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"No power is as expensive as no power."
Dr.Homi J Bhabha

The father of the Indian atomic endeavour was a dreamer. He dreamt grand dreams: of catching up with the West; of breaking the vicious circle of poverty; of unlimited growth. His answer to no power was "nu power". Nuclear energy was to be The Answer. Its task was to take India to its rightful place in the new world of plenty for everyone.

Four decades on, the answer does not seem like an answer anymore. There are just too many questions attached to it. What then, are the answers? Is there an alternative to nuclear power? What is the 'ay out? Will poverty ever vanish from this land?

The energy establishment today, like the political leadership, is not made up of dreamers- but rather by schemers. Their thinking is immobilised by self constructed mental blocks. Like the Bourbons of France they have "learnt nothing and. forgotten nothing". The nation strives on, borrowing more and more from abroad, lurching from one crisis to another, beset by endemic power shortages, hoping against hope that the latest 'temple' of modern India would somehow ease the situation.

The real energy crisis - women walking yet more miles for firewood; nutrient rich biomass ending up as smoke and adding to the greenhouse effect; the resultant deterioration in soil fertility requiring ever larger quantities of chemical fertilizers .... is not of concern to the power obsessed.

"How much land does a man require?" is the title of a short story [by Tolstoy. It beautifully illustrates our present condition. Like the protagonist in the story we are running wildly, trying to gather more and more while the target seems 'farther than ever. If we are not to kill ourselves like him, we need to pause and think.

Do we need energy per se or do we need energy for accomplishing certain tasks? Can we do these tasks using less energy? Is electricity synonymous with energy? Who needs and gets electricity? How much is enough? What is the relation between the deepening ecological crisis the loss of traditional sources of energy to the common people, the increasing role of the commercial' sector and the grandiose dreams of power? How long will the present system, based on conspicuous consumption by a few and enormous waste by all, last?

Today Bhabha's dictum stands on its head. No power is cheaper than no power (unwasted power). Others use ten times less power than we do to produce the same quantity of goods. By far the overwhelming portion of new energy all over the world during the last fifteen years has come from increased efficiency and less wastage.

India is not a poor country. There is enough for everyone's need. What we need is to get rid of the greed and the greedy. That is the way to Swarajya.

Surendra Gadekar

"Energy and Environment" is the title of a course offered by the Sampoorna Kranti Vidyalaya in Vedchhi, Gujarat. The duration of this course would be approximately three months beginning according to the convenience of the participants as well as the Vidyalaya. The course is open to young men and women interested in the subject who are able to read English and are able to study independently under the guidance of an instructor. Other courses at the Vidyalaya - a non-violent training centre in the tradition of Gandhi, Vinoba and JP - are "Ahimsa and World Peace" and "Revolution in Theory and Practise". For more information, please contact Editor Anumukti.

Bursa's Forests in Danger

The Asian mainland's largest tropical forest area is now in grave danger of being denuded as demand for Burmese wood increases, making the export of tropical wood a very lucrative business in Burma.

Some time back, Thai authorities issued a decree revoking all logging concessions nationwide. Since then, there has been a rush by Thai businessman and bureaucrats to make timber deals with their counterparts in Burma and Laos.

Unlike India or Thailand large parts of Burma are still forested, with deciduous teak forests in the mountains and monsoon forest' in the south.These forests are a home.to many indigenous tribes whose very survival depends on the forests and its resources. They are also a home to hornbills,tapirs, rhinoceros, and wild elephants.

The military government in Burma has stepped up the export of Burmese hardwood to Thailand. According to news reports from Rangoon, Burma has already auctioned some U.S.$3.28 million worth of teak to timber firms from Japan, Europe, Singapore, Thailand, India and Hongkong. The current developments clearly indicate that logging activities will be intensified and if unchecked, Burma's magnificent forests will very soon be a thing of the past.

Khor Kok Peng
World Rainforest Movement
Source: 'Third World Network

A study by the Rocky Mountain Institute in the U.S. says that a massive worldwide nuclear power programme in which a transition from coal to nuclear electricity is completed by 2025 would not only not solve the global warming problem, it would actually contribute to the effect. This is because investing in nuclear capacity would preclude investment in more effective carbon dioxide abatement .strategies. The study finds that money spent in building nuclear power stations could do seven times as much good in diminishing greenhouse effect if it was invested in improving energy efficiency.

Source: New Scientist 5.11.'88

A Paradigm Of Plenty For Ever

We are in the midst of a major ohange in our way of thinking about energy, and for that matter about every other natural resource. The old (and still largely conventional) supply-obsessed approach to energy is running into more and more serious difficulties. A new development focussed paradigm for energy use and supply is emerging.

. The conventional "wisdom" on energy planning is as follows: development = growth = energy = centralised electricity generation and grid distribution.

Most of the steps in this argument are highly questionable, if not patently false. Development should not bo confused with growth in the volume of goods and services. If development is to lead to reduction of poverty, then the structure and the content of growth, as well as the distribution of its benefits, should be seen as being as important as the magnitude of growth. The benefits of growth do not necessarily trickle down to the poor, because its main beneficiaries invariably turn out to be the affluent. Growth does not necessarily lead to development.

Two Conditions

The second step of the argument reflects the widespread belief that there can be growth if, and only if, there' are increasing inputs of energy. But this correlation is valid only under two conditions: There must be no changes in the product mix of the economy; (For example, there must not be a trend away from energy intensive to energy saving products and processes.) And/or there must not be significant improvements in end-use efficiencies. For if either of these changes take place (and both have been observed in modern times) then there can be an increase in the GDP despite a decrease in the energy consumption.

The third step, which equates energy with electricity, is illustrated with the fact that the , central Ministry for Electricity is called the Energy ministry. In fact,, till the oil crisis, energy planning used to mean electricity planning.

The undermining of the energy = electricity approach really began with the almost complete domination of the transport sector by petroleum. But, oil has also had a rising share in the domestic, industrial and agricultural sectors. Thus the assumption has grown that for most of these end uses there is no alternative to the use of petroleum derivatives. Hence, *a* modern addendum to the conventional "wisdom" on energy: development = growth = energy = oil = engines, furnaces, and other heating devices fuelled by petroleum,derivatives.

But, just as electricity is not merely large scale centralised generation and grid transmission, the use of petroleum derivatives is neither inevitable nor unavoidable: alternative devices can be fuelled with ethyl or methyl alcohol; cooking can be done wih producer gas or biogas; and furnaces can be run on producer gas generated from wood. The basic flaw in the conventional approach to energy described above is the implicit belief that energy is an end in itself. Further, by adopting growth as an objective, and then believing that growth requires increasing energy inputs, the emphasis turns to energy consumption and therefore to the projection of energy demand.

These projections are usually distorted by several biases:

1.Current growth patterns are socio-economically just and ecologically sustainable.

2. That the prevailing distribution of energy need not be" questioned .or modified.

3. That the current efficiencies of energy generation distribution **and**

utilisation will prevail even in the future.

Energy planning thus becomes an exercise in increasing energy consumption. in the search for energy supplies, the large scale sources inevitably attract most of the funds. Thus the vast differences between the budgets of the ministries of petroleum, coal, (electrical) energy, and atomic energy on the one hand, and the budget of the department of non-conventional (small scale) energy sources.

. Demand management is ignored and what is left is the energy version of the supply, side economics.If at all conservation and efficiency improvements are given any attention, it is only as after thoughts, add-ons and retrofits for cosmetic purposes.

The R & D is also largely restricted to the supply end of t.he energy spectrum, and furthermore to the large scale energy sources. In fact the end-uses and therefore the human aspects- of energy are not even considered to be legitimate subjects of technical study by the science and technology establishments.

Fortunately, this supply-sided approach to energy planning is breaking down. It is becomming clear that growth, unconstrained by equity and justice, bypasses the poor. If development is to be our goal, then the emphasis must be on the immediate and direct satisfaction of basic human needs, starting from the needs of the neediest.

The present patterns of growth are becomming unsustainable because they extrapolate to impossibly high Values of future demand. The easy sources of energy have long since been harnessed, and the remaining sources are becomming more and more difficult and expensive to tap. More dangerous and unforgiving technologies demand more stringent safety measures which are inevitably more expensive.

Marginal Cost

All this means that the marginal cost of generating the energy carriers (i.e. the extra cost of producing the next kilowatt of electricity or the next barrel of oil or the next tonne of coal) is increasing steadily. The real cost of energy is therefore increasing and at the same time there is increasing pressure to devote an ever rising fraction of public funds to energy generation.

The production of energy (electricity, oil,coal) is * also associated with environmental impacts. The victims of these environmental consequences are becomming the basis of growing protest movements. Whether it is a large scale hydroelectric project or a super thermal plant or a nuclear reactor, there is a rising storm of opposition. Finding themselves hamstrung the supply lobbies accuse the environmentalists of blocking "development", even though 'what is being obstucted is growth in the interest of the affluent. But actually it is the environmental impact of energy supply which is accumulating and gutting in the way of further increases in energy supply. Hydroelectric projects often require large scale destruction of prime forests and this destruction is said to diminish the rainfall upon which the projects depend.

Inefficient Use

Energy is used very inefficiently today. Hence there are tremendous opportunities for efficiency improvements. If such opportunities are seized, then growth will not necessarily require corresponding increases in energy supplies. And, using currently available energy supplies more efficiently may make more economic sense than generating more energy to sustain prevailing patterns of inefficiency. But as long as the preoccupation is with supply, the efficiency with which energy is used, will only be given peripheral attention.

From the standpoint of technical efficiencies, energy sources should be matched to energy utilizing tasks. And since these tasks are varied in nature, a mix of energy sources is invariably essential for an energy system. Although, electricity is the best carrier, the cost of transporting it do increase with distance. Hence beyond a break-even distance, decentralised generation from local sources may turn out to be more economical than the total generation plus transmission costs associated with centralised generation. It is in the context of this failure of conventional "wisdom" That a new approach to energy analysis and planning is emergi: g.

Hew Paradign

The essence of the new paradigm is that energy is only a means to an end, not an end in itself. The energy system must contribute to the goals of equity, economic efficiency, environmental soundness, long-term sustainability and self-reliance. This necessarily means an emphasis, not on energy consumption but on energy services, end-uses and needs. The spotlight in this new development fooussed end-use (defendus) approach is on human beings and the services that the energy provides for them, the tasks that it performs and the needs that it satisfies.

The starting point of the defendus approach is the detailed scrutiny of demand through a disaggregation of energy consumption beyond sectors and consumers to end-use devices and energy services. It may involve new carriers and new end-use devices. Even traditional carriers (e.g.biomass) may have to be converted into new forms (producer gas) or utilized in improved devices. Energy consumption must also be disaggregated beyond consumers in order to determine who are the beneficiaries of energy supplies and whether current distribution patters are consistent with development.

A central and integral part of the new paradigm' is the conviction that energy sources are finito and their extraction involves both economic and environmental costs. Consequently, in every attempt to maintain or improve energy services, a decision has to be taken whether to go in for efficiency improvement or For supply increases or for a mix of both. It is quite irrelevent whether these services are provided through improved utilisation technologies, or through energy supply schemes. Both have to become open contenders for the provision of energy services.

Decision makers must . therefore summarily reject all proposals that are exclusivly devoted to either supply or to conservation. The only one that should be tolerated must be proposals for the provision of energy services, and in these proposals both the options of energy conservation and energy supply (as well as combinations of supply and conservation) must be treated explicitly and compared fairly.

Bright Future

In the past, projects for supply increase have been the reflex-like response of the energy establishment. Efficiency improvement proposals have emanated from outside the establishment. This bias may have been justified when the demand was low, capital was in plenty and there was no urgency. But recent analysis both in other countries and in India, shows in case after case, that it is far cheaper, quicker and environmentally sounder to use energy more efficiently than to increase supply. Very approximately, it is two to three times costlier and it takes three to five times longer to generate a megawatt than to save it. For example, a 30% saving in power corresponding to 120 MW can be achieved by introducing in about 1-2 years simple efficiency improvements in Karnataka's 500,000 irrigation pumpsets at a total cost of about Rs.50 crores, but it would take Rs.120 crores and 5 -10 years to construct power station facilities to generate 120 MW. In this example efficiency improvement cost about Rs 42 lakh per megawatt compared to about Rs.1 crore per megawatt for generation.

There are innumerable other possibilities. There are enormous saving possibilities through the use of solar water heaters and fluorescent lights in all-electric homes which .consume 15% of Karnataka's electricity, and through fluorescent lights in non-AEH homes (which account for 7% of consumption.) The magnitude of energy demand depends very markedly on what efficiencies are assumed for energy generation, transmission and utilisation. Hence, it is only after decisions are taken regarding the generation-conservation options that a picture'of future energy demand can be sketched. But to the extent that the efficiencies are matters of deliberate implementation, future energy demand is a matter of choice, not destiny.

In . taking these decisions, a crucial goal is to minimise the environmental impacts of energy generation, transmission and utilisation. The old bias for supply increases through centralised non-renewable sources has to give way to unbiased decisions between:

1. efficiency improvements vs supply increases
2. decentralised vs centralised production
3. renewable vs non-renewable sources of energy

The decision makers must be neutral umpires rather than partisan supporters. These choices are mutually related. With increasing efficiency, the magnitude of the final demand decreases and with decreasing final demand, a greater variety of supply options (especially those related to decentralised renewable sources) become serious contenders for providing energy services. Thus, . the outcome of the defendus analysis and planning is likely to be a lower cost, quicker, environmentally sounder, sustainable solution to the energy problem. What is likely to emerge is a solution that is not only consistent with other societal problems but also one that points to a brighter future.

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Enough For Everyone?

We have become used tb living in an era "where the resources no longer limit decisions but rather the decisions make the resources." The attainment of escape velocity in development has resulted in a tremendous guzzling of energy resources. Half of all the energy consumed by humans in all history has been done within the last hundred years.

Such an increase in energy consumption has lead to a deterioration of the environment. Today India consumes between 200 and 300 million tons of firewood every year. This means that nearly 700 million trees are being cut every year only to meet cooking and hot water needs. Fortunately a good part of it comes from barks and twigs in village woodlots, minor forests and roadside plantations.

A good housewife will balance her budget within the monthly income of her family and only under emergencies will she dip her hand into the storage kitty. This prudence introduces longterm stability into the lifestyle of the family. A similar approach is necessary in energy planning for a district or a state or the country.

Instead, what we have in the name of energy planning today in the country is pure . chaos. There are as ' many organisations dealing with different aspects of energy as there are energy sources and end uses. Thus, Coal India "produces" coal; Oil India and ONGC "produce" oil; Nuclear Power Corporation and the State Electricity Boards "produce" electricity: many agencies manufacture end use devices like motors, pumpsets, furnaces, stoves etc. In this maze of organisations and agencies there is no integrated approach to energy planning. People calculate growth rates for each fuel and project it for many years. Then they look around for additional supplies* to meet these projected demandemands This supply and demand based "planning" is done for each individual energy form. Because of this lack of coordination and the total absence of an integrated approach to energy planning we get many situations,of wasteful energy use. Mr.S.G.Ramachandra, an eminent energy specialist, estimates that the energy consumed by individual household pumps to lift water from .a sumpwell to an overhead tank in Bangalore city is nearly twice that used by the water supply board (BWSSB). Thus, proper availability of supply of power to BWSSB and well maintained pumping heads, can very easily reduce this wasteful energy consumption by individual households.

Despite all the additions to the generation of electricity from newer power " plants there continues to be a shortfall between demand and supply. And this deficit is projected to continue and even increase for many years to come! Thus power cuts have become and Shall remain a way of life. Industries use captive diesel sets to generate electricity in their own premises in order to meet their demands. During a survey we found that in Karnataka the industries sampled by us produced about 40% of their electrical energy from diesel sets.

Thus, any deficit in one form of energy (e.g. electricity) leads to substitution by another form (e.g. diesel). This substitution has reached enormous proportions that today not only industries but even shops and households are buying diesel generator sets. Hospitals, computer centres and other similar institutions are forced to own their own uninterrupted power supply to run their equipment. The cost of power supply is of ten more than the cost of the equipment. This situation coupled with the disappearance of forests, wood-lots and roadside trees is conclusive proof if any proof were needed of the absurdity of our energy planning.

Whenever we convert energy from one form to another, the full energy content is not converted into useful form; some energy is invariably lost. In other, words, no device can be 100% efficient. This fact illuminates another facet of the energy planning problem. There ought to be minimum conversions of energy between different forms since each conversion implies waste. Energy sources need to be well matched to end uses. For example, electricity is a very high quality energy whereas agrowaste or dung are of lower quality. End uses can be categorized according to then quality requirements. At the' lower end is low temperature heating (bath water). Next in ascending order are cooking, high temperature heating, metallurgical furnaces, very high temperature heating, lighting, movement, electrochemical activities, etc. We have tried to maximise the efficiency of many different sources like biogas, firewood, solar energy, electricity, kerosene by properly matching them to various end uses like cooking, lighting, irrigation, transport, industries, etc. The model gives us a plan for use of each type of resource and an optimal path. For example the plan suggested use of electricity for lighting instead of kerosene. The study showed that the optimal path resulted in an order of magnitude (a factor of ten) reduction in the energy costs per household.

An ideal energy planning strategy ought to have the following objectives:

i. Maximize energy conservation,
ii. Optimize energy source - end use matching.
iii. Maximize use of renewable resources.
iv. Penalize use of depletable resources.
v. Maximize production of renewable resources like biomass.

Users of energy are very diverse ranging from individual families to commercial units, small industries, transportation systems and **large** industrial complexes. Hence any reduction in energy use and the consequent **increase** in efficiency requires very' **strong** motivation amongst many. Actually, in our social system we have disincentives. 'A major disincentive is the price of energy. Our energy is heavily subsidised. Large subsidies result in a wasteful consumption of energy. Curious situations obtain. A dichotomy can be seen from the following example: whenever an electricity board increases the tarriff, the industries, and their representative organisations voice a very strong protest saying that the costs of their products will increase and they should **get** subsidised energy. (This despite the fact that an many industries the cost of energy! is less than 10% of the cost of production.) But, on the other hand, whenever there is a power cut, these industries have happily switched over to captive diesel generation unmindful of the fact that the cost of electricity from such sets works up to about two Rupees per unit compared to the cost of grid electricity at around 40-60 paise per unit. (Until recently the cost of grid electricity was five paise per unit for industrial establishments.)

Let us now look at the following two questions:

. Are there sufficient savings available by energy conservation that we can aim for zero growth rate even though our per capita consumption is very low compared to industrialised countries?

ii. Is there sufficient potential of renewable energy sources so that we can look for meeting our energy needs from renewable energy sources only?'

Questions like does increase in energy consumption lead to development etc. 'are not discussed here.

Comparisons of Energy **Use**

We shall start looking at the first question by first defining certain parametres for comparison and then by comparing Karnataka's specific energy consumption with that of industrialised countries.

There are many indicators to compare lifestyles in various countries. Energy consumption plays an important role in indicating lifestyle. Initially energy consumption was compared with a country's gross domestic product (GDP). Later, energy consumption/capita was plotted against GDP/capita. It was found that there is a strong multi-country correlation existing between national output per capita and energy use per capita. Table I which gives the energy-output relationships for six industrialised countries and Karnataka state illustrates, that Karnataka has very low energy/capita and GDP/capita values. But these do not reveal the true state of energy use; what one would like to know is what is the level of efficiency? Normally it is said that since our energy use/capita is low compared to that of the 'advanced' countries we should increase our energy production so as tor reach the levels of the advanced countries. It is assumed that the energy/capita reflects the true state of the development of a country.

Country	GDP/Capita (dollars)	Energy Cons./ Capita (toe)	Energy/6DP .... ------- toe/at	Index
U.S.A.	5643	8.35	1400 1772 795	190 120 54
Canada	4728	8.38		
France	4168	3.31		
W.Germany	3991	4.12	1831	70
U.K.	,3401	3.91	1121	76
Japan	3423	2.90	849	57
Karnataka *?4-*75	696.05 (Rupees)	0.444		493
Karnataka '79-'88	728.8 (Rupees)	0.492	8893	547

Table I : Energy/Output Relationships
toe/ $: tonnes of oil equivalent / million dollars

Recently there has been a shift" in thinking even in the industrialised nations. The important index is that which reflects the efficiency of energy use. This index is not energy/capita but rather energy/GDP This is given in column 4 of table I in absolute terms and in column 5 of table I in relative terms compared to U.S. as standard.One finds that Karnataka is using five times more energy compared to U.S. for producing the same output. The-comparison with France or Japan is even worse. Two points need to be mentioned about this table. First, it does not include human or animal energy. Our society uses more of these forms of energy. Secondly, most of these countries require a large amount of energy for space heating during winters due to unfavourable weather conditions We are fortunate in having an warme climate and require little space heating. If adjustment is made for both these factors, then the energy/GDP index for Karnataka becomes even more unfavourable.

Next, we take a closer look at industrial energy consumption. Table II is a comparison of industrial energy/, industrial GDP figures of different countries and Karnataka. One finds that in karnataka, industry is consuming 8.8 times the energy by U.S. industry for the same output. This definitely reveals the enormous possibilities of improving energy conservation in our industries.

Country	toe/es Industrial 6DP	Index	Electricity as a X of energy in Industries
USA	1427.7	108	17.3
Canada	1777.2	124	21.8
France	574	48	15.1
W.5eraan	736.6	52	16.0
y	1146.1	98	'4.8
U.K.	924.t.	65	20.0
Japan	12615	884	
Karnataka 74-75 Karnataka	8105	568	69.0

Table IhEnergy Consueption in the Industrial Sector
All prices adjusted to 1972
toe/a s:tonnes of oil equivalent aillion dollars

Column 3 in table II is the quantum of energy consumed by industries as a percentage of total industrial energy. We find that despite power cuts for the past many years the share of electricity in Karnataka's -industrial cake is much higher than what obtains in industrially advanced countries. Electricity - a very high quality source - is being used for lot of low or medium temperature heating by industries in Karnataka. This wasteful application is taking place not. because electricity is efficient, but because it is convenient and has been priced to be cheaper than other fuels. The comparisons of table II were done for the year 197)2 - before the start of the oil crisis. Since 1973 many of these countries have gone in for energy conservation in a big way.

Detailed studies have been done regarding specific energy consumption - energy required to produce one unit of an item. .These studies have been done on various industries like engineering, chemical, metallurgical, paper, textile, sugar,etc. These studies cover a period of many years. Two interesting points emerge. First, there are large differences in energy consumption per unit of production within each sector. Thus, one paper unit uses 17245 units/unit of production whereas anotjher manages to make do using 12510. Similarly in textiles the values range from 5345 to 8102. Secondly, observed over a period of five years from 1979 to 1984 many industries have become progressively more inefficient. In 1984 for example, the heavy engineering industry was using more than one and a half times the energy to produce the same amount of goods that it did in 1979.

From all this we are led to a conclusion that there is a very large potential for energy conservation I in Karnataka. It is good to recall he an estimate of the National Productivity Council that we can reduce our consumption very easily by 25% | by incorporation os simple inexpensive strategies in our energy use.

Renewable Energy Resouroes of Karnataka

Having set the stage by first looking back at our energy consumption strategies and then at possible improvements in the efficiencies of use, let us now consider the second question. How do we meet our additional demands) , if any? Are there enough renewable energy resources to meet this? !

The first point that we ' should clarify here is that many of us' confuse energy with electricity. Even a cursory look at Karnataka's energy scene would tell us that electricity accounts for less than 20% of the total energy consumption. Even amongst commercial **energy** sources electricity cones second after oil.

Source	Potential/Year (MKW-Hours)
Agricultural residues	**50,000**
Biogas (Animals)	11,790
Biogas (Sewage)	500
Major Hydro	14,500
Microhydel on Canals	800 - 3200
Microhydel on Streams	Not Known
Solar	5000 -10000
Wind	40,000

Table III Potential of Renewable Energy Sources in Karnataka

Table III gives the available potential/year for renewable energy sources in Karnataka. The present annual energy consumption in Karnataka is around 35,000 million units. We see from the table that this requirement can very easily be met from the renewable resources. Actually the potential available is quite large compared to the requirements.

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Global Warming Threatens Nuolear Plants

According to an article in the British Journal **The Ecologist,** nuclear power plants situated mostly in low level coastal sites in many countries are likely to be inundated by the rise in sea levels as a result of global warming caused by the greenhouse effect. Sizewell and Bradwe11 stations, located in East Anglia in the UK are especially at risk. In 1953, sea levels **there** had risen by up to four, metres, producing widespread flooding. Sea levels in East Anglia are rising twice as fast as the global average due to subsidence. Flood emergency plans do not specifically cover nuclear plants.

Storm surges powerful enough to knock out a nuclear plant's auxiliary power systems could, in the extreme, cause several major system failures at once. In the case of a defuelled reactor (in the early stages of decommissioning), flooding could cause the release of radionuclides from less well protected facilities. Seawater would cause corrosion of concrete structures. Even without flooding, raised sea levels could raise water table levels and lead to the intrusion of saline groundwaters, which could then attack the concrete base of a reactor's containment building releasing radionuclides into water resources inland.

Although somo precautions are being taken at coastal sites in UK, the East Anglia sites are especially poorly defended. At Sizewell, dunes are being reinforced to a height of ten metres above the sea level - but the 1953 surges would have reached nearly half this height and given their force,could have breached them. By the time the decommissioning of Sizewell B is due to be completed in the early 22nd century, sea levels are predicted to have risen by up to two metres. This figure does not take into account the melting of the West Antarctic ice. It is obvious that the risk to reactors from flooding and damage from surges- and saline groundwater intrusion will increase considerably.

The cost of adequate sea defenses and other on-site measures which might reduce (though not necessarily prevent) the risks to a nuclear plant over the 130 years of its operation and decommissioning, would add enormously to nuclear costs. But anyway there is no evidence that such considerations have been taken seriously in siting policy by any nuclear authority anywhere.

Source: WISE News Communique 311.3105

Editor's NoterTarapur and Kalpakkam are already built and in operation. Urgent safety measures need to be taken to help reduce risk there. However, it is, downright foolhardy to plan further coastal constructions without taking greenhouse effect into consideration. Jaitpur and Koodankulam take note.

Disorder In The Deep

The Rational Idea

The ecosystem is composed of the natural , interwoven, ecological cycles and provides all the resources that support human life and- activity. The production system is the man made net-work of labour processes and technology that converts the resources into goods and services - the real wealth that sustains society, the economic system is the recipient of this wealth and governs the manner in which it is distributed to the members of the society

Energy flows within and between the three systems play a leading role in integrating them together. The quantum, the quality and the pattern of these energy flows greatly condition the nature of the interaction between the systems. It is logical to .expect the economic system to confirm to the requirements of the production system **and** the latter to the requirements of the ecosystem. Anyway, that is the rational idea. With this logic in mind let us look at the marine fisheries sector in Kerala.

The Low Energy Sector

In Kerala, the marine ecosystem is blessed with nature's bounty of a high quantum of stored solar energy in the form of fish. It is assessed that the annual sustainable, free flow from this ecosystem is a little over 30 tonnes of fish per square kilometre of coastal sea area - or an equivalent of about 720 million kilo calories of energy. The potential in other parts of India is only between one half to one third this level. Kerala's coastal area measures 12570 square kilometres and this places the maximum sustainable yield (MSY) per annum around. 380,000 tonnes of fish.

This potential of stored energy was initially converted into a resource by a traditional community of fisherfolk who lived by the sea and laboured on it. They used low energy, low entropy production system with artefacts manufactured and operated using renewable sources of energy. The resource was in turn converted into wealth through an economic system which was **also** low in energy Use and largely dependent on solar and human energy.

This scenario was a familiar scene in Kerala as recently as a decade ago. Fishermen on elegant, sail-powered canoes laden with a catch of fish heading for the shore. The waiting fish distributors women and men - who moved the fish to neighbouring markets carrying it in baskets on their heads or the back of bicycles. They took the fish to the market in the fresh state or after drying it in the Sun. .

These were the concrete expressions of the low energy consuming but highly efficient' chain of interaction between the ecosystem, the production system and the economic system. The methods of fishing were "passive and selective". They caught fish without disrupting the ecosystem, the fish catch per fisherman was low - well within the sustainability of the ecosystem. The price of fish was low and hence incomes were meagre. The level of disparity between participants in this economy was also low. The fishery was largely dependent on other local and national sectors of the economy for supply of inputs (wood for crafts; cotton for nets; rice, tapioca and other provisions for food; clothes etc.) and market for Its fish - the bulk of which rarely moved to markets beyond 20 - 50 kms. of the landing centre.

This was by no means a Utopia. There was exploitation. Lack of basic necessities and amenities for a full human existence were well apparent. Fisherfolk were however in full command of the production process.. Nature was not an entity outside their frame of life. The Sea was the Mother and they were her children. They well understood the ecosystem with which they interacted and possessed a pragmatic and holistic perception of it. The production system and the ecosystem were in harmony. The economic system, though limited in its spatial extension was however outside their control. They did not perceive it to be overexploitative and were hardly prepared to change it through collective action.

The High Energy Seotor

A new pattern of fisheries development undertaken at the initiative of the state, but driven primarily by the international market forces, was imposed upon such an economy.

On land it was possible to intervene in the ecosystem to raise its productivity by using energy additives (fertilisers) or energy aggregators (greenhouses). Such options at sea were limited. There was a fallacious yet strongly held , belief that sea was an inexhaustable biomass of fish. This provided the rationale for an excessive concentration on introducing technologies in the - production system for **harvesting** the sea more effectivly. Moreover, since the sea was considered a "free for all' terrain - a common property resource - this seemed the most sensible option available.

A big leap in the harvesting power of the fishing units resulted. Crafts powered by renewable energy sources and employing a range of passive and selective fishing gear were set aside. Instead mechanised grafts with single, active and non-selective fishing gear were preferred. Trawlers and purse seiners are two examples of these craft types used for fish harvesting under this new "planned fisheries development" regime.

There is one important dimension about these two sea harvesting artefacts which rarely gets highlighted. They were invented for an ecosystem (temperate zone sea) with a totally different energy configuration compared to the ecosystem (tropical sea) into which they were introduced.; Like any other exotic, **they were prima facie unsuitable in** uncontrolled numbers.

In the activities of processing and marketing, new technologies were introduced that resulted in a quantum jump in non-renewable energy use. Freezing, canning and the use of ice for preservation expanded the shelf life of the fish and thus immediately opened up possibilities of long distance marketing. This in turn became feasible only with the use of fossil fuel powered transport like insulated vans, refrigerated railway wagons and cargo ships.

The new energy and capital intensive technologies initially increased the labour productivity. It became possible to "dominate" and "exploit" Nature with them. The harvest of fish was soon above the desired levels of sustainability. The value of the output increased sharply consequent to the export orientation of the harvest from the sea. The incomes of those who utilised these technologies also increased. (In Kerala only between 10% - 15% of the fishermen work on mechanised boats.) Disparities between the owners of the new artefacts and the rest also widened. The dependence of the local fishery on the national and the international economy became greater both for the supply of inputs and as a market for outputs. The active disruption of the, marine ecosystem was on the increase: trawling resulted in indiscriminate damage of the aquatic milieu and purse seining overfished to the point, of species genocide.

The High Entropy Scenario

Until 1969 the fish catch in Kerala was below the annual mean sustainable yield (MSY) of 380,000 tonne. This harvest was made exclusively in the coastal waters and 95% of it by the traditional fishermen using 24,000 non-mechanised crafts. My rough estimate 'is that for every unit of energy input into the production process (the metabolic energy equivalent of the labour of the fishermen measured in Koal.) the output was between 40 to 80 units. (The energy in Koal. from fish.)

Between 1971 and 1974 the fish harvest rose above the MSY. It averqaged 400,000 tonnes and rose to 448,000 tonnes in 1973. The mechanised boats - now

predominantly trawlers - accounted for *23%* of the fish harvested in 1974. Their harvest was composed of prawns and large quantities of bottom dwelling species of fish caught along with it. This spurt in the harvest of prawns came as a result of consumers in developed countries with high energy luxury diets exercising their power on the economic system. Prawn prices on the seashores of Kerala increased from Rs.10,000/tonne in 1970 to Rs.20,000/tonne in 1975. The common property character of the sea, the encouragement by the state and the big profits to be earned from the "pink gold" resulted in an influx of trawlers owned almost wholly by non-fishermen. The trawler fleet increased from • around 700 in 1969 to over 2400 by 1975. An important energy issue which also had a strong influence in creating this situation was the rather low prices of petroleum products. The HP ratings of the engines used in the mechanised boats were also significanly above their necessary requirements. But a more powerful trawler could rake up the bottom of the soa more effectively thus enhancing the share of the prawns in every haul of the trawl net.Tho disorder and the damage this created in the sea bottom was considerable. Nature was wounded, but then Nature never reacts to her wounds immediately, and when she does, it is not always those .who cause the harm who suffer the most!

After 1975 the total fish harvest in Korala began to register a decline. Prawn harvest also dropped significantly. In 1980 the fish catch was as low as 280,000 tonnes - the lowest since 1963! Prawn production dropped from the peak of 77,000 tonnes in 1975 to 30,000 tonnes in 1980. The price of prawns however, continued to soar reaching a new height of Rs.46,000/tonne in 1980. Despite this overall decline in the fish harvests, the catches made by the trawlers actually registered an increase, implying that it was a large number of traditional fishermen who suffered the most..

So, despite increased fuel prices after 1973, enhanced investment costs and rising running expenditure, the number of trawlers in Kerala continued to rise. In 1902 it had crossed the 3200 mark. Energy balance too became increasingly adverse. While several traditional non-mechanised fishing techniques maintained a ratio of output to input energy between 20 to 60, similar analysis in the case of trawlers gave a figure of 0.5 -a negative balance!

	Low Energy Sector		**High Energy Sector**	
Year	**Productivity Kg/Year**	**Income* (Rs.)**	Productivity Kg/Year	Income* (Rs.)
1961	**3540**	**330**	**NA**	**NA**
1965	**3820**	**380**	**NA**	***NA***
1969/70	**3340**	**630**	**5150**	**790**
1974	**3200**	**870**	**10040**	**5060**
1979/80	**1780**	**540**	**7540**	**2630**
1982	**1620**	**420**	**7700**	**1560**

* Income adjusted to 1960-61 prices

Table I Estimates of Productivity and Real Incomes of Fishermen in the Low and High Energy Sectors of Kerala's Fish Economy.

The increased energy use and the high levels of disorder created very significant disparities: (i) that between fishermen using renewable energy technologies and those using mechanised crafts; (ii) that between fishermen workers as a whole and the class of owners of mechanised crafts Who were all non-fisherfolk.

In table 1 we see that between the years 1961 and 1982, the physical productivity as well as the real income of the fishworkers within the two sectors, first rose and then dec lined. The incomes and the productivity levels of the high energy sector were generally significantly higher than that of the low energy sector. However, the rate of decline of the incomes in the high energy sector is more rapid although the converse is true with physical productivity

Beating Entropy and Inequality with More Energy?

The disparities that arose as a consequence of the high energy, high entropy state of Kerala's fish economy gave rise to two important responses on the part of the fishworkers. The first is by now well known: The militant unionisation of traditional fishworkers. The greatest achivement of this "blue political movement" was its ability to extract a reaffirmation from the state that the exclusive access to the coastal waters was indeed their traditional and historical right.

There is however a lesser known response. From our perspective it is the more important. This has to do with the initially slow - and - cautious but subsequent tidal-wave-like shift towards using outboard motors on traditional crafts. In my opinion' this . trend frittered away the gains achieved by the political movement.

In 1980 the first commercially marketed outboard engines were sold to fishermen in the central regions of Kerala.By 1982 the number of motors used on traditional crafs in the whole of Kerala was around 2,000. By mid-1988 it was estimated ' that over 75% of the active fishermen were using the now ubiquitous outboard motor. We have here a revolutionary change in the technology configuration, a drastic change in the composition of energy use. and the energy balance. This was coupled with a concomitant rise in costs.

Fishermen have been caught on the one, hand in an upward increasing spiral of rising HP ratings on their engines, increased investments in their fishing gear and higher energy costs. On the other hand, it has been a downward spiral in relation to the fish harvests. They have 'lost their earlier knowledge and the control over the production process, virtually handing it over to multi-national corporations. Harmony has been ruined. Armed with mechanised power they also began to use more active and non-selective fishing gear which for all practical purposes were merely smaller versions of the destructive purse-seine nets used by the larger mechanised vessels.

In order to beat the entropy crisis the fishermen have sought to expand' life beyond the radius of tradition by a total shift from metabolic and renewable energy to a state of almost exclusive dependence on non-renewable energy and mechanical power. Fishermen, who less than a decade ago were the best sailors have stopped using sails altogether. Rowing is ofcourse totally out of the question. Enslavement to the outboard engines is by now almost total. More such gadgets await their turn in the pipeline. The multi-nationals which market these artefacts have acquired the ability to create and shape the basic needs of the working fisherman .into something which the multi-national alone can satisfy The hold of the multinationals on the labour power and the labour process of the fisherfolk is complete.

An inquiry into a cross section of the fishermen has revealed that in their opinion the most important feature of using the outboard motor was the reduction in the drudgery and the physical strain of their work. Surely this is an important and laudable goal to be achieved? The- real question that needs to be asked however is, whether this reduction in drudgery has resulted in a greater range of fishing operations, higher incomes, more comfort, less alienation and enhanced sustainability.

The evidence now being gathered points to a situation where the above list of desirables is hardly visible on the horizon of the vast majority of the fishermen in Kerala today. In dust eight years they are bonded to an economic system which determines both their choice of technology and the prices of the product of their labour. There seems to be no possibility of going back to a more sensible energy balance. They are caught in a downward vicious spiral. This is forcing them to ruin the ecosystem on which their long term future depends. It is on this score that Kerala's fishermen can be said to have won a battle but lost the war.

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LETTERBOX

As far back as 1953, the Swedish Fuel Commission in a preliminary report initiated a move to put a break on the over-dependence on non-renewable energy resources like oil and instead advocated active energy saving measures by way of encouraging insulation of dwellings, developing wind power machines and solar domestic heating systems. But by the time the commission submitted its final report in 1956 its enthusiasm had evaporated. The industrial mandarins had managed to hijack attention to nuclear power as an omnipotent and everlasting alternative to oil.

Godfrey Boyle has remarked that non-renewable energy sources have a unique characteristic eminently suitable for exploitation by the ruling oligarchies for the furtherance of their interest and hegemony. Fossil fuels are accumulated.. in specific locations and thus can be easily appropriated by them. Renewable energy sources have an egalitarian . Character being pretty evenly, distributed around the world. Their low concentration prevents easy exploitation

According to Ralph Nader, and John Abbots, the inexhaustable source of solar energy was, to the power holders, "an ugly duckling whose eggs were never to be hatched." Since solar energy resources can be provided at individual dwelling sites, they are under the individual's control and management and hence beyond the control of utilities or governments. Since the 1950s fossil fuel stocks have started dwindling at an ever increasing rate. Uranium has managed to fit into this existing politico-engineering framework to cater to the hegemonistic world view of the powerful.

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The struggle for housing - for a place to live in security and dignity - is one of the most basic (if unrecognised) struggles that all- people are engaged in. It is in terms of this struggle that people at a mass level can be made concerned about and involved in, the intense and ultimate contradiction to life that nuclearisation represents.

Nuclearisation inherently increases the level of hazard in our environment and therefore intrinsically contradicts the right of every woman, man and child to live in security and dignity. There is therefore an undeniable need for those of us interested in the right to housing, to very critically assess the situation, so as to intervene effectively in the public interest.

It is our belief that people, in general do not and will not become concerned with abstract questions of environmental risk'. Such questions' will only concern them if it is related to what they do in ordinary life. Housing is one such activity - basic, continuous, unrelenting, unrecognised but known intimately to all ordinary people. It has tremendous potential as an entry point and as a point of integration and insight.

Finally, we are working on the hypothesis that nuclearisation today has been successfully made almost a patriotic goal. To question it, bring a reflex reaction not about the merits of the argument but about the motives of the questioner. Therefore, we feel that it is first necessary to marshall and put forward information and to use such information actively and purposefully.

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Shri Laxmi Narain Modi, Director, Nation Building Forum has sent us copies of his interesting correspondence with the authorities on matters relating to nuclear power plants. We will continue to Pablish excerpts from these letters. Asking the government to justify its policy is an important means of demonstrating public awareness.

"Recently, the proposal to store hazardous chemicals atop Antop Hills near Bombay has been rejected by the expert committee appointed under the directions of the "Supreme Court. The Honable Court stated:
"The fundamental right to live also includes the right to a clean environment."

There are many reports that even while the atomic plants are operating normally, they do cause lot of environmental disturbances.* Under the newly enacted Factories Act, it is the responsibility of the management to give full, information not only to the workers but! also to the people in the vicinity about the dangers involved but regretfully no such information is being given by the DAE. There is more of concealment than disclosures of correct information.

Even with regard to the economics, nuclear power plants would not be economic when it is clear that their life is only about 25 years whereas radioactive wastes are a threat for thousands of years. It is therefore important, that before any atomic power plants are made critical, there should be satisfactory plans for waste storage ana true details of the costs should be known to the public. Otherwise there is no advantage in going in for such high investment technologies."

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Cycling Out **of the Greenhouse**

A report by Ian Grayson for Friends of Earth - Australia, reminds us of the role played by the transport sector in causing the greenhouse effect. A switch in transport priorities by the industrialised world to bicycles and public transport would reduce the greenhouse threat substantially. Cars account for 17% of all atmospheric carbon dioxide released by fossil fuels.
Source:WISE News Communique 304

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