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MATHEMATICAL, PHYSICAL & ENGINEERING SCIENCES

Financial investment and environmental performance

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Financial investment and environmental performance

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The organizers of this discussion meeting have aimed deliberately to review the scope for clean technology in activities which span both the private sector and the public sector. Dr Ekins has analysed the wider aspects and implications of the economics of clean businesses in the preceding paper. This paper will survey some of the factors which are considered by companies and public utilities when justifying financial investment in selected programmes designed to improve environmental performance. Accountability demands, in both the private and public sector, that there should both be a return on each investment though the yardsticks might differ.

1. Financial investment

For operating companies and utilities in the public and private sector there are broadly three scenarios for the introduction of clean technology: (a) to minimize waste arisings, effluent and the energy input within the factory or operating unit, i.e. mainly 'end-of-pipe' solutions; (b) to change the overall process technology using less of the same raw materials and less energy; and (c) to change raw materials, process, etc., to make a redesigned environmentally friendly product.

In figure 1 (Clift 1995), the inner box 1, designated by a broken line, depicts the scope of (a). Scenario (b) might well include some materials processing as shown in box 2. The scope of (c) covers the whole of the diagram.

For each scenario, once the technical requirements are specified, the financial investment can be determined and the business risks assessed using accepted methodology. In general the financial investment and the risks will increase as scenarios 1–3 are addressed.

In scenario 1, there may be a net return based on lower raw material and energy costs with few risks associated; a payback period may be estimated.

Scenario 2 can also be costed with some certainty if the clean technology new to this application has been used in other processes. If not, there will be additional development costs and additional risks associated with the new process. The financial investment is likely to be higher than for 1, but the procedures for assessing overall cost and reasonable contingencies will be familiar to the company or public utility.

In scenario 3, research and development will be required for the clean process, and for the design of the new product to be environmentally friendly. The robustness of supply and cost fluctuations of the new raw materials also will demand careful analysis. Private and public companies are used to making decisions on financial investments of this kind in familiar business areas. The situation compares with the judgements which have to be made when introducing a new product and/or a new

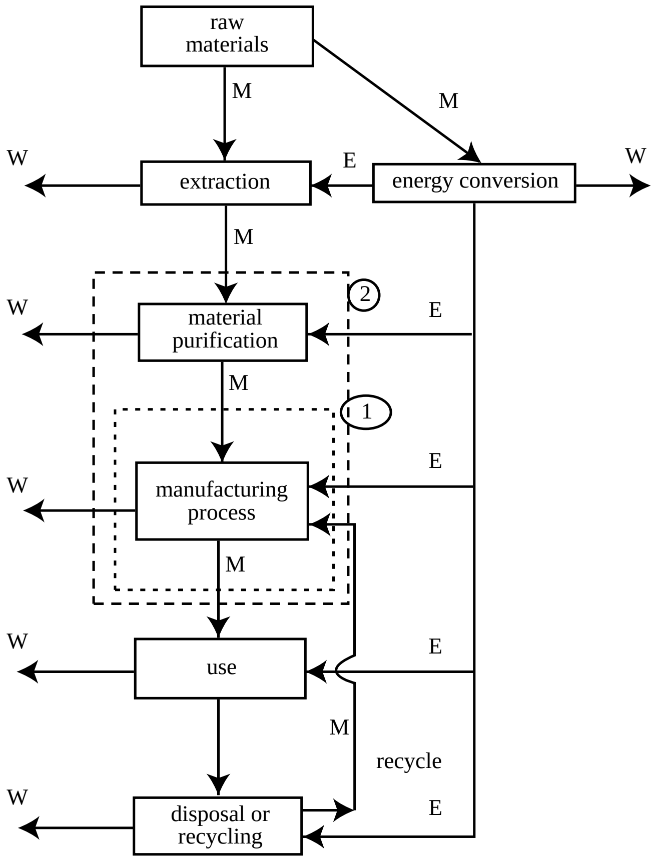

Figure 1. Life cycle assessment. W, waste; E, energy; M, material flow.

process. There would have to be a compelling reason or a major business opportunity to make such a fundamental change.

In each scenario, once the decision to invest is made, there are well understood practices for monitoring the progress of the investment and signalling if the project is deviating from the set course. Indeed, it is now common practice when judging such a capital proposal to use a 'challenge' technique to ensure its cost effectiveness. This involves a scrutiny of the project and its costing by an internal or external team qualified to determine whether the proposal is not overdesigned or overcomplicated to provide the final product at the quality specified. Normally the challenge team would not be allowed to change the specification of the final product, but rather be given the task to ensure that only essential unit operations are included in the most effective sequence in the overall process. Real savings of the order of 5–10% of the capital investment can often be made using this technique.

2. Environmental performance

Competitive pressures in business, the cost of capital and years of experience with operating companies have ensured that there is a strict discipline attached to the assessment and realization of financial investment. By contrast the methodology by which environmental performance is measured is still evolving. Governments

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are still discussing appropriate standards, regulation and legislation on a national or regional and sometimes a global basis and there is uncertainty about timetables for implementation. Even the determination of 'best practical environmental options' on individual industrial sites often involves confusing three-body collisions between government, industry and pressure groups, each supported by independent, and sometimes conflicting, technological information.

A company considering a financial investment can set it in the context of its overall financial strength and commercial performance and then make a measured decision. Assessment of the corresponding impact on environmental performance is still very difficult (Moilanen & Martin 1996) given the present state of development of methodology and accumulated experience. A company may well be able to judge quantitatively the 'end-of-pipe' technical improvement with respect to a particular process or the improvement of a product. However, it is not always easy to determine the impact of the process improvement on the locality. We are not yet at all well placed to assess the impact on the overall environmental performance of the company across its range of products and processes. There is an extended and complex chain to be considered encompassing the sourcing of raw materials, manufacturing operations, impact of products in their use and their ultimate fate.

As we have heard from Professor Alting, 'life-cycle assessment' is a decision support tool for this purpose and he has demonstrated its use in product development. It is now being developed by ISO following the lead of the Society of Environmental Toxicology and Chemistry (SETAC).

Life-cycle analysis is defined as: '*a process to evaluate environmental burdens with a product or process by identifying and quantifying energy and materials used and wastes released to the environment; to assess their impact and to evaluate opportunities to effect environmental improvements. The assessment includes the entire life-cycle of the product encompassing extracting and processing raw materials, manufacture transportation and distribution; use and reuse, maintenance recycling and final disposal*'.

Life-cycle assessment is thus meant to be an environmental total system analysis. It focuses on an economic unit, fed with materials and energy which produces goods and/or services and also extraneous material in the form of waste, emissions, heat, etc. The economic unit together with the environment which surrounds it can be considered as a thermodynamic system.

The analysis of the operating unit surrounded by its environment usually proceeds in four stages:

(i) goal definition and scope, which defines the unit and system to be studied, the problem to be tackled and the methodology appropriate for the scope of the study;

(ii) inventory analysis, which quantifies resources used and the wastes generated;

(iii) impact assessment, which converts the inventory data into a number of environmental impacts; and finally

(iv) improvement assessment, by reducing resources used, wastes and emissions.

The assessment requires a great deal of information regarding the process and the quantification of all the flows which cross the boundary of the economic unit, i.e. materials and energy in, waste out. The inventory table derived from step (ii) will contain many entries. Impact assessment then requires in stage (iii) a great deal more additional information relating to local, regional and in some instances (cf. ozone layer/chlorofluorocarbons) global conditions. Necessarily the process is iterative, so that as the analysis proceeds earlier stages need to be revisited, modified

Table 1.

themes	safeguard subjects
abiotic depletion	biodiversity
energy depletion	productive capacity
global warming	human health
ozone depletion	resources
aquatic/terrestrial ecotoxicity	aesthetic values
acidification	
human toxicity	
photochemical oxidant creation	
nutrification	

and hopefully refined. There is an urgent need to simplify this form of analysis if it is to gain wide use in assisting companies at board level to make investment decisions, just as there is an urgent need for governments to clarify environmental legislation and to set agreed targets for the various environmental burdens.

Because of the complexity of the total system for a given cycle and because life-cycles intersect we are far from achieving a useful *modus operandi*. Not much is written about simplification. However, Clift (1995) has proposed that in the economic unit which is subject to the decision under consideration, the 'foreground system', be described by quantitative primary data. The 'background system' which supplies or removes materials and energy from the economic unit but which is not part of the decision on the other hand is described by generic averaged data. This concept would simplify especially steps (iii) and (iv). If handled with care it would not produce gross distortions, but still it has to gain acceptance.

In the Netherlands simplification has been sought via a problem oriented approach by identifying nine general 'environment themes'. In Sweden the 'environmental points system' is an environmental accounting approach which identifies five 'safeguard subjects'. However, the results of these analyses are usually as uncertain as in the more general LCA approach and the latter is probably more useful at the strategic level. See table 1.

Hopefully a methodology will evolve from LCA which will enable judgements to be made on whether the introduction of a defined piece of clean technology will move the prevailing environmental conditions substantially closer to the desired targets, and be developed further to allow informed choices between different options. Only then we can begin to correlate financial investment with a considered view of environmental performance. The evidence from preceding papers at this meeting is that progress is being made. A useful perspective of the current 'state of the art' as it applies to the use of fuels for energy genertion has been given recently by Clift (O'Brien *et al.* 1996).

3. The commercial case

Even though we are at a rudimentary stage in estimating environmental performance it is clear that other factors, not always quantifiable but which bear on environmental performance, also drive the investment in clean technology.

(1) Every private company and public utility has a natural aim to continue its profitable enterprise and where there are obvious environmental problems will endeavour to take appropriate action, if only to stay in business.

(2) Public perception especially in developed countries is increasingly sensitive to environmental issues surrounding major processes and will move companies, utilities and governments into concerted action to clean up their activities.

In the non durable consumer goods areas, retailers (usually supermarket chains) are alert to customer perceptions reinforced by reactions to eco-labelling. They do not hesitate to pressure their suppliers to comply with the perception.

(3) Promotions by virtue of advertising the final product as being environmentally friendly, may at first sight seem to be a secondary factor driving improved environmental performance. Indeed the National Consumer Council (1996) recently has doubted the soundness of some of these advertising campaigns. Having made a considerable investment in the design and advertising of an environmentally friendly final product, be it a car, computer, telephone or another semidurable consumer item, there is clear evidence that pressure to improve environmental performance is relayed down the supply chain by the final product manufacturer. The component suppliers in the chain have little option to comply or look elsewhere for business.

Thus the desire to stay in business long term, the presentation and perception of the product are factors which trigger financial investment in clean technology in some instances with only a qualitative assessment rather than an attempt at an in-depth quantitative analysis of the impact on environmental performance.

Perhaps we should not be surprised that unquantified factors are significant in favouring the introduction of clean technology. After all, although the setting of environmental standards often begins with technological measurements, taking account of erratic dispersion of the burden or uncertain degrees of exposure, together with the application of the precautionary principle and 'safety factors' causes the standard set ultimately to be influenced by qualitative rather than quantitative factors.

4. Prospect

The evidence is that the private and public sectors take the acquisition of clean technology increasingly seriously. The European Union and its member states have begun to generate a flow of environmental initiatives of increasing importance. Enforcement is variable but in certain sectors industry has set its own agenda sometimes in response, sometimes ahead of these initiatives.

Consider for example the figures produced by the Trade Association of the Dutch chemical companies (VNCI 1993). Figure 2 shows that investment in clean technology has risen steadily over the past 10–15 years irrespective of the profit performance of the sector. In the same period, figure 3 shows that the energy consumption index has remained rather steady whilst the production index has risen 50%. Judged by the per cent of investment devoted regionally to environmental improvement, the US chemical industry leads, as figure 4 shows.

There is rarely agreement on the pace at which the introduction of clean technology should proceed or on priorities and as we have seen, there is much to be done to develop methodology to estimate improved environmental performance. Some other relatively simple operational improvements are required if we are to improve our ability to manage our environment. For example our competence to monitor emissions and effluents at source and their dispersion over longer distances is often not

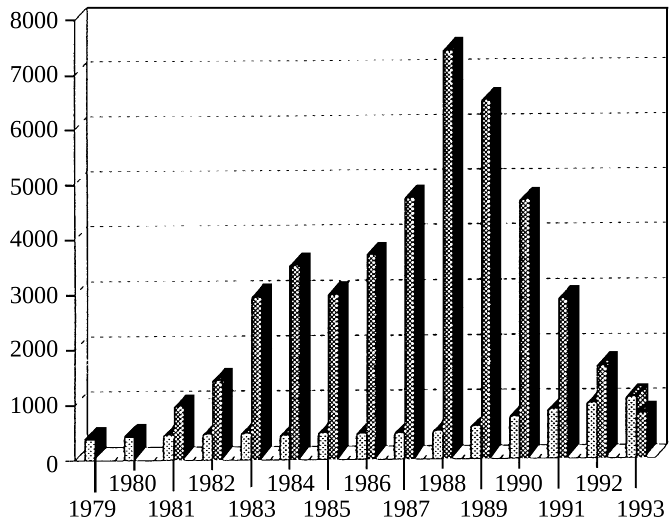

Figure 2. Environmental spend against profit (guilder).

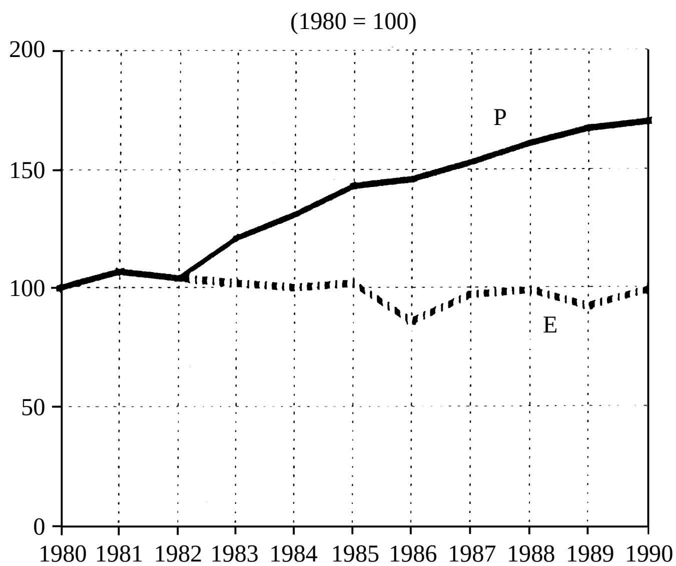

Figure 3. Energy and production index.

as good as we suppose. There is scope for new techniques, methodology and a more comprehensive network of meters and monitors.

Governments must find simpler and more effective ways of working together with industry so that priorities can be set and the evolution of a sustainable society begun. The public are increasingly concerned and it behoves government, industry and also the environmental pressure groups to base their arguments on accurate data and avoid misleading distortions; to work together to recognize and promote good practice where it exists; to articulate their cases forcibly without sensationalism or extreme speculation. There is sufficient acceptance of the need to actively preserve the environment, that persuasion can be more effective than confrontation in catalysing responses from government and industry to pressure group agendas. This

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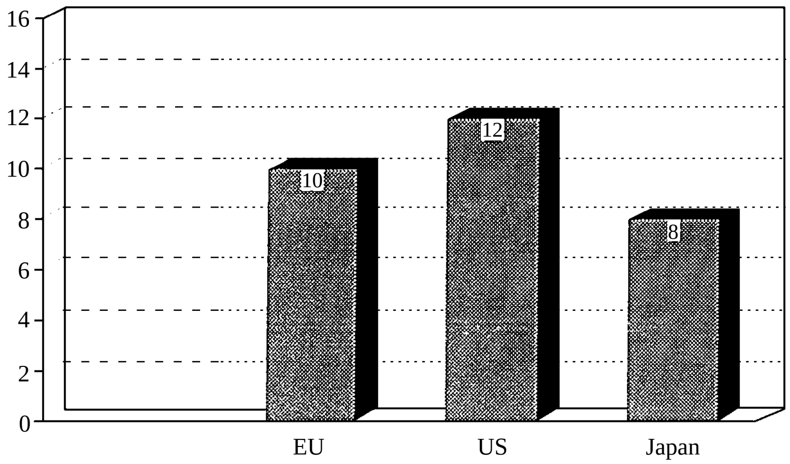

Figure 4. Environmental investment against total investment (percent).

would provide a more robust setting for environmental assessment methodology to evolve and influence the scale and direction of financial investment in environmental performance.

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