PARIS
REINFORCE

27/11/2020

D8.11 REPORT ON SCIENTIFIC PUBLICATIONS

WP8 – Communication, Dissemination, & Exploitation

Version: 1.00

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Grant Agreement Number	**820846**	**Acronym**	**Paris Reinforce**
Full Title	Delivering on the Paris Agreement: A demand-driven, integrated assessment modelling approach		
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Project URL	https://www.paris-reinforce.eu/		
EU Project Officer	Frederik Accoe		
Project Coordinator	National Technical University of Athens – NTUA		
Deliverable	D8.11 - Report on scientific publications		
Work Package	WP8 - Communication, Dissemination & Exploitation		
Date of Delivery	Contractual	30/11/2020	Actual 27/11/2020
Nature	Report	Dissemination Level	Public
Lead Beneficiary	NTUA		
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Contributors			
Reviewer(s):	George Stravodimos (IEECP), Haris Doukas (NTUA)		
Keywords	Scientific publications; papers; journals; impact; projects; modelling		

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

EC Summary Requirements

1. Changes with respect to the DoA

No changes with respect to the work described in the DoA.

2. Dissemination and uptake

The present deliverable can be used by anyone interested in the PARIS REINFORCE scientific outputs, in terms of publications and special issues in high-impact scientific journals as well as presentations in academic/scientific conferences, in order to direct them into exploring the project's outcomes.

3. Short summary of results (<250 words)

To mobilise acquired, processed and accumulated knowledge for scientific debate and progress, including for the purpose of feeding into the Intergovernmental Panel on Climate Change (IPCC) 6th Assessment Report (AR6) Cycle, PARIS REINFORCE has ensured timely scientific publications in high-impact, peer-reviewed journals, as well as presence in distinguished academic conferences. This deliverable summarises this scientific output, by listing the papers, conferences, and special issues.

By November 2020, a total of twenty two articles in scientific journals, six papers/presentations/posters in conferences, and one special issue have been published within PARIS REINFORCE. Although the scientific output in high-impact journals (including Nature, Nature Climate Change, Nature Energy, Environmental Innovation & Societal Transitions, Energy Research & Social Science, Environmental Research Letters, Renewable & Sustainable Energy Reviews, etc.) has been rich and diverse, the project has had limited impact in conferences. This is attributed to the COVID-19 pandemic, due to which most conferences during the first half of the project have been postponed and/or cancelled, with a few exceptions going ahead in the virtual domain. Nevertheless, the project has had an impact in major scientific assessments/meetings, including official meetings of the Integrated Assessment Modeling Consortium (IAMC), the ETSAP community, and the Energy Modeling Forum (EMF). Finally, a special issue was successfully launched in the Energy Sources, Part B: Economics, Planning & Policy as early as during the first months of the project, already counting five publications.

4. Evidence of accomplishment

This report, all scientific publications (in the listed DOI links), as well as the following links:

- PARIS REINFORCE Scientific Publications (website link)
- PARIS REINFORCE Conferences (website link)

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Preface

PARIS REINFORCE will develop a novel, demand-driven, IAM-oriented assessment framework for effectively supporting the design and assessment of climate policies in the European Union as well as in other major emitters and selected less emitting countries, in respect to the Paris Agreement. By engaging policymakers and scientists/modellers, PARIS REINFORCE will create the open-access and transparent data exchange platform I^{2}AM PARIS, in order to support the effective implementation of Nationally Determined Contributions, the preparation of future action pledges, the development of 2050 decarbonisation strategies, and the reinforcement of the 2023 Global Stocktake. Finally, PARIS REINFORCE will introduce innovative integrative processes, in which IAMs are further coupled with well-established methodological frameworks, in order to improve the robustness of modelling outcomes against different types of uncertainties.

NTUA - National Technical University of Athens	GR	
BC3 - Basque Centre for Climate Change	ES	
Bruegel - Bruegel AISBL	BE	
Cambridge - University of Cambridge	UK	
CICERO - Cicero Senter Klimaforskning Stiftelse	NO	
CMCC - Fondazione Centro Euro-Mediterraneo sui Cambiamenti Climatici	IT	
E4SMA - Energy Engineering Economic Environment Systems Modeling and Analysis	IT	
EPFL - École polytechnique fédérale de Lausanne	CH	
Fraunhofer ISI - Fraunhofer Institute for Systems and Innovation Research	DE	
Grantham - Imperial College of Science Technology and Medicine - Grantham Institute	UK	
HOLISTIC - Holistic P.C.	GR	
IEECP - Institute for European Energy and Climate Policy Stichting	NL	
SEURECO - Société Européenne d'Economie SARL	FR	
CDS/UnB - Centre for Sustainable Development of the University of Brasilia	BR	
CUP - China University of Petroleum-Beijing	CN	
IEF-RAS - Institute of Economic Forecasting – Russian Academy of Sciences	RU	
IGES - Institute for Global Environmental Strategies	JP	
TERI - The Energy and Resources Institute	IN	

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Executive Summary

To mobilise acquired, processed and accumulated knowledge for scientific debate and progress, including for the purpose of feeding into the Intergovernmental Panel on Climate Change (IPCC) 6th Assessment Report (AR6) Cycle, PARIS REINFORCE has ensured timely scientific publications in high-impact, peer-reviewed journals, as well as presence in distinguished academic conferences. This deliverable summarises this scientific output, by listing the papers, conferences, and special issues.

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The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

1 Introduction

As of November 2020, 22 scientific papers have been published in high-impact scientific journals. Moreover, the PARIS REINFORCE special issue "Transdisciplinary science in energy transitions: thinking outside strictly formalised modelling boxes" in Energy Sources, Part B: Economics, Planning, and Policy has been published, counting five academic publications and one editorial. Finally, the consortium has participated in six conferences. Section 2 reports the publications supported by and acknowledging the PARIS REINFORCE project, Section 3 discusses the PARIS REINFORCE Special Issue, and Section 4 lists the conferences where the project has made an impact.

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2 List of scientific publications in peer-reviewed journals

Below, we list all scientific publications published in the framework of the PARIS REINFORCE project, indicating among others the title, authors (and PARIS REINFORCE partners), journal, abstract and keywords, and any synergies with other EC-funded projects.

2.1 Van de Ven et al. (2019), Environmental Research Letters

Title: Integrated policy assessment and optimisation over multiple sustainable development goals in Eastern Africa

Authors: Dirk-Jan Van de Ven (BC3), Jon Sampedro (BC3), Francis X Johnson, Rob Bailis, Aikaterini Forouli (NTUA), Alexandros Nikas (NTUA), Sha Yu, Guillermo Pardo (BC3), Silvestre García de Jalón (BC3), Marshall Wise, and Haris Doukas (NTUA)

Journal: Environmental Research Letters

Abstract: Heavy reliance on traditional biomass for household energy in eastern Africa has significant negative health and environmental impacts. The African context for energy access is rather different from historical experiences elsewhere as challenges in achieving energy access have coincided with major climate ambitions. Policies focusing on household energy needs in eastern Africa contribute to at least three sustainable development goals (SDGs): climate action, good health, and improved energy access. This study uses an integrated assessment model to simulate the impact of land policies and technology subsidies, as well as the interaction of both, on greenhouse gas (GHG) emissions, exposure to air pollution and energy access in eastern Africa under a range of socioeconomic pathways. We find that land policies focusing on increasing the sustainable output of biomass resources can reduce GHG emissions in the region by about 10%, but also slightly delay progress in health and energy access goals. An optimised portfolio of energy technology subsidies consistent with a global Green Climate Funds budget of 30–35 billion dollar, can yield another 10% savings in GHG emissions, while decreasing mortality related to air pollution by 20%, and improving energy access by up to 15%. After 2030, both land and technology policies become less effective, and more dependent on the overall development path of the region. The analysis shows that support for biogas technology should be prioritised in both the short and long term, while financing liquefied petroleum gas and ethanol technologies also has synergetic climate, health and energy access benefits. Instead, financing PV technologies is mostly relevant for improving energy access, while charcoal and to a lesser extend fuelwood technologies are relevant for curbing GHG emissions if their finance is linked to land policies.

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

We suggest that integrated policy analysis is needed in the African context for simultaneously reaching progress in multiple SDGs.

Keywords: Africa; Eastern Africa; SDGs

DOI: https://doi.org/10.1088/1748-9326/ab375d

Open Access: Gold

First Online: August 20, 2019

Repository: Zenodo (Link: https://zenodo.org/record/4022245)

Synergies with: H2020 TRANSrisk GA-642260

Citation (APA): Van de Ven, D. J., Sampedro, J., Johnson, F. X., Bailis, R., Forouli, A., Nikas, A., ... & Doukas, H. (2019). Integrated policy assessment and optimisation over multiple sustainable development goals in Eastern Africa. *Environmental Research Letters, 14*(9), 094001.

Figure 1: Preview of 'Integrated policy assessment and optimisation over multiple sustainable development goals in Eastern Africa' in Environmental Research Letters

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

2.2 Song et al. (2020), Energy Research & Social Science

Title: Contested energy futures, conflicted rewards? Examining low-carbon transition risks and governance dynamics in China's built environment

Authors: Lei Song, Jenny Lieu, Alexandros Nikas (NTUA), Apostolos Arsenopoulos (NTUA), George Vasileiou (NTUA), and Haris Doukas (NTUA)

Journal: Energy Research & Social Science

Abstract: China's urbanisation has caused city populations to grow rapidly, boosting continuous development and scaling up the construction industry more intensely. The building sector is thus a key area to consider for climate change mitigation efforts. This study initially seeks to explore the development of a green transition pathway for the Chinese building sector, informed by national and local low-carbon policies and strategies, with specific references to Beijing and Shanghai. Acknowledging that the barriers and impacts of these policies have not been explored in depth and in consideration of the multiplicity of stakeholder views, we then set out to collect stakeholders' perspectives of implementation and consequential risks associated with the envisaged transition and with the policies aiming to promote this transition. These concerns are evaluated in a multiple-criteria group decision making approach. By focusing on the resulting most critical implementation barriers, we then outline five plausible socioeconomic scenarios, against which we simulate the impacts of the considered policy strategies on the low-carbon transition of the Chinese built environment as well the extent of their key possible negative consequences, by means of fuzzy cognitive maps.

Keywords: Transition; Risks; Building sector; China

DOI: https://doi.org/10.1016/j.erss.2019.101306

Open Access: Gold

First Online: September 23, 2019

Repository: Zenodo (Link: https://zenodo.org/record/4061008)

Synergies with: H2020 TRANSrisk GA-642260

Citation (APA): Song, L., Lieu, J., Nikas, A., Arsenopoulos, A., Vasileiou, G., & Doukas, H. (2020). Contested energy futures, conflicted rewards? Examining low-carbon transition risks and governance dynamics in China's built environment. *Energy Research & Social Science, 59*, 101306.

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

Energy Research & Social Science
Volume 59, January 2020, 101306

Original research article

Contested energy futures, conflicted rewards? Examining low-carbon transition risks and governance dynamics in China's built environment

Lei Song [a], Jenny Lieu [b] ✉, Alexandros Nikas [c] ✉, Apostolos Arsenopoulos [c], George Vasileiou [c], Haris Doukas [c]

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[c] Management & Decision Support Systems Lab, School of Electrical and Computer Engineering, National Technical University of Athens, Iroon Politechniou 9, 157 80, Athens, Greece

Figure 2: Preview of 'Contested energy futures, conflicted rewards? Examining low-carbon transition risks and governance dynamics in China's built environment' in Energy Research & Social Science

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

2.3 Gramkow & Anger-Kraavi (2019), Sustainability

Title: Developing Green: A Case for the Brazilian Manufacturing Industry

Authors: Camila Gramkow (CDS/UNB), and Annela Anger-Kraavi (Cambridge)

Journal: Sustainability

Abstract: The recent IPCC Special Report on global warming of 1.5 °C emphasizes that rapid action to reduce greenhouse gas (GHG) emissions is vital to achieving the climate mitigation goals of the Paris Agreement. The most-needed substantial upscaling of investments in GHG mitigation options in all sectors, and particularly in manufacturing sectors, can be an opportunity for a green economic development leap in developing countries. Here, we use the Brazilian manufacturing sectors as an example to explore a transformation of its economy while contributing to the Paris targets. Projections of Brazil's economic futures with and without a portfolio of fiscal policies to induce low carbon investments are produced up to 2030 (end year of Brazil's Nationally Determined Contribution—NDC), by employing the large-scale macro econometric Energy-Environment-Economy Model, E3ME. Our findings highlight that the correct mix of green stimulus can help modernize and decarbonize the Brazilian manufacturing sectors and allow the country's economy to grow faster (by up to 0.42% compared to baseline) while its carbon dioxide (CO_2) emissions decline (by up to 14.5% in relation to baseline). Investment levels increase, thereby strengthening exports' competitiveness and alleviating external constraints to long-term economic growth in net terms.

Keywords: Climate change macroeconomics; Fiscal policy; Sustainable economic development

DOI: https://doi.org/10.3390/su11236783

Open Access: Gold

First Online: November 29, 2019

Repository: Zenodo (Link: https://zenodo.org/record/4022583)

Synergies with: N/A

Citation (APA): Gramkow, C., & Anger-Kraavi, A. (2019). Developing Green: A Case for the Brazilian Manufacturing Industry. *Sustainability, 11*(23), 6783.

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

Figure 3: Preview of 'Developing Green: A Case for the Brazilian Manufacturing Industry' in Sustainability

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

2.4 Vielle (2019), Environmental Economics and Policy Studies

Title: Navigating various flexibility mechanisms under European burden-sharing

Authors: Marc Vielle (EPFL)

Journal: Environmental Economics and Policy Studies

Abstract: In July 2016, the European Commission presented its proposal for a regulation to reduce greenhouse gases emissions in sectors not covered by the emissions trading system with regard to post-2020 binding targets. The proposal extends the burden-sharing framework designed in 2008. This new burden-sharing, called by the European Commission as the Effort Sharing Regulation, is based on a GDP per capita rule and aims to reflect the economic capacity of each European Member State on the basis of its relative wealth. However, several papers have pointed out that this way of allocating emissions can result in great cost-inefficiencies, as the allocations do not take Member State abatement costs into account. The proposal acknowledges this issue and proposes a range of flexibility instruments (i.e., more than 15 flexibility options) that intend to enhance cost-effectiveness. This paper evaluates the proposal and analyzes the economic impacts of each flexibility option with respect to fairness and cost-effectiveness using a computable general equilibrium model. The performed analysis demonstrates that flexibility mechanisms that allow "inter-Member state flexibility" constitute the most efficient options. Specifically, they reduce compliance costs and, simultaneously, increase fairness between low-income Member States and high-income Member States.

Keywords: Effort Sharing Regulation; European Union; Climate Policy; Computable general equilibrium model

DOI: https://doi.org/10.1007/s10018-019-00257-3

Open Access: Green

First Online: December 19, 2019

Repository: Zenodo (Link: https://zenodo.org/record/4088158)

Synergies with: N/A

Citation (APA): Vielle, M. (2020). Navigating various flexibility mechanisms under European burden-sharing. *Environmental Economics and Policy Studies, 22*(2), 267-313.

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

Springer Link

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Research Article | Published: 19 December 2019

Navigating various flexibility mechanisms under European burden-sharing

Marc Vielle

Environmental Economics and Policy Studies **22**, 267–313(2020) | Cite this article

137 Accesses | **0** Altmetric | Metrics

Abstract

In July 2016, the European Commission presented its proposal for a regulation to reduce greenhouse gases emissions in sectors not covered by the emissions trading system with regard to post-2020 binding targets. The proposal extends the burden-sharing framework designed in 2008. This new burden-sharing, called by the European Commission as the *Effort Sharing Regulation*, is based on a GDP per capita rule and aims to reflect the economic capacity of each European Member State on the basis of its relative wealth. However, several

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Figure 4: Preview of 'Navigating various flexibility mechanisms under European burden-sharing' in Environmental Economics and Policy Studies

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

2.5 Hausfather & Peters (2020), Nature

Title:	Emissions–the 'business as usual' story is misleading
Authors:	Zeke Hausfather, and Glen P. Peters (CICERO)
Journal:	Nature
Abstract:	More than a decade ago, climate scientists and energy modellers made a choice about how to describe the effects of emissions on Earth's future climate. That choice has had unintended consequences which today are hotly debated. With the Sixth Assessment Report (AR6) from the Intergovernmental Panel on Climate Change (IPCC) moving into its final stages in 2020, there is now a rare opportunity to reboot.
Keywords:	IPCC
DOI:	http://dx.doi.org/10.1038/d41586-020-00177-3
Open Access:	Green
First Online:	January 29, 2020
Repository:	Zenodo (Link: https://zenodo.org/record/4118610)
Synergies with:	N/A
Citation (APA):	Hausfather, Z., & Peters, G. P. (2020). Emissions–the 'business as usual' story is misleading. *Nature, 577*, 618-620.

Figure 5: Preview of 'Emissions–the 'business as usual' story is misleading' in Nature

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

2.6 van Vliet et al. (2020), Environmental Innovation and Societal Transitions

Title:	The importance of stakeholders in scoping risk assessments—Lessons from low-carbon transitions
Authors:	Oscar van Vliet, Susanne Hanger, Alexandros Nikas (NTUA), Eise Spijker, Henrik Carlsen, Haris Doukas (NTUA), and Jenny Lieu
Journal:	Environmental Innovation and Societal Transitions
Abstract:	Identifying the risks that could impact a low-carbon transition is a prerequisite to assessing and managing these risks. We systematically characterise risks associated with decarbonisation pathways in fifteen case studies conducted in twelve countries around the world. We find that stakeholders from business, government, NGOs, and others supplied some 40 % of these risk inputs, significantly widening the scope of risks considered by academics and experts. Overall, experts and academics consider more economic risks and assess these with quantitative methods and models, while other stakeholders consider political risks more. To avoid losing sight of risks that cannot be easily quantified and modelled, including some economic risks, impact assessment modelling should be complemented with qualitative research and active stakeholder engagement. A systematic risk elicitation facilitates communication with stakeholders, enables better risk mitigation, and increases the chance of a sustainable transition.
Keywords:	Stakeholders; Climate policy; Risk assessment; Low-carbon transitions; Modelling; Integrated assessment models
DOI:	https://doi.org/10.1016/j.eist.2020.04.001
Open Access:	Gold
First Online:	May 12, 2020
Repository:	Zenodo (Link: https://zenodo.org/record/4022683)
Synergies with:	H2020 TRANSrisk GA-642260
Citation (APA):	van Vliet, O., Hanger, S., Nikas, A., Spijker, E., Carlsen, H., Doukas, H., & Lieu, J. (2020). The importance of stakeholders in scoping risk assessments—Lessons from low-carbon transitions. *Environmental Innovation and Societal Transitions, 35*, 400-413.

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

Environmental Innovation and Societal Transitions
Volume 35, June 2020, Pages 400-413

The importance of stakeholders in scoping risk assessments—Lessons from low-carbon transitions

Oscar van Vliet [a], Susanne Hanger-Kopp [a, b], Alexandros Nikas [c], Eise Spijker [d], Henrik Carlsen [e], Haris Doukas [c], Jenny Lieu [f, g]

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[b] Risk and Vulnerability Group, IIASA, Laxenburg, Austria
[c] Management & Decision Support Systems Laboratory, NTUA, Athens, Greece
[d] Joint Implementation Network (JIN), Groningen, the Netherlands
[e] Stockholm Environment Institute (SEI), Sweden
[f] Transdisciplinarity Lab, ETH Zürich, Switzerland
[g] Multi-Actor Systems Department, TU Delft, Netherlands

Figure 6: Preview of 'The importance of stakeholders in scoping risk assessments—Lessons from low-carbon transitions' in Environmental Innovation and Societal Transitions

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

2.7 Le Quéré et al. (2020), Nature Climate Change

Title: Temporary reduction in daily global CO_2 emissions during the COVID-19 forced confinement

Authors: Corinne Le Quéré, Robert B. Jackson, Matthew W. Jones, Adam J. P. Smith, Sam Abernethy, Robbie M. Andrew (CICERO), Anthony J. De-Gol, David R. Willis, Yuli Shan, Josep G. Canadell, Pierre Friedlingstein, Felix Creutzig, and Glen P. Peters (CICERO)

Journal: Nature Climate Change

Abstract: Government policies during the COVID-19 pandemic have drastically altered patterns of energy demand around the world. Many international borders were closed and populations were confined to their homes, which reduced transport and changed consumption patterns. Here we compile government policies and activity data to estimate the decrease in CO_2 emissions during forced confinements. Daily global CO_2 emissions decreased by –17% (–11 to –25% for ±1σ) by early April 2020 compared with the mean 2019 levels, just under half from changes in surface transport. At their peak, emissions in individual countries decreased by –26% on average. The impact on 2020 annual emissions depends on the duration of the confinement, with a low estimate of –4% (–2 to –7%) if prepandemic conditions return by mid-June, and a high estimate of –7% (–3 to –13%) if some restrictions remain worldwide until the end of 2020. Government actions and economic incentives postcrisis will likely influence the global CO_2 emissions path for decades.

Keywords: Climate sciences; Energy and society; Energy science and technology; Environmental sciences

DOI: https://doi.org/10.1038/s41558-020-0797-x

Open Access: Green

First Online: May 19, 2020

Repository: Zenodo (Link: https://zenodo.org/record/4118105)

Synergies with: H2020 4C GA-821003; H2020 VERIFY GA-776810; H2020 CHE GA-776186

Citation (APA): Le Quéré, C., Jackson, R. B., Jones, M. W., Smith, A. J., Abernethy, S., Andrew, R. M., De-Gol, A., Willis, D. R., Shan, Y., Canadell, J. G., Friedlingstein, P., Creutzig, F., & Peters, G. (2020). Temporary reduction in daily global CO 2 emissions during the COVID-19 forced confinement. *Nature Climate Change, 10*, 647–653.

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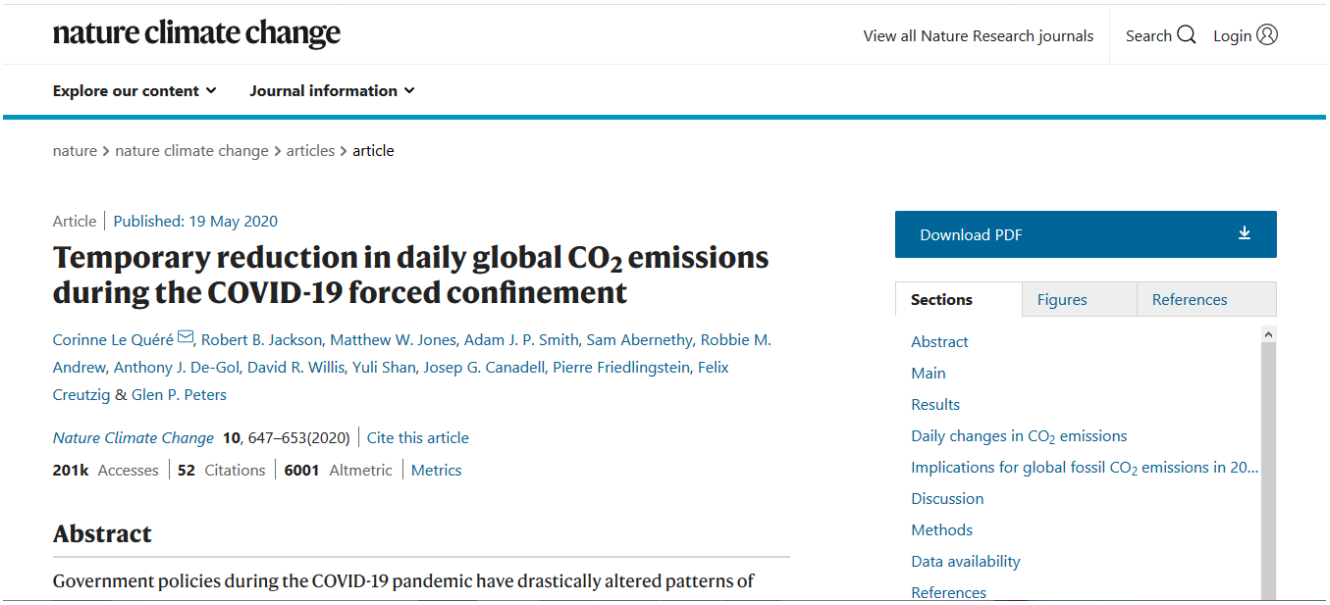

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Article | Published: 19 May 2020

Temporary reduction in daily global CO_2 emissions during the COVID-19 forced confinement

Corinne Le Quéré, Robert B. Jackson, Matthew W. Jones, Adam J. P. Smith, Sam Abernethy, Robbie M. Andrew, Anthony J. De-Gol, David R. Willis, Yuli Shan, Josep G. Canadell, Pierre Friedlingstein, Felix Creutzig & Glen P. Peters

Nature Climate Change **10**, 647–653(2020) | Cite this article

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Abstract

Government policies during the COVID-19 pandemic have drastically altered patterns of

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Figure 7: Preview of 'Temporary reduction in daily global CO 2 emissions during the COVID-19 forced confinement' in Nature Climate Change

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

2.8 Nikas et al. (2020), Operational Research

Title: A robust augmented ε-constraint method (AUGMECON-R) for finding exact solutions of multi-objective linear programming problems

Authors: Alexandros Nikas (NTUA), Angelos Fountoulakis (NTUA), Aikaterini Forouli (NTUA), and Haris Doukas (NTUA)

Journal: Operational Research

Abstract: Systems can be unstructured, uncertain and complex, and their optimisation often requires operational research techniques. In this study, we introduce AUGMECON-R, a robust variant of the augmented ε-constraint algorithm, for solving multi-objective linear programming problems, by drawing from the weaknesses of AUGMECON 2, one of the most widely used improvements of the ε-constraint method. These weaknesses can be summarised in the ineffective handling of the true nadir points of the objective functions and, most notably, in the significant amount of time required to apply it as more objective functions are added to a problem. We subsequently apply AUGMECON-R in comparison with its predecessor, in both a set of reference problems from the literature and a series of significantly more complex problems of four to six objective functions. Our findings suggest that the proposed method greatly outperforms its predecessor, by solving significantly less models in emphatically less time and allowing easy and timely solution of hard or practically impossible, in terms of time and processing requirements, problems of numerous objective functions. AUGMECON-R, furthermore, solves the limitation of unknown nadir points, by using very low or zero-value lower bounds without surging the time and resources required.

Keywords: Augmecon; ε-constraint; Multi-objective programming; Optimisation; Pareto

DOI: https://doi.org/10.1007/s12351-020-00574-6

Open Access: Gold

First Online: May 24, 2020

Repository: Zenodo (Link: https://zenodo.org/record/4023114)

Synergies with: N/A

Citation (APA): Nikas, A., Fountoulakis, A., Forouli, A., & Doukas, H. (2020) A robust augmented ε-constraint method (AUGMECON-R) for finding exact solutions of multi-objective linear programming problems. *Operational Research*, https://doi.org/10.1007/s12351-020-00574-6

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

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Original paper | Open Access | Published: 24 May 2020

A robust augmented ε-constraint method (AUGMECON-R) for finding exact solutions of multi-objective linear programming problems

Alexandros Nikas, Angelos Fountoulakis, Aikaterini Forouli & Haris Doukas

Operational Research (2020) | Cite this article

539 Accesses | **1** Citations | Metrics

Abstract

Systems can be unstructured, uncertain and complex, and their optimisation often requires operational research techniques. In this study, we introduce AUGMECON-R, a robust variant of the augmented ε-constraint algorithm, for solving multi-objective linear programming problems, by drawing from the weaknesses of AUGMECON 2, one of the most widely used improvements of the ε-constraint method. These weaknesses can be summarised in the

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Figure 8: Preview of 'A robust augmented ε-constraint method (AUGMECON-R) for finding exact solutions of multi-objective linear programming problems' in Operational Research

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

2.9 Nikas et al. (2020), Energy Sources, Part B: Economics, Planning, and Policy

Title: Sustainable and socially just transition to a post-lignite era in Greece: a multi-level perspective

Authors: Alexandros Nikas (NTUA), Hera Neofytou (NTUA), Anastasios Karamaneas (NTUA), Konstantinos Koasidis (NTUA), and John Psarras (NTUA)

Journal: Energy Sources, Part B: Economics, Planning, and Policy

Abstract: Lignite has long dominated Greece's electricity system, boosting economic growth and energy security, given the abundant domestic resources. In line with its national and international commitments to climate action and sustainable development, the country is currently facing the urgent need to transform its energy system, overcome its technological lock-ins, and transition to a low-carbon economy. Drawing from the need to secure a sustainable transition that considers the impacts of a lignite phase-out on local economies, this study builds upon the Multi-Level Perspective framework and further focuses on the phase-out of the dominant fossil fuel, rather than solely exploring the phase-in of new technologies. By delving into the landscape that established lignite as the mainstream energy resource in Greece, as well as the factors sustaining its dominance despite niche technologies and innovations challenging the regime, we discuss how the envisaged decarbonization can be socially just and effective across multiple sustainability dimensions.

Keywords: Greece; Multi-level perspective; Systems of innovation; Just transitions; Lignite; Coal; Sustainable development; Renewable energy; NECP

DOI: https://doi.org/10.1080/15567249.2020.1769773

Open Access: Green

First Online: May 27, 2020

Repository: Zenodo (Link: https://zenodo.org/record/4088144)

Synergies with: N/A

Citation (APA): Nikas, A., Neofytou, H., Karamaneas, A., Koasidis, K., & Psarras, J. (2020) Sustainable and socially just transition to a post-lignite era in Greece: a multi-level perspective, *Energy Sources, Part B: Economics, Planning, and Policy*, https://doi.org/10.1080/15567249.2020.1769773

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

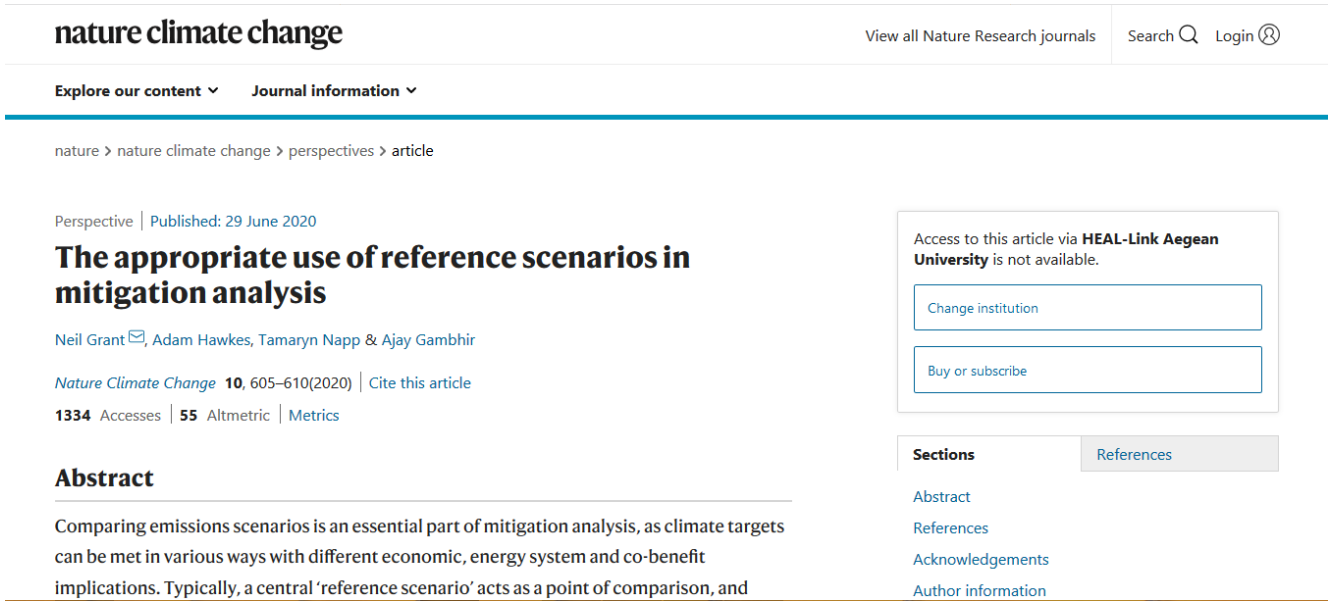
Figure 9: Preview of 'Sustainable and socially just transition to a post-lignite era in Greece: a multi-level perspective' in Energy Sources, Part B: Economics, Planning, and Policy

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

2.10 Grant et al. (2020), Nature Climate Change

Title:	The appropriate use of reference scenarios in mitigation analysis
Authors:	Neil Grant (Grantham), Adam Hawkes (Grantham), Tamaryn Napp (Grantham), and Ajay Gambhir (Grantham)
Journal:	Nature Climate Change
Abstract:	Comparing emissions scenarios is an essential part of mitigation analysis, as climate targets can be met in various ways with different economic, energy system and co-benefit implications. Typically, a central 'reference scenario' acts as a point of comparison, and often this has been a no policy baseline with no explicit mitigative action taken. The use of such baselines is under increasing scrutiny, raising a wider question around the appropriate use of reference scenarios in mitigation analysis. In this Perspective, we assess three critical issues relevant to the use of reference scenarios, demonstrating how different policy contexts merit the use of different scenarios. We provide recommendations to the modelling community on best practice in the creation, use and communication of reference scenarios.
Keywords:	Climate Change Mitigation; Climate Change Policy; Energy Economics; Energy Policy
DOI:	https://doi.org/10.1038/s41558-020-0826-9
Open Access:	Green
First Online:	June 29, 2020
Repository:	Zenodo (Link: https://zenodo.org/record/4088256)
Synergies with:	N/A
Citation (APA):	Grant, N., Hawkes, A., Napp, T., & Gambhir, A. (2020). The appropriate use of reference scenarios in mitigation analysis. *Nature Climate Change, 10*, 605–610.

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.



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Perspective | Published: 29 June 2020

The appropriate use of reference scenarios in mitigation analysis

Neil Grant, Adam Hawkes, Tamaryn Napp & Ajay Gambhir

Nature Climate Change **10**, 605–610(2020) | Cite this article

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Abstract

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Abstract

Comparing emissions scenarios is an essential part of mitigation analysis, as climate targets can be met in various ways with different economic, energy system and co-benefit implications. Typically, a central 'reference scenario' acts as a point of comparison, and

Figure 10: Preview of 'The appropriate use of reference scenarios in mitigation analysis' in Nature Climate Change

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

2.11 Babacan et al. (2020), Nature Energy

Title: Assessing the feasibility of carbon dioxide mitigation options in terms of energy usage

Authors: Oytun Babacan (Grantham), Sven De Causmaecker (Grantham), Ajay Gambhir (Grantham), Mathilde Fajardy (Grantham), A. William Rutherford (Grantham), Andrea Fantuzzi (Grantham), and Jenny Nelson (Grantham)

Journal: Nature Energy

Abstract: Measures to mitigate the emissions of carbon dioxide (CO_2) can vary substantially in terms of the energy required. Some proposed CO_2 mitigation options involve energy-intensive processes that compromise their viability as routes to mitigation, especially if deployed at a global scale. Here we provide an assessment of different mitigation options in terms of their energy usage. We assess the relative effectiveness of several CO_2 mitigation routes by calculating the energy cost of carbon abatement (kilowatt-hour spent per kilogram CO_2-equivalent, or kWh $kgCO_2e–1$) mitigated. We consider energy efficiency measures, decarbonizing electricity, heat, chemicals and fuels, and also capturing CO_2 from air. Among the routes considered, switching to renewable energy technologies (0.05–0.53 kWh $kgCO_2e–1$ mitigated) offer more energy-effective mitigation than carbon embedding or carbon removal approaches, which are more energy intensive (0.99–10.03 kWh $kgCO_2e–1$ and 0.78–2.93 kWh $kgCO_2e–1$ mitigated, respectively), whereas energy efficiency measures, such as improving building lighting, can offer the most energy-effective mitigation.

Keywords: Carbon Capture and Storage; Climate Change; Climate Change Mitigation; Energy Infrastructure; Energy science and technology

DOI: https://doi.org/10.1038/s41560-020-0646-1

Open Access: Green

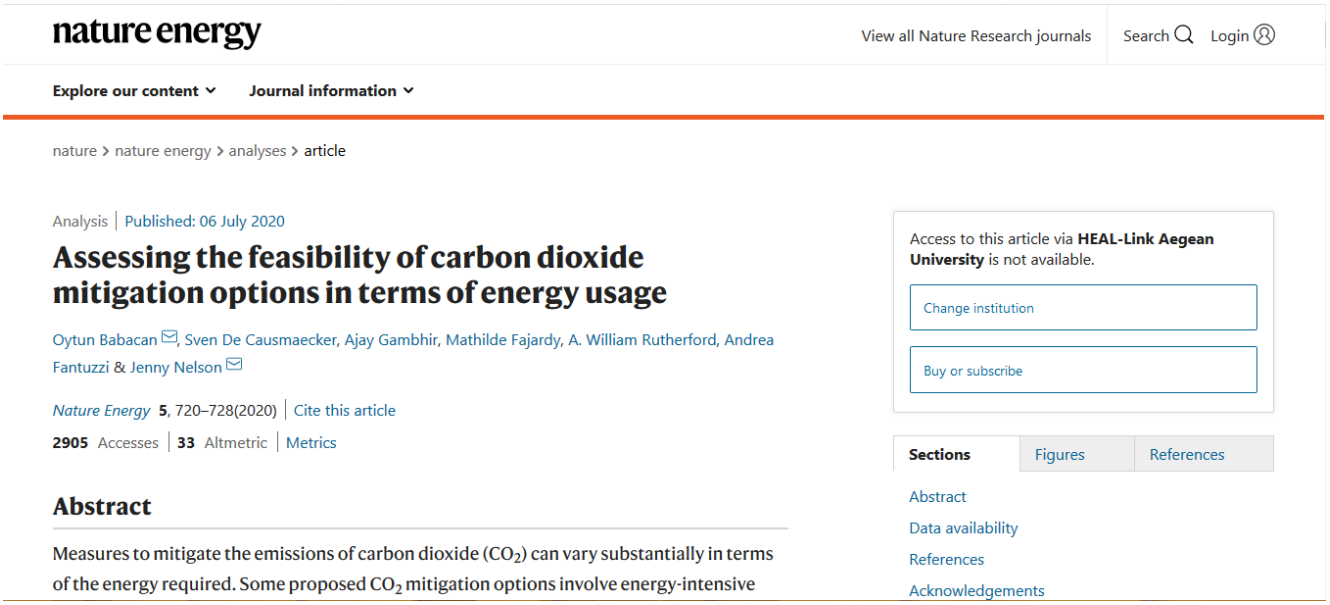
First Online: July 6, 2020

Repository: Zenodo (Link: https://zenodo.org/record/4088221)

Synergies with: ERC GA-742708

Citation (APA): Babacan, O., De Causmaecker, S., Gambhir, A., Fajardy, M., Rutherford, A. W., Fantuzzi, A., & Nelson, J. (2020). Assessing the feasibility of carbon dioxide mitigation options in terms of energy usage. *Nature Energy, 5*(9), 720-728.

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.



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Analysis | Published: 06 July 2020

Assessing the feasibility of carbon dioxide mitigation options in terms of energy usage

Oytun Babacan, Sven De Causmaecker, Ajay Gambhir, Mathilde Fajardy, A. William Rutherford, Andrea Fantuzzi & Jenny Nelson

Nature Energy **5**, 720–728(2020) | Cite this article

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Abstract

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References

Acknowledgements

Abstract

Measures to mitigate the emissions of carbon dioxide (CO_2) can vary substantially in terms of the energy required. Some proposed CO_2 mitigation options involve energy-intensive

Figure 11: Preview of 'Assessing the feasibility of carbon dioxide mitigation options in terms of energy usage' in Nature Energy

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

2.12 Neofytou et al. (2020), Renewable and Sustainable Energy Reviews

Title: Sustainable energy transition readiness: A multicriteria assessment index

Authors: Hera Neofytou (NTUA), Alexandros Nikas (NTUA), and Haris Doukas (NTUA)

Journal: Renewable and Sustainable Energy Reviews

Abstract: With climate change mainly originating from the extensive use of fossil fuels and having impacts on many aspects of life, changing the way energy is utilised constitutes a challenge that the world collectively must tackle. In this respect, all countries should implement a variety of measures focusing on energy efficiency and use of sustainable energy sources towards decarbonising their economies and achieving effective greenhouse gas emission reductions and sustainable development. Technological innovations, economic growth, societal compliance, and the regulatory and institutional frameworks constitute prominent factors that could promote, hinder or shape energy transitions as well as indicate the capacity of energy systems to be transformed. Therefore, investigating energy transitions and the extent to which countries are prepared to carry out such transitions requires the consideration of insights into multiple dimensions. This study outlines a multicriteria analysis framework to assess a country's sustainable energy transition readiness level, drawing from four pillars—social, political/regulatory, economic and technological—comprising a consistent set of eight evaluation criteria. The proposed decision analysis framework builds on the PROMETHEE II and AHP methods. Fourteen countries of different profile and level of progress towards sustainable development are evaluated and ranked, in an effort to highlight areas for improvement, and to support policymakers in designing appropriate pathways towards a greener economy.

Keywords: Sustainable energy transitions; Energy policy; Index; MCDA; PROMETHEE; AHP

DOI: https://doi.org/10.1016/j.rser.2020.109988

Open Access: Green

First Online: July 6, 2020

Repository: Zenodo (Link: https://zenodo.org/record/4088194)

Synergies with: N/A

Citation (APA): Neofytou, H., Nikas, A. & Doukas, H. (2020). Sustainable energy transition readiness: A multicriteria assessment index. *Renewable and Sustainable Energy Reviews, 131*, 109988.

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

Renewable and Sustainable Energy Reviews
Volume 131, October 2020, 109988

Sustainable energy transition readiness: A multicriteria assessment index

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National Technical University of Athens, School of Electrical & Computer Engineering, 9 Iroon Polytechniou Str., 15780, Zografou, Athens, Greece

Received 17 September 2019, Revised 9 May 2020, Accepted 10 June 2020, Available online 6 July 2020.

Figure 12: Preview of 'Sustainable energy transition readiness: A multicriteria assessment index' in Renewable and Sustainable Energy Reviews

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

2.13 Koasidis et al. (2020), Sustainability

Title: Many Miles to Paris: A Sectoral Innovation System Analysis of the Transport Sector in Norway and Canada in Light of the Paris Agreement

Authors: Konstantinos Koasidis (NTUA), Anastasios Karamaneas (NTUA), Alexandros Nikas (NTUA), Hera Neofytou (NTUA), Erlend A. T. Hermansen (CICERO), Kathleen Vaillancourt (IEECP), and Haris Doukas (NTUA)

Journal: Sustainability

Abstract: Transport is associated with high amounts of energy consumed and greenhouse gases emitted. Most transport means operate using fossil fuels, creating the urgent need for a rapid transformation of the sector. In this research, we examine the transport systems of Norway and Canada, two countries with similar shares of greenhouse gas emissions from transport and powerful oil industries operating within their boundaries. Our socio-technical analysis, based on the Sectoral Innovation Systems approach, attempts to identify the elements enabling Norway to become one of the leaders in the diffusion of electric vehicles, as well as the differences pacing down progress in Canada. By utilising the System Failure framework to compare the two systems, bottlenecks hindering the decarbonisation of the two transport systems are identified. Results indicate that the effectiveness of Norway's policy is exaggerated and has led to recent spillover effects towards green shipping. The activity of oil companies, regional and federal legislative disputes in Canada and the lack of sincere efforts from system actors to address challenges lead to non-drastic greenhouse gas emission reductions, despite significant policy efforts from both countries. Insights into the effectiveness of previously implemented policies and the evolution of the two sectoral systems can help draw lessons towards sustainable transport.

Keywords: Norway; Canada; Electric mobility; Transportation; Socio-technical transitions; Climate policy; Sectoral innovation systems; System failure framework; Systems of innovation

DOI: https://doi.org/10.3390/su12145832

Open Access: Gold

First Online: July 20, 2020

Repository: Zenodo (Link: https://zenodo.org/record/4024636)

Synergies with: N/A

Citation (APA): Koasidis, K., Karamaneas, A., Nikas, A., Neofytou, H., Hermansen, E.A.T., Vaillancourt, K. & Doukas, H. (2020). Many Miles to Paris: A Sectoral Innovation System Analysis of the

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

Transport Sector in Norway and Canada in Light of the Paris Agreement. *Sustainability, 12*, 5832.

Figure 13: Preview of 'Many Miles to Paris: A Sectoral Innovation System Analysis of the Transport Sector in Norway and Canada in Light of the Paris Agreement' in Sustainability

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

2.14 Forouli et al. (2020), Environmental Modelling & Software

Title: A multiple-uncertainty analysis framework for integrated assessment modelling of several sustainable development goals

Authors: Aikaterini Forouli (NTUA), Alexandros Nikas (NTUA), Dirk-Jan Van de Ven (BC3), Jon Sampedro (BC3), and Haris Doukas (NTUA)

Journal: Environmental Modelling & Software

Abstract: This research introduces a two-level integration of climate-economy modelling and portfolio analysis, to simulate technological subsidisation with implications for multiple Sustainable Development Goals (SDGs), across socioeconomic trajectories and considering different levels of uncertainties. We use integrated assessment modelling outputs relevant for progress across three SDGs—namely air pollution-related mortality (SDG3), access to clean energy (SDG7) and greenhouse gas emissions (SDG13)—calculated with the Global Change Assessment Model (GCAM) for different subsidy levels for six sustainable technologies, across three Shared Socioeconomic Pathways (SSPs), feeding them into a portfolio analysis model. Optimal portfolios that are robust in the individual socioeconomic scenarios as well as across the socioeconomic scenarios are identified, by means of an SSP-robustness score. A second link between the two models is established, by feeding portfolio analysis results back into GCAM. Application in a case study for Eastern Africa confirms that most SSP-robust portfolios show smaller output ranges among scenarios.

Keywords: Integrated assessment modelling; Global change assessment model; Shared socioeconomic pathways; Sustainable development goals; Stochastic uncertainty; Scenario analysis

DOI: https://doi.org/10.1016/j.envsoft.2020.104795

Open Access: Gold

First Online: July 21, 2020

Repository: Zenodo (Link: https://zenodo.org/record/4025086)

Synergies with: N/A

Citation (APA): Forouli, A., Nikas, A., Van de Ven, D.-J., Sampedro, J. & Doukas, H. (2020). A multiple-uncertainty analysis framework for integrated assessment modelling of several sustainable development goals. *Environmental Modelling & Software, 131*, 104795.

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

Environmental Modelling & Software
Volume 131, September 2020, 104795

A multiple-uncertainty analysis framework for integrated assessment modelling of several sustainable development goals

Aikaterini Forouli [a], Alexandros Nikas [a] ✉, Dirk-Jan Van de Ven [b], Jon Sampedro [b], Haris Doukas [a]

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Received 24 November 2019, Revised 8 May 2020, Accepted 8 July 2020, Available online 21 July 2020.

Figure 14: Preview of 'A multiple-uncertainty analysis framework for integrated assessment modelling of several sustainable development goals' in Environmental Modelling & Software

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

2.15 Fuss et al. (2020), One Earth

Title:	Moving toward Net-Zero Emissions Requires New Alliances for Carbon Dioxide Removal
Authors:	Sabine Fuss, Josep G. Canadell, Philippe Ciais, Robert B. Jackson, Chris D. Jones, Anders Lyngfelt, Glen P. Peters (CICERO), and Detlef P. Van Vuuren
Journal:	One Earth
Abstract:	The 1.5°C target will require removing at least some of the carbon dioxide (CO_2) previously emitted. Knowledge on how this can be done has been increasing, though barriers remain concerning governance, policy, and acceptability. For the 26th session of the Conference of the Parties (COP26) to move beyond an academic debate on CO_2 removal (CDR), a broader alliance of research and policy communities, industry, and the public is needed.
Keywords:	Paris Agreement; Climate change; Carbon dioxide removal; NDCs
DOI:	https://doi.org/10.1016/j.oneear.2020.08.002
Open Access:	Green
First Online:	August 21, 2020
Repository:	Zenodo (Link: https://zenodo.org/record/4118120)
Synergies with:	N/A
Citation (APA):	Fuss, S., Canadell, J. G., Ciais, P., Jackson, R. B., Jones, C. D., Lyngfelt, A., ... & Van Vuuren, D. P. (2020). Moving toward Net-Zero Emissions Requires New Alliances for Carbon Dioxide Removal. *One Earth, 3*(2), 145-149.

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

One Earth
Volume 3, Issue 2, 21 August 2020, Pages 145-149

Commentary

Moving toward Net-Zero Emissions Requires New Alliances for Carbon Dioxide Removal

Sabine Fuss [1, 2], Josep G. Canadell [3], Philippe Ciais [4], Robert B. Jackson [5], Chris D. Jones [6], Anders Lyngfelt [7], Glen P. Peters [8], Detlef P. Van Vuuren [9]

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2 Institute of Geography, Humboldt University of Berlin, Germany
3 CSIRO Oceans and Atmosphere Flagship, Canberra, Australia
4 Laboratoire des Sciences du Climat et de l'Environnement, Institut Pierre-Simon Laplace, CEA-CNRS-UVSQ, Gif sur Yvette Cedex, France
5 Department of Earth System Science, Woods Institute for the Environment, and Precourt Institute for Energy, Stanford University, Stanford, CA, USA
6 Met Office Hadley Centre, Exeter, UK
7 Energy Technology, Department of Space, Earth, and Environment, Chalmers University of Technology, Gothenburg, Sweden
8 CICERO Center for International Climate Research, Oslo, Norway

Figure 15: Preview of 'Moving toward Net-Zero Emissions Requires New Alliances for Carbon Dioxide Removal' in One Earth

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

2.16 Nikas et al. (2020), Energy Research & Social Science

Title: The desirability of transitions in demand: Incorporating behavioural and societal transformations into energy modelling

Authors: Alexandros Nikas (NTUA), Jenny Lieu, Alevgul Sorman (BC3), Ajay Gambhir (Grantham), Ethemcan Turhan, Bianca Vienni Baptista, and Haris Doukas (NTUA)

Journal: Energy Research & Social Science

Abstract: Quantitative systems modelling in support of climate policy has tended to focus more on the supply side in assessing interactions among technology, economy, environment, policy and society. By contrast, the demand side is usually underrepresented, often emphasising technological options for energy efficiency improvements. In this perspective, we argue that scientific support to climate action is not only about exploring capacity of "what", in terms of policy and outcome, but also about assessing feasibility and desirability, in terms of "when", "where" and especially for "whom". Without the necessary behavioural and societal transformations, the world faces an inadequate response to the climate crisis challenge. This could result from poor uptake of low-carbon technologies, continued high-carbon intensive lifestyles, or economy-wide rebound effects. For this reason, we propose a framing for a holistic and transdisciplinary perspective on the role of human choices and behaviours in influencing the low-carbon transition, starting from the desires of individuals and communities, and analysing how these interact with the energy and economic landscape, leading to systemic change at the macro-level. In making a case for a political ecology agenda, we expand our scope, from comprehending the role of societal acceptance and uptake of end-use technologies, to co-developing knowledge with citizens from non-mainstream and marginalised communities, and to defining the modelling requirements to assess the decarbonisation potential of shifting lifestyle patterns in climate change and action.

Keywords: Integrated assessment modeling; Transdisciplinary research; Behavioral change; Lifestyle; Climate policy; Deliberative democracy

DOI: https://doi.org/10.1016/j.erss.2020.101780

Open Access: Gold

First Online: September 21, 2020

Repository: Zenodo (Link: https://zenodo.org/record/4061526)

Synergies with: H2020 SHAPE_ID GA-822705

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

Citation (APA): Nikas, A., Lieu, J., Sorman, A., Gambhir, A., Turhan, E., Baptista, B.V., & Doukas, H. (2020). The desirability of transitions in demand: Incorporating behavioural and societal transformations into energy modelling. *Energy Research & Social Science, 70*, 101780.

Energy Research & Social Science
Volume 70, December 2020, 101780

Perspective

The desirability of transitions in demand: Incorporating behavioural and societal transformations into energy modelling

Alexandros Nikas [a], Jenny Lieu [b], Alevgul Sorman [c], Ajay Gambhir [d], Ethemcan Turhan [e], Bianca Vienni Baptista [f], Haris Doukas [a]

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[d] Imperial College London, Grantham Institute, SW7 2AZ, London, United Kingdom
[e] University of Groningen, Department of Spatial Planning and Environment, Landleven 1, 9747 AD Groningen, Netherlands

Figure 16: Preview of 'The desirability of transitions in demand: Incorporating behavioural and societal transformations into energy modelling' in Energy Research & Social Science

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

2.17 Koasidis et al. (2020), Energies

Title:	The UK and German Low-Carbon Industry Transitions from a Sectoral Innovation and System Failures Perspective
Authors:	Konstantinos Koasidis (NTUA), Alexandros Nikas (NTUA), Hera Neofytou (NTUA), Anastasios Karamaneas (NTUA), Ajay Gambhir (Grantham), Jakob Wachsmuth (Fraunhofer ISI), and Haris Doukas (NTUA)
Journal:	Energies
Abstract:	Industrial processes are associated with high amounts of energy consumed and greenhouse gases emitted, stressing the urgent need for low-carbon sectoral transitions. This research reviews the energy-intensive iron and steel, cement and chemicals industries of Germany and the United Kingdom, two major emitting countries with significant activity, yet with different recent orientation. Our socio-technical analysis, based on the Sectoral Innovation Systems and the Systems Failure framework, aims to capture existing and potential drivers of or barriers to diffusion of sustainable industrial technologies and extract implications for policy. Results indicate that actor structures and inconsistent policies have limited low-carbon innovation. A critical factor for the successful decarbonisation of German industry lies in overcoming lobbying and resistance to technological innovation caused by strong networks. By contrast, a key to UK industrial decarbonisation is to drive innovation and investment in the context of an industry in decline and in light of Brexit-related uncertainty.
Keywords:	United Kingdom; Germany; Systems of innovation; Sectoral innovation systems; System failures; Industrial transitions
DOI:	https://doi.org/10.3390/en13194994
Open Access:	Gold
First Online:	September 23, 2020
Repository:	Zenodo (Link: https://zenodo.org/record/4058501)
Synergies with:	N/A
Citation (APA):	Koasidis, K., Nikas, A., Neofytou, H., Karamaneas, A., Gambhir, A., Wachsmuth, J., & Doukas, H. (2020). The UK and German Low-Carbon Industry Transitions from a Sectoral Innovation and System Failures Perspective. *Energies, 13*(19), 4994.

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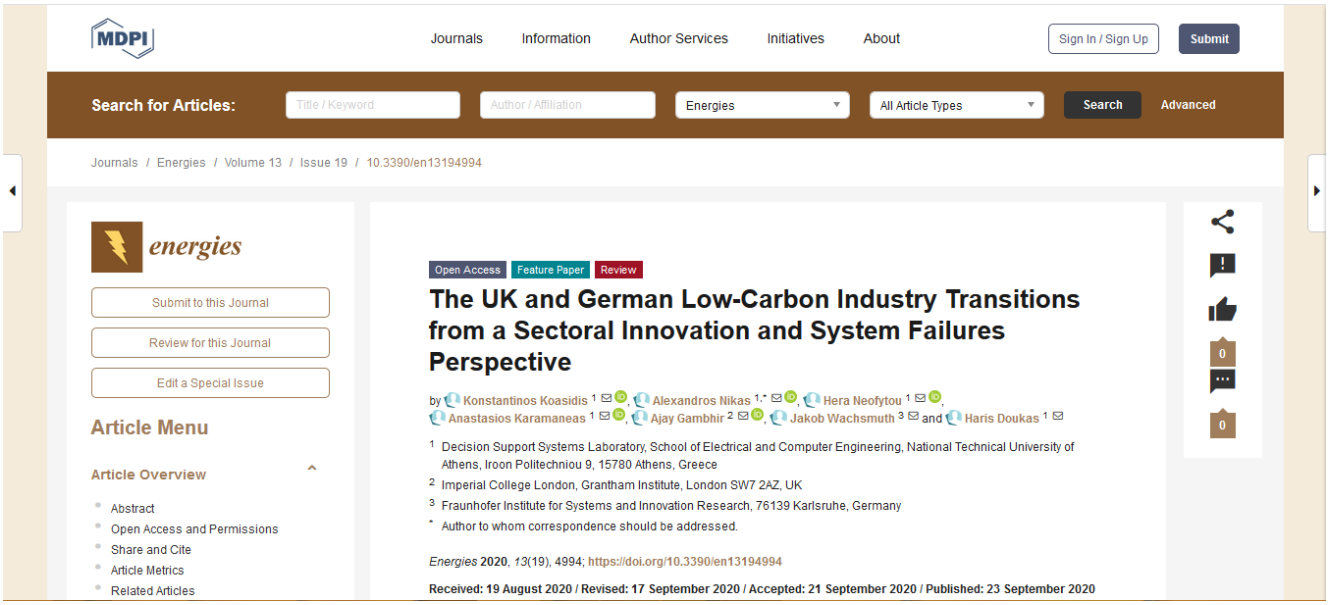

Figure 17: Preview of 'The UK and German Low-Carbon Industry Transitions from a Sectoral Innovation and System Failures Perspective' in Energies

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

2.18 Labella et al. (2020), International Journal of Computational Intelligence Systems

Title:	APOLLO: A Fuzzy Multi-criteria Group Decision Making Tool in Support of Climate Policy
Authors:	Alvaro Labella, Konstantinos Koasidis (NTUA), Alexandros Nikas (NTUA), Apostolos Arsenopoulos (NTUA), and Haris Doukas (NTUA)
Journal:	International Journal of Computational Intelligence Systems
Abstract:	Multi-criteria decision making is a daily process in everyday life, in which different alternatives are evaluated over a set of conflicting criteria. Decision making is becoming increasingly complex, and the apparition of uncertainty and vagueness is inevitable, especially when related to sustainability issues. To model such lack of information, decision makers often use linguistic information to express their opinions, closer to their way of thinking, giving place to linguistic decision making. However, the participation of multiple experts usually involves disagreements within the group, leading to unreliable solutions. To assist in decision making and reduce such complexities, APOLLO, a fuzzy decision support system, is introduced to deal with such problems in climate change and policy. The tool implements a framework for group decision making, using 2-tuple TOPSIS, coupled with a new consensus measuring model to increase robustness of selected solutions. The operation of the software tool is showcased in a real case carried out in Austria, where stakeholders were asked to assess the risks embedded in pathways for decarbonising the country's iron and steel sector. Results indicate that a coherent strategy addressing funding and competition issues is necessary, with experts displaying a consensus level of 85% in that these risks are the most threatening for the transition.
Keywords:	Linguistic decision making; Consensus; 2-tuple TOPSIS; APOLLO; Multi-criteria group decision making; Austria; Climate policy
DOI:	https://doi.org/10.2991/ijcis.d.200924.002
Open Access:	Gold
First Online:	October 1, 2020
Repository:	Zenodo (Link: https://zenodo.org/record/4084727)
Synergies with:	N/A
Citation (APA):	Labella, Á., Koasidis, K., Nikas, A., Arsenopoulos, A., & Doukas, H. (2020). APOLLO: A Fuzzy Multi-criteria Group Decision-Making Tool in Support of Climate Policy. *International Journal of Computational Intelligence Systems, 13*(1), 1539-1553

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

Figure 18: Preview of A Fuzzy Multi-criteria Group Decision Making Tool in Support of Climate Policy in International Journal of Computational Intelligence Systems

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

2.19 Doukas et al. (2020), Energies

Title:	The Green Versus Green Trap and a Way Forward
Authors:	Haris Doukas (NTUA), Alexandros Nikas (NTUA), Giorgos Stamtsis, Ioannis Tsipouridis
Journal:	Energies
Abstract:	Massive deployment of renewables is considered as a decisive step in most countries' climate efforts. However, at the local scale, it is also perceived by many as a threat to their rich and diverse natural environment. With this perspective, we argue that this green versus green pseudo-dilemma highlights how crucial a broad societal buy-in is. New, transparent, participatory processes and mechanisms that are oriented toward social licensing can now be employed.
Keywords:	Climate; Biodiversity; Integrative policy support; Social participation; Renewable energy
DOI:	https://doi.org/10.3390/en13205473
Open Access:	Gold
First Online:	October 20, 2020
Repository:	Zenodo (Link: https://zenodo.org/record/4165016)
Synergies with:	N/A
Citation (APA):	Doukas, H., Nikas, A., Stamtsis, G., & Tsipouridis, I. (2020). The Green Versus Green Trap and a Way Forward. *Energies, 13*(20), 5473.

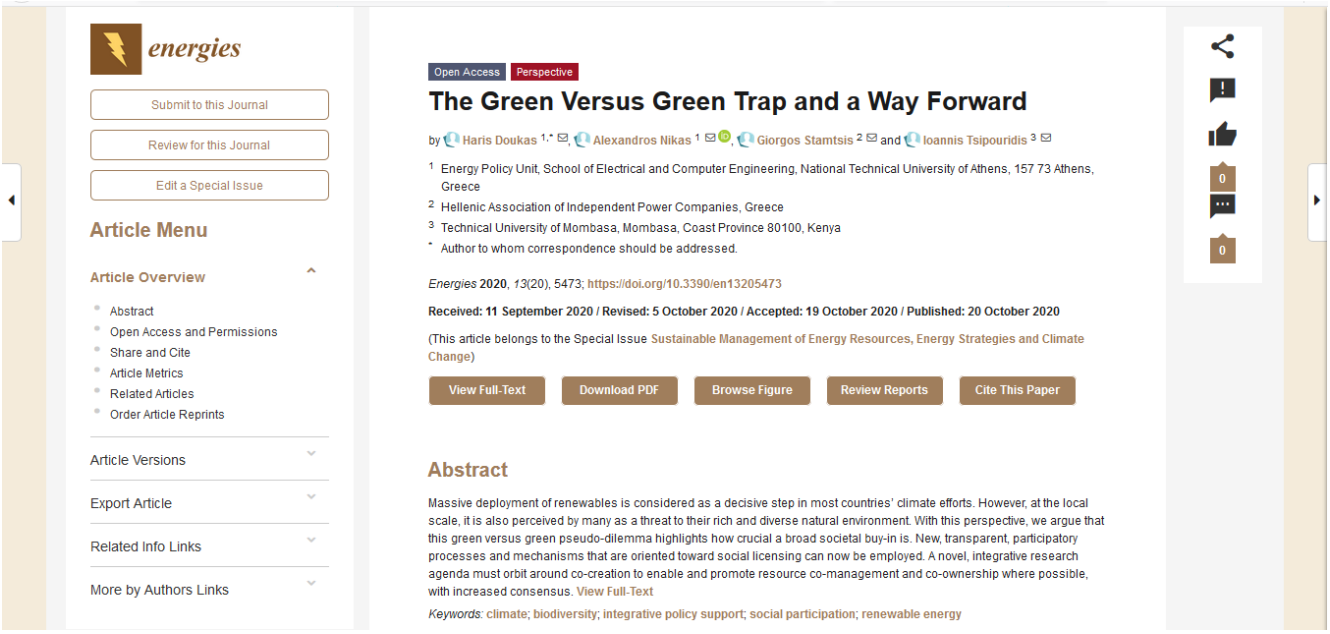

Figure 19: Preview of The Green Versus Green Trap and a Way Forward in Energies

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

2.20 Babonneau et al. (2020), Environmental Modeling & Assessment

Title: An oligopoly game of CDR strategy deployment in a steady-state net-zero emission climate regime

Authors: Frédéric Babonneau, Olivier Bahn, Alain Haurie, Marc Vielle (EPFL)

Journal: Environmental Modeling & Assessment

Abstract: In this paper, we propose a simple oligopoly game model to represent the interactions between coalitions of countries in deploying Carbon Dioxide Removal (CDR) strategies in a steady-state net-zero emission climate regime that could take place by the end of the 21st century. The emission quotas and CDR activities obtained in the solution of this steady-state model could then be used as a target for end-of-period conditions in a dynamic integrated assessment analysis studying the transition to 2100. More precisely, we analyze a steady-state situation where *m* coalitions exist and behave as *m* players in a game of supplying emission rights on an international emission trading system. The quotas supplied by a coalition must correspond to the amount of CO_2 captured through CDR activities in the corresponding world region. We use an extension of the computable general equilibrium model GEMINI-E3 to calibrate the payoff functions and compute an equilibrium solution in the noncooperative game.

Keywords: Carbon dioxide removal; Climate change; Integrated assessment; Mitigation; Negative emissions; Steady-state game

DOI: https://doi.org/10.1007/s10666-020-09734-6

Open Access: Green

First Online: October 22, 2020

Repository: Zenodo (Link: https://zenodo.org/record/4118144)

Synergies with: N/A

Citation (APA): Babonneau F., Bahn O., Haurie A., & Vielle M. (2020). An oligopoly game of CDR strategy deployment in a steady-state net-zero emission climate regime. *Environmental Modeling & Assessment*, in press.

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An Oligopoly Game of CDR Strategy Deployment in a Steady-State Net-Zero Emission Climate Regime

Frédéric Babonneau, Olivier Bahn, Alain Haurie & Marc Vielle

Environmental Modeling & Assessment (2020) | Cite this article

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Abstract

In this paper, we propose a simple oligopoly game model to represent the interactions between coalitions of countries in deploying carbon dioxide removal (CDR) strategies in a steady-state net-zero emission climate regime that could take place by the end of the twenty-first century. The emission quotas and CDR activities obtained in the solution of this steady-state model could then be used as a target for end-of-period conditions in a dynamic integrated assessment analysis studying the transition to 2100. More precisely, we analyze a steady-state situation where m coalitions exist and behave as m players in a game of supplying emission

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Figure 20: Preview of An oligopoly game of CDR strategy deployment in a steady-state net-zero emission climate regime in Environmental Modeling & Assessment

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

2.21 Nikas et al. (2021), Energy

Title:	Perspective of comprehensive and comprehensible multi-model energy and climate science in Europe
Authors:	Alexandros Nikas (NTUA), Ajay Gambhir (Grantham), Evelina Trutnevyte, Konstantinos Koasidis (NTUA), Henrik Lund, Jakob Z. Thellufsen, Daniel Mayer (Bruegel), Georg Zachmann (Bruegel), Luis Javier (de) Miguel González, Noelia Ferreras-Alonso, Ida Sognnaes (CICERO), Glen P. Peters (CICERO), Emanuela Colombo, Mark Howells (Grantham), Adam Hawkes (Grantham), Machteld van den Broek, Dirk-Jan Van de Ven (BC3), Mikel Gonzalez-Eguino (BC3), Alexandros Flamos, Haris Doukas (NTUA)
Journal:	Energy
Abstract:	Europe's capacity to explore the envisaged pathways that achieve its near- and long-term energy and climate objectives needs to be significantly enhanced. In this perspective, we discuss how this capacity is supported by energy and climate-economy models, and how international modelling teams are organised within structured communication channels and consortia as well as coordinate multi-model analyses to provide robust scientific evidence. Noting the lack of such a dedicated channel for the highly active yet currently fragmented European modelling landscape, we highlight the importance of transparency of modelling capabilities and processes, harmonisation of modelling parameters, disclosure of input and output datasets, interlinkages among models of different geographic granularity, and employment of models that transcend the highly harmonised core of tools used in model inter-comparisons. Finally, drawing from the COVID-19 pandemic, we discuss the need to expand the modelling comfort zone, by exploring extreme scenarios, disruptive innovations, and questions that transcend the energy and climate goals across the sustainability spectrum. A comprehensive and comprehensible multi-model framework offers a real example of "collective" science diplomacy, as an instrument to further support the ambitious goals of the EU Green Deal, in compliance with the EU claim to responsible research.
Keywords:	Energy; Modelling; Model inter-comparisons; Europe; Climate policy; Science diplomacy
DOI:	https://doi.org/10.1016/j.energy.2020.119153
Open Access:	Gold
First Online:	October 27, 2020
Repository:	Zenodo (Link: https://zenodo.org/record/4165034)
Synergies with:	N/A

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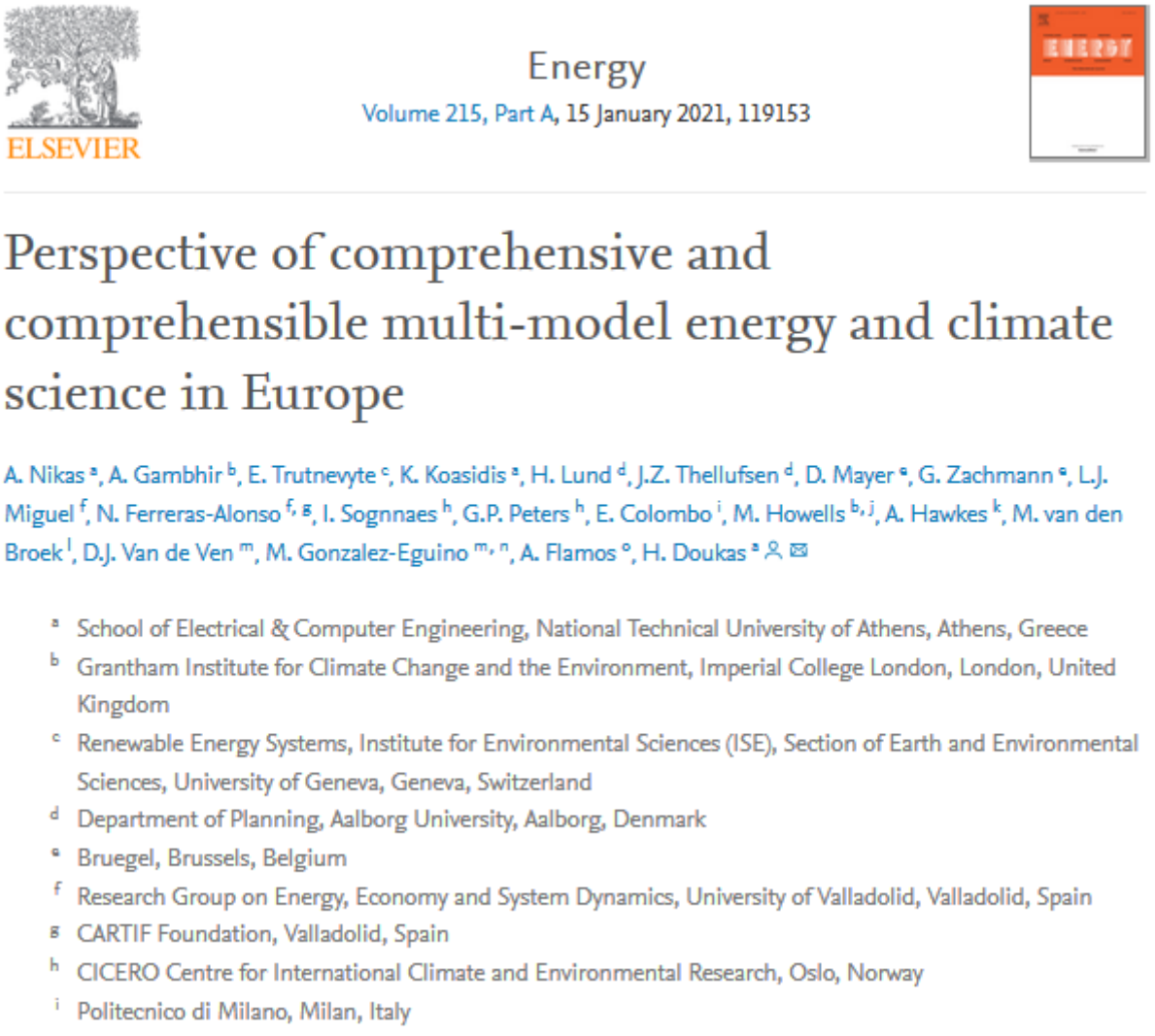
Citation (APA): Nikas A., Gambhir A., Trutnevyte E., Koasidis K., Lund H., Thellufsen J.Z., Mayer D., Zachmann G., Miguel L.J., Ferreras-Alonso N., Sognnaes I., Peters G.P., Colombo E., Howells M., Hawkes A., van den Broek M., Van de Ven D.J., Gonzalez-Eguino M., Flamos A., & Doukas H. (2021). Perspective of comprehensive and comprehensible multi-model energy and climate science in Europe. *Energy, 215*, 119153.



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Energy

Volume 215, Part A, 15 January 2021, 119153

Perspective of comprehensive and comprehensible multi-model energy and climate science in Europe

A. Nikas [a], A. Gambhir [b], E. Trutnevyte [c], K. Koasidis [a], H. Lund [d], J.Z. Thellufsen [d], D. Mayer [e], G. Zachmann [e], L.J. Miguel [f], N. Ferreras-Alonso [f, g], I. Sognnaes [h], G.P. Peters [h], E. Colombo [i], M. Howells [b, j], A. Hawkes [k], M. van den Broek [l], D.J. Van de Ven [m], M. Gonzalez-Eguino [m, n], A. Flamos [o], H. Doukas [a] ✉

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Figure 21: Preview of Perspective of comprehensive and comprehensible multi-model energy and climate science in Europe in Energy

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

2.22 Sorman et al. (2020), Frontiers in Energy Research

Title:	Democratizing Energy, Energizing Democracy: Central Dimensions Surfacing in the Debate
Authors:	Alevgül H. Sorman (BC3), Ethemcan Turhan, Marti Rosas-Casals
Journal:	Frontiers in Energy Research
Abstract:	This perspective piece sets out to contribute to the academic and practitioner debates around energy transitions and democracy initiatives in the age of a climate crisis. For tackling present-day energy challenges in a democratic, equitable and just manner, critical social science and humanities research on meaning and materialities, new actors and narratives, values and democracy is indispensable. In doing so, we centralize our work around three fundamental axes: The Concept, reflecting on the energy itself and revitalizing its essence; The Political, embracing the value laden, political and gendered nature of energy, and recognizing citizens' initiatives as counter currents to centralized energy decision-making; and The People, anticipating the far right's post-truth narratives that jeopardize planetary futures. We contend that "normative, political and embodied" research and praxis can serve for diversifying the energy transition debate as well as energizing bottom-up community led initiatives in order to democratize the energy playing field of recent times.
Keywords:	Energy democracy; Climate crisis; Equity; Sustainability; Energy justice; Decarbonization
DOI:	https://doi.org/10.3389/fenrg.2020.499888
Open Access:	Gold
First Online:	October 28, 2020
Repository:	Zenodo (Link: https://zenodo.org/record/4165038)
Synergies with:	N/A
Citation (APA):	Sorman, A. H., Turhan, E., & Rosas Casals, M. (2020). Democratizing energy, energizing democracy: Central dimensions surfacing in the debate. *Frontiers in Energy Research, 8*, 499888.

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Front. Energy Res., 28 October 2020 | https://doi.org/10.3389/fenrg.2020.499888

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Democratizing Energy, Energizing Democracy: Central Dimensions Surfacing in the Debate

Alevgül H. Sorman[1,2], Ethemcan Turhan[3,4*] and Marti Rosas-Casals[5]

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Matthijs Bogaards

This perspective piece sets out to contribute to the academic and practitioner debates around energy transitions and democracy initiatives in the age of a climate crisis. For tackling present-day energy challenges in a democratic, equitable and just manner, *critical* social science and

Figure 22: Preview of Democratizing Energy, Energizing Democracy: Central Dimensions Surfacing in the Debate in Frontiers in Energy Research

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

3 Special Issues in high-impact journals

3.1 Special Issue in Energy Sources, Part B: Economics, Planning, and Policy

The call for papers for this special issue on the subject of "Transdisciplinary science in energy transitions: thinking outside strictly formalised modelling boxes" had a submission deadline of January 15, 2020.

Responding to the climate crisis requires transdisciplinary processes to come into play in order to put together a jigsaw of initiatives that altogether constitute effective policy at different geographic scales: the Paris Agreement, the Global Stocktake, the Talanoa spirit and the urgent need for constantly increasing ambition all highlight existing and bring about new challenges to science in support of energy and climate policy making.

From an empirical point of view, research must stand ready to answer emerging questions that stray from the traditional climate change and policy impact assessment. These include but are not limited to the quantification of Paris-compliant transitions pathways; the consideration of diverse cooperation and coordination regimes; the quantitative assessment of ancillary benefits and avoided impacts from climate action; focused analysis of all dimensions of Nationally Determined Contributions, such as adequacy in respect to actual 1.5°C objectives, potential distributional impacts, and contribution to international equity and other sustainable development goals; and quantitative or qualitative consideration of synergies and conflicts with other policies and/or initiatives.

Furthermore, there currently exist heated debates on the right approach to mitigating emissions from the aviation industry, on the implementation of pathways that highlight energy and climate justice, as well as on the role of negative emissions technologies that most modelling scenarios currently rely on, cultivating the need to carefully examine how their potential could be overestimated and give rise to delays in emission reductions.

Given these challenges and needs, the scientific community must move outside its comfort zone and work hard on combining perspectives across various disciplines and fields, in order to effectively contribute to climate action talks and inform policymaking processes on realistic grounds and in response to actual policy needs. In essence, this calls for improving or integrating climate-economy models with other tools, unlocking assumptions from anchored socioeconomic scenarios, assessing the true impact of uncertainties, and working together with policymakers and other stakeholder groups.

This special issue is devoted to research that touches such critical policy questions, while enhancing the transparency and legitimacy of the scientific processes in support of climate policymaking, as well as introducing innovative frameworks that improve the robustness of modelling outcomes against different types of uncertainties.

The guest editors for the issue are Dr. Annela Anger-Kraavi (Cambridge) and Dr. Haris Doukas (NTUA).

List of included papers

- Pizarro-Irizar, C., Gonzalez-Eguino, M., van der Gaast, W., Arto, I., Sampedro, J., & van de Ven, D. J. (2020). Assessing stakeholder preferences on low-carbon energy transitions. *Energy Sources, Part B: Economics, Planning, and Policy*, in press.

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

- De Oliveira-De Jesus, P. M., González De León, M., & Melán, R. A. (2020). A mitigation scenario for Latin American power-related carbon dioxide emissions. *Energy Sources, Part B: Economics, Planning, and Policy*, in press.
- Nikas, A., Neofytou, H., Karamaneas, A., Koasidis, K., & Psarras, J. (2020). Sustainable and socially just transition to a post-lignite era in Greece: a multi-level perspective. *Energy Sources, Part B: Economics, Planning, and Policy*, in press.
- Islas-Samperio, J. M., Birlain-Escalante, M. O., & Grande-Acosta, G. K. (2020). Toward a Low-Carbon Industrial Sector in Mexico. *Energy Sources, Part B: Economics, Planning, and Policy*, in press.
- Neofytou, H., Sarafidis, Y., Gkonis, N., Mirasgedis, S., Askounis, D. (2020). Assessment of Energy Efficiency measures towards sustainable development in Greece, based on MCDA. *Energy Sources, Part B: Economics, Planning, and Policy*, in press.

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

4 Conferences

4.1 Twelfth Annual Meeting of the Integrated Assessment Modeling Consortium, December 2, 2019

Title: Achieving sustainable development in Eastern Africa: a portfolio-based integrated assessment modelling analysis among different Shared Socioeconomic Pathways

Type Poster

Authors: Aikaterini Forouli (NTUA), Alexandros Nikas (NTUA), Dirk-Jan Van de Ven (BC3), Jon Sampedro (BC3), Haris Doukas (NTUA)

Abstract: We introduce a two-level integration of integrated assessment modelling and portfolio analysis, in order to simulate technological subsidisation and climate policies with implications for multiple Sustainable Development Goals (SDGs), across different socioeconomic trajectories and considering different levels of uncertainties.

Conference: Twelfth Annual Meeting of the Integrated Assessment Modeling Consortium

Date: December 2, 2019

Venue: Tsukuba, Japan

Citation (APA): Forouli, A., Nikas, A., van de Ven, D. J., Sampedro, J., & Doukas, H. (2019). Achieving sustainable development in Eastern Africa: a portfolio-based integrated assessment modelling analysis among different Shared Socioeconomic Pathways. Twelfth Annual Meeting of the Integrated Assessment Modeling Consortium, December 2, 2019, Tsukuba, Japan.

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

4.2 International workshop of the Energy Modeling Forum (EMF) 35 Study: Japan Model Inter-Comparison Project (JMIP) on long-term climate policy, December 5, 2019

Title: PARIS REINFORCE and the I^{2}AM PARIS platform

Type Presentation

Authors: Haris Doukas (NTUA), & Alexandros Nikas (NTUA)

Abstract: PARIS REINFORCE will develop a novel, demand-driven, IAM-oriented assessment framework for effectively supporting the design and assessment of climate policies in the European Union as well as in other major emitters and selected less emitting countries, in respect to the Paris Agreement. By engaging policymakers and scientists/modellers, PARIS REINFORCE will create the open-access and transparent data exchange platform I^{2}AM PARIS, in order to support the effective implementation of Nationally Determined Contributions, the preparation of future action pledges, the development of 2050 decarbonisation strategies, and the reinforcement of the 2023 Global Stocktake. Finally, PARIS REINFORCE will introduce innovative integrative processes, in which IAMs are further coupled with well-established methodological frameworks, in order to improve the robustness of modelling outcomes against different types of uncertainties.

Conference: EMF 35: Japan Model Inter-Comparison Project (JMIP) on long-term climate policy

Date: December 5, 2019

Venue: Tokyo, Japan

Citation (APA): Doukas, H., & Nikas, A. (2020). PARIS REINFORCE and the I^{2}AM PARIS platform. EMF 35: Japan Model Inter-Comparison Project (JMIP) on long-term climate policy. December 5, 2019, Tokyo, Japan.

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

4.3 76th Semi-Annual ETSAP Meeting, December 11, 2019

Title: The H2020 Project PARIS REINFORCE

Type Presentation

Authors: Maurizio Gargiulo

Abstract: PARIS REINFORCE will develop a novel, demand-driven, IAM-oriented assessment framework for effectively supporting the design and assessment of climate policies in the European Union as well as in other major emitters and selected less emitting countries, in respect to the Paris Agreement. By engaging policymakers and scientists/modellers, PARIS REINFORCE will create the open-access and transparent data exchange platform I^{2}AM PARIS, in order to support the effective implementation of Nationally Determined Contributions, the preparation of future action pledges, the development of 2050 decarbonisation strategies, and the reinforcement of the 2023 Global Stocktake. Finally, PARIS REINFORCE will introduce innovative integrative processes, in which IAMs are further coupled with well-established methodological frameworks, in order to improve the robustness of modelling outcomes against different types of uncertainties.

Conference: 76th Semi-Annual IEA-ETSAP Meeting

Date: December 11, 2019

Venue: Mayfield West, Australia

Citation (APA): Gargiulo M. (2019). The H2020 Project PARIS REINFORCE. 76th Semi-Annual ETSAP Meeting, December 11, 2019, Newcastle, Australia.

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

4.4 Fifteenth Congress of the Spanish Association of Energy Economics, January 30, 2020

Title:	Delivering on the Paris Agreement: A demand-driven, integrated assessment modelling approach
Type	Presentation
Authors:	Mikel Gonzalez-Eguino and Dirk-Jan Van de Ven (BC3)
Abstract:	PARIS REINFORCE will develop a novel, demand-driven, IAM-oriented assessment framework for effectively supporting the design and assessment of climate policies in the European Union as well as in other major emitters and selected less emitting countries, in respect to the Paris Agreement. By engaging policymakers and scientists/modellers, PARIS REINFORCE will create the open-access and transparent data exchange platform I^{2}AM PARIS, in order to support the effective implementation of Nationally Determined Contributions, the preparation of future action pledges, the development of 2050 decarbonisation strategies, and the reinforcement of the 2023 Global Stocktake. Finally, PARIS REINFORCE will introduce innovative integrative processes, in which IAMs are further coupled with well-established methodological frameworks, in order to improve the robustness of modelling outcomes against different types of uncertainties.
Conference:	Fifteenth Congress of the Spanish Association of Energy Economics (AEEE)
Date:	January 30, 2020
Venue:	Toledo, Spain
Citation (APA):	González-Eguino, M., & Van de Ven, D.J. (2019). Delivering on the Paris Agreement: A demand-driven, integrated assessment modelling approach. Fifteenth Congress of the Spanish Association of Energy Economics, January 30, 2020, Toledo, Spain.

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

4.5 Joint Annual Meeting of the Society for Social Studies of Science (4S) and the European Association for the Study of Science and Technology (EASST), August 21, 2020

Title: How do policymakers use climate mitigation scenario information?

Type Presentation

Authors: Bård Lappegård Lahn, Erlend Andre T. Hermansen (CICERO), Ida Sognnaes, Glen P. Peters (CICERO)

Abstract: The number of Integrated Assessment Models (IAMs) and mitigation scenarios produced by IAMs have been steadily growing since the first IPCC assessment report, and scenarios have become increasingly influential in climate policy debates. Lots of scenarios are now produced that are compatible with the policy targets of the Paris Agreement. IAMs – developed at universities, research institutes, and government agencies – contribute with scenarios to the IPCC reports and the academic literature. In addition, several organisations and companies such as the IEA, Equinor, BP, and Shell, use their own models and methods to produce scenarios that meet the Paris goals.

While there is an extensive and growing literature on scenario analysis (e.g. Hausfather and Peters 2020), and some literature on intended users of scenarios (Parson 2008), there is a striking gap in the literature when it comes to how scenarios are actually used by different actors, and how this use varies across different contexts. Without a proper understanding of how scenarios are used, by whom, and for what, we risk missing important aspects of how their performative effects play out. Knowledge of how scenarios are used in practice is critical for establishing much needed learning loops between so-called users and producers of scenario information, thus improving institutional reflexivity and taking seriously the "politics of anticipation" (Beck and Mahony 2018) implicit in scenario modelling.

This presentation begins to address this knowledge gap, by reporting preliminary findings from a comparative study investigating and analyzing how policymakers across different governmental bodies in European countries use scenario information. Based on interviews conducted so far with Norwegian officials, the presentation highlights a number of challenges to the modelling community as well as to the sociological study of modelling practices and performativity in STS.

Conference: Joint Annual Meeting of the Society for Social Studies of Science (4S) and the European Association for the Study of Science and Technology (EASST)

Date: August 21, 2020

Venue: Prague, the Czech Republic

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

Citation (APA): Lahn, B., Hermansen, E. A. T., Sognnæs, I., & Peters, G. (2020). How do policymakers use climate mitigation scenario information? Joint Annual Meeting of the Society for Social Studies of Science (4S) and the European Association for the Study of Science and Technology (EASST), August 21, 2020, Prague, the Czech Republic.

The PARIS REINFORCE project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 820846.

4.6 14th International FLINS Conference, October 2020

Title:	Prioritisation of risks associated with decarbonisation pathways for the Austrian iron and steel sector using 2-tuple TOPSIS
Type	Conference Paper
Authors:	Alexandros Nikas (NTUA), Apostolos Arsenopoulos (NTUA), Haris Doukas (NTUA), Alvaro Labella-Romero
Abstract:	Decarbonising emissions-heavy industrial sectors is key to delivering on the Paris Agreement. In Austria, the iron and steel sector holds a large share of the country's greenhouse gas emissions and is in need of introduction of new technologies, orienting on green hydrogen and renewable energies. Acknowledging that such a transition features diverse exogenous risks and possible consequences, our research attempts to prioritise the risks associated with a pathway promoting a low-carbon iron and steel sector in Austria, from the stakeholders' perspective. We use a 2-tuple TOPSIS model and carry out group decision making based on the Computing with Words methodology.
Conference:	14th International FLINS Conference
Date:	October 2020
Venue:	Online (COVID-19)
Citation (APA):	Nikas, A., Arsenopoulos, A., Doukas, H., & Romero, A. L. (2020). Prioritisation of risks associated with decarbonisation pathways for the Austrian iron and steel sector using 2-tuple TOPSIS. 14th International FLINS Conference. October, 2020.

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