

GREENING SEMICONDUCTOR MANUFACTURING

STORIES FROM CONTRACT MANUFACTURERS AND SUPPLIERS

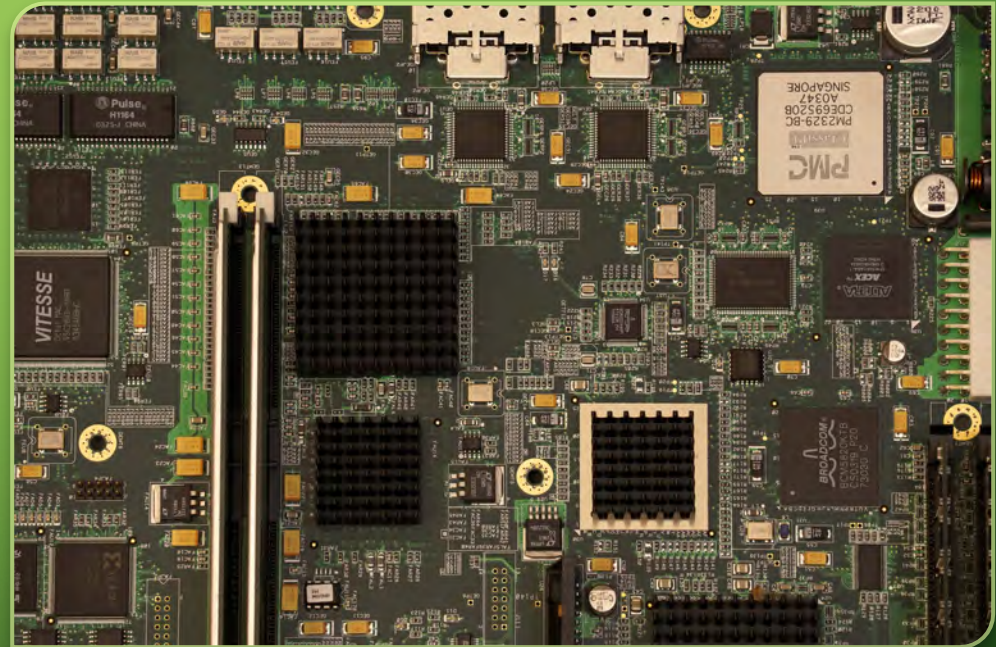
JULIA L F GOLDSTEIN

MEPTEC LUNCHEON

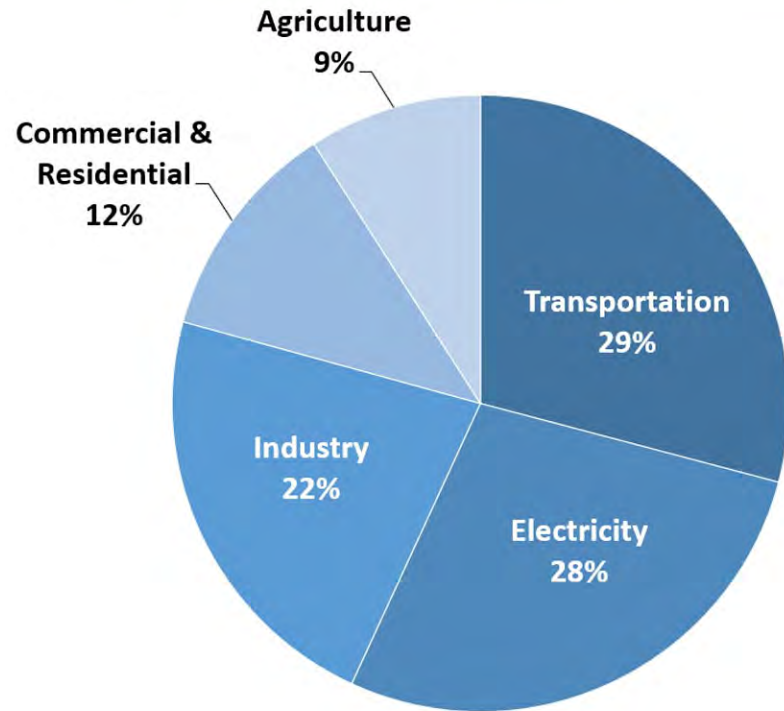
OCTOBER 16, 2019

SMALLER, FASTER, CHEAPER CLEANER, GREENER

- Why should you care?
- Who's on board?
- Aspects to consider
- Up and down the supply chain
- Resources/next steps



Total U.S. Greenhouse Gas Emissions by Economic Sector in 2017



U.S. Environmental Protection Agency (2019). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2017

WHY SHOULD YOU CARE?

- The climate is changing
- Contribution of manufacturing
 - Scope 1: company-owned
 - Scope 2: purchased energy
 - Scope 3: supply chain

WHY SHOULD YOU CARE?

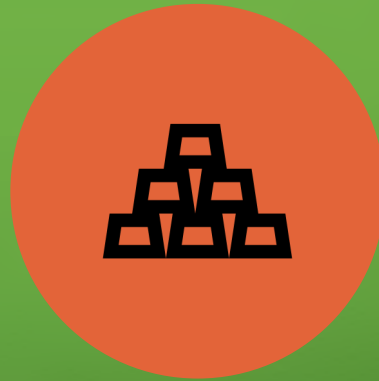


18 kids in a VW bus

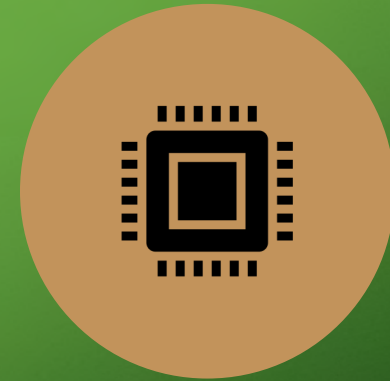
WHY SHOULD YOU CARE? THE ENERGY COST OF MATERIALS



ALUMINUM =
MOST RECYCLED

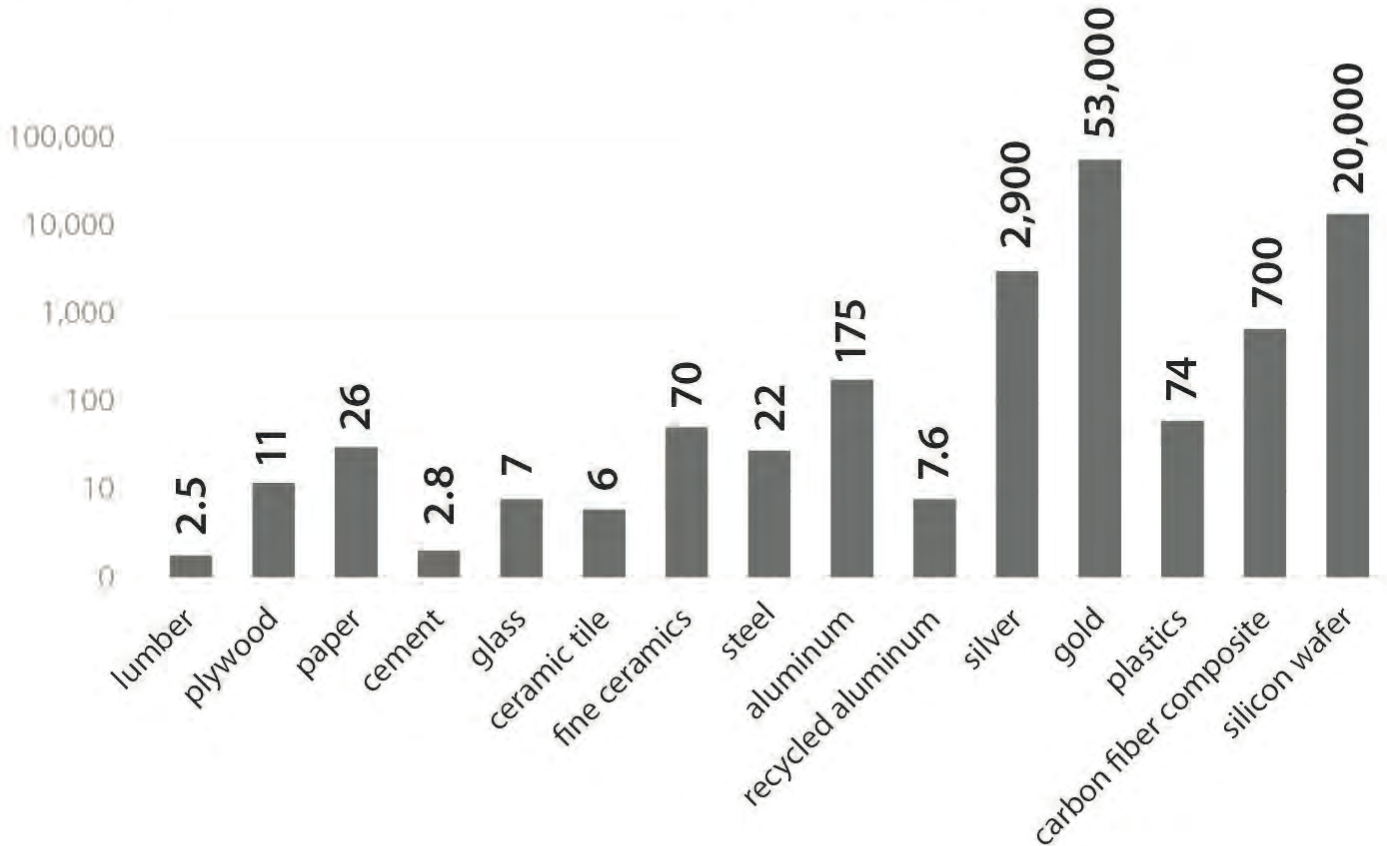


GOLD IS EXPENSIVE



SO IS SILICON

Energy cost of various materials, gigajoules per ton



Data from Vaclav Smil,
Making the Modern World.

WHY SHOULD YOU CARE? THE BUSINESS CASE

- Triple bottom line:
 - People
 - Planet
 - Profit
- All three are interrelated
- Lead or be left behind



WHY SHOULD YOU CARE? THE BUSINESS CASE

“Our customers show increasing concern about the environmental impacts of materials” — JSR Micro 2018 CSR Report

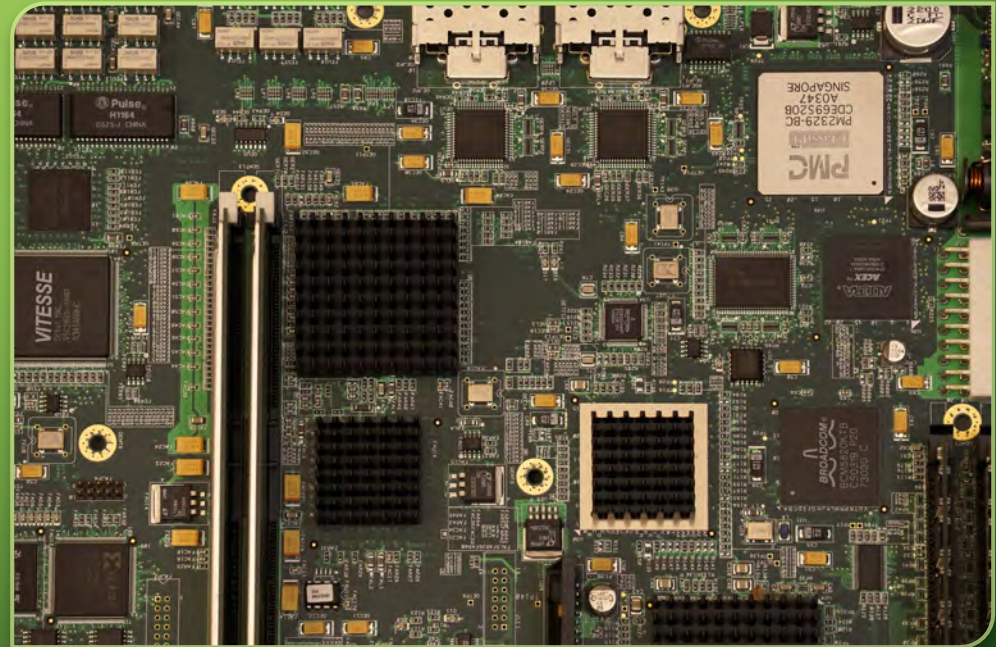


“We weave sustainability into our day-to-day operations, not only because it is good for business but also because it is the right thing to do.”— Flex website



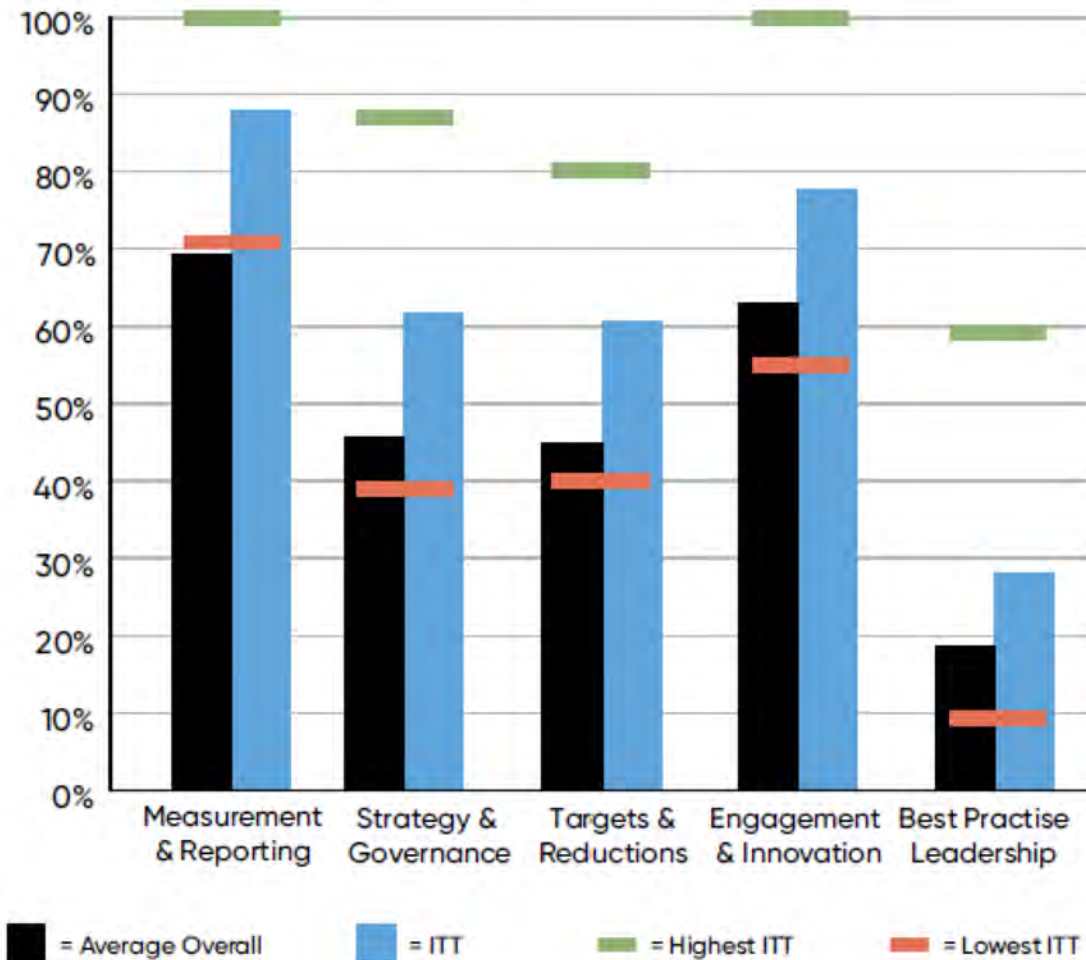
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WHO'S ON BOARD?

ITT sector scores compared to all sectors



- In 2018, 86% of companies in the S&P 500 published sustainability reports
- All companies in the Dow30 report on carbon emissions
- Information Technology and Telecom sector is leading

Data from EcoAct report

WHO'S ON BOARD? DOW30

#1 Microsoft *

#2 Cisco Systems*

#3 Intel

#7 Apple

#9 IBM

WHO'S ON BOARD? MICROSOFT

Devices Sustainability at Microsoft



- Carbon neutral data centers
- Energy 100% renewables
- Efficient water use
- Recyclable packaging
- Product lifecycle

WHO'S ON BOARD? HP

- Recycled plastic in inkjet and toner cartridges: 99,000 tonnes through 2017
- Forest Stewardship Council (FSC) certified paper: zero deforestation
- Faster 3D printing



WHO'S ON BOARD? ISO 14001:2015



GRI: COMPREHENSIVE REPORTING

- Global Reporting Initiative (GRI)
- Founded in 1997
- Nearly 14,000 organizations
- GRI standards, took effect July 2018
- 82% of world's largest 250 companies issue reports



REPORTING ACCORDING TO GRI STANDARDS



Materials use



Energy consumption



Water use



Biodiversity impact



Organic and inorganic pollutants



Waste generation and disposal



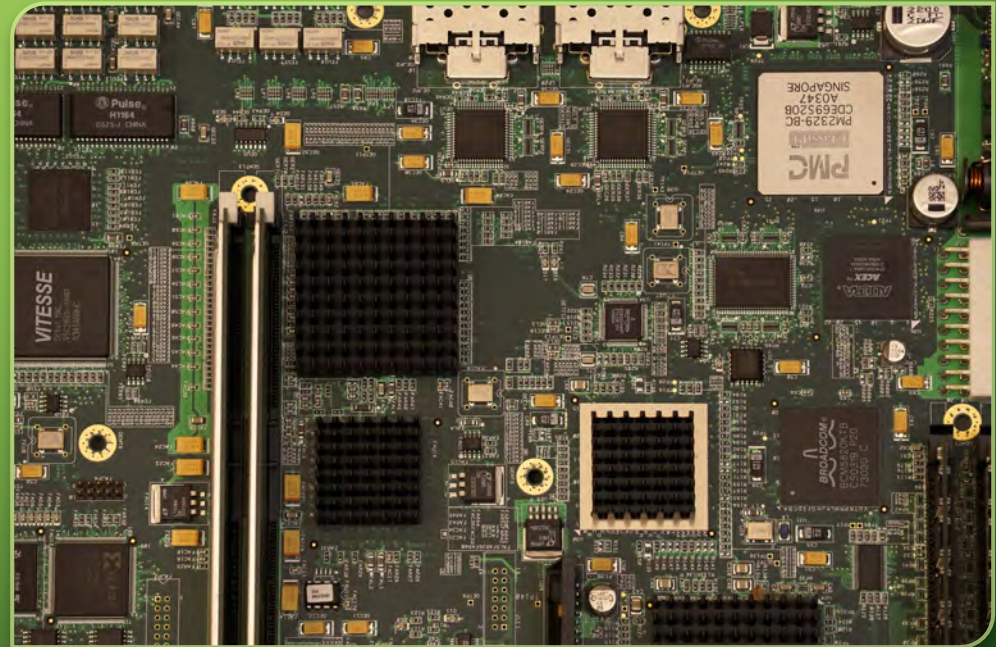
Fines for noncompliance



Supplier environmental assessment

SMALLER, FASTER, CHEAPER, CLEANER, GREENER

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ASPECTS TO CONSIDER



Energy usage



Water usage and treatment



Hazardous waste generation and disposal



Resource use and conservation



Circular Economy



Manufacturing locations and transportation

ASPECTS TO CONSIDER ENERGY USAGE

- Efficient buildings (LEED certified)
- Efficient equipment
- Renewable energy

- Example: JSR Micro's scope 2 emissions dropped from 1500 to 100 metric tons of CO₂ equivalent by switching to 50% renewables in 2017



ASPECTS TO CONSIDER WATER USAGE AND TREATMENT

- Operations and landscaping
- Water treatment (effluents)
- Recycling water on-site

- Example: Siliconware Precision Industries (SPII) reduced organic pollutants discharge over 100 tons in 2018 through more efficient wastewater treatment.



ASPECTS TO CONSIDER HAZARDOUS WASTE GENERATION AND DISPOSAL

- Can you reduce generation rate?
- Can you replace hazardous chemicals with nontoxic ones?
- Can you recycle solvents in-house?
- Example: Brewer Science fuel blending processes hazardous waste (liquid and solid) into fuel that powers kilns used in manufacturing.



ASPECTS TO CONSIDER RESOURCE USE AND CONSERVATION

- Buy less raw material
- Resell chemicals, equipment, materials
- Example: Texas Instruments sells unusable silicon wafers to solar panel manufacturers

“When we purchase materials, we consider the resulting waste and whether there is an opportunity to reuse existing materials or purchase recycled materials or environmentally friendly items instead.”— TI Materials Management
brief

ASPECTS TO CONSIDER CIRCULAR ECONOMY

- Example: Brewer Science zero waste to landfill since 2016
 - Recycling, fuel blending, solvent reuse
 - Trash compactor converts nonhazardous waste to energy
- Example: TI collects hairnets and shoe covers for recycling into nylon and plastics
- Example: Sinctronics recycles plastics recovered from e-waste into raw materials and parts
- Example: Apple's goal of eliminating mined metals; announced use of recycled (post-industrial) rare earths in new iPhones



ELEMENTS OF A SMARTPHONE

ELEMENTS COLOUR KEY: ● ALKALI METAL ● ALKALINE EARTH METAL ● TRANSITION METAL ● GROUP 13 ● GROUP 14 ● GROUP 15 ● GROUP 16 ● HALOGEN ● LANTHANIDE

SCREEN



Indium tin oxide is a mixture of indium oxide and tin oxide, used in a transparent film in the screen that conducts electricity. This allows the screen to function as a touch screen.



The glass used on the majority of smartphones is an aluminosilicate glass, composed of a mix of alumina (Al₂O₃) and silica (SiO₂). This glass also contains potassium ions, which help to strengthen it.



A variety of Rare Earth Element compounds are used in small quantities to produce the colours in the smartphone's screen. Some compounds are also used to reduce UV light penetration into the phone.

BATTERY



The majority of phones use lithium ion batteries, which are composed of lithium cobalt oxide as a positive electrode and graphite (carbon) as the negative electrode. Some batteries use other metals, such as manganese, in place of cobalt. The battery's casing is made of aluminium.

ELECTRONICS



Copper is used for wiring in the phone, whilst copper, gold and silver are the major metals from which microelectrical components are fashioned. Tantalum is the major component of micro-capacitors.



Nickel is used in the microphone as well as for other electrical connections. Alloys including the elements praseodymium, gadolinium and neodymium are used in the magnets in the speaker and microphone. Neodymium, terbium and dysprosium are used in the vibration unit.



Pure silicon is used to manufacture the chip in the phone. It is oxidised to produce non-conducting regions, then other elements are added in order to allow the chip to conduct electricity.



Tin & lead are used to solder electronics in the phone. Newer lead-free solders use a mix of tin, copper and silver.

CASING



Magnesium compounds are alloyed to make some phone cases, whilst many are made of plastics. Plastics will also include flame retardant compounds, some of which contain bromine, whilst nickel can be included to reduce electromagnetic interference.

ASPECTS TO CONSIDER MANUFACTURING LOCATIONS



Where are
your factories?



Where are
your suppliers?



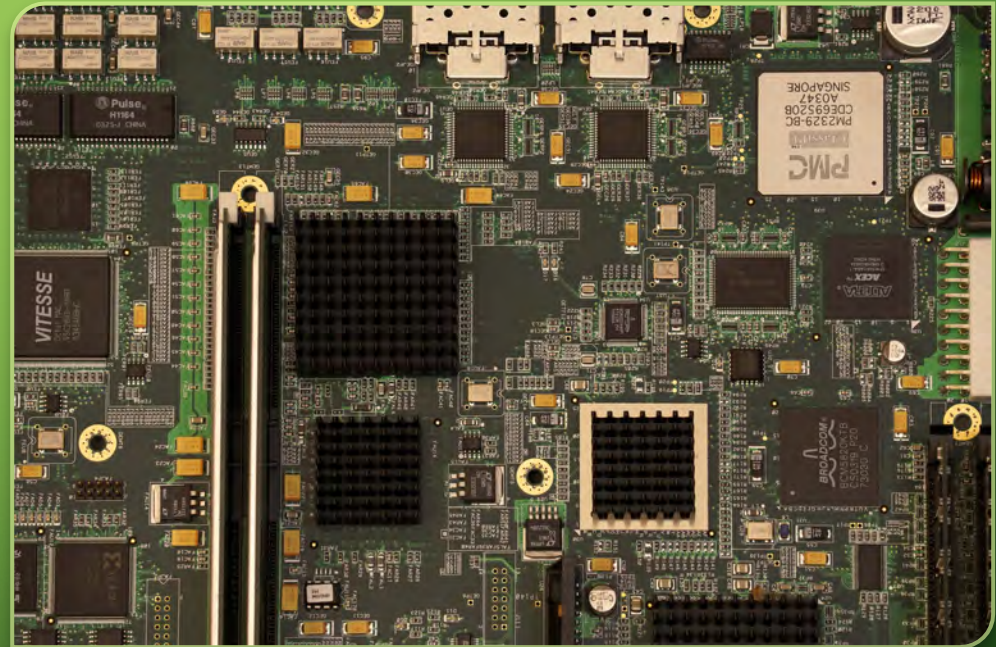
Where are
your customers?



Transportation
is important

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UP AND DOWN THE SUPPLY CHAIN



Raw materials



Manufacturing



Packaging and distribution



Customer use



Disposal

UP AND DOWN THE SUPPLY CHAIN

- Consider the environment during design
 - Bill of materials
 - Recyclability
 - Toxic chemicals
 - Manufacturing process



UP AND DOWN THE SUPPLY CHAIN



Supplier codes of conduct



Awards: Intel's Supplier Continuous
Quality Improvement Award

SUPPLY CHAIN: RESPONSIBLE BUSINESS ALLIANCE

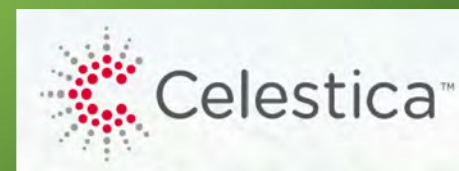


“World's largest industry coalition dedicated to corporate social responsibility in global supply chains.”



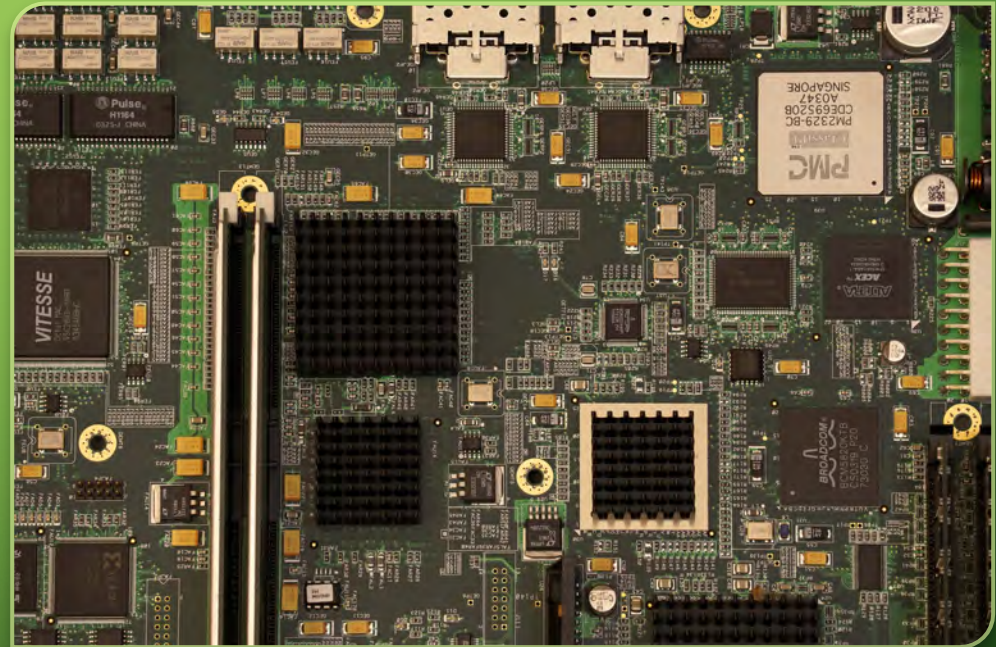
Annual conference,
October 21 and 22 in
Santa Clara

RESPONSIBLE BUSINESS ALLIANCE MEMBERS



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RESOURCES: CERTIFICATIONS AND REPORTING

- Carbon Disclosure Project: <https://www.cdp.net/en>
- Ecovadis, CSR ratings: <https://www.ecovadis.com/>
- Global Reporting Initiative, GRI Standards:
<https://www.globalreporting.org/Pages/default.aspx>
- ISO 14001:2015 and 26000 certification: <https://www.iso.org/developing-sustainably.html>
- Sustainability Accounting Standards Board: <https://www.sasb.org/>

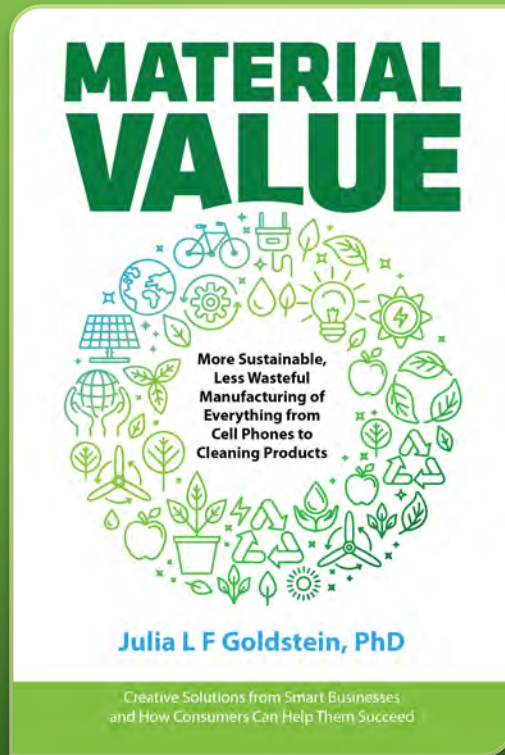
RESOURCES: BUSINESS ASSOCIATIONS

- American Sustainable Business Council: <https://www.asbcouncil.org/>
- Business for Social Responsibility: <https://www.bsr.org/en/>
- Green Electronics Council: <https://greenelectronicscouncil.org/>
- Responsible Business Alliance: <http://www.responsiblebusiness.org/>
- Sustainable Packaging Coalition: <https://sustainablepackaging.org/>
- World Business Council for Sustainable Development: <https://www.wbcsd.org/>

NEXT STEPS

- Where does your company stand?
- What role can you play?
- Evaluate your position in the supply chain
- Continue the conversation
- Change the conversation

CONTACT



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