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Sustainable development in practice

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1. Introduction to this special issue of the Journal of Cleaner Production pertaining to new pathways to the future

This special issue of the Journal of Cleaner Production (JCP) contains selected papers from the European Environment Sustainability Conference, which was held in Aalborg, Denmark on May 2005. In general the conference posed the question: "Will the business community enter Sustainable Partnerships?" These conference papers have a focus on sustainability related to the issue of Climate Change. The concept of sustainability refers to the Brundtland Report from 1987 [1] as generally covering issues of environment, global warming and energy such that economic development must be mindful of its surroundings including those who work in any institutions (businesses, public sector and non-profits). This and subsequent reports on sustainability were often vague and theoretical only. Thus, the field of sustainable development needed practical "cases" from which to define and illustrate through actions, what was implied by that 1987 report.

Without repeating various theoretical views of sustainable development and the related areas of industrial ecology, design manufacturing or symbiosis, sustainability in the context of businesses now has increasingly strong backing and support from both public policy and private sectors. For example Romm [2] argues that better management within companies can produce more environmentally sensitive, if not clean industrial operations. "*Every company can increase its profits and productivity dramatically by reducing pollution*" [2] which is most likely true and well-worth advocating as part of the industrial ecology approach to the global environment. Nonetheless, there are many other economic analysts who make the same point in reference to general business practices.

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The basic point is, nevertheless, significant: changes in the management of companies can be both profitable and environmentally sound. This is a significant issue debated by most corporate Boards of Directors under one form or another of "corporate governance". Today, even investment, venture and pension funds enact policies about financing "sustainable development entities". However, management within industry seldom appears to be concerned or motivated enough to assure "responsible corporate" decision-making about the environment. This is changing rapidly. In 1995, Porter and van der Linde argued from a case in Holland, that in order to have environmentally responsible companies, there must be some form of governmental regulation or guidelines [3]. In short, an "environmental" "invisible hand" left to corporation good will or markets is suspected. Governments must partner and play an active role.

In a classic volume on "Industrial Ecology", Graedel and Allenby (1994) placed the economics of industrial ecology directly on the shoulders of businesses, "especially product and process design" [4]. In other words, if companies consider what they produce, manufacture and distribute, then they will make environmentally "friendly" goods and services. Again, while this perspective is important, it does not cover the basic concern for how businesses introduce new technologies that are environmentally friendly and sufficient to reverse or solve the tremendous global ecological and social problems.

Several studies, including [3] suggest that nations can have competitive advantages if they follow certain courses of action leading to sustainable economies. Other scholars [6], especially Saxenian [5] argues that competitive advantage can be seen regionally, as she compared the high-tech areas of Silicon Valley in California to Route #128 surrounding Boston. Her work identified a number of elements that distinguished Silicon Valley from Route #128, and hence made it far more competitive and ultimately successful. One item, in particular, was the sustainable environment in which people worked. In Silicon Valley the workplace was comfortable, almost campus-like with causal dress, informal rooms, recreational fields and gyms as well as day care for children. Route #128 was far more formal and rigid in both its environment and behavior toward employees.

By identifying the characteristics of a region, economic analysts build models and economic programs for any region that increasingly focuses upon sustainability issues including the environment, goods, services, products as well as the working environment of the workforce.

Nevertheless, the creation or expansion of business activities fails to be explained solely on the products and the work environment. If new technology is the impetus for new business, then its commercialization is never addressed. Entrepreneurial and growing companies need sustainable technology(s) to advance and compete. Thus, on a micro-economic level, business creation must be linked with macro-economic policies, plans and programs. In Europe, this is often done through the creation of ‘‘Science Parks’’ which are very different from industrial parks, incubators and the like as they have evolved in the USA [7,8].

One of the most compelling technology regions for environmentally sound technologies (ESTs), for example, has been cited in the literature is the city of Kalundborg, outside Copenhagen, Denmark. Here the concept of ‘‘Industrial Symbiosis’’ was created and has been in operation for over 35 years. Basically, the community is organized as a public–private partnership around six industries, where one industry’s waste is another’s raw material for manufacturing. Thus, the entire community has become more sustainable with little waste and degradation to the environment. Since then other communities are trying to replicate this cooperative effort. In the US, communities are seeking to implement ‘‘Eco Industrial Parks’’ around this same conceptual framework.

The first paper in this special issue, the Könnölä et al. paper, considers such a community approach. The authors note that the hydrogen economy promises to be an important and viable alternative to fossil fuel based systems. But there are considerable ‘‘lock-in’’ barriers from both the public and private sectors. The use of an integrative policy tool known as the prospective voluntary agreement (PVA) is advocated. The result is the creation of Techno-Institutional Complexes (TICs) for large energy infrastructures as well as the managerial systems needed to establish the hydrogen economy. The same process systems can be used for the automobile and personal computers.

The approach is voluntary and evolves into a public–private partnership whereby barriers for new policies and programs are discussed and resolved, collaboratively. The policy-making issues may not be the only change from public entities such as the energy sector becoming ‘‘privatized’’ into businesses or de-regulated ‘‘markets’’ for entrepreneurs. California demonstrated how this did not work in its energy crisis from 2000–2002. In large, the problem with California was basically that the State gave the role in oversight and planning [9].

Another paper (David Toke) discusses these issues as they developed very differently in the UK. However, Könnölä et al. raise questions about a voluntary approach based on ‘‘market forces’’. But clearly, the authors argue for the need to create a public–private partnership to create a ‘‘road map’’ which is sustainable and lasting over time with subsequent safe guards and oversight, since all the main ‘‘actors’’ play a continuing and active role in creating and maintaining it.

The third paper, authored by Sookkumnerd et al., on the other hand, discusses how a new technological approach to the rice milling industry in Asia is sustainable in that it uses waste from rice for generating energy for the mill. Thus, a husk-fuelled steam engine in Thailand is sustainable in terms of its social and economic impacts. Traditionally, rice mill husking was done through either an electric or a mechanical process. In the electrical rice mill, all equipment is powered by electricity. In the husk-fuelled rice mill, the heat combustion of rice husk converts water into steam. In the steam engine, the thermal energy of the steam is converted into mechanical power and the generated mechanical power is used to drive the milling equipment directly without converting it into electrical energy. This is sustainable development through the reuse of waste materials for energy and hence is a sustainable business model.

Since May 2002, Sookkumnerd notes that electricity distributors in Thailand have allowed renewable energy producers of up to 1 MW in size to connect their generators to the power grid. Thus, the renewable energy producers receive an attractive long term and government backed retail tariff rate for the electricity they feed into the grid. The husk-fuelled rice mill consumes only 52.3% of the generated husk from the rice milling process. However, by allowing additional small generators to connect to the grid, additional income opportunities are created for the husk-fuelled steam engine owners. They are able to generate not only mechanical power for the rice process itself, but also electricity for the power grid. Similar cleaner production by the use of Combined Heat and Power (CHP) has been implemented and the appropriate market design has been discussed in various other countries especially in the Nordic and in the former East European countries [10–19].

Furthermore, the entire process is sustainable since a larger amount of husk than 52.3% is converted to energy generation purposes. When steam engines are used with a grid-connected generator, an alternative design concept for a steam engine rice mill is made. Instead of transmitting mechanical energy to the milling equipment, the steam engine is connected to an electricity generator, which supplies the electrical power to the rice mill and also feeds surplus electricity to the utility grid.

In the next paper, authored by Nordheim and Barrasso, sustainable development is discussed in the aluminum industry, from an entirely different perspective. Theirs is a consideration of an entire industry known for environmental degradation and what it can do to be more environmentally friendly. In 2001, the European aluminum industry, represented by the European Aluminum Association through its Executive Committee and General Assembly, embarked on a sustainable development program for those companies active on the European market.

One of the reasons for embarking on such an initiative was to demonstrate that the challenges presented to companies on their social and environmental impacts are clearly signaling an era of heightened accountability and corporate governance. Sustainable development is, in other words, the responsibility of large companies both externally with their surroundings and internally with their management. The industry's objective was to address the issues in an open, inclusive and pro-active, responsible way in order to align the industry with the 21st century standards of corporate governance. Moreover, this signaled a significant shift from passive to active responsibility for the corporate environment.

The aluminum industry initiated the work on sustainability by developing an indicator set (SDI). There were already a number of such available indicators from different organizations. One of the challenges for the individual plants was to integrate sustainable development into continuous improvement of their business processes.

A number of key initial requirements were identified for creating an ''Aluminum SDI'' that included the following:

- not more than 30 indicators in total;
- well-balanced between environmental, social and economic parameters;
- relevant for the aluminum industry;
- relevant for external stakeholders;
- quantitatively measurable and/or qualitatively descriptive;
- possible to aggregate at European level; and
- data available or possible to generate.

In order to progress with these starting requirements, the industry engaged two experienced external institutes. The programs have been established, tested and demonstrated. Now they are being implemented with results measured over a longer period of time. The current plan is to conduct new industry surveys every 3 years, therefore, the next phase will commence in 2006 and will use industry data from 2005. Finally, the European aluminum industry's intention is to ensure that this remains a dynamic and continuous process, and that the sustainability surveys are the basis for a continued stakeholder dialogue.

Investment in renewable energy, financial support and cost-effectiveness is the focus of Toke's paper. The objective of this paper is to assess the effectiveness of the UK's ''Renewable Obligation'' (RO) in achieving two key objectives. The first objective is to have the cost-effective deployment of renewable energy. That is to consider renewable energy a prime goal of society and hence it is backed by the government. The second is to have an effective partnership between the government and business at trans-national and local levels. Thus, there needs to be a discussion of the effectiveness of other renewable electricity procurement mechanisms like those developed in other countries.

The setting of goals like the RO is an important topic since renewable energy is a key part of the strategy to combat climate change and to promote sustainability. Yet, at the same time, there is great pressure to minimize the costs for renewable energy generation. In point of fact, reducing carbon dioxide emissions will cost money but can be mitigated if both government and private companies collaborate for mutually agreed upon sustainable goals, then much can be achieved.

Nonetheless, there are arguments between the public and private sectors about whether the procurement systems should be, for example, ''fixed price'' or market based; and whether one country should move to a pan-European market for renewable energy offering the same incentives to all countries. The continued concern is over costs; which type of policy can achieve greatest deployment at least cost? Given that the Renewable Obligation (RO) is the largest functioning green electricity market system for renewable energy, it is important to assess its effectiveness according to different criteria. RO penalizes suppliers for not meeting their quota to supply renewable power. Hence RO Certificates (ROC) have been created and perhaps can be traded.

Other countries, regions and states have similar programs but often without enforcement or regulation. Many US states have Renewable Portfolio Standards (RPS), which are either backed with long-term government contracts or enforcement for delivery of supplies.

In Germany, there are the Feed in Laws (REFIT) which use capital costs to offset tax incentives. They provide long-term agreements and guarantees. The concept of a pan-European green electricity market is interesting but difficult to implement both equally and fairly, as the markets develop and government enforcement is sporadic. The problem with nationalism, as Toke notes, is that it leaves, as has been found in the US, most of the pro-active programs for renewable energy to the local levels where policies can best be overseen and ownership is local.

The next paper addresses the regional approach to power generation and hence sustainability in communities and nation-states. It's authors Andersen and Lund discuss Combined Heat and Power (CHP) as partnerships for balancing renewable production and therefore, being more sustainable in both business operations and environmental mitigation contexts. European Energy Policies have given priority to the fight against global warming and promotion of sustainable development. Both energy efficiency and the development of new and renewable energy technologies are considered key elements in the change. They are the challenge in Europe, if it is to meet or extend the Kyoto Accords. Thus, replacement of boilers and power stations with CHP-units and an increase in the share of Renewable Energy Systems (RES) in the energy supply are objectives to the European Union and the need for integration of the two have previously been investigated [15–19].

The implementation of such policies results in an increased share of distributed power generation. Regions, communities and areas including farms and shopping centers are more likely to have much higher than the average of CHP-units and to therefore, achieve RES standards. For instance, the objective of increasing the average share of RES electricity production to 22% is distributed among the EU member states resulting in RES percentages between 6 and 78%. Meanwhile, large-scale integration of RES and distributed generation raises the problem of finding balance between electricity demand and production. The EU targets for the deployment of CHP and renewable energy will only be achieved if this balance can be found throughout the EU.

In the final paper, Clark argues for partnerships to form sustainable agile communities since sustainable development is far more likely on the regional level. According to Clark and Bradshaw ‘‘Agile energy systems’’ [9] are flexible and adaptive to change effectively and efficiently for sustainable economic, environmental and social benefits that impact the triple bottom line. The formation of a new association of agile communities, cities and nation-states is useful to plan public policies and to create the ‘‘government market drivers’’ for procurement, long-term contracts and coordination of public resources for renewable energy onsite and central grid power generation.

Governments, at all levels, need to implement public policies that create and oversee ‘‘agile communities’’. In short, governments must recognize the diversity of communities not only in terms of energy needs, but also in identifying the sources of energy production. In every region and community of the world, there are different strengths in natural and sustainable sources for energy.

In the end, agile communities must also develop waste, water, transportation and telecommunications for their regions. These communities need to be interconnected with other communities, which redefine the conventional central power plants that exist today. The historical role of central energy plants must change. Downsizing, providing back up and redundant power, onsite energy generation, among other things, are new and different roles for ‘‘public’’ and now ‘‘private’’ power utility companies. Today, the immediate transition to the agile communities will be difficult and painful (smaller companies mean reduced workforce and income), but necessary for a less polluted environment and for cleaner, more sustainable world for tomorrow’s generations.

2. Conclusions to the roads along the pathway

Popular magazines and professional journals are increasingly recognizing the need to consider sustainable development at all levels. Here, we have presented a set of papers that cover issues concerning sustainable development in communities, regions, manufacturing and corporate associations. Everyone is attempting to tackle the issues within the global and institutional concerns set forth in the late 1980s. With UN, Kyoto, US states (like California since the US national government has not complied), and EU mandates, partnerships are forming that address the solutions to global warming and climate change. Sustainable development can be a large part of the solution to these facts about the earth.

Könnölä focuses on the voluntary changes needed from market forces that have evolved from governmental regulations. The ‘‘lock-in’’ barriers to the hydrogen economy can be significant. The debate is basically, as Jeremy Rifkin argues, between ‘‘black and green hydrogen’’ [20]. The former is reformulated from fossil fuels, coal and nuclear sources; while the latter is electrolyzed from renewable energy sources such as water, geothermal gases or electricity from the sun, wind or biomass. In the end, voluntary changes will not be enough in terms of consistent policies that are made and enforced as well as in monetary support via long-term contracts, standards and enforcement.

The discussion by Sookkumnerd on rice husk as a renewable energy source is significant on many levels. The fact that waste from a process can be part of a solution, in this case renewable energy for the mill, illustrates how sustainable business operations can work, be cost effective and friendly to the environment. What is even more significant is that the concepts are not costly or even ‘‘advanced’’ technologies. The internal rate of return is excellent. And there is extra power that is sold from the rice mill plant to others in the surrounding community. The argument is to simply look at and understand a problem (waste and energy) and finding practical solutions.

Nordheim and Barrasso demonstrate that the aluminum industry is committed to the concept of sustainable development and is prepared to show its stakeholders how the industry is progressing to establish and use a set of indicators that are relevant for their particular industry. With the experience gained from their first survey and the recent round of stakeholder workshops, the industry is in the process of refining its indicators to fulfill the following recommendations: eliminate certain indicators deemed to be less relevant and difficult to answer, and to include certain indicators agreed upon during the stakeholder’s discussions where some felt it important for the industry to report.

Toke’s discussion of renewable energy costs with reliance on procurement mechanism and ‘‘combination of incentives and tax regimes’’ is critical to achieve sustainable energy sources. Market-based schemes create limited, protected markets for renewable energy. Governments must obligate the suppliers to produce ever-increasing portions of their electrons from renewable generation. As Toke puts it, ‘‘Just because we set up a market, this does not mean this will be a perfectly competitive market where Adam Smith’s ‘magic hand’ conjures the most resource-efficient outcome. On the other hand, experience suggests that well-designed, market based obligation procurement regimes, can work effectively’’. As an article in the Economists noted ‘‘Large bits of Britain’s power-generation capacity will disappear over the next decade. That will test the government’s commitment to markets’’ [21]. But the government’s test of markets is to set the goals and obligate businesses to achieve them or be penalized. It is difficult to impose RO or RPS all over the EU or the US let alone in Asia and other areas around the global. But local and regional goals for sustainable power generation can be and are being set, met and audited.

Andersen and Lund discuss how these regional and community goals can be met. The focus on energy base load and intermittency has been resolved. Both CHP and renewable energy are important parts of European climate change policies toward sustainable development for everyone. CHP is a very efficient way of transforming fuels into energy services. A number of studies have investigated the methodologies of optimizing different CHP technologies in relation to variations in the district heating demand and energy conservation in buildings. Such studies have also included the development of models to optimize the use of heat storage capacities into the operation. However, the issue is for renewable energy CHP to be base load. Communities and individual (residential, business, and public sector) customers must have reliable energy supplies. However, renewables are rated as being intermittent. That is, the sun does not always shine during the day and is not available at night. Wind is even more problematic. Hence CHP as a combination of technologies with renewables (or hybrids), they can solve the base load problem [22,23].

The introduction of CHP plants into the electricity market helps the process of integration of fluctuating electricity production from renewable energy sources. Such solutions call for new organizational setups and partnerships, for software tools to be used in small and medium sized CHP. These local plants enable the combination of technologies to act as if they are "hybrids" and hence "virtual big power plants". The Andersen and Lund paper presents the principle methodologies and tools for calculating such partnership bidding prices for regulating the power market. This process allows for the new partnerships to offer services to regional and local electricity markets, which are currently only offered by big power plants.

Clark addresses the California energy crisis and similar energy crises globally to make it clear that extreme public policies: (a) regulate versus de-regulate; and (b) public ownership versus privatization/liberalization are not the answers to sustainable development [24]. These simplistic economic theories provide misleading policy approaches that miss the actual needs of communities and environmental concerns of society itself [25]. Infrastructure systems play a critical role and must be a combination of both public and private concern, ownership, finance and operations [26,27]. Such an approach has become known as creating a "civic core" and hence the need to have "agile systems". These local energy systems encourage and can meet public standards, help to establish and enforce rules based on public oversight.

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