

ADOPTING LCSA IN THE AUTOMOTIVE INDUSTRY.

TACKLING A MULTI-CRITERIA AND MULTI-STAKEHOLDER ISSUE.



LCM for Transport and Mobility | Peter Tarne



Rolls-Royce
Motor Cars Limited

AGENDA.

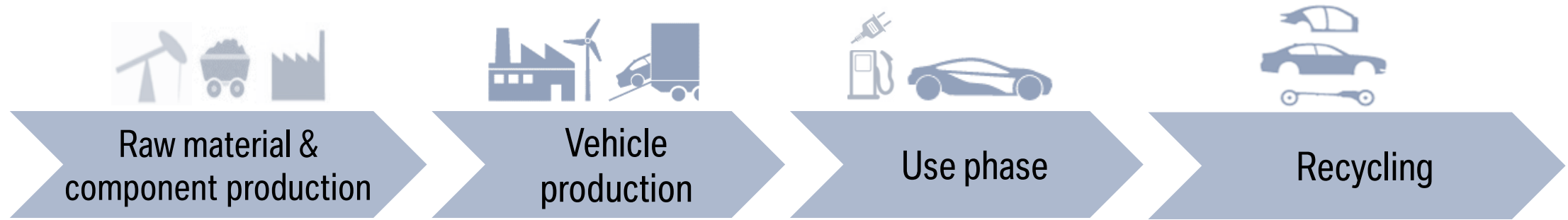
1

Application of LCSA to vehicle production

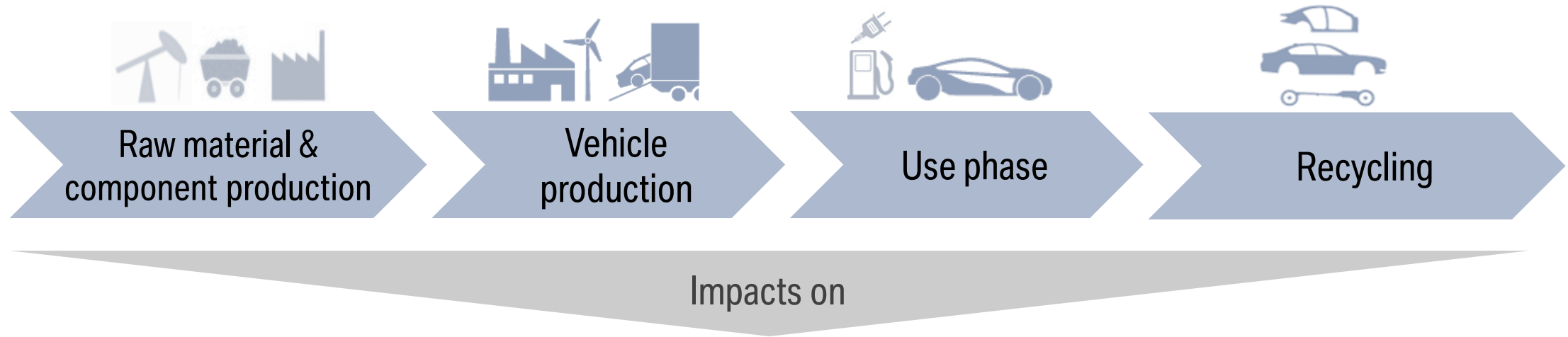
2

Weighting of sustainability dimension

LIFE CYCLE BASED PRODUCT SUSTAINABILITY ASSESSMENT.



LIFE CYCLE BASED PRODUCT SUSTAINABILITY ASSESSMENT.



Environment

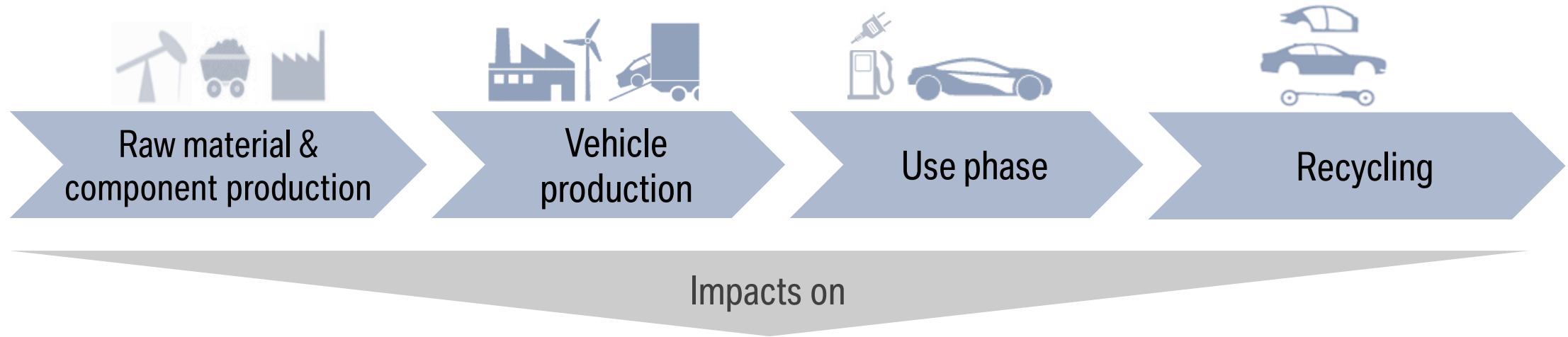


Economy



Social

LIFE CYCLE BASED PRODUCT SUSTAINABILITY ASSESSMENT.



Environment



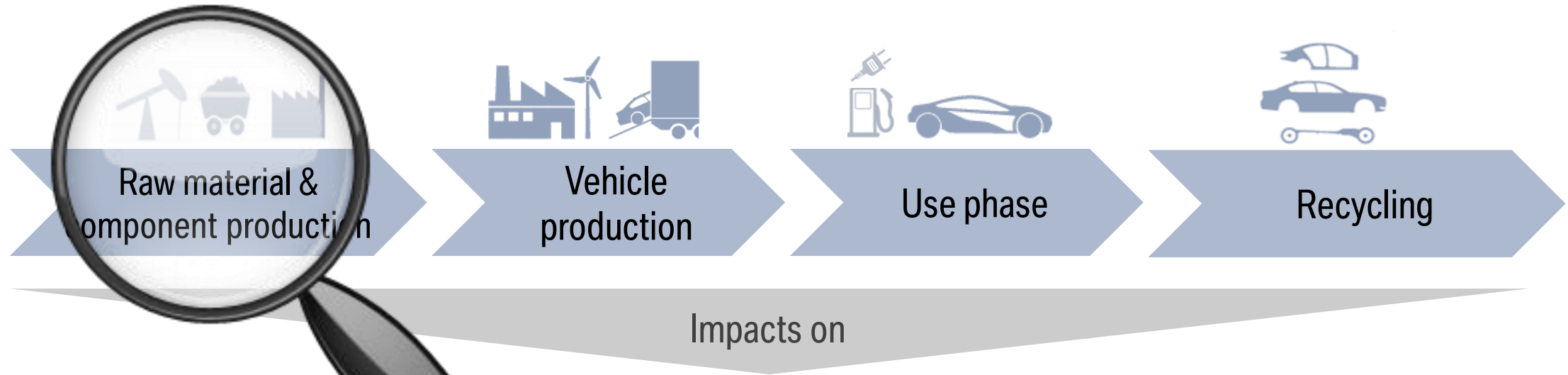
Economy



Social

= Life Cycle Sustainability Assessment (LCSA)

LIFE CYCLE BASED PRODUCT SUSTAINABILITY ASSESSMENT.



Environment



Economy



Social

= Life Cycle Sustainability Assessment (LCSA)

APPLICATION OF LCSA TO VEHICLE PRODUCTION ON COMPONENT LEVEL.



fictional values

Entire vehicle
↓

Component	Criticality points LCA	Criticality points LCC	Criticality points S-LCA
Component A	72	12	63
Component B	82	17	42
Component C	19	53	89
Component D	4	15	54
...

100 = highest criticality within the vehicle
0 = lowest criticality within the vehicle



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APPLICATION OF LCSA TO VEHICLE PRODUCTION ON COMPONENT LEVEL. EXEMPLARY CALCULATION OF LCA CRITICALITY POINTS.

fictional values



Component	Global Warming Potential [CO ₂ e]	Relative Performance	Water Consumption	Relative Performance	Criticality points LCA (average)
Component A					
Component B					
Component C					
Component D					
...					

APPLICATION OF LCSA TO VEHICLE PRODUCTION ON COMPONENT LEVEL. EXEMPLARY CALCULATION OF LCA CRITICALITY POINTS.

fictional values



Component	Global Warming Potential [CO ₂ e]	Relative Performance	Water Consumption	Relative Performance	Criticality points LCA (average)
Component A	50 kg				
Component B	35.5 kg				
Component C	10 kg				
Component D	13 kg				
...	...				

APPLICATION OF LCSA TO VEHICLE PRODUCTION ON COMPONENT LEVEL. EXEMPLARY CALCULATION OF LCA CRITICALITY POINTS.

fictional values



Component	Global Warming Potential [CO ₂ e]	Relative Performance	Water Consumption	Relative Performance	Criticality points LCA (average)
Component A	50 kg	100			
Component B	35.5 kg	64			
Component C	10 kg	0			
Component D	13 kg	8			
...			

$$= \frac{GWP - \min[GWP]}{\max[GWP] - \min[GWP]}$$

APPLICATION OF LCSA TO VEHICLE PRODUCTION ON COMPONENT LEVEL. EXEMPLARY CALCULATION OF LCA CRITICALITY POINTS.

fictional values



Component	Global Warming Potential [CO ₂ e]	Relative Performance	Water Consumption	Relative Performance	Criticality points LCA (average)
Component A	50 kg	100	950 l	43	72
Component B	35.5 kg	64	2,000 l	100	82
Component C	10 kg	0	850 l	38	19
Component D	13 kg	8	150 l	0	4
...

APPLICATION OF LCSA TO VEHICLE PRODUCTION ON COMPONENT LEVEL. EXEMPLARY CALCULATION OF LCA CRITICALITY POINTS.

fictional values



Component	Global Warming Potential [CO ₂ e]	Relative Performance	Water Consumption	Relative Performance	Criticality points LCA (average)
Component A	50 kg	100	950 l	43	72
Component D	13 kg	8	150 l	0	4
...

- Other or additional indicators possible
- Building the average assumes equal weighting → other weights could be assigned

APPLICATION OF LCSA TO VEHICLE PRODUCTION ON COMPONENT LEVEL.



fictional values

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Relative evaluation of environmental indicators like **GWP** and **Water Use**



Relative evaluation of economic indicators like **manufacturing costs**




Relative evaluation of material related risks for **social violations**

APPLICATION OF LCSA TO VEHICLE PRODUCTION ON COMPONENT LEVEL.



fictional values

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↓
Relative evaluation of environmental indicators like **GWP** and **Water Use**

↓
Relative evaluation of economic indicators like **manufacturing costs**

↓
Relative evaluation of material related risks for **social violations**

SURVEY ON THE WEIGHTING OF SUSTAINABILITY DIMENSIONS.



How should the sustainability dimensions be weighted to identify **overall improvement potentials?**

AGENDA.

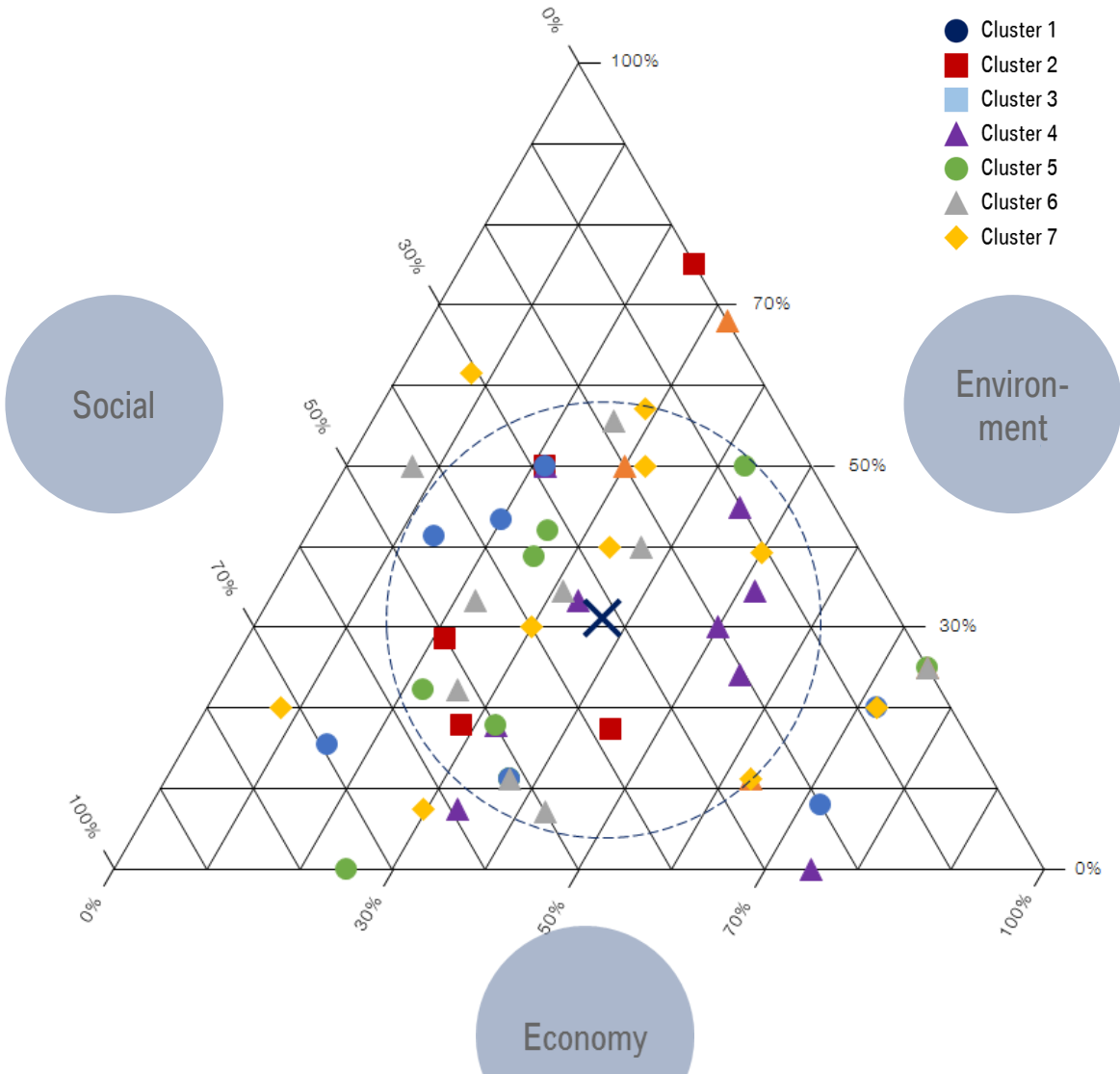
1

Application of LCSA to vehicle production

2

Weighting of sustainability dimension

SURVEY ON THE WEIGHTING OF SUSTAINABILITY DIMENSIONS.



	Environment	Economy	Social
Overall	31.2%	37.0%	31.8%

- Weight distributions in sustainability assessment were clearly scattered
- Overall, all three dimensions were considered important
- Economic dimension was deemed slightly more important

SURVEY ON THE WEIGHTING OF SUSTAINABILITY DIMENSIONS.

Cluster	Environment	Economy	Social
Sales	33.5%	33.3%	33.2%
All	31.2%	37.0%	31.8%

Entire sample divided by expertise in sustainability:

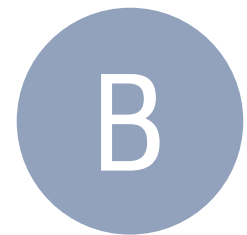
Sustainability (n = 16)	33.6%	31.0%	35.4%
Non-Sustainability (n = 38)	30.1%	39.6%	30.3%

- Consumers' expectation (sales cluster as proxy) would weight all three dimensions equally
- To ensure balanced weighting, sustainability experts should be included in decision making

TWO POSSIBLE WEIGHTING SETS TO ADOPTING LCSA RESULTED FROM THE SURVEY.



Adopt **overall mean weighting** of the entire sample



Adopt **equal weighting** following consumers' expectation

TWO POSSIBLE WEIGHTING SETS TO ADOPTING LCSA RESULTED FROM THE SURVEY.

A

Adopt **overall mean weighting** of the entire sample

- Depicts the current decision making process → higher chance of acceptance
- Only valid for investigated company
- Already close to an equal weighting

B

Adopt **equal weighting** following consumers' expectation

- Constitutes optimal weighting set as the consumers' expectation is met
- Weighting only derived via sales cluster proxy

TWO POSSIBLE WEIGHTING SETS TO ADOPTING LCSA RESULTED FROM THE SURVEY.



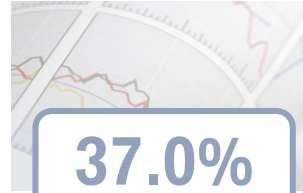
Adopt **overall mean weighting** of the entire sample

Strategic decision for **set A**:

- Goal is to adopt LCSA → **higher chance of acceptance** preferred
- **Only 2.4% deviation** per sustainability dimension from equal weighting

APPLICATION OF LCSA TO VEHICLE PRODUCTION ON COMPONENT LEVEL. WEIGHTS ENABLE OVERALL EVALUATION.

fictional values

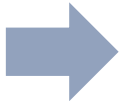
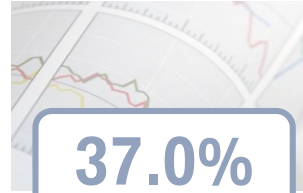


Component	Criticality points LCA	Criticality points LCC	Criticality points S-LCA	Criticality points LCSA (combined)
Component A	72	12	63	46.9
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Component C	19	53	89	53.8
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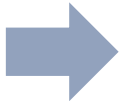
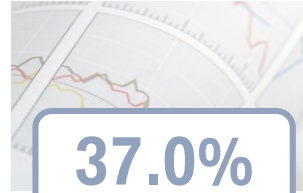


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APPLICATION OF LCSA TO VEHICLE PRODUCTION ON COMPONENT LEVEL. WEIGHTS ENABLE EVALUATION OF IMPROVEMENT MEASURES.

fictional values

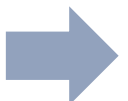
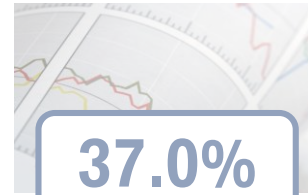


Component	Criticality points LCA	Criticality points LCC	Criticality points S-LCA	Criticality points LCSA (combined)
Component A	72	12	63	46.9
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Component C*	19 + 1 ↑	53 + 2 ↑	89 - 17 ↓	53.8 - 4.3 ↓
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APPLICATION OF LCSA TO VEHICLE PRODUCTION ON COMPONENT LEVEL. WEIGHTS ENABLE EVALUATION OF IMPROVEMENT MEASURES.

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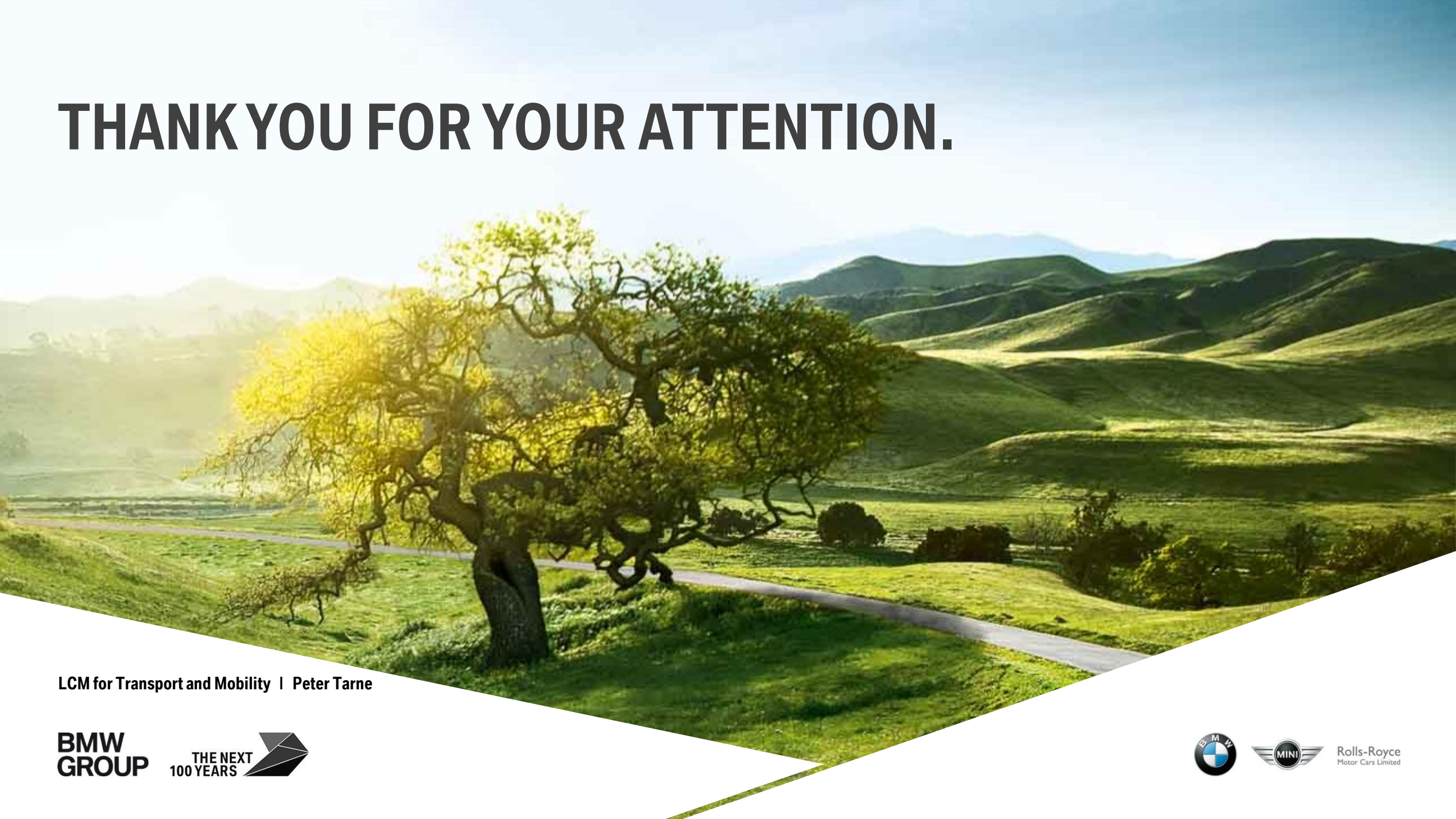


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SUMMARY.

- LCSA can be applied to the component level of a vehicle
- Relative evaluation of indicators enables **criticality score per sustainability dimension**
- Indicators and their weights can be chosen depending on product sustainability strategy
- Weights for sustainability dimensions were investigated via a study at a company
- Two possible weighting sets** were identified:
 - A: Adopt overall mean weighting of the entire sample
 - B: Adopt equal weighting following consumers' expectation
- As the goal is adoption of LCSA, set A was preferred
- Chosen weighting set enabled **overall evaluation of product sustainability performance and assessment of improvement measures**

THANK YOU FOR YOUR ATTENTION.



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