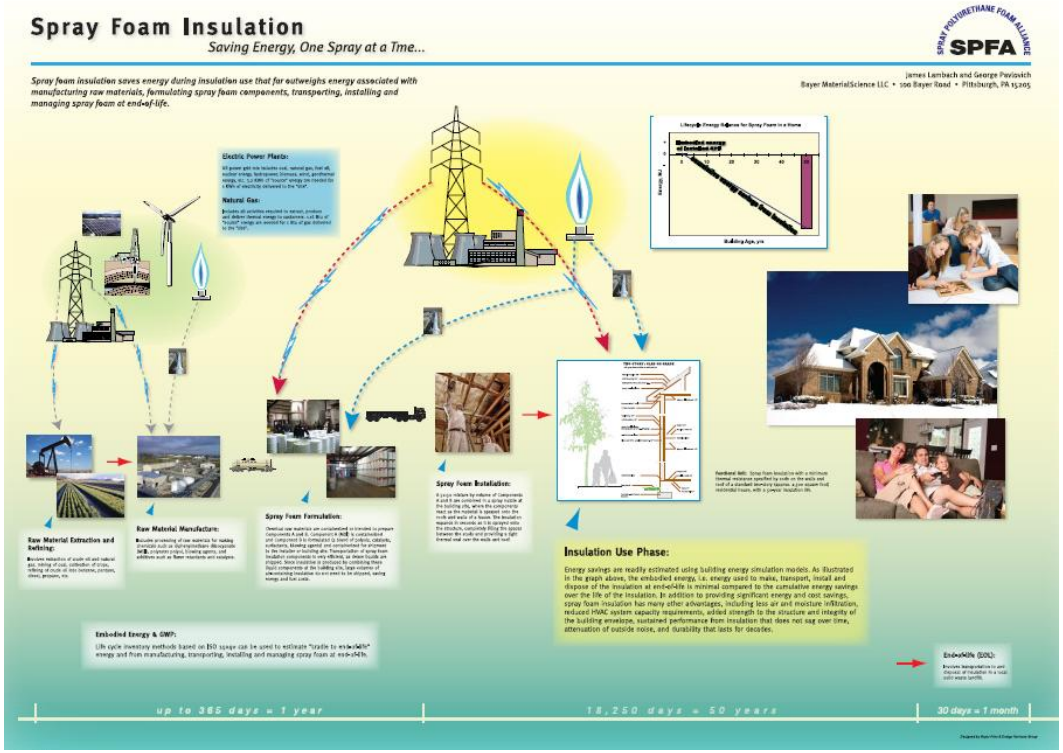



SPRAY POLYURETHANE FOAM ALLIANCE

SPFA

# Life Cycle Analysis

**LCA Software and Database**

**Materials Inventory and Processes**

**Energy Consumption and GWP**

**Transportation and landfill**

Jim Lambach and George Pavlovich
Bayer Material Science, LLC
100 Bayer Rd
Pittsburgh, PA 15205

Bayer MaterialScience

# What is “Life Cycle Analysis?

A methodology to holistically assess energy and environmental impacts of a material, cradle-to-grave.

Standardized method per ISO 14040 series

- Wellhead to installation includes …

  Raw materials for electricity, oil & natural gas for chemicals

  Manufacturing of components, preparation

  Transportation and installation

- Use phase modeled using recognized whole building energy simulation methods
- End of life removal and disposal

# Why is LCA Important?

- Product Reputation

  Communicating facts based on comprehensive and sound technical analysis

- Product Positioning

  Beneficial for LEED and other environmental programs

- Marketing

  Sell the unique benefits of SPF

- Product Optimization

  Improve SPF product (and sales) by addressing impacts from each life cycle stage

# Data Sources

- Published inventory data from recognized life cycle engineering software; e.g. NREL, GaBi, EIO-LCA
- Published life cycle reports for comparison and validation
- Process data from manufacturers, e.g. BaySystems, local installers
- Include European data sources for similar operations, where US sources not available

# LCA Process Software

## Ex. Gabi - for Wellhead to Installation

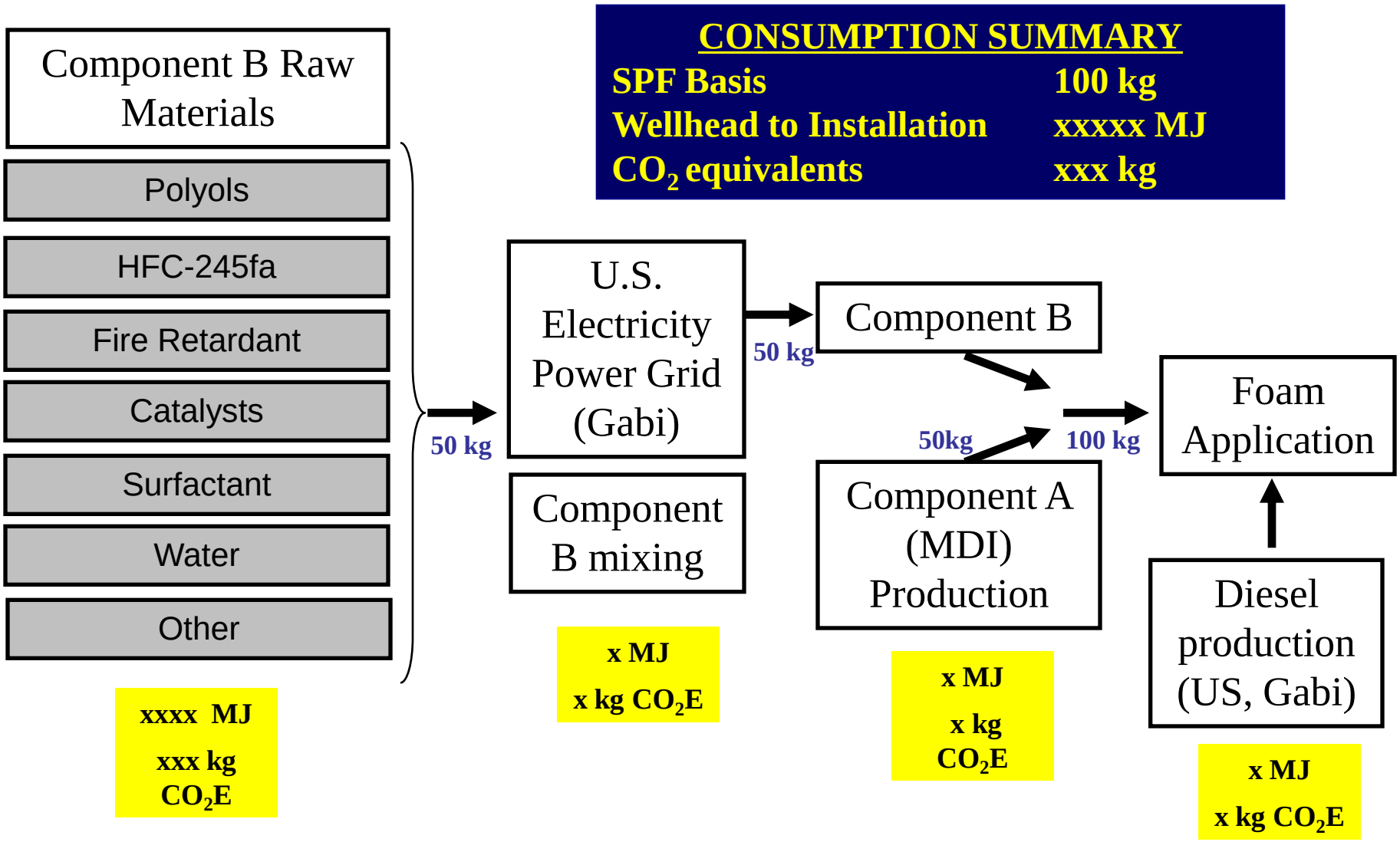
Use software to …

- Build a plan
- Choose processes or build processes and change parameters
- Connect process
- Balance Calculation then get energy consumption and GWP

*Advantages: Cradle to gate LCA, newly updated data,*

*Disadvantage: not all materials included in their database*

# Flow Chart for cc-SPF

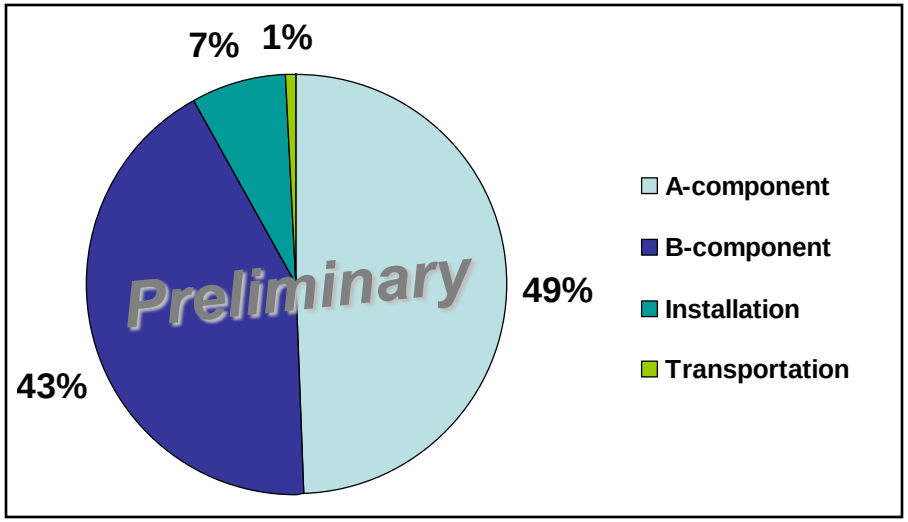


# Transportation

- Assume every raw material is transported by truck trailer
- Avg distance from manufacturing sites for raw materials to blending site, then transportation to insulation installation site
- Factor in truck return; e.g., 20% empty return to 100% empty return, by changing loaded percentage and distances input into Gabi

# LCA Phases

## Phase I Wellhead to Installation




## Phase II Use

## Phase III End of Life

**Gabi - commercial waste for municipal disposal (source: plastic Europe)**

# Use Phase

## Defining the Functional Unit for Energy Modeling Input

### Factors and Variations

- Selection of US Cities for Analysis
- Weather Data
- Type, Size, and Geometry of House
- Construction
- Number and Schedule of Occupants
- Internal Loads
- Thermal Envelope Variations
- Whole wall/ceiling/roof U-Value Calculations
- Leakage Properties
- HVAC & Environmental Control

# Model Input References

- Selection of US Cities for Analysis US Census
- Weather Data World Meteorological Organization / US DOE
- Type, Size, and Geometry of House Energy Information Administration
- Construction IECC Code
- Number and Schedule of Occupants US Census
- Internal Loads Energy Information Administration
- Thermal Envelope Variations Project Specific, Standard Practice
- Whole wall/ceiling/roof U-Value Calculations ASHRAE, ORNL Data
- Leakage Properties LBL Leakage Database, Other Data
- HVAC & Environmental Control 2008 ASHRAE Handbook

# Climate in Various U.S. Cities

| CITY | CLIMATE ZONE | CLIMATE NAME AND TYPE | THERMAL CRITERIA* | by Population* | NEW HOUSING STARTS 2007* |
|---|---|---|---|---|---|
| Miami | 1A | Very Hot – Humid | 5000 < CDD10ºC | 43 | 15,145 |
| **Houston** | **2A** | **Hot – Humid** | **3500 < CDD10ºC ≤ 5000** | **4** | **63,274** |
| **Phoenix** | **2B** | **Hot – Dry** | **3500 < CDD10ºC ≤ 5000** | **5** | **37,272** |
| **Atlanta** | **3A** | **Warm – Humid** | **2500 < CDD10ºC ≤ 3500** | **34** | **44,770** |
| **Dallas** | **3A** | **Warm – Humid** | **2500 < CDD10ºC ≤ 3500** | **9** | **43,568** |
| Charlotte | 3A | Warm – Humid | 2500 < CDD10ºC ≤ 3500 | 19 | 21,190 |
| Las Vegas | 3B | Warm – Dry | 2500 < CDD10ºC ≤ 3500 | 28 | 24,089 |
| Los Angeles | 3C | Warm – Marine | CDD10ºC ≤ 2000 | 2 | 26,616 |
| **DC** | **4A** | **Mixed – Humid** | **CDD10ºC ≤ 2500 AND HDD18ºC ≤ 3000** | **25** | **22,459** |
| **Seattle** | **4C** | **Mixed - Marine** | **2000 < HDD18ºC ≤ 3000** | **24** | **25,403** |
| Boston | 5A | Cool - Humid | 3000 < HDD18ºC ≤ 4000 | 23 | 11,248 |
| **NYC** | **5A** | **Cool - Humid** | **3000 < HDD18ºC ≤ 4000** | **1** | **56,405** |
| **Chicago** | **5A** | **Cool - Humid** | **3000 < HDD18ºC ≤ 4000** | **3** | **33,933** |
| Milwaukee | 6A | Cool - Humid | 4000 < HDD18ºC ≤ 5000 | 22 | 3,266 |

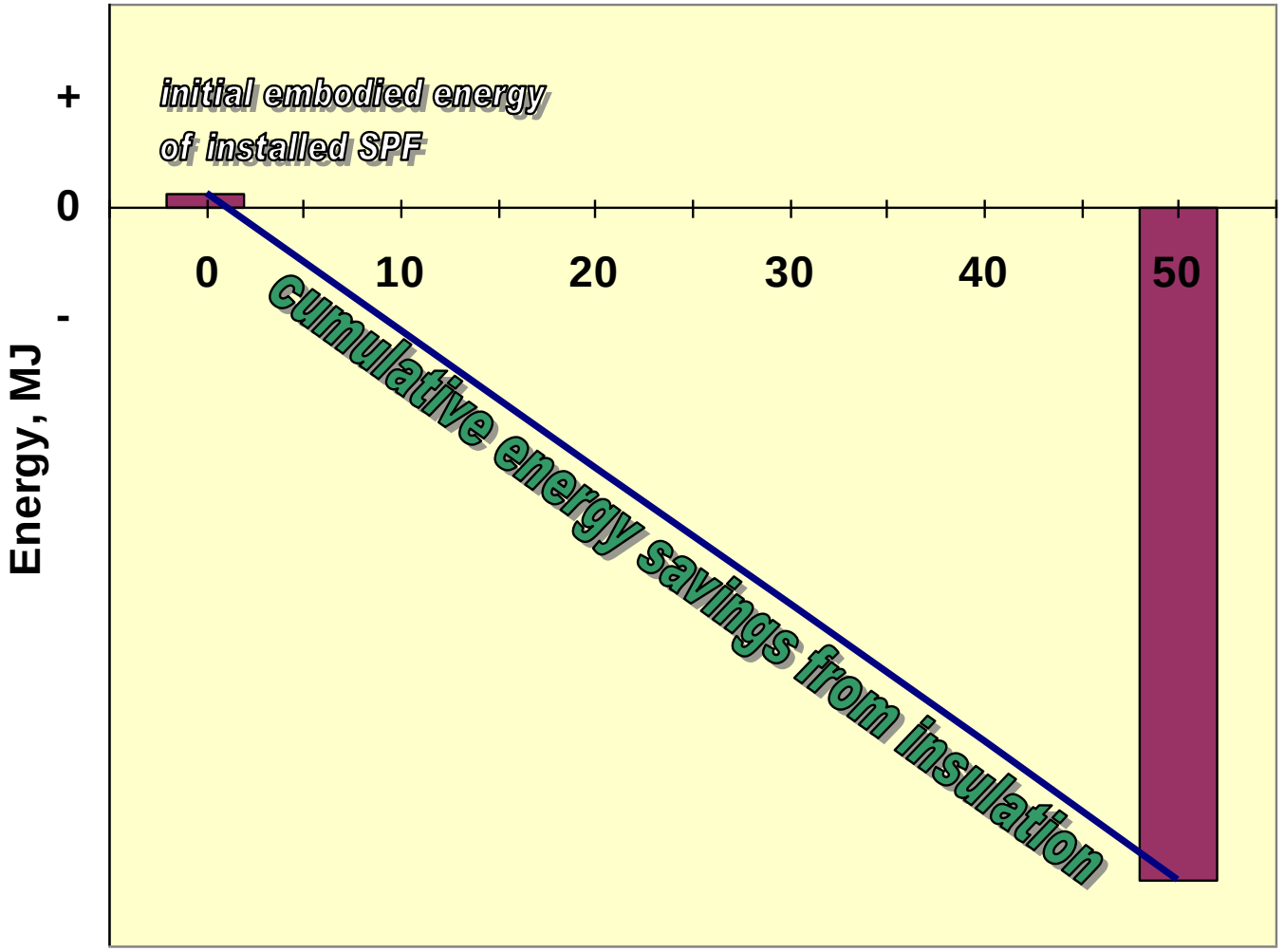
* US Census Bureau. "Cities with 100,000 or More Population in 2000 ranked by Population per Square Mile, 2000 in Alphabetic Order". County and City Data Book. Table C-1.

* US Census Bureau. Table 3au. : "New Privately Owned Housing Units Authorized Unadjusted Units by Metropolitan Area." Annual 2007.

* Briggs, Robert S., Robert G. Lucas and Z. Todd Taylor. *Climate Classification for Building Energy Codes and Standards*. Pacific NW National Laboratory.

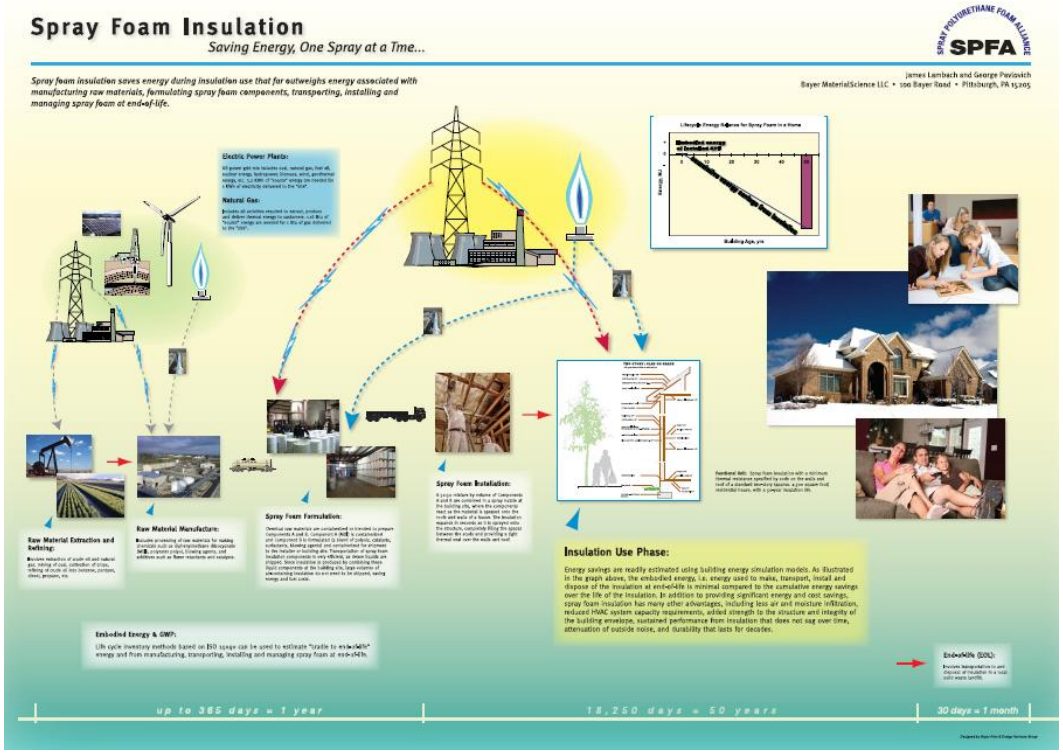
# Energy Savings in Use Phase

**Lifecycle Energy Balance for SPF in a Home**



# Summary

- **LCA Parameters**
  - **Standardized ISO Methodology**
  - **Three Phases**
    - **wellhead-to-installation**
    - **USE**
    - **end-of-life**
- **Preliminary Results Show Use Phase Energy Savings from SPF Insulation Overwhelm Embodied Energy at Installation and End-of-Life!**




SPRAY POLYURETHANE FOAM ALLIANCE

SPFA

# Life Cycle Analysis

**LCA Software and Database**

**Materials Inventory and Processes**

**Energy Consumption and GWP**

**Transportation and landfill**

Jim Lambach and George Pavlovich
Bayer Material Science, LLC
100 Bayer Rd
Pittsburgh, PA 15205

Bayer MaterialScience