

Technology Assessment (TA): a framework for combination of tools

Getachew Assefa

Division of Industrial Ecology, Department of Chemical
Engineering and Technology,
Royal Institute of Technology,
Stockholm, Sweden

TA –definition

UNEP's

- a category of policy studies
- provides decision-makers with an ordered set of analysed policy options and their implications for the *economy*, the *environment* and the *social, political* and *legal* processes and institutions of society
- intended to provide decision-makers with **information** about the possible impacts and consequences of a **new** technology or a significant change in an old technology

..... definition

- concerned with both direct and indirect/ secondary consequences
- both benefits and disadvantages
- mapping the uncertainties involved in any government or private use or transfer of a technology

TA - past and present

- 1972: UN Conference on Human Settlement, Stockholm,
 - “*environmentally sound technologies..... alternatives to existing harmful technologies; adequately assessing their environmental consequences*”
- 1972: Office of Technology Assessment (OTA) by US Congress
- 1992: UN Conference on Environment and Development, Rio de Janeiro
- 1995: OTA closure
 - for, among other things, methodological problems

..... past and present

- Institutes, boards, offices of Technology [Assessment] in 7 European countries - Parliamentary or independent
- European Parliament Technology Assessment (EPTA)
- International Association for Technology Assessment and Forecasting Institutions (IATAFI), sponsored by the UN
- UNEP's TA programme called Environmental Technology Assessment (EnTA)

... past and present

- European Parliament Technology Assessment (EPTA).
- International Association for Technology Assessment and Forecasting Institutions (IATAFI), sponsored by the UN, was established in 1993 with a secretariat in Bergen, Norway.
- UNEP's TA programme called Environmental Technology Assessment (EnTA)

TA types

Basis: object of assessment, starting point

1. Project assessment TA
2. Generic TA
3. Problem assessment TA
4. Policy assessment TA
5. Global problematique TA

1. Project-induced TA
2. Problem- induced TA
3. Technology-induced TA

Basis: purpose, objective

1. Academic TA
2. Industrial TA
3. Parliamentary TA
4. Executive power TA
5. Laboratory TA

1. Awareness TA
2. Strategic TA
3. Constructive TA
4. Back-casting TA

Steps in TA

1. TECHNOLOGY DESCRIPTION AND ALTERNATIVE PROJECTIONS

- 1.1 Data Acquisition
- 1.2 Bounding the Assessment Domain
- 1.3 Projection of technological Alternatives

2. IMPACT ASSESSMENT

- 2.1 Impact Criteria Selection
- 2.2 Predicting and Assessing Impacts
- 2.3 Impact Comparisons and Presentation

3. POLICY ANALYSIS

- 3.1 Implementation of Technological Alternatives
- 3.2 Search for Permeating Issues, Concerns, and Uncertainties

Break-up analysis: title and subtitle

- Title
 - Technology?
 - Assessment?
- Subtitle
 - Framework?
 - Combination?
 - Tools?

Technology

- Technology (1859) - practical application of knowledge especially in a particular area. related to ENGINEERING
- Engineering (1720) - application of science and mathematics by which the properties of **matter** and the sources of **energy** in **nature** are made **useful** to **people**.

Merriam-Webster Online Dictionary

- Technology - application of scientific knowledge to the **practical aims** of **human life** or, as it is sometimes phrased, to the change and manipulation of the **human environment**

Encyclopedia Britannica

.... in this context

- technology as “the ways in which humans do and make things with **materials** and **energy**”

Manahan (1999)

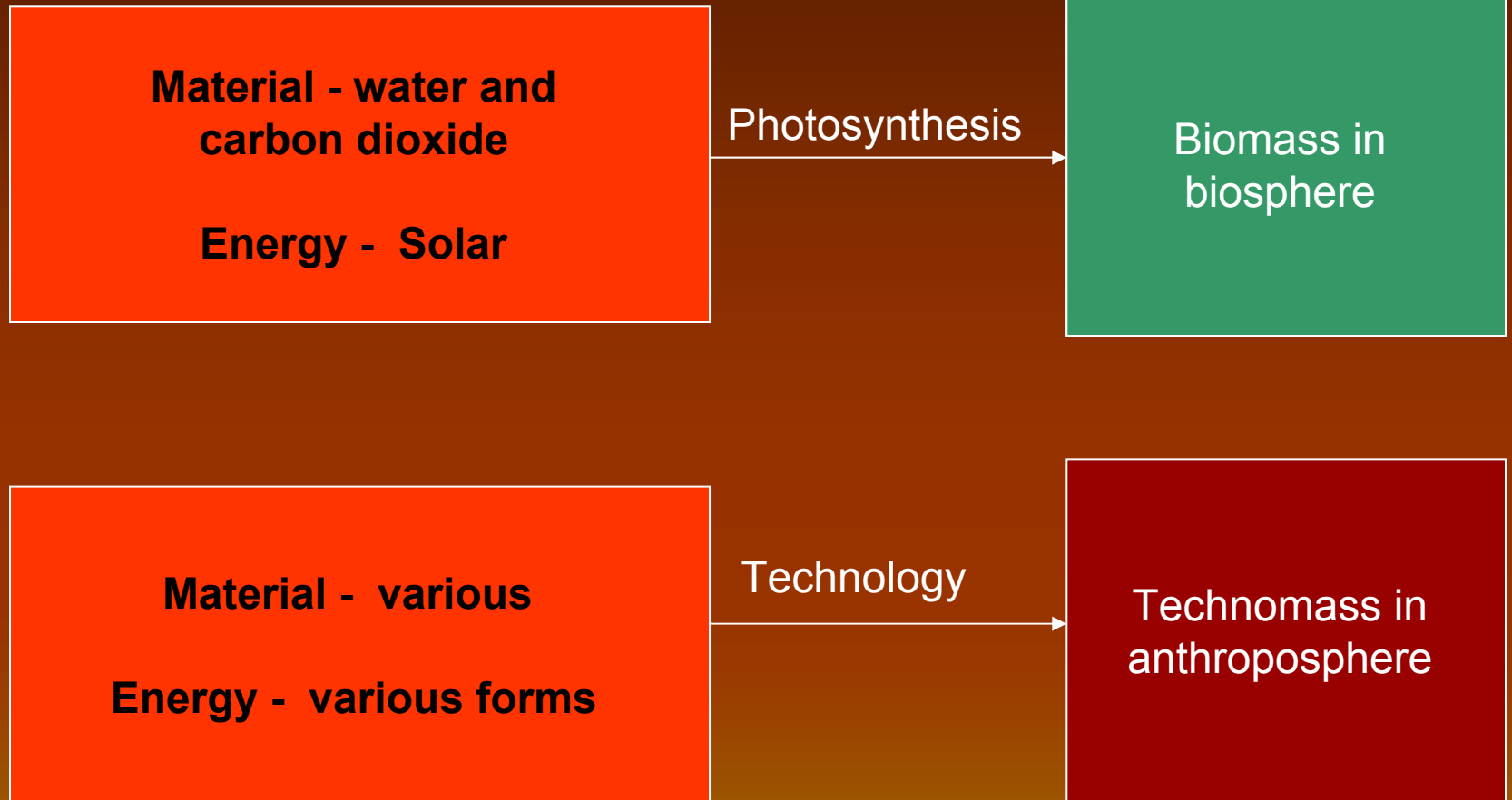
- economic activity as “a process of transforming **materials** and **energy**”

Turner et al. (1994)

.... technology

- The term "technology" : [technical] systems versus material and energy flows - photosynthesis analogy
- Technology - as **hard** and soft **means** of *transfer*, *transport* and *transformation* of **materials** and **energy** in a given economy

.... in this context - analogy



Assessment

- the action or an instance of “determining the importance, size, or value of.....”

....Impacts

Impacts

1. Economic
2. Legal
3. Environmental
4. Institutional
5. Social
6. Political
7. Technological

1. Economic
2. Sociological
3. Legal
4. Environmental
5. Technical

.....in this context

- New world order since OTA- Sustainability
- TA discussions vis-à-vis sustainable development
- Impacts :
 - ecological
 - economic
 - social
- need for metrics (e.g. WRI)

TA - tools

- Different tools, different levels, different areas
- Henriksen (1997) : 61 TA tools
 - economic analysis (11)
 - technical performance assessment (9)
 - market analysis (4)
 - decision analysis (9)
 - systems engineering/systems analysis (7)
 - technological forecasting (6)
 - information monitoring (4)
 - risk assessment (5)
 - externalities/impact analysis (6)

In this context

- tools for assessing
 - ecological
 - economic
 - social impacts

Combination

- not to make the tools one
- to enable the tools *“to act together”*

Framework

- a basic conceptual structure (as of ideas)

Synthesis: title and subtitle

- tools “acting together” in a common “conceptual structure” for “determining the importance, size, or value” of ecological, economic and social impacts of “doing and making things with materials and energy”

Ecological - MFA/SFA and LCA

- MFA/SFA : from biology, ecology, sociology, cultural anthropology, and social geography
(Fischer-Kowalski, 1997)
- *Metabolism of the Anthroposphere*
(Baccini and Brunner, 1991)
- three phases of carrying out MFA/SFA:
 - goal and system definition
 - inventory and modelling
 - interpretation
(Udo de Haes et al., 1997)

.....ecological - LCA

- LCA as a model and as a procedure
- as a model:
 - environmental impacts of a product, service or activity throughout its entire life cycle
- as a procedure:
 - goal definition and scoping
 - inventory analysis
 - impact assessment
 - interpretation
- Retrospective LCA and Prospective LCA

Economic -LCC

- LCC = Internal and External
- Internal = conventional + less tangible costs
- Conventional= capital + operating costs
- Less tangible = waste handling +
environmental permitting + . . .
- External = emissions and resource use/
environmental and human health effects

Social - SIA

- Still at the level of development
- Difficulty due to the connection of social impact to project level assessment and corporate/firm level responsibility (e.g. CSR)
- Basis: theories and practices of SIA
- Starting-point - Vanclay's (2003) eight “changes to” people's

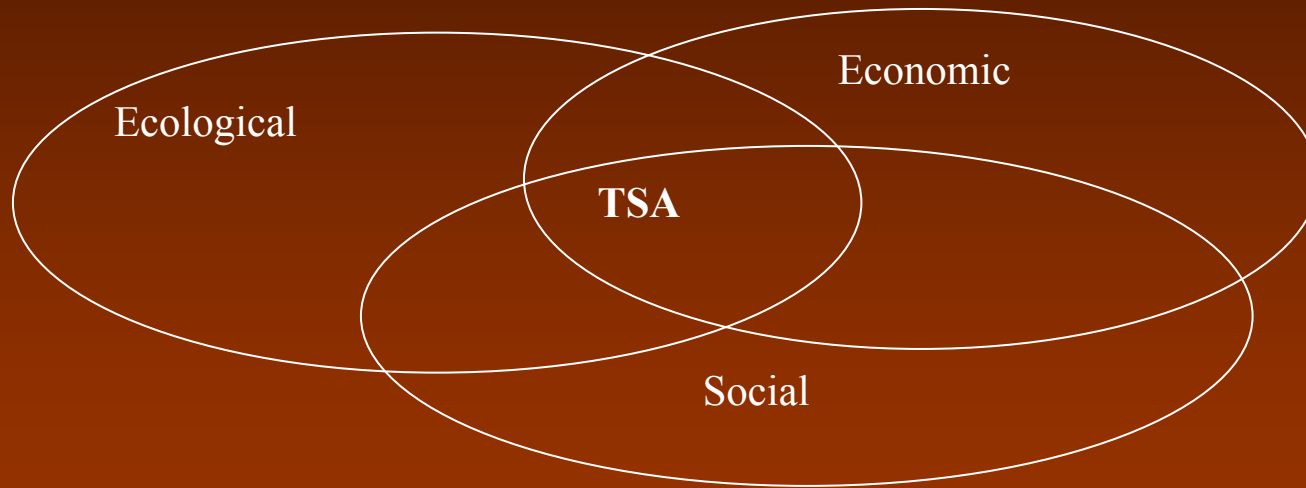
(Vanclay, 2003)

.....social - SIA

Social impacts as “changes to” people’s

1. way of life - how live, work, play
2. culture – shared beliefs, customs, values
3. community – stability, cohesion, services and facility
4. political systems – participation in decisions
5. environment – availability, quality and access to
6. health and wellbeing – WHO’s definition
7. personal and property rights – human rights
8. fears and aspirations – perception of safety, future

Cross-fertilization of tools and concepts



*An ideal technology assessment tool with
sustainability if focus (TSA)*

Parameters for “acting together”

- About the tools
 - quantitative wherever possible
 - established, standardized
- About the methodology
 - recognition and consideration to different levels
 - conceptual level - common conceptual frame of reference
 - tactical level- specific data collection and calculation method
 - “clear scientific and methodological status”
 - “paradigmatic and cumulative”
 - both social and natural sciences

...parameters for “acting together”

- About the implementation of the combination
 - systematic
 - coherent body of ideas or principles marked by thoroughness and regularity
 - even-handedness
 - considerable magnitude of integration
 - “sound co-ordination, integration and overall balance” between the ecological, economic, and social aspects
 - credibility
 - free from assessor’s own judgment and intuition
 - Platform for methodology development and harmonization

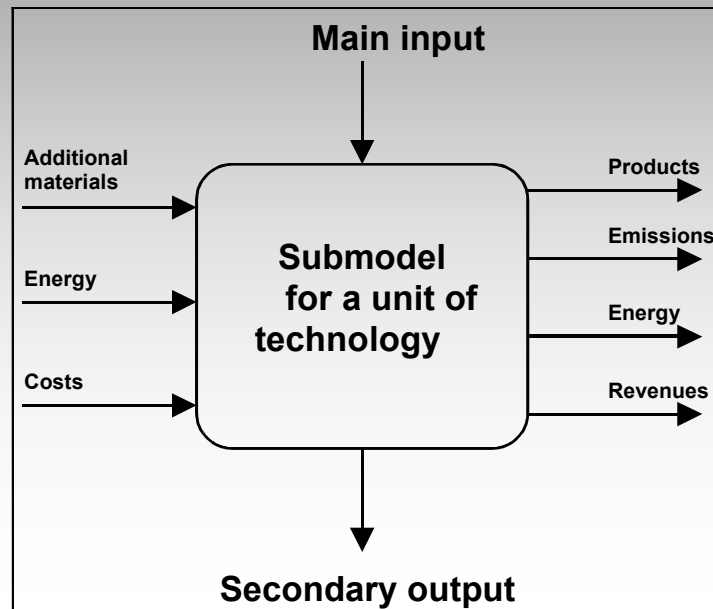
... parameters for “acting together”

- About the result
 - manageable result presentation
 - enhanced credibility and reproducibility
 - applicability, usefulness

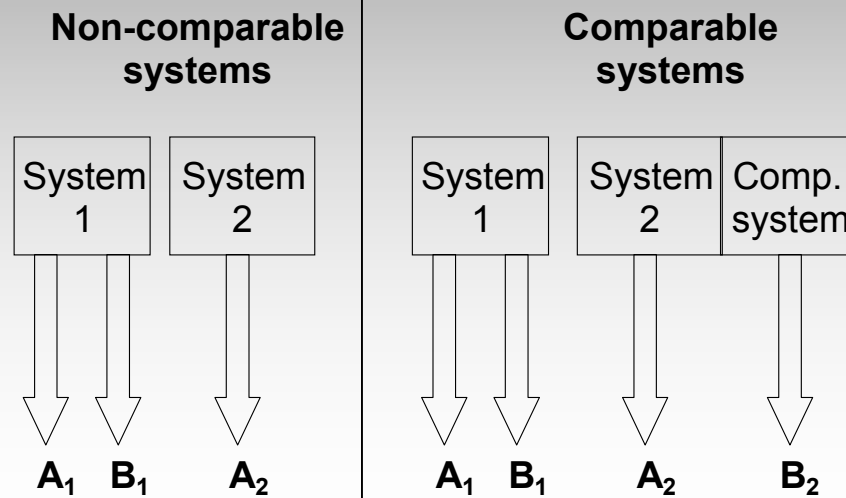
Implementation platform – ORWARE

- Computer-based model tool, ORWARE
 - composed of sub-models for ecological, economic and social aspect of technology units
- MATLAB/SIMULINK with result presentation in MS Excel
- purely quantitative data and quantitative data based on qualitative info
 - both as a raw input data and as background information for final analysis of results
- three parts-
 - data input
 - data processing
 - result presentation parts

Submodels in ORWARE

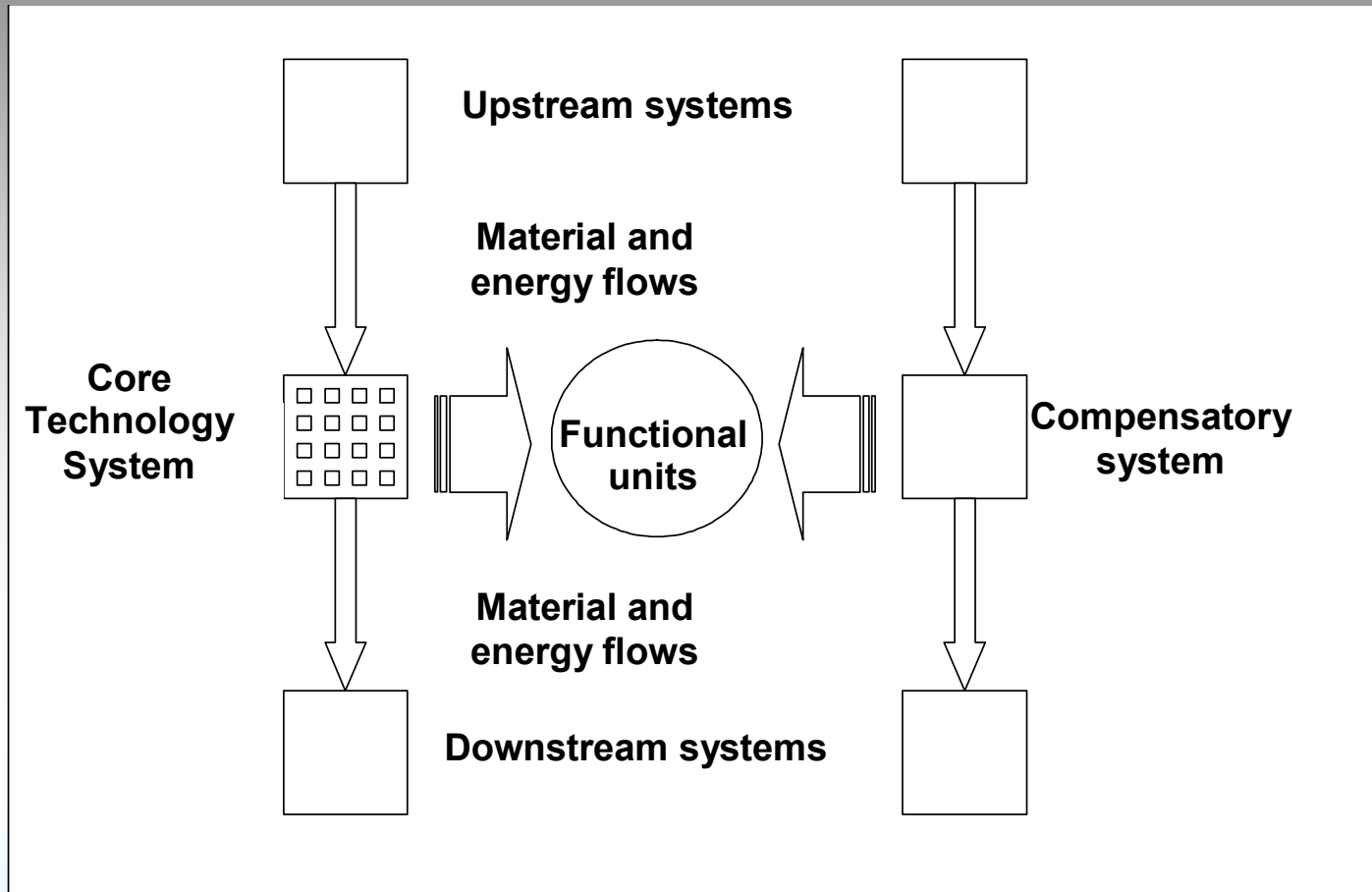


Comparison of systems



Finnveden, 1998

Conceptual model of the total system



Final remarks - opportunities

- modular feature : flexibility, transparency and simplicity
- more even-handed assessment
- compensate for weaknesses in a tool
- comprehensive and systematic at the same time
 - **avoids problem shifting**
 - from area to area
 - from one part of the life cycle to another
 - dimension to dimension

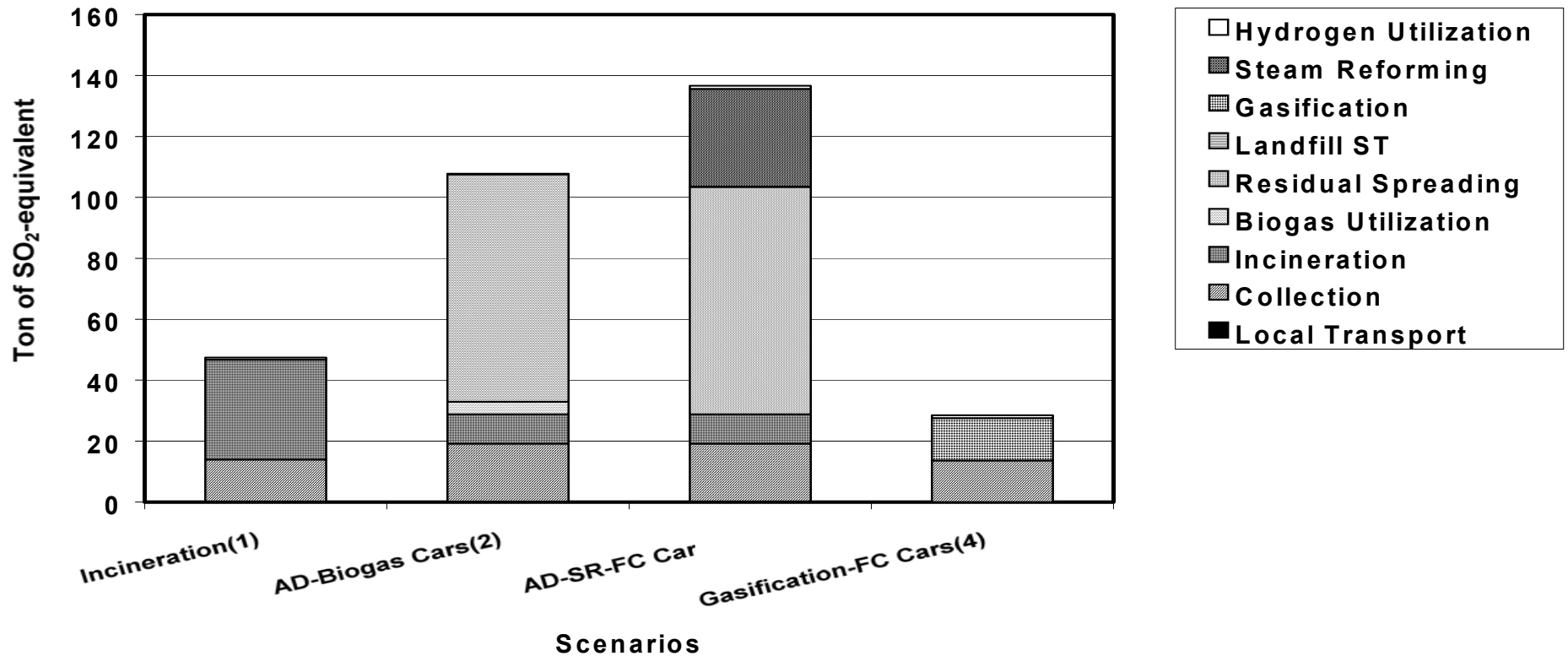
.....opportunities

- locating and determining weak points along chain of technologies
- structure - scenario construction
- data handling and data storage
- result presentation
- when associated with ongoing R&D work-
 - provides insight regarding where the next invention or R&D should focus

Challenges

- difficulty in comparing established and non-existing/ non commercial technologies
 - performance
 - unavailability of data or poor quality
- scale problems between laboratory scale and commercial scale
- detail-level of modeling
- handling of data quality/uncertainty
- development of weighting of different categories within the ecological and social dimension

Result presentation



Result presentation

