Life-Cycle-Analysis of Vehicle Bodies (BIW’s)

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Germany- Current Economic & Labor Conditions

- Population- 82 million
- GDP $2.1 trillion, 2.8% growth in 1998
- Unemployment 10.9% - above 4.5 million
- Highest corporate taxes amongst OECD countries
- Unit labor costs lower than in UK and Japan
- Annual industry working hours
  - ~13% less than in US and Japan
Outline

- Current Economic situation
  - Overview
  - Industry Statistics
- Our Goals
- Economic Analyses
- Preliminary Conclusions
- Summary

Industry Statistics (1997)

<table>
<thead>
<tr>
<th>Industry</th>
<th>Employment</th>
<th>Production (M-tons)</th>
<th>Automotive Use (M-tons)</th>
<th>In Percent</th>
<th>Exports (M-tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel</td>
<td>85,000</td>
<td>45</td>
<td>16</td>
<td>36%</td>
<td>15</td>
</tr>
<tr>
<td>Aluminum Forming</td>
<td>12,000</td>
<td>2.5</td>
<td>1</td>
<td>40%</td>
<td>-2</td>
</tr>
<tr>
<td>Plastics</td>
<td>60,000</td>
<td>12</td>
<td>1</td>
<td>8%</td>
<td>NA</td>
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Goals and Objectives

• Reduce unemployment
• Promote favorable conditions for economic growth
• Maintain social security system
• Strengthen East German economy
• Reconcile economic and ecological goals

Economic Analyses

• Strategy
  – Evaluate Options
    • Materials Combination
    • Production Volume
    • Other...
  – Sensitivity Analysis
    • Future Market?
    • Impact of Input Changes

• Outline
  – Manufacturing Costs
    • BIW
  – Operation of Vehicle
    • Fuel Costs
  – Recycling
    • Dismantler
    • Shredder
  – Total
Manufacturing of BIW

Relationship between BIW Mass and BIW Cost

- Poly. (100)
- Poly. (300)
- Poly. (800)

Total Manufacturing Cost BIW [\$]

BIW Mass [lb]

Production Cost vs. BIW Mass
Cost of Operation

- Assumptions: “First Principle”
- 3111lb all-steel-BIW Ford Taurus is baseline (21.4MPG)

Cost of Operations are Independent of Q

Recycling Costs

- Recycling Costs Independent of Production Volume

Note that Dismantler Revenue: ~$90.45 (excl. glass, rubber, fluids)
Total Cost of Vehicle
(including BIW costs, fuel, recycling)

Sensitivity Analysis

Change in costs assuming fuel increase to $8/gal (double) and decrease of aluminum raw price to $1.30/lb (from 1.50) and increase of scrap aluminum to $0.35/lb (from 0.30) [Q=300,000]
Preliminary Recommendations

- Aluminum is the best compromise material
  - benefits outweigh costs
  - potential for new industries
- Specific material proportions left up to automotive manufacturers
  - no industry regulation
- Plastics are not currently a viable option
  - Acceptable Manufacturing and Operation Costs
  - Recycling Problems

Aluminum-Pro's & Cons

<table>
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<tr>
<th>Pros</th>
<th>Cons</th>
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<tr>
<td>Lifetime savings in fuel three times more than rise in sticker price</td>
<td>Increased cost of production i.e. affects competitiveness of German auto manufacturers</td>
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<tr>
<td>New aluminum forming plants</td>
<td>Import of raw aluminum</td>
</tr>
<tr>
<td>Sustainable recycling</td>
<td>Limited Aluminum availability?</td>
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<tr>
<td>Expansion of existing recycling infrastructure</td>
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Summary - Policies to Promote Use of Aluminum

- Award tax credits to automotive manufacturers in proportion to aluminum use
- Reduce annual road tax for vehicles made with a determined proportion of aluminum
- Educate consumers about fuel cost savings (as well as environmental benefits) associated with increased fuel efficiency
- Provide economic incentives to companies entering or expanding aluminum forming and recycling industries