Challenges of Promoting a Green Economy

Anil Kakodkar
The International Centre, Goa
4th September 2012

Challenges of Promoting a Green Economy

- Growth in population
- Growth in consumption
- Upset equilibrium of different cycles
- Credible waste management
- Exceeding carrying capacity
- Credible regulation
- Expertise v/s Activism
- Poverty is the worst polluter

Evolving modes of value generation

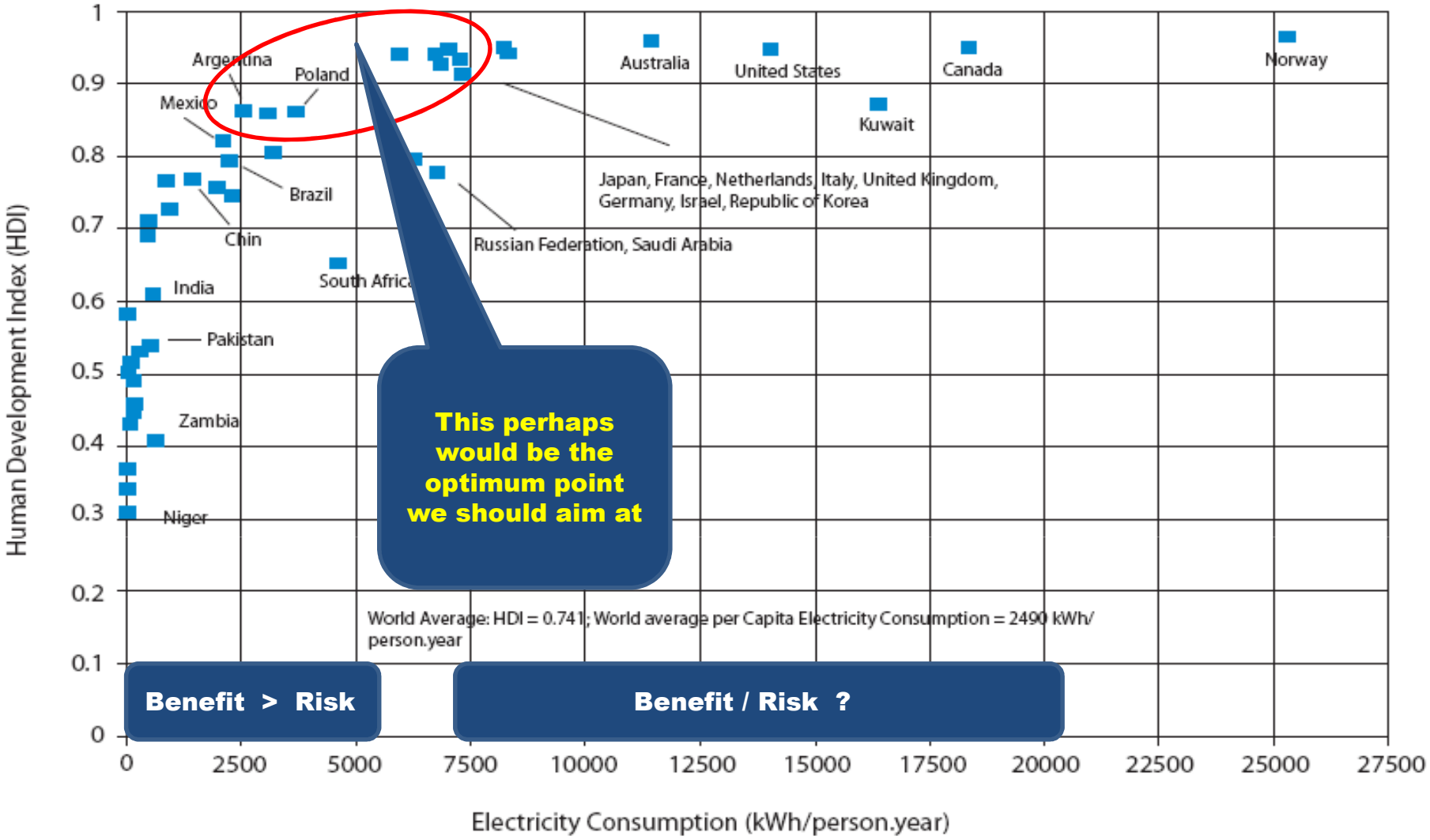
- ❑Market raw resources
- ❑ Market value added materials
- ❑ Market products
- ❑ Market technology
- ❑ Market innovation

Large disparity in education and opportunities as well as large demand for products and consumables in India would necessitate our living with all layers for quite some time

Environment Impact assessment

- **Do nothing approach to new economic development does not necessarily guarantee environment security**

- **National expertise to quantitatively model dynamics in the society and related environmental impact needs to evolve**



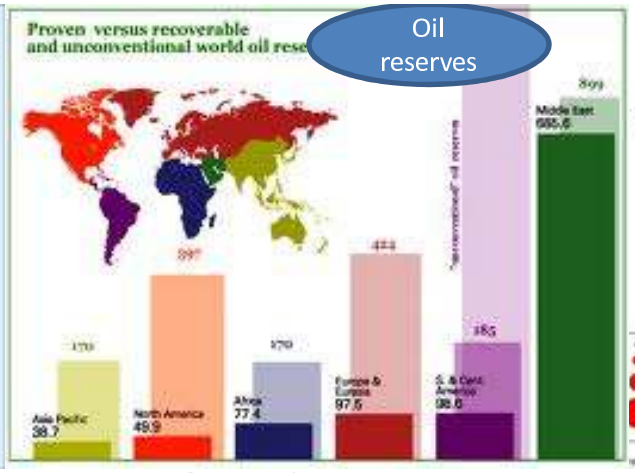
Source: Dr. Steve Chu, Department of Energy, US

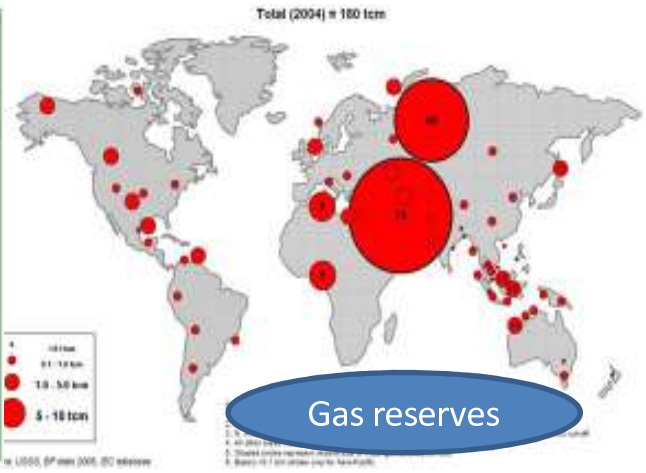
Human Development Index and Electricity Consumption

Securing energy for India's future is a major challenge

	World	OECD	Non-OECD (developing world)	India	India of our dreams
Population (billion)	**6.7**	**1.18**	**5.52**	**1.2**	**1.6 (stabilised)**
Annual av. per capita Electricity (kWh)	**~2800**	**~9000**	**~1500**	**~675**	**5000**
Annual Electricity Generation (trillion kWh)	**18.8**	**10.6**	**8.2**	**0.811**	**8.0**
Carbon-di-oxide Emission (billion tons/yr)	**30**	**13**	**17**	**1.7**	**?**

India alone would need around 40% of present global electricity generation to be added to reach an average 5000 kWh per capita electricity generation

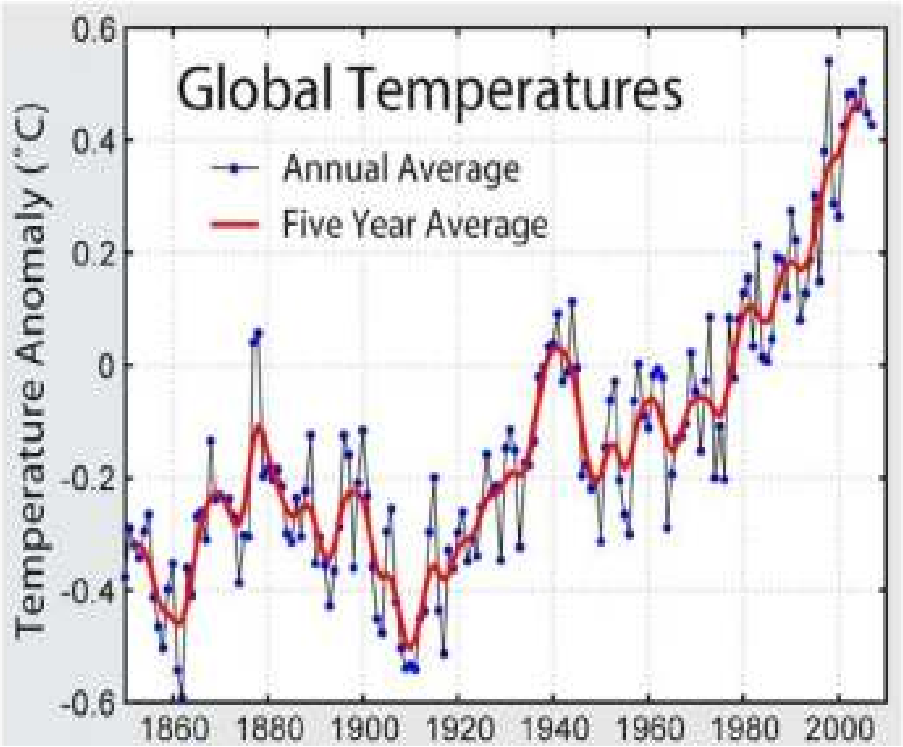




Per Capita key energy reserves/(production/yr)

	World	China	India
Coal (t)	**122 (0.88)**	**87 (2.38)**	**50 (0.45)**
Oil (barrels)	**192 (4.4)**	**12 (1.12)**	**5 (0.27)**
Gas(1000cft)	**885 (13.3)**	**62 (1.1)**	**30 (0.85)**
Uranium(gm)	**770 (6)**	**131 (0.56)**	**66 (0.42)**

Figures in brackets are numbers for production per year



. **Global average temperature over last one and a half century showing a more or less steady increase over the last fifty years or so. The fluctuations and their cycles can be correlated with various events like solar cycles**

We do not know how close we are to the tipping point. However we need to act now to secure survival of our future generations.

Number of years a domestic non-renewable energy source (as known today) can last at 5000 kWh/capita electricity consumption in India (8 trillion units/yr)

Coal	Hydro-carbon	Uranium once-through	Uranium recycle	Thorium
11.5	----	0.36	18.5	>170

Non-renewable

Renewable

WHILE WE MUST MAKE FULL USE OF ALL AVAILABLE ENERGY RESOURCES ONLY THORIUM AND SOLAR ENERGY IS SUSTAINABLE IN THE LONG RUN

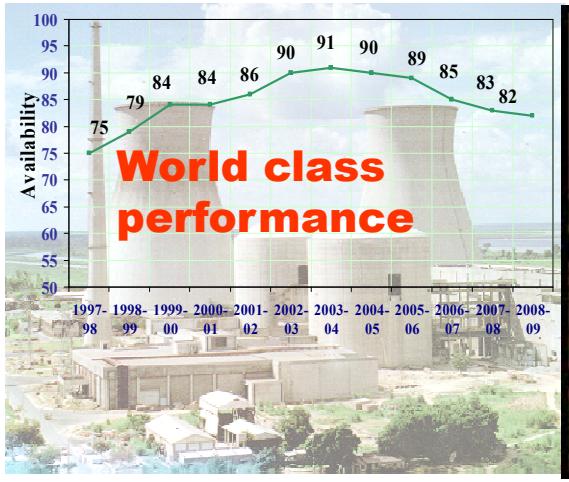
(FUSION ENERGY NOT CONSIDERED FOR THE PRESENT)

Electricity generation potential from renewable sources in India (as fraction of 8 trillion units/yr)

Hydro	solar	Other renewables (wind+biomass)
0.075	>1.0*	0.0225

*Would need ~45,000 sq.km which corresponds to a fourth of barren and uncultivable land in India

Three Stage Indian Nuclear Power Programme



Stage – I

PHWRs

- 18 – Operating (4460 MWe)
- 4– 700 MWe units under construction(2800 MWe)
- Several 700 MWe units planned

LWRs

- 2 --BWRs Operating (320 MWe)
- 2 -- VVERs under advanced stage of construction (2000 MWe)
- Several LWR Units planned

Stage - II

Fast Breeder Reactors

- 500 MWe PFBR- under advanced stage of construction
- Pre-project activities for two more FBRs approved

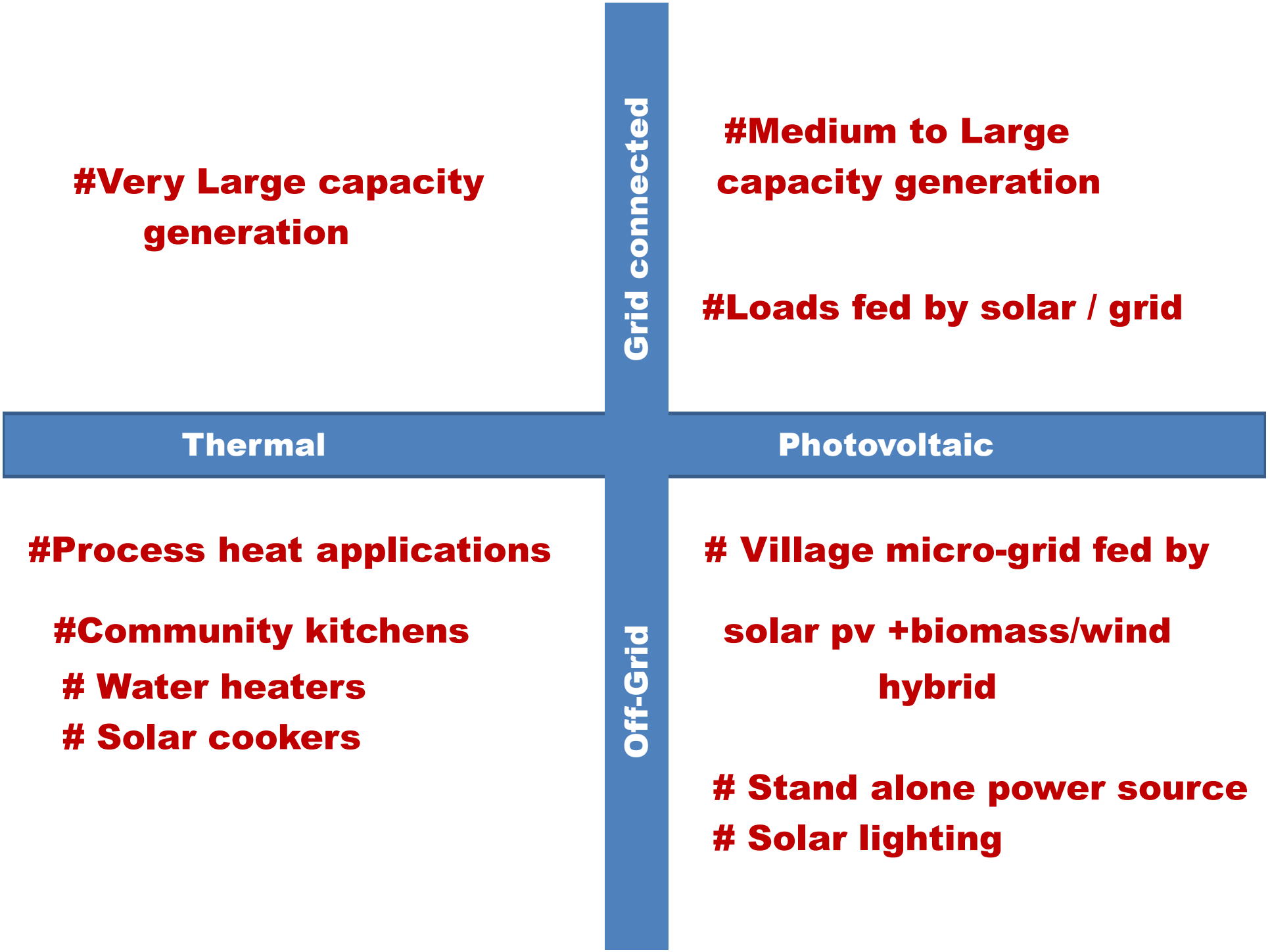
With limits on Uranium availability, Fast Breeder Reactors are the only means to scale up power generation capacity to required levels

Stage - III

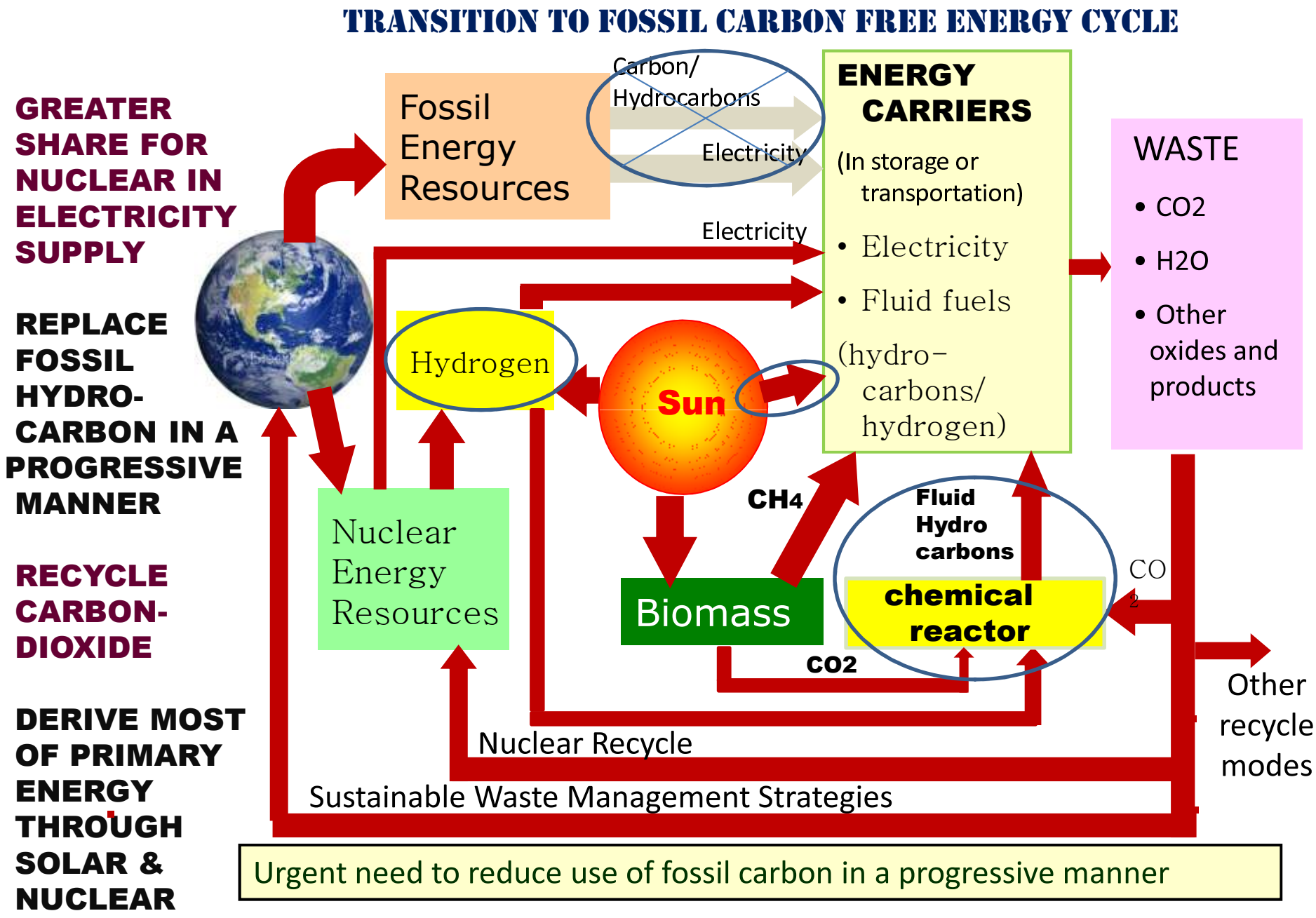
Thorium Reactors

- 30 kWth KAMINI- operating
- 300 MWe AHWR- ready for deployment
- Availability of ADS can enable early introduction of Thorium on a large scale

ENERGY POTENTIAL IS VERY LARGE


Grid connected
Off-Grid
Thermal
Photovoltaic
#Very Large capacity generation
#Medium to Large capacity generation
#Loads fed by solar / grid
#Process heat applications
#Community kitchens
Water heaters
Solar cookers
Village micro-grid fed by solar pv +biomass/wind hybrid
Stand alone power source
Solar lighting

sector


TRANSITION TO FOSSIL CARBON FREE ENERGY CYCLE
GREATER SHARE FOR NUCLEAR IN ELECTRICITY SUPPLY
REPLACE FOSSIL HYDRO-CARBON IN A PROGRESSIVE MANNER
RECYCLE CARBON-DIOXIDE
DERIVE MOST OF PRIMARY ENERGY THROUGH SOLAR & NUCLEAR
Fossil Energy Resources
Carbon/ Hydrocarbons
Electricity
Electricity
ENERGY CARRIERS
(In storage or transportation)
• Electricity
• Fluid fuels
(hydro-carbons/ hydrogen)
WASTE
• CO2
• H2O
• Other oxides and products
Hydrogen
Sun
Nuclear Energy Resources
CH4
Fluid Hydro carbons
chemical reactor
Biomass
CO2
CO2
Other recycle modes
Nuclear Recycle
Sustainable Waste Management Strategies
Urgent need to reduce use of fossil carbon in a progressive manner

Standalone solar powered pumps

- Agricultural pumps consume grid electricity leading to higher tariff to be paid by industrial consumers that erodes their competitiveness

- This perpetual cross subsidy can be avoided by one time liberal capital subsidy support to standalone solar powered pumps

- This will lead to a more optimum ground water use while at the same time make our economy grow faster on account of cheaper electricity supply

- Adoption of efficient dc motors to drive pumps would not only make pumping more energy efficient but also save on cost of invertors

- Large scale production of rare earth magnets for such dc motors is necessary to make them cost competitive

Solar lights for rural areas

- A large number of villages still do not have electricity and depend on kerosene for lighting
- There is recurring subsidy burden on use of kerosene
- Free supply of solar lights in lieu of corresponding cut in kerosene quota would not only lead to better quality light but also save on a significant part of kerosene subsidy
- Facility for free charging of batteries from roof top panels at schools could ensure light for home study of school children
- Similar solar panels for energy taps could be established in a well distributed manner for charging solar lights and mobile telephones (could become a key input towards A3 connected society)
- Cottage industry could be built for assembly, supply and maintenance of solar lights under franchise operation of qualified brands
- This could well be a nearly cost neutral programme over a period of time

Integrated Development taking place at GSRF

- Coal pyrolysis to recover volatiles as value added **hydrocarbons** and Char as a carbon source for metallurgical/heating/reduction and other uses
- Recovery **of Iron,** Titania and Alumina values from red mud and reduction of Iron ore using Char
- Carbo-chlorination of Red-mud slag, Bauxite and Ilmenite
- Energy efficient electrolysis for production of **Aluminum and Titanium**

Potential gains: No new red mud arising, efficient use of available coal, substitute hydrocarbon source, low cost production of Aluminum and Titanium

NISARGRUNA PLANT: RAW MATERIALS

Type of material	No. of plants	Locations
Kitchen discards	> 60	Most of the existing plants
Vegetable market	> 30	Some plants receive mix materials
Abattoir discards	3	Deonar, Solapur, Kalyan
Bone protein factory discards	1	Chandrapur
Cattle dung	6	Nasik, Chiplun, Pali, Anjangaon, Vasai, Tara

APPROXIMATE QUANTITY OF MATERIAL PROCESSED AT MAJOR LOCATIONS

Location	Material processed (MT)	Location	Material processed (MT)
Anushaktinagar	5000	Pandharpur	1000
Govandi	5000	Kaiga	1000
Matheran	4000	Cochin refinery	500
Kalameshwar	1000	Nasik	800
Katol	800	Symbiosis	500
TIFR	1000	Symbiosis _2	500
INS Kunjali	1500	TCS, Thane	300
Pune (Model Colony)	600	Alibag	300
Pen	1000	Roha	300
Panvel	1000	Pune	1000
Anjangaon	500	Kerala	1000
Chiplun	500	Thane	1500
Pali	500	Ankaleshwar	2000

AKRUTI-KRUTIK-FORCE

Interactions

TECHNOLOGY CAMPAIGN

KRUTIK FORMATION

AKRUTI

Advanced Knowledge based RUral Technology Initiative

KRUTIK

Knowledge & RUral Technology Implementation Kendra

FORCE MOBILIZATION

FORCE IDENTIFICATION

FORCE Group

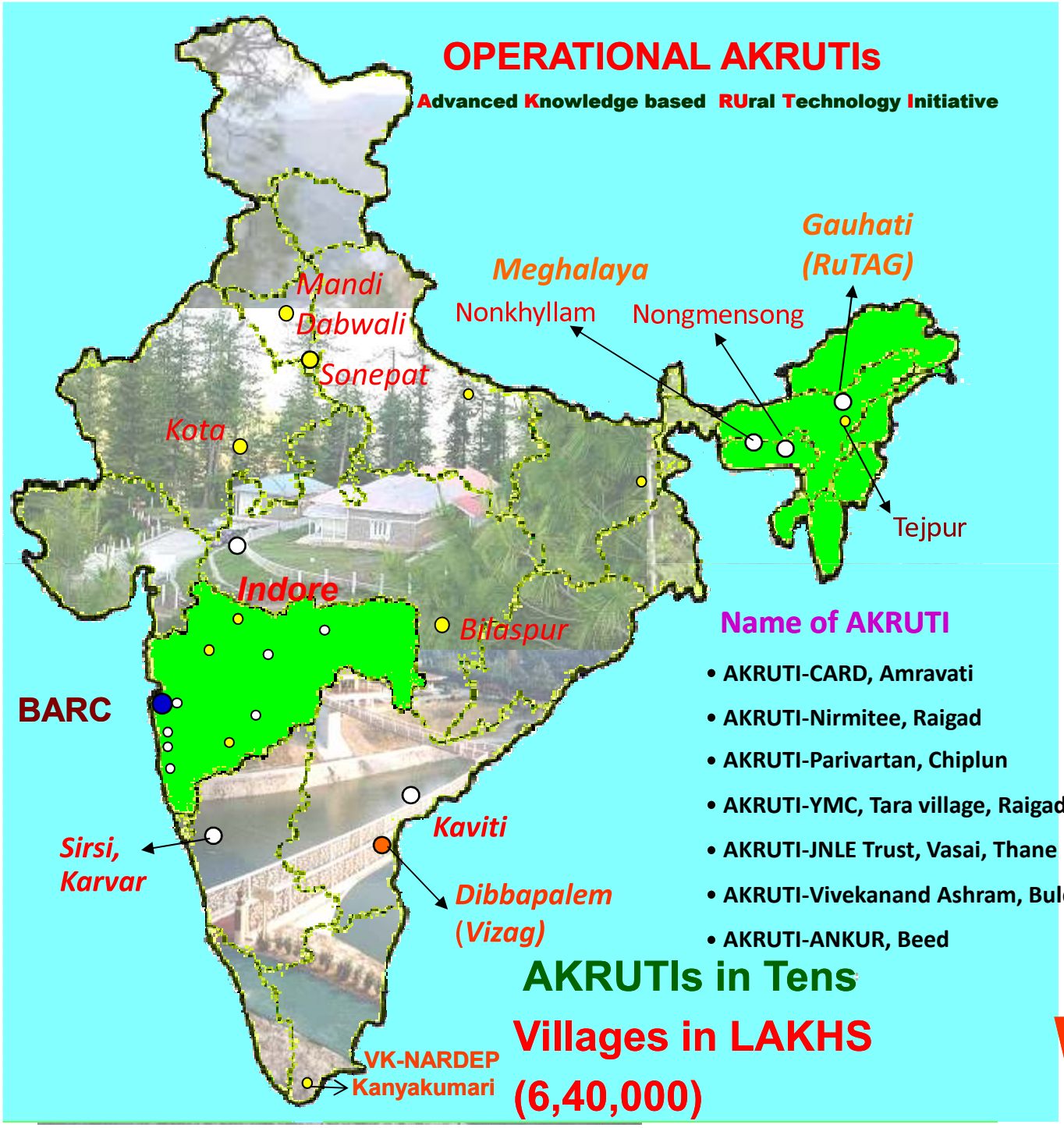
Farmer's Organised group for Rural Creative Entrepreneurship

FORCE villages :

Asgani, Waderu, Palkot, Shivne, Kajurli, Nagthana, Kalapani, Pipalagad, Karwar, Linga, Ner, Jamgaon, Hirdamal, Sindi, Karli, Harisal, Tebhursonda, Dharamdoah, Telkhar, Badnapur, Chichati, Varapgaon, Lokhandi Sawargaon, Dipivadgaon, Sawleshwar, Ladegaon, Sangaon, Borisavargaon, Dighol Amba, Damodi, Malkapur, Akot, Chincholi, Wasim, Dhotra, Sakhri Trishul, Kudli, Mundhe, Dalwatane, Khandat Pali, Lavel, Datoda, Badiya, Nimar Khadi, Sulgaon, Unhere, Kewele, Kumbharshet, Tadgaon, Dhokle Wadi, Pilosari

OPERATIONAL AKRUTIs

Advanced **K**nowledge based **RU**ral **T**echnology **I**nitiative



- 3 AKRUTIs in NER
- AKRUTI by Fresh-O-Veg, Indore, in Madhya Pradesh
- AKRUTI- MEARDS, Sirsi in Karnataka
- NAYUDAMMA'S AKRUTI setup by ARTIC, BREDS, GUEST & SRUTI in Andhra Pradesh
- Techno Entrepreneurship by AKRUTI TECH PACK.

Name of AKRUTI	Funded by
• AKRUTI-CARD, Amravati	- RGSTC, GoM
• AKRUTI-Nirmitee, Raigad	- RGSTC, GoM
• AKRUTI-Parivartan, Chiplun	- RGSTC, GoM
• AKRUTI-YMC, Tara village, Raigad	- TRUST
• AKRUTI-JNLE Trust, Vasai, Thane	- TRUST
• AKRUTI-Vivekanand Ashram, Buldana	- TRUST
• AKRUTI-ANKUR, Beed	- SELF

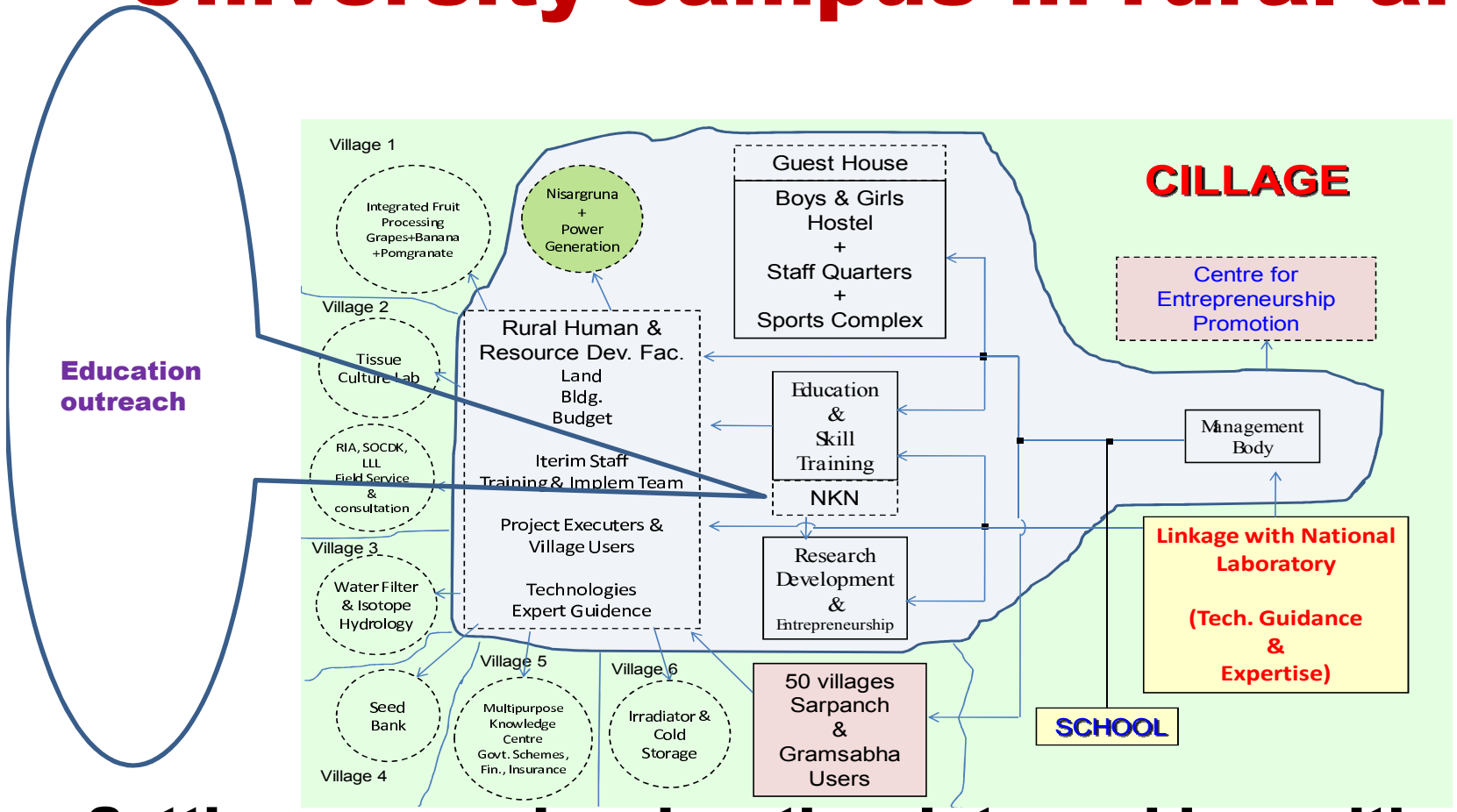
AKRUTIs in Tens

Villages in LAKHS

(6,40,000)

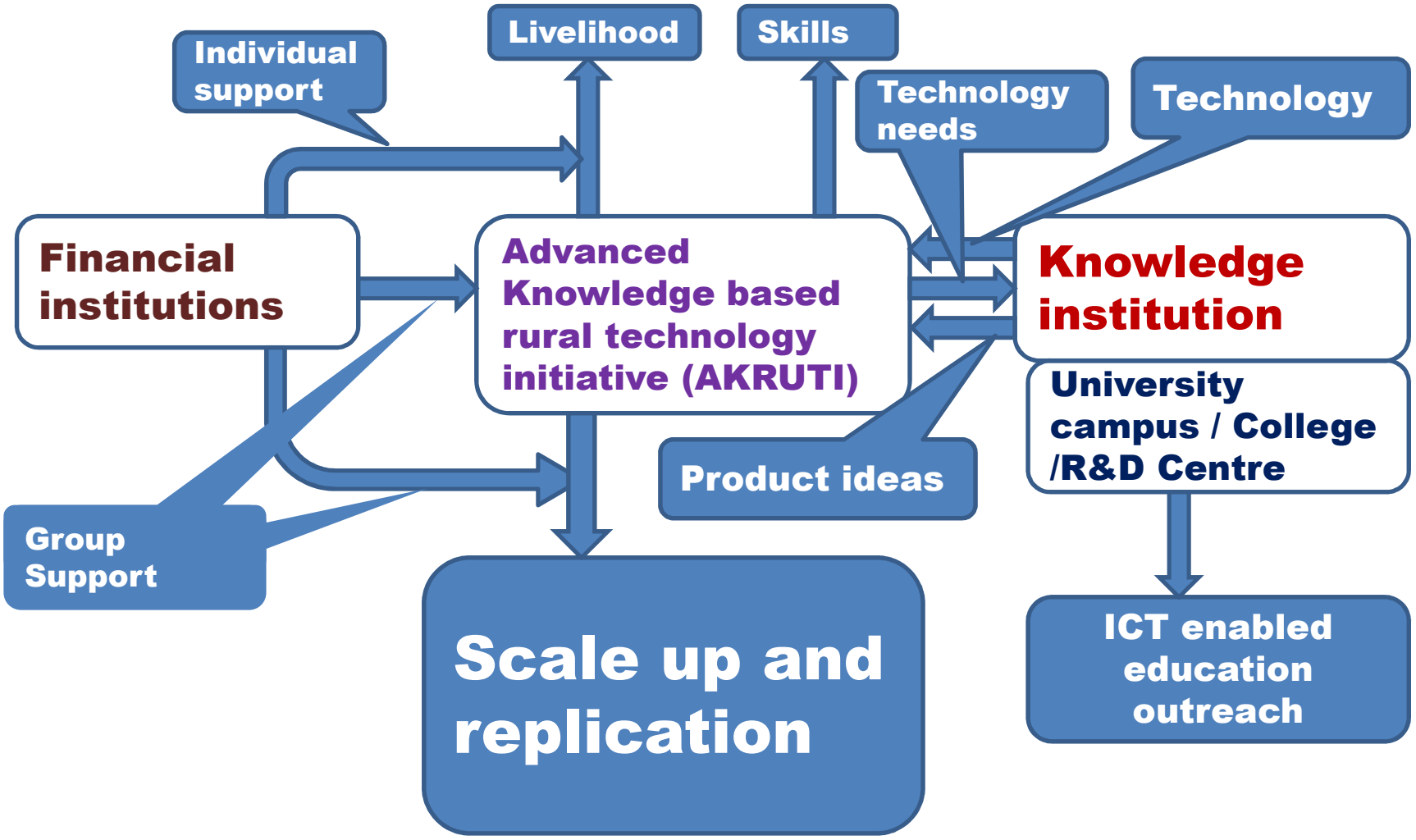
WHAT NEXT?

University campus in rural area



- **Setting up such educational townships with modern amenities away from major cities would contribute to development and technology enabled education in rural areas and equitable distribution of wealth across layers**
- **Needs better connectivity**

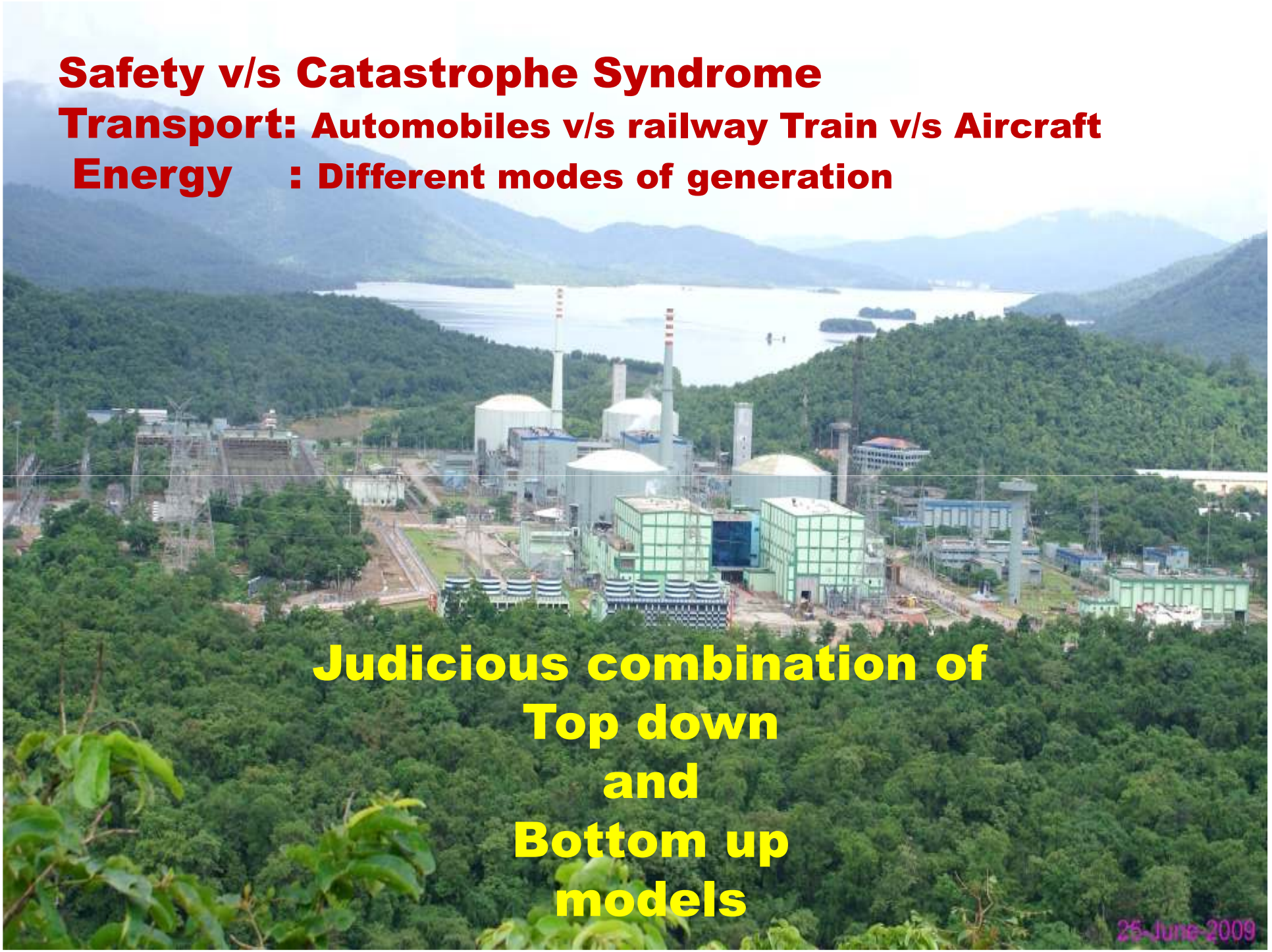
DNA of rural development



Safety v/s Catastrophe Syndrome

Transport: Automobiles v/s railway Train v/s Aircraft

Energy : Different modes of generation



Thank you