



Verkosto-LCA: Hiilijalanjälkilaskentaa alihankintaketjuille

VTT

Susflow webinar 2025-06-09

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17/06/2025 VTT – beyond the obvious

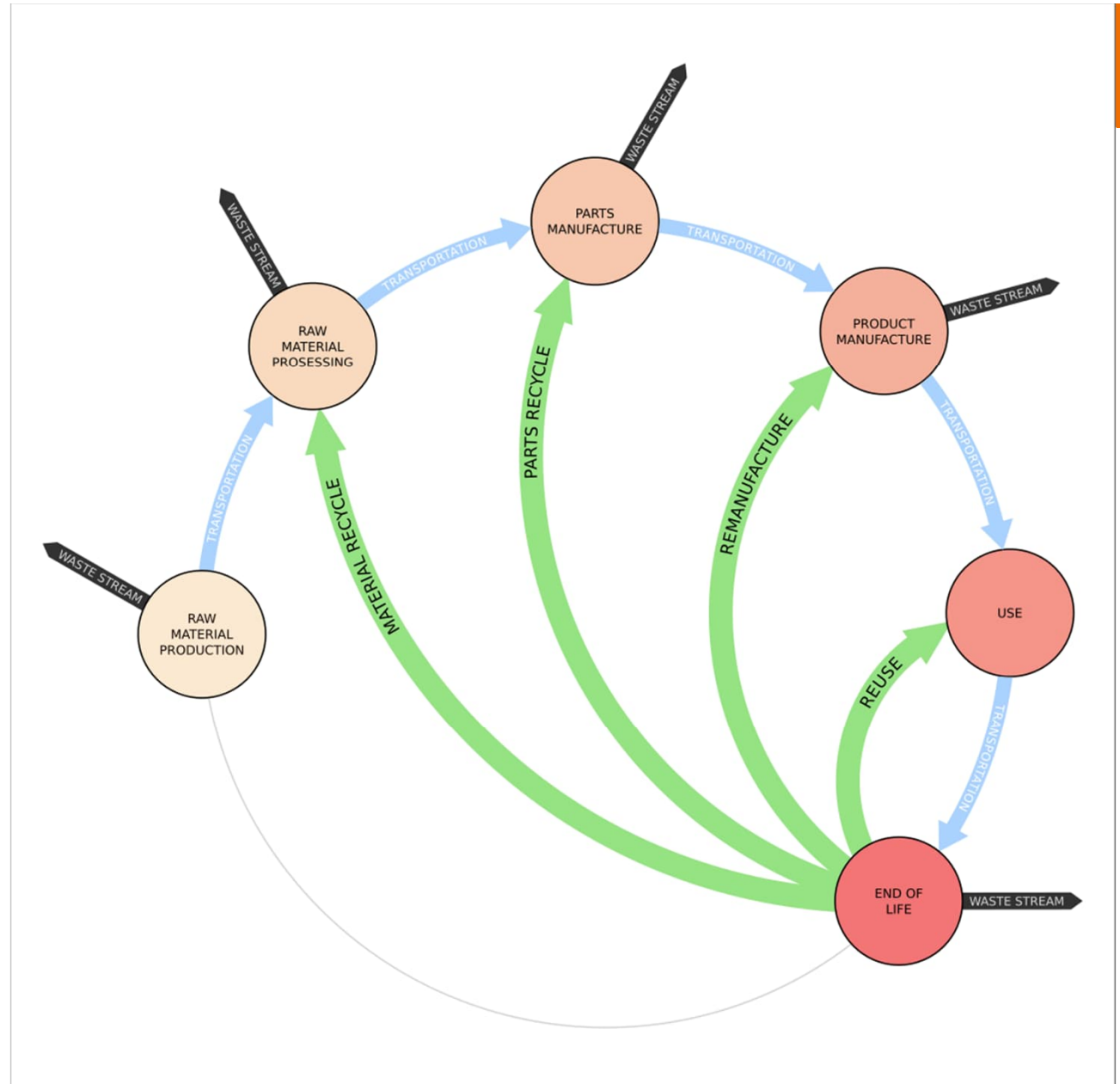
Network LCA in circular economy applications

- Network LCA is a tool which can be used for
 - LCA data collection
 - LCA data analysis
 - Product design
 - Sharing the LCA results within the network of multiple operators/companies (value chain/network)

Network LCA & circular economy

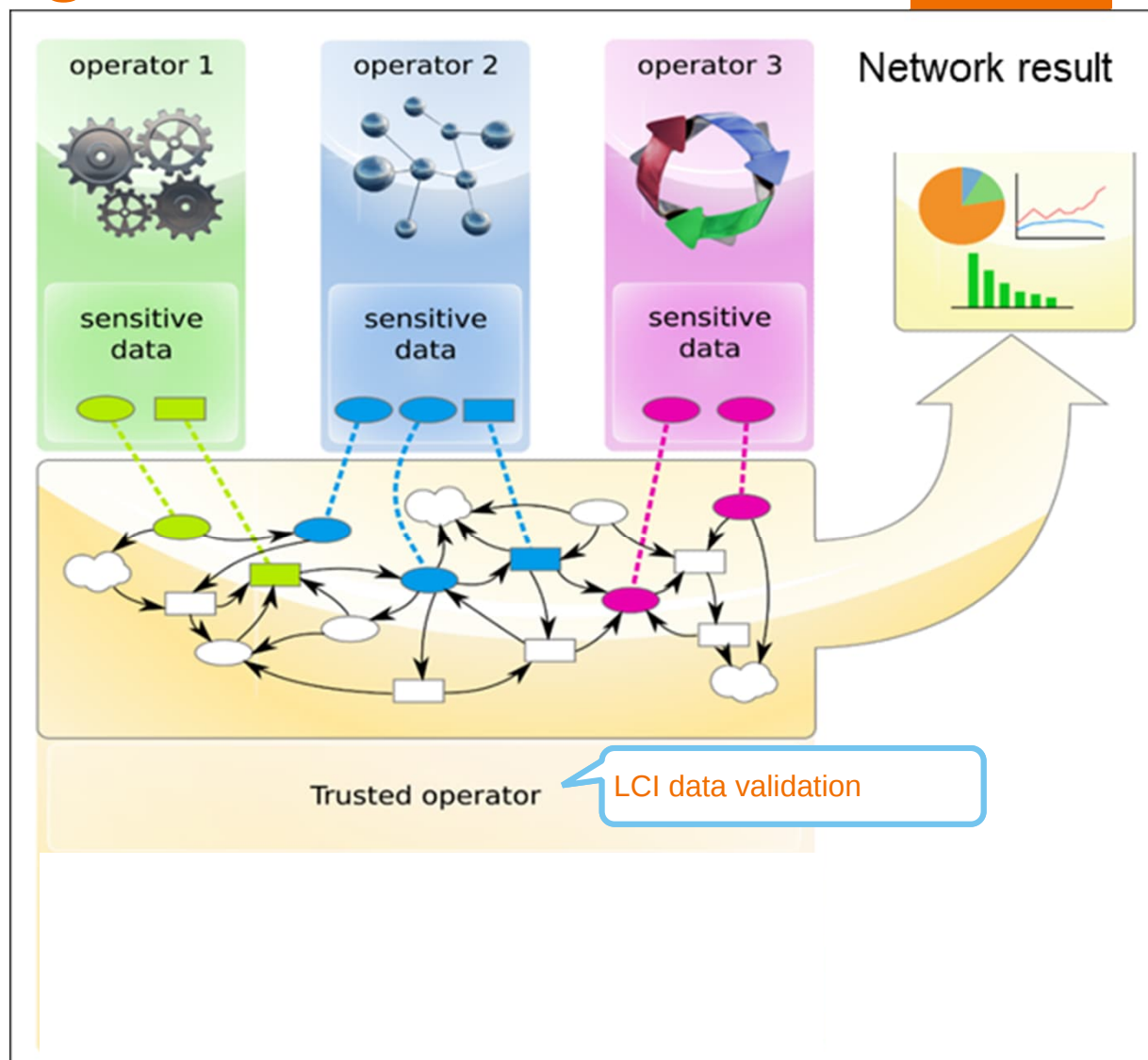
- Circular economy requires tools which facilitate collaboration between various value chain partners from different companies
- Works both for linear and circular economy settings
- The tool can also serve the value chain operators within a single organization

17/06/2025 VTT – beyond the obvious



How to share knowledge in the network?

- Trusted operator (e.g. VTT) maintains network level shared model. While the **model is shared**, **data is not in the original set-up**. **NOTE: this requirement can be relaxed in the new set-up (to ease e.g. sustainability reporting): all network partners can send data requests to each other.**
- Network **partners can test independently** of the trusted operator and each other **how changes of their own data affects their local and the network level results**, e.g. total carbon footprint => process design & optimization
- Model and data inputs can be **constantly improved & updated** (can start with incomplete data)
- Can be extended to integrated assessments such as **LCC** (Life Cycle Costing analysis) + LCA

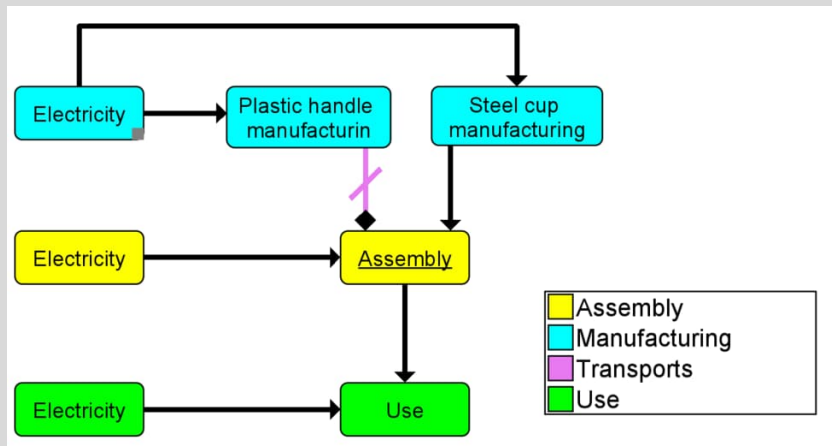


How to use Network LCA for product design & carbon footprint minimization?

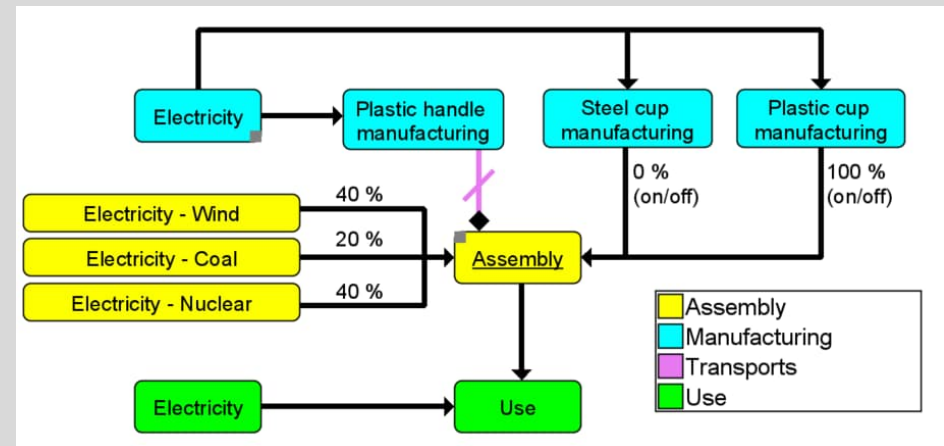


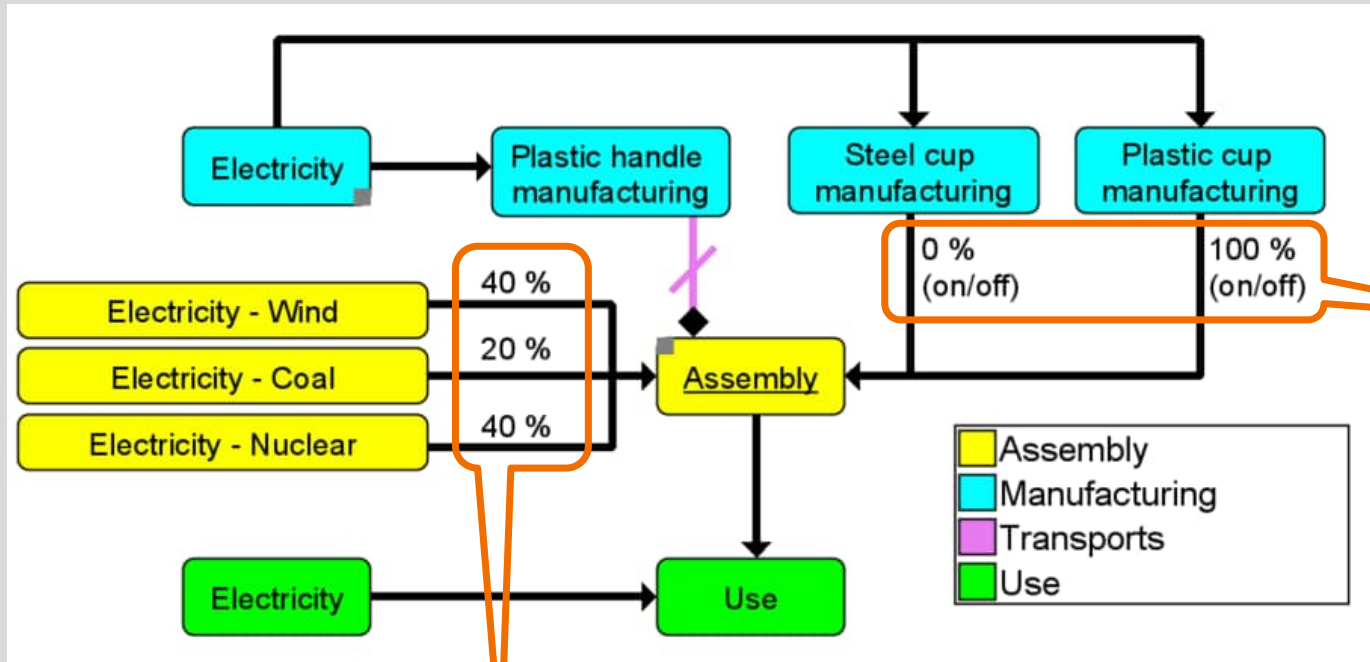
Simple example (comparing two steel cup manufacturing methods)

BASELINE SYSTEM



NEW PRODUCT SYSTEM





Can be modified by the user

Can be modified by the user

Baseline system : ReCiPe Midpoint (H) incl.long-term		
	Label	Climate change (GWP100) [kg CO2eq]
1	Baseline system	
2	Primary Codes	3,688
3	Assembly	0,06250 1,69%
21	Manufacturing	0,5000 13,56%
49	Transports	0,0001800 0,00%
61	Use	3,125 84,74%
83	New product system	
84	Primary Codes	3,469
85	Assembly	0,03110 0,90%
121	Manufacturing	0,3125 9,01%
158	Transports	0,0001800 0,01%
170	Use	3,125 90,09%
192	New product system handprint	
193	Primary Codes	0,2189 5,94%
194	Assembly	0,03140 50,24%
239	Manufacturing	0,1875 37,50%
276	Transports	
288	Use	

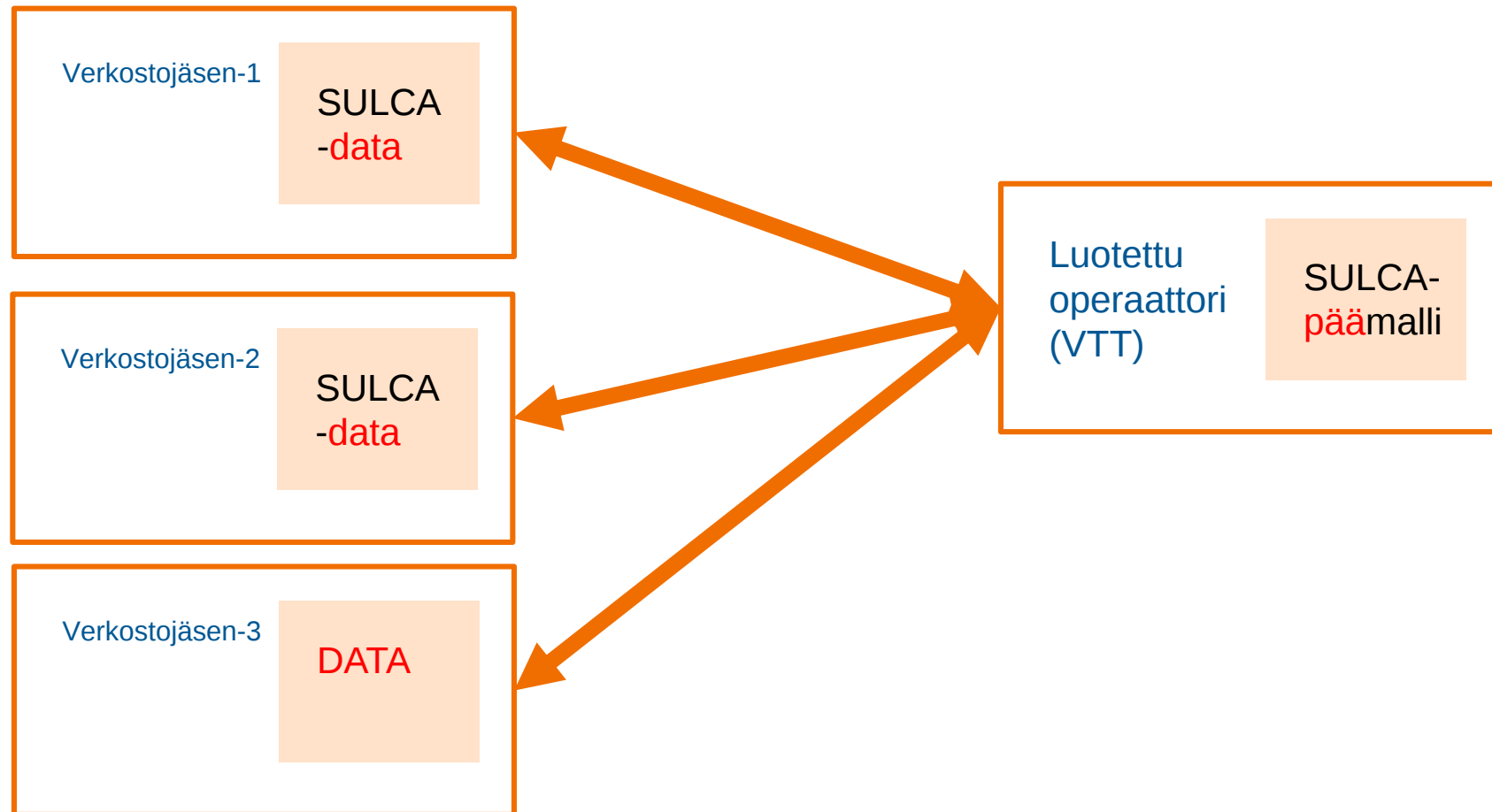
Results table

Carbon footprint
results for
baseline system

Carbon footprint
results for new
product system

Carbon handprint –
positive impact gained
with the new product
system

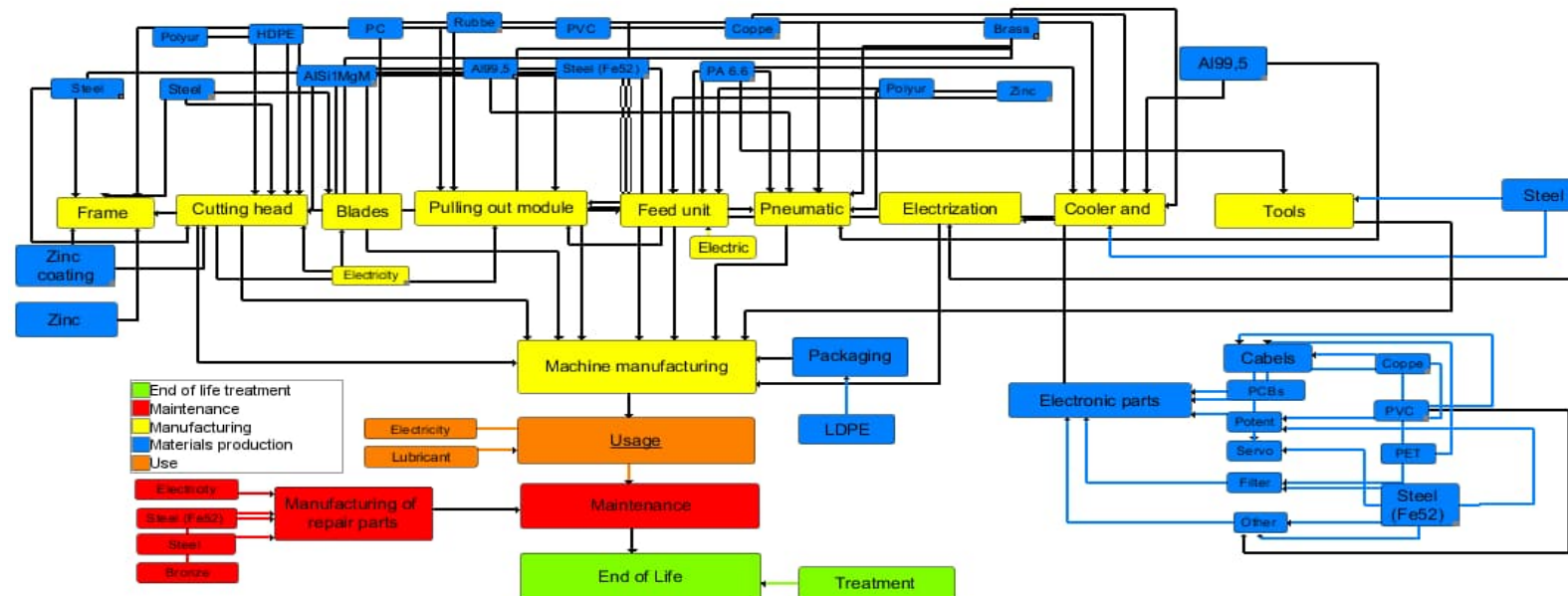
Data flow diagram of VTT Network LCA tool



LCA model data input sources

- Sulca and other LCA modeling software tools can use and map data inputs from commercial databases (e.g. EcolInvent)
- Primary data sources for accurate assessments (e.g. company-specific databases, measurement systems etc.)
 - (1) from within the same company
 - (2) from other network partners

Why are software tools for LCA modeling needed? Example: Sulca model



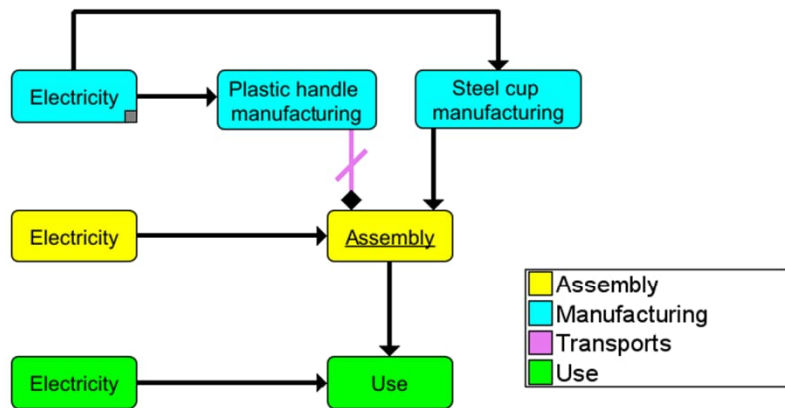
- Large amounts of data are used for calculations (e.g. the flowsheet above includes > 50 processes and > 3000 variables)
- Visualisation of complex life cycles
- Analysis of results easier than with Excel

Using LCA models through GUI

- Two simple graphical user interfaces have been constructed during the project
- (1) GUI-1 (coffee cup manufacturing) <= fast, open
- (2) GUI-2 (ship manufacturing) <= slow, closed
- No installation is needed, usable via browser
- Does not require deep LCA expertise (model ready-made)
- Human-machine interaction (transferable amount of data is small, standardized static input fields)

GUI: Example 1 (open demo model)

Network LCA example 1



Electricity (kWh) - Option 1

0.5

Electricity (kWh) - Option 2

2.0

Output variable choice

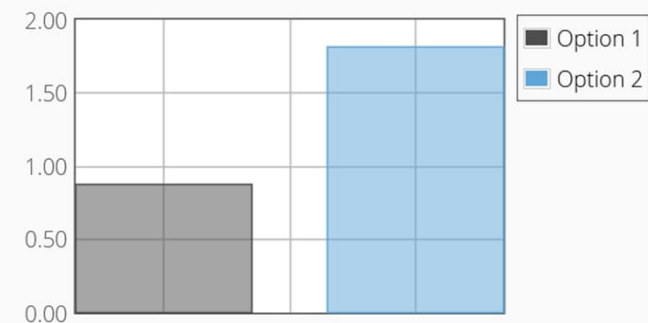
GWP CO2-eq

GWP CO2-eq

Coffee mug life-cycle.ia[8]

Simulate

Comparison: Option 1 vs. Option 2 (kg CO2-eq). Change inputs and click Simulate again.



Option 1

0.88

Option 2

1.81

GUI: Example 2 (ship model)

Network LCA example 2



Cabin (kg-tot) - Option 1

Cabin (kg-tot) - Option 2

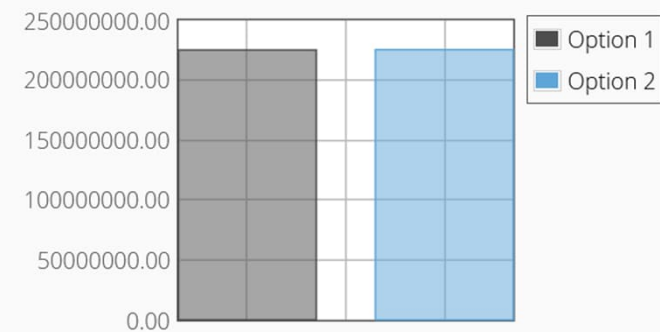
Output variable choice



Simulate

Simulate

Comparison of Option 1 and Option 2 (change inputs and click Simulate to recompute)



Option 1

225,134,272.00

Option 2

225,473,568.00

Using LCA model through API

- A well-documented application programming interface (API) is available for Network LCA
- Interface for machine-to-machine communication
- Leaving out initialization and final clean-up commands, the API workflow looks as follows:

Calling Network LCA API via command line tool

- (1) Attach value for the **input** variable (Crew cabin, unit: kg):
 - > curl --request POST ... -F
"variableNames=[\"**MT_Shipbuilding_model_to_VTT.c.Ship.var.Crew_Cabin.i**
nput.config\"]" -F values=[**1086581.0**]
<https://ciss.modellingfactory.com/API/fmi2cs/?request=fmi2SetReal>

```
{"message": "Setting FMU variables succeeded", "fmi2Status": "fmi2OK"}
```

... = Some parameters left out for clarity

Calling Network LCA API via command line tool

- (2) Perform simulation = life-cycle impact assessment (for a single time-step):
 - > curl --request POST ... -F totalSimulationTime=0.1 -F stepSize=0.1 <https://ciss.modellingfactory.com/API/fmi2cs/?request=fmi2DoStep>

```
{"message":"fmu current time: 0.1","fmi2Status":"fmi2OK","time":0.1}
```

... = Some parameters left out for clarity

Calling Network LCA API via command line tool

- (3) Read **output** variable (carbon emissions (air)):
 - > curl --request POST ... -F "variableNames=[\"**Variables.Air.ia[0]**\"]"
<https://ciss.modellingfactory.com/API/fmi2cs/?request=fmi2GetReal>

```
{"message":"","fmi2Status":"fmi2OK","values":[2.28745984E8],"time":0.1}
```

... = Some parameters left out for clarity



Using Sulca model through API

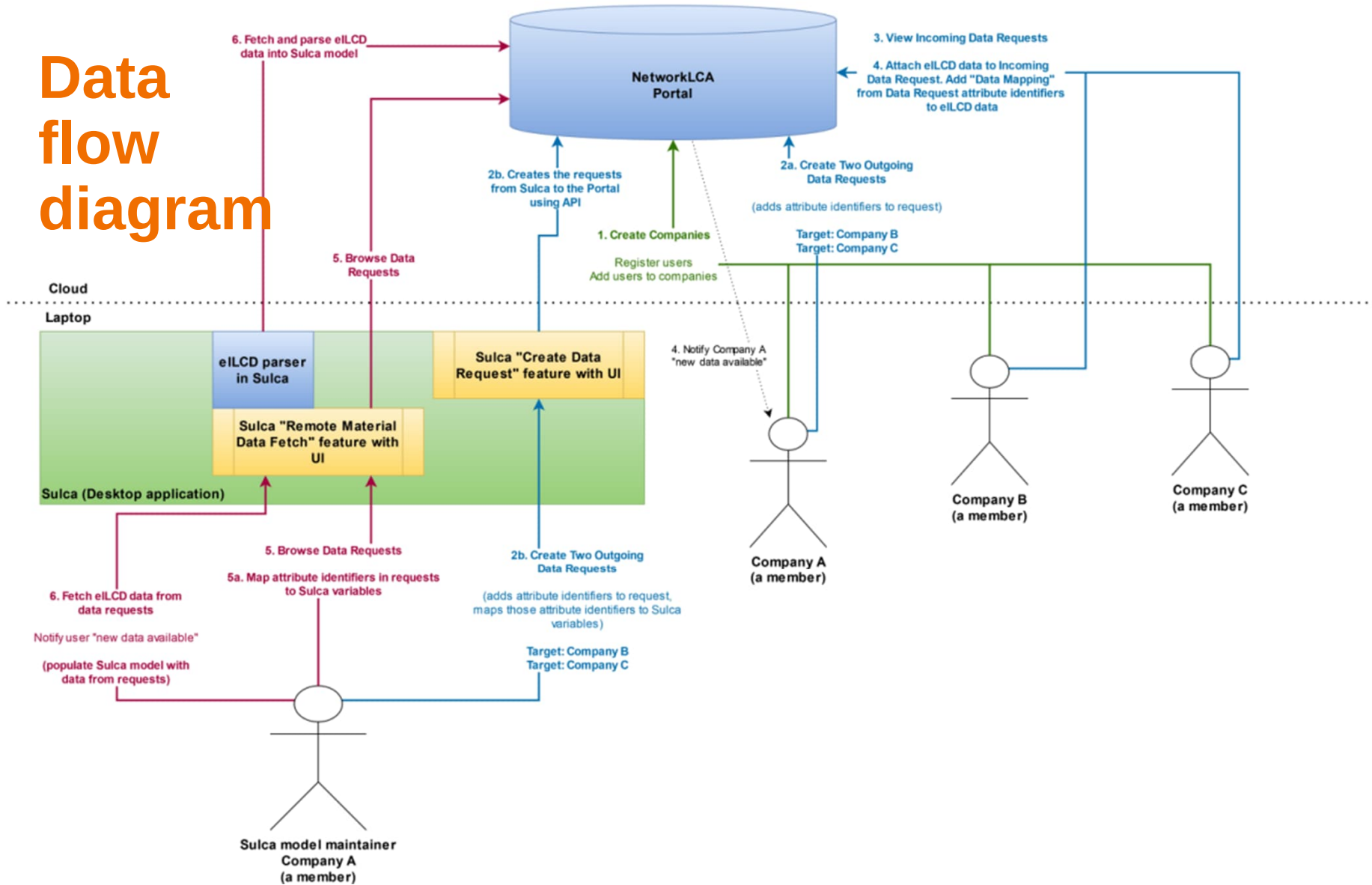
- NOTE: API enables generation and transfer of **large amounts of sustainability data**
- Possible to generate data for a full-fledged LCA report, **calculation not restricted to just carbon footprint**
- Possible to generate '**what-if-scenarios**' for different product composition and process conditions

Data transfer in data portal (Semantum)

- VTT Network LCA tool and Semantum Network LCA data portal are independent software installations
- Currently, Semantum data portal focuses primarily on shared non-sensitive data transfer in LCA-standard format (ILCD/eILCD, also Excel) between all network members
- VTT tool supports both sensitive and non-sensitive data usage in fixed non-LCA-standard format
- Possible to combine these two approaches in the future

Susflow Demo Case "Example Actions"

Data flow diagram



Creating data request template

← CANCEL

SULCA CONVERSION TEMPLATE

UPLOAD TEMPLATE →

1 / 1

Material Sub-Contractor Data Form version 1.0 (2025 edition)

+ ADD A SHEET

← Environment →

Environment

EnvironmentSheet

REMOVE CATEGORY ☐ Allow users to add Entries

Production

ProductionCategory

+ ADD SUBCATEGORY

	label	database id (must be unique)	min	max	explanation threshold (%)	unit	type	Flow type
DEL	Annual steel production	annualSteelProd	0			kg	number ▾	output ▾
DEL	Steel grade	steelGrade					text ▾	output ▾
DEL	Trade name of steel	steelTradeName					text ▾	output ▾

+ ADD FIELD

Answering data request

incoming data request

Title: Data Request to steel material sub-contractors 2025

Description: -

Source company: Semantum Ltd

Creation time: 08:01 27/2/2025

Is completed: No

MARK COMPLETED

Upload Data

1 / 1

← Environment →

Environment

Production

Annual steel production:

10000

kg

Steel grade:

Stainless Steel

Trade name of steel:

1925hMo

Consumption

Iron ore:

8000

kg

Scrap Iron:

6000

kg

← Environment →

SUBMIT

Summary

- In the **widest sense** Network LCA is a tool which can be used for LCA **data collection, analysis, product design** and **sharing the LCA results** within the network of multiple operators/companies
- Semantum and VTT have both contributed to creation of LCA tools for networked operators. Semantum's focus has been in LCA-standard data transfer and VTT's focus in offering LCA calculation services without using standardized data format. **Both approaches can be combined in the future.**