

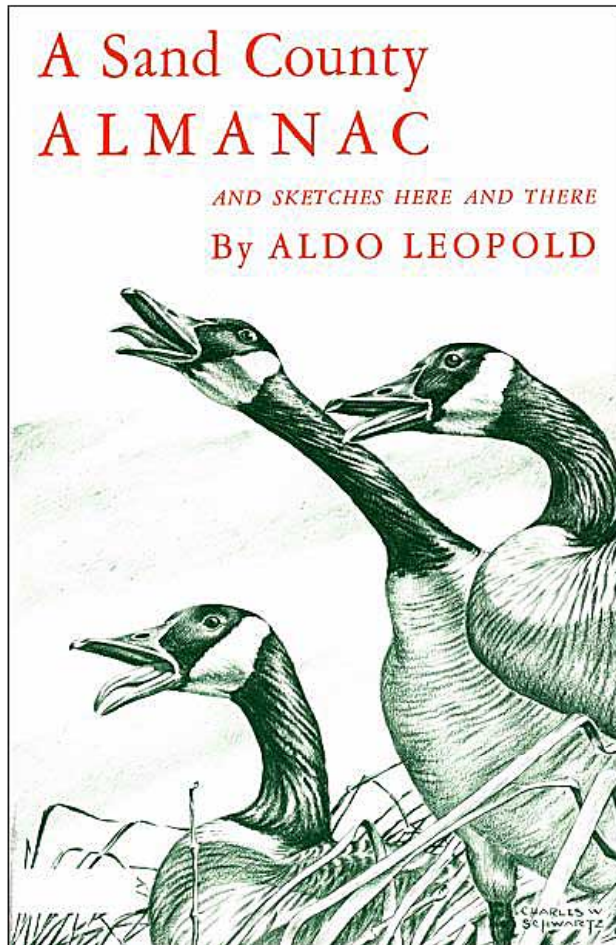


The Mineral Footprint™ of Green Choices



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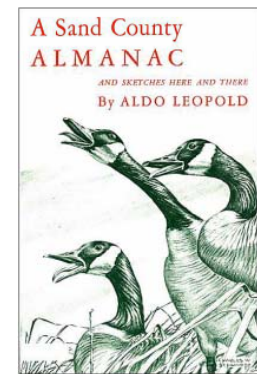
Aldo Leopold is credited with awakening modern society's **ecological awareness** and consciousness, inspiring many movements including:

- ✓ The Land Ethic
- ✓ Bioregionalism
- ✓ Deep Ecology



There are two “spiritual dangers in not owning a farm. One is the danger of supposing that breakfast comes from the grocery, and the other that heat comes from the furnace.”

Aldo Leopold, *A Sand County Almanac*





The ecological awareness and **reverence for nature** awakened by Aldo Leopold has arguably also inspired metrics such as the:

- ✓ Ecological Footprint
 - ✓ Carbon Footprint
 - ✓ Water Footprint
-



Our ecological awareness and reverence for nature must be complemented with a **material awareness** and respect for the **tools** we will need for a green, sustainable society.

The focus of this symposium . . .

. . .the **minerals** needed for these tools.



There is in fact, a **third** spiritual danger in not owning a farm; it is supposing that the axe used to fell the tree, and the brick used to build the furnace, simply come from the local hardware store.

D. Anderson, *The Mineral Footprint™ Initiative*¹

¹Upcoming Article in *Mining Engineering* Magazine, published by the Society for Mining, Metallurgy and Exploration (SME)



REDEFINING FOOTPRINTS



Our transition towards a

New Green Economy

will require a focus much broader and more holistic than solely a ‘**carbon footprint**’ paradigm allows...



REDEFINING FOOTPRINTS



Some people come into our lives
and leave footprints in our hearts
and we are never the same

Flavia Weedn



REDEFINING FOOTPRINTS



During your time of trial and suffering
When you saw only one set of footprints
It was then that I carried you.

-*"Footprints in the Sand"* poem*



REDEFINING FOOTPRINTS



I promise you, I'm always there
When your heart is filled with sorrow and despair
I'll carry you when you need a friend
You'll find my footprints in the sand

Leona Lewis



REDEFINING FOOTPRINTS

OUR HUMAN FOOTPRINT

Includes

ENVIRONMENTAL FOOTPRINTS

+

MATERIAL FOOTPRINTS

+

SOCIOECONOMIC FOOTPRINTS



each footprint is not necessarily 'additive' but rather, is 'integrative'



REDEFINING FOOTPRINTS...

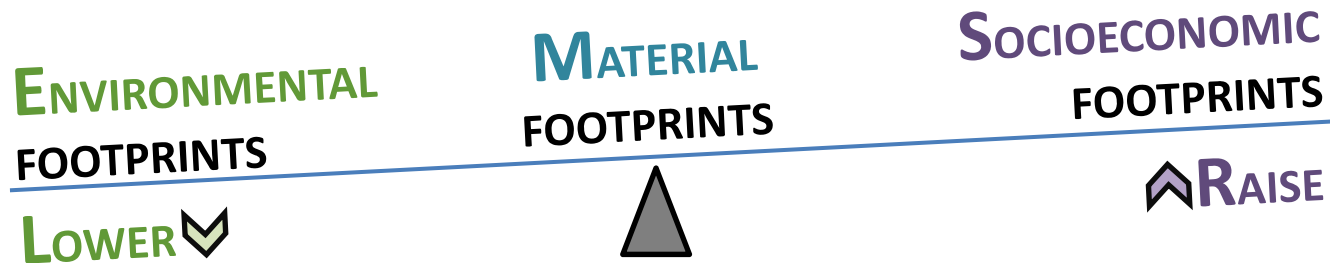


Goals?

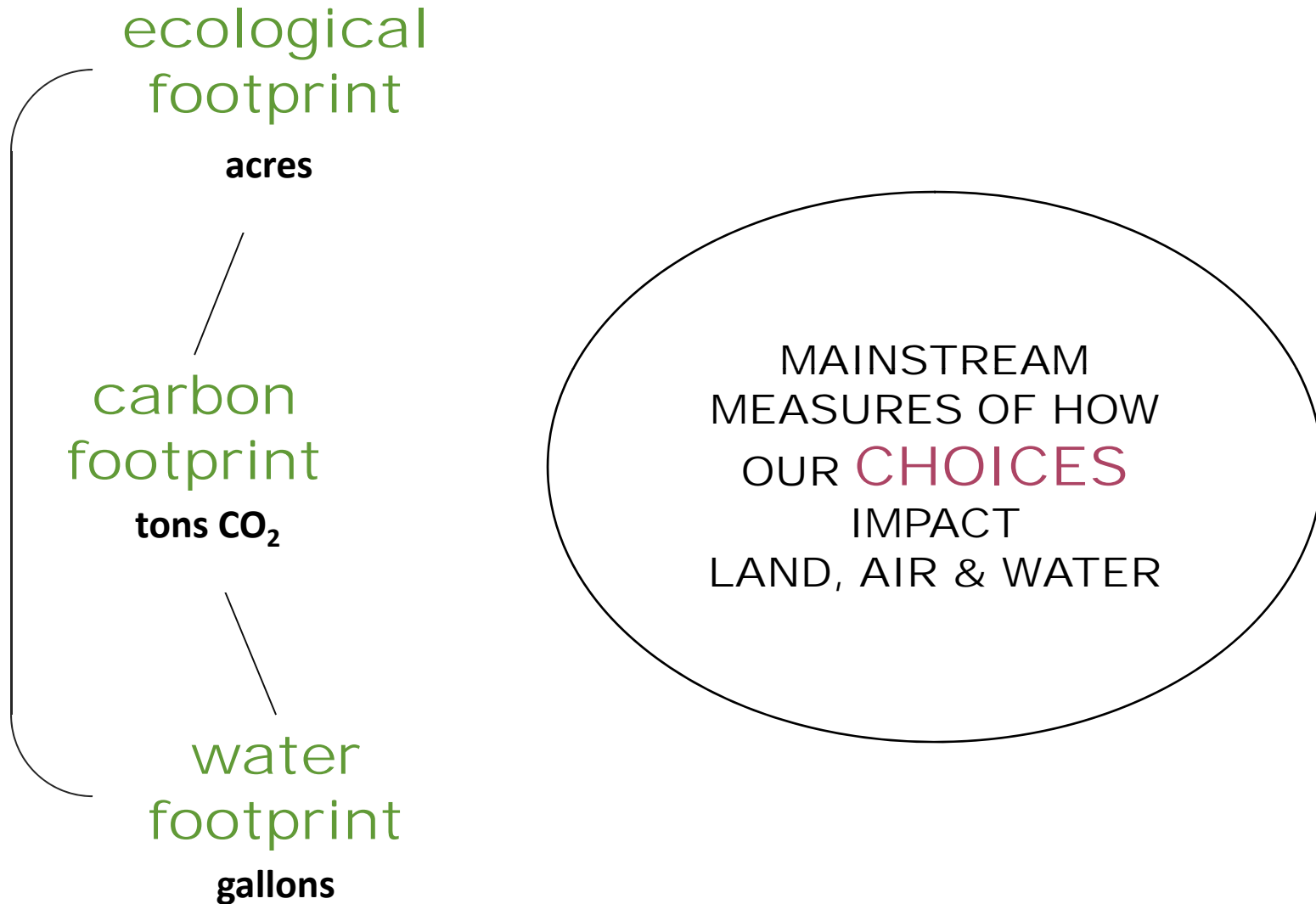
ENVIRONMENTAL FOOTPRINTS  **LOWER**

MATERIAL FOOTPRINTS  **LEVERAGE**

SOCIOECONOMIC FOOTPRINTS  **RAISE**



ENVIRONMENTAL FOOTPRINTS



MATERIAL FOOTPRINTS

ecological
footprint

wood, paper, clothing ...

mineral
footprint

metals, non-fuel minerals

chemical
footprint

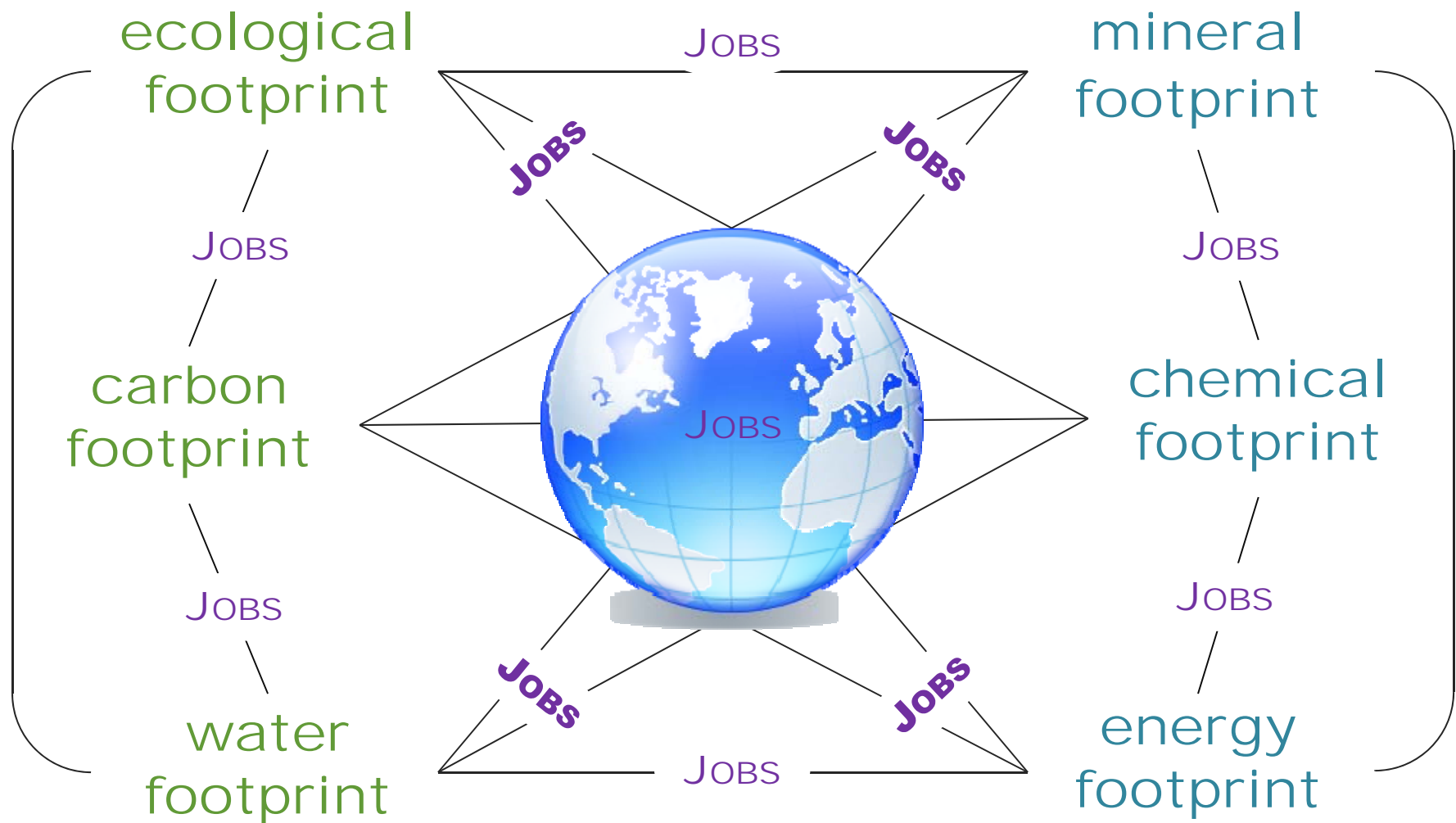
biopolymers, petrochemicals ...

energy
footprint

renewables, fossil fuels, fuel minerals

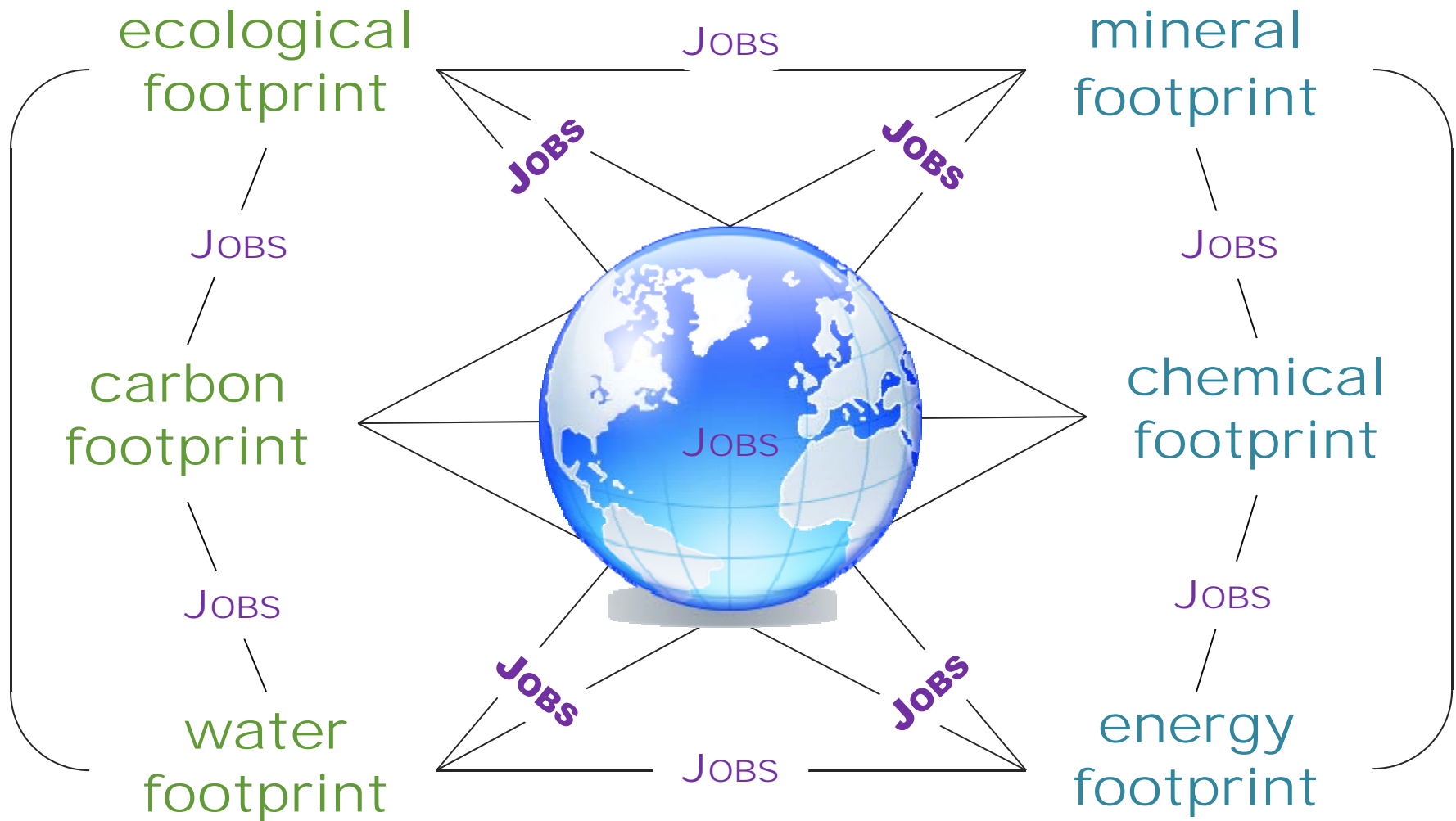
MATERIALS REQUIRE
A COMPLEX
COMBINATION OF
ANIMAL, PLANT,
MINERAL AND
ENERGY INPUTS

SOCIOECONOMIC FOOTPRINTS



EACH FOOTPRINT IS LINKED TO JOBS IN A GLOBAL ECONOMY

OUR HUMAN FOOTPRINT



**ENVIRONMENTAL
FOOTPRINTS**
LOWER 

**MATERIAL
FOOTPRINTS**



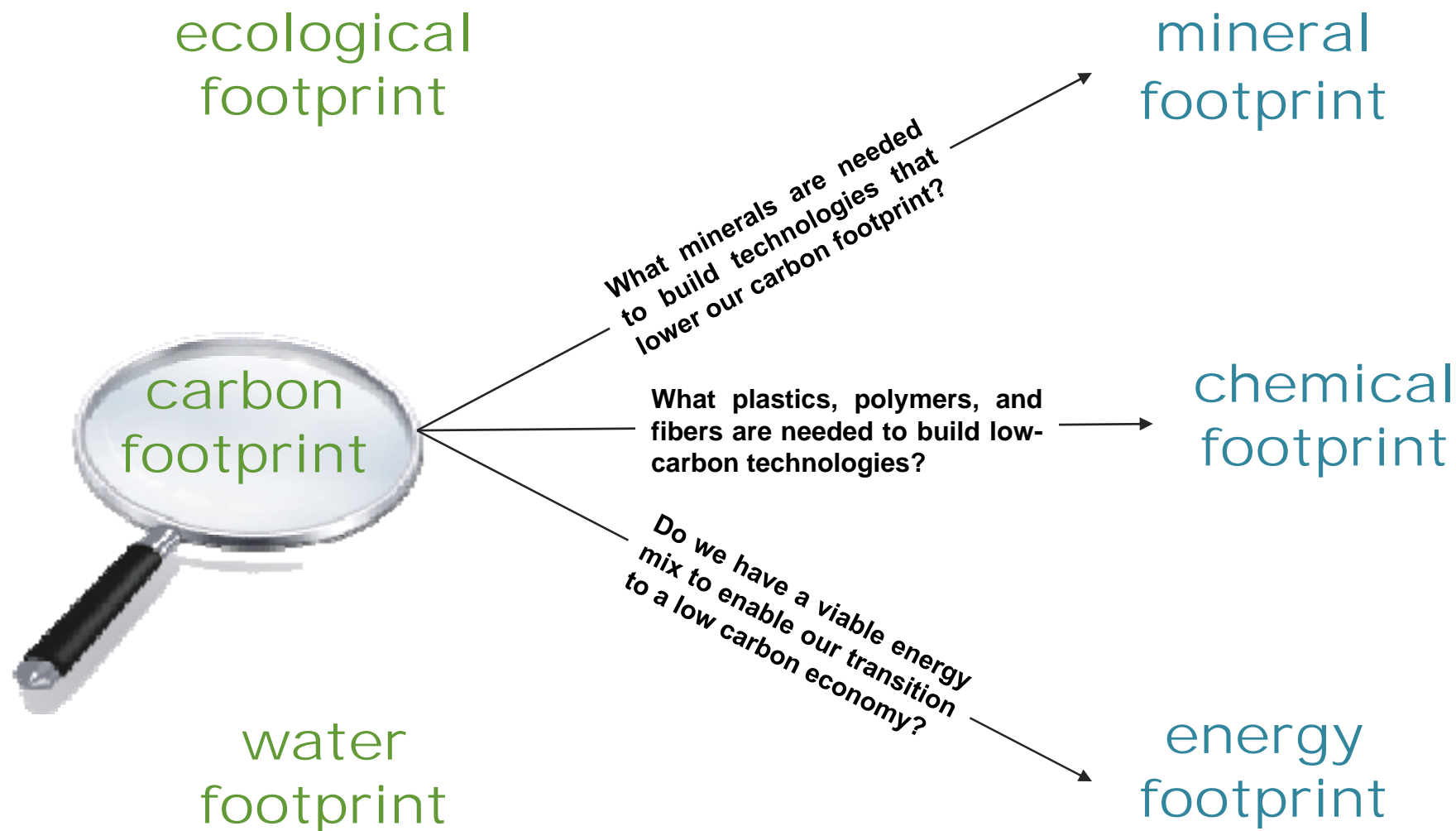
**SOCIOECONOMIC
FOOTPRINTS**
RAISE 



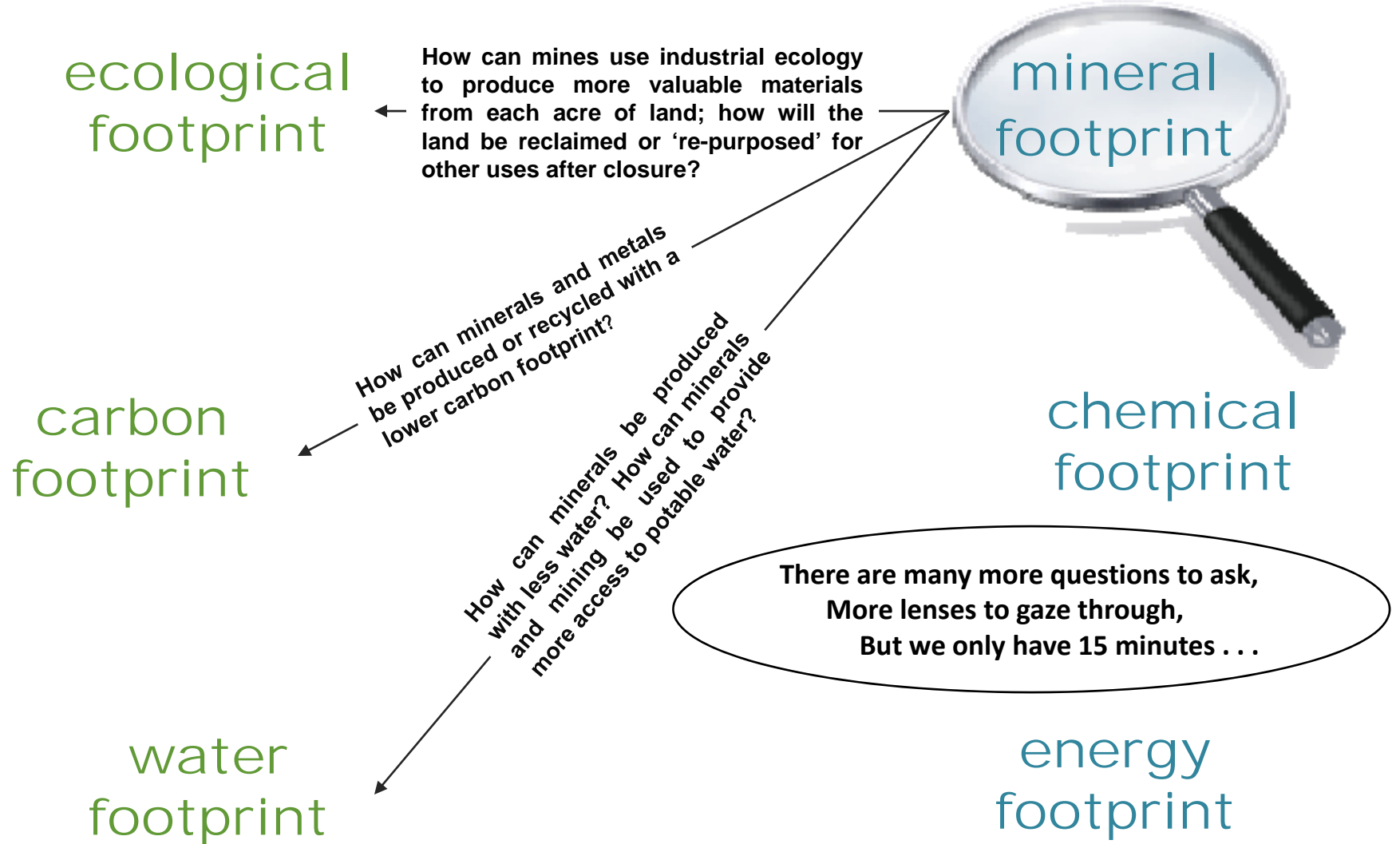
Assuming the last slide is roughly the “WHOLE PICTURE” . . .



- ✓ What lens are we using when we look at it?
- ✓ Are we really making the best decisions if we aren't looking at all of these 'footprints' at the same time
- ✓ How does each footprint interact or overlap with the others?
- ✓ How do our choices **reinforce**, **distort** or **sever** the relationships?



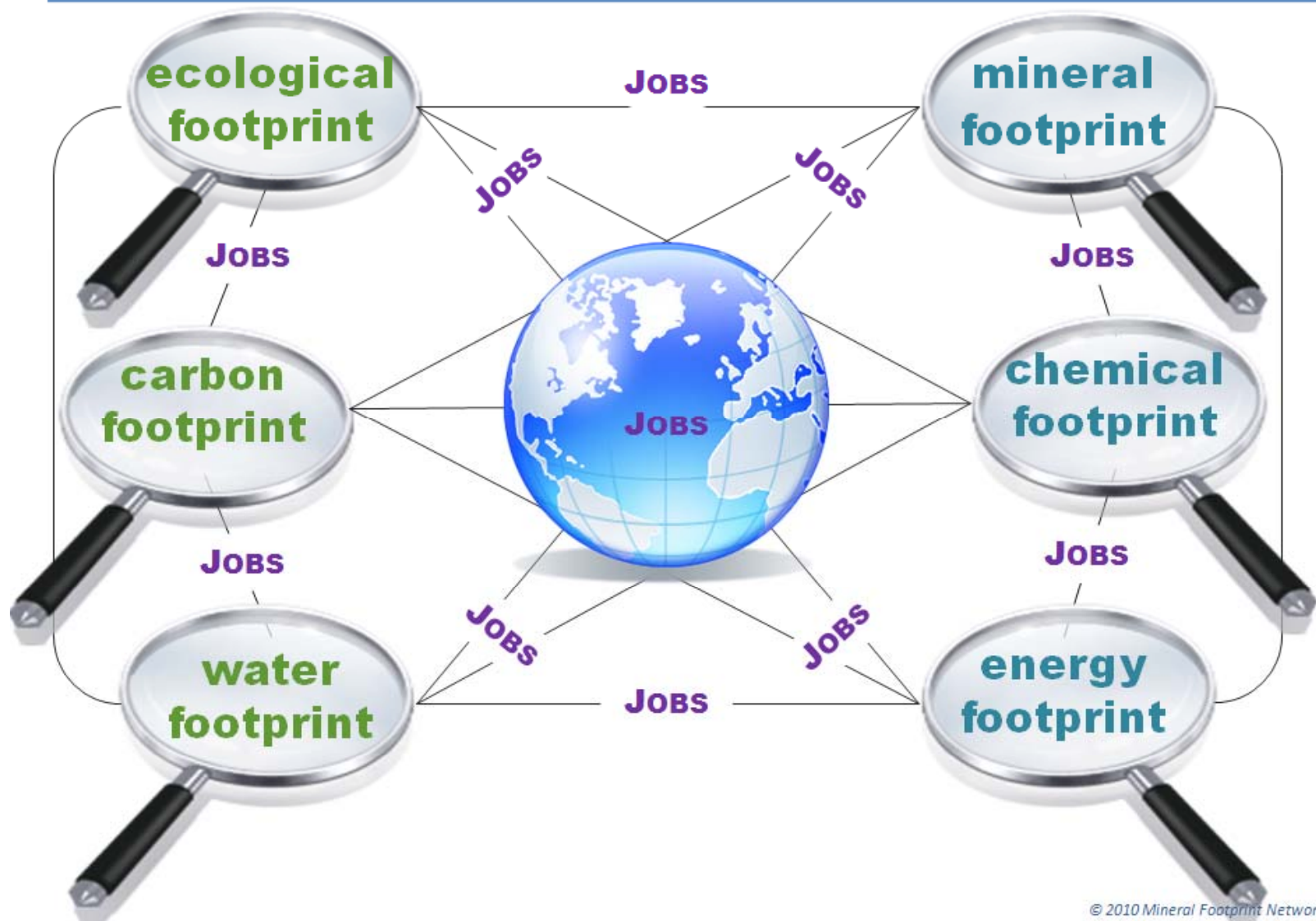
A FEW RELATIONSHIPS TO CONSIDER...



A FEW RELATIONSHIPS TO CONSIDER...

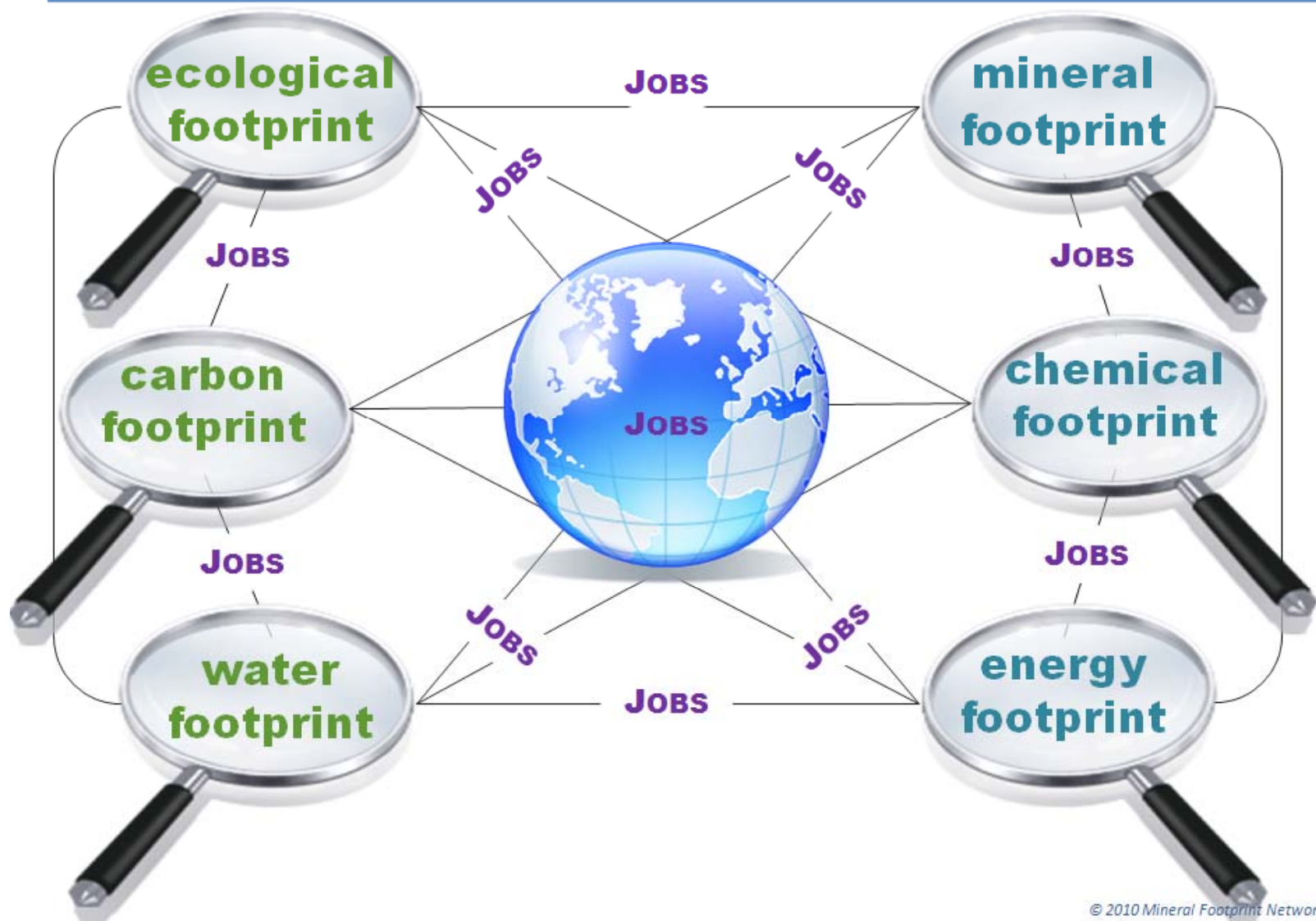


AS POLICY MAKERS . . . YOU MUST LOOK THROUGH MANY LENSES AT THE SAME TIME





ARE YOU SUPPORTING RESEARCH IN **ALL** TECHNICAL AREAS NEEDED TO ADDRESS **ALL** FOOTPRINTS?

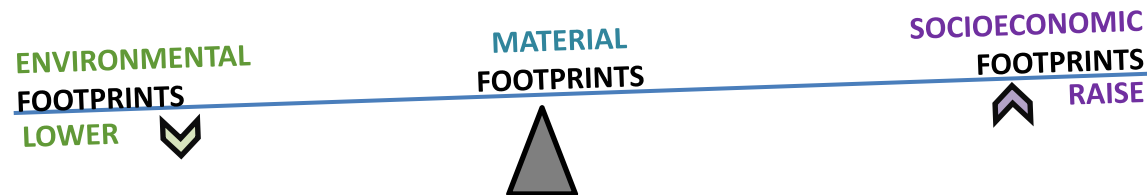




REDEFINING FOOTPRINTS...



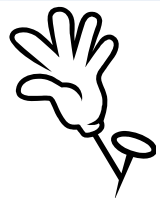
What **information** and capacity do we need to effectively and efficiently leverage our mineral-based material footprints, now and in the long term?






“Full information on the mineral life cycle, and the **critical mineral cycle** particularly, requires information on recycling and scrap generation and inventories of old scrap; in-use stocks; reserves and resources; downstream uses; subeconomic resources; material flows; and international information in each of these areas. Federal mineral information collection presently does not include these factors.”


2008 National Research Council Report,
Minerals, Critical Minerals and the U.S. Economy





5 Dimensions of Mineral Availability


WHAT Questions Must We Ask?

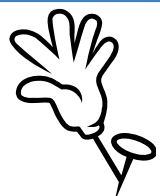
-
- 1 Geologic Availability**  ✓ Does the mineral resource exist?

 - 2 Technical Availability**  ✓ Can we extract and process it?

 - 3 Environmental & Social Availability**  ✓ Can we produce it in environmentally and socially responsible and acceptable ways?


 - 4 Political Availability**  ✓ How do governments influence availability through their policy and actions?


 - 5 Economic Availability**  ✓ Can we produce it at a cost users are willing and able to pay?





5 Dimensions of Mineral Availability


WHO can help us answer these questions?

-
- 1 **Geologic**
Availability  ✓ Economic Geologists, Geochemists, etc.,

 - 2 **Technical**
Availability  ✓ Engineers (Mining, Metallurgical, Geotechnical, Reclamation, Environmental, etc.,)

 - 3 **Environmental
& Social**
Availability  ✓ Sociologists, Anthropologists, Ecologists, Environmental Scientists & Engineers, etc.,

 - 4 **Political**
Availability  ✓ Policy makers and government agency professionals that understand minerals, mining, recycling and sustainable development

 - 5 **Economic**
Availability  ✓ Mineral, Energy and Petroleum Economists, etc.,
-

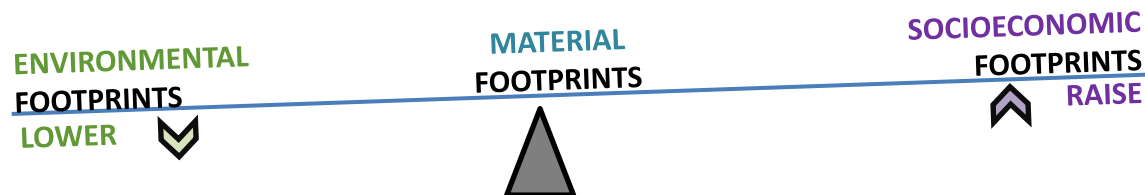


REDEFINING FOOTPRINTS . . .



To make informed decisions and to most effectively leverage its material footprints, society (consumers, manufactures, policy makers, etc.) need a more fundamental understanding of materials.

A consumer-oriented online tool is under development . . .





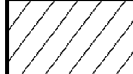


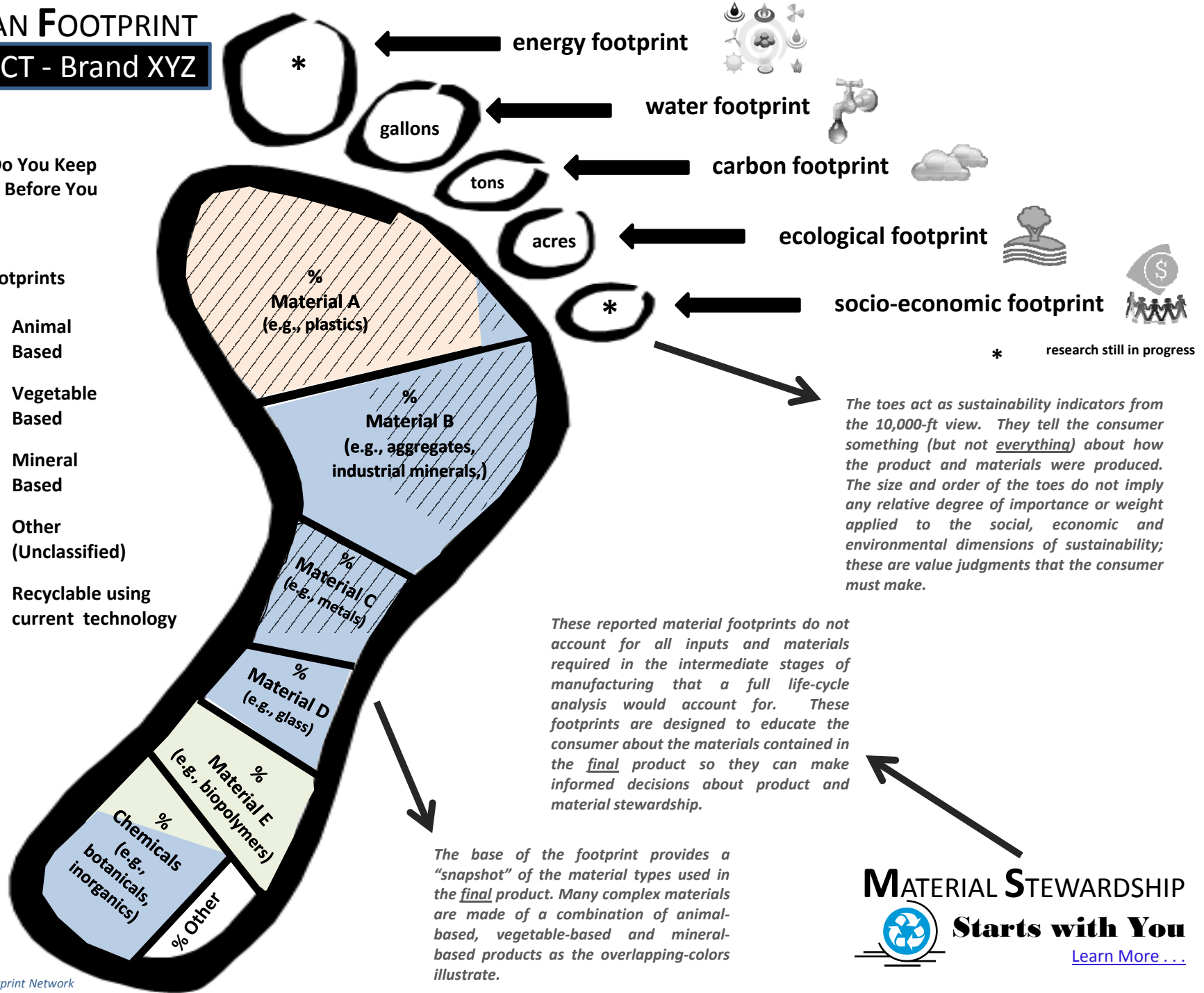
HUMAN FOOTPRINT

PRODUCT - Brand XYZ

How Long Do You Keep the Product Before You Replace it?

Material Footprints

-  Animal Based
-  Vegetable Based
-  Mineral Based
-  Other (Unclassified)
-  Recyclable using current technology




* research still in progress

The toes act as sustainability indicators from the 10,000-ft view. They tell the consumer something (but not everything) about how the product and materials were produced. The size and order of the toes do not imply any relative degree of importance or weight applied to the social, economic and environmental dimensions of sustainability; these are value judgments that the consumer must make.

These reported material footprints do not account for all inputs and materials required in the intermediate stages of manufacturing that a full life-cycle analysis would account for. These footprints are designed to educate the consumer about the materials contained in the final product so they can make informed decisions about product and material stewardship.

The base of the footprint provides a "snapshot" of the material types used in the final product. Many complex materials are made of a combination of animal-based, vegetable-based and mineral-based products as the overlapping-colors illustrate.





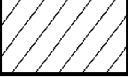
MATERIAL STEWARDSHIP
Starts with You

[Learn More . . .](#)

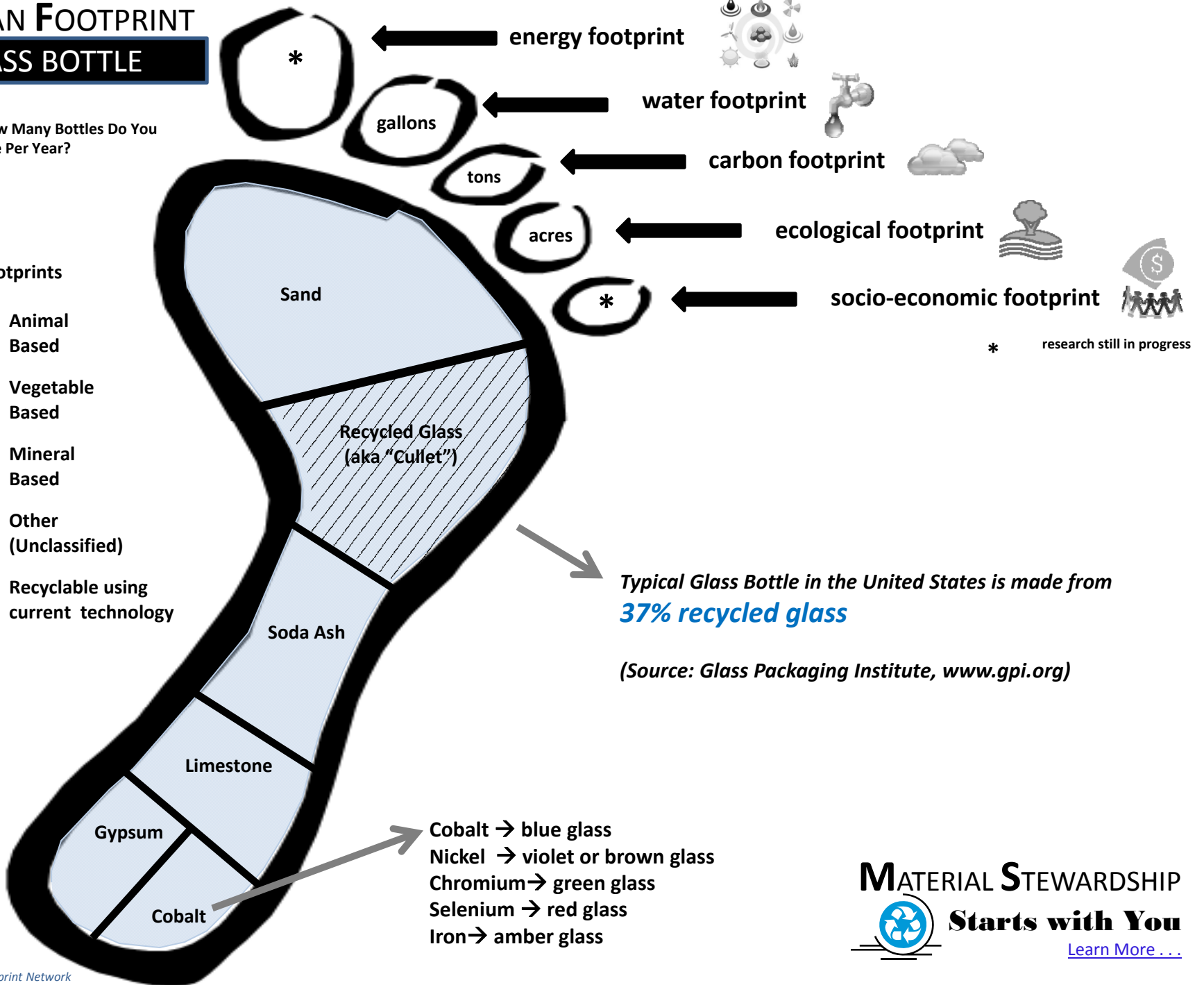
HUMAN FOOTPRINT GLASS BOTTLE



How Many Bottles Do You Use Per Year?

Material Footprints

-  Animal Based
-  Vegetable Based
-  Mineral Based
-  Other (Unclassified)
-  Recyclable using current technology



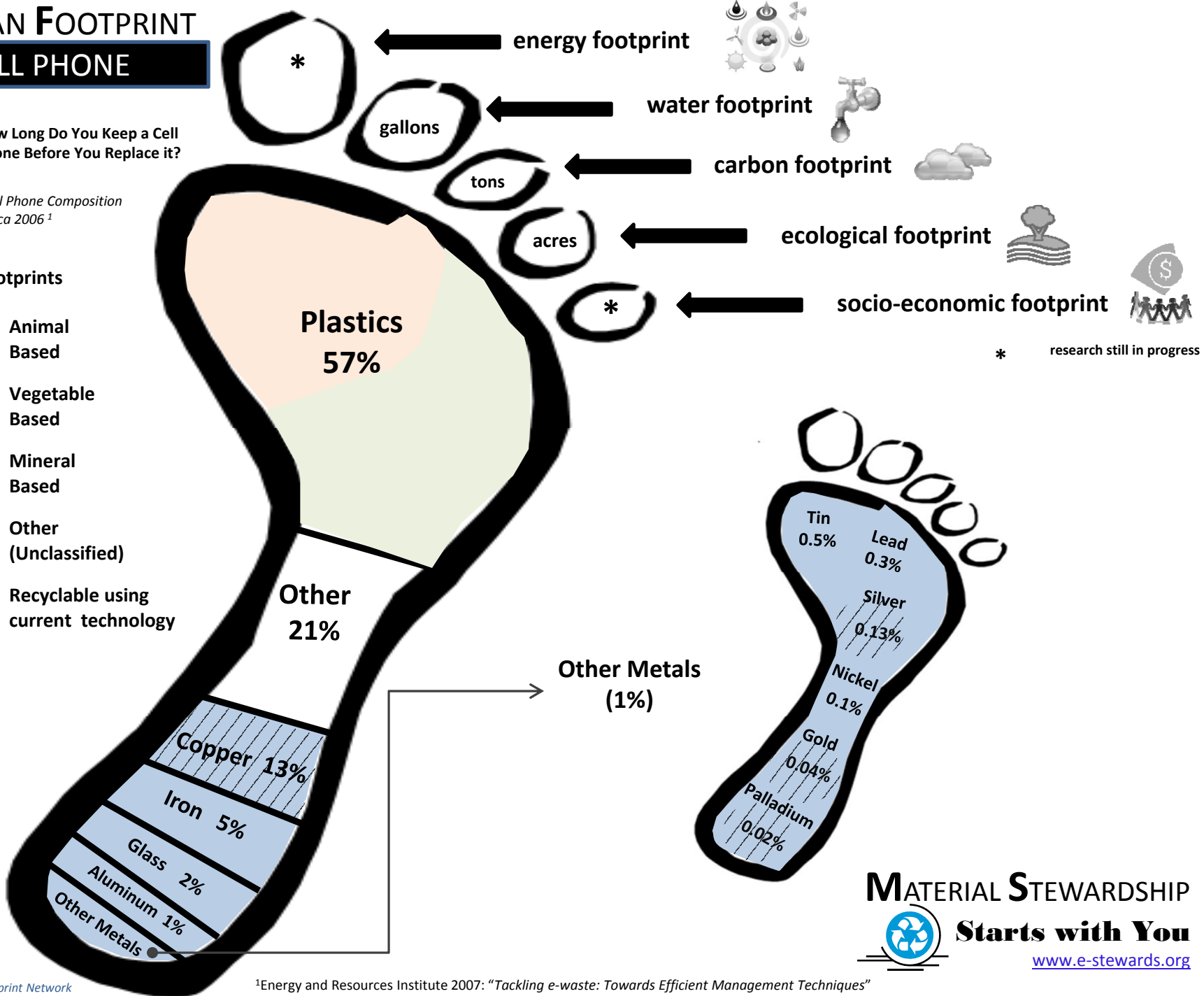
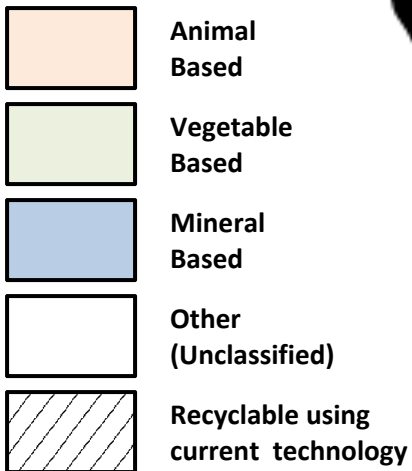
HUMAN FOOTPRINT CELL PHONE



How Long Do You Keep a Cell Phone Before You Replace it?

Cell Phone Composition
Circa 2006¹

Material Footprints





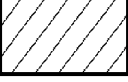


HUMAN FOOTPRINT WIND TURBINE¹



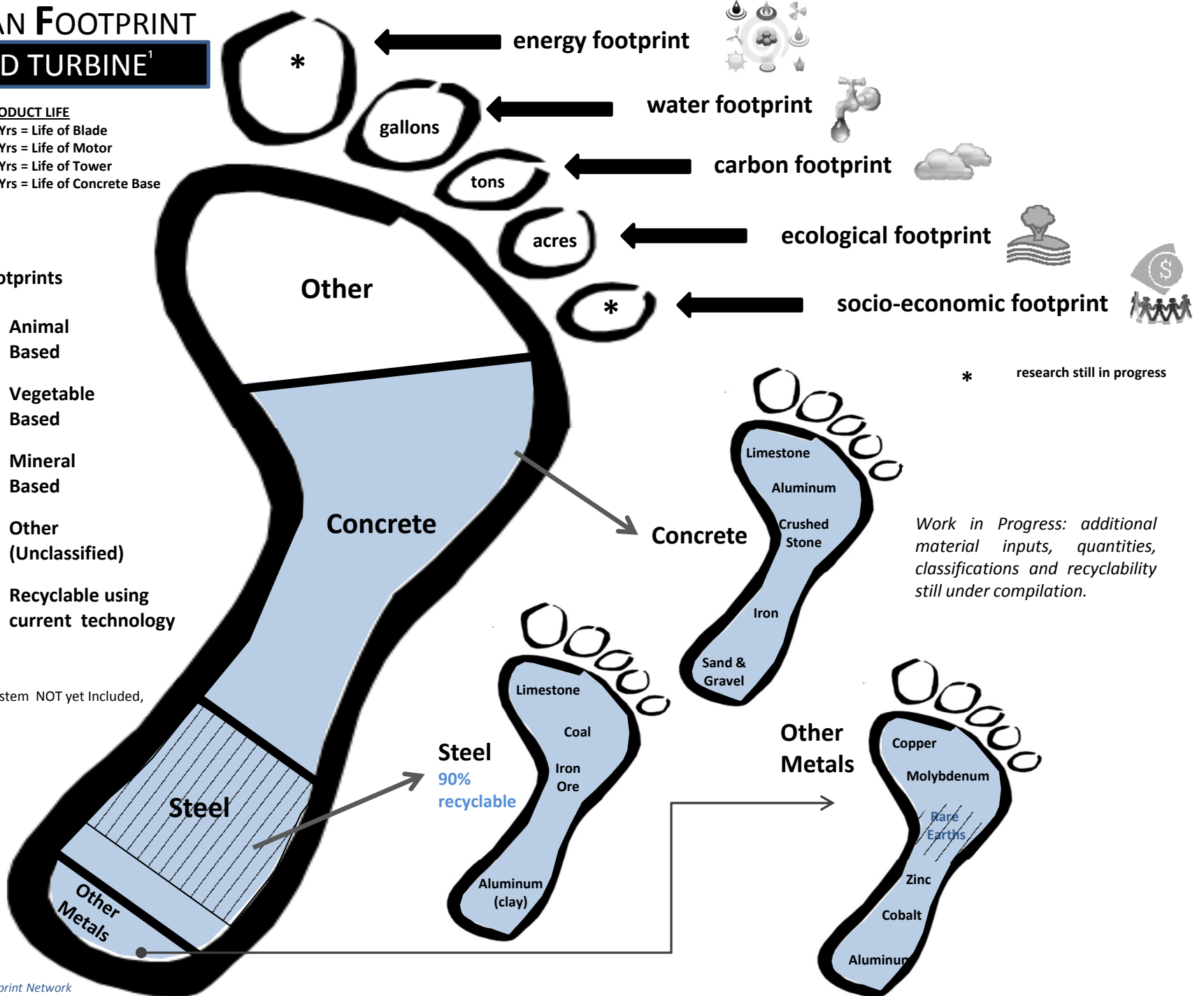
PRODUCT LIFE
 ?? Yrs = Life of Blade
 ?? Yrs = Life of Motor
 ?? Yrs = Life of Tower
 ?? Yrs = Life of Concrete Base

Material Footprints

-  Animal Based
-  Vegetable Based
-  Mineral Based
-  Other (Unclassified)
-  Recyclable using current technology

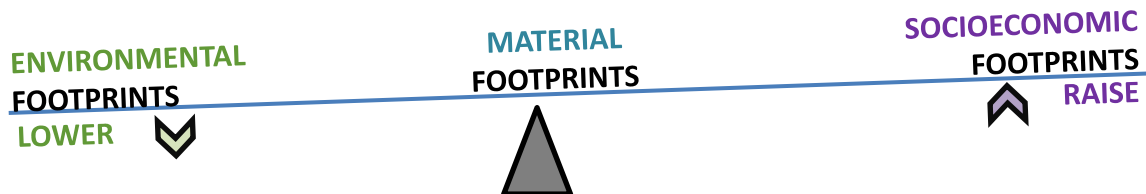
¹Energy Storage System NOT yet Included,

Data incomplete; research still in progress





THANK YOU FOR YOUR ATTENTION



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MINERAL FOOTPRINT™

*The **Mineral Footprint Network** is a non-profit research collaborative, engaged in developing a set of tools communicating what minerals, mining and materials stewardship mean for a sustainable society.*

*The **Mineral Footprint™** will support a larger sustainable development framework encompassing the social, environmental, economic, geopolitical and intergenerational dimensions of natural resource use and material stewardship.*