

External Model Calculator

API user guide

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1 Introduction

This document explains how to use the External Model Calculator (EMC) API. The external model calculator allows you to enrich the organization's existing business intelligence systems with sustainability metrics.

To test the API, we provide an onboarding package which contains:

- **API user guide** (current document) with step-by-step instructions.
- **Postman collection** with a set of ready-to-use API requests and a bill of materials. Some variables are placeholders and will need to be replaced with your user- or organization-specific data.
- **Primary data library** file. If you don't have an existing primary data library in your SimaPro organization, you can import this file.

As part of the onboarding package, you also receive a demo bill of materials for an e-bike that is already included in your Postman collection.

A glossary of the SimaPro terminology is listed in the Appendix.

2 Architecture

2.1 How does the EMC work?

The EMC takes the bill of materials from your business intelligence system and executes an LCA calculation using life cycle data in SimaPro, without the need to create and store the data in the SimaPro database. Since the results are not stored in SimaPro, they need to be written back to the same location as the input – some type of Binary Large Object storage.

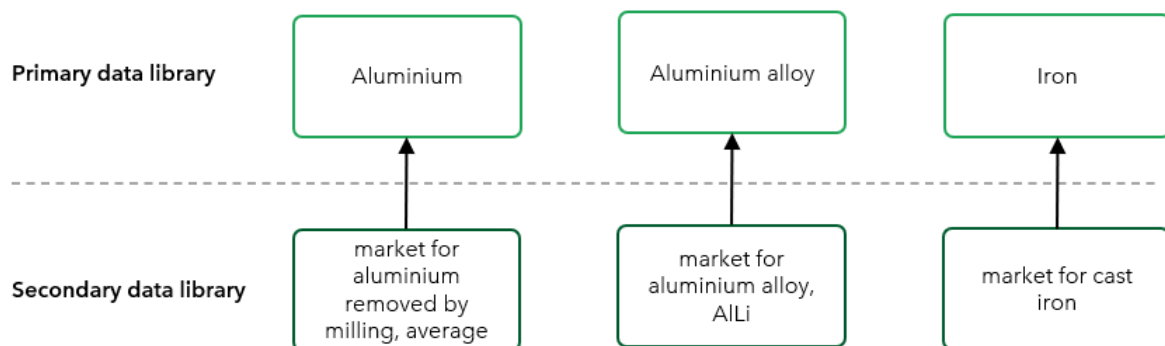
A process, known as data mapping, enables the BOM to utilize life cycle data in a primary data library in SimaPro as the basis for calculating impact.

2.2 What is a primary data library?

A primary data library is a contained collection of datasets owned by an organization. The source of the data is more specific to the scope, specifically collected and or tailored for a specific objective, increasing relevance and specificity. These libraries are managed by LCA experts.

A primary data library is backed by one or more secondary data libraries, which are a collection of datasets from an authoritative source, characterized as "secondary" due to its generalized nature, not tailored specifically for a current objective. Examples include ecoinvent and Agri-footprint.

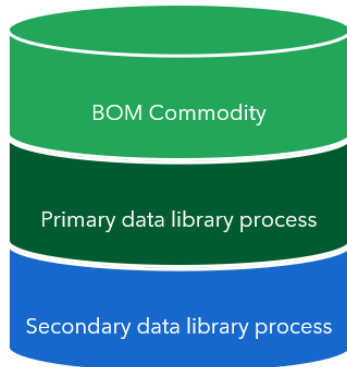
A primary data library is a prerequisite for the EMC to work. The diagram below depicts an example of such a library.



2.3 What is data mapping?

A data mapping connects the input data of the organization's external system to a process from a primary or secondary data library source. Data mappings can be managed at an organization or an integration level. Once a mapping is created, it does not break, which means it can be reused in many LCA calculations. Each calculation targets only one primary data library at a time.

The diagram shows the structure of a single data mapping.



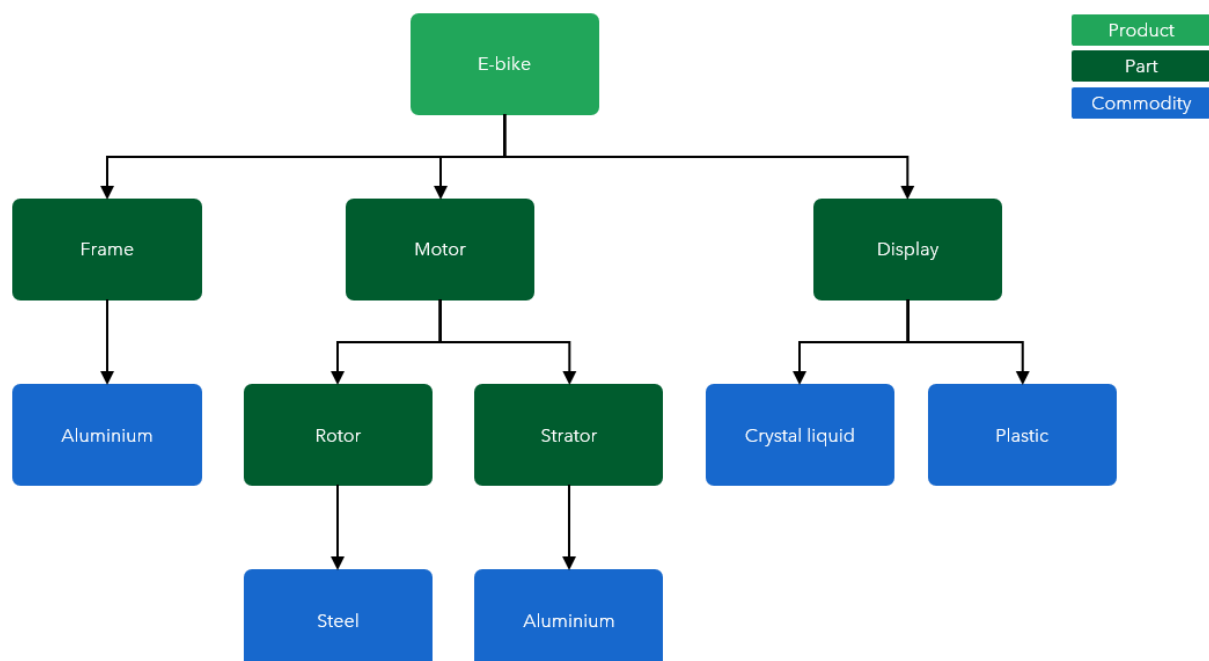
2.4 What is the structure of my BOM?

The BOM needs to have a hierarchical structure consisting of one top product, parts, and commodities.

- **Product** is the final product being calculated.
- **Parts** are the components that make up the product.
- **Commodities** are the raw materials and processes at the lowest tier of the BOM. These processes get mapped to the processes in the primary data library.

The diagram below shows a simplified structure of a BOM. It consists of one product, several parts, and several commodities. The structure of parts and commodities is flexible. A part can be made of one or more commodities, as well as of other parts.

It is also possible to map commodities directly to the top product, skipping the parts entirely.



Commodities have commodity numbers which get mapped to the primary data library in SimaPro. For additional details about a commodity, you can create custom tags. Tags can describe things like where the part comes from, supplier details, color, etc.

The “composed of” relation contains the quantity, amount, and unit, describing how much of that part or commodity is used.

2.5 What is a placeholder process?

A placeholder process is an empty calculation container that allows the EMC calculation to take place while not storing any data in SimaPro. It needs to exist in a separate project in your company on the SimaPro Footprint Platform. The same placeholder process can be used in every EMC request.

3 Demo material set-up

3.1 How to import the primary data library?

To import the demo primary data library into SimaPro via the UI:

1. Go to <https://appsv2.simapro.com/> and log in.
2. Click on + New project.
3. Change the details of your project, such as Name, Comment, Author, etc.
4. Check *Is a library*, then click Save.

The screenshot shows the 'Details' tab of the SimaPro Flow interface. The 'Project name' field is filled with 'Company library'. Below it is a 'Comment' text area. The 'Author' field contains 'li@pre-sustainability.com', and the 'Publisher' field contains 'Amplify'. The 'Major version' and 'Version' fields are empty. The 'Is a library' checkbox is checked, and the 'Use watersheds' checkbox is unchecked. A green 'Save details' button is at the bottom right.

5. Click on the Libraries tab and select the ecoinvent 3.9 Cut-off library.

The screenshot shows the 'Libraries' tab in the SimaPro Flow interface. A list of libraries is displayed, including 'Agri-footprint 6.3 - mass - unit', 'Company library', 'ecoinvent 3.8 Cut-off' (which is selected with a blue checkmark), 'ecoinvent 3.9.1 Cut-off', and 'Ecoinvent Products'. At the bottom, there are navigation controls showing page 1 of 46 items.

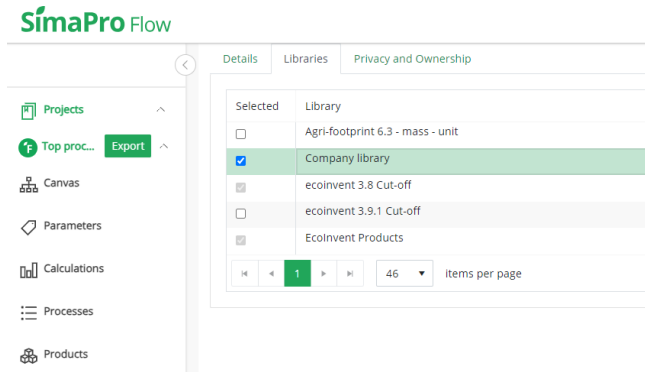
6. Drag and drop (or Click 'Import') the *Primary data library* CSV file in the area shown below or anywhere else in your new project.
7. In the Import details pop-up, select Professional 9.5 and click *Continue*.

The screenshot shows a 'File import' dialog box. The title is 'File import "Company Library (EMC).csv" into "Company library"'. Below the title, it says 'Import details' and 'Find out more about import options in the SimaPro Help Center.' There are three radio button options: 'Professional 9.4' (selected), 'SimaPro EF 3.1', and 'Professional 9.5'. At the bottom, there are 'Back', 'Continue', and 'Cancel' buttons.

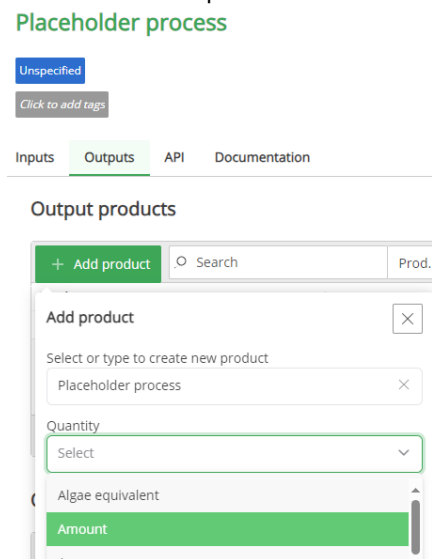
3.2 How to set up a placeholder process?

To set up a placeholder process in SimaPro via the UI:

1. Create a new SimaPro project.
2. Enable the target Primary data library as a library.



3. Go to *Processes*.
4. Click *+Add new process*. Give the process a name.
5. Then, go to the *Outputs* tab.
6. Click on *+Add product*.
7. Give the output the same name as the process and click on create.



8. Set the allocation to 100%.
9. Click *Save*.



The project containing a placeholder process must **always** enable the targeted primary data library as a library.

4 How do I begin using the API?

We will be using Postman – a platform for building and testing APIs. You can download Postman [here](#).

4.1 Configure your request

The demo Postman collection has been pre-configured. However, some values are placeholders and will require you to insert your own data. This will be specifically stated where necessary.

If you are making a new request, use this checklist to make sure that every call is configured properly:

- ☐ Select HTTP method.
- ☐ Insert URL of the endpoint.
- ☐ Insert access token to authorize the request.
- ☐ Insert headers: content type, subscription key, and company ID (if necessary).
- ☐ Insert the body data (if necessary).

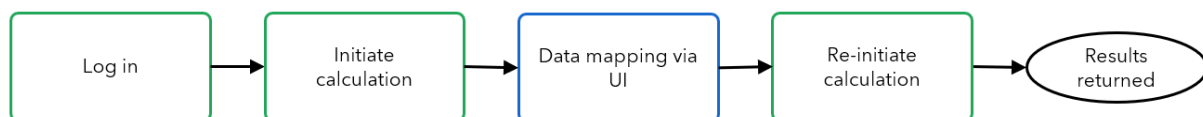
For detailed instructions on how to configure new requests, see Appendix B-F.

4.2 Follow this sequence of requests

The general sequence of requests to do an external model calculation is as follows:

1. Log in to the SimaPro API.
2. Initiate the calculation. This request will trigger the creation of a mapping page in the primary data library.
3. An LCA expert will intervene and map missing data mappings.
4. When the mapping is complete, initiate the calculation again.

NB: In the case that the mapping is already complete when initiating the first calculation call, the request will immediately retrieve results, and the mapping step can be skipped.



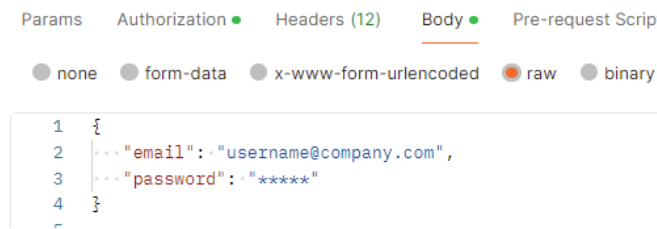
4.3 Send the requests

Open Postman. Import the demo Postman collection file provided in the onboarding package.

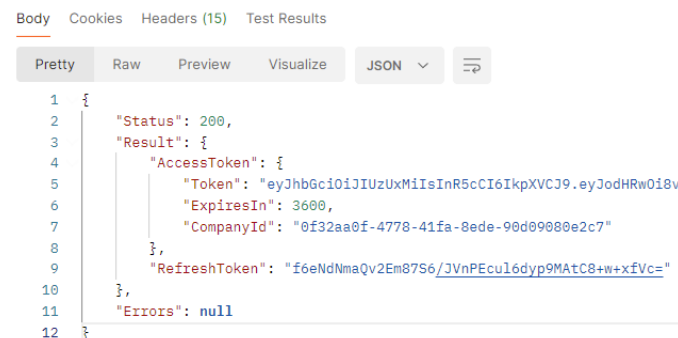
4.3.1 Login

POST	https://api-platform.simapro.com/auth/token
------	---

1. Go to the *Login* request. The HTTP method, endpoint URL, and headers are preconfigured. Authorization header is skipped at this stage.
2. Go to the *Body* tab. Replace placeholder values with your SimaPro API username and password.



3. Send the request. The response will return an access token.



The request contains a script in the *Test* tab which will save this access token in the variable `access_token`. You can use this variable to authorize all subsequent requests.

4.3.2 Calculate

POST	https://api-platform.simapro.com/api/calculation/bom/
------	---

1. Go to the *Calculate* request. The HTTP method, endpoint URL, headers, and authorization are preconfigured.
2. Go to the *Header* tab. Replace {subscriptionKey} with the value of your primary or secondary subscription key.

NB: Your subscription key is different per API product. Make sure to use the subscription key for External Model Calculations API.

3. Go to the *Body* tab. The body contains the bill of materials for an e-bike.

Params Authorization Headers (12) **Body** Pre-request Script Tests Settings

☐ none ☐ form-data ☐ x-www-form-urlencoded ☒ raw ☐ binary ☐ GraphQL **JSON** ▾

```

1  {
2    "libraryId": "68c9e5c8-1791-4c0c-b592-a9d1d25b3558",
3    "placeholderProcessId": "195e6718-71f2-47d7-9d76-48e54594077e",
4    "description": "string",
5    "method": "cdba8445-4f12-4fd1-b64a-5632e7af8a00",
6    "externalReference": "string",
7    "product": {
8      "productNo": "0",
9      "productName": "e-bike",
10     "amount": 1,
11     "unit": "p",
12     "composedOf": [
13       {
14         "partNo": "1",
15         "amount": 1,
16         "unit": "p"
17       },
18       {
19         "partNo": "2",
20         "amount": 1,
21         "unit": "p"
22       },
23       {
24         "partNo": "3",
25         "amount": 1,
26         "unit": "p"
27       }
28     ]
29   }
30 }

```

4. Replace the *placeholderProcessId* value with the ID of the process created in section 3.2.
5. Replace the *libraryId* value with your target primary data library ID.
6. This calculation uses the ReCiPe 2016 Midpoint (H) LCIA method.
7. Send the request. The response will give you a *missing mapping* error.

Body Cookies Headers (4) Test Results

Pretty Raw Preview Visualize JSON ▾

```

1  {
2    "errors": [
3      {
4        "name": "Mapping",
5        "code": "EMIM",
6        "message": "Missing mapping for commodity 'Aluminium'."
7      }
8    ],
9    "result": null
10 }

```

However, if all commodities are already mapped in the primary data library, you will get impact results immediately, meaning no further action is needed.



When Part No. is mentioned more than once in a BOM, the grammar, casing, and spacing **have to be consistent**. Otherwise, the request will fail.

Custom tags (specifications)

It is possible to add custom tags to each data mapping for additional detail about the commodity. They do not affect the calculation, but they are useful for organization of the mappings library.

Verification

An LCA expert can use the Verified toggle to signal that the commodity has been checked and is correctly mapped to an appropriate primary data library process. The setting of the toggle has no impact on the performance of the mapping.

4.3.3 Create data mappings

Once the calculation has been initiated, data mappings will be done by an LCA expert via the SimaPro user interface. No action is required from the backend.

Each key in the BOM file corresponds to a column in the SimaPro user interface mapping page. See table 2.

For the LCA expert

To create data mappings via the user interface:

1. Log in to the SimaPro Footprint Platform <https://appsv2.simapro.com/>.
2. Open your company library.
3. Go to the *Processes* tab.
4. In *Processes*, click on the *Mapping* tab.
5. In the *Mapped Process* column, select a library process for each BOM commodity.

External ID	External process name	Mapped Process	Geography	Verified
aluminium alloy	market for aluminium alloy, AlU	market for aluminium alloy, AlU GLO	global	☐
iron	market for cast iron	market for cast iron GLO	global	☐
steel	market for chromium steel removed by milling, average	market for chromium steel removed by milling, average GLO	global	☐
silicon	market for silicon, electronics grade	market for silicon, electronics grade GLO	global	☐
plastic	market for polyethylene terephthalate, granulate, amorpho...	market for polyethylene terephthalate, granulate, amorpho...	global	☐
lithium	market for anode, graphite, for Li-ion battery	market for anode, graphite, for Li-ion battery CN	china	☐
liquid crystal	market for glass, for liquid crystal display	market for glass, for liquid crystal display GLO	global	☐
aluminium	market for aluminium removed by milling, average	market for aluminium removed by milling, average GLO	global	☐
rubber	market for synthetic rubber	synt market for synthetic rubber GLO	global	☐

Mapping page in a company library via SimaPro user interface.

Table 1. Mapping page header descriptions.

Mapping page headers	Description
External ID	CommodityNo
External process name	CommodityName
Mapped process	Primary data library process
Material type (custom tag category)	Specifications (custom tag category)
Verified	(not) checked by LCA expert

4.3.4 Reinitiate calculation

Once the data mapping is complete, reinitiate the calculation request. A successful calculation will return your impact results. They will look something like this:

Body Cookies Headers (3) Test Results

Pretty Raw Preview Visualize JSON

```

23  "product": {
24    "partNo": "0",
25    "impact": {
26      "Human non-carcinogenic toxicity": 268.6931758525483,
27      "Ozone formation, Human health": 0.5656168370846218,
28      "Freshwater eutrophication": 0.12250203183198727,
29      "Stratospheric ozone depletion": 8.104122110319509E-05,
30      "Marine eutrophication": 0.012774714743471353,
31      "Marine ecotoxicity": 25.02701903703761,
32      "Terrestrial acidification": 1.04000096070019,
33      "Human carcinogenic toxicity": 45.94349046591109,
34      "Freshwater ecotoxicity": 19.535104903566804,
35      "Terrestrial ecotoxicity": 755.157359125147,
36      "Land use": 5.413089527104435,
37      "Fossil resource scarcity": 57.58226702393097,
38      "Ionizing radiation": 17.870927182404017,
39      "Mineral resource scarcity": 2.3597973448338543,
40      "Water consumption": 25.071878146529293,
41      "Fine particulate matter formation": 0.4850532269726159,
42      "Global warming": 238.4774404800326,
43      "Ozone formation, Terrestrial ecosystems": 0.5818225583373061
44    }
45  },
46  "parts": [
47    {
48      "partNo": "1",
49      "impact": {
50        "Human non-carcinogenic toxicity": 95.08140493888924,
51        "Ozone formation, Human health": 0.16940095429999333,
52        "Freshwater eutrophication": 0.028728195360576324,
53        "Stratospheric ozone depletion": 1.5414325610582867E-05,
54        "Marine eutrophication": 0.004271617848122894,
55        "Marine ecotoxicity": 13.296354515259065,
56        "Terrestrial acidification": 0.2841808509847901,
57        "Human carcinogenic toxicity": 12.021863861809175,
58        "Freshwater ecotoxicity": 10.693341619422691,
59        "Terrestrial ecotoxicity": 148.46330598840976,
60        "Land use": 1.33906007859336,
61        "Fossil resource scarcity": 13.726447360122505,
62        "Ionizing radiation": 1.4540689466021917,

```

5 How to interpret results

- Product = always shows impact for 1 unit of output
- Part = always shows impact for 1 unit of output
- Commodity = always shows impact for 1 unit of output of the primary data library process that it is mapped to.

NB: typically, an LCA expert will create a primary data library process with output of 1 unit.

6 Technical specifications

6.1 Request validation

To get a successful calculation, it is essential that your request meets the following validation requirements:

1. Library ID is entered
2. Placeholder process ID is entered
3. Method ID is entered
4. Product is entered
5. Commodities contain at least 1 entry
6. ComposedOf element for commodities is empty
7. PartNo's throughout the BOM are consistent in grammar, casing, spacing, etc.

6.2 Error codes

The external model API implements most of the common HTTP results.

Success - 200

All successful requests will return a 200 code, as well as the expected response message.

Client error – 4XX

This class of errors means there is a problem with the request caused by the client/user.

- **400** – The server cannot understand the request due to invalid syntax, malformed request, or other client-side errors.
- **401** Unauthorized – Incorrect log in credentials or access token has expired.
- **403** Forbidden – The request contains valid data understood by the server, but you do not have permission to access the requested source.

Table 2. 400 error messages and descriptions.

Message	Solution
PartNo is required	PartNo is missing. Fill in PartNo.
Amount is required	Amount is missing. Fill in an amount.
Unit is required	Unit is missing. Fill in a unit
ComposedOf should contain at least 1 entry	ComposedOf element is missing. Fill in a value for PartNo, Amount and Unit.
Description is required	Description of commodity is missing. Fill in a name of the primary data library process to link.

Missing mapping for commodity X is missing	Commodity X has not been mapped. Map the missing commodity and reinitiate the calculation.
--	--

If validation of input was correct but you are still not getting expected results, other functional errors might have occurred:

Error	Solution
Library access	You are not authorized to have access to the selected primary data library. Select a different primary data library or reach out to SimaPro Support ¹ to request access.
ID not found	Placeholder process ID or any other referenced ID is not found in the database. Check if all IDs are correct.
Calculation succeeds but no commodity impact	There is no impact from a primary data library process. Add an input product to the primary data library process.

Server error – 5XX

This class of errors means that the server is unable to perform the request and requires intervention by the administrator.

- **500** – an unexpected problem occurred; technical support is needed.
- **50X** – an unexpected problem occurred in the infrastructure; technical support is needed.

¹ support@simapro.com

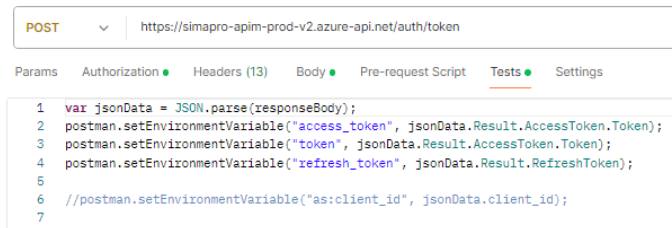
Appendix

Appendix A: Glossary

Term	Definition
Bill of materials (BOM)	A list of the raw materials, sub-assemblies, intermediate assemblies, sub-components, parts, and the quantities of each needed to manufacture an end product.
Data mapping	A data mapping connects the input data of the organization's external system to a process from a primary or secondary data library source. Data mappings can be managed at an organization or an integration level.
External Model Calculator (EMC)	API product that calculates impact based on a bill of materials.
Placeholder process	Empty calculation container that allows the EMC calculation to take place while not storing any data in SimaPro
Primary data library	A contained collection of datasets owned by an organization. The source of the data is more specific to the scope, specifically collected and or tailored for a specific objective, increasing relevance and specificity.
Secondary data library	A collection of datasets from an authoritative source, characterized as "secondary" due to its generalized nature, not tailored specifically for a current objective. Examples: ecoinvent, Agri-footprint.

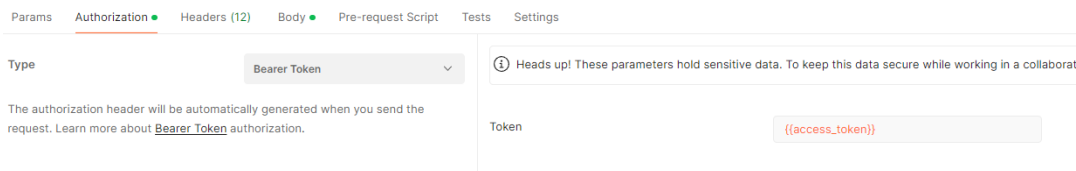
Appendix B: Guide for inserting access token to authorize the request

When you log in to the SimaPro API, the response will contain an access token. Your demo request contains a script in the *Tests* tab that saves your access and refresh tokens as variables in the Postman Environment.



This means that you can authorize all subsequent requests using the variable *access_token*. To do this:

1. Go to *Authorization* tab.
2. Select *Bearer Token* as the authorization type.
3. Insert `{{access_token}}` in the token input field.



NB: you do not need to add an access token to the Login request.

Appendix C: Guide for request headers – content type

Every request must use the JSON media type. To do this in Postman:

1. Go to *Headers* tab.
2. Write *Content-Type* in the Key column.
3. Write *application/json* in the Value column.

Some requests use *application/json;v=2.0*. This will be explicitly stated where applicable.

Params Authorization ● Headers (12) Body ● Pre-request Script Tests ● Settings

Headers 9 hidden

	Key	Value
☒	Content-Type	application/json
☒	Ocp-Apim-Subscription-Key	1wf*****
☒	X-companyId	0f32aa0f-4778-41fa-8ede-90d09080e2c7
	Key	Value

Appendix D: Guide for request headers - subscription key

To authorize the use of a specific API product, you will need to insert a subscription key in the header. To do this in Postman:

1. Go to *Headers* tab.
2. Type *Ocp-Apim-Subscription-Key* in a new row under the Key column.
3. Insert your primary or secondary subscription key into the Value column.

Params Authorization ● **Headers (12)** Body ● Pre-request Script Tests ● Settings

Headers <> 9 hidden

Key	Value
☒ Content-Type	application/json
☒ Ocp-Apim-Subscription-Key	1wf*****
☒ X-companyId	0f32aa0f-4778-41fa-8ede-90d09080e2c7
Key	Value

You can decide if you want to choose a primary or secondary subscription key based on your needs.



Primary Subscription Key: the main and default key associated with a subscription. It's used for regular and ongoing access to the API. This key is often used in the initial setup and integration of your application with the API.

Secondary Subscription Key: provided as a backup or for use in specific scenarios. It can be used as a failover key or as a replacement for the primary key if needed. The secondary key may be rotated or regenerated periodically for security reasons, and developers can switch to using the new secondary key while the primary key is updated.

Appendix E: Guide for request headers - company ID

Company ID is only necessary when you have access to multiple company environments on the SimaPro Platform. The company ID allows you to make calls in the targeted company. To specify a company ID in Postman:

1. Go to *Headers* tab.
2. Type *X-companyId* in a new row under the Key column.
3. Insert the company ID into the Value column.

Params Authorization ● **Headers (12)** Body ● Pre-request Script Tests ● Settings

Headers <> 9 hidden

	Key	Value
☒	Content-Type	application/json
☒	Ocp-Apim-Subscription-Key	1wf*****
☒	X-companyId	0f32aa0f-4778-41fa-8ede-90d09080e2c7
	Key	Value

Appendix F: Guide for request headers - body data format

If your request contains data in the Body section, you need to use the raw JSON mode. To do this in Postman:

1. Go to the *Body* tab.
2. Select the *raw* option.
3. Select *JSON* mode in the drop-down menu.

