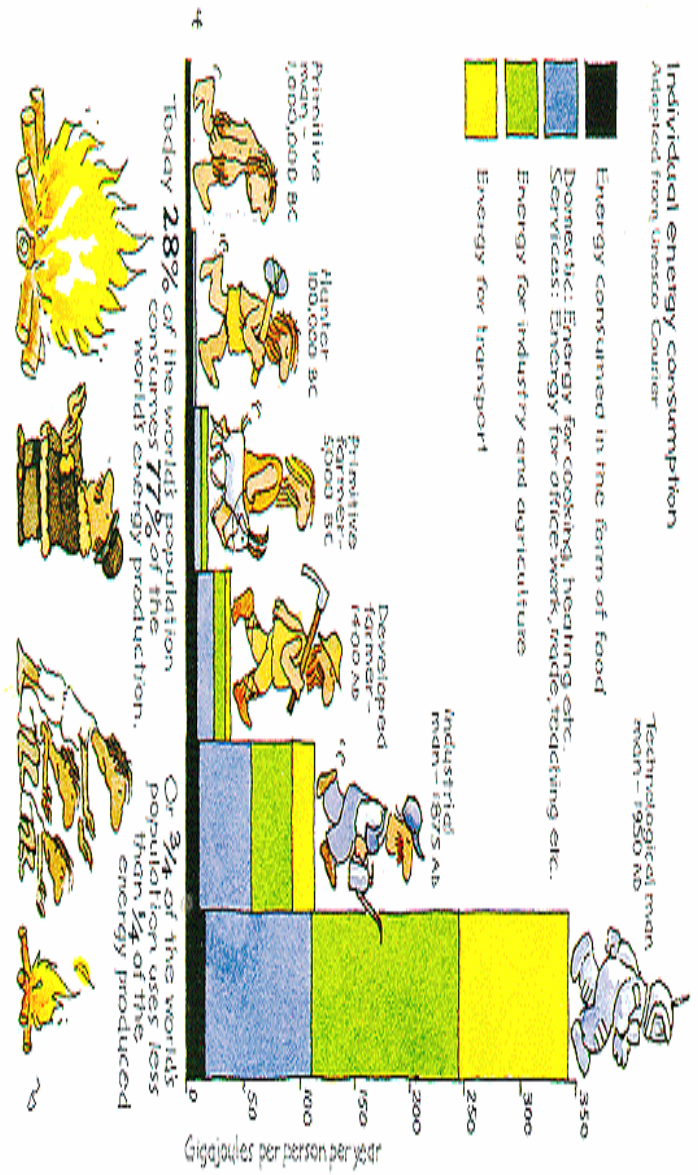


MAKING RENEWABLE PROJECTS VIABLE

Presentation by

A.A. Khatana, Chief General Manager
Indian Renewable Energy Development Agency Ltd

Individual Energy Consumption



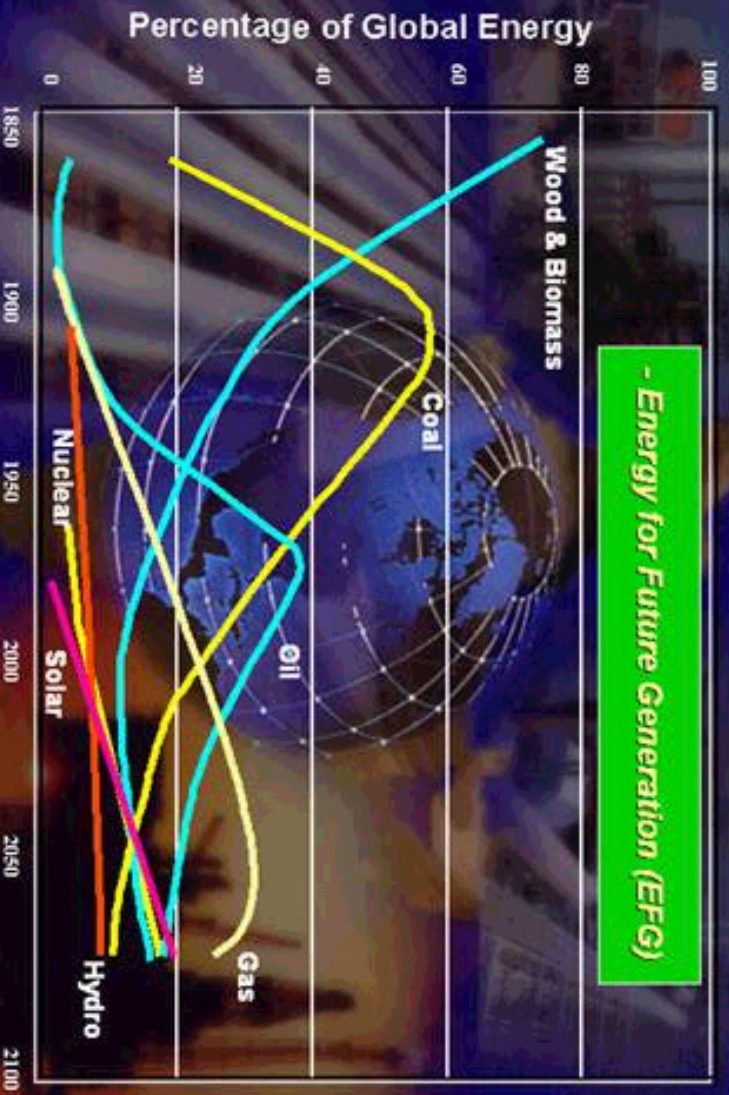


World Energy Use Pattern

- 19th Century - Coal
- 20th Century - Oil
- 21st Century - Natural Gas
- Industrial Revolution -
- 1850-1900 - Coal
- 1900- 1950 - Oil
- 1950-2000 - Natural gas
- 2000-2050 - Renewable Energy

PATTERN OF GLOBAL ENERGY DEPENDENCE

- Energy for Future Generation (EFG)



Source: World Energy Council

Energy Options for India

- **Primary energy**
 - wood
 - coal, oil, natural gas, natural uranium
 - wind, hydro power, and
 - sunlight
- **Secondary energy**
 - electricity and
 - petrol.

Renewable Energy Technologies

- **Power Generation Technologies**
 - **Wind Power**
 - **Small Hydro Power**
 - **Biomass Energy and Cogeneration**
 - **Biomass power**
 - **Biomass Cogeneration**
 - **Bagasse Cogeneration**
 - **Biomass gasification**
 - **Energy from Waste**

Renewable Energy Technologies

- Solar Energy Technologies
 - Solar Thermal
 - Solar water heating
 - Solar air drying
 - Solar cooker
 - Solar Photovoltaic
 - Solar home lighting
 - Solar Photo Voltaic water pumping
 - Solar lantern
- Rural Energy Technologies
 - Biogas
 - Improved Chulhas

Renewable Energy Technologies

- New Technologies
 - Fuel Cells
 - Hydrogen Energy
 - Geothermal
 - Ocean Energy
 - Tidal Energy
 - Ethanol
 - Biodiesel

Characteristics of Renewable Energy

- ❏ Decentralized Production
- ❏ Modular in use
- ❏ Zero or low cost fuels.
- ❏ Low gestation period, providing quicker benefits.
- ❏ Socially relevant and useful.
- ❏ Economically viable and financially sound
- ❏ Provides energy security

Government of India - National Programmes

- Solar Energy Programme
- National Programme on Improved Chulhas
- National Programme on Biogas Development
- National Programme on Biomass Assessment Programme
- National Programme on Biomass Power/Cogeneration
- National Programme on Wind Energy
- National Biomass Gasifier Programme
- Small Hydro Programme
- National Programme for recovery from Urban, Municipal and Industrial wastes
- UNDP/GEF assisted "Development of High Rate Biomethantion Processes as means of Reducing Green House Gases Emission".

Government of India - Policy Initiatives

CENTRAL GOVERNMENT

- Income Tax holiday
- Accelerated Depreciation
- Concessional Import duties
- Capital/ Interest Subsidies

STATE GOVERNMENT

- Energy Wheeling, Banking and buy back facilities
- Sales Tax and Excise duty concessions
- Electricity tax and Tariff Concessions
- Capital Subsidy
- Demand cut concession offered to Industrial units who are establishing power generating units from renewable energy sources.

RENEWABLE ENERGY AT A GLANCE IN INDIA

S.No.	Source / system	Estimated potential	Achievement as on 31 st March, 2008
I	Power from renewables		
A	Grid-Interactive renewable power	MW	MW
1	Wind power	45195	8757.00
2	Bio power (agro residues and plantations)	16881	606.00
3	Bagasse Cogeneration	5000	800.00
4	Small Hydro Power (upto 25 MW)	15000	2180.00
5	Energy recovery from waste (MW)	2700	55.25
6	Solar Photovoltaic power	--	2.12
	Sub total (A)	84776	12400.37
B	Captive/combined heat and power/distributed renewable power	MW	MW
7	Biomass / cogeneration (non-bagasse)	--	95.00
8	Biomass Gasifier	--	100.11
9	Energy recovery from waste	--	26.70
	Sub total (B)	--	221.81
	Total (A+B)	--	12622.18

RENEWABLE ENERGY AT A GLANCE IN INDIA

S.No.	Source / system	Estimated potential	Achievement as on 31 st March, 2008
II	Remote Village Electrification		4198 villages / hamlets
III	Decentralized energy systems		
10	Family-type biogas plants	120 lakh	39.94 lakh
11	Solar photovoltaic systems	50 MW/km ²	120 MW
	i. Solar street lighting system	--	70474 nos.
	ii. Home lighting system	--	402938 nos.
	iii. Solar lantern	--	670059 nos.
	iv. Solar power plants	--	2.22 MW
	v. Solar Photovoltaic pumps		7148 nos.
12	Solar Thermal systems		
	i. Solar water heating systems	140 million m ² collector area	2.30 million m ² collector area
	ii. Solar Cookers		6.20 lakh
13	Wind pumps		1284 nos.
14	Aero generator / hybrid systems		675.27 kW
IV	Awareness Programmes		
15	Energy parks	--	504 nos.
18	Akshay Ujya shops	--	269 nos.
20	Renewable Energy Clubs	--	521 nos.
19	District Advisory Committees	--	560 nos.

Cost of Renewable Energy

Sector	Capital cost per MW (Rs Cr.)	Cost of Generation Per kWh (Rs)
Small Hydro	5.50 to 7.00	2.50 to 3.50
Wind Energy	6.00 to 6.50	2.75 to 3.75
Biomass power	4.00 to 4.50	3.50 to 4.00
Bagasse Co-gen	3.50 to 3.50	3.00 to 3.50

Barrier of RE Financing in India

- Risk assessment/ Mitigation Measures
- Small Players with no credit history
- Lack of effective & efficient utilization of funds
- Lack of local level financing like cooperative banks

Hydro Energy

- **The Advantages**
- Long useful life extending over 50 years

- **Bottlenecks**

Land Acquisition problem

- **Security of supply**

Large year-to-year variations in snow and rainfall

- **Price**

capital investment very high, life cycle cost low

- **Environment**

Non-polluting and environmentally benign source of energy

Wind Energy

- **The Advantages**

Clean, abundant energy source

- **Bottlenecks**

Seasonal variations- unreliable

- **Security of supply**

Wind suffers from a security of supply problem

- **Price**

Fossil-fuelled plants on standby for times

- **Environment**

Non air-polluting

Bio Energy

- **The Advantages**

Tremendous scope for income generation

- **Bottlenecks**

Biomass technologies are renewable provided energy plantation is carried out

- **Security of supply**

Scope of expansion productivity

- **Price**

Becoming competitive, especially for industrial customers

- **Environment**

Neutral greenhouse gas emissions provided energy plantation

Solar Water Heating

- **The Advantages**

Clean, abundant energy source

- **Bottlenecks**

Seasonal variations- unreliable, daylight/ whether-dependent

- **Security of supply**

Enhances energy security

- **Price**

Reasonable capital cost. Fully commercial. Commonly used

- **Environment**

Eliminates air pollution -NO_x, SO_x, CO₂

Solar Cooker

- **The Advantages**

No recurring expenditure on fuel

- **Bottlenecks**

Not for frying purpose

- **Security of supply**

Enhances energy security

- **Price**

Rs 5000 for Dish Solar Cooker

- **Environment**

Reduction of smoke, reducing drudgery of women and children..

Solar Photo Voltaic

- **The Advantages**

Decentralized sources of energy

- **Bottlenecks**

Solar electricity generation using photo voltaic is expensive

- **Security of supply**

Enhances energy security

- **Price**

Very high capital cost

- **Environment**

Eliminates air pollution -NO_x, SO_x, CO₂

SPV Water Pumping

- **The Advantages**

Zero recurring cost on diesel/ electricity

- **Bottlenecks**

Very high cost. Need to be highly subsidized

Security of supply

Enhances energy security

- **Price**

System cost including AMC -Rs 3 lakhs

Environment

Eliminates air pollution -NO_x, SO_x, CO₂

Solar Lantern

- **The Advantages**

Flexible domestic use for lighting

- **Bottlenecks**

Overcoming technical and non technical barriers

- **Security of supply**

No fuel is required.

- **Price**

Rs 3,000-3,500

- **Environment**

Elimination/ reduction of smoke, reducing drudgery of women and children

Solar Passive Architecture

- **The Advantages**

Effective use of solar radiation

- **Bottlenecks**

Active solar devices in the building's skin

- **Security of supply**

44 kWh/m² per year, compared with 172 kWh/m² in other contemporary buildings.

- **Price**

Can be incorporated relatively cheap

- **Environment**

Optimisation of the technology and the environment

Ethanol

- **The Advantages**

Renewable energy source

- **Bottlenecks**

Dependence on single substrate (molasses).

- **Security of supply**

Enhances energy security of transport fuel

- **Price**

Efficient manufacturing processes, economic of scale, may lower cost

- **Environment**

Lowering of smoke level

Biodiesel

- **The Advantages**

Renewable energy source

- **Bottlenecks**

Jatropha plantations may be unprofitable in comparison to other cash crop

- **Security of supply**

Reduced dependence on foreign oil supplies

- **Price**

Seed is procured at Rs 5/kg then Rs 20-25 / litre of biodiesel is an attainable

- **Environment**

Reduced vehicle emission

Improved Chulhas

- **The Advantages**

Thermal efficiency of about 20 per cent or more as compared to 5 % to 10% of traditional chulhas

- **Bottlenecks**

Lack of appropriate models for local adaptability & sustainability

- **Security of supply**

Check on deforestation

- **Price**

Fixed type chulha with chimney Rs 160-Rs 200

- **Environment**

Elimination of smoke, reducing drudgery of women

Biogas Development

- **The Advantages**

Biogas is clean non-polluting and smokeless free fuel

- **Bottlenecks**

Lack of skill fabricator and technicians for installations

- **Security of supply**

Biogas saves fuelwood and manurial value is enhanced

- **Price**

3 cubic metre 8-12 Persons Rs 15.000

- **Environment**

Elimination/ reduction of smoke, reducing drudgery of women and children

Biomass Gasification

- **The Advantages**

Partial combustion of biomass material used for production of thermal, mechanical and electrical energy.

- **Bottlenecks**

Operation and maintenance of the system

- **Security of supply**

Sustainable biomass supply from existing social forestry

- **Price**

Dual fuel engine has become uneconomical

- **Environment**

Eliminates air pollution -NO_x, SO_x, CO₂

Biomethanation

- **The Advantages**

High energy density, can be transported by gas grid

- **Bottlenecks**

Biogas alone-fired engine is imported

- **Security of supply**

Uses agri-residues

- **Price**

Green Investment of 8-10 crore per MWe

- **Environment**

Clean fuel (No particulate emissions, no SO_x, NO, NO_x, No sulphur)

Waste to Energy

- **The Advantages**
 - Reduces the quantity and improves the quality of waste
 - **Bottlenecks**
- Organic and non-organic materials difficult to segregate
 - **Security of supply**
- Replacement of petroleum products
 - **Price**
- Difficulties and high costs associated with sorting such material
 - **Environment**
- Safe disposal and Energy recovery from urban & industrial waste

Fuel Cells

- **The Advantages**
 - Reliability, durability, power quality, ease of operation and modularity
 - **Bottlenecks**
- Overcoming technical and non technical barriers including productions, delivery, storage and safety
 - **Security of supply**
- Enhances energy security
 - **Price**
- Very high capital cost
 - **Environment**
- Eliminates air pollution -NO_x, SO_x, CO₂

Hydrogen Energy

- **The Advantages**

Decentralized sources of energy

- **Bottlenecks**

Overcoming technical and non technical barriers including productions, delivery, storage and safety

- **Security of supply**

Enhances energy security

- **Price**

Production, storage, transportation, delivery and end use application requiring major investments.

- **Environment**

Eliminates air pollution -NO_x, SO_x, CO₂

Battery Operated Vehicles

- **The Advantages**

Surface transportation

- **Bottlenecks**

Overcoming technical and non technical barriers including productions, delivery, storage and safety

- **Security of supply**

Battery operated buses/vans/3 wheelers/ cars

- **Price**

Very high capital cost.

- **Environment**

Eliminates air pollution -NO_x, SO_x, CO₂ and Significantly lower noise pollution

Hydrogen Energy

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Eliminates air pollution -NO_x, SO_x, CO₂ and Significantly lower noise pollution

Tidal Energy

- **The Advantages**

Capturing tidal power inherent in moving vast quantities of water back and forth twice a day.

- **Bottlenecks**

Relentlessly harsh environment

- **Security of supply**

Potentially suited to Indian conditions

- **Price**

Technology is currently expensive and in its infancy.

- **Environment**

Environment and marine safety issues

Ocean Energy

- **The Advantages**

Converting the up and down motion of the waves into electricity using devices either fixed to the shore, or floating out at sea.

- **Bottlenecks**

Relentlessly harsh environment

- **Security of supply**

Enhances energy security

- **Price**

Technology is currently expensive and in its infancy.

- **Environment**

Environment and marine safety issues

Geothermal

- **The Advantages**

Geothermal power involves drilling deep wells to tap into this high temperature water to produce steam to turn electricity turbines.

- **Bottlenecks**

Rare availability of economic site

- **Security of supply**

May provide continuous generation

- **Price**

Some reserves may turn out to be economical to develop.

- **Environment**

Eliminates air pollution -NOx, SOx, CO2

IREDA's ROLE

- Played a key role in financing & promoting Renewable Energy & Energy Efficiency in the country
- Accelerated the momentum of development and helped in large scale utilization of Renewable Energy sources in the country.
- Has been a pioneer in commercialization of RE technologies in the country
- Also financing projects with a scope of Energy Efficiency/Energy Conservation in various industries.
- Would like to expand its business in the R&M / Life Extension of Thermal / Hydro Power plants

Sectors for Financing

- ♣ Solar Energy,
- ♣ Small Hydro Energy,
- ♣ Biomass Power
- ♣ Cogeneration
- ♣ Wind Energy
- ♣ Energy Efficiency & Conservation,
- ♣ Bio Fuels, Waste to Energy etc.
- ♣ New & Emerging Technologies

Financing Parameters & Assumptions

- Project Cost, Interest During Construction (IDC), Working Capital & Tariff,
- Operating Cash Flow = (Revenue - Expenses)
- Net Cash Flow = (Operating Cash Flow - Capital Cost)
- Project IRR >> 12%
- Debt Equity Ratio 70 : 30
- Interest Payment on Loan , Depreciation & Taxes
- Post Tax Return on Equity (ROE) 14%
- Payback Period < 10 years
- Projected Profitability Statement
- Projected Balance Sheet
- Projected Cash Flow
- Asset Coverage Ratio (ACR) > 1
- Debt Service Coverage Ration (DSCR) > 1.2
- Break Even Point < PLF
- Cost of Generation < Tariff

TERMS OF FINANCE

Sector	Interest Rate (%)	Repayment Period (incl. grace period)	Extent of Loan
Wind	14.00 – 14.75	10 years	Upto 70% of the project cost
Small Hydro	14.50 – 15.25	10 years	- do -
Biomass / Cogen	14.50 – 15.25	10 years	- do -
Energy Efficiency / Conservation	14.50 – 15.25	10 years	- do -
Solar Thermal / Photovoltaic	14.00 – 14.75	10 years	- do -

HIGHLIGHTS OF CUMULATIVE LENDING OPERATIONS (As on 31.03.2008)

Number of Projects Approved (Gross)	: 1845
Loan Commitment (Rs. In Crores)	: Rs.8865.98
Loan Disbursements (Rs.In Crores)	: Rs. 5009.80
Power Generation Capacity Sanctioned	: 3169 MW
Conventional Fuel Replacement MTCR / Year	: 12.92 lakh Lakhs
Commissioned Capacity	: 1430 MW
IREDA's share in Indian RE Development	: 30%

International Assistance

- International Assistance Mobilised
 - Government of Netherlands - 18 million Dutch Guilders
 - Asian Development Bank - 100 million US \$
 - The World Bank/GEF/SDC - 145 million US \$
 - DANIDA - 15 million US \$
 - KfW, Germany - 120 million US \$
 - WB 2nd Line of Credit - 135 million US \$

WHY RISK ANALYSIS by a financial institution ... ?

It helps the financial institutions to determine a *proper price* to be charged for the funds to be lent.

It helps in determining the amount and the kind of *securities, mortgages, etc.* are to be asked from the client for the *proper hedging of the risk* involved.

It helps in designing repayment schedule.

It helps in formulating various types of terms, conditions and covenants in loan agreement.

To determine the *extent of risk* to which a financial institution will be exposed to. (as it will determine the quality of its assets.)

As such an analysis will be helpful in determining the quantum and the quality of the risk, a financial institution can *design its portfolio* of investment assets so as to minimise the overall risk.

... A NEGATIVE PARAMETER... HAVING DIFFERENT SHADES!!!

- Risk is a threat.
- Risk prevents the project to realise its expected goals.
- Risk is a fear.
- Risk is pessimism.
- Risk is expected loss.
- Risk is a chance of loss.
- Risk comes out from unexpected undesirable events.
- Risk is unwanted.
- Risk is variation, fluctuation and volatility.
- Risk is dynamic.
- Risk arises due to uncertainty.
- Risk is because of change.
- Risk is *an odd thing out*.

MAIN OBJECTIVES OF SENSITIVITY ANALYSIS

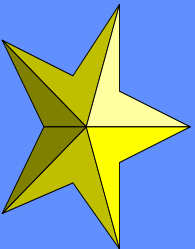
- To test the robustness and sensitivity of the estimates of a project;
- To determine the likelihood impact of the undesirable and uncertain events on the return/viability of a project.

RESULTS OF SENSITIVITY ANALYSIS ...

are meaningless unless and until

chances of occurrences are attached to
the prospective changes in the
important variables.

the results of the Sensitivity Analysis
provide us an exact measure of risk.



MANAGE THE RISK

AVOID

REDUCE

**KITE OF RISK
MANAGEMENT**

TRANSFER

ACCEPT

