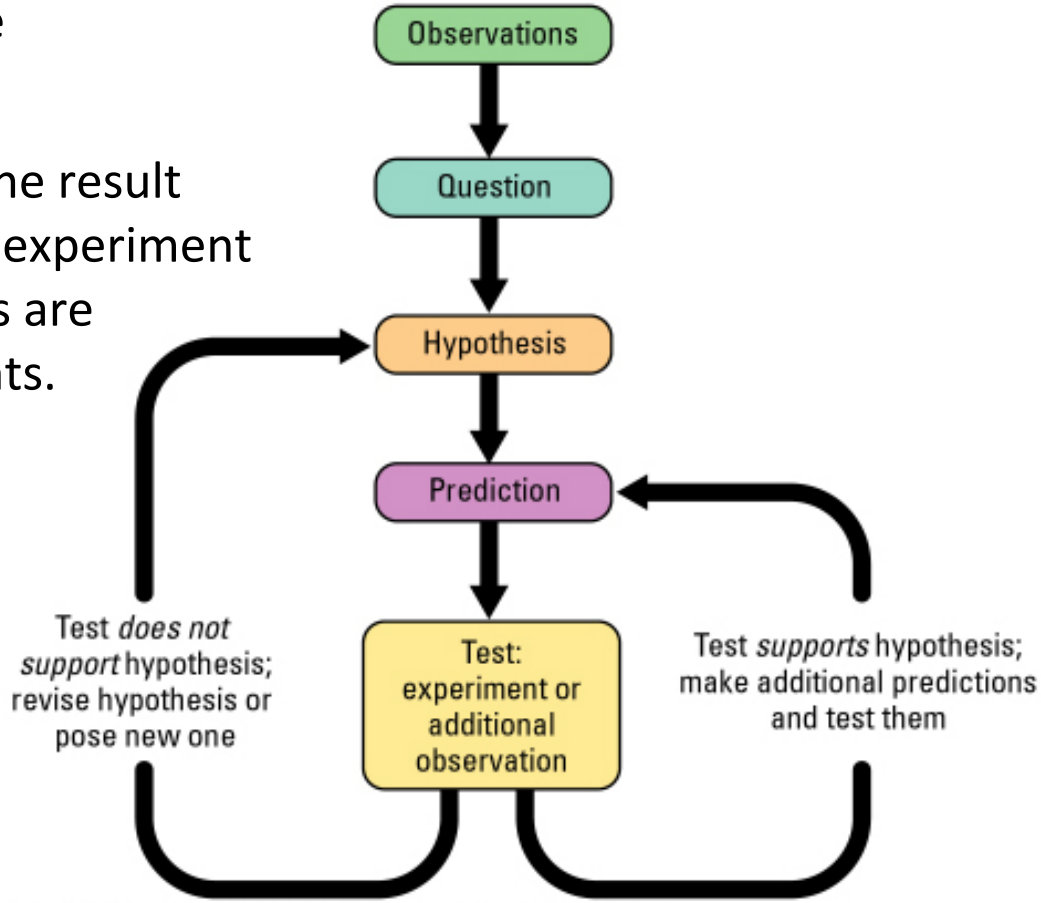
Science in LCA

Okala Practitioner Chapter 14

Scientific Process

The scientific method identifies real phenomena based on physical evidence. It poses hypotheses, which are tested by physical experiments that give measurable results.

An experiment that delivers one result will deliver it again in another experiment if the same physical conditions are maintained in both experiments.



Environmental Science

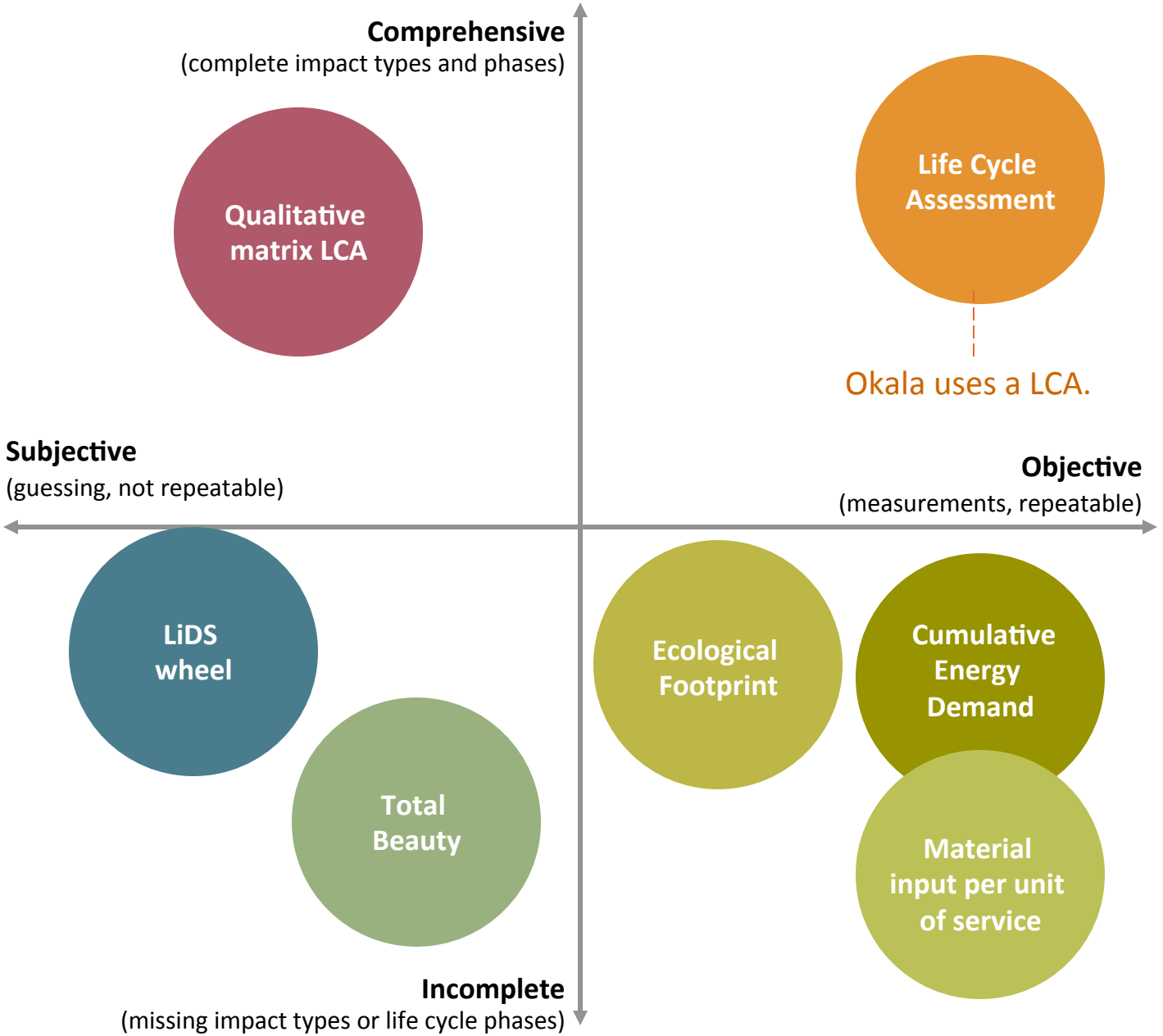
The practice of environmental science often combines skills from multiple disciplines, depending on the needs of the study. Regardless of the disciplines that join in the research, the scientific method is systematically applied.

The following image shows a diagram of environmental impact methods that design teams might use. These methods are described in more detail on pages 64-65 of Okala Practitioner.

Environmental Science can include:

Environmental Chemistry
Biochemistry
Ecology
Species Population Dynamics
Geology
Hydrology
Soil Science
Agriculture
Toxicology
Radiology
Epidemiology
Biology
Physics
Climatology
Statistics
Mathematical Modeling
Global Energy & Resource Studies

Environmental Impact Assessment Methods

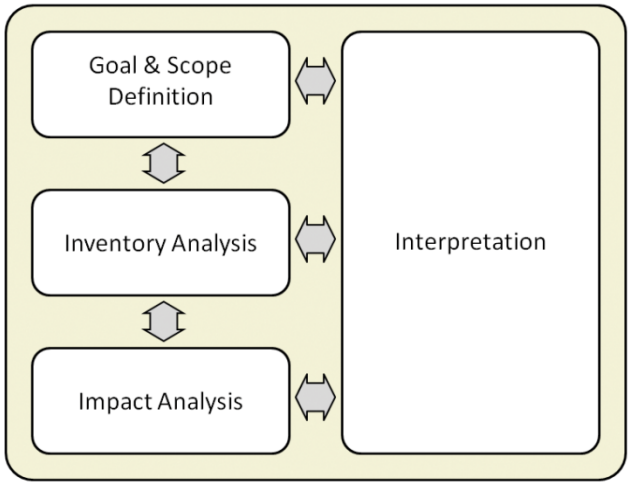


Life Cycle Assessment

Lifecycle assessment (LCA) is both objective (based on quantified measurements) and comprehensive (including the entire lifecycle of the system and including most impacts categories).

LCA strives to avoid transfer of environmental and human health damage from one impact category to another and from one phase of a product system life cycle to another phase.

LCA is an internationally recognized method. Its practice is guided by international standards (ISO 14040 LCA series).



The stages of LCA defined by ISO 14044.

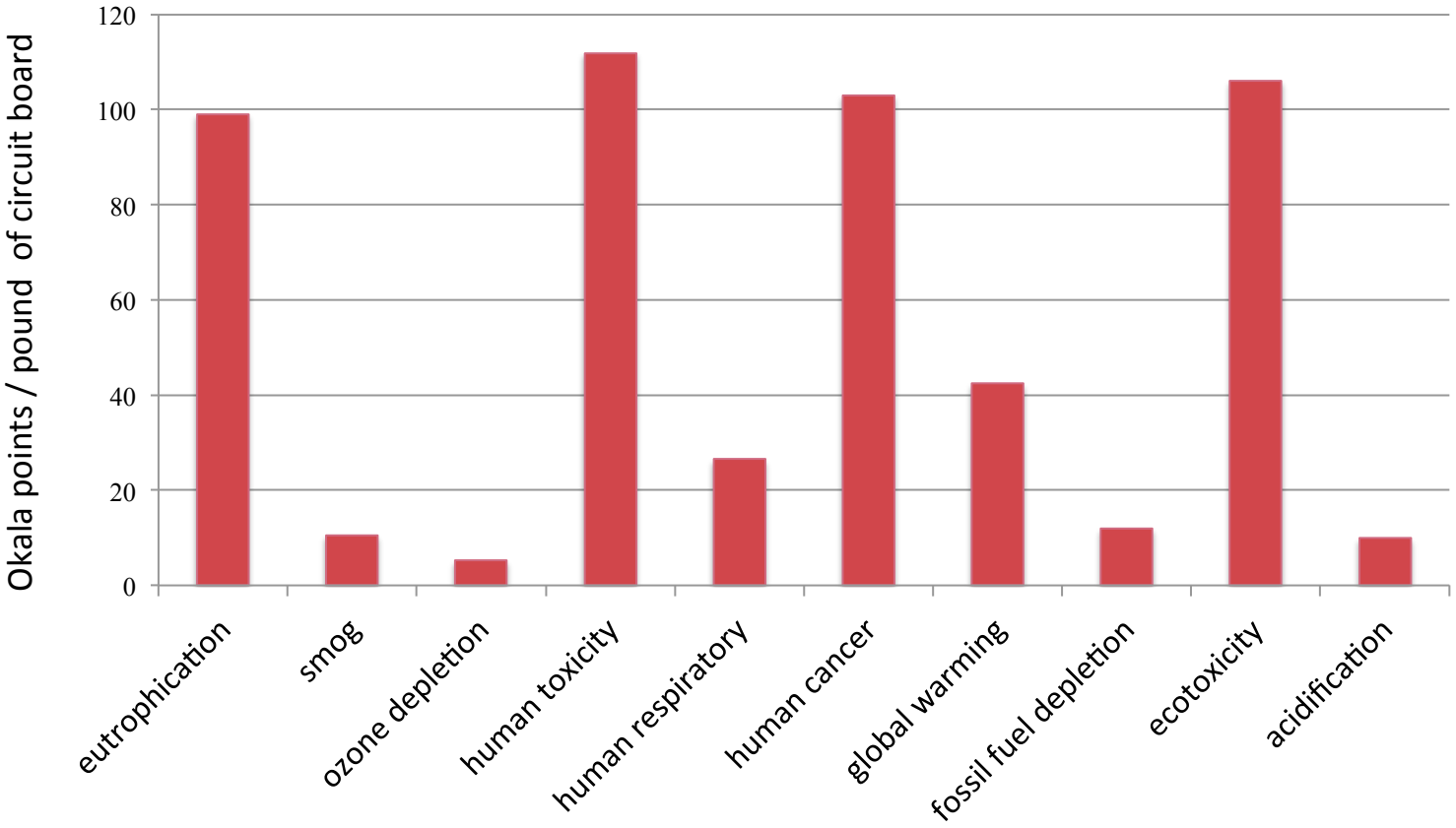
LCA Data Progression

1	2	3	4	5
System bill of materials	**Inventory**	**Characterization**	**Normalization**	**Weighting**
Materials, processes, energy used, transport, end-of-life	Emissions, resource depletion, and land-use	Environmental impacts: global warming, carcinogens, ecotoxicity, etc.	Scales impacts according to average impacts of a person in a continental area	Scales impacts according to their significance
Length of list depends on the product	**Can be hundreds of chemicals per material**	**Typically 8-12 categories, via scientific, peer reviewed formulae**	**North American or European normalization available.**	

These steps are explained in detail in chapter 14.

An assessment showing many categories is shown on the next page.

Example of a material assessed in ten impact categories



Impacts of production of one pound of populated RoHS compliant (lead free) circuit board. All of these impact categories are added together to create the Okala Impact Factor for each material and process.

Okala Impact Factors

Okala Impact Factors utilize state of the art inventory data for over 500 materials and processes. Okala Impact Factors use TRACI for characterization. TRACI was created by the US Environmental Protection Agency (US EPA), and adopted the new international standard for toxicity measurement, USETOX in 2011. These refinements are reflected in the Okala Impact Factors 2014.

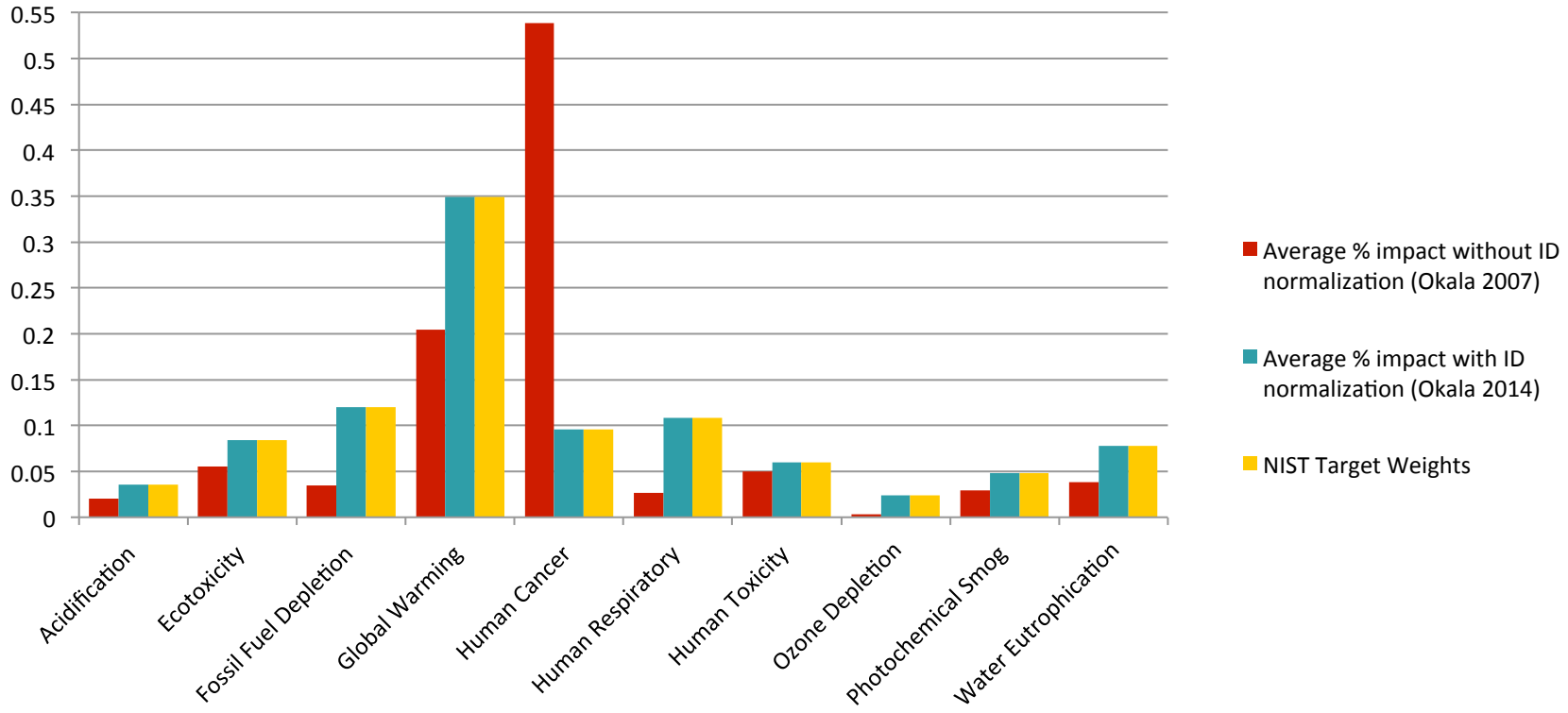
Okala's weighting was developed by the United States based National Institute of Science and Technology (NIST). These weight values place a value on climate change calibrated to be approximately four times greater than the weighting value of the other individual impact categories.

NIST
National Institute of Standards and Technology
U.S. Department of Commerce

Okala Impact Factors

Okala uses Inventory Dataset (ID) Normalization to remove the bias that occurs in normalized LCA results. In the graph below, the red bar shows the average characterized and weighted results of all items listed in the Okala Impact Factors. The disproportionate representation of Human Cancer is due to a mismatch of inventory and normalization datasets. Different groups of scientists collect these datasets.

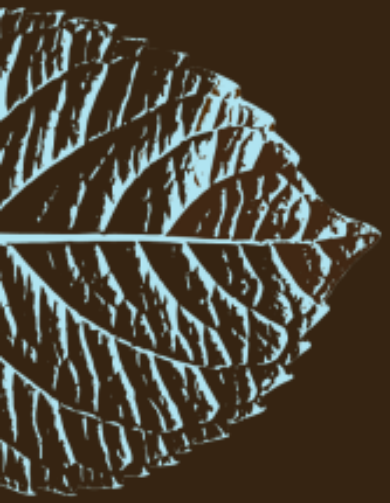
The blue bar is the average of all the items in the menu after ID normalization has been applied. The yellow bar is the NIST weighting value. Once the ID normalization is applied, it directly matches, on the average, the values in the weight set. This balances Okala Impact Factors 2014.



Okala Impact Factors

Okala Impact Factors include or are:	Okala Impact Factors exclude or are not:
Process LCA	Economic input-output LCA
Mid-point characterization with USETOX	End-point characterization
Multiple impact categories combined In a single-figure result	Multiple impact category results
Inventory Dataset Normalization	Normalization with Bias

Okala Impact Factors are easy to use because they contain one single-figure score, as opposed to the many impact scores that multiple-category LCA requires. This makes the Okala Impact factors significantly faster to use than multiple-category LCA.



Okala Practitioner

Integrating Ecological Design

This presentation is part of an educational presentation series that supports teaching from the *Okala Practitioner* guide.

Okala Practitioner and these presentations were created by the Okala Team to disseminate fact-based knowledge about ecological design to the design disciplines and business.

Unless provided in the presentations, Information sources are found in the *Okala Practitioner* guide.

The Okala Team:

Philip White IDSA	Associate Professor, Arizona State University
Louise St. Pierre	Associate Professor, Emily Carr University of Art + Design
Steve Belletire IDSA	Professor, Southern Illinois University Carbondale

The Okala Team initiated the collaboration with the US EPA and the Industrial Designers Society of America (IDSA) in 2003. The team developed Okala Practitioner with support from Autodesk, IBM, Eastman Chemical and the IDSA Ecodesign Section.

Okala Practitioner is available through amazon.com.

More information and the free Okala Ecodesign Strategy App are found at Okala.net.