

Impacts of Science and Technology on Environment

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Abstract

Technology and science support our society by helping us to develop certain facts and discover new methods of living but at the same time it brings harmful and negative effects to our environment. There are many benefits and uses that we rely on in this two important varieties of developing our lives. Without these two we cannot imagine how we can live in a society full of chaos and disorder. Though humans want to have an order and organize things, technology and science made human society this far from the old and ancient methods of governing. But, are technology and science really helping us or making it worst? Do we notice how bad the situation of our environment? Besides from its benefits into our society it has different kinds of harmful effect unto our environment.

1. Types of Impacts

EnTA focuses on characterising potential impacts associated with outcome categories, or endpoints. The outcome categories are: Human Health Impacts, Local Natural Environment Impacts, Social and Cultural Impacts, Global Impacts, and Resource Sustainability. The performance of each technology option is evaluated using these broad categories.

Each outcome category aggregates a large amount of information associated with the environmental consequences of a technology. This approach provides a useful way to combine impacts so that different technological options can be compared against common criteria. However, it must be acknowledged that specific impacts of a technology intervention may not receive appropriately detailed or balanced attention in such an approach. Moreover, there is no simple, objective way to combine impacts.

While there are various schemes that attempt to assign relative weights to individual impacts, thus allowing them to be subsequently aggregated in a rational way, their somewhat complex and arbitrary nature make them inappropriate for use in EnTA. One objective of an EnTA is to show if more information-intensive and rigorous assessments, such as environmental risk assessment and environmental impact assessment, are necessary and justified. Such tools can provide a more rational way to aggregate impacts, resulting in increased confidence in the assessment findings.

A description of each of the outcome categories, or endpoints, is provided below.

Impacts involving human health and safety. This category focuses on the potential impacts of a technology on the health, safety and well being of the community and workers. Impacts may be associated with injury, discomfort or death. There are three main impact pathways that need to be considered in the assessment of human health and safety;

- **Communicable Diseases** - Vector borne diseases (e.g. malaria), sanitary hygiene diseases, risk associated with handling of infectious wastes;
- **Injury** - Risk of accidents from traffic, explosions,

falls, heat stress, operation of machinery, handling of physically hazardous wastes and resources (e.g. sharps), loss of hearing; and

- **Exposure to hazardous chemicals** - Inhalation (e.g. air pollution), dermal contact, ingestion of contaminated food and water (e.g. pesticide residue) of hazardous chemicals and of radioactive material.

The primary focus for this category normally involves characterising the effects of chemical releases and other hazards associated with the technology. When assessing the effect of chemicals three principal questions should be asked:

- What is the toxicity or potential hazard associated with release?
- How much of this chemical is likely to be released either through normal operational practices or as a consequence of spills and other accidents?
- How many people will likely be affected by the hazard?

2. Impacts on the Local Natural Environment

This category focuses on the effects a technology may have on organisms, their habitats, the life supporting capacity of natural ecosystems, and on biodiversity. Of particular concern is the loss of endangered and rare plant and animal species, and destruction of endangered and limited habitats. Three principal impact pathways should be considered when assessing impacts in this category:

- **Habitat loss or alteration** through land clearance (e.g. as a consequence of raw material demand or development of a site);
- **Physical disruption of habitat**; for example, the construction of pipelines that inhibit the migration of animals; and
- **The chemical contamination of the environment** through the release of wastes that have a direct toxic effect on flora and fauna (e.g. pesticides) or that alter the functionality of an ecosystem through such processes as eutrophication (e.g. the discharge of nutrients or other chemicals with high biological oxygen demand (BOD)) and acidification.

3. Global Environmental Impacts

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This category is concerned with the impact of the technology at a global scale, typically as a cumulative impact. These impacts may or may not be associated with a significant effect on a given local ecosystem or community. Particular emphasis is placed on the release of substances that:

- Enhance global warming (i.e. greenhouse gases such as carbon dioxide, methane and nitrous oxides); and those that
- Deplete the stratospheric ozone layer, for example chlorofluorocarbons.

The significance of gaseous emissions with global warming or ozone depleting potential varies with the chemical species, the amount released and the time frame over which the impacts are considered.

Some technology interventions might also reduce the effectiveness of carbon sinks, such as through the clearing of treed areas or through soil degradation leading to the release of carbon into the atmosphere.

4. Impacts on Scarce or Non-renewable Resources

This impact category relates to the effect that the technology has upon the continued existence and availability of valued and scarce resources. There are two principal ways a technology can affect resource sustainability:

- By consuming a resource at a rate greater than it is replenished or greater than the rate at which it may be continually supplied over the lifetime of the technology; and
- By contaminating a resource that is either used by the technology operators or by other parties, but which has no direct link to the technology (e.g. contamination of groundwater by an industrial manufacturing process).

When identifying and evaluating impacts on such resources it is necessary to consider the relative scarcity of the resource, in both local and regional or global terms, as well as the demands of the technology over its lifetime (e.g. how much will be consumed or contaminated).

In general, three basic resource categories should be considered in the assessment:

- Living Resources: Consumption or destruction of flora and fauna resources such as crops, forests (e.g. tropical rainforests), and fisheries;
- Non-living resources: Mineral and chemical resources such as the fossil fuels used in energy generation or the materials used in production, and also the consumption or contamination of water resources; and
- Land resources: The land required by the industrial site, wastes, and by supporting infrastructures and services which may reduce its potential for later use.

To evaluate the significance of resource consumption it is necessary to consider the future demands for the resource and how the technology limits the potential for this resource to be used in the future. A technology that uses recyclable materials and recycles wastes will generally have a lower impact than a process that does not.

5. Social Impacts

This category is related to the effects of a technology on a community's values, social services and social

cohesion. These impacts are in addition to those related to human health, safety and well being. There are many ways in which a technology may affect the social structure and well being of a community, but the EnTA process will normally focus on three principal concerns:

- Cultural resources and values: Attention is directed towards the effects a technology may have on sites or areas that have significant cultural, religious, historical, scientific or other value to the community. Possible pressures include the inappropriate use of a resource (e.g. the clearance of a site leading to disruption of culturally valued ecosystems), or the potentially detrimental effect that emissions may have on a resource (e.g. by way of acid rain). When evaluating potential consequences, consideration should also be given to visual, aesthetic and nuisance impacts. For example, an industrial plant, or power lines, might be inappropriate in a landscape well known for its historic or natural beauty, or the release of odorous compounds from an industrial process might be unacceptable to the neighbouring community.
- Social disruption to the community: Included here are impacts that may be associated with significant consequences for the social and economic structure of the community. Important issues that might need to be considered include the effect new workers (and their dependants) may have on the community, the possible loss of livelihood through the over use of a resource (e.g. fisheries), and the relocation of people as a result of a technology intervention.
- Equity issues: It is unlikely that impacts associated with a technology will be equally distributed through the community - specific sections of society may suffer disproportionately. In many instances the people most affected are those without strong institutional support. Particular attention should be paid to the potential effects of a technology development on indigenous people, the poor, children and women.

Since many of these concerns will also be related to the health impacts and resource demands associated with the technology, it is appropriate for this impact category to be the last to be examined.

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Web Sites

UNEP's Global Directory of Environmentally Sound Technologies (maestro)	http://www.unep.or.jp/maestro/
The Global Directory for Environmental	http://www.eco-web.com/intro.html

Technology	
UNEP Division of Technology, Industry and Economics	http://www.unepie.org/
Division of Technology, Industry, and Economics Production and Consumption Unit: Environmental Technology Assessment Homepage	http://www.unepie.org/pc/pc/tools/enta.htm
The EnTA Newsletter can be ordered from:	http://www.unepie.org/enta/newslet.html
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Center of Technology Assessment in Baden-Wurttemberg (not available in English)	http://www.ta-akademie.de/
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