

- **Measuring a pavement's carbon footprint / sustainability**
 - **GHG-based and life-cycle including end-of-life**
 - **Allows comparison of different technologies**
 - **Considers structural and performance characteristics**
- **Variety of different models (WB, NIST, UKHA, private)**
 - **No absolute “protocols”**
 - **Confusion over energy-based GHG emissions**
 - **Process GHG / “embodied” energy in context of GHG**
 - **Simple construction energy-based → complex life-cycle**
 - **Companies / agencies using to make “green” decisions**
- **Other factors affecting sustainability / carbon footprint:**
 - **Pvmt smoothness; bio-based binders; other env effects**

■ GHG emissions are here to stay

- Offers “off-set” and carbon-cost capabilities
- Allows metric comparison of different technologies
- Strives to reduce overall life-cycle energy

■ Should include other environmental factors

- Other emissions; other releases
- Stormwater quality issues (permeable and open-graded)
- May drive smoother pavements based on fuel economy

- **Lack of specific carbon footprint methodology**
 - **Life-cycle vs discrete components**
 - **Primary energy and process-based GHG emissions**
 - **Treatment of embodied energy in context to GHG emissions**
 - **Authoritative sources of emissions data**
 - **End-of-life treatment**
 - **How to treat the carbon footprint of imported raw materials**
- **Uncertainty on comparing different pavement structural / performance characteristics**
 - **Shouldn't use a low carbon footprint pavement designed for small loads on an interstate highway (e.g., chipseal I-95)**
- **Impact of pavement smoothness on vehicle fuel economy**

- **Identify proper methodology to measure a pavement's carbon footprint**
 - **Transparent, accurate, authoritative**
 - **Total life-cycle: cradle to cradle including raw material acquisition**
 - **Accounts for end-of-life / recycling / pavement reconstruction**
 - **Accounts for all GHG-based processes / primary energy; “embodied” energy in context to GHG emissions**
 - **Accounts for importation of raw (or finished) materials**
- **How does pavement smoothness affect vehicle fuel consumption**
 - **Not part of “carbon footprint”, but impacts transportation-related GHG emissions**