**Centre for the study of innovation policy for industrial transformation, sustainability and digitalization (INTRANSIT)**

* 1. **Rationale and objectives of INTRANSIT**

The global economy is on an unsustainable course. This urgently needs to be changed, as almost all countries in the world have agreed upon, seeking to tackle some of the grand societal challenges of the 21st century, including climate change, depletion of natural resources, sustainable food production and ramifications of digitalization among others. The desired direction of economic change is thus set, and as envisaged in the Paris Agreement and the UN sustainable development goals, it is now up to each country to develop and implement policies that enable the transition to a more sustainable economy and society. Research and innovation (R&I) policies are key resources for achieving this aim. However, it is also widely acknowledged that traditional research and innovation policies have not been developed to handle such complex tasks (Janssen, 2018; Kuhlmann & Rip, 2018; Schot & Steinmueller, 2018). A fundamental rethink of the meaning and content of R&I policy is therefore needed. Traditionally, R&I policy has focused on increasing innovation efforts to generate higher levels of value creation and economic growth. R&I policy for meeting grand challenges entails setting directions for novel efforts that can contribute to solving societal problems, as well as changing the course of existing activities that are no longer seen as socially desirable. Meeting grand challenges moreover requires broadening the perspective on what constitutes R&I policy to include industrial policy and policy domains that influence the demand for new solutions (Weber & Rohracher, 2012). Transformative innovation policy can broadly be defined as an attempt to mobilize innovation in the pursuit of UN’s sustainable development goals, which also include efforts to diversify industrial structures and underlying capabilities towards more sustainable endeavors (Janssen, 2018). Key roles of policy is to identify transformation barriers and to support change efforts in established sectors as well as the development and growth of new industrial and technological capabilities in areas that are socially and economically desirable. This is indeed a complex task that requires detailed knowledge of industrial transformation processes and how they interrelate with broader socio-economic, political, geographical and cultural developments.

With this in mind, the INTRANSIT Centre has one overall mission: *to understand how industrial transformation towards a more sustainable and smarter Norwegian economy can be fostered*. To achieve this, our aim is threefold. *First,*we investigate the preconditions, drivers and barriers for transformation processes towards smarter and more sustainable development in significant Norwegian economic sectors. *Second,* we address how the growth of new and sustainable industrial niches can be supported by generating new insights into the relationship between transformations of existing industries and the development of new niches. We regard these as necessary steps towards the *third* aim, which is to understand how R&I policies can support the development of a smarter and greener Norwegian economy and society.

Norway is a small and open economy that is highly dependent on natural resources, particularly the oil and gas (O&G) sector that currently is one of the most innovative, fast growing and export-oriented parts of the economy (Thune et al., 2018). Other important natural resource-based sectors include for example fish and farming and process industries. In Norway advanced manufacturing and service sectors (e.g. ICT) are often connected to the resource-based sectors as well, and particularly to petroleum. Given Norway’s natural resource-oriented industrial structure, technological upgrading, diversification and industrial transformation towards a greener and smarter future are the strategic goals of Norwegian industrial policy (Meld. St. 27, 2017). Given the high dependence on export earnings from O&G the long-term robustness and resilience of the Norwegian economy has increasingly been questioned. On the other hand, gradual reduction in oil production over the next decades may provide windows of opportunity to reorient resources towards a more diversified industrial structure and a greener and smarter industrial palette for improved environmental and economic sustainability.

How such processes occur and evolve, and how they can be supported by R&I policy is the main research topic of the INTRANSIT Centre. The basic assumption is that we regard industrial transformation as an outcome of interaction between established and new industries. This interaction is conditioned and mediated by broader context dimensions, requiring a multi-level systems perspective that also addresses the role of firms and other actors in transformation processes. Against this background, INTRANSIT employs at socio-technical transitions perspective as its theoretical core, while drawing on other theoretical perspectives from several related fields to articulate an industrial perspective on transitions. With these considerations in mind, the key research questions posed in INTRANSIT are:

1. What are the most important drivers and barriers for industrial transformation and in what directions are industrial development efforts currently proceeding and expected to proceed in the future? To what extent is the current direction of change conditioned by past developments and achievements?
2. How diversified are Norwegian industries and in what directions are established industries currently diversifying? To what extent is there a link between diversification efforts of established industries and formation and growth of new industries and firms? How does this vary between sectors and regions?
3. What characterizes industrial transformation processes towards becoming greener and smarter? How specific are such processes to industrial, regional and firm contexts?
4. What is the connection between the increasing prevalence of ‘smart’ technologies and transformation processes involving digitalization and the transition towards a more sustainable economy? How do these processes interplay, and how do they play out at the industry as well as firm level?
5. What role do existing research and innovation policies play in industrial transformation processes? How can policies and policy instruments be developed for greater impact on transforming the Norwegian economy towards a smarter and greener one?

By addressing these questions, INTRANSIT aims at developing novel, high quality scientific knowledge that contributes to fill important knowledge gaps and create high impact for users and stakeholders.

**1.2. State of the art and knowledge gaps**

INTRANSIT will investigate the ongoing transformation of the Norwegian economy using a socio-technical transitions perspective as the theoretical basis (Geels 2002; Geels & Schot, 2007). Transition studies have emerged over the last two decades as a response to the need for researchers to address grand societal challenges, an area of research where standard approaches within R&D policy and innovation studies seem inadequate (Schot & Steinmueller, 2017). This also implies a normative standpoint in that the economy and society *needs* to develop in a certain direction. In this section, we first briefly present what we mean by a multi-level perspective (MLP) on socio-technical transitions and how this relates to industrial transformations. We then outline important knowledge gaps, and review state of the art on these issues. Because industrial transformation is a topic that is addressed in many disciplines, we also draw on insights from economic geography, management and organizational theory, entrepreneurship and innovation studies, and R&I policy studies.

*1.2.1 A socio-technical transitions perspective on industrial transformation*

A key notion in the literature on socio-technical transitions (or transition studies) is ‘system innovation’ which accentuates that ‘innovation as usual’ – or support to the development and diffusion of new products, services and processes, will be insufficient to meet the grand challenges our economies and societies are currently facing (Geels 2004; OECD 2015, Markard, et al., 2012; Martin 2012; Elzen, et al., 2004). Transition studies provide process-oriented perspectives on how new technological solutions over time develop and potentially outcompete established solutions. Within the MLP a transition is defined as a process of major technological change within a specific societal sector, or stated differently, a major shift in the way a specific societal function (e.g. mobility, energy) is performed (Geels, 2002). The MLP explains socio-technical transitions as an outcome of the complex interplay of dynamics at three different levels: landscape, regime and niches. Regimes constitute the core 'rules of the game' (i.e. institutions) and are made up of multi-actor networks representing routinized ways of solving a specific societal function. They are “dynamically stable”, in the sense that new developments tend to be incremental and thus extend established technological trajectories. The generation of radical novelty is seen mainly to occur in technological niches that are pockets of experimental work protected from conventional market selection processes, for instance by being supported via policy instruments. Niches thus represent the “seeds for change” in socio-technological systems, but their ability to gain momentum and upscale is contingent on regime developments as well as developments at the landscape level (referring to broader contexts and factors such as e.g. global commodity prices or consumer awareness) that puts pressures on the regime and opens new windows of opportunities.

Research on socio-technical transitions has so far provided important insights into the stability of established sectors, the emergence of new technologies, and their patterns of interaction. Commonly such interaction is studied as “substitution” whereby niches ultimately replace dominant regimes. However, even early studies in this tradition acknowledged various types of transition pathways (Geels & Schot, 2007). For instance, some niche-regime interactions may be disruptive whereas others may co-exist or have symbiotic relationships. Geels and Schot (2007) discuss four different *transition pathways*: transformation, de-alignment/realignment, substitution, and reconfiguration. In the substitution and de-alignment pathways, developments at the landscape level pressures the regime to the extent that it de-aligns, opening up for one or several new technologies to take root and potentially overtake the existing regime. In the other two pathways, elements of niches are absorbed and blended with regimes in ways that change key elements of the established regime.

The perspective is also supported by evidence from innovation studies, management studies and economic geography showing that innovation and the emergence new industries often rely on demand from established sectors (Robertson et al., 2003; Sandven et al.,2005), are based on re-combinations of extant resources and capabilities (Schumpeter 1934; Helfat & Eisenhardt 2004; Bathelt, 2009), and draw on resources that are geographically “sticky” (Boschma & Frenken 2011; Asheim & Isaksen 2002). This research points to continuity in terms of resources and capabilities rather than disruption and discontinuity. Recent research on the geography of sustainability transitions (e.g. Boschma et al., 2017; Coenen et al., 2015) has moreover highlighted sectoral and geographical context-specific dimensions of transition processes. The conditions for industrial transformations vary immensely not only between sectors but also between countries and regions depending on resources and assets, positioning in (global) value chains or production networks, institutional settings, policy mixes and social capital (Grillitsch, et al. 2018). These are focal points of INTRANSIT; we aim to understand conditions for transitions towards a sustainable economy and society by looking specifically at transformations of existing sectors and how the transformation of established sectors and growth of new niches are interconnected.

With the MLP as a key theoretical backbone of our proposal, we note three specific shortcomings in the literature. First, the current transitions literature focuses on systems and system change with relatively little attention on industries (understood as the 'production side' of regimes (Steen & Weaver, 2017)) and firms, the importance of value creation and economic restructuring and growth, and how such ambitions can be combined with a sustainability transition (Boschma et al, 2017; Fagerberg, 2018; Foxton, 2017). This research gap calls for a better understanding of both sector-specific transformation processes and further knowledge on the role of both incumbent and new entrant firms.

Second, we know little about the interplay between sustainability transitions and the diffusion of general purpose technologies such as ICT. Transition studies typically study single technologies (e.g. solar PV, water treatment technology) (Markard, et al., 2012). It has however been argued that the cluster of ‘sustainability technologies’ and the cluster of ICT technologies will, at some point, become mutually reinforcing drivers of development (Perez 2014; Mathews 2017), but such assumptions are yet to be underpinned by empirical research. The increasing pervasiveness of digital technologies and the greening of industries needs to be addressed in tandem, however as transformation pressures they are not only very different but their effects will play out differently in different sectoral and geographical contexts.

Third, as mentioned the transitions studies literature has traditionally pivoted around studies of single technologies or sectors without attempts to aggregate policy insights to inform a nation-wide, yet multi-scalar transition policy. Recent work has proposed new R&I policy concepts (e.g. Mazzucato, 2017), but still struggles with operationalizing what this entails in practice. An important argument in this line of work is that a transition requires directionality, however it is far from clear how R&I policies (and other policies) can steer developments in a desired direction, nor do we have a good understanding of under which conditions firms and other actors themselves provide directionality. These gaps are important to fill in order gain a better overall understanding how industrial transformation can be fostered. As such studies of the transformative effects of R&I policy and the intersection between different domain policies and their effects in specific contexts, are important research questions (Fagerberg, 2018) which INTRANSIT is devoted to. Before we outline the detailed research program to address these gaps in the next section, we first review the state of the art on each question separately.

*1.2.2 Industries and firms in transitions*

The literature on sustainability transitions has traditionally not had firms or industries as their main focal point, but increasingly scholars are addressing firms’ and industries’ roles in transition processes drawing on insights from e.g. innovation and management studies. Transition studies have tended to focus on either incumbents or entrants and their differential abilities and roles in transition phases, or comparing incumbents and entrants. Most transition and innovation scholars view incumbents as conserving actors, while newcomers are associated with the development of radical innovations and new niches (Smink, et al., 2015; Späth, et al., 2016, van Mossel et al. 2018; Farla et al. 2012). Particularly in the context of sustainability transitions, entrepreneurial firms have been conceptualized as a major conduit for new products, processes, and services, with a strong ambition to transform existing industries or create new ones that address social and/or environmental concerns (Cohen & Winn, 2007; Dean & McMullen, 2007; Pacheco, et al., 2008).

This dichotomy is, however, increasingly questioned (van Mossel et al., 2018; Wesseling et al., 2015). First, incumbent actors may play a dual role by both developing existing and new technologies even if those new technologies are potentially competitive with core lines of business (Ansari & Krop, 2012; Bergek et al., 2013; Berggren et al., 2015; Steen & Weaver, 2017; Patala, et al., 2017). Incumbent firms may therefore display rather different behaviors during a transition, such as early movers, late followers or inert behavior (van Mossel et al. 2018), however there is limited empirical research on this issue to date. Another topic that has not been sufficiently addressed is interaction between incumbents and new entrants and what the higher-level outcomes of for example collaboration between such actors are for transition pathways.

One reason for such knowledge gaps may be that systems-oriented and more agency-oriented theory (e.g. entrepreneurship, management, organizational studies) have largely developed independently of each other, calling for much needed research bridging the two. Such broadening of scope to illuminate systemic transitions at the firm and organizational level is not only necessary to clarify the role of agency and interfirm collaborations in transitions (Smith, et al.. 2005), but also to advance insights into the dynamics and feedback loops at various levels of analysis to more fully illuminate the driving factors, processes, and outcomes of transformations of entire systems. We thus argue that the interplay and collaboration between incumbents and entrants, and outcomes of such organizational interaction for entire industries and systems is an important topic for both innovation management and systems-oriented research.

To the extent that firms and industries are tied also to regional innovation systems, the question becomes how particular regions can contribute to sustainability transitions while levering historically developed place-based assets and capabilities (Boschma et al., 2017). Given the well-documented path dependency of industrial specialization of countries and regions, the extent to which resources and competences underpinning an economy’s existing industrial specialization can be retrofitted and redeployed to support a sustainability transition, will arguably by a key determinant for the prospects of combining a transition with a prosperous industry transformation that ensures value creation and capture domestically. Taking this one step further, redeployment of extant resources and capabilities may be the only politically feasible as well as the overall lowest-cost transition pathway. The questions of industrial diversification at national and regional level has received considerable attention in policy discussions and research (Neffke et al, 2018) but only recently been addressed in transitions related research.

At the same time successful industrial transformation (i.e. that generates domestic value creation and capture) will be contingent on the ability of both (transformed) established actors as well as new entrants to connect or 'strategically couple' with the demands and needs of lead firms and other key actors in global production networks or value chains that are, as seen for example in the new renewable energy industries (MacKinnon et al., 2018). This is of course especially important for export-oriented industries.

INTRANSIT aims to contribute to transition studies by cross-fertilizing and developing novel frameworks for better accounting for these important aspects and thereby fundamentally improving our understanding of firms, industries and industrial transformations in transitions. This includes both the role of and interplay between incumbent and entrepreneurial firms, the role of regional dynamics in promoting sustainable transformations of industries, and broader – global - industry dynamics in which transformation processes unfold. We refer to this task as articulating an industrial perspective on sustainability transitions.

*1.2.3 The role of digital technologies in sustainability transitions*

Supporting development and diffusion of new technologies is considered to be an important policy tool towards sustainable development (Nill & Kemp, 2009). What has received less attention than studies of the evolutionary trajectories of disruptive “clean technologies” (Geels, 2018) is how the diffusion of multiple technologies impact on sustainability transitions (Papachrsitos et al, 2013). Geels (2018) has called for studies that look at broader repertoires of change mechanisms that can play a role in systems transformations. Specifically, addressing transformations of entire systems entails looking at the development and diffusion of specific technologies across a range of socio-technical regimes. One broad set of enabling technologies affecting developments in most sectors of society is ICT or digital technologies, but they are rarely thematized in the transition literature.

According to Dicken (2011: 80) the digitization of the economy is "without doubt, the most pervasive and influential technological development in recent years". Digital technologies can be defined as ‘‘products or services that are either embodied in information and communication technologies or enabled by them’’ (Lyytinen, et al., 2016: 49) and include digital infrastructures like the Internet of Things, digital platforms (a shared and common set of digital architecture that hosts complementary offerings), and digital artifacts in new products or service designs (Nambisan, 2017).

A core challenge in understanding the role of ICTs in industrial transformations and transitions is the level of complexity as ICTs are not modular solutions but connected into webs of interconnected systems and socio-technical relations. At the firm level, the increasingly digitized world poses new challenges and opportunities for innovation strategies, organization and business models. Digitalization will also likely have a significant impact on employment, and groups of employees will be affected differently. These are topics that research has just recently begun to tackle (e.g., Briel et al., 2018; Nambisan, 2017; Yoo, et al., 2012; Aanestad & Jensen, 2011). At the industry level, the way of doing business in the digital age and the impact of ICTs will differ industries and a differentiated approach at the industry level will be needed to better understand the barriers and drivers of sustainable digital innovation. This, in turn, may hold fundamental implications for industrial transformations and associated large-scale transition processes in multiple industries.

There are many examples of how digital technologies could enable developments in more sustainable directions. For example, in Geels’ (2018) recent study of transformation of the UK mobility system, the pervasive diffusion of ICT is seen as an enabler for changes in travel patterns of passengers. Another example is how the convergence of Internet and mobile technologies has generated platform-based business models that can empower local consumption networks by shortening supply chains between farmers and consumers and supporting peer-to-peer sharing of goods (Frenken & Schor, 2017; Frenken, 2017).

The possibly enabling role of digitalization in the context of sustainability transitions is therefore an important research topic on which there are many good examples and considerable hype, but limited systematic knowledge (Seele & Lock, 2017). Some authors (e.g., Mathews, 2017; Perez, 2015) claim that pervasive digitalization will have a profoundly and mainly positive impact on sustainability transitions. Perez (2015) envisions a new “green golden age” where environmental crisis translates into new economic opportunities enabled by ICTs. Examples of how digitalization is expected to have positive impact on sustainability includes reduced depletion of natural resources and energy consumption, increased efficiency in production, changed mobility and consumption patterns through platforms for sharing resources, increased knowledge and information enabling better choices, enlargement of niche markets for sustainable solutions and increased communication and participation in governance and networks for promoting sustainable choice and change. The potential negative impacts should also be addressed, including increased inequality, loss of jobs, in addition to increased consumption and other negative impacts on sustainability (Røpke, 2012).

Perez (2015) claims that the global economy currently is in the middle of the ICT revolution and that there are still large potential gains to be reaped. The prospects for succeeding in this depend in her view crucially on policy-makers’ abilities to give the ICT-revolution an appropriate direction, which she suggests to call “green”, implying among other things a transition to a more sustainable economy. Perez’ insistence on seeing technological, social, institutional and political change as interrelated processes is very much at the core of INTRANSIT. However, the insistence on seeing ICT as a “driver” of change implies to see the unfolding sustainability transition as a side-effect made possible by ICT rather than being a driver in itself. A more nuanced lens, however, is needed as ICTs consume an increasing share of energy, pose substantial security concerns, and potentially create rebound effects if energy efficiency gains given by digitalization are consumed unsustainably. Moreover, prior studies have mainly targeted electricity and mobility sectors, as well as changed consumption behavior. The impact of digital technologies in enabling green transformations in other sectors (e.g. manufacturing or the bioeconomy) has received scarce attention. As suggested by Dolata (2009) we assume that the impacts of digitalization will vary considerably across sectors.

It is the ambition of INTRANSIT to address this question by investigating how digital technologies can enable change towards sustainability in industrial settings. We thus acknowledge that while green transformations and digitalization are different and bring separate challenges and opportunities, they need to be studied in tandem as both drive processes of industrial transformation. Conceptually, we approach the interaction between the ICT sector and other sectors as multi-sector interactions in transitions which is yet to receive theoretical scrutiny (Andersen & Markard 2017; Papachristos, et al., 2013; Geels 2018). Empirically, key issues to be addressed are under which conditions "smart" and "green" are complementary as well as under which conditions ICTs are stabilizing (e.g. generating productivity improvements) or destabilizing the sectoral regime by facilitating new entrants, business models or interaction patterns.

*1.2.4 A policy perspective on transitions*

Curbing greenhouse gas emissions in accordance with the Paris agreement and developing a more sustainable society and economy in correspondence with the UN sustainable development goals will require extensive changes in knowledge and technology, regulatory frameworks, economic structures, policy and governance arrangements, life styles and consumption patterns. A key premise in recent policy perspectives on sustainability transitions is thus that the changes needed are fundamental (i.e. require “deep transitions” (Kanger & Schot, 2018) and that they address changes in the production system of the economy (the traditional realm of innovation and industrial policy) as well as in the demand-side and even system innovations (Elzen, et al. 2004). With this perspective on change, the role of policy and governance is seen as more important than in traditional innovation systems perspectives (Weber and Rohracher 2012; Tödtling and Trippl 2018), but also highly complex and uncertain.

Where early studies within the transitions literature pivoted around studies of single technologies or sectors without attempts to aggregate policy insights to inform a nation-wide transition policy, there has recently been a surge of attempts at developing new policy concepts such as eco-innovation policy (Kemp, 2011), transformative innovation policy (Steward, 2012), mission-oriented innovation policy (Mazzucato, 2017) and ‘innovation policy 3.0’ (Schot & Steinmueller, 2016). A key issue underpinning these efforts is a criticism of traditional notions of R&I policy and the knowledge base on which such concepts were built (Schot & Steinmueller, 2018, Mowery et al., 2010; Weber & Rohracher, 2012), suggesting that current challenges facing the economy and society cannot be solved with the tools of the past. Sustainability transitions, indeed, will require interaction between policy areas to develop effective policy mixes (Rogge & Reichhardt, 2016; Frenken, 2017).

First, a broader policy perspective is necessary in order to understand the barriers confronting a 'green shift' within a sector or most often at the intersections of several sectors. Whereas classical R&I policy aimed to remedy market failures, sustainability transitions warrants that systemic and transformational failures (Weber & Rohracher 2012) are addressed. Policy formulation must be guided by the need for providing directionality and spelling out clear missions (Perez, 2016; Mazzucato, 2017), and policy agencies need increased attention on managing expectations, negotiation and governing efforts across multiple policy areas and stakeholder groups (Fagerberg, 2018; Schot & Steinmueller, 2016; Kuhlman & Rip, 2018). The role of the state in actively shaping markets and systems as well as remedying market failures by taking on entrepreneurial risk (Mazzucato, 2017) is highlighted. However, it is still uncertain how efforts to increase directionality in policy can be fostered. Since concerted efforts to address grand challenges are seen as necessary, broadening the participation in the policy process beyond R&I policy alone is important (Schot & Steinmueller, 2016) and a more experimental and learning intensive policy process is advised (Sengers et al., 2016; Kivimaa et al., 2017).

System innovation requires not only the introduction of new types of public policies and policy approaches – it also involves challenging established industries, policies and handling the many negative side-effects of innovation (Geels, 2014; David, 2017). If some solutions (such as renewable energy) are to be prioritised, other solutions may need to receive less support. This typically will lead to conflicts, negotiations, and power struggles involving (political/non-political and state/private/civil sector) actors and groups with different interests and ideas. Studying such processes of negotitations, often with attention to the role of incumbents and vested interests, has become an important research area within the sustainability transitions field (e.g. Markard, et al., 2016; Normann 2015; Kern & Rogge 2017; Geels 2014; Lockwood et al. 2016; Meadowcroft 2011). The role of established industries is important in terms of political legitimacy for a transition i.e. the feasibility (or not) of introducing strong policy measures in support of a transition. This is because incumbent actors are less likely to attempt to block or slow institutional change if they can envision a role for themselves in a post-transition economy (Andersen & Gulbrandsen, 2018). Broadening the focus to explore also how powerful actors (e.g. large firms or policy think-tanks) actively shape the institutional context for their solutions (i.e. institutional entrepreneurship) is a relevant study object in this regard (Battilana et al. 2009).

This latter focus entails that research interest has shifted from prescribing policy or analysising the effects of policy, to studies of how polices are developed. To do so, transitions scholars have drawn on a variety of policy process theories (Kingdon 2011; Marsh & Smith 2000; Sabatier & Weible 2007), which allows for systemic assessments of how different actors participate and shape the policy process. Such analyses should include firms and other relevant stakeholders such as trade unions, business coalitions and other lobby organization, political parties and different actors in the policy system. One avenue for studying opportunities for transformative policy is to identify goals that can unite actors with different interests (Köhler et al, 2017), and explore how a broader set of policies might help create the space for such common goals.

One important topic that remains to be sufficiently addressed is on how policy can mobilize private business to engage proactively with sustainability transitions. There is also a need to look further at how R&I policy can contribute to diversifying existing industries. Two complementary policy strategies can be explored. First, knowing that firms are reluctant to change their knowledge base, policy can focus on supporting new market niches into which such existing knowledge can be put to use in new ways (Boschma et al. 2017; Steen & Weaver, 2017). Directing innovation policy at the demand side also provides a way to integrate sustainable production with sustainable consumption policies. Second, as firms are not likely to make substantial investments in unrelated knowledge bases, R&I policy has an important role in lowering risks in experimental diversification projects and in connecting unrelated fields of knowledge (Cooke, 2011; Neffke et al, 2018). Such activities are likely to be promoted locally, as collaboration across knwoledge fields and industry, require proximity, faciliated by reduced geographical and social/institutional distances (Boschma et al., 2017).

With these reflections in mind, the INTRANSIT Centre will build on and extend current research on transformative R&I policies, particularly addressing “system change”. Here, policy and politics is an object of study object in itself, yet importantly connected to our ambition to study how private sector actors attempt to shape R&I policies as well as the broader policy context. We also aim to look at the effects of existing R&I policies and policy mixes for industrial transformations, specifically with the aim of understanding transformation failures (Weber & Rohracher, 2012) and development of polcies to adress them. Finally, we assume that these two rather different perspectives on policy research need to be better integrated, as understanding how policies are parts of established regimes and vested interest, is neccessary for an imporoved understanding how polcies work and how they can be developed.

* 1. **Research design and approaches in INTRANSIT**

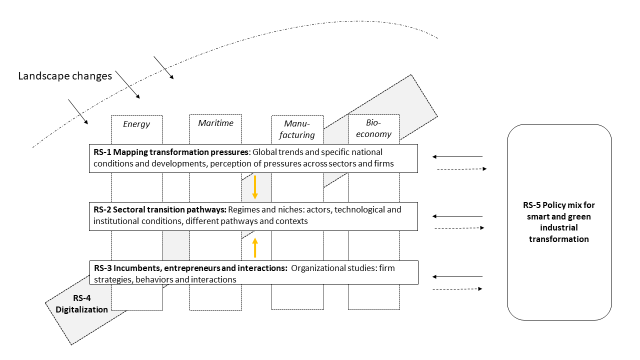
*1.3.1 Research design – a matrix of empirical pillars and thematic research streams*

In sections 1.1 and 1.2 we identified three significant knowledge gaps to which INTRANSIT aims at contributing by employing an overarching perspective that links industrial transformations to socio-technical transitions. This also frames more specific research topics and approaches. In line with transitions thinking, an empirical approach to address smart and green transformations of the Norwegian economy will need to follow processes of change – or pathways – at the macro (landscape), meso (regime and niches) and micro (actor) levels and their interconnections. As discussed previously transition pathways are not uniform but context- and sector-specific. Whereas moderate changes may be needed in some sectors others will be subject to profound changes and may not exist (at least not in their current form) in the not-too-distant future. The magnitude of change involved in sector transitions thus needs to be taken into account, because pathways that are in many ways continuous differ substantially from those that are discontinuous.

Empirical work will thus be designed to shed light on differences and similarities in transition pathways in different industrial sectors and across different kinds of transformation processes. Increased attention to agency and improved understanding of incumbents and entrants alike is important, while simultaneously understanding how agency is conditioned by sectoral and spatio-economic characteristics, and vice versa. Neither regimes nor niches are necessarily defined by national borders but are often connected to global developments and value chains while being spatially embedded in particular regions and localities. *Figure 1* summarizes the theoretical reflections that underpin the research design including an identification of the focal sectors we seek to investigate. This, in turn, serves as the basis for the organization of the research activities in INTRANSIT.

*1.3.2 Empirical pillars – four sectoral case studies*

Research work in INTRANSIT reflects the interrelated macro, meso and micro levels in a transition analysis. Empirical analysis will be based on detailed studies of four sectors (energy/petroleum, maritime/shipping, bio-economy/aquaculture, and manufacturing, all of which include their supply chains for construction and operation) that are important to the Norwegian economy and whose successful adaptation to green and digital transformation pressures will have major implications for Norwegian value creation potential and employment in coming decades. Norwegian regions are also specialized within some of these sectors, although the focal sectors are also large and also distributed across the whole country.

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**Fig. 1: Research design in INTRANSIT**

The four focal sectors that constitute the empirical backbone in the overall research design are examples of relatively mature industries with established regimes (Wicken, 2009), whereas the general-purpose technology sector ICT cuts across them. As stated previously INTRANSIT differs from conventional transition research in that we do not focus on societal functions (e.g. energy, mobility) but rather on how transformative pressures caused by decline in O&G, meeting grand challenges (e.g. climate change) and digitalization will impact on these sectors that represent vital parts of Norwegian productive capability (Fagerberg & Shrolec, 2017) as well as how and to what extent they will (have to) transform. All four sectors are subject to both green and smart transformation demands, albeit in different ways, and they also have many overlaps. Comparative analysis across these sectors will enhance our understanding of industrial transformation/transitions and the role of policy in facilitating and supporting necessary changes. We will briefly describe the sectors before outlining research streams and tasks in detail.

**Pillar 1: Smart and green energy production - focusing on oil and gas**

The petroleum sector faces substantial transformation pressures towards reduced cost-levels, reduced emissions, the broader transition from fossil to renewable energy while also adapting to a more resource-scarce and demanding production context. The sector is affluent, knowledge-intensive and highly globalized (Reve and Sasson, 2012) and has historically invested heavily in research and innovation, including ICT and digital technologies (Thune et al., 2018). Historically, the sector to large extent developed based on resources and capabilities from shipping/maritime competences and hydro-power, whereas current supply chains are multi-sectoral (Thune & Makitie, 2018). This legacy raises optimism in terms of prospects for future restructuring. There has been considerable emphasis on efficiency, standardization and digitalization in recent years, and O&G has been a global front-runner in the use of remote/robotized solutions as well as big data technologies. Increased digitalization is nonetheless important to maintain competitiveness. The "greening" of the O&G sector encompasses a range of initiatives and plans (e.g. CCS, power from shore or from offshore wind farms) and an increased emphasis on natural gas. In a medium- to long-term scenario the O&G industry faces pressures to transform away from fossil fuels altogether and find new growth paths in for example renewable energy or aquaculture (Mäkitie et al., 2018; Steen and Weaver, 2017; Winther et al., 2017).

**Pillar 2: Smart and green transport - focusing on maritime**

The transport sector is experiencing a rapid transformation with the introduction of "greener" energy fuels and carriers and also digitalization (e.g. autonomous vehicles and ships). The maritime shipping sector (MSS) is highly internationalized and constitutes (together with O&G and aquaculture) one of Norway's "global knowledge industries" (Reve and Sasson, 2012). The Norwegian fleet is comprised of a high share of advanced vessels whereas domestic service/product suppliers are in the global forefront of technological development for maritime application (Mellbye et al., 2015). This applies both to "green" (Steen, 2018) and "smart" (DNV GL, 2017) technology. In recent decades the offshore O&G industry has articulated strong demand for sophisticated vessels, machinery and solutions (Fagerberg et al., 2009; Reve and Sasson, 2012). A decline in O&G could thus result in diminishing innovation drivers for the maritime sector. In terms of becoming "greener" numerous mainly incremental innovations in design/engineering/equipment have contributed to energy efficiency gains (Rusten, 2010). Most ships still run on fossil fuels whereas a number of different low- or zero-carbon energy technologies (e.g. battery-electric, hydrogen) are in various stages of development and diffusion with public procurement playing a key role in niche stimulation (Bergek et al., 2018). Regarding digitalization there are clear links to sustainability issues (e.g. advanced software for power control systems), and digital technologies are being implemented across the industry (e.g. in engineering and design, operations).

**Pillar 3: Smart and green manufacturing – focusing on process and fabrication**

The manufacturing sector constitute a diverse set of industries with their own particular value chains and dynamics. INTRANSIT will cover both fabrication (e.g. furniture, auto parts) and process (e.g. metallurgical) manufacturing industries. Both of these (broad) types face various pressures to become greener (reducing energy use and emissions, implementing 'circle economy' measures) and smarter. Process industries have already seen substantial emission reductions (and production increases) whereas future emission cuts that can ensure continued domestic value creation hinges on implementation of new process technologies and continued attention to energy efficiency (Norsk Industri, 2016). Many process industry firms are now owned by multinational firms. A broader local and national embeddedness of these firms in supplier relations, including R&D relations, would be required to secure growth through new Norwegian green and smart technology with global market potentials. By contrast restructuring in fabrication industries has involved outsourcing of manufacturing and domestic upscaling of design and development. Recently, reshoring of manufacturing has occurred, partly because robotization and automation has improved competitiveness (Lund and Steen, 2018). In new low volume products for industry and infrastructure, particularly those with a heavy ICT hardware and software component, structuring of these new industries depends on voluminous science-based development work and on-site prototyping. Other adaptive strategies include mass customization, combining technologies of high volume automation with technology, logistics, and design adapted to one-off products. In terms of greening, the focus in this industry is on e.g. waste reduction and recycling rather than emission reductions, whereas the introduction of advanced digital technologies is expected to have profound effects on industry dynamics and organization.

**Pillar 4: Smart and green bioeconomy - focusing on aquaculture**

The value creation prospects from the bioeconomy has gained increasing attention in recent years both globally and nationally (NFD, 2016). Within bioeconomy INTRANSIT will focus on the Norwegian aquaculture sector which is expected to grow substantially in coming decades (Reve and Sasson, 2012). Innovations within a range of areas (e.g. feedstocks, pen technology, breeding, vaccines) have allowed for a rapid production increase over a relatively short time period. This growth has however come with various environmental costs and concerns (Osmundsen and Olsen, 2017), especially related to biological and ecological issues such as fish health (e.g. antibiotics, lice) and the overall feedstock resource equation (Trondsen, 2013). More recently some attention is being paid to reducing GHG emissions, e.g. by implementing power from shore on pens and new energy solutions on vessels. Meeting these challenges while maintaining the ambition to upscale production dramatically in coming decades will require development and diffusion of radical innovations (NFD, 2016). Also in the aquaculture sector digital technologies are expected to have pervasive effects on operations and value chains.

INTRANSIT researchers will collect and analyze data and compare sectoral development paths, using a multilevel perspective. To allow for a structured comparative approach, data protocols and joint data collection will occur across the four sectoral studies. Analysis will be based on a mixed-methods research design that includes large-scale quantitative analysis of statistical data, sectoral firm level surveys, interviews and documentary analysis. The specific empirical work and analytical tasks performed are described below. Analytical generalization across and to other sectors and contexts will be a key target for INTRANSIT.

*1.3.3 Research streams*

**Research stream 1: Mapping transformation pressures**

RS1 addresses the question of "green" and "smart" transformation pressures on focal sectors. This includes how pressures are experienced by actors as well as current and foreseen types and directionality of transformation processes. Understanding transformation pressures and potential future pathways also requires an understanding of historical trajectories of the focal sectors given mechanisms of path dependence in sectoral and systems change. This requires grounding the issue of transformation pressures and pathways in knowledge on the history of key Norwegian industrial sectors and regions.

Task 1.1: Taking stock

A first aim in RS1 will therefore be to establish a solid knowledge foundation for understanding recent and ongoing industrial transformations in Norway. For this we will draw on our comprehensive research experience on innovation and industrial change in Norwegian sectors and regions, including recent and ongoing projects on e.g. the petroleum, manufacturing and maritime sectors. T1.1. will also review the (global) research literature on socio-technical transitions, industrial and regional transformation and R&I policy literature to provide a SOTA synthesis of the existing knowledge. From this we aim to distill an extended analytical framework that outlines sector- and context-specific factors (key actors, institutions, policies, geographical scales, etc.) that affect the way transition pathways unfold.

Task 1.2: Transformation pressures.

This task will focus on the four focal sectors outlined previously, major transformation pressures and how these are perceived by key actors, and also assess current types and directions of transition pathways (based e.g. on prevalence of niche activities). For this we will draw on existing documentary evidence (prior research, industry roadmaps and reports) and participate in events (seminars, conferences) organized by industry and/or public actors. We will also invite industry experts and representatives from business organizations, clusters and policy-making bodies (national and regional) to take part in a foresight study to assess current status and perceptions of future developments. In addition we will employ novel data-mining approaches to study industry-wide attention to transformation pressures and directionality, inspired by the dialectical issue lifecycle method (Geels and Penna, 2012)

**Research stream 2: Industrial transformation processes across four sectors**

RS2 focuses on how focal sectors react to transformation pressures identified in RS1 while taking into account context conditions (e.g. knowledge infrastructure, value chain organization, policy, natural resources, regional factors). A main aim of RS2 is to pursue cross-sector comparative analysis across the four focal sectors using transition pathway theory.

Task 2.1. Comparative sector pathway analysis.

This task includes mapping sector regimes, promising emergent niches, and their interplay over time including key actors, key industrial networks, technology value chains, institutions, and spatial distribution of activities in the four sectors described above. Mapping transition pathways in each sector will be done using two empirical strategies – one focusing on regime changes and the second one on niches: 1) We will use event history analysis focusing on recent history (last 15 years) to understand developments in actor compositions, key technological developments (and scientific developments underpinning introduction and diffusion of new technologies) and key institutional developments, within each focal sector and across different geographical scales . The event history analysis will rely on documentary data, available statistical data and interviews with industry experts in each sector. 2) The second approach is to study the emergence and growth of novel niches (market and/or technological) within each sector and analyze how such niches relate to established regimes and geographical context within each sector (Bergek et al., 2015). This analysis will be based on mapping activities in 1.1 and 2.1, and by surveys to samples of firms in the different focal sectors, performed in collaboration with industry and/or cluster organizations.

Task 2.2 Case studies of regime-niche interactions.

To gain deeper knowledge on the issue of regime-niche interactions, and the issue of diversification and resource recycling in transitions, task 2.2 will identify and analyze cases of diversification and exchange in and across the focal sectors as an approach to study regime-niche interactions. Doing so, we will also pay attention to the spatial contexts in which such activities occur, given that different regional contexts provide different conditions for such interactions. This will extend work already performed by the team within areas such as O&G-offshore wind and O&G-marine industry interactions and novel uses of marine infrastructures (Steen & Weaver, 2017; Makitie, et al. 2018).

Task 2.3. Analysis of implications for value creation and capture.

By employing a global production network approach this task explores how and to what extent the transformation processes observed in tasks 2.1-2.2 as well as other research streams generate changes in the spatial (where economic activities are located), structural (the composition of firm types e.g. in a given sector), and functional (the nature of firms' economic activities) patterns of industries. A key focus will be on the implications of both green and smart transformation on processes of value creation and capture in different sectors and regions, as evidenced e.g. by firm value chain upgrading and changes in regional employment. The task will be based primarily on qualitative data derived from interviews with both 'lead firms' and their suppliers in the focal sectors, and survey data collected in task 2.1.

**Research stream 3: Incumbents, entrepreneurs and interaction**

RS3 addresses the organizational perspective in transformation processes by studying firm-level strategies and behaviors in relation to the pending sustainability transition. RS3 aims at acquiring fundamental theoretical and empirical knowledge on the roles and relationships of incumbents and new entrants, their interactions, and the role of digital technologies in enabling or facilitating such collaborations. This stream complements the system-oriented analysis in RS2, by focusing on the agents, their behaviors and interactions.

Task 3.1. Analysis of incumbent firm behavior and strategies.

This task will conduct in-depth process studies of how and why established firms (incumbents) develop particular strategies for meeting transformation pressures including the degree and direction of firm-level changes, but also the rationale and strategies of de novo entrants and how these interact with incumbent firms. Identification of specific case firms will be identified through the mapping work in RS1 and sector studies in RS2. This task will draw on interviews and documentary data on firm behavior, their investment decisions, and their strategic direction.

Task 3.2 Analysis of incumbent-entrepreneur interactions.

While research on the management of innovation and technology has highlighted the many challenges that incumbent firms face as they seek to navigate technological transitions, little is known about how incumbents and entrants collaborate during periods of transitions, and what higher-level outcomes of such collaborations are for pathways towards green innovation. This task focuses on identifying and mapping collaborative efforts between incumbents and entrants during periods of transition across the four focal sectors. This task will perform a large-scale data collection effort of incumbent-entrant collaborations across the focal sectors (and other Norwegian sectors, incl. ICT) to better understand the role of collaboration and potential transfer of knowledge and expertise between incumbents and firms in emerging niches. The task will be performed by using available data sources on R&D and innovation collaborations (as described under 5.2), as well as collecting and analyzing data applying novel “big data” research tools, including extracting and statistically analyzing relevant data on e.g. firm partnerships and mergers and acquisitions from reports of private and public organizations, industry associations, press releases, and industry magazines.

**Research stream 4: Impact of digitalization on transition pathways**

Here we address the question of the linkage between digitalization and greening of industries and sectors. To address this question, three tasks will be performed.

Task 4.1. Analysis of digital and green interactions.

This task explores the role of digital technologies in sectoral transition pathways, with particular focus on 1) the conditions under which "smart" and "green" growth are complementary, and 2) under which conditions ICTs serve to stabilize the green trajectories within established regimes (e.g. generating energy and material productivity improvements) or enable new green trajectories destabilize a regime by facilitating new entrants, business models, energy technologies or materials. This also entails paying attention to potential unwanted or negative effects, such as job instability and inequality. This will be studied by identifying case studies within the focal sectors where digital technologies seemingly are contributing to greening of industry such as enabling autonomous, electric freight shipping, automation of manufacturing, or control systems of aquaculture. Case studies will be based primarily on qualitative data (interviews, reports, documents etc.).

Task 4.2. Analysis of digital platforms and their role in transitions.

To further extend the understanding the link between digitalization and transition pathways, this task focuses on the transformative capacity of digital platforms on the focal sectors in terms of disintermediation, geography, and (data) ownership structures. The analysis will focus on how platforms disrupt, and sometimes empower, traditional large-scale business and their value chains, and will look both at business-to-consumer (b2c), peer-to-peer (p2p) and business-to-business (b2b) platform business models. These platforms not only match efficiently supply to demand, but also collect and commercialize data on people, places and transactions, and enable new business models that hold the promise of sustainable consumption e.g. by goods being provided on-demand or being shared b2c, p2p or b2b. This task explores new platform-based business models, their success or failure in different geographical and sectoral contexts, the role of incumbent businesses, and how they are affected and respond. The task will be based on case studies and a comprehensive quantitative mapping of platform-based business models in the four respective sectors, including a regressions analysis regarding the factors driving the success and failures of platforms.

Task 4.3 Digital technologies and inter-firm collaborations.

This task generates insights into the role of digital technologies in fostering or hindering collaboration between incumbents and entrants. Building on and extending research efforts in RS 3.2, we will analyze the role of digital platforms and digital infrastructures in interfirm collaboration. Prior research on digital platforms and infrastructures has shown that they are important communication and coordination tools among organizations and other actors, that may generate innovation by changing conventional products, sectors and organizational boundaries (Tiwana 2014; Hoholm et al., 2018). Working with the in-depth cases identified through RS 3.2., 4.3 investigates via interviews and observations how incumbents and entrants jointly orchestrate digital platforms and infrastructures, how such a collaborative process re-configures organizational boundaries, and re-defines the role of incumbents and entrants during transition phases.

**Research stream 5: Policy for smart and green industrial transformation**

RS5 focuses on how the existing mix of policies and policy instruments contribute (or not) towards realizing the goal of system transformation and industrial change, to identify strengths and gaps in the existing policy mix and to suggest avenues for experimental policy work. There is also currently a push for development of new methods to evaluate impact of policy on industrial transformations (Janssen, 2018), looking at the extent to which policies support increased diversification and new connections in the science, technology and innovation activities. A multi-scalar approach is important, as policies emerge both at national, sectoral and regional levels. Methods to address policy impacts on transformation is a rather novel field and requires further work, experimentation and testing. This research stream will study these questions in three related, but different approaches

Task 5. 1: Analysis of existing policy-mix for sectoral transformation.

This task will perform a study of the policy mix that support industrial transformation in the specific case sectors. The empirical analysis here will be based on the sectoral studies in RS-2 and mapping work in RS-1. Three interlinked activities will be included in this task: 1) A detailed mapping of the R&I policies that influence innovation activities in specific societal sectors will be carried out. This will include policy tools focusing on upstream innovation activities, but also demand-oriented policy tools that can facilitate market entry and success with innovative solutions over time (Boon & Edler, 2018). 2) Mapping of how firms perceive and use policy tools in specific innovation processes or projects. The data that will inform this research activity will be a combination of survey data and in-depth interviews with selected firms collected in task 2.1 and 4.1. 3) We will analyze the processes that led to a set of policy goals and tools. We will here also study policy processes that led to failed attempts to implement goals and tools. The selection of goals and tools for this activity will be informed by the mapping of firms perception of policy tools, initial interviews with policy-makers, and insights from the case studies in research stream 2,3 and 4. In this part, we will pay particular attention to how the different goals and tools align with various interest groups. This entails looking at documents, advisory board composition, in addition to additional interviews with policy stakeholders.

Task 5.2: Policy-impact on diversification and knowledge interaction.

This task will perform an analysis of the project portfolio supported by R&I policy tools and the extent to which the current portfolio of activities and projects has enabled firms to develop new networks or whether the exiting tools lead to segmentation in established techno-industrial structures. Inspired by Janssen’s (2018) diversification policy impact framework, we will specifically address whether Norwegian firms engage in repeated interactions with the same organizations or whether firms engage in diverse networks and in different technological domains over time. This represents a bottom-up perspective on the role of R&I policy for industrial diversification and exchange of knowledge and technology between sectors. A dynamic network analysis of the R&D project portfolio of the NRC (Simensen & Abbasiharofteh, 2019) is underway as TIK already has access to network data for the whole NRC project portfolio, as well as network data from Cordis. Repetition of this analysis and similar analyses can be performed on the network structures contained in other policy agencies’ project portfolios (such as IN and Enova, potentially regional actors’ policy tools can be included as well) on their abilities to transfer competences and resources across fields of knowledge and areas of industrial application. This latter activity must be carried out in collaboration with users, as it is necessary with contributions and data from policy agencies to perform such tasks.

Task 5.3: Policy learning and development workshops**.**

A fundamental insight in recent policy work on innovation policy for transformation is that policy development needs to be opened up and become more learning oriented and experimental. This learning orientation to policy development is grounded on the insight that policy for addressing transitions and levitating grand challenges is something very different than traditional policy approaches. Learning from experiences of other regions and countries and addressing policy development in a more open, process oriented and experimental way is neither problems or solutions are presently well conceived. As part of this discussing and comparing different countries’ approaches to policy development for industrial transformations towards smart and sustainable economies will be performed. Relevant experiences from countries such as the Netherlands, Germany, Finland, and Korea will be reviewed and discussed, as well as examples of regional policy development. In addition to synthesis of policy developments in different countries and regions, this task will also organize interactive policy workshops involving international R&I policy experts (see SAB), representatives of Norwegian policy organizations, firms and third-sector organizations.

**Table 1: Summary of research streams, main research staff involved, links and user interactions**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Research streams | Responsible | Leader/Partners | RQs | User interaction |
| RS-1 Trans. pressures  *1.1Tacking stock*  *1.2Trans. pressures* | Andersen (PI)  Wicken/Frenken  Andersen/Steen/ | TIK  TIK/UU  TIK/Sintef | RQ 1/5 | Exploratory workshops, foresight exercises, broad involvement |
| RS-2 Sectoral pathways  *2.1 Comp. pathway ana.*  *2.2 Regime-niche cases*  *2.3 Value creation* | Steen (PI)  Steen/Thune/Finne  Andersen  Steen/Græsli | Sintef/TIK  Sintef/TIK  TIK/Sintef  Sintef | RQ3  RQ3  RQ2/3  RQ2/3 | User board workshops  Liaison in data collection and analysis phases  Collaborating with industry orgs/clusters |
| RS-3 Agents -interactions  *3.1 Incumbents*  *3.2 I-E interactions* | Soppe (PI)  Steen/Græsli  Soppe | IFI/Sintef  Sintef  IFI | RQ 1/2/3/4 | User board workshops  Liaison in data collection and analysis phases (survey, interviews, cases) |
| RS-4 Digital impacts  *4.1 Dig–green int.*  *4.2 Dig. platforms*  *4.3 Dig. Collab.* | Frenken (PI)  Andersen  Lorenz  Aanestad | UU/IFI  IFI  UU  IFI | RQ 3 | User board workshops  Liaison in data collection and analysis phases (survey, interviews, cases) |
| RS-5 Policy  *5.1 Policy-mix*  *5.2 Portfolio analysis*  *5.3 Policy workshops* | Thune (PI)  Truffer/Wanzenböck  Castellacchi  Thune/Fagerberg | TIK/all  TIK/Sintef/UU  TIK  All/SAB | RQ5 | Liaison in data collection and analysis phases  Analyzing data (RNC, IN, Enova, Cordis)  Policy workshops and user board |

**2. Significance of establishing the centre**

The INTRANSIT centre will generate fundamental knowledge with significant relevance for policy development. The establishment of the centre will foster national and international cooperation in the fields of transitions research, industry studies, and research and innovation policy studies, both among leading research organisations in these fields and in interaction with users and policy developers. Moreover, the centre will lead to higher concentration of research activities in this field in Norway. The centre is expected to generate substantial additionality effects in the Norwegian research sector, since the Research Council of Norway’s financial support will trigger new activities and results that would not be achieved without this support. In particular, the centre will consolidate research environments that have considerable empirical research experience on these issues, with the aim of developing broader theoretical perspectives. Consequently, a lot of activities in the centre is devoted to PhD and post-doctoral work (9 positions) and to reinforce connections between research and policy communities nationally and internationally. A long-term centre like INTRANSIT will also be able to develop user interaction on systematic basis, allowing for a stronger learning orientation both among research and policy communities.

INTRANSIT brings together three organizations (four research groups) that approach the topic of smart and green industrial transformation in different ways. The set-up of the consortium with expertise on digital technologies and business models, sustainability transitions, industry studies, entrepreneurship research, research and innovation policy and economic geography is novel and will be important for accomplishment of the goals. Expertise on both technology, policy, agency and systems focused transitions research is necessary to accomplish the research objectives.

Through the set-up of the centre with the two research groups at the University of Oslo as the main hub, we aim at tight integration of the activities with frequent meetings and exchange of personnel among the partners. The four research groups that will join the centre have distinct areas of expertise and specialisation that make them particularly relevant for the research issues to be investigated, but they also have a good track-record as collaborators of research projects, joint PhD training and publication work to build on. Building on prior collaboration and experience developed through extensive empirical studies will enable the centre to move quickly into both analytical and policy development work. Research groups at UiO, Utrecht and SINTEF have been partners in FME Censes and several ongoing research projects. INTRANSIT will also collaborate with other research centres at the University of Oslo and Sintef that work on issues connected to digitalization and transformation within specific industrial contexts, such as the SIRIUS centre at IFI and SFI Manufacturing, where Sintef Digital is partner.

The TIK centre already has a centre funded by the FORINNPOL schema (OSIRIS). INTRANSIT is however borne out of the “transitions research group” at TIK, and partnership with the DIGENT group at the Faculty of Mathematics and Natural Science entails that a broader research community is involved in INTRANSIT at the University of Oslo. This is a valuable contribution seen from the University of Oslo’s perspective, and reinforces a strategy of cross-disciplinary research supported by the University of Oslo leadership (UiO’s Strategic Advisory Board, 2014). Although the research themes are rather different, the experiences with the OSIRIS Centre has been valuable when organising INTRANSIT. Coordination between the two centres will also be easy, and we will organise some activities, particularly in relation to methodology workshops, writing retreats, PhD supervision and other activities that will strengthen both centres. Some of the methodologies employed by OSIRIS (process tracing methods) and the socio-technical perspective on sustainability transitions are similar in the two centers, and we will develop joint methodology workshops for the mutual benefits of both centres. Interaction with users and particularly policy development work can also be coordinated. Strict reporting procedures will be in place to avoid cross-subsidizing between the two centres.

**3.** **Organisation and governance of centre**

The host institution will be the University of Oslo, and it will be jointly coordinated by the **Centre for Technology, Innovation and Culture (TIK)** and the **Digitalization and Entrepreneurship (DIGENT)** section at the **Department of Informatics**. **TIK, the main contract partner,** is an interdisciplinary centre at the Faculty of Social Science, University of Oslo. TIK is the leading Norwegian academic institution in the fields of transition studies, innovation studies and research and innovation policy studies. The centre has grown substantially in recent years, and has today a staff of around 50 employees, organised in two research groups. TIK has a PhD programme that currently enrols around 25 PhD students. The centre also has two Master programmes on science, technology and innovation studies. The centre coordinates a large number of externally funded projects, including an ERC Starting Grant, and participates as coordinator and partner in national and international research centers, including CenSes and OSIRIS. TIK recently got a very favourable assessment in the SAMEVAL research assessment exercise, and was commended for its high quality, high impact research activities. TIK also has substantial experience with dissemination activities and dialogue with users and policy developers.

TIK’s research staff includes some of the most highly cited Norwegian researchers in the fields of research and innovation policy studies. Professor and research director **Taran Thune** will be the Director of the INTRANSIT centre. She has worked for more than 15 years on science and technology policy research and also on studies of industrial transformation questions, and has during the last years coordinated a large research project on the transformation of the Norwegian petroleum industry (SIVAC). Thune has significant research leadership experience, having been leader of the research and innovation policy section at NIFU and currently leads the innovation group at TIK, as well as coordinator of numerous projects for the Research Council of Norway and other funding agencies. Several senior researchers from TIK will be involved in INTRANSIT. Senior Researcher, **Dr. Allan Dahl Andersen** will lead research stream 1. He has significant experience from studies of transitions in areas such as energy, petroleum and agriculture. Professor **Jan Fagerberg** (emeritus from sept. 2018) is a leading international expert on the economics of science and innovation and has extensive experience in empirical research on the effects of R&D and innovation, as well as science and innovation policy questions at large. Fagerberg will participate in work stream 5, and will serve (and co-ordinate) the scientific advisory board. Professor **Olav Wicken** is an economic historian and has built up the transitions research community at TIK. He will contribute to RS1 and 55. TIK’s Director **Dr.** **Fulvio Castellacci** is also an expert on the economics of R&D and innovation will contribute to RS5 Associate Professor Markus Bugge economic geographer will participate in research stream 1 and 2, as will **Dr. Jens Hansson**, expert on interaction between incumbent industries and renewable technology niches. **Dr. Håkon Normann** and **Dr. Maria Tsouri** will contribute to RS1.

**DIGENT** is a newly established research section within the Department of Informatics (IFI)/Faculty of Mathematics and Natural Sciences at the University of Oslo. **IFI**, a pioneer in computer science in Norway, hosts the country’s leading expertise on ICT. The department offers a wide range of study programs (800 undergraduates, 450 master students, 220 PhD students), is involved in numerous research projects as well as centres for research excellence (e.g., SIRIUS, HISP), and has a strong interdisciplinary research focus combining natural and social sciences. **DIGENT** was established by bringing together previously successful research groups within the department: the earlier Centre for Entrepreneurship and researchers from Information Systems and Information Design. The establishment of DIGENT reflects an important ambition of the Department: to advance research on the diffusion and impact of digital technologies on individual, economic, and social life, including organizational value creation activities. **Associate Professor Birthe Soppe** will be the principal investigator of RS3. She has a strong international research background in organization studies, with a focus on entrepreneurship and technology management. Soppe has studied the emergence of green and digital industries, including interfirm collaborations, in various countries, and holds significant research and leadership experience as the head of the research cluster on entrepreneurship at IFI and the previous leader of the Program Council for the Master’s Program in Entrepreneurship. **Professor Margunn Aanestad,** Head of DIGENT, will be involved in RS4. With a background in both Informatics and Organization Studies, she is a leading expert on digital transformations. **Professor Bendik Bygstad**, Professor of Digitization and Entrepreneurship, studying the digitalization of organizations as well as IT strategies/leadership, will serve on the scientific advisory board.

Research partner SINTEF is among the largest independent research organizations in Europe with a strong international track record in R&D in technology, science, social science, and medicine. **SINTEF's Department of Technology Management** and its research group Innovation and Management recently transferred to SINTEF Digital, underlining a strategic growth initiative for SINTEF's social science activities related to digital and green transitions in industry and society. SINTEF's strategic partner agreement with the University of Oslo and the routinely occurring cooperation projects between the two partners make for a tight, smooth, and highly valued integration of INTRANSIT. The research group in SINTEF is involved in national and international studies of green transitions in shipping, manufacturing, renewable energy technologies and more. The research group in SINTEF is also a research partner in SFI Manufacturing and has studies digitalization in multiple industries and firms. SINTEF's principal investigator and leader of RS2will be **Dr.** **Markus Steen**, senior research scientist, an economic geographer who combines an understanding of global competitive pressures with place-based innovation resources and the strategies of individual firms in his studies of socio-technical systems transitions. He will contribute to RS 2 and 3. **Håkon Finne**, a senior research scientist with a hybrid engineering – social science background and extensive international experience will contribute to RS2. Dr. **Lisa Græslie** will contribute to RS2 and 3, and **Eli Fyhn Ullern and Assiya Kenzhegaliyeva** will contribute mainly to RS2.

Research partner, the **Copernicus Institute of Sustainable Development** is the scientific institute for sustainability research and teaching of **Utrecht University**. The institute aims to contribute to the transition to a sustainable society through scientific excellence in a multi-disciplinary environment. The most recent research quality assessment (2014) ranked Utrecht University’s Copernicus Institute of Sustainable Development first in The Netherlands in environmental-science and sustainability research. The principal investigator in Utrecht University is **Koen Frenken,** who is Full Professor in Innovation Studies. He acts as Utrecht’s coordinator in the project and the Principal Investigator of Research Stream 4 on digital impacts. Frenken has a background in economic geography and innovation studies, and has lead multiple research projects. He has extensively studied economic development at national and regional levels as well as technical change and industry dynamics in various sectors. More recently, he analyses the rise of online platforms from an economic and institutional perspective. Dr. **Annika Lorenz** is Assistant Professor and has a background in economics of innovation and management studies. She holds extensive experience in research on open innovation and disruptive technologies. Her research focuses on disruptive digital business models and the role of strategy and collaboration, and will contribute to RS4. Dr. **Iris Wanzenböck** is also Assistant Professor and has a background in regional science, economic geography and political science. She did extensive research on inter-regional collaboration networks and their effect on regional innovation and development. Iris also specializes in science, technology and innovation policy will contribute to RS5. **Professor Bernhard Truffer** is a full professor and chair in the geography of transitions at Utrecht University and will work in RS 5.

*3.2 Coordination and governance*

In the INTRANSIT centre, research work will be distributed among the partners. To achieve coordination and integration, we will meet regularly both at the centre and research stream level. The partners will spend a substantial amount of time at UiO in order to maximise synergies, concentration and co-location effects. Second, supervising and supporting junior researchers will as far as possible occur across organisations, PhD students and postdocs will have stays at least at one of the other partners. Collaboration between the research partners will take the form of ordinary scientific interaction, such as development of joint publication databases, methodology development, joint data gathering, analyses and co-authored publications. In addition, we will organise four types of larger workshops at the centre level: scientific workshops, PhD/post doc workshops, policy workshops and conferences (see milestone plan).

The centre will be managed by a **director and a deputy director** from the UiO. They will be responsible to follow the centre’s research activities and the related administrative, recruitment and economic aspects. An extended **steering group** will contain the other PIs and a representative of the funder will meet once every semester. Discussions of allocations of activities in the ‘10 % lot’ can also be coordinated in steering group meetings.

The centre will also have a **scientific** **advisory board**. This will gather a multidisciplinary mix of scientific and policy experts that can give advice to and become engaged in the centre’s activities, and in particular, to participate in the policy workshops organised in RS5. The following persons have confirmed participation in the advisory board: Professor **Stefan Kuhlmann**, University of Twente; Dr. **Jochen Markard**, ETH Zurich; Dr. **Karoline Rogge**, SPRU; Dr. **Patries Boekholt**, Innovation Policy Matters; Professor **Marko Hekkert** Utrecht University; Professor Bendik **Bendik Bygstad,** UiO and Professor **Jan Fagerberg, UiO** (emeritus).

INTRANSIT will also set up a **user partner board** that will meet annually to discuss strategic priorities and development of activities in the centre. Being a point of contact between researchers and industries/firms/policy makers in data collection and participating in dissemination activities are tasks for user partners. In addition, researchers can work directly on research tasks that are particularly relevant for one or several users, including policy analysis, experimental policy work or development of policy workshops. The following organisations have confirmed interest in serving on the user board: **GCE Blue Maritime, NCE Energy Technology, Innovation Norway GCE Aquaculture, Digital Norway and Zero**.

**4. International cooperation and networks**

The centre will strive to maintain a strong international presence and impact. All senior researchers in the INTRANSIT team have extensive personal networks and regular presence at international conferences and policy consultancy forums. The group plans to have a strong presence at conferences such as the annual international sustainability transitions conference, EGOS, regional innovation policy, EuSpri, AoM etc, and will organise and convene special tracks and sessions at these and others based on ongoing research activities. Furthermore, we will organize workshops and thematic meetings with international partners and our advisory board to discuss our research insights and challenges. We will also host the annual International Sustainability Conference which is the main international academic conference for innovation and sustainability research globally, with an overarching theme ‘transitions and industrial transformations’ at midterm. The SAB will also be an important platform for international collaboration and exchange both for senior and junior INTRANSIT scholars, and we will set up a consortium for the development of an ITN with partners and SAB members during the center period, and support individual applications to the Marie Curie program. We also intend to use the INTRANSIT centre as a platform to develop new project applications to ERC and the Horizon Europe program.

**5. Relevance of centre**

We have developed the centre’s thematic and management framework to address the primary objectives of the FORINNPOL programme, as well as the specific requirements of the call. Regarding the fulfilment of the programme’s objectives, the INTRANSIT centre will produce high quality - high impact research, promote national and international research collaboration, and lead to synergies and concentration effects in Norway. INTRANSIT will promote multi-disciplinary research by combining several fields of knowledge, and will enhance recruitment and training of a new generation of young researchers.

Regarding the specific requirements of the current call, our description in the previous sections highlights that INTRANSIT focuses on what is defined as the main goal of the call, namely to study how research and innovation policy can be developed to support transformation of Norwegian industry, towards “less dependence on oil and increased environmental sustainability and a more diversified industrial structure. In addition to a green shift, digitalisation is an important driver that can accelerate transformation (…)”. The INTRANSIT centre targets directly these concerns by looking at smart and green industrial transformation processes, and the role of R&I policy in supporting this process.

The INTRANSIT centre seeks not only to study transformation processes and distil policy advice, rather we base the design on an “engaged scholarship” model (Van de Ven, 2007), collaborating and working with stakeholders and users to analyse, experiment and facilitate an open dialogue on issues connected to policy for industrial transformation. This, by nature, entails looking broadly on policy for transformation and addressing policy change at multiple levels, by interacting with regional, national and international policy communities. This includes both R&I policy organisations such as Innovation Norway, Enova and the Norwegian Research Council, and regional and local agencies such as cluster organisations, regional authorities and non-governmental policy organisations. Due to the interactive platform that we intend INTRANSIT to be, the centre will have high relevance for key user groups, for research and innovation policy targets and development needs, which is another major objective underlying the FORINNPOL programme

Moreover, in INTRANSIT we have chosen to focus on industrial transformation in four sectors that are important to the Norwegian economy and whose successful adaptation to green and digital transformation pressures will have major implications for Norwegian value creation in the decades ahead: The energy/petroleum, maritime, bio-economy, manufacturing sector. These sectors, and particularly the three first ones, are connected to national strategic research priorities such as “oceans” and “energy” (Long-term R&D plan), and all of them are important domestic sectors currently transformed by enabling technologies such as digitalisation in ways that changes business models and production capability in Norway (Industry White paper 2017; Digital21-strategy 2018). Such developments will be important for the ability to keep production capability in Norway, but also enable competitiveness in global technology niches, such as petroleum technology, renewable energy technologies, and marine technologies (Governmental strategy for green competitiveness, 2017). INTRANSIT will therefore contribute with new knowledge on how goals of the “long term R&D plan” and the strategic ambitions of the recent “Industry white paper”can be realised, with a specific focus on the industrial R&I activities and how they are connected to broader transformation pathways in industrial sectors, regions and firms.

**6. User dialogue and communication**

As seen, user dialogue and communication is an integral part of the overall research design. From the start, INTRANSIT plans to work with users and stakeholders, and plan multiple meeting points and interaction platforms. The viewpoints and experiences of users are important sources of data, and the empirical research planned requires contribution from stakeholders in industry and policy. We consequently foresee involving users both in the design and data collection phases, and in the communication of results. Moreover, as policy and policy development is a key target in INTRANSIT, working with policy makers in understanding the policy process, policy tools and development of policies is important. This entails that INTRANSIT will work with policy making bodies, such as the NRC, Innovation Norway, Enova and others, to investigate both how existing policies work and how they can be developed (for instance as part of the 10% work). Consequently, both in the research streams, and through dialogue meetings, foresight exercises, and regular meetings with the user board.-

Communication of results from INTRANSIT will be a mix of traditional scientific formats and summaries of project results in the form of policy briefs, blog posts and media contributions. We will also develop further the use of visual, digital media in communication of research results and develop a website, where reports, presentations, blog posts and more will be available. (See the communication plan in application form)

**7. Research training**

The centre will have an important role in capacity building. Recruitment of several PhDs and postdocs will contribute to long-term competence development in questions connected to STI policy for sustainable development and industrial change. These positions will be integrated in all partners’ research environment and will be expected to have a stay at one of the partner institutions as well. Joint supervision for PhDs and mentoring of post docs will be effectuated

The TIK Centre has its own PhD program, enrolling about 30 PhD students. TIK is member of the NORSI PhD School for innovation studies and TIK can organise PhD courses in NORSI as well as for the University of Oslo’s Summer School in Comparative Social Sciences and on its own. Furthermore, TIK has two Master programmes enrolling 30 new students every year. These programmes provide an excellent platform to foster a broader interest on INTRANSIT related themes among students. Among other things, there is a separate module on innovation and sustainability transitions that attracts attention of a large number of students. We will use research resources and staff to strengthen both the PhD and master level teaching at TIK. Master student projects will be assigned annually, and these will contribute to the overall research program.

DIGENT has a PhD program and is also provider of PhD courses to the Department of Informatics, and organises two large bachelor as well as three master programs (MSc in Entrepreneurship, IT and leadership, Informatics design) in which results from INSTRANSIT will not only foster learning and educating the students, but particularly the MS students will also be able to work, through their master theses, on INTRANSIT related themes. In addition, DIGENT has emerged as a hub for the nationally renowned Gründerskolen (GS) – an award-winning internship program for Master students for innovative and practice-oriented entrepreneurship education. INTRANSIT, with its research insights, will be able to develop small trainings for the students on topics related to digital and sustainable entrepreneurship.

Researchers at SINTEF also act as supervisors for students at various NTNU study programmes (e.g MS in Entrepreneurship, Innovation and Society) and expect to enrol several master students into the research centre. The Copernicus Institute has many PhD students, who enrol in the faculty wide PhD program in geosciences. They also teach two bachelor and five master programs, of which two are in innovation and sustainability related topics. All partners will set up a system to involve master students in research activities during their master thesis period.

**8. Gender balance**

Efforts have been taken to ensure that the centre has a balanced mix of male and female researchers. There are six female senior researchers involved in INTRANSIT and it is to be directed by two female professors (Thune and Soppe). We will aim at maintaining a balanced gender composition also in the PhD and post doc group, as well as in the scientific advisory group.

**9. Milestone plan**

The centre’s progress plan is outlined in the following table, and the related milestones and list of deliverables are also reported in the electronic submission form.

Regarding the plans to extend the centre’s framework after the funding from the Research Council will be ceased in 2026, the centre’s staff will use the INTRANSIT platform to develop new project applications to ERC the European Commission and the Research Council scheme to support top-level researchers. We also plan to apply for an Innovative Training network, during the late stages of the center’s funding period.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Year*** | ***2019*** | | | | ***2020*** | | | | ***2021*** | | | | ***2022*** | | | | ***2023*** | | | | ***4*** | ***5*** | ***6*** |
| ***Quarter*** | ***1*** | ***2*** | ***3*** | ***4*** | ***1*** | ***2*** | ***3*** | ***4*** | ***1*** | ***2*** | ***3*** | ***4*** | ***1*** | ***2*** | ***3*** | ***4*** | ***1*** | ***2*** | ***3*** | ***4*** |
| **0. Coordination and comm.** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Start-up, prep. infrastructure |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Centre meetings |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| PhD/post doc meetings |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SAB meetings |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| User board meetings |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Larger conferences |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **RS1 Trans. pressures** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1.1 Tacking stock |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| *DL: Position papers* |  |  |  | X |  |  |  | X |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1.2 Transformation pressures |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| *DL: Report and roadmaps* |  |  |  |  |  | X |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **RS2 Industrial trans. process** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2.1 Comparative sector analysis |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2.2 Regime-niche cases |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2.3 Value creation analysis |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| *DL: Papers, book on comparative study, cases* |  |  | X |  |  |  |  |  | X |  |  | X |  |  | X |  |  |  |  | X | X | X | X |
| **RS3 Agents and interactions** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 3.1 Incumbent behavior |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 3.2 I-E network analysis |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| *DL: Papers and book chapters* |  |  |  |  |  |  |  |  | X |  |  |  |  | X |  |  | X |  |  | X |  |  |  |
| **RS4 Digital impacts** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 4.1 Green – digital int. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 4.2 Dig. Platforms |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 4.3 Dig. collaboration |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| *DL: Papers, case collections* |  |  |  |  |  | X |  | X |  |  | X |  |  |  | X |  |  |  | X | X | X |  |  |
| **RS5 Policy** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 5.1 Policy mix |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 5.2 Portfolio analysis |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 5.3 Policy workshops |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| *DL: policy maps, maps of project portfolio, position papers, country studies, papers* |  | X |  | X |  | X |  |  |  | X |  |  |  | X |  |  |  | X |  |  | X | X | X |
| **Recruitment and training** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| PhD 1 (UU) RS5 (5.1) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| PhD 2 (UU) RS4 (4.2) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| PhD 3\* (IFI) RS3 (3.2) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| PhD 4 (IFI) RS4 (4.3) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| PhD 5 (TIK) RS2 (2.1) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| PhD 6\* (TIK) RS5 (5.1/5.2) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Post doc 1 (TIK) RS1/2 (1.1/2.2) (methods/survey) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Post doc 2 (TIK) RS2/3 (2.2/2.3/3.1) Cases |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Post doc 3 (IFI) RS3 (3.2) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| *In addition research assistants, adjuncts and visitors on a continuous basis* | | | | | | | | | | | | | | | | | | | | | | | |

**10. Budget and own funding**



**11. Costs per partner**



**12. Costs and contributions**

