Carbon Leadership Forum

Wood in LCIs and LCA Tools

Speaker Background

Maggie Wildnauer

- Consulting Director, Sustainability @ Sphera
- Credentials:
  - M.S. Structural Engineering, MIT
  - B.S. Civil Engineering, Johns Hopkins
  - LEED GA
- Key experiences
  - LCA Practitioner for 7 years
  - Provided background data for the Tally tool
  - Contributed to LCA data in Quartz
  - Former researcher at Concrete Sustainability Hub

Life Cycle Inventory (LCI)

Materials Production

Flow	Quantity
Electricity	100,000 MWh
Fuel oil	100,000 MJ
Emissions	100,000 tons

+

Manufacturing

Flow	Quantity
Natural Gas	100,000 ft^3
Electricity	100,000 MWh
Waste	100,000 tons

+

Distribution

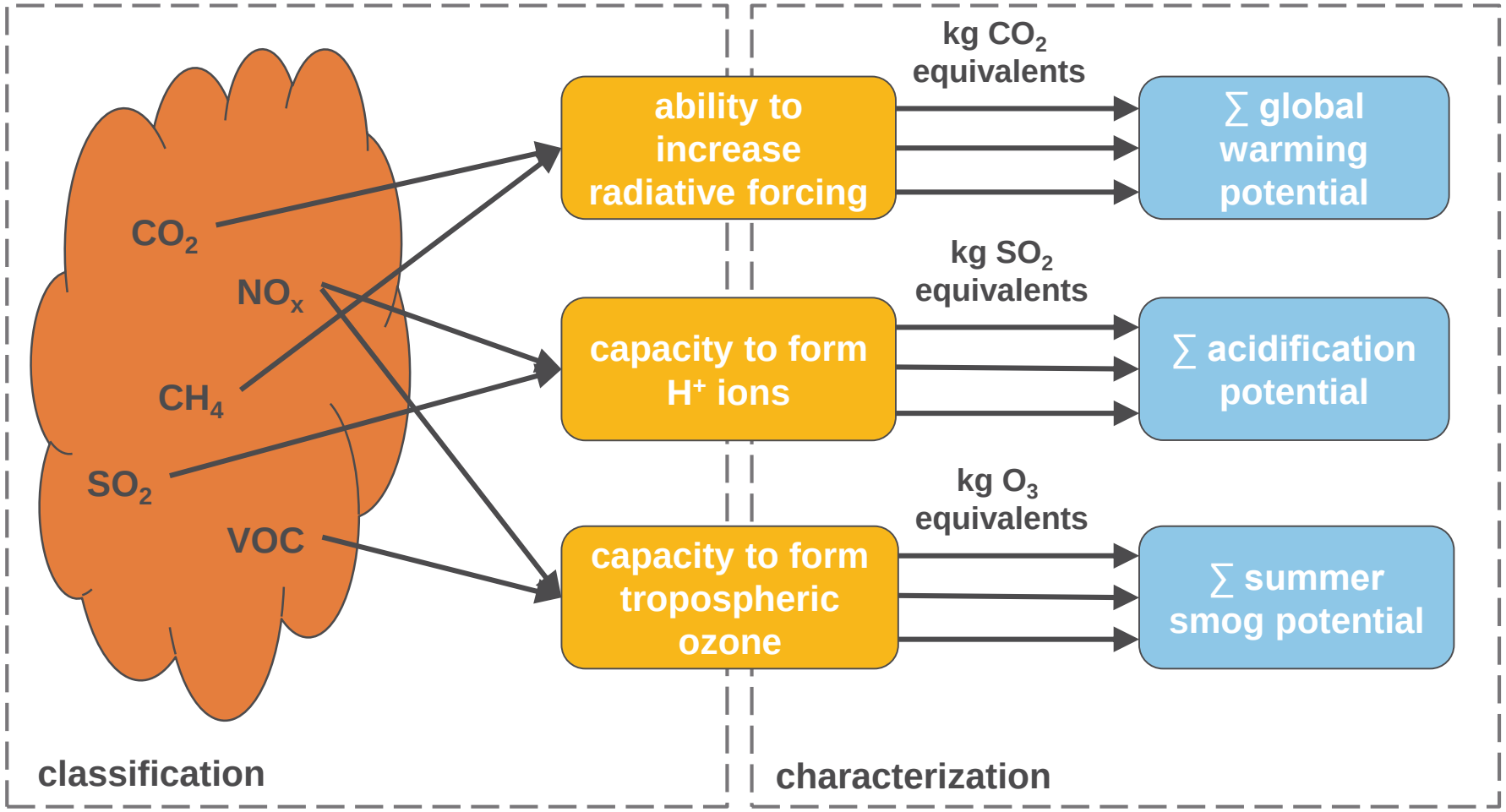
Flow	Quantity
Diesel Fuel	100,000 gal.

- Translate to natural resources and emissions to air, water, and soil
- Primary and secondary data sources (e.g., LCI databases)

Resources		Emissions	
0.5 MJ	Crude oil	6.5 kg	CO_2, to air
0.9 MJ	Hard coal	0.03 kg	NO_x, to air
200 kg	Ground water	0.03 kg	Nitrates, to water
	…		…

= elementary flows/exchanges

Life Cycle Impact Assessment (LCIA)



Life Cycle Impact Assessment (LCIA)

Inventory value	*	GWP Factor	=	Impact potential
25 kg CO_2	*	1	=	25 [kg CO_2-Equivalent]
2 kg CH_4	*	30	=	60 [kg CO_2-Equivalent]
...	*	...	=	...
			Total:	85 [kg CO_2-Equivalent]

Elementary flow/exchange LCI value

LCIA result

Topics

LCA Software

- GaBi
- SimaPro
- Open LCA
- Umberto

LCI Databases

- GaBi
- Ecoinvent
- US LCI / Federal LCA Commons

LCA Tools

- Tally
- Athena Impact Estimator for Buildings
- EC3
- OneClick LCA

LCIA Databases

- Quartz (suspended)

LCI Software

- Software
  - GaBi
  - SimaPro
  - Open LCA
  - Umberto
- Characteristics
  - Can use multiple LCI Databases within each software
  - Requires an experienced LCA practitioner
  - Methodological decisions are up to the practitioner

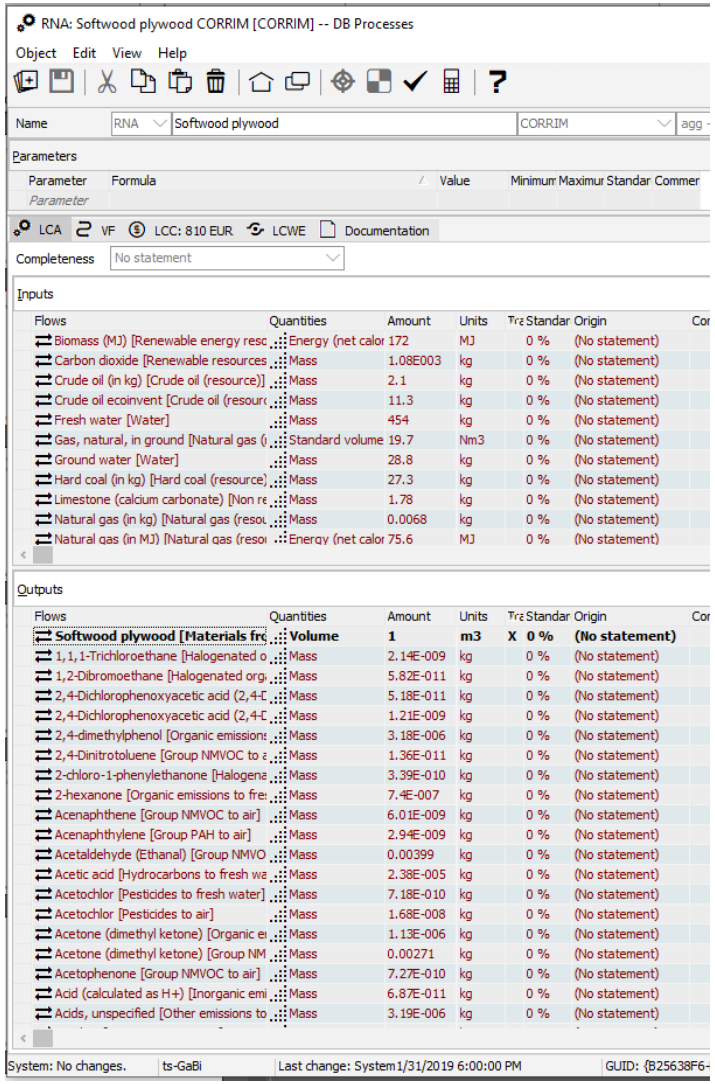
sphera™
GaBi Solutions

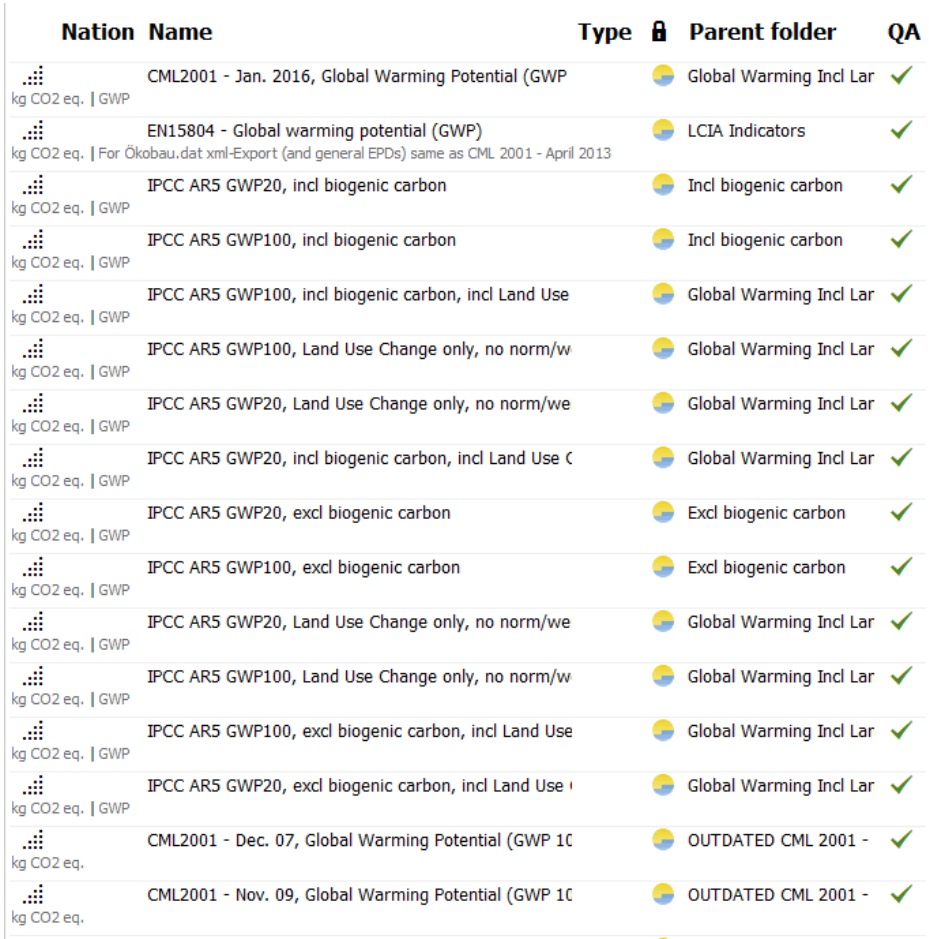
SimaPro

OPENLCA

umberto®
know the flow.

LCI Software (GaBi screenshots)





- Provides life cycle inventories by elementary flows/exchanges
- Can apply any impact assessment methodology to obtain LCIA results
- Typically include details on carbon contents of products

LCI Databases

- LCI Databases
  - GaBi
  - Ecoinvent
  - US LCI / Federal LCA commons
- Characteristics
  - Emissions to air
    - Carbon dioxide, non-fossil/biogenic [To Environment]
    - Methane, non-fossil/biogenic [To Environment]
  - Natural resource inputs
    - Carbon dioxide from air
    - Carbon, organic, in soil or biomass stock
  - Elemental composition as a property of reference flow/exchanges (i.e. carbon content both fossil and non-fossil) does not contribute to final impacts but can be used to ensure carbon balances

sphera™
GaBi Database

ecoinvent Centre

FEDERAL LCA COMMONS

Biogenic Carbon Modeling in LCA Software

- Challenges in modeling biogenic carbon
  - Biomass feedstock carbon contents may vary
  - Not all carbon-containing flows and emissions may be tracked throughout manufacturing of the final product
  - If multi-output processes are allocated using any other allocation key than the carbon content, the carbon balance will not be closed → either too many or too little inputs of carbon-containing flows
- Pragmatic solution
  - Find out the biogenic carbon content of the final product
  - Add a process inventory that makes sure that the cradle-to-gate carbon balance matches the biogenic carbon content of the product

Biogenic Carbon Modeling in LCA Software

- Biogenic carbon is only ‘carbon neutral’ if all of the CO_2 that was removed from the atmosphere is released as CO_2 again, i.e. not transformed to CH_4
- Without the proper accounting of biogenic carbon flows, the contribution of bio-based materials to climate (net source or sink) may be inaccurate or omitted
- Accounting for 100% of all biogenic carbon flows in the product system can be challenging
- ‘Back-calculating’ the carbon removals from the carbon content of the material in question is a pragmatic way to close the carbon balance

GWP100 Characterization Factors

Emission	TRACI 2.1 (IPCC AR4)		IPCC AR5	
	Incl. biogenic	Excl. biogenic	Incl. biogenic	Excl. biogenic
Carbon dioxide, fossil	1	1	1	1
Carbon dioxide, biogenic	1	0	1	0
Methane, fossil	25	25	30	30
Methane, biogenic	25	22.3	30	28
Nitrous oxide	298	298	265	265

LCA Tools

Tool	Data Source	LCIA Methodology (North America)	Treatment of biogenic carbon
Tally	GaBi, EPDs conducted using GaBi data	TRACI 2.1	GWP including and excluding biogenic carbon
Athena Impact Estimator for Buildings	Primarily from LCAs conducted by the Athena Institute	TRACI 2.1 (though LCI also presented)	GWP including biogenic carbon
One Click LCA	Various public and private sources (both generic data and EPDs) using a variety of background data sources	TRACI 2.1	Unclear, may depend on selected EPDs
EC3	Publicly available EPDs (manufacturing impacts only)	Likely TRACI 2.1 but dependent on EPDs, GWP only	Estimates to include biogenic carbon where not provided by the EPD

LCA Tools

- LCA Tools for Buildings
  - Tally
  - Athena Impact Estimator for Buildings
  - OneClick LCA
  - EC3
- Characteristics
  - May present impact assessment results only (though Athena does present LCI results)
  - Impact categories are selected by the tool creator or the source of data (i.e., EPD)
    - Where LCI is presented (i.e. Athena) the user could manually apply other impact category methodologies if desired
  - Interpretation of results is up to the user of the tool

Additional Comments

- Inclusion or exclusion of things like forest management and land use change (direct and indirect), etc. will depend on the details of the background data
  - ISO 21930 allows for wood from sustainably managed forests to be counted as having zero emissions from land-use change (incl. CSA, FSC, SFI standards)
- Selection of GWP indicator including or excluding biogenic carbon is up to the LCA practitioner in EPDs
  - ISO 21930 mandates the declaration of emissions and removals of biogenic carbon if included in the GWP calculation

Conclusions

- LCA Software and LCI Databases allow the practitioner to choose whether to include biogenic carbon or not
  - Ensuring you've accurately modeled the carbon flows in your model is crucial
- System boundaries for LCI Data will vary and the practitioner should review the assumptions of the background data selected
- LCA Tools have often made the decision for the user, though tools like Tally still allow for distinction between GWP including and excluding biogenic carbon

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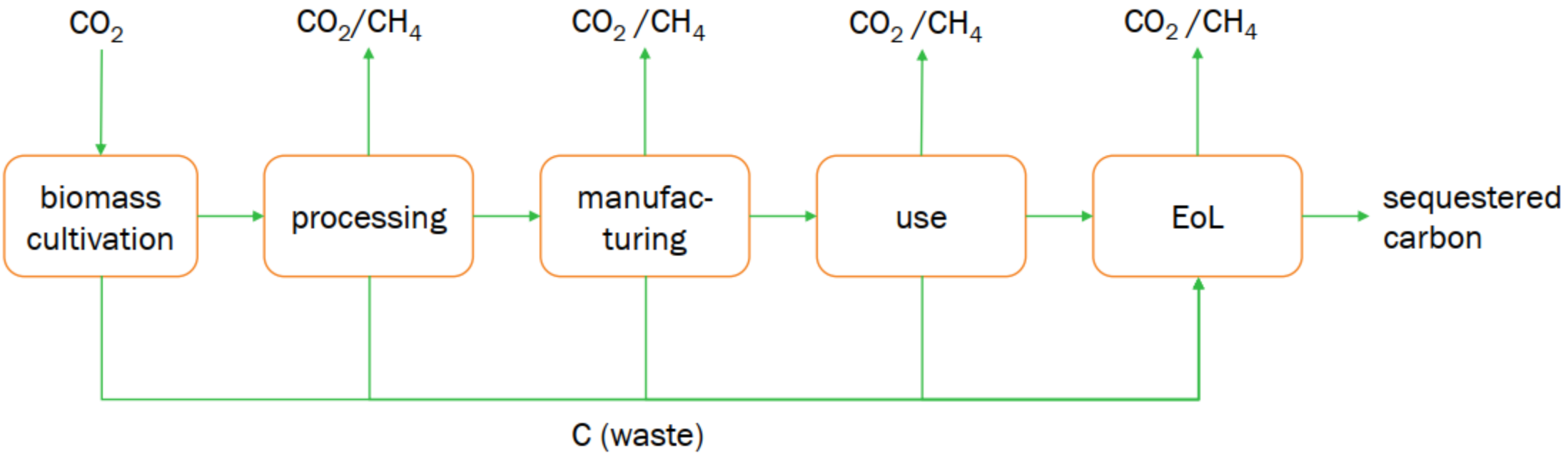
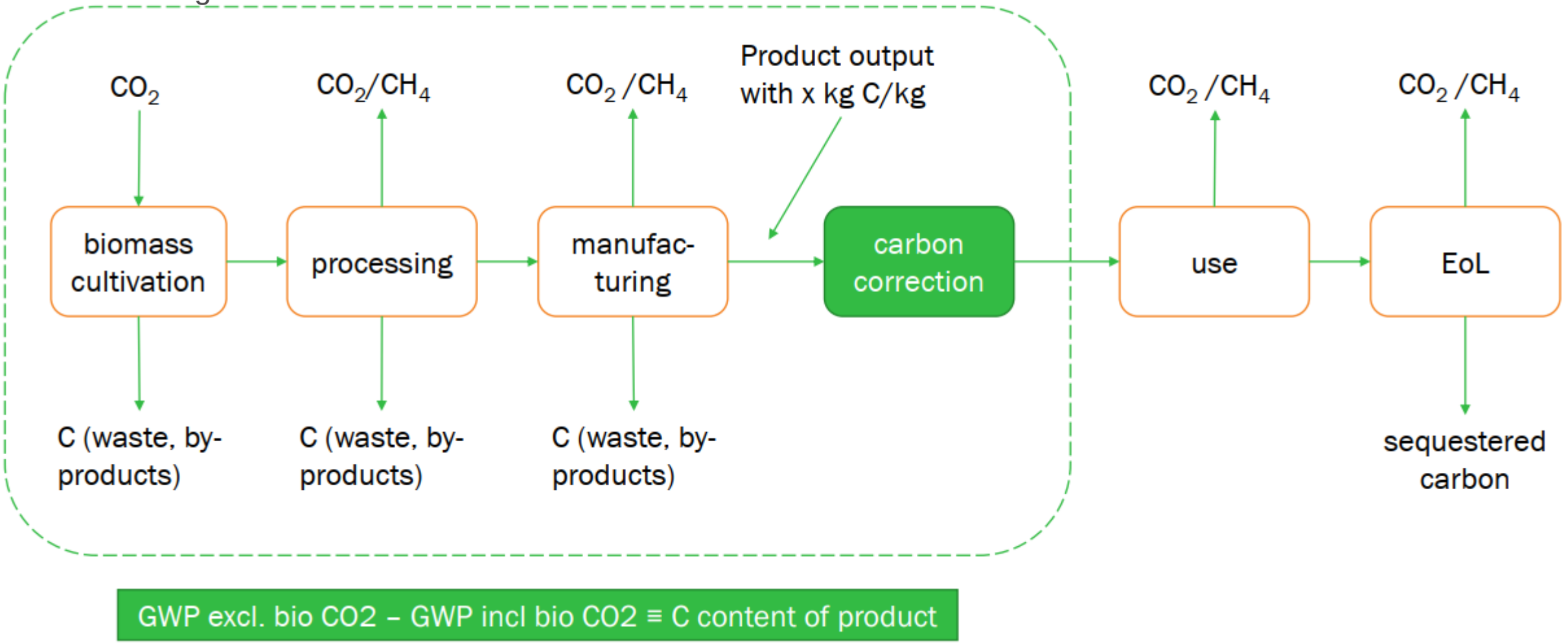
Additional Slides

Biogenic Carbon Modeling in LCA software

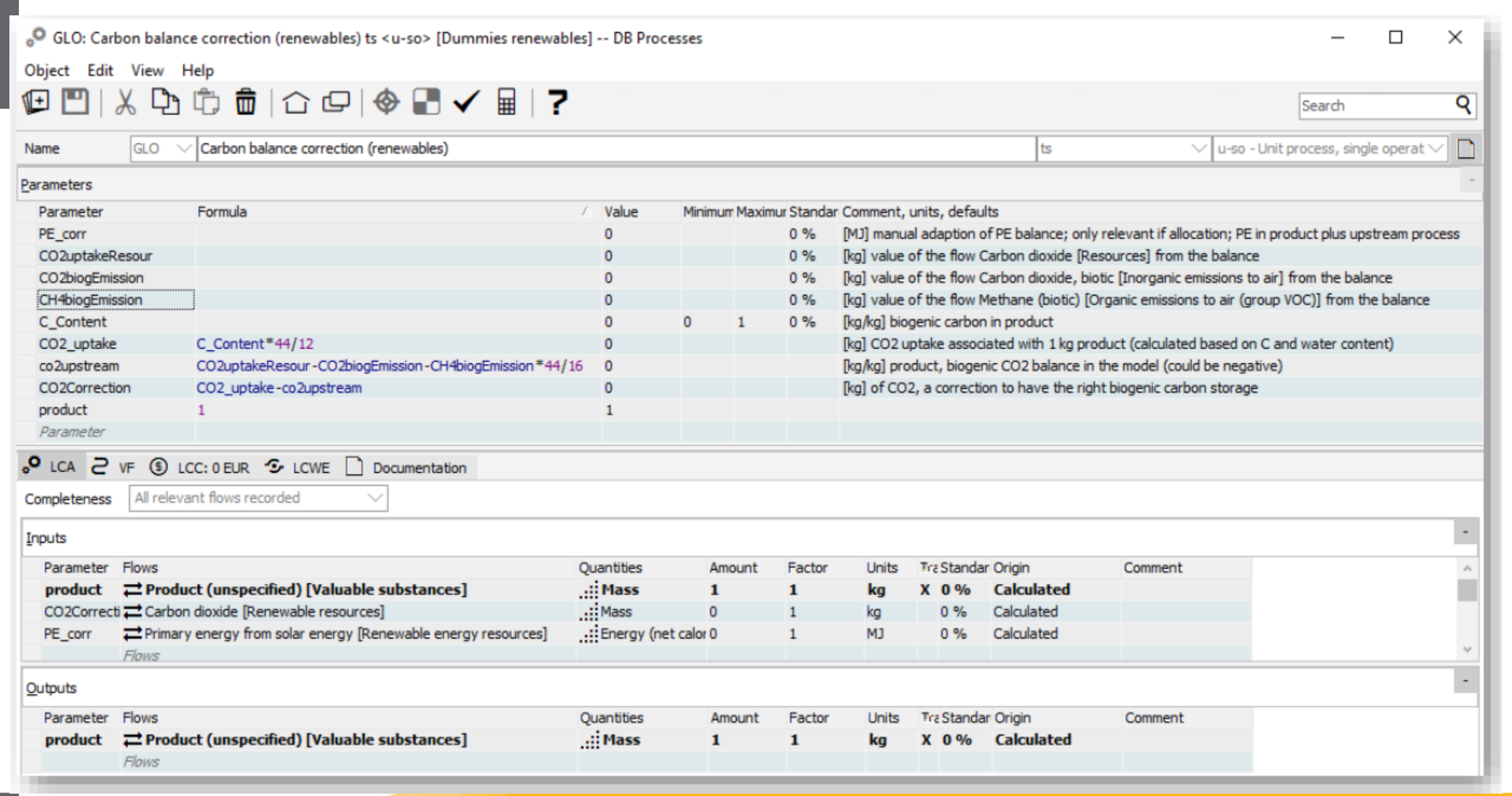


Biogenic Carbon Modeling in LCA software

Cradle-to-gate



GWP excl. bio CO2 – GWP incl bio CO2 ≡ C content of product


GLO: Carbon balance correction (renewables) ts <u-so> [Dummies renewables] -- DB Processes
Object Edit View Help
Search
Name GLO Carbon balance correction (renewables) ts u-so - Unit process, single operat
Parameters
Parameter Formula Value Minimum Maximum Standar Comment, units, defaults
PE_corr 0 0 % [MJ] manual adaption of PE balance; only relevant if allocation; PE in product plus upstream process
CO2uptakeResour 0 0 % [kg] value of the flow Carbon dioxide [Resources] from the balance
CO2biogEmission 0 0 % [kg] value of the flow Carbon dioxide, biotic [Inorganic emissions to air] from the balance
CH4biogEmission 0 0 % [kg] value of the flow Methane (biotic) [Organic emissions to air (group VOC)] from the balance
C_Content 0 0 1 0 % [kg/kg] biogenic carbon in product
CO2_uptake C_Content*44/12 0 [kg] CO2 uptake associated with 1 kg product (calculated based on C and water content)
co2upstream CO2uptakeResour-CO2biogEmission-CH4biogEmission*44/16 0 [kg/kg] product, biogenic CO2 balance in the model (could be negative)
CO2Correction CO2_uptake-co2upstream 0 [kg] of CO2, a correction to have the right biogenic carbon storage
product 1 1
Parameter
LCA VF LCC: 0 EUR LCWE Documentation
Completeness All relevant flows recorded
Inputs
Parameter Flows Quantities Amount Factor Units Tra Standar Origin Comment
product Product (unspecified) [Valuable substances] Mass 1 1 kg X 0 % Calculated
CO2Correcti Carbon dioxide [Renewable resources] Mass 0 1 kg 0 % Calculated
PE_corr Primary energy from solar energy [Renewable energy resources] Energy (net calor 0 1 MJ 0 % Calculated
Flows
Outputs
Parameter Flows Quantities Amount Factor Units Tra Standar Origin Comment
product Product (unspecified) [Valuable substances] Mass 1 1 kg X 0 % Calculated
Flows