

The new paradigm for energy*

At any period in history, according to Thomas Kuhn, there is a ruling paradigm¹ within the constraints of which most thinking takes place. When its effectiveness diminishes and it begins to break down, a paradigm shift takes place and a new paradigm comes into being.

What follows is a brief account of the paradigm shift that is taking place with regard to energy, and of the perhaps unique international collaboration involving Jose Goldemberg (Brazil), Thomas Johansson (Sweden), Amulya Reddy (India) and Robert Williams (USA) whose contribution to the new energy paradigm was recognized by the award of the Volvo Environment Prize 2000.

The collaborators (popularly known in energy circles as the 'Gang of Four') came together through visits to Sao Paulo and Princeton. Though they were four individuals from four countries in four continents, they discovered a great deal of like-mindedness. They had mutual respect. They also had humility in the sense that each one knew that he did not know it all and that, in order to develop greater understanding, he had to listen to the others and learn from what he heard. They worked with an equality that was quite unlike most North-South collaborations, in which Northerners are more equal than the Southerners. Their chemistry worked. They have sustained their interaction for over 20 years. Even without an institutional umbrella, they created a 'virtual institution' long before modern information technology with its faxes, emails, etc.

In 1980 when the 'Gang of Four' came together, energy systems were based on the growth-oriented, supply-sided, consumption-directed paradigm that dominated the views of governments, the approach of official planners, and the thinking of most decision-makers. According to this conventional pattern of thinking, development is equated to economic growth (measured by GDP), and an increase of energy consumption is con-

sidered to be a necessary condition for an increase of GDP. So energy becomes an end in itself and the main task is to make demand projections, so that the supply of energy can be increased through various energy sources to meet that demand.

Deeply troubled by the equity, environmental and security implications of that conventional paradigm, the 'Gang of Four' wanted to evolve a different perspective. To them, the human dimensions of energy were as important as the technical one. They were deeply concerned about inequity between industrialized and developing countries. They were also disturbed by inequalities within developing countries, with their small islands of glaring affluence amidst their vast oceans of abject poverty. They were acutely sensitive to the environmental impacts of energy production and use. Above all, they shared a vision of energy as an instrument of development, and of technology as a crucial mechanism for energy to play this role. This unity of perspective and values was enriched by the diversity arising from differences in their backgrounds, cultures, experiences and expertise. As a result, they produced together what none of them could have produced alone – the whole was greater than the sum of the parts.

In 1988, they published the book *Energy for a Sustainable World*² and several other expositions^{3,4}. These publications contributed significantly to the new paradigm for energy. It was emphasized that energy is not the only major global problem. So, the solution to the energy problem must contribute to, and be consistent with, the solutions of other major problems such as poverty, population growth, under-nutrition, ill-health, environmental degradation and security. Energy must be an instrument for advancing economically viable, need-oriented, self-reliant and environmentally sound development – what came to be referred⁵ to as *sustainable development*.

The emphasis on basic needs meant that the focus must be on the end-uses of energy and the services that energy provides human beings. The shift in emphasis from the magnitude of energy consumption to the level of energy services as the measure of development, is not a semantic device. It enlarges the

domain of opportunities in so far as energy services can be increased, not only by increasing the supply (and consumption) of energy, but also by using energy more efficiently. Technological opportunities abound for enhancing energy services⁶. Developing countries can therefore leapfrog technologically, avoiding a repetition of the mistakes of the industrialized countries. Developing countries can become exciting theatres of technological innovation. Further, implementation of the new energy paradigm in industrialized countries leads to the possibility of lowered energy intensities and convergence between the energy consumption of industrialized and developing countries. Above all, the goal-oriented, strategy-based, policy-driven approach to energy implies that the future becomes a matter of choice rather than destiny. The 'Gang of Four' were harbingers of hope, rather than prophets of doom.

All that is the good news. The bad news is that radical ideas do not become new orthodoxy overnight⁷, and certainly not without continuous struggle and persistent effort. The old growth-oriented, supply-sided, consumption-directed paradigm still dominates the thinking of decision-makers. This is so particularly in the developing countries where unfortunately the magnitude of energy consumption (rather than the level of energy services) is still naively viewed as the measure of development⁸, despite abundant evidence that GDP can increase even when energy consumption goes down.

The liberalization, marketization, privatization and globalization trend of the 90s has introduced into the energy situation new issues such as the following. What is the role of the public sector in a market-driven economy? How can public benefits be advanced in a situation guided by the financial bottom-line? What are the dangers of unregulated reform of energy utilities? What are the barriers to implementation and how are they to be surmounted? How is the central importance of technological innovation to be ensured? How can the emergence of a myriad exciting technological opportunities be exploited? How can one tackle the enormous challenge of poverty with about two billion

*Based substantially on the author's acceptance speech (on behalf of Goldemberg, Johansson, Reddy and Williams) at the ceremony for the award of the Volvo Environment Prize for 2000 at Gothenburg, Sweden, on 17 October 2000.

people without the modern energy services that are taken for granted in the industrialized world?

These challenges have been addressed with a flurry of fresh efforts at analysis, advocacy and action. Mention should be made of the books to which many of the 'Gang of Four' have contributed: *Electricity: Efficient End-use and New Generation Technologies, and their Planning Implications*⁹, *Renewable Energy: Sources for Fuels and Electricity*¹⁰, *Energy after Rio: Prospects and Challenges*¹¹, *Energy as an Instrument of Socio-economic Development*¹² and most recently the *World Energy Assessment: Energy and the Challenge of Sustainability*^{13,14}.

Among their many visions for energy in the new millennium¹⁵ are the following:

- The drastic reduction, if not elimination, of the coupling between energy consumption on the one hand and economic growth (GDP), materials use and emissions, on the other.
- Re-examination of the assumption that energy problems can be solved without changes in lifestyles in the industrialized countries – Mahatma Gandhi said: 'The world has enough for everyone's need, but not for every man's greed!'
- Universal access to affordable modern energy services, particularly in developing countries, and especially for the poor and for women.
- Harnessing of the immense possibilities of information technology.
- Increasing the scope for people's

participation with decentralized energy systems.

- Modernization of rural energy systems leading to a dramatic improvement of the quality of life.
- Making the 21st century one of sustainable development so that energy acquires a human face and contributes to 'wiping every tear from every face'.

To realize these visions there is a need for new people who must have human values and spiritual courage, apart from intellectual capability.

The future is difficult, but the present is unsustainable. Fortunately, ideas are powerful and when they become visionary messages, capturing the hearts and minds of the people, mighty empires crumble and powerful structures collapse.

1. A paradigm is analogous to a raga in Indian classical music. Anybody who sings and plays an instrument in a raga adheres to its framework and pattern, but within the constraints of that framework and pattern, the musician can extemporize to any extent that she or he wants. A paradigm shift is like changing over from one raga to another raga.
2. Goldemberg, J., Johansson, T. B., Reddy, A. K. N. and Williams, R. H., *Energy for a Sustainable World*, Wiley Eastern, Delhi, 1989.
3. Reddy, A. K. N. and Goldemberg, J., *Sci., Am.*, 1990, **262**, 65–74.
4. Goldemberg, J., Johansson, T. B., Reddy, A. K. N. and Williams, R. H., *Annu. Rev. Energy Environ.*, 1985, **10**, 613.
5. World Commission on Environment and Development, The 'Brundtland Report', Oxford University Press, London, 1987.

6. Goldemberg, J., Johansson, T. B., Reddy, A. K. N. and Williams, R. H., *AMBIO – J. Hum. Environ.*, 1985, **14**, 190–200.
7. Thomson, K. S., *Am. Sci.*, January–February 1988, 59–61.
8. Chidambaram, R., *Curr. Sci.*, 2001, **81**, 17–21.
9. Johansson, T. B., Bodlund, B. and Williams, R. H., (eds), *Electricity: Efficient End-use and New Generation Technologies, and Their Planning Implications* Lund University Press, Lund, 1989.
10. Johansson, T. B., Kelly, H., Reddy, A. K. N. and Williams, R. H. (eds), *Renewable Energy: Sources for Fuels and Electricity*, Island Press, Washington DC, 1993.
11. Reddy, A. K. N., Williams, R. H. and Johansson, T. B. (eds), *Energy after Rio: Prospects and Challenges*, United Nations Development Programme (with International Energy Initiative and Stockholm Environment Institute), New York, 1997.
12. Goldemberg, J. and Johansson, T. B. (eds), *Energy as an Instrument for Socio-economic Development*, United Nations Development Programme, New York, 1995.
13. Goldemberg, J. (ed.), *World Energy Assessment: Energy and the Challenge of Sustainability*, United Nations Development Programme, United Nations Department of Economic and Social Affairs, World Energy Council, New York, 2000.
14. Patterson, Walt, *Science*, 2001, **294**, 1287–1288.
15. Goldemberg, Jose, Johansson, Thomas, B., Reddy, Amulya K. N. and Williams, Robert, H., *AMBIO – J. Hum. Environ.*, 2001, **XXX**, 330–337.

Amulya K. N. Reddy is in the International Energy Initiative, 25/5 Borebank Road, Benson Town, Bangalore 560 046, India (e-mail: amulya1@vsnl.com)