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Gap Analysis of GHG Emissions Inventories related to Data from the Private Sector (Armenia, Georgia, Republic of Moldova)

Final Report

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Produced by **Maria Purzner**
Expert on Emissions Inventories and MRV
Environment Agency Austria

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1. Introduction:

The GHG inventory compilation plays a pivotal role in the global effort to combat climate change, serving as a crucial source of information on a country's total emissions. Historically, under the UNFCCC, only Annex I countries were obligated to provide comprehensive National Inventory Reports annually, while non-Annex I parties were encouraged to include a GHG inventory as a chapter to National Communications, and as National Inventory Report (NIR) within their Biennial Update Reports (BUR). However, under the Paris Agreement, developing countries will also be required to submit GHG inventory reports on a biennial basis.

The cornerstone of emissions reporting under the Paris Agreement will be the National Inventory Document (NID) that will replace the NIR, containing data, methodologies, and results related to the emissions estimation. The NID, mandated by the Paris Agreement offers valuable insights into both global emissions trends and a country's emission reduction efforts. This comprehensive document contains all information on data, methodologies, and results related to emissions estimation. With the ratification of the Paris Agreement, developing country parties are mandated to develop and publish NIDs biennially.[1] These documents serve not only to offer insights into global emissions trajectories but also to provide a detailed account of the effectiveness of emission reduction measures implemented within a country.

Reporting under the Enhanced Transparency Framework (ETF) of the Paris Agreement means that current non-Annex I Parties will have the same reporting obligations as Annex I Parties, with a few flexibilities to those developing country parties that will need them in light of their capacities, and with longer intervals between reports.

From 2024 onwards, developing Parties will have to submit:

1. National Communications every 4 years, as a stand-alone report, or with the Biennial Transparency Reports (BTR) as an annex in those years a BTR is published.
2. Biennial Transparency Reports (BTRs): the BTR will contain chapters on GHG emissions and removals (with the NID as a stand-alone report, or part of the BTR); the NDC tracking progress; Adaptation, Support needed and received; and on areas of improvement where parties can improve their reporting, the NID is outlined in Decision 5/CMA.3 Guidance for operationalizing the modalities, procedures and guidelines for the enhanced transparency framework referred to in Article 13 of the Paris Agreement;
3. National Inventories, which consist of the National Inventory Document (NID) and common reporting tables (CRT) every two years;
4. Undergo independent Technical Expert Review every two years, to assess consistency of the information submitted by the Parties, taking into consideration adherence of GHG inventory to the TACCC (transparency, accuracy, completeness, consistency and comparability) principles, the Party's implementation and achievement of its NDC, as well as information on support, etc. This means that the national inventory report will be reviewed, most probably similar to the reviews of Annex I countries that have been performed under the Convention, as well as the information necessary to track progress made in implementing and achieving NDCs.

[1] In Decision 7/CMA.2 adopted in December 2019 it was requested that the GEF adequately supports developing country Parties in preparing their first and subsequent biennial transparency reports.

The first NID will need to be published before the 31st of December 2024, depending on the availability of the CRT reporter (i.e. the software necessary for transmitting emission estimates) as well financial support by GEF to Non-Annex I countries. This means that developing countries will have to start with the first inventory cycle in 2023.

1.1. Guidelines for Inventory Compilation:

Inventory compilation follows a set of rules outlined in the Intergovernmental Panel on Climate Change (IPCC) guidelines. These guidelines encompass best practices for inventory compilation, general methodologies, the calculation of key emission categories, and methods to assess uncertainties in the data. Additionally, they include sector-specific chapters that offer guidance on methodologies for calculating emissions in various sectors.

Under the Paris Agreement, countries must adhere to the 2006 version of the IPCC Guidelines, replacing the earlier 1996 edition. While the 2019 Refinement of the Guidelines introduces additional methodologies and information, compliance with these updates remains voluntary.

The GHG inventory principles as laid out in volume 1, section 1.4 of the IPCC 2006 Guidelines are still applicable. They provide the basis for transparent, accurate, complete, consistent and comparable inventory reporting, i.e. a high quality of reporting.

Transparency: information on the compilation of inventories should be available in a report, in such a way, that individuals or groups other than the inventory compilers can understand how the inventory was compiled, and that documentation and reporting is done according to the guidance in chapter 8 of volume 1, and that emissions were calculated using methods laid out in the IPCCC guidelines, volumes 2-6.

Accuracy: Emissions are estimated in a correct manner, with neither over- or underestimates, so far as can be judged.

Completeness: Estimates are reported for all relevant categories of sources and sinks, and gases, as well as for all relevant years. Where data is not available, the absence of this estimate should be clearly documented, together with justification for exclusion.

Consistency: Estimates for different inventory years, gases and categories are made in such a way that differences in the results between years and categories reflect real differences in emissions. Inventory annual trends, as far as possible, should be calculated using the same method and data sources in all years and should aim to reflect the annual fluctuations in emissions or removals and not be subject to changes resulting from methodological differences.[2]

Comparability: the inventory is reported in a way so that it can be compared with other national greenhouse gas inventories of other countries. This means the key categories need to be chosen appropriately[3] and emissions should be calculated based on the IPCC reporting guidance.

[2] The IPCC guidelines provide guidance on data collection in chapter 2, methodological choice and identification of key categories in chapter 4, and time series consistency in chapter 5 of volume 1 of the 2006 guidelines

[3] According to Volume 1, Chapter 4 of the 2006 guidelines

1.2. Tiered Calculation Methodologies:

Emission calculations are structured around a tiered approach, which takes into account the complexity of the calculation method and the associated data requirements. Typically, three tiers are presented in the IPCC Guidelines:

- Tier 1 Methodologies: These rely on readily available data, often combining Activity Data based on statistical information with default Emission Factors provided in the Guidelines. However, this approach is associated with higher levels of uncertainty.
- Tier 2 Methodologies: Tier 2 incorporates country-specific information and considers the technologies involved, thus offering a more refined estimate.
- Tier 3 Methodology: This is assessment based on highly specific data of the individual country and is based on measured or based on highly disaggregated data derived from the intrinsic properties of the emission source.

Higher-tier methodologies offer the advantage of accurately reflecting changes in emissions due to technological advancements or the implementation of abatement methods. They are also crucial for monitoring emissions changes resulting from a country's applied measures.

1.3. Key Categories and Flexibilities:

A fundamental rule requires that "Key Categories," representing source categories contributing to 95% of a country's total emissions, be calculated using methodologies of at least Tier 2. To provide flexibility to developing countries, the Paris Agreement allows key categories to represent up to 85% of total emissions. Countries are “allowed” to apply flexibilities in using Tier 1 methodologies, provided they outline a clear plan for transitioning to higher-tier methods in the NID. However, countries should try to apply higher tier methodologies wherever possible, as they will be able to gain additional input through the in-country review after the first inventory cycle.

Countries preparing for Paris Agreement reporting must prioritize data accuracy and disaggregation in their emission estimates. This precision is equally crucial for Article 6 mechanisms, where external financing of emission reduction projects hinges on the ability to accurately track changes in emissions resulting from effective measures.

Article 6 of the Paris Agreement outlines market and non-market mechanisms designed to enhance the flexibility and effectiveness of global climate action. These mechanisms aim to promote emissions reductions and facilitate cooperation among countries. Article 6 establishes two key market-based instruments: Article 6.2, which allows countries to engage in international emissions trading, and Article 6.4, which enables the use of cooperative approaches to achieve emissions reductions. Article 13, on the other hand, pertains to the establishment of the Enhanced Transparency Framework (ETF), which fosters trust and confidence in the implementation of the Agreement.

Developing countries seeking access to Article 6 mechanisms, such as emissions trading and cooperative approaches, will need to undertake several crucial steps. Firstly, they must establish and maintain robust greenhouse gas (GHG) inventory and reporting systems, aligning with the ETF

guidelines set forth in Article 13. This involves transparently monitoring and verifying emissions reductions, ensuring data accuracy and completeness. Secondly, these countries must communicate their emissions reduction targets and actions in their Nationally Determined Contributions (NDCs) and submit these plans for international review through the ETF. This review process helps ensure that their proposed actions align with their sustainable development goals and the overall objectives of the Paris Agreement. Lastly, developing countries will need to engage in capacity-building efforts to strengthen their ability to participate effectively in international emissions trading and cooperative approaches, ultimately facilitating their access to the benefits and mechanisms under Article 6. This inclusive approach aims to harness the collective efforts of all nations to combat climate change while supporting the development aspirations of developing countries.

1.4. Resource Allocation Considerations:

Parties to the Paris Agreement should carefully consider the resource allocation necessary for developing robust and accurate emissions inventories, especially with the first reporting deadline before the end of 2024. Establishing reporting mechanisms, such as data transfer to the Centralized Reporting Tool (CRT) reporter, might require additional resources. The IPCC is currently updating the IPCC Inventory Software, which will be compiled in such a way that can be easily transferred into the CRT Tables. The GHG Institute has published a complimentary tool, SAGE, that works as a data archive, and can help with Time Series Consistency.

1.5. Challenges in Private Sector Data:

This report centers on the formidable challenges faced by three countries—Georgia, Armenia, and the Republic of Moldova—in obtaining data from the private sector. These challenges are most pronounced in three sectors: Energy, Industrial Processes and Product Use (IPPU), and Waste. Gaining access to data from private companies proves arduous due to concerns surrounding the confidentiality of business information.

By addressing these challenges and enhancing the accuracy and reliability of private sector data, countries can substantially improve the quality of their emission inventories. This, in turn, will enable them to contribute more effectively to global climate action, and it might also allow for easier access to Article 6 cooperation. .

This report aims to provide a more comprehensive and detailed overview of the issues faced by the countries in the respective sectors, and information on where to bundle efforts to gain disaggregated data. As sector 2.F. on emissions on ODS substitutes poses a problem for all three countries equally, this sector will be discussed separately.

2. Status Quo in Armenia:

Sector	Gas	Tier of methodology used
1.A.1. Energy Industries – Gaseous Fuels	CO_2	T3
1.A.4.b Residential – Gaseous Fuels	CO_2	T2
1.A.3.b Road Transportation – Gaseous Fuels	CO_2	T2
1.B.2.b Fugitive emissions from Natural Gas transportation and distribution	CH_4	T2
2.F.1 Refrigerant and Air Conditioning	HFCs	T2a
1.A.3.b Road Transportation – Liquid Fuels	CO_2	T1
3.C.4 Direct N_2O Emissions from managed soils	N_2O	T1
3.A.1.a Enteric Fermentation – Cattle	CH_4	T2
1.A.4.a Commercial/institutional – Gaseous fuels	CO_2	T2
3.B.1.a Forest land Remaining Forest Land	CO_2	T2
4.A Solid Waste Disposal	CH_4	T2
1.A.2 Manufacturing Industries and Construction – Gaseous Fuels	CO_2	T2
2.A.1 Cement production	CO_2	T3
3.C.5 indirect N_2O Emissions from managed soils	N_2O	T1
1.A.4.c Agriculture/Forestry/Fishing/Fish Farms	CO_2	T2
3.A.1.b-j Enteric Fermentation – Other	CH_4	T2/T1
4.D Wastewater Treatment and Discharge	CH_4	T1
4.D Wastewater Treatment and Discharge	N_2O	T1
1.A.4 Other Sectors – Liquid Fuels	CO_2	T1
1.A.2 Manufacturing Industries and Construction – Liquid Fuels	CO_2	T1
1.A.3.b Road Transportation	CH_4	T1

Figure 1: Information taken from the Armenian NIR, 2023 compiling Key Categories and the methodology tiers. KCs from the AFOLU sector in grey, as they are not relevant for this study.

2.1 Energy Sector:

The key categories of the Energy Sector of Armenia are all calculated using a higher tier methodology, except for Road Transportation and Liquid Fuels, as well as Other Sectors, and Manufacturing Industries and Construction, all also concerning liquid fuels. According to the team working on the preparation of the inventory, this is due to a lack of data for liquid fuels use in the country, and the lack of laboratory that could undertake exhaustive tests. For the estimation of a CS EF, information on the carbon content, and calorific value of the liquid fuels needs to be known. Road Transportation, which is one of the major emitting sources, is also currently calculated using a tier 1 methodology. The two subsectors go hand in hand, even though liquid fuels used for Manufacturing Industries and Construction are not known. It is very possible, that importers of liquid fuels have information regarding the composition of the fuels, however, they are currently not obliged to part with this data. Therefore, given the necessity of data of this important source, it is possibly not enough to try to obtain data from the different importers, but a study would be needed to assess Road Transportation, as well as the total of liquid fuels placed on the market, the different application of the fuels. This could be done in a bigger study, together with universities and laboratories, if information on the composition of fuels is incomplete or if doubts exist. There should be a legal obligation for importers to obtain this data, and to provide it to the inventory compilers.

Fugitive emissions from natural gas system are currently calculated using a T2 methodology, but enough information will be available for the next submission, so a T3 methodology will be applied.

Even though this is not concerning a key category, when it comes to biofuels, firewood as well as manure are being used in rural areas. This information is calculated, however, there is a discrepancy between the official statistics and data from forest companies. This discrepancy equals a factor 10. This problem could be solved with another study.

2.2. IPPU Sector:

There are only two key categories from this sector, Cement Production and F-Gases, and for both a T2 methodology is applied. For the rest of the sector, a government decision will be put into place that the private sector will have to provide information on emissions on a regular basis. Such a government decision will help inventory compilers to calculate higher tier methodologies for the rest of the IPPU sector. For suggestions on the F-gas sector, please refer to the annex of this document.

2.3. Waste Sector:

Key Categories from the Waste Sector regard Wastewater Treatment and Discharge. The NIR provides information on planned or possible improvements for Domestic and Commercial wastewater. For the domestic sector, a census is planned, that will provide more accurate information on the population of rural areas, as well as their access to the sewer system. This could be combined with intensifying collaboration with municipalities that are usually responsible for the sewer system. For industrial wastewater, estimations could be ameliorated by introducing information from administrative statistics. This system would have to be introduced first, but could provide information on technological processes and treatment systems of companies that have organic substance discharge, as well as information from treatment plans would help to move to a higher tier estimation methodology, and lower uncertainties.

2.4 Closing remarks:

Given the fact that a decision by the Armenian government that is currently in the pipeline for adoption provides the inventory team with the necessary legal background to access data from the private sector, it should be possible to access information from importers of liquid fuels once this law has been passed. However, the transport sector is usually one of the biggest Key Categories, liquid fuels rank at 6th place of Armenia's key categories. Given the size of this sector, it is usually not possible for inventory compilers to go into depth during an inventory cycle. Thus, it might be an idea to outsource the work for this sector to a university or external consultant. It should be made legally binding for importers of liquid fuels to make the accompanying information available to inventory compilers, or, if it is available at the statistical office, to be made available to inventory compilers. If the data is not available, importers should be obliged to gain this data, as it must be available somewhere.

As for firewood and manure, the data between the statistical office and the forest companies varies by a factor 10. If a mistake in the unit of data can be excluded, another study of a university might be another way forward to gain information for the inventory. Scientific studies that are transparently performed (i.e. background data is available to inventory compilers, and not just the final results) are a valid background for inventory data. This study could assess the different biofuels used in rural areas of the country, which might also provide baseline data for possible future projects in the area, dealing with solar energy, etc, as stoves based on biofuels often cause health problems due to the high indoor particulate matter concentrations due to burning of wet wood. The IPPU sector mostly concerns HFCs – see chapter on F-gases. .

3. The Status Quo in Georgia:

Georgia submitted its last NIR in April 2021 as a stand-alone document with the NC4, which provides a time series until 2017. It was compiled during a GEF funded project ("The Fourth National Communication and Second Biennial Update Report to the UN Framework Convention on Climate Change", which was led by the Climate Change Division of the Ministry of Environmental Protection and Agriculture, and UNDP Georgia as an implementing agency. In the chapter on Insitutional Arrangement of the National GHG Inventory, an active cooperation on data exchange between the Ministry of Environmental Protection and Agriculture and National Statistics Office of Georgia based on a MoU signed in 2014.

The NIR provides an assessment of emissions, as well as key categories and uncertainties, and follows IPCC GL 2006. For the purpose of this project, the chapters on Energy, IPPU and Waste were looked at closely, as these sectors usually contain information from the private sector.

In the Energy sector, only T1 methodologies are stated, except for CH_4 emissions, where T1/T2 methodologies were applied for Fugitive Emissions – Oil and Natural Gas.

Overview on Key Categories and Methodologies Used:

IPCC Category Code	**IPCC Category**	**GHG**	**Reasons to select as KC**	**M**	**EF**	**M**	**EF**	**M**	**EF**
				CO_2		CH_4		N_2O	
3.B.1.a	Forest Land remaining Forest Land	CO_2	L, T						
1.A.3.b	Road Transportation	CO_2	L, T	T1	D	T1	D	T1	D
3.B.3.a	Grassland Remaining Grassland	CO_2	L, T						
1.A.4	Other Sectors-Gaseous Fuels	CO_2	L, T	T1	D	T1	D	T1	D
3.B.2.a	Cropland Remaining Cropland	CO_2	L, T						
3.A.1	Enteric Fermentation	CH_4	L,T						
1.B.2.b	Natural Gas	CH_4	L,T	T1	D	T1/ T2	D/C S	T1	D
4.A.	Solid Waste Disposal	CH_4	L,T	T1	D	T1	D	T1	D
1.A.1	Energy Industries- Gaseous Fuels	CO_2	L, T	T1	D	T1	D	T1	D
3.C.4	Direct N_2O Emissions from managed soils	N_2O	L, T						
1.A.2	Manufacturing Industries and Construction – Solid Fuels	CO_2	L, T	T1	D	T1	D	T1	D
2.A.1	Cement Production	CO_2	L, T	T2	D				
1.A.1	Energy Industries - Solid Fuels	CO2	L, T	T1	D	T1	D	T1	D
3.C.5	Indirect N2O Emissions from managed soils	N2O	L, T						
2.C.2	Ferroalloys Production	CO2	L, T	T1	D	T1	D		
2.B.1	Ammonia Production	CO2	L, T	T2	D	T2	D		
4.D	Wastewater Treatment and Discharge	CH4	L, T	T1	D	T1	D	T1	D

3.A.2	Manure Management	N2O	L, T						
1.A.2	Manufacturing Industries and Construction - Gaseous Fuels	CO2	L, T	T1	D	T1	D	T1	D
2.B.2	Nitric Acid Production	N2O	L, T					T1	D
1.A.3.e	Other Transportation	CO2	L	T1	D	T1	D	T1	D
2.F.1	Refrigeration and Air Conditioning	HFCs, PFCs	L	T1[4]	D				
1.A.4	Other Sectors - Liquid Fuels	CO2	T	T1	D	T1	D	T1	D
2.C.1	Iron and Steel Production	CO2	T	T2	CS	T2	CS		
1.A.2	Manufacturing Industries and Construction - Liquid Fuels	CO2	T	T1	D	T1	D	T1	D
1.B.1	Solid Fuels	CH4	T	T1	D	T1	D		
1.A.1	Energy Industries - Liquid Fuels	CO2	T	T1	D	T1	D	T1	D

Table 2: Overview of Key Categories, and Methodologies applied collected from National Greenhouse Gas Inventory Report of Georgia, 1990-2017, published in 2021 under the UNFCCC. Please note that for reasons of completeness, KCs from Sectors 3, AFOLU were added to this table, but not analyzed in depth, as they usually do not contain information from the private sector.

The reason for T1 methodologies were discussed with Georgian inventory experts in two calls in May 2023.

Given that Georgia has sectoral NDCs, i.e. transport, buildings, energy generation and transmission, industry, agriculture, waste and forestry, it is important to move to higher tiers for reporting in order to be able to track progress.

3.1. Energy sector:

In the Energy sector, only a certain amount of data is obtained from the private sector. This data concerns activity data of transnational companies dealing with import and export of fuels, and is being made available by the companies.

Still, all key categories from this sector are calculated using T1 methodology, except fugitive emissions of CH_4 which qualifies as a T1/T2 method. Given that out of 27 key categories, 12 come from the Energy sector, it shows how important an improvement of the methodologies used from this sector are.

The main data source is the Energy Balance which is officially provided by the National Statistics Office of Georgia (GEOSTAT), since 2013. For the rest of the time series, information from the International Energy Agency is used. Currently T1 methodologies are applied, except for fugitives, where more disaggregated data was made available. For the next submission, experts are expecting to be able to access more disaggregated data for Energy Power Production (Sector 1.A.1.a.1 – Electricity Generation), and then apply a T2 methodology.

The main problems identified are the limited data availability for establishing country specific emission factors (CS EF), as well as the necessity of more disaggregated data than the one available now:

[4] The Methodology used refers of course to the methodology used for the calculation of HFCs and PFCs.

Currently, only limited data is available for the establishment of CS EFs, and this work exceeds the usual work of inventory compilers, as these topics are too extensive for a small team busy with other work. The areas identified, where research is necessary, are the transport sector, and composition and amounts of fuels used, also for energy generation.

The transport sector is a very complex and big sector, and in the case of Georgia, no disaggregated data is available for the different types of vehicles on the market and approximate km driven, and the different fuels used. Usually, higher tier methodologies for the transport sector are based on complex models, such as COPERT and similar.

A model needs to be created that allows inventory compilers to estimate emissions for the transport sector at a higher tier methodology, but in order to do so, cooperation with a research institution would be necessary. This research institution might need additional input by experts from international consulting projects or similar, that would help Georgian inventory compilers as well as the research institute. It needs to make sure that the research conducted is in line with the IPCC 2006 guidelines, and that all information is documented and archived in a way so it can be accessed during a review.

This should also include research on marine bunkers, where currently only fragmented data is available, as well as domestic aviation, where gaps in available information exist.

Another issue is the rest of the Energy sector, e.g. Energy production: here, the types of fuels used, and also the amount of power produced need to be assessed, this also would need to be conducted by a research institute, possibly with outside aid.

As for fugitive emissions, data for a T2 methodology exist in parts (for gas transmission and distribution losses), to adapt the IPCC 2006 GL, additional data, like the km of pipelines, their characteristics, data on compression etc. is needed, as well as data on the amount of gas transported. Georgia serves as a transit country for fuels both from north to south as well as from east to west, so here information is necessary. In order to do this, governmental institutions should request data, and trainings and help from qualified experts that help with establishing spreadsheets for the calculation of emissions from this subsector are needed.

Whilst mining of solid fuels stopped in 2017, there is some oil and gas production in Georgia, for which no technological information is compiled. However, this is data that should be made available by Geostat in the Energy Balance, which also should be improved, as disaggregated data is missing.

Lastly, another issue that could be improved is additional capacities for inventory experts to work on cross-sectoral issues, as according to the 2006 IPCC GL emissions should be separated between the different sectors (energy to IPPU, waste and agriculture), in order to disaggregate emissions between the different sectors. .

3.2. IPPU:

When it comes to the IPPU sector, the situation is different, as a lot of key categories are already calculated using higher tier methodology. The Climate Action Plan foresees Currently, experts are expecting to be able to move to a T 3 methodology for ammonia and nitric acid production, and are hoping to be able to apply a higher tier methodology for ferroalloy production. The Climate Action Plan (CAP) of Georgia under Goal 4 foresees some projects aiming at improving the situation in the IPPU sector, by projects that aim at lowering emissions, such as a project aiming at lowering

emissions from cement production by substituting wet with dry method, and low-emission production of Nitric Acid, which will allow for disaggregated and very accurate data from the IPPU sector. The other projects under CBIT aim at the development of individual emission factors per production, which will also help to establish higher tier methodologies. Thus, no additional approach of the private sector is necessary.

When it comes to the inventory of F-gases, information on the use for fire extinguishers, foam blowing and solvents are currently lacking. There is a CBIT project planned to tackle this information. Another CBIT project deals with the disaggregation of data between the Energy and IPPU sector, as some companies are currently not aware of IPPC methodology, which needs to be changed.

Therefore, it seems that the IPPU sector is currently being improved and higher tier methodologies will be applied.

For F-Gases, Georgia is currently finalizing a registry with an accompanying law:

- Importers will have to register all amounts of HFCs that are imported into the country, and are only allowed to sell to certified personnel
- Personnel needs to be certified in order to handle HFCs, as foreseen in the EU F-gas regulation. They will need to provide information on the use of HFCs in the registry, and perform leakage checks between once – 4 times per year, depending on the size of equipment and the amount of HFCs it contains.
- All information will be transferred into the registry, and inventory compilers will have access to this information.

3.3. Waste sector*:*

Currently, experts are working on a T2 methodology for solid waste disposal, as better data has become available. This data is based on data from different solid waste disposal sites. All companies in charge of solid waste disposal sites under the Ministry of Regional Infrastructure, where data is collected.

The Climate Action Plan of Georgia (CAP) under goal 6 foresees these project with the aim of having the new and improved landfills by 2030. It foresees the closure of up to 400 existing dumpsites in the different regions, especially unofficial ones, and establish 7 regional landfills, as well as one for Tbilisi, bigger non-hazardous landfills. The description of the progress of the projects under the CAP includes projections, which means that a time series going back to 2015 (with a possibility of projecting back in time) is available. Currently, the CAP is being updated for the progress until 24/25, which means that information for a higher tier calculation for the first BTR should be possible. The CAP also aims at the utilization of landfill gas in Kutaisi, Batumi, and Tbilisi, and at lowering emissions from recycling. This will be done by municipalities as well as private companies, under the tutelage of the Ministry of Environmental Protection and Agriculture. This means that site specific data should become available over time.

The CAP also looks at the construction of wastewater treatment plants, with capture and recovery of GHGs in Tbilisi, Batumi and Kobulet. Objective 6.4 of the CAP aims at a consolidated process for collecting and updating data for the waste sector. This activity should provide education for the National Statistics Office of Georgia under an EU Twinning project.

All these planned activities show that data is either becoming available, or should become available in due time. It is important, though, that parallel to the implementation of the CAP, private companies are made aware of the importance of obtaining data, and should be trained in data collection. When it comes to flaring and current amounts recovered, information is also scarce.

3.4. Closing remarks:

The CAP already takes data for inventory compilation and higher tier methodologies into account. Thus, rather than training the private sector through this project, the implementation and updates of the CAP should be done in close cooperation with the inventory team, especially after the next inventory cycle, because all gaps should be identified by then. The main focus should be on the Energy sector, to close the gaps there. In order to assess emissions from the Transport sector, a COPERT or similar model needs to be created to cover this important sector. The types of fuel used and their intrinsic properties necessary for establishing a country specific EF need to be assessed. As this might exceed the capacity of the inventory team, help from universities or private consultants that are experts on this field should be sought. The data needed for fugitive emissions, governmental institutions should request the data from losses during transport – this is important information for distributing companies, so this data should be available. Sector experts should look, with help of the ongoing CBIT project, into disaggregation of data between the different sectors.

4. Status quo in Moldova:

The MRV system in Moldova is already very advanced and working on a very high level. The last NIR was published in 2023 as a stand alone report, covering the time series from 1990 – 2020. An accompanying publication covers the National Greenhouse Gas Inventory System, which provides detailed information on Key Category analysis, Methods and Data Documentation, which provides detailed and transparent information on the methodology applied, data sources,QA/QC and potential improvements. Dedicated experts, working on a project basis for different sectors, contribute to the system's success. However, there's room for improvement in the system's efficiency, especially in terms of data access. Currently, the inventory compilers must navigate through the statistical office to obtain data, which can sometimes be overly disaggregated and challenging to use effectively for inventory purposes. Additionally, accessing confidential data can be a cumbersome process.

To enhance the MRV system's functionality, it's essential for the statistics office to be trained and willing to collect data, ensuring it meets the specifications required for inventories. Alternatively, inventory compilers should have the flexibility to approach relevant companies and installations directly, gathering the necessary data where needed, including confidential information.

4.1. Energy Sector

The following table provides an overview of the different tier methodologies applied in the Energy sector, the reason for choosing this methodology, and planned improvements:

Sector	Tier used	Reason for choosing method and Potential Improvements
1A1a Main activity electricity and heat production, solid fuels / CO2	T1	The Tier 1 method has been chosen because the CS EFs are not available. Potential improvements within the 1A1 'Energy Industries' category could be possible once new AD regarding the fuel consumption for electricity and heat generation on the territory of the LBDR are available (filling the gaps for certain years). Also, another potential improvement could be identifying additional AD sources or updating AD from official statistical publications.
1A1a Main activity electricity and heat production, liquid fuels / CO2	T1	
1A1a Main activity electricity and heat production, gaseous fuels / CO_2	T1	
1A2 Manufacturing industries and construction – CO_2	T1	Due to the unavailability of country specific emission factors, the Tier 1 methodology has been used. Potential improvements within the 1A2 'Manufacturing Industries and Construction' category could be possible once the updated AD regarding the fuel consumption with energy purposes for the territory on the LBDR are available, thus filling the gaps for certain years.
1A2 a-m, liquid fuels / CO2	T1	
1A2 a-m, gaseous fuels / CO2	T1	
1A3b Road transportation, liquid fuels / CO2	T3	Due to the importance of this source and availability of detailed data, the Tier 3 methodology has been tested. For 1A3b Road Transport, potential improvements can be obtained using the COPERT 4.9 model program. Test calculations were carried out for 1995-2019.
1A3b Road transportation, gaseous fuels / CO2	T3	
1A3c Railways, liquid fuels / CO2	T1	The Tier 1 method has been chosen because the CS EFs are not available. Potential improvements within the 1A3c 'Railways' could be possible once updating the available AD on real fuel consumption in the ATULBD for each source of emissions.
1A4a Commercial/Institutional, solid fuels / CO2	T1	Due to the unavailability of country specific emission factors, the Tier 1 methodology has been used. Potential improvements within the 1A4 'Other Sectors' category could be possible by updating the available AD on fuel consumption on the territory of the LBDR and filling the existing gaps for certain years. GHG emissions will be reported by fuel types in the next inventory cycle.
1A4a Commercial/Institutional, liquid fuels / CO2	T1	
1A4a Commercial/Institutional, gaseous fuels / CO2	T1	
1A4b Residential, solid fuels / CO2	T1	Due to the unavailability of country specific emission factors, the Tier 1 methodology has been used. Potential improvements within the 1A4 'Other Sectors' category could be possible by updating the available AD on fuel consumption on the territory of the ATULBD and filling the existing gaps for certain years. GHG emissions will be reported by fuel types in the next inventory cycle.
1A4b Residential, solid fuels / CH4, N2O	T1	
1A4b Residential, gaseous fuels / CO2	T1	
1A4b Residential, biomass / CH4,	T1	
1A4c Agriculture/Forestry/Fishing, 1A4cii 'Mobile' ('Off-Road Vehicles and Other Machinery'), liquid fuels / CO2	T1	
1B2b.iii.2 'Natural Gas – Production' /, CH4,	T1	The Tier 1 method has been chosen because not all enhanced characterization data are available. Potential improvements within the 1B2 'Fugitive Emissions from Oil and Natural Gas' source category could be possible
1B2b.ii 'Natural Gas - Wells Servicing' CH4,	T1	

		regarding the availability of new data related to fugitive leaks from oil and natural gas distribution networks (from the infrastructure needed to produce, collect, process, refine and distribute oil products and natural gases for the final consumers; from equipment functioning, evaporation and flashing losses, flaring, accidental releases from pipeline dig-ins, etc.), respectively in the case of adopting a higher-ranking assessment methodology. Improvements are also possible when presenting each category separately and for each region.
1B2b.iii.4 'Gas Transmission and Storage', CH4,	T1	
1B2b.iii.5 'Gas Distribution' , CH4	T1	
1B2b.i 'Natural Gas – Venting' CH4,	T1	

Table 3.1: Information on methodological tier applied, reasons for choosing this method, and planned improvements. All information from Report on National Greenhouse Gas Inventory System in the Republic of Moldova, 2022, Chapter 2.

All potential improvements for key categories deal with the availability of additional data. Energy production lacks data on the types fuels used, that are necessary for establishing a country specific EF, which is necessary for applying a higher tier methodology. This gap mostly has to do with a gap in statistical data. However, in chapter 6 of the National Inventory System Report, additional information is provided on planned improvements. The planned improvement for 1A1, Energy and Heat Production, is stated as:

The availability of new activity data on fuel consumption for electricity and heat production (source category 1A1 "Energy industry"), for industrial production and the construction sector (source category 1A2 "Manufacturing Industry and Construction"), for the provision of energy of the commercial and institutional sector, residential, agriculture, forestry and fisheries (source category 1A4 "Other sectors"), respectively for other works and energy needs (source category 1A5 "Other"), for the territory on the left bank of the Dniester River (filling in existing gaps for some years); there could also be potential improvements in identifying additional data sources or updating activity data in official statistical publications;

As this is seen as an improvement, there seems to be additional data available, but it is necessary to improve statistical data.

For 1.B, Fugitive emissions, chapter 6 of the NIS report states:
Availability of additional information on leakage from crude oil and gas distribution systems (from infrastructure for production, collection, processing, refining and distribution of petroleum and natural gas products to final consumers; from equipment operation, evaporation losses, ventilation , flamethrower combustion, accidental emissions due to deterioration of pipeline systems, etc.) (source category 1B2 'Fugitive emissions from oil and natural gas'), i.e. in the case of switching to higher-ranking assessment methodologies; the possibilities for obtaining activity data associated with the consumption of liquefied petroleum gases on the left bank of the Dniester River for the entire reference period will also be assessed;

Companies dealing with oil and gas distribution usually have data on leakages, as those are technical losses that have economic impact. In this case, either the statistical office or the inventory compilers dealing with this chapter should directly approach companies dealing with oil and gas distribution.

4.2. IPPU Sector:

An analysis of the applied methodologies in the IPPU sector shows, that for the two key categories of the IPPU sector, tier two methodologies have been applied. F-gases are discussed separately at the end of the report, as the same problems concern all countries and are being analysed there.

	Tier used	Reason for choosing method and Planned Improvements
2A1 Cement Production / CO2	T2	Due to the importance of this source and availability of the plant specific data, the Tier 2 methodology has been used. Potential improvements under the 2A1 Cement Production source category aim at collecting plant specific activity data from Cement Plant in Ribnita, on the left bank of Dniester River for the whole reporting period.
2F1 Refrigeration and Air Conditioning / HFCs	T2	Due to the increase use of F-gases, Tier 2a methodology have been used. Potential improvements could include capacity building activities by setting up an on-line information system for collecting AD from companies that import, use, dispose, recover and recycle refrigerants and refrigerant equipment. This information system will provide the National Ozone Office of the Public Institution "Environmental Projects Implementation Unit", as well as to the Environment Agency and Ministry of Environment, more accurate AD that could potentially help reduce uncertainties in estimating GHG emissions from the 2F1 'Refrigeration and Air Conditioning Equipment' source category in the Republic of Moldova.

Table 3.2: Information taken from the NIS Report on Key Categories from the IPPU sector, the tier used and the reason for choosing this methodology, including information on planned improvements.

Dedicated experts, working on a project basis for different sectors, contribute to the system's efficacy. However, there's room for improvement, especially in terms of data access. Currently, the inventory compilers must navigate through the statistical office to obtain data, which can sometimes be overly disaggregated and challenging to use effectively for inventory purposes. Additionally, accessing confidential data can be a cumbersome process.

To enhance the MRV system's functionality, it's essential for the statistics office to be trained and willing to collect data, ensuring it meets the specifications required for inventories. Alternatively, inventory compilers should have the flexibility to approach relevant companies and installations directly, gathering the necessary data where needed, including confidential information.

4.3. Waste Sector:

There are three key categories in the Waste sector, where Solid Waste Disposal is already calculated using a T3 method. As the text for planned improvements are very long, they were taken out of the table for easier legibility:

Sector	Tier used	Reason for choosing method	Planned improvements
5A Solid Waste Disposal	T3	Due to the importance of this source and availability of CS parameters and EFs, the Tier 3 methodology has been used.	For easier legibility, the text is provided below
5D1. Domestic wastewater – CH4	T1	Due to the lower importance of this source and unavailability of detailed data from measurements, the Tier 1 methodology has been used.	For easier legibility, the text is provided below
5D Wastewater Treatment and Discharge	T1	Due to the lower importance of this source and unavailability of detailed data from measurements, the Tier 1 methodology has been used.	For easier legibility, the text is provided below

Table 3.3: Information taken from the NIS Report on Key Categories from the Waste sector, the tier used and the reason for choosing this methodology, including information on planned improvements.

Planned improvements for 5A Solid Waste Disposal:

Among the main priorities is the need to foster improved statistical recording related to waste. Waste management will be essentially restructured. Thus, in the period 2018-2020, several legislative acts were adopted for the coherent application of the Law on Waste, 209/2016, in particular Government Decision on approval Waste list no. 99/2018, which transposes the Commission Decision 2000/532 / EC. At the same time, the approach to waste data record keeping was reviewed, by approving the Government Decision no. 501/2018 on the Instruction on records keeping and reporting of waste data and information on waste management, and Government Decision no. 682/2018 on approving the Concept of Automated Waste Management Information System and the reporting system has been developed - www.siamd.gov.md

It must be acknowledged, however, that 2020 was the first reporting year in the new system and the information gathered does not reflect the real situation in the field of waste management. Thus,for example, the volumes of MSW generated in rural localities are not subject to statistical records, as there are usually no registered waste collection services. In addition, although there arewaste processing companies operating in the Republic of Moldova, the information on the quantities of recycled waste is not subject to strict statistical records. Taking into account the tendency ofthe Republic of Moldova to align with EU standards, the sector is to be essentially restructured. In this context, most MSW deposits are to be re-cultivated, and their number - drastically reduced.

With regard to the elaboration of the next reports to the United Nations Framework Convention on Climate Change, the activity data will be updated, in particular the coefficient of transformation of the quantity of MSW from m3 to kt. In recent years, the share of packaging has increased, and according to the data provided by waste collection service from Chisinau, 1m3 of MSW correspondsto 180-200 kg, which will cause the revision of the coefficient of 0.4 kg / 1 m3 of MSW and to reduce it. In the next period, it is expected to assess the activity data reported in the Automated Information

System National Pollutant Release and Transfer Register and the Waste Management AutomatedInformation System. It is also proposed to update the study on the morphological composition of municipal solid waste in Chisinau, Causeni and Straseni, with the involvement of the Environmental Reference Laboratory of the Environmental Agency. At the same time, it will be necessary to weigh the waste trucks in order to deduce the coefficient of transformation of the volume of MSW. Another aspect that needs to be mentioned is the recently adopted Law no. 89/2020 on the ratification of the Financing Agreement between the Republic of Moldova and the European Investment Bank regarding the implementation of the project "Solid waste in the Republic of Moldova". Through this agreement signed on October 18, 2019 between the European Investment Bank and the Government of the Republic of Moldova, a loan of 100 million euros will be granted for the improvement of solid waste management services in the country. The first installment is EUR 25 million.

The Agreement aims to implement the Waste Management Strategy 2013-2027 in the Republic of Moldova, involving projects aimed at modernizing and developing solid waste management systems in eight regions of the country. The projects will provide the localities with new collection systems, mechanical-biological waste treatment facilities and new regional sanitary warehouses for the whole country. The projects will aim to reduce the negative impact on the environment and human health, by modernizing waste collection systems and separate collection of recyclable materials and bio-waste, as well as rehabilitating or closing landfills. Regional landfills will be equipped with biogas recovery systems.

This exhaustive text shows that apart from problems that usually arise with the implementation of a new information system like the above mentioned database, the inventory compilation for this sector is well under control. It seems that as the Statistical Agency of Moldova has been responsible for data collection, but this data is now collected via the database set up by the Ministry for the Enviroment, data gaps for a few years can be expected. It might be necessary to inform companies and municipalities to provide this data via the database, and it might be necessary to fill data gaps in the future, but it is to be expected that this part of the inventory will increase even more in quality.

For both 5D1 Domestic Wastewater and CH_4 emissions, as well as 5D Wastewater Treatment and Discharge- CH_4 emissions, T1 methodologies have been applied. The planned improvements for both sectors are again described here:

At the national level, the Government Decision no. 199/2014 Water Supply and Sanitation Strategy (2014–2030) (amended by Government Decision no. 442/2020), which denotes the impact of climate change, combined with water scarcity in the country, requires an integrated urban planning. The general objective of the Strategy is to ensure the gradual access to safe water and adequate sanitation for all localities and population of the Republic of Moldova, thus contributing to the improvement of health, dignity and quality of life and economic development of the country. Regulation on the conditions of wastewater discharge into water bodies, approved by Government Decision no. 802/2013 aims to regulate the conditions of discharge, introduction of specific substances in water. Thus, the regulation specifies the emission limit values that apply to the discharge of wastewater from industrial sectors (activities) in a body of surface water. Regulation on the requirements for the conditions of collection, treatment and discharge of wastewater in the sewerage system and / or in water outlets for urban and rural localities, approved by Government Decision no. 950/2013 aims to regulate the conditions of collection, treatment of wastewater discharge into the sewerage system and / or water outlets. Thus, the Regulation stipulates the maximum permissible limit values for the loading of wastewater with pollutants for natural discharge, which will contribute to the safe reduction of emissions from this sector. Both regulations

need to be properly enforced. There is need to apply the following economic instruments: appropriate combination of tariffs, fees and transfers to finance recurring and capital costs and to boost other forms of financing; predictability of public subsidies to facilitate investment (planning); tariff policies that make services accessible to all, including the poorest categories, while ensuring the sustainability of service providers. The planning perspective of the sector can significantly improve the management of wastewater and sludge from this category. Sludge treatment actions will reduce the risk of affecting the quality of natural water resources, which is becoming increasingly sensitive to climate change. The actions listed above will contribute to fulfillment of the Republic of Moldova's obligations towards the Protocol on Water and Health and other international acts, which aim to reduce the share of the population without access to drinking water sources and sewerage systems, and in the same time and the provisions of UNFCCC. The planning of gradual harmonization of national water legislation with that of the European Union is also a good tool for increasing the implementation of best practices, wastewater and sludge treatment technologies, which would allow the capture and sustainable use of methane emissions from sludge storage fields (including for the production of heat and power). As regards the potential improvements for the methodology of calculation CH_4, it would be recommended to conduct a study of the possibility of using national information on the CBO fraction removed with sludge, maximum methane formation capacity, methane correction factor and other relevant parameters which will improve the quality of the national inventories of greenhouse gas emissions.

The inventory team proposes a study for certain parameters that will increase the quality on the greenhouse gas emission inventory of wastewater treatment. This study should be funded as soon as possible, so that those key categories can also be analysed using higher tier methodologies.

4.4. Closing remarks:

The assessment of the Moldovan GHG inventory improvement plan reveals that the primary quality concerns stem from data gaps. Fortunately, measures have already been initiated to address these issues. It thus became evident that there's no need for extensive training within the private sector. Instead, the key lies in enhancing collaboration between the statistics agency and the inventory team.

It is crucial to raise awareness within the statistics agency regarding the specific data granularity required for the inventory. Additionally, there's a need to explain the robust QA/QC framework and a safe archive that should allow the inventory team access to confidential data. Moreover, granting them access to the raw data collected by the statistics agency could also significantly increase the quality of the GHG inventory. It should also be made clear, where the limits of the statistics office lay, and where the GHG inventory team should approach the private sector themselves, and access data. It should also be made clear, what type of data is needed, like fuel composition, amounts of fuels used, carbon contents, carbon oxidation factors, fuel quality, etc. along the provisions of the 2006 IPCC Guidelines. For fugitive emissions, distribution and transmission companies should have information on technical losses (i.e. amount going into the pipeline – amount coming out at the end of the pipeline), as these losses have an economic impact. These measured results are often more accurate than any IPCC methodology.

The missing data from the left side of the Dniester river is a delicate issue that needs to be handled with diplomacy. If real data is not available, maybe rough estimates can be done comparing to

information available from the right side of the river. Data gaps can be filled either with real data, or with methods as described in Chapter 5 of Volume 1 of the IPCC guidelines.

In order to improve the system, it isn't necessary to train the private sector, but rather to analyse the reasons behind data gaps, which could not be done in the scope of this project, but will be done in another. It is necessary to find a way to work with the statistical office, and to gain access to data directly obtained from the private sector.

When it comes to F-gases, Moldova has been suggesting a database for equipment containing HCFCs, which became part of a law that was passed in March. It needs to be evaluated how much help Moldova will need in establishing this database, as in other countries it will be necessary to start from scratch.

5. F-Gases for the Inventory:

Ozone Depleting Substances (ODS) were used as cooling and foaming agents, aerosols, fire protection agents and for other uses, until their inherent properties became apparent with the discovery of the hole in the ozone layer. Thus, in 1987, the Vienna Convention for the Protection of the Ozone Layer was adopted, and in 1989 its Montreal Protocol came into force. The Montreal Protocol is deemed (by many) the most successful international agreement to date.

Fluorinated gases (or F-gases, which is a term used to describe all fluorinated gases, HFCs, PFCs, SF_6 and NF_3, and as of lately HFOs) were used as alternatives to ODSs, and emissions from their use have been increasing since the early 1990s. Emissions take place as a by-product of production, from leakages from the RACHP (Refrigeration, Air Conditioning and Heat Pump) sector, from their use as foaming agents, their use as aerosols, as agents used in fire protection, as solvents, at the production of aluminium, as well as magnesium or aluminium casting, from switchgear and from the electronics industry. Due to their high GWP and increasing emissions, they are considered greenhouse gases and add to climate change, and have thus to be reported in the national greenhouse gas inventories.

As the problems in all three countries can be considered very similar, this suggestion is valid for the whole region.

In 2016, the Kigali Amendment to the Montreal Protocol has been adopted, which foresees a global step-wise phase down of F-gases. It starts with developed countries, with a longer time-frame for developing countries (article 5 countries) with certain extended time frames for HAT (high ambient temperature) countries. The EU has put into place a regulation in 2006 (Regulation No 842/2006) in order to make sure that handling of F-gases was only allowed to certified personnel with a certain knowledge of responsible handling of F-gases (avoidance of leakages, thorough decommissioning). It also stipulated that trading was left to certified companies that would only deliver F-gases to certified personnel. This regulation was updated in 2014 (Regulation No 517/2014) which added includes bans for certain applications as well as a step-wise phase down of HFCs placed on the EU market to 21% of the average amount (in CO_2 eq) of 2009-2012. This means that low GWP alternatives (HFOs, HFO-HFC blends, as well as natural refrigerants, i.e. ammonia, CO_2, hydrocarbons such as propane or (iso-)butane etc) have to be used as alternatives. Currently, the EU is working on a re-draft of the 2014 version of the regulation, which will include even more ambitious targets for 2030-2040, resulting in almost a phase-out of HFCs.

The problem with the F-gas sector, which is a subsector of IPPU, foresees detailed reporting on the different uses of HFCs. Whilst there is a numerous amount of different blends, there are also multitudes of different installations, where F-gases are being used: i.e. Air Conditioning (and the different types thereof), Refrigeration (and the different types thereof, like Commercial Refrigeration (e.g. in Restaurants and Food Stalls, Supermarkets), Industrial Refrigeration (e.g. in pharmaceutical companies, large installations)), Heat Pumps, Mobile AC (i.e. Air Conditioning in all types of vehicles), Transport Refrigeration (i.e. cooled containers for lorries and ships). The other uses, like uses of F-gases in foams, as fire protection, in metered dose inhalers, in other aerosols, switchgear and other uses of SF_6 also have to be reported. Thus, even though the percentage of F-gases contributing to the total emissions of a country might be well below 10%, inventory compilers are facing a multitude of factors that have to be taken into account! It is not just necessary to know the AD of refrigerants used, but the estimation contains EFs for refrigerants filled into new installations, emissions during use, and at decommissioning. Besides, EF have to be estimated for the different types of equipment within a range of applications used.

The 2019 revision of the 2006 Guidelines provides a tier 2 methodology for the RACHP sector (Sector 2.F.1) inventory compilers can use, if the total amount of F-gases placed on the market of a country is known. However, there are several areas that leave room for uncertainties:

- choosing the right emission factor can be difficult, as ranges are wide.
- It also doesn't allow for following technological advances, i.e. equipment with smaller loads of refrigerants, leakage controls and better leakage avoidance.
- The IPCC 2019 Refinement does provide a split of uses into the different subsectors, based on inventories of other countries which is a valid approach for inventories if no detailed data is available, but it has to be seen as a first approach with relatively high uncertainties.
- With a view of the Kigali Amendment, it is also difficult to pinpoint measures for a future phase down of HFCs in these sectors, and to set the course for "natural" refrigerants, or low GWP solutions. Given the environmental impact of some HFOs and HFCs with regards of the PFAS restrictions of the EU, tracing their uses might become even more important.

These problems could be avoided by establishing a registry for HFCs, for both importers, as well as servicing companies in the countries. This would help to establish a better understanding of HFC use, leakages, and to trace the future phase down of HFCs.

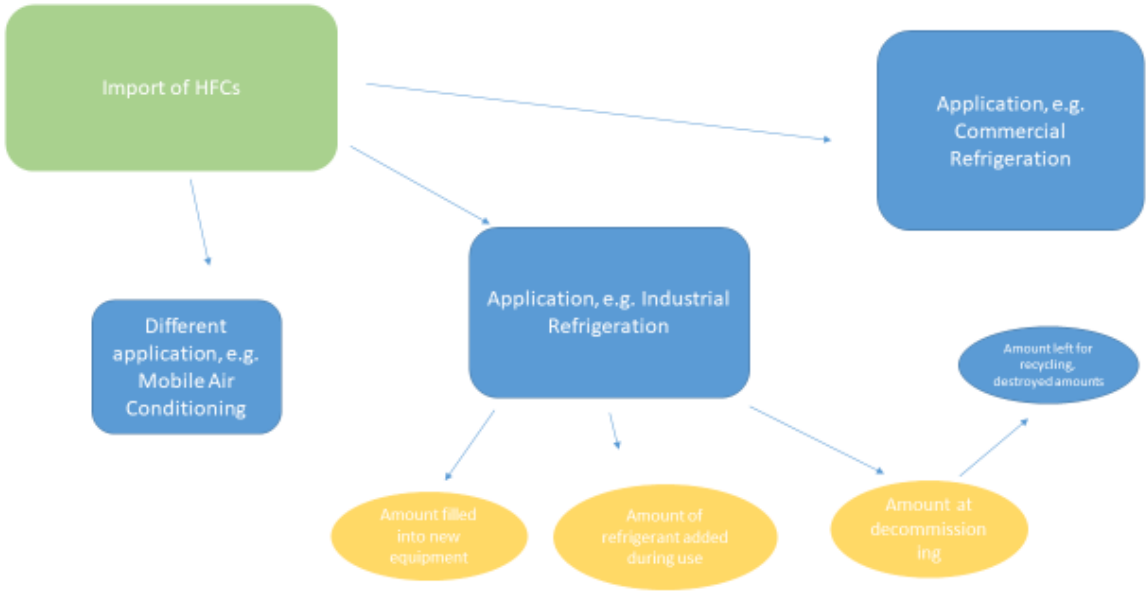

Figure 1: Simplified overview of the data collected in a registry, please note that not all subsectors are depicted, as the theoretic emissions occur at the same time, only the emission factors vary. Parameters needed and therefore to be collected in the registry are: total import of the different blends, amount of blends used in different applications of each installation: the amount filled into new equipment, the amount of refrigerant added during use (i.e. that had gotten lost through leakages), and the amount left at decommissioning, as well as the "fate" of these amounts, i.e. amounts recycled, or destroyed.

Any refrigerant that is being used, can be emitted during three different stages during the life cycle of equipment:

1. At the beginning of the life cycle of refrigerant containing equipment, i.e. amounts lost during first filling of new equipment. It can be assumed that trained personnel handles refrigerants with care, thus emissions during the filling can be assumed as rather low.
2. Leakage, which is equivalent to amount of refrigerant added during use, i.e. refillings. Any refrigerant that is missing from a closed circuit got lost i.e. emitted. These amounts are reported under emissions during the life cycle of the equipment. It has to be noted that the optimal amount of refrigerant ensures maximum energy efficiency. This means that trainings need to be in place for service personnel, and customers need to be aware that regular servicing increases energy efficiency. Many countries have legislation in place that demand regular servicing of refrigerant containing equipment. With such a legislation, servicing companies could also be demanded to report refilled amounts into the registry.
3. At the end of life of equipment, with high potential emissions as – if no measures are in place - up to 100% of refrigerant gets lost during decommissioning. Thus, it is important to enforce recycling/destruction of F-gases, and in terms of emission inventories, to ensure the reporting of these amounts, to allow for an estimate of how much of the refrigerant got lost during decommissioning. With a global phase down of HFCs, refrigerants will become more valuable with time, so interest in recycling will increase. This also provides a chance for legislators to increase recycling of refrigerants.

   A registry for refrigerants should go hand in hand with trainings for the servicing sector, capacity building in institutions, the public (especially re energy efficiency) and the legislators. Only then such a registry could work. Data from such a registry would allow for actual emission factors, as emitted quantities of refrigerants will be known (these amount equal to the quantities refilled). This data also allows for targeted measures, as well as tracing of the phase down of HFCs.

   As a lot of countries face the same problems with the F-gas chapter of the inventory, this could be a regional effort, as the IT part of the registry could be applied for all countries, only the interface would have to be translated into national languages. Moldova and Georgia are already quite advanced with their work on the registries, but the additional efforts surrounding the registry could be shared:

   - The legal framework needs to contain some sort of certification for handling of HFCs, to make sure that the information is put in the registry, and that HFCs are handled with care, to avoid unnecessary emissions.
   - It also needs to contain a legal obligation for leakage checks on a regular basis
   - Information on the fate of all amounts of HFCs imported into the country needs to be traceable
   - Trainings for leakage checks (maintenance) and also the safe handling of flammable (A2L) and natural (A3) refrigerants will be necessary, as the intrinsic properties of the HFCs could become safety issues.

   The Multilateral Fund (MLF) currently opened a two-year funding window for registries, thus such an effort should be undertaken soon. It is possible, that the registry proposed here will exceed the funding requirements, but additional funds could be applied for under the GEF and possibly CBIT that deal with reporting under the Paris Agreement.