Digitization and sustainability measurement

25.11.2020 | Christian Hasenstab | ASPA Seminar 2020

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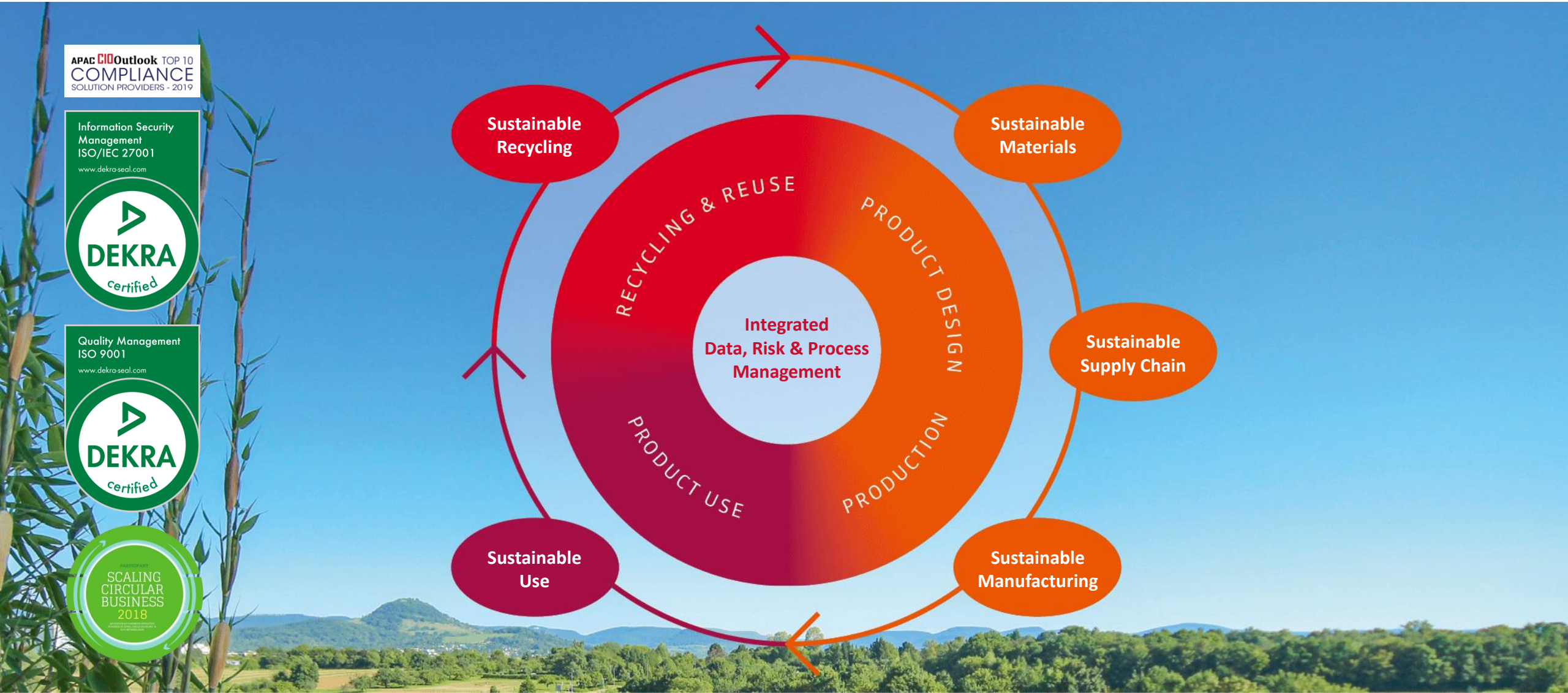

Digitization and sustainability measurement

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1. Introduction
   - Digitization/Digitalization
   - Sustainability measurement
2. Sustainability measurement in a digitized world
3. Sustainability of digitization
4. Conclusions

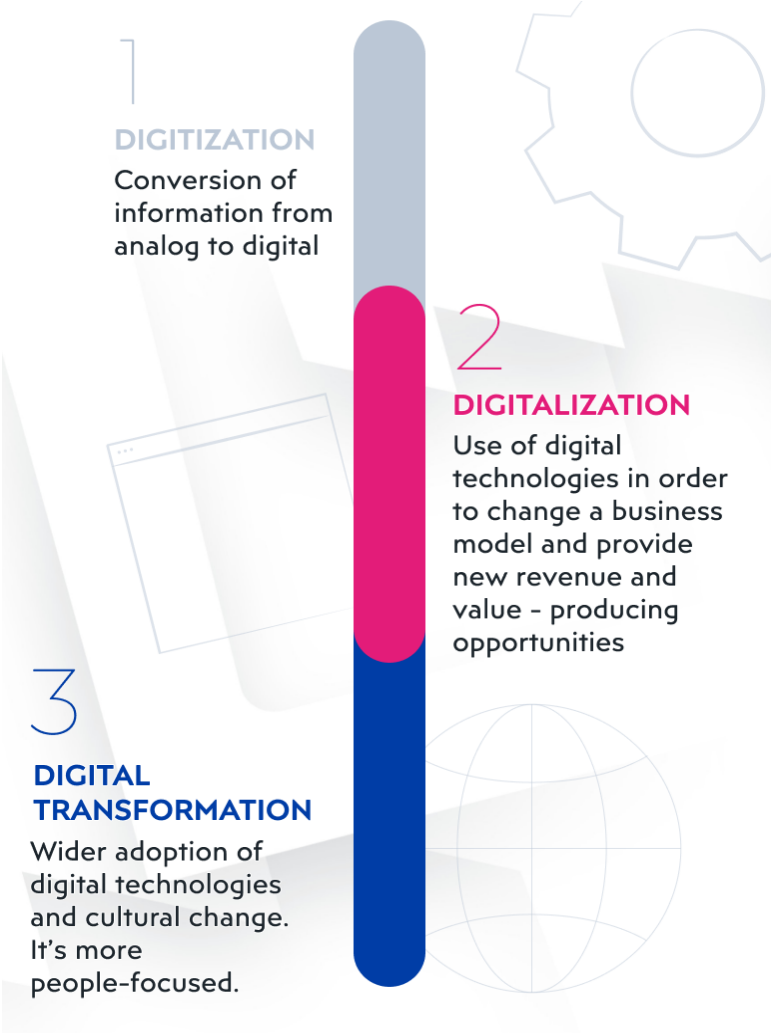
Fuente: Umweltministerium Baden-Württemberg

Introduction - Digitization

- Transmitting/storing/processing of information on
  - processes/transformations
  - (intermediate) products
  - wastes
  - ➢ Internet of Things (IoT)
- Machine learning, AI
- Automation
- De-materialization

“Exponential growth of technology will disrupt every business sector that has significant, and growing, information content.”
Mike Mastroyiannis

“Nothing is sustainable about digitization”
(J.Sommer, Gerente Deutsche Umweltstiftung)



Source: Filip Bubalo (tweakyourbiz,com)

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Introduction - Sustainability measurement

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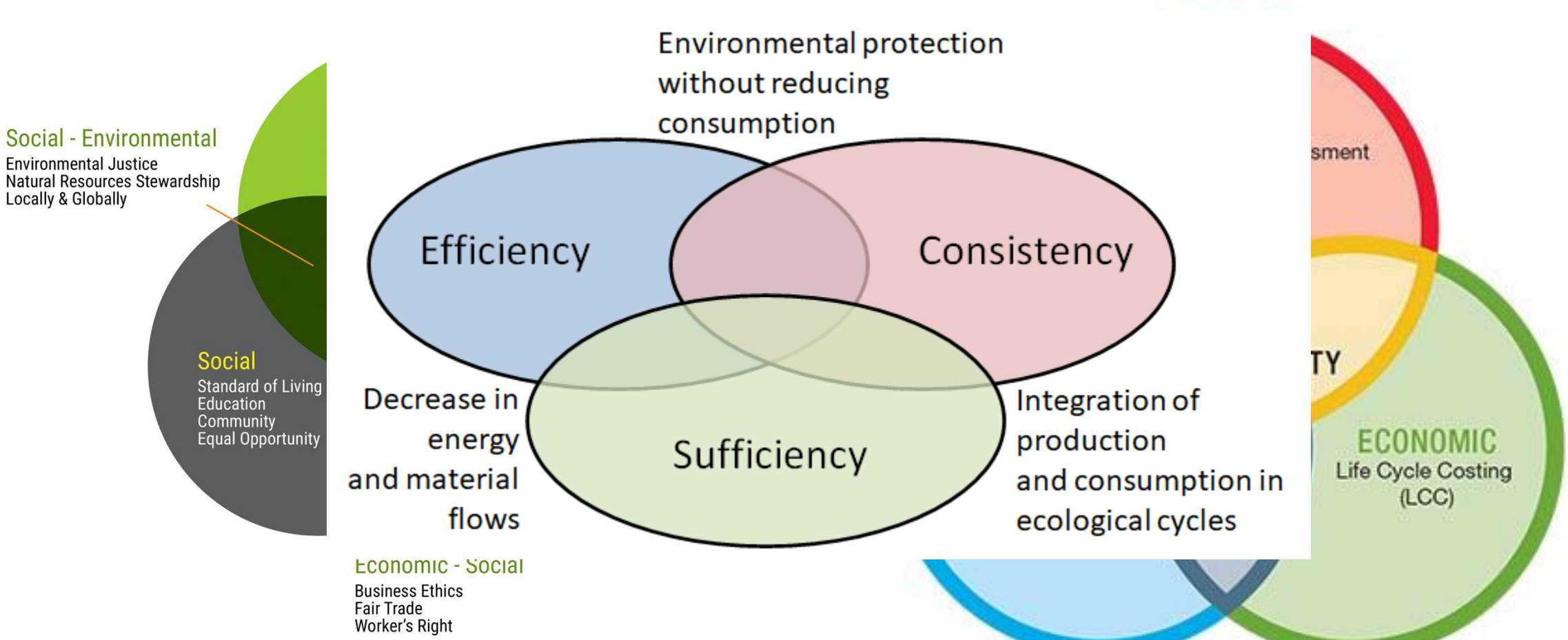
THE THREE SPHERES OF SUSTAINABILITY



Source: fathopesenergy,com

Source: worldsteel.org

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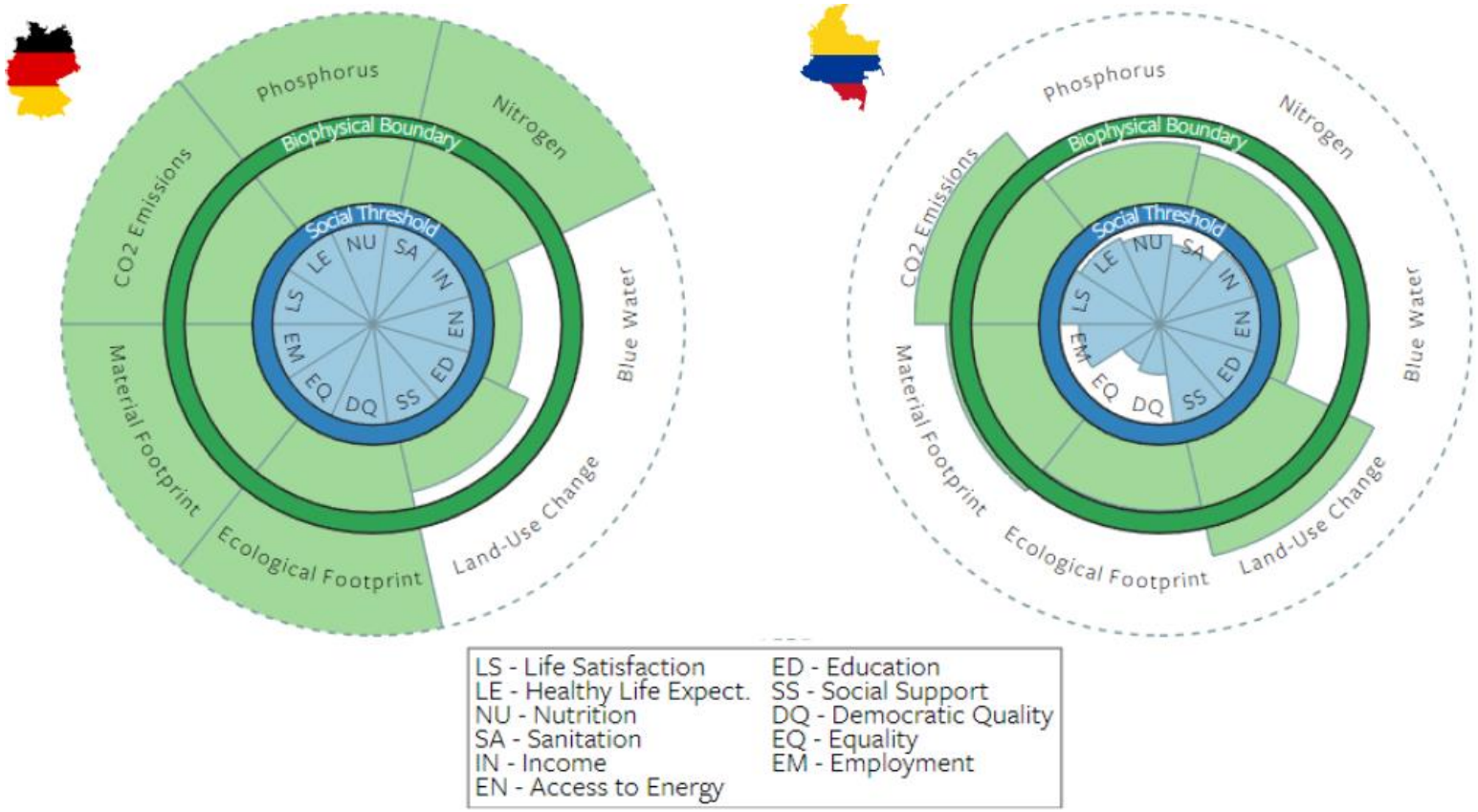
Planetary limits and science based targets

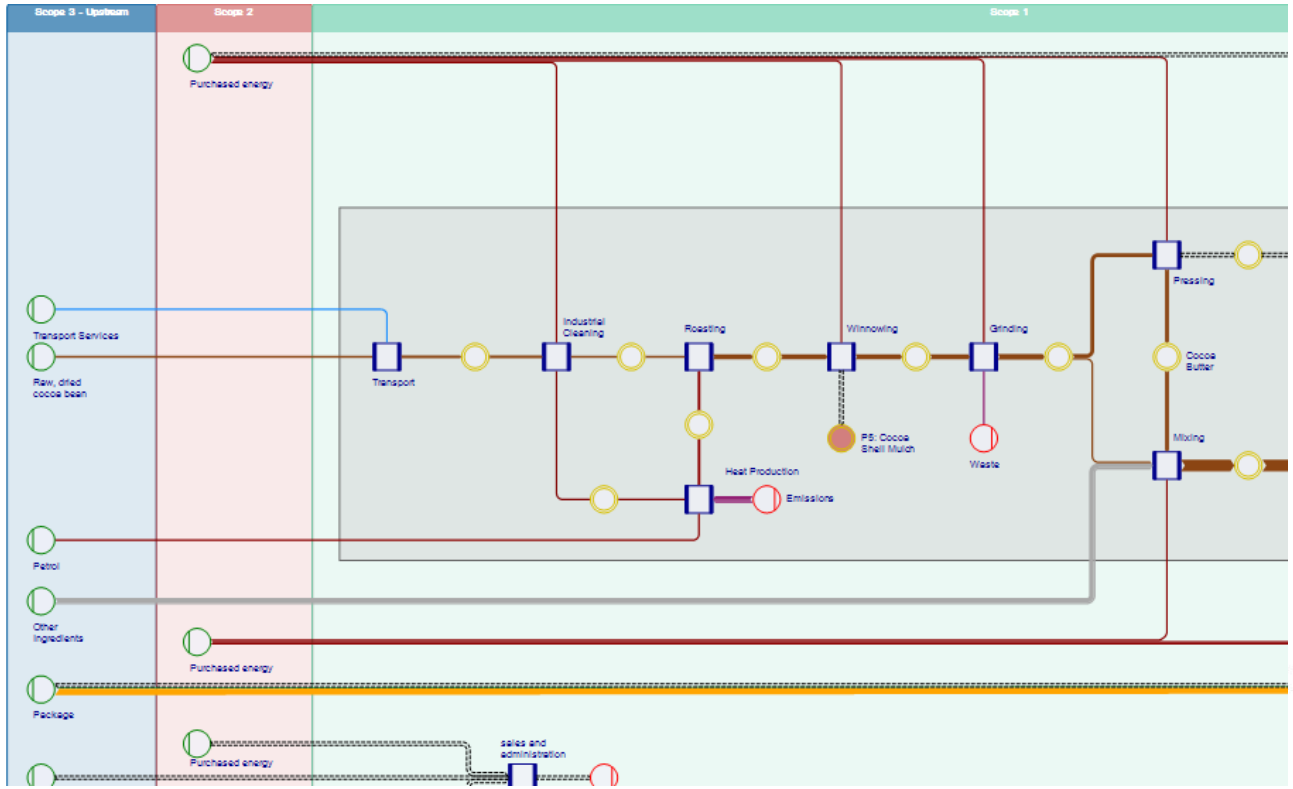


2018 O'Neill et al. - A good life for all within planetary boundaries / https://goodlife.leeds.ac.uk/countries

Source: carboncredentials.com

Introduction - Sustainability measurement

- Organizational and Life cycle analysis
- Ideally based on Material Flow Analysis (MFA)
- Life cycle inventory (LCI) data providers
- Life cycle impact assessment (LCIA) models



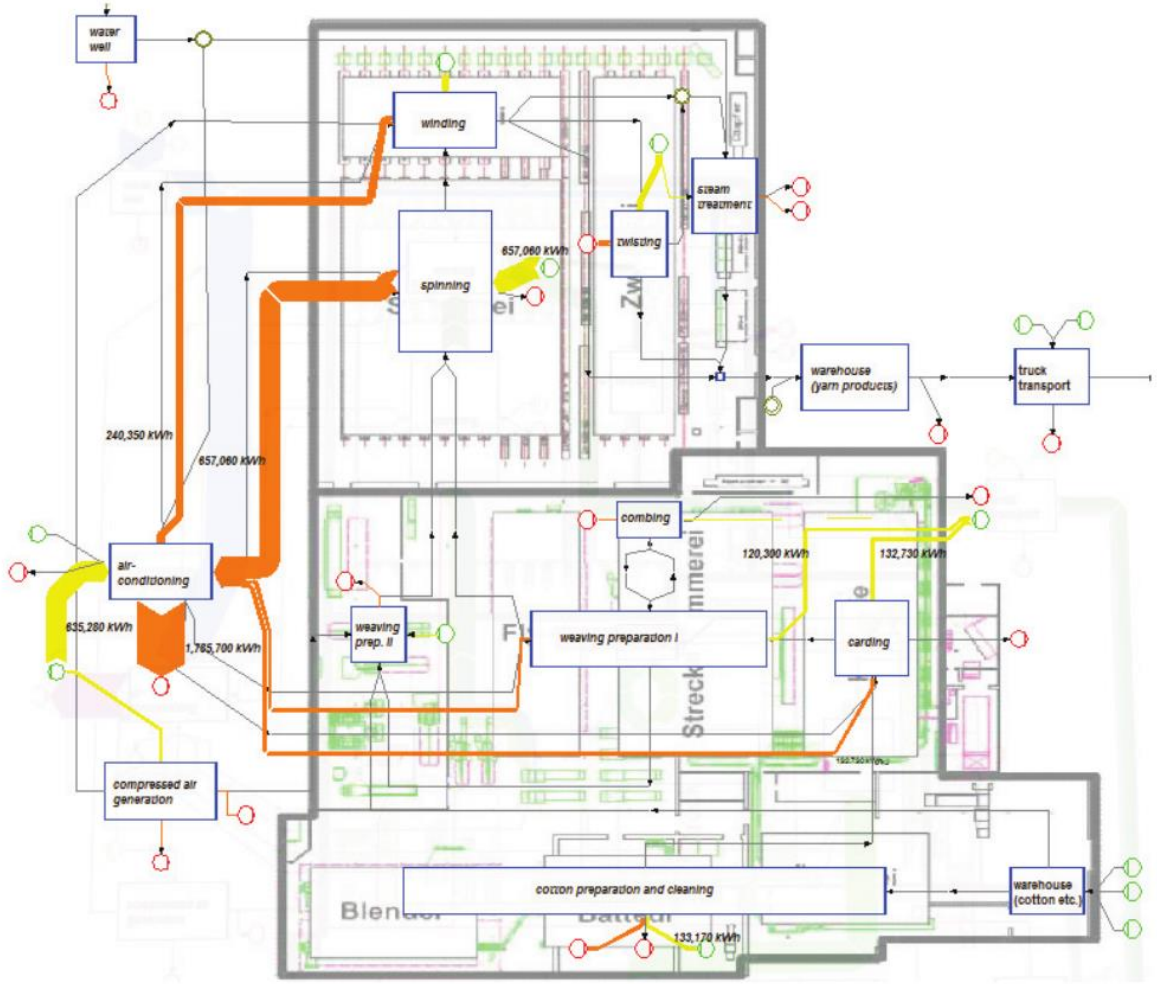


Figure 6: Energy-based Sankey diagram of SWU's production site in Waldkirch

From Viere, T.; Stock, M.; Genest, A.; How to achieve energy and resource efficiency: Material and energy flow modeling and costing for a small and medium-sized company; ifu Institut für Umweltinformatik Hamburg GmbH; EnHiPro; 2013. Seen on www.knowtheflow.com

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Introduction - Sustainability measurement

From inventory to indicators

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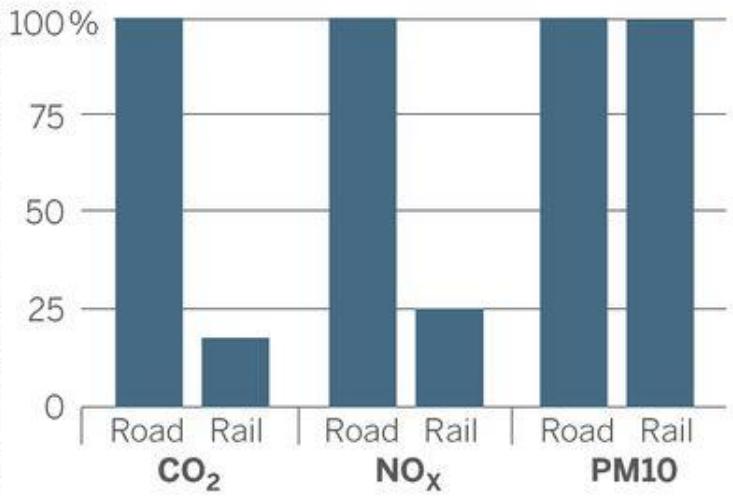
1. Goal and scope definition

2. Inventory analysis

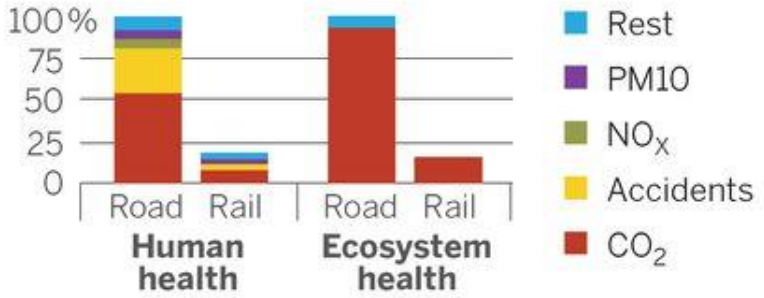
- Technical inputs and outputs of all processes
- Emissions (to air, water, and soil)
- Resource use (land, water, fossiles, metals)



3. Life-cycle impact assessment

- Climate change
- Ozone depletion
- Photochemical ozone creation
- Human toxicity
- Ecotoxicity
- Eutrophication
- Acidification
- Land stress
- Water stress
- Resource depletion

Human health
Biodiversity/ ecosystem services
Natural resources



4. Interpretation

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Sustainability measurement in a digitized world

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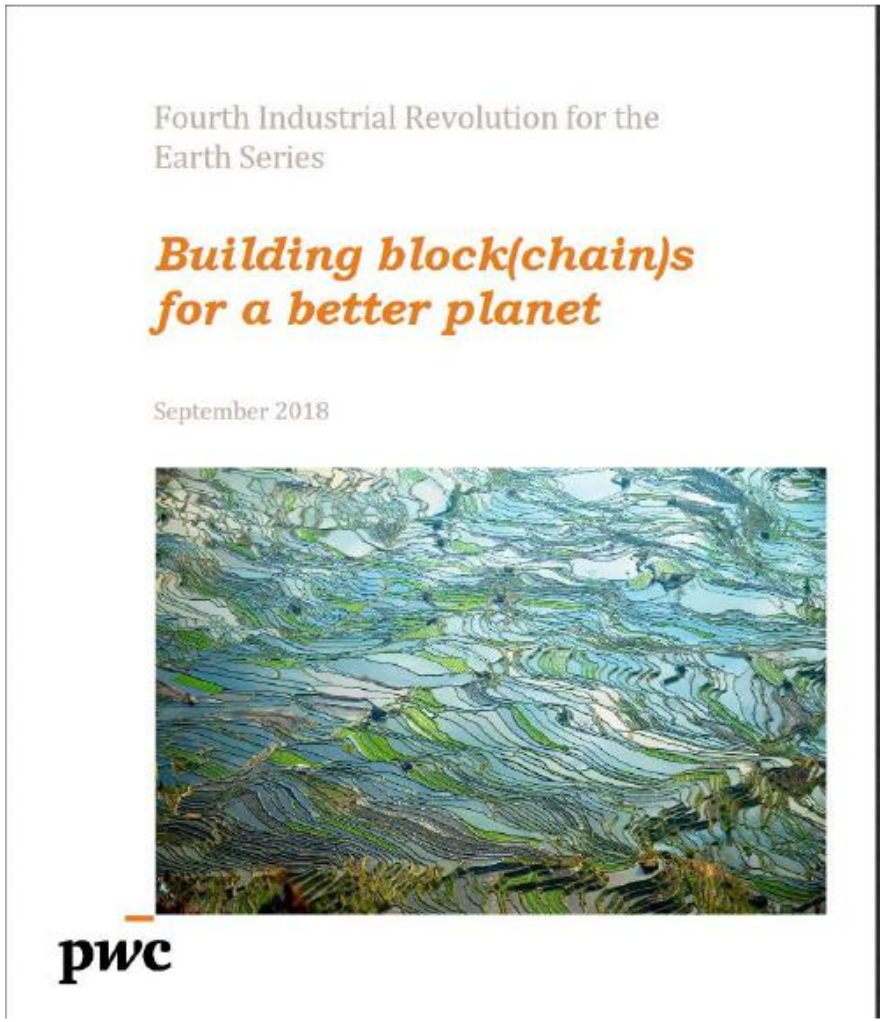
- Higher availability of specific data throughout the life cycle
- Application of Blockchain
  - Gathering LCA data
  - Agricultural and food products verification of origin and certifications and tracking food born illness
  - Product material and chemical constituents transparency
  - Prevent waste by tracking materials
  - Trace non-conflict materials (e.g. “Oro verde”)
- Analysis of Big Data
- Automation of life cycle analysis
  - Support mass customization
  - Usage of existing ERP data (BOMs)
  - Example: Product sustainability



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Automation of Life Cicle Analysis

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Project: Live LCA

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Automation of Life Cicle Analysis

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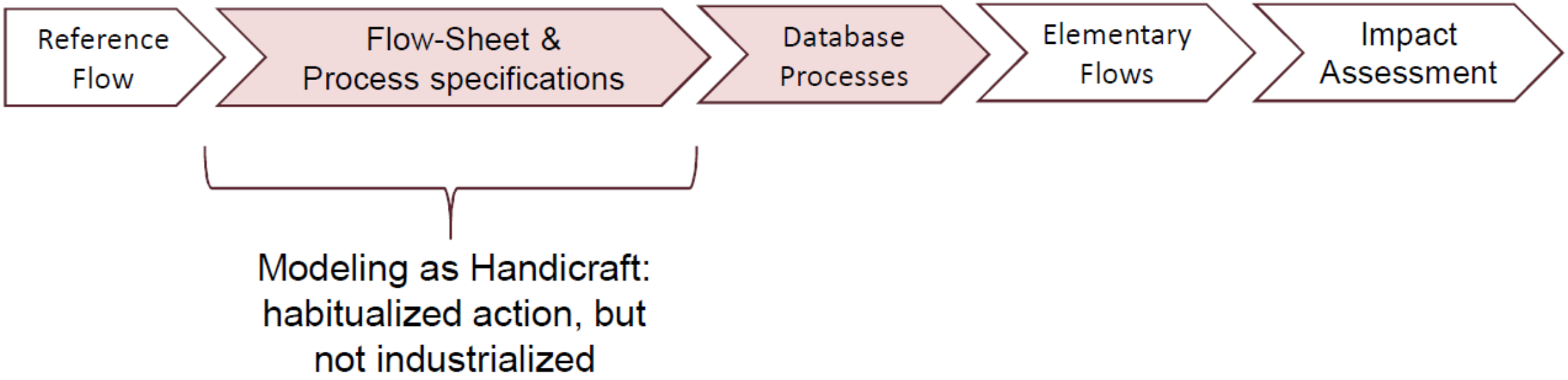

- Hard-coded process specifications (materials, coefficients,…)
- Single reference flow, product system
- Application of “tools” (!)
- Tailor-made LCAs for every reference flow

Fuente: Andreas Möller

Automation of Life Cicle Analysis

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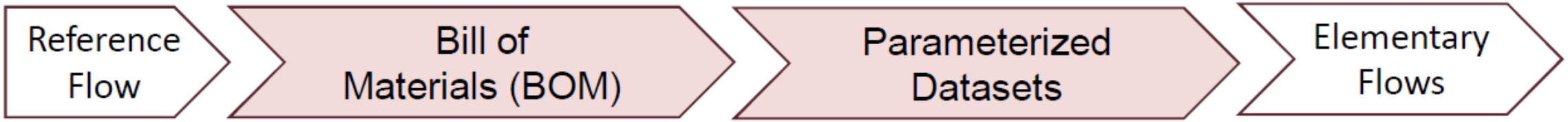

1. **Bill of Materials (BOM)** and "BOM explosion": ERP system components for material logistics, e.g. Material Requirement Planning (MRP),
   in combination of parameterized service processes (LCA result processes, e.g. machines, maintenance, energy consumption, transport,…)

2. **Parameterized Datasets** for
   „raw materials" or intermediate goods, e.g. screws, housings or packaging,
   with parameters, e.g. size, length, form, alloy

3. **Mapping** of required materials to datasets and parameters

Fuente: Andreas Möller

Automation of Life Cicle Analysis

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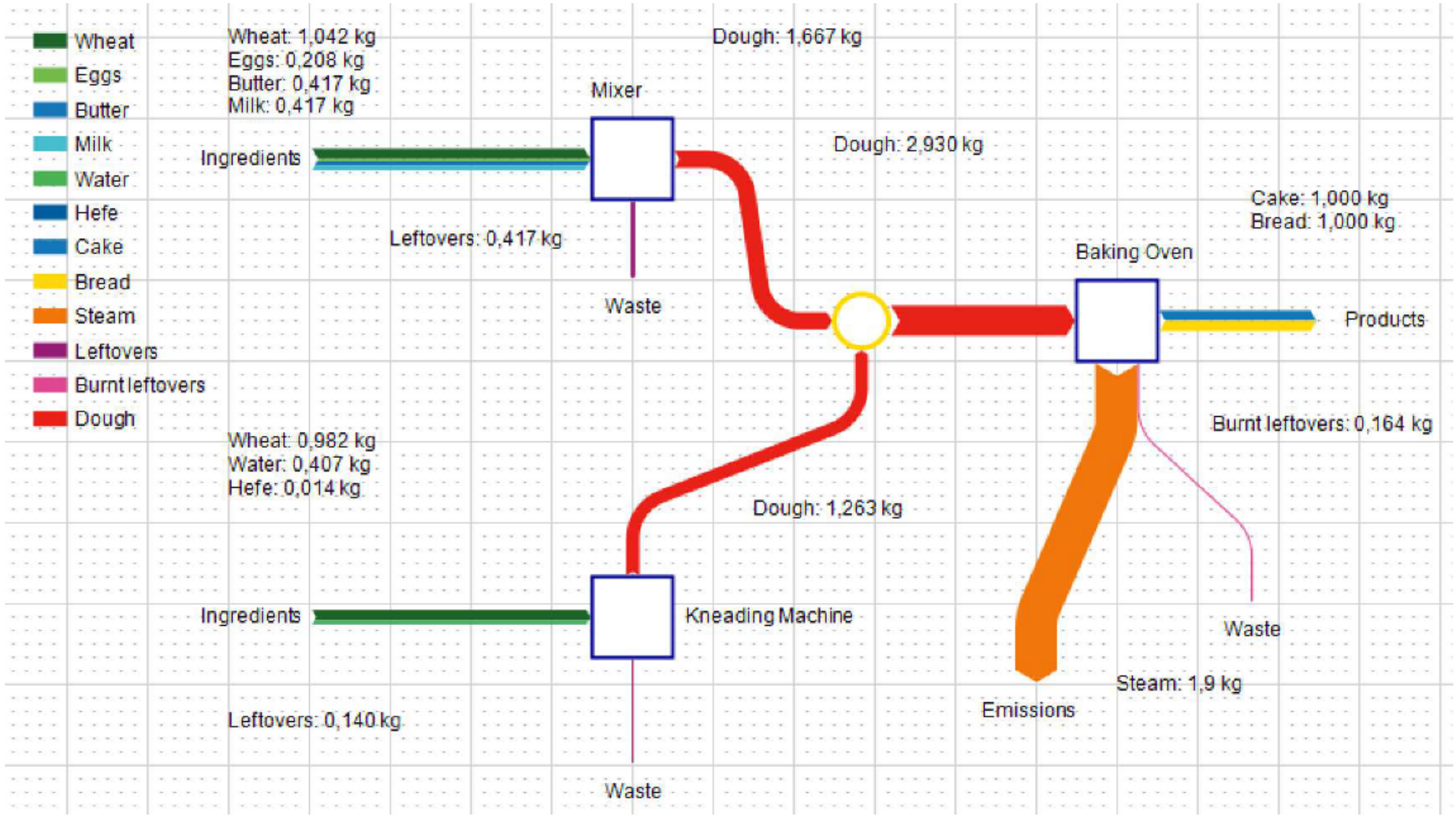

Fuente: Andreas Möller

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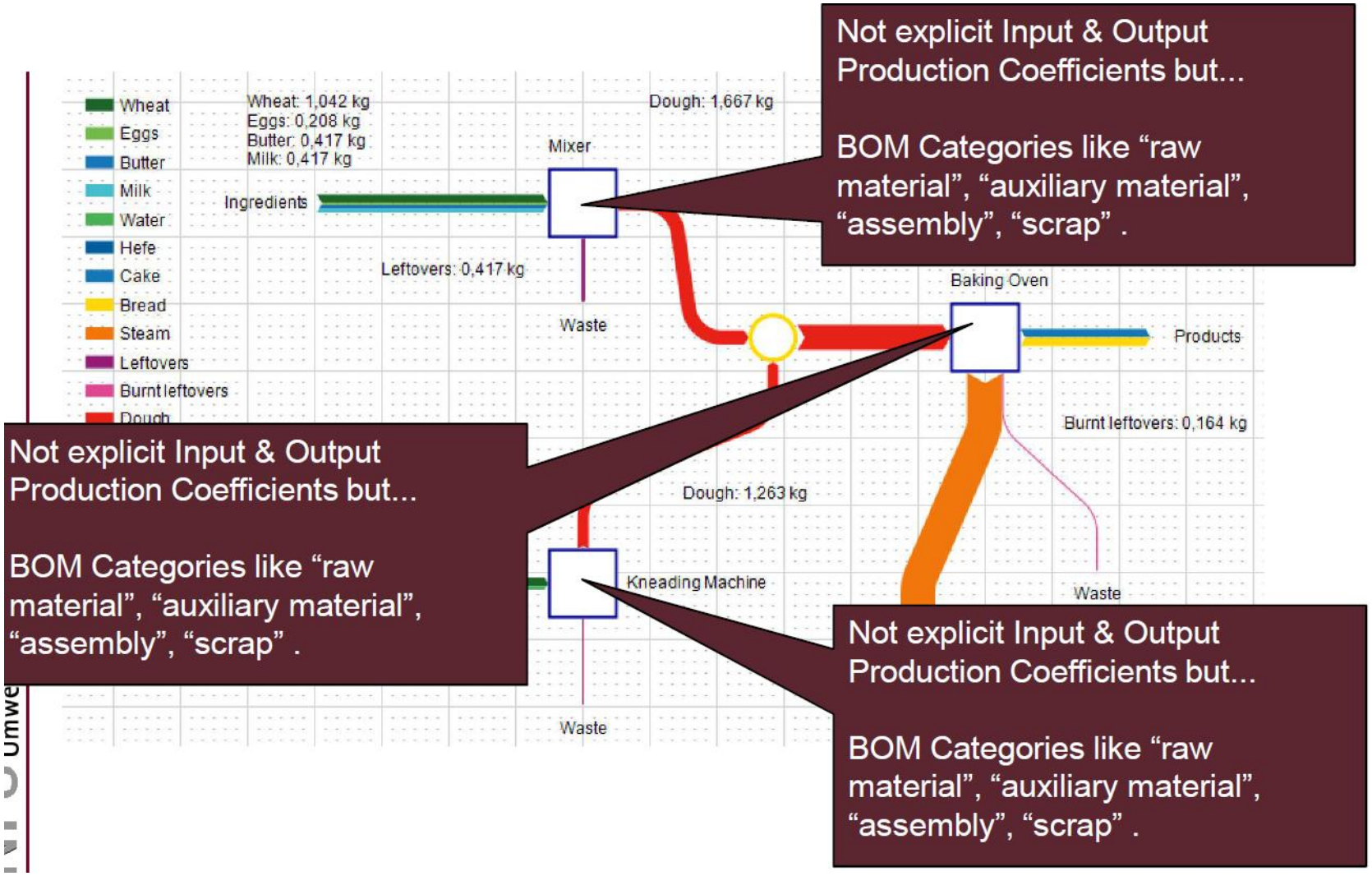

Fuente: Andreas Möller

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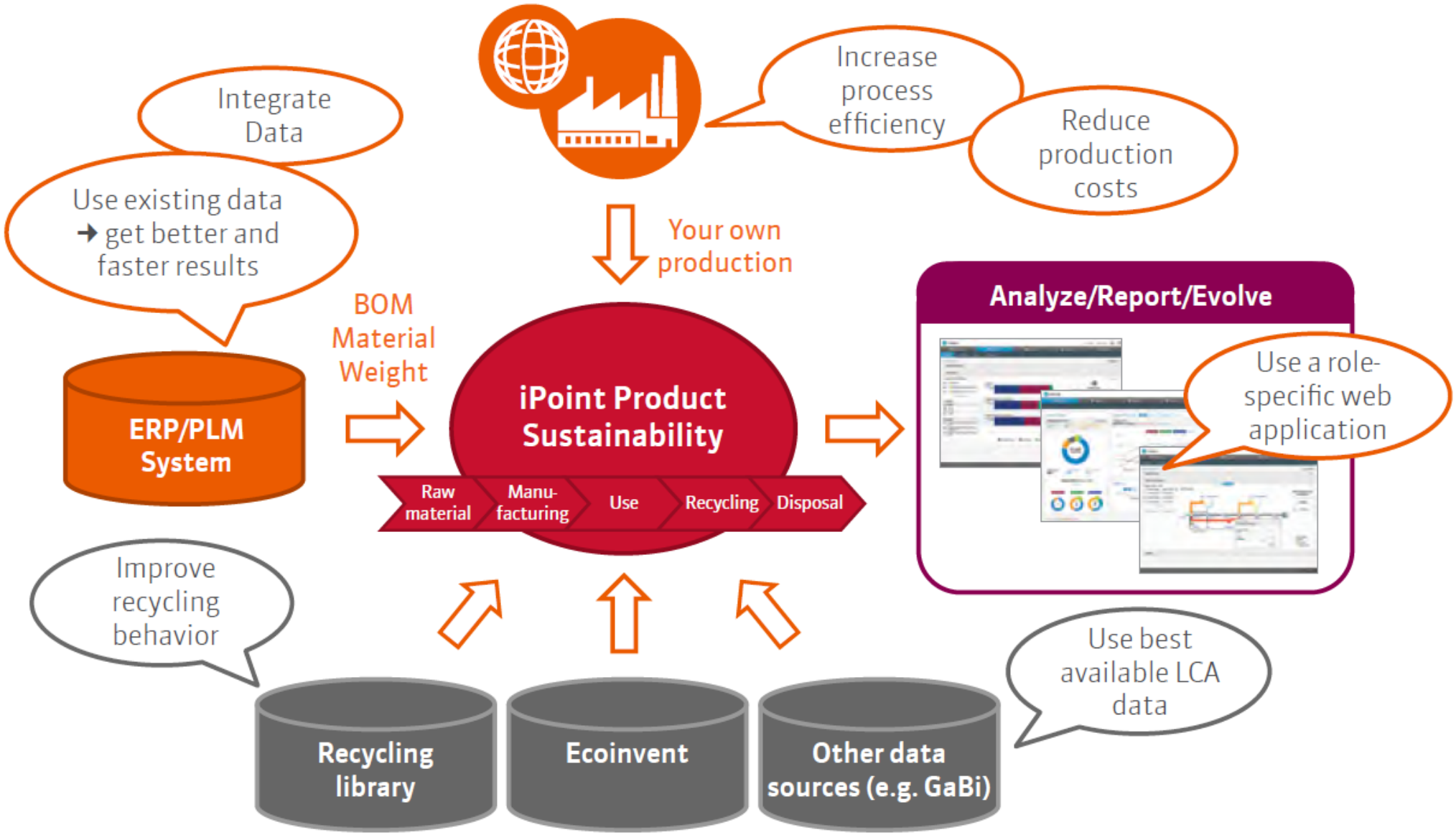

Application of Blockchain

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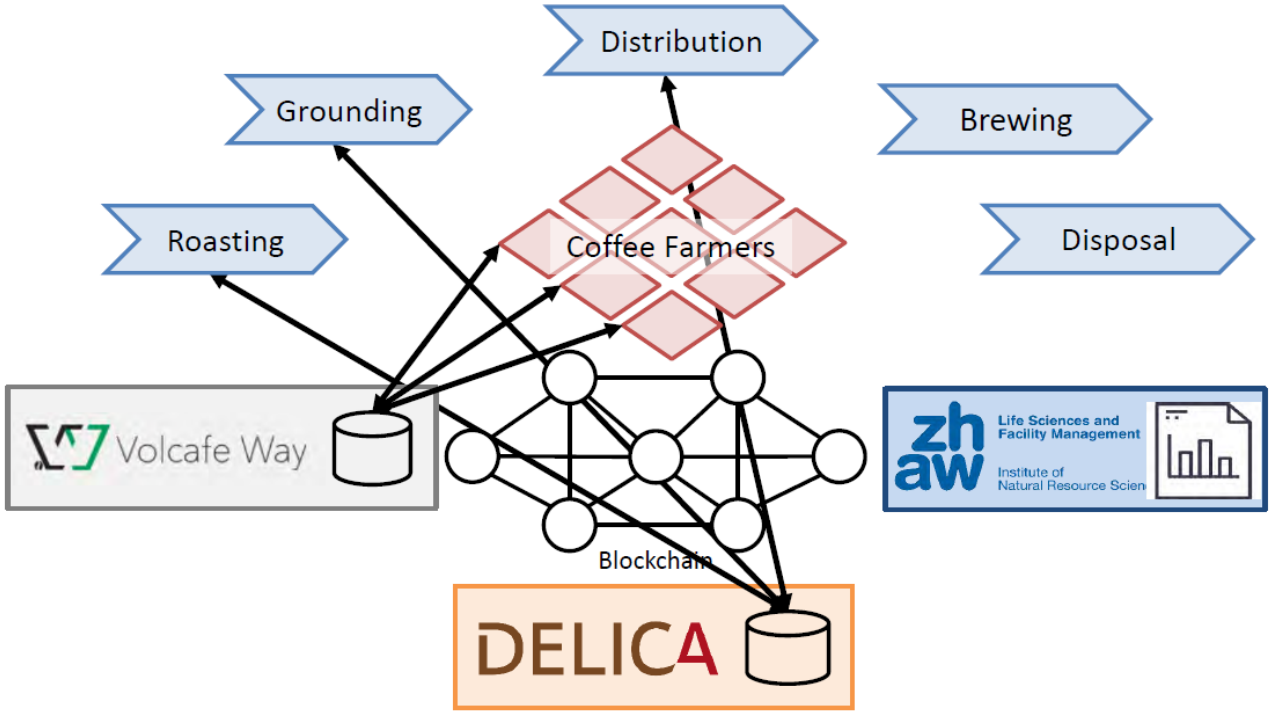
Digitization of coffee life cycle analysis (René Itten & Matthias Stucki)

https://www.reddit.com/r/interestingasfuck

https://www.rainforest-alliance.org/



- Continuous reporting of yield, location, fertilisers, pesticides and other expenditures
- Collect trustworthy and transparent information for Life Cycle Inventory models
- Challenge for blockchain : internet access at farms
- The digitised value chain will bring the involved actors closer together

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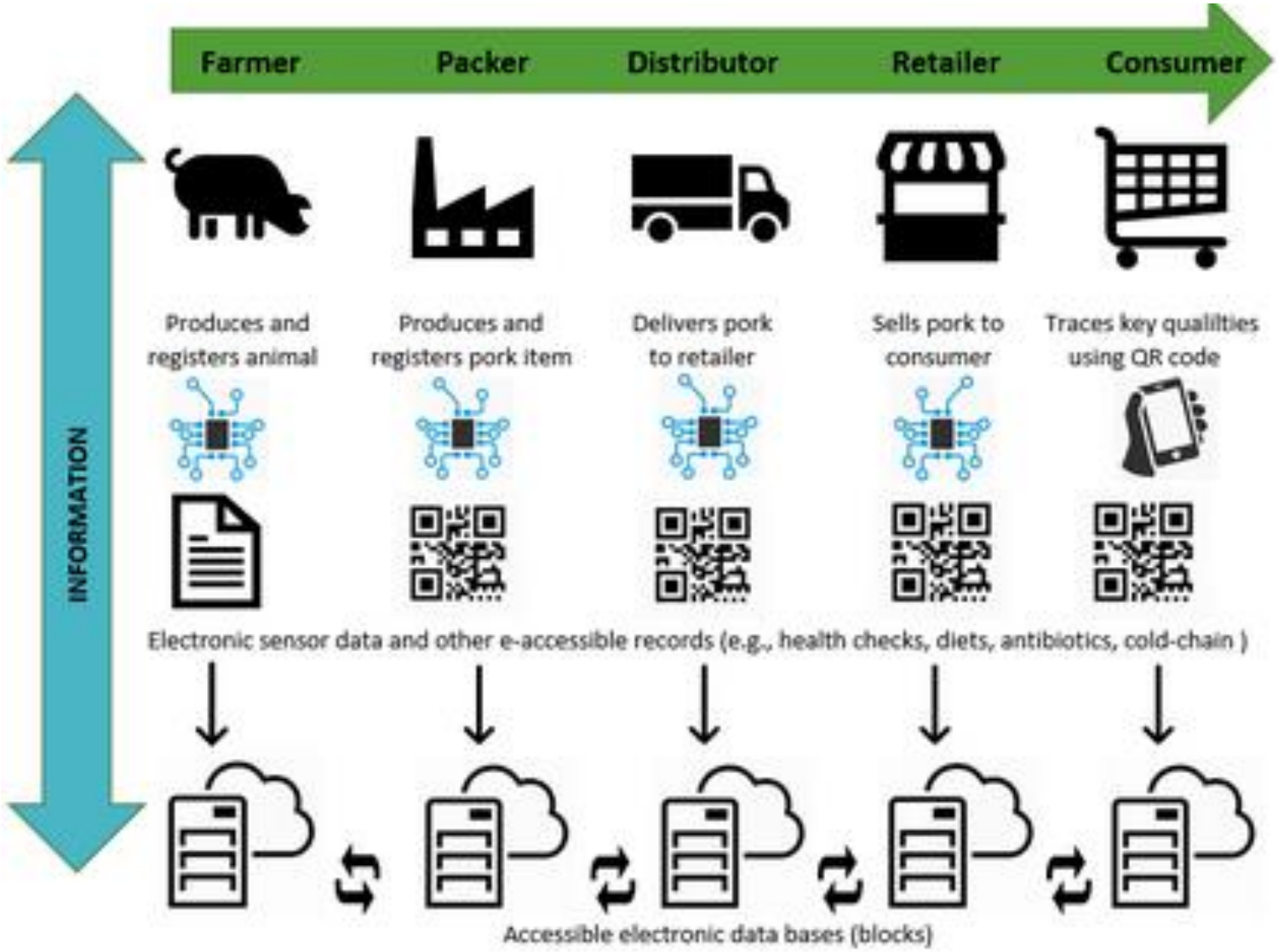
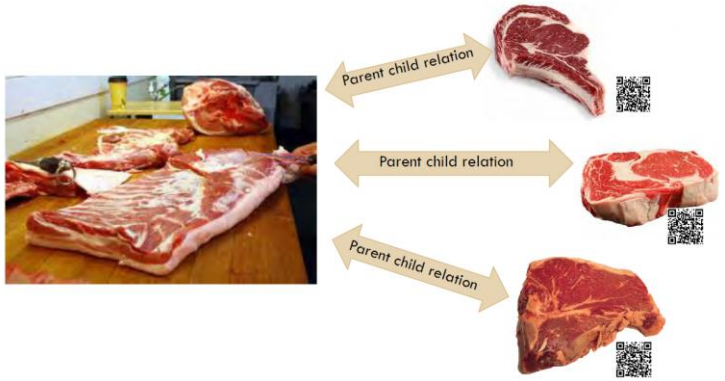
Example: Digital twin pork



Source: swineweb.com



- Aggregation of information from the traceability chain
- Cutting information
- Best before date
- Data available by app

Source: fraunhofer, M.Eisenhauer

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Example: Reusable take-away dish Vytal (or Rebowl)

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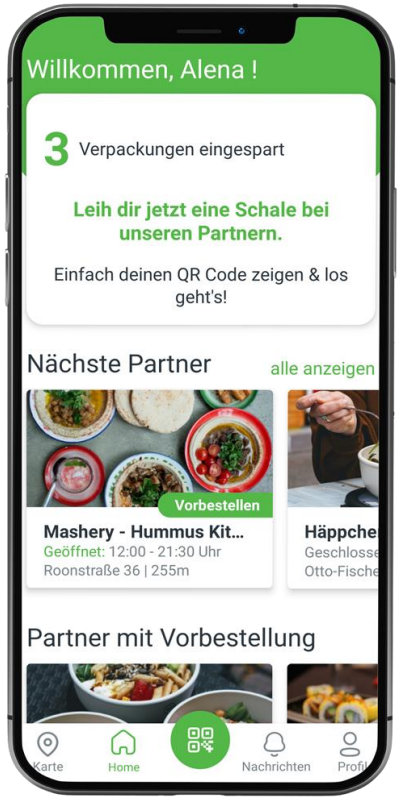

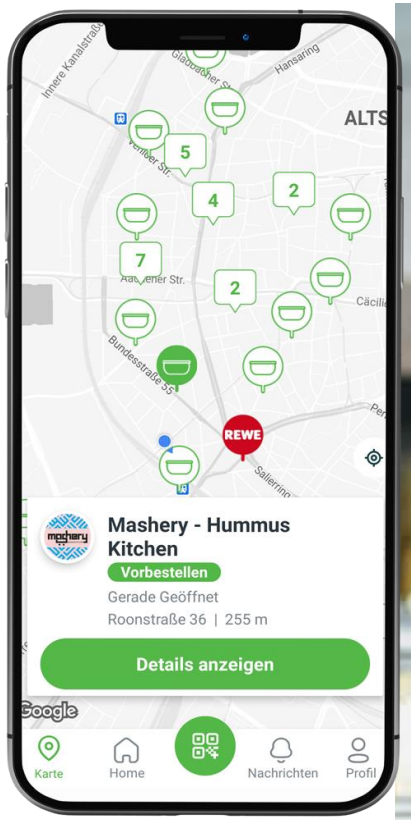

Source: vytal.org

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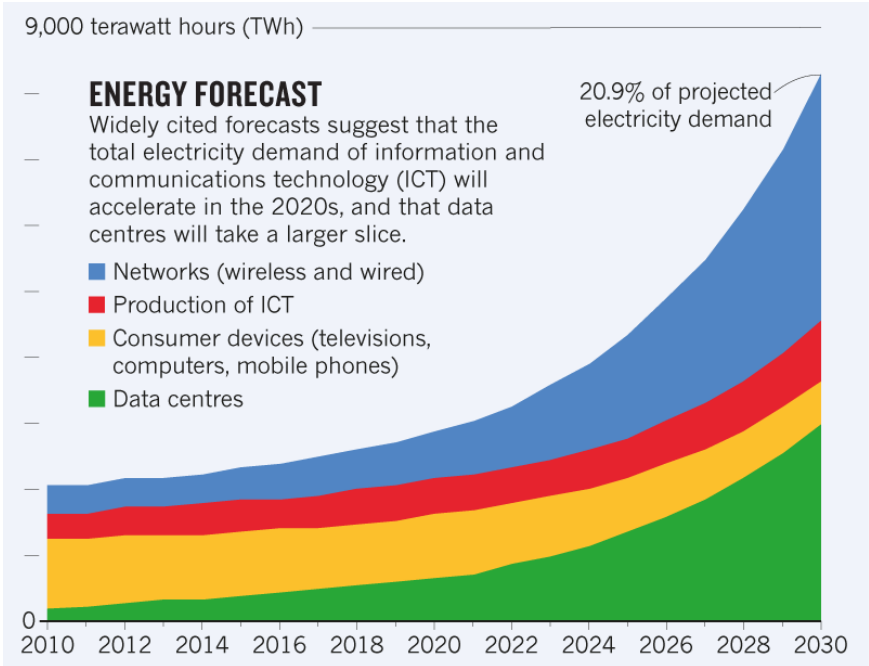
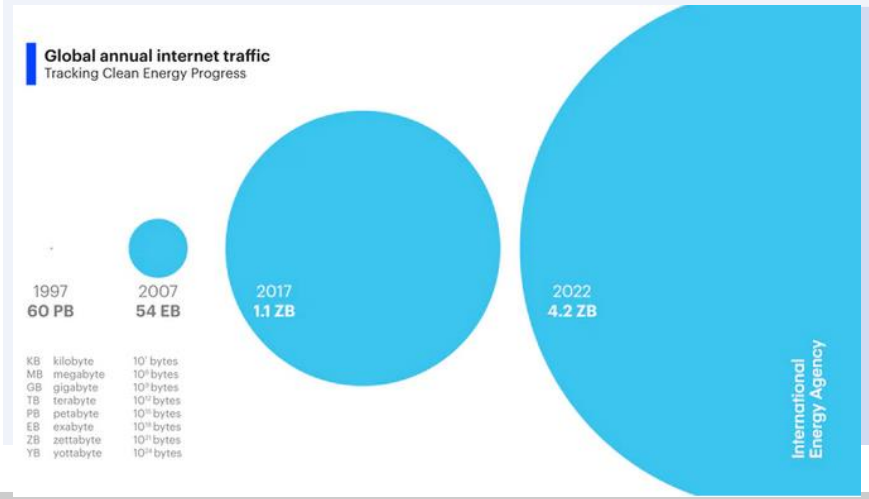
Sustainability of digitization

- Some ecological aspects
  - ⊕ De-Materialization (cameras, GPS, car sharing, less waste, miniaturization e.g. iPad Air)
  - ⊕ Videoconferences vs. travel
  - ⊕ Supporting circular economy, efficiency
  - ⊖ Energy and infrastructure resources demand (in spite of Koomey's law!)

- Some social aspects
  - ⊕ Empowerment, participation
  - ⊕ Accessibility of education and knowledge
  - ⊖ Digital divide, Unemployment for low-skilled

- Some economical aspects
  - ⊕ Increasing innovation, New business models
  - ⊖ Even faster and more unstable?





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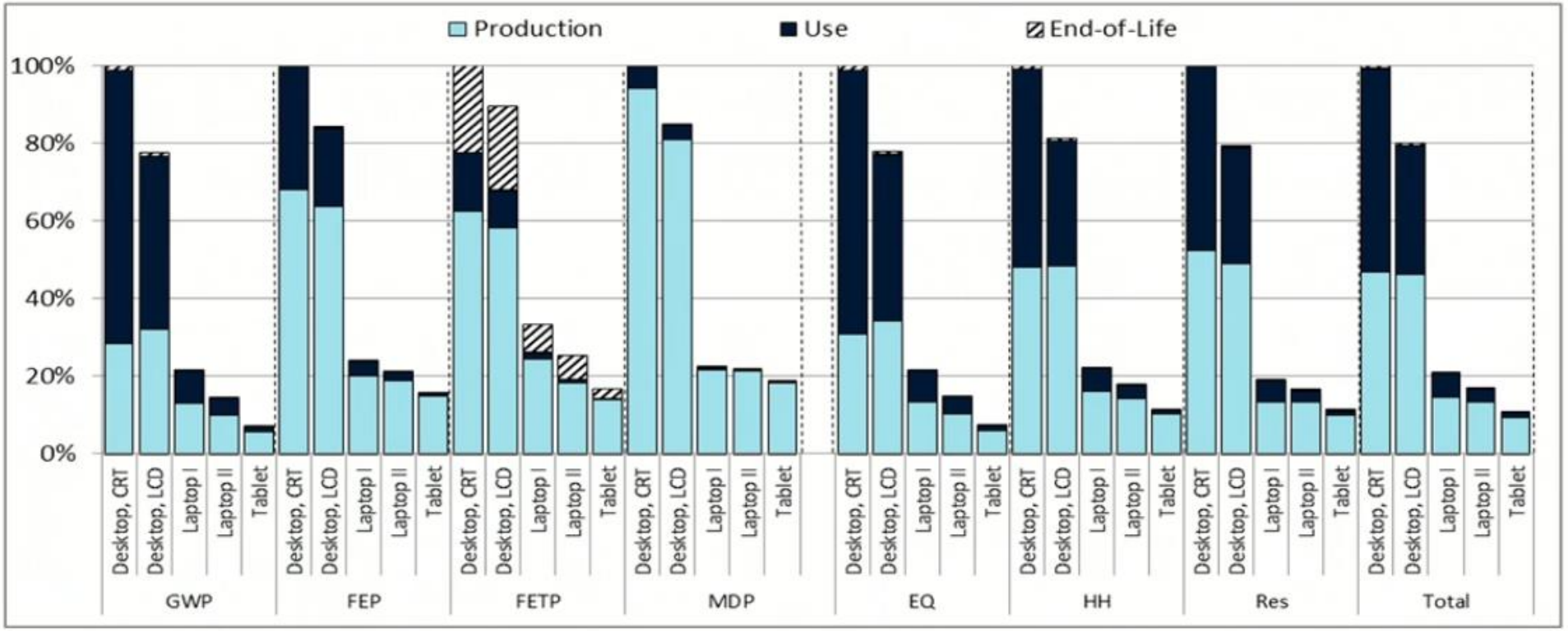
LCA of ICT end-user devices: desktop PCs, laptops, tablets (1 h of use)



Environmental impacts of 1 hour of use of ICT devices (relative to a PC with CRT Screen, which is set at 100%). Midpoint impact categories: **Global Warming Potential (GWP), Freshwater Eutrophication Potential (FEP), Freshwater Ecotoxicity Potential (FETP), Metal Resource Depletion (MDP)**, endpoint damage categories: **Ecosystem Diversity (EQ), Human Health (HH), and Resource availability (Res)**, weighted total.

Source: Hischier, R., Wäger, P.A. (2015): The Transition from Desktop Computers to Tablets: A Model for Increasing Resource Efficiency? In: ICT Innovations for Sustainability. Springer, 243-256

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Sustainability of digitization

Software in theory is the ideal sustainable product, but:

- Programmed obsolescence
  - Counting printed pages or battery cycles to reduce quality of or stop service
  - Recognition of replacement parts by competitors to stop service

- Software-induced obsolescence
  - Increasing hardware requirements, devices have to be replaced by more powerful ones
  - Older versions no longer supported

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Conclusions and situation in Colombia

- Digitalization can help to improve sustainability measurement
- Sustainability should be at the heart of digitalization to make it a tool to mitigate climate change and other environmental problems
- Increased need to move to a post-growth society

Colombia

OECD Review / IDB Report 2019:

- Sustainable growth not sustainable development
- Lowest fixed and mobile penetration rates in the OECD
- Digital divide reduced
- Certification of artesan/manual work (agriculture/artwork)
- Smart farming projects for banana (LCA applicable?)
- Transparency portal (http://www.pte.gov.co/)

https://www.dw.com/en/dw-akademie/speakup-barometer-colombia/s-46454156

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Gracias – Thank you - Danke

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