

March 24, 2016

California Air Resources Board  
1001 I Street  
Sacramento, CA 95812

**Re: Use of 20-year GWPs in the Draft Aliso Canyon Methane Leak Climate Impacts Mitigation Program**

Dear ARB staff,

Thank you for the opportunity to comment on the Draft Mitigation Program for the Southern California Gas Company (SoCalGas) methane leak in Aliso Canyon.<sup>1</sup> Our remarks focus on scientific issues that arise in the course of using 20-year global warming potentials (GWPs) to convert non-CO<sub>2</sub> gases into their carbon dioxide equivalents (CO<sub>2</sub>e).

As the Draft Program observes, Governor Brown's January 2016 Proclamation directs ARB to "fully mitigate" the leaked methane emissions from Aliso Canyon.<sup>2</sup> In turn, ARB's Draft Program recommends that Southern California Gas focus its mitigation efforts on methane emissions in California. It also contemplates mitigation of other greenhouse gases, including non-methane short-lived climate pollutants (SLCPs) and carbon dioxide.

In order to ensure equivalence between the impact of the original leak and mitigation effects across a portfolio of greenhouse gases, ARB's Draft Program uses a standard metric: the GWPs published by the Intergovernmental Panel on Climate Change (IPCC). To the best of our knowledge, the Draft Program, if finalized and applied to SoCalGas, would constitute the first time a legally binding climate mitigation policy

---

<sup>1</sup> California Air Resource Board, Aliso Canyon Methane Leak Climate Impacts Mitigation Program (Draft) (Mar. 14, 2016) ("Draft Program"), available at [http://www.arb.ca.gov/research/aldo\\_canyon\\_natural\\_gas\\_leak.htm](http://www.arb.ca.gov/research/aldo_canyon_natural_gas_leak.htm).

<sup>2</sup> Governor's Proclamation of a State of Emergency (Jan. 6, 2016) at ¶ 12, available at <https://www.gov.ca.gov/news.php?id=19263>.

selects 20-year GWPs. In contrast, most climate mitigation policies apply 100-year GWPs to calculate CO<sub>2</sub>e.<sup>3</sup>

The application of a GWP time horizon involves both normative and scientific judgments. In its most recent report, for example, the IPCC recognized that the choice of time horizon involves value judgments that cannot be established by scientific analysis alone.<sup>4</sup> Furthermore, we note that the Draft Program's selection of 20-year GWPs follows the approach taken in ARB's Draft SLCP Reduction Strategy, which outlined a variety of mitigation options for SLCPs and expressed their impacts using 20-year GWPs.<sup>5</sup> The Draft Program also reflects discussion in the 2014 Updated Scoping Plan regarding the potential use of 20-year GWPs for SLCPs.<sup>6</sup>

Nevertheless, ARB's selection of 20-year GWPs in the Draft Program raises important technical issues that we believe that Board staff should monitor in order to maintain consistency within and between California's climate mitigation policies. In particular, we identify three issues in the Draft Program that we hope that ARB staff will clarify in the final version and a fourth area we believe ARB should monitor for consistency with other climate mitigation policies:

- **Recommendation #1: Clarify the application of GWPs for non-methane greenhouse gases.**

The Draft Program adopts a 20-year GWP from the IPCC's Fifth Assessment Report (AR5) to convert the total leaked methane

---

<sup>3</sup> Including the Kyoto Protocol, the United States' Intended Nationally Determined Contribution under the Paris Agreement, and California's statewide emission goals under AB 32.

<sup>4</sup> Myhre et al. (2013), Anthropogenic and Natural Radiative Forcing. Chapter 8 in Climate Change 2013: The Physical Science Basis, Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, at 711-12, available at <http://www.ipcc.ch/report/ar5/wg1/>.

<sup>5</sup> California Air Resources Board, Draft Short-Lived Climate Pollutant Reduction Strategy (September 2015) at ES-10 (Table 2), available at <http://www.arb.ca.gov/cc/shortlived/shortlived.htm>.

<sup>6</sup> California Air Resources Board, First Update to the Climate Change Scoping Plan (May 15, 2014) at 14-17, available at <http://www.arb.ca.gov/cc/scopingplan/document/updatedscopingplan2013.htm>.

emissions into CO<sub>2</sub>e.<sup>7</sup> In contrast, ARB’s choice of GWP for converting mitigation of non-methane, non-CO<sub>2</sub> emissions into CO<sub>2</sub>e was not made explicit. The Draft Program implies that reductions of non-methane gases will be converted to CO<sub>2</sub>e using 20-year GWPs,<sup>8</sup> but does not state a clear policy. For example, if SoCalGas wished to meet part of its mitigation obligation by reducing emissions of the hydrofluorocarbon gas HFC-134a, should it use the 20-year AR5 GWP or the 100-year AR5 GWP for this gas?

We recommend that ARB make the application of 20-year GWPs consistent across all greenhouse gases that are eligible for mitigation. This is necessary in order to ensure consistency across a mitigation portfolio that includes multiple gases—both when (1) comparing the contribution of different gases to the mitigation portfolio and (2) assessing the equivalence of the mitigation portfolio and the original leak over the timeframe ARB determines is most relevant as a policy matter.

- **Recommendation #2: Cite the final version of the IPCC GWPs, not the pre-publication draft.**

The Draft Program cites to the pre-publication version of the applicable IPCC AR5 chapter reporting the most recent GWPs.<sup>9</sup> The final published version of the chapter in question differs slightly from the version cited in the Draft Program and should be the reference in any future documents.<sup>10</sup>

- **Recommendation #3: Make an explicit selection of GWPs with or without climate-carbon feedbacks.**

Since the IPCC’s initial estimates of GWPs were made in the 1990s, new developments in carbon cycle modeling and atmospheric chemistry have warranted periodic revisions. In the most recent IPCC report (AR5), one of the most important methodological changes to the GWP calculation was to standardize treatment of so-called climate-

---

<sup>7</sup> Draft Program at 6.

<sup>8</sup> *Id.* at 7 (see the first bullet point under Section IV.A).

<sup>9</sup> *Id.* at 6, footnote 4.

<sup>10</sup> The correct citation is Myhre et al. (2013), *supra* note 4.

carbon feedbacks. These feedbacks apply whenever a greenhouse gas contains carbon, which will enter the global carbon cycle once the original gas decays; similar effects may apply if the gas has other chemical components or decay products that alter the global carbon cycle. The climate-carbon feedback matters because it applies to methane ( $\text{CH}_4$ ) and halocarbons—including hydrofluorocarbons (HFCs), which along with methane and black carbon constitute the target pollutants in ARB’s SLCP Reduction Strategy.

Earlier IPCC reports—including the second-most recent report, AR4—applied the climate-carbon feedback only to  $\text{CO}_2$ , not to other greenhouse gases containing carbon. As a result, AR4 GWP estimates for methane and other HFCs did not account for the full range of climate-carbon feedbacks now documented in the scientific literature. In light of recent evidence that carbon-cycle feedbacks are important and likely increase the warming impact of greenhouse gases that lead to these feedbacks, AR5 reports GWPs both with and without the climate-carbon feedback.<sup>11</sup>

The Draft Program identifies the 20-year GWP for methane as 84.<sup>12</sup> It would be more accurate to say that this is the IPCC AR5 20-year GWP for methane *without* carbon-cycle feedbacks in response to methane emissions. For comparison, the IPCC estimates that the 20-year GWP for methane *with* these carbon-cycle feedbacks is 86.<sup>13</sup>

We believe that ARB should make an explicit decision about the choice to apply GWPs with or without carbon-cycle feedbacks. ARB staff may wish to refer to the IPCC for a discussion of the decision. The authors of the relevant IPCC chapter concluded:

---

<sup>11</sup> Myhre et al. (2013), *supra* note 4 at 714 (Table 8.7) (reporting GWPs with and without climate-carbon feedbacks for methane and other key greenhouse gases); *see also* Myhre et al. (2013), Anthropogenic and Natural Radiative Forcing Supplementary Material, 8SM-24 to 8SM-39 (Table 8.SM.16) (reporting GWPs with and without climate-carbon feedbacks for all remaining gases), available at [http://www.climatechange2013.org/images/report/WG1AR5\\_Ch08SM\\_FIN\\_AL.pdf](http://www.climatechange2013.org/images/report/WG1AR5_Ch08SM_FIN_AL.pdf).

<sup>12</sup> Draft Program at 6.

<sup>13</sup> Myhre et al. (2013), *supra* note 4 at 714 (Table 8.7).

Though uncertainties in the carbon cycle are substantial, it is *likely* that including the climate-carbon feedback for non-CO<sub>2</sub> gases as well as for CO<sub>2</sub> provides a better estimate of the metric value than including it only for CO<sub>2</sub>.<sup>14</sup>

For context, the IPCC defines the term *likely* as having between a 66% and 100% probability of being correct.<sup>15</sup>

- **Recommendation #4: Monitor interactions between mitigation policies that apply different GWP time horizons.**

Finally, we note that there may be complications in adopting different time horizons for the same greenhouse gas across different policies. ARB has proposed using a 20-year GWP for methane under the Draft Aliso Canyon Program and, potentially, programs arising under ARB's SLCP Reduction Strategy. Similarly, the Draft SLCP Reduction Strategy calculates CO<sub>2</sub>e mitigation in 2030 using 20-year GWPs.<sup>16</sup>

In contrast, ARB calculates the statewide target for 2020 emissions using AR4 100-year GWPs.<sup>17</sup> 100-year GWPs also apply in ARB's approved carbon offset protocols, though a different vintage is used (from the IPCC's Second Assessment Report (SAR), as opposed to AR4 or AR5).<sup>18</sup>

We foresee the possibility for two related issues that warrant ARB's continued attention.

First, the use of different time horizons can frustrate the goal of calculating equivalent metrics at an aggregate level. For example, it is

---

<sup>14</sup> *Id.* at 714.

<sup>15</sup> Mastrandrea et al. (2010), Guidance Note for Lead Authors of the IPCC Fifth Assessment Report on Consistent Treatment of Uncertainties, available at <https://www.ipcc.ch/pdf/supporting-material/uncertainty-guidance-note.pdf>.

<sup>16</sup> Draft SLCP Reduction Strategy, *supra* note 5 at ES-10.

<sup>17</sup> First Update to the Climate Change Scoping Plan, *supra* note 6 at 24.

<sup>18</sup> See, e.g., California Air Resources Board, Compliance Offset Protocol: Rice Cultivation Projects (June 25, 2015), at 22 (citing Cal. Code Regs. tit. 17, § 95102(a)); Cal. Code Regs. tit. 17, § 95102(a)(66) (defining CO<sub>2</sub>e by reference to GWPs listed in Table A-1 to 40 C.F.R. Part 98); 40 C.F.R. Part 98, Table A-1 (listing IPCC SAR 100-year GWPs).

not sensible to compare the 20-year CO<sub>2</sub>e from methane mitigation with the 100-year CO<sub>2</sub>e measurement of California's statewide target. Additional technical work and policy judgments are necessary to properly compare these metrics; both aspects should be made explicit.

Second, the use of different time horizons for the same gas across multiple policies will influence the economics of climate mitigation. For example, if a source of methane mitigation is eligible to earn credit either under a policy that applies a 20-year GWP (such as the Draft Program or a policy subsequently developed under the SLCP Reduction Strategy) or a policy using a 100-year GWP (such as a compliance-grade carbon offset protocol), the methane source should prefer the program that provides the higher CO<sub>2</sub>e reward (as determined by the higher 20-year GWP). Whether these policy interactions are positive or negative in normative terms depends on ARB's policy goals, as well as on the accounting methods employed for monitoring progress towards statewide climate goals.

Again, we appreciate the opportunity to comment on the Draft Program and thank ARB staff for their hard work.

Sincerely,

**Danny Cullenward**, JD, PhD  
<http://www.ghgpolicy.org/about/>

**Michael D. Mastrandrea**, PhD  
NearZero & Carnegie Institution for Science  
<http://web.stanford.edu/~mikemas/>

**Emily Grubert**  
PhD Candidate, Stanford University  
<https://earth.stanford.edu/emily-grubert>

**Aaron Strong**  
PhD Candidate, Stanford University

*Disclaimer: this letter is written on behalf of its signatories in their individual capacities and does not represent the view of any affiliated organization or employer.*