Publications of Jyoti Parikh

Energy, Environment, Climate Change and Science

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Preface

I am happy to present this compilation of the research and abstracts of my research papers published in Peer Reviewed journals and a few book chapters. They do not cover all the papers, but only those covered by search engines such as Scopus, Science Direct and Econlit.

We hope these abstracts are useful in getting the gist of research papers and make reference search easier.

I am grateful to all my collaborators for their support and good wishes.

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Contents

Publications of Professor Jyoti Parikh on

Energy, Environment, Climate Change and Science

from Scopus and Science Direct

1. Parikh J., Parikh K (2012), "Growing pains: Meeting India's energy needs in the face of limited fossil fuels", *IEEE Power and Energy, Magazine*, Volume 10, Issue 3, May 2012, Article number 6185786, Pages 59-66

Abstract

India needs economic growth of 810% over the next three decades to satisfy its human development needs. With nearly 40% of the Indian people below the poverty line, 400 million people without electricity, and some 700 million people without access to clean cooking fuels according to the National Sample Survey of 20042005, rapid economic growth is essential. But economic growth calls for growth in energy consumption. India has a shortfall of fossil fuel resources and therefore faces a huge challenge in meeting its energy needs. The global concern for climate change would make it difficult to exploit coal, the least scarce of India's hydrocarbon resources. © 2012 IEEE.

2. Hardships and health impacts on women due to traditional cooking fuels: A case study of Himachal Pradesh, India (Article) (Dec 2011), Energy Policy Volume 39, Issue 12, Pages 7587-7594

Abstract

This paper explores the inter-linkages of gender, energy use, health and hardships in the Himalayan State of Himachal Pradesh in India. It brings out a gender-differentiated and age-differentiated picture of hardships and health impact on the use of traditional biofuels. The study is based on survey with questionnaires covering 4296 individuals, 729 households, 84 villages and 9 districts where biomass fuels meet 70% of household fuel needs. On an average, women walk 30. km each month taking 2.7. h per trip for fuel wood collection over hilly terrain, often at high altitudes and undergo stress like stiff-neck, backache, headache and loss of work days. Girls below 5 and females in 30-60 age-groups have higher proportion of respiratory symptoms than males of similar age-groups. While many studies are done on the health impact of cooking fuels, very little quantitative work is done on the other aspects of the fuel chain viz. collection,

transportation and processing of fuels. Such studies would guide energy policy and health policy to improve the lives of women. © 2011 Elsevier Ltd.

3. Parikh, J. , Parikh, K. (2011), "India's energy needs and low carbon options", *Energy* Volume 36, Issue 6, pp. 3650-3658.

Abstract

India's aspiration for economic growth has consequences for energy growth and CO_2 emissions. This paper examines India's need for energy with 20 year perspectives. From an earlier paper by K. Parikh et al. (2009), demand scenario are examined from the supply perspectives ranging from coal, hydrocarbon, nuclear, hydrogen, hydro and other renewable etc. None of these are substantial and India will have to rely on imports. The need for energy has to be reduced by a drive for energy efficiency and renewable energy. Government programmes for the above are also commented upon. Though India's CO_2 emissions are unlikely to grow very much due to energy scarcity and energy mix the article examines the potential to reduce CO_2 emissions and the associated costs involved in various options. It finds that 30% reduction in CO_2 emissions by 2030 is feasible but would involve additional costs. The most promising option is to reduce energy demand by various measures to increase energy use efficiency in production and consumption. © 2011 Elsevier Ltd.

4. Parikh, J. _, Ghosh, P.P. (2009), "Energy technology alternatives for India till 2030" *International Journal of Energy Sector Management*, Volume 3, Issue 3, 11 September 2009, Pages 233-250

Abstract

Purpose - India aspires for high economic growth of around 8-9 percent over next few years. Higher economic growth would lead to higher production and consumption, more energy use and more CO_2 emissions. At a time when CO_2 emissions reductions are becoming an important point of debate and fast erosion of fossil fuel reserves all over the world, it is necessary to identify technological choices that reduce CO_2 emission and dependence on fossil fuels. A few modeling studies have explored India's technology options. The Integrated Energy Policy (IEP) report of the Planning Commission of India presents different scenarios for energy supply. The IEP model is however an energy technology model and does not consider a feed back into the economy due to changes in technological choice. This paper aims to follow the IEP in the kind of scenario's envisaged and attempts to investigate its macro-economic impacts. Design/methodology/approach - The Integrated Research and Action for Development model is an activity analysis model that uses a social accounting matrix to account for inter-sectoral influence and which allows for a two-way interaction between energy sectors (coal, oil, natural gas, and electricity) and other sectors of the economy. This paper tries to have three scenarios that are comparable to IEP in terms of specifications and their resultant energy demand (Mtoe). Findings - The analyses prove that changing technological choice results in gross domestic product gains, and reduction in energy demand and CO_2 emission. The results show that the policies considered can have adverse welfare impacts. Originality/value - This paper helps in providing an insight into the macro-economic impacts of the IEP scenarios. The two-way dependence of technological choice and output shows the gains and loses out of moving to more costlier but low emission-based power generation technology. © Emerald Group Publishing Limited.

5. Parikh J., Lior N. (2009), "Energy and its sustainable development for India, Editorial Introduction and commentary to the Special Issue of Energy" - The International Journal, *Energy*-Volume 34, Issue 8, August 2009, Pages 923-927

6. Parikh J., Panda M., Ganesh-Kumar A., Singh V. (2009), "CO2 emissions structure of Indian economy" Energy - Volume 34, Issue 8, August 2009, Pages 1024-1031

Abstract

This paper analyses carbon dioxide (CO_2) emissions of the Indian economy by producing sectors and due to household final consumption. The analysis is based on an Input-Output (IO) table and Social Accounting Matrix (SAM) for the year 2003-04 that distinguishes 25 sectors and 10 household classes. Total emissions of the Indian economy in 2003-04 are estimated to be 1217 million tons (MT) of CO_2, of which 57% is due to the use of coal and lignite. The per capita emissions turn out to be about 1.14 tons. The highest direct emissions are due to electricity sector followed by manufacturing, steel and road transportation. Final demands for construction and manufacturing sectors account for the highest emissions considering both direct and indirect emissions as the outputs from almost all the energy-intensive sectors go into the production process of these two sectors. In terms of life style differences across income classes, the urban top 10% accounts for emissions of 3416 kg per year while rural bottom 10% class accounts for only 141 kg per year. The CO_2 emission embodied in the consumption basket of top 10% of the population in urban India is one-sixth of the per capita emission generated in the US. © 2009 Elsevier Ltd.

7. Parikh J., Biswas C.R.D., Singh C., Singh V., (2009), "Natural Gas requirement by fertilizer sector in India" *Energy* - Volume 34, Issue 8, Pages 954-961

Abstract

Natural Gas is one of the important fossil fuel energy resources in India. Anchor customers of natural gas are the power sector and nitrogenous fertilizer. It is the cleanest form of energy derived from the fossil fuel basket. Because of clean combustion characteristics, natural gas is the fuel choice for many sections of Indian industry. The demand for natural gas will grow with time. Currently natural gas accounts for 7% of the primary energy consumption of India. The Government of India has its commitment to food security and energy security. The policies are directed toward greater allocation of natural gas on a priority basis to fertilizer and the power sector. Natural gas is the main and preferred feedstock for urea manufacture. This paper analyzes and estimates projected demand of natural gas in the next two decades. The demand projections have been reviewed in the context of changing government policies regarding the fertilizer industry, such as farm gate price regulation and self-sufficiency level of indigenous urea production. The current growth plan of natural gas supply and evolving supply scenario in the future are also considered in the study. © 2009 Elsevier Ltd. All rights reserved.

8. Parikh J. (2008), "India and climate change: Mitigation, adaptation, and a way forward" *Global warming: Looking beyond Kyoto*, Pages 205-214

Abstract

The problem of climate change poses challenging issues to almost all countries, and India is no exception. Along with global problems like ocean pollution and species extinction, and local problems such as pollution of air and water as well as the degradation of soil and forests, the problem of climate change has to be addressed in the context of

sustainable development. Development activities and poverty alleviation programs also increase emissions of greenhouse gases (GHGs). The 1992 United Nations Framework Convention on Climate Change (UNFCCC) recognized the need for the development of developing nations while expecting contributions from all signatory nations. Given that 75 percent of global GHG emissions were emitted by the 25 percent of the world's population who live in developed countries (these are listed in UNFCCC Annex I and hence called Annex I countries), the UNFCCC required the developed countries to lead the efforts to reduce GHG emissions.[1] Developing countries were exempt from any commitment to reduce emissions but were asked to do their best. Since then, emissions of developing countries, which have risen, now pose challenges and cause concern. One should not lose the perspective that accumulated emissions, and not annual emissions, should be the criterion for reductions in the near term of twenty years-because, once emitted, greenhouse gases remain in the atmosphere for centuries. The 1997 the Kyoto Protocol brought developing countries closer to the ambit of GHG reduction by making it attractive for them to reduce emissions by providing carbon credits under the proposal of the Clean Development Mechanism (CDM). Each year, numerous training programs, workshops, and consultations take place involving Annex I states, non-Annex I states, policymakers, experts from public and private sectors, nongovernmental organizations (NGOs), and academic organizations. The discussion in this chapter covers the following: -India's efforts to reduce GHG emissions, -The problems of India's adaptation to climate change, -Future scenarios on India's GHG emissions, especially carbon dioxide (CO_2), -Suggestions for resolving the impasse about developing countries' participation in the UNFCCC Framework, -Concluding remarks.

9. Parikh J., Purohit P., Maitra P., (2007), "Demand projections of petroleum products and natural gas in India", *Energy*, Volume 32, Issue 10, Pages 1825-1837

Abstract

Indian economy has moved into a dynamic phase. It is necessary to see how energy demand will grow in this phase. In this paper, econometric models are developed for the various petroleum products separately with the aim of capturing variables that are specific to the individual fuel. This study projects the demand of fuels up to 2011-2012, end period for the 11th Five Year Plan, under two scenarios of annual gross domestic product (GDP) growth of 6% and 8%. The demand of petroleum products for the year 2011-2012 is estimated to be 147 and 162 million tons in the business as usual scenario of 6% and optimistic scenario of 8% GDP growth, respectively. Similarly, the demand of natural gas for the year 2011-2012 has been estimated to be 46 and 49 billion cubic meters for 6% and 8% growth, respectively. The projections suggest the level of preparedness that will be required from the oil and gas sector to enable India achieve the GDP growth target that it aims to.

10. Purohit P., Parikh J., (2005), "CO2 emissions mitigation potential of bagasse based cogeneration in India", *Proceedings of the Solar World Congress 2005: Bringing Water to the World, Including Proceedings of 34th ASES Annual Conference and Proceedings of 30th National Passive Solar Conference*, Volume 3, 2005, Pages 1743-1748

Abstract
We estimate the CO_2 emissions mitigation potential of bagasse based cogeneration projects in India. The potential estimation of bagasse for cogeneration takes into account the state wise area under sugarcane production, state wise yield of the sugarcane, residue to crop ratio, and fraction of sugarcane and bagasse being used for alternative applications. The estimated potential of bagasse for cogeneration is estimated at about 68 million tonnes (MT). To estimate the CO_2 emissions mitigation potential of bagasse cogeneration in the reference case it is assumed that the bagasse cogeneration project substitute grid electricity. Therefore, the CO_2 emissions mitigation potential of bagasse cogeneration in India using the regional as well as national baselines is estimated. The preliminary results indicate that the annual CO_2 emissions mitigation potential through bagasse cogeneration projects is more than 64 MT and 66 MT using the regional and national baselines respectively. Policy issues for the promotion of bagasse cogeneration in India are briefly discussed.

11. Nag B., Parikh J.K (2005), "Carbon emission coefficient of power consumption in India: Baseline determination from the demand side" *Energy Policy*, Volume 33, Issue 6, April 2005, Pages 777-786

Abstract
Substantial investments are expected in the Indian power sector under the flexibility mechanisms (CDM/JI) laid down in Article 12 of the Kyoto Protocol. In this context it is important to evolve a detailed framework for baseline construction in the power sector so as to incorporate the major factors that would affect the baseline values directly or indirectly. It is also important to establish carbon coefficients from electricity generation to help consider accurate project boundaries for numerous electricity conservation and DSM schemes. The objective of this paper is to provide (i) time series estimates of indirect carbon emissions per unit of power consumption (which can also be thought of as emission coefficient of power consumption) and (ii) baseline emissions for the power sector till 2015. Annual time series data on Indian electricity generating industry, for 1974-1998, has been used to develop emission projections till 2015. The impacts of generation mix, fuel efficiency, transmission and distribution losses and auxiliary consumption are studied in a Divisia decomposition framework and their possible future impacts on baseline emissions are studied through three scenarios of growth in power consumption. The study also estimates and projects the carbon emission coefficient per unit of final consumption of electricity that can be used for conducting cost benefit of emission reduction potential for several electricity conserving technologies and benchmarking policy models.

12. Das A., Parikh J. (2004), "Transport scenarios in two metropolitan cities in India: Delhi and Mumbai", *Energy Conversion and Management*, Volume 45, Issue 15-16, September 2004, Pages 2603-2625

Abstract
With rising population and increasing migration to the cities, it is expected that the urban population will increase and many more metropolitan cities will arise. Urban transport

will also increase due to the high growth in population, travel demand and vehicles. In this paper, we look at the growth in vehicles and travel demand up to 2020, assuming business as usual, high GDP growth and low GDP growth scenarios for Mumbai and Delhi assuming a certain population growth. The consequent energy needs and local and global environment implications are studied. The case studies demonstrate that despite similar population and higher per capita GDP, due to the higher share of public bus transport and suburban railway system, the Mumbai transport results in 60% less energy and emissions compared to Delhi. This picture may change in the future with the introduction of metro in Delhi, but basic differences remain even in 2020, perhaps also due to the different urban design. The vehicle stock increases nearly three times in both cities in 23 years due to the increase in population, migration and economic growth. However, the vehicle ownership per 1000 persons only doubles and is far lower in 2020, even compared to the present world average ownership. Emissions, however, do not rise as much due to the introduction of more efficient vehicles and fuels, such as CNG or battery operated vehicles. The high share of public transport also helps. The effects of various policies, such as urban design, suburban railway system, transport management, control practices, etc. are very important.

13. Parikh, J. (2003), "India's efforts to minimize greenhouse gas emissions: Policies, measures, and institutions", *India and Global Climate Change: Perspectives on Economics and Policy from a Developing Country* - Pages 333-340

14. Parikh J.K., Hadker N. (2003), "Economic impacts of urban air pollution: Valuation for Mumbai, India" *International Journal of Environment and Pollution***,** Volume 19, Issue 5, Pages 498-515

Abstract

Urban air pollution is on the rise in many cities of the world. There are associated health impacts that affect urban residents, especially the poor. By doing economic valuation, it is possible to draw the attention of citizens, policymakers and, of course, researchers to the extent of damage and the value of it. In this paper, such a valuation is done using time-series data for the suburb of Mumbai called Chembur and cross-sectional data for several wards. We value mortality and morbidity from air pollution using the above data. It is shown that the pollution in Mumbai can lead to high health costs. In general the average cost amounts 0.26% of income due to highly subsidized treatment and poverty. However, 5% of patients who suffer severe attacks may pay as much as much as 19% of their income. Workdays lost are of equal importance to health expenditures. Distributional aspects of the damage are such that children and senior citizens are affected most.

15. Yedla S., Parikh, J.K. Shrestha, R.M., (2003) "Sustainable urban transportation: Impact of CO2 mitigation strategies on local pollutants", *International Journal of Environment and Pollution* - Volume 19, Issue 5, Pages 475-482

Abstract

This paper assesses CO_2 mitigation strategies in Delhi and Mumbai against the dynamics of local pollutants. After testing against techno-economic feasibility, compressed natural

gas (CNG) technology, four-stroke two-wheelers and battery-operated vehicles (BOV) were selected as candidate options for Mumbai and Delhi. Multiple constrained optimization for finding out the optimal mix of vehicles to meet the travel demand under the business-as-usual scenario for the period of 1998-2020 revealed the dominance of CNG vehicles. CO_2 mitigation targets of 5, 10, 15, 20, 25% resulted in reduced stock of diesel and petrol vehicles, with the reduction spanning over different points of the above time period. In the case of Mumbai, battery-operated three-wheelers dominated the vehicular mix, with the share of CNG vehicles remaining at a standard level. CO_2 reduction targets did not influence the CNG option significantly. CO_2 mitigation influenced the dynamics of local pollutants considerably in both Delhi and Mumbai. In Delhi, TSP and SO_x reduction levels against the CO_2 mitigation target were found to be significant. In Mumbai, the percentage reduction in local pollution (TSP in particular) was higher than the target CO_2 reduction. Local pollutants other than TSP and SO_x showed an increasing trend against the CO_2 mitigation strategies in Delhi. In the case of Mumbai, all non-target pollutants showed a falling trend against the CO_2 mitigation strategies, though insignificantly for pollutants other than TSP and SO_x.

16. Laxmi V., Parikh J., Karmakar S., Dabrase P., (2003), "Household energy, women's hardship and health impacts in rural Rajasthan, India: need for sustainable energy solutions", *Energy for Sustainable Development*, Volume 7, Issue 1, Pages 50-68

Abstract

The use of unprocessed bio-fuels for cooking is interlinked with many other factors such as socio-economic conditions, availability of alternative fuels, cooking practices, health impacts, gender equality, and housing characteristics. To examine these factors and their linkages, we collected data through a large and comprehensive survey covering perhaps the largest sample of 58,768 individuals in 10,265 rural households from three states in northern India, viz., Uttar Pradesh, Rajasthan and Himachal Pradesh. We included socio-economic variables, smoking habits, fuels used, characteristics of the kitchen, cooking practices, 19 types of health symptoms, etc. In this paper, we report on analysis of the data collected only from the rural areas of Rajasthan, covering 6,403 females and 5,552 males from 1,989 households in 13 villages. The results reveal that women undergo a lot of drudgery due to the use of bio-fuels. They walk approximately 2.5 km to collect fuel-wood. About 50 hours per month per household are expended in fuel-wood collection and transportation. The use of kerosene for cooking is negligible in the area, because of unavailability more than non-affordability. The people in the rural areas of Rajasthan are willing to pay for kerosene, the next fuel on the energy ladder above bio-fuels. It is estimated that even at a price of Rs. 13 per litre, which is higher than the market price, about 34 % of households are willing to buy additional quantities of kerosene for cooking. Therefore there is a need to meet this unmet demand by addressing market failures. The health impacts of the use of bio-fuels are quite high for adult women. The linkages between many socio-economic variables and respiratory symptoms in adult women show that health impacts can be reduced by increasing female literacy, reducing the use of bio-fuels, and changing the housing design by, for example, introducing ventilation or separating the kitchen from the living area. The losses incurred because of cooking fuels, including work days spent, expenditure on illness and lost working days due to illness are Rs. 29 billion per year in the rural areas of Rajasthan. By minimizing these losses even by some fraction, one can give a boost to the rural economy and improve women's welfare. For this we need coordinated, consistent and focused

cooperation of all the stakeholders at the grassroots, policy-making and implementation levels. Action-oriented programmes should include a treatment strategy at public health centres to help suffering women. © 2003 International Energy Initiative, Inc.

17. Parikh J.**,** (2002) "Poverty - Environment - Development nexus", *International Journal of Global Environmental* Issues, Volume 2, Issue 3-4, Pages 344-365

Abstract

Environmental resources provide life support and livelihood to poor. Degradation of the environment whether caused by rich or poor, affects the poor the most. Today we have different levels of societies viz., tribal and traditional, rural and agrarian and urban, each of which relates to the environment differently. The environment provides basic necessities such as water, fuel, food materials and other resources. Human development indicators such as life expectancy and infant mortality depend on environmental indicators such as access to safe drinking water and sanitation. Environmentally friendly economic growth and industrialisation are emphasised in modern societies now. East Asian experience may be different from the European experience of the past. Alleviation of poverty is essential for the sustainability of the global environment.

18. Balakrishnan K., Parikh J., Sankar S., Padmavathi R., Srividya K., Venugopal V., Prasad S., Pandey V.L. (2002), "Daily average exposures to respirable particulate matter from combustion of biomass fuels in rural households of Southern India, *Environmental Health Perspectives*, Volume 110, Issue 11, 1 Pages 1069-1075

Abstract

Indoor air pollution resulting from combustion of biomass fuels in rural households of developing countries is now recognized as a major contributor to the global burden of disease. Accurate estimation of health risks has been hampered by a paucity quantitative exposure information. In this study we quantified exposures to respirable particulate matter from biomass-fuel combustion in 436 rural homes selected through stratified random sampling from four districts of Tamil Nadu, India. The study are a subset of a larger sample of 5,028 households from the same districts in which socioeconomic and health information has been collected. Results of measurements for personal exposures to respirable particulate matter during cooking were reported earlier. This been extended to calculation of 24-hr exposures with the aid of additional measurements during noncooking times and the collection of time-activity records. Concentrations of respirable particulate ranged from 500 to 2,000 $\mu g/m^3$ during cooking in biomass-using households, and average 24-hr exposures ranged from 90 ± 21 $\mu g/m^3$ for those not involved in cooking to 231 ± 109 $\mu g/m^3$ for those who cooked. The 24-hr exposures were around 82 ± 39 $\mu g/m^3$ for those in households using clean fuels (with similar exposures across household subgroups). Fuel type, type and location of the kitchen, and the time spent near the kitchen while cooking were the most important determinants of exposure across these households among other parameters examined, including stove type, cooking duration, and smoke from neighborhood cooking. These estimates could be used to build a regional exposure database and facilitate health risk assessments.

19. Beg N., Morlot J.C., Davidson, O., Afrane-Okesse, Y. Tyani, L. Denton, F. Sokona, Y. Thomas, J.P. La Rovere, E.L. Parikh J.K., Parikh K., Atiq Rahman A. (2002) " Linkages between climate change and sustainable development" *Climate Policy***,** Volume 2, Issue 2-3, Pages 129-144

Abstract

Climate change does not yet feature prominently within the environmental or economic policy agendas of developing countries. Yet evidence shows that some of the most adverse effects of climate change will be in developing countries, where populations are most vulnerable and least likely to easily adapt to climate change, and that climate change will affect the potential for development in these countries. Some synergies already exist between climate change policies and the sustainable development agenda in developing countries, such as energy efficiency, renewable energy, transport and sustainable land-use policies. Despite limited attention from policy-makers to date, climate change policies could have significant ancillary benefits for the local environment. The reverse is also true as local and national policies to address congestion, air quality, access to energy services and energy diversity may also limit GHG emissions. Nevertheless there could be significant trade-offs associated with deeper levels of mitigation in some countries, for example where developing countries are dependent on indigenous coal and may be required to switch to cleaner yet more expensive fuels to limit emissions. The distributional impacts of such policies are an important determinant of their feasibility and need to be considered up-front. It follows that future agreements on mitigation and adaptation under the convention will need to recognise the diverse situations of developing countries with respect to their level of economic development, their vulnerability to climate change and their ability to adapt or mitigate. Recognition of how climate change is likely to influence other development priorities may be a first step toward building cost-effective strategies and integrated, institutional capacity in developing countries to respond to climate change. Opportunities may also exist in developing countries to use regional economic organisations to assist in the design of integrated responses and to exploit synergies between climate change and other policies such as those designed to combat desertification and preserve biodiversity. © 2002 Elsevier Science Ltd.

20. Kulshreshtha, M. , Parikh, J.K., (2002), "Study of efficiency and productivity growth in opencast and underground coal mining in India: A DEA analysis", *Energy Economics* Volume 24, Issue 5, August 2002, Pages 439-453

Abstract

This paper attempts to study efficiency and productivity of coal mining in the Indian coal sector using detailed input and output data for underground and opencast coal mining for the period between 1985 and 1997. The non-parametric approach of data envelopment analysis (DEA) is adopted for performance analysis of different coal mining regions. Total factor productivity growth was analysed using the Malmquist index by decomposing productivity change into efficiency and technical change. Results of the analysis do not conform to the prevailing notion of opencast (OC) mining having shown more productivity growth than underground mining in India. An increasing percentage of OC mining regions showed a decline in efficiency over the period of analysis.

Approximately 58%, 59% and 67% of the mining regions showed decline in productivity between 1985 and 1990, 1990 and 1995 and 1995 and 1997, respectively. Technical progress seems to have been the major driving factor behind productivity growth in opencast mining, while efficiency growth has been the most important factor in growth of underground mine productivity. Underground mines seem to have adopted a more efficient practice of operation to compensate for the lag in technical change. On the other hand, operational efficiency of opencast mines seems to have been overlooked in the process of increasing production through technological improvement in OC mining.

21. Yedla S., Parikh J.K., (2002), " Development of a purpose built landfill system for the control of methane emissions from municipal solid waste, *Waste Management* - Volume 22, Issue 5, Pages 501-506

Abstract

In the present paper, a new system of purpose built landfill (PBLF) has been proposed for the control of methane emissions from municipal solid waste (MSW), by considering all favourable conditions for improved methane generation in tropical climates. Based on certain theoretical considerations multivariate functional models (MFMs) are developed to estimate methane mitigation and energy generating potential of the proposed system. Comparison was made between the existing waste management system and proposed PBLF system. It has been found that the proposed methodology not only controlled methane emissions to the atmosphere but also could yield considerable energy in terms of landfill gas (LFG). Economic feasibility of the proposed system has been tested by comparing unit cost of waste disposal in conventional as well as PBLF systems. In a case study of MSW management in Mumbai (INDIA), it was found that the unit cost of waste disposal with PBLF system is seven times lesser than that of the conventional waste management system. The proposed system showed promising energy generation potential with production of methane worth of Rs. 244 millions/y ($5.2 million/y). Thus, the new waste management methodology could give an adaptable solution for the conflict between development, environmental degradation and natural resources depletion.

22. Parikh J., Balakrishnan K., Laxmi V., Biswas H., (2001), "Exposure from cooking with biofuels: Pollution monitoring and analysis for rural Tamil Nadu, India" *Energy* -Volume 26, Issue 10, Pages 949-962

Abstract

In this paper, statistical analysis to examine the links between pollution and the types of kitchen and fuels is carried out for rural houses by first monitoring the indoor air quality (IAQ) followed by regression analysis of 418 households in Tamil Nadu, India. Exposures to the chief cook (females, who are mainly involved in the cooking during monitoring) are measured with personal monitors. The results shows that the values of respirable particles (PM10) ranged from 500-2000 $\mu g/m^3$ during a two-hour cooking period from burning biofuels. The range depends on the type of kitchen and fuel use. Stationary monitors, placed two metres away from the stove, also recorded similar concentrations. Thus, the individuals who stay inside the houses using biofuels also face

high concentrations even if they are not cooking. They could be senior citizens, children or adult males. Thus, there are two major findings from this analysis. Improved house designs that pay attention to kitchen location and put up partitions should also be considered in the intervention portfolio. Secondly, the exposure is not limited to the cooks alone. The rest of the family in the vicinity is also exposed through a "passive cooking effect".

23. Kumar K.S.K., Parikh J., (2001), "Indian agriculture and climate sensitivity" *Global Environmental Change* Volume 11, Issue 2, Pages 147-154

Abstract

This study estimates the relationship between farm level net-revenue and climate variables in India using cross-sectional evidence. Using the observed reactions of farmers, the study seeks to understand how they have adapted to different climatic conditions across India. District level data is used for the analysis. The study also explores the influence of annual weather and crop prices on the climate response function. The estimated climate response function is used to assess the possible impacts of a 'best-guess' climate change scenario on Indian agriculture. © 2001 Elsevier Science Ltd.

24. Kulshreshtha M., Parikh J.K. (2001), "A study of productivity in the Indian coal sector" *Energy Policy* - Volume 29, Issue 9, Pages 701-713

Abstract

In this paper, non-parametric index number methods are used to investigate the overall productivity growth and also the disaggregated factor productivity performance in the Indian coal sector. An attempt has been made to do an in-depth analysis of the productivity growth in the Indian coal sector during the period 1980-92. Total factor productivity (TFP) Tornqvist indices are calculated from the output and input indices for Coal India Ltd. (CIL) and its major subsidiary companies. The partial labour and capital productivity indices are decomposed into components to study interactions between labour, capital, output and techniques of mining in the coal sector that might explain their long run trends. Results of the analysis indicate that in spite of the output index indicating a two-fold increase during the period of analysis TFP declined by around 50% due to the sharp increase in the input index by about four times. Partial productivity analyses of capital and labour productivity reflect the massive capital accumulation in the Indian coal sector to the extent where it does not contribute to additions in output. The labour productivity increase of around 37.6% is not to the extent of capital deepening of around 150%. Study of the individual subsidiaries indicate that companies with larger share of underground mines have shown slower growth in productivity. The poor performance can be attributed to the underutilization of capital, surplus labour, power shortages in the underground mines, inability to adapt to modern technologies and a pricing structure of coal, which does not provide incentives to the producers to increase production. © 2001 Elsevier Science Ltd. All rights reserved.

25. Yedla S., Parikh J.K., (2001), "Economic evaluation of a landfill system with gas recovery for municipal solid waste management: A case study", *International Journal of Environment and Pollution* - Volume 15, Issue 4, 2001, Pages 433-447

Abstract

Economic activity uses resources, which leads to waste generation. With rapid industrialization and urbanization, per capita solid waste generation has increased considerably. Solid waste generation data for last two decades shows an alarming increase. Owing to its improper and untimely collection, the transport and disposal of municipal solid waste poses a severe threat to various components of the environment and also to public health. This paper describes the merits and demerits of various technological aspects of solid waste management. Landfill technology, as it is the most widely employed and is regarded as the most suitable and simple mechanism, especially for tropical countries such as India, is emphasized. All possible costs and benefits and externalities are examined. A cost-benefit analysis of a landfill system with gas recovery (LFSGR) has been carried out for Mumbai city's solid waste, accounting for certain external costs and benefits, and found that it could make a huge difference of savin gs of about Rs. 6.366 billion (approx. $0.140 billion) per annum with reference to the existing system of waste disposal.

26. Parikh, J.K., (2000), "Linking technology transfer with clean development mechanism (CDM): A developing country perspective", *Journal of Global Environment Engineering* Volume 6, Pages 1-12

Abstract

Framework Convention on Climate Change (FCCC) expressly commits the Annex 1 countries to provide financial resources and technology to developing countries so as to control, reduce or prevent GHG emissions. The present paper argues that the ultimate goal of any action in the field of transfer of technology (TT) should not be just applying particular technological solutions to the GHG problem, but to enhance the capabilities of developing countries to assess the need, select, import, assimilate, adapt and develop the appropriate technologies. The paper also looks into the various dimensions of TT that results in capacity building in developing countries. High up-front costs and lack of awareness (information) has resulted in significant under-utilization of capacities, thus acting as major barriers in their diffusion. The paper also looks into the various market and government related barriers forestalling the diffusion of various GHG reducing technologies.

27. Nag B., Parikh J. (2000), "Indicators of carbon emission intensity from commercial energy use in India" *Energy Economics*, Volume 22, Issue 4, August 2000, Pages 441-461

Abstract

This study tries to analyze the commercial energy consumption evolution patterns in India in terms of primary energy requirements and final energy consumption and their

implications for overall carbon intensity of the economy. The relative contribution and impact of different factors such as activity levels, structural changes, energy intensity, fuel mix and fuel quality on the changes in aggregate carbon intensity of the economy has been studied, taking into account coal quality which has declined drastically in the last two decades. The major findings of the study are: firstly, from the 1980s onwards, income effect has been the major determinant of India's per capita emission increase, although prior to that, energy intensity used to be the most important factor. Secondly, there has been a major shift towards electricity from primary energy carriers in the major energy consuming sectors, and the higher end use-efficiency of electricity has been able to compensate for the high emission coefficient of electricity consumption. Thirdly, emission intensity of thermal power generation shows a substantial decline when the data is controlled for the declining quality of coal used in power generation.

The evolution of commercial energy consumption patterns in India is analyzed in terms of primary energy requirements and final energy consumption for the 1970-95 period. The implications of these trends for overall carbon intensity of the economy are assessed. Income effect proved the major determinant of per capita emission increases after 1980; energy intensity was the most important factor prior to 1980. A shift toward electricity from primary energy carriers in major energy consuming sectors is evident. The higher end-use efficiency of electricity has compensated for the high emission coefficient of electricity usage. Emission intensity of thermal power generation is marked by a substantial decline when the data are controlled for the declining quality of coal used for power production.

28. Kulshreshtha M., Parikh J.K., (2000) "Modeling demand for coal in India: Vector autoregressive models with cointegrated variables" *Energy* Volume 25, Issue 2, February 2000, Pages 149-168

Abstract

In this paper, long-run structural relationship of coal demand with price and income variables have been estimated for the four major coal consuming sectors in India using annual time series data from 1970-1995. Some of the recent developments in multivariate dynamic econometric time series modeling techniques have been used, including the estimation of long-run cointegrating relationship, short-run dynamics and measurement of the effects of shocks and their effect on the evolution of dynamic coal demand system. The models have been estimated using cointegrating VAR framework, which allows for endogeneity of regressors. Results indicate that coal demand is likely to grow more than proportionately with economic growth due to high GDP elasticities and low price elasticities. Further, coal prices are found to be weakly exogenous in all the sectors except cement. Persistence profiles indicate that coal demand systems in the four sectors seem to be stable and converge to equilibrium within a period of around 4-7 years after a typical system-wide shock.

29. "Linkages among energy, agriculture and environment in rural India" *Energy Economics* -Volume 21, Issue 6, 1 Pages 561-585

Abstract

The interconnections between energy, agriculture and environment in rural India are analyzed in this paper using a systems perspective. Rural areas of developing countries use biomass for fuel, fodder, fertilizer and other purposes, and it is necessary to understand the fuel-fodder-fertilizer relationships for optimal biomass allocation. The allocation is explored using a linear programming model. First, the model is validated by simulating it using data for the year 1990-1991. The model is then applied for the year 2000, and several scenarios are generated to obtain answers to various policy questions. The results show that it is necessary to increase fertilizer consumption, to increase efficiencies of cooking stoves, to improve livestock feed, and / or to decrease population growth for maximizing the revenue generated in the rural system of India. It shows that when the prices of fertilizers increase, a large increase in kerosene requirements can be expected. It also points to the necessity to increase kerosene consumption to reduce emissions (due to non-commercial fuels) and soil fertility loss. For example, the carbon dioxide emissions associated with the scenarios range from 137.50 to 62.50 million tons (in carbon equivalent terms) for the high and low cases, respectively. Correspondingly, kerosene consumption ranges from 0.18 to 15.49 kilotons (kT).

30. Tiwari P., Parikh K., Parikh J., (1999) "Structural design considerations in house builders' model: Optimization approach" *Journal of Infrastructure Systems* - Volume 5, Issue 3, Pages 102-110

Abstract

In a housing market model, the supply of housing, particularly new houses, is usually treated in a very cursory fashion, with new housing being regarded as homogeneously good and building cost function defined as a function of capital and labor costs. This paper formally recognizes heterogeneity in a housing model and introduces engineering design parameters in building cost function. Using structural engineering concepts, an engineering cost function is derived in terms of design parameters. A multiobjective compromise optimization algorithm is suggested to choose from various building cost functions. An empirical application of this method is demonstrated by solving the production function of a modular room 3.5 m x 3.5 m in area and 3.14 m in height.

In a housing market model, the supply of housing, particularly new houses, is usually treated in a very cursory fashion, with new housing being regarded as homogeneously good and building cost function defined as a function of capital and labor costs. This paper formally recognizes heterogeneity in a housing model and introduces engineering design parameters in building cost function. Using structural engineering concepts, an engineering cost function is derived in terms of design parameters. A multiobjective compromise optimization algorithm is suggested to choose from various building cost functions. An empirical application of this method is demonstrated by solving the production function of a modular room 3.5 m × 3.5 m in area and 3.14 m in height.

31. Reddy B.S., Parikh J.K., Srinivasan P.V, (1999), "Plantation programmes through people's participation: A case study from India" *Biomass and Bioenergy* -Volume 17, Issue 3, September 1999, Pages 257-271

Abstract

This paper provides a framework for analysing land regeneration programmes combining financial, economic and environmental aspects as applied to a wood plantation programme undertaken by a Tree Grower's Cooperative Society (TGCS) established by the National Tree Growers' Cooperative Federation (NTGCF), Anand, India. Mallanahally TGCS, situated in the southern part of Karnataka state in India was selected and a survey was carried out. Benefit-cost ratios and internal rate of return are worked out for various situations. The paper also examines the role of cooperatives in managing plantation activities and assesses the distributional aspects of the benefits of the plantations. The survey elicited information on the villagers' perceptions regarding benefits from and barriers to implementation of plantation programmes. It is shown here that despite apparently unequal distribution of benefits, the present arrangements preserve cooperation as each of the stakeholders derive positive benefits.

32. Tiwari P., Parikh J., (2000), "Housing paradoxes in India: Is there a solution?" *Building and Environment* - Volume 35, Issue 1, Pages 59-75

Abstract

If providing a decent shelter is an immediate concern for developing countries, the reduction of global emissions such as carbon dioxide is a cause of concern for industrialized countries. A short focused policy prescription for a country like India would be to provide a decent shelter for its more than 15% citizens, who do not have adequate housing. However, a sustainable path would be to develop a well strategized path to meet current needs of housing and also to reduce absolute contribution to global emissions through those construction techniques which are environment friendly. We develop an optimization framework to analyse a sustainable path to meet housing shortages in India, considering that the sustainable path should not be at the cost of engineering design criteria. The criteria to measure sustainability in this paper is cost effectiveness, efficient utilization of resources and environment friendliness. A computer model called 'MHOPE' has been developed to estimate resources and construction techniques required to achieve housing for all in India. The technologies incorporated in the model are suitable for India, however, the model can be upgraded to include the house construction technologies suitable for any other country of interest. The results indicate that it is not possible to provide housing for all in India with the present set of construction techniques which are predominantly cement and brick based. However, if low cost housing techniques, which use locally available materials, are used, we can achieve this target of 'Shelter for all'. It will not only reduce cost, but also reduce CO_2 emissions because locally available materials are less energy intensive. The paper quantifies the level of investment, resources and employment required to provide shelter for all.

33. Ramanathan R., Parikh J.K., **(1999), "**Transport sector in India: An analysis in the context of sustainable development" *Transport Policy,* Volume 6, Issue 1, Pages 35-45

Abstract

A brief review of the Indian transport sector in the past few decades is provided in this article. It is shown that the period has witnessed a gradual transformation from rail-dominated transport to road-dominated transport. Infrastructure bottlenecks such as lack

of roads and railways network and aircraft are the limiting factors. Emission of local pollutants and carbon dioxide (CO_2) because of fuel consumption in transport were estimated. Future transport performance is projected using cointegrating econometric models. The models project that passenger traffic in India is likely to grow at more than 8% per year and freight traffic at more than 5% per year during the period 1990-2021. This will increase the energy consumption and CO_2 emissions at equivalent rates. The effects of various policy options aimed at reducing energy consumption and CO_2 emission were analysed using a scenario approach. The scenario analysis shows that efficiency improvements can reduce future energy consumption and CO_2 emissions by 26%. If the model split is promoted in favour of public transport modes (rail and public road transport), about 45% reduction in energy requirements and CO_2 emissions is expected.

34. Tiwari P., Parikh K., Parikh J. (1999) " Effective housing demand in Mumbai (Bombay) metropolitan region" *Urban Studies*, Volume 36, Issue 10, 1999, Pages 1783-1809

Abstract

Housing policy formulation should be informed by a careful understanding of the behaviour of the urban housing market, as reflected by housing demand behaviour. Such basic information is important, not only for improved project design but also for the development of better sector-wide policies. The overall analysis in this paper stresses the importance of prices and income on the demand for housing in Mumbai metropolitan region. Estimates of housing demand function are given. In our analysis, we account for rent control in Mumbai which distorts rents. The results indicate that housing demand is elastic with respect to income and price. The income and price elasticities are around 1 and -1 respectively. We also estimate income and price elasticities for different income classes. The paper concludes with policy prescriptions.

35. Dinar A., Mendelsohn R., Evenson R., Parikh J., Sanghi A., Kumar K., McKinsey J., Lonergan S; (1998) "Measuring the impact of climate change on Indian agriculture" *World Bank Technical Paper*, Issue 402, Pages X-7

Abstract

New scientific evidence made scientists more confident that greenhouse gases may lead to future climate change. Research on measuring the economic impacts climate change might cause has proceeded world-wide, but most of the empirical research has focused on developed countries. It has been commonly believed that developing countries are more vulnerable to climate change because of their reliance on low-capital agriculture. It has been assumed, but never tested, that low-capital agriculture would have more difficulty adapting to climate changes. Country-wide economic analyses have been completed only for the United States even though experts have extrapolated results to all countries. Agronomic studies of crop yield reductions support this wisdom implying large potential agricultural damages in India, for example. The vulnerability of low-capital agriculture to climate change, however, depends upon whether the affected farmers can adjust to changing climates. The recent research in the United States suggests that adaptation by private producers would reduce damages to agriculture from climate change, and carbon fertilization would actually lead to net agricultural benefits from climate change. The set

of studies in this report, explores farm performance across climates in India. The goal of the study is to examine farm behavior and test if there is any evidence that farmers in developing countries, such as India, currently adjust to their local climates. The reported studies measure the climate sensitivity of low-capital agriculture. They test whether actual farm performance is as sensitive to climate as agronomic models predict assuming no adaptation. The studies also compare the climate sensitivity of low-capital farms against the results already calibrated for United States agriculture. The analyses feature the Ricardian approach, a cross sectional analysis of farm performance across different climate zones. The method uses an economic measure of farm performance: farm value or net farm income. Performance is compared across a large landscape where farms exist in different local climates. By regressing farm performance on long term climate, one can empirically measure long run climate sensitivity. Other important factors determining economic performance, such as access to markets and soil quality must also be included in the analysis. The approach carefully measures long run climate responses, and not short-run adjustments or weather effects. Although the method does not explicitly identify how farmers have adjusted, the measure of economic performance captures the consequences of all the adjustments farmers currently undertake in responding to their local climates. Each of the Ricardian studies emphasizes a different methodology - all leading to similar estimates of climate change impact. The pooled data analysis (Chapter 4) examines overall expected effects. The year by year analysis (Chapter 5) examines annual fluctuations in climate sensitivity, while controlling for annual prices and weather. The climate-technology study (Chapter 6) examines the interaction between endogenous technology and climate sensitivity in India and Brazil, respectively. The results indicate that existing farms are only mildly climate sensitive implying a substantial amount of adaptation. This adaptation is predicted to reduce potential warming damages by one-third to one-half. The analysis further suggests that the climate response functions for farmers in India and Brazil are similar to the estimated functions for United States farmers. Low-capital agriculture appears to be no more climate sensitive than modern farms. These results suggest that warming alone will hurt agriculture in tropical (developing) countries relative to temperate countries. Damages from 8-12% are predicted by the Ricardian models. These results, however, do not include the effect of carbon fertilization. Carbon fertilization reduces the predicted damages in the agronomic models from 28% to 16%. Adding a 12% increase from carbon fertilization to the Ricardian estimates would drive the overall effects to near zero. The net results suggest that global warming will have only small effects on aggregate developing country agricultural sectors. The adaptation being measured in these Ricardian studies is largely private efforts by farmers to maximize net income given local environmental conditions. Each farmer is making different choices depending upon the conditions he/she faces. Because these subtle adaptations make farmers better off, we expect that farmers will engage in these activities as climate changes. These subtle adjustments reduce the overall sensitivity of agriculture to climate change. Technical change has been important to both India and Brazil over the years, substantially increasing productivity. However, agronomic research has not systematically focused on changing the climate sensitivity of crops. Investments in new technology have consequently not historically changed climate sensitivity in India or Brazil. This does not rule out the possibility of an important public research response to warming, it merely indicates that historic efforts have had no effect. Although aggregate agricultural sectors may not be at risk to climate change, individual farmers may still suffer large damages. Some areas will suffer from higher than average temperature changes and some areas may experience deleterious precipitation effects. The entire sector may not be affected because these effects will average out, but this does not

protect local areas. Further, the aggregate sectors in developing countries may be less sensitive because important components of these sectors tend to lie in more temperate zones. Damages in marginal areas may have little impact on the aggregate because they contribute little to the aggregate outcome today. Poor people dependent on these local areas may be highly vulnerable to warming even when national agricultural impacts are minimal.

36. Kavi Kumar, K.S., Parikh J., (1998) "Climate change impacts on Indian agriculture: The Ricardian approach" *World Bank Technical Paper*, Issue 402, Pages 203-204

37. Tiwari P., Parikh J. (1998) "Affordability, housing demand and housing policy in urban India" *Urban Studies*, Volume 35, Issue 11, Pages 2111-2129

Abstract

Designing housing policies and programmes requires a careful estimation of household affordability and demand for housing. The efficiency of housing subsidies would depend on price elasticities of housing demand. Different households have different perceptions of housing demand based on their economic and demographic factors. We estimate the demand function of housing for urban India using step econometric analysis. The first step estimates the hedonic price index for states and in the second step the demand for housing is estimated as a function of economic and household characteristics. The problem of multicollinearity is observed with the data. Ridge regressions are used to correct for multicollinearity and to obtain efficient estimates. The results indicate that the housing demand is inelastic with respect to income and price. The income elasticity is 0.75 while price elasticity is slightly less than -1. A further analysis to estimate income and price elasticities for different income classes as well as states has also been carried out. We comment on the efficiency of housing subsidies based on our results. The paper concludes with some policy questions.

38. Bhattacharya K., Chattopadhyay D., Parikh J, (1998), "Real-time adaptive pricing for load-frequency control in an interconnected power system" *International Journal of Power and Energy Systems*, Volume 18, Issue 2, Pages 102-108

Abstract

ln an interconnected power system, overdrawal of power from one area by a neighbouring area causes a frequency clip in the system. This paper presents a real-time pricing scheme that is effective in controlling the frequency and tie-line power excursions. The proposed scheme is adaptive and is updated every sampling period by deriving its input from the area control error (ACE). The pricing scheme takes into account the system dynamics and gives the importing area a signal in terms of increased price for any increment in the drawal from its scheduled value. The increase in price can be viewed as a penalty that discourages any deviation from the scheduled power flow and thereby ensures grid discipline. Two cases have been considered: demand pricing, in which the importing area reduces its demand in response to the price and generation pricing, where the exporting area adjusts its generation to a change in demand by directly responding to the price

signal. Simulation studies considering a two-area reheat thermal system reveal that both pricing schemes yield satisfactory system dynamic responses.

39. Haripriya G.S., Parikh J.K. (1998), "Socioeconomic development and demand for timber products: A panel data analysis" *Global Environmental Change*, Volume 8, Issue 3, October 1998, Pages 249-262

Abstract

The present paper analyses the relationship between consumption of timber products and socioeconomic variables by estimating timber consumption functions, using fixed and random effects methods. To this end, we regress the per capita consumption of timber products (roundwood equivalent) of a sample of developed and developing countries over the period 1978 to 1989 on various national indicators relevant to the development transition. The panel nature of the data facilitates us to track trends in consumption as economic development proceeds. The results suggest that the response of the timber consumption with respect to changes in the variables is sensitive to factors specific to the country concerned. The coefficients of all the variables are inelastic and it is found that income, density and price are the main determinant variables although other variables also affect the consumption. The observations of this study are expected to assist the policy makers in projecting future requirements of timber with more reliability.

40. Parikh, J.K (1998), "The emperor needs new clothes: Long-range energy-use scenarios by IIASA-WEC and IIPCC" *Energy*, Volume 23, Issue 1, January 1998, Pages 69-70

Abstract

Long term global energy scenarios are needed for long term policy on energy and climate change, IIASA-World Energy Council (WEC) energy scenarios up to 2100 are evaluated here to show that they satisfy economic and environmental criteria and take into account resource and market penetration constraints. They are contrasted with the IPCC scenarios of 1992 which are too simplistic to use to the analysis of long term strategies on climate change.

41. Dinar A., Mendelsohn R., Evenson R., Parikh J., Sanghi A., Kumar K., McKinsey J., Lonergan S. (1998), "Measuring the impact of climate change on Indian agriculture" *World Bank Technical Paper*, 266p

Abstract

The set of studies in this report, explores farm performance across climates in India. The goal of the study is to examine farm behavior and test if there is any evidence that farmers in developing countries, such as India, currently adjust to their local climates. The reported studies measure the climate sensitivity of low-capital agriculture. They test whether actual farm performance is as sensitive to climate as agronomic models predict assuming no adaptation. The studies also compare the climate sensitivity of low-capital farms against the results already calibrated for United States agriculture. The analyses feature the Ricardian approach, a cross sectional analysis of farm performance across different climate zones. The method uses an economic measure of farm performance:

farm value or net farm income. Performance is compared across a large landscape where farms exist in different local climates. Each of the Ricardian studies emphasizes a different methodology--all leading to similar estimates of climate change impact. the pooled data anlysis (Chapter 4) examines overall expected effects. The year by year analysis (Chapter 5) examines annual fluctuations in climate sensitivity, while controlling for annual prices and weather. The climate-technology study (Chapter 6) examines the interaction between endogenous technology and climate sensitivity in India and Brazil, respectively. The results indicate that existing farms are only mildly climate sensitive implying a substantial amount of adaptation. This adaptation is predicted to reduce potential warming damages by one-third to one-half. The analysis further suggests that the climate response functions for farmers in India and Brazil are similar to the estimated functions for United States farmers. Low-capital agriculture appears to be no more climate sensitive than modern farms. These results suggest that warming alone will hurt agriculture in tropical (developing) countries relative to temperate countries. Damages from 8-12% are predicted by the Ricardian models. These results, however, do not include the effect of carbon fertilization. Carbon fertilization reduces the predicted damages in the agronomic models from 28% to 16%. Adding a 12% increase from carbon fertilization to the Ricardian estimates would drive the overall effects to near zero. The net results suggest that global warming will have only small effects on aggregate developing country agricultural sectors.

42. Majumdar S., Sridhar R., Parikh J., (1997), "Marginal cost of electricity: Probabilistic formulation" E*nergy Sources* ,Volume 19, Issue 6, Pages 537-548

Abstract

In this article, density estimation procedure is used to calculate the marginal cost of producing electricity after accounting for fixed outages. Two density estimation techniquex, the Kernel method and the maximum penalized likelihood method are used to estimate load density. Next, in a production cost modeling framework, both the marginal variable operating cast and the marginal fixed capital cost an calculated for an Indian utility.

43. Painuly J.P., Bhattacharya K., Parikh J., "Joint implementation for carbon-dioxide reduction in India: An analysis of auxiliary reduction in power plants", *International Journal of Global Energy Issues*, Volume 9, Issue 4, 1997, Pages 275-285

Abstract

In view of increasing power requirements, concerns for both the local and global environment are increasing. One of the cheapest ways of reducing emissions is by efficiency improvements. India has about 120 power plants of 210 MW with auxiliary consumption ranging from 8% to 14%. Auxiliaries in a majority of the units can be upgraded to improve efficiency and reduce emissions of global as well as local pollutants. Case studies of four power plants in India have been carried out to identify possible measures to reduce auxiliary consumption. Potential carbon-dioxide emissions reductions from such modernisation of 210 MW plants are estimated to be 1.5 million tonnes per year. It is suggested that these case studies and analysis provide the basis for projects for North-South co-operation in activities implemented jointly.

44. Majumdar S., Sridhar R., Parikh J., (1997) "Interutility electricity pricing for optimal capacity utilization in power sector", *Energy Sources,* Volume 19, Issue 5, Pages 451-460

Abstract
The cost of supplying electricity in a grid is minimized in a nonlinear optimization framework. The formulation of the problem gives the incentive-compatible trading prices of electricity among mam independently operating state utilities. The problem it solved both for a central planner (central grid operator) and for the case of a state planner (independent state utility). It is proved that there exist trading prices that are compatible with both. Finally, as an example, the theorem a applied to the case of the Indian National Grid.

45. Parikh J.K., Panda M.K., Murthy N.S., (1997), "Consumption patterns by income groups and carbon-dioxide implications for India: 1990-2010" *International Journal of Global Energy Issues* ,Volume 9, Issue 4, Pages 237-255

Abstract
This paper highlights consumption pattern differences across income classes in India, namely the top 10%, middle 40% and bottom 50% of the population in rural and urban areas. The analysis is based on an input-output (I-O) model that uses consumption expenditure distribution data from various sources. It examines direct and indirect demand on resources and carbon-dioxide emissions due to consumption of each of these income classes. Out of a total of 167 mtC of carbon emissions in 1989-90, 62% was due to private consumption, 12% from direct consumption by households and remaining 50% due to indirect consumption of intermediates like power, steel and cement, while the rest was attributed to investment, government consumption and exports. The analysis reveals that the consumption of the rich is oriented more towards energy using sectors like electricity and transport, and uses relatively more resources in the form of minerals and metal products. The net effect is that the rich have a more carbon intensive lifestyle. The per capita direct and indirect emission level of the urban rich is about 15 times that of the rural poor and yet about the same as the world average. In a scenario where private consumption expenditure is expected to reach twice the 1990 level by 2010, carbondioxide emissions are projected to rise to 502 mtC. The low purchasing power of the poor results in their dependence on nature and the environment. This points to the conclusion that poverty is unsustainable.

46. Murthy N.S., Panda M., Parikh J (1997), "Economic development, poverty reduction and carbon emissions in India" *Energy Economics,* Volume 19, Issue 3, July, Pages 327-354

Abstract
This paper analyses carbon dioxide (CO2) emissions from energy consumption using an input-output (I-O) model, for different sectors of the Indian economy in 1990. Alternative scenarios are developed for 2005. The I-O model considers structural changes in aggregate consumption behaviour and sectoral composition of output between 1990 and 2005. Alternative energy efficiency programmes are compared for their potential CO2 reduction in 2005. Under ambitious poverty reduction targets, the annual growth rate

of CO2 emissions increases from 4.8% to 5.9%. However, energy efficiency programmes could reduce the average annual growth rate of CO2 emissions back to 4.9%. It is also seen that reducing CO2 through oil conservation is a preferred policy for India compared with saving coal.

47. Tiwari P., Parikh J., (1997) "Demand for housing in the Bombay metropolitan region", *Journal of Policy Modeling*, Volume 19, Issue 3, June 1997, Pages 295-321

Abstract
We estimate the demand function of housing for Bombay Metropolitan Region in a two-step econometric analysis. The first step estimates the hedonic price index for different regions in Bombay, and in the second step the demand for housing is estimated as a function of economic and household characteristics. The results indicate that housing demand is inelastic with respect to income and price. The income elasticities for owners and tenants are around 0.33 and 0.38, respectively, while the price elasticities are -0.21 and -0.75, respectively, for owners and tenants. We also estimate income and price elasticities for different income classes. The paper concludes with policy prescriptions. © Society for Policy Modeling, 1997.

48. Murthy N.S., Panda M., Parikh J; (1997), "Economic growth, energy demand and carbon dioxide emissions in India: 1990-2020" *Environment and Development Economics*, Volume 2, Issue 2, Pages 173-193

Abstract
This article investigates the linkages between economic growth, energy consumption and carbon dioxide (CO_2) emissions in India by analysing the structure of production and consumption in the Indian economy. We begin with an examination of the consumption pattern of six different income classes, three each in urban and rural India, and then estimate the direct and indirect energy and CO_2 emission coefficients for supporting production in various sectors. This provides us with a basis for estimating the energy and emission content of the consumption baskets of the different income classes in India. CO_2 emissions are projected to increase from 0.18 tonnes of carbon (tC) per capita in 1990 to about 0.62 tC per capita in 2020 under the reference scenario which corresponds to a GDP growth rate of 5.5% per annum. We then analyse scenarios of technology improvement in which emissions are reduced to 0.47 tC per capita in 2020. Our projection methodology takes into account the changes in aggregate consumption pattern due to mobility of the population across the income classes and from rural to urban areas, besides the increase in per capita consumption of all classes.

49. Parikh J., Babu P.G., Kavi Kumar K.S; (1997), "Climate change, North-South co-operation and collective decision-making post-Rio" *Journal of International Development*, Volume 9, Issue 3, Pages 403-413

Abstract
This article reviews the progress made since the signing of the Framework Convention on Climate Change. We argue for increasing the efforts to introduce a collective decision

making process. Developing arguments mainly from a Southern perspective, the article discusses the risk factors that need to be assessed for collective decision making, the implications of such processes and policy instruments such as Joint Implementation to implement the decision making framework. The criteria for interregional allocation of emission abatement and the potential cooperation between North and South in the context of climate change are also discussed. The article highlights the need to reduce the risk of climate change by early action. © 1997 by John Wiley & Sons, Ltd.

50. Reddy B.S., Parikh J.K. (1997), "Economic and environmental impacts of demand side management programmes" *Energy Policy*,Volume 25, Issue 3, Pages 349-356

Abstract
This paper studies 12 DSM options which could be implemented in various categories of industries in India. It examines their costs and economic and environmental impacts, and estimates yearly targets for the next 15 years (1995-2010). The results indicate that savings of 24 616 MW and 122 991 GWh can be achieved over the base line growth with a cost of Rs 325 568 million (in present values). Finally, the potential environmental trade-off between system cost and power plant emission reductions is discussed. This is an effort to carry out bottom-up modelling, which mainly looks at programme costs where much of the funds come from customers themselves. However, they require extra support through DSM programmes. © 1997 Elsevier Science Ltd. All rights reserved.

51. Majumdar S., Chattopadhyay D., Parikh J. (1996), "Interruptible load management using optimal power flow analysis" IEEE Transactions on Power Systems Volume 11, Issue 2, 1996, Pages 715-720

Abstract
An intcmiptible load management (ILM) scheme is proposed using dynamic Optimal Power Flow analysis. It enables real-time selection of interruptible loads incorporating network constraints and dynamic restriction on generation viz. ramp-rate limits. The model provides an analytical framework for addressing several important Issues associated with optimal selection of load curtailment e.g. advance notification for load curtailment, short-term price discounts and long-term discounts on demand-charges, power factor of the load and customer-cost associated with the load to be curtailed, and system security. A six-bus example illustrates the proposed methodology. © 1995 IEEE.

52. Majumdar S., Parikh J. (1996), "Energy demand forecasts with investment constraints" *Journal of Forecasting,* Volume 15, Issue 6, November 1996, Pages 459-476

Abstract
The energy sector in India claims 30% of the available investments. Moreover, oil import bills have the largest share among the total import bills. Thus, macro economic development and energy sector are highly interdependent. Where energy demand is forecasted without these linkages one cannot be sure if investments and imports required for energy sector will be available. The Simulation of MAcroeconomic scenarios (SIMA) model generates macroeconomically consistent energy scenarios from two interlinked

submodels i.e. economic and energy submodels. The energy sector is a part of the non-agricultural sector but it is linked to both the agricultural and the non-agricultural sectors. These three sectors compete with each other for the available capital. In a two-step procedure, various energy economy relations are econometrically estimated and then these are solved simultaneously by feeding in the exogenous parameters (population, oil prices, etc.). The scenarios created correspond to 1991-2010. They are the Dynamics As Usual and the High Oil Price scenarios with capital required for phasing in the electricity sector. Energy-related emission levels for pollutants such as CO_2, NO_x and SO_2 emissions are also calculated for each scenario.

53. Parikh J.K, Sudhakara Reddy B., Banerjee R., Koundinya S, (1996), DSM survey in India: Awareness, barriers and implementability" *Energy*, Volume 21, Issue 10, October 1996, Pages 955-966

Abstract

This paper provides results of a survey on DSM programs for the high-tension industries of Maharashtra. Technical potentials, costs, savings and the need for financial mechanism are covered. The types of programs industries prefer and needed incentives, extent of participation, agencies suitable for implementation, and barriers to implementation are highlighted. Policy measures are suggested for the efficient implementation of DSM plans.

54. Rao R.D., Parikh J.K. (1996), "Forecast and analysis of demand for petroleum products in India" *Energy Policy*, Volume 24, Issue 6, June 1996, Pages 583-592

Abstract

This paper analyses the demand for petroleum products in India. For this purpose, econometric models based on time series data are generated for individual products so as to capture product specific factors affecting demand. The models generated follow the non-homothetic translog functional form. The models are validated against historical data by testing them for ex post forecast accuracy. Demand forecasts till the year 2010 are obtained for the various petroleum products using these models. The forecasts indicate a high rate of growth in demand for motor gasoline, high speed diesel oil, kerosene, liquid petroleum gas and aviation turbine fuel. However, the demand for fuel oils, light diesel oil, naphtha and lube oils is expected to grow at a relatively lower rate. To arrive at an optimal refinery process configuration, an analysis of alternative means of satisfying the demand, which include product import options and domestic refining options with alternative process configurations, need to be done. Thus, investment plans for augmenting domestic refining capacity will have to take into account the future pattern of demand, to arrive at an optimal product mix. Forecasting demand forms a crucial aspect in the overall policy analysis of the oil and gas sector. Copyright © 1996 Elsevier Science Ltd.

55. Tiwari P., Parikh J., Sharma V, (1996), "Performance evaluation of cost effective buildings - A cost, emissions and employment point of view" *Building and Environment*, Volume 31, Issue 1, January 1996, Pages 75-90

Abstract

Given the uphill task of providing housing for all within a short time frame and making it affordable, the construction industry has to look into various low cost options of construction using locally available building materials. This paper evaluates various dimensions of low cost techniques. For the same engineering criterion to be satisfied, a room of dimensions 3.5 m×3.5 m×3.14 m constructed using low cost techniques costs only 66% of the conventional construction cost. Since these materials are low energy consuming, the associated CO_2 emission is also low. The CO_2 emission with the conventional method of construction is 5.88 tonnes compared to 2.42 tonnes in the low cost method of construction. There is a possibility of further reducing the emissions by 23% with 0.03% increase in the cost. Another implicit advantage for a country like India with surplus labour force, is that employment increases with greater use of methods of construction involving reduction in CO_2 emission due to the switch towards labour intensive techniques.

56. Parikh, J.K. (1995), "Joint implementation and North-South cooperation for climate change" *International Environmental Affairs***,** Volume 7, Issue 1, 1995, Pages 22-41

Abstract

Joint implementation for projects addressing climate change is the subject of an ongoing debate primarily between the North and the South. That is, should the South permit investments from the North? This article examines issues ranging from cost-effectiveness to the North, and sustainable development in the South, fair compensation, carbon-sink projects, links with carbon reduction targets by the North, and effectiveness of global environmental objectives. The North can consider joint implementation among a portfolio of options for mitigating climate change. Joint implementation should be only considered in addition to the Annex I countries' commitments as one of the options for containing developing countries' emissions without compromising their development. This article concludes by supporting a pilot phase of joint implementation, which should be closely monitored. -from Author

57. Parikh, J.K. (1995), "Gender issues in energy policy" *Energy Policy***,** Volume 23, Issue 9, 1995, Pages 745-754

Abstract

Gender issues have received attention at micro level in terms of technological interventions such as cookstoves, biogas, solar cookers, wood plantations and so on. They have yet to be addressed in macro level policies. Women's needs for energy vary depending on whether they are in urban or rural areas, their stage of economic development and whether they are economically active. This article emphasizes the need for better understanding of these issues for women engaged in different sectors, whether agriculture, transport, industries, household and the energy sector itself (ie charcoal making, fuel gathering and fuel marketing). Deeper enquiries, analysis and action for gender issues are needed through surveys, laboratory experiments, macro policy modelling and analysis, and technology development and production. This article makes a plea to include gender issues in macro level energy policies such as energy investment,

imports and pricing. The latter are discussed in detail. A lot more work lies ahead. - Author

58. Chattopadhyay D., Bhattacharya K., Parikh Jyoti (1995), "Optimal reactive power planning and its spot-pricing: an integrated approach" *IEEE Transactions on Power Systems*, Volume 10, Issue 4, November 1995, Pages 2014-2020

Abstract

The paper presents an integrated framework to analyze the issues of reactive power planning along with reactive power pricing. The planning problem involves optimal placement and sizing of capacitors in a network such that operating and investment costs are minimum. A simple bus-wise cost-benefit analysis (CBA) scheme is proposed which involves solving a modified optimal power flow problem (OPF) iteratively. The proposed CBA incorporates detailed hourly loading conditions at a bus and achieves a fairly accurate estimate of the benefits from capacitor placement. The formulation is directly handled by the well known MINOS code and is solved efficiently. It obviates the need to introduce integer variables and is thus suitable for large system applications. A two-part reactive power spot-pricing scheme is formulated, by which the investment and operational costs can be recovered by the utility. The proposed reactive power price has two parts - a fixed part to account for the investment costs of new capacitor at a bus and a variable spot price to account for the operating costs incurred in supplying the additional reactive power from generating units.

59. Chattopadhyay D., Bhattacharya K., Parikh Jyoti, (1995), "Systems approach to least-cost maintenance scheduling for an interconnected power system" *IEEE Transactions on Power Systems*, Volume 10, Issue 4, November 1995, Pages 2002-2007

Abstract

The paper presents an integrated approach to least-cost generating unit maintenance scheduling for interconnected power systems. A Mixed Integer Programming (MIP) Model is developed which analyses the fuel supply decisions, generation and maintenance scheduling decisions as well as inter-utility transfer schedules in a comprehensive way. The method is applied to two interconnected Indian utilities. Firstly, the impact of fuel supply constraints and hydro energy availability on maintenance schedule has been examined for one utility. The analysis has further been extended to develop a centralized maintenance plan for both the utilities incorporating inter-utility transfer decisions. Studies reveal that interconnected mode of operation can lead to substantial changes in fuel supply decisions and the overall system operating costs are significantly reduced.

60. Chattopadhyay D., Banerjee R., Parikh Jyoti**,** (1995), "Integrating demand side options in electric utility planning: a multiobjective approach" *IEEE Transactions on Power Systems* Volume 10, Issue 2, May 1995, Pages 657-663

Abstract

This paper proposes simultaneous integration of DSM options in a multiobjective framework (using compromise programming technique) for electric utility planning. The two distinct advantages of this method are: (i) explicit consideration of all associated benefits of DSM options viz. cost reduction, emissions reduction and improvement of supply system reliability (ii) consideration of the integration method specific characteristics of various types of DSM options depending upon the control of utility on their usage. The methodology is applied for an Indian utility (Maharashtra State Electricity System(MSES)) for its integrated resource planning for the period 1990-2000 to illustrate the methodological issues. Various methodological issues related to the specific nature of DSM options and multiobjective framework are discussed in the context of MSES.

61. Painuly J.P., Rao H., Parikh J., (1995), "A rural energy-agriculture interaction model applied to Karnataka state" *Energy*, Volume 20, Issue 3, March 1995, Pages 219-233

Abstract
A comprehensive approach that considers fuel, fodder and fertiliser relationships has been used to analyse the rural energy system of Karnataka. A linear programming model that incorporates these relationships has been used to simulate and study the effects of various policy options on the rural energy system in 2000 A.D. Increased efficiency of non-commercial fuel use and provision for improved and increased quantities of feeds to animals emerge as the most desirable options to meet the energy requirements that maximize the gains to rural Karnataka. © 1995.

62. Parikh J., Shukla V. (1995), "Urbanization, energy use and greenhouse effects in economic development. Results from a cross-national study of developing countries" *Global Environmental Change*, Volume 5, Issue 2, 1995, Pages 87-103

63. Tiwari P., Parikh J. (1995), "Cost of CO2 reduction in building construction" *Energy*, Volume 20, Issue 6, 1995, Pages 531-547

64. Parikh,J., Chattopadhyay D., Nandapurkar U., (1995), "Simulation of national grid operation in India *Utilities Policy*, Volume 5, Issue 1, January 1995, Pages 65-74

Abstract
The formation of a national grid is a promising option for improving upon the current status of power shortages and uneconomic operations in India. A linear programming simulation model (NATGRID) is used to analyse the key issues related to national grid operations. A simulation exercise for the year 1989/90 shows that the power shortage could be reduced by 22.9 TWh and total generation could be increased by 26 TWh (10.9% of actual generation) through better capacity utilization. Four additional interregional transmission links are identified to reduce power shortages in the southern states. The short-run marginal costs for all states vary considerably across peak and off-peak periods, indicating the need for a time-of-day pricing mechanism for inter-utility power trading. © 1995.

65. Parikh J.K., Banerjee R., (1994), "Promoting faster diffusion of energy efficiency with Type 1 projects" *International Journal of Environment and Pollution*, Volume 4, Issue 3-4, 1994, Pages 322-328

Abstract

The Framework on Climate Change Convention provides for incremental costs for those measures that help developing countries to reduce carbon dioxide emissions. The Global Environmental Facility (GEF) was set up to fund projects to provide incremental costs. Some argue that this means that fossil-fuel efficient technologies should not be included because they are economic on their own right and there is no `incrementality' about them. This paper argues that even if they are `economic', it is desirable to set up programmes for faster diffusion to achieve better results. An illustrative example of the promotion of energy-efficient motors (EEM) in the high tension industry sector in Maharashtra State in India is presented. In the cost-sharing programme case, 50% of the incremental cost difference of the EEM is borne by the GEF. A programme results in additional adoption of 203,000 motors and a net saving of 1.6 million tonnes of carbon, reducing the overall cost to $16 per tonne of carbon. The GEF would find it worthwhile to promote Type 1 projects that could lead to reduction of carbon dioxide emission.

66. Parikh J.K., Painuly J.P., (1994), "Population, consumption patterns and climate change: A socioeconomic perspective from the South" *Ambio*, Volume 23, Issue 7, 1994, Pages 434-437

67. Chattopadhyay, D., Parikh, J.K., (1993), "CO_2 emissions reduction from the power system in India" *Natural Resources Forum*, Volume 17, Issue 4, 1993, Pages 251-261

Abstract

The power system in India accounts for nearly one-third of CO_2 emissions of the country as a whole. A comparison of some of the technical options to reduce CO_2 emissions is presented in this paper. A linear programming framework is used to simulate the integrated optimal operation of the three regional grids, and it is shown that such operations lead to lower fuel costs and to lower CO_2 emissions. Reduced fuel requirements also lead to reductions in other pollutants ie SO_2, NO_x and fly ash. The reductions in CO_2 emissions and other pollutants are at far lower cost in the case of integrated optimal operations as compared to reductions due to gas fuelled generation or thermal efficiency improvements. Thermal efficiency improvements under optimal integrated operations result in much higher reductions in operating costs, coal consumption and total emissions of all pollutants. -from Authors

68. Parikh, J., Gokarn, S., (1993), "Climate change and India's energy policy options. New perspectives on sectoral CO_2 emissions and incremental costs" *Global Environmental Change*, Volume 3, Issue 3, September 1993, Pages 276-291

Abstract

This paper presents an analysis of CO_2 emissions in the Indian economy and examines the implications of alternative policies to reduce them. This analysis goes beyond the conventional approaches of looking at energy supply structure and end-uses of energy. Instead, it examines flows of energy in the economy of India through a 60-sector input-output mode). The authors show that direct emissions of CO_2 are highest in the electricity sector followed by iron and steel, road and air transport, and coal tar. If a similar analysis by final demand is carried out, incorporating both direct and indirect emissions, the highest emitting sector is construction, followed by food crops, road and air transport, and so on. This indicates that, in addition to energy efficiency, improving construction efficency could also lead to CO_2 savings (by using less energy-intensive materials or by making optimal use of them). It is also shown, by generating alternative energy policy scenarios, that if India saves energy from coal rather than from imported oil to reduce CO_2 emissions, then savings foregone are more than Rs 5634 million for only 10% of energy saving. Sectoral priorities also change. To save coal, the power sector, iron and steel, coal tar, etc will require attention. To save oil, transport, refinery and fertilizers will require attention. Similar arguments are made for substitution of coal by oil and gas. Additional costs of Rs 10 billion would be incurred for 10% substitution of coal by oil and gas as compared to the current policy of substituting oil and gas with coal. This article offers another Interpretation of the notion of 'incremental costs' though comparison of two alternative development strategies. © 1993.

69. Painuly J.P., Parikh J., (1993), "Policy analysis of oil substitution by natural gas in India: transport and industry sectors" *Energy Policy* Volume 21, Issue 1, Pages 43-52

Abstract

Diesel and fuel oil are the two major petroleum products consumed in the Indian economy. They are predominantly used in the transport and industry sectors. Both of these products can be partly substituted by natural gas (NG), which is indigenously available. The paper explores levels of substitutions that should be planned for diesel by compressed natural gas (CNG) driven vehicles and for fuel oil by natural gas. Such an approach would require maximization of consumers' and producers' surplus so that economic costs to the country and financial costs to the users are realistically assessed. It is shown that when international crude prices and refinery margins increase, the natural gas allocated to the transport sector increases, followed by the industry sector. This leads to savings of US$460-3700 million for crude price of $14 per barrel to $32 per barrel respectively. -from Authors

70. Parikh J.K., (1992) "IPCC strategies unfair to the South", *Nature* Volume 360, Issue 6404, , Pages 507-508

71. Singh R.P., Painuly J.P., Parikh J., Sen C., (1992), "Rural energy and agricultural interactions in 2000 AD: a study of Uttar Pradesh", *Indian Journal of Agricultural Economics*, Volume 47, Issue 4, , Pages 601-617

Abstract

The rural energy system model developed by Parikh (1985) is used for the study. It captures the interactions between crop production and associated residues, livestock production system, fertilisers, household energy, etc, in a linear programming framework. The model considers different energy (fuel) sources for household use (biomass sources, dung and commercial energy sources), different fertiliser choices (chemical, biogas sludge, straws and manure) in terms of N, P, K for six different asset groups, viz. landless, marginal, small, medium, large and very large farmers. For the livestock, distinction between working and non-working animals is made and their contributions to energy and their feed requirements are taken into account. Possible future scenarios are evaluated and the effects of various policy alternatives on various resources and corresponding end uses are analysed. The rural energy model constructed here allocates biomass for fuel, fodder and fertiliser. The two most important desirable options that lead to improvements that emerge are efforts to improve the efficiency of non-commercial fuel use, especially for crop residues use in addition to wood and to increase nutrition for livestock that would result in increased availability of dung and milk. In conclusion, the model has spelled out implications for a variety of policy alternatives and scenarios ranging from increased fertiliser prices and reduced wood available, and increased rural population. -from Authors

72. Parikh J., Deshmukh S.G, (1992), "Policy alternatives for western and southern power systems in India", *Utilities Policy*, Volume 2, Issue 3, July, Pages 240-247

Abstract

Utility policy issues addressed in this paper include: how much could be gained by interconnecting two regional grids?; what are the implications if the Indian eighth plan targets for capacity additions are reduced?; and, what is the role of energy conservation and reductions in peak power demand? A non-linear optimization model is used for simulating interconnection of two regional grids. The area under consideration includes seven major state utilities and six central sector plants, each having a pool of installed capacities of various types of plants and the transmission lines in place. The model minimizes the total variable costs for the total power system with physical constraints on the demand and supply side. The model is validated for the base-run for 1987-1988. Simulations are carried out for the terminal year of the eighth five-year plan (1994) assuming the capacity expansion plan already formulated by the government. The model is also capable of identifying the additional peaking capacity required for each utility. The simulation results for the eighth plan quantify the gains from interconnection and need for effective transmission linkages required between western and southern regions. This has to be backed-up by a suitable hardware programme, if the gains from interconnected systems are to be realized. © 1992.

73. Parikh J.K., Pai M.G, (1988), "Applications of high-temperature superconductors to the power sector in developing countries", *Journal of Superconductivity*, Volume 1, Issue 4, Pages 395-406

Abstract

Developing countries imported power equipment worth US$25 billion in 1986, and their power requirements are expected to rise well into the 21st century. Therefore, a global

view needs to be taken while according priorities for superconductivity research to the power sector. The scale of the power applications, feasibility of which is earlier established for low temperature superconductors, may have to be reduced if they have to be relevant for the developing countries (e.g., superconducting power generators of 100-500 MW, storage of 500-2000 MWh, and transmission lines of about 100-400 KVA). Fortunately, due to the easier availability of coolant (LN) and ceramics, there could be greater efforts in R & D and, therefore, faster progress. © 1988 Plenum Publishing Corporation.

74. Parikh J.K., Syed S, (1998), "Energy use in the post-harvest food (PHF) system of developing countries" *Energy in Agriculture*, Volume 6, Issue 4, Pages 325-351

Abstract

This paper reports on the methodology and results of the study on estimation of energy consumption in post-harvest-food systems in developing countries. The components of the PHF system are: food processing, transportation, storage and cooking. The study is rather ambitious in its coverage of 70 processed commodities in 90 countries of Africa, Latin America, the Far East and Near East. This was possible because of the considerable variety of computer data available at FAO for such an analysis. Of course, extensive checking was required for each country but much of the approximations remain, leading only to broad implications. Despite the difficulties with precise data, it seems reasonable to draw the following conclusions from the available information: the post-harvest-food system requires 2 to 4 times more energy than at farm level: the share of commercial energy which is often used for food processing, such as milling, crushing, and food transport, and to some extent for cooking, ranges between 22% in Africa and 80% in the Near East; the levels of energy consumption in the PHF system depends on income levels and extent of urbanization, and whether a country has locally available fossil fuels or forests. In addition, different components of the PHF system are sensitive to different parameters. For example, energy in food processing depends on cropping, dietary patterns, and whether food is exported or imported, whereas food transport depends on the size of the countries and location of urban areas with respect to farms. These parameters are discussed here for the four worl regions as well as for the 90 developing countries as a whole. Country-specific insights are given graphically due to impracticability of reporting all data in detail. © 1988.

75. Parikh Jyoti K., CAPITAL GOODS FOR ENERGY DEVELOPMENT: POWER EQUIPMENT FOR DEVELOPING COUNTRIES", Annual Review of Energy, Volume 11, 1986, Pages 417-450

Abstract

The procurement of electric power equipment by developing countries concerns not only them alone, but also the developed countries. Of the total world trade of about US45 billion, the share of developing countries was nearly 32% in 1983. To reduce foreign exchange payments and to increase self-reliance, the developing countries need to increase their efforts in domestic manufacturing of electric power equipment in whatever

modest way is possible. Behind the goals of indigenization lies the basic desire for participation in the process of industrialization. At present, the most important factor militating against the domestic manufacture of power equipment in the developing countries is the surplus capacity that exists at the global level due to falling or stagnant demand for capital goods for electricity in the western world.

76. Parikh J.K, (1986), "From farm gate to food plate. Energy in post-harvest food systems in south Asia" *Energy Policy*, Volume 14, Issue 4, Pages 363-372

Abstract
This paper estimates energy consumed in the post-harvest food systems of India, Pakistan, Burma and Sri Lanka. The components of the post-harvest food system are: food processing, food transport and cooking. It is shown that they represent a significant share of national energy consumption and that variations among countries depend on variables such as urbanization, income, cropping patterns and whether a country is a food importer or food exporter. The policies to reduce energy consumption would involve measures for increased energy efficiencies, reduced food losses and careful consideration of markets vs food production areas for perishable commodities. © 1986.

77. Parikh J.K.,(1985), " Household energy assessment: Integration of approaches and additional factors", *Biomass*, Volume 7, Issue 1, Pages 73-84

Abstract
An appropriate household energy assessment for developing countries, which use substantial biomass, requires a coordinated effort between surveyors, experimentalists and analysts. This paper describes the role of each and also the additional factors which need to be considered, recorded, measured and analysed to account for variations in energy consumption across countries, income classes, etc. These range from seasonal and regional differences, fuel scarcities and coping strategies, dietary and cooking practices, food and fuel processing, to the role of women. © 1985.

78. Parikh J.K., Krömer G., (1985), "Modeling energy and agriculture interactions-II: Food-fodder-fuel-fertilizer relationships for biomass in Bangladesh", *Energy*, Volume 10, Issue 7, Pages 805-817

Abstract
The model developed by Parikh[1] is applied to Bangladesh for which the situation in 1976-1977 is simulated first. This base case provides insights into the present behavior of different income groups with regard to choices of fuels and allocation of biomass for various purposes. It is shown that, due to high needs and prices of fuels, the biomass allocation for fuels takes priority over feed and fertilizers. In fact, the landless burn all, and small farmers burn 80% of animal dung rather than use it for fertilizers. The model also shows that, unless substantial amounts of fertilizers are used, the small and middle farmers would have feed and fuel shortages on adopting high-yielding varieties (HYV) that minimize straw-grain ratios. Similarly, by 1990, when the population increases further, middle farmers also become vulnerable in meeting their feed, fuel, fertilizer requirements. To mitigate these effects, improved stoves and other measures would be necessary to increase biomass use efficiencies considerably. Since Bangladesh is a very

low-income and resource-scarce country, the choices of biogas, charcoal kilns, and alcohol distilleries, and the choices of mechanization, all of which require investment, play a minor role. © 1985.

79. Parikh J. (1985), "Modeling energy and agriculture interactions-I: A rural energy systems model" *Energy* Volume 10, Issue 7, July 1985, Pages 793-804

Abstract

Since many of the factors related to rural energy systems are gradually being quantified, there is a need to construct a model that integrates a number of these factors simultaneously in a consistent framework. Therefore, a general linear programming model is developed to capture energy and agricultural interactions existing in the rural areas of developing countries. Energy used for agriculture includes fertilizers, irrigation, and mechanization. Several technological choices of each of the above are considered and so are several crop commodities, several types of livestock, and farmers of different income groups along with their assets, i.e. land holdings, livestock, etc. The by-products of agriculture, i.e. biomass, such as crop residues, animal dung, wood, etc., can be used to generate energy. On the demand side the use of them for feed, fuel, and fertilizer must be considered. Thus, the household sector (which is the largest user of noncommercial energy), as well as the rural industries sector, is intimately related to the agriculture sector. Twelve different energy sources and several conversion technologies, such as biogas, charcoal kilns, alcohol distilleries, etc., are considered. The model is applicable to low-income, biomass-scarce developing countries. However, different types of countries will require different approximations, and their needs for detailing some aspects or other may vary. The model is suitable for policy purposes because it considers several income groups separately and considers how different changes affect each of them. © 1985.

80. Kennes W., Parikh J.K., Stolwijk, H., (1984), "Energy from biomass by socio-economic groups-a case study of Bangladesh" *Biomass* Volume 4, Issue 3, 1984, Pages 209-234

Abstract

The paper provides a detailed quantitative description of the biomass energy situation in Bangladesh. An attempt is made to relate the biomass energy situation to income distribution by subdividing the economy into nine basic socio-economic classes. For each of these classes demand and supply of biomass resources - firewood, several types of crop residuals and animal dung - are examined. A consistent quantitative picture is constructed of production, trade and use of energy by these classes. Studies of the effects of policy measures or investments projects dealing with biomass energy resources on particular groups of the population require this information. Although the presentation suggests major information gaps in this area, it still makes clear that actual endowments of energy resources are very skewed. Therefore it is likely that programmes to increase the supplies of traditional energy are no exception to the rule that their income distribution effects may be skewed as well. © 1984.

81. Parikh J.K. (1982) "Energy requirements for India: A systems approach" *Studies in Environmental Science*, Volume 16, Issue C, 1982, Pages 535-546

82. Parikh J. (1981) "Energy and agriculture interactions" *Food for all in a sustainable world: the IIASA Food and Agriculture Program*, Pages 178-183

Abstract

Examines the linkages between agriculture as a source and as a user of energy, with regard to developing countries. Here, typically 30% - 70% of agricultural input costs are directly/indirectly for energy, and agriculture typically provides 20% - 90% of these supplies, as dung, wood etc. -C.Barrow

83. Parikh Jyoti K. (1980), "Renewable Energy Options: What Could Developing Countries Expect From Them? *Solid State Ionics* 1980, Pages 989-994, Renewable Energy Prospects, Proc of a Conf on Non-Fossil Fuel and Non-Nucl Fuel Energy Strategies; Honolulu, HI, USA; ; 9 January 1979 through 12 January 1979

Abstract

Since fossil fuels need to be conserved and nuclear energy is not an option for many of the developing countries, what renewable options could bring is evaluated in detail. Socio-techno-economic parameters for developing and employing renewable energy sources are identified for biogas, wood plantation, solar, and hydropower.

84. Parikh J.K., Parikh K.S. (1957), "Simulation of macroeconomic scenarios to assess the energy demand for India; (Sima)" *Research Report, International Institute for Applied Systems Analysis* Volume 79-15, 1979, Page 50

Abstract

Details the use of the SIMA model, a macroeconimic simulation model to assess energy demand for India. The authors project alternative future energy demand scenarios consistent with economic developments and possible energy supply scenarios. They also examine the interaction between the increased costs of energy and economic development, which may be important for developing countries where capital accumulation and imports generally constitute the major constraints on development. The alternative paths selected for use with the SIMA model included a greater intensification of agriculture, increasing aid, and stepped-up investments and exports (to generate high economic growth). Also considered explicity are the uses of non-commercial energy and the extent and pace of rural electrification characteristic of developing economies. -R. K. Turner

85. Parikh J.K. (1979), "Renewable energy options: What could developing countries expect from them? *Energy*, Volume 4, Issue 5, October 1979, Pages 989-994

Abstract

In order to make a realistic assessment of the energy alternatives for the developing world, the present conditions of the developing region, consisting of Africa and Asia (excluding South Africa, Japan and China), are studied first. Highlights include: low commercial energy consumption (0.2 kW/cap), heavy dependence on oil and noncommercial energy, and especially poor conditions of the rural energy supply. Since fossil fuels need to be conserved and nuclear energy is not an option for many of the developing countries, what renewable options could bring is evaluated in detail. Socio-techno-economic parameters for developing and employing renewable energy sources are identified for biogas, wood plantation, solar, and hydropower. The study concludes that the developing countries could obtain 35% of the energy in 2030 with the low-demand scenario of 0.9 kW/cap. However, with the high-demand scenario of 1.4 kW/cap, active policies in nuclear energy and fossil fuels as well would be required. © 1979.

86. Parikh J.K. (1978), "Assessment of solar applications for transfer of technology a case of solar pump" *Solar Energy* Volume 21, Issue 2, 1978, Pages 99-106

Abstract

For the large and increasing rural population in the developming countries, decentralized solar applications could be relevant. However, new solar technologies being developed in the laboratories presently have to ultimately be acceptable in the field conditions. The conditions which have to be satisfied before the solar applications could be acceptable are discussed. The solar pump is examined in detail in particular due to the interest expressed by many developing countries in this specific application. A comparative techno-economic analysis is carried out for solar pumps and diesel pumps which considered escalation of the diesel price and factors related to climate, geography, locale, social and institutional environment for two types of uses namely for drinking water and for irrigation. It seems unlikely that a solar pump could compete with the diesel engine before the costs are brought down by a factor of 20-50 for irrigation purposes. However, for obtaining the drinking water the cost reduction required is by a factor less than 10 than currently charged for the prototypes. Although specific example of India is taken the matters are relevant to most developing countries. The issues discussed for the case of a solar pump are also relevant to other solar applications used only for seasonal purposes since the capital costs are high and operating diesel pumps during the season would be cheaper for several decades. © 1978.

87. Parikh, J.K. Energy use for subsistence and prospects for development" *Energy* Volume 3, Issue 5, October 1978, Pages 631-637

Abstract

This paper focuses on the present use of energy in the developing countries in order to estimate the energy required for subsistence-level activities and to see how much surplus is available for economically productive activities, taking into account both commercial and non-commercial (firewood, farmwaste) sources of energy. The energy required for subsistence is estimated to be in the range of 0.3 to 0.4 tce per capita. The consumption of most low income groups countries is below this level if only commercial energy is considered. Relations are derived to explain the uses of each of these energy forms in terms of economic and demographic variables from a sample of 82 countries. These relations are then employed to show that the dependence on non-commercial energy is likely to continue beyond 2000 AD and that, inspite of the annual rise of commercial energy consumption by 6%, the improvements in per capita consumption are small because of an increase in population and a decrease in per capita non-commercial energy. © 1978.

88. Parikh J.K (1977), "Environmental problems of India and their possible trends in future" *Environmental Conservation* Volume 4, Issue 3, 1977, Pages 189-198

89. Parikh, Jyoti K., Parikh, Kirit S "Potential of bio-gas plants and how to realize it", Microb Energy Convers, Proc of a Semin; Goettingen, Swed; ; 1 October 1976 through 1 October 1976

Abstract

This paper is concerned with the efficient utilization of animal dung and agricultural byproduct in India. It is shown that this goal can be achieved through production of methane and fertilizers by employing anaerobic fermentation. The economic benefits to a family of a family bio-gas plant and the impact of its widespread acceptance on a national scale are evaluated. However, the scope of such bio-gas plants is likely to be limited for a number of reasons. For fully realizing the potential of bio-gas, village plants of approximately 6000 cft capacity for approximately 100 familes are suggested instead. The impact of full scale adoption could mean that by 2000 A. D. almost 90% of rural energy requirements of domestic sector could be met; at present this is about 45% of the total energy consumption in India. In addition organic manure containing 2 million tons of additional nitrogen would be available every year to enhance soil nutrients and hence boosting food production. Refs.

90. Parikh J.K., Parikh K.S (1977), "Mobilization and impacts of bio-gas technologies" Energy Volume 2, Issue 4, December 1977, Pages 441-455

Abstract

At present, energy and fertilizer requirements of many of the developing countries are largely met by locally available, non-commercial sources, such as firewood and farm wastes. Extensive use of firewood is one of the factors that can lead to deforestation. When organic farm wastes are burnt, soil nutrients, which should return to soil, are lost and this can severely affect agricultural production. The problem of efficient utilization of these locally available resources, therefore, needs to be studied in a systematic manner. As an option for efficient utilization of local resources, bio-gas plants are considered, taking India as a case study. In these plants, animal dung and agricultural byproducts are utilized to obtain both methane and

fertilizer through anaerobic fermentation. This is an example of appropriate technology for rural environments, which requires low investment, which does not need highly skilled labor and which can be operated with local materials and self-help in the 576,000 villages of India. The economic benefits to a family using a bio-gas plant and the impact of its widespread acceptance on a national scale are evaluated. It is felt, however, that the scope of such individual family bio-gas plants is likely to be limited for a number of reasons. To realize the potential of bio-gas fully, village plants of about 200 m3 capacity for approx. 100 families are needed. The introduction of such seemingly sensible new technologies has failed in the past for want of appropriate management and organizational structures and, consequently, for want of social participation by persons of various income groups in the successful operation of such community plants. To remedy this, a pricing policy for purchase of farmwastes and distribution of gas and fertilizer has been suggested as an essential tool to ensure that no-one is worse off by the introduction of bio-gas plants and thus to motivate the required participation in the scheme. Given a different organizational set-up, the idea could also be tried out for providing energy and sanitation in urban areas. The impact of full-scale adoption could mean that, by 2000 ad, almost 90% of the rural energy requirements of the domestic sector could be met; at present, this accounts for about 45% of the total energy consumption in India. The consequent reduction in firewood consumption would help to prevent deforestation. In addition, organic manure containing two million tons of additional nitrogen would be available every year to enhance soil nutrients, hence boosting food production and helping to solve the problem of sanitation at the same time. © 1977.

91. Parikh Jyoti K. (1977), " Energy from Bio-conversion for Developing Countries. [ENERGIE PAR BIO-CONVERSION POUR LES PAYS EN VOIE DE DEVELOPEMENT.]" *Revue de l'Energie* Volume 28, Issue 293, April 1977, Pages 239-251

Abstract

Energy options appropriate for rural areas where locally available renewable resources could be utilized with self-help and without large capital investments are considered. In particular, a method of methane generation from organic waste in bio-gas plants by microbial energy conversion is presented and discussed. As an example, a single-family bio-gas plant is considered.

92. Parikh, J.K., (1976), "Multi-band spectra of odd and even nuclei of the s-d shell", Pramana, Volume 6, Issue 1, January 1976, Pages 42-58

Abstract

The energy levels of21, 23Na,22, 23Ne,24, 28Mg and25, 29Al are obtained by mixing various bands using the projected deformed Hartree-Fock (DHF) method. Solutions having minimum energies are found to be prolate for all the nuclei considered here. Higher bands are obtained either by considering particle-hole excitations or oblate solutions. These various bands are mixed using the projection method and care has been taken to orthogonalize the bands. The interactions used in this study are those given by Kuo, Preedom-Wildenthal (PW) and WHMK interactions. The last one seems to give good results for most of the nuclei considered here. Not only are the lowest bands well-reproduced but the second lowest bands agree reasonably well in most nuclei. The third lowest ones obtained in some nuclei are not

yet observed as complete bands. However, K obtained for the third band seems to be correct. A comparison with shell model calculations-which are numerically exhausting-shows similar results for the lowest band. However, the agreement of the second band varies from nucleus to nucleus. A comparison between matrix elements of the interactions is made to analyze the results. © 1976 Indian Academy of Sciences.

93. Parikh, J.K. (1974), "Projected band-mixed spectra of Fe and Ni isotopes" *Physical Review C* Volume 10, Issue 6, 1974, Pages 2568-2576

Abstract

The nuclear spectra of Fe54,56,58 and Ni58,60,62 are obtained by mixing various bands. The bands for each nucleus are obtained by considering the prolate and oblate Hartree-Fock solutions. The third band is obtained by considering two-particle-two-hole excitations on whichever is the lower solution of the above two. The states with definite angular momenta are projected and the orthogonalization is carried out to obtain the nuclear spectra. The Yukawa-Rosenfeld interaction (YR) and the Kuo-Brown interaction modified by McGrory et al. (KM) are used as the two-body interactions. The single particle energies are varied for each mucleus to give a good fit. A comparison between the interactions shows that the KM interaction for the Fe isotopes and the YR interaction for the Ni isotopes give better results. In general, the agreement with the experimental spectra is very good. However, the second 2+ state in Fe56,58 and Ni60 cannot be explained by this model which considers only K=0 bands. The high spin states have also been obtained. The effects of the band mixing on the nuclear spectra are discussed in detail for each nucleus. NUCLEAR STRUCTURE Fe54,56,58, Ni58,60,62 calculated energy levels. Projected Hartree-Fock method, band mixing. © 1974 The American Physical Society.

94. Parikh, J.K. (1973), "Study of V, Mn, and Co isotopes" *Physical Review C,* Volume 7, Issue 5, 1973, Pages 1864-1870

Abstract

Nuclei with odd number of protons are studied using the Hartree-Fock-Bogoliubov method. The binding energies, single-particle spectra, quadrupole moments, B (E2) values, and the pickup strengths are calculated. By comparing the results for the neighboring even nuclei one can study the sets of isotones. The nuclei with N=26 (Ti48, V49, Cr50, Mn51, and Fe52), N=28 (Ti50, V51, Cr52, Mn53, Fe54, and Co55), and N=30 (V53, Cr54, Mn55, Fe56, and Co57) are studied to understand the effects of the addition of a proton on the deformation, Fermi surface, fluctuations of the proton separation energies, pair separation energies, and the configuration mixing. © 1973 The American Physical Society.

95. Parikh, J.K. (1973), "Ground-state correlations for NZ nuclei" *Physical Review C*, Volume 8, Issue 4, 1973, Pages 1433-1437

Abstract

The method of calculating ground-state correlations in the random-phase approximation (RPA) has been extended for N Z nuclei. The expressions for the single-particle densities and RPA equations are derived. An application of this method could be made in explaining the anomalous isotope shift in the charge radii of Ca40-Ca48. © 1973 The American Physical Society.

96. Parikh, J.K. (1972), "Hartree-Fock-Bogoliubov calculations for even-even nuclei in p-f shell" *Physical Review C*, Volume 5, Issue 1, 1972, Pages 153-157

Abstract

Hartree-Fock-Bogoliubov (HFB) calculations are done for some even-even nuclei in the p-f shell taking Ca40 as a doubly closed core. It is observed that the nuclear shape changes from a prolate to oblate shape, and the pairing correlations increase in the neutron states and decrease in the proton states as one goes from the Ti to the Zn and Ge isotopes. Whether the f72 shell-closure approximation in which Ni56 is taken as a closed core is valid or not is discussed by comparing the calculated occupation probabilities of the f72 shell and the break in the pair separation energy at Ni56 with the experimental values. Projected HFB spectra have been obtained for Zn64, Zn66, and Ge70. Reasonable agreement with the experimental spectra is obtained for Zn66 and Ge70. The reasons for the failure of the present method in Zn64 are discussed. © 1972 The American Physical Society.

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Abstract

In order to study the effects of the addition of neutrons, one has to study the even as well as odd isotopes of a given nucleus. For this reason, the Hartree-Fock-Bogoliubov formalism which is available for even-even nuclei is extended for the even-odd nuclei. The blocking effect introduced by the odd nucleon is taken into account in the formalism. The numerical calculations are carried out for 22 nuclei of the p-f shell (the isotopes of Ti, Cr, Fe, and Zn) considering Ca40 as a doubly closed core. By comparing the results of the odd nuclei with the results of the even-even nuclei, the spectra of which are obtained in our earlier work, one understands the effects of the addition of neutrons on the nuclear properties such as the deformation, Fermi surface, saturation properties of the nuclear force, single-particle levels,

and the pickup strengths. The calculated binding energies, separation energies, pair separation energies, B(E2) values, quadrupole moments, and the neutron and proton pickup strengths compare very well with the experimental values. The possibility of obtaining the "equivalent deformation" for which the Nilsson levels correspond to the calculated single-particle levels is discussed. © 1972 The American Physical Society.

98. Parikh, J.K (1972), "Variations of nuclear shape and deformation in p-f shell" *Physics Letters B*, Volume 41, Issue 3, 2 October 1972, Pages 271-274

Abstract

The quadrupole moments of the first excited states and BE2 values of the even-even nuclei of p-f shell are calculated using the projected Hartree-Fock-Bogoliubov wave functions. The results are compared with the experimental data and with the predictions of the collective model. © 1972.

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Deformed Hartree-Fock-Bogulubov calculations have been carried out for 46, 48, 50Ti. The angular momentum projected spectra show a great improvement over the projected Hartree-Fock ones and are in very good agreement with the experimental results. © 1970.

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