

# PERSPECTIVE

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## Calculating the Carbon Footprint and Minimum Greenhouse Gas Production of SMEs in Southeast Asia

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*In the effort to slow global warming, all sources of emissions need to be considered. SMEs have usually been overlooked, at least in part because they have been too difficult to measure. In this picture, a worker packs coffee for sale at a small factory in Pringsewu, Indonesia's Lampung province on 15 November 2021. Photo: PERDIANSYAH, AFP.*

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**EXECUTIVE SUMMARY**

- Few attempts have been made to gauge the overall level of greenhouse gas emissions produced by small- and medium-sized enterprises (SMEs), even though they account for more than 90% of all firms globally and in ASEAN.
- There are currently estimated to be more than 71 million SMEs in Southeast Asia today, employing almost 205 million persons.
- We employ a series of highly conservative assumptions to estimate the minimum (baseline) amount of greenhouse gases emitted by the most common form of SME in Southeast Asia, which is equivalent to a single-person, home-based service sector firm.
- We estimate the very basic amount of emissions produced by such an SME in ASEAN to be at least 0.145 tonnes of CO<sub>2</sub> (*t CO<sub>2</sub>*) per person, per annum.
- In total, our figures suggest that SMEs in Southeast Asia account for a minimum of 29.7 million tCO<sub>2</sub> of emissions annually. This is more than the total annual national emissions of Brunei or Cambodia, and close to that of Laos.
- These figures only provide a base level of emissions; they are highly conservative and are very likely to be an under-estimation of the actual level of SME emissions in the region.

## **INTRODUCTION**

As the old management adage goes, you can't manage what you can't measure. However, the world faces a conundrum in terms of measuring the greenhouse gas emissions (GHGs) generated by business and industry: there are few, if any, estimates of the aggregate output of small- and medium-sized enterprises, even though they constitute the majority of the world's business entities.

Doing so is a difficult process, fraught with both practical and methodological challenges. Yet if no effort is made in this direction, policymakers will not be able to gauge the relative contribution of SMEs to global warming in order to develop policies needed to help these firms reduce emissions and ultimately move to net zero.

In this paper, we lay out a process for calculating the very smallest minimum GHG output of any firm, and then use it to subsequently estimate highly conservative, minimal levels of emissions by the SME sector in aggregate. A small, basic "back of the envelope" approach is suggested, based on the likely emissions generated by a single, self-employed small business person working from home. This is the simplest and the most common form of SME found in the ASEAN region (as well as globally), and has the benefit of being intuitively easy to understand, to calculate, and to tweak if more complex modelling is also sought.

## **HOW MUCH EMISSIONS DO SMEs PRODUCE?**

A first step in estimating SME emissions in Southeast Asia is to gauge the number of small firms in existence. Unfortunately, small business data sets and demographic figures in the region are bedevilled by a paucity of comprehensive, harmonised information.

Globally, SMEs account for at least 90% of all business enterprises. In most economies, though, this figure is closer to 95% or more, and in ASEAN, they represent at least 97% of all firms (ADB 2020). Exactly how many such businesses actually exist is still a matter of some conjecture, as there is no universal definition of what constitutes a small firm and no authoritative single international data set of the total number of such enterprises. Multilateral agencies such as the OECD (2018c) and International Labour Organisation (2019) have attempted to strengthen the calibre of these statistics by undertaking targeted studies and business surveys in parts of ASEAN, especially in high growth or poorly resourced countries such as Vietnam, Indonesia, Laos and Myanmar. However, these efforts have not been coordinated across the region and maintained over the years. In contrast, there is much more systematic SME data collection in Thailand, Malaysia and the Philippines.

A detailed examination of SME numbers and employment across ASEAN in 2020 (Schaper 2020), based on publicly available official data from relevant national government agencies, indicated a minimum of 70 million SMEs, employing 140 million persons. However, this underestimated the likely real number of firms and employment, as some nations (Laos PDR, Malaysia, Myanmar and Vietnam) did not publish a full set of data for employment, whilst the number of firms in Myanmar was not publicly available.

Our estimate of the current real number is approximately 71.2 million firms, employing almost 205 million individuals, as shown in Table 1 below. This is based on updated data from publicly available national government sources, as well as imputed figures in those countries where public information is not available. Where information has not been accessible in the public domain, firm numbers and employment sizes in a country have been calculated from other national and regional averages provided by reliable national and multilateral statistical databases. However, this remains an approximation rather than a definitive enumeration.

**Table 1: Number of SMEs in Southeast Asia**

	<b>Number of SMEs</b>	<b>Total Number of Businesses</b>	<b>SMEs as % of All Firms</b>	<b>Persons Employed by SMEs</b>
Brunei (2019)	5,900	6,000	97.20%	130,200
Cambodia (2019)	460,000	510,000	90% +	1,200,000
Indonesia (2018)	64,194,000	64,199,600	99.90%	131,728,800
Laos (2018)	178,200	178,600	99.80	3,050,200
Malaysia (2019)	1,151,300	1,344,900	85.61%	7,807,000
Myanmar (2015)	126,200	127,000	99.4	12,577,800
Philippines (2018)	998,300	1,003,100	99.50%	5,714,200
Singapore (2019)	271,800	273,100	99.50%	2,520,000
Thailand (2019)	3,077,800	3,084,300	99.80%	13,950,200
Vietnam (2019)	744,800	760,000	98%	26,210,700
<b>Total</b>	<b>71,208,300</b>	<b>71,486,600</b>	<b>99.60%</b>	<b>204,889,100</b>

*Figures rounded to the nearest hundred. Sources: Schaper (2020), Michael (2017), World Bank (2021a), World Bank (2021b), World Bank (2021c), World Bank (2021d), Pisei (2019), OECD (2018a), OECD (2018b), OECD (2018c), World Bank (2019), DSMOP (2021), PSA (2021), ADB (2020), BoT (2020), and GSO (2021).*

Given their sheer numbers, the role of small firms in responding to climate change should not be overlooked. Indeed, the United Nations' Framework Convention on Climate Change has argued that "... private sector action, including that by SMEs, will be critical in addressing climate change" (UNFCCC/UNESCAP 2021: 1).

But how much GHGs do SMEs produce? This is a difficult phenomenon to measure. Major research work on GHGs, such as the various IPCC reports (2021, 2014) that attempt to synthesise the many individual studies on climate change, do not provide data on the quantum of emissions produced by small firms. Some other estimates of SME-induced emissions have been made but are generally country- or region-specific and highly generalised. For example, some cited research in the UK has suggested that SME-induced emissions account for at least 12% of that nation's emissions (Hailstone 2021); however, another UK study suggests this figure may instead be as low as 6%, with the average emissions of an individual employing firm in the manufacturing or retail sectors being 4.4 tonnes (Small 99, 2021). This is a wide variation, and so perhaps it is not surprising that

Blundel & Hampton (2021:1) have concluded in a recent review of SMEs and climate change issues that “...there is a serious lack of comprehensive data on greenhouse gas emissions ...”. At present, then, no researchers can clearly state what quantum of GHGs are currently being produced by SMEs.

### **DIFFICULTIES IN MEASURING THE EMISSIONS OF SMEs**

In some respects, a lack of information should not be surprising. There are many problems in effectively collecting emissions data from the SME sector – much more so than amongst larger firms.

As noted above, the lack of a universally-accepted definition of an SME is one factor. Most countries have their own unique definition of a “small business,” meaning that different data sets are usually not measuring exactly the same types of business entities.

Calculating the exact number of firms in each country is another problem, since many different databases are used. These may range from formal registrations with a national taxation authority in some countries, or business name registration systems, whilst other national data sets only count companies and exclude non-corporate structures. Some nations include the self-employed, and/or the informal sector, but others do not. Some countries maintain highly detailed records which are publicly available, whilst others do not (for a detailed discussion of this issue, see Schaper 2020).

Finally, there is substantial difficulty in segmenting the SME sector by size and industry. Some nations enumerate their counts of businesses by firm size category, splitting their counts into micro-, small- and medium-sized enterprises, whilst others collapse all of these into just one or two groups. Some nations publish data using highly complex industry and trading sector classifications, whilst other jurisdictions provide very little breakdown of their SME population by field of industry. It is not currently possible to definitively provide a breakdown across ASEAN of SMEs by industry sector.

There are also major impediments due to the fact that we are dealing with an individual enterprise unit. Data keeping often gets problematic, especially amongst the self-employed and micro-sized enterprises; few of these rarely collect emissions data. Even calculating “typical” or average figures can be difficult: SMEs are found in every industry sector, and since every industry tends to produce a unique and different pattern of emissions output, it is hard to generalise between sectors. Furthermore, individual firms do not follow industry norms: some firms may produce above average emissions while others may operate well below these levels.<sup>1</sup> Finally, SMEs are also highly heterogeneous; medium-sized firms, for example, often operate in a very different manner and produce emissions at levels that are quite different from that of micro-firms or sole traders. In reality, every business is somewhat different to one another, and it is almost impossible to measure the greenhouse gas output of all businesses at all times.

Despite this, a number of government agencies, NGOs and multilateral bodies have attempted to provide simple tools to allow SMEs to calculate their own emissions. Today

there are a number of websites and other (usually online) sources that can be used by small firms to gauge their firm-level Scope 1 and 2 emissions output (see, for example, US EPA 2021; Nature Conservancy 2021). However, whilst useful at the individual firm level, they do not provide an easily-utilised tool for calculating likely baseline SME emissions across a country or region.

What is needed is a simple methodological process that can be used to economically and speedily estimate likely GHG emissions for the small business sector as a whole.

### **WHAT IS THE MOST REPRESENTATIVE OR “TYPICAL” FORM OF SME?**

There is a very wide diversity of SMEs in existence across Southeast Asia. There are both informal and formal sector enterprises. Some businesses employ staff, but many are non-employing, consisting only of owner-operators; in contrast, employing firms can range from those with just one or two workers to some with dozens of employees. Some ventures are operated full-time, but many others only trade on a part-time basis. SMEs are also found in almost every industry sector, ranging from artisans and traditional streetside vendors to farms, retail operations, professional service providers, manufacturing, construction, transport and high-tech emergent new industries.

At first glance, then, it can seem difficult to assume what the typical characteristics of this polyglot group of businesses are. However, in recent years, some general norms have been established, notwithstanding problems in the paucity and variation of SME statistics internationally.

The most common form of business enterprise is the self-employed service sector firm, according to analysis undertaken by a number of multilateral bodies. The ILO (2019) recently observed that the self-employed sole trader in the service sector remains the single largest group of SMEs, both globally and regionally, and is especially large in developing economies. Many of these service sector operators are tradespeople, professionals, managers and other service providers, who produce no goods as such but rather earn their income from their own knowledge, skills and labour – and thus have only a limited carbon footprint. The ADB’s recent review (2020) of SMEs across ASEAN estimated that services accounted for somewhere between 61-89% of all trading enterprises, whereas manufacturing-based enterprises accounted for just 5-17% of firms.

In other words, the most common (frequently occurring) type of SME is likely to be an enterprise consisting of one individual working in the service sector. Although few countries keep data on business locations, commentators and researchers have typically observed that the most common location is the home. Working from home is a much cheaper, flexible and convenient mode than formally renting premises is. In fact, home-based businesses typically represent more than half of all firms (US Small Business Administration 2018; Eurostat 2019). This proportion is likely to have increased since the advent of Covid-19.

For these reasons, in this paper, we base our calculations of the minimum level of emissions as that produced by one individual service sector operator working from home.

**DEVELOPING AN APPROPRIATE METHODOLOGY: SIMPLE IS BEST**

A number of researchers and commercial organisations (Anthesis 2021; Ecometrica 2021; Skillett & Ventress 2020; Crow & Ariane 2020) have attempted in the last two years to gauge the likely emissions output of a single individual working at home. This can form the basis of a simple “ready reckoner” for calculating the likely baseline, minimum emissions of a group of SMEs. Although somewhat different assumptions are used by each study, they nevertheless adopt a broadly similar approach employing three steps:

***1. Calculate the base level of business-related annual minimum energy (kWh) produced by an individual working at home.***

This focuses only on the basic typical emission-producing (Scope 1) activities common to persons conducting commercial activity – specifically electric usage by office equipment, air-conditioning or heating, a laptop, flat screen monitor, mobile phone, printer and room lighting. It excludes private (after working hours) energy consumption, for example. Typically, this data is collected or estimated in the form of kilowatt hours (kWh). Estimates vary, but the conservative estimate put forward by Ecometrica (2021) is approximately 1.2 kWh of energy use per home office per working day per person.

In most cases, the business is only assumed to operate 5 days a week for 48 weeks a year, after allowing for leave, public holidays and unexpected interruptions. This equates to 240 working days a year – again, a very conservative figure and likely an underestimation of actual working time and of business-related energy consumption.

***2. Convert the kWh into emissions.***

Region- or nation-specific data (if available) is required here, since the production of energy (kWh) in different parts of the world can vary significantly, depending on the mixture of energy sources and efficiency of conversion. The latter is determined by the technology type, plant size, and outdoor temperature (Noussan & Neirotti 2020).

***3. Multiply by the number of persons working in the SME sector.***

This requires using actual or assumed numbers of employees in aggregate; once again, the level of data and its accuracy will vary significantly from one country to another.

**WHAT ARE THE ESTIMATED EMISSIONS?**

Using the above formula, we estimate the GHG emissions of the SME sector in ASEAN to be the following:

**1. Determine the annual level of energy (kWh or MWh) consumed by an individual working at an SME.**

By comparing the energy usage at home before and during the pandemic, Ecometrica provided a baseline figure of 1.2 kWh<sup>2</sup> per home office per working day per person. We adopt the estimated typical operating time of a small firm to be 240 days a year (with the assumption that businesses work five days a week, for 48 weeks a year).

Therefore, the calculation is: 1.2 kWh x 5 days a week x 48 weeks a year = 288 kWh (or 0.288 MWh) of energy used by each person in an SME each year.

**2. Convert the kWh or MWh quantum into emissions.**

The emissions generated for every kilowatt hour (kWh) of energy can vary across countries and regions depending on the energy mix and grid efficiency. For our purposes, the Grid Emission Factors<sup>3</sup> specific to the Southeast Asian region have been used.

The Asian Development Bank has provided a Grid Emission Factor for each of the ten ASEAN member states.<sup>4</sup> We obtained an average to represent the regional estimate, which is 0.5620 tCO<sub>2</sub>/MWh. It is assumed here that all the energy consumed have come from major electricity grid(s) in the country. Mini grids and home-based energy generators frequently used in the unelectrified rural areas in less developed countries were not accounted for.

The general formula for calculating greenhouse gas emissions (Asian Development Bank 2017) is:

$$\text{GHG emissions} = \text{EC} \times E_{\text{elec}} / (1 - \%L)$$

*Whereby*

EC = electricity consumption, MWh/year

$E_{\text{elec}}$  = electricity emission factor, tCO<sub>2</sub>/MWh; if electricity is from the grid, this refers to the grid emission factor

%L = transmission and distribution losses expressed as decimal equivalent (e.g., 20% loss is expressed as 0.20)

Therefore, the annual GHG emissions of a Southeast Asian working in an SME = 0.288 MWh/year x 0.562 tCO<sub>2</sub>/MWh x 0.897<sup>5</sup> = 0.145 tCO<sub>2</sub>/year

**3. Multiply by the number of persons working in the SME sector.**

We use the estimates of the total number of persons working in SMEs in ASEAN as per Table 1 above, which is 204,889,100.

Total minimum annual regional GHG emissions produced by SMEs = 0.145 tCO<sub>2</sub>/year x 204,889,100 persons = 29,708,920 tCO<sub>2</sub>/year.



In other words, SMEs in Southeast Asia accounted for a minimum of 29.7 million tonnes of CO<sub>2</sub>.

## COMPARATIVE SIGNIFICANCE

How important are 29.7 million tonnes in the overall level of GHG emissions?

At first glance, it may not seem especially high. After all, ASEAN member states generated 1,670 million tonnes of CO<sub>2</sub> equivalent during the 2020 calendar year (Ritchie & Roser 2020). This means that, based on our limited calculations, SMEs accounted for only 1.8% of the total annual emissions produced in the region. And this 1.8% figure seems low compared to the estimated 6-24% of all UK emissions attributed to SMEs in that country.

However, this may underestimate the significance of SME emissions. At 29.7 million tonnes per annum, the SME sector in the region as a whole is already producing more GHGs than the total annual national emissions of Brunei or Cambodia, and is close to that of Laos (see Table 2).

**Table 2: Territorial GHG Emissions Amongst ASEAN Nations in 2020**

	MTCO <sub>2e</sub>	Population (approx.)
Brunei	10	0.44 million
Cambodia	15	16.7 million
Indonesia	590	273.5 million
Laos	34	7.3 million
Malaysia	273	32.4 million
Myanmar	36	54 million
Philippines	136	109.5 million
Singapore	46	5.8 million
Thailand	258	69.8 million
Vietnam	254	97.3 million
Total	1,652	

*Source: Global Carbon Project (2021). MTCO<sub>2e</sub> = million metric tons of carbon dioxide equivalent. "Territorial" = emitted within the designated country. Global total in 2021 was 34,807 MTCO<sub>2e</sub>.*

And is 1.8% of all regional emissions a much lower figure than that of SMEs in other regions across the globe? This research has not been done, but the issue is certainly worthy of more detailed examination.

We believe our figures for the ASEAN region should be regarded as a very bare minimum, given the conservative assumptions employed to calculate it. In practice, we believe the overall amount of SME-generated emissions is much higher. Our "ready reckoner" approach excludes small firms in heavy industry, emission-intensive activities, as well as

the impact of supplementary business-related emissions generated, such as air conditioning, work-related travel or domestic vehicle usage. For these reasons, the cited figure above should be treated as a floor figure, below which total real emissions are unlikely to fall.

## LIMITATIONS

A degree of caution is needed when utilising these data. It is important to note that calculating emissions is a somewhat fraught exercise, with the capacity for results to vary significantly depending upon the assumptions used. Conservative values will result in a much lower estimated level of GHG emissions than might otherwise be the case.

Likewise, calculations are also impacted by the accuracy of data sets available to researchers. As we have noted above, the count of SMEs in ASEAN and the total number of employees may not be fully accurate, due to both poor data availability and inconsistent definitions. Moreover, many more SMEs operate in so-called “dirty” industries (which produce high levels of GHGs, such as small-scale manufacturing, travel, transportation, agriculture and the like) than is assumed here; as such, the real level of emissions is likely to be much higher.<sup>6</sup>

## CONCLUSION

There is no small degree of irony that although climate change is recognised as one of the most pressing global issues currently facing the business and political community, yet knowledge about it is largely based on incomplete and highly variable assumptions and calculations. There is little, if any, doubt that warming is occurring and must be reversed, but there is considerable divergence in how the extent of warming is measured.

Be that as it may, these figures may not be perfect, but at least they provide a starting point for analysis and discussion. This study welcomes refinement and enhancements from other researchers.

In the effort to slow global warming, all sources of emissions need to be considered. SMEs have usually been overlooked, at least in part because they have been too difficult to measure. This paper shows a simple way to begin doing so. It also indicates that micro, small and medium-sized businesses are significant factors to consider in climate change policy – after all, their impact is bigger than that of some entire nations. Although these data is only initial, and highly conservative, they nevertheless indicate that more attention, not less, on the SME sector is warranted in future.

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<sup>1</sup> As a case in point, a detailed energy audit of some 280 SMEs in the European Union across a different range of industries and countries by Fresner et al (2018) showed variances of up to 3:1 between different firms in the same industry.

<sup>2</sup> This 1.2kWh is merely energy used for powering the home office equipment including a laptop, a flat screen, and a printer. Energy required for space cooling and heating is not incorporated.

<sup>3</sup> The UNFCCC defines Grid Emission Factors as the amount of carbon dioxide emitted, along with the provision of electricity by a specific electricity system. It serves as a baseline for gauging the changes to emission intensity due to the deployment of Clean Development Mechanism projects in the renewable energy sector.

<sup>4</sup> For grid emission factors, see Appendix C at the following site:

<https://www.adb.org/sites/default/files/institutional-document/296466/guidelines-estimating-ghg.pdf>

<sup>5</sup> The average of transmission loss percentage across all Southeast Asian countries except Lao PDR is 10.3%. (IEA data on World Bank portal)

<sup>6</sup> Given the difficulty of obtaining accurate data about the number of firms operating in these “dirty industries” across all of ASEAN, and of calculating realistic average emissions for them, we have refrained from doing so in this paper.

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