

Designing the Greener Shoe: A Lesson in Sustainability and Life Cycle Analysis

Evaluate and document how you used the lesson plan at: <https://goo.gl/forms/frKk8cyEW95baSSX2>

Author(s):	Shana McAlexander
Author Affiliation and Location: (e.g. Duke, Beaufort, NC)	NC State University
Optional Author Website	https://research.cnr.ncsu.edu/sites/sustainablebioproducts/
Optional Author Contact Information (e.g. email)	slmcalex@ncsu.edu
Abstract to Lesson Plan (max. 100 Words) Summary description of the main activity(ies) of your lesson plan and the main learning goal for each activity. Include aspects of the lesson that are unique and innovative.	In the engage activity, students will make observations of the materials that make up their shoes. They will consider inputs and outputs of those materials and map out where and how those materials are made. The students then review current media and literature sources about the environmental impacts of various materials. Students next explore the making of mathematical models to apply quantitative measures to compare the sustainability of different shoes/materials using Excel or Google Sheets.
Introduction. Teachers generally appreciate more detail in this section to help them become oriented with the lesson plan's discipline of origin/learning objectives. Aim for 2-3 paragraphs. Include aspects of the lesson that are unique and innovative. Please remember to define jargon!	Students are consumers and they have a growing market influence on what and how products are made. Have them examine an everyday item (shoes) and understand the environmental, social, and economic impacts of the life cycle of the shoe. Too often students take marketing campaigns on face value. For example, the electric car is considered more environmentally friendly than a gas car. But, the issue is more complicated. If students took the source of electricity into account, the car that runs on electricity from a coal-powered plant, the comparison becomes more complex and students realize that geography and policy can influence the sustainability of the car. To compare the sustainability of products, materials, or processes, a modeling system called Life Cycle Analysis is performed. Inputs and outputs of the product/material/process can be quantified and compared.
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Learning Objectives using Measurable Verbs (what students will be able to do)	After this activity students will be able to: <ul style="list-style-type: none"> • Identify inputs and outputs in the life cycle of everyday products. • Understand how mathematical models can be used to compare the sustainability of products/materials/processes • Critically examine marketing claims of “Green” products
Appropriate Grade Levels	6-8, 9-12
Group Size/# of students activities are designed for	Groups of 2-3 are recommended
Approximate Time of Lesson (Break down into 20-50 minute periods)	Input/outputs map for student shoes: 20 min Media/ Literature Review: 10 min Discuss LCA modelling and sample data 10 min

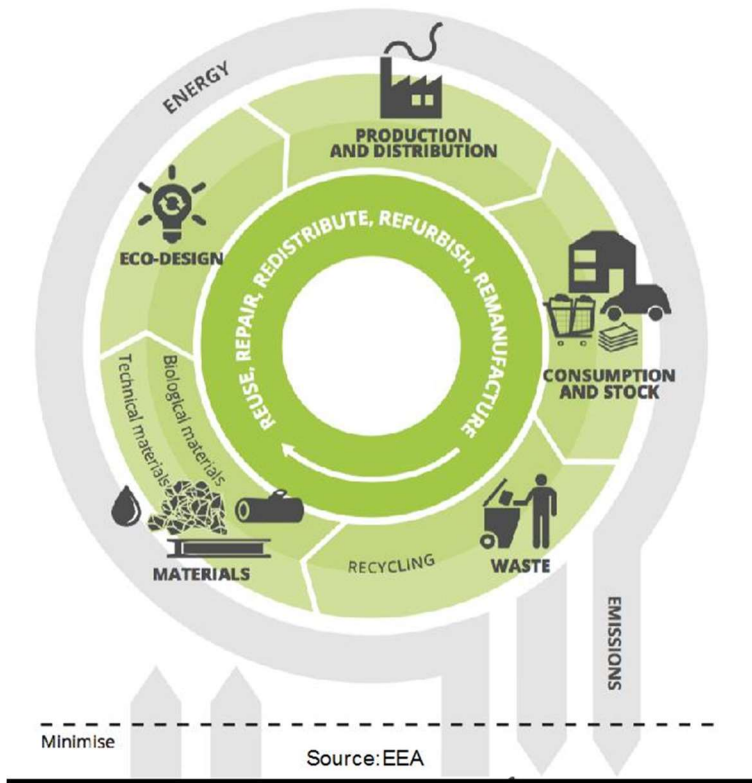
	Extend model to include other inputs or weights on factors: 20 min Present model and findings: Time varies based on number of groups
Resources Needed for Students (e.g. scissors, paper, pencils, glue, etc.)	Pencils/Paper, whiteboard, or computer/tablet for input/output mapping activity. Computer/tablet for manipulating LCA model.
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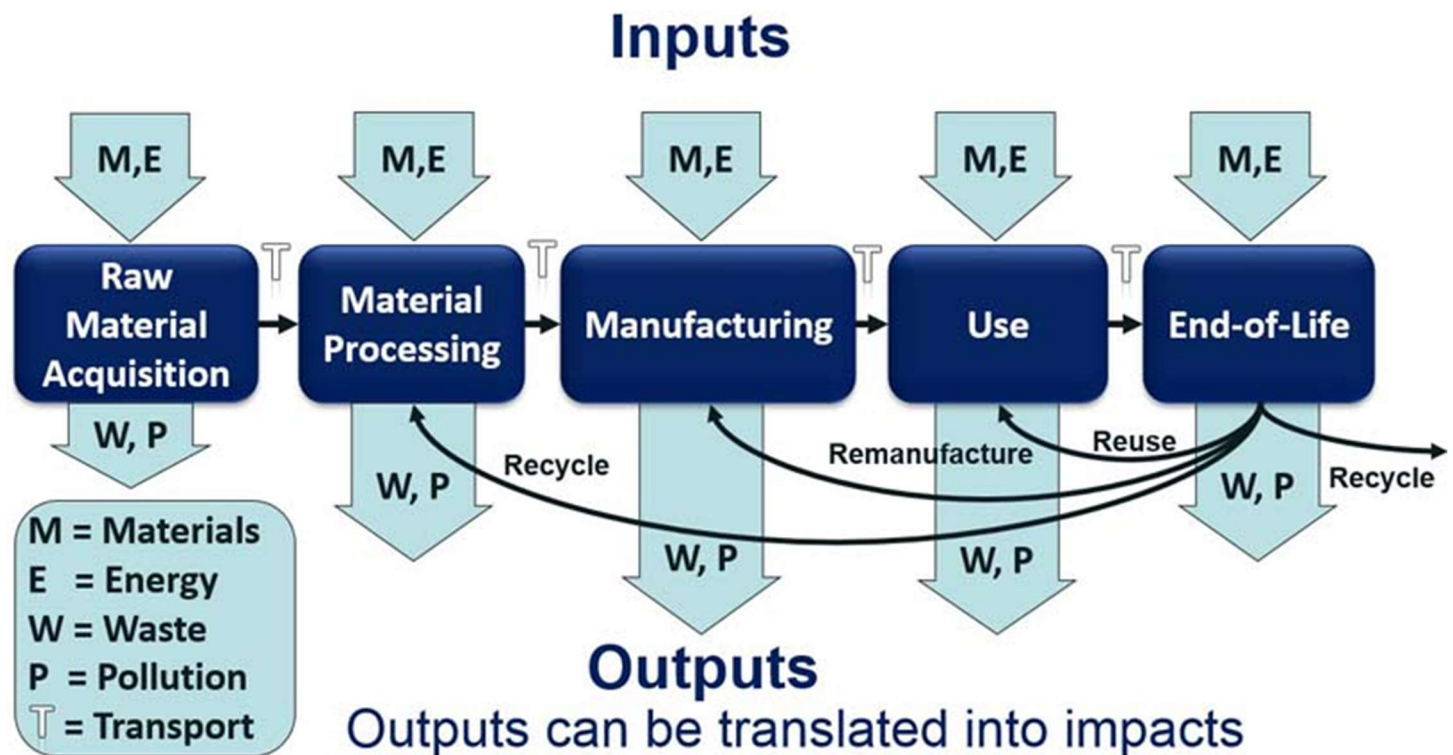
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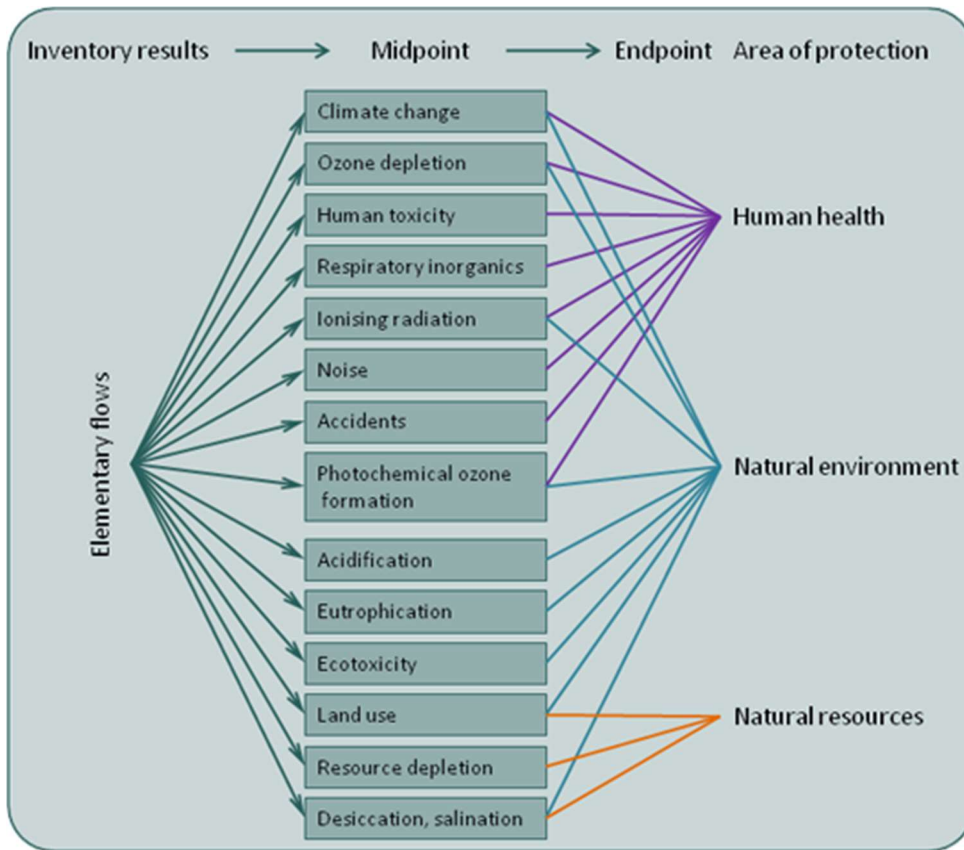


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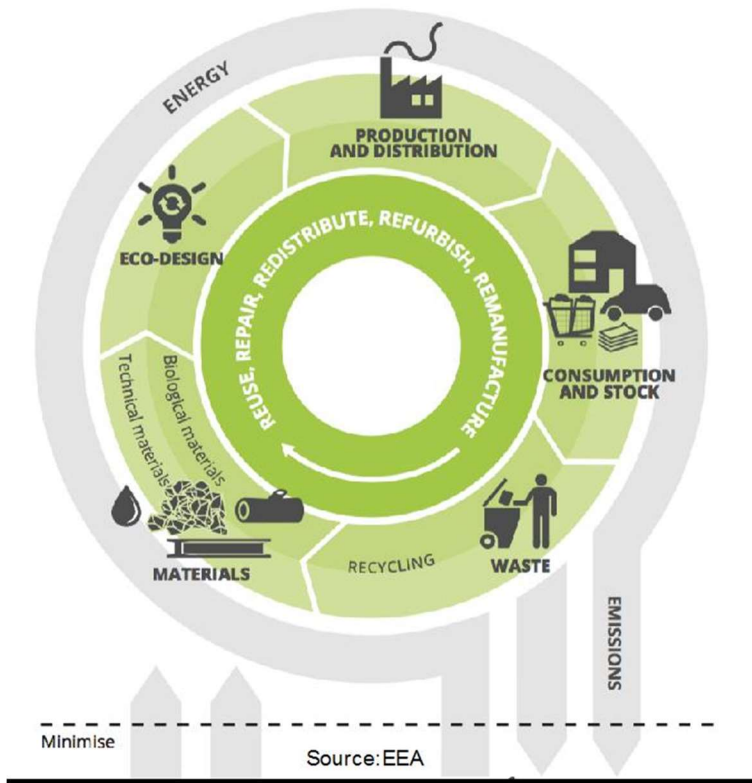
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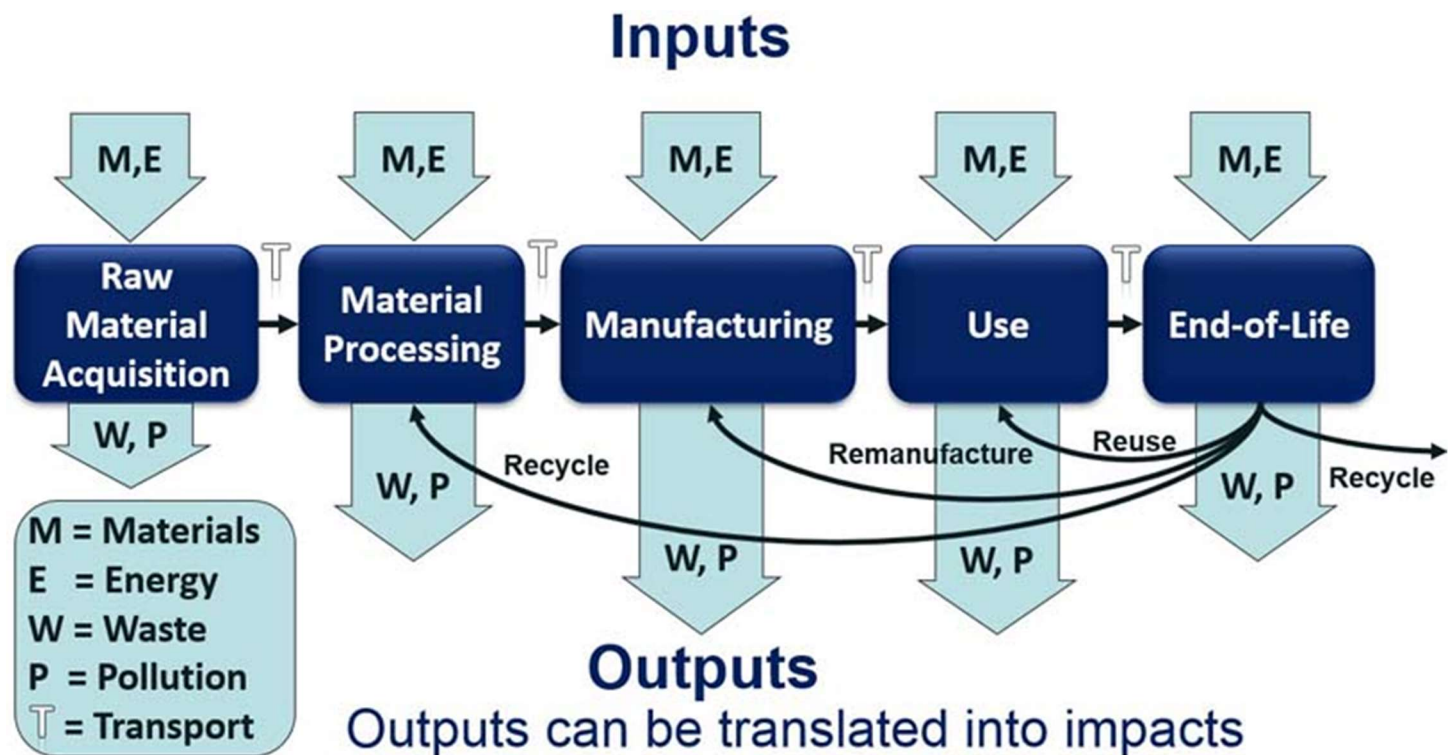
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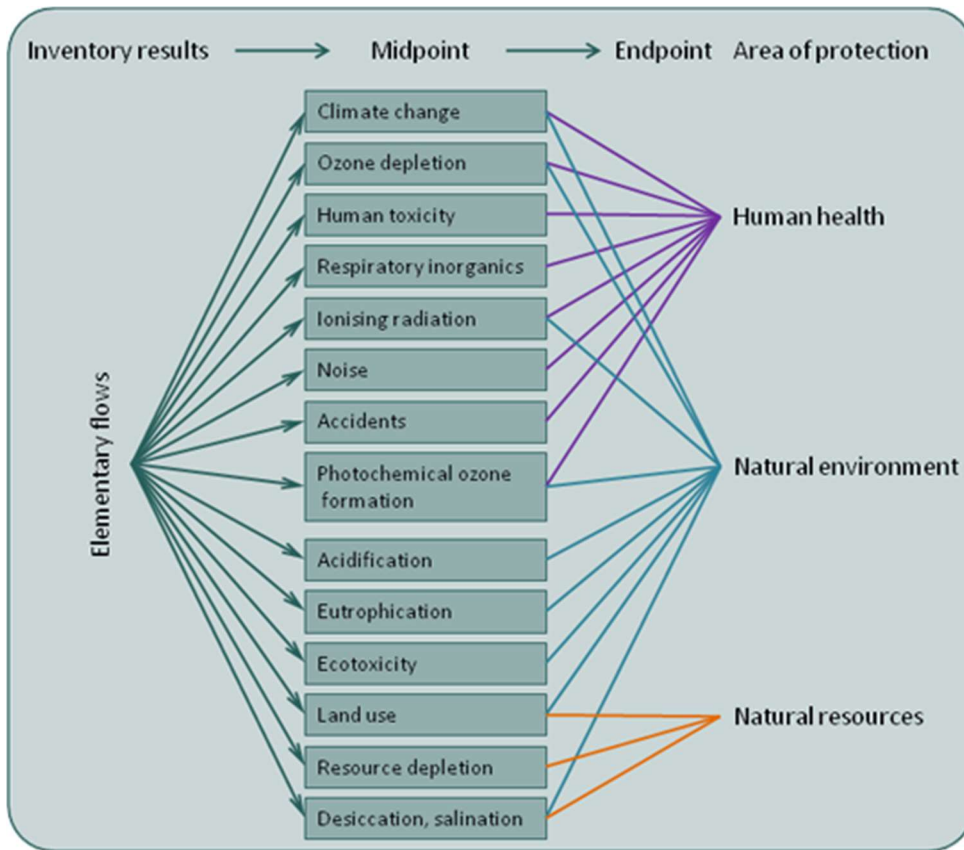


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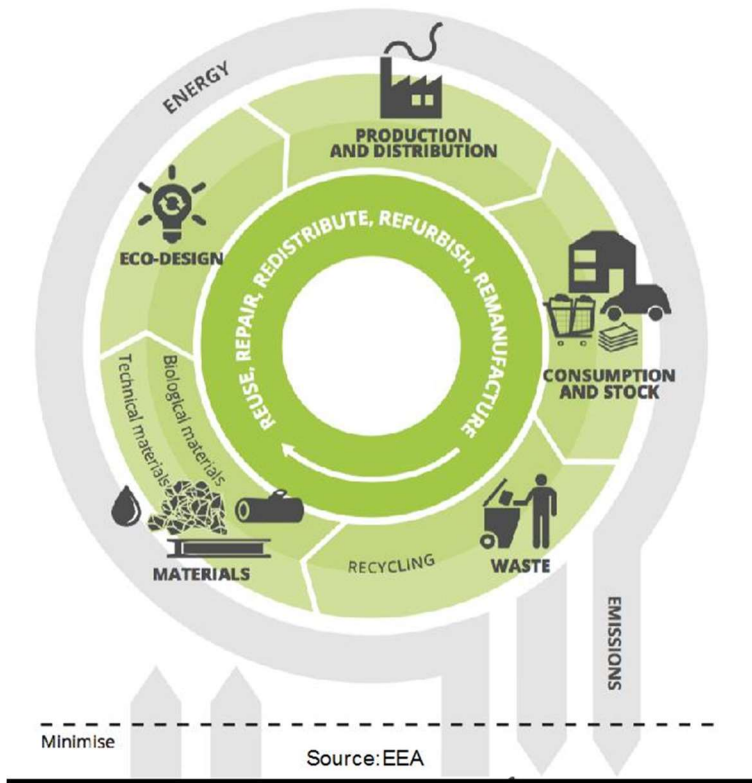
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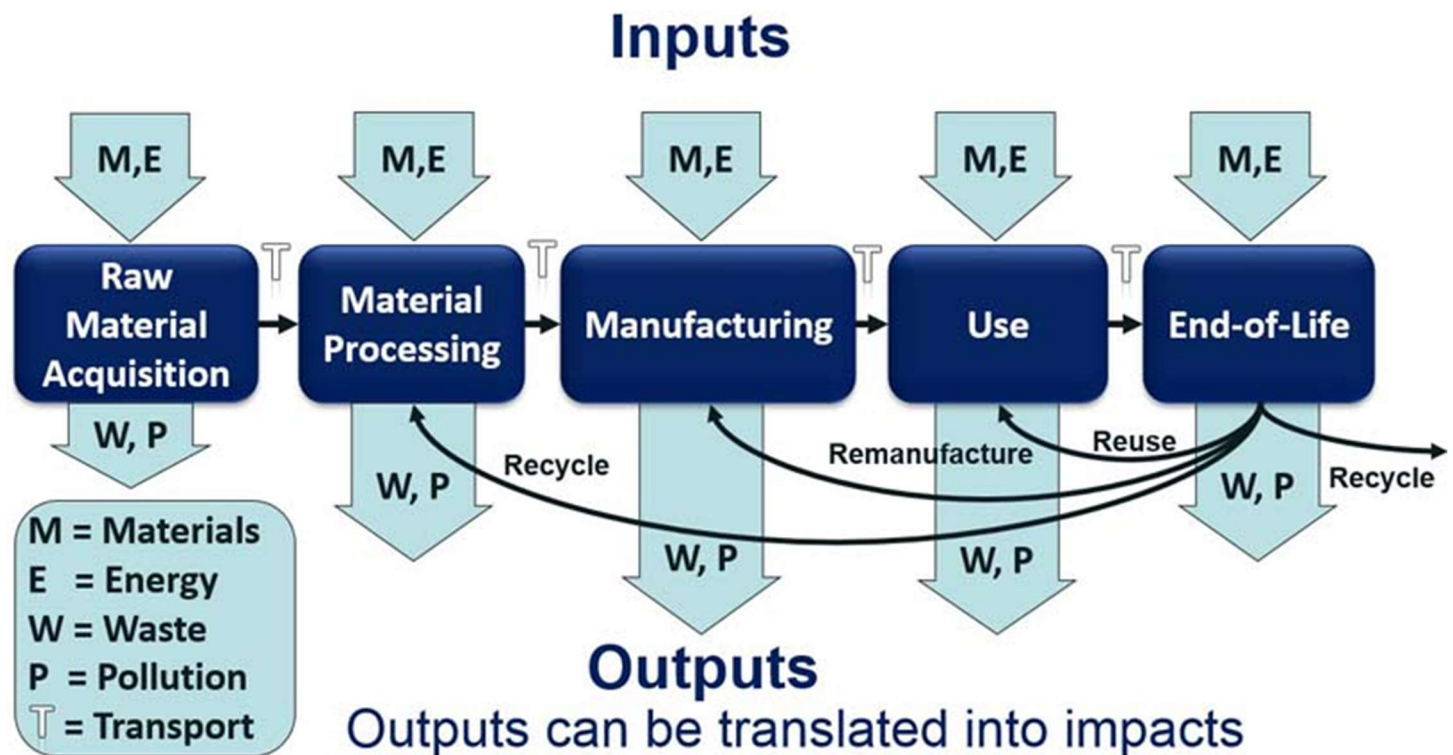
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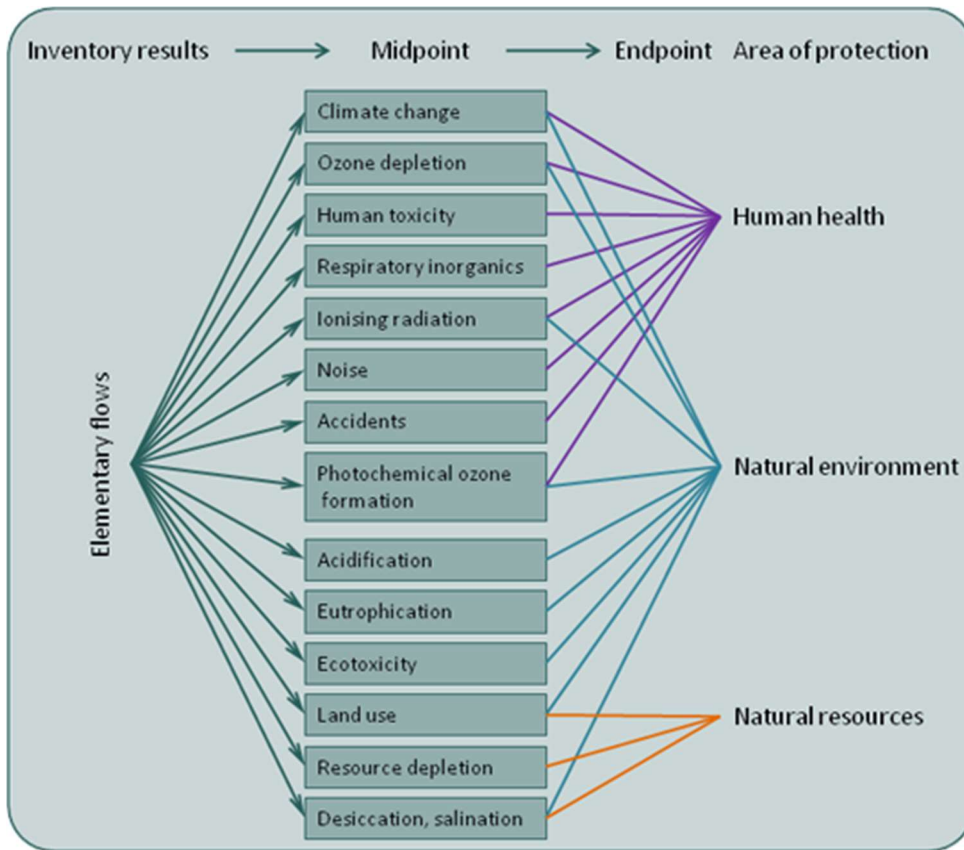


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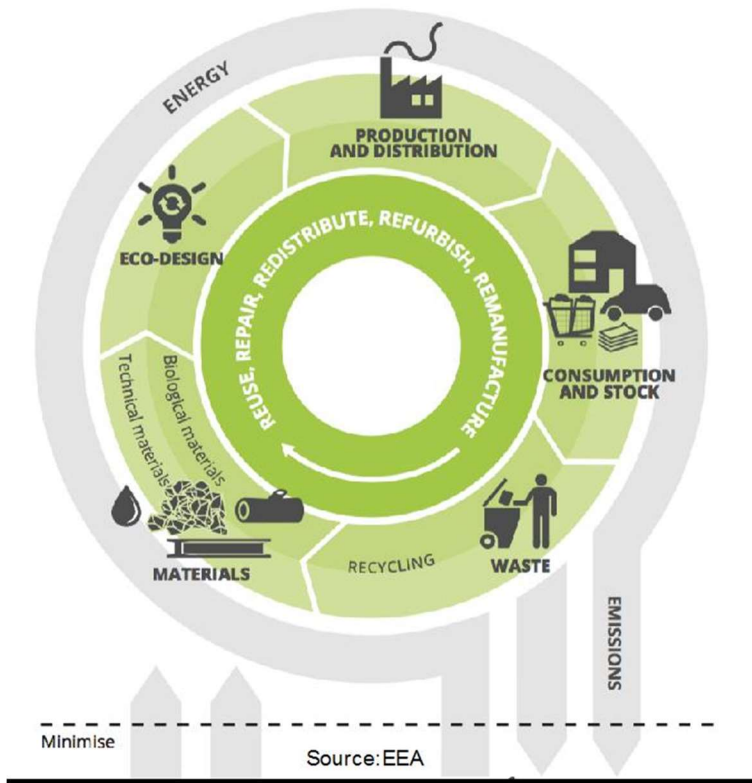
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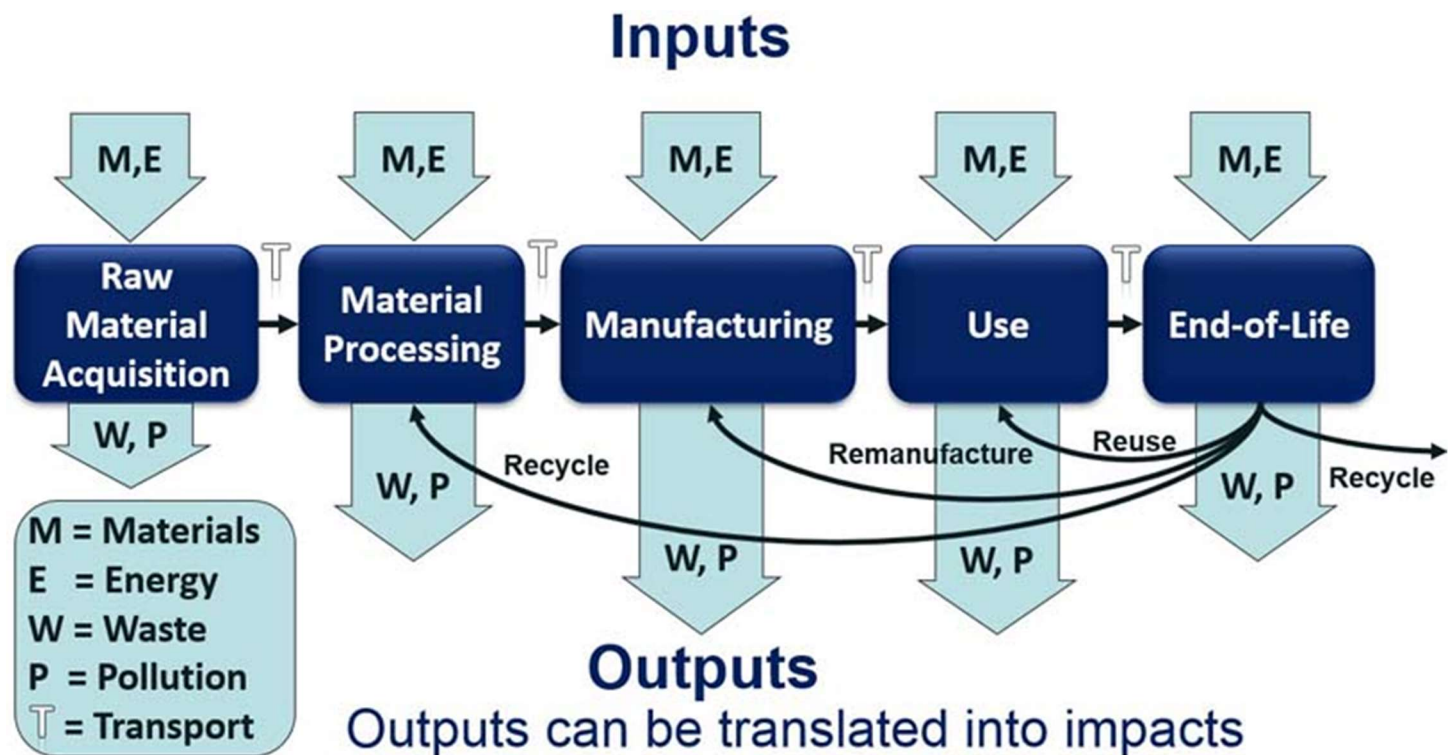
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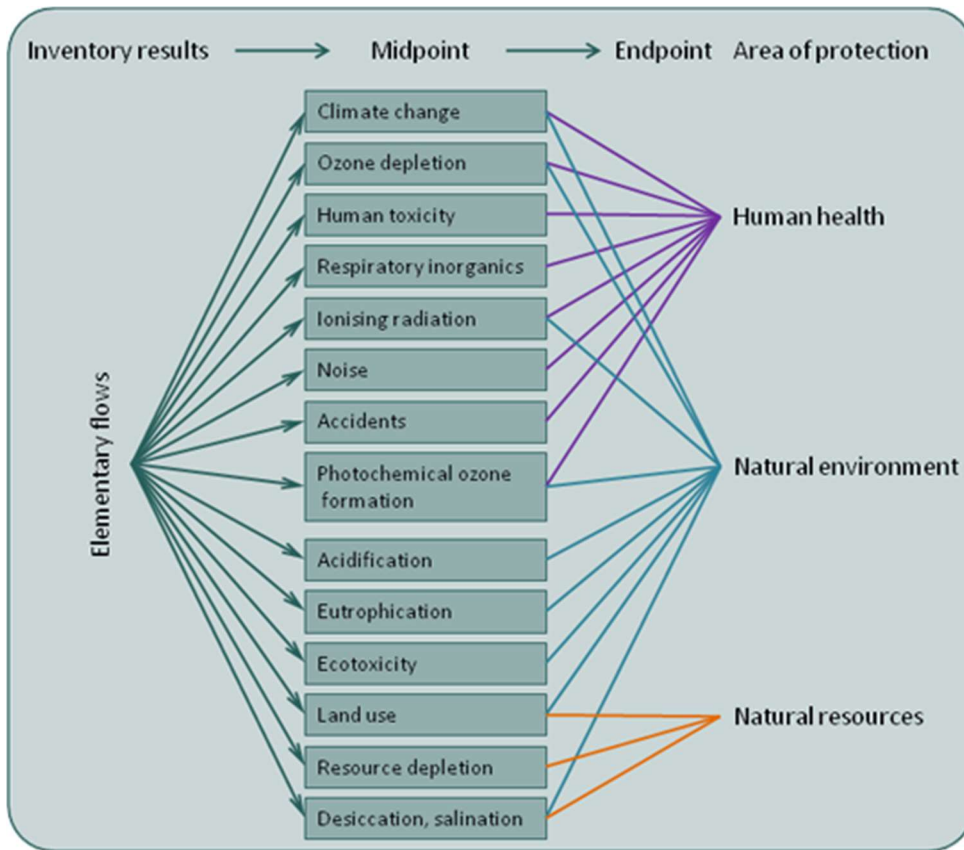


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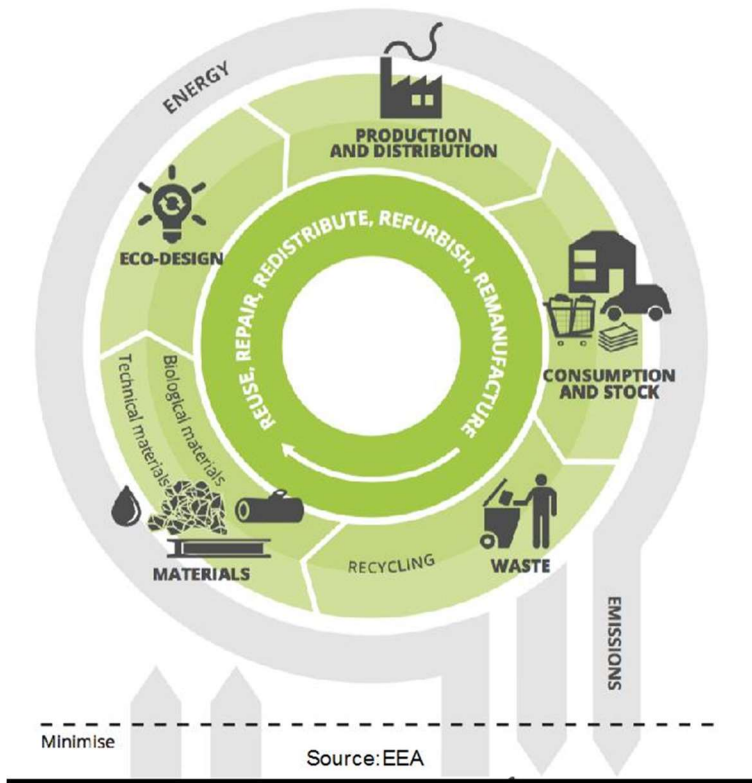
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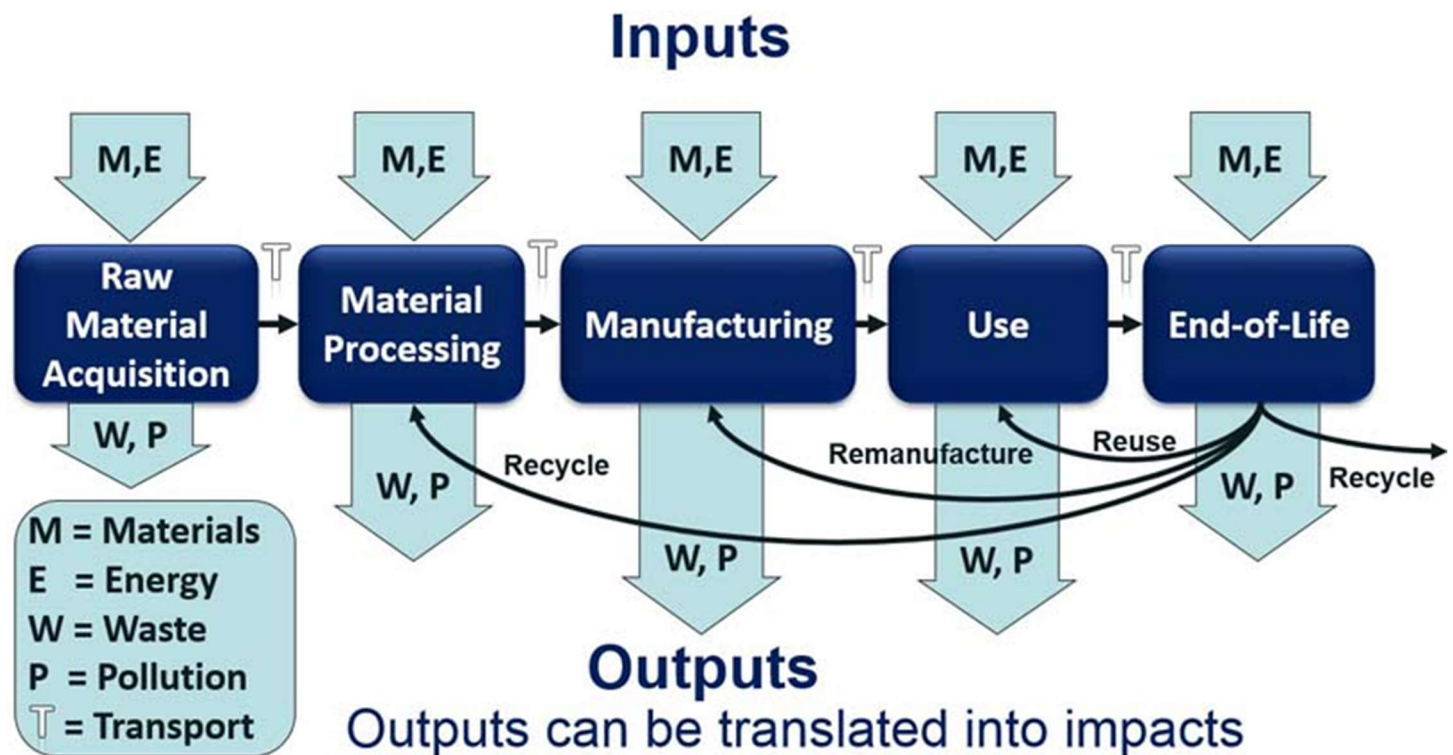
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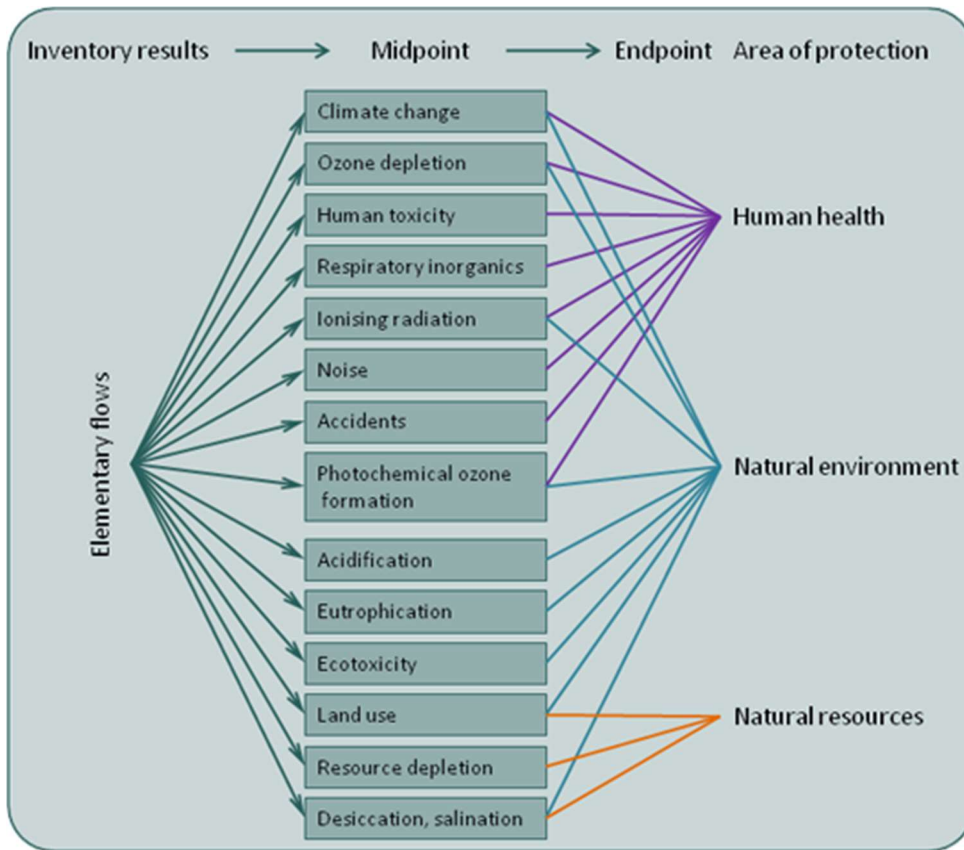


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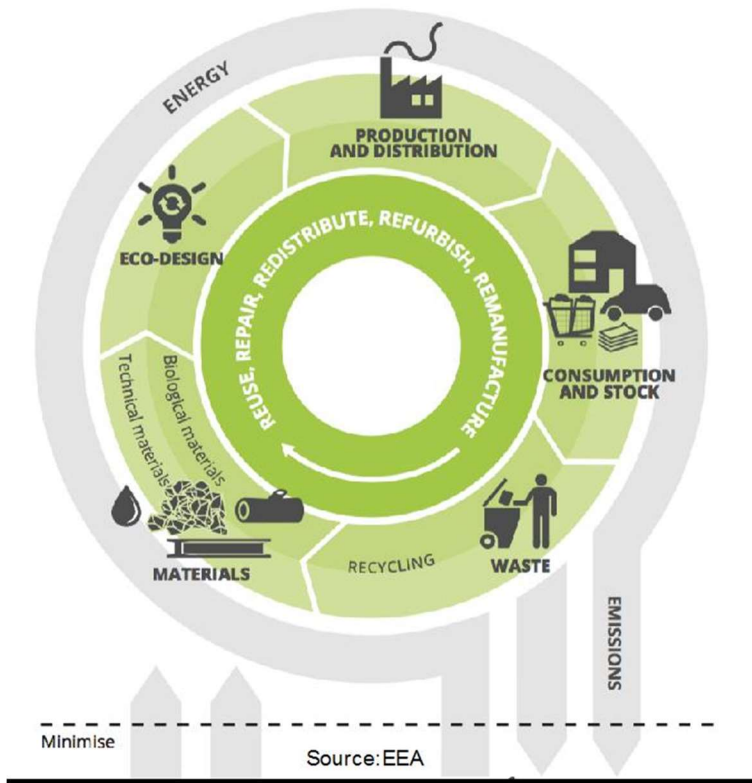
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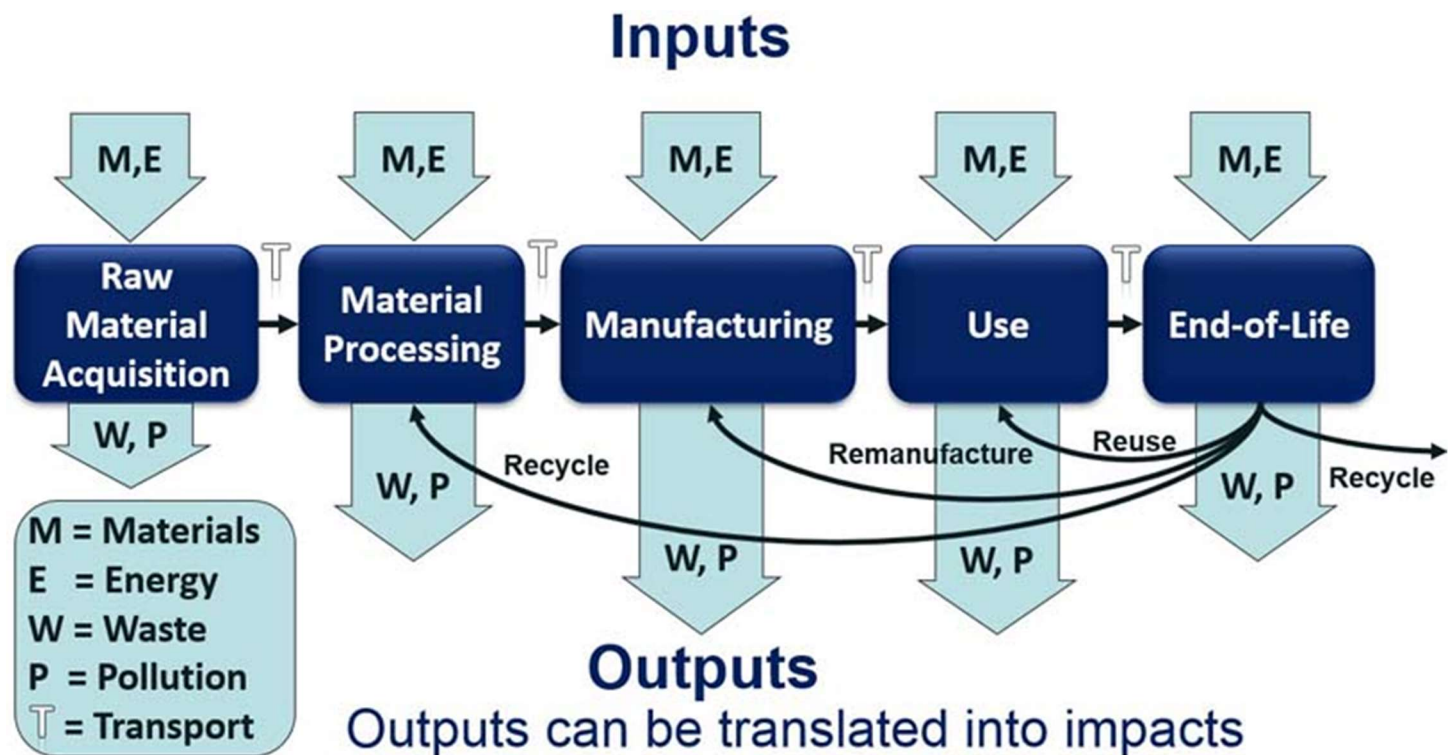
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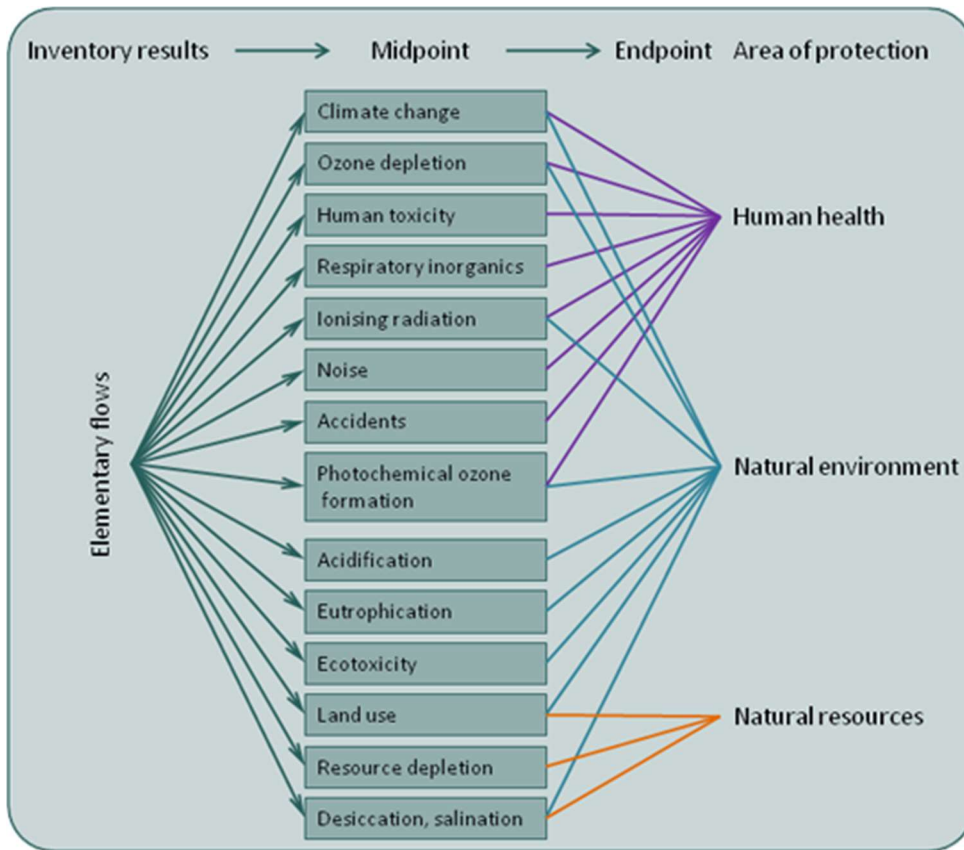


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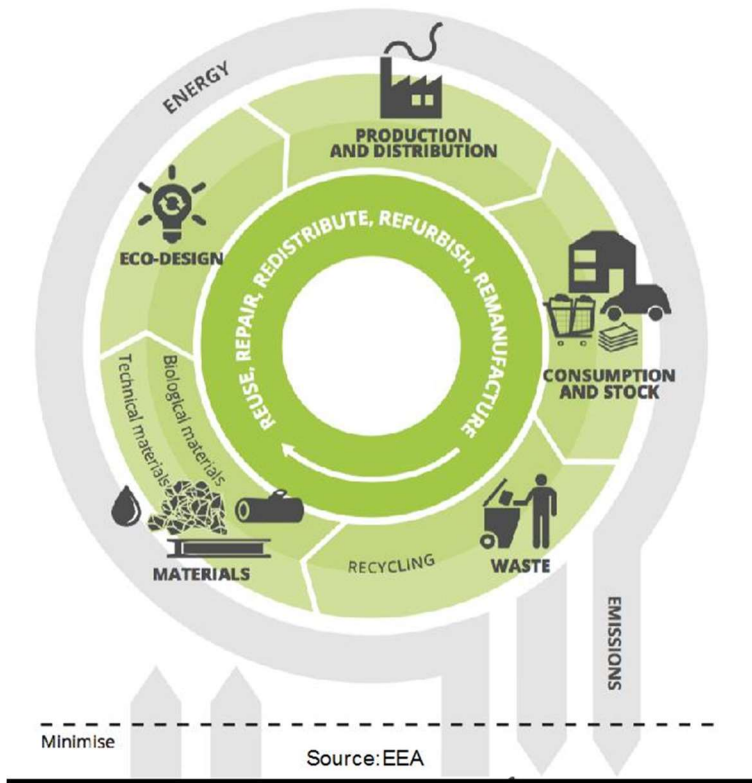
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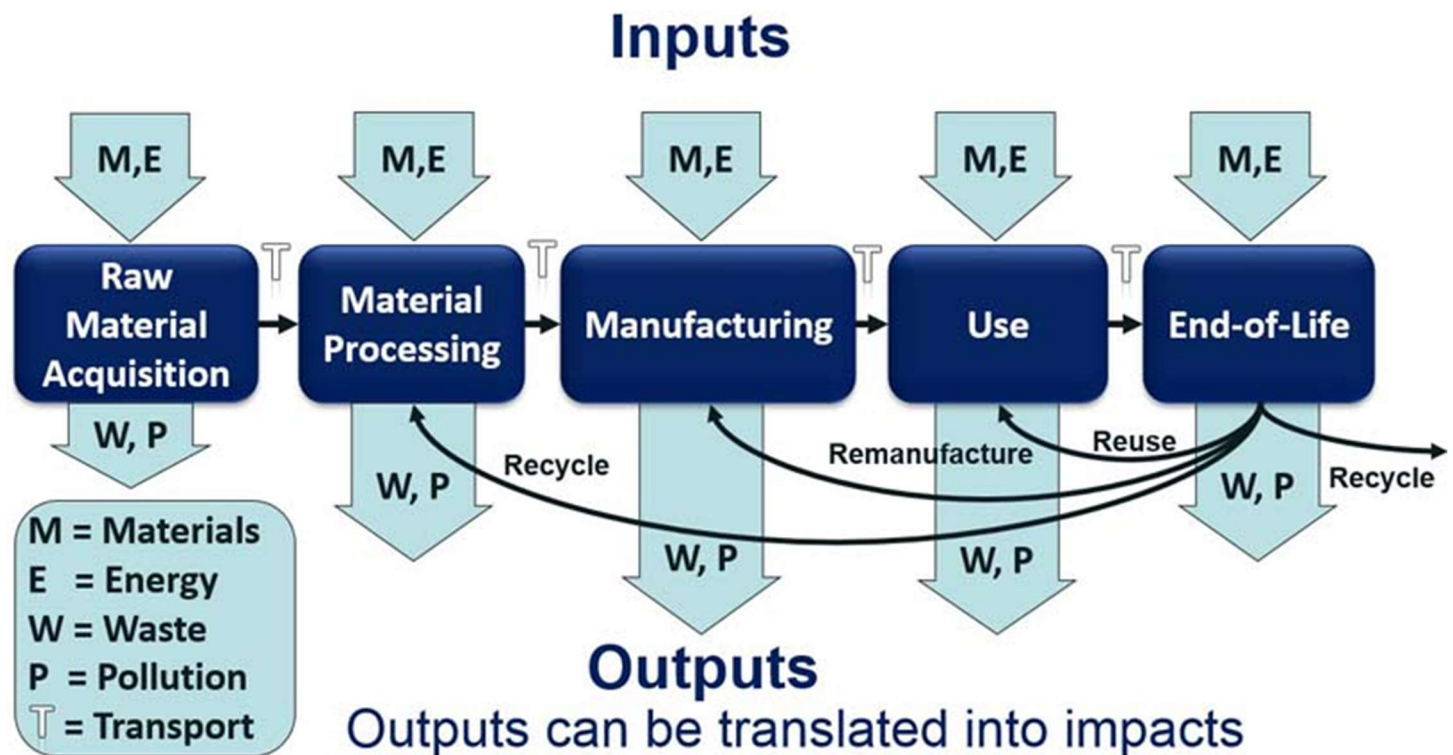
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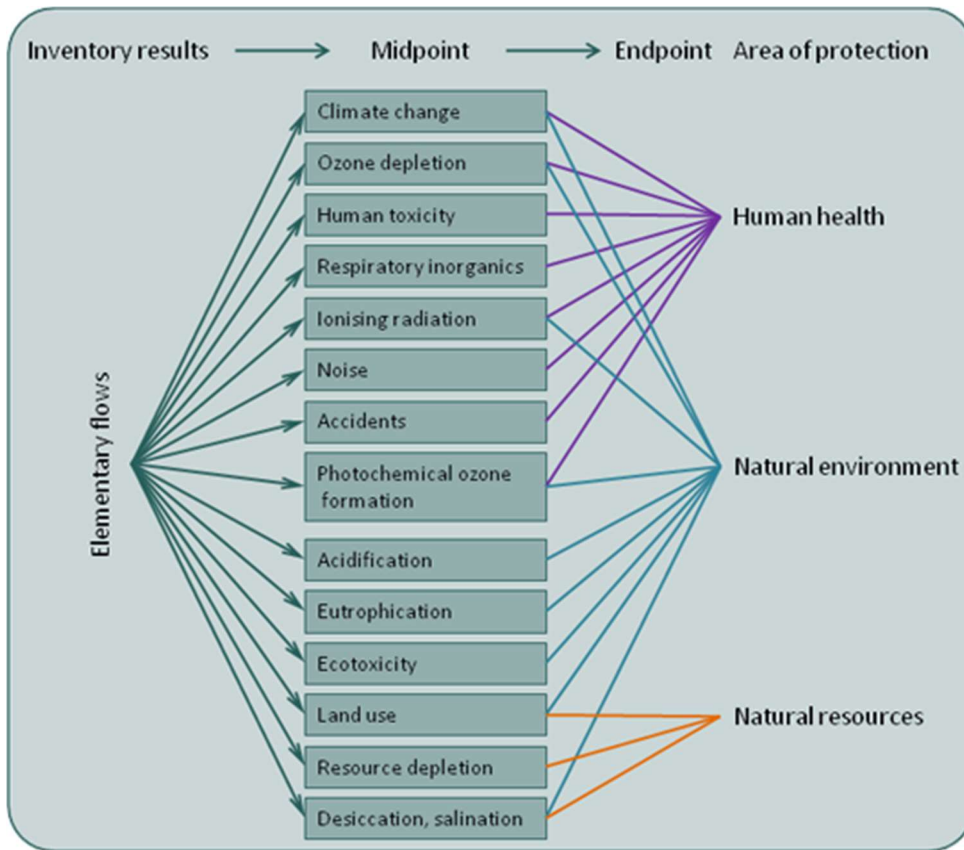


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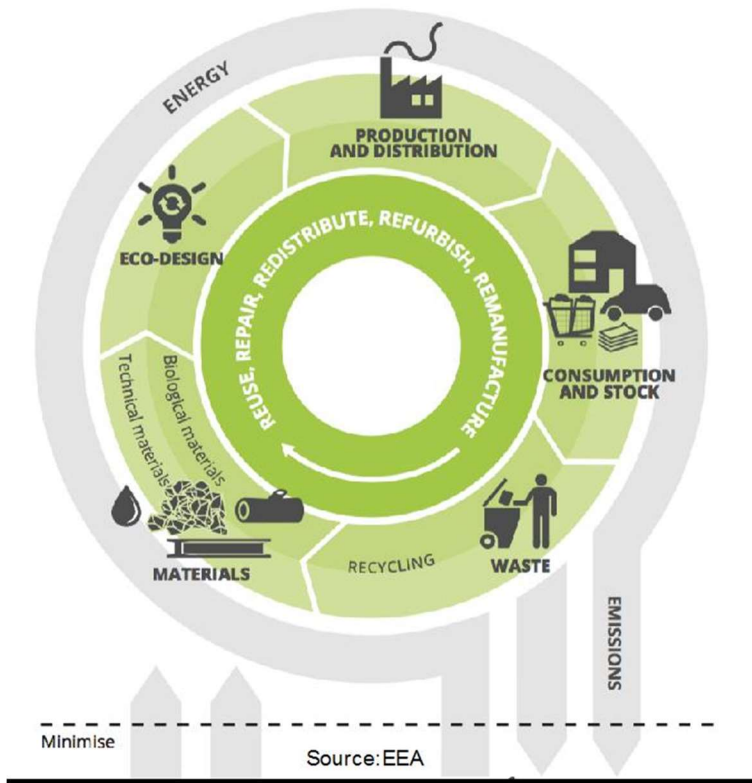
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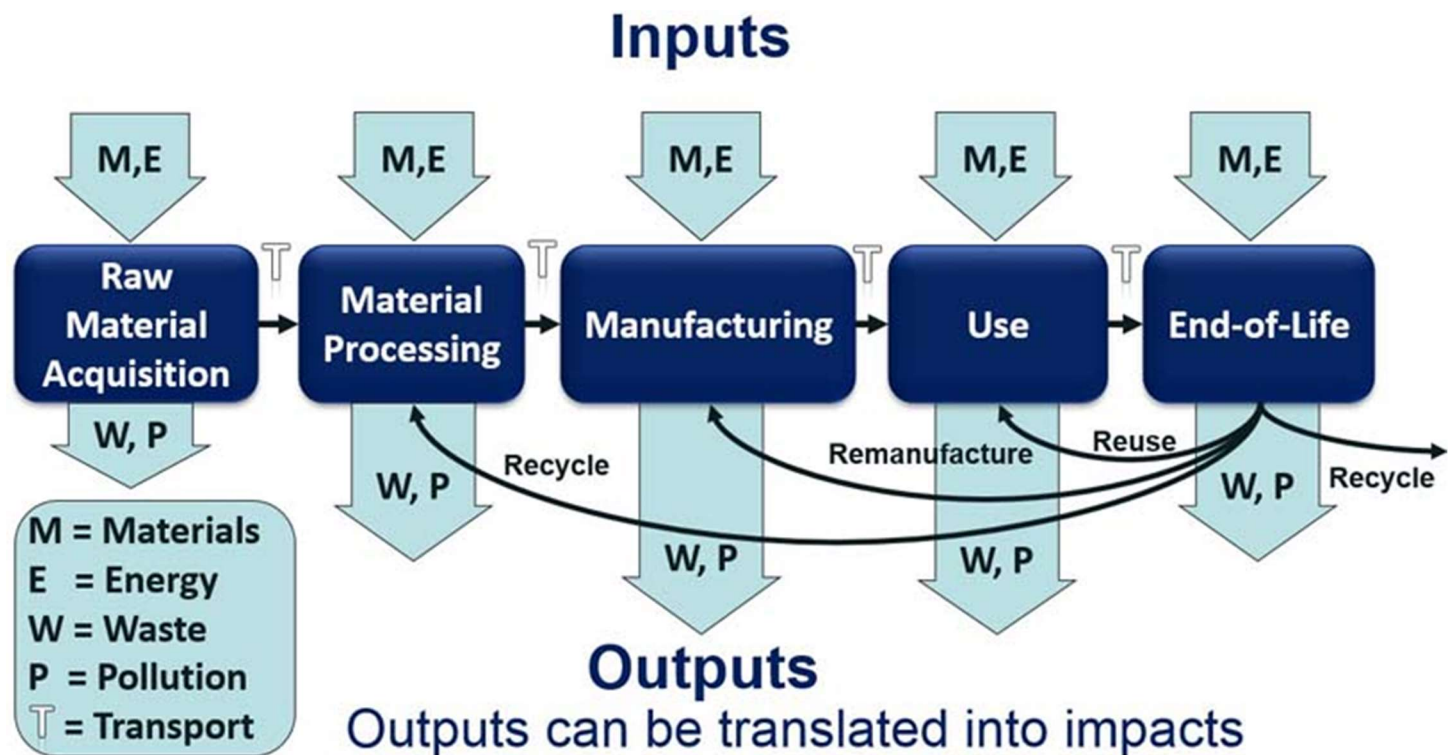
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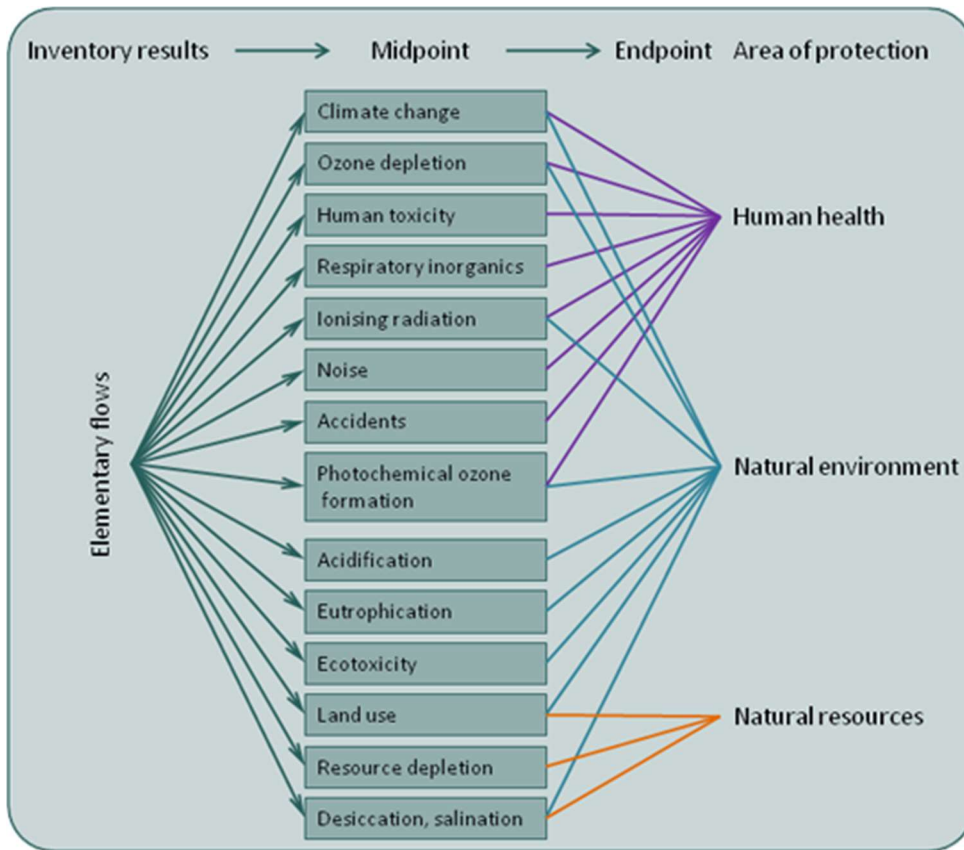


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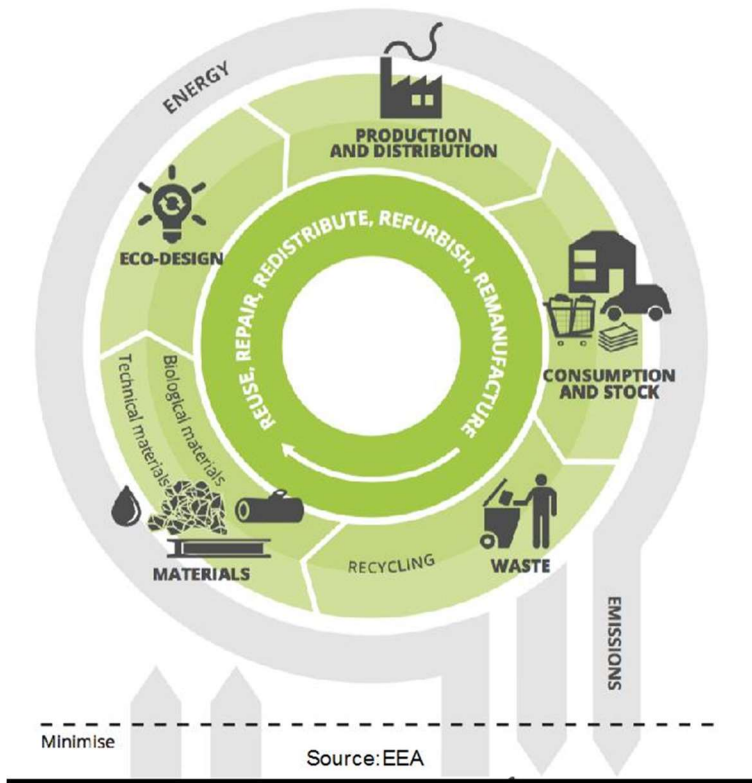
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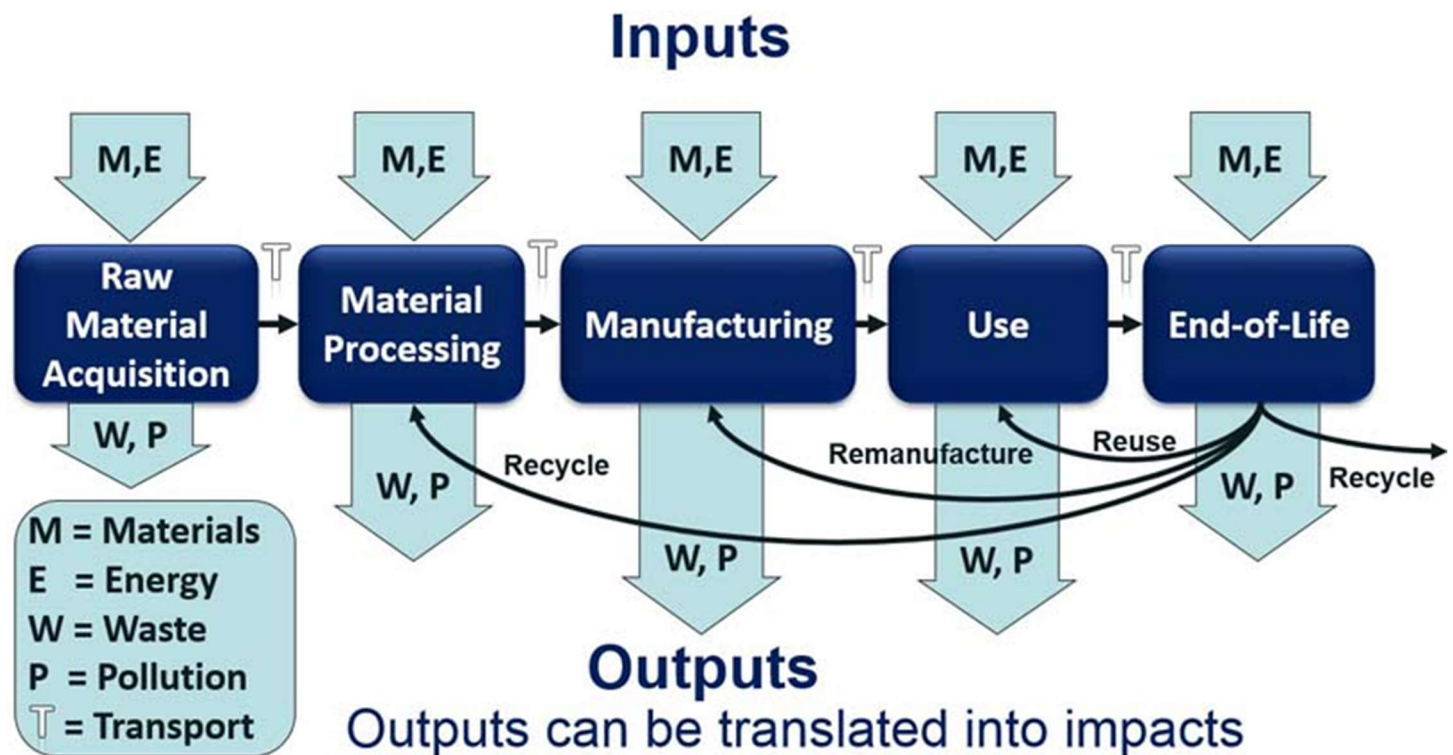
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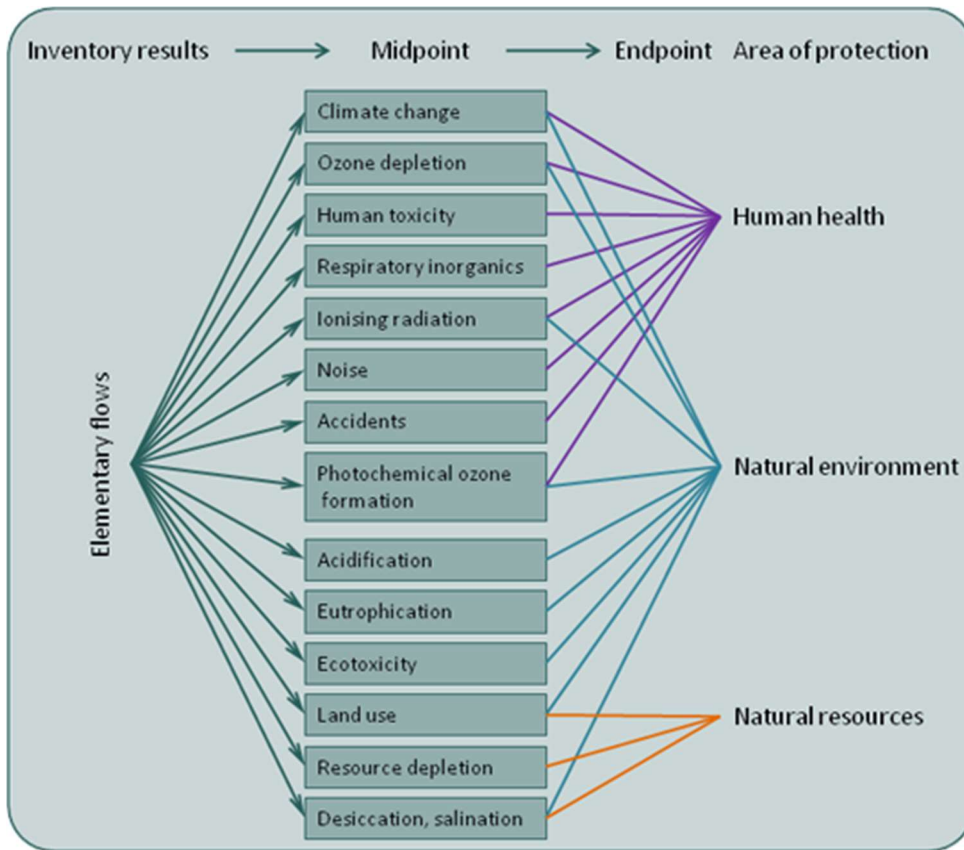


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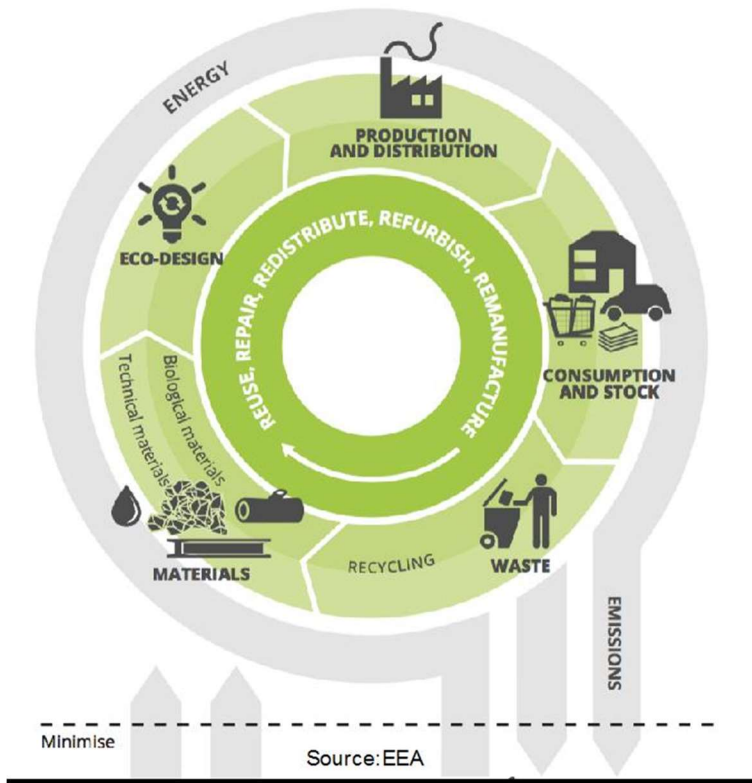
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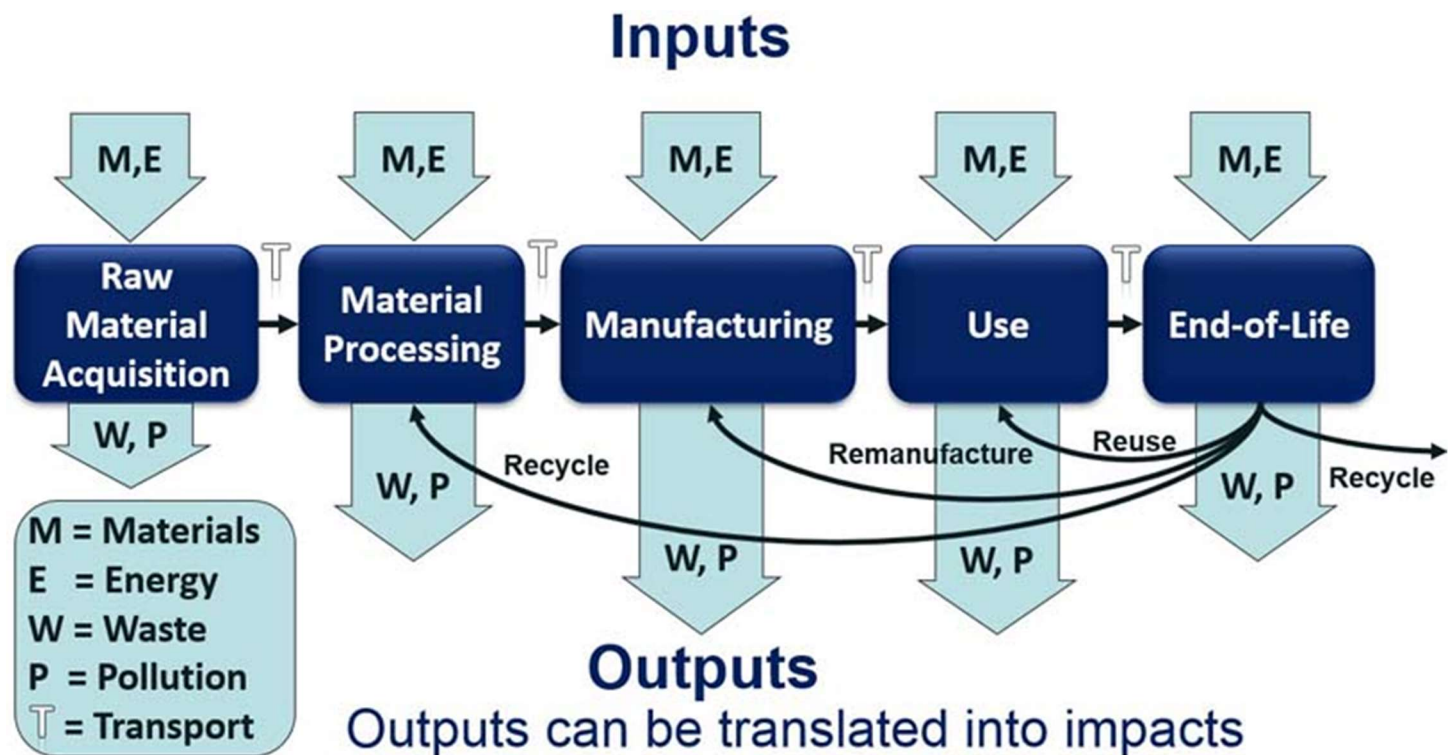
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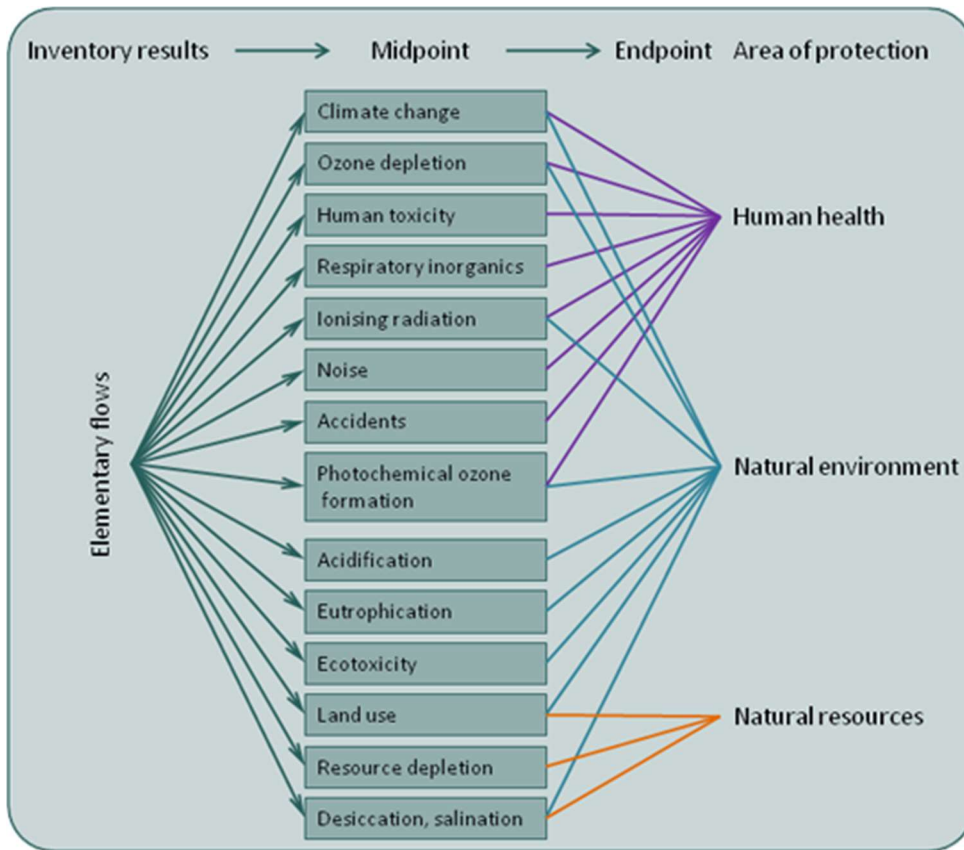


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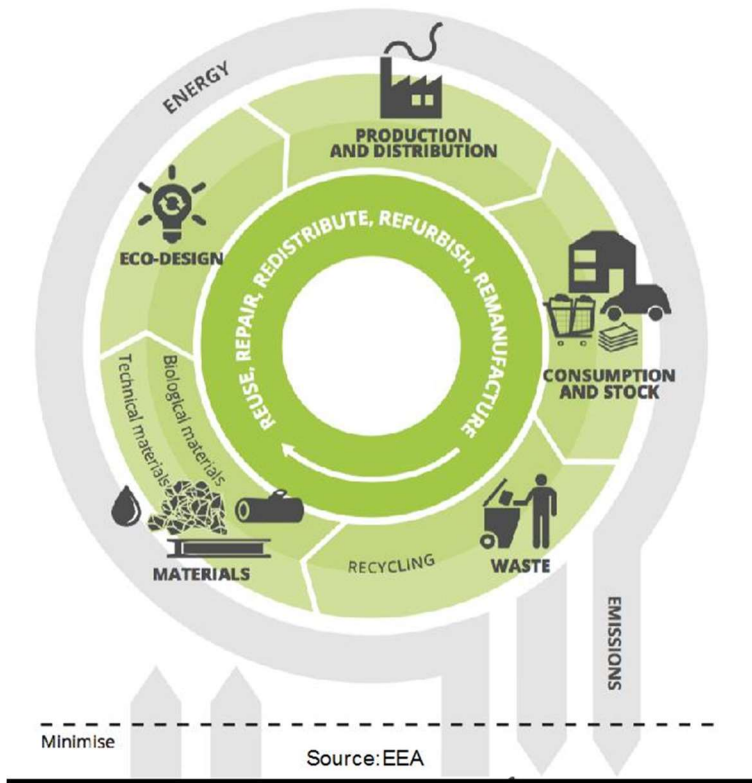
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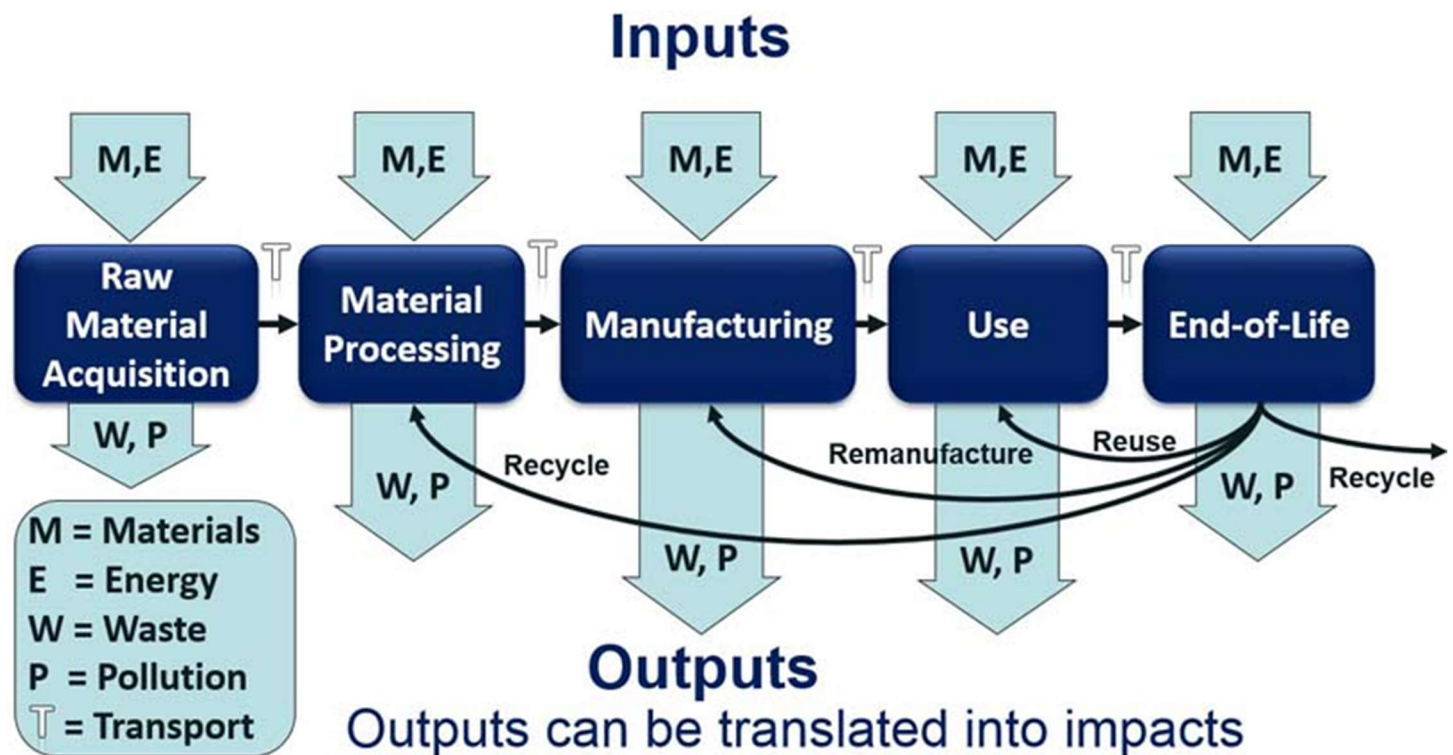
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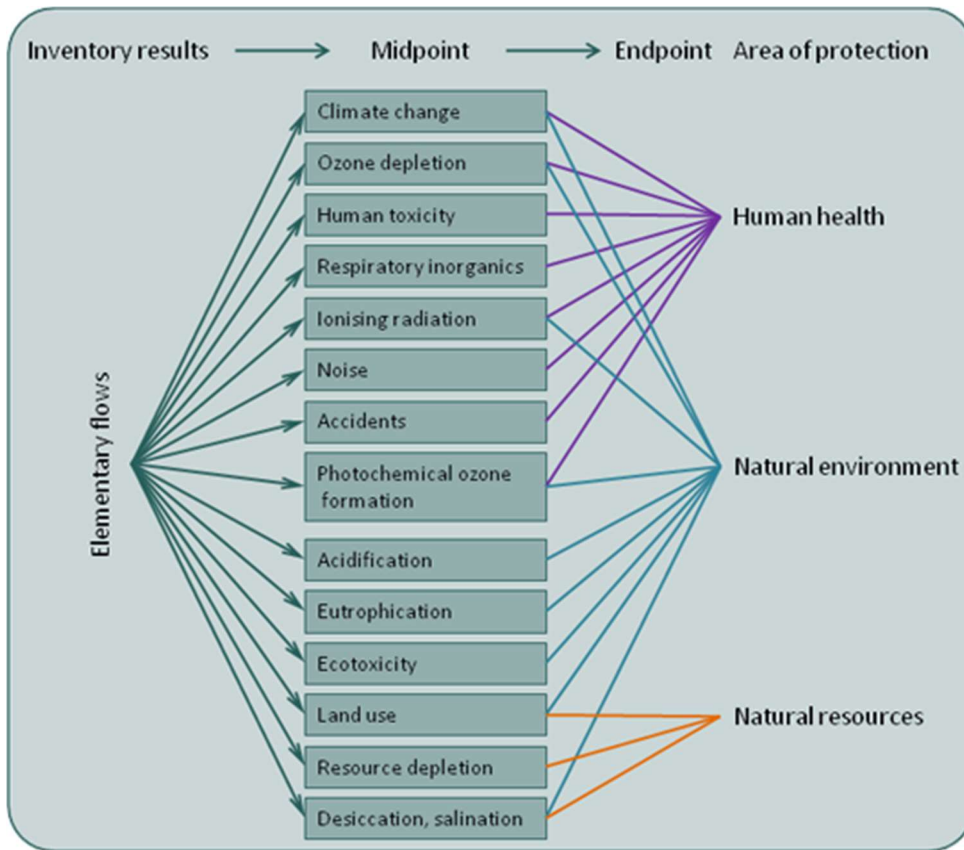


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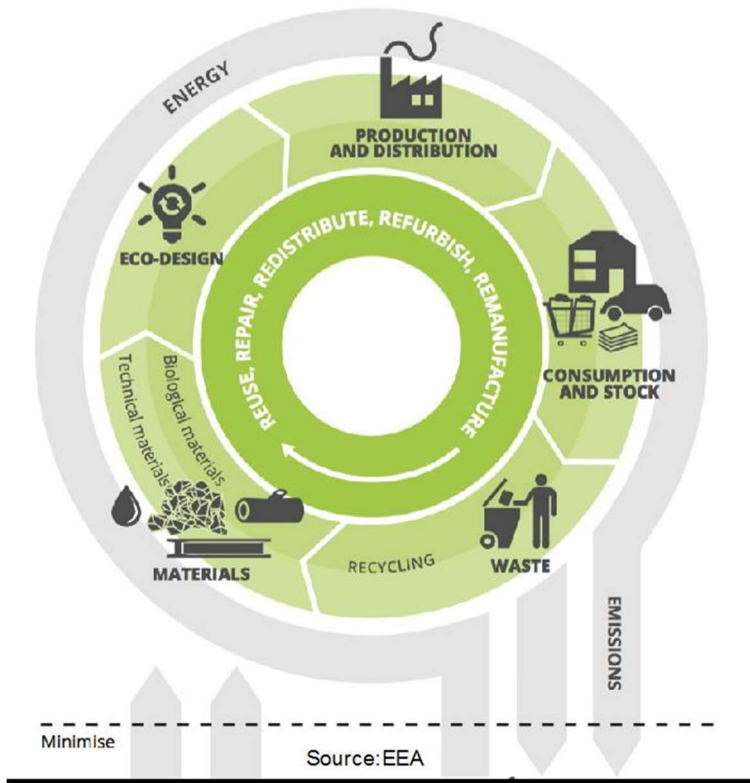
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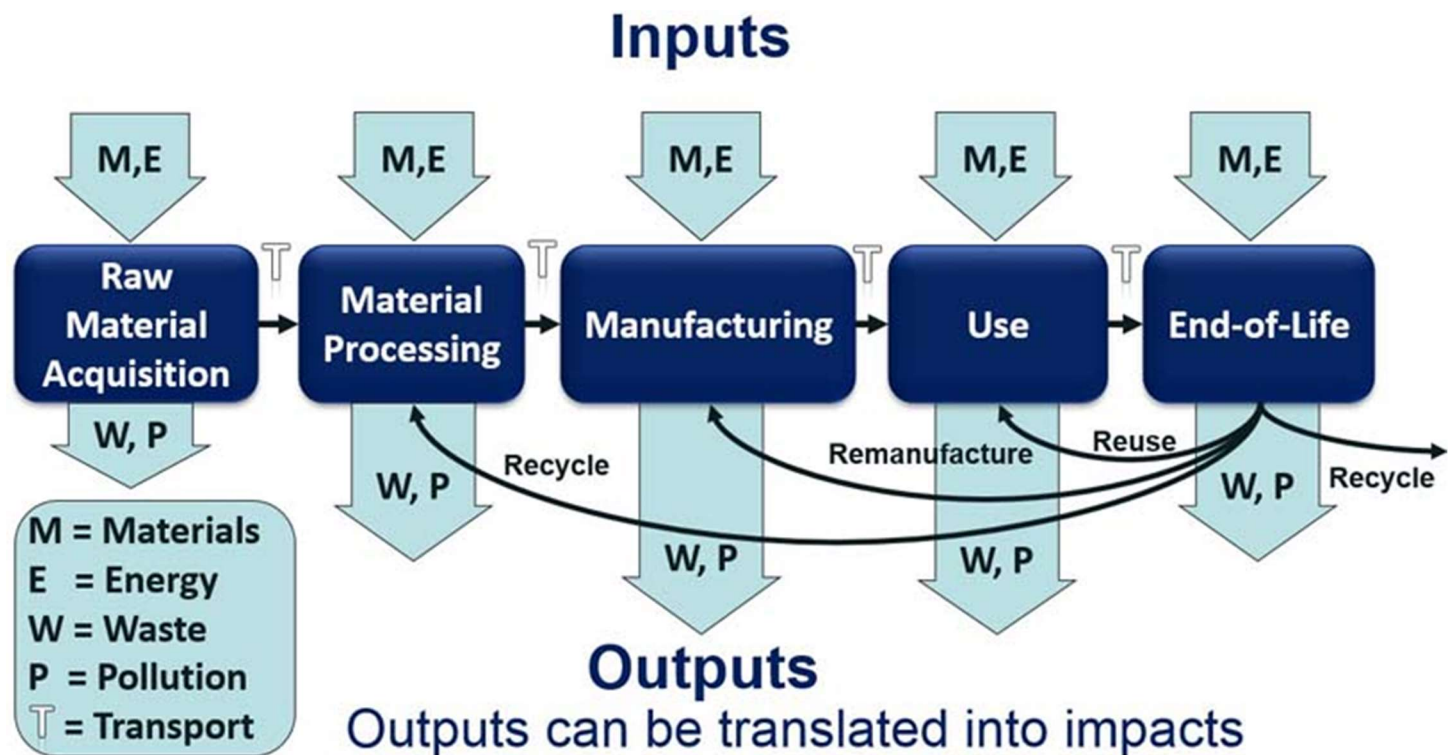
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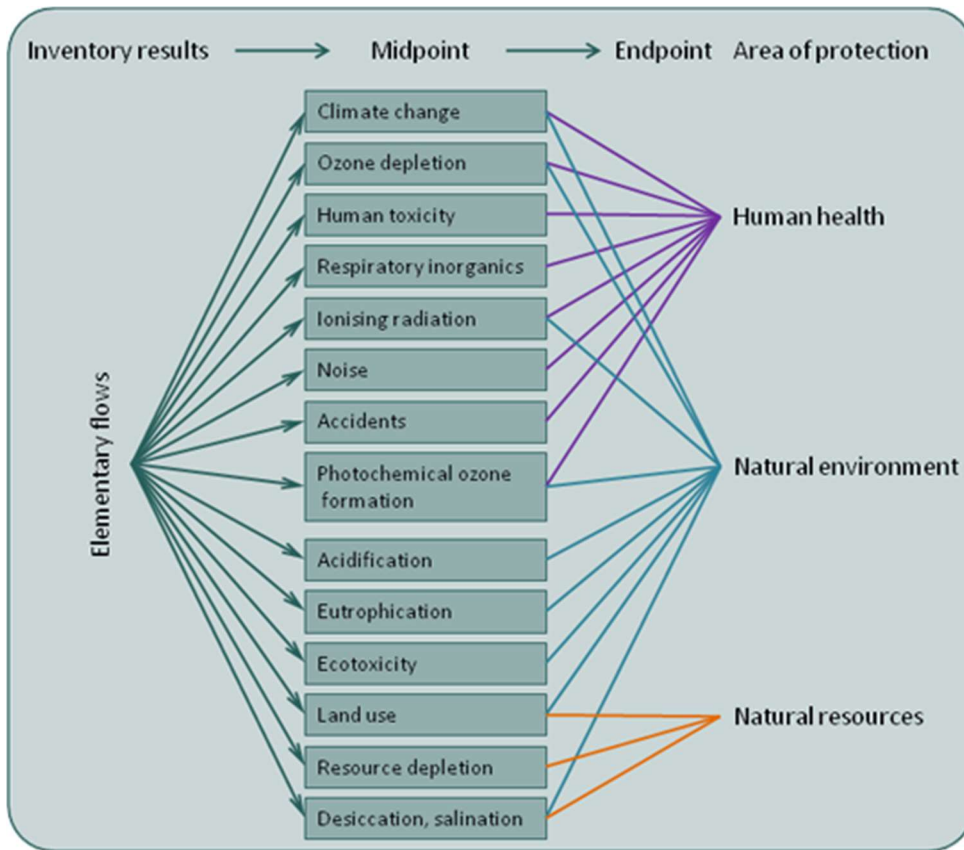


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Introduction. Teachers generally appreciate more detail in this section to help them become oriented with the lesson plan's discipline of origin/learning objectives. Aim for 2-3 paragraphs. Include aspects of the lesson that are unique and innovative. Please remember to define jargon!	Students are consumers and they have a growing market influence on what and how products are made. Have them examine an everyday item (shoes) and understand the environmental, social, and economic impacts of the life cycle of the shoe. Too often students take marketing campaigns on face value. For example, the electric car is considered more environmentally friendly than a gas car. But, the issue is more complicated. If students took the source of electricity into account, the car that runs on electricity from a coal-powered plant, the comparison becomes more complex and students realize that geography and policy can influence the sustainability of the car. To compare the sustainability of products, materials, or processes, a modeling system called Life Cycle Analysis is performed. Inputs and outputs of the product/material/process can be quantified and compared.
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Learning Objectives using Measurable Verbs (what students will be able to do)	After this activity students will be able to: <ul style="list-style-type: none"> • Identify inputs and outputs in the life cycle of everyday products. • Understand how mathematical models can be used to compare the sustainability of products/materials/processes • Critically examine marketing claims of “Green” products
Appropriate Grade Levels	6-8, 9-12
Group Size/# of students activities are designed for	Groups of 2-3 are recommended
Approximate Time of Lesson (Break down into 20-50 minute periods)	Input/outputs map for student shoes: 20 min Media/ Literature Review: 10 min Discuss LCA modelling and sample data 10 min

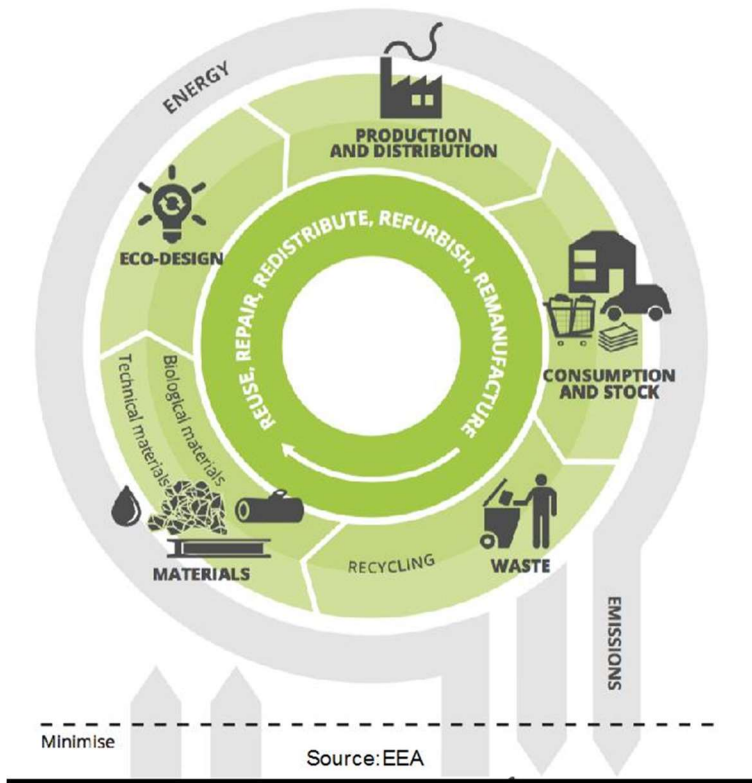
	Extend model to include other inputs or weights on factors: 20 min Present model and findings: Time varies based on number of groups
Resources Needed for Students (e.g. scissors, paper, pencils, glue, etc.)	Pencils/Paper, whiteboard, or computer/tablet for input/output mapping activity. Computer/tablet for manipulating LCA model.
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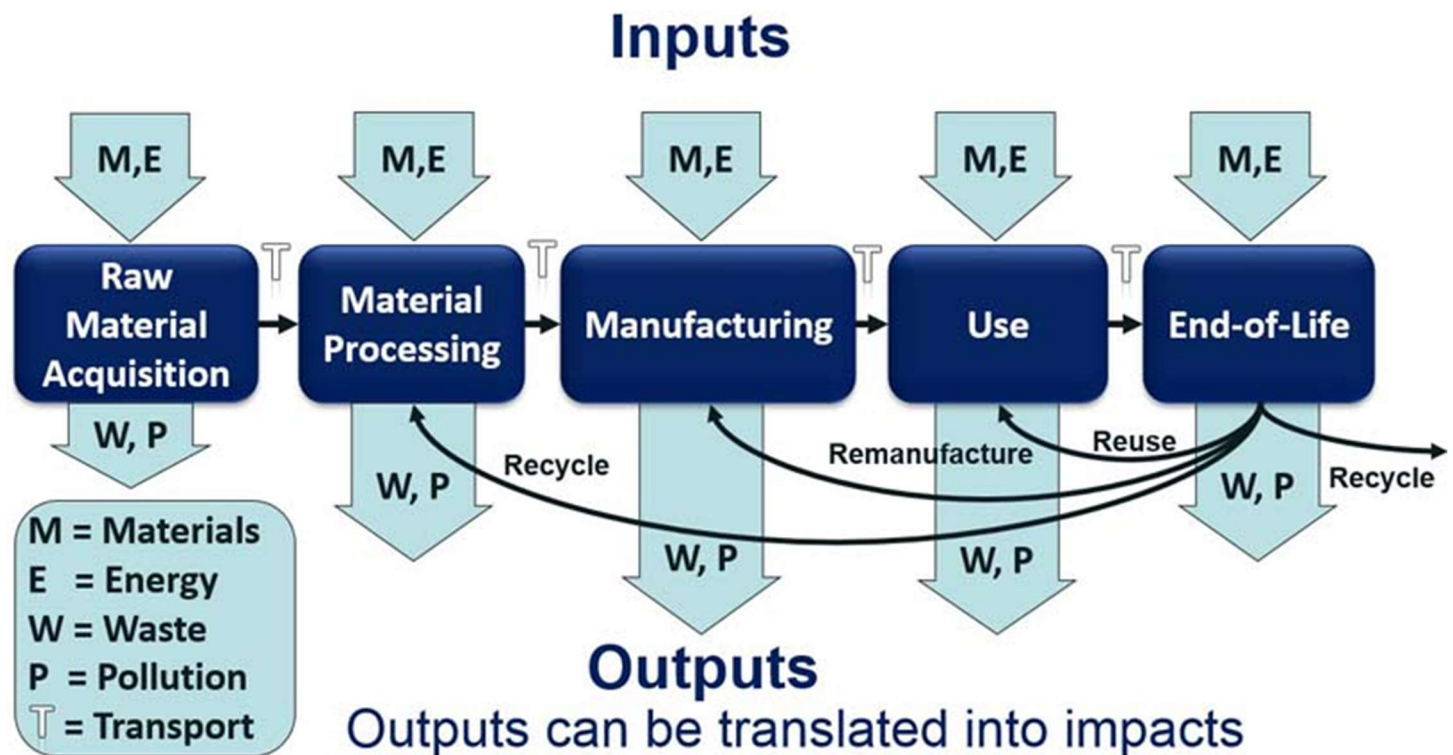
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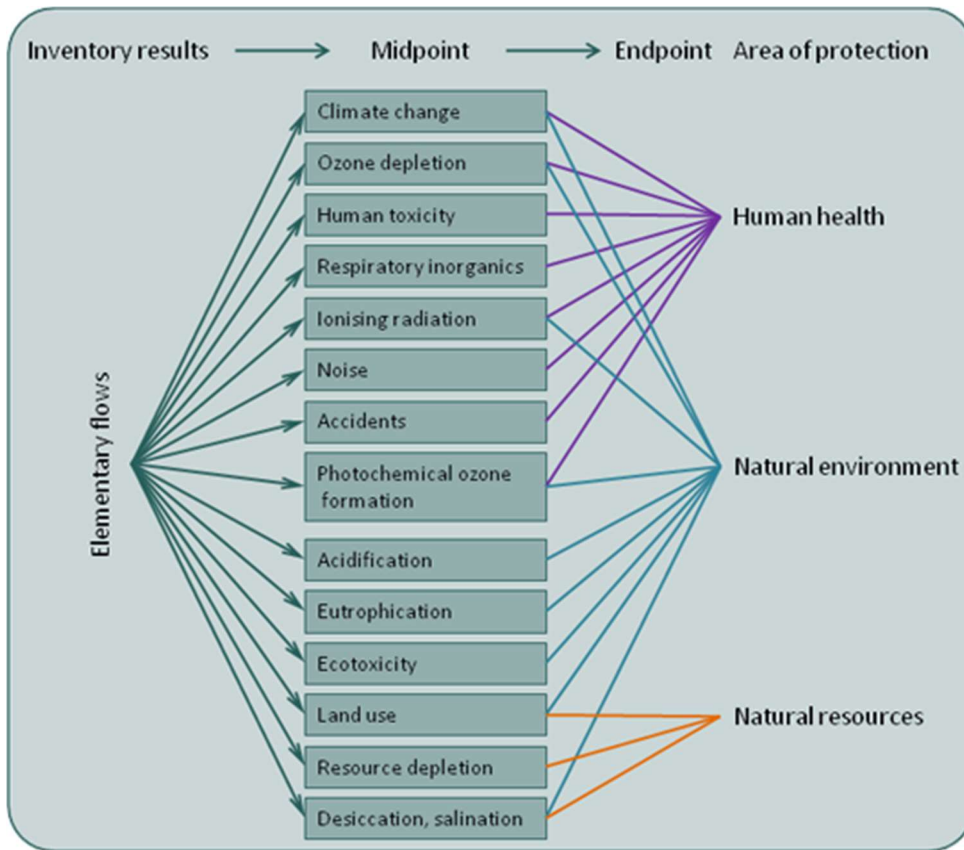


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CED = cumulative energy demand; FEU = fossil energy use; n.d. = not defined; NRCED = nonrenewable cumulative energy demand; PFEU = primary fossil energy use; SEU = secondary energy use

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Designing the Greener Shoe: A Lesson in Sustainability and Life Cycle Analysis

Evaluate and document how you used the lesson plan at: <https://goo.gl/forms/frKk8cyEW95baSSX2>

Author(s):	Shana McAlexander
Author Affiliation and Location: (e.g. Duke, Beaufort, NC)	NC State University
Optional Author Website	https://research.cnr.ncsu.edu/sites/sustainablebioproducts/
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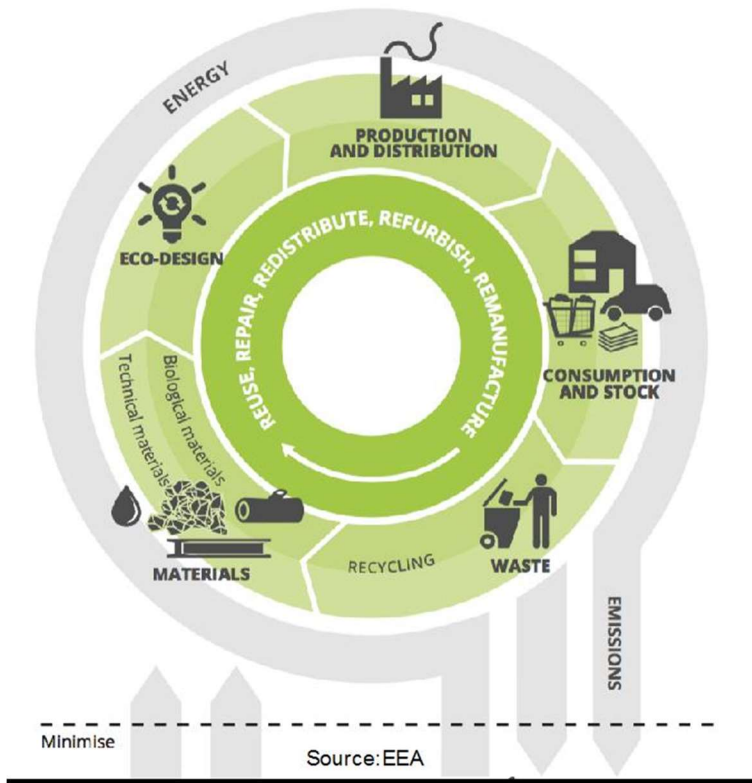
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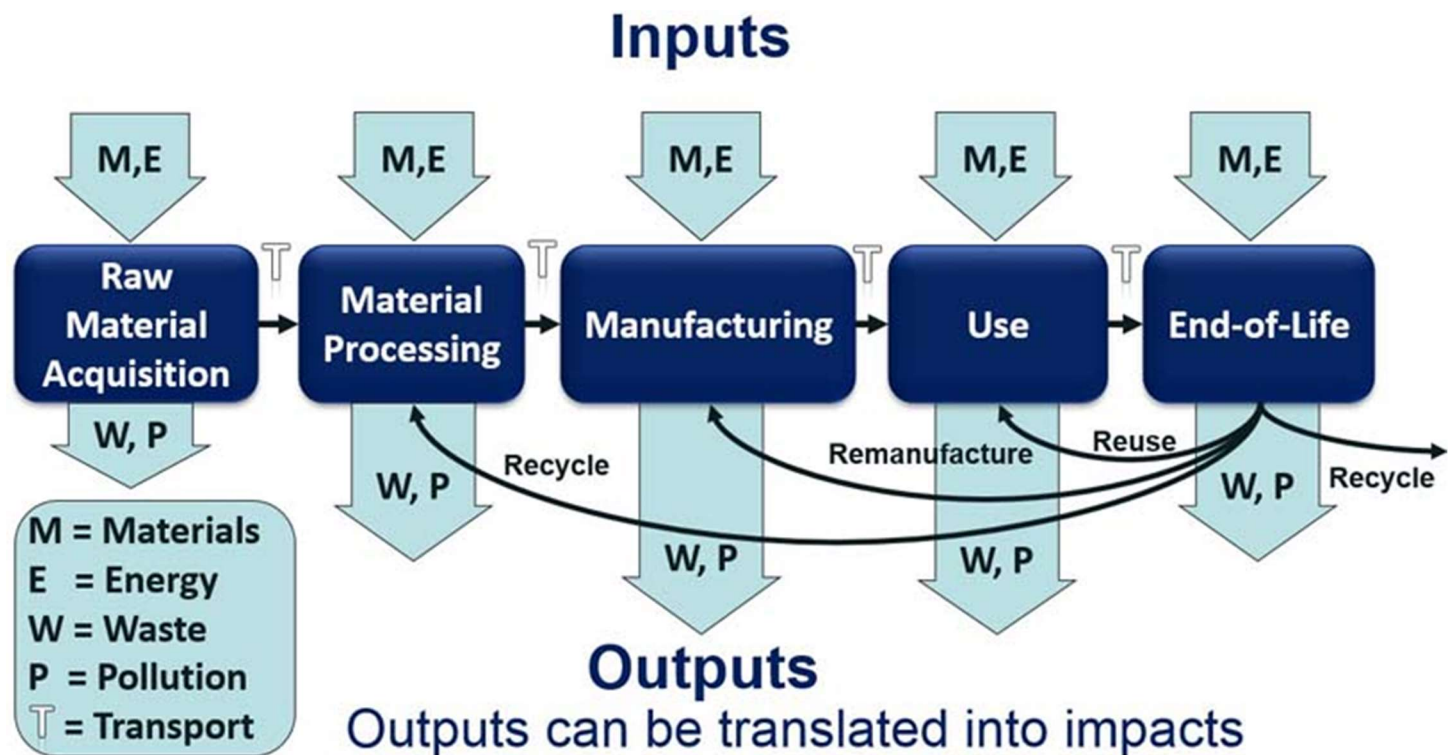
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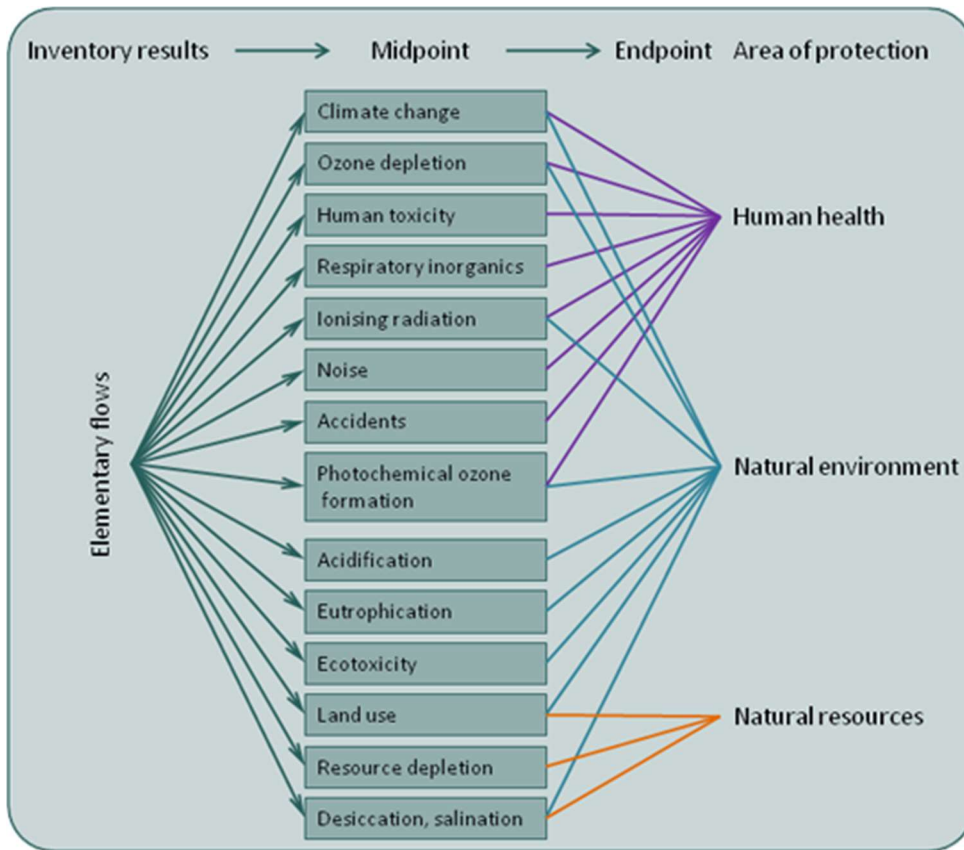


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Author(s):	Shana McAlexander
Author Affiliation and Location: (e.g. Duke, Beaufort, NC)	NC State University
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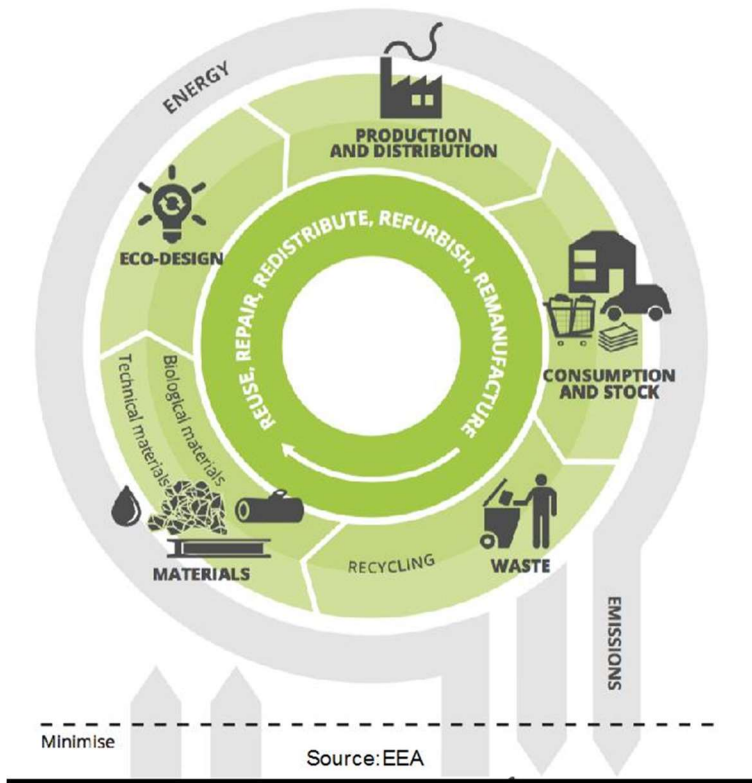
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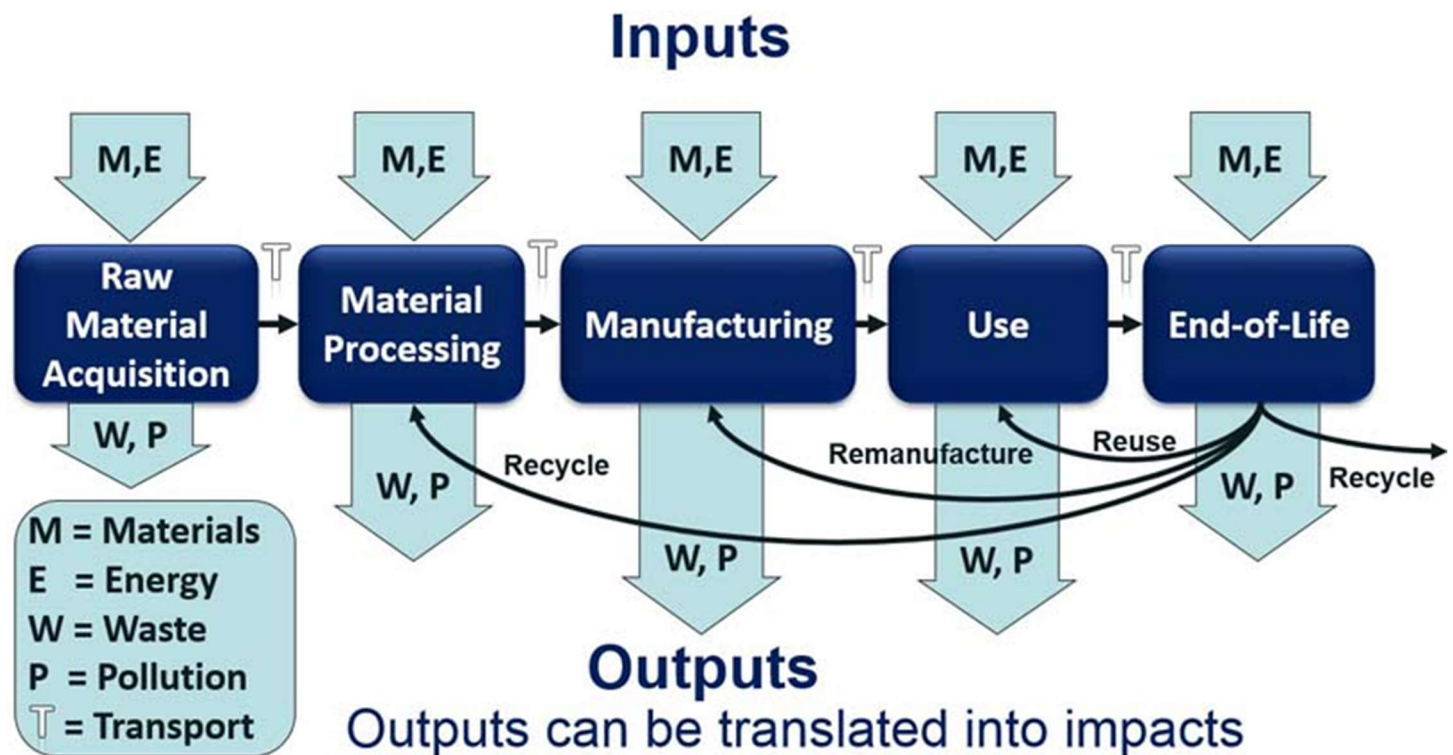
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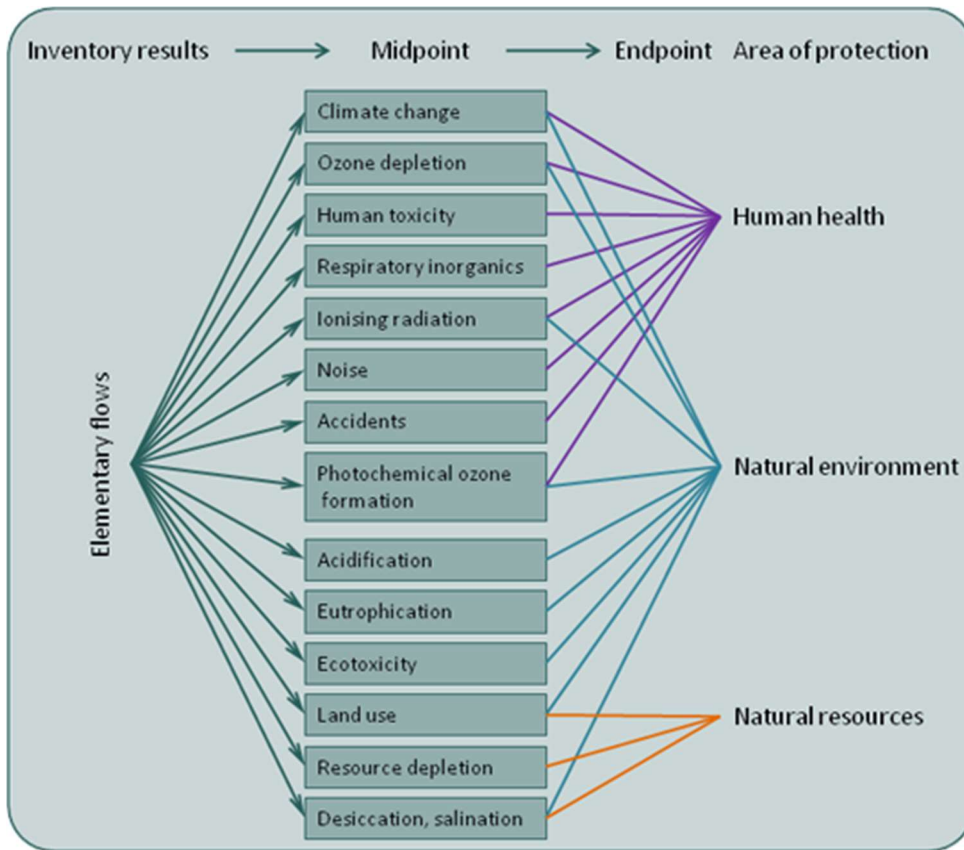


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