An Evolutionary Tree Framework for a Fair and Inclusive Twin Transition in Europe

Special Session: Twin Transition and its Unequal Geography

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Abstract.

The FITTER-EU project addresses critical challenges to help ensure that a fair and inclusive twin transition encompassing both green and digital transformation, in Europe are delivered. The project takes a process-oriented approach with the aim to replicate and extend it to multiple contexts/sectors throughout Europe. For benchmarking purposes, the project implements the approach in six use cases - Germany, Hungary, Italy, Ireland, Spain, and Portugal, covering four important sectors - Energy, transport, building, and agri-food/agriculture. This paper introduces an innovative evolutionary tree framework to map the project's developmental stages from data collection to the final policy-relevant outputs, similar to the evolution of a tree through the seasons —Winter (Research inputs and foundation), Spring (Progression and fine-tuning of research towards actionability), and Summer (policy-level decision-making - Influence, Impact, and Guidelines)—each illustrated by distinct figures (Figures 2–4). The fruit-bearing "Summer" season in the FITTER-EU project becomes possible through the development of the FITTER Digital Platform, which is powered by an intelligent decision-support system for policymakers. Thus, the platform is the fruit, or the manifestation of the project research work carried out across the preceding seasons, including data gathering, scenario building, vulnerability mapping, along with complex operation insights. It is symbolic of the strength of the roots that support the FITTER-EU evolutionary tree and that ultimately help produce the fruit. The digital platform will be used to identify and mitigate risks of social exclusion among vulnerable groups during the twin transition. Preliminary outcomes include the development of scenarios for a vulnerability risk assessment with respect to the socio-economic factors in the twin-transition oriented strategic policy objectives and mechanisms in the four important sectors that form the basis of the vulnerability mapping process. Further, these findings inform targeted policy interventions and underpin the development of the best practice guides. The innovation of this work lies in its potential to drive anticipatory governance and ensure that transition policies do not inadvertently exacerbate existing inequalities. Further developments will focus on scaling up the platform, integrating real-time data, and refining composite indicators to adapt to evolving socio-economic conditions.

Keywords: Twin Transition, Evolutionary Framework, Vulnerability Mapping, Digital Platform, Composite Indicators, Inclusive Policy

1. Introduction

Europe's ambitious dual agenda of green deal and digital transitions—commonly referred to as the twin

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transition—presents both opportunities and challenges. The twin transition refers ‘not only to two concurrent transformational trends (the green and digital transitions) but rather to a process that unites the two and possibly accelerate changes towards the level of transformation that is needed (Muench et al. 2022) and the European Green Deal is aimed at positioning Europe as the first climate-neutral continent by 2050, while the Digital Europe Programme is aimed at enhancing Europe's digital competitiveness and sovereignty Yet, despite growing prosperity in Europe, structural inequalities continue to persist, both within and between the member states (McCaughey, 2024). Arguably, without acknowledging these, strategies developed within the twin transition will only allow to treat the symptoms and not the cause – particularly because the climate crisis itself is deeply rooted in structural inequalities between different groups in society and regions of the world (Arabadijeva, 2022). So, while these transitions promise economic growth and environmental sustainability, they also risk deepening existing inequalities if vulnerable populations are not adequately protected. There is clear evidence of the differentiated impacts of digital and green transitions on various groups within society. However, there is a significant lack of intersectional equality impact assessments, which are essential for early identification, aversion, and mitigation of potential inequalities that could be exacerbated or newly created by these transitions.

FITTER-EU addresses this gap! It contributes to research on the origins, dynamics, and determinants of inequalities, and by supporting anticipatory governance to help ensure that a fair and inclusive twin transition in Europe will be realized. The project was conceived as a pre-emptive response to the potential challenges posed by Europe’s twin-transition. FITTER-EU provides the groundwork by developing a forward-looking comprehensive ecosystem that integrates risk assessment, mitigation strategies, and policy simulations to ensure that Europe’s twin-transition - Green and Digital - is inclusive and equitable. The methodology adopted for building this ecosystem ensures that throughout the process, all the stakeholders - citizens, policymakers, policy experts, social researchers and civil societies - are actively involved with a strong sense of participation in decision-making, problem-solving and planning. The participative approach allows the project to be highly democratic, enabling stakeholders to have a say in the methodological aspects for a more informed and potentially more effective outcome. In addition, the FITTER ecosystem incorporates wide interoperability through the development of digital tools that pivotally include a highly interactive and gamified digital platform powered by an Intelligent Predictive Decision Support System (IPDSS). It is through the digital platform that the knowledge developed under the project becomes actionable and made open to the stakeholders in a gamified manner that instigates critical thinking and paves a way for policymaking on the principles of just transition.

The aim of building this ecosystem is to: 1) enable the policy makers with a foresight, from an intersectional perspective, on the potential societal and social risks that could be imposed by the twin transition policies, and 2) instigate critical thinking to mitigate these risks preemptively. It is a lens that allows policy makers to not only carefully study the effects and the impact of the twin transition policies but also look at the methods and mechanisms to mitigate the potential risks posed by them.

In this paper, the methodology of the project is presented as “The Evolutionary Tree” framework. This metaphorical construct delineates the entire project’s life cycle in three broad phases equivalent to the three seasons that eventually lead to fruit-bearing in a tree, which, in the case of FITTER-EU, are the set of tools and functionalities in the FITTER digital platform built on top of the research to help the policy makers in their decision-making process.

The Winter phase represents the foundational inputs and framework to carry out the research. It includes data gathering through literature review and stakeholder workshops to clearly define the concepts that form the basis of the entire research in the project. The Spring phase captures the growth of research methodologies and the refinement of Key Performance Indicators (KPIs) through multiple activities planned across the project including scenario analyses, inequalities risk assessments across multiple sector; followed by the summer phase where the research culminates into tangible and consultable outputs—most notably, a digital platform that informs policymaking. The “Evolutionary tree” is a perfect representation of the structured yet dynamic roadmap that the project follows for achieving a fair and inclusive twin transition.

The project is further contextualized by its strategic alignment with European policy priorities, emphasizing the need to tailor transition policies to the socio-economic realities of diverse European countries. As inequality structures are quite complex, an intersectional perspective can provide a nuanced understanding of appropriate

responses to the challenges (Kuran et al., 2020). Within the scope of "Just Transition", FITTER-EU attempts to redefine the principle of 'leaving no one behind', with application to the vulnerable groups, places and regions which develop unequally. The project profoundly delves into the concepts of eco-social contracts, understandings of justice, and perspectives on power as key building blocks for a definition of a just transition, eventually paving the way for developing novel approaches towards policy design, implementation and evaluation. At the core of FITTER is the commitment to take an intersectional approach to tool-building that will assist policy development which addresses, or at least does not further exacerbate, societal or social inequalities across four sectors – energy, transport, building and housing, and food and agriculture. Together, these concepts underscore the project's motivation: to transform raw data and innovative research into actionable policy tools that protect vulnerable social groups while promoting sustainable growth. With the aim to build a replicable and transferable model, The FITTER-EU project brings these concepts together in six national case studies, conducted by the consortium's national research teams, covering the following countries: Germany, Hungary, Ireland, Italy, Portugal and Spain.

The project is funded under Horizon Europe, which is the key EU's investment programme for research and innovation. It has a budget of around €95.5 billion for the period 2021-2027 to address climate change, pursuing the Sustainable Development Goals, and increase the EU`s competitiveness and growth.

2. Methodology

The FITTER-EU project employs a mixed-methods approach that integrates qualitative and quantitative data, within the evolutionary tree framework. This metaphor captures the organic growth of the project, starting with the foundational research to define the concept of "Just Transition" capturing the ground realities and complexities of social justice into the twin-transition. The FITTER-EU project develops the conceptual and methodological framework that guides and informs the project's overall research to develop a model of effective transition governance based on a mapping of structures and practices already in place in Europe. These foundational concepts stand on the strong roots of the evolutionary tree comprising of extensive and rigorous exercise of data collection through literature review, workshops, Focus Groups and Interviews that ultimately support the larger ecosystem of the evolutionary tree - data-driven research methodologies and key performance indicators (branches), culminating into the tangible outcomes (fruits) that help policymakers and stakeholders define laws that integrate disadvantaged groups in society.

To achieve its objectives, FITTER-EU is implemented with a mixed-methods methodology based on co-creation principles, making it highly participatory. Specifically, it involves the creation of the FITTER-EU Cluster Community Group of stakeholders (CCGS), a diverse group of stakeholders—policymakers, external experts, Civil Society Organisations (CSOs), research and academia experts, among others—engaged from the beginning of the project to participate in the different steps of the methodology. The various aspects of the FITTER-EU methodology that include a stakeholder engagement component are:

a) Scenarios, hazards and vulnerability mapping.
b) Inequalities risk assessment and intersectional mitigation plans.
c) FITTER Digital platform Validation and demonstration.
d) Dissemination, communication and outreach.

According to the principle of inclusive collaboration, and the systemic, complexity-oriented theoretical approach FITTER-EU is embracing, engagement strategies should acknowledge the "different kinds of knowledge [that diverse stakeholders] hold, including lived, professional and specialist expertise" (Blomkamp, 2022, p. 18). Consultation with a wide range of stakeholders increases the possibility that policy design and implementation adopt a user-oriented approach and incorporate "a more explicit, articulated, transformative, and less-biased approach to intersectionality since the inclusion of embodied subjects expressing different concerns can promote greater self-reflexivity on one's own biases" (Lombardo & Rolandsen Agustín, 2012, p. 491)

Due to the complex societal structures, there is no "One-Size-Fits-All" approach that could yield accurate research knowledge in the context of Twin-Transition governance. While the twin-transition objectives remain constant, the devil lies in the methods and mechanisms to reach or fulfill these objectives. It is in these mechanisms that vulnerabilities exist, and inequalities become evident. Thus, the project takes a policy-specific approach to carry

out the research with the aim of developing a replicable model that could be applied to different sectors, different countries and different twin-transition policies. The research work carried out across the 6 case studies within the scope of the 4 sectors forms the pilot for developing, refining and testing the research model developed on the way.

The high-level research methodology model is as follows (Figure 1):

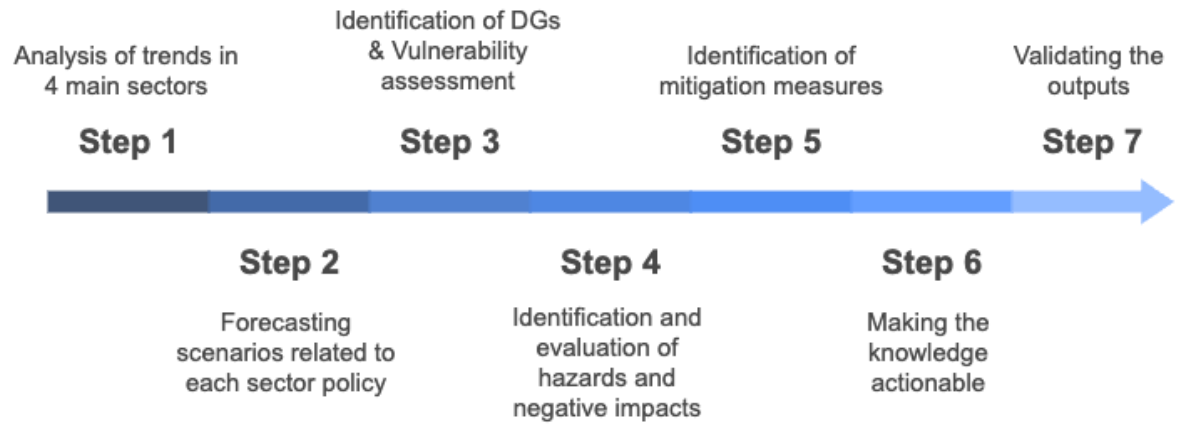


Figure 1. Steps of research methodology

To focus on producing quality research results, the project focuses on 2 sectors per case study country. Of the 4 sectors, the energy sector is transversal and is considered for research work for each country. This is deliberately performed because the energy sector is directly or indirectly correlated with all the other individual sectors. As a backbone of economic and social development, the energy sector is a critical component of the twin transition process. The division sector analysis per case study country is as follows (Table 1):

Table 1. Division of sector analysis per country

Country	Spain	Hungary	Germany	Portugal	Italy	Ireland
Sector 1	TRANSPORT		HOUSING		AGRICULTURE	
Sector 2	ENERGY					

Furthermore, the FITTER-EU focuses on one broad objective per sector for research. Under each objective, the project explores multiple policy mechanisms implemented to reach the objective. The research is carried out to derive a series of dimensions and indicators to measure social justice and equality in the mechanisms in relation to the twin transition. In line with the definition of a just transition, the FITTER-EU project accounts for core tenets of environmental, energy and climate justice. Subsequently these indicators and dimensions help in identifying the vulnerabilities, inequalities and the degree to which the various socio-demographic and socio-economic profiles (Disadvantaged groups) are likely to be impacted as a result. This is followed by identification of the hazards and the negative impacts on the disadvantaged groups. Finally, the project explores various mitigation measures that could be put in place to reduce the risk of the identified hazards. These mitigation measures are segregated into short-term, mid-term and long-term measures. While the short-term and mid-term measures could be considered as fixes in the existing policy mechanisms, the long-term mitigation measures become the policy mechanisms themselves, thus paving a way for systemic design thinking for policymakers.

This segregation of sectors per case study country and further narrowing down to one objective per sector and allows FITTER-EU to dive deep into the intersectionality driven analysis of the policy mechanism per country to bring out the finer nuances of vulnerabilities and inequalities that lie hidden in the complex societal structures.

In the context of the Evolutionary Tree, the overall methodology is structured in three sequential phases, with each phase representing a season in the life of a tree (Figures 2-4):

1. Winter – Inputs and Foundations

The project starts with the mobilization of data sources to build a baseline understanding of the twin transition across four sectors: energy, transport, buildings, and agri-food/agriculture. Foundational input includes literature reviews, surveys, interviews, focus groups, stakeholder workshops, and engagement with sister projects that are carrying out the research in the same context of twin-transition.

The project builds an understanding of the just transition concept and related definitions and provides the foundations for the methodological approach to be undertaken in FITTER, thus guiding the data collection process. At the core of this phase is a literature review of theories, approaches and indicators of social justice and of equality. Drawing on various disciplines (including philosophy, sociology, law, economy and political science) and schools of thought, the deliverable also examines how the concept is articulated in academic and public debate. To fully explore the multiple aspects of the just transition, the analysis also considers different drivers of inequality in contemporary European Union (EU), with structural and spatial inequality at its focus. The twin transition concept is also operationalised through in-depth scrutinisation of the 'green' and 'digital' aspects of the socio-economic shifts, with a further examination of their impact on inequalities in four sectors: Energy; Transport; Building & Housing; and Food & Agriculture. In the intersectional analysis to find vulnerabilities and inequalities, FITTER-EU also takes into account the economically inactive population - individuals who are not currently employed and are not actively seeking employment. The EIP "Economically Inactive Population" is an important demographic category in understanding the composition of the population that is not engaged in the labour market.

As the next step in the phase, the project starts with a critical literature review of transition governance concepts, principles and frameworks which will allow the project to set up a normative compass for identifying the elements that a just transition governance system should comprise. The normative compass will be structured in an agile checklist compiled, including the most relevant requisite emerged from the literature review. The checklist will be further refined by a mapping exercise of policies, policymaking structures, actors and processes. At this second step, our normative model will enable the identification of possible gaps, bottlenecks as well as good practice in twin transition governance systems and dynamics. Within this mapping exercise, a selection of digital and green transition policies implemented in the last ten years (both at national and EU "European Union" levels) will be analysed in more depth to gain better insights into the governance of the twin transitions. This selection will be undertaken by each FITTER research team in the six case-study countries covered by the project and justified on the basis of both literature review and mapping exercise. In addition, the same exercise will be conducted at the EU level to investigate the effectiveness of the EU mechanisms in place. Results of this analysis will inform the development of strategies for stakeholder engagement to be carried out in the subsequent phases of the evolutionary tree framework.

Desk research is conducted by the research teams in each case-study country with the aim to gather information and data on existing structural inequalities at the national level, considering regional and sectoral variations, and the implications for the twin transition. In conducting this part of the research, all national research teams utilise a standardised method of approaching the problem with the help of enquiry forms and questionnaires, developed by the core team of researchers. This standardisation allows for both a national overview and comparisons of differences and similarities between the countries. The information gathered through this approach is supposed to vary from a general overview of the country's socio-economic context to more specific mapping of issues related to twin transitions, the four FITTER sectors, structural and spatial inequalities, and previous crises' impact and response, followed by a cross-country comparison of the gathered data. In addition, public debate will also be analysed for each country, with different thematic areas highlighted by each national research team. This level of analysis will help capture the nuances of the effects of the twin-transition in a country's context. This activity is structured around different types of stakeholders, and the national teams will use desk research methods (e.g., the analysis of newspaper content, key word search, and the analysis of the content of specific institutional websites).

Building on the outcomes of the desk research during this phase, the project further focuses on building strategies for identifying and involving a set of relevant transnational stakeholders, including researchers, civil servants, policymakers, trade unions, employers' organisations, and civil society organisations, amongst others. Dedicated "expert groups" are to be established that would be consulted in different methodological steps across the subsequent seasons / phases. This exercise becomes important to consider the knowledge and experience of actors

involved in the project as well as the management, monitoring and evaluation of policy measures related to the twin transition. The participatory character of FITTER considers co-creation as one of the central elements of the project; thus, each step of the methodology involves relevant actors that can contribute with their practical or scholarly expertise to the development of the proposed activities.

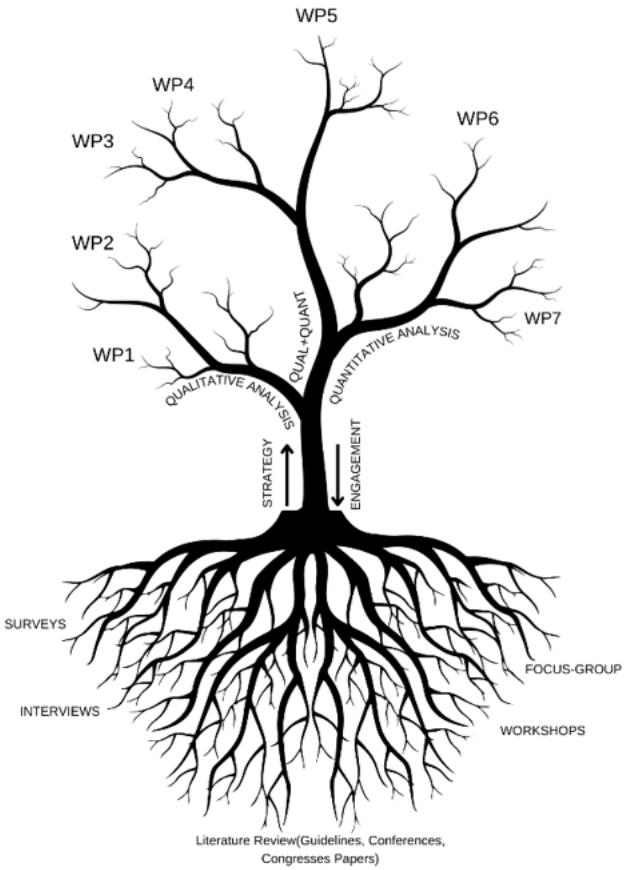
At the end of this phase, the project will have the following outcomes - 1) a measurable and an operational definition of the concept of 'just transition', 2) a checklist incorporating the requisites for "good" transition governance, and 3) methodological guidelines for data collection and analysis plus stakeholders and target groups engagement to carry out the further research work.

In summary, the phase in the Evolutionary tree framework of the project outlines key areas of focus for building a theoretical framework – understandings of the social contract; distinct understandings of the subject, object and domain of justice; applied theories of justice; and understandings of power relations. It further presents an overview of existing structural and spatial inequalities in contemporary Europe, with examples from the FITTER case studies. During this phase, the project also looks at the academic debate on the twin transition. With structural vulnerabilities at the core of the analysis, it examines distinct aspects of the 'green' and 'digital' transition and provides a summary of some aspects of the academic debate on the just transition. Section 5 considers the impact of the twin transition on the four FITTER sectors, with specific focus on social impacts and inequalities, with country case studies also included. Section 6 focuses on the public debate in the six national case studies, and provides perspectives from various stakeholders, including political parties, industry, trade unions and NGOs. Finally, Section 7 considers the FITTER approach to the just transition and provides the methodological foundations for the data gathering process to be conducted in subsequent stages of the project.

The results of this phase will allow us to derive a series of dimensions and indicators to measure social justice and equality in relation to the twin transition in the subsequent phases. Building on the results of the literature review and the operationalised definition of just transition, the methodology for both the quantitative and qualitative part of FITTER research will be developed and finetuned in terms of the research data that is needed to achieve the project objectives and how this data will be collected and analysed. The outcomes of this phase will also shed light on convergent/divergent ideals of a just transition not only across sectors addressed by FITTER but also across different vulnerable groups. The outcomes will inform the activities of subsequent phases to ensure conceptual and methodological clarity and coherence throughout the project.

In addition to its own research, FITTER-EU investigates exploring synergies with the sister researching projects with a similar focus. These projects are: 1) READJUST - The project investigates policies and develops solutions to mitigate unintended negative consequences of the Twin Transition, and 2) ST4TE - The project is aimed at providing a comprehensive view of the drivers of the Twin Transition, inequalities that emerge or are widened by it, and a set of policies to build greener, more equal and more productive societies. Initial level exploration discussions are carried out to find points of convergence among the three projects. These preliminary discussions should pave the way for a deeper and more comprehensive integration at a later stage allowing all three projects to leverage the knowledge pool developed by each.

This conceptual understanding forms the basis of the research activities carried out during the spring phase of the evolution tree framework followed by the FITTER-EU project in the context of the evolutionary tree framework, as the tree prepares for growth, the various task-oriented segments/arms of the project (work packages) emerge as branches, setting the stage for the next phase. The various work packages of the project are shown in Figure 2.



WP1: **Project Coordination**

WP2: **Conceptual framework and methodology**

WP3: **Scenario, hazards, and vulnerable mapping**

WP4: **Inequalities risk assessment and intersectional mitigation plans**

WP5: **FITTER Digital Platform**

WP6: **Validation and demonstration**

WP7: **Dissemination, communication and outreach**

Figure 2. Inputs of the FITTER-EU projects - Step 1 (Winter) and work packages descriptions

2. Spring – Research and Technical Development

The Spring phase symbolizes a result-oriented advancement of the research work (see Figure 3) with a heavy focus on the identification, mapping and analysis of scenarios, vulnerabilities, hazards, and disadvantaged groups to study negative impacts created by twin transition and set the guidelines to elaborate intersectional mitigation plans. All these activities are built on top of the groundwork proposed in the preceding phase of the framework. The study and analysis will be carried out using qualitative (experts semi-structured interviews etc.) and quantitative methods (data gathering and analysis). The results will form the basis for the development of intersectional mitigation plans and stakeholder engagement within the CCGS network. The research work done during this phase of the project will eventually help generate the knowledge that will power the FITTER digital platform to be used by the policymakers and other stakeholders to address identified twin transition challenges in relation to social justice.

The phase begins with identifying the twin-transition policy objectives to be analysed per sector. Based on the proposed Country-Sector Mapping (see Table 1), the policy mechanisms adopted / implemented to reach the objectives in the case study country are further identified and analysed. This analysis is informed by the foundational work done in the preceding phase. A structured vulnerability assessment method is proposed based on an adapted version of the Hazid template to map the potential vulnerabilities around four main categories: affordability, social accessibility, geographical accessibility, reliability and Environmental Health and Safety impacts. Both qualitative methods (expert workshops and policy consultations) and quantitative methods (statistical modeling and KPI development) are employed to refine risk assessments, thus, helping in the modeling of forward-looking scenarios with hazard mapping and risk indices to analyze the potential negative impacts of transition policies. A set of KPIs is mapped into the impact category to guide evaluation of severity of the identified risks for policy assessment —influence and impact—ensuring that the developed research model is robust and reproducible. Important quantified indicators and data touchpoints are identified from the available datasets across Eurostat and other national statistical platforms. The available data points help the project identify the potential vulnerable groups, the associated hazards and their negative impacts and the risk index of the hazards.

Following the proposed methodology of analysing 2 sectors per country, the policy analysis for the energy sector

is carried out in each case-study country and the other sector analysed per country is based on the sector-country mapping proposed in table 1. The analysis takes a two-fold approach to identify vulnerabilities comprising of baseline scenario analysis plus future scenario analysis.

The baseline scenario analysis is framed within the context of national long-term strategies, policies, and action plans related to the key targets of the twin transition process, as well as associated vulnerabilities. It will establish the baseline situation in each sector of analysis within the framework of current targets and analyse inequality impacts drawing on lessons from previously implemented policies. For the analysis of inequality impacts, a mapping of vulnerability features and profiles by country and sector under the baseline scenario will be undertaken, in search of common and meaningful contextual patterns that could explain national and sectoral differences and similarities.

Proposed activities to gather the data required for the baseline analysis are as follows:

- Online workshops with international experts in policy making, academic research, social justice, and green and digital transitions.
- Policy review of national long-term strategies, relevant policies and action plans in each of the six FITTER-EU countries.
- Online consultation with experts in the twin transition process in the four sectors of analysis.
- Desk research of relevant reports and statistical data on the progress of the twin transition process and associated vulnerabilities across the four sectors.

The inquiry is guided by the need to: a) contextualize and systematize the advancement of the twin transition process in each of the sectors and national scenarios, and b) identify potential negative impacts of this transition on existing vulnerabilities and/or drivers of additional inequalities that hinder social justice and fairness.

Proposed main themes to be addressed during the baseline analysis include:

- Key pillars, targets, commitments and priority action lines of national long-term strategies, policies and action plans to implement the twin transition process.
- The meaning of vulnerability in the context of the twin transition process: common grounds and sectoral specificities.
- Critical challenges and emerging opportunities of the twin transition process to ensure social justice and fairness.

Starting from the baseline scenario established, future scenarios are created within a timeframe of 30 years, based on an in-depth literature review, an online focus group with experts drawn from the CCGS, and a Delphi survey developed as a result of the literature review and the outcomes of the focus group. The future scenarios will be based on the KPI values that measure the impact of the existing policies identified and analysed under the baseline scenarios. Assuming varying KPI values, hypothetical scenarios will be created to establish correlation with the existing baseline vulnerabilities and inequalities and explore possibilities of new inequalities / vulnerabilities emerging in the process.

The scenarios building exercise will help the project identify the potential vulnerable groups in the twin-transition process. Scenario building processes can lead to individual learning by stakeholders, assist in more comprehensive public debates, and reduce overconfidence in the future outcomes of policies and practices (as a result of better understanding of problem complexity). Policy makers need to have trust in the scenario building process in terms of its ‘salience, legitimacy and credibility’ (Volkery and Ribeiro, 2009: 1201).

This is immediately followed by the identification of the potential hazards and their corresponding negative impacts for different vulnerable groups. An extremely detailed mapping of vulnerable groups and the corresponding hazards and negative impacts is thus established through this activity. Further, methodological guidelines will be proposed to reach out to these “at-risk” population groups. Taking as inputs the identified “Vulnerable Group-Hazard-Negative Impact”, the probability and the severity of a hazard is calculated using the quantitative data on inequality indicators. This quantitative data is collected from the Vulnerable groups through surveys developed in each target sector. Surveys are proposed to be structured in 2 parts: Socio-demographic part (Part A) and Assessment part (Part B).

The guidelines will further include a sectoral and country-specific stakeholder engagement strategy for reaching out to disadvantaged individuals beyond organisations that might represent them, to ensure their involvement in the FITTER labs. Specific country action plans will be developed for the implementation of the engagement strategy. FITTER labs are established in each country of analysis to implement a co-creation process intended to propose one or more mitigation measures for each of the negative effects previously identified. The combined results will generate wider recommendations and guidelines for policymakers and other stakeholders to address identified twin transition challenges in relation to social justice. The results will form the basis for the development of intersectional mitigation plans. The project develops the most appropriate mitigation plan in the short, medium and long- term addressing specific hazards in the context of vulnerable profiles. The mitigation plan is based on the outputs from the FITTER labs, where the hazards are mapped to a mitigation policy for a vulnerable group, including a list of mitigation measures applicable in the short, medium and long-term for several socio-demographic profiles. This model for the mitigation plans is built with an interdisciplinary approach, where social experts and technicians are cooperating together in the assignment of mitigation measures to each socio-demographic profile and in the determination about which measure should be considered short, medium and long-term.

The strength of the developed research model lies in its thorough and complex intersectional analysis across multiple socio-demographic and socio-economic profiles to identify vulnerable groups; thus, not leaving any stone unturned. Some of the profiles analyzed during the research phase include: a) unemployed / low-income, and low-skilled people; b) People with disabilities; c) Elderly people; d) Ethnic minorities and migrants; e) rural/remote underprivileged communities; f) Young people from peripheral and rural areas; g) People at risk of extreme poverty and social exclusion, including homeless people. In addition, a rigorous analysis is carried out for the possible identification of new vulnerable groups caused by the transition policies and measures, and market forces; Our engagement too with the sister projects only strengthens the outcome of the project.

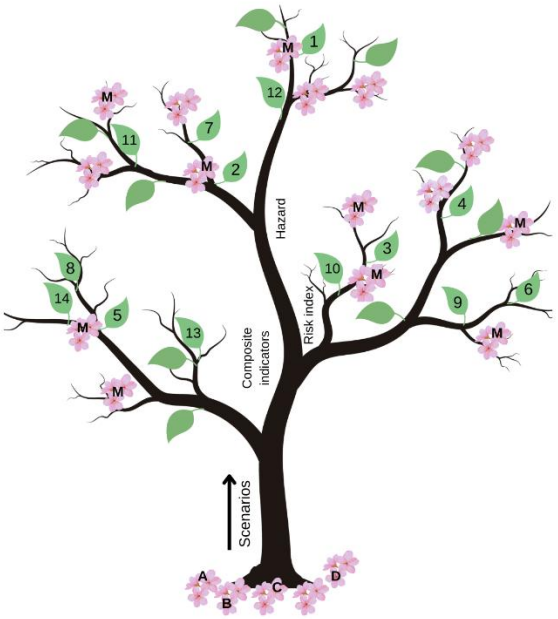


Figure 3. RESEARCH AND TECHNICAL DEVELOPMENT of the FITTER-EU projects - Step 2 (Spring)

The hazard assessment, risk indices, and vulnerability indicators in the research model are represented as structural components of the evolutionary tree. Various operational key performance indicators (KPIs: leaves) track the project's impact through public events, scientific publications, media engagement, and stakeholder interactions, demonstrating the project's maturity represented by blossoms on the tree that are symbolic of the most relevant mitigation measures and the policy best practices formulated through research (M: blossoms), while the blossoms on the ground (A, B, C, D) represent the measures that have been discarded due to their ineffectiveness. The KPIs measure engagement, dissemination, and scientific contributions, ensuring that the project meets its objectives in supporting the twin transition. The table below (Table 2) presents the selected KPIs, categorized into public engagement, digital outreach, and academic impact.

Table 2. FITTER-EU PROJECT KEY PERFORMANCE INDICATORS (leaves)

1- Number of public events for external audiences	8- Total impressions for social media campaigns
2- External events attended representing the project	9- Scientific publications in peer-reviewed journals,
3- Workshops and collective intelligence session	10- Presentations at international conferences
4- Meetings/Presentations	11. N. unique visitors of FITTER-EU website
5- Total social media followers	12- N. of references in other websites
6- News published on the websites	13- Scientific publications as open access
7- Posts published on social networks	14- Persons reached by FITTER-EU project

3. Summer – Outputs and Policy Impact

The final phase, represented by Figure 4, is the culmination of the project's efforts and engagement with the sister projects. In this phase, the outputs of the research are translated into actionable knowledge. The tree is now fully developed, bearing fruits symbolic of the various functionalities of the FITTER-EU platform. These outputs provide practical tools and insights for policymakers, represented by a figure collecting the fruits. This project phase delivers tangible resources that facilitate informed decision-making and policy formulation.

The project pivotally includes a highly interactive and gamified digital platform powered by an Intelligent Predictive Decision Support System (IPDSS). The digital platform within the larger ecosystem is a culmination of the entire social research carried out in the FITTER-EU project. It is through the digital platform that the knowledge developed under the project becomes actionable and made open to the stakeholders in a gamified manner that instigates critical thinking and paves a way for policymaking on the principles of just transition. The development of the platform in the FITTER Ecosystem is aimed at enabling policymakers to predict which social groups may be at risk of being adversely affected by twin transition policies under different scenarios, with the ability to simulate the implementation of these policies to assess inequalities and social exclusion risks in real-time. The IPDSS (i.e., platform backend computational layer) is underpinned by a thoroughly researched intersectionality framework that considers different socially constructed categories, including (but not limited to) socio-economic status, gender identity and sexual orientation, age, ability, race and ethnicity, interconnect. This intersectionality framework offers the opportunity to investigate how a model of governance can be made more inclusive and pre-emptive in its policy-making approach, accounting for different dimensions that give rise to potential inequalities. Moreover, the IPDSS, within the Digital Platform, will be provided with an impact assessment module to predict how the implementation of a mitigation measure will affect the probability of exclusion risks and the severity rate for a specific socio-demographic profile. Each mitigation measure will have assigned an estimated implementation cost and based on it, the impact assessment module will select, for each specific profile, those mitigation policies with the highest efficiency (those with the higher impact on the reduction of social exclusion risk and the severity and with the lowest cost). The usability of the platform and the underlying knowledge is further enhanced by incorporating wider platform connectivity capability and better practice guides which will not only help to meet the needs of the engaging FITTER Cluster Community Group of Stakeholders but also allow us to collaborate with other projects and platforms of a similar nature and a common end-goal. Similar to the overall project methodology, a highly participative co-creation approach would be followed from the beginning, involving stakeholders from the user community (i.e., FITTER Cluster Community Group) that are a part of the consortium. The development of an API (Application Programming Interface) for the capability to enable other platforms to engage with the digital platform will strengthen wide reach and interest.

Key outputs include - a) A user-friendly digital platform that integrates simulation tools for policy-making; b) Best practice guides and mitigation measures aimed at curbing the adverse effects of transition policies on vulnerable populations; c) Policy briefs and actionable recommendations that inform the development of national and regional strategies for a just transition, d) APIs for external platforms to connect to the FITTER digital platform and leverage its knowledge to the best possible extent.

The platform is a living tool built on the research work done in the preceding phases. Presenting the knowledge of the project in a highly gamified and interactive way. The proposed usability of the platform will allow an end user to carry out the following in their local context:

a) Policy Simulations and Impact assessment - The end-user gets to choose the policy mechanisms and evaluate their impact in the local context of the end-user. The impact assessment will be based on the customised inputs from the user as per their selection of the mechanisms. These inputs are needed to bootstrap the values for the indicators / KPIs to carry out the impact assessment.
b) Structured Risk Assessment - The end-user will be able to change the indicator values in real-time to see how the vulnerabilities change in their local context. This interactive risk assessment will be helping to instigate critical thinking in the end-user.
c) Mitigation Measures Simulations - The end-user will be able to apply mitigation measures to the scenario in the local context and see the changes in the existing hazards and their risk and severity index. This is supported by the efficiency and effectiveness index of the mitigation measure applied to the scenario. A scenario in the context of the FITTER Digital Platform is a simulated environment with vulnerabilities, vulnerable groups, hazards and negative impacts given a selection policies and the inputs for indicators.
d) Regional / Area Performance Comparisons - The end-user will be able to carry out multiple local / regional assessments and compare them with each other. Further, comparison to the assessments made by other platform users may also be made if the assessment data is made publicly available by the end-users.

Given the complexity of the features and toolsets of the FITTER Digital Platform, a supplementary better practice guide is developed that acts as a complete reference manual for all end-users and stakeholders to use the platform to the best of its capabilities and fully leverage the knowledge of the FITTER-EU Project. The Better Practice Guide (BPG) is expected to help the stakeholders with the following:

1) Understanding the development pipeline, the underlying thought process behind choosing a certain method of development, the underlying principles that guided the development process.
2) All technical details of the platform, the flow of data within the platform, the various module inputs required by each module, outputs produced by each module and the platform as a whole.
3) The effective usability of the platform. What to use the platform for, how to use, what to expect, where to use the data produced by the platform. The various use cases for different end-users will be demonstrated through examples.
4) Effective use of platform APIs for integration with 3rd party platforms. Effectively leveraging the knowledge created under the FITTER-EU project, API inputs, outputs. A step-by-step guide on how to use the APIs, different use cases with examples.
5) Observations and outcomes from the multiple stakeholder workshops conducted during the beta testing of the platform.
6) The future usability and the applicability of the platform and its various components such as the APIs.

As the tree reaches its full maturity, the work of validating the outputs begins. Validation is an important part of the FITTER-EU methodology as it helps in increasing the confidence of the community in FITTER's research methods and outcomes. All the elaborated methods, theories and processes, especially the definition of 'just and socially fair transition' and concepts built on it are validated. The first step of the validation is against relevant risk and resilience assessment standards, measuring compliance with standardized risk assessment technologies. The second step performs a validation from the mathematical and software development point of view. The third step consists of tabletop exercises oriented around a scenario involving stakeholders in online workshops, resulting in benchmarking of elaborated methods as well as feedback on theories and processes. In the third step, each mitigation measure is proposed to be assessed using the four A's approach (availability, accessibility, affordability and acceptability) to guarantee the absence of cognitive and social biases in them.

As the platform is a critical aspect of the FITTER-EU outcomes, the project proposes a comprehensive validation of the platform components (i.e., The AI "Artificial Intelligence" toolbox and gamification) by the same set of people who are taking part in the co-design and co-creation of the Platform. The platform will be presented to stakeholders, and they will be invited for a walkthrough ending with a collection of feedback. When the platform is ready for a closed beta test, a series of hackathons will be organized for end-users where IT "Information

Technology" personnel, actual end-users from practitioner organisations (e.g., EC "European Commission" RSB " Regulatory Scrutiny Board", EP "European Parliament" Common Approach/ IAH, national scrutiny officers in MS "Member States" ministries) get together with students (major/PhD) from political science or legal faculties, receive given scenarios and are tasked to perform impact assessments and make policy recommendations based on the results from the system. Finally, after updates and validation results, the platform beta version will be presented to stakeholders (online) and to gather their feedback.

Further, the project proposes a rigorous validation of the FITTER-EU components in terms of its resourcefulness, i.e., the potential of use by policymakers in their decision-making processes. Scenario pilots will be implemented, aiming at simulating the use of the FITTER toolbox in the policy-making processes at the national level (i.e., policies aimed at tackling the twin transition's negative effects). The pilots are proposed to be implemented in 4 pan-European online sessions with policymakers of different EU countries. The methodology deployed in the pilots will be the Cognitive Walkthrough for Implementation Strategies (CWIS), which will identify a set of usability factors in each pilot, i.e., the necessary conditions to guarantee an efficient and adequate implementation of the FITTER toolbox in the decision-making processes intended to counteract the twin transition negative effects. These rigorous validation methods will ensure that every aspect of the FITTER-EU project adds huge value to the stakeholders at all levels.

The co-creation methodology across the three phases of the project (i.e., winter, spring & summer) ensures that stakeholders, including policymakers, academic experts, and civil society organizations—are actively involved throughout the project - from validating the research findings, all the way to refining the functionalities of the digital platform. This participatory approach also enhances the legitimacy of the digital platform and its predictive decision support system.

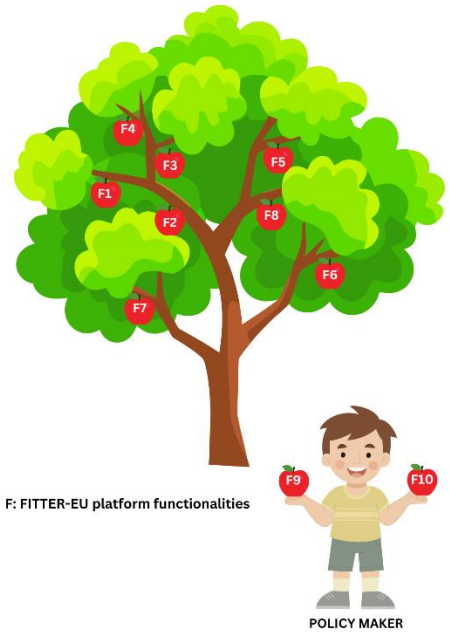


Figure 4. Outputs of the FITTER-EU Project- Step 3 (Summer)

3. Results

The evolutionary tree framework has enabled the systematic identification of critical vulnerabilities across key sectors. Key findings will include:

- Definition of "Just Transition": Project's fundamental research revolves around embedding social justice into

twin-transition of the. The aim of the research is to successfully articulate the concept of just transition and provide the foundations for the methodological approach to be undertaken in FITTER, thus guiding the research process. The twin transition concept is also operationalised through in-depth scrutinisation of the 'green' and 'digital' aspects of the socio-economic shifts, with a further examination of their impact on inequalities in four sectors: Energy; Transport; Building & Housing; and Food & Agriculture.

- Effective Twin Transition governance models: The FITTER project aims to contribute to existing research on the origins, dynamics and determinants of inequalities and enable anticipatory governance to support a fair and inclusive twin transition in Europe. A key objective is to enable timely assessments of twin transition policies under different scenarios to assess how policy measures may address or further exacerbate existing inequalities.
- Composite Risk Indicators: The project will successfully develop composite indicators for assessing energy poverty, transport challenges, and housing vulnerabilities. These indicators integrate quantitative measures (such as the share of renewable energy, energy efficiency indices, and transport accessibility metrics) with qualitative insights from stakeholder consultations.
- Digital Platform Functionality: As outlined in the Spring and Summer phases, the co-creation approach will result in a robust digital platform that offers simulation tools for policymakers. This platform enables users to predict the potential adverse impacts of transition policies under different scenarios and to explore mitigation measures.
- Policy Relevance and Engagement: The integration of expert workshops and policy consultations will enhance the project's policy relevance through critical feedback proposed to be incorporated into the refinement of baseline scenarios and vulnerability profiles across the six use cases. This co-creation process not only validates the research approach but also fosters a sense of ownership among stakeholders.
- Policy design: FITTER-EU considers the parameters of four approaches - eco-social policy design, systemic design practice, intersectional policy design criteria, and the capabilities approach to forecasting and evaluating policy impact.
- Operational Efficiency: By leveraging the evolutionary tree concept, the project has achieved a streamlined approach to transitioning from data collection (Winter) to policy output (Summer). The clear delineation of phases has facilitated timely progress, with each phase building upon the previous one to generate actionable insights.

4. Discussion

The significance of the FITTER-EU project lies in its ability to integrate complex, multi-dimensional data into a coherent framework that informs policy decision-making through the development of indicators that have the potential to serve as standardized metrics for assessing the impact of twin transition policies across Europe. This is particularly important given the diverse challenges faced by different social groups. The project's emphasis on vulnerable populations ensures that policy interventions are both equitable and targeted.

The in-depth understanding of the various complex twin-transition concepts lays the groundwork for identifying vulnerable groups whose needs are at risk during the transition. In line with our definition of a just transition we account for core tenets of environmental, energy and climate justice. FITTER does not anticipate that a just transition is possible without a fundamental restructuring of economic models, land stewardship, energy sources, and mindsets. The transition to a carbon neutral economy is very unlikely with existing climate policies and the prevailing economic growth-focused mindset. We propose situating the 'eco-social-growth' trilemma as a 'systems trilemma' with complex relationships between 'reproduction, production and consumption systems', 'planetary ecosystems' and 'political structures and norms' framed in terms of the reality defined by the climate emergency. We propose situating 'justice' at the core of the wider triangle.

1. Principles of the FITTER System Design Practice:

1) Purpose-driven – we seek to enable a just twin transition which addresses intersectional inequalities, with fair burden-sharing, while controlling climate change and taking the dimensions of environmental, climate, and energy justice into account.

2) Recognising complexity – we commit to understanding justice concerns as situated within the 'systems

trilemma'. We commit to understanding inequalities as co-constitutive (not multiple), making dynamics of oppression and privilege explicit and articulated; gendering policies; challenging privilege (Lombardo and Agustín, 2012).

3) Rights-based/Self-determination – we commit to upholding human rights, taking the core tenets of energy, environmental and climate justice into account.

4) Addressing power relations – we commit to taking a conflict resolution approach to deliberative mechanisms, acknowledging operative power dynamics, and seeking to create a negotiated compromise that does not sacrifice social justice requirements to achieve environmental and economic goals. We also aim to challenge harmful exclusionary norms and extend the boundaries of what is 'normal' (addressing invisible power).

5) Inclusive collaboration – we commit to consulting a wide range of stakeholders to adopt a user-oriented approach and incorporate 'a more explicit, articulated, transformative, and less-biased approach to intersectionality since the inclusion of embodied subjects expressing different concerns can promote greater self-reflexivity on one's own biases'.

6) Adaptive learning – we commit to collaborative problem-solving, openness to reframing problems, the unlearning of exclusionary norms, understanding inequalities as systemic, and ongoing adaptation throughout the design process.

Despite these strengths, the project faces challenges that warrant further investigation. These include the need for continuous data updates, the integration of real-time monitoring systems, and the refinement of these indicators to capture emerging vulnerabilities. Future work will need to address these issues by incorporating advanced data analytics and machine learning techniques to enhance the predictive power of the digital platform.

2. Why the scenario approach:

Public policy problems are characterized by a high degree of complexity, uncertainty about long-term future developments, cross-cutting spatial scales, and a myriad of driving forces. Scenario building thus increasingly takes account of a broad range of social, ecological, technological, economic, and political trends. Developing scenarios can anticipate discontinuities, reduce overconfidence in the future, improve willingness to consider a range of plausible futures, detect early warning signals, and increase willingness to think innovatively (Volkery and Ribeiro, 2009: 1206). Scenario building entails interpretation of, and value judgements on, each structuring element. It may not be possible to achieve consensus on the driving forces/scenario axes, but it is important to document each step (including discarded interpretations) of building the scenario.

5. Conclusion

The FITTER-EU project represents a pioneering effort to address the challenges of embedding social justice into twin transitions in Europe. There are four strands of work across FITTER tasks– assessment of the production of inequalities, forecasting of policy impact in the context of twin-transition; systemic and policy design thinking from an eco-social perspective, development of tools to assist stakeholders in addressing intersectional inequalities in the context of a just twin transition. Acknowledging the limitations that the project operates under, FITTER-EU carries out the research work with a narrowed focus on specific policy objectives and their corresponding mechanisms in the context of the twin-transition. The aim is to build a transferable research model that can be used for similar evaluations across multiple sectors, policy objectives and their corresponding policy instruments across Europe.

The project assesses how systems and structures produce disadvantages of varying degree and how this creates structurally vulnerable cohorts within each of the four FITTER sectors - Energy, Transport, Housing, Agriculture. The project attempts to look at "just" transition as a process that addresses intersectional inequalities, with fair burden-sharing, while controlling climate change and taking the dimensions of environmental, climate, and energy justice into account. Thus, accounting for the following core tenets of justice:

Environmental justice (local/national): Environmental justice can be defined as 'the extent to which the physical and economic burdens of pollution and degradation, as well as environmental benefits, are equitably distributed

across society, both spatially and temporally, and the degree to which individuals and communities most vulnerable to environmental risks can access and participate in relevant decision-making processes' (O'Neill et al, 2022: 5)

Climate Justice (global): concerned with addressing inequitable outcomes of climate change for differing peoples, communities, contexts and generations. Aims to achieve greater equity in the distribution of climate related burdens and responsibilities, as well as greater parity of decision-making and human rights protection.

Energy Justice (global): concerned with developing mechanisms to enable justice (recognitive, representative, distributive and restorative) at all stages of the energy life cycle 1) Extraction; 2) Production; 3) Operation and supply; 4) Consumption; 5) Waste Management (Heffron and McCauley, 2017)

FITTER does not anticipate that a just transition is possible without a fundamental restructuring of economic models, land stewardship, energy sources, and mindsets. FITTER takes a systemic approach to explore the root causes of an issue, considering different perspectives and the interrelatedness of problems (Blomkamp, 2022: 20). The goal of the project is to effectively intervene in the system rather than addressing specific issues in isolation from wider systems. Therefore, in line with the above core tenets, FITTER-EU project looks at the possibilities for enabling "Eco-Social" political structures and norms. An eco-social approach to policy design can be built on the understanding that we need to structure adaptation so that it is transformative of systems and enables the wellbeing of all. The evidence base demonstrates the need to transform economies and societies to halt climate breakdown and promote social inclusion and equality. Analysis of twin transition processes indicate that technological developments (digital transition) can, but do not necessarily, support the achievement of environmental objectives (green transition) and/or social objectives (just transition). It is important that technological developments work in service of integrated eco-social policy design.

The fundamental aspects that remain central to the FITTER-EU research are as follows:

- Understanding the reproduction of inequalities and environmental harms as the product of systems and structures
- Taking climate, energy and spatial justice into account in policy assessment
- Taking a systems approach to policy design, implementation and evaluation.
- Enable policy design which explicitly pursues both environmental and social objectives in an integrated way.

The integration of comprehensive scenario analysis and corresponding vulnerability mapping offers policymakers an invaluable resource for anticipatory governance.

The identified vulnerabilities are translated into quantitative and qualitative measures that are termed as composite indicators in the project. A composite indicator enables the exploration of how specific changes in particular variables or component indicators will affect the overall measure. In line with the requirements of eco-social policy development a composite indicator will include environmental, economic and social component indicators regardless of the overall focus of the composite indicator measure e.g. poverty, mobility patterns etc. The project looks at designing and adjusting the indicators for specific functions (e.g. risk identification or evaluation or risk management performance) (Buhr et al, 2018: 10).

The project carries out surveys with stakeholders representing potential vulnerable groups to understand the severity of the hazards associated with the vulnerabilities. This is further followed by co-creation stakeholder workshops to develop mitigation measures to reduce or eliminate a hazard.

FITTER-EU enables actionability on the research work through the development of a digital platform that offers simulating scenarios to identify vulnerabilities along with the corresponding mitigation measures. The platform goes further to provide an interface for the policymakers to learn about the eco-social policy design approach through the help of gamified simulations that encourage the end-users of the platform to "learn by doing".

Key takeaways of the FITTER-EU project include:

- An intersectional approach for identification of vulnerabilities in existing policy objectives and their corresponding mechanisms.
- A robust co-creation model that ensures stakeholder engagement and enhances the practical relevance of the research.

- The development of composite risk indicators provides a nuanced understanding as well as problems with the current policy instruments in energy, transport, housing and agriculture.
- A structured risk assessment methodology to identify the potential vulnerabilities in the current policy instruments.
- Mitigation measures to reduce or eliminate vulnerabilities.
- System design thinking underpinned by Eco-Social principles of policy design and implementation.
- A highly gamified / interactive digital platform that brings all the aspects of the project research together to support policymaking and inculcate system design thinking through simulations.

Future work will focus on scaling up the platform, integrating real-time data, and refining composite indicators to adapt to evolving socio-economic conditions. Ultimately, the project's outcomes are expected to contribute significantly to achieving a fair and inclusive twin transition, ensuring that the benefits of the green and digital revolutions are equitably distributed across society.

Acknowledgments

This work is funded by the European Union under the project FITTER-EU (Grant Agreement number: 101132546). The views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.


Funded by the European Union

References

1. Kelly, J. A., Clinch, J. P., Kelleher, L., & Shahab, S. (2020). Enabling a just transition: A composite indicator for assessing home-heating energy-poverty risk and the impact of environmental policy measures. Energy Policy, 146, 111791. https://doi.org/10.1016/j.enpol.2020.111791
2. Verhorst, T., Fu, X., & van Lierop, D. (2023). Definitions matter: Investigating indicators for transport poverty using different measurement tools. European Transport Research Review, 15(1), 21. https://doi.org/10.1186/s12544-023-00596-z
3. European Commission. (n.d.). Transport poverty: Definitions, indicators, determinants, and mitigation strategies - Final report.https://employment-social-affairs.ec.europa.eu/transport-poverty-definitions-indicators-determinants-and-mitigation-strategies-final-report_en
4. FITTER-EU. (n.d.). Methodology. https://fitter-eu.com/page/methodology
5. European Commission. (n.d.). Fair and inclusive twin transitions for a stronger social Europe | FITTER-EU | Project | Fact sheet | HORIZON. CORDIS. https://cordis.europa.eu/project/id/101132546
6. AITEC. (n.d.). FITTER-EU. https://www.aitec-intl.com/fitter-eu/
7. READJUST. (n.d.). READJUST – Just transition to a green and digital future for all. https://readjust.eu/
8. ST4TE. (n.d.). Strategies for just and equitable transitions in Europe. https://st4te.eu/
9. Muench, S., Stoermer, E., Jensen, K., Asikainen, T., Salvi, M., & Scapolo, F. (2022). Towards a green and digital future. Publications Office of the European Union. https://data.europa.eu/doi/10.2760/977331
10. McCaughey, M. (2024). Inequalities unmasked: Reality of disparities across the EU. European Foundation for the Improvement of Living and Working Conditions. https://www.eurofound.europa.eu/en/blog/2024/inequalities-unmasked-reality-disparities-across-eu
11. Arabadjieva, K. (2022). Reshaping the Work–Life Balance Directive with Covid-19 lessons in mind. ETUI Research Paper - Working Papers 2022.01. SSRN. https://ssrn.com/abstract=4013346
12. Lombardo, E., & Agustín, L. R. (2012). Framing gender intersections in the European Union: What implications for the quality of intersectionality in policies? Social Politics: International Studies in Gender, State & Society, 19(4), 482–512. https://doi.org/10.1093/sp/jxr001
13. Volkery, A., & Ribeiro, T. (2009). Scenario planning in public policy: Understanding use, impacts and the role of institutional context factors. Technological Forecasting and Social Change, 76(9), 1198–1207. https://doi.org/10.1016/j.techfore.2009.07.009
14. O'Neill, J., Holland, A., & Light, A. (2022). Environmental values. Routledge.
15. Heffron, R. J., & McCauley, D. (2017). The concept of energy justice across the disciplines. Energy Policy, 105, 658–667. https://doi.org/10.1016/j.enpol.2017.03.018
16. Blomkamp, E. (2022). Systemic design practice for participatory policymaking. Policy Design and Practice, 5(1), 12–31. https://doi.org/10.1080/25741292.2021.1887575

17. Buhr, B., Volz, U., Donovan, C., Kling, G., Lo, Y., Murinde, V., & Pullin, N. (2018). Climate change and the cost of capital in developing countries. Imperial College London; SOAS University of London; UN Environment. https://unepinquiry.org/publication/climate-change-and-the-cost-of-capital-in-developing-countries/