EUROPEAN COOPERATION
IN SCIENCE AND TECHNOLOGY

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Versailles, France, October 20th - 21st, 2016

WG 2 – ECO DESIGN OF FOOD PROCESSES

- About WG2
- State of the art
- Possible case studies
- Possible deliverables and dissemination
- Possible industrial partnerships
- Possible synergies with other national and European projects

OBJECTIVE 5

- Eco-design is an approach to conceive products and processes to include sustainability criteria.
- In food production, eco-design is starting to be used to balance several contradictory criteria, such as taste, safety, nutritional value, cost-effectiveness, and environmental impact of the final products. Existing methods of optimization, knowledge integration, modelling and decision-making need to be upgraded, or tailored specifically for food production. Eco-design is not only a scientifically motivating research field, but an important driver for industrial innovation as well. Unless research efforts are coordinated and focused, they may fail to reach the critical mass needed to address the great challenges of the food sector.

STATE – OF – ART

Product

Process

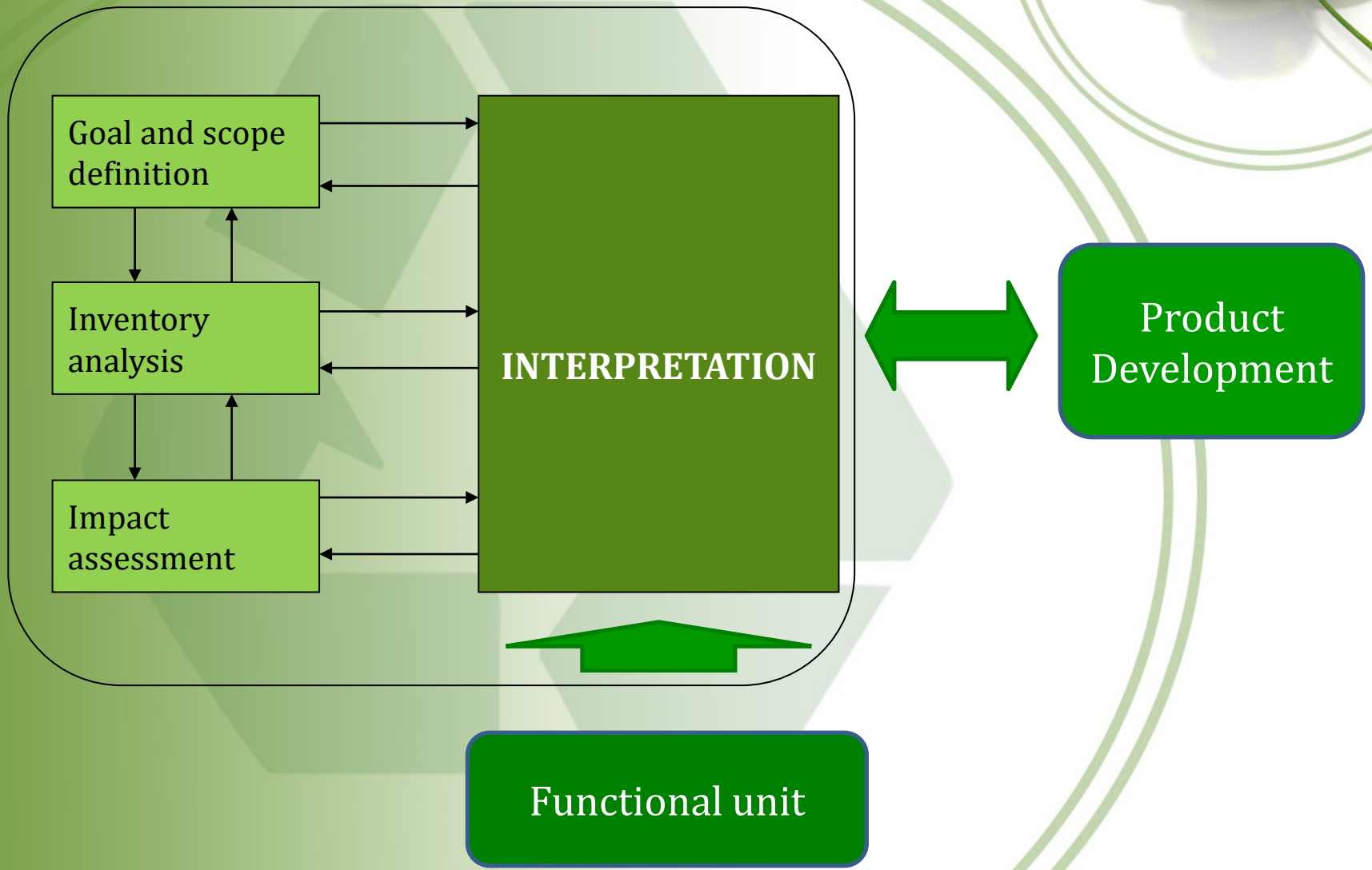
System

PRODUCT (FOOD)

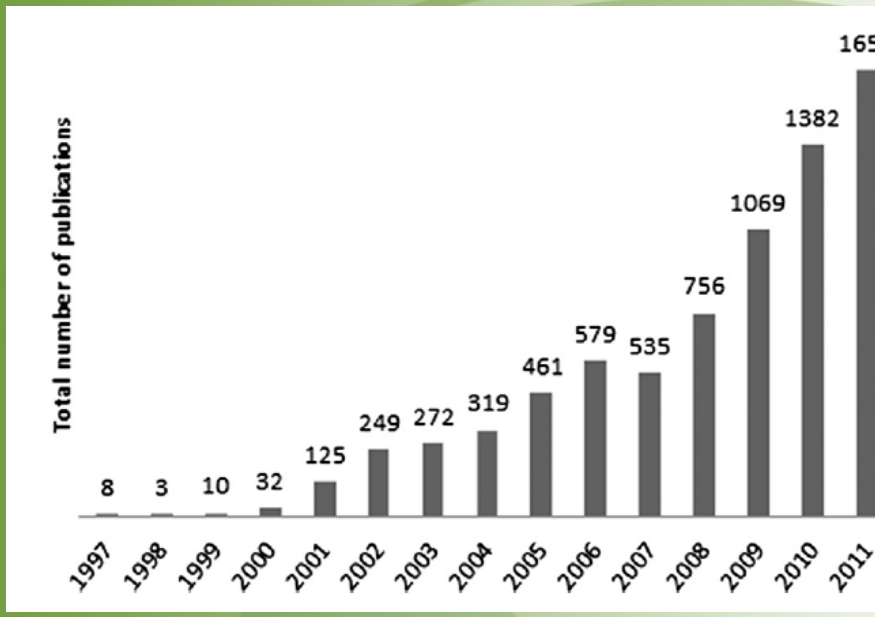
LIFE-CYCLE ASSESSMENT

- Life cycle assessment (LCA) is a compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle
- Typical life-cycle subsystems
  - Cradle-to-gate studies;
  - Gate-to-gate studies
  - Gate-to-disposal studies

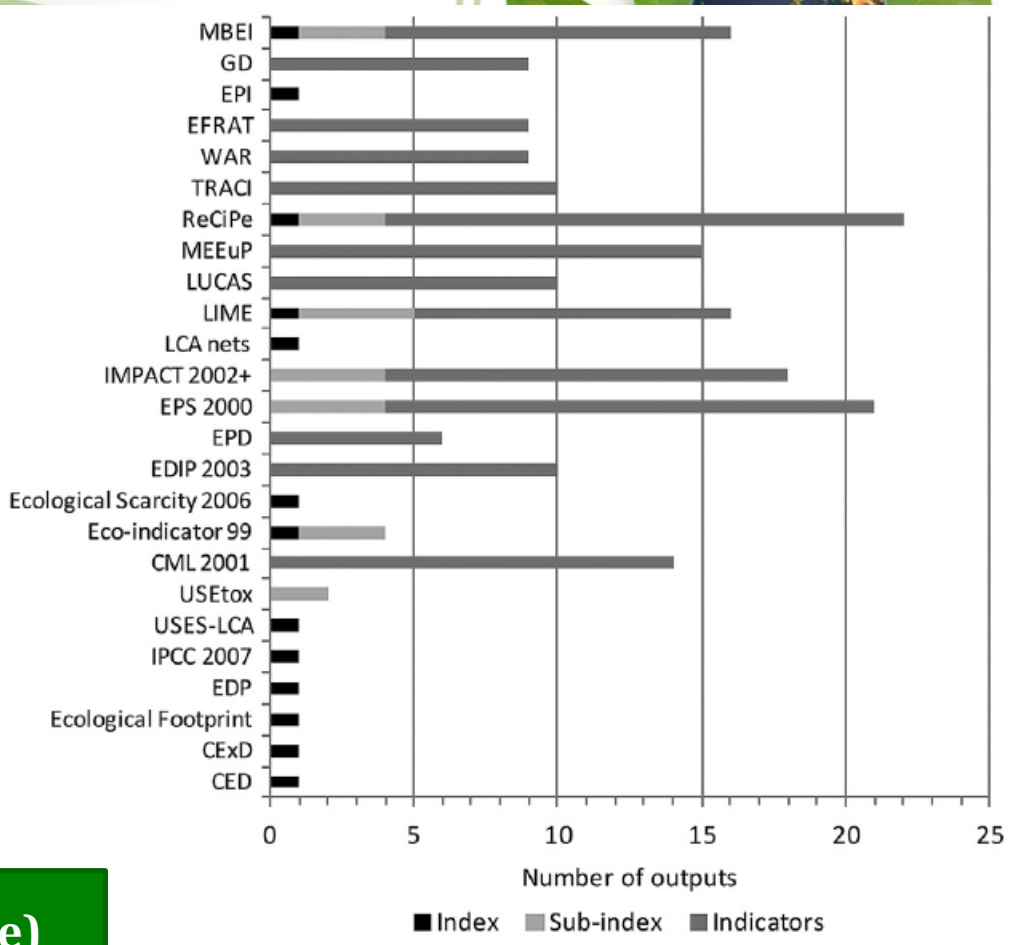
LIFE-CYCLE ASSESSMENT



LCA MATHEMATICAL MODELS



Number of scientific publications on environmental impact assessment

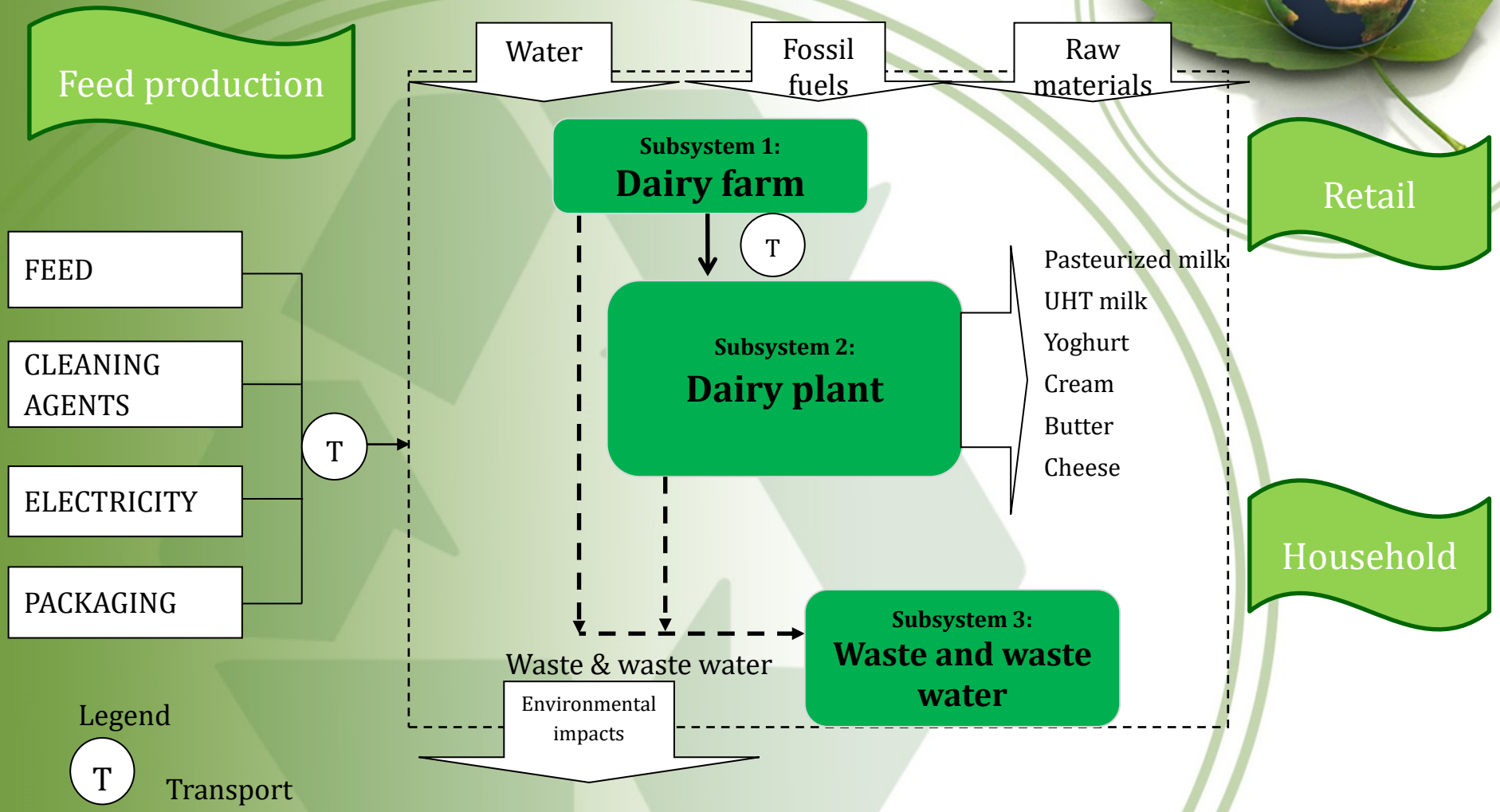


Output data from each model

25 LCA methodologies (and software) developed.

Carvalho, A., Mimoso, A. F., Mendes, A. N., & Matos, H. A. (2014). From a literature review to a framework for environmental process impact assessment index. *Journal of Cleaner Production, 64*, 36-62

GENERIC SYSTEM BOUNDARIES OF DAIRY PRODUCT PRODUCTION LIFE CYCLE



Djekic I., Miocinovic J., Tomasevic I., Smigic N., and Tomic N. (2014). „Environmental life-cycle assessment of various dairy products.“ Journal of Cleaner Production 68(0): 64-72

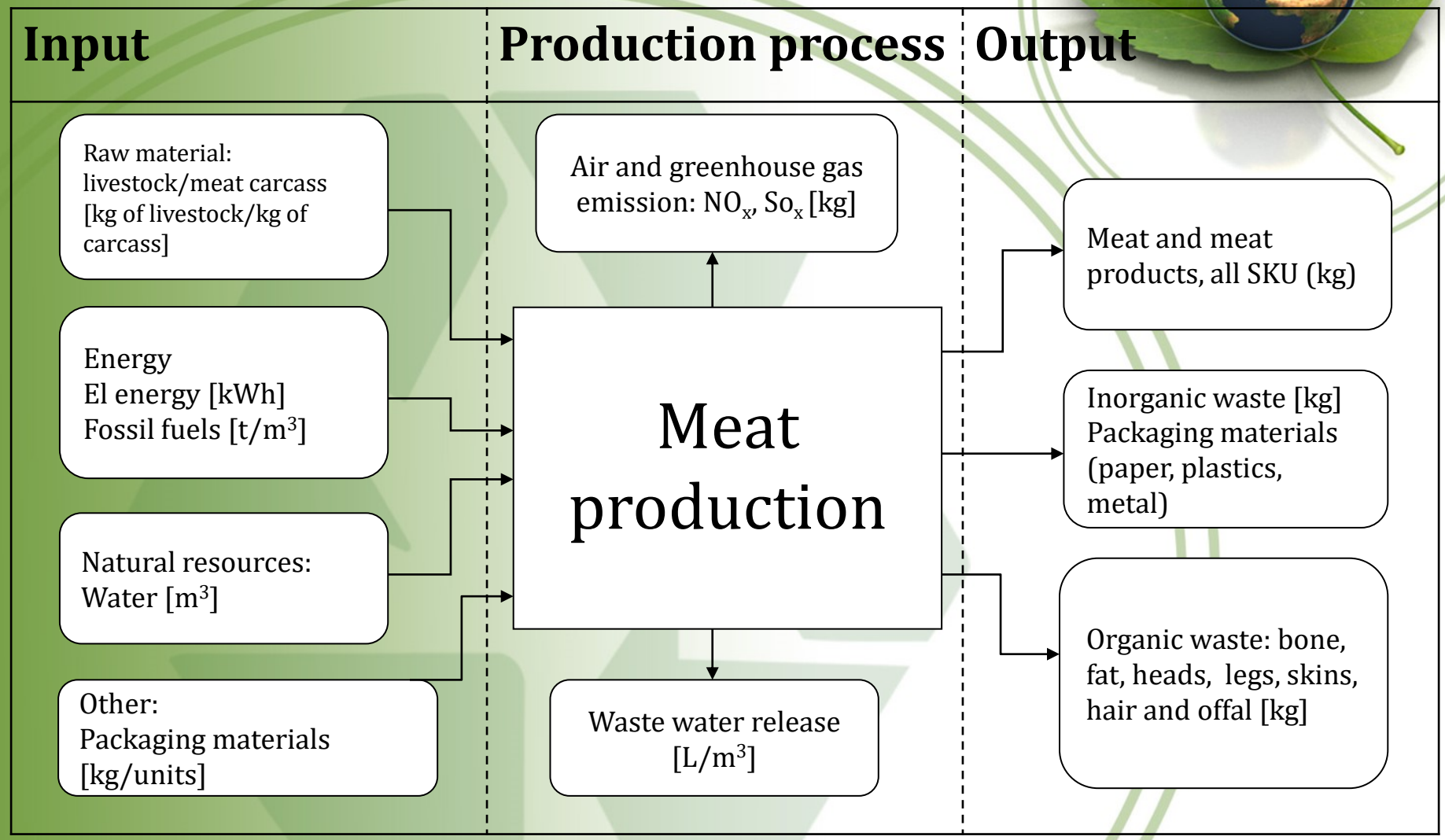
Environmental Impact Assessment Based on production of 1 kg of pork products

Impact category	Unit	SubS 1	SubS 2	SubS 3	SubS 4	Total
Global warming potential	kg CO_2eq	4.2688	0.4323	0.7247	3.6134	9.0392
Acidification potential	kg SO_2eq x 10^{-3}	1.915	0.148	0.234	7.577	9.874
Eutrophication potential	kg PO_4eq	0.0119	0.0000189	0.0000245	0.00314	0.0151
Ozone layer depletion potential	kg R11 x 10^{-5}	0.0595	1.112	1.669	0.00017	2.839
Photochemical smog potential	kg C_2H_4 x 10^{-4}	0.797	0.0996	0.162	4.33	5.388
Human toxicity potential	kg DCB	0.2196	0.00547	0.0169	0.1299	0.3719

Djekic, I., Radović, Č., Lukić, M., Stanišić, N., & Lilić, S. (2015). Environmental life-cycle assessment in production of pork products. Meso, XVII(5), 345-351

PROCESS

GENERIC MODEL OF MEAT PRODUCTION (MASS-ENERGY BALANCE)



Djekic, I., Tomasevic, I., (2016). Environmental impacts of the meat chain – Current status and future perspectives. Trends in Food Science & Technology 54, 94-102.

MAIN FOOTPRINT TOOLS

Environmental footprints

- Carbon footprint
- Water footprint
- Emmision footprint (air, water, soil)
- Energy footprint
- Land footprint
- Biodiversity footprint
- Waste footprint,
- Nitrogen / Phosphorus footprint, etc.

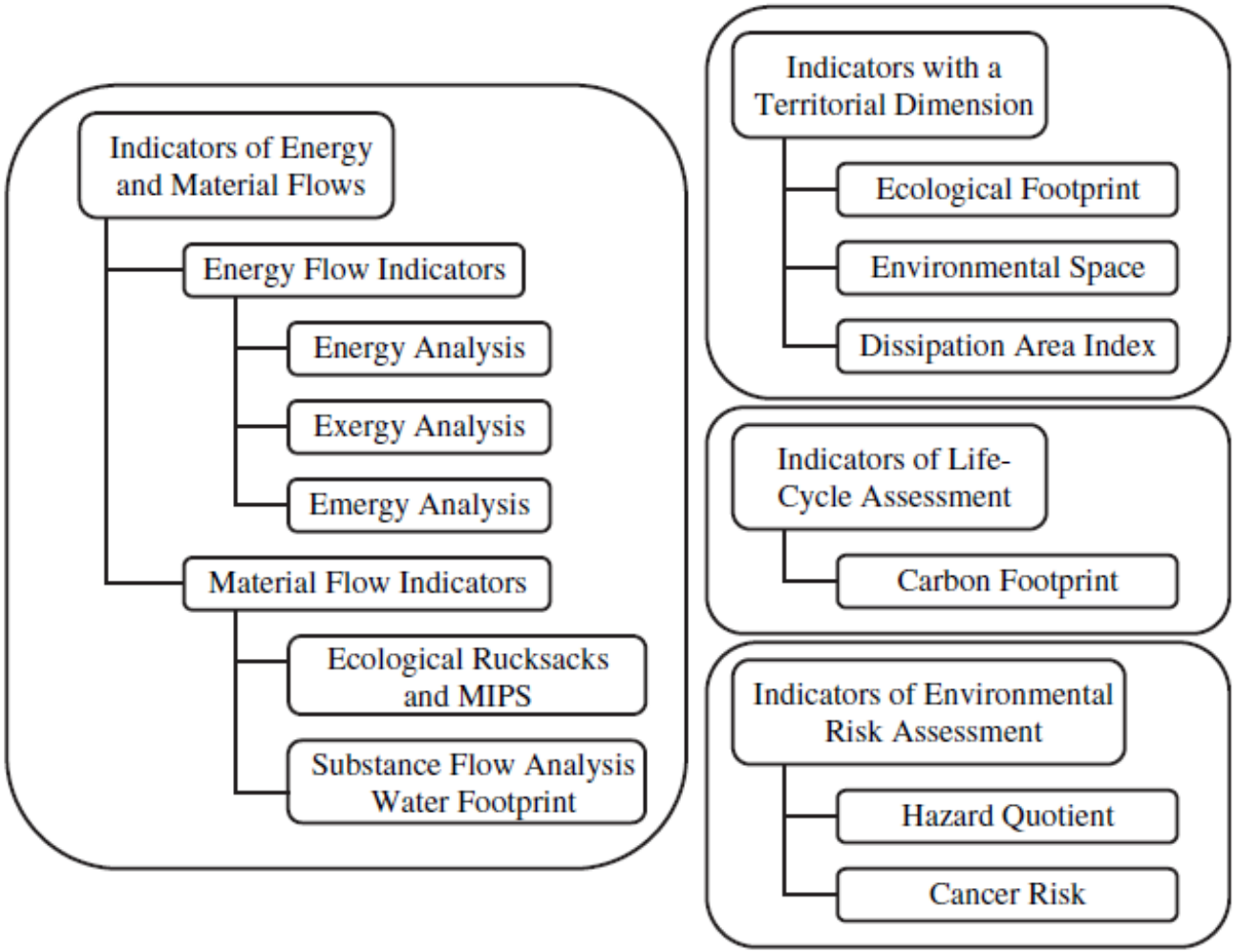
Other footprints

- Exergy footprint
- Chemical footprint
- Ecological footprint
- Sustainable footprints
- Social footprint
- Financial footprint

100+ tools and mathematical models

Čuček, L., Klemeš, J. J., & Kravanja, Z. (2012). A Review of Footprint analysis tools for monitoring impacts on sustainability. *Journal of Cleaner Production, 34*(0), 9-20

VARIOUS APPROACHES



Environmental dimension of sustainability

Herva, M., Franco, A., Carrasco, E. F., & Roca, E. (2011). Review of corporate environmental indicators. *Journal of Cleaner Production, 19*(15), 1687-1699

SYSTEM

RESEARCH (2000 – date)

Time dimension:

- *ex ante* (prior to implementation of EMS),
- ongoing/mid-term (during the implementation)
- *ex post* (upon the implementation of EMS)

Topics:

- Drivers and motivation in implementing EMS
- Costs and financial issues in implementing EMS
- Benefits and effects of implemented / certified EMS

Djekic I., Rajkovic A., Tomic N., Smigic N., Radovanovic R. (2014): "Environmental management effects in certified Serbian food companies", **Journal of Cleaner Production**, 76: 196-199

INSTRUMENTS

- **Scope**:
  - EMS (ISO 14001 or similar)
  - Specific theme (aspects / impacts)
  - New breakthroughs (intellectual capital)
- **Questionnaires (Likert and other types of scales, open questions)**
- **Techniques**:
  - On-site visits
  - Interview (by phone)
  - On-line questionnaires

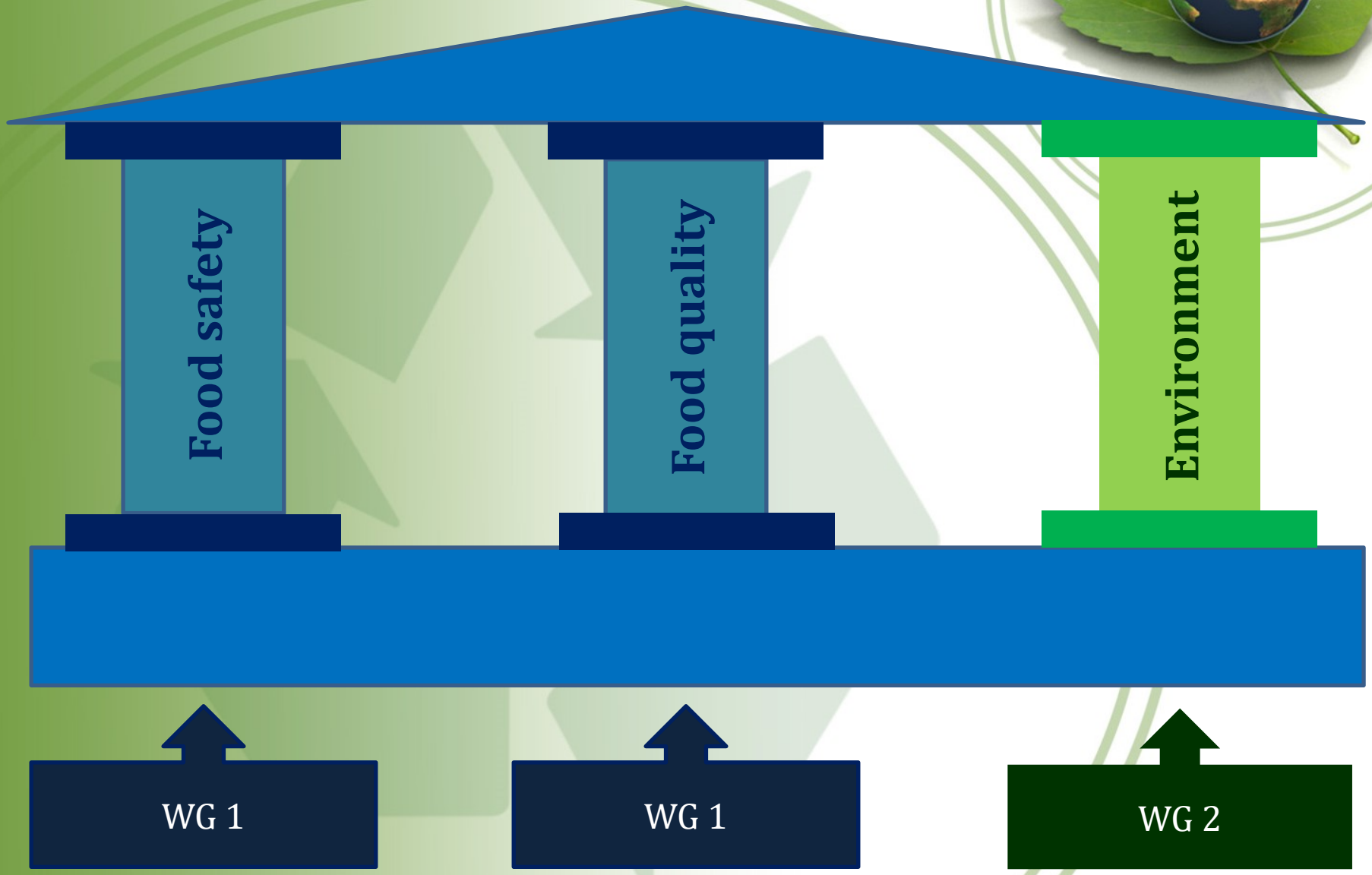
STATE – OF – ART

- All models are generic regardless of type of companies / products
- No specific eco-design „food“ model

Back to objective 5:

- In food production, eco-design is starting to be used to balance several contradictory criteria, such as **taste, safety, nutritional value, cost-effectiveness, and environmental impac** of the final products.
- **Existing methods** of optimization, knowledge integration, modelling and decision-making **need to be upgraded, or tailored specifically for food production**.

THREE FOOD PILLARS



POSSIBLE CASE STUDIES

- Mathematical models in three dimensions - food safety, quality, environment (with WG1):
  - Existing food technologies (food drying, postharvest technologies, logistic / transportation, food quality assurance, non-thermal food processes)
  - New food packaging (new materials, intelligent packages, shelf-life)
  - Novel food processing technologies - high pressure systems, pulsed electric field systems, high power ultrasonics, infrared, sc-CO2, ozone, etc.
  - Specific (animal origin) food – meat / dairy products

DISSEMINATION - JOURNAL

PRO	CONTRA
• Must be a review paper (cca 8,000 – 10,000 words, cca 85+ references) • high level of citation • If well written, publishable within one year	• 3-6 anonimous reviewers; • must be written in a scientifically sound manner; • higher possibility to fail to be published

ACCEPTED BY THE WORK GROUP ☑

DISSEMINATION - BOOK

PRO

- Respectable publishers (Elsevier, CRC Press, Springer, Wiley, etc.)
- Chapter (10,000 words, 50+ references)
- Editors – members of FoodMC / WGs
- Chapter authors – FoodMC members and others
- Can include results of already performed work from authors

CONTRA

- At least 2 years
- Finding Editor(s) – under some occasions editors should have high publication and citation coefficients (sum of impact factors, index, etc.);
- Finding publisher interested (Elsevier, Emerald, CRC Press, etc.);
- Finding reviewers (2-3 per chapter);

REJECTED BY THE WORK GROUP ☒

DELIVERABLES

- Technical report on state-of-the-art and strategic issues (Y1),
- Technical report on the definition of food problems in MCS terminology and identification of illustrative cases (Y2)
- Roadmap for orientation of the research on the subject matter (Y3),
- Position paper (Y4),
- Documents for stakeholders (Y4),
- Education and/or training material (Y2, Y3),
- Joint peer-reviewed publications and/or applications for funding to international programs or agencies (Y1-4),
- Annual progress reports, reports from STSM and meetings, proceedings from the workshop, and other dissemination materials (posters, communications, etc.)

OTHER

- Industrial partnership
- Possible synergies with other (inter) / EU projects