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Comment to the Secretariat in Response to the Call for Input

**By John M. Fitzgerald
Attorney and Advocate**

May 25, 2023

From: John M. Fitzgerald, Attorney and Advocate, and Member of the Board of Several Conservation and Climate Protection Organizations

To: Supervisory Body at Supervisory-Body@unfccc.int.

Re: *Input to SB005 annotated agenda and related annexes* in response to the Call for input on issues included in the annotated agenda and related annexes of the [fifth meeting of the Article 6.4 Supervisory Body](#)

Date: May 25, 2023

I have worked for over two years with many scientists on the development of methane removal and methane emissions avoidance methods as you prefer to call near source removal and/or suppression after working throughout most of my career of the past fifty years at the state, national, and international levels to advance natural resource conservation, renewable energy and ecosystem restoration through the law and science.

I am following up on input from the Institute for Governance and Sustainable Development which spoke on behalf of one of my clients as IGSD is a registered observer, and on my own

¹ As you require a logo, Gawain's shield is mine for purposes of this submission. This is the pentangle on the shield of Gawain in "Gawain and the Green Knight". As a knight of the Round Table Gawain did his best to represent and advance the causes of civilization and chivalry. He learned that the pursuit of perfection for himself or his colleagues is always a pursuit worth undertaking even though perfection is not attainable in this life yet pursuit of perfection in those qualities leads to progress, justice and understanding.

more detailed comments in March, both of which were urging you to include methane removal in the Article 6.4 removal processes.

I have also included in an appendix to this submission excerpts from comments I submitted in March 2023 to further elaborate on Sustainable Development Goals addressed by methane and NOX removal and on progress being made in the R&D of methane removal as reflected in recent peer reviewed papers and in regular reports from researchers in the Atmospheric Methane Removal Community.

Therefore, I will address the information note on removal (**A6.4-SB005-AA-A09 --Information note --Removal activities under the Article 6.4 mechanism** today.

And, although your proposed agenda for the Bonn meeting is lengthy, given that you plan to address primarily the Activity Cycle Procedures for Projects, (ACPP) while leaving the other two documents on Rules Modalities and Procedures for later, I will largely address that ACPP here and withhold comments on the other two for the future.

Article 6.4 addresses both reduction of emissions and removal of emitted GHGs. CO2 removal has received the vast majority of the investment, subsidies and attention since the UNFCCC was signed on June 12, 1992.

My first major point is that **methane removal deserves a much greater emphasis than it has yet received in the documents and plans under A6.4.**

Methane removal is likely to be no less crucial than CO2 removal, hence the urgency in understanding what options may be available here. And methane removal and CDR play fundamentally different roles in the climate solution ecosystem — ideally, we'd have them both, and they shouldn't be pitted against each other, to paraphrase one of Spark Climate Solutions' founders.

Comments on A6.4-SB005-AA-A09 -- Information note: Removal activities under the Article 6.4 mechanism Version 04.0

I appreciate the passage from the Note under 4 at 42-43, but I note that it is not reflected in the operational aspects such as the draft Activity Cycle Procedure for Projects. Here is the positive note that needs to be incorporated in the Rules and Procedures and not just in a Note:

4. Quantification of mitigation value of removal activities

42. The mitigation value of a climate action can be defined in various ways with respect to different climate goals or climate policy objectives.

43. While removals cannot serve as a substitute for deep emissions reductions, these can still play multiple complementary roles in the mitigation strategies at global or national levels (R-32:h):

(a) Removals can further reduce net CO2 or GHG emission levels in the near-term;

(b) Removals can counterbalance residual emissions from hard-to-transition sectors, such as CO2 from industrial activities and long-distance transport (e.g., aviation, shipping), or methane and nitrous oxide from agriculture, and thus help reach net zero CO2 or GHG emissions in the mid-term;

(c) Removals can achieve and sustain net-negative CO2 or GHG emissions in the long-term, by deploying removal activities at levels exceeding annual residual CO2 or GHG emissions.

A key example and cause of the failure of the process so far is that methane is still being measured in its impact over a 100-year scale compared to CO2 rather than recognizing its powerful impact over the initial twenty years after its release of roughly 84 times the GWP of CO2. In fact, the documents go so far as to report without comment on Table 1, on page 13 of the Note, the IPCC recommendation of removing an equivalent of CO2 rather than removing methane itself or both:

These three points below (followed by our short response in italics) are offered in the table as three reasons not to include removal of Non-CO2 GHGs while flying in the face of numerous peer reviewed articles that do in fact anticipate removing methane at scale at achievable costs per ton over less than the next two decades. (See citations to several papers by Rob Jackson, Renaud de Richter, etc. in March comments excerpted in the Annex below.)

- Removal of other GHGs is not currently anticipated at relevant scales; *[the rebuttal is in papers by top researchers at top universities and agencies cited in the appendix]*

- It is unclear if the removal of other GHGs has a comparable mitigation effect to the removal of CO2; *[So, let us pursue both as research indicates that removing non-CO2 GHGs is likely to be far more effective and much faster and avoiding tipping points and reducing overall GWP, than either natural or mechanical CO2 alone. The US Inflation Reduction Act alone provides more than enough funding and tax expenditures for a decade to make great progress across the spectrum of CO2 and methane and NOX reductions and removals.]*

- The Intergovernmental Panel on Climate Change (IPCC) recommends that, for now as well in the foreseeable future, the effects of non-CO2 GHGs should be balanced through additional removal of CO2 based on 100-year global warming potential equivalence. *[This is akin to recommending aspirin and better dental hygiene for an impacted, infected tooth instead of removing the decay and restoring the tooth to treat the infection and prevent its return.]*

While I understand that a table limits the discourse, presenting these arguments against non-CO2 removals in this way appears to follow or support a pattern of dismissing overall general

categories of progress by raising objections based on a lack of knowledge about one or two specific examples of the overall category of removals. That is an old trick or mind game that is illogical, non-persuasive and intellectually dishonest and has no place in international decision-making. Therefore, I suggest that draft decision documents and notes in support of them avoid such terse presentations unless they are accompanied by much more thorough analysis.

This pattern is repeated throughout the table, implying that the existence of pros and cons should lead to inaction instead of informing the research and assessment process to do what works in time to save what we can and restore functioning ecosystems where we can.

Furthermore, the documents still focus on net zero and achieving no more than 1.5 degrees C of warming on average more slowly rather than learning from the great harm experienced since 2020's heat spikes, fires, droughts, etc. and pressing for the more ambitious net negative targets and reducing average temperatures. Given the many options now under development this should well be possible over the coming decades in a joint program of methane, NOX, CO2 and other GHG removal and widely adopted near source avoidance or capture. The latter include methods on offer now that can provide significant progress toward several Sustainable Development Goals from reducing hunger to reducing traditional air pollutants and their human, animal and plant health consequences (e.g., <https://www.windfall.bio/about>).

The Taxonomy of Removal and description of removal methods under Section 3 is entirely limited to CO2 removal despite my having submitted detailed descriptions and references to methane removal methods in March which offer similar potential and scalability over the relevant time frames given even modest RD&D support.

Appendix I of the Note offers useful descriptions of promising CO2 sequestration systems and methods from Enhanced Rock Weathering to Ocean Alkalinization to Ocean Fertilization which descriptions should lead to research and assessment programs that could refine and target their use. This research agenda appears to be missing entirely from the agenda of the Supervisory Body and the Bonn Meeting and thus likely to be absent from the MOP in the fall.

Environmental and Social Impact Assessment of Continuing Emissions and of Removals:

Part of the research agenda and the Rules for Article 6.4 must be full compliance with national and international obligations for impact assessments and for compliance with existing law and the law as it is evolving in order to govern both GHG emissions and removal methods. These include the London Convention and Protocol and the Convention on Biological Diversity as well as other customary and codified international and domestic law. The same rigor should be applied by the MOP and its parties to any new or continuing emissions of direct or indirect GHGs such as hydrogen is increasingly recognized to be given that it impedes nature's oxidation of methane and thus extends methane's life in the atmosphere and the harm it does there *via* global warming.

The devoting of 5% of the proceeds of fees to adaptation is a good thing that could be a model for devoting a tax on fossil fuel production to climate and ecosystem restoration such as foreseen

and provided for in Articles 8 on restoring degraded ecosystems and curtailing actions that harm biodiversity and 14.1 on impact assessment and 14.2 on payments for restoration of the CBD. The U.S. has all of the required laws and authorities and resources to participate in such a program despite not having ratified the CBD or the London Protocol.

Appendix –

Excerpts from Comments filed by John Fitzgerald as an individual in response to the call for Input on 6.4 Removals in March 2023

This appendix is included given that points made herein were not all acknowledged or used in the draft decision documents provided to date to or by the Supervisory Body or the Secretariat so that these points will be more likely to be included in the materials considered by the Meeting of the Parties and related meetings alongside the MOP this fall, including the Methane Pledge stocktaking and a proposed Removal Pledge modeled after the Methane Pledge.

...

The Secretariat is rightly recognizing the rapid advances in the removal of greenhouse gases in recent years and rightly seeking to ensure these methods are used well by ensuring good governance of the process and applications that support sustainable development overall. While several forms of CO₂ removal are being used, rewarded and advanced in recent years, research at several universities and laboratories over the past several years has demonstrated that other greenhouse gases including methane and nitrous oxides can also be removed at rates that vary considerably depending on the density of the agent and other factors. For example, laboratory tests have replicated one of nature's methods of removing methane in which methane is converted by being oxidized into water and very small amounts of CO₂. This is what nature does with iron and salt sea spray in sunlight. Further research is needed to understand the full potential effects, costs and potential scale of enhancing this process, among others but the high

potential warrants the inclusion of this and other methods of GHG removals in any Article 6.4 planning process that is intended to guide cooperative international or transnational removals for many years to come.

This and other methods are among those our allied researchers have developed in concept, in peer reviewed papers, and in laboratory smog chambers. At least two groups are now planning pilot projects to test the removal of both methane and other pollutants in the field from near sources such as cow barns and coal mines to ambient settings over the ocean.

Since the Article 6.4 process is to be on-going, it should be created with the evolution of these as well as new and additional CO2 removal methods in mind.

Key Challenge

In the overall area of international government-supported GHG removal, the main challenge is how to encourage the most effective use of real, transparent, safe GHG removals at scale in developing countries while also encouraging rapid reductions in emissions and fair adaptation support. The field is rapidly evolving but already presents approaches that are more nature-based and lower in risk while being more than symptomatic relief and are longer term solutions in some cases than solar radiation management, for example.

Additional Issues Include:

Achieving Net Removals and Not Just Offsets: The Secretariat is aware but I point out here that the 6.4 project process is designed to spur actual mitigation and removal. It may also create a good platform for offsets but those must be accounted for separately.

Track Removal of Each Greenhouse Gas Separately: Well informed experts note the need for speed in reducing the most powerful greenhouse gases such as methane as fast as possible in order to buy time to handle the longer-term CO2. The enactment of the Inflation Reduction Act made it clear that the Biden Administration understands that we must pursue both at once and that the days of limiting our efforts to what is in a balanced budget are over for now and we must invest as much as it takes to ensure our survival as a civilization.

Across domestic and international laws there are different legal obligations, rewards, and commitments for each pollutant. Therefore, the 6.4 process should be designed to assist all of these pathways while letting the separate rules for each play out and be adjusted by the relevant authorities for each. The 6.4 process must not become a bottleneck for any removal method but should facilitate any reasonable removal process and partnership that it can.

Remove the Most Powerful GHG As Fast as Possible: Given the daily increase in harm due to ghgs already released, the best outcome for the 6.4 removal process in the near to mid-term would be to remove as much CO2 equivalent gas as rapidly and safely as possible while maintaining accountability for all ghgs over the long term.

Accounting for GHG Emissions

In recent years as our ability to remove ghgs has grown, our ability to track the sources of human controlled releases has also grown. After addressing accounting for emissions, we will note briefly ways of accounting for removals.

The best-known system for such accounting is probably the work of Rick Heede, founder of Climate Accountability (<https://climateaccountability.org/carbon-majors/>). Heede has documented the release of ghgs by major oil, gas, coal, and cement companies through the industrial era as described on their website:

Accounting for carbon and methane emissions 1854-2010

In groundbreaking peer-reviewed research forthcoming in *Climatic Change*, researcher Richard Heede offers the most complete picture to date of which institutions have extracted the fossil fuels that have been the root cause of global warming since the Industrial Revolution. Rather than attribute emissions to nations, the study aggregates historical emissions according to carbon *producing* entities themselves. Heede concludes that nearly two-thirds of carbon dioxide emitted since the 1750s can be traced to the 90 largest fossil fuel and cement producers, most of which still operate today.

Key findings

The research attributes 63 percent of the carbon dioxide and methane emitted between 1751 and 2010 to just 90 entities. Fifty are investor-owned companies such as Chevron, Peabody, Shell, and BHP Billiton. Thirty-one are state-owned companies such as Saudi Aramco and Statoil, and nine are government-run industries in countries such as China, Poland, and the former Soviet Union. The research also classified the 90 entities according to type of fossil fuel extracted and marketed. There are 56 oil and natural gas companies, and 37 coal producers. In addition, the CO₂ emissions from seven cement manufacturers are included.

Climate Accountability Institute is releasing a new dataset quantifying how much each of the largest oil, natural gas, and coal companies has contributed to the climate crisis from 1965 to 2018. We find that the Top Twenty companies have collectively contributed 493 billion tonnes of carbon dioxide and methane, chiefly from the combustion of their products, equivalent to 35% of all fossil fuel and cement emissions worldwide since 1965 (global total of 1.41 *trillion* tCO₂e). <https://climateaccountability.org/carbonmajors.html>

Accounting for GHG removals: The CO₂ removal market has developed a number of methods of accounting for removal, storage and leakage over the past several years. The mandatory system run by the California Air Resources Board is one example. Near source methane removals have been by flaring which is not totally reliable. Newer methods will allow and indeed require measuring the methane's presence both within the system used if it is a closed chamber or before and after if it is a filter, for example. Ambient Carbon of Denmark has been offering pilot projects of such systems over the past several months. Dense methane can be detected and its presence estimated to some degree based on real time observations and special cameras. Ambient removal is more difficult but practicable. Solar Chimneys present a controlled flow the measurement of which is straightforward. Open air removal can also be measured. One example was outlined in the peer reviewed article on environmental assessment of a field test for

enhanced atmospheric methane removal via iron salt aerosols.² The removal in open air systems is likely to be interpolated based on before and after measurements of the basic approach and using a formula that would be derived from smog chamber tests and field tests using lasers and mirrors before and after the passage of the ships distributing the iron salt aerosol. The formula would be filled out for each application and contain the elements necessary to oxidize such methane, such as the ratio of iron salt aerosol surface to sunlight and salt sea spray and time of exposure. A team from Denmark, Holland and Spain led by Prof. Matthew Johnson of the University of Copenhagen has been planning such as field test.

How Can 6.4 Move from Accountability to Remedy?

Implementing Existing Law: As noted above there are a number of different commitments and duties for removing ghgs that 6.4 can accommodate in turning these goals and principles into practice. These run from a general duty under international customary law not to harm the environment of another country via pollution established in the Trail Smelter Arbitration in which Canada was required to pay for the damage done by air pollution from a Canadian smelter in the town of Trail, British Columbia to farms in Washington State.

That general duty was incorporated as part of Article 3 of the Convention on Biological Diversity now ratified by almost every country in the world.

Climate pollutants create forms of harm that include reducing crop growth and potentially harming humans and animals as in the Trail Smelter Arbitration but also go far beyond that. Thus, that duty applies in principle and it is indeed one of the most basic principles of civil and common law that one should not affect another without consent in such a way as to pose a significant risk of harm and if one does so, one is liable to make his victim whole. Before

²Environmental Impact Modeling for a Small-Scale Field Test of Methane Removal by Iron Salt Aerosols

Timothy M. Sturtz ¹, Peter T. Jenkins ^{2,*} and Renaud de Richter ^{3,*}

Abstract: Various authors have highlighted the possible removal of methane from the atmosphere via oxidation by broad releases of iron salt aerosols in order to serve climate protection goals. This technique is known as enhanced atmospheric methane oxidation (EAMO). This study proposes and employs a modeling approach for the potential environmental impacts associated with a hypothetical small-scale field test of EAMO consisting of seeding cargo-ship exhaust plumes with iron salt aerosols. Using a sample region in the Southern Caribbean Sea as a hypothetical testing site, it provides assessments of potential impacts to air quality, human health, and the marine environment. ...

removal was potentially available, some scholars argued that a level of pollution was common practice or unavoidable but those who exceeded the norms should be held liable.³ Treaties such as the Convention on Long Range Transboundary Air Pollution (<https://www.state.gov/key-topics-office-of-environmental-quality-and-transboundary-issues/convention-on-long-range-transboundary-air-pollution/>) have also taken on one pollutant at a time. See also, <https://unece.org/convention-and-its-achievements>.

The U.S. EPA is in the process of promulgating a modern set of standards for minimizing methane leaks throughout the process of producing and transporting natural gas under Section 111 of the Clean Air Act for existing and new domestic sources and Section 115 offers an avenue for international cooperation. The US EPA may have to adopt additional requirements under the Toxic Substances Control Act as well.⁴

Helping Implement The Methane Pledge: A primary example of the different commitments for different GHGs noted above is the Methane Pledge. In the Pledge roughly 150 nation-states have committed to reduce their human controlled methane emissions by 30% over ten years. The second paragraph of the Pledge commits signers to adopt standards for controlling methane emissions in most sectors and incentives for doing so in Agriculture. This is just what the US EPA and US Department of Agriculture are doing now using authorities and resources available to them under the Clean Air Act and the Inflation Reduction Act respectively. Methane Action has filed comments with each agency in order to ensure that they are aware of progress toward methane removal for different settings and that they will take up those methods and assist in their development and eventual deployment.

Parties to the Pledge are supposed to meet annually to compare their reductions, as well as the standards and incentives they have adopted. This process is one with which Article 6.4 actions

³ SHARES Research Paper 45 (2014); Transboundary Damage in Climate Change: Criteria for Allocating Responsibility, Henry Shue, *University of Oxford* -- available at www.sharesproject.nl .

⁴ A petition under the Toxic Substances Control Act to require the sellers of oil and gas to pay for the removal of CO₂ and methane was filed by several entities and persons led by the climate scientist Jim Hansen, the Climate Protection and Restoration Initiative, a group on whose Advisory Board he serves and Dan Galpern, Dr. Hansen's lawyer and policy advisor.⁴ In its reply the EPA admitted that if it were to decide that current patterns of fossil fuel use and accompanying pollution were to present an unreasonable risk to human health and the environment then those who placed them in commerce would from that point on be responsible for removing them to the extent possible. The petition was denied by the EPA in light of unspecified regulations EPA anticipated promulgating that would accomplish similar results. The petition is now the subject of litigation in the Federal Courts in which the plaintiffs seek to require the EPA to use its Toxic Substances Control Act authorities to help pay for the research, development and deployment of both CO₂ and methane removal so as to undo as much of the climate harm done by the oil and gas sector as possible. If Dr. Hansen's petition is successful the removal of methane will be greatly expedited with more rapidly advancing methods being developed and deployed. That in turn should not only reduce ground level ozone but climate forcing as well.

can and should be aligned so that nations seeking to cooperate on methane emissions reduction and removal can keep up with advancing technologies use the best systems of emission reduction and removal.

Some of the countries who emit the most methane have not joined the Pledge but do have NDCs under the Paris Agreement and would benefit greatly from reduced methane in and around their countries. These countries include China, India and Russia. The first two off-gas massive amounts of methane from coal mines, often open-pit mines, which methane contributes to ground level ozone, directly harming human health. Russia has notoriously leaky natural gas pipelines. When repairs are undertaken further leaks can occur but those can be minimized with proper procedures. Halting such leaks is also in the business interest of Russia or any producer.

CCAC Programs for Emissions Reductions: The CCAC has deep resources at work already in reducing methane emissions around the world -- (<https://www.ccacoalition.org/en/activity/methane-roadmap-action-programme-m-rap?R6wF9AvbqY=B08FDF90665E65579DDC5D598A0108C4>). Our hope is that the CCAC will also help with the RD&D of methane removal.

From Reductions to Removal:

While the Methane Pledge addresses emissions reductions the 6.4 program could allow pledging countries to pay for or conduct removals to augment their emissions reductions in order to achieve or exceed their pledged reductions on time.

Therefore the 6.4 mechanism should monitor and assist the progress of these efforts under the Pledge and share the knowledge with nations seeking to cooperate under the 6.4 process.

Answering the Call of the Secretariat for Recommendations on Governance

The Secretariat rightly understands that for the Article 6.4 platform to work even as a facilitating device it should have in place the beginning of controls. So, in paragraph 19 of the call of the Secretariat for comments to inform the Supervisory Body, the Secretariat asked for comments on “**appropriate monitoring, reporting, accounting for removals** and crediting periods, addressing reversals, avoidance of leakage, and avoidance of other negative environmental and social impacts, in addition to the activities referred to in chapter V of the rules, modalities and procedures.

In paragraph 20 the Secretariat “*Requests* the Supervisory Body to consider the views of Parties and observers in elaborating and further developing recommendations on activities involving removals, as referred to in paragraph 19 above, **on the basis of the rules, modalities and procedures...**”

In short, the Secretariat is asking for our advice on how to govern removals. We suggest that the Supervisory body use elements suggested since 2021 by scientific and policy experts from around the world in this regard.

Leading scientific and policy experts offered their advice since 2021 calling for a Declaration in which nations would cooperate to ensure that methane removal would be developed and deployed as soon as practicable and that it would not be overdone, underdone, or improperly done so as to return methane levels to preindustrial levels. Here are excerpts from a letter of support for a Methane Declaration to help govern methane removal and from the endorsed Draft Declaration itself:

In April 2021 leading climate scientists, atmospheric scientists and other experts issued a [statement](#) urging national and global leaders to take effective measures to achieve a rapid reduction in atmospheric methane levels. In addition to reducing methane emissions, they called for more research on scalable ways of removing methane from the atmosphere. Some emerging methods for removing methane from the atmosphere were discussed in the most recent IPCC report, which also cited current research about them².

The [April statement](#) called upon all countries to commit to cutting methane emissions aggressively, to fund research on methane mitigation and removal, and to frame and implement global governance to ensure full and proper implementation of such methods in order to return to atmospheric methane concentrations to preindustrial levels.

Now it's time for leaders to act, and take concrete steps toward these goals.

The [Declaration on Reducing Atmospheric Methane](#) lays out such steps that can be taken now, and a framework for researching a range of potential methane solutions and implementing those that prove safe and effective, including but not limited to the ones the Declaration mentions by name. We urge national governments and other jurisdictions to adopt it.

Furthermore, given that rising methane concentrations contribute significantly to global warming, ecosystem damage and biodiversity loss, we urge parties to the [United Nations Framework Convention on Climate Change](#), the [Convention on Biological Diversity](#), and other relevant treaties and agreements to take swift, effective action on methane emissions reduction and atmospheric methane removal, incorporating as appropriate the goals and framework of the [Declaration on Reducing Atmospheric Methane](#). ⁵*(Emphasis added.)*

The Conclusion of the Draft Declaration on Reducing Atmospheric Methane --

⁵ In preparation for the initial Earth Day Summit of 2021, the non-profit project Methane Action also suggested to the White House a slightly more detailed draft Methane Agreement and a draft Executive Order on Greenhouse Gas Removal (<https://methaneaction.org/request-to-president-biden-to-issue-executive-order-expediting-active-ghg-removal/>), but the Administration decided to pursue a Methane Pledge instead on the run up to Glasgow's COP and an Order on Emissions Reduction initially. Since then, President Biden has signed into law billions of dollars in funding for methane removal by the US Department of Agriculture and other departments in the Inflation Reduction Act.

To that end, we declare that individually and collectively we will:

- 1) Ensure that all our jurisdictions are aggressively reducing or mitigating emissions of methane at their sources while conserving and restoring the ecological functions of wetlands and other ecosystems;
- 2) Fund and initiate programs to monitor atmospheric methane;
- 3) Fund and initiate programs to develop technologies that reduce atmospheric concentrations of methane safely and effectively, facilitated by working groups addressing methane removal methods that include, but are not limited to, enhanced atmospheric methane oxidation via photocatalysis, zeolite and other adsorption technologies, atmospheric radicals, and methanotrophic conversion; and
- 4) Frame and implement global governance for the use of such methods to return atmospheric methane to preindustrial levels. (*Emphasis added.*)

Furthermore, as ways to remove ghgs become available governments, courts, consumers and investors are likely to demand or require those who profited from the pollution to pay for the removal of those ghgs or the equivalent if one of the six is not removable or if methane for example emitted a generation ago has been replaced by new methane but an equivalent amount of CO₂ could still be removed. The 6.4 program could facilitate such removals, for example, by locating methane removal systems paid for by the oil and gas companies of the developed world next to coal mines, landfills, livestock facilities and sewage or wastewater treatment plants in the developing world. **But most importantly, the 6.4 program can include the simple governance principles set out in the draft Methane Declaration above.**

Methane Removal Methods in Detail

The removal of methane from air may be accomplished by a number of nascent technologies. Some are more advanced than others. The most advanced are near-source removals, where methane concentrations are highest. Conversely, the least developed removal technologies are for use in atmospheric concentrations (near 2 ppm). Some of the methane removal methods that our allied scientists have developed in concept, in laboratories and in a small pilot project or two also may remove other greenhouse gases. We urge UNFCCC Parties and Secretariat to recognize the field of Greenhouse Gas Removal overall, in addition to carbon dioxide removal in general and in particular for purposes of Article 6.4. The technologies, their cost efficiencies, and the timing of their potential benefits in achieving UNFCCC climate goals or restoring the climate to healthy levels of greenhouse gases can be very different. Given the climate urgency posed by rapidly increasing methane levels in the atmosphere and the high rate of global warming potential associated with methane, removing it, in particular, from the atmosphere presents one of the few opportunities for successful near to medium-term climate recovery action. Methane Action, a non-profit project now combined with Spark Climate, has for over two years hosted a collaboration of scientist, engineers, lawyers and policy and communications experts who together have assembled a Catalog of methods of removing methane and related pollutants, steps toward the governance of such removals, and leading researchers or contacts for most of these. I refer you to Methane Action's *Catalog of Research Funding Needs to Advance Methane*

Removal, describing as of January 2023 nearly 20 current or potential projects for methane removal and the governance of it (<https://methaneaction.org/catalogue-of-research-funding-needs-to-advance-methane-removal/>).

You may also wish to review the Spark Climate Solutions “methane removal” web pages (<https://www.sparkclimate.org/methane-removal/home>), especially under “Field Narrative” and “Approaches,” for very useful information including a typology of methane removal, as well as a list of a number of projects Spark is funding through major grants.

The esteemed U.S. National Academy of Sciences is in the process of writing a major review of methane removal research (<https://www.nationalacademies.org/our-work/atmospheric-methane-removal-development-of-a-research-agenda>). Further, the peer-reviewed journal *Environmental Research Letters* is planning a dedicated issue to publish collected articles in field later in 2023 (https://iopscience.iop.org/collections/1748-9326_Focus-on-Methane-Drawdown).

Win-Win Progress on Sustainable Development and Greenhouse Gas Removal

The request of the Secretariat of November 2022 reminds us that Article 6 aims to achieve collateral or synergistic sustainable development benefits such as improved environmental and public health as set out in Article 6.2:

2. **Parties shall**, where engaging on a voluntary basis in cooperative approaches that involve the use of internationally transferred mitigation outcomes towards nationally determined contributions, **promote sustainable development and ensure environmental integrity and transparency, including in governance**, and shall apply robust accounting to ensure, inter alia, the avoidance of double counting, consistent with guidance adopted by the Conference of the Parties serving as the meeting of the Parties to this Agreement.

Sustainable Development is defined and redefined regularly by the UN and cooperating bodies and quantified via the use of Sustainable Development Goals. These “SDGs” are supposed to guide investment by developed countries in assisting developing countries both bilaterally and via multilateral agencies such as the World Bank. These “SDGs” are revised over regular intervals, having arisen in part from the UN Conferences on Development. For example, Agenda 21 of the Rio Conference on Environment and Development contributed to the Environmental elements of the SDGs. We now have 17 SDGs. SDG 3 includes 3.9 which states: “By 2030, substantially reduce the number of deaths and illnesses from **hazardous chemicals and air, water and soil pollution** and contamination.”

Methane removal is a prime example of a win-win process in Sustainable Development given that methane is not only a potent greenhouse gas but is also a precursor or constituent of ground level ozone, one of the most damaging and wide spread air pollutants of all affecting even relatively rural areas as well as urban centers.

Nitrous Oxides can be removed along with methane. Nitrous Oxides are another set of air pollutants that are also greenhouse gases that can also damage human health in more ways than one and should be included in the 6.4 program as the methods for removing them are proven out. Recent studies show NOX contribute to the loss of bone density in post-menopausal women, for example. So, if chimneys coated with catalysts can remove NOX as well as methane, we would

have a triple win. See, [Air pollution and decreased bone mineral density among Women's Health Initiative participants](https://doi.org/10.1016/j.eclinm.2023.101864). <https://doi.org/10.1016/j.eclinm.2023.101864>
[https://www.thelancet.com/journals/eclinm/article/PIIS2589-5370\(23\)00041-X/fulltext](https://www.thelancet.com/journals/eclinm/article/PIIS2589-5370(23)00041-X/fulltext)

The solar chimney approach to removing greenhouse gases that is summarized in the Catalog of Research Needs could remove NOX as well as methane according to the following authors:

Removal of non-CO₂ greenhouse gases by large-scale atmospheric solar photocatalysis
Author links open overlay
panel [Renaud de Richter](#)^a, [Ming Tingzhen](#)^b, [Philip Davies](#)^c, [Liu Wei](#)^d, [Sylvain Caillol](#)^a

Abstract

Large-scale atmospheric removal of greenhouse gases (GHGs) including methane, nitrous oxide and ozone-depleting halocarbons could reduce global warming more quickly than atmospheric removal of CO₂. Photocatalysis of methane oxidizes it to CO₂, effectively reducing its global warming potential (GWP) by at least 90%. Nitrous oxide can be reduced to nitrogen and oxygen by photocatalysis; meanwhile halocarbons can be mineralized by red-ox photocatalytic reactions to acid halides and CO₂.⁶ ...

Further Peer Reviewed Publications Supporting These Comments:

Here is a sample list of key recent publications setting out the peer reviewed basis for methane removal and providing guidance for research going forward:

Oeste, F.D.; de Richter, R.; Ming, T.; Caillol, S. Climate engineering by mimicking natural dust climate control: The iron salt aerosol method. *Earth Syst. Dyn.* 2017. 8, 1–54.

Ming, T.; de Richter, R.; Oeste, F.D.; Tulip, R.; Caillol, S. A nature-based negative emissions technology able to remove atmospheric methane and other greenhouse gases. *Atmos. Pollut. Res.* 2021. 12, 101035.

⁶ Photocatalysis avoids the need for capture and sequestration of these atmospheric components. Here review an unusual hybrid device combining photocatalysis with carbon-free electricity with no-intermittency based on the solar updraft chimney. Then we review experimental evidence regarding photocatalytic transformations of non-CO₂ GHGs. We propose to combine TiO₂-photocatalysis with solar chimney power plants (SCPPs) to cleanse the atmosphere of non-CO₂ GHGs. Worldwide installation of 50,000 SCPPs, each of capacity 200 MW, would generate a cumulative 34 PWh of renewable electricity by 2050, taking into account construction time. These SCPPs equipped with photocatalyst would process 1 atmospheric volume each 14–16 years, reducing or stopping the atmospheric growth rate of the non-CO₂ GHGs and progressively reducing their atmospheric concentrations. Removal of methane, as compared to other GHGs, has enhanced efficacy in reducing radiative forcing because it liberates more ·OH radicals to accelerate the cleaning of the troposphere. The overall reduction in non-CO₂ GHG concentration would help to limit global temperature rise. By physically linking greenhouse gas removal to renewable electricity generation, the hybrid concept would avoid the moral hazard associated with most other climate engineering proposals.

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Summary

In light of the abundant activity on Methane Removal and progress on Nitrous Oxide Removal as well, it is vital that the topic of removals not be limited to Carbon Dioxide going forward. Therefore, I recommend that in all UNFCCC references to removals, the language be revised to explicitly cover methane and to potentially cover the removal of other greenhouse gases also.

Please contact John Fitzgerald the primary drafter of these comments if you have additional questions, at Greenknights.law@gmail.com.