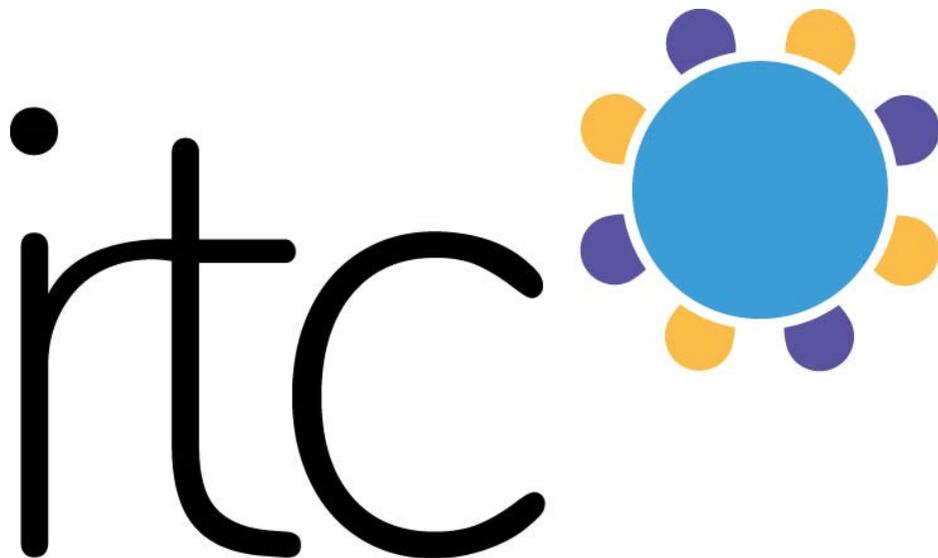


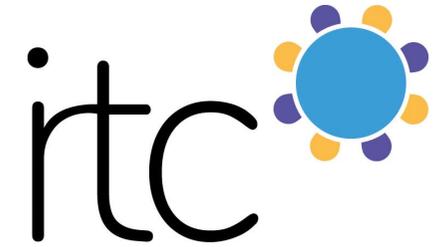
HOW METHODOLOGY DETERMINES WHAT IS CRITICAL



June 19, 2018

Resources for Future
Generations Conference,
Vancouver



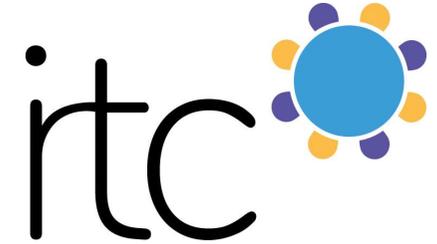


Yale methodology

[2011-2015]

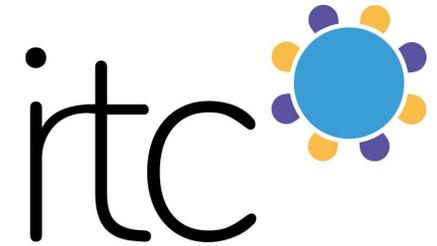
Tom Graedel
Yale University

Goal and Scope



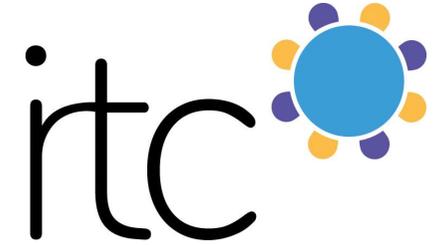
- Goal: To devise a consistent and defensible methodology that would serve different levels and types of users
- Our activities were centered on year 2008 data, though much of the data either change slowly or are reported only occasionally
- No plans for new methodology releases

Scope explanation



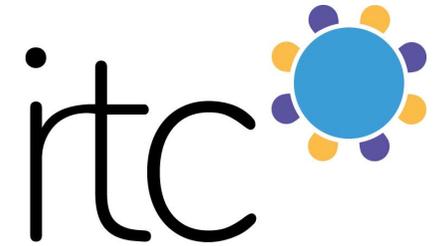
- Scope: 62 metals and metalloids
- Scope limitations: Noble gases, soluble elements, and radioactive elements were not included because they are likely to see only minimal use in industrial products with extended lifetimes
- Time scale: one or two decades into the future
- Potentially applicable to organic materials, but we have not done this

Factor explanation



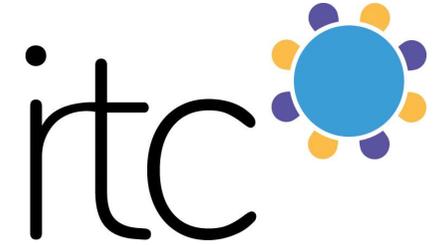
- Explicitly addresses global, country, and corporate levels, with some factors being chosen specifically for the level being assessed
- Retains the two NRC axes and adds a third: Environmental implications

Aggregation



- For a specific axis, indicators are evaluated on a 0-100 scale, and the average value of the indicators yields the axis value. No weighting of indicators is performed, though the method is transparent in allowing weighting if desired by the analyst
- We choose not to apply weightings as a general case, because we feel this is a choice of a specific user

Unique features



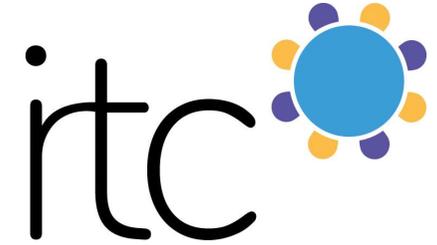
- Explicit inclusion of environmental implications – this permits easy recognition of materials with high toxicities or high embedded energies
- No specific identification of critical/not critical boundaries, because different users have different goals, perspectives, and time scales

Results and implications



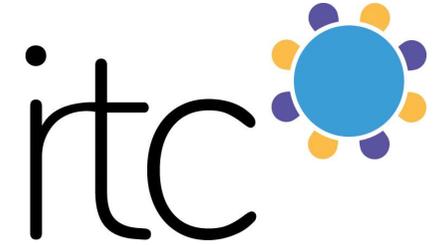
- Metals of most concern are those available largely or entirely as by-products, those used in small quantities in specialized applications, and those with no effective substitutes
- This methodology inspired that of General Electric and perhaps other corporations, as well as that of the US Geological Survey

Limitations



- Results are constrained by scarcity of data, especially for companion metals
- Corporate feedback would help improve the methodology, but corporate feedback tends not to happen (GE is the exception)

Outlook



- At this time we are not actively involved in criticality assessment evaluation, and have no definite plans to do so in the future