ENHANCERIA		
	Work package	WP3 Sustainable development through transdisciplinary research
	Deliverable	D3.2.1 Catalogue of Joint Advisory for supporting transdisciplinary research
	Date	31/08/2023
	Type	Report (R)
	Dissemination	Public
	Lead	Technische Universität Berlin, Dr. Kathrin Wieck (TUB), Final report: Sarah Fowkes (TUB)

CATALOGUE OF JOINT ADVISORY FOR SUPPORTING TRANSDISCIPLINARY RESEARCH

ENHANCERIA
Funded by the European Union's Horizon 2020 research and innovation program grant number 101035806

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// EXECUTIVE SUMMARY

This catalogue builds on the work of WP3 *Sustainable Development through Transdisciplinary Research* in ENHANCERIA to promote understanding and support for transdisciplinary approaches as a research mode for solving grand societal challenges, and to develop structures for the institutionalisation of knowledge exchange between science and society.

Central to the overarching mission of the ENHANCE Alliance is the goal to drive responsible societal transformation, empowering our researchers and students to address global challenges in a sustainable manner. It is increasingly clear that the major challenges facing our society today cannot be adequately addressed through traditional, disciplinary research approaches and that transdisciplinary approaches can play an important role here (Lang, 2012).

Drawing on the core methodology that has been established in this Work Package, the methods and tools used for data gathering and analysis have developed along two key paths. Firstly, with the goal of establishing a broad, shared understanding of transdisciplinarity and the positive contribution this research mode can make to sustainable development. Secondly, to identify good practice examples within the ENHANCE Alliance and map and categorise these according to critical factors including levels of engagement and societal impact. We draw on inter-university exchange within the Alliance, comprehensive mapping efforts, the ENHANCERIA Walk & Talk Series, and desk research to inform our analysis.

We explore the ENHANCE approach to transdisciplinarity, as well as the nuances of terminology that are important to navigate when pursuing transdisciplinary collaboration, which results in this broad understanding:

> *Transdisciplinary research refers to the interaction between various academic disciplines and relevant non-academic stakeholders with the goal of driving knowledge exchange between science and society to tackle sustainable development challenges and bring about societal transformation.*

The gradual institutionalisation of transdisciplinarity requires the right environment, and in this catalogue, we explore the different triggers and barriers experienced by ENHANCE universities. A nurturing environment for transdisciplinary research can be helped by normative measures and cultural shifts as well as crucial structural support in the form of institutional structures, funding programmes, strategic direction and organisational networks. Bottom-up, project-based factors also play an important role. However, we see that our universities still face many challenges in creating the right environment for this research mode. As made evident by the difficulty in identifying a comprehensive shared definition of transdisciplinarity, the level of experience and support for transdisciplinarity varies greatly across institutions. Often, we see an embedded culture of disciplinarity which can be hard to tackle, or structural incentives which are not suited to this research mode. Funding and other resource challenges are unsurprisingly an additional barrier for many universities.

Three case studies offer some more real-world insight into how different initiatives in the ENHANCE Alliance have broached these challenges, and highlight the factors that have been important to their success. We look at a structural, institutional level initiative at TU Berlin, a bottom-up project at NTNU, and a course-based programme at Chalmers University of Technology.

One main aim of this catalogue is to support the gradual institutionalisation of knowledge exchange between science and society across the ENHANCE Alliance, by investigating the structures and strategies already present in our universities and looking at the ongoing pilots and select case studies. We have sought to set out some of the key parameters for this research mode, and work towards establishing a pathway towards increased support for transdisciplinary research in our universities. One central conclusion is that, whilst there is an abundance of established methods and tools for conducting transdisciplinary research, networks and supportive structures (the 'policy' dimension) for promoting this approach within universities are still limited. The institutionalisation of transdisciplinarity – anchoring this as a supported research mode at a structural level in universities – is therefore not yet fully developed.

Through continued exchange and sharing of good-practice within ENHANCE we therefore aspire to continue to increase awareness and understanding of the importance of this research mode for tackling sustainability challenges and together work towards the institutionalisation of transdisciplinarity.

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// 1. INTRODUCTION

1.1 DEVELOPMENTS WITHIN ENHANCERIA WP3

Within ENHANCERIA, a Horizon 2020 funded SwafS project that aims to support and strengthen the research and innovation dimensions of the ENHANCE Alliance, WP3 *Sustainable Development through Transdisciplinary Research* is concerned with the institutionalisation of knowledge exchange between science and society and seeks to promote understanding and support for transdisciplinary approaches as a research mode for solving grand societal challenges.

This objective is aligned with the central mission of the ENHANCE Alliance, and will support our universities in fostering transdisciplinary research approaches and equipping students with the relevant competencies so that, ultimately, we as an Alliance can help drive sustainable societal transformation and develop solutions to global challenges. Transdisciplinarity is a research mode that can be used to address diverse grand societal challenges, as it considers many different perspectives, from both academia and other stakeholders, including industry, civil society and government. The multitude of actors involved in these initiatives means that transformation processes are less linear and top-down, and instead become more iterative and inviting.

This catalogue draws on results and ongoing activities from the first half of the ENHANCERIA project period. WP3 has continued to map transdisciplinary initiatives including supporting structures and practices across the ENHANCE Alliance to build a fuller picture of the **diversity of approaches to transdisciplinarity** in the Alliance, as well as the particularities of the transdisciplinary activities being developed, including their core objectives, scope and societal impact. Building on the conclusions of D3.1.1, *a Discussion, Comparison and Analysis of Transdisciplinary Approaches in ENHANCE Member Universities*, we are continuing our exchanges on this topic to better understand the different approaches taken within ENHANCE. We are now drawing conclusions from the comparative analysis, building transparency and working towards a shared understanding of key terms, as well as continued sharing of good practice for stimulating and supporting transdisciplinary research initiatives and acknowledgement of our different strengths and experience.

In the second year of the project, we are therefore building on the initial mapping exercises (carried out in WP2 *Exploration, Identification and Mapping*) to explore in greater detail what conditions are necessary for institutionalising transdisciplinary research. What **institutional environment and supporting measures** have been instrumental in developing successful transdisciplinary research activities at ENHANCE universities so far? Which **methods and formats** of joint knowledge creation have researchers employed? Furthermore, what **challenges** have been encountered? This catalogue is an essential part of these efforts. It will continue to strengthen ENHANCE's capacity for establishing transdisciplinarity as a research principle and is another step towards establishing a solid foundation for creating synergies and joint transdisciplinary activities of the ENHANCE Alliance in the future.

1.2 SCOPE AND OBJECTIVES OF THE CATALOGUE OF JOINT ADVISORY FOR SUPPORTING TRANSDISCIPLINARY RESEARCH

The overarching objective of this catalogue is to contribute to the emerging framework for transdisciplinary research in the ENHANCE Alliance. It synthesises key literature and outcomes of ENHANCERIA mapping activities and analysis on this topic, offering insight into relevant triggers and barriers that impact the development of transdisciplinary research initiatives. It offers guidance on what central questions need to be addressed and provides basic information on the different methods and formats needed to stimulate and establish transdisciplinarity at the ENHANCE Universities, e.g. through sharing good practice. The catalogue gives an overview about possible types of services, strategies and structures.

The framework will support ENHANCE universities in institutionalising transdisciplinarity, serving as an instrument to identify suitable methods and formats for fostering and supporting transdisciplinary research. We want to promote new ways of working and increase enthusiasm for this approach in the long-term, promoting visibility and awareness - inside and outside the academic world - of the opportunities for circular knowledge transfer it presents. With regard to developing a common goal and providing a shared language among the

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ENHANCE partners, we have recognised in the first phase of the ENHANCERIA project that this ambition must be grounded in some degree of shared understanding about what transdisciplinary research involves, and the valuable contribution it can make to the ENHANCE mission – namely to drive responsible societal transformation, in cooperation with societal actors. In the more long-term, this could include delivering high-quality joint transdisciplinary projects, and thereby strengthen the capacity of the Alliance to contribute to finding sustainable solutions to grand societal challenges.

This deliverable is part of ENHANCERIA Task 3.2 (Development of a framework for transdisciplinary research processes and integrated knowledge exchange between science and society), which aims to develop methods and formats capable of enabling, supporting and fostering transdisciplinary research at ENHANCE universities. It is therefore the aim of this catalogue to share the lessons-learned of the first half of the ENHANCERIA project and with the collective input of all member universities, provide colleagues with some guidance as to how new transdisciplinary initiatives can be developed, what the crucial building blocks are and where potential challenges may lie.

We cover these points in three main chapters:

- **An ENHANCE Approach to Transdisciplinarity** What is the ENHANCE approach to transdisciplinarity – introduction to the central principles and core building blocks of transdisciplinary research approaches that are relevant for the ENHANCE approach, including advisory on how to navigate the variations in terminology when developing transdisciplinary research.
- **Creating the Right Environment – Triggers and Barriers** What structural and normative measures can support transdisciplinary research, and how do these reciprocally interplay with bottom-up initiatives? Moreover, what are potential barriers that can hinder the development of transdisciplinary initiatives? Based on the experiences mapped and analysed across ENHANCE so far, we explore the factors that help build a favourable environment for engaging, supporting and promoting transdisciplinary research projects and driving institutionalisation of transdisciplinarity as a research principle in our universities.
- **Successes and Challenges in Transdisciplinary Research Initiatives – ENHANCE Good Practice** We take a closer look at three examples within the ENHANCE Alliance to provide some real-life examples of the triggers and barriers explored earlier, and illustrate how different kinds of transdisciplinary initiatives (at the structural level, at the project-level, and course-based) can be successfully developed, and how these respectively contribute to the institutionalisation of transdisciplinarity.

// 2. METHODOLOGY

This catalogue draws on the core methodology that has been established in the Work Package. The methods and tools used for data gathering and analysis have developed along two key paths. Firstly, with the goal of establishing a broad, shared understanding of transdisciplinarity and the positive contribution this research mode can make to sustainable development. Secondly, to identify good practice examples within the ENHANCE Alliance and map and categorise these according to critical factors including levels of engagement and societal impact.

The subsequent analysis and recommendations in this document therefore draw on the results of several initiatives carried out within WP3. In combining different data collection methods, from desk research, surveys, and mappings, to structured interviews and workshops, we employ a methodological triangulation approach to our research and ensure a broad basis for our analysis and advisory. We summarise the key methods used below:

Inter-university exchange: Within the scope of WP3, regular exchange on the topic of transdisciplinarity takes place between all ENHANCE member universities. The WP meets twice monthly and in addition, has held dedicated workshops for more in-depth discussion to explore, for example, the most important factors for a structured analysis of mapped transdisciplinary initiatives and to agree an approach to the methodology and categorisation of these within WP3. A collaborative Miroboard serves as a communication and workshop platform to support continuous exchange and data gathering (see also D3.1.1 deliverable).

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Mapping: Extensive mapping exercises have been carried out (with initial mapping done by WP2), resulting in over 60 initiatives mapped across the ENHANCE Alliance – including a differentiation of top-down strategies and funding initiatives and bottom-up research projects. The mapping includes one-pagers relating to sustainability research and transdisciplinary activities, projects, research, platforms and structures at each ENHANCE university. Through two rounds of surveys, completed by all ENHANCE partners, we have gathered further valuable detail on the relevant drivers, funding structures and methodological approaches of these initiatives. Selected projects were then chosen for structured interviews where the contribution of a transdisciplinary initiative to sustainable development, and the institutionalisation of transdisciplinarity and relevant research processes was explored (see also D3.1.1 deliverable).

Walk & Talk Series: to reflect on the mapping and analysis of transdisciplinary initiatives within ENHANCE, the Walk & Talk series has been designed and further developed to help researchers and other relevant staff get to know local research projects that facilitate knowledge exchange between science and society, as well as better understand the strategies and structures established at the ENHANCE Universities that support these projects. Participants are invited to exchange experience and share good practice, taking lessons learned back to their home university. The workshop series started with an initial Walk & Talk event at TU Berlin in September 2022, followed by a second Walk & Talk workshop at NTNU in April 2023. All ENHANCE member universities will host one by the end of the project period.

Desk Research: transdisciplinarity as a research mode is garnering increased interest for enabling circular knowledge transfer between science and society with regard to complex societal challenges and as we seek to determine a suitable approach to the institutionalisation of transdisciplinarity within ENHANCE, it is important to reflect on the latest developments and insights from the wider transdisciplinary research community. We complement our data collection and analysis from the first reporting phase with desk research to ensure this advisory is grounded within the relevant theoretical framework.

// 3. AN ENHANCE APPROACH TO TRANSDISCIPLINARITY

3.1 INTRODUCTION

Central to the overarching mission of the ENHANCE Alliance is the goal to drive responsible societal transformation, empowering our researchers and students to address global challenges in a sustainable manner. It is increasingly clear that the major challenges facing our society today cannot be adequately addressed through traditional, disciplinary research approaches and that transdisciplinary approaches can play an important role here (Lang, 2012). This paradigm shift has also been strongly driven at the European level, with EU science policy supporting a shift towards citizen-oriented research, as evident for example in two of the H2020 Transformation Modules which call for reinforced cooperation in research and innovation with other sectors, especially academia-business cooperation, and the active engagement of citizens, civil society, local communities and public authorities in all stages of the research and innovation process (Research Executive Agency, 2020). The mode of transdisciplinarity itself however does not necessarily invoke the same understanding in all institutions, scientific theories and research modes.

Despite efforts to reach a coherent framework for transdisciplinary research, there remains a considerable degree of disparity, including with regard to the terminology used. There have been attempts to consolidate the common characteristics of popular definitions (see for example Lawrence et al., 2022) but as Brandt observes, "this lack of common research framing hampers scientific communication and knowledge exchange between scientific disciplines that do not share methodological or conceptual definitions" (2013). In light of the challenges this can pose, we have endeavoured within the scope of the ENHANCERIA project to reach a level of shared understanding of transdisciplinarity.

To recall our starting point, the initial mapping exercises (as outlined in D3.1.1) quickly revealed a wide range of approaches to conducting and supporting transdisciplinarity within the ENHANCE Alliance. Often the same terms

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are used with different understandings, or different terms are used interchangeably (e.g. participatory research, co-production, multidisciplinary research, collaboration), the project design itself can differ greatly, and core values are often differently defined (e.g. in terms of use and development of methods and tools, defining outcomes and impacts or setting up criteria for evaluation). Nonetheless, we were able to identify some common ground. There is, for example, a shared ambition to improve access to transdisciplinary (or other participatory) research projects for academics and non-academic stakeholders and to thereby foster the university's role as a platform for knowledge exchange with society, and circular knowledge transfer.

This common ground is the starting point for this chapter, where we will take a more in-depth look at the common denominators present in the different approaches to transdisciplinarity across the ENHANCE Alliance. In identifying a more nuanced shared understanding of this concept, we aim to offer guidance on 1) which fundamental building blocks we have identified in the mapped transdisciplinary initiatives, and 2) elements that may differ according to the type of project, purpose, or stakeholders involved, or indeed may only be applicable to certain types of transdisciplinary initiative. This chapter therefore builds on the conclusions of D3.1.1 and is informed by the outcomes of inter-university workshops and structured interviews with ENHANCE staff working on transdisciplinary initiatives, complemented by desk research.

Establishing a degree of common understanding is an important step towards building a framework for transdisciplinary research processes and integrated knowledge exchange between science and society. As the ENHANCE universities each have their own organisational structure and culture, a shared understanding of transdisciplinarity is needed if we are to anchor this concept as a research principle in our universities and encourage this kind of collaboration. For the reasons outlined above, this shared understanding will by necessity be based on a broad definition of transdisciplinarity. This definition can help make it easier for universities seeking to strengthen their work in this area to focus on the underlying principles of transdisciplinarity and take an inclusive approach, without getting lost in complex discussions about the concept itself.

3.2 CORE FEATURES OF THE ENHANCE APPROACH TO TRANSDISCIPLINARITY

These central elements summarise the core features of transdisciplinarity that emerged during our analysis. Whereas, as shown further below, many aspects of a transdisciplinary project will vary depending on its exact purpose and a multitude of other factors, there are some central building blocks that we can identify within the ENHANCE Alliance:

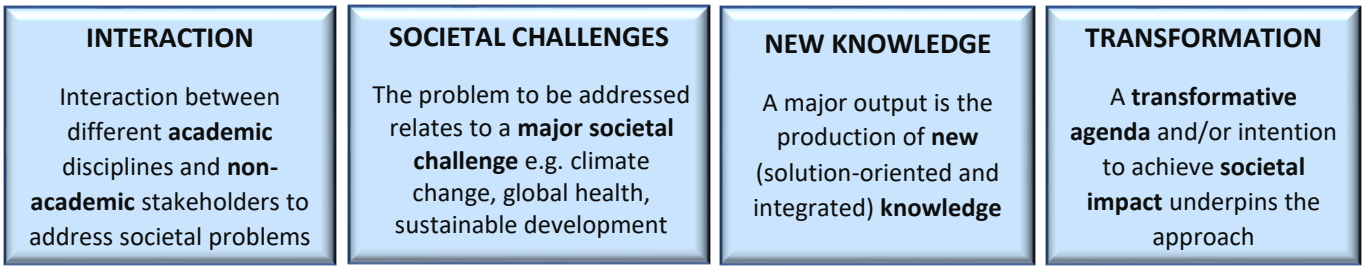

Figure 1. Building blocks of transdisciplinarity – the ENHANCE approach

This has led us to the following broad approach to a shared definition of transdisciplinary research within the ENHANCE Alliance:

Transdisciplinary research refers to the interaction between various academic disciplines and non-academic stakeholders with the goal of generating new knowledge between science and society to tackle sustainable development challenges and bring about societal transformation.

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INTERACTION – LEVELS OF ENGAGEMENT

The type and degree of interaction between different academic disciplines and non-academic stakeholders can be defined within a framework for the *levels of engagement* in a transdisciplinary initiative. Different terms may be used to characterise this interaction, such as co-creation, co-design and co-production. The below is based on the different definitions applied by ENHANCE member universities, as well as informed by current literature:

Co-creation – a collaborative approach to solving problems creatively between various stakeholders at all stages of the scientific research process, from *problem definition* to *evaluation* of the research results.
Co-design – in co-design various stakeholders actively collaborate on the design of a *solution* to a predetermined problem. It promotes the participation of citizens in formulating or improving specific concerns.
Co-production - this is a more comprehensive process that goes beyond the implementation of solutions and tries to build accompanying *systems or structures.* This can include supporting policy, innovation ecosystems, and networks. Citizens have active impact and constitute a part of the development process (e.g. see Sheila Jasanoff, 2004).

Within ENHANCERIA we chose to employ the EUSEA (European Science Engagement Association, (https://eusea.info/news/show-and-tell-science-communication-and-public-engagement-training/) definition as our basis for categorising the level of involvement of non-academic stakeholders in transdisciplinary research. This identifies three levels: 1) informing and inspiring, 2) consulting, and finally the highest level of engagement 3) collaborating.

An important learning from the mapping and analysis has been that there are different levels of engagement present, and that we do not need to seek to qualify this spectrum, but rather acknowledge that transdisciplinary research can be pursued via a range of collaboration modes. That said, within the scope of this project we aim to illustrate a potential pathway for universities to build to more extensive forms of collaboration, if that is what would be beneficial for their institutional or particular project aims. We would encourage an approach which supports stakeholders in beginning with any level of engagement they deem achievable and valuable, with room to increase this in future iterations or initiatives. The appropriate level of engagement for any given initiative may vary - our mapping for example suggests that transdisciplinary initiatives with the highest levels of engagement are those at a project or institutional level. On the other hand, initiatives at the broader level of international networks or funding programmes sit at the lower end of the engagement scale. Both are valid and can have significant impact, but by their nature employ different degrees of interaction with non-academic stakeholders.

At the first level of 'informing and inspiring', funding programmes and excellence strategies such as the **German Excellence Strategy** have helped shape transdisciplinary research approaches within ENHANCE by way of programme requirements that increasingly reward interdisciplinary or transdisciplinary approaches. The **ENHANCERIA Walk & Talk** format is a very different kind of initiative but seeks also to shape transdisciplinary research approaches within the Alliance. It does this by offering a platform for sharing of good practice, for interested colleagues to see projects in action in the local environment and hopefully be inspired by the ideas being developed at other universities and build networks. At the 'consulting' level, we find initiatives that promote shared understanding and inform decision-making, such as advisory committees, focus groups or social research. Within ENHANCE we can see examples of this at a structural level, such as in the **RWTH campus structure,** where more than 420 companies are represented on campus. This allows interdisciplinary academic teams to work closely with industry consortia on different subject areas, embedded in 16 long-term clusters. Interdisciplinary interaction at this level is also enabled by the **PoliMi META project.** This interdisciplinary academic network aims to offer expertise in philosophical, ethical and social issues related to the processes of science, technology and innovation, including via outreach to citizens. At the higher end of the spectrum, we can see examples within ENHANCE of participatory research, stakeholder dialogue and other kinds of collaboration. The **TU Berlin science shop KUBUS**, as an intermediary between science and civil society, provides and improves cultural translation in the areas of dialogue, participation and research design. The thematic focus is on sustainable development and social innovation. However, we should note that even within these types of

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engagement, it is still quite rare for non-academic actors to be awarded real decision-making authority (Lawrence et al., 2022).

The results of the Work Package survey also point to the different roles of different kinds of non-academic stakeholders. Some universities distinguished between two main categories of actors – business and innovation actors who are mainly involved in project activities, and less frequently in training and competency-based activities, and public administration stakeholders whose cooperation is more often based on initiatives with a broader scope and more long-term horizon, such as strategic programmes. Whilst not all universities made the same distinction, we could deduct a broad differentiation between stakeholder interaction in terms of long-term collaboration taking place at an institutional/organisational level, and more-short-term project-based interaction. An example of long-term transdisciplinary institutional collaboration is the RWTH Campus structure which allows individual companies to enrol in a specific centre and thereby help to fund research and infrastructure that is of mutual benefit, or the long-standing and close collaboration between the City of Aachen and RWTH Aachen University that seeks to align research with societal questions. At the project level, however, ENHANCE member universities noted that stakeholders are often involved in a more short-term and volatile manner – unless the same project partners continue to succeed in joint funding, allowing long-term collaboration despite the intermittency of project-based work.

SOCIETAL CHALLENGES

The topics tackled by transdisciplinary approaches within ENHANCE may vary but are related always to a major societal challenge, where the involvement of non-academic stakeholders is particularly relevant to the identification of suitable solutions. Key topics include climate change, public health, urban planning and design, and sustainable development. The specific problem to be addressed within these topics may be identified by external actors (e.g. public administration, citizens) or by project participants through observation and analysis of the needs of the external environment. The exact process for the problem identification process may vary depending on the level of engagement and foreseen process design. At a project level, there may be a very specific objective, for example as in the **Restoration of the Church of San Nicolas in Valencia** project in which UPV worked with a multidisciplinary team, including an architectural studio, a historical foundation, and restoration experts to restore the 15th century gothic structure. On the other hand, high level strategies or funding programmes can to a degree shape the thematic focus of initiatives by supporting – through institutional leadership support, funding, human resource, or other means – transdisciplinary research approaches in select fields. For example, the **Strategic Research Areas** at NTNU which identifies four focus areas for interdisciplinary collaboration, or the **Clusters of Excellence** at RWTH and TU Berlin which provide increased resource to specialised research institutions and facilitate interdisciplinary approaches on these topics.

KNOWLEDGE PRODUCTION

The production of new (integrated) knowledge in transdisciplinary research is reliant on the interaction between academic and non-academic stakeholders. Although, as discussed above, the level of engagement can vary, this interaction should lead to the production of new knowledge that is informed by the different stakeholders involved, and ideally co-produced. The production of knowledge can face many challenges when stakeholders are working within different disciplines, knowledge systems, or social contexts, with different knowledge types or methodologic approaches, or in otherwise different environments. However, it is precisely this added value of bringing different perspectives together that we seek to achieve through transdisciplinary research. An important stage is also the integration of this new knowledge, whereby it is applied and integrated into an ongoing knowledge dialogue. The **NTRANS initiative** (Norwegian Centre for Energy Transition Strategies) hosted by NTNU, for example, provides long-term funding for transdisciplinary teams involving research partners, industry, the public sector, and special interest organisations. NTRANS focuses on the role of the energy system in the decarbonisation of key sectors such as energy, industry and buildings. It develops theory, methods, knowledge and tools to support key stakeholders in the development and implementation of transition strategies. The interdisciplinary and transdisciplinary approaches in the centre's work ensure the co-creation of new knowledge, that is then applied to real user cases.

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TRANSFORMATION – SOCIETAL IMPACT

Within ENHANCERIA we are particularly interested in the application of transdisciplinary research in the field of sustainable development. A shared objective of the mapped initiatives is to bring about (societal) transformation by addressing sustainability challenges, such as climate-neutral cities. In this regard, the impact of transdisciplinarity should enhance knowledge production to real societal impact. This impact can take different forms, depending on the academic and social context within which a project takes place. For example, it may include behavioural changes resulting from social impacts of knowledge, that can positively affect social relations between organisations and people, transform the socio-spatial or socio-natural environment as well as improve the quality of life of individuals. Societal impact is therefore seen as a consequence of a process in which knowledge and expertise circulate to achieve specific goals deemed relevant for society's development.

Below we outline the ENHANCE approach, namely that societal impact (as an added value) can be achieved by:

1. **Transdisciplinary process design**, beginning with joint problem definition, through to evaluation of the research results, including reflection on the transferability for potential upscaling
2. Enabling **knowledge exchange and knowledge integration** for transdisciplinary research processes and projects in the long-term, including the co-production of accompanying systems and structures that facilitate knowledge production
3. **Addressing societal challenges and co-designing problem solutions** through advanced research areas and developing research ideas, prototypes and pilot projects and new values in strategic partnerships (e.g. with industry)
4. **Raising awareness in society** about the need for co-designed solutions integrating research and business teams with other stakeholders from industry, policy and society.

Measuring the societal impact of transdisciplinary initiatives is however very complex. There have been some attempts to formulate an evaluation framework, Walter et al. (2007), for example, identify three distinct types of societal impact: 1) Outputs - measured as procedural and product-related involvement of the stakeholders, 2) Impacts - intermediate effects connecting outputs and outcomes, and 3) Outcomes - enhanced decision-making capacity. An additional fourth level can be added, namely empowerment, where the authority to decide is given to the non-academic stakeholders involved (Brandt et al., 2013). Within this framework we can distinguish between the more immediate impact a project or initiative can have on the participants, including societal stakeholders (outputs in terms of level of engagement), intermediary impact, and the more long-term effects for society (outcomes and empowerment). The fact that the societal effects of transdisciplinary research are often only evident in the more long-term can therefore make it difficult to assess (Schäfer et al., 2021). Significantly, emerging approaches to measuring and evaluating social impact point to the value of centralised, project-independent expertise for this purpose (Nagy & Schäfer, 2021). This is therefore an important factor that must be considered when embarking on a transdisciplinary project or initiative.

Given many of the mapped ENHANCE initiatives are still at relatively early stages of implementation, it is difficult to assess the outcomes of these. But we can nonetheless see some common themes in the approach to impact and the objectives of these initiatives with regard to societal transformation. The TD Academy project, **TransImpact**, offers some interesting insight on this issue. Their research found that one of, if not the most, important factors for securing societal impact is to address this aspect very early on. “This is because societal effects arise out of complex interdependencies between research processes and the results produced by these” (Lux et al., 2020, p.4). That is to say, the potential societal impact will be heavily influenced by the degree to which participants explicitly address and reach a shared understanding on the approach, organisation and reach of a project from the very beginning of the process Designing for impact in this manner can, for example, involve consulting and involving relevant stakeholders early on, strategising on who to involve in what way, sharing decision-making powers at different stages of project design and implementation.

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3.3 ADDITIONAL CHARACTERISTICS OF TRANSDISCIPLINARY INITIATIVES

Beyond these core building blocks, our analysis has made clear the vast range and diversity of approaches to transdisciplinarity. Below we highlight those elements which may vary according to the particular characteristics of a project. We do not seek to qualify one approach over the other, but rather to illustrate the range of possibilities within this research mode, aiming to create synergies for developing the transformation agenda. To avoid an overly prescriptive understanding of transdisciplinarity that may inadvertently discourage new transdisciplinary projects, we have elected to agree the above broad understanding within ENHANCE and not attempt to include all potential aspects in that understanding. The below additional overview is informed both by current literature and the evident diversity of schools of thought on transdisciplinarity as well as communities of practice, and the results of the surveys carried out within WP3, which illustrated the range of transdisciplinary approaches present within ENHANCE member universities in terms of format, scope, and process.

Figure 2. Characteristics of transdisciplinary initiatives

FORMAT/TYPE	Transdisciplinary research approaches can be applied in different types of initiatives e.g. research centres, programmes, living labs, strategic platforms, research projects, networks, research teams, partnerships, centralised offices. In turn, they can also be stimulated, fostered and activated by different kinds of initiatives. In this regard, there is a reciprocal relationship between strategic and structural *policies and entities*, and transdisciplinary *projects and practices*.
TRIGGERS	The driving factors or triggers for a transdisciplinary project can be external, structural supporting measures, institutional level triggers, as well as more bottom-up driven by individual motivations or teams. Broadly speaking, an initiative may be prompted by a more top-down process (methodological approaches to institutionalisation such as executive level strategies, centralised structures, funding measures) or more bottom-up (e.g. initiated at an individual or project level, driven by different types of knowledge production, methods and tools). For some actors this distinction, however, does not reflect their approach – within ENHANCE we see that in practice transdisciplinary initiatives are often born from a combination of top-down and bottom-up processes. For example, top-down funding programmes facilitate the realisation of project ideas based on pre-existing relationships with societal stakeholders. This change can be driven in both directions, with either top-down or bottom-up measures acting as the catalyst. For some actors, the ideal driver should be the identification of a problem, in a joint process involving academic and societal stakeholders. However, this focus on problem-solving can sometimes be a very engineering-focussed perspective that risks limiting further creativity in the co-design stage. We look at the range of possible triggers in more detail in Chapter 4.
PROCESS DESIGN *(in transdisciplinary practices and projects)*	Scholars typically identify three main phases in the 'ideal' transdisciplinary process: 1) co-design - collaboratively defining and developing the problem and aims, 2) co-production – the most intensive phase, referring to the generation of new knowledge towards problem solutions, and 3) re-integration – the gradual transferability of generated knowledge into the wider societal and research spheres (Bergmann et al., 2021, Schäpke et al. 2018, Jahn, Keil & Bergmann 2012). But within this broad structure there can be differences – for example the problem may not always be collectively defined in the co-design phase, but societal stakeholders may be involved at a slightly later stage in the process. Or the approach to re-integration may vary depending on the type of knowledge to be integrated.
METHODOLOGY *(in transdisciplinary practices and projects)*	A range of different methodologies may be employed in transdisciplinary research practices and projects, or indeed innovative methodologies may also be fostered by top-down structures (strategic direction or funding stipulations for example). These could include living labs, focus groups, knowledge transfer,

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	design studios, co-creation, trainings, workshops, observation, joint communication tools etc.
SCOPE OF TRANSDISCIPLINARITY	Transdisciplinary initiatives may involve not only transdisciplinary research but also disciplinary, interdisciplinary (collaboration between scientists from various disciplines) and multidisciplinary (perspective of several disciplines independently applied to a problem) approaches. This is an additional learning from the WP3 mapping, that the different perspectives and experience with transdisciplinarity across ENHANCE universities invites a broad understanding (see approach for joint definition).
STAKEHOLDERS	Interaction with non-academic stakeholders is an essential feature of transdisciplinary research, but the type of non-academic stakeholders involved can vary significantly. That may include industry partners (business, SMEs), civil society (citizens, educational institutions, associations, unions) or government (national, regional, local) and NGOs.

Establishing a framework for transdisciplinary research is intended to support researchers in initiating transdisciplinary activities and we therefore do not want to exclude activities based on a set list of criteria, but rather support an understanding of the spectrum of transdisciplinarity. In doing so we hope to encourage researchers active in this field to look at the potential to explore different transdisciplinary research models and e.g. adapt the levels of engagement or other factors in future activities, according to the specific needs of the identified problem.

3.4 NAVIGATING THE TERMINOLOGY OF TRANSDISCIPLINARITY

There is no definitive guide for the terminology applied to this mode of research, indeed the discussion above has shown that the term transdisciplinarity itself is often understood differently by different actors or disciplines. Transdisciplinary research by its nature brings different perspectives and experiences together and so we cannot expect all stakeholders to take an aligned view on terminology, or to have a deep understanding of the broad spectrum of concepts that may be applied in these activities. In this regard, it should be acknowledged that developing a truly shared terminology is neither realistic nor desirable, but fostering a nuanced understanding of key terms of reference is important. As we have learned from the results of the mapping activities and exchanges between different stakeholders, projects and institutions often have a different understanding of the same concept. An open discussion about terminology is therefore advised, to ensure all project members are working within the same parameters and with the same expectations. This can be done without striving to reach a shared terminology – efforts to unify terminology without recognising and accepting differences can conversely lead to actors feeling unsatisfied or unheard during the project development.

Increased awareness of and understanding for the nuanced application of key terminology in transdisciplinary activities can not only support the smoother running of individual projects, but is important for broader cooperation between initiatives, and at a European level. With increased transparency and an awareness of terms beyond those your discipline or institution may choose to apply, it can for example be easier to understand the aims of other initiatives and subsequently identify possible opportunities for collaboration or shared learning. The goal should be to support cooperation, giving room for a range of terminologies depending on the local epistemic culture, and avoid a narrow, discipline-specific use of terminology which instead risks hindering communication in transdisciplinary projects (Norris, 2016).

Within ENHANCERIA WP3, we have developed a living glossary of key terms in transdisciplinarity to initiate an open discussion amongst the ENHANCE member universities, increase awareness of our different applications and understandings of these terms and support a shared understanding and expectation when it comes to designing new transdisciplinary projects or initiatives. The first stages of this glossary were presented in D3.1.1, *a Discussion, Comparison and Analysis of Transdisciplinary Approaches in ENHANCE Member Universities*. The

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shared glossary has been co-created by all member universities. It offers a diverse overview of some the most widely used concepts and terminology in transdisciplinary initiatives, as well as the relationships between them, including the ENHANCE approach to these terms where appropriate, and key literature references. This glossary will continuously be expanded and updated as the project progresses and offers a useful tool in navigating the often complex landscape of terminology used within transdisciplinary research.

// 4. CREATING THE RIGHT ENVIRONMENT – TRIGGERS AND BARRIERS

In this chapter, we turn to the triggers for transdisciplinarity in ENHANCE universities – measures that can help to create a nurturing environment for transdisciplinary research and support the gradual institutionalisation of the research mode of transdisciplinarity – and explore what kind of measures are already present across ENHANCE universities, and which are still missing. We then consider the barriers, or areas which can pose challenges to individuals or universities looking to run successful transdisciplinary research projects and institutionalise this approach. Which aspects of university administration, infrastructure, research culture or the funding landscape are currently not very compatible with transdisciplinary research approaches, and what strategies can we use to overcome these barriers?

Based on the results of the mapping and structured interviews with ENHANCE staff responsible for the mapped initiatives, we have identified the major triggers and barriers, and drawn out some of the main patterns and lessons from the experience of ENHANCE member universities. Our insight was also strengthened in particular by the ENHANCERIA Walk & Talk series, where ENHANCE colleagues have had the opportunity to exchange experiences and share good practice – strengthening their understanding of the different success factors or challenges local projects face, and taking these findings back to their home university. We also reviewed relevant academic literature to locate barriers and collaborate our findings with those of the wider research community.

4.1 TRIGGERS

When reviewing the range of positive triggers that ENHANCE member universities identified as influential for transdisciplinarity in their institutions, we were able to distinguish broadly between two kinds of supporting measures or incentive structures. On the one hand, measures at a project or institutional level where the concrete and direct impact on transdisciplinarity is visible and, in many cases, driven by a clear and pragmatic vision. On the other, we see that many, often very influential, triggers can be more indirect. Initiatives or structures that may not even be directly linked to societal engagement themselves – international networks or funding programmes for example - but which indirectly foster and support transdisciplinary research approaches.

INSTITUTIONAL TRIGGERS

- Institutional or organisational structures – structural measures at an institutional level can help foster transdisciplinary research approaches via different means. The **Stadtmanufaktur Berlin**, for example, is a central and strategic platform for living lab research at TU Berlin. This platform matches scientific questions, methods, tactics and data with practical know-how and actors, so that concepts and strategies may be jointly developed, and relevant solutions applied directly in urban areas. The founding phase was funded by the Berlin State Senate, illustrating the close links with non-academic stakeholders. The Stadtmanufaktur has helped introduce a new contemporary research and transformation culture, and as a networking platform not only supports matchmaking but generates transformation knowledge and ensures the transferability of results. The **RWTH Living Labs Incubator (LLI)** has similar goals and works to create and nurture a network of Living Labs, enabling and fostering co-creation, participation and transdisciplinary knowledge exchange. A further example is the **TRD3.0** initiative of NTNU and Trondheim Municipality, a partnership agreement reached in 2018 which build on the existing long-term collaboration between the university and the city to

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drive joint projects across five thematic areas. An important goal is to establish a new model for continuous mutual competence and knowledge transfer between academia and municipalities.

- University governance – at a governance level, the position of university leadership and relevant executive boards can be a decisive factor. Within ENHANCE we see that new initiatives or projects that have been successfully implemented have often benefitted from the strong support of individual senior university leaders who are convinced of the added value of transdisciplinary research approaches.
- Strategic direction – a framework provided by an institutional level or VP-led strategy can provide further impetus and support for increased transdisciplinarity at institutional level. For example, at TU Berlin the development of a Transfer Strategy initiated further institutionalisation of transdisciplinary approaches (see case study in Chapter 5). At a national level, strategies such as the German Excellence Strategy also serve as drivers and can offer funding for transdisciplinary initiatives.

- Cultural shift – a growing recognition of and support for the view that engineering and related disciplines – and indeed science at large - must take into account a range of stakeholder perspectives and consider different approaches to innovation if it is to help address grand societal challenges. This includes new forms of collaboration, and therefore new ways of producing knowledge, e.g. transdisciplinary research, are needed. Mazzucato for example clearly outlines the value of a mission-oriented approach for European research and innovation in her 2018 report commissioned by then Commissioner for Research, Science and Innovation Carlos Moedas, including the importance of cross-disciplinary, cross-sectoral and cross-actor innovation for addressing global challenges (European Commission, 2018).

- Interdepartmental collaboration – when addressing complex societal challenges around the transformation challenges of the Anthropocene like climate change, the energy crisis, circular economies, mobility etc it becomes necessary to bundle different methodological approaches, knowledge systems and systems knowledge from different disciplines, including linkages between social sciences, natural sciences and engineering. The extent and quality of interdepartmental collaboration, and links between associated services and facilities can therefore positively impact the genesis of new transdisciplinary activities, with a strong foundation on multi- or interdisciplinary research. The organisational structure of universities is traditionally, and still today, commonly very discipline based, but new educational programmes or other initiatives in teaching and research can help break these silos and establish interdisciplinary collaboration.

- Study regulations - the structural framework of study regulations influences what kind of courses are possible, and made available to students, and opportunities to influence these regulations and introduce openness to transdisciplinary teaching formats can provide an important foundation for the development of new offers. This can for example include specific modules integrated in study programmes allowing collaborations with municipality administrations, societal and political initiatives, schools, start-ups, and other actors. This is an opportunity for transdisciplinarity as a research mode to be more strongly addressed as a teaching principle, offering experimentation to make knowledge more tangible, and providing flexible and experienceable methods and formats.

- Project-based initiatives – project participants, who through observation and analysis of the needs of the external and daily environment, may see the potential for a transdisciplinary approach to support their research aims. This can also include citizen science initiatives, such as the TU Berlin Science Shop ‘Kubus’, part of a worldwide network of science shops called ‘Living Knowledge’, which all work to bridge the gap between citizens and the scientific community. Kubus uses different formats to involve citizens in a number of projects on the topic of sustainability.

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NATIONAL OR INTERNATIONAL TRIGGERS

- European funding programmes – Horizon2020 and Horizon Europe, whose mission-oriented approach encourages participatory and transdisciplinary research approaches that actively foster cooperation with society.

- National funding programmes and strategies – changes in funding requirements that stipulate public outreach, public engagement or participatory methods must be included in research projects are clearly a direct driver of transdisciplinary approaches. The **German Excellence Strategy** for example calls on technical universities to strengthen social sciences and humanities research, and interdisciplinary research in general. ENHANCE member universities TU Berlin and RWTH both host several Clusters of Excellence under the programme. In addition, TU Berlin works with its partners in the **Berlin University Alliance** (a consortium also funded by the German Excellence Strategy), to strengthen the transdisciplinary mode of research through initiatives such as the **Research Forums** which conduct transdisciplinary processes with various groups of societal stakeholders together with scientists. At Chalmers, the Areas of Advance is a programme initially funded by the Swedish government that the university has now expanded upon, with a total of seven **Areas of Advance** that bring interdisciplinary expertise from the university together with that of societal stakeholders to address complex societal challenges. Through dialogues, challenge-based projects and strategic partnerships with industry, this programme supports a wide range of projects.

- Organisational Networks – sharing of good-practice and experience in the field of transdisciplinary research within the scope of different networks at e.g. regional level (e.g. **TD Academy**), or European level (**ENHANCE Alliance**, **IDEA League**) allows universities to build on existing platforms and standards that are emerging, incorporating lessons learned. A major focus of the TD Academy is for example to support networking and capacity building within the transdisciplinarity community, via trainings, events, blogs, projects, and other communication activities. Within ENHANCERIA WP3 we have already seen the potential for member universities to learn from one another, for example through the Walk & Talk series, and in particular for those universities who do not yet widely apply transdisciplinary approaches and are able to learn from the experiences of others.

ENHANCE MEMBER UNIVERSITY EXPERIENCES

Supporting Structures

The mapping and analysis has demonstrated that for transdisciplinary initiatives to succeed or often even emerge at ENHANCE universities, there is a need for more support from university governance or executive boards. The nature of that support can vary, but we have seen that both leadership support and high-level structural initiatives can be very influential in the uptake of transdisciplinary research projects. The different framework conditions at the respective universities play a big role here. The strategic partnerships held by a university, their involvement in excellence strategies, approach to knowledge transfer, available funding instruments and overall governance structures can all shape the approach to transdisciplinarity. This is one reason for the diversity of approaches evident within the ENHANCE Alliance – the organisational structures of universities need to support the academic staff in their transdisciplinary endeavours. The fact that these kinds of institutional level structures are often more long-term can also help create more long-lasting connections between stakeholders, to the benefit of future collaborations.

Capacity and Motivations

ENHANCE member universities also found that whilst the involvement of the highest levels of the university governance were crucial for the launching of new transdisciplinary initiatives, the success of their implementation, particularly in the long-term, was very dependent on the involvement of individual staff members, teams and departments. Those without a centralised structure or coordination unit for transdisciplinary activities often face greater challenges in establishing transdisciplinary activities and securing

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support for these, but other factors at a departmental or project level arguably proved more influential at later stages. Academic staff must therefore be motivated to participate in and set up these initiatives. The resources available to staff and the quality of existing relationships with societal stakeholders can for example also be crucial factors. A combination of top-down and bottom-up structures is therefore often present in the transdisciplinary initiatives we have mapped.

Levels of Engagement

Furthermore, the mapping and analysis carried out by ENHANCE member universities suggests that transdisciplinary initiatives with the highest levels of engagement are those at departmental level or project-based. On the other hand, initiatives at a broader level (international networks, funding programmes) sit at the lower end of the engagement scale. This aligns with our identification of two broad categories of triggers. Whilst national funding programmes, or indeed institutional level initiatives such as a Knowledge Transfer Strategy, may for example have a significant impact on the capacity of individual researchers to pursue transdisciplinary projects, their impact on the local societal context is less direct. The scope and purpose of the initiative are the decisive factors here – research teams may interact with non-academic actors such as local authorities or companies within a high-level structural initiative, but the level of collaborative engagement between these actors is likely to be higher in a local, project-based initiatives with specific goals, for example learning outcomes of a course.

4.2 BARRIERS

Drawing again on the experience of the ENHANCE universities and our mapping, we turn now to the barriers that can hinder the development of transdisciplinary approaches, or challenges that may be faced during the project process. In doing so, we touch on both structural and normative barriers.

- Lack of resources to build quality relationships with societal stakeholders: Building trusted and sustainable relationships with different non-academic stakeholders requires time and human resource investment, yet many partners lack the time and long-term funding that is needed to build these quality relationships. The extent of existing close, trusted relationships with relevant societal stakeholders can greatly impact the potential for shared problem definition, and for the later successful implementation of a project where challenges around different interpretations of key terminology or different methodological standards can emerge. The ability to invest in building relationships with societal stakeholders can help prevent these problems early on. Another angle to stakeholder relationship can be the challenge of managing complex networks, whereby a societal stakeholder may interact with a university at several different levels. Establishing a coordinated approach can be helpful, but also brings the risk of complicating or hindering existing working relationships with societal stakeholders that individual colleagues or faculties are reliant on.

- Lack of coordination and strategic navigation during project stakeholder or participant selection: Identifying the right academic (internal) and non-academic (external, societal) stakeholders can be a challenge for universities pursuing transdisciplinary research. It has been argued that this team formation is itself a 'wicked problem' (Norris et al., 2016). Finding the right balance of expertise and disciplines can be crucial to the success of the project, but this can be a difficult process to navigate – particularly if universities do not have any centralised coordination unit that can support the management and administration of transdisciplinary initiatives. Moreover, if initiatives are located with a disciplinary faculty or department, there is the risk that this disciplinary perspective dominates the process, and other (non-)academic stakeholders feel unable to voice their perspective.

- Limited societal stakeholder involvement: As outlined earlier in this catalogue, societal stakeholders may not always be involved from the early stages of problem definition and the setting of project objectives, or may only be involved to a limited extent. Whilst this does not necessarily negate the transdisciplinary nature of

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a project, it can lead to 'unbalanced problem ownership' (Lang et al. – 2012). This can lead to the remaining process being dominated by the perspectives of the academic stakeholders and remaining at best multi- or interdisciplinary, rather than truly transdisciplinary. Similarly, when the core non-academic stakeholders involved in a project are industry or government actors, this can lead to societal or civic actors participating as second tier stakeholders only.

- Funding challenges: A critical barrier can be the lack of long-term funding opportunities that are suited to the needs of transdisciplinary processes. Transdisciplinary cooperation is still mostly based around short-term, project-funded work which means stakeholders are working under more limited and volatile conditions. This can unnecessarily limit the possibilities for this kind of collaboration. Moreover, the need to apply for competitive and short-term funding is another drain on resources. This can affect not only project-based initiatives, but also more structural and organisational networks that require long-term funding solutions.

- Lack of incentives at individual, departmental or institutional level: There can be a lack of incentives for individual researchers to engage in transdisciplinary activities, which costs time and money that could otherwise be invested in less costly (disciplinary) efforts towards professional recognition or publishing. Against the backdrop of competing priorities and the limited time and resources available at individual, departmental or institutional level, garnering support for transdisciplinary research can be challenging. A related factor is the impact on career opportunities – scientists with a trans- or interdisciplinary portfolio may face challenges advancing within their discipline (Ylijoki, 2022).

- Lack of prior experience in transdisciplinarity: Transdisciplinary research can require particular skills, including expertise on knowledge integration processes and participatory research methods. The extent to which different project participants have experience in transdisciplinarity can impact the collaboration process. Teaching transdisciplinary research skills and methods to both students and staff is therefore an important aspect of institutionalisation efforts.

- Embedded culture of disciplinarity: Overcoming the often still limited exchange between, across and beyond different study programmes can be a challenge, including at the first stage of developing a joint proposal. Research culture at universities is still largely oriented towards disciplinary education and research – promoting transdisciplinary approaches involves a cultural shift. Moreover, when the academic system favours disciplinary research, individual researchers can be faced with personal dilemmas regarding their own career paths when choosing whether to pursue more transdisciplinary research (Ylijoki, 2022). We have also observed that a lot of transdisciplinary research is led by architectural, design or urban planning departments, and still limited in other faculties. Establishing transdisciplinary or interdisciplinary approaches in the hard sciences potentially has to overcome a more embedded culture of disciplinarity than other fields.

ENHANCE MEMBER UNIVERSITY EXPERIENCES

In light of the above identified barriers, we carried out a survey amongst ENHANCE member universities to better understand what they viewed as the most urgently lacking normative or structural support measures for transdisciplinarity. At both an institutional level, as well as thinking about the funding and research landscape more broadly, what change is still needed if we are to foster more widespread institutionalisation of this research approach? Three main issues emerged:

Funding

Current funding structures are often ill-suited to the nature of transdisciplinary research projects. Short-term, competitive funding avenues mean transdisciplinarity activities are resource intensive to establish, and must contend with uncertainty regarding longer-term funding. Funding structures that invite and reward longer-term transdisciplinary collaboration would greatly support institutionalisation efforts in this area. Moreover, it would

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enable researchers to increase the level of societal stakeholder engagement in initiatives, if for example funding structures supported participatory approaches from the first point of problem identification and project design. This is an issue that goes beyond individual institutional structures, but requires attention at national and European policy levels. Fragmented funding policy landscapes can produce unnecessarily competitive systems that are not favourable to transdisciplinary research approaches.

Networking
Inter-university networks - whether at national, European or international level – are a valuable resource in the path towards growing institutionalisation of transdisciplinarity. Through networks such as the ENHANCE Alliance we must increasingly take advantage of these opportunities to share good-practice, learn from each other and find opportunities to collaborate. There are some excellent platforms and networking structures at national level, whose potential is sometimes underused. The TD Academy in Germany for example works to improve awareness and understanding of transdisciplinarity, enable research and connect interested stakeholders. Some ENHANCE member universities also pointed to the need to further increase collaborative cooperation between universities and research institutions.

Human Resource
Related to funding challenges is the need to secure the right people with the right skills and experience to drive transdisciplinarity within the institution. ENHANCE member universities point to the need for more positions focused on transformation management, as integration experts or facilitators for transdisciplinary work (see for example Gaasch, Kryst et al., 2022). Other expert positions in the area of citizen science, and mediation between academic and societal partners would also be valuable. In parallel, appropriate professional supporting structures are needed. Better training and more publication opportunities are needed for young scientists.

Institutionalisation
Centralised institutional level structures can help address many of the identified challenges. A unit that can support, coordinate and administrate transdisciplinary initiatives across the university can for example foster closer relationships with societal stakeholders and support team formation, it can provide advice to research teams interested in pursuing transdisciplinary projects, and it can strengthen institutional support (normative but also financial or human resource) for transdisciplinarity across the university. This latter point is critical – interested researchers and other academic staff must be enabled to dedicate the time and resource needed to these initiatives. ENHANCE member universities find that, without such a centralised structure, activities can often remain more small-scale or disjointed, and opportunities for learning can be missed. Institutionalisation of transdisciplinary approaches is also important to foster the necessary cultural shift in both research and teaching. Beyond the university itself, institutionalisation of transdisciplinary approaches is needed in the innovation ecosystems which universities collaborate with and operate in. Efforts in this direction must therefore consider structures that go beyond single organisations but can support the wider regional or national networks.

// 5. SUCCESSES AND CHALLENGES IN TRANSDISCIPLINARY RESEARCH INITIATIVES – ENHANCE GOOD-PRACTICE

5.1 INTRODUCTION

Within the various transdisciplinary initiatives that we have mapped for ENHANCERIA, we have sought to identify examples of good practice that exemplify particular elements of the potential transdisciplinary research approaches hold for sustainable development projects, and/or offer insight into how common challenges can be addressed. In this chapter we take a closer look at three cases within the ENHANCE Alliance to identify some of the mapped good practice examples as roles models for the Alliance. In doing so we also seek to address the challenge that 'best-practice' is often presented at a very conceptual level that does not always match real-life experience (Lawrence et al., 2022). With the below case studies, we hope to offer some helpful insight that goes beyond the theoretical or conceptual level.

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We have chosen to look at three types of initiative in more detail:

1. Structural, institutional level initiative
2. Project-based initiative
3. Course-based initiative

Our mapping has illustrated a wide range of types of initiatives within the ENHANCE Alliance, and each can bring about different kinds of impact, and thus support different research objectives. Beginning with those at a **structural, institutional level**, we have seen that comprehensive initiatives of this type are still rather limited. Many institutions are at an early stage regarding the institutionalisation of transdisciplinarity as a research mode, and do not have any centralised coordination unit, or similar, whose goal is to support these efforts. Nonetheless, the instrumental role of institutional support for transdisciplinarity features heavily in the universities' analysis of the genesis of their mapped initiatives. Even though comprehensive centralised units dedicated to this topic may still be rare, the role of leadership or executive support for transdisciplinarity, and/or its anchoring in relevant university strategies is evident in the development of many of the initiatives mapped within ENHANCE. One limiting factor in this regard is the continued reliance on individuals willing and able to drive this forward. We see that in many cases, initiatives have only been able to evolve in large part due to the motivations of one or more individuals to push for increasingly transdisciplinary approaches. This is one reason why more centralised, permanent structures can be so beneficial in working towards the institutionalisation of transdisciplinarity. For example, **Polisocial** is an academic social responsibility and engagement programme launched in 2012 at POLIMI, aimed at expanding the university's mission to include societal issues and needs that arise at both a local and global level. This institutional level programme sets out to create new areas of expertise, with the goal of training professionals and researchers capable of producing social change and contributing responsibly to the communities in which they operate. PoliSocial promotes and encourages a new multidisciplinary approach to projects in the university, including through the Off Campus initiative, whereby university hubs are established in the city of Milan to facilitate the joint development of innovative teaching activities, in collaboration with local communities. At the structural, institutional level, RWTH Aachen has established or helped to establish two institutional structures to support the advancement of transdisciplinary research practices. On the one hand, to strengthen the exchange and collaboration between science and society., RWTH Aachen together with three other local universities and the City of Aachen set up the **Future Lab Aachen**, a communication and outreach platform which bundles information on events by each partnering institution and organises additional joint events where science and society can meet and interact. On the other hand, to strengthen cooperation between science, business and industry, RWTH Aachen set up **RWTH Campus GmbH**, allowing business partners to enrol and make use of university research infrastructures and expertise to collaborate on innovations in seven different thematic clusters and the cross-cutting Innovation Factory. At a more structural level, we can also look at the example of the **RWTH Sustainability Office.** The overarching goal of this strategic staff unit is to map and partly to coordinate the multifaceted processes within the university regarding the topic of sustainability. This centralised unit coordinates a wide range of sustainable measures and projects as part of the overarching sustainability process and is aligned with a transdisciplinary agenda setting. Whilst it does not deal solely with transdisciplinary activities, it is an example of how other governance structures can be used to support the institutionalisation of this research mode. In some cases, one limiting factor in this regard is however the continued reliance on individuals willing and able to drive this forward. We see that in many cases, initiatives have only been able to evolve in large part due to the motivations of one or more individuals to push for increasingly transdisciplinary approaches. This is one reason why more centralised, permanent structures can be so beneficial in working towards the institutionalisation of transdisciplinarity. Below we take a closer look at the **Office for Science and Society at TU Berlin,** the most established centralised unit in this regard within the ENHANCE Alliance.

Turning to initiatives at a **project-based level**, more characterised by bottom-up developments, our analysis illustrates that – following structural initiatives – these are the second most prolific within the Alliance. Whereas the impact from institutional or structural initiatives can be more indirect, ENHANCE member universities report that project-based initiatives have the benefit of delivering more concrete results in terms of outreach and societal impact. A major driving force here is that such co-creation processes are normally needs-based. A project

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is more likely to have a very focused, achievable goal, leading to a more concrete output. For this to be effective, the involvement of societal actors from the very beginning of the process is important, enabling joint definition of a problem, formulation of the research question, and conceptualisation of the project. Nonetheless, there remain challenges in how to effectively evaluate the impact of projects and ensure the sustainable integration of newly produced knowledge, also considering the funding and resource constraints within which many transdisciplinary projects must operate. In addition to better funding, specialised advice and project support can make a big difference here, and can for example be provided by central structures in the university. One example at project level is the **UPV ISAlab,** which coordinates transdisciplinary research teams via collaborative action research workshops for transdisciplinary sustainability science. International teams of Master students and PhD candidates from complementary disciplines work with societal stakeholders on sustainable urban development challenges. One of the project aims is also to equip students with the skills needed to carry out this kind of research and, in reflecting on the results of the research process to understand the social dynamics that come into play when applying transdisciplinary approaches to real sustainability challenges. Indeed, some of the challenges teams encountered included the stage of problem definition, with some participants lacking clarity or confidence in their role. Such initiatives provide valuable insight into the challenges of this research process so that adjustments can be made and the needs of participants better understood. We have selected the **Autoferry project** from NTNU for a more detailed case study below, as an example of a truly bottom-up project initiative.

A third major type of initiative mapped across the Alliance are **course-based, pedagogical initiatives** that incorporate transdisciplinary research practices. These can not only offer excellent platforms for transdisciplinary research, but also support the development of key transdisciplinary skills in both students and teachers that can support long-term capacity-building. For ENHANCE member universities, pursuing transdisciplinary approaches at a pedagogical level is fundamental to the institutionalisation of this research mode. However, it is still the case that pedagogical initiatives in particular are still heavily dependent on the motivations of individual teaching staff. Courses that are embedded into the curricula at a wider level and offered to all students would therefore be favourable. One such course-based initiative is the **NTNU programme Experts in Teamwork (EiT),** that has already been piloted across the ENHANCE Alliance and is an excellent example of how interdisciplinary skills are taught in a practical setting via experience-based learning. Student teams work together on major real-life challenges facing society, with ca. 3,300 students taking the course every year. Working in so-called 'villages', the EiT teams collaborate with external partners, including from the private sector, public administration or voluntary organisations. An ongoing dialogue with these partners throughout the programme encourages students to consider societal perspectives in their work, and external partners benefit from an interdisciplinary perspective on their project. At RWTH Aachen, a student-led Living Lab developed into the 'Sustainably Dressed' Initiative. **nACHhaltig angezogen** emerged from the RWTH Aachen Master's in Sociology programme, where a living lab on the topic of sustainable fashion, as part of a project seminar in collaboration with the innovation space BioTexFuture (a large-scale, long-term transdisciplinary project on the transition towards bio-based textiles co-led by adidas and RWTH Aachen), established itself as an ongoing initiative. Students have, for example, set up a website highlighting second-hand and sustainable fashion stores in Aachen, organised clothes swaps or second-hand markets, run an Instagram channel and network with other sustainability initiatives in the city. Another example can be found in the TU Berlin and Berlin University of the Arts (UdK) joint project **UNIversal spaces**. The spatial laboratory creates a space for open experimentation and practical and pioneering learning, that features, for example, in the TU Berlin-UdK joint MA in Design and Computation. For over 15 years Chalmers University has offered a **Master's Programme** which incorporates participatory research methods and tools through a number of **Design Studios**. We have selected this programme for the more detailed example of a course-based initiative within ENHANCE below.

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5.2 CASE STUDIES: EXAMPLES OF ENHANCE GOOD-PRACTICE

TU Berlin	Office for Science and Society	Example of top-down, institutional structures

TU Berlin has been pursuing the institutionalisation of transdisciplinarity in research and teaching for many years through a combination of top-down and bottom-up initiatives. This comprehensive process, which included internal discourse development, networking of existing transdisciplinary projects, pilot activities with societal actors, and the integration of transdisciplinarity as a research mode in the TU Berlin Transfer Strategy (published in 2021), was the basis for the founding of the TU Berlin Office for Science and Society in 2021. ENHANCE partners had the opportunity to get to know this initiative better during the TU Berlin Walk & Talk in September 2022.

An important factor for the implementation of the new structure of the Office for Science and Society was the fact that the first TU Berlin Vice-President (in the term 2014-2022) stood for election on a platform focused on transdisciplinarity. With this orientation, and the substantive mandate confirmed by the election, the topic of transdisciplinary research was gradually built up and resources dedicated to it. Following the change of the university's Executive Board in 2022, the topic was already well anchored in the structure of TU Berlin, which led to the new leadership supporting the continued development of this issue with great goodwill. Within the new board, the position Vice President for Transfer, Sustainability and Transdisciplinarity has been established, illustrating how the topic of transdisciplinarity has already been quite successfully institutionalised at the management level.

In particular, embedding transdisciplinarity within the Transfer Strategy of the entire university has awarded knowledge exchange and cooperation between science and society an important position in the long-term strategic outlook of the university and facilitated the continued development and expansion of transdisciplinary activities, spearheaded by the Office for Science and Society (Podann, 2022). One benefit of the centralised office is that projects of general strategic importance for the university can be located and developed there, for example the Laboratory for Transdisciplinary Research (TD Lab) of the Berlin University Alliance. Projects are supported in achieving greater visibility and networking opportunities. In addition, the current development of the TU Berlin university campus as a living lab is coordinated by the office.

Head of the Office for Science and Society, Dr Audrey Podann, and former TU Berlin Vice President, Prof Christine Ahrend, determine that the transformation needed to institutionalise transdisciplinarity in universities requires the review and renewal of incentive systems, cultures of recognition, career paths, and resource allocation, as well as the adaption of intra-institutional mechanisms. While the institutionalisation of transdisciplinarity may therefore require universities to adapt current thinking and structures to a degree, it does not call for any fundamental change to our core research values – the aim is essentially for transdisciplinary research to be recognised and supported in the same way as disciplinary or interdisciplinary work (Ahrend & Podann, 2021).

The Office for Science and Society is therefore clearly anchored in the top-down strategy of the university, which included a recommendation to develop structures in the university that can provide the central docking point for transdisciplinary activities, foster networking, support agenda setting, and offer advisory services. The Office fulfils this role by building the bridge between this and the many bottom-up initiatives and projects that exist. It works closely with a wide range of projects and partnerships, some with sponsorship from industry, some doing citizen science projects, some doing counselling work, and helps foster transdisciplinary approaches, including by acting as a measure of quality assurance (Podann, 2022).

A core function of the Office for Science and Society is to serve as the centralised contact and coordination point for all transdisciplinarity activities – and more broadly speaking, cooperation with society – at the university. Important tasks include providing information and advice to the President and Vice-Presidents, coordinating the various existing measures and institutions that systematically cooperate with societal partners, implementing the Transfer strategy and developing projects with central strategic significance for the entire university. Networking is also promoted nationally and internationally. All employees of the Office for Science and Society work in a service-oriented, scientific and public relations manner, and public in scientific journals. However, there are also limitations to the top-down approach. Since there is no obligation

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for departments to cooperate with this central structure, contact is not as systematic as intended and often more situation specific. What has worked particularly well with this structure is the cooperation with the local municipality, in this case the district of Charlottenburg-Wilmersdorf. Increasingly, joint projects can be developed and implemented for the benefit of both partners. Cooperation between TU Berlin and the other Berlin universities also benefits from this centralised structure. The newly founded Society for Transdisciplinary and Participative Research has for example been established in the Office for the next two years, and organises the German-speaking community of participative researchers.

The office is mainly financed by third-party funds, only two of the current 12 positions are centrally financed. This is a shortcoming of the current structure, since more positions financed by the central university budget would provide more capacity for advice and transfer to the specialist areas, which in turn would lead to even better project development and third-party funding. At the same time, the acquisition of projects in the office also makes it possible to attract motivated and innovative employees, which greatly benefits the work and also makes it more attractive for other future employees, as well as scientific and public partners.

It was the combination of top-down and bottom-up measures that proved so influential for the founding of the Office for Science and Society. On the one hand, this experience has illustrated how critical leadership-level support for the success of transdisciplinary research in universities is – it was crucial to have individuals at leadership level willing to push for the long-term implementation of this approach and work towards its institutionalisation. Dr Podann notes that, "the change management processes required to achieve this require a leadership that is open for innovation and recognises the need for closer interaction with society on big transformation questions – and therefore open to allocating funding and human resource to support this work" (Podann, 2022). On the other hand, the process to foster transdisciplinarity as a research mode that was launched by the university leadership in 2014 was able to build on a long tradition of transdisciplinarity at project level – many departments were already engaged in transdisciplinary research or some form of research in cooperation with societal actors. This surrounding environment is also vital, and the more established this work and the relationships with societal actors are, the easier it can be to demonstrate the potential of this approach to university leadership.

NTNU	AutoFerry	Example of bottom-up transdisciplinary project

The *milliAmpere2* ferry is an autonomous all-electric passenger ferry for urban water transport. It was developed as part of the Autoferry project, one of nine projects under the NTNU Digital Transformation Initiative. The initiative aims to support "groundbreaking ideas where digital technology and applied research is merged". Digital transformation processes involve a number of societal challenges, and it follows that projects within this initiative are multidisciplinary and, in some cases, including the Autoferry, transdisciplinary. The Autoferry project aims to develop new concepts and methods that will enable the development of small autonomous passenger ferries for urban water transport, and ENHANCE partners had the opportunity to see a prototype ferry in action in Trondheim during the NTNU Walk & Talk in April 2023. We thank Prof Ole Andreas Alsos for his insight into the project, which has informed this overview.

The motivation for the project was first driven by a development in the local municipality transport planning – in 2016 the municipality announced plans to build a bridge over a canal in Trondheim so that two parts of the city would be better connected. This proposal was criticised, including by the Veteran Boat Society who were concerned about the impact another bridge would have on their ability to keep their boats in the canal. The initial idea for an alternative solution to this problem in the shape of a self-driving ferry came from a member of the Veteran Boat Society, who was also a Professor in Electronic Systems at NTNU. This established connection between the university and a societal initiative, and an individual level, was therefore an important factor in the development of the project. The autonomous urban ferry was thus proposed as a more flexible alternative to building a bridge, whose construction would be very expensive and involve high energy costs. It had the potential to become a new tool for city planners – offering great flexibility for connecting previously unconnected parts of a city.

The project itself was launched in 2019, with initial funding from the university (and later from the municipality) and six PhD positions to run the project. However in reality several hundred PhD students and

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PostDocs have been involved in the project in some manner, due to its multidisciplinary nature. Autoferry brings together disciplines including Design, Electronic Systems, Marine Science, Naval Architecture, Psychology, as well as Business when it comes to the commercialisation and scalability of the project. The boat design itself was designed by an NTNU Master's student in Industrial Design. Overall, the design and construction of the ferry involved close collaboration between a number of different departments, with support from industry. The Trondheim Harbour Authority, Trondheim Municipality and the University City TRD3.0 were important partners, and the Norwegian Maritime Authority was important in addressing regulatory issues.

In September 2022 NTNU launched a prototype which has been the main experimental platform in the project. Since then, data has been collected from around 500 trips with over 1500 passengers. Ca. 100 passengers completed questionnaires before and after the ferry trip, and over 200 passengers took part in short interviews immediately after the trip. A research paper is currently being written on the outcomes of this data collection, which also includes interviews with other boat drivers, larger tourist boats, the AutoFerry safety hosts, technicians, and the Maritime Safety Authority.

A large team, involving ca. 50 people from NTNU and company partners Zeabuz and Torhatten, led the planning and execution of this trial operation. This included technicians who prepared and oversaw the systems, professional boat drivers who acted as a safety host onboard, and designers who collected data from the passengers and other stakeholders. The technology spin-off Zeabuz was founded by the university faculty involved in the project and how has 25-30 employees, of whom a majority hold a PhD from the NTNU departments involved in the project.

A second trial operation will take place this autumn with some small adjustments. This will include moving the safety host on shore to a local operation centre near the area of the operation, with access to the boat. The following summer a third trial operation will move the safety host to a remote operation centre. In addition, Zeabuz has this summer put an autonomous ferry into commercial operation in Stockholm, together with the ferry company Torghatten.

The ferry and control room are often visited by international universities and companies. In 2022 approximately 100 dissemination activities and tours were given to guests and visitors, ranging from students to government ministers and royals. The results are communicated through a range of channels, such as popular science conferences, Op-eds, scientific publications and other media. The target group for this dissemination is the public, the research community, industry and government actors, such as the Norwegian Maritime Authority, county municipality, Trondheim municipality, etc.

The project has already had a significant tangible impact on the urban transport policy in Trondheim. The municipality has now included in their transport plan the intention to use ferries instead of bridges where different parts of the city need to be connected. The hopes of the research team are that their work will ultimately lead to the creation of a regular autonomous ferry service in the city. For citizens living on small remote islands this could really change their quality of life – currently they are dependent on a limited number of scheduled ferry services, and do not have the flexibility to go to and from their homes at other times outside of this schedule. A regular autonomous ferry service therefore holds great potential for societal impact at an individual level, beyond the benefits it offers in terms of providing a more energy efficient and sustainable transport solution.

Chalmers	Master's in Architecture and Planning Beyond Sustainability	Example of course-based initiative

Since 2008 the Department of Architecture at Chalmers offers a Master's in Architecture and Planning Beyond Sustainability. This 120 ECTS programme includes a combination of theory courses, method courses, and design studios. Within the programme, there is a set of interlinked courses which focus on societal aspects of architecture and urban design, collaboration with local stakeholders, and taking a practice-oriented approach to learning. This includes studios such as Dare2Build, Design and Planning for Social Inclusion, and Reality, as well as the Master's thesis direction on Design Activism. The teaching staff behind this set of courses were

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recognised by the International Union of Architects (UIA) for their work in April 2023, with the *UIA award for innovation in architectural education*. It was in particular their innovative pedagogical work on Design Activism and the focus on collaborative pedagogical practices which was celebrated, and indeed why we have chosen to highlight this as a good-practice example of transdisciplinary course-based initiatives within the ENHANCE Alliance.

This set of courses seeks to push research agendas beyond conventional approaches to sustainability by involving methodologies and pedagogies of circulatory, emergency architecture and design activism. In this regard, it is designed to give students the opportunity to tackle real world problems and gain experience in collaborating across disciplinary and cultural borders whilst developing sustainable development solutions.

The teachers involved in the aforementioned courses have designed a co-creation methodology that is applied in a series of project-based studios. The design projects are based on real tasks and problems in society where students handle real-life situations, while immersed in the local context and in close collaboration with the local stakeholders. A toolbox has been designed for co-creation and design activism – this combination of tools, methods and concepts supports students in being able to adapt to the different challenges and includes topics such as co-creation, co-design, and co-evaluation. The studios communicate results to the public through virtual and physical exhibitions that allow for interaction with stakeholders, academics, and interested organisations all over the globe. We look at two studios in more detail below.

Design and Planning for Social Inclusion Studio

The studio was established in 2008, and runs each year from the end of September to the beginning of January. Ca. 15-30 students participate each year, and over half of the students are international, allowing different perspectives and design methods to be brought into the studio. Specifically, the studio looks at challenges and opportunities for development in suburban areas built in the 1960-70s in Gothenburg, Sweden, as part of a government initiative that aimed to provide affordable homes and improve housing standards. The studio facilities are located in one of these suburbs, which gives students the chance to work directly in the local environment. There, students work in partnership with societal stakeholders (such as public housing companies, local high schools) on real urban design and architecture projects for social inclusion in these suburbs. There is a specific focus on introducing and practicing participatory methods for citizens in co-creation processes as an important dimension of working for social inclusion.

The course was initially a joint project between Chalmers and the University of Gothenburg, who together founded the Centre for Urban Studies in the Hammarkullen suburb of Gothenburg, where the studio facilities are located. Following the closure of the centre in 2010, collaboration continued, including with additional partners and funding from the European Social Fund from 2015-2017. Since 2017 Chalmers coordinates this course alone, continuing to build on the connections established with local stakeholders throughout the first ten years of the course.

Source: DOI: 10.13140/RG.2.2.20433.97125

Dare2Build Studio

The educational framework Dare2Build aims to contribute to the continued development of higher education, towards competency-building that is targeted to the needs of the societal challenges of current and future generations. The studio immerses students in cross-disciplinary teams, who work with co-creational methods to solve practice-based tasks. This transdisciplinary learning environment is needed to address the environmental and societal transformations relevant to the urban planning and design sectors. The Studio involves collaboration between architects and civil engineers in a selected partner city each year, with a clear goal of achieving outreach and impact for the local community, and a specific topic around the theme of sustainability in the built environment. In 2023 the Studio takes place in the city of Gothenburg.

An important element of the framework is the proximity to the explorative research environment, in particular the role of Living Labs. The HSB Living Lab (HLL) at Chalmers University of Technology is a living lab infrastructure in the form of student housing, and also includes prototyping infrastructure to foster the innovation and prototyping process. Through HLL, technologies and user behaviours are evaluated through the lens of promoting sustainable innovations for the home. Business partners play an important role here as

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well, creating networks between students and companies as they work together to develop innovative solutions.

Source: DOI: 10.1007/978-3-319-33527-8_9

// 6. CONCLUSIONS

One aim of this catalogue is to support the gradual institutionalisation of knowledge exchange between science and society across the ENHANCE Alliance, by investigating the structures and strategies already present in our universities and looking at the ongoing pilots and select case studies. We have drawn on the large pool of data gathered throughout mapping exercises, structured interviews, surveys, and inter-university workshops to inform this catalogue, exploring what synergies and lessons we can draw out for the benefit of the whole Alliance and beyond. With the model of levels of engagement and societal impact, we are able to take a systematic approach to assessing how deep interaction with society is. Building on this, an even higher level of engagement can be aimed for in future. The case studies and the mapping of the projects in the partner universities therefore form an important common knowledge base that can become a basis of common action.

We have looked at the two levels of transdisciplinarity institutionalisation within the university context – both policy and practice. As Baptista explores, the policy dimension refers to decisions and actions taken to implement transdisciplinarity, while practice refers to the actual enactment of transdisciplinarity through activities and knowledge production (Vienni Baptista, 2020). In this catalogue we have reviewed the role of policy - the strategies, institutional structures, funding programmes and other policies that shape the approach of ENHANCE member universities to transdisciplinary research, and the practice – the range of projects and initiatives that employ transdisciplinary research formats and methods to tackle grand societal challenges.

We have sought to set out some of the key parameters for this research mode, and work towards establishing a pathway towards increased support for transdisciplinary research in our universities. It was important to begin with this work, and appreciate the dimensions in which all partners understand and organise cooperation with social partners. The diversity of approaches is clear, but should not deter interested stakeholders from exploring this research mode. Instead, we hope to have illustrated that there are a number of effective ways to explore transdisciplinarity – the most important takeaway is to welcome all approaches equally and be open minded to their respective advantages. By its nature, transdisciplinary research thrives on diverse, interdisciplinary teams and so there is no onus for individual researchers to bring all the necessary expertise with them – it instead offers a great opportunity to explore a problem from a different perspective and co-create sustainable solutions and knowledge.

By fostering support for transdisciplinary teaching and research practices in our universities, we enable our students to work together with societal stakeholders and encourage the future generation of academics to be more open to inter- and transdisciplinary collaborations. Developing more transdisciplinary-friendly organisational structures can support researchers, exposing the benefits of this research mode and allowing them to explore this without undue concern for the impact on their (disciplinary) career. Awareness-raising of the potential applications and benefits of transdisciplinarity must however go beyond our own institutions. The wider research and innovation communities and policy sphere are influential actors, and they too must be engaged in this debate. We have already seen some increased openness towards transdisciplinary approaches, for example with a focus on citizen science and cooperation with society in European funding schemes, but project requirements and funding schemes are often still poorly suited to transdisciplinary research.

One central conclusion of our work is that, whilst there is an abundance of established methods and tools for conducting transdisciplinary research, networks and supportive structures (the ‘policy’ dimension) for promoting this approach within universities are still limited. The institutionalisation of transdisciplinarity – anchoring this as a supported research mode at a structural level in universities – is therefore not yet fully developed. It involves

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a cultural shift in many cases, and is a gradual process. Our analysis has highlighted the importance of both top-down and bottom-up structures for the successful development of transdisciplinary initiatives, and a clear prerequisite for this is adequate political support at a programme-funding and institutional leadership level. Progress in this area is needed in order to provide more long-term clarity and support for this approach. Relying too heavily on the motivation of individual researchers or teams to drive these projects forward, despite the ongoing challenges, cannot be a sustainable approach.

With regard to the 'practice' dimension, further ENHANCE Walk and Talks will take place during the remaining project period. It has been shown that these on-site visits, where many of the local stakeholders can be personally interviewed, bring even more noteworthy projects to light and offer valuable opportunities for shared learning. It is also a format to make shared knowledge tangible. We believe that combining a common conceptual understanding, our mapping efforts and site visits such as these will allow for even more informed and systematic recommendations to be made. At the same time, the ENHANCERIA project is in itself an incubator for project ideas, since the transferability of ideas becomes very clear and trust is built up between the ENHANCE partners at an institutional level, and individual level between the scientists involved in these exchanges. Through continued cooperation and sharing of best-practice within ENHANCE we therefore aspire to continue to increase awareness and understanding of the importance of this research mode for tackling sustainability challenges and together work towards the institutionalisation of transdisciplinarity.

// 7. OUTLOOK

As mentioned before aiming to support gradually and systematically the institutionalisation of transdisciplinary research for better promoting and enabling sustainable development through transdisciplinary research in the ENHANCE Alliance the Work Package could contribute to establish a certain quality level. The aim is still to create an innovation ecosystem for the structural and strategic requirements with an adapted supporting framework at the ENHANCE Universities. Further recommendations to tackle the SDG's at the ENHANCE universities with transdisciplinary approaches and a set up of adapted toolkits for building frameworks of anchoring a permanent knowledge exchange between science and society are necessary. On the practice level, a testbed for working on a joint agenda could possibly be given through the development of a joint transdisciplinary project conducted through integration experts and decentralised structures with resources at each University. On the strategic level, the TU Berlin innovation ecosystem could serve as a role model and mediator for supporting applications as research funding possibilities or engaging in institutional networks for transdisciplinary research. Another step and on basis of the Walk & Talk format is to strengthen the further method development for implementing the shared knowledge at the ENHANCE Universities. This could foster the role of ENHANCERIA in creating a transformation agenda for the ENHANCE alliance.

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// ACKNOWLEDGEMENTS

We would like to thank all ENHANCE partners for their valuable contributions to this Catalogue, including all members of ENHANCERIA Work Package 3: *Sustainable Development through Transdisciplinary Research,* and other colleagues whose insight and expertise has supported our work.

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Funded by the European Union's Horizon 2020 research and innovation program grant number 101035806