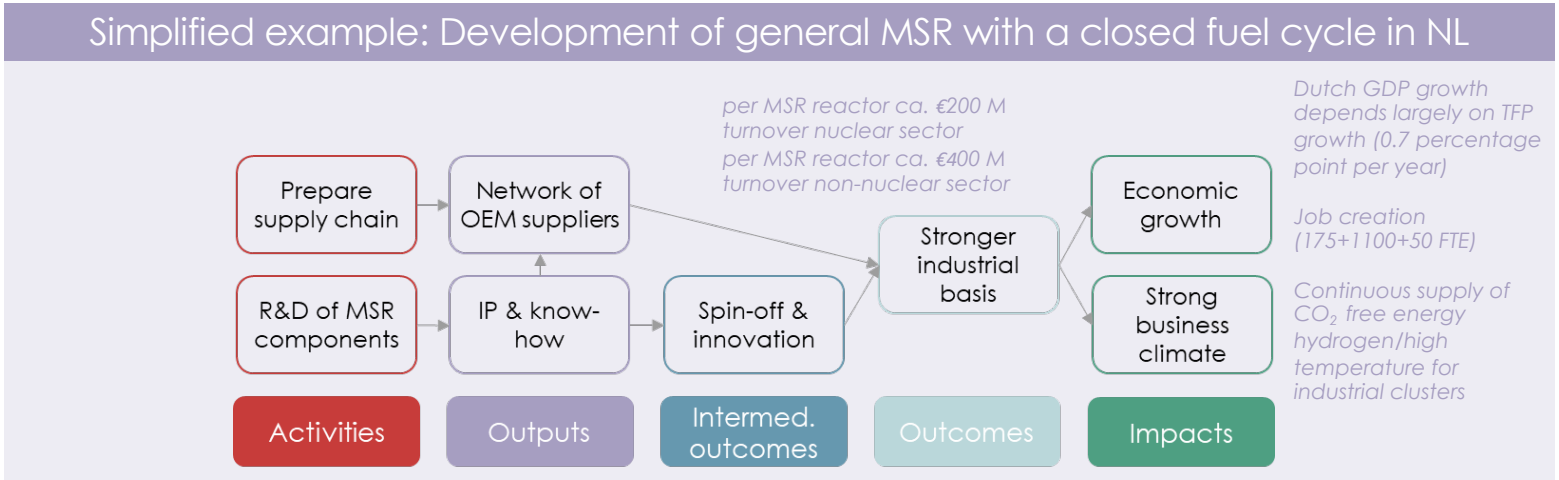
Impact pathway to societal value

- Logical: establish logical relations to and argumentation for how activities contribute to **societal challenges** and address ethical concerns



Impact pathway to economic value

- Logical: establish logical relations to and argumentation for how activities contribute to **economic effects** on the energy market, nuclear sector and power-intensive industry and on the innovative and competitive position



Impact pathway to economic value

- Substantiate and quantify: collect evidence from multiple sources for each outcome and impact in this relation to substantiate or quantify, based on defined scope, conditions and variables, potential impact

Examples of evidence: development of general MSR with a closed fuel cycle in NL
• Market potential of MSRs untill 2045: volume/number and potentially interesting locations • Average local demand for thermal power of less than 500 MW_{th} and electrical power of less than 200 MW_e • Potential production of hydrogen in kilotons per year and compared to hydrogen demand and policy goals • Pricing estimates based on lower marginal costs compared to fossil sources and other emission free energy sources • Effects of design within supply chains • Direct economic effects due to local generation and consumption • Effect on energy supply (availability of energy and contribution to sustainability)

A grasp of conclusions from the MSR impact assessment

- **Sustainability impact** ○ ○ ●
  - MSRs can contribute to supply of low-CO_2 electricity, heat and hydrogen
  - MSRs can contribute to stable low-CO_2 energy alongside fluctuating renewable sources
  - MSRs can contribute to achieving climate goals if available and deployed in time
- **Social-ethical impact** ○ ○ ●
  - MSRs can help reduce dependence on electricity imports from abroad
  - MSRs are more responsive to societal concerns of RA waste than conventional NPPs
  - MSRs are safer than conventional NPPs and statistically as safe as wind and solar power
- **Economic impact** ○ ○ ●
  - MSRs could reduce wholesale electricity price when partially replacing fossil power plants
  - Needs for cogeneration could potentially be met with 10-20 MSRs in the EU until 2045
  - MSRs could contribute to future hydrogen demand, but not meet projected demand

When to apply this approach?

1 To gain public support for nuclear R&D&I activities

The value of nuclear R&D&I projects or pilots beyond its added technical and business value is often important for public support and needs to be demonstrated.

2 To build an impact story for (external/public) communication

The logical relations, collected evidence and being challenged helps in addressing societal concerns and building a storyline that helps in communication to external stakeholders (incl. society).

3 To deliver convincing proposals/propositions for (public) funding

The approach helps in showing expected societal and economic impacts convincingly based on evidence. This information is valuable to funders: either to assess risks or to assess wider value.

4 To develop programmes, policies or strategies that addresses wider impacts

To ensure innovations really reach the market it is important to develop new technologies not in isolation but to consider the concerns, conditions and needs in society as well ('responsible' R&D&I).

Key take-aways

- Assessing the impact and wider benefits of next-generation reactors forms a solid base for multiple objectives and (needs of) target groups
  - For understanding potential wider value
  - For strategic programme development
  - For attracting (public) investments and support for further R&D
- Scoping is key; needs to be done with multiple stakeholders following a clear structure which requires know-how to logically link different elements and to contextualise argumentation
- Theory of Change applied in the context of advanced nuclear reactors requires
  - understanding sectoral, R&D&I, economical and societal aspects
  - collecting evidence to substantiate and quantify outcomes and impacts

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Get in touch!

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Summary (update of previously submitted version)

Assessment of economical and societal impact of the development of next-generation reactors
by Chiel Scholten & Anna Menenti, Technopolis Group

In this session, Technopolis Group will introduce a robust methodology designed to evaluate the multifaceted impacts of next-generation reactors on economy and society. Through practical examples drawn from an impact assessment study on Molten Salt Reactors (MSRs) that Technopolis Group conducted last year, we will demonstrate how this methodology can be applied effectively to other areas.

Assessing the impact of next-generation reactors is crucial not only for understanding their potential (wider) benefits but also for attracting (public) investments, strategic programme development and support for further research and development. By employing a comprehensive approach, we can better grasp the implications of these advanced technologies on various sectors and societal challenges, such as those related to energy production, environmental sustainability, and public health.

Throughout this session, we will delve into the key components of our methodology, exploring how it incorporates qualitative discussions, quantitative assessments, analysis and scenarios to provide a holistic understanding of the impacts. By taking examples from our MSR study, we aim to showcase the practical applicability of our approach and highlight its relevance in informing decision-making processes.

Whether you are a researcher, policymaker, investor, or industry stakeholder, we invite you to join us in this discussion as we explore innovative ways to evaluate the potential of next-generation reactors and pave the way for a sustainable energy future.

Vragen voor in panel discussie

- Inputs
  - In your role within the context of the development of Gen. IV reactors who are your key stakeholders and why
  - According to you what should be in place in terms of investments to foster the development of advanced nuclear reactors – who should organise these investments if missing?
  - What do you miss in your stakeholder relations and why
- Activities
  - What are key activities in your work to accelerate the development of Gen. IV reactors
  - From which results of previous activities are you depending on
- Outputs & outcomes
  - What do you consider the average time frame of the development of Gen IV reactors and what is the average scope in time of your projects
  - What did you deploy to accelerate throughput time
- Impacts
  - How do you convey the impact of advanced nuclear reactors on society within your job/daily work
  - Which actions do you take to stimulate public support for advanced nuclear reactors within your job/daily work
    - Which arguments do you use?

Vragen in panel discussion (continued, zoom out)

- To what extent is the just presented approach useful for your organization? How do you demonstrate societal and economic impact? Is there a need to so, e.g. from funders?
- How is the governmental and societal sentiment towards next-generation nuclear reactors in your country? How do you convince or generate support?
- What is your expectation of the contribution of next-generation nuclear reactors to the green transition and climate goals? Will the development be in time? How can the impact be maximized?
- What do you see as the key drivers for the development of next generation reactor? What are currently the key challenges?