Sustainable Bridge Design

What does a *more* sustainable bridge project look like?

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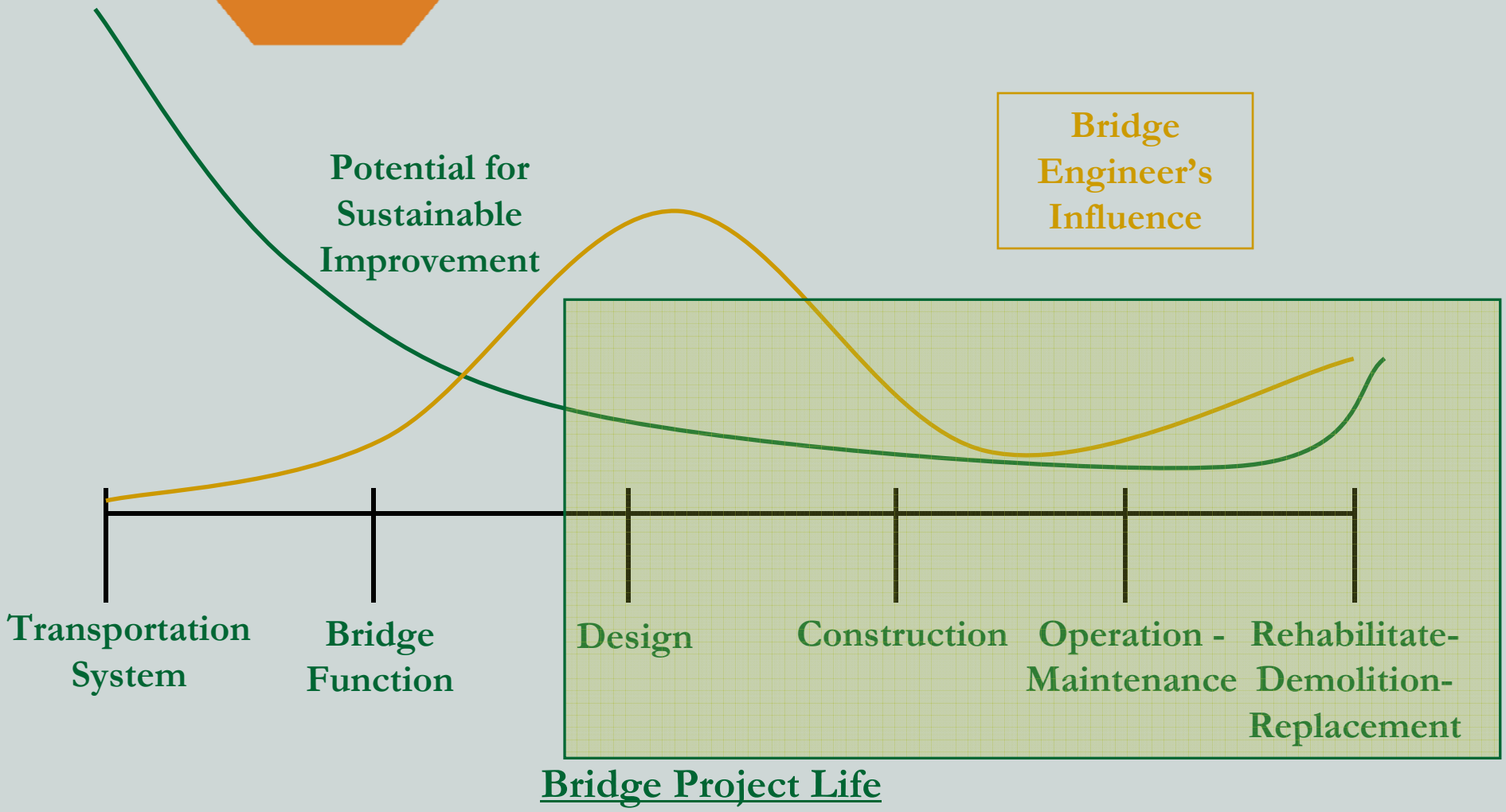
What We're Covering

- Sustainability and the Bridge Project Life
- Engineer's Impact – Design and Construction
- Engineer's Impact – Rehab/Demo/Replace
- Questions and Opportunities

What We're Not Covering

- Why sustainability is important
- Transportation system planning
- Relative benefits of different transportation options
- Sustainability and environmental regulations
- Sustainable engineering office practices

Sustainability and the Bridge Project Life



Engineer's Impact - Design & Construction

- What does a more sustainable bridge project look like?
  - Lower energy input
    - Life Cycle Assessment/Greenhouse Gas Inventory
      - Environmental measure of all aspects of the product life
        - Extraction and Processing of raw materials
        - Using product
        - Recycle/disposal of used product
        - Transportation at all stages

Engineer's Impact - Design & Construction

- What does a more sustainable bridge project look like?
  - Lower energy input
    - Life Cycle Assessment
      - Tools –
        - Athena Institute's *Life-Cycle Inventory Reports*
        - University of Bath's *Inventory of Carbon and Energy*
        - Carnegie Mellon's *Economic Input-Output Life-Cycle Assessment Model*
    - Embodied Energy During Construction[1]

Engineer's Impact - Design & Construction

- What does a more sustainable bridge project look like?
  - Lower energy input
  - Increased durability
    - Increased designed service life
      - British Standard has been 120 year design life since 1988
      - Many European Locations require 100 year for major bridge and tunnel projects
    - Aesthetic Component

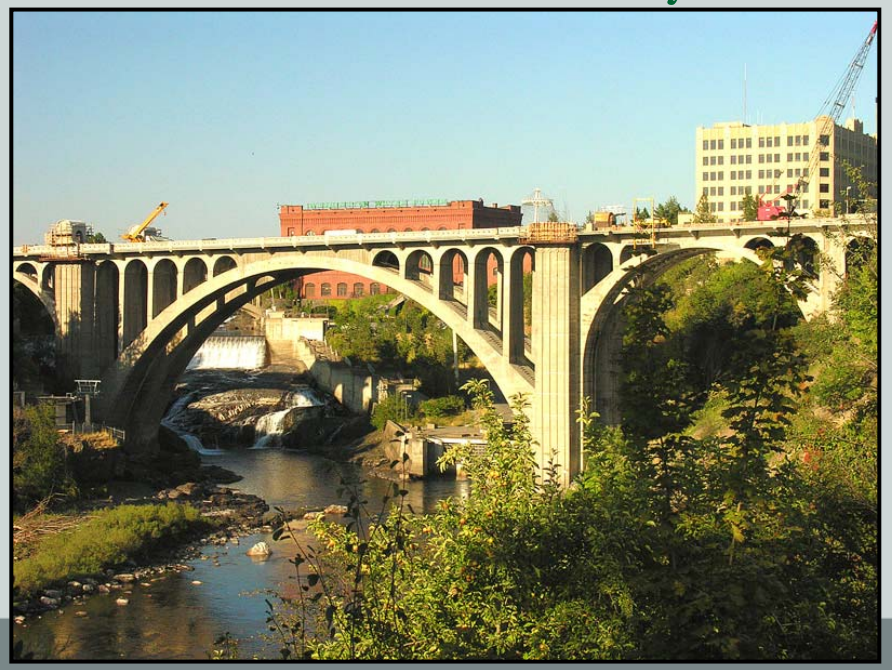
Engineer's Impact - Design & Construction

- What does a more sustainable bridge project look like?
  - Lower energy input
  - Increased durability
  - Simplified Deconstruction

Engineer's Impact - Design & Construction

Concrete

- The Good
  - Very durable
  - Abundant, local raw materials
  - Precast Options
  - 'Green' Concrete
- The Bad
  - 6-8% of anthropogenic carbon emissions
  - Down-cycled



Engineer's Impact - Design & Construction

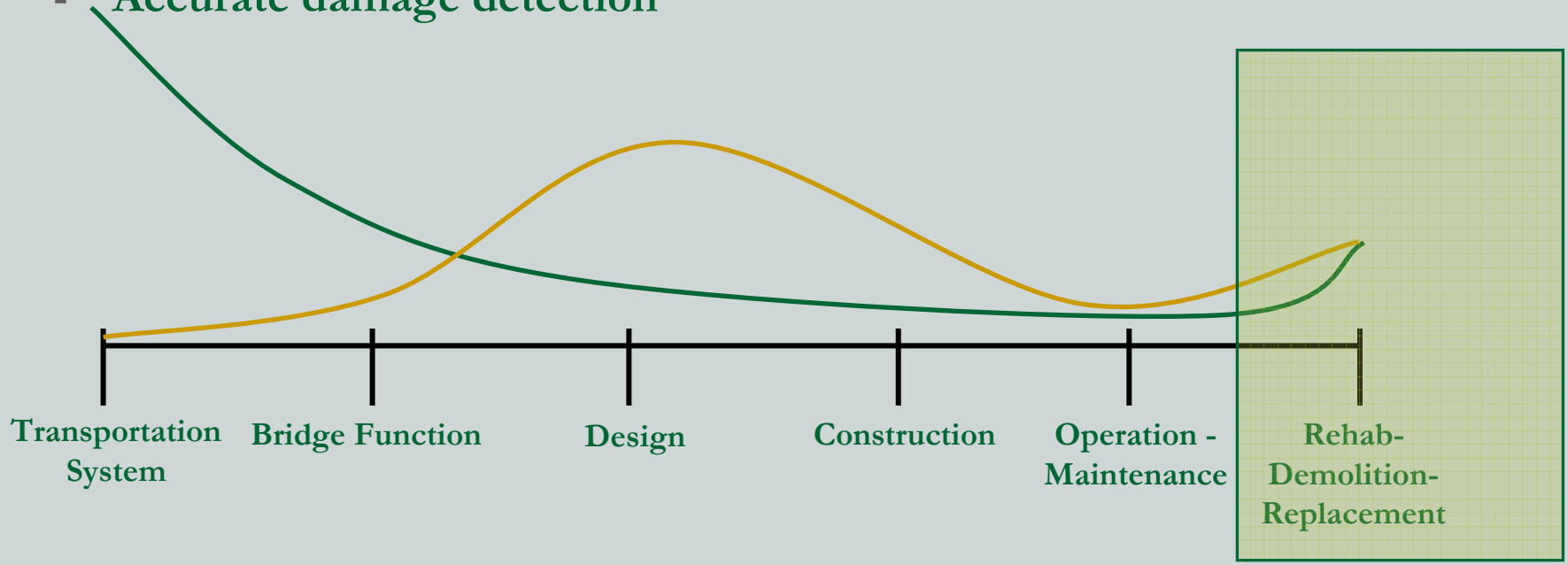
Steel

- The Good
  - High recycled content
  - Connections facilitate deconstruction/reuse

- The Bad
  - High energy cost for virgin material
  - Long term durability

Engineer's Impact – Rehab/Demo/Replace

- The Potential
  - The Rehab vs Replace decision
  - Accurate damage detection
  - Bridge preservation
  - Bridge component re-use



Engineer's Impact – Rehab/Demo/Replace

- The Potential
  - High performance materials – Fiber Reinforced Polymer (FRP)
    - Broadway Bridge – Multnomah County, Portland, Oregon

Engineer's Impact – Rehab/Demo/Replace

- The Potential
  - Low tech materials – Reuse of existing components
    - Beaver Creek Bridges – Multnomah County, Portland, Oregon

Questions and Opportunities

- What can been done to facilitate more sustainable bridges?
  - Develop and implement project specifications leading to extended service life in new bridges, minimum recycled content in materials, local material usage
  - Implement Life-cycle Assessment/GHG Analysis early in the project development
  - Focus on ease of repair/rehabilitation/reuse

Questions and Opportunities

What other questions do we need to ask?

References

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7. Carbon Sense Solutions, www.CarbonSenseSolutions.com