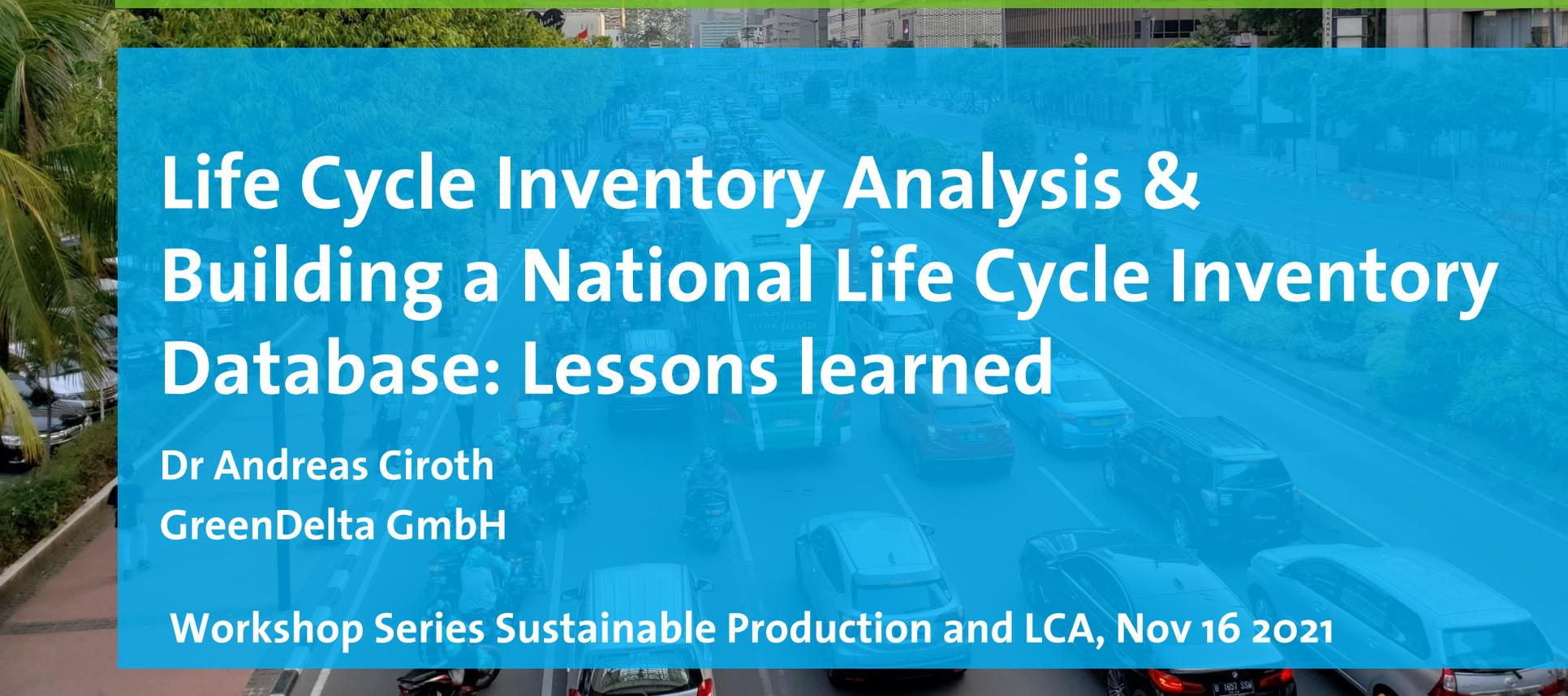


The top half of the slide features a green semi-transparent overlay on a background image of a city skyline with various skyscrapers. The GreenDelta logo is prominently displayed in white text on the left side of this overlay.

# GreenDELTA

software / data / know-how

The bottom half of the slide features a blue semi-transparent overlay on a background image of a busy multi-lane road with many cars and motorcycles. The title text is centered in white on this overlay.

## Life Cycle Inventory Analysis & Building a National Life Cycle Inventory Database: Lessons learned

Dr Andreas Ciroth  
GreenDelta GmbH

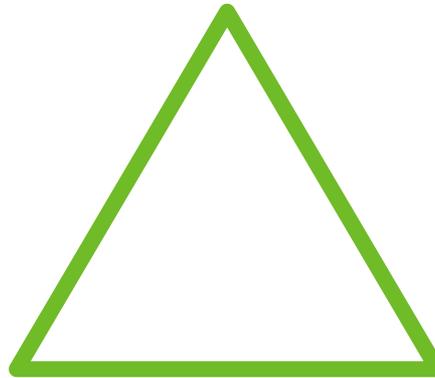
Workshop Series Sustainable Production and LCA, Nov 16 2021

# GreenDelta, greendelta.com

SME, team of 20, interdisciplinary (engineers, economists, IT, architects..), international (DE, IT, FR, SP, RU, IN, BR), office in Berlin, independent capital company founded 2004

## Sustainability consultancy and research

environmental LCAs, resource criticality, social LCAs, Life Cycle Costing, Circular Economy



Database development  
and –distribution (Nexus)

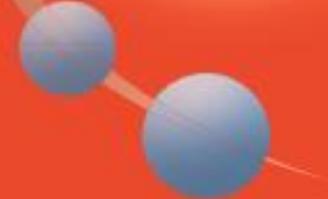
Software development,  
especially open source  
(e.g. openLCA)

# Points for the talk

- Life Cycle Inventory Analysis
- Building a national life cycle inventory database

Andreas Croth

Rickard Arvidsson *Editors*



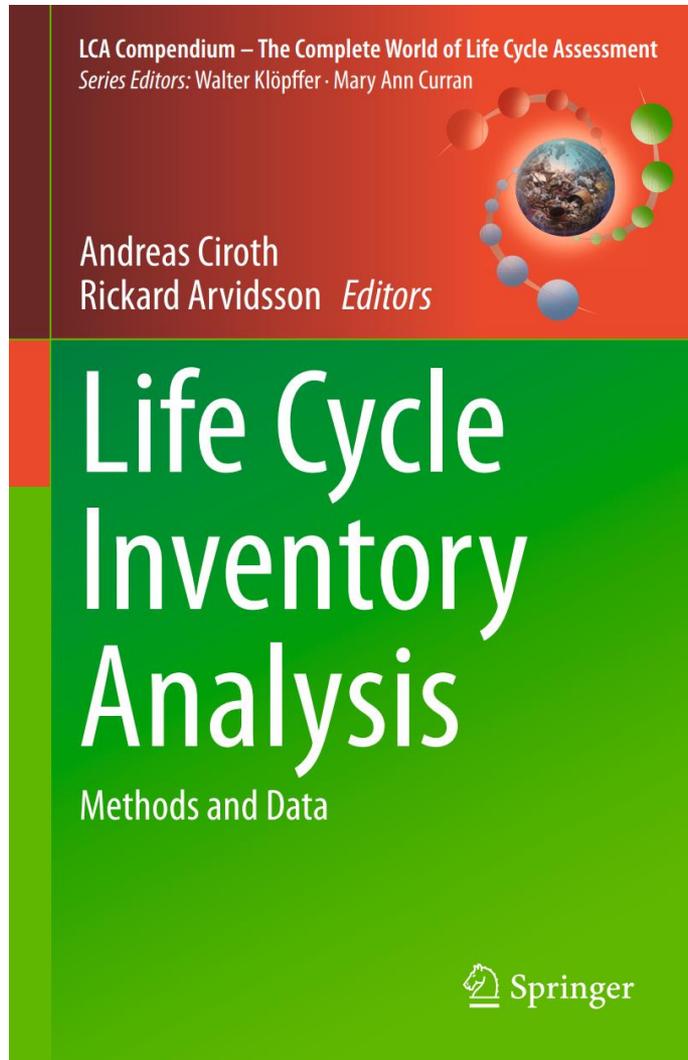
# Life Cycle

Life Cycle Inventory Analysis

# Inventory

# Analysis

# Life Cycle Inventory Analysis, 2021



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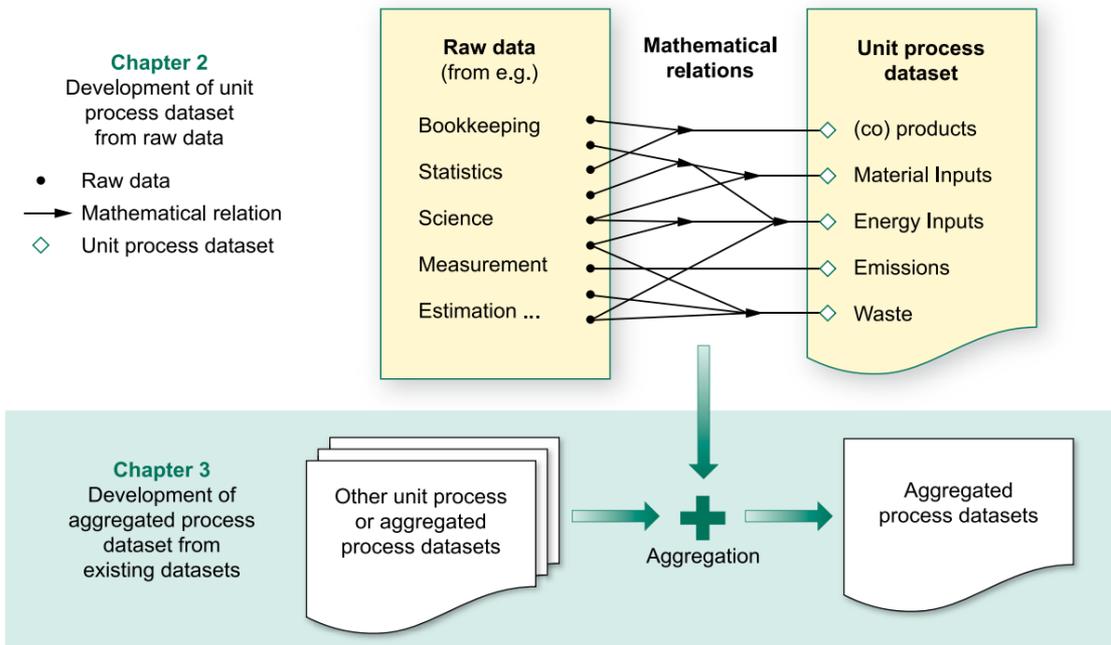
# Principles of Life Cycle Inventory Modeling

- [-] [🔖] Chapter 2: Principles of Life Cycle Inventory Modeling: The Basic Model, Extensions, and Conventions
  - [🔖] 1 The Basic Life Cycle Inventory Model
  - [-] [🔖] 2 Some Fundamental Modeling Topics in the Basic LCI Model
    - [🔖] 2.1 Modeling Benefits and Impacts: The Functional Unit
    - [🔖] 2.2 Modeling Causality: Attributional Versus Consequential Perspectives
    - [🔖] 2.3 Setting Boundaries in an Infinite Inventory Model
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    - [🔖] 3.3 Low Probability Flows of High Impact, Unknown Mechanisms
  - [-] [🔖] 4 Life Cycle Modeling Conventions
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    - 2.4 Internal Check
    - 2.5 Sensitivity Analysis (Optional)
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    - 2.7 Documentation
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# Development of Unit Process Datasets



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  - [🔖] 2 Definition of Data Quality and Fitness for Purpose
  - [-] [🔖] 3 Addressing Data Quality in Life Cycle Assessment
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    - [🔖] 3.2 The Janus Property of Data Quality
    - [🔖] 3.3 Components of Data Quality Descriptors
    - [🔖] 3.4 Data Quality Topics in LCI and Generic Indicators
    - [-] [🔖] 3.5 Data Quality Use Cases – Frameworks
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  - [-] [🔖] 4 Notes on Selected Data Quality Indicators
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  - [🔖] 5 Conclusion and Way Forward
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# Data Quality

- Data quality is fitness for purpose
- Two sides:
  - a) When creating a dataset
  - b) When using a dataset



# Data Quality

- Data quality is fitness for purpose
- Two sides:
  - a) When creating a dataset
  - b) When using a dataset



# Algorithms

- Chapter 7: Algorithms of Life Cycle Inventory Analysis
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  - 5 Performance Considerations
    - 5.1 Selection of Algorithms
    - 5.2 Precalculated Results
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# Algorithms

## Algorithm 7.3 Calculating an upstream tree

1. **function** *UTREE* ( $\mathbf{A}$ ,  $s_{ref}$ ,  $g_k$ ,  $\mathbf{m}$ )
2.      $root \leftarrow Node(idx \leftarrow ref, scaling \leftarrow s_{ref}, result \leftarrow g_k)$
3.     **call** *CHILDS* ( $root$ ,  $\mathbf{A}$ ,  $\mathbf{m}$ , 0)
4.     **return**  $root$
5. **function** *CHILDS* ( $parent$ ,  $\mathbf{A}$ ,  $\mathbf{m}$ ,  $depth$ )
6.     **if**  $depth > depth_{max}$  **return**
7.     **for**  $r \leftarrow 1 \dots rows(\mathbf{A})$
8.         **if**  $r = parent.idx$  **continue**
9.          $v \leftarrow \mathbf{A}(r, parent.idx) \cdot parent.scaling$
10.        **if**  $v = 0$  **continue**
11.         $child \leftarrow Node(idx \leftarrow r)$
12.         $child.scaling \leftarrow \frac{-v}{\mathbf{A}(r,r)}$
13.         $child.result \leftarrow \mathbf{m}(r) \cdot \mathbf{A}(r, r) \cdot child.scaling$
14.         $add(parent.childs, child)$
15.        **if**  $abs(child.result) > u_{min}$
16.            **call** *CHILDS* ( $child$ ,  $\mathbf{A}$ ,  $\mathbf{m}$ ,  $depth + 1$ )

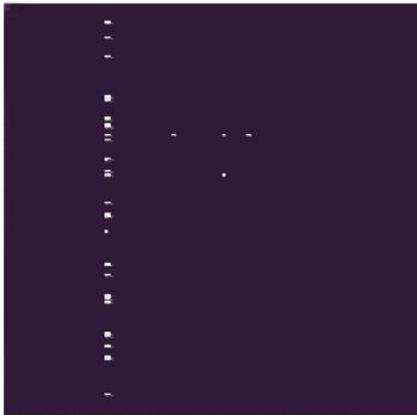
# LCI Data and Databases

- [-] [ ] Chapter 6: Life Cycle Inventory Data and Databases
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  - [ ] 2 The Role of Life Cycle Inventory Databases for Life Cycle Assessment
  - [ ] 3 Types of Databases
  - [-] [ ] 4 Issues in Life Cycle Inventory Databases
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    - [ ] 4.2 Quality Assurance
    - [ ] 4.3 Maintenance
    - [ ] 4.4 Integration into LCA Software
  - [-] [ ] 5 Data Exchange
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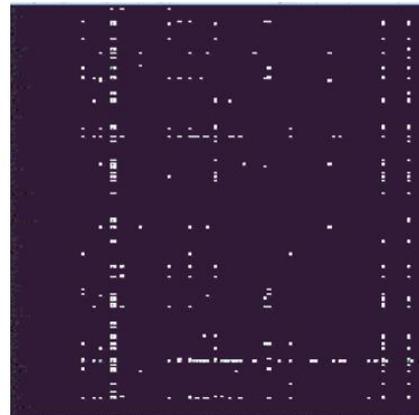
# LCI Data and Databases

→ process sectors

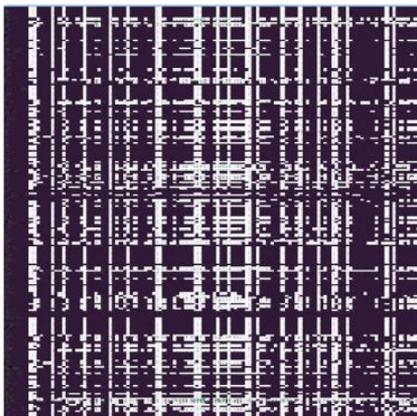
→ countries



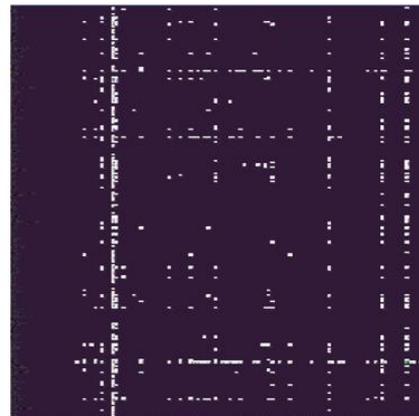
a) ELCD



b) ecoinvent v3.2



c) eora



d) ecoinvent v3.5

white = process dataset



# Creating a national LCI database

# Creating a national LCA database

(i.e., a database that is national reference, often provided for free, and maintained by public institutions)

- LCA databases first existed for several EU countries, US, Japan, Australia
- In other regions, processes are often very different → need for additional databases
- LCA data is like infrastructure -> free access to LCA data is a public service
- there is often need for an agreed value of e.g. electricity grid Greenhouse Gas emissions
- creating the database fosters national industry and science

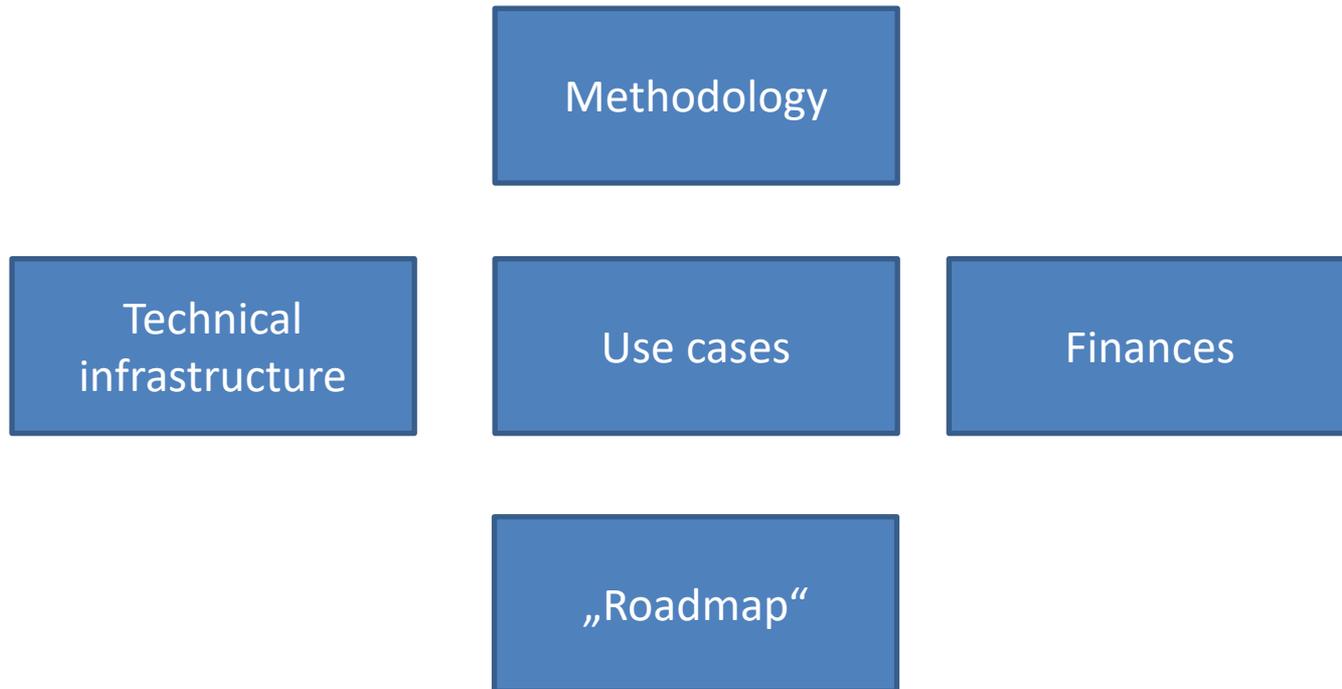
# Creating a national LCI database

Quite some national databases are now created or have been created since some time:

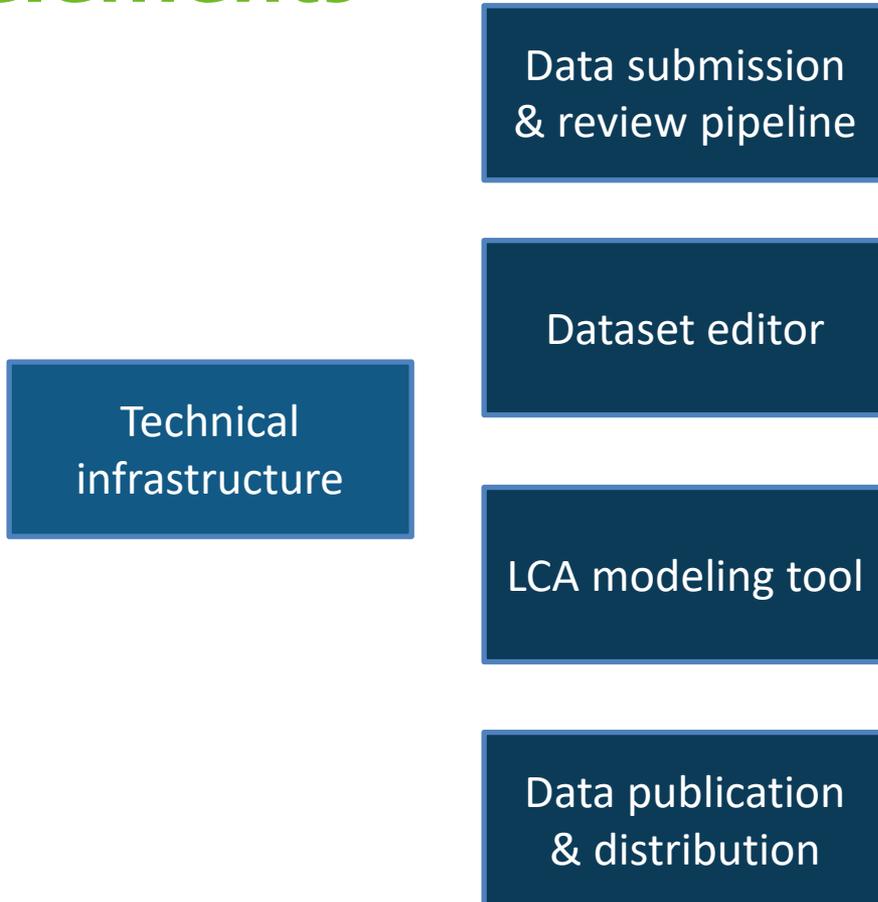
- Chile
- Brazil
- Malaysia
- Thailand
- Korea (CO<sub>2</sub>)
- ...

This is a chance for local LCA communities, to bring in innovation, and to benefit from existing experiences at the same time

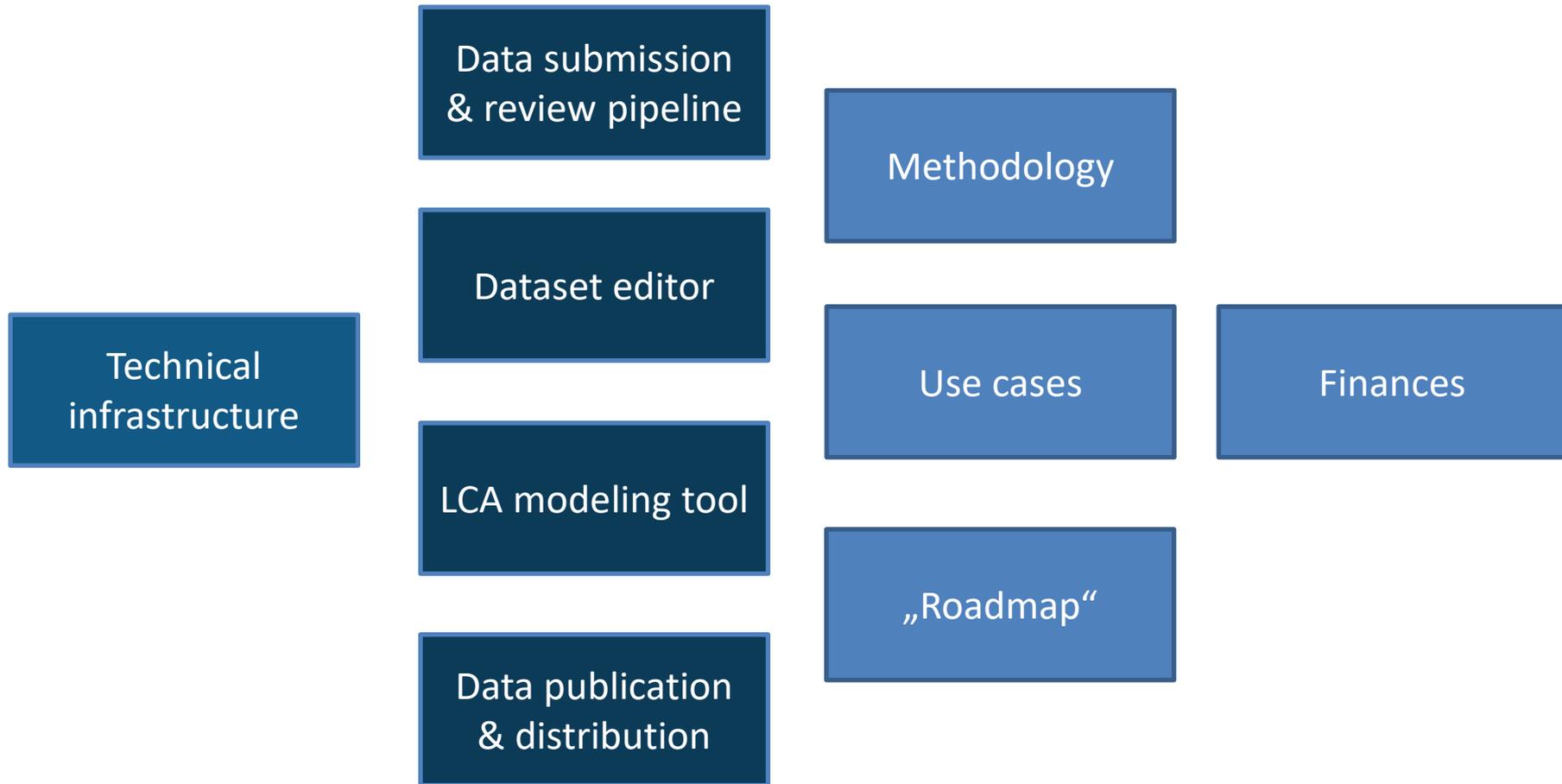
# A national LCI database, elements



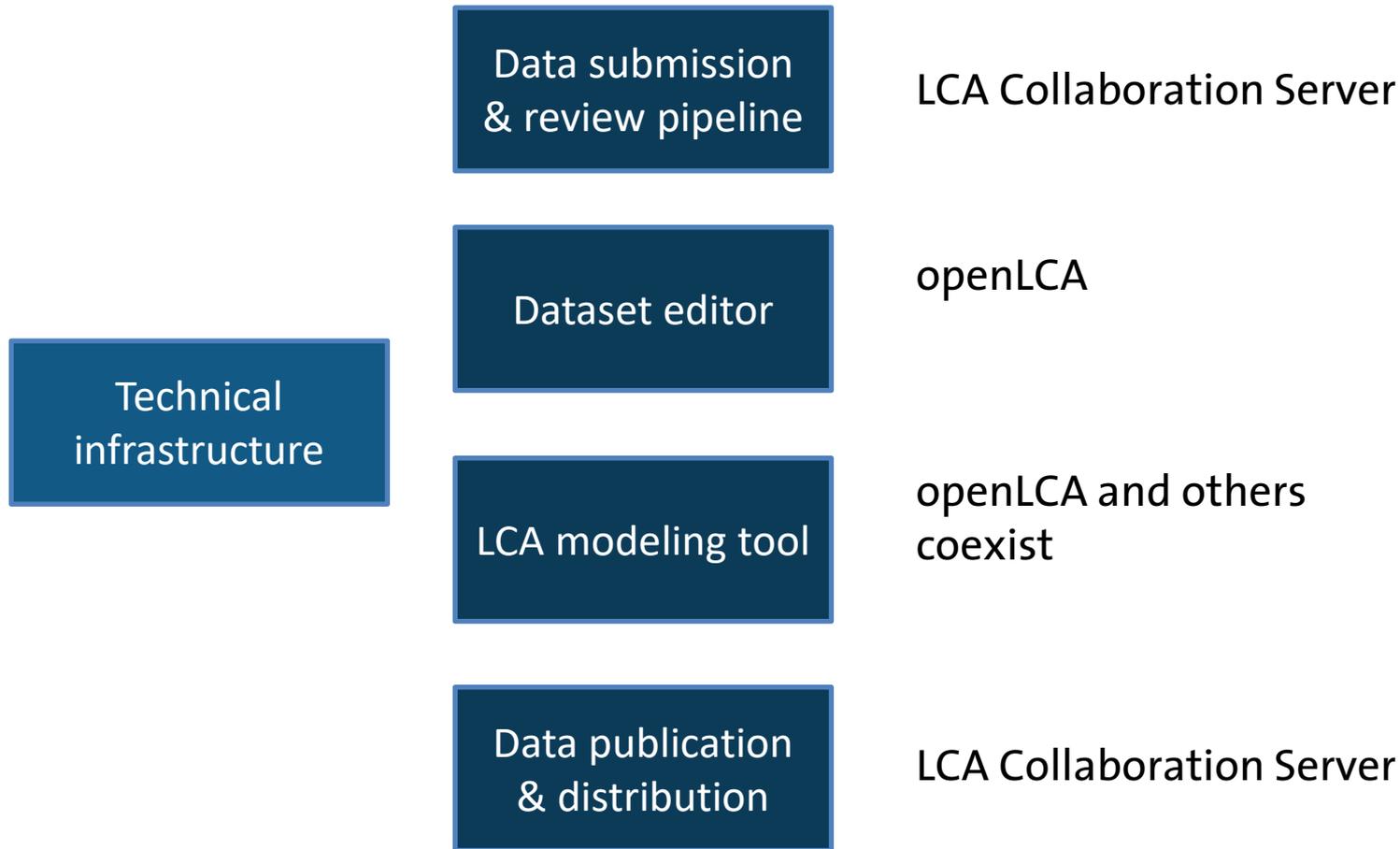
# A national LCI database, elements



# A national LCI database, elements

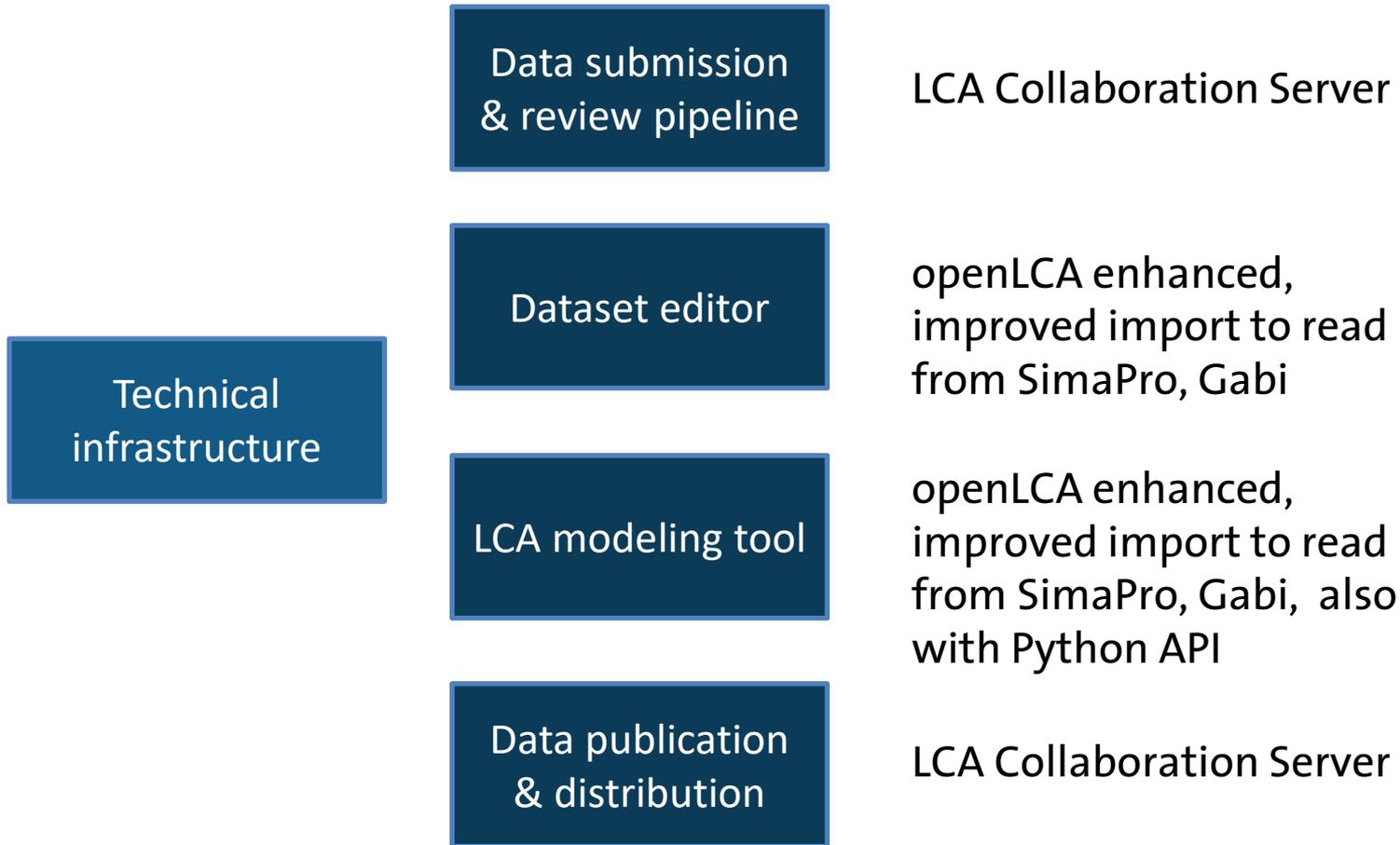


# A national LCI database, examples: USA (US Department of Agriculture, US EPA)



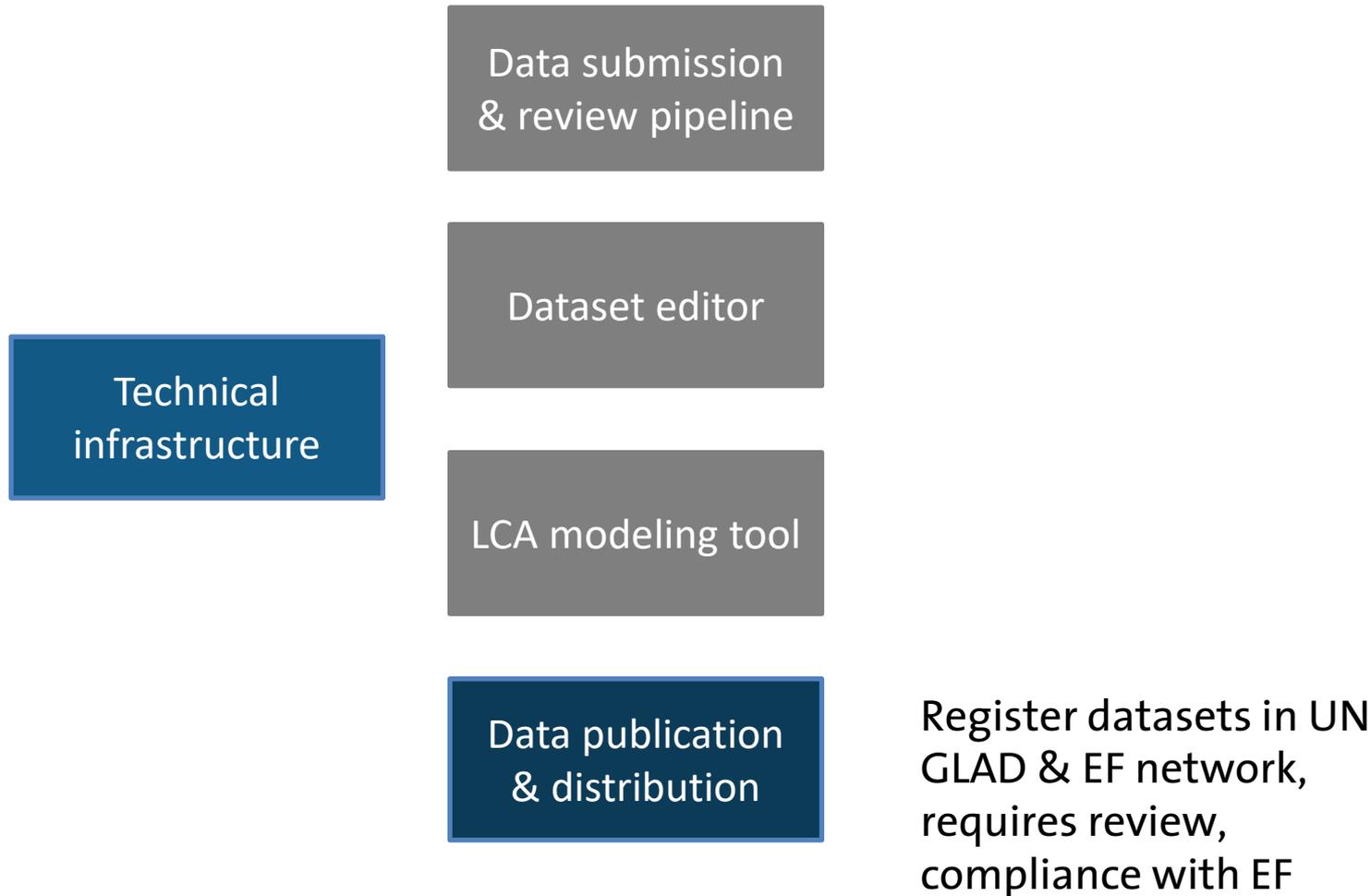
(project with GreenDelta, since 2015)

# A national LCI database, examples: **Canada** (National Resources Canada)



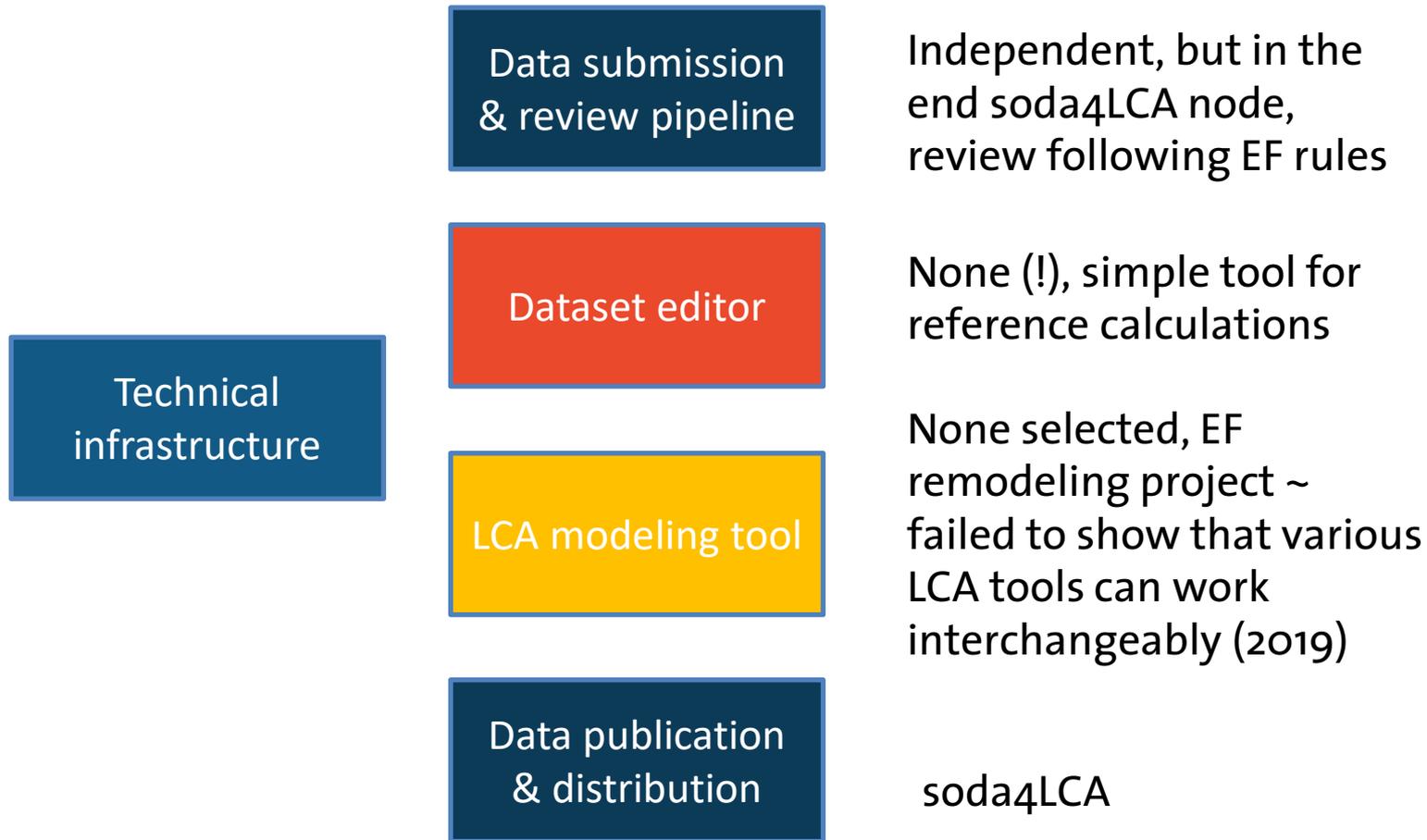
(project with GreenDelta, 2021+)

# A national LCI database, examples: Korea

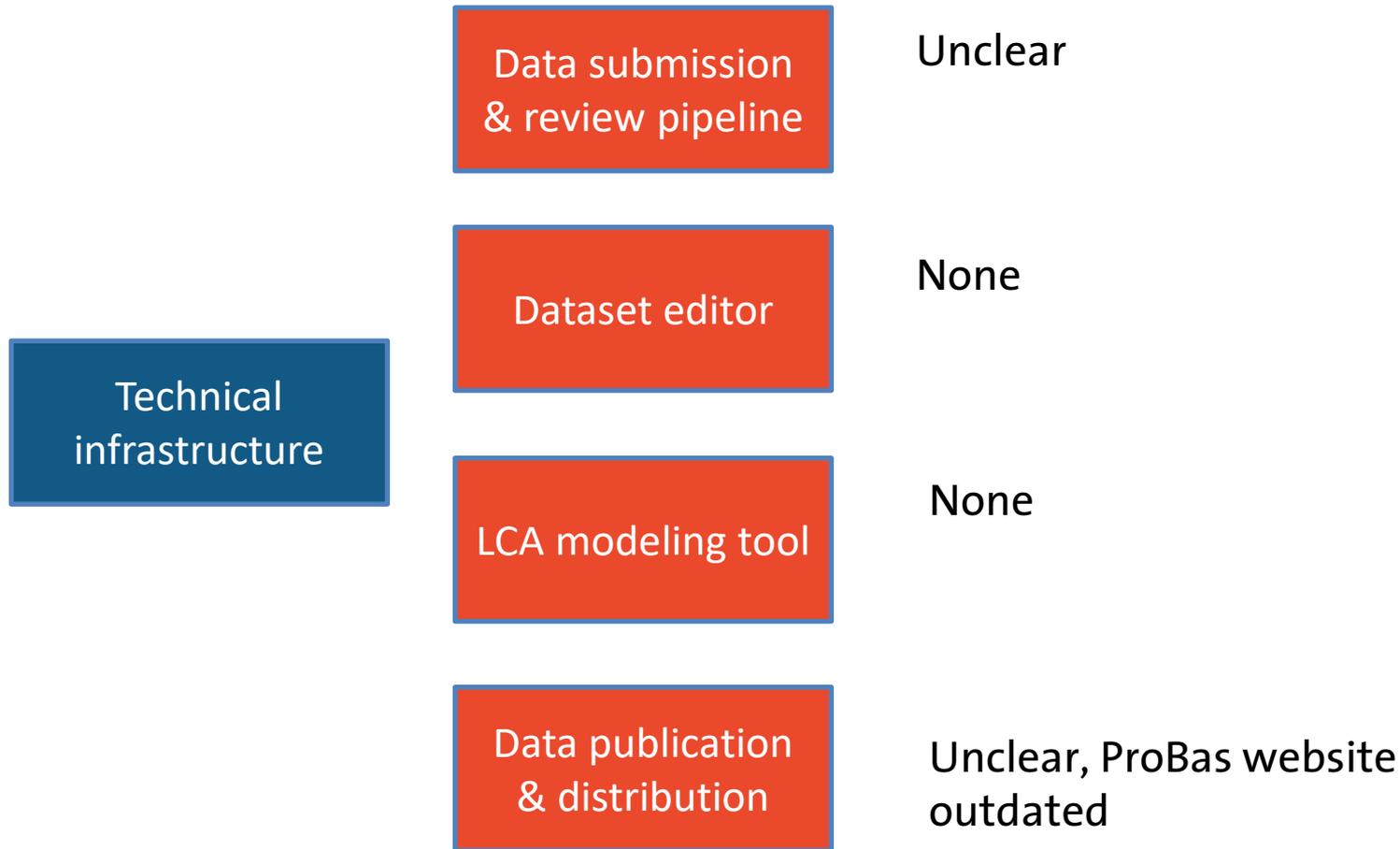


(project with GreenDelta, 2021)

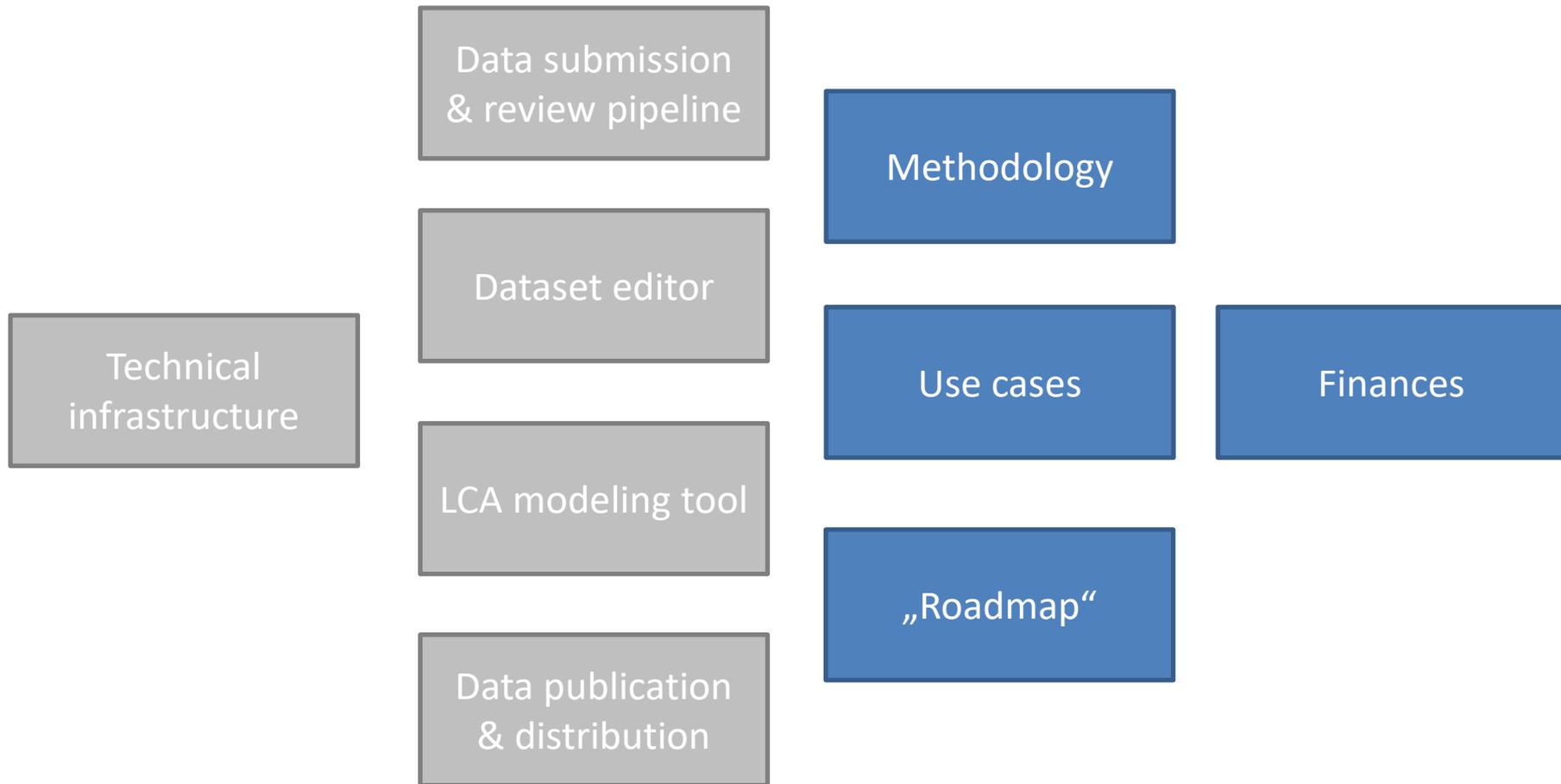
# A national LCI database, examples: EU



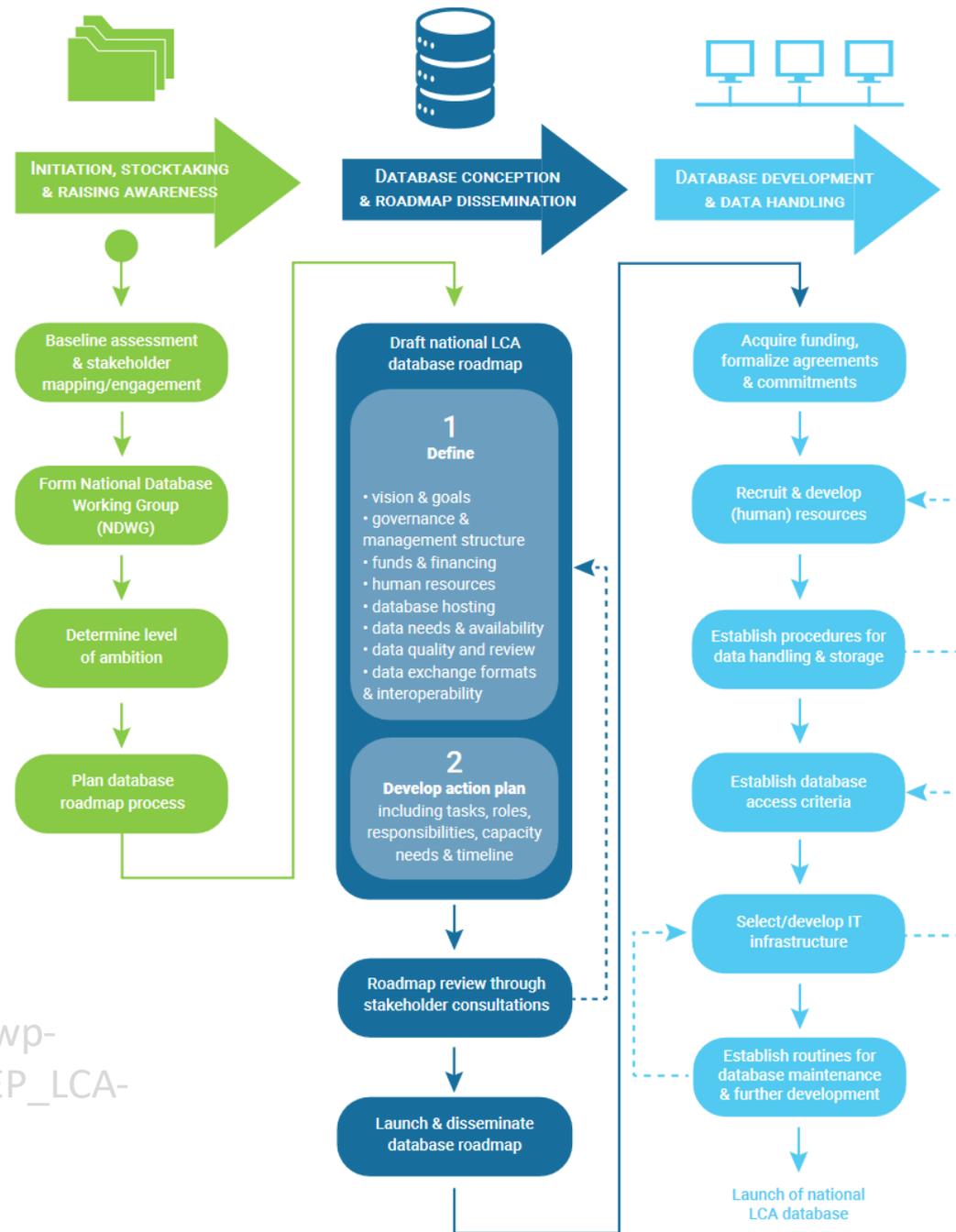
# A national LCI database, examples: German



# A national LCI database, elements



# A national LCI database, roadmap (UN report)



[https://www.lifecycleinitiative.org/wp-content/uploads/2020/11/INT\\_UNEP\\_LCA-Dev\\_Nov-19\\_WEBsml.pdf](https://www.lifecycleinitiative.org/wp-content/uploads/2020/11/INT_UNEP_LCA-Dev_Nov-19_WEBsml.pdf)

# A national LCI database, Now is the time

Never before have good data on life cycle impacts been so important.

Major companies and economies assess and improve now their carbon footprint and other life cycle impacts.

Public LCA data are like public infrastructure, they are a great benefit and advantage for local industry..

.. if done well.

There are now sufficient examples to learn from, there is also sufficient infrastructure to start from. For the start, it is important to bring main players on board.

This is also a chance to reflect Indonesian conditions and background, to and support Indonesian research and scientists.

# GreenDELTA

sustainability consulting + software

## *Thank you very much!*

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