

APPROACHING THE 21ST CENTURY: SOME PERSONAL REFLECTIONS ON ENERGY SYSTEMS¹

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Introduction: Having had the good fortune to work on energy problems at the village, city, state, country and global levels, I am hoping that the thoughts that I would like to share with you today will help me to walk the thin line between spoiling an excellent dinner with trivia and ruining the digestion with overly technical material.

A good starting point for my keynote address is the book *Energy for a Sustainable World* which was largely written at the Center for Energy and Environmental Studies, Princeton University. Each of the authors (Goldemberg, Johansson, Reddy and Williams) had an established track record in energy analysis *before* they started collaborating. Each of the four had established careers and did not look to the collaboration as a career path. Notwithstanding the success of the collaboration, they continued to work in their countries and national institutions, and therefore, their collaboration did not need a conventional organizational or institutional umbrella³. Since the authors were committed to economically viable, need-oriented, self-reliant and environmentally sound development, they were intensely concerned about economic efficiency, equity, empowerment and the environment. They consequently brought to their work a sensitivity to socio-economic issues in addition to a scientific/technological background and competence. Above all, they shared a vision of energy as an instrument of development and global progress and of technology as a crucial mechanism for energy to play this role.

What I have learned since *Energy for a Sustainable World*: The collaboration started in 1978 and the book was published a decade ago. Since then, the authors have kept in touch sometimes with further collaborations but also embarked in different directions. I would now like to share some of the insights I have gained since the book even though I run the risk that all of this may be neither original nor unique.

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- 1 Keynote address to the CEES-IEI Workshop on *CATALYSING SOUTH-NORTH AND SOUTH-SOUTH COLLABORATIONS ON ENERGY STRATEGIES FOR SUSTAINABLE DEVELOPMENT*, Princeton University, Princeton, 3-5 December 1998
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 - 3 Such interactions involving virtual organizations have become very much easier with the developments in information technology in general and the email and web-sites in particular.

(1) In pursuing advocacy particularly in India, I have learnt that the **approach** should be: "I'll help you discover the answer" rather than "This is the answer!" **Integrated Resource Planning** is a very important way of transmitting this catalytic approach for it says "I don't know the supply mix (of Efficiency Improvements, Decentralized Sources and Clean Centralized Sources) appropriate to your situation; but you can discover it!"

(2) **Spreadsheets** are one of the best tools/heuristics for discovery because of their complete transparency, alterable models, illustrative examples, user-friendly and user-dominated character, and their help in identifying missing data (which consequently ceases to be an impenetrable barrier).

(3) It has become increasingly clear that success can be claimed only when a trainee/user does the analysis on his/her own and the **guru(s)** become(s) unnecessary and redundant.

(4) However creative or brilliant the solution proposed, there are **barriers** at all levels -- at the international, government, utility, equipment manufacturer/distributor and consumer levels.

(5) Hence, a **multi-level and multi-target strategy** is required with simultaneous advocacy and action at all levels. This strategy must be addressed not only to decision-makers in government (with their obsolete paradigms), but also to politicians, utilities (with their vested interests), various categories of consumers, the media, and civil society.

(6) The top-down approach pursued by international organizations and governments is necessary, but not sufficient. One of the problems is that governments and their bureaucracies are the custodians and propagators of obsolete paradigms. Paradigm-shifts definitely require the **bottom-up** pressure from civil society.

(7) Apart from technology generation and demonstration, what is essential is **technology dissemination** which is totally different Aball-game@. For, manufacturing a thousand or a million is a totally different challenge from making one off. And establishing and running hundred or thousand units is quite different from one demonstration.

(8) Notwithstanding the usual official enthusiasm to rush implementation with a step-function or a linear increase of penetration, it is best to start with a slow penetration incorporating learning from field trials and then to increase more rapidly before achieving saturation. In other words, it is best to follow a **logistic curve for dissemination**.

(9) Since not only technology but also economics, financing, management, training, institutions, etc., are essential, it is important to have implementation packages (**IMPACKS**), i.e., complete hardware plus software packages, to guide the dissemination and replication of technology. Quite clearly therefore the evolution has to be **from hardware to software to systems integration**.

(10) If the interest is not only in analysis but also in implementation, the entire gamut of activities from Information, Training, Analysis, Advocacy and Action (*INTAAACT*) assumes importance. A crucial part of action is *commercialization* going from prototypes to products in the economy.

(11) Abandoning command-and-control approaches involves turning to the *market* as an allocator of money, manpower and materials. The market, however, is not perfect. It has both *power and limits*. In particular, the market cannot be entrusted to deal with issues of equity (and access), empowerment and the environment. Whereas the market can ensure economic growth, it cannot ensure *sustainable development* or *sudevelopment* by which is meant a socio-economic process of growth characterized by economic efficiency, equity (ensuring "universal" access), empowerment (as a path to endogenous self-reliance) and environment soundness.

(12) Our efforts require the establishment of *institutions*⁴ that consist of a combination of *rules* or *customs* and *forums* or *organizations* through which the concerned individuals or groups interact. Institutions become *sustainable* only if they are relevant, excellent, accountable, self-governing and financially self-reliant.

(13) Technology shifts are analogous to predator-prey relationships where the Apredator@ is the emerging technology and the Aprey@ is the technology that is getting displaced. Even the equations describing the technology shifts are of the same form as the (Lotka-Volterra) equations for predator-prey populations.

(14) Technology choices by consumers (households, firms and governments) are based on *discount rates* which are a measure of the preparedness of consumers to sacrifice present consumption for future benefits. And, the "poorer" the consumer, i.e., the lesser the amount of disposable capital available to the consumer, the higher the consumer's discount rate. And the poorest consumers (households, firms and governments) use very high discount rates of several tens and even hundreds per cent - already below recommended consumption levels, they cannot afford to sacrifice present consumption for future benefits. In effect, the life-cycle cost for them becomes equivalent to the first cost.

(15) Not only consumers, but governments, donors and energy implementors also use discount rates for decisions. The higher the discount rates used by them, the more they are concerned with showing immediate results, and the greater their preoccupation with short-gestation projects rather than slow-yielding programs and

4 According to dictionaries, the word *institution* has two meanings -- it is either "a set of rules or customs" or a "forum or organization" through which the concerned individuals groups interact. It turns out that institutional issues are better understood by considering both these two meanings as necessary components of institutions.

paradigms. And though paradigm shifts offer the most lasting and sure impacts, they are given the least attention by decision-makers with short time horizons.

Where we have failed: After more than a decade of *Energy for a Sustainable World*, the growth-oriented supply-sided consumption-directed (GROSSCON) paradigm still dominates the thinking of decision-makers, particularly in the developing countries. Almost every statement of these decision-makers begins with the observation: "In the US, the per capita consumption is so much; in our country, it is only so much; therefore we must increase energy consumption." So, the new development-focussed end-use-oriented service-directed (DEFENDUS) paradigm may be stale stuff to sophisticated energy analysts in the industrialized countries, but it is still *avant garde* thinking in decision-making circles in India and other developing countries.

Good management requires scrutiny of the so-called "A" class items that account for the bulk of the problem. On this basis, the crux of the global energy problem is the United States. But, the energy pattern there is not at all encouraging⁵. Consumption levels have come back to the pre-1973 oil-crisis levels. The major reductions in consumption per device/appliance/ vehicle or per unit of floor space have all been overtaken by increases in the number and/or usage. Against the pledge to reduce carbon emissions by 7% by 2010, it has been predicted that there will be a 30% increase. These are major failures. It is time to say to the USA: "Physician, heal thyself!"

Alas, energy analysis is dominated overwhelmingly by men. This gender disparity is serious. Experience is mounting to confirm that the decisions of women (for example, in micro-lending programs such as the Grameen Bank in Bangladesh) take into account the long-term and the next generation, a natural consequence of their linkage with children. The discount rate used by women seems to be lower than that of men. It is precisely such a view that leads to sustainability. Hence, women are naturally endowed to be better custodians and implementors of sustainable development. Energy analysis is still by and large Northern dominated. Do a head count on any recent edited book (even the 1998 UNDP book: *Energy after Rio: Prospects and Challenges*) and it will be seen that the Southern contribution is negligible. One must also note the negative and counter-productive role played by the major diversion of scarce Southern talent into greenhouse gas mitigation analysis for developing countries even though the problem has arisen primarily from Northern energy consumption patterns.

Obviously, capacity building in developing countries is given low priority even by organizations (such as the UN) that are supposed to be committed to this challenge. Capacity building is a slower time-consuming process and program executives in a hurry (with high discount rates) do not emphasize the task.

⁵ A lucid description of energy consumption trends in the USA has been given in the article "U.S. Splurging on Energy After Falling Off Its Diet", *New York Times*, October 22, 1998..

Despite some deliberate attempts by the Gang-of-Four, similar collaborations do not seem to have arisen. Hopefully, workshops like this will make a dent on the problem.

Energy analysis tends to focus exclusively either on hardware or on the "software" (economics, financing, institutions, management, policies, training, etc.) required to use the hardware effectively. In fact, there seems -- with some notable exceptions -- to be two different types of analysts -- the hardware types and the "software" types. There is inadequate integration of hardware and software and very little work on systems.

Current discussions of energy systems are dominated by the goal of greenhouse gas abatement and prevention/minimization of climate change. This is a reflection of the preoccupation of the industrialized countries. Accordingly, there is an overwhelming emphasis on energy technologies, particularly renewable energy technologies (RETs) and end-use efficiency improvements (EIs). Maximization of RETs and/or EIs has become the objective function. RETs and EIs have become ends in themselves. The proponents have become RETs and EI energy fundamentalists. They even demand that the playing field has to be distorted in favor of these technologies. Environmental soundness has become the dominant concern to the exclusion of equity and empowerment.

Rural energy is equated with rural electrification, and in the process, the most important energy need of cooking is bypassed. After initial bursts of enthusiasm for improved cookstoves, the cooking problem has been largely forgotten. At the same time, the energy needs of the poor and of women have been overlooked. In fact, it was realized late into the finalization of *Energy after Rio: Prospects and Challenges* that there was no discussion of cooking in the chapter on technological opportunities, and a hurried end-course correction was made that sticks out like a sore thumb.

There is far less work on biomass than on photovoltaics. This disparity is perhaps because industrialized countries can find a greater role in selling PV modules and systems than in growing and harnessing biomass⁶.

Practitioners and implementors tend to focus on short-term and immediate requirements. In contrast, analysts are attracted to technological opportunities that will only fructify over the long-term. This difference in perception also coincides with the short-term neglect of technology and the long-term neglect of human beings. A balanced emphasis on the short-, medium- and long-term (along with forward compatibility) is lacking.

What trends may change

Except for some questioning during the past year, *globalization* has been assumed to be a relentless, inexorable and inevitable trend everywhere. Now, there is talk of the importance of imposing limits on globalization. This new stress is likely to be

⁶ Hopefully, Shell International is attempting to correct this weakness.

strengthened by a resurgence of the spirit of self-reliance based on the belief that the destiny of nations must be decided endogenously and not by external foreign forces.

Similarly, the trend towards *marketization* is likely to be curbed by concerns of equity, empowerment and the long-term, none of which are ensured by the market. The fundamental problem is that the issues of equity, empowerment, infrastructure and the long-term require a discount rate that is too low to be acceptable to the market.

The trend of *democratization* is sure to continue but the content of democratization may be enriched with a greater emphasis on decentralization, peoples and community participation. Empowerment may be the thrust.

The trend of *corporatizing* inefficient public sector units may need to be tempered with imposed obligation to serve the underprivileged.

Challenges for the 21st Century

The fundamental challenge is to present a vision for energy, a vision that consists of not only a paradigm but also programs and projects involving realistic and small measures. The measures must include short-gestation quick-yielding projects that deliver outputs within the time-horizon of five years or the next election. Assured of this political return, most politicians and decision-makers will be prepared to support long-term visions.

Another important challenge is to reduce, if not eliminate, the important couplings between energy consumption on the one hand and economic growth (GDP), materials use and emissions on the other.

Hopefully, the decoupling/dematerialization/decarbonization will lead to convergence in energy consumption, materials use and emissions between the industrialized and developing countries. Convergence is a must because the present disparities are unsustainable and a root cause of international conflicts.

We have assumed/argued that energy problems can be solved without insisting on changes in life-styles in the industrialized countries. Increasingly, this position is becoming untenable. If we have been blind to truth in our yearning for acceptability, the time for honesty has come. As Gandhi said: "The world has enough for everyone's need, but not for every man's greed!".

Another crucial challenge is universal access to modern energy services, particularly in developing countries and especially for the poor, women and the elderly.

The immense possibilities of information technology have to be harnessed to enhance the capability of energy becoming an instrument of sustainable development.

The optimum scale of energy systems varies with energy source and service and with energy supply and end-use. If "optimum is beautiful", there should be a mix of centralized and decentralized systems.

There has been historical discrimination (in the matter of interest rates, financing, R&D investments, government backing, etc.) against renewable sources, decentralized systems and energy saving options. Thus, the slogan of a level playing field for non-renewable and renewable sources, for centralized and decentralized systems and for energy generation and energy saving options, must reckon with this discrimination. As in the socio-economic arena, "affirmative action" may be required to enable the yet-to-mature systems to compete. But, care must be taken to ensure that "affirmative action" is an enabling transition rather than a permanent crutch.

The scope for people's participation will increase with decentralized systems particularly in rural areas. Decentralization of electrical power will facilitate decentralization of political power.

Rural energy systems must be modernized with a significant enhancement of energy services leading to dramatic improvement of the quality of life and the indicators of human development. In fact, rural energy systems must cease to be energy sinks and become sources of energy supply. Then, the balance of (energy) payments may reverse.

Southern and women energy analysts must increase in number and stature so that energy analysis will cease to be an exercise concentrated in the North and dominated by men.

If the 20th Century was the century of economic growth, the challenge is to make the 21st Century, the century of sustainable development -- economically efficient, equitable, self-reliant and environmentally sound economic growth. Then, energy will acquire a human face.