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Background Document

The world's cities take up just two percent of the Earth's surface, yet account for roughly 78 percent of the carbon emissions from human activities, 76 percent of industrial wood use, and 60 percent of the water tapped for use by people. These figures suggest that the struggle to achieve an environmentally sustainable economy will be won or lost in the world's urban areas. Urban systems are undermining the planet's health and failing to provide decent living conditions for millions of people.

Rapid urbanization in the twentieth century has magnified the environmental impact of cities. In 1900, only 160 million people, one tenth of the world's population, were urbanites. By 2006, half the world (3.2 billion people) will live in urban areas, a 20-fold increase in numbers. Because of inadequate systems and poor planning, cities are disproportionately driving global warming, deforestation, and increasing water scarcity.

As cities move into the 21st Century the need to reduce environmental impacts, control costs, risks and liabilities are of paramount importance. Society is faced with environmental and economic issues and problems that will have profound effects upon survival, quality of life and sustainable development. Furthermore, there is an increasing belief that the original approach to environmental impacts and their mitigation, characterized by centralized "command-and-control" regulation targeted at emissions and existing waste sites, is far too limited to support the achievement of sustainable cities.

The concept of sustainable development applied to cities is central to IETC's mandate. Cities have pollution sources and sinks, and people living in them utilize resources and generate waste. Cities also import resources and export pollutants, although these importing and exporting activities have limits. For example, the trucking of garbage to landfills outside of a city becomes increasingly costly, the further from the city the

landfills are located. Also, the importation of fresh water to replenish a city's depleted aquifers becomes increasingly costly, the greater the distance the water must be piped.

Cities have limited carrying capacities. If the carrying capacity of a city is eroded, it becomes increasingly difficult, if not impossible, to create a sustainable environment. The infrastructure of a city influences its carrying capacity. A sustainable city must have adequate infrastructure and flexibility to support the needs of its population, particularly its poorest citizens, and the needs of the ecosystem as a whole. As in the case of the global system as a whole, sustainable cities must not use resources faster than they can be replenished or substituted for, nor generate pollution faster than it can be assimilated.

One of the guiding principles for the future will be to reform urban systems so that they mimic the metabolism of nature. Rather than devouring water, food, energy, and processed goods, and then belching out the remains as pollutants, the city could align its consumption with realistic needs, produce more of its own food and energy, and put much more of its waste to use.

CASE: A Conceptual Framework

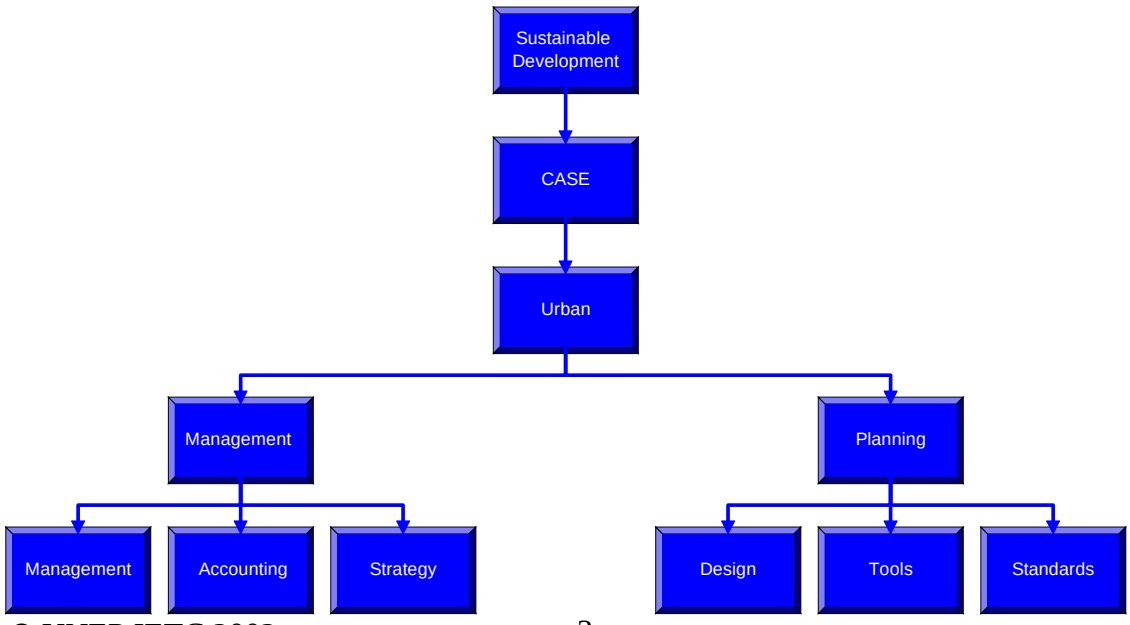
The goal of sustainable cities cannot be reached without developing a more sophisticated coherent intellectual framework. This framework should support the development of urban management and planning theories, as well as methodologies required by "new" urban decision and policy makers and technical experts to assist them in implementing environmentally preferable processes, operations and technologies. To this end, IETC has developed "Cities as Sustainable Ecosystems" (CASE). CASE deals with issues such as the interaction and relationship within and between cities, their impacts upon the environment and opportunities for all types wastes to become useful inputs. It embraces the interactions of all urban activity and the environment and how these can be transformed into a sustainable relationship.

While the need for the development of environmentally sound technologies (ESTs) is paramount, this must be underpinned by the concomitant development of urban environmental management strategies. Only then will it be possible to generate the wealth that is necessary for the restoration of the environment and at the same time

improve the quality of life of the citizens of this planet in a sustainable manner. Similarly, without the research and development of new urban environmental management methods and approaches there is a danger that the same problems of environmental degradation and ecological impoverishment will continue. Given that past environmental problems have arisen primarily because of inappropriate management and lack of understanding of the impact of management practices upon the environment, it is essential that new management methods are researched and implemented. Unless cities change their management practices, the resources they expend on protecting the environment will be wasted. Underlying this dilemma is the failure to recognize the importance of management in the causation of the problems in the first place and the continued (and erroneous) belief that "techno-fix" and the "end-of-pipe" solutions are the only and, therefore by default, the most efficient solutions.

CASE is the objective, multidisciplinary study of urban and economic systems and their linkages with fundamental natural systems. As shown in Figure1, it incorporates, among other things, research involving energy supply and use, new materials, new technologies and technological systems, basic sciences, economics, law, management, and social sciences. CASE provides a conceptual framework upon which understanding, and reasoned improvement, of current practices can be based.

Figure 1: CASE: A Conceptual Framework



CASE involves the integration of existing scientific, technological and management disciplines includes the legal, economic and other incentive systems, methodologies and tools, and data and information resources by which society provides the necessary and appropriate support for efforts by individuals and cities to implement the principles of sustainable development. The urban component of CASE is the implementation of sustainable development principles in the near term at the city or municipality level. Examples might include the development of materials databases, based on CASE R&D, which would provide simple, easily-accessed rankings of the environmental preferability of materials in traditional uses.

CASE can be broken-down further into two separate sets of activities at the organizational level:

- "Management" includes the development of competencies, organizations, methodologies, and rules and tools across the city, which generally improves the city's environmental performance regardless of specific design and production activities. Examples might include the development and deployment of green accounting systems, green planning practices, and green procurement, specifications and standards.
- "Planning" includes the development and deployment of rules, tools, and data sets intended to directly improve the environmental preferability of policies, planning processes, design and operation. Examples might include development of process checklists, and software to be included in GIS and/or CAD/CAP systems. In all cases, CASE activities require inclusion of life-cycle considerations in the analytical process.

CASE: Related Activities

Basic research and development in CASE is necessary to provide the objective understanding and support required for the integration of environmental considerations throughout the economy of the city. It is also a necessary prerequisite for the development and implementation of economically and environmentally efficient regulatory structures, currently a critical policy deficiency. Related activities include:

- Planning and implementing a series of studies to understand and model stocks, flows, and logistics of material movements throughout city for all major materials, including both renewables and non-renewables, and wastes. Environmental impacts and human/ecosystem exposure data could be mapped onto these models, providing the basis for developing environmentally preferable processes, and helping the urban and civil sectors and labour markets adjust to an environmentally preferable world. Such knowledge is also critical to support the development of valid, efficient, risk- based environmental regulations. Indeed, it is difficult to see how environmental regulation can be effective in the long term without such data and models.

- Developing an integrated approach using Environmental Risk Assessment (EnRA) and Environmental Technology Assessment (EnTA) models of energy production and use, water usage and conservation, waste production and disposal, and transportation systems. These models can be linked where feasible to technology, demographic and other systems, with risk assessment and technology option overlays. As above, this will facilitate the identification of optimal national and local strategies and programmes to produce environmentally and economically preferable (and, hopefully, eventually sustainable) energy, water, waste, transportation, and other EST systems.

- Developing integrated models of urban communities, including small relatively self-contained cities, larger cities with surrounding suburbs, and large megalopolises with decayed centres and most business activity decentralized throughout the suburbs. Such models would include transportation, physical infrastructure, food, energy and other systems. This would facilitate identification of major sources of environmental impacts; patterns of activities, which give, rise to them, and potential environmentally preferable EST or mitigation options.

- Developing integrated models of specific urban sectors of particular economic, environmental, or cultural importance - including, for example, agriculture, forestry, waste and water management - which could then be used to understand how they might be affected by an increasingly environmentally sensitive world. Such an approach could be particularly important in mitigating potential economic and

employment shocks of discontinuous environmental, and/or related economic and regulatory, changes, and in supporting the continuous improvement in quality of life while reducing attendant environmental impacts.

One of the hypotheses of CASE is that rapid evolution of environmentally sound technological (EST) systems is a prerequisite for improvement of quality-of-life in an environmentally sensitive world. The fundamentals of technological evolution and diffusion throughout the economy are, however, poorly understood. Even less is known about the optimum, or maximum, rates of technological evolution, the associated economic and labour costs and benefits (and how they could be optimized), and how such variables differ by class of EST. (For example, it is apparent that moving to a solar-hydrogen based energy economy will be significantly more difficult, and a far more lengthy process, than substituting for CFC-based cleaning systems in electronics manufacture.) The CASE approach to such issues may well produce valuable insights into:

- Investigating the interdependency of legal, economic, cultural, scientific and technological activities and policies as they affect environmental protection and the evolution of EST systems.
- Different regulatory tools and approaches in terms of how cities and citizens behave.
- Developing efficient public environmental management structures that support the adoption of appropriate EST systems.

CASE can provide information that can assist in the prioritization and reordering of environmental values, both among themselves (e.g., is ecotoxicity, human carcinogenicity, or global climate change more important?) and in the broader context of other social values (e.g., employment, private property rights). While it is doubtful that an unambiguous, uncontentious prioritization of values is possible, some broader consensus is necessary to provide support for further progress. How, for example, can an urban planner be expected to design a "green" residential area when what is environmentally preferable cannot be made clear? This is not a trivial task. It requires the development of comprehensive environmental risk assessment (EnRA)

methodologies, which evaluate and balance risks and possible benefits on a systems-wide basis.

Clearly, cities are able to develop on their own the overarching legal, regulatory and economic incentive structures, which will be necessary to support the integration of environment into all urban activity. They are also able to restructure existing regulatory systems - including environmental and other related regulatory regimes as consumer protection and government procurement - so that they avoid unnecessary interference with the achievement of environmental quality while still meeting their original objectives. Similarly, in a world where environmental perturbations are not restricted to political boundaries, it is obvious that the CASE programme, and others like it around the world, must be linked together in a collaborative international network. Existing international organizations, both quasi-governmental and private, must assume increased responsibility in this area and proactively support the integration of science, technology and environment in all urban activities.