

# Fuel demand elasticities for energy and environmental policies: Indian sample survey evidence

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## Abstract

India has been running large-scale interventions in the energy sector over the last decades. Still, there is a dearth of reliable and readily available price and income elasticities of demand to base these on, especially for domestic use of traditional fuels. This study uses the linear approximate Almost Ideal Demand System (LA-AIDS) using micro data of more than 100,000 households sampled across India. The LA-AIDS model is expanded by specifying the intercept as a linear function of household characteristics. Marshallian and Hicksian price and expenditure elasticities of demand for four main fuels are estimated for both urban and rural areas by different income groups. These can be used to evaluate recent and current energy policies. The results can also be used for energy projections and carbon dioxide simulations given different growth rates for different segments of the Indian population.

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## 1. Introduction

The main objective of this paper is to estimate the income and price elasticities of household demand for different kinds of fuels in India. There are a number of motivations for this. Energy is an important necessity for any household. In India the households need to choose not only how

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much but also which fuel to use. These decisions can have important consequences for the household budget, time allocation and health. They can also lead to negative environmental externalities at local, regional or global level. Price and income elasticities of demand are important for the choice of domestic energy policies. They are also useful in the context of energy policies for greenhouse gas abatement.

Given the policy importance of these elasticities, it is striking that there is such a dearth of reliable and readily available estimates.<sup>2</sup> Of course, several studies have examined the elasticities of commercial fuels like electricity and LPG in India. However, though some studies have examined the elasticities of fuelwood and also the substitution between fuelwood and commercial fuels, surprisingly few studies have done rigorous analysis. Earlier studies that attempted to analyse fuel demand in India ranged from large-scale macro planning exercises to local household case studies. There was interest in estimates of elasticities for different kinds of fuels as part of macro planning exercise, such as the [Energy Survey of India Committee \(1965\)](#), [The Working Group on Energy Policy \(1979\)](#), [The Advisory Board on Energy \(1985\)](#), [The Energy Demand Screening Group \(1986\)](#), [The Rajadhyaksha committee of power sector planning \(Gadgil et al., 1989\)](#) and the [Planning Commission \(1998\)](#). However, the main limitation of all the studies at macro level was that the projections that were made only took into account the aggregates such as population growth rate, increase in GDP, urbanisation and technological advancements. The fundamental problem with these studies is that although macro factors can influence energy consumption patterns indirectly, the actual determinants of household energy consumption are found at the household level. Aggregate fuel demand is made up by the day-to-day decisions at the household level. These decisions are affected by budget and time constraints of the household, their opportunity costs of time, the relative accessibility of fuels (relative prices) as well as social and cultural factors. Given such a perspective, it is obvious that it is e.g. not only GDP growth that matters but also its distribution.

A second group of studies estimated the consumption of biofuels mostly for rural regions (e.g. [Joshi et al., 1992](#)). Although surveys of fuelwood consumption at the regional level are an improvement over macro level studies, as the fuel consumption mix is different for different agro-climatic zones, the estimates give only consumption per capita for rural areas. Some studies addressed the urban energy patterns and only some of these studies analysed the determinants of urban energy demand ([Ray, 1980](#); [Alam, 1985](#); [Macauley, 1989](#); [Dunkerley et al., 1990](#); [ESMAP, 1992, 2001](#)). Other studies have looked into various other aspects of urban fuel usage. [Reddy and Reddy \(1983\)](#) made a case study of fuelwood use in Bangalore, India. The studies by [Dunkerley et al. \(1990\)](#) and [Bowonder and Unni \(1988\)](#) did not estimate the demand for fuelwood or other fuels but looked at consumption and prices of fuelwood for Indian cities in the aggregate. [Soussan et al. \(1990\)](#) analysed in a comprehensive study the fuelwood combustion practices in an urban context. [Turare \(1998\)](#) used secondary data to analyse the criteria behind choice of domestic fuel. [Alam et al. \(1998\)](#) too is an investigation into the efficiency aspects of urban domestic fuel choices. [Barnes et al. \(2005\)](#) looked at aggregated energy demand in 46 cities in 13 different countries and is the most comprehensive study of urban fuel in the developing country context to date. A more recent study by [Gupta and Köhlin \(2006\)](#) analysed the preferences for domestic fuel for the Indian city of Kolkata.

A third group of studies examined the consumption of fuelwood in different areas by controlling for income, size of households, landholdings, type of profession, agro-climatic zones, season,

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<sup>2</sup> This is actually true also in general for developing countries. In an extraordinarily ambitious survey of energy demand elasticities for the developing world, Carol Dahl only found 20 estimates that included biomass. Out of these two were for India, both from the seventies ([Dahl, 1994](#)).

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