EXTENDED RESEARCH DESIGN

Funding criteria to promote environmentally sustainable (health)care research practices

Learning from European research funding organizations

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STUDENT NUMBER
2678294

COMMISSIONING PARTY
ZonMw

ECTS + COURSE CODE SPECIALISATION
30 ECTS + AM_471119

DATE
27-06-2025

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VU Athena Institute
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Colophon

Title: Funding criteria to promote environmentally sustainable (health)care research practices
Keywords: Research funding organization, environmental sustainability, climate change, health(care) research, funding criteria, research on research
Word count: 13.760
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Commissioning organization: ZonMw
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VU supervisor: Kristiaan Kok

Date: 27-06-2025
Course code: AM_471119

This internship report was established in cooperation with the Athena Institute.

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Executive summary - English

Context – Human activity has driven the climate change towards planetary boundaries; the limits of our earth's system. Additionally, climate change has an increasing effect on human health. Conversely, the healthcare sector itself contributes to climate change. Therefore, health(care) research is essential for mitigating these effects but is also a resource intensive sector that negatively impacts the environment through emissions, waste production, and inefficiencies. This highlights a paradox that can be addressed by focusing on more sustainable research methods and practices. Considering this paradox, several policies targeting sustainability in general and health(care) have been introduced over the past years including the Paris agreement, Sustainable Development Goals, and European green deal. Additionally, representative organizations such as Science Europe, European Molecular Biology Organization (EMBO), and Ensuring Value in Research (EViR) have started initiatives such as working groups and developed 'agreement' documents. Research funding organizations (RFOs), such as ZonMw in the Netherlands, play an important role in these initiatives as they can influence sustainable practices in research through funding conditions. However, there is limited insight into how sustainability considerations are operationalized within their organizations. The main research question guiding this study is: "What can ZonMw learn from European RFOs to successfully develop and implement contextually appropriate funding conditions to encourage environmental sustainability of ZonMw-funded (research) projects?"

Methods – To answer this question, a qualitative comparative case study was conducted, based on the Consolidated Framework for Implementation Research (CFIR) 2.0. This framework was chosen to systematically analyze the implementation process within organizational settings, with attention to four key domains: innovation characteristics, inner setting, outer setting, and individuals. Data collection was conducted through a combination of methods. First, an extensive document review was carried out to map the current landscape of sustainable research initiatives and policy frameworks among European RFOs. Then, 14 semi-structured interviews were conducted with representatives of national and multinational RFOs. These interviews aimed to explore organizational perceptions on promoting environmental sustainability, current practices, and barriers and facilitators related to the implementation of funding criteria. Additional insight was gained through close collaboration with ZonMw staff concerned with environmental sustainability, allowing for internal comparison and tailored recommendations.

Results – All organizations represented by the interviewed participants focus on sustainability in terms of research topics. Some are also addressing sustainable research methods in their funding calls. The findings show that participants view the scientific community, not their country, as their external context. This outer setting view is amplified by high levels of international collaboration. There are shared concerns about a lack of policy pressure within the European Union (EU) and from national governments. Additionally, participants mentioned that an increasing focus on socio-political developments could shift funding away from sustainability matters. Prioritization of other issues is also observed specifically in health(care). There is a moral and scientific responsibility to promote sustainability among European RFOs. High intrinsic motivation among individuals involved in the implementation of funding criteria, combined with a strong internal culture of sustainability, emerged as key facilitating factors. At the same time, tensions were identified between promoting sustainability and safeguarding epistemic freedom, as well as concerns about a potential dilution of scientific excellence. Regarding funding conditions, participants expressed a preference for the introduction of formal criteria as opposed to mainstreaming efforts, but encountered difficulties in both qualitative and quantitative assessment. These difficulties were encountered in several possible variations of including sustainability into calls, including their target (individual researcher vs. institutional infrastructure), timing (pre-assessment vs. during assessment) and placement (additional criterion vs. integration in current criteria). Strategies aimed at mainstreaming environmentally sustainable research methods within the scientific community are being used while working toward more formalized criteria.

Conclusions – Findings recommend the improvement of collaborative governance approaches among RFOs, as multiple international initiatives operate in isolation despite shared goals suggesting a disconnect between collaborative intent and actual coordination. Transdisciplinary approaches (i.e., including the research community (universities, RPOs, and foundations, and notably peer reviewers and panelists) will encourage the mainstreaming of sustainability in research methods and aid in the development of harmonized, yet contextually appropriate assessment methods. Further post-implementation research, applying the CFIR 2.0 model to funding criteria on sex, gender, diversity, and collaboration is recommended to RFOs to enhance the relevance and contextual applicability of the current study's findings. The study concludes that ZonMw is well-positioned to lead by example. Its thematic focus on health research and programming offers a unique opportunity to implement funding conditions without undermining epidemic freedom, as calls already include a strategic direction. Mission-oriented Innovation Policies (MOIPs) for health(care) can be a promising framework in this programming to draw on the validity of providing strategic direction. Furthermore, the development of analytic methods such as LCAs in health(care) research is achievable in a singular research domain and may prove valuable in the process towards harmonization. Finally, ZonMw can contribute to existing efforts by initiating the creation of a shared repository of sustainable health(care) research methods. Providing the applicants with several options to consider the sustainability of their research (project) will support implementation by increasing perceptions of agency; the illusion of choice will aid implementation of funding conditions. This research provides actionable insights for ZonMw and other RFOs, and contributes to broader discussions on the role of public funders in promoting environmental sustainability in research.

Samenvatting – Nederlands

Context – Menselijke activiteit heeft klimaatverandering richting planetaire grenzen gedreven; de grenzen van onze planeet. Klimaatverandering heeft ook steeds meer effect op de menselijke gezondheid, maar de gezondheidszorg draagt ook bij aan dit probleem. Gezondheid(zorg) onderzoek is daarom van belang om deze effecten tegen te gaan, maar ook dit is een grondstof intensieve sector. Dit belicht een paradox die kan worden aangekaart door op duurzame onderzoeksmethodes te richten. Naar aanleiding van deze paradox zijn de afgelopen jaren verschillende duurzaamheidsbeleidsmaatregelen geïntroduceerd, waaronder het Klimaatakkoord van Parijs, de Duurzame Ontwikkelingsdoelen (SDG's) en de Europese Green Deal. Daarnaast zijn organisaties zoals Science Europe, European Molecular Biology Organization (EMBO) en Ensuring Value in Research (EViR) gestart met initiatieven zoals werkgroepen en gezamenlijke overeenkomsten. Onderzoeksfinanciers (RFO's), zoals ZonMw in Nederland, bevinden zich in een unieke positie binnen deze initiatieven door de mogelijkheid om duurzame onderzoeksmethodes te bevorderen via subsidievoorwaarden. Er is echter weinig inzicht in hoe RFO's deze rol binnen hun organisaties wordt geoperationaliseerd. De centrale onderzoeksvraag in dit onderzoek luidt: "Wat kan ZonMw leren van Europese RFO's om succesvol context specifieke subsidievoorwaarden te ontwikkelen en implementeren om de ecologische duurzaamheid van door ZonMw gefinancierde (onderzoeks)projecten te bevorderen?"

Methoden – Om deze vraag te beantwoorden is een kwalitatieve, vergelijkende casestudie uitgevoerd, gebaseerd op het *Consolidated Framework for Implementation Research* (CFIR) 2.0. Dit raamwerk is gekozen om het implementatieproces binnen organisaties systematisch te analyseren en bestaat uit vier domeinen: kenmerken van de innovatie, interne context, externe context, en individuen. Eerst werd een uitgebreid documentenonderzoek uitgevoerd om het huidige landschap van duurzame onderzoeksinitiatieven en beleidskaders bij Europese RFO's in kaart te brengen. Vervolgens heeft de dataverzameling plaatsgevonden door middel van 14 semigestructureerde interviews met vertegenwoordigers van nationale en multinationale RFO's. Deze interviews richtten zich op de opvattingen van de geïnterviewden over het bevorderen van ecologische duurzaamheid, de huidige praktijken, en de belemmeringen en bevorderende factoren rond de implementatie van subsidiecriteria. Aanvullende inzichten werden verkregen door nauwe

samenwerking met ZonMw-medewerkers die zich bezighouden met duurzaamheid, wat interne vergelijking en gerichte aanbevelingen mogelijk maakte.

Resultaten – Alle organisaties van de geïnterviewde participanten richten zich op duurzaamheid in termen van onderzoeksonderwerp. Sommigen richten zich ook al op duurzame onderzoeksmethodes in hun subsidieoproepen. Uit de bevindingen blijkt dat de participanten de wetenschappelijke gemeenschap als hun externe context zien, niet hun land. Deze blik op de externe omgeving wordt versterkt door een hoge mate van internationale samenwerking. Er zijn gedeelde zorgen over het gebrek aan beleidsdruk vanuit de Europese Unie (EU) en nationale overheden. Daarnaast gaven deelnemers aan dat een toenemende focus op sociaal-politieke ontwikkelingen de aandacht voor duurzaamheid in de financiering kan verminderen. Dit wordt met name waargenomen in de gezondheids(zorg)sector, waar andere thema's vaak prioriteit krijgen. Binnen Europese RFO's heerst een morele en wetenschappelijke verantwoordelijkheid om duurzaamheid te bevorderen. Een hoge intrinsieke motivatie van de individuen betrokken bij de implementatie van subsidiecriteria, gecombineerd met een sterke interne duurzaamheidscultuur, bleken belangrijke bevorderende factoren. Tegelijkertijd werden spanningen gesignaleerd tussen het bevorderen van duurzaamheid en het waarborgen van epistemische vrijheid, evenals zorgen over een mogelijke verwatering van wetenschappelijke excellentie. Wat betreft subsidievoorwaarden, gaven de participanten de voorkeur aan het invoeren van formele criteria boven het 'mainstreamen' van duurzaamheid, maar ze ondervonden moeilijkheden bij het zowel kwalitatief als kwantitatief beoordelen. Deze uitdagingen deden zich voor bij verschillende manieren waarop duurzaamheid in subsidieoproepen kan worden opgenomen, waaronder de focus (individuele onderzoeker vs. institutionele infrastructuur), het moment (voorafgaand aan vs. tijdens de beoordeling) en de plaatsing (extra criterium vs. integratie in bestaande criteria). Strategieën die zich richten op het 'mainstreamen' van duurzame onderzoeksmethodes vanuit de wetenschappelijke gemeenschap worden ingezet tijdens het ontwikkelen van formele criteria.

Conclusies – Op basis van de bevindingen wordt aanbevolen om de bestuurlijke samenwerking tussen onderzoeksfinanciers (RFO's) te verbeteren, aangezien internationale initiatieven geïsoleerd opereren ondanks gedeelde doelen. Dit wijst op een kloof tussen de intentie tot samenwerking en de daadwerkelijke coördinatie. Transdisciplinaire benaderingen, waaronder de betrokkenheid van de onderzoeksgemeenschap (universiteiten, onderzoeksorganisaties, fondsen, en met name peer reviewers en beoordelingspanels) zullen bijdragen aan het integreren van duurzaamheid van onderzoeksmethoden en helpen bij het ontwikkelen van geharmoniseerde, maar contextueel passende beoordelingsmethoden. Verder post-implementatieonderzoek, waarbij het CFIR 2.0 model wordt toegepast op subsidiecriteria rondom sekse, gender, diversiteit en samenwerking, wordt aanbevolen aan RFO's om de relevantie en contextuele toepasbaarheid van de bevindingen van deze studie te versterken. De studie concludeert dat ZonMw goed gepositioneerd is om het goede voorbeeld te geven. De thematische focus op gezondheidsonderzoek en programmering biedt een unieke kans om subsidievoorwaarden in te voeren zonder de epistemische vrijheid aan te tasten, aangezien de subsidierondes al een strategische richting omvatten. Missiegedreven Innovatiebeleid (MOIP's) voor gezondheid(zorg) kan een veelbelovend kader vormen om deze strategische richting te onderbouwen. Daarnaast is de ontwikkeling van analysemethoden zoals Levenscyclusanalyse (LCA) binnen de gezondheid(zorg)onderzoek realiseerbaarder binnen één onderzoeksdomein. Tot slot kan ZonMw bijdragen aan bestaande inspanningen door het initiatief te nemen voor het opzetten van een gedeelde opslag van duurzame onderzoeksmethoden binnen de gezondheid(zorg). Door aanvragers meerdere opties ter overweging te bieden om duurzaamheid in hun onderzoeks(project), wordt de implementatie ondersteund doordat het gevoel van handelingsvrijheid toeneemt; de illusie van keuze bevordert de invoering van subsidievoorwaarden. Dit onderzoek levert toepasbare inzichten op voor ZonMw en andere RFO's en draagt bij aan bredere discussies over de rol van publieke financiers in het bevorderen van ecologische duurzaamheid van het onderzoek.

List of abbreviations

CFIR – Consolidated Framework for implementation research
CoARA – Coalition for Advancing Research Assessment
CSRD – Corporate Sustainability Reporting Directive
DNSH – Do no significant harm
EC – European Commission
EMBO – European Molecular Biology Organization
ERC – European Research Council
ESR – Effort-Sharing Regulation
EU – European Union
EViR – Ensuring Value in Research
GDDZ – Green Deal Sustainable Care
GDPR – General Data Protection Regulation
GHG – Greenhouse gas
HE – Horizon Europe
HIROs – Head of international research organizations
LCA – Life cycle assessment
MOIP – Mission-oriented innovation policies
MSCA – Marie Skłodowska-Curie Actions
NDC – Nationally Determined Contribution
NWO – ("Nederlandse Organisatie voor Wetenschappelijk onderzoek") Netherlands Organization for Scientific Research
R&I – Research and innovation
RFO – Research funding organization
RPO – Research performing organizations
SDG – Sustainable development goals
SPARK-Hub – Sustainable Practices and Research and Knowledge Practice Hub Outline
UK – United Kingdom
UKRI – UK Research and Innovation
UN – United Nations
UNFCCC – United Nations Framework Convention on Climate Change
VWS – ("Ministerie van Volksgezondheid, Welzijn en Sport") Ministry of Health, Welfare and Sport

Nb. Full list of research funding organizations' abbreviations in annex 1

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1 Introduction

Human activity is driving climate change towards planetary boundaries; the limits of our earth's system (Rockström et al., 2009). Crossing these boundaries can cause significant risk to humanity through irreversible ecological impacts. Additionally, climate change has an increasing effect on human health (IPCC, 2023; Romanello et al., 2022). The multiplicity of impacts include heat related illnesses, changing patterns of disease transmission, mental health impacts, health risks from natural disasters, respiratory illness resulting from air pollutants, and impacts on food and water security (Hoffmann et al., 2023; Romanello et al., 2022). Conversely, the (health)care sector itself contributes to climate change; this is about 7% of the national greenhouse gas (GHG) emissions in the Netherlands (Lenzen et al., 2020; Skapetis et al., 2024; Steenmeijer et al., 2022). Health(care) research is essential for mitigating the effects of climate change on human health and the development of more sustainable healthcare systems. Research is however also a resource intensive sector and negatively impacts the environment through GHG emissions, pharmaceutical and solid waste production, and energy usage for digital infrastructures (Belkhir & Elmeligi, 2019). Additionally, it is estimated that 85% of health and health(care) research is redundant due to non-publication, inadequate reporting, and methodological flaws leading to wasted resources and unnecessary environmental strain (Baker, 2015; Chalmers & Glasziou, 2009; Freedman et al., 2015; You et al., 2025). This highlights a paradox that can be addressed by focusing on environmentally sustainable research methods and practices such as 'reduce, reuse, recycle' principles, sustainable travel policies and more efficient resource use.

International efforts such as the 2015 United Nations (UN) Paris agreement have attempted to reduce GHG emissions across multiple economic sectors including (health)care (UNFCCC, 2016). Additionally, the UN sustainable development goals (SDGs) aim for planetary and human health now and in the future (*THE 17 GOALS | Sustainable Development*, n.d.). SDG 13 in particular calls for climate action beyond reducing GHG emissions, such as reducing waste and promoting circular economies. The SDGs encourage governments to integrate sustainability measures into national policies, strategies and planning. Public research funding organizations (RFOs) can play a unique role in developing these strategies to reduce the ecological footprint of the research sector specifically as they work closely with national governments.

In the Netherlands, the public RFO ZonMw has ambitions to help minimize the environmental impact of the national health(care) research sector. This can be achieved in multiple areas as ZonMw funds many different projects ranging from fundamental to applied sciences, all on topics related to health(care). However, it is unclear what role they should play in promoting environmental sustainability. Literature points out the potential of implementing funding conditions to steer towards environmentally sustainable research methods and practices, but practical approaches to implementation have yet to emerge (Skapetis et al., 2024; Weber et al., 2024). Lessons can be learned by aggregating implementation experiences from other RFOs and understanding their organizational contexts and implications. Therefore, the objective of this study is to explore ways of minimizing the environmental impact of ZonMw-funded research by consolidating strategies and best practices of other European RFOs. The focus will lie specifically on funding conditions and their applicability to promoting environmentally sustainable research methods and practices. The main research question is as follows: *What can ZonMw learn from European RFOs to successfully develop and implement contextually appropriate funding conditions to encourage environmental sustainability of ZonMw-funded (research) projects?*

2 Contextual background

This section will elaborate on the current policy landscape regarding environmental initiatives in general, in health(care) and in the research sector. Furthermore, this chapter will cover the currently applied initiatives to promote sustainable research practices and conclude with an overview of key collaborations, organizations, and stakeholders.

2.1 Climate policies

Throughout recent history, several collaborations have attempted to mitigate climate change through laws and regulations. The first international collaboration to combat climate change was the operationalization of the United Nations Framework Convention on Climate Change (UNFCCC) (UNFCCC, 1997). This assembly resulted in the Kyoto protocol of 1997, which aimed to reduce GHG emission of 37 industrialized countries and the European Union (EU). The agreed upon targets reflect its principle of "common but differentiated responsibility and respective capabilities".

After Kyoto, the UN introduced the SDGs in 2015 to promote peace and prosperity for people and the planet (THE 17 GOALS | Sustainable Development, n.d.). The SDGs reflect a call to action for both industrialized and developing countries, in contrast to the Kyoto Protocol. These goals recognize that current global issues, such as poverty and climate change, are all interlinked and must be addresses as a whole. Importantly for the subject of this paper, the SDGs have clearly linked climate change to health, which was missing from the acknowledgement of previous climate movements. Shortly after, the Paris Agreement was set up by the UNFCCC as an iteration of the Kyoto Protocol and was adopted by 196 countries, also expanding its scope to more than only industrialized countries (UNFCCC, 2016). This agreement aims to limit the average global rise in temperature to 1.5°C above pre-industrial levels. The Paris Agreement is a legally binding treaty that countries implement in national policies through Nationally Determined Contributions (NDCs).

In accordance with the Paris Agreement, the European Commission (EC) established the European Green Deal which includes legislative measures and economic incentives to support the transition to a sustainable economy within the EU. The Green Deal is an even more ambitious plan than Paris Agreement and aims to make the EU the first carbon neutral continent. A key element of the Green Deal is the "Fit for 55 package". This offers a regulatory foundation for a 55% decrease in emissions by 2030 compared to 1990 levels. The objectives of the Green Deal are further formalized by the European Climate Law, which imposes a legally enforceable responsibility on all EU member states to achieve climate neutrality by 2050. The Effort-Sharing Regulation (ESR) system was set up to distribute the reduction of GHG emission per industry and requires countries by law to reduce GHG emissions based on their respective capabilities. 2019 saw the implementation of the Dutch Climate Agreement ("Klimaatakkoord"), which sets legally enforceable goals for reducing GHG emissions compared to 1990 levels. The bill seeks to reduce emissions by 49% by 2030 and 95% by 2050. The objectives are categorized into mobility, industry, buildings, agriculture, and power (Ministerie van Economische Zaken en Klimaat, 2023).

2.2 Climate policies in health(care) research

Initiatives concurrent to the above-mentioned developments in climate policy have aimed to reduce emissions and waste of the research sector. Environmental sustainability was long considered an ethical issue. The leading document for ethical practice in health(care) research, the Declaration of Helsinki, has included a principle to minimize environmental harm of health(care) research since its 1975 reiteration (World Medical Association, 1975). The current version (2024) is the first to explicitly appeal for sustainability: "Medical research should be designed and conducted in a manner that avoids or minimizes harm to the

environment and strives for environmental sustainability" (World Medical Association, 2025). Although the Declaration of Helsinki is seen as a reputable document, it has no legal binding character. Several principles of Declaration, including informed consent, have however been written into law in the Netherlands, such as The Medical Research Involving Human Subjects Act. This law sets content and procedural requirements for research involving human subjects. Health(care) research has evolved over the past decades, reducing the centrality of human subjects in medical research. In concert, research using animals and big-data have gained presence in the sector. Thus, there are now many other statements and documents on best practices in (medical) research, including the Dutch Law on Animal Experimentation ('Wet op de Dierproeven') and the EU General Data Protection Regulation (GDPR) (General Data Protection Regulation, 2016; Ministerie van Algemene Zaken, 2024). However, these documents have all yet to echo environmental sustainability from the Declaration of Helsinki as research principles.

Although the healthcare sector was not emphasized in the Dutch Climate Agreement, The Green Deal Sustainable Care (GDDZ) 3.0, was introduced to promote sustainable practices in healthcare (Ministerie van Volksgezondheid, Welzijn en Sport, 2022). GDDZ 3.0 aims to contribute to mitigating climate change through five themes: (1) health promotion, (2) knowledge and awareness, (3) CO_2 emissions, (4) circular working, and (5) medication. Such political developments ignite allocation of public funding to research topics. For example, ZonMw has signed the GDDZ 3.0 and contributes by funding research on its 5 themes. The topic of this paper, however, concerns the environmental sustainability of the research itself across all disciplines of health(care) research. How this could be incentivized by RFOs is elaborated on in the following section.

2.3 Sustainability in funding schemes

A small number of RFOs have included aforementioned policies into their funding schemes to promote environmentally sustainable research practices. The next section will discuss the leading organizations and notable funding schemes regarding the environmental sustainability of research practices.

2.3.1 Horizon Europe

The Horizon Europe (HE) Framework Program is the EC's main funding program focusing on research and innovation (R&I). HE was initiated in 2021, following up the Horizon 2020 program and will distribute 93.5 billion euros between 2021 and 2027 (Horizon Europe, 2025). The program comprises three main pillars: (I) Excellent Science, (II) Global Challenges & European Industrial Competitiveness, and (III) Innovative Europe (Horizon Europe, 2025). Pillar I includes, for example, the European Research Council (ERC); HE's main program for funding excellent research (bottom-up). Pillar II is more thematic, and includes the cluster 'Health' (Horizon Europe, 2025). The HE programming guide refers to multiple, but ambiguous recommendations and guidelines. Sustainability is first sectioned under ethical considerations and research integrity (ALLEA, 2023; Horizon Europe, 2025). Further along in the HE program, the 'do no significant harm' (DNSH) principles are mentioned, that prevent funding to projects who's "directionality" (i.e., the intended use for produced knowledge) poses potential harm to the environment. Finally, the HE program advocates for open science principles to, among other reasons, mitigate research waste and waste of resources.

The Marie Skłodowska-Curie Actions (MSCA) are a distinct set of programs under pillar I that focus on advancing skills and (international) careers of doctoral and postdoctoral researchers (About MSCA, 2024). MSCA stands out within HE due to their introduction of the MSCA Green Charter (MSCA Green Charter, 2024). These guiding principles are solely aimed at MSCA applicants but are also referred to as inspiration in, for example, ERC grants. The guidelines comprise tangible recommendations to mitigate climate impact of research, including "reduce, reuse and recycle" principles and directions for sustainable travel practices. However, the adherence to these principles is voluntary and not monitored. The MSCA Green Charter is the first of its kind and views on best practices have changed since its introduction in 2021. For instance, the

MSCA Green Charter included 'carbon offsetting' as a possibility for climate mitigation, which entails investing in projects that reduce, or eliminate emissions elsewhere. This is no longer considered a suitable alternative to reducing emissions within a project's own scope; the charter is currently being updated to current standards.

2.3.2 Wellcome Trust

Although the focus of this paper is on public funders, activities of the private organization Wellcome Trust have been found relevant to outline in this study due to their strides in funding conditions for environmental sustainability of research practices. As a private organization, they are more flexible in determining internal policy, as they are less bound to political structures. The Wellcome Trust has been able to position itself ahead of the curve regarding sustainable research practices by working together with stakeholders in the United Kingdom (UK) R&I sector including RFOs, RPOs, and universities. This collaboration resulted in The Concordat for the Environmental Sustainability of Research and Innovation Practice (Wellcome Trust, 2024). It was developed to complement other existing policy areas and was realized in the interest of stakeholders as opposed to top-down governance, lending it significant stature in the UK and international scientific community. The Wellcome Trust encourages grant recipients to align their practices with the concordat, by working individually and on an organizational level to reduce the climate impact of research. This has been an important step in the recognition of the role that funders can play in steering towards environmentally sustainable research practice.

2.4 International collaborative efforts

Several collaborations of RFOs have formed over the past years in light of the developments discussed previously. For example, Science Europe represents several key research performing organizations (RPOs) and many national RFOs to promote excellent, ground-breaking scientific research in Europe (Science Europe, 2024). Since 2021, the organization has been focusing on 'Greening Research', defined as "the processes leading to sustainability of research activities involving the planning, management and conduct of research" (Science Europe, 2024). In this effort they have produced a framework focused on practices of RPOs, and how RFOs can play into these changes. The framework identifies opportunities regarding the sustainability of research, including best practices and how to overcome barriers. Additionally, clear definitions are set out in this document; the first step to successful policy development (Hunt et al., 2022). The key objectives, including environmental criteria in research evaluation, are shown in figure 1.

Figure 1: The Framework for the Environmental Sustainability of Research Organizations (Science Europe, 2024)

Furthermore, Ensuring Value in Research (EViR) funders' forum is an international collaboration of health(care) RFOs (About us – EViR, 2023). Their main focus is to develop new approaches in increasing the value of health-related research. EViR has produced a self-audit tool for RFOs based on the value framework published in the Lancet by Chalmers & Glasziou (2009). Currently, this tool is the subject of renewal as sustainability has been added as an aspect of value. The renewed principles aim in guiding research funders: "To contribute to environmental, social, and economic sustainability, funders should actively work to improve their own practices, consider expectations and requirements of researchers and consider sustainability in the topics they fund" (Self-Audit Tool - EVIR, n.d.).

One of the most recent developments in international cooperation on promoting environmental sustainability of research practices is the 2024 Heidelberg agreement on Environmental Sustainability in Research Funding (Weber et al., 2024). The agreement was initiated by the European Molecular Biology Organization (EMBO) and stipulates guiding principles for RFOs to effectively encourage sustainable research by providing a framework on how to include sustainability into funding schemes. The agreement was the product of a collaboration between multiple RPOs, RFOs and other stakeholders, reflecting its importance to the field. Finally, other initiatives include the Sustainable Practices and Research and Knowledge Practice Hub Outline (SPARK-Hub) initiated by United Kingdom Research and Innovation (UKRI) (not yet published). This hub intends to: (1) provide quality-controlled guidance on incorporating sustainability into research practices; (2) offer tools to estimate environmental impacts; and (3) develop certification mechanisms to verify environmental sustainability. The previous initiatives are still in early stages and concrete implementing of the discussed principles and guidelines have yet to occur.

2.5 Public funding organizations

The previous sections discussed several initiatives and funding organizations. Figure 2 presents a stakeholder map based on Stickdorn & Schneider's (2010, p. 162) bullseye model, categorizing stakeholders as core, direct, or indirect. These categories reflect their similarity to ZonMw, with core stakeholders sharing the closest focus or activities. The next section elaborates on each group.

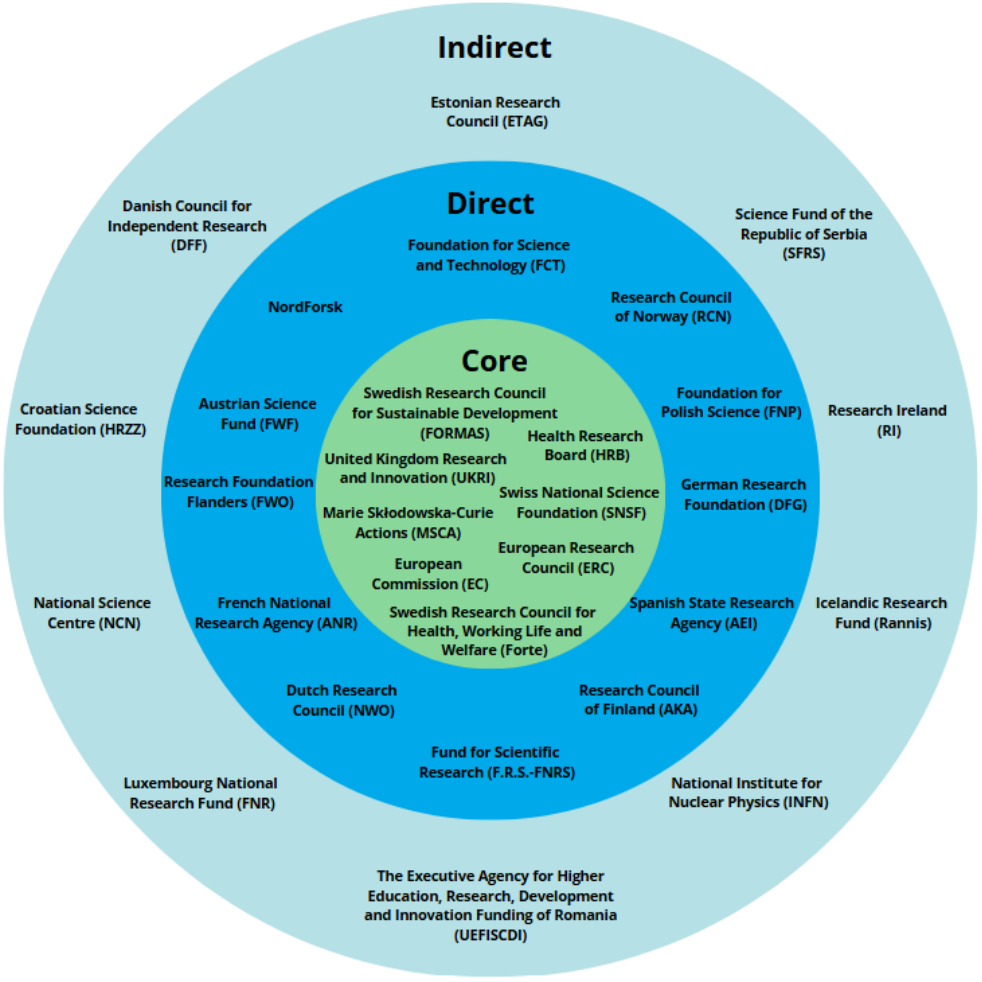

Figure 2: Stakeholder classification based on Stickdorn & Schneider's (2010, p. 162) bullseye model

This study identifies eight organizations as core stakeholders due to their strong comparability to ZonMw. For example, the Health Research Board (HRB) and Swedish Research Council for Health, Working Life and Welfare (Forte) focus specifically on funding health(care) research. The Swiss National Science Foundation (SNSF) and Swedish Research Council for Sustainable Development (FORMAS) are actively involved in promoting sustainable research through EViR and the Science Europe Greening Research workgroup. Additionally, MSCA, EC, ERC, and UKRI are included for their leading roles in promoting sustainable research practices.

The direct stakeholder group includes funders that fund health(care) research alongside other domains. While their activities differ slightly from ZonMw's, most are members of the Greening Research workgroup and thus remain relevant. NordForsk, though not a member, is included due to its unique multinational scope within the Nordic region. Indirect stakeholders are less comparable to ZonMw, as they do not focus on health(care) and/or are not involved in sustainability initiatives though collaborations or working groups (full list and abbreviations in annex 1).

3 Theoretical background

Funding criteria to encourage sustainable research practices in health(care) research concerns the operationalization of the aforementioned environmental sustainability policies. However, organizational differences prevent "one size fits all" operationalization strategies of these policies into funding criteria. Differences can include types of funding schemes used to distribute funding: bottom-up or thematic. Bottom-

up organizations or calls mostly focus on excellent research including projects from all disciplines of science, whereas thematic calls are focused on achieving certain goals and thus dictate what disciplines and research types are eligible for funding based on relevance criteria in addition to excellence. This differentiation in the assessment of eligible applications also dictates how environmental sustainability can be included in funding schemes. Recognition of organizational differences and their influence on the uptake of research and evidence-based findings into health(care) settings led to the emergence of implementation science (Eccles et al., 2006). Implementation science has been applied for across several subjects including policy, leading to the development of, for example, Walt and Gilson's (1994) Health Policy Triangle (Eccles et al., 2006). Since its inception, implementation science has further evolved to include more factors that are important to modern settings. These developments will be discussed in the following sections.

3.1 Innovation in healthcare

The healthcare field has become increasingly complex; multiple innovations have emerged in past years that show potential in health(care) (Golenko et al., 2023). However as a result of implementation difficulties, a gap has developed between innovations resulting from scientific and applied research, and their uptake into practice (Ben Charif et al., 2022). A health innovation can take on multiple identities, including new working processes that aim to improve health outcomes, efficiency, cost-effectiveness or user experience. Integrated care models are an example of these innovations; they challenge conventional hierarchies and structures, which requires consideration of numerous stakeholders with conflicting interests. As a result, there is an increasing focus on understanding the implementation of services and processes, and evaluations that involve these multiple stakeholders (Eccles et al., 2006). The topic of this paper can be seen as a process innovation; novel funding conditions would entail changing or adding criteria to funding instruments, which would ultimately affect RFOs' employees working processes regarding the development of the calls and the assessment processes of peer reviewers and panel members. The following section will introduce a model that is applicable to the implementation process innovations.

3.2 Consolidated Framework for implementation research

The Consolidated Framework for Implementation Research (CFIR) was developed by combining 19 theories related to dissemination, innovation, organizational change, implementation, knowledge translation, and research uptake (Damschroder et al., 2009). The aim of consolidating theories was to provide consistent terminology within implementation science in health(care), as the field lacked consensus. However, its applicability ranges beyond this field; a systematic review on studies using the CFIR model by Damschroder et al. (2022) found that 20% concerned non-healthcare settings. Although the model originally contained health(care) specific concepts such as "patient needs and resources", it was reformulated in the CFIR 2.0 to enhance applicability to other fields. The renewed model consists of five domains that are influential to implementation: innovation characteristics, the outer and inner settings of organization, the individuals involved, and the implementation process. The CFIR 2.0 is a pragmatic model that provides an understanding of processes and can thus be used to inform implementation strategies. It is intended to guide data collection from individuals in position to influence implementation.

The following section will discuss the model's five domains. First, the innovation domain comprises characteristics of an innovation, along with the elements, structures and systems related to the organization into which the innovation is being implemented. The CFIR 2.0 also provides several sub-concepts to the innovation domain including innovation source, evidence base, relative advantage, adaptability, trialability, complexity, design quality, and cost. It is important to understand the perspective of key stakeholders on these sub-concepts, as they have been shown to influence the implementation process.

Next, the setting of an organization is influential to implementation in the CFIR 2.0 model. The outer setting of the organization is a product of the economic, political and social context. The CFIR 2.0 sub-concepts of the outer setting include critical incidents, local attitudes, local conditions, partnerships and connections, policies and laws, financing, external pressures.

In turn, the individual domain captures roles and characteristics of those involved in the implementation process. Individuals beliefs and actions stem from cultural and social context; the outer setting. The sub-concepts in this domain comprise project roles (e.g. high-level and mid-level leaders, implementation leads, facilitators, and team members, opinion leaders, and deliverers and recipients of an innovation) and characteristics that these individuals have in the implementation process (e.g. capability, motivation, need and opportunity).

Individual's actions then shape the organization's inner setting. The sub-construct of the inner setting are tangible and intangible manifestations of structural characteristics (e.g. physical infrastructure, information technology infrastructure and work infrastructure), relational connections, communications, culture, and implementation (e.g., tension for change, compatibility, relative priority, incentive systems, access to knowledge and information, and mission alignment, which further comprises funding, space, and materials and equipment).

Finally, the implementation process includes sub-concepts that describe practices during implementation: teaming, assessing needs of deliverers and recipients, assessing context, planning, tailoring strategies, engaging, doing, reflecting, evaluating and adapting. These concepts reflect that implementation is often not a linear process, but a collection of simultaneous initiatives throughout different levels within the organization that influence implementation.

3.3 Visualization of the CFIR 2.0 model

Figure 3 shows the CFIR 2.0 model as visually presented in the paper of Best et al. (2021). This illustration aids in the understanding of the position of concepts relative to implementation and each other. The outer setting comprises the most outer ring; while it is furthest from the center, it also has the largest area. This reflects the great amount of influence of an organization's setting on implementation climates. One layer inward, the characteristics of individuals and the process influence implementation on the same level, as these concepts are the most interdependent; one cannot consider an implementation process without understanding who is involved. Next, the inner setting is encapsulated by the characteristics of individuals and the process that influence implementation, as these directly shape the inner setting along with longer standing cultures. Finally, the innovation characteristics are at the core of the model; whether the innovation can be successfully implemented depends on the context in the surrounding rings.

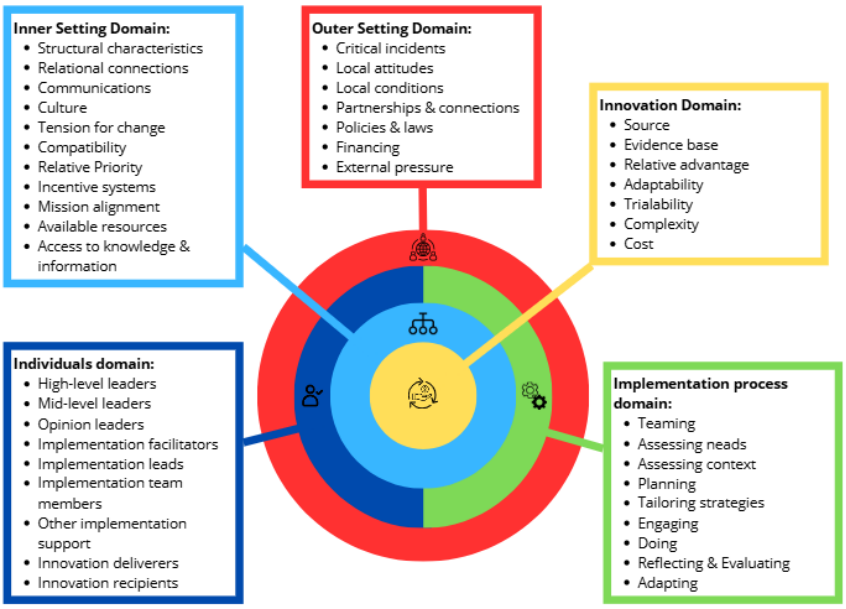

Figure 3: Visualization of CFIR 2.0 model based on Best et al. (2021)

4 Conceptual framework

As the CFIR 2.0 model has been adapted to analyze the implementation of innovations in more settings than health(care) alone, this study employs it in the realm of (health)care research funding, with funding conditions as a process innovation. Using the CFIR 2.0 model will help dissect the elements of implementation processes within international RFOs, and thus aid in understanding the best organizational and contextual fit for ZonMw. The choice for this framework is further supported by the thematic focus of ZonMw; the implementation of funding conditions has (indirect) effects on the health(care) landscape in the Netherlands. The concepts and sub-concepts as mentioned briefly above will be specified to the context of this study in the following sections. ZonMw and other RFOs, and (sustainability) funding criteria will be used to give examples and operationalize the concepts. The CFIR 2.0 sub-concepts are underlined in the following sections for clarity.

4.1 Outer setting

The circumstances beyond the walls of an organization exert influence over the organization though effects that are country, time or sector specific. Critical incidents comprise the first sub-construct of outer setting; as large-scale or unanticipated events that influence implementation. In the Netherlands (and globally), the current political skew to the right can be seen as a critical event. This influences the local conditions and local attitudes as governments are generally less committed to sustainability. Therefore, policies and laws may be changed and allocation of financing to sustainability initiatives, in the case of ZonMw from the ministry of health, welfare and sport (VWS) could be reduced. These developments will inevitably change partnerships and connections, which is defined as the networking of the inner setting with external entities. RFOs are linked through several initiatives, including Science Europe and EViR. The current political situation in the United States serves as a notable example, as the outer (political) situation in the country has led to the abandonment of (among others) the EViR membership by American public RFOs as 'environmental sustainability' may not be referred to in governmental organizations. Other external pressures can drive or thwart implementation processes; societal pressure from social media or protests campaigns, or market pressure from competition or imitation of peer entities influence implementation processes. RFOs do not directly compete with one another in a market, however research is seen as a competitive world, possibly

leading to knowledge or products with market value. This is a complex area, as law in the EU and the Netherlands dictates that public funding may not be used to provide individuals or organizations a favorable market position. Perceptions on how funding criteria could influence these “state aid” regulations may influence the implementation.

4.2 Individuals domain

Individuals within organizations have different influences on implementation processes. The CFIR 2.0 model sets out several roles with project characteristics. Each role has different needs, capabilities, opportunities and motivation, which change based on the project at hand.

Roles such as high-level and mid-level leaders depend on hierarchical structures. The organizational structure of ZonMw is shown in figure 4. This chart shows the hierarchical structures of the organization and the horizontal spread, illustrating the differentiation of positions. High-level leaders include key decision-makers or executive leaders, who are positioned in the board and directorate. The managers of the program departments are also high and mid-level leaders. ZonMw has several employees in these positions committed to environmental sustainability, thus leading by example for colleagues. However, implementation processes are executed by many employees in shared efforts, including program secretaries and assistants. The practical process involves implementation facilitators, leads, and team members; employees throughout all other levels of hierarchy. At ZonMw, there are currently no employees with specific commitments within the organization to promote sustainability of funded research.

Figure 4: Organogram of ZonMw.

Other individuals can influence the implementation through informal routes. These opinion leaders may have established authority through other routes than organizational hierarchies; for example, an employee of ZonMw is currently operating the secretariate of EViR ensuring opinion leader status (ZonMw, 2025). Furthermore, employees with activities in addition to their work at ZonMw in sustainability movements or

councils could grant status level in thinking on the subject. It is important to include these employees in an implementation process to ensue enthusiasm and motivation in other employees.

Furthermore, we can differentiate between the deliverer and recipients of an innovation. In this study, ZonMw intends to deliver novel funding conditions within the entire organization, across departments. In turn, the recipients are the RFO employees write develop instruments for funding calls, and peer reviewers and review panel members who use the funding criteria in their assessment processes. It is important to take these individuals into account to ensure feedback from those who's processes are influenced by the implementation.

4.3 Inner setting

The inner setting is shaped by the individuals working in an organization and has a direct influence on the fit of an innovation in an organization. Culture, comprising the degree to which employees have aligned norms, values, and beliefs can underly the quality of relational connections and communication between colleagues and within an organization. Some initiatives may fail because they are not in line with organizational or group culture; successful implementation of funding conditions for sustainable research practice is dependent on shared environmental values among employees across all departments. Tension for change, mission alignment and relative priority can be seen as more tangible manifestations of the internal relations, culture, and communications, and have to do with the need for implementing an innovation. Implementation of funding conditions for sustainable research practices can remind employees of their intentions towards sustainability. Compatibility of funding conditions to the workflow is an important factor; addition of extra steps in processes can be perceived as barriers despite motivation for sustainability. Incentive systems, could help in alleviating these perceptions.

Finally, available resources and access to knowledge and information are important as guidance and/or training to implement and deliver the innovation may also ease concerns regarding the complexity and compatibility. Additionally, structural characteristics include the assets that influence functional performance regardless of active implementations. Aspects such as technology, or funding application systems could influence the adoption of new funding criteria. Other structural characteristics include the physical infrastructure of organizations. Figure 4 shows an organogram of ZonMw and its many departments and programs.

4.4 Innovation domain

Finally, part of the implementation success can be attributed to the innovation itself. This study focusses on funding criteria to promote sustainable research practices as a process innovation. Innovation design is defined in the CFIR 2.0 model as the assemblage, bundling and presentation of an innovation. This terminology is clearly geared towards physical objects, but this study interprets design as the wording, placement and assessment protocol of funding conditions; there are many different options and combinations leading to varying designs. In process innovations, the relative advantage is an important factor to understand; to what degree are specific designs of funding criteria superior to others in achieving environmentally sustainable research practices.

The evidence base is described in the CFIR 2.0 model as the degree to which evidence supports the innovations effectiveness, or the ability of funding conditions to effectively achieve sustainability of research. Information on this topic is still lacking due to the low degree of implemented funding conditions regarding sustainability, but references with regards to effectivity of designs can be made to previous endeavors such as sex, gender and diversity conditions. The source of inspiration for specific operationalizations of sustainability funding criteria could therefore play a role in the implementation process. The degree to which

empirical evidence gathered from other RFOs can be translated to ZonMw and The Netherlands is dependent on the similarities and differences between the organizations. Adaptability is the degree to which an innovation *can* then be tailored to the local context (sections 4.1 and 4.3). Next, trialability is concerned with possibilities for testing the innovation on a small scale within the organization. Adaptation to the local context may alter outcomes in unforeseen ways and thus piloting can be seen as important. For example, piloting can be done in individual calls before full organizational rollout. Complexity is reflected by scale, radicalness, and disruptiveness of the innovation. This applies to funding criteria for promoting sustainable research in the spread of departments that change their work processes during implementation and the differences between workflows in these departments. Finally, cost of the innovation can include monetary value, effort exerted or other recourses used to implement funding conditions within or outside of a RFO.

4.5 Implementation process

Finally, the implementation is not a one-off event; context present pre-implementation and activities in preparation of implementation processes have been discussed previously. The implementation process domain comprises best practices (figure 3) for successful delivery of innovations within organizations. However, as this paper focusses on understanding the contextual factors that may influence future implementation of funding conditions, the implementation process domain is not yet taken into account. A systematic review by Kirk et al., (2015) on the use of the CFIR in implementation research showed the same adaptation in a pre-implementation study by Robins et al. (2013), validating this approach.

4.6 Sub-questions

The theoretical framework introduced in the previous sections, will aid in answering the main research question: "*What can ZonMw learn from European RFOs to successfully develop and implement contextually appropriate funding conditions to encourage environmental sustainability of ZonMw-funded (research) projects?"* The CFIR 2.0 model provides a practical grip to answer this question and has helped to formulate three sub-research questions.

4.6.1 Organizational role

The many concepts and sub-concepts discussed throughout section 4 reflect aspects that influence an organization's implementation processes. However, as the subject of this study are public RFOs, their societal motives are of interest. It is therefore first important to understand RFOs perceptions of their role in influencing environmental sustainability.

"How do European RFOs perceive their role as public organization in promoting sustainable research practices?"

4.6.2 Perceptions of funding criteria

Following the previous sub-question and building on the perception of European RFOs concerning their role in promoting environmental sustainability, it is important to understand if other organizations see potential specifically in funding conditions to achieve their objectives. In this study, we focus on the implementation of funding criteria to promote environmentally sustainable research practices of funded projects. This leads to the second sub-question:

"*What is the perspective of European RFOs regarding funding conditions as an innovation to encourage sustainable research practices?*"

4.6.3 Facilitators of funding criteria implementation

As discussed above, the CFIR 2.0 model provides many pragmatic factors that are influential to the implementation of innovations in an organization. Not all concepts from the CFIR 2.0 model will resonate with all RFOs and especially the inner setting factors will differ from ZonMw. Thus, this question aims at deductively gaining knowledge on the importance of organizational factors on the implementation of funding criteria to promote environmentally sustainable research practices. Sub-question three is as followed:

"What are organizational barriers and facilitators to the implementation of funding criteria?"

5 Methodology

This chapter provides a description of the current study's methodology including the study design, case selection, data collection, data analysis, ethical considerations, and finally a position statement.

5.1 Study design

This study used a qualitative comparative case study design to understand the similarities, differences and patterns in the environmental sustainability strategies of multiple RFOs in Europe. Comparative case studies have been used plentily in social sciences, policy analysis and health(care) research because they are useful in gaining understanding in complex issues (Gray, 2021). Additionally, qualitative approaches allow for thick, detailed insights into contextual perspectives, behaviors, narratives and organizational strategies regarding the implementation of funding criteria to promote sustainable research practices (Geertz, 2008).

First, an extensive document review was conducted to understand the current situation regarding environmental sustainability policy and research guidelines, in addition to current funding conditions of public RFOs in Europe. Interviews were then conducted to gain understanding in rationales behind current actions and to expand on this knowledge with further plans and insights. Interviews are an important qualitative method for demystifying complex subjects such as the implementation of funding conditions at public RFOs (Lim, 2025). Finally, analysis of ZonMw's internal structure and processes was accomplished by close collaboration with ZonMw employees concerned with environmental sustainability. This information was used as a comparator for the external interviews and to formulate recommendations.

Inclusion criteria for interview participants were based on section 2.5 Public funding organizations; employees concerned with the environmental sustainability within organizations in the core and direct stakeholder groups were contacted for participation through ZonMw's professional network, internet search for contact information or through snowballing. No requirements on maturity of sustainable funding criteria were set for participants, to help inform ZonMw along various stages of implementation.

5.2 Data collection

Previous to this study, multiple initiatives regarding promoting sustainability of research practices were launched within ZonMw and Netherlands Organization for Scientific Research (NWO). These initiatives yielded direction for the document review conducted to consolidate the state-of-the-art in sustainability policy and practices. Sources included national and international governmental policies and guidelines for research sustainability, integrity, value, funding directions and guidelines for grant applicants, and several "agreements", "concordats", "movements", "initiatives" etc. originating from differing (alliances of) non-governmental organizations (including RPOs and RFOs), and aimed at promoting or developing sustainable research methods and practices.

The main data collection method comprised stakeholder interviews regarding the implementation of funding criteria for promoting sustainable research practices. Interview guides were developed in English and Dutch (annexes 2 and 3) to answer the three sub-questions presented in section 4.6. The formulation and delivery of questions differed slightly per stakeholder as to tailor to the differences between their organizational positions or settings. The interview guide was piloted with a test respondent within ZonMw to ensure validity of the guide; revisions were made where necessary. To build rapport, a previously sent email containing information was reiterated at the beginning of the interviews, and interviewees were given the opportunity to ask questions (Gray, 2021). All participants were asked at the beginning if they consented to the use and sharing of data from the interview through this study and were informed on their right to withdraw at any time.

The stakeholder interviews used a semi-structured approach to allow the stakeholders to elaborate on their responses while structurally collecting data on the same topics (Gray, 2021). Semi-structured interviews provide room to gather additional information by diverging from the interview guide and central framework during the interviews (Yanow et al., 2007). This allowed for a more in-depth understanding of stakeholders personal experiences with environmental sustainability, interpretation of issues, and narratives on implementation of funding conditions. By using probing questions, participants were encouraged to elaborate and give examples from their experiences within their organizations. Missing information was retrospectively retrieved from the stakeholders through member checks.

Interview lengths varied between 40 to 60 minutes. Interviews were held in English or Dutch depending on the preference of the interviewee, and were conducted in person or via videoconference. All interviews were recorded and immediately transcribed using Microsoft Teams software. These transcriptions were then checked and refined manually to ensure quality.

5.3 Data analysis

The interview transcripts were analyzed using a qualitative-descriptive method to ensure integrity to the language and experiences of the interviewees (Gray, 2021; Hall & Liebenberg, 2024). Deductive axial coding of the transcripts was done using the adapted CFIR 2.0 codebook (Damschroder et al., 2009; annex 4), first vertically and then horizontally using Atlas.ti software. Vertical coding aims to identify themes, narratives and key messages within each interview (Clarke et al., 2015). Second, the data was coded horizontally to aggregate recurring themes and overarching narratives across interviews (Clarke et al., 2015). Finally, an inductive coding round was conducted to identify codes additional to the codebook. In this stage of analysis, codes and definitions were refined (Gray, 2021).

To validate the transcript analysis, 2 interviews were deductively coded by another student and colleague from ZonMw using the CFIR 2.0 codebook. The codes were then compared to the those compiled through the vertical and horizontal coding rounds to ensure that analysis and the study's conceptual framework were intuitive and logical. Any differences were addressed in a reflexive coding round, that corrected for any found biases of the researcher (Yanow et al., 2007). The final draft was sent back to the participants to ensure reliability of the contents and narrative interpretation, and provide an opportunity for comments and additional remarks (Patton, 1999). This meticulous analysis of the interviews, along with the extensive document analysis resulted in an overall abductive approach and allowed for an extensive description and understanding of stakeholders' experiences and accurately compiled information important to the implementation of funding conditions to promote sustainable research practices. Thereby, the study's design allowed for fulfillment of the objective of this study: to explore ways of minimizing the environmental impact of ZonMw-funded research by consolidating strategies and best practices of other European RFOs.

5.4 Ethical considerations

This paper was written in the context of a thesis for the master's program Management, Policy Analysis and Entrepreneurship in Health and Life Sciences (MPA) at the Vrije Universiteit (VU) in Amsterdam, The Netherlands. The study was instigated by ZonMw, a Dutch RFO that works largely in commission of the Dutch ministry of VWS. According to the guidelines provided by the Ethical Review Committee of the Faculty of Science (BETHCIE) from the VU Amsterdam, no ethical review was necessary prior to this study. Participants gave verbal consent before participation and were pseudonymized in this study providing sufficient confidentiality of the participants. In accordance with the GDPR, a data management plan was developed to protect collected data and participant information (annex 5).

The main researcher and author (MS) has experience in conducting interviews and has professional knowledge from multiple areas in health(care) and research, but does acknowledge to be relatively new to the field of research funding and environmental sustainability. It is recognized that the results of this study may be influenced by the background of MS. However, as this paper is partly a product of public funding, MS acknowledges the duty to proceed ethically and contribute to society in the Netherlands.

6 Results

6.1 Population

This study attempted to contact all organizations included in the 'core' and 'direct' categories of the bullseye model shown in figure 2. Contact information was retrieved through professional relations or found online, except for F.R.S.-FNRS. The interviewees provided insights in the current activities and future plans with regards to the implementation of approaches for promoting the environmental sustainability of funded research.

A total of 15 nationally focused public RFOs were contacted for participation in this study. This yielded nine interviews with representatives of these RFOs (AKA, DFG, FCT, FORMAS, FWF, FWO, RCN, SNSF, UKRI). Reasons for non-participation included non-response (n=4), and reluctance to participate because this topic was not yet formally on the agenda within the organization (n=2). Three additional stakeholders working for the Horizon Europe Framework Program (ERC and MSCA) and NordForsk (only "cold-called" participant) were contacted and interviewed, leading to a total of three interviews with representatives of multi-national funders. One additional participant working within the EC and concerned with the development of the DNSH principle was approached through snowballing. Finally, one interview was conducted with a representative of Science Europe; the organization representing major public RFOs in Europe. The interview participant's organizations, along with descriptive information is shown in table 1.

Table 1: Represented organizations

	Operational area	**Funding subject**
National funders (n=9; P1, P3, P4, P5, P6, P7, P9, P10, P13)		
AKA (n=1)	Finland	All fields of research
DFG (n=1)	Germany	All fields of research
FCT (n=1)	Portugal	All fields of research
FORMAS (n=1)	Sweden	Environment science, spatial planning and agricultural sciences
FWF (n=1)	Austria	Basic research
FWO (n=1)	Belgium (Flanders)	Fundamental/ basic research
RCN (n=1)	Norway	All fields of research
SNSF (n=1)	Switzerland	Basic research
UKRI (n=1)	United Kingdom	All fields of research
Multi-national funders (n = 3; P2, P8, P14)		

Horizon Europe Framework Program (n=2)	ERC (n=1)	European Union	All fields of research
	MSCA (n=1)	European Union	Mobility, careers
NordForsk (n=1)		Nordic (occasionally Baltic)	All fields of research
Additional experts (n=2; P11, P12)			
European Commission (n=1)		European Union	-
Science Europe (n=1)		Continental Europe	-

This group of participants mainly covers the perspective of employees concerned with the sustainability of research at national RFOs (n=9), supplemented by the perspective from multi-national funders (n=3), a contributor to the development of functional funding conditions to promote sustainable research (DNSH) (n=1), and an expert on the current state of international discussions and progress on the topic of sustainability funding conditions (n=1), and therefore effectively aim to answer the main research question.

6.2 Current practices

The interviews first covered the participant's organizations' current activities regarding the environmental sustainability of funded research. All participating RFOs aim to contribute sustainability through their funding activities. Some funders (P1, P2, P4, P5, P7, P10, P13) have included sustainability aspects into their calls but only relating to the research topic. Of these funders, all but P10 ask applicants to relate their project to the UN SDGs in varying ways. In addition to funding research on the topic of sustainability, table 2 shows how RFOs have included a focus on the sustainability of research methods and practices in their calls.

Table 2: Inclusions of sustainable research practices in calls

Funder	**Environmental Sustainability in funding model**
AKA	An additional question asks applicants to elaborate on their project's contribution to sustainable development, which includes responsible research practices.
DFG	Requires applicants to consider sustainability in their research processes; guiding questions regarding travel, experiments, computing, and procurement are provided. Considerations are assessed on plausibility by reviewers and review boards.
FORMAS	Asks applicants to integrate climate and environmental considerations into the planning of their project.
RCN	Several calls include a reference to the organization's responsible R&I approaches guidelines.
UKRI	Asks applicants to answer: "*How is environmental sustainability considered in the delivery of this project?*" (if this applies/ optional).
MSCA Green Charter	Encourages sustainable research methods and other research related activities of funding recipients.

6.3 Outer setting

The following sections will use the CFIR 2.0 model to structure the RFO's future plans. The goal of using this model is to consider a broad spectrum of factors that influence the implementation of funding conditions. The 4 domains considered in this study are: (1) Outer Setting, (2) Individuals domain, (3) Inner setting, and (4) Innovation domain. Again, the CFIR 2.0 sub-constructs will be underlined.

As illustrated in figure 3, the outer setting influences many aspects within the organization. Interviewees saw the scientific community, the continent of Europe, and separately the EU as their outer setting, rather than their individual countries. Overall, participants viewed sustainability as a global concern and highlighted the importance of collaboration in national and international context to reduce the environmental footprint of research. National collaboration included <u>partnerships and connections</u> with universities and RPOs. Participants were overall positive about the strides made by the scientific community, as practices have started to change despite the absence of funding conditions. Interviewees indicated widespread positive socio-cultural values and beliefs (<u>local attitudes</u>) towards sustainability within their respective countries. Furthermore, the implementation of funding conditions was supported by local economic, environmental, political, and/or technological <u>conditions</u> across north-western Europe (table 1).

Additionally, all participants shared the notion that policies and laws stemming from the EU's European Green Deal have had a direct or indirect influence on their organization. Interviewees from European countries indicated that they operate in a 'gray area' where they are not subject to regulations for public institutions nor the Corporate Sustainability Reporting Directive (CSRD) guidelines as they are not for profit. Still, participants stated these developments sparked initiation of their sustainability strategies as they await the development of policy to include their field of work. Some organizations already had other reporting requirement to their respective national governing bodies (P2, P4-P7, P13). Although EU regulations do not apply, participants outside of the EU (SNSF, RCN, UKRI) indicated that they are also influenced by these political developments in collaboration and inspiration. The above-mentioned parallels between the countries of the representatives harbor the possibility for international collaborations such as the Science Europe working group. These international partnerships and connections are mentioned as an important outer setting factor to many interviewees (P1-P6, P9, P10,P14):

"I think this kind of setups [The Science Europe Greening Research Group] are key in getting your thoughts running, that you hear what's happening elsewhere and just to get ideas of how to go about this" – P6

Due to collaborations and other shared outer setting factors, the participating RFOs also face the same barriers to the implementation of funding conditions. Interviewees experienced decreasing external pressure to implement sustainability measures. In part, because the 'hype' of sustainability has decreased post-pandemic and due to current critical incidents on socio-political level. Participants mentioned concerns that responding to security threats would be increasingly prioritized over sustainability (P1, P2, P4, P6, P9, P13, P14). For example, the Horizon Europe Framework Program is currently focusing on increasing financing towards "competitiveness" to strengthen economic growth and global positioning in response to current socio-political events, taking the spotlight of the European Green Deal. Notably, the national RFOs (except AKA) are geographically removed from these threats, explaining why the national RFOs still included sustainability as a relative priority on their agendas. Potential national budget cuts in response to these international developments were also seen as barriers to participants (P1, P6, P9). Within the healthcare sector specifically prioritization of other issues was observed as well:

"There are so much serious things going on in health and welfare, like antibiotic resistance, the demographic changes, the lack of workforce, poor women health, the digital tools, AI. There are so many other topics that come before looking at sustainability." – P2

Thus, interviewees described how their outer setting influences the implementation of funding conditions in very similar manners due to high levels of international collaboration and geographical proximity.

6.4 Individuals domain

Within the CFIR 2.0 model, the outer setting directly influences an organization through the individuals. As the model is intended for use with individuals that have an effect on the implementation process, the included participants were all in positions to initiate or influence the implementation of funding conditions at their respective organizations; i.e. innovation deliverers. Participants had differing positions relating to sustainability within their organization, ranging from advisory roles (implementation facilitator/ implementation leads) to departmental leads (mid- & high-level leader). If not in direct managerial position, the interviewees were at least in direct dialogue with top management/ directors board. Only two interviewees (P1, P9) were concerned with sustainability matters full-time, reflecting participants concerns about the lack of dedicated personnel, and thus opportunity and potential to facilitate a successful implementation of funding criteria. The remaining participants had other primary roles with time available

for this topic ranging from a couple hours a month (P2, P5-P7, P13) to a couple hours a week (P3, P4, P8, P10, P11).

All participants working at national RFOs represented their organizations in the Greening Research Working Group of Science Europe (except P9, who's organization is represented by another colleague). Some were further involved through a Funding Criteria Task Force within the workgroup (P1, P13); the participants of this group were seen by some of the other interviewees as opinion leaders due to their commitment. Though capability was not directly discussed during the interviews, participation in the working group and task force, showed participants were attempting to build on their knowledge, competence, and skills to successfully implement funding conditions within their organizations. Interviewees were motivated to fulfilling their roles with regards to sustainability and thus their aim to implement funding conditions. The degree to which the participants had personal needs that would be addressed by implementation of funding criteria, did not come up during the interviews.

Cooperation of other employees (implementation team members) as innovation receivers (i.e. those who would adopt new sustainability criteria into their work processes) was not seen as a barrier to interviewees. Participants (P2, P3) supposed that those working in the scientific field tend to have values in line with sustainability and would adopt funding criteria in line with their values (further discussed in section 6.5). Yet, the broad scope of these innovation receivers, including external actors (i.e. peer reviewers and panelists), was seen as a possible barrier to the implementation process (P2, P3, P7, P9).

6.5 Inner setting

Only two factors of the CFIR 2.0 inner setting domain were seen as facilitators to the implementation of funding conditions to promote sustainable research practices; strong culture in favor of sustainability and thus tension for change. Interviewees stated that individual's environmental values, beliefs, and norms created an organizational culture in line with implementing funding conditions to promote sustainable research practices. Individual's principles stem from the outer setting, as employees work closely with and within the scientific field; the very place that produces knowledge urging to act on the climate crisis:

"I think we lose credibility if we're doing the opposite of what our science says [...] we really believe in science, so we don't want our own science to be ignored" – P9

All interviewees portrayed sustainable ideologies as the driver for tension for change. Putting funding conditions into effect is crucial for respondents to act in line with their own standards. The absence of additional incentives or external pressures (section 6.3) implied a strong internal motivation to promote sustainable research practices.

The remaining inner setting factors were generally depicted as barriers during the interviews. Interviewees indicated a misalignment between culture for environmental sustainability and organizational missions. The overarching commitment, purpose, and goal of many public RFOs concerns funding scientific excellent research. Interviewees agreed that excellent scientific output must always remain the highest goal of research funding. When discussing funding conditions specifically, one participant said:

"The choice of methods is free and depends on the best way to achieve excellent scientific results. This is the first priority I would say. We now ask as a second priority, to please also try to work more sustainably if it is possible, but do not interfere with the outcome of scientific knowledge" – P3

Interviewees shared a desire for sustainable methods that do not interfere with excellent research output (P1, P3, P5, P10, P11, P13). They argued that funding conditions could only be implemented if new sustainable methods are validated to produce scientifically excellent results. Nonetheless, other participants found this to be a false dilemma and expressed that the sustainability of methods is synonymous to efficiency (P1, P8, P9, P12,):

"And there are a lot of arguments in favor of sustainability, which are not only about climate and the environment, but there are also positive co-benefits. For example, you can save money in many cases if you implement more sustainable measures." – P12

The notion that efficiency and responsible resource use are contributions to research excellence and are becoming the next best practice was articulated frequently (P1, P2, P6, P10, P12, P13). Participants mentioned the potential of putting emphasis on this framing, indicating a budding movement towards integration of sustainability into missions. Participants found that other employees (6.4 individuals domain), may be unaware of the misalignment between cultures and mission:

"It's often a bit of a gap between what people think is happening and what is actually happening. You always try to communicate positively to show what we have achieved already, and this is really important" – P1

Several interviewees (P1, P3, P4, P9, P12, P14) highlighted that improved communication among employees could provide better access to knowledge & information and help include sustainability into missions. However, interviews revealed structural characteristics and available resources in terms of staffing levels as a barrier to effective communication on the topic. Participants agreed that there was a lack of ownership over sustainability as a result of the absence of dedicated personnel to lead the development and eventual implementation of funding conditions (P1, P6, P14).

Finally, compatibility of funding conditions within organizational workflows or processes were not discussed, as concrete methods and strategies for promoting sustainability through funding conditions have yet to be developed. The innovation, funding conditions, are thus moldable to organizational context. These variations will be discussed next.

6.6 Innovation domain

The innovation domain was most broadly discussed during the interviews, as the aim of this study evidently was to guide the formulation of recommendations for implementing funding criteria to promote sustainable research practices. The adaptability of the innovation (funding conditions), that can be modified, tailored, or refined to fit organizational context or needs emerged as the most important sub-construct. Table 3 shows interviewees considerations of several variations of including sustainability into calls. These themes were inductively retrieved from the interviews and uncover dilemmas relating to the relative advantage of some dimensions compared to others.

Table 3: Possible variations and dilemmas in dimensions of funding criteria

Dimension	Dilemmas
Goal	Mainstreaming vs. formal criteria
Assessment method	Qualitative vs. quantitative
Target	Individual researcher vs. institutional infrastructure
Timing	Pre-assessment vs. during assessment
Placement	Additional criterion vs. integration in current criteria

6.6.1 Goal

Two main goals for including sustainability in calls were discussed in the interviews: mainstreaming and formal criteria. 'Nudging' was described as a method to mainstream the use of environmentally sustainable methods from within the research community as opposed to formally assessed, decisive criteria imposed by RFOs that enforce adoption. Of the approaches shown in table 2, all are considered nudging. For example, in DFG's mandatory consideration of sustainable research practices, applicants can dwell on a set of questions to facilitate the decision if and how their project might contribute or is affected. The answers are then reviewed on their 'plausibility'. However, this is barely ever the basis for rejection; the overall value of this approach thus lies in mainstreaming environmental considerations regarding research practices during the design phase. Additionally, DFG can use the input to build a repository of sustainable research methods and practices.

"The goal is to find new ideas, to collect them, and provide them again to the scientific communities" – P3

While all participants were motivated to contribute to improving the environmental sustainability of funded research, some were hesitant about nudging; interviewees raised several concerns about adding un-assessed questions in the application form. First, it could cause bias in the assessment, even if reviewers were asked not to take this element into account (P7). Others found that if something was included in the application, it should be followed-up to not confuse applicants (P6). Additionally, participants (P1, P2, P4, P6, P11) indicated wanting to avoid extra administrative effort for applicants. Finally, some were concerned implementation would risk 'empty words' in applications without real effect on the mainstreaming of sustainable research practices (P2, P6):

"Despite having the leverage, we then want to also use [funding conditions] in a way that is actually fruitful and not that people just invent things and 'paste it on'."– P6

To avoid this extra burden, one participants (P4) organization is considering using an analytic AI system to accumulate the same type of repository of best-practices from application forms when the sustainability or efficiency of methods are mentioned. Other RFOs are still considering adopting methods like DFG's until formal criteria are available (P2, P6, P10). Formalized criteria were most desired by all interviewees, however, concerns arose with regards to the assessment methods, discussed next.

In summary, nudging was mostly seen as an intermittent solution that aims to mainstream the idea of sustainable research practices while formal criteria are being developed. The development of formal criteria is however dependent on understanding the environmental impact of research methods to develop assessment methods; this knowledge is still in development.

6.6.2 Assessment method

To develop assessment methods, interviewees agreed that a better understanding of the ecological impact of research methods is necessary, showing that assessment is tied to the evidence base of evaluating the environmental impact of research. Although outcomes are explicitly out of scope for the CFIR 2.0 model, this was an important topic to the interviewees. The absence of knowledge on sustainable research methods among peer reviewers and panelists could add to the complexity of implementing novel assessment processes (P1, P2, P6, P7, P9, P10 P11, P13).

Despite this lack of evidence, two approaches to assessing funding criteria were discussed in the interviews: qualitative and quantitative. Most participants agreed that qualitative assessment had its pitfalls in terms of subjectivity. Therefore, participants favored quantitative methods for assessing the environmental sustainability of a research proposal. For example, asking assessors to score the sustainability of a proposal

based on the absence or presence pre-specified determinants. Although efforts are under way, there were still many unclarities on concrete approaches to quantification. The most important issue that came up was what determinants to consider and how to weight these determinants for scoring. Participants were primarily concerned about this aspect for the assessment process of bottom-up calls and thus how to compare different fields of research:

"What is the benchmark of a young researcher doing lab work and one participating in an abundant national community, and somebody who is doing Africanology or Asian Sciences, or on a topic where they are constantly travelling?" – P11

Participants were positive about the potential for scoring academic travel emissions. Most RFOs already had internal sustainable travel policies in place and thus had refined methods for collecting and assessing emissions. One participant said:

"Travel is often seen as a strong starting point for advancing sustainable practices, thanks to the availability of data on emissions and its universal relevance across disciplines" – P1

However, the representatives mentioned throughout the interviews that universities and RPOs already have or are in the process of developing their own quantification methods for travel. These efforts have resulted in incomparable scales (P1), making their assessment difficult. Additionally, some RPOs calculate emissions on departmental level making it challenging for applicants to single-out their study or project and provide this data in a funding application (P1, P6).

In sum, interviewees were positive about the potential for quantitative assessment methods but were adamant more data needed to be collected to do so. Thus, the emphasis remains on nudging to collect best-practices and develop assessment methods.

6.6.3 Target

Because of the apprehensions regarding duplicate and incompatible efforts of universities and RPOs (section 6.5.2), interviews mentioned different targets for funding conditions; individual researchers or institutional infrastructures. Some interviewees (P6-P9, P11,) were reluctant to impose sustainability criteria in calls because they found that this would unfairly influence (primarily young) researchers working in outdated facilities. These researchers are often not able to influence the organization's electricity source or other material procurements. This issue is addressed by one participant's organization in an innovative way:

"Applications are assessed in comparison to other applications from the same university or research institute. At [our organization], it is always about the inter-institutional competition" – P7

Still, targeting institutions would not be effective through funding conditions. However, engaging and collaborating with stakeholders in the research field can help determine how responsibilities regarding the use of more sustainable research practices are distributed, as illustrated by one participant:

"It was discussed in the beginning, what is the target group and are we responsible for acting concerning sustainability at all. It is quite clear that the individual research institutions are also responsible to have more environmental friendly electricity and heating, instrumentation and buildings [...]. So in the whole system there are different levels of responsibility" – P3

6.6.4 Timing

Interviews revealed different options for including funding conditions in terms of timing. With regards to funding criteria, there are two instances when sustainability can be included in a call; pre-assessment, or during assessment. 'Triaging' was mentioned as a possibility by one participant (P9) and would entail evaluating the sustainability of an application during completeness check often performed by RFO employees. In this approach, applications are given a go/no-go assessment of their sustainability before sending the applications on for a formal review (P2, P9):

"It gives them [reviewers] the freedom to just look at the science and then the environmental aspect is already pre-looked at. It's a bit like ethics get checked before they go to the panel" – P9

An issue that came up with this method however include the knowledge of RFO employees in assessing this aspect of the application (P3, P9, P11). This concern could be addressed by consulting with sustainability experts, similar to the 'plausibility check' method (P3, P6). The trivialities of the addition of a sustainability criteria during assessment have been discussed in the previous sections.

6.6.5 Placement

Finally, the placement of funding criteria into calls were discussed. Two main possibilities came up during the interviews; integration of sustainability aspects into current criteria or the addition of an entirely new criterion. Incorporating sustainability into research excellence was most discussed as participants found this would have the most effect on the environment due to the importance of this criterion in the current assessment process (see 6.5). Additionally, participants suggested that sustainability could be part of ethical reviews, as to not weaken the concept of excellence by layering on additional sustainability demands (P9, P11). A concrete example of incorporating sustainability into ethical reviews is the DNSH principle, however, this assessment of sustainability is related to the research topic and less so the scientific methods.

The addition of new sustainability criterion would provide more opportunities, such as 'triaging' discussed above (section 6.6.4.). Other possibilities include using sustainability as a secondary assessment criteria (e.g., a tie-breaker). P2 indicated that they have used differing tie-breaking criteria in the past, but that these were based on the thematic goal calls and would need to experiment with adding a tie-breaker based on institutional goals.

Concluding the innovation domain, source, innovation trialability, and cost did not come up as important during the interviews.

7 Discussion

The objective of this study was to explore ways of minimizing the environmental impact of ZonMw-funded research by consolidating strategies and best practices of other European RFOs with regards to funding conditions. The results presented in the previous chapter represent the respondent's views on the feasibility and impact of funding conditions within the context of their organizations. In this section, the key results are discussed in relation to literature to answer the sub-research questions, the conceptual framework is reflected upon and strengths and limitations discussed.

7.1 The role of RFOs

The findings discussed in the previous section helped to answer the first sub-question: "How do European RFOs perceive their role as public organization in promoting sustainable research practices?". The

participants in this study showed environmental morals conflicting with their organizations' scientific rational and missions.

While the literature portraying the imperative to limit climate change is clear (IPCC, 2023; Romanello et al., 2022), concrete data on the environmental impact of research practices and the effectiveness of sustainable alternatives remain limited. This reveals a paradox between RFO's intention to promote sustainable research practices and act in line with science. However, this scientific rational as a basis for their focus on excellence is at odd with literature that portrays that 'excellence' not fixed, but definitions are context and time dependent (Jong et al., 2021). The objectivity of scientific excellence is challenged frequently, suggesting room to amend definitions (Gläser and Laudel, 2016; Powell et al., 2018). Collaborations can help in understanding how other RFOs define excellence, thereby identifying opportunities to include environmental sustainability.

In line with collaborative governance theory, participants already emphasized the importance of collaboration, particularly for addressing wicked problems such as climate change (Kapucu & Hu, 2020; Krogh, 2020). However, this study showed interviewees were often unaware of initiatives parallel to those they were embedded in. Efforts such as EViR, Science Europe, Coalition for Advancing Research Assessment (CoARA), ERC, Head of international research organizations (HIROs), and the Organisation for Economic Co-operation and Development (OECD) operate independently despite overlapping aims. The abundance of uncoordinated initiatives suggests fragmented collaboration and indicate that current efforts fall short of realizing full potential. Moreover, two currently ongoing studies by the ERC and Funding Criteria Task Force of Science Europe were discovered with very similar objectives during the finalization of this paper, highlighting the duplication of efforts.

Secondly, while policy documents often highlight the unique role of RFOs in leveraging and promoting environmental sustainability, literature highlights an ongoing debate about the appropriateness in relation to epistemic freedom. This was first touched upon in the implementation of funding conditions related to gender and diversity, which can be seen as the first iteration of science-policy interactions towards the projection of RFO's norms onto researchers (Sjöö, 2025). Governing epistemic norms can be perceived as a challenge to scientific freedom; a core value within the research community. From this point of view, the influence of RFOs should be limited in terms of directing research methods and other research-related activities. The latter can have several undesired consequences. For example, asking researchers to limit travel to conferences for sustainability reasons may unintentionally hinder career development. This is especially relevant given findings that link receiving research funding more closely to career advancement than to research performance itself (Gläser & Laudel, 2016). As such, enforcing policies that target travel can create tensions that may undermine both career progression and scientific freedom, which both hinder the progression of sustainable research practices.

Contrastingly, there is a growing support for providing strategic direction to research, especially regarding climate action. For example, mission-oriented innovation policies (MOIP) emphasize the pressing need for long-term investments in economic, environmental, and societal transformation; issues that may not be addressed sufficiently through bottom-up, curiosity driven research (Mazzucato, 2018). Moreover, challenge-driven innovation as opposed to incremental, is seen to harbor more profound transformation and is therefore favored from a sustainability science perspective (Pfotenhauer et al., 2022; Suitner et al., 2022).

In summary, the findings show that European RFOs see themselves as responsible for promoting sustainable research, but are thwarted by lacking evidence on environmental impact of research methods. While collaboration is widely valued, stronger international governance is needed to align definitions of excellence to include sustainability, and realize RFOs' potential in advancing ecological sustainability. Additionally, the

findings reveal tension between imposing sustainability norms onto researchers and preserving their epistemic freedom. However, this view is contested given the transformative potential of providing strategic direction and the gravity of environmental issues.

7.2 The effectiveness of funding criteria

With regards to the second sub-question, "What is the perspective of European RFOs regarding funding conditions as an innovation to encourage sustainable research practices?", the findings portray that respondents perceive formal criteria (table 3) as the most promising approach to foster sustainable research practices. However, this raised questions regarding the dimensions of sustainability to include and exclude into criteria and the assessment thereof.

The concerns expressed by participants about the qualitative assessment of new funding conditions related to environmental sustainability is echoed in literature. Studies on 'collaboration' as a funding criterion revealed that reviewers often failed to internalize its meaning, leading to little impact on funding decisions (Hultqvist et al., 2021; Jonsson & Iwarsson, 2022). Hultqvist et al. (2021) found that fewer than 20% of applications reflected the intended definition of collaboration, further complicating qualitative assessments. To address subjectivity and inconsistency in qualitative assessments, some have turned to analytic or quantitative approaches (Martinuzzi et al., 2023; Smith et al., 2023). Life cycle assessment (LCA) has emerged as a method to standardize environmental impact evaluations within health(care) settings (Ministerie van Volksgezondheid, Welzijn en Sport, 2025). This shows its potential for health(care) research in alignment with participants' call for quantitative tools.

However, LCA also has limitations, particularly for emerging innovations and research, where long-term environmental impacts are uncertain (Matthews et al., 2019; Wulf et al., 2019). Furthermore, concerns regarding quantitative methods underscore that these approaches oversimplify issues by neglecting to include the full range of factors (Matthews et al., 2019; Wulf et al., 2019). Even where AI tools have been introduced to reduce bias in assessments, they fall short in accounting for contextual and disciplinary nuance, a strong suit of qualitative assessment methods (Carbonell Cortés et al., 2024).

Additionally, standardization of assessment methods raises concerns about the applicability of these methods across research fields. A review by Tuffaha et al. (2018) found that the weight of funding criteria in assessments is linked to the research topic (i.e. research on collaborations is more strictly assessed on collaboration criteria). This is due to differing norms and values within fields and thus assessors. Sjöö (2025) added to this narrative that appeal of funding criteria to applicants was heavily dependent on their resonance with the rhetoric used in calls. This reflects a difficulty regarding the effectiveness of funding conditions to promote sustainable research practices in research fields other than sustainability sciences. Transdisciplinary collaboration is highlighted in sustainability science as a method to overcome this hurdle and develop harmonized assessment tools that still take the needs and contexts of multiple research domains (Defila & Di Giulio, 2024; Lang et al., 2012).

To summarize, there is a tension between the ambition of RFOs to develop funding conditions as a means to promote sustainable research practices and the practical challenges in the of development assessment guidelines, both in quantitative and qualitative evaluations. This underscores the necessity of understanding norms and values of differing fields to establish common vocabulary to tailor rhetoric in funding criteria. The emphasis in sustainability science on the importance of transdisciplinary approaches can help further develop contextually appropriate funding conditions to meaningfully contribute to the environmental sustainability of research practices.

7.3 Organizational barriers and facilitators

Several influential factors were found regarding the third sub-question, “What are organizational barriers and facilitators to the implementation of funding criteria?”. These organizational factors, derived from the CFIR 2.0 pertain mostly to the inner setting, outer setting and individual domains, as the relation of the innovation domain to literature has been elaborated on in the previous sections.

Literature points to the policy ‘grey area’, formerly regarded as a barrier, as an opportunity for creative policy development (De Vries et al., 2016; Houtgraaf & Ropes, 2024). The high motivation present among implementation leads and strong organizational culture towards sustainability discussed above may therefore be the most important facilitator in the absence of nationally formalized procedures. It is however important to note that the views expressed in this study reflect only those in position to implement funding conditions. Adoption by others (i.e., RFO staff, peer reviewers, panelists) remains a known barrier to implementations, as process innovations can challenge epistemic cultures in organizations (Knorr-Cetina, 1999). This hurdle can be overcome by borrowing from organizational and implementation science theories; engaging these innovation receivers in the development phase has been shown to enhance adoption of innovations by raising perceptions of agency over implementation outcomes (Ahmad et al., 2012; Borges, & Janissek-Muniz, 2021).

Though there was a general lack of organizational barriers to the implementation of funding criteria, issues could arise from the observed clouding of the integrative perspective on sustainability. Sustainability science links environmental sustainability to other social and economic challenges, as is emphasized in the SDGs (Kapucu & Hu, 2020; Krogh, 2020; Mazzucato, 2018; *THE 17 GOALS | Sustainable Development*, n.d.). To proceed in the development of funding conditions, it is important to understand the interrelation between socio-political developments, ecological effects and health. For example, the mentioned pressing issue of antimicrobial resistance can be seen as a result of climate change, and addressing this underlying issue can help decrease threats of antimicrobial resistance (Schmitt et al., 2017). Lack of dedicated staff and thus ownership of sustainability, may contribute to this incomplete view; a barrier widely recognized in implementation science (Thijssen et al., 2023).

In sum, the implementation of funding criteria to promote sustainable research practices is shaped by a mix of enabling and constraining organizational factors. The lack of formalized policy may empower RFOs with creative freedom to develop innovative approaches. However, structural barriers persist, including limited staffing, unclear ownership of sustainability goals, and the previously discussed rooting in scientific excellence. Finally, a view on sustainability disconnected from other global challenges underscores the need for a more integrated and systemic understanding within RFOs to fully realize the potential of sustainable funding criteria.

7.4 Reflections on conceptual framework

Use of the CFIR 2.0 model for design and analysis of this study led to several critical reflections. This model was developed to understand the differences and interactions of several factors leading to successful implementation processes. In the case of this study, there were however no clear boundaries between innovation deliverers and receivers, since RFOs tend to hire researchers to perform assessment (e.g. peer reviewers and panelists). Though systematic attention was paid to the definitions of the concepts, this caused difficulties in differentiating between elements from the outer setting, inner setting and individual domain, and may have caused inadequate use of the model as intended by Damschroder et al. (2022). The choice of the CFIR 2.0 model for this study was based on its intended use in health(care) system; this study focusses on health(care) research which is embedded in the health(care) system. However, the implementation of funding criteria at RFOs may be too far-stretched for the application of the CFIR 2.0 model. Nevertheless,

there is a lack of literature relating to RFOs and funding criteria. For example, a scoping analysis conducted Ščepanović et al. (2021) found that only 6 of the 210 included publications examined RFOs, and only 54 of these papers produced guidance to RFOs. Therefore, the choice of an implementation model is justified.

Furthermore, this study found a discrepancy in the importance of the source, trialability, and cost of an innovation. These are highly influential factors in many implementations, as concluded in a systematic review by Thijssen et al. (2023) of papers using the CFIR 2.0 model in relation to the implementation of innovations in health(care). The source and trialability may not be pressing issues in this context due to co-creation and dialogue through international collaborations such as the Science Europe working group, exemplifying the facilitating effects of collaborative governance in policy development (Kapucu & Hu, 2020; Krogh, 2020). Cost may not have been discussed due to the preceding issue in terms of staffing recourses. Findings from this study suggest that high levels of (international) collaborative governance deplete the significance of several outer setting concepts. Further studies within RFOs could help understand if this finding is unique or could serve as an adaptation to the CFIR 2.0 model for studying the implementation of funding conditions in RFOs.

Finally, future research should consider formal criteria for sustainability as an independent innovation to the assessment methods thereof. The current study lacked this differentiation leading to a highly adaptable innovation and variations with an unclear evidence base. Further research should build on the findings of this study to adapt and amend the CFIR 2.0 model for better understanding of the concepts with regards to funding criteria implementation at RFOs.

7.5 Strengths and limitations

This study is unique in its qualitative approach to understanding the factors that influence the implementation of funding conditions to promote sustainable research practices. The cross-sectionality of the study's focus significantly contributes to the body of literature on policy and implementation sciences by using the CFIR 2.0 model. Strengths of this study include the structured, and transparent process due to the use of the CFIR 2.0 model, leading to strong empirical findings that have been validated in the preliminary results from the aforementioned initiatives lead by the ERC and the Funding Criteria Task Force. Furthermore, participants were from RFOs with diverse national, international and funding focusses, and the participants had varying roles and seniorities within their organizations allowing for a balanced view on sustainability funding criteria from within and outside RFOs.

This study also acknowledges several constraints that affect the generalizability of the findings. Although the sample of participants is diverse, its size was limited and the geographical spread was skewed towards north-western Europe. This sampling bias is due to selection of participants from the Science Europe Greening Research Workgroup, leading to response from participants that are deeply embedded in this topic. Additionally, participants were overwhelmingly from countries with mature national sustainability policies, limiting the applicability of the results to Europe or globally. RFOs outside this area may hold different views and further research on RFOs outside of Europe could prove valuable. Furthermore, this study did not go into depth on the exact funding mechanisms used within the included RFOs. Further detailed analysis of the differences in funding mechanisms in relation to this studies finding and could prove valuable to the implementation process. Another limitation included the lack of literature regarding RFOs activities. While this may have allowed for out-of-the-box approaches and analyses, it also made it difficult to validate results with literature.

8 Conclusion and recommendations

In conclusion, this study displayed several findings that answer the main research question: "*What can ZonMw learn from European RFOs to successfully develop and implement contextually appropriate funding conditions to encourage environmental sustainability of ZonMw-funded (research) projects?".* The findings show that European RFOs see themselves as responsible for promoting sustainable research, but are thwarted by lacking evidence on environmental impact of research methods, and face difficulties in developing evaluation methods. Strengthening collaborative governance and transdisciplinary approaches can help provide standardized methods of including sustainability into scientific excellence to ensure its thorough consideration during assessment. The urgency of climate change justifies introducing sustainability standards into funding calls. Internally, motivated staff and sustainability culture enable progress, yet structural barriers such as limited capacity and unclear ownership persist. In light of these lessons learned, several recommendations are made to RFOs in general and ZonMw specifically.

Three key strategies and further directions can aid RFOs in the development of funding criteria and assessment methods: first, further collaborative governance will aid the development harmonized, yet contextually appropriate assessment methods. Allying the numerous international working groups and collaborations can improve synergy. Connections gained through conducting this study can contribute. Second, transdisciplinary approaches including the research community (e.g., universities, RPOs, and foundations), and notably peer reviewers and panelists, will encourage the mainstreaming of sustainability in research methods and assessments. This approach will further increase the proficiency in future funding criteria implementations distinct from sustainability. Third, as this study did not examine specific funding mechanisms in detail, it lacks contextual insight into RFOs' internal processes. Post-implementation research, applying the CFIR 2.0 model to funding criteria on sex, gender, diversity, and collaboration could enhance the relevance and contextual applicability of the current study's findings.

Additionally, several recommendations apply to ZonMw specifically. ZonMw is in a unique position compared to other RFOs in Europe to implement funding conditions due to its thematic focus on health(care) research and funding of projects through programming. Understanding values within health(care) alone is a considerably more achievable undertaking compared to the broad scope of bottom-up funders, providing opportunities for effective rhetoric tailoring. Furthermore, the development of analytic methods such as LCAs in health(care) research is achievable in a singular research domain and may prove valuable in the process towards harmonization. The frequently employed programmed calls at ZonMw provide opportunities for environmental sustainability to be included in funding criteria without undermining epistemic freedom, as calls already have specified objectives and goals. MOIPs in health(care) can be a promising framework in this programming to draw on the validity of providing strategic direction. Finally, ZonMw can contribute to existing efforts by initiating the creation of a shared repository of sustainable health(care) research methods. Providing this information back to applicants and offering several options to consider the sustainability of their research (project) will support implementation by increasing perceptions of agency; the illusion of choice will aid implementation of funding conditions.

These recommendations provide a promising foundation, but systemic integration of sustainability values in relation to other global challenges, such as security and health must occur to fully engage efforts in RFOs and the research community. Ultimately, ZonMw can use its unique position as a thematic RFO and its pioneering role in conducting this explorative study to create a ripple effect on other RFOs to promote more sustainable research practices and contribute to the research sector's shared responsibility to address the climate crisis.

9 References

About MSCA. (2024, 11 december). Marie Skłodowska-Curie Actions. https://marie-sklodowska-curie-actions.ec.europa.eu/about-msca

About us – EViR. (2023, 23 november). EViR. https://evir.org/about-us/

Ahmad, R., Kyratsis, Y., & Holmes, A. (2012). When the user is not the chooser: learning from stakeholder involvement in technology adoption decisions in infection control. *Journal of Hospital Infection*, *81*(3), 163-168.

ALLEA. (2023). The European Code of Conduct for Research Integrity [Code of Conduct]. In *ALLEA*. ALLEA | All European Academies. https://doi.org/10.26356/ECOC

Belkhir, L., & Elmeligi, A. (2019). Carbon footprint of the global pharmaceutical industry and relative impact of its major players. *Journal of Cleaner Production*, *214*, 185-194.

Ben Charif, A., Zomahoun, H. T. V., Gogovor, A., Abdoulaye Samri, M., Massougbodji, J., Wolfenden, L., ... & Légaré, F. (2022). Tools for assessing the scalability of innovations in health: a systematic review. *Health Research Policy and Systems*, *20*(1), 34.

Borges, N., & Janissek-Muniz, R. (2021). Perceived value of organizational foresight processes: effects of the illusion of control and individual foresight. *BBR. Brazilian Business Review*, *18*, 516-536.

Carbonell Cortés, C., Parra-Rojas, C., Pérez-Lozano, A., Arcara, F., Vargas-Sánchez, S., Fernández-Montenegro, R., … López-Verdeguer, I. (2024). AI-assisted prescreening of biomedical research proposals: ethical considerations and the pilot case of "la Caixa" Foundation. *Data & Policy*, *6*, e49. doi:10.1017/dap.2024.41

Chalmers, I., & Glasziou, P. (2009). Avoidable waste in the production and reporting of research evidence. *The Lancet*, *374*(9683), 86-89.

Clarke, V., Braun, V., & Hayfield, N. (2015). Thematic analysis. Qualitative psychology: A practical guide to research methods, 3, 222-248.

Damschroder, L. J., Aron, D. C., Keith, R. E., Kirsh, S. R., Alexander, J. A., & Lowery, J. C. (2009). Fostering implementation of health services research findings into practice: a consolidated framework for advancing implementation science. *Implementation science*, *4*, 1-15.

Damschroder, L. J., Reardon, C. M., Widerquist, M. A. O., & Lowery, J. (2022). The updated Consolidated Framework for Implementation Research based on user feedback. *Implementation science*, *17*(1), 75.

Defila, R., Di Giulio, A. (2024). Transdisciplinary Development of Quality Criteria for Transdisciplinary Research. In: Regeer, B.J., Klaassen, P., Broerse, J.E.W. (eds) Transdisciplinarity for Transformation. Palgrave Macmillan, Cham. https://doi-org.vu-nl.idm.oclc.org/10.1007/978-3-031-60974-9_5

De Vries, H., Bekkers, V., & Tummers, L. (2016). Innovation in the public sector: A systematic review and future research agenda. *Public administration*, *94*(1), 146-166.

Eccles, M.P., Mittman, B.S. (2006). Welcome to Implementation Science . Implementation Science, 1, 1 https://doi.org/10.1186/1748-5908-1-1

Freedman, L. P., Cockburn, I. M., & Simcoe, T. S. (2015). The economics of reproducibility in preclinical research. *PLoS biology*, *13*(6), e1002165.

Geertz, C. (2008). Thick description: Toward an interpretive theory of culture. In *The cultural geography reader* (pp. 41-51). Routledge.
Gläser, J., & Laudel, G. (2016). Governing Science: How Science Policy Shapes Research Content. *European Journal of Sociology*, *57*(1), 117–168. doi:10.1017/S0003975616000047

General Data Protection Regulation (GDPR), Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC. (2016). Official Journal of the European Union, L119, 1–88. https://eur-lex.europa.eu/eli/reg/2016/679/oj

Golenko, X., Meyer, C., Ogrin, R., & Lowthian, J. A. (2023). Challenging traditional methodologies in health management research: MMR applications in the codesign, implementation, and evaluation of a health care intervention. In *Handbook of Mixed Methods Research in Business and Management* (pp. 223-242). Edward Elgar Publishing.

Gray, D. E. (2021). Doing research in the real world.

Hall, S., & Liebenberg, L. (2024). Qualitative description as an introductory method to qualitative research for master's-level students and research trainees. *International Journal of Qualitative Methods*, *23*, 16094069241242264.

Hoffmann, J. M., Bauer, A., & Grossmann, R. (2023). The carbon footprint of clinical trials: a global survey on the status quo and current regulatory guidance. *BMJ global health*, *8*(9), e012754. https://doi.org/10.1136/bmjgh-2023-012754

Horizon Europe. (2025, 18 februari). Research And Innovation. https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe_en

Houtgraaf, G., & Ropes, E. (2024). Thinking "Outside the Box" Whilst Remaining "Inside the Box": Do Rules and Procedures Demotivate Creativity and Innovation in the Public Sector? *Review of Public Personnel Administration*, *0*(0). https://doi-org.vu-nl.idm.oclc.org/10.1177/0734371X241266117

Hultqvist, S., Jonsson, O., Jönson, H., & Iwarsson, S. (2021). Collaboration in Grant Proposals and Assessments in Ageing Research – Justification or a Quest for a Collaborology? *Social Epistemology*, *35*(5), 427–440. https://doi.org/10.1080/02691728.2021.1913769

Hunt, L., Nielsen, M. W., & Schiebinger, L. (2022). A framework for sex, gender, and diversity analysis in research. *Science*, *377*(6614), 1492-1495.

IPCC, 2023: *Climate Change 2023: Synthesis Report.* Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland, pp. 35-115, doi: 10.59327/IPCC/AR6-9789291691647.

Jong, L., Franssen, T., & Pinfield, S. (2021). 'Excellence' in the research ecosystem: a literature review. *RoRI Working Paper Series*, *5*(5).

Jonsson, O., & Iwarsson, S. (2022). Scrutinizing the collaboration criterion in research: how do policy ambitions play out in proposals and assessments?. *Scientometrics*, *127*(8), 4675-4696.

Kapucu, N., & Hu, Q. (2020). Network Governance: Concepts, Theories, and Applications (1st ed.). Routledge. https://doi-org.vu-nl.idm.oclc.org/10.4324/9781351056540

Kirk, M. A., Kelley, C., Yankey, N., Birken, S. A., Abadie, B., & Damschroder, L. (2015). A systematic review of the use of the Consolidated Framework for Implementation Research. *Implementation Science*, *11*, 1-13.

Knorr-Cetina, K. (1999). *Epistemic cultures: How the sciences make knowledge*. harvard university press.Krogh, A. H. (2020). Facilitating collaboration in publicly mandated governance networks. *Public Management Review*, *24*(4), 631–653. https://doi-org.vu-nl.idm.oclc.org/10.1080/14719037.2020.1862288

Lang, D. J., Wiek, A., Bergmann, M., Stauffacher, M., Martens, P., Moll, P., ... & Thomas, C. J. (2012). Transdisciplinary research in sustainability science: practice, principles, and challenges. *Sustainability science*, *7*, 25-43.

Lenzen, M., Malik, A., Li, M., Fry, J., Weisz, H., Pichler, P. P., ... & Pencheon, D. (2020). The environmental footprint of health care: a global assessment. *The Lancet Planetary Health*, *4*(7), e271-e279.

Lim, W. M. (2025). What is qualitative research? An overview and guidelines. *Australasian Marketing Journal*, *33*(2), 199-229.

Martinuzzi, A., Hametner, M., Windsperger, A., & Brunnhuber, N. (2023). A Framework for Assessing the Climate Impacts of Research and Innovation Projects and Programmes. *Sustainability*, *15*(24), 16600. https://doi.org/10.3390/su152416600

Matthews, N. E., Stamford, L., & Shapira, P. (2019). Aligning sustainability assessment with responsible research and innovation: Towards a framework for Constructive Sustainability Assessment. *Sustainable production and consumption*, *20*, 58–73. https://doi.org/10.1016/j.spc.2019.05.002

Mazzucato, M. (2018). Mission-oriented innovation policies: challenges and opportunities. *Industrial and corporate change*, *27*(5), 803-815.

Ministerie van Algemene Zaken. (2024, 29 april). *Regels dierproeven*. Dierproeven | Rijksoverheid.nl. https://www.rijksoverheid.nl/onderwerpen/dierproeven/regels-dierproeven

Ministerie van Economische Zaken en Klimaat. (2023, 13 april). *Klimaatakkoord*. Klimaatverandering | Rijksoverheid.nl. https://www.rijksoverheid.nl/onderwerpen/klimaatverandering/klimaatakkoord

Ministerie van Volksgezondheid, Welzijn en Sport. (2022, 7 november). *Handtekening gezet onder nieuwe afspraken over verduurzamen van de zorg*. Nieuwsbericht | Rijksoverheid.nl. https://www.rijksoverheid.nl/actueel/nieuws/2022/11/04/handtekening-gezet-onder-nieuwe-afspraken-over-verduurzamen-van-de-zorg

Ministerie van Volksgezondheid, Welzijn en Sport. (2025, 12 juni). Advies - Personeelsinzet en milieu meewegen bij wel of niet vergoeden zorg. Advies | Zorginstituut Nederland. https://www.zorginstituutnederland.nl/publicaties/adviezen/2025/05/21/advies-van-de-commissie-arbeidsinzet-en-duurzaamheid

MSCA Green Charter. (2024, 12 april). Marie Skłodowska-Curie Actions. https://marie-sklodowska-curie-actions.ec.europa.eu/about-msca/msca-green-charter

Romanello, M., Di Napoli, C., Drummond, P., Green, C., Kennard, H., Lampard, P., Scamman, D., Arnell, N., Ayeb-Karlsson, S., Ford, L. B., Belesova, K., Bowen, K., Cai, W., Callaghan, M., Campbell-Lendrum, D., Chambers, J., van Daalen, K. R., Dalin, C., Dasandi, N., Dasgupta, S., … Costello, A. (2022). The 2022 report of the Lancet Countdown on health and climate change: health at the mercy of fossil fuels. *Lancet (London, England)*, *400*(10363), 1619–1654. https://doi.org/10.1016/S0140-6736(22)01540-9

Patton, M.Q., 1999. Enhancing the quality and credibility of qualitative analysis. Health Serv. Res. 34, 1189–1208.

Pfotenhauer, S., Laurent, B., Papageorgiou, K., & Stilgoe, A. J. (2022). The politics of scaling. *Social studies of science*, *52*(1), 3-34.

Powell, A., Davies, H. T., & Nutley, S. M. (2018). Facing the challenges of research-informed knowledge mobilization:'Practising what we preach'?. *Public Administration*, *96*(1), 36-52.

Robins, L. S., Jackson, J. E., Green, B. B., Korngiebel, D., Force, R. W., & Baldwin, L. M. (2013). Barriers and facilitators to evidence-based blood pressure control in community practice. *The Journal of the American Board of Family Medicine*, *26*(5), 539-557.

Rockström, J., Steffen, W., Noone, K., Persson, Å., Chapin, F. S., Lambin, E. F., ... & Foley, J. A. (2009). A safe operating space for humanity. *nature*, *461*(7263), 472-475.

Ščepanović, R., Labib, K., Buljan, I., Tijdink, J., & Marušić, A. (2021). Practices for research integrity promotion in research performing organisations and research funding organisations: A scoping review. *Science and engineering ethics*, *27*(1), 4.

Schmitt, H., Blaak, H., Kemper, M., van Passel, M. W., Hierink, F., Van Leuken, J., ... & Zuidema, T. (2017). Bronnen van antibioticaresistentie in het milieu en mogelijke maatregelen.

Sjöö, K. (2025). Rhetoric in Science Policy Implementation: Persuading Researchers to Integrate Sex and Gender Perspectives. *Minerva*, 1-23.

Skapetis, T., Nicholl, B., & Hansen, K. (2024). Consideration of Sustainability When Approving Human Medical Research—A Scoping Review. *Journal of Bioethical Inquiry*, 1-7.

Smith, P., Feijao, C., Ang, C., Politi, C., Flanagan, I., Qu, M., & Guthrie, S. (2023). Advancing environmentally sustainable health research. *Wellcome Trust*, 2023-08.

Steenmeijer, M. A., Pieters, L. I., Warmenhoven, N., Huiberts, E. H. W., Stoelinga, M., Zijp, M. C., Rijksinstituut voor Volksgezondheid en Milieu, Zelm, R. V., & Waaijers-van Der Loop, S. L. (2022). Het effect van de

Nederlandse zorg op het milieu. In *RIVM-rapport 2022-0127* [Report]. Rijksinstituut voor Volksgezondheid en Milieu. https://doi.org/10.21945/RIVM-2022-0127

Stickdorn, M., & Schneider, J. (2010). *This is service design thinking: Basics, tools, cases* (1st ed.). Wiley.

Suitner, J., Krisch, A., & Aigner, A. (2022). *Transformative experiments: Getting the phenomenon right*. Working Paper 1.

THE 17 GOALS | Sustainable Development. (z.d.). https://sdgs.un.org/goals
UNITED NATIONS. (2015). *PARIS AGREEMENT*. https://unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement.pdf

Thijssen, S. V., Jacobs, M. J., Swart, R. R., Heising, L., Ou, C. X., & Roumen, C. (2023). The barriers and facilitators of radical innovation implementation in secondary healthcare: a systematic review. *Journal of health organization and management*, *37*(3), 289-312.

Tuffaha, H. W., El Saifi, N., Chambers, S. K., & Scuffham, P. A. (2018). Directing research funds to the right research projects: a review of criteria used by research organisations in Australia in prioritising health research projects for funding. *BMJ open*, *8*(12), e026207.

United Nations Framework Convention on Climate Change (UNFCCC). (1997). Kyoto Protocol to the United Nations Framework Convention on Climate Change. https://unfccc.int/resource/docs/convkp/kpeng.pdf

Wellcome Trust. (2024). *Concordat for the environmental sustainability of research and innovation practice*. https://www.ukri.org/publications/concordat-for-environmental-sustainability/

United Nations Framework Convention on Climate Change (UNFCCC). (2016). *THE PARIS AGREEMENT* [Press-release]. https://unfccc.int/sites/default/files/resource/parisagreement_publication.pdf

Walt, G., & Gilson, L. (1994). Reforming the health sector in developing countries: the central role of policy analysis. *Health policy and planning*, *9*(4), 353-370.

Weber, P. M., Bendiscioli, S., Wallon, G., von Ahsen, U., de Beaufort, A. M., Boland, M., Dekkers, F., Dunon-Bluteau, D., Farley, M., Fox, A., Guillot, S., Lannelongue, L., Łazarowicz-Kowalik, M., Rouse, B., Samuel, G., Sanchis, T., Simon, S., Tata, M., van der Goot, G., & Watt, F. M. (2024). The Heidelberg Agreement on Environmental Sustainability in Research Funding (1.0). Zenodo. https://doi.org/10.5281/zenodo.13938809

World Medical Association. (2025). World Medical Association Declaration of Helsinki: ethical principles for medical research involving human participants. *JAMA*, *333*(1), 71-74.

Wulf, C., Werker, J., Ball, C., Zapp, P., & Kuckshinrichs, W. (2019). Review of Sustainability Assessment Approaches Based on Life Cycles. *Sustainability*, *11*(20), 5717. https://doi.org/10.3390/su11205717

Yanow, D., Fischer, G., Miller, G., Sidney, M.S., 2007. Qualitative-interpretive methods in policy research, in: Handbook of Public Policy Analysis: Theory, Politics, and Methods. CRC Press/Taylor & Francis, Boca Raton, pp. 405–416.

You, F., Coffey, T., Powell, D., Williamson, P. R., & Gillies, K. (2025). Carbon emissions associated with clinical trials: A scoping review. *Journal of Clinical Epidemiology*, 111733.

ZonMw. (2025, 17 januari). Internationaal samenwerkingsverband EViR komt naar ZonMw. *ZonMw*. https://www.zonmw.nl/nl/nieuws/internationaal-samenwerkingsverband-evir-komt-naar-zonmw

10 Annexes

10.1 Research funding organizations in Europe

Country/ area	Organization	Funding focus	Network affiliation
Austria	Austrian Science Fund (FWF)	General/ Basic research	Science Europe Greening Research working group
Belgium (Flanders)	Research Foundation Flanders (FWO)	General/ Basic research	Science Europe Greening Research working group
Belgium (Wallonia)	Fund for Scientific Research (F.R.S.-FNRS)	General/ Basic research	Science Europe Greening Research working group
Croatia	Croatian Science Foundation (HRZZ)	General/ Basic research	Science Europe Greening Research working group
Denmark	Danish Council for Independent Research (DFF)	General/ Basic research	-
Estonia	Estonian Research Council (ETAG)	General/ Basic research	Science Europe Greening Research working group
EU	Marie Skłodowska-Curie Actions (MSCA)	Advancing skills and careers of doctoral and postdoctoral researchers	-
EU	European Research Council (ERC)	General/ Basic research	-
Finland	Research Council of Finland (AKA)	General/ Basic research	Science Europe Greening Research working group
France	French National Research Agency (ANR)	General/ Basic research	Science Europe Greening Research working group
Germany	German Research Foundation (DFG)	General/ Basic research	Science Europe Greening Research working group
Iceland	Icelandic Research Fund (Rannis)	Icelandic Research Fund (Rannis)	-
Ireland	Health Research Board (HRB)	Health(care) research	Science Europe Greening Research working group and EViR
Ireland	Research Ireland (RI)	General/ Basic research	Science Europe Greening Research working group
Italy	National Institute for Nuclear Physics (INFN)	Nuclear and particle physics	Science Europe Greening Research working group

Luxembourg	Luxembourg National Research Fund (FNR)	General/ Basic research	Science Europe Greening Research working group
The Netherlands	Dutch Research Council (NWO)	General/ Basic research	Science Europe Greening Research working group
The Netherlands	Netherlands Organization for Health Research (ZonMw)	Health(care) research	EViR
Nordic countries	NordForsk	Multinational coordination on research addressing societal challenges	-
Norway	Research Council of Norway (RCN)	General/ Basic research	Science Europe Greening Research working group and EViR
Poland	Foundation for Polish Science (FNP)	General/ Basic research	Science Europe Greening Research working group
Poland	National Science Centre (NCN)	General/ Basic research	Science Europe Greening Research working group
Portugal	Foundation for Science and Technology (FCT)	General/ Basic research	Science Europe Greening Research working group
Romania	The Executive Agency for Higher Education, Research, Development and Innovation Funding of Romania (UEFISCDI)	General/ Basic research	Science Europe Greening Research working group
Serbia	Science Fund of the Republic of Serbia (SFRS)	General/ Basic research	Science Europe Greening Research working group
Spain	Spanish State Research Agency (AEI)	General/ Basic research	Science Europe Greening Research working group
Sweden	Swedish Research Council for Sustainable Development (FORMAS)	Sustainability, environment, and agricultural sciences	Science Europe Greening Research working group
Sweden	Swedish Research Council for Health, Working Life (Forte)	Health(care) research	-
Swiss	Swiss National Science Foundation (SNSF)	General/ Basic research	Science Europe Greening Research working group and EViR
United Kingdom	United Kingdom Research and Innovation (UKRI)	General/ Basic research	Science Europe Greening Research working group

10.2 Interview guide English

Interview guide		
Main topic	**Questions**	**Probes**
Organizational role in achieving sustainability	What is your role within the organization? Wat do you do in this role? How do you work with others concerned with sustainability? What does sustainable research and innovation entail to you? - environmental footprint; - criteria in the evaluation and management of research; - sustainable travel policy; - digital solutions; - environmental impacts of digitalization; - science for policy activities; - inter- and trans-disciplinary approaches; - knowledge management Is this topic gaining traction within your organization? What have you already done regarding sustainability? What effect has this had? Are you involved with discussions on this topic? Difficult subject? Referents, commissions or steering groups? Are there developments that drive these discussions? Is sustainability achievable? For all types of projects that your organization funds? Differences between departments, programs, research topics etc.?	- Do you have experience with promoting sustainable practices in research and innovation? - How? - Who is involved? - Enough knowledge? - Resources spent? - Formal/ informal communication - How is your organization organized? - Has there been a comparable situation in the past? (think of fair data, open science etc.)
Now I would like to talk about the other funders in Europe?	What role do you see for yourself as a public funder compared to a private funder? Do you think this topic is a priority of other funders? Do you work together with other organizations? Do you get inspiration from other organizations? (other funders, universities, knowledge institutes, researchers/ project leaders, the government)	- Barriers and facilitators of others?
Funding criteria	Do you think that funders should include sustainability in their calls? Can this be practically realized? What are your hesitations? How could sustainability be included in funding criteria? ➔ What was said for the first question? ➔ Some aims included, some not?	- In your country/ organization? - Internal or external reasons? - Barriers and facilitators? - Organizational structure - Progressive/ conservative

	Should there be any exceptions? How would this be considered in the evaluation of applications? How should this be weighted in the evaluation, as a condition or stimulus? What role should this play in the evaluation Where do you see these developments going in the future?	 Can it be denied based on… What do you need from whom?
Conclusion		
Thank you again for taking the time to talk. Do you have any final remarks or questions? I will make a summary of our conversation to consolidate you key remarks. Is it okay if I send you this summary for you to read and check if I have taken away your main message?		

10.3 Interview Guide Dutch

Interview Guide Nederlands		
Hoofdonderwerp	**Vragen**	**Probes**
Rol van de organisatie bij het verduurzamen	Wat is uw rol binnen de organisatie? Wat doet u zoal in deze rol? Wat verstaat u onder verduurzamen van onderzoek en innovatie? - ecologische voetafdruk; - criteria voor de evaluatie en het beheer van onderzoek; - duurzaam reisbeleid; - digitale oplossingen; - milieueffecten van digitalisering; - wetenschap voor beleidsactiviteiten; - inter- en trans-disciplinaire benaderingen; - kennisbeheer Leeft dit onderwerp in uw organisatie? Wat doe je allemaal? Wat levert het op? Bent u betrokken bij discussies over dit onderwerp? Is het een moeilijk onderwerp? Zijn er ontwikkelingen die deze discussies aandrijven? Is verduurzaming haalbaar? Voor alle types projecten die uw organisatie subsidieert? Verschillen tussen afdelingen, programma's, onderzoek topics etc.? Zouden funders een invloed moeten hebben?	 - Heeft u ervaring met het verduurzamen van onderzoek en innovatie? - Hoe? - Wie is betrokken? - Genoeg kennis? - Middelen gebruikt/ besteed? - Formeel/ informeel? - Hoe is uw organisatie opgebouwd? - Heeft er een vergelijkbare situatie in het verleden plaatsgevonden? (denk aan fair data, open science etc.)

	Welke rol ziet u voor zichzelf als publieke funder t.o.v. stichting?	
Andere funders	Denkt u dat dit onderwerp leeft bij andere funders? Werkt u samen met andere organisaties? Wordt u geïnspireerd door andere funders? (andere funders, universiteiten, kennisinstellingen, onderzoekers/ projectleiders, overheid)	- Barriers en facilitators van anderen?
Subsidievoorwaarden	Vindt u dat financiers in oproepen naar duurzaamheid moeten vragen? Kan dit praktisch uitgevoerd worden? Wat zijn uw aarzelingen? Hoe kan duurzaamheid in subsidievoorwaarden worden opgenomen? ➔ **Koppelen aan het antwoord van vraag 1** ➔ **Waarom kan een van de punten wel en andere niet in subsidievoorwaarden** Zouden er uitzonderingen moeten zijn? Welke rol zou duurzaamheid moeten hebben in de beoordeling van de aanvraag? Hoe zou dit moeten meewegen in de beoordeling van de aanvraag? Waar zie je het naartoe bewegen?	- In uw land/ organisatie? - Intern of externe redenen? - Barriers en facilitators? - Organisatie structuur? - Progressief/ conservatief? - Afwijzen op basis van gebrek aan… - Van wie heb je wat nodig?
Conclusie		
Nogmaals bedankt dat u de tijd hebt genomen om met mij te praten. Heeft u nog een laatste opmerking of vragen? Ik zal een samenvatting maken van ons gesprek om uw belangrijkste opmerkingen te consolideren. Is het goed als ik deze samenvatting opstuur zodat u deze kunt lezen en controleren of ik je hoofdboodschap goed heb begrepen?		

10.4 Codebook

Innovation domain	Innovation adaptability	The degree to which the innovation can be modified, tailored, or refined to fit local context or needs.
	Innovation complexity	The degree to which the innovation is complicated, which may be reflected by its scope and/or the nature and number of connections and steps
	Innovation cost	The degree to which the innovation purchase and operating costs are affordable
	Innovation evidence base	The degree to which the innovation has robust evidence supporting its effectiveness
	Innovation relative advantage	The degree to which the innovation is better than other available innovations or current practice
	Innovation source	The degree to which the group that developed and/or visibly sponsored use of the innovation is reputable, credible, and/or trustable
	Innovation trialability	The degree to which the innovation can be tested or piloted on a small scale and undone
Outer setting	Critical incidents	The degree to which large-scale and/or unanticipated events disrupt implementation and/or delivery of the innovation
	External pressure	The degree to which external pressures drive implementation and/or delivery of the innovation. This can be societal pressure, market pressure or performance measurement pressure
	Financing	The degree to which funding from external entities (e.g., grants, reimbursement) is available to implement and/or deliver the innovation
	Local attitudes	The degree to which sociocultural values (e.g., shared responsibility in helping recipients) and beliefs (e.g., convictions about the worthiness of recipients) encourage the Outer Setting to support implementation and/or delivery of the innovation
	Local conditions	The degree to which economic, environmental, political, and/or technological conditions enable the Outer Setting to support implementation and/or delivery of the innovation
	Partnerships & connections	The degree to which the Inner Setting is networked with external entities, including referral networks, academic affiliations, and professional organization networks
	Policies & laws	The degree to which legislation, regulations, professional group guidelines and recommendations, or accreditation standards support implementation and/or delivery of the innovation
Inner setting	Access to knowledge & information	Specifically applies to the innovation, the degree to which guidance and/or training is accessible to implement and deliver the innovation
	Available resources	Specifically applies to the innovation, the degree to which resources are available to implement and deliver the innovation. This includes funding, space and materials/ equipment.
	Communication	The degree to which there are high quality formal and informal information sharing practices within and across Inner Setting boundaries (e.g., structural, professional)

	Compatibility	Specifically applies to the innovation, the degree to which the innovation fits with workflows, systems, and processes
	Culture	The degree to which there are shared values, beliefs, and norms across the Inner Setting. This includes human equality-centeredness, recipient-centeredness, deliverer-centeredness and learning-centeredness (psychological safety, continual improvement, and using data to inform practice).
	Incentive system	Specifically applies to the innovation, the degree to which tangible and/or intangible incentives and rewards and/or disincentives and punishments support implementation and delivery of the innovation
	Mission alignment	Specifically applies to the innovation, the degree to which implementing and delivering the innovation is in line with the overarching commitment, purpose, or goals in the Inner Setting
	Relational connections	The degree to which there are high quality formal and informal relationships, networks, and teams within and across Inner Setting boundaries (e.g., structural, professional)
	Relative priority	Specifically applies to the innovation, the degree to which implementing and delivering the innovation is important compared to other initiatives
	Structural characteristics	The degree to which infrastructure components support functional performance of the Inner Setting. This can include physical infrastructure, information technology infrastructure or work infrastructure (= Organization of tasks and responsibilities within and between individuals and teams, and general staffing levels, support functional performance of the Inner Setting)
	Tension for change	Specifically applies to the innovation, the degree to which the current situation is intolerable and needs to change
Individuals domain **(Project roles)**	High-level leader	Individuals with a high level of authority, including key decision-makers, executive leaders, or directors
	Implementation facilitator	Individuals with subject matter expertise who assist, coach, or support implementation
	Implementation leads	Individuals who lead efforts to implement the innovation
	Implementation team member	Individuals who collaborate with and support the Implementation Leads to implement the innovation, ideally including Innovation Deliverers and Recipients
	Innovation deliverers	Individuals who are directly or indirectly delivering the innovation
	Innovation recipients	Individuals who are directly or indirectly receiving the innovation
	Mid-level leader	Individuals with a moderate level of authority, including leaders supervised by a high-level leader and who supervise others
	Opinion leader	Individuals with informal influence on the attitudes and behaviors of others
Individuals domain	Capability	The degree to which the individual(s) has interpersonal competence, knowledge, and skills to fulfill Role
	Motivation	The degree to which the individual(s) is committed to fulfilling Role

(Project characteristics)	Need	The degree to which the individual(s) has deficits related to survival, well-being, or personal fulfillment, which will be addressed by implementation and/or delivery of the innovation
	Opportunity	The degree to which the individual(s) has availability, scope, and power to fulfill Role

10.5 Annex: Data Management Plan

1. *Project description: This project aims to understand the experiences of international research funding organizations, in the implementation of funding conditions to promote sustainable research practices. The aim will be achieved by interviewing employees of these organizations, including ZonMw, to understand what factors involved in the implementation of funding criteria are of importance to ZonMw as an organization.*

2. *Planning:* This study took place between February and June of 2025. Initial literature and policy document review was conducted in February and March. The extended research design including introduction, contextual background, theoretical background, theoretical framework, methodology and data management plan was finished on 11-03-2025. After Go/No-go assessment, the interview guide was finalized. During this period stakeholders were contacted for participation and interviews were planned. Interviews were conducted in March, April and May. During this time, interview transcripts (raw data) were also analyzed vertically, and the initial codebook was composed. Further horizontal analysis was conducted after data saturation had been observed half May (resulting in processed data). Thereafter, overall analysis of the data took place and was written into results (further processed data). Finally, the discussion, conclusion and recommendations were completed for the final draft due on 06-06-2025. After receiving feedback, the report was revised before final submission on 27-06-2025. Along with finalization of the report, the presentation was prepared for demonstration at the VU on 20-06-2025. A second presentation of the key findings was presented to colleagues at ZonMw on 26-06-2025.

3. *Data assets: the following data assets are described chronologically and accumulatively.*
    - *Interviews*
    - *Researcher notes*
    - *Audio files*
    - *Transcripts*
    - *ATLAS.ti files*
    - *Text files*
    - *PowerPoint files*

4. *Data (risk) classification: low at all times as RFOs stimulate open science and collaboration (no confidentiality risks)*

5. *Methods / standards/ protocols for collection and/or analysis*
    - *Verbal/ informed consent,*
    - *verbatim transcription,*
    - *member-check*
    - *data anonymization (where possible and/ or necessary)*
    - *deductive coding*
    - *inductive coding*

6. *Storage*
    - *All data is stored on ZonMw's secure data drive. After completion of the internship, Renata Klop will be responsible for data storage as she will retain access.*

    - *Draft versions and final versions are all stored in the same file: Renata Klop has access to the data, as it is shared in a file she has and will remain access to. As the project does not fall directly under a department, only those related to the "cluster overstijgend programma duurzaamheid en gezondheid" may have access, unless access is requested at IT after approval of Renata Klop.*

    - *Archiving: the data will remain in the same file and the same access method as described above will be used for at least 5 years after completion of the internship*