ICOS

INTEGRATED CARBON OBSERVATION SYSTEM

IMPACT PATHWAYS

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The socio-economic impact of RIs

- The key component of the value chain that determines an RI's societal significance is establishing the link between an RI's operations and the economic and social decision-making that results from them, subsequently having a long-lasting impact on society.
- Demonstrating or communicating the often slowly evolving impact - that especially the environmental RIs generate - is challenging
- The materialisation of impacts is not only stretched over long periods, but is also diverse and develops through a complex set of channels and phenomena.

What is an “impact pathway”?

- The *simplified* causal chain of events that connects the activities carried out on a Research Infrastructure to *identifiable* effects on the economy and wider society (RI-PATHS)
- A useful approach to identify the chain of events and multiple factors that contribute to the materialisation of RIs’ societal impact
- Can also be understood as the contexts where a particular impact emerges (Muhonen et al. 2020), making it clearer to demonstrate how impacts accumulate over time

Muhonen & al (2020). From productive interactions to impact pathways: Understanding the key dimensions in developing SSH research societal impact. *Research Evaluation*, 29(1), 2020, 34–47. DOI: 10.1093/reseval/rvz003

What is an “impact pathway”?

- “Pipeline pathway”:
  - comprises scientific development, a productive interaction, and a transfer that produces discrete societal benefit.
    - For example: the results from measuring Key Performance Indicators. This creates evidence of the RI’s activities and provides a basis for starting to identify resulting pathways towards impact

What is an “impact pathway”?

- Emerging pathways can be identified through **types of knowledge, interaction modes and beneficiaries related to research activities**.
- The pathway comprises of:
  - Dissemination: information transfer to scientific communities and to society (e.g. scientific publications)
  - Co-creation: knowledge facilitation (e.g. collaboration with industry)
  - Reacting to Societal Change: knowledge transfer to society (e.g. providing information for a global initiative)
  - Driving Societal Change: societal action (e.g. imposed mitigation methods as the result of RI’s activities)

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Example: “publications-citations-recognition” - pathway

- A ‘knowledge push’: the RI generates scientific publications either directly or via its users; the publications produce citations by other users, and eventually form a new body of knowledge.
- Later on, the body of knowledge is recognised within a broader research community and society.
- Eventually, the RI-generated knowledge may be applied to societal problem-solving efforts or translated into economic benefits.

Finding the impact pathways in an RI?

Type of knowledge	Modes of interaction/approach	Target groups
Scientific information: **research questions related specific phenomena**	**Scientific publishing** The appropriate science questions are related to improving the understanding of… Questions include …	Scientists, interdisciplinary scientific communities
Knowledge facilitation: **Supporting national and European level research and GHG monitoring through enabling research**	**Publishing for wider audience (scientific, societal, and for industry)** Developing high-precision and long-term GHG observations and providing access to the ICOS data for wide user communities linking research, education, and innovation to promote technological developments, and to provide independent data to contribute to analysis of emission inventories	Societies, general public, businesses, industry, educational sector
Enabling knowledge transfer to society and societal change: **Supporting global policy-making through promotion and cooperation related to systematic GHG observations**	**Publishing for wider audience (policy-makers, stakeholders)** Providing scientific findings via peer-reviewed publications related to observing essential climate variables, including GHG to INFCCC, IPCC Cooperating with the Climate Observing System (GCOS), the climate observing component of the Global Earth Observation System of Systems (GEOSS)	Policy-makers, NGOs, interdisciplinary research, professionals

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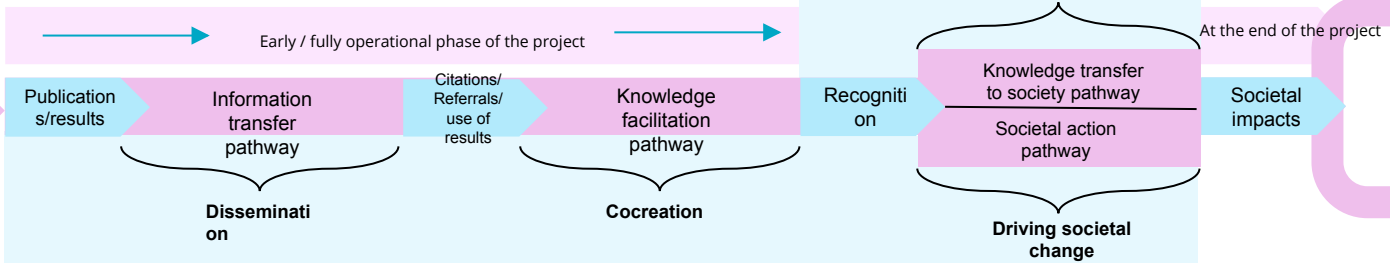
Pipeline pathway in NUBICOS

Results from the deliverables indicate activity that is assumed to result to societal impacts:



ICOS Science Conference and national conferences

What else?

Are there planned collaborations with industry, other projects, scientific communities outside ICOS, or anything like that?

Or, will activities in the project help ICOS do this?

Support or interaction with global initiatives/other large influential bodies?

Or, will activities in projects help ICOS do this?

ICOS makes continuous efforts to disseminate its obtained scientific results.

What will be done in projects to facilitate or actually do this?

Or, will activities in projects help ICOS do this?

1st level impact:

Knowledge diffusion to society

(ICOS generated knowledge becomes part of general societal body of knowledge)

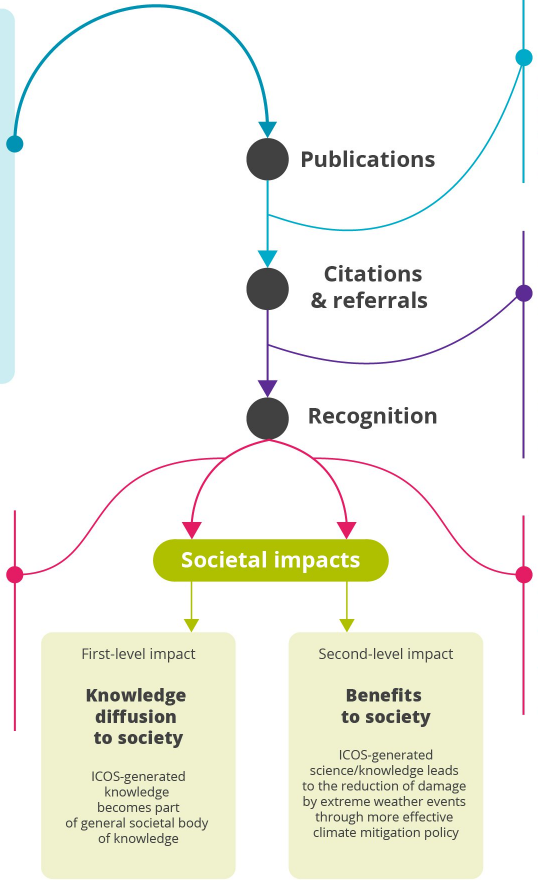
2nd level impact:

Benefits to society

ICOS generated science/knowledge leads to the reduction of damage by extreme weather events through more effective climate mitigation policy

ICOS in action
Pipeline pathway

- Total of 330 000 dataset downloads in 2022 (various data sets)
- Publications 187 in 2021, citations approx. 7000 in 2021
- 59 areas where ICOS data was used in 2021, produced almost 3000 publications
- The Drought 2018 Initiative, Warm Winter 2020 initiative, and the occurrence of the Nord stream leak resulted in over 22 scientific publications
- 233 ICOS-related papers were cited in the IPCC's
- 6th assessment report
- ICOS was represented in 33 global main events between 2019-2022



Information transfer
Dissemination

- ICOS Science Conference and national conferences
- FLUXES – European Carbon Bulletin
- Growing interest in ICOS activities in general media (1502 mentions in 2022)
- High-level events (e.g. with the EC), ambassador event in Hyytiälä
- Continuing improvements to open access (e.g. through ATMO-ACCESS)
- ICOSScapes and ExploreICOS campaigns provide visual context for ICOS science

Knowledge facilitation
Co-creation

- ICOS publications cited in 15 scientific fields; generating different types of knowledge
- ICOS data is increasingly used in MSC and PhD theses; and used as basis
- for university lectures and high-school teaching (e.g. related to FAIR data, ICOS Finland, CP, FCL)
- NASA training course on Arctic Methane and Permafrost in 2022
- Collaboration with industry e.g. via GEORGE
- Growing interest in ICOS activities in general media; 1502 mentions in 2022
- Supporting climate action with citizens and policymakers via ICOS Cities project

Societal action
Driving societal change

ICOS makes continuous efforts to disseminate its obtained scientific results.

If policy and decision-makers are open to using the evidence that the RI provides through its observations, ICOS's social and economic impact reflects the public relevance of ICOS's research (ESFRI monitoring report 2023)

Knowledge transfer to society
Reacting to societal change

- Support for European Green Deal e.g. through the ICOS Cities project
- ICOS-related papers cited in the IPCC's 6th assessment report
- Expertise sharing related to sudden events, such as the Nord Stream leak in collaboration with ECMWF via CoCO2
- Timely scientific publications to extreme events such as the draught in 2018 and The Warm Winter 2020 Initiative
- Interactions in COP, EGU, ICRI, GERI, WMO, IPCC, Copernicus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THANK YOU!