US President Bill Clinton has said that the challenge of attaining sustainable development can only be met by developing and deploying technologies that will protect the environment while sustaining economic growth.

ESTs and future challenges 15

The wider use of existing environmentally sound technologies (ESTs) would bring major environmental and economic gains, particularly in the shorter term. Yet there also remains a pressing need to develop new, more advanced EST solutions to a wide range of problems, still low on the agenda, but certain to become urgent. What are the main environmental challenges ahead, and what are the technology needs?

Without environmentally sound technologies (ESTs), the world would be in a much worse state than it is. And if available end-of-pipe and cleaner production ESTs were used more widely, in both the industrialized and the developing countries, it would be in even better shape. It is important to recognize what ESTs have already achieved, as well as how much more they could achieve in terms of further significant environmental gains and economic benefits. It is also important to recognize that many problems persist not because there are no technological solutions, but because those solutions are not being applied.

Of course, the ultimate goal, agreed on at the United Nations Conference on Environment and Development in Rio in 1992, is sustainable development. The global community, however, is still falling a long way short of reaching it. Agenda 21 is nowhere near complete, and it will take a major effort, involving fundamental changes, not just tinkering at the edges, to finish the job. However, making even some progress on Agenda 21 will depend both on getting existing ESTs more widely adopted by industry and others, and on the development of a number of new technologies.

The list of future environmental challenges is a daunting one. The focus will be increasingly on preventing pollution, although control technologies may still be used to bridge the gap. The key challenges fall into several major areas, including:

- air quality;
- energy efficiency and climate change;
- toxic substances and hazardous and solid wastes;
- water resources;
- resource use and management.

New prevention and control technologies are needed to deal cost effectively with local and global air quality problems such as air toxicity, indoor air pollution, acid deposition and ground-level ozone. Today's technologies are inadequate to resolve the problems of greenhouse gas emissions and global climate change.

The key to solving the problems of climate change and energy efficiency will be new technologies that reduce energy requirements. Other measures include conversion to low-carbon fuels, reducing emissions of greenhouse gases and, particularly in developed countries, infrastructure developments to improve energy efficiency in road vehicles, lighting and heating. The energy-inefficient infrastructure in Central and Eastern Europe badly needs improving, while developing countries need to develop low-carbon energy sources.

Pollution prevention will play an increasingly important role in reducing toxic and hazardous wastes at source. Toxic substances are found in the wastes produced by industrial and combustion processes, and also result from accidental

At humankind's peril, grace has been divided from nature and spirit from matter.

A society has developed where everything from human habits to politics and economics exploits the environment with callous indifference. Unless the nature of the state is harmonized with the state of nature, humanity's greed and ignorance will eventually take us beyond the capacity of the very ecosystems that support human existence.

Ecology would suggest that spirit, soul, consciousness and creativity are part of the mystery of evolution, not outside the process, and that creation is ongoing, not simply an epic event in our past.

ENVIROTECH LTD. is a private sector consulting and project management company, whose purpose is applying technology and scientific engineering and know-how to reverse degradation of the environment, prevent pollution and minimize waste.

BOX 15.1

New technologies needed: air, energy and waste

To improve air quality

- New building materials and consumer products that minimize adverse impacts on indoor air quality.
- New cars and trucks that emit fewer pollutants, and transport systems redesigned to address the increasing number of vehicles on the roads.
- Renewable energy production technologies capable of displacing fossil fuel combustion.
- Redesigned industrial and chemical production technologies with inherently low potential for air emissions.
- High-efficiency fossil fuel power plants that substantially reduce emissions of pollutants.
- New technologies to reduce wind erosion of soils and air pollution by dusts and airborne particulates.
- Cost-effective, efficient particulate, air toxicity, sulphur dioxide and nitrogen oxide control technology capable of being retrofitted to existing power plants.
- Low-cost technology to control volatile organic compounds from small stationary sources.
- Cost-effective nitrogen oxide control technologies for residential, commercial and small industrial combustion systems.
- Controls to mitigate critical air toxicity compounds from major sources such as incinerators, wood stoves and iron and steel production.

To improve energy efficiency and deal with climate change

- Accelerated commercial development of renewable fuels and technologies.
- Improved thermal efficiency of coal-fired plants through clean-coal technologies.
- Improved coal-gas, natural-gas and hydrogen-based fuel cells.
- High-efficiency advanced gas turbine systems.
- New on-board vehicle technologies and materials, and improved efficiency of vehicles powered by alternative fuels.
- More efficient lighting and heating systems for residential and commercial buildings.
- Increased industrial energy efficiency through improved electric motors, recycling of used materials and co-generation.
- Substitutes for CFC-12 in automobile air conditioners, further development of refrigerant replacements, and new materials to replace CFC-blown foam insulation.
- Technologies to reduce or capture methane emissions from natural gas flaring, venting and leaking during oil production, and from coal seams.
- Improved technologies for collecting and purifying landfill gas.
- Technologies for recovering nitrogen oxide emissions.
- Cost-effective methods of re-using and recycling chlorofluorocarbons (CFCs), and incinerating them.

To deal with toxic substances and hazardous and solid wastes

- Pollution prevention-based processes for alternative energy sources and cycles.
- Pesticides and fertilizers based on improved chemicals and biotechnology, alternatives to non-selective chemical pesticides, and implementation of targeted application of fertilizers.
- Alternative chemical synthesis routes that use less toxic feedstocks and cause less toxic chemical intermediates and waste products.
- Advanced systems for effluent treatment of toxic substances formed during chemical synthesis and combustion, mineral extraction and manufacturing processes.
- Advanced sewage treatment systems capable of handling toxic organics using an engineered anaerobic, energy-efficient digestion stage and other biotechnology-based systems.

chemical discharges. Generally speaking, hazardous wastes are controlled mainly by end-of-pipe technologies which separate them from waste emissions and effluents and treat them for final disposal, either by burning or burying. The need is to employ ESTs which:

- avoid toxic and hazardous substances where their use is not essential;
- minimize waste formation, and promote recovery, recycling and re-use;
- achieve cost-effective management of non-recycled wastes and their disposal.

The environmental challenges facing the world require a political as well as a technological response – including a wider application of economic instruments to internalize environmental costs and a change in both corporate and individual behaviour.

Sustainable Water Development: the STL-Merit Way

Water is an increasingly precious resource. Through its innovative participation in the water sector, STL-Merit Limited is working to ensure that supplies in Ghana and other African countries are sustainable.

STL-Merit is active in most areas of the water supply industry – as a provider of water for small, medium- and large-scale schemes, through handling packaged water treatment plants and large water treatment installations, and sewerage and wastewater systems, and through working with multinational companies to supply water delivery projects in rural areas.

STL-Merit has equity participation in a joint venture water drilling and engineering unit with the Ghana Water and Sewerage Corporation (G.W.S.C.), and is discussing with authorities in Zimbabwe, Cameroon, Guinea and South Africa, the possibility of replicating their water delivery strategies. It is also sponsoring an international water export transmission line to carry treated water from Ghana to neighbouring countries. STL-Merit is also working to develop capacity-building skills in Ghana and West Africa – sponsoring human resources development programmes, and working with a UK specialist water industry training association, to develop G.W.S.C.'s training facility into a regional institute for water supply and sanitation training.

STL-Merit knows that water is a resource that must be utilized in a sustainable way. In putting its knowledge of the water supply – in Ghana in particular and Africa in general – at the disposal of other companies interested in becoming active in this market, it is determined to implement this philosophy in all its projects.

STL-Merit's solutions to a serious water problem for a major municipality in Ghana demonstrate its commitment to environmental sustainability. The present water source is highly polluted, suffers from seasonal drought and can only meet 45 percent of current demand.

The short-term solution to meet the present water shortage involves drilling various boreholes and fitting them with mechanized pumps to deliver water to the existing distribution network. This system virtually eliminates the need to use water treatment chemicals – and the pumps are driven by solar energy.

The long-term solution to meet future demand involves drawing water from a new surface source through tube wells along the riverbed, instead of directly from the lake. This system takes advantage of natural water filtration and purification, and eliminates flocculating agents.

STL-Merit is also developing a programme to make the catchment area of the river serving the existing water treatment works environmentally safe and sustainable, addressing problems of waste material dumped in the river and deforestation along its banks.

Mr. Steve Mawuenyega,
Executive Director
STL-Merit Limited
PO Box C35 Cantonments
Accra, Ghana
Tel. (233) 21 779500

BOX 15.2

New technologies needed: water and resources

To improve water quality and supply

- Technologies and practices that prevent agricultural contamination of groundwater.
- Alternative technologies for bleaching techniques that avoid dioxin production.
- New manufacturing processes that limit the production of toxic by-products.
- Cost-effective technologies to conserve water in industrial, agricultural and residential applications.
- Improved desalination technologies.
- Technologies for improving the control, removal or degradation of toxic contaminants that are present in low concentrations in wastewater.
- Improved capability to detect the movement of toxic chemicals into groundwater from other sites.
- More effective nutrient removal technologies for wastewater, agricultural runoff and other non-point sources.
- Technologies for improved biodegradation of organic pollutants.
- Polishing technologies for diluting aqueous industrial wastes following membrane and biotreatment.
- Improved membrane technologies for drinking water.
- Cost-effective, low-tech treatment systems for use by small utilities.
- Advanced technologies for recycling and disposal of biosolids and other residuals, industrial recycling of process water, recycling and re-use of household water.
- Cost-effective treatment and preventive technologies and practices for reducing urban runoff.

To improve resource use and management

- Shortening of both extraction and processing chains to produce advanced minerals in a single operation.
- New materials and products that can be fully recycled so that all wastes are re-usable.
- Recycling technologies using cellulose-based materials to reduce carbon dioxide release.
- Long service life materials (advanced metals, composites, ceramics) that can be substituted for conventional materials.
- Pollution reduction technologies that convert sulphur in coal into re-usable products.

Both renewable and non-renewable resources must be managed much more efficiently. About 75 per cent of all extracted minerals are non-renewable. The need is to find technology solutions that conserve the mineral stocks already in circulation, thereby reducing demand for virgin resources and the environmental damage due to extraction. These technologies include processes that minimize pollutants and recycle wastes internally, make mineral-based products more durable, repairable and re-cyclable, and improve energy efficiency. The need for new technologies to protect water resources, improve their quality and reduce their cost is also urgent.

Agriculture is another major source of pollution problems in many developed countries. In other parts of the world, point source pollution, for example from industrial and mining wastes, is equally serious. Non-point source runoff is a serious issue everywhere. Engineering solutions alone do not work: the answer will depend on technologies and practices that combine ecological know-how with engineering capabilities. Bringing down the cost of water and wastewater treatment is one of the biggest challenges. Reducing the cost of existing technologies or finding other cheaper approaches are essential to ensure safe, adequate water supplies.

STARTECH
ENVIRONMENTAL CORP

PRODUCING THE POWER OF THE STARS
FOR A CLEANER AND SAFER ENVIRONMENT

A 21st century solution to waste problems

Waste is perhaps the most visible sign of our mistreatment of our planet – our most conspicuous footprint. Our throwaway society generates mountains of waste materials – of all kinds and in all shapes and sizes. All of the waste we create is an affront to the environment: much of it is also deadly.

To date, waste has been treated mainly by burning, or burying in the ground. But those days are over. Now, there is a 21st century solution: Startech Environment Corporation's Plasma Waste Converters (PWCs), which remediate and recycle a range of wastes into useful commodity products.

PWCs use a process of molecular dissociation – also referred to as Closed Loop Elemental Recycling – to tackle hazardous and non-hazardous wastes, organic and inorganic solids, liquids and sludge. They can even handle medical wastes, tyres, contaminated soils, and hazardous aqueous liquids.

Depending on the waste feed, the clean, electrically-driven PWCs can produce a synthesis gas, Plasma Converted Gas™ (PCG), as well as metals and silicates, as commodities. PCG can be used in many ways, including as a fuel to produce electricity, as a chemical feedstock to produce chemical industry products, and for powering heating and cooling systems.

Startech's solution is capturing customers' imagination.

★ A new $100 million, world-class PWC Resource Recovery Centre being built for a consortium of municipalities in Puerto Rico will handle 1,000 tons of solid municipal waste per day when it is completed in 1999.

★ One of Australia's leading companies engaged in eradicating hazardous wastes is buying the Startech systems for its operations – and plans to present the service to the Australian Government for the clean-up preparations for the 2000 Olympics.

★ A 5,000 tons a year medical waste facility in Massachusetts, USA, will provide the health care industry with major cost savings, as well as improving public health and safety.

★ Self-contained, mobile PWC units are being incorporated into various semi-trailer and self-propelled mobile configurations produced by a US company, so that they can process hazardous waste on health care, military and industrial sites, ensuring the waste does not leave the facility.

★ Two industrial-sized PWC systems have been delivered to Hawaii to help deal with the dangerous situation of removing munitions, contaminated soil and hazardous debris from the island of Kahoolawe, left after decades of military exercises.

With increasing public opposition to waste incineration, and a growing shortage of land for landfill dumps, there is now an urgent need to find new solutions to the mounting waste problem worldwide. Startech's solution is a proven, cost-effective 21st century technology that is ready and available now.

Startech Environmental Corp.
Tel. +1 (203) 762 2499 Fax +1 (203) 761 0839

An integrated approach

The National Science and Technology Council in the United States stresses that "given the interwoven nature of environmental problems, systems approaches are essential if we are to attain sustainable development". This will mean integrating technology needs and solutions, and addressing specific, key "macro-challenges": energy, materials, biotechnology and urban environments.

The World Resources Institute (WRI) says that "technological change consists of both innovation – the introduction of a new product, process, or system – and diffusion – the application of innovations in new contexts. Technological change links social and economic needs with technical solutions. The needed fusion of economic and environmental objectives requires technologies that meet two criteria. First, they must be able to transform industry and transportation from materials-intensive, high-throughput processes to systems that use fuel and raw materials highly efficiently, rely on inputs with low environmental costs, generate little or no waste, recycle residuals, and release only benign effluents. The need, in short, is for technological systems that are environmentally 'closed' – that is, detached as much as possible from natural systems. Second, because the first criterion cannot be fully met, new technology must help societies live strictly off nature's income, rather than consuming nature's capital."

The WRI adds: "Bringing about this transformation will be neither certain, quick, nor easy. Many adverse trends in global environmental quality are evident. Nevertheless, the current moment offers unique potential – in part because of new technological developments. These advances could create a new technical base for long-term environmentally sustainable development."

The environmental challenges require a political as well as a technological response. Agenda 21 urged major policy changes. More than five years on, many of these have not been implemented and, where they have been introduced, they have not always been pursued with the necessary vigour. The 'shopping list' of policy items is well-known, and includes a wider application of economic instruments to internalize environmental costs and thus change both corporate and individual behaviour. The issue of funding, central to the transfer of technologies to the developing countries, remains no nearer resolution now than in 1992. The information revolution poses another challenge. Telecommunications products and services, including teleconferencing, telecommuting, teleshopping and telemedicine, will increasingly replace many activities which today use considerable energy and raw materials, and also cause waste and pollution. But it is essential that these services reach the developing countries and that the information society becomes a truly global one.

So, the political and technological agenda is a formidable one. Its successful implementation requires political will to introduce the policies that will accelerate the adoption of ESTs; more understanding within business of the benefits of ESTs and a greater commitment to using them; and more resources for technology transfer and to research and develop new technologies. But, as United States President Bill Clinton has said: "Attaining sustainable development is one of the greatest challenges facing the global community – a challenge that can only be met by developing and deploying technologies that will protect the environment, while sustaining economic growth."

Sources

Technology for a Sustainable Future: A Framework for Action, 1994, United States National Science and Technology Council.

Transforming Technology: An Agenda for Environmentally Sustainable Growth for the 21st Century, 1991, World Resources Institute.