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Roadmap for the Development of a Functional National Greenhouse Gas Emissions Inventory System for Armenia

Produced by **Maria Purzner, Dr.**

Climate protection & emissions inventories
Environment Agency Austria

EU4Climate
Armenia, Azerbaijan, Belarus, Georgia, Republic of Moldova, Ukraine

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The objective of the report is to support a functional greenhouse gas emissions inventory system in Armenia with reliance on the national experience and best international practices in accordance with the Comprehensive and Enhanced Partnership Agreement the country signed with the European Union.

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Contents

List of Abbreviations:

BTR	Biennial Transparency Report
BUR	Biennial Update Report
CEPA	Comprehensive and Enhanced Partnership Agreement
CMA	Conference of the Parties serving as the Meeting of the Parties to the Paris Agreement
COP	Conference of the Parties
CRF	Common Reporting Format
CTF	Common Tabular Format
EF	Emission Factor
ETF	Enhanced Transparency Framework
GHG	Greenhouse Gas
IPCC	Intergovernmental Panel on Climate Change
MPGs	Modalities Procedures and Guidelines
MRV	Monitoring, Reporting and Verification
NC	National Communication
NDCs	Nationally Determined Contributions
NIR	National Inventory Report
PA	Paris Agreement
QA/QC	Quality Assurance/Quality Control
RA	Republic of Armenia
UNFCCC	United Nations Framework Convention on Climate Change

1 Context

1.1 MRV

Measuring, Reporting and Verification of GHG emissions is an important tool in combating climate change. MRV is a term used to describe all measures that countries take to collect data on emissions, mitigation action, and support. In order to be able to see progress of a country's struggle to lower emissions, and to compare its efforts with that of the global community, it is necessary to have an MRV system in place that adheres to the same principles as that of other countries.

The three letters stand for the following principles:

- Measure or monitor (M) data and information on emissions, mitigation actions and support. This can entail measured GHG emissions, estimating emissions or emissions reductions utilizing activity data and emission factors, calculating changes relevant to sustainable development, and collecting information about support for climate change mitigation
- Report (R) by compiling this information in inventories and other standardized formats to make it accessible to a range of users and facilitate public disclosure of information
- Verify (V) by periodically subjecting the reported information to some form of review or independent assessment to establish completeness and reliability. Verification helps to ensure accuracy and conformance with any established procedures, and can provide meaningful feedback for future improvement.

MRV can be applied to emissions of GHG, on a national, organizational and/or facility level, and can be reported in the form of an emissions inventory. However, MRV can also be applied to mitigation actions (e.g. policies or projects) in order to assess their effects on emissions, but also on sustainable development or the implementation of climate-related projects, without estimating emissions. This can also be applied to support tools, like climate finance, technology transfer and capacity building, in order to track provisions and receipt of climate support and in order to assess the impact of this funding.

This gap analysis focuses on the MRV of GHG emissions on a national level.

The basis for an MRV system is GHG emissions reporting that provides information about the emission trends and is published in the National Inventory Report (NIR). In its NIR, a country provides information about the development of GHG emissions from the different source and sink categories, based on the methods outlined in the guidelines provided by the IPCC. As this is an international framework that is binding to all parties to the UNFCCC that have to report their emissions, emissions timelines are comparable between countries and allow for a global overview of emissions. The reporting obligations for developed countries and those on the path of development are different, which will be described in the next chapter.

1.2 The Paris Agreement

The Paris Agreement, which was signed by Armenia in 2015 and ratified in 2017, was decided upon with the objective to lower global emissions in a way that global temperatures will not rise above +2°C by 2050 (whilst aiming for a maximum of 1.5°C). It follows the Kyoto protocol, that was ratified by Armenia in 2002. The Paris Agreement aims to do so by strengthening the global response to climate change in general, including by: committing to a long-term temperature goal; enhancing adaptive capacity and climate resilience; and making finance flows consistent with low-emission development pathways. Differing

national circumstances[1] will be taken into account, which is a shift away from the differentiation between developed and developing countries, which also increases obligations of developing countries.

Each Party to the Paris Agreement is obliged to determine at the national level the actions they are able and willing to take in order to achieve the objective of the Paris Agreement. These so called "Nationally Determined Contributions" (NDCs) can contain efforts on mitigation and adaption, but also by providing the means of implementation (finance and technology transfer, as well as capacity building) to developing countries.

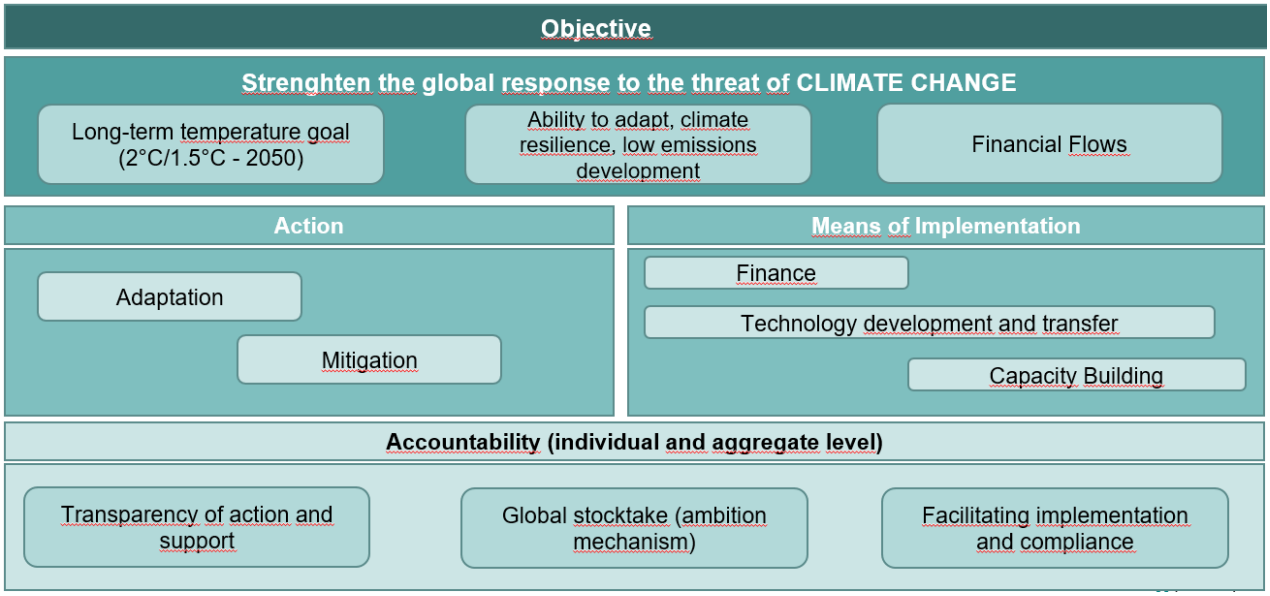

Figure 1: *Paris Agreement: the bigger picture*

Parties will have to report NDCs every five years and will have to put domestic mitigation measures into place in order to achieve them. Every five years, a global stocktake will take place, where the CMA[2] will take stock of the implementation of the Paris Agreement and assess the collective progress towards achieving the purpose of the PA and its long-term goals.

NDCs should be clear and transparent, in accordance with guidance from the CMA, while taking into account existing methods and guidance under the UNFCCC. NDCs will be recorded in a registry (handled by the UNFCCC Secretariat). Countries can always adjust their existing NDCs in order to enhance their level of ambition over time, but have to meet the minimum as described in their NDCs, that were put forward by the parties when joining the Paris Agreement (as Intended National Contributions, or INDCs). Depending on the timeframe of the INDC, parties will have to report new NDCs or updates of their NDCs in 2020 and every 5 years onwards.

In order for the CMA to be able to follow track on the implementation of NDCs, Parties to the PA will have to report on their progress in a transparent manner. This is why the *Enhanced Transparency Agreement* was decided upon, its *Modalities, Procedures and Guidelines (MPGs) for the Transparency of Action and Support* contain all necessary obligations for how, when and what parties will have to report.

[1] It should be noted that there is no definition of „national circumstances"

[2] the Conference of the Parties serving as the Meeting of the parties to the Paris Agreement, so all states that are Parties to the Paris Agreement

A solid MRV system will help the country to be able to report on the implementation of its NDCs, the changes in emissions and also to report projections of emissions with measures in place.

1.3 Legislative Context

The "Gap analysis of the existing legal framework in the Republic of Armenia and development of a road map for approximation with the EU acquis related to climate action" by Svetlana Zhekova, as part of the EU4Climate project, provides an extensive overview of the existing legal framework, abridged findings for which is presented here for easier reference.

Development and sharing of GHG emission data in Armenia, needed for implementation of the UNFCCC transparency requirements, is regulated by:

- ✓ Commitments under the UNFCCC, in particular articles 4.1 and 12.1, which provide the legal basis for developing the GHG inventory.
- ✓ Government Decree No 49 from 8 December 2016, which includes measures to implement the commitments taken by the RA pursuant to international treaties, including: UNFCCC and the Paris Agreement, Vienna Convention on Protection of the Ozone Layer, the UN Convention on Biodiversity and the Cartagena Protocol on Biosafety. It specifies that the National Greenhouse Gas Inventories shall be developed biennially while the Ministry of Environment has the overall responsibilities for the national inventory;
- ✓ the Comprehensive and Enhanced Partnership Agreement (CEPA) between the European Union and Armenia of 24 November 2017 (entered into force on 1 March 2021). The Agreement emphasizes the importance of strengthening the multilateral cooperation on the further development and implementation of the international climate-change framework under the UNFCCC and agreements and decisions related thereto, including the Paris Agreement. Particularly, it requires the establishment of a national greenhouse gas inventory system and of a national MRV mechanism by 2026.

The **Statistical Committee** is in charge with handling and disseminating official statistical information, including climate-related data, in the country. The **Roadmap for the Development of Climate Change-related Statistics** (adopted in the beginning of 2020) recognizes the need to acquire new knowledge and expertise through training and building partnerships with other information providers and experts. It also recognizes that there is a need for organizational changes to support the development of climate change-related statistics across the entire statistical system, including data reporting, collection, storage and exchange. EU4Climate may contribute to setting up the basis for such organizational changes.

The MoE is responsible for the overall coordination of the NIR, BUR and NC development, while **national verification and approval** thereof is carried out by the Inter-agency Coordination Council, pursuant to Decree No 49/08.12.2016.

It is acknowledged that as a non-Annex I Party to the UNFCCC Armenia has already established the **basic national system for MRV** under the existing transparency arrangements. It has designated a formal coordinating body (MoE), as well as other institutions involved in the process, and has established a horizontal inter-institutional coordination and verification mechanism.

However, **obligations of the various designated institutions for climate-related data reporting, collection, storage and exchange are not regulated by any legally binding instrument**. A legal/formal

mandate is needed to assign specific roles to each appointed institution and to facilitate the various stages of the process. A legal/formal mandate can also help the coordinating body to mobilize necessary expertise, in particular through appointment of the focal points among the stakeholders concerned. It

could be in the form of implementing regulation (on MRV) or legally binding guidelines adopted by Government Decision.

The establishing an MRV system in the scope of the ETS Directive (Annexes I and II) is examined in detail in the report "Gap analysis of the existing legal framework in the Republic of Armenia and development of a road map for approximation with the EU acquis related to climate action", which provides extensive and exhaustive suggestion for further action. Please refer to this document for more information on the legislation and necessary alignments of the MRV system to the EU acquis.

1.4 Reporting Obligations now and then

Under the current climate framework, Parties were split into two groups: Annex-I countries, i.e. industrialized countries that were members of the OECD in 1992 plus countries with economies in transition, like the Russian Federation, the Baltic States, and several Central and Eastern European countries.[3] By virtue of exclusion, all other countries obtained the status of Non-Annex I Parties. While most were developing countries, some were also in advanced stages of industrialization.

This meant that Armenia, as a non-Annex I country, so far had the following reporting obligations that were the key elements of the MRV Framework under the Climate Convention.

1. National Communications (NC): which should be submitted every four years, and contain chapters on national circumstances and institutional arrangements; a National GHG inventory; a description of steps taken or envisaged to implement the Convention; other information considered relevant to the achievement of the objective to the Convention, constraints and gaps, and related financial, technical, and capacity-building needs; and an optional technical annex. Armenia submitted the first NC in 1998, and the fourth in 2020.
2. A Biennial Update Report (BUR): which should be submitted every two years, with chapters on national circumstances and institutional arrangements relevant to the preparation of the national communications on a continuous basis; a National inventory of all GHG (except F-Gases), including a National Inventory Report (NIR) as a stand-alone document or part of the BUR); Mitigation actions and their effects, including associated methodologies and assumptions, objectives, progress of the implementation and estimated outcomes, international market mechanisms and their measurement, reporting and verification; constraints and gaps, and related financial, technical and capacity needs, including a description of support needed and received; description of support needed and received, also information on support received for the preparation of the BUR; information on domestic MRV, any other information that the Party considers relevant to the achievement of the objective to the Convention; and an optional technical Annex. Armenia has so far submitted the first BUR in 2016, second BUR in 2018 and third BUR in 2021 (May).The BUR is then subjected to the International Consultation and Analysis (ICA), which is conducted in a manner that is non-intrusive, non-punitive and respectful of national sovereignty that aims to increase transparency of mitigation actions and their effects. It consists of two steps, namely a technical analysis by a team of technical experts in consultation with the Party, resulting in a summary report, and a facilitative sharing of views.

[3] A list of all parties to the Kyoto Protocol can be found here: https://unfccc.int/process/parties-non-party-stakeholders/parties-convention-and-observer-states

3. Armenia underwent the first ICA cycle in 2017 (https://unfccc.int/ICA-cycle1), the second in 2019 (https://unfccc.int/ICA-cycle2).

The ICA, i.e. the review process, is an important part of reporting, when reports are subjected to a peer review. This should not be seen as an embarrassing test a country needs to pass, or a way of unveiling incompetence of inventory compilers, but as a chance to being able to improve the quality of inventories. In this process, reviewers, who themselves are inventory compilers of other countries, take a critical look at inventory reports of other countries and compare them to the reporting guidelines and rate them according to the "TACCC" principles of transparency, accuracy, completeness, consistency, and comparability (see next chapter for a description of inventory principles). Review findings always help an inventory team to increase transparency and the overall quality of their work. Becoming reviewers themselves help inventory compilers to understand their own work better, and to also tackle their own inventory report from the point of view of a reviewer, thus again increasing the quality of their own work.

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 as an annex to the Biennial Transparency Reports (BTR)in those years a BTR is published. Differences between NCs under the Kyoto Protocol and the Paris Agreement are not yet finalized but can be considered minor;

2. Biennial Transparency Reports (BTR): will contain chapters on GHG emissions and removals (with the NIR 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;

3. National Inventories (incl. National Inventory Reports) every two years (see chapter on National Inventory Systems);

4. Undergo a Technical Expert Review every two years, which consists of a technical review of the consistency of the information submitted by Parties, taking into consideration 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 Kyoto protocol, as well as the information necessary to track progress made in implementing and achieving NDCs.

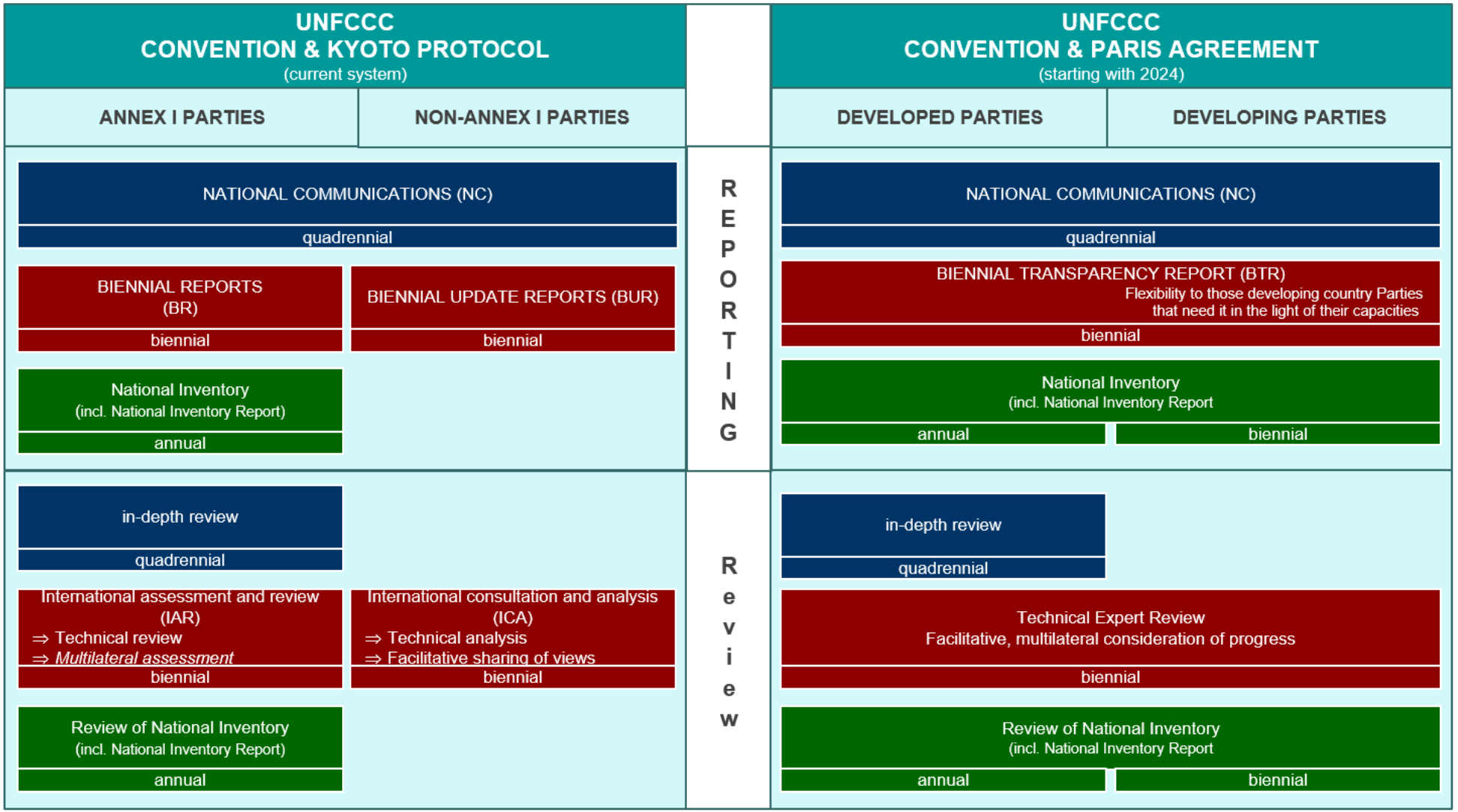

Figure 2: Reporting requirements for developed and developing countries under the UNFCCC Convention&Kyoto Protocol, and changes under the Paris Agreement, source: WRI (2017) Designing the Enhanced Transparency Framewrok, Part 2: Review under the Paris agreement, modified Source

1.5 Modalities, procedures, and guidelines (MPGs) for the transparency framework

To ensure that all Parties to the PA report in a comparable and transparent manner, the Conference of the Parties (COP)s decided on modalities, procedures and guidelines for the transparency framework (MPGs)[4]. In it, all basic rules are put forward for all Parties on how to report from 2024 onwards. The MPGs provide a framework for the reporting obligations. in the chapter below, necessary information on national inventory reports of anthropogenic emissions by sources and removals by sinks of greenhouse gases are described.

1.5.1 GHG inventory principles

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.[5]

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[6] and emissions should be calculated based on the IPCC reporting guidance.

[4] 18/CMA.1 Modalities, procedures and guidelines for the transparency framework for action and support referred to in Article 13 of the Paris Agreement; Report on the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement on the third part of its first session held in Katowice from 2 to 15 December 2018; Addendum, p. 18ff

[5] 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

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

1.5.2 National circumstances and institutional arrangements

According to the MPGs, each Party should[7] implement and maintain national inventory arrangements, including institutional, legal and procedural arrangements for the continued estimation, compilation and timely reporting of national inventory reports in accordance with these MPGs. National inventory arrangements can vary by Party depending on their national circumstances and preferences, and change over time. Each Party shall report on the following functions related to inventory planning, preparation and management:

(a) Its national entity or national focal point with overall responsibilities for the national inventory;
(b) Its inventory preparation process, including division of specific responsibilities of institutions participating in the inventory preparation to ensure that sufficient activity data collection, choice and development of methods, emission factors and other parameters are in accordance with the IPCC guidelines referred to in the MPGs (§20);
(c) Its archiving of all information for the reported time series, including all disaggregated emission factors and activity data, all documentation about generating and aggregating data, including quality assurance/quality control (QA/QC) review results and planned inventory improvements;
(d) Its processes for the official consideration and approval of the inventory.

1.5.3 Documentation and archiving, Quality Assessment

The MPGs in Chapter C paragraph 6 refer to a QA/QC system, in which basic specifications are provided. Even though developing country Parties are given flexibility and are encouraged only to establish such a system, it should be noted that a QA/QC system with good documentation and archiving is not an unnecessary addition to a National System, but a foundation: the better a QA/QC system, the easier it becomes to enhance the quality of reports, to find references and to make sure that information does not get lost with changes in staff.

The MPGs also stipulate a QA/QC system as a requirement for all parties when it comes to key categories and those categories where significant methodological changes and or data revisions have been applied. The IPCC guidelines provide information on what a basic QA/QC system should contain.

2 Roadmap for establishing an MRV system in Armenia

2.1 Aim

The aim is to build a strong, competent and sustainable National System with defined roles, and experts that are able to provide the necessary reporting at a high standard. A well-established National System will assure long lasting quality, with increasing competence from experts. Depending on financial and legal backing of the country, this should be a team with clearly defined roles and rights, which is also important when it comes to data collection. A thorough QA/QC system that includes documentation and archiving is necessary as a foundation for continuous improvement, ensuring that the system survives changes in staff, as well as making quick and concise responses during a review process possible.

[7] Please note: „should", in the context of climate negotiations, means that an action is not required, but advised. "shall", on the other hand, means that an action is required. More information on the terminology of climate negotiations can be found here: 10148IIED.pdf

2.2 Specific situation in Armenia – The existing National System[8]

A strong National System with defined roles, functioning data flow, good quality data, a strong QA/QC system is paramount for TACCC.

The Ministry of the Environment is responsible for GHG inventory development coordination according to a Government Protocol Decision from 2016. [9] Although clear definition of roles and responsibilities of different ministries and agencies are not specified. National statistics and existing legal arrangements (with the inspectorate) ensure availability of certain activity data including ones for Energy Balance, industrial emissions, the waste, or agriculture sector, on forests and land use (LULUCF). However, there are a lot of activity data required for GHG emissions assessment which are not publicly available. The collection of the rest of the required activity data is carried out by the MoE, through official inquire to data providers, as there are no formal arrangements for collecting GHG Inventory activity data on a continuous basis. During the discussion in the workshop, it was specified that information could also be collected through the inspectorate but that software for the aggregation of data was not available.

The GHG inventory reports currently are developed by the expert group hired under UNDP-GEF funded projects and consists of experts that were engaged in the preparation of previous inventories and familiar with 2006 IPCC Guidelines and software to ensure continuity and quality of the inventory process. New experts are trained before a new inventory cycle starts and supported by lead experts. The Climate Change department of the Ministry of the Environment is the responsible department for collection of activity data as needed, and for validation of the draft NIR with key activity data providers before the publication of the NIR.

The constraining factor currently seems to be the limited financing of the responsible department in order to increase the staff of the corresponding divisions of the Ministry of Environment, and there are no budget allocations in order to outsource specific tasks to external experts or expert institutions. The budget necessary for the compilation of the BURs and the NCs (as well as the inventory) currently comes from the GEF. The other constraining factor is data availability, and unclear roles of who should collect what.

There is no QA/QC plan, even though there are several checks in place, performed by the inventory compilers and data managers, but there is no overall QA/QC plan. The establishment of a QA/QC plan would allow for data to be stored and information on how the inventory was compiled and the rationale behind it. It would improve the overall quality of the inventory and the related reports. This QA/QC system should ensure archiving, providing minimum requirements for information stored in calculation files, an archive for relevant correspondence with data providers, clear roles and chain of commands, training plans for sector experts (e.g. becoming reviewers themselves), a structured and robust system of ensuring timely and concise response to review questions (by making sure that sector experts or deputies are available, and necessary information can be accessed, even years later). This last point is also necessary for ensuring time series consistency of calculations.

Thus, the QA/QC system should be prioritized in any case, independently on whether experts are hired under GEF projects for each cycle, or are part of a fixed team.

2.3 Gap analysis and proposed steps

In order to allow for continuity and an increasing quality of inventory and reports this roadmap should aim at setting up a team (within the Ministry of the Environment or as an independent entity) with clearly defined roles and a running QA/QC system. This team could only concentrate on GHG emissions reporting,

[8] For additional information please refer to the Report "Gap analysis of the existing legal framework in the Republic of Armenia and development of a road map of approximation with the EU acquis related to climate action"

in which case, emissions of air pollutants should be estimated by a different team, but synergies should be used[10]. As approaches are quite similar, both calculations could be performed by one team, or two teams working closely with each other.

2.3.1.1.1 Measuring/Monitoring of emissions:

National System:

Above all, there needs to be detailed regulatory framework that

1) appoints a national entity responsible for the compilation of the inventories and submission of reports under the Paris Agreement's Enhanced Transparency Framework,
2) establishes procedures and principles for their preparation, and
3) assigns clear responsibilities and obligations among the government agencies as well as from the private sector to facilitate preparation of such reports through provision of data and information.

At the moment there is no fixed inventory team in Armenia, which can lead to gaps between inventory cycles and omissions in archiving the information necessary for answering potential review questions.

It is paramount that the team is supported by enabling legislation obligating other government agencies to share information and provide the data necessary for the preparation of the inventories. Such legislation should include inclusion of reporting obligations in appropriate framework laws as well as enabling executive decisions setting up the necessary procedures and addressing issues such response timelines and confidentiality concerns.

A fixed inventory team would mean that:

- Experts could improve their skills and to help their peers in improving their part of the inventory, and possibly to have two sector experts working on it.
- Data collection and surveillance of data quality is only possible, if inventory processes are understood. The more knowledge an expert has of inventory compilation and sectoral needs, the more it is possible for them to look for other data sources that might be more feasible, thus increasing the quality of the inventory and accuracy of inventory preparation.
- There would be room for improvement of the inventory between cycles, by looking for additional data sources, in order to apply higher tier methodologies for all sectors
- Stability in the team leaves room for additional trainings for team members, which will also improve answers to the review team.
- Synergies with the team reporting under the LRTAP convention could be used, which could benefit both inventories, as data very often comes from the same data providers. This would lead to more streamlined efforts, which are also beneficial in building trust and support with data providers.
- The overall quality of the inventory would be improved, as each party knows what to do.

Data collection:

There aren't any legal and contractual arrangements in place for data collection, and problems with private companies do exist. Data is provided by the Statistical Committee via the statistical yearbooks, energy balance, etc.

[10] Synergies between the air pollution database and GHG emissions reporting should be used wherever possible, which would allow for combined efforts in those areas where it is possible (e.g. industrial processes, the private sector, as it will allow cross checking on technologies applied, as well as the forestry and land use monitoring system). In any case, the air pollution team should be included in the QA/QC system.

- A legal mandate for the inventory team or the entity would allow the inventory team to access data more easily. Data collected and published by the Statistical Committee often differs to the needs of inventory compilers. Also, often information on technologies used are necessary to report using a higher tier methodology, which is necessary for so called key categories (the biggest polluters). Often, measured data is available in different plants, this information should also always be accessible to the inventory team.
- A good understanding with official data providers is important as often publication of statistical data can be used by the inventory team. This should be set in stone via a Memorandum of Understanding, or similar.

2.3.1.2 Reporting:

In Armenia's BUR2, Chapter 1, National Circumstances, the need to improve the corresponding institutional arrangements in Armenia, enabling development of the biennial update reports and national communications on a continuous basis for timely provision of information in a reliable, complete and transparent way. Several steps are mentioned as having been implemented, however, there is no description of those steps.

Report compilation, other than that of the NIR, which should be provided by the inventory team, is an important part of the requirements of the obligations vis a vis the UNFCCC. Roles need to be defined in advance, the tasks should clearly be assigned to individual experts that also get the chance to participate in trainings for report compilation. Reports undergo a review, which means that improvement of reports should also be part of the verification process.

2.3.1.3 Verification:

Verification strongly depends on the QA/QC system in place. Armenia so far has no QA/QC plan.

This QA/QC system constitutes the backbone of a national system, which means that several issues are being taken care of:

1. **Safe data storage and handling:** in order to calculate a robust inventory, sensitive data is often necessary to describe production processes, and the amount of product produced, as well as other information. Often, data providers do not feel at ease to share such data with inventory compilers. IPCC guidelines suggest possible ways of reporting sensitive data. However, in order to be able to work with sensitive data, data storage needs to be secure and in a centralized place. This concerns not just sensitive data, but all data that goes into the inventory: reviews take place years after the compilation of the NIR, and even though something seems to be clear at the time of inventory compilation, this memory tends to get lost quickly. Thus, all data that goes into the inventory, plus calculation sheets, need to be stored in an orderly manner, with calculation sheets set to read-only at the end of an inventory cycle.
2. **Documentation:** thorough documentation makes it easier to follow-up calculation processes after the end of the inventory cycle. This documentation should contain information on where data was obtained, additional information from the data providers, e.g. on unusual fluctuations, and information on recalculations. It should also contain information on emission factors (EFs) used, the rational behind applying a particular EF, or information on the emission data used. Anything that could be of use for future years, even thoughts on amelioration of calculation methodologies etc. should be written down and stored centrally. This documentation can also help to facilitate answering questions during a review.

3. Checks and improvements: there should always be a 4-eye principle involved in order to avoid mistakes, either in calculation or in reporting. Thus, sector experts should always have a counterpart, either a deputy or another expert from another sector, who basically does an internal audit of the calculations or report chapters. This is to avoid petty mistakes that lead to a multitude of recommendations or encouragements. The better the report, the more constructive review recommendations will be, because they will address a higher level of reporting. Report recommendations should then be collected in an improvement list, which allows sector experts to work on improvements of methodologies, data or approaches used between the different reporting cycle, thus improving the overall quality of the reports.

3. **Data transfer:** inventories consist of a huge amount of different data. A way should be found of compiling and storing data, and transferring it into the CRF reporter or its replacement, the common tabular format (CTF). This should be done in an organised and structured manner to avoid mistakes during transferral of data.
4. **Organisation of the team:** the team for inventory compilation should be structured, roles should be clear, and also communication to the data providers should be coordinated and concise. This means that the team should have a good understanding of processes, and their continuing training in issues close to the inventory should be ensured. QA/QC plans should be established, and performed during each and every inventory cycle, to ensure that all data is kept and can be accessed in the future.
5. **Reporting:** roles should be established for the compilation of reports, and it should be clear how responsibilities are shared, down to the layout of the report. Sectoral chapters should be cross checked by deputies or other sector experts to make sure that information in the chapters is correct and concise. As reports are the basis for reviews, this approach ensures that minimum information gets lost, which will then make future reviews easier.

The following decisions are necessary for a way forward:

1. Decision on the structure and the future of the inventory team, as described above. The National System should be mandated by law, which should provide the team with the necessary power to obtain data, even if it is confidential. This should also include the time between review cycles that should be used for improvements based on review recommendations or on achieving a higher tier methodology for key categories.
2. Nomination of experts: Nominations of sectoral experts, their roles and also their deputies. Information on the necessary trainings should also be available. Nomination of the head of the QA/QC system, and other roles should be defined.
3. Establishment of a QA/QC system: this should be written down and accessible, templates of forms and calculation sheets should be established, as well as of necessary documentation.
4. Training of experts: depending on the experience of experts involved, modular trainings can be provided. Depending on the experience, experts could start at a beginners level, and later join trainings for more advanced levels. This should include general aspects of inventory and report compilation, but also the QA/QC system.
5. Regulatory basis for access to data for inventory compilers: data collection is at the heart of each inventory. Whilst measured data on emissions (from e.g. production sites) are the best available, it is not always possible for inventory compilers to get access to data sets. Thus regulation should give inventory compilers access to data sets that might be obtained from different reporting obligations (e.g. pollution permits), or to include GHG emissions to the mandatory data for sites having to report under these obligations. In cases where no measured data is available, accurate activity data is necessary, as well as information on technical processes and possible abatement methods in place, in order to be able to apply a higher tier methodology. This information very often includes sensitive data, thus data providers often do not want to part from it. A certain level of trust can be built by providing information on a good QA/QC system, but regulatory provisions for inventory compilers can facilitate data transfer.

3 Proposed workshops

The following workshops are proposed based on the needs taken out of the questionnaire (see Annex), and address the problems mentioned above. They meant as suggestions, some building upon another, and some stand alone. The actual content of the workshops can change according to additional information that becomes available throughout the process. The workshops can be conducted on a national level or combining several countries with similar issues that are involved in the EU4Climate project.

1. National Consultation Workshop for Armenian Experts

   The aim of this online workshop in 2021 – with guidance by Environment Agency Austria under its current assignment for the EU4Climate project - is to assess the status quo and define a clear way forward. This workshop should consist of presentations of the fundamentals of inventory compilation, needed data, and the basics of a QA/QC system. Participants should be from the Agency responsible for inventory compilation, colleagues from LRTAP convention, those experts taking part at the COP; but also statistical agencies, other related ministries and agencies (working on other issues, like the IED directive etc), data providers (where necessary), Ozone Unit etc. After the presentations it should contain breakout rooms where problems should be discussed and then brought forward. The outcome of this workshop could be a refined RoadMap, containing ideas for future workshops and a list of skills and things still needed for the establishment of a National System.

The following workshops should be part of a MRV RoadMap, but might be outside the scope of the EU4Climate Project:

2. Workshop topic – methods for GHG estimation (could be done with sector experts from all involved countries)

Based on the findings of workshop 1, preparation of targeted trainings with inventory experts. This should be a modular approach per sector, starting on beginners level and also offering one for more advanced sector experts. Aim: inventory compilers are able to compile future inventories, and also be able to apply higher tier methodologies, should better data become available

- Sectoral workshops on GHG estimation
- Available data, data gaps, and reaching out to data providers
- Time series consistency and splicing techniques
- Writing of a NIR chapter
- Review of a NIR chapter of another sector and vice versa, in order to start understanding review processes and necessary contend.
- Working with the Common reporting tables (CTR) and the CRF reporter
- Review suggestions: discussion of a way forward.

Workshops on data availability (on a national level, however, the IPPU – Ozone Unit discussion could be done for all countries at the same time) and synergies with other reporting systems: whatever issue of synergies between CLRTAP and UNFCCC could not be discussed in the first workshop, this should be discussed here, on a sectoral basis, in case problems persist. Otherwise, this should aim at Ozone Units and IPPU experts, in order to define gaps and assess the availability of data on the use of F-gases, as those are usually difficult for sector experts to get access to.

- Synergies in activity data – what is there, what is needed, who gets what?
- Definition on gaps, decision on moving forward in getting data that is necessary.
- Are there country specific emission factors and parameters available? If yes, additional information for the others could be available
- Is information on underlying technologies available? In both conventions, this information can be used for applying tier 2 EFs.

- Additional workshops depending on sectors, depending on necessity
- Special workshop with Ozone Unit and IPPU sector experts, in order to define gaps, and assess availability of data.

3. Elements of a QA/QC and verification System (international):

The outcome should be a centralised QA/QC system, where data is securely and safely stored, and all information is available. This can be done in workshops for all interested countries, with a final workshop on a national basis, in order to allow for an adaption of necessary tools to the national circumstances.
For the following processes, methodologies will have to be worked out, and put together in a QA/QC handbook that is the basis for a QA/QC system:

- Collection of activity data, selection of emission factors and methods, determination of emission data;
- identification of key categories;
- recalculation of emission data;
- quality management (quality objectives, quality control, quality assurance);
- (internal and external) verification of emission data;
- handling of confidential data
- data storage and management

(1) The need for a QA/QC system
Establishment of a basic QA/QC system with all involved experts, also for those working on the LRTAP convention, definition of necessary tools and internal auditing processes. This will have to go hand in hand with preconceived definitions of roles and responsibilities, and the preconceived structure of the QA/QC system. This also includes a training manual for new staff and handover procedures in case of experts leaving.

(2) Tools of a QA/QC system: this needs to involve data storage, documentation of work steps, conservation of calculation files, etc.

(3) Workshop topic - Preparation of "country specific" checklists –general quality control procedures after the trainings on sector specific calculation methods
- Preparation of country specific (tailor-made) checklists category specific quality control procedures
- tailor-made for each sector / category

ANNEX: Armenia - Questionnaire on National Inventory System as a basis for gap analysis

Question	Answer by Armenia	Open questions – for discussion at the workshop
National GHG Inventory System		
1. Is a single national entity with overall responsibility for the national inventory designated? If yes, what is the name of the institution and what is the legal basis? If not, please explain how the national system works in your country.	Ministry of Environment is responsible for GHG Inventory development coordination according to the Government Protocol Decision #49, from 08.12.2016	
2. Is the single national entity also responsible for QA/QC and reporting?	Ministry of Environment, is authorized agency for UNFCCC commitments implementation coordination in Government of Armenia	
3. Are roles and responsibilities in the inventory preparation, QA/QC and reporting process defined? This definition shall specify the roles of, and cooperation between, government agencies and other entities involved in the preparation of the inventory, as well as the institutional, legal and procedural arrangements made to prepare the inventory.	The said roles and responsibilities are included in the Organizational Charts presented in NIR and BUR2 [BUR2, p27, NIR2014 Ch1.1.3] and also set forth in the Government Decree #49, from 08.12.2016, see answer # 1 However, the roles and responsibilities of different ministries and agencies are not specified through any regulatory document related GHG Inventory preparation. There are legal arrangements for activity data collection on regular and continuous nature, e.g. development of Energy Balance, data collection and reporting for monopoly utility services under Public Services Regulatory Commission delegated functions, reporting of private sector on emissions of polluting and hazardous substances and effluents to water objects under Air Protection Law and Water Code , as well as reporting and publication of the Statistical Committee – in accordance with the law of the Republic of Armenia "On the Official Statistics" and "On the State Governance System Bodies" and with "Statistics Program for 2020" of the Statistical Committee.	What are the problems with data collection (accessibility? Data formats? Is specific data lacking?) and how can it be solved?

Question	Answer by Armenia	Open questions – for discussion at the workshop
4. ~ Does an inventory compilation team exist? Or are new consultants contracted for each reporting year? Please describe the set-up, whichever is the case.	GHG inventory expert group is hired under UNDP-GEF funded project. The team is formed with the involvement of experts engaged in the preparation of the previous inventories, who are familiar with 2006 IPCC Guidelines and software trying to keep "professional memory" and ensure continuity and quality of the assessment process. All experts pass introductory training before each (biennial) cycle of GHG preparation. The new experts also are involved after appropriate instruction and provision of all reference and background documents, guidelines, etc.	Is status quo to be kept? Can this process be ameliorated? What are the advantages and disadvantages of this way forward?
5. ~ Are emission inventories for GHG estimated within the same team or project as the emission inventory for air pollutant?	The former focal point of LRTAP convention is involved in expert team for IPPU sector. The Inventory team closely cooperate with corresponding division of the Ministry of Environment.	
6. ~ Who is currently in charge of the Inventory Management? Is this the same person for subsequent years, or is someone new nominated for each inventory round?	The Inventory preparation currently is done in the frames of the UNDP-GEF project. The same Task Leader managed the development of 2012, 2014, 2016 Inventories (and currently is coordinating the work with preparation of NIR2017) .	Is status quo to be kept? Can this process be ameliorated? What are the advantages and disadvantages of this way forward?
7. ~ Are the legal and contractual arrangements in place sufficient to collect data and information needed for inventory preparation? In other words: does obtaining data work in your country, or do you have problems in getting data? Please identify those sectors where this is working well, and those, where problems are occurring.	The main activity data necessary for the Inventory preparation are collected and mostly reported in National Statistical Yearbooks, Energy Balance, published by the Public Services Regulatory Commission. The rest is collected by the Ministry of Environment through enquire send to data owners (Ministry of Economy, Statistical Committee for not publicly available information, State Revenue Committee, private sector). There certain problems with some private companies.	What are the problems with private companies, and how can this be solved?

Question	Answer by Armenia	Open questions – for discussion at the workshop
8. ~ Does the inventory agency (single national entity) have a good understanding with the national agency for statistics? Does the inventory team obtain data from them? Is the statistical agency ready to provide data in a way the inventory team can use them?	The Ministry closely cooperates with the Statistical Committee, especially on exchange of data.	Is statistical data available in a format that helps inventory compilers? Are there certain thresholds that might lower activity data? Is data complete and accessible, or is more Information needed (e.g. by disaggregating information)
9. ~ Which institution/department is responsible for the preparation of your BUR, NC (and NIR, if stand alone report).	Till 2020 it was Climate Change and Air Protection Policy Division under Environmental Policy Department of the Ministry of Environment. After structural changes in the Ministry of Environment, the UNFCCC related policy issues are delegated to the Climate Change department.	Was continuity (i.e. same experts in a different department) ensured, or did an official transfer of information take place? Is sufficient staff available?
10.~ Is there a plan on how any national system will transition into the Enhanced Transparency Framework from 2024 onwards? If yes, please provide information on this plan.	Ministry of Environment has applied for financial support to GEF under Capacity Building for Initiative for Transparency window. Under that project it is planned to ensure legal regulatory and institutional capacity building for proper reporting under Paris Agreement Article 13.	Please provide more information before the workshop.
11.~ In case of an encountered problem, what is the chain of command, and who is responsible for whom in order to find a solution for that problem?	The relevant department mentioned # 9 on behalf of the Ministry of Environment and UNFCCC Focal Point.	
12.~ What is, in your view, the most crucial improvements needed to establish a functioning national inventory system?	There are no legal obstacles as the regular reporting and GHG inventory development requirement is envisaged by the Government decree #49, form 09.12.2016. However, the main obstacles are: considering limited financing for increasing the staff of corresponding division of the Ministry of	In order to come up with a concise list of needed improvements, this should be at the heart of the discussion

Question	Answer by Armenia	Open questions – for discussion at the workshop
	Environment and no budget allocations for outsourcing specific task under GHG inventory preparation to external experts or professional institutions. The GHG Inventory preparation and reporting under UNFCCC still needs financial assistance from the Convention financial mechanism – GEF. Development of the legal document which will clearly define roles and responsibilities of key institutions, proper timeline/cycle for GHG inventory preparation. It will be necessary to define department/division in each stakeholder ministry/agency and nominate focal person for certain area of GHG Inventory preparation, including data provision, QA/QC etc.	of the workshop.
ELEMENTS OF A QA/QC AND VERIFICATION SYSTEM		
13.Is a person responsible for coordinating QA/QC activities designated?	QC was done by the inventory sector responsible expert in close cooperation with Data manager, followed by the GHG Inventory Task leader review. QC check includes internal review of the draft NIR by the Ministry of Environment and by the working group of the Inter-agency Council. The internally cleared NIR is submitted for the review and comments to the stakeholder ministries and companies and is uploaded on the Ministry web-site for public comments. All received comments are thoroughly reviewed and addressed in the final version of the NIR.	
14.Is there a QA/QC plan?	No, there is no plan.	What should/could such a plan entail?
15.Are general quality control procedures that apply to all inventory categories and the national total estimates in place?	General inventory QC checks included routine check of the integrity, correctness and completeness of the data, as well as identification of errors. This was done by the sectoral experts and data manager.	

Question	Answer by Armenia	Open questions – for discussion at the workshop
16. Are category specific quality control procedures in place and documented (performed by the inventory experts during inventory preparation)?	Category-specific QC checks including technical reviews of the source categories, activity data, emission factors and methods were applied on a case-by-case basis focusing on key categories and on categories where significant methodological and data revision have taken place. This was done by the sectoral experts and task lead expert.	
17. Are quality assurance and review procedures, e.g. a peer review prior submission, in place and documented?	The QA reviews are performed after the implementation of QC procedures for the finalized NIR. The QA review was performed for 3 GHG Inventory reports (2010, 2012, 2014) by the external international expert. The expert was involved due to the support of the Global Support Program.	
18. Are verification activities planned/undertaken and documented?	The verification of the finalized NIR is done by the Inter-agency Coordinating Council. After which the NIR is considered as final for submission to UNFCCC and publication on the Ministry of Environment and www.nature-ic.am web-sites.	
19. Is there a procedure for official approvement before submission?	see answer above, #18	
20. Are reporting, documentation and archiving procedures defined?	They are described in the NIR, however they do not constitute a formally defined protocol.	
21. Is a list of terms, definitions and abbreviations available?	Yes	
22. Is the QA/QC system following or in line with international standards or comparable requirements?	All the necessary quality control procedures for all subcategories were implemented in compliance with Chapter 6 "Quality Control/Quality Assurance and Verification", Volume 1 "General Instructions and Reporting" of 2006 IPCC Guidelines.	

Question	Answer by Armenia	Open questions – for discussion at the workshop
23. Is the QA/QC system audited in any way, and if yes, following which procedures?	An example of such type of audit is the QA/QC workshop organized by UNFCCC in November 4-8, 2019 in Armenia and summary recommendation report submitted to the Ministry of Environment.	
24. How well are your inventory estimations documented? If one expert leaves, and another one takes over, would expert no.2 be able to understand methods and data sources of his or her predecessor?	Armenia submits stand-alone National Inventory Report along with BUR1 and BUR2, which describes all used methods, data sources and thus any predecessor expert has well documented information in his disposal. Obviously, also knowledge stays with task leader expert and data manager.	
25. Is any feedback on the national GHG inventory such as complaints and appeals from national players or issues raised during the review process documented? Are procedures for this inventory improvement process defined and is the outcome documented?	See answers #13 and #18	
26. Do these issues - if justified - trigger improvements of the GHG inventory? Who has the responsibility to define, implement and document the measures?	The comments received to the draft NIR are considered, the relevant changes are adopted as needed, otherwise, a proper justification is provided, and all the amendments are documented in summary table, which is archived in the Ministry of Environment.	
27. Please provide information on any potential improvement that you think are especially important.	Establishment of institutional arrangements enabling activity data collection in continuous manner. Continuous training of the key nominated specialists of the corresponding ministries and agencies, recognition of their work through certain encouragement mechanism. Establish roster of national experts and institutions for outsourcing certain work under GHG Inventory with responsibility on confidentiality of information they can access during Inventory preparation.	

Question	Answer by Armenia	Open questions – for discussion at the workshop
Resources (Personnel and facilities and equipment) and resource planning		
28. Are sufficient resources (personal / time) available/allocated for the(a) preparation of the emission inventory, (b) performing/conducting QA/QC activities and implementing appropriate measure and (c) the preparation of reports?	See answer #6	
29. Are roles within the inventory team c (e.g. quality manager, inventory expert, data manager)? Can you provide an organisational chart to describe the hierarchical structure within the inventory team?	The organizational chart is reported in the NIR2014 and in NC4, although there is no chart on roles within the team.	Why is this? Could/should this be ameliorated?
30. Are duties, responsibilities and authorizes of the different roles defined? Can you provide a responsibility matrix for the different steps in inventory preparation?	The ToRs for each expert involved in the Inventory preparation clearly define the role and responsibility for certain task.	
31. Has the personnel involved in inventory preparation adequate education, training, skills and experience and where is this documented (e.g. personal file, CV)?	The experts are selected for GHG inventory preparation according to their education, experience and evaluation of their performance (if they are previously involved in GHG inventory development).	
32. Is a fallback option defined in the case of sudden and unexpected absence of personnel, e.g. such as designation of deputies?	There is a roster of experts involved in the GHG Inventory preparation and consistent effort is in place to involve young specialists from universities.	
33. How is it ensured that the personnel / inventory team is informed about the latest updates / versions of the guidelines, reporting requirements etc.?	The UNFCCC Focal point is sharing all the information received from the Secretariat with the BUR/NC development team.	

Question	Answer by Armenia	Open questions – for discussion at the workshop
34. Is it ensured that the personnel responsible for inventory preparation, QA/QC and reporting is free from any commercial, financial and other pressures that might influence their technical judgment?	This issue is not observed considering that GHG Inventory development team has no commercial or financial interest in any aspects related to the GHG Inventory data. However for future it must be taken in consideration; see answer #27.	
35. In order to ensure the planning, preparation and management of the emission inventory in a timely and professional manner are all technical resources necessary (personal computers and supporting IT infrastructure (providing data security and a backup system) provided and maintained?	Yes, relying on the effort under the UNDP-GEF project to allocate the necessary equipment, backup system, data archiving on server, and save those on a separate hardware, as detailed in new NIR2017. All the data are incorporated in the IPCC software, which is back-upped.	
36. What kind of data integrity and security measures are taken by the National Inventory Compiler and each member of the inventory team?	The database manager archives the files on the hard drive as well as on an external memory support, while also ensures automatic data backup in the Google Drive cloud.	
37. Is there an annual process for resource planning, e.g. in the process of an annual management review?	See answer #6	
Subcontracting	**See answer #6**	
38. Are parts of the inventory contracted out/prepared by someone not within the inventory team?		
39. If yes, are quality procedures describing the process for contracting out studies in place?		
40. If yes, how is ensured that the quality objectives and the requirements for the preparation of emission inventories are followed by the subcontractor?		

Question	Answer by Armenia	Open questions – for discussion at the workshop
41. If yes, is there a procedure regarding the handling with confidential data?		
42. If yes, is a procedure defined regarding the handling of results and reports (ownership/publication)?		
Contacts for further questions:		
43. All questions are necessary for tier 1 of our gap analysis. Depending on your answers, we might have to ask further questions. Could you please provide names and contact detail of the following roles, and information, whether we can contact them directly for an interview, or if those questions should be sent to the UNDP coordinator?		
44.Head of Inventory Team	**Marina Sargsyan, marinasargsyan@mail.ru**	
45.QA/QC responsible		
46.**Responsible for reporting on BURs and NCs under UNDP projects**	**Diana Harutyunyan,** diana.harutyunyan@undp.org	
47.Responsible for reporting in MoE	**Nona Budoyan head of Climate Change Department nona.budoyan@env.am**	