

Anil Agarwal Dialogue 2015

CONTOURS OF INEQUALITY

What Census 2011 tells about India's energy poverty



Contents

Introduction Why we need to be serious about energy poverty	5
CHAPTER 1 The energy divide Chronic power deprivation in some districts raises serious policy issues	8
CHAPTER 2 How India cooks its food The disparity between India and Bharat is glaring when one looks at the fuel used for cooking	11
CHAPTER 3 State matters An analysis of the states that are faring well and the ones that are not in sourcing energy	18
CONCLUSION Energy access must be treated as investment for overall human development	53

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We are grateful to the Swedish International Development Cooperation Agency (Sida) for institutional support



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Material from this publication can be used, but with acknowledgement.

Published by

Centre for Science and Environment
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New Delhi 110 062

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Printed at Multi Colour Services, New Delhi

Introduction

Access to energy is an important determinant of quality of life. Inequality of access to energy for cooking, lighting and livelihood purposes has engaged the attention of researchers, policy planners and activists in recent years. In 2005, India launched the ambitious Rajiv Gandhi Grameen Vidyutikaran Yojana that aimed at universal access to electricity by 2009. Similarly, efforts towards universal access to modern cooking energy were initiated by creating a liquefied petroleum gas (LPG) distribution network and deploying renewable energy-based cooking energy solutions. Internationally too, in April 2011, the UN General Assembly declared 2012 as the International Year of Sustainable Energy for All.

Increased realisation of the futility of business-as-usual approach—expanding conventional energy infrastructure, particularly power—has led to a serious search for alternatives. Renewable energy solutions provide one such promising alternative.

But before coming to solutions, it is important to assess the nature and extent of the problem in the Indian context. This can be done at three levels:

- Macro,
- Meso, using data sets such as the National Sample Survey Office survey,
- Micro, using the Census data at the district and the sub-district levels and, if possible, at the village level.

The macro picture indicates the gravity of the problem. To begin with, we will concentrate on this. According to Census 2001, as many as 84.7 million households did not have access to electricity. In Census 2011, the figure has reduced marginally to 80.7 million households.

A break-up of the country's population into rural and urban segments indicates that about 75 million rural households (44.7 per cent of rural population) do not have access to electricity, while only 5.8 million urban households (7.3 per cent of urban population) lack such access. This makes the extent of rural-urban inequality obvious.

The fraction of non-commercial energy in the consumption basket is another macro indicator. Energy forms that are not sold in the regulated markets and are usually produced and consumed by an individual household are referred to as non-commercial energy. Use of non-commercial energy has increased in absolute terms from 74 MTOE (million tonnes of oil equivalent) in 1961 to 174 MTOE in 2011. But it has decreased in per capita terms from 169 KGOE (kilograms of oil equivalent) in 1961 to about 144 KGOE in 2011—not a significant decrease (see 'Skewed energy equations' p6).

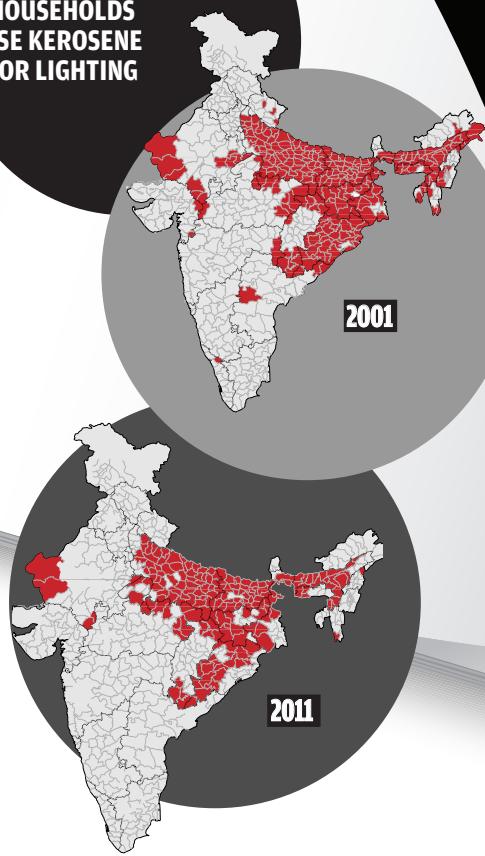
Here it would be pertinent to point out that the latest McKinsey report in January 2014 puts the current consumption of non-commercial energy at 160 MTOE. The report also reckons that consumption will stay at 160 MTOE till 2030 in a business-as-usual scenario. Even in an optimistic scenario aiming at energy independence, consumption of non-commercial energy is projected to decrease only to 147 MTOE. It is apparent that the segment using non-commercial energy is no one's concern.

This can be further elaborated when we look at the meso picture. The economic decile-wise energy consumption among rural and urban households not just reveals the rural versus urban consumption inequality, but also shows the intra-rural and the intra-urban consumption inequality (see 'Average electricity consumption per household per month' p7). The data makes

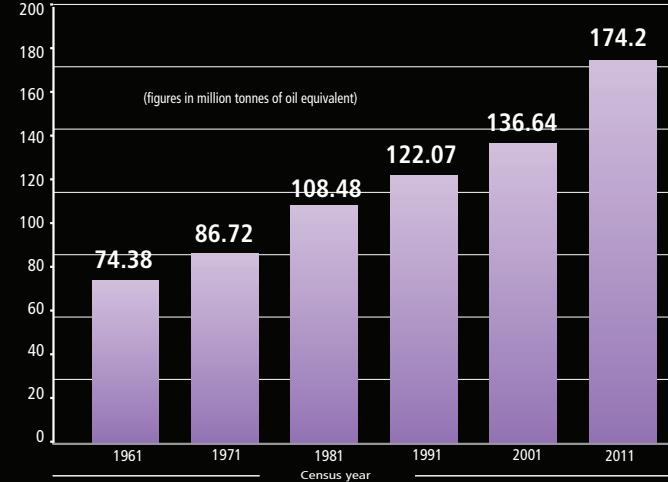
Skewed energy equations

45 per cent of rural population still depends on non-commercial energy sources because it does not have access to electricity

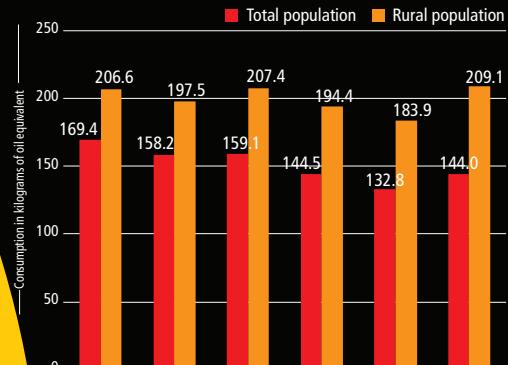
REGIONS WHERE MORE THAN 50% HOUSEHOLDS USE KEROSENE FOR LIGHTING



India's consumption of non-commercial energy



Per capita consumption trend of non-commercial energy



Source: Census of India for population data and Planning Commission data for non-commercial energy

GRAPHIC: VIVEK BHARDWAJ

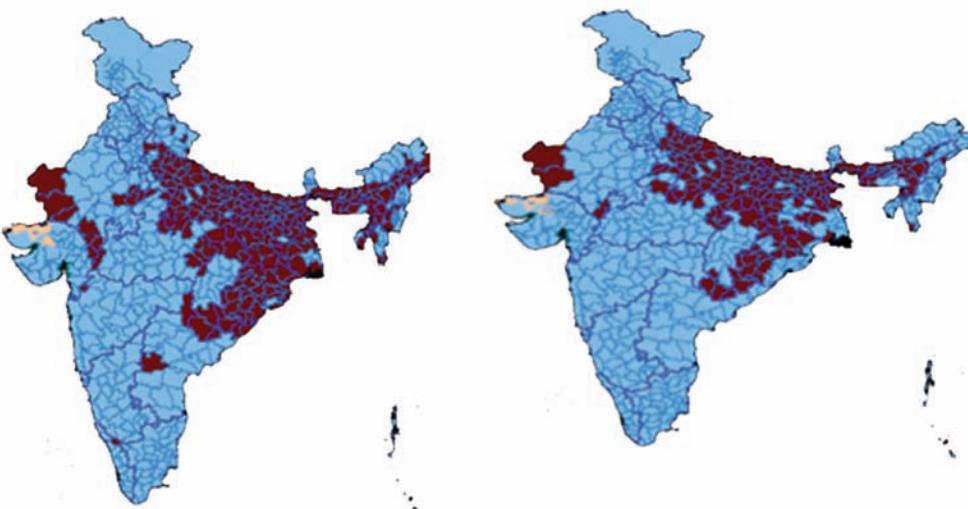
it clear that there is considerable inequality in energy consumption per household per annum in the rural area. What is more dramatic is the regional inequality in the access to electricity for lighting purposes in rural households. A compact cluster of districts in the eastern and northern regions had nearly half the households using kerosene for lighting in 2011 because they lack access (see 'A constant problem'). This data reinforces the urgency of eradicating basic energy poverty, especially since deprivation in this cluster is a strongly enduring one: even in 2001, it was nearly the same cluster where more than 50 per cent households were using kerosene as source of lighting.

Average electricity consumption per household per month						
Decile class of MPCE	Monthly per capita expenditure (MPCE) by decile (in ₹)		Electricity consumed per household (excludes non-consuming households) (in kWh)		Electricity consumed per household (includes all households) (in Kilowatt hour or kWh)	
	Rural	Urban	Rural	Urban	Rural	Urban
1	505	707	35	53	16	43
2	664	979	40	66	22	61
3	774	1,192	42	76	25	73
4	876	1,401	43	85	29	82
5	977	1,632	49	93	35	90
6	1,100	1,908	52	103	40	101
7	1,249	2,246	56	111	44	108
8	1,452	2,730	59	114	50	111
9	1,786	3,563	67	135	58	133
10	3,409	7,639	81	196	75	194

Source: Census of India for population data and Planning Commission data for non-commercial energy

A constant problem

Several districts in eastern and northern regions have high dependency on kerosene for lighting



Regions where more than 50% households use kerosene as source of lighting in 2001

Regions where more than 50% households use kerosene as source of lighting in 2011

1 The energy divide

Chronic power deprivation in some districts raises serious policy issues

The data from Census 2001 and 2011 are good indicators of energy use in the country. The data show that Indians use firewood, crop residue, cow dung cake, kerosene, LPG and coal—lignite, charcoal and biogas—as fuel sources.

Electricity, followed by kerosene, fulfills lighting needs of most households in the country. Other sources, including solar light, account for a very small fraction. The census data also categorises households as “No lighting”. But this category is very small numerically—ideally, it should have been near zero.

Given the relatively straightforward distribution of lighting sources, it will be convenient to take up this category first. The set of maps ('What lights India' p9) shows states in terms of use of electricity and kerosene as a source of lighting: high, medium and low. For example, the first map (see 'Districts that lack electricity make up with kerosene' p9) shows low electricity use in a contiguous patch in northern and north-eastern India, Uttar Pradesh, Bihar, Jharkhand, Odisha, West Bengal and Assam (shown in red in the first map in the set). Kerosene use, concomitantly, is high in these areas (green in the second map in the set). Rajasthan, Madhya Pradesh and Chhattisgarh occupy an intermediate position in terms of electricity use (yellow in the first map) while most southern and western states and the northern states of Punjab, Haryana Himachal and Jammu and Kashmir show high electricity use (green in the first map). This pattern persists for both rural and urban areas.

The pattern becomes sharper once we look at the district-level in the next set of maps (see 'Scenario improved since 2001, but not enough' p9). The map on the left depicts the cluster of districts by percentage of households using electricity as a source of lighting. In a large segment of districts shown in green, electricity is the main source of lighting for more than 80 per cent of the households. But in another compact cluster, shown in red, less than 47 per cent households have such access.

As any discerning reader would realise, this is quite the same cluster where more than 47 per cent households use kerosene as the major source of lighting. The map on the right in this set is somewhat similar. The latter map depicts the situation in 2001 but here districts shown in green are the ones where electricity is a major source of lighting in more than 67 per cent of households. What is more interesting is the compact cluster shown in red where such access was available to less than 25 per cent households.

The two maps tell us that the situation has no doubt improved since 2001 but the cluster of the deprived districts has remained more or less the same. This is a repeatedly recurring pattern; while the levels of deprivation decrease, the locus of deprivation endures far more strongly. This is a serious challenge to policy makers, planners, programme implementers, researchers and activists alike.

How do urban and the rural segments compare with regard to access to electricity for lighting? For that we turn to the third set of maps (see 'The rural-urban divide' p10). The map on the left shows that a very large part of the urban landscape has more than 80 per cent households that access electricity as a major source of lighting. But the map on the right reveals the rural reality where a far smaller set of districts can boast of 75 per cent or more households having such an access.

It would appear logical that solar energy should have made a much stronger headway in the region where kerosene has been used for lighting. But that does not seem to have happened (see 'Solar has not stepped in to replace kerosene' p10). One can no doubt see

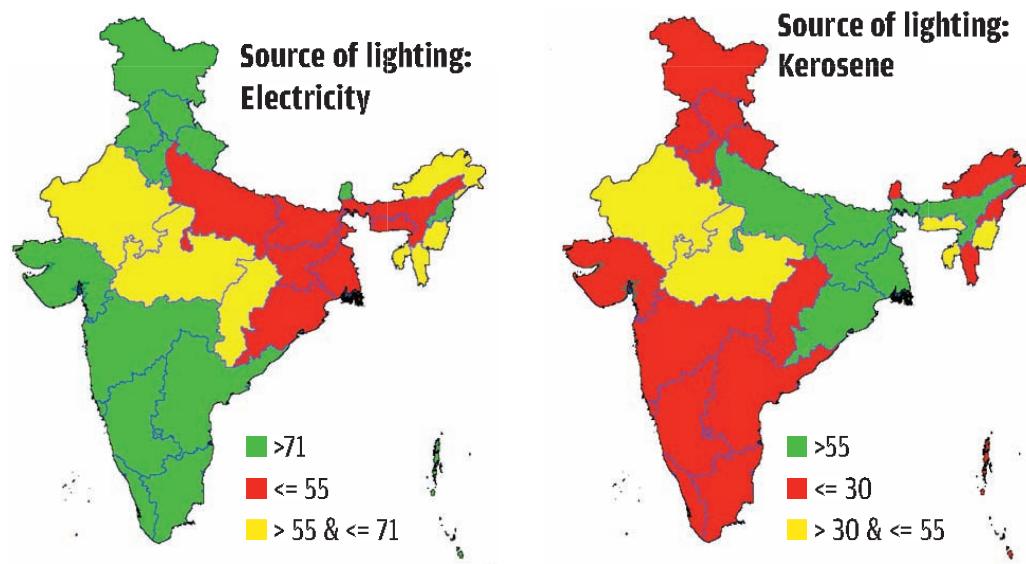
a sizeable cluster of districts in rural area where solar energy is used for lighting. But this cluster shows up only when we lower the cut-off level to as low as 0.2 per cent households. However, census data also shows that the number of urban districts where more than 0.2 per cent households were using solar energy for lighting has reduced considerably between 2001 and 2011. Solar energy has not been able to replace kerosene as the major source of lighting whether in rural or in urban areas. It needs to be analysed whether it is a cost issue, an access issue or a governance issue.

There is some hope. The 2011 Census data also shows that in 46 districts in the country more than two per cent households use solar energy as a source of electricity.

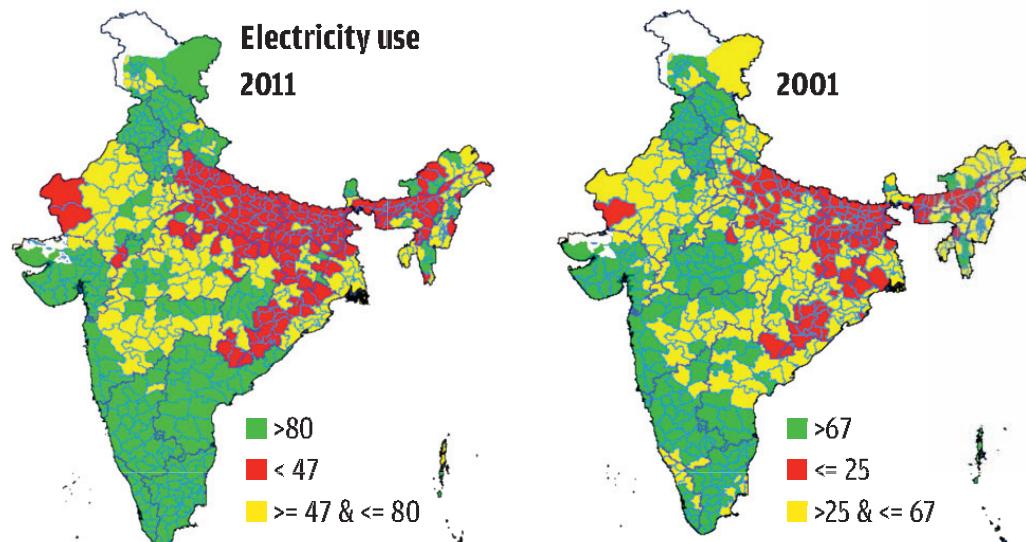
What lights India

Households where electricity hasn't reached use kerosene. Solar has not made much headway

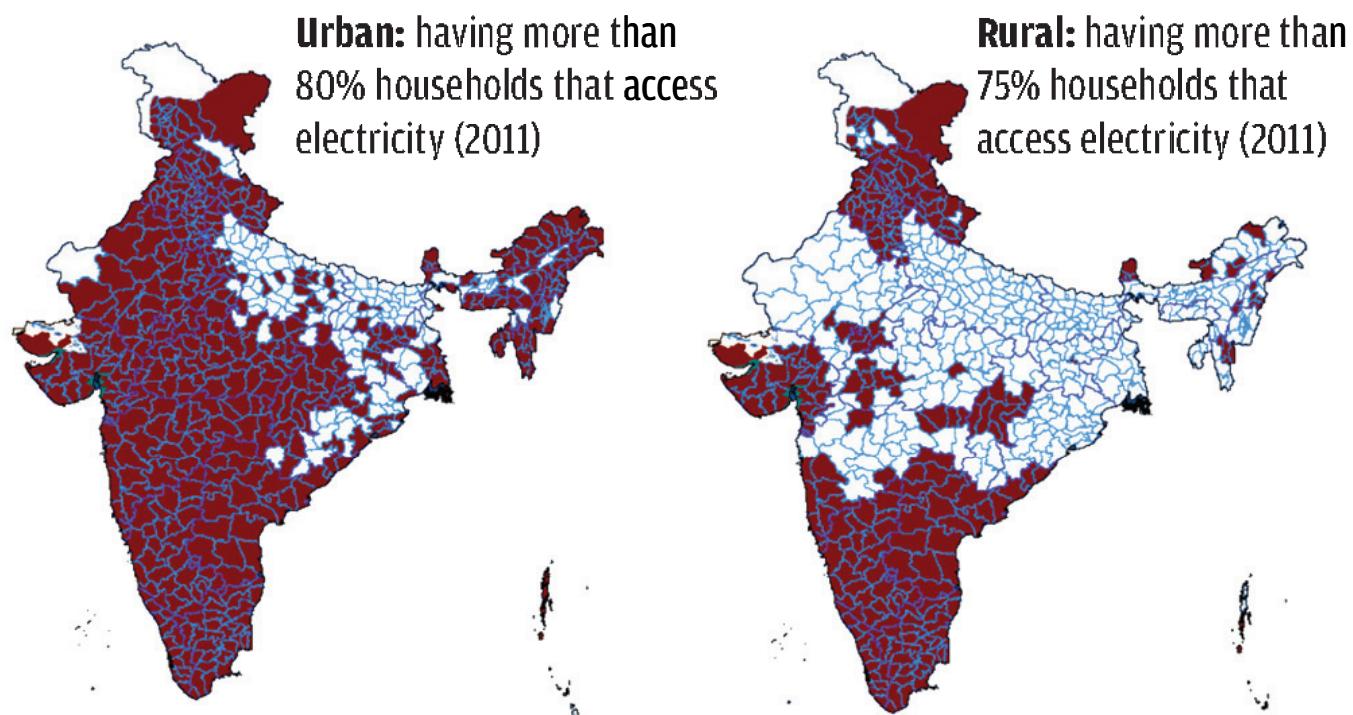
Districts that lack electricity make up with kerosene (2011)



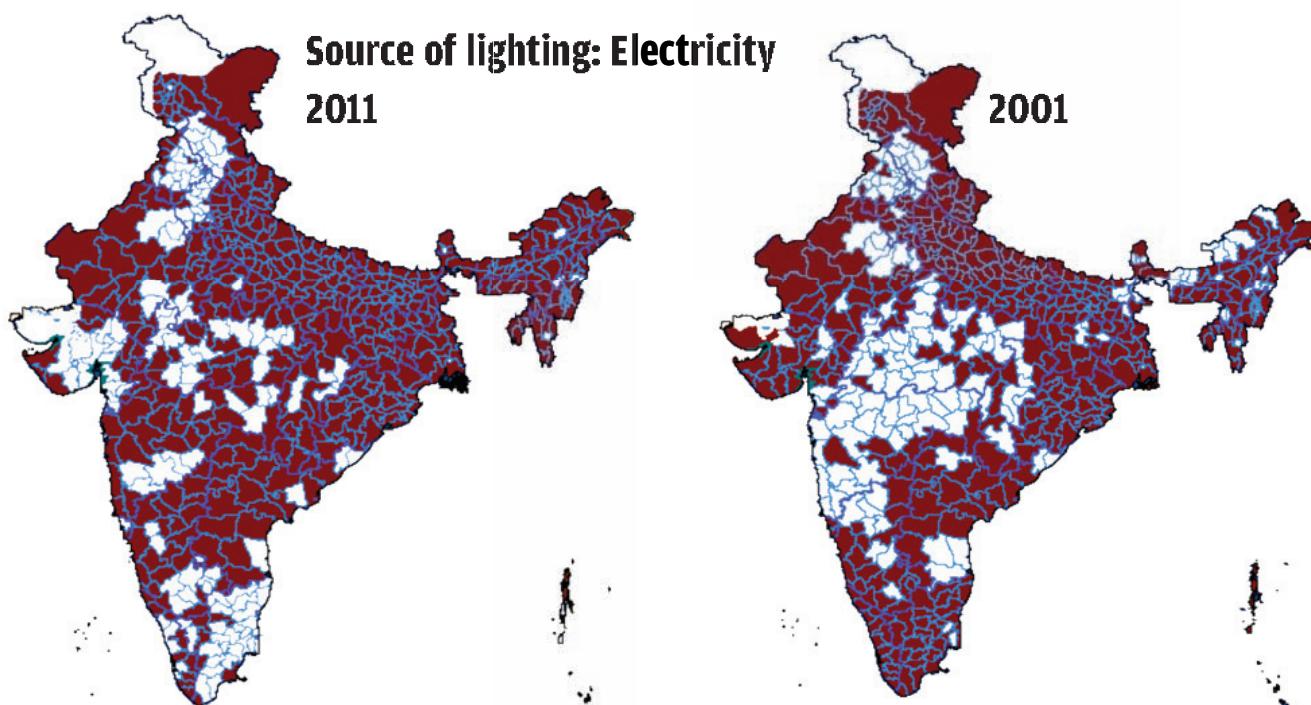
Scenario improved since 2001, but not enough



The rural-urban divide



Solar has not stepped in to replace kerosene



Source: Census reports of 2001 and 2011

2 How India cooks its food

The disparity between India and Bharat is glaring when one looks at the fuel used for cooking

The census data of 2001 and 2011 sheds light on the use of different sources of fuel and lighting. It lists firewood, crop residue, cow dung cake, kerosene, LPG and coal—lignite, charcoal biogas—as fuel sources. The census data also has a category “no cooking”. The tables on p11, 12, 13 provide state-wise data from 2011 Census in terms of percentage of households using these fuel sources.

Households using different fuels as primary source for cooking (in %)

A sizeable portion of India continues to use firewood as fuel for cooking

States	TOTAL (Rural + Urban)									
	Firewood	Crop residue	Cow dung cake	Coal/lignite/charcoal	Kerosene	LPG	Electricity	Biogas	Any other	'No cooking'
Jammu & Kashmir	58.9	2.5	4.2	0	1.3	31.6	0.3	0.8	0.2	0.2
Himachal Pradesh	57.5	1.1	0.2	0	2.1	38.6	0.1	0.1	0	0.3
Punjab	13.3	6.5	20.4	0.2	3.2	54.5	0	1.4	0.1	0.3
Chandigarh	4.6	0.3	0.2	0.1	21.9	71.6	0	0.1	0.1	1.1
Uttarakhand	48.7	1.3	3.2	0.1	1.8	44.2	0	0.5	0	0.3
Haryana	26	14.1	14.2	0.1	1	44	0	0.2	0.1	0.2
NCT of Delhi	3.4	0.3	0.6	0.1	5.3	89.9	0	0.1	0.1	0.3
Rajasthan	61.8	11	3	0.1	0.9	22.8	0	0.1	0.1	0.2
Uttar Pradesh	47.7	8.7	23.1	0.3	0.7	18.9	0.1	0.2	0.1	0.2
Bihar	34.7	32.5	21.7	1	0.3	8.1	0.1	0.2	1.2	0.2
Sikkim	52.5	0.6	0.2	0.1	4.4	41.3	0.3	0.1	0	0.6
Arunachal Pradesh	68.7	0.7	0.1	0	0.7	29.2	0.1	0.1	0.1	0.3
Nagaland	77.9	0.8	0.1	0	0.6	20	0.1	0.1	0.1	0.2
Manipur	65.7	1.1	0.2	2.1	0.2	29.7	0.1	0.2	0.6	0.1
Mizoram	44.5	0.3	0.1	0.4	1.8	52.5	0.2	0.1	0	0.1
Tripura	80.5	0.8	0.1	0.1	0.6	17.6	0	0.1	0.1	0.1
Meghalaya	79	0.9	0.3	2.3	3.7	11.8	1.6	0.2	0.1	0.2
Assam	72.1	6.4	0.9	0.1	0.6	19	0	0.1	0.4	0.4
West Bengal	33.1	25.6	10	7.9	2.1	18	0.1	0.3	2.7	0.3
Jharkhand	57.5	4	7.2	18.1	0.2	11.7	0.3	0.1	0.6	0.1
Odisha	65	10.2	9.4	1.6	1.1	9.8	0.4	0.2	2	0.3
Chhattisgarh	80.8	0.9	3.7	2.3	0.5	11.2	0.1	0.2	0.1	0.2
Madhya Pradesh	66.4	5.6	7.7	0.2	1.3	18.2	0	0.3	0	0.2
Gujarat	44	5.7	2.6	0.5	7.6	38.3	0	0.9	0.1	0.4
Daman & Diu	10.8	1.4	0.2	0.2	30.8	53	0.1	0.9	0.1	2.4
Dadra & Nagar Haveli	40.4	0.4	0.2	0.1	17.8	39.8	0	0.4	0	0.8
Maharashtra	42.6	4.5	1.2	0.2	6.5	43.4	0.1	0.7	0.1	0.8
Andhra Pradesh	56.8	1.4	0.6	0.3	3.8	35.8	0.1	0.7	0.1	0.3
Karnataka	57.5	2.9	0.2	0.1	5.4	32.5	0.1	0.9	0.1	0.3
Goa	20.7	0.9	0.2	0.1	4.1	72.7	0.1	0.4	0.1	0.7
Lakshadweep	54.8	10.7	0.1	0.1	13.7	16.6	1.2	0.2	0	2.5
Kerala	61.9	0.8	0.1	0.1	0.4	35.8	0	0.6	0	0.3
Tamil Nadu	43.5	0.6	0.2	0.1	6.9	47.9	0.1	0.3	0	0.4
Puducherry	18	0.3	0.1	0	10.3	70.5	0.1	0.1	0	0.6
Andaman & Nicobar Islands	33.8	0.4	0	0	19.8	44.5	0	0	0.1	1.4

Source: Census 2011

Rural households using different fuels as primary source for cooking (in %)

Rural India accounts for the excessive use of firewood for cooking

States	Rural									
	Firewood	Crop residue	Cow dung cake	Coal/lignite/charcoal	Kerosene	LPG	Electricity	Biogas	Any other	'No cooking'
Jammu & Kashmir	73.8	3	5.2	0	0.5	16.3	0.1	0.6	0.2	0.2
Himachal Pradesh	64	1.1	0.2	0	1.6	32.7	0.1	0.1	0	0.2
Punjab	17	9.8	30.5	0.1	1.5	38.9	0	1.8	0.1	0.3
Chandigarh	11.1	0.1	1	0	18	67.1	0	0.1	0.1	2.5
Uttarakhand	63.3	1.5	3.9	0.1	0.9	29.4	0	0.6	0	0.2
Haryana	34.2	21	19.6	0.1	0.4	24.1	0	0.3	0	0.2
NCT of Delhi	11.3	1.6	3.7	0.1	7.7	75.2	0.1	0.1	0	0.2
Rajasthan	74.4	13.9	3.4	0.1	0.2	7.7	0	0.1	0.1	0.2
Uttar Pradesh	54.4	10.5	27.9	0.1	0.2	6.4	0.1	0.1	0.1	0.2
Bihar	35.5	35.4	23.3	0.4	0.2	3.4	0.1	0.2	1.3	0.2
Sikkim	70.8	0.7	0.2	0	2.9	24.3	0.3	0.1	0	0.6
Arunachal Pradesh	85.3	0.8	0.1	0	0.5	13	0.1	0.1	0	0.2
Nagaland	91.8	0.8	0.1	0	0.1	6.7	0.1	0.1	0	0.2
Manipur	80.2	1.3	0.2	1.3	0.1	16	0.1	0.2	0.5	0.1
Mizoram	80.8	0.3	0.1	0.3	0.3	17.9	0.1	0.1	0.1	0.1
Tripura	93.3	0.8	0.1	0.1	0.2	5.3	0	0	0.1	0.1
Meghalaya	93.7	1	0.3	0.7	0.7	2.6	0.8	0.1	0.1	0.2
Assam	80.6	7.4	1	0.1	0.2	9.9	0	0.1	0.4	0.4
West Bengal	39.2	35.7	13.6	3.3	0.2	4	0.1	0.2	3.6	0.2
Jharkhand	71.6	4.8	8.8	11.8	0.1	1.9	0.1	0.1	0.6	0.1
Odisha	70.6	11.7	10.7	0.8	0.3	3.1	0.2	0.1	2.3	0.2
Chhattisgarh	92.1	0.9	4.4	0.3	0.1	1.6	0	0.2	0	0.2
Madhya Pradesh	78.6	7.1	9.9	0	0.2	3.5	0	0.4	0	0.1
Gujarat	67.9	9.7	3.6	0.1	3.1	14.3	0	1	0	0.3
Daman & Diu	37.3	6.3	0.2	0	10.5	42.3	0.1	0.9	0.6	1.9
Dadra & Nagar Haveli	72.4	0.5	0.3	0	14.4	11.8	0	0.1	0	0.4
Maharashtra	68.9	7.7	2	0.1	1.7	17.9	0.1	1	0.1	0.4
Andhra Pradesh	74.9	1.6	0.7	0.2	0.8	20.6	0	0.6	0.1	0.3
Karnataka	82	4.3	0.3	0.1	1.1	11	0.1	1	0.1	0.2
Goa	35.4	1.2	0.2	0.1	2.6	59.5	0.1	0.3	0	0.6
Lakshadweep	36.5	44.6	0.1	0.1	12.2	2.9	1.7	0.1	0	1.9
Kerala	73	0.9	0.1	0.1	0.2	24.7	0	0.7	0	0.3
Tamil Nadu	66.8	0.8	0.3	0.1	2.5	28.6	0	0.3	0	0.4
Puducherry	36	0.4	0.2	0.1	9.8	52.9	0.1	0.1	0	0.6
Andaman & Nicobar Islands	51	0.5	0.1	0	15.6	31.5	0	0	0.1	1.2

Source: Census 2011

Urban households using different fuels as primary source for cooking (in %)

The dependency on firewood reduces sharply in urban areas

States	Urban									
	Firewood	Crop residue	Cow dung cake	Coal/lignite/charcoal	Kerosene	LPG	Electricity	Biogas	Any other	'No cooking'
Jammu & Kashmir	15.7	1.1	1.3	0	3.5	75.7	1	1.3	0	0.3
Himachal Pradesh	6.8	0.7	0.1	0	5.9	85.1	0.5	0.1	0	0.7
Punjab	7.5	1.3	4.5	0.3	5.9	79.3	0	0.8	0	0.3
Chandigarh	4.5	0.3	0.2	0.1	22	71.8	0	0.1	0.1	1
Uttarakhand	14	0.7	1.4	0.1	3.8	79.4	0	0.1	0.1	0.4
Haryana	12.2	2.4	5	0.2	2	77.6	0	0.2	0.1	0.3
NCT of Delhi	3.2	0.2	0.5	0.1	5.2	90.3	0	0.1	0.1	0.3
Rajasthan	23.3	1.9	1.6	0.3	2.9	69.4	0	0.2	0.1	0.4
Uttar Pradesh	24.8	2.5	6.9	0.7	2.4	61.7	0.1	0.2	0.1	0.3
Bihar	28.6	7.7	8	5.7	1	47.4	0.1	0.4	0.7	0.3
Sikkim	5.3	0.2	0.1	0.2	8.3	85.1	0.1	0.1	0	0.6
Arunachal Pradesh	19.2	0.5	0.1	0	1.5	77.5	0.2	0.3	0.1	0.6
Nagaland	43.6	0.7	0.1	0.1	1.9	52.7	0.1	0.2	0.2	0.4
Manipur	37.3	0.9	0.2	3.6	0.3	56.4	0.1	0.3	0.9	0.1
Mizoram	11.7	0.2	0	0.6	3.1	83.8	0.2	0.1	0	0.2
Tripura	47.3	0.6	0.2	0.1	1.8	49.7	0	0.1	0.1	0.1
Meghalaya	25.8	0.4	0.1	8.1	14.8	45.6	4.5	0.4	0.1	0.2
Assam	26.2	1.2	0.2	0.3	3.2	68	0.1	0.2	0.1	0.5
West Bengal	19.9	3.6	2.3	17.8	6.3	48.2	0.1	0.4	0.9	0.5
Jharkhand	13.5	1.5	2	38.1	0.7	42.1	1.2	0.2	0.6	0.3
Odisha	34.8	2.2	2.6	5.6	5.6	46.1	1.7	0.2	0.5	0.5
Chhattisgarh	40.8	0.9	1.3	9.2	1.8	45	0.3	0.1	0.3	0.3
Madhya Pradesh	31	1.2	1.3	0.7	4.5	60.5	0.1	0.1	0.1	0.4
Gujarat	14.2	0.7	1.3	0.8	13.2	68.3	0	0.8	0.1	0.5
Daman & Diu	3.7	0.2	0.2	0.2	36.3	55.9	0.1	1	0	2.5
Dadra & Nagar Haveli	10.3	0.2	0.1	0.2	21.1	66.2	0	0.6	0	1.3
Maharashtra	10.8	0.7	0.3	0.3	12.3	74.1	0	0.2	0.1	1.1
Andhra Pradesh	18.8	0.9	0.2	0.6	10.2	67.7	0.1	0.9	0.2	0.4
Karnataka	21.2	0.9	0.1	0.1	11.7	64.3	0.2	0.8	0.1	0.5
Goa	11.5	0.7	0.2	0.1	5.1	81.1	0	0.4	0.1	0.8
Lakshadweep	60.5	0.3	0.1	0	14.2	20.9	1.1	0.2	0	2.7
Kerala	49.4	0.7	0.1	0.1	0.5	48.4	0	0.6	0	0.3
Tamil Nadu	18.4	0.4	0.1	0.1	11.5	68.7	0.1	0.3	0.1	0.4
Puducherry	9.7	0.2	0.1	0	10.6	78.7	0.1	0.1	0	0.6
Andaman & Nicobar Islands	4.4	0.2	0	0	26.8	66.9	0	0	0	1.6

Source: Census 2011

The census data is presented in terms of percentage of households that use the fuel concerned as primary source for cooking. It does not preclude the possibility of use of other “secondary” source, but that is beyond the scope of the present analysis. One can clearly see two distinct groups: one, comprising firewood, crop residues and cow dung cake, and the other “clean fuel” group, primarily LPG and, very marginally, biogas and electricity. Between themselves these cover most households, except Jharkhand and West Bengal where coal is used by a significant number of households, and certain island states, NCT of Delhi, Chandigarh and, surprisingly, Tamil Nadu and Puducherry, where kerosene is used for cooking. This grouping of fuels as “clean” and “not-so-clean” is important from the view point of indoor pollution to which women and children are exposed—a point which we visit later.

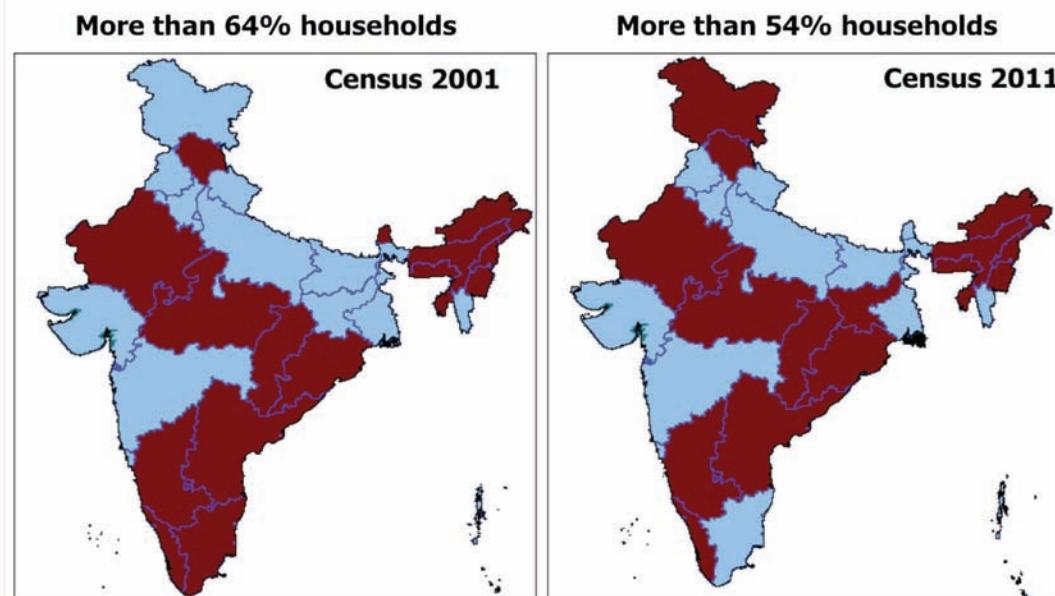
Firewood still the mainstay?

Firewood remains a major source of fuel even in 2011. High dependency on firewood was a problem in 2001 as (see ‘% of hh using firewood’). The position has not changed in 2011 except that the cut off percentage has come down from 64 per cent to 54 per cent. In the urban areas, such a clustering of states can be seen at the cut off of 27 per cent for 2001 and 18.6 per cent for 2011 (see ‘% of households using firewood in urban sector’ p15).

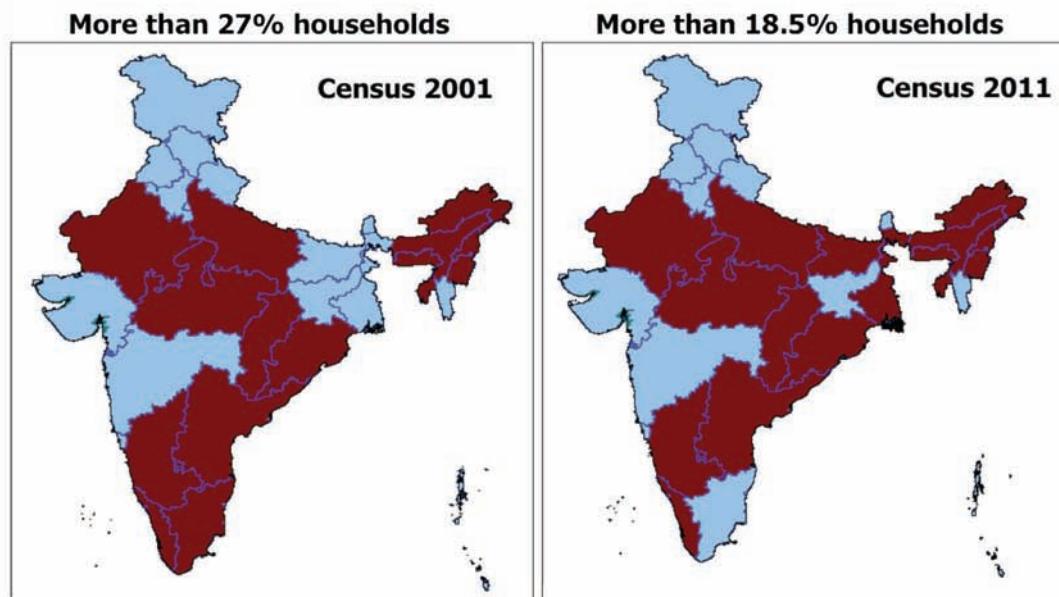
The district-level maps reveal a much sharper figure (see ‘District-wise use of firewood’). On breaking them into rural and urban, we see that the use of firewood is quite intense in rural areas and the intensity of use has hardly changed between 2001 and 2011 (see ‘District-wise use of firewood in rural sector’ p16). Similarly, in urban areas, the firewood-using areas have remained nearly the same even though there is a drop in the cut off percentage—districts where more than 25 per cent households were using firewood for cooking in 2001 to a cut off per cent of 20 per cent in 2011 (see ‘District-wise use of firewood in urban sector’). We see that the levels of deprivation reduce faster in urban areas but are more enduring in the rural areas.

Complementing firewood, crop residue and cow-dung show a compact belt from Punjab to West Bengal where the use of firewood is comparatively less.

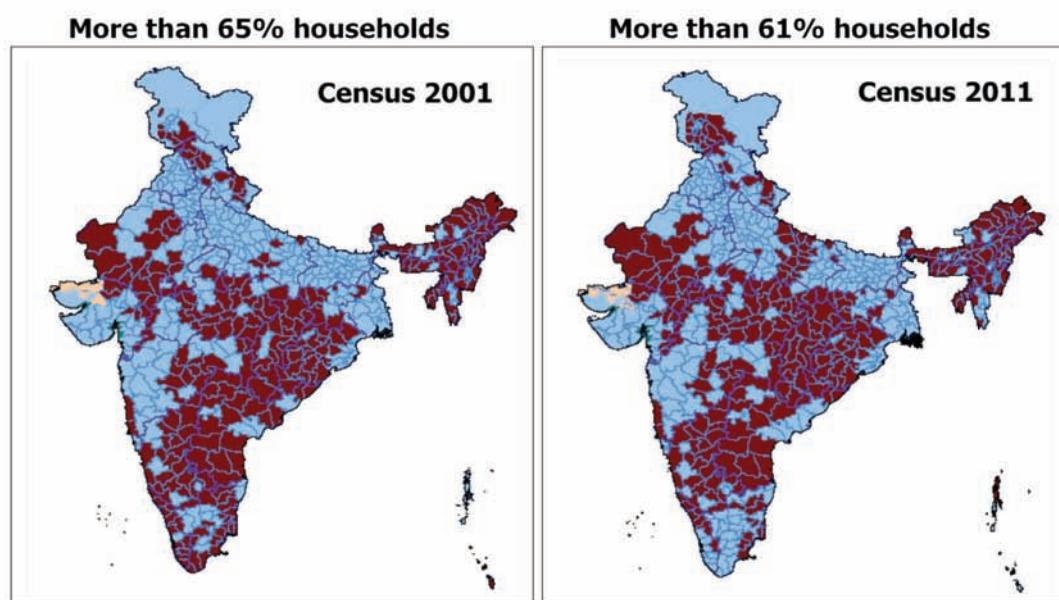
Fuel used for Cooking % of households using firewood in (Rural + Urban) sector



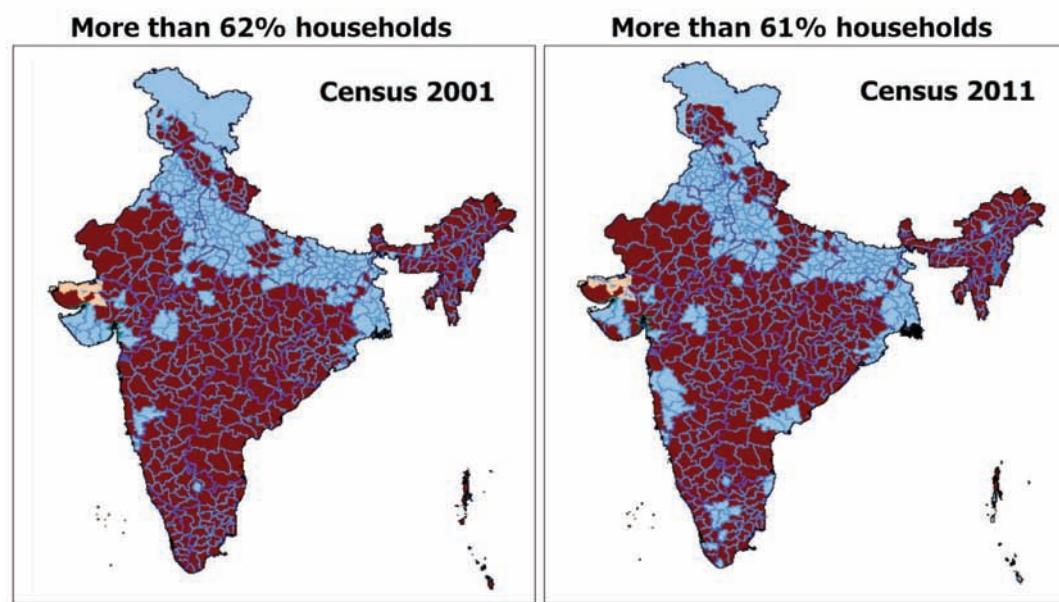
Fuel used for Cooking % of households Using Firewood in Urban sector



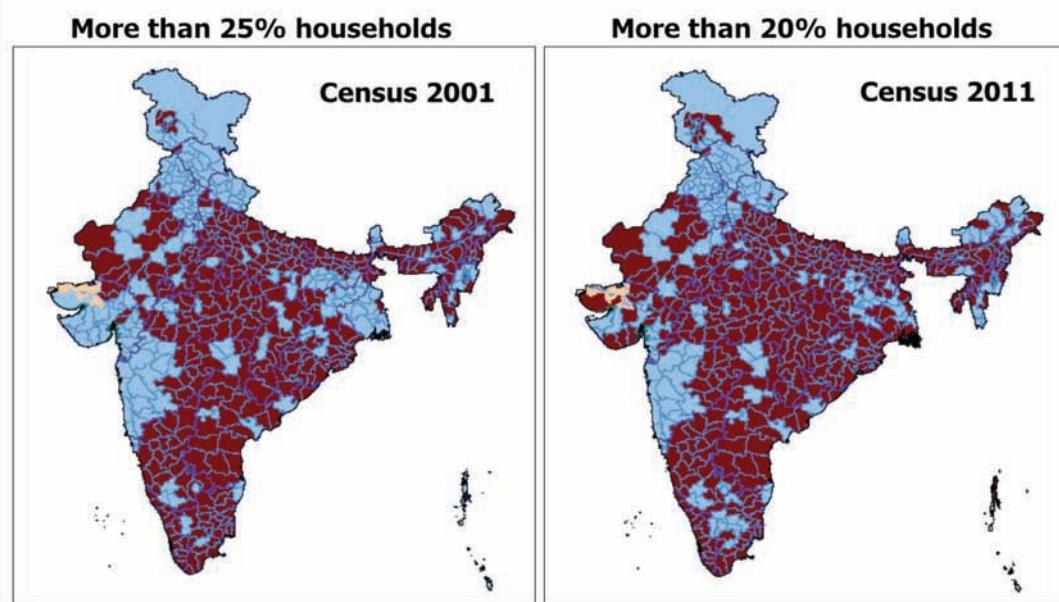
Fuel used for Cooking Use of Firewood in (Rural + Urban) sector



Fuel used for Cooking Use of Firewood in Rural sector



Fuel used for Cooking Use of Firewood in Urban sector



Kerosene: the story of success and failure

We saw earlier, in passing, that the reduction in the usage of kerosene as a fuel for cooking represents a success story, though not adequately publicised. However, as a source for lighting, it represents a story of failure; first in terms of electricity not reaching everywhere and, second, in terms of solar home lighting not being able to capture the space occupied by kerosene. It is important to highlight this point since petroleum products claim the third biggest subsidy in our economy (about ₹65,000 crore per annum), next only to food (₹1.2 lakh crore) and fertiliser (₹1 lakh crore). Furthermore, the government gives a subsidy of ₹33 for every litre of kerosene used. Assuming a consumption of about 30-35 litres of kerosene per annum per household for lighting purposes, there is a subsidy out flow of ₹1,000-1,200 per household per annum. Contrast this with the one-time subsidy of ₹1,000 or less that will be needed for the solar home lighting system. If we invest ₹1,000 crore in one year, we will be saving a like amount every year, year after year. The reduced carbon footprint is an additional bonus.

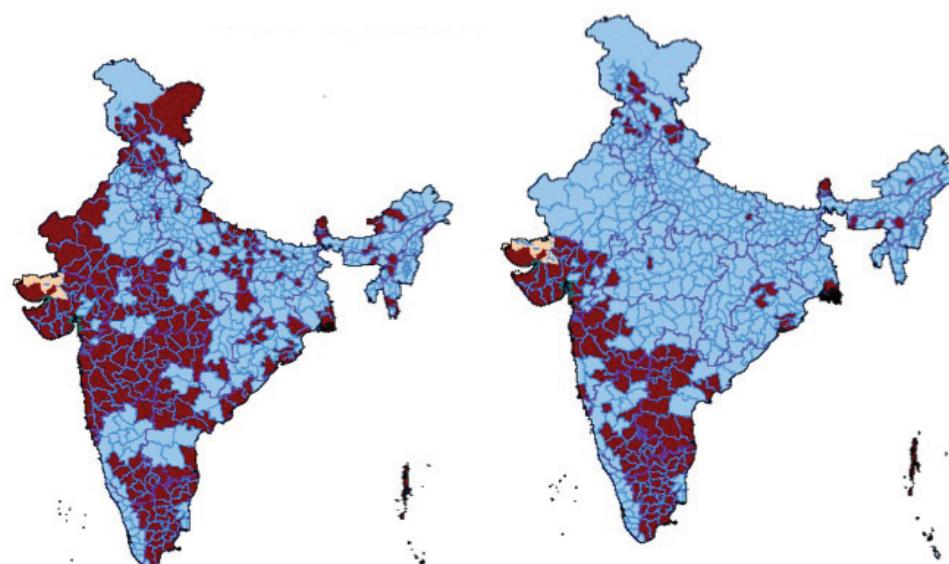
The “subsidy” for solar home lights is, therefore, not a charity but an investment. This investment must come from the Ministry of Petroleum and not from the Ministry of Renewable Energy, which has an annual budget of just ₹1,600 crore as against the subsidy budget of about ₹65,000 crore on petroleum products.

The scale of this problem will be clear if we note that as per the 2011 Census there are more than 75 million households which depend on kerosene as a source for lighting. Most of the districts, however, show that solar energy as a source covers hardly 0.3 to 0.5 per cent of the households. There is surely a long way to go.

The reduction in the number of households using kerosene as a source of fuel for cooking has been significant. The number of districts where 6 per cent or more urban households use kerosene as fuel for cooking has drastically reduced between 2001 and 2011 ('A positive sign'). In rural areas, too, the number of districts where less than 1 per cent households use kerosene as a fuel for cooking has increased substantially although such low usages may also be a result of lower purchasing power.

A positive sign

Districts with urban households using kerosene has drastically reduced



Regions where more than 12% urban households use kerosene as source of fuel for cooking

Regions where more than 6% urban households use kerosene as source of fuel for cooking in 2011

3 State matters

An analysis of the states that are faring well and the ones that are not in sourcing energy

The picture changes when we disaggregate the data for each state below the district level. Certain counter-intuitive trends emerge along with action points. In some cases the kerosene-use pockets come into sharper focus. The census data also provides the number of households using different sources of fuel in absolute terms. It is useful to look at such data as well. It is quite plausible to expect the intra-state variations to be sharper and also to expect quite different patterns of consumption of kerosene for lighting and as a fuel for cooking.

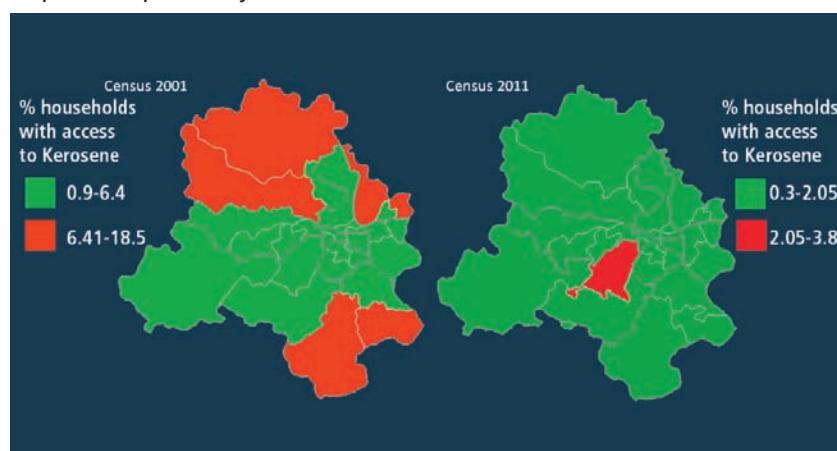
Delhi

Quite predictably, the National Capital Territory (NCT) has seen a drastic reduction in the use of kerosene as a source of lighting between 2001 and 2011, which is how it should be (see ‘Delhi households that use kerosene for lighting’). Intriguingly however, the cantonment sub-district continues to show a rather high percentage (3.8 per cent) of households using kerosene for lighting—a level comparable to the 2001 level. This needs some scrutiny—are these households still without electricity or some continuing “entitlement” is resulting in siphoning of kerosene?

But it is in the use of kerosene for cooking where the real concern emerges. As per Census 2011, about 175,000 households out of a total of about 3.3 million households still depend on kerosene for cooking with another 112,000 using firewood. While the reduction in use of kerosene from 2001 levels, when most sub-districts reported 12 per cent or more households using it, is impressive (see ‘Delhi households that use kerosene as fuel for cooking’ p19), the use of kerosene by more than 9 per cent households in Chanakyapuri, Delhi Cantonment and Model Town sub-districts is a matter of concern. Delhi’s cooking fuel gives sub district-wise details of number of households using different fuel sources. It is intriguing to see a large number of households using kerosene and firewood even in places such as Defence Colony and Hauz Khas. An equally intriguing figure is of 91 biogas plants in Vasant Vihar and 573 biogas plants in Defence Colony. It will be interesting to

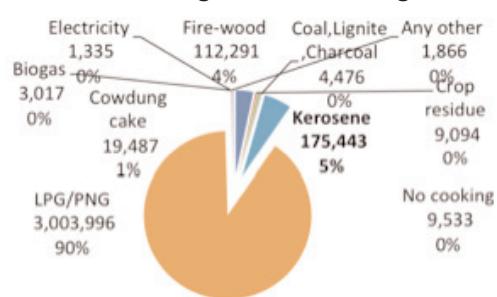
Delhi households that use kerosene for lighting

Capital's dependency on kerosene has reduced between 2001 and 2011



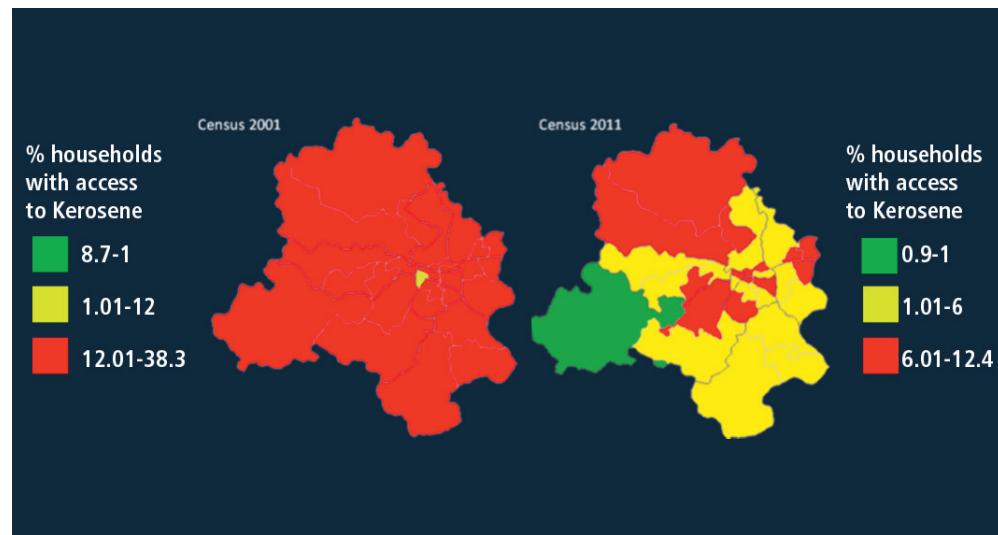
Capital's fuel mix for cooking

Households using firewood still high



Delhi households that use kerosene as fuel for cooking

Kerosene is being used in Chanakyapuri, Model Town



Delhi's cooking fuel

A large number of households are still using kerosene and firewood in Defence Colony and Hauz Khas

Area Name	Total	Type of Fuel used for Cooking									
	Number of households	Firewood	Crop residue	Cow-dung cake	Coal, Lignite, Charcoal	Kerosene	LPG/PNG	Electricity	Biogas	Any other	No cooking
STATE - NCT OF DELHI	33,40,538	1,12,291	9,094	19,487	4,476	1,75,443	30,03,996	1,335	3,017	1,866	9,533
North West	7,30,034	35,080	2,628	5,246	1,040	57,234	6,25,662	350	532	591	1,671
Narela	1,60,861	14,613	1,222	2,466	352	14,096	1,27,388	21	99	252	352
Saraswati Vihar	4,48,310	15,149	1,218	1,891	558	28,275	3,99,291	284	382	321	941
Model Town	1,20,863	5,318	188	889	130	14,863	98,983	45	51	18	378
North	1,75,890	3,827	748	866	93	8,063	1,61,067	47	147	46	986
Civil Lines	1,37,681	3,222	656	679	74	5,797	1,26,389	31	135	33	665
Sadar Bazar	24,232	445	84	186	11	1,700	21,514	11	5	7	269
Kotwali	13,977	160	8	1	8	566	13,164	5	7	6	52
North East	3,95,060	8,212	803	4,202	581	22,667	3,56,769	67	407	409	943
Seelam Pur	2,36,475	4,278	506	2,874	262	10,161	2,17,128	29	356	353	528
Shahdara	56,649	670	90	163	98	3,628	51,801	21	8	17	153
Seema Puri	1,01,936	3,264	207	1,165	221	8,878	87,840	17	43	39	262
East	3,54,385	7,877	562	1,435	119	15,738	3,27,253	74	232	89	1,006
Gandhi Nagar	81,164	2,330	218	106	19	3,200	74,994	38	14	30	215
Vivek Vihar	48,911	839	45	107	25	3,925	43,857	2	18	5	88
Preet Vihar	2,24,310	4,708	299	1,222	75	8,613	2,08,402	34	200	54	703
New Delhi	30,385	1,226	54	27	18	2,042	26,681	112	12	10	203
Connaught Place	6,331	112	17	12	7	315	5,828	11	3	1	25
Chanakya Puri	13,466	879	21	13	-	1,261	11,029	96	7	8	152
Parliament Street	10,588	235	16	2	11	466	9,824	5	2	1	26
Central	1,14,587	2,704	175	170	97	8,753	1,01,826	187	47	77	551
Darya Ganj	50,254	1,610	56	56	71	5,910	42,134	146	11	51	209
Pahar Ganj	35,246	926	84	112	23	2,418	31,388	37	26	16	216
Karol Bagh	29,087	168	35	2	3	425	28,304	4	10	10	126
West	5,23,703	16,239	889	1,616	1,272	25,770	4,75,985	203	385	245	1,099
Patel Nagar	2,63,957	7,328	314	700	545	10,070	2,43,922	83	270	192	533
Rajouri Garden	1,01,148	2,334	97	44	97	8,867	89,350	27	38	18	276
Punjabi Bagh	1,58,598	6,577	478	872	630	6,833	1,42,713	93	77	35	290
South West	4,62,772	17,881	1,882	3,447	296	13,714	4,23,855	139	218	220	1,120
Najafgarh	2,70,344	8,910	1,393	2,827	119	2,429	2,53,873	80	112	169	432
Delhi Cantonment	49,693	2,404	119	48	38	6,161	40,668	22	15	20	198
Vasant Vihar	1,42,735	6,567	370	572	139	5,124	1,29,314	37	91	31	490
South	5,53,722	19,245	1,353	2,478	960	21,462	5,04,898	156	1,037	179	1,954
Hauz Khas	2,46,911	9,478	547	1,443	138	4,408	2,29,864	27	234	79	693
Defence Colony	1,32,210	3,092	114	296	115	6,573	1,20,804	53	573	45	545
Kalkaji	1,74,601	6,675	692	739	707	10,481	1,54,230	76	230	55	716

Source: Census 2011

survey the working of biogas plants in Delhi.

If there really are 112,291 households using firewood, NCT is an ideal place for the Ministry of Renewable Energy to propagate modern and efficient cook-stoves that use firewood but provide cleaner blue flame. These users will not certainly be the illiterate and rural poor who are unable to pay for modern wood burning cook-stoves. There are adequate numbers of forced draft blue flame wood-burning stoves that can be marketed as well.

'Capital's fuel mix' on p18 gives the break-up of use of various fuel sources in the NCT as per 2011 census. While LPG does show an impressive coverage of 90 per cent, the fact that nearly 300,000 households use kerosene and firewood, is disconcerting. Three action points are clear: a cross check of the 2001 census figures, replacement of kerosene with LPG and introduction of wood-stoves with blue flame.

Coming back to the kerosene story, however, there is a clear need to follow up the census data with a more detailed survey to find out how Delhi can be made kerosene free.

Prosperous north India

From the energy consumption point of view, northern states can be grouped into two separate types. The first, comprising of Haryana, Punjab and the three hill states of Uttarakhand, Himachal Pradesh and Jammu and Kashmir (J&K), and the second, comprising Uttar Pradesh (UP), Bihar, Rajasthan and Madhya Pradesh and the new states of Chhattisgarh and Jharkhand.

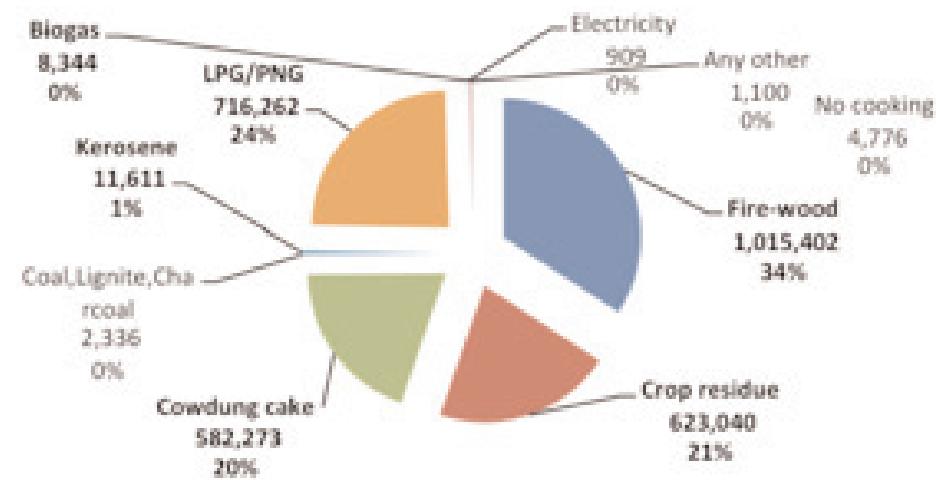
We first take up the case of Haryana, Punjab and the three hill states of Himachal Pradesh, Uttarakhand and J&K.

In Haryana, the use of kerosene has declined considerably between 2001 and 2011 with less than 4 per cent households dependent on kerosene for their lighting needs in a majority of sub-districts.

The sub-district dip in use of kerosene as a source of lighting in urban Haryana can be seen in 'Kerosene as source of light in urban Haryana' on p21. Similarly, in rural Haryana, too, (see 'Kerosene as source of light in rural Haryana' p21) sub-districts where more than 18 per cent households used kerosene for lighting (shown in red) has declined considerably

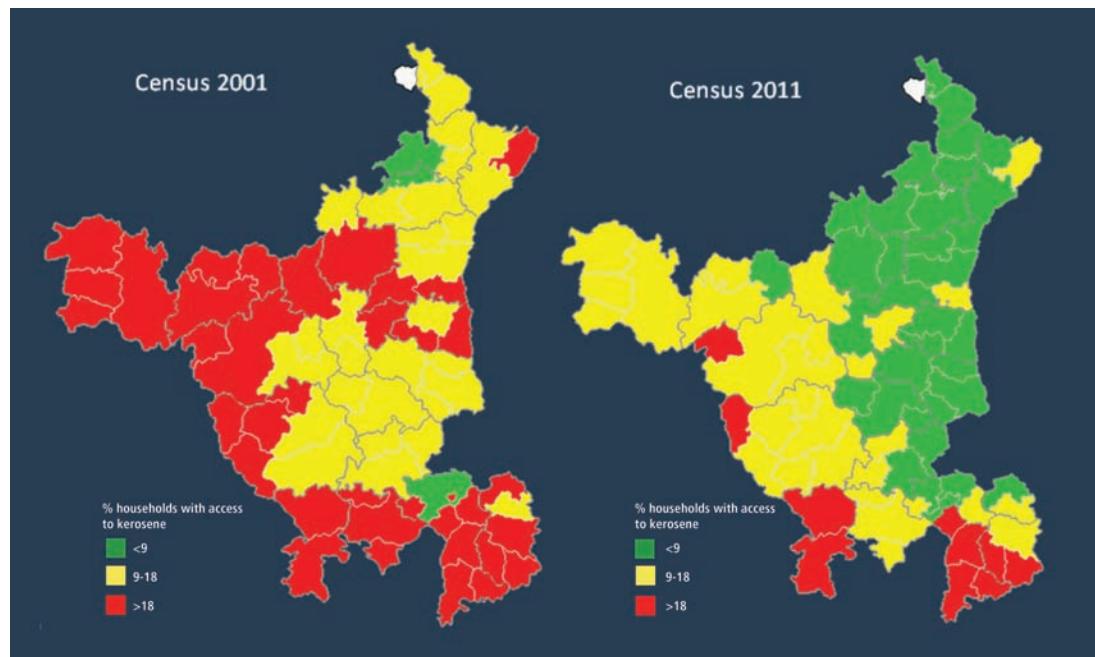
Haryana's rural fuel mix

Firewood is a primary source for cooking in rural Haryana households



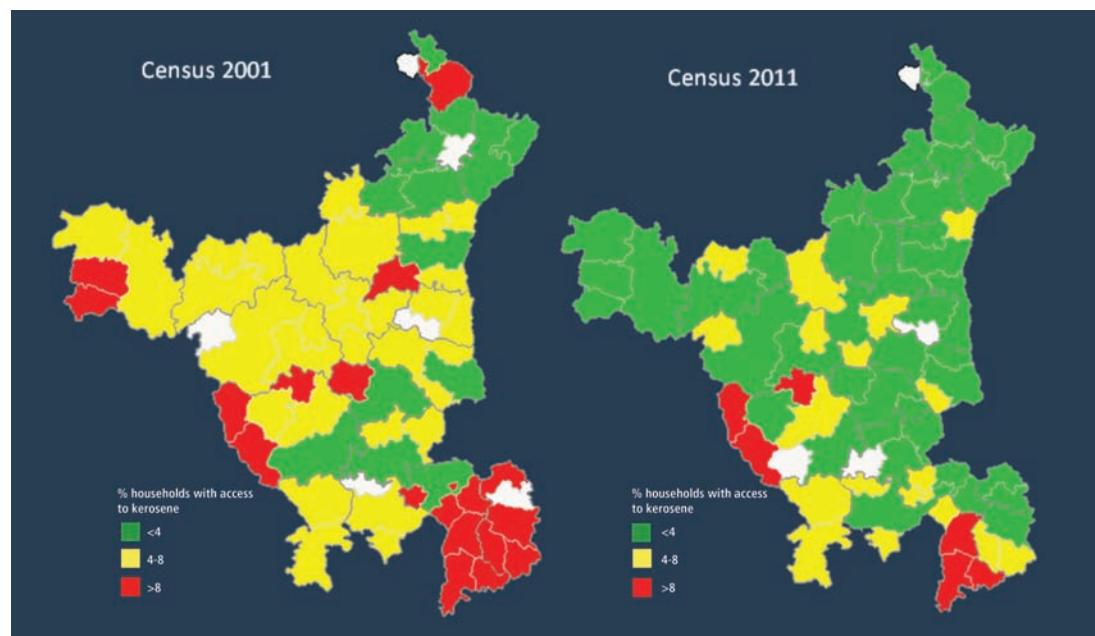
Kerosene as source of light in urban Haryana

There has been a positive reduction in urban Haryana's dependency on kerosene



Kerosene as source of light in rural Haryana

Sub-districts where more than 18 per cent households use kerosene for lighting has declined

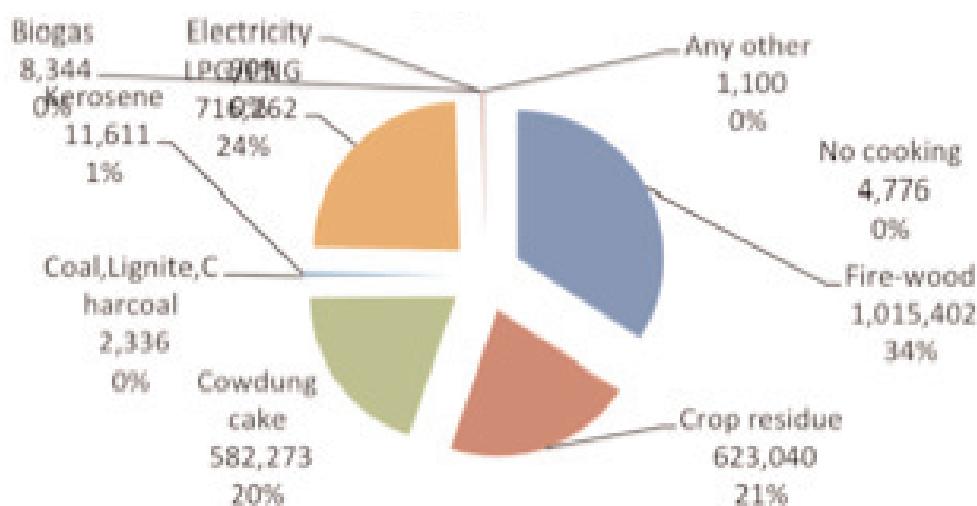


while sub districts where less than 9 per cent households depend on kerosene (green) has gone up substantially, covering most of the north-eastern Haryana.

Even in cooking, the use of kerosene as a fuel is low in Haryana, both in its rural and urban areas. Most sub-districts in rural areas show less than 2 per cent households using kerosene as fuel for cooking purposes while in urban Haryana most sub-districts show less than 4 per cent households dependent on kerosene for such use.

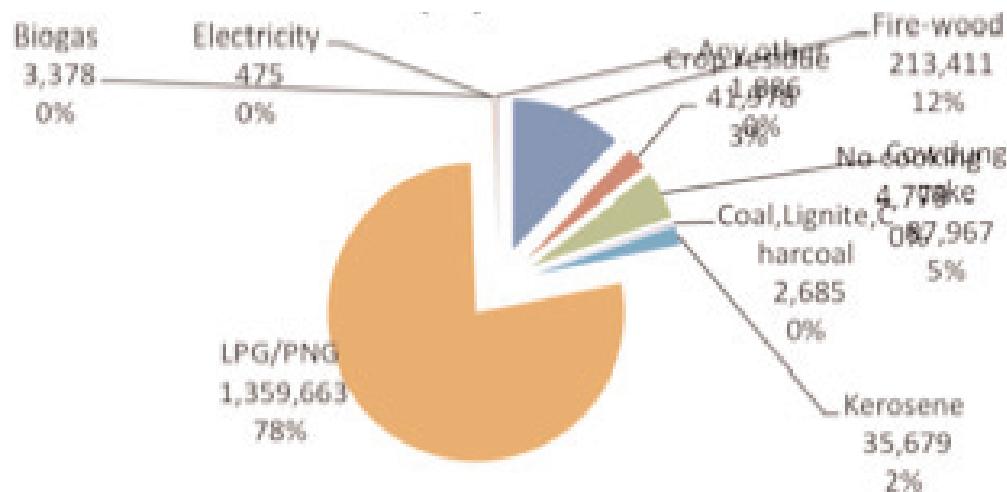
Rural Haryana's fuel mix for cooking

Only 24 per cent households use LPG



Fuel sources for cooking in urban Haryana

There is considerable dependence on firewood and crop residue



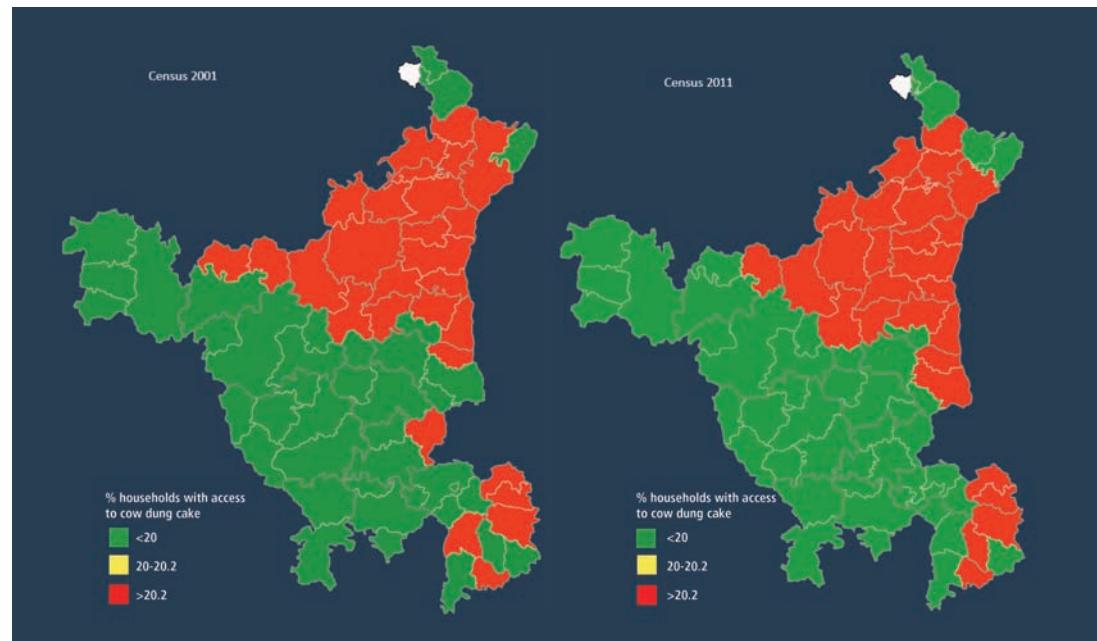
The low use of kerosene does not, however, mean a switch over to LPG. Even in urban Haryana, there is considerable dependence on firewood, crop-residues and cow-dung cake even though 78 per cent households use LPG (see 'Rural Haryana's fuel mix for cooking').

The rural fuel consumption pattern stands out in contrast (see 'Fuel sources for cooking in rural Haryana). Only 24 per cent households use LPG, not very different proportion from those using cow-dung cake (20 per cent) and crop residue (21 per cent) and certainly much less than firewood that accounts for 34 per cent households. Just as solar home lighting has been unable to capture the space occupied by kerosene, biogas plants have been unable to capture the space occupied by cow dung for direct burning, a mode where we lose on the fertiliser part completely and lose out of the clean fuel part due to direct burning.

Use of cow-dung cake is predominant in the north-eastern part of Haryana with very little change between 2001 and 2011 (see 'Cow dung cake as fuel used for cooking in rural Haryana' p23).

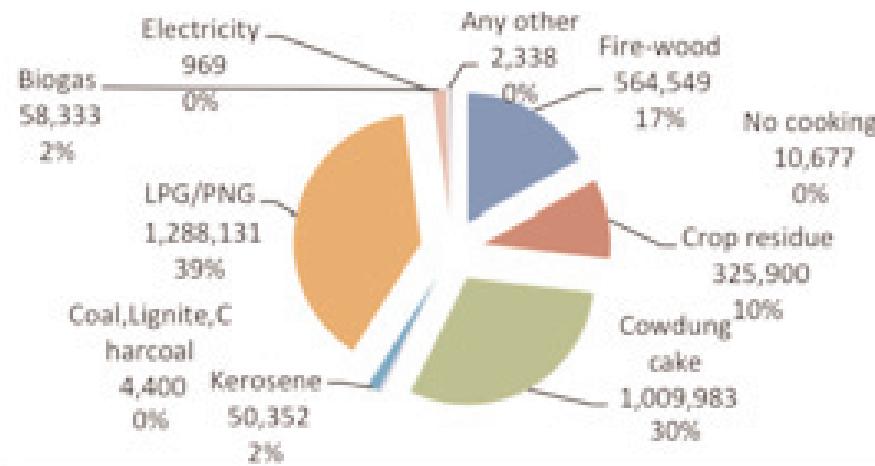
Cow dung cake as fuel used for cooking in rural Haryana

Use of cow-dung cake is predominant in the north-eastern part of Haryana



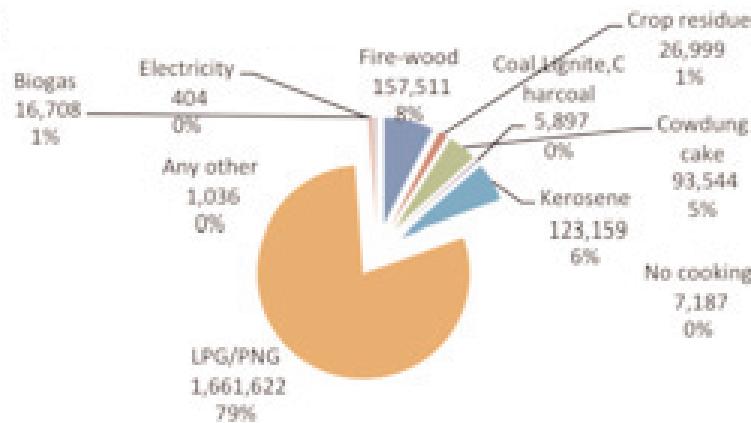
Rural Punjab's fuel mix for cooking

Use of LPG is higher than that of Haryana



Urban Punjab's fuel mix for cooking

Use of LPG in rural Punjab is higher than in Haryana



We will come to the detailed state-level analysis of other energy sources for Haryana later. It will be interesting to contrast the fuel-mix pattern of Punjab and Haryana.

While the use of LPG in rural Punjab (see ‘Rural Punjab’s fuel mix for cooking’ p23) is considerably greater (39 per cent) than that in Haryana (24 per cent), the use of cow-dung cake surprisingly occupies the second position (30 per cent households) and not firewood (17 per cent) or crop residue (10 per cent). Urban Punjab, however, shows a fuel mix distribution pretty much similar to that of urban Haryana (see ‘Urban Punjab’s energy mix’ p23).

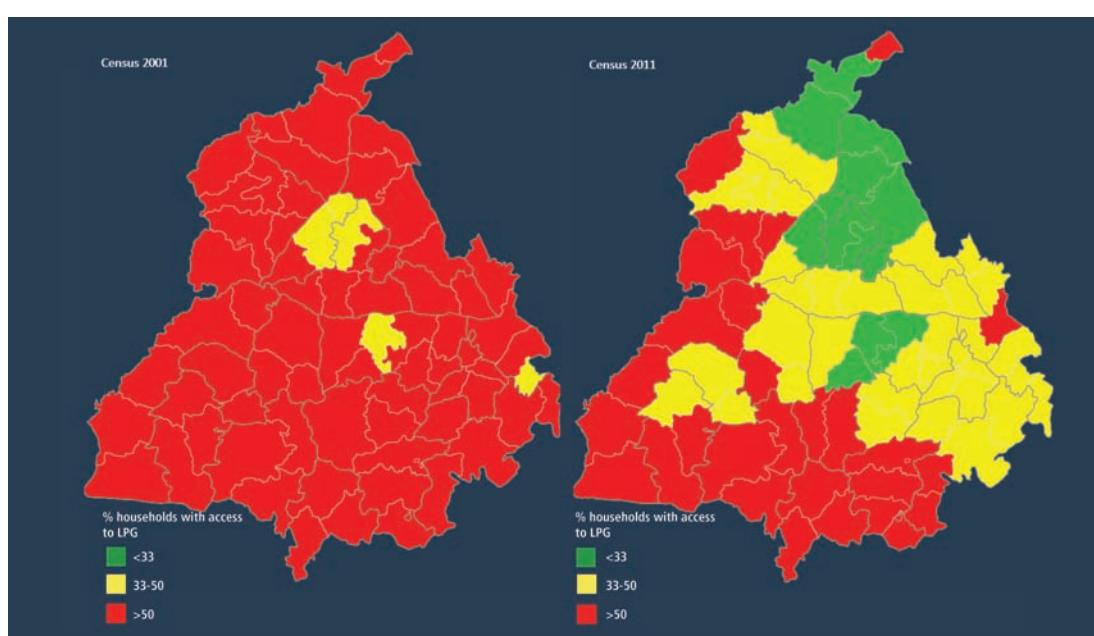
Coming back to the kerosene story, its use for lighting has drastically reduced in Punjab. In the urban areas, there are hardly any sub-districts where more than 3.5 per cent households use kerosene, except Dhar Kalan (7.8 per cent), Anandpur Sahib (5.3 per cent) and, surprisingly, Amritsar (3.9 per cent); in rural Punjab, too, there are no sub-districts where more than 5 per cent households use kerosene for lighting, except Fazilka, Abohar and Ajnala. It is worth examining whether these outliers represent any siphoning of kerosene.

Similarly, in cooking, too, the usage of kerosene as a fuel has substantially come down with most sub-districts having less than 3 per cent households using it as such. But in parts of Amritsar, Kapurthala, Ludhiana and Fatehgarh Saheb high usage of kerosene needs further scrutiny, particularly in Payal (10.5 per cent) and Amloh (20.7 per cent). In rural Punjab, the use of kerosene is very low as we have seen above with most sub-districts reporting less than 6 per cent households using it.

In urban areas, the low usage of kerosene can be attributed to increased usage of LPG. Sub-districts where more than 75 per cent households use LPG has increased significantly between 2001 and 2011 with hardly three sub-districts where this is below 40 per cent. However, this is not the case in rural Punjab as can be inferred from ‘LPG as fuel used in rural Punjab’. The maps show that in a number of sub-districts less than 33 per cent households use LPG even though areas where more than 33 per cent (yellow) and 50 per cent (green) households use LPG has increased considerably. Interestingly, the low LPG region is clustered in the south-western part of the state while the high usage region is developing in the northern tip.

LPG as fuel used for cooking in rural Punjab

Use of LPG has not increased substantially in rural Punjab



Hill states

The three hill states of Himachal Pradesh, Uttarakhand and J&K seem to have fared well in their energy mix.

Himachal Pradesh: In Himachal Pradesh, the use of kerosene has reduced considerably, especially in the rural area between 2001 and 2011 (see ‘Kerosene as source of light in rural Himachal’), with the area where less than 5 per cent households depend on kerosene for lighting having expanded rapidly.

Even in the urban areas, except Una and Kasauli, not a single sub-district has more than 5 per cent households dependent on kerosene for lighting. The reason for this is the enviable track record of electrification. Even in its rural region, 83 per cent or more households use electricity for lighting with the exception of Spiti where nearly two-thirds households use electricity. Given this track record, there is, in fact, a strong case for solar home lighting taking the place of kerosene to make the state kerosene-free.

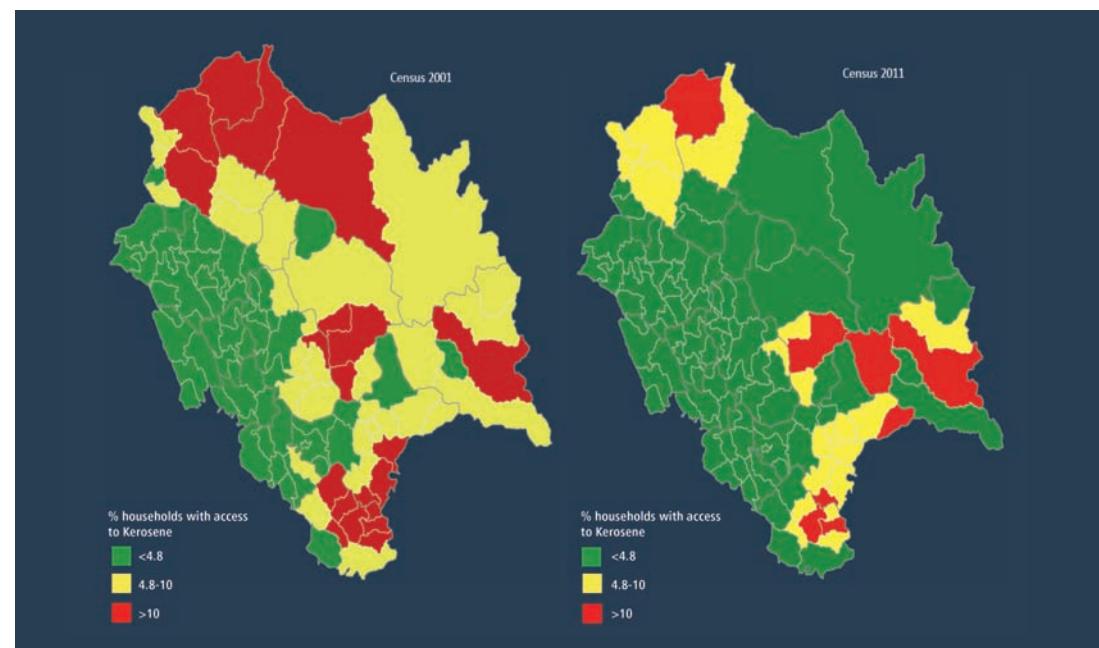
Such a case becomes even stronger once we note that the use of kerosene for cooking is also considerably low in Himachal Pradesh, both in rural and urban areas, with most places reporting dependence on kerosene by less than 10 per cent of the households.

While in the rural areas, it is only in Kalpa in Kinnaur district where more than 10 per cent households use kerosene as fuel for cooking, in urban areas there are four such urban sub-districts: Naina Devi (14.6 per cent) in Bilaspur, Baddi (18 per cent), Kasauli (12.6 per cent) in Solan and Seoni (12.6 per cent) in Simla. It is worth examining whether these outliers represent any siphoning of kerosene.

Interestingly, in Spiti, hardly one per cent households use kerosene as fuel for cooking and it may be worthwhile to make Spiti kerosene-free through solar home lighting programme. It will be instructive to see the fuel mix for cooking, both in the rural and the urban Himachal (see ‘Rural and urban Himachal’s energy mix for cooking’). In rural regions, LPG (33 per cent) and firewood (64 per cent) cover most of the use with other sources being insignificant players. This makes a strong case for making improved cook stoves popular in this region.

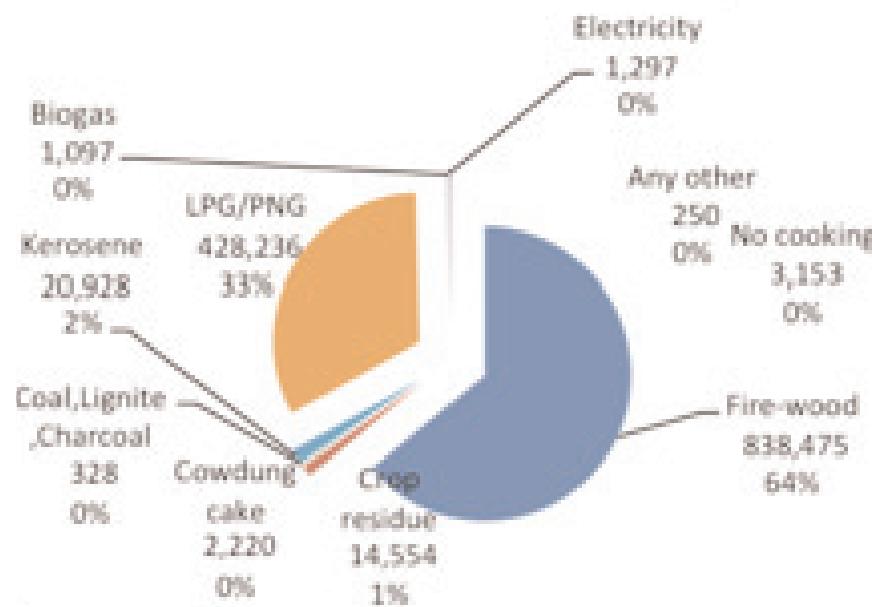
Kerosene as source of light in rural Himachal Pradesh

Use of kerosene has substantially dropped between 2001 and 2011



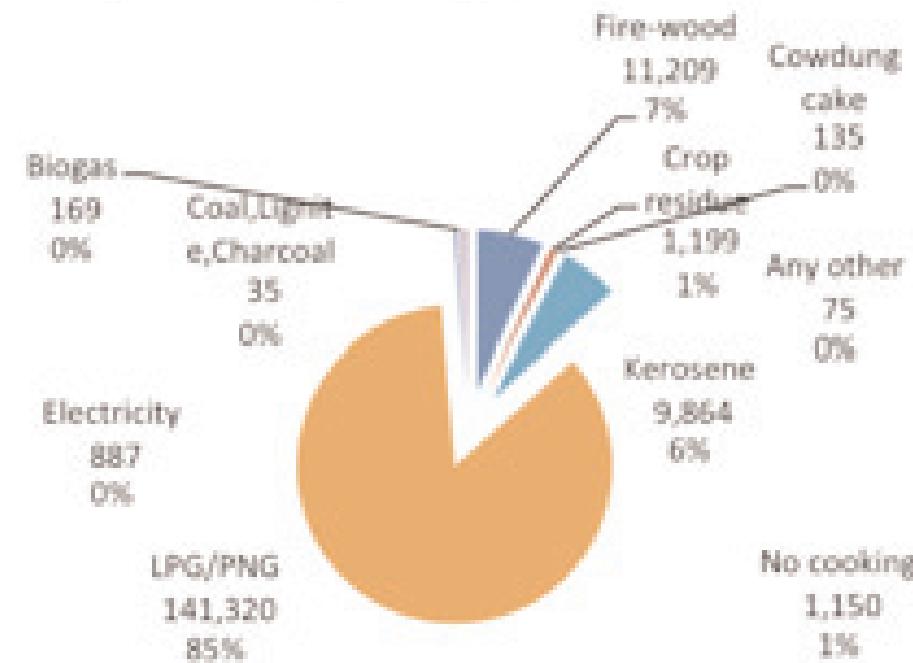
Rural Himachal's energy mix for cooking

The heavy dependency on firewood makes it an ideal place to popularise cook stoves



Urban Himachal's energy mix for cooking

Firewood is the second most popular source

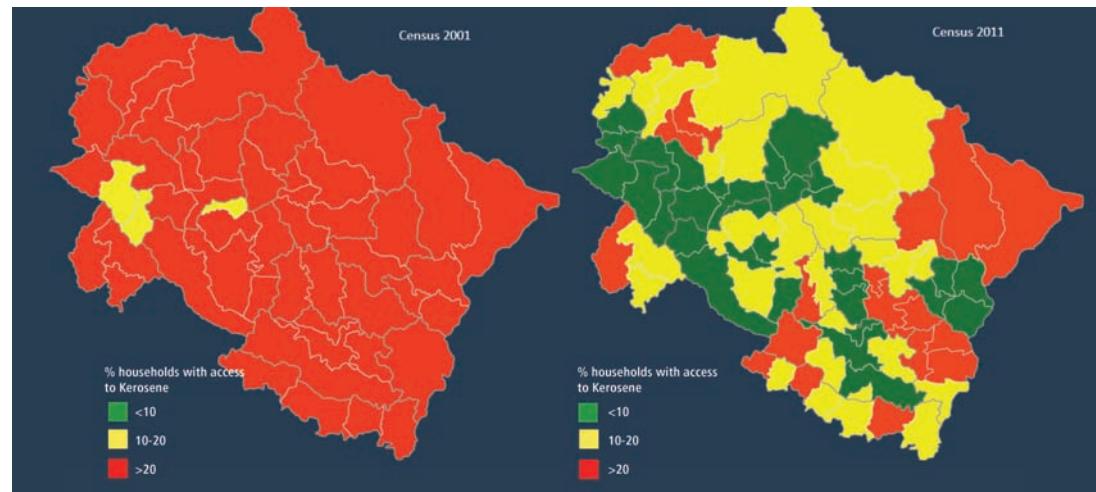


But it is the urban distribution which is noteworthy, with 85 per cent households using LPG as the main source of cooking fuel followed by firewood (7 per cent) and kerosene (6 per cent).

Uttarakhand: Coming back to the story of kerosene, it is once again seen that rural Uttarakhand has done well in reducing its dependence on kerosene for lighting (see 'Kerosene as source of light in Uttarakhand' p27). The percentage of households dependent on kerosene has reduced from a range of 14-72 per cent in 2001 to a range of 2.8-40.6 per

Kerosene as source of light in Uttarakhand

The percentage on households dependent on kerosene has come down substantially



cent in 2011. But the state does lag behind Himachal Pradesh significantly, given the large number of sub-district units where the dependence continues to be more than 20 per cent (shown in red).

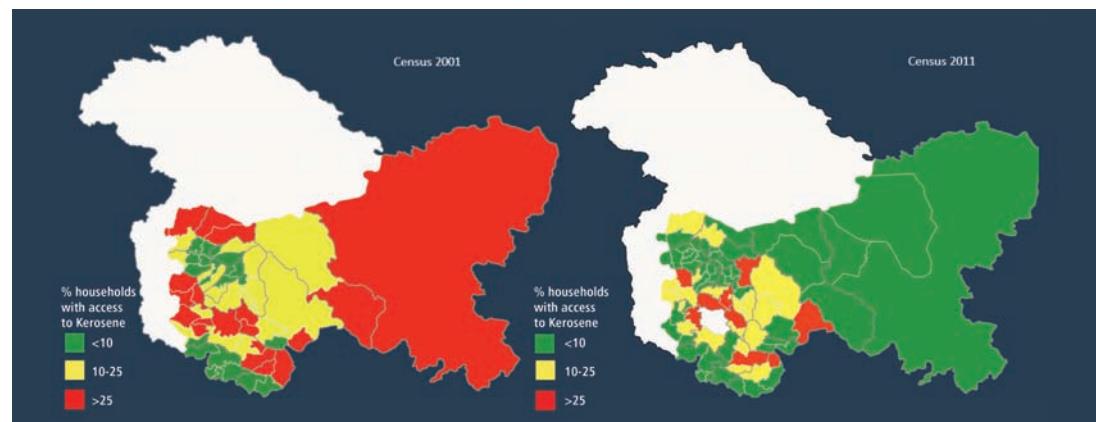
However, the story in urban Uttarakhand is different. Barring Udhampur Singh Nagar and Poornagiri sub-district in Champawat (9 per cent), nowhere else more than 5 per cent households depend on kerosene for lighting purposes. Here again, solar light has not been able to claim the space occupied by kerosene.

Uttarakhand has done remarkably well in reducing the use of kerosene as a fuel for cooking purposes. In urban Uttarakhand in 2011, there is hardly any sub-district where more than 10 per cent households depend on kerosene as fuel while in rural areas such usage is even less—below three per cent households depend on it. This does not, however, correspond to high use of LPG.

J&K: Like Uttarakhand, rural J&K has also brought down the dependence on kerosene as source of lighting between 2001 and 2011. However, there are a number of sub-districts where more than 25 per cent households are dependent on kerosene for lighting (see

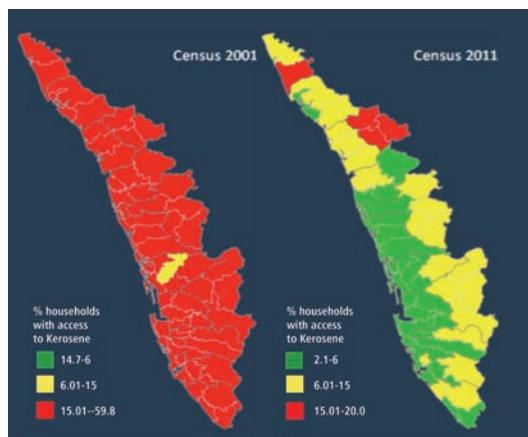
Kerosene as source of light in rural J&K

While the state has brought down its dependency on kerosene, some pockets still remain



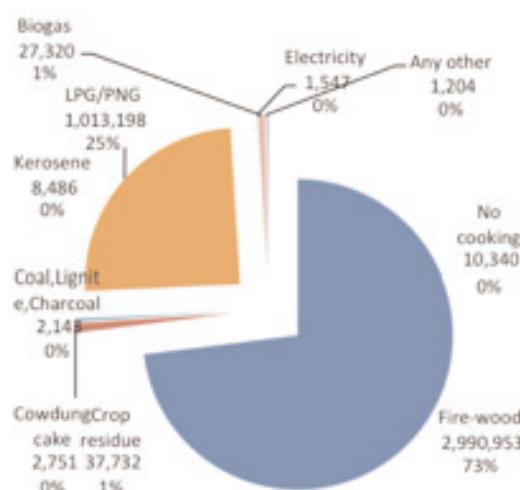
Kerosene use in Kerala for lighting

Most sub-districts have reduced using kerosene



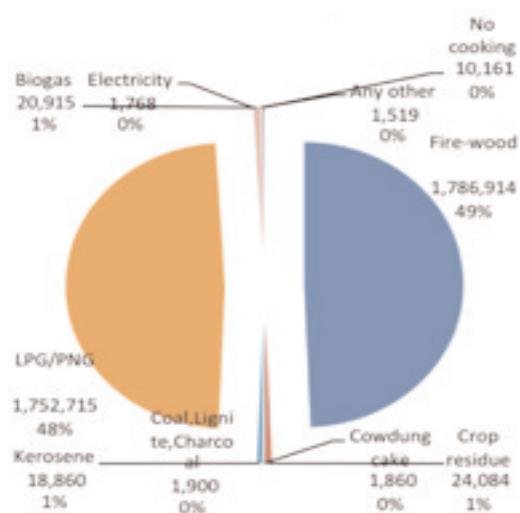
Rural Kerala's energy mix for cooking

The state heavily depends on firewood



Urban Kerala's energy mix for cooking

Almost 50 per cent divide between LPG and firewood usage



'Kerosene as source of light in rural J&K). In urban areas, however, there is hardly any sub-district where such dependence is above 10 per cent. Solar home lighting definitely has a scope in replacing kerosene in the state as has indeed been done in a number of sub-districts successfully. The need is to saturate the solar home lighting coverage.

In urban J&K also, the dependence on kerosene as fuel for cooking has declined considerably between 2001 and 2011, with very few sub-districts where more than 6 per cent households are dependent on it and none where this dependence exceeds 12 per cent. In rural areas, too, hardly 2-3 per cent households use kerosene as fuel.

All the three hill states have, thus, fared well in terms of reducing dependence on kerosene whether for lighting or as a fuel for cooking. While Punjab has fared well too, the same cannot be said of Haryana particularly in use of kerosene as fuel for cooking.

The kerosene story in southern states

The four southern states have done very well in terms of providing electricity to their people. The states also show a good penetration of LPG. Interestingly, between themselves, LPG and firewood account for most cooking energy, use of other sources of biomass is insignificant. The strides made between 2001 and 2011 in terms of providing electricity have been striking.

Kerala: Kerala's track record in providing electricity to its rural areas can be inferred from the reduction in the number of households dependent on kerosene for this purpose. 'Kerosene use in Kerala for lighting' shows a sharp decline in the number of sub-districts where more than 15 per cent households depend on kerosene for lighting purpose (shown in red). More important is the rise in a number of sub-districts (shown in green) where less than 6 per cent households have such dependence. In urban Kerala, most sub-districts have less than 5 per cent households using kerosene for lighting.

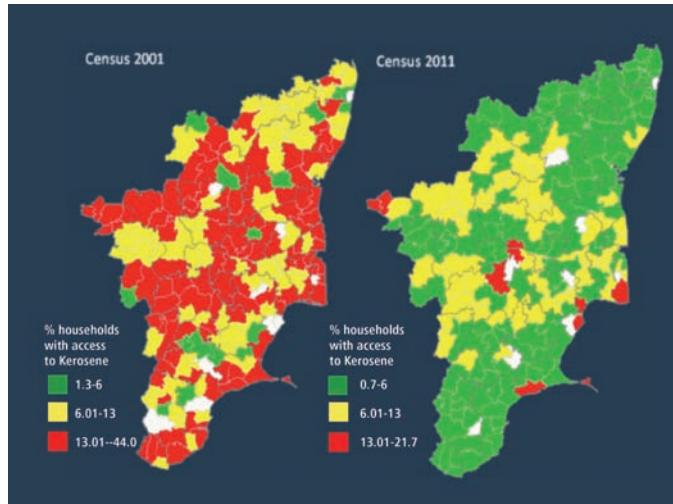
When it comes to use of kerosene as a fuel for cooking, Kerala has done extremely well with no sub-district showing more than 0.5 per cent households using kerosene as fuel, except in Kochi where it is 0.6 per cent. In urban Kerala, too, no sub-district in 2011 has more than 1 per cent population using kerosene as fuel for cooking, except Palakkad (1.3 per cent) and Kochi (2.8 per cent).

It is also interesting to look at the sources of fuel used for cooking in Kerala. Unlike in northern states, LPG and firewood account for most energy consumption, both in urban and rural areas. All other sources are insignificant. However, the use of LPG is relatively low in rural areas (25 per cent) and, surprisingly, urban areas as well (48 per cent) as seen in 'Rural and urban Kerala's energy mix for cooking' on p28. Equally surprisingly, 49 per cent urban households in Kerala use firewood as a source of fuel for cooking purposes.

Tamil Nadu: Kerala's neighbour, Tamil Nadu, too has done well in providing its rural and urban households access to electricity. Between 2001 and 2011 (see 'Kerosene used for lighting in urban

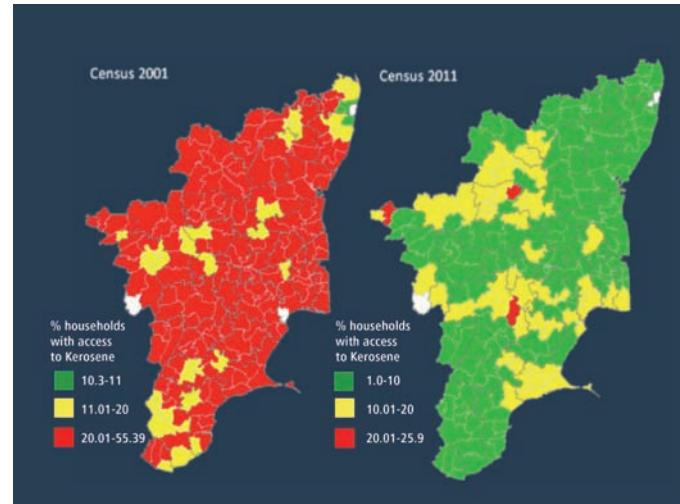
Kerosene used for lighting in urban Tamil Nadu

The dependency has come down



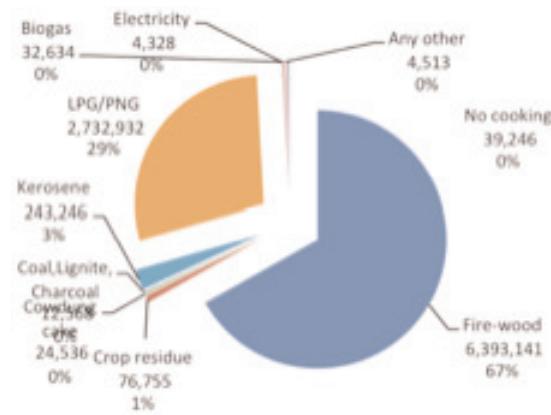
Kerosene used for lighting in rural Tamil Nadu

Compact patches with high dependency on kerosene remain



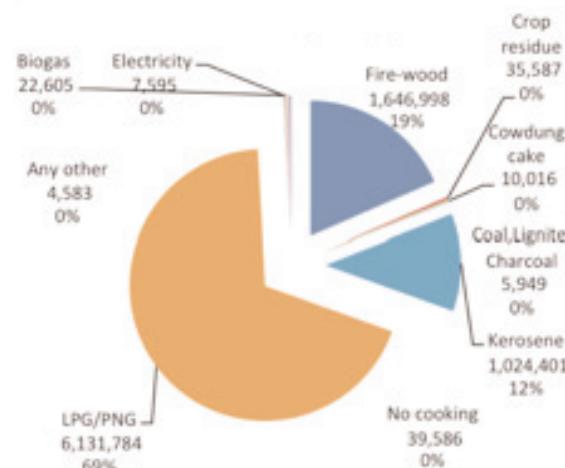
Rural TN's energy mix for cooking

The mix is similar to that of Kerala's



Urban TN's energy mix for cooking

Still high on firewood

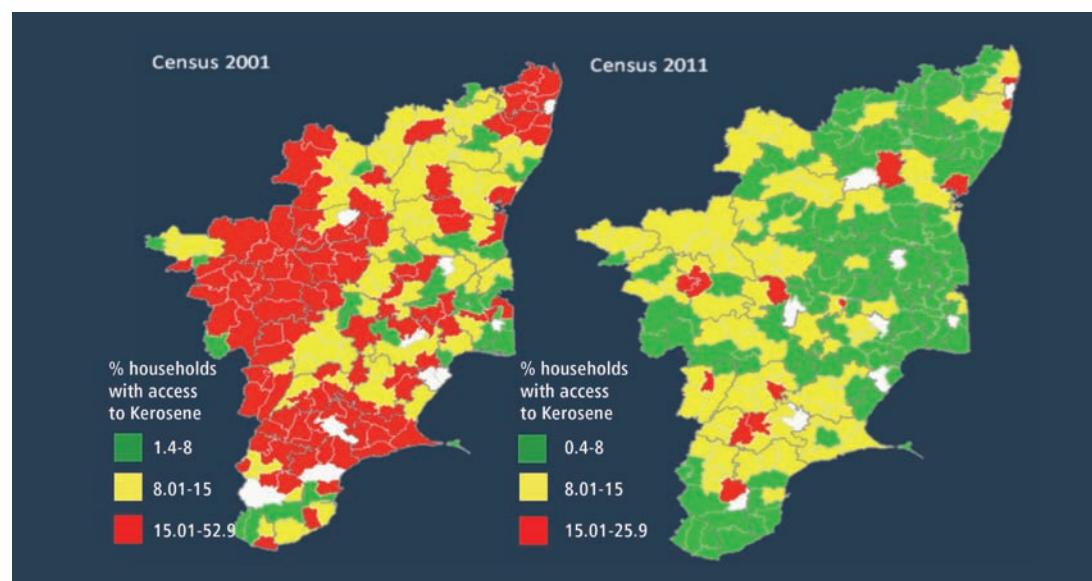


Tamil Nadu'), the percentage of urban households depending on kerosene has reduced significantly as can be seen in the increase in the region (shown in green) where less than 6 per cent households depend on kerosene for lighting and a very sharp reduction in the number of sub-districts where more than 13 per cent households show such dependence. Yet there is a significant region where more than 6 per cent households still use kerosene for lighting. In rural Tamil Nadu, too, the area (shown in green) where less than 10 per cent households use kerosene for lighting has increased significantly between 2001 and 2011 (see 'Kerosene used for lighting in rural Tamil Nadu'). But, there are compact patches where this percentage ranges between 10-20 per cent and these may need specific focus. The pattern of fuel energy source for cooking purposes in rural Tamil Nadu (see 'Rural TN's energy mix for cooking') is quite similar to that in rural Kerala, with LPG accounting for 67 per cent households, and firewood, 29 per cent. However, unlike Kerala, the use of kerosene is higher, with 3 per cent or nearly 243,000 households using it.

But it is in urban Tamil Nadu (see 'Urban TN's energy mix for cooking') where the dependence on kerosene as a source of fuel for cooking is high with 12 per cent or nearly a million households using it. Of course, the use of LPG is quite high at 69 per cent and firewood accounts for about 19 per cent households only. It must be stated that the usage of kerosene has significantly reduced between 2001 and 2011 in urban Tamil Nadu (see

Kerosene used as fuel for cooking in urban Tamil Nadu

The state's urban areas have reduced their dependency on kerosene

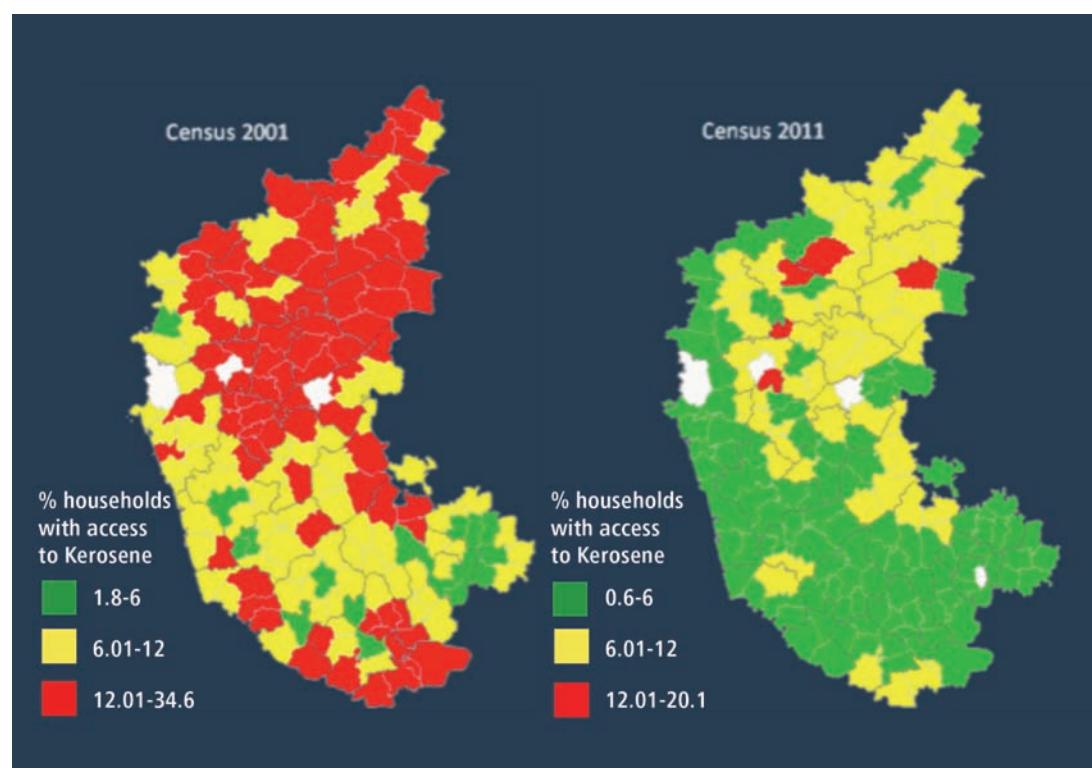


'Kerosene used as fuel for cooking in urban Tamil Nadu').

Karnataka: Urban Karnataka has also been able to reduce dependence on kerosene for lighting considerably. Compared to 2001, there are very few sub-districts (see 'Kerosene used for lighting in urban Karnataka') where more than 12 per cent households show such dependence on kerosene (shown in red). But there is an interesting north-south divide, with most of the southern half showing less than 6 per cent households depending on kerosene for lighting while most of the northern half shows this dependence ranging between 6 and 12 per cent.

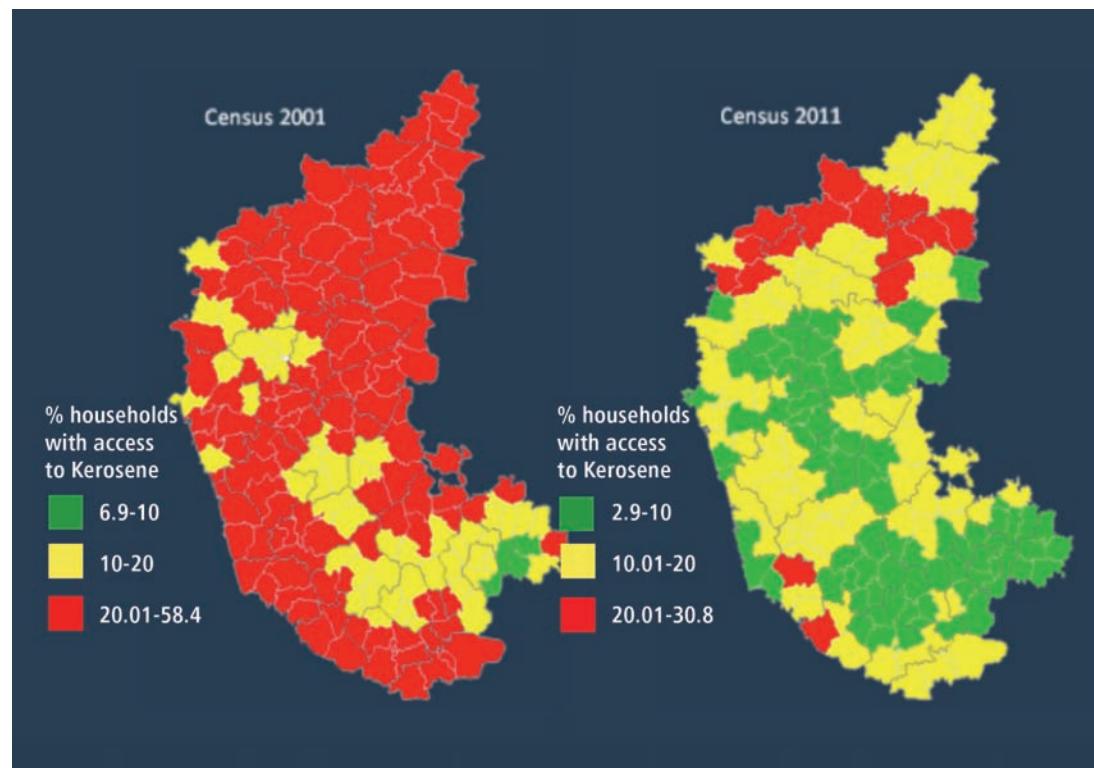
Kerosene used for lighting in urban Karnataka

Compared to 2001, the dependency on kerosene has come down in 2011



Kerosene used for lighting in rural Karnataka

A stubborn west-east strip in the northern fringe seems to have high dependency

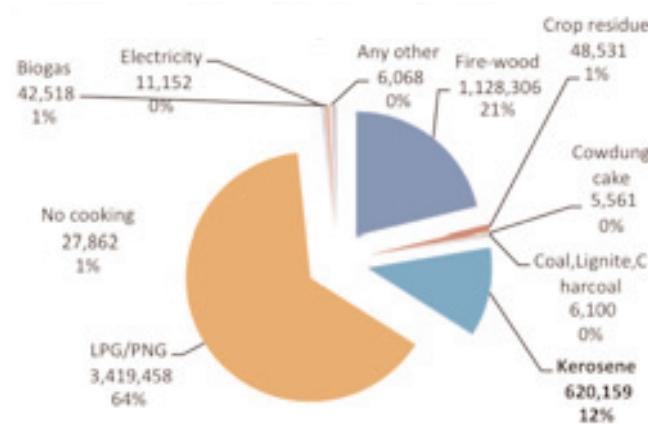


Rural Karnataka shows an interesting pattern. While the area where more than 20 per cent households depend on kerosene for lighting has come down sharply between 2001 and 2011, a stubborn west-east strip in the northern fringe seems to hold out. Furthermore, while the dependence on kerosene has gone below 6 per cent households in certain compact patches, more than 10 per cent households continue to have such dependence in a large part of the state.

When it comes to fuel sources for cooking (see ‘Urban Karnataka’s energy mix for cooking’ p31), urban Karnataka shows large usage of kerosene at about 12 per cent or 620,000 households. Firewood accounts for 21 per cent households and LPG covers about 64 per cent households. The high kerosene usage is mainly confined to a compact southern cluster (see ‘kerosene used for lighting in urban Karnataka’) where more than 15 per cent

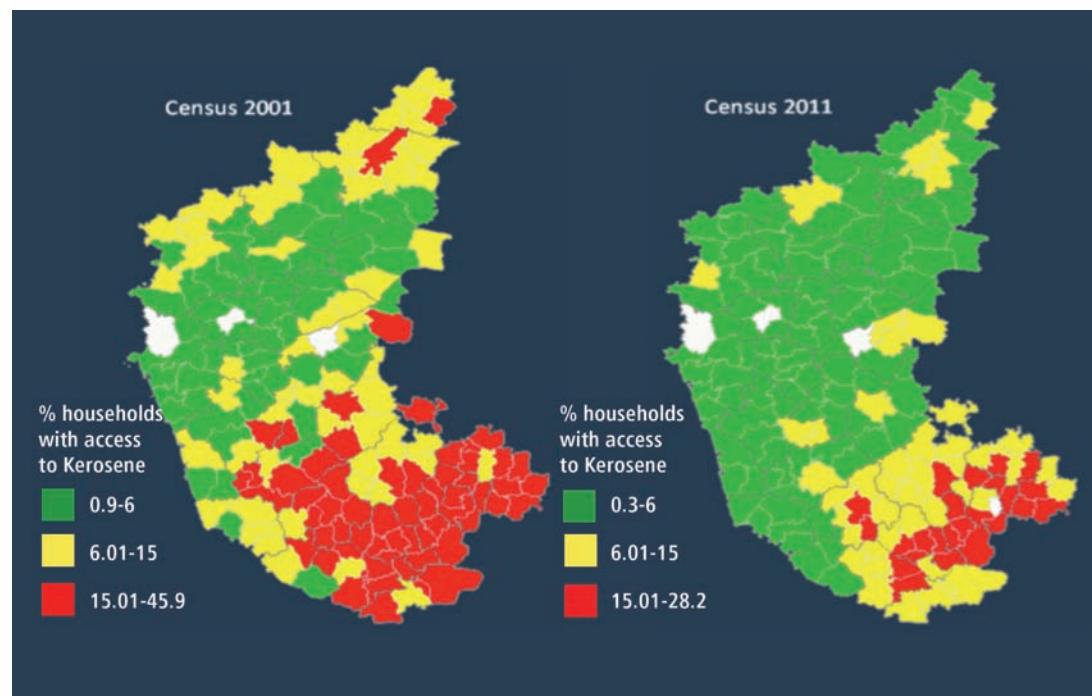
Urban Karnataka’s energy mix for cooking

Dependency on firewood and kerosene remains high



Kerosene used for lighting in urban Karnataka

High kerosene usage is restricted to a compact southern cluster



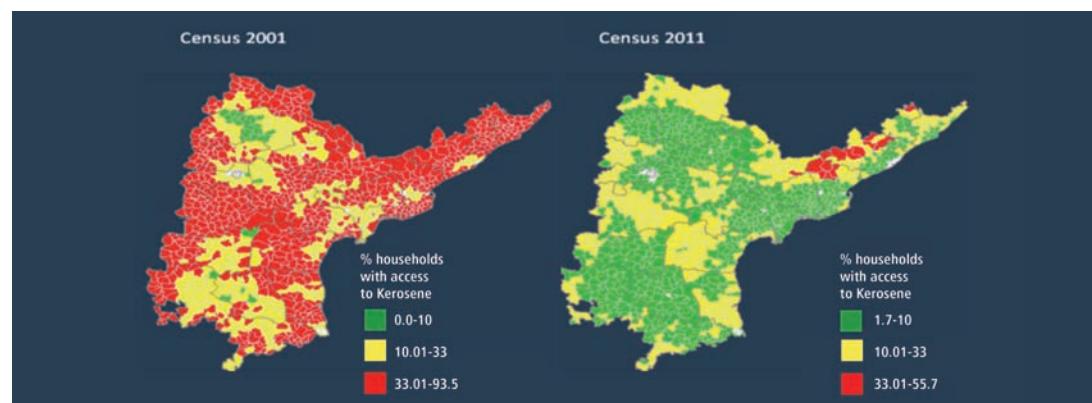
households (shown in red) and 6-15 per cent households (shown in yellow) use it as fuel for cooking.

In rural Karnataka the usage of firewood has been rather high (82 per cent) and LPG penetration low (11 per cent). The usage of kerosene has traditionally been low (about 1 per cent), less than that of crop residue (4 per cent). However, around Bengaluru rural, about 10 per cent households use kerosene.

This leaves us with Andhra Pradesh (undivided). While it may not have done as well as its other three southern neighbours, it has brought down the usage of kerosene for lighting considerably (see 'Kerosene as source of light in rural Andhra Pradesh' p32). Rural Andhra has seen considerable reduction in areas where more than 33 per cent households depend on kerosene (shown in red) and increase in the area where this dependence is below 10 per

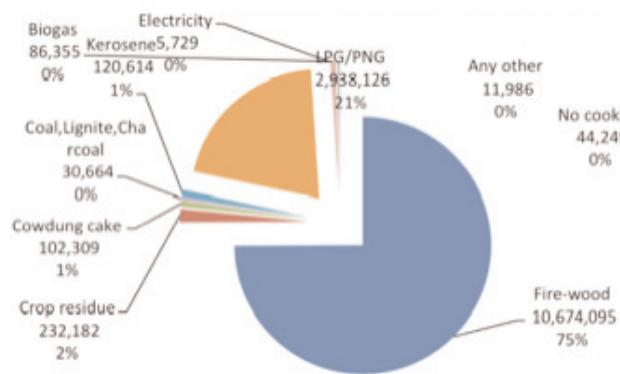
Kerosene as source of light in rural Andhra Pradesh

A considerable reduction in areas where more than 33 per cent households depend on kerosene



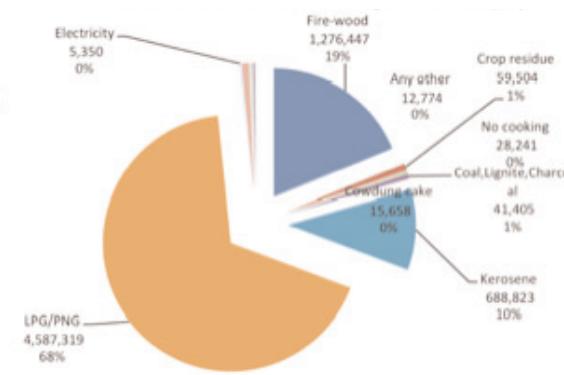
Rural Andhra's energy mix for cooking

High dependency on firewood



Urban Andhra's energy mix for cooking

Kerosene and firewood dependency high



cent (shown in green). But the 10-33 per cent patch is large enough for concern and for thinking of solar home lighting as an alternative. Urban Andhra has done remarkably well by bringing such dependence down to below 5 per cent in most urban areas.

When it comes to sources of fuel for cooking, the picture in Andhra resembles that in Tamil Nadu. Rural Andhra has significant dependence on firewood (75 per cent) followed by LPG (21 per cent) (see 'Rural Andhra's energy mix for cooking'). Other sources are not significant. In the urban usage pattern for cooking energy, LPG accounts for 68 per cent of the fuel mix no doubt, but nearly 700,000 households (10 per cent) still use kerosene as fuel for cooking and firewood accounting for 19 per cent of the households (see 'Rural Andhra's energy mix for cooking').

The four southern states, thus, have a good track record in low usage of kerosene for lighting though the potential of solar home lighting has not been exploited. As regards reducing usage of kerosene as fuel for cooking, Kerala has an enviable record which its neighbours need to emulate. In terms of fuel mix, there is very little use of any biomass other than fuel wood; a pattern considerably different from the northern states.

While the contrast between the better off northern states and the four southern states is noteworthy, but there is a much sharper contrast awaiting us when we look at the BIMARU states which emerge as the seat of a far enduring deprivation in terms of the energy poverty

The kerosene story in the BIMARU states

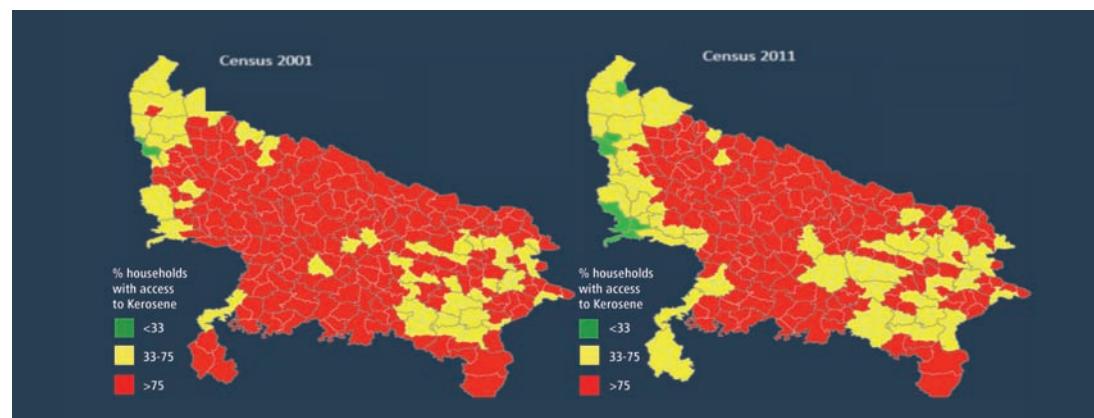
Compared to the southern states, the states of Punjab, Haryana and the three hill states have fared quite well. But a sharp contrast can be seen in the BIMARU states in terms of the fuel mix for cooking and the large dependence on kerosene for lighting.

Uttar Pradesh: The first striking feature that emerges is the use of kerosene for lighting with a substantial area showing 75 per cent or more households dependent on it in rural UP (see 'Kerosene as source of light in rural Uttar Pradesh' p34). Even the region in yellow band in eastern UP, where the range is taken as 33-75 per cent, most sub-districts fall in the 60-75 per cent band. There are hardly any sub-districts where the dependence is below 20 per cent, the few green patches shown have 20-33 per cent households depending on kerosene.

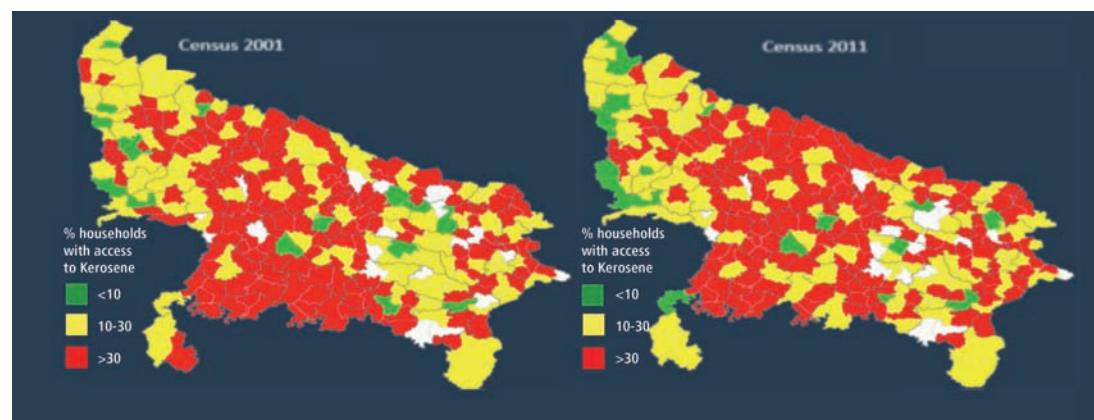
Urban UP has not fared very well either. Very few sub-districts have less than 10 per cent

Kerosene as source of light in rural Uttar Pradesh

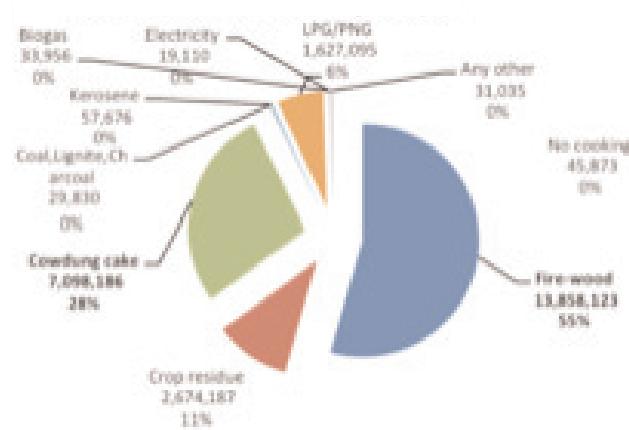
Extremely high dependency on kerosene

**Kerosene as source of light in urban Uttar Pradesh (UP)**

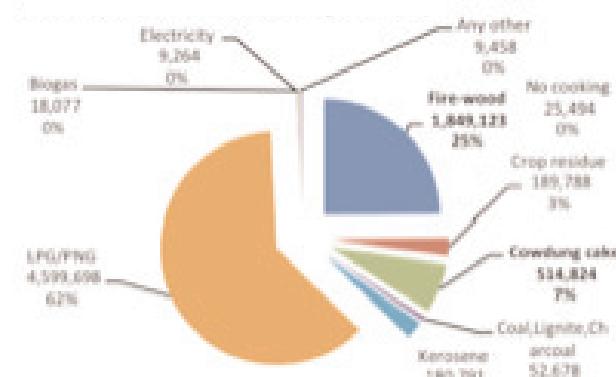
Alarming high dependency in urban sectors

**Rural UP's energy mix for cooking**

High dependency on firewood

**Urban UP's energy mix for cooking**

Firewood still an important source



households using kerosene (green) and in a very large number of sub-districts more than 30 per cent households show this dependence. The change between 2001 and 2011 in urban areas is very marginal 'Kerosene as source of light in urban Uttar Pradesh' p34). This should be a matter of worry.

Consumption of kerosene as fuel for cooking is very low in UP, both in urban and rural areas. In urban UP, there are a few sub-districts where more than 6 per cent households use kerosene as fuel for cooking and in most sub-districts this percentage is less than 2 per cent.

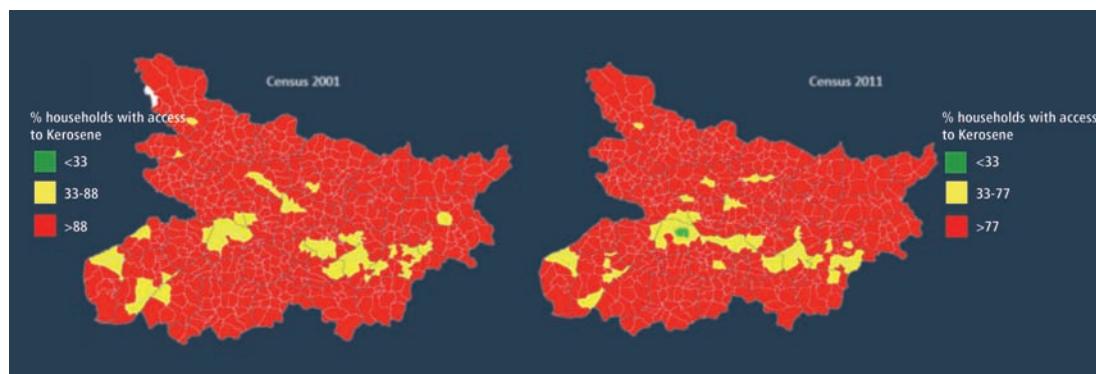
Use of kerosene in rural UP is even less. But this is not on account of high LPG consumption. In most sub-districts of UP, except a compact patch in the western part, less than 10 per cent households use LPG. Even in urban areas, sub-districts where more than 66 per cent households use LPG are few and far between.

The pie chart on fuel mix (see ‘Rural and urban UP’s energy mix for cooking’ p34) reveals that UP still depends on firewood, crop residues and cow dung cakes in a large measure. While urban UP does show 62 per cent households using LPG, there are 1.8 million households using firewood and nearly 900,000 households (25 per cent) using cow dung cakes.

Bihar: The state’s position is even more disconcerting. In 2011, most sub-districts show

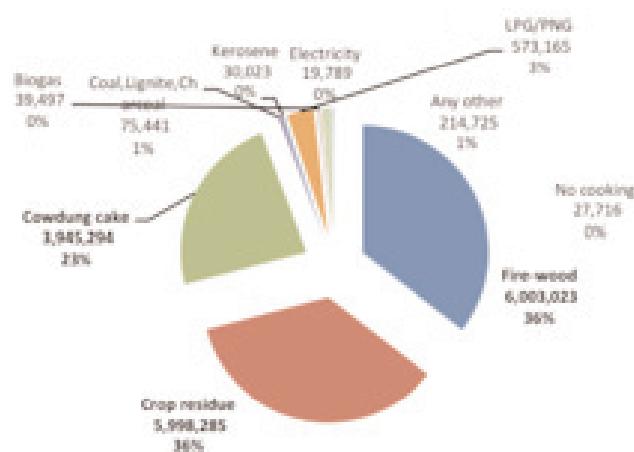
Kerosene as source of lighting in rural Bihar

Most sub-districts have high dependence on kerosene



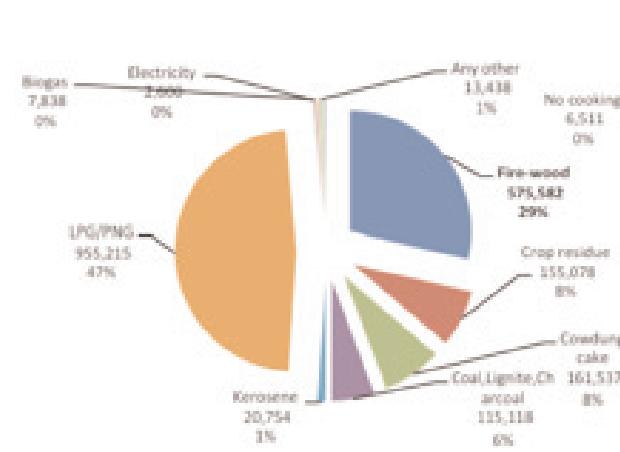
Rural Bihar's energy mix for cooking

Use of firewood and crop residue high



Urban Bihar's energy mix for cooking

Only Patna has low dependency on firewood



77 per cent or more rural households dependent on kerosene for lighting except in a thin strip along the Ganga where this percentage is in the range of 33-77 per cent. Only in two sub-districts in Patna this is below 33 per cent (see ‘Kerosene as source of lighting in rural Bihar’ p35)

Urban Bihar has three disadvantages: i) sparse urbanisation ii) a large number of

sub-districts where more than 33 per cent households still use kerosene for lighting and iii) most sub districts, except Patna, have more than 10 per cent households depending on kerosene.

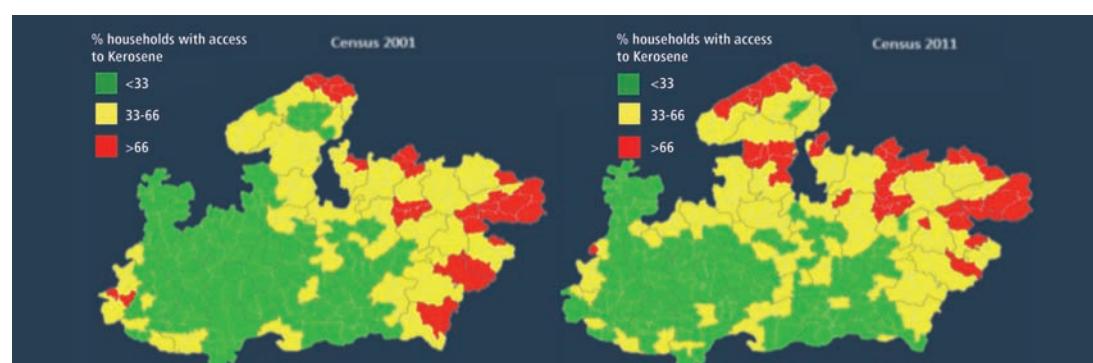
Like UP, consumption of kerosene as fuel for cooking is very low in Bihar both in urban and rural areas. In urban Bihar, there are few sub-districts where more than 2 per cent households use kerosene as fuel for cooking.

Use of kerosene in rural Bihar is even less—below 1 per cent households use it. But this is not on account of high LPG consumption. Most sub-districts of Bihar show less than 6 per cent rural households using LPG. Even in urban areas, most sub-districts have less than 33 per cent households using LPG.

The pie chart on fuel mix (see ‘Rural and urban Bihar’s energy mix for cooking’ p35) reveals that Bihar still depends on fire wood, crop residues and cow dung cakes in a larger measure than UP.

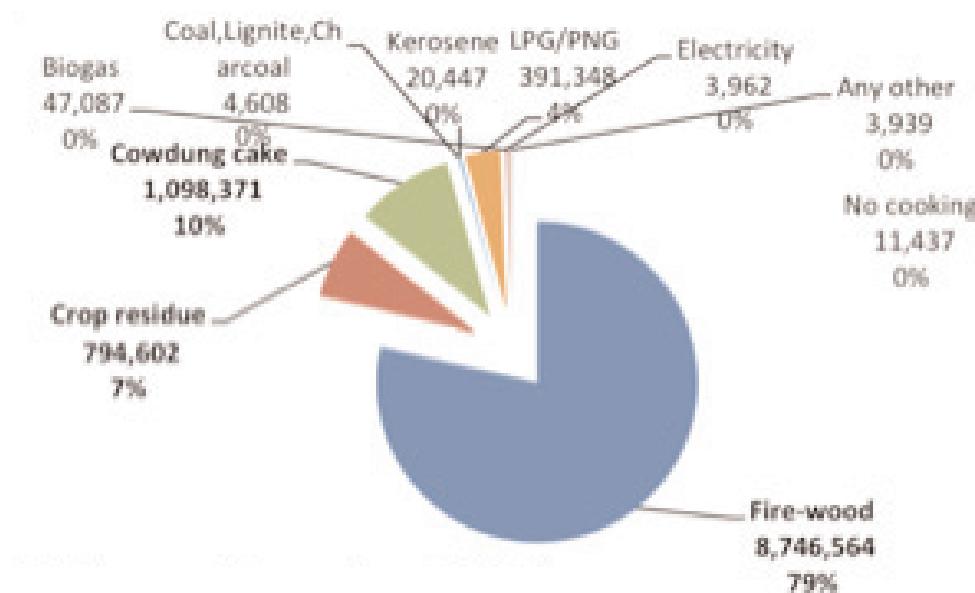
Kerosene as source of light in rural Madhya Pradesh (MP)

The performance is slightly better than that of Bihar and UP



Rural MP’s energy mix for cooking

High dependency on firewood



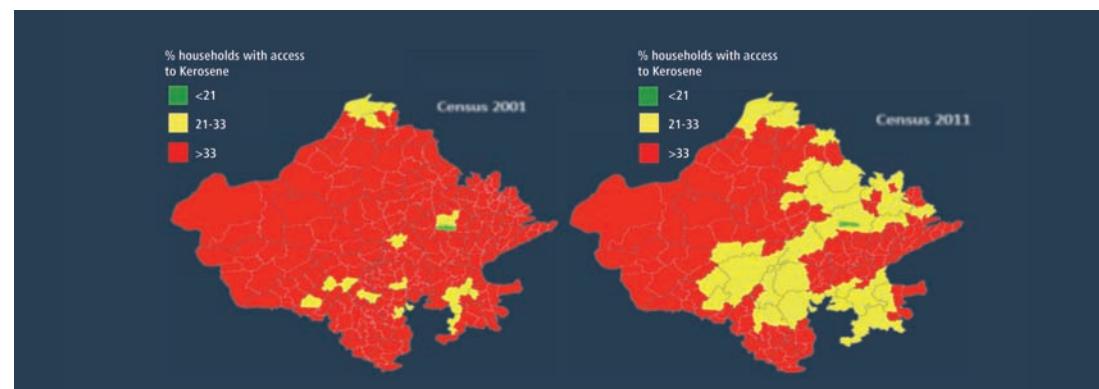
Madhya Pradesh: The state has done better than Bihar and UP, though in rural areas the dependence on kerosene for lighting is still high (see ‘Kerosene as source of light in rural Madhya Pradesh’ p36). There are contiguous patches where this dependence is above 66 per cent (shown in red) which needs attention on a priority basis. Urban MP has a large area where less than 10 per cent households depend on kerosene and very few sub-districts where such dependence exceeds 30 per cent.

Consumption of kerosene as fuel for cooking usage is very low in Madhya Pradesh, both in urban areas and in rural areas. In urban MP, most sub-districts have less than 3 per cent households using kerosene as fuel for cooking while usage of kerosene in rural MP is even less—below 1 per cent households use it as fuel for cooking purpose. But this again is not on account of high LPG consumption though the LPG consumption position here is better than in UP and Bihar.

The pie chart on fuel mix in rural areas (see ‘Rural MP’s energy mix for cooking’ p36) reveals a huge dependence on firewood (79 per cent), crop residues and cow dung cakes and very low penetration of LPG (< 5 per cent) even though urban MP can boast of 61 per cent households using LPG. But even there, 31 per cent or about 1.2 million households use firewood and about 170,000 households (5 per cent) use kerosene.

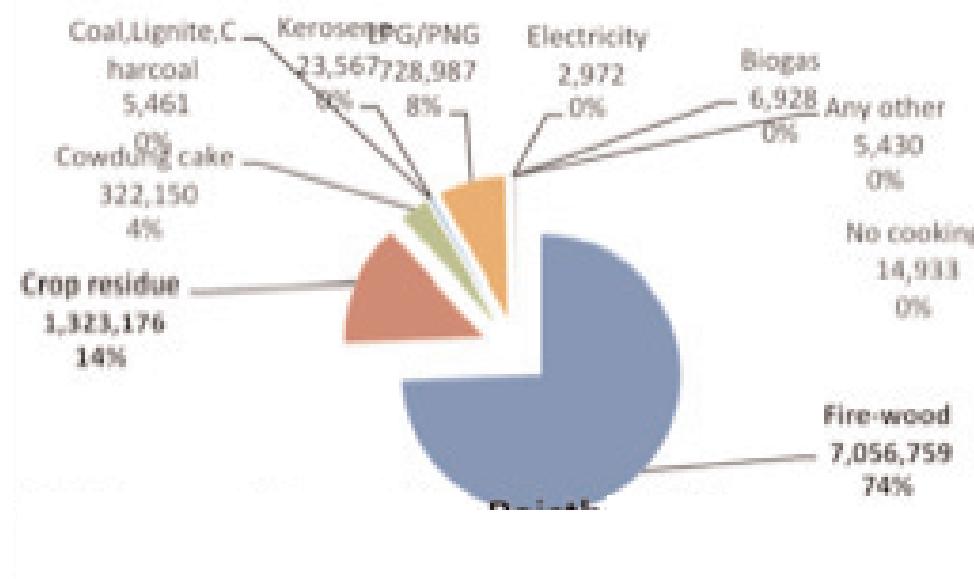
Kerosene as source of lighting in rural Rajasthan

Kerosene dependency reduced in eastern Rajasthan, but western side lagging behind



Rural Rajasthan's energy mix for cooking

Energy source similar to that of Madhya Pradesh



Rajasthan: Like MP, urban Rajasthan too has done far better than UP or Bihar. There is a large area where less than 10 per cent households depend on kerosene for lighting and very few sub-districts where such dependence exceeds 20 per cent. The improvement between 2001 and 2011 in reducing usage of kerosene for lighting purpose has been considerable. The same cannot be said of rural Rajasthan (see ‘Kerosene as source of lighting in rural Rajasthan’ p37).

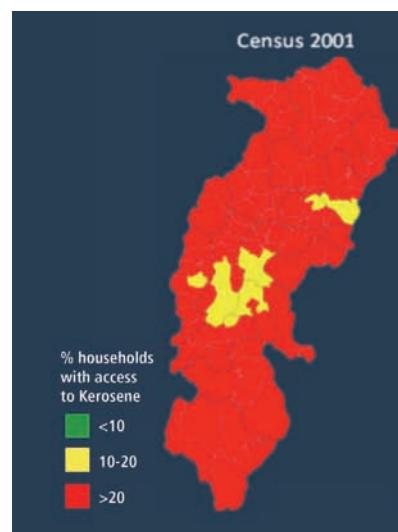
Rural Rajasthan has a large area where more than one-third households are dependent on kerosene for lighting and very few sub-districts where such dependence is less than 10 per cent. However, there has been considerable improvement from the situation in 2001 in its eastern half.

Level of consumption of kerosene as fuel for cooking usage in Rajasthan is quite similar to that of Madhya Pradesh, both in urban and rural areas. In urban areas, most sub-districts have less than 3 per cent households using kerosene as fuel for cooking while in rural Rajasthan this is even less—less than 1 per cent households use it. But this again is not on account of high LPG consumption in urban Rajasthan.

The pie chart on fuel mix in rural areas (see ‘Rural Rajasthan’s energy mix for cooking’ p37) reveals a huge dependence on firewood (74 per cent), followed by crop residues

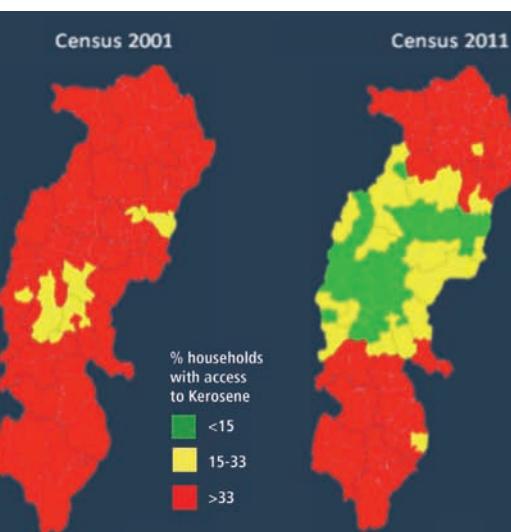
Kerosene as source of light in urban Chhattisgarh

Remarkable reduction in use of kerosene



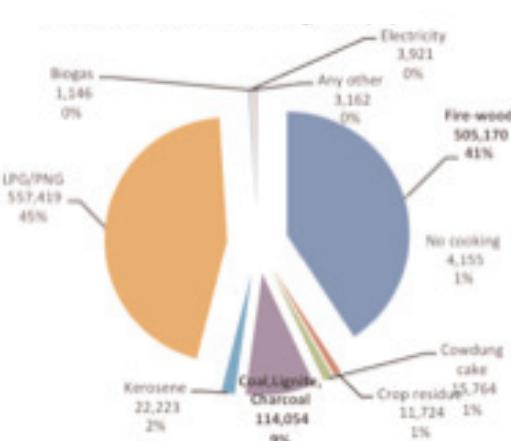
Kerosene for lighting in rural Chhattisgarh

Central part still has high dependence



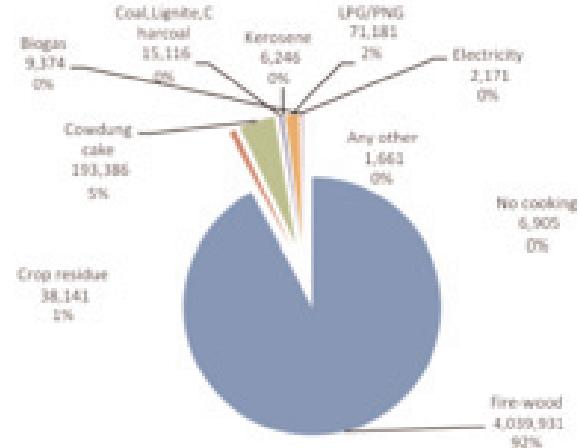
Urban Chhattisgarh’s energy mix for cooking

Consumption pattern similar to that of Madhya Pardesh



Rural Chhattisgarh’s energy mix for cooking

Extremely high dependency on firewood



(14 per cent), with very low LPG penetration (about 8 per cent). While urban Rajasthan can boast of LPG usage by 69 per cent households, there are 23 per cent households (about 700,000) using firewood. The pattern is quite similar to that of MP.

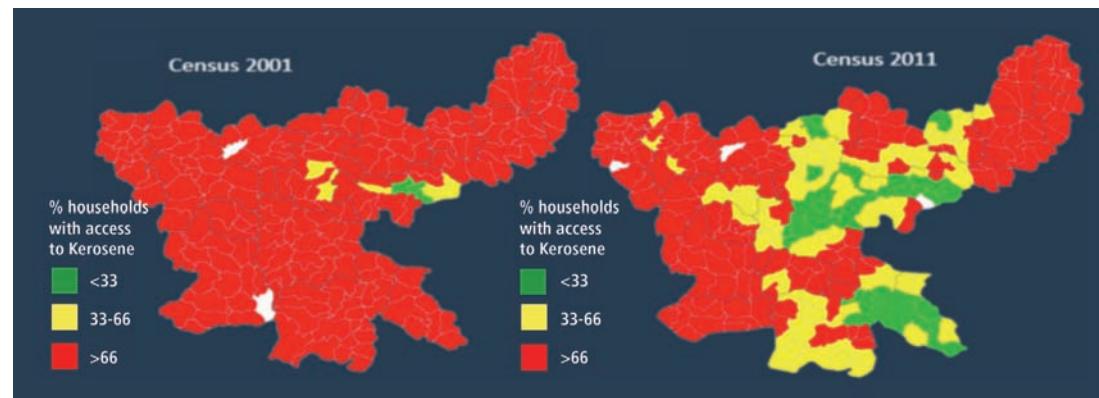
Chhattisgarh: Urban Chhattisgarh has done relatively well with a large area where less than 10 per cent households depend on kerosene for lighting and very few sub-districts where such dependence is more than 33 per cent. The improvement in 2011 from the situation in 2001 is quite clear (see ‘Kerosene as source of light in urban Chhattisgarh’ and ‘Kerosene for lighting in rural Chhattisgarh’ p38).

Rural Chhattisgarh has also done considerably well. There is a vast improvement from the situation in 2001 in the central part, with a large area where less than 15 per cent households depend on kerosene for lighting. However, lack of progress in the northern Chhattisgarh, which is free from the influence of the Left-wing extremism, is difficult to understand.

Like MP, consumption of kerosene as fuel for cooking usage is very low in Chhattisgarh, both in urban and rural areas (see ‘Rural and urban Chhattisgarh’s energy mix for cooking’ p38). Most sub-districts have less than 3 per cent households using kerosene as fuel for cooking in urban areas. In rural Chhattisgarh, this is even less—below one per cent households use kerosene. But this again is not on account of high LPG consumption. The pie chart on fuel mix reveals unusually high dependence on firewood (92 per cent) in the rural area and a very low LPG usage (2 per cent). Such dependence in urban areas is also significant, about 41 per cent. A new element is the use of coal by a significant number of urban households (about 9 per cent).

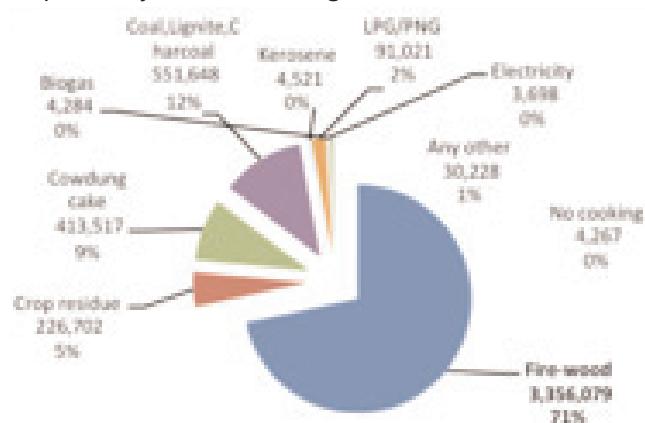
Kerosene as source of light in rural Jharkhand

Dependency reduced in central sub-districts



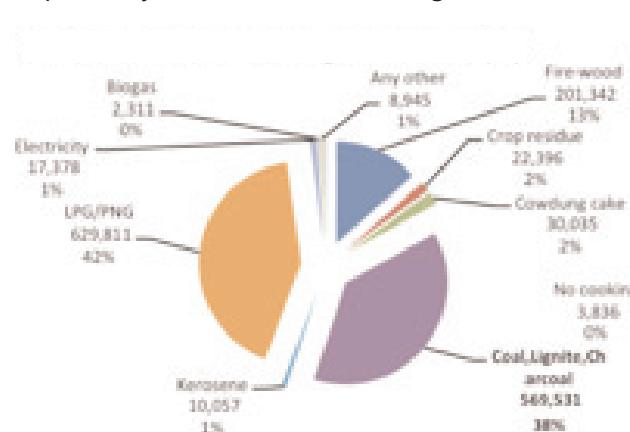
Rural Jharkhand’s energy mix for cooking

Dependency on firewood high as in most BIMARU states



Urban Jharkhand’s energy mix for cooking

Dependency on coal and firewood high



The large dependence on firewood in rural areas, make a strong case for a better LPG distribution, as well as an intensive programme for improved cook stoves.

Jharkhand: Urban Jharkhand has done considerably well in reducing dependence on kerosene for lighting between 2001 and 2011, increasing vastly the number of sub-districts where less than 10 per cent households depend on kerosene for lighting and another set of sub-districts where this dependence is between 10 and 33 per cent. The improvement is in sharp contrast with Bihar.

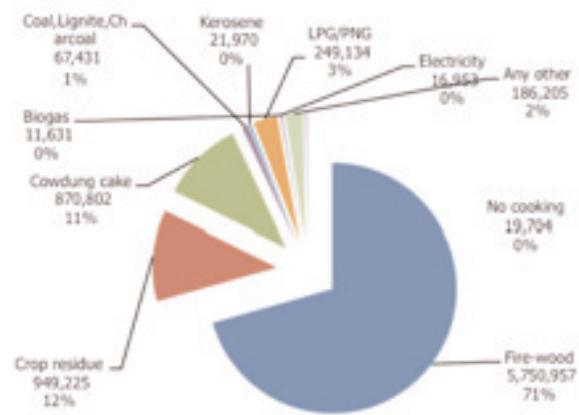
Even rural Jharkhand has brought considerable improvement in its central part compared to the situation in 2001 (see ‘Kerosene as source of light in rural Jharkhand’ p39). However, existence of large patches in the eastern and western parts where more than 66 per cent households depend on kerosene for lighting should be a cause of worry.

The story of consumption of kerosene as fuel for cooking usage in Jharkhand is very similar to what has been noticed in Chhattisgarh and MP. In urban areas, most sub-districts have less than 3 per cent households using kerosene as fuel for cooking (see ‘Urban Jharkhand’s energy mix for cooking’ p39). Usage of kerosene in rural Jharkhand is even less—below one per cent households use it for cooking (see ‘Urban Jharkhand’s energy mix for cooking’ p39). But this again is not on account of high LPG consumption. Interestingly, coal is used by a significant number of households in rural (12 per cent) and in urban areas (38 per cent). The pie chart on fuel mix reveals substantial dependence on traditional sources like fire wood (71 per cent), crop residues (5 per cent) and cow dung cakes (9 per cent).

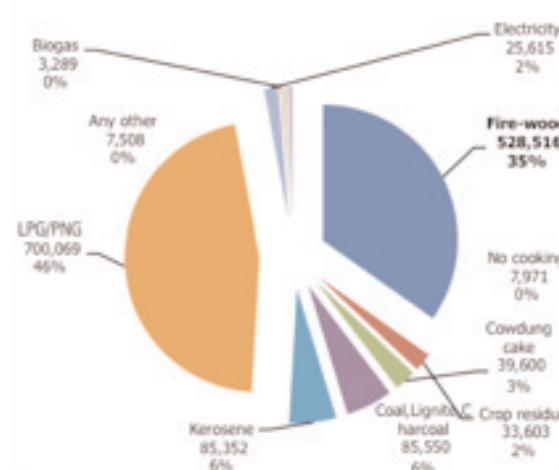
The BIMARU states thus reveal a picture of failure as far as reducing dependence on kerosene for lighting is concerned. The low dependence on kerosene as a source of fuel for cooking has not gone hand in hand with higher use of LPG. There is considerable use of traditional fuels like firewood, crop residue and cow dung cakes.

There is a huge opportunity and need for promoting use of solar home lighting, improved cook-stoves and biogas plants. Suitable financial incentives are needed for these schemes which should be viewed as “investment” and not “subsidy” given the attractive returns in monetary terms by way of the subsidy saved on petroleum products. The additional health benefits for mother and child, the lowering of carbon foot print and reduced imports are added bonus.

Rural Odisha’s energy mix for cooking
Huge dependence of firewood and crop residue



Urban Odisha’s energy mix for cooking
Dependence on firewood significant



The East and the West – when will the twain meet?

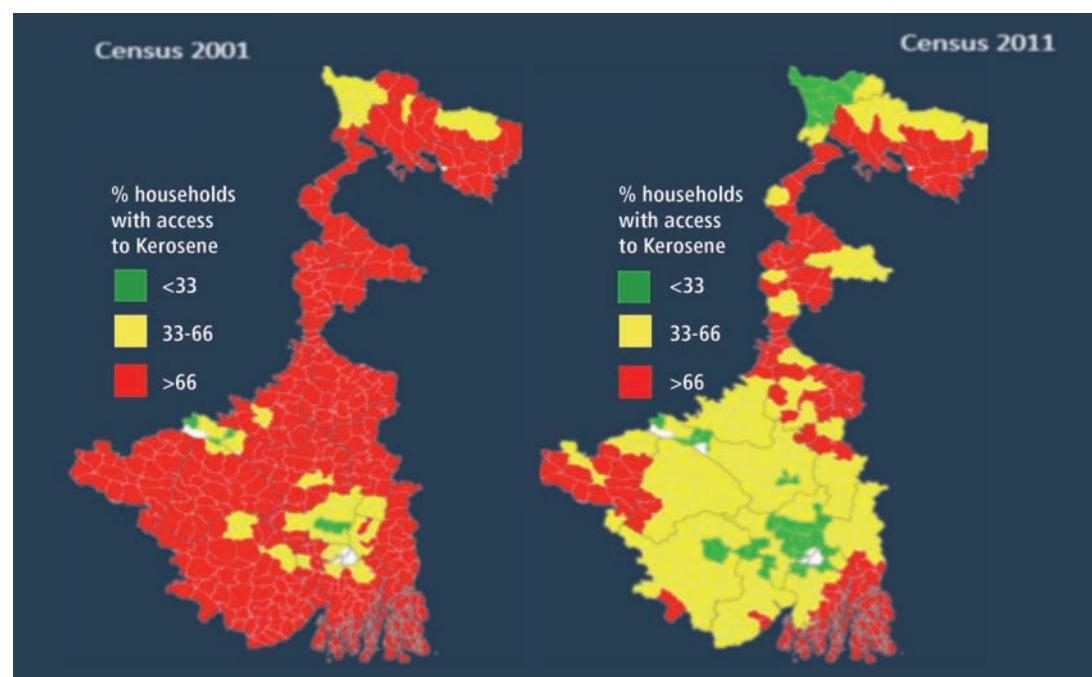
The eastern and the western regions of India stand in stark contrast in most development patterns. It is instructive to study this contrast to highlight the development gap in terms of the basic household energy consumption—lighting and cooking. We do this by comparing Odisha and West Bengal, on the one hand, and Maharashtra, Gujarat and Goa on the other.

Rural Odisha depends considerably on kerosene for lighting even though there has been an improvement in its coastal and western parts in 2011 compared to the situation in 2001. However, the long compact south-north patch where more than 66 per cent households depend on kerosene for lighting should be a cause for worry. In urban Odisha, too, there are several sub-districts where more than 30 per cent households depend on kerosene for lighting, and very few areas where this dependence is less than 10 per cent.

When we look at the sources of fuel for cooking purposes, rural Odisha shows a huge dependence on firewood (71 per cent), crop residue (12 per cent) and cow dung cakes (11 per cent). LPG use is meagre three per cent while usage of kerosene is insignificant (see ‘Rural Odisha’s energy mix for cooking’ p40). Urban Odisha, on the other hand, is able to make available LPG to 46 per cent of its households even though the dependence on

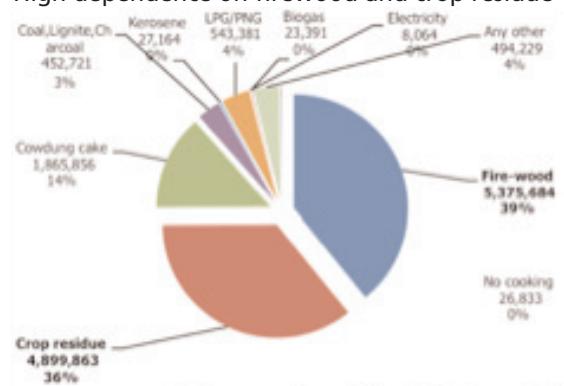
Kerosene as source of lighting in rural West Bengal

Compared to 2001, the dependency on kerosene has come down substantially



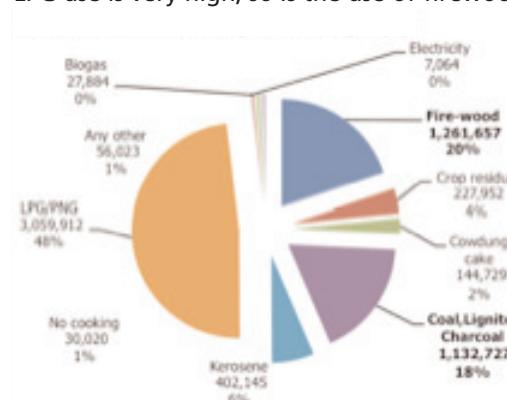
Rural West Bengal's energy mix for cooking

High dependence on firewood and crop residue



Urban West Bengal's energy mix for cooking

LPG use is very high, so is the use of firewood, coal



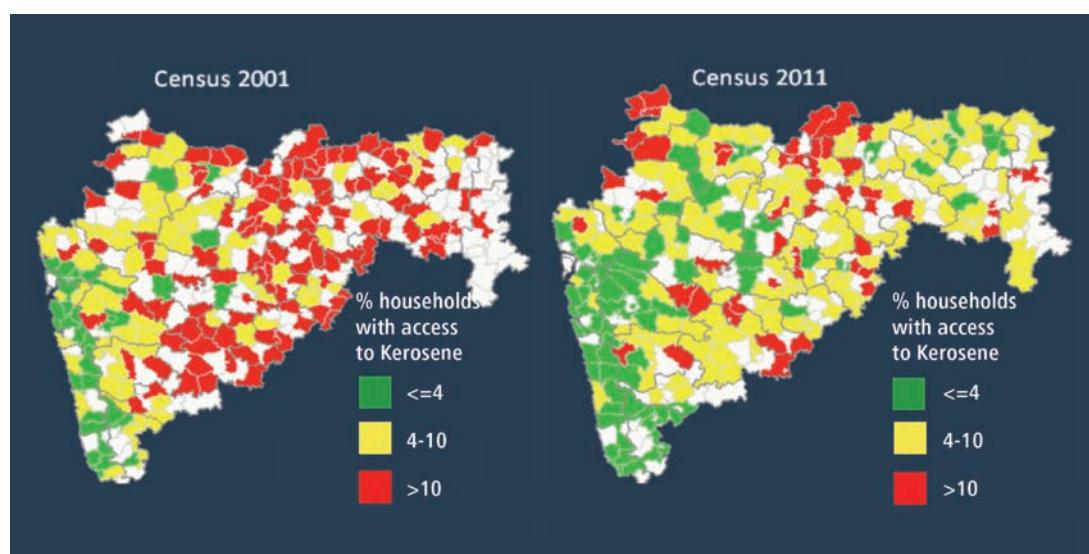
firewood (35 per cent) remains significant. Coal stands at 6 per cent, which is the same as West Bengal ('Rural Odisha's energy mix for cooking' p40).

Urban West Bengal, notwithstanding its development and urbanisation, reveals a sizeable region with more than 33 per cent households being dependent on kerosene for lighting and very few sub-districts where this dependence is below 10 per cent. While rural West Bengal has shown considerable improvement in 2011, compared to 2001, it has a number of sub-districts where more than two-third households still depend on kerosene for lighting (shown in red in 'kerosene as source of lighting in rural West Bengal' p41), while the area where such dependence is below 33 per cent (shown in green) is rather small.

West Bengal shows certain different trends in use of fuel sources for cooking purpose both in the rural and the urban areas. LPG use is pathetically low (4 per cent) while the dependence on firewood (39 per cent) is comparable to that of crop residue (36 per cent). Use of coal (3 per cent) is not significant—a picture that changes in urban areas considerably (see 'Rural and urban West Bengal's energy mix for cooking' p41).

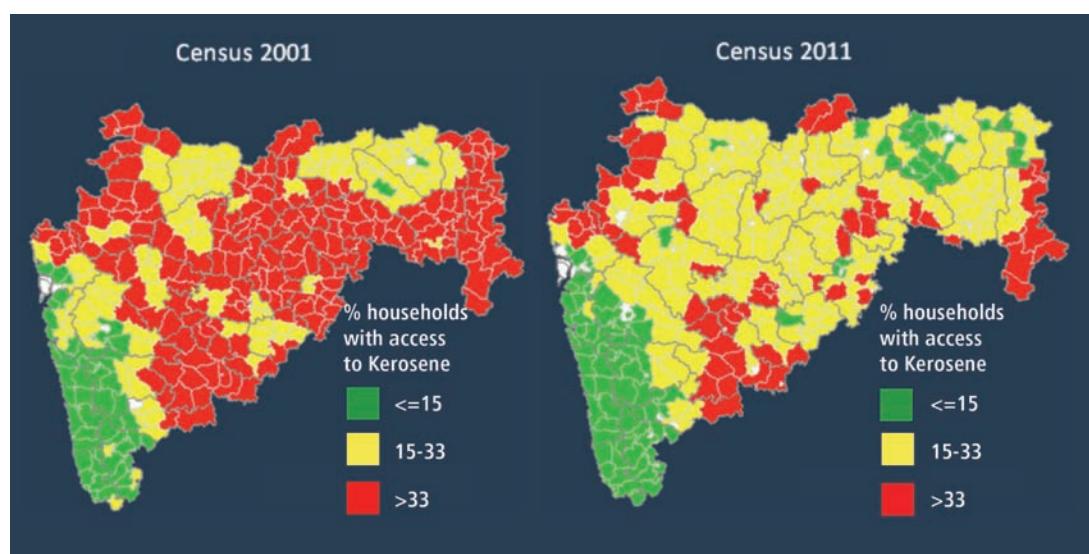
Kerosene as source of lighting in urban Maharashtra

Has been successful in reducing dependency on kerosene



Kerosene as source of lighting in rural Maharashtra

Kerosene use has reduced considerably



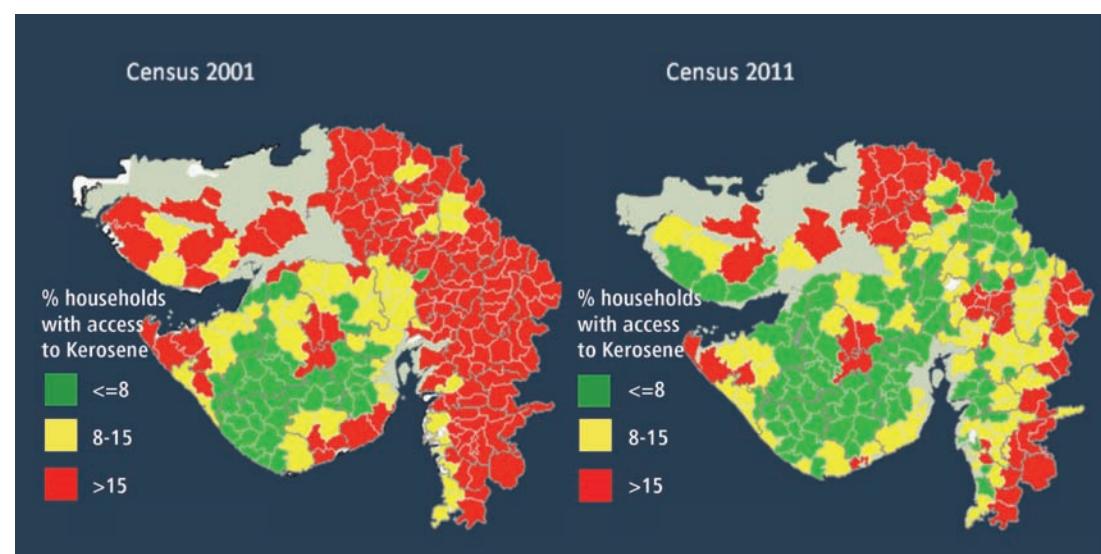
Urban West Bengal does not score very well on LPG usage (48 per cent). Kerosene is used by less than 6 per cent households and even this usage is confined to few pockets. The reduced dependence on firewood (20 per cent) is partly on account of coal (18 per cent). There is surely a case for introduction of improved cook stoves in urban West Bengal.

The western states: Even with a far more stringent benchmark of 10 per cent or more households dependent on kerosene for lighting being shown in red, urban Maharashtra has shown considerable improvement between 2001 and 2011, with sharp reduction in the number of such sub-districts. Meanwhile, sub-districts where less than 4 per cent households use kerosene for lighting (shown in green) has gone up significantly (see ‘Kerosene as source of light in urban Maharashtra p42).

Rural Maharashtra has not been so fortunate (see ‘Kerosene as source of light in rural Maharashtra’ p42). While the number of sub-districts with more than 33 per cent households dependent on kerosene has reduced considerably, most sub-districts remain in the 15 per cent to 33 per cent band (shown in yellow), except the compact cluster in the

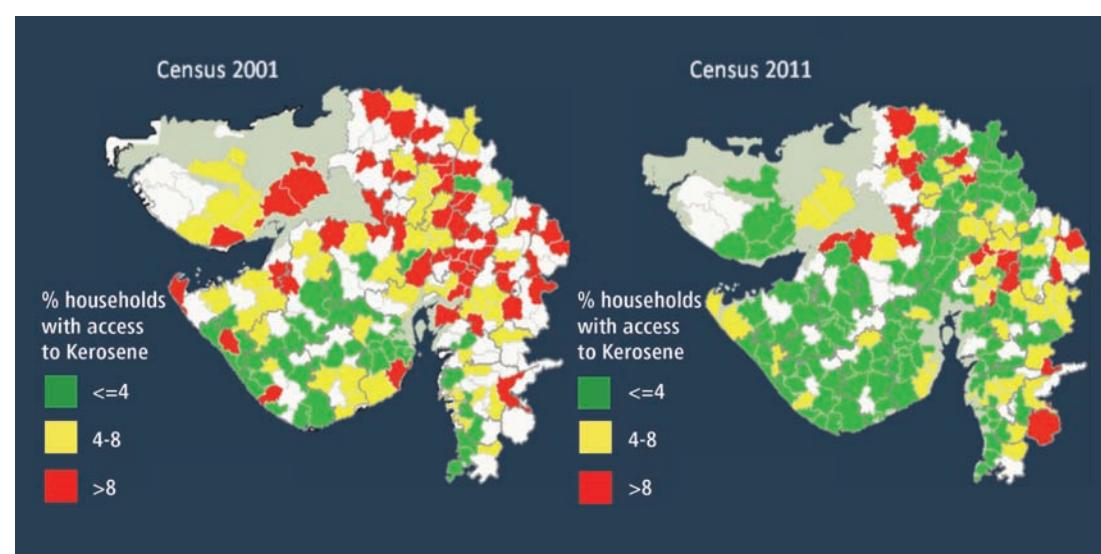
Kerosene as source of lighting in rural Gujarat

Compact clusters on eastern and northern periphery dependent on kerosene



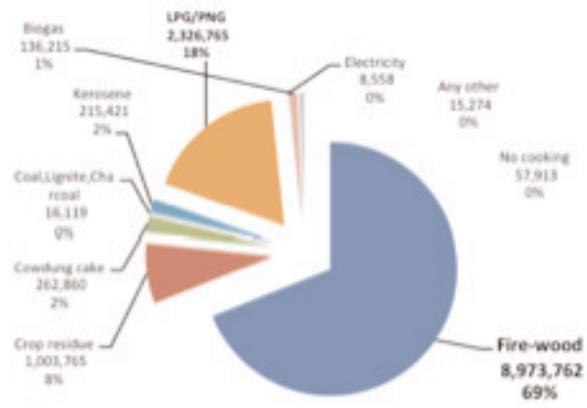
Kerosene as source of lighting in urban Gujarat

Most sub-districts have less dependency on kerosene



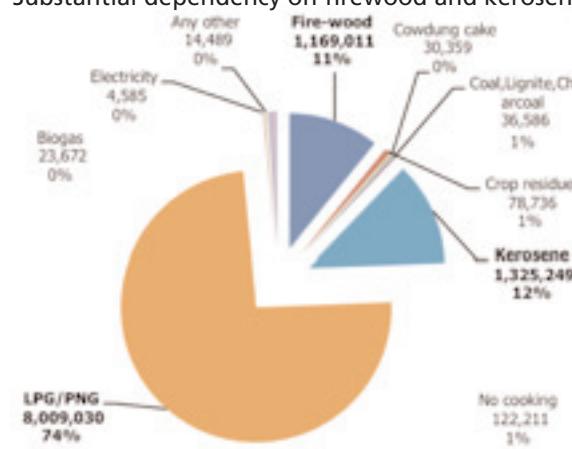
Rural Maharashtra's energy mix for cooking

High dependency on firewood



Urban Maharashtra's energy mix for cooking

Substantial dependency on firewood and kerosene



coastal and western part (shown in green) and a small cluster around Nagpur. Maharashtra's southern neighbours have done better in this regard and so has rural Gujarat.

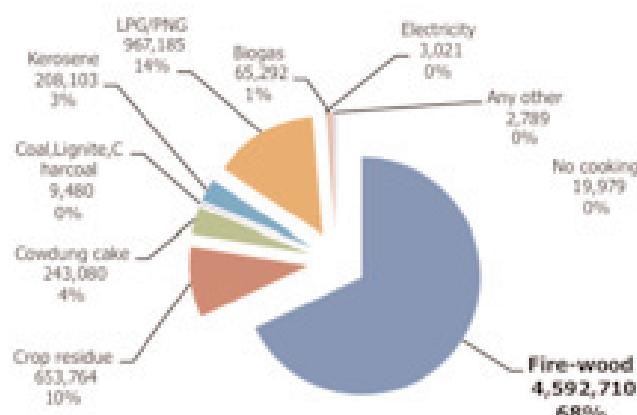
Rural Gujarat has reduced substantially the number of sub-districts where more than 15 per cent households use kerosene. The couple of compact clusters on the eastern and northern periphery should be a matter of concern for planers, though. The cluster where less than 6 per cent households use kerosene for lighting (shown in green) has expanded considerably and contiguously (see 'Kerosene as source of lighting in rural Gujarat' p43).

Not surprisingly, urban Gujarat has performed well, bringing a majority of sub-districts below the benchmark of 4 per cent households depending on kerosene for lighting. It is certainly possible to step this up to cover all urban areas and make the bench mark even tighter (see 'Kerosene as source of lighting in urban Gujarat' p43).

In terms of energy use for cooking, rural Gujarat has not done very well on LPG usage (14 per cent). Kerosene use is certainly low—less than 3 per cent households depend on it. But

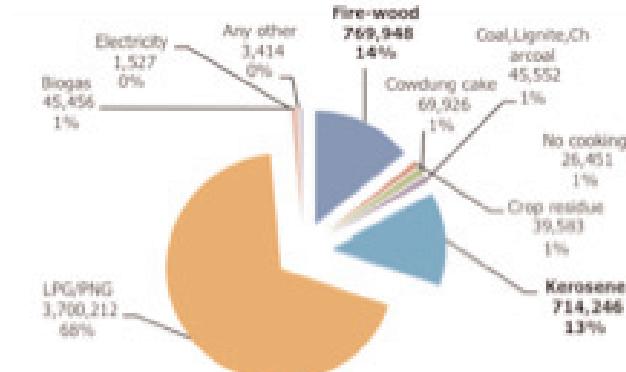
Rural Gujarat's energy mix for cooking

Low dependency on LPG



Urban Gujarat's energy mix for cooking

Substantial dependency on firewood and kerosene

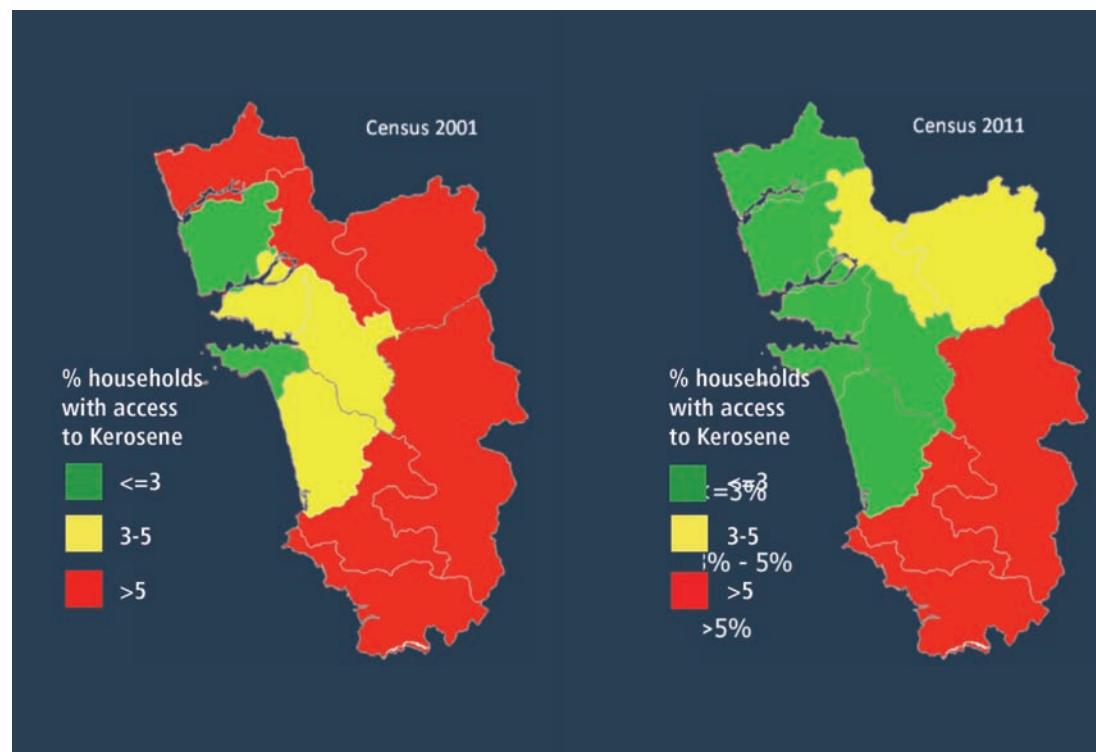


the dependence on firewood (68 per cent) and crop residue (10 per cent) is substantial though the use of cow dung is quite low (see ‘Rural Gujarat’s energy mix for cooking’ p44).

In urban Gujarat, LPG (68 per cent) and firewood (14 per cent) use pattern reverses, and, although other sources are used very less, the use of kerosene (13 per cent) is significant.

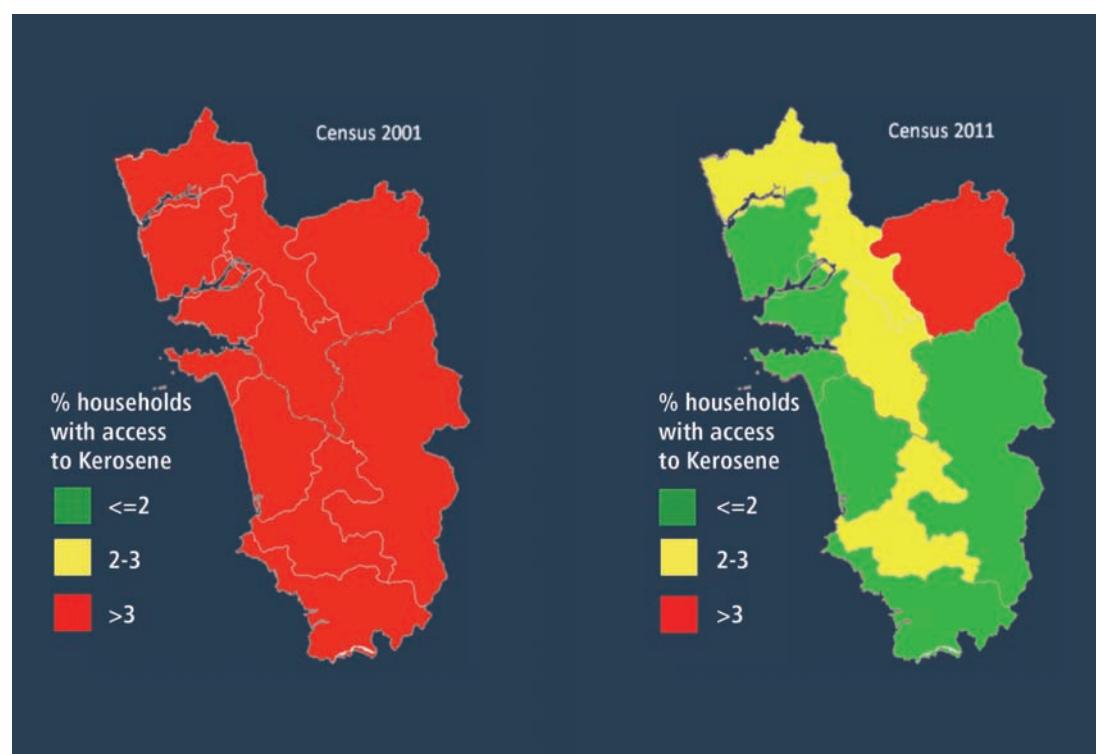
Kerosene used as a source for lighting in rural Goa

Rural Goa has very little dependence on kerosene



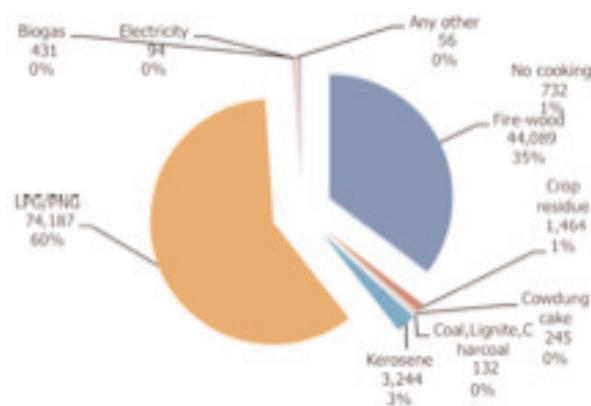
Kerosene used as a source for lighting in urban Goa

Most of the sub-districts use less kerosene

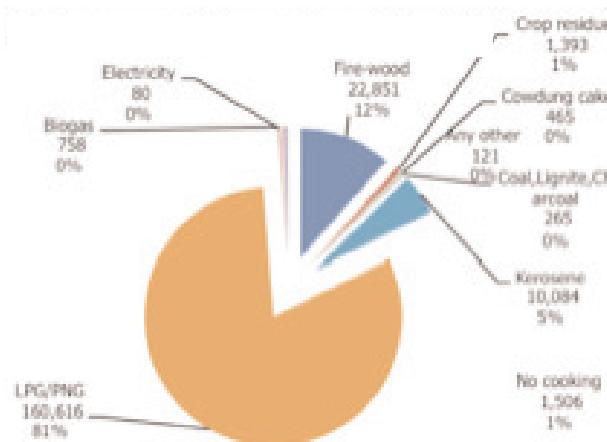


Rural Goa's energy mix for cooking

High dependency on LPG

**Urban Goa's energy mix for cooking**

High dependency on LPG



Rural Maharashtra, too, does not score very well on LPG usage (18 per cent). There is a huge dependence on firewood (69 per cent). Kerosene is used by just about 2 per cent of the households. The pattern is quite similar to that seen for rural Gujarat. In urban Maharashtra, LPG usage (74 per cent) is quite high, with rest of the space being accounted for mainly by kerosene (12 per cent) and firewood (11 per cent) (see 'Rural Gujarat's energy mix for cooking' p44).

It is interesting to see how Goa fares against Gujarat and Maharashtra. Rural Goa has very little dependence on kerosene for lighting and within this it presents an interesting east-west divide (see 'Kerosene as a source for lighting in rural Goa' p45).

Urban Goa has done even better with hardly one sub-district (shown in red) having more than 3 per cent households depending on kerosene for electricity, and a majority where the number of such household is less than 2 per cent (shown in green) (see 'Kerosene as a source for lighting in urban Goa' p45).

LPG usage (60 per cent) in rural Goa is impressive, with firewood (35 per cent) and kerosene (3 per cent) accounting for the rest (see 'Rural Goa's energy mix for cooking'). There is surely a case for introduction of improved cook stoves programme to its optimum given the compact size of the state.

LPG consumption in urban Goa (81 per cent) is impressive by any standard. Firewood (12 per cent) and kerosene (5 per cent) account for the rest (see 'Urban Goa's energy mix for cooking'). Given the power availability, urban Goa could be a pilot for popularising the forced draft blue flame cook stoves.

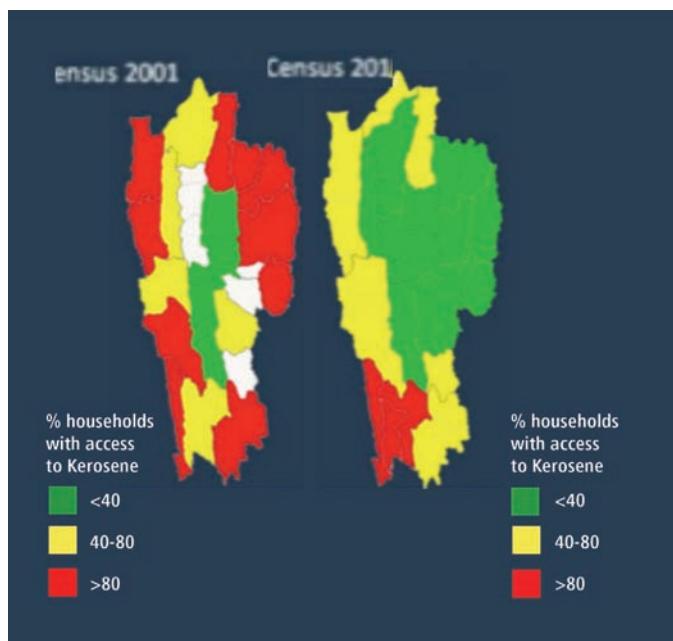
We thus see a stark contrast between the eastern and western states. The important question in the context of the energy divide that emerges is "when will the twain meet—if at all".

'The electricity story in the Ishanya Kone (Sikkim and the seven sisters)'

The north-eastern states have their own energy consumption pattern. Almost all the states, except Assam, have done very well in terms of providing electricity for lighting both urban and rural areas. Most states, however, show heavy dependence on firewood for cooking: as high as 92 per cent in Nagaland and 94 per cent in Tripura. The dependence on firewood

Electricity as a source of lighting in rural Mizoram

High penetration of electricity



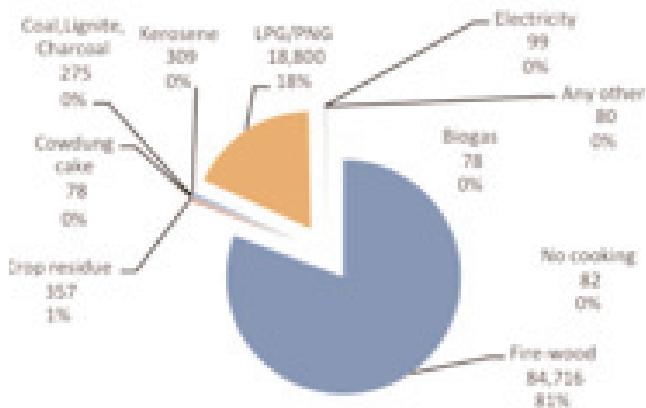
is considerable even in urban areas. The use of LPG in urban areas is considerable in most states.

Use of kerosene is quite insignificant as a cooking fuel. Interestingly, firewood continues to be used for cooking. This makes a case for introducing and popularising forced draft wood cook stoves. Given the efficiency of these *chulhas*, considerable firewood can be saved. More important, however, is the blue flame feature of these cook stoves, which could improve indoor air quality.

We begin with Mizoram. Rural Mizoram boasts of a considerable area where more than 80 per cent households have access to electricity in green (see 'Electricity as a source of lighting in rural Mizoram' p47). The improvement over 2001 is quite discernable in the rest of the state too, except in Lawngtlai district, where the coverage dipped lower than 2001 to 40 per cent. In urban Mizoram, more than 95 per cent households have access to electricity in most sub-districts.

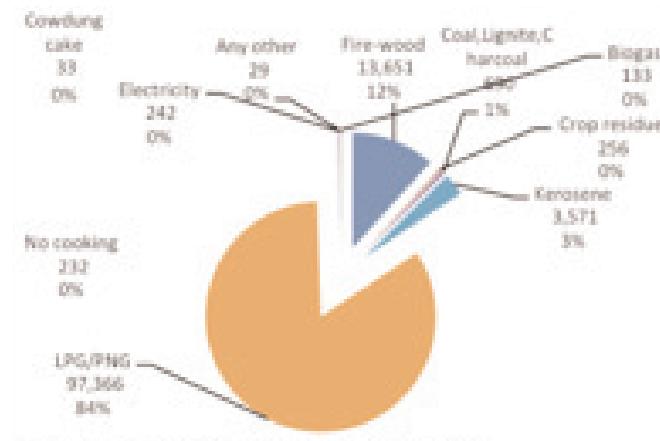
Rural Mizoram's energy mix for cooking

High dependency on firewood



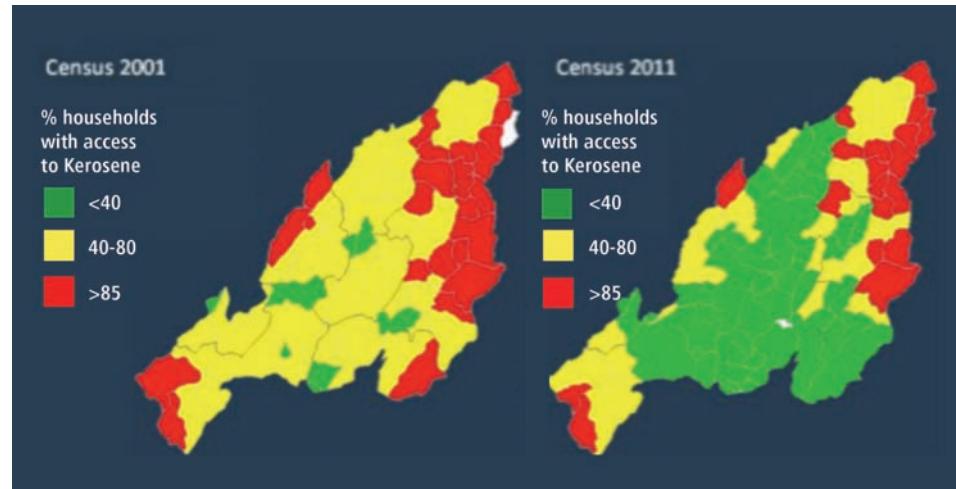
Urban Mizoram's energy mix for cooking

Most areas have access to LPG



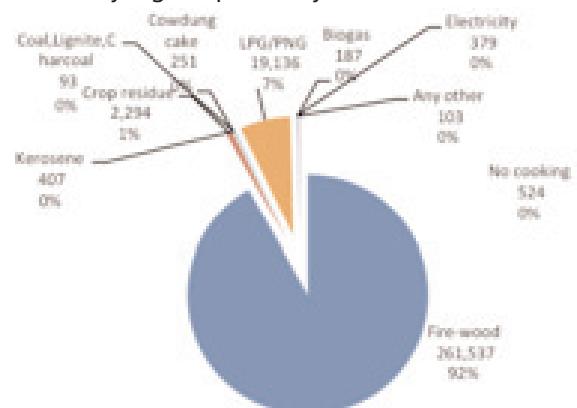
Electricity as source of lighting in rural Nagaland

Most areas have access to electricity



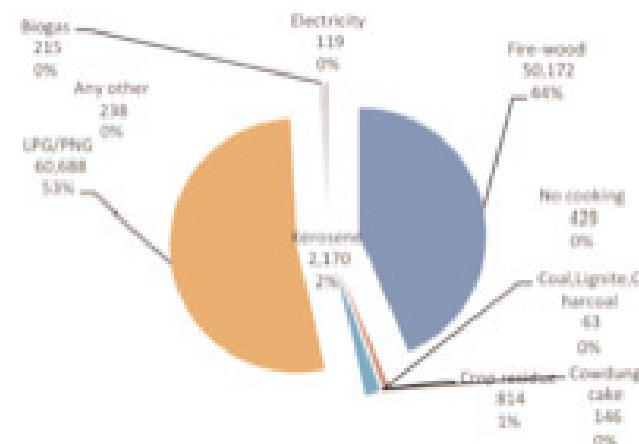
Rural Nagaland's energy mix for cooking

Extremely high dependency on firewood



Urban Nagaland's energy mix for cooking

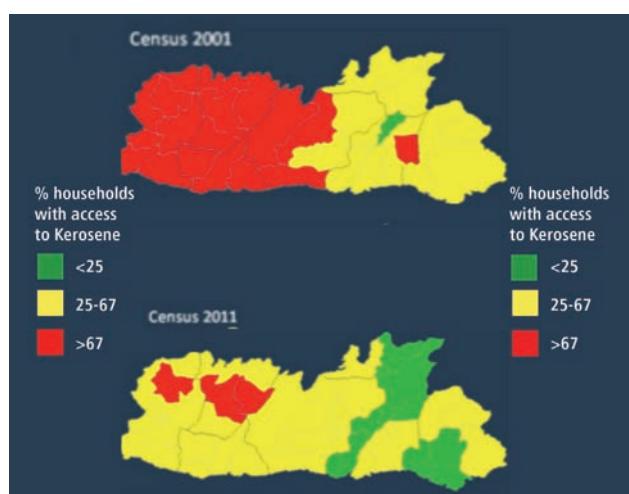
LPG usage lower than that of other north-eastern states



The breakup of cooking fuel is the same in both rural and urban areas. In rural, 81 per cent households use firewood and 18 per cent LPG (see 'Rural Mizoram's energy mix for cooking' p47). In urban areas, 84 per cent households use LPG and 12 per cent firewood (see 'Urban Mizoram's energy mix for cooking' p47). Kerosene is used by about 3 per cent households.

Electricity as light source in rural Meghalaya

Compared to 2001, access to electricity has improved

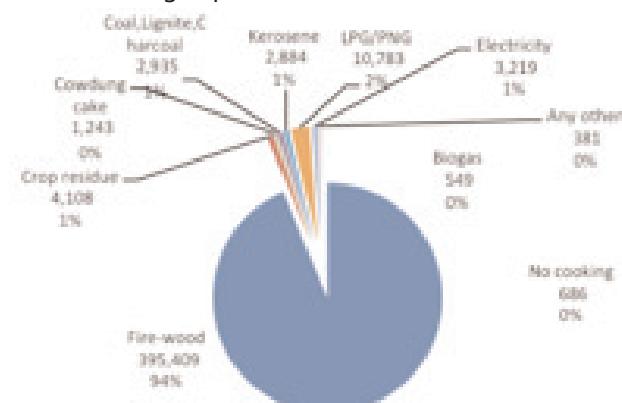


Nagaland is another success story where most rural areas have more than 85 per cent households with electricity (shown in green in 'Electricity as source of lighting in rural Nagaland' p47). The improvement over 2001 is quite striking in rest of the state, too, except in the eastern part where the coverage is low—in some cases below 40 per cent (shown in red). In urban Nagaland, more than 90 per cent households have access to electricity in most sub-districts.

Rural Nagaland shows huge dependency on firewood with 92 per cent households using it (see 'Rural Nagaland's energy mix for cooking' p48). Another 7 per cent use LPG. The remaining fuel sources account for just 1 per cent. In urban Nagaland (see 'Urban Nagaland's energy mix for cooking' p48)), LPG is used by 53 per cent households, which is quite low in comparison with other north-eastern states. Over 44 per cent urban households still use firewood, making it

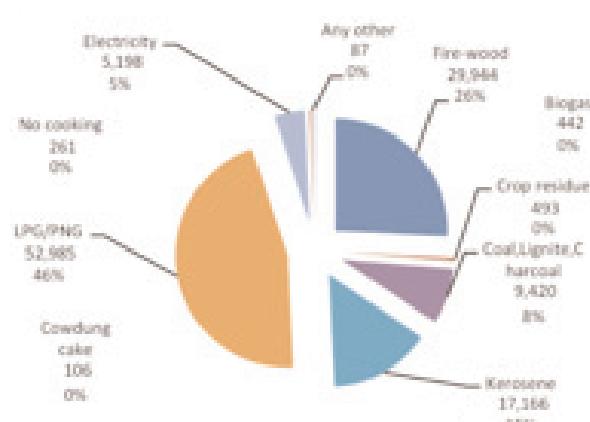
Rural Meghalaya's energy mix for cooking

Overwhelming dependence on firewood



Urban Meghalaya's energy mix for cooking

A balanced energy mix

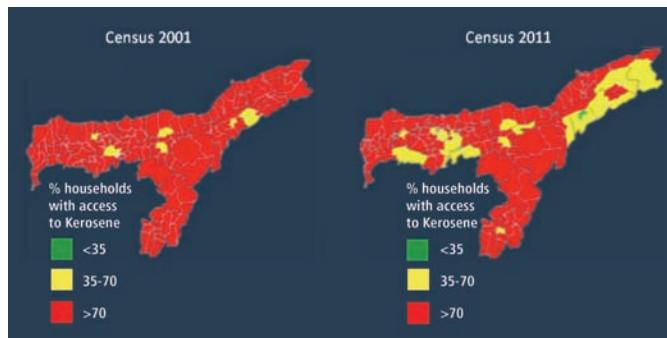


worthwhile to popularise forced draft wood cook stoves.

Meghalaya: Availability of electricity for lighting in rural Meghalaya has improved considerably between 2001 and 2011 (see 'Electricity as light source in rural Meghalaya' p48). Yet a majority of the sub-districts show coverage of only between 15 and 67 per cent (shown in yellow). In urban Meghalaya, the position is much better in 2011 with most sub-districts enjoying coverage of 87 per cent or more households.

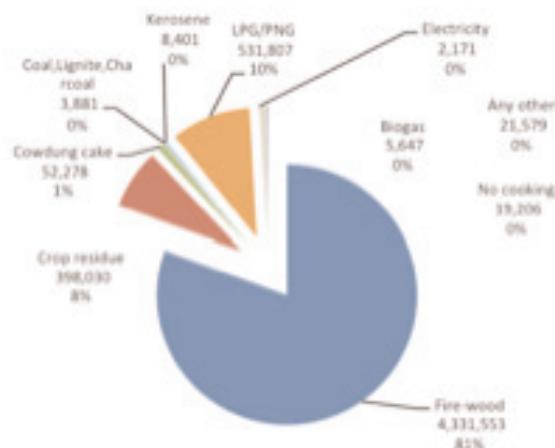
Electricity as source of light in rural Assam

Limited access compared to other north-eastern states



Rural Assam's energy mix for cooking

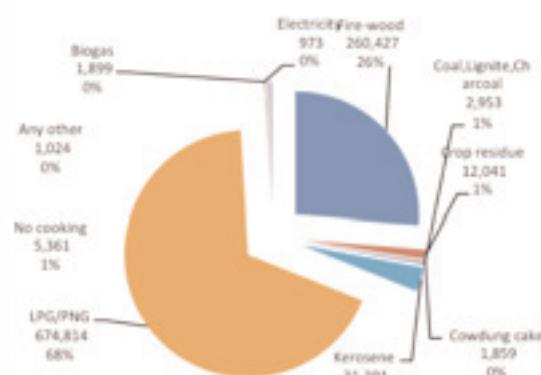
Extremely high dependence on firewood



As regards sources of fuel for cooking, rural and urban Meghalaya provide an interesting contrast. Rural Meghalaya shows overwhelming dependence on firewood at 94 per cent. In urban Meghalaya, the fuel mix is quite broad (see 'Rural and urban Meghalaya's energy mix for cooking' p49).

Urban Assam's energy mix for cooking

Substantial dependence on firewood

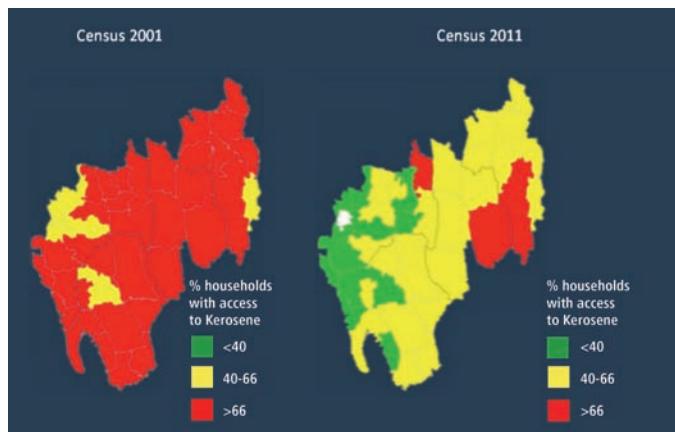


Assam: Rural Assam has performed relatively poorly. Only one sub-district, Jorhat East, has more than 70 per cent households with access to electricity. A large region of the state shows less than 35 per cent households have such an access (shown in red). Even in urban

Assam, a large part has less than 80 per cent households with access to electricity. Consequently, use of kerosene for lighting is significant.

Electricity as light source in rural Tripura

Dependency on kerosene has reduced

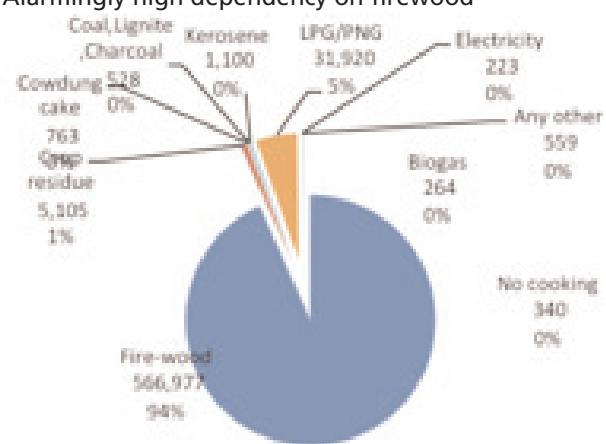


Rural Assam has large dependence on firewood (81 per cent), with LPG accounting for just 10 per cent and crop residue 8 per cent. Other sources are insignificant (see 'Rural Assam's energy mix for cooking' p49). In urban Assam, LPG (68 per cent) and firewood (26 per cent) cover most of the usage, with kerosene accounting for just 3 per cent (see 'Rural Assam's energy mix for cooking' p49).

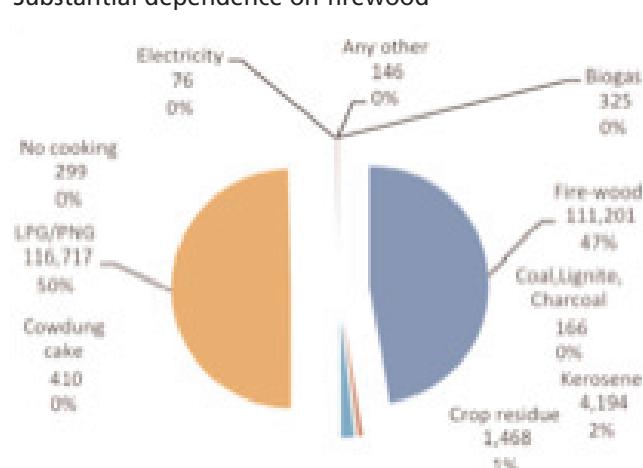
Tripura: Rural Tripura has performed much better compared to Assam in reducing dependence on kerosene (see 'Electricity as light source in Tripura' p49). The

Rural Tripura's energy mix for cooking

Alarming high dependency on firewood

**Urban Tripura's energy mix for cooking**

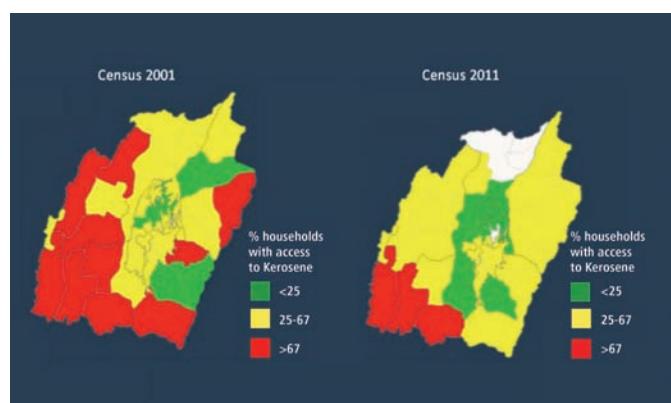
Substantial dependence on firewood



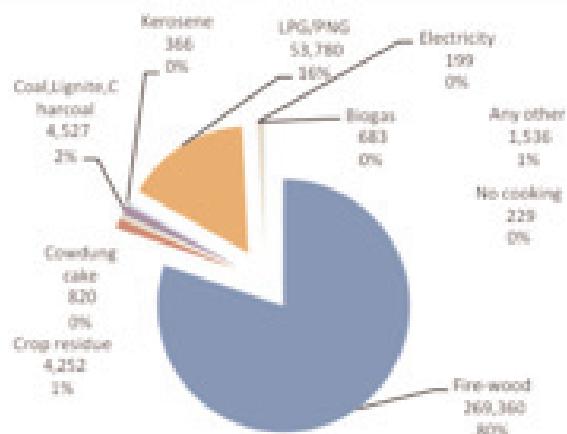
improvement between 2001 and 2011 is discernible except for a small area where less than 40 per cent households have access to electricity for lighting. Urban Tripura has done well with most sub-districts, except three, showing more than 75 per cent households having access to electricity.

Electricity as source of light in rural Manipur

Dependency has gone down

**Rural Manipur's energy mix for cooking**

High dependence on firewood

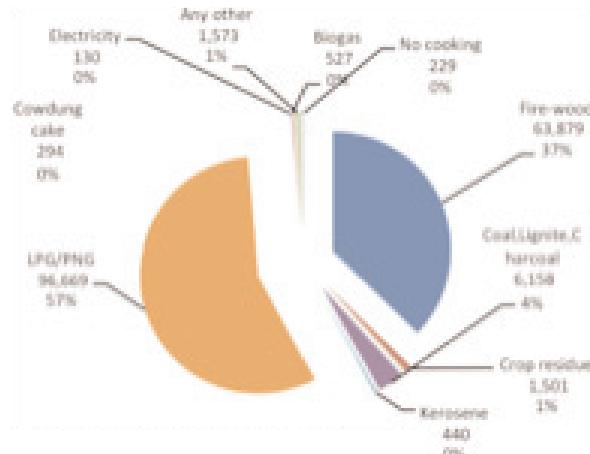


Rural Tripura has the maximum dependence on firewood (94 per net) with LPG accounting for just about 5 per cent (see 'Rural Tripura's energy mix for cooking' p50). Other sources are insignificant. In urban Tripura, the honours are evenly shared between LPG (50 per cent) and firewood (47 per cent) with kerosene accounting for just 3 per cent of the households, numbering only around 4,000 (see 'Urban Tripura's energy mix for cooking' p50).

Manipur: Rural Manipur has also fared satisfactorily in terms of providing electricity for lighting. The improvement between 2001 and 2011 is discernible except for a smaller area in the south-western corner

Urban Manipur's energy mix for cooking

Substantial dependence on firewood



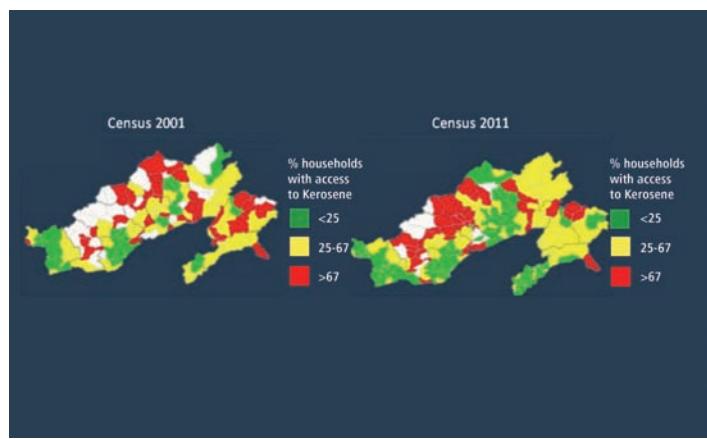
where less than 25 per cent households have access to electricity for lighting.

Urban Manipur has shown improvement between 2001 and 2011 in terms of access of households to electricity for lighting, but surprisingly, in certain part of the central region the coverage has gone down in 2011 compared to 2001. This needs detailed scrutiny.

Rural Manipur shows considerable dependence on firewood as source of fuel for cooking (Lawngtlai) and a low penetration of LPG (16 per cent). Other sources do not count for much except coal (2 per cent) (see ‘Electricity as light source in rural Manipur’ p50). In urban areas, too, LPG (57 per cent) and firewood (37 per cent) account for most of the fuel sources with coal being used by about 4 per cent households (see ‘Rural and urban Manipur’s energy mix for cooking’ p50).

Electricity as source for lighting in rural Arunachal

Many areas have low electricity access

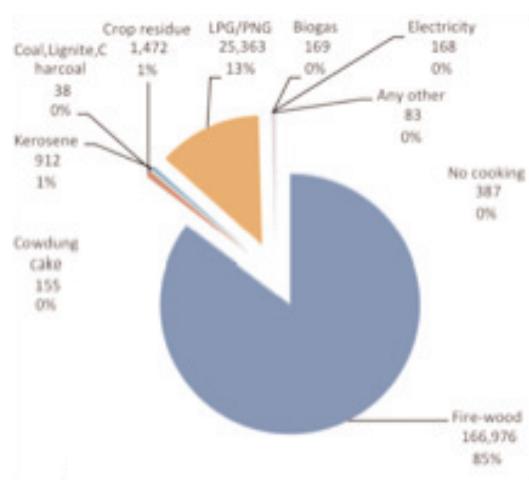


Arunachal Pradesh: Rural Arunachal Pradesh has improved access of households to electricity between 2001 and 2011. However, in many rural areas less than 25 per cent households have access to electricity (shown in red). Urban Arunachal has, of course, done well by providing access to electricity.

Rural Arunachal shows huge dependence on fire wood (85 per cent households) (see ‘Rural Arunachal’s energy mix for cooking’ p50) with LPG covering only 13 per cent of the households in contrast to 78 per cent households in urban areas having access to LPG. Firewood (19 per cent) and kerosene (2 per cent) account for the rest (see ‘Urban Arunachal’s energy mix for cooking’ p50).

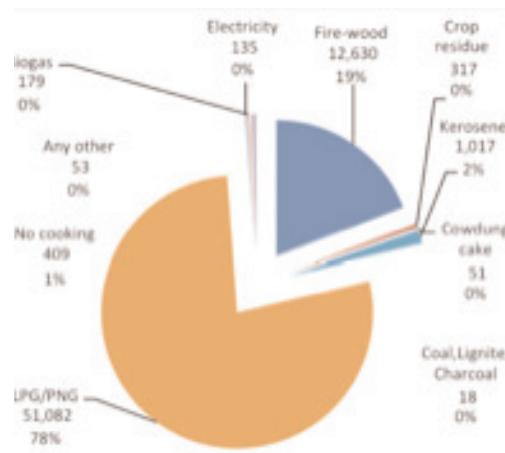
Rural Arunachal’s energy mix for cooking

High dependency on firewood



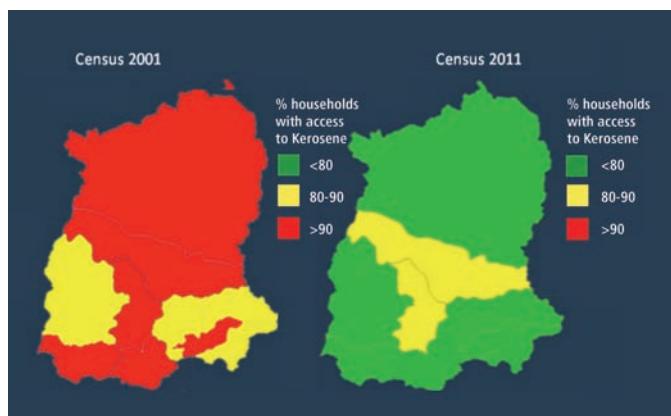
Urban Arunachal’s energy mix for cooking

High penetration of LPG



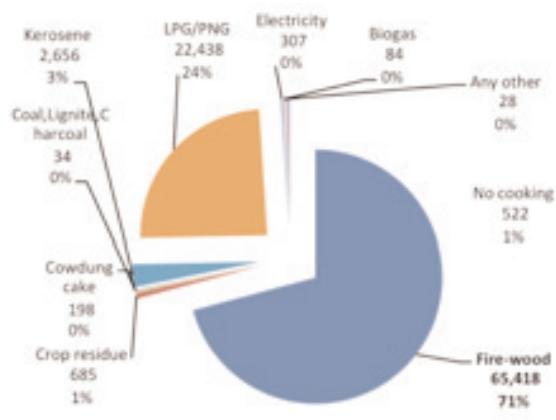
Electricity as source of light in rural Sikkim

Dependency on kerosene has substantially reduced



Rural Sikkim's energy mix for cooking

High dependence on firewood

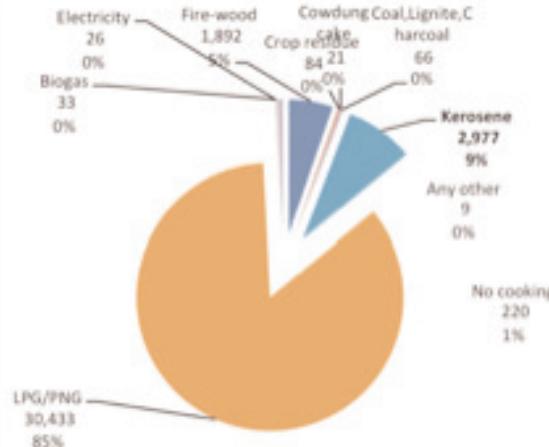


Sikkim: Rural Sikkim has performed remarkably well in providing electricity (see 'Electricity as light source in rural Sikkim' p51). The improvement between 2001 and 2011 is clearly discernible with most sub-divisions showing more than 90 per cent households having access to electricity for lighting (shown in green). In urban Sikkim, the coverage is remarkable too with more than 95 per cent households having access to electricity in most sub-districts.

When it comes to sources for fuel for cooking, rural Sikkim has a huge dependence on firewood (71 per cent) followed by LPG (24 per cent) (see 'Rural Sikkim's energy mix for cooking'). Other sources (5 per cent) are insignificant, with kerosene accounting for 3 per cent out

Urban Sikkim's energy mix for cooking

High penetration of LPG



of these. LPG usage in urban Sikkim is high at 85 per cent (see 'Urban Sikkim's energy mix for cooking'). There are 9 per cent or just 3,000 households that use kerosene. The availability of LPG for 85 per cent urban households and 71 per cent of rural households continue using firewood raises an issue as to whether we are looking at purchasing power being absent in rural areas or whether it is a logistics issue. Coexistence of electricity and use of firewood for cooking perhaps provides an opportunity of looking at promoting forced draft wood stoves.

We thus see that the north-eastern states present a different pattern of energy access. There are some puzzles and some opportunities. The prime minister in one of his addresses in the Northeast had emphasised the importance of keeping the energy situation in right shape in the *Ishanya* (north-east in *Vaastu*) corner of our country. It is time we take up this task.

4 Conclusion

Energy access must be treated as investment for overall human development

We, thus, see that the state-wise analysis of energy consumption patterns both for lighting and cooking gives a much more nuanced insight into the issue of energy access. This is particularly because the maps reveal the clusters of deprivation. They not only show whether the shoe pinches, but where it does. The rhetorical refrain about India-Bharat divide comes alive both in the maps and in the pie-charts. The inequalities in consumption, notwithstanding individual resources in the rural sector, are issues of infrastructure and governance and the failure to make LPG more easily available.

We also notice that while the extent of deprivation may come down, relative deprivation is stable. The change from 2001 to 2011 brings this out in some detail. We also notice that the “one-size-fits-all” formula will not work once we come to the specifics. States have performed differently depending on their resource endowments as well governance abilities. We also notice that the access issue has two dimensions—one infrastructural and the other individual.

The analysis also opens up the debate over why the poor in some of the better-governed states have better access to electricity and LPG compared to the non-poor in some richer states. We also notice that solar home light has not been able to occupy the space occupied by kerosene for lighting, and biogas has not been able to replace kerosene even in places where cow dung is easily available.

We need to take into account the conterminous locations of electricity availability for lighting and use of firewood for cooking. Propagation of improved cook stoves has to be nuanced differently. Analysis of data from NCT of Delhi shows the need to look at the micro data more carefully.

But this also underscores the opportunity and need for promoting the use of solar home lighting, improved cook stoves and biogas plants—three important programmes which have been forgotten in our obsession with solar energy. These three programmes pursued appropriately will give much higher return, and more importantly help bring down the subsidy burden in the two most subsidy-guzzling sectors of our economy—petroleum and fertilisers. Suitable financial incentives are needed for these schemes which should be viewed as “investment” and not “subsidy”, given the attractive returns in monetary terms, in terms of the subsidy saved. The additional health benefits for women and children, the lowering of carbon footprint and reduced imports are added bonus.

While regional disparities are noticeable, the better performance of the hill states is noteworthy. This suggests the possibility of making various regions kerosene-free. One needs to walk on both the legs—eliminate kerosene use from the better-performing states and reduce the dependence on the fuel in some of the heavy-burden states through more effective programmes.

We hope the analysis will contribute towards better policy design and in achieving the desirable objective of “*Tamaso ma jyotirgamaya*” (Lead me from darkness to light), literally.

NOTES

Anil Agarwal 1947-2002

It is truly amazing how much he managed to do in the past seven years. When we first found out he had a rare and possibly fatal lymphoma, which had spread to his brain, his spine and his eyes, his only response was, "Is there a possible treatment?" He took chemotherapy so calmly you would think it was a simple stomach pain.

The focus, even then, was on work. Centre for Science and Environment (CSE) had expanded, started a fortnightly magazine, but with hardly any management systems. In the US and then in France, where Anil went for a bone marrow transplantation, we worked furiously to set up internal systems. Anil's impatience drove colleagues up the wall. But he soon learnt to also give his strength and generosity and, most of all, his time. He died with the knowledge that he had created an institution which would continue to drive the environmental message, as loudly and as stridently as he would have done.

In the 1980s it was generally accepted that environment was "pretty trees and tigers" and that "smoke was the sign of progress". Poverty was the greatest polluter. Anil debunked this effectively. Environment for the poor was not a luxury but a matter of survival. Today, all this is common knowledge. But for someone who has journeyed with him, I know how difficult each step was.

Our book, *Global Warming in an Unequal World* forced us to fight the most powerful research institutions of the industrialised world. The campaign on air pollution made us take on the powerful automobile industry. But Anil never ever let us, even for one moment, feel that we were less powerful. This is because his faith in democracy was total. As long as we were absolutely sure about our facts we could challenge the world.

"Forensic rigour combined with passion" was how a leading UK journalist described CSE's work. My last memory of him — barely minutes before he died — was Anil correcting me about something I was saying to a journalist on the phone about a report on the auto fuel policy. For Anil, life began and ended with work.

Sunita Narain



Chronology

- 1970: Graduated in Mechanical Engineering from Indian Institute of Technology, Kanpur.
- 1973: Joined *The Hindustan Times* as a science journalist. The Chipko Movement catalyses his understanding of environment-development processes.
- 1982: Founder-director, Centre for Science and Environment (CSE).
- 1983: Co-editor, *First Citizen's Report on the State of India's Environment*.
- 1985: Co-editor, *Second Citizen's Report on the State of India's Environment*.
- 1986: Prime Minister Rajiv Gandhi invites him to address the Council of Ministers.
- 1992: Started *Down To Earth* magazine.
- 1996: Began Right to Clean Air campaign, instrumental in introducing CNG-based public transport in Delhi.
- 1997: With *Dying Wisdom: the Rise, Fall and Potential of India's Traditional Water Harvesting Systems*, started a campaign to popularise rainwater harvesting. *Making Water Everybody's Business* was a subsequent seminal publication.
- 1997: Launched the Green Rating Project, aimed at making industry more environment-friendly. Guided the rating of the automobile industry, and the paper and pulp industry.
- 1999: Co-editor, *Green Politics*, on global environmental negotiations. Along with *Poles Apart* (2001), considered important books on the Third World's perspective on these treaties.

Awards

- 2000: Padma Bhushan, Government of India, New Delhi
- 2000: Environment Leadership Award, given by the Global Environment Facility, Washington DC
- 1994: Environmentalist of the Year by *Les Realites de l'Ecologie*, France
- 1991: Distinguished Alumnus Award, Indian Institute of Technology, Kanpur.
- 1987: Elected to the Global 500 Honour Roll by the United Nations Environment Programme. Honour Summus Award, Watumull Foundation, Hawaii.
- 1986: Padma Shri by the Government of India, New Delhi.
- 1984: Fifth Vikram Sarabhai Memorial Award by the Indian Council of Social Science Research, New Delhi.
- 1979: First A. H. Boerma Award given by the Food and Agriculture Organisation in Rome



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