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White Paper

Climate change, negative emissions and solar radiation management: It is time for an open societal conversation

Final Version – Swiss Climate Engineering Science Dialogue

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About this white paper

This white paper resulted from a risk dialogue project with climate scientists and experts on the subject of climate engineering – conducted by the neutral and independent Risk-Dialogue Foundation St. Gallen between April 2016 and March 2017. The aim was to identify the current state of research on the topic as well as related risk and to evaluate a potential need for wider public deliberation. The project was carried out on behalf of the Swiss Federal Office for the Environment (FOEN), Climate Division. In line with views expressed during the dialogue, the sole objective of this paper is to argue for an open and public deliberation process and not to favour or promote any technologies or deployment thereof. The views expressed in this report are solely those of its authors, and do not reflect any official positions.

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Key Messages

- **To limit climate risk**, 197 nations agreed at the Paris conference in 2015 to cap warming well below 2 °C or even at 1.5 °C. There is growing evidence that both goals may not be achievable by cutting greenhouse gas emissions alone, given that without other measures full decarbonisation would be needed before 2050. This is not reflected in current policy plans.
- **Mitigation remains key:** Decisive cuts of greenhouse gas emissions with a global decline starting no later than 2020 are essential for limiting climate risks. A rapid and systematic reduction of CO_2 emissions is the most important requirement, and delays would significantly increase the risk of dangerous climate change.
- **An open societal conversation** needs to address the emerging topic of climate engineering. The possibility of novel approaches to limit climate risk is increasingly discussed among researchers and carries important social, environmental, and ethical implications and risks. Tough questions on governance, protection against misuse, costs, benefits and risks of both climate change and climate engineering demand an open conversation in order to build a robust basis for reasoned and democratic decisions in Switzerland and indeed the whole world.
- **Negative emissions:** Capturing CO_2 from ambient air and storing it underground is sometimes termed as a type of climate engineering, which will likely be needed at large scale later this century. Switzerland alone might need to remove 280 million tons of CO_2 before 2100. Besides raising important social, environmental and ethical questions, it is unclear whether CO_2 removal can actually be funded and implemented at such scales. Relying on CO_2 removal now could be detrimental later, if it turns out to be infeasible.
- **Solar radiation management** e.g. by redirecting sunlight through reflective particles in the atmosphere is a fundamentally different type of climate engineering. While it could help prevent some severe consequences of climate change, it introduces significant novel risks and it could be misused to justify delays in mitigation or negative emissions. Again, many scientific, political, social, and ethical questions are to be addressed and explored transparently in order to judge its merits.
- **Switzerland can take an active role** in reaching the goals of Paris and establishing a frank conversation – by promoting research to better understand the urgency and challenges of CO_2 emissions reductions, by working to address the governance challenge posed by climate engineering, and by pioneering a proactive approach to public deliberation on these difficult but important questions.

Why we must address the cause of climate change more decisively than ever

Climate change poses severe threats to most people, infrastructure, and ecosystems.[1] To limit these threats, the Paris Agreement has set a target of limiting warming to well below 2 °C and to pursue efforts to limit the temperature increase to 1.5 °C in order to constrain climate risks to manageable levels.[2] To this end, the Paris Agreement calls on the global community to reach net-zero emissions – a balance of emitted greenhouse gas (GHG) emissions and sinks[3] thereof – in the second half of the century[4]. This is an enormous challenge for the international community. Currently, the global economy is largely powered by fossil fuels, and a global transformation that allows eliminating GHG emissions from most human activities will take time despite the growing understanding that this is necessary.[5] Current climate models tell us that we can emit only another 5-20 years' worth of current emissions if we want to achieve this target. Although national commitments made in the Paris Agreement are a big step for international climate diplomacy, they move the world forward on a path to around 3 ˚C, rather than the envisaged 1.5 to 2 °C and thus fall short of meeting the Paris goals.[6] Therefore, it is entirely possible that these targets will not be met. Furthermore, incoming government administrations sometimes undo legislative progress made by previous administrations causing further delays. Unless there are substantial changes of political, social, or economic trajectories compared to those assumed within IPCC scenarios, it is improbable that even the 2 °C target can be met. A frank public discourse needs to address this discrepancy and evaluate how to best establish more stringent climate policies for curbing GHG emissions.

Can carbon be taken back out of the atmosphere?

Many climate experts argue that large-scale operation of technologies or practices that yield so-called negative emissions – meaning the removal of GHGs from the atmosphere – would allow us to still meet the Paris targets despite the present political inertia. Removing CO_2 addresses the cause of climate change, namely elevated atmospheric GHG concentrations. In fact, most IPCC mitigation scenarios compatible with the 2 °C target – and all those compatible with the 1.5 °C target – already rely on the assumption that large-scale applications of negative emissions will be taking place.[4] These scenarios – and the Paris Agreement itself – are predicated on the rapid upscaling of CO_2 removal activities within decades, leading to removal of CO_2 that exceeds remaining emissions to achieve 'net negative emissions' (see the following box).

[1] IPCC, 2014: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1132 pp.

[2] UNFCCC (2015). Paris Agreement. United Nations Framework Convention on Climate Change. Retrieved from http://unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement.pdf

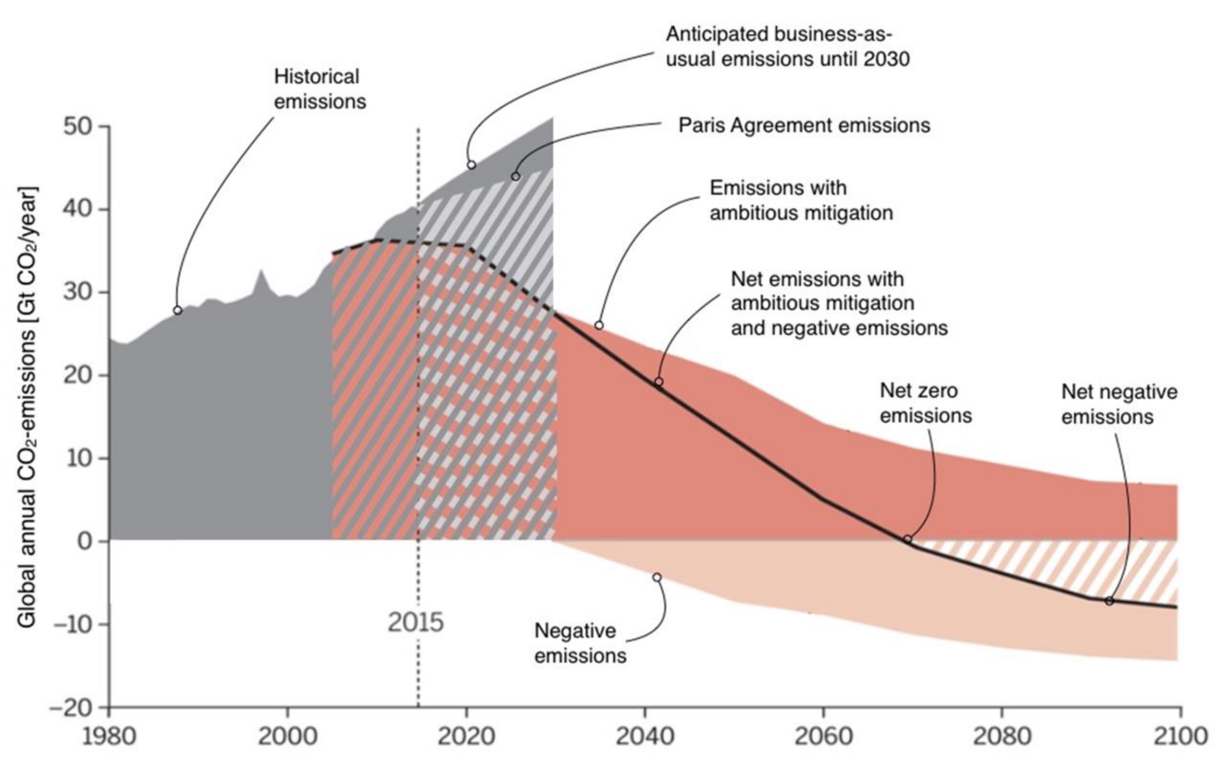
[3] Article 1, para 8 of the text establishing the United Nations Framework Convention on Climate Change (UNFCCC) states that: "Sink" means any process, activity or mechanism which removes a greenhouse gas, an aerosol or a precursor of a greenhouse gas from the atmosphere.

[4] See the graph on the following page. Besides the Paris Agreement stating the balance is to be achieved „in the second half of the century", Rogelj et al. (2015) have shown that for 1.5 °C net zero carbon emissions worldwide ought to be achieved between 2045 and 2060. See Rogelj, J., Luderer, G., Pietzcker, R. C., Kriegler, E., Schaeffer, M., Krey, V., & Riahi, K. (2015). Energy system transformations for limiting end-of-century warming to below 1.5 °C. *Nature Climate Change*, *5*(6), 519–527. https://doi.org/10.1038/nclimate2572

[5] International Energy Agency. (2016). *World Energy Outlook 2016 - Executive Summary*. Paris, France: OECD/IEA. Retrieved from https://www.iea.org/publications/freepublications/publication/WorldEnergyOutlook2016ExecutiveSummaryEnglish.pdf

[6] Rogelj, J., Den Elzen, M., Höhne, N., Fransen, T., Fekete, H., Winkler, H., Schaeffer, R., Sha, F., Riahi, K. & Meinshausen, M. (2016). Paris Agreement climate proposals need a boost to keep warming well below 2 C. *Nature*, *534* (7609), 631-639.

Understanding anthropogenic drivers: emissions reductions, negative emissions, and net negative emissions.
Historical emissions and the anticipated business-as-usual scenario are shown in dark grey. The light grey area between 2015 and 2030 represents emissions resulting from implementation of countries' current promises under the Paris Agreement. The red area represents emissions under a hypothetical ambitious GHG mitigation path. The beige area below the x-axis represents negative emissions or CO_2-removals. The black line represents net emissions i.e. subtracting the volume of negative emissions (in beige) from emissions (in red). Upon crossing the x-axis, the net emissions line indicates achieving net zero emissions. Only once negative emissions exceed emissions, net negative emissions are achieved and the CO_2 concentration in the atmosphere starts to decline.



Adapted from: Anderson, K., & Peters, G. (2016). The trouble with negative emissions. Science, 354(6309), 182-183.

In some scenarios, the scaling-up of negative emissions is assumed to start as early as within the next decade. However, negative emissions technologies are currently not at a level of maturity or scale to accomplish this. Moreover, we do not have the necessary policy instruments in place to provide regulatory guidance and help mobilize critical financial resources. The most prominent approach is to use biomass for thermal power generation, while sequestering and storing the resulting CO_2 in the ground[7], yet other approaches have also been discussed.[8] Large-scale implementation of such land-intensive methods is likely problematic and fraught with social

[7] IPCC (2014): Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
[8] Royal Society (2009): Geoengineering the climate – science, governance and uncertainty; S Policy document 10/09.

conflicts, given that it could divert resources away from the production of food crops and forests, affecting food security and livelihoods, as experienced in the production of biofuels for transportation.[9] This means that a frank conversation is needed to anticipate and proactively address potential conflicts of land-based carbon removal approaches and to include different viewpoints for designing policy instruments that reflect social values and minimize adverse outcomes, while acknowledging that socially acceptable levels of biomass energy with carbon capture and storage deployment may never reach the scale that some mitigation pathways assume.

Other approaches – such as directly capturing carbon from the atmosphere through chemical or biological "filters" – are tentatively being tested. Their primary advantage is that they do not require large amounts of productive land. However, these technologies come with their own challenges, in particular their large energy requirements and correspondingly high costs.[10] Deploying these technologies at the scales envisioned by the IPCC would cost several percent of global economic product unless the costs of these technologies can be dramatically downscaled. The need for negative emissions thus raises questions of justice such as: Who will be paying for this atmospheric clean-up operation?[11] In the absence of substantial dedicated research and development programs, progress on such technologies is likely to be too slow. Even if a technical process could be developed that reduced energy use to a minimum, a global funding effort or a substantial global price on carbon will be required to build and maintain a global industry that cleans up our atmosphere. This effort far exceeds anything achieved yet at the international level and for this to be possible, it would be essential to begin a societal conversation early on how to make research, development and financing succeed in the short time available.

Climate engineering / geoengineering

Climate engineering or geoengineering are methods and technologies that aim to deliberately alter the climate system at a global scale in order to alleviate the impacts of climate change. There are two types:

1. Negative Emissions Technologies (NETs) or Carbon Dioxide Removal (CDR) encompasses technologies that remove greenhouse gases from the atmosphere and store them permanently.
2. Solar Radiation Management (SRM) encompasses technologies that reduce warming by reflecting some amount of sunlight back to space (e.g. through the dispersion of aerosols in the atmosphere).

Some fear that by paying attention to such technologies a political argument for scaling back efforts toward classical mitigation can be made. Such behaviour would be unethical and dangerous given that cutting emissions is the only way to address the source of the climate change problem. Nevertheless, some might still try to make that argument for political reasons a concern that should be taken seriously. However, a frank conversation also has to be based on the best available scientific knowledge: By improving our understanding of the mitigation challenge and the potential

[9] Kraxner, F., Fuss, S., Krey, V., Best, D., Leduc, S., Kindermann, G., Yamagata, Y., Schepaschenko, D., Shvidenko, A., Aoki, K. and Yan, J., (2015): The role of bioenergy with carbon capture and storage (BECCS) for climate policy. Handbook of Clean Energy Systems.

[10] Keith, D. W. (2009): Why capture CO2 from the atmosphere? Science, 325(5948), 1654-1655.

[11] See e.g.: Gardiner, S., (2010): Is arming the future with geoengineering really the lesser evil? Chapter 16. In: Gardiner, S., Caney, S., Jamieson, D., Shue, H. (eds.), *Climate Ethics: Essential Readings*. Oxford: Oxford University Press, 284–314.

need for large-scale use of hard-to-deploy technologies we can raise awareness of the urgency to phase out GHG emissions.[12]

Currently there is no systematic governance framework in place to guide further research or to facilitate decision making about deployment of negative emissions other than the Paris Agreement, which remains rather unspecific on this aspect. By not making plans for decarbonizing our global economy by before 2050, we are as a global community currently fooling ourselves into relying on untested negative emissions technologies[13]. Negative emissions technologies cannot be a silver bullet magically solving climate change. These technologies have to contribute incrementally to the overall challenge of dealing with dangerously high GHG concentrations in the atmosphere. We need to have a frank conversation about the fact that only by an unprecedented concerted global effort they can be applied at significant scales, while also taking into account possible conflicts over limited natural resources and the need to achieve sustainable development. This conversation needs to take place so that policy decisions are taken in a balanced and well-deliberated manner.[13]

Can we limit the sun's energy reaching earth?

The other kind of intervention, which is fundamentally different from reducing emissions and CO_2-removal, is called solar radiation management (SRM). It is very controversial, but – as the recent IPCC fifth assessment report puts it – "if realizable, could to some degree offset global temperature rise and some of its effects".[14] As described in the previous sections, climate change that corresponds to current policy planning gravely exceeds what appears to be acceptable risk levels and it is a real possibility that negative emissions technologies do not deliver at the scale they would need to. These two observations give reason to believe that ecosystem collapses and societal disruptions reversing decades of development are a real risk under anticipated climate change. While far from perfect as we will describe in the following, there is a possibility that SRM could alleviate such risks and this possibility should be taken seriously. One such approach would be to introduce additional aerosols – small particles – into the upper atmosphere, such that a fraction of the incoming sunlight is scattered back to space, resulting in less solar energy reaching Earth's surface. Volcanic eruptions, as well as atmospheric models, have shown that aerosols indeed generate a cooling effect and that in small doses they also might put a break on a general acceleration of rainfall that is expected under climate change.[15] Other ideas for SRM also exist, but we will focus on stratospheric aerosol injection given its prominence in the academic discourse.[8]

SRM would not eliminate all of the threats of high GHG concentrations (e.g. ocean acidification), and it could introduce new risks, e.g. changes in regional rainfall patterns or a rapid increase in temperature if it were suddenly discontinued. The amount of research devoted to understanding these risks, and finding ways of mitigating them through the specific choice of technologies and deployment patterns, has been extremely low considering the large risk climate change poses. Conducting the research to find out whether SRM could complement rapid mitigation and CO_2 removal in a comprehensive risk management approach, may need to become a high priority for government funding agencies. A frank conversation is needed on whether and how such research can be undertaken in a way that does not undermine but strengthen global efforts to address climate change.

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[12] Reynolds, J. (2015): A critical examination of the climate engineering moral hazard and risk compensation concern. *The Anthropocene Review*, 2(2), 1–18.

[13] Fuss, S., Canadell, J.G., Peters, G.P., Tavoni, M., Andrew, R.M., Ciais, P., Jackson, R.B., Jones, C.D., Kraxner, F., Nakicenovic, N. and Le Quéré, C. (2014): Betting on negative emissions. Nature Climate Change, 4(10), pp.850-853.

[14] Page 89 in IPCC (2014): Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp.

[15] Keith, D. W., & MacMartin, D. G. (2015): A temporary, moderate and responsive scenario for solar geoengineering. Nature Climate Change, 5(3), 201-206.

Given that SRM does not directly address the cause of the climate change problem and given that it would likely represent one of the largest and longest lasting human interventions in environmental systems – rivalled only by our unwitting emissions of greenhouse gases in the first place – it is seen by many as morally more problematic than negative emissions technologies. It could be especially problematic if it competes with efforts to eliminate GHG emissions or to remove GHG from the atmosphere.[16] Some take issue with the deliberate modification of nature that SRM embodies, yet humanity has reached a point where our activity is already fundamentally altering the planet. If SRM offered a chance to save lives or limit environmental degradation, it seems at least debatable whether it would really be preferable to leave it off the table.[17] Given that unwanted effects of SRM application likely increase with the volume of its application, meaningful application would have to be limited and combined with strengthened efforts to remove CO_2 as well as with measures to adapt and compensate for damages.[18] All of this indicates an important ethical dimension associated with decisions on SRM – intertwined with other efforts to fight climate change.[19] Careful deliberation of the ethics and appropriate principles of conduct arguably require public participation.[20]

The governance issues arising from SRM pose particular challenges at the international level. How can the international community decide to start – and eventually to cease using such measures? How can continued funding be ensured given that – contrary to most mitigation investments – SRM represents continuous costs? How will decisions be made over unequally distributed results and how are environmental and social impacts to be attenuated? What are impacts regarding local and global justice, human rights and how can they be addressed? How can international governance frameworks be designed to withstand geopolitical changes over the many decades during which they need to be operational? The international research community has started exploring these difficult but unavoidable questions, but Switzerland has so far hardly contributed to this research. The global policy community has not addressed any of these questions and it is important that countries start setting in motion the processes which will eventually allow answering these questions in a deliberate and democratic manner.[21] This will require a global conversation on what constitutes an appropriate design of climate engineering governance institutions, in which Switzerland will want to participate.

Why a frank public conversation is needed

There is a need to publicly discuss the questions and issues raised in the previous sections for three reasons: Firstly, the possibility of severe climate change risks emerging this century, secondly the reliance on untested technologies to remove greenhouse gases from our atmosphere and finally the theoretical possibility of Solar Radiation Management technologies being used. These three issues are related and we argue they deserve more attention and public deliberation due to their far-reaching societal relevance. We believe a frank public conversation will help society and policymakers to address these issues and enhance the quality and legitimacy of decisions

[16] Preston, C. J. (2013): Ethics and geoengineering: reviewing the moral issues raised by solar radiation management and carbon dioxide removal. In: Climate Change, 4(1): 23-37.
[17] For further reading see: Jamieson, D. (2010): Climate Change, Responsibility, and Justice. In: Science and Engineering Ethics, 16(3): 431–445.
[18] Svoboda, T., Irvine, P. (2014): Ethical and Technical Challenges in Compensating for Harm Due to Solar Radiation Management Geoengineering. In: *Ethics, Policy & Environment*, 17(2), 157–174.
[19] Svoboda, T., Keller, K., Goes, M., Tuana, N. (2011): Sulfate Aerosol Geoengineering: The Question of Justice. In: *Public Affairs Quarterly*, 25(3), 157–179.
[20] See also Tuana, N., Sriver, R. I., Svoboda, T., Olson, R., Irvine, P. J., Haqq-Misra, J., Keller, K. (2012): Towards Integrated Ethical and Scientific Analysis of Geoengineering: A Research Agenda. Ethics, Policy and Environment, 15(2): 136–157.
[21] This is the objective of a new project of the Carnegie Council under the leadership of Janos Pasztor (see https://www.carnegiecouncil.org/programs/ccgg/index.html)

ultimately taken. Research shows that early public deliberation of emerging issues of public concern regularly results in better and more legitimate decisions.[22] We believe that early deliberation on the basis of a dialogue between citizens, decision makers and experts in the form of an inclusive, honest and proactive conversation can help building up critical contextual knowledge and an understanding of complex and interlinked issues surrounding climate change and climate engineering. During such conversations different concerns, opinions and viewpoints not foreseen by experts often surface. Such a broad-based understanding then serves as a basis to arrive at comprehensive and well-supported decisions that reflect societal values and preferences. However, such deliberative and political processes take years or even decades. Given that climate engineering is becoming more and more prominent in discussions on climate change, there is currently still time to start a public conversation in a deliberative spirit. Taking this opportunity would allow addressing critical issues in a deliberated, transparent and democratic manner in line with Swiss democratic practice and based on Swiss leadership in climate change science and diplomacy.

What Switzerland's role can be

Switzerland is an important player for international policy – the United Nations Office at Geneva (UNOG) is the second largest of the four major office sites of the United Nations. Switzerland is a Party to the Paris Agreement and it appears likely that at least some governance aspects of climate engineering may be addressed in context of the Agreement's implementation. In international climate negotiations Switzerland often acts as a pioneer, as was the case in 2015 when it was the first country to submit its national mitigation contribution and it is widely viewed among climate change diplomats as a champion for the environment. At the same time, Switzerland is home to some of the world's most renowned climate scientists and – hosting its secretariat in Geneva – it significantly contributes to the work of the IPCC. Switzerland is known for its history of proactively addressing environmental problems. Removing carbon from the atmosphere represents the equivalent of cleaning up environmental pollution, in addition to stopping new pollution. This is what the people of Switzerland have done in the past with other forms of pollution, including phosphates in surface waters, and toxic chemicals in our soils.

Its liberal political system and direct democracy puts Switzerland high on global rankings of democratic practice.[23] Moreover, Switzerland's state policies perform well on environmental and sustainability rankings[24] with significant investments in green innovations anticipating future environmental problems. The Swiss energy strategy enhances security of supply and energy efficiency and the use of more renewable energy is a good example of green investment planning in Switzerland. Climate change is a problem that requires both qualities – democracy and anticipation – because deliberating and addressing the issues surrounding mitigation, negative emissions and SRM are long-term projects, requiring a great deal of public consideration and analysis. Getting public conversations going – including on difficult topics – is what makes Switzerland strong as a country and it is how problems get solved.

Furthermore, every country has a responsibility to not only stop emissions by the second half of the century, but to even get to a point, where its removals exceed its remaining emissions. Switzerland's responsibility according to a number of global calculations of what constitutes a fair global distribution of the remaining carbon budget is to remove more GHGs than our country emits

[22] Nanz, P., & Steffek, J. (2005): Assessing the democratic quality of deliberation in international governance: criteria and research strategies. Acta politica, 40(3), 368-383.

[23] The Economist Intelligence Unit's Democracy Index 2016 puts Switzerland in 8th position in its global democracy index.

[24] The Environmental Performance Index (EPI) puts Switzerland on the 16th place in 2016 concerning the environmental performance of a state's policies. Both in 2012 and 2014 Switzerland was on the first place.

during the period from 2050 to 2100.[25] This excess removal amount corresponds to approximately six times the GHGs that Switzerland emitted in 2016. That is a lot of negative emissions for which this country is responsible and a frank conversation is required to figure out how Switzerland can deliver on this responsibility and how it – being a diplomatic, scientific and innovation leader – can help other countries live up to theirs.

How to start the conversation

The science-science dialogue, from which this white paper originates, has sparked an exchange and learning across academic disciplines. Participants noted a need to broaden this conversation to include non-experts: citizens as well as civil servants and environmental non-governmental organizations. Public research and engagement activities are already ongoing in Germany,[26] and the UK[27] and numerous organizations have called and are planning for public dialogues within and beyond national boundaries.[28] In this same spirit of inclusion and participation that we believe is fundamental to enable democratic decisions, we recommend establishing a publicly supported dialogue and deliberative process. At this early stage, such a dialogue would allow citizens, civil society organizations and civil servants in Switzerland to become aware of the issue and to better understand the ethical, societal, ecological, economic and technological dimensions of climate engineering and to actively contribute to their governance.

We see the Federal Office for the Environment in an excellent position to further explore the issue, for instance by means of a concern assessment that elicits views and concerns of various stakeholder groups and a representative sample of the Swiss population in order to assess concerns and the general level of understanding of climate engineering. On the basis of such an assessment, proactive public engagement processes could be developed. A Swiss citizen jury could be one possible element of such a public engagement process. Another one could be an information platform that enables compilation and dissemination of information and enables dialogue. In our view, it will be crucial that the conversation is opened up to address not only the scientific or technological dimensions, but that social concerns, ethical considerations, as well as environmental and economic issues also receive the attention they deserve.

[25] The carbon budget allocated to Switzerland for 2 °C in the period 2050 to 2100 is cumulatively –280 million tCO_2-eq, meaning that it has to remove 280 million tons of CO_2 before the end of the century in addition to removing the equivalents of any residual emissions it may still produce during that period [see du Pont, Y. R., Jeffery, M. L., Gütschow, J., Rogelj, J., Christoff, P., & Meinshausen, M. (2017): Equitable mitigation to achieve the Paris Agreement goals. Nature Climate Change, 7(1), 38-43].

[26] An ongoing DFG funded priority programme (SPP 1689) undertakes an interdisciplinary assessment of Climate Engineering.

[27] The Natural Environment Research Council of the UK – as the latest element in a sequence of public research programs on this issue – is launching a concerted research program on carbon removal.

[28] The Office of Technology Assessment at the German Bundestag identified a great need for public engagement on climate engineering in its 2014 study. The Forum for Climate Engineering Assessments based in Washington DC aims to broaden the debate in the US, while the Solar Radiation Management Governance Initiative (SRMGI) aims to enable developing countries to participate in the global discourse.

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