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Kurzbeschreibung: Conference on "Resource-Efficient Decarbonisation Pathways"

Dieser Band fasst die Diskussionen der Konferenz Conference on "Resource-Efficient Decarbonisation Pathways" zusammen.

Abstract: Title

This report summarizes the discussions at the conference on Resource-Efficient Decarbonisation Pathways held on 4/5 November in Berlin.

Table of Contents

1 Conference Agenda

Day 1: Monday 4 November 2019		
Time	Topic	Presenter
12.30 – 13.00	Registration	
13.00 – 13.05	Opening: presentation of agenda and schedule for the day	Conny Czymoch
13.05 – 13.20	Opening remarks by UBA president	Maria Krautzberger (UBA)
13.20 – 13.50	Keynote 1: Sustainable resource use and climate change	Shardul Agrawala (OECD)
13.50 – 14.15	Keynote 2: Global energy transformation: a roadmap to 2050	Sean Collins (IRENA)
14.15 – 14.30	Plenary discussion	Keynote speakers
14.30 – 15.00	Coffee break	
15.00 – 17.00	RESCUE – Resource-efficient pathways towards greenhouse gas neutrality Intro/setting the scene Modelling approach Selected RESCUE results and scenario comparisons Main conclusions from the project	Harry Lehmann (UBA) Monika Dittrich (ifeu)
17.00 – 17.40	Podium discussions	Harry Lehmann, Monika Dittrich
17.40 – 17.45	Wrap-up/outlook for the next day	Conny Czymoch
17:45 – 20:00	Get-together	

	Day 2: Tuesday 5 November 2019	
Time	Topic	Presenter
09.00 – 09.05	Welcome and introduction to Day 2	Conny Czymoch
09.05 – 09.30	Keynote 3: Overview of the UNEP IRP work on resource efficiency and climate change scenarios	Stefan Pauliuk (University of Freiburg)
09.30 – 11.00	Session 1: Challenges and opportunities – decarbonisation of the industry	Bettina Rechenberg (UBA) Joachim Hein (BDI) Andreas Theuer (Thyssen-Krupp) Peter Viebahn (Wuppertal Institute) Moderator: Regine Vogt (ifeu)
	Session 2: Challenges and opportunities – transforming the energy system	Eric Vidalenc (L'Agence de l'environnement et de la maîtrise de l'énergie, ADEME) Karsten Krause (UBA) Benno Hain (UBA) Moderator: Klaus Müschen (FFU Berlin)
	Session 3: Challenges and opportunities – transforming the transport sector/mobility	Martin Lange (UBA) Ruth Blanck (Öko-Institut) Fabio Marques Dos Santos (Joint Research Centre) Moderator: Günter Hörmandinger (Agora Verkehrswende)
11.00 – 11.15	Coffee break	
11.15 – 11.45	Summary of the parallel sessions	Moderators workshop sessions + Conny Czymoch
11.45 – 12.45	Shaping the transformation: Behavioural change as major element. What does this mean for decarbonisation strategies?	Ullrich Lorenz (UBA) Sanne Nijburg (economist) Myriam Rapior (BUND Youth)
12.45 – 13.45	Lunch break	
13.45 – 14.45	Measuring the transformation: Beyond GDP and RTD – how can new approaches from degrowth and alternative economic indices help foster the developments?	Dorothee Rodenhäuser (FEST), Roland Zieschank (FFU) Q&A facilitated by Conny Czymoch
14.45 – 15.00	Coffee break	
15.00 – 16.00	Policy and systemic approaches corresponding with transformation: How to shape governmental and economic regimes at the national, EU and international level?	Julia Hertin (SRU) Kai Neumann (consideo) Felix Creutzig (TU Berlin, Mercator Research Institute on Global Commons)
16.00 – 16.15	Wrap-up & closing remarks	Conny Czymoch Harry Lehmann (UBA)

2 Introduction

Unsustainable patterns of natural resource consumption, including energy consumption, trigger global climate change. At the same time, modern economies are dependent on the availability and accessibility of natural resources. Driven by population growth and economic development, global use of material resources has increased tremendously in recent years and is expected to continue to grow even further. This trend puts at risk the global agreement to limit global warming to 1.5°.

At the RESCUE conference ("Resource-Efficient Pathways towards Greenhouse Gas Neutrality"), the German Environment Agency (Umweltbundesamt, UBA) shared the results of a project to further explore the mutual dependencies and feedback loops between climate policies and associated resource requirements. Six different quantitative scenarios for Germany were modelled and analysed. These scenarios describe potential alternative pathways to achieve a greenhouse gas-neutral and resource-efficient economy in Germany by the year 2050. At the conference, these scenarios were presented and discussed with experts and stakeholders from across the world. The implications for the wider policy context were also explored, drawing on the work of other institutions and individuals in this field.

The two-day conference, organized by UBA and supported by adelphi, gathered around 200 experts and decision-makers in the fields of policy development, industry, academia and civil society from Germany, Europe and around the globe. The keynote speakers at the event were Maria Krautzberger (UBA president), Shardul Agrawala (OECD), Sean Collins (IRENA) and Stefan Pauliuk (University of Freiburg, UNEP Resource Panel). This report will summarize some of the most important insights.

Summary

- Transformative changes need to start immediately to achieve the targets of the Paris agreement.
- Prices need to reflect environmental costs to provide incentives for investments in industry and changes in consumption patterns and lifestyles.
- Achieving climate neutrality is expected to require an enormous increase in raw materials demand, e.g. for batteries for electric vehicles.
- A resource-efficient and climate-neutral Germany is possible without carbon capture and storage, nuclear power plants and energy from biomass.
- Changes in lifestyles and consumption patterns as well as a zero GDP growth rate can play a key role in achieving the targets.

3 First conference day

3.1 Opening and keynote speeches

Conny Czymoch, conference moderator, opened the conference with a brief overview of recent events and developments in environmental degradation. She noted that once again, the world had passed the "earth overshoot day" earlier than in the previous year. In pop culture, a currently popular online game is "Climate Trail", in which the player needs to survive in a world with 4-6 degrees of global warming. Regarding the business sector, Czymoch mentioned that she recently read a statement by H&M's CEO that he is afraid that "Fast Fashion Shaming" could follow "Flight Shaming".

In her opening remarks, **Maria Krautzberger, president of the German Environment Agency**, called climate change the biggest threat to our societies. She noted that humanity needs to find ways to live a good life while remaining within boundaries. Even though the planetary boundaries are currently being transgressed, Krautzberger emphasized that "*it is not too late, at least not yet*". The RESCUE scenarios show that a greenhouse gas-neutral Germany with a 95% reduction in GHG emissions until 2050 is feasible. The GreenSupreme scenario shows that it is even possible to reach a 1.5 degree pathway. According to Krautzberger, "*[w]hat is necessary to reach this goal is a rapid phase-out of fossil fuel*". Additionally, the scenario is based on assumptions that are still controversial, like lower economic growth or even zero growth by 2050. A collective rethinking of lifestyles and consumption patterns is required in order to lower resource use and emissions. Krautzberger compared this steady state of the economy with Japan, which still has a high living standard despite a stagnant GDP. There needs to be a search for alternative wellbeing measures, because GDP as an indicator is not sufficient, Krautzberger added. She also called for the RESCUE modelling to be scaled up to the level of the European Union (EU) in the future, as more ambitious action is required globally.

Shardul Agrawala, Head of the Environment and Economy Integration Division at the OECD Environment Directorate, gave the first conference keynote speech. The global projections show a tripling of the economy by 2060, with a shrinking share for OECD countries. The OECD also assumes that global growth rates will shrink in the future, while living standards and consumptions patterns worldwide will converge towards current OECD levels. These developments would entail a massive growth in resource consumption of more than 280 gigatonnes. The current level is about 80 gigatonnes per year. Two factors could help to mitigate this increase, Agrawala stated. First, a structural change in the economy towards the service sector with its lower material intensity could reduce the increase by 110 gigatonnes. Secondly, technology and improvements in material efficiency could reduce consumption growth by 80 gigatonnes. Finally, Agrawala highlighted five priority actions for climate and the circular economy. Agrawala emphasized: "*The basics that need to be fixed are: prices for polluting activities, effective regulations and standards, encouraging green innovations and facilitating better consumer choices*". Furthermore, potential conflicts between climate change and resource efficiency need to be anticipated and managed. As an example, Agrawala mentioned the end-of-life management of batteries, which could amount to more than one million per year in the USA alone by 2030.

In the second keynote speech, **Sean Collins, Associate Programme Officer at the International Renewable Energy Agency,** highlighted the cost reductions for renewable energies already achieved. "*Today most renewable energy sources are in the same range as fossil fuels*", he said. To achieve the climate targets further progress is required in the electrification of more sectors, such as heat and transport. IRENA has calculated that in order to electrify these

sectors today's renewables growth has to increase six-fold. In IRENA's Renewable Energy Roadmaps (REmap) 2050 scenarios, electricity will become the major energy carrier with a share of 49% of global total final energy consumption (19% today). To achieve this change it is necessary to shift investments towards energy efficiency, renewables and the electrification of heat and transport. Finally, Collins summarized the necessary central actions in the power, construction, transport and energy sectors.

Following these presentations, Czymoch started off the discussion with a question regarding assumptions on the share of biomass in IRENA's REmap scenarios. This question was also raised later by conference participants. Collins stated that only second-generation biomass, which is not in conflict with nutritional aspects, is assumed by IRENA for the share of biomass. Furthermore, the question of the feasibility of decoupling was debated. Agrawala emphasized that this question touches on the responsibility of each of us and our insatiable demand for more products. Additionally, he highlighted the role of correct prices. An internalization of costs for the environment could contribute to a change in consumption patterns.

3.2 Presentation of Scenario Results

After the coffee break, there followed the first public presentation of the RESCUE scenarios. **Monika Dittrich, researcher and leader of the RESCUE project** at the Institute for Energy and Environment Research in Heidelberg, and **Harry Lehmann, General Director for Sustainability Strategies at the German Environment Agency**, summarized the core results and conclusions over two hours. More information can be found in the presentation slides and the reports that are now publicly available. In his concluding remarks, Lehmann noted that "*it is important to consider changes in consumption patterns to achieve climate neutrality. The transformative changes for a climate-neutral and resource-efficient Germany need to start immediately*".

In the discussion following the presentation, participants emphasized the need to discuss the scenario results with business leaders, politicians as well as the public. For business leaders, the results reveal the need for new business models. Politicians need to stimulate changes in lifestyles and consumption patterns. One participant mentioned the example of policies to reduce smoking as successful policies for behaviour change. Another participant proposed that these changes need to be communicated differently, creating new images of the future. These should both raise awareness of the consequences of current lifestyles and focus on the advantages of future lifestyles. The public needs to discuss the results in order to prepare for the envisioned changes. Furthermore, one participant emphasized that the RESCUE scenarios are not too ambitious. He referred to the fact that permafrost is already melting. The emissions resulting from this melting are not yet considered in IPCC scenarios.

4 Second conference day

4.1 Keynote speeches

Stefan Pauliuk, assistant professor for sustainable energy and material flow management at the University of Freiburg, opened the second day with his keynote speech on the findings of the International Resource Panel of the UN Environment Programme project on resource efficiency and climate change. The results show that global resource extraction drives climate change and biodiversity loss. The emissions related to material production more than doubled in the past 25 years. Construction and manufacturing are the two largest sectors, contributing 40% each to overall emissions. This is the reason for an in-depth analysis of potential solutions towards material efficiency in buildings (construction) and transport (manufacturing). The largest reductions in the buildings sector can be achieved through an intensification of use through smaller living spaces and changes in the urban form. In the transport sector, there are big potentials in ride- and car-sharing as well as a downsizing of cars. Pauliuk made clear that within the study, "*it is a different economy that we are imagining here*". With regard to policies, Pauliuk emphasized the need for new products and infrastructures. However, he noted that many resource efficiency strategies are too new to have associated policies. In his closing remarks, Pauliuk highlighted the fact that "*the material efficiency GHG reduction potentials are large and largely untapped*". In a short question-and-answer session, Pauliuk noted that policy conclusions are rather similar for industrial and developing countries. However, the lock-in effects are lower in developing countries.

Following the keynote speech, the conference participants split up for three panel discussions comparing the RESCUE results with other studies of three key sectors: the industry, energy and transport sectors.

4.2 Panel Discussion "Decarbonisation of the industry"

Dr. Bettina Rechenberg, head of the department for sustainable production and circular economy at the German Environment Agency, presented the RESCUE results for the industry sector. She highlighted the importance of phasing out fossil fuel uses for energetic and non-energetic uses in the sector. This requires a conversion of processes. Rechenberg stressed that "*social aspects need to be considered in the course of the transition*".

Dr. Peter Viebahn, head of the research field sectors and technologies at Wuppertal Institute, showed that the most important shares of industrial GHG emissions are caused by iron and steel production (29%), basic chemistry (19%), and cement production (10%). "*The need for high-temperature heat, some process emissions that are difficult to avoid and long investment cycles are key challenges for the industry sector*", he said. Key strategies towards becoming GHG-neutral include the development of new processes, circular economy approaches and carbon capture and storage.

Dr. Joachim Hein, Senior Manager Energy and Climate Policy at BDI (Federation of German Industries), compared an 80% GHG reduction target for Germany with a 95% GHG reduction based on scenarios of BDI. He stressed that the changes and investments required just for the 80% goal would be enormous. This would require more than doubling installed renewables capacities in Germany (to 240 GW), 14 heat pumps in the residential sector (compared to 800,000 today), and 26 million electric vehicles in German streets by 2050. In BDI scenarios, the 95% reduction necessarily requires energy imports of synthetic fuels and CCS. "*This shows that for the two scenarios we are talking of two different worlds*", Hein emphasized. This is also

reflected in the costs, with an estimate of 500 billion euros for the 80% reduction and 1 trillion euros for the 95% reduction.

Andreas Theuer, head of environmental and climate affairs, sustainability at thyssenkrupp Steel Europe AG, presented his company's plans for climate mitigation. The company has clear reduction goals: in a first step, a reduction of about 30% in energy consumption and GHG emissions until 2030, and climate neutrality by 2050. There are two main strategies to achieve these goals. The first is carbon avoidance by using hydrogen, e.g. in blast furnace operations, and electricity in arc furnaces. The second strategy is the processing of CO_2 through conversion into chemicals. "*We need the support of policy-makers and investors to create favourable framework conditions*", Theuer said. He highlighted the need for a competitive energy and hydrogen supply and for beneficial production conditions in Germany and Europe, e.g. through "Carbon Border Adjustments". Additionally, a market for climate-neutral steel needs to be created. Furthermore, investments in the steel industry are required rather than a "blacklisting" of the industry by investors.

In the conclusion of the session on pathways to decarbonizing the industry sector, it was emphasized that recycling can lead to large reductions in the industry sector. Furthermore, product design for durability and long product lifecycles can contribute to reductions. All participants agreed that to achieve the transformation, massive investments in production technology and regulations to stimulate these are required.

4.3 Panel Discussion "Transforming the energy system"

Dr. Karsten Krause, German Environmental Agency, replaced Tom Howes, DG Energy, European Commission, to present the European 2050 Strategy. "*The strategy should ensure a prosperous, modern, competitive and climate-neutral economy*", Krause said. The strategy comprises seven building blocks, of which three were presented in more depth. 1) Energy efficiency could accomplish a reduction of energy consumption of 50% by 2050 compared to 2005. 2) The deployment of renewable energies is expected to lead to a share of 80% in the final energy demand by 2050. 3) Remaining emissions should be tackled with carbon capture and storage (CCS). The strategy considers barriers such as the lack of demonstration and proof of economic viability. Nevertheless, the technology seems indispensable in order to achieve a net-zero-emissions economy. Krause highlighted the need for a considerable increase in investments and cooperation with partners worldwide in order to achieve this transition.

Eric Vidalenc, economist at ADEME (Agence de l'Environnement et de la Maîtrise de l'Énergie) presented the planned development of carbon neutrality scenarios of the French Environment and Energy Management Agency. "*Our study will include a strong work on narratives and the co-construction with stakeholders of scenario assumptions*", Vidalenc emphasized. In addition, strategic foresight for some sectors for the year 2030 is part of the project. In comparison with the RESCUE project, only four scenarios are planned, some of which will also include nuclear power and CCS as viable options. These were excluded in the RESCUE scenarios. Additionally, a consumption-based calculation of emissions will also be carried out within the project.

Finally**, Dr. Benno Hain, Head of the department for energy strategies at the German Environment Agency**, presented the RESCUE results focused on the energy sector. "*It is very important to achieve a reduction in final energy demand through energy efficiency and lifestyle changes*", Hain stressed. The reduction is important as the final energy demand significantly influences the demand for renewable energies and the associated raw material demand as well as the dependency on energy imports. The scenarios show the necessity for sector coupling and Power-to-X (PtX) technologies. However, Hain emphasized the point that PtX products should

only be used for applications for which direct electricity use is not possible. He highlighted that synthetic gas is not a viable option for decentralized heating.

In the subsequent discussion, the speakers pointed out the importance of carbon pricing in order to reach the targets. Furthermore, Eric Vidalenc noted that important developments in technology as well as price trends for new technologies are difficult to estimate. This will also apply for important technologies for storage options and P2X. However, one participant mentioned the example of crop-based biomass, which was also thought to be a key solution ten years ago, but today is seen as a dead end.

4.4 Panel Discussion "Transforming the transport sector/mobility"

Fabio Marques dos Santos, researcher at the Joint Research Centre of the European Commission, presented the implications of automated, connected low-carbon and shared mobility for the future of road transport. "*With alternative fuels and increases in energy efficiency, the GHG emissions of the transport sector could be reduced by 50% or more*", Dos Santos stated. The shift to battery electric vehicles will entail a massive increase in demand for raw materials. For example, the demand for lithium, cobalt and graphite is expected to increase 25 times by 2030. This is why reuse and recycling approaches will be required as well as new shared mobility services in order to increase resource efficiency.

Martin Lange, researcher in the transport sector at the German Environment Agency, then presented the RESCUE scenarios and their implications for the transport sector. "*In order to achieve climate neutrality in this sector two approaches – a transition in transport and in energy sources – are required*", he said. The first approach is a transition in transport, based on strategies to avoid unnecessary transport, a modal shift and finally energy efficiency improvements. The second approach is a transition of the energy sources in the transport sector through alternative drives like battery electric vehicles and synthetic fuels. Lange further highlighted assumptions in the GreenSupreme scenario[1] like the importance of car- and ride-sharing and public transport for urban populations. This could result in a strong reduction in the number of cars.

Ruth Blanck, senior researcher at Öko-Institut, focused in her presentation on policies to reduce CO_2 emissions in the transport sector. She highlighted the need to reduce or at least stabilize the absolute number of cars in order to achieve the transition. "*More electric cars do not necessarily mean a decrease in conventional cars*", Blanck said. With regard to policies, she pointed out that EU regulations will lead to increased efforts by car companies to sell battery electric cars in order to avoid fines. This is why the recently adopted purchase incentives of the German government might not have any additional effects. Furthermore, these incentives entail social imbalances, as they are more beneficial to high-income households, which are more inclined to buy new cars. She proposed some alternative policy measures: 1) clear exit strategies for internal combustion engines, 2) more ambitious CO_2 standards at the EU level, and 3) revenue-neutral national policies, for example increased taxes on petrol in order to finance incentives for battery electric cars.

Günter Hörmandinger, Deputy Executive Director at Agora Verkehrswende, opened the discussion with the topic of the effects of automation in the sector. He noted that this topic received significantly less attention just a few years ago. The effects of automation could be

[1] The GreenSupreme scenario is the most ambitious of all six RESCUE scenarios. It combines the most effective measures of the other scenarios and additionally zero GDP growth after 2030. It is the only scenario compatible with the average 1.5 °C pathway of the Intergovernmental Panel on Climate Change (IPCC).

beneficial if the number of private cars is thereby reduced. However, different scenarios are also possible, in which people still own private automated cars. In order to achieve GHG reductions, policies are needed. However, all panellists agreed that it seems to be difficult for policy-makers to make some decisive choices for climate mitigation. One reason cited is the importance of the car industry and the related social consequences of job losses in this industry. Towards the end of the discussion, Blanck noted that in her opinion one central problem is the lacking consensus on a reduction in the number of cars. Manufacturers and policy makers still hope for a silver bullet in order to continue the current business model.

Wrap up

In a short question-answer session with conference moderator Conny Czymoch, key insights of each of the workshops were summarized.

4.5 Shaping the transformation: Behavioural change as major element for decarbonisation strategies?

GreenLife and GreenSupreme scenarios include assumptions beyond changes in technology and efficiency increases, like reductions in meat consumption, living space and car ownership. These options for GHG emission and resource use reduction are framed in the context of sustainability as "sustainable lifestyles" or "sufficiency measures". As a starting point for the panel, **Ullrich Lorenz**, from the German Environmental Agency, confronted participants with a systemic framework of feedback loops impeding behavioural change. "*How can behavioural change be stimulated?*" was then the main topic of the following discussion between **Sanne Nijburg** and **Myriam Rapior** (BundJugend, youth organization of Friends of the Earth Germany). Both were invited as representatives of the young generation in the context of the Fridays for Future protests. Ullrich Lorenz presented three statements on behavioural change based on the RESCUE scenarios. The opinions of conference participants on these statements were collected using Slido. In general, there was a large overall agreement and consensus amongst participants as well as between Sanne Nijburg and Myriam Rapior on the need for behavioural changes. The statements and discussion touched on the topics of consumption practices, reduction in living space per person and reduction of car use in urban areas. Myriam Rapior stated that "*we need more creativity and co-living as a solution with social and environmental benefits*". As Sanne Nijburg noted, "[i]*n the Netherlands the government is already promoting co-living in old churches as intergenerational housing projects*". One conclusion of the discussion was that sustainable lifestyles need to be made more practical and convenient in order to be adopted by more people. Therefore, changes in infrastructures – safe biking lanes were mentioned in the session – and regulations are required to make sustainable practices easy and safe.

4.6 Measuring the transformation: how can alternative economic indices help foster the developments?

An alternative to GDP, the national welfare index (NWI), was the topic of the panel following the lunch break. It is relevant in the context of the RESCUE scenarios as the GreenSupreme scenario includes assumptions on a zero GDP growth rate after 2030. **Roland Zischank**, researcher at the Environmental Policy Research Centre (FFU) of the Freie Universität Berlin, and **Dorothee Rodenhäuser**, researcher at Forschungsstätte der Evangelischen Studiengemeinschaft (FEST) e. V. Heidelberg, Protestant Institute for Interdisciplinary Research, started their presentation by stating that "*[d]eclining growth rates are not only a scenario assumption but have been a fact in*

the last decades". The national welfare index integrates 20 components, complementing the GDP with environmental aspects like GHG emissions and social factors like the Gini coefficient. As a result, the NWI is considerably lower than GDP for Germany, showing, in the opinion of the speakers, that economic growth can imply lower welfare. In the following question-and-answer session, conference participants discussed the difficulty of establishing a new international standard, as it exists for GDP. Additionally, it was mentioned that new indices are currently developed not only for nation states but also for companies. This was seen as a sign highlighting the relevance of the discussion.

4.7 Policy and systemic approaches for the transformation: Shaping governmental and economic regimes?

How do the RESCUE results resonate for experts involved in policy and scientific processes? What could be the implications of the scenarios in policy and society? Conny Czymoch discussed these central questions at the closing panel of the conference. Kai Neuman, co-founder and managing director of consideo, stated: "*the title, 'RESCUE', is a perfect starting point for the communication of the results*". He further said that GreenSupreme assumptions might seem ambitious today, but once the transformations started changes could progress more rapidly. Felix Creutzig, researcher at Mercator Research Institute on Global Commons and Climate Change, appraised the results from the point of view of a lead author of IPCC: "*RESCUE scenarios are important because they prove that climate mitigation in an industrial country is possible with 100% renewables and without technologies like CCS and nuclear power plants*". These are included in IPCC scenarios. Julia Hertin, secretary-general of the German Advisory Council on the Environment (SRU), highlighted the systemic barriers to environmental policy making. She pointed out that SRU has been working since the 1970s on recommendations for policy-makers. But instead of policies for emission reductions being implemented, the emission curves in scenarios are steeper and steeper every year. However, the panellists were optimistic that transformations could still be achieved with a correct pricing of emissions. Julia Hertin said that the climate expert commission agreed on within the climate package of the German government could contribute to raising the ambitions in the coming years. Felix Creutzig also emphasized the power of local governments, giving the following example: if a number of European cities were to decide to exclude fossil fuel cars, path dependencies could be overcome.

In his closing remarks, Harry Lehmann emphasized the importance of political engagement and discussions about lifestyle changes. Conny Czymoch closed the conference with a quote from Antonio Gramsci: "*The old world is dying, and the new world struggles to be born: now is the time of monsters*".