Recommendations for the Use of EPDs in Procurement and for LCA

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Outline

- Objectives:
  - Uses of EPDs
  - Learn about methodologies and key considerations when developing benchmarks
  - Understand the necessity and importance of benchmarks in the context of Buy Clean Policies

- Reference:
  - White Paper from National Center for Sustainable Transportation: https://ncst.ucdavis.edu/research-product/recommended-approach-use-cradle-gate-environmental-product-declarations-epds

What are EPDs?

Environmental Product Declaration

communication by an industry or company to its customers

Environmental Facts

Functional unit: 1 metric ton of asphalt concrete

Primary Energy Demand [MJ]	4.0×10^3
Non-renewable [MJ]	3.9×10^3
Renewable [MJ]	3.5×10^2
Global Warming Potential [kg CO_2-eq]	79
Acidification Potential [kg SO_2-eq]	0.23
Eutrophication Potential [kg N-eq]	0.012
Ozone Depletion Potential [kg CFC-11-eq]	7.3×10^{-9}
Smog Potential [kg O_3-eq]	4.4

Boundaries: Cradle-to-Gate
Company: XYZ Asphalt
RAP: 10%

Example LCA results

Adapted from slide by Steve Muench

Cradle to gate EPDs

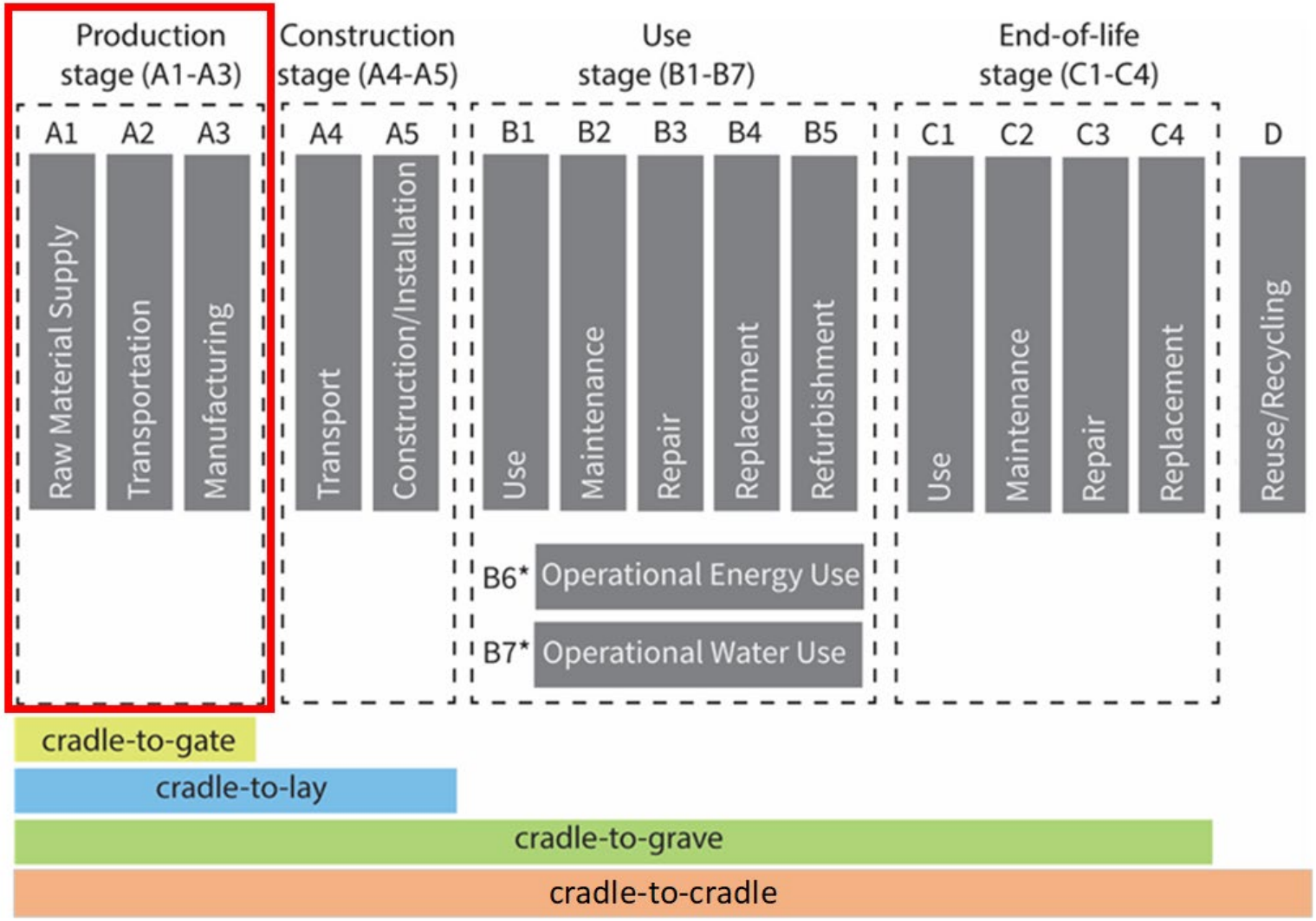
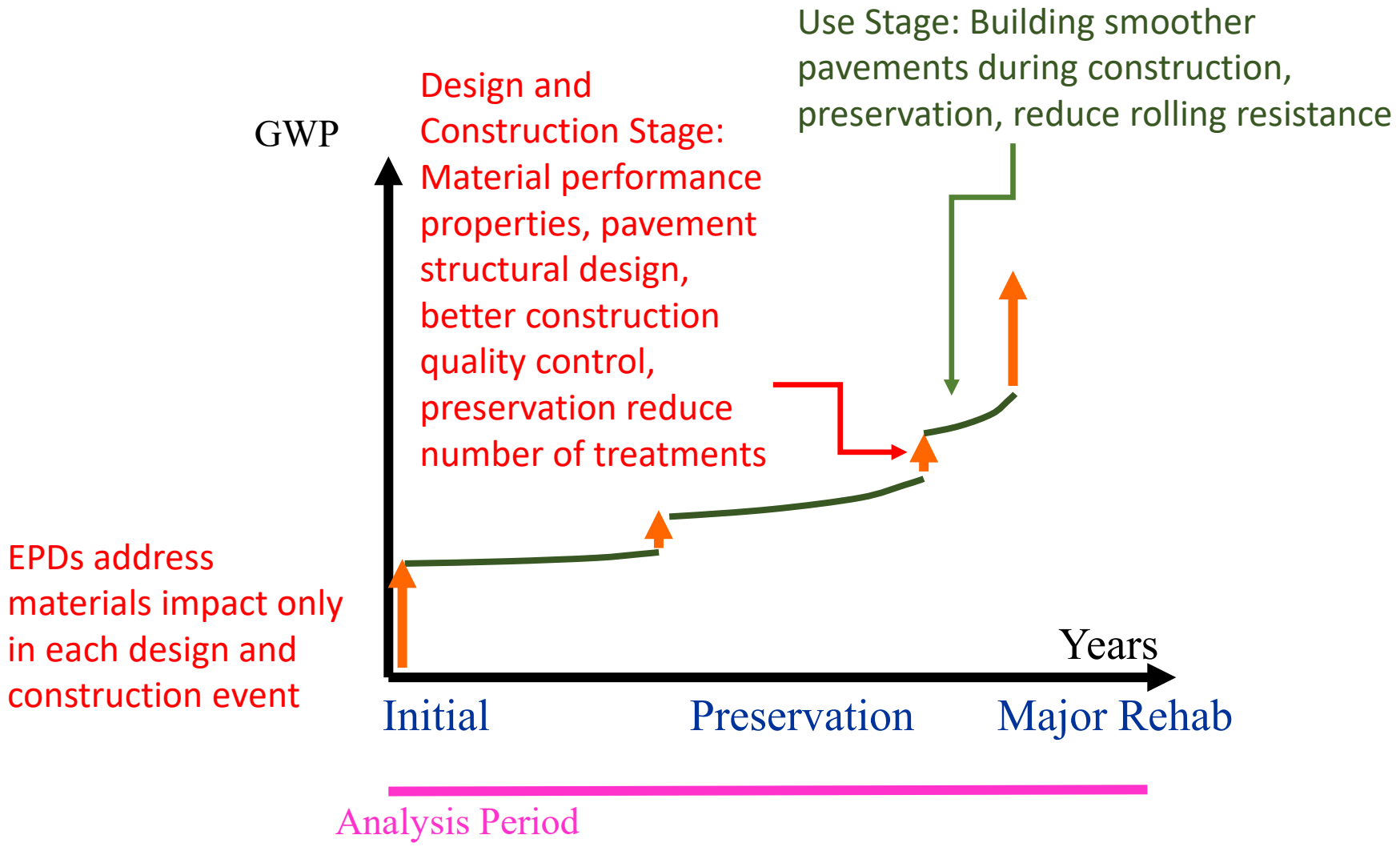


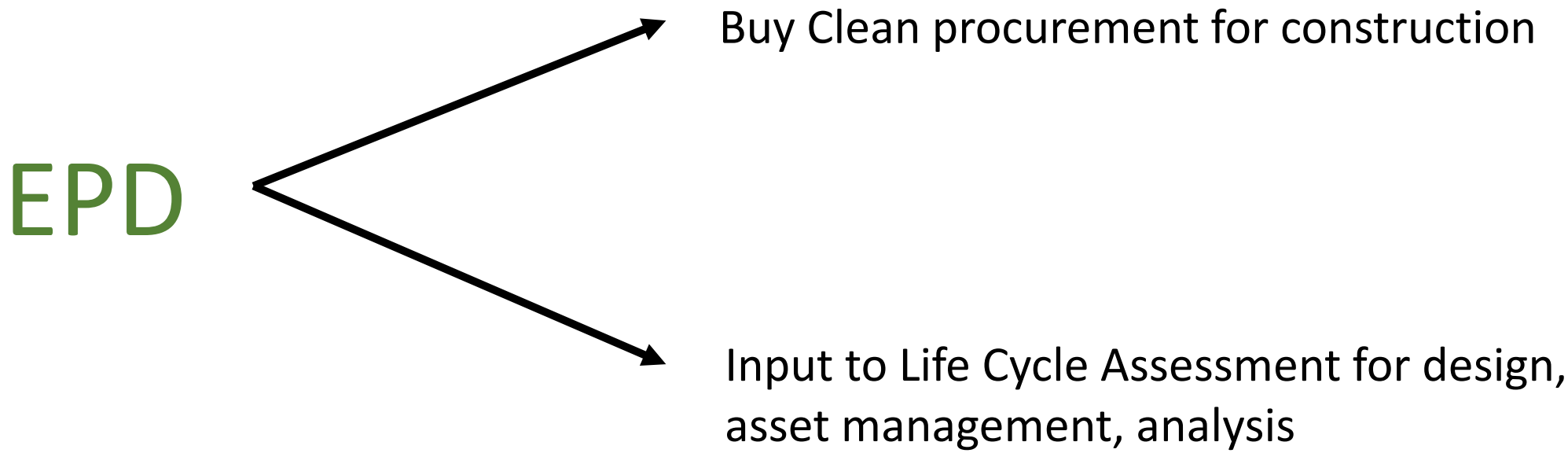
Figure 1. Life cycle stages for building products (adapted from ISO 21930:2017) with boundary conditions for different LCA scopes.

- How much of the pavement life cycle does an EPD cover?

Environmental Impacts over the Pavement Life Cycle
What do EPDs cover?

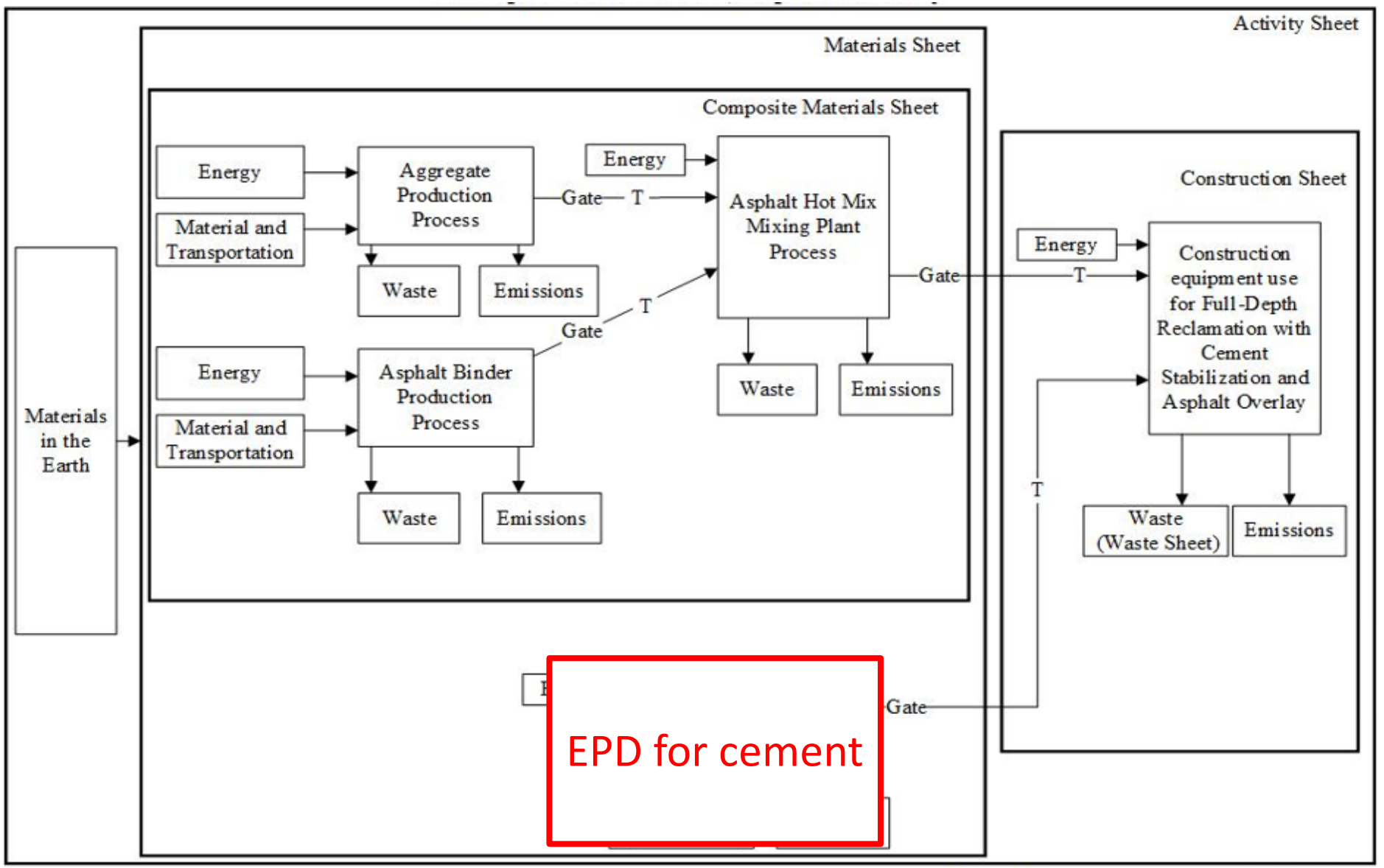


What can EPDs be used for?



An LCA model of Full-Depth Recycling with cement stabilization and asphalt overlay, cradle-to-laid

FHWA
LCA tool
Goal and
Scope



What is Buy Clean procurement?

- Buy Clean legislation or regulation sets a “benchmark” limit for an emission, typically Global Warming Potential (GWP)
- The contractor then must produce an EPD showing that the material being used is less than the emission limit

What are benchmarks used for?

- What is a benchmark?
  - A benchmark is a threshold value for an environmental impact that an agency sets to communicate with producers
  - Typically, global warming potential (GWP) calculated by TRACI (US EPA) method for civil infrastructure materials in USA
  - Agencies use the benchmark when procuring materials in Buy Clean type legislation based on producer's environmental product declaration (EPD) impact value(s)

- What about cradle-to-gate EPDs should be considered when using them in procurement?
  - Performance categories
  - Variability
  - Completeness
  - Regionality, timeliness of data
- Is there only one type of benchmark and one way of using them?
  - There are different ways of setting benchmarks
  - There are different ways of using benchmarks
- Are there other considerations for agencies as they move ahead?
  - Yes

Performance related properties of materials must be in same category for comparison

- A material with low GWP on their cradle-to-gate EPD may produce more GWP over the life cycle of the infrastructure
  - Example: A material may have 15% less GWP in its EPD than benchmark
  - But if it is 25% less durable, it will be replaced more frequently, and emit more GWP over the life cycle
  - Greater use of EPDs in procurement will require greater use of performance related specifications and tests to categorize materials to avoid this potential unintended negative consequence

Analysis period = 60 yrs	
Material A	Material B
0.85 GWP	1.0 GWP
15 year life	20 year life
15	20
30	40
45	
Total GWP	Total GWP
3.4	3.0

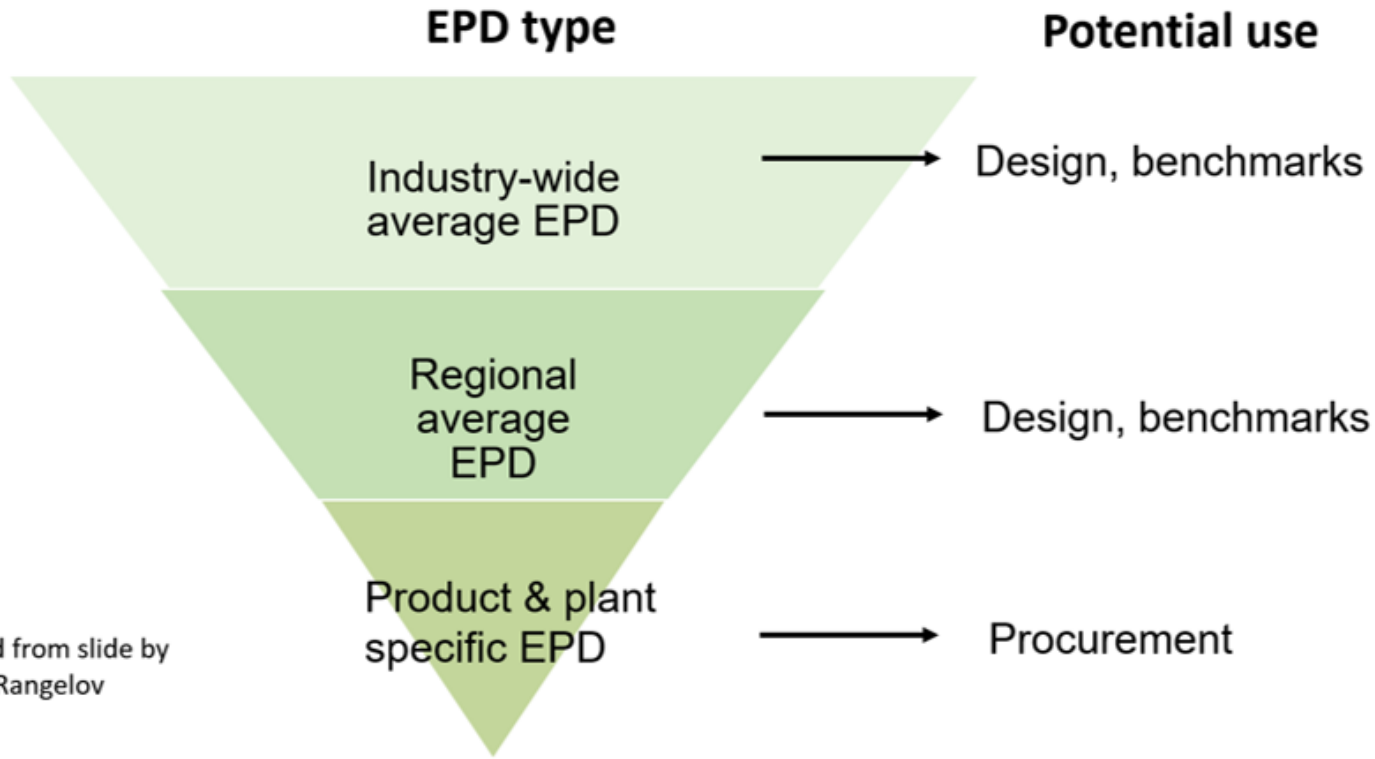
Some example pavement materials performance related properties

- Asphalt concrete:
  - Stiffness
  - Rutting
  - Aging
  - Fracture
  - Fatigue
  - Moisture damage
- Portland (or other hydraulic) cement concrete
  - Flexural strength (can be related to compressive strength)
  - Drying shrinkage
  - Coefficient of thermal expansion
  - Chemical reaction (ASR, sulfate, chloride) and freezing durability
- Aggregate base
  - Shear strength
  - Reactivity to water

Which of these do current specifications consider?

Types of EPDs

Want plant and product specific



Adapted from slide by Milena Rangelov

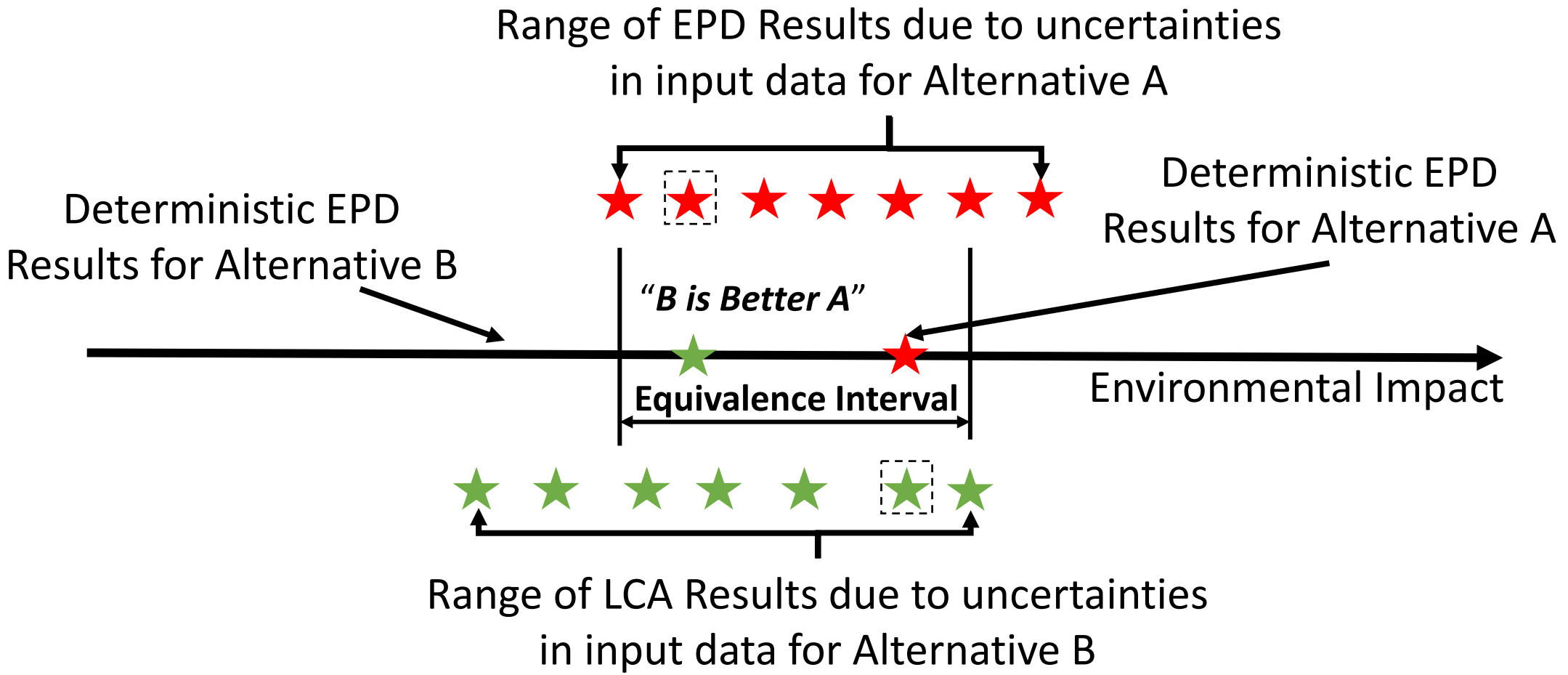
Figure 2. EPD types with different specificity

- Types of benchmarks
  - National average
    - Are specifications the same across country?
    - What are built-in inputs to local production compared to national average inputs?
    - Who calculates this and how often updated?
  - Regional average
    - Can be based off first 1-3 years of collecting EPDs from agency's suppliers for information only
    - Update periodically using recently collected EPDs

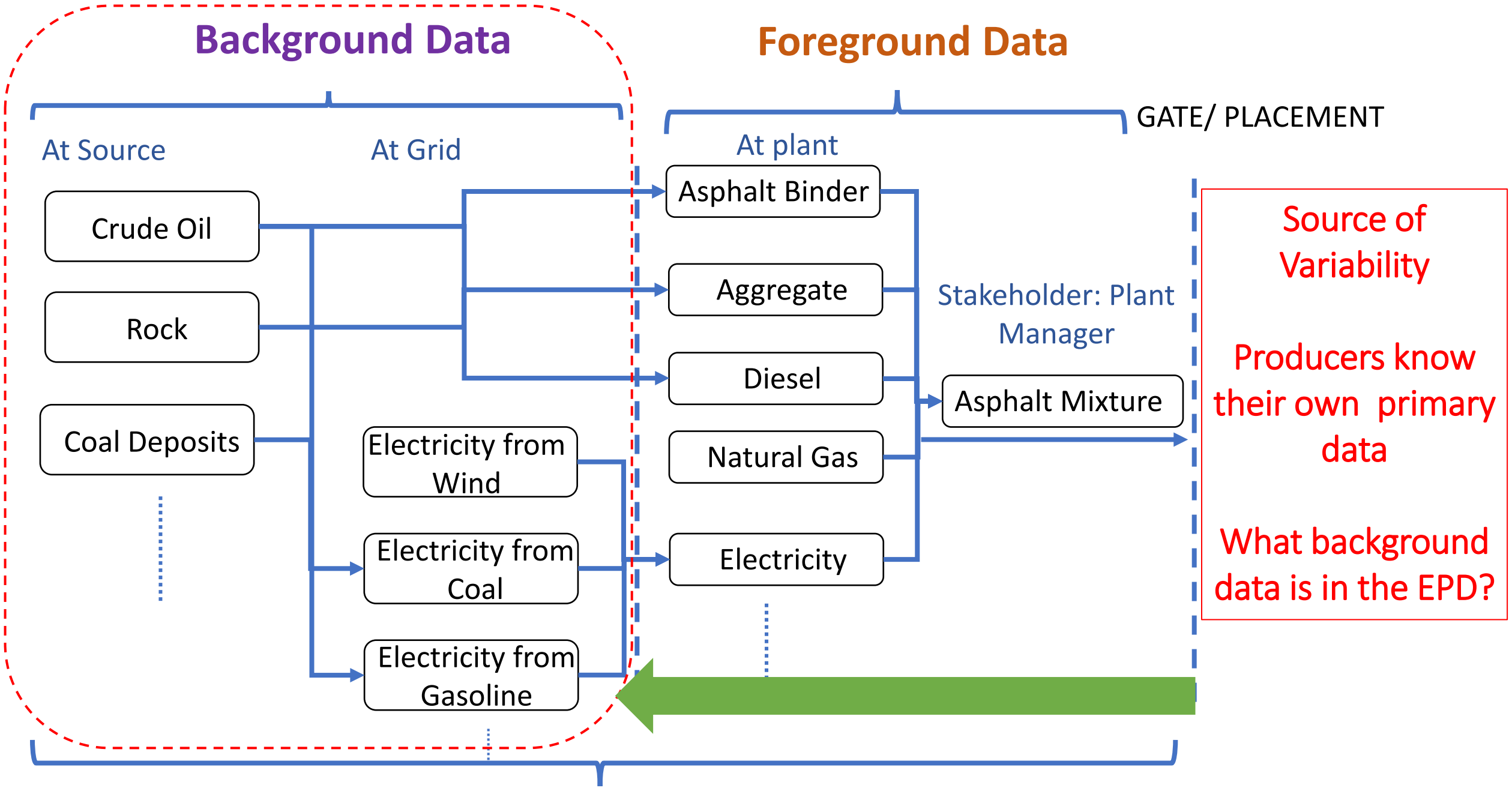
What could go wrong with national average benchmarks for regionally sourced materials?

- Regionally sourced materials may have regional supply chain constraints
- Asphalt and concrete can only be sourced within a small finite radius of the construction location (time to set for concrete, time to cool for asphalt)
- Different regions have different:
  - Electrical energy supply sources
  - Different transportation distances and available modes (truck, rail, barge) to obtain recycled and other lower impact materials
  - Different specifications for materials to meet local climate conditions
- Bad outcomes:
  - All your suppliers are better than the national average (no improvement)
  - None of your suppliers can become better than the national average (no suppliers)

Variability: What is the variability of an EPD value for a given product and how can it affect procurement?



Bhat, C. G., & Mukherjee, A. (2019), "*Sensitivity of Life-Cycle Assessment Outcomes to Parameter Uncertainty: Implications for Material Procurement Decision-Making",* Transportation Research Record, 2673(3), 106–114.



Complete Supply-Chain for Asphalt Mixture

Adding flexibility to the use of benchmarks
Use of whole-project emission benchmarks

- Goals:
  - Minimize GWP emissions for a given project
  - Make it easier for the contractor to meet that goal
- Current typical approach: use a benchmark and acceptance for materials on a one-by-one basis
  - This may be hard to achieve for some materials and very easy to achieve for others
- Alternative approach: use material benchmarks and quantities to calculate a project benchmark
  - Calculate: sum of material benchmark (GWP emissions limit) x units of material in project
  - Contractor optimizes combination of materials they deliver to maximize the reduction for the overall project, and to maximize their incentive
  - Can start by doing project material budget for all materials under the same Product Category Rule, such as all concrete materials, all asphalt materials, all steel materials, etc
  - Requires consideration and language about how to distribute the incentive/disincentive to general contractor then to the materials supplier subcontractors

Can benchmarks go the wrong direction in the future?

- Some legislation requires that benchmarks must always be improving
- Some reasons they can legitimately go the wrong direction at times:
  - More higher emission suppliers start producing EPDs
  - EPDs become more complete (gaps are filled)
  - Higher quality background data are required that have higher emissions
  - Plants become able to partition energy use to different products; some will go up and some will go down
  - Plant specific EPDs become available for important ingredient materials, are used instead of national averages
    - Example: asphalt binder
- Good thing if getting more realistic data even if benchmark goes up
  - Agencies should understand what is happening in their collected EPDs and participate in PCR development

Some current EPD use and benchmarking practices

- Buy Clean California (2017)
  - Benchmarks: national averages (plate steel, reinforcing steel, plate glass, mineral wool), those above cannot supply (go/no go)
  - Procurement implemented July 2023
  - Benchmarks cannot go down
  - Developing EPD program for asphalt, concrete and aggregate materials
  - Concerned that data may show increase as more EPDs come in
- Buy Clean Colorado (2021)
  - Collecting EPDs since summer 2022
  - No benchmarks set yet, looking at regional and national data
  - Go/no go specification, not sure yet if average or percentile
  - Concerned that data may show increase as more EPDs come in

Some current EPD use and benchmarking practices

- Washington (2021-2022)
  - The maximum acceptable GWP must be set at the 20th percentile value for each eligible product category, determined by consulting with nationally or internationally recognized databases of EPDs of like performance and quality materials
  - Must report benchmarking method to the legislature by January 1, 2024
- Oregon (2022)
  - Limits are set approximately 45% above the National Ready Mix Concrete Association's Pacific Northwest GWP Benchmarks, same as the City of Portland
  - Estimated that will allow roughly 80% of the mixes with EPDs in the Oregon market to meet the proposed limits now
- Minnesota Buy Clean and Buy Fair Minnesota Act (2023)
  - Industry average benchmark by 2025 or 2027 depending on material, considering nationally or internationally recognized databases
  - Benchmarks cannot go in reverse

Agency knowledge

- If EPDs are not being reviewed for data quality, completeness, etc they are not providing best value
  - Like collecting QA data but not using it to support decisions
- Recommendation:
  - Support continuous improvement of agency knowledge and ability to interpret information and act on it
  - And to write better technical specifications for EPDs
  - And to push for improvements in PCRs

Conclusions

- EPDs are an important tool for improving environmental outcomes for pavement, including use in procurement
- Not the only tool, consider the whole life cycle and whole project delivery process
- Recommend better differentiation of materials performance
- Should work towards improved EPDs
  - Less variability, more complete data
- Benchmarks can be set different ways
- Benchmarks can be used different ways
- Benchmarks can move in different directions for valid reasons

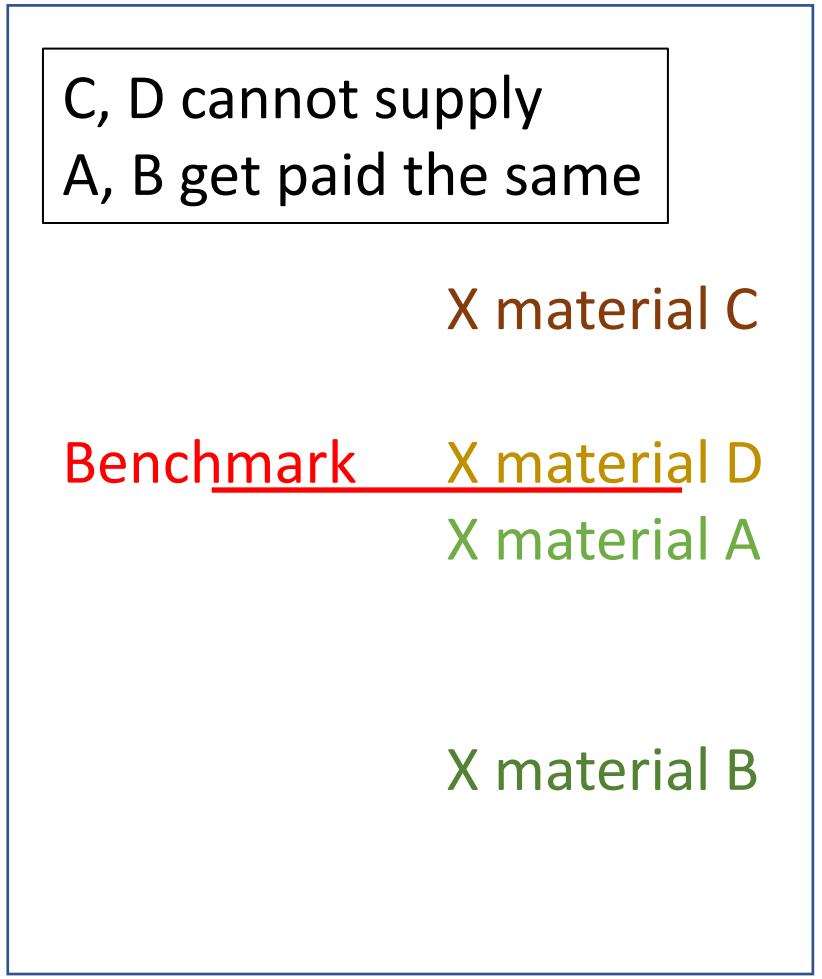
Thank you!

Questions and discussion

- Note: author is solely responsible for information and opinions in this presentation
- Thanks to Chait Bhat, Ali A. Butt and Chris Senseney for some of the information presented

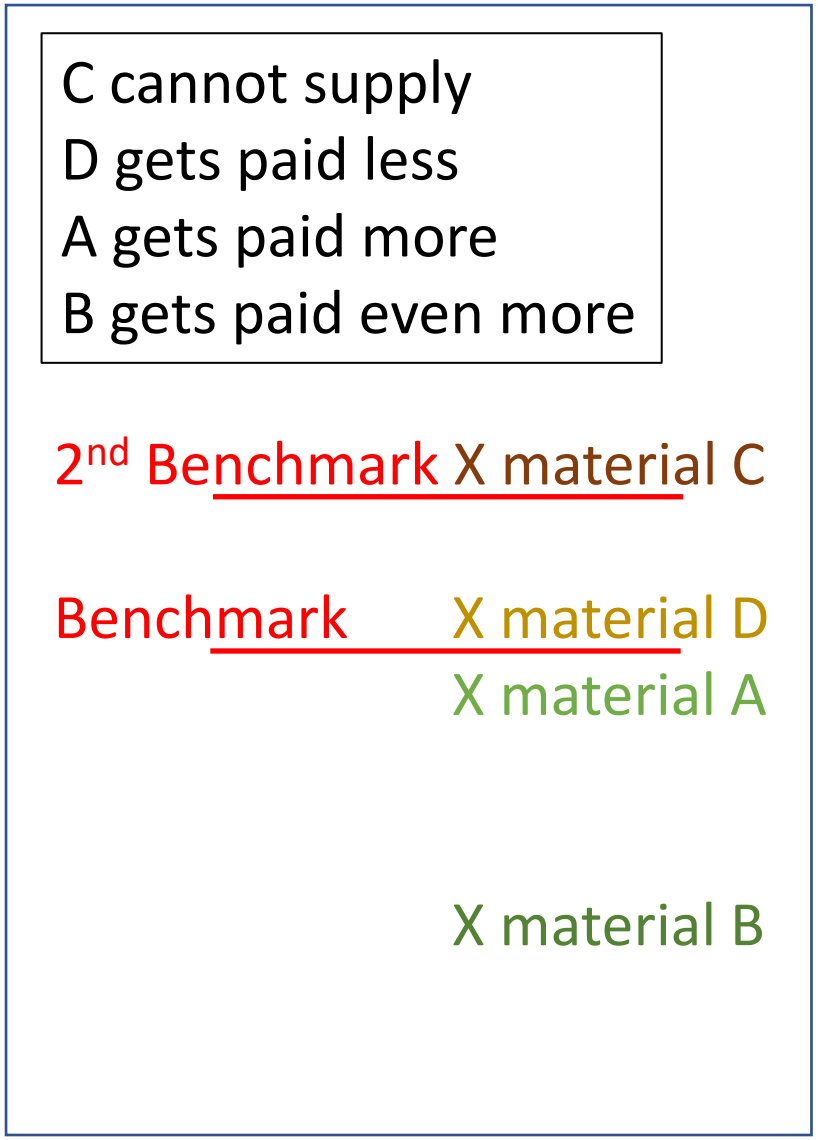
Uses of benchmarks in procurement go/no go vs incentive/disincentive

- Goals:
  - Improving environmental outcomes
  - Keep a healthy pool of suppliers, with all competing to improve
- Go/no go procurement specifications
  - Set benchmark and only accept materials with GWP < benchmark
  - Does not differentiate just under the benchmark from substantially under the benchmark
  - Incentive is to do the minimum improvement
  - Risk when setting benchmark of too few suppliers can meet it, or nearly all meet it



Uses of benchmarks in procurement go/no go vs incentive/disincentive

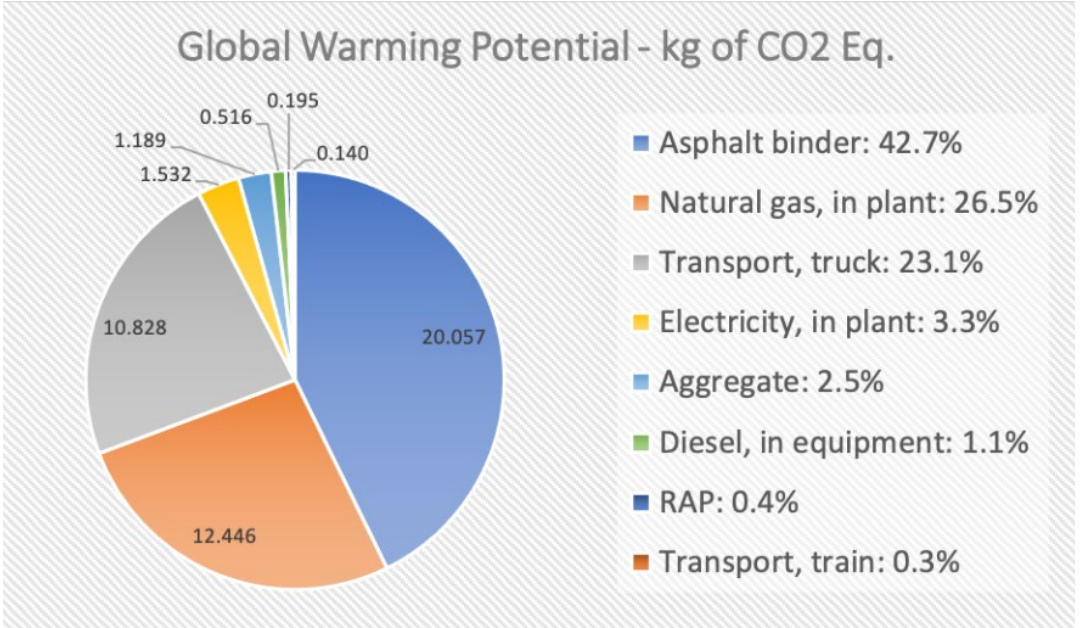
- Incentive/disincentive specifications
  - Incremental reward or penalty for how much below or above benchmark
  - Set second benchmark above incentive/disincentive benchmark where unacceptable material
  - Everyone incentivized to get better to compete against benchmark
  - Similar system used in QC/QA
- For both go/no go and incentive/disincentive
  - There must be enough confidence in the EPD system that claims are not filed when supplier cannot supply or receives disincentive
  - See previous notes about variability and bias



How might benchmarks change with improved data

- The Asphalt Institute published a national (USA/Canada) average LCA for asphalt binders in 2019
- Most EPDs for asphalt mixes are using those national average binder GWP values
- If plant or regional specific EPDs become available for asphalt binder then those values would likely be different for different binder suppliers
- Binder drives mix GWP; crude source drives binder GWP

Mukherjee for NAPA, 2021



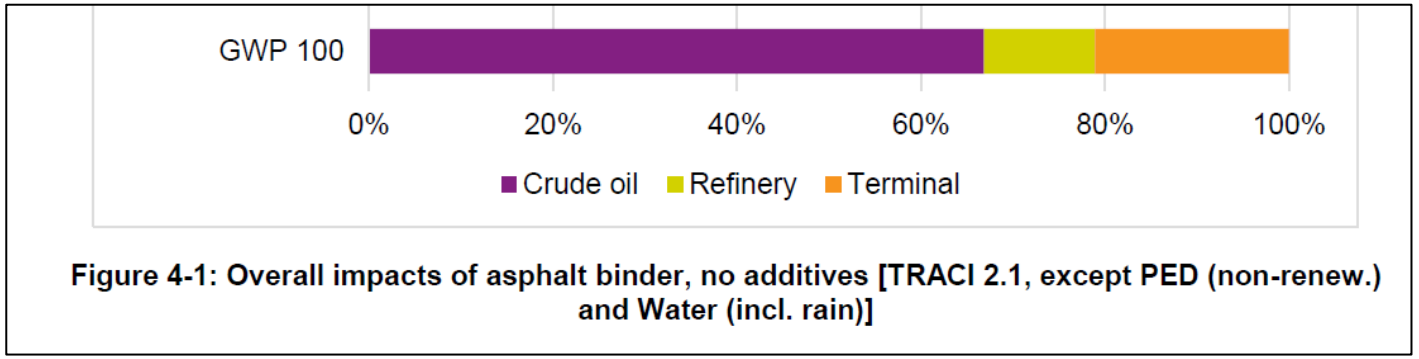


Figure 4-1: Overall impacts of asphalt binder, no additives [TRACI 2.1, except PED (non-renew.) and Water (incl. rain)]

Thinkstep for Asphalt Institute 2019

Different crude sources have different GWP

- GWP depends on extraction method, flaring of gas, and transportation
  - AI LCA is heavy on Canadian oil sands; unconventional onshore extraction (see Bhat webinar)
- UCPRC has estimated differences for PADD5 and California refined binders vs national average
  - Not yet peer reviewed
- Regional benchmarks will likely change; supply chains depend on ability to transport crude and binder

Thinkstep for AI 2019

Table 3-1: Crude oil extraction method of AI asphalt binder

Category of extraction technology	Percentage (by mass)
Crude from oil sands	44%
Primary extraction	22%
Secondary extraction	16%
Tertiary extraction, steam injection	15%
Tertiary extraction, CO_2 injection	1%
Tertiary extraction, nitrogen injection	1%
Tertiary extraction, natural gas injection	1%
Other (refinery products)	<1%

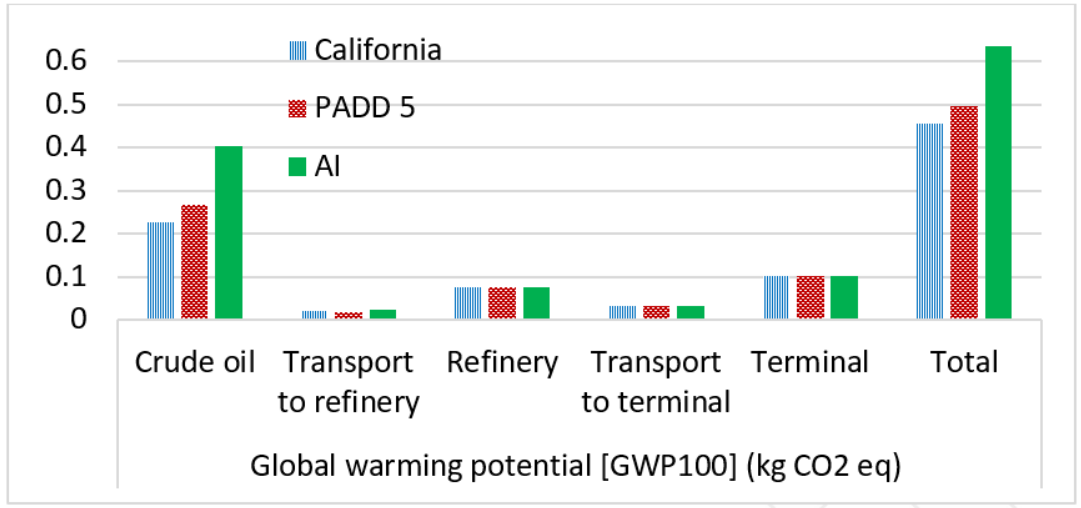


Figure 2-13. Global Warming Potential results for 1 kg of Asphalt binder in California, PADD 5, and AI

Ostovar et al UCPRC for Caltrans 2023 in press