PARIS REINFORCE

D8.12 REPORT ON SCIENTIFIC PUBLICATIONS – Update 1

WP8 – Communication, Dissemination, & Exploitation
Version: 1.00

www.paris-reinforce.eu

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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			
Topic	LC-CLA-01-2018			
Funding scheme	Horizon 2020, RIA – Research and Innovation Action			
Start Date	June 2019	Duration		42 Months
Project URL	https://www.paris-reinforce.eu/			
EU Project Officer	Frederik Accoe			
Project Coordinator	National Technical University of Athens – NTUA			
Deliverable	D8.12 - Report on scientific publications – Update 1			
Work Package	WP8 - Communication, Dissemination & Exploitation			
Date of Delivery	Contractual	30/11/2022	Actual	30/11/2022
Nature	Report	Dissemination Level		Public
Lead Beneficiary	National Technical University of Athens (NTUA)			
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Reviewer(s):	George Stravodimos (IEECP), Haris Doukas (NTUA)			
Keywords	Scientific publications; papers; journals; impact; projects; modelling			

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

This public deliverable can be used by anyone interested in the PARIS REINFORCE scientific outputs, providing an overview of—and pinpointing—scientific publications and project-launched special issues in high-impact scientific journals, as well as presentations in academic/scientific conferences, and allowing them to explore and disseminate the project's scientific/research findings in science, business, and/or policy.

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 2022, a total of 86 articles in scientific journals (and 33 more currently under review, in revision, or accepted), 43 papers/presentations/posters in conferences, and two special issues have been published within PARIS REINFORCE. The project has overperformed in terms of scientific output in high-impact journals, which has been rich and diverse, as well as in terms of participation in high-profile conferences, despite the slow start due to the pandemic-associated restrictions. Finally, two special issues were successfully launched in the Energy Sources, Part B: Economics, Planning & Policy journal during the first months of the project, as well as in the Renewable & Sustainable Energy Transition journal, towards the end of the project.

4. Evidence of accomplishment
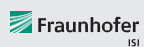
This report, all scientific publications (in the listed DOI links), as well as the following links:

- PARIS REINFORCE Scientific Publications ([website link](#))
- PARIS REINFORCE Conferences ([website link](#))

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	

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.

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1   Introduction

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

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

Dirk-Jan Van de Ven[1] ⓘ, Jon Sampedro[1], Francis X Johnson[2], Rob Bailis[2] ⓘ, Aikaterini Forouli[3] ⓘ, Alexandros Nikas[3] ⓘ, Sha Yu[4] ⓘ, Guillermo Pardo[1], Silvestre García de Jalón[1], Marshall Wise[4]

+ Show full author list

Published 20 August 2019 • © 2019 The Author(s). Published by IOP Publishing Ltd
Environmental Research Letters, Volume 14, Number 9

Citation Dirk-Jan Van de Ven *et al* 2019 *Environ. Res. Lett.* **14** 094001

[📄 Article PDF]   [◆ Article ePub]

This article is corrected by 2020 *Environ. Res. Lett.* **15** 039602

Figures ▾   References ▾

+ Article information

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

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

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), 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.

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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Highlights

- We employ stakeholder insights, multi-criteria analysis and fuzzy cognitive mapping.

- Twenty risks associated with four selected climate policy strategies are evaluated.

- Barriers of investment risks, monitoring capacity and intermittency are highlighted.

- Stakeholders are also worried about land requirements, climate poverty and injustice.

- Interplay of risks, policy and transition depends on future socioeconomic challenges.

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

2.3 Gramkow & Anger-Kraavi (2019), Sustainability

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

Authors: Camila Gramkow (CDS/UNB), 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.

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- Supplementary Materials
- Author Contributions
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Developing Green: A Case for the Brazilian Manufacturing Industry

by Camila Gramkow [1,2,3,*] ✉ and Annela Anger-Kraavi [4,5] ✉

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[2] School of Environmental Sciences, University of East Anglia, NR4 7TJ, Norwich, UK
[3] Tyndall Centre for Climate Change Research, NR4 7TJ, Norwich, UK
[4] University of Cambridge, Cambridge CB2 1TN, UK
[5] Emmanuel College, St Andrew's St, University of Cambridge, Cambridge CB2 3AP, UK
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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

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

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 (available on Zenodo)

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.

Springer Link

Navigating various flexibility mechanisms under European burden-sharing

Marc Vielle ✉

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.

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

2.5   Hausfather & Peters (2020), Nature

Title: Emissions–the 'business as usual' story is misleading

Authors: Zeke Hausfather (Breakthrough Institute), 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 (available in Zenodo)

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

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), 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 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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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.

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

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, 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 (available in Zenodo)

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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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

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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.

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Main

Results

Daily changes in CO_2 emissions

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Acknowledgements

Author information

Ethics declarations

Additional information

Supplementary information

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About this article

Further reading

Figure 7: Preview of 'Temporary reduction in daily global CO_2 emissions during the COVID-19 forced confinement' in Nature Climate Change

2.8 Nikas et al. (2022), 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), 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

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Open Access: Gold

First Online: May 24, 2020

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Synergies with: N/A

Citation (APA): Nikas, A., Fountoulakis, A., Forouli, A., & Doukas, H. (2022). A robust augmented ε-constraint method (AUGMECON-R) for finding exact solutions of multi-objective linear programming problems. *Operational Research, 22*, 1291-1332.

SpringerLink

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

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.

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

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), 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

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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*, *15*(10-12), 513-544.

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Research Article

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

Alexandros Nikas ✉ ⓘD, Hera Neofytou ⓘD, Anastasios Karamaneas ⓘD, Konstantinos Koasidis ⓘD & John Psarras

Pages 513-544 | Published online: 27 May 2020

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In this article

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

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Published online: 5 Sep 2019

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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

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

Title: The appropriate use of reference scenarios in mitigation analysis

Authors: Neil Grant (Imperial), Adam Hawkes (Imperial), Tamaryn Napp (Imperial), Ajay Gambhir (Imperial)

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

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Open Access: Green (available in Zenodo)

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.

nature climate change

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The appropriate use of reference scenarios in mitigation analysis

Neil Grant ✉, Adam Hawkes, Tamaryn Napp & Ajay Gambhir

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.

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

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 (Imperial), Sven De Causmaecker (Imperial), Ajay Gambhir (Imperial), Mathilde Fajardy (Imperial), A. William Rutherford (Imperial), Andrea Fantuzzi (Imperial), Jenny Nelson (Imperial)

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 (available in Zenodo)

First Online: July 6, 2020

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

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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.

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 ✉

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.

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

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), 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
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Open Access:	Green (available in Zenodo)
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.

Renewable and Sustainable Energy Reviews

Volume 131, October 2020, 109988

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Sustainable energy transition readiness: A multicriteria assessment index

H. Neofytou, A. Nikas ☒, H. Doukas

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Highlights

- A sustainable energy transition readiness index is introduced and implemented.

- The proposed index is based on a multiple-criteria decision analysis framework.

- Weights are determined with AHP, and final rankings are calculated with PROMETHEE II.

- Fourteen countries of different profile and progress are selected as a case study.

- Major emitters outside Europe appear to lack capacity for drastic energy transitions.

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

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

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Open Access Review

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

by Konstantinos Koasidis [1] ✉ ⓘ, Anastasios Karamaneas [1] ✉, Alexandros Nikas [1,*] ✉ ⓘ, Hera Neofytou [1] ✉ ⓘ, Erlend A. T. Hermansen [2] ✉, Kathleen Vaillancourt [3] ✉ and Haris Doukas [1] ✉

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* Author to whom correspondence should be addressed.

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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. View Full-Text

Keywords: Norway; Canada; electric mobility; transportation; socio-technical transitions; climate policy; sectoral innovation systems; system failure framework; systems of innovation

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

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), 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
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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.

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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Highlights

- An integrated assessment model is linked to a portfolio analysis model in two stages.

- Technological subsidisation is modelled in different shared socioeconomic pathways.

- Impacts on health, energy access and resulting emissions are considered uncertain.

- We create a midpoint dataset and analyse uncertainty across the broad scenario range.

- For validation, the most robust technological portfolios are simulated again in GCAM.

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

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), 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

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First Online: August 21, 2020

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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.

One Earth

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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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.

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

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 (Imperial), Ethemcan Turhan, Bianca Vienni Baptista (ETH), 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

Perspective

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

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

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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

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

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 (Imperial), Jakob Wachsmuth (Fraunhofer ISI), 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

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The UK and German Low-Carbon Industry Transitions from a Sectoral Innovation and System Failures Perspective

by Konstantinos Koasidis [1] ✉ ⓘ, Alexandros Nikas [1,*] ✉ ⓘ, Hera Neofytou [1] ✉ ⓘ,
 Anastasios Karamaneas [1] ✉ ⓘ, Ajay Gambhir [2] ✉ ⓘ, Jakob Wachsmuth [3] ✉ and Haris Doukas [1] ✉

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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. View Full-Text

Keywords: United Kingdom; Germany; systems of innovation; sectoral innovation systems; system failures; industrial transitions

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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.

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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), 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

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ABSTRACT

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3. APOLLO   ▼

4. CASE STUDY   ▼

5. CONCLUSIONS

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International Journal of Computational Intelligence Systems

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APOLLO: A Fuzzy Multi-criteria Group Decision-Making Tool in Support of Climate Policy

Authors

Álvaro Labella[1], Konstantinos Koasidis[2], Alexandros Nikas[2, *], Apostolos Arsenopoulos[2], Haris Doukas[2]

[1] Department of Computer Science, University of Jaén, Campus Las Lagunillas, Jaén, 23071, Spain
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Corresponding Author
Alexandros Nikas

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

2.19 Yang et al. (2021), Renewable & Sustainable Energy Reviews

Title:	The environmental co-benefit and economic impact of China's low-carbon pathways: Evidence from linking bottom-up and top-down models
Authors:	Xi Yang (CUP), Jun Pang, Fei Teng, Ruixin Gong, Cecilia Springer
Journal:	Renewable & Sustainable Energy Reviews

Abstract: Deep decarbonization pathways (DDPs) can be cost-effective for carbon mitigation, but they also have environmental co-benefits and economic impacts that cannot be ignored. Despite many empirical studies on the co-benefits of NDCs at the national or sectoral level, there is lack of integrated assessment on DDPs for their energy, economic, and environmental impact. This is due to the limitations of bottom-up and top-down models when used alone. This paper aims to fill this gap and link the bottom-up MAPLE model with a top-down CGE model to evaluate China's DDPs' comprehensive impacts. First, results show that carbon dioxide emissions can be observed to peak in or before 2030, and non-fossil energy consumption in 2030 is around 27%, which is well above the NDC target of 20%. Second, significant environmental co-benefits can be expected: 7.1 million tons of SO2, 3.96 million tons of NOx, and 1.02 million tons of PM2.5 will be reduced in the DDP scenario compared to the reference scenario. The health co-benefits demonstrated with the model-linking approach is around 678 billion RMB, and we observe that the linked model results are more in accordance with the conclusions of existing studies. Third, after linking, we find the real GDP loss from deep decarbonization is reduced from 0.92% to 0.54% in 2030. If the environmental co-benefits are considered, the GDP loss is further offset by 0.39%. The primary innovation of this study is to give a full picture of DDPs' impact, considering both environmental co-benefits and economic losses. We aim to provide positive evidence that developing countries can achieve targets higher than stated in the NDCs through DDP efforts, which will have clear environmental co-benefits to offset the economic losses.

Keywords:	Environmental co-benefit, Model linking, China-MAPLE, CGE, Deep decarbonization, Energy system optimization
DOI:	https://doi.org/10.1016/j.rser.2020.110438
Open Access:	Green (embargoed until 10 October 2022)
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Synergies with:	N/A

Citation (APA): Yang, X., Pang, J., Teng, F., Gong, R., & Springer, C. (2021). The environmental co-benefit and economic impact of China's low-carbon pathways: Evidence from linking bottom-up and top-down models. *Renewable and Sustainable Energy Reviews*, *136*, 110438.

Renewable and Sustainable Energy Reviews
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The environmental co-benefit and economic impact of China's low-carbon pathways: Evidence from linking bottom-up and top-down models

Xi Yang [a, b] ✉, Jun Pang [c], Fei Teng [d], Ruixin Gong [a], Cecilia Springer [e]

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Highlights
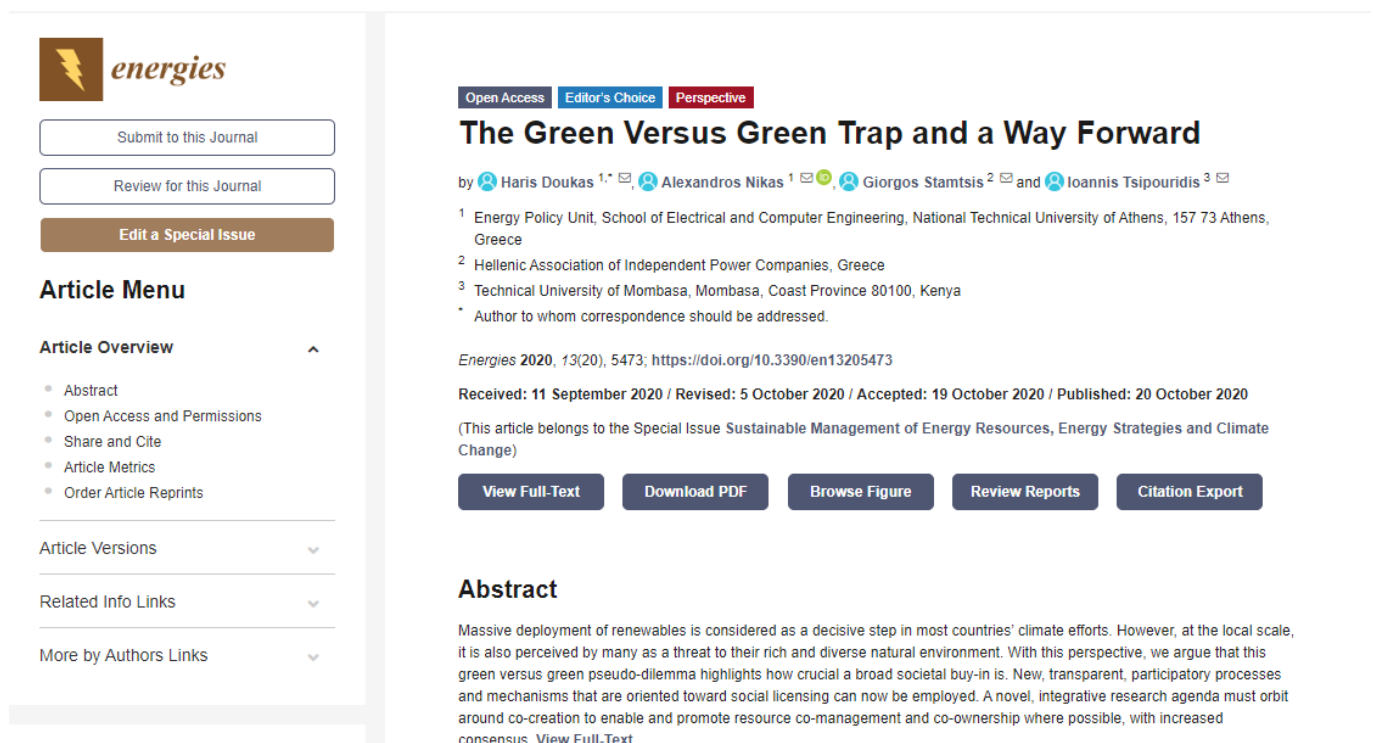
- We perform an integrated analysis of energy systems, the economy, and environmental impacts of China's DDP efforts.

- Soft-linking of a bottom-up and a top-down model is a methodological improvement on co-benefit analyses.

- China's DDPs have positive environmental co-benefits of around 678 billion RMB in 2030.

- Taking environmental co-benefits into account reduces estimated GDP loss from DDP from 0.45% to 0.15%.

Figure 19: Preview of The environmental co-benefit and economic impact of China's low-carbon pathways: Evidence from linking bottom-up and top-down models

2.20 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 20: Preview of The Green Versus Green Trap and a Way Forward in Energies

2.21 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 (available in Zenodo)
First Online:	October 22, 2020
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Synergies with:	N/A
Citation (APA):	Babonneau, F., Bahn, O., Haurie, A., & Vielle, M. (2021). An oligopoly game of CDR strategy deployment in a steady-state net-zero emission climate regime. *Environmental Modeling & Assessment*, *26*(6), 969-984.

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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

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 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.

Figure 21: 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.

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2.22 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:	H2020 SENTINEL (GA: 837089), H2020 LOCOMOTION (GA: 821105) & H2020 NAVIGATE (GA: 821124)

Energy
Volume 215, Part A, 15 January 2021, 119153

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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] ... H. Doukas [a] ✉

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Highlights

- EU energy & climate policy can benefit from a harmonised European modelling landscape.

- Transparency, harmonisation, interlinkages, and granularity aspects are highlighted.

- Employment of models transcending the highly harmonised core of models is stressed.

- Disruptive innovations, extremes, and broad sustainability questions must be explored.

- Policy responsiveness, international cooperation & science diplomacy can be enhanced.

Figure 22: Preview of Perspective of comprehensive and comprehensible multi-model energy and climate science in Europe in Energy

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

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

[1] Basque Centre for Climate Change (BC3), Leioa, Spain
[2] IKERBASQUE, Basque Foundation for Science, Bilbao, Spain
[3] Faculty of Spatial Sciences, University of Groningen, Groningen, The Netherlands
[4] Environmental Humanities Laboratory, Division of History of Science, Technology and Environment, Royal Institute of Technology (KTH), Stockholm, Sweden
[5] Universitat Politecnica de Catalunya (BarcelonaTech-UPC), Barcelona, Spain

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.

Figure 23: 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.

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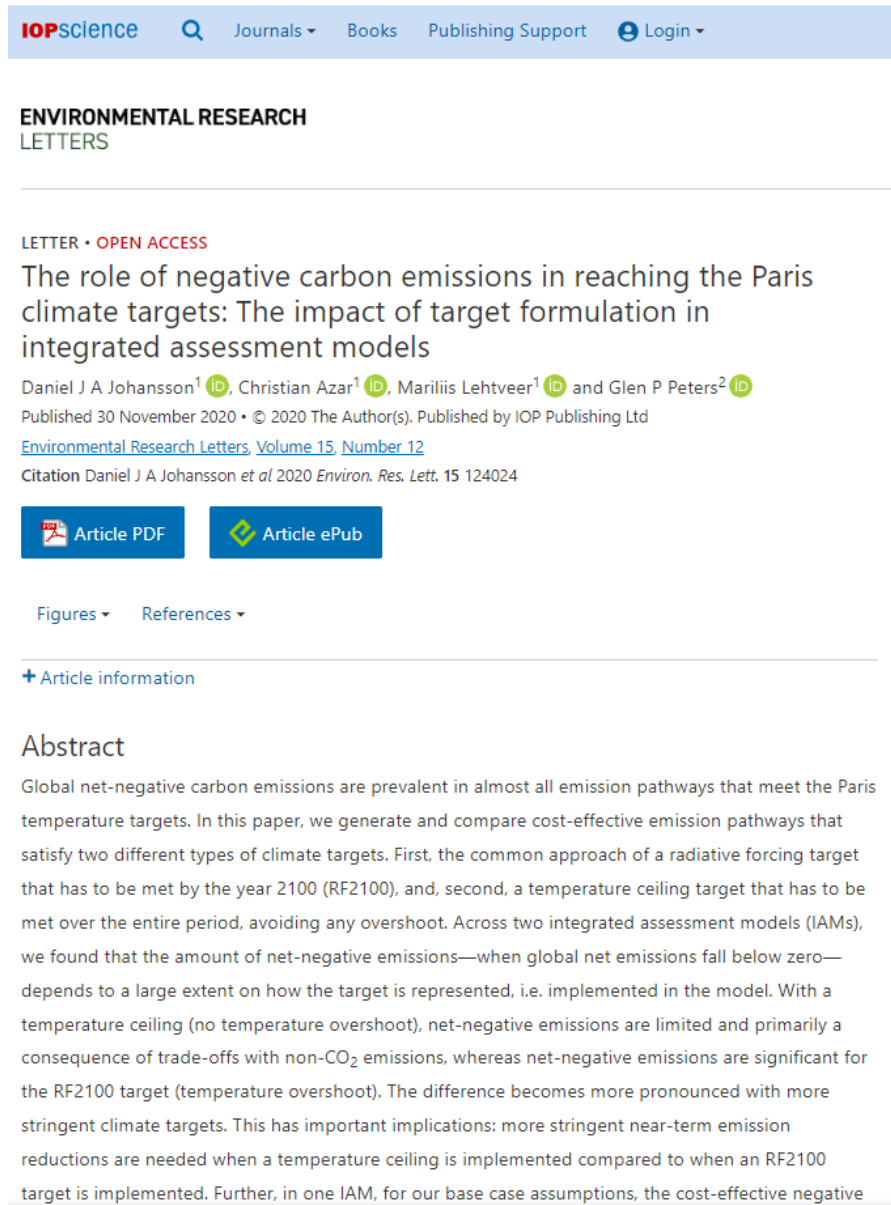
2.24 Johansson et al. (2020), Environmental Research Letters

Title: The role of negative carbon emissions in reaching the Paris climate targets: The impact of target formulation in integrated assessment models

Authors: Daniel J A. Johansson, Christian Azar, Mariliis Lehtveer, Glen P Peters (CICERO)

Journal: Environmental Research Letters

Abstract: Global net-negative carbon emissions are prevalent in almost all emission pathways that meet the Paris temperature targets. In this paper, we generate and compare cost-effective emission pathways that satisfy two different types of climate targets. First, the common approach of a radiative forcing target that has to be met by the year 2100 (RF2100), and, second, a temperature ceiling target that has to be met over the entire period, avoiding any overshoot. Across two integrated assessment models (IAMs), we found that the amount of net-negative emissions—when global net emissions fall below zero—depends to a large extent on how the target is represented, i.e. implemented in the model. With a temperature ceiling (no temperature overshoot), net-negative emissions are limited and primarily a consequence of trade-offs with non-CO2 emissions, whereas net-negative emissions are significant for the RF2100 target (temperature overshoot). The difference becomes more pronounced with more stringent climate targets. This has important implications: more stringent near-term emission reductions are needed when a temperature ceiling is implemented compared to when an RF2100 target is implemented. Further, in one IAM, for our base case assumptions, the cost-effective negative carbon emissions (i.e. gross anthropogenic removals) do not depend to any significant extent on how the constraint is implemented, only, largely, on the ultimate stringency of the constraint. Hence, for a given climate target stringency in 2100, the RF2100 target and the temperature ceiling may result in essentially the same amount of negative carbon emissions. Finally, it is important that IAM demonstrate results for diverse ways of implementing a climate target, since the implementation has implications for the level of near-term emissions and the perceived need for net-negative emissions (beyond 2050).

Keywords: climate stabilisation, pathways, scenarios, negative emissions, integrated assessment model, temperature, radiative forcing

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Open Access: Gold

First Online: November 30, 2020

Repository: Zenodo (Link: https://zenodo.org/record/4428315#.YXKKuBpByUk)

Synergies with: N/A

Citation (APA): Johansson, D. J., Azar, C., Lehtveer, M., & Peters, G. P. (2020). The role of negative carbon emissions in reaching the Paris climate targets: the impact of target formulation in integrated assessment models. *Environmental Research Letters*, *15*(12), 124024.

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The role of negative carbon emissions in reaching the Paris climate targets: The impact of target formulation in integrated assessment models

Daniel J A Johansson[1] ⓘ, Christian Azar[1] ⓘ, Mariliis Lehtveer[1] ⓘ and Glen P Peters[2] ⓘ

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➕ Article information

Abstract

Global net-negative carbon emissions are prevalent in almost all emission pathways that meet the Paris temperature targets. In this paper, we generate and compare cost-effective emission pathways that satisfy two different types of climate targets. First, the common approach of a radiative forcing target that has to be met by the year 2100 (RF2100), and, second, a temperature ceiling target that has to be met over the entire period, avoiding any overshoot. Across two integrated assessment models (IAMs), we found that the amount of net-negative emissions—when global net emissions fall below zero— depends to a large extent on how the target is represented, i.e. implemented in the model. With a temperature ceiling (no temperature overshoot), net-negative emissions are limited and primarily a consequence of trade-offs with non-CO_2 emissions, whereas net-negative emissions are significant for the RF2100 target (temperature overshoot). The difference becomes more pronounced with more stringent climate targets. This has important implications: more stringent near-term emission reductions are needed when a temperature ceiling is implemented compared to when an RF2100 target is implemented. Further, in one IAM, for our base case assumptions, the cost-effective negative

Figure 24: Preview of The role of negative carbon emissions in reaching the Paris climate targets: The impact of target formulation in integrated assessment models

2.25 Doukas and Anger-Kraavi. (2020), Energy Sources Part B: Economics, Planning, and Policy

Title: Editorial of special issue on transdisciplinary science in energy transitions: thinking outside strictly formalized modeling boxes

Authors: Haris Doukas (NTUA), Annela Anger-Kraavi (Cambridge)

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

Abstract: Responding to the climate crisis requires transdisciplinary processes to come into play 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 policymaking. 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 pathway, the consideration of diverse cooperation and coordination regimes and the quantitative assessment of ancillary benefits and avoided impacts from climate action.

Keywords: N/A

DOI: https://doi.org/10.1080/15567249.2020.1853348

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First Online: December 06, 2020

Repository: Zenodo (Link: https://zenodo.org/record/5619757#.YzMgiHZByUk)

Synergies with: N/A

Citation (APA): Doukas, H., & Anger-Kraavi, A. (2020). Editorial of special issue on transdisciplinary science in energy transitions: thinking outside strictly formalized modeling boxes. *Energy Sources, Part B: Economics, Planning, and Policy*, *15*(10-12), 453-454.

Figure 25: Preview of Editorial of special issue on transdisciplinary science in energy transitions: thinking outside strictly formalized modeling boxes

2.26 Jones et al. (2021), Scientific Data

Title: Gridded fossil CO_2 emissions and related O_2 combustion consistent with national inventories 1959–2018.

Authors: Matthew W. Jones, Robbie M. Andrew, Glen P. Peters (CICERO), Greet Janssens-Maenhout, Anthony J. De-Gol, Philippe Ciais, Prabir K. Patra, Frederic Chevallier, Corinne Le Quéré

Journal: Scientific Data

Abstract: Quantification of CO_2 fluxes at the Earth's surface is required to evaluate the causes and drivers of observed increases in atmospheric CO_2 concentrations. Atmospheric inversion models disaggregate observed variations in atmospheric CO_2 concentration to variability in CO_2 emissions and sinks. They require prior constraints fossil CO_2 emissions. Here we describe GCP-GridFED (version 2019.1), a gridded fossil emissions dataset that is consistent with the national CO_2 emissions reported by the Global Carbon Project (GCP). GCP-GridFEDv2019.1 provides monthly fossil CO_2 emissions estimates for the period 1959–2018 at a spatial resolution of 0.1°. Estimates are provided separately for oil, coal and natural gas, for mixed international bunker fuels, and for the calcination of limestone during cement production. GCP-GridFED also includes gridded estimates of O_2 uptake based on oxidative ratios for oil, coal and natural gas. It will be updated annually and made available for atmospheric inversions contributing to GCP global carbon budget assessments, thus aligning the prior constraints on top-down fossil CO_2 emissions with the bottom-up estimates compiled by the GCP.

Keywords: CO_2 emissions, national inventories

DOI: https://doi.org/10.1038/s41597-020-00779-6

Open Access: Gold

First Online: January 06, 2021

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Synergies with: H2020 CHE (GA: 776186), H2020 VERIFY (GA: 776810), H2020 4C (GA: 821003)

Citation (APA): Jones, M. W., Andrew, R. M., Peters, G. P., Janssens-Maenhout, G., De-Gol, A. J., Ciais, P., ... & Le Quéré, C. (2021). Gridded fossil CO_2 emissions and related O_2 combustion consistent with national inventories 1959–2018. *Scientific Data*, *8*(1), 1-23.

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Gridded fossil CO$_2$ emissions and related O$_2$ combustion consistent with national inventories 1959–2018

Matthew W. Jones ✉, Robbie M. Andrew, Glen P. Peters, Greet Janssens-Maenhout, Anthony J. De-Gol, Philippe Ciais, Prabir K. Patra, Frederic Chevallier & Corinne Le Quéré

Abstract

Quantification of CO$_2$ fluxes at the Earth's surface is required to evaluate the causes and drivers of observed increases in atmospheric CO$_2$ concentrations. Atmospheric inversion models disaggregate observed variations in atmospheric CO$_2$ concentration to variability in CO$_2$ emissions and sinks. They require prior constraints fossil CO$_2$ emissions. Here we describe GCP-GridFED (version 2019.1), a gridded fossil emissions dataset that is consistent with the national CO$_2$ emissions reported by the Global Carbon Project (GCP). GCP-GridFEDv2019.1 provides monthly fossil CO$_2$ emissions estimates for the period 1959–2018 at a spatial resolution of 0.1°. Estimates are provided separately for oil, coal and natural gas, for mixed international bunker fuels, and for the calcination of limestone during cement production. GCP-GridFED also includes gridded estimates of O$_2$ uptake based on oxidative ratios for oil, coal and natural gas. It will be updated annually and made available for atmospheric inversions contributing to GCP global carbon budget assessments, thus aligning the prior constraints on top-down fossil CO$_2$ emissions with the bottom-up estimates compiled by the GCP.

Figure 26: Preview of Gridded fossil CO₂ emissions and related O₂ combustion consistent with national inventories 1959–2018.

2.27 Galende-Sánchez & Sorman (2021), Energy Research & Social Science

Title:	From consultation toward co-production in science and policy: A critical systematic review of participatory climate and energy initiatives
Authors:	Ester Galende-Sánchez (BC3), Alevgul H. Sorman (BC3)
Journal:	Energy Research & Social Science

Abstract: In recent decades, co-production has become a cornerstone both in science and policy-making, motivating further collaboration between different actors. To scrutinize such participatory processes within the climate and energy fields, we conducted a critical systematic review of 183 records, which includes scientific publications, but also other initiatives coming from the public administration or the non-profit sector. First, we unpack six aspects of co-production: (1) the different levels of participation; (2) the emerging topics and issues; (3) the scale and location at which initiatives are conducted; (4) the actors who take part in the processes; (5) the different methods and tools for participation and (6) the outcomes and transformational potential of the initiatives. Our results show that real co-production is still far from being mainstream, with consultation still accounting for a majority of initiatives. Themes remain focused on the mitigation sphere, a tendency related to a majority of the records happening in developed countries. However, we also observe new categories of actors challenging traditional decision-making, as well as emerging methods and tools opening the space for more social innovation and participation. Following, in our critical analysis, we argue that there is a crucial need for a better interconnection between science and policy (especially at national and international scales) and that a reflection on transformation is fundamental when planning any participatory initiative. We finally claim that, despite not being a silver bullet, meaningful citizen participation constitutes a viable alternative to tackle today's complex problems.

Keywords:	Co-Production, Citizen participation, Climate crisis, Energy transition, Decision-making
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First Online:	January 25, 2021
Repository:	Zenodo (Link: https://zenodo.org/record/4501219#.YXKYXxpByUk)
Synergies with:	N/A
Citation (APA):	Galende-Sánchez, E., & Sorman, A. H. (2021). From consultation toward co-production in science and policy: A critical systematic review of participatory climate and energy initiatives. *Energy Research & Social Science*, *73*, 101907.

Energy Research & Social Science
Volume 73, March 2021, 101907

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Review

From consultation toward co-production in science and policy: A critical systematic review of participatory climate and energy initiatives

Ester Galende-Sánchez [a] [✉], Alevgul H. Sorman [a, b]

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Highlights

- It is imperative to move beyond consultation to achieve genuine co-production.

- Innovative methods and tools unravel new ways to capture citizen knowledge.

- Citizens' assemblies and other innovations are making way for more participation.

- Science-policy synergies are essential to unlock co-production potentials.

- Citizen participation is a viable alternative to better tackle the climate crisis.

Figure 27: Preview of From consultation toward co-production in science and policy: A critical systematic review of participatory climate and energy initiatives

2.28 Le Quéré et al. (2021), Nature Climate Change

Title:	Fossil CO_2 emissions in the post-COVID-19 era
Authors:	Corinne Le Quéré, Glen P. Peters (CICERO), Pierre Friedlingstein, Robbie M. Andrew (CICERO), Josep G. Canadell, Steven J. Davis, Robert B. Jackson, Matthew W. Jones
Journal:	Nature Climate Change
Abstract:	Five years after the adoption of the Paris Climate Agreement, growth in global CO_2 emissions has begun to falter. The pervasive disruptions from the COVID-19 pandemic have radically altered the trajectory of global CO_2 emissions. Contradictory effects of the post-COVID-19 investments in fossil fuel-based infrastructure and the recent strengthening of climate targets must be addressed with new policy choices to sustain a decline in global emissions in the post-COVID-19 era.
Keywords:	COVID-19, CO_2 emissions, pandemic, recovery
DOI:	https://doi.org/10.1038/s41558-021-01001-0
Open Access:	Green (available in Zenodo)
First Online:	March 03, 2021
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Synergies with:	H2020 CHE (GA: 776186), H2020 VERIFY (GA: 776810)
Citation (APA):	Le Quéré, C., Peters, G. P., Friedlingstein, P., Andrew, R. M., Canadell, J. G., Davis, S. J., ... & Jones, M. W. (2021). Fossil CO_2 emissions in the post-COVID-19 era. *Nature Climate Change*, *11*(3), 197-199.

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Fossil CO$_2$ emissions in the post-COVID-19 era

Corinne Le Quéré ✉, Glen P. Peters, Pierre Friedlingstein, Robbie M. Andrew, Josep G. Canadell, Steven J. Davis, Robert B. Jackson & Matthew W. Jones

Abstract

Five years after the adoption of the Paris Climate Agreement, growth in global CO$_2$ emissions has begun to falter. The pervasive disruptions from the COVID-19 pandemic have radically altered the trajectory of global CO$_2$ emissions. Contradictory effects of the post-COVID-19 investments in fossil fuel-based infrastructure and the recent strengthening of climate targets must be addressed with new policy choices to sustain a decline in global emissions in the post-COVID-19 era.

Figure 28: Preview of Fossil CO$_2$ emissions in the post-COVID-19 era

2.29 Lalas et al. (2021), Energies

Title: Energy and GHG Emissions Aspects of the COVID Impact in Greece

Authors: Dimitri Lalas, Nikolaos Gakis, Sebastian Mirasgedis, Elena Georgopoulou, Yannis Sarafidis, Haris Doukas (NTUA)

Journal: Energies

Abstract: The effects of COVID-19 have had devasting effects on both health and economies in 2020. At the same time, the lockdown and the downturn of economic activity resulted in a decrease in energy consumption and an accompaning reduction in greenhouse gas emissions. In this article, a comparison with the temperature adjustment of energy use is presented for the main carriers of electricity, natural gas, and oil products in the residential, tertiary, industry, and transport (road transport, domestic aviation, and navigation) sectors in 2020 against the previous two years in Greece, along with the corresponding emissions. As the comparison covers the entire year, both COVID peaks in the March–April and November–December periods and the corresponding lockdown effects as well as seasonal variations are included. The analysis shows a reduction, adjusted for temperature, of 3528 GWh in electricity and 10,286 GWh in transport, and an increase of 1916 GWh in heating and other final uses for a net 11,898 GWh decrease and a resulting emissions reduction of 3.48 $MtCO_2eq$ (1.29 MtCO2eq in electricity, 2.69 $MtCO_2eq$ in transport, and an increase of 0.54 $MtCO_2eq$ in heating), or 4.1%, from total national emissions in 2019. The effect is, to a considerable extent, the result of drastic tourist activity contraction, which is starkly evident in the electricity consumption in the Aegean islands. The comparison between the two lockdown periods brings out clear differences, with the reduction in the second one being considerably smaller as the population reverted, to a large extent, to pre-COVID behavior, which implies that no permanent gains from the COVID long-term impact toward decarbonization should be expected.

Keywords: COVID-19, Greece, electricity, greenhouse gas emissions, lockdowns

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Citation (APA): Lalas, D., Gakis, N., Mirasgedis, S., Georgopoulou, E., Sarafidis, Y., & Doukas, H. (2021). Energy and GHG Emissions Aspects of the COVID Impact in Greece. *Energies*, *14*(7), 1955.

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Energy and GHG Emissions Aspects of the COVID Impact in Greece

by Dimitri Lalas [1] ✉, Nikolaos Gakis [1] ✉, Sebastian Mirasgedis [2] ✉, Elena Georgopoulou [2] ✉ ⓘ, Yannis Sarafidis [2] ✉ and Haris Doukas [3],* ✉ ⓘ

[1] FACE³TS S.A., 1 Agiou Isidorou Str., 11471 Athens, Greece
[2] National Observatory of Athens, Lofos Nymfon, Thesseon, 11810 Athens, Greece
[3] Decision Support Systems Laboratory, School of Electrical and Computer Engineering, National Technical University of Athens, Iroon Politechniou 9, 15780 Athens, Greece
* Author to whom correspondence should be addressed.

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Abstract

The effects of COVID-19 have had devasting effects on both health and economies in 2020. At the same time, the lockdown and the downturn of economic activity resulted in a decrease in energy consumption and an accompanying reduction in greenhouse gas emissions. In this article, a comparison with the temperature adjustment of energy use is presented for the main carriers of electricity, natural gas, and oil products in the residential, tertiary, industry, and transport (road transport, domestic aviation, and navigation) sectors in 2020 against the previous two years in Greece, along with the corresponding emissions. As the comparison covers the entire year, both COVID peaks in the March–April and November–December periods and the corresponding lockdown effects as well as seasonal variations are included. The analysis shows a reduction, adjusted for temperature, of 3528 GWh in electricity and

Figure 29: Preview of Energy and GHG Emissions Aspects of the COVID Impact in Greece

2.30 Giarola et al. (2021), Science of the Total Environment

Title:	Challenges in the harmonisation of global integrated assessment models: A comprehensive methodology to reduce model response heterogeneity
Authors:	Sara Giarola, Shivika Mittal, Marc Vielle, Sigit Perdana, Lorenza Campagnolo, Elisa Delpiazzo, Ha Bui, Annela Anger-Kraavi, Andrey Kolpakov, Ida Sognnaes, Glen Peters, Adam Hawkes, Alexandre Koberle, Neil Grant, Ajay Gambhir, Alexandros Nikas (NTUA), Haris Doukas (NTUA), Jorge Moreno, Dirk-Jan van de Ven
Journal:	Science of the Total Environment

Abstract: Harmonisation sets the ground to a solid inter-comparison of integrated assessment models. A clear and transparent harmonisation process promotes a consistent interpretation of the modelling outcomes divergences and, reducing the model variance, is instrumental to the use of integrated assessment models to support policy decision-making. Despite its crucial role for climate economic policies, the definition of a comprehensive harmonisation methodology for integrated assessment modelling remains an open challenge for the scientific community.

This paper proposes a framework for a harmonisation methodology with the definition of indispensable steps and recommendations to overcome stumbling blocks in order to reduce the variance of the outcomes which depends on controllable modelling assumptions. The harmonisation approach of the PARIS REINFORCE project is presented here to layout such a framework. A decomposition analysis of the harmonisation process is shown through 6 integrated assessment models (GCAM, ICES-XPS, MUSE, E3ME, GEMINI-E3, and TIAM). Results prove the potentials of the proposed framework to reduce the model variance and present a powerful diagnostic tool to feedback on the quality of the harmonisation itself.

Keywords:	Integrated assessment modelling, Model inter-comparison, Harmonisation
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Open Access:	Gold
First Online:	April 07, 2021
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Synergies with:	N/A
Citation (APA):	Giarola, S., Mittal, S., Vielle, M., Perdana, S., Campagnolo, L., Delpiazzo, E., … & van de Ven, D. J. (2021). Challenges in the harmonisation of global integrated assessment models: A comprehensive methodology to reduce model response heterogeneity. *Science of the Total Environment*, *783*, 146861.

Science of The Total Environment
Volume 783, 20 August 2021, 146861

Challenges in the harmonisation of global integrated assessment models: A comprehensive methodology to reduce model response heterogeneity

Sara Giarola [a] ✉, Shivika Mittal [a], Marc Vielle [c], Sigit Perdana [c], Lorenza Campagnolo [d, e, f], Elisa Delpiazzo [d, e, f], Ha Bui [h], Annela Anger Kraavi [h], Andrey Kolpakov [i], Ida Sognnaes [g], Glen Peters [g], Adam Hawkes [a], Alexandre C. Köberle [a], Neil Grant [a], Ajay Gambhir [a], Alexandros Nikas [j], Haris Doukas [j], Jorge Moreno [b], Dirk-Jan van de Ven [b]

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Highlights

- Step-by-step harmonisation on socio-economics, techno-economics, and policies

- Up-to-date open source data are supplied for socio-economics and techno-economics.

- The proposed harmonisation procedure reduces emissions gap to 2.3 Gt of CO_2 in 2030.

Figure 30: Preview of Challenges in the harmonisation of global integrated assessment models: A comprehensive methodology to reduce model response heterogeneity

2.31 Koutsandreas et al. (2021), Energies

Title: What is the Macroeconomic Impact of Higher Decarbonization Speeds? The Case of Greece

Authors: Diamantis Koutsandreas (NTUA), Evangelos Spiliotis (NTUA), Haris Doukas (NTUA), John Psarras (NTUA)

Journal: Energies

Abstract: In alignment with the European Union's legislation, Greece submitted its final 10-year National Energy and Climate Plan (NECP) in December 2019, setting more ambitious energy and climate targets than those originally proposed in the draft version of the document. Apart from higher penetration of renewable energy sources (RES), the final NECP projects also zero carbon use in power generation till 2030. Although decarbonization has long been regarded beneficial for economies that base their energy production on coal, as it is the case with Greece, the macroeconomic and societal ramifications of faster transitions to carbon-free economies remain highly unexplored. Under this context, in this paper, we soft-link energy models, namely Times-Greece and Primes, with a macroeconomic model, namely Global Trade Analysis Project (GTAP), to measure the effects of the final and draft NECPs on the Greek economy and evaluate the impact of higher decarbonization speeds. We find that the faster transition scenario displays both economic and societal merits, increasing Gross Domestic Product (GDP) and household income by about 1% and 7%, respectively.

Keywords: Greece, energy transition, delignitization, energy modeling, computable general equilibrium modeling, macroeconomic impacts, double dividends

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First Online: April 16, 2021

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Synergies with: N/A

Citation (APA): Koutsandreas, D., Spiliotis, E., Doukas, H., & Psarras, J. (2021). What Is the Macroeconomic Impact of Higher Decarbonization Speeds? The Case of Greece. *Energies*, *14*(8), 2235.

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What Is the Macroeconomic Impact of Higher Decarbonization Speeds? The Case of Greece

by Diamantis Koutsandreas [1,*] ✉ ⓘ, Evangelos Spiliotis [2] ✉ ⓘ, Haris Doukas [1] ✉ ⓘ and John Psarras [1] ✉

[1] Decision Support Systems Lab (EPU-NTUA), School of Electrical and Computer Engineering, National Technical University of Athens, 157 73 Athens, Greece

[2] Forecasting and Strategy Unit, School of Electrical and Computer Engineering, National Technical University of Athens, 157 73 Athens, Greece

* Author to whom correspondence should be addressed.

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Abstract

In alignment with the European Union's legislation, Greece submitted its final 10-year National Energy and Climate Plan (NECP) in December 2019, setting more ambitious energy and climate targets than those originally proposed in the draft version of the document. Apart from higher penetration of renewable energy sources (RES), the final NECP projects also zero carbon use in power generation till 2030. Although decarbonization has long been regarded beneficial for economies that base their energy production on coal, as it is the case with Greece, the macroeconomic and societal ramifications of faster transitions to carbon-free economies remain highly unexplored. Under this context, in this paper, we soft-link energy models, namely Times-Greece and Primes, with a macroeconomic model, namely Global Trade Analysis Project (GTAP), to measure the effects of the final and draft NECPs on the Greek economy and evaluate the impact of higher decarbonization speeds. We find that the faster transition scenario displays both economic and societal merits, increasing Gross Domestic Product (GDP) and household income by about 1% and 7%, respectively.

Keywords: Greece; energy transition; delignitization; energy modeling; computable general equilibrium modeling; macroeconomic impacts; double dividends

Figure 31: Preview of What Is the Macroeconomic Impact of Higher Decarbonization Speeds? The Case of Greece

2.32 Doukas et al. (2021), Transportation Research Part D: Transport and Environment

Title:	Low-cost emissions cuts in container shipping: Thinking inside the box
Authors:	Haris Doukas (NTUA), Evangelos Spiliotis (NTUA), Mohsen A. Jafari, Sara Giarola (Imperial), Alexandros Nikas (NTUA)
Journal:	Transportation Research Part D: Transport and Environment
Abstract:	Container shipping has become an emission-intensive industry; existing regulations, however, continue to display limitations. Technical emissions reduction measures require large, long-term investments, while operational measures may negatively impact transportation costs and supply-chain practices. For container shipping to become more sustainable, innovative, low-cost technological solutions are required. This study discusses such a technological game-changer which utilizes a lighter container type that, contrary to conventional ones, does not require wood in its floor. In this regard, emissions reductions are achieved both due to lower fuel consumption and tree savings. We estimate the global impact of this technology until 2050 using an integrated assessment model and considering different projections about future characteristics of the container fleet. Our results indicate that the adoption of the examined technology can reduce CO_2 emissions by 4.7–18.8% depending on the main fuel used in container shipping lines, saving also a total of about 44 million trees.
Keywords:	Container shipping, Climate change, CO_2, Emissions, Freight weight reduction, Tree savings
DOI:	https://doi.org/10.1016/j.trd.2021.102815
Open Access:	Gold
First Online:	April 19, 2021
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Synergies with:	N/A
Citation (APA):	Doukas, H., Spiliotis, E., Jafari, M. A., Giarola, S., & Nikas, A. (2021). Low-cost emissions cuts in container shipping: Thinking inside the box. *Transportation Research Part D: Transport and Environment*, *94*, 102815.

Low-cost emissions cuts in container shipping: Thinking inside the box

Haris Doukas [a], Evangelos Spiliotis [b], Mohsen A. Jafari [c], Sara Giarola [d], Alexandros Nikas [a] ⚲ ✉

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Highlights

- The emission-intensive container shipping industry needs environmental innovations.

- Conventional emissions reduction measures are costly or require structural changes.

- We assess impacts of a container lightweighting technological innovation up to 2050.

- The MUSE global integrated assessment model is employed for different fuel scenarios.

- A 4.7

Figure 32: Preview of Low-cost emissions cuts in container shipping: Thinking inside the box

2.33 Babonneau et al. (2021), Climatic Change

Title:	Economic assessment of the development of CO_2 direct reduction technologies in long-term climate strategies of the Gulf countries
Authors:	Frédéric Babonneau, Ahmed Badran, Maroua Benlahrech, Alain Haurie, Maxime Schenckery, Marc Vielle (EPFL)
Journal:	Climatic Change
Abstract:	This paper proposes an assessment of long-term climate strategies for oil- and gas-producing countries—in particular, the Gulf Cooperation Council (GCC) member states—as regards the Paris Agreement goal of limiting the increase of surface air temperature to 2°C by the end of the twenty-first century. The study evaluates the possible role of carbon dioxide removal (CDR) technologies under an international emissions trading market as a way to mitigate welfare losses. To model the strategic context, one assumes that a global cumulative emissions budget will have been allocated among different coalitions of countries—the GCC being one of them—and the existence of an international emissions trading market. A meta-game model is proposed in which deployment of CDR technologies as well as supply of emission rights are strategic variables and the payoffs are obtained from simulations of a general equilibrium model. The results of the simulations indicate that oil and gas producing countries and especially the GCC countries face a significant welfare loss risk, due to "unburnable oil" if a worldwide climate regime as recommended by the Paris Agreement is put in place. The development of CDR technologies, in particular direct air capture (DAC) alleviates somewhat this risk and offers these countries a new opportunity for exploiting their gas reserves and the carbon storage capacity offered by depleted oil and gas reservoirs.
Keywords:	Paris Agreement, Gulf Cooperation Council, Climate Change Mitigation, Carbon dioxide removal, Direct Air Capture
DOI:	https://doi.org/10.1007/s10584-021-03058-4
Open Access:	Gold
First Online:	April 25, 2021
Repository:	Zenodo (Link: https://zenodo.org/record/5636528#.YzQku3ZByUk)
Synergies with:	N/A
Citation (APA):	Babonneau, F., Badran, A., Benlahrech, M., Haurie, A., Schenckery, M., & Vielle, M. (2021). Economic assessment of the development of CO 2 direct reduction technologies in long-term climate strategies of the Gulf countries. *Climatic Change*, *165*(3), 1-18.

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Economic assessment of the development of CO_2 direct reduction technologies in long-term climate strategies of the Gulf countries

Frédéric Babonneau ✉, Ahmed Badran, Maroua Benlahrech, Alain Haurie, Maxime Schenckery & Marc Vielle

Abstract

This paper proposes an assessment of long-term climate strategies for oil- and gas-producing countries—in particular, the Gulf Cooperation Council (GCC) member states—as regards the Paris Agreement goal of limiting the increase of surface air temperature to 2°C by the end of the twenty-first century. The study evaluates the possible role of carbon dioxide removal (CDR) technologies under an international emissions trading market as a way to mitigate welfare losses. To model the strategic context, one assumes that a global cumulative emissions budget will have been allocated among different coalitions of countries—the GCC being one of them—and the existence of an international emissions trading market. A meta-game model is proposed in which deployment of CDR technologies as well as supply of emission rights are strategic variables and the payoffs are obtained from simulations of a general equilibrium model. The results of the simulations indicate that oil and gas producing countries and especially the GCC countries face a significant welfare loss risk, due to "unburnable oil" if a worldwide climate regime as recommended by the Paris Agreement is put in place. The development of CDR technologies, in particular direct air capture (DAC) alleviates somewhat this risk and offers these countries a new opportunity for exploiting their gas reserves and the carbon storage capacity offered by depleted oil and gas reservoirs.

Figure 33: Preview of Economic assessment of the development of CO_2 direct reduction technologies in long-term climate strategies of the Gulf countries

2.34 Yang et al. (2021), Sustainable Cities and Society

Title:	Transport decarbonization in big cities: An integrated environmental co-benefit analysis of vehicles purchases quota-limit and new energy vehicles promotion policy in Beijing
Authors:	Xi Yang (CUP), Wanqi Lin, Ruixin Gong, Mingzhe Zhu, Cecilia Springer
Journal:	Sustainable Cities and Society
Abstract:	In the deep decarbonization era against climate change, big cities set ambitious targets for road transport. As China's capital, Beijing has very strict vehicles quota-limit policies. This study contributes to the literature for its innovations on the evaluation of quota-limit executive policy for big cities which few studies have studied, and its improved method with integrated analysis model which distinguish itself for including future co-benefit estimation and enterprise-level data analysis. This study estimates the energy consumption and health environmental co-benefit up to 2030, results show that the ambitious policy will significantly reduce both CO_2 and key atmospheric pollutants emissions. Besides, the health economic loss from different illnesses attributed to NO_X, CO, $PM_{2.5}$ and HC will be 65%, 61%, 19% and 57 % lower than reference scenario in 2030. During the energy transition, gasoline will still occupy the biggest proportion of the passenger sector fuel use in Beijing. However, the quota-limit policy will have significant integrated impact on both emission mitigation and avoiding public health damage. This study provides a good reference for big cities in other countries for both its improved method and the effectiveness of administrative decree policy for urban transport planning.
Keywords:	Decarbonization in cities, Environmental co-benefits, New energy vehicle, Purchase quota-limit
DOI:	https://doi.org/10.1016/j.scs.2021.102976
Open Access:	Green (embargoed unti April 30, 2023)
First Online:	April 30, 2021
Repository:	Zenodo (Link: https://zenodo.org/record/5657559#.YzQlrXZByUk)
Synergies with:	N/A
Citation (APA):	Yang, X., Lin, W., Gong, R., Zhu, M., & Springer, C. (2021). Transport decarbonization in big cities: An integrated environmental co-benefit analysis of vehicles purchases quota-limit and new energy vehicles promotion policy in Beijing. *Sustainable Cities and Society*, *71*, 102976.

Transport decarbonization in big cities: An integrated environmental co-benefit analysis of vehicles purchases quota-limit and new energy vehicles promotion policy in Beijing

Xi Yang [a, b] ⚇ ✉, Wanqi Lin [a], Ruixin Gong [a], Mingzhe Zhu [c], Cecilia Springer [d]

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Highlights

- The nonnegligible environmental health co-benefit is considered in Beijing road transport sector.

- Beijing's electric vehicles policy are studied under different level of EV market penetration.

- The strict electric vehicles policy in Beijing will help the city to fulfil its low carbon city target.

- The quota-limit policy and EV promotion in Beijing has substantial positive health co-benefit.

- It provides a reference for effectiveness analysis of administrative decree policy in big cities.

Figure 34: Preview of Transport decarbonization in big cities: An integrated environmental co-benefit analysis of vehicles purchases quota-limit and new energy vehicles promotion policy in Beijing

2.35 Martz et al. (2021), Environmental Research Letters

Title:	Global perspective on CO_2 emissions of electric vehicles
Authors:	Alexandra Märtz, Patrick Plötz (ISI Fraunhofer), Patrick Jochem
Journal:	Environmental Research Letters

Abstract:

Plug-in electric vehicles (PEVs) are a promising option for greenhouse gas (GHG) mitigation in the transport sector - especially when the fast decrease in carbon emissions from electricity provision is considered. The rapid uptake of renewable electricity generation worldwide implies an unprecedented change that affects the carbon content of electricity for battery production as well as charging and thus the GHG mitigation potential of PEV. However, most studies assume fixed carbon content of the electricity in the environmental assessment of PEV and the fast change of the generation mix has not been studied on a global scale yet. Furthermore, the inclusion of up-stream emissions remains an open policy problem. Here, we apply a reduced life cycle assessment approach including the well-to-wheel emissions of PEV and taking into account future changes in the electricity mix. We compare future global energy scenarios and combine them with PEV diffusion scenarios. Our results show that the remaining carbon budget is best used with a very early PEV market diffusion; waiting for cleaner PEV battery production cannot compensate for the lost carbon budget in combustion vehicle usage.

Keywords:	CO_2 emissions, electric vehicles
DOI:	https://doi.org/10.1088/1748-9326/abf8e1
Open Access:	Gold
First Online:	June 1, 2021
Repository:	Zenodo (Link: https://zenodo.org/record/5636616#.YzQmzHZByUk)
Synergies with:	N/A
Citation (APA):	Märtz, A., Plötz, P., & Jochem, P. (2021). Global perspective on CO2 emissions of electric vehicles. *Environmental Research Letters*, *16*(5), 054043.

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Global perspective on CO_2 emissions of electric vehicles

Alexandra Märtz[4,1] (iD), Patrick Plötz[2] (iD) and Patrick Jochem[1,3] (iD)

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Abstract

Plug-in electric vehicles (PEVs) are a promising option for greenhouse gas (GHG) mitigation in the transport sector - especially when the fast decrease in carbon emissions from electricity provision is considered. The rapid uptake of renewable electricity generation worldwide implies an unprecedented change that affects the carbon content of electricity for battery production as well as charging and thus the GHG mitigation potential of PEV. However, most studies assume fixed carbon content of the electricity in the environmental assessment of PEV and the fast change of the generation mix has not been studied on a global scale yet. Furthermore, the inclusion of up-stream emissions remains an open policy problem. Here, we apply a reduced life cycle assessment approach including the well-to-wheel emissions of PEV and taking into account future changes in the electricity mix. We compare future global energy scenarios and combine them with PEV diffusion scenarios. Our results show that the remaining carbon budget is best used with a very early PEV market diffusion; waiting for cleaner PEV battery production cannot compensate for the lost carbon budget in combustion vehicle usage.

Export citation and abstract   [BibTeX]   [RIS]

Figure 35: Preview of Global perspective on CO_2 emissions of electric vehicles

2.36 Grant et al. (2021), Environmental Research Letters

Title:	Confronting mitigation deterrence in low-carbon scenarios
Authors:	Neil Grant (Imperial), Adam Hawkes (Imperial), Shivika Mittal (Imperial), Ajay Gambhir (Imperial)
Journal:	Environmental Research Letters

Abstract: Carbon dioxide removal (CDR) features heavily in low-carbon scenarios, where it often substitutes for emission reductions in both the near-term and long-term, enabling temperature targets to be met at lower cost. There are major concerns around the scale of CDR deployment in many low-carbon scenarios, and the risk that anticipated future CDR could dilute incentives to reduce emissions now, a phenomenon known as mitigation deterrence. Here we conduct an in-depth analysis into the relationship between emissions reduction and emissions removal in a global integrated assessment model. We explore the impact of CDR on low-carbon scenarios, illustrating how the pathway for the 2020s is highly sensitive to assumptions around CDR availability. Using stochastic optimisation, we demonstrate that accounting for uncertainty in future CDR deployment provides a strong rationale to increase rates of mitigation in the 2020s. A 20% chance of CDR deployment failure requires additional emissions reduction in 2030 of 3–17 $GtCO_2$. Finally, we introduce new scenarios which demonstrate the risks of mitigation deterrence and the benefits of formally separating CDR and emissions reduction as climate strategies. Continual mitigation deterrence across the time-horizon leads to the temperature goals being breached by 0.2–0.3 °C. If CDR is treated as additional to emissions reduction, up to an additional 700–800 $GtCO_2$ can be removed from the atmosphere by 2100, reducing end-of-century warming by up to 0.5 °C. This could put sub-1.5 °C targets within reach but requires that CDR is additional to, rather than replaces, emission reductions.

Keywords:	negative emissions, Carbon dioxide removal, Low-carbon transitions
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Open Access:	Gold
First Online:	June 28, 2021
Repository:	Zenodo (Link: https://zenodo.org/record/5636632#.YzQnVHZByUk)
Synergies with:	N/A
Citation (APA):	Grant, N., Hawkes, A., Mittal, S., & Gambhir, A. (2021). Confronting mitigation deterrence in low-carbon scenarios. *Environmental Research Letters*, *16*(6), 064099.

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Confronting mitigation deterrence in low-carbon scenarios

Neil Grant[3,1] (ID), Adam Hawkes[2] (ID), Shivika Mittal[1] (ID) and Ajay Gambhir[1] (ID)

📄 Article PDF   🔷 Article ePub

Figures ▾   References ▾

➕ Article information

Abstract

Carbon dioxide removal (CDR) features heavily in low-carbon scenarios, where it often substitutes for emission reductions in both the near-term and long-term, enabling temperature targets to be met at lower cost. There are major concerns around the scale of CDR deployment in many low-carbon scenarios, and the risk that anticipated future CDR could dilute incentives to reduce emissions now, a phenomenon known as mitigation deterrence. Here we conduct an in-depth analysis into the relationship between emissions reduction and emissions removal in a global integrated assessment model. We explore the impact of CDR on low-carbon scenarios, illustrating how the pathway for the 2020s is highly sensitive to assumptions around CDR availability. Using stochastic optimisation, we demonstrate that accounting for uncertainty in future CDR deployment provides a strong rationale to increase rates of mitigation in the 2020s. A 20% chance of CDR deployment failure requires additional emissions reduction in 2030 of 3–17 $GtCO_2$. Finally, we introduce new scenarios which demonstrate the risks of mitigation deterrence and the benefits of formally separating CDR and emissions reduction as climate strategies. Continual mitigation deterrence across the time-horizon leads to the temperature goals being breached by 0.2–0.3 °C. If CDR is treated as additional to emissions reduction, up to an additional 700–800 $GtCO_2$ can be removed from the atmosphere by 2100, reducing end-of-century

Figure 36: Preview of Confronting mitigation deterrence in low-carbon scenarios

2.37 Nikas et al. (2021), Science of the Total Environment

Title: Where is the EU headed given its current climate policy? A stakeholder-driven model inter-comparison

Authors: Alexandros Nikas (NTUA), Alessia Elia (E4SMA), Baptiste Boitier (SEURECO), Konstantinos Koasidis (NTUA), Haris Doukas (NTUA), Gabriele Cassetti (E4SMA), Annela Anger-Kraavi (Cambrdige), Ha Bui, Lorenza Campagnolo (CMCC), Rocco De Miglio (E4SMA), Elisa Delpiazzo (CMCC), Arnaud Fougeyrollas, Ajay Gambhir (Imperial), Maurizio Gargiulo (E4SMA), Sara Giarola (Imperial), Neil Grant (Imperial), Adam Hawkes (Imperial), Andrea Herbst (ISI Fraunhofer), Alexandre C. Köberle (Imperial), Andrey Kolpakov, Pierre Le Mouël (SEURECO), Ben McWilliams (Bruegel), Shivika Mittal (Imperial), Jorge Moreno (BC3), Felix Neuner (BC3), Sigit Perdana (EPFL), Glen P. Peters (CICERO), Patrick Plötz (ISI Fraunhofer), Joeri Rogelj, Ida Sognnæs (CICERO), Dirk-Jan Van de Ven (BC3), Marc Vielle (EPFL), Georg Zachmann (Bruegel), Paul Zagamé (SEURECO), Alessandro Chiodi (E4SMA)

Journal: Science of Total Environment

Abstract: Recent calls to do climate policy research with, rather than for, stakeholders have been answered in non-modelling science. Notwithstanding progress in modelling literature, however, very little of the scenario space traces back to what stakeholders are ultimately concerned about. With a suite of eleven integrated assessment, energy system and sectoral models, we carry out a model inter-comparison for the EU, the scenario logic and research questions of which have been formulated based on stakeholders' concerns. The output of this process is a scenario framework exploring where the region is headed rather than how to achieve its goals, extrapolating its current policy efforts into the future. We find that Europe is currently on track to overperforming its pre-2020 40% target yet far from its newest ambition of 55% emissions cuts by 2030, as well as looking at a 1.0–2.35 GtCO$_2$ emissions range in 2050. Aside from the importance of transport electrification, deployment levels of carbon capture and storage are found intertwined with deeper emissions cuts and with hydrogen diffusion, with most hydrogen produced post-2040 being blue. Finally, the multi-model exercise has highlighted benefits from deeper decarbonisation in terms of energy security and jobs, and moderate to high renewables-dominated investment needs.

Repository: Zenodo (Link: https://zenodo.org/record/5636655#.YzQqjnZByUk)

Synergies with: N/A

Citation (APA):   Nikas, A., Elia, A., Boitier, B., Koasidis, K., Doukas, H., Cassetti, G., ... & Chiodi, A. (2021). Where is the EU headed given its current climate policy? A stakeholder-driven model inter-comparison. *Science of The Total Environment*, 148549.

Science of The Total Environment
Volume 793, 1 November 2021, 148549

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Where is the EU headed given its current climate policy? A stakeholder-driven model inter-comparison

Alexandros Nikas [a] ✉, Alessia Elia [b], Baptiste Boitier [c], Konstantinos Koasidis [a], Haris Doukas [a], Gabriele Cassetti [b], Annela Anger-Kraavi [d], Ha Bui [e], Lorenza Campagnolo [f, g, h], Rocco De Miglio [b], Elisa Delpiazzo [f, g, h], Arnaud Fougeyrollas [c], Ajay Gambhir [i], Maurizio Gargiulo [b], Sara Giarola [j], Neil Grant [i], Adam Hawkes [j], Andrea Herbst [k] ...
Alessandro Chiodi [b]

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Highlights

- We define the scenario logic & scope of a model inter-comparison with stakeholders.

- We explore the EU's energy future, if its current policy is projected in the long run.

- The diverse modelling ensemble employed includes seven global and four regional models.

- Far from its new 2030 goal the EU is looking at a 1.0–2.35 $GtCO_2$ 2050 emissions range.

Figure 37: Preview of Where is the EU headed given its current climate policy? A stakeholder-driven model inter-comparison

2.38 Li et al. (2021), Mitigation and Adaptation Strategies for Global Change

Title: Potential integration of Chinese and European emissions trading market: welfare distribution analysis

Authors: Ru Li, Sigit Perdana (EPFL), Marc Vielle (EPFL)

Journal: Mitigation and Adaptation Strategies for Global Change

Abstract: Central to the aims of the Paris Agreement, an integrated carbon market could potentially be a practical bottom-up option for effective and efficient mitigation. This paper quantifies the welfare effects of integration of Emission Trading Scheme (ETS) between the European Union (EU) and China. Using the European version of the computable general equilibrium model GEMINI-E3, our assessment reveals that integrating trading markets benefits both regions through the decrease welfare costs from abatements. China's welfare improves through net gain of selling the allowance, while the EU experiences lower deadweight loss. This effect is stronger to some notable countries in the EU, with high energy-intensive industries such as Poland and the Czech Republic. While a few others, such as Netherlands and Ireland, face higher welfare costs from negative trade gain. Limiting the trade quotas to 40% captures most of the EU welfare gain coming from CO_2 trading. Further analysis at the sectoral level reveals that market integration significantly minimizes the loss of competitiveness of European energy-intensive industries and reduces international leakage. Our finding thus confirms the potential of the emissions trading market as an effective instrument to facilitate multilateral coordination in global mitigation.

Keywords: EU ETS, emissions trading systems, Europe, China

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First Online: June 25, 2021

Repository: Zenodo (Link: https://zenodo.org/record/5636729#.YzQrWXZByUk)

Synergies with: N/A

Citation (APA):   Li, R., Perdana, S., & Vielle, M. (2021). Potential integration of Chinese and European emissions trading market: welfare distribution analysis. *Mitigation and Adaptation Strategies for Global Change*, *26*(5), 1-28.

Springer Link

Potential integration of Chinese and European emissions trading market: welfare distribution analysis

Ru Li, Sigit Perdana ✉ & Marc Vielle

Abstract

Central to the aims of the Paris Agreement, an integrated carbon market could potentially be a practical bottom-up option for effective and efficient mitigation. This paper quantifies the welfare effects of integration of Emission Trading Scheme (ETS) between the European Union (EU) and China. Using the European version of the computable general equilibrium model GEMINI-E3, our assessment reveals that integrating trading markets benefits both regions through the decrease welfare costs from abatements. China's welfare improves through net gain of selling the allowance, while the EU experiences lower deadweight loss. This effect is stronger to some notable countries in the EU, with high energy-intensive industries such as Poland and the Czech Republic. While a few others, such as Netherlands and Ireland, face higher welfare costs from negative trade gain. Limiting the trade quotas to 40% captures most of the EU welfare gain coming from CO_2 trading. Further analysis at the sectoral level reveals that market integration significantly minimizes the loss of competitiveness of European energy-intensive industries and reduces international leakage. Our finding thus confirms the potential of the emissions trading market as an effective instrument to facilitate multilateral coordination in global mitigation.

Figure 38: Preview of Potential integration of Chinese and European emissions trading market: welfare distribution analysis

2.39 Stoddard et al. (2021), Annual Review of Environment and Resources

Title:	Three Decades of Climate Mitigation: Why Haven't We Bent the Global Emissions Curve?
Authors:	Isak Stoddard, Kevin Anderson, Stuart Capstick, Wim Carton, Joanna Depledge,Keri Facer, Clair Gough, Frederic Hache, Claire Hoolohan, Martin Hultman, Niclas Hällström, Sivan Kartha, Sonja Klinsky, Magdalena Kuchler, Eva Lövbrand, Naghmeh Nasiritousi, Peter Newell, Glen P. Peters (CICERO), Youba Sokona, Andy Stirling,Matthew Stilwell, Clive L. Spash, Mariama Williams
Journal:	Annual Review of Environment and Resources
Abstract:	Despite three decades of political efforts and a wealth of research on the causes and catastrophic impacts of climate change, global carbon dioxide emissions have continued to rise and are 60% higher today than they were in 1990. Exploring this rise through nine thematic lenses—covering issues of climate governance, the fossil fuel industry, geopolitics, economics, mitigation modeling, energy systems, inequity, lifestyles, and social imaginaries—draws out multifaceted reasons for our collective failure to bend the global emissions curve. However, a common thread that emerges across the reviewed literature is the central role of power, manifest in many forms, from a dogmatic political-economic hegemony and influential vested interests to narrow techno-economic mindsets and ideologies of control. Synthesizing the various impediments to mitigation reveals how delivering on the commitments enshrined in the Paris Agreement now requires an urgent and unprecedented transformation away from today's carbon- and energy-intensive development paradigm.
Keywords:	climate mitigation, energy transitions, lock-ins, power, knowledge traditions, societal transformations
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Open Access:	Gold
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Repository:	Zenodo (Link: https://zenodo.org/record/5636741#.YzQsdHZByUk)
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Citation (APA):	Stoddard, I., Anderson, K., Capstick, S., Carton, W., Depledge, J., Facer, K., … & Williams, M. (2021). Three decades of climate mitigation: why haven't we bent the global emissions curve?. *Annual Review of Environment and Resources*, *46*(1), 653-689.

Three Decades of Climate Mitigation: Why Haven't We Bent the Global Emissions Curve?

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Abstract

Despite three decades of political efforts and a wealth of research on the causes and catastrophic impacts of climate change, global carbon dioxide emissions have continued to rise and are 60% higher today than they were in 1990. Exploring this rise through nine thematic lenses—covering issues of climate governance, the fossil fuel industry, geopolitics, economics, mitigation modeling, energy systems, inequity, lifestyles, and social imaginaries—draws out multifaceted reasons for our collective failure to bend the global emissions curve. However, a common thread that emerges across the reviewed literature is the central role of power, manifest in many forms, from a dogmatic political-economic hegemony and influential vested interests to narrow techno-economic mindsets and ideologies of control. Synthesizing the various impediments to mitigation reveals how delivering on the commitments enshrined in the Paris Agreement now requires an urgent and unprecedented transformation away from today's carbon- and energy-intensive development paradigm.

Figure 39: Preview of Three Decades of Climate Mitigation: Why Haven't We Bent the Global Emissions Curve?

2.40 Marinakis et al. (2021), Energies

Title:	AI and Data Democratisation for Intelligent Energy Management
Authors:	Vangelis Marinakis (NTUA), Themistoklis Koutsellis (NTUA), Alexandros Nikas (NTUA), Haris Doukas (NTUA)
Journal:	Energies

Abstract: Despite the large number of technology-intensive organisations, their corporate know-how and underlying workforce skill are not mature enough for a successful rollout of Artificial Intelligence (AI) services in the near-term. However, things have started to change, owing to the increased adoption of data democratisation processes, and the capability offered by emerging technologies for data sharing while respecting privacy, protection, and security, as well as appropriate learning-based modelling capabilities for non-expert end-users. This is particularly evident in the energy sector. In this context, the aim of this paper is to analyse AI and data democratisation, in order to explore the strengths and challenges in terms of data access problems and data sharing, algorithmic bias, AI transparency, privacy and other regulatory constraints for AI-based decisions, as well as novel applications in different domains, giving particular emphasis on the energy sector. A data democratisation framework for intelligent energy management is presented. In doing so, it highlights the need for the democratisation of data and analytics in the energy sector, toward making data available for the right people at the right time, allowing them to make the right decisions, and eventually facilitating the adoption of decentralised, decarbonised, and democratised energy business models.

Keywords:	artificial intelligence, data democratisation, energy data spaces, interoperability; data sharing, energy management, decarbonisation, decision support
DOI:	https://doi.org/10.3390/en14144341
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First Online:	July 19, 2021
Repository:	Zenodo (Link: https://zenodo.org/record/5614602#.YzQtfnZByUk)
Synergies with:	H2020 BD4NRG (GA: 872613), H2020 MATRYCS (GA: 101000158)
Citation (APA):	Marinakis, V., Koutsellis, T., Nikas, A., & Doukas, H. (2021). AI and Data Democratisation for Intelligent Energy Management. *Energies*, *14*(14), 4341.

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- A Data Democratisation Framework for Intelligent Energy Management
- Discussion
- Conclusions
- Author Contributions
- Funding
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- Conflicts of Interest
- References

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AI and Data Democratisation for Intelligent Energy Management

by 🔵 Vangelis Marinakis * ✉ 🆔, 👤 Themistoklis Koutsellis ✉ 🆔, 🔵 Alexandros Nikas ✉ 🆔 and
🔵 Haris Doukas ✉ 🆔

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Abstract

Despite the large number of technology-intensive organisations, their corporate know-how and underlying workforce skill are not mature enough for a successful rollout of Artificial Intelligence (AI) services in the near-term. However, things have started to change, owing to the increased adoption of data democratisation processes, and the capability offered by emerging technologies for data sharing while respecting privacy, protection, and security, as well as appropriate learning-based modelling capabilities for non-expert end-users. This is particularly evident in the energy sector. In this context, the aim of this paper is to analyse AI and data democratisation, in order to explore the strengths and challenges in terms of data access problems and data sharing, algorithmic bias, AI transparency, privacy and other regulatory constraints for AI-based decisions, as well as novel applications in different domains, giving particular emphasis on the energy sector. A data democratisation framework for intelligent energy management is presented. In doing so, it highlights the need for the democratisation of data and analytics in the energy sector, toward making data available for the right people at the right time, allowing them to make the right decisions, and eventually facilitating the adoption of decentralised, decarbonised, and democratised energy business models.

Keywords: artificial intelligence; data democratisation; energy data spaces; interoperability; data sharing; energy management; decarbonisation; decision support

Figure 40: Preview of AI and Data Democratisation for Intelligent Energy Management

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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2.41 Mandev et al. (2021), Environmental Research Communications

Title:	The effect of plug-in hybrid electric vehicle charging on fuel consumption and tail-pipe emissions
Authors:	Ahmet Mandev, Patrick Plötz (ISI Fraunhofer), Frances Sprei
Journal:	Environmental Research Communications

Abstract: Plug-in hybrid electric vehicles (PHEV) have an electric motor and an internal combustion engine and can reduce greenhouse gas emissions (GHG) from transport. However, their environmental benefit strongly depends on the charging behaviour. Several studies have analysed the GHG emissions from upstream electricity production, yet the impact of individual charging behaviour on PHEV tail-pipe carbon emissions has not been quantified from empirical data so far. Here, we use daily driving data from 7,491 Chevrolet Volt PHEV with a total 3.4 million driving days in the US and Canada to fill this gap. We quantify the effect of daily charging on the electric driving share and the individual fuel consumption. We find that even a minor deviation from charging every driving day significantly increases fuel consumption and thus tail-pipe emissions. Our results show that reducing charging from every day to 9 out of 10 days, increases fuel consumption on average by 1.85 ± 0.03 l/100 km or 42.7 ± 0.8 gCO_2 km^{-1} tail-pipe emissions ($\pm$ on standard error). Charging more than once per driving day has less impact in our sample, this must occur during at least 20% of driving days to have a noteworthy effect. Even then, a 10% increase in frequency only has moderate effect of decreasing fuel consumption on average by 0.08 ± 0.02 l/100 km or 1.86 ± 0.46 gCO_2 km^{-1} tail-pipe emissions. Our results illustrate the importance of providing adequate charging infrastructure and incentives for PHEV users to charge their vehicles on a regular basis in order to ensure that their environmental impact is small as even long-range PHEVs can have a noteworthy share of conventional fuel use when not regularly charged.

Keywords:	electric vehicles,charging, fuel consumption, Greenhouse gas emissions
DOI:	https://doi.org/10.1088/2515-7620/ac1498
Open Access:	Gold
First Online:	July 30, 2021
Repository:	Zenodo (Link: https://zenodo.org/record/5636771#.YzQwGXZByUk)
Synergies with:	N/A
Citation (APA):	Mandev, A., Plötz, P., & Sprei, F. (2021). The effect of plug-in hybrid electric vehicle charging on fuel consumption and tail-pipe emissions. *Environmental Research Communications*, *3*(8), 081001.

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The effect of plug-in hybrid electric vehicle charging on fuel consumption and tail-pipe emissions

Ahmet Mandev[1] 🆔, Patrick Plötz[2] 🆔 and Frances Sprei[1] 🆔

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➕ Article information

Abstract

Plug-in hybrid electric vehicles (PHEV) have an electric motor and an internal combustion engine and can reduce greenhouse gas emissions (GHG) from transport. However, their environmental benefit strongly depends on the charging behaviour. Several studies have analysed the GHG emissions from upstream electricity production, yet the impact of individual charging behaviour on PHEV tail-pipe carbon emissions has not been quantified from empirical data so far. Here, we use daily driving data from 7,491 Chevrolet Volt PHEV with a total 3.4 million driving days in the US and Canada to fill this gap. We quantify the effect of daily charging on the electric driving share and the individual fuel consumption. We find that even a minor deviation from charging every driving day significantly increases fuel consumption and thus tail-pipe emissions. Our results show that reducing charging from every day to 9 out of 10 days, increases fuel consumption on average by 1.85 ± 0.03 l/100 km or 42.7 ± 0.8 gCO$_2$ km^{-1} tail-pipe emissions ($\pm$ on standard error). Charging more than once per driving day has less impact in our sample, this must occur during at least 20% of driving days to have a noteworthy effect. Even then, a 10% increase in frequency only has moderate effect of decreasing fuel consumption on average by 0.08 ± 0.02 l/100 km or 1.86 ± 0.46 gCO$_2$ km^{-1} tail-pipe emissions. Our results illustrate the importance of providing adequate charging infrastructure and incentives for PHEV users to charge their vehicles on a regular basis in order to ensure that their environmental impact is small as even long-range PHEVs can have a noteworthy share of conventional fuel use when not regularly charged.

Figure 41: Preview of The effect of plug-in hybrid electric vehicle charging on fuel consumption and tail-pipe emissions

2.42 van de Ven et al. (2021), Earth's Future

Title:	The Impact of U.S. Re-engagement in Climate on the Paris Targets
Authors:	Dirk-Jan van de Ven (BC3), Michael Westphal, Mikel González-Eguino (BC3), Ajay Gambhir (Imperial), Glen Peters (CICERO), Ida Sognnæs (CICERO), Haewon McJeon, Nathan Hultman, Kevin Kennedy, Tom Cyrs, Leon Clarke
Journal:	Earth's Future

Abstract: The Paris Agreement seeks to combine international efforts to keep global temperature increase to well-below 2°C. Whilst current ambitions in many signatories are insufficient to achieve this goal, optimism prevailed in the second half of 2020. Not only did several major emitters announce net-zero mitigation targets around mid-century, but the new Biden Administration immediately announced the U.S.'s re-entry into Paris and a net-zero goal for 2050. U.S. federal re-engagement in climate action could have a considerable impact on its national greenhouse gas emissions pathway, by significantly augmenting existing state-level actions. Combined with U.S. re-entry in the Paris Agreement, this could also serve as a stimulus to enhance ambitions in other countries. A critical question then becomes what such U.S. re-engagement, through both national and international channels, would have on the global picture. This commentary explores precisely this question, by using an integrated assessment model to assess U.S. national emissions, global emissions, and end-of-century temperatures in five scenarios combining different climate ambition levels in both the U.S. and the rest of the world. Our analyses finds that ambitious climate leadership by the Biden Administration on top of enhanced climate commitments by other the major economies could potentially be the trigger for the world to fulfill the temperature goal of the Paris Agreement.

Keywords:	Paris Agreement, COP26
DOI:	https://doi.org/10.1029/2021EF002077
Open Access:	Gold
First Online:	August 16, 2021
Repository:	Zenodo (Link: https://zenodo.org/record/5636775#.YzQxN3ZByUk)
Synergies with:	H2020 NDC ASPECTS (GA: 101003866)
Citation (APA):	van de Ven, D. J., Westphal, M., González-Eguino, M., Gambhir, A., Peters, G., Sognnaes, I., … & Clarke, L. (2021). The Impact of US Re-engagement in Climate on the Paris Targets. Earth's Future, 9(9), e2021EF002077.

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The Impact of U.S. Re-engagement in Climate on the Paris Targets

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Abstract

The Paris Agreement seeks to combine international efforts to keep global temperature increase to well-below 2°C. Whilst current ambitions in many signatories are insufficient to achieve this goal, optimism prevailed in the second half of 2020. Not only did several major emitters announce net-zero mitigation targets around mid-century, but the new Biden Administration immediately announced the U.S.'s re-entry into Paris and a net-zero goal for 2050. U.S. federal re-engagement in climate action could have a considerable impact on its national greenhouse gas emissions pathway, by significantly augmenting existing state-level actions. Combined with U.S. re-entry in the Paris Agreement, this could also serve as a stimulus to enhance ambitions in other countries. A critical question then becomes what such U.S. re-engagement, through both national and international channels, would have on the global picture. This commentary explores precisely this question, by using an integrated assessment model to assess U.S. national emissions, global emissions, and end-of-century temperatures in five scenarios combining different climate ambition levels in both the U.S. and the rest of the world. Our analyses finds that ambitious climate leadership by the Biden Administration on top of enhanced climate commitments by other the major economies could potentially be the trigger for the world to fulfill the temperature goal of the Paris Agreement.

Figure 42: Preview of The Impact of U.S. Re-engagement in Climate on the Paris Targets

2.43 Joshi et al. (2021), Nature Communications

Title:	High resolution global spatiotemporal assessment of rooftop solar photovoltaics potential for renewable electricity generation
Authors:	Siddharth Joshi, Shivika Mittal (Imperial), Paul Holloway, Priyadarshi Ramprasad Shukla, Brian Ó Gallachóir, James Glynn
Journal:	Nature Communications

Abstract:	Rooftop solar photovoltaics currently account for 40% of the global solar photovoltaics installed capacity and one-fourth of the total renewable capacity additions in 2018. Yet, only limited information is available on its global potential and associated costs at a high spatiotemporal resolution. Here, we present a high-resolution global assessment of rooftop solar photovoltaics potential using big data, machine learning and geospatial analysis. We analyse 130 million km^2 of global land surface area to demarcate 0.2 million km^2 of rooftop area, which together represent 27 PWh yr^{-1} of electricity generation potential for costs between 40–280 \$ MWh^{-1}. Out of this, 10 PWh yr^{-1} can be realised below 100 \$ MWh^{-1}. The global potential is predominantly spread between Asia (47%), North America (20%) and Europe (13%). The cost of attaining the potential is lowest in India (66 \$ MWh^{-1}) and China (68 \$ MWh^{-1}), with USA (238 \$ MWh^{-1}) and UK (251 \$ MWh^{-1}) representing some of the costliest countries.

Keywords:	solar photovoltaics, rooftop solar, Renewable energy, Modelling
DOI:	https://doi.org/10.1038/s41467-021-25720-2
Open Access:	Gold
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Repository:	Zenodo (Link: https://zenodo.org/record/5636791#.YzQySnZByUk)
Synergies with:	N/A
Citation (APA):	Joshi, S., Mittal, S., Holloway, P., Shukla, P. R., Ó Gallachóir, B., & Glynn, J. (2021). High resolution global spatiotemporal assessment of rooftop solar photovoltaics potential for renewable electricity generation. *Nature communications*, *12*(1), 1-15.

High resolution global spatiotemporal assessment of rooftop solar photovoltaics potential for renewable electricity generation

Siddharth Joshi ✉, Shivika Mittal, Paul Holloway, Priyadarshi Ramprasad Shukla, Brian Ó Gallachóir & James Glynn

Abstract

Rooftop solar photovoltaics currently account for 40% of the global solar photovoltaics installed capacity and one-fourth of the total renewable capacity additions in 2018. Yet, only limited information is available on its global potential and associated costs at a high spatiotemporal resolution. Here, we present a high-resolution global assessment of rooftop solar photovoltaics potential using big data, machine learning and geospatial analysis. We analyse 130 million km^2 of global land surface area to demarcate 0.2 million km^2 of rooftop area, which together represent 27 PWh yr^{-1} of electricity generation potential for costs between 40–280 \$ MWh^{-1}. Out of this, 10 PWh yr^{-1} can be realised below 100 \$ MWh^{-1}. The global potential is predominantly spread between Asia (47%), North America (20%) and Europe (13%). The cost of attaining the potential is lowest in India (66 \$ MWh^{-1}) and China (68 \$ MWh^{-1}), with USA (238 \$ MWh^{-1}) and UK (251 \$ MWh^{-1}) representing some of the costliest countries.

Figure 43: Preview of High resolution global spatiotemporal assessment of rooftop solar photovoltaics potential for renewable electricity generation

2.44 Nikas et al. (2021), IEEE International Conference on Information, Intelligence, Systems & Applications

Title: Integrating Integrated Assessment Modelling in Support of the Paris Agreement: The I2AM PARIS Platform

Authors: Alexandros Nikas (NTUA), Stavros Skalidakis (NTUA), Alevgul H. Sorman (BC3), Ester Galende-Sanchez (BC3), Konstantinos Koasidis (NTUA), Filippos Serepas (NTUA), Dirk-Jan Van de Ven (BC3), Jorge Moreno (BC3), Anastasios Karamaneas (NTUA), Themistoklis Koutsellis (NTUA), Eleni Kanellou (NTUA), Haris Doukas (NTUA)

Journal: IEEE International Conference on Information, Intelligence, Systems & Applications

Abstract: Calls "to do science differently" and democratise the research process have proliferated in the last decades, especially in the context of climate science and policy support. This new arena demands more participatory procedures to expand the knowledge-making beyond researchers and experts. One way that science has started to interact with society has been the increasing number of online platforms that have emerged as alternative forums, providing the opportunity for engaging a variety of tools, models, results, and preferences. This study presents I^{2}AM PARIS, a platform dedicated to delivering on comprehensive and comprehensible scientific information in support of climate policymaking. It does so by bringing the climate-economy modelling community together in a common workspace, with shared protocols, data exchange formats, and nomenclature, and by making the used and produced information accessible to and digestible by all stakeholders. To this end stakeholders, who lie at the heart of the platform, have co-designed the presentation of the platform in order to respond to pertinent questions in the climate debate co-created with stakeholders and the scientific processes together. Oriented on documenting detailed capabilities of integrated assessment models, providing access to input datasets and assumptions driving them, and offering ad hoc visualisation and databases of their outputs, I^{2}AM PARIS emphasises transparency, reproducibility, inclusivity, plurality, and comprehensibility.

Keywords: Integrated assessment models, open science, climate-economy modelling, Climate policy

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Synergies with: N/A

Citation (APA): Nikas, A., Skalidakis, S., Sorman, A. H., Galende-Sanchez, E., Koasidis, K., Serepas, F., … & Doukas, H. (2021, July). Integrating integrated assessment modelling in support of the Paris Agreement: The I2AM PARIS platform. In *2021 12th International Conference on Information, Intelligence, Systems & Applications (IISA)* (pp. 1-8). IEEE.

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Integrating Integrated Assessment Modelling in Support of the Paris Agreement: The I2AM PARIS Platform

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Abstract

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II. High Level Platform Architecture

III. I2 AM PARIS Platform Services

IV. Conclusions

Authors

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References

Abstract:

Calls "to do science differently" and democratise the research process have proliferated in the last decades, especially in the context of climate science and policy support. This new arena demands more participatory procedures to expand the knowledge-making beyond researchers and experts. One way that science has started to interact with society has been the increasing number of online platforms that have emerged as alternative forums, providing the opportunity for engaging a variety of tools, models, results, and preferences. This study presents I^2 AM PARIS, a platform dedicated to delivering on comprehensive and comprehensible scientific information in support of climate policymaking. It does so by bringing the climate-economy modelling community together in a common workspace, with shared protocols, data exchange formats, and nomenclature, and by making the used and produced information accessible to and digestible by all stakeholders. To this end stakeholders, who lie at the heart of the platform, have co-designed the presentation of the platform in order to respond to pertinent questions in the climate debate co-created with stakeholders and the scientific processes together. Oriented on documenting detailed capabilities of integrated assessment models, providing access to input datasets and assumptions driving them, and offering ad hoc visualisation and databases of their outputs, I^2 AM PARIS emphasises transparency, reproducibility, inclusivity, plurality, and comprehensibility.

Figure 44: Preview of Integrating Integrated Assessment Modelling in Support of the Paris Agreement: The I2AM PARIS

2.45 Breed et al. (2021), Energy Policy

Title: CO_2 fleet regulation and the future market diffusion of zero-emission trucks in Europe

Authors: Annelis K. Breed, Daniel Speth, Patrick Plötz (ISI Fraunhofer)

Journal: Energy Policy

Abstract: Fuel economy regulation is a powerful instrument to reduce CO_2 emissions of vehicles and has recently been extended to heavy-duty vehicles. In Europe, truck manufacturers are required to reduce the CO_2 emissions of newly sold vehicles by 30% until 2030 compared to 2019/2020. Accordingly, several manufacturers have announced the introduction of zero emission vehicles (ZEVs) such as battery electric or fuel cell trucks. However, the sales shares of zero emission trucks to meet the targets have not been analyzed in the literature yet. Here, we derive sales share scenarios for zero emission trucks in Europe based on emissions reduction options and their associated costs. We find that manufacturers will require at least 4–22% of their newly sold heavy-duty vehicles to be zero emission in 2030, depending on their strategy to improve their diesel trucks. This implies a stock share of 2–11% for ZEV trucks in Europe in 2030. Yet, high sales shares for ZEVs and the super credits granted by the regulation allow manufacturers to meet their target with little CO_2 reduction in the conventional fleet leading to low actual emission reduction.

Keywords: Electric truck, Zero emission vehicle, CO_2 fleet regulation, Climate policy

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First Online: October 8, 2021

Repository: Zenodo (Link: https://zenodo.org/record/5636800#.YzQ0sHZByUk)

Synergies with: eWayBW (grant number 16EM3167-1) and BOLD (grant number 16EM4011-1), funded by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety.

Citation (APA):   Breed, A. K., Speth, D., & Plötz, P. (2021). CO2 fleet regulation and the future market diffusion of zero-emission trucks in Europe. *Energy Policy*, *159*, 112640.

CO$_2$ fleet regulation and the future market diffusion of zero-emission trucks in Europe

Annelis K. Breed [a, b], Daniel Speth [b], Patrick Plötz [b]

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Highlights

- We analyze the impact of truck CO2 regulation on zero emission truck sales.

- We use disaggregated sales data for regulated truck size classes in Europe.

- We summarize CO2 reduction cost potential estimates for trucks.

- Three scenarios capture the uncertainty of OEM strategies.

- We obtain 4–22% zero emission trucks in sales and 2–11% in stock in 2030.

Figure 45: Preview of CO₂ fleet regulation and the future market diffusion of zero-emission trucks in Europe

2.46 Mohan et al. (2021), One Earth

Title:	UNFCCC must confront the political economy of net-negative emissions
Authors:	Aniruddh Mohan, Oliver Geden, Mathias Fridahl, Holly Jean Buck, Glen P. Peters (CICERO)
Journal:	One Earth
Abstract:	Recent demands by developing countries, like India, that developed countries need to reach net-negative emissions, must be negotiated seriously under the UNFCCC. Failure to acknowledge that limiting global average temperature rise to 1.5°C leaves very little carbon budget for equitable redistribution risks further ambiguity on how to achieve the Paris Agreement's goals.
Keywords:	UNFCCC, net zero emissions, net negative emissions, negative emissions, political economy, developing countries
DOI:	https://doi.org/10.1016/j.oneear.2021.10.001
Open Access:	Green (embargoed until October 13, 2023)
First Online:	October 13, 2021
Repository:	Zenodo (Link: https://zenodo.org/record/5704937#.Y1fOlHZByUk)
Synergies with:	N/A
Citation (APA):	Mohan, A., Geden, O., Fridahl, M., Buck, H. J., & Peters, G. P. (2021). UNFCCC must confront the political economy of net-negative emissions. *One Earth*, *4*(10), 1348-1351.

One Earth

Commentary

UNFCCC must confront the political economy of net-negative emissions

Aniruddh Mohan [1] ✉, Oliver Geden [2], Mathias Fridahl [3], Holly Jean Buck [4], Glen P. Peters [5]

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Recent demands by developing countries, like India, that developed countries need to reach net-negative emissions, must be negotiated seriously under the UNFCCC. Failure to acknowledge that limiting global average temperature rise to 1.5°C leaves very little carbon budget for equitable redistribution risks further ambiguity on how to achieve the Paris Agreement's goals.

Figure 46: Preview of UNFCCC must confront the political economy of net-negative emissions

2.47 Grant et al. (2021), Joule

Title:	The policy implications of an uncertain carbon dioxide removal potential
Authors:	Neil Grant (Imperial), Adam Hawkes (Imperial), Shivika Mittal (Imperial), Ajay Gambhir (Imperial)
Journal:	Joule

Abstract: Many low-carbon scenarios rely on carbon dioxide removal (CDR) to meet decarbonization goals. The feasibility of large-scale CDR deployment is highly uncertain, and existing scenarios have been criticized for overreliance on CDR. We conduct an expert survey on the feasible potential for CDR via bioenergy with carbon capture and storage, direct air capture and afforestation. We use the survey results to represent uncertainty in future CDR availability and explore the implications in an integrated assessment model. Stochastic optimization demonstrates that uncertainty in future CDR availability provides a strong rationale to increase near-term rates of decarbonization. In scenarios with high CDR uncertainty, emissions are reduced by an additional 10 $GtCO_2e$ in 2030 compared with scenarios with no consideration of CDR uncertainty. This highlights the urgent need to increase ambition contained in nationally determined contributions (NDCs) for 2030, to get the world on track to deliver 1.5°C and to hedge against an uncertain future CDR potential.

Keywords:	carbon dioxide removal, NETsfeasibility, low-carbon scenarios, expert survey, uncertainty, NDCs ,afforestation, BECCS, DACCS
DOI:	https://doi.org/10.1016/j.joule.2021.09.004
Open Access:	Green (embargoed until October 20, 2023)
First Online:	October 20, 2021
Repository:	Zenodo (Link: https://zenodo.org/record/5704937#.YzQ2SXZByUk)
Synergies with:	N/A
Citation (APA):	Grant, N., Hawkes, A., Mittal, S., & Gambhir, A. (2021). The policy implications of an uncertain carbon dioxide removal potential. *Joule*, *5*(10), 2593-2605.

Joule

Report

The policy implications of an uncertain carbon dioxide removal potential

Neil Grant [1,3] ✉, Adam Hawkes [2], Shivika Mittal [1], Ajay Gambhir [1]

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Referred to by   Danny Broberg, Caroline Normile, Addison K. Stark

Uncertainty drives carbon ambition, even as deployment potential still at some remove

Chem, Volume 7, Issue 11, 11 November 2021, Pages 2854-2856

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Highlights

- Experts are surveyed on the feasible CDR potential from BECCS, DACCS, and afforestation

- Results highlight a potentially large but highly uncertain CDR potential

- Uncertainty in future CDR potential drives greater climate action in the 2020s

- High uncertainty in CDR leads to an extra 10 $GtCO_2e$ of emissions reductions by 2030

Figure 47: Preview of The policy implications of an uncertain carbon dioxide removal potential

2.48 Köberle et al. (2021), Nature Climate Change

Title:	The cost of mitigation revisited
Authors:	Alexandre C. Köberle (Imperial), Toon Vandyck, Celine Guivarch, Nick Macaluso, Valentina Bosetti, Ajay Gambhir (Imperial), Massimo Tavoni, Joeri Rogelj
Journal:	Nature Climate Change
Abstract:	Estimates of economic implications of climate policy are important inputs into policy-making. Despite care to contextualize quantitative assessments of mitigation costs, one strong view outside academic climate economics is that achieving Paris Agreement goals implies sizable macroeconomic losses. Here, we argue that this notion results from unwarranted simplification or omission of the complexities of quantifying mitigation costs, which generates ambiguity in communication and interpretation. We synthesize key factors influencing mitigation cost estimates to guide interpretation of estimates, for example from the Intergovernmental Panel on Climate Change, and suggest ways to improve the underlying models. We propose alternatives for the scenario design framework, the framing of mitigation costs and the methods used to derive them, to better inform public debate and policy.
Keywords:	Climate change mitigation, costs, IAMs
DOI:	https://doi.org/10.1038/s41558-021-01203-6
Open Access:	Golden
First Online:	November 11, 2021
Repository:	Zenodo (link: https://zenodo.org/record/5713899#.YzRFHXZByUk)
Synergies with:	H2020 NAVIGATE (GA: 821124), H2020 ENGAGE (GA: 821471)
Citation (APA):	Köberle, A. C., Vandyck, T., Guivarch, C., Macaluso, N., Bosetti, V., Gambhir, A., ... & Rogelj, J. (2021). The cost of mitigation revisited. *Nature Climate Change*, *11*(12), 1035-1045.

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Perspective | Published: 11 November 2021

The cost of mitigation revisited

Alexandre C. Köberle ✉, Toon Vandyck, Celine Guivarch, Nick Macaluso, Valentina Bosetti, Ajay Gambhir, Massimo Tavoni & Joeri Rogelj

12k Accesses | **4** Citations | **293** Altmetric | Metrics

ℹ️ A Publisher Correction to this article was published on 29 November 2021

ℹ️ This article has been updated

Abstract

Estimates of economic implications of climate policy are important inputs into policy-making. Despite care to contextualize quantitative assessments of mitigation costs, one strong view outside academic climate economics is that achieving Paris Agreement goals implies sizable macroeconomic losses. Here, we argue that this notion results from unwarranted simplification or omission of the complexities of quantifying mitigation costs, which generates ambiguity in communication and interpretation. We synthesize key factors influencing mitigation cost estimates to guide interpretation of estimates, for example from the Intergovernmental Panel on Climate Change, and suggest ways to improve the underlying models. We propose alternatives for the scenario design framework, the framing of mitigation costs and the methods used to derive them, to better inform public debate and policy.

Figure 48: Preview of The cost of mitigation revisited

2.49 Grant et al. (2021), One Earth

Title:	Cost reductions in renewables can substantially erode the value of carbon capture and storage in mitigation pathways
Authors:	Neil Grant (Imperial), Adam Hawkes (Imperial), Tamaryn Napp, Ajay Gambhir (Imperial)
Journal:	One Earth
Abstract:	Tackling climate change requires a rapid transition to net-zero energy systems. A variety of different technologies could contribute to this transition, and uncertainty remains over their relative role and value. A growing school of thought argues that rapid cost reductions in renewables reduce the need for carbon capture and storage (CCS) in mitigation pathways. Here we use an integrated assessment model to explore how the value of CCS is affected by cost reductions in solar photovoltaics, onshore, and offshore wind. Low-cost renewables could erode the value of CCS by 15%–96% across different energy sectors. Renewables directly compete with CCS, accelerate power sector decarbonization, and enable greater electrification of end-use sectors. CCS has greatest value and resilience to low-cost renewables in sustainable bioenergy/industrial applications, with limited value in hydrogen/electricity generation. This suggests that targeted, rather than blanket, CCS deployment represents the best strategy for achieving the Paris Agreement goals.
Keywords:	Renewables, CCS, wind, solar, low-carbon scenarios, climate change, mitigation, technology value, IAMs, CDR
DOI:	https://doi.org/10.1016/j.oneear.2021.10.024
Open Access:	Green (embargoed until November 19, 2022)
First Online:	November 19, 2021
Repository:	Zenodo (link: https://zenodo.org/record/5714518#.YzRICnZByUk)
Synergies with:	N/A
Citation (APA):	Grant, N., Hawkes, A., Napp, T., & Gambhir, A. (2021). Cost reductions in renewables can substantially erode the value of carbon capture and storage in mitigation pathways. *One Earth*, *4*(11), 1588-1601.

One Earth

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Article

Cost reductions in renewables can substantially erode the value of carbon capture and storage in mitigation pathways

Neil Grant [1, 3] 🗙 ✉, Adam Hawkes [2], Tamaryn Napp [1], Ajay Gambhir [1]

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Highlights

- Cost reductions in wind/solar reduce the value of CCS by 15%–96%

- Renewables directly compete with CCS in electricity/hydrogen production

- Low-cost renewables enable rapid power sector decarbonization and electrification

- Using low discount rates reduces the value of CCS by up to two-thirds

Figure 49: Preview of Cost reductions in renewables can substantially erode the value of carbon capture and storage in mitigation pathways

2.50 Sognnaes et al. (2021), Nature Climate Change

Title:	A multi-model analysis of long-term emissions and warming implications of current mitigation efforts
Authors:	Ida Sognnaes (CICERO), Ajay Gambhir (Imperial), Dirk-Jan Van de Ven (BC3), Alexandros Nikas (NTUA), Annela Anger-Kraavi (Cambridge), Ha Bui, Lorenza Campagnolo (CMCC), Elisa Delpiazzo (CMCC), Haris Doukas (NTUA), Sara Giarola (Imperial), Neil Grant (Imperial), Adam Hawkes (Imperial), Alexandre C. Koberle (Imperial), Andrey Kolpakov, Shivika Mittal (Imperial), Jorge Moreno (BC3), Sigit Perdana (EPFL), Joeri Rogelj, Marc Vielle (EPFL), Glen P. Peters (CICERO)
Journal:	Nature Climate Change
Abstract:	Most of the integrated assessment modelling literature focuses on cost-effective pathways towards given temperature goals. Conversely, using seven diverse integrated assessment models, we project global energy CO_2 emissions trajectories on the basis of near-term mitigation efforts and two assumptions on how these efforts continue post-2030. Despite finding a wide range of emissions by 2050, nearly all the scenarios have median warming of less than 3 °C in 2100. However, the most optimistic scenario is still insufficient to limit global warming to 2 °C. We furthermore highlight key modelling choices inherent to projecting where emissions are headed. First, emissions are more sensitive to the choice of integrated assessment model than to the assumed mitigation effort, highlighting the importance of heterogeneous model intercomparisons. Differences across models reflect diversity in baseline assumptions and impacts of near-term mitigation efforts. Second, the common practice of using economy-wide carbon prices to represent policy exaggerates carbon capture and storage use compared with explicitly modelling policies.
Keywords:	Climate change, mitigation, IAMs, emissions, warming
DOI:	https://doi.org/10.1038/s41558-021-01206-3
Open Access:	Green (available in Zenodo)
First Online:	November 22, 2021
Repository:	Zenodo (link: https://zenodo.org/record/5727089#.YzRQjXZByUk)
Synergies with:	N/A
Citation (APA):	Sognnaes, I., Gambhir, A., van de Ven, D. J., Nikas, A., Anger-Kraavi, A., Bui, H., ... & Peters, G. P. (2021). A multi-model analysis of long-term emissions and warming implications of current mitigation efforts. *Nature Climate Change*, *11*(12), 1055-1062.

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Article | Published: 22 November 2021

A multi-model analysis of long-term emissions and warming implications of current mitigation efforts

Ida Sognnaes ✉, Ajay Gambhir, Dirk-Jan van de Ven, Alexandros Nikas, Annela Anger-Kraavi, Ha Bui, Lorenza Campagnolo, Elisa Delpiazzo, Haris Doukas, Sara Giarola, Neil Grant, Adam Hawkes, Alexandre C. Köberle, Andrey Kolpakov, Shivika Mittal, Jorge Moreno, Sigit Perdana, Joeri Rogelj, Marc Vielle & Glen P. Peters

> ⓘ This article has been updated

Abstract

Most of the integrated assessment modelling literature focuses on cost-effective pathways towards given temperature goals. Conversely, using seven diverse integrated assessment models, we project global energy CO_2 emissions trajectories on the basis of near-term mitigation efforts and two assumptions on how these efforts continue post-2030. Despite finding a wide range of emissions by 2050, nearly all the scenarios have median warming of less than 3 °C in 2100. However, the most optimistic scenario is still insufficient to limit global warming to 2 °C. We furthermore highlight key modelling choices inherent to projecting where emissions are headed. First, emissions are more sensitive to the choice of integrated assessment model than to the assumed mitigation effort, highlighting the importance of heterogeneous model intercomparisons. Differences across models reflect diversity in baseline assumptions and impacts of near-term mitigation efforts. Second, the common practice of using economy-wide carbon prices to represent policy exaggerates carbon capture and storage use compared with explicitly modelling policies.

Figure 50: Preview of A multi-model analysis of long-term emissions and warming implications of current mitigation efforts

2.51 Song et al. (2021), Nature Communications

Title:	Production of hydrogen from offshore wind in China and cost-competitive supply to Japan
Authors:	Shaojie Song, Haiyang Lin, Peter Sherman, Xi Yang (CUP), Chris P. Nielsen, Xinyu Chen, Michael B. McElroy
Journal:	Nature Communications
Abstract:	The Japanese government has announced a commitment to net-zero greenhouse gas emissions by 2050. It envisages an important role for hydrogen in the nation's future energy economy. This paper explores the possibility that a significant source for this hydrogen could be produced by electrolysis fueled by power generated from offshore wind in China. Hydrogen could be delivered to Japan either as liquid, or bound to a chemical carrier such as toluene, or as a component of ammonia. The paper presents an analysis of factors determining the ultimate cost for this hydrogen, including expenses for production, storage, conversion, transport, and treatment at the destination. It concludes that the Chinese source could be delivered at a volume and cost consistent with Japan's idealized future projections.
Keywords:	Hydrogen, offshore wind, wind, China, Japan
DOI:	https://doi.org/10.1038/s41467-021-27214-7
Open Access:	Golden
First Online:	November 29, 2021
Repository:	Zenodo (Link: https://zenodo.org/record/7271669#.Y2FK1XZByUk)
Synergies with:	N/A
Citation (APA):	Song, S., Lin, H., Sherman, P., Yang, X., Nielsen, C. P., Chen, X., & McElroy, M. B. (2021). Production of hydrogen from offshore wind in China and cost-competitive supply to Japan. *Nature communications*, *12*(1), 1-8.

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Article | Open Access | Published: 29 November 2021

Production of hydrogen from offshore wind in China and cost-competitive supply to Japan

Shaojie Song, Haiyang Lin ✉, Peter Sherman, Xi Yang, Chris P. Nielsen, Xinyu Chen & Michael B. McElroy ✉

Abstract

The Japanese government has announced a commitment to net-zero greenhouse gas emissions by 2050. It envisages an important role for hydrogen in the nation's future energy economy. This paper explores the possibility that a significant source for this hydrogen could be produced by electrolysis fueled by power generated from offshore wind in China. Hydrogen could be delivered to Japan either as liquid, or bound to a chemical carrier such as toluene, or as a component of ammonia. The paper presents an analysis of factors determining the ultimate cost for this hydrogen, including expenses for production, storage, conversion, transport, and treatment at the destination. It concludes that the Chinese source could be delivered at a volume and cost consistent with Japan's idealized future projections.

Figure 51: Preview of Production of hydrogen from offshore wind in China and cost-competitive supply to Japan

2.52 Cain et al. (2022), Philosophical Transactions of the Royal Society

Title: Methane and the Paris Agreement temperature goals

Authors: Michelle Cain, Stuart Jenkins, Myles R. Allen, John Lynch, David J. Frame, Adrian H. Macey and Glen P. Peters (CICERO)

Journal: Philosophical Transactions of the Royal Society

Abstract: Meeting the Paris Agreement temperature goal necessitates limiting methane (CH_4)-induced warming, in addition to achieving net-zero or (net-negative) carbon dioxide (CO_2) emissions. In our model, for the median 1.5°C scenario between 2020 and 2050, CH_4 mitigation lowers temperatures by 0.1°C; CO_2 increases it by 0.2°C. CO_2 emissions continue increasing global mean temperature until net-zero emissions are reached, with potential for lowering temperatures with net-negative emissions. By contrast, reducing CH_4 emissions starts to reverse CH_4-induced warming within a few decades. These differences are hidden when framing climate mitigation using annual 'CO_2-equivalent' emissions, including targets based on aggregated annual emission rates. We show how the different warming responses to CO2 and CH_4 emissions can be accurately aggregated to estimate warming by using 'warming-equivalent emissions', which provide a transparent and convenient method to inform policies and measures for mitigation, or demonstrate progress towards a temperature goal. The method presented (GWP*) uses well-established climate science concepts to relate GWP100 to temperature, as a simple proxy for a climate model. The use of warming-equivalent emissions for nationally determined contributions and long-term strategies would enhance the transparency of stocktakes of progress towards a long-term temperature goal, compared to the use of standard equivalence methods.

This article is part of a discussion meeting issue 'Rising methane: is warming feeding warming? (part 2)'.

Keywords: Paris Agreement, methane, temperature, emissions

DOI: https://doi.org/10.1098/rsta.2020.0456

Open Access: Golden

First Online: December 6, 2021

Repository: Zenodo (link: https://zenodo.org/record/7197610#.Y1fPw3ZByUk)

Synergies with: H2020 4C (GA: 821003), H2020 FoRCES (GA: 821205)

Citation (APA): Cain, M., Jenkins, S., Allen, M. R., Lynch, J., Frame, D. J., Macey, A. H., & Peters, G. P. (2022). Methane and the Paris Agreement temperature goals. *Philosophical Transactions of the Royal Society A*, *380*(2215), 20200456.

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Section

Abstract

1. Introduction

2. Methods

3. Results

4. Progress towards the Paris temperature goal

5. Discussion

6. Conclusion

Data accessibility

Authors' contributions

Competing interests

Funding

Research articles

Methane and the Paris Agreement temperature goals

Michelle Cain ✉, Stuart Jenkins, Myles R. Allen, John Lynch, David J. Frame, Adrian H. Macey and Glen P. Peters

Abstract

Meeting the Paris Agreement temperature goal necessitates limiting methane (CH_4)-induced warming, in addition to achieving net-zero or (net-negative) carbon dioxide (CO_2) emissions. In our model, for the median 1.5°C scenario between 2020 and 2050, CH_4 mitigation lowers temperatures by 0.1°C; CO_2 increases it by 0.2°C. CO_2 emissions continue increasing global mean temperature until net-zero emissions are reached, with potential for lowering temperatures with net-negative emissions. By contrast, reducing CH_4 emissions starts to reverse CH_4-induced warming within a few decades. These differences are hidden when framing climate mitigation using annual 'CO_2-equivalent' emissions, including targets based on aggregated annual emission rates. We show how the different warming responses to CO_2 and CH_4 emissions can be accurately aggregated to estimate warming by using 'warming-equivalent emissions', which provide a transparent and convenient method to inform policies and measures for mitigation, or demonstrate progress towards a temperature goal. The method presented (GWP*) uses well-established climate science concepts to relate GWP100 to temperature, as a simple proxy for a climate model. The use of warming-equivalent emissions for nationally determined contributions and long-term strategies would enhance the transparency of stocktakes of progress towards a long-term temperature goal, compared to the use of standard equivalence methods.

This article is part of a discussion meeting issue 'Rising methane: is warming feeding warming? (part 2)'.

Figure 52: Preview of Methane and the Paris Agreement temperature goals

2.53 Nikas et al. (2022), Sustainable Production and Consumption

Title: Coupling circularity performance and climate action: from disciplinary silos to transdisciplinary modelling science

Authors: Alexandros Nikas (NTUA), Georgios Xexakis (Holistic), Konstantinos Koasidis (NTUA), José Acosta-Fernández, Iñaki Arto (BC3), Alvaro Calzadilla, Teresa Domenech, Ajay Gambhir (Imperial), Stefan Giljum, Mikel Gonzalez-Eguino (BC3), Andrea Herbst (ISI Fraunhofer), Olga Ivanova, Mariësse A. E. van Sluisvel, Dirk-Jan Van De Ven (BC3), Anastasios Karamaneas (NTUA), Haris Doukas (NTUA)

Journal: Sustainable Production and Consumption

Abstract: Technological breakthroughs and policy measures targeting energy efficiency and clean energy alone will not suffice to deliver Paris Agreement-compliant greenhouse gas emissions trajectories in the next decades. Strong cases have recently been made for acknowledging the decarbonisation potential lying in transforming linear economic models into closed-loop industrial ecosystems and in shifting lifestyle patterns towards this direction. This perspective highlights the research capacity needed to inform on the role and potential of the circular economy for climate change mitigation and to enhance the scientific capabilities to quantitatively explore their synergies and trade-offs. This begins with establishing conceptual and methodological bridges amongst the relevant and currently fragmented research communities, thereby allowing an interdisciplinary integration and assessment of circularity, decarbonisation, and sustainable development. Following similar calls for science in support of climate action, a transdisciplinary scientific agenda is needed to co-create the goals and scientific processes underpinning the transition pathways towards a circular, net-zero economy with representatives from policy, industry, and civil society. Here, it is argued that such integration of disciplines, methods, and communities can then lead to new and/or structurally enhanced quantitative systems models that better represent critical industrial value chains, consumption patterns, and mitigation technologies. This will be a crucial advancement towards assessing the material implications of, and the contribution of enhanced circularity performance to, mitigation pathways that are compatible with the temperature goals of the Paris Agreement and the transition to a circular economy.

Keywords: Circular economy, Decarbonization, Mitigation, Climate-economy modelling, Transdisciplinary science, Integrated assessment modelling

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Citation (APA): Nikas, A., Xexakis, G., Koasidis, K., Acosta-Fernández, J., Arto, I., Calzadilla, A., ... & Doukas, H. (2022). Coupling circularity performance and climate action: From disciplinary silos to transdisciplinary modelling science. *Sustainable Production and Consumption*, *30*, 269-277.

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Research article

Coupling circularity performance and climate action: From disciplinary silos to transdisciplinary modelling science

Alexandros Nikas [a] ✉, Georgios Xexakis [b], Konstantinos Koasidis [a], José Acosta-Fernández [c], Iñaki Arto [d], Alvaro Calzadilla [e], Teresa Domenech [e], Ajay Gambhir [f], Stefan Giljum [g], Mikel Gonzalez-Eguino [d, h], Andrea Herbst [i], Olga Ivanova [j], Mariësse A. E. van Sluisveld [j], Dirk-Jan Van De Ven [d], Anastasios Karamaneas [a], Haris Doukas [a]

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Abstract

Technological breakthroughs and policy measures targeting energy efficiency and clean energy alone will not suffice to deliver Paris Agreement-compliant greenhouse gas emissions trajectories in the next decades. Strong cases have recently been made for acknowledging the decarbonisation potential lying in transforming linear economic models into closed-loop industrial ecosystems and in shifting lifestyle patterns towards this direction. This perspective highlights the research capacity needed to inform on the role and potential of the circular economy for climate change mitigation and to enhance the scientific capabilities to quantitatively explore their synergies and trade-offs. This begins with establishing conceptual and methodological bridges amongst the relevant and currently fragmented research communities, thereby allowing an interdisciplinary integration and assessment of circularity, decarbonisation, and sustainable development. Following similar calls for science in support of climate action, a transdisciplinary scientific agenda is

Figure 53: Preview of Coupling circularity performance and climate action: From disciplinary silos to transdisciplinary modelling science

2.54 Gambhir et al. (2022), Nature Climate Change

Title:	Near-term transition and longer-term physical climate risks of greenhouse gas emissions pathways
Authors:	Ajay Gambhir (Imperial), Mel George, Haewon McJeon, Nigel W. Arnell, Daniel Bernie, Shivika Mittal (Imperial), Alexandre C. Köberle (Imperial), Jason Lowe, Joeri Rogelj (Imperial), Seth Monteith
Journal:	Nature Climate Change

Abstract: Policy, business, finance and civil society stakeholders are increasingly looking to compare future emissions pathways across both their associated physical climate risks stemming from increasing temperatures and their transition climate risks stemming from the shift to a low-carbon economy. Here, we present an integrated framework to explore near-term (to 2030) transition risks and longer-term (to 2050) physical risks, globally and in specific regions, for a range of plausible greenhouse gas emissions and associated temperature pathways, spanning 1.5–4 °C levels of long-term warming. By 2050, physical risks deriving from major heatwaves, agricultural drought, heat stress and crop duration reductions depend greatly on the temperature pathway. By 2030, transition risks most sensitive to temperature pathways stem from economy-wide mitigation costs, carbon price increases, fossil fuel demand reductions and coal plant capacity reductions. Considering several pathways with a 2 °C target demonstrates that transition risks also depend on technological, policy and socio-economic factors.

Keywords:	Transition, climate risks, greenhouse emissions, crop yield, socio-economic analysis
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Open Access:	Green (available in Zenodo)
First Online:	December 13, 2021
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Synergies with:	N/A
Citation (APA):	Gambhir, A., George, M., McJeon, H., Arnell, N. W., Bernie, D., Mittal, S., … & Monteith, S. (2022). Near-term transition and longer-term physical climate risks of greenhouse gas emissions pathways. *Nature Climate Change*, *12*(1), 88-96.

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Analysis | Published: 13 December 2021

Near-term transition and longer-term physical climate risks of greenhouse gas emissions pathways

Ajay Gambhir ✉, Mel George, Haewon McJeon, Nigel W. Arnell, Daniel Bernie, Shivika Mittal, Alexandre C. Köberle, Jason Lowe, Joeri Rogelj & Seth Monteith

Abstract

Policy, business, finance and civil society stakeholders are increasingly looking to compare future emissions pathways across both their associated physical climate risks stemming from increasing temperatures and their transition climate risks stemming from the shift to a low-carbon economy. Here, we present an integrated framework to explore near-term (to 2030) transition risks and longer-term (to 2050) physical risks, globally and in specific regions, for a range of plausible greenhouse gas emissions and associated temperature pathways, spanning 1.5–4 °C levels of long-term warming. By 2050, physical risks deriving from major heatwaves, agricultural drought, heat stress and crop duration reductions depend greatly on the temperature pathway. By 2030, transition risks most sensitive to temperature pathways stem from economy-wide mitigation costs, carbon price increases, fossil fuel demand reductions and coal plant capacity reductions. Considering several pathways with a 2 °C target demonstrates that transition risks also depend on technological, policy and socio-economic factors.

Figure 54: Preview of Near-term transition and longer-term physical climate risks of greenhouse gas emissions pathways

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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2.55 Koasidis et al. (2022), Energy Policy

Title:	Monetising behavioural change as a policy measure to support energy management in the residential sector: A case study in Greece
Authors:	Konstantinos Koasidis (NTUA), Vangelis Marinakis (NTUA), Alexandros Nikas (NTUA), Katerina Chira (NTUA), Alexandros Flamos, Haris Doukas (NTUA)
Journal:	Energy Policy
Abstract:	Energy efficiency from behavioural changes will play a key role in meeting future climate targets. Current energy management actions, however, are still dominated by conventional interventions. Furthermore, demand-side transformations based on behavioural actions are hitherto underrepresented in modelling scenarios informing climate policy. In this context, this study aims to explore whether monetisation of behavioural change should be considered as a policy measure to support energy management in the residential sector. To address this question, ATOM, an energy efficiency reward mechanism based on a digital energy currency, is linked with the Dynamic high-Resolution dEmand-sidE Management model, a bottom-up agent-based model designed to simulate buildings' energy consumption. A case study in the Greek residential sector, implementing an energy management action associated with manual adjustments of a thermostat, showcases potential for achieving a nation-wide and household-level energy reduction of 5.3% and 10% respectively, with monetisation providing an additional €200 to each engaged household on average. We highlight that monetisation of behavioural change should be considered as a promising policy, since the reward provides an adequate incentive for end-users to actively reduce consumption, and its implementation enables the quantification of behavioural change in monetary units, rendering social aspects easier to integrate in models.
Keywords:	Behavioural change, Energy management, Energy efficiency, Digital energy currency, Monetisation, Climate policy
DOI:	https://doi.org/10.1016/j.enpol.2021.112759
Open Access:	Golden
First Online:	December 17. 2021
Repository:	Zenodo (link: https://zenodo.org/record/7197922#.Y1fbEXZByUk)
Synergies with:	HFRI ATOM (GA: HFRI-FM17–2566)
Citation (APA):	Koasidis, K., Marinakis, V., Nikas, A., Chira, K., Flamos, A., & Doukas, H. (2022). Monetising behavioural change as a policy measure to support energy management in the residential sector: A case study in Greece. *Energy Policy*, *161*, 112759.

Monetising behavioural change as a policy measure to support energy management in the residential sector: A case study in Greece

Konstantinos Koasidis [a] ☒, Vangelis Marinakis [a], Alexandros Nikas [a], Katerina Chira [a], Alexandros Flamos [b], Haris Doukas [a]

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Highlights

- We examine behavioural change monetisation as a policy to support energy management.

- A digital energy currency is linked to a bottom-up model for the residential sector.

- In Greece, moderate engagement can yield 5.3/10% national/household energy savings.

- Monetisation is found rewarding to households engaged in reducing their consumption.

- It also allows the quantification of behavioural social aspects in monetary units.

Figure 55: Preview of Monetising behavioural change as a policy measure to support energy management in the residential sector: A case study in Greece

2.56 Nikas et al. (2022), Renewable & Sustainable Energy Reviews

Title:	A comparative study of biodiesel in Brazil and Argentina: An integrated systems of innovation perspective
Authors:	Alexandros Nikas (NTUA), Konstantinos Koasidis (NTUA), Alexandre C. Koberle (Imperial), Georgia Kourtesi, Haris Doukas (NTUA)
Journal:	Renewable & Sustainable Energy Reviews

Abstract: Transport is among the sectors highly dependent on fossil fuels, relying almost exclusively on petroleum products. Biofuels have been suggested as a technology contributing to the sector's decarbonisation, especially in sub-sectors where upscaling electrification innovation is challenging. Brazil and Argentina have long been top biofuel producers. This research employs an integrated innovation systems framework to study the historical evolution of the dominant regime in the two countries' transportation and the recent emergence of the biodiesel technological system to provide insights and policy implications for future trajectories and decarbonisation strategies. Our analysis highlights that landscape pressures have provided windows of opportunity for technological change, with Brazil following a more sustainable pathway based on ethanol as an alternative fuel, which allowed the country to later build on cumulative knowledge and lessons transferred from the passenger vehicle sector to freight, while Argentina has locked-into a natural gas-based innovation path. It also discusses that, with the recent expansion of the biodiesel industry, a key challenge for Brazil lies in keeping up the pace and unlocking the potential after reaching the 10% mandate amid concerns over food security and the lack of diversified feedstock, and for Argentina in balancing its biodiesel exports and domestic consumption.

Keywords:	Brazil, Argentina, Transport, Biodiesel, Multi-level perspective, Technological innovation systems
DOI:	https://doi.org/10.1016/j.rser.2021.112022
Open Access:	Golden
First Online:	December 27, 2021
Repository:	Zenodo (link: https://zenodo.org/record/7198054#.Y1fbVXZByUk)
Synergies with:	N/A
Citation (APA):	Nikas, A., Koasidis, K., Köberle, A. C., Kourtesi, G., & Doukas, H. (2022). A comparative study of biodiesel in Brazil and Argentina: An integrated systems of innovation perspective. *Renewable and Sustainable Energy Reviews*, *156*, 112022.

A comparative study of biodiesel in Brazil and Argentina: An integrated systems of innovation perspective

A. Nikas [a] ☒, K. Koasidis [a], A.C. Köberle [b], G. Kourtesi [c], H. Doukas [a]

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Highlights

- An integrated Systems of Innovation framework is applied to Brazil and Argentina.

- Transport is analysed from a multi-level perspective, then biodiesel from a TIS lens.

- Brazil's innovation was driven by ethanol and biodiesel; Argentina's locked into gas.

- A key challenge for Argentina lies in balancing biodiesel exports and domestic use.

- Brazil must instead focus on unlocking the potential after reaching the 10% mandate.

Figure 56: Preview of A comparative study of biodiesel in Brazil and Argentina: An integrated systems of innovation perspective

2.57 Koasidis et al. (2022), Multiple Criteria Decision Making for Sustainable Development

Title:	Towards Sustainable Development and Climate Co-governance: A Multicriteria Stakeholders' Perspective
Authors:	Konstantinos Koasidis (NTUA), Anastasios Karamaneas (NTUA), Eleni Kanellou (NTUA), Hera Neofytou (NTUA), Alexandros Nikas (NTUA), Haris Doukas (NTUA)
Journal:	Multiple Criteria Decision Making for Sustainable Development
Abstract:	Although 2015 featured the adoption of the 2030 Agenda for Sustainable Development, broken down into 17 sustainable development goals (SDGs), the year is mostly remembered for the global climate targets of the Paris Agreement. Seemingly two separate agendas, sustainable development and climate action are highly intertwined: the former is an explicit part of the Paris Agreement, while the latter constitutes one of the 17 goals. And they both emphasise the need to consider the interests and views of the broad societal range in the decision-making process, in an inclusive dialogue. This study uses a multi-criteria group decision analysis framework, based on the TOPSIS method and the 2-tuple linguistic representation model, to capture European climate stakeholders' perceptions of the urgency to integrate other SDGs in scientific support of climate policy design that is based on climate- and energy-economy modelling. We find that stakeholders prioritise sustainability aspects related to biodiversity and ecosystems as well as responsible resource use and social equalities, as targets to integrate in modelling exercises for climate change and policy. Based on a novel consensus measuring approach, we also find high consensus overall, with national policymakers however displaying assessments concentrated in the lower end of the importance scale.
Keywords:	Sustainable development goals, Multi-criteria decision aid, Climate co-governance, Climate policy, TOPSIS, 2-tuples
DOI:	https://doi.org/10.1007/978-3-030-89277-7_3
Open Access:	Green (embargoed until January 1, 2024)
First Online:	January 1, 2022
Repository:	Zenodo (link: https://zenodo.org/record/7229795#.Y1fbnHZByUk)
Synergies with:	N/A
Citation (APA):	Koasidis, K., Karamaneas, A., Kanellou, E., Neofytou, H., Nikas, A., & Doukas, H. (2021). Towards Sustainable Development and Climate Co-governance: A Multicriteria Stakeholders' Perspective. In *Multiple Criteria Decision Making for Sustainable Development* (pp. 39-74). Springer, Cham.

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Multiple Criteria Decision Making for Sustainable Development pp 39–74 | Cite as

Towards Sustainable Development and Climate Co-governance: A Multicriteria Stakeholders' Perspective

Konstantinos Koasidis, Anastasios Karamaneas, Eleni Kanellou, Hera Neofytou, Alexandros Nikas ✉ & Haris Doukas

Abstract

Although 2015 featured the adoption of the 2030 Agenda for Sustainable Development, broken down into 17 sustainable development goals (SDGs), the year is mostly remembered for the global climate targets of the Paris Agreement. Seemingly two separate agendas, sustainable development and climate action are highly intertwined: the former is an explicit part of the Paris Agreement, while the latter constitutes one of the 17 goals. And they both emphasise the need to consider the interests and views of the broad societal range in the decision-making process, in an inclusive dialogue. This study uses a multi-criteria group decision analysis framework, based on the TOPSIS method and the 2-tuple linguistic representation model, to capture European climate stakeholders' perceptions of the urgency to integrate other SDGs in scientific support of climate policy design that is based on climate- and energy-economy modelling. We find that stakeholders prioritise sustainability aspects related to biodiversity and ecosystems as well as responsible resource use and social equalities, as targets to integrate in modelling exercises for climate change and policy. Based on a novel consensus measuring approach, we also find high consensus overall, with national policymakers however displaying assessments concentrated in the lower end of the importance scale.

Figure 57: Towards Sustainable Development and Climate Co-governance: A Multicriteria Stakeholders' Perspective

2.58 Wilgosh et al. (2022), Futures

Title:	When two movements collide: Learning from labour and environmental struggles for future Just Transitions
Authors:	Becca Wilgosh, Alevgul H. Sorman (BC3), Iñaki Barcena
Journal:	Futures

Abstract: The term 'Just Transition' (JT) emerged from the 1970s North American labour movement to become a campaign for a planned energy transition that includes justice and fairness for workers. There is diversity in the JT narratives and ambitions that different actors put forward regarding its aims and strategies. This article critically reviews academic and grey literature on the JT in the Global North and South Africa to examine how labour, advocacy, private sector, and governmental actors frame and formulate the JT, and how narrative patterns across actors can signal transformative justice. Highlighting the JT's origins, we fill a gap in transition literature by reintroducing the labour perspective into an analysis of affirmative and transformative justice, and propose an original theoretical framework that unites scholarship in environmental and labour studies. JT proposals are examined through an analysis of the actors, approaches, and tensions across five key themes: depth & urgency, scale & scope, identity & inclusion, material equity, and participation & power. Finally, we synthesise trends in our findings in relation to prominent JT discourses in the literature – Green Growth, Green Keynesianism, Energy Democracy, and Green Revolution – and discuss the transformative potential of JT alliances and coalitions going into the future.

Keywords:	Just transition, Unions, Labour movement, Environmental justice, Transformation
DOI:	https://doi.org/10.1016/j.futures.2022.102903
Open Access:	Golden
First Online:	January 12, 2022
Repository:	Zenodo (link: https://zenodo.org/record/7198086#.Y1fb4XZByUk)
Synergies with:	N/A
Citation (APA):	Wilgosh, B., Sorman, A. H., & Barcena, I. (2022). When two movements collide: learning from labour and environmental struggles for future Just Transitions. *Futures, 137*.

When two movements collide: Learning from labour and environmental struggles for future Just Transitions

Becca Wilgosh [a, b, c] ⚆ ✉, Alevgul H. Sorman [c, d, e], Iñaki Barcena [a, c]

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Highlights

- The Just Transition (JT) has been shaped by labour and environmental actors.

- Private and governmental actors typically frame JT as an opportunity for growth.

- Environmental groups with transformative JT visions may lack scale or long-term strategy.

- Union approaches vary from negotiation for job creation to democratically managed public systems.

- Labour-environment coalitions can build stronger strategy toward transformative justice.

Figure 58: Preview of When two movements collide: learning from labour and environmental struggles for future Just Transitions

2.59 Plotz (2022), Nature Electronics

Title:	Hydrogen technology is unlikely to play a major role in sustainable road transport
Authors:	Patrick Plötz (ISI Fraunhofer)
Journal:	Nature Electronics
Abstract:	Technical and economic developments in battery and fast-charging technologies could soon make fuel cell electric vehicles, which run on hydrogen, superfluous in road transport.
Keywords:	Batteries, charging technologies, EVs, hydrogen
DOI:	https://doi.org/10.1038/s41928-021-00706-6
Open Access:	Green (available in Zenodo)
First Online:	January 31, 2022
Repository:	Zenodo (link: https://zenodo.org/record/7198146#.Y1fcGXZByUk)
Synergies with:	H2020 STORM (GA: 101006700), eWayBW (grant number 16EM3167-1) and BOLD (grant number 16EM4011-1), funded by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
Citation (APA):	Plötz, P. (2022). Hydrogen technology is unlikely to play a major role in sustainable road transport. *Nature Electronics*, *5*(1), 8-10.

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Hydrogen technology is unlikely to play a major role in sustainable road transport

Patrick Plötz ✉

Nature Electronics **5**, 8–10 (2022) | Cite this article

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Technical and economic developments in battery and fast-charging technologies could soon make fuel cell electric vehicles, which run on hydrogen, superfluous in road transport.

Road transport remains dominated by fossil fuels. Transport is responsible for about one-quarter of all energy-related greenhouse gas emissions and about 72% of this is due to road transport[1]. However, the emissions budgets implied by the Paris Agreement mean that transport should be climate neutral — that is, it should have net zero greenhouse gas emissions — within just a few decades[2,3,4]. Urgent action is thus needed, and stock turnover in road transport is slow[2].

Figure 59: Preview of Hydrogen technology is unlikely to play a major role in sustainable road transport

2.60 Edelenbosch et al. (2022), Iscience

Title:	Translating observed household energy behavior to agent-based technology choices in an integrated modeling framework
Authors:	Oreane.Y. Edelenbosch, Luciana Miu (Imperial), Julia Sachs (Imperial), Adam Hawkes (Imperial), Massimo Tavoni (CMCC)
Journal:	iScience
Abstract:	Decarbonizing the building sector depends on choices made at the household level, which are heterogeneous. Agent-based models are tools used to describe heterogeneous choices but require data-intensive calibration. This study analyzes a novel, cross-country European household-level survey, including sociodemographic characteristics, energy-saving habits, energy-saving investments, and metered household electricity consumption, to enhance the empirical grounding of an agent-based residential energy choice model. Applying cluster analysis to the data shows that energy consumption is not straightforwardly explained by sociodemographic classes, preferences, or attitudes, but some patterns emerge. Income consistently has the largest effect on demand, dwelling efficiency, and energy-saving investments, and the potential to improve a dwellings' energy use affects the efficiency investments made. Including the various sources of heterogeneity found to characterize the model agents affects the timing and speed of the transition. The results reinforce the need for grounding agent-based models in empirical data, to better understand energy transition dynamics.
Keywords:	Energy sustainability, Energy Resources, Energy systems
DOI:	https://doi.org/10.1016/j.isci.2022.103905
Open Access:	Golden
First Online:	February 10 ,2022
Repository:	Zenodo (link: https://zenodo.org/record/7198356#.Y1fdD3ZByUk)
Synergies with:	FP7/2007-2013 COBHAM (GA: 154336155)
Citation (APA):	Edelenbosch, O. Y., Miu, L., Sachs, J., Hawkes, A., & Tavoni, M. (2022). Translating observed household energy behavior to agent-based technology choices in an integrated modeling framework. *Iscience*, *25*(3), 103905.

Article

Translating observed household energy behavior to agent-based technology choices in an integrated modeling framework

Oreane.Y. Edelenbosch [1, 2, 6, 7] ⚲ ✉, Luciana Miu [3, 4, 6], Julia Sachs [3], Adam Hawkes [3], Massimo Tavoni [1, 5] ⚲ ✉

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Highlights

- Household survey data used to enhance empirical grounding of agent based model

- New method developed to translate survey questions to model parameters

- Sociodemographics and perspectives do not easily explain consumption behavior

- Income has largest effect on demand, efficiency and energy-saving investments

Figure 60: Preview of Translating observed household energy behavior to agent-based technology choices in an integrated modeling framework

2.61 Parris et al. (2022), Environmental Science & Policy

Title:	Cultures of transformation: An integrated framework for transformative action
Authors:	Hannah Parris (Cambridge), Alevgul H. Sorman (BC3), Carmen Valor, Andreas Tuerk, Annela Anger-Kraavi (Cambridge)
Journal:	Environmental Science & Policy
Abstract:	The challenges posed by climate change have generated many initiatives that seek to implement societal transformations. In most cases, these focus on technology developments, adoption and diffusion but neglect the social and cultural dimensions of a transformation. Insights from systems and behavioural sciences can provide valuable guidance on these aspects, but the utility of this literature is limited by two factors. Firstly, the literature on the intersection between social transformation and psychological processes of behaviour change by individuals is limited. Secondly, the complex technical nature of much of the transition relevant literature limits its accessibility by stakeholders outside academia. We seek to address these challenges through the development of a transdisciplinary Transformation Process Framework for use as a 'knowledge integration' tool as part of a co-design process for transformative change. The Framework: (1) develops a systematic narrative of the transformational changes that need to be triggered at multiple scales (from individual to society), (2) generates a map to identify key variables, drivers, and blockers in a transformation process integrating different knowledge from fragmented disciplines; (3) serves as a tool to support the exploration of relevant academic (and other) literature to collate and utilise relevant knowledge.
Keywords:	Sustainability transitions, Knowledge co-production, Energy Cultures Framework, Multi-level Perspective, Psychology of behavioural change
DOI:	https://doi.org/10.1016/j.envsci.2022.02.008
Open Access:	Gold
First Online:	February 18, 2022
Repository:	Zenodo (link: https://zenodo.org/record/7198280#.Y1fcc3ZByUk)
Synergies with:	N/A
Citation (APA):	Parris, H., Sorman, A. H., Valor, C., Tuerk, A., & Anger-Kraavi, A. (2022). Cultures of transformation: An integrated framework for transformative action. *Environmental Science & Policy*, *132*, 24-34.

Cultures of transformation: An integrated framework for transformative action

Hannah Parris [a] ✕ ✉, Alevgul H. Sorman [b, c], Carmen Valor [d], Andreas Tuerk [e], Annela Anger-Kraavi [a]

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Abstract

The challenges posed by climate change have generated many initiatives that seek to implement societal transformations. In most cases, these focus on technology developments, adoption and diffusion but neglect the social and cultural dimensions of a transformation. Insights from systems and behavioural sciences can provide valuable guidance on these aspects, but the utility of this literature is limited by two factors. Firstly, the literature on the intersection between social transformation and psychological processes of behaviour change by individuals is limited. Secondly, the complex technical nature of much of the transition relevant literature limits its accessibility by stakeholders outside academia. We seek to address these challenges through the development of a transdisciplinary Transformation Process Framework for use as a 'knowledge integration' tool as part of a co-design process for transformative change. The Framework: (1) develops a systematic narrative of the transformational changes that need to be triggered at multiple scales (from individual to society), (2) generates a map to identify key variables, drivers, and blockers in a transformation process integrating different knowledge from fragmented disciplines; (3) serves as a tool to support the exploration of relevant academic (and other) literature to collate and utilise relevant knowledge.

Figure 61: Preview of Cultures of transformation: An integrated framework for transformative action

2.62 Koasidis et al. (2022), Maritime Policy & Management

Title:	A multi-criteria decision support framework for assessing seaport sustainability planning: the case of Piraeus
Authors:	Konstantinos Koasidis (NTUA), Alexandros Nikas (NTUA), Vasiliki Daniil, Eleni Kanellou (NTUA), Haris Doukas (NTUA)
Journal:	Maritime Policy & Management

Abstract:	Seaports will play a pivotal role in the low-carbon transition of maritime shipping, the policy landscape in which is currently being shaped. In this context, we introduce a multi-criteria decision support framework for seaport sustainability planning, to identify the competitiveness of interventions under uncertainty and evaluate the direction of the sector's policy context in terms of required actions. The framework, based on the 2-tuple TOPSIS model, heterogeneous variables, and a Monte Carlo robustness analysis, is empirically applied to the port of Piraeus, Greece, to explore the most competitive interventions and their vulnerability to uncertainties. To inform port authorities and policymakers in the sector, we emphasise the added value of selected, inexpensive actions for energy efficiency and hybrid mobility. Furthermore, we find costly and seemingly obligatory actions under current European legislation, like cold ironing and LNG, to be robust and in the right direction if perception of non-financial risks is reduced.

Keywords:	Seaport sustainability, maritime shipping, multiple-criteria decision making, 2-tuple TOPSIS, uncertainty, greenhouse gas emissions
DOI:	https://doi.org/10.1080/03088839.2022.2047815
Open Access:	Green (embargoed until September 15, 2023)
First Online:	March 15, 2022
Repository:	Zenodo (link: https://zenodo.org/record/7229896#.Y1fdt3ZByUk)
Synergies with:	N/A
Citation (APA):	Konstantinos, K., Nikas, A., Daniil, V., Kanellou, E., & Doukas, H. (2022). A multi-criteria decision support framework for assessing seaport sustainability planning: The case of Piraeus. *Maritime Policy & Management*, 1-27.

Figure 62: Preview of A multi-criteria decision support framework for assessing seaport sustainability planning: the case of Piraeus

2.63 Doukas et al. (2022), Renewable & Sustainable Energy Reviews

Title:	Wind repowering: Unveiling a hidden asset
Authors:	Haris Doukas (NTUA), Apostolos Arsenopoulos (NTUA), Miltiades Lazoglou, Alexandros Nikas (NTUA), Alexandros Flamos
Journal:	Renewable & Sustainable Energy Reviews

Abstract: Given the abundant availability of resources, the market potential, and their cost competitiveness, onshore wind farms and photovoltaic units are expected to drive the overall growth of renewable energy sources in the next decade. However, Europe is a small and densely populated continent, which results in many countries experiencing a severe shortage of suitable land sites for installing new wind and photovoltaic facilities. This, combined with the fact that many existing wind turbines and photovoltaic units reach the end of their operational lifetime, has laid the groundwork for 'repowering'. Repowering includes upgrading or retrofitting renewable energy sources' components and exploits existing land sites, in which renewables are operating for years. This paper intends to emphasise the multiple dimensions of repowering, also delving in its surrounding socio-economic context in various European countries, to identify its barriers and allies as well as gather best practices and lessons learnt from its implementation. Considering data availability, extent of spatial use and bulk equipment, and consequent attention in literature and practice, the analysis mainly orbits around repowering of wind projects, rather than solar photovoltaics. Finally, the paper presents key directions toward wider future exploitation of repowering.

Keywords:	Repowering, Renewable energy, Wind potential, Land scarcity, Europe
DOI:	https://doi.org/10.1016/j.rser.2022.112457
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Repository:	Zenodo (link: https://zenodo.org/record/7198538#.Y1ffonZByUk)
Synergies with:	N/A
Citation (APA):	Doukas, H., Arsenopoulos, A., Lazoglou, M., Nikas, A., & Flamos, A. (2022). Wind repowering: Unveiling a hidden asset. *Renewable and Sustainable Energy Reviews*, *162*, 112457.

Wind repowering: Unveiling a hidden asset

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Highlights

- Land scarcity problem with high renewable energy potential addressed by repowering.

- In-depth socio-economic extensions of repowering are discussed.

- Semi-quantified evaluation highlighting main implementation pillars of repowering.

- Best practices and lessons learnt from the implementation of repowering.

- Legislative barriers against the wider implementation of repowering.

Figure 63: Preview of Wind repowering: Unveiling a hidden asset

2.64 Burke and Gambhir (2022), Energy and Climate Change

Title:	Policy incentives for Greenhouse Gas Removal Techniques: the risks of premature inclusion in carbon markets and the need for a multi-pronged policy framework
Authors:	Joshua Burke, Ajay Gambhir (Imperial)
Journal:	Energy and Climate Change

Abstract: Almost all modelled emissions scenarios consistent with the Paris Agreement's target of limiting global temperature increase to well below two degrees include the use of greenhouse gas removal (GGR) techniques. Despite the prevalence of GGR in Paris-consistent scenarios, and indeed the UK's own net-zero target, there is a paucity of regulatory support for emerging GGR techniques. However, the role of carbon pricing is one area that has experienced more attention than others, including discussion about the future inclusion of GGR in carbon markets.

Here we identify three risks associated with using carbon markets as the sole, or main, policy lever to encourage the deployment of GGR techniques. Our categorisation of risks stems from discussions with policymakers in the UK and a review of the broader literature on carbon markets and GGR. We present a three-pronged risk assessment framework to highlight the dangers in doing so. First, treating emissions removals and emissions reductions as entirely fungible allows for undesirable substitution. Second, carbon markets may provide insufficient demand pull to drive currently more-costly GGR techniques to deployment at commercial scales. Third, opening up a carbon market for potentially lower-cost GGR (such as nature-based solutions) too early could exert downward pressure on the overall market-based price of carbon, in the absence of adjustments to emissions caps or other safeguards. We discuss how these risks could hamper overall efforts to deploy GGR, and instead suggest a multi-pronged and intertemporal policy and governance framework for GGR. This includes considering separate accounting targets for GGR and conventional emissions abatement, removing perfect fungibility between GGR permits and carbon market permits and promoting a a wide range of innovation and technology-specific mechanisms to drive currently expensive, yet highly scalable technological GGR down the cost curve. Such a framework would ensure that policymakers can utilise carbon markets and other incentives appropriately to drive development and deployment of GGR techniques without compromising near-term mitigation, and that the representation of GGR in modelled low-carbon pathways is cognisant of its real-world scale-up potential in light of these incentives.

Keywords:	Mitigation, Negative emissions, GGR, Carbon markets, Policy instruments, Governance
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Policy incentives for Greenhouse Gas Removal Techniques: the risks of premature inclusion in carbon markets and the need for a multi-pronged policy framework

Joshua Burke [a] ✉, Ajay Gambhir [b]

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Abstract

Almost all modelled emissions scenarios consistent with the Paris Agreement's target of limiting global temperature increase to well below two degrees include the use of greenhouse gas removal (GGR) techniques. Despite the prevalence of GGR in Paris-consistent scenarios, and indeed the UK's own net-zero target, there is a paucity of regulatory support for emerging GGR techniques. However, the role of carbon pricing is one area that has experienced more attention than others, including discussion about the future inclusion of GGR in carbon markets.

Here we identify three risks associated with using carbon markets as the sole, or main, policy lever to encourage the deployment of GGR techniques. Our categorisation of risks stems from discussions with policymakers in the UK and a review of the broader literature on carbon markets and GGR. We present a three-pronged risk assessment framework to highlight the dangers in doing so. First, treating emissions removals and emissions reductions as entirely fungible allows for undesirable substitution. Second, carbon markets may provide insufficient demand pull to drive currently more-costly GGR techniques to deployment at commercial scales. Third, opening up a carbon market for potentially lower-cost GGR (such as nature-based solutions) too early could exert downward pressure on the overall market-based price of carbon, in the absence of adjustments to

Figure 64: Preview of Policy incentives for Greenhouse Gas Removal Techniques: the risks of premature inclusion in carbon markets and the need for a multi-pronged policy framework

2.65 Song et al. (2022), iScience

Title:	Deep Decarbonization of the Indian Economy: 2050 Prospects for Wind, Solar, and Green Hydrogen
Authors:	Shaojie Song, Haiyang Lin, Peter Sherman, Xi Yang (CUP), Shi Chen, Xi Lu, Tianguang Lu, Xinyu Chen, Michael B. McElroy
Journal:	iScience

Abstract: The paper explores options for a 2050 carbon free energy future for India. Onshore wind and solar sources are projected as the dominant primary contributions to this objective. The analysis envisages an important role for so-called green hydrogen produced by electrolysis fueled by these carbon free energy sources. This hydrogen source can be used to accommodate for the intrinsic variability of wind and solar complementing opportunities for storage of power by batteries and pumped hydro. The green source of hydrogen can be used also to supplant current industrial uses of gray hydrogen produced in the Indian context largely from natural gas with important related emissions of CO_2. The paper explores further options for use of green hydrogen to lower emissions from otherwise difficult to abate sectors of both industry and transport. The analysis is applied to identify the least cost options to meet India's zero carbon future.

Keywords:	India, Decarbonisation, Renewable energy, Hydrogen
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Open Access:	Golden
First Online:	May 12, 2022
Repository:	Zenodo (link: https://zenodo.org/record/7230037#.Y1fgeXZByUk)
Synergies with:	N/A
Citation (APA):	Song, S., Lin, H., Sherman, P., Yang, X., Chen, S., Lu, X., ... & McElroy, M. B. (2022). Deep decarbonization of the Indian economy: 2050 prospects for wind, solar, and green hydrogen. *iScience*, 104399.

Article

Deep decarbonization of the Indian economy: 2050 prospects for wind, solar, and green hydrogen

Shaojie Song [1, 2, 8], Haiyang Lin [2, 3, 8] ✉, Peter Sherman [2], Xi Yang [2], Shi Chen [5], Xi Lu [5], Tianguang Lu [6], Xinyu Chen [7], Michael B. McElroy [2, 4, 9] ✉

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Highlights

- A novel integrated renewable energy-hydrogen planning model is developed for India

- Scenarios that include green H_2 could reduce 2050 energy system costs by 10%

- Green hydrogen allows for cheap decarbonization of industrial and power sectors

Figure 65: Preview of Deep decarbonization of the Indian economy: 2050 prospects for wind, solar, and green hydrogen

2.66 Koasidis et al. (2022), Energy for Sustainable Development

Title:	Climate and sustainability co-governance in Kenya: A multi-criteria analysis of stakeholders' perceptions and consensus
Authors:	Konstantinos Koasidis (NTUA), Alexandros Nikas (NTUA), Anastasios Karamaneas (NTUA), Michael Saulo, Ioannis Tsipouridis, Lorenza Campagnolo (CMCC), Ajay Gambhir (Imperial), Dirk-Jan van de Ven (BC3), Ben McWilliams (Bruegel), Haris Doukas (NTUA)
Journal:	Energy for Sustainable Development

Abstract:	The Paris Agreement and the 2030 Agenda for Sustainable Development embody highly intertwined targets to act for climate in conjunction with sustainable development. This, however, entails different meanings and challenges across the world. Kenya, in particular, needs to address serious sustainability threats, like poverty and lack of modern and affordable energy access. This study uses a multi-criteria group decision aid and consensus measuring framework, to integrate both agendas, and engages with Kenyan stakeholders to help inform future mitigation research and policy in the country. Results showed that stakeholders highlight topics largely underrepresented in model-based mitigation analysis, such as biodiversity preservation and demand-side transformations, while pointing to gaps in cross-sectoral policies in relation to access to modern energy, agriculture, life on land, and climate change mitigation. With numerous past and recent policies aiming at these issues, persistent stakeholder concerns over these topics hint at limited success. Sectoral and technological priorities only recently emphasised in Kenyan policy efforts are also correlated with stakeholders' concerns, highlighting that progress is not only a matter of legislation, but also of coordination, consistency of targets, and comprehensibility. Higher bias is found among the preferences of stakeholders coming from the country's private sector. Results from this exercise can inform national policymakers on effectively reshaping the future direction of the country, as well as modelling efforts aimed at underpinning Kenya's energy, climate and sustainable development policy.

Energy for Sustainable Development
Volume 68, June 2022, Pages 457-471

ELSEVIER

Climate and sustainability co-governance in Kenya: A multi-criteria analysis of stakeholders' perceptions and consensus

Konstantinos Koasidis [a], Alexandros Nikas [a] ✉, Anastasios Karamaneas [a], Michael Saulo [b], Ioannis Tsipouridis [b], Lorenza Campagnolo [c], Ajay Gambhir [d], Dirk-Jan Van de Ven [e], Ben McWilliams [f], Haris Doukas [a]

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Highlights

- We propose a climate & sustainability co-governance multi-criteria decision framework.

- Stakeholder preferences are assessed based on 2-tuple TOPSIS and consensus measuring.

- Biodiversity, AFOLU, and demand-side residential transformations among key priorities

- Recent policy aimed at these issues but stakeholder concerns hint at limited success.

- Our exercise also unveils higher bias among private-sector stakeholders' preferences.

Figure 66: Preview of Climate and sustainability co-governance in Kenya: A multi-criteria analysis of stakeholders' perceptions and consensus

2.67 Koutsellis et al. (2022), Operational Research

Title:	Parameter analysis for sigmoid and hyperbolic transfer functions of fuzzy cognitive maps
Authors:	Themistoklis Koutsellis (NTUA), Georgios Xexakis (Holistic), Konstantinos Koasidis (NTUA), Alexandros Nikas (NTUA), Haris Doukas (NTUA)
Journal:	Operational Research

Abstract: Fuzzy cognitive maps (FCM) have recently gained ground in many engineering applications, mainly because they allow stakeholder engagement in reduced-form complex systems representation and modelling. They provide a pictorial form of systems, consisting of nodes (concepts) and node interconnections (weights), and perform system simulations for various input combinations. Due to their simplicity and quasi-quantitative nature, they can be easily used with and by non-experts. However, these features come with the price of ambiguity in output: recent literature indicates that changes in selected FCM parameters yield considerably different outcomes. Furthermore, it is not a priori known whether an FCM simulation would reach a fixed, unique final state (fixed point). There are cases where infinite, chaotic, or cyclic behaviour (non-convergence) hinders the inference process, and literature shows that the primary culprit lies in a parameter determining the steepness of the most common transfer functions, which determine the state vector of the system during FCM simulations. To address ambiguity in FCM outcomes, we propose a certain range for the value of this parameter, λ, which is dependent on the FCM layout, for the case of the log-sigmoid and hyperbolic tangent transfer functions. The analysis of this paper is illustrated through a novel software application, In-Cognitive, which allows non-experts to define the FCM layout via a Graphical User Interface and then perform FCM simulations given various inputs. The proposed methodology and developed software are validated against a real-world energy policy-related problem in Greece, drawn from the literature.

Keywords:	fuzzy cognitive maps, operational research, mental modelling, Decision-making, participatory modelling
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Citation (APA):	Koutsellis, T., Xexakis, G., Koasidis, K., Nikas, A., & Doukas, H. (2022). Parameter analysis for sigmoid and hyperbolic transfer functions of fuzzy cognitive maps. *Operational Research, 22*, 5733-5763.

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Parameter analysis for sigmoid and hyperbolic transfer functions of fuzzy cognitive maps

Themistoklis Koutsellis, Georgios Xexakis, Konstantinos Koasidis ✉, Alexandros Nikas & Haris Doukas

Abstract

Fuzzy cognitive maps (FCM) have recently gained ground in many engineering applications, mainly because they allow stakeholder engagement in reduced-form complex systems representation and modelling. They provide a pictorial form of systems, consisting of nodes (concepts) and node interconnections (weights), and perform system simulations for various input combinations. Due to their simplicity and quasi-quantitative nature, they can be easily used with and by non-experts. However, these features come with the price of ambiguity in output: recent literature indicates that changes in selected FCM parameters yield considerably different outcomes. Furthermore, it is not a priori known whether an FCM simulation would reach a fixed, unique final state (fixed point). There are cases where infinite, chaotic, or cyclic behaviour (non-convergence) hinders the inference process, and literature shows that the primary culprit lies in a parameter determining the steepness of the most common transfer functions, which determine the state vector of the system during FCM simulations. To address ambiguity in FCM outcomes, we propose a certain range for the value of this parameter, λ, which is dependent on the FCM layout, for the case of the log-sigmoid and hyperbolic tangent transfer functions. The analysis of this paper is illustrated through a novel software application, _In-Cognitive_, which allows non-experts to define the FCM layout via a Graphical User Interface and then perform FCM simulations given various inputs. The proposed methodology and developed software are validated against a real-world energy policy-related problem in Greece, drawn from the literature.

Figure 67: Preview of Parameter analysis for sigmoid and hyperbolic transfer functions of fuzzy cognitive maps

2.68 Speth et al. (2022), Environmental Research: Infrastructure and Sustainability

Title:	Public fast charging infrastructure for battery electric trucks – a model-based network for Germany
Authors:	Daniel Speth (ISI Fraunhofer), Patrick Plötz (ISI Fraunhofer), Simon Funke (ISI Fraunhofer), Emanuel Vallarella (ISI Fraunhofer)
Journal:	Environmental Research: Infrastructure and Sustainability

Abstract: Globally, road freight accounts for 40% of the CO_2 emissions in the transport sector, mainly from heavy-duty vehicles (HDVs). All the major truck markets have introduced fuel efficiency regulations for HDV, and the more ambitious regulations require the introduction of zero-emission HDV, for which battery electric trucks (BEVs) are a promising candidate. However, frequent long-distance trips require a dense public high-power charging network if BEV are to meet today's operating schedules in logistics. Here, we develop a model for public BEV high-power fast-charging that uses widely available traffic count data as input and combines this with on-site queueing models. We apply the model to Germany and obtain a fast-charging network where average waiting times do not exceed 5 min. For 15% BEV in the truck stock and 50% public charging, the model shows 267 charging locations, each with 2–8 charging points per location, for a dense network with 50 km distance between charging locations. We calculated 142 charging locations with 2–13 charging points for a wider network with 100 km distance between locations. Our results help to design future charging infrastructure for electric road freight transport.

Keywords:	electric vehicles, Electric Mobility, Germany
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Synergies with:	VDA HoLa (GA: 03EMF0404A)
Citation (APA):	Speth, D., Plötz, P., Funke, S., & Vallarella, E. (2022). Public fast charging infrastructure for battery electric trucks–a model-based network for Germany. *Environmental Research: Infrastructure and Sustainability, 2(2), 025004.*

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Public fast charging infrastructure for battery electric trucks —a model-based network for Germany

Daniel Speth[2,1] 🆔, Patrick Plötz[1] 🆔, Simon Funke[1] and Emanuel Vallarella[1]

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➕ Article information

Abstract

Globally, road freight accounts for 40% of the CO_2 emissions in the transport sector, mainly from heavy-duty vehicles (HDVs). All the major truck markets have introduced fuel efficiency regulations for HDV, and the more ambitious regulations require the introduction of zero-emission HDV, for which battery electric trucks (BEVs) are a promising candidate. However, frequent long-distance trips require a dense public high-power charging network if BEV are to meet today's operating schedules in logistics. Here, we develop a model for public BEV high-power fast-charging that uses widely available traffic count data as input and combines this with on-site queueing models. We apply the model to Germany and obtain a fast-charging network where average waiting times do not exceed 5 min. For 15% BEV in the truck stock and 50% public charging, the model shows 267 charging locations, each with 2–8 charging points per location, for a dense network with 50 km distance between charging locations. We calculated 142 charging locations with 2–13 charging points for a wider network with 100 km distance between locations. Our results help to design future charging infrastructure for electric road freight transport.

Figure 68: Preview of Public fast charging infrastructure for battery electric trucks – a model-based network for Germany

2.69 Babonneau and Vielle (2022), Climate Change Economics

Title: A post-COVID-19 economic assessment of the Chilean NDC revision

Authors: Frederic Babonneau, Marc Vielle (EPFL)

Journal: Climate Change Economics

Abstract: Last year, Chile updated its Nationally Determined Contributions, moving from intensity-based emissions reductions to an effective emissions target. This paper aims to assess the economic and environmental impacts of this change in the current context of high uncertainty Chile faces with social protests and the COVID-19 pandemic. Using the computable general equilibrium model GEMINI-E3, we performed a sensitivity analysis assuming different levels of economic growth through 2030. Though at first glance the revised commitments appear more ambitious, we found that they could lead to higher emissions in low-growth scenarios. The results show that intensity-based emissions targets indeed become less stringent when assuming high levels of economic growth and thus may result in highly uncertain effective emissions in 2030. On the other hand, given the uncertainty surrounding Chilean economic growth, the updated commitments would be politically more amenable as it would lead to lower welfare losses. In addition, we analyze different redistribution schemes of a CO_2 tax and we show that a per capita redistribution rule makes the CO_2 tax more progressive and thus fiscally more acceptable.

Keywords: COVID-19, NDCs, Chile

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Citation (APA): Babonneau, F., & Vielle, M. (2022). A post-COVID-19 economic assessment of the Chilean NDC revision. *Climate Change Economics*.

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A POST-COVID-19 ECONOMIC ASSESSMENT OF THE CHILEAN NDC REVISION

FRÉDÉRIC BABONNEAU ✉ and MARC VIELLE

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Abstract

Last year, Chile updated its Nationally Determined Contributions, moving from intensity-based emissions reductions to an effective emissions target. This paper aims to assess the economic and environmental impacts of this change in the current context of high uncertainty Chile faces with social protests and the COVID-19 pandemic. Using the computable general equilibrium model GEMINI-E3, we performed a sensitivity analysis assuming different levels of economic growth through 2030. Though at first glance the revised commitments appear more ambitious, we found that they could lead to higher emissions in low-growth scenarios. The results show that intensity-based emissions targets indeed become less stringent when assuming high levels of economic growth and thus may result in highly uncertain effective emissions in 2030. On the other hand, given the uncertainty surrounding Chilean economic growth, the updated commitments would be politically more amenable as it would lead to lower welfare losses. In addition, we analyze different redistribution schemes of a CO_2 tax and we show that a per capita redistribution rule makes the CO_2 tax more progressive and thus fiscally more acceptable.

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Figure 69: Preview of A post-COVID-19 economic assessment of the Chilean NDC revision

2.70 Liu et al. (2022), Nature Geoscience

Title: Global patterns of daily CO_2 emissions reductions in the first year of COVID-19

Authors: Zhu Liu, Zhu Deng, Biqing Zhu, Philippe Ciais, Steven J. Davis, Jianguang Tan, Robbie M. Andrew (CICERO), Olivier Boucher, Simon Ben Arous, Josep G. Canadell, Xinyu Dou, Pierre Friedlingstein, Pierre Gentine, Rui Guo, Chaopeng Hong, Robert B. Jackson, Daniel M. Kammen, Piyu Ke, Corinne Le Quéré, Crippa Monica, Greet Janssens-Maenhout, Glen P. Peters (CICERO), Katsumasa Tanaka, Yilong Wang, Bo Zheng, Haiwang Zhong, Taochun Sun, Hans Joachim Schellnhuber

Journal: Nature Geoscience

Abstract: Day-to-day changes in CO_2 emissions from human activities, in particular fossil-fuel combustion and cement production, reflect a complex balance of influences from seasonality, working days, weather and, most recently, the COVID-19 pandemic. Here, we provide a daily CO_2 emissions dataset for the whole year of 2020, calculated from inventory and near-real-time activity data. We find a global reduction of 6.3% (2,232 $MtCO_2$) in CO_2 emissions compared with 2019. The drop in daily emissions during the first part of the year resulted from reduced global economic activity due to the pandemic lockdowns, including a large decrease in emissions from the transportation sector. However, daily CO_2 emissions gradually recovered towards 2019 levels from late April with the partial reopening of economic activity. Subsequent waves of lockdowns in late 2020 continued to cause smaller CO_2 reductions, primarily in western countries. The extraordinary fall in emissions during 2020 is similar in magnitude to the sustained annual emissions reductions necessary to limit global warming at 1.5 °C. This underscores the magnitude and speed at which the energy transition needs to advance.

Keywords: CO_2 emissions, COVID-19

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Synergies with: H2020 VERIFY (GA: 776810), H2020 CoCO₂ (GA: 958927), H2020 4C (GA: 821003)

Citation (APA): Liu, Z., Deng, Z., Zhu, B., Ciais, P., Davis, S. J., Tan, J., ... & Schellnhuber, H. J. (2022). Global patterns of daily CO2 emissions reductions in the first year of COVID-19. *Nature Geoscience*, *15*(8), 615-620.

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Global patterns of daily CO_2 emissions reductions in the first year of COVID-19

Zhu Liu ✉, Zhu Deng, Biqing Zhu, Philippe Ciais, Steven J. Davis, Jianguang Tan, Robbie M. Andrew, Olivier Boucher, Simon Ben Arous, Josep G. Canadell, Xinyu Dou, Pierre Friedlingstein, Pierre Gentine, Rui Guo, Chaopeng Hong, Robert B. Jackson, Daniel M. Kammen, Piyu Ke, Corinne Le Quéré, Crippa Monica, Greet Janssens-Maenhout, Glen P. Peters, Katsumasa Tanaka, Yilong Wang, … Hans Joachim Schellnhuber

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Abstract

Day-to-day changes in CO_2 emissions from human activities, in particular fossil-fuel combustion and cement production, reflect a complex balance of influences from seasonality, working days, weather and, most recently, the COVID-19 pandemic. Here, we provide a daily CO_2 emissions dataset for the whole year of 2020, calculated from inventory and near-real-time activity data. We find a global reduction of 6.3% (2,232 MtCO_2) in CO_2 emissions compared with 2019. The drop in daily emissions during the first part of the year resulted from reduced global economic activity due to the pandemic lockdowns, including a large decrease in emissions from the transportation sector. However, daily CO_2 emissions gradually recovered towards 2019 levels from late April with the partial reopening of economic activity. Subsequent waves of lockdowns in late 2020 continued to cause smaller CO_2 reductions, primarily in western countries. The extraordinary fall in emissions during 2020 is similar in magnitude to the sustained annual emissions reductions necessary to limit global warming at 1.5 °C. This underscores the magnitude and speed at which the energy transition needs to advance.

Figure 70: Preview of Global patterns of daily CO₂ emissions reductions in the first year of COVID-19

2.71 Allen et al. (2022), Annual Review of Environment and Resources

Title: Net Zero: Science, Origins, and Implications

Authors: Myles R. Allen, Pierre Friedlingstein, Cécile A.J. Girardin, Stuart Jenkins, Yadvinder Malhi, Eli Mitchell-Larson, Glen P. Peters (CICERO), Lavanya Rajamani

Journal: Annual Review of Environment and Resources

Abstract: This review explains the science behind the drive for global net zero emissions and why this is needed to halt the ongoing rise in global temperatures. We document how the concept of net zero carbon dioxide (CO_2) emissions emerged from an earlier focus on stabilization of atmospheric greenhouse gas concentrations. Using simple conceptual models of the coupled climate–carbon cycle system, we explain why approximately net zero CO2 emissions and declining net energy imbalance due to other climate drivers are required to halt global warming on multidecadal timescales, introducing important concepts, including the rate of adjustment to constant forcing and the rate of adjustment to zero emissions. The concept of net zero was taken up through the 5th Assessment Report of the Intergovernmental Panel on Climate Change and the United Nations Framework Convention on Climate Change (UNFCCC) Structured Expert Dialogue, culminating in Article 4 of the 2015 Paris Agreement. Increasing numbers of net zero targets have since been adopted by countries, cities, corporations, and investors. The degree to which any entity can claim to have achieved net zero while continuing to rely on distinct removals to compensate for ongoing emissions is at the heart of current debates over carbon markets and offsetting both inside and outside the UNFCCC. We argue that what matters here is not the precise makeup of a basket of emissions and removals at any given point in time, but the sustainability of a net zero strategy as a whole and its implications for global temperature over multidecadal timescales. Durable, climate-neutral net zero strategies require like-for-like balancing of anthropogenic greenhouse gases sources and sinks in terms of both origin (biogenic versus geological) and gas lifetime.

Keywords: carbon budget, net zero, climate neutrality, nature-based solutions, greenhouse gases, carbon markets, Paris Agreement

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Synergies with: H2020 4C (GA: 821003), H2020 FORCeS (GA: 821205), H2020 NEGEM (GA: 869192)

Citation (APA): Allen, M. R., Friedlingstein, P., Girardin, C. A., Jenkins, S., Malhi, Y., Mitchell-Larson, E., ... & Rajamani, L. (2022). Net Zero: Science, Origins, and Implications. *Annual Review of Environment and Resources, 47.*

Net Zero: Science, Origins, and Implications

Myles R. Allen,[1,4] Pierre Friedlingstein,[2,3] Cécile A.J. Girardin,[1] Stuart Jenkins,[4] Yadvinder Malhi,[1,5] Eli Mitchell-Larson,[1] Glen P. Peters,[6] and Lavanya Rajamani[7]

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Abstract

This review explains the science behind the drive for global net zero emissions and why this is needed to halt the ongoing rise in global temperatures. We document how the concept of net zero carbon dioxide (CO_2) emissions emerged from an earlier focus on stabilization of atmospheric greenhouse gas concentrations. Using simple conceptual models of the coupled climate–carbon cycle system, we explain why approximately net zero CO_2 emissions and declining net energy imbalance due to other climate drivers are required to halt global warming on multidecadal timescales, introducing important concepts, including the rate of adjustment to constant forcing and the rate of adjustment to zero emissions. The concept of net zero was taken up through the 5th Assessment Report of the Intergovernmental Panel on Climate Change and the United Nations Framework Convention on Climate Change (UNFCCC) Structured Expert Dialogue, culminating in Article 4 of the 2015 Paris Agreement. Increasing numbers of net zero targets have since been adopted by countries, cities, corporations, and investors. The degree to which any entity can claim to have achieved net zero while continuing to rely on distinct removals to compensate for ongoing emissions is at the heart of current debates over carbon markets and offsetting both inside and outside the UNFCCC. We argue that what matters here is not the precise makeup of a basket of emissions and removals at any given point in time, but the sustainability of a net zero strategy as a whole and its implications for global temperature over multidecadal timescales. Durable, climate-neutral net zero strategies require like-for-like balancing of anthropogenic greenhouse gases sources and sinks in terms of both origin (biogenic versus geological) and gas lifetime.

Expected final online publication date for the *Annual Review of Environment and Resources*, Volume 47 is October 2022. Please see http://www.annualreviews.org/page/journal/pubdates for revised estimates.

Figure 71: Preview of Neto Zero: Science, Origins and Implications

2.72 Perdana et al. (2022), La Revue de l'Énergie

Title:	Cutting off Russian energy imports: energy and economic implications in the EU
Authors:	Sigit Perdana (EPFL), Maxime Schenckery, Marc Vielle (EPFL)
Journal:	La Revue de l'Énergie

Abstract: We use a macroeconomic model to evaluate the economic impacts of an embargo by the European Union on its fossil energy imports from Russia. In the context of the new ''Fit for 55'' climate package, import restrictions are progressively being increased in order to reach a total ban in 2025. Such an embargo would significantly increase the cost of Europe's energy supply. Demand for natural gas is expected to decline in all sectors, with the greatest decline occurring in power generation. The cost would amount to €2,500 per European citizen over the period 2022-2030.

Keywords:	Russian gas, energy crisis
DOI:	https://doi.org/10.1787/f6eb5b48-fr
Open Access:	No Access
First Online:	August, 2022
Repository:	N/A
Synergies with:	N/A
Citation (APA):	Perdana, S., Schenckery, M., & Vielle, M. (2022). Cutting off Russian energy imports: energy and economic implications in the EU. *La Revue de l'Énergie, 663,* 71-83. (*in French*)

Figure 72: Preview of Cutting off Russian energy imports: energy and economic implications in the EU
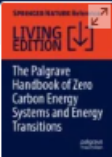
2.73 Karamaneas et al. (2022), The Palgrave Handbook of Zero Carbon Energy Systems and Energy Transitions

Title:	Prioritizing Climate Action and Sustainable Development in the Central Asia and Caspian Region
Authors:	Anastasios Karamaneas (NTUA), Hera Neofytou (NTUA), Konstantinos Koasidis (NTUA), Alexandros Nikas (NTUA), Rocco De Miglio (E4SMA), Ben McWilliams (Bruegel), Haris Doukas (NTUA)
Journal:	The Palgrave Handbook of Zero Carbon Energy Systems and Energy Transitions
Abstract:	The Central Asia and Caspian region is a geographical area facing the harsh effects of climate change, such as rapid temperature rise, water body desiccation, and biodiversity losses. Nevertheless, national climate policies in the region have not demonstrated the necessary ambition. A first glance primarily points to the abundance and exploitation of fossil fuels. Taking a closer look at the national and regional context, we identify a diversity of infrastructural, economic, and social challenges to the region's sustainable development. To further examine the relationship between sustainable development and climate change, our study carries out a stakeholder-driven multiple-criteria group decision and consensus analysis. This exercise aimed at capturing the importance of different sustainability dimensions, using the UN's Sustainable Development Goals as reference points, from the regional stakeholders' perspective. A diverse pool of stakeholders helped prioritise each Goal, yielding overall agreement that clean energy, urban sustainability, effective waste management, and biodiversity preservation should be prioritized. Issues related with waste management and responsible consumption were ranked as the most important for climate action. Conversely, the analysis showed that social sustainability – including eliminating poverty, hunger, and inequalities – is of less urgency due to recent progress, especially when considered within the confines of climate action.
Keywords:	Kazakhstan, Uzbekistan, Turkmenistan, Azerbaijan, Climate Action, Sustainable Development Goals, Multi-Criteria Decision-Making
DOI:	https://doi.org/10.1007/978-3-030-74380-2_1-1
Open Access:	Green (embargoed until August 30, 2024)
First Online:	August 30, 2022
Repository:	Zenodo (link: https://zenodo.org/record/7198838#.Y1fianZByUk)
Synergies with:	N/A
Citation (APA):	Karamaneas, A., Neofytou, H., Koasidis, K., Nikas, A., De Miglio, R., McWilliams, B., & Doukas, H. (2022). Prioritizing climate action and sustainable development in the Central Asia

and Caspian region. In: Wood, G., Onyango, V., Yenneti, K., Liakopoulou, M.A. (eds) The Palgrave Handbook of Zero Carbon Energy Systems and Energy Transitions. Palgrave Studies in Energy Transitions. Palgrave Macmillan, Cham.

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The Palgrave Handbook of Zero Carbon Energy Systems and Energy Transitions pp 1–27 | Cite as

Prioritizing Climate Action and Sustainable Development in the Central Asia and Caspian Region

Anastasios Karamaneas, Hera Neofytou, Konstantinos Koasidis, Alexandros Nikas, Rocco De Miglio, Ben McWilliams & Haris Doukas ✉

Living reference work entry | First Online: 30 August 2022

13 Accesses | 4 Altmetric

Part of the Palgrave Studies in Energy Transitions book series (PSET)

Abstract

The Central Asia and Caspian region is a geographical area facing the harsh effects of climate change, such as rapid temperature rise, water body desiccation, and biodiversity losses. Nevertheless, national climate policies in the region have not demonstrated the necessary ambition. A first glance primarily points to the abundance and exploitation of fossil fuels. Taking a closer look at the national and regional context, we identify a diversity of infrastructural, economic, and social challenges to the region's sustainable development. To further examine the relationship between sustainable development and climate change, our study carries out a stakeholder-driven multiple-criteria group decision and consensus analysis. This exercise aimed at capturing the importance of different sustainability dimensions, using the UN's Sustainable Development Goals as reference points, from the regional stakeholders' perspective. A diverse pool of stakeholders helped prioritise each Goal, yielding overall agreement that clean energy, urban sustainability, effective waste management, and biodiversity preservation should be prioritized. Issues related with waste management and responsible consumption were ranked as the most important for climate action. Conversely, the analysis showed that social sustainability – including eliminating poverty, hunger, and inequalities – is of less urgency due to recent progress, especially when considered within the confines of climate action.

Figure 73: Preview of Prioritizing Climate Action and Sustainable Development in the Central Asia and Caspian Region

2.74 Grant et al. (2022), International Journal of Greenhouse Gas Control

Title:	Enhancing the realism of decarbonisation scenarios with practicable regional constraints on CO_2 storage capacity
Authors:	Neil Grant (Imperial), Ajay Gambhir (Imperial), Shivika Mittal (Imperial), Chris Greig, Alexandre C. Köberle (Imperial)
Journal:	International Journal of Greenhouse Gas Control
Abstract:	Most low-carbon scenarios produced by integrated assessment models deploy substantial amounts of carbon capture and storage (CCS). These models generally assume that CO_2 storage is a low-cost and globally ubiquitous resource. Here we challenge this assumption, introducing a CO_2 storage potential which accounts for the financial, contractual, and institutional barriers to CO_2 storage, which we term the investable potential. We provide a first estimate of this investable potential and utilise a global energy system model to explore the implications for global and regional mitigation pathways. Our results suggest that low-carbon scenarios which assume abundant CO_2 storage may substantially overestimate the role of CCS in deep decarbonisation, particularly in key regions such as China and India. Limited CO_2 storage leads to mitigation pathways with faster emission reductions and greater reliance on renewable energy for decarbonisation. We demonstrate that the optimal use of CCS depends heavily on the availability of CO_2 storage, with different use-cases prioritised at different scales of storage availability. Finally, we present exploratory analysis on the potential for cross-border trade in captured CO_2 to match sources and sinks. The results of this analysis can help calibrate expectations and inform policy decisions around the role of CCS in addressing climate change.
Keywords:	Climate change, Mitigation, CCS, CO_2 storage, Carbon dioxide removal
DOI:	https://doi.org/10.1016/j.ijggc.2022.103766
Open Access:	Golden
First Online:	September 15, 2022
Repository:	Zenodo (link: https://zenodo.org/record/7198921#.Y1fiq3ZByUk)
Synergies with:	N/A
Citation (APA):	Grant, N., Gambhir, A., Mittal, S., Greig, C., & Köberle, A. C. (2022). Enhancing the realism of decarbonisation scenarios with practicable regional constraints on CO2 storage capacity. *International Journal of Greenhouse Gas Control*, *120*, 103766.

Enhancing the realism of decarbonisation scenarios with practicable regional constraints on CO_2 storage capacity

Neil Grant [a] ✉, Ajay Gambhir [a], Shivika Mittal [a], Chris Greig [b], Alexandre C. Köberle [a]

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Highlights

- Integrated assessment model scenarios substantially overestimate CO_2 storage potential.

- A new storage potential estimate, the investable potential, is introduced.

- Reduced CO_2 storage requires faster mitigation and greater use of renewable energy.

- Scenarios prioritise very different CCS applications depending on storage availability.

- The impact of cross-border trade in CO_2 and low discount rates are also explored.

Figure 74: Preview of Enhancing the realism of decarbonisation scenarios with practicable regional constraints on CO_2 storage capacity

2.75 Van de Ven et al. (2022), One Earth

Title:	COVID-19 recovery packages can benefit climate targets and clean energy jobs, but scale of impacts and optimal investment portfolios differ among major economies
Authors:	Dirk-Jan van de Ven (BC3), Alexandros Nikas (NTUA), Konstantinos Koasidis (NTUA), Aikaterini Forouli (NTUA), Gabriele Cassetti (E4SMA), Alessandro Chiodi (E4SMA), Maurizio Gargiulo (E4SMA), Sara Giarola (Imperial), Alexandre C. Köberle (Imperial), Themistoklis Koutsellis (NTUA), Shivika Mittal (Imperial), Sigit Perdana (EPFL), Marc Vielle (EPFL), Georgios Xexakis (Holistic), Haris Doukas (NTUA), Ajay Gambhir (Imperial)
Journal:	One Earth

Abstract:	To meet the Paris temperature targets and recover from the effects of the pandemic, many countries have launched economic recovery plans, including specific elements to promote clean energy technologies and green jobs. However, how to successfully manage investment portfolios of green recovery packages to optimize both climate mitigation and employment benefits remains unclear. Here, we use three energy-economic models, combined with a portfolio analysis approach, to find optimal low-carbon technology subsidy combinations in six major emitting regions: Canada, China, the European Union (EU), India, Japan, and the United States (US). We find that, although numerical estimates differ given different model structures, results consistently show that a >50% investment in solar photovoltaics is more likely to enable CO_2 emissions reduction and green jobs, particularly in the EU and China. Our study illustrates the importance of strategically managing investment portfolios in recovery packages to enable optimal outcomes and foster a post-pandemic green economy.

Keywords:	COVID-19, green recovery, Climate Change Mitigation, employment
DOI:	https://doi.org/10.1016/j.oneear.2022.08.008
Open Access:	Golden
First Online:	September 16, 2022
Repository:	Zenodo (link: https://zenodo.org/record/7198939#.Y1fi73ZByUk)
Synergies with:	N/A
Citation (APA):	van de Ven, D. J., Nikas, A., Koasidis, K., Forouli, A., Cassetti, G., Chiodi, A., ... & Gambhir, A. (2022). COVID-19 recovery packages can benefit climate targets and clean energy jobs, but scale of impacts and optimal investment portfolios differ among major economies. *One Earth*, *5*(9), 1042-1054.

One Earth

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COVID-19 recovery packages can benefit climate targets and clean energy jobs, but scale of impacts and optimal investment portfolios differ among major economies

Dirk-Jan van de Ven [1, 8] 🔍 ✉, Alexandros Nikas [2], Konstantinos Koasidis [2], Aikaterini Forouli [2], Gabriele Cassetti [3], Alessandro Chiodi [3], Maurizio Gargiulo [3], Sara Giarola [4], Alexandre C. Köberle [5], Themistoklis Koutsellis [2], Shivika Mittal [5], Sigit Perdana [6], Marc Vielle [6], Georgios Xexakis [7], Haris Doukas [2], Ajay Gambhir [5]

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Highlights

- Analysis of emissions and employment impact of six regions' COVID-19 recovery plans

- Solar photovoltaics funding dominance maximizes emissions cuts and employment gains

- Green recovery packages can have notable impacts in the EU and China

- Size of outcomes is highly dependent on the specific energy-economy model used

Figure 75: COVID-19 recovery packages can benefit climate targets and clean energy jobs, but scale of impacts and optimal investment portfolios differ among major economies

2.76 Perdana and Vielle (2022), Energy Policy

Title:	Making the EU Carbon Border Adjustment Mechanism acceptable and climate friendly for least developed countries
Authors:	Sigit Perdana (EPFL), Marc Vielle (EPFL)
Journal:	Energy Policy
Abstract:	Implementation of CBAM to support EU climate neutrality by 2050 has raised several concerns. As the mechanism aims to minimise leakage through equal fairness in global mitigation, imposing carbon tariffs on the EU's imports of energy-intensive goods could curtail the export of EU trading partners. This might be detrimental, especially to the LDCs, due to their high exposures and vulnerability risks. This paper assesses and quantifies the implication of EU-CBAM and analyses eight complementary measures to mitigate the impacts on LDCs. Scenario developments are constructed by projecting the EU's new climate targets relative to the reference scenario of the EU's current policies. A more stringent climate target results in carbon leakage, and implementing CBAM will reduce the rate by one-third by 2040. The analysis also confirms significant welfare loss for LDCs through declining exports. Exempting LDCs from EU CBAM is less justifiable, as this measure results in greater leakage than other options. A further assessment confirms that policy recommendation for CBAM complementary measures should focus on the climate transformation pathway for LDCs. EU CBAM implementation with revenue-redistribution targeted to promote clean and efficient use of energy in LDCs has improved the welfare of recipient countries, substantially reduced leakage, and proven cost-efficient for the EU.
Keywords:	Carbon Border Adjustment Mechanism, Climate finance, Computable general equilibrium model, International competitiveness, Developing countries
DOI:	https://doi.org/10.1016/j.enpol.2022.113245
Open Access:	Golden
First Online:	September 19, 2022
Repository:	Zenodo (link: https://zenodo.org/record/7198995#.Y1fjJ3ZByUk)
Synergies with:	N/A
Citation (APA):	Perdana, S., & Vielle, M. (2022). Making the EU carbon border adjustment mechanism acceptable and climate friendly for least developed countries. *Energy Policy, 170*, 113245.

Making the EU Carbon Border Adjustment Mechanism acceptable and climate friendly for least developed countries

Sigit Perdana [1] ✉, Marc Vielle [2] ✉

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Highlights

- Model-based simulation analysing the effect of the EU Carbon Border Adjustment.

- Adverse effects for least developing countries; complementary measures are needed.

- Exemption improves welfare, yet with a significant increase of leakage.

- Revenue used for green transformation limits leakages with lower welfare cost.

Figure 76: Preview of Making the EU Carbon Border Adjustment Mechanism acceptable and climate friendly for least developed countries

2.77 Yang et al. (2022), Nature Energy

Title:	Breaking the hard-to-abate bottleneck in China's path to carbon neutrality with clean hydrogen
Authors:	Xi Yang (CUP), Chris P. Nielsen, Shaojie Song, Michael B. McElroy
Journal:	Nature Energy
Abstract:	Countries such as China are facing a bottleneck in their paths to carbon neutrality: abating emissions in heavy industries and heavy-duty transport. There are few in-depth studies of the prospective role for clean hydrogen in these 'hard-to-abate' (HTA) sectors. Here we carry out an integrated dynamic least-cost modelling analysis. Results show that, first, clean hydrogen can be both a major energy carrier and feedstock that can significantly reduce carbon emissions of heavy industry.
Keywords:	China, hydrogen
DOI:	https://doi.org/10.1038/s41560-022-01114-6
Open Access:	Golden
First Online:	September 29, 2022
Repository:	Zenodo (link: https://zenodo.org/record/7199028#.Y1fjc3ZByUk)
Synergies with:	Energy Foundation Project 'Advanced Technologies for Decarbonization of China's Iron and Steel Sector' (grant number 2206-33971) & Energy Foundation Project 'Technology Systems for Carbon Neutrality' (grant number G-2008-32164)
Citation (APA):	Yang, X., Nielsen, C. P., Song, S., & McElroy, M. B. (2022). Breaking the hard-to-abate bottleneck in China's path to carbon neutrality with clean hydrogen. Nature Energy, *7*, 955-965.

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Breaking the hard-to-abate bottleneck in China's path to carbon neutrality with clean hydrogen

Xi Yang ✉, Chris P. Nielsen, Shaojie Song & Michael B. McElroy ✉

Abstract

Countries such as China are facing a bottleneck in their paths to carbon neutrality: abating emissions in heavy industries and heavy-duty transport. There are few in-depth studies of the prospective role for clean hydrogen in these 'hard-to-abate' (HTA) sectors. Here we carry out an integrated dynamic least-cost modelling analysis. Results show that, first, clean hydrogen can be both a major energy carrier and feedstock that can significantly reduce carbon emissions of heavy industry. It can also fuel up to 50% of China's heavy-duty truck and bus fleets by 2060 and significant shares of shipping. Second, a realistic clean hydrogen scenario that reaches 65.7 Mt of production in 2060 could avoid US$1.72 trillion of new investment compared with a no-hydrogen scenario. This study provides evidence of the value of clean hydrogen in HTA sectors for China and countries facing similar challenges in reducing emissions to achieve net-zero goals.

Figure 77: Preview of Breaking the hard-to-abate bottleneck in China's path to carbon neutrality with clean hydrogen

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

Page 166 of 244

2.78 Koutsellis et al. (2022), IEEE International Conference on Information, Intelligence, Systems & Applications

Title: Normalising the Output of Fuzzy Cognitive Maps

Authors: Themistoklis Koutsellis (NTUA), Alexandros Nikas (NTUA), Konstantinos Koasidis (NTUA), Georgios Xexakis (Holistic), Christos Petkidis (Holistic), Anastasios Karamaneas (NTUA), Haris Doukas (NTUA)

Journal: IEEE International Conference on Information, Intelligence, Systems & Applications

Abstract:

Fuzzy cognitive maps (FCMs) constitute a quasi-quantitative modelling tool with the inherent ability to reduce the computational and data complexity of a represented system, as well as engage experts in the process to introduce human cognition in terms of how a system behaves. However, despite being constructed with and for experts, aiming to assist them into better understanding system dynamics, the interpretation of the semi-quantitative outputs of FCMs has been found challenging. The use of transfer functions in the FCM iterations has led to the distortion of the output values, hampering the qualitative interpretation of the results, and making it difficult for experts to understand the link with the fuzzy input they provided. For this reason, this study introduces a normalisation procedure, following an optimal selection of the λ parameter of the sigmoid and hyperbolic tangent functions, to enable operating the transfer functions in the "almost linear" area, and then map the output domain into the input domain by a means of a linear transformation. Based on a case study in the energy field, we find that the proposed procedure reduces the distortion caused by the transfer functions, compresses the results and avoids the risk of exaggerating the differences in the output values, and thus builds towards enhancing FCMs' ability to provide qualitatively interpretable results.

Keywords: Fuzzy cognitive maps

DOI: https://doi.org/10.1109/IISA56318.2022.9904369

Open Access: Green (embargoed until September 30, 2024)

First Online: September 30, 2022

Repository: Zenodo (link: https://zenodo.org/record/7234080#.Y1fjs3ZByUk)

Synergies with: N/A

Citation (APA):   Koutsellis, T., Nikas, A., Koasidis, K., Xexakis, G., Petkidis, C., Karamaneas, A., & Doukas, H. (2022). Normalising the Output of Fuzzy Cognitive Maps. In *2022 13th International Conference on Information, Intelligence, Systems & Applications (IISA)* (pp. 1-7). IEEE.

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Normalising the Output of Fuzzy Cognitive Maps

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Themistoklis Koutsellis ; Alexandros Nikas ; Konstantinos Koasidis ; George Xexakis ; Christos Petkidis ; Anastasios Karamaneas ; Haris Doukas   **All Authors**

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Abstract

Document Sections

I. Introduction

II. Theoretical Background & Problem Description

III. Normalisation In the Case of the Sigmoid Transfer Function

IV. Normalisation In the Case of the Hyperbolic Tangent Transfer Function

V. Case Study Validation of the Proposed Framework

Abstract:

Fuzzy cognitive maps (FCMs) constitute a quasi-quantitative modelling tool with the inherent ability to reduce the computational and data complexity of a represented system, as well as engage experts in the process to introduce human cognition in terms of how a system behaves. However, despite being constructed with and for experts, aiming to assist them into better understanding system dynamics, the interpretation of the semi-quantitative outputs of FCMs has been found challenging. The use of transfer functions in the FCM iterations has led to the distortion of the output values, hampering the qualitative interpretation of the results, and making it difficult for experts to understand the link with the fuzzy input they provided. For this reason, this study introduces a normalisation procedure, following an optimal selection of the λ parameter of the sigmoid and hyperbolic tangent functions, to enable operating the transfer functions in the "almost linear" area, and then map the output domain into the input domain by a means of a linear transformation. Based on a case study in the energy field, we find that the proposed procedure reduces the distortion caused by the transfer functions, compresses the results and avoids the risk of exaggerating the differences in the output values, and thus builds towards enhancing FCMs' ability to provide qualitatively interpretable results.

Figure 78: Preview of Normalising the Output of Fuzzy Cognitive Maps

2.79 Forouli et al. (2022), SoftwareX

Title:	AUGMECON-Py: A Python framework for multi-objective linear optimisation under uncertainty
Authors:	Aikaterini Forouli (NTUA), Anastasios Pagonis (NTUA), Alexandros Nikas (NTUA), Konstantinos Koasidis (NTUA), Georgios Xexakis (Holistic), Themistoklis Koutsellis (NTUA), Christos Petkidis (Holistic), Haris Doukas (NTUA)
Journal:	SoftwareX
Abstract:	This paper presents AUGMECON-Py, a Python framework for solving large and complex multi-objective linear programming problems under uncertainty, optimally and robustly capturing all solutions. On the core of the AUGMECON-Py software lies the integration of a well-established optimisation algorithm (AUGMECON) with Monte Carlo analysis that helps maximise robustness against stochastic uncertainty, thereby avoiding the complexity of numerous cascading methods and code scripts. Using an object-oriented language, AUGMECON-Py overcomes limitations of its predecessors regarding memory requirements, and further extends the solution algorithm to ensure no efficient solution is left outside the solution grid. The framework is easily accessible, offering effortless data pre- and post-processing, management, and visualisation of results.
Keywords:	Multi-objective linear programming, Uncertainty analysis, Python, ε-constraint
DOI:	https://doi.org/10.1016/j.softx.2022.101220
Open Access:	Golden
First Online:	October 17, 2022
Repository:	Zenodo (link: https://zenodo.org/record/7271688#.Y2FLQ3ZByUk)
Synergies with:	N/A
Citation (APA):	Forouli, A., Pagonis, A., Nikas, A., Koasidis, K., Xexakis, G., Koutsellis, T., … & Doukas, H. (2022). AUGMECON-Py: A Python framework for multi-objective linear optimisation under uncertainty. *SoftwareX*, *20*, 101220.

Original software publication

AUGMECON-Py: A Python framework for multi-objective linear optimisation under uncertainty

Aikaterini Forouli [a] [⊠], Anastasios Pagonis [a] [⊠], Alexandros Nikas [b] [⊠], Konstantinos Koasidis [a] [⊠], Georgios Xexakis [c] [⊠], Themistoklis Koutsellis [b] [⊠], Christos Petkidis [c] [⊠], Haris Doukas [b] [⊠]

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Abstract

This paper presents AUGMECON-Py, a Python framework for solving large and complex multi-objective linear programming problems under uncertainty, optimally and robustly capturing all solutions. On the core of the AUGMECON-Py software lies the integration of a well-established optimisation algorithm (AUGMECON) with Monte Carlo analysis that helps maximise robustness against stochastic uncertainty, thereby avoiding the complexity of numerous cascading methods and code scripts. Using an object-oriented language, AUGMECON-Py overcomes limitations of its predecessors regarding memory requirements, and further extends the solution algorithm to ensure no efficient solution is left outside the solution grid. The framework is easily accessible, offering effortless data pre- and post-processing, management, and visualisation of results.

Figure 79: Preview of AUGMECON-Py: A Python framework for multi-objective linear optimisation under uncertainty

2.80 Yang et al. (2022),Current Climate Change Reports

Title:	Assessing Methane Emissions From the Natural Gas Industry: Reviewing the Case of China in a Comparative Framework
Authors:	Xi Yang (CUP), Yiying Gao, Mingzhe Zhu, Cecilia Springer
Journal:	Currenct Climate Change Reports

Abstract:

The aim of this paper is to explore methane emissions from China's fossil fuel industry compared with the USA and Canada, with a focus on the methane emission mechanisms, calculation methods, mitigation potential, and abatement technologies. As a large methane-emitting country, China lags behind the USA and Canada in methane emission reduction. Therefore, Chinese scientists, policy makers, and entrepreneurs should pay attention to methane emissions.

Keywords:	Methane, China, USA, Canada
DOI:	https://doi.org/10.1007/s40641-022-00187-5
Open Access:	Green (embargoed until October 18, 2023)
First Online:	October 18, 2022
Repository:	Zenodo (link: https://zenodo.org/record/7271706#.Y2FLU3ZByUk)
Synergies with:	N/A
Citation (APA):	Yang, X., Gao, Y., Zhu, M., & Springer, C. (2022). Assessing Methane Emissions From the Natural Gas Industry: Reviewing the Case of China in a Comparative Framework. *Current Climate Change Reports*, in press.

SpringerLink

Assessing Methane Emissions From the Natural Gas Industry: Reviewing the Case of China in a Comparative Framework

Xi Yang ✉, Yiying Gao, Mingzhe Zhu & Cecilia Springer

Abstract

Purpose of Review

The aim of this paper is to explore methane emissions from China's fossil fuel industry compared with the USA and Canada, with a focus on the methane emission mechanisms, calculation methods, mitigation potential, and abatement technologies.

Recent Findings

This paper explores the methane emissions from China's natural gas industry from a comparative perspective. The main conclusions are as follows: (1) methane emissions from the natural gas production phase are the largest in the whole natural gas supply chain. (2) When it comes to measurement and estimation methods, methane emissions in the gas industry in the USA and Canada typically achieve a Tier 3 level, while China tends to be at the Tier 1 and Tier 2 levels. (3) There is large mitigation potential for methane emissions from the natural gas industry. More effective waste reduction technologies like green well completion should be implemented in the production phase, especially in China. At the same time, more attention should be drawn to the need for leakage detection technologies of pipelines in all countries compared here.

Figure 80: Preview of Assessing Methane Emissions From the Natural Gas Industry: Reviewing the Case of China in a Comparative Framework

2.81 Koasidis et al. (2022),Energy Policy

Title:	Towards a green recovery in the EU: Aligning further emissions reductions with short- and long-term energy-sector employment gains
Authors:	Konstantinos Koasidis (NTUA), Alexandros Nikas (NTUA), Dirk-Jan van de Ven (BC3), Georgios Xexakis (Holistic), Aikaterini Forouli (NTUA), Shivika Mittal (Imperial), Ajay Gambhir (Imperial), Themistoklis Koutsellis (NTUA), Haris Doukas (NTUA)
Journal:	Energy Policy
Abstract:	To tackle the negative socioeconomic implications of the COVID-19 pandemic, the European Union (EU) introduced the Recovery and Resilience Facility, a financial instrument to help Member States recover, on the basis that minimum 37% of the recovery funds flow towards the green transition. This study contributes to the emerging modelling literature on assessing COVID-19 vis-à-vis decarbonisation efforts, with a particular focus on employment, by optimally allocating the green part of the EU recovery stimulus in selected low-carbon technologies and quantifying the trade-offs between resulting emissions reductions and employment gains in the energy sector. We couple an integrated assessment model with a multi-objective linear-programming model and an uncertainty analysis framework aiming to identify robust portfolio mixes. We find that it is possible to allocate recovery packages to align mitigation goals with both short- and long-term energy-sector employment, although over-emphasising the longer-term sustainability of new energy-sector jobs may be costlier and more vulnerable to uncertainties compared to prioritising environmental and near-term employment gains. Robust portfolios with balanced performance across objectives consistently feature small shares of offshore wind and nuclear investments, while the largest chunks are dominated by onshore wind and biofuels, two technologies with opposite impacts on near- and long-term employment gains.
Keywords:	Economic recovery, Employment, Integrated assessment modelling, Portfolio analysis, Uncertainty, Climate policy
DOI:	https://doi.org/10.1016/j.enpol.2022.113301
Open Access:	Golden
First Online:	October 22, 2022
Repository:	Zenodo (Link: https://zenodo.org/record/7271736#.Y2FLYHZByUk)
Synergies with:	N/A
Citation (APA):	Koasidis, K., Nikas, A., Van de Ven, D. J., Xexakis, G., Forouli, A., Mittal, S., … & Doukas, H. (2022). Towards a green recovery in the EU: Aligning further emissions reductions with short- and long-term energy-sector employment gains. *Energy Policy*, *171*, 113301.

Towards a green recovery in the EU: Aligning further emissions reductions with short- and long-term energy-sector employment gains

Konstantinos Koasidis [a], Alexandros Nikas [a] ⚇ ✉, Dirk-Jan Van de Ven [b], Georgios Xexakis [c], Aikaterini Forouli [a], Shivika Mittal [d], Ajay Gambhir [d], Themistoklis Koutsellis [a], Haris Doukas [a]

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Highlights

- The EU recovery strategy prioritises investments promoting the green transition.

- We employ a methodology based on GCAM, portfolio theory, and Monte Carlo analysis.

- We find considerable trade-offs among emissions cuts and new near- and long-term jobs.

- Robust, optimal subsidy portfolios include wind, biofuels, and small nuclear shares.

- COVID recovery can boost renewables penetration, but short of the intended 200 GW goal.

Figure 81: Towards a green recovery in the EU: Aligning further emissions reductions with short- and long-term energy-sector employment gains

2.82 Cassetti et al. (2022), Energy

Title:	The interplay among COVID-19 economic recovery, behavioural changes, and the European Green Deal: An energy-economic modelling perspective
Authors:	Gabriele Cassetti (E4SMA), Baptiste Boitier (SEURECO), Alessia Elia (E4SMA), Pierre Le Mouël (SEURECO) ,Maurizio Gargiulo (E4SMA), Paul Zagamé (SEURECO), Alexandros Nikas (NTUA), Konstantinos Koasidis (NTUA), Haris Doukas (NTUA), Alessandro Chiodi (E4SMA)
Journal:	Energy

Abstract:	In the EU, COVID-19 and associated policy responses led to economy-wide disruptions and shifts in services demand, with considerable energy-system implications. The European Commission's response paved the way towards enhancing climate ambition through the European Green Deal. Understanding the interactions among environmental, social, and economic dimensions in climate action post-COVID thus emerged as a key challenge. This study disaggregates the implications of climate ambition, speed of economic recovery from COVID-19, and behavioural changes due to pandemic-related measures and/or environmental concerns for EU transition dynamics, over the next decade. It soft-links two large-scale energy-economy models, EU-TIMES and NEMESIS, to shed light on opportunities and challenges related to delivering on the EU's 2030 climate targets. Results indicate that half the effort required to reach the updated 55% emissions reduction target should come from electricity decarbonisation, followed by transport. Alongside a post-COVID return to normal, the European Green Deal may lead to increased carbon prices and fossil-fuel rebounds, but these risks may be mitigated by certain behavioural changes, gains from which in transport energy use would outweigh associated consumption increases in the residential sector. Finally, the EU recovery mechanism could deliver about half the required investments needed to deliver on the 2030 ambition.

Keywords:	Europe, Energy-economic modelling, European green deal, COVID-19, Economic recovery, Behavioural change
DOI:	https://doi.org/10.1016/j.energy.2022.125798
Open Access:	Golden
First Online:	October 31, 2022
Repository:	Zenodo (Link: https://zenodo.org/record/7308403#.Y2vb-3ZByUk)
Synergies with:	HFRI ATOM (GA: HFRI-FM17–2566)
Citation (APA):	Cassetti, G., Boitier, B., Elia, A., Le Mouël, P., Gargiulo, M., Zagamé, P., ... & Chiodi, A. (2022). The interplay among COVID-19 economic recovery, behavioural changes, and the European Green Deal: An energy-economic modelling perspective. *Energy*, 125798.

The interplay among COVID-19 economic recovery, behavioural changes, and the European Green Deal: An energy-economic modelling perspective

Gabriele Cassetti [a], Baptiste Boitier [b], Alessia Elia [a], Pierre Le Mouël [b], Maurizio Gargiulo [a], Paul Zagamé [b, c], Alexandros Nikas [d] ✉, Konstantinos Koasidis [d], Haris Doukas [d], Alessandro Chiodi [a]

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Highlights

- This study soft-links an energy system model and a macroeconometric model for the EU.

- Electricity decarbonisation can make up half the effort to −55% followed by transport.

- Investments as part of EU green recovery could finance about half of what is required.

- The pandemic is unlikely to heavily impact the EU's long-term emissions trajectory.

- Work- and travel-related behaviour changes could considerably reduce investment needs.

Figure 82: Preview of The interplay among COVID-19 economic recovery, behavioural changes, and the European Green Deal: An energy-economic modelling perspective

2.83 Sognnaes (2022), Joule

Title:	What can we learn from probabilistic feasibility assessments?
Authors:	Ida Sognnaes (CICERO)
Journal:	Joule
Abstract:	In a new paper in Nature Energy, Odenweller et al. use uncertainty analysis to derive a probabilistic feasibility space for green hydrogen supply. Their analysis shows that even if electrolysis capacity grows as fast as wind and solar power have done, green hydrogen supply will remain scarce in the short term and uncertain in the long term.
Keywords:	Hydrogen, feasibility
DOI:	https://doi.org/10.1016/j.joule.2022.10.018
Open Access:	Green (Embargoed until November 16, 2023)
First Online:	November 16, 2022
Repository:	Zenodo (Link: https://zenodo.org/record/7360781#.Y4CicHZByUk)
Synergies with:	Horizon Europe IAM COMPACT (GA: 101056306) & Norwegian Research Council StressTest (grant no. 309613)
Citation (APA):	Sognnaes, I. (2022). What can we learn from probabilistic feasibility assessments?. *Joule*, *6*(11), 2450-2452.

Figure 83: Preview of What can we learn from probabilistic feasibility assessments?

2.84 Jochem et al. (2022), Transportation Research Part D: Transport and Environment

Title:	Where should electric vehicle users without home charging charge their vehicle?
Authors:	Patrick Jochem, Till Gnann, John E. Anderson, Moritz Bergfeld, Patrick Plötz (Fraunhofer ISI)
Journal:	Transportation Research Part D: Transport and Environment
Abstract:	An often-heard argument against using plug-in electric vehicles (PEV) by urban dwellers is the missing curbside charging option. Some users are even expecting these charging stations to deliver cheap electricity. However, from an economic perspective several arguments speak against this hope and, furthermore, the need of curbside chargers is often exaggerated in literature. Consequently, we shed more light into these two hypotheses (H1. curbside charging is very costly and H2. there is hardly any need for curbside charging) and base our arguments on current and representative mobility data from Germany. Policymakers may focus stronger on charging offers at workplace or shopping facilities for achieving an efficient allocation of charging infrastructure.
Keywords:	electric vehicles, Charging infrastructure, Curbside, Public Charging
DOI:	https://doi.org/10.1016/j.trd.2022.103526
Open Access:	Green (Embargoed until November 18, 2024)
First Online:	November 18, 2022
Repository:	Zenodo (Link: https://zenodo.org/record/7373218#.Y4TXHXZByUk)
Synergies with:	German Federal Ministry for Digital and Transport HoLa project (Grant no. 03EMF0404A)
Citation (APA):	Jochem, P., Gnann, T., Anderson, J. E., Bergfeld, M., & Plötz, P. (2022). Where should electric vehicle users without home charging charge their vehicle?. *Transportation Research Part D: Transport and Environment*, *113*, 103526.

Where should electric vehicle users without home charging charge their vehicle?

Patrick Jochem [a] 👤 ✉, Till Gnann [c], John E. Anderson [b], Moritz Bergfeld [b], Patrick Plötz [c]

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Abstract

An often-heard argument against using plug-in electric vehicles (PEV) by urban dwellers is the missing curbside charging option. Some users are even expecting these charging stations to deliver cheap electricity. However, from an economic perspective several arguments speak against this hope and, furthermore, the need of curbside chargers is often exaggerated in literature. Consequently, we shed more light into these two hypotheses (H1. curbside charging is very costly and H2. there is hardly any need for curbside charging) and base our arguments on current and representative mobility data from Germany. Policymakers may focus stronger on charging offers at workplace or shopping facilities for achieving an efficient allocation of charging infrastructure.

Figure 84: Preview of Where should electric vehicle users without home charging charge their vehicle?

2.85 Babonneau et al. (2022), Operations Research Letters

Title:	Reaching Paris Agreement Goal through Carbon Dioxide Removal Development: a Compact OR Model
Authors:	Frédéric Babonneau, Alain Haurie, Marc Vielle (EPFL)
Journal:	Operations Research Letters
Abstract:	A compact operations research (OR) model is proposed to analyse the prospects of meeting the Paris Agreement targets when direct air capture technologies can be used or not. The main features of the OR model are (i) the representation of the economy and energy use with a nested constant elasticity of substitution production function; (ii) the representation of climate policy through the use of a safety emissions budget concept; and (iii) the representation of an international emissions trading scheme for the implementation of climate policy. Using dynamic optimisation, several contrasting scenarios are analysed and the potential use of the model in future developments of climate/economy modelling is discussed.
Keywords:	Climate policy, Optimal economic growth, Dynamic optimisation model, Market equilibrium constraints, CO_2 direct reduction
DOI:	https://doi.org/10.1016/j.orl.2022.11.002
Open Access:	Green (Embargoed until November 21, 2024)
First Online:	November 21, 2022
Repository:	Zenodo (Link: https://zenodo.org/record/7376688#.Y4XqhnZByUk)
Synergies with:	N/A
Citation (APA):	Babonneau, F., Haurie, A., & Vielle, M. (2022). Reaching Paris Agreement Goal through Carbon Dioxide Removal Development: a Compact OR Model. *Operations Research Letters. In press*

Reaching Paris Agreement Goal through Carbon Dioxide Removal Development: a Compact OR Model

Frédéric Babonneau [a, b] ⚲ ✉, Alain Haurie [b, c, d], Marc Vielle [e]

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Abstract

A compact operations research (OR) model is proposed to analyse the prospects of meeting the Paris Agreement targets when direct air capture technologies can be used or not. The main features of the OR model are (i) the representation of the economy and energy use with a nested constant elasticity of substitution production function; (ii) the representation of climate policy through the use of a safety emissions budget concept; and (iii) the representation of an international emissions trading scheme for the implementation of climate policy. Using dynamic optimisation, several contrasting scenarios are analysed and the potential use of the model in future developments of climate/economy modelling is discussed.

Figure 85: Preview of Reaching Paris Agreement Goal through Carbon Dioxide Removal Development: a Compact OR Model

2.86 Perdana et al. (2022), Energy Strategy Reviews

Title:	European Economic impacts of cutting energy imports from Russia: A computable general equilibrium analysis
Authors:	Sigit Perdana (EPFL), Marc Vielle (EPFL), Maxime Schenckery
Journal:	Energy Strategy Reviews

Abstract:

The recent economic sanctions against Russia can jeopardise the sustainability of the European Union's (EU) energy supply. Despite the EU's strong commitment to stringent abatement targets, fossil fuels still play a significant role in the EU energy policy. Furthermore, high dependency on Russian energy supplies underlines the vulnerability of the EU energy security. Using a global computable general equilibrium model, we prove that the current EU embargo on coal and oil imported from Russia will have adverse supply effects, substantially increasing energy prices and welfare costs for the EU resident. Although it reduces emissions, extending the embargo to include natural gas doubles this welfare cost. The use of coal is likely to increase, especially with respect to EU electricity generation, given the current constraints of additional import capacities from non-Russian producers. The impact on Russia once the EU extends the sanctions to natural gas is less substantial than on the EU. Russian welfare cost will increase less than 50%, indicating that extending the current restriction to boycott Russian gas is a costly policy option.

Keywords:	European union, Russia, Computable general equilibrium model, Fit for 55 package, Imports ban
DOI:	https://doi.org/10.1016/j.esr.2022.101006
Open Access:	Golden
First Online:	November 26, 2022
Repository:	Zenodo (Link: https://zenodo.org/record/7373252#.Y4TYFnZByUk)
Synergies with:	N/A
Citation (APA):	Perdana, S., Vielle, M., & Schenckery, M. (2022). European economic impacts of cutting energy imports from Russia: A computable general equilibrium analysis. *Energy Strategy Reviews*, *44*, 101006. https://doi.org/10.1016/j.esr.2022.101006

Energy Strategy Reviews

Volume 44, November 2022, 101006

ELSEVIER

European Economic impacts of cutting energy imports from Russia: A computable general equilibrium analysis

Sigit Perdana [a] [1] ✉, Marc Vielle [a,2] ✉, Maxime Schenckery [b,3] ✉

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Highlights

- We simulate scenarios of EU embargo on Russian energy within the Fit for 55 package.

- Embargo on coal and oil costs 1'521 US$ per European cumulatively over 2022-2030.

- Extending the embargo to Russian natural gas will double the welfare cost for the EU.

- In the full embargo, European gas consumption will have to decrease by around 1/3.

- Embargo on coal and oil is more detrimental to Russia.

Figure 86: Preview of European Economic impacts of cutting energy imports from Russia: A computable general equilibrium analysis

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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2.87 Papers acknowledging the project that are not yet published

PARIS REINFORCE has been a project with significant scientific impact which has been quite prominent taking into consideration the multitude of peer-reviewed publications presented above. But, apart from these 86 published papers, as of November 2022 the project has submitted or is about to submit at least 33 more manuscripts. Below, we list the manuscripts that are being prepared or under review/in revision/accepted, etc., which acknowledge the project (non-exhaustive list):

1. Bailie, A., Pied, M., Vaillancourt, K., Bahn, O., Koasidis, K., Gambhir, A., Wachsmuth, J., Nikas, A., McWilliams, B., & Doukas, H. (n.d.). Co-creating Canada's path to net-zero: a stakeholder-driven modelling analysis. *Renewable and Sustainable Energy Transition*, to be submitted.

2. Campagnolo L., Delpiazzo E., Moreno J., Van de Ven D.-J. Chiodi A., Gargiulo M., Boitier B., Koasidis K., Doukas, H., & Nikas A. (n.d.). Paris-compliant sustainable development pathways in the EU: a multi-model study. *Nature Sustainability*, to be submitted.

3. Cassetti, G.,Elia, A.,Gargiulo, M., & Chiodi, A.(n.d.). Reinforcing the Paris Agreement: ambitious scenarios for the decarbonisation of the Central Asian and Caspian region. *Renewable & Sustainable Energy Transition*, in revision.

4. Di Lallo, G., Chiriacò, M. V., Tarasova, E., Köhl, M., & Perugini, L. (n.d.) The land sector in the low carbon emission strategies in the European Union: role and future expectations. *Climate Policy*, under review.

5. Fragkos, P., Kanellou, E., Konstantopoulos, G., Nikas, A., Fragkiadakis, K., Filippidou, F., Fotiou, T., & Doukas, H. (n.d.). Energy poverty and just transformation in Greece. *Lecture Notes in Energy, Springer*, in revision.

6. Frilingou, N., Xexakis, G., Koasidis, K., Nikas, A., Campagnolo, L., Delpiazzo, E., Chiodi, A., Gargiulo, M., McWilliams, B., Koutsellis, T., & Doukas, H. (n.d.). Navigating through an energy crisis: challenges and progress towards electricity decarbonisation, reliability, and affordability in Italy. *Energy Research & Social Science*, in revision.

7. Galende-Sanchez, E., Sorman, A., Gonzalez-Eguino, M., Gonzalez-Medina, M., & Gomez-Fuertes, B. (n.d.) Time to listen: A deliberative survey on citizens' perspectives on the climate crisis in Spain. *Environmental Policy and Governance*, to be submitted.

8. Gambhir, A. (2022) Powering past coal is not enough. *Nature Climate Change*, accepted.

9. Gambhir, A. (2022). This really does change everything: attaining 1.5C needs all available mitigation levers, *Environmental Research Letters*, under review.

10. Giarola, S., Moya, D.A., García Kerdan, I., Hawkes, A., Koberle, A., & Gambhir, A. Exploring emission mitigation options for Brazil under different energy demand electrification growths. *Renewable and Sustainable Energy Transition,* to be submitted.

11. Joshi, S., Zakeri, B., Mittal, S., Mastrucci, A., Holloway, P., Krey, V., Shukla, P.R., Ó Gallachóir, B., & Glynn, J. (n.d.) Assessing the growing role of decentralised rooftop solar photovoltaics in future global energy system. *Joule*, under review.

12. Karamaneas, A., Koasidis, K., Frilingou, N., Xexakis, G., Nikas, A. & Doukas, H. (n.d.). A stakeholder-informed modelling study of Greece's energy transition amidst an energy crisis: the role of natural gas and climate ambition. *Renewable & Sustainable Energy Transition*, in revision.

13. Koasidis, K., Koutsellis, T., Xexakis, G., Nikas, A., & Doukas, H. (n.d.). Understanding expectations from and capabilities of climate-economy models for measuring the impact of crises on sustainability. *Journal of Cleaner Production*, under review.

14. Koasidis, K., Nikas, A., & Doukas, H. (n.d.). Why models alone are insufficient to navigate us through the

polycrisis. *One Earth*, to be submitted.

15. Köberle, A.C., Mittal, S., Gambhir, A., van de Ven, D.J., Bui, H., Campagnolo, L., Delpiazzo, E., Vielle, M., Perdana, S., Giarola, S., Koasidis, K., Rogelj, J., Anger-Kraavi, A., Peters, G., Soggnaes, I., Hawkes, A., Doukas H., & Nikas, A. (n.d.) Diagnosing inter-model differences in the macro-economic implications of deep mitigation. *Nature Climate Change*, to be submitted.

16. Koutsandreas, D., Trachanas, G.P., Pappis, I., Nikas, A., Doukas, H., & Psarras, J. (n.d.). A multicriteria modeling approach for evaluating power generation scenarios under uncertainty: The case of green hydrogen in Greece. *Energy Strategy Reviews*, under review.

17. Lahn, B., Ida, S., Hermansen, E. A. T., & Peters, G.P. (2023). Scenario users and the politics of scenario choice. *Climate Action*, to be submitted.

18. May, E., & Anger-Kraavi, A. (n.d.). The Global Stocktake: Where are we, where are we heading, and how do we achieve the Paris Agreement goals? *Renewable and Sustainable Energy Transitions*, to be submitted.

19. Mittal, S., Koberle, A., Shukla, P.R., & Gambhir, A. (n.d.) India's energy system transformation to net-zero. *Renewable and Sustainable Energy Transition*, to be submitted.

20. Moreno, J., Van de Ven, D.J., Sampedro, J., Gambhir, A., Woods, J., & Gonzalez-Eguino, M. (n.d.). Assessing synergies and trade-offs of diverging Paris-compliant mitigation strategies with long-term SDG objectives. *Global Environmental Change*, accepted.

21. Nikas, A., Gambhir, A., & Boitier, B. (n.d.) Surveying sustainable transitions around the world. *Renewable and Sustainable Energy Transition,* to be submitted.

22. Parris, H., & Anger-Kraavi, A. (n.d.). Are we talking ourselves out of limiting global warming to 1.5°C? *Climate Policy*, in revision.

23. Parris, H., Anger-Kraavi, A., & Peters, G.P. (n.d.). Does a change in the 'global net zero' language matter? *Global Sustainability*, in revision.

24. Perdana, S., & Vielle, M. (2022). Carbon border adjustment mechanism in the transition to net-zero emissions: collective implementation and distributional impacts. *Environmental Economics and Policy Studies*, in revision.

25. Perdana, S., Xexaxis, G., Koasidis, K., Vielle, M., Nikas, A., Doukas, H., Gambhir, A., Anger-Kravi, A., May, E., McWilliams, B., & Boitier, B. (2022). Expert perceptions of game-changing innovations toward net zero. *Energy Strategy Reviews*, in revision.

26. Plötz, P., Wachsmuth, J., Sprei, F., Gnann, T., Speth, D., Neuner, F., & Link, S. (2022): Policies and Greenhouse Gas Budgets for Zero-Carbon Road Transport. *Climate Policy*, in revision.

27. Riemer, M., Wachsmuth, J., Boitier, B., & Elia, A. (n.d.): How can system-wide net-zero scenarios be informed by bottom-up sector models? A novel approach based on benchmarking indicators and index decomposition analysis. *Energy Strategy Reviews*, to be submitted.

28. Russo, M., Anger-Kraavi, A., & Archibald, A. (n.d.). Limited Climate Impacts from IAMs and scenario uncertainties. *Science of the Total Environment*, to be submitted.

29. Shirov, A.A., Kolpakov, A.Y., Gambhir, A., Koasidis, K., Koberle, A.C., McWilliams, B., & Nikas, A. (n.d.). Stakeholder-driven scenario analysis of ambitious decarbonisation of the Russian economy. *Renewable & Sustainable Energy Transition*, under review.

30. Van de Ven, D.J., Mittal, S., Gambhir, A., Doukas, H., Giarola, S., Hawkes, A., Koasidis, K., Koberle, A.C., Lamboll, R., McJeon, H., Perdana, S., Peters, G.P., Rogelj, J., Sognnaes, I., Vielle, M., & Nikas, A. (n.d.). A multi-model analysis of post-Glasgow climate action and feasibility gap. *Nature Climate Change*, under

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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review.

31. Wachsmuth, J., Jackwerth-Rice, T., Seus, S., & Warnke, P. (n.d.): A A Methodology for Co-Creating Transformative Policy Mixes as an Approach to Generalise Diffusion-Based Transition Pathways. *Technological Forecasting and Social Change*, under review.

32. Wachsmuth, J., Warnke, P., Gambhir, A., Giarola, S., Koasidis, K., Nikas, A., Pied, M., Vaillancourt, K., & Bailie, A. (n.d.): Co-Creating Transformative Policy Mixes: Comparison of National Case Studies. *Renewable & Sustainable Energy Transition*, to be submitted.

33. Yang, X., De Miglio, R., & Cassetti, G. (n.d). Greening China's BRI in Central Asian Countries: The Role of Hydrogen Towards Net-Zero Future. *One Earth*, in revision.

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

- Doukas, H., & Anger-Kraavi, A. (2020). Editorial of special issue on transdisciplinary science in energy transitions: thinking outside strictly formalized modeling boxes. *Energy Sources, Part B: Economics, Planning, and Policy*, *15*(10-12), 453-454.

- 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.

- 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.
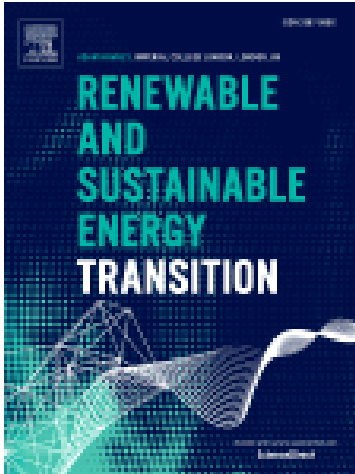
3.2 Special Issue in Renewable and Sustainable Energy Transition

The call for papers for this special issue on the subject of "Promoting sustainable transitions across the globe" has a submission deadline of January 31, 2023, thus there is still limited information on the papers included in this Special Issue.

This Special Issue explores a range of feasible yet ambitious greenhouse gas emissions reduction pathways in major regions/countries of the world, in principle compatible with the goals of the Paris Agreement on climate change. Each of the region's low-carbon pathways have been developed using energy system models or whole economy models, in most cases using mitigation scenarios co-created with a range of policy, civil society, academic and business stakeholders.

The guest editors for the issue are Dr. Ajay Gambhir (Imperial), Dr. Alexandros Nikas (NTUA) and Dr. Baptiste Boitier (SEURECO).

List of submitted papers so far:

1. Cassetti, G.,Elia, A.,Gargiulo, M., & Chiodi, A.(n.d.). Reinforcing the Paris Agreement: ambitious scenarios for the decarbonisation of the Central Asian and Caspian region. *Renewable & Sustainable Energy Transition, in revision.*

2. Karamaneas, A., Koasidis, K., Frilingou, N., Xexakis, G., Nikas, A., & Doukas, H. (n.d.). A stakeholder-informed modelling study of Greece's energy transition amidst an energy crisis: the role of natural gas and climate ambition. *Renewable & Sustainable Energy Transition, in revision.*

3. Murugesan, M., Reedman, L., Brinsmead, T.S., Rifkin, W., Mallavarapu, M., & Gordon, J. (n.d.). Modelling least-cost technology pathways to decarbonise the New South Wales energy system by 2050. *Renewable & Sustainable Energy Transition, in press.*

4. Shah, K.U., Blechinger, P., & Raghoo, P. (n.d.). A moratorium on coal in Indonesia? Analyzing least-cost and low-carbon strategies to meet growing electricity demand. *Renewable & Sustainable Energy Transition, under review.*

5. Shirov, A.A., Kolpakov, A.Y., Gambhir, A., Koasidis, K., Koberle, A.C., McWilliams, B., & Nikas, A. (n.d.). Stakeholder-driven scenario analysis of ambitious decarbonisation of the Russian economy. *Renewable & Sustainable Energy Transition, under review.*

6. Taliotis, C., Karmellos, M., Fylaktos, N., & Zachariadis, T. (n.d.). Enhancing Decarbonization of Power Generation Through Electricity Trade in the Eastern Mediterranean and Middle East Region. *Renewable & Sustainable Energy Transition, under review.*

Furthermore, the consortium will be submitting at least 6 more papers to the Special Issue in December 2022, documenting the project's latest scientific findings:

1. Bailie, A., Pied, M., Vaillancourt, K., Bahn, O., Koasidis, K., Gambhir, A., Wachsmuth, J., Nikas, A., McWilliams, B., & Doukas, H. (n.d.). Co-creating Canada's path to net-zero: a stakeholder-driven modelling analysis. *Renewable & Sustainable Energy Transition*, to be submitted

2. Giarola, S., Moya, D.A., García Kerdan, I., Hawkes, A., Koberle, A., & Gambhir, A. Exploring emission mitigation options for Brazil under different energy demand electrification growths. *Renewable & Sustainable Energy Transition,* to be submitted

3. May, E., & Anger-Kraavi, A. (n.d.). The Global Stocktake: Where are we, where are we heading, and how do we achieve the Paris Agreement goals? *Renewable & Sustainable Energy Transitions*, to be submitted

4. Mittal, S., Koberle, A., Shukla, P.R., & Gambhir, A. (n.d.) India's energy system transformation to net-zero. *Renewable & Sustainable Energy Transition*, to be submitted

5. Wachsmuth, J., Warnke, P., Gambhir, A., Giarola, S., Koasidis, K., Nikas, A., Pied, M., Vaillancourt, K., & Bailie, A. (n.d.): Co-Creating Transformative Policy Mixes: Comparison of National Case Studies. *Renewable & Sustainable Energy Transition*, to be submitted.

6. Nikas, A., Gambhir, A., & Boitier, B. (n.d.) Surveying sustainable transitions around the world. *Renewable and Sustainable Energy* Transition, *to be submitted*.

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.

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 I²AM 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 I²AM 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 I²AM PARIS platform. EMF 35: Japan Model Inter-Comparison Project (JMIP) on long-term climate policy. December 5, 2019, Tokyo, Japan.

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

Title:	The H2020 Project PARIS REINFORCE
Type	Presentation
Authors:	Maurizio Gargiulo (E4SMA)

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.

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 (BC3) 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 I²AM 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.

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 (CICERO), 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

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.

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.

4.7 Current and Future Challenges to Energy Security, 5th AIEE Energy Symposium, December 15-17, 2020

Title:	The BRIDGE study: "Belt and Road Initiative and the Development of Green Economies" - Challenges and opportunities for a Green BRI
Type	Presentation
Authors:	Rocco De Miglio (E4SMA), Gabriele Cassetti (E4SMA), Xi Yang (CUP)
Abstract:	This study analyses the impact of China's hydrogen economy on its border Belt and Road Initiative (BRI) countries under a regional long-term nearly-zero vision.
Conference:	5th AIEE Energy Symposium
Date:	December 15-17, 2020
Venue:	Milan, Italy (Hybrid)
Citation (APA):	De Miglio, R., Cassetti, G., Yang, Y., (2020), The BRIDGE study:"Belt and Road Initiative and the Development of Green Economies"-Challenges and opportunities for a Green BRI. In *5th AIEE Energy Symposium.*

4.8 Energy, COVID and Climate Change, 1st IAEE Online Conference, June 7-9, 2021

Title: Multi-Objective Evaluation of Renewable Technology Subsidy Portfolios from COVID-19 Recovery Packages

Type Presentation

Authors: Aikaterini Forouli (NTUA), Dirk-Jan Van de Ven (BC3), Konstantinos Koasidis (NTUA), Alexandros Nikas (NTUA), Ajay Gambhir (Imperial), Themistoklis Koutsellis (NTUA), Anastasios Karamaneas (NTUA), Haris Doukas (NTUA)

Abstract: To support the green transition, national recovery and resilience plans should allocate at least 37% of investments towards battling climate change and be aligned with the updated target of the European Green Deal of 55 emissions reduction by 2030. This study aims to optimise the impact of the proposed fiscal program and the budget allocated towards the "green" transition in terms of jobs created in the energy sector and further reduction of GHG emissions.

Conference: 1st IAEE Online Conference

Date: June 7-9, 2021

Venue: Online

Citation (APA): Forouli, A., Koasidis, K., Nikas, A., Unit, E. P., Koutsellis, T., Karamaneas, A., & Doukas, H. (2021). Multi-Objective Evaluation of Renewable Technology Subsidy Portfolios from COVID-19 Recovery Packages. In *Energy, COVID, and Climate Change, 1st IAEE Online Conference, June 7-9, 2021*. International Association for Energy Economics.

4.9 EUSPRI Conference 2021: Science and Innovation – an unseasy relationship? Rethinking the roles- and relations of STI Policies, June 9-11, 2021

Title:	Towards a Methodology for Co-Creating Transformative Policy Mixes
Type	Presentation
Authors:	Jakob Wachsmuth (Fraunhofer ISI), Thomas Jackwerth-Rice, Sarah Seus, Philine Warnke (Fraunhofer ISI)
Abstract:	The extent to which modelled future pathways support effective challenge-led policy making has been questioned for a long time, with one major issue being the insufficient integration with the perspectives of policymakers and further stakeholders.
Conference:	EUSPRI Conference 2021: Science and Innovation – an unseasy relationship? Rethinking the roles- and relations of STI Policies
Date:	June 9-11, 2021
Venue:	Oslo, Norway (Hybrid)
Citation (APA):	Wachsmuth, J., Jackwerth-Rice, T., Seus, S. & Warnke, P. (2021). Towards a Methodology for Co-Creating Transformative Policy Mixes. *EUSPRI Conference 2021: Science and Innovation – an uneasy relationship? Rethinking the roles and relations of STI policies.* Oslo (virtual). Extended abstract available at: https://www.euspri2021.no/wp-content/uploads/2021/06/Session-15.3.pdf.

4.10 XVI Conference of the Spanish Association for Energy Economics, June 29-30, 2021

Title:	Allocation of European green COVID-19 recovery packages to mitigation emissions and create jobs in crisis years.
Type	Presentation
Authors:	Dirk-Jan Van de Ven (BC3), Aikaterini Forouli (NTUA), Konstantinos Koasidis (NTUA), Ajay Gambhir (Imperial), Themistoklis Koutsellis (NTUA), Haris Doukas (NTUA), Alexandros Nikas (NTUA)
Abstract:	To support member states' economic recovery from the effects of COVID-19, the EU has mobilised financial resources as part of the long-term budget of 2021-2027 (European Commission, 2020a). Among the proposed recovery efforts, the EU launched the Recovery and Resilience Facility (RRF) to provide €672.5 billion of financial support to Member States in the coming years (European Commission, 2020b).
Conference:	XVI Conference of the Spanish Association for Energy Economics
Date:	June 29-30, 2021
Venue:	Online
Citation (APA):	Van de Ven, D.-J., Forouli, A., Koasidis, K., Gambhir, A., Koutsellis, T., Doukas, H., & Nikas, A. (2021). Allocation of European green COVID-19 recovery packages to mitigation emissions and create jobs in crisis years.. In *XVI Conference of the Spanish Association for Energy Economics.*

4.11 31st European Conference on Operation Research, July 11-14, 2021 (1/4)

Title:	Identifying optimal COVID-19 recovery packages: a robust IAM-portfolio analysis of renewable energy technological subsidisation
Type	Presentation
Authors:	Alexandros Nikas (NTUA), Aikaterini Forouli (NTUA), Dirk-Jan Van de Ven (BC3), Konstantinos Koasidis (NTUA), Ajay Gambhir (Imperial), Themistoklis Koutsellis (NTUA), Haris Doukas (NTUA)
Abstract:	The pandemic has had significant impacts on the European economy, with approximately 1.8 million EU citizens losing their jobs between September 2019 and September 2020. Towards facilitating a swift and sustainable recovery, the EU launched the Recovery and Resilience Facility (RRF) to provide €672.5 billion of financial support to Member States in the coming years. In line with the European Green Deal and climate efforts, 37% of investments in national plans requesting RRF financing must focus on a "green" transition.
Conference:	31st European Conference on Operation Research
Date:	July 11-14, 2021
Venue:	Athens, Greece (Hybrid)
Citation (APA):	Nikas, A., Forouli, A., Van de Ven, D.-J., Koasidis, K., Gambhir, A., Koutsellis, T., & Doukas, H. (2021). Identifying optimal COVID-19 recovery packages: a robust IAM-portfolio analysis of renewable energy technological subsidisation. In *31st European Conference on Operation Research*.

4.12 31st European Conference on Operation Research, July 11-14, 2021 (2/4)

Title:	Exploring the impact of analyst's choices in fuzzy cognitive maps for climate policy applications
Type	Presentation
Authors:	Themistoklis Koutsellis (NTUA), Konstantinos Koasidis (NTUA), Alexandros Nikas (NTUA), Haris Doukas (NTUA)
Abstract:	Fuzzy Cognitive Maps (FCMs) have recently gained ground in energy and climate policy applications, partly due to stakeholders encountering difficulties in understanding, or being excluded from, state-of-the-art policy support frameworks, like energy- and climate-economic modelling tools.
Conference:	31st European Conference on Operation Research
Date:	July 11-14, 2021
Venue:	Athens, Greece (Hybrid)
Citation (APA):	Koutsellis, T., Koasidis, K., Nikas, A., & Doukas, H. (2021). Exploring the impact of analyst's choices in fuzzy cognitive maps for climate policy applications. In *31st European Conference on Operation Research.*

4.13 31ˢᵗ European Conference on Operation Research, July 11-14, 2021 (3/4)

Title:	A multiple-criteria evaluation framework for seaport sustainability considering non-homogeneous variables and uncertainty: the case of Piraeus, Greece
Type	Presentation
Authors:	Eleni Kanellou (NTUA), Konstantinos Koasidis (NTUA), Vasiliki Daniil, Alexandros Nikas (NTUA), John Psarras (NTUA)
Abstract:	The maritime industry is associated with high amounts of emissions produced. With shipping being excluded from the Paris Agreement, the International Maritime Organization has set a 50% CO_2 emissions reduction target, although, a concrete pathway has yet to be established, with negotiations being in progress to set a roadmap for the sector after 2023. Seaports are critical in the sector's sustainability. Infrastructural interventions not only reduce direct emissions from ports, but also enable the use of a more efficient fleet.
Conference:	31ˢᵗ European Conference on Operation Research
Date:	July 11-14, 2021
Venue:	Athens, Greece (Hybrid)
Citation (APA):	Kanellou, E., Koasidis, K., Daniil, V., Nikas, A., & Psarras, J. (2021). A multiple-criteria evaluation framework for seaport sustainability considering non-homogeneous variables and uncertainty: the case of Piraeus, Greece. In *31st European Conference on Operation Research*.

4.14 31ˢᵗ European Conference on Operation Research, July 11-14, 2021 (4/4)

Title:	Interlinking climate action and sustainable development: a fuzzy linguistic group decision making framework
Type	Presentation
Authors:	Anastasios Karamaneas (NTUA), Lorenza Campagnolo (CMCC), Konstantinos Koasidis (NTUA), Michael Saulo, Ioannis Tsipouridis, Ajay Gambhir (Imperial), Dirk-Jan Van de Ven (BC3), Zsolt Lengyel (IEECP), Ben McWilliams (Bruegel), Alexandros Nikas (NTUA), Haris Doukas (NTUA)
Abstract:	The Paris Agreement and the 2030 Agenda for Sustainable Development embody highly intertwined targets and guidelines to act for the climate crisis in conjunction with sustainability. Interlinking climate action and sustainable development is key to prioritising research and informing future mitigation analysis and policy. Here we seek to establish a methodology for implicitly eliciting stakeholders' unbiased preferences, based on a fuzzy linguistic group decision making and consensus framework.
Conference:	31ˢᵗ European Conference on Operation Research
Date:	July 11-14, 2021
Venue:	Athens, Greece (Hybrid)
Citation (APA):	Karamaneas, A., Campagnolo, L., Koasidis, K., Saulo, M., Tsipouridis, I., Gambhir, A., Van de Ven, D.-J., Lengyel, Z., McWilliams, B., Nikas, A., & Doukas, H. (2021). Interlinking climate action and sustainable development: a fuzzy linguistic group decision making framework. In *31st European Conference on Operation Research*.

4.15 12th International Conference on Information, Intelligence, Systems and Applications, July 12-14, 2021

Title: Integrating Integrated Assessment Modelling in Support of the Paris Agreement: The I2AM PARIS Platform

Type Paper

Authors: Alexandros Nikas (NTUA), Stavros Skalidakis (NTUA), Alevgul Sorman (BC3), Esther Galende-Sanchez (BC3), Konstantinos Koasidis (NTUA), Filippos Serepas (NTUA), Dirk-Jan Van de Ven (BC3), Jorge Moreno (BC3), Anastasios Karamaneas (NTUA), Themistoklis Koutsellis (NTUA), Eleni Kanellou (NTUA), Haris Doukas (NTUA)

Abstract: Calls "to do science differently" and democratise the research process have proliferated in the last decades, especially in the context of climate science and policy support. This new arena demands more participatory procedures to expand the knowledge-making beyond researchers and experts. One way that science has started to interact with society has been the increasing number of online platforms that have emerged as alternative forums, providing the opportunity for engaging a variety of tools, models, results, and preferences.

Conference: 12th International Conference on Information, Intelligence, Systems and Applications

Date: July 12-14, 2021

Venue: Chania, Greece (Hybrid)

Citation (APA): Nikas, A., Skalidakis, S., Sorman, A. H., Galende-Sanchez, E., Koasidis, K., Serepas, F., ... & Doukas, H. (2021). Integrating integrated assessment modelling in support of the Paris Agreement: The I2AM PARIS platform. In *2021 12th International Conference on Information, Intelligence, Systems & Applications (IISA)* (pp. 1-8). IEEE.

4.16 6th HAEE Energy Transition Symposium, September 28 – October 1, 2021

Title:	6th HAEE Energy Transition Symposium
Type	Presentation
Authors:	Haris Doukas (NTUA)
Abstract:	N/A
Conference:	6th HAEE Energy Transition Symposium
Date:	28 September – October 1, 2021
Venue:	Athens, Greece (Hybrid)
Citation (APA):	Doukas, H. (2021). In *6th HAEE Energy Transition Symposium*.

4.17 2021 EU Conference on modelling for policy support: collaborating across disciplines to tackle key policy challenges, November 22-26, 2021

Title:	Investigating optimal allocation of green recovery funds in the EU
Type	Paper
Authors:	Alexandros Nikas (NTUA), Dirk-Jan Van de Ven (BC3), Aikaterini Forouli (NTUA), Konstantinos Koasidis (NTUA), Shivika Mittal (Imperial), Sara Giarola (Imperial), Ajay Gambhir (Imperial), Alexandre C. Koberle (Imperial), Alessandro Chiodi (E4SMA), Gabriele Cassetti (E4SMA), Maurizio Gargiulo (E4SMA), Sigit Perdana (EPFL), Marc Vielle (EPFL), Themistoklis Koutsellis (NTUA), Haris Doukas (NTUA)
Abstract:	The pandemic had dramatic economic consequences in the EU: despite significant public interventions, more than 1.8 million jobs were lost between September 2019 and September 2020. As fiscal stimulus measures have been and continue to be announced, policymakers can ensure that the short-term stimulus points the economic recovery in a sustainable direction in the long term; in doing so, they must consider the trade-off between these goals.
Conference:	2021 EU Conference on modelling for policy support: collaborating across disciplines to tackle key policy challenges
Date:	November 22-26, 2021
Venue:	Online
Citation (APA):	Nikas, A., Van de Ven, D.-J., Forouli, A., Koasidis, K., Mittal, S., Giarola, S., Gambhir, A., Koberle, A. C., Chiodi, A., Cassetti, G., Gargiulo, M., Perdana, S., Vielle, M., Koutsellis, T., & Doukas, H. (2021). 2021 Investigating optimal allocation of green recovery funds in the EU. In *2021 EU Conference on modelling*.

4.18 Fourteenth Annual Meeting of the Integrated Assessment Modeling Consortium (IAMC), November 29- December 3, 2021 (1/8)

Title:	An IAM-based framework for evaluating the environmental impact of low-cost technological solutions in the container shipping industry
Type	Poster
Authors:	Haris Doukas (NTUA), Evangelos Spiliotis (NTUA), Mohsen A. Jafari, Sara Giarola (Imperial), Alexandros Nikas (NTUA)
Abstract:	We focus on the container shipping industry and consider a low-cost technology, namely a lighter type of container, which can reduce fuel consumption and save trees. We evaluate the global impact of this technology until 2050 using an IAM, considering different projections about the future characteristics of the container fleet, including its capacity and size, as well as the main types of fuel and steaming practices used by the container ships.
Conference:	Fourteenth Annual Meeting of the Integrated Assessment Modeling Consortium (IAMC)
Date:	November 29- December 3, 2021
Venue:	Online
Citation (APA):	Doukas, H., Spiliotis, E., Jafari, M. A., Giarola, S., & Nikas, A. (2021). An IAM-based framework for evaluating the environmental impact of low-cost technological solutions in the container shipping industry. In *Fourteenth Annual Meeting of the Integrated Assessment Modeling Consortium (IAMC)*

4.19 Fourteenth Annual Meeting of the Integrated Assessment Modeling Consortium (IAMC), November 29- December 3, 2021 (2/8)

Title:	Allocating global COVID-19 recovery packages over low-carbon technologies to optimise between emission reductions and employment gains
Type	Presentation
Authors:	Alexandros Nikas (NTUA), Dirk-Jan Van de Ven (BC3), Konstantinos Koasidis (NTUA), Aikaterini Forouli (NTUA), Shivika Mittal (Imperial), Sara Giarola (Imperial), Ajay Gambhir (Imperial), Alexandre C. Koberle (Imperial), Alessandro Chiodi (E4SMA), Gabriele Cassetti (E4SMA), Maurizio Gargiulo (E4SMA), Sigit Perdana (EPFL), Marc Vielle (EPFL), Themistoklis Koutsellis (NTUA), Haris Doukas (NTUA)
Abstract:	N/A
Conference:	Fourteenth Annual Meeting of the Integrated Assessment Modeling Consortium (IAMC)
Date:	November 29- December 3, 2021
Venue:	Online
Citation (APA):	Nikas, A., Van de Ven, D.-J., Koasidis, K., Forouli, A., Mittal, S., Giarola, S., Gambhir, A., Koberle, A. C., Chiodi, A., Cassetti, G., Gargiulo, M., Perdana, S., Vielle, M., Koutsellis, T., & Doukas, H. (2021).). Allocating global COVID-19 recovery packages over low-carbon technologies to optimise between emission reductions and employment gains. In *Fourteenth Annual Meeting of the Integrated Assessment Modeling Consortium (IAMC).*

4.20 Fourteenth Annual Meeting of the Integrated Assessment Modeling Consortium (IAMC), November 29- December 3, 2021 (3/8)

Title:	A multi-model analysis of long-term emissions and warming implications of current mitigation efforts
Type	Presentation
Authors:	Ida Sognnaes (CICERO), Ajay Gambhir (Imperial), Dirk-Jan Van de Ven (BC3), Alexandros Nikas (NTUA), Annela Anger-Kraavi (Cambridge), Ha Bui, Lorenza Campagnolo (CMCC), Elisa Delpiazzo (CMCC), Haris Doukas (NTUA), Sara Giarola (Imperial), Neil Grant (Imperial), Adam Hawkes (Imperial), Alexandre C. Koberle (Imperial), Andrey Kolpakov, Shivika Mittal (Imperial), Jorge Moreno (BC3), Sigit P. Perdana (EPFL), Joeri Rogelj, Marc Vielle (EPFL), Glen P. Peters (CICERO)
Abstract:	N/A
Conference:	Fourteenth Annual Meeting of the Integrated Assessment Modeling Consortium (IAMC)
Date:	November 29- December 3, 2021
Venue:	Online
Citation (APA):	Sognnaes, I., Gambhir, A., Van de Ven, D.-J., Nikas, A., Anger-Kraavi, A., Bui, H., Campagnolo, L., Delpiazzo, E., Doukas, H., Giarola, S., Grant, N., Hawkes, A., Koberle, A. C., Kolpakov, A., Mittal, S., Moreno, J., Perdana, S. P., Rogelj, J., Vielle, M., & Peters, G. P. (2021). A multi-model analysis of long-term emissions and warming implications of current mitigation efforts. In *Fourteenth Annual Meeting of the Integrated Assessment Modeling Consortium (IAMC)*.

4.21 Fourteenth Annual Meeting of the Integrated Assessment Modeling Consortium (IAMC), November 29- December 3, 2021 (4/8)

Title:	Assessing SDG synergies and trade-offs of diverging Paris-compliant mitigation strategies
Type	Presentation
Authors:	Jorge Moreno (BC3), Dirk-Jan Van de Ven (BC3), Jon Sampedro (BC3), Ajay Gambhir (Imperial), Jem Woods, Mikel Gonzalez-Eguino (BC3)
Abstract:	N/A
Conference:	Fourteenth Annual Meeting of the Integrated Assessment Modeling Consortium (IAMC)
Date:	November 29- December 3, 2021
Venue:	Online
Citation (APA):	Moreno, J., Van de Ven, D.-J., Sampedro, J., Gambhir, A., Woods, J., & Gonzalez-Eguino, M. (2021). Assessing SDG synergies and trade-offs of diverging Paris-compliant mitigation strategies Presentation. In *Fourteenth Annual Meeting of the Integrated Assessment Modeling Consortium (IAMC)*.

4.22 Fourteenth Annual Meeting of the Integrated Assessment Modeling Consortium (IAMC), November 29- December 3, 2021 (5/8)

Title:	A stakeholder-driven approach to modelling national emissions pathways across the world
Type	Presentation
Authors:	Shivika Mittal (Imperial), Baptiste Boitier (SEURECO), Gabriele Cassetti (E4SMA), Lorenza Campagnolo (CMCC), Alessandro Chiodi (E4SMA), Rocco De Miglio (E4SMA), Elisa Delpiazzo (CMCC), Haris Doukas (NTUA), Maurizio Gargiulo (E4SMA), Sara Giarola (Imperial), Alexandre C. Koberle (Imperial), Andrey Kolpakov, Ben McWilliams (Bruegel), Jorge Moreno (BC3), Alexandros Nikas (NTUA), Sigit P. Perdana (EPFL), Marie Pied, Alexander Shirov, Diego Silva Herran, Kathleen Vaillancourt, Dirk-Jan Van de Ven (BC3), Marc Vielle (EPFL), Xi Yang (CUP), Georg Zachmann (Bruegel), Ajay Gambhir (Imperial)
Abstract:	N/A
Conference:	Fourteenth Annual Meeting of the Integrated Assessment Modeling Consortium (IAMC)
Date:	November 29- December 3, 2021
Venue:	Online
Citation (APA):	Mittal, S., Boitier, B., Cassetti, G., Campagnolo, L., Chiodi, A., De Miglio, R., Delpiazzo, E., Doukas, H., Gargiulo, M., Giarola, S., Koberle, A. C., Kolpakov, A., McWilliams, B., Moreno, J., Nikas, A., Perdana, S. P., Pied, M., Shirov, A., Silva Herran, D., … Gambhir, A. (2021). A stakeholder-driven approach to modelling national emissions pathways across the world Presentation. In *Fourteenth Annual Meeting of the Integrated Assessment Modeling Consortium (IAMC)*.

4.23 Fourteenth Annual Meeting of the Integrated Assessment Modeling Consortium (IAMC), November 29- December 3, 2021 (6/8)

Title:	Assessing near-term transition and longer-term physical climate risks of greenhouse gas emissions pathways
Type	Presentation
Authors:	Ajay Gambhir (Imperial), Mel George, Haewon McJeon, Nigel Arnell, Dan Bernie, Shivika Mittal (Imperial), Alexandre C. Koberle (Imperial), Jason Lowe, Joeri Rogelj, Seth Monteith
Abstract:	N/A
Conference:	Fourteenth Annual Meeting of the Integrated Assessment Modeling Consortium (IAMC)
Date:	November 29- December 3, 2021
Venue:	Online
Citation (APA):	Gambhir, A., George, M., McJeon, H., Arnell, N., Bernie, D., Mittal, S., Koberle, A. C., Lowe, J., Rogelj, J., & Monteith, S. (2021). Assessing near-term transition and longer-term physical climate risks of greenhouse gas emissions pathways. In *Fourteenth Annual Meeting of the Integrated Assessment Modeling Consortium (IAMC).*

4.24 Fourteenth Annual Meeting of the Integrated Assessment Modeling Consortium (IAMC), November 29- December 3, 2021 (7/8)

Title: Challenges in the harmonisation of global integrated assessment models: A comprehensive methodology to reduce model response heterogeneity

Type Presentation

Authors: Sara Giarola (Imperial), Shivika Mittal (Imperial), Marc Vielle (EPFL), Sigit P. Perdana (EPFL), Lorenza Campagnolo (CMCC), Elisa Delpiazzo (CMCC), Ha Bui, Annela Anger-Kraavi (Cambridge), Andrey Kolpakov, Ida Sognnaes (CICERO), Glen P. Peters (CICERO), Adam Hawkes (Imperial), Alexandre C. Koberle (Imperial), Neil Grant (Imperial), Ajay Gambhir (Imperial), Alexandros Nikas (NTUA), Haris Doukas (NTUA), Jorge Moreno (BC3),Dirk-Jan Van de Ven (BC3)

Abstract: N/A

Conference: Fourteenth Annual Meeting of the Integrated Assessment Modeling Consortium (IAMC)

Date: November 29- December 3, 2021

Venue: Online

Citation (APA): Giarola, S., Mittal, S., Vielle, M., Perdana, S. P., Campagnolo, L., Delpiazzo, E., Bui, H., Anger-Kraavi, A., Kolpakov, A., Sognnaes, I., Peters, G. P., Hawkes, A., Koberle, A. C., Grant, N., Gambhir, A., Nikas, A., Doukas, H., Moreno, J., & Van de Ven, D.-J. (2021). Challenges in the harmonisation of global integrated assessment models: A comprehensive methodology to reduce model response heterogeneity. In *Fourteenth Annual Meeting of the Integrated Assessment Modeling Consortium (IAMC)*.

4.25 Fourteenth Annual Meeting of the Integrated Assessment Modeling Consortium (IAMC), November 29- December 3, 2021 (8/8)

Title: Co-creating a model inter-comparison exercise with stakeholders in the EU

Type Presentation

Authors: Alexandros Nikas (NTUA), Alessia Elia (E4SMA), Baptiste Boitier (SEURECO), Konstantinos Koasidis (NTUA), Haris Doukas (NTUA), Gabriele Cassetti (E4SMA), Annela Anger-Kraavi (Cambridge), Ha Bui, Lorenza Campagnolo (CMCC), Rocco De Miglio (E4SMA), Elisa Delpiazzo (CMCC), Arnaud Fougeyrollas, Ajay Gambhir (Imperial), ,Maurizio Gargiulo (E4SMA), Sara Giarola (Imperial), Neil Grant (Imperial), Adam Hawkes (Imperial), Andrea Herbst (ISI Fraunhofer), Alexandre C. Koberle (Imperial), Andrey Kolpakov, Pierre Le Mouel (SEURECO), Ben McWilliams (Bruegel), Shivika Mittal (Imperial), Jorge Moreno (BC3), Felix Neuner (ISI Fraunhofer), Sigit Perdana (EPFL), Glen P. Peters (CICERO), Patrick Plotz (ISI Fraunhofer),Joeri Rogelj, Ida Sognnaes (CICERO), Dirk-Jan Van de Ven (BC3), Marc Vielle (EPFL), Georg Zachmann (Bruegel), Paul Zagame (SEURECO),Alessandro Chiodi (E4SMA)

Abstract: N/A

Conference: Fourteenth Annual Meeting of the Integrated Assessment Modeling Consortium (IAMC)

Date: November 29- December 3, 2021

Venue: Online

Citation (APA): Nikas, A., Elia, A., Boitier, B., Koasidis, K., Cassetti, G., Anger-Kraavi, A., Bui, H., Campagnolo, L., De Miglio, R., Delpiazzo, E., Fougeyrollas, A., Gambhir, A., Gargiulo, M., Giarola, S., Grant, N., Hawkes, A., Herbst, A., Koberle, A. C., Kolpakov, A., ... Chiodi, A. (2021). Co-creating a model inter-comparison exercise with stakeholders in the EU. In *Fourteenth Annual Meeting of the Integrated Assessment Modeling Consortium (IAMC).*

4.26 Green Finance Research Advances 2021 Seminar, December 7-8, 2021

Title:	Comparative analysis of modelling approaches to assess transition impacts - First insights from the NEMESIS models
Type	Presentation
Authors:	Baptiste Boitier (SEURECO),
Abstract:	N/A
Conference:	Green Finance Research Advances 2021 Seminar
Date:	December 7-8, 2021
Venue:	Institut Louis Bachelier, Paris (Hybrid)
Citation (APA):	Boitier, B., (2021). Comparative analysis of modelling approaches to assess transition impacts - First insights from the NEMESIS models. In *Green Finance Research Advances 2021 Seminar*.

4.27 ECEEE 2022 Summer Study on Energy Efficiency, June 6-11, 2022 (1/2)

Title:	Co-Creating Transformative Policy Mixes for Energy-Intensive Industries in Germany and the UK
Type	Presentation
Authors:	Jakob Wachsmuth (Fraunhofer ISI), Thomas Jackwerth-Rice, Sarah Seus, Philine Warnke (Fraunhofer ISI)
Abstract:	In view of the long-term climate targets of Germany and the UK, their industry sectors need to be geared to a pathway towards climate neutrality rapidly, which requires radi-cal process innovations in energy-intensive industries such as the production of steel, cement and basic chemicals.
Conference:	ECEEE 2022 Summer Study on Energy Efficiency
Date:	June 6-11, 2022
Venue:	Hyères, France
Citation (APA):	Wachsmuth, J., Jackwerth-Rice, T., Seus, S. & Warnke, P. (2022). Co-Creating Transformative Policy Mixes for Energy-Intensive Industries in Germany and the UK. *ECEEE 2022 Summer Study on energy efficiency. Agents of Change. Hyères, France*. Extended abstract available at: https://www.eceee.org/static/media/uploads/site-2/summerstudy2022/pdfs_docs/abstracts_2022_rev4june.pdf.

4.28 ECEEE 2022 Summer Study on Energy Efficiency, June 6-11, 2022 (2/2)

Title:	Modelling pathways towards a climate-neutral EU industry sector
Type	Presentation
Authors:	Khaled Al-Dabbas (Fraunhofer ISI), Tobias Fleiter, Matthias Rehfeldt, Marius Neuwirth, Andreas Herbst (Fraunhofer ISI)

Abstract:	To attain climate neutrality by 2050, the European industry must achieve significant reductions in greenhouse gas emissions. The EU's Green Deal with the new 55 % reduction target by 2030 and the 'Fit for 55' package set the frame for the transition. The Fit-For-55 package is accompanied by an impact assessment that includes scenario analyses for the development of the EU energy system until 2030.

Conference:	ECEEE 2022 Summer Study on Energy Efficiency
Date:	June 6-11, 2022
Venue:	Hyères, France
Citation (APA):	Al-Dabbas, K.. Fleiter, T., Rehfeldt, M.. Neuwirth, M. & Herbst, A. (2022): Modelling pathways towards a climate-neutral EU industry sector. *ECEEE 2022 Summer Study on energy efficiency. Agents of Change* : Proceedings : 7-11 June 2022. Brussels: European council for an energy efficient economy, pp. 1475–1483.

4.29 14th Conference of the European Society for Ecological Economics, June 14-17, 2022

Title:	Time to listen: A deliberative dialogue in Spain for tackling the climate crisis
Type	Presentation
Authors:	Ester Galende-Sanchez (BC3), Alevgul Sorman (BC3), Mikel Gonzalez
Abstract:	Ester Galende-Sanchez, Alevgul Sorman, and Mikel Gonzalez-Eguino (BC3) presented project work on a deliberative dialogue held with 40 Spanish citizens in May-June 2021, focusing on Spanish citizens' perceptions and feelings on different behavioural changes regarding mobility, consumption, food and waste, at the 14th Conference of the European Society for Ecological Economics.
Conference:	14th Conference of the European Society for Ecological Economics
Date:	June 14-17, 2022
Venue:	Pisa, Italy (Hybrid)
Citation (APA):	Galende-Sanchez, E., Sorman, A., & Gonzalez, M. (2022). Time to listen: A deliberative dialogue in Spain for tackling the climate crisis. In *14th Conference of the European Society for Ecological Economics*.

4.30 Scenarios Forum 2022: Forum on Scenarios for Climate and Societal Futures, June 20-22, 2022

Title: Are interactive scenario tools an effective solution for expanding the uncertainty space and communicating scenario results of integrated assessment modeling?

Type Presentation

Authors: Georgios Xexakis (Holistic)

Abstract: Georgios Xexakis (HOLISTIC) presented a collection of results from two empirical studies on using interactive scenarios tools for stakeholder engagement and scenario communication at the 2022 Scenarios Forum, at the International Institute for Applied Systems Analysis (IIASA) and Laxenburg Conference Center in Laxenburg, Austria.

Conference: Scenarios Forum 2022: Forum on Scenarios for Climate and Societal Futures

Date: June 20-22, 2022

Venue: Laxenburg, Austria (Hybrid)

Citation (APA): Xexakis, G., (2022). Are interactive scenario tools an effective solution for expanding the uncertainty space and communicating scenario results of integrated assessment modeling? In *Scenarios Forum 2022: Forum on Scenarios for Climate and Societal Futures.*

4.31 2022 Gulf Research Meeting, July 14-16, 2022

Title:	EU-GCC cooperation opportunities on behavioural energy efficiency
Type	Paper
Authors:	Konstantinos Koasidis (NTUA), Nikolaos Vourgidis (NTUA), Vangelis Marinakis (NTUA), Haris Doukas (NTUA)
Abstract:	Heading to as well as in the aftermath of the 26th UN Climate Change Conference (COP26), the European Union (EU) and Member States of the Gulf Cooperation Council (GCC), through the European Green Deal and the updated Nationally Determined Contributions respectively, renewed their pledges, raising the ambition towards battling climate change. Despite differences in individual commitments, the pathways to achieve these pledges pass through energy efficiency.
Conference:	2022 Gulf Research Meeting
Date:	July 14-16, 2022
Venue:	University of Cambridge, UK (Hybrid)
Citation (APA):	Koasidis, K., Vourgidis, N., Marinakis, V., & Doukas, H. (2022). EU-GCC cooperation opportunities on behavioural energy efficiency. In *2022 Gulf Research Meeting*.

4.32 13th International Conference on Information, Intelligence, Systems and Applications, July 18-20, 2022

Title:	Normalising the Output of Fuzzy Cognitive Map
Type	Paper
Authors:	Themistoklis Koutsellis (NTUA), Alexandros Nikas (NTUA), Konstantinos Koasidis (NTUA), Georgios Xexakis (Holistic), Christos Petkidis (NTUA), Anastasios Karamaneas (NTUA), Haris Doukas (NTUA)
Abstract:	Fuzzy cognitive maps (FCMs) constitute a quasi-quantitative modelling tool with the inherent ability to reduce the computational and data complexity of a represented system, as well as engage experts in the process to introduce human cognition in terms of how a system behaves. However, despite being constructed with and for experts, aiming to assist them into better understanding system dynamics, the interpretation of the semi-quantitative outputs of FCMs has been found challenging.
Conference:	13th International Conference on Information, Intelligence, Systems and Applications
Date:	July 18-20, 2022
Venue:	Corfu, Greece
Citation (APA):	Koutsellis, T., Nikas, A., Koasidis, K., Xexakis, G., Petkidis, C., Karamaneas, A., & Doukas, H. (2022). Normalising the Output of Fuzzy Cognitive Map. In *13th International Conference on Information, Intelligence, Systems and Applications*.

4.33 Petrocultures 2022: Transformations, August 24-27, 2022

Title:	Letting it all out! Behavioural and emotional drivers and our lock-ins to Petrocultures
Type	Paper
Authors:	Alevgul Sorman (BC3), Esther Galende-Sanchez (BC3)
Abstract:	PARIS REINFORCE researchers, Alevgul Sorman and Esther Galende-Sanchez from the Basque Centre for Climate Change (BC3), took part in the Petrocultures 2022 conference in Stavanger, Norway, presenting their findings from a deliberative dialogue conducted in Spain on how behavioural and emotional drivers can lock us into petroleum-intensive mobility and consumption patterns or move us forward toward climate action, in the session on Oil Behaviours.
Conference:	Petrocultures 2022: Transformations
Date:	August 24-27, 2022
Venue:	Stavenger, Norway
Citation (APA):	Sorman, A., & Galende-Sanchez, E. (2022). Letting it all out! Behavioural and emotional drivers and our lock-ins to Petrocultures. In *Petrocultures 2022: Transformations*.

4.34 European Climate and Energy Platform 2022 (ECEMP), October 5-7, 2022 (1/3)

Title:	An integrated methodology for power generation planning decision support: the case of Greece's green hydrogen economy
Type	Paper
Authors:	Diamantis Koutsandreas (NTUA), Georgios P. Trachanas (NTUA), Ioannis Pappis, Alexandros Nikas (NTUA), Haris Doukas (NTUA), John Psarras (NTUA)
Abstract:	Green hydrogen could compose an invaluable tool for governments on the race to net zero emissions. It could stabilize variable clean power generation through storage and assist in decarbonizing hard-to-abate sectors (e.g., transport), where electricity is not an option.
Conference:	European Climate and Energy Platform 2022 (ECEMP)
Date:	October 5-7, 2022
Venue:	Online
Citation (APA):	Koutsandreas, D., Trachanas, G. P., Pappis, I., Nikas, A., Doukas, H., & Psarras, J. (2022). An integrated methodology for power generation planning decision support: the case of Greece's green hydrogen economy. In *European Climate and Energy Platform 2022 (ECEMP)*.

4.35 European Climate and Energy Platform 2022 (ECEMP), October 5-7, 2022 (2/3)

Title:	Stakeholder-informed modelling to decarbonise the Greek power sector in the light of today's energy crisis
Type	Paper
Authors:	Konstantinos Koasidis (NTUA), Anastasios Karamaneas (NTUA), Alexandros Nikas (NTUA), Diamantis Koutsandreas (NTUA), Haris Doukas (NTUA)
Abstract:	While fossil fuel prices soar during the 2022 global energy crisis, Greece still plans to use natural gas as a transition fuel for delignitisation intending to heavily invest on additional natural gas infrastructure, with strong concerns over potential exacerbation of fossil fuel lock-ins, energy poverty and hurdles to progress in climate action.
Conference:	European Climate and Energy Platform 2022 (ECEMP)
Date:	October 5-7, 2022
Venue:	Online
Citation (APA):	Koasidis, K., Karamaneas, A., Nikas, A., Koutsandreas, D., & Doukas, H. (2022). Stakeholder-informed modelling to decarbonise the Greek power sector in the light of today's energy crisis. In *European Climate and Energy Platform 2022 (ECEMP)*.

4.36 European Climate and Energy Platform 2022 (ECEMP), October 5-7, 2022 (3/3)

Title:	What do experts perceive as critical game-changing innovations to consider in modelling and policy?
Type	Paper
Authors:	Sigit Perdana (EPFL), Georgios Xexakis (Holistic), Konstantinos Koasidis (NTUA), Marc Vielle (EPFL), Alexandros Nikas (NTUA), Haris Doukas (NTUA), Ajay Gambhir (Imperial), Annela Anger-Kraavi (Cambridge), Elin May (Cambridge), Ben McWilliams (Bruegel), Baptiste Boitier (SEURECO)
Abstract:	Achieving the temperature goals of the Paris Agreement, which has encouraged major economies to pledge for carbon neutrality around or shortly after the middle of this century, requires a clear pathway to carbon-free industrial, economic, and societal activities.
Conference:	European Climate and Energy Platform 2022 (ECEMP)
Date:	October 5-7, 2022
Venue:	Online
Citation (APA):	Perdana, S., Xexakis, G., Koasidis, K., Vielle, M., Nikas, A., Doukas, H., Gambhir, A., Anger-Kraavi, A., May, E., McWilliams, B., & Boitier, B. (2022). What do experts perceive as critical game-changing innovations to consider in modelling and policy? In *European Climate and Energy Platform 2022 (ECEMP)*.

4.37 Fifteenth Annual Meeting of the Integrated Assessment Modeling Consortium (IAMC), November 29-December 1, 2022 (1/7)

Title: Tracing the transformation through a decade of mitigation scenarios

Type   Presentation

Authors: Dirk-Jan van de Ven (BC3), Panagiotis Fragkos, Faidra Filippidou, Lukas Hermwille, Wolfgang Obergassel, Leon Clarke, Ajay Gambhir (Imperial), Mikel Gonzalez-Eguino (BC3), Shivika Mittal (Imperial), Alexandros Nikas (NTUA), Glen P. Peters (CICERO), Ida Sognnaes (CICERO)

Abstract: N/A

Conference: Fifteenth Annual Meeting of the Integrated Assessment Modeling Consortium (IAMC)

Date: November 29-December 1, 2022

Venue: Maryland, USA

Citation (APA): Van de Ven, D.J., Fragkos, P., Filippidou, F., Hermwille, L., Obergassel, W., Clarke, L., Gambhir, A., Gonzalez-Eguino, M., Mittal, S., Nikas, A., Peters, G.P. & Sognnaes, I. (2022). Tracing the transformation through a decade of mitigation scenarios. *Fifteenth Annual Meeting of the Integrated Assessment Modeling Consortium (IAMC)*, November 29 - December 1, 2022, Maryland, USA.

4.38 Fifteenth Annual Meeting of the Integrated Assessment Modeling Consortium (IAMC), November 29-December 1, 2022 (2/7)

Title:	An Open and Transparent Modelling Initiative for Globally Implemented Emission Reduction Policies
Type	Presentation
Authors:	N/A
Abstract:	Presented by Dirk-Jan van de Ven (Basque Centre for Climate Change).
Conference:	Fifteenth Annual Meeting of the Integrated Assessment Modeling Consortium (IAMC)
Date:	November 29-December 1, 2022
Venue:	Maryland, USA
Citation (APA):	Van de Ven, D.J. (2022 An Open and Transparent Modelling Initiative for Globally Implemented Emission Reduction Policies. *Fifteenth Annual Meeting of the Integrated Assessment Modeling Consortium (IAMC)*, November 29 - December 1, 2022, Maryland, USA.

4.39 Fifteenth Annual Meeting of the Integrated Assessment Modeling Consortium (IAMC), November 29-December 1, 2022 (3/7)

Title:	India's Energy System Transformation to Net Zero
Type	Poster
Authors:	Shivika Mittal (Imperial), Alexandre C. Köberle (Imperial), Priyadarshi R. Shukla, Ajay Gambhir (Imperial)
Abstract:	N/A
Conference:	Fifteenth Annual Meeting of the Integrated Assessment Modeling Consortium (IAMC)
Date:	November 29-December 1, 2022
Venue:	Maryland, USA
Citation (APA):	Mittal, S., Köberle, A.C., Shukla, P.R. & Gambhir, A. (2022). India's Energy System Transformation to Net Zero. *Fifteenth Annual Meeting of the Integrated Assessment Modeling Consortium (IAMC)*, November 29 - December 1, 2022, Maryland, USA.

4.40 Fifteenth Annual Meeting of the Integrated Assessment Modeling Consortium (IAMC), November 29-December 1, 2022 (4/7)

Title:	Paris-compliant sustainable development pathways in the EU: a multi-model study
Type	Presentation
Authors:	Lorenza Campagnolo (CMCC), Elisa Delpiazzo (CMCC), Jorge Moreno (BC3), Dirk-Jan van de Ven (BC3), Alessandro Chiodi (E4SMA), Maurizio Gargiulo (E4SMA), Baptiste Boitier (SEURECO), Konstantinos Koasidis (NTUA), Alexandros Nikas (NTUA)
Abstract:	N/A
Conference:	Fifteenth Annual Meeting of the Integrated Assessment Modeling Consortium (IAMC)
Date:	November 29-December 1, 2022
Venue:	Maryland, USA
Citation (APA):	Campagnolo, L., Delpiazzo, E., Moreno, J., Van de Ven, D.J., Chiodi, A., Gargiulo, M., Boitier, B., Koasidis, K. & Nikas, A. (2022). Paris-compliant sustainable development pathways in the EU: a multi-model study. *Fifteenth Annual Meeting of the Integrated Assessment Modeling Consortium (IAMC)*, November 29 - December 1, 2022, Maryland, USA.

4.41 Fifteenth Annual Meeting of the Integrated Assessment Modeling Consortium (IAMC), November 29-December 1, 2022 (5/7)

Title:	Course correcting 1.5C mitigation pathways in light of new adverse information
Type	Presentation
Authors:	Ajay Gambhir (Imperial), Shivika Mittal (Imperial), Robin Lamboll (Imperial), Neil Grant (Imperial), Alexandre C. Köberle (Imperial), Adam Hawkes (Imperial), Joeri Rogelj, Jason Lowe
Abstract:	N/A
Conference:	Fifteenth Annual Meeting of the Integrated Assessment Modeling Consortium (IAMC)
Date:	November 29-December 1, 2022
Venue:	Maryland, USA
Citation (APA):	Gambhir, A., Mittal, S., Lamboll, R., Grant, N., Köberle, A.C., Hawkes, A., Rogelj, J. & Lowe, J. (2022). Course correcting 1.5oC mitigation pathways in light of new adverse information. *Fifteenth Annual Meeting of the Integrated Assessment Modeling Consortium (IAMC)*, November 29 - December 1, 2022, Maryland, USA.

4.42 Fifteenth Annual Meeting of the Integrated Assessment Modeling Consortium (IAMC), November 29-December 1, 2022 (6/7)

Title:	IPCC AR6 climate scenarios and the open-source "climate-assessment" tool for IAM emissions scenarios
Type	Presentation
Authors:	Jarmo Kikstra, Zebedee Nicholls, Christopher Smith, Jared Lewis, Robin Lamboll, Edward Byers, Marit Sandstad, Malte Meinshausen, Matthew Gidden, Joeri Rogelj, Elmar Kriegler, Glen Peters (CICERO), Jan Fuglestvedt, Ragnhild Skeie, Bjørn Samset, Laura Wienpahl, Detlef Van Vuuren, Kaj-Ivar Van der Wijst, Alaa Al Khourdajie, Piers Forster, Andy Reisinger, Roberto Schaeffer, Keywan Riahi
Abstract:	N/A
Conference:	Fifteenth Annual Meeting of the Integrated Assessment Modeling Consortium (IAMC)
Date:	November 29-December 1, 2022
Venue:	Maryland, USA
Citation (APA):	Kikstra, J., Nicholls, Z., Smith, C., Lewis, J., Lamboll, R., Byers, E., Sandstad, M., Meinshausen, M., Gidden, M., Rogelj, J., Kriegler, E., Peters, G.P., Fuglestvedt, J., Skeie, R., Samset, B., Wienpahl, L., Van Vuuren, D., Van der Wijst, K.I., Al Khourdajie, A., Forster, P., Reisinger, A., Schaeffer, R. & Riahi, K. (2022). IPCC AR6 climate scenarios and the open-source "climate-assessment" tool for IAM emissions scenarios. *Fifteenth Annual Meeting of the Integrated Assessment Modeling Consortium (IAMC)*, November 29 - December 1, 2022, Maryland, USA.

4.43 Fifteenth Annual Meeting of the Integrated Assessment Modeling Consortium (IAMC), November 29-December 1, 2022 (7/7)

Title:	Diagnosing inter-model differences in the macro-economic implications of deep mitigation
Type	Presentation
Authors:	Alexandre C. Köberle (Imperial), Shivika Mittal (Imperial), Ajay Gambhir (Imperial), Dirk-Jan van de Ven (BC3), Ha Bui, Lorenza Campagnolo (CMCC), Elisa Delpiazzo (CMCC), Marc Vielle (EPFL), Sigit Perdana (EPFL), Sara Giarola (Imperial), Joeri Rogelj, Alexandros Nikas (NTUA)
Abstract:	N/A
Conference:	Fifteenth Annual Meeting of the Integrated Assessment Modeling Consortium (IAMC)
Date:	November 29-December 1, 2022
Venue:	Maryland, USA
Citation (APA):	Köberle, A.C., Mittal, S., Gambhir, A., van de Ven, D.J., Bui, H., Campagnolo, L., Delpiazzo, E., Vielle, M., Perdana, S., Giarola, S., Rogelj, J. & Nikas, A. (2022). Diagnosing inter-model differences in the macro-economic implications of deep mitigation. *Fifteenth Annual Meeting of the Integrated Assessment Modeling Consortium (IAMC)*, November 29 - December 1, 2022, Maryland, USA.

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