LONG TRAIL SUSTAINABILITY
Experts in Product Stewardship


# DATASMART LCI Package

# Manual

# 2017

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Long Trail Sustainability (LTS), formerly EARTHSHIFT
830 Taft Road, Huntington, VT 05462
Email support@ltsexperts.com • Phone (802) 434-3326 • www.ltsexperts.com

**DATASMART LCI Package is a dataset representative of the North American region** provided by Long Trail Sustainability (LTS). This dataset was originally based on a combination of USLCI and Ecoinvent 2.2 data modified specifically to be representative of North American operations, as well as data developed by LTS and submitted to LTS by providers for inclusion in DATASMART. A wide range of processes are included covering such industries as textiles, packaging, bio-materials and dairy and all 50 U.S. state electricity mixes.

## DATASMART details:

DATASMART consists of a wide range of materials and processes inclusive of U.S. natural gas from hydraulic fracturing, updated U.S. natural gas mix, geothermal electricity generation, textile production processes, waste treatment processes for white goods and electronics, Chinese based pulp and paper data, updated energy modelling and much more.

Currently for U.S. LCI data, many LCA practitioners utilize Ecoinvent, which is primarily European data, or USLCI, which has limited data and is in large part incomplete. Wherever possible the DATASMART replaces links in the Ecoinvent v.2.2 unit processes with U.S.-specific data, including electricity, natural gas, soybeans, etc. The Dummy processes in the USLCI data are replaced with a close proxy. The end result is a database that better represents U.S. operations. DATASMART can fill the requirements of PCRs that require USLCI data with the dummy processes replaced with appropriate data.

Additionally, over 700 custom datasets are included in DATASMART, covering such industries as textiles, packaging, bio-materials and dairy, all 50 U.S. state electricity mixes, and U.S. eGRID electricity mixes have been added. It includes also critically reviewed branded data.

The 2017 update includes an update to the underlying energy in most datasets, updated U.S. State electricity mixes, new U.S. eGRID electricity mixes, consolidation into one library project, updated LTS Method and updated library and documentation descriptions. More details below.

*The DATASMART LCI Package is developed and maintained by LTS with one to two updates a year. It is currently only sold as a package and available in SimaPro for SimaPro 8 license holders.*

## Citing the DATASMART LCI Package:

LTS. 2017. DATASMART LCI Package (US-EI SimaPro® Library).
http://ltsexperts.com/services/software/datasmart-life-cycle-inventory/ Accessed on <Date>.

# What's in the DATASMART LCI Package?

## Material datasets

| | | | |
|---|---|---|---|
| Agriculture | Dairy products | Metals | Plastics |
| Ceramics | Electronics | Minerals | Water |
| Chemicals | Fuels | Packaging | Wood |
| Construction | Glass | Paper & Board | |

## Processes datasets

| | | | |
|---|---|---|---|
| Agriculture | Glass | Plastics | Water Use |
| Cardboard | Household activities | Power Plants | Wood |
| Compressed air | Metals | Textiles | |
| Electronics | Painting | Ventilation | |

## Details on 2017 Update

The 2017 DATASMART update includes 49 new processes, 52 updated processes, with thousands of processes updated because of those (e.g. US state production mixes updated, which then updated the high, medium and low voltage processes), 57 additions from the consolidation of libraries and 1 updated method. For the full process list, see *DATASMART 2017 Full Process List.xlsx*.

### Underlying energy

The underlying electricity and natural gas mix were updated from the 2011 U.S. mix to 2015. This will affect all datasets based on Ecoinvent 2.2 data. See Table 1 for more details.

*Table 1: Underlying U.S. electricity mix (Source: U.S. EIA)*

| | 2011 (Used previously) | 2015 (Used in 2017 update) |
|---|---|---|
| **Hard coal** | 46.04% | 33.17% |
| **Oil** | 0.16% | 0.69% |

| | | |
|---|---|---|
| **Natural gas** | 19.74%<br>23% shale | 32.70%<br>47% shale |
| **Industrial gas** | 0.24% | 0.16% |
| **Petroleum coke** | 0.37% | 0.16% |
| **Nuclear** | 21.11% | 19.55% |
| **Hydro** | 7.88% | 6.11% |
| **Cogen** | 0.74% | 0.103% |
| **Geothermal** | 0.38% | 0.39% |
| **Solar PV** | 0.04% | 0.61% |
| **Wind** | 2.98% | 4.68% |
| **Canadian imports** | 0.31% | 0.31% |
| **Mexican imports** | 0.01% | 0.03% |

*Data source:*

U.S. Energy Information Administration, Table 7.2a Electricity Net Generation: Total (All Sectors), June 2017 Monthly Energy Review, https://www.eia.gov/totalenergy/data/browser/?tbl=T07.02A#/?f=A&start=1949&end=2016&charted=1-2-3-5-8-14, downloaded 06/2017.

Approximately 0.53% from waste to energy is not modeled due to the use of the cut off method in ecoinvent. Negative pumped storage has been ignored. Other gases split equally between industrial gas and petroleum coke.

The split for the imported electricity from Canada (90%) and Mexico (10%) is estimated from the U.S. EIA Electric Power Annual 2015 report, Table 2.13, http://www.eia.gov/electricity/annual/pdf/epa.pdf, downloaded 06/2017.

### U.S. State electricity mixes

The 50 U.S. state electricity mixes (production + import) were updated from 2011 data to 2014 data. This is reflected in the high, medium and low voltage electricity processes as well, although they were not updated directly.

*Data source:*

Data from U.S. EIA 2014, Electric Power Sector Consumption Estimates, Table C9,

http://www.eia.gov/state/seds/seds-data-complete.cfm#Consumption, downloaded 06/2017.

The split for the imported electricity from Canada (89%) and Mexico 11%) is estimated from the U.S. EIA Electric Power Annual 2014 report, Table 2.13, http://www.eia.gov/electricity/annual/pdf/epa.pdf, downloaded 06/2017.

### U.S. eGRID electricity mixes

The 10 U.S. eGRID regions (see map in figure 1) were added at the production, high, medium and low voltage levels:

- Alaska Systems Coordinating Council (ASCC)
- Florida Reliability Coordinating Council (FRCC)
- Hawaiian Islands Coordinating Council (HICC)
- Midwest Reliability Organization (MRO)
- Northeast Power Coordinating Council (NPCC)
- Reliability First Corporation (RFC)
- SERC Reliability Corporation (SERC)
- Southwest Power Pool (SPP)
- Texas Regional Entity (TRE)
- Western Electricity Coordinating Council (WECC)

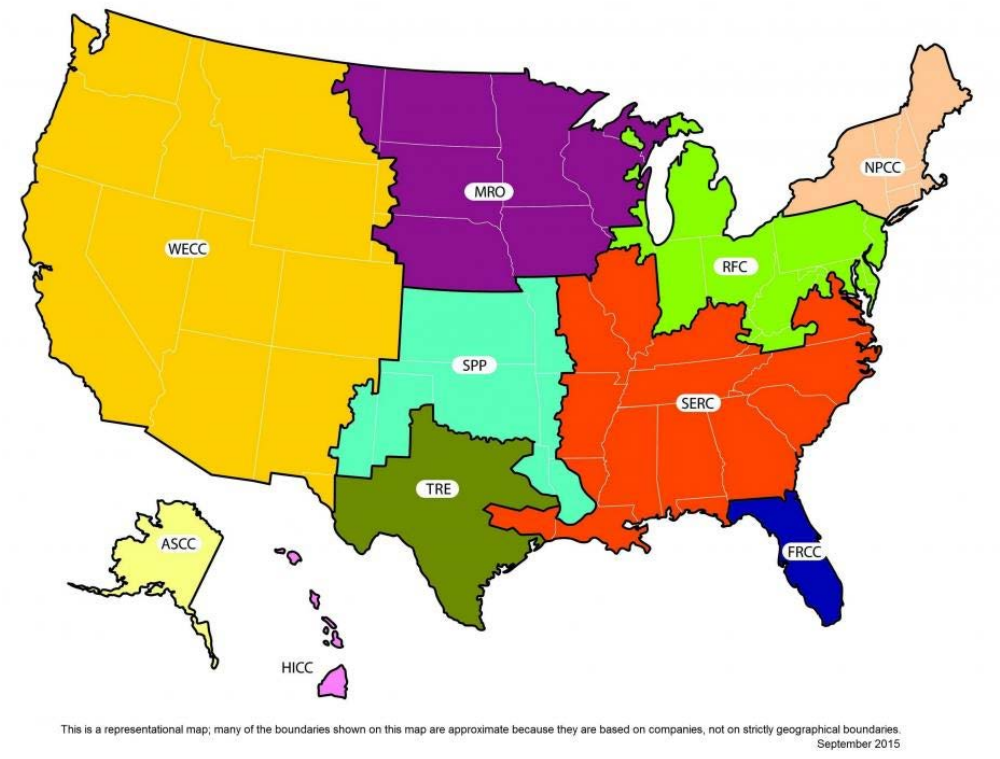


*Figure 1: Map of U.S. eGRID Subregions (Source: U.S. EPA)*

Table 2 details the electricity sources for each eGRID mix.

*Table 2: 2014 U.S. eGRID mixes (Source: U.S. EPA)*

| | ASCC | FRCC | HICC | MRO | NPCC | RFC | SERC | SPP | TRE | WECC |
|---|---|---|---|---|---|---|---|---|---|---|
| Coal | 9% | 22% | 15% | 60% | 4% | 50% | 42% | 54% | 33% | 28% |
| Oil | 7% | 1% | 68% | 0% | 2% | 1% | 1% | 2% | 0% | 0% |
| Natural gas | 54% | 61% | 0% | 4% | 41% | 16% | 25% | 26% | 45% | 30% |
| Petrol. Coke | 0% | 1% | 3% | 0% | 1% | 1% | 0% | 0% | 0% | 0% |
| Nuclear | 0% | 13% | 0% | 12% | 32% | 29% | 26% | 4% | 11% | 8% |
| Hydro | 26% | 0% | 1% | 6% | 13% | 1% | 3% | 2% | 0% | 22% |
| Biomass | 1% | 2% | 3% | 2% | 4% | 1% | 2% | 1% | 0% | 2% |
| Geothermal | 0% | 0% | 3% | 0% | 0% | 0% | 0% | 0% | 0% | 2% |
| Solar | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 2% |
| Wind | 3% | 0% | 6% | 16% | 2% | 2% | 0% | 12% | 10% | 6% |
| Other | 0% | 1% | 2% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |

*Data source:*

Data from U.S. EPA eGRID 2014, NERC Region Resource Mix (Summary Table 8),

https://www.epa.gov/sites/production/files/2015-10/documents/egrid2012_summarytables_0.pdf, downloaded 06/2017.

Supporting technical documents and region maps available from the U.S. EPA:

https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid

### Consolidation into one library project

DATASMART has been consolidated into one library project, the US-EI 2.2. We no longer update or provide the original Ecoinvent 2.2 data. Our previous additions to the Ecoinvent 2.2 library project have been moved to the US-EI 2.2 library as system level processes:

**Material**

- Liquid Laundry Detergent/RER
- Powdered Laundry Detergent/RER
- Plasticising Admixtures, Normal, at plant/kg/RER
- Arsenic, metallic/tonne/RER
- zirconium oxide, at plant, allocated/kg/AU
- Zirconium metal ingots, at plan/kg/GLO

- Niobium oxide, 57.6% Nb2O5, 1.88% Ta2O5/tonne/RER
- Strontium carbonate, 95%, at plant/kg/GLO
- Strontium sulfate, 90%, at plant/kg/GLO
- Thallium/RER
- Tungsten, metallic/RER
- Scandium, at plant/GLO
- Molded npulp, 8% water, cutoff/CN
- Molded npulp, 8% water, system expansion/CN
- Molded recycled pulp, from AOCC, 8% water/CN
- Molded recycled pulp, from OCC, 8% water/CN
- npulp, from straw, 0% water, cutoff/CN
- npulp, from straw, 0% water, system expansion/CN
- Recycled pulp, from AOCC, 0% water/CN
- Recycled pulp, from OCC, 0% water/CN
- Tap water, at user/CN

**Processing**

- Clothes washing and drying/RER
- Clothes washing and drying/CN
- Clothes washing and drying/JP
- Cutting and sewing/Central America
- Cutting and sewing/CN
- Fabric combined dyeing/CN
- Fabric mercerizing/CN
- Fabric pretreatment and finishing, no dyeing/CN
- Fabric pretreatment, dyeing and finishing, combined process/CN
- Fabric pretreatment/CN
- Fabric wetting/ bleaching/CN
- Knitting, circular, synthetic yarn/CN
- Pulp Molding/CN
- Spinning fiber, synthetic/CN
- Staple fiber production, PET/CN
- Weaving, synthetic yarn/CN
- Yarn production, synthetic, air textured (ATY)/CN
- Yarn production, synthetic, drawn textured (DTY)/CN
- Yarn production, synthetic, partially oriented (POY)/CN

**Energy**

- Electricity, biomass, at power plant/TW U

- Electricity, geothermal, from low temperature reservoir/RER
- Geothermal power plant/RER
- Electricity, biomass, at power plant /TW U
- Steam, from coal, at plant/RER
- Electricity mix/CN
- Electricity mix/HN
- Electricity mix/SV
- Electricity mix/TW
- Electricity, high voltage, at grid/TW
- Electricity, medium voltage, at grid /TW
- Electricity, medium voltage, at grid/SV
- Electricity, high voltage, at grid/SV
- Electricity, medium voltage, at grid/HN
- Electricity, high voltage, at grid/HN
- Electricity, low voltage, at grid/CN
- Electricity, medium voltage, at grid/CN
- Electricity, high voltage, at grid/CN

**Waste treatment**

- Waste water treatment, fabric production/l/ U.S.

Additionally, the following datasets were recreated as U.S. specific, unit level processes.

- Pulp Molding
- Recycled pulp, from AOCC, 0% water
- Recycled pulp, from OCC, 0% water
- Fabric combined dyeing
- Fabric mercerizing
- Fabric pretreatment
- Fabric pretreatment and finishing, no dyeing
- Fabric wetting/ bleaching
- Fabric pretreatment, dyeing and finishing, combined process

### LTS Method

The LTS Method, previously called the ES Method, was updated, specifically the ReCiPe endpoints and water midpoint category were updated to version 1.13.

### Library and documentation descriptions

The library and documentation descriptions were updated, including revising our new company name and email address.

## Previous Update Summaries

The 2016 update included an update ES Method (impact assessment method), new waste scenarios based on the latest U.S. EPA report, new 2015 electricity mixes (at the production, high, medium and low voltage levels) and updated library descriptions.

The 2015 update included 47 new processes and 9 updated processes. Now for the first time there is U.S. specific landfill processes to cater for the much needed U.S. landfill disposal data. Also included in the update were new metals and other materials data.

## U.S. Landfill Data

The landfill processes are based on extensive research and consultation with experts. These processes are modeled with full documentation and parameterization of key data inputs. These key data inputs include landfill gas yield 0-2 years, 2-100 years and 100-500 years, landfill gas captured, flared and emitted, landfill gas oxidation rate, and electricity credit generated as a result of landfill gas capture. The model documentation includes a description of the landfill gas generation model and input parameters. These input parameters can be tweaked by the user, if the data need to be customized.

## Metals Data

Over 10 new metal processes have been added, including Beryllium, Germanium and Rheniumare. They are either European or global data. Data for the metals is obtained from Nuss and Eckleman (2014).

## Natural Gas – U.S. specific data & improved mixture

The dataset includes U.S. natural gas from hydraulic fracturing and a new U.S. natural gas mix created based on 2010 actuals, as well as a geothermal electricity process. The U.S. electricity mix was updated using these processes.

**The following processes reroute to the U.S. natural gas mix:**
Natural gas, at long-distance pipeline /RER* US-EI U
Natural gas, at long-distance pipeline/CH* US-EI U
(these processes have been renamed to /U.S.- and /U.S.* respectively)

## Improved natural gas modeling

Todd Krieger of Dupont and his team have been carefully considering the energy flows in both the US-EI and the ecoinvent libraries and have found inconsistencies in the use of higher heating values and lower heating values as the fuels move through the supply chain. In addition to working with ecoinvent to improve this consistency in ecoinvent 3, Todd provided us with his suggestions for improving the natural gas mixture in the US-EI library. We have implemented his suggestions. Other changes include a move of the fugitive emissions during the life of the well from the well itself (infrastructure) to the extracted

natural gas. **As a result, analysis using U.S. electricity or natural gas from the US-EI will show higher emissions than before. Many thanks to Todd and his team for their valuable contributions!**

To continue fleshing out the USLCI data, the US-EI includes the natural gas at extraction site with a 23% shale gas mix.

### Waste treatment and scenarios

A new waste scenario and packaging waste scenario were created based on the 2014 U.S. EPA report. Waste scenarios for White Goods and Electronics also exist. Additional waste types for electronics components were added and these are used in the new waste scenario.

### Dry material disposal processes

The dataset includes waste treatment processes that no longer include the water content in the mass. This allows these processes to be applied directly kilogram for kilogram of dry material disposed. Waste scenarios use these new processes and reflect the latest data available from the EPA.

### Consumption electricity mixes are available for all 50 states.

LCA practitioners now don't have to create a custom electricity mix or rely on the U.S. average, which can be drastically different than states where there is an increased use of nuclear or renewables. The electricity usage indicator was added to all new state mixes.

### Algae Biodiesel

DATASMART includes the data from an algae biodiesel study with Sandia Labs which included data from two operational facilities, one cultivating algae and the other creating diesel from algae oil. Many thanks to Sandia Labs for conducting the study and allowing the data to be made public.

### Textile production

Over 20 new processes for textile production have been added, including knitting, weaving, fabric dyeing and synthetic yarn production.

Due to the extensive use of dye in many industrial processes and the lack of available data, we've created a system level process of the U.S. Input Output data for dyes and pigments to use as a placeholder. While this data will overestimate the impacts of dye in some cases, it may still underestimate the impacts of the most toxic dyes. More information on this process can be found in the U.S. Input Output library.

## Strawberries and Milk: Dairy Data from the U.S. Dairy Greenhouse Gas Carbon Footprint project

The U.S. Dairy Association recently published data in the U.S.DA Digital Commons for milk and cheese products. We were unable to bring this data from the Digital Commons into SimaPro, however, Greg Thoma of the University of Arkansas who did the study was kind enough to send us his SimaPro project, which is what has been implemented in the current version of the US-EI library. This version may not match the data in the Digital Commons. **As an added bonus, this dataset contains data for strawberries!**

## Packaging Processes

Over 10 new packaging process have been added, including recycled containerboard and corrugate and molded pulp, including YFYJupiter's branded straw-based npulp.

## Household Activities

For any product with a use phase, it is often an environmental hotspot. The new database includes several household activities including clothes washing and drying and dishwashing.

## No More Dummy Processes

The USLCI database has been modified by entering ecoinvent proxy data into many of the dummy processes. These processes have been renamed "Proxy" and moved to a proxy folder. This version of the US-EI library contains all of the newer USLCI datasets already in SimaPro and a few of the newer ones that have yet to be included. A more detailed description of this database and its terms follows.

## Detailed Description and Other Revisions

Specifically, for the USLCI Database 146 of the 186 dummy processes were replaced with ecoinvent proxies using U.S. electricity (detailed in *DATASMART - US-EI Dataset - Dummy USLCI Processes Replaced with Proxies.xlsx*, which is available upon request). Some of the dummy processes were not replaced if they were not available in the ecoinvent dataset, or if they were intentionally empty because they followed the cut-off approach. For the ecoinvent dataset, all processes using electricity from Switzerland or one of the European regions (RER, UCTE, CENTREL or NORDEL) were indirectly adapted to instead use U.S. electricity. This was done by rerouting electricity production/ distribution to U.S. electricity production/ distribution in the following processes:

Electricity, medium voltage, production UCTE, at grid/UCTE U
Electricity, low voltage, at grid/CH U
Electricity, low voltage, production UCTE, at grid/UCTE U
Electricity, medium voltage, at grid/CH U
Electricity, medium voltage, production NORDEL, at grid/NORDEL U
Electricity, high voltage, production UCTE, at grid/UCTE U

Electricity, production mix UCTE/UCTE U
Electricity, low voltage, production RER, at grid/RER U
Electricity, medium voltage, production CENTREL, at grid/CENTREL U
Electricity, low voltage, production CH, at grid/CH U
Electricity, medium voltage, production CH, at grid/CH U
Electricity, medium voltage, at grid/DE U

Process names were changed to show the U.S. nature of the new processes:

/CH changed to /U.S.*
/RER changed to /U.S.-
/DE changed to /U.S.**

Available U.S. processes were also substituted for non-U.S. processes in the ecoinvent datasets:

| | |
|---|---|
| Fluosilicic acid, 22% in H2O, at plant/RER U | Fluosilicic acid, 22% in H2O, at plant/U.S. U |
| Soya oil/RER | Soybean oil, at oil mill/U.S. U |
| Grain maize IP, at farm/CH U | Corn at farm/U.S. U |
| Potatoes IP, at farm/CH U | Potatoes, at farm/U.S. U |
| Rape seed IP, at farm/CH U | Rape seed, at farm/U.S. U |
| Rape seed extensive, at farm/CH U | Rape seed, at farm/U.S. U |
| Soy beans IP, at farm/CH U | Soybeans, at farm/U.S. U |
| Wheat grains IP, at farm/CH U | Wheat grains, at farm/U.S. U |

No other work was done to adapt the ecoinvent library, and because of geographic differences other than those modified, there is no guarantee that the resulting inventory is closer to the U.S. reality than the original ecoinvent dataset. For additional information on the original process, see the Ecoinvent System Description.

Most materials with non-mass units have been duplicated with mass units. This allows them to be used easily in Product Stages.

### Parameterized Semiconductor Oxidation Data

We've included the parameterized semiconductor oxidation process from Murphy et al.

### Uncertainty

We've continued to add uncertainty to data in the combined dataset. This is an ongoing process.

### U.S. Fresh Water Source

All fresh water use in RNA processes has been modified to a U.S. water source that will be picked up by most of the water scarcity methods.

### A number of methods, including:

- **The LTS Method**, previously called the ES Method (Includes indicators for human health, ecosystem quality and resources (from ReCiPe (H)), as well as climate change (from IPCC 100 year), water depletion (from ReCiPe (H)), and cumulative energy demand.)
- **The GPP (Global Protocol on Packaging) method**
- **Methods found in several PCRs including: Printers (ULE), North American Concrete; and the Sustainable Apparel Coalition.**
- **Electricity Usage**

### New U.S. processes added to account for exports

Some U.S. processes from the US-EI library have been added as system level processes to account for exports. As an example, the AOCC (American Old Corrugated Container) used in making recycled pulp in China uses waste corrugate imported from the U.S. The waste corrugate has been duplicated in the ecoinvent library to better account for the U.S impacts. If the user wants to better understand the supply chain of these system processes, we recommend they make a copy of the higher level process and change the link to the appropriate data in the US-EI library.

### New Detergent and Water Use Processes

Some processes added to the US-EI library have been converted into European processes by substituting U.S. data with RER data. These include the detergents and water use processes.

### Non US Energy & Processes

Energy data and processes from regions outside North America have been included in DATASMART as many North American products either contain materials produced outside the region or begin their production in another country, such as China. For this reason we have chosen to include this data in DATASMART.

### Updated Chinese Electricity & New Processes

The Chinese electricity data has been updated to 2011. Some additional Chinese processes have been added, including tap water, at user.

### More Electricity Data

Electricity mixes have been added for Taiwan, Honduras and El Salvador.

### Improved Capability to Account for Electricity Usage

A newly created substance called electricity usage, found under resources, has been added to all Production + import electricity processes. Adding this resource to a method or using the new Electricity Usage method will give a good indication of total grid electricity used. A few processes pull in the grid electricity without imports and these will be missed.

### Data you shouldn't use

Some data that came with the original US-EI was not modified when the specific electricity mixes were changed, and in many cases have a strange mix of upstream processing in this context. This data has been moved to a category called Non-RNA data. If this data has been used in your projects, we suggest that you select the appropriate Ecoinvent 2.2 data in its place.

We also found that users were not consistent with the selection of which transformed process to use. To make it easier for new users, LTS has left a recommended process in the main folder and created an alternative folder for other data that might be used. We selected the recommended processes according to the following decision tree:

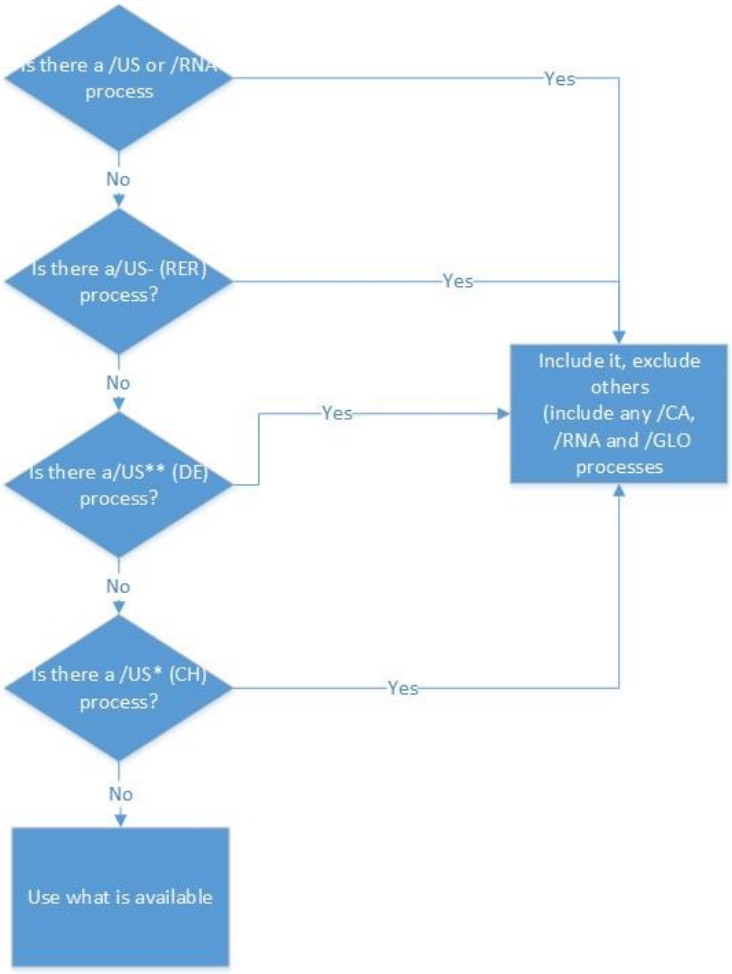


*Figure 2: Decision tree used to select data for use in the US-EI main datasets.*

The decision tree was based on LTS's empirical experience with U.S. manufacturers indicating that a European average was more similar to the U.S. condition than a particular country average and that manufacturing conditions in Germany are in general more similar to the U.S. than in Switzerland. If this is not the case for a particular piece of data, it can still be found under a subcategory with the same name as the parent category with the word "alternative" after.

For newcomers to LCA, we recommend not using alternative data unless the user has a specific reason to.