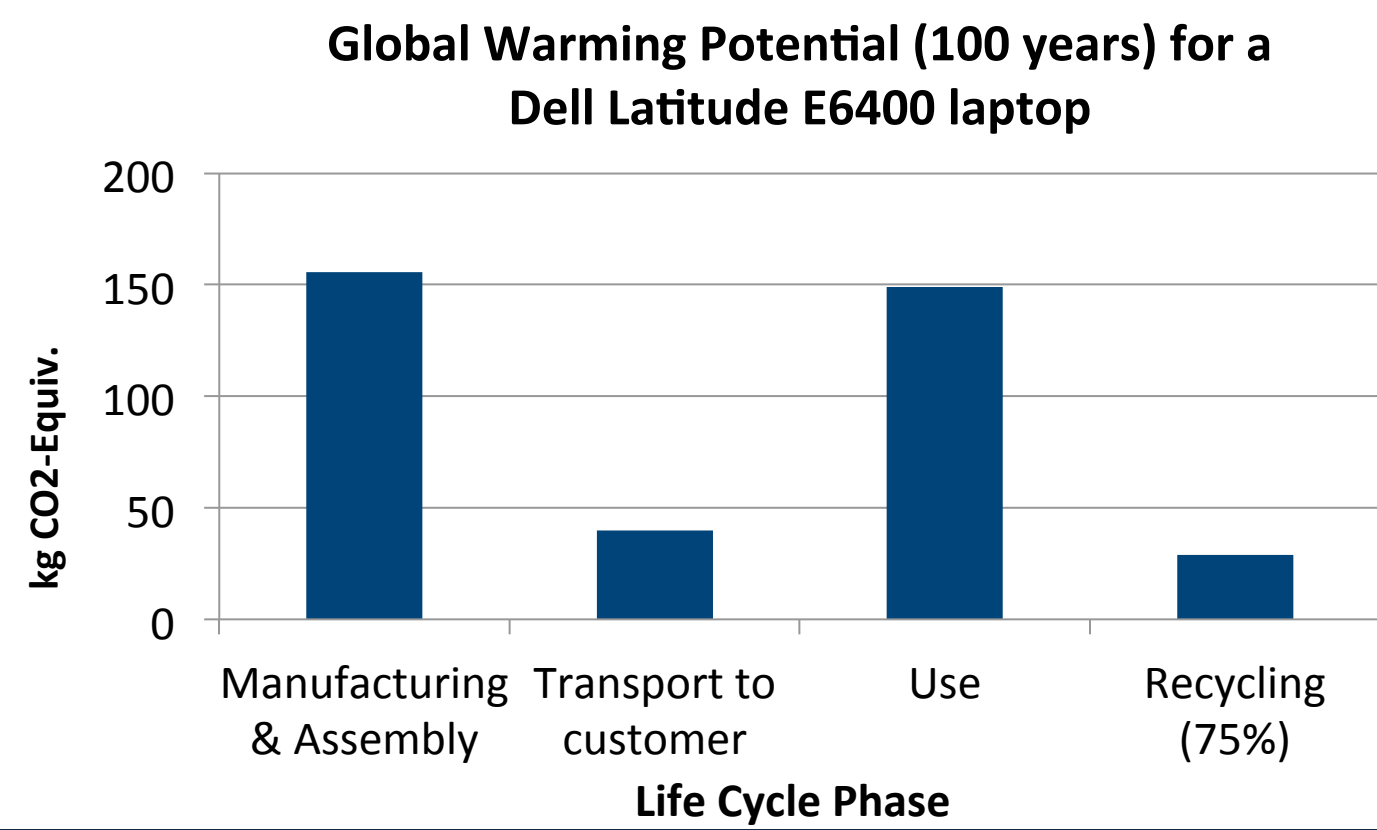


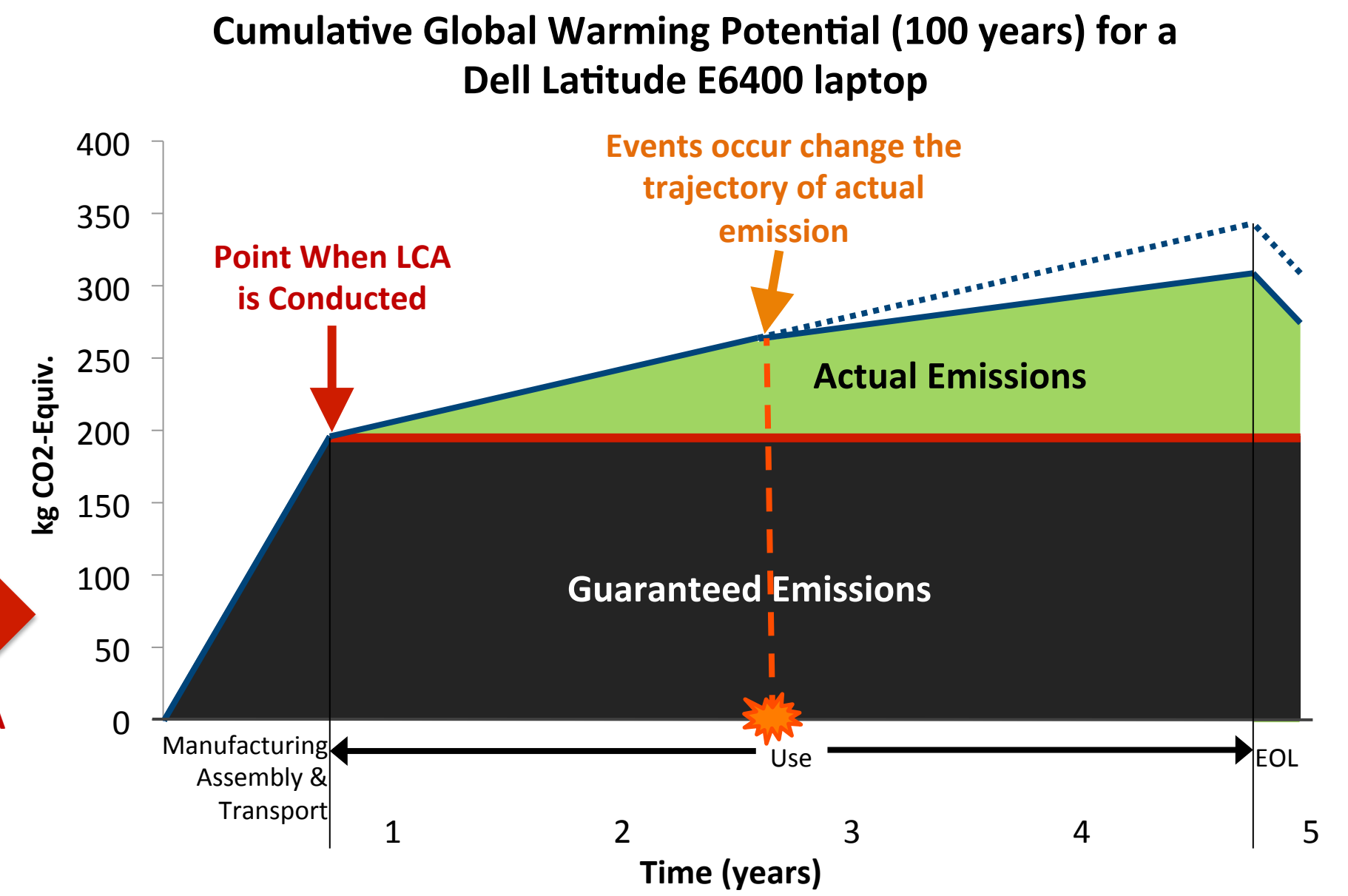
Framework for Modeling the Uncertainty of Future Events in Life Cycle Assessment

Objectives

- LCA may provide non-significant result if uncertainty is not included.
- A model framework is proposed to incorporate the uncertainty of future events into LCA.
- Traditional thinking of LCA:

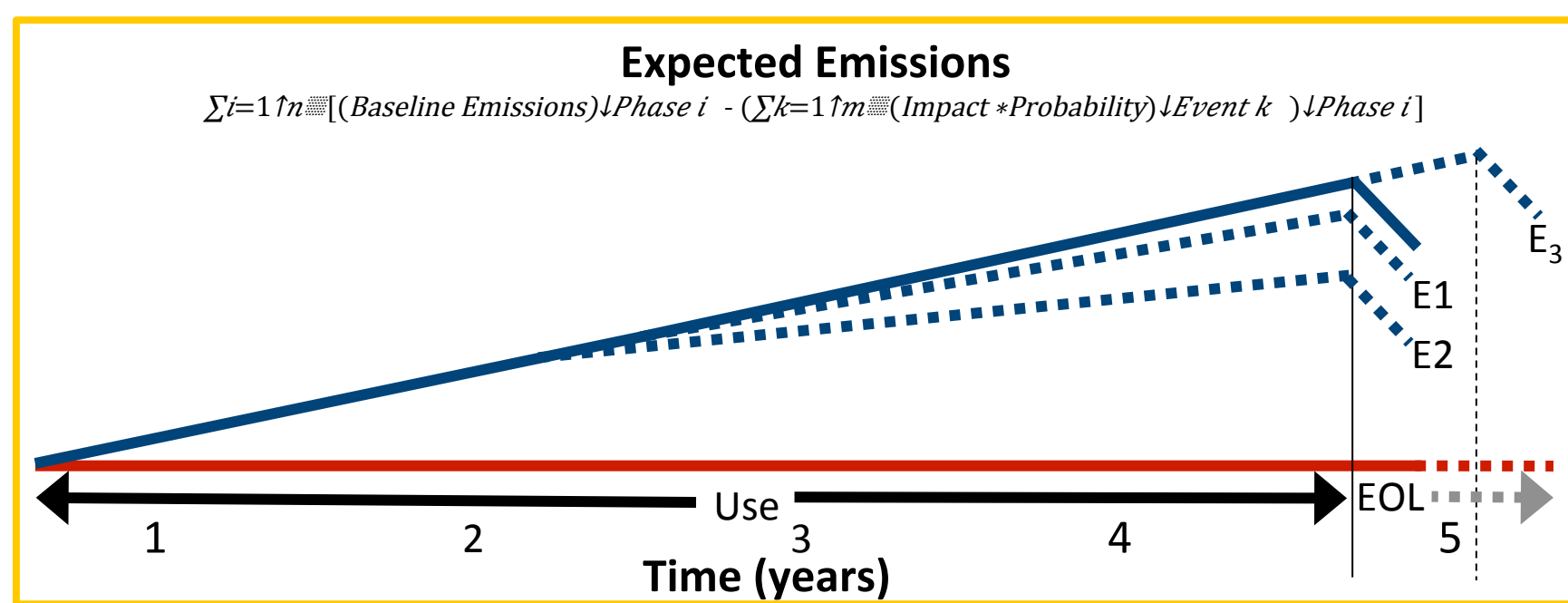


Rethinking LCA



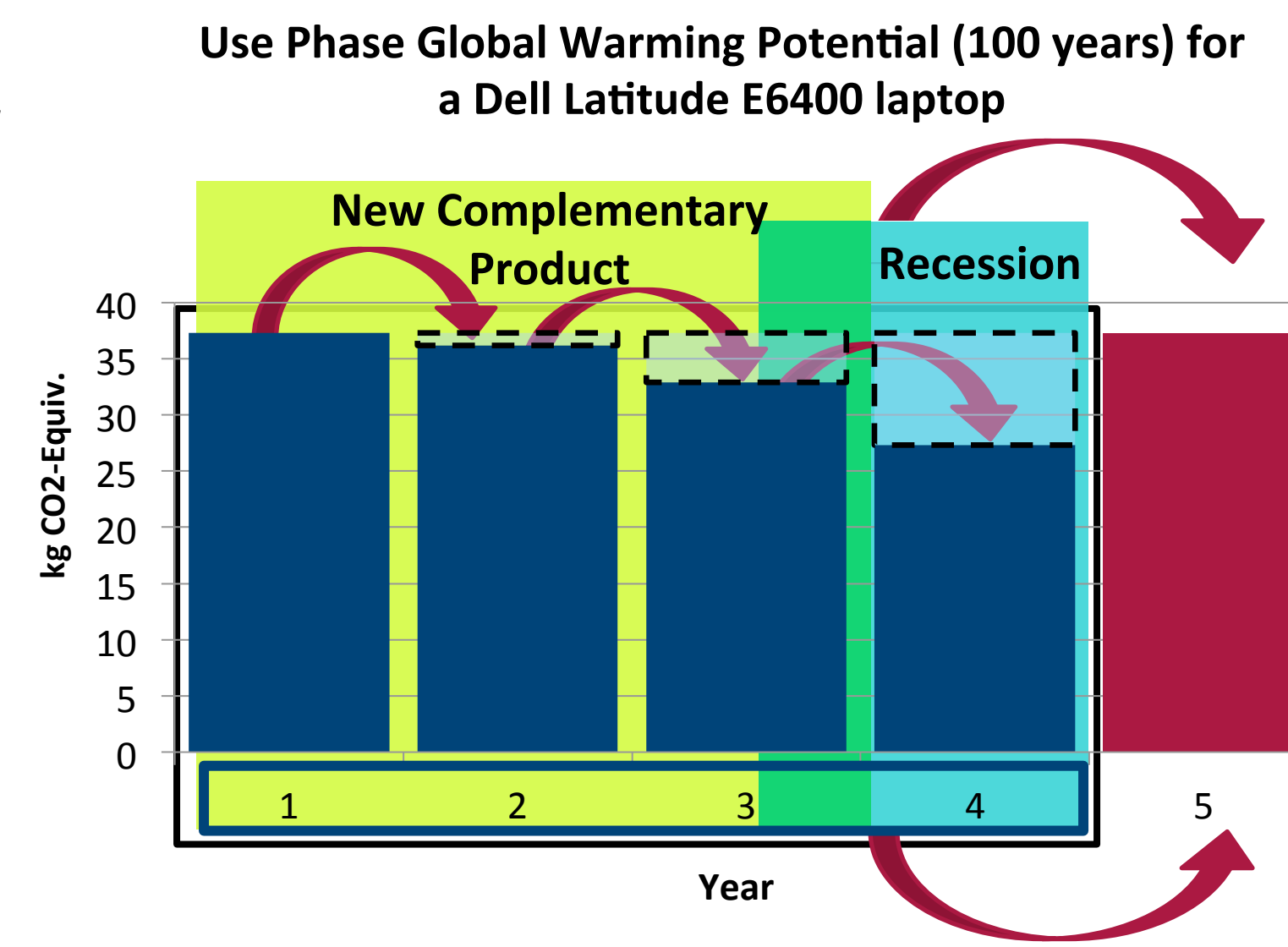
Model Framework: Rethinking LCA

- Concept for Event Adjusted LCA**
1. Identify events
 2. Determine probability over period
 3. Evaluate impacts
 4. Incorporate into LCA



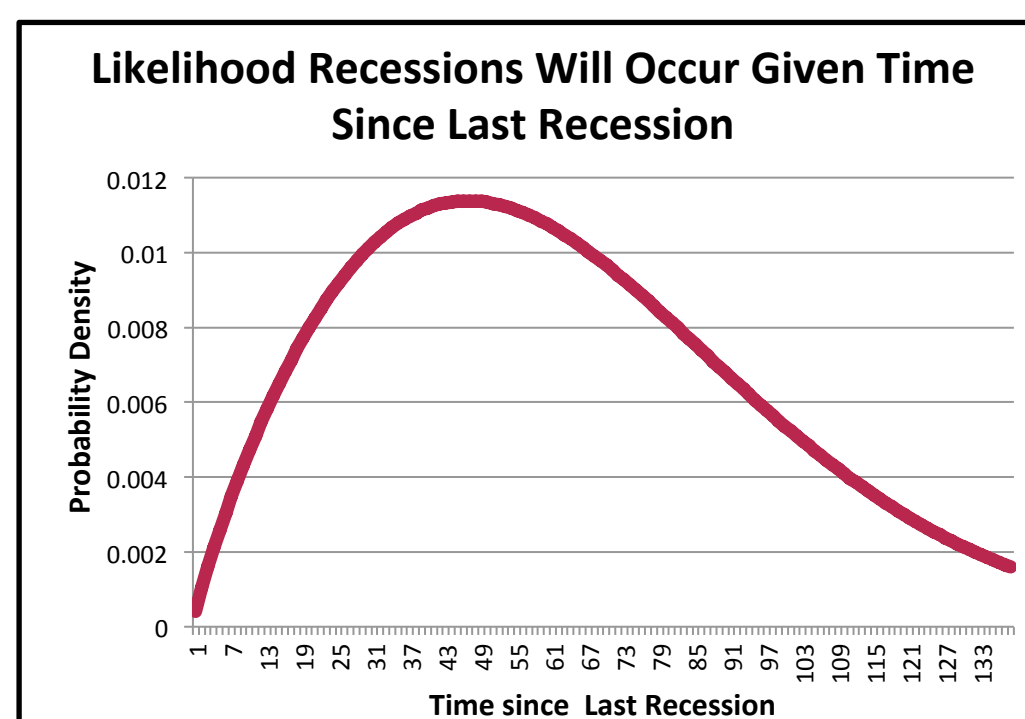
Case Study -- Laptop

- Carbon footprint of the use phase of laptop is significant.
- Two events are considered in the case study.
 - Recession
 - Complementary Technology
- Two scenarios with uncertainty are analyzed.



Probability of Recession

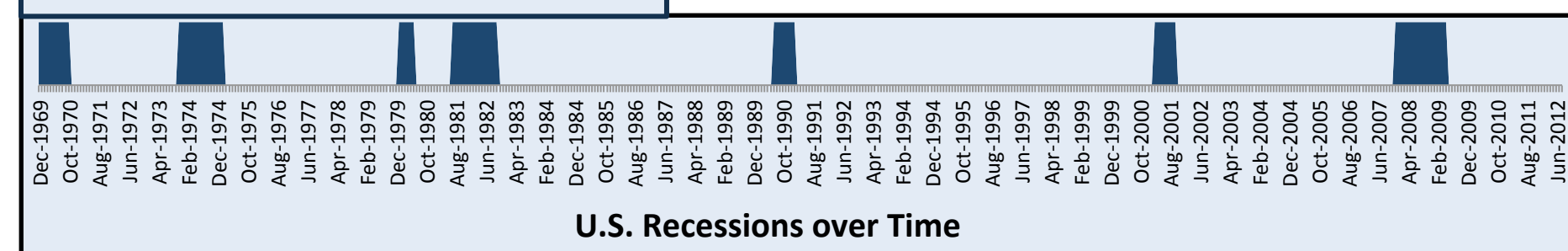
Chance of a Recession Occurring When People Begin Replacing Their Devices (third year of consideration on, in the U.S.)



The National Bureau of Economic Research (NBER) Recession Indicator significant decline in economic activity, lasting more than a few months, measured by:

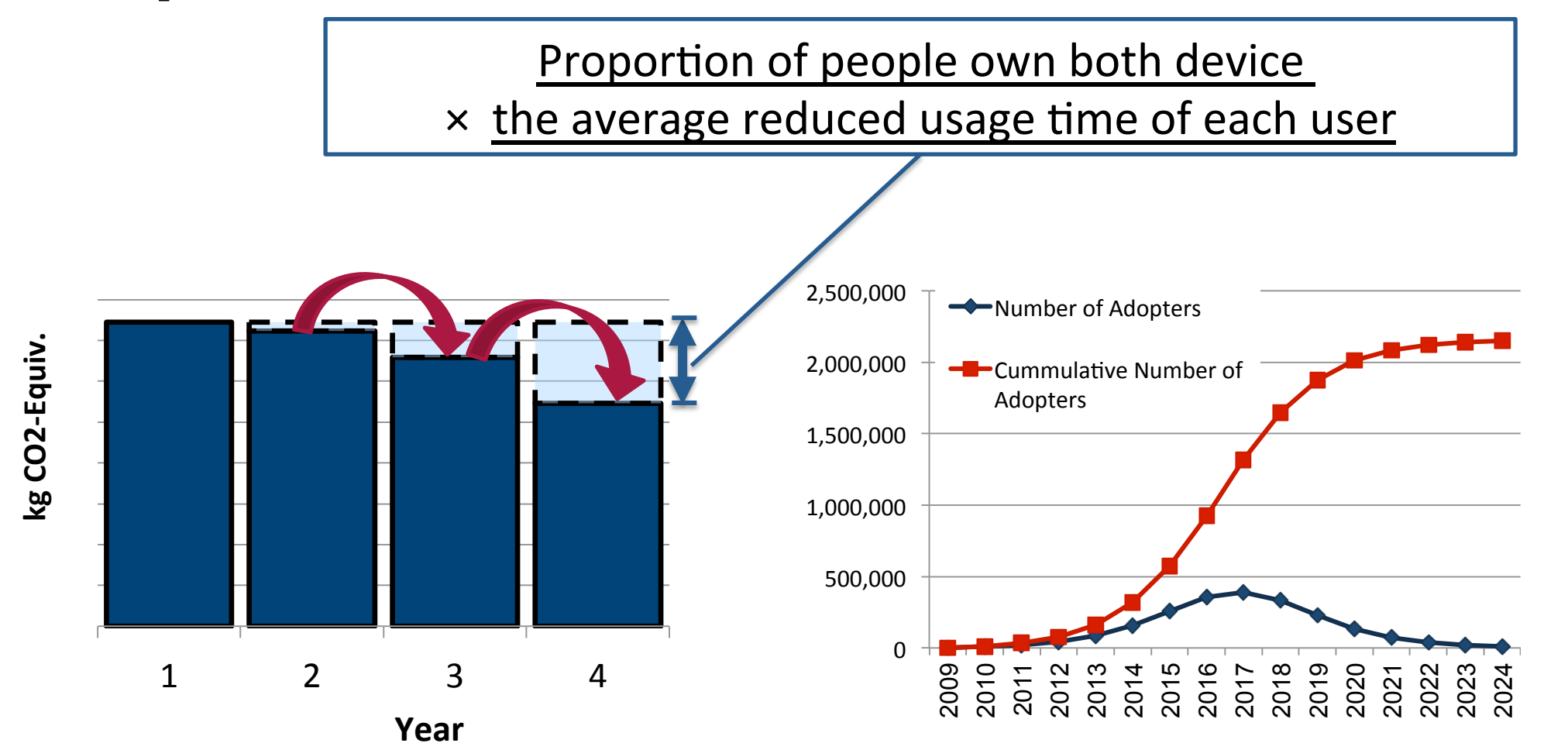
- Real GDP,
- Real income,
- Employment,
- Industrial production, and
- Wholesale-retail sales

Time Intervals between Events Fitted To Weibull Distribution



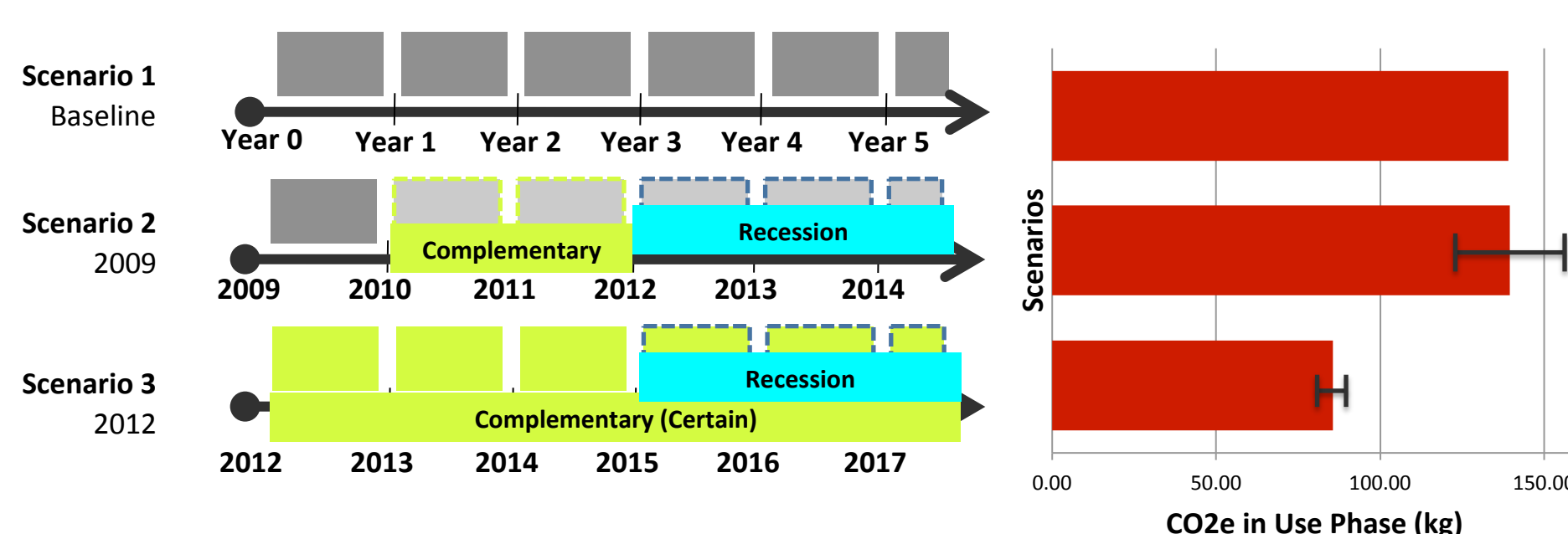
Tablet Impact on PC usage

- As a new complementary technology, surveys suggested that users who own both a tablet and a PC reduce their use time on old PCs for content consumption activities. [Morgan Stanley, 2010]



Case Study Results

- With the inclusion of uncertain events,
 - Use phase greenhouse gas emissions are up to **40%** lower than the benchmark scenario
 - **32%** to the overall LCA emissions reported by O'Connell and Stutz (2010) as opposed to their estimates of 47%.



Conclusion and Future Work

- A model framework is proposed to incorporate the future uncertainty.
- The model provides additional information about the possible range of the values that the carbon footprint will likely take.
- Case study on laptop shows the impacts of including such uncertainty has the potential to alter the LCA result significantly.
- More and better quality data may be required for better probability estimation of events.
- Future work: construct a database for identifying events and their probabilities.