AQUENCE

Life Cycle Assessment

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What is Aquence?

- Alternative to Electrocoat (E-Coat)
- Protect metal parts from corrosion
- Third Generation Epoxy/Acrylic Coating (2008)
- Primer or Single-Coat:
  - Applied before powder coat, clear coat, topcoat
- Coats parts of many sizes & shapes

Painting/coating in Manufacturing

Automotive coating processes contribute a significant share of environmental burden during vehicle manufacturing[1]

- Automotive painting operations consume

  ~ 23% of Ford's reported auto plant energy[2]

- Pretreatment & electrocoating

  ~3.09% of Ford's reported auto plant energy[3]

[1]Prendi et. al 2006

[2]Ford Motor Company 1998

[3]Roeland et al. 2004

Environmentally Responsible Coating

- Hazardous air pollutant free
- Low VOC <0.03 lb/gallon (paint solids)

Still impacts from

– Energy, water, chemical use

Aquence LCA Goals

- Understand Aquence's environmental impacts across all categories and identify areas to focus on for improvement

- Benchmark against traditional electrocoating technology

Goal and Scope:

- “Gate-to-gate”
  - Analyzing only one stage in the life cycle
  - No capital equipment, overhead

- Three month internship

Goal and Scope:

Functional Unit:

Corrosion protection for m^2 metal surface

Reference Flow:

m^2 of coated Aquence 930 surface from Auto Parts Plant, Mexico

Data Flow:

1.8 m^2 part

Data Source:

Henkel fiscal calculator

Goal and Scope:

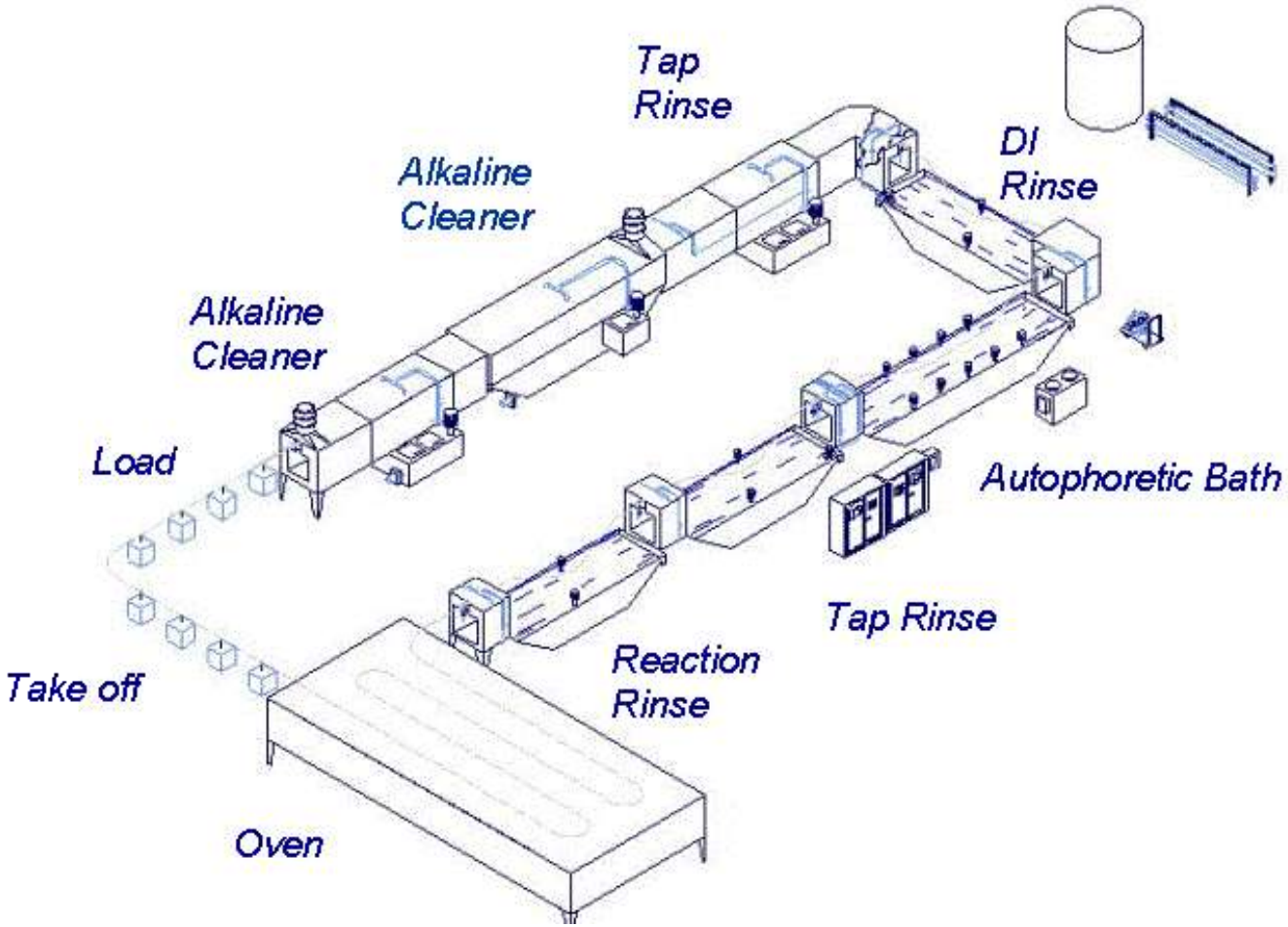
Included

- Electricity*
- Thermal
- Chemical Manufacture*
- Water Use
- Wastewater
- VOC

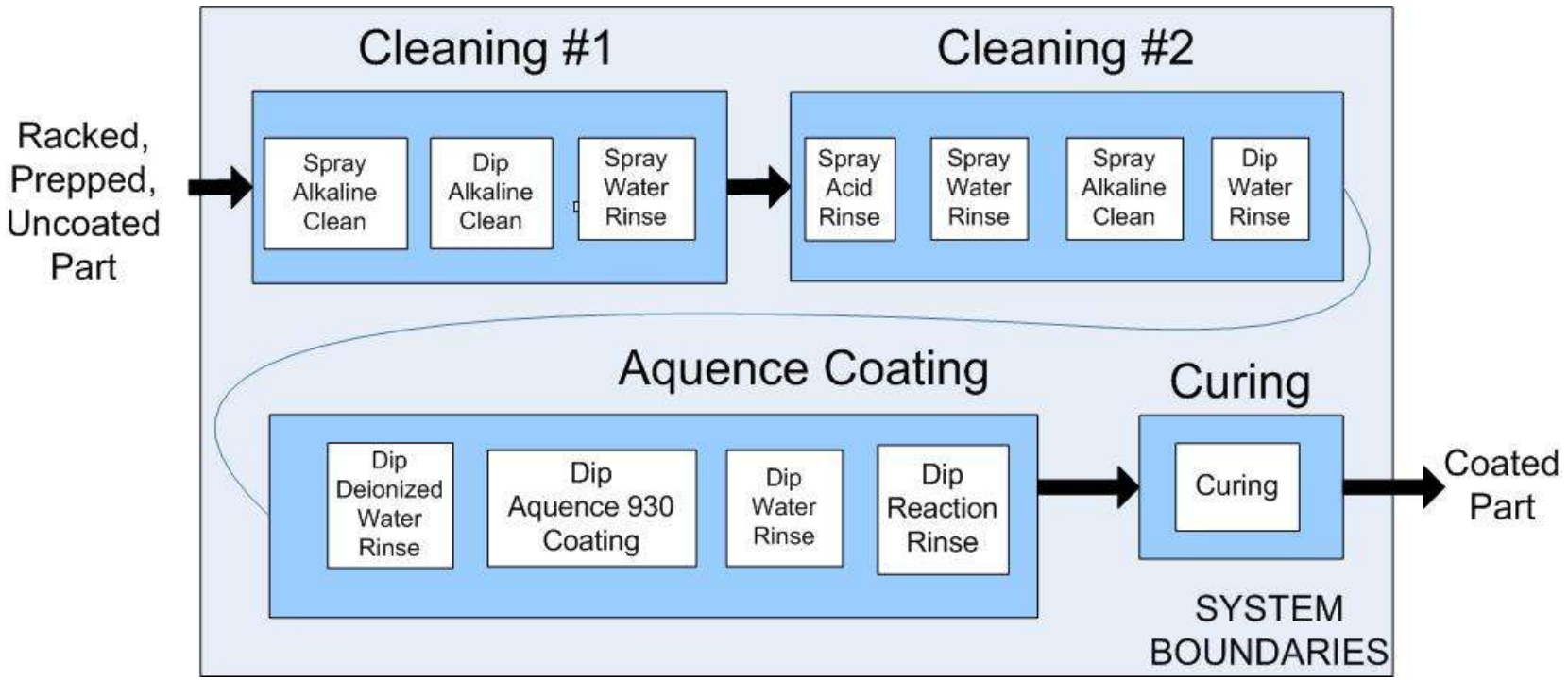
Excluded

- Shipping to facilities
- Totes/containers
- Capital Equipment
- Use
- End of Life

Typical 7 Stage Conveyor Line



Process Flow Diagram: Auto Parts Plant



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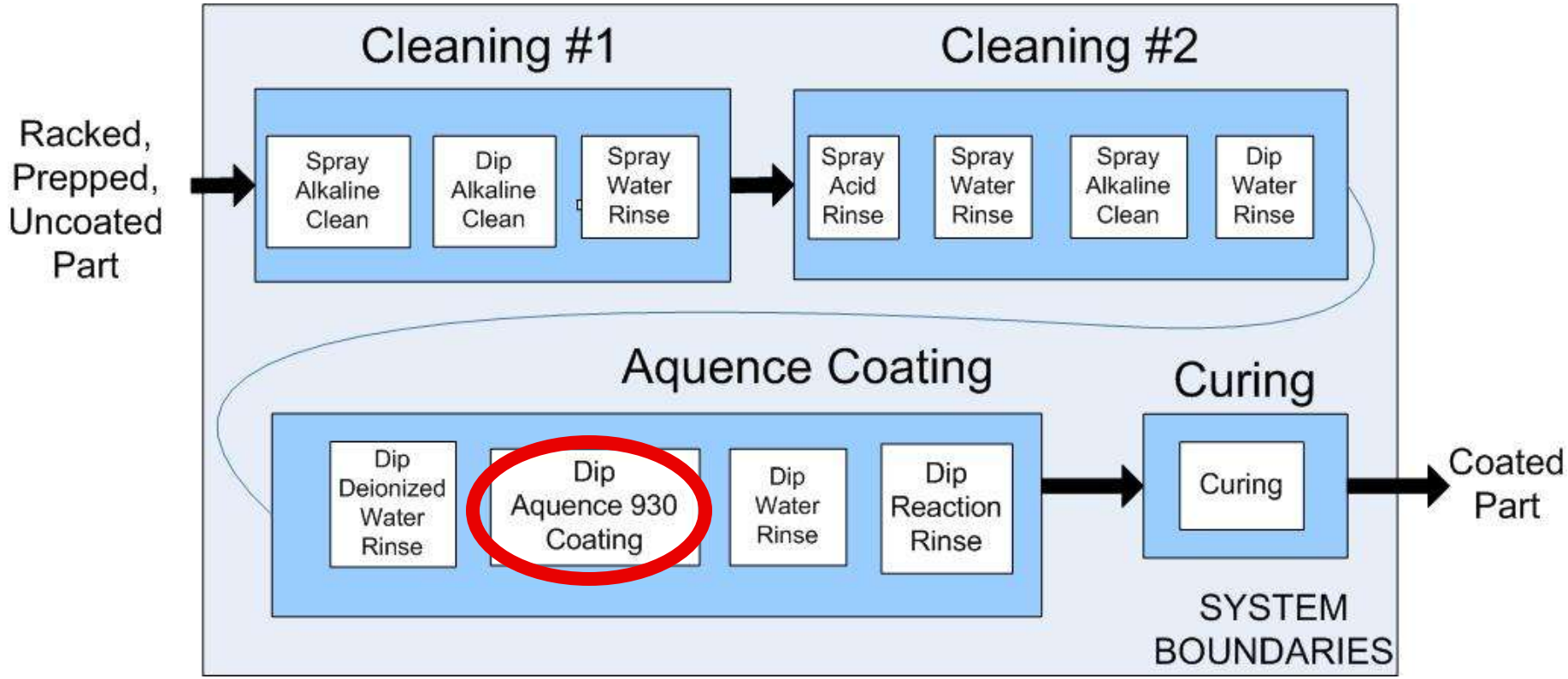
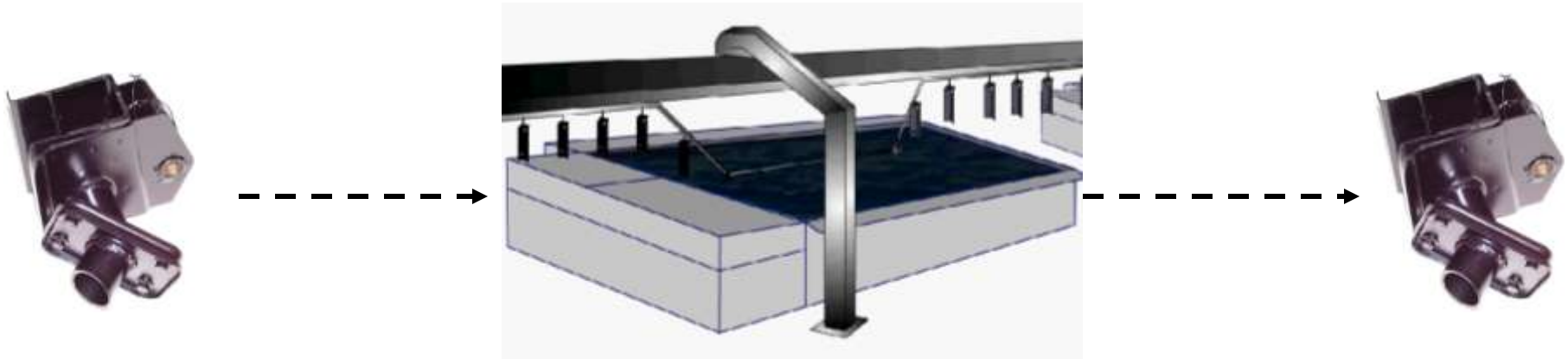


LCI: Aquence 930 Unit Process

Inputs
- Paint
- Industrial Water
- Electrical energy
- Thermal energy



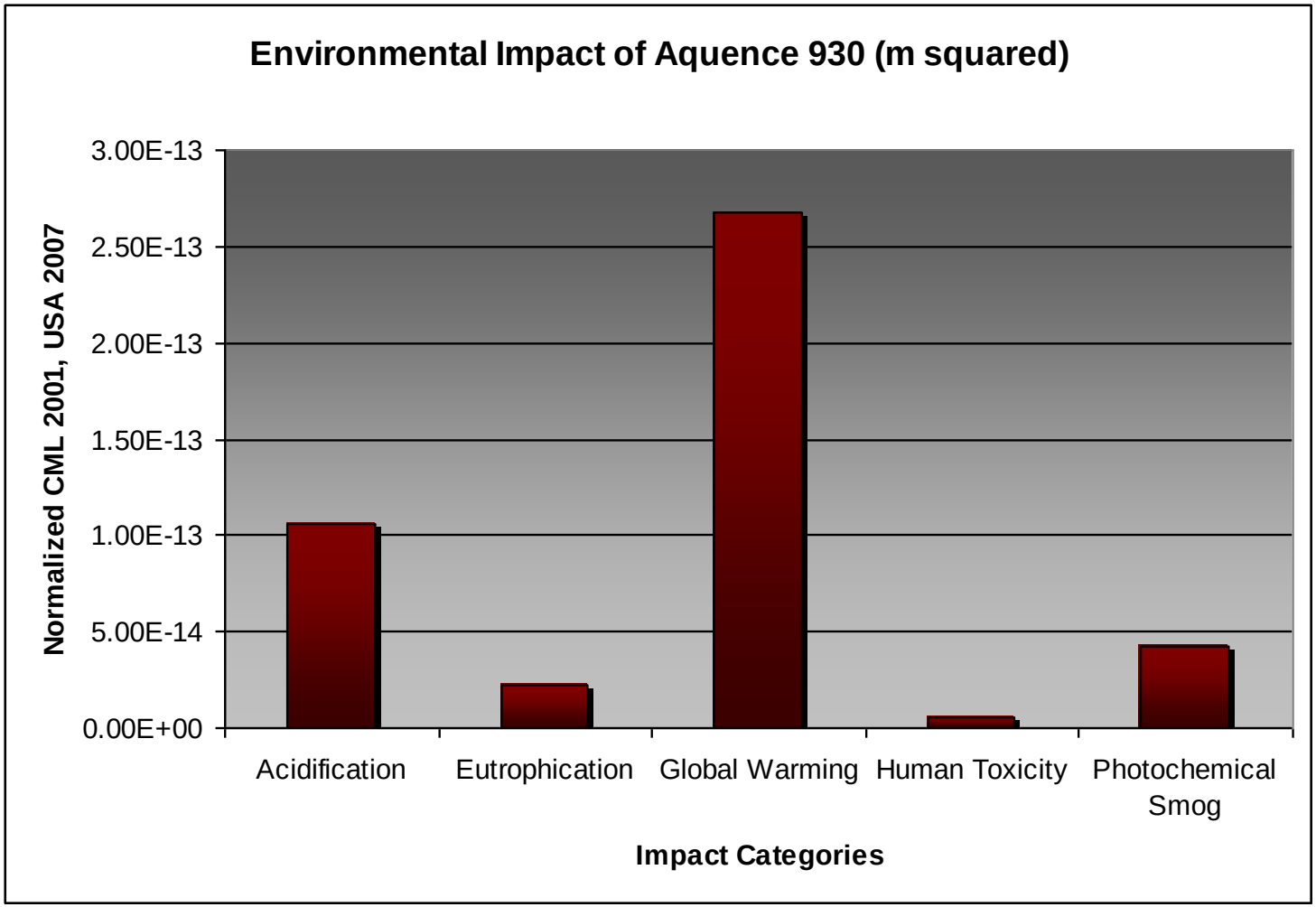
Outputs
- Wastewater
- VOC

Impact Assessment

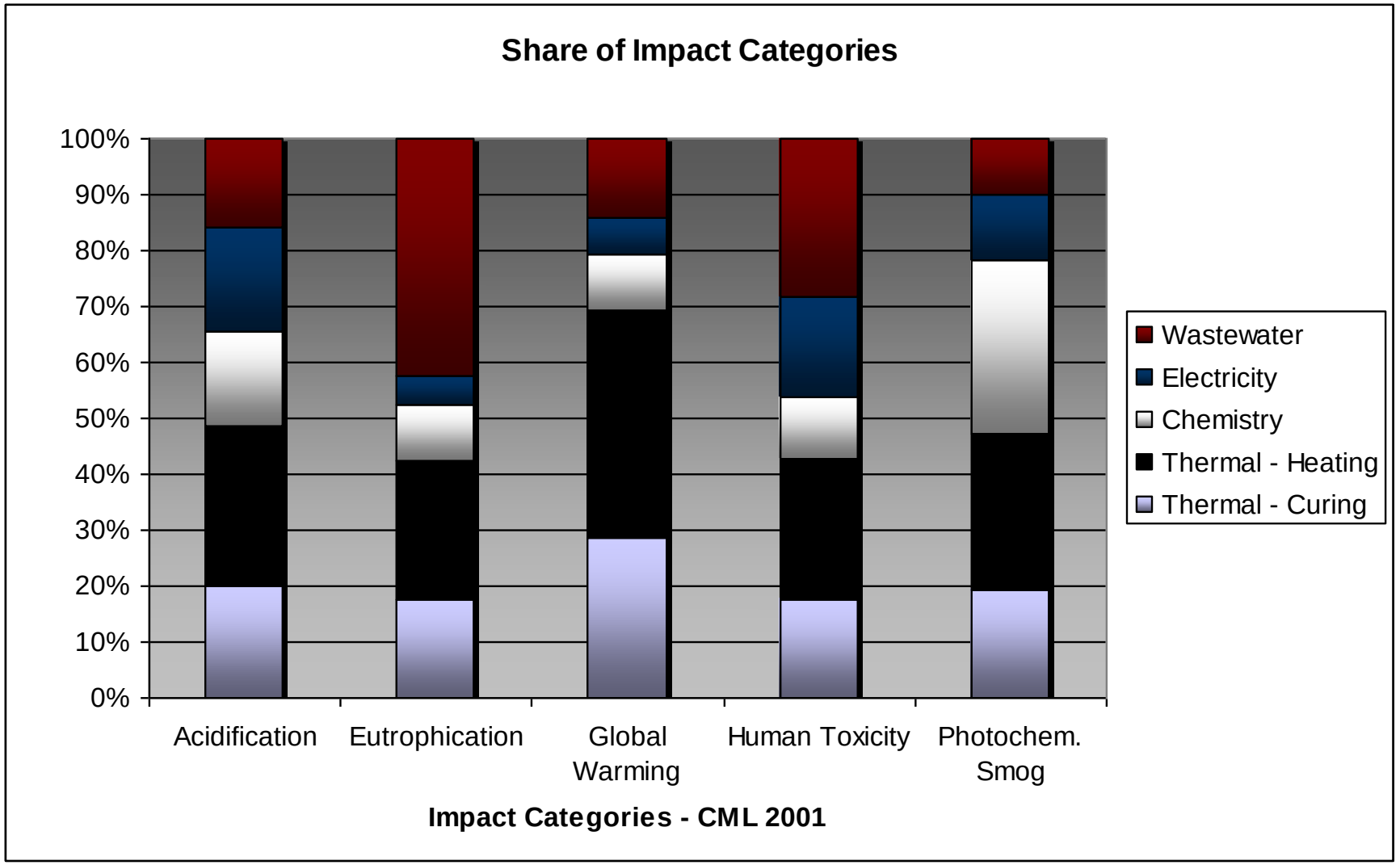
CML 2001 – Dec. 07

- Global Warming Potential (GWP)
- Acidification Potential (AP)
- Human-and Eco-Toxicity Potential (HTP, ETP)
- Eutrophication Potential (EP)
- Photochemical Oxidant Creation Potential (POCP)

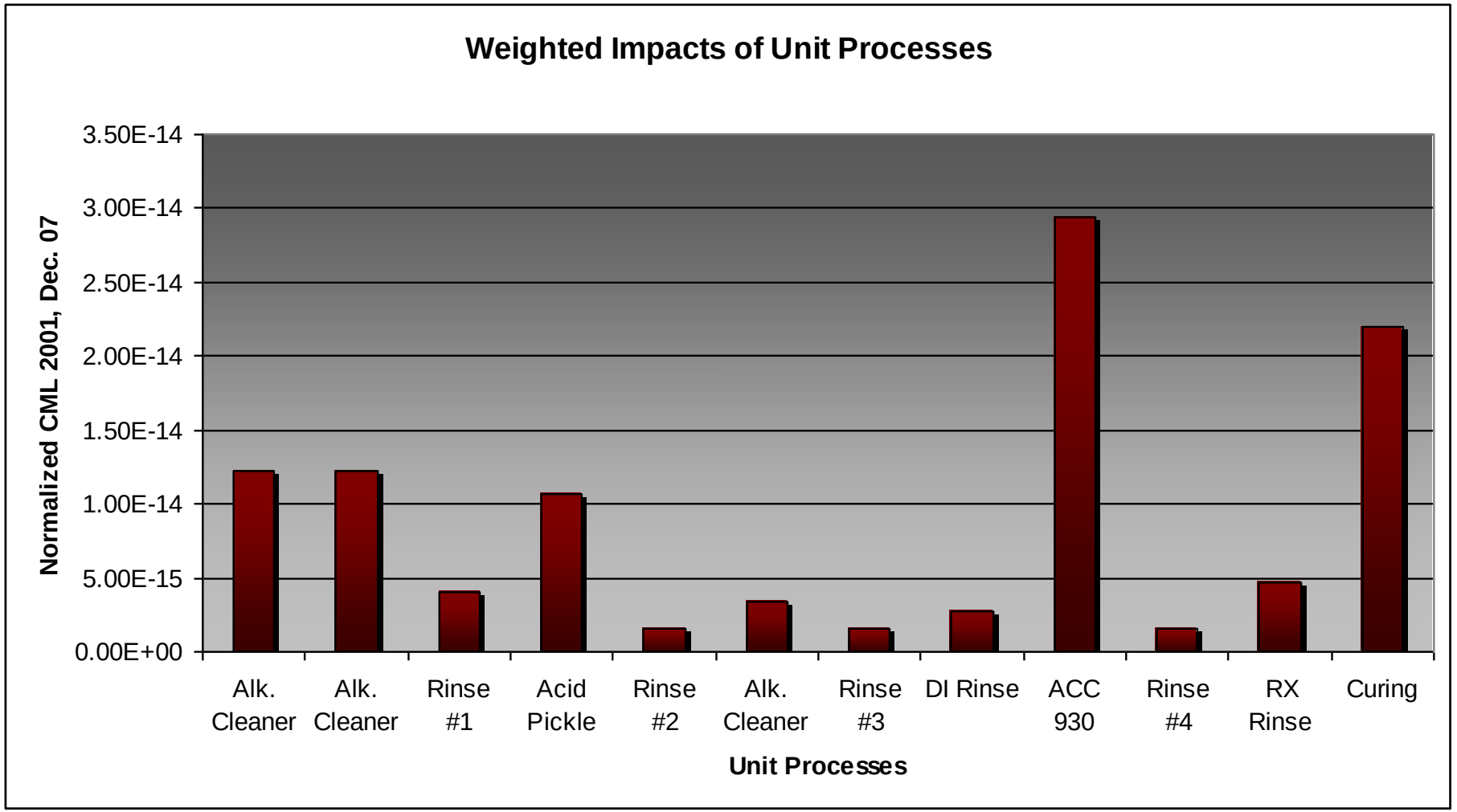
Final Results



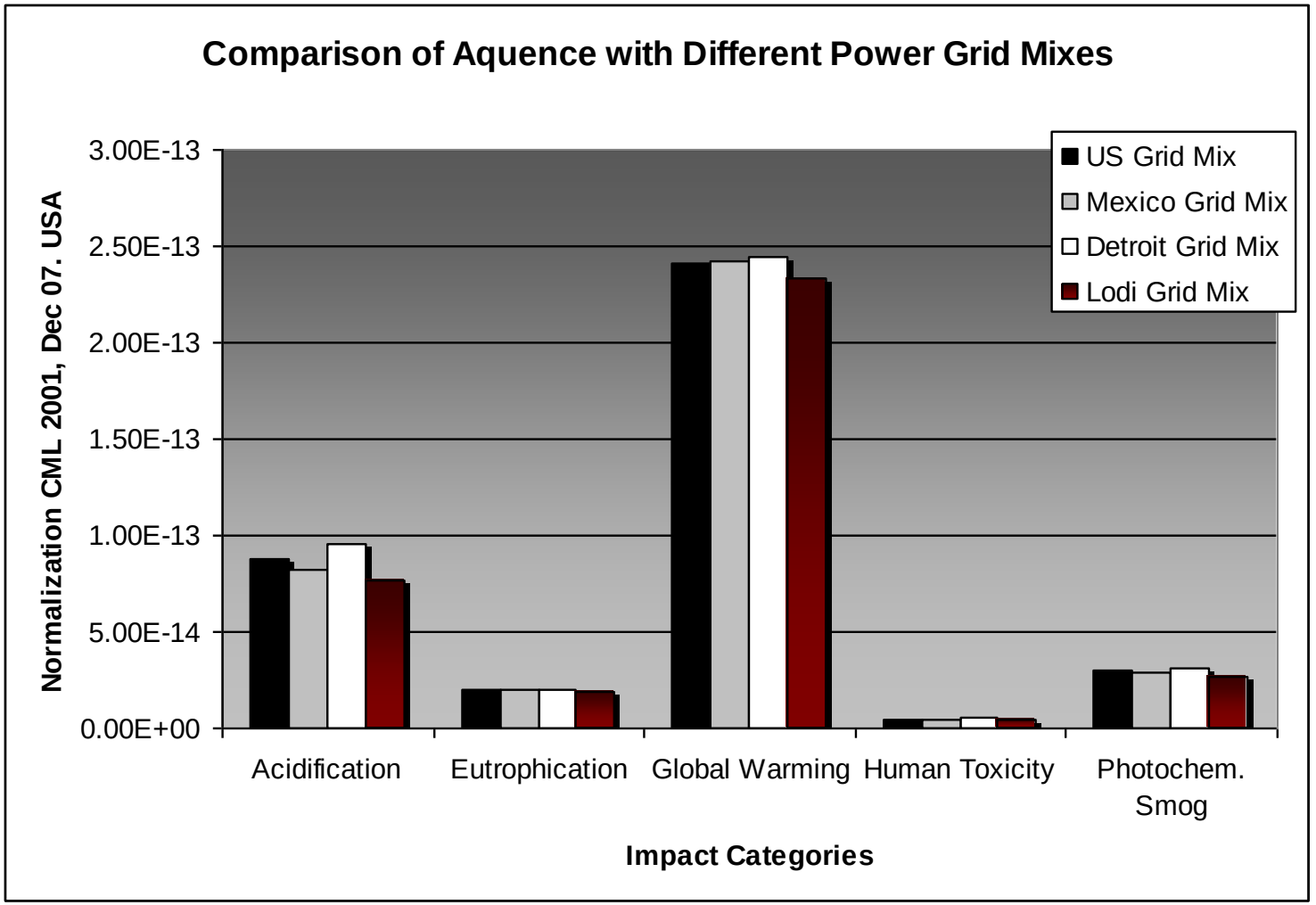
Final Results



Unit Process Impacts



Grid Mix Impact on Model



Future Modeling Challenges

- Curing/co-curing
- Linear scaling?
  - Size, shape, complexity, durability of part
- Overflow/backflow between treatment stages
    - Closed-loop water recycling
- Wastewater treatment

Limitations

- Lack of primary data
- Chemical modeling
- Does not address scalability of part size

Recommendations

- Energy audit to benchmark estimates
- Update LCA model as data is available
- Set up a system with customers to track environmental performance indicators
- Target thermal energy use
  - Over 70% GWP
- Adapt fiscal calculator for LCA