
Life Cycle
Assessment
Explanation

LCA Data EconX®
Compressor
600cc

LCA Data EconX®
Electronic
Clutch Actuator

LCA Data EconX®
EBS5
2-Ch EPM

LCA Data EconX®
EBS5
1-Ch EPM

LCA Data EconX®
Trailer EBS
(TEBS4)



What is a Life Cycle Assessment (LCA)?

- Life Cycle Assessment (LCA) is the state-of-the-art method to analyze, quantify and understand the environmental impacts associated with manufactured products
- LCAs consider the entire life cycle of a product: From raw material extraction and acquisition, through energy and material production and manufacturing, to use and end-of-life treatment and final disposal
- LCAs evaluate inputs, outputs and potential environmental impacts of a product throughout its life cycle



Life Cycle Assessment Explanation

LCA Data EconX[®]
Compressor
600cc

LCA Data EconX[®]
Electronic Clutch Actuator

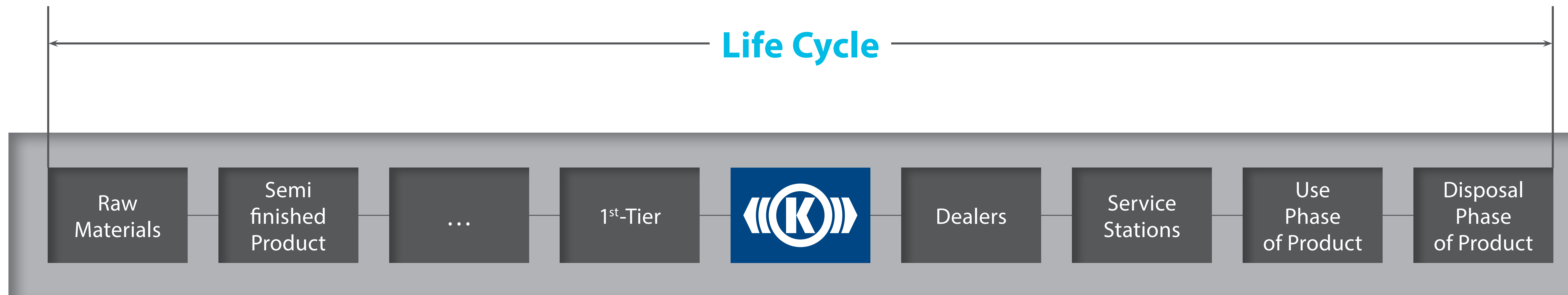
LCA Data EconX[®]
EBS5
2-Ch EPM

LCA Data EconX[®]
EBS5
1-Ch EPM

LCA Data EconX[®]
Trailer EBS
(TEBS4)

What is a Life Cycle Assessment (LCA)?

- Life Cycle Assessment (LCA) is the state-of-the-art method to analyze, quantify and understand the environmental impacts associated with manufactured products
- LCAs consider the entire life cycle of a product: From raw material extraction and acquisition, through energy and material production and manufacturing, to use and end-of-life treatment and final disposal
- LCAs evaluate inputs, outputs and potential environmental impacts of a product throughout its life cycle



Life Cycle
Assessment
Explanation

LCA Data EconX[®]
Compressor
600cc

LCA Data EconX[®]
Electronic
Clutch Actuator

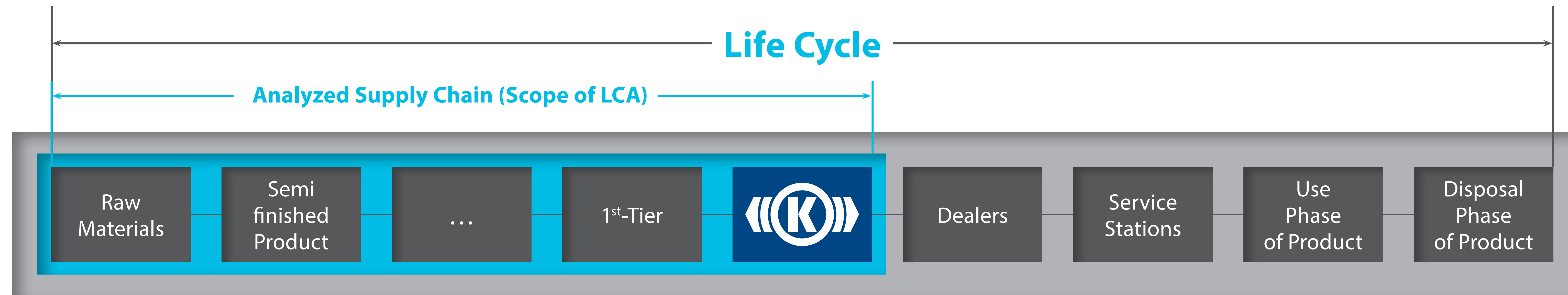
LCA Data EconX[®]
EBS5
2-Ch EPM

LCA Data EconX[®]
EBS5
1-Ch EPM

LCA Data EconX[®]
Trailer EBS
(TEBS4)

What is a Life Cycle Assessment (LCA)?

- Life Cycle Assessment (LCA) is the state-of-the-art method to analyze, quantify and understand the environmental impacts associated with manufactured products
- LCAs consider the entire life cycle of a product: From raw material extraction and acquisition, through energy and material production and manufacturing, to use and end-of-life treatment and final disposal
- LCAs evaluate inputs, outputs and potential environmental impacts of a product throughout its life cycle



Life Cycle Assessment Explanation

LCA Data EconX[®] Compressor 600cc

LCA Data EconX[®] Electronic Clutch Actuator

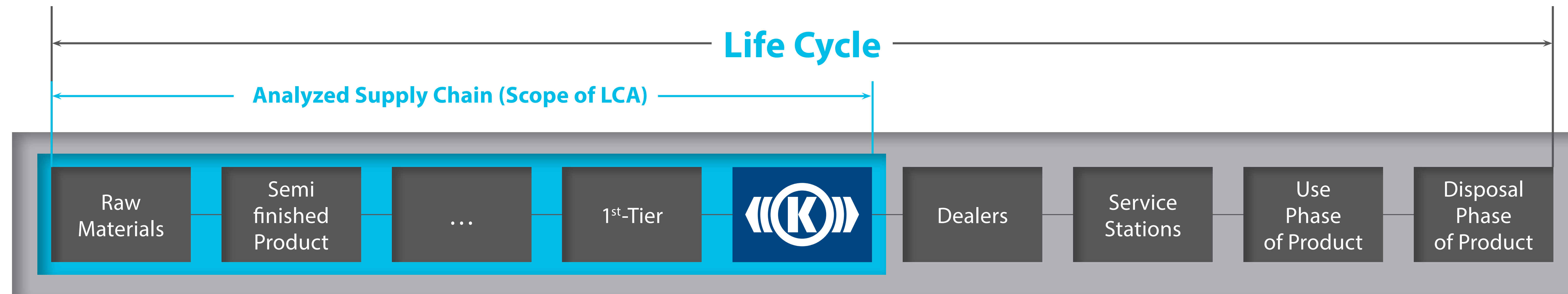
LCA Data EconX[®] EBS5 2-Ch EPM

LCA Data EconX[®] EBS5 1-Ch EPM

LCA Data EconX[®] Trailer EBS (TEBS4)

What is a Life Cycle Assessment (LCA)?

- Life Cycle Assessment (LCA) is the state-of-the-art method to analyze, quantify and understand the environmental impacts associated with manufactured products
- LCAs consider the entire life cycle of a product: From raw material extraction and acquisition, through energy and material production and manufacturing, to use and end-of-life treatment and final disposal
- LCAs evaluate inputs, outputs and potential environmental impacts of a product throughout its life cycle



Inputs

Extractions out of the Environment: Materials, Energies, other Inputs

Life Cycle Assessment Explanation

LCA Data EconX[®]
Compressor
600cc

LCA Data EconX[®]
Electronic Clutch Actuator

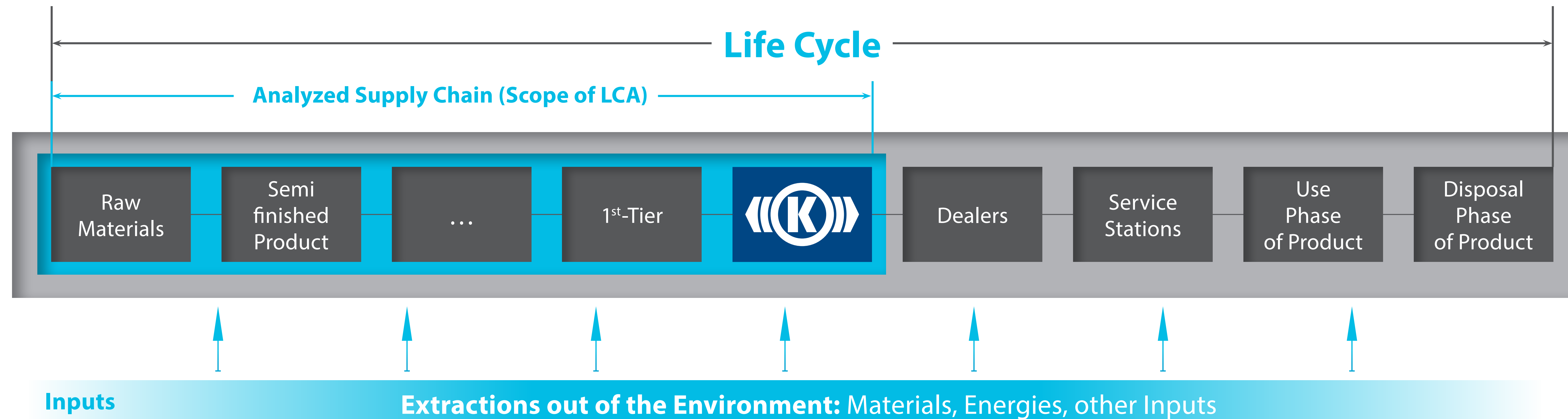
LCA Data EconX[®]
EBS5
2-Ch EPM

LCA Data EconX[®]
EBS5
1-Ch EPM

LCA Data EconX[®]
Trailer EBS (TEBS4)

What is a Life Cycle Assessment (LCA)?

- Life Cycle Assessment (LCA) is the state-of-the-art method to analyze, quantify and understand the environmental impacts associated with manufactured products
- LCAs consider the entire life cycle of a product: From raw material extraction and acquisition, through energy and material production and manufacturing, to use and end-of-life treatment and final disposal
- LCAs evaluate inputs, outputs and potential environmental impacts of a product throughout its life cycle



Life Cycle Assessment Explanation

LCA Data EconX[®] Compressor 600cc

LCA Data EconX[®] Electronic Clutch Actuator

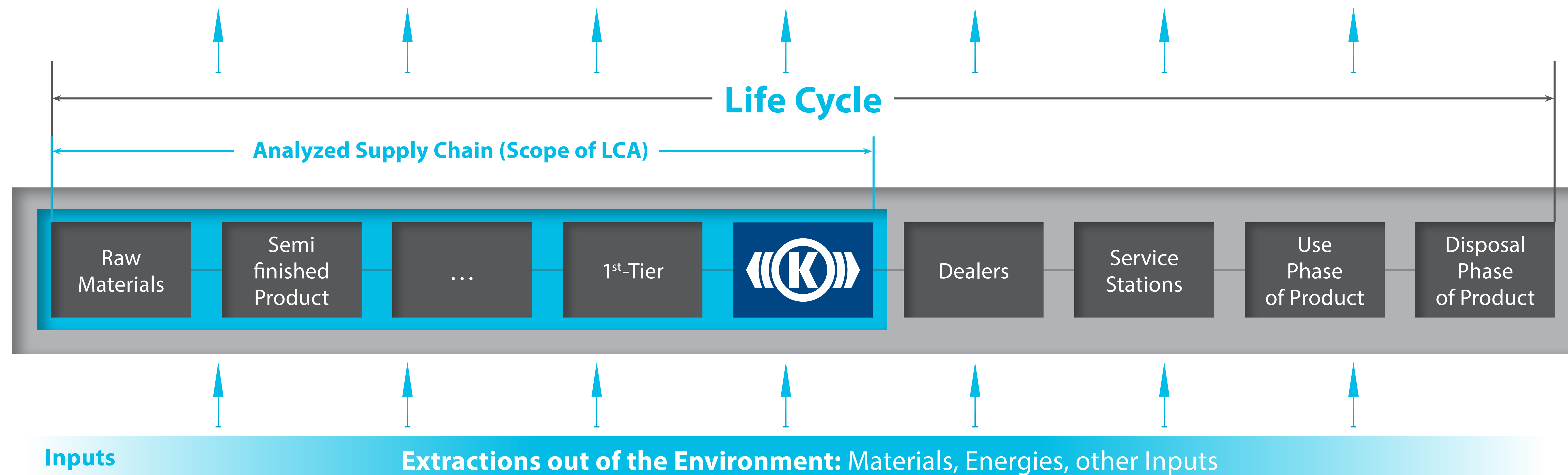
LCA Data EconX[®] EBS5 2-Ch EPM

LCA Data EconX[®] EBS5 1-Ch EPM

LCA Data EconX[®] Trailer EBS (TEBS4)

What is a Life Cycle Assessment (LCA)?

- Life Cycle Assessment (LCA) is the state-of-the-art method to analyze, quantify and understand the environmental impacts associated with manufactured products
- LCAs consider the entire life cycle of a product: From raw material extraction and acquisition, through energy and material production and manufacturing, to use and end-of-life treatment and final disposal
- LCAs evaluate inputs, outputs and potential environmental impacts of a product throughout its life cycle



Life Cycle Assessment Explanation

LCA Data EconX[®] Compressor 600cc

LCA Data EconX[®] Electronic Clutch Actuator

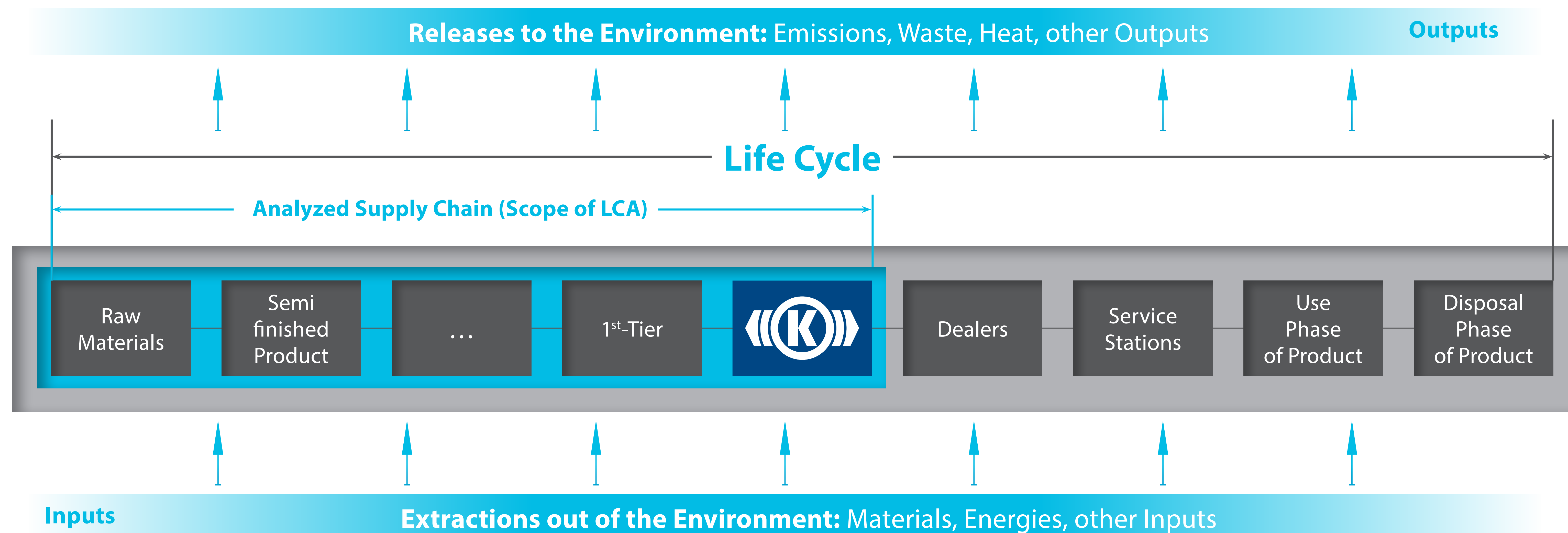
LCA Data EconX[®] EBS5 2-Ch EPM

LCA Data EconX[®] EBS5 1-Ch EPM

LCA Data EconX[®] Trailer EBS (TEBS4)

What is a Life Cycle Assessment (LCA)?

- Life Cycle Assessment (LCA) is the state-of-the-art method to analyze, quantify and understand the environmental impacts associated with manufactured products
- LCAs consider the entire life cycle of a product: From raw material extraction and acquisition, through energy and material production and manufacturing, to use and end-of-life treatment and final disposal
- LCAs evaluate inputs, outputs and potential environmental impacts of a product throughout its life cycle



Life Cycle Assessment Explanation

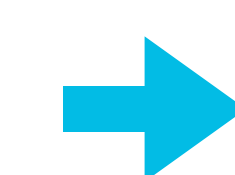
LCA Data EconX[®] Compressor 600cc

LCA Data EconX[®] Electronic Clutch Actuator

LCA Data EconX[®] EBS5 2-Ch EPM

LCA Data EconX[®] EBS5 1-Ch EPM

LCA Data EconX[®] Trailer EBS (TEBS4)



Life Cycle Assessments (LCA)¹⁾ at Knorr-Bremse TruckServices

Life Cycle Assessments at Knorr-Bremse Commercial Vehicle Systems (CVS) Remanufacturing

- Evaluation of the environmental impact of EconX[®] Products compared to Service New Products
- LCA Verification Statement issued by DEKRA Assurance Services GmbH
- Critical review of Knorr-Bremse CVS Life Cycle Methodology
- Critical review report no. A 16071012; Reviewer: Dr.-Ing. Ivo Mersiowsky 14/12/2016
- Methodology according
 - DIN EN ISO 14040 / 14044
 - Regenerative Supply Chains by Dr. Daniel C. F. Köhler (2011)



Life Cycle
Assessment
Explanation

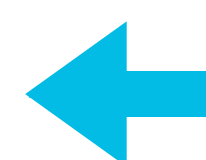
LCA Data EconX[®]
Compressor
600cc

LCA Data EconX[®]
Electronic
Clutch Actuator

LCA Data EconX[®]
EBS5
2-Ch EPM

LCA Data EconX[®]
EBS5
1-Ch EPM

LCA Data EconX[®]
Trailer EBS
(TEBS4)

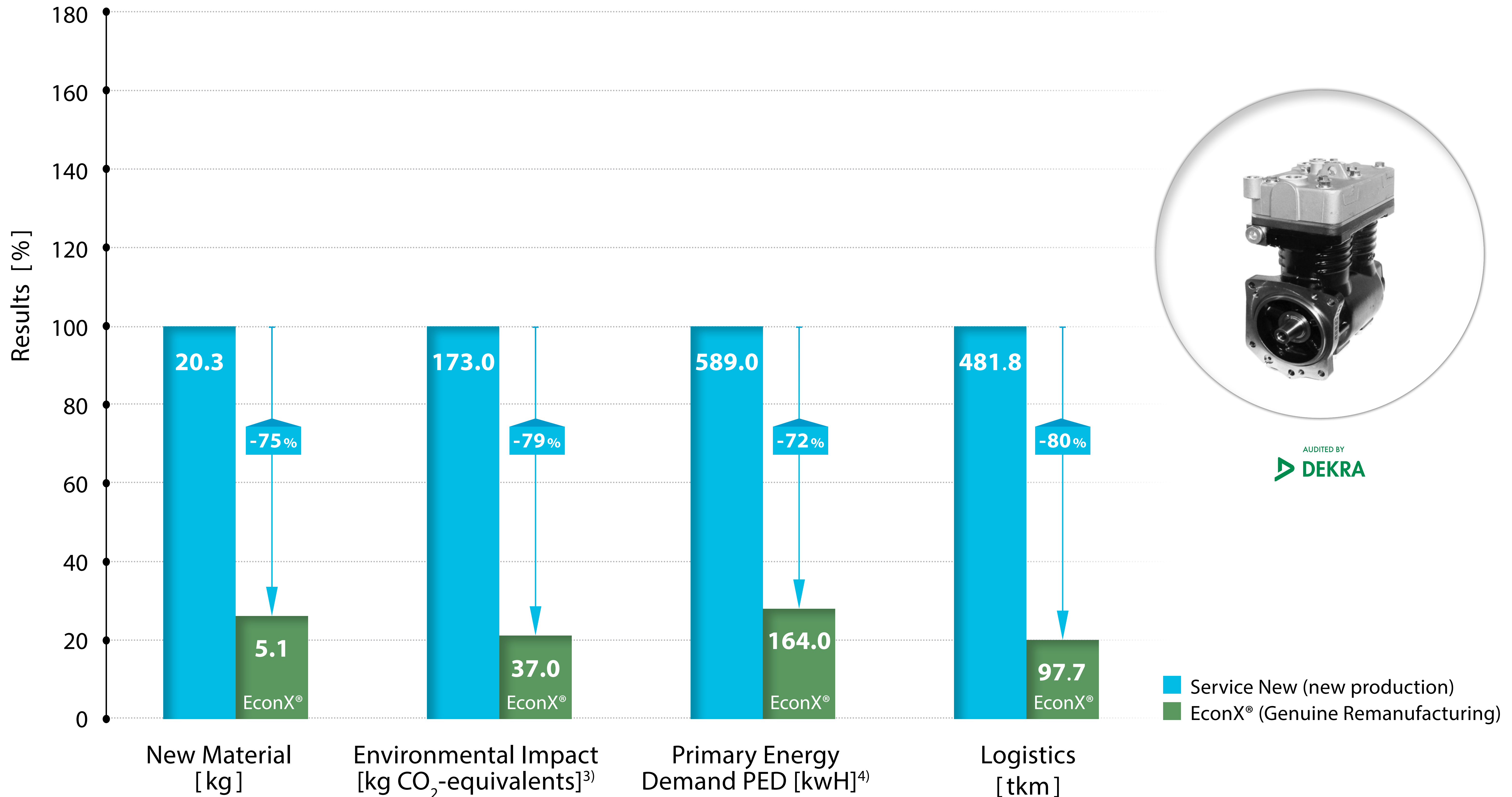


Life Cycle Assessment (LCA) Methodology Footnotes

- 1) Life Cycle Assessment (LCA) methodology according to DIN EN ISO 14040 and 14044; scope: cradle-to-gate study; impact category: climate change with characterization factor GWP100; major processes and its in-/outputs are measured and investigated with industry partners; additional processes modelled with ecoinvent 2.2 and Gabi 6 PE-international datasets; year of study 2014-2017; functional unit: finished product in saleable status
- 2) CO₂-equivalents (CO₂e): category indicator result in kg CO₂-equivalents; methodology uses Global Warming Potentials (GWP100) to calculate the potency of greenhouse gases over a timescale of 100 years; used in Kyoto-Protocol
- 3) Environmental Impact (EI); measured according to 1) + 2)
- 4) Primary Energy Demand (PED); quantity of energy withdrawn from hydrosphere, atmosphere, geosphere or energy source w/o any anthropogenic change; calculated with Gabi 6 (Modelling Principles 2015)
- 5) LCA Verification Statement issued by DEKRA Assurance Services GmbH; Critical Review of Knorr-Bremse Commercial Vehicle Systems Life Cycle Methodology – Critical Review Report No. A16071012; Reviewer: Dr.-Ing. Ivo Mersiowsky; 14/12/2016

Knorr-Bremse Genuine Remanufacturing

Remanufacturing saves 136.0 kg CO₂-equivalents²⁾ per EconX[®] Compressor 600cc



AUDITED BY
DEKRA

Life Cycle Assessment Explanation

LCA Data EconX[®] Compressor 600cc

LCA Data EconX[®] Electronic Clutch Actuator

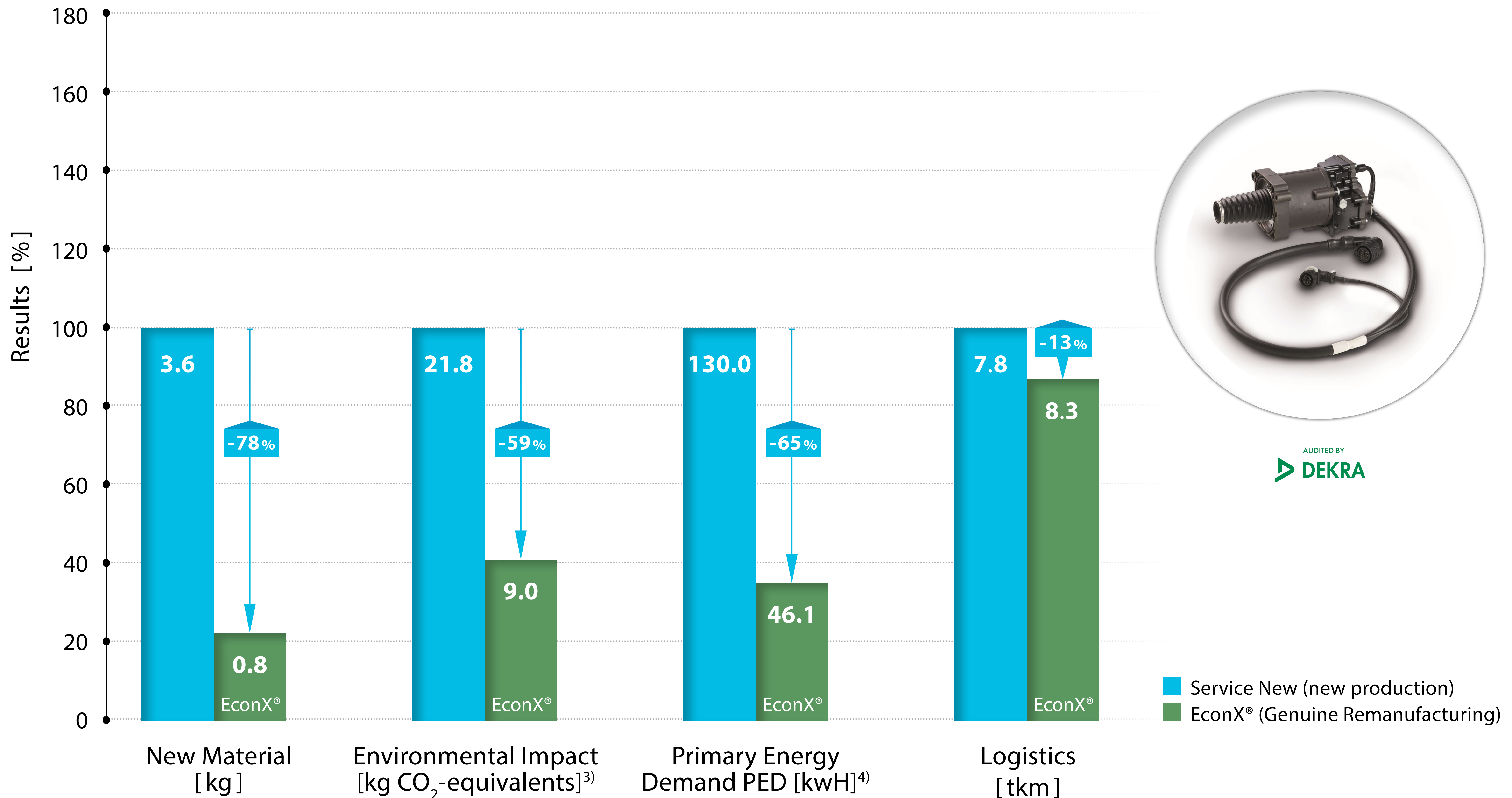
LCA Data EconX[®] EBS5 2-Ch EPM

LCA Data EconX[®] EBS5 1-Ch EPM

LCA Data EconX[®] Trailer EBS (TEBS4)

Knorr-Bremse Genuine Remanufacturing

Remanufacturing saves 12.8 kg CO₂-equivalents²⁾ per EconX[®] Electronic Clutch Actuator



AUDITED BY
DEKRA

Life Cycle Assessment Explanation

LCA Data EconX[®] Compressor 600cc

LCA Data EconX[®] Electronic Clutch Actuator

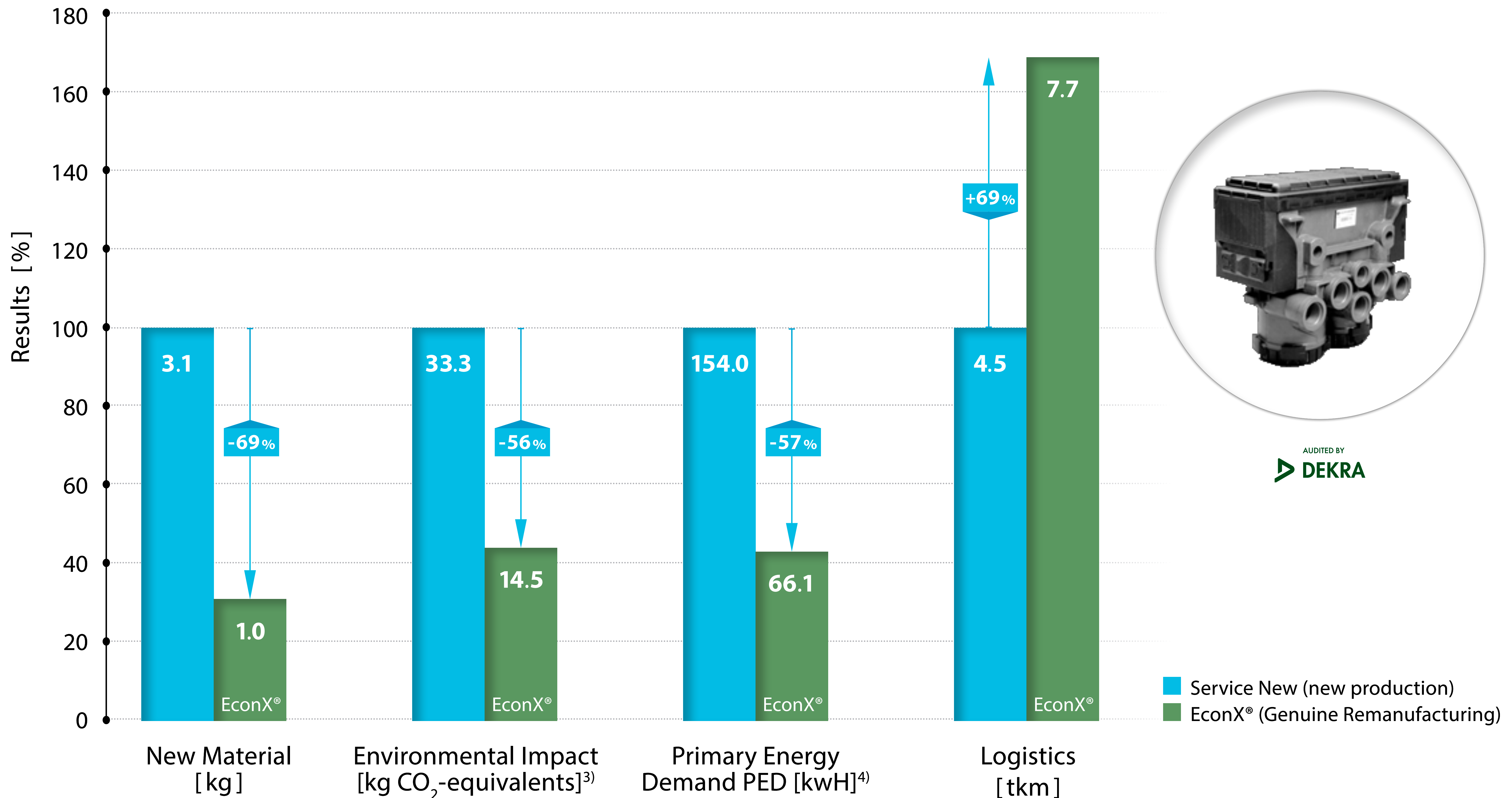
LCA Data EconX[®] EBS5 2-Ch EPM

LCA Data EconX[®] EBS5 1-Ch EPM

LCA Data EconX[®] Trailer EBS (TEBS4)

Knorr-Bremse Genuine Remanufacturing

Remanufacturing saves 18.8 kg CO₂e²⁾ per EconX[®] EBS5 2-Channel Electro-Pneumatic Module



Life Cycle Assessment Explanation

LCA Data EconX[®] Compressor 600cc

LCA Data EconX[®] Electronic Clutch Actuator

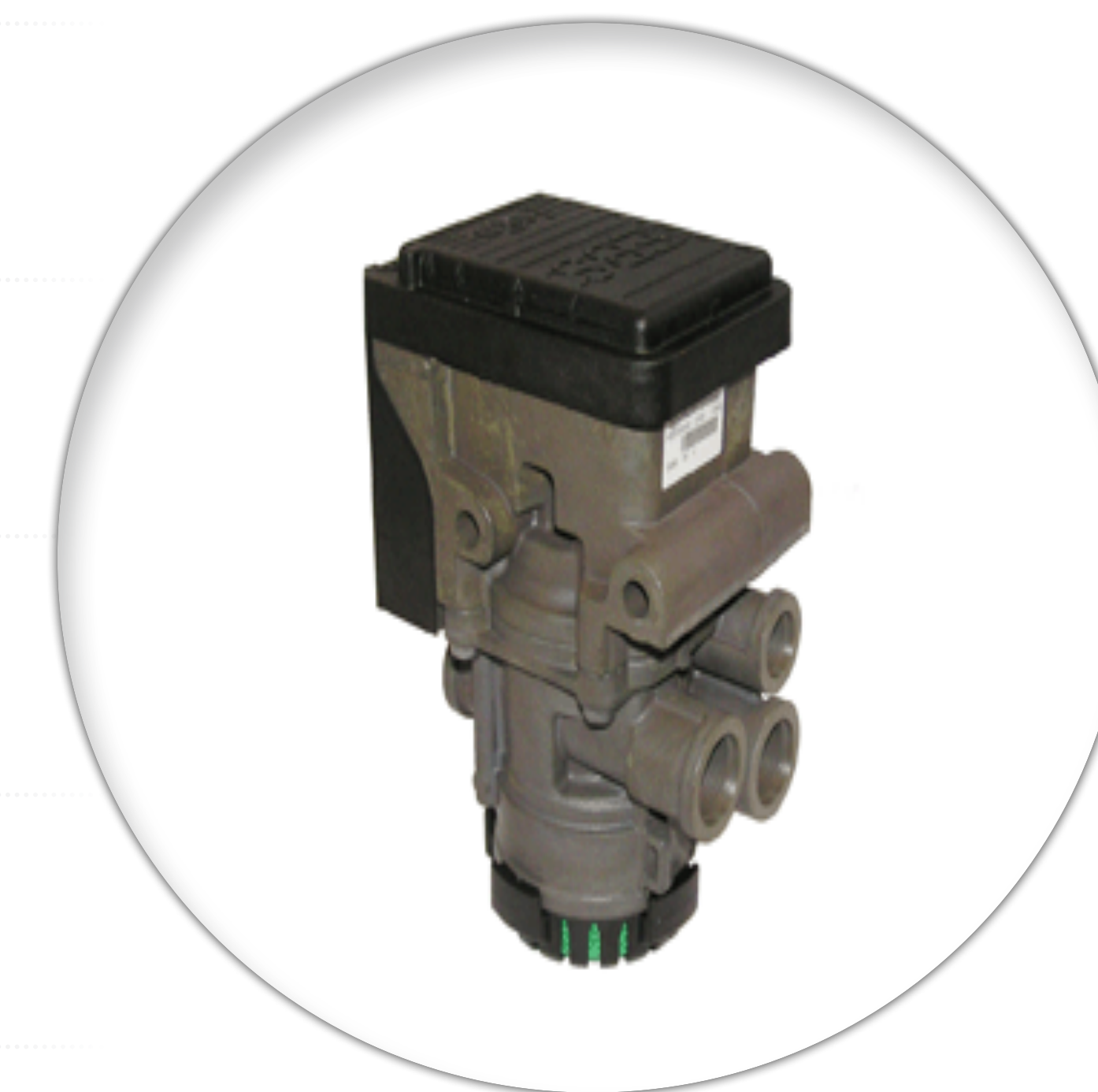
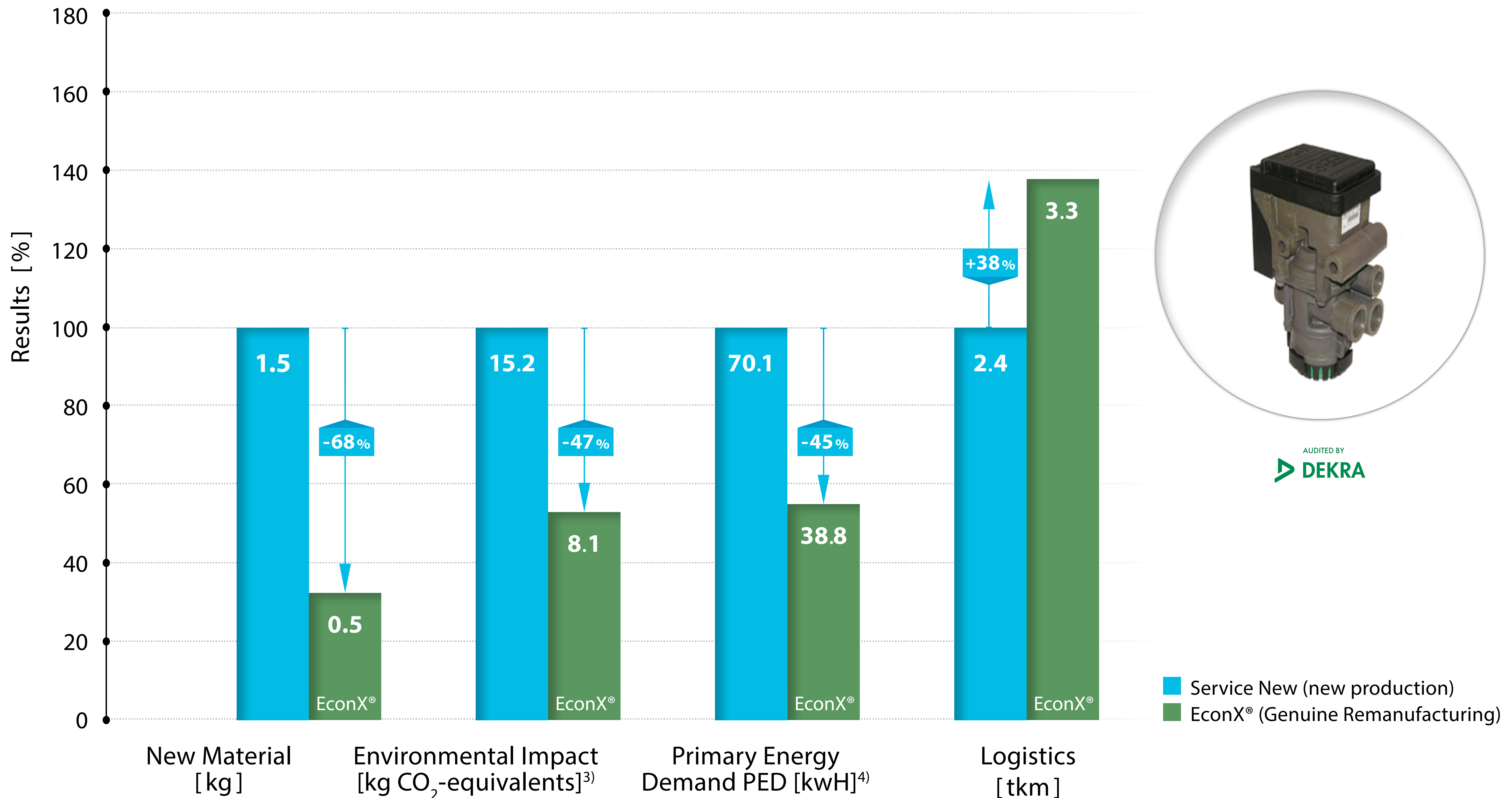
LCA Data EconX[®] EBS5 2-Ch EPM

LCA Data EconX[®] EBS5 1-Ch EPM

LCA Data EconX[®] Trailer EBS (TEBS4)

Knorr-Bremse Genuine Remanufacturing

Remanufacturing saves 7.0 kg CO₂-equivalents²⁾ per EconX[®] EBS5 1-Channel Electro-Pneumatic Module



AUDITED BY
DEKRA

Life Cycle Assessment Explanation

LCA Data EconX[®] Compressor 600cc

LCA Data EconX[®] Electronic Clutch Actuator

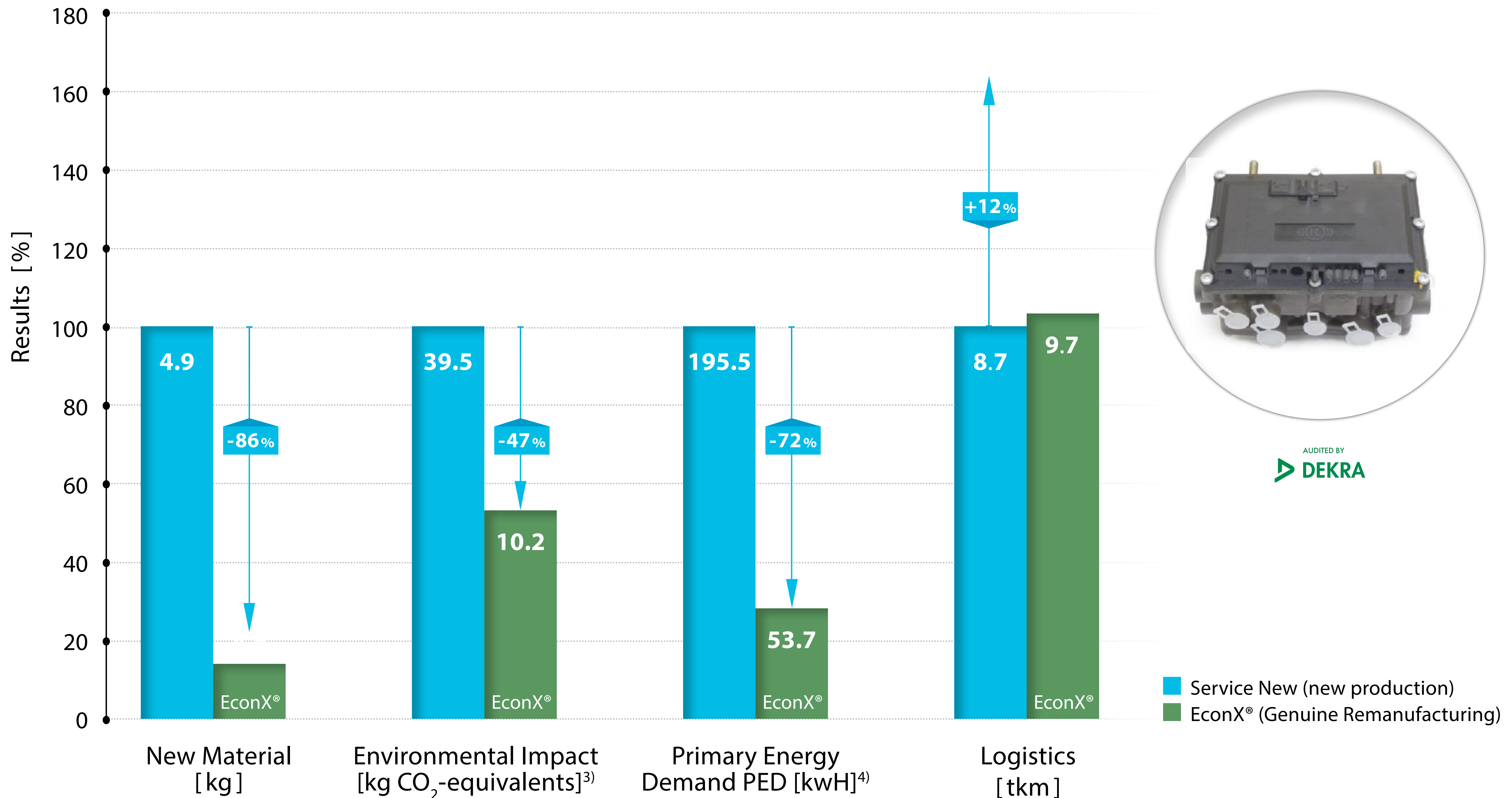
LCA Data EconX[®] EBS5 2-Ch EPM

LCA Data EconX[®] EBS5 1-Ch EPM

LCA Data EconX[®] Trailer EBS (TEBS4)

Knorr-Bremse Genuine Remanufacturing

Remanufacturing saves 29.3 kg CO₂-equivalents²⁾ per EconX[®] Trailer EBS (TEBS4)



Life Cycle Assessment Explanation

LCA Data EconX[®] Compressor 600cc

LCA Data EconX[®] Electronic Clutch Actuator

LCA Data EconX[®] EBS5 2-Ch EPM

LCA Data EconX[®] EBS5 1-Ch EPM

LCA Data EconX[®] Trailer EBS (TEBS4)