

# EVALUATION OF RESOURCE EFFICIENCY IN RESEARCH AND INNOVATION PROJECTS

## Challenges and Recommendations of the MEASURE project for Industry

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# AGENDA

- The MEASURE project
- Context of resource efficiency evaluation
- Challenges of resource efficiency evaluation in research and innovation (R&I) projects
- Recommendations and path forward

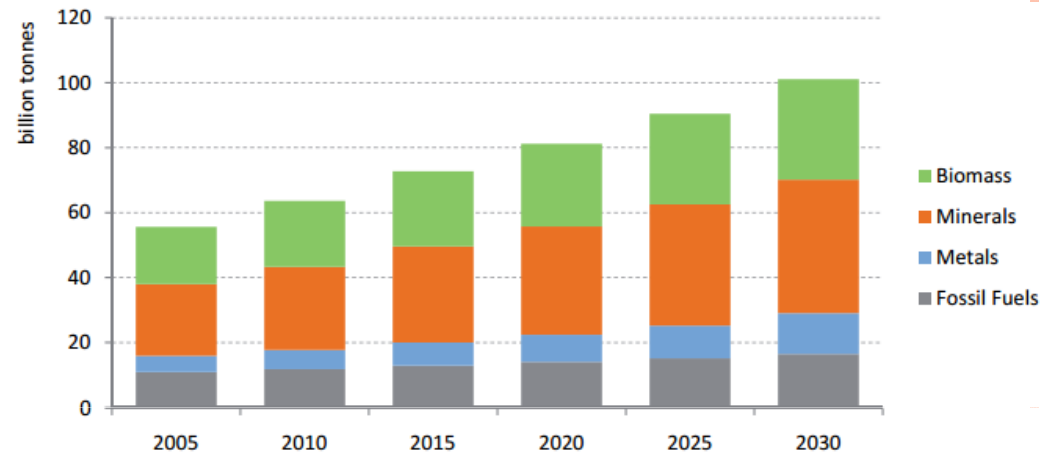


# THE MEASURE PROJECT

- From January 2015 to April 2016 (15 months)
- 8 partners from industry and academia
- Aim of the project:
  - Recommend best-suited LCSA evaluation tools
  - Improve the consideration of sustainability assessment results in SPIRE projects by:
    - Enhancing the comparability between the projects
    - Supporting the design of sustainable technologies within the SPIRE PPP program
  - Provide a roadmap towards standardised sustainability assessment tools and methods in EU process industries

# CONTEXT OF RESOURCE EFFICIENCY EVALUATION – GLOBAL SITUATION

- Extraction rates are increasing
- More resource types are used



- Land availability is challenged by population increase
- Resources prices are difficult to predict

*Based on Giljum et al.  
2009*

→ The world is facing a resource supply challenge



# CONTEXT OF RESOURCE EFFICIENCY EVALUATION – *R&I PROGRAMS*

- Increase of policy measures within the last 20 years
- R&I programs: key strategies to tackle these challenges

→ A portion of the EU calls from the Horizon2020 funding program focuses on R&I in industry



SPIRE calls



Other such as WASTE,  
FoF...



# CONTEXT OF RESOURCE EFFICIENCY EVALUATION – *THE EXPECTED IMPACTS*



**“Increasing the resource and energy efficiency for the process industries by at least 20% while leading to a significant decrease in greenhouse gas emission.”**

*SPIRE-3-2014*

**“reduction of at least 30% in the material usage”**

**“Reduction  
for relevant**

**How to evaluate the  
expected impacts  
regarding resource  
efficiency?**

**use**

*SPIRE-5-2015*

**“Significant gains [...] in material and energy efficiency, with reduction of greenhouse gas and other pollutants emissions in the short term.”**

*WASTE-1-2014*



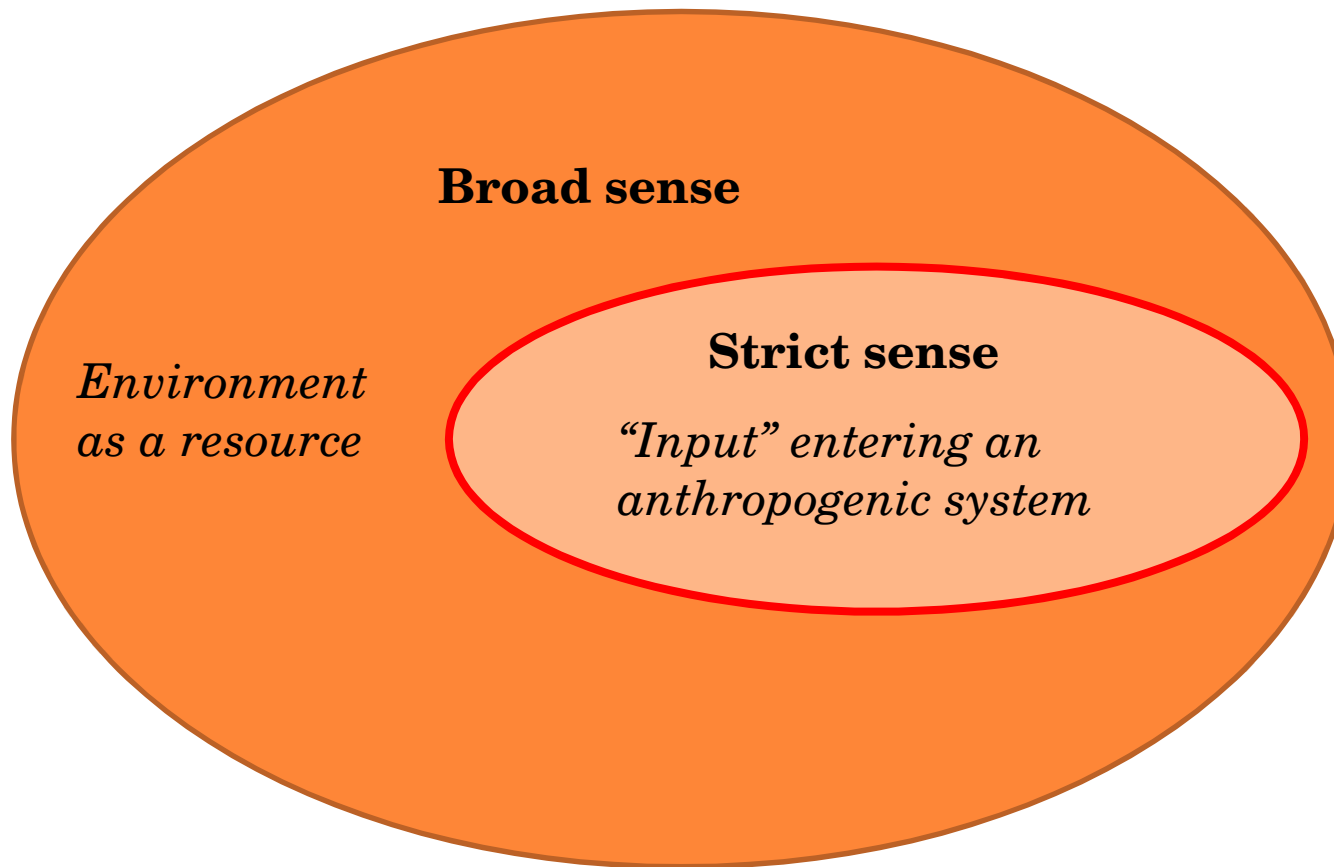
# CHALLENGES OF RESOURCE EFFICIENCY EVALUATION IN (R&I) PROJECTS

- Several questions arise when evaluating “*resource efficiency*”:
  - What are resources?
  - What is resource efficiency?
  - What is the level of evaluation?



# CHALLENGES OF RESOURCE EFFICIENCY EVALUATION IN (R&I) PROJECTS

- What are resources?





# CHALLENGES OF RESOURCE EFFICIENCY EVALUATION IN (R&I) PROJECTS

## ○ What are resources?

*“objects of nature which are extracted by man from nature and taken as useful input to man-controlled processes, mostly economic processes”*

*Udo de Haes et al., 1999*

*“energy, raw materials and water”*

*SPIRE 2013*

**Strict sense**

*“Input” entering an anthropogenic system*

*“natural assets (raw materials) occurring in nature that can be used for economic production or consumption”*

*OECD*



# CHALLENGES OF RESOURCE EFFICIENCY EVALUATION IN (R&I) PROJECTS

- What is resource efficiency?

**Resource efficiency is a ratio**

$$\text{Resource efficiency} = \frac{\text{Benefits from resources}}{(\text{Impact from}) \text{ Resources used}}$$

$$\text{Resource intensity} = \frac{(\text{Impact from}) \text{ Resources used}}{\text{Benefits from resources}}$$



# CHALLENGES OF RESOURCE EFFICIENCY EVALUATION IN (R&I) PROJECTS

- What is resource efficiency?

$$\text{Resource efficiency} = \frac{\text{Benefits from resources}}{\text{(Impact from) Resources used}}$$

Physical accounting of  
resources

*Mass / volume*

*Energy*

*Exergy*

*Area*

Impact assessment of resource use

*Based on resource reserves*

*quality / quantity*

*Based on distance to target*

*Based on willingness-to-pay*

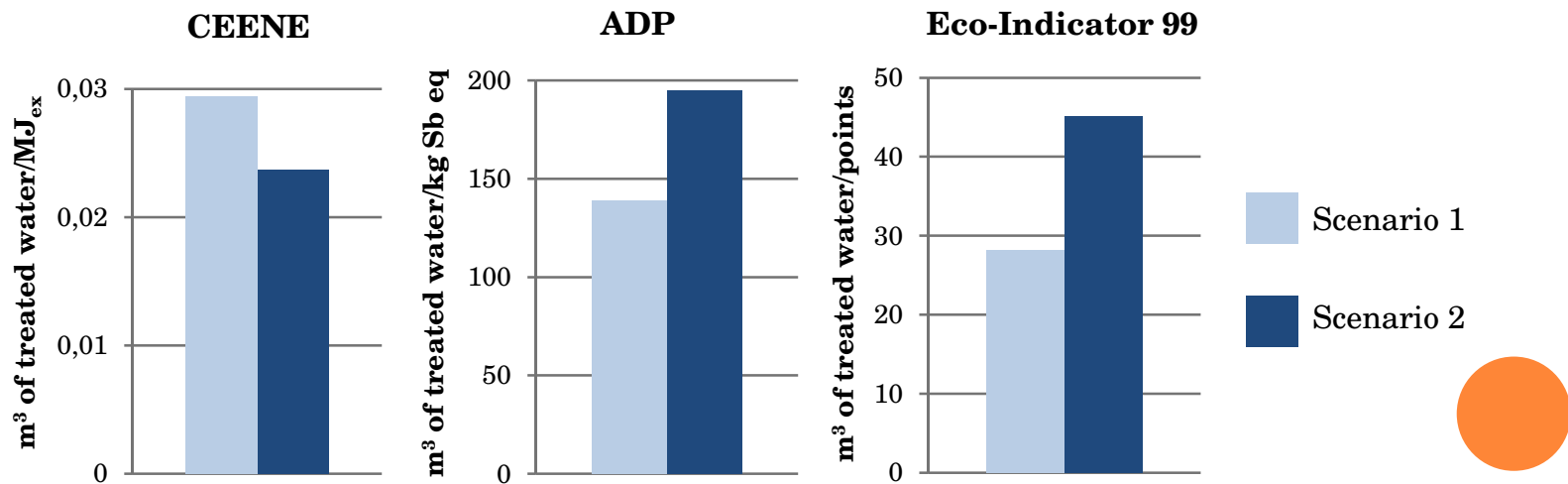
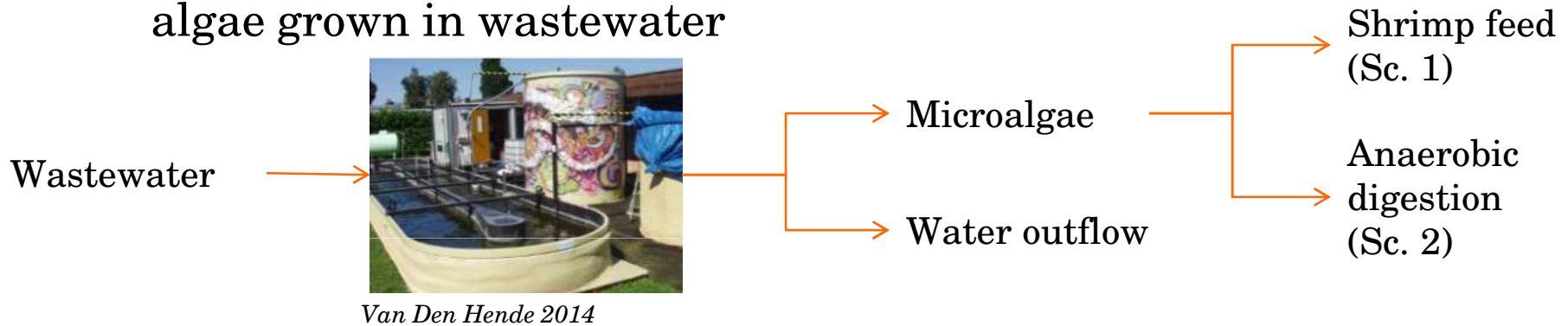
*Based on future consequences*

→ Different resources and  
aspects are covered  
*(see Dewulf et al. 2015)*



# CHALLENGES OF RESOURCE EFFICIENCY EVALUATION IN (R&I) PROJECTS

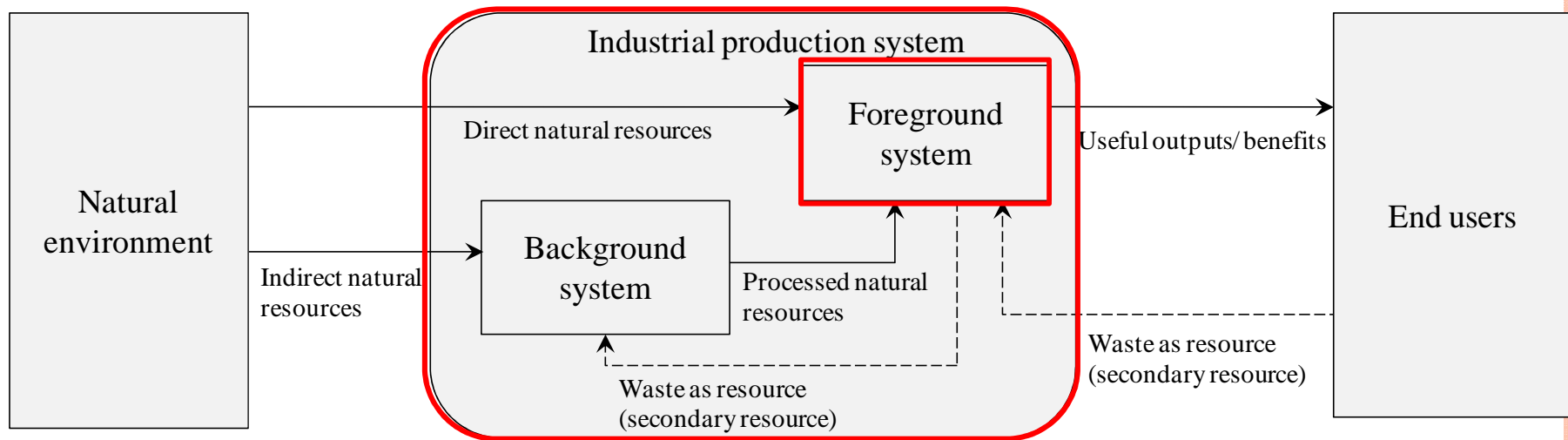
- Example: Resource efficiency of two valorization pathways for algae grown in wastewater



Resource efficiency of the 2 scenarios using 3 different LC-based methods

# CHALLENGES OF RESOURCE EFFICIENCY EVALUATION IN (R&I) PROJECTS

- What is the level of evaluation?



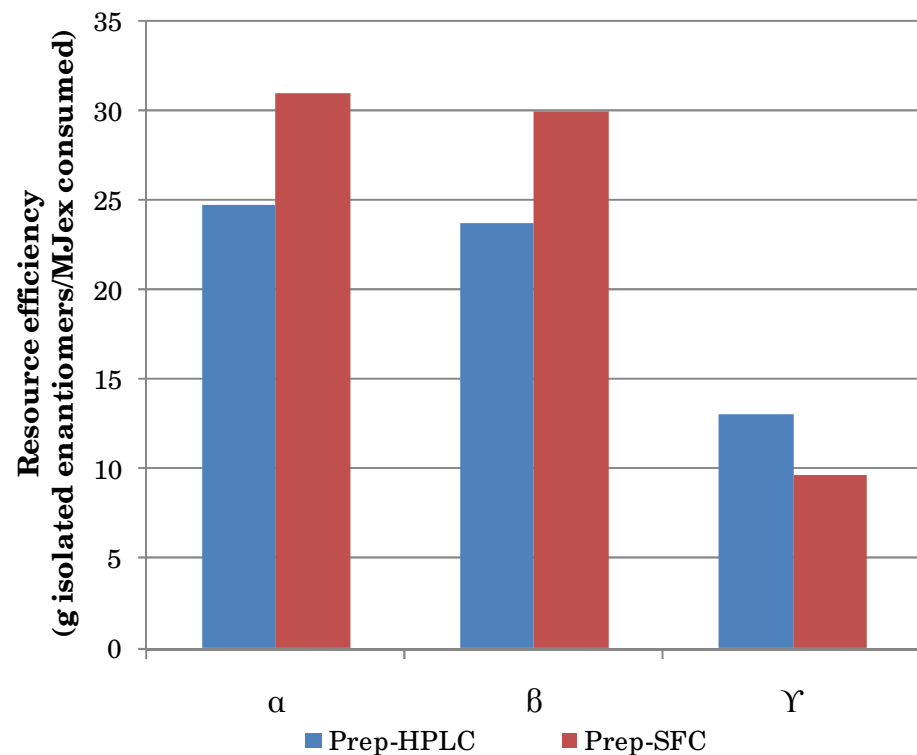
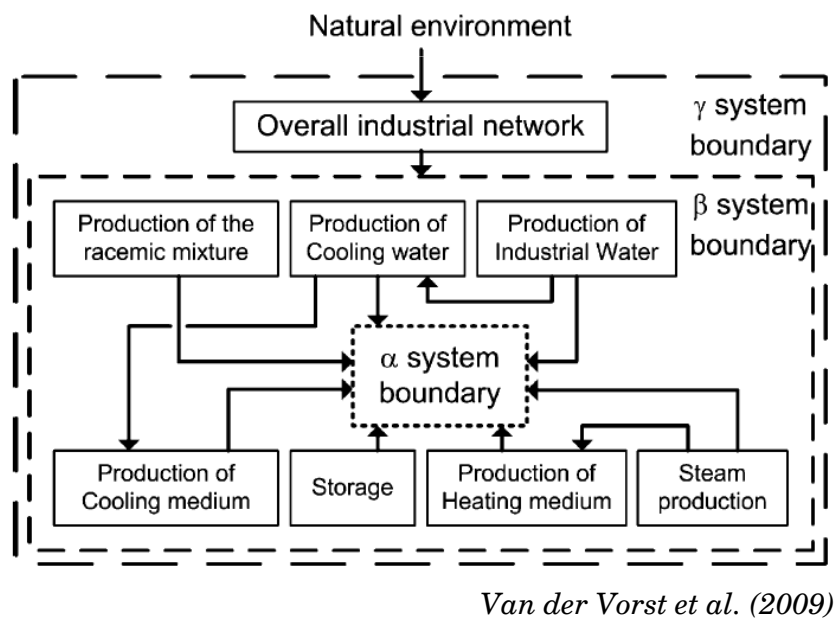
*Sfez et al. 2016, submitted*



# CHALLENGES OF RESOURCE EFFICIENCY EVALUATION IN (R&I) PROJECTS

- Example: Comparison of resource efficiency in the prep-HPLC and prep-SFC methods at the process, plant and life cycle levels

Functional unit (FU) = 450 g isolated enantiomers



## RECOMMENDATIONS AND PATH FORWARD

- Many different approaches are followed and methodological choices are not always justified
- A framework is needed to evaluate the resource efficiency of innovative processes and products

What to do when expected impacts are

***“Increasing the resource and energy efficiency for the process industries by at least 20%”***



# RECOMMENDATIONS AND PATH FORWARD

## Recommendation 1: Define more specifically expected impacts in calls

- Coherent definition of resources

Energy

Raw materials

Water

Land



- Specification of the level of the targets expected to be reached:  
EU level? Project level?

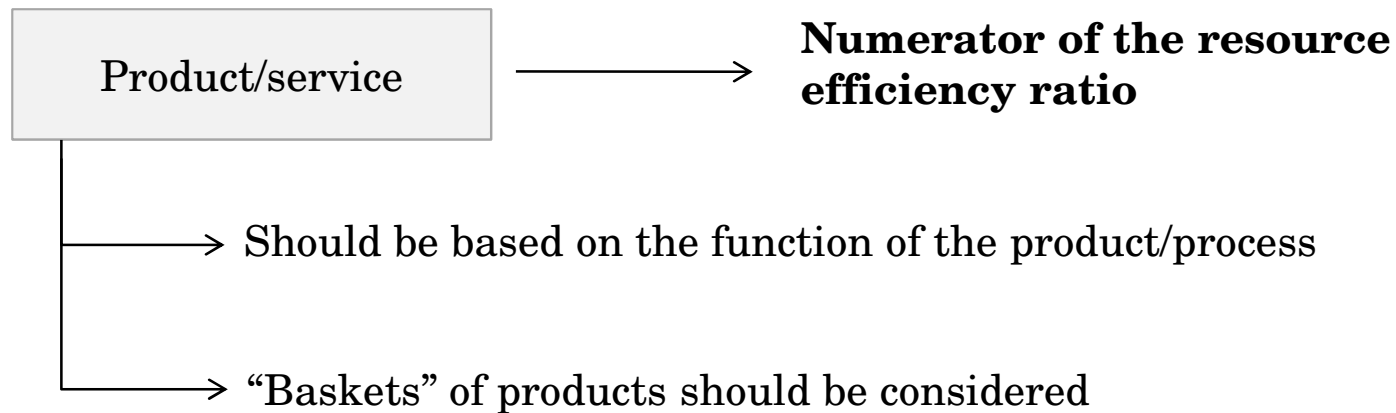
→ The link between both levels should be made





# RECOMMENDATIONS AND PATH FORWARD

## Recommendation 2: Define the product/service and the system under study

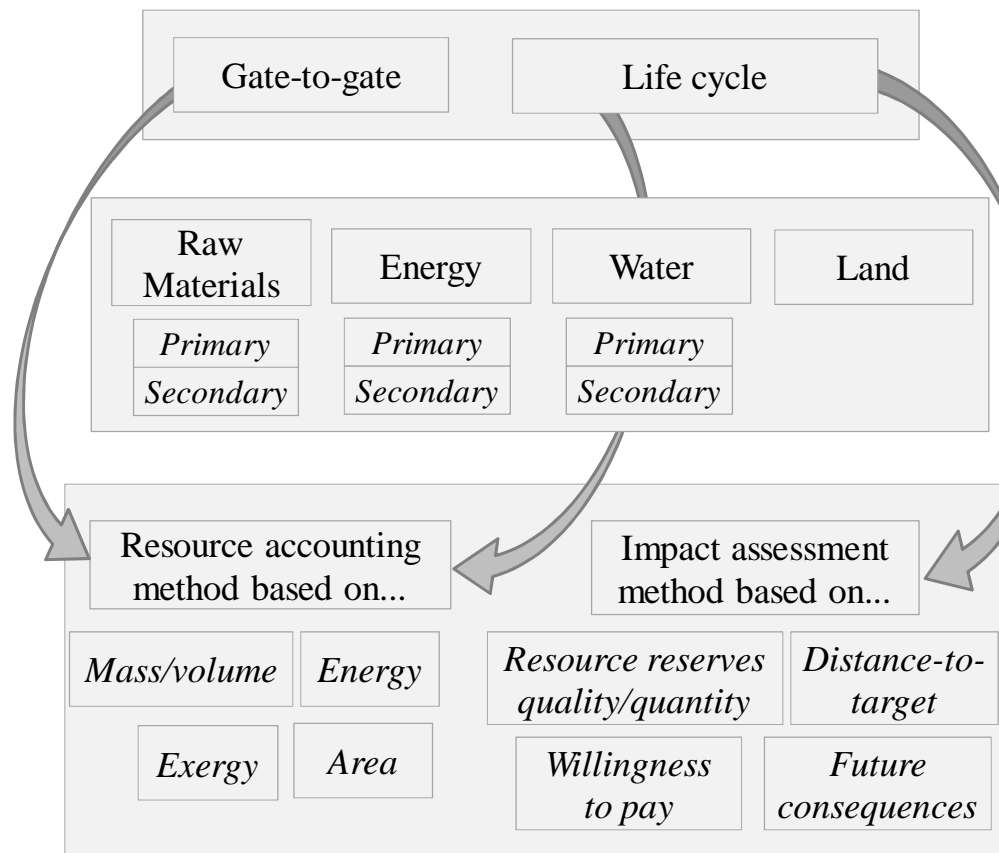


Foreground system



# RECOMMENDATIONS AND PATH FORWARD

## Recommendation 3: Select the proper aspects and methods to calculate the denominator



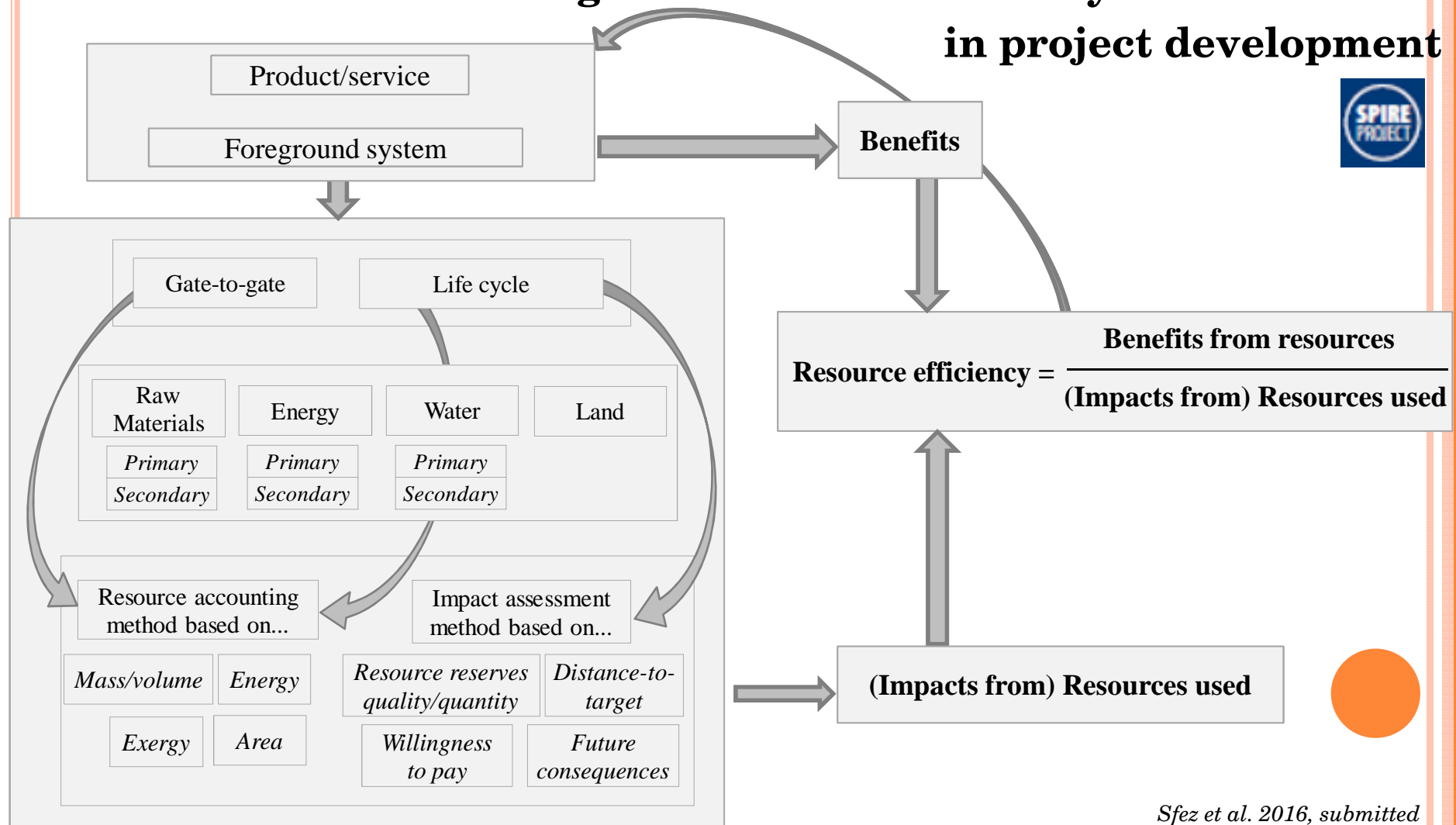
① At least also use life cycle thinking in addition to gate-to-gate analysis

② Cover all resources

③ Make an informed choice on the aspects of resource covered

# RECOMMENDATIONS AND PATH FORWARD

## Recommendation 4: Integrate resource efficiency considerations in project development



# RECOMMENDATIONS AND PATH FORWARD

## Recommendation 5: Implement these recommendations at:



→ General calls: justification of the choices should be required in the call



→ Product or sector specific calls: specific methodological approaches should be required from the call



→ Consistent definitions and evaluation procedures can help PPPs to better define targets and the PPP's strategic agenda



Thank you!

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<https://www.spire2030.eu/measure/>



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