TRANSrisk
TRANSITION PATHWAYS AND RISK ANALYSIS FOR CLIMATE CHANGE POLICIES

TRANSITIONS PATHWAYS AND RISK ANALYSIS FOR CLIMATE CHANGE MITIGATION AND ADAPTATION STRATEGIES

D3.2 Context of 15 case studies:

Introduction and Summary

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Preface

Both the models concerning the future climate evolution and its impacts, as well as the models assessing the costs and benefits associated with different mitigation pathways face a high degree of uncertainty. There is an urgent need to not only understand the costs and benefits associated with climate change but also the risks, uncertainties and co-effects related to different mitigation pathways as well as public acceptance (or lack of) of low-carbon (technology) options. The main aims and objectives of TRANSrisk therefore are to create a novel assessment framework for analysing costs and benefits of transition pathways that will integrate well-established approaches to modelling the costs of resilient, low-carbon pathways with a wider interdisciplinary approach including risk assessments. In addition, TRANSrisk aims to design a decision support tool that should help policy makers to better understand uncertainties and risks and enable them to include risk assessments into more robust policy design.

PROJECT PARTNERS

No	Participant name	Short Name	Country code	Partners' logos
1	Science Technology Policy Research, University of Sussex	SPRU	UK	
2	Basque Centre for Climate Change	BC3	ES	
3	Cambridge Econometrics	CE	UK	
4	Energy Research Centre of the Netherlands	ECN	NL	
5	Swiss Federal Institute of Technology (funded by Swiss Gov't)	ETH Zurich	CH	
6	Institute for Structural Research	IBS	PL	
7	Joint Implementation Network	JIN	NL	
8	National Technical University of Athens	NTUA	GR	
9	Stockholm Environment Institute	SEI	SE, KE	
10	University of Graz	UniGraz	AT	
11	University of Piraeus Research Centre	UPRC	GR	
12	Pontifical Catholic University of Chile	CLAPESUC	CL	

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1 EC Summary Requirements

1.1 Changes with respect to the DoA

There are no changes with respect to the DoA for this deliverable.

1.2 Dissemination and uptake

This deliverable is an internal 'work in progress' document, and is intended to feed into the development of D3.3 'Final brief of 14 country case studies". This deliverable sets the background for further research in developing transitions pathways for the respective country cases studies. The contextual factors for the country case studies may be updated over the course of the project as we engage further with stakeholder and carry out additional research. The case studies contexts will be available on our website for interested parties and will also be sent to specific members of the Scientific Advisory Board who have expressed an interested in reviewing particular countries.

1.3 Short summary of results

This deliverable consists of 1 standalone global and regional case study and 14 separate country case studies. The global and regional case study provides an overview of the key global issues along with highlights from regional issues related to climate change mitigation. The country case studies cover five standard aspects including: 1) the research questions; 2) an introduction to the contextual issues (environmental, economical, societal and political); 3) the human innovation system; 4) the system map of the case study and 5) an update on stakeholder contact and engagement.

We have developed dedicated software, MATISE (Mapping Tool for Innovation Systems Evaluation), as an unintended output, which supports the analytical process in our case study work. MATISE was developed to address the need of streamlining the process of creating system maps across the case studies. We have written a paper to describe the tool and the potential uses of MATISE as a tool in developing low carbon pathways. We have submitted the article to a journal and it is currently under review (see Appendix A for the abstract).

2 TRANSRISK CASE STUDY CONTEXT INTRODUCTION

This deliverable includes 14 separate case studies that introduces the country contexts and 1 global and regional report which describes the main global socio-economic trends and climate policy developments. The global and regional report sets the stage for the 14 country case studies that are the core part of this deliverable.

Table 1 lists the 14 country case studies and the respective sectors covered in each country and also indicates whether it is a 'full' or 'limited' study, as indicated in the previous deliverable D3.1 'Matrix of technological innovation systems' selected for 12 case studies.

Table 1: Confirmed full and limited 15 case studies

Country/Region	Sector covered	Full case study (≥ 15 interviews; ≥ 1 workshop)	Limited case study (≤ 15 interviews; optional workshop)
1. Global & regional overview	General discussion on direction of global trends, climate agreements		X
2. Austria	Energy and steel	X	
3. Canada	Oil Sands/ energy		X
4. Chile	Energy and industry		X
5. China	Building sector		X
6. Greece	Solar power and building sector	X	
7. India	Solar power and wind		X
8. Indonesia	Biomass and cook stoves		X
9. Kenya	Geothermal and charcoal		X
10. Netherlands	Solar PV and integrated manure management		X
11. Poland	Energy sector	X	
12. Spain	Transport, biofuels, biomass	X	
13. Sweden	Solar and Wind		X
14. Switzerland	Renewable energy electricity		

15.	UK Nuclear power		X

As seen in Table 1 there are a wide variations of sectors covered in the country case studies. In order to facilitate the case study comparison process (e.g. in D7.1 'Report on the comparison of transition pathways'), we developed a framework and overarching research questions to guide the case study research process.

The next sections will:

a. Describe the framework (see section 2.1) we have developed;
b. Introduce the overarching research questions (see section 2.3) to provide guidance for the direction of search in each case study; and
c. Present a basic outline that stems from the framework (see section 2.3).

2.1 Analytical framework

Figure 1, "The Enabling/Limiting Environment for Low Carbon Transitions Pathways", provides the overarching analytical framing for each case study. It is based on extended approach of Bergek et al's (2008) framing of the technology innovation system. The framework helps us to better understand the enabling, or limiting, environment for developing potential low carbon pathways.

The framework explicitly acknowledges the spatial and time dimension, while considering the interaction that occurs within and across the context of both the natural system (resource potential and limitations) and the human system. These interactions include the economic, policy, political and social context as well as the circular economy.

This deliverable will only cover selected parts of the framework, including:

1. Natural Systems;

2. Human innovation systems;

2.1 Context: (physical & human landscape);

2.2 Technological innovation system: circular economy: cradle to grave live cycle of economic sectors

Part II of the case study work (D3.3 'A final brief of 14 country case studies') will cover the latter half of the framework, including: 2.3 Capabilities which encompasses stakeholders (2.3.1); their respective institutions (2.3.2); and the institutions' corresponding functions (2.3.3). We will briefly describe the framework below and indicate how the sections correspond to the case study work.

The natural system (1) is categorised based on the European Commission's resource sectors (European Commission, 2011) that contribute to the economy, which consists of: marine, water, minerals and materials, fossil fuels, wastes, air, land, biodiversity.

The Human Innovation System (HIS) is defined as the broad systems humanity has constructed that allows for our survival and development. The HIS is enabled or constrained by the natural systems. We describe the human innovation system in our case study by framing the discussion with the unique spatial context (2.1) (e.g. global, regional, country), including the economy, politics, policy, and society that has been developed over time.

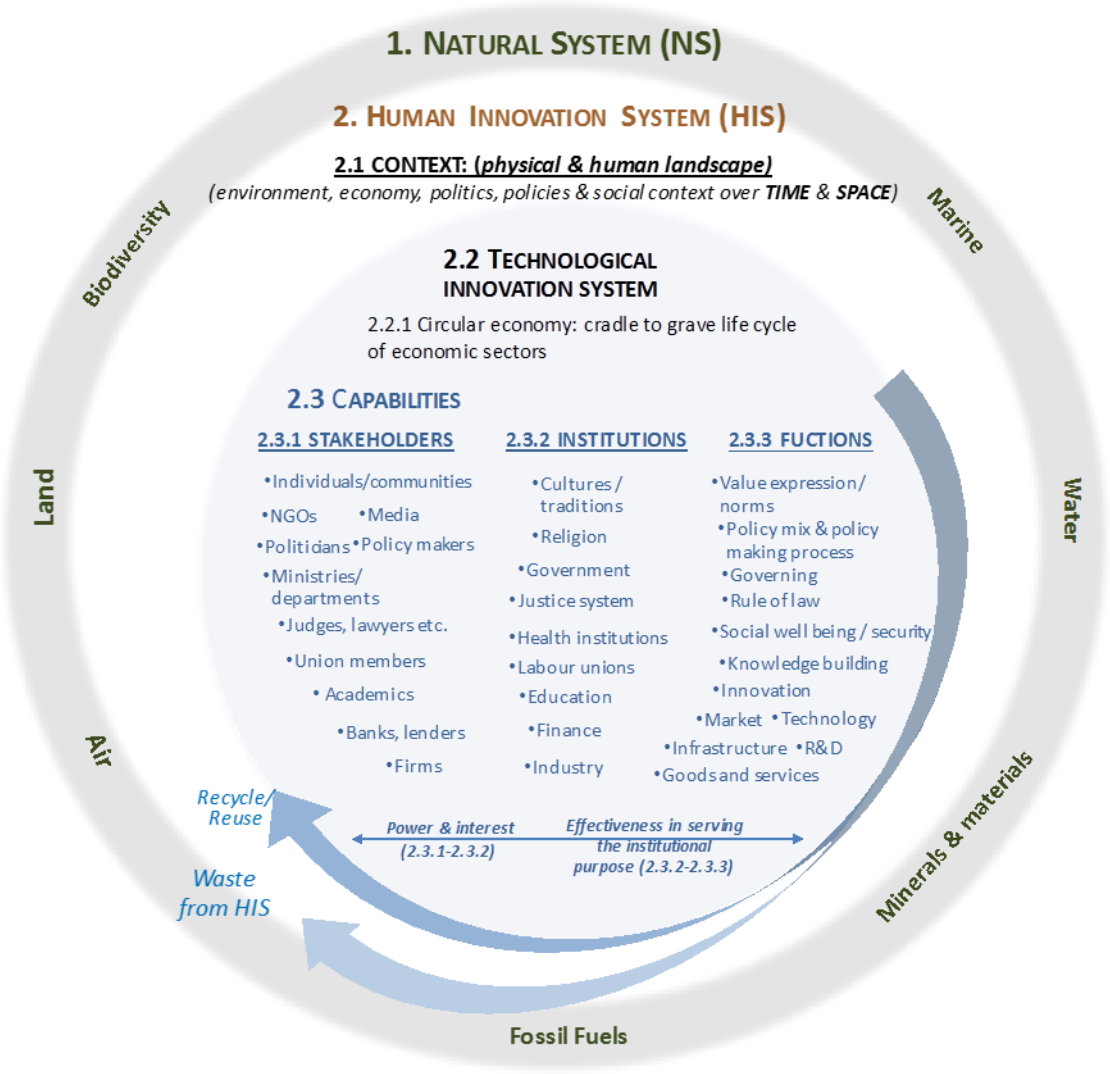

Figure 1: The enabling/limiting environment for low carbon transition pathways

The broader context provides the historic background needed for each country case study. The unit of analysis in each case study is the technological innovation system (2.2) or the selected sector we identified for each country in D3.1 'Matrix of TIS' (e.g. energy, building, agriculture, transport, service, manufacturing & others). For example, the unit of analysis in the Austrian case study is the steel sector; in China, the building sector; and in Sweden the transport sector.

We analyse each TIS using a circular economy (2.2.1) approach using a 'cradle to grave' analysis of each sector explored. For instance, we consider the entire value chain from the resource extraction to the disposal, recycle or reclamation of materials/land. The cradle to grave approach of the TIS will enable us to identify the key elements of the value chain that could directly or indirectly have potential risks and uncertainties in development of a low carbon pathway.

The next part of the framework explores capabilities (2.3), an important element of our analysis that we will carry out when developing the future pathways. Developing future pathways requires a thorough understanding of the current capabilities and the interactions within and across the human and natural systems.

The framework lists the key stakeholders, institutions and their respective functions within an enabling and limiting environment. It is not intended to be linear, as institutions often have multiple functions and stakeholders may fall under more than one institution. For example, an academic in a university may also be an advocate for an NGO.

We focus on three aspects of the capabilities including: stakeholders (2.3.1), institutions (2.3.2) and their corresponding functions (2.3.3).

The capabilities in a system are sets of learned processes and activities carried out by systemic interactions of stakeholder in a system (e.g., firms, public organisations, universities, etc.) that enable actors to individually and/or collectively to produce and deliver particular outcomes of the system. For instance, a production system (or a sector) is a system formed by production firms, the firms that support them (e.g. suppliers of inputs for production) and other organisations, which supply complementary resources or produce specific goods or services. These goods and services are delivered to the specific consumers of the sector in a society.

Stakeholders and their interactions are the core element of the human system. Stakeholders (i.e. individuals/groups) in the system are a part of wider 'institutions'. Institutions are defined "a complex of positions, roles, norms and values lodged in particular types of social structures and organising relatively stable patterns of human activity with respect to fundamental problems in producing life-sustaining resources, in reproducing individuals, and in sustaining viable societal structures within a given environment" (Jonathan Turner, 1997). Institutions broadly describe the social structure in a system and include both formal and institutions.

Institutions often have roles or functions within the system. Functions or activities are carried out by individual stakeholders or institutions to influence the processes of the (TIS) system. In TRANSrisk, functions are associated with institutions and relate to the purpose of their existence. For instance, the function of a government is to carry out the activities relating to governing, including designing and implementing policies. In some countries, the government, media, and religious institutions, express the values of society and build key infrastructure.

We will assess the capacities of the TIS by exploring how the power and interest of stakeholders and their corresponding institutions influence the direction of the future (pathway), as well as how their actions and perceptions create path dependences. The interactions between stakeholders/ institutions and their context are key to understanding the dynamics of a system.

We then can evaluate the effectiveness of the institutions' function within the system. For instance, one of the purposes of a government is to create and implement policies, but if the government has not been effectively implementing policies to achieve its goal (e.g. of reducing CO_2 emissions) we can explore the reasons for this through stakeholder interviews and research.

This deliverable will only focus on two narrow aspects of capabilities: 1) the government institutions and 2) the policy mix (policies as a function of policy makers within the broader government institution). This will be a starting point of analysis for part II of the case studies. Each case study will focus on specific stakeholders, institutions and their functions that are key to either supporting or hindering a low carbon development pathway.

2.2 TRANSrisk overarching research questions, links for case study and research steps and framework

The following research questions have been co-developed by the TRANSrisk consortium partners and serve as the overarching 'guidance of search' for the project case studies.

Before introducing the research questions, we have defined 3 research statements to guide the background analysis required for the case study, as indicated below in Box 1.

BOX 1: Research Statement (RS) background analysis: setting the stage

RS1: Understand the risks of climate change. *Reference IPCC 2°C target in The Global & Regional Case Studies.*

RS2: Understand the risks of continuing on the current pathway. *Reference existing research in The Global & Regional Case Studies*

RS3. Understand how we got here and where we are now

a. What is our current energy mix, what are the technological lock-ins, and what are the (natural) resource constraints/opportunities? *The country case studies explore this*

Research statements 1 and 2 help to set the stage for the research by describing global and regional targets and agreements. Here we acknowledge the risks of continuing on the current pathway and describe the key issues in the global and regional report. The case studies then explore research statement 3 by providing the context for each country case study.

We then introduce the overarching research questions and 4 more sub-questions, as indicated in Box 2.

BOX 2: Overarching Research Question (RQ):

What are the costs, benefits and risks associated with transitions pathways for climate change mitigation policies/strategies at the global, regional level and the national level?

RQ1. What are possible future(s) in our case study country/sector context and how might we get there?

- a. What are the economic, social and environmental priorities to be considered in a low-carbon transition to arrive at our desired future(s)?

RQ2. What changes are required for us to get to our desired future(s)?

- a. Which specific transition pathways are to be examined, each ensuring the future we want, while considering our priorities?
- b. What are the, costs, benefits, risks and opportunities of the low-carbon options included in the pathways (e.g. economic, social and environmental impacts)?

- c. What are the interests and capabilities of actors involved and what are the external pressures that may influence the identified changes?

RQ3. What are the policy options for realising pathway(s) and what are their risks, uncertainties and opportunities?

- a. What policy options can help accelerate implementation of the identified pathways?
- b. What are the uncertainties involved, in which dimensions are these uncertainties and what are they dependent on?
- c. What are the risks & opportunities of the policy options connected to these transition pathways, given the uncertainties?

RQ4. How can we prepare to deal with these risks and options, and what policy tools and actions could we take within and across transition pathways?

Each case study will develop further country specific research questions whilst also considering the overarching research questions. The research questions will be identified here in each cases study, but will not be addressed in this deliverable; rather the research questions will be explored in part II of the case study work, which begins to identify transitions pathways. The pathway development work will contribute to D3.3 Final Brief of 14 country case studies.

Each case study will explore research questions 1, 2 and 3, which identify: possible futures; changes that are needed; and the potential policy options. However, only a few case studies may explore research question 4 in detail, as it deals more with implementation which is beyond the scope of the TRANSrisk project. Question 4 requires formulation of a plan to prepare for the risks and a selection of policy tools for implementation. Each case study leader will individually assess the extent to which they will address (or not address) the 4 research questions.

2.3 Report structure for the country case studies

Each case study presented in this deliverable follows a basic outline that includes five sections: 1) Research questions; 2) Introduction to the context; 3) The human innovation system; 4) System map(s); and 5) Stakeholder engagement.

2.3.1 Research questions

Each country case will define a specific set of research questions, often sector specific, that relate to the broader overarching TRANSrisk questions. These questions are often sector specific. The research questions may include questions that can be answered by qualitative methods and tools (e.g. stakeholder engagement, desk research) as well as by quantitative models, as each case study is paired with at least one model.

2.3.2 Introduction to the context

The context introduced in each case study provides a general overview of the environmental, economical, societal, and political context. The environmental context includes a broad discussion

of each country's energy sector, which is the starting point of each case study as discussed in D3.1 'Technological Innovation System Matrix'. The environmental context includes: the natural resource and environmental properties, the electricity mix, energy end-use by sector and greenhouse gas (GHG) emissions by sector.

The economic context includes the general economy situation of each country and the national economic priorities. The social context highlights the key social issues within the country that relate to energy and climate change, as well as the societal perception of climate change where relevant. The political context highlights the political priorities within the country, which cut across many other contextual factors. The political context may also discuss the political structure of the country if it is relevant to the case study.

We recognised that some elements of the contextual factors are interlinked. For example, protecting jobs which is a social issue that has economic impact and can also be a political priority. The context categories are meant to facilitate the analysis by providing a flexible framing to discuss the case studies, while considering a wider perspective beyond the usual economic argument.

2.3.3 Human innovation system

The human innovation system, as discussed earlier in 2.1 'Analytical Framework', is discussed through three aspects in the case study: the technological innovation system, the policy mix, and government institutions.

Each case study identifies the full life cycle value chain (cradle-to-grave) of the technological innovation system for the sector studied. The objective of identifying the full value chain is to look beyond the production aspect (e.g. electricity generation) and to include all key elements of the supply chain that could potentially be interesting (but are often ignored) in terms of developing/inhibiting a low carbon transitions. Furthermore, defining the full value chain will help us to identify stakeholder that may be impacted throughout the value chain but may be margined. For instance, in the Canadian case study, the indigenous population is at the beginning of the value chain in resource abstraction and are among the stakeholders that face the highest risks and uncertainties related to oil sands production

Additionally, identifying the full value chain helps to define the boundaries of the enabling environment, which includes the policy mix and the government institutions. The case studies will identify policies that have a direct or indirect impact on the TIS value chain or the sector. For instance, the policy mix for the Swedish transport sector will include regulations, incentives, targets, taxes etc. that will not only impact the renewable energy sector (production of biofuel) but also land use and agriculture (resource production) and air quality (consumption of biofuels). The respective institution drafting, implementing and/or monitoring the policies can then be identified.

2.3.4 System map

The system map helps to visualise the conceptual boundaries of a system, by identifying all relevant actors, policies and functions within key components of an innovation system, namely the TIS life cycle of the complete supply chain; the environment of enablers and barriers that directly or indirectly impact the system; and facilitating services that are external to the system but are fundamentally necessary. The system map involves capturing and exploring the past and present dynamic interactions between these actors, policies and functions. Building on the identified system dynamics, the framework finally allows for evaluating pathways towards low-carbon, climate-resilient economies, by exploring such dynamics while also assessing different policy strategies.

We have developed a dedicated software application that has been designed to create a structured format for representing the system map. The software helps us to easily create a system map and allows us to make modifications to the complex systems. The proposed system maps framing and dedicated tool can, moreover, assist with comparison analysis of different innovation systems (e.g. of a particular sector across a large number of countries, or of different sectors within the same country), since it features consistent representation of elements and building blocks across varied system maps.

We have written a paper that provides a description of the software in detail and explains how MATISE (i.e. system maps) can be used as an analytical tool for developing low carbon transition pathways (See appendix A).

Each case study will provide an initial draft of the system map using the software, which will be updated over time through stakeholder engagement and more detailed research.

2.3.5 Stakeholder engagement

This section includes the stakeholders that have been contacted thus far in our case study work. Some case studies have included stakeholder inputs, while other case studies will include stakeholder inputs in part II of the case study. In general, stakeholder inputs have a limited role in this deliverable, as we are mainly identifying the key contextual aspects and verifying the context with stakeholders. However, the stakeholder engagement process will be an integral aspect of the case study work in D3.3 'A final brief of 14 country case studies', where we will integrate stakeholders into the development of potential low carbon development pathways.

2.3.6 Case studies: variations and comparisons

There will be variations in the level of detail provided in each section throughout the country case studies. The variation will depend on the starting point of each case study, as some case studies stem from earlier research projects outside of TRANSrisk. Furthermore, some case studies have carried out stakeholder interviews or workshops that have helped to develop some content in various sections. Additionally, we have a range of cross-disciplinary researchers. Those who

specialise in policy analysis may have developed the policy mix section further, while modellers may provide greater detail on statistics and offer some insights on potential pathways.

The aim of creating a standardised table of contents was to provide a minimum threshold of information required to understand the unique context of each country and to allow for cross country comparison. We have compiled the key contextual factors and enabling environment (policy mix and government institutions) for each country case study in a matrix (see Appendix B), which may help us to identify common elements across each country that could potentially enable or impede a low carbon pathway.

References and interviews

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Appendix A: System Mapping Tool Abstract

We have submitted the following article to a journal and it is currently under review. Please see the article abstract below:

MATISE: A mapping tool for evaluating the dynamics of an innovation system for climate change

Alexandros Nikas, Haris Doukas, Jenny Lieu, Rocio Alvarez Tinoco, Vasileios Charisopoulos, and Wytze van der Gaast

Abstract:

This paper discusses the use of system maps for evaluating innovation systems with regard to climate change, and introduces Mapping Tool for Innovation Systems Evaluation (MATISE), a dedicated software application for automating system mapping. MATISE facilitates the development of a visual narrative through a bottom-up approach, building on stakeholder knowledge of system boundaries, as well as key elements and interactions within the system. We argue that system maps address a conceptual gap in the systems of innovation literature, by providing a framing that helps to identify key determinants of innovation and to codify dynamic individual interactions; they can, therefore, contribute to evaluating systems for climate change, by identifying the main interactions and capturing the dynamic interrelations between mitigation or adaptation policy strategies and other system components. Automating the process with MATISE also allows users to easily reproduce iterations of a system map and explicitly track the continuously evolving system dynamics.

Key words: system maps, innovation systems, decision support, climate change, climate policy

Software availability

MATISE is freely available online at http://transrisk-project.eu/matise.zip, and can be run in Windows, as a reference implementation in MATLAB, versions R2009b up to R2014a. The lead developers are (1) Alexandros Nikas, National Technical University of Athens, School of Electrical and Computer Engineering, Energy Policy Unity, Iroon Politechniou 9, 157 80, Athens, Greece. Email: anikas@epu.ntua.gr; and (2) Vasileios Charisopoulos, National Technical University of Athens, School of Electrical and Computer Engineering, Iroon Politechniou 9, 157 80, Athens, Greece. Email: vharisop@gmail.com.

MATLAB is a proprietary programming language and environment, developed by Mathworks, and can be run in Windows, Mac and Linux. MATISE can only be run in MATLAB versions R2009b up to R2014a. The specifications needed to run MATLAB on any system are described in the following webpage: http://www.mathworks.com.

yEd Graph Editor is developed by yWorks under a permissive license, and freely available online at www.yworks.com, in both a 32-bit and a 64-bit version for Windows Vista or later, Linux, and

Mac OS X 10.8 or higher. The executable file is approximately 70 MB for Windows, 100 MB for Mac OS X and 80 MB for Linux.

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Appendix B: Country case study context overview

The country case study context matrix describes 16 common elements (listed below) of each country case study contexts, providing a quick overview of each case study and an easy means of comparing their content.

Due to the size of this matrix it is best viewed on screen as an Excel file, rather than printed out on paper. The Excel file will be published on our project website shortly after submission of this deliverable – see http://transrisk-project.eu/content/transrisk-results.

Country case study context overview matrix contents:

- Main research question
- (Intended) National Development Commitments (I)NDC
- Policy overview (broad overarching policies)
- Natural resources and environmental priorities
- Energy end-use (consumption): dominate source
- Electricity mix (production)
- GHG emissions: largest contributor
- Economic priorities
- Societal priorities perspective on climate change
- Politics of energy development priorities
- Conflicts and synergies of priorities
- TIS life cycle value chain: a cradle to grave analysis
- Enabling environment: policy mixes in the socio-economic system (includes detail sector policies)
- Enabling environment: government institutions
- The Innovation System map (key categorisations)
- Stakeholder engagement- contacted thus far