A global study of economically and socially feasible low carbon transitions, with a focus on understanding risk and uncertainty.
Introduction

TRANSrisk was a global study of technically, economically and sociably feasible low carbon transitions. It focused on understanding risk and uncertainty within these transitions. Our work aimed to improve the ability of policy makers to plan low carbon transitions and to understand the risks and uncertainties that lie in their implementation.

Low carbon transition pathways describe how, where and when carbon reduction targets can be met. They may, for example, set out what technologies (and other measures) will be used, where they will be deployed and when they will be rolled out.

The success of a pathway will not simply depend on the technical feasibility of the technologies involved – social and economic factors will also have significant impacts.

TRANSrisk has enhanced our understanding of how these pathways can be developed, and the risks and opportunities that may lie within them. This booklet outlines some of the key outputs of our work, with links to further reading.

We hope you find our work interesting. Please get in touch if you want to find out more.
Who Are We?
The team behind TRANSrisk are a tight knit partnership of 12 leading universities and research institutions based in the EU, Switzerland and Chile. The project was coordinated by SPRU (Science Policy Research Unit) at the University of Sussex in the UK. Funding was provided by the EU’s Horizon 2020 programme.

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How Can TRANSrisk Help You?
TRANSrisk’s work could be of interest to a wide range of people, from policy makers and researchers to members of the public seeking to understand the challenge of addressing climate change. In this booklet we have grouped our work under seven key themes, stating the kind of questions we can help to answer.
1. Evaluating potential low carbon transition pathways

TRANSrisk developed tools to help researchers and policy makers evaluate options for low carbon transition pathways. Some of our tools can help to explore, categorise and analyse the expertise of key sector stakeholders. Others can help make quick and easy estimates of the impacts of proposed policy changes; these, for example, can be used to inform sector stakeholders about the economic impacts of potential low carbon pathways.

Questions we can help with include:

- What tools can be used to compare policy mixes/strategies against both climate and economic criteria?
- How can we evaluate policy packages (as opposed to individual policies), both against their effectiveness in cutting carbon emissions and other socioeconomic goals?
- How can we use economic modelling tools to provide fast, direct feedback into the policy making process, for example via quick and easy ‘what if?’ analysis?

These questions were addressed in TRANSrisk’s Work Package 7 ‘Comparison of Transition Pathways and Decision Support Tools’, led by NTUA.

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2. Harnessing the knowledge of stakeholders to inform and develop low carbon transition pathways

TRANSrisk worked with stakeholders to investigate how their knowledge can be used to guide and shape low carbon transition pathways. The tools and guidance we developed were tested extensively in our 14 country case studies.

Questions we can help with include:

> What are viable approaches for engaging stakeholders in a research project in order to capture their knowledge effectively?
> How can we ensure that identified stakeholders are representative in terms of sectors and interests?
> How can we characterise stakeholders in order to classify and weigh their input into decision-making processes?
> Which of the broad range of available stakeholder consultation tools are most effective, and how do we decide which tool(s) to use during the analytical stage?

These questions were addressed in TRANSrisk’s Work Package 2 ‘Stakeholder Engagement and Interactions’, led by JIN, and Work Package 6 ‘Innovations Policies and Transition Pathways’, led by SEI.

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3. Integrating quantitative (computer models) and qualitative (stakeholder input) techniques in the assessment of potential low carbon transition pathways

Computer models and stakeholder input are both powerful tools for assessing low carbon transition pathways. Integrating the two techniques has significant advantages: models can be grounded in the complex realities of the socio-political environment, whilst stakeholders can be shown what their views could actually mean in terms of technology deployment and economic impact.

Questions we can help with include:

> How can stakeholder preferences and concerns be collected and processed as input for quantitative tools, such as models?
> How can modelled futures for low-carbon transition pathways be communicated to stakeholders for them to obtain a clear overview of risks (socio-economic impacts) and benefits of low-carbon transition options?
> What are viable tools to assess (with stakeholders) what risks of a low-carbon pathway are acceptable within their socio-economic and political context, given the modelled benefits?
> How can practitioner knowledge be used to assess constraints and enablers in innovation processes for accelerated uptake of low-carbon transition pathways?

These questions were addressed in TRANSrisk’s Work Package 2 ‘Stakeholder Engagement and Interactions’, led by JIN, and Work Package 6 ‘Innovations Policies and Transition Pathways’, led by SEI.

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4. Understanding the impact of feedback effects, policy synergies and conflicts

Policy for carbon emissions does not exist in a bubble: there are many interactions with other economic and social goals, and also natural systems. TRANSrisk explored the economic costs of potential climate feedback systems, and analysed synergies and conflicts with other policy goals.

Questions we can help with include:

› How could Arctic feedback impacts (permafrost and ice melt) affect the economic cost of tackling climate change? Is avoiding these ‘tipping points’ economically advantageous?
› How can behaviour change measures contribute towards meeting carbon reduction targets?
› What are the synergies and conflicts between reducing carbon emissions and other economic, social and environmental policy aims? How do these vary across the regions of the world?

These questions were addressed in TRANSrisk’s Work Package 4 ‘Synergies and Conflicts Between Different Energy System Pathways’, led by BC3.

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5. Identifying and understanding risks and uncertainties in low carbon transition pathways

All transition pathways contain risks and uncertainties. Successful implementation is dependent on understanding what we don’t know, what might go wrong and planning measures to mitigate potential negative impacts. TRANSrisk worked extensively to understanding where the gaps in our knowledge lie, and how risk and uncertainties can be both identified and mitigated.

TRANSrisk developed tools and techniques to make integration of these techniques a reality, and validated these through its 14 country case studies.

Questions we can help with include:
> What kind of risks and uncertainties exist in low carbon transition pathways, and how can we assess and characterise them?
> How well do we understand pathway risks and uncertainties from the available research base? Where are the research gaps?
> How do stakeholders identify and assess risks and uncertainties in low carbon transition pathways? How do these assessments vary between countries and technologies?
> What are the key uncertainties in the socioeconomic, energy and climate systems that influence the impact of low-carbon mitigation pathways?
> How do uncertainties affect the input parameters for numerical models used to assess the costs and benefits of addressing climate change?

These questions were addressed in TRANSrisk’s Work Package 5 ‘Uncertainty and risk appraisal of Policy Options’, led by ETHZ.

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6. Understanding what low carbon technologies are suitable for different areas of world, and the barriers and opportunities to their deployment

The suitability of low carbon technologies will vary across the regions and countries of the world. This is not only due to the technical potential for a technology (e.g. the available sunlight or wind resource), but also because of social and economic factors. TRANSrisk explored these factors through 14 country case studies, ranging from Europe and North America to the fast growing economies of Asia, Africa and Latin America.

**Questions we can help with include:**

- What is the economic, social and policy context for climate and energy action in our case study countries?
- What country and technology specific risks and uncertainties might be encountered in low carbon transition pathways, and how can these be identified and mitigated?

These questions were addressed in TRANSrisk’s Work Package 3 ‘Country Case Studies’, led by SPRU.

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7. Managing the work of a multi-national research project, and disseminating its outputs

In addition to academic findings, TRANSrisk developed expertise in the management of a large, multinational climate research project and also how the results of such a project can be disseminated to a target audience. By recording our ‘learning whilst doing’ we are able to pass on experience of what works, and equally what does not work.

Questions we can help with include:

- What kind of technical and management systems can be used to run large, multi-national research partnerships?
- How can we meet the open access and open data requirements of Horizon 2020 funding?
- What are the most successful methods for disseminating research outputs to both academic and policy making audiences?

These questions were addressed in TRANSrisk’s Work Package 1 ‘Project Management’, led by SPRU, and Work Package 8, ‘Dissemination’, led by UPRC.

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The TRANSrisk Case Studies

TRANSrisk has explored potential low carbon transitions across the world, from Europe and North America to the fast growing economies of Asia, Africa and Latin America. Each case study has explored technologies and sectors that are of particular importance to that country.

In addition to the country specific outputs and recommendations, we have worked across the case studies to identify common risks, uncertainties and opportunities.
Austria: Decarbonising the iron & steel and electricity supply sector
Leader: UniGraz

This case study focused on low carbon pathways for the iron and steel sector. Austria has a large iron and steel sector, contributing approximately half of current industrial CO₂ emissions and 16% of national GDP. Decarbonising the industry is therefore of crucial importance to a national low carbon transition.

Canada: Oil sands
Leader: SPRU

Oil sands production in the Canadian province of Alberta is a polluting on both a local and global basis, but is a key component of the local economy. This case study explored both the broader environmental impacts of oil sand production, as well as the environmental, economic and social impacts on the Native (First Nations) population who live on land where the majority of oil sands are situated.

Chile: Renewable energy and energy poverty
Leader: CLAPES UC

Chile has significant potential for developing solar energy. This case study explored solar energy production from PV systems. It also examined the potential impacts of a low carbon transition on energy poverty, and how any negative impacts could be mitigated. Finally, the case study looked at the links between air pollution and climate change, focusing on how carbon mitigation measures can be fine tuned to improve urban air quality.
China: **The building sector**  
Leader: **SPRU**

China’s building stock has grown enormously over recent decades, alongside the country’s booming economy. This case study focused on the use of renewable energy and energy efficiency in the building sector, exploring how new ‘green’ buildings and retrofitting existing buildings could reduce both energy use in buildings and coal consumption in the power sector.

Greece: **Solar power and the building sector**  
Leader: **NTUA-UPRC**

This case study explored pathways towards a low carbon energy system based on the diffusion of micro-generation and storage (both thermal and electrical) in the residential sector. The study had a particular focus on solar energy.

India: **Solar and wind power**  
Leader: **SPRU**

This case study examined strategies for scaling up solar and wind energy capacity. India intends to decrease its GDP emission intensity to 33-35% below 2005 levels by 2030, and therefore renewable energy is currently considered of high importance by the Indian Government.
Indonesia: **Biogas for electricity and cooking**
Leader: **SEI**

Indonesia is a fast developing archipelago nation with highly variable levels of access to energy. This case study centred on the use of biodigesters and biogas, both at the small (village) scale and at a large scale for electricity generation.

Kenya: **Geothermal and charcoal**
Leader: **SEI**

The Kenya case study focused on energy access and security objectives. It explored the country’s abundant geothermal resource and the sustainable use and trade of charcoal, a traditional fuel widely used in Kenya.

Spain: **Solar and wind power**
Leader: **BC3**

This case study focused on renewable options for Spain in the context of European climate targets and the country’s previous experience of incentivising renewables. The study also explored the role of gender in energy decision making, as well energy poverty and energy justice elements.
Sweden: **Road freight transport**  
Leader: **SEI**

This case study examined how the road freight sector could transition to low carbon fuels such as biofuels or electric road systems. It also considered the development of future freight transport needs, including aspects of other modes of transport (sea, rail, air etc.) and possible shifts in the volume and patterns of demand.

The Netherlands: **Solar PV and livestock farming**  
Leader: **JIN**

Two case studies were carried out in the Netherlands. The first explored the scope for solar PV at both the rooftop and solar park scales. The second examined transition in the country’s large livestock sector, focusing on the sustainable management of animal manure.

Poland: **Power sector**  
Leader: **IBS**

The Poland study focused on transition in the energy generation sector, with particular attention to coal and renewables. The study examined the costs of a transition and impacts on employment, particularly on the coal sector which holds significant political power in Poland.
Switzerland: **Renewable energy and nuclear phase out**  
**Leader:** ETH Zurich

Switzerland aims to decommission its nuclear power plants within one generation and transition to renewable energy. This case study explored scenarios for this transition, paying particular attention to the social and political contexts of Switzerland.

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United Kingdom: **Nuclear power**  
**Leader:** SPRU

The UK is one of the few countries planning a significant nuclear expansion. This case study focused on the two pathways of nuclear expansion and no new nuclear, exploring the impacts on the UK’s decarbonisation targets and renewable deployment. It also explored issues relevant to the controversial nature of nuclear technology including public acceptance, political interests, the investment environment, proliferation issues and resources use.
Further Reading and Contacts

All of TRANSrisk’s work is published on our website www.transrisk-project.eu. We also publish short summaries of much of our work on http://climatechangemitigation.eu/. In early 2019 our work will be published in two open access books:

> “Understanding risks and uncertainties in energy and climate policy: Multidisciplinary methods and tools towards allowing carbon society” (Springer).

For a more detailed discussion of our work, and how it might be able to help you, please get in touch using the details below.

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