

Intelligent manufacturing and environmental sustainability

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Abstract

The definition of sustainability which is generally adopted is: “meeting the needs of the present generation without compromising the ability of future generations to meet their own needs” (World Commission on the Environment and Development, 1987. Brundtland report). The EU MDG7 report, describes environmental sustainability as: “...meeting current human needs without undermining the capacity of the environment to provide for those needs over the long term...” (UN, 2005a). Over the past decade public concern about sustainable development has profoundly transformed attitudes and to a lesser extent practices in manufacturing industries. A sustainable approach to design and engineering involves evaluating where a product or system has the greatest environmental impact and then prioritising strategies which reduce that impact. There is hardly any industry sector in which the management of environmental sustainability is not of significant relevance. The degradation of pristine ecosystems, global warming, and unprecedented energy usage, has become key issues for all of earths ‘tenants’. It is essential that all facets of design and manufacturing take action on environmental sustainability concerns through appropriate strategies, and endeavour to implement standards such as the ISO 14001, and accommodating related legislation as a foundation for sustainable manufacturing. This paper discusses the sustainability challenges of the industrial world, the sustainable management issues they face, and the strategies they might employ, while maintaining corporate responsibility and gaining competitive advantage.

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1. Introduction

The Brundtland report (1987) is now 20 years old, and its definition of sustainability is now more urgently in need of addressing than it was back then. The seemingly alarmist predictions of the sustainability minded are now accepted by most thinking people, inside and outside industry. The report defined sustainability thus: “meeting the needs of the present generation without compromising the ability of future generations to meet their own needs” (World Commission on the Environment and Development, 1987). However, we now need to consider sustainability of energy and consumables in the context of this generation and protecting the Earth from the ravages of human mismanagement. Global warming and resulting climate change, and sustainable energy are two of the most important environmental challenges facing mankind. The

manufacturing and consumer industry has a very significant part to play in responding to these challenges.

2. Fossil fuels

2.1. Oil reserves and usage

Bioscience says: “On average, every year each American uses about 93,000 kWh [of power], equivalent to 8000 l of oil, for all purposes, including transportation, heating, and cooling.” The estimates on oil reserves vary considerably, however the experts do agree that the peak of production may have, as predicted by Hubbert’s more than half a century ago, been reached, while consumption continues to climb. The world consumes 75 million barrels of oil a day. Of the world’s total oil reserves, which are estimated to have been some 2 trillion barrels in volume, approximately 900 billion barrels have already been consumed. At present production rates, oil supplies are predicted to last another 40 years.

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Geologists Campbell and Laherrère claimed in 1998: “Within the next decade, the supply of conventional oil will be unable to keep up with demand.” A very important factor in considering the extraction of what is left of oil reserves is the rising energy requirements to achieve this. In the early 1900s this was about 1 barrel of oil per 100 barrels harvested; however this has increased at least 10-fold. A huge influence on energy usage, including oil consumption is the worldwide growth in population. In 25 years there has been an almost 50% increase in population (Fig. 1).

These oil-industry experts warned: “Conventional wisdom erroneously assumes that the last bucket of oil can be pumped from the ground just as quickly as the barrels of oil gushing from wells today. In fact, the rate at which any well—or any country—can produce oil always rises to a maximum and then, when about half the oil is gone, begins falling gradually back to zero. From an economic perspective, when the world

runs completely out of oil is thus not directly relevant: what matters is when production begins to taper off.” When is oil production expected to taper off? Petroleum geologist Joseph Riva says that “planned oil production expansions ... are less than half that needed to meet the 2010 world oil demand projected by IEA [International Energy Agency].” New Scientist warns: “If production rates fall while demand continues to rise, oil prices are likely to spike or fluctuate wildly, raising the prospect of economic chaos, problems with transporting food and other supplies, and even war as countries fight over what little oil is available” (from Awake [1]). While the Western world continues to use oil at unprecedented rates, the new giants of industry, China and India are only ‘cranking up’. Fig. 2 below shows the estimated world oil reserves. However, any increase in production is almost instantly absorbed by rising economies, as well as population increase.

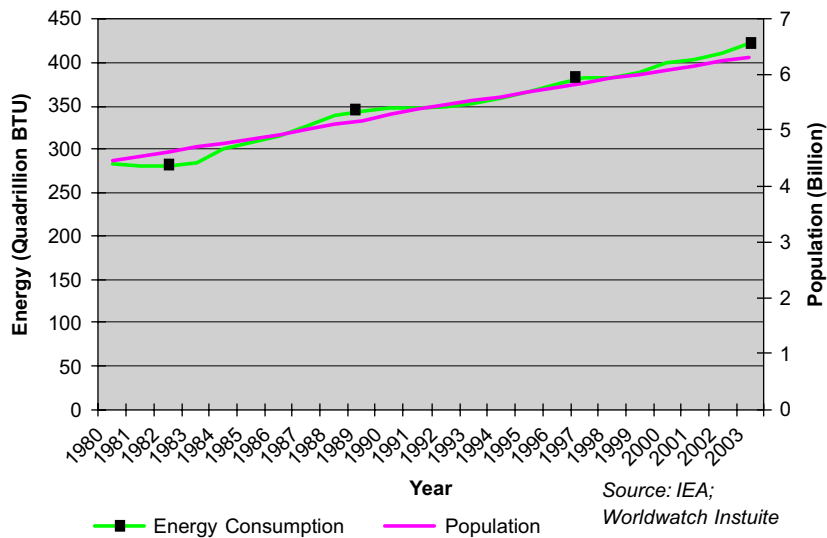


Fig. 1. Energy use and population rise.

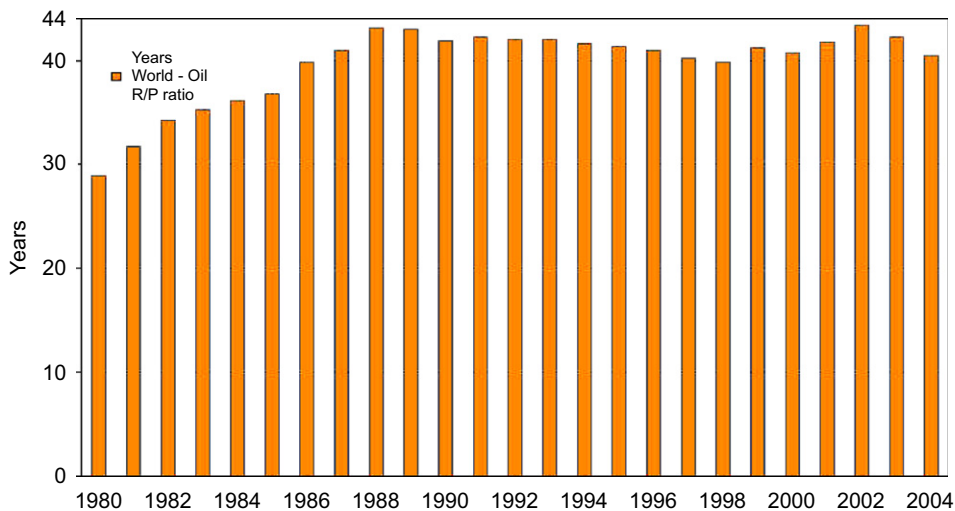


Fig. 2. World oil reserves (BP tactical review of world energy June 2005 [3]).

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