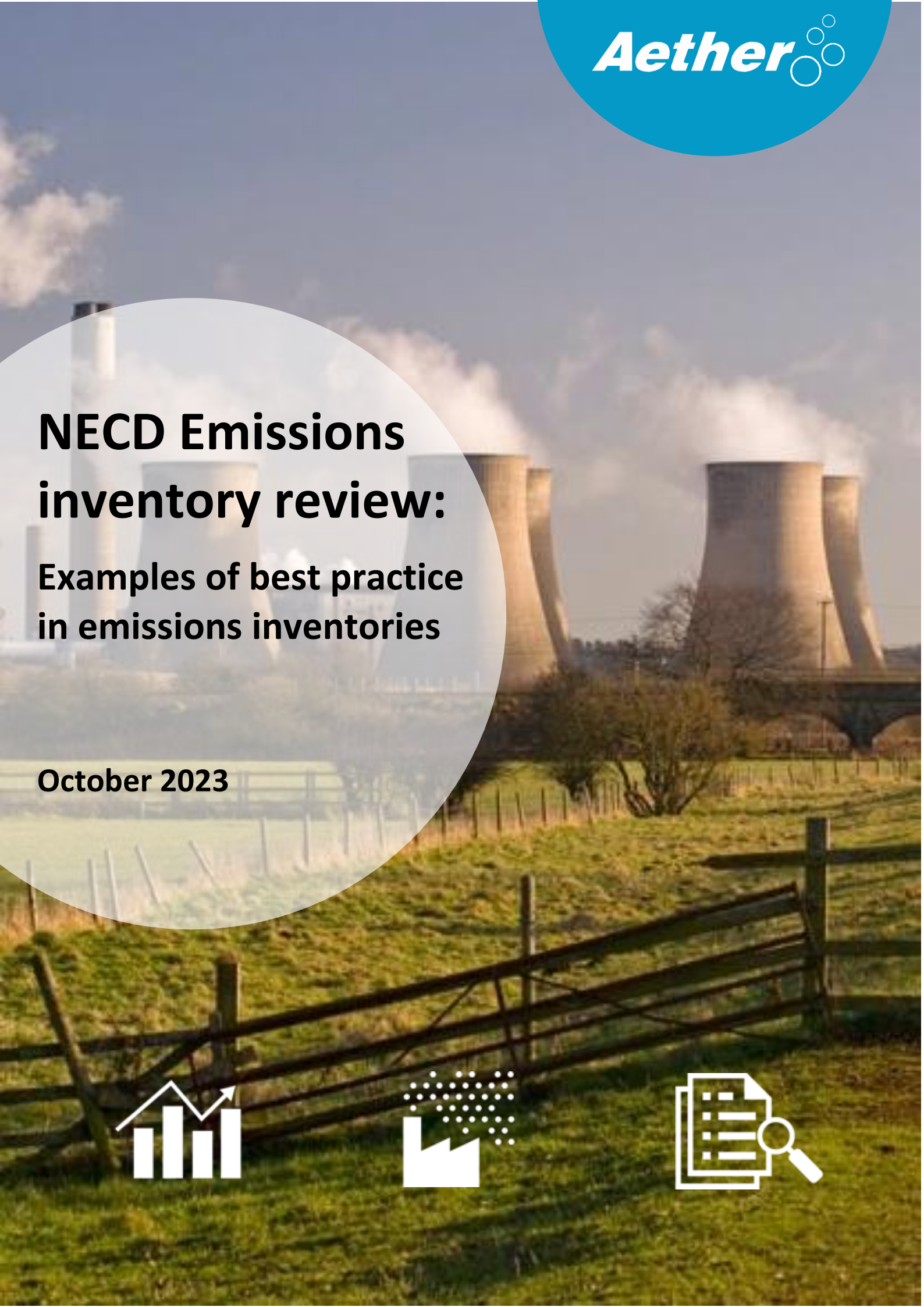

NECD Emissions inventory review:

Examples of best practice in emissions inventories

October 2023

Executive Summary

A substantial amount of information is gained by the emissions inventory review team each year on the quality of the different Member States´ (MS) submissions under the National Emission reduction Commitments Directive (NECD). Thus far there has not been a simple way of compiling and communicating examples of best practices that could help the MS with their emissions inventory improvement activities. This report presents information on best practice in emissions inventories and reporting under the NECD with the aim of sharing this information across the MS.

Some key messages from this report include the following:

1A Stationary combustion: Austria and Estonia provide comprehensive and transparent information in their IIRs.

1A3b Road transport: The long-term funding of the COPERT model has been successful in that the majority of MS are considered to have good quality road transport emission estimates in their inventories.

1A3d Shipping - Maritime and Inland Waterways: There remain some significant challenges for the MS, associated with sourcing activity data for these sources. However, a new proxy solution is available for use until a longer-term solution becomes available.

2 IPPU: Denmark, Finland, France, the Netherlands, and Sweden are considered to have more sophisticated inventories than other MS, and **Austria** presents information in the IIR in a particularly transparent way, as do **Estonia, Hungary, Latvia, and Romania**. On the other hand, there continues to be the need to further develop the guidance provided in the EMEP/EEA Air Pollutant Emission Inventory Guidebook as well as to update some obsolete emission factors.

2A5a Quarrying and mining: The tier 2 methodology in the EMEP/EEA Guidebook is arguably a tier 3, and is not extensively used by MS because they do not have the required input data readily available. A proxy solution has been proposed for an approach considered to be closer to a tier 2 methodology, which is more accessible. However, further work is needed before inclusion in the EMEP/EEA Guidebook.

3 Agriculture: France provides detailed data reporting in their IIR, **Czechia** use Excel appendices to provide comprehensive data for agriculture calculations, and **Lithuania** provided the N-flow tool Excel calculation file to support transparency. A tier 1 methodology is used for NOx emissions from agricultural soils by almost all MS, because currently no tier 2 method exists in the EMEP/EEA Guidebook.

3F Field burning: Most MS report this as “not occurring” because the practise is banned. However, satellite data may provide improved estimates in the future.

5C2 Open burning of waste: The EMEP/EEA does not have a methodology for this, which is an omission that needs to be addressed.

IIRs and transparency: A lack of sufficient detail in IIRs is the most common transparency issue identified during the NECD emissions inventory reviews and is likely to be a focal point for MS considering improvement activities. **Austria and Denmark** are stand-out examples of high quality IIRs. There are efficient ways of updating and

managing the content of IIRs, but these practices are not yet widely shared. **Germany and France** use innovative approaches to compiling information that may be of interest to some MS.

Accuracy: The use of tier 1 methodologies for estimating emissions from key sources has significantly reduced in recent years but does still exist in several MS´ submissions. Many MS do not report an uncertainty analysis, and therefore do not have information that helps to prioritise improvement activities.

Completeness: Only a limited number of isolated completeness issues remain. These can arise from MS having either inadequate resources or a lack of data, or insufficient guidance in the EMEP/EEA Guidebook for specific sources.

Consistency and Comparability: Consistency is generally of a good standard across the MS, and comparability is rarely an issue.

Working with limited resources: Informal discussions with national inventory teams suggest that some are severely impacted by insufficient resources and that this impacts on the quality of their submission. However most do not invest any significant time to sourcing additional funding, and there are likely to be some options that could help to address existing shortfalls in available resources which are worth exploring.

More details are provided in the Chapters of this report.

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Author(s)	Chris Dore
Reviewed by	Sabine Schindlbacher, Kristina Saarinen
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Contents

1 Introduction

1.1 Aim, purpose, scope of this report

The project team undertaking the technical review of the National Emission reduction Commitments Directive (NECD) inventories for the European Commission are uniquely well-placed to comment on the quality of EU MS´ submissions, and this knowledge is used to identify areas for improvement and make recommendations to the MS as part of the review process. The inventory review project team also identifies examples of best practice. This report has been prepared with the aim of presenting information on best practice in emissions inventories compilation and reporting under the NECD, as well as proposed solutions to recurring issues, for use by MS' emission inventory teams.

1.2 Structure of this report

Chapter 2 of this report highlights examples of best practice, with the aim of efficiently directing MS to reference material that they may be able to use in improving their emissions inventory systems. These examples also provide good context for national inventory teams to understand how the quality of their outputs compare with other MS.

Chapter 3 presents cross-cutting and sector specific recurring issues, as well as some potential solutions to the more common recurring issues. Some of the solutions are things that can be implemented by individual MS, but others would need action at a higher, or more cross-cutting, level.

Chapter 4 explains the extent to which proxy solutions were used in the 2023 inventory review. A proxy solution for estimating emissions from *2A5a Quarrying and Mining* has been included as an Appendix.

Chapter 5 briefly considers some of the resource challenges that national inventory teams face and provides some suggestions for working within budget constraints.

Chapter 6 provides some concluding observations on the content of Chapters 1-5.

2 Examples of best practice

2.1 Approach/Methodology

The sector experts and lead reviewers in the 2023 NECD emissions inventory review teams gathered a large amount of information on the quality of the NECD submissions from individual MS during the review process. In addition to providing recommendations in the MS review reports on improvement needs, it was decided to share with the MS some examples of best practice in other MS´ reporting.

The authors also drew on their experience of working with the MS on numerous support projects and their involvement in the TFEIP (Task Force on Emission Inventories and Projections), providing insight into the challenges that MS´ inventory compilers face, and the ways in which effective solutions can be delivered.

2.2 Examples of best practice methodologies: road transport and IPPU

An overview of information provided by sector experts and lead reviewers on best practice methodologies is presented below. The section that follows provides information relating to IIRs and transparency.

Road transport

There were no MS submissions which stood out as being exceptional, but this is primarily because across the MS there is extensive use of the COPERT model, which delivers accurate emission estimates and is considered to be good practice.

However, in recent years, an increasing number of MS have been additionally using data from the Handbook of Emission Factors for Road Transport[1] (HBEFA), and it is sensible for MS to familiarise themselves with the information available from HBEFA to assess whether this provides improvements compared to the use of COPERT alone.

The transparency of reporting of road transport emissions inventories is considerably more variable than the accuracy.

IPPU (Industrial Processes and Solvent Use)

The IPPU sector is the most variable in quality across the MS. From informal discussions with the MS and interpreting information on the quality of the national inventories, the emissions inventory of category *2D3a Domestic solvent use including fungicides* in particular is considered to be one of the sources that MS find most difficult to estimate accurately.

Denmark, Finland, France, the Netherlands, and Sweden are all considered to have more sophisticated IPPU emission estimates than other MS, and it is noteworthy that the **French** inventory is the basis for much of the content of the EMEP/EEA Air Pollutant Emission Inventory Guidebook[2] (EMEP/EEA Guidebook).

[1] https://www.hbefa.net/

[2] https://www.eea.europa.eu/publications/emep-eea-guidebook-2019

Activity data: However, sharing information on the high-quality emission inventories may not significantly support other MS in delivering improvements. This is because the limiting factor for making high quality emission estimates from IPPU sources is usually the availability of detailed activity data. For example, **the EU Nordic countries** (Denmark, Finland and Sweden) have a national "Product Registry" that is unique to the country and provides very valuable sources of data concerning the downstream uses of chemical substances in products on the national markets. This allows their national inventory teams to compile their inventories in more detail and accuracy. In cases where details from the national Product Register are not available or are insufficient, the inventory team cooperates with registers maintained by trade and industrial associations and carry out own regular surveys.

Nevertheless, many MS would benefit from reviewing the information available from the high quality emissions inventories, and considering how this could be applied to their own national circumstances. This might require some bilateral meetings between MS[3].

Facility-level data: There are other sources of data which are helpful to consider. For example, all MS have a national and/or local reporting system for emissions from facilities, and this allows the inventories to include plant specific estimates i.e., a tier 3 methodology. However, there may be cases where it is not possible for the inventory team to undertake quality checks on data reported by a facility. In these cases, cooperation with supervising authorities and directly with the plant operators can be used to address data gaps and possible errors.

Industry associations and ESIG: For some activities, national industry associations provide an input into the national inventories, but the data provided are typically confidential and cannot be shared with other MS to provide valuable insights. The extent to which industry associations provide data into national inventories varies considerably across the MS, and it is certainly sensible for a national inventory team reviewing their improvement options to consider whether this could be a source of additional country specific information.

In cases where the inventory uses CN and/or PRODCOM codes, it can be challenging to allocate data to the correct code(s) and product groups that correspond to *2D3a Domestic solvent use*, even if detailed emissions inventory data is available.

If no national data sources are available, it is worth considering the data from ESIG (European Solvent Industries Group). ESIG provide MS specific emission estimates that are calculated from their own activity data. However, the activity data is confidential and thus cannot be compared with national statistics or plant data of individual MS. According to ESIG, the emission calculations use the methodology in the EMEP/EEA Guidebook.

[3] Which can be supported by the European Commission through the TAIEX-EIR Peer 2 Peer tool.

2.3 Examples of best practice IIRs and transparency

2.3.1 Consistently high quality IIRs

There are several countries with particularly high quality IIRs, both in terms of completeness and transparency. **Austria and Denmark** are stand-out examples, but other MS also have specific sections which are noted to be examples of good practice.

National inventory teams wishing to address transparency issues would benefit from making the time to review the content and the level of details provided in IIRs from other MS. Whilst it is recognised that some MS are very constrained in the resources they have available for drafting the annual IIR submissions, there are several steps which can be taken to minimise the resources that are needed, in order to deliver high quality and transparent IIRs efficiently. These aspects are considered in the section below.

2.3.2 Updating IIRs

Updating IIRs each year is time consuming. However, carefully designing the structure and content of the IIR can reduce the burden significantly.

For example, IIR chapters can easily be structured so that sections of the text that do not change year to year are grouped together as “timeless text”, and therefore the main requirements of yearly revisions are focused on updating data tables and any relevant methodology descriptions, with other sections only requiring review every several years. Even the process of pasting new tables into a report can be automated, although this is a rather specialist undertaking. However, automatically generating tables in e.g., Microsoft Excel format from the latest inventory datasets can be directly pasted into the IIR. Similarly, having a clear way of logging which tables do or do not require updating in a given year is a way of managing the time spent on the report.

It has been recognised that providing guidance in updating IIRs could help many MS and the TFEIP could consider holding a workshop or drafting some informal guidance on this.

It is important for national inventory teams to recognise their resource limitations and clearly explain the reasons for the need of additional resources to the relevant governmental representatives.

Experience shows that IIRs from most MS do not steadily improve but develop in “step-changes”. To explain this, it is helpful to consider two slightly different activities relating to the IIR compilation and improvement:

- **Routine annual updates:** There will always be a certain amount of effort needed to update the IIR each year, even if processes are highly efficient and streamlined. However, this is insufficient in the long-term.

- **IIR improvements:** Periodically IIRs require significant updates to reflect the development of the emissions inventory, or to improve the processes used for compiling the report. For example, if the inventory team undertake an uncertainty assessment for the first time or improve a propagation of errors approach to additionally undertake a Monte-Carlo uncertainty analysis, it is very easy to focus on undertaking the work, and overlook the resources needed for updating the reporting in the IIR.

Consistency and QA/QC

A not uncommon issue is inconsistent reporting between the data included in the methodology description provided in the IIR and the data reported in the NFR tables. This is typically caused by the MS not updating data in the IIR in line with updated data used in the emissions calculations. As noted above, organising the IIR so that data are e.g., in tables rather than embedded in sentences makes it much easier to automate IIR updates and ensure the completeness of the updating process.

Many MS do not have a clear way of managing and checking the IIR update process and would benefit from strengthening associated QA/QC activities.

2.3.3 Alternative approaches to compiling an IIR

There are alternative approaches to the traditional stand-alone IIR report for providing information that supports the NECD emissions inventory data submission.

Germany maintains a "wiki" which acts as a central storage location for very detailed methodology descriptions. The primary aim is to provide detailed and easily editable information for the in-house uses of the emissions inventory team. However, the wiki platform and content are set up in a way that allows ready export of information that can be used to quickly populate an IIR. The wiki is available here:

https://iir.umweltbundesamt.de/

The German team note that this approach to holding methodological details has been particularly effective and is especially good at protecting institutional knowledge should there be significant turnover of staff. Furthermore, they note that setting up a wiki does not require extensive or detailed IT knowledge. But it is a different way of working, and some teams may take time to adapt to this.

The **French** inventory team maintain an on-line system called OMINEA, and information can be obtained here:

https://www.citepa.org/fr/ominea/

This is not a wiki but acts in a broadly similar way to the German system. However, the French system additionally includes data handling, and delivers to both air quality and climate change reporting requirements. This is an example of a well-designed integrated system, and other MS could benefit from investing in something similar. However, it would be a large undertaking to set up and maintain a similar system, and it would require extensive IT skills and knowledge.

The links above provide access to parts of both the German and French systems. National inventory teams that are interested in the platforms being used, the time required for information management, and the resulting benefits etc. would need to approach the French and German teams directly and ask whether they are able to provide more detailed information.

2.3.4 Sector specific observations on transparency

The following sections provide some pointers for those wishing to quickly refer to technical sections of the IIR that are considered to be presented with a good level of transparency. In general, this is determined by the level of detail that is included in the

IIRs, and particularly the extent to which data, as well as methodologies, are included in the IIRs.

Stationary combustion: For the stationary combustion sector, **Austria and Estonia** both provide comprehensive and transparent information, and are particularly good examples of good practice that other countries may wish to learn from.

Road transport: Road transport is usually one of the longest chapters in the IIRs, because explanations need to be provided in some detail due to its higher complexity and importance compared to other transport subsectors, i.e., it has more vehicle types, fuels, euro standards, driving conditions, etc. Many IIRs are considered to provide a good level of transparency.

IPPU (excluding solvent use): Austria is an example of a MS that provides extensive details, particularly on the generation and use of country-specific emission factors. However, there are several other countries that provide clear and consistent descriptions of emission estimates, activity data and emission factors, including Estonia, Hungary, Latvia, and Romania.

Solvent use: Many MS have transparency issues with the solvent use sector. This can arise due to not reporting information on the division of point sources vs. diffuse sources, or limited reporting of activity data due to commercial confidentiality restrictions. However, **Denmark, Finland, France, the Netherlands, and Sweden** have good reporting in their IIRs.

Agriculture: For agriculture, MS take a variety of approaches in reporting the methodologies and accompanying data. Some include a large amount of information in the IIR chapter, others include most data tables in appendices, and some refer extensively to information in other reports. Examples of different approaches include the following:

- The **French** IIR is considered excellent for agriculture. It includes the activity data sources, methodology, emission factors and other parameters very comprehensively. Reasons for recalculations are also well documented, both within the agriculture chapter and in the Recalculations chapter.

- Some IIRs, a good example being **Czechia**, use Excel appendices to provide most or all the key activity data and parameters used for agriculture calculations, such as N excretion, VS excretion, manure management splits and documentation of abatement calculations. This is particularly convenient format for supporting both the review process or a compiler from another MS wishing to use the available information for their own purposes.

- **Lithuania** provides the N-flow tool Excel calculation file (where tier 2 has been used) as an annex to the IIR. This provides an excellent level of transparency as it allows the "reader" direct and easy access to the calculations as well as the activity data and emission factors. It also supports the review process by making it considerably easier to identify errors compared to IIRs that include simple data tables. This approach provides better transparency than many countries using more sophisticated tier 3 models, which can often be presented in a rather intransparent way in the IIRs.

All approaches presented above are good examples that inventory teams can learn from, and copy whichever approach is most suited to their own national circumstances. As a general principle, instead or referring in the IIR to national reports that are difficult to obtain, the relevant texts should be included directly in the IIR, and the references should only be needed to transparently document information sources.

3 Recurring issues

3.1 Recurring quality issues

The following sections reflect the high-level views of key individuals who have been involved in the NECD inventory reviews since they started.

Transparency
A lack of transparency remains one of the issues that most limits the review process. It is noteworthy that the IIRs that are consistently assessed as being of good quality are not only extensive, but many also provide direct access to Excel tables, either on-line or as report Annexes.

A key take-away message is that transparency issues are typically associated with a limited or complete lack of information being provided in the IIR. The IIR needs to provide sufficient documentation relating to the sources and the emission estimates to enable verification, and even allow the emissions inventory review team to replicate the calculations used to determine the emissions estimates.

Accuracy
Tier 1 and tier 2 methodologies: The occurrences of tier 1 methodologies being used for key sources has decreased across recent years. There are still some occurrences, but these are now relatively isolated instances. This is a reflection of improvements made to the EMEP/EEA Guidebook as well as the success of the inventory reviews and the supporting work of both the inventory review team and the MS.

Uncertainty analyses: Many MS continue to not report an uncertainty analysis. This is a key tool in interpreting the emissions inventory outputs as well as steering improvement activities. The barrier is thought to be associated with the MS´ resources/prioritisation rather than a lack of good guidance material.

Completeness
There have in the past been some recurring completeness issues, but the majority of these have been addressed. Some isolated cases remain and are identified each year during the review. A lack of completeness can arise from either inadequate resources for identifying relevant existing emission sources in the country, a lack of data for estimating emissions from existing sources, or insufficient or unclear guidance presented in the EMEP/EEA Guidebook. The respective MS will need to work on addressing issues that arise from a lack of resources and/or data. Proxy solutions have been developed to overcome shortcomings of the EMEP/EEA Guidebook, and these are considered in chapter 4 below.

Consistency and Comparability
Consistency is generally of a good standard across the MS, and where issues arise, they are typically isolated errors, such as transcription errors, which are then corrected in future reporting.

Comparability is rarely an issue, with common definitions and reporting structures being used across all MS.

3.2 Recurring issues by source sector

For the preparation of this report, information was gathered from the current review teams on recurring quality issues and recommendations from the 2023 NECD inventory review were analysed for detailed issues common to several MS, originating in any year from 2017 to 2020 (and have therefore been "live" for at least three years). These are considered to be recurring issues that are relevant for several MS, and an assessment of these issues is included here.

Whilst a large number of recurring issues were addressed and therefore closed in the 2023 review, some noteworthy issues remain. Consideration is also given to recent successes in addressing recurring issues.

Stationary Combustion
Most recurring issues arising are isolated cases and are associated with MS that have general challenges with reporting good quality emissions data, either because input datasets are limited and/or they are resource constrained.

Shipping - Maritime and Inland Waterways
Both the analysis of the EMRT contents and sector experts identified *1A3di(ii) International inland waterways* and *1A3di(i) International maritime navigation* (Memo Item) as source sectors which some MS have continued challenges with. Some MS are not able to resolve emissions into the individual NFR source sectors, and others are using very simple methodologies. Challenges in estimating emissions from *1A3di(ii) International inland waterways* can be associated with cross-border issues - for example, the Danube River runs across several Member States.

A proxy solution was used for these sources to solve reporting shortcomings for two countries in this year's inventory review for the first time (detailed in Chapter 4). However, in the longer term there is a need to provide MS with guidance on:

- How/where to source activity data for relevant sources;
- How to separate out activity between *1A3di(ii) International inland waterways* and *1A3di(i) International maritime navigation* (Memo Item), and more generally;
- How to estimate and report emissions from these sectors.

The TFEIP has been informed of this need and will consider if/when it might be possible to compile and circulate improved guidance. This might be achieved by reviewing the extent to which existing approaches in some MS could be replicated in others.

Resolving, i.e. reporting separately, industrial combustion and process emissions

There are many MS that are not able to resolve industrial combustion and process emissions, and this is an issue that has been present in emission inventories for many years. The problem arises because emission inventory compilers choose to use point source data where it is available, as it is typically more detailed and of higher quality than tier 1 or tier 2 methodologies. However, the majority of point source datasets provide a total emission from each installation/facility, and do not resolve the combustion and process emissions that arise from the range of different activities in a given installation/facility.

There is no simple solution to this, and whilst each case needs to be assessed on an individual basis, it is typically recommended that inventory compilers use the more reliable point source data, and then manage the inability to resolve the industrial combustion and process emissions by using notation keys in their reporting, e.g. reporting the total emission in the combustion source category, and IE (included elsewhere) in the industrial processes source category.

Quarrying and mining of minerals

For *2A5a Quarrying and Mining*, most MS use a simple tier 1 methodology, and only a few use the tier 2 methodology provided in the EMEP/EEA Guidebook. Some MS are of the opinion that the tier 2 methodology cannot be applied to all types of mineral quarrying/mining, and it may be necessary to review the descriptive text in the EMEP/EEA Guidebook. It has also been suggested that the highly detailed nature of the tier 2 methodology in the EMEP/EEA Guidebook would be more appropriately labelled as a tier 3 methodology. This is something that the TFEIP has indicated that they will review in due course, and there is therefore the possibility that a methodology will be developed that fits "between" the current tier 1 and tier 2 approaches.

A total of 15 Technical corrections, Unquantified potential technical corrections, Revised Estimates, and/or Recommendations were raised for this source category in the 2023 NECD inventory review. Nearly all of these issues originated in 2022 or 2023, indicating that this is not a long-standing issue.

Recognising the need for an improvement to the current tier 1 methodology for *2A5a Quarrying and Mining* that would be more accessible than the current tier 2 methodology, a proxy solution method has been developed. The method is described in Annex 1 of this report.

Construction and Demolition

Construction and Demolition has been an emission source that the MS have not reported well in previous years. However, there were five technical corrections and/or revised estimates for this source sector during the 2023 review, resolving many issues raised in the last several years.

Domestic solvent use

Five technical corrections were implemented during the 2023 review, four of these resolving issues first raised in 2017. This reflects the efforts made across recent years to support the MS with improvements to these emission estimates. However, numerous recommendations were made, the majority of these were related to issues first raised in 2022 and 2023, indicating that there are still improvements that are needed. In making these recommendations, the inventory review team outlines what actions the MS can enact to resolve the issue.

Solvent and product use, other than domestic
There are many issues across the source sectors for solvent use in general. However, most of these are issues that were raised in the 2022 and 2023 reviews. There are some older/recurring issues, but these are typically isolated cases for MS that have broader challenges with the quality of their emissions inventory. Potential solutions are detailed in the recommendation text that the inventory review team provides to each MS.

A specific issue that was raised by sector experts is that emissions are not reported consistently under the categories *2D3i Other solvent use* and *2G Other product use*. It is suggested that the text in the EMEP/EEA Guidebook is improved to more specifically define what should be reported in each of these two source categories. This suggestion has been passed to the TFEIP.

Agriculture - livestock
Sector experts noted that issues with tier 2 emission calculations of NMVOC from *3B Manure Management* are quite common, and that issues for several MS have not been resolved from previous reviews. It may be that recent updates to the EMEP/EEA Guidebook will help MS to resolve these issues for future submissions. This is now available here:

https://www.eea.europa.eu//publications/emep-eea-guidebook-2023

Agricultural soils
A tier 1 is used for NOx emissions from agricultural soils by almost all MS, because no tier 2 method exists in the EMEP/EEA Guidebook. This is also the case for the JRC AgrEE tool because it is based on the information in the EMEP/EEA Guidebook.

Some knowledge exchange between MS´ experts could help the development of country-specific tier 2 methods. Whilst the MS are free to develop their own, more sophisticated methodologies, it is likely that this is something that will be organised by the TFEIP. A possible first step would be to identify which countries are currently using their own tier 2 methodologies, and then determine how easily these could be adapted to give a more general methodology that can be used by other countries.

Field Burning
3F Field Burning has historically been a source where there is considerable uncertainty about the extent to which the practice is carried out, irrespective of whether it has been banned. Few issues are raised during the review for this source sector, with most MS now reporting that emissions are “not occurring”. However, this may significantly underestimate emissions in some countries.

Datasets derived from satellite-measurements are able to provide activity data on fires, but it will be necessary to gain a better understanding of whether the available data can resolve field burning from accidental fires, and whether information can readily be provided in formats that are of use to inventory compilers. This investigation is something that the TFEIP has included in their workplan as a potential future task.

Open burning of waste/other waste
Emission inventories may consistently underestimate emissions from this source sector because the information in the EMEP/EEA Guidebook is limited. The methodologies in the Guidebook for *5C2 Open burning of waste* cover burning of green waste from orchards and forests, and methodologies in *5E Other waste* include house and car fires.

Consequently, the Guidebook does not include a methodology for small-scale burning of "yard waste" or garden waste in bonfires. This is a known omission from the EMEP/EEA Guidebook, but resource constraints have meant that Guidebook improvement activities have been allocated elsewhere.

It may be possible to address this shortcoming of the Guidebook by undertaking a literature review, and then developing emission factors for a simple tier 1 methodology that could be readily used by the MS. This is something that the TFEIP has included in their workplan as a potential future task.

3.3 Concluding observations

Recurring issues arise due to a variety of reasons, and the most effective ways of addressing each one depends on the underlying reason. Whilst some are expected to be solved by the MS on an individual basis, often the recurring issues are because the relevant emissions estimation methodologies require data that is not readily available across all MS, or because the methodologies are not well enough developed to provide accessible tier 2 methodologies comprehensively across all sources.

Whilst there has been a significant improvement in addressing recurring issues found during the NECD emissions inventory reviews, it may now be slower to address the remaining issues. This is because many require a new or amended methodology to be developed and published in the EMEP/EE Guidebook, and then implemented by the MS.

4 Proxy solutions

4.1 Introduction

The expert inventory review teams work with the MS to try to collaboratively deliver solutions and improvements to major issues[4] during the review. This is done by the inventory review team implementing technical corrections, or the MS sending information that is processed as a revised estimate.

However, there are occasions when the inventory review team is unable to determine a technical correction with sufficient certainty or calculate revised emission estimates that are of good quality. Consequently, during some previous years, the concept of an "unquantified potential technical correction" was used to indicate the importance of an issue that could not be resolved during the review.

For the NECD inventory review undertaken in 2023, rather than use unquantified potential technical corrections (which provide no numerical information), "proxy solutions" were used when possible. These are technical corrections calculated by the inventory review team, but the calculations may not be of sufficient quality to follow best practice, and hence they do not resolve the issue for the long term. These are in effect a compromise, in that an improvement in emission estimates is determined and implemented during the inventory review, even if this improvement is not a fully adequate solution to the issue.

[4] Defined by demonstrating that the impact of delivering a suitable improvement is above a given emission threshold – termed the "threshold of significance".

Ahead of the 2023 inventory review, analysis of previous issues was undertaken to determine which common issues resulted in unquantified potential technical corrections. Proxy solution methodologies/approaches were then developed for those which were considered likely to arise during the 2023 review. These "solutions" were circulated to the review teams before the review started, to ensure consistency in approach in handling these cases.

It was expected that proxy solutions would not necessarily provide a solution to every identified issue, due to relevant activity data not being available to the expert inventory review team. Consequently, the option of concluding issues as unquantified potential technical corrections was retained.

4.2 Use of proxy solutions in 2023

There were only two cases where a proxy solution approach was used[5] by the inventory review team to implement a technical correction- both for emissions from *1A3di(ii) International inland waterways*.

These numbers, however, under-represent the impact of proxy solutions in the 2023 review, because there were numerous cases where a sector expert proposed a proxy solution, and the MS used this in providing a revised estimate (this was particularly the case for emissions from *2D Solvent use*, which have accounted for a large number of recommendations and technical corrections in the past). This is not specifically identified in the EMRT as a proxy solution, making it difficult to quantify the full impact that proxy solutions may have had on improving emissions inventories in the 2023 review.

1A3di(ii) International inland waterways
MS often find it difficult to obtain activity data for this source sector and implementing a proxy solution allowed estimates to be made for two MS rather than issuing unquantified potential technical corrections.

The specific issues were very similar:

For one MS, emissions from *1A3di(i) International maritime navigation* (memo item) were included in *1A3di(ii) International inland waterways*, and the MS used a tier 1 approach for a key category.

The proxy solution used the % share of inland waterways and the % share of maritime in total freight transport (tonne-kilometres) from Eurostat as proxy data to disaggregate emissions between *1A3di(ii) International inland waterways* and *1A3di(i) International maritime navigation*. The shortcomings associated with this approach were clearly explained to the relevant MS, but it provides emission estimates that can be used whilst they develop an improvement plan (e.g., gathering port statistics and vessel type information).

The issue, and solution, was the same for another MS, except that these are not key sources and therefore do not require a methodology better than a tier 1 approach – although it is preferable to use a methodology that is better than tier 1 to give a good level of accuracy.

[5] and nine cases where an unquantified potential technical correction was used.

5 Working within the confines of limited resources

The main aim of this report is to share information that helps MS identify activities that they can undertake to improve the quality of their annual submissions. However, it is appreciated that for many (if not all) MS, a key limitation is that insufficient resources are made available each year for emissions inventory compilation, QA/QC, reporting etc.

There are numerous approaches that can be adopted when the work programme is resource constrained. But, whilst many national inventory teams tailor the amount of work to fit the available budgets and look for efficiencies, informal communications with national inventory teams indicates that they rarely invest time in identifying and securing additional resources.

Suggestions for easing the challenges of working with resource constraints are provided below.

5.1 Engagement with other experts

A time efficient way of improving the quality of the national inventory is to engage with other experts.

It may be possible to secure some support from other European emissions inventory experts, for example by establishing bilateral meetings, which can be supported by the European Commission through the TAIEX-EIR Peer 2 Peer tool.

The TFEIP does not have resources to provide direct support, but is available to act in a facilitation role, providing ready access to a network of emissions inventory specialists, most of whom are able to offer at least a degree of help. In general, MS rarely engage with this network, and hence miss out on this opportunity.

The type of support that the TFEIP is best suited to is arranging a small amount of technical expertise to help national inventory teams interpret and implement methodologies in the EMEP/EEA Guidebook. But, it can sometimes also facilitate other types of support. For example, if a MS is struggling to allocate sufficient resources to compiling an uncertainty analysis, then approaching the TFEIP might result in the TFEIP organising a workshop on the topic, organising some practical hands-on support, or perhaps arranging a one-to-one meeting with an expert at the TFEIP annual meeting - all for no cost.

5.2 Obtaining funds for specific improvement projects

Emissions inventory teams can sometimes be caught in the “vicious circle” of not having sufficient resources to invest in existing compilation processes, and therefore not being able to work more efficiently to address having insufficient resources. Another common vicious circle is that busy inventory compilers do not typically have the time to find additional funding, that would help to address their high workload.

It is generally difficult to break out of these cycles without bespoke funding for an improvement programme of some kind. Funders are generally more amenable to supporting projects that have specific improvement outcomes, rather than supporting

general on-going improvement activities. So, it is sensible to package up improvement work for specific and discreet tasks and present it in this way to potential funders.

If approached in the right way, there may be opportunities to obtain funding for improvement projects from within national governments, and/or to explore using the existing instruments at the EU level e.g. the TAIEX-EIR Peer 2 Peer tool. Research projects also offer possibilities of supporting specific improvement activities for the national inventory, although it can be challenging to either be involved or establish the right engagement with academia. But involvement in e.g. Horizon 2020 programmes can support national inventory teams with their improvement activities.

5.3 Obtaining increased funds for on-going annual activities

Even if inventory teams are successful in securing funding for specific improvement activities, there may still be a need to increase the annual resources allocated to the "core" or "on-going" tasks of emissions inventory compilation, reporting etc.

This is always challenging, but a useful first step could be to review the amount of funding being provided for estimating GHG emissions, or engaging in discussions with other national inventory teams in an effort to establish the budgets and resources that different countries allocate to their emissions inventory programmes. It can be challenging to interpret this sort of information, and evidently some MS will have more funding available than others. But, given that there does appear to be a link between the quality of inventories and the level of funding devoted to it (as far as can be established with the information currently available), it is sensible that all stakeholders make efforts to ensure that national inventory teams are funded "sufficiently", to deliver inventories that are considered to be of acceptable quality.

This first step of improving the transparency around funding levels in MS that are frequently identified as requiring major improvements to their inventory submissions, could then lead to discussions about ensuring adequate funding for the core work of the national inventory programme.

It is noteworthy that reviews of national greenhouse gas emissions inventories undertaken under the United Nations Framework Convention on Climate Change include an assessment of the inventory management systems and the underlying resources.

5.4 Concluding observations

Having limited resources is something that all MS would probably consider to be a relevant issue, to varying degrees. However, it is considered likely that the limited funding levels in some MS directly result in their NECD submissions having major shortcomings with regards to quality.

It is entirely understandable that national emissions inventory experts consider their role to be technical and rarely undertake significant activities to help increase the resources that are available to them. But it would be sensible for an individual within a resource constrained national inventory team to invest time in trying to bring more resources into the inventory programme. Ensuring that national inventory programmes are funded to a level that allows good quality submissions under the NECD is in the interest of all stakeholders.

6 Concluding observations

Best practice in MS´ emission inventories, and some of the more significant challenges can be summarised as follows:

1A Stationary combustion: Austria and Estonia provide comprehensive and transparent information in their IIRs.

1A3b Road transport: The long-term funding of the COPERT model has been successful in that the majority of MS are considered to have good quality road transport emission estimates in their inventories.

1A3d Shipping - Maritime and Inland Waterways: There remain some significant challenges for the MS, associated with sourcing activity data for these sources. However, a new proxy solution is available for use until a longer-term solution becomes available.

2 IPPU: Denmark, Finland, France, the Netherlands, and Sweden are considered to have more sophisticated inventories than other MS, and **Austria** presents information in the IIR in a particularly transparent way, as do **Estonia, Hungary, Latvia, and Romania**. On the other hand, there continues to be the need to further develop the guidance provided in the EMEP/EEA Air Pollutant Emission Inventory Guidebook as well as to update some obsolete emission factors.

2A5a Quarrying and mining: The tier 2 methodology in the EMEP/EEA Guidebook is arguably a tier 3, and is not extensively used by MS because they do not have the required input data readily available. A proxy solution has been proposed for an approach considered to be closer to a tier 2 methodology, which is more accessible. However, further work is needed before inclusion in the EMEP/EEA Guidebook.

3 Agriculture: France provides detailed data reporting in their IIR, **Czechia** use Excel appendices to provide comprehensive data for agriculture calculations, and **Lithuania** provided the N-flow tool Excel calculation file to support transparency. A tier 1 methodology is used for NOx emissions from agricultural soils by almost all MS, because currently no tier 2 method exists in the EMEP/EEA Guidebook.

3F Field burning: Most MS report this as “not occurring” because the practise is banned. However, satellite data may provide improved estimates in the future.

5C2 Open burning of waste: The EMEP/EEA does not have a methodology for this, which is an omission that needs to be addressed.

IIRs and transparency: A lack of sufficient detail in IIRs is the most common transparency issue identified during the NECD emissions inventory reviews and is likely to be a focal point for MS considering improvement activities. **Austria and Denmark** are stand-out examples of high quality IIRs. There are efficient ways of updating and managing the content of IIRs, but these practices are not yet widely shared. **Germany and France** use innovative approaches to compiling information that may be of interest to some MS.

Accuracy: The use of tier 1 methodologies for estimating emissions from key sources has significantly reduced in recent years but does still exist in several MS´ submissions. Many

MS do not report an uncertainty analysis, and therefore do not have information that helps to prioritise improvement activities.

Completeness: Only a limited number of isolated completeness issues remain. These can arise from MS having either inadequate resources or a lack of data, or insufficient guidance in the EMEP/EEA Guidebook for specific sources.

Consistency and Comparability: Consistency is generally of a good standard across the MS, and Comparability is rarely an issue.

Working with limited resources: Informal discussions with national inventory teams suggest that some are severely impacted by insufficient resources and that this impacts on the quality of their submission. However most do not invest any significant time to sourcing additional funding, and there are likely to be some options that could help to address existing shortfalls in available resources which are worth exploring.

Appendix A1:

A Proxy Solution for Quarrying and Mining

Introduction

During the review, *2A5a Quarrying and mining* was identified as a source that many MS have difficulties estimating in an accurate way. This is because in some MS it is a key source for $PM_{2.5}$, but the available methodology in the EMEP/EEA Guidebook that is labelled a tier 2 methodology is particularly involved, and MS generally find it challenging to source all of the required activity data (the TFEIP are considering whether it should be relabelled as a tier 3 methodology).

There is a clear need for a proxy solution that broadly equates to a tier 2 methodology that does not require highly detailed input data, but allows some country specific tailoring and is better than the single tier 1 emission factors included in the current version of the EMEP/EEA Guidebook.

Existing tier 2 methodology

The current tier 2 methodology, as described in the EMEP/EEA Guidebook, is accompanied by a spreadsheet tool. This tool provides methodologies for estimating:

- Emissions of: TSP, PM_{10} and $PM_{2.5}$;
- Split into the following activities: Drilling & blasting, material processing, internal transport, material handling operation, wind erosion from stockpiles;
- From small, medium, and large quarries;
- For each of the following product types: crushed rock, sand & gravel, and recycled aggregates.
- With potential to incorporate regional data, and variable levels of emissions control.

This requires a significant amount of input data, much of which is not readily available to MS.

Proxy solution methodology

The methodology outlined below is a simplified version of the existing calculations, by using several default values provided in the template. This removed the need for input data that is challenging to obtain.

The proxy solution methodology uses the standard approach of:

Activity data x Emission factor = Emission

The required activity data are the national annual production of crushed rock, sand & gravel, and recycled aggregates (Mega tonnes). These data are readily obtained from national/international statistics.

The emission factors to be used are:

Pollutant	EF – Crushed rock (tonnes/Mtonne)	EF – Sand & Gravel (tonnes/Mtonne)	EF – Recycled aggregate (tonnes/Mtonne)
TSP	223	35	31
PM_{10}	68	11	13
$PM_{2.5}$	8	2	3

Note that these emission factors are particularly sensitive to assumptions made about the distances travelled by machinery on the unpaved roads of the quarry/mine surface. These EFs assume ~45 km/ktonne of product, and this is considered to be a sensible default value, based on the data provided in the existing tier 2 calculation template. However, emissions estimates from another MS indicate values that are nearly an order of magnitude smaller, which has significant impacts on the resulting emissions. So, whilst only the mass of material quarried/mined is required for this proxy solution approach, if data for kms on unpaved roads are available, then these should be used in the tier 2 calculation template to give emission estimates that are as accurate as possible.

Oxford Centre for Innovation

New Road

Oxford

OX1 1BY UK

+44(0)1865 261466

www.aether-uk.com