METHANE GUIDING PRINCIPLES

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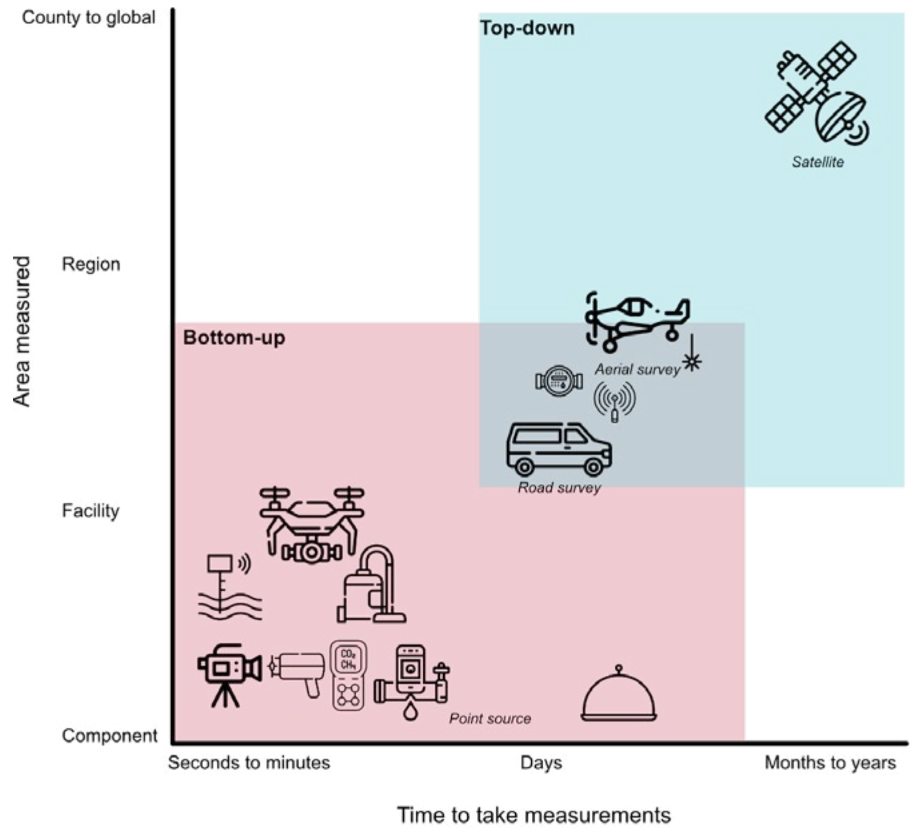
Overview of methane monitoring technologies

Monitoring can be deployed to detect or quantify methane releases. Detection is sufficient to verify the need for action (repairs, the closing of a hatch), but quantification is needed for a better management of emissions. Quantification through bottom-up methods relies on activity data (e.g. the number of facilities, oil and gas production volumes) and either general or specific emission factors (e.g. default values or leak rates for particular equipment types) to calculate overall emission rates. Top-down quantification features direct measurement, normally by airborne or satellite sensors, of atmospheric methane concentrations to infer emission releases.



Technology	Benefits	Disadvantages
Point source	Can identify and measure emissions from individual sources, high accuracy and real time measurements (technology dependent)	Time consuming to survey all components in a facility, access to facility needed
Aerial survey	Can measure large areas quickly	Time consuming and post survey calculations needed
Road survey	Can measure large areas quickly	Snap shot of emissions, post survey calculations needed and weather dependant
Satellites	Can measure large areas quickly	Limited to high emission events and to areas where satellites can take measurements

Components

Emissions from components are small and often hard to locate and thus only the point source technologies have apt minimum detection limit (MDL). However, measuring all components in a facility is time consuming because of the high number - 3,000 to 4,000 per facility. Therefore, using an optical gas imaging (OGI) camera to locate emission sources followed by a measurement technology, such as a flow sampler, bagging or sniffer sampler, is both time and cost effective; via only measure emissions when identified instead of inspecting all components. If an OGI camera is equipped with a qualitative optical gas imagine system, then no additional technology would be needed. However, emission rates estimated using this are based on how sensitive the OGI camera is to a gas plume and prior knowledge of what gas is being emitted is needed e.g., what is composition of gas in pipeline, storage tank, etc.

Wells

Emissions from wells and well pads are larger than individual components. Therefore, many technologies are capable of quantifying emissions from these. Both top-down (measuring the atmospheric concentration of methane and then allocating this to specific sources) and bottom-up (measuring methane at the source and then extrapolating up to whole facility or sites) methods can be applied to wells and well pads. Road and aerial surveys are commonly used in the peer reviewed literature and a variety of different measurement technologies have been used (spectroscopy, laser-based systems, methane analyser, tracer gas etc.) For an overview of technologies that can measure emissions at well/well pad level, see this paper on the role of satellites in emissions detection, reconciling and reporting or MGP Best Practice Guides on Identification, Detection, Measurement and Quantification.

Facilities

For facilities e.g., compressor stations, processing plants, LNG liquefaction and regasification sites, venting and flaring, the emissions are similar if not larger than well/well pads. In general aerial or ground mobile measurement system are more suitable; ground vehicles are preferable when access is possible and cost-effective, and aerial methods otherwise. In reality, each quantification is unique, and specific to the location of the source and measuring teams having various analytical assets. For example, aircraft are useful for analysing emissions from major cities and regions, as well as for verifying inventories from larger areas with multiple sources, such as large gas fields or cities, or vast zones of natural emissions.

Abnormal events such as well blow outs, unlit flares and gas storage leaks may result in emission rates high enough to be detected by satellites. These events can be referred to as super-emitters (or ultra-emitters), which are a known phenomenon in the oil and natural gas sector or even biomethane and biogas supply chain. Super-emitters have been found to account for a significant proportion of emissions. Therefore, in addition to aerial and ground mobile measurement system, satellites could also detect and quantify facility level emissions, provided they are able to take measurements during the event.

Basins

Over larger spatial areas, satellites have a greater opportunity to detect and quantify emissions. Emission sources in a basin are not uniformly distributed (spatially and temporally) and consequentially, extrapolating emissions measured for a subset of facilities, using manned aircraft or ground mobile measurement system, could be problematic. Satellites are beneficial in their ability to account for all emission sources and if used for long term monitoring, would benefit from the reduction in MDL associated with repeat measurements (constant emissions only and wind does not interfere with measurements). However, as a result of accounting for all emission sources, measurements have been found to be much larger than emissions estimated using other technologies. Despite their great potential in quantifying basin emissions, satellites, for the time being, are best used in combination with other technologies, because while they are able to identify high flux/methane concentration pixels, this does not necessarily correlate to a high emitting source.

Other

During events such as hydraulic fracturing, methane can migrate from the gas containing rock through the cracks and fissures created from the fracturing process. This can lead to subterranean seepage of methane, and these must be measured using other methods as emissions are to water and soil and not to air. Carbon isotope analysis of water and soil samples have been useful in identifying whether oil and gas activity has led to groundwater contamination. For buried pipelines, such as distribution gas pipeline, methane can be emitted into the air and the technologies described above would be applicable. Due to the low albedo of oceans/seas, offshore emissions cannot be detected, except for the rare occasions where sun glint allows detection, using satellites that have the ability to directly measure methane, such as Sentinel-5P and GHGSat. Aerial and boat surveys have been used to measure these emissions and found to be suitable. For LNG shipping, the technologies described for components and facilities would be applicable, but emissions are generally not detectable using satellites. Methane emitted from water bodies (oceans, seas and lakes) would also not be detected using these types of satellites, but flux chambers have been used to estimate emissions from lakes. These emissions are important given that emissions from subsea gas pipeline are assumed to dissolve in sea water, and because rising global temperatures are causing the artic to thaw, causing methane to bubble up from permafrost at the bottom of frozen lakes.

For examples of practical experiences that deployed these technologies, see Monitoring Pathways. For more resources on the topic, explore Monitoring and managing methane emissions.

Find out more

Monitoring and managing methane emissions

Monitoring Pathways

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