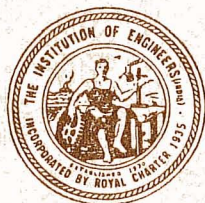


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# The First Indian Engineering Congress 1987

## TWELFTH BHAIKAKA MEMORIAL LECTURE



The Institution of Engineers (India)

**THEME**

**Economic Growth and Innovative Entrepreneurship  
in Rural Development: Issues in Rural Energy**

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**Calcutta**

**January, 1987**

## **Economic Growth and Innovative Entrepreneurship in Rural Development: Issues in Rural Energy**

The Bhaikaka Memorial Lecture has for the past eleven years provided an opportunity for professional engineers to look at the country's development process from the point of view of the engineers role and involvement in development. Distinguished scientists and technologists have been invited to deliver the previous Memorial Lectures. They have extensively covered subjects such as appropriate technology, rural engineering, choice of technologies, importance of irrigation, the impact of ecology, biomass energy, etc. I have been personally present to listen to those distinguished speakers on most of these occasions. All these lectures have set in motion a process of introspection on the role of the professional engineer and his attitude towards economic development. Some of the activities of the Institution have also been influenced by these lectures. A continuing debate has resulted in organising national and international programmes on the subject of low cost sanitation, organisation and water management, rural engineering, etc. To some extent, these Seminars have brought together large number of Indian scientists and technologists working in the areas of rural development.

### **The Early Efforts:**

My mind goes back to the history of rural development. India was always a confederation of large number of rural settlements politically, culturally and economically self reliant, the national spirit however, manifesting itself more on account of the cultural commonalities. Politically, the country suffered setbacks in the 18th and 19th centuries. The beginning of the 20th century, however, brought a few stalwarts into the Indian political and administration scenario. I would like to refer particularly to the concept of economic development as was visualised by the father of the nation Mahatma Gandhi. Just before Gandhi started propagating the concept of decentralised rural development, we in South India had the unique experience of being ruled by a benevolent ruler who entrusted the responsibilities of running the administration to an Engineer Statesman Sir Mokshagundam Visvesvaraya.

Sir M Visvesvaraya joined Mysore service as Chief Engineer on 15th November, 1909. Later in November 1912, he assumed office of Diwan of the State. He continued in office till the end of 1918 and later he was actively involved as adviser to the State Government on many important issues. All of us engineers are familiar with the importance Sir Mokshagundam gave to organising rural industries and technological education based on the needs of the country. His inter-action with the political leadership of the times particularly with Mahatma Gandhi and Pandit Jawaharlal Nehru brought into focus the concept of planning for economic development. In this planning process rural development assumed great importance after the country became independent. The basic object of growth in the country has been to improve the living standards of the rural poor.

After nearly 40 years of independence and six plan periods the country is struggling to evolve a satisfactory planning model to achieve the basic object of planned development. The best brains in the country have contributed to the formulation of policies. However, at the current moment, we find that in implementing our plans we do not appear to have obtained the required degree of success.

## **The Current Situation:**

Many economists have looked at the problem of rural development both in India and abroad. Planning models in many countries have been influenced by such studies. Experts like Peter Drucker and Professor Schumacher have proposed their own concepts of planning for economic growth. I would like to quote Peter Drucker "Contrary to all the expectations, global agricultural output actually rose almost 1/3 between 1972 and 1985 to reach an all time high. It rose the fastest in less developed countries. Similarly production of practically all forest products, metals and minerals has gone up between 20 to 35 percent in the last 10 years, gone up again with the greatest increase in less-developing countries. There is not a slightest reason to believe that the growth rates will slacken despite the collapse of commodity prices. Indeed, as far as farm products are concerned, the biggest increase at an almost exponential rate of growth, may still be ahead".

The spectacular developments in the field of agriculture and dairying have been the results of concerted planned activity with well monitored technology input. The current scientific trends in the field bio-technology may provide further impetus for the growth rate of the countries with a strong agricultural base.

During the same period technology has influenced a process of change in the industrial economies of the world. Product design today has resulted in dropping the raw materials intensity of manufacturing process and also the energy intensity of the process. To quote one classic example, to produce 100 pounds of fibre glass cable used in telecommunication requires no more than 5% of the energy needed to produce 1 ton of copper wire. Similarly, new materials have

reduced the demand for steel. The new materials are less energy intensive and consequently have brought down the prices of manufactured goods.

The structural change of this nature is bound to effect the economies of the developing countries. Our growth strategy cannot be based on low labour costs. The industrial policy alongwith our agricultural strategy needs a new look so that we can sustain higher productivity on the farm without disturbing the price stability. In this context, the sensitivity of the market for price fluctuations may have to be regulated. Two examples that I can quote in this context are the distress in our agricultural operations concerning cotton, collapse of the cotton prices and sickness of the textile industries. Similarly the agricultural operations connected with sugarcane, the health of the sugar industries are matters to be reflected. Keeping in mind the international trends and technology it would be necessary for us to review our entire strategy for maintaining sustained growth rates in our agricultural economy and establish strong linkages with industries, processing agricultural products.

The country has built an organisation structure for the last 40 years to have an effective control over the economy. The entrepreneurs of early 50s and 60s experienced an atmosphere of growth and the entrepreneurs of today are entering the field in a more competitive environment. More risks are involved in today's enterprises. Better management skills are required to manage the complex situation of today. The solution to some of our complex problems may be less and less governmental interference. We see this process of change already set in motion.

### **The Basic Issues:**

Let us examine some of the basic issues arising out of this situation. The process of modernisation which the country has chosen to adopt – Where will it lead us? What kind of economic change will it bring? How will it affect the society? Will the kind of institutions we have, the skills and attitudes and value systems help us achieve our goals?

The 7th plan document declares "Government has to play a major role in the development process in order to promote the interests of the poor, reduce disparities in income and wealth, curb regional inequalities in the level of development, protect the environment, strengthen the scientific technological base for long term growth and safeguard the interests of future generations. These are matters which cannot be left to the free play of market force. Purposive Government intervention in these crucial areas is central to our growth strategy".

Rural development has succeeded only where the entrepreneurship of the individual coupled with innovative skill had an opportunity for a free play. The role of the Government should be limited to a catalytic action. Agriculture and Dairying are two examples where at the lowest operating level of the management there has been no governmental interference of operations in the production process. I hope the policy makers will not miss this essential feature of our success stories. There is hope that the Government will keep this in mind for in the same

document states "Planning for an accelerated growth in a country of India's size and diversity, must have built-in flexibility to cope with the many sources of uncertainty which characterise modern economic life. To add to the effectiveness of the planning process, there must be an adequate emphasis on decentralisation to provide the needed element of built-in flexibility as well as greater involvement of people at all levels".

## **The Seventh Plan Perspective:**

The data provided in the 7th plan documents brings into focus the rural-urban dichotomy. India today has an estimated labour force in the age group 15-59 of 269 million persons – 77% of this labour force is in rural areas. In addition, we have potential labour force of 193 million people below 15 years age excluding children below 5 years. This figure is projected to grow by the turn of the century to about 380 million in the age group 15-59 years and 417 million in the age group 5 – 15. At the turn of the century, the rural population would be only 65% of the total labour force. Such movements of population will create difficulties in urban planning also. Rural development therefore, becomes a vital issue to regulate the population shift.

The plan document also brings out another important issue – the disparity and the inequalities between Rural India and Urban India. This is an explosive situation. It can one day burst into a major conflict. The Institution of Engineers (India) in the early 80's, was involved in serious debate in the planning commission on this vital issue. The then Deputy Chairman of the Planning commission Dr. MS Swaminathan invited the President and few of his Council colleagues for examining the question of making our plan investments far more productive in the rural areas. A major part of the plan investments was on rural development projects whether it be agriculture, water resources development, rural communication, organisation and water management, rural housing, rural public health, etc. The planning commission was trying to analyse the issue of total involvement of the people and the agencies in improving the effectiveness of the programmes. These discussions could not be continued due to the reorganisation of the planning commission. I would however like to suggest the Council commission an independent study to find out the extent to which a professional engineer is involved in the implementation of development schemes? What is his current goal? Can he change his attitude and approach to make our investments more productive and in the process try to find out whether there is a need for any structural changes in the engineering organisations at the state level. There are a few more related issues which a study of this nature can bring about. In this context, I would like to quote Sri RN Haldipur, a distinguished civil servant who after retirement headed an Institute of rural management: "Does rural development lead to employment making people a part of the production process? What kind of institutions emerge and how can we refurbish them? Do the programmes subserve the interests of those for whom they have been conceived? Can the very small surplus generated by the rural poor be processed and marketed by their own organisation, giving the

individual members a stable and remunerative price and not expose them to distress sale. When we survey the development scene, we find that benefits of economic growth hardly trickles down to the poor. On the contrary, it has often been accompanied by a rapid rise in the cost of living”.

**Technology:** Technology has no power to transform their lives. The fact of life is such innovations – which certainly deserve notice and need to be promoted – add value to things and therefore even the throw away articles which were valuable to the poor have now become inaccessible. Further, technology has become one more unmanageable factor in their life”. Such views reflect the anxiety of the thinking people of this country about the inadequacy of our development process with particular reference to rural development.

With the background that I have discussed so far, I would like to examine whether there are any alternative models which would result in our achieving our objective faster. In spite of the very highly centralised organisational set up the Government has in our country, India continues to be a very highly decentralised structure of society in which the individual's entrepreneurship and innovative skills have given results. In fact, it will be correct to say that the progress we have achieved so far is only due to this spirit, which has stood the test of time.

### **Role of Technology:**

The future development of both agriculture and industry, will require increasing application of science and technology so as to increase factor of productivity. Arrangements for access to technology, adaptation and absorption of technology in practice, linkages with sectional R&D facilities need to be improved. Changes in the pattern of education to make it more vocation oriented to help absorption of technology is also essential.

Agriculture coupled with water resources management, development of industries allied to processing of agricultural produce and our mineral wealth, development of the infrastructure in environment, public health, energy, habitat, improvement of communication to markets are all areas where technology input can upgrade quality and productivity. The different divisions and disciplines in the Institution are no doubt looking into several aspects of these issues for many years.

For purposes of discussion, I will choose only one area – Rural Energy.

### **Rural Energy Scenario:**

A system approach to Rural Energy Scenario has so far not been attempted. The studies done so far have concentrated either on the present pattern of consumption by types of fuels, sectorwise or concentrated on the domestic or

house-hold sector, which is dominated by the use of non-commercial sources of energy. The studies done by different sample surveys, NCAER, the planning commission, the development economists all reflect the concern for the inadequacy of the data base. However, the available data point out to some action in planning energy development for rural use.

The four dominant segments of energy use in rural areas are:

1. House-hold or Domestic Sector
2. Energy used in agriculture including water pumping, fertilizers, farm mechanisation and other inputs to agriculture.
3. Energy used in industries and establishments in rural areas
4. Energy consumption in transportation

In the total consumption of energy in the house-hold sector, the share of non-commercial energy is very high – as high as 80%. The Advisory Board on energy has made estimates based on the assumption that a minimum of 620 K. Cals are required for cooking, 30 K Cals for space heating and 30 K Cals for lighting. Based on these assumptions, the requirements of non-commercial forms of energy by 2005 for an estimated population of 1000m. is as follows:

### **Estimated Energy Requirements for 2005 AD of Non-commercial Fuels**

Fuels (mil.Cu.m)	Millions of Tons
Fuelwood	300
Veg/Agri waste	90
Animal Dung	199
Gobar Gas	169
	758

These figures show that in physical terms the requirement will be 2½ times the current level of consumption.

As a result of policy changes and the changes in the economic levels, inter-fuel substitution is taking place. The commercial fuels are slowly replacing the non-commercial segment. The present pattern of use of commercial energy in rural areas is as follows. Kerosene is preferred for lighting, soft coke and charcoal for cooking and space heating. Electricity is more economical for lighting in view of the subsidised tariff of the State Electricity Boards.

#### **The Agricultural Sector:**

The bulk of the energy used on the farm today is made up as follows.

Draught Animals	20%
Human Labour	6.5%



Diesel Operated Equipment –		
including sprayers, etc	:	32.5%
Electric motor operated devices	:	41%

In this sector, the interfuel substitution is taking place – draught animals being replaced by tractors and tillers and diesel pumps being replaced by electric pumps. The pressure on increased supplies of kerosene, diesel and electricity in rural areas is an indicator of this trend.

In the rural industries and transport sector, it has not been possible for any of the research groups to make a realistic forecast. However, the emphasis on decentralisation of industries and dispersal to rural areas, the expanding markets for LCV's and the commercialisation of the activities in small towns, spread of technical education are all resulting in innovative entrepreneurs going to rural areas for establishment of service centres. The spread of diary farming, sericulture, automobile service centres, agricultural machinery service centres, all these are increasing the demand for skills and commercial energy in rural areas. The village blacksmith is slowly being replaced by a village mechanic. As industry also begins to move into non-urban centres, there will be an increasing demand for construction activity including housing, public health facilities, resulting in demand for commercial energy, particularly for electricity and petroleum fuels. This trend will continue during the next two decades, if our agricultural production keeps growing and alongwith it our GDP.

### The Official Line

Sri Hiten Bhaya, Member, Planning Commission in his Mokshagundam Visvesvaraya Lecture last year stated

“Meeting the burgeoning requirement in both fuel wood and animal dung of such magnitude is a formidable task. As most of the non-commercial and non-conventional sources of energy will primarily be in rural areas, there are problems other than technological. As long as the purchasing power of the rural people remains low, any form of commercial energy will need subsidization which the country can ill-afford for a long period. It also needs acceptance of a changed pattern of life. Community biogas plants have not been a great deal of success so far. Individual biogas plants have not been viable for persons owning less than four heads of cattle and such households are very few in rural areas. Energising rural India has, therefore, both socio-economic and technological challenges”.

Where do we go from here? Do we accept the official line and let the situation take care of itself?

The complex total rural energy system is indicated in Chart I and Chart II. The transition from the existing usage pattern to the possible future usage pat-

tern would involve strategic planning and injection of technology and innovative skills in energy using methods and hardware. In addition changes in energy organisations become necessary.

Non-commercial energy today is available to the end user directly by his own organisational effort. He locates the source, collects it and uses it. It has no assigned commercial value except in kilo calories. But we can value it by equivalent quantum of commercial energy for equivalent kilo calories. The user will have to acquire that much purchasing power, either through wages earned or sale of his produce or services. In other words if there is a correct assessment of the value of the services rendered by the rural poor for the productive sector, his wages should be adequate for him to enable him to buy an equivalent commercial energy for his level of survival. We must determine this value. Otherwise we will be compensating him through subsidies.

The rate of substitution to commercial energy is also a function of the level of compensation to the rural labour. When we are talking of the rate of growth of demand for electricity or petroleum products we are essentially coping up with the rate of growth of GDP due to economic development.

Do we want to accelerate this rate of Growth? Yes – that is our goal and that is the area for technology innovation. Entrepreneurship, innovation is possible only when an environment is created for this. The highly centralised management system of the commercial energy organisation of today does not initiate a process of change. There is no accountability for the inefficiencies of the system and consequent losses. Can we build a decentralised energy organisation which will be responsible for supplying to the village all forms of energy in an integrated system? This organisation can develop local resources and if they are inadequate arrange to procure the energy from another supplier and distribute it to the consumers at a price. The experience of rural electric co-operatives, milk co-operatives give us hope that such a system works. In an integrated rural energy system, the management concepts will be service oriented and will lead to more interaction with the consumer.

**Conservation:** Efficient use of existing energy sources will have to be a part of our culture. The present methods of energy use need review. The innovative work of a few heat transfer specialists in the country has resulted in improving the conversion efficiencies of cooking stoves. These designs are now being adopted by a large number of users saving over 50% of the fuel they were normally using. As contrast to this, the organised industry has supplied pumping systems, both run by diesel or by electric motor, where energy conversion efficiencies is less than half of what they should be. There is no organisational mechanism to initiate a process of change to prevent further proliferation of installations of inefficient pumping units. This is a typical example of our inability to handle change. This is partly due to multiplicity of agencies involved in engineering of the system and procurement of the system. The resulting energy losses and consequent financial losses are borne by the tax payer. There

is no accountability in our present management structure. If however, a decentralised agency with accountability for profits, would tackle these, the country would derive enormous benefits.

Biogas technology is another area where the Indian experience is not very satisfactory. Too many designs without adequately taking care of local conditions have resulted in large number of installations which are inefficient. The recent audit report of the KVIC highlights this aspect. Biogas plant needs a very hard look by the designers so that more efficient operations of this unit is made possible under varying regional conditions.

Kerosene is a highly inefficient source of lighting energy. Substitution of the use of kerosene by electricity should be encouraged. For this purpose, development of decentralised source of energy supply should be designed, installed and serviced as a national programme. The present practice of providing electricity for lighting from the national grid is resulting in wastage of energy due to transmission and distribution losses. Also the system is not reliable in rural areas.

#### **Development of local resources:**

The local energy resources, if any, such as mini /micro hydels, use of local wood waste for running gasifiers, generation of electricity through co-operative schemes, should all be developed with the involvement of the community. The maintenance of the system should also be the responsibility of the local community. Such organisational set up would result in optimisation of resources and give better economic return.

Energy for water pumping could also be provided from a decentralised source generating electricity. Where renewable sources of energy afford economic options, they must be adopted. The present capital intensity of the photovoltaic route does not give much hope of its adoption in the next two decades. However, mini hydels, wood gasifiers, biogas units for purposes of electricity generation have broader chances of economic viability.

#### **Organisation Structure:**

One of the basic reasons for slow adoption of new ideas is the organisation structure that the country has built. Over a period of time, a highly centralised structure has developed. There is a case for considering a single organisation for meeting of rural energy needs at the taluk level to begin with. It is also desirable that this organisation is managed by the local co-operatives so that the concept of ownership and accountability will help achieve better operational results. Some of the rural co-operatives for electricity distribution have done their given work.

## Strategic Planning

The success of our development efforts, to a large extent, depends on strategic planning by which we are able to generate better economic resources. This plan would call for higher productivity on the farm, stabilised agricultural prices, assured market for agricultural products, introduction of industries based on agricultural produce as a raw material, better vocational education and training in rural schools, etc. To achieve significant results we may have to have a hard look at the loose structure of the present organisation. I suggest that the Engineering Staff College of India undertakes a serious system study and suggest different organisational modules which will integrate the efforts of the various development agencies. While governmental funds will continue to be the main source of financial resources, the organisation, planning and initiative must be left at the local level. Some of the studies done during the last few years by many of our research workers in the area of rural management provides adequate data for analysis of this nature. The ultimate objective should be to develop adequate surplus for reinvestment.

In the model adopted for development in the past we have made one assumption that the consumer market is dominant in urban areas. While this is true in terms of volume, the potential however exists in rural area. To tackle the twin problems of providing employment at the local level and also generate increases in purchasing power, we should seriously consider shifting our units of production which are labour intensive to the source of the raw materials and transport only, the finished product to the nearest market. Just as we produce our food on the farm the processing of farm products, forest produce and mineral wealth, should all be done very close to the source of raw materials. The concept is not new. We generate electricity at the pithead and transmit it to consumption centres. Our strategic planning should bring about this change.

There are many individuals who are not only attempting but initiating change in rural area. I have read reports about some of our engineers setting up in rural areas, hitech assembly units for assembly of Television sets and in the process create employment and purchasing power bringing about a perceptible change in the quality of life. People in West Bengal must be familiar about the Rangabelia experiment initiated by a school master Sri Tushar Kanjilal with the active support of a very dynamic official in the state agricultural directorate. A few individuals working together highly motivated have been able to establish a chain of non-formal education centres spread over 28 villages. In 1976 the per capita income of Rangabelia was Rs. 500 and today it is Rs. 1040/-. Rangabelia today has schools, roads, hospitals, sanitary latrines, piped drinking water all built by villagers, who had not even heard of many of these things decades ago. I quote this example of a success where entrepreneurship, individual initiative of a few individuals has brought about desired change.

Similarly, the example of the work done by Sri Vilas Balwant Salunke, an engineer, in the drought prone district of Pune needs to be mentioned. His work relates to water management and soil conservation on a 16 acre barren

land taken on lease from a temple. He adopted a strategy of optimising the use of water in both good rainfall years and poor rainfall years, by construction of tanks, reservoirs, barrages and percolation tanks. He harnessed the water directly from these storages and also by digging open wells fitted with pump sets. In three years the food grain production increased from 10 quintals to 200 quintals. Number of crops per year also increased.

The success of this experiment led to formation of co-operative projects involving local people leading to 62 schemes, with 1800 families over 1500 hectares. He has been recognised by the society by conferring the Jammalal Bajaj Award for this year. We need more engineers of this type, in the tradition of Sir M Visvesvaraya.

The decision of the Institution of Engineers (India) to set up a rural development forum and a water management forum, will enable engineers all over the country to initiate similar process of change. This can happen provided our engineering education and training focus the attention of our young engineers on the harsh realities of our rural economy. Our new education policy I regret to say, completely overlooks these linkages with any vocation, entrepreneurship and innovation. I plead that the authorities of the Engineering Staff College to develop a suitable education and training module with a view to initiate change in rural areas. I trust, such an approach will make the rural economy self-reliant for resources for development, reduce the cross subsidies and accelerate the development process.

Let me conclude by quoting Peter Drucker from his recent article.

“Can we learn something from India? Everyone knows of India’s problems – and they are a legion. Few people seem to realise, however, that since independence India has done a better development job than almost any other third world country. It has enjoyed the fastest increase in farm production, and farm yields....., the emergence of a large and highly entrepreneurial middle class and arguably, the greatest achievement in providing schooling and health care in the villages..... India has followed a policy of strengthening agriculture and encouraging consumer goods production. India and its achievements are bound to get far more attention in the future”.

Thanking you.

# CHART I

## RURAL ENERGY SYSTEM

### SOURCE

Solar Heat	Animal Power	Animal Power	Solar Heat
Animal Power	Diesel Power	Diesel Power	Firewood – Wastes
Diesel Power	Human Power	Electricity for	Dung – Cattle
Human Power	Electricity Power	Industry	Kerosene
			Electricity

### END USE

Agricultural Operation	Water Pumping	Transport Industry	House-hold
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### APPLICATION

Ploughing			Heating
Harvesting			Cooking
Thrashing			Lighting
Drying			

### OWNERSHIP

Individually owned system	Individual or Group	Individual or Commercial Service	Individual System Community System
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## CHART II

### Technology Options for Rural Energy Development

<b>1. Renewables</b>	<b>- Resources</b>
Photosynthesis	- Solar Route
Afforestation	- Energy Plantations Social Forestry
Conversion	- Direct - use - Charcoal - Gas - Tar - Bio mass - Gasifier - Electricity - Engine - Mechanical Power
Solar Thermal	- Low Grade Heat - Concentrated Heat - Conversion to Steam - Electricity Route
Photo Voltaic	- Electricity - Storage Devices
Wind Energy	- Direct Pumping - Pumped Water Storage - Electricity Route
Hydro	- Large Systems - Mini/Micro decentralised system
Agro Wastes	- Bio-mass - Animal Fodder
Animal Dung	- Bio-gas
Animal Energy	- Optimization - better breeding - Veterinary Science

### 2. Technology for Energy Storage

- For making Solar, a continuous Source, Absorption - Chilling
- For Wind, continuous source
- Tidal a continuous source
- Parallel operation with large systems
- Battery technology - Solar - lighting

### 3. Non-Renewables

- Coal/Lignite
- Low Grade Oils
- Refined Petroleum Products
- Kerosene                      Direct use or Conversion to
- Diesel                         Mechanical Power/
- Petrol                         Electricity
- Naphtha                      Fertiliser
- Gas                         - Fertiliser
- Electricity

### 4. Electricity

- Secondary - Accepted as most convenient form of Energy
- Feeding from the grid
- Decentralised Systems
- Good System design - Transmission, Distribution and utilisation

### 5. Technology for Efficient Energy Conversion & use

- Chula - Use of low grade heat
- Gasifiers, sterling engine
- I.C. engines, efficiencies
- Electrical apparatus/systems
- T & D Systems
- Conservation of all types of Energy
- Solar heat to Reciprocal motion
- Good System design for high efficiency and Reliability in service

### 6. Economic options

Economic Viability  
Capital Intensity  
Rate of return on Investment

Improve purchasing power to make transition to commercial Smoother  
Development of Decentralised Systems for servicing rural energy needs  
managed by consumers

Attach Value to all energy - Kilo Calories  
   - Rupees/Unit



## 7. Technology

is successful only when Economically viable

- This can happen with Entrepreneurial Skill – Innovation – Technovation
- Our efforts should not stop with prototypes to prove Scientific Principles of energy conversion.