Novo Nordisk Foundation conference on the societal impact of research – welcome and introduction

novo nordisk **fonden**

Thomas Alslev Christensen

It began with insulin

THE CLINICIAN
H.C. Hagedorn

THE INVESTOR
August Kongsted

THE SCIENTISTS
Marie Krogh and August Krogh

THE ENTREPRENEUR
Thorvald Pedersen

THE ENTREPRENEUR
Harald Pedersen

Corporate purpose

- To provide a stable basis for the commercial and research activities of the Novo Group companies.*

Philanthropic purposes

- To support physiological, endocrinological, metabolic and other medical research,
- To support research hospital activities within diabetes in Denmark, and
- To support other scientific as well as humanitarian and social purposes.

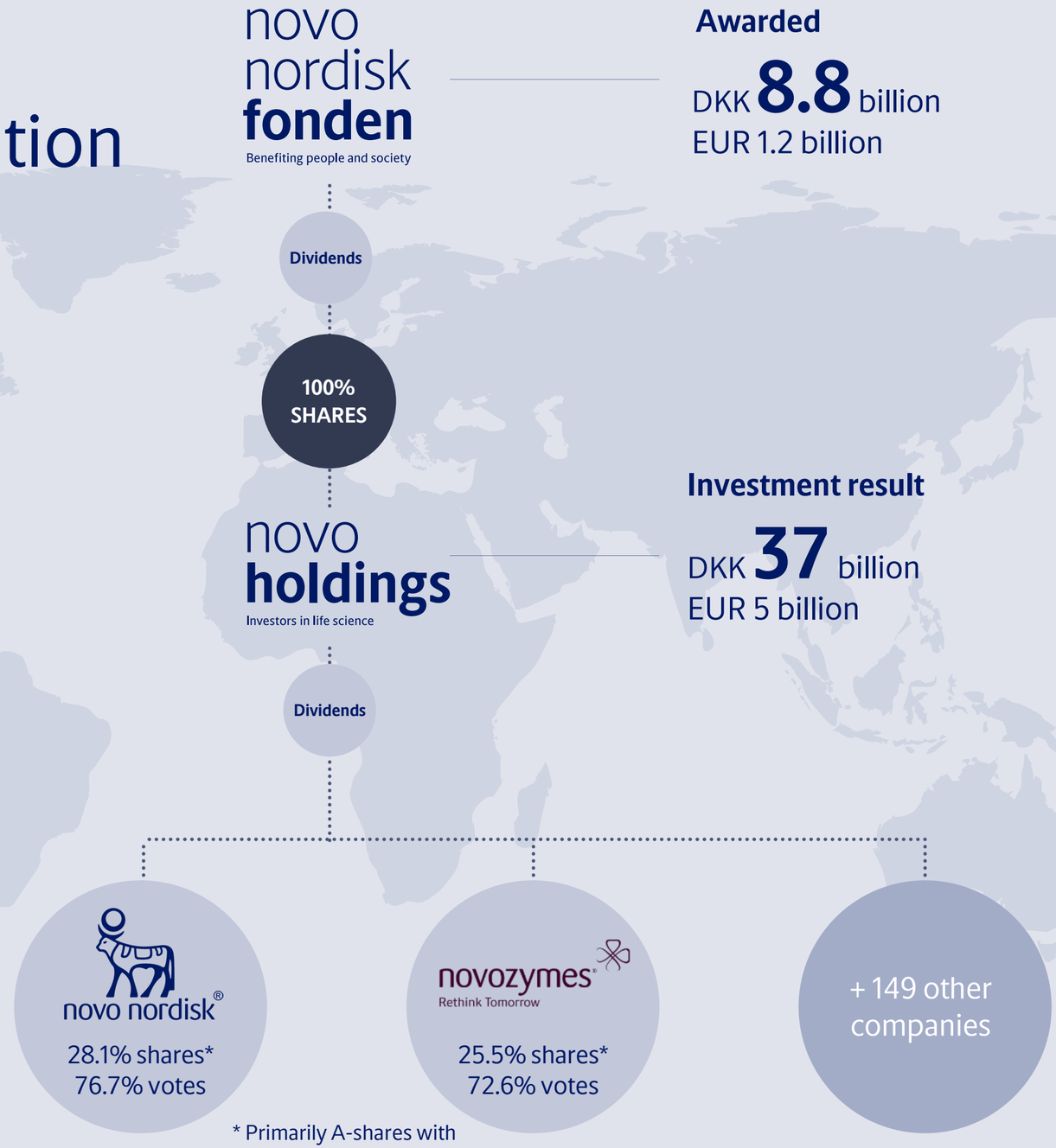
novo nordisk **fonden**

Our vision is to improve people's health and the sustainability of society and the planet

* The Novo Group comprises Novo Nordisk A/S, Novozymes A/S and Novo Holdings A/S, and companies in which Novo Holdings A/S may hold a material equity interest or over which it may have material influence.

Facts about the Novo Nordisk Foundation

2021



* Primarily A-shares with 10x voting power

novo nordisk **fonden**

Progress research and innovation in prevention and treatment of cardiometabolic and infectious diseases

Health

Sustainability

Advance knowledge and solutions to support the green transition in society

To **improve people's health** and the **sustainability of society** and **the planet**

The life science ecosystem

Invest in scientific research, education and innovation to enable a world class life science ecosystem

novo nordisk **fonden**

Nine impact principle for society

- Promoting excellent research and innovation
- Fostering the development of talent across different life stages and scientific fields
- Developing new medicines and other clinical aids and interventions
- Developing patient-centred and research-based care and disease prevention
- Developing innovative products and solutions supporting sustainable development
- Supporting the development of world-class education
- Creating jobs and growth
- Supporting organizations, systems and infrastructure to catalyse knowledgebased societal development
- Helping people in difficult settings

With Denmark as its centre of gravity, the Foundation’s focus is to improve the lives of people through better health, education and the development of a knowledge-based sustainable society.

Research programme on the socioeconomic impact of research

The NNF science-of-science programme

- **Purpose: to document and develop new knowledge about the economic impact of investments in Danish public research and about the societal impact of research in health and diseases.**
- **Nine projects up to DKK 10 million, up to 4 years duration, have been funded from 2016-2018 and take place at CBS, University of Copenhagen, University of Southern Denmark, and Aarhus University**

Research programme on the socioeconomic impact of research

Funding research and innovation

- Investments, incentives, and the impact of Danish research
- Educational choice and research-based education
- Investigating the microfoundations of socioeconomic impact of university-industry relations
- Promoting the socio-economic impact of research - the role of funding practices

Health

- Regulating and nudging for improved societal impact of research-based knowledge in health care
- Behavioural Responses to Health Innovations and the Consequences for Socio-economic outcomes
- Equity and the Socioeconomic Impact of Disease Management Programmes in Denmark
- Socioeconomic Impact of Policy Instruments for Health Research Dissemination
- The socioeconomic impact of research-based innovations-implementation and long-term consequences of population-based childhood vaccine programmes

Societal impact in 2021

Overall grant-giving

90 DKK million awarded in 2016-2018

Supporting people in science and knowledge creation

60 jobs in science funded, including 30 PhDs and postdocs

200 new publications, 55% were published in peer reviewed scientific journals

70% of journal articles are co-authored with international collaborators

50% have co-authors for other Danish universities

Promoting excellent research

22% of journal articles among top 10% most frequently cited in the world

Impact beyond science

120 engagement activities (talks, keynotes, conferences, seminars, social medial activities, etc.)

36 awards and recognitions

22 new collaboration projects

The projects also contribute to policy documents, policy committees and advisory boards

106 DKK million in Further Funding

Keynote by: Dr. Cassidy R. Sugimoto, Georgia Tech

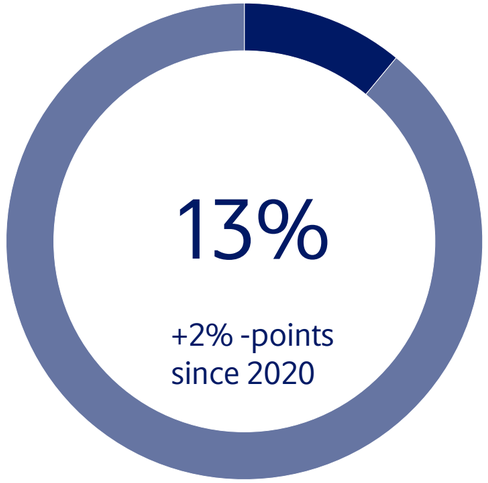
The use of metascience for research funding

Evaluate societal impact of science in the Novo Nordisk Foundation

By Thomas Alslev Christensen

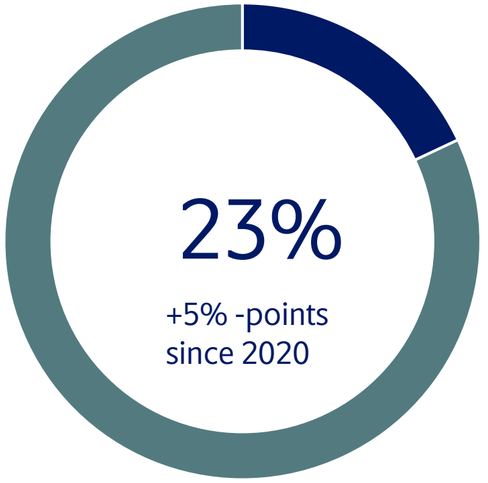
Novo Nordisk Foundation Group finances approximately **20%** of all research and development in Denmark

Public sector



of research and development expenditure
in the public sector financed by
Novo Nordisk Foundation
(DKK 3.6 billion in 2021)

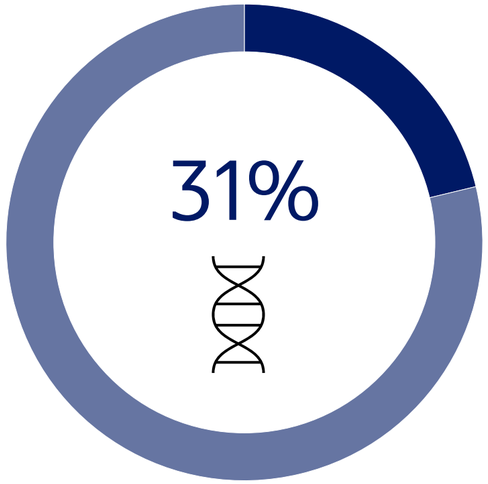
Private sector



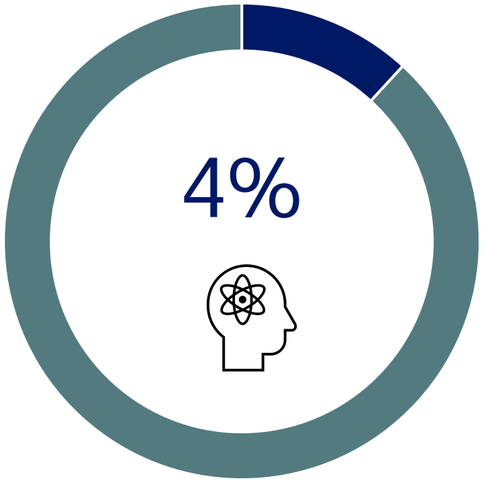
of research and development expenditure
in the private sector from
Novo Nordisk Foundation Group companies
(DKK 9.8 billion in 2021)

The grant-giving finances 31% of public research in medical and health sciences and 4% in natural sciences in Denmark

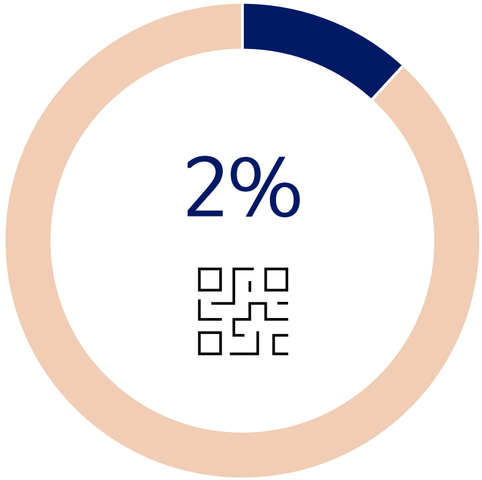
Medical and health sciences



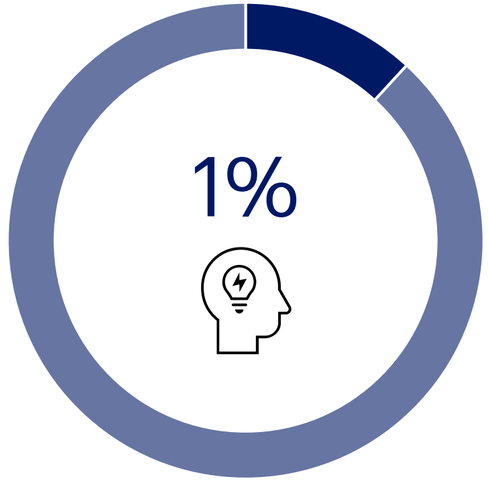
Natural sciences



Engineering and technical sciences

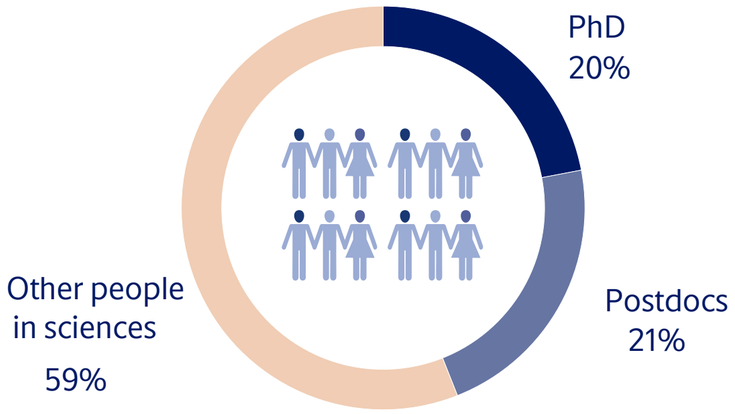


Humanities and social sciences

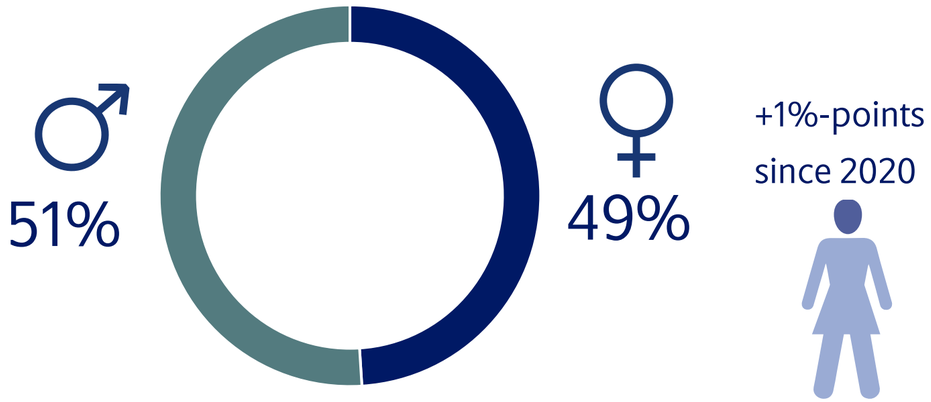


40% increase in number of people in science fully or partly supported by the Foundation in 2021

PhD and Postdocs in science



Gender distribution

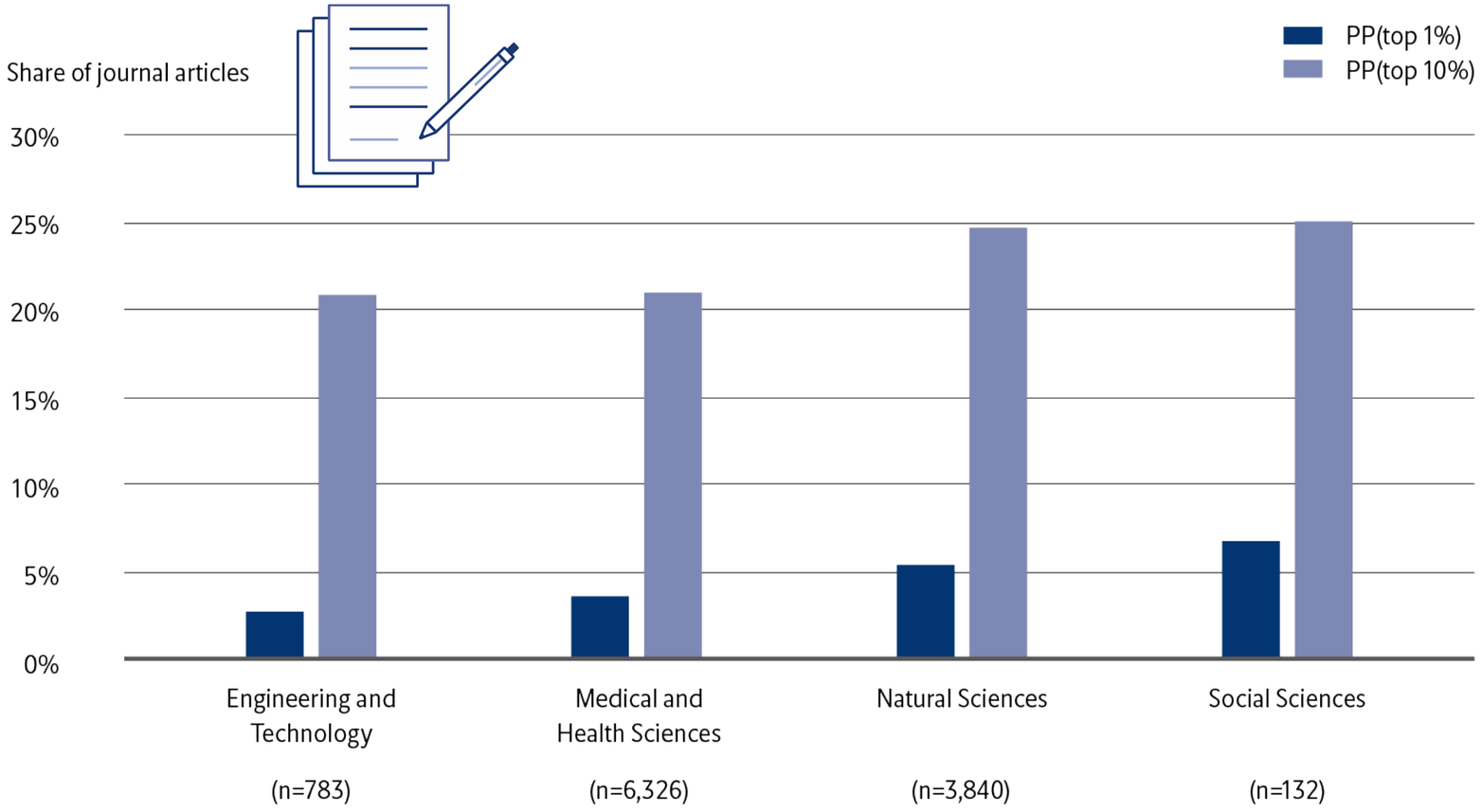


6,400 people in science

+40% since 2020

novo nordisk **fonden**

4% and 23% of NNF funded articles are among world's top 1% and 10% most cited. The share published with industry, international researchers and in interdisciplinary teams is high.



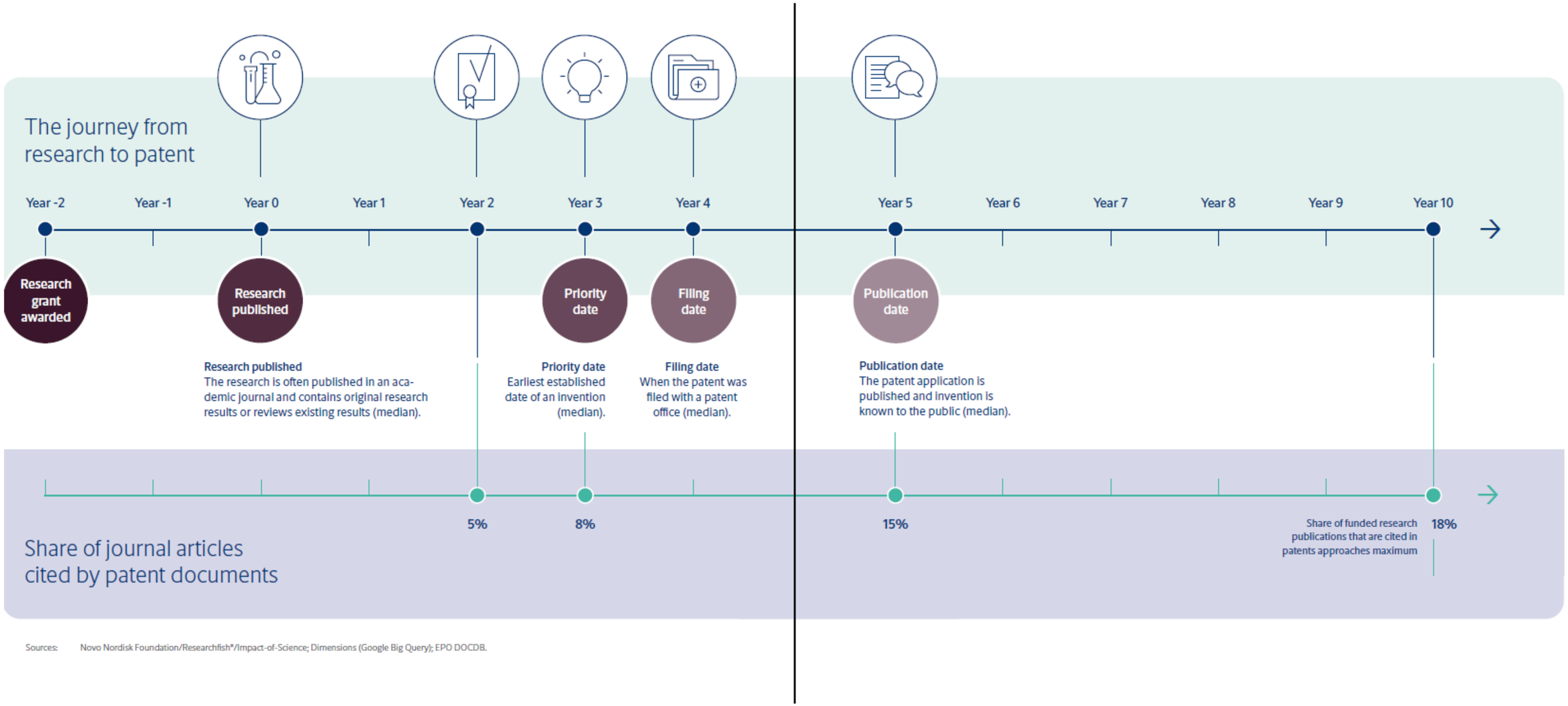
68% international

12% industry

64% interdisciplinary

88% mixed gender

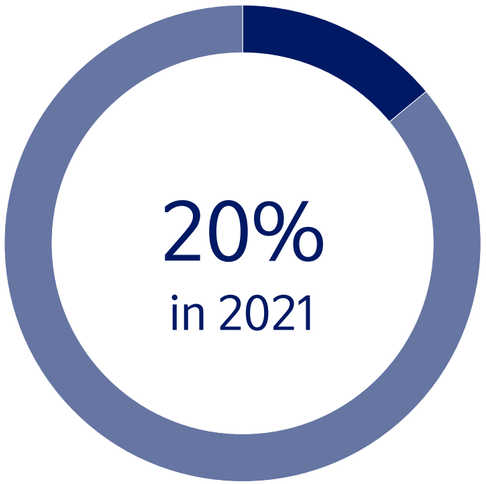
Patent citation timeline for Novo Nordisk Foundation-funded articles



Sources: Novo Nordisk Foundation/Researchfish®/Impact-of-Science; Dimensions (Google Big Query); EPO DOCDB.

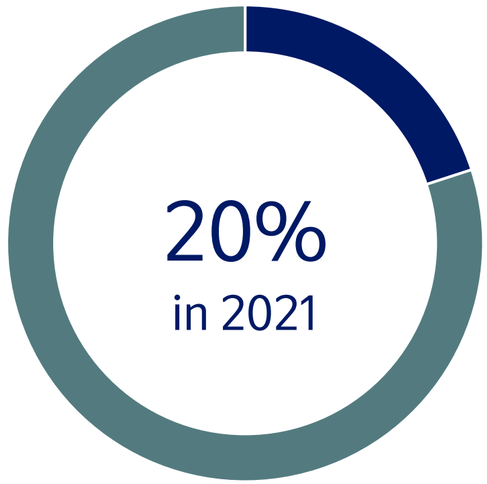
The companies in the Novo Nordisk Foundation Group account for 20% of Danish published patents and 20% of Danish granted patents

Share of Danish patent applications



More than 13,800 patent applications
worldwide since 2018

Share of Danish granted patents



More than 2,500 patents granted
worldwide since 2018

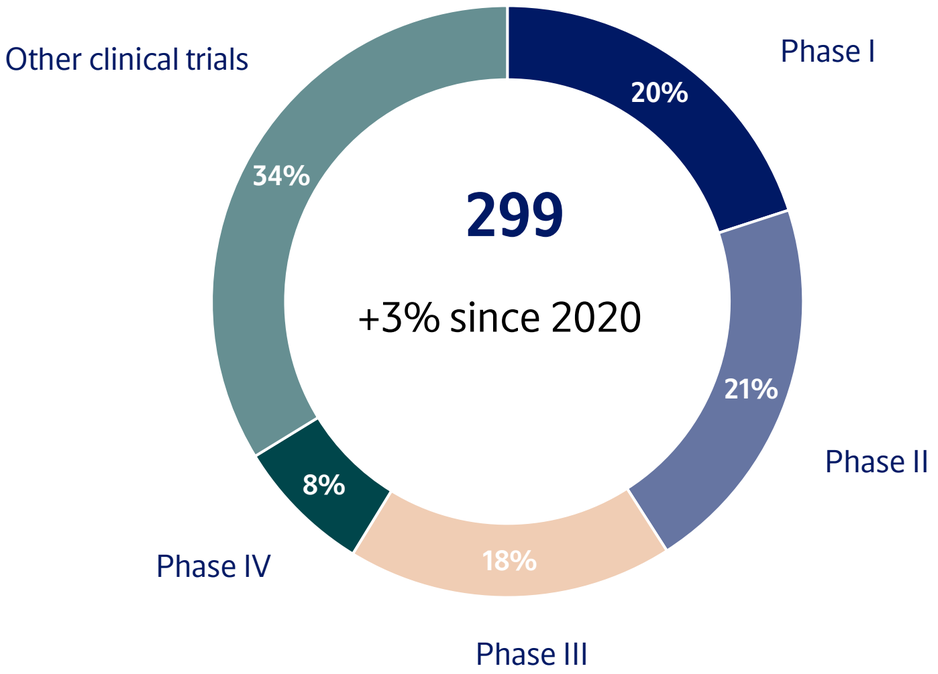
The Novo Nordisk Foundation Group contributed to translation of research to medicines through 299 clinical trials in 2021

~119,000

People participated in clinical trials in 2021

-6% since 2020

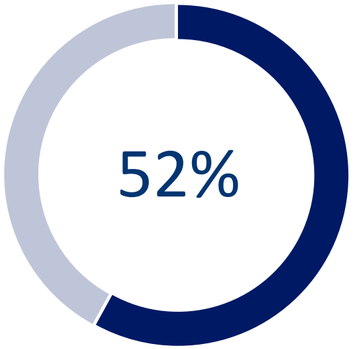
Active clinical trials 2021



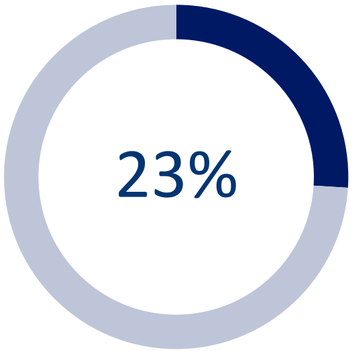
novo nordisk **fonden**

18% of 991 national and international clinical guidelines and treatment recommendations cite Foundation-funded research

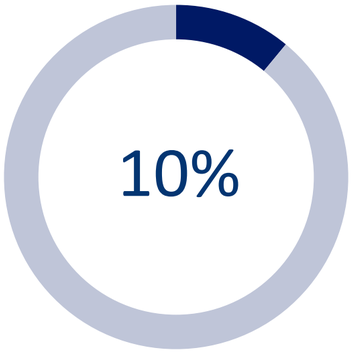
Diabetes
113 guidelines
(2011–2021)



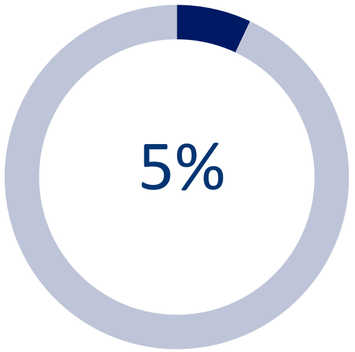
Cardiology
339 guidelines
(2011–2021)



Cancer
371 guidelines
(2011–2021)



Respiratory diseases
169 guidelines
(2011–2021)



Number of people using the products from the Novo Group and Novo Holdings' life science portfolio in 2021

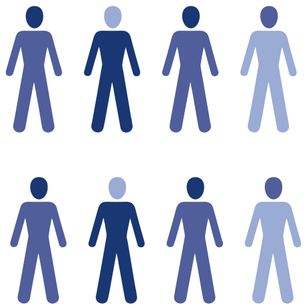
Users of
MedTech products

+40
million people

Users of
medicine

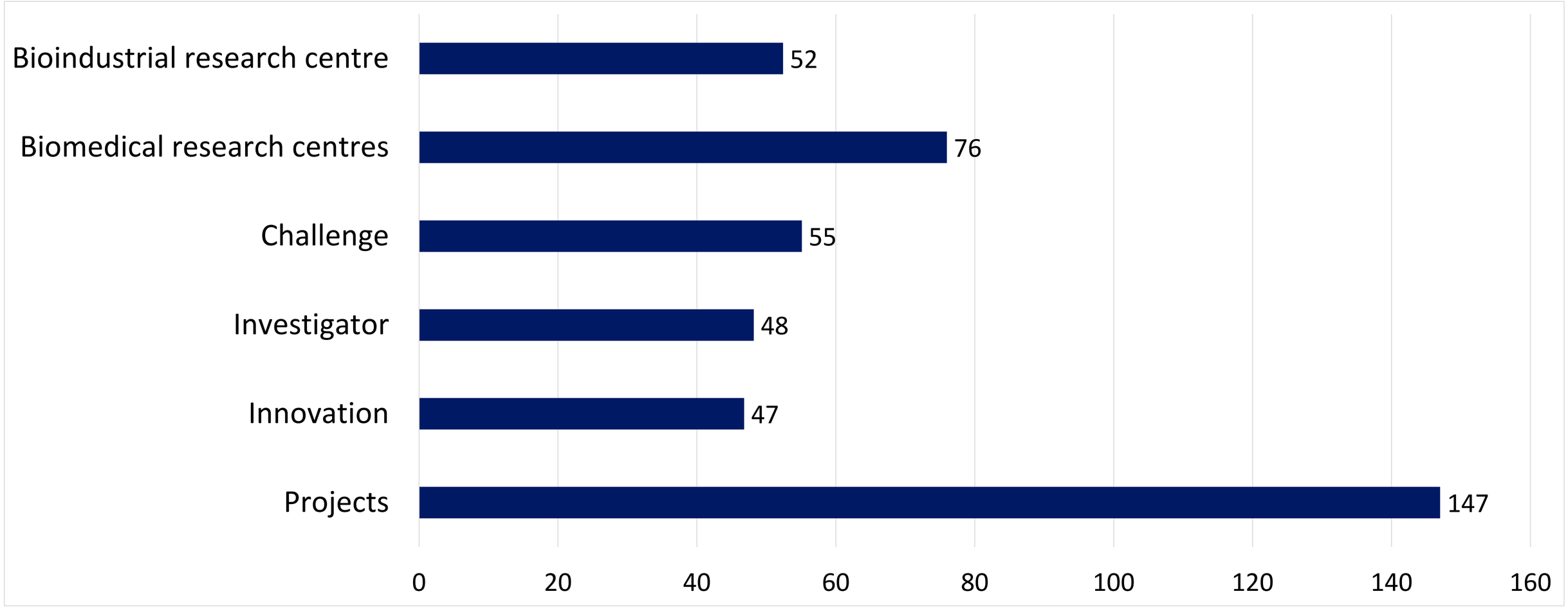
+40
million people

+22%
since 2020

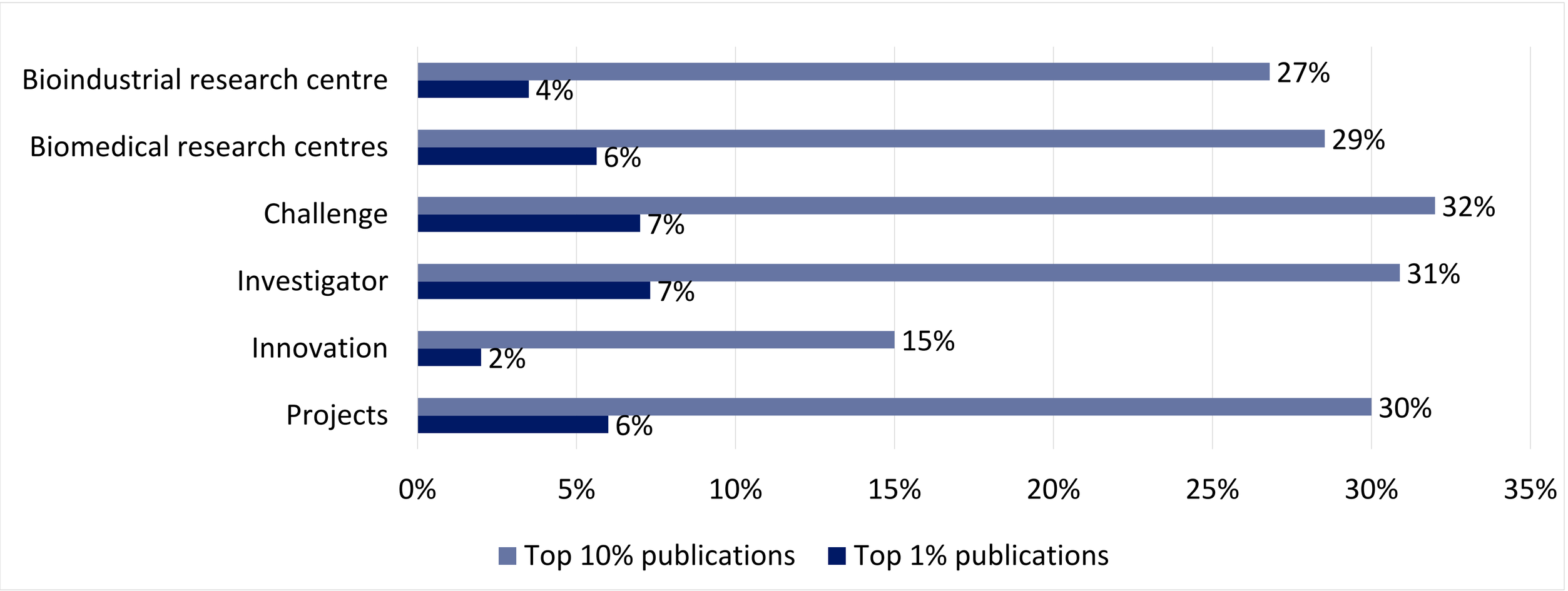


novo nordisk **fonden**

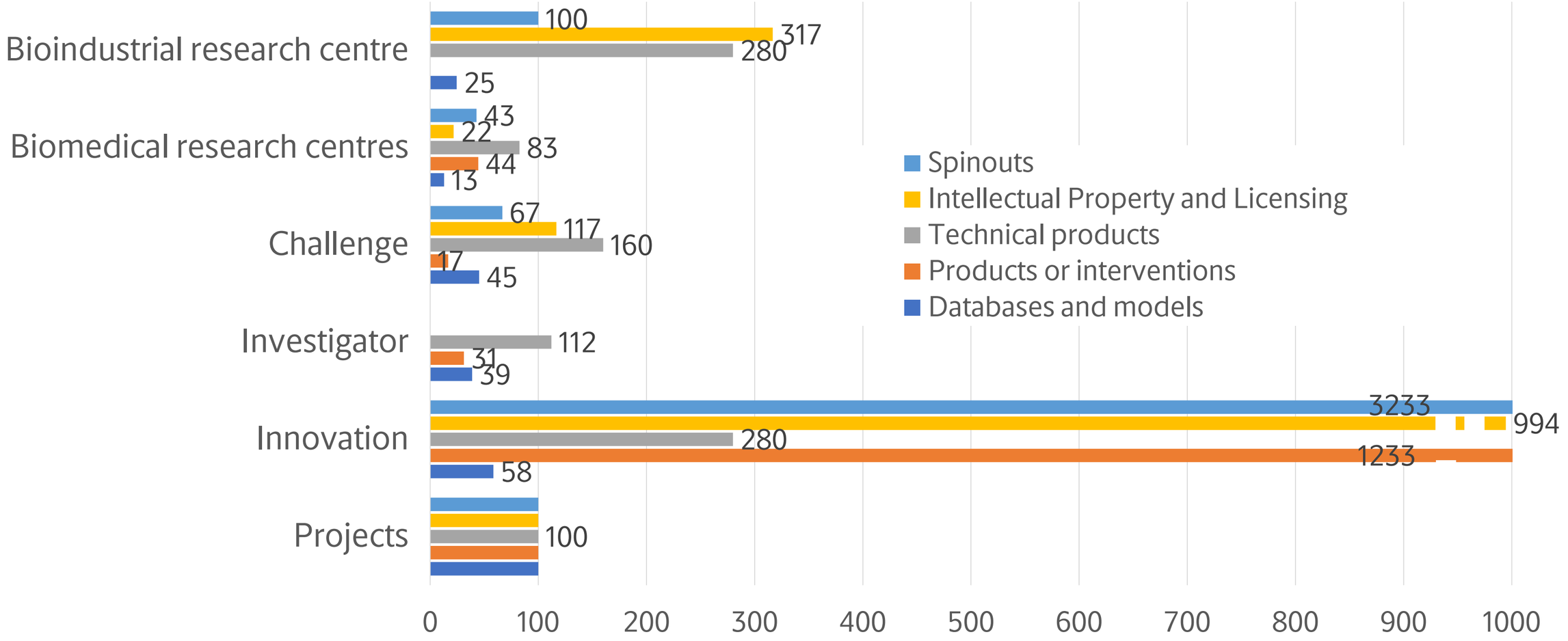
Number of journal articles per DKK 100m total funding



Citation impact of reported journal articles



Reported instances of research products and commercial outcomes (IP and spinouts) per 100 DKKm



Impact management in NNF 2021/22

New impact frameworks

26
developed

New data models

22
Data collection models included in new grant agreements

Monitoring in NNF Dashboard

3,400
Grantees report and NNF Impact collects and prepare data

Impact framework

- Theory of change and logic model
- Data collection model
- Timeline
- Baseline
- Monitoring

Elements in grant agreement

- Success factors, impact markers and indicators
- Project scorecard
- Data sources & preparation
- Acknowledgment policy

Collect and prepare data

- Ensure reporting and quality of reporting
- Data collection through FG and RF via annual reporting
- Collection and use of additional data prepared by grantees
- Enrich and use data from data external sources (patient data, clinical, business-/science-intelligence etc.)

Monitor progress

- New NNF Dashboard

Impact Framework philosophy

Supply side

Funder/investor

The level of NNF intent and input of resources to create real-world impact via.....

Strategy, vision, missions, themes & key objectives

Impact mechanisms: Grant-giving models & instruments to optimise impact

Align funding with the NNFs strategy, vision, three focus-missions and nine impact principles	Contribute with non-financial support and co-development of initiatives in project centric organisation
Funding is directly linked to one of NNFs 12 themes and one or more of the NNFs 49 key objectives	Contribution with financial support, funding instrument, impact framework and KPIs signalling that societal impact matters

Demand side

Grantee/investee

activities that the grantee carries out which result in production of ....

- ❑ Operations of initiative and project intervention
- ❑ Monitoring of activities initiated and in progress
- ❑ Monitor critical success criteria (“impact markers”)
- ❑ Full control over initiated activities by recipient

the **outputs** that the grantee generates...

- ➢ Direct and immediate results of activities in terms of products or operations that intend to deliver future changes
- ➢ Evaluate critical success criteria (“impact markers”)
- ➢ Very high degree of influence over direct results from activities by recipient

to achieve the desired medium and long term **outcomes** and tangible short-term results ....

- ❖ Changes in outcomes as result of activities
- ❖ Evaluate critical success criteria (“impact markers”)
- ❖ Reduced or little control by recipient of grants

Society

Equilibrium for People/citizens

so they create the **strategic impact changes** that we ultimately seek

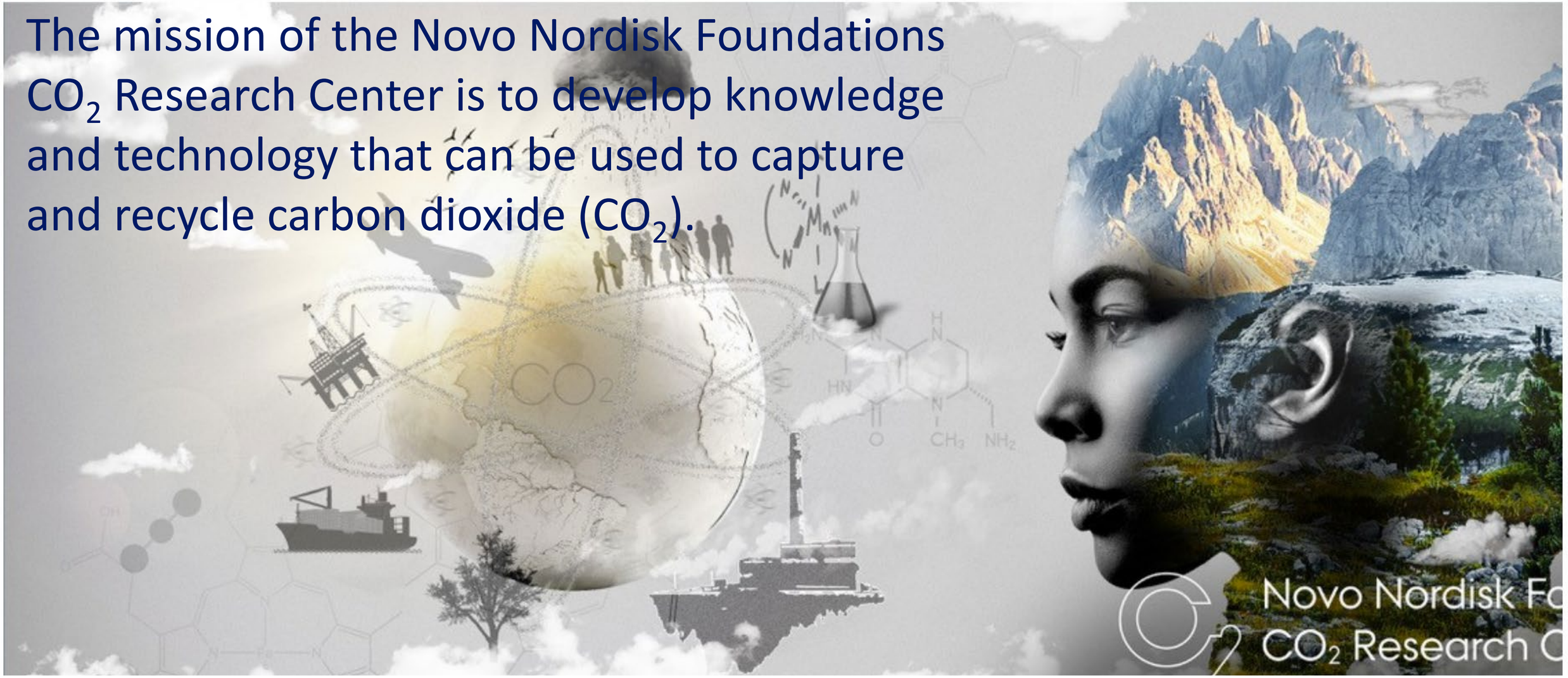
- ✓ Changes in long-terms outcomes caused by activities, interventions and outputs
- ✓ Verify or reject long-term impact goal hypothesis
- ✓ Very little or no influence over medium and long-term outcome
- ✓ Evaluate strategic objectives and critical success criteria (“impact markers”)

in order to fulfil our **vision** and **long-term objective**

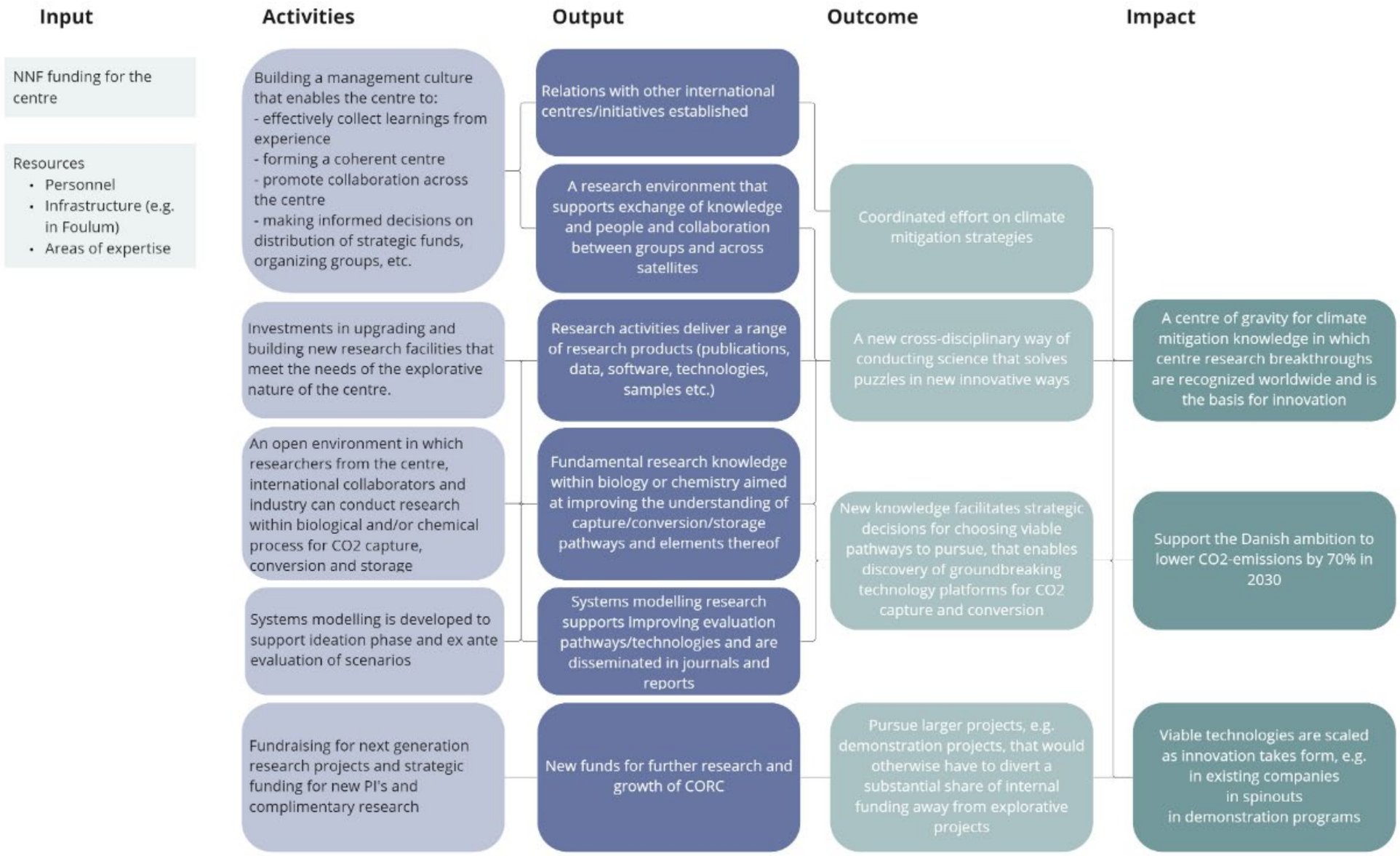
Societal change measured (additionality for society in terms of before and after situation or in terms of differences for treatment group versus control group)

The Novo Nordisk Foundation CO_2 Research Center

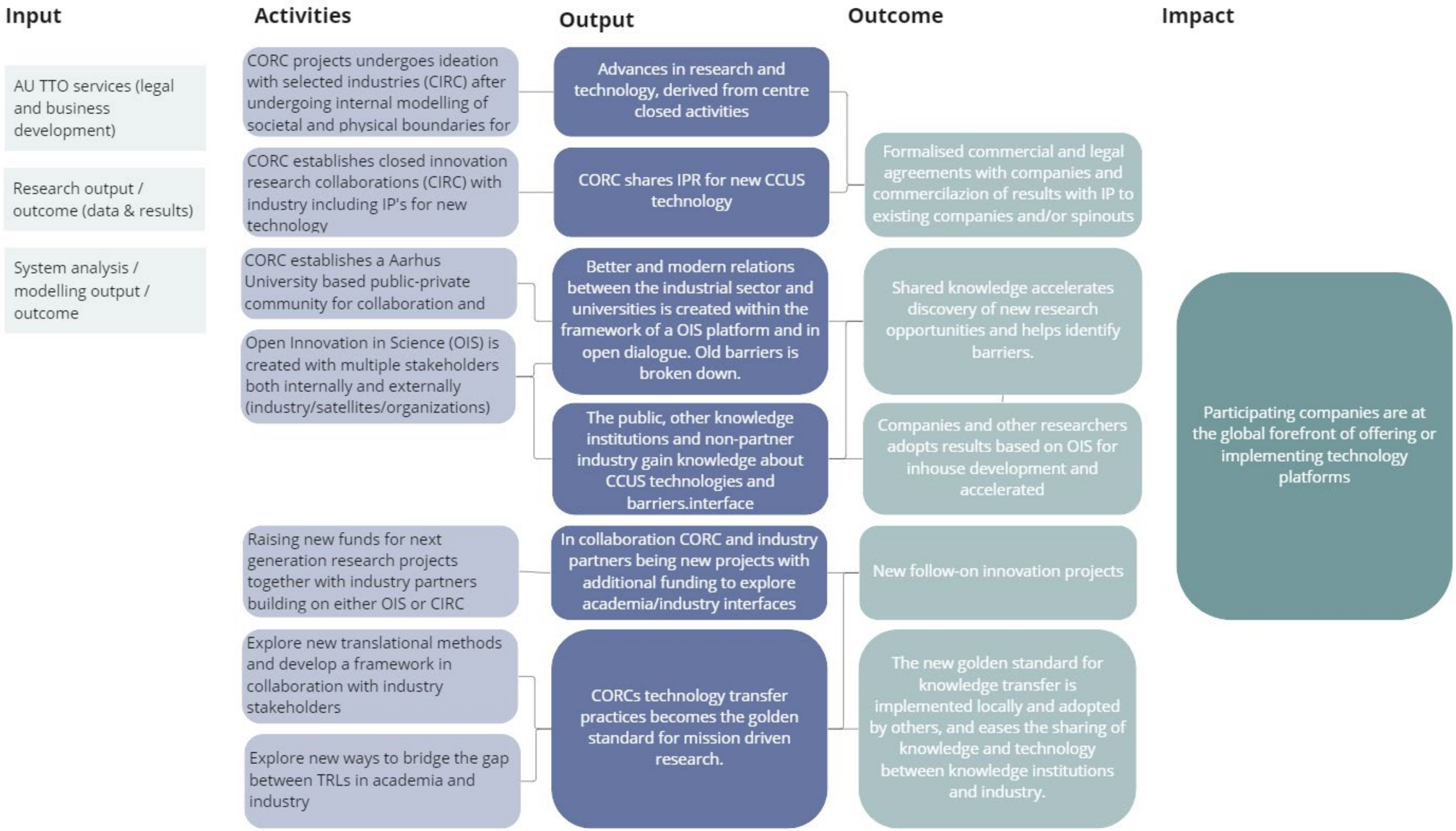
The mission of the Novo Nordisk Foundations CO_2 Research Center is to develop knowledge and technology that can be used to capture and recycle carbon dioxide (CO_2).



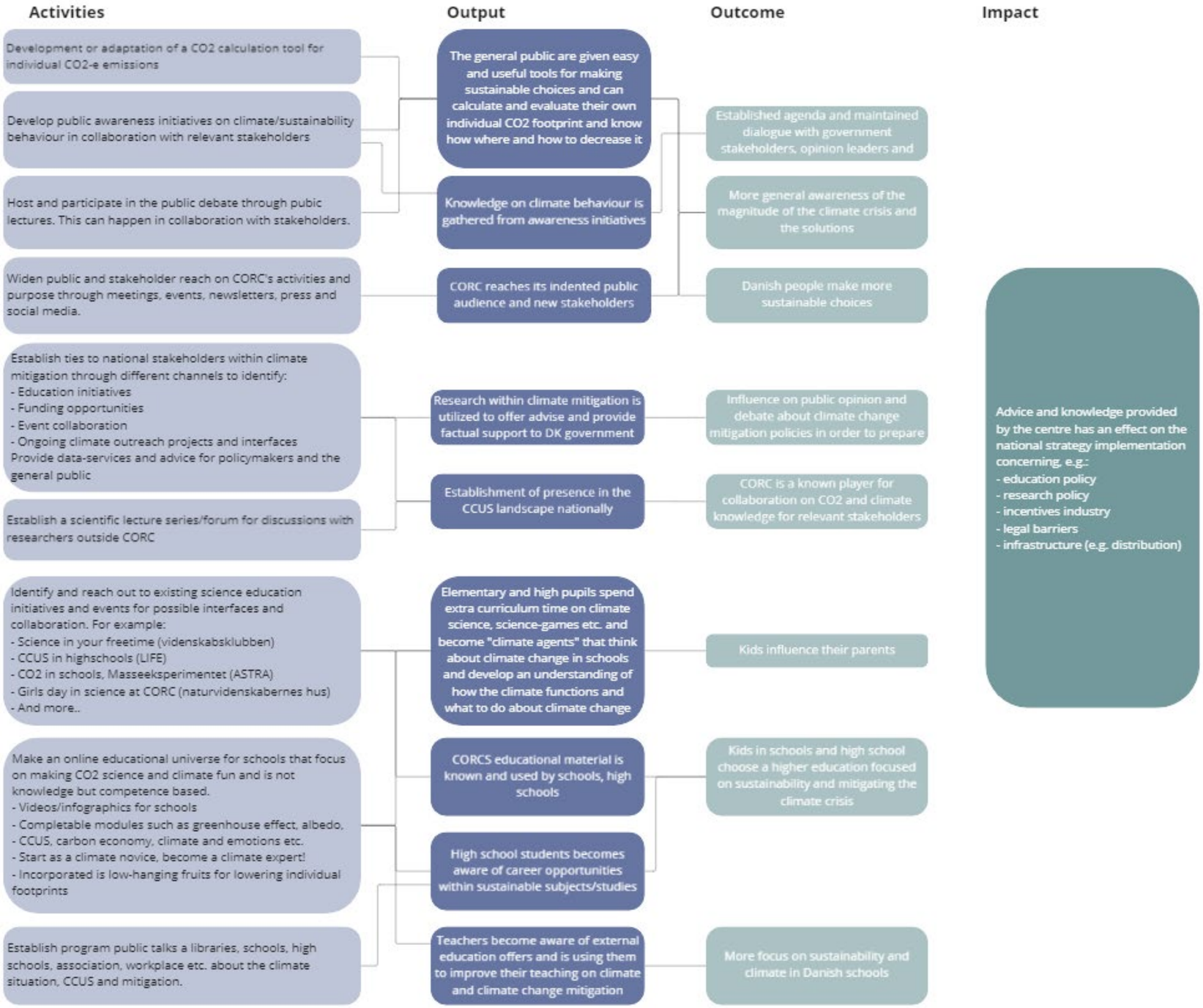
Research


Input
Activities
Output
Outcome
Impact
NNF funding for the centre
Resources
• Personnel
• Infrastructure (e.g. in Foulum)
• Areas of expertise
Building a management culture that enables the centre to:
- effectively collect learnings from experience
- forming a coherent centre
- promote collaboration across the centre
- making informed decisions on distribution of strategic funds, organizing groups, etc.
Investments in upgrading and building new research facilities that meet the needs of the explorative nature of the centre.
An open environment in which researchers from the centre, international collaborators and industry can conduct research within biological and/or chemical process for CO2 capture, conversion and storage
Systems modelling is developed to support ideation phase and ex ante evaluation of scenarios
Fundraising for next generation research projects and strategic funding for new PI's and complimentary research
Relations with other international centres/initiatives established
A research environment that supports exchange of knowledge and people and collaboration between groups and across satellites
Research activities deliver a range of research products (publications, data, software, technologies, samples etc.)
Fundamental research knowledge within biology or chemistry aimed at improving the understanding of capture/conversion/storage pathways and elements thereof
Systems modelling research supports Improving evaluation pathways/technologies and are disseminated in journals and reports
New funds for further research and growth of CORC
Coordinated effort on climate mitigation strategies
A new cross-disciplinary way of conducting science that solves puzzles in new innovative ways
New knowledge facilitates strategic decisions for choosing viable pathways to pursue, that enables discovery of groundbreaking technology platforms for CO2 capture and conversion
Pursue larger projects, e.g. demonstration projects, that would otherwise have to divert a substantial share of internal funding away from explorative projects
A centre of gravity for climate mitigation knowledge in which centre research breakthroughs are recognized worldwide and is the basis for innovation
Support the Danish ambition to lower CO2-emissions by 70% in 2030
Viable technologies are scaled as innovation takes form, e.g.
in existing companies
in spinouts
in demonstration programs

Innovation


Input
Activities
Output
Outcome
Impact
AU TTO services (legal and business development)
Research output / outcome (data & results)
System analysis / modelling output / outcome
CORC projects undergoes ideation with selected industries (CIRC) after undergoing internal modelling of societal and physical boundaries for
CORC establishes closed innovation research collaborations (CIRC) with industry including IP's for new technology
CORC establishes a Aarhus University based public-private community for collaboration and
Open Innovation in Science (OIS) is created with multiple stakeholders both internally and externally (industry/satellites/organizations)
Raising new funds for next generation research projects together with industry partners building on either OIS or CIRC
Explore new translational methods and develop a framework in collaboration with industry stakeholders
Explore new ways to bridge the gap between TRLs in academia and industry
Advances in research and technology, derived from centre closed activities
CORC shares IPR for new CCUS technology
Better and modern relations between the industrial sector and universities is created within the framework of a OIS platform and in open dialogue. Old barriers is broken down.
The public, other knowledge institutions and non-partner industry gain knowledge about CCUS technologies and barriers.interface
In collaboration CORC and industry partners being new projects with additional funding to explore academia/industry interfaces
CORCs technology transfer practices becomes the golden standard for mission driven research.
Formalised commercial and legal agreements with companies and commercilazion of results with IP to existing companies and/or spinouts
Shared knowledge accelerates discovery of new research opportunities and helps identify barriers.
Companies and other researchers adopts results based on OIS for inhouse development and accelerated
New follow-on innovation projects
The new golden standard for knowledge transfer is implemented locally and adopted by others, and eases the sharing of knowledge and technology between knowledge institutions and industry.
Participating companies are at the global forefront of offering or implementing technology platforms

Outreach


Activities
Output
Outcome
Impact
Development or adaptation of a CO2 calculation tool for individual CO2-e emissions
Develop public awareness initiatives on climate/sustainability behaviour in collaboration with relevant stakeholders
Host and participate in the public debate through pubic lectures. This can happen in collaboration with stakeholders.
Widen public and stakeholder reach on CORC's activities and purpose through meetings, events, newsletters, press and social media.
Establish ties to national stakeholders within climate mitigation through different channels to identify:
- Education initiatives
- Funding opportunities
- Event collaboration
- Ongoing climate outreach projects and interfaces
Provide data-services and advice for policymakers and the general public
Establish a scientific lecture series/forum for discussions with researchers outside CORC
Identify and reach out to existing science education initiatives and events for possible interfaces and collaboration. For example:
- Science in your freetime (videnskabsklubben)
- CCUS in highschools (LIFE)
- CO2 in schools, Masseeksperimentet (ASTRA)
- Girls day in science at CORC (naturvidenskabernes hus)
- And more..
Make an online educational universe for schools that focus on making CO2 science and climate fun and is not knowledge but competence based.
- Videos/infographics for schools
- Completable modules such as greenhouse effect, albedo,
- CCUS, carbon economy, climate and emotions etc.
- Start as a climate novice, become a climate expert!
- Incorporated is low-hanging fruits for lowering individual footprints
Establish program public talks a libraries, schools, high schools, association, workplace etc. about the climate situation, CCUS and mitigation.
The general public are given easy and useful tools for making sustainable choices and can calculate and evaluate their own individual CO2 footprint and know how where and how to decrease it
Knowledge on climate behaviour is gathered from awareness initiatives
CORC reaches its indented public audience and new stakeholders
Research within climate mitigation is utilized to offer advise and provide factual support to DK government
Establishment of presence in the CCUS landscape nationally
Elementary and high pupils spend extra curriculum time on climate science, science-games etc. and become "climate agents" that think about climate change in schools and develop an understanding of how the climate functions and what to do about climate change
CORCS educational material is known and used by schools, high schools
High school students becomes aware of career opportunities within sustainable subjects/studies
Teachers become aware of external education offers and is using them to improve their teaching on climate and climate change mitigation
Established agenda and maintained dialogue with government stakeholders, opinion leaders and
More general awareness of the magnitude of the climate crisis and the solutions
Danish people make more sustainable choices
Influence on public opinion and debate about climate change mitigation policies in order to prepare
CORC is a known player for collaboration on CO2 and climate knowledge for relevant stakeholders
Kids influence their parents
Kids in schools and high school choose a higher education focused on sustainability and mitigating the climate crisis
More focus on sustainability and climate in Danish schools
Advice and knowledge provided by the centre has an effect on the national strategy implementation concerning, e.g.:
- education policy
- research policy
- incentives industry
- legal barriers
- infrastructure (e.g. distribution)

Data points/indicators

Mapping of data points/indicators to success factors of the logic model.

Research

Category	Success factor	Indicators	Reporting system	NNF	CORC
Input	NNF funding for the centre	# funding obtained from NNF Annual expenditure distributed on funding sources		NORMA	Template
	Resources (Personnel, existing infrastructure, areas of expertise)	# staff # diverse research groups at the facility			Staff list
Activities	Building a management culture that enables the centre to: - enable researchers to effectively conduct research - forming a coherent centre - promote collaboration across the centre - making informed decisions on distribution of strategic funds, organizing groups, etc.	✓ Key personnel hired to meet organisational setup # internal workshops/activities that binds group/satelites/hub together] # persons in residence programme # collaborations	RF		
	Investments in upgrading and building new research facilities that meet the needs of the explorative nature of the centre.	Reporting on investments in infrastructure	(FG)		
	An open environment in which researchers from the centre, international collaborators and industry can conduct research within biological and/or chemical process for CO2 capture, conversion and storage	# International collaborators # Industrial collaborators # Researchers in residence programme	RF		
	Systems modelling is developed to support ideation phase and ex ante evaluation of scenarios	See research-related outputs	RF		
Output	Relations with other international centres/initiatives established	# collaborations and partnerships # intl. co-authored journal articles	RF	NNF enriched	
	A research environment that supports exchange of knowledge and people and collaboration between groups and across satellites	# collaborations across hub/satellites # cross-groups publications	RF	NNF enriched	
	Research activities deliver a range of research products (publications, data, software, technologies, samples etc.)	# publications # of research products (cf. RF)	RF	NNF enriched	
	Fundamental research knowledge within biology or chemistry that improves the understanding of capture/conversion/storage pathways and elements thereof	# journal articles by research field(s) # cross-disciplinary journal articles	RF	NNF enriched	
	Systems modelling research supports improving evaluation pathways/technologies and are disseminated in journals and reports	# publications # relevant research products (e.g. developed models, software, datasets, etc.) # Dissemination and outreach activities	RF	NNF enriched	
	New funds for further research and growth of CORC	# Additional funding attracted	RF		

Research

Category	Success factor	Indicators	Reporting system	NNF	CORC
Outcome	Coordinated effort on climate mitigation strategies	Descriptis in annual report			
	A new cross-disciplinary way of conducting science that solves puzzles in new innovative ways	# disruptive or truly novel publications # citation impact		NNF enriched	Template
	New knowledge facilitates strategic decisions for choosing viable pathways to pursue, that enables discovery of ground-breaking technology platforms for CO2 capture and conversion	# pathways pursued # new technology platforms	Possibly FG		Template
	Pursue larger projects, e.g. demonstration projects, that would otherwise have to divert a substantial share of internal funding away from explorative projects	# demonstration projects	Possibly FG		Template TBC
Impact	A centre of gravity for climate mitigation knowledge in which centre research breakthroughs are recognized worldwide and is the basis for innovation	# network position # international ranking # citation impact	RF	NNF enriched	
	Support the Danish ambition to lower CO2-emissions by 70% in 2030	# public policy referring to CORC publications # seats on committees # projected ton CO2 implemented in Denmark by viable technologies			
	Viable technologies are scaled as innovation takes form, e.g. in existing companies, in spinouts, or in demonstration programs	# open innovation (TBD) # invention disclosures # patent applications by CORC or companies adopting/further developing technologies # licenses # research cited by patents # spinouts # demonstration projects			

Innovation

Category	Success factor	Indicators	Reporting system	NNF	CORC
Input	AU TTO services (legal and business development)				
	Research output / outcome (data & results)	# candidate projects identified			
	System analysis / modelling output / outcome				
Activities	CORC projects undergoes ideation with selected industries (CIRC) after undergoing internal modelling of societal and physical boundaries for scalability.	# collaboration with industrial partners # ideation workshops and researchers/companies reached	RF		
	CORC establishes a Aarhus University based public-private community for collaboration and dialogue about CCUS	# collaboration with industrial partners	RF		
	Open Innovation in Science (OIS) is created with multiple stakeholders both internally and externally (industry/satellites/organizations)	# network activities, workshops, conferences etc. # residence program # collaborations # people reached in network activities, workshops, conferences etc.			
	Raising new funds for next generation research projects together with industry partners building on either OIS or CIRC	See related outputs			
	Explore new translational methods and develop a framework in collaboration with industry stakeholders	# meeting with companies (TBD)			
	Explore new ways to bridge the gap between TRLs in academia and industry				
Output	Outputs from open innovation and science	# open innovation (TBD)			
	CORC shares IPR for new CCUS technology	# invention disclosures # patent applications / granted patents	RF		
	Better and modern relations between the industrial sector and universities is created within the framework of a OIS platform and in open dialogue. Old barriers is broken down.	# e.g. testimonials # returning partners			
	The public, other knowledge institutions and non-partner industry gain knowledge about CCUS technologies and barriers.	# collaboration with industrial partners # next destination	RF		
	In collaboration CORC and industry partners begin new projects with additional funding to explore academia/industry interfaces	# grant applications # funding granted			
	CORCs technology transfer practices becomes the golden standard for mission driven research.		RF		

Innovation

Category	Success factor	Indicators	Reporting system	NNF	CORC
Outcome	Formalised commercial and legal agreements with companies and commercialising of results with IP to existing companies and/or spinouts				
	Shared knowledge accelerates discovery of new research opportunities and helps identify barriers	# licenses			
	Companies and other researchers adopts results based on OIS for inhouse development and accelerated innovation	# patents citing centre publications # (Marie-Louise) # trace acknowledgement			
	New follow-on innovation projects	# returning collaborators			
	The new golden standard for knowledge transfer is implemented locally and adopted by others, and eases the sharing of knowledge and technology between knowledge institutions and industry.	# xx			
Impact	Participating companies are at the global forefront of offering or implementing technology platforms	# companies # spinouts # products and methods/processes			

Outreach

Category	Success factor	Indicators	Reporting system	NNF	CORC
Activities					
Output					
Outcome					
Impact					

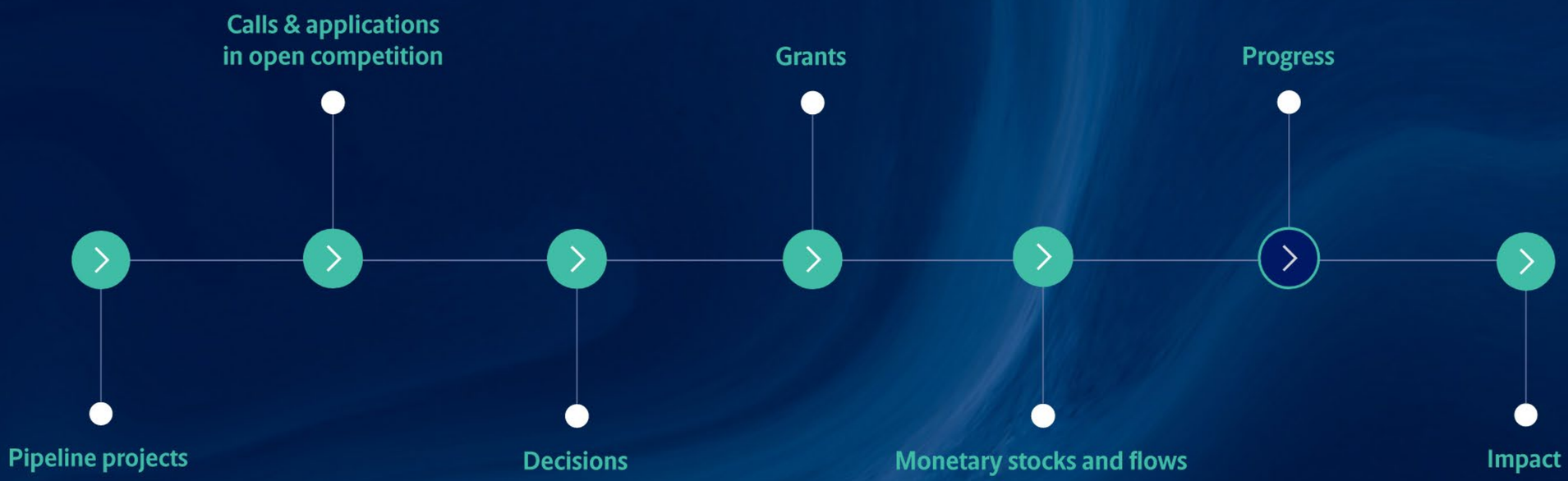
Education and training

Category	Success factor	Indicators	Reporting system	NNF	CORC
Activities					
Output					
Outcome					
Impact					

novo nordisk fonden

Grant-awarding overview

Strategy follow-up



Grants & Impact