It turns out that there are lots of very promising climate solutions. Drawdown, for example, provides an excellent list. Implementing those solutions – moving them to pilots, policy, and scale – remains very challenging, for a variety of reasons, some legal and regulatory, some political, economic, and technical.

I have started Project Climate at the Center for Law, Energy & Environment to focus on moving climate solutions more quickly. For the next few blog posts, I want to describe some of the solutions and barriers to implementation and how we might accelerate action.

California's Scoping Plan and other documents set forth the primary categories for climate action: energy, transportation, buildings, short-lived climate pollutants, working and natural lands, carbon sequestration, and resilience/adaptation. For each of these, there are many compelling solutions, and many barriers to action and success.

Let's start with short-lived climate pollutants, or SLCPs. While the main greenhouse gas, CO2, lasts in the atmosphere for 100 years or more, SLCPs last for a shorter time, although they are more potent greenhouse gases than CO2. By eliminating SLCPs, we buy more time for the overall climate system. If methane emissions (the most important SLCP) are eliminated, for example, added methane would be out of the atmosphere in about 12 years. Because methane is something like 34 times as potent a greenhouse has as CO2, it accounts for perhaps 25% of overall radiative forcing – the amount of additional energy retained as the result of GHGs.

So, this is a big deal, and it should be a huge priority. One of the world's leading climate scientists and SLCP expert, Ram Ramanathan of UC San Diego, has focused for decades on the need, benefit, and overall viability of reducing SLCPs quickly, here, for example, in a 2017 article. The United Nations has set up an agency to reduce SLCPs. The oil and gas industry has an entire initiative to reduce methane, the most prevalent SLCP. In California, the Air Resources Board has developed an aggressive SLCP plan, requiring by 2030 a 40% reduction of HFCs and methane, and a 50% reduction of black carbon. Progress has been made, but painfully slowly. Why?

Let's start with methane. Methane is a colorless, odorless flammable gas, and the main constituent of natural gas – a valuable product. And yet it is released into the atmosphere in massive quantities. Methane emissions have three primary sources: agricultural waste (particularly animal waste (often from massive contained animal

feeding operations) but also from food and crop waste), landfill emissions (from the breakdown of organic materials), and oil and gas operations.

I will get to agricultural waste and landfills next time, so let's focus on emissions from oil and gas operations. There are lots of complexities here, so I will stay at a pretty high level. In the US, the general view has been that most oil and gas operation methane emissions are believed to be from a small number of super-emitting sources. There is a growing data set, however, showing that we have underestimated emissions from the complex and extensive (and aging) gas pipeline system in cities. The issues outside of the US are confounded by sloppier operations, weaker regulations and enforcement, less maintenance, and less infrastructure. Let's stick to the US for now.

There are a number of reasons for inaction on methane capture, even though it is a product and has value. For example, because it is colorless and odorless, operators don't always know that they have a leak. Capture technology costs money, and not all operators want to invest. For oil operations, methane may be seen as a waste product with insufficient value. For pipeline infrastructure, utilities and cities may be on the hook for finding and fixing leaks – costs that would prefer to avoid. These issues create a good deal of inertia and opposition to regulation.

There is some hopeful news – real solutions. But it underscores the need to focus on implementation. There are at least two very serious satellite methane (and other GHG) detection initiatives underway, that are complementary. Both the Environmental Defense Fund and California in conjunction with Planet Labs and others are in the process of planning and raising funds for satellite systems that can identify sources of methane emission both in large areas and small (down to about 30 square meters in the California/Planet Lab case). This data will dramatically change methane leak detection in the oil and gas industry. It will be public and transparent. In addition, ground and mobile-based methane leak detection (including by drone) is expanding rapidly.

With greater leak detection and data transparency, the question will be, first, whether the oil and gas industry will embrace leak control and capture, and, second, whether cities and utilities will do the same. In all likelihood, regulation and enforcement will be essential. And we need to start preparing for that now, so when the data is fully available, action can be rapid.

Next time, I will focus on agricultural and landfill methane and some of the

challenges.