

# Recycling Strategies in Automotive Industries

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## **Materials Systems Laboratory**

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- Eighteen Year Effort at MIT to Study the Strategic Implications of Materials and Materials Processing Choices
  - MIT Department Of Materials Science & Engineering
  - Center For Technology, Policy & Industrial Development
  
- Emphasis:
  - Application Of Analytic Methods To Detailed Case Studies Drawn From Current Strategic Industrial Issues
  
- Objective:
  - Competitive Position Of Materials
  - Evaluation Of Materials Processing Technologies
  - Analysis Of Strategic Opportunities And Threats
  - Evaluation Of The Promise/Limits Of Materials, Processes & Designs

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## Methodological Approach

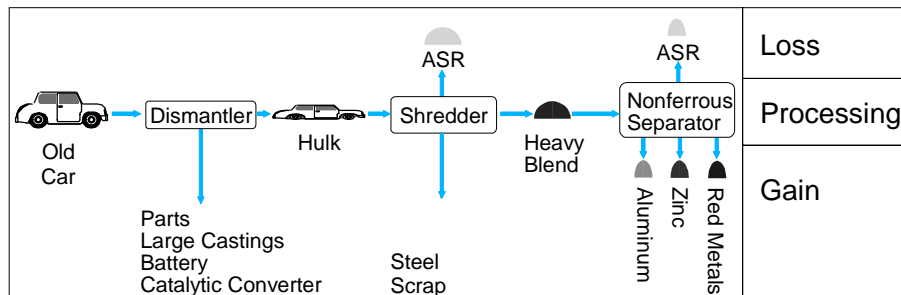
- **Methodological Approach:**
  - **Development Of Engineering And Economic Based Tools For Evaluation Of Alternatives In Advance Of Full Blown Development**
    - *Technical Cost Modeling*
    - *Lifecycle Cost And Emissions Tracking*
    - *Decision Analysis Techniques*
    - *Systems Dynamics Modeling*
  - **Systems Approach to Strategic Decisionmaking**
    - *Multiple Objectives Must Be Considered Simultaneously*
    - *Interactive Effects Between Individual Process/Material Choices*
    - *Functional Equivalence Needed for Meaningful Comparisons*
- **Synthesis Of Results Into A Description Of Materials Competitiveness**

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## Vehicle Recycling - A Recurring Automobile Issue

- **Depending on How You Look At It, This Is The Second (or Third) Time Around**
- **Well-Established Vehicle Recycling Infrastructure**
- **Economics Of Infrastructure Dominated By Shredder Economics**
  - **Recovery of Scrap Metals, Particularly Ferrous Metals**
- **Policies Driven By A Conventional View Of Recycling**



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## Overview: Latest Version of Recycling Goals

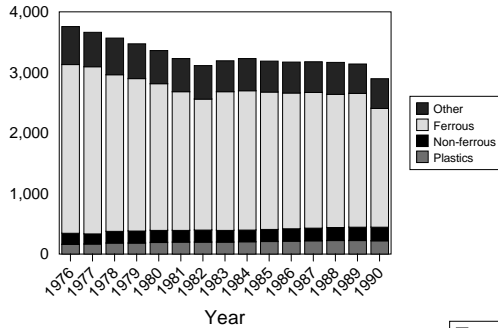
- By 2006,
  - Re-use/recycle 80% of vehicles by weight
  - Re-use/recover 85% of vehicles by weight
  - Design for 85% recyclability and 95% recoverability
  
- By 2015
  - Re-use/recycle 85% of vehicles by weight
  - Re-use/recover 95% of vehicles by weight
  
- Automakers are to integrate as much recycled material into car as possible
  
- Problem: How To Reconcile These Objectives With Other Environmental Goals?

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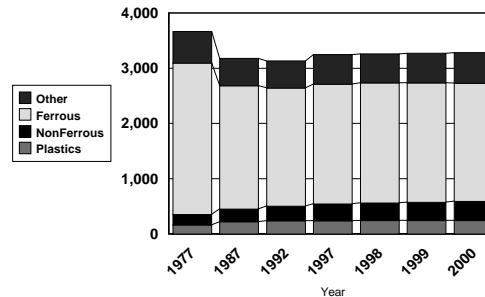
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## Changes In Automobile Materials - in type and quantity

Pounds/average vehicle



Pounds/average vehicle

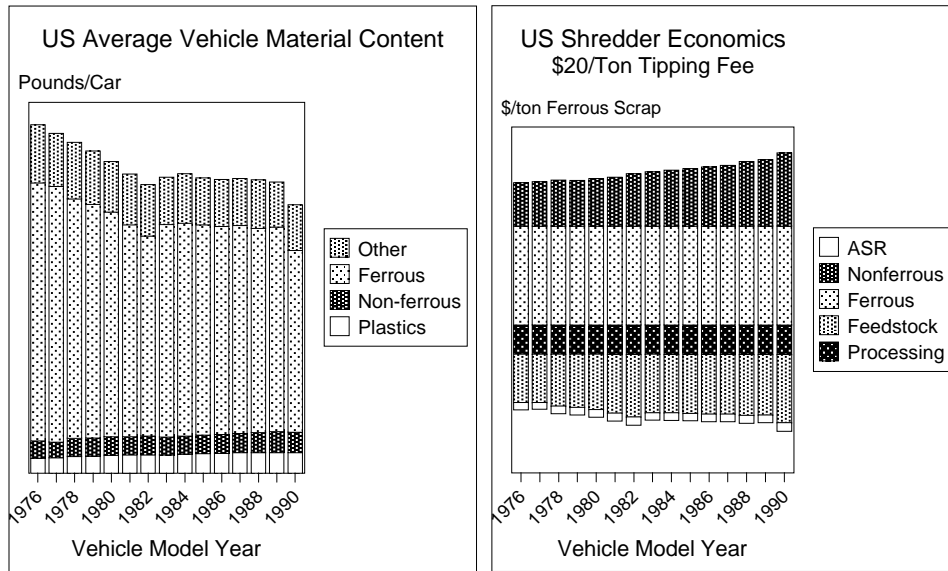


Source: AMM WWW site

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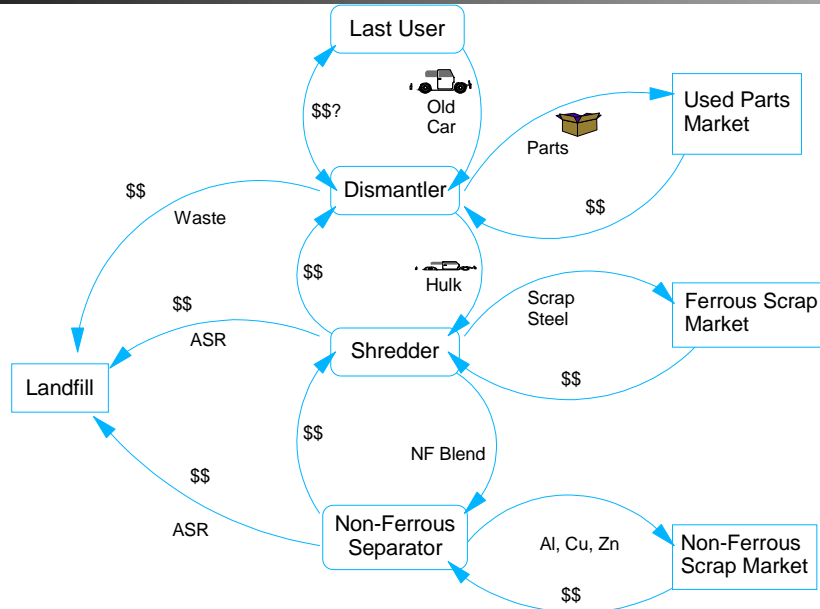
## Shredder Economics - Versus Vehicle Material Content



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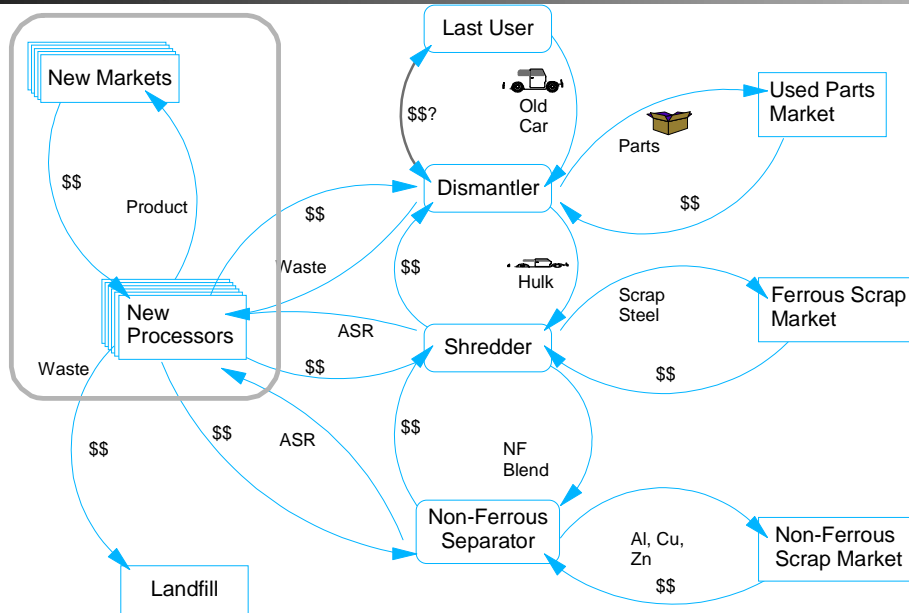
## Recycling — An Economic Activity With Many Participants



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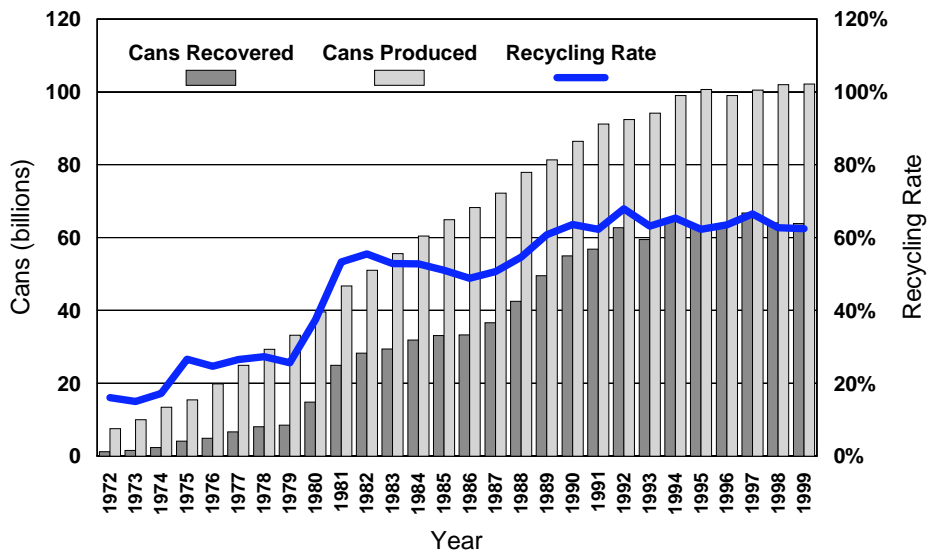
## Implications Of "Increased Recycling" For Existing Infrastructure



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## Another Recycling Market - Beverage Cans



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## **So, Again, What Are The Goals?**

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- **By 2006,**
  - Re-use/recycle 80% of vehicles by weight
  - Re-use/recover 85% of vehicles by weight
  - Design for 85% recyclability and 95% recoverability
  
- **By 2015**
  - Re-use/recycle 85% of vehicles by weight
  - Re-use/recover 95% of vehicles by weight
  
- **Automakers are to integrate as much recycled material into car as possible**
  
- **Problem: How To Reconcile These Objectives With Other Environmental Goals?**

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## **Issues In The Expansion Of Recycling**

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- **Technological**
  - Separation Is Difficult & Expensive
  - Separation Is Key To (Re)Processing Efficiency and Product Quality
  - Ferrous, Nonferrous, and Polymeric Materials *ALL* Subject To These Limitations
  
- **Economic**
  - **Primary Materials Markets**
    - *Focus Upon Purity/Quality Of Material*
  - **Secondary Markets**
    - *Balance Costs Of Purification Against Market Demand*
    - *Ceiling On Price - Virgin Material Or Ores/Feedstocks*
  - **Markets Reflect Tension Between Product Value & Separation Expenses**
  
- **Political**
  - **Unacceptability Of Disposal & Thermal Recovery**
  - **Unwillingness To Levy Fees On (Last) Vehicle User**

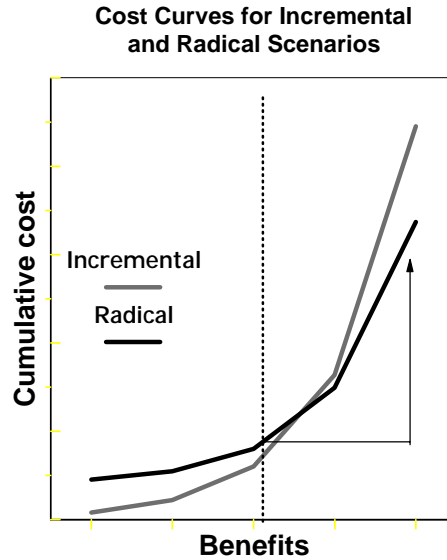
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## Pending European Issue: Compliance Costs

- Which technologies are necessary for achieving regulations cost-effectively?
- Radical technologies are more costly at existing benefits
- However, at higher standards, incremental change may end up costing more



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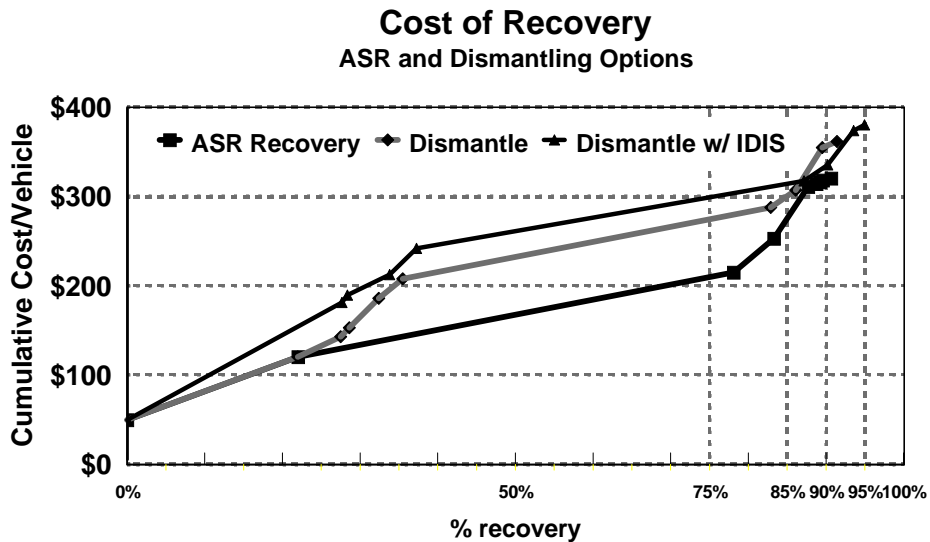
## Incremental vs. Radical Scenarios

	<b>Incremental</b>	<b>Radical</b>
Method	<b>"End-of-pipe"</b>	<b>Industry consolidation</b>
Technology Emphasis	<b>ASR recovery</b>	<b>Mass dismantling, vertical integration</b>
Infrastructure	<b>Existing</b>	<b>New with SME's exiting</b>
New Investment	<b>Minor</b>	<b>Major</b>
Market	<b>Secondary plastics market</b>	<b>Secondary parts market</b>

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## ASR Recovery or More Dismantling?



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## Conclusions

- From a recycling perspective, current infrastructure, with additional NF separation, can reach 80% recycling with today's vehicle material mix, if...
  - Shredders and NF separators operate BAT
  - A secondary market for plastics arises
  - Current secondary metals and hulk prices improve
- However, additional investment will be needed for higher recycling/recovery levels of 85%-95%
  - ASR investments around \$220 million
  - Dismantling path may require \$1.2 to \$1.9 billion depending on retrofitting or greenfield sites
  - Consolidation of facilities may require \$1.1 to \$2.4 billion in new investments

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## **Conclusions (continued)**

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- **Radical scenario of facilities consolidation may not be cost effective at any recovery level, unless**
  - **More parts are recovered for re-use to supplement higher cost of additional dismantling**
  - **Infrastructure in place to collect materials and/or resale/remanufacture parts**
  - **Outside subsidy likely necessary**
  
- **Otherwise, ASR recovery is the most cost-effective scenario, unless**
  - **Stakeholders are willing to encourage dismantling by providing subsidies of \$50-\$150 per vehicle to maintain a profitable industry**

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## **Conclusions, Generally**

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- **"You Can't Push A Rope"**
  - **Recycling Goals Cannot Be Just About Technology Forcing**
  - **Governments Have Key Roles That Cannot Be Achieved By Industry**
  
  - **Monitor The Operation Of The Recycling Industry**
    - *Guarantee Access To Secondary Markets For Credible Players*
    - *Assure Flow Of Used Vehicles Into Secondary Markets*
  
  - **Remove Market Distortions Favoring Virgin Materials**
  
  - **Provide Flexibility To Private Sector Participants In The Market**
    - *Avoid Prescribing Or Proscribing Specific Technical Arrangements*
  
  - **Assure The Economic Viability Of**
    - *The Overall Recycling System*
    - *Individual Elements Within The System*

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## **Industry Has A Key Role As Well**

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- **Principle:** *Act To Improve Product Recyclability*
  - Promote Material Labeling And Information Standards
  - Develop New Fastening Technologies That Simplify Disassembly
  - Remove Industry Barriers To Use Of Appropriately Reconditioned And Remanufactured Components
  - Choose Materials That Improve Vehicle Recyclability
    - Ease Of Species Segregation
    - Employ Secondary Materials
  - Support R&D Into Secondary Materials & Processing Technologies
  - Develop Design Tools Supporting Evaluation of Alternatives

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