

Environmental and Social Impacts of Recycling

DRAFT Agenda

Tuesday, June 2, 2-4:30 p.m.

Online webinar — Register in advance for this meeting:

Updated registration link as of 6/1/20:

<https://zoom.us/meeting/register/tJwpdO6gqj8sHNV3vLeVpgxfUgBlqkMj8Klj>

After registering, you will receive a confirmation email containing information about joining the meeting. Please note, you will need to register for a free Zoom account to complete your registration.

Purpose of the meeting: to understand the methods used by DEQ to assess the environmental impacts and the social costs of those impacts for recycling infrastructure scenarios. Results of this assessment will be delivered alongside results presented by Cascadia Consulting Group as part of the Recycling Steering Committee research process on June 10 and 12.

Time	Task	Objective
2-2:15 p.m.	Welcome, intros and webinar logistics — <i>Brian Stafki, DEQ</i>	
2:15-2:25 p.m.	Why is DEQ trying to evaluate the environmental impacts and social costs of recycling infrastructure scenarios — <i>David Allaway, DEQ</i>	Understand the context of this info session and how these tools will be used with the recycling infrastructure analysis
2:25-2:55 p.m.	About life-cycle assessment — <i>Peter Canepa, DEQ</i>	Understand how LCA is used to estimate certain environmental impacts from resource extraction to end of life
2:55-3:25 p.m.	About the Waste Impact Calculator — <i>Martin Brown, DEQ</i>	Understand how the DEQ WIC tool uses LCA factors to estimate the impacts of different recycling infrastructure scenarios
3:25-3:55 p.m.	About social cost accounting — <i>David, DEQ</i>	Understand how environmental impacts are expressed as economic impacts representing social costs/benefits
3:55-4:30 p.m.	Additional questions and discussion/adjourn (the webinar may end early if there are no further questions)	

Alternative formats

DEQ can provide documents in an alternate format or in a language other than English upon request. Call DEQ at 800-452-4011 or email deqinfo@deq.state.or.us.



State of Oregon
Department of
Environmental
Quality

Materials Management

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www.oregon.gov/DEQ

DEQ is a leader in restoring, maintaining and enhancing the quality of Oregon's air, land and water.

Info Session: Environmental Impacts and Social Costs of Recycling

Recycling Steering Committee

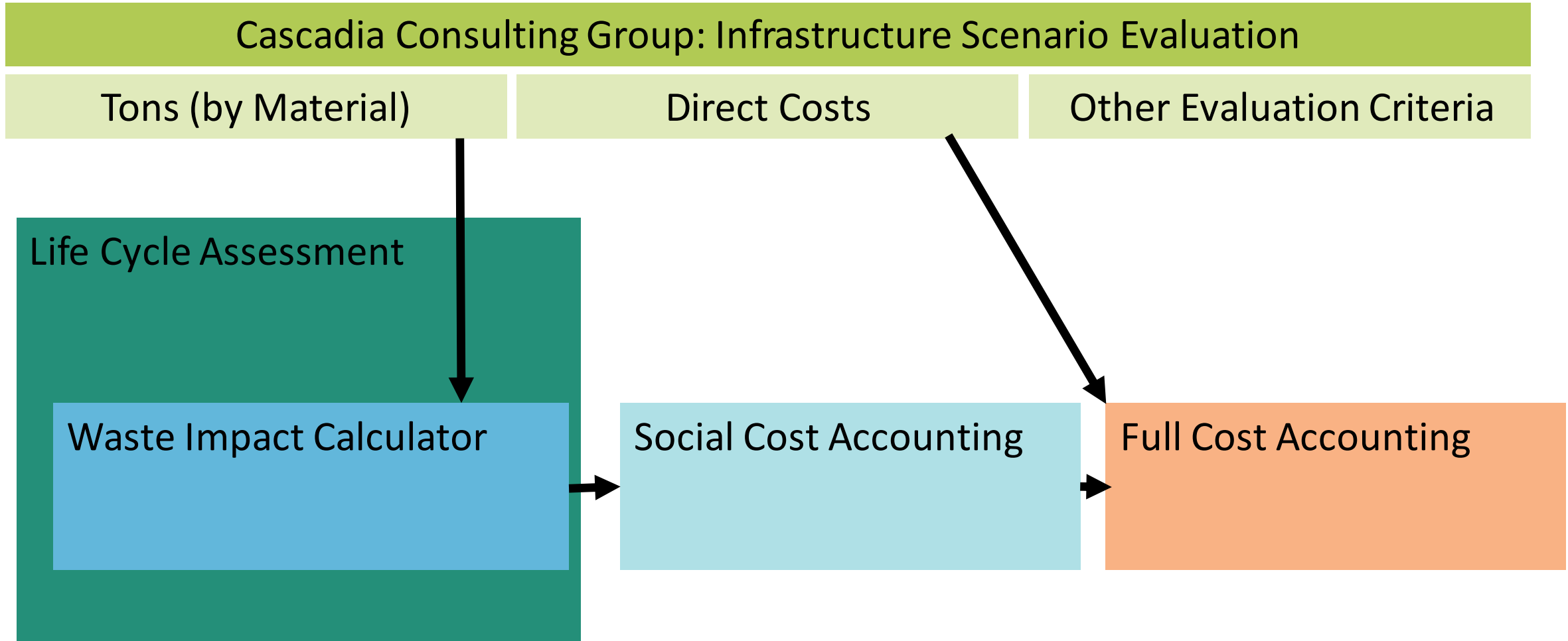
June 2, 2020



Today's agenda

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Introduction to today's webinar



Introduction to LCA

Recycling Steering Committee

June 2, 2020



overview

- What is Life Cycle Assessment (LCA)
- Why is it useful
- How does it work
- What are its limitations

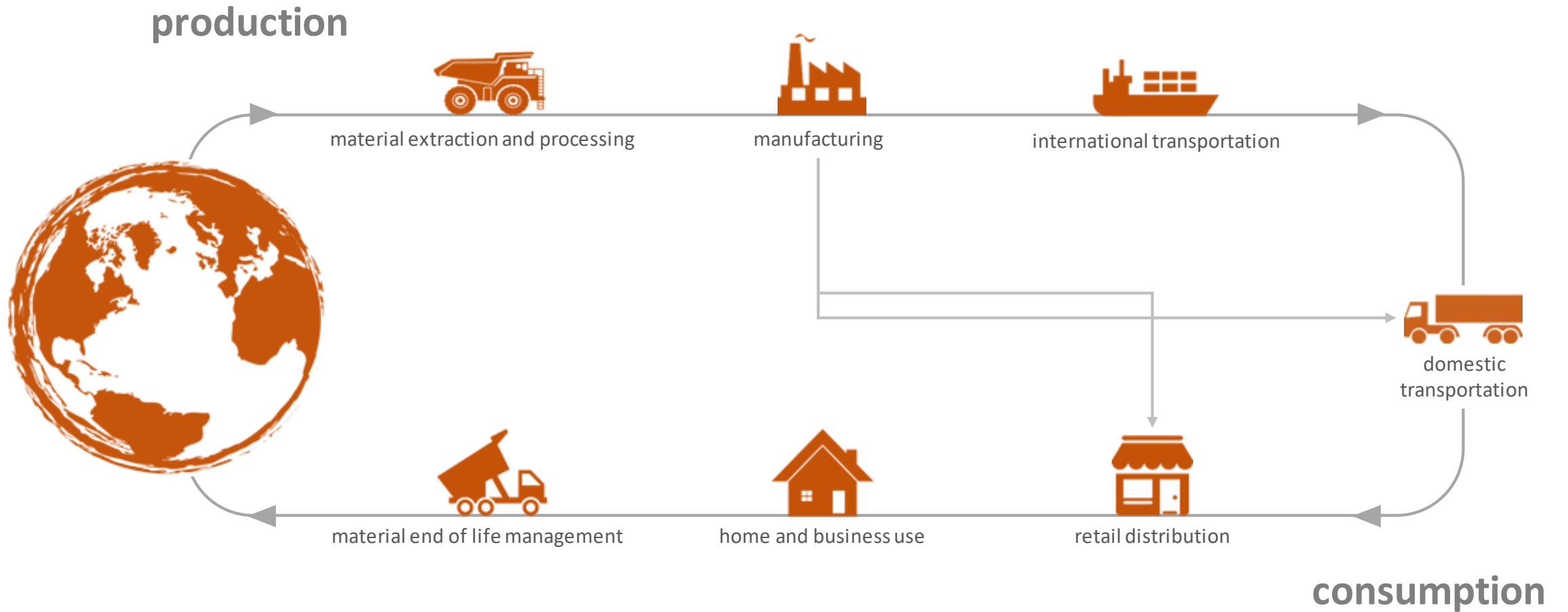




Life Cycle Assessment is

*“the compilation and evaluation of the **inputs, outputs** and the **potential environmental impacts** of a product system throughout its life cycle.”*

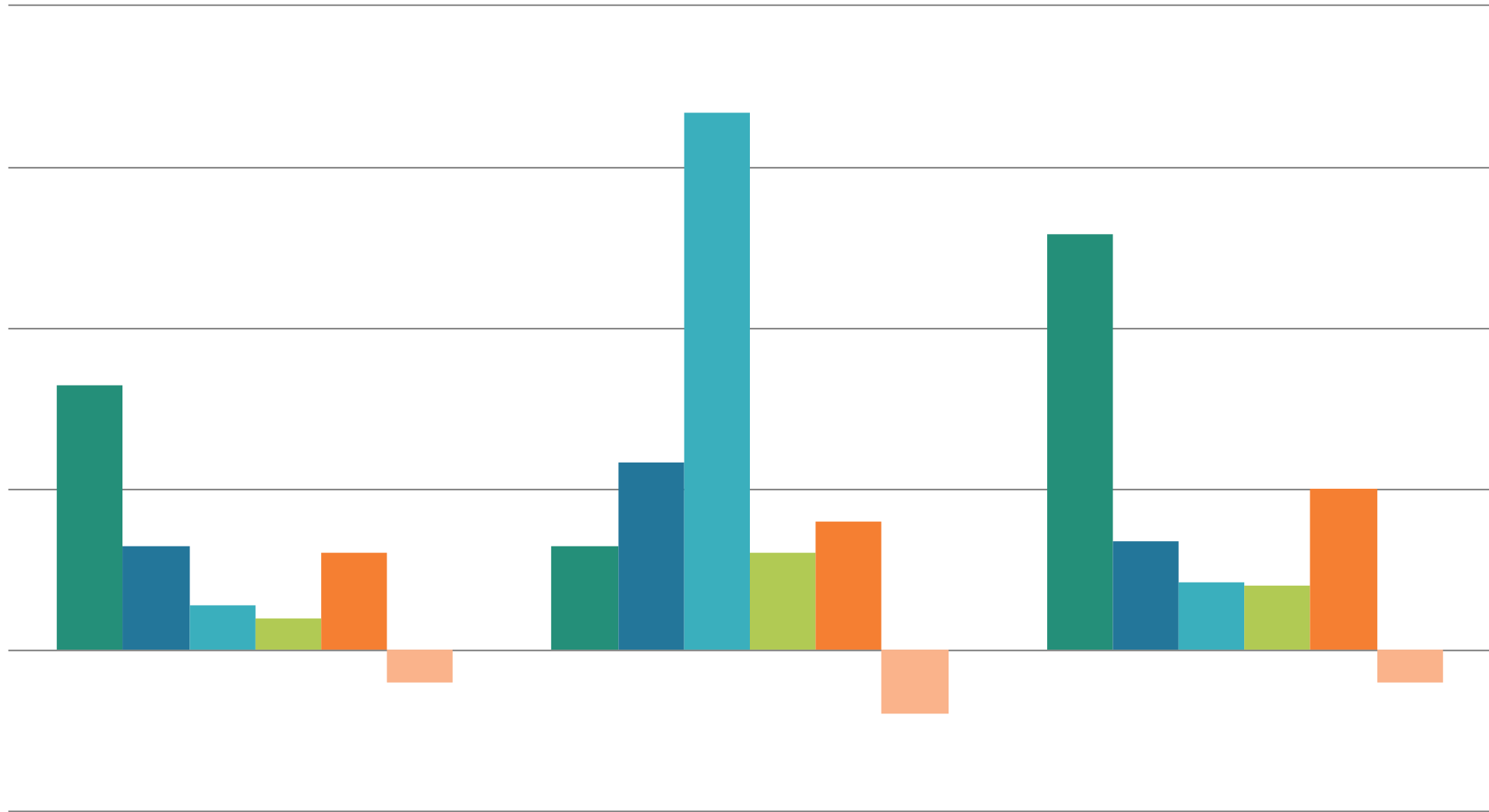
material life cycle



Holistic



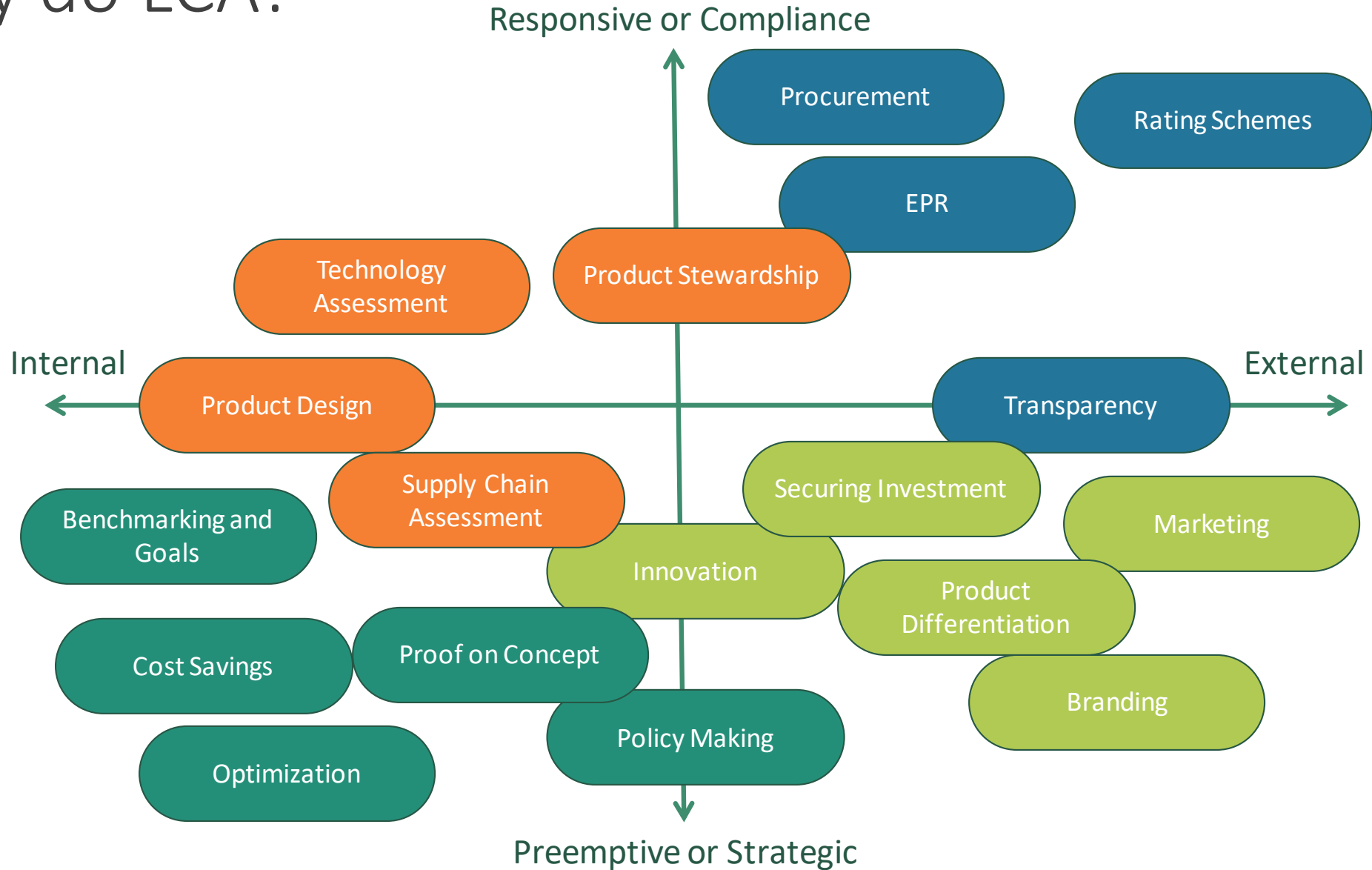
quantitative



comparative



why do LCA?



For Example



vs.



vs.



vs.



vs.



vs.



vs.



vs.



vs.



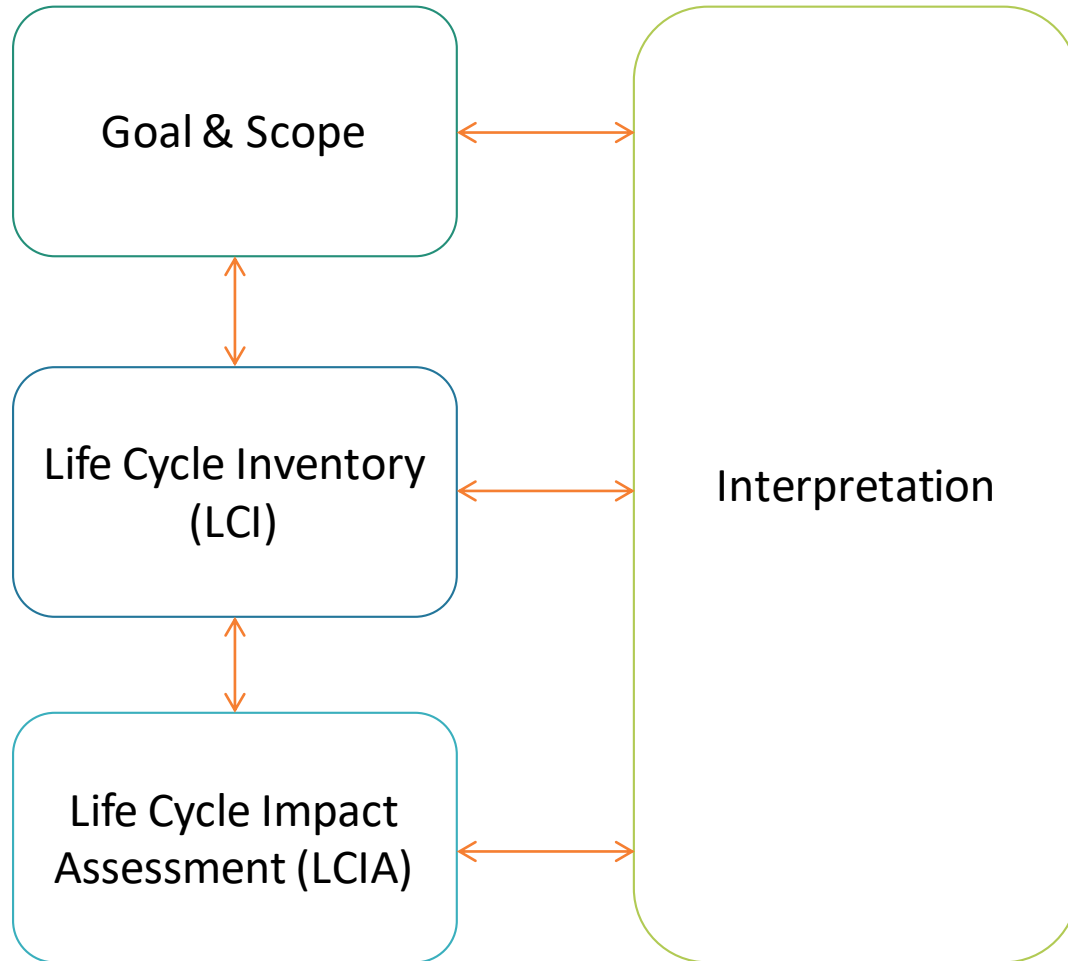
vs.



vs.



The 4 Phases of LCA

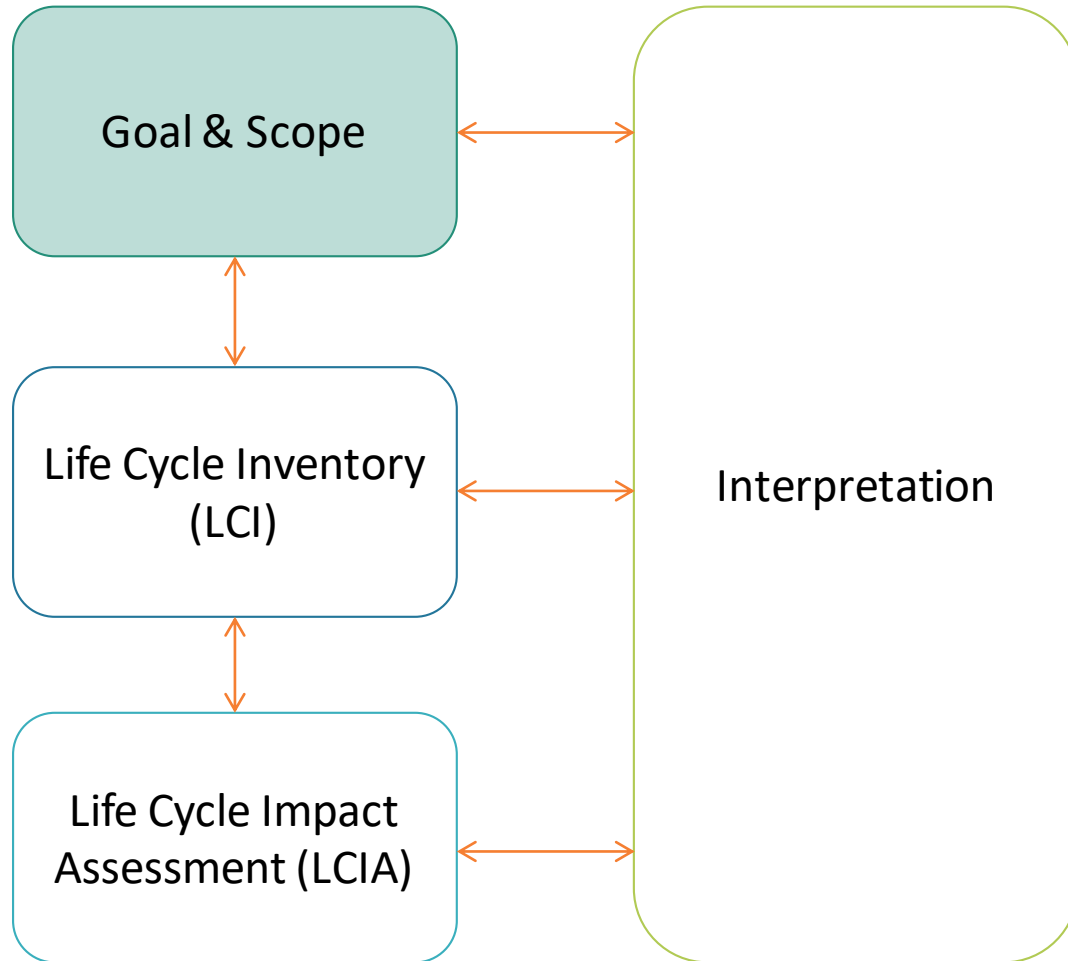


Applications:

- Strategy
- Public policy
- Product design
- Marketing



The 4 Phases of LCA



Applications:

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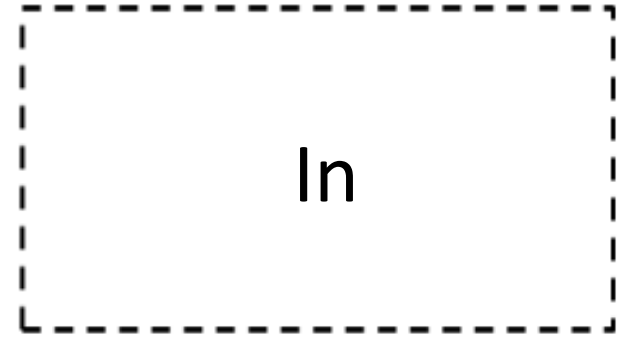
goal

- the intended application
- the reasons for carrying out the study
- the intended audience, i.e. to whom the results of the study are intended to be communicated
- whether the results are intended to be used in comparative assertions intended to be disclosed to the public



scope

- the product system(s) to be studied
- the function(s) of the product system(s)
- **the functional unit**
- **the system boundary**
- allocation procedures
- LCIA methodology and types of impacts
- interpretation to be used
- data requirements
- assumptions
- value choices and optional elements
- limitations
- data quality requirements
- type of critical review, if any
- type and format of the report required for the study.



Out

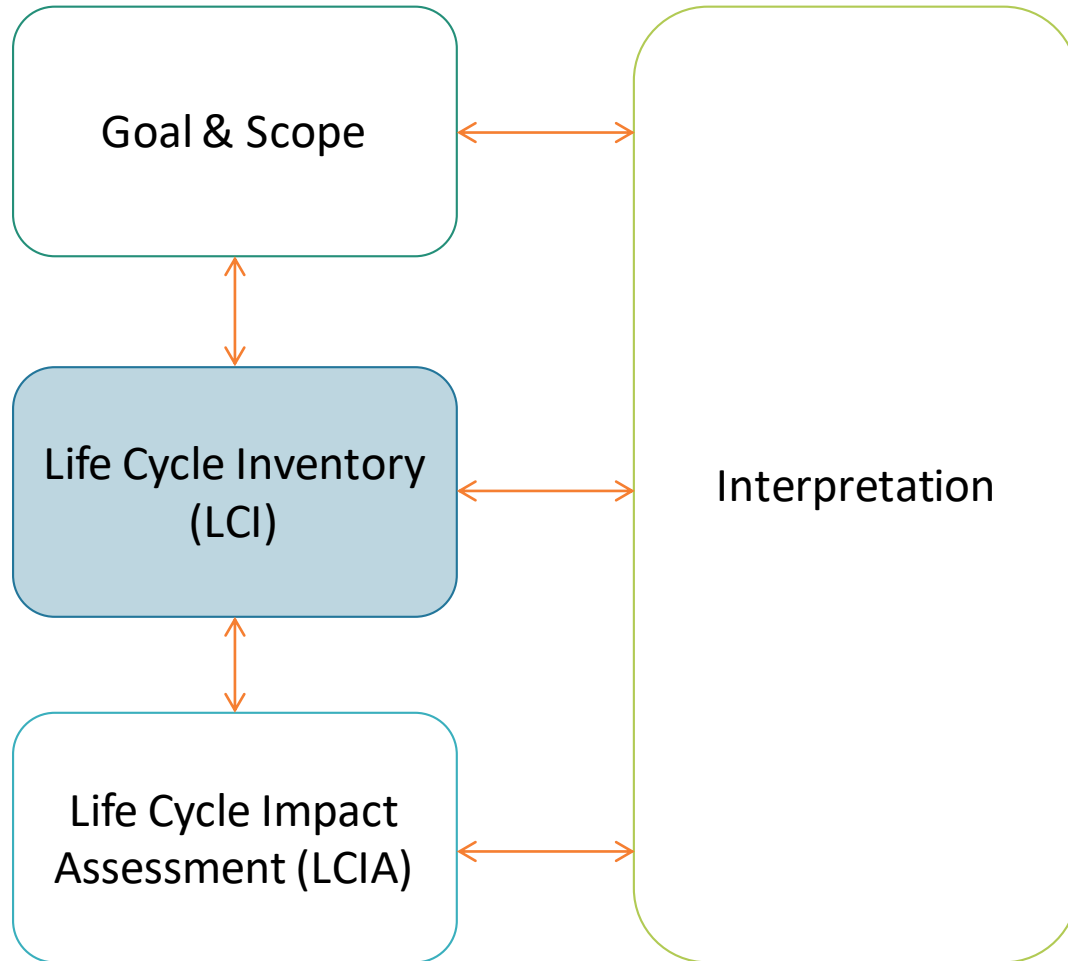


Function



Unit

The 4 Phases of LCA



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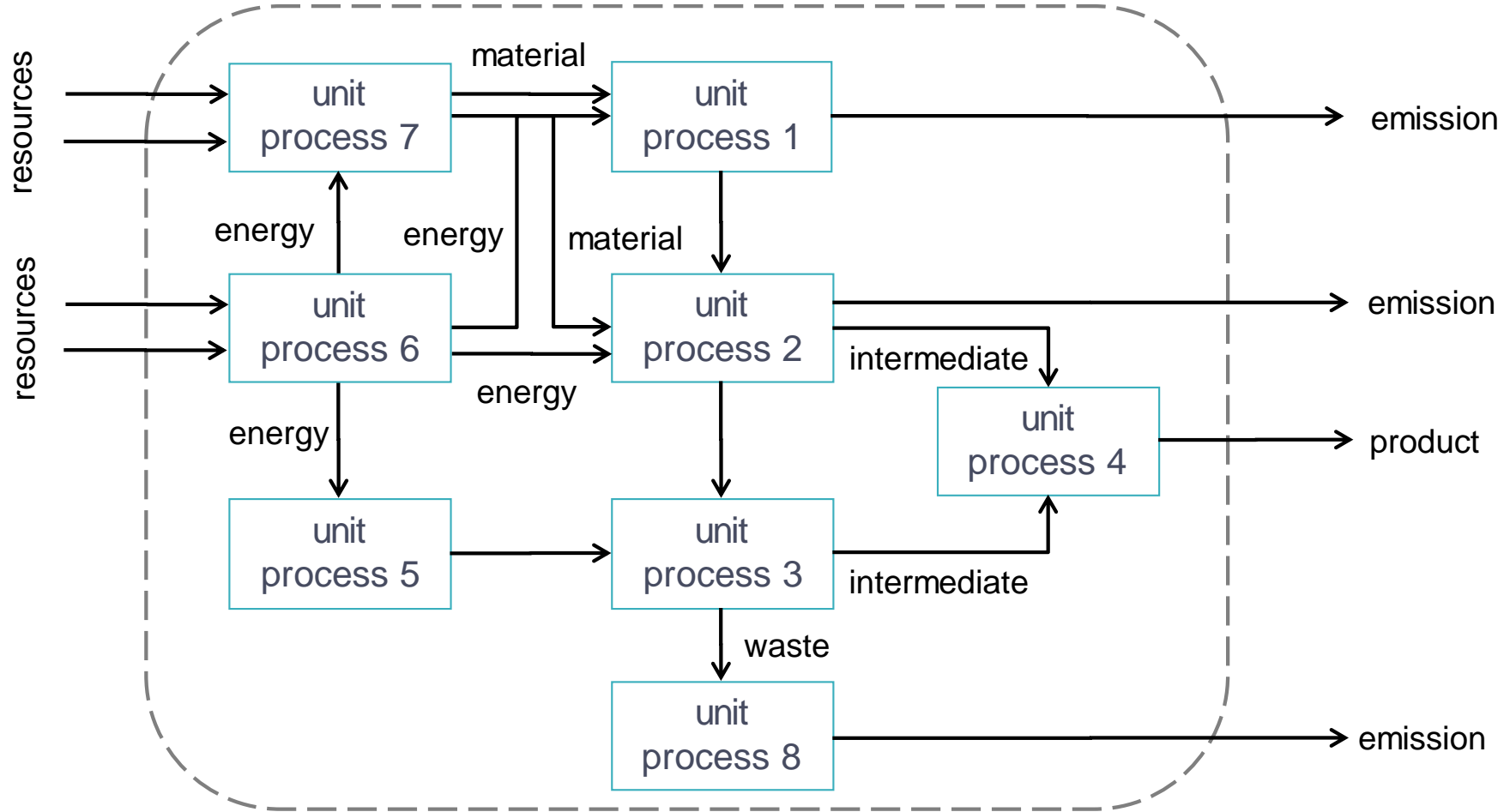
life cycle inventory (LCI)

Life cycle inventory analysis (ISO 14044, 3.3): phase of life cycle assessment involving the compilation and quantification of inputs and outputs for a product throughout its life cycle

Life cycle inventory analysis result (ISO 14044, 3.24): outcome of a life cycle inventory analysis that catalogues the flows crossing the system boundary and provides the starting point for life cycle impact assessment



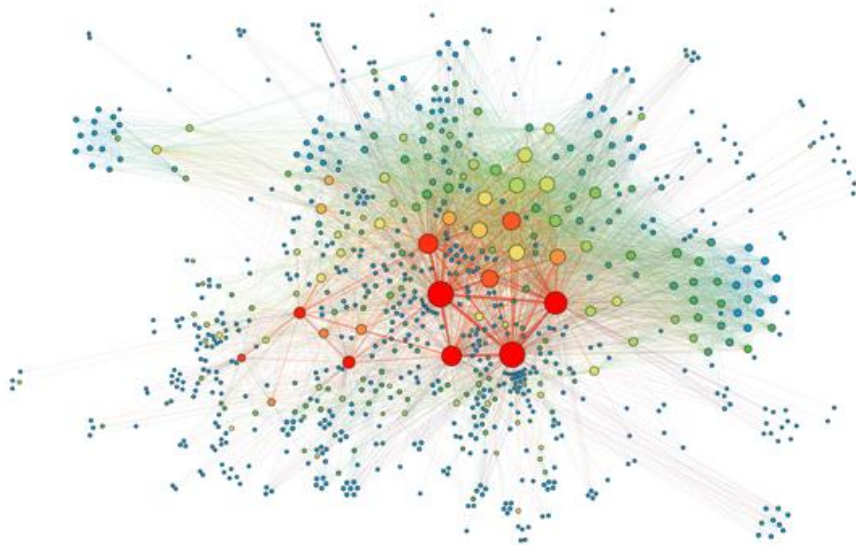
system boundary defines LCI



Example of a “cradle-to-gate” product system and boundary

data sources

Primary data: collected directly from the process operators



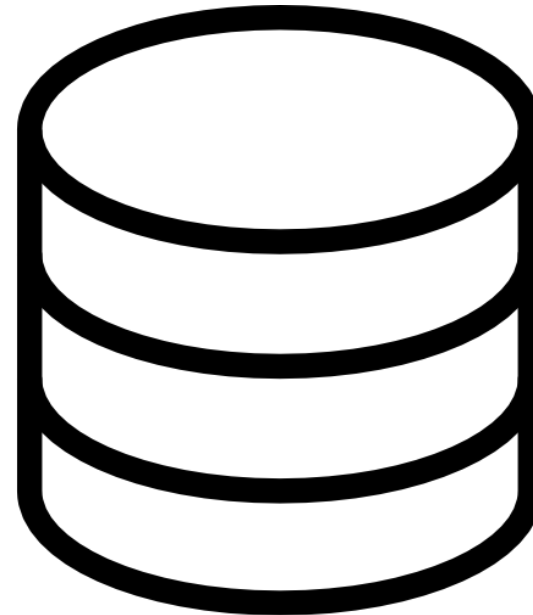
Sources for primary data:

- Energy & raw material accounting
- Process flow diagrams
- Design documents - bills of materials
- Emission reporting
- Financial reporting
- Equipment specs
- Technical experts

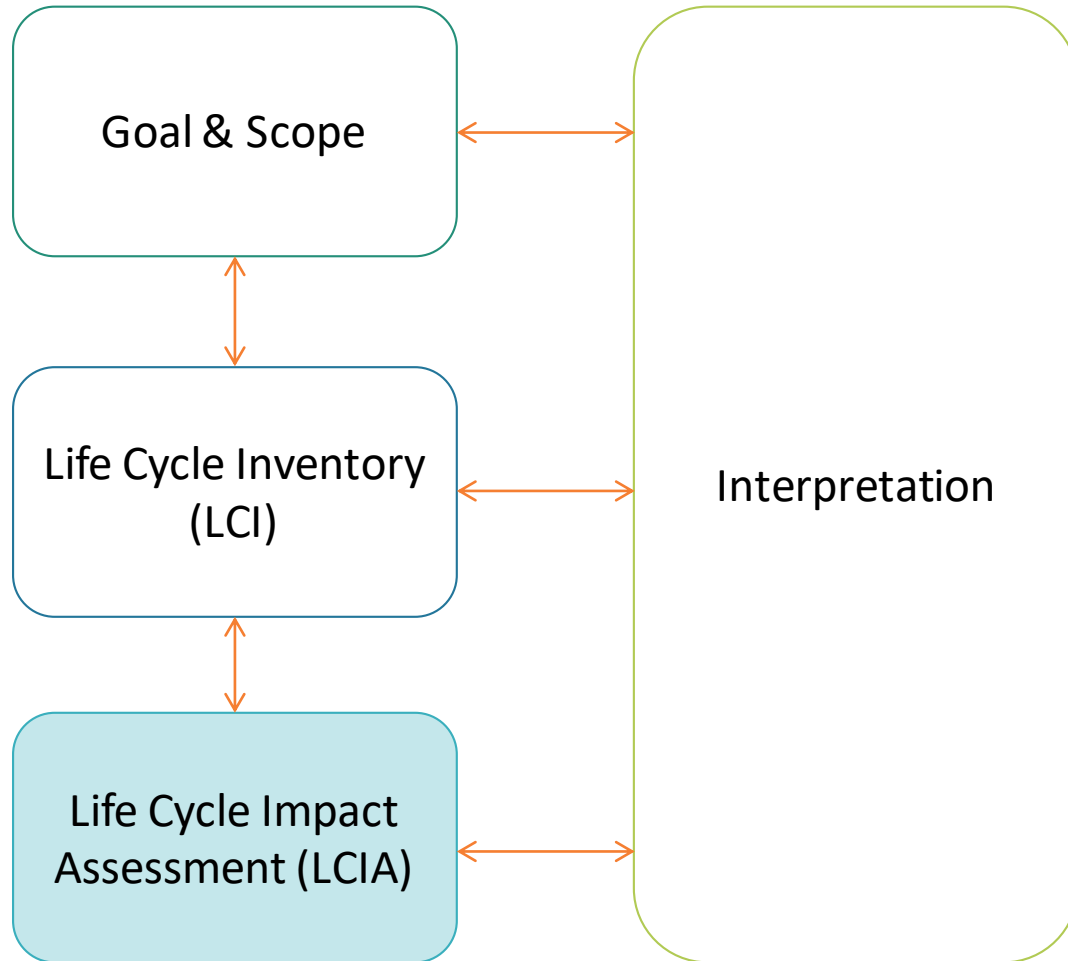
data sources

Secondary data: all publicly available data

- LCI databases / LCA software: Ecoinvent, GaBi, USLCI, ELCD
- Industry associations: WorldSteel, AA, ACC, PlasticsEurope, NAIMA, NRMCA
- Other published LCAs
- Environmental Product Declarations (EPDs)
- Ullmann's Encyclopedia of Industrial Chemistry
- Scientific journals
- BAT/BREF documents
- Patents
- National economic input-output tables



The 4 Phases of LCA



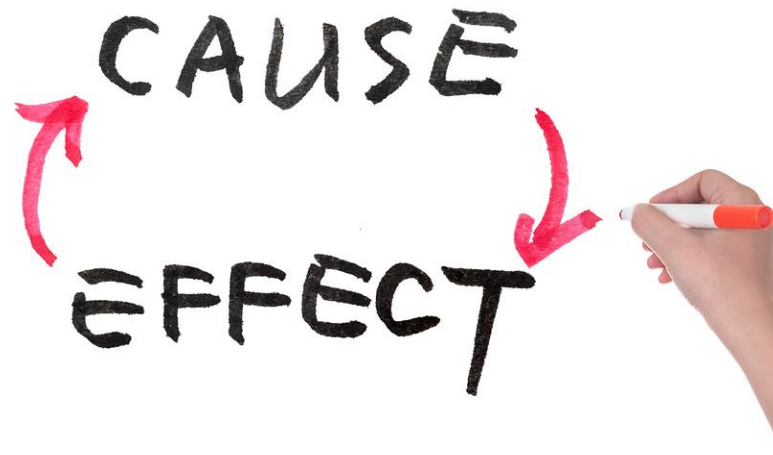
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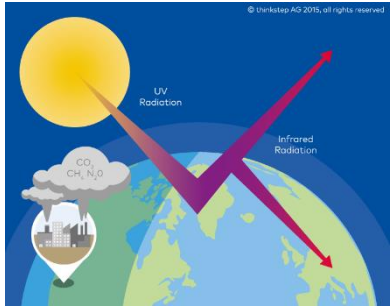


life cycle impact assessment (LCIA)

Phase of life cycle assessment aimed at understanding and evaluating the magnitude and significance of the potential environmental impacts for a product system throughout the life cycle of the product (ISO 14044, 3.4).



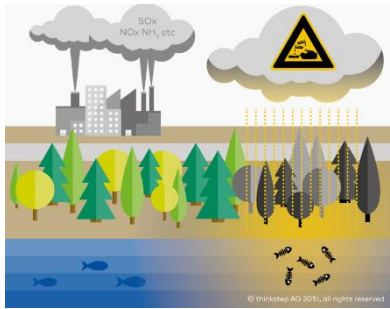
life cycle impact assessment categories



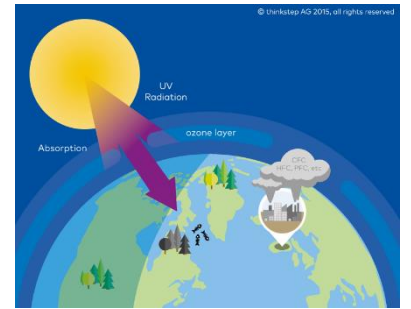
Global Warming Potential (GWP)



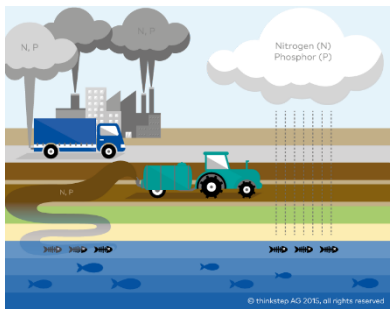
Smog Creation Potential (SFP/POCP)



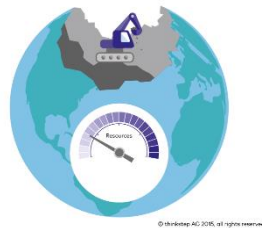
Acidification Potential (AP)



Ozone Depletion Potential (ODP)



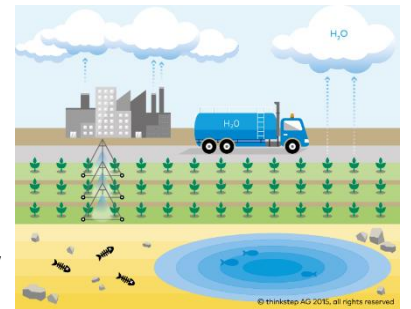
Eutrophication Potential (EP)



+



Water Scarcity

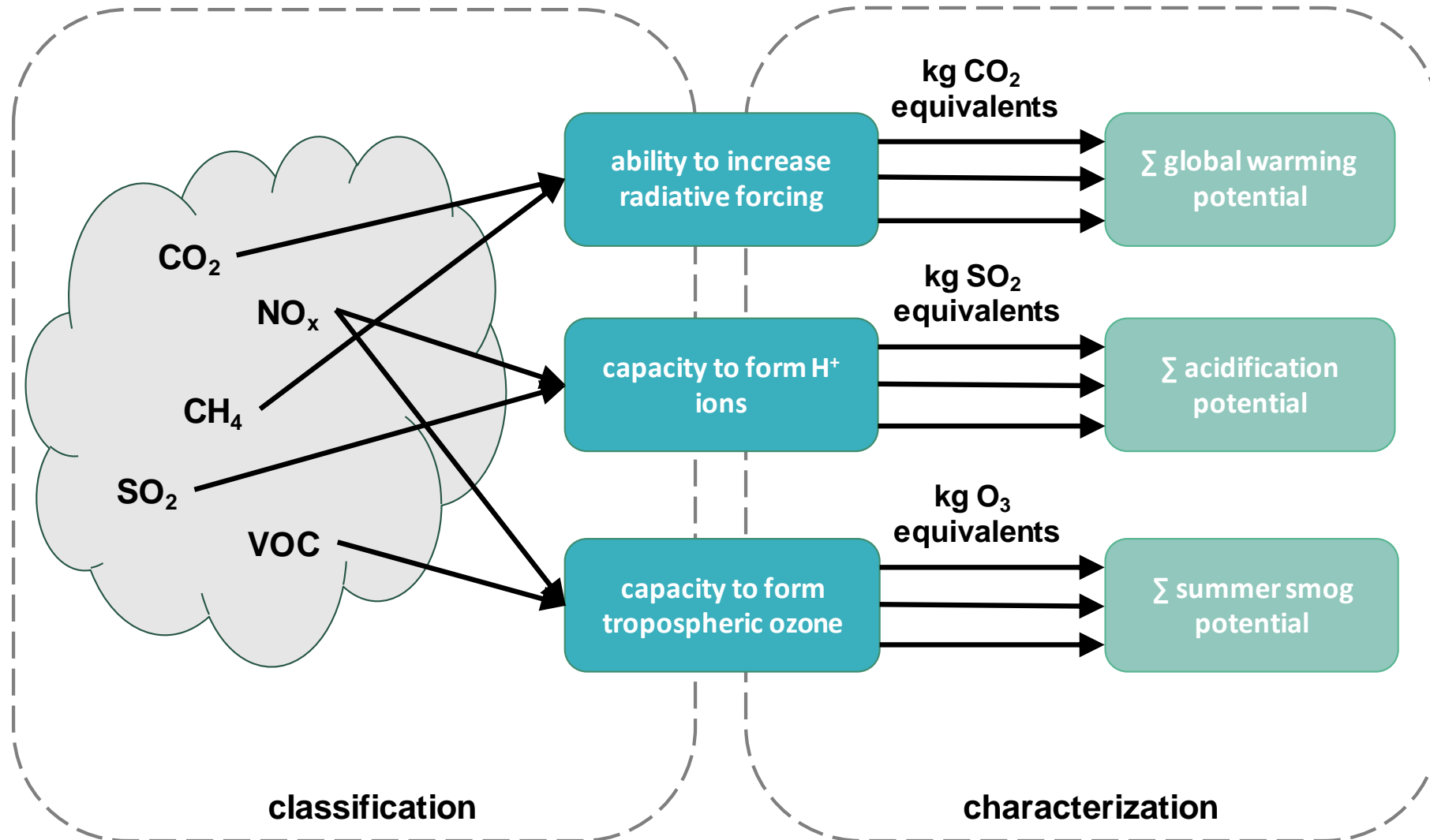


Primary Energy Demand (PED)

Source: thinkstep, used with permission and iStockphoto.com/DrAfter123



life cycle impact assessment (LCIA)



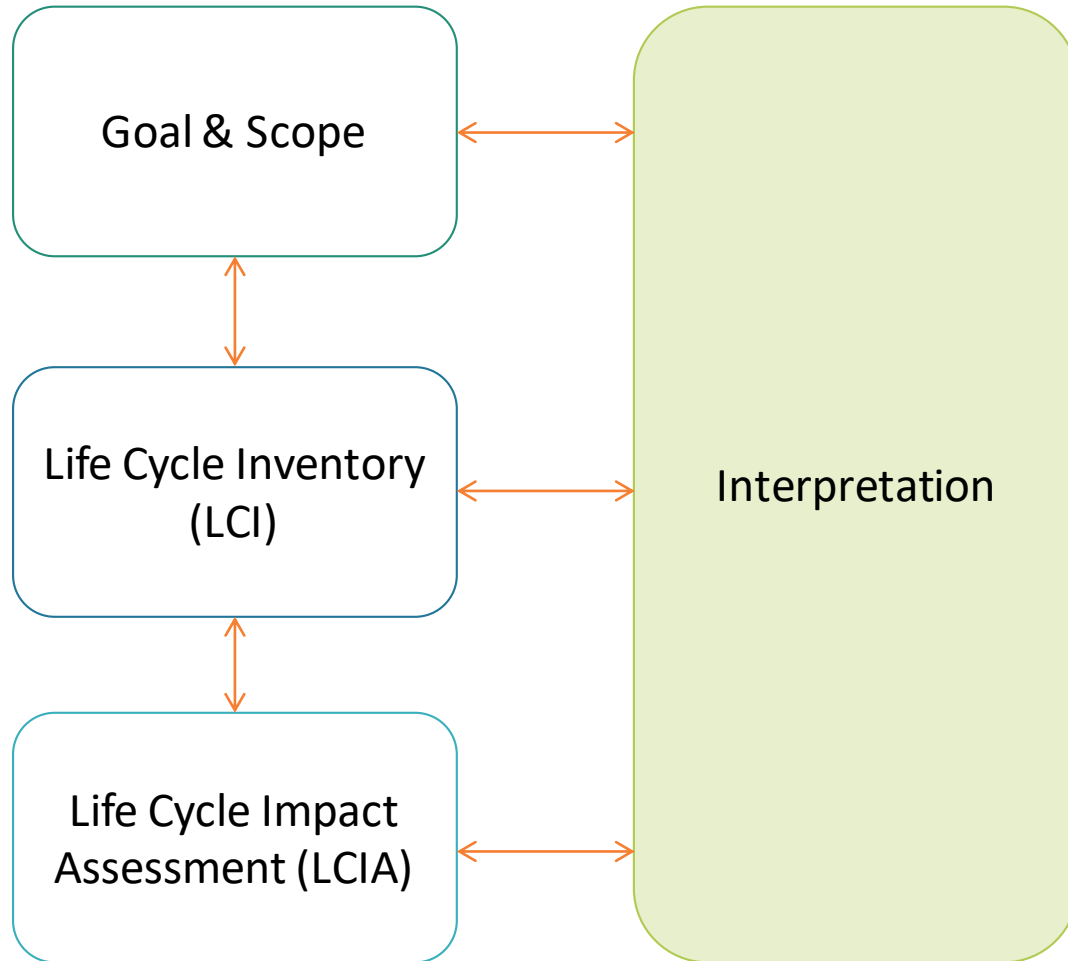
life cycle impact assessment (LCIA)

LCI Values							
Outputs	Value	Unit	Characterization Factors			Impact Potential (GWP)	Unit
Carbon Dioxide	50	kg	*	1	=	50	kg CO2-equiv.
Methane	2	kg	*	30	=	60	kg CO2-equiv.
Nitrous Oxide	1	kg	*	265	=	265	kg CO2-equiv.
Inputs	Value	Unit					
Carbon Dioxide	-60	kg	*	1	=	-60	kg CO2-equiv.

= **315 kg CO2-equiv.**

Must be done for each indicator/impact category!

The 4 Phases of LCA



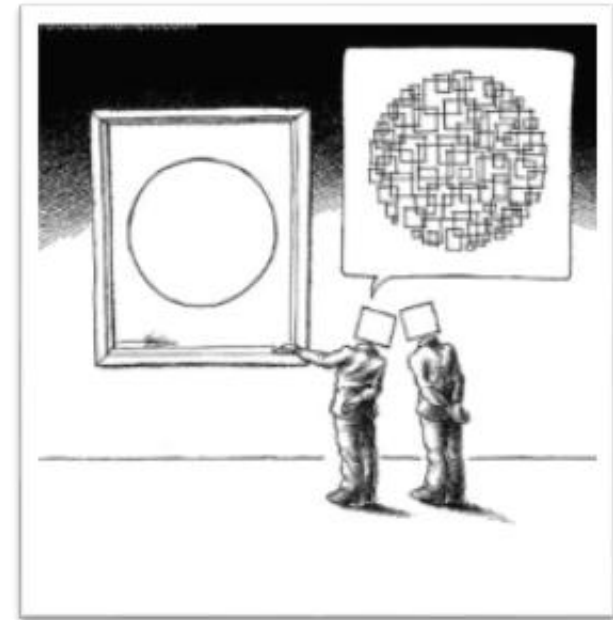
Applications:

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- Public policy
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- Marketing



interpretation

- The key findings of the study
- Assumptions, limitations, or significant issues
- Data quality assessment
- Conclusions and recommendations
- Use and applications of results



reporting



- Goal & Scope
- data sources
- process descriptions
- LCI & LCIA results
- Interpretation

Has to be critically reviewed by an independent panel of three experts if it is intended to support comparative assertions intended to be disclosed to the public.

limitations

LCA addresses potential environmental impacts; **LCA does not predict absolute or precise environmental impacts** for a number of reasons:

- the relative expression of potential environmental impacts to a reference unit,
- the integration of environmental data over space and time,
- the inherent uncertainty in modeling of environmental impacts, and
- the fact that some possible environmental impacts are clearly future impacts

(ISO 14040, section 4.3)

materials management

conserving resources
protecting the environment
living well

peter.canepa@state.or.us



Introduction to the Waste Impact Calculator



WIC is a special type of LCA



vs.



vs.



- *Bigger scale*
- *Somewhat simplified*

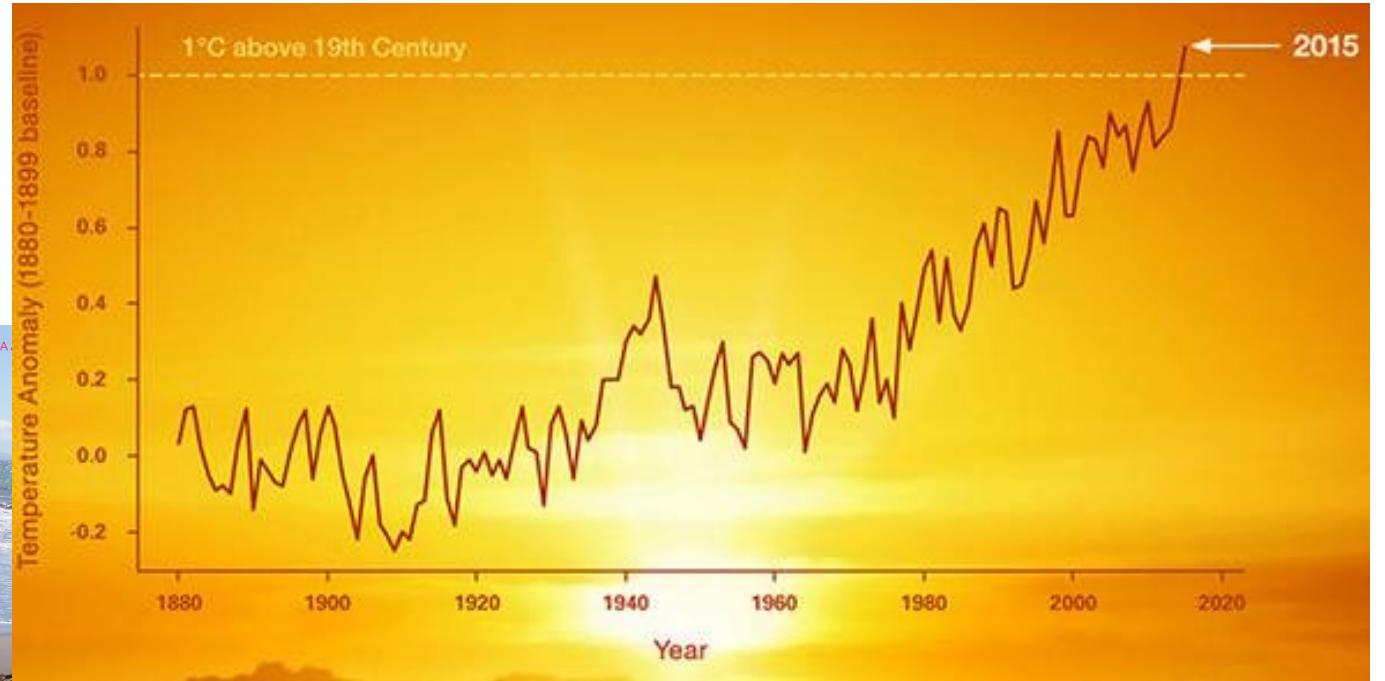
Outline

- The “big problem” WIC addresses
- What it does
- Who it’s for
- Ways to use it
- How we’ll use it for RSC
- What it leaves out

- *Disclaimer: work in progress*



The problem of waste





Weight vs. impact views of waste



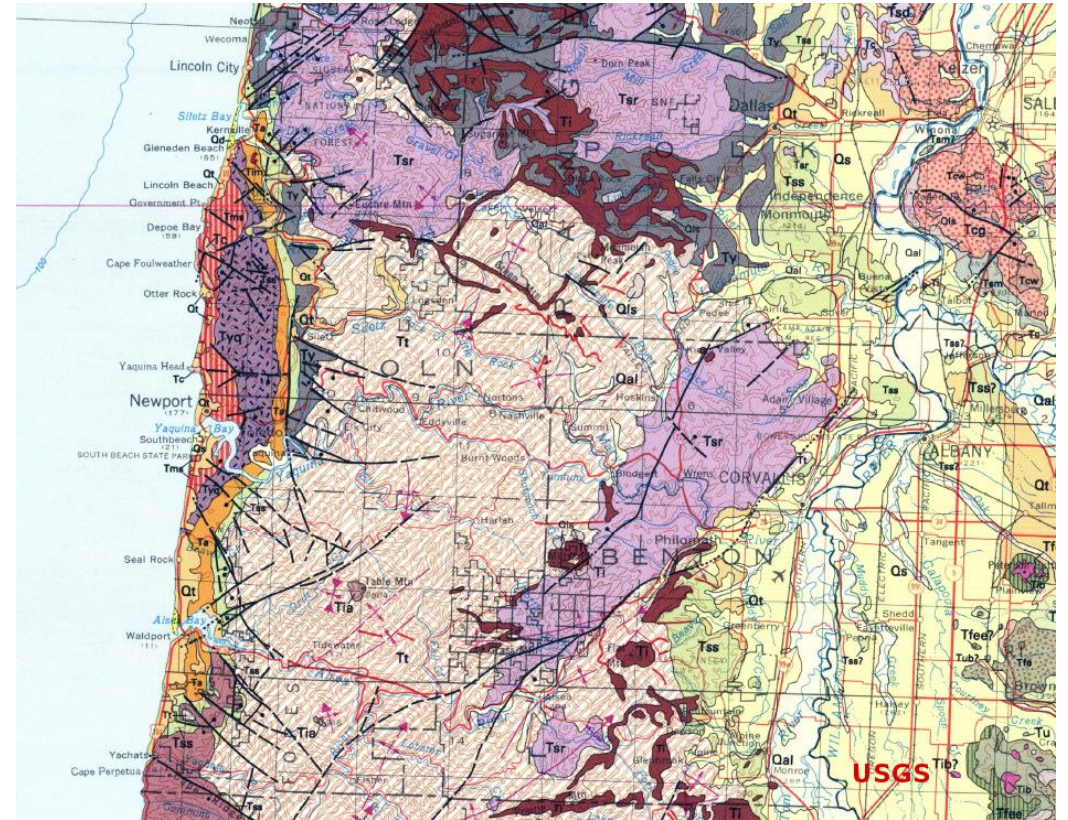
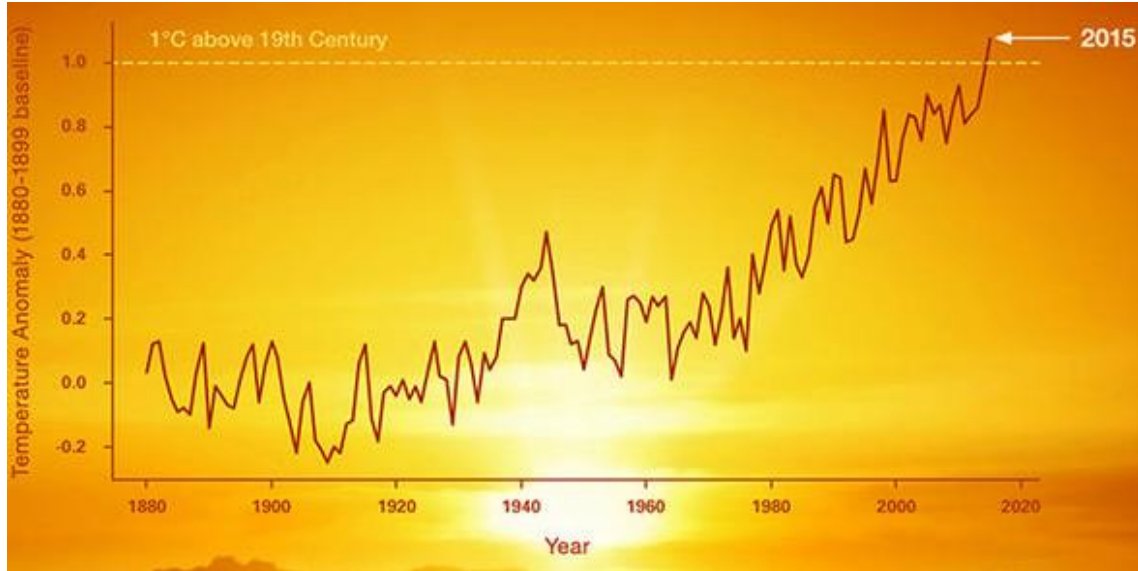
Weight based views of waste



Weight-based statistics and goals

	<i>definition</i>	<i>units</i>
Generation	=  + 	(tons)
Recovery, recycling, or diversion rate	= $\frac{\text{}}{\text{ + $	(%)

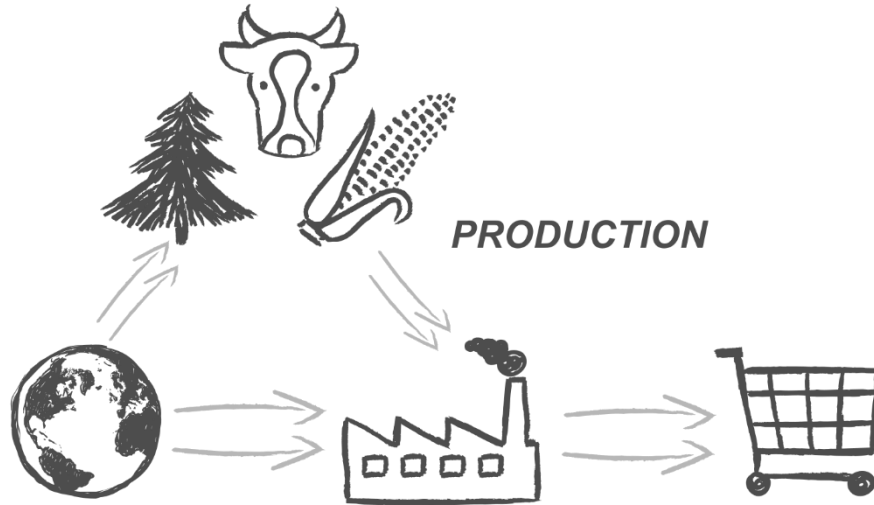
The other perspective: environmental impacts



Impacts come from across a whole life cycle



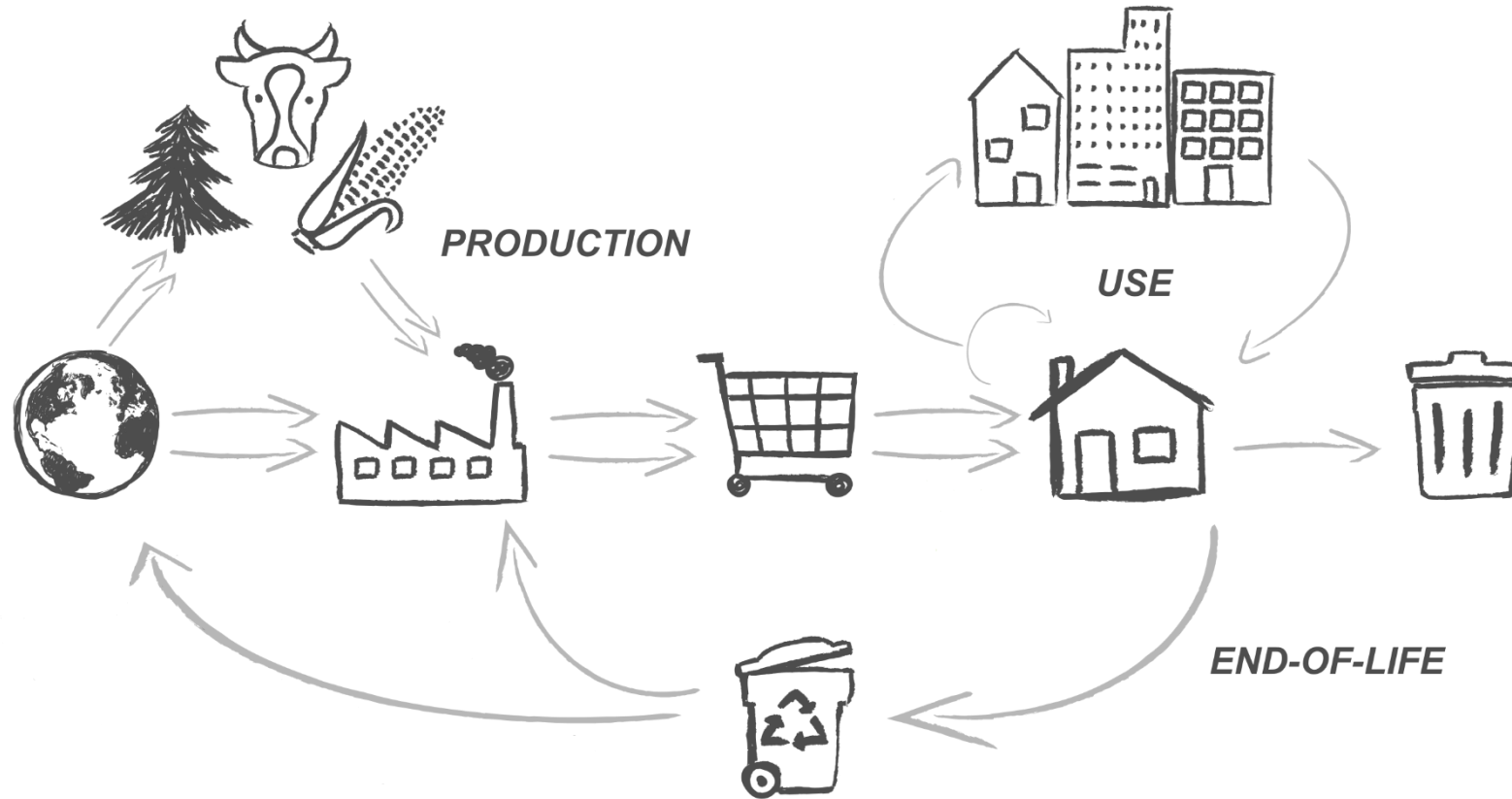
Impacts come from across a whole life cycle



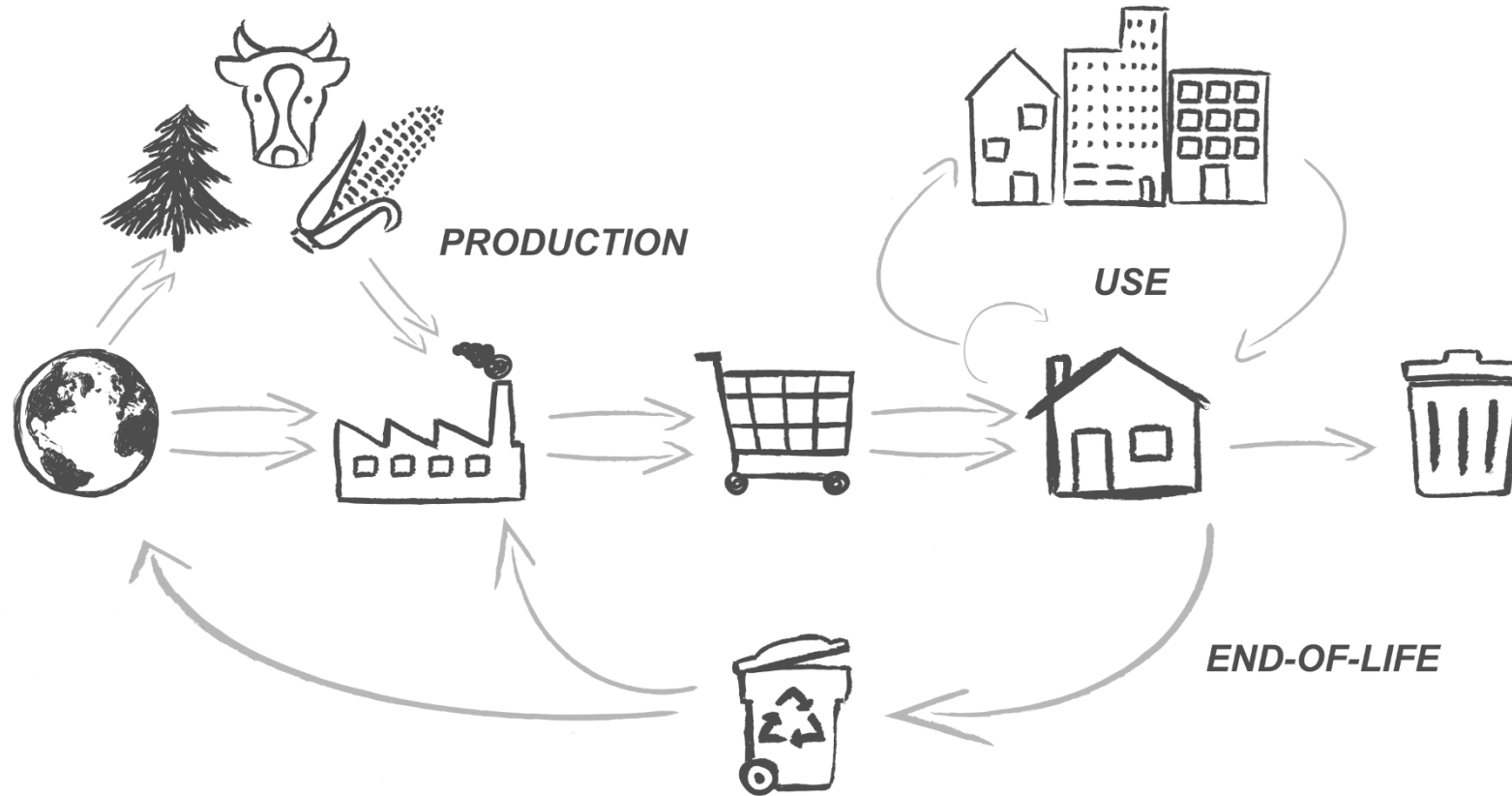
Impacts come from across a whole life cycle



Impacts come from across a whole life cycle



We want to reduce the total “life cycle impact”

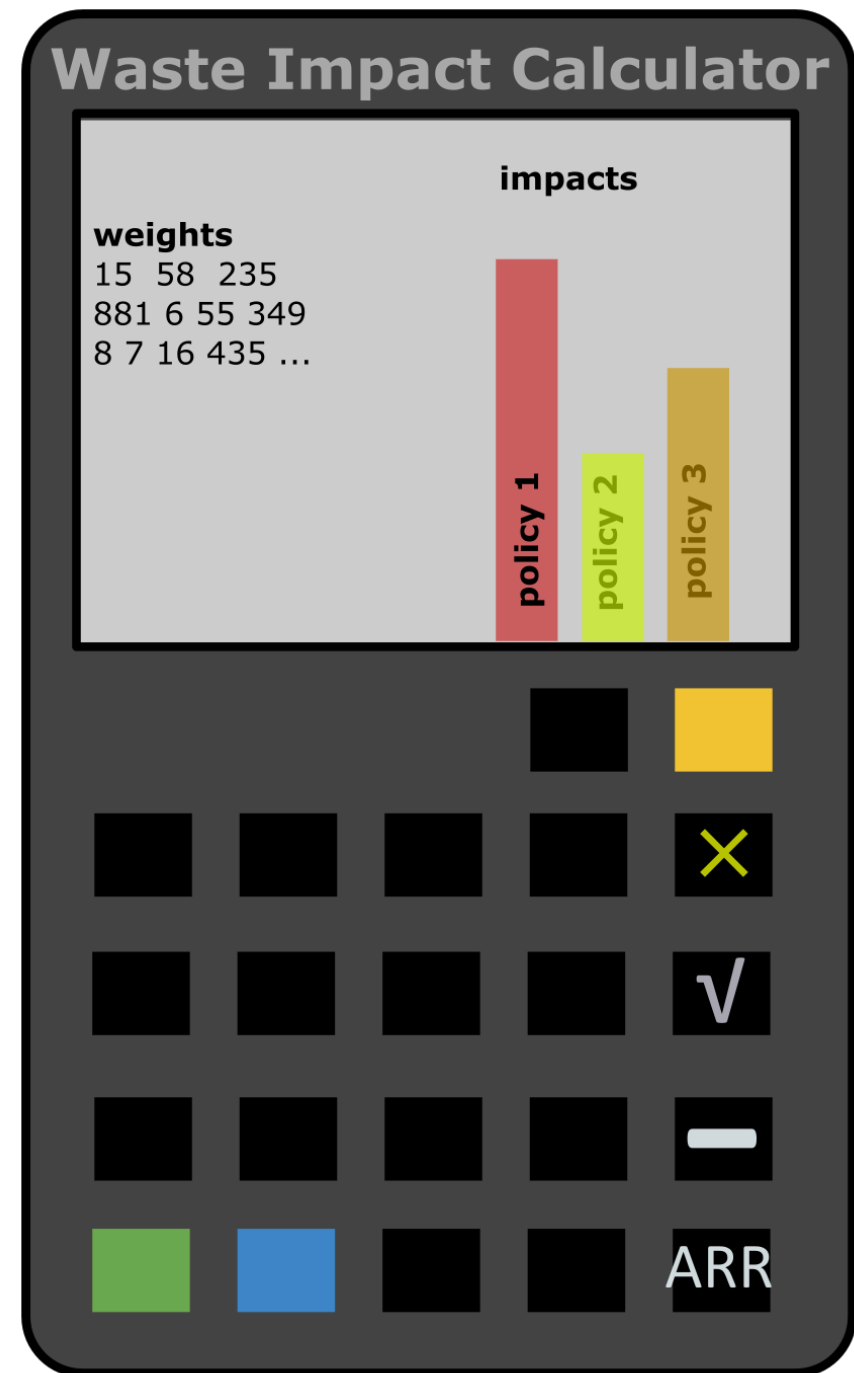


Waste Impact Calculator bridges the gap



WIC basics

- Takes standard weight-based data as input
- Works it backwards through life cycle
- Outputs estimated life cycle impacts
- Allows you to experiment with managing waste different ways.
- Intended for people who manage or are interested in managing solid waste – government staff, waste industry managers, etc.
- Also calculates “Alternative Recovery Rate” for Oregon counties



Some examples of WIC's two main functions

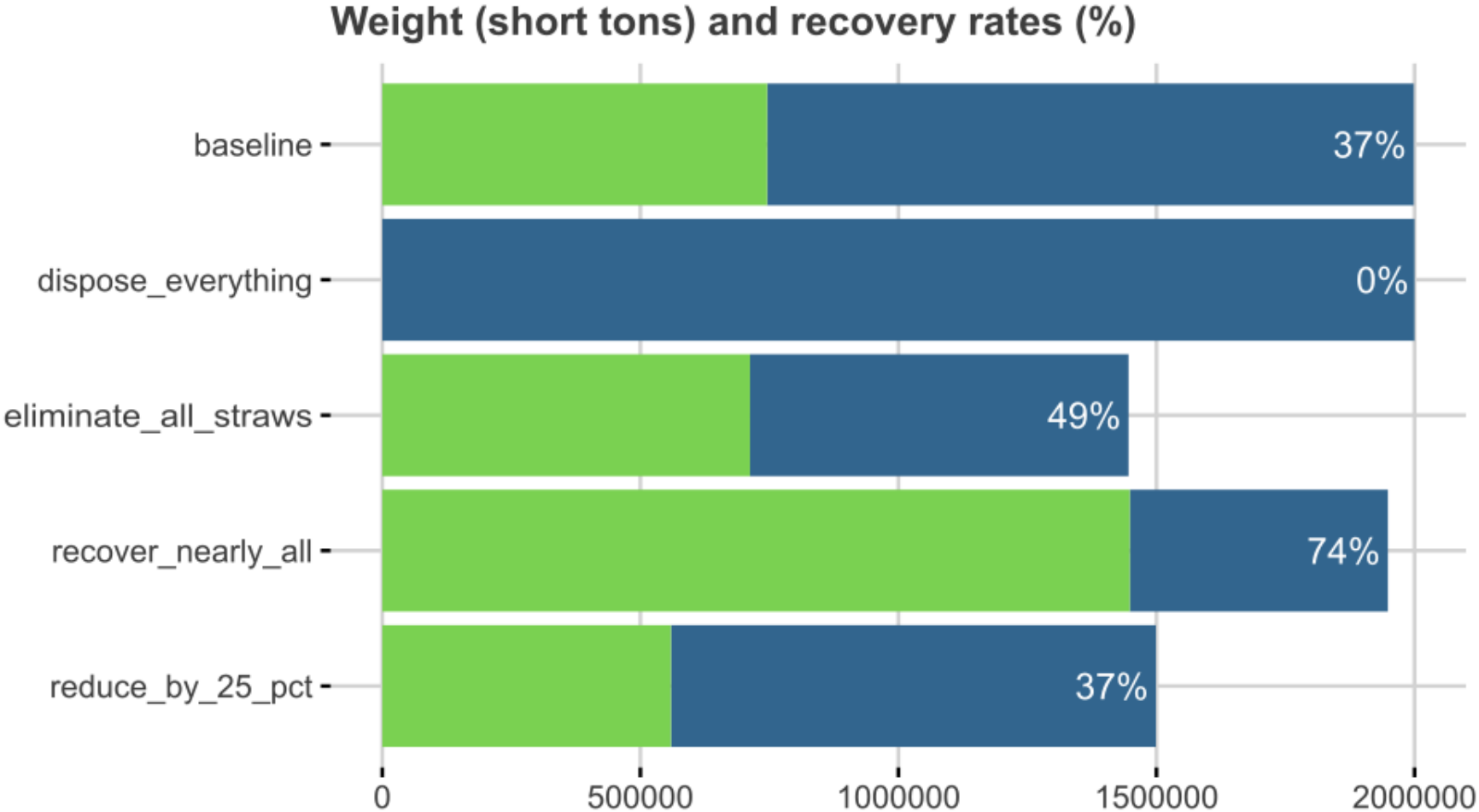
(switch to app)

(describing waste stream)

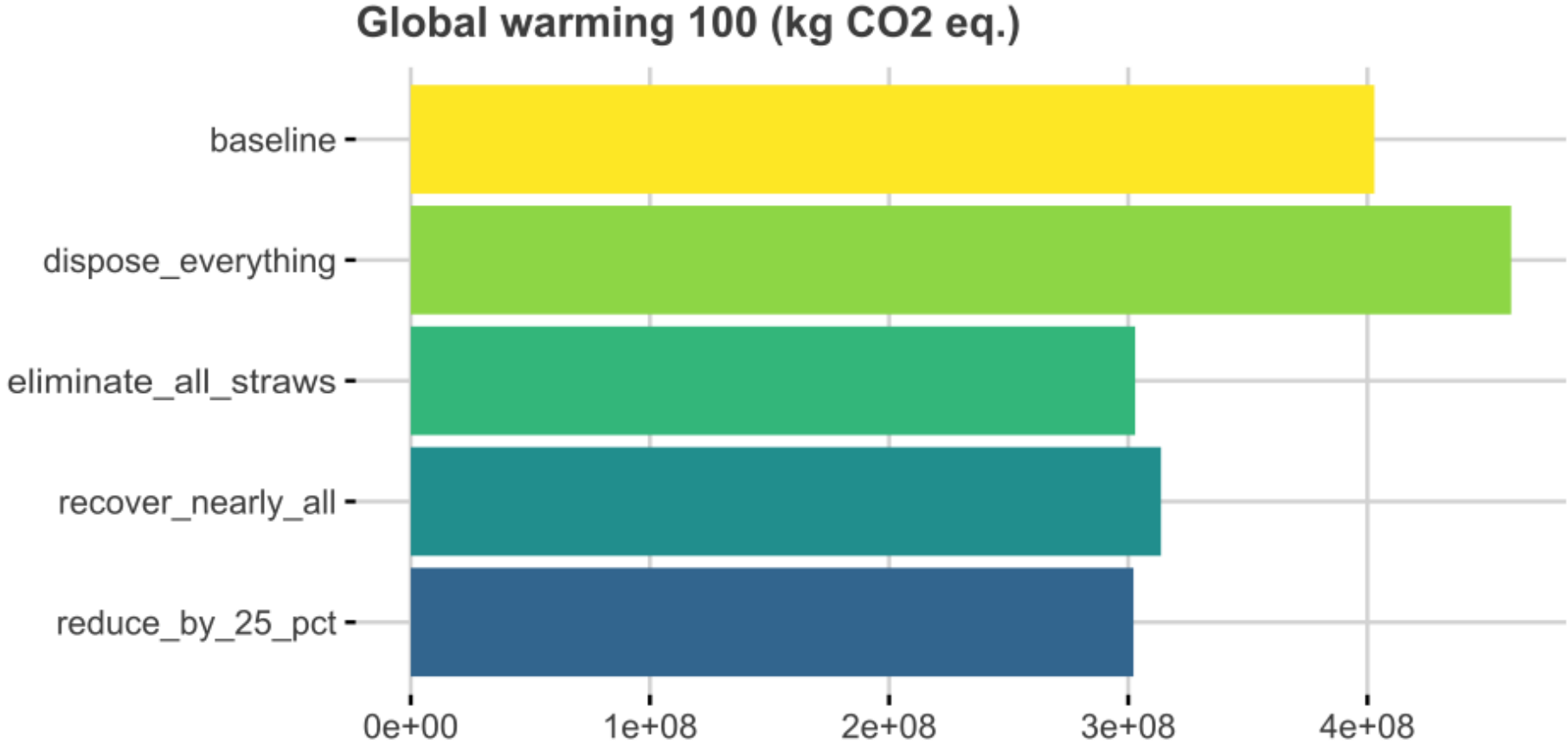
(comparing impacts of scenarios)

DEQ will customize those kind of results for RSC

Weights from Cascadia's scenarios (example only)



Impacts of Cascadia's scenarios (example only)



What does WIC leave out?



The use phase is ignored

- Solid waste data tends to be in terms of commodity materials, not products
- E.g. “10 tons of steel”
- We can’t know what the use was



WIC only includes things recorded as solid waste



Hadley Paul Garland / Creative Commons

Some materials with large impacts are omitted



WIC *only* calculates environmental impacts

It doesn't say anything about...

- Practicality
- Finances
- Non-environmental concerns (e.g. equity)

In conclusion

- WIC can tell you a lot
- It adds valuable environmental impact information to discussions of solid waste
- It shouldn't be your only source of information

Thanks

Martin Brown
Martin.Brown@state.or.us



Environmental Damage Costs

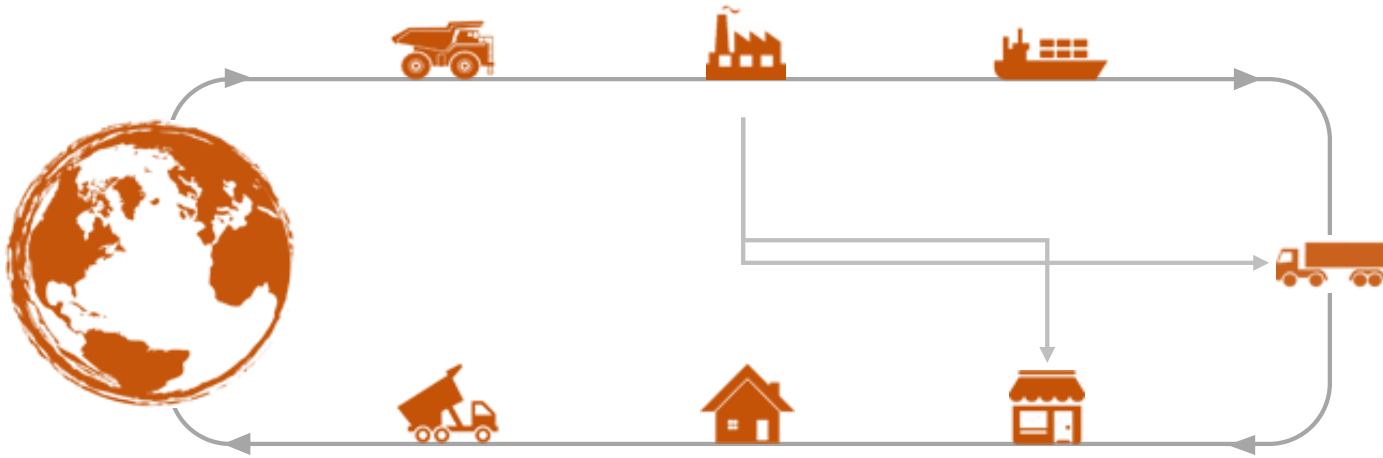
David Allaway

Recycling Steering Committee

June 2, 2020

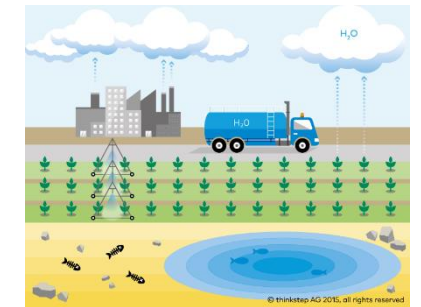
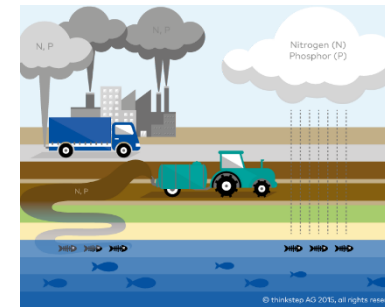
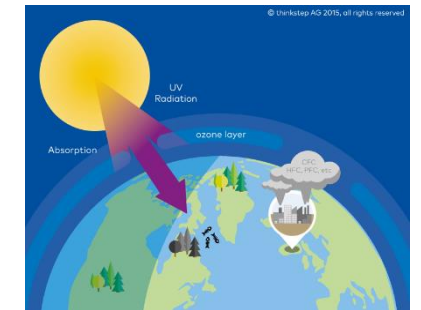
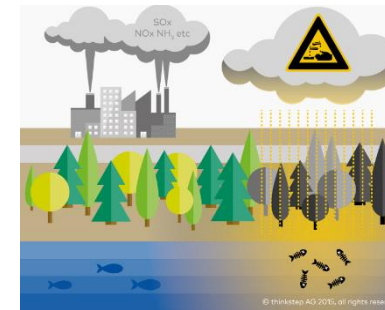
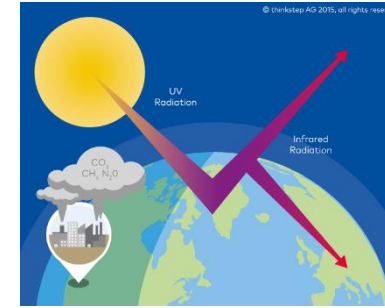


LCA + Environmental Damage Costs



Overview

- Economic theory
- *2050 Vision*
- Expressing LCA results as social costs
- Methods to develop damage cost factors
- Categories of monetized environmental impacts
- Next steps



Review of economic theory



Internalized costs: Costs that are reflected in product prices – included in the normal cost of doing business

Externalized costs: Costs generated by producers but paid for by society as a whole

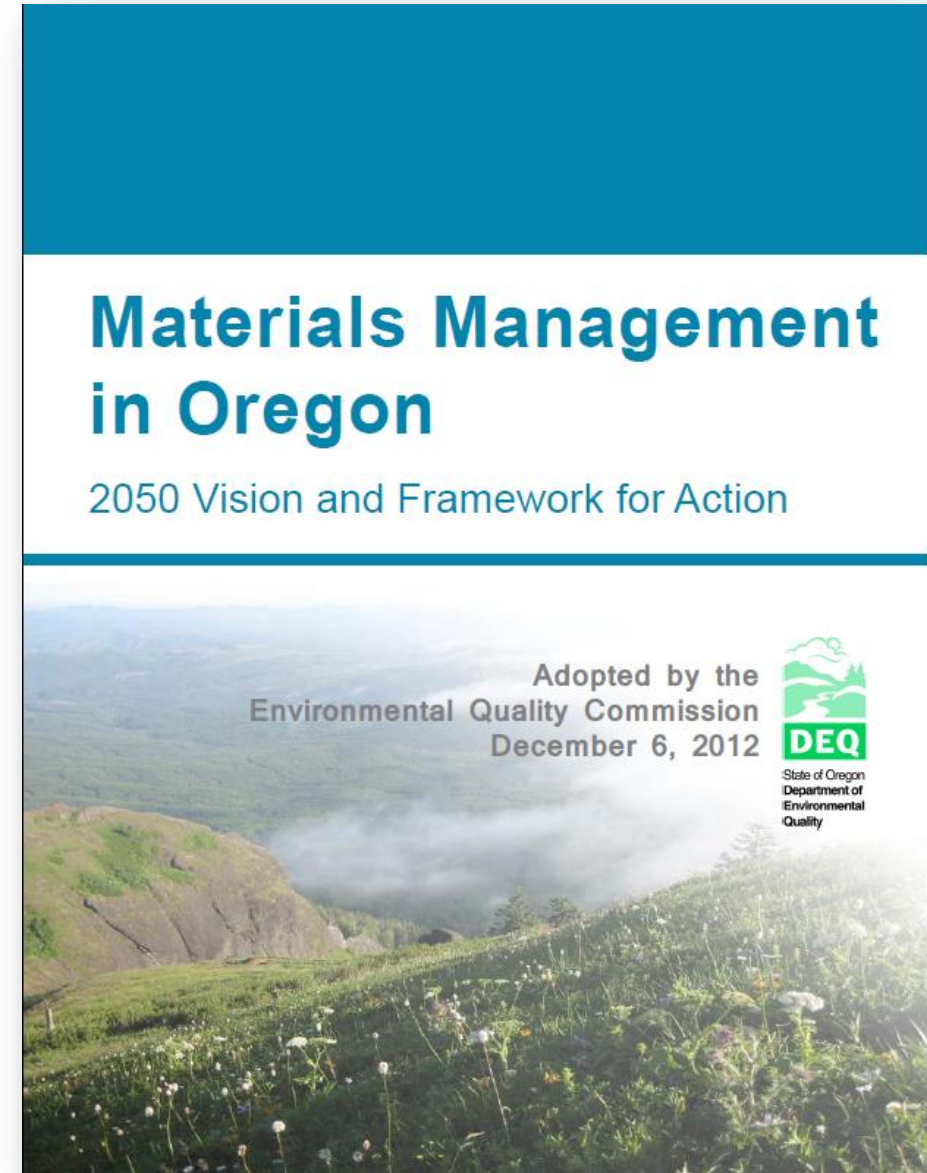
Market failure: When costs aren't accounted for in prices



<https://www.oregon.gov/deq/FilterDocs/mmexternalities.pdf>

2050 Vision

*Oregonians in 2050 produce
and use materials responsibly
conserving resources
protecting the environment
living well*



Social cost formula



Social cost formula



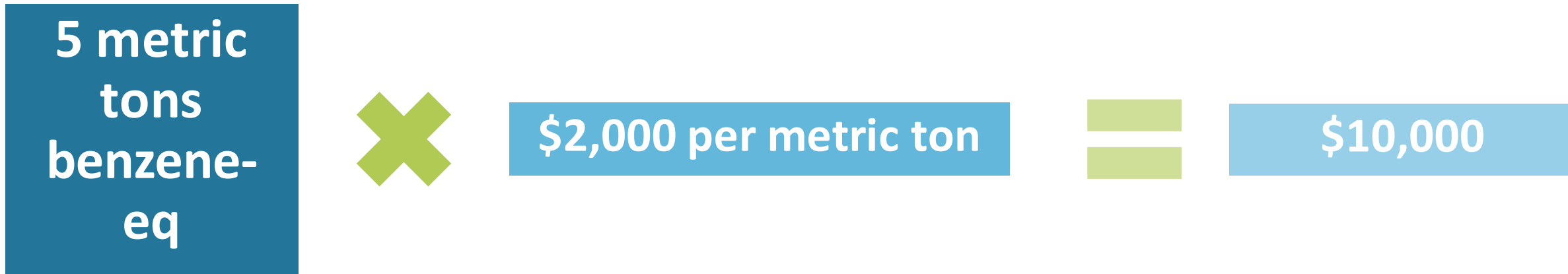
So...



Social cost formula



So...



The social cost of emitting 5 metric tons of benzene (or benzene-equivalent) is \$10,000

Total cost formula

Transactional Costs



Social Costs



Total Costs

*Such as:
Drivers' wages and benefits, fuel, trucks, carts, maintenance, management, overhead, education, etc.*

*Such as:
Pollution, land use impacts, other environmental impacts, gentrification, etc.*

Traditional cost benefit assessment: Are the transactional costs of a policy or investment justified by the resulting benefits?

Estimating damage cost factors – some methods:

- **Abatement cost:** Cost of removing a pollutant, for example, by reducing emissions
- **Direct market pricing:** Certain environmental impacts, or ecosystem services, are bought and sold in commercial markets, i.e. national cap-and-trade system for acid rain
- **Replacement cost:** Evaluates the economic value of ecosystem services based on cost of replacing or providing substitute services
- **Hedonic pricing:** Estimates economic value of ecosystem services that directly affect the market price of another good or service, i.e. proximity to open spaces and housing prices
- **Site choice/travel cost method:** Reveals willingness to pay based on the additional cost that people will pay to travel to a site with higher environmental quality
- **Contingent valuation:** Asks a survey panel how much they would be willing to pay in order to achieve a specific environmental outcome

Damage Cost Factors

Environmental Impacts

1. Climate change
2. Human health – respiratory effects
3. Human health – non-carcinogenic effects (non-respiratory)
4. Human health – carcinogenic effects
5. Waterway eutrophication
6. Acidification
7. Aquatic freshwater ecotoxicity
8. Ozone layer depletion
9. Ground level smog formation

Natural Resource Impacts

10. Water consumption
11. Land use change
12. Mineral depletion
13. Fossil resource depletion

Note that this is not a complete list of impacts!



Damage Cost Factors

Environmental Impacts

1. Climate change
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Sound Resource Management Group

TruCost

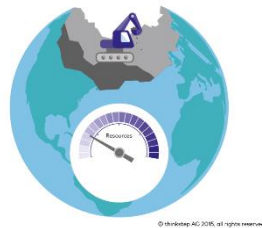
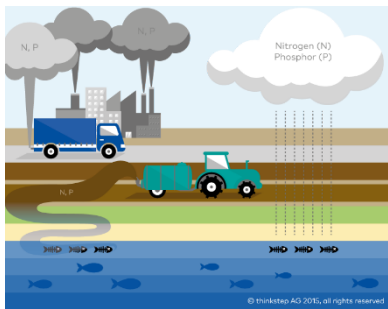
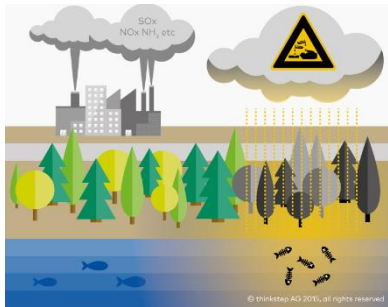
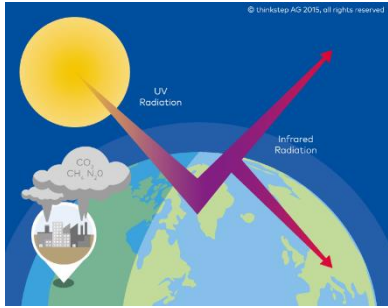


Where we are now

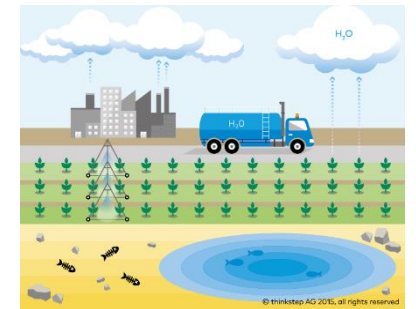
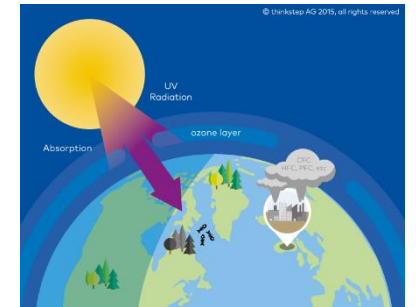
- Cascadia finishing first draft of infrastructure scenario evaluation, including estimates of:
 - Transactional costs (fuel, labor, etc.)
 - Tons of material
- Working WIC model is up and running
 - Still needs critical review
- Draft social cost factors in hand from Sound Resource Management and TruCost

What's next

- In the next week, DEQ will:
 - Generate estimates of environmental impacts through WIC
 - Calculate social costs
 - Calculate total costs
- Share results at June 10 RSC meeting
 - Q&A on June 10 & 12, and beyond



Thank you
Questions?



Final questions

Peter Canepa, peter.canepa@state.or.us

Martin Brown, martin.brown@state.or.us

David Allaway, david.allaway@state.or.us

To learn more about the Recycling Steering Committee, visit <https://go.usa.gov/xmYYe>.

