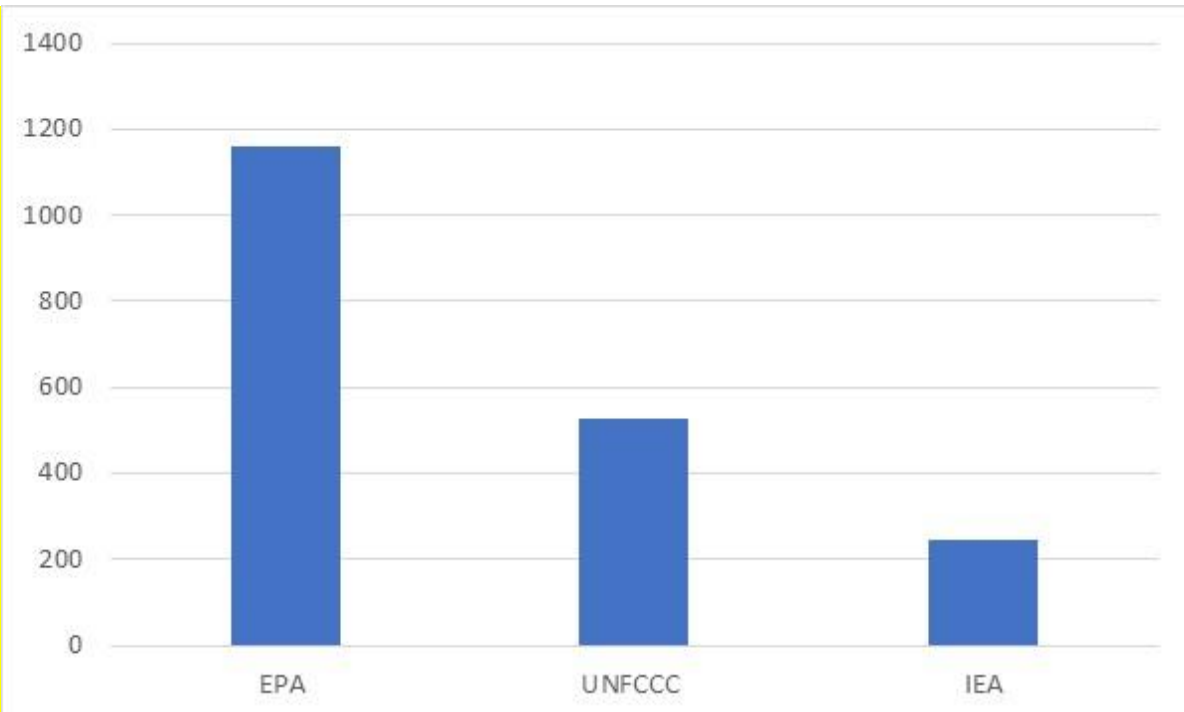
Methane emissions inventory for SOCAR

Initial condition:

According to data reported by the Government of Azerbaijan to the UNFCCC, the country's emission of methane from oil and gas sector installations in 2013 amounted to 528,000 tons. This represents about 21% of the total Azerbaijan's greenhouse gas emissions (GHG).[1] In contrast, the International Energy Agency (IEA) estimated in 2017 that the emissions in question were at the level of 244,00 tons.[2] Then there are also 2015 estimates by the US Environmental Protection Agency (USEPA),[3] which are about twice as high as the UNFCCC data and four times the IEA calculations (see Figure 1).[4]

Figure 1: Estimates of methane emission from the oil and gas sector in Azerbaijan. Thousand tonnes CH_4.



Sources: See footnotes at the botom of the page.

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1 https://unfccc.int/documents/182955

2 https://www.iea.org/reports/methane-tracker/country-and-regional-estimates

3 https://www.epa.gov/global-mitigation-non-co2-greenhouse-gases

4 Although these estimates are for different years, it is unlikely that actual emissions have changed much from year to year.

Discrepancies of such magnitudes are not uncommon for methane emissions from the oil and gas sector. Data for several countries shows a large variation in their methane emissions estimates depending on a source. There are also cases where estimates made by the same single source (e.g. UNFCCC data) are substantially revised from one year to another.[5] The above observation notwithstanding, the differences in estimates, as illustrated in Figure 1, caused a concern within the State Oil Company of the Azerbaijan Republic (SOCAR) and other local institutions, and they motivated the company to scale up the efforts to establish a reliable inventory for its methane emissions. Emissions estimates from SOCAR are of great importance for the national GHG inventory, as the company operates an important part of the oil and gas infrastructure in Azerbaijan.

SOCAR has been developing and publishing GHG inventories since 2011. The data are primarily published in the company's Annual Sustainable Development Report.[6] According to that report, SOCAR's 2018 GHG emissions in Azerbaijan amounted to 7.8 million tonnes of CO_2 equivalents. Direct emissions of methane constituted slightly more that 50% of that number (130,900 tonnes). The above amount covers emissions from all levels of oil and gas supply chains controlled by SOCAR, including oil wells, oil and gas processing, transportation and distribution. Methane emissions are calculated by use of emission factors from international studies and from the selected leak rates measured. The GHG inventories of SOCAR are an important source of information for the national estimates as submitted by the Ministry of Ecology and Natural Resources of Azerbaijan to the UNFCCC.

As in many other countries, calculating methane emissions in Azerbaijan is particularly challenging due to the vast number of emission sources and the lack of primary data of emissions rates and intensities. It is for that reason that SOCAR, in cooperation with the Norwegian company Carbon Limits,[7] initiated in 2018 a project to develop an inventory for methane emissions at its installations. The inventory will represent an important repository of knowledge allowing the company to develop its methane management strategy, with the objective to substantially reduce the emissions. It will also be an important source of information for Azerbaijan, facilitating its efforts to report reliable data to the UNFCCC in accordance with requirements of the Paris Agreement.

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[5] See Section 2.2 of the UNECE "Best Practice Guidance for Effective Methane Management in the Oil and Gas Sector" http://www.unece.org/energywelcome/areas-of-work/methane-management/activities/methane-management-in-extractive-industries/oil-and-gas-sector/best-practice-guidance/model-framework-for-reducing-methane-emissions-along-the-gas-value-chain.html

[6] http://www.socar.az/socar/assets/documents/en/socar-annual-reports/Sustainable%20development%20report-2018.pdf

[7] Carbon Limits' work has, for an important part, been financed through grant contributions from the ClimateWorks Foundation and Flora Family Foundation.

Process:

Early in the process an analytical framework for calculating annual methane inventory data was established, including determination of data sources to be used and a model tool to store the data and perform calculations and reports. The developed analytical framework leverages the international best practices guidelines. Two data sets are central, activity data and emission factors, and estimates are made using the following equation:

$$E_{\text{methane, source/segment}} = A_{\text{source/segment}} \bullet EF_{\text{methane, source/segment}}$$

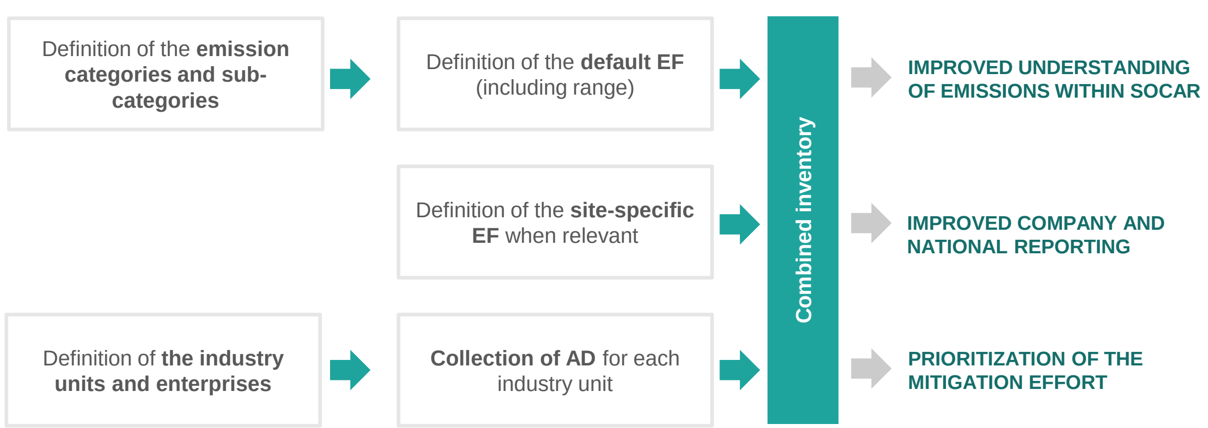
Where:

$E_{\text{methane, source/segment}}$	are the annual emissions of methane (tonnes) for a specific emission source in a segment of the oil and gas system[8]
$A_{\text{source/segment}}$	is an activity value for a specific source and segment. Activity data would typically be throughput of oil and gas, count of equipment that are sources of emissions, and kilometres of pipelines
$EF_{\text{methane, source/segment}}$	is the emission factor (emissions per unit of activity for the source and segment)

The first step in the process of establishing the SOCAR inventory was to decide on the breakdown into emission sources and segments of the oil and gas system.

In Azerbaijan SOCAR has both, extraction and processing sites of oil and gas, as well as oil and gas storage, transportation and distribution facilities. The extraction and processing sites were divided into 8 production units and additional 4 mid-stream and downstream segments were singled out. Those 12 segments represent distinct administrative units, or enterprises of SOCAR, and activity data is collected from each of them separately.

Figure 2: Overview of the process



[8] The segments of the oil and gas system (supply chain), as per the IPPC Guidelines Oil and Gas System, cover a number of defined segments in the supply chain from exploration, production, gathering & processing, to long distance transmissions/transport, to refining and distribution to end-use consumers.

For each segment there is a further breakdown into emission sources, which represent different types of equipment, installations, or events, which typically give rise to methane emissions, including:

(i) compressors,

(ii) liquid storage tanks,

(iii) blow-downs and equipment depressurization, and

(iv) equipment and component leaks.

The above segments are again divided into sub-categories; some 50 in total. The structure of the sub-categories was designed to capture the future improvement in emission patterns: for examples centrifugal compressors are reported in different category if they are unmitigated (i.e. wet seals) and if they are mitigated (i.e. dry seal or re-routed emissions).

Not all types of emission sources are applicable to all segments, but in the case of SOCAR, in total there are data entries for about 200 categories of segments/sources (activity variables).

Activity data are collected annually for each of the relevant activity variables and entered into an Activity Data Module. Collected data is typically oil and gas throughput (in barrels for oil and m^3 for gas), counts of equipment (e.g. number of dry seal compressors, well pad dehydration units), count of activities (number of oil well workover per year), and kilometres of gas pipelines.

In accordance with the formula for emission calculations shown above, emission factors are attributed to each emission sub-categories. For each emission sub-category, emission factors include: (i) best guess EF, which reflects the best information available at the time of the inventory, and (ii) a lower and upper boundary EF to reflect the current uncertainty.

Emission factors were developed in order of priority using:

1. The results of the measurement campaigns performed at SOCAR facilities;
2. SOCAR emission factors (internal SOCAR sources, primarily based on various calculation-based methods);
3. International literature sources, in particular EF from the US national inventory, OGMP, and other international EF databases.

For specific installations/fields, default EF were revised to reflect specific on-site conditions that were observed during field visits. In total, about 300 different EF are being used for the analysis. In a number of cases (for example leaks in some administrative units), the uncertainty ranges are relatively low, as the emissions have been directly measured for a part of given installations and extrapolated to the other ones. In other cases (e.g. blowdown), the uncertainty is much greater due to the absence of measurements.

Several meetings and workshops have been held with relevant entities within SOCAR to discuss the analytical approach, data specification and reporting processes. Institutions such as the

Ministry of Ecology and Natural Resources have also been informed about the process and the preliminary results of the work.

Results:

The first version of an inventory model with a full data set was completed during the first quarter of 2020. It offers an improved, comprehensive and consistent system for calculating methane emissions from SOCAR installations. As explained above, great uncertainty remains about the true values of emission factors and considerably more work is needed to assess the factors which are currently in use. Still, with the establishment of the model and the data which are in place, an important step has been taken to create annual inventories based on the so-called Tier 3[9] guidelines of the IPCC.

As noted above the inventory will serve for various purposes, such as:

- ✓ Providing public information on SOCAR's environmental performance and progress in emission reduction efforts;
- ✓ Contributing significantly to reporting of emissions data and results of mitigation activities to the UNFCCC;
- ✓ Forming the base for an active and cost-efficient strategy for methane emissions management at SOCAR, with important linkages to the Nationally Determined Contribution by Azerbaijan to the goals of the Paris Agreement.

With regard to the last point, the first steps have been taken to include data on emissions mitigation costs related to the emission sources distinguished in the model. This will allow for prioritizing efforts and making calculations for capital requirements, at various ambition levels, for methane emission reductions.

The inventory is designed to be a living document, which is to be improved over time; emission sources that are currently not adequately covered could be added, emission factors could be improved based on measurement campaigns at installation, and emission reduction potentials as well as mitigation options could be identified.

[9] The most detailed approach based on a rigorous bottom-up assessment at the facility level, involving identification of equipment-specific emission sources, count of equipment units, measurement of emission rates per equipment type, etc. See https://www.ipcc-nggip.iges.or.jp/public/2006gl/