

Sustainable Materials and Standards

Dr. Yuan Yao

Forest Biomaterials Department

NC State University

Green Buildings and Sustainable Materials Project

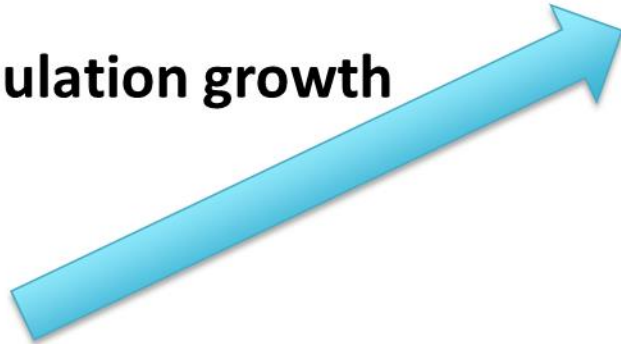
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and Technology**

150 Years of Fast Development

2016: 7.4 billion



Rapid population growth



1.2 billion



Steam engine



Electric motor



Gasoline engine



Vacuum tube



Commercial aviation



Television



Nuclear energy



Microchip

WWW
Internet

1850

1875

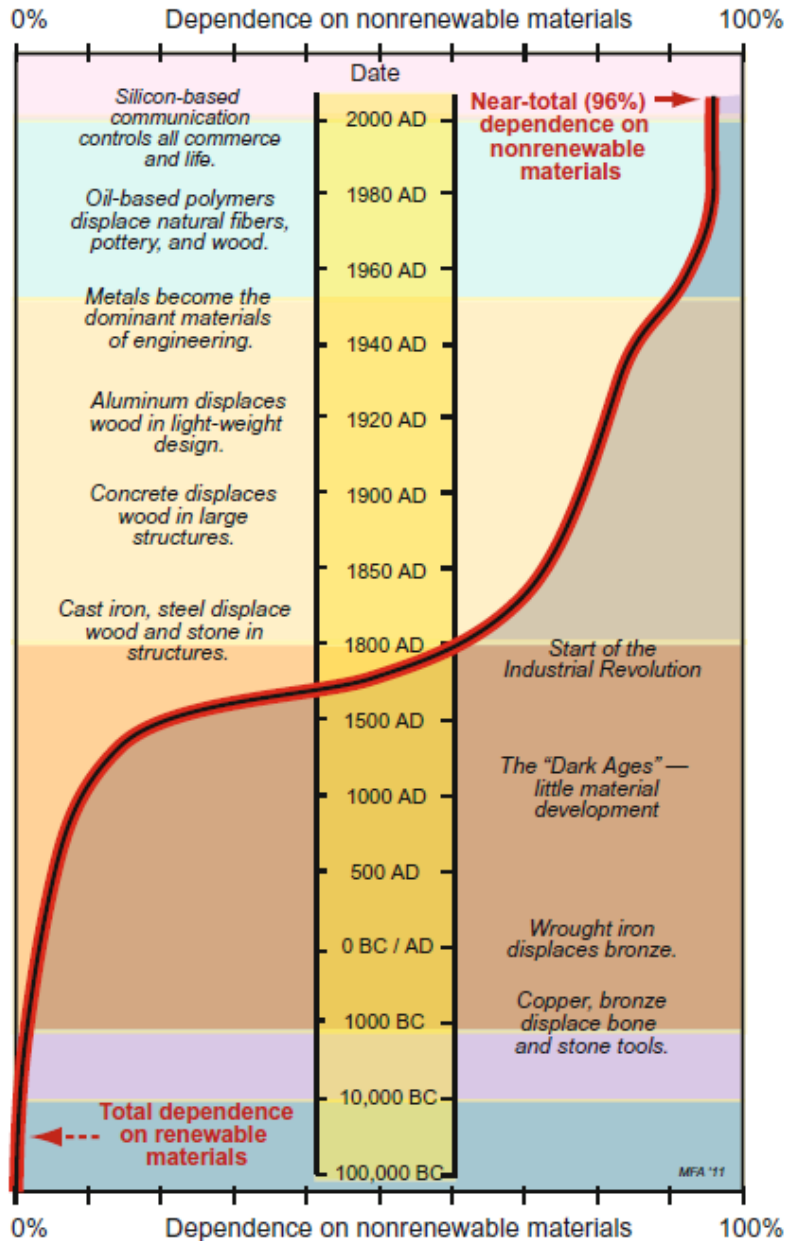
1900

1925

1950

1975

2000 2008



Increasing Dependence on Nonrenewable Materials

Renewable: a resource which can be replaced naturally in a short time.

- Forest
- Plants
- Animals



<https://forestry.ces.ncsu.edu/>

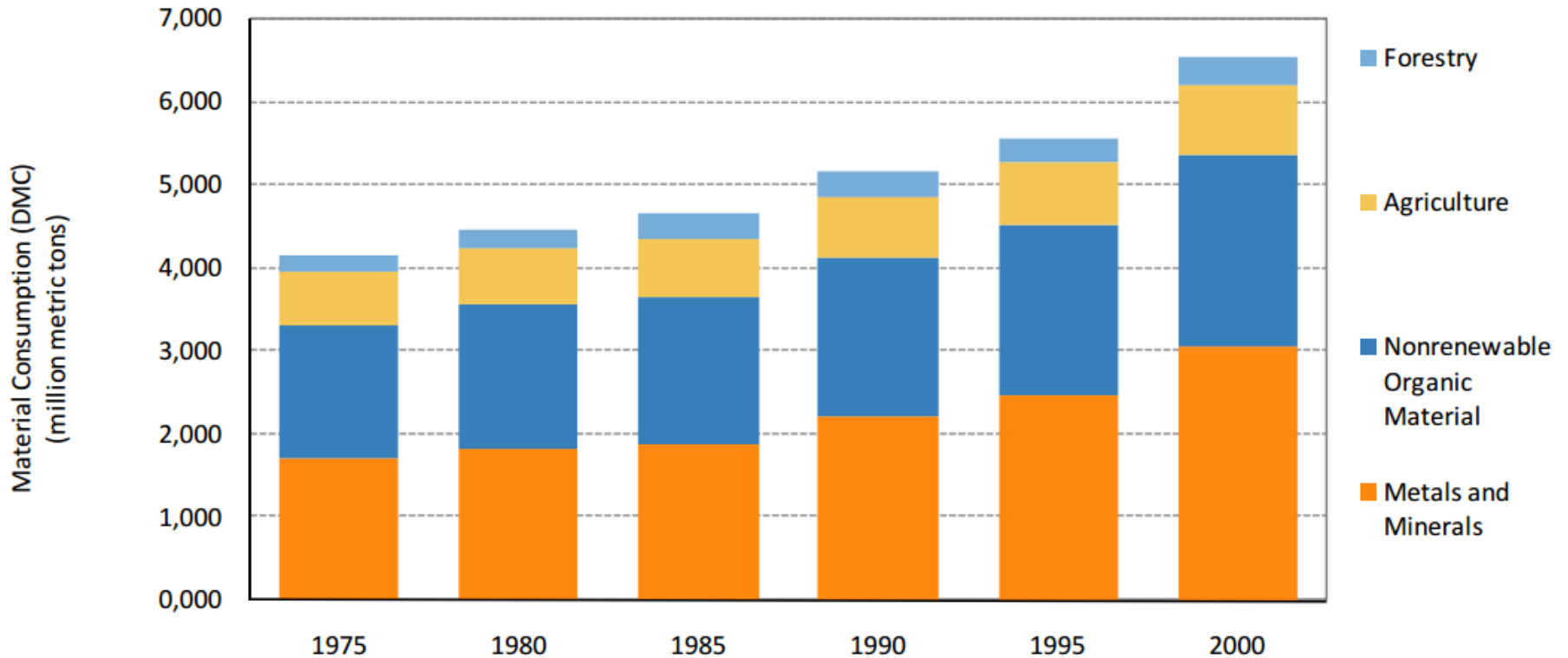
Non-renewable: a resource which cannot be replaced naturally in a meaningful human time-frame.

- Fossil fuels
- Metal ores
- Minerals



<https://www.miningreview.com/water-impacts-coal-power-underestimated/>

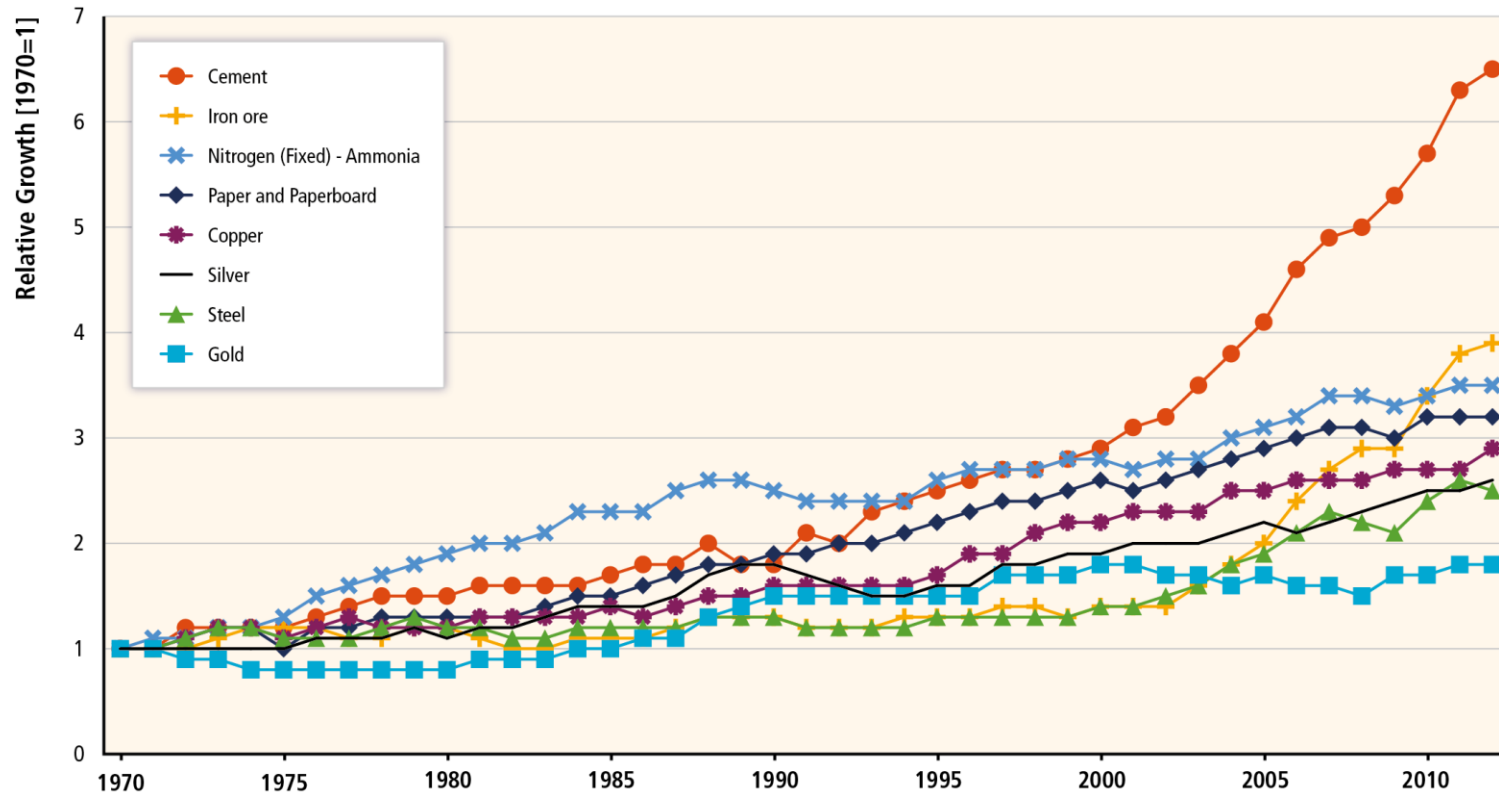
Increasing Dependence on Nonrenewable Materials



Materials Consumption in the United States by Sector of Origin, 1975-2000

The production and use of materials is critical to our economy and the environment

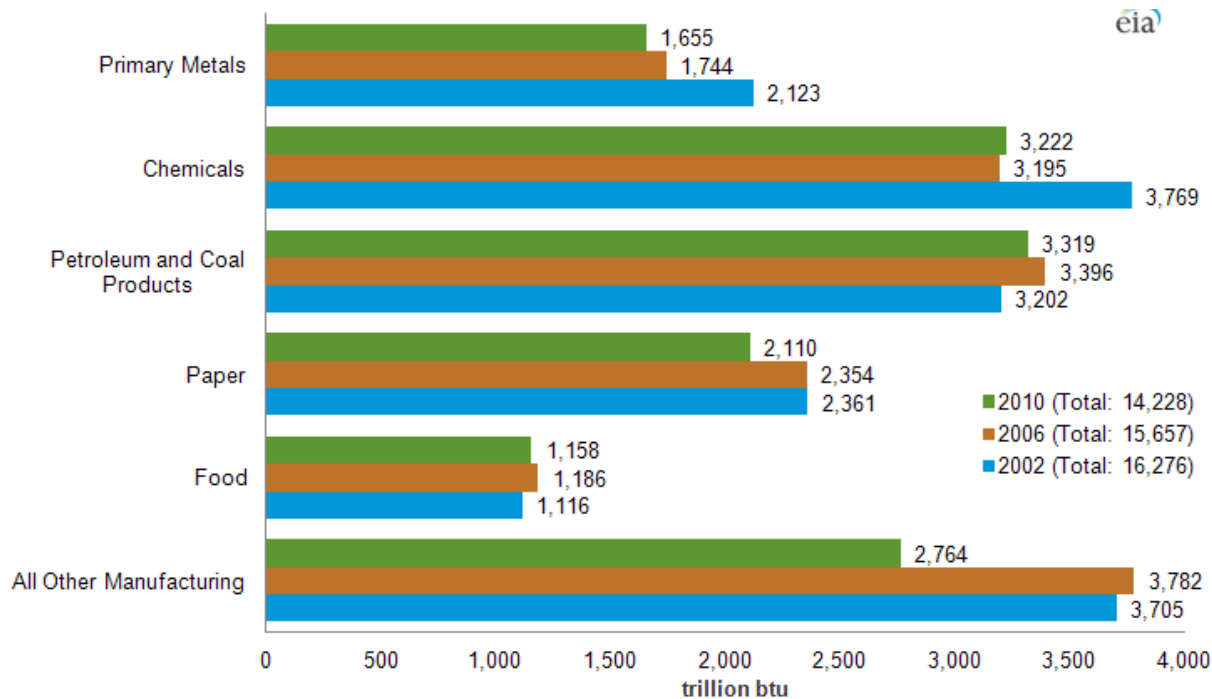
- Materials are critical to almost every economic sector. The demand of materials is increasing with population and economic growth.



Source: IPCC, AR5 Climate Change 2014: Mitigation of Climate Change

The production and use of materials is critical to our economy and the environment

- Materials are critical to almost every economic sector. The demand of materials is increasing with population and economic growth.
- The production and use of materials can be energy intensive

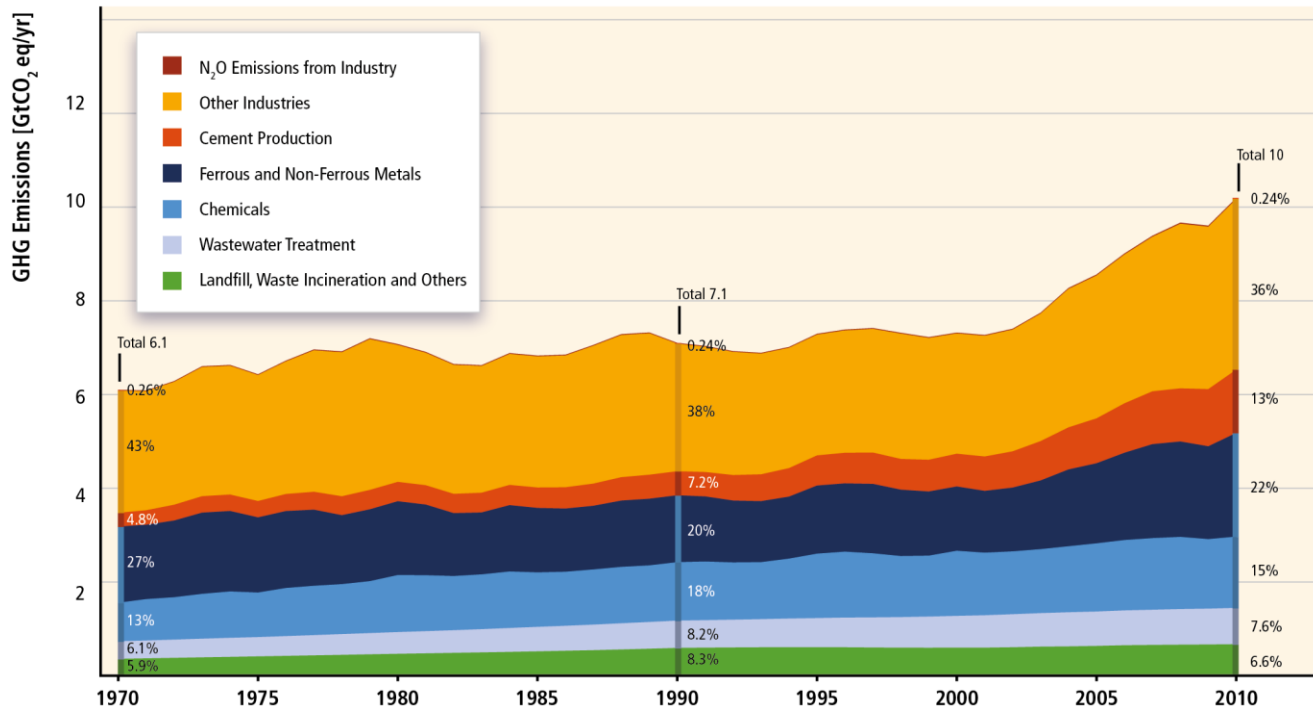


Source: U.S. Energy Information Administration, Manufacturing Energy Consumption Survey - Table 3.2: Fuel Consumption, 2002, 2006, and 2010

The production and use of materials is critical to our economy and the environment

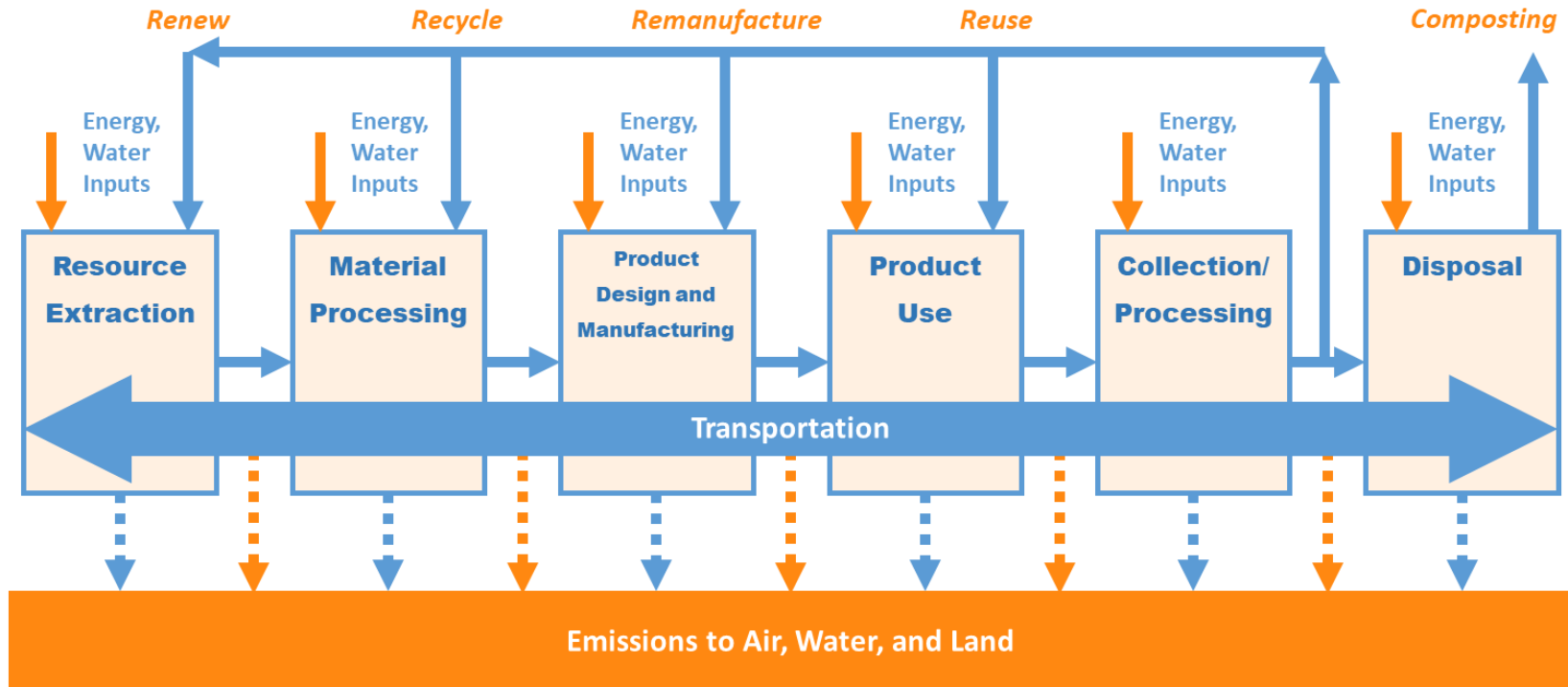
- Materials are critical to almost every economic sector. The demand of materials is increasing with population and economic growth.
- The production and use of materials can be energy intensive
- Our use of materials have impacts on the environment, such as air, water, and land.

Direct Emissions



Source:
 IPCC, AR5 Climate
 Change 2014:
 Mitigation of
 Climate Change

Sustainable Production, Use, and Management of Materials



A Typical Life-Cycle of Materials

Life Cycle Assessment (LCA)

A concept and methodology to evaluate the environmental effects of a product or activity holistically, by analyzing the whole life cycle of a particular product, process, or activity (U.S. EPA, 1993).



Life Cycle Assessment (LCA) and ISO Standards

ISO 14040, Environmental management – Life cycle assessment – Principles and framework, provides a clear overview of the practice, applications and limitations of LCA to a broad range of potential users and stakeholders, including those with a limited knowledge of life cycle assessment.

ISO 14044, Environmental management – Life cycle assessment – Requirements and guidelines, is designed for the preparation of, conduct of, and critical review of, life cycle inventory analysis. It also provides guidance on the impact assessment phase of LCA and on the interpretation of LCA results, as well as the nature and quality of the data collected.



ISO: International Organization for Standardization. ISO is an independent, non-governmental international organization with a membership of 162 national standards bodies.

Environmental Product Declaration (EPD)

Type III environmental declarations present quantified environmental information on the life cycle of a product to enable comparisons between products fulfilling the same function. Such declarations

- are provided by one or more organizations,
- are based on independently verified life cycle assessment (LCA) data, life cycle inventory analysis (LCI) data or information modules in accordance with the ISO 14040 series of standards and, where relevant, additional environmental information,
- are developed using predetermined parameters, and
- are subject to the administration of a programme operator, such as a company or a group of companies, industrial sector or trade association, public authorities or agencies, or an independent scientific body or other organization.

EPD and ISO Standard

ISO 14025 Environmental labels and declarations -- Type III environmental declarations -- Principles and procedures

- ISO 14025 establishes the principles and specifies the procedures for developing Type III environmental declaration programmes and Type III environmental declarations. It specifically establishes the use of the ISO 14040 series of standards in the development of Type III environmental declaration programmes and Type III environmental declarations.
- ISO 14025 establishes principles for the use of environmental information, in addition to those given in ISO 14020 Environmental labels and declarations — General principles.
- Type III environmental declarations as described in ISO 14025 are primarily intended for use in business-to-business communication, but their use in business-to-consumer communication under certain conditions is not precluded.

Standards for Sustainability Assessment of Specific Materials and Products

- **NSF 140** Sustainability Assessment for Carpet
- **NSF 332** Sustainability assessment for Resilient Floor Coverings
- **NSF 336** Sustainability Assessment for Commercial Furnishings Fabric
- **NSF 342** Sustainability Assessment for Wallcovering Products
- **NSF 347** Sustainability assessment for Single Ply Roofing Membranes



NSF International is an American product testing, inspection and certification organization. As a program operator, NSF assists in developing product category rules, help develop LCA and conduct LCA critical reviews, and provide EPD verifications across multiple product groups and industries.

Standards for Sustainable Manufacturing

- **ASTM E2987 / E2987M** Standard Terminology for Sustainable Manufacturing
- **ASTM E2979** Standard Classification for Discarded Materials from Manufacturing Facilities and Associated Support Facilities
- **ASTM E3096** Standard Guide for Definition, Selection, and Organization of Key Performance Indicators for Environmental Aspects of Manufacturing Processes
- **ASTM E3012** Standard Guide for Characterizing Environmental Aspects of Manufacturing Processes
- **ASTM E2986** Standard Guide for Evaluation of Environmental Aspects of Sustainability of Manufacturing Processes



ASTM is a not-for-profit organization that provides a forum for the development and publication of international voluntary consensus standards for materials, products, systems and services.

Source: <https://www.astm.org/ABOUT/faqs.html>

Other Sustainability Related Standards

ASTM E3027 Standard Guide for Making Sustainability-Related Chemical Selection Decisions in the Life-Cycle of Products

- Cover social, economic, and ecological considerations

ASTM E2129 Standard Practice for Data Collection for Sustainability Assessment of Building Products

- Provide general guidelines on collecting data for assessing the sustainability of buildings, including materials, manufacturing, operational performance of installed products, indoor environmental quality, and corporate environmental policy.

ASTM E917 Standard Practice for Measuring Life-Cycle Costs of Buildings and Building Systems

- Cover life Cycle Cost Analysis – similar concept as environmental LCA but with different approach and focus.

Visit Our Project Website

<https://faculty.cnr.ncsu.edu/yuanyao/green-buildings-and-sustainable-materials/>

This presentation and video were prepared by the project team (Yuan Yao, Stephen Kelley, Traci Rider, and Adam Scouse) at North Carolina State University using Federal funds under award 70NANB18H277 from the National Institute of Standards and Technology, U.S. Department of Commerce. The statements, findings, conclusions, and recommendations are those of the author(s) and do not necessarily reflect the views of the National Institute of Standards and Technology or the U.S. Department of Commerce.