How to measure greenhouse gas emissions in investment property?
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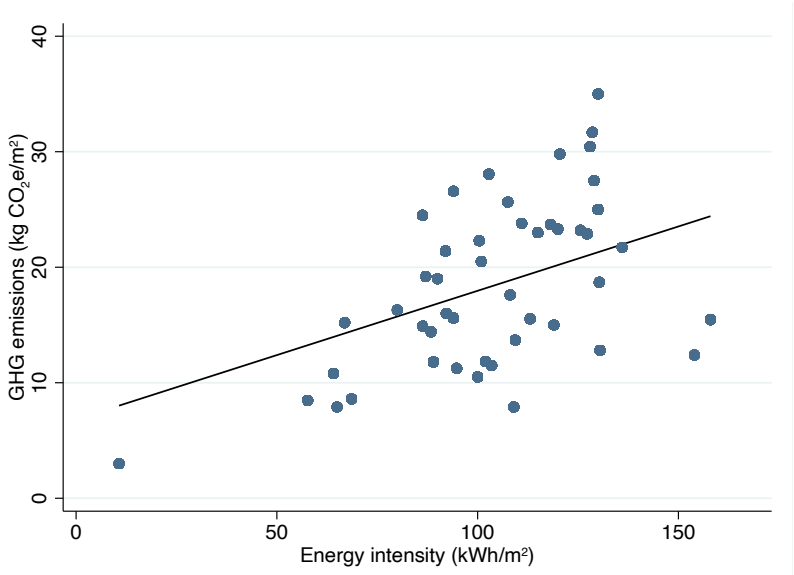
Decarbonizing the Swiss economy requires a massive reduction in carbon emissions. For the real estate sector, which accounts for around 24% of the country's emissions (OFEV, 2022), this is a particularly sensitive issue. Pressure is mounting on property owners, both individual and collective, to renovate their buildings and drastically reduce the greenhouse gas (GHG) emissions associated with the production of heat and hot water in homes. The paradox is that, despite the importance of the subject, there is as yet no standard for measuring GHG emissions and, even among real estate investment trusts, reported emissions are extremely heterogeneous [2].

The graph 1 below shows the energy intensity and GHG emissions of all the real estate funds in the SIX index, as reported in their annual reports. Emissions correspond to emissions associated with the production of heating and cooling, the production of hot water and electricity consumption in common areas (Scope 1+2 emissions).Each point on the graph corresponds to the average energy intensity and GHG emissions of a fund's buildings (according to the 2021 annual reports). The graph shows that emissions average 18.14kg CO_2-eq./m^2, with 50% of funds reporting emissions between 12.40 and 23.30.

Graph 1: Energy intensity and GHG emissions intensity emissions reported by SIX



A direct interpretation of this heterogeneity is that some funds have made significant energy renovation efforts, which should result in low emissions for a given energy intensity. However, this interpretation is biased by the fact that funds adopt different calculation standards.

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[2] In line with the conclusions of this note, other experts on the Swiss real estate market, such as Signa-Terre / Ouzilou (2022) and Gauderon and Beça (2023), have also stressed the importance of harmonisation in the sector.

The aim of this note is to briefly describe the different approaches to measuring GHG emissions, and to assess the emissions of real estate funds in a harmonized way. The difficulty of this exercise lies in the fact that funds adopt non-harmonized definitions and do not provide all the information needed to move from one definition to another. It is therefore necessary to make certain assumptions in order to make these measures comparable.

1. What exactly are we trying to measure?

GHG emissions resulting from the production of heat and electricity in buildings can be classified into three categories.

1. Emissions resulting from the *use of fuels* for building heating and hot water production. These include emissions linked to the fuel used, whether fossil fuel (oil, natural gas and coal) or non-fossil fuel (wood, pellets and biogas).

2. Emissions from *district heating*. The main energy sources are waste incineration, wood, natural gas and, to a lesser extent, nuclear power and heat pumps.

3. Emissions resulting from *electricity consumption* in the building, including air conditioning (for common areas or for building occupants).

For each of these categories, two types of emissions can be calculated:

1. *Direct emissions*: they result from fuel use, district heating and electricity consumption.

2. *Indirect emissions*: these are emissions linked to the production, transport and distribution of fuels, district heating and electricity. They include in particular the construction and dismantling of infrastructures, and losses during transport and distribution.

These three categories partially overlap with the scopes defined by the Greenhouse Gas Protocol.

1. *Scope 1 emissions* correspond to emissions linked to the use of fuels within the building.

2. *Scope 2 emissions* correspond to upstream emissions linked to the production of electricity, heat and cold acquired for the building's consumption. This includes in particular district heating and electricity consumption for heat pumps and the building's common areas (entrance, elevators, laundry).

3. *Scope 3 emissions* correspond to emissions not taken into account elsewhere. They include in particular

    a. Emissions linked to the manufacture of materials and equipment for the construction, renovation and deconstruction of the building (scope 3.2)

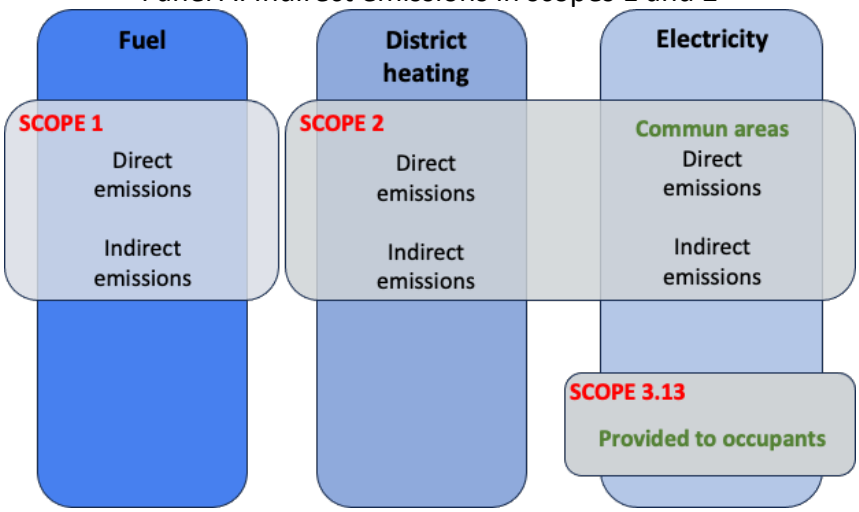
b. Emissions linked to transmission and distribution losses of fuels and purchased electricity (scope 3.3)
c. Emissions from downstream leased assets, such as electricity consumption by building occupants (scope 3.13).

There is some ambiguity in the definition of scopes concerning indirect emissions from fuels, district heating and electricity. Losses associated with the transmission and distribution of fuels, district heating and electricity can be classified in Scope 1 (indirect emissions from fuels) and 2 (indirect emissions from district heating and electricity) as well as in Scope 3.3. In practice, funds choose whether to include indirect emissions in their scope 1+2 emissions or in their scope 3.3 emissions. In the latter case, scope 1+2 emissions reported by funds exclude indirect emissions.

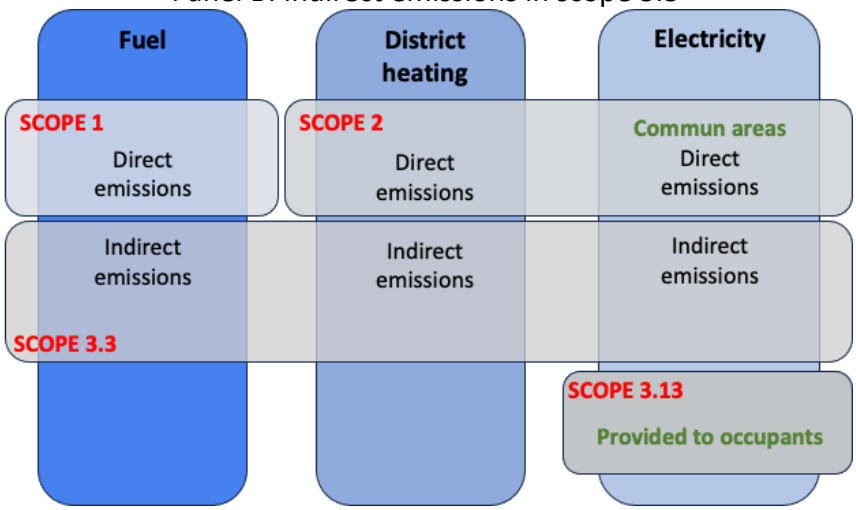
The two diagrams below represent the two alternative approaches to the treatment of indirect emissions linked to fuels, district heating and electricity.

Diagram 1: Representation of the different emission concepts

Panel A: Indirect emissions in scopes 1 and 2



Panel B: Indirect emissions in scope 3.3



2. How do you measure energy consumption and GHG emissions?

Energy consumption (EC) includes the energy used to heat and cool the building, as well as the electricity required for common-area installations. The energy intensity of a building, expressed in kWh per m2 of determining surface (DS), depends on many factors specific to the building, such as its date of construction and the date and extent of its most recent renovation:

Energy intensity = EC / DS
(kWh / m^2) (kWh) (m^2)

The decisive surface area can be measured as the rental surface area of the building or as the energy reference surface area.

Measuring energy consumption depends on the information available. The recommended approach is to measure actual energy consumption from the building's meters. The SIA 380 standard specifies how a building's energy consumption should be calculated. SIA 2031 (2016) specifies how these energy consumption measurements are to be used to prepare a cantonal energy certificate for the building (CECB).

When this information is not available, statistical estimates can be made based on certain indications of the building's condition (age of the building, renovation dates), with an obvious loss of precision. This approach has been adopted by PACTA (Paris Agreement Capital Transition Assessment) in its "Swiss Climate Test" study (2022), mainly for practical reasons.

The other important component in calculating carbon emissions concerns emissions factors, i.e. the quantity of GHG emitted to produce one kWh. Several emission factor bases coexist, with values that vary depending on the generation of the bases and the scope covered. For example, the KBOB (Coordination Conference of Building and Real Estate Bodies of Public Builders) (2022) emissions factor base provides the emissions factor for heat and electricity production, corresponding to the global (direct and indirect) emissions of the different types of fuel and heating system. REIDA (Real Estate Investment Data Association) (2022) provides a breakdown of these elements into direct and indirect emissions.[3] Table 1 shows the overall direct and indirect emissions factors for different energy systems.

Table 1: Examples of global, direct and indirect emissions factors

	Global emissions factor (KBOB, 2022)	Direct emissions factor (REIDA, 2022)	Indirect emissions factor (REIDA, 2022)
Fuel oil	0.323	0.252	0.071
Natural gas	0.230	0.182	0.047
District heating[a]	0.067	0.037	0.028
Grid electricity[b]	0.054	0.013	0.018

Note: All measurements are reported in kg. CO_2eq. / m^2. [a]: average of Swiss networks. [b]: mix of Swiss suppliers. For electricity, the sum of direct and indirect factors is less than the overall factor.

[3] The Intep study (2022) also provides a breakdown of direct and indirect emission factors.

It should be noted that the choice of allocating indirect emissions from fuels, district heating and electricity to scope 3.3 is not possible with the KBOB (2022) emissions factors, as they are not distinguished from direct emissions.

In the PACTA approach, estimates of GHG emissions at building level were carried out using the CO2 calculator developed by Wüst & Partner on behalf of the FOEN. As stated in this study, "renewable energy sources are assigned a zero value for CO2 emissions, as for reasons of data availability, only scope 1 emissions from buildings are considered (excluding electricity "scope 2" and indirect emissions related to building materials "scope 3")."

Estimated scope 1 emissions are also reported in the Federal Register of Buildings and Dwellings (RegBL) managed by the Federal Statistical Office. This register was created on the basis of information from the 2000 population census. It contains information on construction projects, buildings, dwellings, entrances, and streets.[4] It is supplied by the cantons and municipalities. See also OFEV (2023).

For each building, the RegBL database provides building age, heating type and GHG emissions (scope 1 emissions only, by fuel type) and determining surface, but not energy intensity.[5]

Carbon emissions can be deduced by:

Emissions intensity = Emissions factor x Energy intensity
(kg CO_2-éq./m^2) (kg CO_2-éq./kWh) (kWh/m^2)

GHG emissions = Emissions intensity x. DS
(kg CO_2-éq.) (kg CO_2-éq./m^2) (m^2)

3. Method of calculation

For each fund in the SIX index, we have access to the list of buildings owned by the fund in a given year. Certain information is generally provided by the funds, such as the surface area of the building or its year of construction. However, the funds rarely report information on the building's energy consumption or GHG emissions. These data must therefore be estimated.

Furthermore, as previously mentioned, funds use different calculation methods for GHG emissions, choosing either global emission factors (KBOB) or direct and indirect emission factors (REIDA). In order to obtain harmonized emissions between the funds, we have adopted a common strategy. This strategy is necessarily based on a number of simplifying assumptions.

Based on the type of heating indicated in the RegBL register, we determine the corresponding emission factor using the Swiss energy mix (heating oil, natural gas, district heating, electricity). We adopt both approaches, based on global emission factors or direct and indirect emission factors, in order to measure the extent of the bias associated with this choice.

[4] https://www.bfs.admin.ch/bfs/fr/home/registres/registre-batiments-logements.html.
[5] The decisive surface area in the RegBL database is often approximate and some data (such as the heating system) is not necessarily up to date, which can lead to biases in the calculation of energy intensity.

As the energy intensity of buildings is not available, we use the intensity reported for the fund's portfolio as a whole.

The other difficulty concerns electricity consumption in the communal part of the building, which is not known. Given the Swiss energy mix for electricity production, which implies fairly low GHG emissions for electricity consumption, we do not include this consumption in our calculations. Our estimates therefore correspond to a lower limit of GHG emissions from buildings. For certain funds, for which information on GHG emissions is provided, the share of electricity consumption is in practice around 1%-2% of emissions (scope 1 and 2).

The AMAS (Asset Management Association Switzerland) recently issued a recommendation on the definition of environmental indices for real estate funds (AMAS, 2022). The method for calculating GHG emissions from buildings is similar to that described above, based on energy consumption and emission factors specific to the energy used. AMAS specifies that the emission factors are based on "ecological balance sheet data for the various energy sources." It also mentions that the ecobalance data produced by the KBOB (2022) "can be used as publicly available emission factors." AMAS does not explicitly state that it is overall emissions (direct and indirect) that must be taken into account when calculating Scopes 1+2 emissions. However, by mentioning only the KBOB emission factors, which relate only to global emissions, AMAS suggests that indirect emissions should be included in scopes 1+2.

4. Results

We consider three measures of emissions from Swiss real estate funds:

- Direct emissions from fuels (measure 1): for each building, we use the estimated measures reported RegBL resulting from the use of fuels for the production of heat and hot water. This calculation is close to that used by PACTA.

- Direct emissions from fuels and district heating (measure 2): based on the building's heating system and surface area, we calculate the direct GHG emissions resulting from the use of fuels and district heating for the production of heat and hot water. This measure does not include electricity consumption (common or tenant).

- Direct and indirect emissions from fuels and district heating (measure 3): based on the building's heating system and surface area, we calculate the direct and indirect GHG emissions resulting from the use of fuels and district heating for the production of heat and hot water. This measure does not include electricity consumption (common or tenant).

Table 2 shows the fund-wide average for these three measures of emissions intensity, compared with the average emissions intensity reported by the funds themselves, according to their own methodology. According to our estimates, indirect emissions represent approximately 32% ((21.6-16.39)/16.39) of direct emissions for fuels and district heating. This difference reflects those observed in Table 1 for fuel emission factors.

Table 2: GHG emissions intensity of SIX real estate funds
real estate funds by emission factor calculation method

	Emissions intensity (kg CO_2eq. / m^2)
Direct emissions from fuels	15.20
Direct emissions from fuels and district heating	16.39
Direct and indirect emissions from fuels and district heating	21.60
Scope 1+2 emissions reported by funds	18.14

It can be seen that the average reported by funds is roughly midway between measures 2 (direct emissions only) and 3 (direct and indirect emissions). Chart 2 shows reported emissions on the x-axis and emissions calculated according to measure 2 (Panel A) or measure 3 (Panel B) on the y-axis. Panel A shows that some funds (those above the straight line) have reported emissions well below or close to direct emissions (measure 2), suggesting that these funds adopt this measure for their own calculations. Panel B shows that some funds (those below the straight line) have emissions reported well above or close to direct+indirect emissions (measure 3), suggesting that these funds adopt this measure for their own calculations.

Chart 3 shows energy intensity on the x-axis, and reported emissions calculated according to measure 2 (Panel A) or measure 3 (Panel B) on the y-axis. Reported emissions are represented by a blue circle, calculated emissions by a red triangle. These two figures show the correction that should be made to each fund according to the measure used. In Panel A (measure 2), corrections tend to be downward, while in Panel B (measure 3), corrections tend to be upward.

These graphs clearly show that Swiss real estate funds use at least two methods for reporting their GHG emissions: the first considers only direct emissions for fuels, district heating and probably electricity; the second considers both direct and indirect emissions. The use of two calculation methods makes comparison very difficult, as the funds do not provide the information needed to correct method bias.

Chart 2: Intensity of reported and calculated GHG emissions
Panel A: Reported and direct emissions Panel B: Reported and direct+indirect emissions

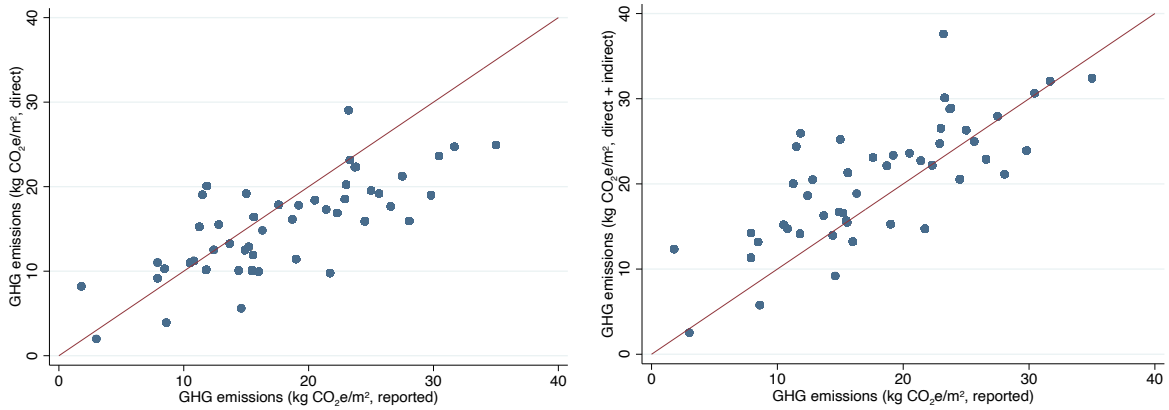
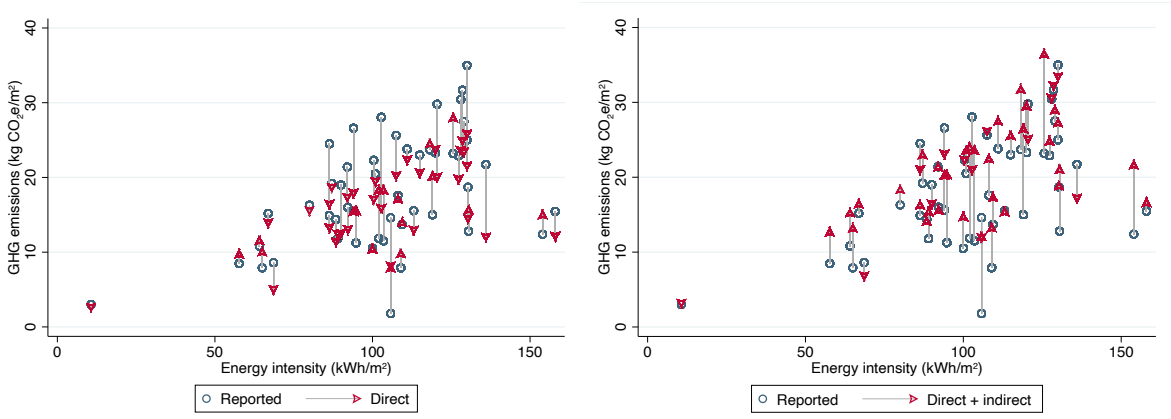


Figure 3: Energy intensity and GHG emissions intensity
Panel A: Reported and direct emissions Panel B: Reported and direct+indirect emissions



5. Recommendation

It is important for the industry to adopt a common methodology for calculating GHG emissions, as this indicator is gradually becoming an important selection criterion for investors. In the absence of harmonized methodology, investors cannot make informed decisions and risk being misled.

The harmonization of GHG emissions measurements is also important in terms of alignment with decarbonization trajectories. Emissions reduction targets in the real estate sector provided by the Confederation must be able to be set against the actual emissions reported by real estate funds. The use of a clear calculation standard will facilitate the positioning of funds in relation to these targets.

The AMAS proposal for calculating GHG emissions is a step in the right direction. However, this proposal remains ambiguous, as it states that KBOB data "can be used" as emission factors (including direct and indirect emissions), leaving open the possibility of alternative, less restrictive choices. The choice of KBOB emission factors seems a good compromise, as it does not lead to an underestimation of scope 1+2 emissions, whatever the definition adopted. Another, more complex option would be for each fund to provide, as a minimum, the information needed to calculate emissions according to KBOB emission factors. In addition, it is crucial to adopt a harmonized method for measuring the floor area and energy intensity of buildings to minimize the heterogeneity in emissions data due to measurement biases.

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