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Regional Integrated Energy Plan

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Abstract: In this paper most favorable energy allocation using RIEP for Uttara Kannada district is described .It is developed on DSS approach. Features of DSS used are flexible structure, integrated nature and iterative nature. RIEP is a computer-assisted accounting and simulation Tool developed to help in policy making. DSS for Uttara Kananda district energy planning focuses on renewable resources that could be used for allocation of energy resources.

Keywords: DSS, Regional integrated energy plan

I. INTRODUCTION

Overall development of a country is somewhere dependent on energy system of that country. So energy system must be efficient and sustainable. Many energy models are developed based on different approaches. According to analytical approach, models can be divided into top-down and bottom-up models. Top-bottom model focuses on interaction between energy sector and other sectors for overall macroeconomic performance of the economy. It follows historical pattern so it can't be practical for developing countries. It is only suitable for short term purposes. On the other hand, bottom-up models examines only on energy sector. In this, it is assumed that interaction to other sectors is completely zero. It is completely based on optimistic engineering concept. These models are very practical in developing countries as they are independent of market conditions.

There are many methods of designing energy systems. System dynamic models, accounting framework simulation models and normative models are some of them. Models are also classified as simulation, optimization, Econometric, macro-economic, economic equilibrium and Toolbox models. The main disadvantages of these models is that they never provide satisfactory results. Many systems are LEAP, MARKAL, MESAP, RES-DSS, Solar energy planning system, RIEP. RIEP minimizes annual cost and inequality constraints using different algorithm.

In section II & III, the decision support system approach & Design approach will be reviewed followed by Results and discussions in Section IV. Implementation is explained in section V.

II. DECISION SUPPORT SYSTEM APPROACH

DSS is a coherent system of computer-based technology used by managers as an aid to decision-making in semi-structured tasks. It is an adjustable tool for policy anatomizing. Modelling tool consist of three-component subsystem. First is the database management subsystem which handles data to all the models. Second is the model management subsystem which provide user modelling tools. Third is dialogue management subsystem which provides guidelines for designing system.

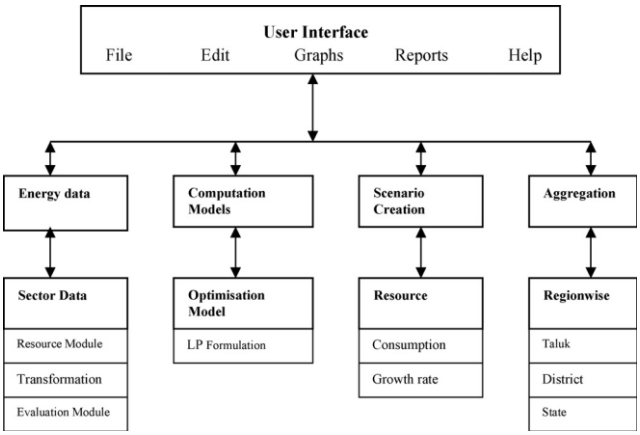

Fig.1

The regional energy planning has four stages energy scenarios, computation models, aggregation and the energy database.

A) *The energy demand module*- In this data are assembled in hierarchical order in 4 levels. These are sectors, subsectors, end uses and devices.
B) *Transformation module*- it simulates the energy sector conversion processes.
C) *Energy resource modules*- which includes different types of resource modules. It includes Biomass module, Wind resource module, solar module, hydroelectric energy operation module.
D) *Evaluation module*- This includes financial anatomization and environment programs used to calculate overall consequences.

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E) *Computation models*- Energy planning in some particular area includes resources and conversion devices to meet future demands.

The basic components in regional energy planning are regional energy system, tasks and integration of sources.

III. DESIGN APPROACH

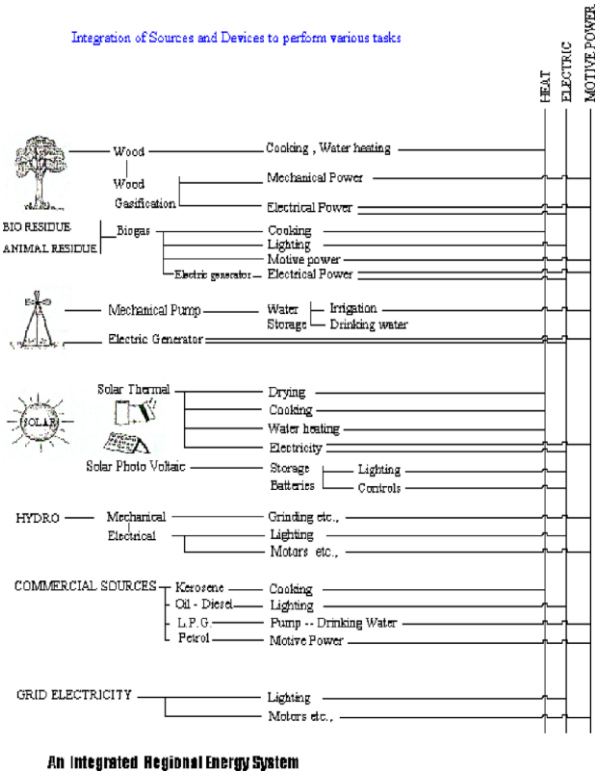

Fig.2

The design of the regional energy system includes resources required per year and minimum cost per year.

Constraints are Task satisfaction i.e. energy required must be equal to energy supplied. Availability of local resources i.e. consumption should be less than or equal to maximum value. Non-negativity and Power requirements i.e. rate of energy must be according to energy planning.

The regional energy tasks can be categorized as domestic, agricultural, industrial, transport and commercial and service sectors. In domestic cooking and water heating are most important task which consumes most of the energy. Street lighting also one of the major sector which consumes energy. Agriculture also is a major area which consumes most domestic energy.

Assumptions-

Scenario I— According to this energy consumption in a region is totally dependent on the population growth of that area and development in that area.

Scenario II— It is for industrial sector.

Scenario III— considerable change in attitude of energy consumption.

Scenario IV— More efficiency gains are quite achievable for a given technology.

Fig.3

(Scenario I) Uttara Kannada Scenario I-base case demand results for all fuels by sector (mkWh)

	2000	2005	2010	2015
Commercial, services, PL	11.17	13.10	14.72	16.75
Transport	100.57	115.52	127.99	152.35
Industry	1827.60	2300.56	2694.82	3063.81
Agriculture	3254.59	3350.74	3948.09	4848.80
Domestic	9981.52	10881.33	10982.38	11083.41
Total	15175.44	16661.26	17768.00	19165.11

PL: public lighting.

(Scenario II) Uttara Kannada "Scenario II" case demand results for all fuels by sector (mkWh)

	2000	2005	2010	2015
Commercial, services, PL	11.17	13.10	17.27	25.90
Transport	100.57	115.52	147.02	222.71
Industry	1827.60	2459.42	4084.14	8684.90
Agriculture	588.70	650.13	897.23	1449.31
Domestic	8941.56	9415.08	9852.32	11553.69
Total	11469.60	12653.25	14997.97	21936.51

PL: public lighting.

(Scenario III) Uttara Kannada "Scenario III—transformation" case demand results for all fuels by sector

	2000	2005	2010	2015
Commercial, services, PL	11.17	13.16	14.79	18.15
Transport	100.57	110.43	117.35	137.81
Industry	1827.60	2319.34	2722.26	3351.92
Agriculture	3254.59	4090.77	5289.21	5745.25
Domestic	9981.53	9449.60	8617.78	8262.17
Total	15175.44	15983.30	16761.39	17515.30

PL: public lighting.

(Scenario IV) Optimal allocation of resources for various tasks—maximisation of efficiency (year: 2015)

Resources (mkWh)	Tasks						Total	Remnant resources	
	1	2	3	4	5	6		mkWh	%
F.W. + bioresidue	3389.66	21704.71	2525.72	478.17		1751.44	29849.70	6516.93	17.92
Biogas		2576.21				358.38	2934.59	0.00	0.00
Wind					172.53	33.02	205.55	0.00	0.00
Solar	3742.94					1048.56	4791.50	0.00	0.00
Hydro		1481.58			1408.03		2889.61	0.00	0.00
Grid electricity			280.74	39.26			320.00	0.00	0.00
Kerosene					12.63	2.51	15.14	0.00	0.00
Diesel					31.38	68.61	99.99	0.00	0.00

IV. *RESULTS AND DISCUSSIONS*

Energy demand-

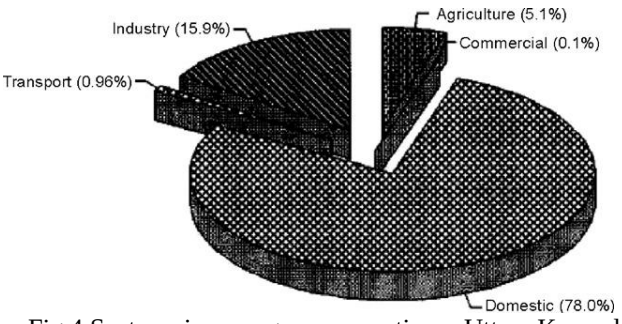

Fig.4 Sector wise energy consumption—Uttara Kannada District.

Main components in any residential area are firewood and agricultural residues etc.

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Sectorwise energy consumption (mkWh) in Uttara Kannada

Sector	Energy (in mkWh)	Share (%)
Agriculture	588.704	5.133
Commercial	11.168	0.097
Domestic	8941.560	77.959
Transport	100.570	0.877
Industry	1827.598	15.934
	11469.600	100.000

Fig.5 Resource scenario results

Sourcewise and typewise composition of energy (mkWh) in Uttara Kannada

Source	Type	Energy (in mkWh)	Share (%)
Noncommercial	Firewood	8956.703	78.091
	Dung (biogas)	1504.533	13.118
	Animate En.	576.290	5.024
Commercial	Electricity	328.321	2.863
	Oil	103.750	0.904
	LPG	0.003	0.000
		11469.600	100.000

Sourcewise composition of energy (mkWh) in Uttara Kannada

Source	Energy (in mkWh)	Share (%)
Noncommercial	11037.526	96.233
Commercial	432.074	3.767
	11469.600	

Sectorwise and sourcewise consumption of energy (mkWh) in Uttara Kannada

Sector	Source	Energy (in mkWh)	Share (%)
Domestic	Noncommercial	8908.773	77.673
Industry		1552.459	13.535
Agriculture		576.290	5.024
Commercial + PL	Commercial	11.168	0.097
Domestic		32.794	0.286
Industry		275.134	2.399
Agriculture		12.410	0.108
Transport		100.572	0.877
	Total	11469.600	100.00

Fig.6

Computation model results

Energy demand in Uttara Kannada District (mkWh)

Type	Demand
Fuel wood	8908.778
Dung (biogas)	1552.459
Animate energy	576.290
Electricity	328.320
Kerosene	0.140
Diesel	69.130
Petrol	34.480
LPG	0.003
	11469.600

Fig.7

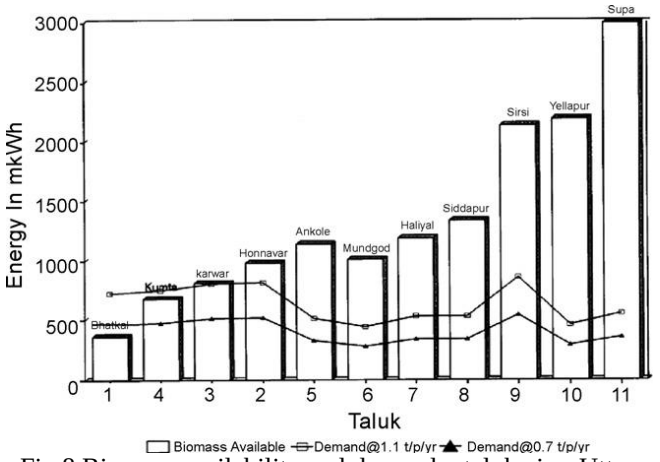

Fig.8 Biomass availability and demand—talukwise, Uttara Kannada District

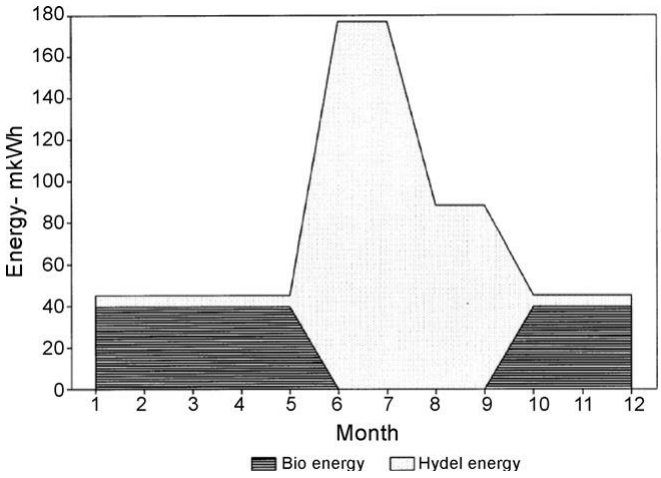

Fig.9 Net energy available in Bedthi Basin—from an area of 95.8 km2.

V. IMPLEMENTATION

Management aspects of energy planning-

There is no balance in energy sector and the overall planning and development at different levels. Fields require immediate attentions are –

1. Support at local level
2. Synchronization between energy development sector and planning at different categorized levels.

Strengthening of local institutions for energy development-

It consist of group of energy databases, advancement of community participation, extension and exercise, spreading of more efficient devices and employment and supportable management of locally available renewable energy resources.

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Generation of energy databases-

Methods of obtaining information at lower level is explained.

Promotion of community participation-

Role of local bodies is generally underestimated by planners. These can provide a power full lobby. Also when political will is involved, funds are assigned, applying a large-scale afforestation crusade is an unpredictably composite and challenging process.

There is a need to differentiate the subsistence energy requirements and energy required for economic development. The less efficient devices is a important aspect in the framework of scheming energy intervention plans.

Extension and training-

Rural Energy Center- purpose is to establish the energy techniques appropriate for local conditions and see that these techniques are useful and dependable from locals' point of view.

Institutional coordination and energy development Strategy.

VI. CONCLUSION

Presently, bioresource is important energy source in Uttara Kannada, meeting a major portion of the total energy needs. The accessibility of wind resource has a good potential. The electrical energy can also be coupled by solar source. Hydropower-1079.17 million units (mkWh) in Bedthi River can be harnessed.

The DSS is used for energy planning. Proposed plan can meeting energy needs considering seasonal constraints.

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