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SUSTAINABLE DEVELOPMENT:

FROM ACTION TO CONCEPT

by

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C O N T E N T S

SUSTAINABLE DEVELOPMENT: FROM ACTION TO CONCEPT

Rob Lichtman

SUMMARY

The notion of sustainable development remains ambiguous, difficult to measure, and concrete, credible examples of it are rare. Most discussions of the "concept" are concerned with sustainable resource use (means), rather than the need to provide sustainable livelihoods for all (ends). Given a number of trends in both OECD and developing countries, providing sustainable livelihoods for all is essential to regional and global security. Yet, to support sustainable development, policy-makers are relying upon indirect measures only, such as using prices/market mechanisms, "transferring" technology, and "building institutional capacity" to support sustainable development. The assumption is these conventional approaches will cause individuals, governments, and firms to behave in ways that cause sustainable development to emerge spontaneously. Theoretical and operational problems with these conventional approaches raise fundamental doubts that they can link political and organisational capability, finance, and technical assistance, to make sustainable development operational. Broad new demands must be made upon technologies and social organisations such as integrating systems, rethinking the appropriate scale of supplying basic goods and services, and strengthening opportunities for democratic management of resources.

To deliver sustainable development, a partnership should be formed with 8-10 large metropolitan regions around the world linked with "best practices" in energy, food, agriculture, waste use, "clean" production", and social organisation. The effort would develop jointly a set of planning tools, participatory organisation, detailed investment strategies, and financing to provide basic goods and services efficiently and equitably, while minimising environmental damage. Large metropolitan regions spend about 5% of their income managing energy, wastes and water. Using existing technologies, it should be possible to save at least 10% of these annual payments. For most urban regions of several million people, this means annual net savings of well over $50M, enough to also capitalize locally controlled "urban innovation/social development" funds. At a global level, 0.5% of world output approaches total foreign direct investment, and is about triple current levels of development assistance. Encouraging pieces of the approach exist, but this work has yet to be integrated or replicated widely. A deliberate, focussed attempt to create sustainable development in different, specific regions will improve our sense of the concept, it will clarify the appropriate mix of local action and policy reform, and it will establish a credible base of tested organisation and technical support to aid in replication.

I. INTRODUCTION

Though the wording has changed, for more than a quarter century, the need to harmonise "development" and "environment" has been the focus of endless international studies and conferences.[1] These periodic overviews have described the magnitude of the global challenges confronting us. They have repeatedly suggested a wide range of needed policy changes. Yet these cries for change rarely marshal the political will to implement recommendations, and the problems seem only to get worse.

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[1] These include the "Pearson Report", *Partners in Development* (IBRD, 1969); the "limits to growth" studies (Meadows *et. al.*, 1972; 1992), the UN Stockholm Conference on the Human Environment (1972); *What Now: Another Development* (Dag Hammarskjold Foundation, 1975); *The Global 2000 Report to the President* (Barney, 1981); *The World Conservation Strategy* (IUCN, 1980); *North-South: A Programme for Survival* (Brandt Commission, 1984); *Our Common Future* (WCED, 1987), the Rio "Earth Summit's *Agenda 21* (UNCED, 1992), and the annual *Global Environmental Outlook* (UNEP), *State of the World* (Worldwatch Institute) and *World Resources* (WRI) reports, UN conferences on Population, Social Development, Women, and Human Settlements (1993-1996), the Kyoto, Monterrey, Copenhagen, Durban, Doha Summits, as well as several 5, 10, and 25 year "anniversary" UN conferences, etc.

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Treating "sustainable development" at the global level has a certain first look logic. Overall patterns of consumption and development are determined increasingly by global capital flows and communications. Many threatened resources can only be protected by international action due to their trans-border nature (e.g. ozone depletion, over-fishing, acid rain, destruction of coral reefs), their links with international trade (e.g. tropical timber extraction, loss of species diversity), or the sheer level of finance needed to deal with the problem (global warming).

However, as the meagre results from all global negotiations since the 1992 Earth Summit and especially on-going negotiations to limit greenhouse gas emissions show, serious structural obstacles continue to hobble the "global" approach. The high visibility of global negotiations threatens national sovereignty, it creates a climate for "we-they", North-South posturing, and by definition, it invokes the cumbersome procedures of United Nations, and its tangled political bodies, Agencies, and technical commissions. Despite the efforts of those who believe in the potential of the United Nations, its practice continues to frustrate decades of attempted reforms.

The concern of this paper goes deeper than this year's conference or the state of global institutions. Most conventional approaches to encourage sustainable development, (OECD, 2001; UNCED, 1992; World Bank, 1992) are based upon assumptions concerning how social change occurs, and how different measures and actors influence this process:

1. There is a consensus on the meaning of sustainable development.

2. If prices, and public and private decision-making methods, can better reflect environmental costs and benefits, market mechanisms will guide the behaviour of governments, firms, and individuals in ways that support sustainable development.

3. Led by re-invigorated United Nations organisations, and governments' domestic ministries, new programmes can "build capacity" and transfer needed technology.

4. Sustainable development will emerge spontaneously from the interplay of the above.

These assumptions have yet to receive the fundamental questioning they deserve.

II. THE MEANINGS OF SUSTAINABLE DEVELOPMENT

The widely cited "definition" of sustainable development as a process which maximises opportunities for the present generation without compromising possibilities for those to come is really a minimalist description upon which nations could agree during the preparation of the report *Our Common Future* (WCED 1987). Many observers feel the concept of sustainable development is both imprecise and limited in its usefulness when choosing among conflicting policies and investments (Dasgupta, 1993; Mitlin, 1992; Lele, 1991; Pezzey, 1989). Another review suggested merely that "agreement" on what sustainable development means is not as important as openly discussing and considering its main themes, at the project and policy levels (Holmberg *et. al.*, 1992).

This paper will not attempt to review all aspects of the still-evolving concept (surveyed by e.g. OECD, 2001; Pearce and Warford, 1993). Some further discussion of sustainable

development is important, because the notion embraces several ideas beyond merely incorporating environmental protection into the process of economic development.

The point of development is to enable people to have more control over their lives, building upon the notion of "expanding choices", discussed in the *Human Development Report* (1990). The "sustainability" aspect refers to the quantity and quality of natural and human resources that can make this possible.

A. First Principles

Thus, in an attempt to summarise a wide literature to some manageable form, I suggest the process of sustainable development embraces three broad principles:

1. The process should be equitable.

Development will not preclude conflict, social and cultural change, and tradeoffs. But these effects should be transparent, particularly as they affect cultural norms and the distribution of income. Losers in the process should be compensated fairly. When possible, development should seek to promote decentralised ownership and management of resources and to align institutions, legal structures, and technologies to foster this. Without these steps, inequalities tend to perpetuate themselves. But the implications, particularly as they affect points 2 and 3 below, should also be made clear in an open, democratic fashion. The process should maximise opportunities, especially of the poor, for the present generation without compromising the possibilities for those to come. This means increasing per capita income and consumption, though again, trying not to violate points 2 and 3 below.

2. The process should be efficient.

Resource use can be based largely on prices determined by competitive markets, as long as these prices are corrected for environmental effects. Such correction can be difficult, depending on the degree of agreement on valuing these effects, the administrative and political skill of the regulating government, and whether the resource is traded internationally. Beyond this broader notion of efficiency, development activities should be self-sustaining, and not dependent on extraordinary inputs of finance, management, etc. Finally, resource use and democratic decision-making within governments and firms must be linked, not because it is fashionable or morally correct, but because it is essential for the efficient management of human and natural resources.

3. The process should use, rather than disrupt ecological processes, and avoid irreparable damage to the environment.

Development activities should minimise the release of toxins, "close" resource flows in production cycles, and base these on renewable resources, biological processes, and extensive recycling, whenever possible. Development should raise incomes without necessarily raising material throughput. Nevertheless, there are several difficulties with this seemingly simple idea. "Carrying-capacities" or "threshold limits" are not so easily measured in open systems (with tradable exchange of goods and services), complicating estimation of the extent of damage. The sources, methods of delivery, transformation, and disposal of inputs and outputs throughout the production process can all have varying degrees of environmental damage (Ayres and Simonius, 1994; Bringezu *et. al.*, 1994). One can imagine activities that cause short-term environmental damage, both at local and global levels, which are reasonable nevertheless because lives are saved and the environmental damage can be repaired later.

This discussion only underscores how development activities simultaneously cut across the natural/physical, technical, political, economic, and cultural dimensions of society.

"Sustainability" will have different detailed meanings within each of these contexts. What is deemed "sustainable" is determined by the level of analysis (the different environments mentioned above), "who" has the power to make such decisions, their motives, and their time horizons. Although there are other reasons why it is difficult to create indicators of sustainable development (see below), the sheer complexity of the concept itself is sufficient.

While these dimensions of sustainable development are linked, they may also be in conflict. The more a development activity can reconcile conflicts among these different contexts, the more likely it will be "sustainable".

B. Sustainable "Resource Use" vs. Sustainable "Development"

This paper ignores further complexities in these simple objectives, in particular the trade-offs that might exist among them.[2] What is important is that there are two further issues embedded within notions of sustainable development. Though they are related, they differ in their time horizons, and in the nature of the intervention required to address them.

1. Sustainable Resource Use

This pertains to redressing the acute damage caused by unsustainable use of resources due to current patterns of economic development. Prime examples are soil degradation, deforestation, urban air pollution, and the release of toxic materials in the biosphere. While not denying their seriousness, in principle, these are *relatively* easily and rapidly addressed through a variety of technical interventions at the level of the farm, factory, or city, as well as enforcing national policies and international agreements that constrain resource degradation, and which currently receive much attention.

However, these measures may or may not improve the quality of people's lives. Many people live in a condition of "sustainable" poverty, while using resources in an efficient and ecological fashion. Women walking hours through snake-infested areas to collect heavy loads of firewood from a self-financing, soil-enhancing agro-forestry plantation, and then burning that wood in a cheap, efficient stove with particulate emissions equivalent to inhaling daily several packs of cigarettes, is not sustainable development. Neither is riding on a city bus, fuelled by biomass-derived ethanol, to collect years' of unemployment checks, or to receive a daily dose of methadone.

2. Sustainable Livelihoods

Thus a broader notion is needed to get at the purpose of sustainable development: sustainable livelihoods for all (*Human Development Report*, 1998; Chambers and Conway, 1992). This does not mean that the entire world should or can consume in the same fashion as the developed countries. But we must aim toward making it possible for

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[2] Choosing among conflicting priorities depends on who is deciding, their reasoning, and the state of knowledge at the time of a decision. For example, what should take priority if there are conflicts between increasing agricultural yields and reducing the leaching of nitrates from chemical fertilisers? The Aswan Dam in Egypt was planned to satisfy a number of irrigation and power needs, based on local, renewable (hydro) resources, once the dam was built. Yet the project has been associated with silting and the spread of schistosomiasis. Should the dam not have been built? Should capital rich but resource poor countries curb their imports if these are detrimental the poorer exporting countries' ecosystems? What if the poor country prefers income now, which could be invested in environmental projects later? The issue of trade-offs is central to the debate about what to do, and when to do it, when economists consider global warming issues (Stern *et. al.*, 2006; Cohen, 1995; Cline, 1992; Beckerman, 1992; IPCC, 2007 and 1992; Nordhaus, 1991). See Pearce *et. al.* (1993); Mitlin (1992); Lele (1991); and Pezzey (1989) for further discussion of ambiguities surrounding "sustainable development".

people anywhere to acquire the basics of food, energy, transport, medical care, communications, education, housing, security, etc., in ways that are efficient, ecological, and equitable. The physical and financial means to do this must be resilient against shocks, they must be convenient, affordable, and accountable to those who use them, and they must increase people's sense of freedom and control over their lives (Sen, 1999).

Providing sustainable livelihoods for all is the underlying challenge of sustainable development. We simply do not know how to do this, in either the Northern or Southern Hemispheres, and insufficient attention is being directed toward obtaining credible answers.

C. Limits

There is still no agreement that the world as a whole is approaching insurmountable limits to the expansion of economic activity. The question remains whether the *stock* of global resources, or the *pattern of their use* can continue to support either current levels of consumption and pollution, or those expected from the growth, particularly in developing countries in Asia, and to an extent in Latin America. Clearly, there are severe local and regional problems of erosion, water scarcity, release of acidic substances, air pollution, disposal of radioactive wastes, over-fishing, etc. (UNDP, 1998; DPCSD, 1997; World Resources Institute, 1994; Homer-Dixon, 1994b; Smil, 1993). Ozone layer destruction and greenhouse gas emissions bear watching. Even though some of these effects are not yet completely understood, a variety of solutions to these problems are available, with little disruptive (even positive) effects on economic growth (Lovins, (2003); ACEEE, 1996; Lovins *et. al*, 1995; Lovins and Romm, 1993; Kotzloff and Dower, 1993; Johansson *et. al.*, 1992, 1989; Rubin *et. al.*, 1992).

There are two causes for concern. First, it seems unlikely that in the long-run, the world's resources and pollution "sinks" can support 8-10 billion people living at *current* OECD patterns of consumption. In one of the more thorough studies of global carrying capacity, Cohen (1995) shows how the level of consumption is as important as the number of consumers. As global population approaches 15 billion, there are questions about whether sufficient resources exist to support that number of people in a tolerable fashion. By one estimate (Vitousek *et. al.*, 1986), human activity now appropriates 40% of the terrestrial, and 25% of the total (including aquatic) biomass that is produced annually through photosynthesis. A projected doubling of world population within the next century (even assuming no increase in the standard of living) suggests that meeting human biomass demand may be problematic, requiring an unprecedented management of the biosphere. Systems of fertilisers, pesticides, irrigation water, energy, ocean farming, genetically altered plants and animals, etc., will need to be financed, adopted, and actually function, at a rate in keeping with "best case" expectations (Brown and Kane, 1994). Several recent surveys of global environment trends suggest that even under more optimistic scenarios, the rates of degradation cannot be reversed but merely slow over the next 25-50 years for greenhouse gas emissions, loss of freshwater aquifers, air pollution, etc. (USEPA, 2002; UNEP, 2002). The Millennium Ecosystem Assessment (2005) suggests that of 24 ecosystems critical to survival and economic activity, 15 are under severe stress or degradation. There are worries about global greenhouse gas emissions, and regional air pollution from the 10-fold increase in energy consumption needed (under current technology) to meet the basic needs of the world's mid-21st century population (WCED, 1987; Duchin *et. al.,* 1994). The effects of global warming may not proceed in a slow, linear fashion that facilitates adjustments, but could occur in abrupt jumps (IPCC, 2007; NRC, 2002). Seldom mentioned is the possibility of global warming that might result from the sheer release of heat from industrial activity, if developing countries were to generate it at current OECD levels.[3]

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[3] Most cogently stated in Robert Heilbroner, *An Inquiry into the Human Prospect* (1975), building upon earlier work by the Rand Corporation. For a rethinking of the issues and the "source" vs. "sink" distinction, see Duchin *et. al.* (1994), Daly and Goodland (1992), Meadows *et.al.* (1992), and Goodland (1991).

Second, increasing inequality in *both* rich and poor nations (Wade 2001; *Human Development Report*, 1998, 1990-1994) poses a set of security threats. A combination of relentless automation, ageing populations, and increased competition from low-cost developing country exports may make it increasingly difficult for OECD countries to respond to chronic unemployment among low-skill workers (Cline, 1997; Wood, 1994; Krugman, 1994). This coupled with high medical and welfare costs, and social polarisation has already led to increases in urban violence, drug abuse, homelessness, single-parent families, and a resurgence of fascist/nationalist political movements. In the South, unprecedented numbers of poor people have an unprecedented awareness that their misery is increasingly distant from life in the affluent countries. This stark contrast is relentlessly portrayed through radio, film, and video on a global basis. Poverty has provoked fundamentalist, nationalist, authoritarian reaction in parts of the former Soviet bloc, India, the Mahgreb, and China, where water and arable land constraints are becoming acute, and where perhaps one hundred million people "float", seeking temporary employment (Homer-Dixon, 1994a; Smil, 1993).

The 2001 attacks in New York and Washington are only opening shots. With the increasingly availability of weapons of mass destruction, it is a huge gamble to assume that the world's poor will continue to peacefully tolerate their staggering inequality. This will be especially true if the poor's patience is rewarded by proof that the modernisation they seek will cause catastrophic global environmental damage, and thus, must be denied to them.

There is insufficient evidence to form a judgement on the severity and timing of these threats. The arguments depend on one's faith in the ability of capital and technology to substitute for natural resources, in the ability of markets to adjust rapidly to scarcities, and that the political support for change will materialise in the face of serious environmental and social upheaval (Cohen, 1995; Homer-Dixon, 1994b).

What is clear is that a better balance is needed between a good life for the wealthy and the educated, and poverty and catastrophic environmental damage for the rest. Providing sustainable livelihoods for all is not merely an ethical or environmental concern; it is essential for regional and global security.

III. ANALYTICAL ISSUES

D. Indicators

Attempts to develop indicators to measure sustainable "development" (actually resource use, as explained above), and the integrated modelling exercises that use these measures to pose useful "limits" questions are still in their infancy. Work on indicators remains scattered and complex, with little agreement on how to make these more useful to decision-makers (Ravetz, OECD 2001[4], 2000, 1994, 1993; ICLEI, 2000; World Bank, 1997; Rogers *et. al.*, Bartelmus, 1995; 1996; Walz *et. al.* 1995; World Bank, 1995, 1994; Rogers and Jalal, 1994). Opschoor and Weterings (1993a,b) argue that a minimum of three dimensions should be represented in any indicators of sustainable development

1. Pollution of natural systems;
2. Depletion of natural resources;
3. Loss of "naturalness" (diversity, absence of disturbance, etc.).

[4] Current thinking has "narrowed" to over 20 such indicators.

Several quick case studies were prepared to gain experience developing preliminary indicators for the "sustainability" of global CO_2 emissions, emissions that cause acid rain in Europe, global depletion of fossil fuels, continental depletion of fish resources, and changes in bio-diversity at the national level. This work has demonstrated the difficulties of developing such indicators (van Latesteijn *et. al.*, 1994; Norgaard, 1989):

1. There is no single measure that can indicate "sustainability". Some attempts to try to do this, such as using the flow of energy as measure or numeraire to evaluate ecological/economic performance are impressive but complex, and these data suffer from many of the same problems discussed below.

2. There are scientific disagreements over levels of tolerance or thresholds that could serve as "targets" for sustainable development or sustainable resource use.

3. There are normative disagreements over resource valuation, limits, and consumption targets, as they often effect the distribution of income or resources within and among nations.

4. There are disagreements over the appropriate scale/boundary within which resource use should be considered.

5. There are disagreements about the ability of capital, technology or alternative resources to substitute for certain natural resources or ecosystem functions.

6. There are huge uncertainties in the models upon which calculations to develop indicators depend.

E. Models

However, one of the biggest drawbacks to "indicators" is that they are static. They provide only a snapshot of a single phenomenon, with little sense of how this is connected to others, nor how they change over time. With all their flaws, only models can do this and still provide a semblance of rigour to sustainable development thinking. The original Club of Rome sponsored "system dynamics" work of the Meadows and colleagues (1974, 1992) continues to be updated. The Stockholm Environment Institute's "Polestar" Model (Raskin *et. al.*, 1995; Shaw and Öberg, 1994), and the ongoing work of Duchin *et. al.* (1994) have begun new efforts to model the long-term resource (static) implications of various levels of regional and global consumption and investment. Several complex integrated efforts in the OECD, US, and European Union are summarised in Rotmans and Vellinga (1998), Alcamo, 1994, Fontella (1993), and Polenske *et. al.* (1992), although these are focused largely on greenhouse gas emissions or air pollution reduction.

Various linear programming packages try to optimise energy and agricultural systems. "Integrated Resource Planning/Least Cost Planning Models" are related techniques to manage electricity grid investments and operations. The International Energy Agency of the OECD has promoted standardised models for this type of analysis (MARKAL). These models are complex; MARKAL has 14,000 variables if fully utilised. Moreover, an "optimal" decision for a sector can result in a sub-optimal decision for the economy, a deficiency which MARKAL users are trying to correct (ETSAP, 2000, 1997; ECN, 1997).

Attempts to correct for this include Input/Output (I/O) analysis (Bulmer-Thomas, 1982), coupled with environmental models (Isard, 1972). R. Costanza and University of Maryland colleagues are developing an interesting regional model of the Chesapeake Bay basin, based on this approach; others are underway for the Florida Everglades, the Puget

Sound region around Seattle, and Southern California[5]. The Netherlands Environment Ministry (VROM) financed a national I/O study that looks at the employment, pollution, and overall growth effects of different technology and pollution policy regimes. I/O analysis was used to model the most important relationships between eco-systems, the economy (divided into 20 sectors), and energy systems of the island of Gottland, off the eastern coast of Sweden (Jansson and Zuchetto, 1985). While prices, energy systems, and other variables' values have changed, the methodology and discussion remain an excellent model for this type of analysis.

The Gottland study illustrates a number of important limitations of I/O analysis. First, *the data must be available.* By choosing an island, within a culture and government that is committed to collecting and using statistics, the study was able to use plentiful and reliable data. The study team had the training and resources to measure a number of eco-system variables that were not readily available. Second, *the results of I/O analyses are "static"* in that the I/O relationships between sectors do not change dynamically, as they do in the real world. When prices or environmental conditions change beyond a certain point, new technologies are introduced, different resources are substituted for traditional inputs, businesses fail, government tax and other policies change, etc. These changes can be modelled to an extent (Duchin, 1994; 1992), but the methods for doing so become extremely complex, costly to obtain, and results become increasingly uncertain over long time horizons.

Government economics ministries, central banks, the OECD, IMF and World Bank, and numerous universities and research organisations have developed national and global variations on computable general (CGE), or partial equilibrium models that attempt to show how different sectors interact (Dervis *et. al.*, 1984). In their analyses of various energy and emissions control policies in Sweden, Carlsson (1988), and Bergman (1990) used simplified or partial variations of CGE models to show that, in some cases, introducing "least-cost" technologies and policies had unintended results (lower economic growth) over the long-term. Rogers *et. al.* (1993) apply similar techniques to economy-water system interactions, and Persson and Munasinghe (1995) show how "sustainable" forest policy, e.g., increasing fees for permits required to fell timber, can lead to *further* deforestation in Costa Rica by causing increased unemployment among low-skilled labour, who are pushed to marginal farming in forested areas. Others are building a series of partial equilibrium models that look at changes in key sectors and how these interact with the macro-economy.[6] Meier and Munasinghe (1994) discuss a project in Sri Lanka, linking energy and agricultural sector development with impacts on pollution, employment, government revenues, exports, investment, etc.

Despite their sophistication, CGE models have been disturbingly inaccurate over the recent past (IMF, 2002a; *Financial Times,* 1993), they have their own problems with data assumptions and availability, and they impose "equilibrium" (where prices change to ensure that supply equals demand), a condition which may not reflect reality. Kenny and Williams (2001) discuss more general disappointments with economic forecasting over the past decade. All of these approaches are only as valid as their data, their equations, and their constraints, and they remain controversial among experts. Thus, we are doubly cursed:

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[5] These are "works-in-progress" and are best followed from their Internet sites (e.g. http://kabir.cbl.umces.edu/PLM/Project.html, and www.prism.washington.edu). A broader on-going compendium of such work is tracked at http://iisd1.iisd.ca/measure/compendium.asp/results.

[6] For agriculture, see Faeth (1995) and the FAO's "K2" model, described in Carley (1994). For energy related work see Schepers and Kram (1999).

1. Much of the discussion of sustainable development confuses and ignores desired *end states* (decent livelihoods for all) with the *means* of getting there (sustainable resource use).

2. Even if there were greater consensus on these points, they are inherently difficult to measure or model.

IV. THE LIMITS OF CONVENTIONAL APPROACHES

A. The Appeal of Market-Based Policies

Partly due to the lack of clarity plaguing the meaning and measurement of sustainable development, policy-makers assume "policies" are the best way to create it. Policies, especially those based on price changes and market mechanisms have an understandable appeal. T.S. Eliot extolled the market as "so perfect that no one needs to be good". The more indirect, market-based approach to harmonise environment and development concerns is presented as value-free, efficient and technical, just as socialism was portrayed as "scientific". Market-based policies are relatively simple to administer. They exert great leverage as they ripple through an economy, inducing socially desirable behaviour from individuals and firms. Price changes provide a certain distancing for governments, who can claim they are not taking money from group A and transferring it to group B; rather they are raising prices to "increase market efficiency", which everyone wants. Many believe that there is no realistic way to guide directly the direction of social development, either because it is too divisive politically, or as Oscar Wilde worried, it would require "too many meetings" (Lindbloom, 1980; Schultz, 1977; Buchanan, 1975; Nozik, 1974).

There are many inappropriate pricing policies that cause serious environmental and developmental problems. The roughly *$400 billion/year* worth of subsidies on fossil and nuclear fuels, water, agriculture, and fertilisers, distort massively resource use and technological development. (OECD, 2001; World Bank, 1997a; Pearce and Warford, 1993; Panayotou, 1993; Bojö *et. al.,* 1992; Timmer, 1991; World Bank, 1991; Stewart, 1991; Schramm and Warford, 1989). But there are serious doubts that if we can get prices "right", the appropriate mix of innovation, investment, productivity, competitiveness, growth, environmental protection, and hence sustainable development, will emerge spontaneously.

Few mainstream economists believe that unregulated markets will ever reflect "real" costs, especially when there are third parties who benefit or suffer indirectly as a result of a transaction. Even without "correct" prices, a number of experts feel that OECD energy demand and greenhouse gas emissions can be greatly reduced simply by utilizing off-the-shelf technologies (efficient lightbulbs, photosensitive windows, variable speed motor drives, etc.). Moreover, this can be done at a net profit based on *current prices*, even ignoring the values of reduced air pollution and military expenditures needed to protect oil supplies (UNDP, 2001; ACEEE, 1996; Romm and Lovins, 1993; DGIS, 1991; Johansson *et. al.*, 1989, 1992; OTA, 1992; Rubin *et. al.,* 1992). Yet, investments in these profitable measures remain weak, due to problems transferring benefits to investors and consumers, poor information flows, various transaction costs, and entrenched economic interests (Olerup, 1994).

Such problems are often described collectively as "market failures". In fact, they are a subset of problems that face a modern economy. In his highly respected work, *The Modern Firm,* Roberts cites earlier work by Coase, Simon, and McMillan, who estimated that "over 70% [of all transactions in the US economy] occur within firms", rather than through market transactions (Roberts, 2004: 77-78). Indeed, one of the modern firm's

reason for being is to conduct transactions more cheaply than relying upon cash markets, mainly through coordinated bargaining. This may come as a shock to "market-fundamentalists", who prefer to see economic life regulated by idealized notions of supply and demand curves held together by invisible hands.

B. The Practical Difficulties of Correcting Market Failures

To correct market failures that lie beyond the remarkable abilities of firms to manage, someone must make decisions in two broad arenas: (1) changes in the *incentives* (i.e. prices) to which economic behaviour responds, to reflect "real costs and externalities, etc., and (2) changes in the *behaviour* itself (how much one may pollute, how much one may possess or own, adjusting contract and antitrust laws, and the distribution of wealth, assets, profits, etc.).

Tampering with these basic forces is the source of much political conflict, involving value judgements about what is correct and fair, and who has the right to make these judgements. Changing the economic rules also risks further market distortions if the planners guess "incorrectly" about arcane issues of supply and demand elasticities (the technical analysis economists use to see how sensitive consumers and producers are to price changes). Such policies have major impact on the distribution of income, which then must be ameliorated through some complex scheme of transfer payments or taxes on windfall profits, if the political pressure from the "losers" is strong enough. If sufficiently severe (as some argue are needed, e.g., doubling or tripling energy prices), price changes can threaten the competitiveness of certain industries and can even induce recessions. To mitigate this, price increases must be introduced gradually. The schedule for doing so is equally problematic; it depends on the current stage of the business cycle, political considerations, and international trade and financial flows. There are always unpredictable events that can disrupt plans, e.g. the potential global financial effects of a major earthquake near Tokyo or San Francisco. Recent economic forecasting shows significant gaps in our understanding of the workings of national economies.[7]

As Polanyi (1957) reminded us, without a series of regulatory and cultural underpinnings, "free" markets cannot function. These include "a dense system of institutions": just and enforceable contract, patent, and property law; regulation of monopoly and concentration of capital and ownership; limits on corporate liability; a stable currency and banking system; regulations on the flows of capital, labour, resources, risk, and information; and a sense that these elements are accountable to an informed, representative polity (de Soto, 2000; Kuttner, 1997; Homer-Dixon, 1994b; Putnam, 1992; Stavins, 1990; Pigou, 1938). Without this social capital, markets will waste both natural and human resources, as the recent experience of ex-communist countries shows all too well.

What remains unclear is how "correct prices", augmented by new approaches to environmental accounting, can improve decision-making without addressing the greater institutional and historical contexts in which they operate. Moreover, even assuming politics or corruption are not at work, these price corrections and appraisal techniques have shown a surprisingly marginal influence on investment decisions and economic policy-making (OECD, 1996). Due to time or political pressures, poor communications, or a lack of training, planners have difficulty applying even relatively simple benefit-cost methodologies to their work. The internal World Bank "Wapenhans Report" (1992) suggested that 20-30% of all recent Bank projects are in serious financial difficulty 5-10

[7] Even before the unforeseen Asian financial turbulence, OECD and IMF projections greatly understated the depth of economic slowdown over the past several years, particularly in the US and Japan (Wolf, 1992). For a broader critique of the role of market liberalisation and its effects on developing countries' economic performance during the last two decades, see Rodrik, (1999), and Banuri (1991).

years after their completion and repayment of loan.[8] One can only guess at the long-term performance of projects appraised by others less rigorous than the World Bank. On a far larger scale, questions can be raised about the appraisal methods used by private western banks in their lending, and market analysts in recommending share purchases, in Asia, Russia, Brazil, Mexico. the US, and Japan which led to the financial scandals and debt crises of the past decade (Shiller, 2000). Economists and environmentalists are suggesting that this performance can be improved by introducing even more complex appraisal methodologies[9]. However superior to the alternative, the right prices and the right methodologies clearly do not guarantee the right outcomes.

Finally, there is the obvious intrusion of political interests. The powerful effects of price changes frequently exacerbate the very political conflicts these "simple" indirect changes supposedly reduce. Price changes pit the interests of the well-organised few (government bureaucrats as well as private interest groups) against many, diffuse potential beneficiaries.[10] This explains why the US Congress took more than 10 years to revise air pollution regulations, and why the OECD states that, however desirable global eco-taxes or emissions- permit trading may be, "they will probably result in enormous wealth transfers and…are unlikely to be politically feasible in the short run" (OECD, 1996, p. 28). As we have seen with "tax" revolts in developed countries, and when developing countries are told to raise food prices to stimulate their agriculture, increase electricity tariffs to cover costs, or cut government staff to reduce budget deficits and debt service, the urban populations may throw the government out of office, or take to the streets.

C. The Messy Links Between Prices and Technological Change

There is a more subtle claim that market-based policies induce needed social and technical innovation, a rational response to price changes (Biswanger and Ruttan, 1978; Ruttan and Hayami, 1971; Schultz, 1964). However, numerous fundamental technological advances occurred for reasons that had little to do with market forces. Frequently, technological change resulted from the tinkering of inventors, or deliberate government interventions responding to war and national rivalries (Moykr, 1991; Vernon, 1989; Rosenberg, 1982; Landes, 1969; Polanyi, 1957). The numbers of uniforms needed during the Napoleonic wars revolutionised machine tools. German engineering training and chemical industry dominance was a response to a fear of English control of dyes. Semiconductors were developed to meet US missile guidance requirements. Government intervention was essential to Asian economies' transformation from poor agricultural producers to world-class technology developers, accomplished largely within the past quarter century (Amsden, 1994, 1989; World Bank, 1993; Wade, 1990).

Technologies respond to factor prices to the extent that products or services *usually* do not cost more than the practices that they replace, although needs for greater quality, speed, control over production inputs and outputs, or "new" demands violate even this

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[8] The portfolio deterioration had been noticed for years as shown by a review of 20 years' experience in World Bank project appraisal efforts (Little and Mirlees, 1991).

[9] See World Bank (1997), Lutz and Munasinghe (1994), United Nations Statistical Office (1993), Pearce and Warford (1993), Daly and Goodland, 1992), and Bartelmus (1989) for thoughtful reviews of the national accounting issues. Nevertheless, it remains difficult to see how many of the recommendations can affect operational decisions, since employment or profits in "defensive" expenditures are still employment and profit to the interest groups involved. Moreover, if we are concerned about running down capital stocks, surely *human* capital must be included (the long-term costs of avoidable illness, crime, poverty, etc. arguably caused by the current patters of resource use). The boundary problems, described earlier by Norgaard (1989) reappear.

[10] As part of the emerging literature on "institutional economics", the difficulties of *implementing* policy changes are receiving much needed attention. See Thomas and Grindle (1990), and Whitehead, (1990). For a survey of the main themes of institutional economics, see Nabi and Nuget (1989). Olson's seminal work (1982) has set the context for much of this discussion

rule. In a recent survey of technological progress since the Middle Ages, Moykr distinguishes between "micro inventions" (the gradual search for improvements in techniques) and "macro inventions" (radical breakthroughs). The former can be at least understood through economic forces; the appearance of macro inventions is "harder to explain and ...we must look for explanations largely outside the trusted and familiar market mechanisms relied upon by economists" (Moykr, 1991: 294).

The literature on how technologies are developed, selected, and diffused is also dubious about simple cause and effect relationships due to relative prices. Even if prices are "correct", interest rates are not distorted, and political considerations or corruption are not involved, the reasons behind a decision to develop or select a particular technology are highly complex. They extend far beyond simple notions of whether technology A is more efficient or less costly than technologies B-Z (assuming there are such separable, multiple options). A partial listing of factors involved includes: does the choice maximise profit, rate of return, or long-term growth; is control of suppliers or workers an issue; is quality of output important; is flexibility in changing the quantity of output important; how will competitive pressures change over time; how scarce is skilled labour/management; how costly is working capital relative to investment capital; to name but a few.[11]

The development and diffusion of technologies cannot be explained easily by movements in relative prices. European petrol prices are almost triple those in the US. Yet the difference in the two regions' petrol consumption of automobile fleet averages is quite small; European cars consume only slightly less petrol (*The Economist*, 1 September, 1991). The price incentives for technological change have evidently not been sufficient to bring to market autos with far greater fuel efficiency. Mills (1991) surveyed a number of recent OECD country energy studies and found that demand elasticities for electricity could vary by a factor of 50, depending on the time horizon. In two countries with similar cultures, climates, and incomes, Danes, with some of the world's highest electricity prices consume *more* electricity per capita than Swedes who pay some of the world's lowest electricity prices. Mills argues there are at least 14 types of non-price and "counter-price" effects on energy demand.

There are of course other issues involved. At a Business Council for Sustainable Development workshop, a senior manager for a transnational corporation noted, "Competitive advantage of an enterprise is based on technological innovation. Transferring technology means transferring competitive advantage; it is therefore a sensitive issue" (BCSD, 1992:15). The decay of many US urban streetcar systems during the early part of this century was caused in no small part by the "market" transactions of large automobile companies who purchased the trolley lines and then let them fall into disuse. In retrospect, this seems a colossal mistake viewed against the pollution, traffic, capital outflows, and loss of national independence this event set in motion (Snell, 1974). More recently, so-called Energy Service Companies (ESCOs) face daunting problems working with utility firms in introducing and financing innovative energy technologies, even with these represent the least-cost solution to consumers. Smaller, more nimble energy producers face protected state and private utility monopolies in many countries (World Bank, 1999a, ESMAP, 2000).

On a more benign note, Timmer (1991:6) suggests that "optimal incentives to private firms to invest in the discovery of new technologies require that the new income streams generated be captured to a significant degree by the firm incurring the costs of research."

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[11] For some explorations of inappropriate choice of technology (where the most efficient technology was passed over for a more costly option) see articles by Timmer and Wells, in Timmer *et. al.* (1975) and Panayotou and Zinnes (1995). For a broader review, see Egea (1990) and Francis Stewart's important works (1991, 1978). Timmer (1993) discusses the more subtle political and operational reasons why agricultural prices seem to divert from their efficiency prices in most countries.

A variety of non-market disincentives related to governance and incentives at the firm level prevent managers from implementing immediately *profitable* and ecological production methods (Panayotou and Zinnes, 1995). Wade (1990: 353) concludes:

> Even if [firms] know they would gain by co-ordinating their investments, ... they may face inherent contradictions of interest, as in a Prisoner's Dilemma game. Hence, market prices may not adequately signal the interdependence that exists among...investment decisions, and uncoordinated firms may invest at sub optimum levels from a national perspective. A big push involving simultaneous expansion of several industries can insure the profitability of each investment, even though each on its own would be unprofitable.

Not to single out market failures or private firms, a French factory discussed installing a gas turbine co-generation system with Gaz de France, the state gas utility. They designed a system that was cheaper than grid electricity to handle peak loads. Electricité de France, the state electric utility, threatened to raise the base tariffs charged to the factory if they went ahead. Independent power producers in Costa Rica have faced similar problems with their national utility. The town of Kungsör, Sweden developed an innovative project to produce more than half the town's heating and electricity needs through a large biogas system. The biomass would be grown on local lands that are being removed from food production, formerly subsidised. The biomass energy project would employ local farmers and support businesses threatened by the austerity move, help defray social welfare costs, and preserve the appearance of the countryside. The project was blocked because the delivered price of electricity, although competitive internationally, cannot compete with highly subsidised electricity from Swedish nuclear power stations. The coal-fired power station in Kalundborg, Denmark designed a system to capture its CO_2 emissions and some of its waste heat and feed these into a large greenhouse to be built around the station. The greenhouse designers estimated they could grow a wide variety of vegetables and flowers at highly competitive prices. Local farmers, who have blocked the project on a legal technicality restricting utilities' use of land, seem to agree.[12]

All of this suggests that we must be realistic about two sets of limits concerning market-based policies: they have their own set of theoretical and implementation problems, and their role in stimulating needed social and technical change can be overstated. Indeed, OCED economies seem to perform effectively, despite sometime widely different tax and pricing regimes (Turner, 2001).

Many argue that the powerful effects of "good" macro policies have yet to be applied and tested adequately so that it is unfair to judge their merit. But *there will always be serious limits on what can be tried using market mechanisms* because of problems targeting their design, their implementation, and their effects. Thus there is a need to clarify when price changes and reliance on market mechanisms are appropriate, to build political support for their introduction, and at the same time, to develop responses that are not overly dependent on these measures.

D. The Limits to Technology Transfer and Capacity-Building

The perceived need to build capacity and create institutions to facilitate "technology transfer" confirms the limits of market-based policies described above. If such policies were as effective as they purport to be, technology transfer would occur on its own, in a manner that would be adapted to local demand, factor prices, and culture. However, one is hard-pressed to find any government *ever* that has not intervened in managing

[12] Personal discussions with staff at the UN Regional Commission for Europe, the Biomass Users Network in Costa Rica, the municipal government in Kungsör, and staff at the Asneas Power Station in Kalundborg, Denmark.

technological change, reflecting the depth of market failures and political considerations involved. Historically, governments and development agencies have spent much effort developing and transferring technologies and nurturing competent local governments, or in their absence, what we now call NGOs. The idea that government could effectively intervene to develop technical capabilities was a central part of the industrial revolution, particularly in Germany, France, and Japan (Landes, 1969; Polanyi, 1957). However, national government "extension services" or UN agencies' technology transfer activities, especially those related to environment and development concerns, have become quite expensive and their effectiveness is increasingly open to question.

E. Constraints on Large Programmes: The Centre

The notion that technology can be "transferred" to developing countries has itself been transferred, based largely on the experience of the US Agricultural Extension Service during the 1930s. The results have been disappointing. Far too often, "institution-building" and technology information services have largely failed to provide relevant groups with the capacity to obtain, modify, or develop technology packages that are critical supports to sustainable development. Not surprisingly, "technology" is only part of the problem, as the forgotten discussion of "appropriate" technology during the 1970s showed us.[13]

Much technology development done by large public and private sector research groups are too removed from local conditions to make such work effective, particularly in the key areas of renewable energy, low-chemical agriculture, and biological waste treatment systems. The problem is compounded through the increasing obsession with advanced database manipulation. Information is too often dated, incomplete, or in a format that makes comparison and analysis difficult. New systems using CD-ROMS, Internet sites and discussion groups, etc., will only make this poor quality information more accessible, with the aura of legitimacy that advanced technologies confer. One is hard-pressed to find evaluations of the effectiveness of these systems, and the cost of making them sufficiently trustworthy still appears prohibitive.[14]

Finally, political considerations intrude on these programmes in destructive ways. All sorts of problems crop up: which agency should run which service, which technology should be recommended, which groups should be involved or targeted, who will make these decisions, etc. Frequently, the most competent groups remain outside the "official" network of local UN agency representatives, local government agencies, university groups, etc. Cronyism and corruption are major problems.[15]

The UN's 20 "technical" agencies are confused and demoralised. Dramatic restructuring and pruning of their operations is needed, missions must be clarified, and competence rewarded. Such reforms have been under discussion since the "Jackson Report" (1969)

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[13] A very brief review of this issue includes the broad works of Stewart *op. cit.,* and Rosenberg (1984). A good discussion of agricultural technology transfer is contained in Biswanger and Ruttan (1978), Griffin (1979), and Lipton and Loghurst (1989). For a discussion of private sector technology transfer, see Marton (1986) and BCSD (1992). For a conventional approach to support technologies for sustainable development, see Heaton *et. al.* (1991).

[14] The problem is not in the hardware, although in many areas, power grids and telephone lines remain poor or non-existent, radio or satellite alternatives are not sufficiently developed, computer viruses are rampant, and servicing and technical assistance spotty. The real bottleneck is the cost of staff trained in economics and engineering (as opposed to typists or graphic artists) whose judgements are required to interpret reliably information in these databases. Both the World Bank and UNDP are developing "solutions" and "best practice" web sites, but selection criteria and quality issues remain.

[15] See Branigin's (1992) series on the UN system, Sesmou (1991) on the FAO, and on development assistance in general, Hancock (1989) for some typical criticisms.

and continue (Nordic UN Project, 1991; Commission on Global Governance, 1995; and Urquart and Childers, 1996). At best, reform will take years to filter down into the management of the agencies. More well-endowed agencies, such as the World Bank, have great difficulty innovating, and linking work that occurs across sectors. Two departments within the World Bank, an institution that devotes great effort to its project appraisals, found two different water projects (in the same country) that showed high rates of return. It took a consultant to notice that both projects required exclusive use of the same water. Co-ordination and learning among donors remains a distant dream, let alone making such knowledge accessible to others.[16] Recently, key international donors have tried to coordinate actions better through the "Poverty Reduction Strategy" process, and the "Millennium Development Goals" to cut world poverty in half by 2015. These try to ensure that governments "own" their development strategies, that policies and budgets fit together, that donors' aid is coordinated, and that the entire exercise is based upon a domestic political process that promotes more open, accountable governance. Imposing more coherence on development policies is clearly helpful, as far as that goes. As even participants acknowledge, this approach can become too simplistic and rigid (IMF 2002b). Our recent experiences with communist output planning, or corporate manipulations of earnings per share numbers suggest the limits of this approach, recalling H.L. Mencken's comment that "every problem has a solution that is simple, direct, and wrong." What does seem likely is that these "coherence" methods will not lead to the kind of cross-sector innovation that is needed (see next section). Even so, while the magnitude of official development assistance is not trivial, it is increasingly marginal compared to the level of international private investment flows.

F. Constraints at the Local Level

At the operational, local or even field level, in both developed and developing countries, the situation is one of "Look Who's Not Talking". Economists are derided as nay-sayers, who only criticise because they cannot create. Engineers find costs, and sometimes even consumers, a nuisance. Political or environmental activists are morally outraged by concerns beyond those of their narrow constituencies. Businesses are firm supporters of the "free market" for others; as far as their particular firm is concerned, a dominant market share (if not monopoly) is the preferred position. Financial and government interests seek to avoid instability, risk, and accountability if at all possible, which seriously impairs their ability to support local innovation. It is sometimes a wonder that anything occurs at all, with such a constellation of interests manoeuvring constantly to block or upstage each other. The obvious pity is that all these different perspectives have much validity, and an open exchange amongst the parties would strengthen the effectiveness of everyone's work.

After hydro-electrification, biogas programmes (to produce methane and fertilisers from the anaerobic digestion of organic wastes) are probably the largest renewable energy effort undertaken in developing countries. Following the oil shocks of the 1970s, both the Indian and Chinese governments created large biogas construction programmes valued at over a billion US dollars. The technology can provide simultaneously an excellent fertiliser (from the digested biomass), and gaseous energy for cooking, shaft-power for

[16] I spent a year identifying projects over the past 20 years that were examples of "integrated, community level sustainable development." I visited many, and contacted most UN agencies, major bilateral donors, multilateral banks, and prominent research institutes and NGOs. The focus was on projects that tried combinations of integrated energy systems, low-external input agriculture methods, and biological waste-processing technologies. I had time, excellent contacts, advanced telecommunications and computer links, and an ample travel budget. Obtaining detailed information was extremely difficult, requiring repeated inquiries, sifting through hundreds of incomplete project documentation, and requests for details and clarifications were impossible to fulfil or frequently ignored. There is no way that city managers, developing country NGOs, bank loan officers, or marketing managers, all with less resources and greater constraints, could try this.

water/irrigation pumping and grinding, and electric lighting, all arguably essential rural needs. But the Indian and Chinese programmes created large inefficient bureaucracies to manage the programmes. Crash targets to build millions of systems caused massive waste and pilfering of construction material and misuses of subsidised loans. Although not well monitored, system failure rates were disturbingly high, due to the rush to disseminate inappropriate designs. Benefits continue to elude those most in need.

Because biogas systems must be integrated with both the economic and cultural constraints on the use of biomass, land, and water, they require an intensive dialogue between the systems' users, designers, and financiers to find the right design, balance of scale, ability to supply biomass, and financing schemes to make the systems useful. It has proven difficult to get the chain of NGOs, local governments, economists, rural sociologists local farmers, equipment manufacturers, and the national banking and construction systems to pool their knowledge, co-ordinate their efforts, and develop systems that truly satisfy local needs (Lichtman, 1992; 1987). Similar problems have plagued large-scale programmes for reforestation and wood-stove dissemination (Smil, 1993).

Current approaches to technology transfer and capacity-building have great difficulties delivering conventional, discrete systems that work as promised, with relatively straightforward demands of creating employment or sustainable resource use. These conventional approaches are utterly incapable of responding to newer, more complex concerns of effectively integrating energy, agriculture and waste recycling systems, and conceiving of social and technical arrangements that reinforce democratic decision-making, some of the pillars upon which sustainable development must rest.

V. THE NEED FOR INTERVENTION

A. Unmet Needs

The preceding discussion suggests that for numerous economic, political, and operational reasons, sustainable development will not emerge from the sum of conventional measures, such as relying on corrected market mechanisms[17], new environmental accounting methodologies, industrial recycling programmes, or technology transfer as now practised. We are still groping for ways to integrate technical and social change, to effectively marry the socio-political knowledge of local organisations with the technical knowledge of specialists. Timmer's (1991:300) comment on lessons from the experience of stimulating rural development holds:

> The World Bank and other donors have financial and analytical resources, governments have policy levers and personnel in various agencies, and private

[17] Prior to their massive devaluations of 1997, the fast-growing "Asian Tigers' experience" (Japan, Singapore, Hong Kong, Korea, Taiwan) which suggests that many of the problems with conventional approaches can be overcome with competent management. As economists do, one can debate causal links and the degree to which these countries' experience can be replicated. It is clear that these economies operate in contexts that are atypical of many countries, including those of the OECD. These conditions include the nature of closed, disciplined, homogeneous cultures, the perception of strong external threats, significant foreign assistance, the distribution of income and assets, the degree of government legitimacy and intrusiveness, and other factors (Amsden, 1994, 1989; World Bank, 1993; Wade, 1991; van Liemt, 1988). What is also clear is that these countries benefited as late entrants, building upon an existing model of industrial (Western) life. They were trying to enter rapidly a series of existing product, financial, and technology markets. Their success is indeed spectacular, as measured by market share, income, foreign reserves, and export growth. But as is all too clear, it has come at a price, financially, politically and environmentally. The Asian experience shows us that "pro-market" interventions can work if done well, and if markets have sufficient confidence (even if not necessarily justified) in these policies. But our need is to develop a set of technologies and social relations that have little precedent, and for which the guided market is of limited help.

> voluntary organisations often have grass-roots leadership potential. Successful ... strategies require the integration of these resources into community desires and constraints. *Such an integration is not a market activity* (italics added).

Our current institutions and market mechanisms have great difficulty in posing the right questions, let alone providing answers. How can we integrate chains of energy, food, and waste systems, whose joint products are not easily compared with current practices? How can we base these largely on renewable resources, and how do we create systems that foster democracy and social cohesion, helping local people manage resources in a comprehensive fashion? Why will companies support technologies that could undermine their existence, or whose profits they cannot capture, however great the social benefit? How can we deliver proven technical information to local governments and non-government organisations, who trust neither each other nor outside experts?

Many governments and international organisations find themselves under real or imagined pressure to do something "big" about these "big" problems. Grandiose notions of "building capacity, national sustainable development strategies, and transferring technologies" too often neglect the simple questions: how, by whom for whom, covering which areas, at what cost, and how will we measure success. Stating that we should do these things is not enough either to make them happen or to surmount their serious limitations.[18] More disturbing, these actions are premature; at the micro-level, we remain unsure what technologies are needed, and what organisational forms can encourage the effective use of such technologies. We are putting a cart, not yet even in prototype form, well before the horse.

While our understanding of what constitutes sustainable development is incomplete, and our ability to guide it through conventional policies questionable, this is no cause for defeat. We must not abandon efforts to correct prices, to strengthen the UN system, to encourage firms to be responsible for the environmental effects of their products throughout the entire product life-cycle, etc. Many pressing environment and development problems relate to the provision of clean air and water, and this is rightfully the focus of much near-term activity (Beckerman, 1992). But however necessary, this will not be enough if we want to go beyond sustainable resource use and provide sustainable livelihoods for all.

There is a need to redress the imbalance of an excessive reliance on policy reforms, structural adjustments, enlightened bureaucracies, and induced innovations that may or may not occur. We must also create sustainable development through a more direct approach that deliberately tries to pull all the pieces together (technologies, organisations, finance, governance). The necessary intervention does not mean centralised control of production or investment. It is based upon market mechanisms, and it relies on many off-the-shelf technologies that are now competitive. But it does require that we combine these approaches, and consciously make a set of demands upon our technologies and our ways of organising social activities that go beyond merely seeking the cheapest, most convenient way of doing something.

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[18] Repeatedly, we see it is easier to sign an emissions agreement, or a local "Agenda 21" and then let them remain unimplemented. Many of the governments who endorsed the Rio Earth Summit also signed the 1928 Kellogg-Briand Pact banishing war as a means of settling international disputes. Focused, limited treaties such as the Montreal Protocol (to phase out ozone depleting CFCs), or agreements to limit greenhouse gas emissions are valuable. But, beyond the ephemeral benefits of consciousness-raising and networking among the "conference-class", it would be extremely useful to see a hard-headed evaluation of the benefits of UN mega-conferences to see if these justify the scores of millions of dollars each costs. As this paper argues, much of the action needs to be taken locally, not globally, and merely requires doing it. See Dalal Clayton *et. al.* (1994) for a related discussion of national sustainable development strategies.

B. Integrate Systems When Possible, and Mimic Nature

Although one must not overstate the ability of technologies to fix social problems, a number of promising systems can provide food, energy, industrial goods, and utilise their wastes in a more sustainable fashion. Some are quite simple and cost-effective *now:* highly-efficient fluorescent lightbulbs; super-insulated gas-filled windows; biological waste-water treatment systems; continuous, variable motor transmissions; coupled heat and electricity production; water-harvesting systems; and composting and biological pest-control systems. Other approaches are more complex, such as growing biomass on degraded lands in Africa, to be linked with methanol-fuel cell facilities for the large-scale production and export of hydrogen (Johansson *et. al.*, 1992). If these systems could be integrated and refined in real life settings, they may provide basic goods and services at vastly reduced levels of cost, pollution, and social inequality when compared with current practices.

However, these integrated systems have not been used at a scale large enough to fully capture their benefits. Technical groups developing these systems are seriously under-funded and isolated. Progress is needlessly slow, information is diffuse and difficult to obtain, much work is duplicated or wasted, and integration with local cultural, political, and economic needs remains problematic.

We must encourage this type of technological development because it offers multiple benefits, creating "joint products". Examples include integrated facilities that produce power and use waste heat to warm greenhouses, or biological wastewater treatment systems that provide energy, food, and sewage treatment at reduced cost and greenhouse gas emissions, and more effective use of local resources. The total economic value of these systems is often greater than that of individual conventional technologies, with which they may *not* necessarily compete. Such opportunities arise only if we ask the right questions.

Comprehensive, integrated thinking is needed to optimise resource use among different sectors. A number of recent energy studies show that only through an integrated approach can greenhouse gas emissions be managed in a cost effective way (Pascala and Socolow, 2004). Lovins et. al. (2004) show that the US can effectively cut oil imports to zero by an integrated programme that links redesigned lighter weight vehicles, a vast energy efficiency program to free up natural gas for hydrogen conversion, and a careful introduction of biofuels. A number of Swedish regions faced complex choices between using natural gas or combusting municipal wastes to produce heat and electricity. Local economic development, air pollution, financing, and waste management issues all factor into the investment decisions, and even these were only understood after sophisticated modelling (Ryden *et. al.*, 1993). Jakarta's urban energy consumption devoted to boiling contaminated water may account for as much as 10% of gross regional product (Bartone *et. al.*, 1994), suggesting water treatment may be a cost-effective way to reduce energy demand.[19] Costa Rican deforestation and expansion of agricultural land has led to serious silting that has dramatically reduced the performance of some of its hydroelectric power stations. Joint management of *materials flows* (particularly steel, aluminium, cement, petroleum-based feedstock chemicals, and wood) and the energy system could reduce future European CO_2 emissions by *50%* more than what is possible by focusing on the energy system alone (Kram *et. al.*, 2001; Gielen and Kram; 1999, and Gielen *et. al.*, 1993). Ayres (1993) shows how so-called "clean industrial production" must include a systems perspective; the environmental impact of processing and manufacturing is far less than that derived from primary extraction and energy embodied in intermediate goods. Rogers *et. al.* (1993) show how a narrow focus on optimising the management of

[19] While this number includes tea-making which would occur even with clean water, it is so large that the argument holds. I am grateful to Gordon McGranahan for this clarification.

Bangladesh's water systems can lead to long term losses for the economy as a whole. Schepers and Kram (1995) show how changes in the Dutch energy system to reduce greenhouse gas emissions can "overshoot" once their dynamic effect on (reducing) economic growth is included. Anderson *et. al.* (2003) raise the disturbing possibility that smoke and particulates from fossil fuel use, crop burning and aerosol releases have actually kept global warming *lower* than it would have been (and by implication may in the future be) with a cleaner fuel mix. On a smaller scale, vast savings of energy and equipment for lighting, heating and cooling appear possible in building design if architects, mechanical engineers, and developers can find ways to combine best practices, including eliminating boilers, air conditioners and costly piping entirely, in many climates. Furthermore, the monetary benefits of increased human productivity in well-designed buildings dwarfs (by a factor of up to 100) any of the costs incurred (Romm, 1999; Wilson *et. al.*, 1998; Lovins *et. al.*, 1995; RMI, 1994).

The costs of obtaining an accurate picture of "end-use" consumption, and for building local political support for private infrastructure investments can be better spread across several sectors. Markets are beginning to recognise these economies of integration. Some energy, water, and telecom firm are finding their skills in managing and financing networked infrastructures can be applied to each others' markets, e.g. Suez (Lyonnaise des Eaux), RWE, etc. A key to making China's reliance upon coal less damaging to the global environment may be to develop integrated coal gasification facilities that co-produce a range of chemical feedstocks, transport fuels, and eventually hydrogen (CCICED, 2003).

Moreover, new least-cost solutions in e.g. energy, waste, and water management increasingly borrow lessons from natural eco-systems, in linking a variety of services in a more distributed, fashion, where "service" as opposed to "product" delivery requires a variety of smaller systems using each others outputs or wastes (Benyus, 2002; Seth, 2000; Hawken *et. al.*, 1999; and Kelly 1994).

Such integrated systems thinking does not preclude phased implementation of different projects, but it does seek a larger, strategic framework to co-ordinate actions (Hirschman, 1991).

C. Seek the Lowest Appropriate Scale

This is not an argument for autarchy or the suspension of trade. Some activities may be viable only on a larger scale, requiring large investments, large land areas, and large distribution systems, such as the biomass-hydrogen example discussed earlier. The point is not to assume that the scale at which we organise modern production and governance is necessarily the most efficient, or most desirable pattern. In general, activities should be organised on the smallest appropriate scale, balancing economic (including environmental) costs, with possibilities for system integration and strengthening democratic resource management. By decentralising a number of systems, particularly in the energy sector, technical reliability may increase and costs may be reduced (Lovins *et al.* 2002; UNDP, 2001; Johansson *et. al.*, 1992; Reddy *et. al.*, 1990). Different resource endowments, agro-climatic settings, different incomes and tastes, and the political power of those deciding will determine the meaning of "appropriate". We also need greater clarity about what change is possible by simply doing it, and what *requires* additional policy, price, and governance changes at different levels (Stren *et. al.*, 1992). We must think harder about the trade-offs involved (World Bank, 1999b; Alesina and Spolaore, 1995; Ruskin, 1986; Dahl, 1985; Dahl and Tufte, 1973; Schumacher, 1973; Goodman and Goodman, 1960).

D. Strengthen Possibilities for Transparent Management of Resources

We must seek ways to allow people to develop greater control over local resource use and decision-making, borrowing from Sen's (1999) notion of "development as freedom". This includes providing accessible and reliable information, affordable credit, and the legal authority to own and manage local resources (de Soto, 2000; Gates, 1998; Chambers and Conway, 1992; Ghai and Vivian, 1992; Pretty and Sandbrook, 1991; Borrini, 1991; Dahr *et. al.*, 1990; Agarwal and Narin, 1989). Technologies and scale options must reinforce this.

What is worrisome is that increasingly, we seem unable to develop a political mechanism that allows meaningful democratic choice on some of the most fundamental issues that affect sustainable development. How do citizens "vote" on establishing an energy or agricultural system made of a vast chain of interdependent actors, technologies, and financing arrangements that require very long lead-times and commitments to organise? In former Communist Eastern Europe, and much of the developing world, the nature of vast new infrastructure investments will greatly influence local economic growth, land-use, and the flows of large payment streams. Mattsson and Wene (1997) suggest without government demonstration financing particularly for solar and fuel cell technologies, we may be "locking" ourselves into more conventional systems that will actually be more costly, long-term. As we have seen from the US urban trolley example, the argument that this all efficiently sorts itself out through the magic of the invisible hand, or competition among elites, is pretty thin.

If we are to have sustainable livelihoods, we must actively develop social and technical systems that allow people greater options than choosing between being passive consumers of globalisation or retreating inward to more personal, or quasi-Luddite "tribal" concerns.[20] Arguments that people do not wish to be bothered with all this, or that they lack the competence to directly manage complex activities, are not born out by the experience of those who have the option.[21] Increasingly, both business people and

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[20] Debray, quoted in Barber (1995), calls the choice as "Coca-Cola or Ayatollah". Further discussions of some of the social aspects of globalisation include Putnam (2000), Luttwak (1999), Gray (1998) and Rodrik (1997). There is a psychological dimension to sustainable development that is often overlooked. Beyond survival, the goods, services, and technologies that people demand are linked with deeper needs for self-expression, identity, self-worth, and how these interact to form needs to project power (Hirsch, 1977). Thus we have the apparently large Falun Gong movement in a China adrift between value-systems. Even among the poor, consumption is often a sign of status, and a way to display control over at least a part of one's life. Thus Indian families willingly supply financially crippling dowries, and US urban ghetto youth play basketball in $200 shoes. The hundreds of billions spent on consumer goods and cosmetics, and at the national level, vast military and prestige infrastructure expenditures are all fulfilling various psychological, if debatable "real" needs. Unless other means are found to satisfy these individual and national needs, changes in consumption patterns will be resisted. While by no means the whole answer, a sense of genuine political efficacy, in one's village, workplace, and government can go some way in redirecting energies away from what one must consume, and more toward what one can be (Putnam, 2000; Ellerman, 1990; Lasch, 1983; Fromm, 1974; and Pateman, 1970).

[21] Historically, opportunities for "democracy" have always been restricted because of the dilemmas of how to allow citizens to decide matters beyond their technical expertise, and how to protect against tyranny of the misguided majority. However, as democratic political systems matured, they have expanded the set of decisions open to popular vote (e.g., permitting citizen referenda), and they have relaxed the minimum qualifications one needs to participate (e.g., abolishing requirements of property ownership, male gender, lowering age requirements, etc.). This evolution has occurred in the private sector as well, where needs for productivity and quality, and the power of information technologies continue to push management decisions down to lower levels. Organisations are becoming less hierarchical, and a great deal of effort is devoted to allow middle managers and production workers more say in what and how they produce. Cooperative or employee-ownership/management schemes, such as the Mondragon Group in Spain, have begun to achieve new visibility as more mainstream firms (Avis, United Airlines, John Lewis Partnership) employ this form of governance. Nevertheless, in both the workplace and at the ballot box, most citizens have only the most remote, indirect chance to influence decisions through voting for their elected representatives and on limited referenda, or by participating in voluntary "interest" groups. Issues are usually framed in oversimplified, "yes/no" terms. See Putnam (2000), Olson (2000), Barber (1986), Dahl (1985), Lindbloom (1980), and Pateman (1970) for penetrating critiques of democratic theory and practice.

political economists are coming to the view that genuine, democratic participation in a dynamic civic culture is a *sine qua non* for stimulating economic development, and managing businesses and resources in an effective, equitable fashion (Putnam, 2000; Putnam *et. al.*, 1992; Senge, 1990; Whyte and Whyte, 1991, Ellerman, 1990). Heimans (2002) mentions significant, rapid improvements in basic service provision in Porto Alegre, resulting from citizen's decision-making in the setting of public expenditures, a process being extended to other Brazilian cities.

But we remain far from making such notions of empowerment operational. Given citizens access to the requisite rights and tools continues to take a back seat to "targeted" technical projects, and "getting policies right", etc. Even the World Bank's (1998) *Assessing Aid* bemoans the continuing lack of efforts that build local capacity, increase citizen knowledge of and participation in public service delivery, and donors' narrow focus on an "approval and disbursement culture", and "physical implementation as a measure of success". While more "coherence and ownership" of government policies is of course useful, it is difficult to see how current notions of "comprehensive development frameworks, development targets", etc. will prevent distorted, undemocratic decision-making.[22]

Sustainable development requires that we make these new demands upon technologies, upon the way we organise our workplaces and governments, and indeed upon ourselves. To encourage these steps, we have had studies, huge conferences, policies, raising-of-awareness, and the results have been disappointing. Now it is time for some hard work, on the ground. How this might begin is suggested below.

VI. ACTION TOWARDS SUSTAINABLE DEVELOPMENT

A. A Moderate Intervention

We simply do not know how the necessary technical and social systems can be made to work together, reliably and conveniently, to support sustainable development. We do not have a practical analytical framework, or indicators, to guide us. As the preceding discussion suggests, conventional approaches to promote sustainable development will be of limited use in delivering it.

We need a way to clarify the appropriate mix of needed changes, in a way that can be understood, supported, and controlled by average citizens. The process will need to learn by trial and error; there is no elegant, foolproof, scientific way to proceed. All of this argues for a highly focused, deliberate effort to flesh out answers to the following questions:

1. **What works**-what proven analytical frameworks, technologies and forms of organisation can support sustainable livelihoods, and what detailed costs and political relationships are involved?

2. **What are the implications for replicating any successes**: local planning techniques, finance, macro-policy reform, political change, and the appropriate scale(s) for addressing different issues?

[22] Measuring progress toward the current seven "Millennium Development Goals for 2015" shows very uneven results (UN Millennium Project, 2005; OECD, 2001). In order to be measurable such targets have to be crude, and it is difficult to make a link between actions and results, at this aggregate level. There has been an earlier experience in targeted outputs – communist central planning - whose results have also been disappointing on both efficiency and equity grounds. We are still searching for the right balance and strategy at the global and macro levels (Easterly, 2001). But our concern here is at a lower, more regional scale.

Our thinking on both about micro-solutions, and the macro-policies that may help support them, should be based on some very concrete examples of success, examples that are difficult to find at present. A deliberate programme of action is needed to create models of sustainable development that could be widely replicated.

We will need a balance of scale:

1. **The effort must be on a scale *small enough* to create a genuine long-term partnership between technical experts and regions.** Although regions are obviously linked to the national and international economies (and resource flows), the regional scale is an appropriate size from which to start. Increasingly, most people in the world live in or near medium-sized cities (UNHCS, 1996), which in turn depend largely on regional resource flows to support economic activities, as well as critical life support systems (food, water, clean air, waste disposal and absorption). Regional "character" often forms the basis for further co-operation; some of the world's most dynamic economic zones are regional in nature (Krugman, 1998; Pike and Sengenberger, 1992; Nijkamp *et. al.*, 1991). The World Bank (1999c, 1999b) states that decentralisation is one of the most important forces now shaping development.

   The partnership requires a deliberate, co-operative effort that goes far beyond the distant, unaccountable processes that are supposedly set in motion by "macro" policy changes, or traditional approaches to technology transfer. Experts and citizens need to actively learn from each other, to begin to transcend the class and cultural barriers and mistrust that are blocking much change, and to manage the dirty operational and political details of social change. At the moment, there is far too much competition between all the relevant technical and political interests. We need to create a framework that rewards co-operation.

   Finally, the effort must not be too large and visible. Too often with "national" projects, major political and economic interests are either threatened or feel compelled to meddle to attract media attention. The stakes and expectations become raised, and the results are watered-down, lowest common denominator solutions rather than the deeper partnership that is needed (Dalal-Clayton *et. al.*, 1994).

2. **The effort must be *sufficiently large* to be credible.** It must attract the notice of citizens, governments, firms, and experts, all with severe competing demands on their time. It must also reflect a representative range of local conditions and cultures, capture economies of scale, guard against isolated failures or successes, and obtain results that can be replicated.

B. The Models of Sustainable Development (MSD) Project

Thus, a number of large urban regions would form a long-term partnership with a technical group composed of leading experts in innovative agriculture, energy, waste-utilisation, regional planning, systems ecology, and "clean" industrial technologies. These regions would be located in Scandinavia, the US, the European Union, Eastern Europe, and several in South America, Africa, and Asia, respectively. Each region would be composed of one or several existing municipalities and their hinterlands, with combined populations of several hundred thousand people, reflecting the scale issues discussed above. The regions would agree to participate voluntarily, and they would have relevant experience and characteristics (e.g. they would be proximate to a university, they have relationships with some of the technical groups in the network; and they have introduced a recycling or energy conservation programme, etc.).

Each region would develop and implement an "integrated sustainable development strategy", to deliver a set of essential goods and services, in a fashion that can be replicated elsewhere, to reduce the gross disparities in livelihoods between rich and poor, while preserving the resource base upon which these livelihoods depend. A balance must be found between acceptable levels of comfort and amenities, greatly reduced costs and consumption of resources, promoting democratic governance, providing incentives for innovation and producers, and minimising inequalities. Richer nations must create an acceptable standard of living while consuming less; poor nations must provide more of life's basic amenities for their populations while minimising the need for costly investments, more debt, more drain on government budgets and staffs, and further degradation of natural resources.

C. Common Approach: Different Solutions

The MSD Project would not seek to impose some rigid image of sustainable development. The realisation of actual plans will reflect local notions and needs that will vary from site to site. Nevertheless, the regions would use a common planning framework to think about the problem, both in a technical sense of understanding the flows of local biomass, water, capital, and human skills, and in the organising sense of how to develop effective dialogue about these issues. There will also be certain shared technical and organisational solutions that will emerge as the project progresses. Defining these common elements, based on a global learning organisation, composed of experts and communities, is the heart of the project. With experience, the cost and "planning intensity" of the effort will fall so that replication will be easier. But this must be based upon the practical experience the MSD Project would generate.

An integrated, regional sustainable development strategy could contain elements shown in the box below:

Elements of a Regional Sustainable Development Strategy

DEMAND SIDE MEASURES:	• Resource price reforms • Changes in regulations
INVESTMENTS:	
Energy Systems:	• Biomass gassifier/ micro gas turbines • Renewables (solar, wind,) • Fuel Cells-stationary & mobile • Real-time "smart" electricity metering
Resource Efficiency:	• Installing advanced lightbulbs; super-insulated windows • Continuous variable drive industrial motors • Organic waste collection & composting • Water-saving devices, etc.
Biological Wastewater Treatment:	• "Engineered marshes"-combining bacteria, plants and fish to treat wastes • Anaerobic digestion of wastes with methane recovery
Low-Chemical Agriculture Systems:	• Inter-cropping with nutrient recycling • Integrated farm systems (trees, livestock, fish, pulses, etc.) • Linkages with organic waste systems
Transport:	• Traffic corridors with frequent transport • Low-emission vehicles-linkages with energy/waste systems for fuel
Industry:	• Advanced separation and recycling • "Closed loop/cradle to grave" management of production processes • Micro-process control systems
Housing & Building Stock:	• Passive lighting, heating and cooling designs • Affordable, flexible layout • Micro-environmental control systems • Blending of residential and commercial space
Investments in Human Capital:	• Primary Health Care • Literacy and numeracy, particularly for women • Employment Banks and Micro-Credit Schemes • Worker Shareholding and Decision-Making in Firm Management • Creation or enforcement of contract, land use/usufruct laws
SOCIAL, FINANCIAL, AND ECONOMIC IMPACT ANALYSIS: how are different groups affected by the plan; who will bear costs and receive benefits; fiscal and employment impact of plan; how does this change over time; divergence between financial and economic analyses.	
ECONOMIC-ENVIRONMENTAL IMPACT ANALYSIS: how is flow of jobs, capital, government finance, wastes, pollutants, toxins, greenhouse gases etc. affected by plan.	
SUPPORTING ORGANISATIONS for systems and policy management (public and private sectors) including training and communications.	
A PHASED INVESTMENT PLAN, and appropriate financing.	
POLITICAL SUPPORT to implement the strategy, at the local and national levels.	

While treating problems in an integrated, comprehensive fashion, this does not mean we would plunge ahead on all fronts simultaneously. One lesson from integrated rural development projects is to keep interventions simple, manageable, and the product of genuinely participatory planning (Timmer, 1991; Operations Evaluation Department, 1986). Proposed solutions would be introduced in phases, but they would reflect comprehensive thinking.

D. Previous Attempts and Current Thinking

There have been some attempts along these lines over the past 20 years. However, these efforts were seriously under-funded, under-monitored, and understaffed. They were attempted in very poor, often violent areas with little social cohesion, and the projects were perceived as an alien presence.[23]

Since then, a number of efforts have successfully grappled with pieces of the sustainable development puzzle. The 5000 residents of Osage, Iowa, have saved over a million dollars annually through low-cost energy efficiency measures. In southern Germany, the city of Rottweil produces 40% of its electricity through decentralised, small gas/co-generation and water turbine systems. Seattle's municipal utility, Seattle Light and Power has a $20 million per year energy efficiency effort that has produced enormous savings over 20 years by working closely with consumers and new residential and commercial developers to get designs right, not just retrofit appliances. Vaxjö, in southern Sweden seeks to become fossil-free in all energy use by 2020 with an integrated efficiency and biomass-based energy program. The Sacremento California Municipal Utility is installing a solar photovoltaic system to produce 40% of the city's electricity. Shell Hydrogen and the government of Iceland have begun a longer-term partnership to transform the island's economy to be fuelled by hydrogen; related pilot efforts are underway with hydrogen-based power station planned in Scotland, and New York City has four wastewater treatment plants powering large fuel cells. Pilot "eco-villages" in Sweden and Denmark combine windmills and methane recovery from the digestion of municipal wastes. Thousands of municipal and private vehicles now run on wastewater treatment plant biogas in southern Sweden, and Lille, France. In some of the worst areas in New York City, the community-based organisation, "R2D2" developed into one of the largest commercial recycling companies in the US. Also in New York City, water consumption, and supply and treatment costs have been reduced through an innovative program of providing free "low-flush" toilets. A number of important demonstration efforts are underway in Sweden and Denmark using urine diversion toilets and biological wastewater treatment systems.

"Closed-loop" and "low external input" agriculture systems are under development at the Rodale Research Station, Pennsylvania; the Agricultural University in Wageningan, Netherlands; Pondicherry, India; and numerous other sites in developing countries. "Integrated Pest Management" has been adopted on a large scale in Indonesia. Since the 1940s, the diversified Mondragon Group in Spain has been owned and managed profitably by its 30,000 workers, with their own development bank and industrial research labs. Similarly, much of China's dynamic rural industrial sector is owned by towns, counties, and old rural collectives. Community land management in Suhkomajri, Nada, and Seed, India has restored local prosperity on barren land, strengthened the bonds of community, and improved relations between citizens and their government. "Engineered marshes" and "biological machines" use plants and fish to treat wastewater in Massachusetts, California, India, Peru, and Bangladesh, selling energy, biomass, and fish for profit. In Kalundborg, Denmark, integrated industries clustered around the Asnaes power station use waste heat to produce organic fertiliser, fabricate construction materials, and warm greenhouses, fish ponds, and buildings. A number of firms such as 3M, Dow Chemicals, Dupont, IKEA, and groups in the Lanskrona (Sweden) and PRISMA (the Netherlands) projects have realised highly profitable reductions in the release of toxins and waste materials through system-wide review and re-tooling of their production processes. Rural industries run on wood-fuelled steam engines linked to agro-forestry plantations in Honduras. In Northern India, Sulabh International has

[23] Examples include energy work in the Bronx and Lower East Side of NYC, the Annacostia section of Washington, DC, Auroville, India, the Kristiana area of Copenhagen, the "Solar Village" in Sri Lanka, the "Three Villages" Project sponsored by UNEP/AMCEN in several African countries. I have visited or had personal communications with those concerned.

commercialised the installation and operation of attractive community latrines linked with biogas systems to produce street lighting. Curitiba, Brazil has developed numerous innovations in recycling wastes and innovative local transportation systems. In southern China, there are scores of integrated crop-fish-livestock farms that also generate much of their energy, process their wastes, while increasing rural income and jobs. The cities of Seattle, Portland, and Chattanooga in the US; Manchester, UK; Porto Alegre, Brazil; Århus, Frederiksborg and Storstrøm in Denmark; and Örebro and Växjö, Sweden, have all made progress mobilising citizens to think about sustainable development in a more coherent fashion, with indicators; innovative waste, water, and energy projects; and greater public participation. [24]

However, these remain isolated attempts and in many cases, we remain unsure about these efforts' economic performance. None have gone beyond a focus on local issues and resources to consider the broader, integrated issues that constitute long-term sustainable development. Many are difficult and costly to contact and none have the capability to advise others to replicate the work in different climates and cultures. There is a great need to strengthen and broaden these interesting micro-efforts, and apply them on a far wider scale.

VII. IMPLEMENTING THE MSD PROJECT

A. Core Organisation

The MSD Project assumes that much progress can be made if the effort has long-term technical and financial support, if issues are confronted and discussed at the local level by a diverse and representative group of interests, and if the Project constantly stresses the need for rigorous analysis, economic viability, replication, and common sense.

Implementing the MSD Project would involve a number of steps:

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[24] Sources for this work are based on an earlier unpublished survey conducted for the Rockefeller Foundation (Lichtman, 1992). Information on Osage and Rottweil are available from the respective local governments. The Danish energy group, OVE, based in Copenhagen, monitors much energy work throughout Scandinavia. Discussions of the renewable energy systems mentioned are found in ACEEE (1996), Johansson *et. al.* (1989), OTA (1992), Romm and Lovins (1993); and in the most comprehensive treatment of all aspects of the subject, Johansson *et. al.* (1992). Low chemical agriculture efforts are being monitored by the ETC Foundation, Leusdan, Netherlands (1993), and Hiemstra *et. al.* (1992) Pretty *et. al.*, in Holmberg (1992) summarises much useful work in this area at the International Institute for Environment and Development, London. Indonesian IPM efforts are contained in World Resources (1994). On Mondragon, see Whyte and Whyte (1989). Indian village resource management experiments are described in Agarwal and Narain (1989) and Dahr and Surin (1990). New York's toilet rebate program is discussed at www.voltviewtech.com. On Chinese co-operatives, see *The Economist* (1992). Details of the Asnaes power station complex are found in the *Financial Times* (1992), and a site visit. Further discussion of urban waste recycling and possibilities for job creation are found in Morris and Platt (1993), and Morris and Irshad (1992). Examples of "clean" production are from de Simone *et al* (1997), WBCSD (1996) and Huisingh and Bass (1991). The Honduras project is assisted by the Community Forestry Division, FAO, Rome. See also Bartone (1994; 1992) and Rabinovitch and Leitmann (1993) for Curitiba and other interesting urban efforts. On Chinese integrated farm systems see Korn (1996), Mitch *et. al.* (1993), Xu *et. al.* (1992), and personal communications with Ron Zweig, Asia Department, World Bank. Recent advances in biological waste and water treatment systems are mentioned in Rogers and Bouhia (1997), and Etnier and Güterstam (1991), which also discusses related developments in China and various biological wastewater treatment systems, and from personal communications with water treatment staff at the World Bank, George Chan, and the Centre for the Restoration of Waters, Falmouth, Massachusetts, the Danish Environment Ministry, and Stockholm Water Company. Additional examples are found in Hawken *et. al.* 1999. Heimans (2002) reviews a number of Porto Alegre public budgeting studies. Ravetz (2004) discusses Manchester, UK's work, and Seattle Light and Power (www.seattle.gov) tracks its ambitious efficiency efforts. Activities at many of these sites change constantly and are best monitored via www.crest.org, following the relevant links.

1. ***Make the Effort Global.*** The MSD Project must be viewed as a collective effort bridging various levels of mistrust between North and South, and East and West. Each region of the world has certain needs and perspectives that must be considered to build the consensus needed to extend the results of the MSD Project. In fact, these differences are sources of strength and useful information; sharing them among the MSD Regions will improve the quality of all efforts. The work must synthesise the productive capacities of the North, the concern for tradition and community of the South, the rights of workers in the East, and the traditions of democracy and efficiency of the West. Each region has its darker sides; none must be perceived as attempting to secure a position of dominance over the others. A global project will also provide local political support for measures that may threaten local vested interests.

2. ***Make the Effort Credible.*** The MSD Project would receive enough funds to enable it to operate for at least three years. It would be an independent effort, able to manage operations without political interference, although it would answer to an Advisory Board (as explained below) and it would co-ordinate its work with on-going efforts as appropriate.

3. ***Establish an International Co-ordinating Office*** within a UN Agency or a respected NGO concerned with environment and development issues. The Project needs a respected, impartial base to attract the support of local participating regions, to draw upon the most competent technical and organisational skills available, and to manage an international effort.

4. ***Establish a Global Advisory Board,*** composed of an internationally respected body of experts (from a diverse background of energy, systems ecology, industry and finance, NGOs, economics, agriculture, anthropology, urban design), as well as representatives from donor agencies and private foundations. The Board would oversee the Co-ordinating Office's efforts to develop a more detailed plan for the project; obtain funding; oversee selections; disperse and monitor the project funds; provide a framework for the detailed activities of each participating region; facilitate the exchange of information among the regions; and develop strategies for disseminating results of the project.

5. ***Identify Candidate Participating Regions.*** The Co-ordinating Office would establish a set of criteria (resource endowments; political traditions; available expertise; willingness to commit local funds; relevant project experience; secured co-operation from universities, financial institutions, and industry, etc.) and then identify regions that best met the selection criteria, through a variety of its own extensive contacts, and those of the Advisory Board members. A broad sample of cultures and climates should be sought, arguing for perhaps 8-10 regions in total. After a period of extensive consultations with candidate regions, donors, and its Advisory Board, final agreements and financing will be arranged. Based upon preliminary discussions, each region will probably require separate financing, although some common support could be forthcoming from instruments such as the Global Environment Facility.

Some may feel this approach selects atypical areas that are "doomed to success" by virtue of their resources, wealth and institutional depth. The MSD objective is to prove a concept for people who are in a position to innovate, to show what is possible and to create a powerful example for those less-organised. The initial effort must ensure that the degree of social change is manageable. The sites should broadly represent regions in their respective countries.

6. ***Establish Regional Management Teams.*** Each Region would establish an oversight management team that would perform many of the functions of the Co-ordination Office, but at the Regional level.

The challenge of sustainable development planning is one of integration; how to integrate economic and environmental concerns (and which ones), how to integrate the interests of different groups, and how to integrate technical, political, and social knowledge. Governments, industry, and market forces have not been able to do this adequately. An intermediate social entity is needed to provide this integration: a multidisciplinary technical team, advised by a board of local "stakeholders" or interest groups. One can argue that this is the role of government. However, government itself is but one of many interests, it may be divided or distorted by all sorts of pressures, and thus a kind of hybrid group is needed to devise a regional sustainable development strategy. Nevertheless, the power of this entity is limited to providing advice and persuading others on the basis of its work, credibility (strengthened by its local and international links, explained below) and the consensus it can achieve. Ultimately, elected government, private investment, and citizen behaviour will determine the effectiveness of this advice. Businesses should also profit from participating in such an arrangement as this will help identify new markets, sources of capital, potential competitive threats. By helping a region better understand the implications of a new factory, and working with local interests to ensure that community needs are addressed in a co-operative fashion during the early stages of a project, much delay and cost over-runs can be avoided. [25]

This hybrid group will concentrate local "social capital". The critical feelings of solidarity and trust can be slowly built, through joint projects, and through shared experience and learning.

a. Regional Co-ordinating Offices

The technical team co-ordinating the formulation of a regional sustainable development strategy should possess expertise in the following areas:

- Energy (particularly related to efficiency measures, biomass & other renewable systems)
- Low-Chemical Agriculture
- Water Supply and Treatment (through natural & bio-engineered systems)
- Solid Waste Management and Recycling
- Transport
- Anthropology
- Economics & Regional Planning
- "Clean" Industrial Systems
- Organisation-Process Theory/Social Psychology (see "Facilitators" in c. below)
- Systems Ecology
- Legal/Institutional Affairs

It is useful to have the group chaired by a pragmatic person with an economics background, someone who understands the discipline and its limits, who is not trapped by its jargon, who is not blind to other disciplines, and who can relate to different social groups. This helps the Regional office to not overemphasise either science for its own sake, or to ignore how much will something cost and who will be affected. Too often, such studies neglect these seemingly obvious points (see below). The presence of an anthropologist, and regional planner should also help connect the work with its social and political context.

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[25] ENRON, among its other woes, learned this lesson the hard way when it tried to rapidly finance and construct the first private power station in Maharashtra state, with support from the central government of India and the US Department of Energy. These entities used a "fast track" permit approval process that was viewed as opaque and imposed upon local interests. These interests, a mix of political parties, unions, government workers, and environmental groups caused long delays and a re-negotiation of contract terms after construction had already begun, precisely the results the "fast track" process sought to avoid.

b. Regional Advisory Boards

A number of interests must participate in the strategy preparations. They need not participate in every discussion, and each region needs to develop a system with which it is comfortable. One way is to form a "Regional Advisory Board" to guide the research effort and review progress, data, and emerging recommendations on a regular basis. The Board acts as a buffer between analytical work and local political interests, it ensures that lines of communication stay open, and it manages sensitive issues by offering a quieter forum to resolve disputes. These functions are parallel to those of the overall Project's Advisory Board.

The Regional Advisory Board can take several forms; it may be placed inside a government department, or be an independent entity. Membership should reflect the major "stakeholders" in a regional sustainable development strategy:

- Important regional government departments (finance, energy, environment), and possibly a link with the Federal government
- All local political parties (so that a change in government will not affect the continuity of work)
- Industry (perhaps large and small)
- The poor
- Environment groups
- Unions
- Women
- Finance
- Universities
- Farmers
- Journalists
- Religious leaders

A group of 10-15 people should be sufficient. The frequency of meetings and subjects for discussion should be kept flexible. The Board will need to sort out how the group's unequal political, economic, and institutional/legal power will formulate rules for decision-making. What is important is that researchers have a sense of accountability and contact with the real world, and that local political interests learn together with the researchers about key information and methodologies to aid in formulating a local strategy for sustainable development. They must force the researchers to explain their work, and researchers must insist that decision-makers make the effort to understand what is being presented.

c. Facilitators

Even in political cultures with a strong tradition of consensus-building, such as the Netherlands and Scandinavia, a professional "facilitator" is often employed to help manage important meetings. These people are trained and experienced in the art of guiding discussions. They are viewed as neutral and impartial, and they act as a kind of referee, to make sure that a group's goals are met. They ensure that participants listen to each other, that no one dominates, that all interests are heard. This is especially valuable when group member's interests or personalities are in conflict.

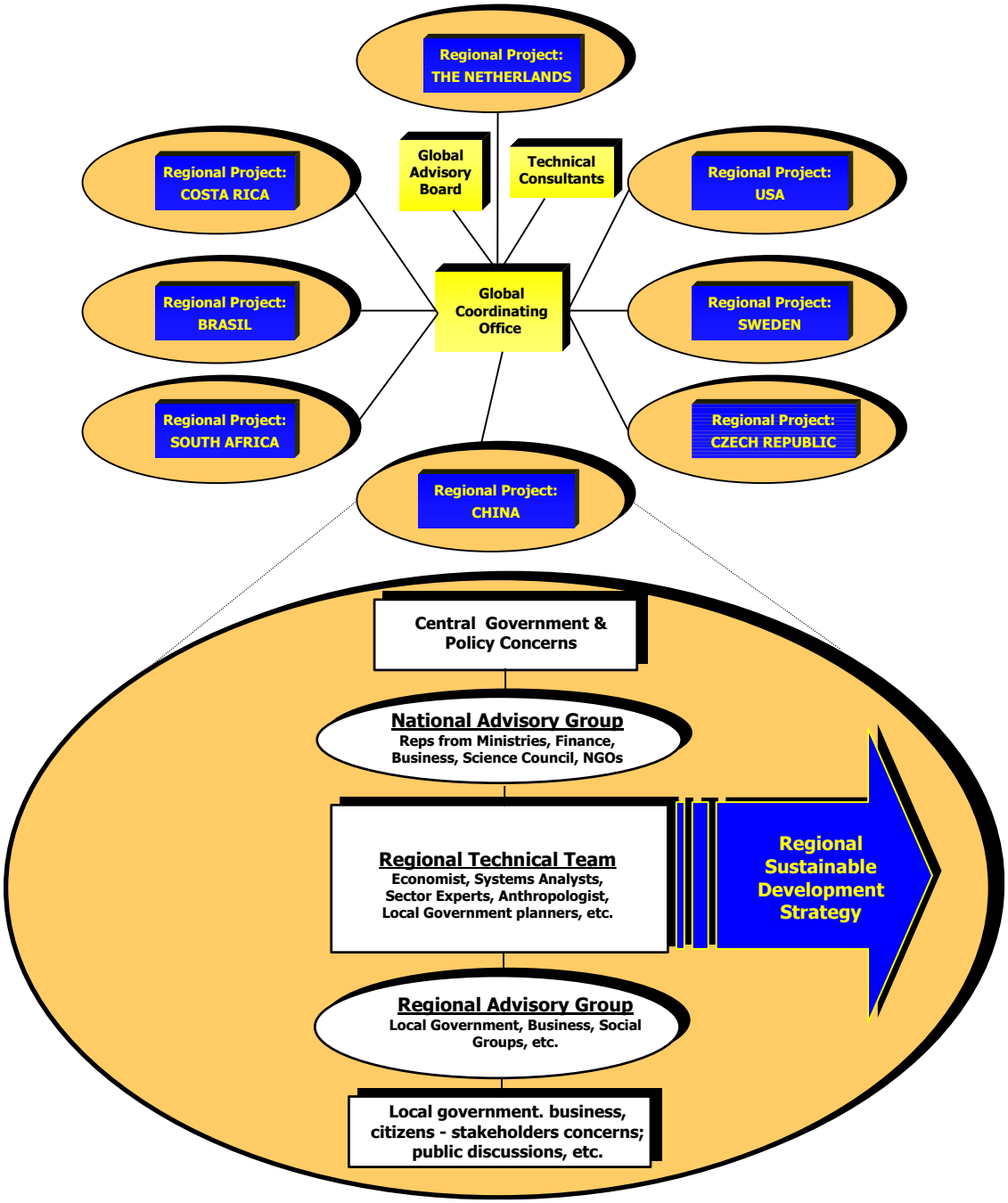
d. External Review

It would be important to retain outside consultants, world leaders in their fields (paralleling the disciplines mentioned above), to review several aspects of the work:

- The methodology of the overall analytical framework-the detailed set of questions to be asked, nature of data to be collected, use of models, etc.

- Initial identification of resource flows, checking for consistency.
- Draft of investment/technology recommendations.
- Draft of policy recommendations.

A schematic diagram of the MSD Project's long-term organisation is shown below:



7. Develop the Analytical Framework to Understand Regional Resource Flows. Imagine you are the mayor of a city, the governor of a province, or a regional planner, interested in sustainable development. What do you do, where do you begin, what questions must you ask, what can be ignored, How can the data be handled conveniently, etc.? It is rather remarkable that despite all the theoretical discussions about sustainable development, little has been said about developing a practical framework that would

permit the integration of economic, social, and environmental forces within some sort of coherent strategy.

Because of all the complexity and ambiguity surrounding the notion of sustainable development, the disagreements among academics, the lengthy government debates in many countries about CO_2 taxes, tradable pollution permits, etc., more practical, local steps are needed. First, a detailed account is needed of the flow of resources through a region that determine its quality of life. These include *physical resources* (such as energy, water, food, wastes, pollution and toxins, etc.), *economic resources* (the movement of capital, balance of payments, income), and *human resources* (jobs, skills, and spatial movement). Some of the distinctions among these categories are complex and arbitrary, and work is still needed on this point. For example, the greenhouse gas emissions for nuclear and hydroelectric power can be grossly understated if the total upstream and downstream construction materials flows effects are ignored (van de Vate, 1997). Swiss energy consumption increases by 30% if the energy "embodied" in imported goods and services is included.[26] Nevertheless, trying to identify these flows, however crudely, is an important beginning. An analysis of a regions' resource flows, where these originate, and where they end up, can identify opportunities for investment, further use/reuse of resources, integrating systems, and hopefully to create jobs, balance government budgets, and increase local incomes. It is extremely rare to find universities, local government offices, statistical bureaux, or private marketing groups that have tried to pull together the information needed, let alone to analyse the social, political, economic, and environmental implications of regional resource flows.[27]

As a first indication of the importance of this issue, the table below shows the magnitude of annual expenditures for a hypothetical, typical OECD region of 1 million people, looking only at electricity, water, and waste handling:

Regional Resource Flows
1 million people
(in US$ per year)

	Users	Units	Per Capita Quantity per day	Per Capita Quantity Per Year	Regional Total/Year	Unit Cost	Total Regional Expenditure per year
Resource Flows	a	b	c	d (c x 340 days)	e (d x a)	f	(e x f)
Electricity	1,000,000	kwh	10	3,400	3,400,000,000	0.10	340,000,000
Heating & Cooling	1,000,000	kwh	5	1,700	1,700,000,000	0.10	170,000,000
Water Supply & Treatment	1,000,000	liters	40	13,600	13,600,000,000	0.02	272,000,000
Waste Processing	1,000,000	kg	40	13,600	13,600,000,000	0.02	272,000,000
						TOTAL	**$ 1,054,000,000**

Local costs will vary, but in many regions, the magnitude of the sum approaches *US$ 1 billion per year* spent by the region's citizens, businesses, and local governments to supply and process basic resources. These payments typically flow outside the region and are still the product of inefficient resource use. If these financial flows could be partially

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26 From personal communication with A. Lovins. This raises a related issue, the so-called "dematerialization" of production, often cited as grounds for optimism that consumption can increase with less environmental impact than has been true historically. However, our understanding is still rudimentary concerning how the flow of energy and materials in production has been affected by recession, structural and technological change, and most important, trade. An example, a car produced in country A is sold in country B. Country B's actual steel consumption does not change but the consumption of steel/GNP appears to fall. The problem is masked by trade in intermediate goods. Data is still too aggregated and recent literature suggests there may be no clear trends (World Resources Institute, 1994; Hoffman and Zivkovic, 1992).

27 The beginnings of this type of analysis can be found in Rotmans and Vellinga (1998), Adriannse *et. al.* (1997), Folke *et. al.* (1997), on-going work in Southern California (Polenske *et. al.*, 1992), at the Wuppertal Institute, Germany (Bringezu *et. al.*, 1994), and an interesting project in the Feldbach region of Austria (Wallner and Narodoslawsky, 1995).

captured locally resulting in e.g. an annual savings of 10% compared to current flows, this represents a large potential source of investment capital that could be used to strengthen the local economy, create jobs, and reduce pollution.

Assume our OECD region of 1 million people has a per capita income of US$ 20,000, and thus its annual regional product would approach $20 Billion. The $1 billion per year in resource payments for energy, wastes, and water management represents 5% of regional product. If this rough 5% rule is extended globally, a $35 trillion global economy spends about $1.75 trillion on basic energy, waste, and water flows. Very conservatively, if we could save only 10% of that sum,, the resulting $175 billion per year is equal in magnitude to all foreign direct investment in developing countries, and more than three times the size of development assistance. [28] Part of these savings would be needed to finance the very investments needed to realize the savings. But part could be returned to consumers, businesses, and governments to lower their costs. Part could also be retained to finance a range of programmes designed to protect the poor, such as credit schemes, basic health care, water delivery, etc. This would show a direct link between more sustainable levels of consumption, and social protection.

These estimates are of course crude and simplistic. They ignore in which countries most savings could be realized and how these might be then be distributed fairly, on a global scale. They ignore possible "rebound" effects, where cost decreases stimulate increases in consumption, partially off-setting savings. They grossly simplify rates of adoption and roll out (which would be spread over years), and the net funds that might be available after financing the investments needed to trigger the savings. There is on-going work on all these points e.g. in California, where large aggressive efficiency drives are ramping up.

However, the savings magnitudes are so large that such schemes should receive much more attention, especially as they could be far easier to implement than greenhouse gas emissions trading regimes, or so-called "clean development mechanisms."

Traditional measures to mobilize new resources for development involve either price or tax increases. A massive programme to increase resource efficiency involves *redirecting money already being spent*, and thus could be a way to transfer resources from rich to poor without wealthier consumers feeling that their costs are increasing. The importance of this cannot be overstated, in an era where central governments everywhere are reducing their support for development assistance, and transfer and welfare system payments (World Bank, 1999b).

These resource flows must then be linked with regional economic, social and political analyses. This indicates how these flows fit into a larger economic system, and to determine relations between social and political groups affected by these flows. As alternative arrangements and policies are considered, the effects on the regional economy and different local interests must be thoroughly explored. While linking this with more sophisticated input-output, and general equilibrium models is desirable (Section II), the

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[28] The 5% estimate matches Shell's (2001) calculations, based only upon energy. These payments can be captured using technical, legal and financial measures currently available to manage resource demand more efficiently (World Bank, 1999a; ACEEE, 1996). With proper financing, and allowing for transition periods and interest rates, an amount 3-6 times greater than the annual payments can be financed by banks or capital markets. Even if only 25% of the above example could be effectively captured, this could support up to $1-5 billion/year in investments in both infrastructure and human development (primary education, micro-credit, health insurance, job training schemes, etc.). Merely offering more consumer choice in purchasing electricity has reduced family electricity costs 5-15% in several US states (*The Economist*, 1999, p.65). Crawford *et. al.* (1999) in the *McKinsey Quarterly*, suggest that even relatively efficient utilities still lose 7-15% of transmitted electricity. A more strategic, integrated management of all key energy, water, and waste streams will yield far greater savings, typically 30-50% as documented in numerous case studies, e.g. McKinsey Global Institute (2006), www.cool-companies.org, and the huge efficiency savings projected in 2050 scenarios work of IEA (2006).

cost and complexity of these steps may be prohibitive to certain regions. The simpler approach, described above, will yield important results. In most cases, even this information does not exist in a central office, and it is a prerequisite for the more demanding methods.

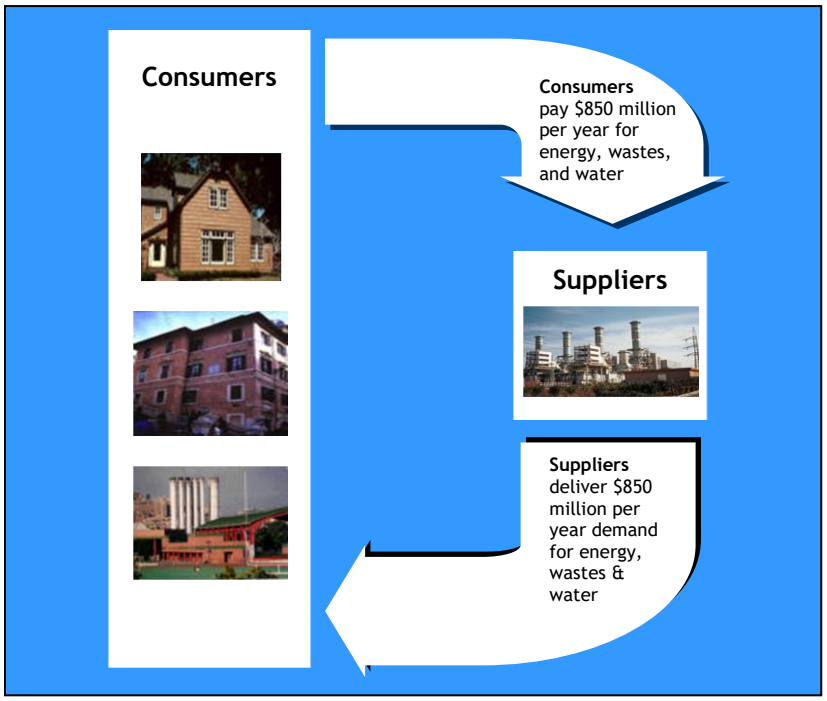
a. An Example from Cape Town, South Africa

Preliminary calculations based upon recent data obtained from the Cape Town region suggest (ESG, 2003) over $550 million is spent annually managing energy, water, and waste streams. A 15% increase in resource efficiency would be worth about $80 million per year to the local economy. We believe far greater savings are possible. A sizable portion of this could be a source of capital to deliver a package of basic human services. If this sum could capitalize a loan or revolving fund through municipal bonds issued against this cash, it could be leveraged to support investments 3-5 times this sum (depending on loan terms). Other developing country urban regions will of course have different sizes of population and levels of income. But in general, large urban regions of over 1 million people should be able to marshal levels of finance approaching $50 million -100 million per year, on their own, through a strategic, integrated use of energy, wastes, and water.[29] This could be done with minimal use of donor or central government funds. It could be done with existing technologies and prices.

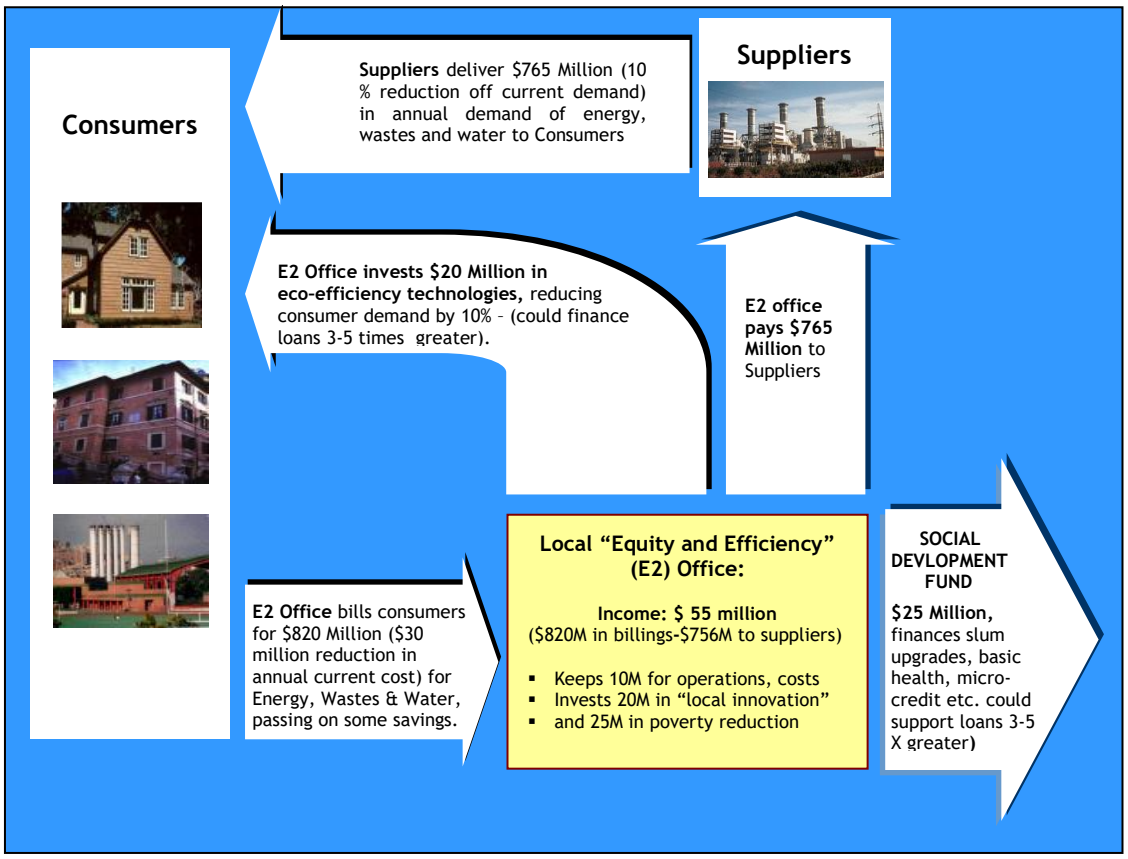
The key to create a local "Efficiency and Equity (E2) Office" to manage the changes necessary to make resource use more sustainable, and channel a portion of savings into new local social development fund:

[29] The actual numbers involved will of course vary from place to place and will be driven by the cost of retrofits, terms of financing, and the pace of adoption of participating residential and commercial entities. We have looked at this in great detail in San Diego and the numbers nevertheless are broadly in agreement with the orders of magnitude discussed here.

a. Current Resource Use: Cape Town, South Africa



b. Financing Development Through Sustainable Resource Use



The Efficiency and Equity (E2) Office: Dual Functions

Traditional urban government departments, facing a range of resource and political constraints, are rarely capable of the timely, strategic, neutral, decision-making and brokering of project finance needed. They need external help to at least jump-start the process described above.

The Efficiency and Equity (E2) Office could assume a variety of organizational forms, depending upon local preferences. It could operate as a chartered agency, sitting within a local government, as an independent non-profit organization with local stakeholders board of directors, as a "public-private partnership", or even a private, "for profit" entity, that would be subject to certain local regulatory constraints.

The E2 idea builds upon the "Energy Services Company" (ESCO) concept[30]. However, the proposed entity would have a broader sector reach (including water and wastes), a more developmental and pro-poor financing focus, and it might be structured to generate profits that would make it self-sustaining while remaining below traditional private firms' required rates of return. In order to complete these tasks, the E2 office needs to have several characteristics:

- It must have links to municipal and regional authorities, possibly with their representation on local governing boards, yet the E2 office must be sufficiently independent to be trusted by other stakeholders. It would coordinate efforts with local governments to complement longer term urban land use planning efforts, and must be viewed as a highly competent, neutral player, above the political fray.

- It must have sufficient capital, expertise and credibility to attract private finance.

- It must be able to broker and finance deals between technology suppliers and users, and have access to state-of-the art knowledge of energy, waste, water, and transport management systems, technologies, and policies.

- It must be able to negotiate with municipal water and energy utilities to potentially purchase bulk supplies.

- It must facilitate a more effective dialogue between local government, business, and citizen's groups (especially those representing the poor), to aid in program design and implementation. Examples would include helping ensure that low-income housing designs and their financing support state-of-the-art energy and water systems, that new commercial property developments are designed and sited to reinforce sustainable transport options, and do not place further burdens on air quality, wastewater treatment and water supply, greenhouse gas emissions, etc. and other externalities for which the state must later pay.

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[30] Recent reviews of the ESCO experience include World Bank (2006); Vine (2005), Bertoldi *et. al*. (2006); Goldman *et. al.* (2005); World Bank (2004); and World Energy Efficiency Association (1999), based upon work done for the World Bank and others, with international firm directory and links. The Lawrence Berkeley National Laboratory, Berkeley, CA has perhaps the largest ESCO database in the world. There are informal groups within Shell, General Electric, RWE (Germany), Vattenfall (Sweden), Eskom (South Africa), and other utilities exploring the idea. The municipal utility Seattle Light and Power has achieved huge savings using a related concept. E-Systems is working with the City of Cape Town and key South African business and university groups to develop the first pilot project for more ambitious concept proposed here. For the larger question of the role of so-called public-private partnerships, see Bult-Spiering and Dewulf (2006), and Osborne (2000).

- It must be able to capture a portion of the savings to reinvest in pro-poor service delivery in a transparent, accountable fashion.

- It must seek to generate significant numbers of jobs in its activities managing energy, waste, and water resources, either directly as part of its operations, or as an incubator for new businesses in these fields.

- Ultimately, over a 3-5 year period, the entity must become self-financing and able to be replicated elsewhere.

The E2 office mission has two components: to coordinate a range of activities to make local resource use more sustainable, and use the surplus this could generate to create a social development fund.

i) Coordinate and implement an integrated approach to make local use of energy, water, and waste flows more efficient and sustainable.

The evidence is rather clear, world-wide, that treating these resource use issues separately, with suppliers in charge of managing change, is not working. Innovation is slow, "best-practices" are not being implemented, integrated approaches are neglected, consumers find it difficult to finance small-scale technical improvements, and suppliers have an understandable need to "sell", rather than "conserve". Finally, while there are a number of compelling technical and economic reasons to think about resource use in an integrated fashion, there is an important additional concern. All too often, various donors or companies push a single technical or sectoral solution or interest that may, or may not, fit into a larger set of local needs. Too often, the implications and linkages of such efforts are ill-considered. Thus we have examples of paper mills constructed far from sources of water in Viet Nam, very poor countries forced to deal with costly methods of reducing greenhouse gas emissions, anti-pollution devices installed in Chinese factories that financially insolvent, or renewable energy systems installed in India to pump water in areas where the entire system of agriculture is destroying aquifers, etc. Too often, we are missing the big picture.

The E2 office would see that region-wide efforts are designed and coordinated to install energy-efficient lighting, variable speed-continuous drive motors, insulation, sustainable building design, rainwater collection, grey-water separation, biological wastewater treatment, "closed loop" industrial processes, etc. It would develop methods to subcontract the delivery of such systems through competitive bidding. The E2 office would need to become involved with a range of analytical, political, organization, and communications issues to make sure that there is broad public understanding of, and support for the alternatives that will be proposed. The failure to address these "soft" issues is a central obstacle to change, and resources must be marshalled to ensure people's active participation in design and implementation of alternatives.

The E2 office would help finance the design and installation of new technical and resource management systems, working with local community groups, housing developers, suppliers, local government procurement policies, and local businesses, hopefully generating new local employment opportunities. By having a larger, institutional status, an ability to bundle projects, perhaps loan guarantees and insurance options, the E2 office should be able to provide capital at a more attractive rate than what small businesses and consumers obtain on their own. The E2 office could assume certain billing and payment responsibilities as shown in Figure 1 above. It would generate a surplus by reducing resource demand by e.g. 30% compared to present levels, invoicing consumers for e.g. 5-10% less than current costs, and keeping the 20% difference. There are other variations possible, e.g. the E2 office does not get involved in the billing process

but simply charges consumers a fee for providing capital and technical assistance. Either way, the office must recoup substantial funds.

ii) Invest a significant share of this surplus into a local "social development fund".

The E2 Office would keep a portion of the surplus its activities will generate to fund its own operations, and to finance the installation of a range of new technologies and practices. But a large share of this surplus (e.g. 50%) would be placed in a local social development fund. This fund could be managed by the local government, or an independent entity. The fund's operations would need to be transparent and accountable, and to clearly show that it is supporting the delivery of basic human rights and services directly to the poor of the region. These activities could include a mix of secure land tenure; slum upgrading; energy and water delivery; waste treatment; providing micro-credit; HIV clinics; primary literacy, etc.

However, the funds should *not* be used for general municipal budget support. We need to show a direct link between more sustainable resource use and delivering a set of basic human rights to the weakest and poorest within a region, to build a feeling of community, and facilitate an equitable transfer of resources from rich to poor.

In thinking about a way to manage a range of local resources more sustainably and more equitably, a number of interests must be considered. The table below suggests some needs of different interest groups, and how the proposed (E2) alternative provides incentives to encourage these interests to cooperate:

Interest Groups and How "E2" Idea Provides Incentives to Cooperate

Interest Group	Key Needs / Desired Outcomes	Incentive to Cooperate
Rich Consumers	▪ Reliable supply ▪ Lower costs ▪ Lower taxes ▪ Increased security ▪ Protect investments and way of life	E2 idea will increase likelihood of all these occurring; transfer of resources to poor will not be burdensome; Social development fund should reduce crime, increase security and feeling of community.
Poor Consumers	▪ Affordable basic supply ▪ Lower costs ▪ Increased security ▪ Reduce health hazards ▪ Obtain secure shelter ▪ Obtain affordable finance	E2 idea makes all more likely; technical help is financed, social development fund provides resources to respond to basic needs – providing new finance that otherwise would not exist
Local Government	▪ Reduce operating costs ▪ Reduce pollution and crime ▪ Reduce social welfare expenditures ▪ Balance revenues with expenditures	E2 idea supports all these outcomes. Some rebalancing of revenues-taxes-services might be needed, as discussed below.
Local Businesses	▪ Reduce operating costs ▪ Reliable supply ▪ Obtain affordable technical assistance	E2 idea supports all these outcomes, bundling finance and technical solutions at costs lower than what businesses could obtain on their own isolated efforts.
Supplier Utilities	▪ Steady revenue stream ▪ Reduced operating costs ▪ Maximize revenue	E2 idea could simplify billing for utilities (one customer-the E2 office); could reduce marginal costs as new demand could be met with existing (peak) capacity, resources freed up for export to national grid. Gross revenues might go down as explained in text.

"E2" Office	▪ Balance revenues with expenditures ▪ Provide affordable technical assistance ▪ Provide sustainable financing ▪ Sufficient cash flow to pay finance and supplier charges	E2 office has great incentive to respond effectively, shop for best practice and least cost suppliers, as this maximizes E2's revenues and impact.
Central Government	▪ Decreased cost of supporting local government ▪ Decrease welfare and transfer costs ▪ Decrease pollution emissions ▪ Stable currency – less energy imports and help balance of payments	E2 idea supports all these outcomes. Cost and management of efforts is pushed down to the local level. "Sustainable" solutions are rapidly implemented to reduce oil imports, greenhouse gas emissions, distant water supply, etc. Local resource mobilization is used to manage social protection, job creation, medical insurance, etc.

This suggests a number of strong incentives exist to stimulate cooperation amongst these different interests. However, there will be conflicts, there will be winners and losers in this process, and no one is suggesting the needed transition will be easy. For example, many governments obtain revenue from a surcharge on e.g. electricity. Revenue reductions from more efficient (lower) electricity consumption would need to be offset somehow, either through other savings in the regional economy (e.g. reduced welfare, health, crime, or pollution costs), new taxes, or a change in other services. We would argue that removing such "hidden" taxes, and more transparent use of local resources is desirable and strengthens local democratic governance. But governments will need to address the revenue issue. This is a classic "systems problem", which shows the need for both integrated solutions, and to consider indirect effects. Our guess is that the indirect effects will on balance, be positive and that government costs will also fall, and efficiency and welfare gains to the local economy could create new jobs and new sources of revenue.[31]

This short concept paper cannot attempt to address all the issues raised by the approach. The numbers analyzed above must be viewed as suggestive; benefits and costs could vary by substantial margins in real life situations. But the potential is clear: an important linkage can be made between more sustainable resource use and financing and delivering a set of basic services to all. As an example of what could be done by local social development funds created from more sustainable resource use, we explore next some cost implications of upgrading local slums.

Slum Upgrading Financed From Sustainable Resource Use

A systematic overview of the cost of slum upgrades is unavailable.[32] We assume a basic bundle of services (energy, water, sanitation, secure public space, drainage) to a slum area could cost anywhere from $500 – 2000, per person, depending upon local costs, degree of contributed labour, level of technology, etc.[33] This does not include land or

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[31] In passing, we should remember that most current energy and water prices are *far* below their real costs, they contain significant subsidies to suppliers and producers, and they ignore all sorts of "externalities" associated with their use, such as risk insurance, health, pollution, and increasingly, security and military costs. See Hubbard H.M (1991), "The Real Cost of Energy", *Scientific American*, April 1991, Vol. 264, No. 4, PP 18-23.

[32] A number of case studies on slum upgrading can be reviewed at http://web.mit.edu/urbanupgrading/upgrading/case-examples/index.html, part of a joint MIT-World Bank-Cities Alliance project. While the cost estimates contained in the case studies are difficult to compare (often not specifying exactly what goods and services are included, or whether all capital costs vs. operating costs are fully described, and some costs are per capita, while others are per hectare), most estimates are lower (by a factor of 2-5) than our estimates here, making our numbers conservative. See also "Slum Upgrade FAQs" at: http://wbln0018.worldbank.org/External/Urban/UrbanDev.nsf/0/EAA16A060D1BD449852569430058CD91?OpenDocument. See also UNHABITAT (2003).

[33] The $2000 figure is taken from a recent Cape Town government estimate in "Our City, Our Pride: The Plan for Cape Town (2003-2005)", although this does not distinguish between investment costs (and the

importantly, housing. Assuming land is donated by the government, and housing – shelter could be provided for an additional $1000 per person. If this total capital cost of e.g. $3000 per capita could be financed at e.g. 10%, over 10 years, which seems reasonable for a developing country local government, the annual capital cost would be $270 per person. The table below shows "rough orders of magnitude" of what levels of investment could upgrade slums of different size, based on a per person annual cost of $300, and $500:

Slum Upgrade Costs as a function of Size and Per Capita Investment

	Required Annual Investment:	
Slum Size	$300 per person	$500 per person
(no. of people)	Annual Cost	Annual Cost
5,000	1,500,000	2,500,000
10,000	3,000,000	5,000,000
20,000	6,000,000	10,000,000
50,000	15,000,000	25,000,000
100,000	30,000,000	50,000,000
300,000	90,000,000	150,000,000

These are gross costs in that they do not include any user charges.[34] They are also conservative; countries with warmer climates and lower input costs might require 50% of this level of investment. Combined with the resource flow savings arguments discussed earlier, the costs shown above suggest several important points:

1. Delivering a package of basic human services to a wide range of slum sizes could be financed by an increase in energy, water, and waste use productivity for many large cities in developing (and developed) countries).

2. If an urban region can deliver the 10-20% productivity increases suggested, this sum support loans-bond financing, slums of over 100,000 people could be upgraded to dignified living areas within 5 years.

3. Larger cities, or resource productivity increases greater than 10%, could do more, faster.

We still need to get from here, to there.

b. Lessons From ECODES and Gottland

There is a common lesson from related research in two very different countries. For more than two years, the universities of Costa Rica, with help from the Ministry of Energy, Mining and Environment, co-ordinated the preparation of ECODES, a national strategy for sustainable development. The integrated economic-environmental modelling of the Swedish island of Gottland was mentioned in Section II. Both of these efforts were ambitious attempts to build knowledge, local research capabilities, and a strategy for action. They succeeded with the first two objectives, but despite the significant effort involved, with the participation of highly respected researchers, it is striking that in both

terms of financing) versus operating costs. Cape Town provides certain minimal flows of water and electricity free, and then charges progressively for additional consumption. The lower estimate of $500 is just a guess for a warmer, lower income country, with less service, based upon personal communications with UNHABITAT.

[34] If slum dwellers earn $1-2 per day, a user charge of $0.25 per day could reduce annual costs 30%-50%.

cases, very little concrete actions and change occurred after the studies were completed. The critical omission was a lack of contact with the political structure. Local politicians were essentially excluded from the process, or they represented the party in power. When the governments changed, the efforts were viewed as a product of the "other" party, and largely ignored. Local citizens, and their organisations were not sufficiently involved to demand that their governments pay attention to the results of the research. Years of work, and public funds were not used most effectively.

Government (bureaucrats and *all* political parties), industry, and civic groups must be intimately involved in such research. Even if the presence of these groups slows the pace of research, in the long-run, such participation is extremely important for several reasons:

- To improve the quality of research, by making sure that all relevant data and interests are considered;
- To build political consensus on the important problems and effective solutions;
- To increase the probabilities for implementing recommendations.

Norgaard (1989) is correct when he states that our ability to model the interactions between economic and ecological systems is still at a very primitive stage. There will be no foreseeable single, simple model to which one can look for answers on how to plan for sustainable development. Several of the approaches described above must be tried to see if they yield conflicting results, and then to understand the reasons for these conflicts. Such a pluralistic, pragmatic approach is messy, it will require judgement, and much discussion to be understood by the various stakeholders. It is ironic, but very important that our best science leads us back toward a need for trial and error, for an acknowledgement of our limitations and an increased reliance on judgement, for accountability from our experts, and for open, transparent democratic decision-making.

8. Begin Initial Planning. With these organisations in place, each region would undertake a comprehensive inventory of the flows of natural, human, and economic resources through the regions, with projected changes extending out perhaps 25 years into the future. This work would be guided by a common framework (6.) upon which the Co-ordination Office, technical experts, and the regions would agree.

9. Develop Regional Strategies. After the completion of the survey work, each Region will prepare a phased strategy describing a series of investments and policy changes, as suggested in the "elements of a regional strategy", described earlier. The strategies will consider issues of timing, finance, technical assistance, organisation, politics, as needed. All Regions will discuss their strategies at combined meetings, and a procedure would be developed to have each strategy approved by the whole assembly, to forge consensus on the approaches and create a sense of mutual learning, accountability, and the political cover for local initiatives that a global effort might provide.

10. Implement/Evaluate/Disseminate On-going Work. Once its strategy is approved, each Region would implement the strategy. Periodic meetings and reports issued all levels to assess progress. Results would then be disseminated widely, including: the publishing of popular and technical works; organised meetings, seminars, training sessions, study tours; production of promotional media; co-ordination of site visits by government officials, donors, technical experts, university groups, entrepreneurs and corporate representatives, journalists, and other interested visitors; lectures by participants, etc.

At the regional level, these steps are summarised in the figure below:

MSD PROJECT: REGIONAL ACTIVITIES

Year 1 | **Year 2** | **Year 3**

FIRST STEPS

- Form interim national Advisory Group.
- Hold extensive discussions with local public and private stakeholders, NGOs, etc. in candidate regions.
- Develop criteria-based selection process to identify region; mutual agreement on region (from both region and Advisory Group).
- Establish interim Regional Organization.
- Form long-term National Advisory Group.
- Secure 3 year's finance.

STRENGTHEN REGIONAL CAPACITY

- Form regional "stakeholders" Advisory Group.
- Form Region's Technical Team.
- Begin "Resource Flow" data collection and analysis [energy, waste, jobs, capital, water, agriculture, traffic, pollution, etc.]
- Develop local fora for citizen participation and discussions.
- Design and implement strategic demonstration projects (e.g., energy efficiency, biological wastewater treatment, municipal composting & recycling, "clean" industrial production, etc.).
- Consultations between Technical Team and National & Regional Advisory Groups.

SHOW CONSEQUENCES: CURRENT RESOURCE USE

- Measure physical *quantities* and monetary *values* of important regional resource flows.
- Complete analysis of region's political economy:
  - Economic structure
  - Balance of Trade & Net Transfers with Central Government
  - Employment and Social Issues
  - Pollution and Health Issues
  - Private and Public investments
  - Trends Over Next 20 years
  - Key "Driving Issues" affecting the Region's Sustainable Development
- Develop model of regional economic-environment-social linkages.
- Hold extensive discussions on data, model, and analysis with different social groups to confirm conclusions; revise as needed.
- Issue report on "State of the Region"; identify initial investments & policies to support region's sustainable development.

DEVELOP CONSENSUS: REGIONAL SUSTAINABLE DEVELOPMENT STRATEGY

- Develop process of open discussions with different social groups, public and private sector, to discuss implications of "State of the Region" Report.
- Develop consensus over an integrated strategy. Test as possible using model. Revise, discuss.
- Draft; Revise; Issue Final "Integrated Strategy for the Sustainable Development of the Region". Obtain written endorsement from government, industry, unions, NGOs, etc. for phased investments, policy changes; behavior changes, responsibilities for different social groups, etc., with final public ceremony covered by local media.
- Arrange financing and responsibilities of Government & private sectors.

IMPLEMENT:
new investments;
technologies;
policies;
organization;
finance;
political support

B. Uses of Funds

The MSD Project would use initial grant funds primarily for planning purposes. Funds should be used to gather disparate information and expertise, to provide planners and citizen participants the freedom and time to undertake the development effort without risking their jobs, personal or family welfare, or being subjected to undue political or commercial pressures.

While the project could ultimately finance some limited investments, it makes more sense for the effort to act as a catalyst, helping to secure investment capital for system installations through conventional capital markets. This imposes a certain market discipline on plans, it reduces complications associated with extraordinary mechanisms of finance, and it increases the chances for efficient implementation and replication.[35]

C. Benefits

The MSD Project could begin to crystallise the types of livelihoods toward which countries must aim. It can help build a consensus within the business, political, and university elites of these countries that will reduce the incidence of investing in the inappropriate technologies and industrial projects that comprise much of developing country debt, crippling many of their economies. In a time of vast debt burdens, costly capital, and a general rethinking of the role of central government (World Bank, 1997), the MSD effort would help reorient national investment strategies by presenting a broad array of proven, less costly alternatives to the conventional provision of food, energy, industrial production and waste utilisation. It will do this in sufficiently varied settings to be credible in both the developed and developing worlds. "Macro" policies related to finance, technology transfer, and price changes, will be better defined if based on practical experience; we will also clarify what actions do and do not depend on changes at the policy level.

The MSD Project would focus the efforts, and increase the effectiveness, of the world's best technical groups. The effort would stimulate further technical and organisational research and development in areas hampered by uncertain private returns. These regions would galvanise joint research and development efforts with universities and corporations to encourage further innovation. The project would create highly visible regions of concrete change that could be visited by anyone interested in the work, such as other community groups, journalists, corporate product developers, government leaders, etc.

To restate the main point, this linkage of more sustainable resource use with delivering basic human services has several important long-term benefits:

- **Create a significant source of new finance for sustainable development** – approaching *US$ 200-400 billion per year*, an amount that is more than four times the size of *all* development assistance.[36]
- **Demonstrate a direct link between sustainable resource consumption and improving living conditions for the poor**. Efficiency gains are shared

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[35] Projects with high initial capital costs albeit low lifecycle costs do require careful financing of cash flow, using a variety of innovative approaches, e.g. rebates to producers, bundled leasing of small projects financed by low-capital cost entities (large companies and utilities), third-party benefit sharing, etc., to make such investments competitive (de Lucia, 1995; Lovins *et. al.*, 1995).

[36] Ironically, this sum is close to OECD estimates of *all current producer subsidies* for energy, water, and agriculture.

between consumers and financing programs that support local health care, micro-credit, secure land tenure, slum-upgrading, etc.

- **Make rapid progress.** Any metropolitan region could do this within 3-5 years, without complex international agreements, huge price increases, or massive bureaucracies, using existing, improved technologies and management systems.

- **Improve local governance, the state of municipal finance, and reduce tax burdens.** Local businesses and citizens obtain cash savings, and governments reduce pollution, welfare, and health costs by managing resource flows in a coherent, strategic fashion.

- **Make changes politically acceptable,** as they involve redirecting funds *already* being spent. This permits a resource transfer from rich to poor that is almost unnoticed, or is seen as a good bargain. In addition, human rights and environmental objectives can be seen as mutually supportive, broadening their appeal.

- **Make the process self-financing -** investors receive an attractive return, sufficient revenues are retained to expand the effort to new regions, and any urban region can finance needed changes to its local economy from a small share of increased resource efficiency gains.

- **Show that delivering basic human services is affordable,** creating markets that support sustainable development in an equitable and efficient manner.

Most important, by their real example, the MSD Project regions would demonstrate the concrete methods and solutions that normal communities can employ *now* to move toward providing sustainable livelihoods for all their inhabitants.

D. Criticism and Some Responses

It will be easy to criticise the project as utopian, isolated, easily swamped by outside forces (especially from the macro-economy or international trade and finance), and guilty of ignoring all sorts of truths about the scale economies of modern agriculture and industry in an age of global capital flows. These risks can be addressed by careful, cautious organising, and insisting that project results compete economically with those of prevailing market economy.[37] The most important component is to involve committed people. Such commitment is present in sufficient numbers around the world, both within numerous technical groups and within communities with whom they have worked, in some cases for more than 20 years.

Facing the immediacy of crushing poverty and disease, do developing countries have the luxury to bother with this? The MSD effort does not pretend to offer short-term relief from these burdens. The simple response is that these immediate problems continue to receive attention through conventional aid and investment channels, with varying degrees of effectiveness. The MSD Project deals with the very deep problem of how to provide sustainable livelihoods at a large scale. The problem arguably underlies most development and environment concerns, and it has not been addressed systematically. Its costs would be a fraction of what is spent annually on poorly designed development projects (in the private as well as public sector), dubious research and international meetings.[38] The potential payoff on the investment could be substantial.

Finally, some might argue we should try the MSD Project idea first at one site. The earlier discussion of technical and scale issues suggests the need for a co-ordinated, global effort. We want to protect the idea against a single failure, or a single success that could be criticised as a "special" case. Through decentralised management, combined with a common planning framework, there will be no difficulty managing a larger effort. Furthermore, there is a compelling political reason to create a North-South global partnership of regions and expertise. As the developed world still consumes most of the world's resources and generates most of its pollution, it is absurd to expect developing countries to assume all the burden of developing a better way.

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[37] This is a complex matter. Many "market prices" are ultimately the result of negotiations between the government and industry over who will pay for all sorts of hidden costs, a process which reflects the distribution of wealth and power (Bok, 1993). Well-known examples include agricultural goods and energy. Privatisation's allure withers when the nuclear power industry is forced to consider private insurance against risk, or to provide its own R&D funds; governments' absorption of these costs greatly affects the price of energy. A barrel of oil may "cost" closer to $100 when the pollution, health, and military-related expenditures are charged directly. Another problem is how to treat "joint products" from integrated systems. It is conceivable that with some technologies, "energy" might cost more than current alternatives, but combined energy and waste systems may jointly cost less than the current charges for both services. To make the competition fair, solutions proposed in the MSD Project should compete with the current annual total (annualised) costs (including taxes, subsidies, pollution and health expenditures, depletion allowances, etc.) *per family* to provide a bundle of goods and services such as energy, water, food, waste processing, transport, and health, etc.

[38] Between the 1992 Rio Earth Summit and the 1998 Buenos Aires (COP4) greenhouse gas meetings, UN conferences alone have spent well over $300 million on direct and indirect (travel and hotel) expenses. This ignores the costs of staff time of thousands of diplomats, researchers, lobbyists, etc. who participated in these meetings. From preliminary calculations completed in Costa Rica, China, the Czech Republic, and the Netherlands, an MSD region would cost perhaps $350,000 per year to support all analytical, organisational, and political work. Thus over a 3 year period, a regional effort would cost in total about $ 1.05 million; 10 such regions would cost about $ 10 million. After this period, these efforts should be self-financing by capturing some portion of regional resource expenditures, as discussed in the table in Section VI above.

E. Replication

A final concern is that whatever successes are realised in the individual MSD Regions, these will remain isolated events with little relevance to other areas. On the contrary, replication is at the heart of the MSD endeavour, to show what people can do if they organise themselves within the context of existing policies and prices, and take advantage of the best expertise available. Throughout the implementation of the overall effort, the project would focus on lessons learned in two key areas:

1. **How can the planning process and system designs be simplified and costs reduced** to aid in replication? Which aspects of the effort were found common to all Regions' activities and which were site specific; and what have we learned about scale issues?

2. **What are the policy implications** of the MSD Project? Which macro price and regulatory changes are needed to support replication of the work (e.g., determining which social and technical innovations are beyond the abilities or control of the Regions; which conditions might justify subsidies; needed changes in property rights, prices, credit, etc.)?

However, we must first ensure the rigorous implementation of the MSD Project, so that there are proven successes to replicate. At present, we are far from this point.

VIII. THE NEED FOR A PRACTICAL VISION

A. Post-Communist Instrumentalism

One of the unfortunate by-products of political change in formerly communist countries is a dismissal of any more coherent vision beyond unleashing the forces of markets and democracy. It is the absence of some larger vision that has us so muddled, unable to sort out priorities and trade-offs, and this explains partially our reliance upon more material yardsticks to measure progress and self-worth. With little more than abstract notions of unfettered commerce and freedom to bind us together, people, whether those enjoying the comforts and power of living in OECD countries, or the billions who aspire to share this, will be unwilling to alter the basic way they live.

The issue is not whether or not some more concrete vision of sustainable development is needed; rather it is to make sure that such a vision is not dogmatic, or one that precludes people's exercise of their fundamental human rights. As the "September 11" attacks in New York and Washington show, if we do not provide such a beacon, surely neo-fascist, ultra-nationalist, or fundamentalist religious movements will (Luttwak, 1999; Gray, 1998; Barber, 1995).

The MSD Project could in time be a fairly dramatic, tangible statement to show what is possible if people have the will to change and wrestle with some complex problems in a practical, manageable fashion. It seeks to demonstrate how people can live with dignity, save money, reduce harmful pollution, and strengthen a sense of democratic community if they are willing to work at it, with a committed group of technical people and sufficient planning resources. The idea proposed is a partial step in offering such a vision. With its emphasis on increasing efficiency, strengthening local control of resources and a feeling of social solidarity and community, it should appeal to both ends of the political spectrum, and to different countries and cultures.

The MSD Project is ambitious but not all that complicated. We have a great deal of experience providing technical assistance and democratic institution-building. We also have a good engineering knowledge base for a variety of energy, agricultural, and waste-recycling systems that appear attractive. What is missing is a way to integrate this knowledge on a scale sufficiently large enough to convince people that these new approaches can be trusted, and then to develop a strategy to replicate this work.

B. Toward A Greater Consensus

The MSD Project seeks to redefine the nature and level of material existence so that the essential needs of people are met in a politically and environmentally sustainable fashion. It will show that a group of regions in the developed world understands the magnitude of needed change, that this change need not be so threatening, and that approaches can be worked out to provide sustainable livelihoods that could be extended to regions anywhere.

Through the joint efforts of a global network of regions, the MSD Project would begin to develop a consensus on needed change that would transcend various political and economic divisions among nations. This would help to overcome the fears of developing countries that sustainable development is a luxury for wealthier nations, and that the West/North is using environmental issues as a sophisticated means of political and economic control.

This mistrust haunts all international discussions related to sustainable development. No single effort can redress the deep feelings among the different players. The MSD Project could act as a bridge between the two camps. The project offers a constructive way to confront the issue of resource consumption related to current patterns of livelihoods. It seeks a way to jointly help the North to change its practices, and to help the South change its aspirations, while keeping the goal of social justice paramount.

During preparations for the Rio Earth Summit, a group of experts gathered in the Netherlands to lay the foundation for a new North-South compact: dramatic increases in OECD development assistance in return for a developing country commitment to protect global resources. The symposium produced a small pamphlet, *Sustainable Development: From Concept to Action* (Pronk and ul Haq, 1992).

Despite good intentions, more than two decades after Rio, we remained mired in concepts. Rather, let us invert the notion, start from action, and refine concepts based on concrete experience. The goal is not to talk about sustainable development; it is to build systems and organisations that can deliver it, sorting out the details of economic-ecological modelling, natural systems engineering and integration, finance, and the politics of implementation, in a way that people find useful and fair.

Let us not wait for the price corrections, policy changes and UN system reforms, all needed, and none likely to occur anytime soon. Let us link our policy-makers, industrialists, and eco-activists with the needs of real people. Let us develop credible models of sustainable development in specific locations, and let grander, global schemes rest upon a new *local* order that works.

The MSD Project offers a complement to the conventional approaches to stimulate sustainable development. It is an ambitious learning effort to see if a group of committed citizens and technical people can simply work out the operational

details of creating sustainable livelihoods at a larger scale. It is surely prudent to try this now rather than during a period of resource scarcity or intense interest group competition, a period which we are assuming, rather blindly, will be staved off by market adjustments and human ingenuity.

Finally we need to get serious. While all credit is due to its philanthropic activities, it says something about our values when Microsoft finds it effective to spend $500 million on the *marketing* of its *Xbox* video game system. We are spending hundreds of billions on space vehicles and stations that do not work, and military and security systems that do little to remove the underlying causes of the security threats. We continue to waste even larger sums on *subsidizing* inefficient fossil fuel-based energy, water, and agricultural systems. Globally we have spent or guaranteed over $15 *Trillion* to deal with the impacts of the 2007 credit crisis. We need to divert some portion of these "*band-aid*" expenditures to develop the *basis* for a more secure, more sustainable world.

If we attempt to stimulate sustainable development in a credible way, with sufficient funding and organisation, and we are still unsuccessful, we can prepare price increases, regulations, and paternalistic social controls, whose acceptance will be made easier by our failure. But if we do succeed, perhaps we can challenge much of the empty rhetoric, lack of leadership, and mistrust of democracy that are the real obstacles to sustainable development.

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REFERENCES

ACEEE (American Council for an Energy Efficient Economy) (1996): *Boosting Prosperity: Reducing the Threat of Global Climate Change Through Sustainable Energy Investments,* San Francisco, the Energy Foundation.

Adriannse, Albert *et. al.* (1997): *Resource Flows: The Materials Basis of Industrial Economies*. Washington DC, World Resources Institute.

Agarwal, Anil and Narain, Sunita (1989): *Towards Green Villages,* New Delhi, Center for Science and Environment.

Alcamo, Joseph, editor (1984): *IMAGE 2.0: Integrated Modeling of Global Climate Change,* Dordrecht, Kluwer Press.

Alesina, Alberto, and Spolaore, Enrico (1995): "On the Number and Size of Nations". Working Paper 5050, Cambridge, MA, National Bureau of Economic Research.

Amsden, Alice (1989): *Asia's Next Giant: South Korea and Late Industrialization,* New York, Oxford University Press.

Amsden, Alice, editor (1994): "Special Section: 'The World Bank's The East Asian Miracle: Economic Growth and Public Policy'", in *World Development,* Vol. 22, No. 4, Oxford, Pergamon Press.

Anderson, T. *et. al.* (2003): "Atmospheric Science: Climate Forcing by Aerosol--a Hazy Picture", in *Science*, 2003, vol. 300, pp. 1103-1104, Washington DC, American Association for the Advancement of Science.

Ayres, Robert (1993): "Industrial Metabolism-Closing the materials cycle", in Jackson, Tim, editor, *Clean Production Strategies: Developing Preventative Environmental Management in the Industrial Economy,* Ann Arbor, Lewis Publishing.

Ayres, Robert and Simonius, Udo, (1994): *Industrial Metabolism: Restructuring for Sustainable Development*, Paris, United Nations University Press.

Banuri, Tariq, editor (1991): *Economic Liberalization: No Panacea,* Oxford: Clarendon Press.

Barber, Benjamin (1986): *Strong Democracy: Participatory Politics for a New Age,* Berkeley: University of California Press.

Barber, Benjamin (1995): *Jihad vs. McWorld*, New York, Ballantine Books.

Barney, Gerald, editor (1981): *The Global 2000 Report to the President: Entering the 21st Century (Summary Report),* New York, Pergamon Press.

Bartelmus, Peter (1995): "Indicators of Sustainable Growth and Development: Linkage Integration and Policy Use." Paper presented at Scientific Workshop on Indicators of Sustainable Development, Wuppertal Institute 15-17 November, available from the author, UN Statistical Office, New York.

Bartlemus, Peter (1989): "Environmentally Sound and Sustainable Development: A Conceptual Framework", available from the UN Statistical Office, New York.

Bartone, Carl *et. al.* (1992): "Environmental Strategies for Cities: A Framework for Urban Environmental Management in Developing Countries", available from Urban and Infrastructure Department, World Bank, Washington DC, UNDP/World Bank/UNCHS.

Bartone, Carl *et. al.* (1994): "Toward Environmental Strategies for Cities: Policy Considerations For Urban Environmental Management in Developing Countries." Paper 18 in a series on Strategic Options for Managing the Urban Environment, Washington DC: Urban Management Programme, World Bank, January [DRAFT].

BCSD (Business Council for Sustainable Development) (1992): "Report on Technology Co-operation". Technical Advisory Group Working Paper, available from WBCSD, Geneva.

Beckerman, Wilfred (1992): "Economic Growth and the Environment: Whose Growth? Whose Environment?", in *World Developmen*t. Vol. 20, No. 4, Oxford, Pergamon Press.

Benyus, Janine (2002): *Biomimicry*, New York, Harperperennial Library Press.

Bergman, Lars (1988): "General Equilibrium Effects of Environmental Policy: A CGE Modeling Approach", Research Report 6415, Stockholm, Handelshogskolan.

Bertoldi, Paulo *et. al.* (2006) "Energy service companies in European countries: Current status and a strategy to foster their development", *Energy Policy* 34 (2006) 1818–1832.

Biswanger, H., and Ruttan, V., editors (1978): *Induced Innovation: Technologies, Institutions and Development,* Baltimore, John Hopkins University Press.

Bojö, Jan, Mäler, Karl-Göran, and Unemo, Lena (1992): *Environment and Development: An Economic Approach*, Dordrecht, Kluwer Academic Publishers.

Bok, Derek (1993): *The Cost of Talent: How Executives and Professionals are Paid and How It Affects America*, New York, Free Press.

Borrini, Grazia (1991): *Lessons Learned in Community-Based Environmental Management,* Rome, International Course for Primary Health Care Managers, available from IIED London.

Brandt Commission (1984): *North-South: A Programme for Survival,* London, Pan Books.

Branigin, William (1992): "The U.N. Empire: Polished Image, Tarnished Reality", in *The Washington Post,* series, 20-24 September.

Bringezu, Stephan *et. al*. (1994): "Integrating Sustainability into the System of National Accounts: The Case of Inter-regional Materials Flows", in *Models of Sustainable Development: Exclusive or Complementary Approaches of Sustainability* [sic], Proceedings of the Paris Conference, 16-18 March, available from Paris, Université Panthéon-Sorbone.

Brown, Lester and Kane, Hal (1994): *Full House: Reassessing the Earth's Population Carrying Capacity,* New York, W.W. Norton and Co.

Buchanan, James (1977): *The Limits of Liberty: Between Anarchy and Leviathan,* Chicago, University of Chicago Press.

Bulmer-Thomas, V. (1982): *Input-Output Analysis in Developing Countries: Sources, Methods, and Applications,* New York, John Wiley & Sons, Ltd.

Bult-Spiering, M. and Dewulf, G. (2006): *Strategic Issues in Public-private Partnerships,* London, Blackwell Publishing.

Carley, Michael (1994): "Policy Management Systems and Methods of Analysis for Sustainable Agriculture and Rural Development", Rome, FAO and IIED.

Carlsson, Anders (1988): "Estimates of the Costs of Emission Control in the Swedish Energy Sector", Research Report 273, Stockholm, Handelshogskolan.

CCICED (China Council for International Cooperation on Environment and Development) (2003): Transforming coal for sustainability: a strategy for China, summary report of the Task Force on Energy Strategies and Technologies, in *Energy for Sustainable Development,* Vol. VII, No. 4, December 2003, Bangalore, IEI.

Chambers, Robert, and Conway, Gordon (1992): "Sustainable Rural Livelihoods: Practical Concepts for the 21st Century", Discussion Paper 296, Brighton, Institute of Development Studies, University of Sussex, February.

Cline, William (1992): "The Economics of Global Warming", Washington DC, Institute for International Economics.

Cline, William (1997): "Trade and Income Distribution", Washington DC, Institute for International Economics.

Cohen, Joel (1995): *How Many People Can the Earth Support?*, New York, W.W. Norton and Co.

Commission on Global Governance (1995): *Our Global Neighborhood*, Geneva, Commission on Global Governance.

Crawford, Peter *et. al.* (1999): "World Power & Light", in *McKinsey Quarterly*, No.1, pp. 38-51, available at www.mckinseyquarterly.com/energy/wopo99.asp.

Dag Hammarskjold Foundation (1975): *What Now: Another Development,* Uppsala.

Dahl, Robert (1985): *A Preface to Economic Democracy,* Berkeley, University of California Press.

Dahl, Robert, and Tufte, Edward (1973): *Size and Democracy*, Stanford, Stanford University Press.

Dahr, S.K. *et. al.* (1990): "Participatory Forest Management in the Shivalik Hills: Experiences of the Haryana Forest Department", Working Paper No. 5, New Delhi, The Ford Foundation.

Dalal-Clayton, B. *et. al.* (1994): "National Sustainable Development Strategies: Experiences and Dilemmas," Environmental Planning Issues Paper No. 6, London, Environmental Planning Group, International Institute for Environment and Development.

Dasgupta, Partha (1993): "Optimal vs. Sustainable Development", Paper presented at World Bank's First Annual Conference "Valuing the Environment", October, available from the author.

de Lucia, Russel (1995): "Financing Renewable Energy Projects: Issues, Options, and Innovations", presented at Conference on Renewable Energy Asia Pacific '95, New Delhi, 23-25 January, Cambridge, MA, available from author.

de Simone, Livio *et. al.* (1997): *Eco-Efficiency: The Business Link to Sustainable Development*, Cambridge, MIT Press.

de Soto, Hernando (2000): *The Mystery of Capital: Why Capitalism Succeeds in the West and Fails Almost Everywhere Else*, New York, Basic Books.

Dervis, Kemal, De Melo, Jaime, and Robinson, Sherman (1984): *General Equilibrium Models for Development Policy*, Cambridge, Cambridge University Press.

DGIS (1991): *A World of Difference: A New Framework for Development Co-operation in the 1990s,* Den Haag, Ministry of Foreign Affairs, Directorate General for International Co-operation.

DPCSD (Department for Policy Coordination and Sustainable Development) (1997): "Critical Trends: Global Change and Sustainable Development", New York, United Nations.

Duchin, Faye (1992): "Industrial Input-Output Analysis: Implications for Industrial Ecology", in *Proceedings of the National Academy of Sciences*, Vol. 89, Washington DC, National Academy of Sciences Press.

Duchin, Faye *et. al.* (1994): *Ecological Economics, Technology, and the Future of the World Environment, New York, Oxford* University Press.

Easterly, William (2001): *The Elusive Quest for Growth: Economists Adventures and Misadventures in the Tropics*, Cambridge, MIT Press.

ECN (Energieonderzoek Centrum Nederlands) 1995: "New Directions in Energy Modeling: Summary of Annex V (1993-1995)", Petten, Netherlands, ECN.

ECOSOC (Economic and Social Council, Commission on Sustainable Development, United Nations) (1993): "Adoption of a Multi-Year Thematic Programme of Work for the Commission," New York, ECOSOC, E/CN.17/(1993/L.4-8).

Egea, A. Nadal November (1990): "Choice of Technique Revisited: A Critical Review of its Theoretical Underpinnings", in *Science and Technology: Issues From the Periphery, (Special Issue), World Development,* Oxford, Pergamon Press.

Ellerman, David (1990): *The Democratic Worker Owned Firm*, Boston, Unwin Hyman.

ESG (Energy and Sustainable Development Group (2003): *State of Energy Report for Cape Town*, available at www.sustainable.org.za.

ESMAP (2000): "Energy Services for the World's Poor: Energy and Development Report 2000", Washington DC, The World Bank.

Etnier, Carl and Guterstam, Björn, editors (1991): *Ecological Engineering for Waste Water Treatment,* Proceedings of the International Conference at Stensund Folkskolan, 24-28 March, Göteborg, Bokskogen.

ETSAP (1997): New Directions in Energy Modeling: Summary of Annex V (1993-1995), Paris, International Energy Agency.

ETSAP (2000): ETSAP Newsletter Vol. 7, No. 1, January 2000, Paris, International Energy Agency.

Faeth, Paul (1995): *Growing Green: Enhancing the Economic and Environmental Performance of U.S. Agriculture*, Washington DC, World Resources Institute.

Folke, Carl *et. al.* (1997): "Ecosystem Appropriation by Cities", in *Ambio*, Vol. 26, No. 3, Stockholm, Royal Swedish Academy of Sciences.

Fontella, Emilio (1993): "Economic and Environmental Modelling", Paper presented at the Società Italiana di Statistica Conference, 4-5 November, available from the author.

Fromm, Erich (1974): *The Art of Loving*, New York, Harper and Row Press.

Gates, Jeff (1998): *The Ownership Solution: Toward a Shared Capitalism for the 21st Century,* Reading Massachusetts, Perseus Books.

Ghai, Dharam and Vivian, Jessica, editors (1992): *Grassroots Environmental Action: People's Participation in Sustainable Development*, London, Routledge Press.

Gielen, D.J. *et. al.* (1993): "Cost Effective CO_2 Reduction in Coupled Energy and Materials Systems," Pettan, Netherlands, ECN.

Glien, D.J., and Kram, T. (1999), "Managing Materials for Greenhouse Gas Reduction", in *ESTAP News*, No. 7, June 1999, Pettan, Netherlands, ECN.

Goldman, Charles *et. al.* (2005) "Review of U.S. ESCO Industry Market Trends: An Empirical Analysis of Project Data", *Energy Policy* 33(2005) 387-405;

Goodland, Robert (1991): "The Case that the World Has Reached Limits", in Goodland *et. al.*, *Environmentally Sustainable Development: Building on Brundtland,* Environment Working Paper No. 46, Washington DC, World Bank.

Goodland, Robert, and Daly, Herman (1992): "Ten Reasons Why Northern Income Growth Is Not the Solution to Southern Poverty", available from the authors, Washington DC, Environment Department, World Bank.

Goodman, Paul and Percival (1960): *Communitas: Means of Livelihood and Ways of Life*, New York, Random House.

Gray, John (1998): *False Dawn*, New York, The New Press.

Griffin, Keith (1979): *The Political Economy of Agrarian Change: An Essay on the Green Revolution,* London, Macmillan.

Haavelmo and Hansen (1991): "On the Strategy of Trying to Reduce Economic Inequality by Expanding the Scale of Human Activity", in Goodland *et. al.*, *Environmentally Sustainable Development: Building on Brundtland,* Environment Working Paper No. 46, Washington DC, World Bank.

Hancock, Graham (1989): *Lords of Poverty: The Power, Prestige, and Corruption of the International Aid Business,* Boston, Atlantic Monthly Press.

Hawken, Paul *et. al.* (1999): *Natural Capitalism: Creating the Next Industrial Revolution*, Boston, Little Brown and Company.

Heaton, George *et. al.* (1991): "Transforming Technology: An Agenda for Environmentally Sustainable Development in the 21st Century", Washington DC, World Resources Institute.

Heilbroner, Robert (1975): *An Inquiry into the Human Prospect,* Revised Edition, New York, W.W. Norton and Company.

Heimans, Jeremy (2002): "Strengthening Paricipation in Public Expenditure Management: Policy Recommendations for Key Stakeholders", Policy Brief No. 22, Paris, OECD Development Centre.

Heimstra, Wim, Reijntjes, and van der Werf, Erik, editors, (1992): *Let Farmers Judge: Experiences in Assessing the Sustainability of Agriculture*, London, Intermediate Technologies Publications.

Hirsch, Fred (1977): *The Social Limits to Growth,* London, Ruttledge and Kegan Paul.

Hirschman, Albert (1991): "The Case Against One Thing at a Time", in *World Development*, Vol. 19, No. 6, Oxford, Pergamon Press.

Hoffman, Ulrich and Zivkovic, Dusan (1992): "Demand Growth for Industrial Raw Materials and its Determinants: An Analysis for the Period 1965-1988", Discussion Paper No. 50, Geneva, UNCTAD.

Holmberg, Johan, editor (1992): *Policies for a Small Planet*, London, Earthscan.

Homer-Dixon, Thomas (1994a): "Environmental Scarcities and Violent Conflict: Evidence from Cases", in *International Security*, Vol. 19, No. 1, Cambridge, MA, MIT Press.

Homer-Dixon, Thomas (1994b):"The Ingenuity Gap: Can Poor Countries Adapt to Resource Scarcity", forthcoming, available from the author, University of Toronto.

Huisingh, D., and Bass, L.W., (1991): "Cleaner Production: The Most Effective Approach to Achieving Water Quality", in *European Water Pollution Control*, Vol. 1, No. 1, available from the authors, Erasmus Centre for Environmental Studies, University of Rotterdam, the Netherlands.

IBRD (International Bank for Reconstruction and Development) (1969): *Partners in Development* London, Pall Mall.

ICLEI (International Council for Local Environmental Initiatives) (2000): "Measuring Progress: Cities21 Pilot Project Final Report", Toronto, ICLEI.

IEA (International Energy Agency) (2006): Energy Technology Perspectives: Scenarios & Strategies to 2050, Paris, IEA.

IMF (International Monetary Fund) (2002a): "Further Cross-Country Evidence on the Accuracy of the Private Sector's Output Forecasts", IMF Staff Papers, Vol. 49, No. 1, Washington DC.

IMF (International Monetary Fund) (2002b): "External Comments and Contributions on the Joint Bank/Fund Staff Review of the PRSP Approach.

Volume II: Civil Society Organizations and Individual Contributions," Washington DC.

IPCC (Inter-Governmental Panel on Climate Change) (1990-1992): *Policy Makers Summary of the Scientific Assessment of Climate Change,* Report by Working Group 1, and Supplement, Geneva, IPCC/WMO.

IPCC (Inter-Governmental Panel on Climate Change) (2007): *Climate Change 2007: The Physical Science Basis,* Report by Working Group 1 as part of 4th Assessment Report, Geneva, IPCC/WMO.

Isard, Walter (1972): *Ecological-Economic Analysis for Regional Development*, New York, The Free Press.

IUCN (International Union for the Conservation of Nature) (1980): *The World Conservation Strategy: Living Resource Strategy for Sustainable Development,* Gland, IUCN, WWF, and UNEP.

Jackson, Robert (1969): *The Capacity of the United Nations Development System*, Geneva, United Nations.

Jansson, Ann-Marie and Zucchetto, James (1985): *Resources and Society: A Systems Ecology Study of the Island of Gottland, Sweden,* New York, Springer-Verlag.

Johansson, Thomas *et. al.* (1989): *Electricity: Efficient End Use and New Generation Technologies, and Their Planning Implications,* Lund, Kreiger Press.

Johansson, Thomas *et. al.* (1992): *Renewables for Fuels and Electricity,* Washington DC, Island Press.

Kelly, Kevin (1994): Out of Control: *The New Biology of Machines, Social Systems, and the Economic World*, Reading MA, Addison-Wesley.

Kenny, Charles, and Williams, David (2001): "What Do We Know About Economic Growth? Or, Why Don't We Know Very Much?" in *World Development*, Vol. 29, No.1, Oxford, Pergamon.

Korn, Mads (1996): "The Dike-Pond Concept: Sustainable Agriculture and Nutrient Recycling in China", in *Ambio*, Vol. 25, No. 1, Stockholm, Royal Swedish Academy of Sciences.

Kotzloff, Keith Lee, and Dower, Roger (1993): *A New Power Base: Renewable Energy Policies for the Nineties and Beyond, W*ashington DC, World Resources Institute.

Kram, T., editor (1994): *National Energy Options for Reducing CO_2 Emissions, Volume 1: The International Connection. A Report of the Energy Technology Systems Analysis Programme /Annex IV (1990-1993),* Petten, Netherlands, Energieonderzoek Centrum Nederlands (ECN).

Kram, T. *et. al,*(2001): *The Matter Project: Integrated Energy And Materials Systems Engineering For GHG Emissions Mitigation.* Report No. 410 200 055 (2001), Bilthoven, the Netherlands, RIVM.

Krugman, Paul (1994): "Competitiveness: A Dangerous Obsession", in *Foreign Affairs*, Winter-Sping 1994, New York, Council on Foreign Relations.

Krugman, Paul (1998): "The Role of Geography in Development", paper presented at the Annual World Bank Conference on Development Economics, April 20-21 1998, Washington DC, the World Bank.

Kuttner, Robert (1997): *Everything For Sale: The Virtues and Limits of Markets*, New York, Alfred E. Knopf.

Landes, David (1969): *The Unbound Prometheus: Technological Change and Industrial Development in Western Europe from 1750 to the Present,* Cambridge, Cambridge University Press.

Lasch, Christopher (1983): *The Culture of Narcissism,* New York, Warner Books.

Leitmann, Josef (1991): "Energy-Environment Linkages in the Urban Sector", Discussion Paper No. 2, available from the Urban Management Programme, Urban Development Division, Environmentally Sustainable Development Group, Washington DC, World Bank.

Lele, Sharachandram (1991): "Sustainable Development: A Critical Review", in *World Developmen*t, Vol. 19, No. 6, Oxford, Pergamon Press.

Lichtman, Robert (1987): "Toward the Diffusion of Renewable Energy Technologies: Some Lessons from the Indian Biogas Programme", in *World Development*, Vol. 15, 3, Oxford, Pergamon.

Lichtman, Robert (1992): "Integrated Approaches to Community-Level Sustainable Development", Unpublished internal report prepared for the Rockefeller Foundation, New York.

Lindbloom, Charles (1980): *Politics and Markets: The World's Political-Economic Systems,* New York, Basic Books.

Lipton and Loghurst, (1989): *New Seeds and Poor People*, Baltimore, Johns Hopkins Press.

Little, I.M.D., and Mirlees, J.A. (1991): "Project Appraisal and Planning Twenty Years On", in *Proceedings of the World Bank Annual Conference on Development Economics, 1990*, Washington DC, World Bank.

Lovins, Amory (1991): "Energy, People, and Industrialization", in Davis, Kingsley, and Bernstam, Mikhail, editors, *Resources, Environment and Population: Present Knowledge, Future Options,* New York, Oxford University Press.

Lovins, Amory *et. al.* (1996): *Factor Four: Target for Sustainable Development,* Munich, Droemer Knaur.

Lovins, Amory, *et. al.* (2002): *Small Is Profitable: The Hidden Economic Benefits of Making Electrical Resources the Right Size,* Snowmass, Colorado, Rocky Mountain Institute**.**

Lovins, Amory, et. al. (2004): *Winning the Oil Endgame*. Snowmass, Colorado, Rocky Mountain Institute, available from www.oilendgame.com

Lovins, Amory (2003): "Twenty Hydrogen Myths", available from www.rmi.org.

Lovins, Amory, and Romm, Joseph (1993): "Fueling a Competitive Economy", in *Foreign Affairs,* Winter-Spring 1993, New York, Council on Foreign Relations.

Luttwak, Edward (1999): *Turbo-Capitalism: Winners and Losers in the Global Economy,* New York, Harper Collins Publishers.

Lutz, Ernst, and Munasinghe, Mohan (1994): "Integration of environmental concerns into economic analyses of projects and policies in an operational context", in *Ecological Economics*, Vol. 10, Amsterdam, Elsevier Science.

Marton, Katharin, editor (1986): *Multinationals, Technology and Industrialization: Implications and Impact in Third World Countries,* Boston, Lexington Books.

Mattsson, Niclas, and Wene, Clas-Otto (2002), "Assessing New Energy Technologies Using an Energy System Model with Endogenized Experience Curves", in International Journal of Energy Research, Vol. 21, New York, John Wiley and Sons, Ltd.

McKinsey Global Institute (2006): "Productivity of Growing Energy Demand: A Microeconomic Perspective", available from www.mckinsey.com

Meadows, Donella *et. al.* (1974): *The Limits to Growth: A Report for the Club of Rome's Project on the Predicament of Mankind,* New York, Signet Books.

Meadows, Donella *et. al.* (1992): *Beyond the Limits,* Post Mills, Vermont, Chelsea Green Publishing Company.

Meier, Peter, and Munasinghe, Mohan (1994): "Incorporating Environmental Concerns into Power Sector Decision-making [sic]: A Case Study of Sri Lanka", World Bank Environment Paper No. 6, Washington DC, World Bank.

Millennium Ecosystem Assessment (2005): *Ecosystems and Human Well-being*, Synthesis Report, Washington, DC, Island Press.

Mills, Evan (1991): "Uncertainties in the Price-Responsiveness of Energy Demand: An End-Use Comparison of Denmark and Sweden", in *Evolving Energy Systems: Technology Options and Policy Mechanisms,* Ph.D. Thesis, available from Department of the Energy & Environmental Systems Studies, University of Lund, Sweden.

Mitch, William *et. al.* (1993): "Ecological Engineering in China", special issue in *Ecological Engineering*, Vol 2/3, Amsterdam, Elsevier Press.

Mitlin, Diana (1992): "Sustainable Development: A Guide to the Literature", in *Environment and Urbanisation*, Vol. 4, No.1, London, Earthscan and IIED.

Mokyr, Joel (1990): *The Lever of Riches: Technological Creativity and Economic Progress*, New York, Oxford University Press.

Morris, David and Ahmed, Irshad (1992): *The Carbohydrate Economy: Making Chemical and Industrial Materials from Plant Matter, W*ashington DC, Institute for Local Self Reliance.

Morris, David and Platt, Brenda (1993): *The Economic Benefits of Recycling, W*ashington DC, Institute for Local Self Reliance.

Nabli, Mustapha, and Nuget, Jeffrey (1989): "The New Institutional Economics and Its Applicability to Development", in *World Development*, Vol. 17, No. 9, Oxford, Pergamon Press.

NRC (National Research Council) (2002): *Abrupt Climate Change: Inevitable Surprises*, Washington DC, National Academy Press.

Nijkamp, Peter *et. al*. (1991): "Regional Sustainable Development and Natural Resource Use", in *Proceedings of the World Bank Annual Conference on Development Economics 1990*, Washington, World Bank.

Nordhaus, William (1991): "The Cost of Slowing Climate Change: A Survey", in *American Economics Review*, Vol 81, No. 46, Nashville, American Economics Association.

Nordic UN Project (1991): *The United Nations: Issues and Options. Five Studies on the Role of the UN in the Economic and Social Fields,* Stockholm, Almqvist and Wiksell International.

Norgaard, Richard (1989): "Three Dilemmas of Environmental Accounting", in *Ecological Economics,* Vol. 1, Amsterdam, Elsevier Science Publishers.

Nozik, Robert (1974): *Anarchy, State and Utopia,* New York, Basic Books.

Osborne, Stephen (2000): *Public-Private Partnerships: Theory and Practice in International Perspective*, London, Routledge Press.

OECD (1993): "OECD Core Set of Indicators for Environmental Performance Reviews: A Synthesis Report by the Group on the State of the Environment", *Environment Monograph No. 83,* Paris, Environment Directorate, State of Environment Division, OECD.

OECD (1994): "Environmental Indicators: Overview of Work Programme and Publications", Paris, Environment Directorate, State of Environment Division, OECD, March.

OECD (1996): "Integrating Environment and Economy: Progress in the 1990s", Paris, OECD.

OECD (2000): "The Interim Report on the OECD Three Year Project on Sustainable Development", Paris, OECD.

OECD (2001): *Sustainable Development: Critical Issues*, Paris, OECD.

OECD (2001a): *Toward a New Role for Spatial Planning*, Paris, OECD.

Olerup, Brita (1994): "Rational Assumptions in Energy Scenarios", in *Sustainable Development: Conflicting or Complementary Approaches. Proceedings of the Paris Conference*, Paris: University de Sorbonne.

Olson, Mancur (1982): *The Rise and Decline of Nations: Economic Growth, Stagflation, and Social Rigidities*, New Haven, Yale University Press.

Olson, Mancur (2000): *Power and Prosperity: Outgrowing Communist and Capitalist Dictatorships*, New York, Basic Books.

Operations Evaluations Department (1986): *Rural Development: World Bank Experience 1965-1986,* Washington DC, The World Bank.

Opschoor, J.B. and Weterings, R. (1993a): "Towards Environmental Performance Indicators Based on the Notion of Environmental Space", Discussion paper prepared for the OECD, Amsterdam, Free University, available from the authors.

Opschoor, J.B. and Weterings, R. (1993b): "Towards Environmental Performance Indicators Based on the Notion of Environmental Space", Report prepared for the Advisory Council for Research on Nature and the Environment, Government of the Netherlands, Amsterdam, Free University, available from the authors.

OTA (Office of Technology Assessment) (1992): Congress of the United States, *Fueling Development: Energy Technologies for Developing Countries, W*ashington DC, US Government Printing Office.

S Pacala, S and Socolow, R (2004): "Stabilization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies", in *Science*,

Washington: Aug 13, 2004.Vol.305, Issue. 5686, pp. 968-973.
Panayotou T., and Zinnes, C. (1995): "Free-Lunch Economics for Industrial Ecologists" in R. Socolow, *Industrial Ecology,* available from the authors, Harvard University.
Panayotou, Theo (1993): *Green Markets: The Economics of Sustainable Development,* San Francisco, ICS Press.
Pateman, Carol (1970): *Participation and Democratic Theory,* Cambridge, Cambridge University Press.
Pearce, David, and Warford, Jeremy (1993): *World Without End: Economics, Environment, and Sustainable Development,* New York, Oxford University Press.
Persson, Annika, and Munasinghe, Mohan (1995): "Natural Resource Management and Economy-Wide Policies in Costa Rica: A Computable General Equilibrium (CGE) Modeling Approach", in *The World Bank Economic Review,*Vol. 9, No. 2, Washington DC, World Bank.
Pezzey, John (1989): "Economic Analysis of Sustainable Growth and Sustainable Development", *World Bank Environment Department Working Paper 15,* Washington DC, World Bank.
Pigou, A.C. (1938): *The Economics of Welfare*, London, Macmillan and Company.
Polanyi, Karl (1957): *The Great Transformation: The Political and Economic Origins of Our Time*, Boston, Beacon Press.
Polenske, Karen *et. al.* (1992): "Evaluation of the South Coast Air Quality Management District's Methods for Assessing Socio-economic Impacts of District Rules and Regulations, Report No. 76, Volume II: Technical Appendices". Unpublished report available from the author, Cambridge, Massachusetts, Department of Urban Studies and Planning, Massachusetts Institute of Technology.
Pretty, J. and Sandbrook, R. (1991): *Guidelines for Primary Environmental Care*, prepared for the DAC/OECD, London, International Institute for Environment and Development.
Pronk, Jan, and ul Haq, Mahbub, editors (1992): *Sustainable Development: From Concept to Action*, New York, United Nations Development Programme, March.
Putnam, Robert *et. al*. (1992): *Making Democracy Work: Civic Tradition in Modern Italy,* Princeton, Princeton University Press.
Putnam, Robert (2000): *Bowling Alone: The Collapse and Revival of American Community*, New York, Simon and Schuster.
Pyke, Frank and Sengenberger, Werner (1992): *Industrial Districts and Local Economic Regeneration*, Geneva, International Institute for Labour Studies, ILO.
Rabinovitch, Jonas with Leitmann, Josef (1993): "Environmental Innovation and Management in Curitiba, Brasil" (1994): Working Paper, No. 1., available from the Urban Management Programme , Urban Development Division, Environmentally Sustainable Development Group, Washington DC, World Bank.
Raskin, Paul *et. al.* (1995): *The Sustainability Transition: Beyond Conventional Development,* [Draft], available from Stockholm Environment Institute, Boston MA, USA.
Ravetz J. (2000): *City-Region 2020: Integrated Planning for a Sustainable Environment*, London, Earthscan.
Reddy, Amulya *et. al.* (1990): "Comparative Costs of Electricity Conservation: Centralised and Decentralised Electricity Generation, in *Economic and Political Weekly,* 2 June 1990, Pune, M/S Book House.
Reyes, Enrique *et. al*. (1994): "Integrated Ecological Economics Regional Modeling for Sustainable Development", in *Sustainable Development: Conflicting or Complementary Approaches. Proceedings of the Paris Conference*, Paris, University de Sorbonne.
RMI (1994): *Rocky Mountain Institute Newsletter*, Fall 1994, Old Snowmass, Colorado, USA.
Roberts, John (2004): *The Modern Firm: Organizational Design for Performance and*

Growth, Oxford UK, Oxford University Press.
Rodrik, Dani (1997): *Has Globalization Gone Too Far?,* Washington, Institute for International Economics.
Rogers, P. *et. al.* (1996): "Environmental Indicators: Final Report for the Asian Development Bank," available from the authors, Environmental Systems Programme, Harvard University, Cambridge, MA, USA.
Rogers, Peter *et. al* . (1993): "Water Resources Planning in a Strategic Context: Linking the Water Sector to the National Economy", in *Water Resources Research.* Vol. 29, No. 7, Washington DC, American Geophysical Union.
Rogers, Peter, and Bouhia, Hynd (1997): "Water for Big Cities: Big Problems, Easy Solutions?", unpublished draft available from the authors, Cambridge, MA, Engineering Department, Harvard University.
Rogers, Peter, and Jalal, Kazi (1994): "Used Cars, Used Environments: How to Chose One?", Paper available from the authors, presented at the *Third Biennial Meeting of the International Society for Ecological Economics,* San Jose, Costa Rica, October.
Romm, Joseph (1999): *Cool Companies: How the Best Businesses Boost Profits and Productivity By Cutting Greenhouse Gas Emissions,* Washington DC, Island Press.
Rosenberg, Nathan (1982): *Inside the Black Box: Technology and Economics*, Cambridge, Cambridge University Press.
Rotmans, Jan and Vellinga, Pier (1998), editors: "Special Issue: Challenges and Opportunities for Integrated Environmental Assessment", in *Environmental Modeling and Assessment*, Bussem, the Netherlands, Baltzer Science Publishers.
Rubin, Edward *et. al.* (1992): "Realistic Mitigation Options for Reducing Global Warming," in *Science*, Vol. 257, 10 July, Washington DC, American Association for the Advancement of Science.
Ruskin, John (1986): *Unto This Last,* London, Penguin Press, Originally published 1860.
Ruttan V., and Hayami, Y., editors (1985): *Agricultural Development: An International Perspective* Baltimore, Johns Hopkins University Press.
Ryden, B., Johnsson, J., and Wene, Clas-Otto (1993): "Combined Heat and Power Production in Integrated Energy Systems: Examples from Five Swedish Communities", in *Energy Policy,* February 1993, London, Butterworth-Heinemann Ltd.
Schepers, Esther, and Kram, Tom (1995): "Energy System with Economic Feedback: Less change under emission restrictions", in *IEA ETSAP Newletter*. No. 5, July 1995, Petten, the Netherlands, ECN.
Schramm, Gunter, and Warford, Jeremy, editors (1989): *Environmental Management and Economic Development,* Baltimore, Johns Hopkins University Press.
Schultz, Charles (1977): *The Public Use of Private Interest,* Washington DC, The Brookings Institution.
Schultz, Theodore (1983): *Transforming Traditional Agriculture,* Chicago, University of Chicago Press.
Schumacher, E.F. (1973): *Small is Beautiful: Economics As If People Mattered*, New York, Harper and Row.
Sen, Amartya (1999): Development As Freedom, New York, Alfred A. Knopf.
Senge, Peter (1990): *The Fifth Discipline: The Art and Practice of the Learning Organisation*, New York, Doubleday/Currency.
Sesmou, Khalil (1991): The Food and Agricultural Organisation of the United Nations: An Insider's View", in *The Ecologist,* Vol. 21, No.2, London.
Seth Dunn (2000): "Micropower: The Next Electrical Era", Worldwatch Paper 151. Washington DC, Worldwatch Institute.
Shaw, Robert and Öberg, S. (1994): "Sustainable Development: Applications of Systems Analysis", available from the authors via the Stockholm Environment Institute.
Shell International (2001): *Energy Needs, Choices, and Possibilities: Scenarios to 2050,* London, Shell International.
Shiller, Robert (2000): *Irrational Exuberance*, Princeton, Princeton University Press.

Smil, Vaclav (1993): *China's Environmental Crisis: An Inquiry into the Limits of National Development*, London, M.E. Sharpe.

Snell, Branford (1974): *American Ground Transportation*, Proceedings of SubCommittee on Anti-trust and Monopoly, US Senate, 93rd Congress, Second Session, Washington, DC, US Government Printing Office.

Stavins, Robert (1990): "Innovative Policies for Sustainable Development: The Role of Economic Incentives for Environmental Protection", *Harvard Public Policy Review*, Cambridge.

Stern, Nicholas, *et. al.* (2006): *Stern Review on the Economics of Climate Change*, available from www.hm-treasury.gov.uk/independent_reviews/ stern_review_economics_climate_change/sternreview_index.cfm

Stewart, Francis (1978): *Technology and Underdevelopment*, Second Edition, London, Macmillan Company.

Stewart, Francis, and Ejaz, Ghani (1991): "How Significant Are Externalities for Development", in *World Developmen*t, Vol. 19:6, Oxford, Pergamon Press.

Stewart, Francis, editor (1991): *Macro-Policies for Appropriate Technology in Developing Countries,* Boulder CO, Westview Press.

Stren, Richard; White, Rodney; and Whitney, Joseph, editors (1992): *Sustainable Cities: Urbanization and the Environment in International Perspective,* Boulder CO, Westview Press.

The Economist (1992): "When China Wakes: A Survey of China", London, 28 November.

The Economist (1999): "The Electric Acid Test", London 25 September.

Thomas, J. and Grindle, M. (1990): "After the Decision: Implementing Policy Reforms in Developing Countries", in *World Development,* Oxford, Pergamon Press, October.

Timmer, C. Peter (1975): "The Choice of Technique in Indonesia" and Wells, Louis, "Economic Man and Engineering Man: Choice of Technology in a Low Wage Country", in Timmer *et. al., The Choice of Technology in Developing Countries: Some Cautionary Tales,* Cambridge, Center for International Affairs, Harvard University.

Timmer, C. Peter (1993): "Why Markets and Politics Undervalue the Role of Agriculture in Economic Development". Paper presented for the Benjamin Hibbard Memorial Lecture Series, Madison WI, Department of Agricultural Economics, University of Wisconsin.

Timmer, C. Peter, editor (1991): *Agriculture and the State: Growth, Employment and Poverty in Developing Countries,* Ithaca, NY, Cornell University Press.

Turner, Adair (2001): *Just Capital: The Liberal Economy*, London, Pan Books.

UNCED (United Nations Conference on Environment and Development) (1992): *Agenda 21*, New York, UN Publications.

UNCHS (United Nations Centre for Human Settlements) (1996): *An Urbanising World: Global Report on Human Settlements*, Oxford, Oxford University Press.

UNDP (United Nations Development Programme) (1990-1998): *Human Development Report*, New York, UN Publications.

UNDP (2001): *World Energy Assessment: Energy and the Challenge of Sustainability,* New York, UN Publications.

UNHABITAT (2003): *The Challenge of Slums: Global Report on Human Settlements 2003*, London, Earthscan.

UNEP (2000): *Global Environmental Outlook 2000,* New York, UN Publications.

UNEP (2002): *Global Environment Outlook* (Geo-3), New York, UN Publications.

UN Millennium Project (2005): *Investing in Development: A Practical Plan to Achieve the Millennium Development Goals*, New York, Earthscan.

UNSO (United Nations Statistical Office) (1993): *SNA Handbook on Integrated Environmental and Economic Accounting*, NY.

USEPA (2002): *Climate Action Report 2002*, available at: www.epa.gov/globalwarming/publications/car/index.html.

Urquart, Brian, and Childers, Erskine (1996): A World in Need of Leadership: Tomorrow's United Nations-A Fresh Approach, Uppsala, Dag

Hammarskjöld Foundation.
van de Vate, Joop (1997): Comparison of energy sources in terms of their full energy chain emissions factors of greenhouse gases", in *Energy Policy*, Vol. 25, No.1, Cambridge, Cambridge University Press.
van Latesteijn, H.C. *et. al*. (1994): "Paradigms of sustainability and perceptions of environmental utilisation space", in *Milieu,* Special Issue: 1994/5, Den Haag, Netherlands Scientific Council for Government Policy.
van Liemt, Gijsbert (1988): *Bridging the Gap: Four Newly Industrialising Countries and the Changing International Division of Labour*, Geneva, International Labour Office.
Vernon, Raymond (1989): "Technological Development: The Historical Experience", Washington DC, Economic Development Institute/World Bank.
Vine, Edward (2005) "An International Survey of the Energy Service Company (ESCO) Industry", *Energy Policy* 33(5): 691-704.
Vitousek, Peter *et. al*. (1986): "Human Appropriation of the Products of Photosynthesis, in *Bioscience,* Vol. 34, No. 6, June, Amsterdam, Elsevier Press.
Wade, Robert (1990): *Governing the Market: Economic Theory and the Role of Government in East Asian Industrialisation,* Princeton, Princeton University Press.
Wade, Robert (2001): "The Rising Inequality of World Income Distribution," *Finance and Development* Vol. 38, no. 4, (December 2001), IMF, Washington DC.
Wallner, Heinz Peter and Narodoslawsky, Michael (1985): "Islands of Sustainability: A Bottom-Up Approach Towards Sustainable Development," in *Environment and Planning A*, available from the authors: Institut für Verfahrenstechnik, Technische Universität Graz, Austria).
Walz, R. *et. al.* (1995): "Synopsis of Selected Indicator Systems for Sustainable Development," available from Fraunhofer Institute for Systems and Innovation Research, Karlsruhe, Germany.
WBCSD (World Business Council for Sustainable Development) (1996): Sustainable Production and Consumption: A Business Perspective", Geneva, World Business Council for Sustainable Development.
WCED (World Commission on Environment and Development) (1987): *Our Common Future,* Oxford: Oxford University Press.
Whitehead, Laurence (1990): "Political Explanations in Macroeconomic Management", in *World Development,* Oxford, Pergamon Press, October.

Whyte, William and Whyte, Kathleen (1989): *Making Mondragon: The Growth and Dynamics of the Worker Cooperative Complex,* Ithaca, NY, Cornell University Press.
Wilson, Alex *et. al*. (1998): *Green Development: Integrating Ecology and Real Estate*, New York, John Wiley and Sons.
Wolf, Martin (1992): "Economic forecasts can endanger your wealth", *Financial Times,* 10 July.
Wood, Adrian (1994): *North-South Trade, Employment and Inequality*, Oxford, Clarendon Press.
World Bank (1990-1992): *World Development Report,* New York, Oxford University Press.
World Bank (1992): *Effective Implementation: Key to Development Impact*, Washington DC, World Bank.
World Bank (1993): *The East-Asia Miracle: Economic Growth and Public Policy,* New York, Oxford University Press.
World Bank (1994): "Draft Report: Proposed Indicators to be Used by the World Bank". Unpublished paper presented at the Informal Meeting of the Secretariat of International Organisations Involved in the Subject of Urban Indicators, 8 July 1994, available from the Transportation, Water and Urban Development Department.
World Bank (1995): *Monitoring Environmental Progress: A Report on Work in Progress.* Washington DC, Environment Department, World Bank.

World Bank (1997): *World Development Report*, Washington DC, World Bank.
World Bank (1997a): *Expanding the Measure of Wealth: Indicators of Environmentally Sustainable Development.* Studies and monograph series No. 17, Washington DC, Environment Department, World Bank.
World Bank (1998): *Assessing Aid*, New York, Oxford University Press.
World Bank (1999a):"The Energy Service Industry: The Experience of the United States and Canada", EMT Occasional Paper No. 12, Washington DC, Energy Unit, Energy, Mining, and Telecommunications Department, World Bank.
World Bank (1999b): *World Development Report,* (1999-2000) New York, Oxford University Press.
World Bank (1999c): *Entering the 21st Century: World Development Report 1999/2000*, New York, Oxford University Press.
World Bank (2004) "World Bank GEF Energy Efficiency Portfolio Review and Practitioners' Handbook", Washington DC, World Bank Press.
World Bank (2006): *Financing Energy Efficiency*, Washington DC, Environment Department, World Bank.
World Energy Efficiency Association (1999) "Briefing Paper on Energy Services Companies" (1999), available from the internet at www.wefa.org
Worldwatch Institute, *State of the World*, New York, Norton and Company, various years.
WRI (World Resources Institute) (1994): *World Resources 1994-1995,* Oxford, Oxford University Press.
Xu, Cheng *et. al*. (1992): "Sustainable Agricultural Development in China", in *World Development,* Vol. 20, No. 8, Oxford, Pergamon Press.