



YESTERDAY, TODAY & TOMORROW

# Using Metrics to Eliminate Waste

Toyota's Efforts to Continually  
Improve Waste Management

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Toyota Motor Sales

A green leaf-shaped graphic with the number '50' inside, surrounded by white radiating lines.

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# Who is Toyota?

- Toyota Motor Company (the parent company)
- Toyota North America
  - Design & Manufacturing
    - 10 Plants
    - 8 Design/R&D Facilities
    - 1 HQ
  - Sales & Distribution
    - 8 Vehicle Distribution Centers
    - 11 Parts Distribution Centers
    - 16 Regional Sales Offices
    - 3 Private Distributors
    - 1 HQ
    - TRD, AirFlite
  - Toyota Puerto Rico, Canada, Mexico
- Dealership Network (Toyota/Scion, Lexus)
  - 1400+ Independent Franchises

- Eliminate *Muda*
  - “...any expenditure of time, money, material, effort, or other resource that does not generate perceptible value for the customer.” – *The Toyota Way*
- Global Earth Charter (1992)
  - “Pursue production activities that do not generate waste”
  - “Participate in the creation of a recycling-based society”
- Respect for People
- *Kaizen* (Continuous Improvement)
- Metrics, Metrics, Metrics

- 10 Plants “Near Zero Waste” (95% reduction of waste to landfill from a 1999 baseline)
- 1 HQ and 5 Distribution Centers that are “Zero Waste to Landfill”
- 12 Distribution Centers >90% Recycling Rate
- Integration of Waste Management into ISO 14001 Environmental Management Systems
- \$1.3 million in net savings on waste management
- Returnable shipping modules saved 4.4M pounds of cardboard, 13.2M pounds of wood, and >\$5.3M in costs.



# Using Metrics to Eliminate Waste

- Difficulties of Waste Metrics
- Our Waste Metrics
- From Metrics to Awareness
- Upstream Waste Information to Reduce Downstream Waste Generation

- Reduce
  - Reuse
  - Recycle
  - Recover Energy
  - Landfill
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- Reduce > Reuse > Recycle > Recover > Landfill

- Problem of Incomplete Information  
(Unintended Signals)
- Waste Landfilled
  - Equates Energy Recovery & Recycling
- Recycling Rate
  - Penalizes Reduce/Reuse of recycled material
- Waste Generation
  - Ignores End-of-Life Management
  - Count Reduce/Reuse positively or negatively?
- Diversion Rate
  - Equates Reduce/Reuse/Recycle/Recover

- Earth Charter: Pursue production activities that do not generate waste
- = 100% Reduce/Reuse
- First stage: 95% Reduction to Landfill from Baseline (“Near Zero Waste”)
- Second stage: 100% Reduction to Landfill from Baseline (“Zero Waste”)
- Third stage: Reduction of Non-salable Waste

- Waste Generated
  - *Recycle + Recover + Landfill*
  - Normalized
  - pounds per unit
  - Measures *Reduce, Reuse*
  - Reduce & Reuse measured negatively
  - Goal: “Do not generate waste”



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# Our Waste Metrics

- Recycling Rate
  - *Recycle/Generated*
  - Percentage
  - Measures *Recycle*
  - Goal: Maintain 90% Recycling Rate



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# Our Waste Metrics

- Waste Landfilled
  - *Landfill*
  - Normalized
  - pounds per unit
  - Measures *Reduce, Reuse, Recycle, Recover*
  - Goal: Reduce landfill to 5 lbs per 1000 part shipments



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## Our Waste Metrics

- Waste Disposed
  - *Landfill + ½ Recover*
  - Normalized
  - pounds per unit
  - Measures *Reduce, Reuse, Recycle (Recover)*
  - Goal: Reduce Disposal to 0.25 pounds per vehicle processed
  - *Reduce/Reuse/Recycle > Recover > Landfill*

- Metrics for the general audience
- Use graspable terms
  - pounds
  - avoided logging
  - gasoline saved
- Use examples
  - Vehicle Distribution Centers send less than 4 oz of waste to the landfill for each vehicle processed



900 Trees

That's how many trees weren't cut down due to our paper, cardboard, and wood recycling efforts.



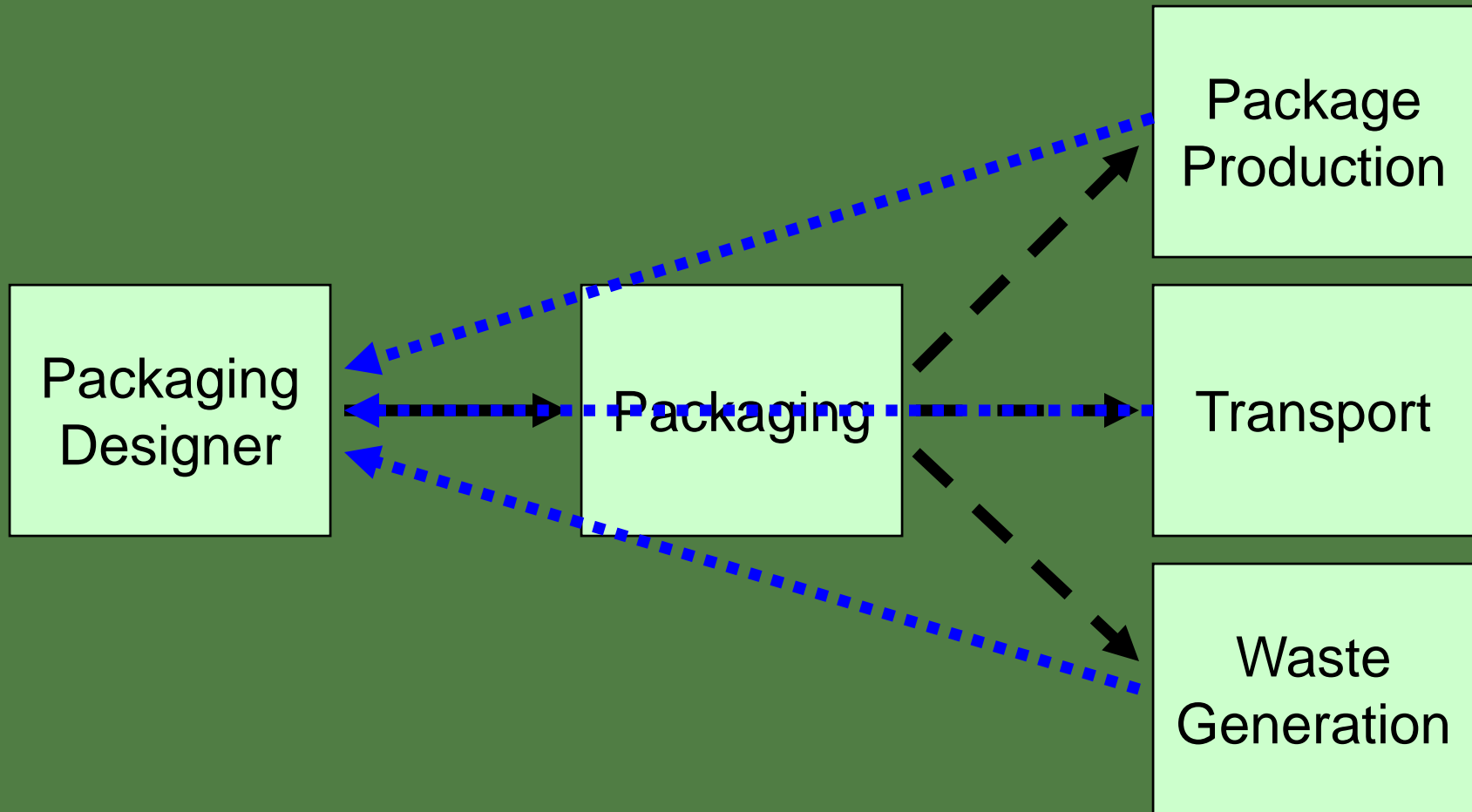
500 Pounds  
That's how much water pollution we've avoided through recycling.



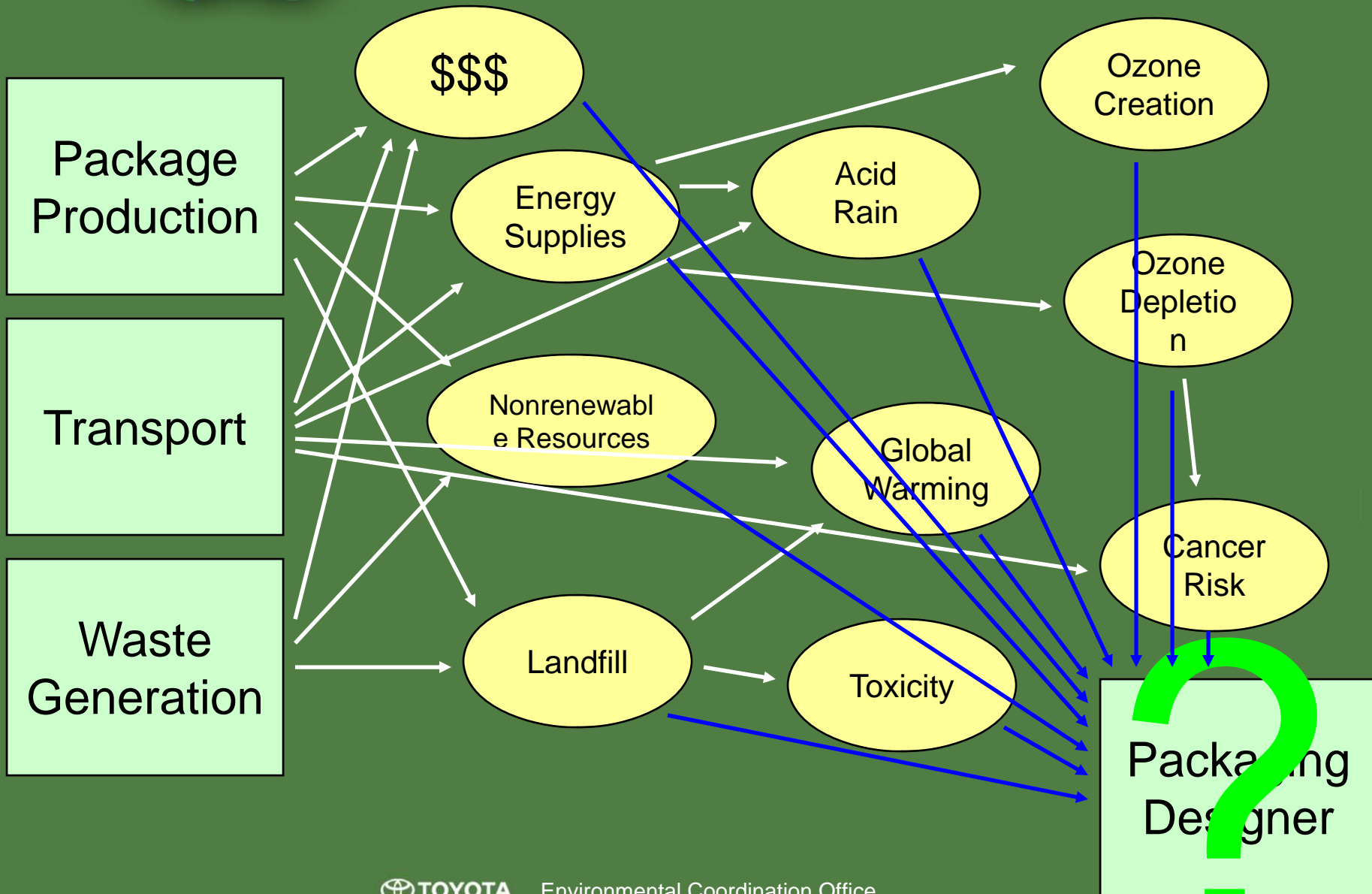
26,000  
Gallons of  
Gasoline

That's how much energy we've saved by providing recycled materials to industry.

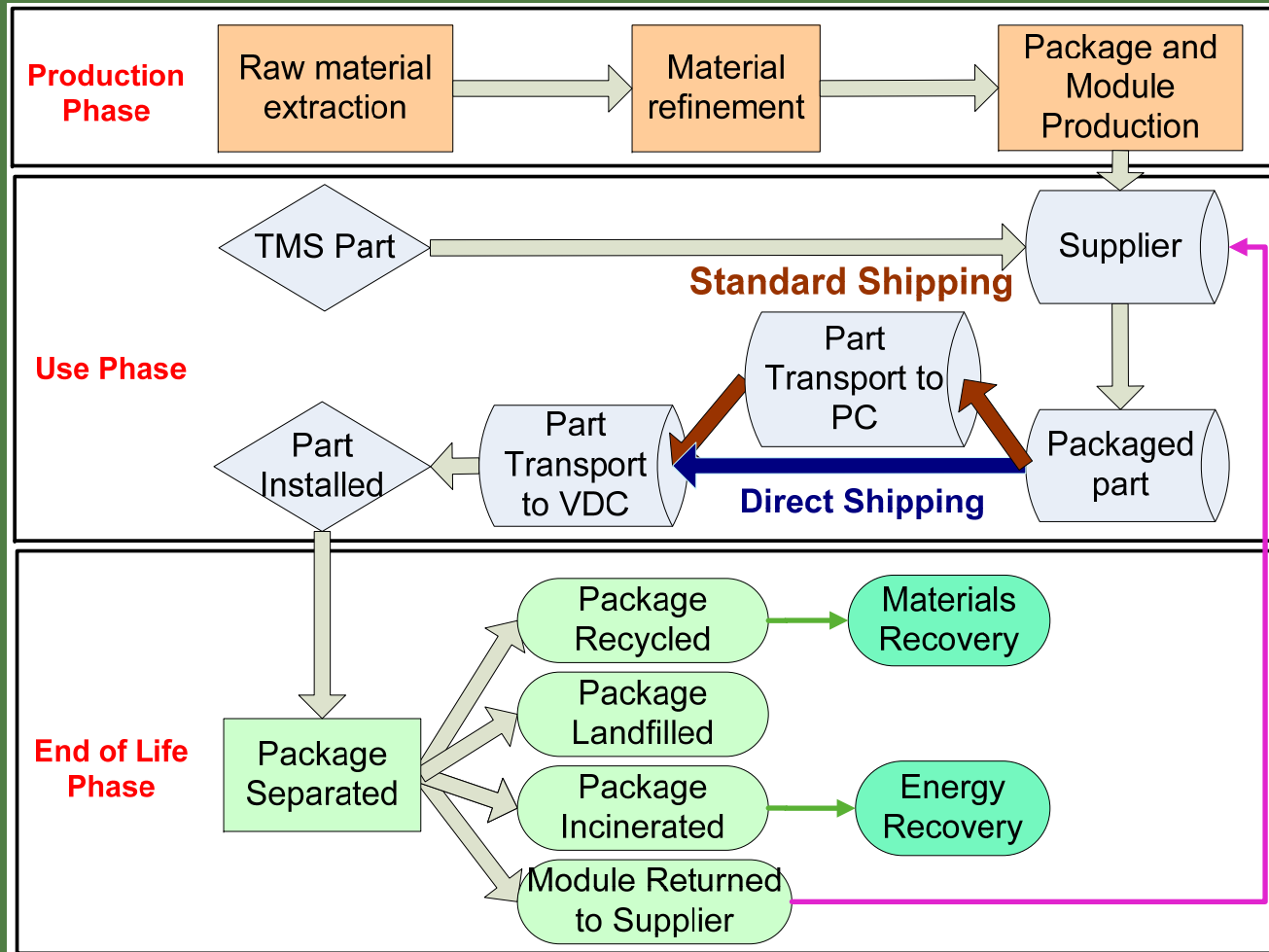
Based on NERC/EPA  
Recycling Benefits Calculator



# Upstream Information



- Environmental Packaging Impact Calculator



- University of California, Santa Barbara
  - Bren School of Environmental Science & Management
  - Masters Thesis Group Project
  - Michelle Corti, Claire Early, Tim Kidman, Wen-Yu Lee
  - Roland Geyer
- GaBi 4.0 Life Cycle Assessment Software
- ISO 14040 Life Cycle Inventories

- Evaluate Packaging Designs
  - Material Choices
  - Effects of size/volume
  - Logistics choices
  - Returnable containers
- Evaluate Trade-offs
  - Package Production vs End-of-Life Management
  - Returnable containers vs Return shipping



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# EPIC

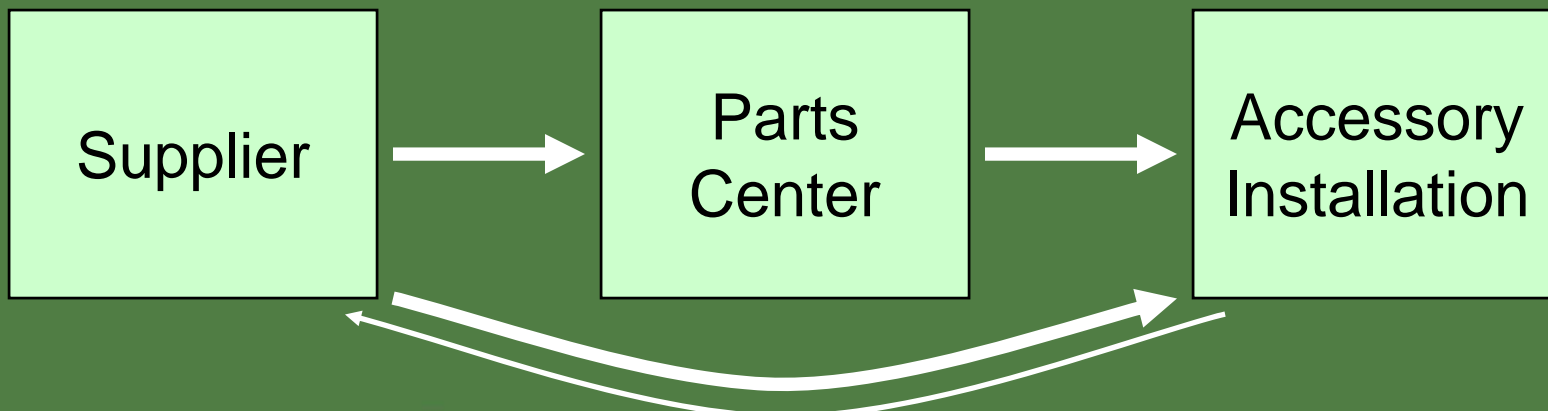
## EPIC Outputs

- Environmental Indicator Comparison
- Life Cycle Cost Comparison
- Life Cycle Stage Analysis
- Life Cycle Inventory

- Floor Mats
- Expendable Bulk Module to Returnable



- Internal Distribution to Direct Shipping



	Package 1	Package 2
<b>Package and Part Basics</b>		
Parts per Package	1	1
Weight of Part (kg)	1.362	1.362
Cost of Package (\$)	\$0.15	\$0.15
<b>Packaging Materials</b>		
LDPE (kg)	0.15	0.15
<b>Module</b>		
Module	Expendable Module	XY Module (Plastic)
Packages per Module	30	70
<b>Transportation</b>		
Shipping Method	Standard Shipping	Direct Shipping
National Parts Center (if standard ship)	NAPCK	n/a
Supplier to Part Center distance (if standard ship)	538.33	n/a
Destination	Accessory Part	Accessory Part
<b>Accessory Destination</b>		
Princeton VDC (%)	100%	100%
<b>Distances (if direct ship)</b>		
Supplier to Princeton (miles)	n/a	741.61

## Results

- Climate Change Impacts: -41%
- Air Pollution Impacts: -43%
- Human Health & Toxicity: -80%
- Resource Use: -54%
- Life Cycle Cost: -55%
  
- Evaluation Time: ~5 minutes

- Environmentally Preferable Paper & Electronics
- Using the Environmental Paper Assessment Tool (EPAT)
  - Developed by the Paper Working Group
  - Available online: [www.epat.org](http://www.epat.org)
  - Uses supplier data and buyer priorities
  - 27 criteria
- Electronic Product Environmental Assessment Tool (EPEAT)
  - Scores computers, monitors, etc.
  - Available online: [www.epeat.net](http://www.epeat.net)



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- Much can be done
- There's a lot of work to do
- More details available at:  
<http://www.toyota.com/about/environment/>
- Ryan McMullan  
[ryan\\_mcmullan@toyota.com](mailto:ryan_mcmullan@toyota.com)
- Questions?