Quarterly emissions to air – prospects for new analyses

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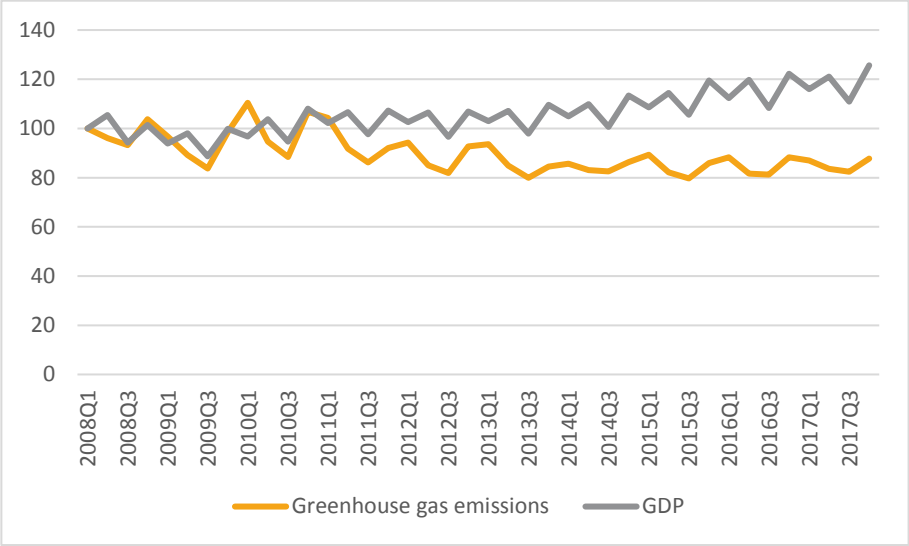
Abstract

Statistics Sweden has published quarterly emissions to air since late 2015. With almost three years of experience a number of possible improvements are pinpointed in this short paper. This relates to publishing quarterly air emissions at the same time as National Accounts, better residence adjustment in the transport industry and temperature adjustment to look at the long term structural trend in air emissions. Better indicators and policy relevant statistics are also discussed in brief.

1. Introduction

To provide faster access to data that monitor air emissions, Statistics Sweden has many years worked for providing quarterly emissions to air. Good quality and up-to-date data is needed to monitor climate policy objectives, and to analyze developments in different parts of the economy. Since 2015, the environmental accounts at Statistics Sweden publishes regular quarterly air emissions including both greenhouse gas (GHG) emissions and air pollution (see e.g. Statistics Sweden, 2018). The statistics make it possible to follow emissions trends on a quarterly basis. Quarterly statistics also enables production of preliminary annual statistics (sum of four quarters) which is published ahead of the final annual statistics on emissions to air.

Diagram 1. Greenhouse gas emissions and economic growth, non-seasonally adjusted. 2008Q1–2017Q4. Index 2008Q1=100



Source: Statistics Sweden, 2018

The publication of new quarterly emissions has often been subject to a lot of attention from policy makers, media and other stakeholders. Moreover, it has helped to put focus on the issue of greenhouse gas emissions, not only once a year, but every quarter, as well as to educate the users of the statistics on environmental accounts and on the connection between environmental and economic development. From that point of view, the quarterly emissions to air can be described as something of a success.

There are, though, several future improvements, or extensions, of the quarterly air emissions, that might be interesting to explore further. A selection of these will be discussed in this brief paper. Some of these are issues related to methodological choices or tradeoffs, while others have to do with communication and policy relevance. Besides

pinpointing these possible improvements of the quarterly air emissions another objective with this paper is to inform and inspire others that are interested to also develop similar statistics.

To produce quarterly air emissions calculations are carried out differently for stationary combustion, mobile combustion and other emissions. In brief, short-term energy statistics are used to the extent possible to estimate stationary and mobile air emissions. For other air emissions, e.g. related to industrial processes or agriculture, available annual data is used and the quarterly data is estimated with different models. More information on the methodology can be found in a report from Statistics Sweden from 2016 (Statistics Sweden, 2016).

In this paper three methodological challenges are discussed. The first one relates timing of publication. The current production time of the quarterly emissions is around four to five months after the previous quarter, which is around two months after the Quarterly National Accounts are available. There is a will to speed up this process and publish air emissions the same time as quarterly national accounts. There is, however, a trade off between the amount of detailed data that can be presented and timing of an early, and probably more aggregated, estimate.

The second one relates to air emissions from the transport industry, and its residence adjustment on a quarterly basis. The third one relates to adjustment for seasonality effects, to estimate the overall trend of emissions without the impact of external temperature. Moreover, other issues concerning quarterly air emissions related to communication and policy relevance is discussed in an own chapter in this paper. The paper ends with a short conclusion and discussion on the way forward.

Please note that the issues discussed in this paper is only a sample of possible improvements that have been raised since the publication of quarterly air emissions first started three years ago. Other, perhaps more innovative examples, could be calculation of consumption based greenhouse gas emissions on a quarterly basis, or monthly air emission indicators. Regarding quarterly consumption based air emissions, National Accounts actually used to calculate input output models in Sweden on a quarterly basis, but unfortunately not anymore. Actually, it was one of the first questions raised when the quarterly air emissions first were released, if the quarterly air emission could be calculated from a consumption perspective. We will definitely save that question for upcoming updates.

2. Timing of publication

An important next step for the quarterly air emissions is to publish quarterly statistics the same time as QNA. As of today, there is a delay with about two months between the quarterly air emissions and QNA. The reason behind this, in comparison late publishing, of the quarterly air emissions is the awaiting of short-term energy statistics sources, such as quarterly fuel statistics, which are published after the QNA.

The starting point for the quarterly air emissions was to make available as much data as possible on the same aggregated level as value added in the QNA. All data is today downloadable at Statistics Sweden's webpage for 32 industries.

An updated, faster process would provide several benefits. First, it would help to shed light on environmental issues when economic development in the short term (i.e. on quarterly basis) is being discussed. When quarterly emissions are published today, approximately two months after the QNA, the economic development that quarter is already forgotten and stakeholders are already waiting for the upcoming quarter. Second, it would provide the users of the statistics with more logic regarding environmental accounts and its connecting to national accounts. Third, it would be an even faster indicator on air emissions. An indicator that might, however, needs to be updated when the short-term energy statistics is definite.

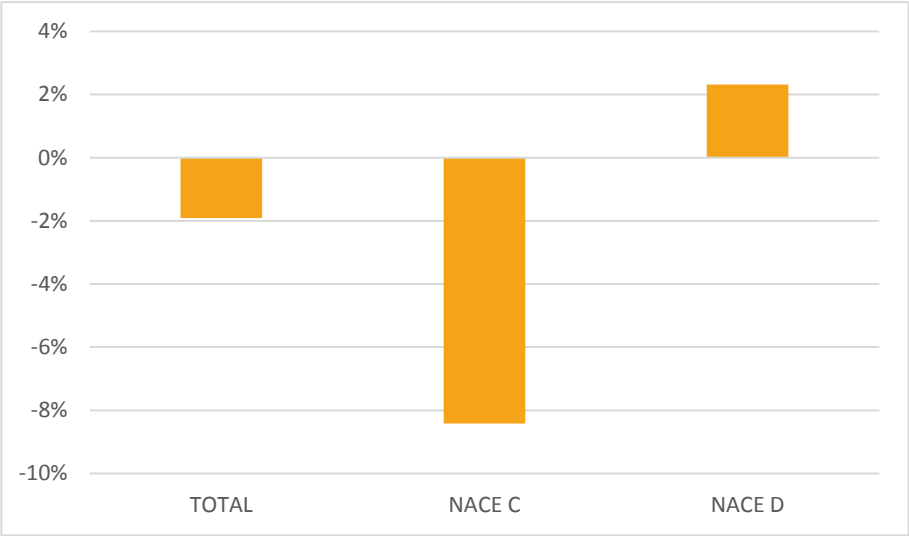
There is a trade off with the quality in assessments and possible problems with access to short-term statistics. The biggest issue is access to reliable early estimates on quarterly fuel statistics, which concerns stationary combustions in industries and energy production. It is less troublesome to find early estimates for mobile emissions where monthly fuel, gas and inventory statistics is used as data source. This survey is published one and a half months after the end of each month.

In Diagram 2, an example of the differences in quarterly fuel statistics, between an early estimate versus a definitive estimate in one quarter. There is only available early data for one quarter, which is why the comparison does not include a time series. These are also preliminary fallouts, with everything except emissions from stationary combustion held constant.

The comparison points at the difficulty of using early estimates in the manufacturing industry. In this example, a number of large corrections on stationary combustion was made for some manufacturing industries, which gave large deviations between preliminary and definitive data. On the contrary emissions from energy producers, NACE D, was overestimated. On the total

preliminary estimated emissions deviated with almost 2 percent compared with the definitive number in this example.

Diagram 2 Early estimated levels of emissions vs definitive estimated levels of emissions, an example for one quarter.



Source: Statistics Sweden, 2018, preliminary figures

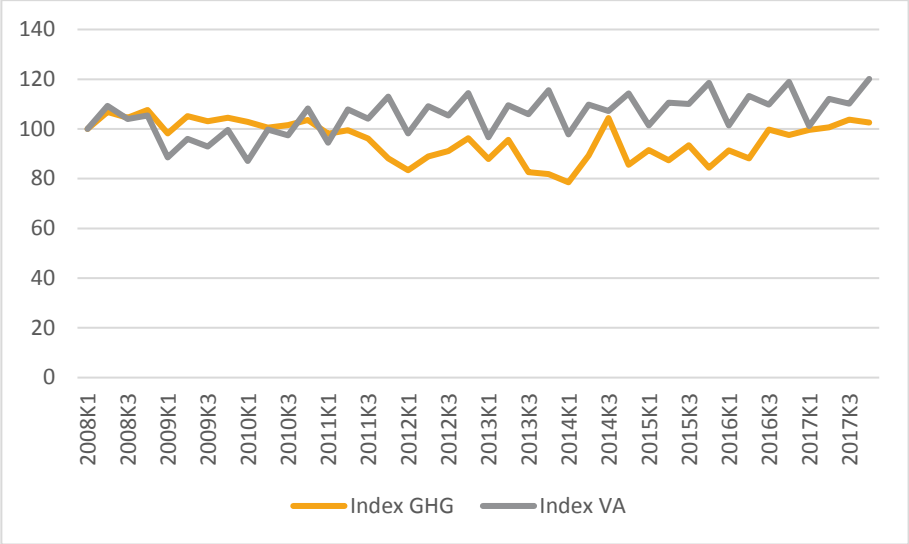
Additional investigations for more quarters are needed to draw any conclusions. There might be a need for specific models for certain industries that have problems with under or overestimations in the early prediction. The example, however, illustrates that the early estimate that would be published the same time as QNA might still be usable as a key figure on the total, but perhaps with some polishing. This key figure would later be updated with definitive data, when the short-term data used as input is finalized, i.e. approximately one to two months later.

3. Transport industry and residence adjustment

There are often very large variation in emissions from the transport industry, NACE H49-53. Especially regarding international maritime traffic, but also air transport on a quarterly basis. The emissions from the transport industry follow no seasonal trend, and there is no seasonality is bunker data used to estimate emissions.

Quarterly National Accounts (QNA), however, illustrates that value Added for the transport industry is normally highest in the fourth quarter and lowest in the first, implying that in monetary terms the activity in the transport industry is higher in the end of the year than the beginning. While there is no particular sign of equality between economic activity and emissions, it points at the importance to investigate the transport industry further on a quarterly basis.

Diagram 3, GHG emission and value added from transport industry, NACE H49-H53. Index 2008Q1=100



Source: Statistics Sweden, 2018

Current calculation methods make it difficult to distinguish between Swedish and foreign actors, which means that the result in these industries should be interpreted with some caution. The most important industry to investigate regarding residence adjustments are shipping, aviation and households. Current assumption includes emissions from international bunkers. A simplified assumption is made that emissions resulting from foreign land transports in Sweden are equal to emissions resulting from Swedish land transports abroad and that emissions related to what Swedish ships and planes bunker abroad are equal to emissions related to what foreign ships and plans bunkers in Sweden. There is currently an ongoing work at Statistics Sweden to investigate a better methodology with more accurate assumptions for the residence adjustment (unfortunately, this study is not finished yet so no results can be presented here).

Bunkers

Bunkering includes fuels delivered to ships or flight aviation engaged in international navigation or international aviation. It is the fuels used to power these ships and aviation. International bunkers do not include domestic fuel consumption.

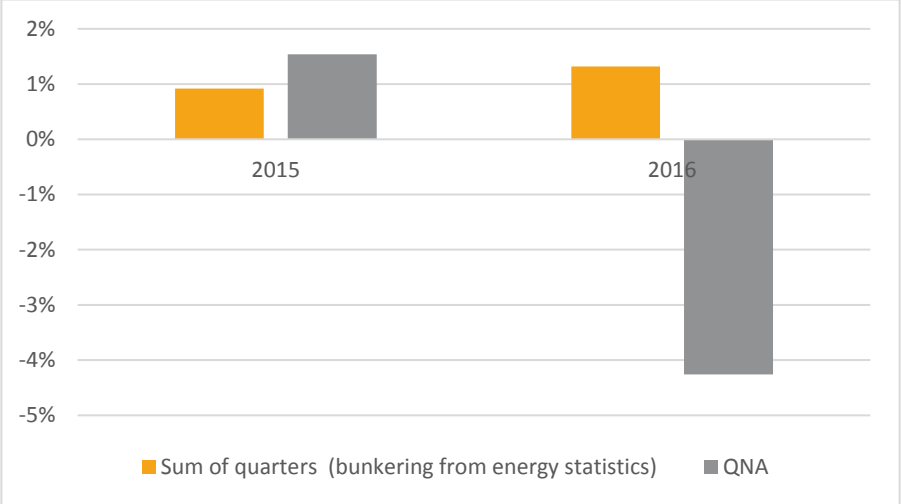
International marine bunkers covers those quantities delivered to ships of all flags that are engaged in international navigation.

International aviation bunkers includes deliveries of aviation fuels to aircrafts for international aviation.

Diagram 4 gives an example of comparison of estimations with quarterly data with bunker data and value added from QNA. For value added in the QNA, adjustments are made to include bunkering of fuels used in flight aviation and shipping, as well as regarding Swedish companies shipping companies' purchases abroad.[1]

Four quarters are summarized for two years 2015 and 2016. Besides illustrating that quarterly bunker data is better at predicting yearly data (that is also based on bunker data, so no surprise), it also illustrate how the emissions would be adjusted if another methodology for residence adjustment is chosen. That is, it might be the case that emissions from the transport industry have been overestimated for some years (or quarters) and underestimated in others. The ongoing investigation and Statistics Sweden might shed some light on this issue in the future, and whether QNA can be used as a complementary data source for quarterly residence adjustment.

Diagram 4, Changes compared to yearly environmental accounts using two models to estimate emissions from transport industry; bunkering from energy statistics and quarterly national accounts.



Source: Statistics Sweden, 2018

4. Temperature and seasonality adjustment

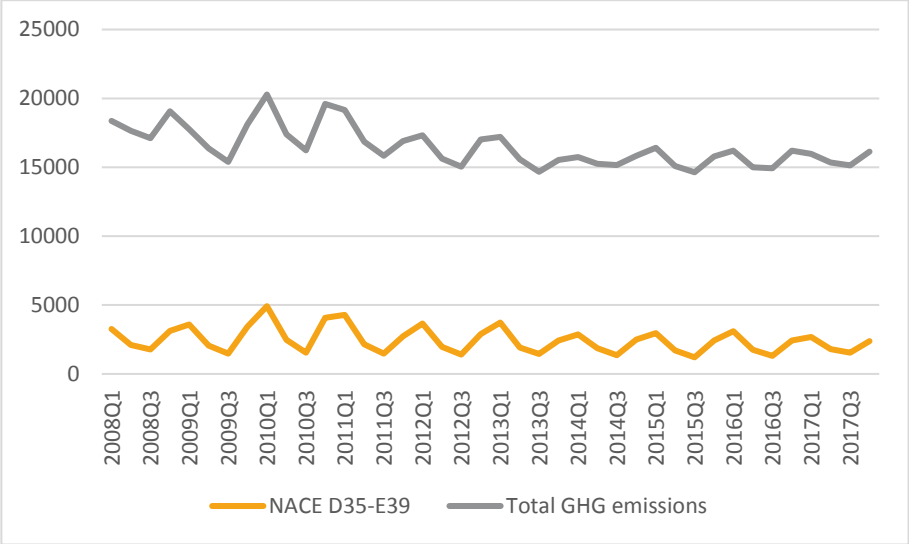
Seasonality and weather affect the heating of buildings and use of fossil fuels in e.g. district heating. Sweden is cold during the winter and during the winter months, emissions are generally higher than in summer months, mainly due to higher demand for heating.

Emissions per quarter show a clear seasonal pattern (Diagram 5), which is especially noticeable in the heat and energy sector.

[1] For more information on Quarterly National Accounts: Statistics Sweden, 2018, Quarterly National Accounts Inventory – Sources and methods in the Swedish National Accounts, September 2018.

Emissions in quarter 1 and quarter 4 are higher since average temperature is lower. Similar patterns can be seen for stationary combustions in households.

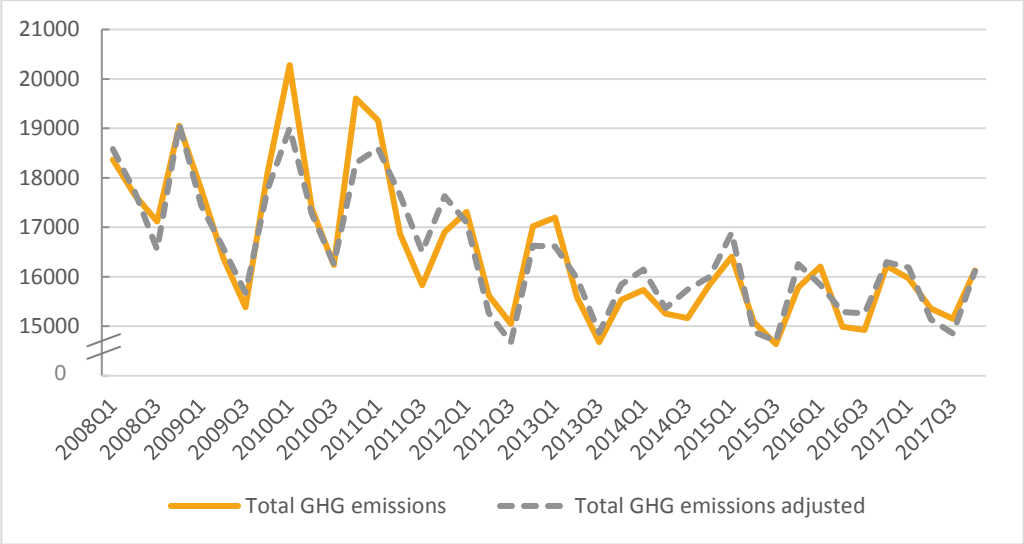
Diagram 5 Total GHG emissions and GHG emissions in NACE 35-39



Correction for differences in weather conditions is one way to enable better comparisons with the economic development, and to estimate the overall trend of emissions without the impact of external temperature.

Temperature adjusted GHG emissions are illustrated in Diagram 6. As a first exercise, the temperature effects are calculated on all stationary combustion, by dividing the quarterly emissions by the number of heat degrees days and multiplying it with the average heat degrees days of that quarter (using average heat degrees days 1990-2017). The GHG emissions have also been adjusted for leap years.

Diagram 6 Total GHG emissions and GHG emissions adjusted for temperature



Source: Statistics Sweden, 2018

Some of the biggest differences between non-adjusted and adjusted GHG emissions are noticed in 2010, both quarter 1 and quarter 4. This is not that surprising since 2010 was one of the coldest years in a hundred year in Sweden. The other way around, quarter 4 in 2011 and 2015 are examples of milder winters where the GHG emissions would be adjusted upwards.

This exercise was done on all stationary combustion to analyze the structural development of GHG emissions over time. Further development, if wanted, would to single out in more detail which economic activities that should be subject to or excluded from temperature adjustment. As well as to investigate if there is need to and possibility to adjust for other factors e.g. number of working days when comparing GHG emissions with economic data on a quarterly basis. It is however important to keep in mind that the seasonality of the air emissions is not only because of temperature, but also due to seasonality in economic activity, which is usually highest in the second and fourth quarter.

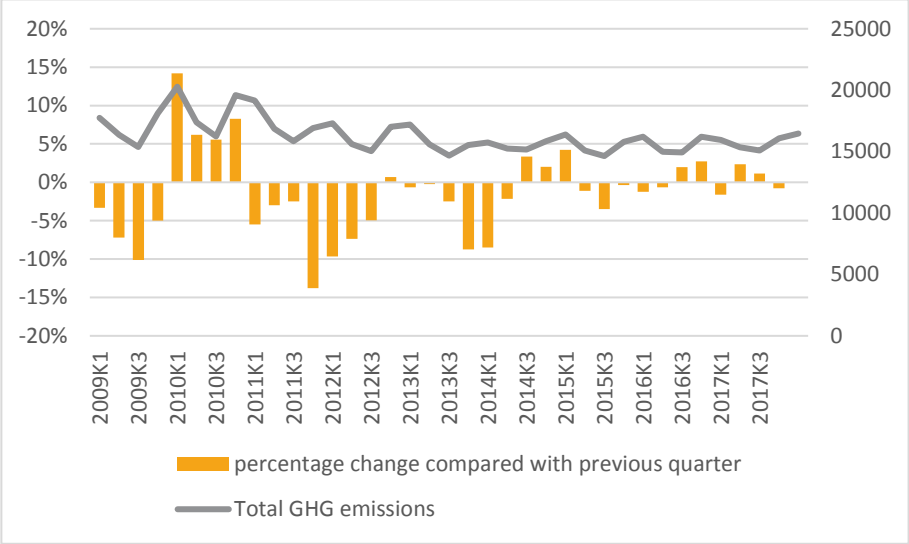
5. Indicators

Since first of January 2018, Sweden has a new Climate Act. Among other things, it establishes that the Government is required to present a climate report every year in its Budget bill. Moreover, the Swedish climate framework includes an overall goal in Sweden to have net zero emissions of greenhouse gases into the atmosphere by 2045, and thereafter negative emissions.

Even though this target concerns only territorial emissions, looking at the long term trend in emissions from the environmental account it

becomes clear that emissions are not decreasing in desired rate. While quarterly emissions main purpose is to give a quick up to date picture of the last quarter connected to the Swedish economy, there is also a point at looking at the whole time series, se example in Diagram 7, where it becomes clear that the rate by which GHG emissions decrease have diminished, and some quarters are even increasing.

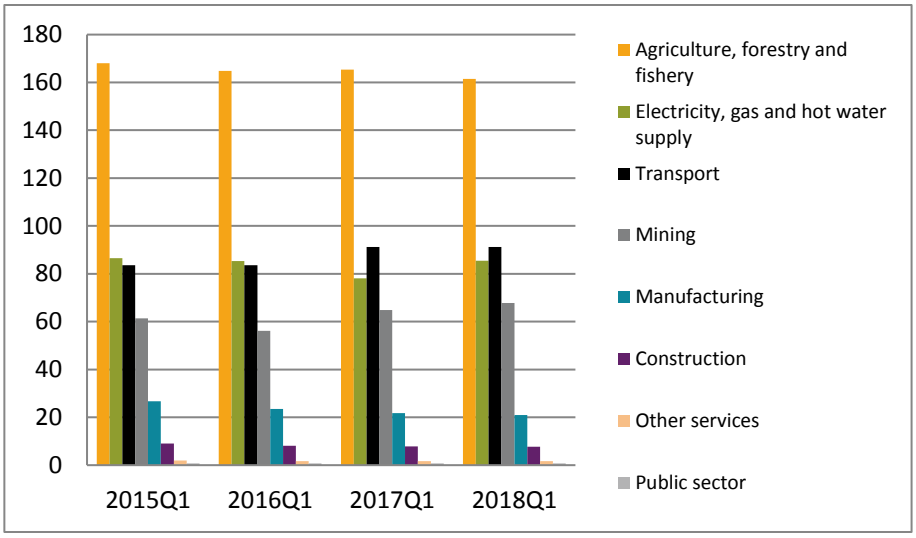
Diagram 7 Total GHG emissions (non-adjusted) and percentage change compared with previous quarter



Source: Statistics Sweden, 2018

Another example on useful indicators from quarterly air emissions are intensities, i.e. looking at how GHG emissions per value in the industry varies for quarters and over time, se example in Diagram 8. Intensity is highest in agriculture industries (NACE A) and electricity (NACE D), and lowest in the service sectors and public sector. While some industries have a decreasing intensity for example agriculture (NACE A), others are increasing, i.e. mining (NACE B).

Diagram 8 Intensities: Emissions of greenhouse gases by value added, 2015Q1-2018Q1. Tonnes carbon dioxide equivalents per million SEK (2016 prices)



Other policy relevant indicators might be related to transport and such indicators, i.e. households' transport emissions or quarterly maritime emissions can easily be developed.

6. Conclusions and the way forward

Since Statistics Sweden started with quarterly air emissions the feedback from the users of environmental account has increased. The is a wide curiosity in how emissions are calculated, uncertainties in the models but also what this means for Sweden's long term climate targets and why emissions in some quarters are increasing. The starting point has always been to publish as much detailed data as possible, that is also easily compared with the quarterly national accounts. An important foreseen next step is to also present GHG air emissions at the same time as the National Accounts publishes their quarterly GDP. This would help to put the focus on the environmental development at the same time as the economy is discussed. If this will be a single key figure or a whole table remains to be decided, depending on the uncertainties in the earlier estimates.

Other important areas for further development are better residence adjustment on a quarterly basis for especially the transport industry. Statistics Sweden is now doing a job on improving the resident adjustment for the Air emissions accounts. Once this job is finished, the next step is to look the quarterly data. Also depending on the type of analysis needed, temperature adjusted data will be important in

the future to compare quarters with each other and for looking at structural long term trends. Last but not last better indicators that communicate the quarterly air emissions, both to the general public, and to policy makers and other stakeholders, are also important and needs to be developed further. Some examples on this are given in this paper.

This paper looked at a number of small improvements for the quarterly air emissions at Statistics Sweden. Besides these improvements one objection with the paper was also to inspire others that are interested to develop quarterly air emissions. The experience from Statistics Sweden illustrates that it is definitely a way of putting the issue on air emissions and environmental accounts in the spotlight. Besides the methodological improvements mentioned in this paper, there are several other innovative changes for the future, such as quarterly consumption based GHG emissions or monthly GHG emission indicators, which will be interesting to investigate further in the future.

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