POLICY OPTIONS FOR AGRO-RESIDUE ELECTRICITY SYSTEM: A CASE STUDY OF WARDHA BLOCK

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by

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CERTIFICATE

This is to certify that thesis entitled, **"Policy Options for Agro-residue Electricity System: A Case Study of Wardha Block"**, being submitted by Mr D.N. Gupta to Indian Institute of Technology, Delhi for the award of Doctor of Philosophy is a record of bonafide research work carried out by him. He has worked under our guidance and supervision in conformity with the rules and regulation of Indian Institute of Technology, Delhi and fulfilled the requirements for the submission of thesis, which has attained the standard required for a Ph.D degree of the Institute. The research report and results presented in this thesis have not been submitted in part or full to any other university for the award of any degree or diploma.

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(DevendraNath Gupta)

Abstract

India faces multiple challenges of meeting country's energy requirement, finding suitable substitutes for fast depleting fossil fuels and addressing the concern of climate challenge. As a long term measure, the National Action Plan for Climate Change (NAPCC, 2008) has adopted, among others, the strategy of deploying appropriate renewable energy technologies.

India has great potential to accelerate the use of its endowed renewable resources to power its economy with a secure and affordable energy supply. Among renewable energy resources, the biomass, especially Agro-residue is available in plenty in different parts of the country and can help in meeting the electricity requirement in the country. But, the studies have indicated that despite big potential of Agro-residue for generating electricity, the success in installation and operation of power plants has not been encouraging, even with the placement of policy and regulatory framework by the government. It has laid stress on the need for the research study. There is a need for examining the current policies and evolving the policy options that can facilitate the growth of the Agro-residue electricity system in the country.

Social systems dealing with public policy making are complex in nature as a result of many factors like large number of components and interactions, non-linearity in interactions, dynamic nature of growth, causality & feedback, and counterintuitive nature of decision making. Due to the complexity, the public policy issues are not well structured, instead these are complex and amorphous.

The present approach of policy making applying mental models to complex system has limitations. It requires applying system approach, more specifically interpretive structural modelling (ISM) and system dynamics (SD) modelling. ISM,

through qualitative methodology, has a capability to transform unclear and poorly articulated mental models of systems into well-defined models for policy making. In order to bring quantitative perspective to policy making, system dynamics (SD) combines the traditional management with computer simulation so as to carry out sound policy analysis.

In the study, firstly, for the agro-residue electricity system, the ISM provided the hierarchical structure of factors through a single systemic framework. It facilitated in identifying the causal relationships and key factors that would impact the realisation of the objective. Building on the inputs from ISM, the system dynamics (SD) model was developed for the system. By way of various analyses like simulation, sensitivity analysis, validation and scenario building, the utility and effectiveness of the model was tested and the policy options were evolved. Both ISM and SD in a combined form have addressed complex nature of problem, which otherwise would have been difficult to comprehend by only mental modelling process. There has been an attempt to provide holistic view of factors affecting the electricity generation, from 'system point of view'.

By way of elaborate process of understanding problem, system conceptualisation, model preparation and analysis, the synthesis of ISM and SD modelling has evolved explicit policy options for setting up and operational success of Agro-residue power projects. Specifically, it has suggested the policy options in the areas of Agro-residue availability, price of Agro-residue, ease of doing business and R&D that deserve early priority in order to promote Agro-residue based electricity system in the country on a sustainable basis.

Both ISM and SD methodologies have flexibility and the models so developed for grid-connected cotton based electricity system with combustion technology can be

applied to off-grid system for other biomass fuels with gasification technology, with modifications based on local situations.

Due to impending climate change concern and availability of abundant natural resources, the renewable energy has significant prospects in the country. The biomass resource is a future energy area, so there is a need to carry out research on various other aspects that may add value for the growth of biomass based energy system.

Also, by drawing on the inputs from this study, there is a potential for evolving policy options for other important resources viz., wind and solar, keeping in view the system perspective for holistic consideration of underlying factors. Finally, the research construct of the study has good potential for carrying out further policy research that may add significance for the growth of renewable energy sector.

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