Documentation of changes implemented in the ecoinvent database v3.7 & v3.7.1

(2020.12.17)

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1 Introduction

After releasing v3.7 in September 2020, a critical error was identified that pushed to the publication of v3.7.1 in December 2020. Namely, the iron sinter production dataset included in v3.7 an error in the estimated emissions for dioxins and PM. As iron and steel supply chains are central in the database, issues with such datasets can have implications on the accuracy of the ecoinvent database. Specifically, the error distorts the results of human health & ecotoxicity indicators on most methods. This report details all changes done from v3.7 to v3.7.1, insisting in the effects on results those updates have. Users working with v3.7 already can therefore decide whether their work can be affected by the updates brought by v3.7.1 or not.

Otherwise, this report covers the changes to the ecoinvent database between version 3.6, released in 2019 and version 3.7, released in September 2020, describing both the database-wide changes that affect the whole database as well as the specific changes in the different sectors. These changes consist in the addition of new datasets, in the deletion of outdated ones, and in the update, re-modelling or corrections of others.

All changes described in this report potentially affect or modify impact assessment results, even when they seem as minor as changing an activity link. The description of the changes has been provided to help the users with the interpretation and understanding of the possible changes in results they might encounter when comparing the new version (v3.7) with the old one (v3.6).

For a full comparison, at the exchange level, between the versions of the database, the Change Report Annex can be downloaded as an excel file from the “Files” section of the ecoQuery by license holders only. This file lists all activities highlighting its changes, it also aligns the 2 versions of the activities, at the flow level, to allow change tracking.

Correspondence files for each system model, as well as for the Undefined database are provided together with this report; they can be checked for equivalences in case of deletion or disaggregation of activities.

More information about the technical background of the sectors can be found in the dedicated sectorial pages, on the ecoinvent website.

2 Summary of updates in v3.7.1 and consequences in results

2.1 Updates in v3.7.1

2.1.1 "Iron sinter production"

The "iron sinter production" activities in RER and GLO contained a mistake in the estimation of the emissions of "Particulates, > 10 um", "Particulates, > 2.5 um, and < 10um" and "Dioxins, measured as 2,3,7,8-tetrachlorodibenzo-p-dioxin". In addition, the datasets lacked emissions for "Particulates, < 2.5 um".

The added and corrected elementary exchange/s and their respective amounts are presented in the table below:

Elementary exchange name	Corrected amounts v3.7.1 (kg)	Amounts v3.7 (kg)
Particulates, > 10 um	9.38E-05	1.51E-04
Particulates, > 2.5 um, and < 10um	1.96E-05	1.08E-04
Particulates, < 2.5 um	1.20E-04	-
Dioxins, measured as 2,3,7,8-tetrachlorodibenzo-p-dioxin	1.55E-12	1.5492E-09

2.1.2 "Zinc mine operation"

In the activity "zinc mine operation, GLO", the exchange amount of the input from the environment "Gold, in ground" (compartment: "natural resource"; subcompartment: "in ground") has changed from 1.37E-03 kg to 1.04E-06 kg, based on updated data supplied by the data provider, the International Zinc Association.

2.1.3 "Ammonium paratungstate production, solvent extraction"

The uncertainty distribution in all exchanges has been changed from "uniform" to "lognormal" in all geographical occurrences of the activity "ammonium paratungstate production, solvent extraction". While this change will not affect calculated results (scores), it will enhance the uncertainty analysis on the datasets and its supply chains.

2.2 Consequences in results: differences between v3.7 and v3.7.1 results

272 indicators covering all impact categories were analysed to write this report. The aggregated "total" indicators are not represented in the graphs or text in the following sections, as the change those indicators represent is better captured and understood with the specific indicators from the same method. Using the 258 remaining indicators, changes in results between v3.7 and 3.7.1 have been analysed and are presented in the following sections for each system model. A full numerical report, comparing the scores between the 2 versions for all system models, with all 272 indicators is available as an excel file annex to this file, the "dataset score comparison, for change report (3.7 vs 3.7.1, all system models)".

The results of the database change visibly from v3.7 to v3.7.1 for some indicators and categories, while they remain unchanged for most of the others. Namely, the categories **human toxicity and ecotoxicity, and mineral resources** are affected for most indicators in all system models. On the other hand, the impact categories climate change, water depletion, cumulative energy demand, land use and land use change, fossil depletion, acidification, eutrophication, ionising radiation, renewable resources, stratospheric ozone depletion, photochemical oxidant formation, radioactive substances and ozone layer depletion, remain basically unaffected.

2.2.1 Changes in the "allocation, cut-off by classification" system model

Only 57 indicators changed results between v3.7 and v3.7.1 in the cut-off system model. They all fall into one of the mentioned categories: **human toxicity, ecotoxicity or mineral resources.**

From those 57, 13 showed minor changes (under 6%) in only the "iron sinter production" datasets and are therefore not explicitly represented in the following graphs. Those are: CML 2001 (superseded)-freshwater aquatic ecotoxicity-FAETP infinite; CML 2001 (superseded)-freshwater aquatic ecotoxicity-FAETP 100a; CML 2001 (superseded)-freshwater aquatic ecotoxicity-FAETP 20a; CML 2001 (superseded)-freshwater aquatic ecotoxicity-FAETP 500a; CML 2001 (superseded)-marine sediment ecotoxicity-MSETP infinite; eco-indicator 99, (E,E) (superseded)-ecosystem quality-ecotoxicity; eco-indicator 99, (H,A) (superseded)-ecosystem quality-ecotoxicity; EDIP2003-human toxicity-via soil; EDIP2003-human toxicity-via air; ReCiPe Midpoint (E) V1.13-human toxicity-HTPinf; ReCiPe Midpoint (E) V1.13-particulate matter formation-PMFP; ReCiPe Midpoint (H) V1.13-particulate matter formation-PMFP; ReCiPe Midpoint (I) V1.13-particulate matter formation-PMFP.

Finally, 7 indicators are not represented in the graphs as they showed small changes (under 10%) in a very reduced number of datasets (under 17), and were covered by similar indicators. Those are: CML 2001 (superseded)-freshwater sediment ecotoxicity-FSETP infinite; CML 2001 (superseded)-freshwater sediment ecotoxicity-FSETP 20a; CML 2001 (superseded)-freshwater sediment ecotoxicity-FSETP 500a; CML 2001 (superseded)-freshwater sediment ecotoxicity-FSETP 100a; CML 2001 (superseded)-marine aquatic ecotoxicity-MAETP 500a; CML 2001 (superseded)-terrestrial ecotoxicity-TAETP infinite; CML 2001 (superseded)-terrestrial ecotoxicity-TAETP 500a.

The changes in results from v3.7 to v3.7.1 obtained with the remaining 37 indicators are represented in the following graphs.

The correction done in the "iron sinter production" datasets affects elementary exchanges that are important to calculate **human health** indicators (dioxins, PM). As it can be seen in Figure 1, changes in the human health category are the most visible ones in the change between v3.7 and v3.7.1, especially with the ecological scarcity method. With this method, the impacts of around 60% of the datasets in the database are reduced by more than 90% with the indicator "carcinogenic substances into air". The correction does not drive so dramatic changes in other methods; it can be seen in Figure 1 that most of the other indicators experience changes of around a 10% reduction or increase in scores.

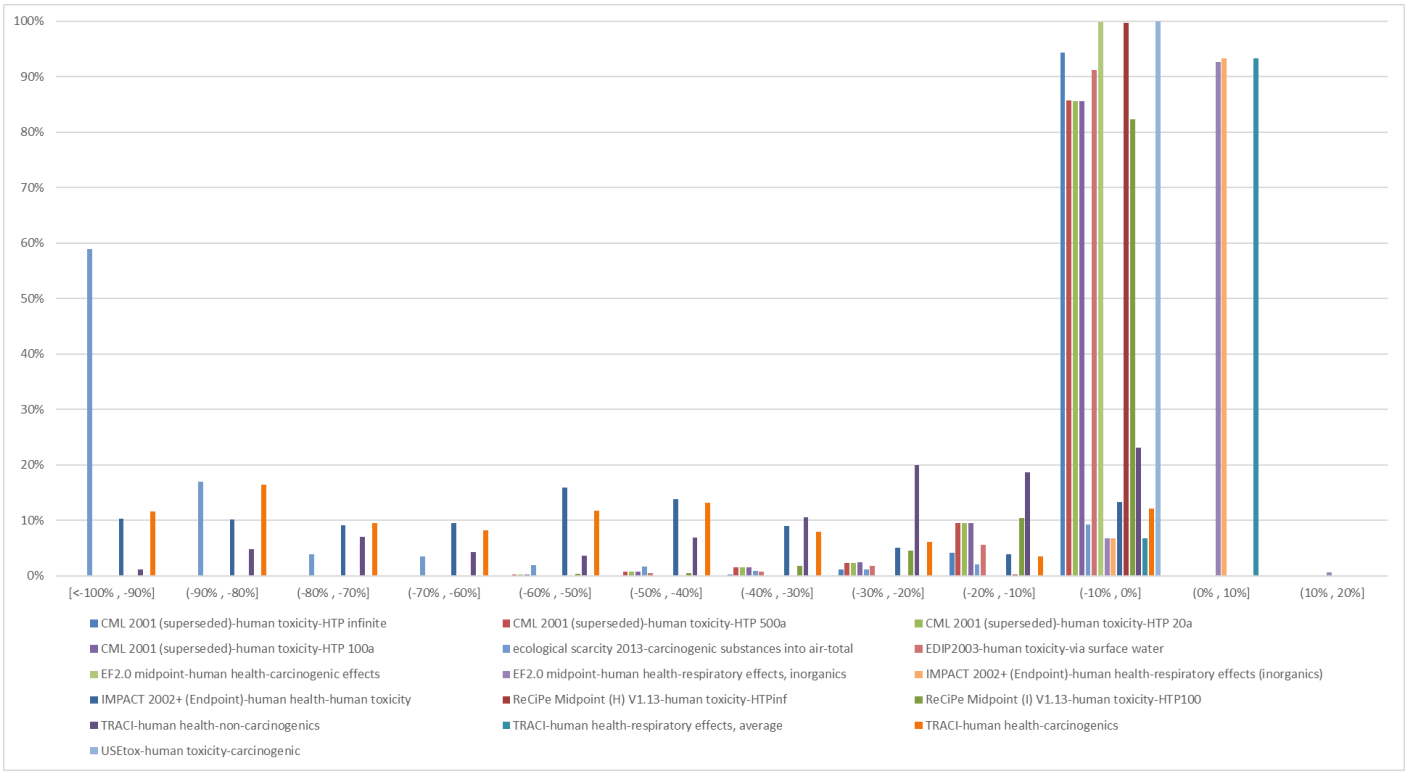


Figure 1. Changes in results obtained for human health categories between v3.7 and v3.7.1 in the cut-off system model*. As described in the text, indicators were selected to capture the change in results under this category. The vertical axis represents the proportion of datasets affected by a change in scores between v3.7 and v3.7.1 (the ecoinvent database contains more than 19'000 datasets in this system model, 10% of the database covers more than 1'900 datasets). The horizontal axis shows the changes in scores between v3.7 and v3.7.1, grouped in intervals.*

The correction to the "iron sinter production" also drives changes in the scores calculated for **ecotoxicity** indicators when comparing v3.7 and v3.7.1 as mentioned. In this case, the changes remain more discreet. As can be seen in Figure 2, almost 100% of the datasets in the database experience a 10% decrease in the scores calculated with the indicators listed, when comparing v3.7 and v3.7.1 results.

Figure 2. Changes in results obtained for ecotoxicity categories between v3.7 and v3.7.1 in the cut-off system model. *As described in the text, indicators were selected to capture the change in results under this category. The vertical axis represents the proportion of datasets affected by a change in scores between v3.7 and v3.7.1 (the ecoinvent database contains more than 19'000 datasets in this system model, 10% of the database covers more than 1'900 datasets). The horizontal axis shows the changes in scores between v3.7 and v3.7.1, grouped in intervals.*

The update in the gold intake of the "zinc mine operation" dataset affects the results related to **mineral resources**. It can be seen in Figure 3 that the correction is captured differently by the different methods and indicators, but overall a big part of the database is affected by the change, in different proportions. Most of the changes point at reductions in scores between 10-40% between v3.7 and v3.7.1, although more dramatic reductions are observed with the EF2.0 method (up to 90% for 20% of the datasets in the database). With the CML method, around 95% of the database experience a reduction of maximum 10% in scores, when comparing v3.7 and v3.7.1 results.

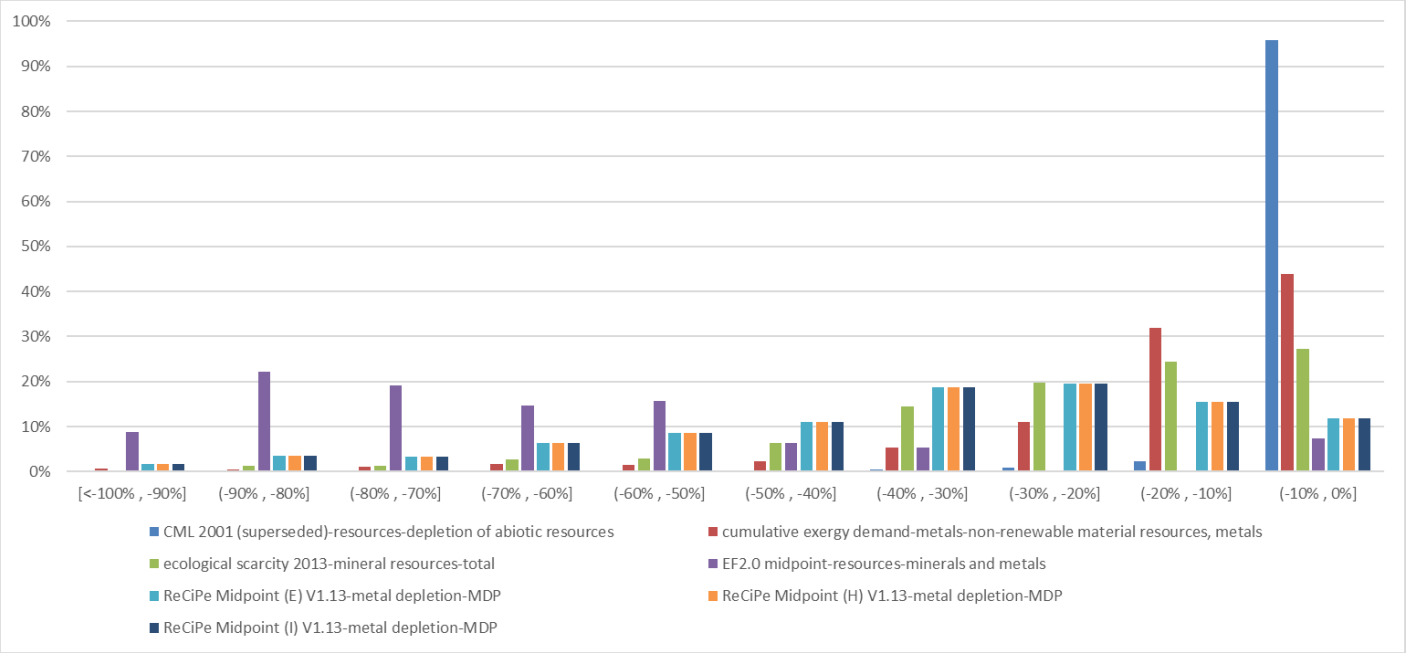


Figure 3. Changes in results obtained for mineral resource categories between v3.7 and v3.7.1 in the cut-off system model. *As described in the text, indicators were selected to capture the change in results under this category. The vertical axis represents the proportion of datasets affected by a change in scores between v3.7 and v3.7.1. The horizontal axis shows the changes in scores between v3.7 and v3.7.1, grouped in intervals.*

2.2.2 Changes in the "allocation at the point of substitution" system model

Overall, the changes in results are very similar as what is observed with the cut-off system model. In the APOS system model, changes in scores are observed in 63 indicators.

The 13 indicators that in cut off showed only changes in results of the "iron sinter production" datasets, show here changes in results to more datasets (up to 46), but still very low (under 7% change), and are again not included in the graphs. Similarly, the same 7 indicators mentioned in cut-off are not represented in the graphs as they showed small changes (under 10%) in still a reduced number of datasets and were covered by similar indicators.

The difference with cut-off comes with the results obtained in 6 indicators, where a small number of datasets (up to 9, depending on the indicators) are affected, showing very small changes in scores when comparing v3.7 and v3.7.1 (under 5%): eco-indicator 99, (E,E) (superseded)-ecosystem quality-land occupation; eco-indicator 99, (H,A) (superseded)-ecosystem quality-land occupation; eco-indicator 99, (I,I) (superseded)-ecosystem quality-land occupation; ecosystem damage potential-total-linear, land transformation; EF2.0 midpoint-climate change-climate change biogenic; IMPACT 2002+ (Endpoint)-ecosystem quality-terrestrial ecotoxicity.

Those changes are identified around the value chain for the product "iron scrap, unsorted", and reflect the way APOS results are calculated allocating impacts through the value chain. Although those indicators fall out of the categories human health, ecotoxicity or mineral resources, the change is extremely low and can be considered a consequence of APOS allocation method.

Changes are shown for the remaining 37 indicators in the following graphs, covering the categories **human health, ecotoxicity and mineral resources**. The interpretation and changes in results are extremely similar as those observed with cut-off, and can be read in section 2.2.1.

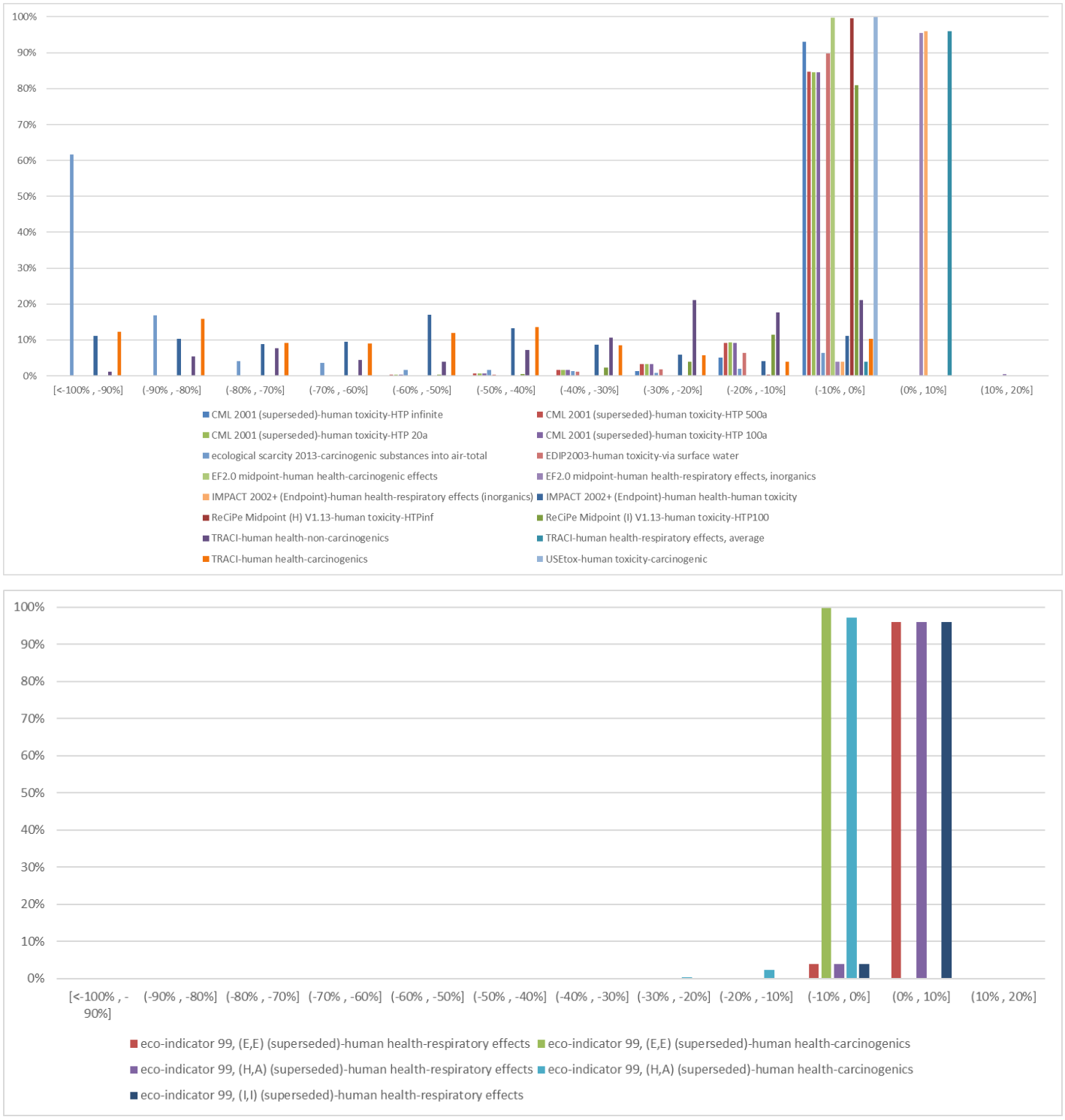


Figure 4. Changes in results obtained for human health categories between v3.7 and v3.7.1 in the APOS system model. *As described in the text, indicators were selected to capture the change in results under this category. The vertical axis represents the proportion of datasets affected by a change in scores between v3.7 and v3.7.1(the ecoinvent database contains more than 19'000 datasets in this system model, 10% of the database covers more than 1'900 datasets). The horizontal axis shows the changes in scores between v3.7 and v3.7.1, grouped in intervals.*

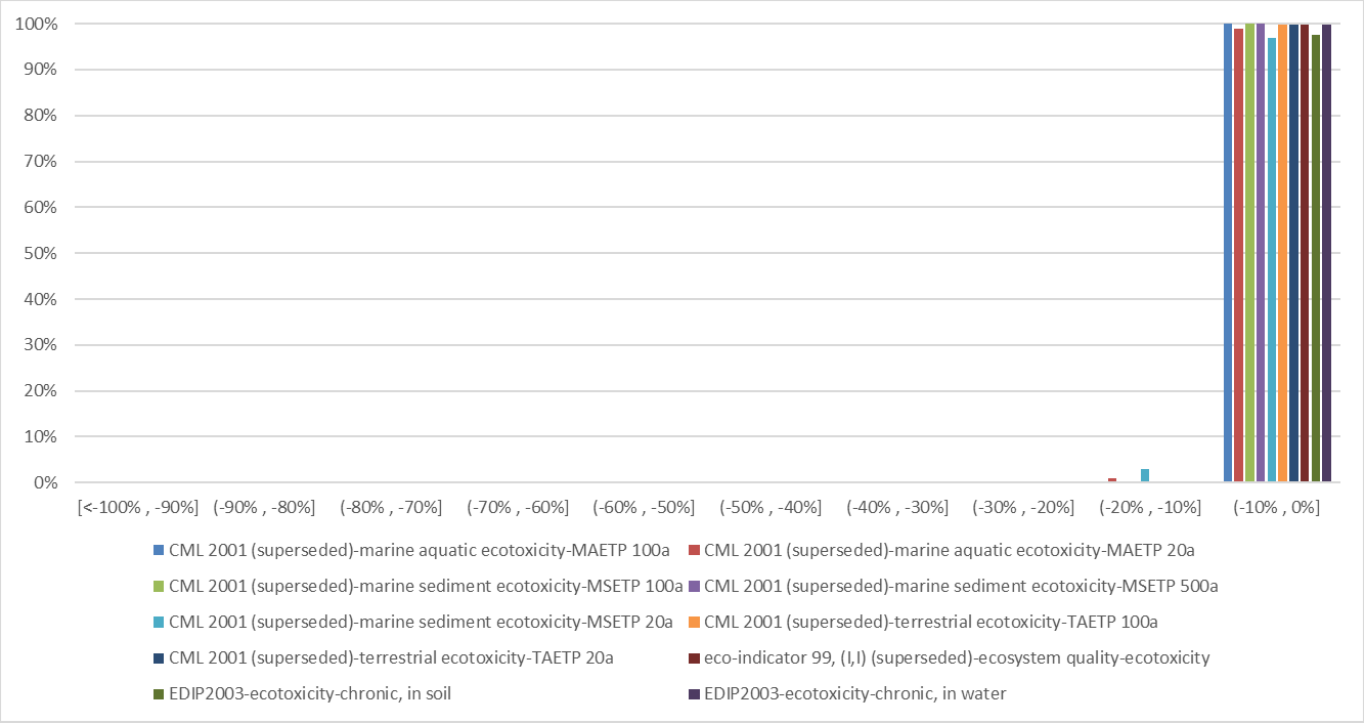


Figure 5. Changes in results obtained for ecotoxicity categories between v3.7 and v3.7.1 in the APOS system model. *As described in the text, indicators were selected to capture the change in results under this category. The vertical axis represents the proportion of datasets affected by a change in scores between v3.7 and v3.7.1 (the ecoinvent database contains more than 19'000 datasets in this system model, 10% of the database covers more than 1'900 datasets). The horizontal axis shows the changes in scores between v3.7 and v3.7.1, grouped in intervals.*

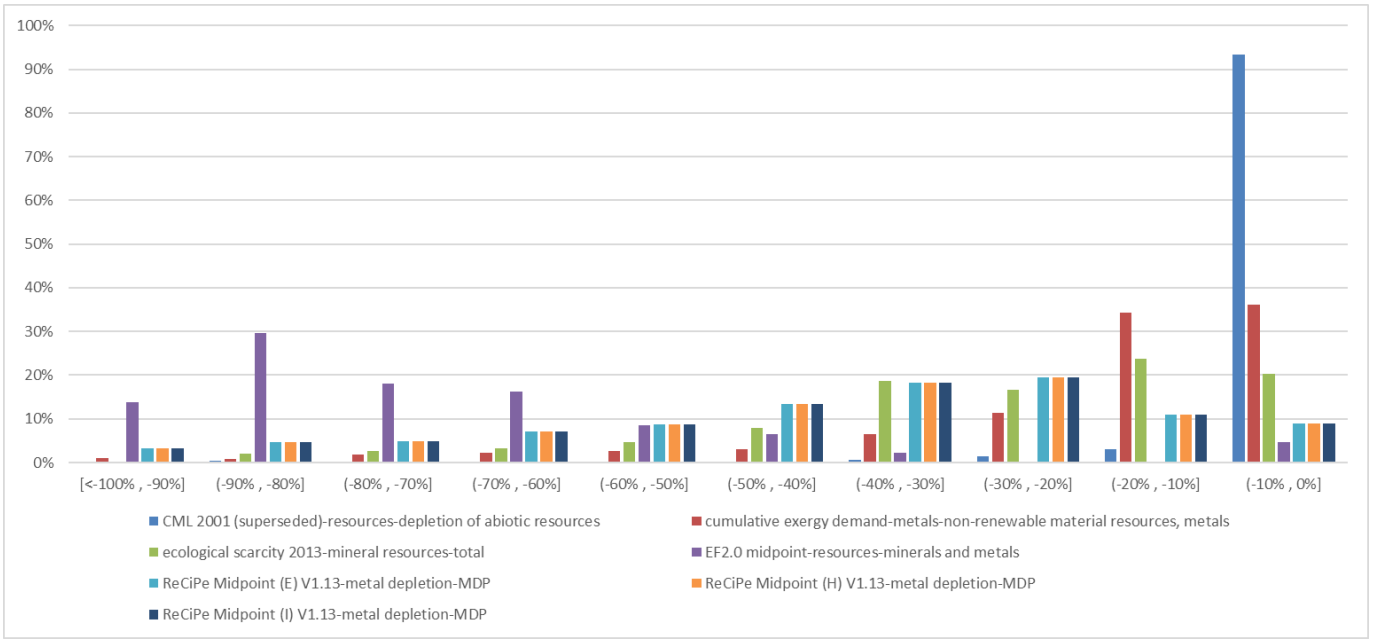


Figure 6. Changes in results obtained for mineral resources categories between v3.7 and v3.7.1 in the APOS system model. *As described in the text, indicators were selected to capture the change in results under this category. The vertical axis represents the proportion of datasets affected by a change in scores between v3.7 and v3.7.1 (the ecoinvent database*

contains more than 19'000 datasets, 10% of the database covers more than 1'900 datasets). The horizontal axis shows the changes in scores between v3.7 and v3.7.1, grouped in intervals.

2.2.3 Changes in the "substitution, consequential, long-term" system model

Although the amounts of the corrected elementary exchanges have decreased from version 3.7 to 3.7.1, the LCIA scores of some datasets in the Consequential system model have increased. This is the result of substitution, whereby processes get credited with negative impact scores associated with products that are produced as by-product. As the LCIA scores generally decreased between versions 3.7 and 3.7.1, this means that the processes that are credited with negative impact scores get a smaller credit in version 3.7.1, resulting in an increase of their LCIA scores.

For two datasets, "helium, crude stockpiling" in the US and the GLO "market for helium, crude" (which is supplied by the first), the LCIA scores fluctuate greatly (in relative terms) between versions 3.7 and 3.7.1 for all indicators. This is due to numerical rounding. Based on the modelling of the US dataset for "helium, crude stockpiling", its impact scores are actually meant to be equal to 0 for all indicators, as the scores of its contributors are supposed to cancel each other out. However, due to numerical rounding, the contributions do not cancel each other out, and the resulting scores of the two datasets are never exactly 0. Although the LCIA scores are very close to 0 in both version 3.7 and 3.7.1, they have very large relative changes, therefore those relative changes are considered irrelevant for this analysis.

For some processes in the Consequential system model, the credits from avoided by-products are so large that the LCIA scores of the credited process are close to 0, or even negative. This leads in some cases to the total LCIA score of the process being quite small in spite of large contributions (both positive and negative) from the inputs from the technosphere and the elementary exchanges contained in the process. This means that even very small changes in the scores (or characterization factors) of the contributing exchanges can lead to noticeable relative changes in the total LCIA scores of the process.

In this system model, 61 indicators change for more than 4 datasets in the database, all of them under the categories **human health, ecotoxicity or metal depletion.** From those, the indicators: ReCiPe Midpoint (E) V1.13-particulate matter formation-PMFP; ReCiPe Midpoint (H) V1.13-particulate matter formation-PMFP; ReCiPe Midpoint (I) V1.13-particulate matter formation-PMFP change less than 9% for a reduced number of datasets (19), so they are not shown in the following graphs.

The remaining 58 indicators are represented in the following graphs.

The correction of "iron sinter production" datasets drives the changes in results under **human health** categories between v3.7 and v3.7.1. For consequential, similarly as in the other two system models, it is the ecological scarcity method that most dramatically reflects those changes (Figure 7). More than 60% of the database (the consequential system model contains around 17'300 datasets) experiences a reduction of more than 90% on the results obtained with the indicator "carcinogenic substances into air" between v3.7 and v3.7.1, as a consequence of the correction in the "iron sinter production" datasets. The effects of the correction are also more visible than in the attributional system models when using TRACI and IMPACT 2002+; up to 20% of the database experiences a 90% reduction in scores using those methods when comparing v3.7 and v3.7.1.

Most of the other indicators point at changes in scores of around 10% (increase or decrease) affecting between 70% and 90% of the database, due to the same correction on the "iron sinter production" datasets.

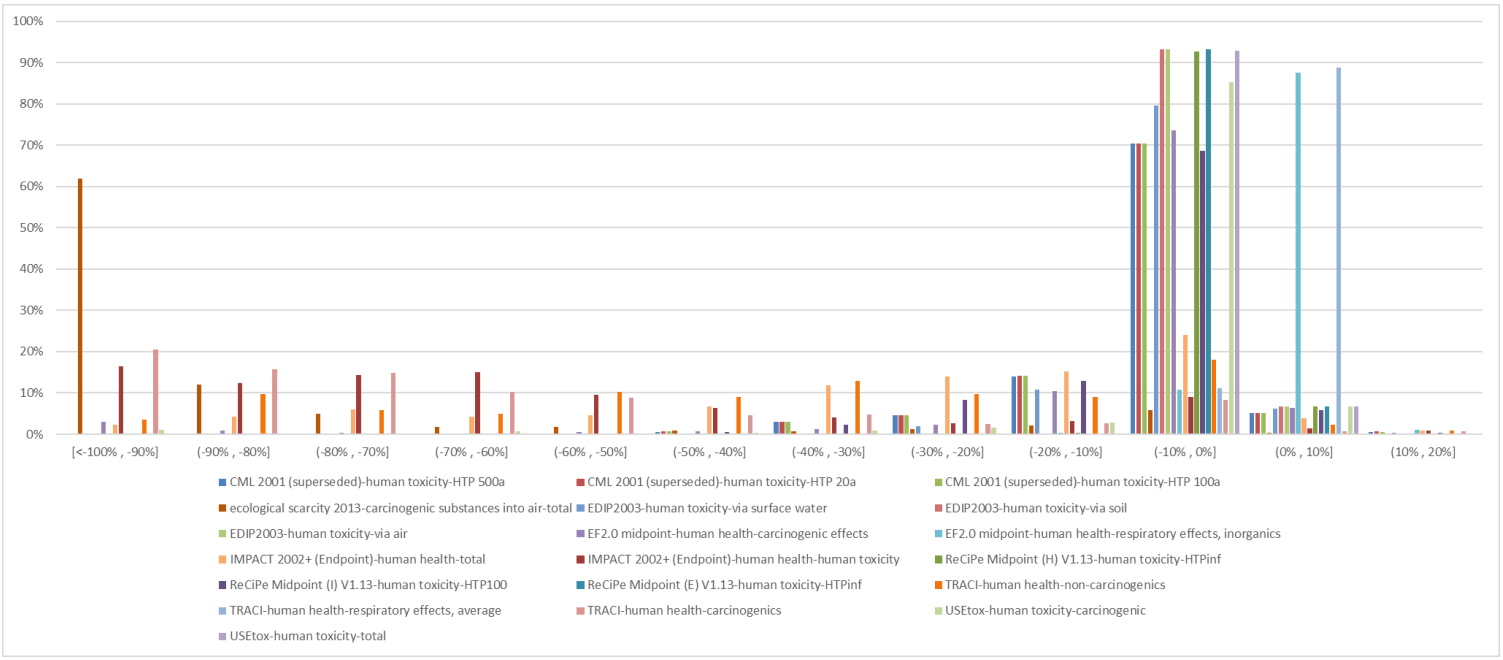


Figure 7. Changes in results obtained for human health categories between v3.7 and v3.7.1 in the consequential system model. *As described in the text, indicators were selected to capture the change in results under this category. The vertical axis represents the proportion of datasets affected by a change in scores between v3.7 and v3.7.1 (the ecoinvent database contains more than 17'000 datasets in this system model, 10% of the database covers more than 1'700 datasets). The horizontal axis shows the changes in scores between v3.7 and v3.7.1, grouped in intervals.*

The correction to the “iron sinter production” also drives changes in the scores calculated for **ecotoxicity indicators** when comparing v3.7 and v3.7.1 as mentioned. In Figure 8 almost 100% of the datasets in the database change their scores with the mentioned indicators, in the direction of a 10% decrease or increase. Some indicators bring larger changes, but to very small parts of the database. The full details of the changes can be seen in the annex excel file “dataset score comparison, for change report (3.7 vs 3.7.1, all system models)”.

Finally, the update in the gold intake of the “zinc mine operation” dataset affects the results related to **mineral resources**. It can be seen in Figure 9 that the correction affects the results obtained with different methods and indicators to different levels, in this system model. Around 20% of the datasets in the database will have scores reduced between 30-40% in the ReCiPe and EF2 mineral resources indicators due to the update, when comparing v3.7 and v3.7.1 calculated with the consequential system model. With the EPS200 and the CML method, more than 90% of the database experience a reduction of maximum 10% in scores, when comparing v3.7 and v3.7.1 results.

Figure 8. Changes in results obtained for ecotoxicity categories between v3.7 and v3.7.1 in the consequential system model. *As described in the text, indicators were selected to capture the change in results under this category. The vertical axis represents the proportion of datasets affected by a change in scores between v3.7 and v3.7.1 (the ecoinvent database contains more than 17'000 datasets in this system model, 10% of the database covers more than 1'700 datasets). The horizontal axis shows the changes in scores between v3.7 and v3.7.1, grouped in intervals.*

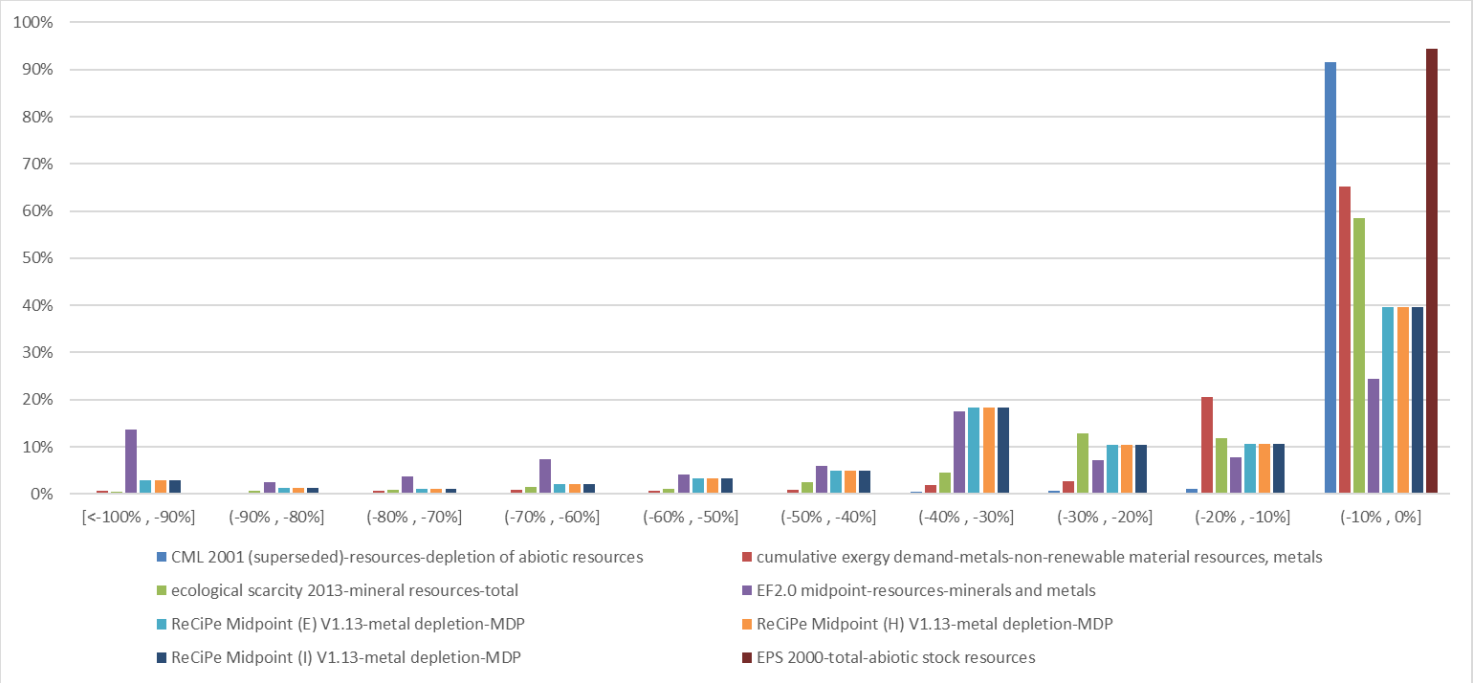


Figure 9. Changes in results obtained for mineral resources categories between v3.7 and v3.7.1 in the consequential system model. *As described in the text, indicators were selected to capture the change in results under this category. The vertical axis represents the proportion of datasets affected by a change in scores between v3.7 and v3.7.1 (the ecoinvent database contains more than 17'000 datasets in this system model, 10% of the database covers more than 1'700 datasets). The horizontal axis shows the changes in scores between v3.7 and v3.7.1, grouped in intervals.*

3 Summary of updates & additions in v3.7

With ecoinvent 3.7, 900 datasets are added new and 1'000 datasets are updated in the database, including more than 100 new products. This update expands the coverage of the database in various sectors such as metals, fertilisers, forestry and wood, packaging materials, waste/recycling, and biogas supply chains, while the electricity market mixes are also updated.

3.1.1 Building and construction materials

This version publishes an updated version of ISOVER Saint Gobain glass wool mat data for Switzerland. This branded product is now modelled with two alternative adhesives in the database.

3.1.2 Energy

For the v3.7 release, attributional electricity market mixes are updated to represent the situation in 2017 for most countries. In the case of US and Canada, the reference year is 2018.

ecoinvent version 3.7 also introduces new data on biogas production and supply chains for Switzerland.

3.1.3 Fertilisers

ecoinvent 3.7 includes new and updated data on mineral fertiliser production from Yara & Fertilizers Europe. Additionally, the markets and market mixes for the fertilisers' sector have been restructured and updated, separating and regionalising the provision of organic and mineral fertilisers for nutrient supply.

3.1.4 Metals

The Metals sector has been updated with new and updated data on copper, cobalt (from Cobalt Institute), iron and steel, and scarce metals such as nickel, rare earths, tungsten or beryllium. The datasets for aluminium in North America have also been revised with data contributed by the Aluminium Association of Canada.

3.1.5 Paper & Pulp

Version 3.7 introduced updates in data related to packaging material. Specifically, it includes updated data from industry associations Pro-Carton, ECMA European Carton Makers Association, Eurosac and CEPI Eurokraft on cartonboard, kraft paper and paper sacks.

3.1.6 Waste Management & Recycling

With version 3.7, the Waste Treatment and Recycling sector has been enhanced with new data on recycling activities of packaging materials, namely a range of new regional data for Europe and Switzerland on the recycling of beverage cans and paperboard.

3.1.7 Wood

Following the release of ecoinvent 3.7, most of the datasets related to forestry activities and wood processing in the Forestry and Wood sector are updated, and some new wood-based products have been added, like cross-laminated timber, structural timber, three and five layered board, and tubular particleboard.

3.1.8 Changes in results

From the perspective of results, the update of the metals drives most of the changes in scores observed in the database in all system models, especially measured with metal depletion indicators. The update of the cobalt supply chain, changes results quite heavily for all system models, but depicts a more accurate picture of the burdens associated to the extraction and further processing of this metal and the corresponding by-products. The changes on the supply chains of iron and steel affect a large number of activities. The chain is updated at several levels and the scores have changed (increased or decreased) for several products in the supply chain. In that case, machinery and infrastructure (including transport related infrastructure) are among the affected supply chains[1]. A similar thing happens with the update in the copper supply chains, that affect a wide number of other supply chains in the database, like cables, machinery, or transmission networks. Rare earths interact with less datasets in the database, but nevertheless, some of those are as central as fuel cells used to burn natural gas, and changes on scores to those are reflected in electricity production as well (specially in attributional system models).

The changes in ammonia and urea, together with those in nitric acid, come up as those that propagate to the largest number of datasets and with heavier impact, after metals (reported with eutrophication indicators and GWP). As can be read in chapter 7, those datasets are heavily remodelled, as well as the subsequent supply chains for nutrient delivery. That remodelling work on the fertilisers manufacturing and use has impacts on one side on the crops using the fertilisers as nutrients, and on the other side on a variety of chemicals using urea, ammonia, or nitric acid as precursors.

It has to be mentioned that the electricity market mixes have been updated, and that, together with the changes in the copper and rare earth scores, as well as the correction in the uranium enrichment technology shares, bring some changes to the electricity sector. Those changes propagate to more than 14 thousand datasets, as electricity is one of the central sectors in the database, and can be measured with different indicators, depending on the origin of the change (metal depletion, ozone depletion, GWP).

The update of the biomethane supply chains, has modified enormously the scores associated to this commodity and its provision, making them more realistic than in previous versions. Those changes propagate relatively little, and remain quite contained.

In the case of wood supply chains, the improvement of the regional coverage of markets, has led to some changes in scores mainly due to transport considerations. This results in bigger changes for products measured in “m3”. The effect of those changes can be seen in some building and construction complex materials.

[1] Update v3.7.1: This comment is still valid.

4 Database-wide changes

4.1 Renamed activities and exchanges

Some activities or products were renamed for version 3.7. The changes are listed in the following tables, and also treated in the sector-dedicated chapters if associated to a change in the modelling.

Table 1. Activities renamed for v3.7. *Most of the changes aim to better define the scope of the activity. More details of some changes are given in the corresponding chapters.*

Activity name in v3.6	Activity name in v3.7
anode slime, silver and tellurium containing stockpiling	stockpiling of anode slime from electrorefining of copper, anode
biogas, burned in micro gas turbine 100kWe	biomethane, low pressure burned in micro gas turbine 100kWe
biogas, burned in polymer electrolyte membrane fuel cell 2kWe, future	biomethane, low pressure burned in polymer electrolyte membrane fuel cell 2kWe, future
biogas, burned in solid oxide fuel cell 125kWe, future	biomethane, low pressure burned in solid oxide fuel cell 125kWe, future
biogas, burned in solid oxide fuel cell, with micro gas turbine, 180kWe, future	biomethane, low pressure burned in solid oxide fuel cell, with micro gas turbine, 180kWe, future
blister-copper conversion facility construction	copper smelting facility construction
cellulose fibre production, inclusive blowing in	cellulose fibre production
chipboard production, white lined	white lined chipboard carton production
copper mine operation, sulfide ore	copper mine operation and beneficiation, sulfide ore
copper production, blister-copper	smelting of copper concentrate, sulfide ore
copper production, solvent-extraction electro-winning	copper production, cathode, solvent extraction and electrowinning process
cucumber production	cucumber production, in heated greenhouse
diesel production, low-sulphur, petroleum refinery operation	diesel production, low-sulfur, petroleum refinery operation
diesel, import from unspecified	diesel, import from RoW
diesel, low-sulfur, import from unspecified	diesel, low-sulfur, import from RoW
electricity, high voltage, import from CSG	electricity, high voltage, import from CN-CSG
electricity, high voltage, import from MRO, US only	electricity, high voltage, import from US-MRO
electricity, high voltage, import from NPCC, US only	electricity, high voltage, import from US-NPCC
electricity, high voltage, import from SGCC	electricity, high voltage, import from CN-SGCC
electricity, high voltage, import from TRE	electricity, high voltage, import from US-TRE
electricity, high voltage, import from WECC, US only	electricity, high voltage, import from US-WECC
electrolytic refining of primary copper	electrorefining of copper, anode
ethanol, from fermentation, to niche market for ethanol, at service station	ethanol, from fermentation, to market for ethanol, vehicle grade
ferronickel production, 25% Ni	ferronickel production
folding boxboard production	folding boxboard carton production
gold-silver-zinc-lead-copper mine operation and refining	gold mine operation and refining
gold-silver-zinc-lead-copper mining and benefication	gold-silver mine operation and beneficiation
heat production, biogas, at diffusion absorption heat pump 4kW, future	heat production, biomethane, low pressure, at diffusion absorption heat pump 4kW, future

Activity name in v3.6	Activity name in v3.7
heavy fuel oil, import from unspecified	heavy fuel oil, import from RoW
import of roundwood, azobe from sustainable forest management, CM, debarked	sawlog and veneer log, azobe, debarked, measured as solid wood, import from CM
import of roundwood, meranti from sustainable forest management, MY, debarked	sawlog and veneer log, meranti, debarked, measured as solid wood, import from MY
import of sawnwood, paraná pine from sustainable forest management, kiln dried	sawnwood, paraná pine, dried (u=10%), import from BR
import of wheat grain, RoW	wheat grain, import from RoW
iron mine operation and iron ore beneficiation to 65% Fe	iron ore mine operation and beneficiation
iron mine operation, crude ore, 46% Fe	iron ore mine operation, 46% Fe
iron mine operation, crude ore, 63% Fe	iron ore mine operation, 63% Fe
iron ore beneficiation to 65% Fe	iron ore beneficiation
kerosene, import from unspecified	kerosene, import from RoW
lettuce360 production	lettuce360 production, in heated greenhouse
light fuel oil, import from unspecified	light fuel oil, import from RoW
liquefied petroleum gas, import from unspecified	liquefied petroleum gas, import from RoW
market for ammonia, liquid	market for ammonia, anhydrous, liquid
market for ammonium nitrate, as N	market for ammonium nitrate
market for ammonium sulfate, as N	market for ammonium sulfate
market for anode slime, silver and tellurium containing stockpiling	market for stockpiling of anode slime from electrorefining of copper, anode
market for anode slime, silver and tellurium containing, from primary copper production	market for anode slime from electrorefining of copper, anode
market for blister-copper conversion facility	market for copper smeting facility
market for cerium concentrate, 60% cerium oxide	market for cerium oxide
market for copper, blister-copper	market for copper, anode
market for dust, unalloyed electric arc furnace steel	market for electric arc furnace dust
market for ethanol, without water, in 99.7% solution state, from fermentation, at service station	market for ethanol, without water, in 99.7% solution state, from fermentation, vehicle grade
market for ferronickel, 25% Ni	market for ferronickel
market for iron ore, beneficiated, 65% Fe	market for iron ore concentrate
market for metal part of electronics scrap, in blister-copper	market for metal part of electronics scrap, in copper, anode
market for methane, 96% by volume, from biogas, from high pressure network, at service station	market for biomethane, high pressure, vehicle grade
market for methane, 96% by volume, from biogas, from low pressure network, at service station	market for biomethane, low pressure, vehicle grade
market for methane, 96% by volume, from biogas, from medium pressure network, at service station	market for biomethane, medium pressure, vehicle grade
market for methane, 96% by volume, from biogas, low pressure, at user	market for biomethane, low pressure
market for natural gas, from high pressure network (1-5 bar), at service station	market for natural gas, high pressure, vehicle grade
market for natural gas, from low pressure network (<0.1 bar), at service station	market for natural gas, low pressure, vehicle grade
market for natural gas, from medium pressure network (0.1-1 bar), at service station	market for natural gas, medium pressure, vehicle grade
market for nickel ore, beneficiated, 16%	market for nickel concentrate, 16% Ni
market for nickel, 99.5%	market for nickel, class 1
market for nitrogen fertiliser, as N	market for inorganic nitrogen fertiliser, as N
market for particle board, cement bonded	market for particleboard, cement bonded

Activity name in v3.6	Activity name in v3.7
market for phosphate fertiliser, as P2O5	market for inorganic phosphorus fertiliser, as P2O5
market for potassium chloride, as K2O	market for potassium chloride
market for potassium fertiliser, as K2O	market for inorganic potassium fertiliser, as K2O
market for potassium sulfate, as K2O	market for potassium sulfate
market for rare earth concentrate, 70% REO, from bastnäsite	market for rare earth oxide concentrate, 70% REO
market for roundwood, azobe from sustainable forest management, CM, debarked	market for sawlog and veneer log, azobe, debarked, measured as solid wood
market for roundwood, azobe from sustainable forest management, under bark	market for sawlog and veneer log, azobe, measured as solid wood under bark
market for roundwood, eucalyptus ssp. from sustainable forest management, under bark	market for sawlog and veneer log, eucalyptus ssp., measured as solid wood under bark
market for roundwood, meranti from sustainable forest management, MY, debarked	market for sawlog and veneer log, meranti, debarked, measured as solid wood
market for roundwood, meranti from sustainable forest management, under bark	market for sawlog and veneer log, meranti, measured as solid wood under bark
market for roundwood, paraná pine from sustainable forest management, under bark	market for sawlog and veneer log, paraná pine, measured as solid wood under bark
market for samarium europium gadolinium concentrate, 94% rare earth oxide	market for samarium-europium-gadolinium oxide
market for saw dust, loose, wet, measured as dry mass	market for sawdust, loose, wet, measured as dry mass
market for saw dust, wet, measured as dry mass	market for sawdust, wet, measured as dry mass
market for sawnwood, azobe from sustainable forest management, planed, air dried	market for sawnwood, azobe, dried (u=20%), planed
market for sawnwood, paraná pine from sustainable forest management, kiln dried	market for sawnwood, paraná pine, dried (u=10%)
market for sinter, iron	market for iron sinter
market for slag, unalloyed electric arc furnace steel	market for electric arc furnace slag
market for sludge, pig iron production	market for blast furnace sludge
market for urea, as N	market for urea
market for wastewater from particle board production	market for wastewater from particleboard production
methane production, 96% by volume, from biogas, from high pressure network, at service station	biomethane production, high pressure, vehicle grade
methane production, 96% by volume, from biogas, from low pressure network, at service station	biomethane production, low pressure, vehicle grade
methane production, 96% by volume, from biogas, from medium pressure network, at service station	biomethane production, medium pressure, vehicle grade
methane production, 96% by volume, from biogas, low pressure, at user	biomethane pressure reduction from high to low pressure
methane production, 96% by volume, from synthetic gas, wood, fixed bed technology	biomethane production, high pressure from synthetic gas, wood, fixed bed technology
methane production, 96% by volume, from synthetic gas, wood, fluidised technology	biomethane production, high pressure from synthetic gas, wood, fluidised technology
mining and benefication of nickel ore	nickel mine operation and benefication to nickel concentrate, 16% Ni
naphtha, import from unspecified	naphtha, import from RoW
natural gas, from high pressure network (1-5 bar), at service station	natural gas production, high pressure, vehicle grade
natural gas, from low pressure network (<0.1 bar), at service station	natural gas production, low pressure, vehicle grade
natural gas, from medium pressure network (0.1-1 bar), at service station	natural gas production, medium pressure, vehicle grade
particle board production, cement bonded	particleboard production, cement bonded
particle board production, for indoor use, from virgin wood	particleboard production, uncoated, from virgin wood
particle board production, uncoated, average glue mix	particleboard production, uncoated, average glue mix

Activity name in v3.6	Activity name in v3.7
petrol, unleaded, import from unspecified	petrol, unleaded, import from RoW
phosphate rock beneficiation, wet	phosphate rock beneficiation
processing of anode slime, primary copper production	processing of anode slime from electrorefining of copper, anode
radish production	radish production, in heated greenhouse
rare earth concentrate production, 70% REO, from bastnäsite	rare earth element mine operation and beneficiation, bastnaesite ore
rare earth oxides production from bastnäsite concentrate	rare earth oxides production, from rare earth oxide concentrate, 70% REO
saw dust, wet, measured as dry mass to generic market for residual softwood, wet	sawdust, wet, measured as dry mass to generic market for residual softwood, wet
sinter production, iron	iron sinter production
smelting and refining of nickel ore	smelting and refining of nickel concentrate, 16% Ni
three layered laminated board production	three and five layered board production
treatment of blast furnace slag, to inert waste	treatment of blast furnace slag, residual material landfill
treatment of metal part of electronics scrap, in blister-copper, by electrolytic refining	treatment of metal part of electronics scrap, in copper, anode, by electrolytic refining
treatment of slag, unalloyed electric arc furnace steel, residual material landfill	treatment of electric arc furnace slag, residual material landfill
treatment of sludge, pig iron production, residual material landfill	treatment of blast furnace sludge, residual material landfill
treatment of spent oxychlor catalyst for ethylene dichloride production, hazardous waste incineration	treatment of spent oxychlor catalyst, hazardous waste incineration
treatment of spent oxychlor catalyst for ethylene dichloride production, underground deposit	treatment of spent oxychlor catalyst, underground deposit
treatment of wastewater from particle board production, capacity 5E9l/year	treatment of wastewater from particleboard production, capacity 5E9l/year
urea production, as N	urea production

Table 2. Intermediate exchanges renamed for version 3.7. *Most of the changes aim to improve the product name, increasing precision. Several of the name changes reflect large remodelling changes, that are detailed in the corresponding chapters of this report.*

Name of exchange in version 3.6	Name of exchange in version 3.7
ammonia, liquid	ammonia, anhydrous, liquid
ammonium nitrate, as N	ammonium nitrate
ammonium sulfate, as N	ammonium sulfate
anode slime, silver and tellurium containing stockpiling	stockpiling of anode slime from electrorefining of copper, anode
anode slime, silver and tellurium containing, from primary copper production	anode slime from electrorefining of copper, anode
blister-copper conversion facility	copper smeting facility
cellulose fibre, inclusive blowing in	cellulose fibre
cerium concentrate, 60% cerium oxide	cerium oxide
copper	copper, cathode
copper, blister-copper	copper, anode
dust, unalloyed electric arc furnace steel	electric arc furnace dust

Name of exchange in version 3.6	Name of exchange in version 3.7
ethanol, without water, in 99.7% solution state, from fermentation, at service station	ethanol, without water, in 99.7% solution state, vehicle grade
ferronickel, 25% Ni	ferronickel
folding boxboard/chipboard	white lined chipboard carton
folding boxboard/chipboard	folding boxboard carton
iron ore, beneficiated, 65% Fe	iron ore concentrate
metal part of electronics scrap, in blister-copper	metal part of electronics scrap, in copper, anode
methane, 96% by volume	biomethane, high pressure
methane, 96% by volume, from biogas, from high pressure network, at service station	biomethane, high pressure, vehicle grade
methane, 96% by volume, from biogas, from low pressure network, at service station	biomethane, low pressure, vehicle grade
methane, 96% by volume, from biogas, from medium pressure network, at service station	biomethane, medium pressure, vehicle grade
methane, 96% by volume, from biogas, low pressure, at user	biomethane, low pressure
natural gas, from high pressure network (1-5 bar), at service station	natural gas, high pressure, vehicle grade
natural gas, from low pressure network (<0.1 bar), at service station	natural gas, low pressure, vehicle grade
natural gas, from medium pressure network (0.1-1 bar), at service station	natural gas, medium pressure, vehicle grade
nickel ore, beneficiated, 16%	nickel concentrate, 16% Ni
nickel, 99.5%	nickel, class 1
particle board, cement bonded	particleboard, cement bonded
particle board, for indoor use[2]	particleboard, uncoated
phosphate rock, as P2O5, beneficiated, wet	phosphate rock, beneficiated
potassium chloride, as K2O	potassium chloride
potassium sulfate, as K2O	potassium sulfate
rare earth concentrate, 70% REO, from bastnäsite	rare earth oxide concentrate, 70% REO
roundwood, azobe from sustainable forest management, CM, debarked	sawlog and veneer log, azobe, debarked, measured as solid wood
roundwood, azobe from sustainable forest management, under bark	sawlog and veneer log, azobe, measured as solid wood under bark
roundwood, eucalyptus ssp. from sustainable forest management, under bark	sawlog and veneer log, eucalyptus ssp., measured as solid wood under bark
roundwood, meranti from sustainable forest management, MY, debarked	sawlog and veneer log, meranti, debarked, measured as solid wood
roundwood, meranti from sustainable forest management, under bark	sawlog and veneer log, meranti, measured as solid wood under bark
roundwood, paraná pine from sustainable forest management, under bark	sawlog and veneer log, paraná pine, measured as solid wood under bark
samarium europium gadolinium concentrate, 94% rare earth oxide	samarium-europium-gadolinium oxide
saw dust, loose, wet, measured as dry mass	sawdust, loose, wet, measured as dry mass
saw dust, wet, measured as dry mass	sawdust, wet, measured as dry mass
sawnwood, azobe from sustainable forest management, planed, air dried	sawnwood, azobe, dried (u=20%), planed

[2] In the context of the renaming of the activity “particle board production, for indoor use, from virgin wood” to “particleboard production, uncoated, from virgin wood”, only.

Name of exchange in version 3.6	Name of exchange in version 3.7
sawnwood, paraná pine from sustainable forest management, kiln dried	sawnwood, paraná pine, dried (u=10%)
sinter, iron	iron sinter
slag, unalloyed electric arc furnace steel	electric arc furnace slag
sludge, pig iron production	blast furnace sludge
spent oxychlor catalyst for ethylene dichloride production	spent oxychlor catalyst
three layered laminated board	three and five layered board
urea, as N	urea
wastewater from particle board production	wastewater from particleboard production

4.2 Changes affecting attributional system models

Changes in price affect the results of the activities, when economic allocation is used. Several prices of products have been adjusted (sometimes only minorly) for the v3.7. The full list of products that experimented a price change can be found in Annex 1: products with updated prices.

4.3 Changes affecting the consequential system model

The Technology Level of an activity determines its behaviour in the consequential system model. Some activities changed Technology Levels for v3.7, and are listed below.

Table 3. Activities with different Technology Level in version 3.7. *The activities were edited to have a "Old" Technology Level instead of "Current".*

Activity Name	Geography	Time period
cathode-ray tube production, cathode ray tube display	GLO	1998-2001
display production, cathode ray tube, 17 inches	GLO	1998-2001
electron gun production, for cathode ray tube display	GLO	2001-2007
frit production, for cathode ray tube display	GLO	2001-2007
funnel glass production, for cathode ray tube display	GLO	2001-2004
operation, computer, desktop, with cathode ray tube display, active mode	CA-QC; CH; Europe without Switzerland; GLO	2001-2006
operation, computer, desktop, with cathode ray tube display, off mode	CA-QC; CH; Europe without Switzerland; GLO	2001-2006
operation, computer, desktop, with cathode ray tube display, standby mode	CA-QC; CH; Europe without Switzerland; GLO	2001-2006
panel glass production, for cathode ray tube display	GLO	2001-2004

4.4 Impact assessment methods

4.4.1 Method name changes

Several methods were renaming, in an effort to better reflect their status. The word "superseded" has been then used for those methods where a more up-to-date version exist.

Name of method in version 3.6	Name of method in version 3.7
CML 2001 (obsolete)	CML 2001 (superseded)
CML 2001 w/o LT (obsolete)	CML 2001 w/o LT (superseded)
eco-indicator 99, (E,E) (obsolete)	eco-indicator 99, (E,E) (superseded)
eco-indicator 99, (E,E) w/o LT (obsolete)	eco-indicator 99, (E,E) w/o LT (superseded)
eco-indicator 99, (H,A) (obsolete)	eco-indicator 99, (H,A) (superseded)
eco-indicator 99, (H,A) w/o LT (obsolete)	eco-indicator 99, (H,A) w/o LT (superseded)
eco-indicator 99, (I,I) (obsolete)	eco-indicator 99, (I,I) (superseded)
ecological scarcity 1997 (obsolete)	ecological scarcity 1997 (superseded)
ecological scarcity 2006 (obsolete)	ecological scarcity 2006 (superseded)
EDIP (obsolete)	EDIP (superseded)
EDIP w/o LT (obsolete)	EDIP w/o LT (superseded)
ILCD 1.0.8 2016 midpoint (obsolete)	EF1.0.8 midpoint (superseded)
ILCD 1.0.8 2016 midpoint no LT (obsolete)	EF1.0.8 midpoint no LT (superseded)
IPCC 2001 (obsolete)	IPCC 2001 (superseded)
IPCC 2007 (obsolete)	IPCC 2007 (superseded)
IPCC 2007 no LT (obsolete)	IPCC 2007 no LT (superseded)
ILCD 2.0 2018 midpoint	EF2.0 midpoint
ILCD 2.0 2018 midpoint no LT	EF2.0 midpoint no LT

4.4.2 Changes in Characterization Factors

4.4.2.1 Ecological scarcity 2013

The CF for dimethyl ether to air has been added to the main air pollutants and PM category and total category.

In v3.6, under mineral resources category, the following metals, in ground, had a characterization factor (CF) when they should have none: germanium, mercury, titanium. The same correction was applied to the total category.

4.4.2.2 EF 2.0 2018 midpoint

In the resources category, minerals and metals indicator, some exchanges in ground did not have a CF in the 3.6 version. The appropriate CF was added to the following exchanges:

- Antimony
- Arsenic
- Beryllium
- Bismuth

- Boron
- Germanium
- Mercury
- Molybdenum
- Potassium
- Selenium
- Silicon
- Sodium
- Thallium
- Vanadium
- Yttrium
- Zirconia

In the resources category, land use indicator, some exchanges in ground did not have a CF in the 3.6 version. The appropriate CF was added to the following exchanges:

- Occupation, cropland fallow (non-use)
- Occupation, forest, primary (non-use)
- Occupation, forest, secondary (non-use)
- Occupation, forest, unspecified
- Occupation, heterogeneous, agricultural
- Transformation, to bare area (non-use)
- Transformation, to forest, secondary (non-use)
- Transformation, to wetland, coastal (non-use)

Finally, in the human health category, photochemical ozone creation, the CF for dimethyl ether to air was added.

4.5 Non-fossil carbon balancing

Working with balanced inventories is the starting point to identify and address distortions introduced by allocation. For this release, we focused in ensuring mass- and carbon-balances for the wood and paper sector at large, as well as to other datasets relevant for the work with the EN1804 standard, in order to prepare the database to apply allocation correction for biogenic carbon in a systematic way.

4.5.1 Wood and paper sector

The following tables list the datasets that were modified in the wood and paper sectors for the purpose of balancing them in terms of non-fossil carbon (some activities might be listed more than once). In several cases, the properties have been edited, to better reflect the carbon content of inputs, for example, or to avoid double counting

of carbon, like in the case of the elementary exchanges “Wood, hard, standing”, “Wood, primary forest, standing”, “Wood, soft, standing”, “Wood, unspecified, standing”, “Energy, gross calorific value, in biomass”. Finally . for the activities with products “under bark” the amounts or properties of the wood exchanges were adjusted for the bark to be taken into consideration correctly.

Table 4. Activities for which properties were adjusted, in the wood and paper sector. *If several geographies of the same activity with the same time period and system model exist, all of them are listed in the “Geography” column.*

Activity name	Geography	Time period
clefting/splitting of energy wood	GLO; RER	2010-2012
containerboard production, fluting medium, recycled	GLO; RER	2009-2015
containerboard production, fluting medium, semichemical	GLO; RER	2009-2015
containerboard production, fluting medium, semichemical, 40% recycled content	CA-QC; GLO	2009-2009
containerboard production, linerboard, kraftliner	CA-QC; GLO; RER	2009-2015
containerboard production, linerboard, testliner	CA-QC	2007-2007
containerboard production, linerboard, testliner	GLO	2007-2015
containerboard production, linerboard, testliner	RER	2009-2015
core board production	CA-QC; GLO; RER	2000-2000
cork forestry	GLO; PT	1996-2003
corrugated board box production	CA-QC	2008-2008
corrugated board box production	GLO	2008-2022
corrugated board box production	RER	2009-2015
cross-laminated timber production	GLO; RER	2012-2012
debarking, hardwood, azobe	CM; GLO	2000-2005
debarking, hardwood, meranti	GLO; MY	2000-2005
debarking, softwood, in forest	GLO; RER	1994-2001
delimbing, with excavator-based processor	GLO; RER	2012-2012
folding boxboard carton production	GLO; RER	2017-2018
folding boxboard carton production	GLO	2017-2018
folding boxboard carton production	RER	2018-2018
forwarding, forwarder	GLO; RER	2012-2012
glued laminated timber production, average glue mix	CA-QC	2009-2011
glued laminated timber production, average glue mix	Europe without Switzerland; GLO	2012-2012
glued solid timber production	GLO; RER	2012-2012
hardwood forestry, azobe, sustainable forest management	GLO	2000-2005
hardwood forestry, azobe, sustainable forest management	CM	2000-2005
hardwood forestry, azobe, sustainable forest management	GLO; CM	2000-2005
hardwood forestry, beech, sustainable forest management	DE; GLO	2010-2012
hardwood forestry, birch, sustainable forest management	GLO; SE	2010-2012

Activity name	Geography	Time period
hardwood forestry, eucalyptus ssp., planted forest management	BR-GO; BR-MG; GLO	2012-2016
hardwood forestry, eucalyptus ssp., planted forest management	BR-SP	2012-2016
hardwood forestry, eucalyptus ssp., sustainable forest management	GLO	2000-2005
hardwood forestry, eucalyptus ssp., sustainable forest management	TH	2000-2005
hardwood forestry, eucalyptus ssp., sustainable forest management	GLO; TH	2000-2005
hardwood forestry, meranti, sustainable forest management	GLO	2000-2005
hardwood forestry, meranti, sustainable forest management	MY	2000-2005
hardwood forestry, meranti, sustainable forest management	GLO; MY	2000-2005
hardwood forestry, mixed species, sustainable forest management	CH; GLO	2010-2012
hardwood forestry, oak, sustainable forest management	DE; GLO	2010-2012
kraft paper production	GLO; RER	2015-2020
kraft paper production, bleached	GLO; RER	1993-1993
kraft paper production, unbleached	GLO; RER	2000-2000
liquid packaging board production	GLO	2009-2009
medium density fibre board production, uncoated	GLO; RER	2012-2012
oriented strand board production	GLO; RER; CA-QC	2012-2012
paper production, newsprint, recycled	Europe without Switzerland; GLO; CH	2000-2000
paper production, newsprint, recycled	Europe without Switzerland; GLO	2000-2000
paper production, newsprint, recycled	CH	2012-2012
paper production, newsprint, virgin	GLO; RER; CA-QC	2000-2000
paper production, newsprint, virgin	RER	2000-2000
paper production, newsprint, virgin	GLO	2000-2000
paper production, newsprint, virgin	CA-QC	2012-2012
paper production, woodcontaining, lightweight coated	CA-QC; GLO; RER	2000-2000
paper production, woodcontaining, supercalendered	CA-QC; GLO; RER	2000-2000
paper production, woodfree, coated, at integrated mill	GLO; RER	2000-2000
paper production, woodfree, coated, at non-integrated mill	GLO; RER	2000-2000
paper production, woodfree, uncoated, 30% recycled content, at integrated mill	CA-QC; GLO	2011-2012
paper production, woodfree, uncoated, 50% recycled content, at non-integrated mill	CA-QC; GLO	2009-2009
paper production, woodfree, uncoated, at integrated mill	GLO; RER; CA-QC	2000-2000
paper production, woodfree, uncoated, at integrated mill	RER	2000-2000
paper production, woodfree, uncoated, at integrated mill	GLO	2000-2000
paper production, woodfree, uncoated, at integrated mill	CA-QC	2011-2012
paper production, woodfree, uncoated, at non-integrated mill	GLO; RER	2000-2000
paper sack production	GLO; RER	2015-2020
plywood production	CA-QC; GLO; RER	2012-2012
plywood production, for indoor use	GLO; RER	1996-1996
plywood production, for outdoor use	GLO; CA-QC;; RER	1996-1996

Activity name	Geography	Time period
pulpwood, softwood, measured as solid wood under bark, import from Europe without Switzerland	CH	2019-2019
sawing and planing, paraná pine, kiln dried	GLO; BR	1999-2005
sawing, hardwood	GLO; Europe without Switzerland; CA-QC; CH	2011-2013
sawing, softwood	GLO; Europe without Switzerland; CA-QC; CH	2006-2012
sawlog and veneer log, hardwood, measured as solid wood under bark, import from Europe without Switzerland	CH	2019-2019
sawlog and veneer log, softwood, measured as solid wood under bark, import from Europe without Switzerland	CH	2019-2019
softwood forestry, mixed species, boreal forest	CA-QC; GLO	2006-2012
softwood forestry, mixed species, sustainable forest management	CH; GLO	2010-2012
softwood forestry, paraná pine, sustainable forest management	GLO	2000-2005
softwood forestry, paraná pine, sustainable forest management	BR	2000-2005
softwood forestry, paraná pine, sustainable forest management	GLO; BR	2000-2005
softwood forestry, pine, sustainable forest management	GLO; SE	2010-2012
softwood forestry, pine, sustainable forest management	DE	2010-2012
softwood forestry, pine, sustainable forest management	GLO; SE; DE	2010-2012
softwood forestry, spruce, sustainable forest management	GLO; SE	2010-2012
softwood forestry, spruce, sustainable forest management	DE	2010-2012
softwood forestry, spruce, sustainable forest management	GLO; SE; DE	2010-2012
solid bleached and unbleached board carton production	CA-QC; GLO; RER	2018-2018
stone groundwood pulp production	GLO; RER	1993-2000
structural timber production	GLO; RER	2012-2012
sulfate pulp production, from eucalyptus, bleached	GLO; RLA	2017-2020
sulfate pulp production, from hardwood, bleached	GLO; RER; CA-QC	2011-2012
sulfate pulp production, from hardwood, bleached	CA-QC	2011-2012
sulfate pulp production, from hardwood, bleached	GLO	2011-2021
sulfate pulp production, from hardwood, bleached	RER	2017-2020
sulfate pulp production, from softwood, bleached	GLO; RER	2017-2020
sulfate pulp production, from softwood, unbleached	GLO; RER	2017-2020
sulfite pulp production, bleached	GLO; RER	1997-2000
three and five layered board production	GLO; RER	2012-2012
treatment of waste paper to pulp, wet lap, totally chlorine free bleached	CA-QC; GLO	2007-2007
treatment of waste paper, unsorted, sorting	Europe without Switzerland; GLO	1993-2007
treatment of waste paper, unsorted, sorting	CH	2012-2012
treatment of waste paperboard, unsorted, sorting	Europe without Switzerland	2012-2012
treatment of waste paperboard, unsorted, sorting	CH; GLO	2012-2012
trellis system construction, wooden poles, soft wood, tar impregnated	CH; GLO	2010-2010
tubular particleboard production	GLO; RER	2012-2012

Activity name	Geography	Time period
white lined chipboard carton production	GLO; RER	2018-2018
wood chipping, mobile chipper, at forest road	GLO; RER	2012-2012
wood chipping, terrain chipper, diesel	GLO; RER	2012-2012
wood preservation, dipping/immersion, solvent-based preservative, indoor use, dry	GLO; RER	2012-2012
wood preservation, dipping/immersion, solvent-based preservative, indoor use, occasionally wet	GLO; RER	2012-2012
wood preservation, dipping/immersion, solvent-based preservative, outdoor use, no ground contact	GLO; RER	2012-2012
wood preservation, dipping/immersion, water-based preservative, indoor use, occasionally wet	GLO; RER	2012-2012
wood preservation, hot/cold dipping, creosote, outdoor use, ground contact	GLO; RER	2008-2008
wood preservation, pressure vessel, creosote, outdoor use, ground contact	GLO; RER	2008-2008
wood preservation, spray tunnel/deluging, solvent-based preservative, indoor use, dry	GLO; RER	2012-2012
wood preservation, spray tunnel/deluging, solvent-based preservative, indoor use, occasionally wet	GLO; RER	2012-2012
wood preservation, spray tunnel/deluging, solvent-based preservative, outdoor use, no ground contact	GLO; RER	2012-2012
wood preservation, spray tunnel/deluging, water-based preservative, indoor use, occasionally wet	GLO; RER	2012-2012
wood wool production	CA-QC; GLO	2002-2002
wood wool production	RER	2002-2002
yarding and processing, mobile cable yarder on truck	GLO; RER	2012-2012
yarding, mobile cable yarder on trailer	GLO; RER	2012-2012
yarding, sled yarder	GLO; RER	2012-2012

Other adjustments were done, at the exchange level, to the datasets in the wood and paper sector to restore their biogenic carbon balances, the datasets edited are listed in the following table.

Table 5. Activities for which individual corrections in favour of balancing the biogenic carbon were applied, in the wood and paper sector. *If several geographies of the same activity with the same time period and system model exist, all of them are listed in the "Geography" column.*

Activity name	Geography	Time period
alkylketene dimer sizing agent production, for paper production	GLO; RER	2000-2000
beverage carton converting	GLO	2009-2009
carton board box production service, with gravure printing	CA-QC; CH; GLO	1993-1993
carton board box production service, with offset printing	CA-QC; CH; GLO	1993-1993
charcoal production	GLO	1985-1996
chemi-thermomechanical pulp production	GLO; RER	2000-2000
coating service, melamine impregnated paper, double-sided	GLO; RER	2012-2012
core board production	CA-QC; GLO; RER	2000-2000
door production, inner, glass-wood	GLO; RER	1997-2005
door production, inner, wood	GLO; RER	1997-2005
door production, outer, wood-aluminium	GLO; RER	1997-2005
door production, outer, wood-glass	GLO; RER	1997-2005

Activity name	Geography	Time period
ethanol production from wood	GLO; SE; CH	1999-2006
EUR-flat pallet production	GLO; RER	2000-2002
fibreboard production, hard	GLO; RER	2011-2012
fibreboard production, soft, from wet & dry processes	CA-QC; Europe without Switzerland; GLO	2012-2012
fibreboard production, soft, from wet processes	GLO; CH	2007-2009
fibreboard production, soft, latex bonded	CH; GLO	2008-2009
fibreboard production, soft, without adhesives	CH; GLO	2008-2009
furniture production, wooden	GLO	2011-2017
gypsum plasterboard production	CH; GLO	1997-2003
offset printing, per kg printed paper	CH; GLO	2007-2011
paper production, woodcontaining, lightweight coated	CA-QC; GLO; RER	2000-2000
paper production, woodcontaining, supercalendered	CA-QC; GLO; RER	2000-2000
paper production, woodfree, coated, at non-integrated mill	GLO; RER	2000-2000
paper production, woodfree, uncoated, at non-integrated mill	GLO; RER	2000-2000
purse seiner construction, wood	GLO; RLA	2010-2020
rosin size production, for paper production	GLO; RER	2000-2000
sawing and planing, azobe, air dried	GLO; RER	2000-2005
sawnwood production, hardwood, dried (u=10%), planed	GLO; RER; CH; Europe without Switzerland	2014-2014
sawnwood production, hardwood, dried (u=20%), planed	GLO; RER; CH; Europe without Switzerland	2014-2014
sawnwood production, hardwood, raw, dried (u=10%)	GLO; RER; CH; Europe without Switzerland	2014-2014
sawnwood production, hardwood, raw, dried (u=20%)	GLO; RER; CH; Europe without Switzerland	2014-2014
sawnwood production, softwood, dried (u=10%), planed	GLO; RER; CH; Europe without Switzerland	2014-2014
sawnwood production, softwood, dried (u=20%), planed	GLO; RER; CH; Europe without Switzerland	2014-2014
sawnwood production, softwood, raw, dried (u=10%)	GLO; RER; CH; Europe without Switzerland	2014-2014
sawnwood production, softwood, raw, dried (u=20%)	GLO; RER; CH; Europe without Switzerland	2014-2014
stone groundwood pulp production	GLO; RER	1993-2000
sulfite pulp production, bleached	GLO; RER	1997-2000
thermo-mechanical pulp production	GLO; RER	1993-2000
tissue paper production	GLO; RER	2000-2000
tissue paper production, virgin	GLO	1998-1998
treatment of waste wood, post-consumer, sorting and shredding	CH; GLO	2004-2010
wood preservation, dipping/immersion, water-based preservative, indoor use, dry	GLO; RER	2012-2012
wood preservation, dipping/immersion, water-based preservative, outdoor use, no ground contact	GLO; RER	2012-2012
wood preservation, oscillating pressure method, inorganic salt, containing Cr, outdoor use, ground contact	GLO; RER	2012-2012
wood preservation, oscillating pressure method, organic salt, Cr-free, outdoor use, ground contact	GLO; RER	2012-2012
wood preservation, spray tunnel/deluging, water-based preservative, indoor use, dry	GLO; RER	2012-2012
wood preservation, spray tunnel/deluging, water-based preservative, outdoor use, no ground contact	GLO; RER	2012-2012
wood preservation, vacuum pressure method, inorganic salt, containing Cr, outdoor use, ground contact	GLO; RER	2012-2012
wood preservation, vacuum pressure method, organic salt, Cr-free, outdoor use, ground contact	GLO; RER	2012-2012
wooden board factory construction, cement bonded boards	GLO; RER	2002-2002
wooden board factory construction, organic bonded boards	GLO; RER	2002-2002

4.5.2 Concrete production

It was identified that some concrete datasets (Table 6) were not carbon balanced. This was mainly due to the fact that the product 'fatty alcohol', which was an input in all the datasets, has a high biogenic carbon content, because it is mainly produced from coconut oil, palm oil and palm kernel oil. In these datasets, fatty alcohol was used as a proxy to model the air entraining agents in concrete production. In communication with the data suppliers of these datasets, it was agreed to replace the more generic fatty alcohol to the more specific and more accurate alkylbenzene sulfonate, linear, petrochemical. The alkylbenzene sulfonate is a very common air entraining agent and it is modelled in the database.

Table 6. Updated datasets where the exchange of fatty alcohol has been replaced by alkylbenzene sulfonate, linear, petrochemical. *If several geographies of the same activity with the same time period exist, all of them are listed in the "Geography" column.*

Activity name	Geography	Time Period
concrete production 20MPa	CA-QC; North America without Quebec	2006-2006
concrete production 30-32MPa	CA-QC; North America without Quebec; GLO	2006-2006
concrete production 35MPa	CA-QC; North America without Quebec	2006-2006
concrete production 50MPa	CA-QC; North America without Quebec	2006-2006

5 Building and construction materials

5.1 Glass wool mat

Two new uncoated glass wool mat datasets for Switzerland are replacing the old “glass wool mat production, Saint-Gobain ISOVER SA” dataset. The new datasets were provided by Saint-Gobain ISOVER SA and represent the production of glass wool mats produced with phenol-based binder or plant-based binder. The reference product of both activities is the same (“glass wool mat, uncoated, Saint-Gobain ISOVER SA”) for which a new market was created. In parallel to the new Swiss datasets, the more generic products “glass wool mat production” and “glass wool mat production, without cullet” (virgin) are still present in the database.

Table 7. New, updated and deleted activities related to glass wool. *If several geographies of the same activity with the same time period exist, all of them are listed in the “Geography” column. In column v3.7, “U” stands for “Updated Activity”, “D” stands for “Deleted Activity” and “N” stands for “New activity”. The unit of the reference product is kg.*

Activity name	Geography	Time period	Product name	v3.7
glass wool mat production	CA-QC; GLO	1993-2000	glass wool mat	U
glass wool mat production, Saint-Gobain ISOVER SA	CH; GLO	2009-2009	glass wool mat	D
glass wool mat production, with phenolic binder, uncoated, Saint-Gobain ISOVER SA	CH; GLO	2018-2018	glass wool mat, uncoated, Saint-Gobain ISOVER SA	N
glass wool mat production, with plant-based binder, uncoated, Saint-Gobain ISOVER SA	CH; GLO	2018-2018	glass wool mat, uncoated, Saint-Gobain ISOVER SA	N
glass wool mat production, without cullet	GLO	1993-2000	glass wool mat	U
market for glass wool mat, uncoated, Saint-Gobain ISOVER SA	CH; GLO	2018-2018	glass wool mat, uncoated, Saint-Gobain ISOVER SA	N

5.1 Other changes in building and construction materials

The new or updated activities of Table 8 were introduced to address some existing gaps or to better represent European supply chains, some relate to corrections of inputs of “Swiss Integrated Production” products, to non-Swiss activities.

***Table 8. New and updated activities related to building and construction materials**. If several geographies of the same activity with the same time period exist, all of them are listed in the "Geography" column. In the column v3.7, "N" stands for "New Activity", "U" stands for "Updated Activity".*

Activity name	Geography	Time period	v3.7
acrylic filler production	GLO; RER	2000-2003	U
activated bentonite production	DE; GLO	1997-2000	U
building construction, hostel	PE	2017-2018	U
building construction, luxury hotel	BR	2017-2018	U
cement production, pozzolana and fly ash 36-55%	GLO	2014-2017	U
clay to generic market for supplementary cementitious materials	GLO	2019-2019	U
concrete production, 20MPa, ready-mix, with Portland cement	GLO	2014-2017	U
door production, inner, glass-wood	GLO; RER	1997-2005	U
door production, inner, wood	GLO; RER	1997-2005	U
granulated blast furnace slag to generic market for supplementary cementitious materials	GLO	2019-2019	U
gypsum plasterboard production	CH; GLO	1997-2003	U
market for anhydrite	RER	2011-2016	N
market for calcareous marl	RER	2010-2016	N
market for clinker	Europe without Switzerland	2011-2011	N
market for supplementary cementitious materials	RER	2019-2019	N

6 Energy

6.1 Power grid geography renaming

In pursuit of more harmonised and informative geography names the geographies of the US NERC (North American Electric Reliability Corporation) region and the Chinese power grids CSG (China Southern Power Grid) and SGCC (State Grid Corporation of China) were renamed as indicated in the following table:

Table 9.Mapping of the power grid geography names from v.3.6 to v3.7.

US NERC region		**Chinese power grids**	
v3.6 geography	**v3.7 geography**	**v3.6 geography**	**v3.7 geography**
ASCC	US-ASCC	CSG	CN-CSG
FRCC	US-FRCC	SGCC	CN-SGCC
HICC	US-HICC		
MRO, US only	US-MRO		
NPCC, US only	US-NPCC		
RFC	US-RFC		
SERC	US-SERC		
TRE	US-TRE		
WECC, US only	US-WECC		

Due to renaming these datasets the geographies of the following datasets were updated:

Table 10. Updated activities due to the renaming of power grid geographies in Table 9. *If several geographies of the same activity with the same time period exist, all of them are listed in the "Geography" column.*

Activity name	**Geography**	**Time period**
deep well drilling, for deep geothermal power	US-HICC	2015-2015
electricity production, deep geothermal	US-HICC; US-WECC	2015-2015
electricity production, deep geothermal	US-SERC	2016-2018
electricity production, hard coal	US-ASCC; US-FRCC; US-HICC; US-MRO; US-NPCC; US-RFC; US-SERC; US-TRE; US-WECC	1980-2015
electricity production, hydro, pumped storage	US-ASCC; US-FRCC; US-HICC; US-MRO; US-NPCC; US-RFC; US-SERC; US-TRE; US-WECC	1945-2015
electricity production, hydro, reservoir, alpine region	US-ASCC; US-MRO; US-NPCC; US-RFC; US-SERC; US-WECC	1945-2015
electricity production, hydro, reservoir, non-alpine region	US-FRCC; US-HICC; US-TRE	1945-2015
electricity production, hydro, run-of-river	US-ASCC; US-FRCC; US-HICC; US-MRO; US-NPCC; US-RFC; US-SERC; US-TRE; US-WECC	1945-2015
electricity production, lignite	US-ASCC; US-FRCC; US-HICC; US-MRO; US-NPCC; US-RFC; US-SERC; US-TRE; US-WECC	1980-2015
electricity production, natural gas, combined cycle power plant	US-ASCC; US-FRCC; US-MRO; US-NPCC; US-RFC; US-SERC; US-TRE; US-WECC	2000-2015
electricity production, natural gas, conventional power plant	US-ASCC; US-FRCC; US-MRO; US-NPCC; US-RFC; US-SERC; US-TRE; US-WECC	1990-2015
electricity production, nuclear, boiling water reactor	US-FRCC; US-MRO; US-NPCC; US-RFC; US-SERC; US-TRE; US-WECC	1990-2015
electricity production, nuclear, pressure water reactor	US-FRCC; US-MRO; US-NPCC; US-RFC; US-SERC; US-TRE; US-WECC	1990-2015
electricity production, oil	US-ASCC; US-FRCC; US-HICC; US-MRO; US-NPCC; US-RFC; US-SERC; US-TRE; US-WECC	1980-2015

Activity name	Geography	Time period
electricity production, photovoltaic, 3kWp slanted-roof installation, multi-Si, panel, mounted	US-FRCC; US-HICC; US-NPCC; US-RFC; US-SERC; US-TRE; US-WECC	2005-2015
electricity production, photovoltaic, 3kWp slanted-roof installation, single-Si, panel, mounted	US-FRCC; US-HICC; US-NPCC; US-RFC; US-SERC; US-TRE; US-WECC	2005-2015
electricity production, photovoltaic, 570kWp open ground installation, multi-Si	US-FRCC; US-HICC; US-NPCC; US-RFC; US-SERC; US-WECC	2008-2015
electricity production, solar thermal parabolic trough, 50 MW	US-FRCC; US-WECC	2010-2020
electricity production, solar tower power plant, 20 MW	US-WECC	2010-2020
electricity production, wind, <1MW turbine, onshore	US-ASCC; US-HICC; US-MRO; US-NPCC; US-RFC; US-SERC; US-TRE; US-WECC	2000-2015
electricity production, wind, >3MW turbine, onshore	US-ASCC; US-HICC; US-MRO; US-NPCC; US-RFC; US-SERC; US-TRE; US-WECC	2012-2012
electricity production, wind, 1-3MW turbine, onshore	US-ASCC; US-HICC; US-MRO; US-NPCC; US-RFC; US-SERC; US-TRE; US-WECC	2005-2015
electricity voltage transformation from high to medium voltage	CN-CSG; CN-SGCC; US-ASCC; US-FRCC; US-HICC; US-MRO; US-NPCC; US-RFC; US-SERC; US-TRE; US-WECC	2012-2012
electricity voltage transformation from medium to low voltage	CN-CSG; CN-SGCC; US-ASCC; US-FRCC; US-HICC; US-MRO; US-NPCC; US-RFC; US-SERC; US-TRE; US-WECC	2012-2012
electricity, high voltage, import from CA-AB	US-WECC	2013-2013
electricity, high voltage, import from CA-BC	US-WECC	2013-2013
electricity, high voltage, import from CA-MB	US-MRO	2013-2013
electricity, high voltage, import from CA-NB	US-NPCC	2013-2013
electricity, high voltage, import from CA-NS	US-NPCC	2013-2013
electricity, high voltage, import from CA-ON	US-NPCC	2013-2013
electricity, high voltage, import from CA-SK	US-MRO	2013-2013
electricity, high voltage, import from CN-CSG	HK	2012-2012
electricity, high voltage, import from CN-CSG	VN	2016-2016
electricity, high voltage, import from CN-SGCC	MN	2012-2012
electricity, high voltage, import from MX	US-TRE; US-WECC	2012-2012
electricity, high voltage, import from US-MRO	CA-MB; CA-SK	2012-2012
electricity, high voltage, import from US-NPCC	CA-NB; CA-NS; CA-ON	2012-2012
electricity, high voltage, import from US-NPCC	CA-QC; GLO	2014-2014
electricity, high voltage, import from US-TRE	MX	2012-2012
electricity, high voltage, import from US-WECC	CA-AB; CA-BC	2012-2012
heat and power co-generation, biogas, gas engine	US-FRCC; US-HICC; US-MRO; US-NPCC; US-RFC; US-SERC; US-TRE; US-WECC	2007-2015
heat and power co-generation, natural gas, combined cycle power plant, 400MW electrical	US-ASCC; US-FRCC; US-MRO; US-NPCC; US-RFC; US-SERC; US-TRE; US-WECC	2000-2015
heat and power co-generation, natural gas, conventional power plant, 100MW electrical	US-ASCC; US-FRCC; US-MRO; US-NPCC; US-RFC; US-SERC; US-TRE; US-WECC	1990-2015
heat and power co-generation, wood chips, 6667 kW, state-of-the-art 2014	US-ASCC; US-FRCC; US-HICC; US-MRO; US-NPCC; US-RFC; US-SERC; US-TRE; US-WECC	2010-2015
heat and power co-generation, oil	US-ASCC; US-FRCC; US-HICC; US-MRO; US-NPCC; US-RFC; US-SERC; US-TRE; US-WECC	1980-2015
market for electricity, high voltage	CN-CSG; CN-SGCC; US-ASCC; US-FRCC; US-HICC; US-MRO; US-NPCC; US-RFC; US-SERC; US-TRE; US-WECC	2014-2017
market for electricity, low voltage	CN-CSG; CN-SGCC; US-ASCC; US-FRCC; US-HICC; US-MRO; US-NPCC; US-RFC; US-SERC; US-TRE; US-WECC	2014-2017
market for electricity, medium voltage	CN-CSG; CN-SGCC; US-ASCC; US-FRCC; US-HICC; US-MRO; US-NPCC; US-RFC; US-SERC; US-TRE; US-WECC	2014-2017

6.2 Deletion of the SPP (Southwest Power Pool) geography

The former US NERC region "SPP" ceased to exist in 2018. Hence, its electricity markets and electricity producing datasets (listed in Table 11) were removed from the ecoinvent database and the former "SPP" power plants were assigned to their new NERC regions. Any "SPP" electricity dataset in life cycle inventories should be replaced by the following inputs from the 2018 NERC regions in case the exact 2018 NERC region is unknown:

- 86.3% from "US-MRO"
- 10.6% from "US-SERC"
- 2.8% from "US-TRE"
- 0.3% from "US-WECC"

Likewise, the v3.7 region "US-MRO" should consist to 53.5% of "US-MRO" and 46.5% of "SPP" from ecoinvent v3.6, the v3.7 region "US-SERC" to 97.7% of "US-SERC" and 2.3% of "SPP" from ecoinvent v3.6, the v3.7 region "US-TRE" to 98.3% of "US-TRE" and 1.7% of "SPP" from ecoinvent v3.6 and the v3.7 region "US-WECC" to 99.9% of "US-WECC" and 0.1% of "SPP" from ecoinvent v3.6. These splits have been calculated from the 2018 electricity production data and the 2018 and 2016 NERC region classification of power plants (EPA, 2020).

Table 11. Deleted activities due to the removal of the SPP power grid geography.

Activity name	Geography	Time period
electricity production, hard coal	SPP	1980-2015
electricity production, hydro, pumped storage	SPP	1945-2015
electricity production, hydro, reservoir, non-alpine region	SPP	1945-2015
electricity production, hydro, run-of-river	SPP	1945-2015
electricity production, lignite	SPP	1980-2015
electricity production, natural gas, combined cycle power plant	SPP	2000-2015
electricity production, natural gas, conventional power plant	SPP	1990-2015
electricity production, nuclear, boiling water reactor	SPP	1990-2015
electricity production, nuclear, pressure water reactor	SPP	1990-2015
electricity production, oil	SPP	1980-2015
electricity production, wind, 1-3MW turbine, onshore	SPP	2005-2015
electricity production, wind, <1MW turbine, onshore	SPP	2000-2015
electricity production, wind, >3MW turbine, onshore	SPP	2012-2012
electricity voltage transformation from high to medium voltage	SPP	2012-2012
electricity voltage transformation from medium to low voltage	SPP	2012-2012
heat and power co-generation, biogas, gas engine	SPP	2007-2015
heat and power co-generation, natural gas, combined cycle power plant, 400MW electrical	SPP	2000-2015
heat and power co-generation, natural gas, conventional power plant, 100MW electrical	SPP	1990-2015
heat and power co-generation, wood chips, 6667 kW, state-of-the-art 2014	SPP	2010-2015
heat and power co-generation, oil	SPP	1980-2015
market for electricity, high voltage	SPP	2014-2017
market for electricity, low voltage	SPP	2014-2017
market for electricity, medium voltage	SPP	2014-2017

6.3 Updates of the electricity market mixes in the attributional system models

The production volumes, trade volumes and loss volumes of electricity supply in the attributional system models, cut-off and APOS, were updated to represent the 2017 electricity mixes. Canadian and US American power grids were updated to represent the year 2018 due the availability of more recent data (EIA, 2019; StatCAN, 2020a-c). to Not included in this update are the electricity mixes in Brazil, India and China, these represent the year 2012 (India and China) and 2014 (Brazil) respectively. Since electricity supply in these geographies is regionalized to the level of regional electricity grids, statistical data are not readily available in IEA or national databases.

The Rest of the World (RoW) markets for electricity are no longer generated in the attributional system models. 100% of statistically covered global electricity supply is covered with specific mixes; no data is available for the remaining geographies, mostly small countries and island states.

The following sections describe the updates, underlying data sources and calculation procedures underlying the updates of the electricity market mixes. Table 12 shows for which geographies the electricity market mixes were updated or added in any of the three system models.

Table 12. Updated market mixes for electricity in the attributional system models. *If several geographies of the same activity with the same time period and system model exist, all of them are listed in the "Geography" column. In column v3.7, "U" stands for "Updated Activity".*

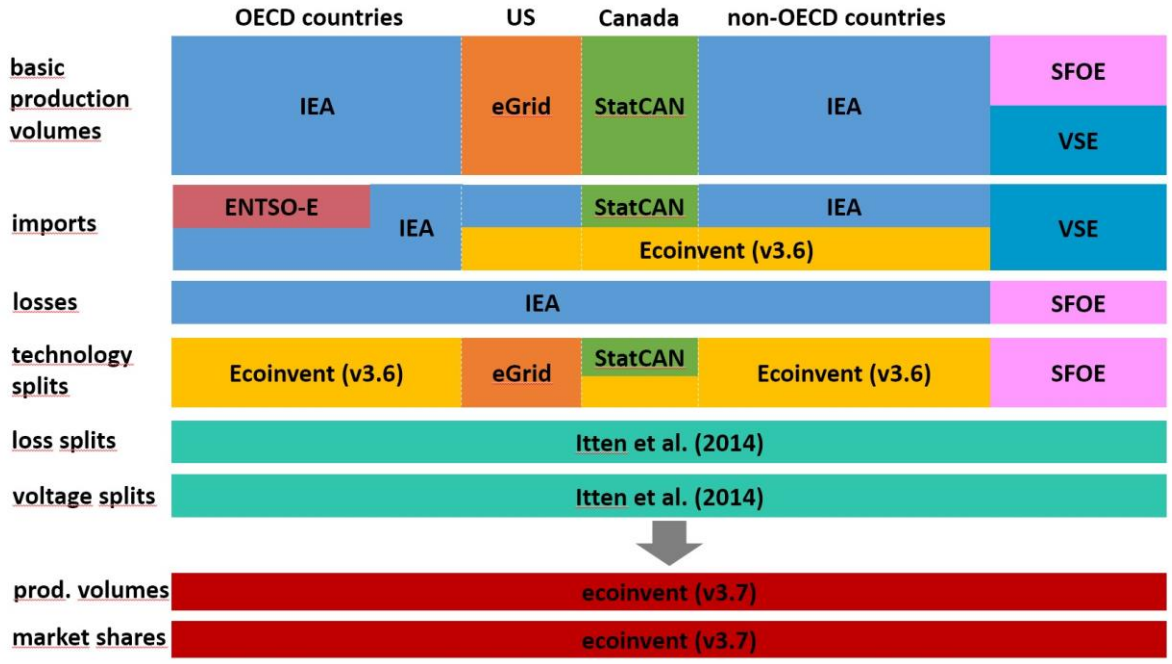
Activity name	Time period	System model	Geography	v3.7
market for electricity, high voltage	2014-2017	Allocation, cut-off; Allocation, APOS	AE; AL; AM; AO; AR; AT; AU; AZ; BA; BD; BE; BG; BH; BJ; BN; BO; BW; BY; CA-AB; CA-BC; CA-MB; CA-NB; CA-NF; CA-NS; CA-NT; CA-NU; CA-ON; CA-PE; CA-QC; CA-SK; CA-YK; CD; CG; CI; CL; CM; CO; CR; CU; CW; CY; CZ; DE; DK; DO; DZ; EC; EE; EG; ER; ES; ET; FI; FR; GA; GB; GE; GH; GI; GLO; GR; GT; HK; HN; HR; HT; HU; ID; IE; IL; IQ; IR; IS; IT; JM; JO; JP; KE; KG; KH; KP; KR; KW; KZ; LB; LK; LT; LU; LV; LY; MA; MD; ME; MK; MM; MN; MT; MU; MX; MY; MZ; NA; NE; NG; NI; NL; NO; NP; NZ; OM; PA; PE; PH; PK; PL; PT; PY; QA; RO; RS; RU; SA; SD; SE; SG; SI; SK; SN; SS; SV; SY; TG; TH; TJ; TM; TN; TR; TT; TW; TZ; UA; US-ASCC; US-FRCC; US-HICC; US-MRO; US-NPCC; US-RFC; US-SERC; US-TRE; US-WECC; UY; UZ; VE; VN; XK; YE; ZA; ZM; ZW	U
market for electricity, medium voltage	2014-2017	Allocation, cut-off; Allocation, APOS	AE; AL; AM; AO; AR; AT; AU; AZ; BA; BD; BE; BG; BH; BJ; BN; BO; BW; BY; CA-AB; CA-BC; CA-MB; CA-NB; CA-NF; CA-NS; CA-NT; CA-NU; CA-ON; CA-PE; CA-QC; CA-SK; CA-YK; CD; CG; CI; CL; CM; CO; CR; CU; CW; CY; CZ; DE; DK; DO; DZ; EC; EE; EG; ER; ES; ET; FI; FR; GA; GB; GE; GH; GI; GLO; GR; GT; HK; HN; HR; HT; HU; ID; IE; IL; IQ; IR; IS; IT; JM; JO; JP; KE; KG; KH; KP; KR; KW; KZ; LB; LK; LT; LU; LV; LY; MA; MD; ME; MK; MM; MN; MT; MU; MX; MY; MZ; NA; NE; NG; NI; NL; NO; NP; NZ; OM; PA; PE; PH; PK; PL; PT; PY; QA; RO; RS; RU; SA; SD; SE; SG; SI; SK; SN; SS; SV; SY; TG; TH; TJ; TM; TN; TR; TT; TW; TZ; UA; US-ASCC; US-FRCC; US-HICC; US-MRO; US-NPCC; US-RFC; US-SERC; US-TRE; US-WECC; UY; UZ; VE; VN; XK; YE; ZA; ZM; ZW	U
market for electricity, low voltage	2014-2017	Allocation, cut-off; Allocation, APOS	AE; AL; AM; AO; AR; AT; AU; AZ; BA; BD; BE; BG; BH; BJ; BN; BO; BW; BY; CA-AB; CA-BC; CA-MB; CA-NB; CA-NF; CA-NS; CA-NT; CA-NU; CA-ON; CA-PE; CA-QC; CA-SK; CA-YK; CD; CG; CI; CL; CM; CO; CR; CU; CW; CY; CZ; DE; DK; DO; DZ; EC; EE; EG; ER; ES; ET; FI; FR; GA; GB; GE; GH; GI; GLO; GR; GT; HK; HN; HR; HT; HU; ID; IE; IL; IQ; IR; IS; IT; JM; JO; JP; KE; KG;	U

			KH; KP; KR; KW; KZ; LB; LK; LT; LU; LV; LY; MA; MD; ME; MK; MM; MN; MT; MU; MX; MY; MZ; NA; NE; NG; NI; NL; NO; NP; NZ; OM; PA; PE; PH; PK; PL; PT; PY; QA; RO; RS; RU; SA; SD; SE; SG; SI; SK; SN; SS; SV; SY; TG; TH; TJ; TM; TN; TR; TT; TW; TZ; UA; US-ASCC; US-FRCC; US-HICC; US-MRO; US-NPCC; US-RFC; US-SERC; US-TRE; US-WECC; UY; UZ; VE; VN; XK; YE; ZA; ZM; ZW

6.3.1 Changes to production, trade, and loss volume

A visual overview of these data sources applied for the update of electricity market mixes from ecoinvent v3.6 to v3.7 is presented in Figure 10.

Figure 10. Visual overview of main data sources used for updating electricity markets from ecoinvent v3.6 to v3.7. *Does not apply to the electricity markets of China, India (not updated)*



Data sources were applied as described in the following list:

- National production volumes for OECD and non-OECD countries: IEA extended World Energy Balances (IEA, 2019), for pumped hydro power IEA World Energy Statistics (IEA, 2019a)
- US grid region production volumes: eGrid (EIA, 2019)
- CA grid region production volumes: StatCAN (2020a-c)
- OECD electricity imports/ exports with OECD and non-OECD countries: OECD electricity imports/ exports (IEA, 2019a-b)
- European electricity imports/ exports: ENTSO-E (2019)
- National transmission and transformation losses: IEA extended World Energy Balances (IEA, 2019)

- Technology split factors: previous ecoinvent version (v3.6) (based on older versions of IAEA (2020), NREL (2020), S&P Global (2018), The Windpower (2020) and others)
- Loss split factors: same as previous ecoinvent versions (based on Itten et al., 2014)
- Voltage level split factors: previous ecoinvent version (v3.6) (based on Itten et al., 2014)
- Canada internal electricity trade split factors: data provided by (Tirado, 2019)
- The shares of the Swiss electricity mixes have been calculated based on statistics for the year 2017 from SFOE (2020) and VSE (2020).

6.3.2 New import and technology splits

An electricity import split was added to Cameroon because the respective import was not included in previous versions of ecoinvent. Temporal inconsistencies may occur due to limited data availability.

Some splits for electricity generation technologies had to be added because they were not included, or the respective plants were not operated in the previous ecoinvent version. These splits are listed in (Table 13). Temporal inconsistencies may occur due to limited data availability.

Table 13. New technology splits for updated electricity markets. *The activities listed in the "Technology splits" column represent the production means with which the countries of column "Geography" produce electricity from the fuel in column "Fuel type". Columns "Data year" and "Data source" represent the year in which the data on technology splits is valid for and the according source respectively.*

Geography	Fuel type	Technology splits	Data year	Data source
BA	wood (CHP)	100% heat and power co-generation, wood chips, 6667 kW (based on ecoinvent technology split for neighboring HR because no major plant in BA known)	2016	Moreno_Ruiz et al., (2019)
BJ	natural gas (non-CHP)	100% electricity production, natural gas, conventional power plant	2018	UNIDO (2019)
DO	wood (CHP)	100% treatment of bagasse, from sugarcane, in heat and power co-generation unit, 6400kW thermal	2016	Renewables Now (2016)
JM	natural gas (non-CHP)	100% electricity production, natural gas, combined cycle power plant	2017	Jamaica Observer (2019), JPS (2020)
ME	wind (total)	100% electricity production, wind, 1-3MW turbine, onshore	2017	The Windpower (2020)
MM	wind (total)	100% electricity production, wind, <1MW turbine, onshore (currently only very small scale as no major wind park known)	2017	The Windpower (2020)
MT	natural gas (non-CHP)	100% electricity production, natural gas, combined cycle power plant	2017	Power Technology (2020)
TT	wind (total)	100% electricity production, wind, <1MW turbine, onshore (currently only very small scale as no major wind park known)	2017	The Windpower (2020), The University of Trinidad and Tobago (2015)
XK	wind (total)	100% electricity production, wind, >3MW turbine, onshore	2017	The Windpower (2020)

6.3.3 New import datasets

With the update of electricity data, especially trade volumes, certain new import datasets had to be created to represent the trade of electricity mentioned in the statistics. Table 14 lists all newly created import datasets with their respective origin and destination.

Table 14. New import activities for electricity. *If several geographies of the same activity with the same time period and system model exist, all of them are listed in the "Geography" column.*

Activity name	Geography	Time period
electricity, high voltage, import from BY	LT	2012-2012
electricity, high voltage, import from EC	PE	2020-2020
electricity, high voltage, import from ES	MA	2020-2020
electricity, high voltage, import from IR	TR	2020-2020
electricity, high voltage, import from JO	EG	2020-2020
electricity, high voltage, import from LV	RU	2020-2020
electricity, high voltage, import from MA	ES	2020-2020
electricity, high voltage, import from MT	IT	2020-2020
electricity, high voltage, import from OM	AE	2020-2020
electricity, high voltage, import from RAF	CM	2020-2020
electricity, high voltage, import from RAS	VN	2020-2020
electricity, high voltage, import from RU	LT; LV	2012-2012
electricity, high voltage, import from TR	GE	2020-2020

6.3.4 Upper limit for electricity grid losses

The electricity losses in a few countries are occasionally very high (>40% of net electricity supply) due to electricity theft, which is not distinguished from physical grid losses in the original data sources. This distorts the composition of ecoinvent electricity markets which are supposed to represent the consumption of 1 kWh of electricity, whether by theft or not. Thus, in ecoinvent versions prior to v3.6, there has been an upper limit for electricity losses that has been applied on a case-by-case basis. It has also been introduced for Haiti (HT) and Iraq (IQ) in v3.7 at a maximum net supply loss of 40% based on Tabaqchali (2020), as these were the only two countries calculated with the electricity market tool with losses that exceeded higher than 40% of net electricity supply. The documentation in the market datasets has been updated accordingly ("An upper limit for losses has been applied at 40% of the net electricity supply to correct for electricity theft (based on Tabaqchali, 2020).").

6.4 Update of uranium enrichment mixes

Reflecting the shift from uranium enriched by diffusion to centrifuge enriched uranium in the industry, the production volumes in those datasets were adjusted. Since enrichment by diffusion is outdated the production volumes have been set to 0, while the datasets remain in the database. The production volumes of centrifuge enriched uranium production have been updated.

Table 15. Uranium producing activities for which the production volumes were updated. *If several geographies of the same activity with the same time period and system model exist, all of them are listed in the "Geography" column. In column v3.7, "U" stands for "Updated Activity".*

Activity name	Geography	Time period	v3.7
uranium production, centrifuge, enriched 3.0%	CN; DE; GB; NL	1993-2000	U
uranium production, centrifuge, enriched 3.0%	GLO; RU	1993-2006	U
uranium production, centrifuge, enriched 3.8%	CN; DE; GB; NL	1993-2000	U
uranium production, centrifuge, enriched 3.8%	GLO; RU	1993-2006	U
uranium production, centrifuge, enriched 3.9%	DE; GB; NL	1993-2000	U
uranium production, centrifuge, enriched 3.9%	GLO; RU	1993-2006	U
uranium production, centrifuge, enriched 4.0%	DE; GB; NL	1993-2000	U
uranium production, centrifuge, enriched 4.0%	GLO; RU	1993-2006	U
uranium production, centrifuge, enriched 4.2%	DE; GB; NL	1993-2000	U
uranium production, centrifuge, enriched 4.2%	GLO; RU	1993-2006	U
uranium production, diffusion, enriched 3.0%	FR; GLO; US	1980-2000	U
uranium production, diffusion, enriched 3.8%	FR; GLO; US	1980-2000	U
uranium production, diffusion, enriched 3.9%	FR; GLO; US	1980-2000	U
uranium production, diffusion, enriched 4.0%	FR; GLO; US	1980-2000	U
uranium production, diffusion, enriched 4.2%	FR; GLO; US	1980-2000	U

6.5 Other new and updated activities

The activity "diesel, burned in diesel-electric generating set, 18.5kW" was initially created as a derivative of the dataset "diesel, burned in diesel-electric generating set, 10MW" and intended to be used with datasets describing the operation of reefers for cooling cargo. However, the reference product was adjusted to take the efficiency of a diesel generator into account and this led to the unit being MJ (electric). The unit has been changed in v3.7 to MJ (thermal) and the dataset adjusted accordingly to harmonise the terminology "…, burned in…" which in all other datasets points to an output in MJ (thermal). All affected datasets (Table 16) have been adjusted to take this change into account.

Table 16. Affected datasets due to the change of the unit of the reference product of "diesel, burned in diesel-electric generating set, 18.5kW" from MJ (thermal) to MJ (electric).

Activity name	Geography	Time period
diesel, burned in diesel-electric generating set, 18.5kW	GLO	2010-2014
operation, reefer, cooling, 40-foot, high-cube, carbon dioxide, liquid as refrigerant	GLO	2010-2014
operation, reefer, cooling, 40-foot, high-cube, R134a as refrigerant	GLO	2010-2014
operation, reefer, freezing, 40-foot, high-cube, carbon dioxide, liquid as refrigerant	GLO	2010-2014
operation, reefer, freezing, 40-foot, high-cube, R134a as refrigerant	GLO	2010-2014
furniture production, wooden	GLO	2011-2017

Finally, Table 17 lists all datasets in the electricity sector that were newly added or updated and are not listed in any tables of this chapter.

Table 17. New and updated datasets related to electricity not mentioned in any of the preceding tables. *In column v3.6, "U" stands for "Updated Activity", and "N" stands for "New activity". The activity "electricity, from municipal waste incineration to generic market for electricity, medium voltage" represents a renaming activity connecting "electricity, from municipal waste incineration" to "electricity, medium voltage".*

Activity name	Geography	Time period	v3.7
electricity production, hydro, pumped storage	CH	1945-2015	U
electricity production, natural gas, combined cycle power plant	AR	2012-2017	U
electricity, from municipal waste incineration to generic market for electricity, medium voltage	CA-AB	2012-2015	N
fuel cell production, polymer electrolyte membrane, 2kW electrical, future	CH; GLO	2000-2005	U
fuel cell production, stack polymer electrolyte membrane, 2kW electrical, future	GLO	2000-2005	U

7 Fertilisers

Fertilisers of man-made nature are produced from fossil sources of nutrients and thus their manufacture and supply are of great interest from a life cycle perspective, as they are used as nutrients for crop production, or as precursors of several other chemicals. In this chapter, users can find documentation and changes related to updates performed in fertilisers for 3.7.

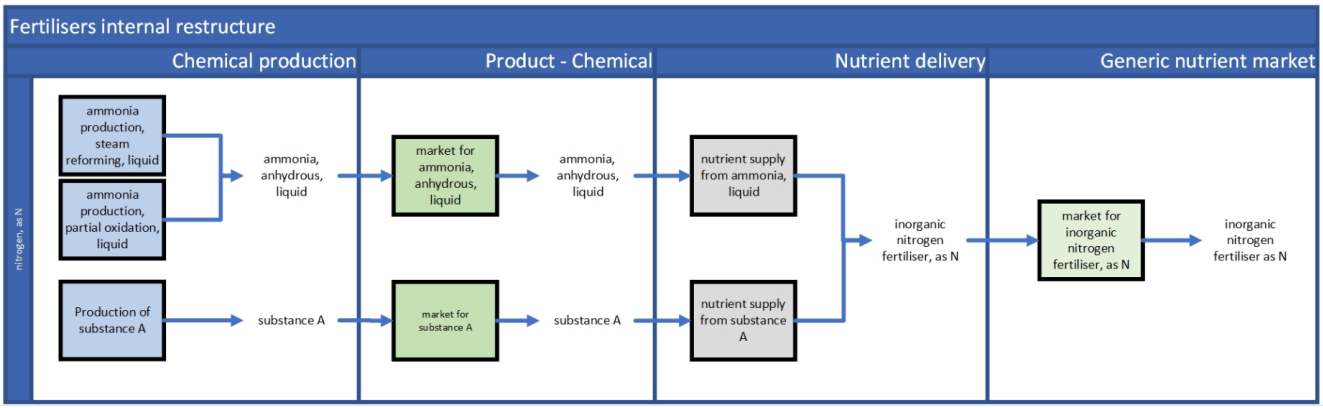


Figure 11: Supply chain of a chemical product, through a local market leading to the nutrient supply and in the end to an generic nutrient product.

One of the most important features of this update is the distinction of a substance from its manufacture and a possible use of the substance as a fertiliser. Hence a production process is responsible for the production of a pure chemical substance regardless of the nutrient it may contain. If substances are meant to be used as fertilisers, then there is a dedicated transforming activity that transforms the chemical into the nutrient or nutrients meant to be delivered. Those activities are called nutrient supplies and are described in detail further below.

Another highlight of the update is the classification fertilisers based on the source of the nutrient. Based on this parameter, fertiliser products and fertilising agents are split into, inorganics, organics and organo-minerals. The split refers to their source of production, generation, or manufacture. Inorganic fertilising agents are those who contain a mineral source of the nutrient they are delivering. Examples are, ammonia, urea, potassium nitrate etc. When nutrients supplied by a fertilising agent is solely of biological origin then the fertilising agent is classified as an organic fertiliser. Examples are, manures, compost, vinasses etc. Finally, organo-mineral, is defined when the nutrients present can be a blend of both biological and mineral sources. Currently, introduced in 3.7, organo-mineral sludge is the only fertilising agent in the database. This new system of classification allows clarity in the sector and of course there are no cases where animal by-products (organic) are competing with chemical substances (inorganic). This classification is documented in detail in the respective European legislation (EC 2019/1009).

7.1 Manufacturing of chemicals

3.7 features new and updated data on a manufacturing level of chemical substances that find application in the fertiliser sector, as well as in the synthesis of several other chemicals. The data were provided by WFLDB (Quantis), Yara and Fertilizers Europe. In addition to that, as has been mentioned, the production of the chemical substance and further use as chemical precursor was decoupled from its use as fertiliser. Certain datasets were updated internally to comply with this methodology. Below there is a list of updated data and new data featured in this version.

Table 18: New and updated activities and products related to inorganic nutrient supplies. *If several geographies of the same activity with the same time period exist, all of them are listed in the "Geography" column. In the column v3.7, "N" stands for "New Activity", "U" stands for "Updated Activity", "Nr" stands for "Replacing Activity" and "D" stands for "Deleted, replaced by new or existing dataset(s)". All products expressed in kg.*

Activity Name	Geography	Time period	Reference product	v3.7
ammonia production, partial oxidation, liquid	RER	2000-2000	ammonia, liquid	D
ammonia production, partial oxidation, liquid	CN	2011-2014	ammonia, anhydrous, liquid	Nr
ammonia production, partial oxidation, liquid	GLO	2011-2014	ammonia, anhydrous, liquid	U
ammonia production, steam reforming, liquid	RER	2000-2000	ammonia, liquid	D
ammonia production, steam reforming, liquid	CN; RAF; RER w/o RU; RLA; RNA; RU; SAS; UN-OCEANIA; UN-SEASIA	2011-2014	ammonia, anhydrous, liquid	Nr
ammonia production, steam reforming, liquid	GLO	2011-2014	ammonia, anhydrous, liquid	U
ammonium nitrate phosphate production	CN; RNA	1997-2007	ammonium nitrate phosphate	Nr
ammonium nitrate phosphate production	GLO	1997-2007	ammonium nitrate phosphate	U
ammonium nitrate phosphate production	RER	1997-2007	ammonium nitrate phosphate	U
ammonium nitrate production	CN; RNA	2011-2014	ammonium nitrate	Nr
ammonium nitrate production	GLO; RER	2011-2014	ammonium nitrate	U
ammonium sulfate production	GLO; RER	1998-2000	ammonium sulfate	U
basic slag fertiliser production	GLO; RER	1997-1997	phosphate fertiliser, as P2O5	D
calcium ammonium nitrate production	CN; RNA	2011-2014	calcium ammonium nitrate	Nr
calcium ammonium nitrate production	GLO; RER	2011-2014	calcium ammonium nitrate	U
calcium nitrate production	GLO; RER	2010-2010	calcium nitrate	U
diammonium phosphate production	CN; RNA	2011-2014	diammonium phosphate	Nr
diammonium phosphate production	GLO; RER	2011-2014	diammonium phosphate	U
monoammonium phosphate production	CN; RNA	2011-2014	monoammonium phosphate	Nr
monoammonium phosphate production	GLO; RER	2011-2014	monoammonium phosphate	U
nitric acid production, product in 50% solution state	RER	1990-2020	nitric acid, without water, in 50% solution state	D
nitric acid production, product in 50% solution state	CN; RAF; RER w/o RU; RLA; RNA; RU; SAS; UN-OCEANIA; UN-SEASIA	2011-2021	nitric acid, without water, in 50% solution state	Nr

Activity Name	Geography	Time period	Reference product	v3.7
nitric acid production, product in 50% solution state	GLO	2011-2021	nitric acid, without water, in 50% solution state	U
NPK (15-15-15) fertiliser production	CN; GLO; RER; RNA	2011-2014	NPK (15-15-15) fertiliser	N
NPK (26-15-15) fertiliser production	CN; GLO; RER; RNA	2011-2014	NPK (26-15-15) fertiliser	N
phosphate rock beneficiation	RER	2011-2011	phosphate rock, beneficiated	Nr
phosphate rock beneficiation	GLO	1986-2011	phosphate rock, beneficiated	U
phosphate rock beneficiation, dry	GLO; MA	1986-2001	phosphate rock, as P2O5, beneficiated, dry	D
phosphoric acid production, dihydrate process	RER	2011-2014	phosphoric acid, fertiliser grade, without water, in 70% solution state	Nr
phosphoric acid production, dihydrate process	MA	1986-2001	phosphoric acid, fertiliser grade, without water, in 70% solution state	U
phosphoric acid production, dihydrate process	US	1986-2001	phosphoric acid, fertiliser grade, without water, in 70% solution state	U
phosphoric acid production, dihydrate process	GLO	1986-2014	phosphoric acid, fertiliser grade, without water, in 70% solution state	U
potash salt production	GLO; RER	2011-2014	potash salt	N
potassium chloride production	CA-SK	2000-2000	potassium chloride, as K2O	D
potassium chloride production	GLO	2000-2014	potassium chloride	U
potassium chloride production	RER	2011-2014	potassium chloride	U
potassium nitrate production	CN	2007-2007	potassium nitrate	Nr
potassium nitrate production	RNA	2013-2014	potassium nitrate	Nr
potassium nitrate production	GLO	2007-2014	potassium nitrate	U
potassium nitrate production	RER	2013-2014	potassium nitrate	U
potassium sulfate production	GLO; RER	1999-1999	potassium sulfate	U
single superphosphate production	GLO; RER	1999-1999	single superphosphate	U
triple superphosphate production	GLO; RER	2011-2014	triple superphosphate	U
urea ammonium nitrate production	CN; RNA	2011-2014	urea ammonium nitrate mix	Nr
urea ammonium nitrate production	GLO; RER	2011-2014	urea ammonium nitrate mix	U
urea production	CN; RNA	2011-2014	urea	Nr
urea production	GLO; RER	2011-2014	urea	U

7.2 Modelling approach in previous versions

Up until version 3.6, substances that can be used as fertilisers were modelled as directly produced in multiple datasets in the ecoinvent database. In most cases, a fertiliser production process would produce directly an equivalent amount of nutrient as a reference product or by-product (i.e. : “urea production” had a reference product of “urea, as N”). While this is convenient for the fertiliser sector, it generated minor inconsistencies for the downstream modelling. In fact, “urea, as N” is a virtual product with its physical correspondence lost after the system boundaries of the production. 1 kg of “urea, as N” is matched with circa 2.1 kg or urea, a value calculated using the nitrogen content of the substance, and being 46% in terms of mass. Therefore, that required from a user to convert the virtual into the physical product to consistently account for the transportation necessary.

Additionally, up to version 3.6, the database accommodated three global generic nutrient markets, one for each of the main nutrients (N, P and K). Market composition was defined by the production volume of the different contributors, without distinction of their origin. As a result, compost and manure were competing with urea in the same market.

7.3 Modelling featured in 3.7

Version 3.7 introduces a clear distinction between the production of a chemical substance and any possible downstream use as fertiliser. Within 3.7, it is a default modelling case that all datasets that refer to the production of a (fertiliser) substance are producing the substance in its pure form. An example is “urea production” where the reference product is now 1 kg of urea (CH_4N_2O). Therefore, production processes of fertilising substances are now consistent with the default modelling methodology of the chemical sector.

7.3.1 Ammonia – urea modelling methodology.

One of the most common and basic nitrogen fertilisers is ammonia. Regardless of its extensive application as fertiliser directly, ammonia is also used as a precursor to produce a wide range of fertilisers. Urea is the most relevant example, being produced from ammonia and carbon dioxide. The latter one is oftentimes by-produced during the ammonia production. Due to the heavy dependency to ammonia, urea production plants are often located next to ammonia plants so CO2 from ammonia production is utilised directly. So far and until version 3.6, ammonia production inventoried a direct emission of CO2 to air. The amount of that emission arised from the fuel employed in the process. On the other hand, urea production had no input of CO2. This modelling situation serves well the worst-case scenario of ammonia production where CO2 is not captured to be further utilised. Despite the mass imbalance in the undefined urea process, the modelling overall was taking into account a consistent mass balance for carbon.

For v3.7, the modelling of ammonia and urea production have been updated. Ammonia follows the same methodological approach with the full amount of emission impacting its production. However, the amounts have been recalculated based on the input of fuel used. In the cases of natural gas, an assumption was performed that the totality of its composition comprises out of methane (CH4). Further, CO2 has been calculated based on this core assumption and by considering that the full amount of carbon is transformed into it. In addition, “carbon dioxide, in chemical industry”, a new product, has been registered as a by-product in ammonia production and in geographies that correspond with urea production only. This product has a zero price and is put there for traceability reasons. The amount of it, is calculated to be 1% of CO2 emissions taking place in ammonia production.

On the other hand, urea production has a technospheric input of this “carbon dioxide, in chemical industry” with an amount that corresponds to the stoichiometric need of C to synthesise urea. In addition to this, urea production features a negative CO2 emission which is calculated based on the (minus) CO2 need plus a loss of CO2.

Overall, the new modelling, captures accurately the mass balance of urea by adjusting the missing flows of carbon from 3.6 and backwards. The new by-product of carbon is mainly being placed there for traceability, but it can enable future updates in the sector.

From an LCIA perspective, modelling choices applied for 3.7 should have minor, close to no contribution to scores for ammonia production. The difference in scores for ammonia between the two versions is attributed to the complete update of the dataset. This is the case for all system models and impact categories.

On the other hand, urea has lower scores (GWP), which is directly assigned to the capture of CO2 from ammonia production. Other than that, any other difference in scores is attributed to the update of the dataset.

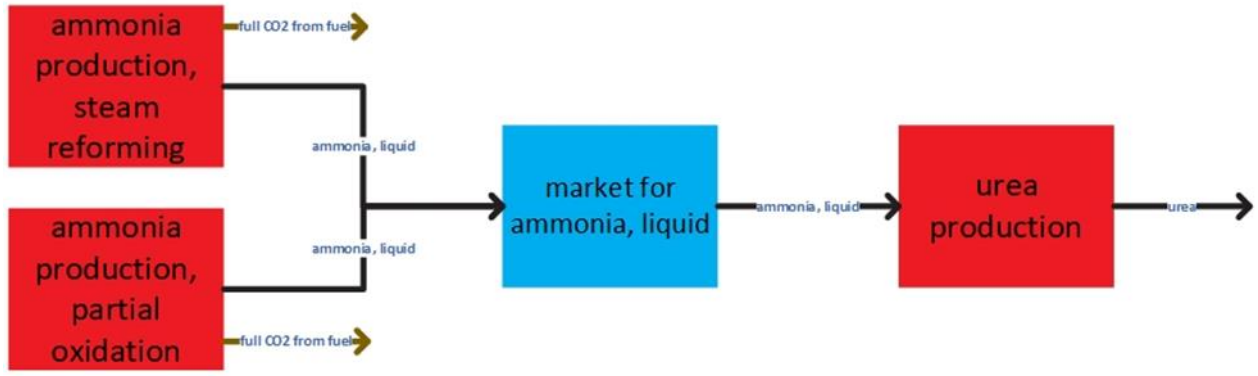


Figure 12: Ammonia and urea production up and including version 3.6. *Note that urea has not an input of CO2 while ammonia is burdened fully with he CO2 emissions generated from the fuels employed in the process.*

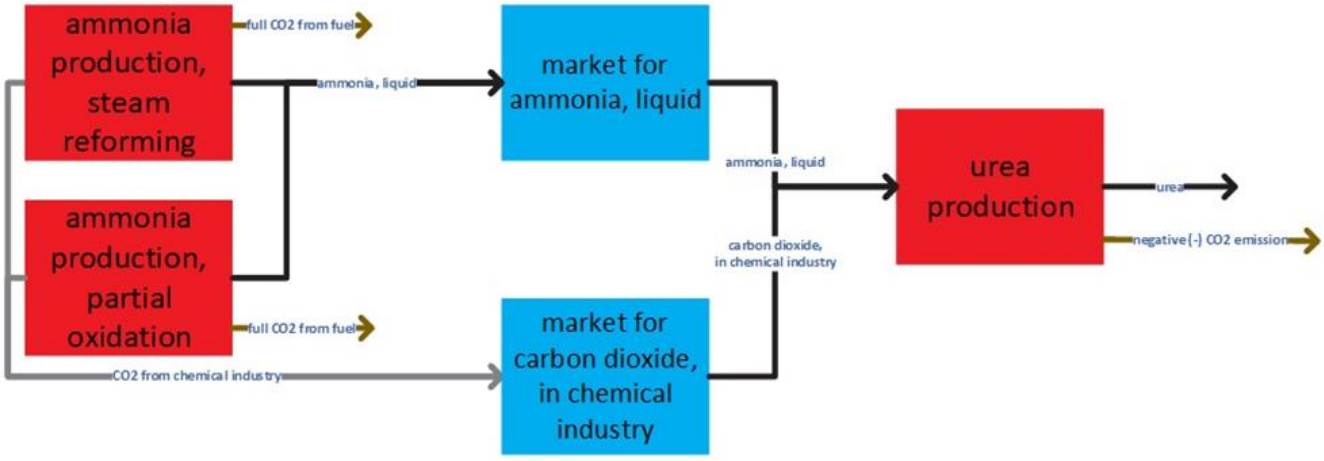


Figure 13: Ammonia and urea production from version 3.7. *Note how ammonia is connected with urea through the "CO2 from chemical industry" exchange. Urea has a negative CO2 emission and ammonia is burdened fully with the CO2 emissions generated from the fuels employed in the process.*

7.3.2 Local product markets

Markets represent consumption mixes of products blending the different technologies and/or processes that produce an identical substance. An example is, "market for ammonia, anhydrous, liquid" in CN where it blends ammonia, anhydrous, liquid from partial oxidation with ammonia from steam reforming. What is worth mentioning here is the fact that the product markets are bearing the transportation expenditure of 1 kg of the substance they supply with clear physical correspondence with the production of this substance. Hence, they do not supply a virtual product but instead a product with a clear physical property. The product markets at this level of the supply chain, have perfect geographical matching with the production activities.

Table 19: New and updated markets in the fertiliser sector. *"N" stands for "New Activity", "Nr" stands for "New, replacing an old market " and "U" stands for "Update" and "Dr" stands for "Deleted, replaced by another market".*

Activity Name	Geography	Time period	v3.7
market for ammonia, anhydrous, liquid	CN; RAF; RLA; RNA; SAS; UN-OCEANIA; UN-SEASIA; RER	2016-2019	Nr, U
market for ammonium nitrate	CN; RER; RNA; GLO	2016-2019	Nr, U
market for ammonium nitrate phosphate	CN; GLO; RER; RNA	2016-2019	N
market for ammonium sulfate	RER; GLO	2016-2019	Nr, U
market for calcium ammonium nitrate	CN; GLO; RER; RNA	2016-2019	N
market for calcium nitrate	RER; GLO	2016-2019	Nr, U
market for diammonium phosphate	CN; GLO; RER; RNA	2016-2019	N
market for mine infrastructure, potash salt	GLO	2000-2002	N
market for monoammonium phosphate	CN; GLO; RER; RNA	2016-2019	N
market for nitric acid, without water, in 50% solution state	CN; RAF; RER w/o RU; RLA; RNA; RU; SAS; UN-OCEANIA; UN-SEASIA; RER	2016-2019	Nr, Dr
market for NPK (15-15-15) fertiliser	CN; GLO; RER; RNA	2016-2019	N
market for NPK (26-15-15) fertiliser	CN; GLO; RER; RNA	2016-2019	N
market for phosphate rock, as P2O5, beneficiated, dry	GLO	2011-2011	Dr
market for phosphate rock, as P2O5, beneficiated, wet	GLO	2011-2011	Dr
market for phosphate rock, beneficiated	GLO; MA; RER; US	2016-2019	Nr
market for phosphoric acid, fertiliser grade, without water, in 70% solution state	RER	2016-2019	Nr
market for potash salt	GLO; RER	2016-2019	N
market for potassium chloride	GLO; RER	2016-2019	Nr, U
market for potassium nitrate	CN; RER; RNA; GLO	2016-2019	Nr, U
market for potassium sulfate	GLO; RER	2016-2019	Nr, U
market for recultivation, potash salt mine	GLO	2000-2002	N
market for single superphosphate	GLO; RER	2016-2019	N
market for triple superphosphate	GLO; RER	2016-2019	N
market for urea	CN; RER; RNA; GLO	2016-2019	Nr, U
market for urea ammonium nitrate mix	CN; GLO; RER; RNA	2016-2019	N
market group for inorganic nitrogen fertiliser, as N	RER	2016-2019	N

Activity Name	Geography	Time period	v3.7
market group for inorganic phosphorus fertiliser, as P2O5	RER	2016-2019	N
market group for inorganic potassium fertiliser, as K2O	RER	2016-2019	N

7.3.3 Supporting datasets

In 3.7 a number of datasets has been added to support the modifications performed in the sector. A case is related to the potash mining where infrastructure has been added using dolomite infrastructure as an approximation. Below there is a list of new additions.

Table 20: New supporting datasets added in 3.7.

Activity Name	Geography	Time period
mine construction, potash salt	GLO; RER	2000-2002
recultivation, potash salt mine	GLO; RER	2000-2002

7.4 From chemical to inorganic nutrient supply

7.4.1 Nutrient supplies

Those are transforming activities. They have as an input a fertiliser substance or a fertilising agent and they deliver the generic form of the nutrient which is essentially defined as a "virtual product".

Nutrient supplies from substances usually deliver one nutrient product. However, there are cases where two or three are delivered from one substance. All nutrient supplies that deliver inorganic fertilisers are set up with multiple reference products (combined production) – if they deliver more than one. During the calculation of the system models, those nutrient supplies, do not allocate or substitute, but subdivide. The amounts of the reference product are calculated based on the nutrient content of the substance they transform. Because of that, inorganic nutrient supplies are preserving the mass balance of the substance they initially transformed.

Example: "ammonium nitrate phosphate", is a substance that can deliver both nutrients of P and N. It has a nutrient content of 0.22 kg of both N and P2O5 per kg of substance. "nutrient supply from ammonium nitrate phosphate" in its undefined form has an input of 1 kg of ammonium nitrate phosphate and transforms this into two RPs, 0.22 of "inorganic nitrogen fertiliser, as N" and 0.22 kg of "inorganic phosphorus fertiliser, as P2O5". In its linked version the nutrient supply produces 1 kg of each product with an input of 1 / 0.22 = 4.54 kg of ammonium nitrate phosphate.

Table 21: New and updated activities and products related to inorganic nutrient supplies. *If several geographies of the same activity with the same time period exist, all of them are listed in the "Geography" column. In the column v3.7, "N" stands for "New Activity", "U" stands for "Updated Activity" and "Nr" stands for "Replacing Activity". The unit of all products is kg.*

Activity Name	Geography	Time period	Product	v3.7
nutrient supply from ammonia, anhydrous, liquid	CN; GLO; RAF; RER w/o RU; RLA; RNA; RU; SAS; UN-OCEANIA; UN-SEASIA	2016-2019	inorganic nitrogen fertiliser, as N	N
nutrient supply from ammonium chloride	GLO	2016-2019	inorganic nitrogen fertiliser, as N	U
nutrient supply from ammonium nitrate	CN; GLO; RER; RNA	2016-2019	inorganic nitrogen fertiliser, as N	N
nutrient supply from ammonium sulfate	GLO; RER	2016-2019	inorganic nitrogen fertiliser, as N	N
nutrient supply from calcium ammonium nitrate	CN; GLO; RER; RNA	2016-2019	inorganic nitrogen fertiliser, as N	N
nutrient supply from calcium nitrate	GLO	2016-2019	inorganic nitrogen fertiliser, as N	U
nutrient supply from urea	CN; GLO; RER; RNA	2016-2019	inorganic nitrogen fertiliser, as N	N
nutrient supply from urea ammonium nitrate mix	CN; GLO; RER; RNA	2016-2019	inorganic nitrogen fertiliser, as N	N
nutrient supply from ammonium nitrate phosphate	CN; GLO; RER; RNA	2016-2019	inorganic nitrogen fertiliser, as N; inorganic phosphorus fertiliser, as P2O5	N
nutrient supply from diammonium phosphate	CN; GLO; RER; RNA	2016-2019	inorganic nitrogen fertiliser, as N; inorganic phosphorus fertiliser, as P2O5	N
nutrient supply from monoammonium phosphate	CN; GLO; RER; RNA	2016-2019	inorganic nitrogen fertiliser, as N; inorganic phosphorus fertiliser, as P2O5	N
nutrient supply from NPK (15-15-15) fertiliser	CN; GLO; RER; RNA	2016-2019	inorganic nitrogen fertiliser, as N; inorganic phosphorus fertiliser, as P2O5; inorganic potassium fertiliser, as K2O	N
nutrient supply from NPK (26-15-15) fertiliser	CN; GLO; RER; RNA	2016-2019	inorganic nitrogen fertiliser, as N; inorganic phosphorus fertiliser, as P2O5; inorganic potassium fertiliser, as K2O	N
nutrient supply from potassium nitrate	GLO	2016-2019	inorganic nitrogen fertiliser, as N; inorganic potassium fertiliser, as K2O	U
nutrient supply from potassium nitrate	CN; RER; RNA	2016-2019	inorganic nitrogen fertiliser, as N; inorganic potassium fertiliser, as K2O	Nr
nutrient supply from phosphate rock, beneficiated	GLO; RER	2016-2019	inorganic phosphorus fertiliser, as P2O5	N
nutrient supply from phosphoric acid, fertiliser grade, without water, in 70% solution state	GLO; RER	2016-2019	inorganic phosphorus fertiliser, as P2O5	N
nutrient supply from single superphosphate	GLO; RER	2016-2019	inorganic phosphorus fertiliser, as P2O5	N
nutrient supply from triple superphosphate	GLO; RER	2016-2019	inorganic phosphorus fertiliser, as P2O5	N
nutrient supply from thomas meal	GLO	2016-2019	inorganic phosphorus fertiliser, as P2O5	Nr
nutrient supply from potash salt	GLO; RER	2016-2019	inorganic potassium fertiliser, as K2O	N
nutrient supply from potassium chloride	GLO; RER	2016-2019	inorganic potassium fertiliser, as K2O	N
nutrient supply from potassium chloride sludge	GLO	2000-2006	inorganic potassium fertiliser, as K2O	N
nutrient supply from potassium sulfate	GLO; RER	2016-2019	inorganic potassium fertiliser, as K2O	N

7.4.2 Generic nutrient markets for inorganic fertilisers

A generic nutrient product is created for each of the three fertiliser sources. The ecoinvent database accommodates fertiliser products and fertilising agents for the three main nutrients of nitrogen (N), phosphorus (P) and potassium (K). However, for the two latter ones, the oxidised form is considered to be delivered in the plants. The following equivalencies are applied across the database:

1 kg of Phosphorus (P) = 0.436 kg of Phosphorus pentoxide (P2O5)

1 kg of Potassium (K) = 0.830 kg of Potassium oxide (K2O)

Within 3.7, generic inorganic markets have been created for a total of 64 different countries including all European ones. Markets are constructed using country specific consumption mixes for each of the three nutrients. The data are publicly available from the International Fertiliser Association (IFA).

Table 22: List of new generic markets and their geographies.

Activity Name	Geography	Time period	v3. 7
market for inorganic nitrogen fertiliser, as N	AL; AR; AT; AU; BA; BD; BE; BG; BR; CA; CH; CI; CL; CN; CO; CR; CY; CZ; DE; DK; EC; EE; ES; FI; FR; GB; GR; HR; HU; ID; IE; IL; IN; IS; IT; KE; LK; LT; LU; LV; MK; MX; MY; NL; NO; NZ; PE; PH; PL; PT; RO; RS; RU; SE; SI; SK; TH; TR; UA; US; VN; XK; ZA; GLO	2016-2019	Nr, U
market for inorganic phosphorus fertiliser, as P2O5	AL; AR; AT; AU; BA; BD; BE; BG; BR; CA; CH; CI; CL; CN; CO; CR; CY; CZ; DE; DK; EC; EE; ES; FI; FR; GB; GR; HR; HU; ID; IE; IL; IN; IS; IT; KE; LK; LT; LU; LV; MK; MX; MY; NL; NO; NZ; PE; PH; PL; PT; RO; RS; RU; SE; SI; SK; TH; TR; UA; US; VN; XK; ZA; GLO	2016-2019	Nr, U
market for inorganic potassium fertiliser, as K2O	AL; AR; AT; AU; BA; BD; BE; BG; BR; CA; CH; CI; CL; CN; CO; CR; CY; CZ; DE; DK; EC; EE; ES; FI; FR; GB; GR; HR; HU; ID; IE; IL; IN; IS; IT; KE; LK; LT; LU; LV; MK; MX; MY; NL; NO; NZ; PE; PH; PL; PT; RO; RS; RU; SE; SI; SK; TH; TR; UA; US; VN; XK; ZA; GLO	2016-2019	Nr, U
market group for inorganic nitrogen fertiliser, as N	RER	2016-2019	N
market group for inorganic phosphorus fertiliser, as P2O5	RER	2016-2019	N
market group for inorganic potassium fertiliser, as K2O	RER	2016-2019	N

The consumption pattern data from IFA have been treated and adjusted with certain assumptions to fit the data available in the database. This is the case for substances that deliver two or three nutrients such as NPK, double nutrient substances for N-P and N-K.

On the first place, IFA reports a total nutrient delivery from NPK products, while in the database only two products are available, NPK 15-15-15 and NPK 26-15-15. The first one is the most common NPK fertiliser and has been assumed therefore that it is the one that contributes to the final generic market.

Additionally, IFA reports total nutrient amounts consumed for substances containing both N and P nutrients without reporting the specific substances. In 3.7, ammonium nitrate phosphate (ANP) and diammonium phosphate (DAP) are available as stand-alone products that can match the category defined by IFA as “other NP fertilisers”. It has been arbitrarily assumed that the totality of N-P fertilisers can be split equally between those two products.

Another double nutrient case is “N K compound” as reported by IFA where it has been assumed that matches “potassium nitrate”, the only possible N K substance available in the database.

From a geographical perspective, it has been assumed that Luxembourg has identical consumption patterns as Belgium, this was necessary as IFA reports data for both countries together. In addition, Kosovo has been assumed to have identical to Albania consumption pattern related to fertilisers. This is supported by the location of both countries in terms of trade routes and additionally their common climatic zone that allows similar crop production hence fertiliser consumption.

In addition, certain tags from IFA could not be matched such as “Other N/P/K straight compound”. Those could not be matched with any of the products available in 3.7. Subsequently, their amounts have been excluded and not considered in the generic markets. As a direct result certain generic markets are not 100% representative of the regional consumption mix. Market composition therefore has been calculated and normalised based on the products available in the database.

Regarding representativeness, all three markets score very high with N being on average 97% representative of the consumption mix reported by the IFA. Same range, P and K are on average 95 and 98% representative. Out of 186 generic nutrient markets, only 21 of them have a representativeness below 90% for the unique combination of country and nutrient consumption.

Given the difference in the consumption mix of each country, different LCIA results can be generated per combination of country and nutrient consumption. Below there is a qualitative comparison between European countries for nitrogen consumption.

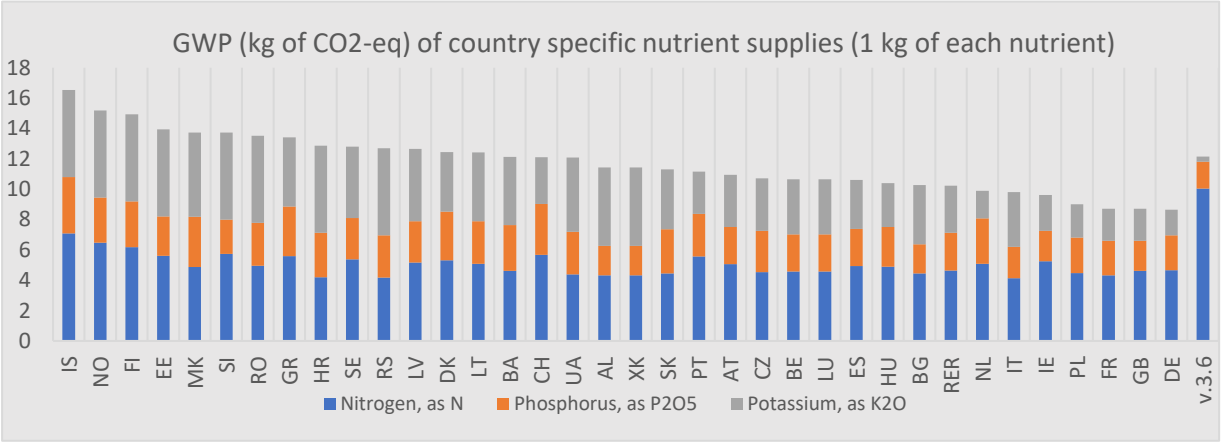


Figure 14: Total score of nutrient consumption for fertiliser use in European countries and the global case of 3.6. *Consumption country profiles were extracted using data from the International Fertiliser Association. Indicator: Global warming potential of 100 years in kg of CO2-equivalents based on IPCC 2016, Allocation cut-off. Total score of nutrient consumption for fertiliser use in European countries and the global case of v3.6.*

The total score per country has of course a different score contribution. Below, an illustration of major European and global consumers (based on production volume).

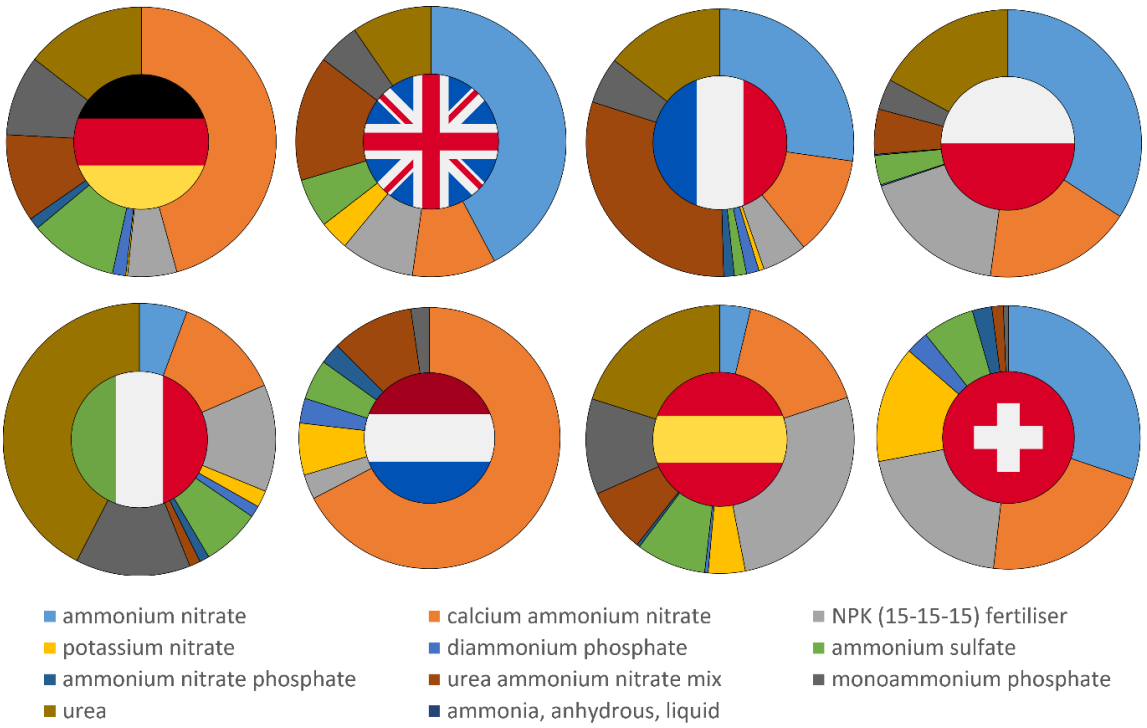


Figure 15: Score contribution of nitrogen consumption (market for inorganic nitrogen fertiliser, as N). *Major European consumers and Switzerland (IPCC, GWP 100a, in kg of CO2-eq. Calculated for cut-off system model).*

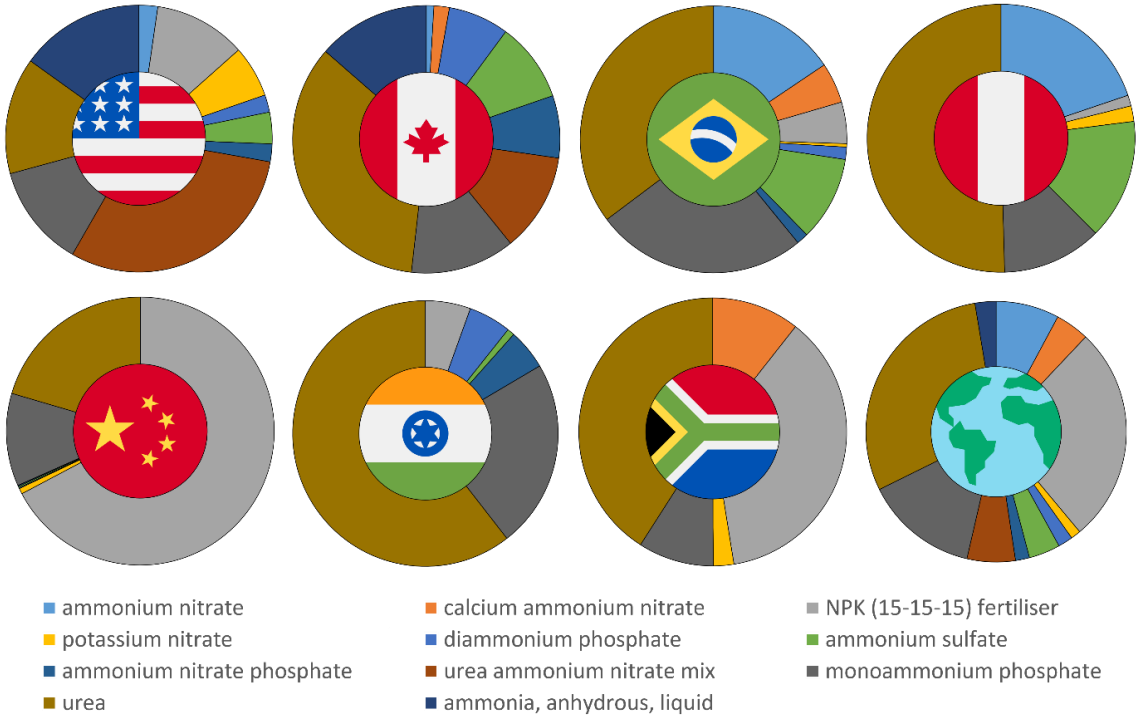


Figure 16: Score contribution of nitrogen consumption (market for inorganic nitrogen fertiliser, as N) . *Top left to right: United States, Canada, Brazil, Peru; Bottom, left to right: China, India, South Africa and Rest of the World. I (IPCC, GWP 100a, in kg of CO2-eq. Calculated for cut-off system model).*

7.5 The organic and organo-mineral fertilisers and nutrient supply

A major aspect of organic and organo-mineral substrates is their constrained production. In all cases, those substrates are produced as by-products which means that their production is constrained by the production of the processes' reference product. In all cases of constrained production of a valuable by-product, an unconstrained supplier must be modelled for the consequential system model to function properly. In the case of organic and organo-mineral fertilising agents, the v3.7 update considers the inorganic ones to be the unconstrained supplier of those products.

In non-inorganics, generic markets are constructed based on the available products on a global scale. The contribution of different substrates into those markets is defined by using their production volumes and their relative production volume share of the market.

7.5.1 Nutrient supplies and generic markets

Prior to v3.7 certain datasets were producing the generic form of a nutrient and those have been modified into different organic or organo-mineral substrates. This follows the same logic described above, of decoupling the chemical production of ammonia with the application of ammonia as fertiliser. The affected datasets, and the performed change are listed below.

Table 23: Producers of fertilisers that were modified and are now producing a fertilising agent. *If several geographies of the same activity exist, all of them are listed in the "Geography" column. The unit of all products is kg.*

Activity Name	Geography	RP/ BP in 3.6 modified	RP/ BP in 3.7
citric acid production	CN; GLO; RER; RNA	ammonium nitrate, as N	fermentation filtrate
heat production, straw, at furnace 300kW	GLO; RER	phosphate fertiliser, as P2O5	ash, from combustion of straw
heat production, straw, organic, at furnace 300kW	GLO; RER	phosphate fertiliser, as P2O5	ash, from combustion of straw
heat production, straw, at furnace 300kW	GLO; RER	nitrogen fertiliser, as N	ash, from combustion of straw
heat production, straw, organic, at furnace 300kW	GLO; RER	nitrogen fertiliser, as N	ash, from combustion of straw
esterification of rape oil	Europe without Switzerland; GLO	potassium sulfate, as K2O	glycerin distillate bottom
magnesium production, electrolysis	GLO; IL	potassium chloride, as K2O	potassium chloride sludge
potassium mining and benefication	CA-SK; GLO	potassium chloride, as K2O	potassium chloride

Comparing the inorganics with the organics and organo-minerals, one can observe the lack of granularity in the two latter ones. Both in terms of production but also in terms of consumption and geographical representation. Unfortunately, organic and organo-mineral fertilising agents are not produced on an industrial scale and not credible statistics can be found related to their consumption. Therefore, it has been decided to offer to users only global markets for both the production of the fertilising substrate and later also for the consumption of the generic nutrients they can provide.

Contrary to inorganics, nutrient supplies from organic fertilising agents are not set up as combined productions but regular transforming activities with reference and by-products - when the substrate is able to deliver more than one nutrient. Therefore, regular allocation is applied in the linked version of the attributional system models, using product prices as allocation keys. Below there is a list of the relevant nutrient supplies.

Table 24: New and updated activities and products related to organic and organo-mineral nutrient supplies. *In the column v3.7, "N" stands for "New Activity", "U" stands for "Updated Activity". Geography of all activities is GLO. The unit of all products is kg.*

Activity Name	Time period	Reference Product	v3.7
inorganic nitrogen fertiliser, as N to generic market for organic nitrogen fertiliser, as N	2016-2019	organic nitrogen fertiliser, as N	N
inorganic nitrogen fertiliser, as N to generic market for organo-mineral nitrogen fertiliser, as N	2016-2019	organo-mineral nitrogen fertiliser, as N	N
inorganic phosphorus, as P2O5 to generic market for organic phosphorus, as P2O5	2016-2019	organic phosphorus fertiliser, as P2O5	N
inorganic phosphorus, as P2O5 to generic market for organo-mineral phosphorus, as P2O5	2016-2019	organo-mineral phosphorus fertiliser, as P2O5	N
inorganic potassium fertiliser, as K2O to generic market for organic potassium fertiliser, as K2O	2016-2019	organic potassium fertiliser, as K2O	N
inorganic potassium fertiliser, as K2O to generic market for organo-mineral potassium fertiliser, as K2O	2016-2019	organo-mineral potassium fertiliser, as K2O	N
market for ash, from combustion of straw	2011-2011	ash, from combustion of straw	N
market for fermentation filtrate	2011-2011	fermentation filtrate	N
market for glycerin distillate bottom	2011-2011	glycerin distillate bottom	N
market for organic nitrogen fertiliser, as N	2016-2019	organic nitrogen fertiliser, as N	Nr
market for organic phosphorus fertiliser, as P2O5	2016-2019	organic phosphorus fertiliser, as P2O5	Nr
market for organic potassium fertiliser, as K2O	2016-2019	organic potassium fertiliser, as K2O	Nr
market for organo-mineral nitrogen fertiliser, as N	2016-2019	organo-mineral nitrogen fertiliser, as N	Nr
market for organo-mineral phosphorus fertiliser, as P2O5	2016-2019	organo-mineral phosphorus fertiliser, as P2O5	Nr
market for organo-mineral potassium fertiliser, as K2O	2016-2019	organo-mineral potassium fertiliser, as K2O	Nr
market for potassium chloride sludge	2011-2011	potassium chloride sludge	N
nutrient supply from ash, from combustion of bagasse from sugarcane	2016-2019	organic potassium fertiliser, as K2O	U
nutrient supply from ash, from combustion of straw	2000-2006	organic phosphorus fertiliser, as P2O5	N
nutrient supply from coconut husk	2016-2019	organic phosphorus fertiliser, as P2O5	U
nutrient supply from compost	2016-2019	organic nitrogen fertiliser, as N	U
nutrient supply from fermentation filtrate	2000-2006	organic nitrogen fertiliser, as N	N
nutrient supply from filter cake, from sugarcane juice filtration	2016-2019	organic phosphorus fertiliser, as P2O5	U
nutrient supply from glycerin distillate bottom	2016-2019	organo-mineral potassium fertiliser, as K2O	N
nutrient supply from manure, liquid, cattle	2016-2019	organic potassium fertiliser, as K2O	U
nutrient supply from manure, liquid, swine	2016-2019	organic potassium fertiliser, as K2O	U
nutrient supply from manure, solid, cattle	2016-2019	organic potassium fertiliser, as K2O	U
nutrient supply from poultry manure, dried	2016-2019	organic nitrogen fertiliser, as N	U
nutrient supply from poultry manure, fresh	2016-2019	organic potassium fertiliser, as K2O	U
nutrient supply from vinasse, from fermentation of sugar beet	2016-2019	organic phosphorus fertiliser, as P2O5	U
nutrient supply from vinasse, from fermentation of sugar beet molasses	2016-2019	organic phosphorus fertiliser, as P2O5	U
nutrient supply from vinasse, from fermentation of sugarcane	2016-2019	organic potassium fertiliser, as K2O	U
nutrient supply from vinasse, from fermentation of sweet sorghum	2016-2019	organic potassium fertiliser, as K2O	U

7.6 Changes in consuming datasets due to the remodelling

The decoupling of chemical substances from their fertiliser use required the remodelling of datasets that were using a generic form of a fertiliser prior to the restructure. In all those cases, the intermediate exchanges have been scaled in order to correspond to the right amount of nutrients necessary for the crop. Scaling keys for those cases can be found in the table below. A complete list of datasets that fall under those changes can be found in the Annex 2: activities with changes in inputs due to remodelling of fertilisers

Table 25: Intermediate exchanges modified, and scaling keys used for the new amounts.

Intermediate Exchange before restructure	Intermediate Exchange after restructure	Amount scale (multiplied) by
ammonium nitrate, as N	ammonium nitrate	2.857
ammonium sulfate, as N	ammonium sulfate	4.717
phosphate rock, as P2O5, beneficiated, dry	phosphate rock, beneficiated	3.125
potassium chloride, as K2O	potassium chloride	1.583
potassium sulfate, as K2O	potassium sulfate	1.85
urea, as N	urea	2.144

In other cases, many datasets had up to version 3.6 the two following Intermediate Exchanges with an activity link: “nitrogen fertiliser, as N”, “phosphate fertiliser, as P2O5”. All those cases had the Intermediate Exchange with the activity linked substituted with an input of the substance as such. The amounts were also scaled since prior to the change, they were delivering a generic form of the nutrient and after the change was simply an input of a substance. The Intermediate Exchanges that refer to those cases along with their scaling factors are found in the following table.

Table 26: Intermediate exchanges of generic nutrient products with activity links that were changed to intermediatte exchanges of substances.

Intermediate Exchange before restructure - Activity linked	Intermediate Exchange after restructure - no Activity Link	Amount scaled (multiplied) by
nitrogen fertiliser, as N	calcium ammonium nitrate	3.7037
phosphate fertiliser, as P2O5	single superphosphate	4.7619
phosphate fertiliser, as P2O5	triple superphosphate	2.1739
nitrogen fertiliser, as N	urea ammonium nitrate mix	3.3333

Finally, activity links to the manufacturing process of the following Intermediate Exchanges: “diammonium phosphate” and “monoammonium phosphate”, “ammonium nitrate phosphate”, “basic slag” were modified, and they were linked to the nutrient supply of the substance instead. In all those cases, amounts were not modified.

7.7 How to use the new data for fertilisers – examples for users.

The split of chemical manufacturing and use as fertiliser enables users to employ substances that are primarily produced for fertilising, into other uses (chemical precursors etc) and models without any need for conversion.

In this chapter some examples of use are constructed so users can have a better idea regarding the optimal use of the data in the fertiliser sector. In addition, a few tips are presented, and recommendations are given for users of urea and urea ammonium nitrate mix.

7.7.1 Substances

The first level of information a user can have, relates to an amount of substance that is used in an agricultural production. For instance, certain amount of kg of ammonia applied in a field. In this case it is recommended to use exactly this amount of substance from the local product market for ammonia. Further, transport distances should be assessed if they match the specific case they wish to model. If the user wants to model a substance with a lower purity, then this calculation has to be performed before the market for this product.

7.7.2 Nutrients

In other cases, a user might have the information of how much of a nutrient is applied and sourced from a certain substance. An example can be certain kg of nitrogen applied in a field and sourced from ammonia. In this case, it is recommended to directly use the nutrient supply of this product. In this situation though, a user is burdened with transportation expenditures assumed before the nutrient supply in the market for this product. Hence a user bares the responsibility to assess the upstream supply chain and make sure it matches their case. Else a modification is required.

7.7.3 CO2 emissions from the application of fertilisers containing carbon

Finally, urea is a fertiliser with an extensive application in many countries with a large agricultural output. Its application is coupled with carbon dioxide emissions that stem from carbon present in it. It is recommended to users to take into account those emissions. More specifically, 1 kg of urea contains 0.2 kg of carbon which can form (maximum) 0.733 kg of CO2 which in turn is emitted to air. It is recommended that users consider the latter, full amount of CO2 emissions when they employ urea in their models for agricultural use. Furthermore, a user may use the nutrient supply of urea, a similar calculation results in 1.571 kg of CO2 emitted per kg of inorganic nitrogen fertiliser, as N that is supplied by urea.

Similarly, urea ammonium nitrate also has a content of carbon of 0.066 kg of C per kg of UAN. This in turn can generate, 0.256487 kg of CO2. Nutrient supply from urea ammonium nitrate mix utilises circa 3.323 kg of UAN which in turn can generate in total 0.8523 kg of CO2 per kg of inorganic nitrogen fertiliser, as N that is supplied by urea ammonium nitrate mix.

Finally, a user employing the generic product “inorganic nitrogen fertiliser, as N” through the market for this product, is advised to check the contribution of urea and urea ammonium nitrate in this market and respectively calculate CO2 emissions from this urea application. Below there is a table that calculates this CO2 emissions by considering the total amount of carbon present in the substances is emitted as CO2 and none of the carbon is absorbed by the soil.

Table 27: Air emissions of CO2 that should be considered and added by users when they use "market for inorganic nitrogen fertiliser, as N" in the following countries. *The calculation is based in the carbon content of urea and urea ammonium nitrate mix and their respective contribution in the market. The total amount in the last column refers to CO2 emissions from the use of 1 kg of "inorganic nitrogen fertiliser, as N" through the "market for inorganic nitrogen fertiliser, as N" in the given geography.*

market geography		Amount (kg)		CO2 emission (kg) per kg of		
Country	Abbreviation	urea	UAN	urea	UAN	N
Albania	AL	0.550	0.000	0.864	0.000	0.864
Argentina	AR	0.640	0.164	1.005	0.011	1.016
Austria	AT	0.186	0.039	0.292	0.003	0.295
Australia	AU	0.613	0.104	0.963	0.007	0.969
Bosnia and Herzegovina	BA	0.344	0.000	0.540	0.000	0.540
Bangladesh	BD	0.896	0.000	1.408	0.000	1.408
Belgium	BE	0.061	0.359	0.095	0.024	0.119
Bulgaria	BG	0.276	0.000	0.433	0.000	0.433
Brazil	BR	0.561	0.000	0.882	0.000	0.882
Canada	CA	0.517	0.091	0.812	0.006	0.818
Cote d'Ivoire	CI	0.599	0.000	0.941	0.000	0.941
Chile	CL	0.844	0.000	1.326	0.000	1.326
China	CN	0.367	0.000	0.576	0.000	0.576
Colombia	CO	0.599	0.035	0.941	0.002	0.943
Costa Rica	CR	0.532	0.000	0.836	0.000	0.836
Cyprus	CY	0.164	0.000	0.258	0.000	0.258
Czechia	CZ	0.196	0.240	0.307	0.016	0.323
Germany	DE	0.240	0.120	0.376	0.008	0.384
Denmark	DK	0.005	0.147	0.007	0.010	0.017
Ecuador	EC	0.638	0.000	1.003	0.000	1.003
Spain	ES	0.351	0.093	0.552	0.006	0.558
France	FR	0.222	0.321	0.349	0.021	0.370
United Kingdom	GB	0.157	0.170	0.247	0.011	0.258
Global	GLO	0.489	0.059	0.768	0.004	0.772
Greece	GR	0.226	0.000	0.354	0.000	0.354
Croatia	HR	0.507	0.003	0.797	0.000	0.797
Hungary	HU	0.104	0.117	0.163	0.008	0.170
Indonesia	ID	0.713	0.000	1.121	0.000	1.121
Ireland	IE	0.180	0.002	0.283	0.000	0.284
Israel	IL	0.741	0.048	1.164	0.003	1.167
India	IN	0.811	0.000	1.274	0.000	1.274
Italy	IT	0.622	0.013	0.977	0.001	0.978
Kenya	KE	0.173	0.000	0.272	0.000	0.272
Sri Lanka	LK	0.846	0.000	1.330	0.000	1.330
Lithuania	LT	0.052	0.195	0.081	0.013	0.094

market geography		Amount (kg)		CO2 emission (kg) per kg of		
Country	Abbreviation	urea	UAN	urea	UAN	N
Latvia	LV	0.076	0.094	0.119	0.006	0.125
North Macedonia	MK	0.245	0.000	0.385	0.000	0.385
Mexico	MX	0.508	0.019	0.798	0.001	0.799
Malaysia	MY	0.186	0.000	0.293	0.000	0.293
Norway	NO	0.001	0.003	0.002	0.000	0.002
New Zealand	NZ	0.822	0.002	1.291	0.000	1.291
Peru	PE	0.504	0.000	0.792	0.000	0.792
Philippines	PH	0.646	0.000	1.015	0.000	1.015
Poland	PL	0.272	0.060	0.427	0.004	0.431
Portugal	PT	0.119	0.134	0.188	0.009	0.196
Romania	RO	0.311	0.034	0.488	0.002	0.490
Serbia	RS	0.510	0.000	0.802	0.000	0.802
Russia	RU	0.067	0.075	0.106	0.005	0.111
Slovakia	SK	0.321	0.189	0.504	0.012	0.516
Thailand	TH	0.601	0.000	0.944	0.000	0.944
Turkey	TR	0.522	0.001	0.820	0.000	0.820
Ukraine	UA	0.232	0.119	0.365	0.008	0.373
United States	US	0.254	0.279	0.399	0.018	0.417
Viet Nam	VN	0.571	0.000	0.896	0.000	0.896
South Africa	ZA	0.638	0.000	1.003	0.000	1.003
Kosovo	XK	0.550	0.000	0.864	0.000	0.864
Luxembourg	LU	0.061	0.359	0.095	0.024	0.119

8 Metals

8.1 Aluminium

For version 3.7 specific data related to the aluminium supply chain in Canada is included. The data is provided by the Aluminium Association of Canada (AAC) that commissioned CIRAIG to integrate the data in the ecoinvent database. The data substitutes the existing data for the region North America. The remaining countries in North America are now included in the Rest of the World (RoW) geography.

Table 28. New, updated, and deleted activities related to aluminium. *If several geographies of the same activity with the same time period exist, all of them are listed in the "Geography" column. In the column v3.7, "N" stands for "New Activity", "U" stands for "Updated Activity", and "D" stands for "Deleted Activity". "U*" signals that only activity links have been updated. The unit of all reference products is kg.*

Activity name	Geography	Time period	Product name	v3.7
aluminium production, primary, cast alloy slab from continuous casting	CA-QC	2012-2012	aluminium, primary, cast alloy slab from continuous casting	U*
aluminium production, primary, ingot	CA	2015-2015	aluminium, primary, ingot	U
aluminium production, primary, liquid, prebake	CA	2015-2015	aluminium, primary, liquid	U
aluminium production, primary, liquid, Söderberg	RNA	2015-2015	aluminium, primary, liquid	D
aluminium, ingot, primary, import from Africa	IAI Area, North America	2016-2016	aluminium, primary, ingot	N
aluminium, ingot, primary, import from Asia (excluding China)	IAI Area, North America	2016-2016	aluminium, primary, ingot	N
aluminium, ingot, primary, import from EU27 & EFTA	IAI Area, North America	2016-2016	aluminium, primary, ingot	N
aluminium, ingot, primary, import from Middle East (Gulf cooperation Council)	IAI Area, North America	2016-2016	aluminium, primary, ingot	N
aluminium, ingot, primary, import from Oceania	IAI Area, North America	2016-2016	aluminium, primary, ingot	N
aluminium, ingot, primary, import from Rest of Europe	IAI Area, North America	2016-2016	aluminium, primary, ingot	N
aluminium, ingot, primary, import from South America	IAI Area, North America	2016-2016	aluminium, primary, ingot	N
aluminium, ingot, primary, import from unspecified	IAI Area, North America	2016-2016	aluminium, primary, ingot	N
anode production, paste, for aluminium electrolysis	RNA	2015-2015	anode, paste, for aluminium electrolysis	D
anode production, prebake, for aluminium electrolysis	CA	2015-2015	anode, prebake, for aluminium electrolysis	U
anode production, prebake, for aluminium electrolysis	GLO	2015-2015	anode, prebake, for aluminium electrolysis	U*
market for aluminium, primary, ingot	IAI Area, North America	2016-2016	aluminium, primary, ingot	N

In the ecoinvent database, the aluminium industry has specific electricity production and consumption mixes, this is to reflect the significant amount of energy produced by the power plants owned by the industry itself. In the context of the Canadian update, the electricity datasets have been updated. To adjust for the inclusion of the Canadian data, the production volumes of the Global aluminium electricity have also been updated.

Table 29. Updated activities related to electricity for the aluminium industry. *The unit of all reference products is kWh.*

Activity name	Geography	Time period	Product name
electricity production, hydro, aluminium industry	CA	2015-2015	electricity, high voltage, aluminium industry
electricity production, natural gas, aluminium industry	CA	2015-2015	electricity, high voltage, aluminium industry
electricity voltage transformation from high to medium voltage, aluminium industry	CA	2015-2015	electricity, medium voltage, aluminium industry
market for electricity, high voltage, aluminium industry	CA	2015-2016	electricity, high voltage, aluminium industry
market for electricity, medium voltage, aluminium industry	CA	2015-2016	electricity, medium voltage, aluminium industry
electricity production, coal, aluminium industry	GLO	2015-2015	electricity, high voltage, aluminium industry
electricity production, hydro, aluminium industry	GLO	2015-2015	electricity, high voltage, aluminium industry
electricity production, nuclear, aluminium industry	GLO	2015-2015	electricity, high voltage, aluminium industry

The activities in Table 30 were using the product "aluminium, primary, liquid" as a source of aluminium metal. It was replaced by "aluminium, primary, ingot" to better reflect the form in which aluminium is supplied to these processes.

Table 30: Activities in which the input of "aluminium, primary, liquid" has been replaced by "aluminium, primary, ingot".

Activity name	Geography	Time period	v3.7
aluminium chloride production	GLO	2015-2020	U
anthraquinone production	GLO; RER	1995-2000	U

8.2 Beryllium hydroxide

New datasets for beryllium hydroxide production were introduced reflecting the mining and processing of bertrandite ore in the US. Beryllium hydroxide is an intermediate product and can be used to produce beryllium oxide, beryllium alloys and beryllium metal. The new datasets are mostly based on a life cycle assessment of metals by Nuss and Eckelman (2014).

Table 31. New activities related to beryllium hydroxide. *If several geographies of the same activity with the same time period exist, all of them are listed in the "Geography" column. The unit of the reference product is kg.*

Activity name	Geography	Time period	Product name
beryllium hydroxide production	GLO; US	2009-2020	beryllium hydroxide
market for beryllium hydroxide	GLO	2009-2020	beryllium hydroxide

8.3 Cobalt

The Cobalt Institute (CI) provided data concerning the production of refined cobalt. The dataset "cobalt production", which was available in previous versions of the database, has been updated completely. The updated dataset is based on an LCA study that was conducted using data supplied by members of the CI (CDI, 2016).

For version 3.7, the activity "cobalt production" includes four new cobalt-containing reference products, which are co-produced alongside the cobalt metal. The names of the new products are listed in Table 32, along with their corresponding market activities.

The data provided by the CI also include an electricity mix that is specific to the cobalt producers that participated in the data collection survey. The datasets related to electricity that were created to model this mix are also listed in Table 32.

The waste exchange "leach residue from copper production" was created to model one of the outputs of the cobalt production dataset. Its market and treatment activities are given in Table 32 as well.

Table 32: New and updated activities and products related to cobalt. *In column v3.7, "U" stands for "Updated activity", and "N" stands for "New activity".*

Activity name	Geography	Time period	Product name	Unit	v3.7
cobalt production	GLO	2012-2020	cobalt acetate; cobalt carbonate; cobalt hydroxide; cobalt oxide; cobalt	kg; kg; kg; kg; kg	U
market for cobalt acetate	GLO	2012-2020	cobalt acetate	kg	N
market for cobalt carbonate	GLO	2012-2020	cobalt carbonate	kg	N
market for cobalt hydroxide	GLO	2012-2020	cobalt hydroxide	kg	N
market for cobalt oxide	GLO	2012-2020	cobalt oxide	kg	N
electricity production, cobalt industry	GLO	2012-2012	electricity, high voltage, cobalt industry	kWh	N
market for electricity, high voltage, cobalt industry	GLO	2012-2012	electricity, high voltage, cobalt industry	kWh	N
electricity voltage transformation from high to medium voltage, cobalt industry	GLO	2012-2012	electricity, medium voltage, cobalt industry	kWh	N
market for electricity, medium voltage, cobalt industry	GLO	2012-2012	electricity, medium voltage, cobalt industry	kWh	N
market for leach residue from copper production	GLO	2009-2009	leach residue from copper production	kg	N
treatment of leach residue from copper production, neutralisation	GLO	2009-2009	leach residue from copper production	kg	N

Furthermore, two by-products of cobalt production, "electrolyte, copper-rich" and "electrolyte, nickel-rich" required the creation and update of additional datasets in order to ensure the functioning of the Consequential system model. These datasets are listed in Table 33.

Table 33: New and updated activities related to the copper-rich and nickel-rich electrolytes produced by cobalt production. *In column v3.7, "U" stands for "Updated activity", and "N" stands for "New activity". (*) The activity "electrorefining of copper, anode" has also been updated in the context of the update of the copper sector, which is described in section 8.4.*

Activity name	Geography	Time period	Product name	Unit	v3.7
market for electrolyte, copper-rich	GLO	2012-2020	electrolyte, copper-rich	kg	N
market for electrolyte, nickel-rich	GLO	2012-2020	electrolyte, nickel-rich	m3	N
electrolyte, copper-rich to generic market for copper-rich materials	GLO	1994-2021	copper-rich materials	kg	N
electrolyte, nickel-rich to generic market for nickel-rich materials	GLO	1994-2021	nickel-rich materials	kg	N
copper, anode to generic market for copper-rich materials	GLO	1994-2021	copper-rich materials	kg	N
nickel concentrate, 16% Ni to generic market for nickel-rich materials	GLO	1994-2021	nickel-rich materials	kg	N
market for copper-rich materials	GLO	1994-2021	copper-rich materials	kg	N
market for nickel-rich materials	GLO	1994-2021	nickel-rich materials	kg	N
electrorefining of copper, anode	GLO	1994-2019	copper, cathode	kg	U*
processing of nickel-rich materials	GLO	1994-2021	nickel, class 1	kg	N

8.4 Copper

Several activities have been added and updated in the copper sector for the pyrometallurgical production of primary copper and the processing of anode slime. The main goal of this update, which was carried out by Empa (the Swiss Federal Laboratories for Materials Science and Technology) in the context of a funded project of the Federal Office for the Environment, is to provide regionalised data that better represent the local production conditions in the areas where mining and smelting of copper take place. An overview of the copper supply chain in version 3.7 is shown in Figure 17. Additional details concerning the modelling of the new and updated activities can be found in Turner & Hischier (2020). The main changes are summarised hereafter.

New, country-specific, geographies have been added for the activity "copper mine operation and beneficiation, sulfide ore", which was previously named "copper mine operation, sulfide ore".

The production of refined copper, which was previously modelled by the activity "copper production, primary", is split into two separate steps for version 3.7:

1. The smelting step, which is named "smelting of copper concentrate, sulfide ore". This activity also replaces the activity "copper production, blister-copper". The product "copper, blister-copper" has been replaced by "copper, anode", which is the product that is obtained by the smelting of copper concentrate. Accordingly, the activity "market for copper, blister-copper" has been renamed to "market for copper, anode" and includes inputs of transport in version 3.7.
2. The refining step, which is named "electrorefining of copper, anode" and replaces the activity "electrolytic refining of primary copper".

The intermediate exchange "copper, cathode", which already existed in previous versions, is now used instead of "copper" to represent refined copper in all activities that have an exchange of refined copper. As both products represent refined copper, and in order to make a distinction with "copper, anode", the name "copper, cathode" is used instead of "copper". Consequently, the "market for copper" is replaced by the "market for copper, cathode".

Additionally, the activity "processing of anode slime, primary copper production" has been renamed to "processing of anode slime from electrorefining of copper, anode" and updated for version 3.7. Based on the material flow analysis used for updating the inventory, two additional valuable by-products have been added to the outputs: gold and selenium.

The list of new and updated activities and products for the copper sector in version 3.7 is given in Table 34.

Table 34: New and updated activities and products related to copper. *In column v3.7, "U" stands for "Updated activity", "N" stands for "New activity" and "D" stands for "Deleted activity". (*) The "market for copper" is replaced by the "market for copper, cathode", which already existed in version 3.6.*

Activity name	Geography	Time period	Product name	Unit	v3.7
copper mine operation and beneficiation, sulfide ore	CA; CN; ID; KZ; RU; US; ZM	1994-2021	copper concentrate, sulfide ore	kg	N
copper mine operation and beneficiation, sulfide ore	AU; CL; GLO	1994-2021	copper concentrate, sulfide ore	kg	U
smelting of copper concentrate, sulfide ore	CL; CN; IN; JP; RU; GLO	1994-2019	copper, anode	kg	N
electrorefining of copper, anode	GLO	1994-2019	copper, cathode	kg	U
processing of anode slime from electrorefining of copper, anode	GLO	2010-2019	copper telluride cement	kg	U
market for copper	GLO	2011-2011	copper	kg	D*
market for copper, anode	GLO	1994-2019	copper, anode	kg	U

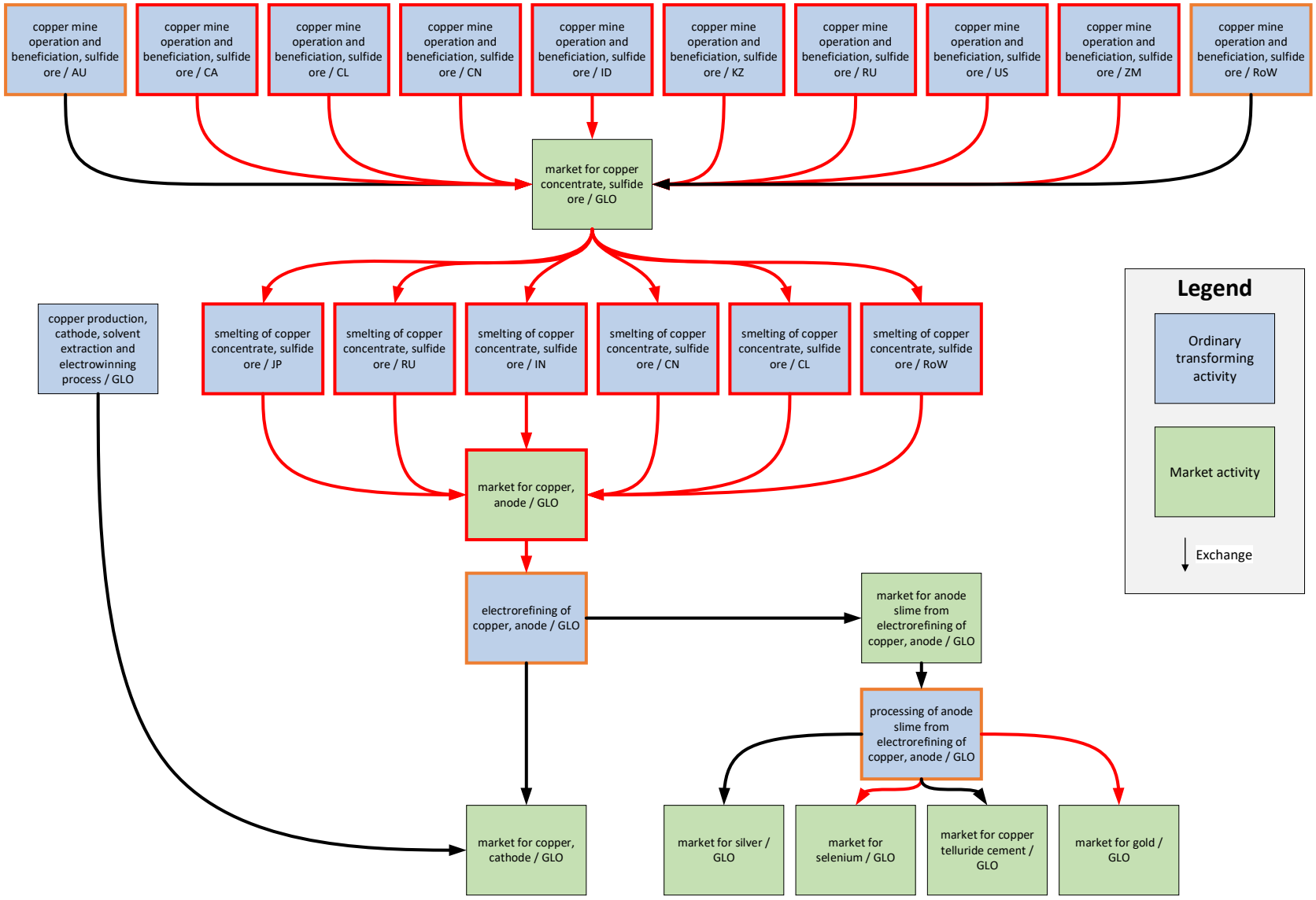


Figure 17: Overview of the activities related to copper in version 3.7. *Activities and exchanges highlighted in red are new in version 3.7, while those highlighted in orange have been updated.*

8.5 Iron and Steel

8.5.1 Iron and steel production

New data have been provided by ETH Zurich and TU Graz on low-alloyed steel production via the electric arc furnace route in Switzerland and Austria, respectively. Additionally, ecoinvent has updated the datasets for iron and steel production, from mining through until steelmaking:

- 'iron ore mine operation and beneficiation, GLO' has been updated so that it represents the weighted average of production of regional datasets.
- 'iron sinter production' activity datasets have been updated in all regions. The dataset is now mass, carbon, oxygen and energy balanced. The dataset includes input exchanges of iron and steel industry by-products supplied from downstream iron and steel production activities (see Section 8.5.2 and Turner and Symeonidis (2020)). 'iron sinter production' replaces the previous dataset 'sinter production, iron'.
- All RER and GLO 'steel production' activity datasets have been updated to the latest data from the European Commission (Remus et al., 2013).
- The activity datasets for 'steel production, converter, chromium steel 18/8' were deleted since the significant majority of global stainless-steel production takes place using an electric arc furnace.
- Markets and production datasets for 'pig iron' were updated. A new regional production and market for 'RER' was created.
- 'steel production, electric, low-alloyed; RER' is being replaced by AT, CH and Europe without Switzerland and Austria datasets (Table 35 and Table 36).

All activities which were either newly created, updated or deleted due to the update of iron and steel are summarised in Table 35. The restructured iron and steel production route is also shown schematically in Figure 18.

Table 35. List of all new, updated and deleted activities related to iron and steel. *If several geographies of the same activity with the same time period exist, all of them are listed in the "Geography" column. In the column v3.7, "N" stands for "New Activity", "U" stands for "Updated Activity" and "D" stands for "Deleted Activity". For "*" check the renaming and replacing section of this report.*

Activity name	Geography	Time period	v3.7
iron ore beneficiation	GLO	1998-2000	U
iron ore beneficiation	IN	2007-2017	U
iron ore mine operation and beneficiation	CA-QC	2011-2011	U
iron ore mine operation and beneficiation	GLO	2011-2011	U
iron ore mine operation, 46% Fe	GLO	1999-2000	U
iron ore mine operation, 63% Fe	GLO; IN	2000-2017	U
iron pellet production	GLO	1999-2002	U
iron pellet production	IN	2010-2017	U
iron pellet production	CA-QC	2011-2011	U
iron sinter production	GLO; RER	2005-2021	N*
iron sinter production	IN	2007-2017	U
sinter production, iron	GLO	1999-2002	D*
market for iron ore concentrate	GLO	2011-2011	U
market for iron pellet	GLO	2011-2011	U
market for pig iron	RER	2020-2020	N*
market for pig iron	GLO	2020-2020	U
pig iron production	RER	2005-2021	N*

Activity name	Geography	Time period	v3.7
pig iron production	GLO	2005-2021	U
pig iron production	IN	2010-2017	U
steel production, converter, chromium steel 18/8	GLO; RER	2001-2001	D
steel production, converter, low-alloyed	IN	2010-2017	U
steel production, converter, low-alloyed	GLO	2013-2023	U
steel production, converter, low-alloyed	RER	2013-2023	U
steel production, converter, unalloyed	GLO	2013-2023	U
steel production, converter, unalloyed	RER	2013-2023	U
steel production, electric, chromium steel 18/8	GLO	2013-2023	U
steel production, electric, chromium steel 18/8	RER	2013-2023	U
steel production, electric, low-alloyed	RER	2001-2001	D*
steel production, electric, low-alloyed	CH	2012-2012	N*
steel production, electric, low-alloyed	Europe without Switzerland and Austria	2013-2023	N*
steel production, electric, low-alloyed	GLO	2013-2023	U

8.5.2 Treatment of iron and steel industry by-products

Apart from updating the production activities of iron and steel, the disposal and recovery of iron and steel industry by-products (ISIBP) were added to the database. In this change report only lists of newly created and updated datasets (Tables Table 36 to Table 44) will be included. Detailed documentation on the treatment of ISIBPs can be found in ecoinvent v3 report "*Life cycle inventories for the treatment of iron and steel industry by-products*" (Turner and Symeonidis, 2020). The deleted activity 'market for dust, alloyed electric arc furnace steel' in Table 36 is being replaced by 'market for electric arc furnace dust'.

Table 36. List of (treatment) market activity datasets created, updated or deleted for iron and steelmaking by-products. *If several geographies of the same activity with the same time period exist, all of them are listed in the "Geography" column. In the column v3.7, "N" stands for "New Activity", "U" stands for "Updated Activity" and "D" stands for "Deleted Activity". For "*" check the renaming and replacing section of this report.*

Activity name	Geography	Time period	v3.7
market for basic oxygen furnace dust	GLO	1987-2017	N
market for basic oxygen furnace dust	RER	2008-2010	N
market for basic oxygen furnace dust	IN	2008-2025	N
market for basic oxygen furnace secondary metallurgy slag	GLO	1987-2017	N
market for basic oxygen furnace secondary metallurgy slag	RER	2008-2010	N
market for basic oxygen furnace sludge	GLO	1987-2017	N
market for basic oxygen furnace sludge	RER	2008-2010	N
market for basic oxygen furnace slag	GLO	1987-2017	N
market for basic oxygen furnace slag	RER	2008-2010	N
market for blast furnace dust	GLO	1987-2017	N
market for blast furnace dust	RER	2008-2010	N
market for blast furnace sludge	CH; Europe without Switzerland; GLO	2008-2010	U
market for blast furnace sludge	IN	2008-2010	N*
market for dust, alloyed electric arc furnace steel	GLO	2011-2011	D*
market for electric arc furnace dust	GLO	2008-2010	N

Activity name	Geography	Time period	v3.7
market for electric arc furnace dust	IN; RER	2008-2010	N*
market for electric arc furnace secondary metallurgy slag	GLO	1987-2017	N
market for electric arc furnace secondary metallurgy slag	RER	2008-2010	N
market for electric arc furnace slag	GLO	2008-2010	U
market for electric arc furnace slag	IN; RER	2008-2010	N*
market for mill scale	GLO	1987-2017	N
market for mill scale	RER	2008-2025	N
market for supplementary cementitious materials	RER	2019-2019	N

In Table 37 the two activities 'treatment of dust, alloyed electric arc furnace steel, residual material landfill' and 'treatment of dust, unalloyed electric arc furnace steel, residual material landfill' are being replaced by 'treatment of electric arc furnace dust, residual material landfill'.

Table 37. List of treatment activity datasets created, updated or deleted for the disposal of iron and steelmaking by-products in a residual material landfill. *If several geographies of the same activity with the same time period exist, all of them are listed in the "Geography" column. In the column v3.7, "N" stands for "New Activity", "U" stands for "Updated Activity" and "D" stands for "Deleted Activity". For "*" check the renaming and replacing section of this report.*

Activity name	Geography	Time period	v3.7
treatment of basic oxygen furnace dust, residual material landfill	GLO	1987-2017	N
treatment of basic oxygen furnace secondary metallurgy slag, residual material landfill	GLO	1987-2017	N
treatment of basic oxygen furnace slag, residual material landfill	GLO	1987-2017	N
treatment of basic oxygen furnace sludge, residual material landfill	GLO	1987-2017	N
treatment of blast furnace dust, residual material landfill	GLO	1987-2017	N
treatment of blast furnace slag, residual material landfill	GLO; US	1987-2017	U
treatment of blast furnace sludge, residual material landfill	GLO; Europe without Swit-zerland; CH	1987-2017	U
treatment of dust, alloyed electric arc furnace steel, residual material landfill	CH; GLO	1994-2000	D*
treatment of dust, unalloyed electric arc furnace steel, residual material landfill	CH; GLO	1994-2000	D*
treatment of electric arc furnace dust, residual material landfill	CH; GLO	1987-2017	N*
treatment of electric arc furnace secondary metallurgy slag, residual material landfill	GLO	1987-2017	N
treatment of electric arc furnace slag, residual material landfill	CH; GLO	1987-2017	U
treatment of mill scale, residual material landfill	GLO	1987-2017	N

Table 38. List of treatment activity datasets that rename (and re-classify) iron and steelmaking by-products for recovery. *If several geographies of the same activity with the same time period exist, all of them are listed in the "Geography" column. In the column v3.7, "N" stands for "New Activity".*

Activity name	Geography	Time period	v3.7
basic oxygen furnace dust to market for basic oxygen furnace dust, for recovery	GLO; RER	2020-2025	N
basic oxygen furnace secondary metallurgy slag to market for basic oxygen furnace secondary metallurgy slag for recovery	GLO; RER	2020-2025	N
basic oxygen furnace slag to market for basic oxygen furnace slag, for recovery	GLO; RER	2020-2025	N
basic oxygen furnace sludge to market for basic oxygen furnace sludge, for recovery	GLO; RER	2020-2025	N
blast furnace dust to market for blast furnace dust, for recovery	GLO; RER	2020-2025	N
blast furnace sludge to market for blast furnace sludge, for recovery	GLO; RER	2020-2025	N
electric arc furnace slag to market for electric arc furnace slag, for recovery	GLO; RER	2020-2025	N
electric arc furnace secondary metallurgy slag to market for electric arc furnace secondary metallurgy slag for recovery	GLO; RER	2020-2025	N

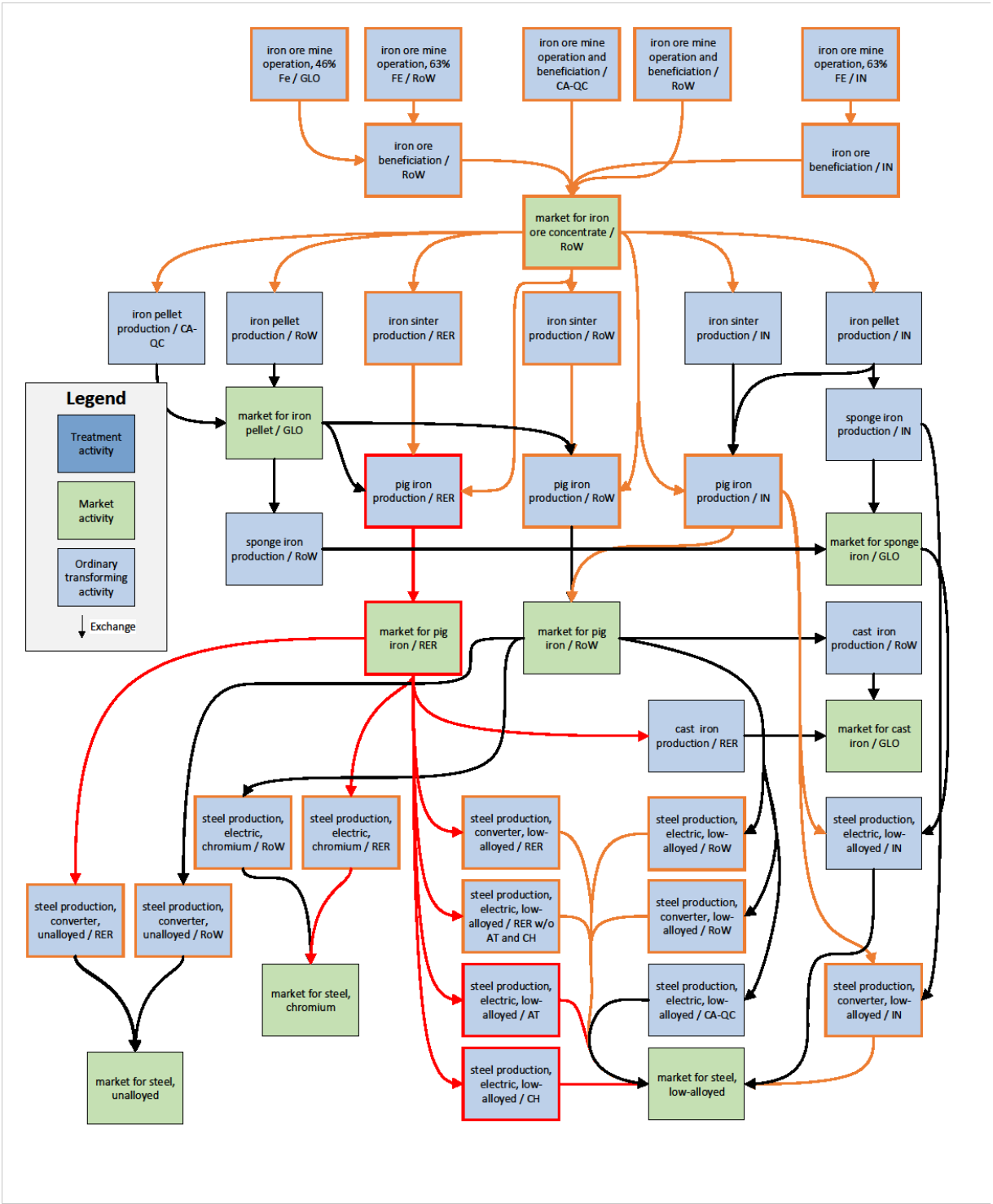
Table 39. List of market activity datasets created for iron and steelmaking by-products that are recovered for recycling. *If several geographies of the same activity with the same time period exist, all of them are listed in the "Geography" column. In the column v3.7, "N" stands for "New Activity".*

Activity name	Geography	Time period	v3.7
market for basic oxygen furnace dust, for recovery	GLO; RER	2008-2010	N
market for basic oxygen furnace secondary metallurgy slag, for recovery	GLO; RER	2008-2010	N
market for basic oxygen furnace slag, for recovery	GLO; RER	2008-2010	N
market for basic oxygen furnace sludge, for recovery	GLO; RER	2008-2010	N
market for blast furnace dust, for recovery	GLO; RER	2008-2010	N
market for blast furnace sludge, for recovery	GLO; RER	2008-2010	N
market for electric arc furnace secondary metallurgy slag, for recovery	GLO; RER	2008-2010	N
market for electric arc furnace slag, for recovery	GLO; RER	2008-2010	N

Table 40. List of ordinary transforming activity datasets that rename iron and steelmaking by-products that are recovered for use in cement making. *If several geographies of the same activity with the same time period exist, all of them are listed in the "Geography" column. In the column v3.7, "N" stands for "New Activity".*

Activity name	Geography	Time period	v3.7
basic oxygen furnace dust, for recovery to generic market for supplementary cementitious materials	GLO; RER	2020-2025	N
basic oxygen furnace secondary metallurgy slag, for recovery to generic market for supplementary cementitious materials	GLO; RER	2020-2025	N
basic oxygen furnace slag, for recovery to generic market for supplementary cementitious materials	GLO; RER	2020-2025	N
basic oxygen furnace sludge, for recovery to generic market for supplementary cementitious materials	GLO; RER	2020-2025	N
blast furnace dust, for recovery to generic market for supplementary cementitious materials	GLO; RER	2020-2025	N
blast furnace sludge, for recovery to generic market for supplementary cementitious materials	GLO; RER	2020-2025	N
electric arc furnace slag, for recovery to generic market for supplementary cementitious materials	GLO; RER	2020-2025	N
electric arc furnace secondary metallurgy slag, for recovery to generic market for supplementary cementitious materials	GLO; RER	2020-2025	N

Figure 18. Schema of iron and steel production in ecoinvent version 3.7. *Activities and exchanges highlighted in red, in orange, with dashed lines are new to v3.7, updated in v3.7 or only present in the undefined version of the database respectively. Activities and exchanges that are transparent in appearance represent those activities and exchanges in other metal production chains that are linked to this chain. Abbreviations in boxes after "/" indicate the geography of the activity.*



8.5.3 Iron and steel in Austria (AT)

Reinforcing steel used as rebar in structures plays an important role in the construction with reinforced concrete. In v3.7, three new datasets modelling the different processes during the reinforcing steel production in Austria were added. The data were provided directly by a steel production company.

Table 41. Activities newly created for the Austrian steel production. *In the column v3.7, "N" stands for "New Activity", "U" stands for "Updated Activity".*

Activity name	Geography	Time period	v3.7
steel production, electric, low-alloyed	AT	2017-2017	N
hot rolling, steel	AT	2017-2017	N
reinforcing steel production	AT	2017-2017	N*

As a consequence of the update, some RER activities had to be deleted, others were updated to maintain the consistency in the sector. See the table below for a summary.

Table 42. New, updated or deleted activities related to the steel sector. *If several geographies of the same activity with the same time period exist, all of them are listed in the "Geography" column. In the column v3.7, "N" stands for "New Activity", "U" stands for "Updated Activity" and "D" stands for "Deleted Activity".*

Activity name	Geography	Time period	v3.7
hot rolling, steel	Europe without Austria	1997-2002	N
hot rolling, steel	GLO	1997-2002	U
hot rolling, steel	RER	1997-2002	D
reinforcing steel production	Europe without Austria	2000-2002	N
reinforcing steel production	GLO	2000-2002	U
reinforcing steel production	RER	2000-2002	D
steel production, chromium steel 18/8, hot rolled	RER	2000-2002	U
steel production, low-alloyed, hot rolled	RER	2000-2002	U

8.6 Nickel

For version 3.7, datasets that represent the mining and refining of nickel concentrate with a nickel content of 7% have been introduced for the geographies CN (China) and GLO. The data was provided by Empa (the Swiss Federal Laboratories for Materials Science and Technology) in the context of a funded project of the Federal Office for the Environment.

The new activity "nickel mine operation and benefication to nickel concentrate, 7% Ni" replaces the activity "nickel mine operation, sulfidic ore" which was available in previous versions.

In order to harmonize the activity names, and specify the nickel content in the nickel concentrate, the activity "mining and benefication of nickel ore" has been renamed to "nickel mine operation and benefication to nickel concentrate, 16% Ni", and the activity "smelting and refining of nickel ore" has been renamed to "smelting and refining of nickel concentrate, 16% Ni".

Furthermore, the product that represents refined nickel, previously named "nickel, 99.5%", has been renamed to "nickel, class 1" in order to follow the naming convention used by the nickel industry.

The production volume of "nickel, class 1" has been updated in the activities "smelting and refining of nickel concentrate, 16% Ni" and "platinum group metal mine operation, ore with high palladium content".

Table 43: New and updated activities and products related to nickel. *In column v3.7, "U" stands for "Updated activity", "N" stands for "New activity". "U*" indicates cases where only the production volume of the nickel outputs was updated.*

Activity name	Geography	Time period	Product name	Unit	v3.7
nickel mine operation and benefication to nickel concentrate, 7% Ni	CN; GLO	2017-2018	nickel concentrate, 7% Ni	kg	U
market for nickel concentrate, 7% Ni	CN; GLO	2017-2018	nickel concentrate, 7% Ni	kg	N
smelting and refining of nickel concentrate, 7% Ni	CN; GLO	2017-2018	nickel, class 1	kg	N
platinum group metal mine operation, ore with high palladium content	GLO; RU	1995-2002	palladium	kg	U*
smelting and refining of nickel concentrate, 16% Ni	GLO	2010-2010	nickel, class 1	kg	U*

8.7 Rare earth oxides (REO)

New datasets for rare earth production in China have been added, while price and production volume data have also been updated. The data was provided by Empa (the Swiss Federal Laboratories for Materials Science and Technology) in the context of a funded project of the Federal Office for the Environment. The datasets were created with data taken from international peer-reviewed articles (Arshi et al., 2018; Sprecher et al., 2017; Lee and Wen, 2017). The list of datasets added, updated or deleted for version 3.7 is given in Table 44. More detail on the modelling and composition is documented in the comment section of the datasets.

In version 3.6, Chinese and global datasets were available that represented REO production from bastnäsite ore. In version 3.7, datasets are now included to represent REO production from three distinct production routes in different regions of china (and, to a lesser extent, globally), namely REO production through the processing of i) bastnäsite ore, ii) bastnäsite and monzanite ores, and iii) ion-adsorption clays.

Figure 19 shows an overview of the current state of REO production as published in v3.7. The chain of datasets presented in version 3.6 that made up the mining and production of REOs have been renamed to ensure consistency with the new dataset for alternative REO production routes, as follows:

- The dataset “rare earth concentrate production, 70% REO, from bastnäsite” has been renamed to “rare earth element mine operation and beneficiation, bastnaesite ore”.
- The dataset “market for rare earth concentrate, 70% REO, from bastnäsite” has been renamed to “market for rare earth concentrate, 70% REO”.
- The dataset “rare earth oxides production from bastnäsite concentrate; CN” has been deleted and is being replaced by “rare earth oxides production, from rare earth oxide concentrate, 70% REO; CN-SC”.

All rare earth oxides were complemented with a renaming activity (“<<rare earth oxide>> to generic market for mischmetal”) linking them to a generic market for mischmetal. The activities “cerium oxide to generic market for polishing powder”, “market for polishing powder” and “cerium oxide to generic market for polishing powder”, marked as deleted in Table 44, were removed as the only served a temporary purpose. Users using “polishing powder” should link to “tin dioxide” instead.

Figure 19. Schema of rare earth oxide production in ecoinvent version 3.7. *Activities and exchanges highlighted in red, in orange, with dashed lines are new to v3.7, updated in v3.7 or only present in the undefined version of the database respectively. Activities and exchanges that are transparent in appearance represent those activities and exchanges in other metal production chains that are linked to this chain. Abbreviations in boxes after "/" indicate the geography of the activity.*

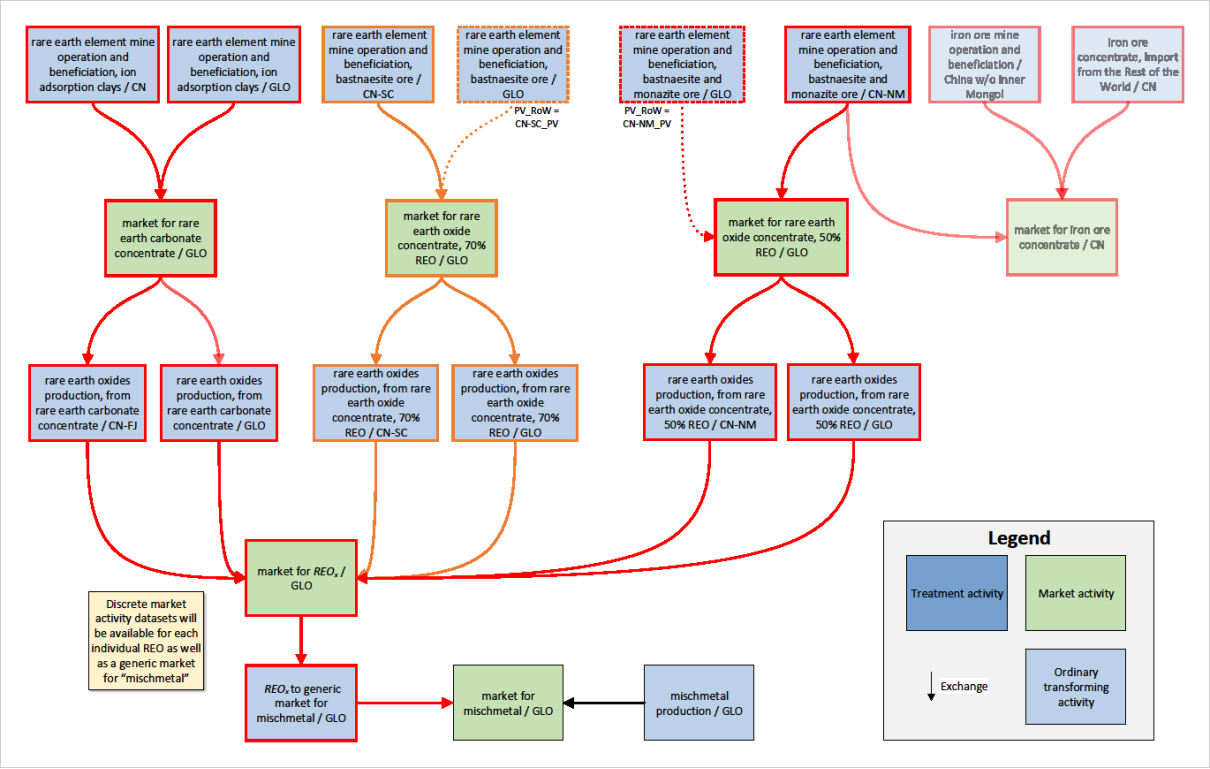


Table 44. List of all new, changed, and deleted activities related to rare earth metals. *If several geographies of the same activity with the same time period exist, all of them are listed in the "Geography" column. In the column v3.7, "N" stands for "New Activity", "U" stands for "Updated Activity" and "D" stands for "Deleted Activity". For "*" check the renaming and replacing section of this report.*

Activity name	Geography	Time period	v3.7
cerium oxide to generic market for mischmetal	GLO	2020-2020	N
cerium oxide to generic market for polishing powder	GLO	2005-2005	D
dysprosium oxide to generic market for mischmetal	GLO	2020-2020	N
erbium oxide to generic market for mischmetal	GLO	2020-2020	N
europium oxide to generic market for mischmetal	GLO	2020-2020	N
gadolinium oxide to generic market for mischmetal	GLO	2020-2020	N
holmium oxide to generic market for mischmetal	GLO	2020-2020	N
lanthanum oxide to generic market for mischmetal	GLO	2020-2020	N
lanthanum-cerium oxide to generic market for mischmetal	GLO	2020-2020	N
lutetium oxide to generic market for mischmetal	GLO	2020-2020	N
market for cerium oxide	GLO	2011-2011	U
market for dysprosium oxide	GLO	2009-2021	N
market for erbium oxide	GLO	2009-2021	N
market for europium oxide	GLO	2017-2018	N
market for gadolinium oxide	GLO	2009-2021	N
market for holmium oxide	GLO	2009-2021	N
market for lanthanum oxide	GLO	2011-2011	U
market for lanthanum-cerium oxide	GLO	2017-2018	N
market for lutetium oxide	GLO	2009-2021	N
market for neodymium oxide	GLO	2011-2011	U
market for praseodymium oxide	GLO	2011-2011	U
market for praseodymium-neodymium oxide	GLO	2017-2018	N
market for polishing powder	GLO	2012-2012	D
market for rare earth carbonate concentrate	GLO	2017-2018	N
market for rare earth oxide concentrate, 50% REO	GLO	2017-2018	N
market for rare earth oxide concentrate, 70% REO	GLO	2011-2011	U
market for samarium oxide	GLO	2017-2018	N
market for samarium-europium-gadolinium oxide	GLO	2011-2011	U
market for terbium oxide	GLO	2009-2021	N
market for terbium-dysprosium oxide	GLO	2009-2021	N
market for thulium oxide	GLO	2009-2021	N
market for ytterbium oxide	GLO	2017-2018	N
market for yttrium oxide	GLO	2017-2018	N
neodymium oxide to generic market for mischmetal	GLO	2011-2011	U
praseodymium oxide to generic market for mischmetal	GLO	2011-2011	U
praseodymium-neodymium oxide to generic market for mischmetal	GLO	2020-2020	N
rare earth element mine operation and beneficiation, bastnaesite and monazite ore	CN-NM; GLO	2017-2018	N
rare earth element mine operation and beneficiation, bastnaesite ore	CN-SC; GLO	2017-2018	U
rare earth element mine operation and beneficiation, ion adsorption clays	CN; GLO	2017-2018	N
rare earth oxides production from bastnäsite concentrate	CN	2000-2005	D*
rare earth oxides production, from rare earth carbonate concentrate	CN-FJ; GLO	2017-2018	N
rare earth oxides production, from rare earth oxide concentrate, 50% REO	CN-NM; GLO	2017-2018	N
rare earth oxides production, from rare earth oxide concentrate, 70% REO	CN-SC	2017-2018	N*
rare earth oxides production, from rare earth oxide concentrate, 70% REO	GLO	2017-2018	U
samarium europium gadolinium concentrate to generic market for mischmetal	GLO	2011-2011	U
samarium oxide to generic market for mischmetal	GLO	2020-2020	N

Activity name	Geography	Time period	v3.7
terbium oxide to generic market for mischmetal	GLO	2020-2020	N
terbium-dysprosium oxide to generic market for mischmetal	GLO	2020-2020	N
tin dioxide to generic market for polishing powder	GLO	2001-2001	D
thulium oxide to generic market for mischmetal	GLO	2020-2020	N
ytterbium oxide to generic market for mischmetal	GLO	2020-2020	N
yttrium oxide to generic market for mischmetal	GLO	2020-2020	N

8.1 Tungsten

New activities were introduced for tungsten, including datasets for tungsten mine operation and beneficiation, datasets for the intermediate product ammonium paratungstate, and datasets for tungsten carbide powder. The new datasets are mainly based on Furberg et al. (2019) and Ma et al. (2017). Two different production datasets for ammonium paratungstate production are available differentiating between two different production technologies, i.e. ion exchange which is the predominant technology used in China and solvent extraction. In addition, new treatment activities for the treatment of wastewater from ammonium paratungstate production were created using the model by Doka (2009) based on wastewater composition found in literature.

Table 45. New activities related to tungsten. *If several geographies of the same activity with the same time period exist, all of them are listed in the "Geography" column.*

Activity name	Geography	Time period	Product name	Unit
ammonium paratungstate production, ion exchange	CN; GLO	2014-2020	ammonium paratungstate	kg
ammonium paratungstate production, solvent extraction	AT; DE; GLO; US	1979-2020	ammonium paratungstate	kg
market for ammonium paratungstate	GLO	1979-2020	ammonium paratungstate	kg
market for tungsten carbide powder	GLO	2014-2020	tungsten carbide powder	kg
market for tungsten concentrate	GLO	1979-2019	tungsten concentrate	kg
market for wastewater from ammonium paratungstate production	CN; GLO	1994-2015	wastewater from ammonium paratungstate production	m3
treatment of wastewater from ammonium paratungstate production, capacity 5E9l/year	CN; GLO	1994-2015	wastewater from ammonium paratungstate production	m3
tungsten carbide powder production	CN	2014-2020	tungsten carbide powder	kg
tungsten carbide powder production	GLO	1979-2020	tungsten carbide powder	kg
tungsten mine operation and beneficiation	CN; GLO	1979-2019	tungsten concentrate	kg

8.1 Other new, updated or deleted activities

Table 46 lists all newly added, deleted, or updated datasets concerning the metals sector that were not yet mentioned in this chapter.

Table 46. Updated activities in the metal sector not yet covered in this chapter. *If several geographies of the same activity with the same time period exist, all of them are listed in the "Geography" column. In the column v3.7, "U" stands for "Updated Activity".*

Activity name	Geography	Time period	v3.7
ferrochromium production, high-carbon, 68% Cr	GLO	1994-2003	U
ferromanganese production, high-coal, 74.5% Mn	GLO; RER	1994-2003	U
gold mine operation and gold production, unrefined	GLO	2012-2016	U
iron-nickel-chromium alloy production	GLO; RER	2000-2005	U
zinc scrap, post-consumer to generic market for zinc	GLO	2018-2018	U

The activity "molybdenite mine operation", GLO (1994-2003) had an input of "Holmium, in ground" which was meant to be "Molybdenum, in ground". This has been corrected for version 3.7.

9 Pulp and paper

9.1 Cartonboard

Activities for solid bleached and unbleached board and folding boxboard/chipboard were replaced by new activities. The new data were provided by the European industry associations for cartonboard producers (Pro Carton) and convertors (ECMA European Carton Makers Association). Compared to the datasets present in version 3.6, the new datasets includes the production of the board, transport to converting sites and converting of the board (printing, cutting, creasing) into blank boxes ready for delivery. The previously separate products, "solid bleached board" and "solid unbleached board" were combined to the new product "solid bleached and solid unbleached board carton". On the other hand, the aggregated product “folding boxboard/chipboard” was disaggregated into “white lined chipboard carton” and “folding boxboard carton”. In the table below, the new activities related to cartonboard are listed. Datasets which changed due to the replacement of one of the cartonboard exchanges are listed in Annex 3: activities with changes in inputs due to remodelling in the paper sector.

Table 47. New, updated, and deleted activities related to cartonboard*. If several geographies of the same activity with the same time period exist, all of them are listed in the “Geography” column. The unit of all reference products is kg. In the column v3.7, “N” stands for “New Activity”, “U” stands for “Updated Activity”, and “D” stands for “Deleted Activity”.*

Activity name	Geography	Time period	Product name	v3.7
folding boxboard carton production	GLO	2017-2018	folding boxboard carton	U
folding boxboard carton production	RER	2018-2018	folding boxboard carton	U
market for folding boxboard carton	GLO; RER	2018-2018	folding boxboard carton	N
market for folding boxboard/chipboard	GLO	2011-2011	folding boxboard/chipboard	D
market for solid bleached and unbleached board carton	GLO; RER	2018-2018	solid bleached and unbleached board carton	N
market for solid bleached board	GLO	2011-2011	solid bleached board	D
market for solid unbleached board	GLO	2011-2011	solid unbleached board	D
market for white lined chipboard carton	GLO; RER	2018-2018	white lined chipboard carton	N
solid bleached and unbleached board carton production	CA-QC; GLO; RER	2018-2018	solid bleached and unbleached board carton	N
solid bleached board production	CA-QC; GLO; RER	2000-2000	solid bleached board	D
solid unbleached board production	GLO; RER	2000-2000	solid unbleached board	D
white lined chipboard carton production	GLO; RER	2018-2018	white lined chipboard carton	U

9.2 Kraft paper

Activities for kraft paper production were updated and new dataset for paper sack were created based on a study by CEPI Eurokraft and Eurosac in 2017. Data were collected specifically for sack kraft paper but are representative for all kraft paper production. The new product “paper sack” represents a hybrid mix of all types of multiwall paper sacks in Europe. The new data showed, that bleached and unbleached sack kraft paper production did not differ significantly regarding their in- and outputs. Therefore, in version 3.7 kraft paper is no longer distinguished by its grade (bleached or unbleached). Instead, the new activity “kraft paper production” represents a mix of both paper grads. New and deleted activities for kraft paper and paper sack are listed below. Datasets which

changed due to the replacement of kraft paper bleached/unbleached by kraft paper are listed in Annex 3: activities with changes in inputs due to remodelling in the paper sector.

***Table 48. New and deleted activities related to kraft paper**. If several geographies of the same activity with the same time period exist, all of them are listed in the "Geography" column. The unit of all reference products is kg. In the column v3.7, "N" stands for "New Activity" and "D" stands for "Deleted Activity".*

Activity name	Geography	Time period	Product name	v3.7
kraft paper production	GLO; RER	2015-2020	kraft paper	N
kraft paper production, bleached	GLO; RER	1993-1993	kraft paper, bleached	D
kraft paper production, unbleached	GLO; RER	2000-2000	kraft paper, unbleached	D
market for kraft paper	GLO; RER	2015-2020	kraft paper	N
market for kraft paper, bleached	GLO	2011-2011	kraft paper, bleached	D
market for kraft paper, unbleached	GLO	2011-2011	kraft paper, unbleached	D
market for paper sack	GLO; RER	2015-2020	paper sack	N
paper sack production	GLO; RER	2015-2020	paper sack	N

9.3 Cellulose fibre production

Datasets for the insulation material cellulose fibre were updated with new data provided sinum AG and isofloc AG. In contrast to version 3.6, the updated cellulose fibre production datasets do not include the blowing in process of the cellulose fibre. Thus, energy used for the application of the fibres as insulation materials in buildings is no longer covered in the new datasets. In addition, exchanges related to packaging were removed from the datasets.

***Table 49 . New, updated, and deleted activities related to cellulose fibre**. If several geographies of the same activity with the same time period exist, all of them are listed in the "Geography" column. The unit of all reference products is kg. In the column v3.7, "N" stands for "New Activity" and "D" stands for "Deleted Activity".*

Activity name	Geography	Time period	Product name	v3.7
cellulose fibre production	CH; GLO	2012-2012	cellulose fibre	U
market for cellulose fibre	CH; GLO	2012-2012	cellulose fibre	N
market for cellulose fibre, inclusive blowing in	GLO	2011-2011	cellulose fibre, inclusive blowing in	D

9.4 Other changes

Other changes and updates in the pulp and paper sector are listed in the table below. Some of the updates were part of the carbon balance project and the fertiliser update described in chapter 4.5, chapter 7 or chapter 10. For some paper production activities, the heat input was remodelled to reflect the on-side steam and power generation in paper mills. Annual production volumes were updated in cases were more recent data was available. Moreover, the outdated dataset "sulfate pulp production, from eucalyptus ssp. from sustainable forest management, unbleached" was deleted.

Table 50. New, updated and deleted activities related to pulp and paper. *If several geographies of the same activity with the same time period exist, all of them are listed in the "Geography" column. In column v3.7, "U" stands for "Updated Activity", "D" stands for "Deleted Activity", and "N" stands for "New activity". "U*" indicates that only the production volume of the specific dataset was updated. U** indicates datasets for which heat inputs were changed. The unit of the reference products is kg.*

Activity name	Geography	Time period	Product name	v3.7
chemi-thermomechanical pulp production	GLO; RER	2000-2000	chemi-thermomechanical pulp	U
containerboard production, fluting medium, semichemical	GLO; RER	2009-2015	containerboard, fluting medium	U
containerboard production, linerboard, kraftliner	CA-QC; GLO; RER	2009-2015	containerboard, linerboard	U
core board production	CA-QC; GLO; RER	2000-2000	core board	U**
corrugated board box production	GLO	2008-2022	corrugated board box	U
liquid packaging board container production	GLO; RER	1993-2000	liquid packaging board container	U**
liquid packaging board production	GLO	2009-2009	liquid packaging board	U*
market for paper, woodcontaining, lightweight coated	RER	2000-2000	paper, woodcontaining, lightweight coated	U
market for paper, woodcontaining, supercalendered	RER	2000-2000	paper, woodcontaining, supercalendered	U
market for paper, woodfree, coated	RER	2000-2000	paper, woodfree, coated	U
market for paper, woodfree, uncoated	RER	2000-2000	paper, woodfree, uncoated	U
market for waste paper, unsorted	CH	2012-2012	waste paper, unsorted	U
market for waste paperboard, unsorted	CH; Europe without Switzerland	2012-2012	waste paperboard, unsorted	N
market for waste paperboard, unsorted	GLO	2012-2012	waste paperboard, unsorted	U
paper production, newsprint, recycled	CH	2012-2012	paper, newsprint	U
paper production, newsprint, recycled	Europe without Switzerland; GLO	2000-2000	paper, newsprint	U
paper production, newsprint, virgin	GLO	2000-2000	paper, newsprint	U
paper production, newsprint, virgin	RER	2000-2000	paper, newsprint	U*
paper production, woodcontaining, lightweight coated	CA-QC; GLO; RER	2000-2000	paper, woodcontaining, lightweight coated	U**
paper production, woodcontaining, supercalendered	CA-QC; GLO; RER	2000-2000	paper, woodcontaining, supercalendered	U**
paper production, woodfree, coated, at integrated mill	GLO; RER	2000-2000	paper, woodfree, coated	U*
paper production, woodfree, coated, at non-integrated mill	GLO; RER	2000-2000	paper, woodfree, coated	U**
paper production, woodfree, uncoated, at integrated mill	GLO	2000-2000	paper, woodfree, uncoated	U
paper production, woodfree, uncoated, at integrated mill	RER	2000-2000	paper, woodfree, uncoated	U*

Activity name	Geography	Time period	Product name	v3.7
paper production, woodfree, uncoated, at non-integrated mill	GLO; RER	2000-2000	paper, woodfree, uncoated	U**
stone groundwood pulp production	GLO; RER	1993-2000	stone groundwood pulp	U
sulfate pulp production, from eucalyptus ssp. from sustainable forest management, unbleached	GLO; TH	2000-2005	sulfate pulp, unbleached	D
sulfate pulp production, from softwood, bleached	GLO; RER	2017-2020	sulfate pulp, bleached	U
sulfate pulp production, from softwood, unbleached	GLO; RER	2017-2020	sulfate pulp, unbleached	U
sulfite pulp production, bleached	GLO; RER	1997-2000	sulfite pulp, bleached	U
thermo-mechanical pulp production	GLO; RER	1993-2000	thermo-mechanical pulp	U
tissue paper production	GLO; RER	2000-2000	waste paper, sorted	U**
treatment of waste paperboard, unsorted, sorting	CH; GLO	2012-2012	waste paperboard, unsorted	U
treatment of waste paperboard, unsorted, sorting	Europe without Switzerland	2012-2012	waste paperboard, unsorted	N
treatment, sludge from pulp and paper production, landfarming	CA-QC; Europe without Switzerland; GLO	2011-2012	sludge from pulp and paper production	U

10 Waste sector

10.1 Collection and treatment of source-segregated recyclables

Life cycle inventories on the collection, sorting, and recycling processes of selected source-segregated municipal solid waste (MSW) fractions in Switzerland were provided Haupt et al. (2018). The material fractions (recyclables) considered for this data submission included aluminium, ferrous metal, and tinplate collected as mixed metal scrap, used beverage cans (UBCs), and waste paper and paperboard. The collection efforts for the unsorted fractions is covered in the database by the corresponding market activities, which might represent either collection from the curbside, at collections points, through retailers, or a representative mix thereof. Analogous product systems were already introduced for waste polyethylene (PE) and polyethylene terephthalate (PET) for recycling with version 3.4 of the ecoinvent database.

For this submission, the inventories were complemented with information from the material flow analysis of the MSW system in Switzerland in Haupt et al. (2017), primarily for annual production volumes. Further modifications compared to the original inventories in Haupt et al. (2018), e.g. related to the assumptions for poorly characterized input/output flows, have been documented in the meta-information of the individual datasets. Several of the Swiss inventories were extrapolated by the ecoinvent team to also provide these product systems in the rest of Europe and worldwide. The uncertainty information in the datasets was adjusted accordingly, but it should be noted that this approximation might be rather crude in some cases, especially given the large variations (e.g. in terms of collection schemes, technologies and degree of automation, qualities of input/out materials and recovery efficiencies, environmental standards, etc.) in waste treatment and secondary resource recovery across the globe

***Table 51. New and updated activities and new products related to collection and treatment of source-segregated recyclables**. If several geographies of the same activity with the same time period exist, all of them are listed in the "Geography" column. All products have the unit of kg.*

Activity name	Geography	Time period	Product name	v3.7
market for aluminium, in mixed metal scrap	CH; Europe without Switzerland; GLO	2012-2012	aluminium, in mixed metal scrap	N
market for ferrous metal, in mixed metal scrap	CH; Europe without Switzerland; GLO	2012-2012	ferrous metal, in mixed metal scrap	N
market for ferrous metal, in mixed metal scrap	CH; Europe without Switzerland; GLO	2012-2012		N
market for iron scrap, sorted, pressed	RER	2012-2012		N*
market for tinplate scrap, sorted	CH; Europe without Switzerland; GLO	2012-2012	tinplate scrap, sorted	N
market for tinplate, in mixed metal scrap	CH; Europe without Switzerland; GLO	2012-2012	tinplate, in mixed metal scrap	N
market for used beverage cans	CH; Europe without Switzerland; GLO	2012-2012	used beverage cans	N
market for waste paper, unsorted	CH	2012-2012	waste paper, unsorted	U
market for waste paperboard, unsorted	CH; Europe without Switzerland	2012-2012	waste paperboard, unsorted	N
paper production, newsprint, recycled	CH	2012-2012	paper, newsprint	U
sorting and pressing of iron scrap	GLO; RER	2002-2002		U
steel production, electric, low-alloyed	CH	2012-2012	steel, low-alloyed	N
tinplate scrap, sorted to generic market for iron scrap, sorted, pressed	CH; Europe without Switzerland; GLO	2012-2012	iron scrap, sorted, pressed	N
treatment of metal scrap, mixed, for recycling, unsorted, sorting	CH; Europe without Switzerland; GLO	2012-2012	aluminium, in mixed metal scrap; ferrous metal, in mixed	N

Activity name	Geography	Time period	Product name	v3.7
			metal scrap; tinplate, in mixed metal scrap	
treatment of used beverage cans, for recycling, unsorted, sorting	CH; Europe without Switzerland; GLO	2012-2012	used beverage cans	N
treatment of waste paper, unsorted, sorting	CH	2012-2012	waste paper, unsorted	U
treatment of waste paperboard, unsorted, sorting	CH; GLO	2012-2012	waste paperboard, unsorted	U
treatment of waste paperboard, unsorted, sorting	Europe without Switzerland	2012-2012	waste paperboard, unsorted	N

10.2 Biogas

Within 3.7 datasets related to biogas production and utilisation have been updated or newly added. The biogas sector spreads into 4 levels as indicated below and is represented in Figure 20.

1. Biogas production (anaerobic digestion)
2. Biogas purification
3. Biomethane injection into the natural gas grid and
4. Biomethane upgrading to vehicle grade

10.2.1 New and updated data

Production of biogas takes place in certain datasets where they have received updates. Below there is a list of datasets updated. The updates refer to various qualitative and quantitative changes in the datasets. Apart from the data update on the biogas production, the supply chains have also been updated. Further to the production, the purification of biogas to biomethane has been updated with the addition of new processes along with the update of the old one. So, “biogas purification to biomethane by pressure swing adsorption” is replacing “biogas purification to methane 96 vol-%”. Another crucial renaming is that “methane, 96% by volume” is now renamed into “biomethane, high pressure”. The latter one is utilised by various transforming activities to produce heat.

Another interesting feature in this update is the fact that “biomethane, high pressure” can actually function exactly as natural gas where they actually meet in “mixed natural gas and biomethane production, high pressure”. The blending is taking place based on the amount of biomethane that can replace natural gas based on literature and statistical data. More information about this can be found in the transforming activity. Finally, new activities were added that produce heat by using only “biomethane, low pressure”. Those were adjusted from activities already using natural gas as a fuel.

Table 52: New and updated activities related to biogas. *If several geographies of the same activity with the same time period exist, all of them are listed in the "Geography" column. In the column v3.7, "N" stands for "New Activity", "U" stands for "Updated Activity", "Nr" stands for "Replacing Activity", "D" stands for "Deleted" and "Dr" stands for "Deleted, replaced by another activity".*

Activity Name	Geography	Time period	v3.7
anaerobic digestion of manure	CH; GLO	2018-2019	U
biogas purification to biomethane by amino washing	CH; GLO	2013-2014	Nr
biogas purification to biomethane by membrane technique	CH; GLO	2018-2018	Nr
biogas purification to biomethane by pressure swing adsorption	CH; GLO	2018-2018	Nr
biogas purification to methane 96 vol-%	CH; GLO	2004-2005	Dr
biomethane pressure reduction from high to low pressure	CH; GLO	2000-2000	U
biomethane production, high pressure from synthetic gas, wood, fixed bed technology	CH; GLO	2008-2016	U
biomethane production, high pressure from synthetic gas, wood, fluidised technology	CH; GLO	2008-2016	U
biomethane production, high pressure, vehicle grade	CH; GLO	2001-2001	U
biomethane production, low pressure, vehicle grade	CH; GLO	2001-2001	U
biomethane production, medium pressure, vehicle grade	CH; GLO	2001-2001	U
biomethane, low pressure burned in micro gas turbine 100kWe	CH; GLO	2000-2005	U
biomethane, low pressure burned in polymer electrolyte membrane fuel cell 2kWe, future	CH; GLO	2000-2005	U
biomethane, low pressure burned in solid oxide fuel cell 125kWe, future	CH; GLO	2000-2005	U
biomethane, low pressure burned in solid oxide fuel cell, with micro gas turbine, 180kWe, future	CH; GLO	2000-2005	U
heat production, biomethane, at boiler condensing modulating <100kW	CH; Europe without Switzerland; GLO	2000-2000	N
heat production, biomethane, low pressure, at diffusion absorption heat pump 4kW, future	CH; GLO	2000-2005	U
market for biomethane, high pressure	CH; GLO	2000-2020	Nr
market for biomethane, low pressure	CH; GLO	2011-2011	U
market for biomethane, low pressure	CH	2016-2016	U
market for biomethane, low pressure, vehicle grade	GLO	2011-2011	U
market for biomethane, low pressure, vehicle grade	CH	2016-2016	U
market for heat, central or small-scale, biomethane	CH; Europe without Switzerland; GLO	2011-2011	N
market for methane, 96% by volume	GLO	2011-2011	Dr
market for methane, 96% by volume	CH	2016-2016	Dr
market for methane, 96% by volume, from biogas, high pressure, at user	GLO	2011-2011	Dr
market for methane, 96% by volume, from biogas, high pressure, at user	CH	2016-2016	Dr
market for mixed natural gas and biomethane, high pressure	CH; GLO	2018-2018	N
market for natural gas, high pressure, vehicle grade	GLO	2011-2011	U
market for natural gas, low pressure, vehicle grade	GLO	2011-2011	U
market for natural gas, medium pressure, vehicle grade	GLO	2011-2011	U
market group for heat, central or small-scale, biomethane	GLO; RER	2015-2015	N

Activity Name	Geography	Time period	v3.7
methane production, 96% by volume, from biogas, high pressure, at user	CH; GLO	2000-2000	D
mixed natural gas and biomethane production, high pressure	CH; GLO	2018-2018	N
natural gas production, high pressure, vehicle grade	CH; GLO	2001-2001	U
natural gas production, low pressure, vehicle grade	CH; GLO	2001-2001	U
natural gas production, medium pressure, vehicle grade	CH; GLO	2001-2001	U
treatment of biowaste by anaerobic digestion	GLO	2011-2015	U
treatment of sewage sludge by anaerobic digestion	CH; GLO	2018-2018	U
treatment of used vegetable cooking oil by anaerobic digestion	GLO	2009-2009	U

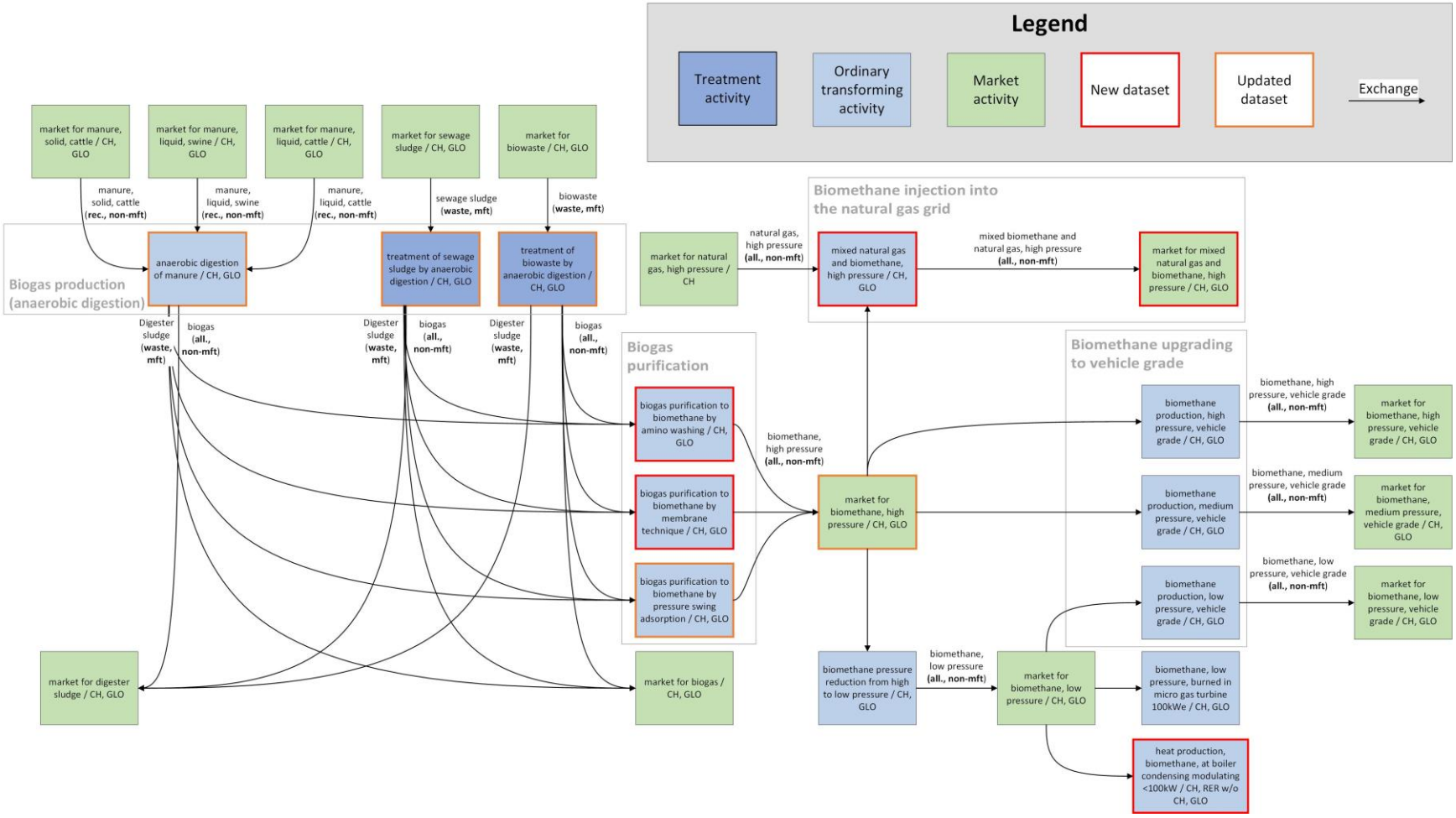


Figure 20. Schema of the biogas and biomethane supply chain in version 3.7.

10.3 Other updates

The new or updated activities listed in Table 53 have been introduced to better reflect the supply chain situation in Europe for these product systems. The rationale or motivation for introducing a regional market or direct activity link to a specific supplying activity is provided in the general comment and/or exchange comments in the respective datasets, as relevant.

Table 53. New and updated activities for improved representation of selected European supply chains*. If several geographies of the same activity with the same time period exist, all of them are listed in the "Geography" column.*

Activity name	Geography	Time period	Product name	Unit	v3.7
market for glass cullet, sorted	RER	2011-2016	glass cullet, sorted	kg	N
market for hazardous waste, for underground deposit	RER	2010-2016	hazardous waste, for underground deposit	kg	N

Hazardous waste incineration (HWI) plants are often net consumers of energy. So far, HWI datasets existed in the database for certain wastes. This was the main reason for the datasets not to have up to 3.6 energy by-production exchanges. However, incinerating certain fractions of wastes may yield amounts of energy that can be further utilised. In 3.7, we have created twin HWI datasets with energy by-production. The two datasets are distinguished by the activity name (hazardous waste incineration, with energy recovery). A user can now choose to use either of them based on their case. Below there is a list of the new twin datasets. In addition to the energy recovery, datasets without it have had an addition of activity links related to heat consumption. The datasets have been linked to a specific heat production (heat production, light fuel oil, at boiler 100kW, non-modulating), based on the original documentation of them. Further on that, production volumes have been updated in certain cases.

Additionally, to the hazardous waste incineration, certain updates took place as reported in the table below. They refer to activity link additions, renaming's and updates due to renamed intermediate exchanges.

Table 54: Waste management processes updated in 3.7. *"N" stands for "New Activity", "AL" stands for "Activity link " and "PV" stands for "Production volume".*

Activity Name	Geography	Time period	v3.7
market for spent oxychlor catalyst for ethylene dichloride production	GLO	2011-2011	U
treatment of leach residue from copper production, neutralisation	GLO	2009-2009	N
treatment of bilge oil, hazardous waste incineration	Europe without Switzerland; GLO	1997-2000	AL
treatment of fly ash and scrubber sludge, hazardous waste incineration	Europe without Switzerland; GLO	1997-2000	AL
treatment of hazardous waste, hazardous waste incineration	Europe without Switzerland; GLO	1997-2000	AL
treatment of refinery sludge, hazardous waste incineration	CH; Europe without Switzerland; GLO	1997-2000	AL
treatment of spent antifreezer liquid, hazardous waste incineration	GLO	1997-2000	AL
treatment of spent solvent mixture, hazardous waste incineration	CH; Europe without Switzerland; GLO	1997-2000	AL

Activity Name	Geography	Time period	v3.7
treatment of used capacitor, to hazardous waste incineration	GLO	1997-2000	AL
treatment of waste emulsion paint, hazardous waste incineration	CH; Europe without Switzerland; GLO	1997-2000	AL
treatment of waste paint, hazardous waste incineration	CH; Europe without Switzerland; GLO	1997-2000	AL
treatment of bilge oil, hazardous waste incineration	CH	1997-2000	PV, AL
treatment of fly ash and scrubber sludge, hazardous waste incineration	CH	1997-2000	PV, AL
treatment of hazardous waste, hazardous waste incineration	CH	1997-2000	PV, AL
treatment of spent antifreezer liquid, hazardous waste incineration	CH	1997-2000	PV, AL
treatment of used capacitor, to hazardous waste incineration	CH	1997-2000	PV, AL
treatment of spent oxychlor catalyst, hazardous waste incineration	CH; GLO	1997-2000	AL, R
treatment of spent oxychlor catalyst, underground deposit	DE; GLO	1993-1999	R
treatment of copper scrap by electrolytic refining	GLO; RER	1994-2003	U
treatment of bilge oil, hazardous waste incineration, with energy recovery	CH; Europe without Switzerland; GLO	1997-2000	N
treatment of fly ash and scrubber sludge, hazardous waste incineration, with energy recovery	CH; Europe without Switzerland; GLO	1997-2000	N
treatment of hazardous waste, hazardous waste incineration, with energy recovery	CH; Europe without Switzerland; GLO	1997-2000	N
treatment of refinery sludge, hazardous waste incineration, with energy recovery	CH; Europe without Switzerland; GLO	1997-2000	N
treatment of spent antifreezer liquid, hazardous waste incineration, with energy recovery	CH; GLO	1997-2000	N
treatment of spent oxychlor catalyst, hazardous waste incineration, with energy recovery	CH; GLO	1997-2000	N
treatment of spent solvent mixture, hazardous waste incineration, with energy recovery	CH; Europe without Switzerland; GLO	1997-2000	N
treatment of used capacitor, to hazardous waste incineration, with energy recovery	CH; GLO	1997-2000	N
treatment of waste emulsion paint, hazardous waste incineration, with energy recovery	CH; Europe without Switzerland; GLO	1997-2000	N
treatment of waste mineral oil, hazardous waste incineration, with energy recovery	CH; Europe without Switzerland; GLO	1997-2000	N
treatment of waste paint, hazardous waste incineration, with energy recovery	CH; Europe without Switzerland; GLO	1997-2000	N

11 Wood and wood products

In the context of a funded project of the Federal Office for the Environment, many existing datasets were updated, and several new datasets were created, mostly on a regional level (Switzerland and Europe). The following sections contains a summary of the changes in the wood sector in version 3.7. A detailed documentation of some of the new datasets can be found in the report by Werner F. (2020).

11.1 Adhesives

New datasets were created representing two adhesives which are commonly used in processed wood products such as glued laminated timber, namely melamine urea formaldehyde (MUF) adhesive and polyurethane (PUR) adhesive. Both production datasets are based on Messmer and Chaudhary (2015).

Table 55. New activities related to melamine urea formaldehyde and polyurethane adhesive. *The unit of the reference products is kg.*

Activity name	Geography	Time period	Product name
melamine urea formaldehyde adhesive production	GLO	2010-2010	melamine urea formaldehyde adhesive
polyurethane adhesive production	GLO	2015-2015	polyurethane adhesive
market for melamine urea formaldehyde adhesive	GLO	2010-2020	melamine urea formaldehyde adhesive
market for polyurethane adhesive	GLO	2015-2020	polyurethane adhesive

11.2 Engineered wood products

Datasets for cross-laminated timber, glued laminated timber, glued solid timber, structural timber, plywood, three and five layered board, and tubular particleboard were updated or newly created. Main data sources for the new and updated datasets are a report by Rüter and Diederichs (2012) as well as a data collection conducted by “Holzindustrie Schweiz”. In version 3.6, glued laminated timber, plywood, and particle board were distinguished based on their application (i.e. indoor or outdoor use). This distinction is no longer made in version 3.7. For glued laminated timber production, several datasets are available in 3.7 depending on the glue type used. For Switzerland, those are “glued laminated timber production, PUR-glue” and “glued laminated timber production, MUF-glue”. For the European and global dataset, an average composition of the various gluing systems was assumed (“glued laminated timber production, average glue mix”). Some of the updates listed in the table below are also mentioned in chapters 4.5 and 7.

Table 56. New, updated, and deleted activities related to engineered wood products. *If several geographies of the same activity with the same time period exist, all of them are listed in the "Geography" column. In column v3.7, "U" stands for "Updated Activity", "D" stands for "Deleted Activity", and "N" stands for "New activity". "U*" indicates that only an activity link changed. The unit of all reference products is m³.*

Activity name	Geography	Time period	Product name	v3.7
cross-laminated timber production	GLO; RER	2012-2012	cross-laminated timber	N
fibreboard production, hard	GLO	2011-2012	fibreboard, hard	U
fibreboard production, hard	RER	2012-2012	fibreboard, hard	U
fibreboard production, soft, from wet & dry processes	CA-QC; Europe without Switzerland; GLO	2012-2012	fibreboard, soft	U
fibreboard production, soft, from wet processes	CH	2008-2009	fibreboard, soft	U
fibreboard production, soft, from wet processes	GLO	2007-2009	fibreboard, soft	U
fibreboard production, soft, latex bonded	CH; GLO	2008-2009	fibreboard, soft, latex bonded	U
fibreboard production, soft, without adhesives	CH; GLO	2008-2009	fibreboard, soft, without adhesives	U
glued laminated timber production, average glue mix	CA-QC	2009-2011	glued laminated timber, for indoor use	U[1]
glued laminated timber production, average glue mix	Europe without Switzerland; GLO	2012-2012	glued laminated timber, average glue mix	N
glued laminated timber production, for indoor use	CA-QC	2009-2011	glued laminated timber, for indoor use	D
glued laminated timber production, for indoor use	GLO; RER	1986-2002	glued laminated timber, for indoor use	D
glued laminated timber production, for outdoor use	GLO; RER	1986-2002	glued laminated timber, for outdoor use	D
glued laminated timber production, MUF-glue	CH; GLO	2018-2018	glued laminated timber, MUF-glue	N
glued laminated timber production, PUR-glue	CH; GLO	2018-2018	glued laminated timber, PUR-glue	N
glued solid timber production	GLO; RER	2012-2012	glued solid timber	N
medium density fibre board production, uncoated	RER	2012-2012	medium density fibreboard	U
oriented strand board production	CA-QC	2005-2006	oriented strand board	U
oriented strand board production	GLO; RER	2012-2012	oriented strand board	U
particle board production, for indoor use	GLO; RER	1986-2000	particle board, for indoor use	D
particle board production, for outdoor use	GLO; RER	1986-2000	particle board, for outdoor use	D
particleboard production, cement bonded	RER	1989-2002	particleboard, cement bonded	U
particleboard production, uncoated, average glue mix	GLO	2012-2012	particleboard, uncoated	U
particleboard production, uncoated, average glue mix	RER	2012-2012	particleboard, uncoated	U
particleboard production, uncoated, from virgin wood	GLO	2000-2012	particleboard, uncoated	U
plywood production	CA-QC; GLO; RER	2012-2012	plywood	N
plywood production, for indoor use	GLO; RER	1996-1996	plywood, for indoor use	D
plywood production, for outdoor use	CA-QC; GLO; RER	1996-1996	plywood, for outdoor use	D
structural timber production	GLO; RER	2012-2012	structural timber	N
three and five layered board production	GLO	2012-2012	three and five layered board	U
three and five layered board production	RER	2012-2012	three and five layered board	U
tubular particleboard production	GLO; RER	2012-2012	tubular particleboard	N

Activity name	Geography	Time period	Product name	v3.7
wood wool boards production, cement bonded	RER	1989-2002	wood wool boards, cement bonded	U*

[1]This is a known error. The reference product of "glued laminated timber production, average glue mix, CA-QC" should have been renamed to "glued laminated timber, average glue mix".

11.3 Sawmill

To improve the regionalisation of supply chains, regional datasets related to activities in the sawmill were introduced. The new regional market activities which were created in this context can be found in the subsection "wood markets". New and updated activities which are related to wood by-products produced in the sawmill can be found in the section "wood by-products".

Datasets for Europe without Switzerland were added to the activities air drying, kiln drying, planing, sawing, and suction of sawdust and shavings. European datasets for sawnwood production were replaced by datasets for the geographies Switzerland and Europe without Switzerland. Sawnwood production activities deliver a generic sawnwood product that averages more specific products produced in a sawmill, namely beam, board and lath. For the global sawnwood production datasets, the share of beam, board and lath was updated.

Table 57. New and updated activities in the sawmill. *If several geographies of the same activity with the same time period exist, all of them are listed in the "Geography" column. In column v3.7, "U" stands for "Updated Activity", and "N" stands for "New activity". "U*" indicates that only the production Volume of the specific dataset was updated. "U**" indicates that only the activity links were changed.*

Activity name	Geography	Time period	Product name	Unit	v3.7
beam, hardwood, raw, air drying to u=20%	Europe without Switzerland	2011-2013	sawnwood, beam, hardwood, raw, dried (u=20%)	m3	N
beam, hardwood, raw, kiln drying to u=10%	Europe without Switzerland	2011-2013	sawnwood, beam, hardwood, raw, dried (u=10%)	m3	N
beam, hardwood, raw, kiln drying to u=20%	Europe without Switzerland	2011-2013	sawnwood, beam, hardwood, raw, dried (u=20%)	m3	N
beam, softwood, raw, air drying to u=20%	Europe without Switzerland	2011-2013	sawnwood, beam, softwood, raw, dried (u=20%)	m3	N
beam, softwood, raw, kiln drying to u=10%	Europe without Switzerland	2011-2013	sawnwood, beam, softwood, raw, dried (u=10%)	m3	N
beam, softwood, raw, kiln drying to u=20%	Europe without Switzerland	2011-2013	sawnwood, beam, softwood, raw, dried (u=20%)	m3	N
board, hardwood, raw, air drying to u=20%	Europe without Switzerland	2011-2013	sawnwood, board, hardwood, raw, dried (u=20%)	m3	N
board, hardwood, raw, kiln drying to u=10%	Europe without Switzerland	2011-2013	sawnwood, board, hardwood, raw, dried (u=10%)	m3	N
board, hardwood, raw, kiln drying to u=20%	Europe without Switzerland	2011-2013	sawnwood, board, hardwood, raw, dried (u=20%)	m3	N
board, softwood, raw, air drying to u=20%	Europe without Switzerland	2011-2013	sawnwood, board, softwood, raw, dried (u=20%)	m3	N
board, softwood, raw, kiln drying to u=10%	Europe without Switzerland	2011-2013	sawnwood, board, softwood, raw, dried (u=10%)	m3	N
board, softwood, raw, kiln drying to u=20%	Europe without Switzerland	2011-2013	sawnwood, board, softwood, raw, dried (u=20%)	m3	N
lath, hardwood, raw, air drying to u=20%	Europe without Switzerland	2011-2013	sawnwood, lath, hardwood, raw, dried (u=20%)	m3	N
lath, hardwood, raw, kiln drying to u=10%	Europe without Switzerland	2011-2013	sawnwood, lath, hardwood, raw, dried (u=10%)	m3	N

Activity name	Geography	Time period	Product name	Unit	v3.7
lath, hardwood, raw, kiln drying to u=20%	Europe without Switzerland	2011-2013	sawnwood, lath, hardwood, raw, dried (u=20%)	m3	N
lath, softwood, raw, air drying to u=20%	Europe without Switzerland	2011-2013	sawnwood, lath, softwood, raw, dried (u=20%)	m3	N
lath, softwood, raw, kiln drying to u=10%	Europe without Switzerland	2011-2013	sawnwood, lath, softwood, raw, dried (u=10%)	m3	N
lath, softwood, raw, kiln drying to u=20%	Europe without Switzerland	2011-2013	sawnwood, lath, softwood, raw, dried (u=20%)	m3	N
planing, beam, hardwood, u=10%	Europe without Switzerland	2011-2013	sawnwood, beam, hardwood, dried (u=10%), planed	m3	N
planing, beam, hardwood, u=20%	Europe without Switzerland	2011-2013	sawnwood, beam, hardwood, dried (u=20%), planed	m3	N
planing, beam, softwood, u=10%	Europe without Switzerland	2011-2013	sawnwood, beam, softwood, dried (u=10%), planed	m3	N
planing, beam, softwood, u=20%	Europe without Switzerland	2011-2013	sawnwood, beam, softwood, dried (u=20%), planed	m3	N
planing, board, hardwood, u=10%	Europe without Switzerland	2011-2013	sawnwood, board, hardwood, dried (u=10%), planed	m3	N
planing, board, hardwood, u=20%	Europe without Switzerland	2011-2013	sawnwood, board, hardwood, dried (u=20%), planed	m3	N
planing, board, softwood, u=10%	Europe without Switzerland	2011-2013	sawnwood, board, softwood, dried (u=10%), planed	m3	N
planing, board, softwood, u=20%	Europe without Switzerland	2011-2013	sawnwood, board, softwood, dried (u=20%), planed	m3	N
planing, lath, hardwood, u=10%	Europe without Switzerland	2011-2013	sawnwood, lath, hardwood, dried (u=10%), planed	m3	N
planing, lath, hardwood, u=20%	Europe without Switzerland	2011-2013	sawnwood, lath, hardwood, dried (u=20%), planed	m3	N
planing, lath, softwood, u=10%	Europe without Switzerland	2011-2013	sawnwood, lath, softwood, dried (u=10%), planed	m3	N
planing, lath, softwood, u=20%	Europe without Switzerland	2011-2013	sawnwood, lath, softwood, dried (u=20%), planed	m3	N
sawing, hardwood	Europe without Switzerland	2011-2013	sawnwood, hardwood, raw	m3	N
sawing, hardwood	CA-QC; GLO	2011-2013	sawnwood, hardwood, raw	m3	U**
sawing, softwood	Europe without Switzerland	2011-2013	sawnwood, softwood, raw	m3	N
sawing, softwood	GLO	2011-2013	sawnwood, softwood, raw	m3	U**
sawnwood production, hardwood, dried (u=10%), planed	CH; Europe without Switzerland	2014-2014	sawnwood, hardwood, dried (u=10%), planed	m3	N
sawnwood production, hardwood, dried (u=10%), planed	GLO	2014-2014	sawnwood, hardwood, dried (u=10%), planed	m3	U
sawnwood production, hardwood, dried (u=10%), planed	RER	2014-2014	sawnwood, hardwood, dried (u=10%), planed	m3	D
sawnwood production, hardwood, dried (u=20%), planed	CH; Europe without Switzerland	2014-2014	sawnwood, hardwood, dried (u=20%), planed	m3	N
sawnwood production, hardwood, dried (u=20%), planed	GLO	2014-2014	sawnwood, hardwood, dried (u=20%), planed	m3	U
sawnwood production, hardwood, dried (u=20%), planed	RER	2014-2014	sawnwood, hardwood, dried (u=20%), planed	m3	D
sawnwood production, hardwood, raw, dried (u=10%)	CH; Europe without Switzerland	2014-2014	sawnwood, hardwood, raw, dried (u=10%)	m3	N
sawnwood production, hardwood, raw, dried (u=10%)	GLO	2014-2014	sawnwood, hardwood, raw, dried (u=10%)	m3	U
sawnwood production, hardwood, raw, dried (u=10%)	RER	2014-2014	sawnwood, hardwood, raw, dried (u=10%)	m3	D
sawnwood production, hardwood, raw, dried (u=20%)	CH; Europe without Switzerland	2014-2014	sawnwood, hardwood, raw, dried (u=20%)	m3	N
sawnwood production, hardwood, raw, dried (u=20%)	GLO	2014-2014	sawnwood, hardwood, raw, dried (u=20%)	m3	U*

Activity name	Geography	Time period	Product name	Unit	v3.7
sawnwood production, hardwood, raw, dried (u=20%)	RER	2014-2014	sawnwood, hardwood, raw, dried (u=20%)	m3	D
sawnwood production, softwood, dried (u=10%), planed	CH; Europe without Switzerland	2014-2014	sawnwood, softwood, dried (u=10%), planed	m3	N
sawnwood production, softwood, dried (u=10%), planed	GLO	2014-2014	sawnwood, softwood, dried (u=10%), planed	m3	U
sawnwood production, softwood, dried (u=10%), planed	RER	2014-2014	sawnwood, softwood, dried (u=10%), planed	m3	D
sawnwood production, softwood, dried (u=20%), planed	CH; Europe without Switzerland	2014-2014	sawnwood, softwood, dried (u=20%), planed	m3	N
sawnwood production, softwood, dried (u=20%), planed	GLO	2014-2014	sawnwood, softwood, dried (u=20%), planed	m3	U
sawnwood production, softwood, dried (u=20%), planed	RER	2014-2014	sawnwood, softwood, dried (u=20%), planed	m3	D
sawnwood production, softwood, raw, dried (u=10%)	CH; Europe without Switzerland	2014-2014	sawnwood, softwood, raw, dried (u=10%)	m3	N
sawnwood production, softwood, raw, dried (u=10%)	GLO	2014-2014	sawnwood, softwood, raw, dried (u=10%)	m3	U
sawnwood production, softwood, raw, dried (u=10%)	RER	2014-2014	sawnwood, softwood, raw, dried (u=10%)	m3	D
sawnwood production, softwood, raw, dried (u=20%)	CH; Europe without Switzerland	2014-2014	sawnwood, softwood, raw, dried (u=20%)	m3	N
sawnwood production, softwood, raw, dried (u=20%)	GLO	2014-2014	sawnwood, softwood, raw, dried (u=20%)	m3	U*
sawnwood production, softwood, raw, dried (u=20%)	RER	2014-2014	sawnwood, softwood, raw, dried (u=20%)	m3	D
suction, sawdust	Europe without Switzerland	2012-2012	sawdust, loose, wet, measured as dry mass	kg	N
suction, sawdust	CH; GLO	2012-2012	sawdust, loose, wet, measured as dry mass	kg	U*
suction, shavings, hardwood	Europe without Switzerland	2012-2013	shavings, hardwood, loose, measured as dry mass	kg	N
suction, shavings, softwood	Europe without Switzerland	2011-2013	shavings, softwood, loose, measured as dry mass	kg	N

11.4 Wood by-products

Wood by-products are produced during debarking, sawing, and planing activities. First, sawlogs and veneer logs are debarked, producing bark which is further processed into bark chips. Second, sawing of the logs leads to the production of sawdust as well as slab and sidings. The latter two are further chipped into wood chips. Third, shavings are produced as a by-product during the planing of the sawnwood. To improve the connectivity of the supply chains of the described wood by-products, new regional production datasets were created for wood by-products such as “bark chip” and “wood chips” for Europe without Switzerland. In addition, new regional activities were created for Québec, Switzerland, and Europe without Switzerland which link the different wood by-products to their generic markets. For the global activities listed in the table below, only the annual production volumes were updated.

Table 58. New and updated activities related wood by-products. *If several geographies of the same activity with the same time period exist, all of them are listed in the "Geography" column. In column v3.7, "U" stands for "Updated Activity", and "N" stands for "New activity". "U*" indicates that only the production volume of the specific dataset was updated.*

Activity name	Geography	Time period	Product name	Unit	v3.7
bark chips production, hardwood, at sawmill	Europe without Switzerland	2011-2013	bark	kg	N
bark chips production, softwood, at sawmill	Europe without Switzerland	2011-2013	bark	kg	N
bark chips, wet, measured as dry mass to generic market for residual hardwood, wet	CA-QC; CH; Europe without Switzerland	2014-2014	residual hardwood, wet	m3	N
bark chips, wet, measured as dry mass to generic market for residual hardwood, wet	GLO	2014-2014	residual hardwood, wet	m3	U*
sawdust, wet, measured as dry mass to generic market for residual softwood, wet	CA-QC; CH; Europe without Switzerland	2014-2014	residual softwood, wet	m3	N
sawdust, wet, measured as dry mass to generic market for residual softwood, wet	GLO	2014-2014	residual softwood, wet	m3	U*
shavings, hardwood, measured as dry mass to generic market for residual wood, dry	CA-QC; CH; Europe without Switzerland	2014-2014	residual wood, dry	m3	N
shavings, hardwood, measured as dry mass to generic market for residual wood, dry	GLO	2014-2014	residual wood, dry	m3	U*
shavings, softwood, measured as dry mass to generic market for residual wood, dry	CA-QC; CH; Europe without Switzerland	2014-2014	residual wood, dry	m3	N
shavings, softwood, measured as dry mass to generic market for residual wood, dry	GLO	2014-2014	residual wood, dry	m3	U*
slab and siding, hardwood, wet, measured as dry mass to generic market for residual hardwood, wet	CA-QC; CH; Europe without Switzerland	2014-2014	residual hardwood, wet	m3	N
slab and siding, hardwood, wet, measured as dry mass to generic market for residual hardwood, wet	GLO	2014-2014	residual hardwood, wet	m3	U*
slab and siding, softwood, wet, measured as dry mass to generic market for residual softwood, wet	CA-QC; CH; Europe without Switzerland	2014-2014	residual softwood, wet	m3	N
slab and siding, softwood, wet, measured as dry mass to generic market for residual softwood, wet	GLO	2014-2014	residual softwood, wet	m3	U*
wood chips production, hardwood, at sawmill	Europe without Switzerland	2011-2013	wood chips, wet, measured as dry mass	kg	N
wood chips production, softwood, at sawmill	Europe without Switzerland	2011-2013	wood chips, wet, measured as dry mass	kg	N

11.5 Machinery and machinery operation in the forestry sector

Several datasets related to forest machinery and machinery operation in the forestry sector were updated and are listed in the table below. Outdated European datasets for chipper production and power saw production were deleted from the database. For those datasets, updated global versions are available in version 3.7.

Table 59 . Updated activities related to machinery and machinery operation in the forestry sector. *In column v3.7, "U" stands for "Updated Activity" and "D" stands for "Deleted Activity". "U*" indicates that only an activity link changed.*

Activity name	Geography	Time period	Product name	Unit	v3.7
cable yarder production, trailer-mounted	GLO	2012-2012	mobile cable yarder, trailer-mounted	unit	U
cable yarder production, truck-mounted	GLO	2012-2012	mobile cable yarder, truck-mounted, incl. processor	unit	U
cable yarder with sled winch production	GLO	2012-2012	cable yarder with sled winch	unit	U
chipper production, mobile, diesel	GLO	2012-2012	chipper, mobile, diesel	unit	U
chipper production, mobile, diesel	RER	1996-2002	chipper, mobile, diesel	unit	D
chipper production, stationary, electric	GLO	1996-1996	chipper, stationary, electric	unit	U
chipper production, stationary, electric	RER	1996-1996	chipper, stationary, electric	unit	D
clefting/splitting of energy wood	RER	2010-2012	clefting of energy wood	hour	U
delimbing, with excavator-based processor	RER	2012-2012	delimbing/sorting, excavator-based processor	hour	U
energy wood harvester production	GLO	2012-2012	energy wood harvester	unit	U
forestry harvester production	GLO	2012-2012	forestry harvester	unit	U
forwarder production	GLO	2012-2012	forwarder	unit	U
forwarder production, with terrain chipper	GLO	2012-2012	terrain chipper on forwarder	unit	U
forwarding, forwarder	RER	2012-2012	forwarding, forwarder	hour	U
harvesting, forestry harvester	RER	2012-2012	harvesting, forestry harvester	hour	U
harvesting/bundling, energy wood harvester	RER	2012-2012	harvesting/bundling, energy wood harvester	hour	U
power saw production, with catalytic converter	GLO	2011-2011	power saw, with catalytic converter	unit	U*
power saw production, with catalytic converter	RER	1995-2001	power saw, with catalytic converter	unit	D
power saw production, without catalytic converter	RER	1995-2001	power saw, without catalytic converter	unit	D
power sawing, with catalytic converter	RER	1993-2001	power sawing, with catalytic converter	hour	U
skidder production	GLO	2012-2012	skidder	unit	U
skidding, skidder	RER	2012-2012	skidding, skidder	hour	U
wood chipping, mobile chipper, at forest road	RER	2012-2012	wood chipping, chipper, mobile, diesel, at forest road	hour	U
wood chipping, terrain chipper, diesel	RER	2012-2012	wood chipping, forwarder with terrain chipper, in forest	hour	U
yarding and processing, mobile cable yarder on truck	RER	2012-2012	cable yarding	hour	U
yarding, mobile cable yarder on trailer	RER	2012-2012	cable yarding	hour	U
yarding, sled yarder	RER	2012-2012	cable yarding	hour	U

11.6 Infrastructure related to the wood sector

Several datasets related to infrastructure in the wood sector were updated in version 3.7. A new activity for "gluing mill construction" was introduced representing a plant for the production of glued timber products. New and updated datasets are listed in the table below.

Table 60. New and updated activities related to infrastructure in the wood sector. *If several geographies of the same activity with the same time period exist, all of them are listed in the "Geography" column. In column v3.7, "U" stands for "Updated Activity" and "N" stands for "New activity". All products have the unit "unit".*

Activity name	Geography	Time period	Product name	v3.7
gluing mill construction	GLO; RER	2018-2018	gluing mill	N
planing mill production	GLO	2002-2002	planing mill	U
sawmill construction	CH	2012-2013	sawmill	U
wood preservation facility construction, flow coating equipment	GLO	2012-2012	wood preservation facility, flow coating equipment	U
wooden board factory construction, cement bonded boards	GLO	2002-2002	wooden board factory, cement bonded boards	U
wooden board factory construction, organic bonded boards	GLO	2002-2002	wooden board factory, organic bonded boards	U

11.7 Other changes for wood and wood products

Next to the datasets mentioned in the previous sections, additional updates and corrections were made within the wood sector. A new European dataset was created for "heat production, wood chips from post-consumer wood, at furnace 300kW" and the global dataset was updated. Some of the updates listed below are were part of chapter .

Table 61. Other new, updated, and deleted activities related to wood and wood products. *If several geographies of the same activity with the same time period exist, all of them are listed in the "Geography" column. In column v3.7, "U" stands for "Updated Activity", "D" stands for "Deleted Activity", and "N" stands for "New activity"." U*" indicates that only an activity link changed.*

Activity name	Geography	Time period	Product name	Unit	v3.7
coating service, melamine impregnated paper, double-sided	GLO	2012-2012	coating, with melamine impregnated paper	m2	U
coating service, melamine impregnated paper, double-sided	RER	2012-2012	coating, with melamine impregnated paper	m2	U
cork slab production	RER	2001-2001	cork slab	kg	U*
ethanol production from wood	GLO	1999-2006	ethanol, without water, in 95% solution state, from fermentation	kg	U
EUR-flat pallet production	GLO	2000-2002	EUR-flat pallet	unit	U
EUR-flat pallet production	RER	2000-2002	EUR-flat pallet	unit	U
furniture production, wooden	GLO	2011-2017	furniture, wooden	kg	U
heat production, wood chips from post-consumer wood, at furnace 300kW	GLO	2000-2014	heat, district or industrial, other than natural gas	MJ	U
heat production, wood chips from post-consumer wood, at furnace 300kW	RER	2000-2014	heat, district or industrial, other than natural gas	MJ	N
treatment of waste wood, post-consumer, sorting and shredding	CH; GLO	2004-2010	waste wood, post-consumer	kg	U

Activity name	Geography	Time period	Product name	Unit	v3.7
tree seedling production, in heated greenhouse	RER	2002-2002	tree seedling, for planting	unit	U
tree seedling production, in unheated greenhouse	RER	2002-2002	tree seedling, for planting	unit	U
trellis system construction, wooden poles, soft wood, tar impregnated	CH; GLO	2010-2010	trellis system, wooden poles, soft wood, tar impregnated	ha	U
wood preservation, dipping/immersion, solvent-based preservative, indoor use, dry	GLO; RER	2012-2012	wood preservation, dipping/immersion method, organic solvent-based, indoor use, dry	kg	U
wood preservation, dipping/immersion, solvent-based preservative, indoor use, occasionally wet	GLO; RER	2012-2012	wood preservation, dipping/immersion method, organic solvent-based, indoor use, occasionally wet	kg	U
wood preservation, dipping/immersion, solvent-based preservative, outdoor use, no ground contact	GLO; RER	2012-2012	wood preservation, dipping/immersion method, organic solvent-based, outdoor use, no ground contact	kg	U
wood preservation, dipping/immersion, water-based preservative, indoor use, occasionally wet	GLO; RER	2012-2012	wood preservation, dipping/immersion method, water-based, indoor use, occasionally wet	kg	U
wood preservation, hot/cold dipping, creosote, outdoor use, ground contact	GLO; RER	2008-2008	wood preservation, hot/cold dipping, creosote, outdoor use, ground contact	kg	U
wood preservation, pressure vessel, creosote, outdoor use, ground contact	GLO; RER	2008-2008	wood preservation, pressure vessel, creosote, outdoor use, ground contact	kg	U
wood preservation, spray tunnel/deluging, solvent-based preservative, indoor use, dry	GLO; RER	2012-2012	wood preservation, spray tunnel/deluging, organic solvent-based, indoor use, dry	kg	U
wood preservation, spray tunnel/deluging, solvent-based preservative, indoor use, occasionally wet	GLO; RER	2012-2012	wood preservation, spray tunnel/deluging, organic solvent-based, indoor use, occasionally wet	kg	U
wood preservation, spray tunnel/deluging, solvent-based preservative, outdoor use, no ground contact	GLO; RER	2012-2012	wood preservation, spray tunnel/deluging, organic solvent-based, outdoor use, no ground contact	kg	U
wood preservation, spray tunnel/deluging, water-based preservative, indoor use, occasionally wet	GLO; RER	2012-2012	wood preservation, spray tunnel/deluging, water-based, indoor use, occasionally wet	kg	U
wood wool production	RER	2002-2002	wood wool	kg	U

11.8 Wood markets:

To improve the connectivity of supply chains, new regional markets were created for many wood products predominantly for the regions Switzerland, Europe, and Europe without Switzerland. In addition, transport distances were corrected for many already existing markets. Transport distances of the new and updated markets are mostly based on ecoinvent default transport assumptions. On a global level, these assumptions are based on transport statistics, according to a methodology developed by Borken & Weidema (2013) while on a regional (European) level transport distances are based on eurostat transport statistics. Transport by light commercial vehicle and transport by barge were removed from the markets since they are not a common mode of transport for wood products. The distances which were covered by light commercial vehicle were added to transport by lorry. As explained in chapter 4.5, properties of several wood products were modified. This also impacted transport distances in cases were the reference product is report with the unit of m^3.

New and updated wood market activities are listed below, also including new markets for the new products described in the previous section. Furthermore, markets for engineered wood products which were deleted due to the modelling changes described in the section “engineered wood products” are indicated in the given table.

***Table 62. New, updated and deleted market activities related to wood**. If several geographies of the same activity with the same time period exist, all of them are listed in the "Geography" column. In column v3.7, "U" stands for "Updated Activity", "D" stands for "Deleted Activity" and "N" stands for "New activity".*

Activity name	Geography	Time period	v3.7
market for bark chips, wet, measured as dry mass	CA-QC; CH; Europe without Switzerland	2019-2019	N
market for bark chips, wet, measured as dry mass	GLO	2019-2019	U
market for bundle, energy wood, measured as dry mass	GLO	2019-2019	U
market for bundle, energy wood, measured as dry mass	SE	2019-2019	N
market for cleft timber, measured as dry mass	CH; Europe without Switzerland	2019-2019	U
market for cleft timber, measured as dry mass	GLO	2010-2012	U
market for cork slab	GLO	2019-2019	U
market for cork slab	RER	2019-2019	N
market for cork, raw	GLO	2019-2019	U
market for cork, raw	PT	2019-2019	N
market for cross-laminated timber	GLO; RER	2012-2012	N
market for EUR-flat pallet	RER	2019-2019	N
market for fibreboard, hard	GLO	2019-2019	U
market for fibreboard, hard	RER	2019-2019	N
market for fibreboard, soft	GLO	2019-2019	U
market for fibreboard, soft	RER	2019-2019	N
market for fibreboard, soft, latex bonded	GLO	2019-2019	U
market for fibreboard, soft, latex bonded	RER	2019-2019	N
market for fibreboard, soft, without adhesives	RER	2019-2019	N
market for furnace, logs, 6kW	CH; GLO	2012-2012	U
market for glued laminated timber, average glue mix	Europe without Switzerland; GLO	2012-2012	N
market for glued laminated timber, for indoor use	GLO	2011-2011	D
market for glued laminated timber, for outdoor use	GLO	2011-2011	D
market for glued laminated timber, MUF-glue	CH; GLO	2018-2018	N
market for glued laminated timber, PUR-glue	CH; GLO	2018-2018	N
market for glued solid timber	GLO; RER	2012-2012	N
market for gluing mill	GLO	2018-2018	N
market for laminated timber element, transversally prestressed, for outdoor use	GLO	2019-2019	U
market for laminated timber element, transversally prestressed, for outdoor use	RER	2019-2019	N
market for medium density fibreboard	GLO	2019-2019	U
market for medium density fibreboard	RER	2019-2019	N
market for oriented strand board	GLO	2019-2019	U
market for oriented strand board	RER	2019-2019	N
market for paper, melamine impregnated	GLO	2019-2019	U
market for paper, melamine impregnated	RER	2019-2019	N
market for particle board, for indoor use	GLO	2011-2011	D

Activity name	Geography	Time period	v3.7
market for particle board, for outdoor use	GLO	2011-2011	D
market for particleboard, cement bonded	GLO	2019-2019	U
market for particleboard, cement bonded	RER	2019-2019	N
market for particleboard, uncoated	GLO	2019-2019	U
market for particleboard, uncoated	RER	2019-2019	N
market for plywood	GLO; RER	2012-2012	N
market for plywood, for indoor use	GLO; RER	2011-2011	D
market for plywood, for outdoor use	GLO; RER	2011-2011	D
market for pulpwood, hardwood, measured as solid wood under bark	CH; Europe without Switzerland	2019-2019	U
market for pulpwood, hardwood, measured as solid wood under bark	GLO	2011-2011	U
market for pulpwood, softwood, measured as solid wood under bark	CH; Europe without Switzerland	2019-2019	U
market for pulpwood, softwood, measured as solid wood under bark	GLO	2011-2011	U
market for residual hardwood, wet	GLO	2011-2011	U
market for residual hardwood, wet	RER	2011-2011	N
market for residual softwood, wet	GLO	2011-2011	U
market for residual softwood, wet	RER	2011-2011	N
market for residual wood, dry	GLO	2019-2019	U
market for residual wood, dry	RER	2019-2019	N
market for sawdust, wet, measured as dry mass	CA-QC; CH; Europe without Switzerland	2019-2019	N
market for sawdust, wet, measured as dry mass	GLO	2019-2019	U
market for sawlog and veneer log, hardwood, measured as solid wood under bark	CH; Europe without Switzerland	2019-2019	U
market for sawlog and veneer log, hardwood, measured as solid wood under bark	GLO	2011-2011	U
market for sawlog and veneer log, softwood, measured as solid wood under bark	CA-QC	2006-2012	U
market for sawlog and veneer log, softwood, measured as solid wood under bark	CH; Europe without Switzerland	2019-2019	U
market for sawlog and veneer log, softwood, measured as solid wood under bark	GLO	2011-2011	U
market for sawnwood, beam, hardwood, dried (u=10%), planed	CH; Europe without Switzerland	2019-2019	N
market for sawnwood, beam, hardwood, dried (u=10%), planed	GLO	2019-2019	U
market for sawnwood, beam, hardwood, dried (u=20%), planed	CH; Europe without Switzerland	2019-2019	N
market for sawnwood, beam, hardwood, dried (u=20%), planed	GLO	2019-2019	U
market for sawnwood, beam, hardwood, raw, dried (u=10%)	CH; Europe without Switzerland	2019-2019	N
market for sawnwood, beam, hardwood, raw, dried (u=10%)	GLO	2019-2019	U
market for sawnwood, beam, hardwood, raw, dried (u=20%)	CH; Europe without Switzerland	2019-2019	N
market for sawnwood, beam, hardwood, raw, dried (u=20%)	GLO	2019-2019	U
market for sawnwood, beam, softwood, dried (u=10%), planed	CH; Europe without Switzerland	2019-2019	N
market for sawnwood, beam, softwood, dried (u=10%), planed	GLO	2019-2019	U
market for sawnwood, beam, softwood, dried (u=20%), planed	CH; Europe without Switzerland	2019-2019	N

Activity name	Geography	Time period	v3.7
market for sawnwood, beam, softwood, dried (u=20%), planed	GLO	2019-2019	U
market for sawnwood, beam, softwood, raw, dried (u=10%)	CH; Europe without Switzerland	2019-2019	N
market for sawnwood, beam, softwood, raw, dried (u=10%)	GLO	2019-2019	U
market for sawnwood, beam, softwood, raw, dried (u=20%)	CH; Europe without Switzerland	2019-2019	N
market for sawnwood, beam, softwood, raw, dried (u=20%)	GLO	2019-2019	U
market for sawnwood, board, hardwood, dried (u=10%), planed	CH; Europe without Switzerland	2019-2019	N
market for sawnwood, board, hardwood, dried (u=10%), planed	GLO	2019-2019	U
market for sawnwood, board, hardwood, dried (u=20%), planed	CH; Europe without Switzerland	2019-2019	N
market for sawnwood, board, hardwood, dried (u=20%), planed	GLO	2019-2019	U
market for sawnwood, board, hardwood, raw, dried (u=10%)	CH; Europe without Switzerland	2019-2019	N
market for sawnwood, board, hardwood, raw, dried (u=10%)	GLO	2019-2019	U
market for sawnwood, board, hardwood, raw, dried (u=20%)	CH; Europe without Switzerland	2019-2019	N
market for sawnwood, board, hardwood, raw, dried (u=20%)	GLO	2019-2019	U
market for sawnwood, board, softwood, dried (u=10%), planed	CH; Europe without Switzerland	2019-2019	N
market for sawnwood, board, softwood, dried (u=10%), planed	GLO	2019-2019	U
market for sawnwood, board, softwood, dried (u=20%), planed	CH; Europe without Switzerland	2019-2019	N
market for sawnwood, board, softwood, dried (u=20%), planed	GLO	2019-2019	U
market for sawnwood, board, softwood, raw, dried (u=10%)	CH; Europe without Switzerland	2019-2019	N
market for sawnwood, board, softwood, raw, dried (u=10%)	GLO	2019-2019	U
market for sawnwood, board, softwood, raw, dried (u=20%)	CH; Europe without Switzerland	2019-2019	N
market for sawnwood, board, softwood, raw, dried (u=20%)	GLO	2019-2019	U
market for sawnwood, hardwood, raw	GLO	2011-2013	U
market for sawnwood, lath, hardwood, dried (u=10%), planed	CH; Europe without Switzerland	2019-2019	N
market for sawnwood, lath, hardwood, dried (u=10%), planed	GLO	2019-2019	U
market for sawnwood, lath, hardwood, dried (u=20%), planed	CH; Europe without Switzerland	2019-2019	N
market for sawnwood, lath, hardwood, dried (u=20%), planed	GLO	2019-2019	U
market for sawnwood, lath, hardwood, raw, dried (u=10%)	CH; Europe without Switzerland	2019-2019	N
market for sawnwood, lath, hardwood, raw, dried (u=10%)	GLO	2019-2019	U
market for sawnwood, lath, hardwood, raw, dried (u=20%)	CH; Europe without Switzerland	2019-2019	N
market for sawnwood, lath, hardwood, raw, dried (u=20%)	GLO	2019-2019	U
market for sawnwood, lath, softwood, dried (u=10%), planed	CH; Europe without Switzerland	2019-2019	N
market for sawnwood, lath, softwood, dried (u=10%), planed	GLO	2019-2019	U
market for sawnwood, lath, softwood, dried (u=20%), planed	CH; Europe without Switzerland	2019-2019	N

Activity name	Geography	Time period	v3.7
market for sawnwood, lath, softwood, dried (u=20%), planed	GLO	2019-2019	U
market for sawnwood, lath, softwood, raw, dried (u=10%)	CH; Europe without Switzerland	2019-2019	N
market for sawnwood, lath, softwood, raw, dried (u=10%)	GLO	2019-2019	U
market for sawnwood, lath, softwood, raw, dried (u=20%)	CH; Europe without Switzerland	2019-2019	N
market for sawnwood, lath, softwood, raw, dried (u=20%)	GLO	2019-2019	U
market for sawnwood, softwood, raw	GLO	2011-2013	U
market for shavings, hardwood, measured as dry mass	CA-QC; CH; Europe without Switzerland	2019-2019	N
market for shavings, hardwood, measured as dry mass	GLO	2019-2019	U
market for shavings, softwood, measured as dry mass	CA-QC; CH; Europe without Switzerland	2019-2019	N
market for shavings, softwood, measured as dry mass	GLO	2019-2019	U
market for slab and siding, hardwood, wet, measured as dry mass	CA-QC; CH; Europe without Switzerland	2014-2014	N
market for slab and siding, hardwood, wet, measured as dry mass	GLO	2014-2014	U
market for slab and siding, softwood, wet, measured as dry mass	CA-QC; CH; Europe without Switzerland	2014-2014	N
market for slab and siding, softwood, wet, measured as dry mass	GLO	2014-2014	U
market for structural timber	GLO; RER	2012-2012	N
market for three and five layered board	GLO; RER	2012-2012	N
market for three layered laminated board	GLO	2011-2011	D
market for tree seedling	GLO	2019-2019	U
market for tree seedling	RER	2019-2019	N
market for tubular particleboard	GLO; RER	2012-2012	N
market for waste wood, post-consumer	GLO	2019-2019	U
market for waste wood, post-consumer	RER	2019-2019	N
market for wood chips and particles, willow	GLO	2012-2012	U
market for wood chips and particles, willow	RER	2012-2012	N
market for wood chips, dry, measured as dry mass	GLO	2011-2011	U
market for wood chips, dry, measured as dry mass	RER	2019-2019	U
market for wood chips, from post-consumer wood, measured as dry mass	GLO	2019-2019	U
market for wood chips, from post-consumer wood, measured as dry mass	RER	2019-2019	N
market for wood chips, wet, measured as dry mass	CH; Europe without Switzerland	2019-2019	U
market for wood pellet	GLO	2011-2011	U
market for wood pellet	RER	2019-2019	U
market for wood preservative, creosote	RER	2019-2019	N
market for wood wool	GLO	2019-2019	U
market for wood wool	RER	2019-2019	N
market for wood wool boards, cement bonded	GLO	2019-2019	U
market for wood wool boards, cement bonded	RER	2019-2019	N

To properly represent the market composition in Switzerland of the market for “pulpwood, softwood”, “sawlog and veneer log, hardwood”, and “sawlog and veneer log, softwood” import datasets from Europe to Switzerland were created and are listed in the table below.

Table 63. New import activities for pulpwood and sawlog and veneer log*. The unit of all the reference products is m3.*

Activity name	Geography	Time period	Product name
pulpwood, softwood, measured as solid wood under bark, import from Europe without Switzerland	CH	2019-2019	pulpwood, softwood, measured as solid wood under bark
sawlog and veneer log, hardwood, measured as solid wood under bark, import from Europe without Switzerland	CH	2019-2019	sawlog and veneer log, hardwood, measured as solid wood under bark
sawlog and veneer log, softwood, measured as solid wood under bark, import from Europe without Switzerland	CH	2019-2019	sawlog and veneer log, softwood, measured as solid wood under bark

11.9 Tropical Wood

Activities linked to tropical wood (azobe, eucalyptus, meranti, and paraná pine) were renamed using the same naming convention as in other wood datasets. New datasets were created for debarking of azobe and meranti hardwood. Debarking of meranti and azobe was included in the respective import datasets in version 3.6 from which they were removed in version 3.7. Import datasets were also revised regarding their transport distances. Other datasets were corrected and updated. Some of the updates were part of chapters 4.5 and 7.

Table 64. New and updated activities related to tropical wood*. If several geographies of the same activity with the same time period exist, all of them are listed in the “Geography” column. In column v3.7, “U” stands for “Updated Activity”, and “N” stands for “New activity”.*

Activity name	Geography	Time period	Product name	Unit	v3.7
debarking, hardwood, azobe	CM; GLO	2000-2005	sawlog and veneer log, azobe, debarked, measured as solid wood	m3	N
debarking, hardwood, meranti	GLO; MY	2000-2005	sawlog and veneer log, meranti, debarked, measured as solid wood	m3	N
hardwood forestry, azobe, sustainable forest management	CM	2000-2005	sawlog and veneer log, azobe, measured as solid wood under bark	m3	U
hardwood forestry, eucalyptus ssp., planted forest management	BR-SP	2012-2016	cleft timber, measured as dry mass	kg	U
hardwood forestry, eucalyptus ssp., sustainable forest management	TH	2000-2005	sawlog and veneer log, eucalyptus ssp., measured as solid wood under bark	m3	U
hardwood forestry, meranti, sustainable forest management	MY	2000-2005	sawlog and veneer log, meranti, measured as solid wood under bark	m3	U
sawing and planing, paraná pine, kiln dried	GLO	1999-2005	sawnwood, paraná pine, dried (u=10%)	m3	U
sawing and planing, paraná pine, kiln dried	BR	2000-2005	sawnwood, paraná pine, dried (u=10%)	m3	U
sawlog and veneer log, azobe, debarked, measured as solid wood, import from CM	RER	2000-2005	sawlog and veneer log, azobe, debarked, measured as solid wood	m3	U

Activity name	Geography	Time period	Product name	Unit	v3.7
sawlog and veneer log, meranti, debarked, measured as solid wood, import from MY	RER	2000-2005	sawlog and veneer log, meranti, debarked, measured as solid wood	m3	U
sawnwood, paraná pine, dried (u=10%), import from BR	RER	2000-2005	sawnwood, paraná pine, dried (u=10%)	m3	U
softwood forestry, paraná pine, sustainable forest management	BR	2000-2005	sawlog and veneer log, paraná pine, measured as solid wood under bark	m3	U

To improve the connectivity of supply chains, new regional markets were created for sawlog and veneer log and sawnwood for azobe, eucalyptus, meranti, and paraná pine. Global market datasets were revised regarding their transport distances and documentation.

***Table 65 New and updated market activities related to tropical wood**. If several geographies of the same activity with the same time period exist, all of them are listed in the "Geography" column. In column v3.7, "U" stands for "Updated Activity", and "N" stands for "New activity". The unit of all the reference products is m3.*

Activity name	Geography	Time period	Product name	v3.7
market for sawlog and veneer log, azobe, debarked, measured as solid wood	RER	2019-2019	sawlog and veneer log, azobe, debarked, measured as solid wood	N
market for sawlog and veneer log, azobe, debarked, measured as solid wood	GLO	2019-2019	sawlog and veneer log, azobe, debarked, measured as solid wood	U
market for sawlog and veneer log, azobe, measured as solid wood under bark	CM	2019-2019	sawlog and veneer log, azobe, measured as solid wood under bark	N
market for sawlog and veneer log, azobe, measured as solid wood under bark	GLO	2019-2019	sawlog and veneer log, azobe, measured as solid wood under bark	U
market for sawlog and veneer log, eucalyptus ssp., measured as solid wood under bark	TH	2019-2019	sawlog and veneer log, eucalyptus ssp., measured as solid wood under bark	N
market for sawlog and veneer log, eucalyptus ssp., measured as solid wood under bark	GLO	2019-2019	sawlog and veneer log, eucalyptus ssp., measured as solid wood under bark	U
market for sawlog and veneer log, meranti, debarked, measured as solid wood	RER	2019-2019	sawlog and veneer log, meranti, debarked, measured as solid wood	N
market for sawlog and veneer log, meranti, debarked, measured as solid wood	GLO	2019-2019	sawlog and veneer log, meranti, debarked, measured as solid wood	U
market for sawlog and veneer log, meranti, measured as solid wood under bark	MY	2019-2019	sawlog and veneer log, meranti, measured as solid wood under bark	N
market for sawlog and veneer log, meranti, measured as solid wood under bark	GLO	2019-2019	sawlog and veneer log, meranti, measured as solid wood under bark	U
market for sawlog and veneer log, paraná pine, measured as solid wood under bark	BR	2019-2019	sawlog and veneer log, paraná pine, measured as solid wood under bark	N
market for sawlog and veneer log, paraná pine, measured as solid wood under bark	GLO	2019-2019	sawlog and veneer log, paraná pine, measured as solid wood under bark	U
market for sawnwood, azobe, dried (u=20%), planed	RER	2019-2019	sawnwood, azobe, dried (u=20%), planed	N

Activity name	Geography	Time period	Product name	v3.7
market for sawnwood, azobe, dried (u=20%), planed	GLO	2019-2019	sawnwood, azobe, dried (u=20%), planed	U
market for sawnwood, paraná pine, dried (u=10%)	RER	2019-2019	sawnwood, paraná pine, dried (u=10%)	N
market for sawnwood, paraná pine, dried (u=10%)	GLO	2019-2019	sawnwood, paraná pine, dried (u=10%)	U

12 Updates in the remaining sectors

Not falling into any of the categories listed below, the dataset “display production, liquid crystal, 17 inches” has been edited for this release, associated to the change in technology level in the cathode tube display (see chapter 4.3).

12.1 Agriculture

Certain global datasets were wrongly using Swiss Integrated Production products in their inventories and were substituted with regular products; in other cases, emission of Nitrate to groundwater were corrected.

Table 66. Datasets updated or corrected for v3.7, in the agriculture sector. *If several geographies of the same activity with the same time period exist, all of them are listed in the “Geography” column. In column v3.7, “S” stands for datasets adjusted to employ regular products instead of Swiss integrated production products; “E” marks datasets where the emission of Nitrate to groundwater have been corrected; “M” for datasets where mathematical formula have been recalculated.*

Activity name	Geography	Time period	v3.7
ethanol production from potatoes	GLO	2002-2006	S
maize starch production	DE; GLO	2002-2002	S
soybean meal and crude oil production	RER	1998-1998	S
potato starch production	DE; GLO	2002-2002	S
maize grain production, rainfed	GLO; ZA	2006-2013	E
maize silage production	ZA	2014-2016	E
orange production, fresh grade	ZA	2015-2015	E
pear production	ZA	2012-2016	E
mango production	BR	2010-2016	M

12.2 Fish infrastructure

The following datasets have had an update in their infrastructure exchanges. The update refers to amounts, mathematical relations or both. The IEs updated are the following: “purse seiner, maintenance, steel”, “purse seiner, steel”, “purse seiner maintenance, wood”, “purse seiner, wood”, “trawler maintenance, steel”, “trawler, steel”.

Table 67: Updated activities related to fish capture infrastructure. *If several geographies of the same activity with the same time period exist, all of them are listed in the "Geography" column.*

Activity Name	Geography	Time period
anchovy, capture by steel purse seiner and landing whole, fresh	GLO; PE	2010-2020
anchovy, capture by wooden purse seiner and landing whole, fresh	GLO; PE	2010-2020
hake, capture by trawler and landing whole, fresh	GLO; PE	2010-2020
patagonian grenadier, capture by trawler and landing in fish blocks, frozen	GLO; RLA	2011-2011
tuna, capture by purse seiner and landing whole, frozen	EC; GLO	2012-2013

12.3 Fuel and Transport

The new or updated activities listed in Table 68 have been introduced to better reflect the supply chain situation in Europe for these product systems. The rationale or motivation for introducing a regional market or direct activity link to a specific supplying activity is provided in the general comment and/or exchange comments in the respective datasets, as relevant. For the transport, freight train datasets, the production volumes and respective comments were updated.

Table 68. New and updated activities for improved representation of selected European supply chains*. If several geographies of the same activity with the same time period exist, all of them are listed in the "Geography" column. . In the column v.3.7, "N" stands for "New Activity", "U" stands for "Updated Activity"; "M" for datasets where mathematical formula have been recalculated.*

Activity name	Geography	Time period	v3.7
market for hard coal	ZA	2014-2014	M
market for lorry, 16 metric ton	RER	2016-2016	N
market for lorry, 28 metric ton	RER	2016-2016	N
market for lorry, 40 metric ton	RER	2016-2016	N
market for peat	RER	2010-2016	N
natural gas production, unprocessed, at extraction	GLO	2000-2005	U
transport, freight train, diesel	CN; GLO	1999-2004	U
transport, freight train, diesel	Europe without Switzerland; US	2000-2000	U
transport, freight train, diesel, with particle filter	CH; GLO	2000-2000	U
transport, freight train, electricity	CH; Europe without Switzerland	2000-2000	U
transport, freight train, electricity	CN; GLO	1999-2004	U
transport, freight train, steam	CN; GLO	1999-2004	U
transport, passenger, electric bicycle	CH; GLO	2005-2009	U
transport, passenger, electric bicycle, label-certified electricity	CH; GLO	2005-2009	U

12.4 Plastics

In this section specific data corrections for plastic related datasets are reported.

The electricity consumption for the datasets for plastics granulate production have been revised. The data provider has introduced the correction following discussions with extruder manufacturers, plastic extrusion experts and plastic recyclers. The comment for the exchange amount has been updated to reflect the new calculation.

The dataset for purified terephthalic acid production was corrected to include missing emissions. The missing emission are: Acetic acid; Methane, bromo-, Halon 1001; Methyl formate; Particulates, > 10 um; Particulates, < 2.5 um. All emissions are to the compartment "air", sub-compartment "unspecified".

Table 69. Data corrections for plastics products. *If several geographies of the same activity with the same time period exist, all of them are listed in the "Geography" column. . In the column v.3.7 "U" stands for "Updated Activity";*

Activity name	Geography	Time period	Product name	Unit	v3.7
plastic granulate production, unspecified, recycled, formal sector	GLO; IN	2017-2017	plastic granulate, unspecified, recycled	kg	U
plastic granulate production, unspecified, recycled, informal sector	GLO; IN	2017-2017	plastic granulate, unspecified, recycled	kg	U
purified terephthalic acid production	GLO; RER	2011-2017	purified terephthalic acid	kg	U

12.5 Textiles: silk

The modelling of silk has been identified to be incorrect in 3.6. Lower quality silk by-products, such as the short fibre of silk, find application in the textile production. In 3.7, the supply chain of silk has been expanded and now meets in parallel man-made fibres of viscose that in theory can substitute each other. The modification ensures a consistent application of the consequential system model in the silk supply chain.

Table 70: New and updated activities and products related to silk supply chain. *In the column v.3.7, "N" stands for "New Activity", "U" stands for "Updated Activity". All product's units are kg: the product "silky fibre" is also new to the database.*

Activity Name	Geography	Time period	Reference product	v3.7
fibre, silk, short to generic market for silky fibres	GLO	2020-2020	silky fibre	N
fibre, viscose to generic market for silky fibres	GLO	2020-2020	silky fibre	N
market for silky fibre	GLO	2011-2011	silky fibre	N
market for fibre, silk, short	GLO	2010-2018	fibre, silk, short	U

12.6 Water supply

Some activities were using an input of "charcoal" as a proxy for activated carbon. This input has been replaced by the product "activated carbon, granular". The waste output was also changed from "waste wood, untreated" to "spent activated carbon, granular". The activities for which these replacements were made are listed in Table 71.

Table 71: Activities in which "charcoal" has been replaced by "activated carbon, granular".

Activity name	Geography	Time period	v3.7
tap water production, conventional treatment	CA-QC; CH; Europe without Switzerland; GLO	2012-2012	U
tap water production, conventional with biological treatment	CA-QC; CH; Europe without Switzerland; GLO	2012-2012	U
tap water production, conventional with biological treatment	CO	2012-2017	U

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Annex 1: products with updated prices

2-methyl-2-butanol; 2-pyridinol; 3-methyl-1-butyl acetate; absorption chiller, 100kW; acetamide-anillide-compound, unspecified; aclonifen; agricultural machinery, unspecified; air compressor, screw-type compressor, 300kW; air compressor, screw-type compressor, 4kW; air distribution terminal panel, steel, 120 m3/h; air filter, central unit, 600 m3/h; air filter, in exhaust air valve; air input/output unit, heat and power co-generation unit, 160kW electrical; aircraft, belly freight, long haul; aircraft, belly freight, medium haul; aircraft, belly freight, short haul; aircraft, belly freight, very short haul; aircraft, dedicated freight, long haul; aircraft, dedicated freight, medium haul; aircraft, dedicated freight, short haul; aircraft, dedicated freight, very short haul; aircraft, passenger, long haul; aircraft, passenger, medium haul; aircraft, passenger, short haul; aircraft, passenger, very short haul; airport; alkyl sulphate (C12-14); alpha-picoline; aluminium alloy, metal matrix composite; aluminium melting furnace; aluminium removed by drilling, computer numerical controlled; aluminium removed by drilling, conventional; aluminium removed by milling, average; aluminium removed by milling, dressing; aluminium removed by milling, large parts; aluminium removed by milling, small parts; aluminium removed by turning, average, computer numerical controlled; aluminium removed by turning, average, conventional; aluminium removed by turning, primarily dressing, computer numerical controlled; aluminium removed by turning, primarily dressing, conventional; aluminium removed by turning, primarily roughing, computer numerical controlled; aluminium removed by turning, primarily roughing, conventional; amine oxide; ammonia, anhydrous, liquid; ammonium nitrite; ammonium thiocyanate; anhydrite; anhydrite floor; anode slime from electrorefining of copper, anode; anodising, aluminium sheet; application of plant protection product, by field sprayer; ascorbic acid; asparagus seedling, for planting; assembly of liquid crystal display, auxilliaries and energy use; atrazine; auxiliary heating unit, electric, 5kW; azodicarbonamide; bale loading; baling; barium hydroxide; barley grain, feed; barley grain, feed, organic; barley grain, feed, Swiss integrated production; barley seed, for sowing; barley seed, organic, for sowing; barley seed, Swiss integrated production, for sowing; batch dyeing, fibre, cotton; beet seed, Swiss integrated production, for sowing; bentonite quarry infrastructure; benzimidazole-compound; biomethane, high pressure, vehicle grade; biomethane, medium pressure, vehicle grade; bisphenol A epoxy based vinyl ester resin; bitumen adhesive compound, cold; bitumen seal, Alu80; bitumen seal, V60; blast furnace; blast oxygen furnace converter; bleaching and dyeing, yarn; bleaching, textile; blower and heat exchange unit, Avent E 97; blower and heat exchange unit, central, 600-1200 m3/h; blower and heat exchange unit, decentralized, 180-250 m3/h; blower and heat exchange unit, GE 250 RH; blower and heat exchange unit, KWL 250; blower and heat exchange unit, KWLC 1200; blower and heat exchange unit, Storkair G 90; boric acid, anhydrous, powder; boric oxide; boron trifluoride; brass; brass removed by drilling, computer numerical controlled; brass removed by drilling, conventional; brass removed by turning, average, computer numerical controlled; brass removed by turning, average, conventional; brass removed by turning, primarily dressing, computer numerical controlled; brass removed by turning, primarily dressing, conventional; brass removed by turning, primarily roughing, computer numerical controlled; brass removed by turning, primarily roughing, conventional; brick production facility; bronze; bronze scrap, post-consumer; building operation, budget hotel; building operation, hostel; building operation, luxury hotel; building operation, upmarket hotel; building, budget hotel; building, hall; building, hall, steel construction; building, hall, wood construction; building, hostel; building, luxury hotel; building, multi-storey; building, upmarket hotel; bulk carrier, for dry goods; butane-1,4-diol; cable yarder with sled winch; cable yarding; cable, data cable in infrastructure; cable, printer cable, without plugs; cable, ribbon cable, 20-pin, with plugs; cable, three-conductor cable; cadmium; cadmium chloride, semiconductor-grade; cadmium sludge from zinc electrolysis; cadmium sludge from zinc electrolysis stockpiling; cadmium sulfide, semiconductor-grade; cadmium telluride, semiconductor-grade; cadmium, semiconductor-grade; calendering, rigid sheets; capacitor, electrolyte type, < 2cm height; capacitor, electrolyte type, > 2cm height; capacitor, film type, for through-hole mounting; capacitor, for surface-mounting; capacitor, tantalum-, for through-hole mounting; carrot seed, for sowing; carrot seed, Swiss integrated production, at farm; cast iron removed by drilling, computer numerical controlled; cast iron removed by drilling, conventional; cast iron removed by milling, average; cast iron removed by milling, dressing; cast iron removed by milling, large parts; cast iron removed by milling, small parts; cast iron removed by turning, average, computer numerical controlled; cast iron removed by turning, average, conventional; cast iron removed by turning, primarily dressing, computer numerical controlled; cast iron removed by turning, primarily dressing, conventional; cast iron removed by turning, primarily roughing, computer numerical controlled; cast iron removed by turning, primarily roughing, conventional; casting, aluminium, lost-wax; casting, steel, lost-wax; cathode-ray tube, cathode ray tube display; cement, unspecified; ceramic factory; chemical factory; chemical, inorganic; chimney; chipper, mobile, diesel; chipper, stationary, electric; chlorine dioxide; chloronitrobenzene; chlorosulfonic acid; chlorothalonil; chlorotoluron; chopping, maize; chromium steel removed by drilling, computer numerical controlled; chromium steel removed by drilling, conventional; chromium steel removed by milling, average; chromium steel removed by milling, dressing; chromium steel removed by milling, large parts; chromium steel removed by milling, small parts; chromium steel removed by turning, average, computer numerical controlled; chromium steel removed by turning, average, conventional; chromium steel removed by turning, primarily dressing, computer numerical controlled; chromium steel removed by turning, primarily dressing, conventional; chromium steel removed by turning, primarily roughing, computer numerical controlled; chromium steel removed by turning, primarily roughing, conventional; clay pit infrastructure; clover seed, Swiss integrated production, at farm; clover seed, Swiss integrated production, for sowing; cobalt; cobwork; cocamide diethanolamine; combine harvesting; compressed air, 1000 kPa gauge; compressed air, 1200 kPa gauge;

compressed air, 600 kPa gauge; compressed air, 700 kPa gauge; compressed air, 800 kPa gauge; concrete mixing factory; concrete, medium strength; concrete, normal; container ship; continuous dyeing, fibre, cotton; contouring, brass; contouring, bronze; conveyor belt; cooling energy; copper cake; copper concentrate, sulfide ore; copper telluride cement; copper, cathode; cottonseed, for sowing; cottonseed, organic, for sowing; crust from Parkes process for lead production; cyclic N-compound; dairy; deep drawing, steel, 10000 kN press, automode; deep drawing, steel, 10000 kN press, single stroke; deep drawing, steel, 3500 kN press, automode; deep drawing, steel, 3500 kN press, single stroke; deep drawing, steel, 38000 kN press, automode; deep drawing, steel, 38000 kN press, single stroke; deep drawing, steel, 650 kN press, automode; deep drawing, steel, 650 kN press, single stroke; deep well, for geothermal power, onshore, 6000m; degreasing, metal part in alkaline bath; delimbing/sorting, excavator-based processor; diazine-compound; diazole-compound; dicyclopentadiene based unsaturated polyester resin; diesel; diesel, burned in agricultural machinery; diesel, burned in diesel-electric generating set, 18.5kW; diesel, low-sulfur; diesel-electric generating set, 10MW; dimethenamide; dimethyl sulfate; dinitroaniline-compound; diode, auxilliaries and energy use; dipropyl amine; disk drive, CD/DVD, ROM, for desktop computer; drawing of pipe, steel; dried roughage store, air dried, solar; dried roughage store, cold-air dried, conventional; dried roughage store, non ventilated; drying of bread grain, seed and legumes; drying of feed grain; drying of grass; drying of maize grain; drying of maize straw and whole-plant; drying, natural gas; dust collector, electrostatic precipitator, for domestic use; dust collector, electrostatic precipitator, for industrial use; dust collector, multicyclone; electric connector, peripheral component interconnect buss; electric connector, peripheral type buss; electric connector, wire clamp; electric parts, heat and power co-generation unit, 160kW electrical; electric scooter, without battery; electricity, high voltage; electricity, low voltage; electricity, medium voltage; electrode, negative, LiC6; electrode, negative, Ni; electrode, positive, LaNi5; electronic component machinery, unspecified; electronic component, active, unspecified; electronic component, passive, unspecified; electronics, for control units; electrostatic paint; enamelling; energy and auxilliary inputs, metal working factory; energy and auxilliary inputs, metal working machine; energy saving; energy wood harvester; establishing orchard; ethoxylated alcohol (AE3); ethoxylated alcohol (AE7); ethylamine; exhaust air outlet, steel/aluminium, 85x365 mm; exhaust air roof hood, steel, DN 400; exhaust air valve, in-wall housing, plastic/steel, DN 125; explosives factory; extrusion of plastic sheets and thermoforming, inline; extrusion, co-extrusion; extrusion, plastic film; fan, for power supply unit, desktop computer; fava bean seed, for sowing; fava bean seed, organic, for sowing; ferronickel; ferry; fertilising, by broadcaster; fertilising, by rig fertiliser, sugarcane; fertilising, by stool splitter, sugarcane; fibre, viscose; field leveling, sugarcane; finishing, textile, knit cotton; finishing, textile, woven cotton; fish canning plant; fish canning, large fish; fish canning, small fish; fish curing plant; fish curing, small fish; fish freezing plant; fish freezing, small fish; fishmeal plant; flat glass factory; floating collar cage; floating hexagonal metal cage; foam glass factory; fodder beet seed, for sowing; fodder loading, by self-loading trailer; forestry harvester; formaldehyde; forwarder; forwarding, forwarder; frit, for ceramic tile; fruit tree seedling, for planting; fuel cell, polymer electrolyte membrane, 2kW electrical, future; fuel cell, solid oxide, 125kW electrical, future; fuel cell, solid oxide, with micro gas turbine, 180kW electrical, future; fuel cell, stack polymer electrolyte membrane, 2kW electrical, future; fuel cell, stack solid oxide, 125kW electrical, future; furrow covering, sugarcane; furrowing, sugarcane; gallium, semiconductor-grade; garage, wood, non-insulated, fire-protected; gas power plant, 300MW electrical; gas power plant, combined cycle, 400MW electrical; gas turbine, 10MW electrical; generator, 200kW electrical; geothermal power plant, 5.5MWel; geothermal power plant, Hot-Dry-Rock; geothermal power plant, undefined type; glass etching factory; glass tube factory; glazing, double, U<1.1 W/m2K; glazing, double, U<1.1 W/m2K, laminated safety glass; glazing, triple, U<0.5 W/m2K; gold; gold, unrefined; gold-silver, ingot; goods wagon; grass seed, organic, for sowing; grass seed, Swiss integrated production, at farm; grass seed, Swiss integrated production, for sowing; gravel/sand quarry infrastructure; green manure, organic, until April; green manure, organic, until February; green manure, organic, until January; green manure, organic, until March; green manure, Swiss integrated production, until April; green manure, Swiss integrated production, until February; green manure, Swiss integrated production, until January; green manure, Swiss integrated production, until March; greenhouse, glass walls and roof; greenhouse, plastic walls and roof; hard chromium coat, electroplating, steel substrate, 0.14 mm thickness; hard coal power plant; hard coal preparation plant; harvesting, by complete harvester, beets; harvesting, by complete harvester, ground crops; harvesting, forestry harvester; harvesting, sugarcane; harvesting/bundling, energy wood harvester; hay; hay, organic, intensive; hay, Swiss integrated production, extensive; hay, Swiss integrated production, intensive; haying, by rotary tedder; heat and power co-generation unit, 160kW electrical, common components for heat+electricity; heat and power co-generation unit, 160kW electrical, components for electricity only; heat and power co-generation unit, 160kW electrical, components for heat only; heat and power co-generation unit, 1MW electrical, common components for heat+electricity; heat and power co-generation unit, 1MW electrical, components for electricity only; heat and power co-generation unit, 1MW electrical, components for heat only; heat and power co-generation unit, 1MWel, 6.4MWth; heat and power co-generation unit, 200kW electrical, common components for heat+electricity; heat and power co-generation unit, 200kW electrical, components for electricity only; heat and power co-generation unit, 200kW electrical, components for heat only; heat and power co-generation unit, 200kW electrical, diesel SCR, common components for heat+electricity; heat and power co-generation unit, 200kW electrical, diesel SCR, components for electricity only; heat and power co-generation unit, 200kW electrical, diesel SCR, components for heat only; heat and power co-generation unit, 500kW electrical, common components for heat+electricity; heat and power co-generation unit, 500kW electrical, components for electricity only; heat and power co-generation unit, 500kW electrical, components for heat only; heat and power co-generation unit, 50kW electrical, common components for heat+electricity; heat and power co-generation unit, 50kW electrical, components for electricity only; heat and

power co-generation unit, 50kW electrical, components for heat only; heat and power co-generation unit, 6400kW thermal, components for electricity only; heat and power co-generation unit, organic Rankine cycle, 1400kW thermal, components for electricity only; heat and power co-generation unit, organic Rankine cycle, 1MWe, 6.4 MWth; heat and power co-generation unit, organic Rankine cycle, 3MW electrical; heat transport fluid system, solar thermal parabolic trough, 50 MW; heat, central or small-scale, natural gas; heat, central or small-scale, other than natural gas; heat, district or industrial, natural gas; heat, district or industrial, other than natural gas; heat, solar+electric, multiple-dwelling, for hot water; heat, solar+gas, multiple-dwelling, for hot water; heat, solar+gas, one-family house, for combined system; heat, solar+gas, one-family house, for hot water; heat, solar+wood, one-family house, for combined system; heavy fuel oil; helium, crude stockpiling; hoeing; horticultural fleece; hot water tank factory; hot water tank, 600l; housing system, cattle, loose, per animal unit; housing system, cattle, tied, per animal unit; housing system, pig, fully-slatted floor, per pig place; housing system, pig, label-certified, per pig place; hydroxylamine; imidazole; impact extrusion of aluminium, 1 stroke; impact extrusion of aluminium, 2 strokes; impact extrusion of aluminium, 3 strokes; impact extrusion of aluminium, 4 strokes; impact extrusion of aluminium, 5 strokes; impact extrusion of steel, cold, 1 strokes; impact extrusion of steel, cold, 2 strokes; impact extrusion of steel, cold, 3 strokes; impact extrusion of steel, cold, 4 strokes; impact extrusion of steel, cold, 5 strokes; impact extrusion of steel, hot, 1 strokes; impact extrusion of steel, hot, 2 strokes; impact extrusion of steel, hot, 3 strokes; impact extrusion of steel, hot, 4 strokes; impact extrusion of steel, hot, 5 strokes; impact extrusion of steel, warm, 1 strokes; impact extrusion of steel, warm, 2 strokes; impact extrusion of steel, warm, 3 strokes; impact extrusion of steel, warm, 4 strokes; impact extrusion of steel, warm, 5 strokes; indium tin oxide powder, nanoscale, for sputtering target; inductor, low value multilayer chip; inductor, miniature radio frequency chip; inductor, ring core choke type; industrial furnace, coal, 1-10MW; industrial machine, heavy, unspecified; inert material landfill; infrastructure, for regional distribution of oil product; injection moulding; insulation spiral-seam duct, rockwool, DN 400, 30 mm; integrated circuit, logic type; integrated circuit, memory type; intermodal shipping container, 20-foot; intermodal shipping container, 40-foot; intermodal shipping container, 40-foot, high-cube; intermodal shipping container, 45-foot, high-cube; internet access equipment; intral; inverter, 0.5kW; inverter, 2.5kW; iron pellet; iron sinter; irrigation; isophthalic acid based unsaturated polyester resin; isopropyl acetate; isopropylamine; isoproturon; jatropha seed; joist, engineered wood; kenaf plant, harvested; keyboard; lead; lead concentrate stockpiling; light emitting diode; light fuel oil; lightweight concrete block, expanded clay; lightweight concrete block, expanded perlite; lime, packed; limestone and gypsum application, by spreader; limestone quarry infrastructure; limestone, crushed, for mill; linseed seed, at farm; linseed seed, for sowing; liquefied petroleum gas; liquid crystal display, unmounted; liquid manure spreading, by vacuum tanker; liquid manure storage and processing facility; lithium brine, 6.7 % Li; lithium hexafluorophosphate; lithium manganese oxide; long liner maintenance, steel; long liner, steel; lorry with refrigeration machine, carbon dioxide, liquid as refrigerant, 16 metric ton; lorry with refrigeration machine, R134a as refrigerant, 16 metric ton; machine, for treatment of waste electric and electronic equipment; magnesium factory; magnesium-alloy, AZ91; magnesium-alloy, AZ91, diecast; maintenance, bicycle; maintenance, electric bicycle; maintenance, electric scooter, without battery; maintenance, heat and power co-generation unit, 160kW electrical; maintenance, intermodal shipping container, 20-foot; maintenance, intermodal shipping container, 40-foot; maintenance, intermodal shipping container, 40-foot, high-cube; maintenance, intermodal shipping container, 45-foot, high-cube; maintenance, light commercial vehicle; maintenance, locomotive; maintenance, lorry 16 metric ton; maintenance, lorry 28 metric ton; maintenance, lorry 40 metric ton; maintenance, micro gas turbine, 100kW electrical; maintenance, mini CHP plant; maintenance, motor scooter; maintenance, passenger car, electric, without battery; maintenance, polymer electrolyte membrane fuel cell, 2kW electrical; maintenance, reefer, intermodal shipping container, 40-foot, high-cube; maintenance, solid oxide fuel cell, 125kW electrical, future; maintenance, solid oxide fuel cell, with micro gas turbine, 180kW electrical, future; maintenance, stirling heat and power co-generation unit, 3kW electrical, wood pellet, future; maintenance, train, passenger, high-speed; maintenance, train, passenger, long distance; maintenance, train, passenger, regional; maize grain, feed, organic; maize grain, feed, Swiss integrated production; maize seed, at farm; maize seed, for sowing; maize seed, organic, at farm; maize seed, organic, for sowing; maize seed, Swiss integrated production, at farm; maize seed, Swiss integrated production, for sowing; maleic anhydride; maleic unsaturated polyester resin; malusil; mancozeb; manual dismantling of electric scooter; manual dismantling of used electric passenger car; manual dismantling of used passenger car with internal combustion engine; manual treatment facility, waste electric and electronic equipment; marine electric motor; marine engine; mechanical treatment facility, waste electric and electronic equipment; mercerizing, textile; metal coating facility; metal part of electronics scrap, in copper, anode; metal working factory; metal working, average for aluminium product manufacturing; metal working, average for chromium steel product manufacturing; metal working, average for copper product manufacturing; metal working, average for metal product manufacturing; metal working, average for steel product manufacturing; metallization paste, back side; metallization paste, back side, aluminium; metallization paste, front side; metamitron; methane sulfonic acid; methanol factory; methyl iodide; methylamine; metolachlor; micro gas turbine, 100kW electrical; milking; milking parlour; mine infrastructure, bauxite; mine infrastructure, gold; mine infrastructure, gold and silver; mine infrastructure, gold-silver-zinc-lead-copper; mine infrastructure, iron; mine infrastructure, open cast, hard coal; mine infrastructure, open cast, ilmenite from hard-rock ore; mine infrastructure, open cast, non-ferrous metal; mine infrastructure, open cast, uranium; mine infrastructure, phosphate rock; mine infrastructure, steatite; mine infrastructure, treatment of sulfidic tailing, off-site, high gold content; mine infrastructure, underground, hard coal; mine infrastructure, underground, non-ferrous metal; mine infrastructure, underground, uranium; mine infrastructure, vermiculite; mineral supplement, for beef cattle; mini CHP plant, common components for heat+electricity; mint

seedling, for planting; mischmetal; mobile cable yarder, trailer-mounted; mobile cable yarder, truck-mounted, incl. processor; molybdenite; molybdenum; molybdenum trioxide; mounting, through-hole technology, Pb-free solder; mowing, by motor mower; mowing, by rotary mower; mulching; multi-Si wafer; multi-Si wafer, ribbon; municipal waste collection service by 21 metric ton lorry; naphthalene sulfonic acid; napropamide; natural gas, high pressure; nickel concentrate, 16% Ni; nickel sulfate; nickel, class 1; nitric acid, without water, in 50% solution state; nitrous dioxide; nitrous oxide; N-methyl-2-pyrrolidone; non-Fe-Co-metals, from Li-ion battery, hydrometallurgical processing; non-Fe-Co-metals, from used Li-ion battery, pyrometallurgical processing; non-ferrous metal smelter; non-ionic surfactant; NOx retained, by selective catalytic reduction; nuclear power plant, boiling water reactor 1000MW; nuclear power plant, pressure water reactor 1000MW; nuclear power plant, pressure water reactor, 650MW; nuclear spent fuel reprocessing facility; nuclear waste storage, final repository for high level radioactive waste; o-aminophenol; oat grain, feed; oat seed, for sowing; oat seed, Swiss integrated production, at farm; offshore platform, natural gas; offshore well, oil/gas; oil mill; onion seedling, for planting; o-nitrophenol; onshore well, oil/gas; operation, computer, desktop, home use; operation, computer, desktop, office use; operation, computer, desktop, with cathode ray tube display, active mode; operation, computer, desktop, with cathode ray tube display, off mode; operation, computer, desktop, with cathode ray tube display, standby mode; operation, computer, desktop, with liquid crystal display, active mode; operation, computer, desktop, with liquid crystal display, off mode; operation, computer, desktop, with liquid crystal display, standby mode; operation, computer, laptop, 68% active work with internet access 0.2 Mbit/s; operation, computer, laptop, 68% active work with internet access 0.2 Mbit/s, label-certified electricity; operation, computer, laptop, videoconference; operation, computer, laptop, videoconference, label-certified electricity; operation, dried roughage store, air dried, solar; operation, dried roughage store, cold-air dried, conventional; operation, dried roughage store, non ventilated; operation, housing system, cattle, loose, per animal unit; operation, housing system, cattle, tied, per animal unit; operation, housing system, pig, fully-slatted floor, per pig place; operation, housing system, pig, label-certified, per pig place; operation, intermodal shipping container; operation, internet access equipment; operation, internet access equipment, label-certified electricity; operation, liquid manure storage and processing facility; operation, reefer, cooling; operation, reefer, freezing; orthophthalic acid based unsaturated polyester resin; packaging glass, brown; packaging glass, green; packaging glass, white; packaging, for fertilisers; packaging, for fertilisers or pesticides; packaging, for pesticides; packing, fibre cement product; packing, lime product; passenger car maintenance; passenger car, electric, without battery; pea seed, for sowing; pea seed, organic, for sowing; peanut seed, at farm; peanut seed, for sowing; pendimethalin; permanent magnet, for electric motor; petrol, unleaded; petroleum refinery; phenoxy-compound; phosphane; phosphorous chloride; phosphorus oxychloride; phosphorus pentachloride; phosphorus trichloride; phosphorus, white, liquid; phosphoryl chloride; photovoltaic cell, multi-Si wafer; photovoltaic cell, single-Si wafer; photovoltaic facade installation, 3kWp, multi-Si, laminated, integrated, at building; photovoltaic facade installation, 3kWp, multi-Si, panel, mounted, at building; photovoltaic facade installation, 3kWp, single-Si, laminated, integrated, at building; photovoltaic facade installation, 3kWp, single-Si, panel, mounted, at building; photovoltaic flat-roof installation, 3kWp, multi-Si, on roof; photovoltaic flat-roof installation, 3kWp, single-Si, on roof; photovoltaic laminate, ribbon-Si; photovoltaic module, building-integrated, for slanted-roof installation; photovoltaic mounting system, for 570kWp open ground module; photovoltaic mounting system, for facade installation; photovoltaic mounting system, for flat-roof installation; photovoltaic mounting system, for slanted-roof installation; photovoltaic panel factory; photovoltaic panel, a-Si; photovoltaic plant, 570kWp, multi-Si, on open ground; photovoltaic plant, electric installation for 3kWp module; photovoltaic plant, electric installation for 570kWp open ground module; photovoltaic slanted-roof installation, 3kWp, a-Si, laminated, integrated, on roof; photovoltaic slanted-roof installation, 3kWp, a-Si, panel, mounted, on roof; photovoltaic slanted-roof installation, 3kWp, CdTe, laminated, integrated, on roof; photovoltaic slanted-roof installation, 3kWp, CIS, panel, mounted, on roof; photovoltaic slanted-roof installation, 3kWp, multi-Si, laminated, integrated, on roof; photovoltaic slanted-roof installation, 3kWp, multi-Si, panel, mounted, on roof; photovoltaic slanted-roof installation, 3kWp, ribbon-Si, laminated, integrated, on roof; photovoltaic slanted-roof installation, 3kWp, ribbon-Si, panel, mounted, on roof; photovoltaic slanted-roof installation, 3kWp, single-Si, laminated, integrated, on roof; photovoltaic slanted-roof installation, 3kWp, single-Si, panel, mounted, on roof; phthalimide; phthalimide-compound; pipeline, natural gas, high pressure distribution network; planning, cogen unit mini CHP plant; planting; planting tree; planting with starter fertiliser, by no till planter; planting, sugarcane; plaster mixing; plastic processing factory; plastic tunnel; platinum; plug, inlet and outlet, for computer cable; plug, inlet and outlet, for network cable; p-nitrophenol; p-nitrotoluene; pointing device, optical mouse, with cable; polarizer, liquid crystals and colour filters, for liquid crystal display; polyacrylamide; polyethylene, low density, granulate; polyphenylene sulfide; port facilities; portafer; potassium perchlorate; potato grading; potato haulm cutting; potato planting; potato seed, at farm; potato seed, for setting; potato seed, organic, at farm; potato seed, organic, for setting; potato seed, Swiss integrated production, at farm; potato seed, Swiss integrated production, for setting; power saw, with catalytic converter; power saw, without catalytic converter; power sawing, with catalytic converter; power sawing, without catalytic converter; power supply unit, for desktop computer; precious metal from electronics scrap, in anode slime; precious metal refinery; printed paper; printed wiring board mounting facility, surface mounting line; printed wiring board mounting facility, through-hole mounting line; printed wiring board, for power supply unit, desktop computer, Pb containing; printed wiring board, for power supply unit, desktop computer, Pb free; printed wiring board, for surface mounting, Pb containing surface; printed wiring board, for surface mounting, Pb free surface; printed wiring board, for through-hole mounting, Pb containing surface; printed wiring board, for through-hole mounting, Pb free surface; printed wiring board, mounted mainboard, desktop computer, Pb containing; printed wiring board, mounted mainboard, desktop computer, Pb free;

printed wiring board, mounted mainboard, laptop computer, Pb containing; printed wiring board, mounted mainboard, laptop computer, Pb free; printed wiring board, surface mounted, unspecified, Pb containing; printed wiring board, surface mounted, unspecified, Pb free; printed wiring board, through-hole mounted, unspecified, Pb containing; printed wiring board, through-hole mounted, unspecified, Pb free; process-specific burdens, hazardous waste incineration plant; process-specific burdens, import of copper to Switzerland; process-specific burdens, municipal waste incineration; propanal; propyl amine; prosulfocarb; protein pea, feed, Swiss integrated production; purse seiner maintenance, steel; purse seiner maintenance, wood; purse seiner, steel; purse seiner, wood; pyrethroid-compound; pyridine-compound; railway track; railway track, for high-speed train; rape seed; rape seed, for sowing; rape seed, organic; rape seed, organic, for sowing; rape seed, Swiss integrated production; reefer, intermodal shipping container, 40-foot, high-cube, carbon dioxide, liquid as refrigerant; reefer, intermodal shipping container, 40-foot, high-cube, R134a as refrigerant; residual material landfill; resistor, metal film type, through-hole mounting; resistor, surface-mounted; resistor, wirewound, through-hole mounting; rice seed, for sowing; road; road maintenance; road vehicle factory; rock crushing; room-connecting overflow element, steel, approx. 40 m3/h; rosin size, for paper production; rye grain, feed, organic; rye grain, feed, Swiss integrated production; rye seed, for sowing; rye seed, organic, for sowing; rye seed, Swiss integrated production, for sowing; salt; sanitary landfill facility; sawmill; seal, natural rubber based; seawater reverse osmosis module; section bar rolling, steel; selective coat, aluminium sheet, nickel pigmented aluminium oxide; selective coat, copper sheet, black chrome; selective coat, copper sheet, black majic; selective coat, copper sheet, physical vapour deposition; selective coat, copper sheet, sputter deposition; selective coat, stainless steel sheet, black chrome; selenium; shed; shed, large, wood, non-insulated, fire-unprotected; sheet rolling, aluminium; sheet rolling, chromium steel; sheet rolling, copper; sheet rolling, steel; silencer, steel, DN 125; silencer, steel, DN 315, 50 mm; silicon, single crystal, Czochralski process, electronics; silicon, single crystal, Czochralski process, photovoltaics; silver; silver, unrefined; single-Si wafer, for electronics; single-Si wafer, photovoltaic; skidder; skidding, skidder; slag landfill; sodium amide; sodium borates; sodium metasilicate pentahydrate, 58% active substance, powder; sodium perborate, monohydrate, powder; sodium perborate, tetrahydrate, powder; sodium percarbonate, powder; sodium persulfate; soft solder, Sn97Cu3; solar collector factory; solar collector system, Cu flat plate collector, multiple dwelling, hot water; solar collector system, with evacuated tube collector, one-family house, combined system; solder factory; solder, bar, Sn95.5Ag3.9Cu0.6, for electronics industry; solder, paste, Sn95.5Ag3.9Cu0.6, for electronics industry; solid manure loading and spreading, by hydraulic loader and spreader; sorting facility, for construction waste; sour gas, burned in gas turbine; sowing; SOx retained, in hard coal flue gas desulfurisation; soybean seed, for sowing; soybean seed, organic, for sowing; spiral-seam duct, steel, DN 125; spiral-seam duct, steel, DN 400; sputtering target, sintered, indium tin oxide; sputtering, indium tin oxide, for liquid crystal display; start-up, heat and power co-generation unit, 160kW electrical; steam generation system, solar tower power plant, 20 MW; steam, in chemical industry; steel removed by drilling, computer numerical controlled; steel removed by drilling, conventional; steel removed by milling, average; steel removed by milling, dressing; steel removed by milling, large parts; steel removed by milling, small parts; steel removed by turning, average, computer numerical controlled; steel removed by turning, average, conventional; steel removed by turning, primarily dressing, computer numerical controlled; steel removed by turning, primarily dressing, conventional; steel removed by turning, primarily roughing, computer numerical controlled; steel removed by turning, primarily roughing, conventional; stirling heat and power co-generation unit, 3kW electrical, future; stone wool factory; stone wool, packed; storage building, chemicals, solid; storage, 10'000 l; strawberry seedling, for planting; sugar beet seed, for sowing; sugarcane loading, by loader; sugarcane transfer, by dump cart; sugarcane vinasse application, by wheel reel irrigation; sulfamic acid; sulfidic tailing, off-site, high gold content; sulfur trioxide; sulfuric acid; sunflower seed; sunflower seed, for sowing; sunflower seed, Swiss integrated production; supply air inlet, steel/SS, DN 75; swath, by rotary windrower; sweet gas, burned in gas turbine; sweetening, natural gas; switch, toggle type; tanker, for liquefied natural gas; tanker, for liquid goods other than petroleum and liquefied natural gas; tanker, for petroleum; tap water; tellurium, semiconductor-grade; terrain chipper on forwarder; tert-butyl amine; thermal plaster, outdoor; thermoforming of plastic sheets; thermoforming, with calendering; tillage, cultivating, chiselling; tillage, currying, by weeder; tillage, harrowing, by offset disk harrow; tillage, harrowing, by offset leveling disc harrow; tillage, harrowing, by rotary harrow; tillage, harrowing, by spring tine harrow; tillage, hoeing and earthing-up, potatoes; tillage, ploughing; tillage, rolling; tillage, rotary cultivator; tillage, subsoiling, by subsoiler plow; tin plated chromium steel sheet, 2 mm; tin plating, pieces; tomato seedling, for planting; train, passenger, high speed; train, passenger, long-distance; tram track; transistor, surface-mounted; transistor, wired, big size, through-hole mounting; transistor, wired, small size, through-hole mounting; transmission network, long-distance; transport, freight train; transport, freight, aircraft with reefer, cooling; transport, freight, aircraft with reefer, freezing; transport, freight, aircraft, long haul; transport, freight, aircraft, medium haul; transport, freight, aircraft, short haul; transport, freight, aircraft, unspecified; transport, freight, aircraft, very short haul; transport, freight, conveyor belt; transport, freight, inland waterways, barge; transport, freight, inland waterways, barge tanker; transport, freight, inland waterways, barge with reefer, cooling; transport, freight, inland waterways, barge with reefer, freezing; transport, freight, light commercial vehicle; transport, freight, light commercial vehicle, EURO1; transport, freight, light commercial vehicle, EURO2; transport, freight, light commercial vehicle, unregulated; transport, freight, lorry >32 metric ton, EURO1; transport, freight, lorry >32 metric ton, EURO2; transport, freight, lorry >32 metric ton, EURO3; transport, freight, lorry >32 metric ton, EURO4; transport, freight, lorry >32 metric ton, EURO5; transport, freight, lorry >32 metric ton, EURO6; transport, freight, lorry >32 metric ton, unregulated; transport, freight, lorry 16-32 metric ton, EURO1; transport, freight, lorry 16-32 metric ton, EURO2; transport, freight, lorry 16-32 metric ton, EURO3; transport, freight, lorry 16-32 metric ton, EURO4; transport, freight, lorry 16-32 metric ton,

EURO5; transport, freight, lorry 16-32 metric ton, EURO6; transport, freight, lorry 16-32 metric ton, unregulated; transport, freight, lorry 28 metric ton, vegetable oil methyl ester 100%; transport, freight, lorry 3.5-7.5 metric ton, EURO1; transport, freight, lorry 3.5-7.5 metric ton, EURO2; transport, freight, lorry 3.5-7.5 metric ton, EURO3; transport, freight, lorry 3.5-7.5 metric ton, EURO4; transport, freight, lorry 3.5-7.5 metric ton, EURO5; transport, freight, lorry 3.5-7.5 metric ton, EURO6; transport, freight, lorry 3.5-7.5 metric ton, unregulated; transport, freight, lorry 7.5-16 metric ton, EURO1; transport, freight, lorry 7.5-16 metric ton, EURO2; transport, freight, lorry 7.5-16 metric ton, EURO3; transport, freight, lorry 7.5-16 metric ton, EURO4; transport, freight, lorry 7.5-16 metric ton, EURO5; transport, freight, lorry 7.5-16 metric ton, EURO6; transport, freight, lorry 7.5-16 metric ton, unregulated; transport, freight, lorry with reefer, cooling; transport, freight, lorry with reefer, freezing; transport, freight, lorry with refrigeration machine, 3.5-7.5 ton, EURO3, carbon dioxide, liquid refrigerant, cooling; transport, freight, lorry with refrigeration machine, 3.5-7.5 ton, EURO3, carbon dioxide, liquid refrigerant, freezing; transport, freight, lorry with refrigeration machine, 3.5-7.5 ton, EURO3, R134a refrigerant, cooling; transport, freight, lorry with refrigeration machine, 3.5-7.5 ton, EURO3, R134a refrigerant, freezing; transport, freight, lorry with refrigeration machine, 3.5-7.5 ton, EURO4, carbon dioxide, liquid refrigerant, cooling; transport, freight, lorry with refrigeration machine, 3.5-7.5 ton, EURO4, carbon dioxide, liquid refrigerant, freezing; transport, freight, lorry with refrigeration machine, 3.5-7.5 ton, EURO4, R134a refrigerant, cooling; transport, freight, lorry with refrigeration machine, 3.5-7.5 ton, EURO4, R134a refrigerant, freezing; transport, freight, lorry with refrigeration machine, 3.5-7.5 ton, EURO5, carbon dioxide, liquid refrigerant, cooling; transport, freight, lorry with refrigeration machine, 3.5-7.5 ton, EURO5, carbon dioxide, liquid refrigerant, freezing; transport, freight, lorry with refrigeration machine, 3.5-7.5 ton, EURO5, R134a refrigerant, cooling; transport, freight, lorry with refrigeration machine, 3.5-7.5 ton, EURO5, R134a refrigerant, freezing; transport, freight, lorry with refrigeration machine, 3.5-7.5 ton, EURO6, carbon dioxide, liquid refrigerant, cooling; transport, freight, lorry with refrigeration machine, 3.5-7.5 ton, EURO6, carbon dioxide, liquid refrigerant, freezing; transport, freight, lorry with refrigeration machine, 3.5-7.5 ton, EURO6, R134a refrigerant, cooling; transport, freight, lorry with refrigeration machine, 3.5-7.5 ton, EURO6, R134a refrigerant, freezing; transport, freight, lorry with refrigeration machine, 7.5-16 ton, EURO3, carbon dioxide, liquid refrigerant, cooling; transport, freight, lorry with refrigeration machine, 7.5-16 ton, EURO3, carbon dioxide, liquid refrigerant, freezing; transport, freight, lorry with refrigeration machine, 7.5-16 ton, EURO3, R134a refrigerant, cooling; transport, freight, lorry with refrigeration machine, 7.5-16 ton, EURO3, R134a refrigerant, freezing; transport, freight, lorry with refrigeration machine, 7.5-16 ton, EURO4, carbon dioxide, liquid refrigerant, cooling; transport, freight, lorry with refrigeration machine, 7.5-16 ton, EURO4, carbon dioxide, liquid refrigerant, freezing; transport, freight, lorry with refrigeration machine, 7.5-16 ton, EURO4, R134a refrigerant, cooling; transport, freight, lorry with refrigeration machine, 7.5-16 ton, EURO4, R134a refrigerant, freezing; transport, freight, lorry with refrigeration machine, 7.5-16 ton, EURO5, carbon dioxide, liquid refrigerant, cooling; transport, freight, lorry with refrigeration machine, 7.5-16 ton, EURO5, carbon dioxide, liquid refrigerant, freezing; transport, freight, lorry with refrigeration machine, 7.5-16 ton, EURO5, R134a refrigerant, cooling; transport, freight, lorry with refrigeration machine, 7.5-16 ton, EURO5, R134a refrigerant, freezing; transport, freight, lorry with refrigeration machine, 7.5-16 ton, EURO6, carbon dioxide, liquid refrigerant, cooling; transport, freight, lorry with refrigeration machine, 7.5-16 ton, EURO6, carbon dioxide, liquid refrigerant, freezing; transport, freight, lorry with refrigeration machine, 7.5-16 ton, EURO6, R134a refrigerant, cooling; transport, freight, lorry with refrigeration machine, 7.5-16 ton, EURO6, R134a refrigerant, freezing; transport, freight, lorry with refrigeration machine, cooling; transport, freight, lorry with refrigeration machine, freezing; transport, freight, lorry, unspecified; transport, freight, sea, bulk carrier for dry goods; transport, freight, sea, container ship; transport, freight, sea, container ship with reefer, cooling; transport, freight, sea, container ship with reefer, freezing; transport, freight, sea, ferry; transport, freight, sea, tanker for liquefied natural gas; transport, freight, sea, tanker for liquid goods other than petroleum and liquefied natural gas; transport, freight, sea, tanker for petroleum; transport, freight, train with reefer, cooling; transport, freight, train with reefer, freezing; transport, passenger car; transport, passenger car with internal combustion engine; transport, passenger car, electric; transport, passenger car, EURO 3; transport, passenger car, EURO 4; transport, passenger car, EURO 5; transport, passenger car, large size, diesel, EURO 3; transport, passenger car, large size, diesel, EURO 4; transport, passenger car, large size, diesel, EURO 5; transport, passenger car, large size, natural gas, EURO 3; transport, passenger car, large size, natural gas, EURO 4; transport, passenger car, large size, natural gas, EURO 5; transport, passenger car, large size, petrol, EURO 3; transport, passenger car, large size, petrol, EURO 4; transport, passenger car, large size, petrol, EURO 5; transport, passenger car, medium size, diesel, EURO 3; transport, passenger car, medium size, diesel, EURO 4; transport, passenger car, medium size, diesel, EURO 5; transport, passenger car, medium size, liquefied petroleum gas, EURO 5; transport, passenger car, medium size, natural gas, EURO 3; transport, passenger car, medium size, natural gas, EURO 4; transport, passenger car, medium size, natural gas, EURO 5; transport, passenger car, medium size, petrol, EURO 3; transport, passenger car, medium size, petrol, EURO 4; transport, passenger car, medium size, petrol, EURO 5; transport, passenger car, small size, diesel, EURO 3; transport, passenger car, small size, diesel, EURO 4; transport, passenger car, small size, diesel, EURO 5; transport, passenger car, small size, natural gas, EURO 3; transport, passenger car, small size, natural gas, EURO 4; transport, passenger car, small size, natural gas, EURO 5; transport, passenger car, small size, petrol, EURO 3; transport, passenger car, small size, petrol, EURO 4; transport, passenger car, small size, petrol, EURO 5; transport, passenger coach; transport, passenger train; transport, passenger, aircraft, unspecified; transport, passenger, bicycle; transport, passenger, electric bicycle; transport, passenger, electric bicycle, label-certified electricity; transport, passenger, electric scooter; transport, passenger, motor scooter; transport, passengers, aircraft, long haul; transport, passengers, aircraft, medium haul; transport, passengers, aircraft, short haul; transport, passengers, aircraft, very short haul;

transport, pipeline, onshore, petroleum; transport, regular bus; transport, tractor and trailer, agricultural; transport, tram; transport, trolleybus; trawler maintenance, steel; trawler, steel; tree seedling, for planting; trellis system, wooden poles, soft wood, tar impregnated; triethyl amine; trimethyl borate; triphenyl phosphate; tris(2,4-ditert-butylphenyl) phosphite; trisodium phosphate; tube insulation factory; ultrafiltration module; uranium conversion facility; uranium enrichment diffusion facility; uranium mill; uranium, enriched 3.0%, per separative work unit; uranium, enriched 3.8%, per separative work unit; uranium, enriched 3.9%, per separative work unit; uranium, enriched 4.0%, per separative work unit; uranium, enriched 4.2%, per separative work unit; uranium, in yellowcake; used cable; used Li-ion battery; vanilla seedling, for planting; vegetable oil esterification facility; vegetable oil refinery; ventilation components factory; ventilation control and wiring, central unit; ventilation control and wiring, decentralized unit; ventilation duct, connection piece, steel, 100x50 mm; ventilation duct, elbow 90°, steel, 100x50 mm; ventilation duct, steel, 100x50 mm; ventilation of dwellings, central, 1 x 720 m3/h; ventilation of dwellings, decentralized, 6 x 120 m3/h; ventilation system, central, 1 x 720 m3/h, polyethylene ducts, with earth tube heat exchanger; ventilation system, central, 1 x 720 m3/h, steel ducts, with earth tube heat exchanger; ventilation system, decentralized, 6 x 120 m3/h, polyethylene ducts; ventilation system, decentralized, 6 x 120 m3/h, polyethylene ducts, with earth tube heat exchanger; ventilation system, decentralized, 6 x 120 m3/h, steel ducts; ventilation system, decentralized, 6 x 120 m3/h, steel ducts, with earth tube heat exchanger; wafer factory; wafer, fabricated, for integrated circuit; washing, drying and finishing laundry; waste collection lorry, 21 metric ton; waste packaging paper; waste plastic, consumer electronics, unsorted; waste x-ray film; wastewater treatment facility, capacity 1.1E10l/year; wastewater treatment facility, capacity 1.6E8l/year; wastewater treatment facility, capacity 1E9l/year; wastewater treatment facility, capacity 4.7E10l/year; wastewater treatment facility, capacity 5E9l/year; water pump operation, diesel; water pump operation, electric; water pump, 22kW; water works, capacity 1.1E10l/year; water works, capacity 6.23E10l/year; water, deionised; weaving, synthetic fibre; weed control, by brush cutter, pasture; welding, arc, aluminium; welding, arc, steel; wheat flour mix; wheat grain, feed; wheat grain, feed, organic; wheat grain, feed, Swiss integrated production; wheat seed, for sowing; wheat seed, organic, for sowing; wheat seed, Swiss integrated production, for sowing; white spirit; wind turbine network connection, 750kW, onshore; wind turbine, 2.3MW, onshore; wind turbine, 750kW, onshore; window frame, poly vinyl chloride, U=1.6 W/m2K; wire drawing, steel; wood chipping, chipper, mobile, diesel, at forest road; wood chipping, forwarder with terrain chipper, in forest; wood chipping, industrial residual wood, stationary electric chipper; wood cladding, softwood; wood pellet factory; wood preservation facility, dipping/immersion tank; wood preservation facility, flow coating equipment; wood preservation facility, hot/cold dipping tank; wood preservation facility, oscillating pressure method; wood preservation facility, vacuum pressure method; wood preservation, dipping/immersion method, organic solvent-based, indoor use, dry; wood preservation, dipping/immersion method, organic solvent-based, indoor use, occasionally wet; wood preservation, dipping/immersion method, organic solvent-based, outdoor use, no ground contact; wood preservation, dipping/immersion method, water-based, indoor use, dry; wood preservation, dipping/immersion method, water-based, indoor use, occasionally wet; wood preservation, dipping/immersion method, water-based, outdoor use, no ground contact; wood preservation, hot/cold dipping, creosote, outdoor use, ground contact; wood preservation, oscillating pressure method, inorganic salt, containing Cr, outdoor use, ground contact; wood preservation, oscillating pressure method, organic salt, Cr-free, outdoor use, ground contact; wood preservation, pressure vessel, creosote, outdoor use, ground contact; wood preservation, spray tunnel/deluging, organic solvent-based, indoor use, dry; wood preservation, spray tunnel/deluging, organic solvent-based, indoor use, occasionally wet; wood preservation, spray tunnel/deluging, organic solvent-based, outdoor use, no ground contact; wood preservation, spray tunnel/deluging, water-based, indoor use, dry; wood preservation, spray tunnel/deluging, water-based, indoor use, occasionally wet; wood preservation, spray tunnel/deluging, water-based, outdoor use, no ground contact; wood preservation, vaccum pressure method, inorganic salt, containing Cr, outdoor use, ground contact; wood preservation, vacuum pressure method, organic salts, Cr-free, outdoor use, ground contact; wood preservative, creosote; wood preservative, inorganic salt, containing Cr; wood preservative, organic salt, Cr-free; wood preservative, organic, indoor use, dry; wood preservative, organic, indoor use, occasionally wet; wood preservative, organic, outdoor use, no ground contact; wood preservative, water-based, indoor use, dry; wood preservative, water-based, indoor use, occasionally wet; wood preservative, water-based, outdoor use, no ground contact; wood wool boards, cement bonded; zeolite, slurry, without water, in 50% solution state; zinc coat, coils; zinc coat, pieces; zinc concentrate; zinc sulfide.

Annex 2: activities with changes in inputs due to remodelling of fertilisers

alfalfa/grass silage production, 2010-2012, [GLO]; alfalfa/grass silage production, 2010-2012, [CA-QC]; alfalfa/grass silage production, 2016-2017, [ZA]; almond production, 2009-2012, [CN; GLO; US]; aluminium alloy production, AlLi, 2013-2013, [CA-QC; GLO]; anhydrite floor production, 2000-2004, [CH; GLO]; apple production, 2009-2012, [CL; CN; GLO; IT; US]; apple production, 2012-2016, [ZA]; apricot production, 2002-2012, [GLO; TR]; apricot production, 2009-2012, [ES; FR; IT]; asparagus seedling production, for planting, 2009-2012, [FR; GLO]; aubergine production, in heated greenhouse, 2010-2010, [GLO]; aubergine production, open field, 2015-2018, [GLO; IN]; avocado production, 2010-2010, [GLO]; banana production, 2009-2012, [CO; CR; EC; GLO; IN]; barley production, 2000-2004, [DE; ES; FR; GLO]; barley production, 2010-2012, [CA-QC]; barley production, Swiss integrated production, extensive, 1996-2003, [CH; GLO]; barley production, Swiss integrated production, intensive, 1996-2003, [CH; GLO]; beef cattle production on pasture, 2006-2015, [GLO]; beef cattle production on pasture, 2016-2016, [ZA]; beef cattle production on pasture and feedlot, 2006-2015, [BR; GLO]; beef cattle production on pasture and proteic supplement, 2006-2015, [BR; GLO]; bell pepper production, in heated greenhouse, 2010-2010, [GLO]; bell pepper production, open field, 2015-2018, [GLO; IN-MH; IN-UP]; broccoli production, 2010-2010, [GLO]; cabbage red production, 2010-2010, [GLO]; cabbage white production, 2010-2010, [GLO]; cabbage white production, 2015-2018, [IN-MH; IN-UP]; carrot production, 2009-2012, [CN; GLO; IL; NL]; carrot seed production, Swiss integrated production, at farm, 2000-2012, [CH; GLO]; cashew production, 2015-2018, [GLO; IN]; castor bean production, 2015-2018, [GLO; IN]; cauliflower production, 2010-2010, [GLO]; celery675 production, 2010-2010, [GLO]; chemical production, inorganic, 2000-2000, [GLO]; chemical production, organic, 2000-2000, [GLO]; chickpea production, 2015-2018, [GLO; IN]; chilli production, 2015-2018, [GLO; IN-UP]; citric acid production, 2010-2011, [RNA]; clinker production, 1998-2017, [GLO]; clinker production, 2009-2013, [CH]; clinker production, 2016-2016, [BR]; clinker production, 2017-2017, [ZA]; clover seed production, Swiss integrated production, at farm, 2000-2000, [CH; GLO]; cocoa bean production, sun-dried, 2009-2012, [CI; GH; GLO; ID]; coconut production, dehusked, 2009-2012, [GLO; ID; PH]; coconut production, dehusked, 2010-2012, [IN]; coffee green bean production, arabica, 2001-2012, [BR]; coffee green bean production, arabica, 2001-2014, [GLO]; coffee green bean production, arabica, 2012-2014, [CO; HN; IN]; coffee green bean production, robusta, 2012-2014, [BR; GLO; ID; IN; VN]; containerboard production, fluting medium, semichemical, 40% recycled content, 2009-2009, [CA-QC; GLO]; containerboard production, linerboard, testliner, 2007-2007, [CA-QC]; containerboard production, linerboard, testliner, 2007-2015, [GLO]; coriander production, 2015-2018, [GLO; IN]; cucumber production, in heated greenhouse, 2010-2010, [GLO]; establishing orchard, 2011-2011, [CH; GLO]; ethanol production from wood, 1999-2006, [CH]; ethanol production from wood, 2000-2008, [SE]; eucalyptus seedling production, in heated greenhouse, 2010-2020, [BR; GLO]; eucalyptus seedling production, in unheated greenhouse, 2010-2020, [BR; GLO]; explosive production, tovex, 1997-2001, [CH; GLO]; fattening of calves for beef cattle production, on pasture, 2006-2015, [BR; GLO]; fattening of calves for beef production, feedlot, 2016-2016, [GLO; ZA]; fattening of heifers for beef cattle production, on pasture, 2006-2015, [BR; GLO]; fattening of heifers for beef production, feedlot, 2016-2016, [GLO; ZA]; fava bean production, Swiss integrated production, at farm, 1996-2003, [CH; GLO]; fennel production, 2010-2010, [GLO]; flax production, 2016-2017, [GLO; IN]; fodder beet production, Swiss integrated production, intensive, 1996-2003, [CH; GLO]; fruit tree seedling production, for planting, 2000-2012, [CH; GLO]; fuel cell production, stack solid oxide, 125kW electrical, future, 2000-2005, [CH; GLO]; glass wool mat production, without cullet, 1993-2000, [GLO]; gold-silver mine operation and beneficiation, 2012-2012, [CA-QC; GLO]; gold-silver mine operation with refinery, 2012-2012, [CA-QC]; grape production, 2010-2010, [GLO]; grape production, 2015-2018, [IN]; grass production, permanent grassland, Swiss integrated production, intensive, 2000-2005, [CH; GLO]; grass production, Swiss integrated production, intensive, 1995-2005, [CH; GLO]; grass seed production, Swiss integrated production, at farm, 2000-2000, [CH; GLO]; grass silage production, Swiss integrated production, intensive, 1995-2005, [CH; GLO]; green asparagus production, 2010-2010, [GLO]; hardwood forestry, eucalyptus ssp., planted forest management, 2012-2016, [BR-GO; BR-MG; GLO]; hay production, 2010-2012, [GLO]; hay production, 2010-2012, [CA-QC]; hay production, organic, intensive, 2005-2005, [CH; GLO]; hay production, Swiss integrated production, intensive, 2005-2005, [CH; GLO]; heat and power co-generation, diesel, 200kW electrical, SCR-NOx reduction, 2000-2000, [CH; GLO]; hydraulic fluid production, for geological stimulation, 2008-2008, [GLO]; iceberg lettuce production, 2010-2010, [GLO]; intensive beef cattle production on pasture, 2006-2015, [BR; GLO]; intensive beef cattle production, fat steers only, on pasture, 2006-2015, [BR; GLO]; iron ore mine operation and beneficiation, 2011-2011, [CA-QC]; jute production, irrigated, 2015-2016, [GLO; IN]; jute production, rainfed, 2016-2017, [BD; GLO]; kenaf production, irrigated, 2016-2017, [GLO; IN]; kiwi production, 2010-2010, [GLO]; lemon production, 2009-2012, [ES; GLO; MX; TR]; lettuce360 production, in heated greenhouse, 2010-2010, [GLO]; lettuce361 production, 2010-2010, [GLO]; linseed production, 2003-2012, [CA; GLO]; linseed production, 2007-2012, [RU]; linseed seed production, at farm, 1996-2012, [CH; GLO]; maize grain production, 2004-2006, [GLO; US]; maize grain production, 2009-2012, [AR]; maize grain production, 2010-2012, [CA-QC]; maize grain production, 2012-2016, [BR-GO; BR-MS; BR-MT; BR-PR; BR-RS]; maize grain production, 2015-2018, [IN]; maize grain production, Swiss integrated production, 1996-2003, [CH; GLO]; maize seed production, at farm, 2000-2000, [GLO]; maize seed production, Swiss integrated production, at farm, 2000-2000, [CH; GLO]; maize silage production, 2010-

2012, [CA-QC; GLO]; maize silage production, 2012-2016, [BR]; maize silage production, Swiss integrated production, intensive, 1996-2003, [CH; GLO]; medium density fibre board production, uncoated, 2012-2012, [GLO]; melamine production, 2000-2020, [GLO; RER]; melon production, 2010-2010, [GLO]; milk production, from cow, 2009-2011, [GLO]; milk production, from cow, 2016-2016, [ZA]; millet production, 2015-2018, [GLO; IN]; mineral supplement production, for beef cattle, 2019-2019, [GLO]; mint production, 1999-2012, [GLO; IN]; mint production, 2007-2008, [US]; mint seedling production, for planting, 2009-2012, [GLO; US]; miscanthus production, 2005-2005, [DE; GLO]; miscanthus rhizome production, for planting, 2005-2005, [DE; GLO]; mulberry production, 2014-2017, [GLO; IN]; mustard production, 2015-2018, [GLO; IN]; nickel mine operation and benefication to nickel concentrate, 16% Ni, 2010-2010, [CA-QC; GLO]; nutrient supply from ash, from combustion of bagasse from sugarcane, 2016-2019, [GLO]; nutrient supply from coconut husk, 2016-2019, [GLO]; nutrient supply from compost, 2016-2019, [GLO]; nutrient supply from filter cake, from sugarcane juice filtration, 2016-2019, [GLO]; nutrient supply from manure, liquid, cattle, 2016-2019, [GLO]; nutrient supply from manure, liquid, swine, 2016-2019, [GLO]; nutrient supply from manure, solid, cattle, 2016-2019, [GLO]; nutrient supply from poultry manure, dried, 2016-2019, [GLO]; nutrient supply from poultry manure, fresh, 2016-2019, [GLO]; nutrient supply from vinasse, from fermentation of sugar beet, 2016-2019, [GLO]; nutrient supply from vinasse, from fermentation of sugar beet molasses, 2016-2019, [GLO]; nutrient supply from vinasse, from fermentation of sugarcane, 2016-2019, [GLO]; nutrient supply from vinasse, from fermentation of sweet sorghum, 2016-2019, [GLO]; oat production, 2009-2012, [Canada without Quebec; FI]; oat production, 2010-2012, [GLO]; oat production, 2010-2012, [CA-QC]; oat seed production, Swiss integrated production, at farm, 1996-2012, [CH; GLO]; olive production, 2001-2012, [GLO]; olive production, 2009-2012, [ES]; onion production, 2004-2012, [GLO]; onion production, 2009-2010, [CN]; onion production, 2009-2012, [NL; NZ]; onion production, 2015-2018, [IN]; onion seedling production, for planting, 2009-2012, [GLO; NZ]; orange production, fresh grade, 2000-2012, [ES]; orange production, fresh grade, 2000-2014, [GLO]; orange production, fresh grade, 2010-2014, [US]; orange production, processing grade, 2000-2012, [BR]; orange production, processing grade, 2000-2014, [GLO]; orange production, processing grade, 2010-2014, [US]; palm fruit bunch production, 2002-2006, [GLO; MY]; palm fruit bunch production, 2009-2012, [ID]; papaya production, 2010-2010, [GLO]; paper production, newsprint, virgin, 2012-2012, [CA-QC]; paris market carrot production, 2010-2010, [GLO]; peach production, 2009-2012, [CN; ES; GLO; IT]; peanut production, 2009-2012, [CN; GLO; IN]; peanut seed production, at farm, 1996-2012, [GLO; IN]; pear production, 2009-2012, [AR; BE; CN; GLO]; peat moss production, horticultural use, 2010-2010, [CA-QC; GLO]; pesticide production, unspecified, 2000-2010, [GLO; RER]; phosphorus production, white, liquid, 2000-2000, [GLO; RER]; photovoltaic laminate production, CIS, 1998-2007, [DE; GLO]; phthalimide-compound production, 2000-2010, [GLO; RER]; pineapple production, 2010-2010, [GLO]; pomegranate production, 2015-2018, [GLO; IN]; potassium hydroxide production, 1998-2004, [GLO; RER]; potassium perchlorate production, 2000-2006, [GLO]; potato production, 2000-2012, [IN]; potato production, 2001-2006, [GLO; US]; potato production, 2003-2013, [CN]; potato production, 2009-2012, [RU; UA]; potato production, 2010-2012, [CA-QC]; potato production, Swiss integrated production, intensive, 1996-2003, [CH; GLO]; potato seed production, at farm, 1996-2003, [GLO]; potato seed production, Swiss integrated production, at farm, 1996-2003, [CH; GLO]; primary zinc production from concentrate, 2011-2012, [CA-QC]; primary zinc production from concentrate, 2015-2017, [GLO]; protein pea production, 2000-2004, [DE; FR; GLO]; protein pea production, Swiss integrated production, intensive, 1996-2003, [CH; GLO]; radish production, in heated greenhouse, 2010-2010, [GLO]; rape seed production, 2000-2004, [DE; FR; GLO]; rape seed production, 2001-2006, [US]; rape seed production, 2009-2012, [Canada without Quebec]; rape seed production, 2010-2012, [CA-QC]; rape seed production, Swiss integrated production, extensive, 1996-2003, [CH; GLO]; rape seed production, Swiss integrated production, intensive, 1996-2003, [CH; GLO]; rice production, basmati, 2015-2018, [GLO; IN]; rice production, non-basmati, 2001-2006, [GLO; US]; rice production, non-basmati, 2009-2012, [CN]; rice production, non-basmati, 2015-2018, [IN]; rye production, 2002-2006, [GLO; RER]; rye production, Swiss integrated production, extensive, 1996-2003, [CH; GLO]; rye production, Swiss integrated production, intensive, 1996-2003, [CH; GLO]; seed-cotton production, conventional, 2015-2016, [IN-GJ]; seed-cotton production, conventional, 2016-2016, [GLO]; seed-cotton production, conventional, 2016-2017, [BD]; sesame seed production, 2015-2018, [GLO; IN]; sheep production, for meat, 2001-2006, [GLO; US]; sheep production, for wool, 2001-2006, [GLO; US]; smelting and refining of nickel concentrate, 16% Ni, 2010-2010, [GLO]; soybean production, 1996-2012, [CH]; soybean production, 2004-2006, [GLO]; soybean production, 2004-2007, [US]; soybean production, 2009-2012, [AR]; soybean production, 2010-2012, [CA-QC]; soybean production, 2012-2014, [BR-GO; BR-MS; BR-MT; BR-PR; BR-RS]; soybean production, 2015-2018, [IN]; soybean production, Swiss integrated production, intensive, 1996-2003, [CH; GLO]; spinach production, 2010-2010, [GLO]; strawberry production, in heated greenhouse, 2009-2012, [GLO]; strawberry production, in heated greenhouse, 2009-2012, [CH]; strawberry production, in unheated greenhouse, 2009-2012, [GLO]; strawberry production, in unheated greenhouse, 2009-2012, [CH]; strawberry production, open field, macro tunnel, 2006-2012, [GLO]; strawberry production, open field, macro tunnel, 2006-2012, [ES]; strawberry production, open field, macro tunnel, 2010-2010, [US]; sugar beet production, 1996-2003, [CH; GLO]; sugar beet production, 2006-2012, [FR]; sugar beet production, 2009-2012, [DE; RU; US]; sugarcane production, 1996-2006, [GLO]; sugarcane production, 2012-2014, [BR-GO; BR-MG; BR-MS; BR-MT; BR-PR]; sugarcane production, 2015-2018, [IN]; sulfate pulp production, from hardwood, bleached, 2011-2012, [CA-QC]; sulfate pulp production, from hardwood, bleached, 2011-2021, [GLO]; sunflower production, 2000-2012, [UA]; sunflower production, 2006-2012, [FR]; sunflower production, 2009-2012, [HU; RU]; sunflower production, Swiss integrated production, intensive, 1996-2003, [CH; GLO]; sunn hemp production, 2016-2017, [GLO; IN]; sweet corn production, 2006-2012, [GLO]; sweet corn production, 2006-2012, [HU; US]; sweet corn production, 2010-2011, [TH]; sweet sorghum production, 2000-2006, [CN; GLO]; tea production,

dried, 2009-2012, [GLO]; tea production, dried, 2009-2012, [CN; KE; LK]; tomato production, fresh grade, in heated greenhouse, 2009-2012, [GLO]; tomato production, fresh grade, in heated greenhouse, 2009-2012, [NL]; tomato production, fresh grade, in unheated greenhouse, 2006-2012, [GLO]; tomato production, fresh grade, in unheated greenhouse, 2006-2012, [ES]; tomato production, fresh grade, open field, 2009-2012, [GLO]; tomato production, fresh grade, open field, 2009-2012, [MX]; tomato production, fresh grade, open field, 2015-2018, [IN-MH; IN-UP]; tomato production, processing grade, open field, 2007-2011, [GLO]; tomato production, processing grade, open field, 2011-2011, [IT]; treatment of waste paper to pulp, wet lap, totally chlorine free bleached, 2007-2007, [CA-QC; GLO]; urea formaldehyde resin production, 1995-2020, [GLO; RER]; weaned calves production on pasture, 2006-2015, [GLO]; weaned calves production on pasture, 2016-2016, [ZA]; wheat production, 2000-2004, [DE; ES; FR]; wheat production, 2001-2006, [GLO; US]; wheat production, 2009-2012, [AU; Canada without Quebec]; wheat production, 2010-2012, [CA-QC]; wheat production, 2015-2018, [IN]; wheat production, 2016-2016, [ZA]; wheat production, Swiss integrated production, extensive, 1996-2003, [CH; GLO]; wheat production, Swiss integrated production, intensive, 1996-2003, [CH; GLO]; white asparagus production, 2009-2012, [CN; FR; GLO; PE]; willow production, short rotation coppice, 2005-2005, [DE; GLO]; zucchini production, 2010-2010, [GLO]; jatropha seed production, 2005-2014, [GLO]; melamine impregnated paper production, 2012-2012, [GLO]; olive production, 2001-2012, [IT].

Annex 3: activities with changes in inputs due to remodelling in the paper sector

air filter production, decentralized unit, 180-250 m3/h, 2003-2003 [GLO; RER]; air filter production, decentralized unit, 250 m3/h, 2003-2003 [GLO; RER]; bitumen seal production, 1992-1993 [GLO; RER]; bitumen seal production, VA4, 1994-2000 [GLO; RER]; blow moulding, 1993-1997 [CA-QC; GLO; RER]; calendering, rigid sheets, 1993-1997 [GLO; RER]; capacitor production, electrolyte type, < 2cm height, 1994-2007 [GLO]; capacitor production, electrolyte type, > 2cm height, 1994-2007 [GLO]; cellulose fibre production, 2012-2012 [CH; GLO]; cement production, alternative constituents 45%, 2014-2017 [CO; GLO]; display production, cathode ray tube, 17 inches, 1998-2001 [GLO]; door production, inner, glass-wood, 1997-2005 [GLO; RER]; door production, inner, wood, 1997-2005 [GLO; RER]; door production, outer, wood-aluminium, 1997-2005 [GLO; RER]; door production, outer, wood-glass, 1997-2005 [GLO; RER]; extrusion, plastic film, 1993-1997 [CA-QC; GLO; RER]; housing system construction, cattle, loose, 1994-2002 [CH; GLO]; housing system construction, pig, label-certified, 1994-2002 [CH; GLO]; injection moulding, 1993-1997 [CA-QC; GLO; RER]; melamine impregnated paper production, 2012-2012 [GLO]; melamine impregnated paper production, 2012-2012 [RER]; packaging glass production, brown, 2002-2002 [CH]; packaging glass production, brown, 1996-1996 [DE]; packaging glass production, brown, 2000-2000 [GLO; RER w/o CH+DE]; packaging glass production, brown, without cullet, 2000-2000 [GLO]; packaging glass production, green, 2002-2002 [CH]; packaging glass production, green, 1996-1996 [DE]; packaging glass production, green, 2000-2000 [GLO; RER w/o CH+DE]; packaging glass production, green, without cullet, 2000-2000 [GLO]; packaging glass production, white, 2002-2002 [CH]; packaging glass production, white, 1996-1996 [DE]; packaging glass production, white, 2000-2000 [GLO; RER w/o CH+DE]; packaging glass production, white, without cullet, 2000-2000 [GLO]; packing, cement, 1997-2001 [CH; GLO]; packing, fibre cement product, 2000-2001 [CH; GLO]; packing, lime product, 2000-2002 [CH; GLO]; potentiometer production, unspecified, 1994-2007 [GLO]; power block installation, solar thermal parabolic trough, 50 MW, 2010-2020 [GLO; ZA]; power block installation, solar tower power plant, 20 MW, 2010-2020 [GLO; ZA]; selective coating, copper sheet, sputtering, 2001-2001 [CA-QC; DE; GLO]; sheet rolling, chromium steel, 1997-2002 [GLO; RER]; sheet rolling, steel, 1997-2002 [GLO; RER]; stone wool production, 2000-2007 [CH; GLO]; stretch blow moulding, 1993-1997 [CA-QC; GLO; RER]; thermoforming, with calendering, 1993-1997 [GLO; RER]; tissue paper production, 2000-2000 [GLO; RER]; washing machine production, 2004-2018 [GLO].

Annex 4: activities with changes in inputs due to remodelling of the wood sector

anaerobic digestion plant construction, agricultural, 2000-2005 [CH; GLO]; anaerobic digestion plant construction, agriculture, with methane recovery, 2004-2006 [CH; GLO]; barge production, 1993-2000 [GLO; RER]; barge tanker production, 1993-2000 [GLO; RER]; building construction, budget hotel, 2017-2018 [PE]; building construction, hall, wood construction, 2000-2001 [CH; GLO]; building construction, hostel, 2017-2018 [PE]; building construction, luxury hotel, 2017-2018 [BR]; building construction, luxury hotel, 2017-2018 [PE]; bulk carrier production, for dry goods, 2007-2012 [GLO]; cladding production, crossbar-pole, aluminium, 2005-2005 [GLO; RER]; composting facility construction, open, 1999-1999 [CH; GLO]; construction work, heat and power co-generation unit, 160kW electrical, 1987-2000 [GLO; RER]; container ship production, 2007-2012 [GLO]; dishwasher production, 2007-2018 [GLO]; door production, inner, glass-wood, 1997-2005 [GLO; RER]; door production, inner, wood, 1997-2005 [GLO; RER]; dried roughage store construction, air dried, solar, 1994-2002 [CH; GLO]; dried roughage store construction, cold-air dried, conventional, 1994-2002 [CH; GLO]; dried roughage store construction, non ventilated, 1994-2002 [CH; GLO]; dryer production, 2007-2018 [GLO]; engineered wood joist production, 2011-2011 [CA-QC; GLO]; EUR-flat pallet production, 2000-2002 [GLO]; EUR-flat pallet production, 2000-2002 [RER]; extrusion, plastic film, 1993-1997 [CA-QC; GLO; RER]; extrusion, plastic pipes, 1993-1997 [CA-QC; GLO; RER]; ferry production, 2007-2012 [GLO]; furniture production, wooden, 2011-2017 [GLO]; garage construction, wood, non-insulated, fire-protected, 2009-2012 [CH; GLO]; goods wagon production, 1993-1993 [GLO; RER]; heat and power co-generation unit construction, 6400kW thermal, building, 2000-2001 [CH; GLO]; heat and power co-generation unit construction, organic Rankine cycle, 1400kW thermal, building, 2000-2001 [CH; GLO]; housing system construction, cattle, loose, 1994-2002 [CH; GLO]; housing system construction, cattle, tied, 1994-2002 [CH; GLO]; housing system construction, pig, label-certified, 1994-2002 [CH; GLO]; intermodal shipping container production, 20-foot, 2010-2014 [GLO]; intermodal shipping container production, 40-foot, 2010-2014 [GLO]; intermodal shipping container production, 40-foot, high-cube, 2010-2014 [GLO]; intermodal shipping container production, 45-foot, high-cube, 2010-2014 [GLO]; locomotive production, 1993-1993 [GLO; RER]; maintenance, intermodal shipping container, 20-foot, 2010-2014 [GLO]; maintenance, intermodal shipping container, 40-foot, 2010-2014 [GLO]; maintenance, intermodal shipping container, 40-foot, high-cube, 2010-2014 [GLO]; maintenance, intermodal shipping container, 45-foot, high-cube, 2010-2014 [GLO]; maintenance, train, passenger, regional, 1993-2000 [CH; GLO]; milking parlour construction, 1994-2002 [CH; GLO]; mine construction, open cast, hard coal, 1980-1993 [GLO]; mine construction, open cast, lignite, 1983-1993 [GLO; RER]; mine construction, underground, hard coal, 1999-2002 [CN]; mine construction, underground, hard coal, 1980-1993 [GLO]; mine infrastructure construction, open cast, peat, 1983-1993 [GLO; NORDEL]; nuclear fuel factory construction, 1980-2000 [CN; GLO]; nuclear fuel factory construction, 1980-2006 [US]; nuclear power plant construction, boiling water reactor 1000MW, 1984-2002 [CH; DE; GLO]; nuclear power plant construction, boiling water reactor 1000MW, 1979-2006 [US]; nuclear power plant construction, pressure water reactor 1000MW, 1979-2002 [CH; CN; DE; FR; GLO]; nuclear power plant construction, pressure water reactor 1000MW, 1979-2006 [US]; nuclear power plant construction, pressure water reactor 650MW, 1982-2008 [CA-QC; GLO]; nuclear spent fuel reprocessing facility construction, 1980-2002 [GLO; RER]; tanker production, for liquefied natural gas, 2007-2012 [GLO]; tanker production, for liquid goods other than petroleum and liquefied natural gas, 2007-2012 [GLO]; tanker production, for petroleum, 2007-2012 [GLO]; train production, passenger, regional, 2000-2000 [CH; GLO]; uranium enrichment diffusion facility construction, 1980-2000 [GLO; US]; uranium mill construction, 1980-1983 [GLO; US].