

Supplement

## **ITU-T L Suppl. 54 (10/2022)**

SERIES L: Environment and ICTs, climate change, e-waste, energy efficiency; construction, installation and protection of cables and other elements of outside plant

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**Guidance for assessing the greenhouse gas emissions consequences of the financial effects generated by information and communication technology**



ITU-T L-SERIES RECOMMENDATIONS

**ENVIRONMENT AND ICTS, CLIMATE CHANGE, E-WASTE, ENERGY EFFICIENCY; CONSTRUCTION,  
INSTALLATION AND PROTECTION OF CABLES AND OTHER ELEMENTS OF OUTSIDE PLANT**

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## Supplement 54 to ITU-T L-series Recommendations

### Guidance for assessing the greenhouse gas emissions consequences of the financial effects generated by information and communication technology

#### Summary

Supplement 54 to ITU-T L-series Recommendations provides a guidance for assessing the greenhouse gas (GHG) emissions consequences of the financial effects (gains or losses) generated by information and communication technologies (ICT), separately considering the user and the vendor financial benefits or losses from the solution. It thus assesses the GHG impact of this common case of rebound effect due to changes in behaviour.

#### History

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## **Introduction**

The question of the environmental impacts of financial investments has been repeatedly raised over the past twenty years, in parallel with the concern of investment funds to assess the environmental impact of their choices [b-ADEME] [b-GHGP]. It is becoming increasingly important as financial actors are increasingly required to justify their priorities, not only in terms of financial profitability, which only exceptionally exceeds a time horizon of 5 to 6 years, but also in terms of their contribution to the sustainability of the planet's habitability.

Information and communication technologies (ICT) solutions (including ICT goods, ICT networks and ICT services), by improving processes, often enable economic efficiency gains through the reduction of costs they generate. By generating, in most cases, financial gains for economic actors, they contribute to overall economic growth.

Moreover, one consequence of the deployment of ICT solutions, sometimes their very objective, is to increase the financial benefits of users. Symmetrically, the associated business transaction is usually accompanied by a financial profit for the ICT solution vendor, or for the ICT organization.

The greenhouse gas (GHG) emissions consequences (modeled by a consequence tree) of the implementation of such an ICT solution therefore implies assessing these direct consequences, which are sometimes their very purpose: financial profits for the vendor on the one hand, and financial gains for the user on the other.

This Supplement gives guidance on how to evaluate these common cases of rebound effect, so as to take them into account when evaluating the GHG effects of an ICT solution.

These rebound effects related to financial gains (or in certain cases losses) fall into the category of behavioural changes resulting from the implementation of an ICT solution. Indeed, the allocation of the cash flow is decided by the economic actor, whether positive (financial gain) or negative (financial loss). This allocation decision is by nature new, thereby changing its behaviour with respect to the previous situation generating GHG effects, which can be positive or negative.

## Supplement 54 to ITU-T L-series Recommendations

### Guidance for assessing the greenhouse gas emissions consequences of the financial effects generated by information and communication technology

#### 1 Scope

This Supplement to ITU-T L.1400 series of Recommendations gives guidance for assessing the greenhouse gas (GHG) emissions consequences of financial effects (gains or losses) generated by an information and communication technologies (ICT) solution or ICT company, separately considering the user and the vendor financial benefits or losses from the solution. It thus assesses the GHG impact of this common case of rebound effect due to changes in behaviour.

More specifically it addresses financial effects on GHG emissions due to:

- changes in first order effects of ICT solutions (e.g., if reductions in energy consumption of networks lead to financial gains);
- changes in second order effects of ICT solutions (e.g., if reductions in travelling due to an ICT service leads to financial gains);
- changes in activities to reduce organizations' GHG emissions of ICT organizations (e.g., if an ICT company reduces its own travelling);
- other changes in organizational activities of ICT organizations (e.g., economically more attractive conditions for renting facilities unrelated to their energy consumption).

Financial gains or losses can be generated by the use of the ICT solution (i.e., on the customer or buyer side) or by the sale of the solution (i.e., on the vendor side). The guidance in this Supplement applies to both the vendor and the buyer (user), the only distinction being whether the buyer is an individual (or household) or a business.

NOTE – The approach described in this Supplement acknowledges that financial gains could be used in ways that either increase or decrease GHG emissions.

#### 2 References

- [ITU-T L.1410] Recommendation ITU-T L.1410 (2014), *Methodology for environmental life cycle assessments of information and communication technology goods, networks and services*.
- [ITU-T L.1420] Recommendation ITU-T L.1420 (2012), *Methodology for energy consumption and greenhouse gas emissions impact assessment of information and communication technologies in organizations*.
- [ITU-T L.1480] Recommendation ITU-T L.1480 (2022), *Enabling the Net Zero transition: Assessing how the use of information and communication technology solutions impact greenhouse gas emissions of other*.

#### 3 Definitions

##### 3.1 Terms defined elsewhere

This Supplement uses the following terms defined elsewhere:

**3.1.1 CO<sub>2</sub> equivalent (CO<sub>2</sub>e) [ITU-T L.1410]:** The universal unit of measurement to indicate the global warming potential (GWP) of each of the seven greenhouse gases, expressed in terms of the GWP of one unit of carbon dioxide. It is used to evaluate releasing (or avoiding releasing) different greenhouse gases against a common basis.

NOTE – See [b-GHGP].

**3.1.2 emission factor** [ITU-T L.1410]: A factor allowing GHG emissions to be estimated from a unit of available activity data (e.g., tonnes of fuel consumed, tonnes of product produced) and absolute GHG emissions.

NOTE – See [b-GHGP].

**3.1.3 environmental impact** [ITU-T L.1410]: Impact including positive and negative aspects on the environment.

**3.1.4 first order effects** [ITU-T L.1480]: Direct environmental effect associated with the physical existence of an ICT solution, i.e., the raw materials acquisition, production, use and end-of-life treatment stages, and generic processes supporting those including the use of energy and transportation.

NOTE 1 – First order effects include GHG and other emissions, e-waste, use of hazardous substances and use of scarce, non-renewable resources.

NOTE 2 – First order effects are sometimes referred to as environmental footprints.

NOTE 3 – This definition has been amended from [ITU-T L.1410].

**3.1.5 higher order effects** [ITU-T L.1480]: The indirect effects (including but not limited to rebound effects) other than first and second order effects occurring through changes in consumption patterns, lifestyles and value systems.

NOTE 1 – Rebound effects includes such as financial gains, savings in time and space, etc.

NOTE 2 – Higher order effects could be associated with both second and first order effects.

NOTE 3 – This is amended from [ITU-T L.1410] where it is referred to as other effects, and is also referred to as higher order effects in some academic literature.

**3.1.6 ICT organization** [ITU-T L.1420]: An ICT organization is an organization, the core activity of which is directly related to the design, production, promotion, sales or maintenance of ICT goods, networks or services.

**3.1.7 ICT solution** [ITU-T L.1480]: A system encompassing ICT goods, ICT networks and/or ICT services that contributes to meeting a technical, societal or business challenge.

**3.1.8 rebound effect** [ITU-T L.1480]: Increases in consumption due to environmental efficiency interventions that can occur through a price reduction or other mechanism including behavioural responses (i.e., an efficient product being cheaper or in other ways more convenient and hence being consumed to a greater extent).

NOTE 1 – This encompasses both price-induced and psychological rebound effects leading to behavioural changes.

NOTE 2 – Based on [b-EC-1]

**3.1.9 reference scenario** [ITU-T L.1480]: The situation without the studied ICT solution applied, i.e., a situation with only the reference activity in place.

**3.1.10 second order effects** [ITU-T L.1480]: The indirect impact created by the use and application of ICT which includes changes of environmental load due to the use of ICT that could be positive or negative.

NOTE 1 – Second order effects can be either actual or potential.

NOTE 2 – This definition has been amended from [ITU-T L.1410].

## **3.2 Terms defined in this Supplement**

This Supplement defines the following terms:

**3.2.1 financial effect:** Difference, over a given period, between revenue and expenses including taxes.



**3.2.2 financial gain:** Positive financial effect.

**3.2.3 financial loss:** Negative financial effect.

## **4 Abbreviations and acronyms**

This Supplement uses the following abbreviations and acronyms:

BACH Bank for the Accounts of Companies Harmonized

GDP Gross Domestic Product

GHG Greenhouse Gas

GWP Global Warming Potential

ICT Information and Communication Technologies

## **5 Assessment guidance**

### **5.1 Main principles and components of the calculation**

This Supplement distinguishes, according to the typology of the beneficiary economic actor of the financial gains or losses, between:

- a private individual who, depending on national regulations, will often be considered as a household in the tax sense,
- or a company.

In each case, account is taken, from the most precise to the least precise, of

- firstly, the actual allocation of these gains if it is known and traced;
- by default, according to the prior allocation of resources of the same nature by the economic actor;
- by default, according to the average allocation of financial resources by actors of the same category (individual/household or company activity sector).

NOTE – It is noted that the behaviour from the past may not fully reflect the behaviour of the future so changes in circumstances may also be considered.

This approach thus allows for a simple evaluation, at least in an initial approach, of the GHG emissions impact of the financial gains or losses generated by the implementation and use of ICT.

### **5.2 Guidance for assessing the consequences in GHG emissions of financial effects generated by ICT**

#### **5.2.1 Calculating financial effects**

Financial gains (or losses) generated by the ICT solution, or an ICT organization are measured according to the reference situation used in the consequence tree, with respect to the actor's financial situation and expenses without the implementation and use of the ICT solution.

This profitability is evaluated, over a given period, as net of any remaining expenses including taxes and duties, and thus corresponds to the cash flow effectively available to the economic actor.

NOTE – This Supplement focuses on effects in relation to financial gains or losses at a company level. For this reasons GHG emission effects of taxes and duties are not considered. However, it is acknowledged that changes in tax levels could also impact GHG emissions.

## 5.2.2 Calculation of the GHG emissions impact of financial gains or losses

### 5.2.2.1 Calculating the GHG emissions impact of financial gains or losses for an individual (or household / tax household)

#### A – Distribution of an individual's (or household) financial gains or losses

An individual's financial gains or losses are split between savings and consumption on an annual basis.

#### B – Allocation of an individual's financial gains or losses and duties

- If the allocation of the gains or losses is known or can be traced, they are allocated according to it.

Example: Gains used for debt reduction, or to purchase insurance related to the ICT solution.

NOTE – if a loan was taken out to acquire the ICT solution evaluated, the gains will be assumed to be allocated to the payment of the loan terms for the duration of the loan.

- By default, for gains or losses whose allocation is not tracked, they are allocated according to the individual's financial saving profile when it is known.

Example: when the bank has observed the average savings rate of its client over time, this observed personalized average rate can be applied.

Otherwise, non-tracked gains or losses of individuals with unknown financial savings profiles, are allocated according to the average saving propensity of individuals in their country of tax residence.

NOTE – Several databases are available to estimate household savings rate per country:

- World Bank: <https://data.worldbank.org/indicator/NY.GNS.ICTR.ZS>
- OECD: <https://data.oecd.org/hha/household-savings.htm>
- Data sources combined by Statista: <https://www.statista.com/statistics/246296/savings-rate-in-percent-of-disposable-income-worldwide/>

When there is no database or information available on a given country, for example because the country is poorly banked or there are not enough sources that can be measured on the spot during the given period (e.g., a period of instability), the ratio of a comparable country in terms of gross domestic product (GDP) per capita can be used, if possible in close geographical proximity, otherwise a household savings rate of zero or less than 5% can be used.

#### C – Calculating the GHG emissions consequences of an individual's financial gains or losses

- If the allocation of the gains or losses is known and it is linked to a specific GHG emissions consequence that is commonly recognized, the associated emission factor data should be applied.

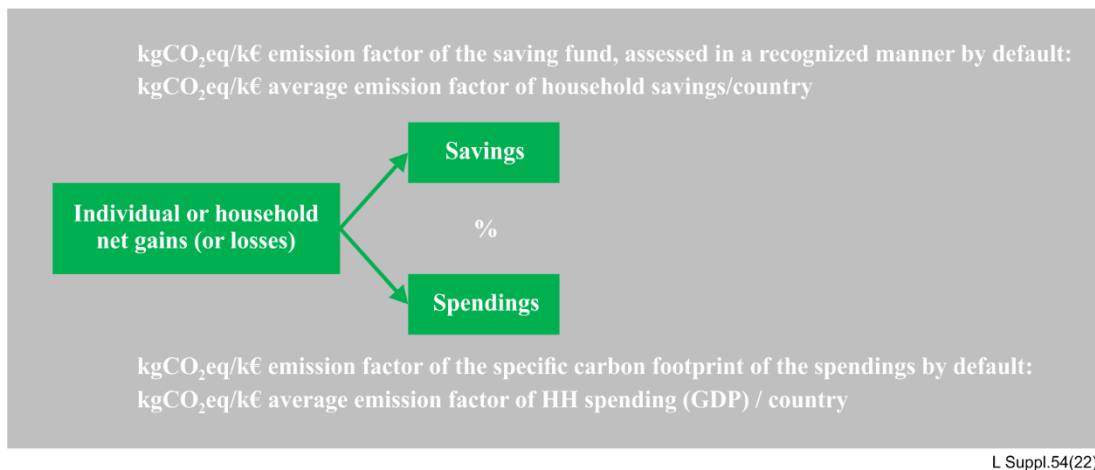
Example: allocation of gains to savings in a specific (ecological) investment fund, or to spending in a specific economic sector.

- By default, once the split between savings and consumption has been evaluated in a section, for the consumed part, the average kgCO<sub>2</sub>e/k€ (or applicable unit of account) emission factor of households in the considered country is applied.

Example: source World Bank, <https://data.worldbank.org/indicator/EN.ATM.CO2E.PP.GD>

- For the saved amount, apply:
  - the kgCO<sub>2</sub>e/k€ emission factor placed with the institution that manages the savings or that of the destination of the savings, depending on the fund selected, if either has been assessed in a recognized manner;
  - otherwise, the kgCO<sub>2</sub>e/k€ average emission factor of household savings in the country where the savings are invested.

Figure 1 shows a summary of GHG emissions consequences of an individual's (or household's) financial gains or losses calculation.



**Figure 1 – Calculating the GHG emissions consequences of an individual's or household's financial gains or losses**

### 5.2.2.2 Calculation of the GHG emissions impact of financial gains or losses

#### A – Uses of a company's financial gains or losses over a given period

The allocation of a company's gains or losses can be split in three options:

- reinvestment in the company (or taking from the company's reserve in case of loss),
- distribution to the owners of the company (shareholders if company is listed on stock market),
- distribution to employees (profit-sharing, incentives or salary increases and extra bonuses).

#### B – Allocation of a company's financial gains or losses over a given period

- If the allocation of gains or losses is known or can be traced, the earnings are allocated according to this allocation.

Example: Exclusive allocation of gains to the purchase GHG emissions sinks shares.

Allocation to a specific use or project should be applicable only for companies that isolate the allocation in their accounts in an auditable manner, without any circumvention (such as for an "earmarked tax").

Example: "80% of our profits on this offer are allocated to ...", with the associated auditable control.

This allocation can be partial, in which case the percentage not allocated is evaluated as in the following section.

- If no preferential allocation is known, the gains or losses are split between the three possibilities detailed above.

The percentage allocated to each possibility is determined according to the history of the company's use of its after-tax profit, preferably averaged over more than one year:

- with a degressive factor of 2 per year beyond year (n-1) so as to give more weight to the most recent behaviour of the company, and
- with a weighting proportional to the amount of the company's profit or loss in order to take into account the magnitude of the distribution decision in the year in question.

Example: During year (n), a listed company made a profit of 20, invested 80% in the company, 15% to shareholders and 5% to employees; during year (n-1) it made a profit of 1,000, invested 10% in the company, 70% to shareholders and 20% to employees.

The average distribution ratio of its financial gains is then calculated as follows:

Company:  $(1 \times 20 \times 0.8 + 1/2 \times 1,000 \times 0.1) / (1 \times 20 + 1/2 \times 1,000) = 12.69\%$

Shareholders:  $(1 \times 20 \times 0.15 + 1/2 \times 1,000 \times 0.7) / (1 \times 20 + 1/2 \times 1,000) = 67.88\%$

Employees:  $(1 \times 20 \times 0.05 + 1/2 \times 1,000 \times 0.2) / (1 \times 20 + 1/2 \times 1,000) = 19.42\%$

NOTE 1 – In the case of a financial loss generated by the ICT solution, this loss, which reduces the after-tax profit, can be split according to the same rules.

NOTE 2 – In the case where the company distributes more than its year n financial gains, the proportions of the observed distribution are to be used, and the weighting for this year n is the amount distributed.

## **C – Calculating the GHG emissions consequences of a company's financial gains or losses**

### **i) Calculation of the GHG emissions consequences of the share of financial gains reinvested in the company (or of financial losses requiring taking from company's reserve)**

#### – Data availability

This amount of financial gains or losses, when not directly available, is calculated from the profit or loss after tax, after deduction of dividends paid to shareholders during the year, and of profit-sharing, incentives and exceptional bonuses also distributed during the year to employees.

In the absence of a financial report specifying these points, this information is included in the company's accounting data, usually available at a registry office.

#### – Calculus

The kgCO<sub>2</sub>e/k€ of financial assets of the company's sector of activity is applied to the relevant geography, which provides the emissions per monetary unit of assets per country for the sector [b-ADEME].

The data are taken from the Bank for the Accounts of Companies Harmonized (BACH) database, by applying correspondences with the French or Organisation for Economic Co-operation and Development (OECD) nomenclatures (cf. p. 124 in [b-ADEME]). However, this database only contains data for certain European countries (Austria, Belgium, Czech Republic, France, Germany, Italy, Luxembourg, Netherlands, Poland, Portugal and Spain).

BACH database (access upon registration):

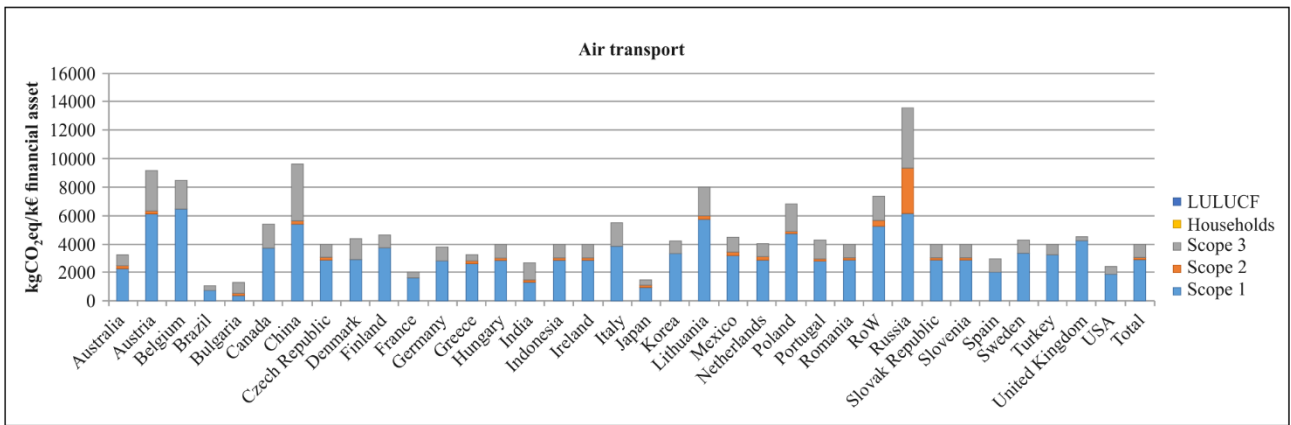
- <https://entreprises.banque-france.fr/etude/la-base-bach-des-comptes-dentreprises-europeennes>
- <https://www.bach.banque-france.fr/>

For other geographical regions, equivalent bases should be applied.

When there is no database or information available on a given country, for example due to the lack of measurable sources over the given period (for example due to civil instability or absence of a measurement agency), the ratio of the activity sector in a comparable country in terms of GDP per capita, preferably geographically close, can be used. Otherwise, the average emission factor in the country, or in a comparable country if it is not known, of the financial investments for all sectors combined can be used.

In case of multiple activities or geographical areas, distribution keys can be used, according to the volume of business in the activity or geographical area.

Figure 2 shows an example regarding air transport GHG emission factors per country.



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**Figure 2 – Example regarding air transport GHG emission factors per country** Source: [b-ORSE]

Table 1 and Table 2 give further details regarding the BACH database.

**Table 1 – Sectors considered in the BACH database:**

01 Aeronautics/Aerospace	13 Distribution/Industry/Goods/Consumption
02 Maritime	14 Energy
03 Other Transports	15 Immovable/Real estate
04 Agrifood	16 Information/Technology
05 Assurance	17 Media/Editing
06 Automotive	19 Health/Pharmacy
07 Heavy Industries	20 Non-commercial services
08 Other Industries	21 Telecom
09 Banks	22 Tourism/Hotel/Restaurant
10 Other financial activities	23 Utilities
11 Wood/Paper/Packaging	24 Other
12 Building and civil engineering	(no #18)

The resulting investment data by sector and geography in terms of GHG emissions are available in the Excel file produced by ADEME and Carbone4, established by correspondence (pages 124-126 in [b-ADEME]) on the following sectors listed in Table 2:

**Table 2 – ADEME/Carbon4 sectors**

1. Agriculture, Hunting, Forestry and Fishing	20. Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles
2. Mining and Quarrying	21. Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods
3. Food, Beverages and Tobacco	22. Hotels and Restaurants
4. Textiles and Textile Products	23. Inland Transport
5. Leather, Leather and Footwear	24. Water Transport
6. Wood and Products of Wood and Cork	25. Air Transport
7. Pulp, Paper, Paper, Printing and Publishing	26. Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies
8. Coke, Refined Petroleum and Nuclear Fuel	27. Post and Telecommunications
9. Chemicals and Chemical Products	28. Real Estate Activities
10. Rubber and Plastics	29. Renting of Machinery and Equipment and Other Business Activities
11. Other Non-Metallic Mineral	30. Public Admin and Defense; Compulsory Social Security
12. Basic Metals and Fabricated Metal	31. Education
13. Machinery, Not elsewhere classified	32. Health and Social Work
14. Electrical and Optical Equipment	33. Other Community, Social and Personal Services
15. Transport Equipment	34. Average
16. Manufacturing, Not elsewhere classified; Recycling	
17. Electricity, Gas and Water Supply	
18. Construction	
19. Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel	

**ii) Calculation of the GHG emissions consequences from the share of financial resources distributed to the company's owners**

The company has shareholders, whether listed or not.

The calculation is made in principle for each shareholder; however, in practice the main owners are identified, i.e., those whose sum represents at least a third of the shareholders, the others being considered, in the absence of more precise information, as individual persons in countries where the company is active in proportion to this activity.

If the shareholders are individuals, the dividends are treated as expenses of an individual in the country concerned, according to the same rules.

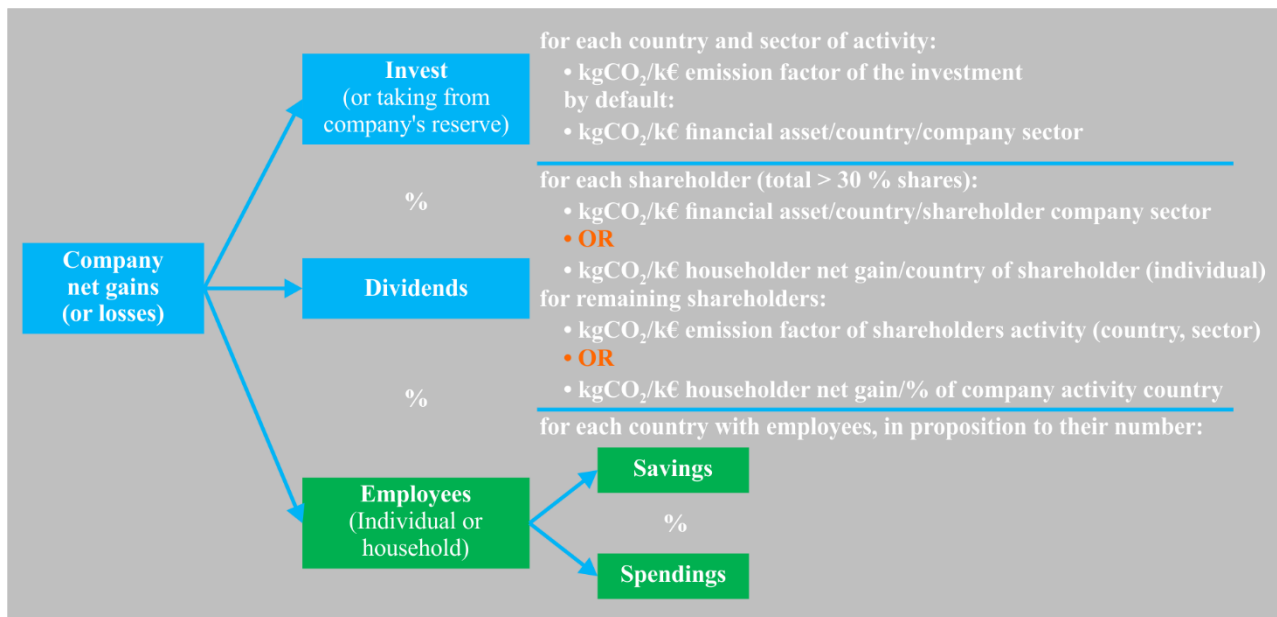
If the shareholders are companies, the geographical area and main sector of activity of the shareholder company are considered. Dividends are then treated as reinvestments in these companies, as described above.

Individual shareholders with a small number of shares are treated as residents in the territories of activity of the company, in proportion to the company revenues in the territory.

**iii) Calculation of the GHG emissions consequences resulting from the share of financial resources distributed to employees**

It is allocated according to the employees' geographical area, split between savings and consumption as indicated above.

Figure 3 shows a summary of GHG emissions consequences of a company's financial gains or losses calculation.



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**Figure 3 – Calculation of the GHG emissions consequences of a company's financial gains or losses**

### 5.3 Calculating the GHG emissions effects generated by the financial gains or losses over several years of the implementation of an ICT solution

The calculation of the GHG emissions effects generated by the financial gains or losses generated by the ICT solution is done each year the solution takes effect, based on the data available at the time the estimate is made.

As with each of the consequences of the ICT solution in the consequence tree, this estimate needs to be updated based on actual observed financial behaviour (household savings/consumption distribution and observed distribution of net corporate earnings), and changes in external factors in the databases, such as decarbonization of the gross domestic product (GDP) in countries or financial investment direction towards green funds.

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