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Methane versus Carbon Dioxide Mitigation Prospects

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Abstract : Atmospheric carbon dioxide (CO_2) has dominated the discussion about the causes of climate change. This is a reflection of the time horizon that has become the norm adopted by the IPCC as the planning horizon. Recently, it has become clear that a 100-year time horizon is much too long, and yet almost all mitigation efforts, including those in the near-term horizon of 30 years, are geared toward it. In this paper, we show that, for a 30-year time horizon, methane (CH_4) is the greenhouse gas whose radiative forcing exceeds that of CO_2. In our analysis, we used radiative forcing of greenhouse gases in the atmosphere since they directly affect the temperature rise on Earth. In 2019, the radiative forcing of methane was ~2.5 W/m² and that of carbon dioxide ~2.1 W/m². Under a business-as-usual (BAU) scenario until 2050, such forcing would be ~2.8 W/m² and ~3.1 W/m², respectively. There is a substantial spread in the data for anthropogenic and natural methane emissions as well as CH_4 leakages from production to consumption. We estimated the minimum and maximum effects of the reduction of these leakages. Such action may reduce the annual radiative forcing of all CH_4 emissions by between ~15% and ~30%. This translates into a reduction of the RF by 2050 from ~2.8 W/m² to ~2.5 W/m² in the case of the minimum effect and to ~2.15 W/m² in the case of the maximum. Under the BAU, we found that the RF of CO_2 would increase from ~2.1 W/m² nowadays to ~3.1 W/m² by 2050. We assumed a reduction of 50% of anthropogenic emission linearly over the next 30 years. That would reduce radiative forcing from ~3.1 W/m² to ~2.9 W/m². In the case of 'net zero,' the other 50% of reduction of only anthropogenic emissions would be limited to either from sources of emissions or directly from the atmosphere. The total reduction would be from ~3.1 to ~2.7, or ~0.4 W/m². To achieve the same radiative forcing as in the scenario of maximum reduction of methane leakages of ~2.15 W/m², then an additional reduction of radiative forcing of CO_2 would be approximately 2.7 -2.15=0.55 W/m². This is a much larger value than in expectations from 'net zero'. In total, one needs to remove from the atmosphere ~660 GT to match the maximum reduction of current methane leakages and ~270 GT to achieve 'net zero.' This amounts to over 900 GT in total.

Keywords : methane leakages, methane radiative forcing, methane mitigation, methane net zero
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