BW_TIMEX: A Novel Framework and software tool for Coherent Representation of Environmental Impacts Over Time

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89th LCA Discussion Forum On the use of prospective LCA to support sustainability transitions

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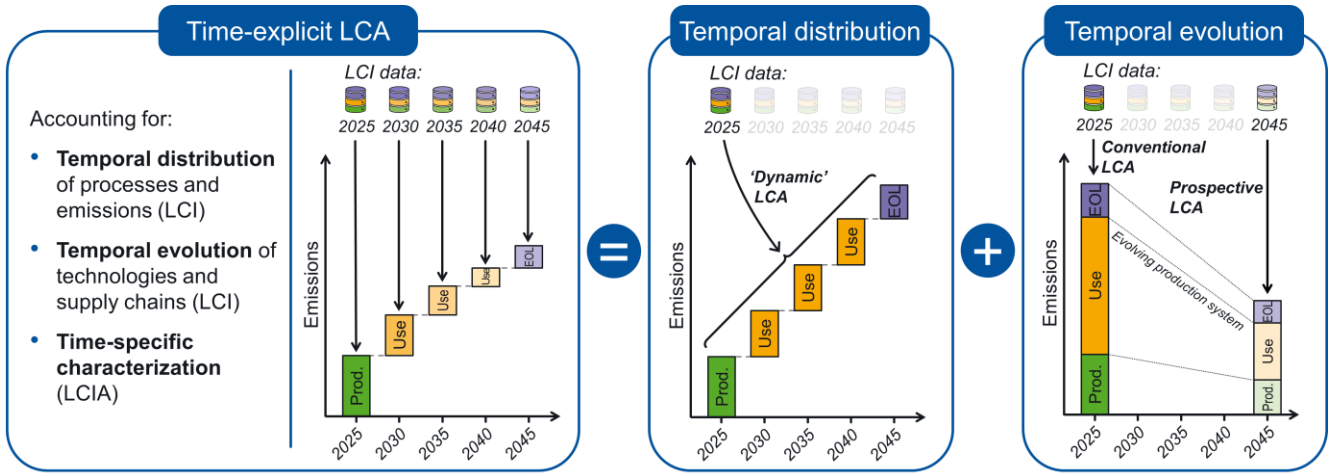
How time is treated LCA models

- **Temporal Distribution:**
  - **temporal considerations that describe the timing of processes, emissions, and environmental responses**
- **Temporal Evolution:**
  - **change over time in processes and supply chains**



	LCI		LCIA	
	Temp. distribution	Temp. evolution	Temp. distribution	Temp. evolution
Conventional LCA	no, 1 current timestep	no	no	no
Dynamic LCA	yes, multiple timesteps	rarely	yes	no
Prospective LCA	no, 1 future timestep	yes	no	rarely
Retrospective LCA	no, 1 past timestep	yes	no	no
Time-explicit LCA	yes, multiple timesteps	yes	yes	yes

bw_timex

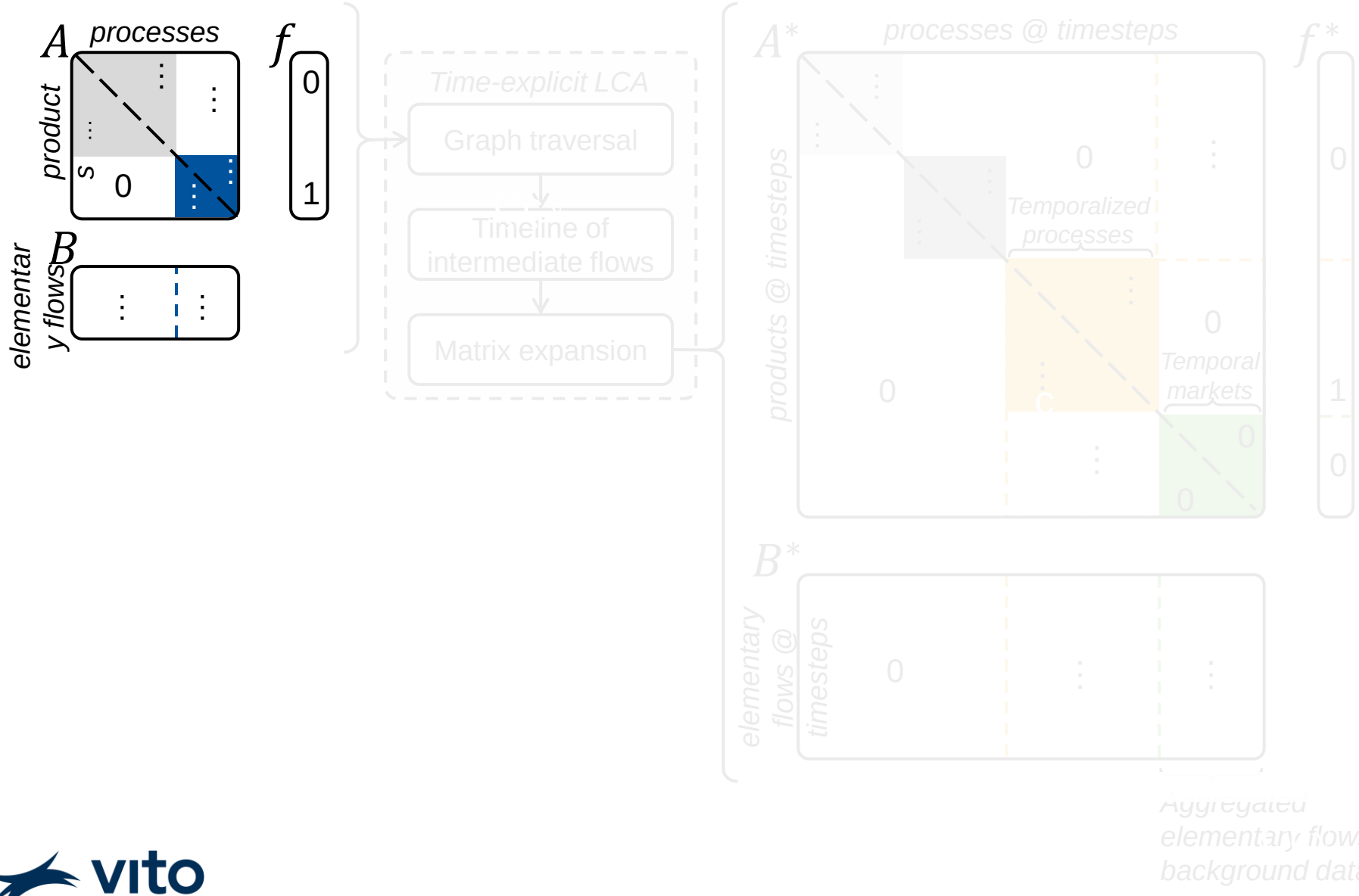
Software tool to perform time-explicit LCA

- **To account for temporal distribution and evolution of:**
  - **processes**
  - **emissions**
  - **impacts**

Brightway

https://github.com/brightway-lca/bw_timex

How bw_timex works



Legend:

- A Technology matrix
- B Biosphere matrix
- f Demand vector
- $*$ Time-explicit
- db with temporal distribution*
- db with temporal evolution*
- Other dbs with temporal evolution
- Temporalized processes
- Temporal markets
- ⋮ Non-zero values possible
- 0 Zeros
- Diagonalized production exchange

**User defined input*

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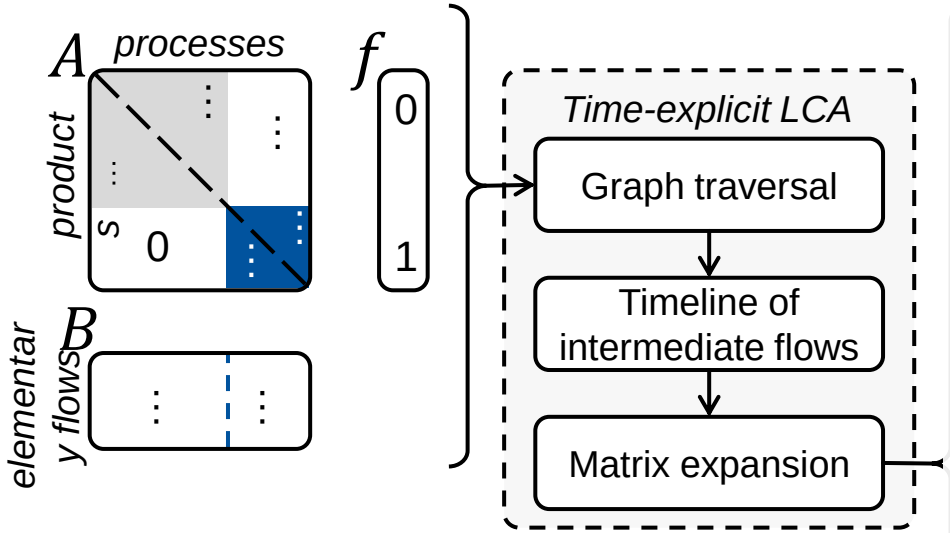

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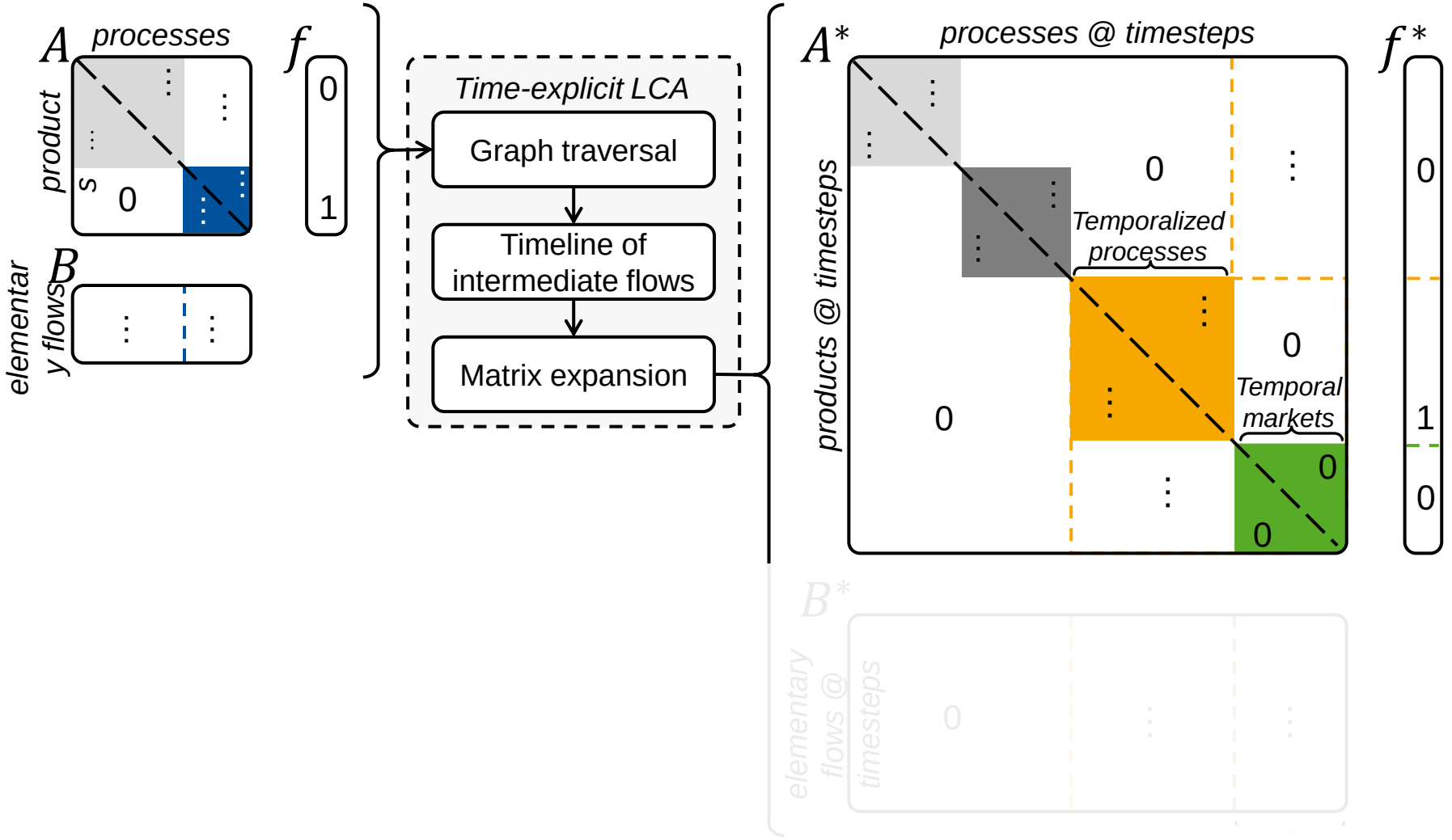

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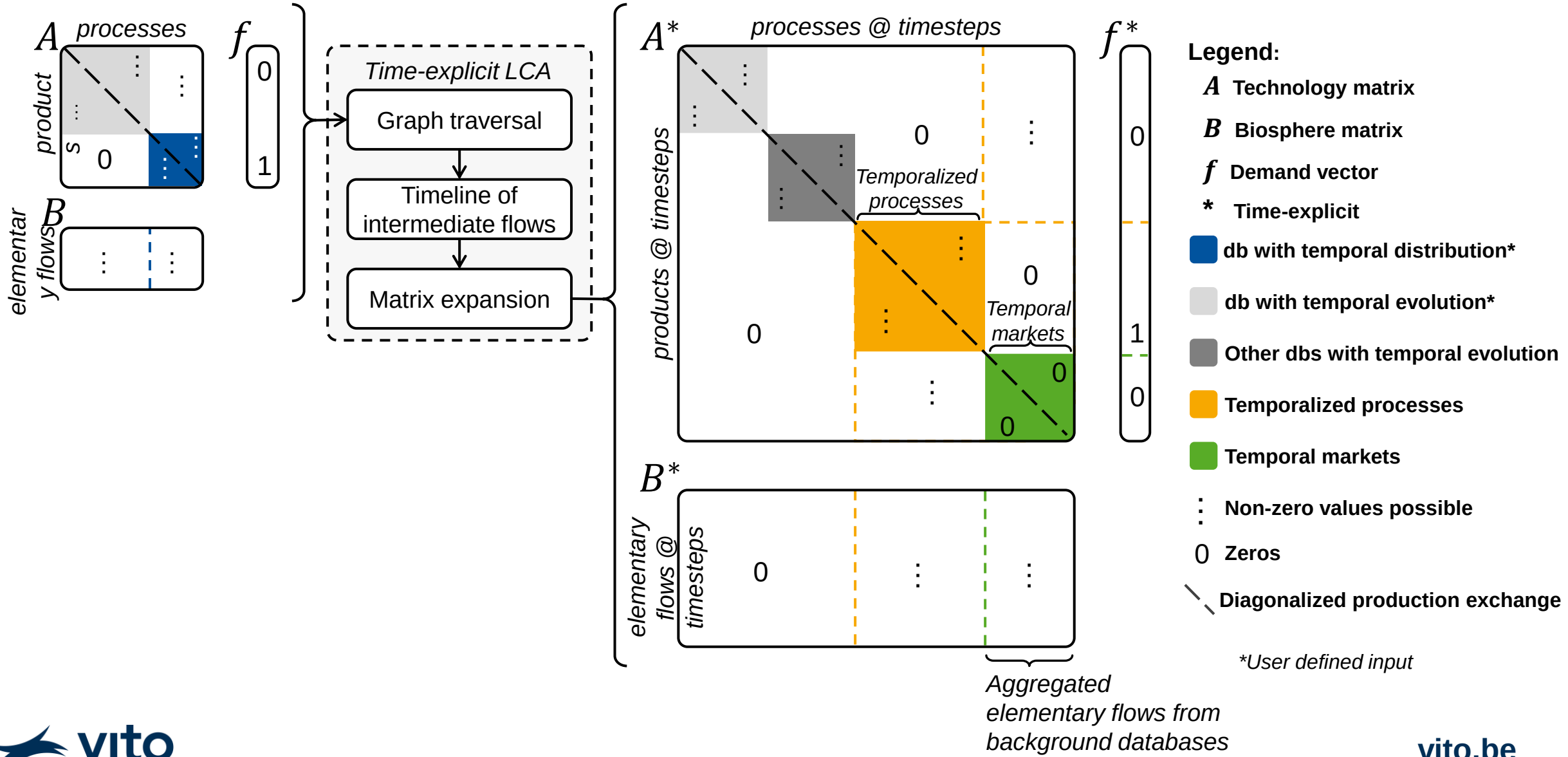
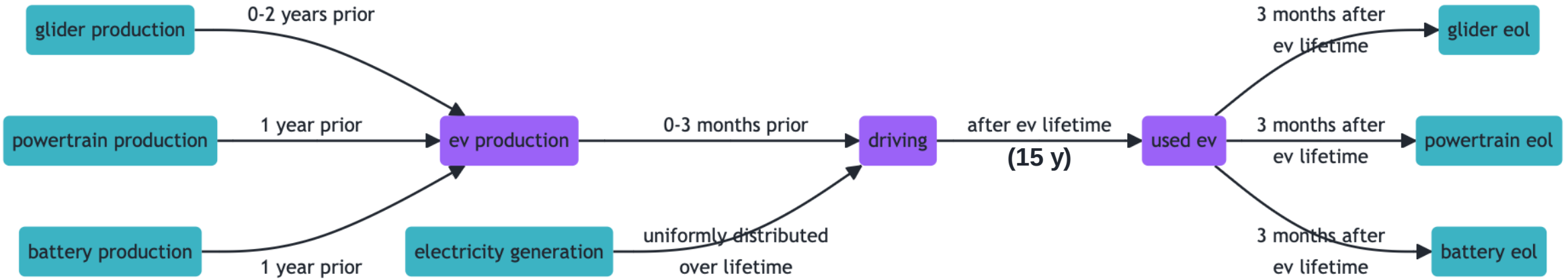


Case study: Electric vehicle

Flowchart



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3 background databases:
- 2020
- 2030
- 2040

premise [3]

w/ ecoinvent 3.10 cutoff & IMAGE SSP2 RCP19 [4]

[3] Sacchi et al, 2021 [4] Wernet et al, 2016

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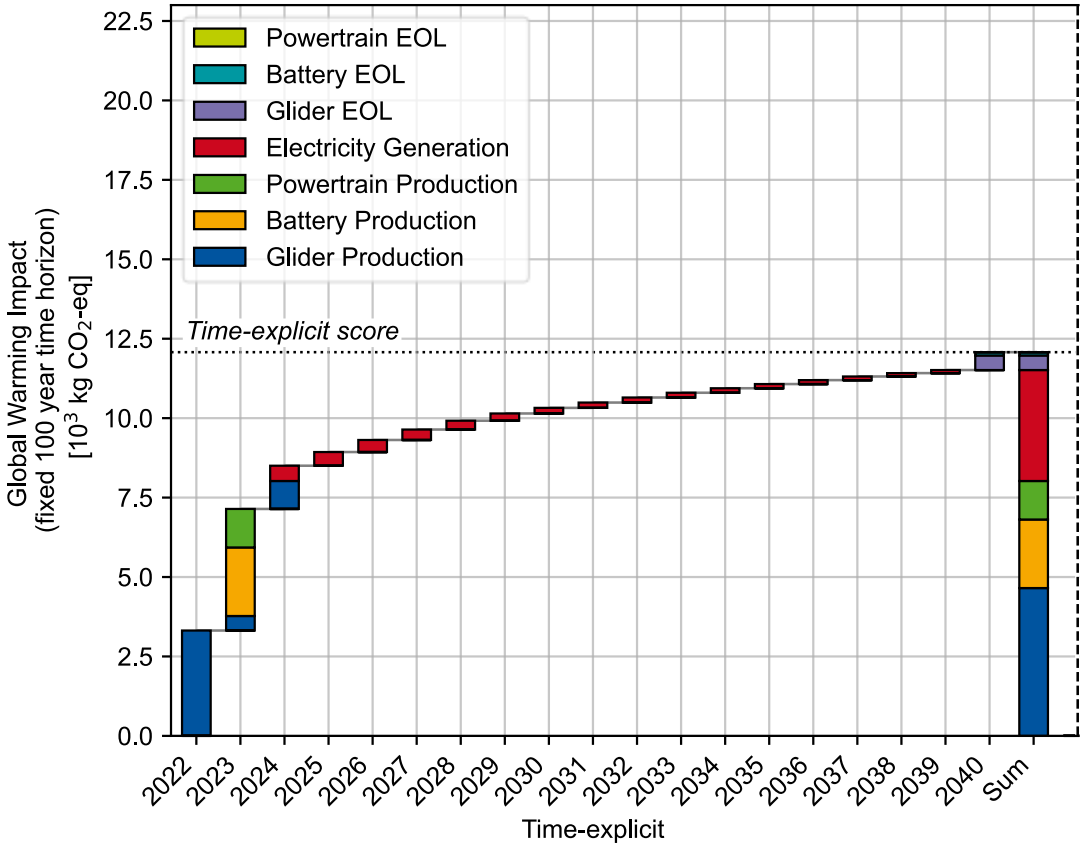
Case study: Time-explicit makes a difference



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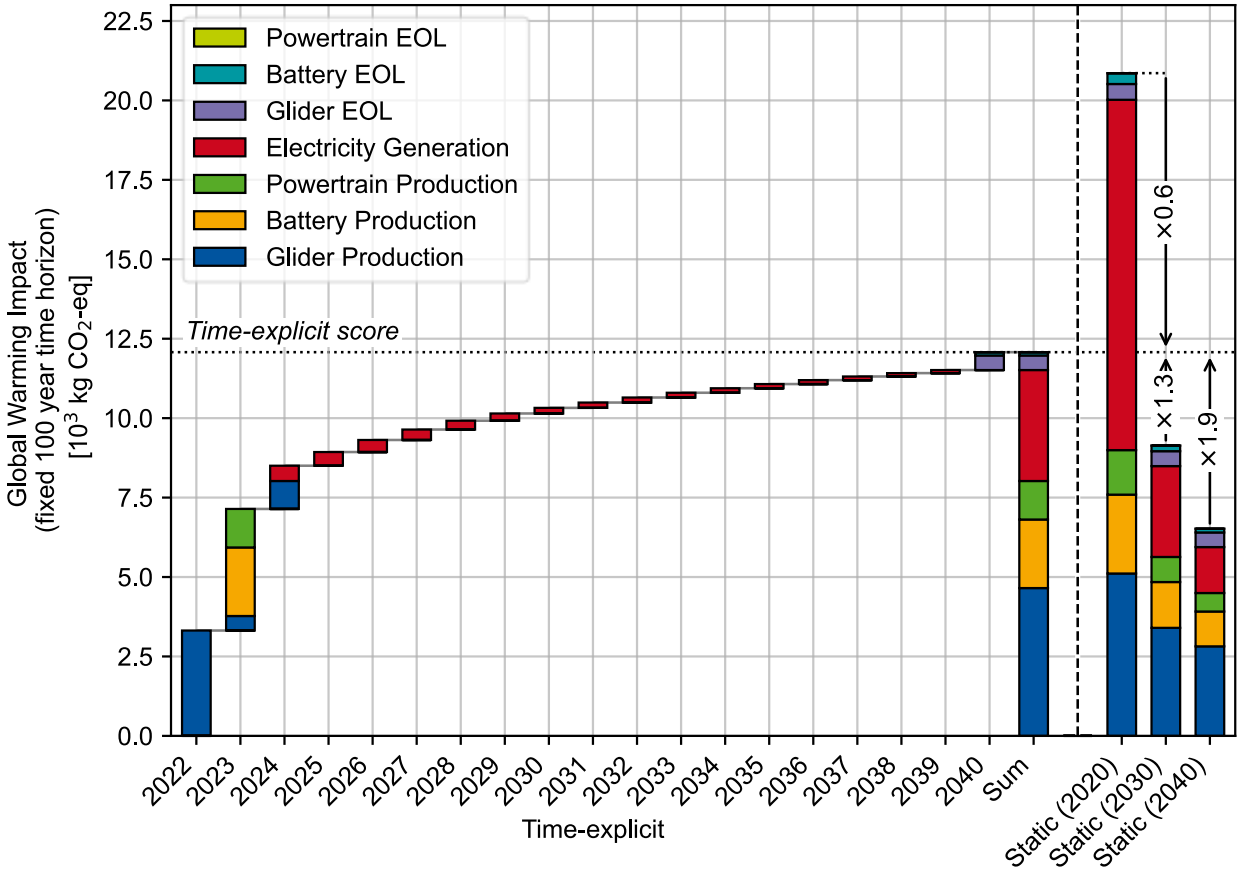

Time-explicit LCA in the context of agricultural systems

Relevance and potential applications

- **Explicit consideration seasonality**
  - **Both in crops production (i.e. LCI) and impacts (i.e LCIA)**
- **From time explicit to spatio-temporal explicit LCA**
  - **(In theory) easy to regionalize bw_timex approach**
- **More accurate LCA of Controlled Environment Agriculture**
  - **better consideration of the energy used now and in the future**
- **Model temporary carbon storage in orchards**
  - **and how it is impacted from climate change**


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