IDENTIFYING MICRO-MARKETS FOR CLEAN ENERGY ACCESS IN UTTAR PRADESH

An analysis of un-electrification, banking services and asset ownership data in Uttar Pradesh

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INTRODUCTION

Social enterprises, supported by impact investors, often provide distributed renewable energy products and services to the poor. These social enterprises need to run their businesses in a financially sustainable manner and impact investors need to generate a positive return on their capital. It is therefore important to target areas which do not receive electricity from the public utilities but at the same time have enough economic capacity to pay for distributed renewable energy products and services.

There is no scientific method to choose target markets. Data on the availability of electricity in rural areas, as can be obtained from utilities is, at best, a metric of the infrastructure to deliver power and not its actual delivery of power to households. Income data at the consumer household level is hard to obtain as many of them lie outside the formal economy. Consumer economic data, as it exists, is often the proprietary information of larger private organizations and social enterprises do not have budgets to undertake detailed market surveys. Impact investors have to also deal with the risk that utility grid expansion plans could make the investment in distributed renewable energy redundant. The inability to apply standard marketing principles is a key bottleneck for scaling of renewable energy solutions that run on the principles of the market economy.

We propose a methodology, based on publicly available Census data in India, to identify districts (administrative units) which meet a set of cascading criteria. We start by identifying districts that have a high percentage of rural households that do not have access to the grid from Census data on their main source of lighting and analyse the pattern of solar lighting products in these districts. For the first criteria, we choose districts that have a relatively large number of households that have bank accounts. This enables both companies whose business models depend on the household level financing of Solar Home Systems by banks as well as companies whose business models depend on the financing of village level entrepreneurs who run micro grids or rent solar individual lighting solutions to select the micro markets where they can focus their limited marketing budgets. At the next level, we choose districts that exhibit relatively buoyant economies based on the rate of increase of asset ownership (in our analysis we have taken the proxy assets as televisions and motorized vehicles). Finally, we look at the 10 year data on household level electricity access to identify areas where grid expansion activity is the most sluggish to help mitigate the risk of infrastructure redundancy.

This data and methodology will help social enterprises target the initial markets of customer adoption, the key early innovator markets needed for any new technology adoption. Our discussions with enterprises on choice of districts almost invariably throws up the responses that enterprises choose districts based on overall extent of un-electrification or based on the desire to create impact in the poorest districts. Our analysis indicates that a far more fine grained approach is required to identify districts in what are extremely challenging markets.

We also hope that this methodology can be adopted by other countries in emerging Asia and Sub Saharan Africa. Finally, we hope that other public and private data sources can be made available to interlay on the Census methodology to provide more frequent and more fine-grained market analysis.

In this report, we apply the methodology to the Indian state of Uttar Pradesh.

OVERVIEW OF UN-ELECTRIFICATION, BANKING SERVICES AND ASSETS

The table below summarizes the total population, percentage of rural households, extent of un-electrification, solar penetration, banking services and asset ownership for the entire state of Uttar Pradesh.

Table 1: Population, Urbanization, Un-electrification, Solar penetration, Banking services and Asset penetration for Uttar Pradesh in 2011 and 2001

		2011	2001
Population	Rural + Urban	199,812,341	166,197,921
Households	Rural + Urban	32,924,266	25,760,601
	Rural	**25,475,071**	**20,590,074**
	Urban	7,449,195	5,170,527
As a % of total households	% of rural households to total households	**77.37%**	**79.93%**
	% of urban households to total households	22.63%	20.07%
Un-electrification	% of households that are un-electrified	63.19%	68.10%
	% of rural households that are un-electrified	**76.23%**	**80.16%**
	% of urban households that are un-electrified	18.58%	20.08%
Solar penetration	% solar households to total un-electrified households	0.75%	0.53%
	% solar households to total rural un-electrified households	**0.73%**	**0.49%**
	% solar households to total urban un-electrified households	1.14%	1.19%
Banking services	% of households availing banking services	72.02%	44.12%
	% of rural households availing banking services	**73.58%**	**41.90%**
	% of urban households availing banking services	66.68%	52.96%
Television sets	% of households owning television sets	33.21%	25.00%
	% of rural households owning television sets	**23.54%**	**16.01%**
	% of urban households owning television sets	66.30%	60.79%
Vehicles	% of households owning vehicles	23.40%	12.62%
	% of rural households owning vehicles	**17.59%**	**8.17%**
	% of urban households owning vehicles	43.30%	30.32%

We draw attention to the following changes in the ten years between 2011 and 2001:

- The overall percentage of rural households in Uttar Pradesh decreased marginally from about 80% (in 2001) to just above 77% (in 2011).
- Most households in rural Uttar Pradesh are un-electrified and the percentage has decreased by about 4% from about 80% (in 2001) to 76% (in 2011).
- Solar penetration remains very small at less than 1%.
- The percentage of rural banked households increased by 32% from about 42% (in 2001) to about 74% (in 2011)
- Television ownership increased in both rural and urban areas. 23% of households in rural areas own a television which is the same percentage of households who receive power from the grid.
- The percentage of households owning vehicles doubled in rural areas from about 8% to about 17%.

Status of solar penetration and un-electrification in rural Uttar Pradesh

The table below shows the top 10 districts with maximum rural solar penetration and the extent of un-electrification in these districts.

Table 2: Solar penetration and un-electrification in rural Uttar Pradesh in 2011

District	Solar penetration among un-electrified rural HHs in 2011	% of rural HHs that were using sources other than solar (since they were un-electrified) or had no lights in 2011
Sonbhadra	2.97%	80.36%
Jyotiba Phule Nagar	1.53%	85.85%
Kannauj	1.50%	84.54%
Lalitpur	1.50%	71.09%
Hardoi	1.38%	92.17%
Moradabad	1.17%	84.65%
Barabanki	1.12%	84.64%
Mahoba	1.08%	81.33%
Kanpur Nagar	1.05%	83.42%
Rampur	0.97%	81.51%

The table above shows that even within the top 10 districts with maximum solar penetration, more than 80% of the rural households were using sources other than solar.

There has been an ***overall increase in number of un-electrified rural households*** over the 2001-2011 period. The potential market size for renewable energy products has increased from 16,425,054 households in 2001 to 19,278,985 households in 2011.

Identifying target districts in rural Uttar Pradesh

As we saw in table 1, about 76% of the rural households in Uttar Pradesh were un-electrified in 2011. With about 93% un-electrified rural households, ***Hardoi*** reported the highest and with about 32% un-electrified rural households, ***Agra*** reported the lowest un-electrification rates.

For the analysis of extent of un-electrification, we have divided the 70 rural districts into four subsets or four quartiles as explained in "Annexure" - "Understanding quartiles". The upper limit of the dataset is the data-point for maximum un-electrification – 93.46%. Based on the highest value (93.46%) and the lowest value of the dataset (32.12%) the median value is calculated – 77.55%. 50% of the 70 rural districts will lie between the median value and the upper limit of the dataset. 50% of the 70 rural districts will lie between the lower limit and the median value.

Table 3: Quartiles for un-electrified rural HHs in 2011

Quartile	Upper limit of every quartile
First quartile (In 25% of districts 32.12%< un-electrification<69.61%)	69.61%
Median value (In 25% of districts - 69.61% < un-electrification < 77.55%)	77.55%
Third quartile (In 25% of districts - 77.55%< un-electrification < 85.64%)	85.64%
Fourth quartile (In 25% of districts - 85.64%<un-electrification<93.46%)	93.46%

In a similar manner, we have divided the dataset of 70 districts into four quartiles for banking services and asset ownership. The objective is to identify districts with high rate of un-electrification, large number of households that have bank accounts and high growth rate in asset ownership.

Identifying target districts among the most un-electrified districts

In 2011, 18 districts in the fourth quartile (85.64%<un-electrification<93.46%) with maximum un-electrification across rural Uttar Pradesh were:

Table 4: Districts with maximum un-electrified rural households in 2011

District in the fourth quartile	% of un-electrified rural HHs in 2011
Hardoi	93.46%
Sitapur	92.87%
Unnao	91.57%
Budaun	90.85%
Fatehpur	90.69%
Shrawasti	90.51%
Bahraich	90.18%
Kanpur Dehat	89.31%
Kheri	88.49%
Shahjahanpur	88.34%
Kaushambi	87.46%
Etah	87.29%
Jyotiba Phule Nagar	87.19%
Balrampur	86.84%
Pilibhit	85.98%
Kannauj	85.83%
Banda	85.80%
Moradabad	85.66%

We will rank these 18 districts with the maximum rural un-electrification in 2011 against their banking quartiles below: (1 – banking quartile shows least banking penetration and 4 – shows highest banking penetration)

Table 5: Banking services in rural districts with maximum un-electrification in 2011

District with maximum rural un-electrification	Banking quartiles	% of rural HHs that had bank accounts in 2011
Hardoi	2	68.66%
Sitapur	4	80.68%
Unnao	2	69.08%
Budaun	1	46.53%
Fatehpur	2	68.12%
Shrawasti	2	72.55%
Bahraich	1	66.14%
Kanpur Dehat	1	67.42%
Kheri	4	81.35%
Shahjahanpur	2	69.14%
Kaushambi	1	66.81%
Etah	1	60.34%
Jyotiba Phule Nagar	4	79.87%
Balrampur	4	82.62%
Pilibhit	3	75.01%
Kannauj	2	68.86%
Banda	1	62.77%
Moradabad	2	69.67%

Among the 18 districts with maximum un-electrification rates in 2011:

- 4 districts have the highest rural household (more than 79.02%) banking penetration. They are ***Sitapur, Kheri, Jyotiba Phule Nagar*** and ***Balrampur***.
- 1 district has more than 73.55% banking penetiration (3- banking quartile). The district is ***Pilibhit***.

We will next rank the 18 districts with the maximum extent of rural un-electrification in 2011 against their increase in asset ownership quartiles. (1 – asset quartile shows least asset growth and 4 – shows highest asset growth)

Table 6: Increase in Television and Vehicle ownership in rural districts with maximum un-electrification in 2011

District with maximum rural un-electrification	Increase in Television ownership quartiles	Increase in Vehicle ownership quartiles
Hardoi	2	1
Sitapur	1	1
Unnao	1	2
Budaun	2	1
Fatehpur	1	2
Shrawasti	1	1
Bahraich	1	1
Kanpur Dehat	1	2
Kheri	2	1
Shahjahanpur	1	1
Kaushambi	1	1
Etah	3	3
Jyotiba Phule Nagar	2	4
Balrampur	1	1
Pilibhit	1	2
Kannauj	2	2
Banda	1	1
Moradabad	1	3

- While generally districts with maximum un-electrification fare poorly on increase in asset ownership scale, ***Jyotiba Phule Nagar, Etah*** and ***Moradabad*** have reported higher increase in % of households owning asset (vehicle or television or both) vs. others.

- Among the 18 districts which have the maximum extent of un-electrification the district which satisfies the condition of high banking penetration AND high asset penetration growth rate is ***Jyotiba Phule Nagar.***

Identifying districts in the third quartile of rural un-electrification dataset

In 2011, districts in the third quartile (77.55%<un-electrification<85.64%) of the un-electrification dataset were:

Table 7: Districts in the third quartile of rural un-electrification dataset in 2011

District in the third quartile	% of un-electrified rural HHs in 2011
Bareilly	85.60%
Barabanki	85.59%
Gonda	84.93%
Kanpur Nagar	84.30%
Farrukhabad	84.29%
Ghazipur	84.01%
Mainpuri	83.58%
Sonbhadra	82.82%
Auraiya	82.49%
Rampur	82.31%
Mahoba	82.22%
Hamirpur	81.86%
Maharajganj	80.62%
Chitrakoot	80.31%
Kushinagar	79.31%
Ballia	79.08%
Siddharthnagar	77.80%

We will rank these 17 districts against their banking quartiles below (1 – banking quartile shows least banking penetration and 4 – shows highest banking penetration).

Table 8: Banking services in rural districts in the third quartile of un-electrification dataset in 2011

District in the third quartile of un-electrification dataset	Banking quartiles	% of rural HHs that had bank accounts in 2011
Bareilly	2	69.32%
Barabanki	3	77.29%
Gonda	4	80.03%
Kanpur Nagar	3	75.27%
Farrukhabad	1	63.85%
Ghazipur	3	77.55%
Mainpuri	1	66.20%
Sonbhadra	4	82.09%
Auraiya	1	62.65%
Rampur	2	71.06%
Mahoba	3	74.33%
Hamirpur	3	74.26%
Maharajganj	4	82.89%
Chitrakoot	2	68.57%
Kushinagar	4	85.60%
Ballia	3	77.21%
Siddharthnagar	3	78.63%

Among the 17 districts with un-electrification rates between 77.55% and 85.64% in 2011:

- 4 districts have the highest rural household (more than 79.02%) banking penetration. They are ***Gonda, Sonbhadra, Maharajganj and Kushinagar.***
- 7 districts have more than 73.55% banking penetration (3 – banking quartile). They are ***Barabanki, Kanpur Nagar, Ghazipur, Mahoba, Hamirpur, Ballia and Siddharthnagar.***

We will next rank these 17 districts against their increase in asset ownership quartiles. (1 – asset quartile shows least asset growth and 4 – shows highest asset growth)

Table 9: Increase in Television and Vehicle ownership in rural districts in the third quartile of un-electrification dataset in 2011

Districts in the third quartile of rural un-electrification dataset	Increase in Television ownership quartiles	Increase in Vehicle ownership quartiles
Bareilly	3	3
Barabanki	1	2
Gonda	1	1
Kanpur Nagar	1	1
Farrukhabad	2	3
Ghazipur	3	3
Mainpuri	3	3
Sonbhadra	2	1
Auraiya	3	2
Rampur	1	4
Mahoba	4	2
Hamirpur	3	1
Maharajganj	3	1
Chitrakoot	2	1
Kushinagar	2	2
Ballia	3	2
Siddharthnagar	2	2

Among the 17 districts which have the rural un-electrification rates between 77.55% and 85.64%,

- **2** districts reported the highest increase in % of households owning asset (television or vehicle). The districts are ***Rampur*** and ***Mahoba***.
- **8** districts reported high increase in % of households owning asset (vehicle or television or both). These districts are ***Bareilly, Farrukhabad, Ghazipur, Mainpuri, Auraiya, Hamirpur, Maharajganj and Ballia.***

5 districts which satisfy the condition of high banking penetration AND high asset penetration growth rate are ***Ghazipur, Mahoba, Hamirpur, Maharganj*** and ***Ballia***.

Identifying districts in the second quartile of rural un-electrification dataset

In 2011, districts in the second quartile (69.61%<un-electrification<77.55%) of the un-electrification dataset were:

Table 10: Districts in the second quartile of rural un-electrification dataset in 2011

District in the second quartile	% of un-electrified rural HHs in 2011
Ambedkar Nagar	77.30%
Jaunpur	77.23%
Faizabad	77.15%
Pratapgarh	76.44%
Azamgarh	75.93%
Basti	74.64%
Bulandshahr	74.21%
Jalaun	73.94%
Aligarh	73.44%
Chandauli	72.28%
Deoria	72.21%
Lalitpur	72.17%
Sant Kabir Nagar	72.04%
Etawah	70.74%
Firozabad	70.73%
Jhansi	69.92%
Lucknow	69.80%

We will rank these 17 districts against their banking quartiles below (1 – banking quartile shows least banking penetration and 4 – shows highest banking penetration).

Table 11: Banking services in rural districts in the second quartile of un-electrification dataset in 2011

District in the second quartile of un-electrification dataset	Banking quartiles	% of rural HHs that had bank accounts in 2011
Ambedkar Nagar	4	79.23%
Jaunpur	4	83.07%
Faizabad	4	82.83%
Pratapgarh	4	82.68%
Azamgarh	4	81.52%
Basti	4	88.43%
Bulandshahr	1	65.09%
Jalaun	3	76.61%
Aligarh	1	66.79%
Chandauli	3	75.85%
Deoria	4	82.58%
Lalitpur	2	69.35%
Sant Kabir Nagar	4	81.71%
Etawah	1	60.36%
Firozabad	1	51.78%
Jhansi	2	72.05%
Lucknow	2	68.13%

Among the 17 districts with un-electrification rates between 69.61% and 77.55% in 2011,

- 8 districts have highest rural household (more than 79.02%) banking penetration. The districts are ***Ambedkar Nagar, Jaunpur, Faizabad, Pratapgarh, Azamgarh, Basti, Deoria*** and ***Sant Kabir Nagar.***
- 2 districts have more than 73.55% banking penetration rate (3 - banking quartile). The districts are ***Jalaun*** and ***Chandauli***.

We next rank these districts against their increase in asset ownership quartiles. (1 – asset quartile shows least asset growth and 4 – shows highest asset growth)

Table 12: Increase in Television and Vehicle ownership in rural districts in the second quartile of un-electrification dataset in 2011

Districts in the second quartile of rural un-electrification dataset	Increase in Television ownership quartiles	Increase in Vehicle ownership quartiles
Ambedkar Nagar	1	3
Jaunpur	3	3
Faizabad	1	3
Pratapgarh	2	3
Azamgarh	3	3
Basti	2	3
Bulandshahr	4	4
Jalaun	4	4
Aligarh	4	4
Chandauli	4	2
Deoria	3	3
Lalitpur	3	3
Sant Kabir Nagar	2	2
Etawah	3	3
Firozabad	4	4
Jhansi	4	4
Lucknow	3	4

Among the 17 districts with un-electrification rates between 69.61% and 77.55% in 2011,

- 7 districts have reported the highest increase in % of households owning asset (television or vehicle or both). The districts are ***Bulandshahr, Jalaun, Aligarh, Chandauli, Firozabad, Jhansi*** and ***Lucknow.***

- 9 districts reported high increase in % of households owning asset (vehicle or television or both). These districts are ***Ambedkar Nagar, Jaunpur, Faizabad, Pratapgarh, Azamgarh, Basti, Deoria, Lalitpur*** and ***Etawah.***

Among the 17 districts with un-electrification rates between 69.61% and 77.55% in 2011, 9 districts satisfy the condition of high banking penetration AND high asset penetration growth rate. The districts are ***Ambedkar Nagar, Jaunpur, Faizabad, Pratapgarh, Azamgarh, Basti, Jaluan, Chandauli*** and ***Deoria.***

Identifying districts in the first quartile of rural un-electrification dataset

In 2011, districts in the first quartile (un-electrification<69.61%) of the un-electrification dataset that had the lowest % of rural households that were un-electrified were:

Table 13: Districts in the first quartile of rural un-electrification dataset in 2011

District in the first quartile	% of un-electrified rural HHs in 2011
Allahabad	69.55%
Mirzapur	69.29%
Gorakhpur	68.20%
Sant Ravidas Nagar Bhadohi	67.87%
Bijnor	67.35%
Sultanpur	65.35%
Rae Bareli	62.93%
Mau	62.52%
Varanasi	60.34%
Muzaffarnagar	57.13%
Hathras/ Mahamaya Nagar	56.89%
Baghpat	49.00%
Meerut	43.13%
Gautam Buddha Nagar	42.94%
Mathura	41.45%
Saharanpur	41.17%
Ghaziabad	35.53%
Agra	32.12%

The lowest rural un-electrification rate is in the Agra district.

We will rank these 18 districts against their banking quartiles below (1 – banking quartile shows least banking penetration and 4 – shows highest banking penetration).

Table 14: Banking services in rural districts in the first quartile of un-electrification dataset in 2011

District in the first quartile of un-electrification dataset	Banking quartiles	% of rural HHs that had bank accounts in 2011
Allahabad	2	71.49%
Mirzapur	3	75.79%
Gorakhpur	4	79.03%
Sant Ravidas Nagar Bhadohi	3	75.58%
Bijnor	3	77.80%
Sultanpur	3	79.01%
Rae Bareli	3	78.18%
Mau	4	81.30%
Varanasi	3	77.16%
Muzaffarnagar	1	67.10%
Hathras/ Mahamaya Nagar	1	65.49%
Baghpat	2	73.02%
Meerut	2	71.46%
Gautam Buddha Nagar	3	74.07%
Mathura	2	71.35%
Saharanpur	1	66.36%
Ghaziabad	1	68.02%
Agra	1	63.55%

Among the 18 districts with minimum un-electrification rates in 2011:

- 2 districts have the highest rural household (more than 79.02%) banking penetration. The districts are ***Gorakhpur*** and ***Mau***.
- 7 districts have more than 73.55% banking penetration rate (3 - banking quartile). The districts are ***Mirzapur, Sant Ravidas Nagar, Bijnor, Sultanpur, Rae Bareli, Varanasi*** and ***Gautam Buddha Nagar.***

We next rank these districts against their increase in asset ownership quartiles. (1 – asset quartile shows least asset growth and 4 – shows highest asset growth)

Table 15: Increase in Television and Vehicle ownership in rural districts in the first quartile of un-electrification dataset in 2011

Districts in the first quartile of rural un-electrification dataset	Increase in Television ownership quartiles	Increase in Vehicle ownership quartiles
Allahabad	4	3
Mirzapur	4	2
Gorakhpur	4	4
Sant Ravidas Nagar Bhadohi	2	1
Bijnor	3	4
Sultanpur	2	2
Rae Bareli	2	2
Mau	4	2
Varanasi	4	2
Muzaffarnagar	3	4
Hathras/ Mahamaya Nagar	4	4
Baghpat	4	4
Meerut	4	4
Gautam Buddha Nagar	4	4
Mathura	4	4
Saharanpur	3	4
Ghaziabad	3	4
Agra	4	4

Among the 18 districts with minimum un-electrification rates in 2011,

15 districts have reported the highest increase in % of households owning asset (television or vehicle or both). The districts are ***Allahabad, Mirzapur, Gorakhpur, Bijnor, Mau, Varanasi, Muzaffarnagar, Hathras, Baghpat, Meerut, Gautam Buddha Nagar, Mathura, Saharanpur, Ghaziabad*** and ***Agra.***

Among the 18 districts with minimum un-electrification rates in 2011, 6 districts satisfy the condition of high banking penetration AND high asset penetration growth rate. The districts are ***Mirzapur, Gorakhpur, Bijnor, Mau, Varanasi and Gautam Buddha Nagar.***

Identifying districts across the four quartiles in areas where the grid has not expanded

For the 21 districts that satisfy the condition of high banking penetration AND high increase in asset ownership, we rank these districts against their decrease in % of un-electrification (1 – quartile shows least decrease in un-electrification and 4 – shows highest decrease in un-electrification). Decrease in un-electrification indicates grid expansion in these areas.

Table 16: Decrease in rural un-electrification between 2001-2011

Districts	Quartile for decrease in % un-electrified rural HHs between 2001 and 2011	% decrease in un-electrified rural HHs between 2001 and 2011
Jyotiba Phule Nagar	3	5.11%
Ghazipur	1	-0.08%
Mahoba	4	10.61%
Hamirpur	3	8.60%
Maharjganj	2	3.63%
Ballia	2	0.61%
Ambedkar Nagar	2	0.04%
Jaunpur	1	-4.07%
Faizabad	1	-2.73%
Pratapgarh	2	0.40%
Azamgarh	2	0.87%
Basti	3	4.81%
Jaluan	4	11.12%
Chandauli	3	5.90%
Deoria	2	3.63%
Mirzapur	2	1.04%
Gorakhpur	3	4.91%
Bijnor	2	0.44%
Mau	3	6.89%
Varanasi	1	-8.52%
Gautam Buddha Nagar	4	12.78%

Among these 21 districts,

- **4** districts – ***Gazipur, Jaunpur, Faizabad and Varanasi*** reported an increase in % of un-electrified households in 2011 vs. 2001.
- **14** districts – ***Jyotiba Phule Nagar, Hamirpur, Maharjganj, Ballia, Ambedkar Nagar, Pratapgarh, Azamgarh, Basti, Chandauli, Deoria, Mirzapur, Gorakhpur, Bijnor*** and ***Mau*** reported less than 10% decrease in un-electrified rural households.

District analysis summary of rural Uttar Pradesh

Here is the snapshot view of the districts that emerge from our cascading analysis:

Table 17: Summary of district analysis in rural Uttar Pradesh

Districts that	Make the first cut of high banking penetration	Make the second cut of high banking penetration AND high asset growth	Make the final cut of exhibiting market potential AND relatively sluggish grid expansion (<10% decrease in un-electrification)
In the Highest (4th quartile) degree of rural un-electrification (85.64%<un-electrification<93.46%)	Sitapur, Kheri, Jyotibha Phule Nagar, Balrampur, Pilibhit.	Jyotibha Phue Nagar.	Jyotibha Phule Nagar.
In the 3rd quartile (second highest rural un-electrification rates) of rural un-electrification (77.55%<un-electrification<85.64%).	Gonda, Sonbhadra, Maharajganj, Kushinagar, Barabanki, Kanpur Nagar, Ghazipur, Mahoba, Hamirpur, Ballia and Siddharthnagar.	Ghazipur, Mahoba, Hamirpur, Maharganj and Ballia.	Ghazipur, Mahoba, Hamirpur, Ballia.
In the 2nd quartile (third highest rural un-electrification rates) of rural un-electrification (69.61%<un-electrification<77.55%)	Ambedkar Nagar, Jaunpur, Faizabad, Pratapgarh, Azamgarh, Basti, Deoria, Sant Kabir Nagar, Jalaun and Chandauli	Ambedkar Nagar, Jaunpur, Faizabad, Pratapgarh, Azamgarh, Basti, Jaluan, Chandauli and Deoria	Ambedkar Nagar, Jaunpur, Faizabad, Pratapgarh, Azamgarh, Basti, Chandauli and Deoria.
In the 1st quartile (lowest rural un-electrification rates) of rural un-electrification (un-electrification<69.61%).	Gorakhpur, Mau, Mirzapur, Sant Ravidas Nagar, Bijnor, Sultanpur, Rae Bareli, Varanasi and Gautam Buddha Nagar.	Mirzapur, Gorakhpur, Bijnor, Mau, Varanasi and Gautam Buddha Nagar.	Mirzapur, Gorakhpur, Bijnor, Mau and Varanasi.

Status of un-electrification in urban Uttar Pradesh

Between 2001 and 2011, urban un-electrification in Uttar Pradesh had decreased by 1.50%. Top 10 urban districts with maximum decease in urban electrification are ***Mahoba, Banda, Hathras, Hamirpur***, ***Lalitpur, Auraiya, Gautam Buddha Nagar, Etawah, Firozabad*** and ***Baghpat***.

As in the case of rural Uttar Pradesh, urban un-electrification did not go down simultaneously in all the 70 districts. 30 urban districts reported an increase in un-electrification over this period. Of these 30 districts, un-electrification had increased by more than 5% in ***Kanpur Dehat, Gonda, Sitapur, Azamgarh, Basti, Siddharthnagar, Sant Ravidas Nagar Bhadohi*** and ***Ambedkar Nagar.***

18.58% of the urban households in Uttar Pradesh were un-electrified in 2011. ***Kaushambi, Shrawasti, Kanpur Dehat, Mahoba*** and ***Buduan*** reported un-electrification rates of more than 40%. ***Sitapur, Hardoi, Kannauj, Siddharthnagar, Ambedkar Nagar, Kheri, Ballia, Barabanki , Unnao, Pilibhit, Fatehpur*** and ***Kushinagar*** had more than 35% un-electrification.

Despite the high rates on un-electrification, solar penetration amongst these un-electrified urban households in Uttar Pradesh was very low.

Table 18: Top 10 districts with highest rate of un-electrification in urban Uttar Pradesh

District	% of un-electrified urban HHs in 2011	Solar penetration among un-electrified urban HHs in 2011
Kaushambi	45.14%	0.48%
Shrawasti	44.62%	1.02%
Kanpur Dehat	41.59%	0.35%
Mahoba	41.42%	0.79%
Budaun	41.38%	0.27%
Sitapur	38.47%	0.51%
Hardoi	38.37%	0.48%
Kannauj	38.27%	0.61%
Siddharthnagar	37.88%	0.71%
Ambedkar Nagar	37.71%	0.50%

Our analysis above shows that opportunities to provide distributed renewable energy products and services exist in urban Uttar Pradesh as much as in rural Uttar Pradesh. Most social enterprises and impact investors do not work in these areas and we would encourage investment of resources in testing and understanding these markets.

We believe that analysis of these markets would require going beyond Census data and we would be looking forward to collaborate with organizations who can provide complementary data sets for analysis.

Annexure

Data collection and definitions

Electrification data is from IndiaStat (www.indiastat.com), a statistical database that is based on census data. The census considers six sources of lighting – electricity, kerosene, solar, other oil, any other and no lighting. Prior to 2000, the census considered the availability or non-availability of electricity as the only criteria. The main source of lighting used for greater part of the year or 12 months is called the "primary source of lighting".

The electrification data in this document is based on the "primary source of lighting". This information is available at the household level. This document does not cover the number of lights, fans, appliances that consume electricity per household.

A household is defined by census as a group of people who normally live together and take their meals from a common kitchen. If a group of unrelated persons live in a census house but do not take their meals from the common kitchen, they are not considered as part of a common household. Each person is treated as a separate household.

The data on asset ownership and banking services is from IndiaStat.com. IndiaStat.com has data on the six assets – television, transistor, radio, telephone, computer and vehicle. From this database, New Ventures India uses television ownership and vehicle ownership information. Vehicles include scooters, motorcycles, mopeds, cars, jeeps and vans. New Ventures India does not consider bicycles for asset ownership computation.

For banking, New Ventures India uses "the total number of households availing banking services" data from IndiaStat.com. As in the case of electrification, the asset ownership and banking services data does not specify the number of assets or bank accounts per household. For example, 100 households in a district may be availing banking services. But, whether all or one person in each household has individual bank accounts cannot be determined.

Formula sheet

Table 19: Formulae used in the document

Formula	Definition
% of Rural Households to Total Households	(Rural households)/(Rural + Urban households)
% of Rural Un-electrified Households	(Households that depend on kerosene+other oil+any other sources+solar+have no lights)/ (Rural households)
Decrease of % of Rural HHs	(% rural households in 2001 - % of rural households in 2011)
Decrease in rural un-electrification between 2011 and 2001	(% rural un-electrified households in 2001 - % rural un-electrified households in 2011)
Solar penetration among un-electrified rural HHs	(Solar households)/ (Households that depend on kerosene+other oil+any other sources+solar+have no lights)
Percentage of rural HHs that had access to banking in 2011	(rural banking households/rural households)
Increase in Banking Penetration among rural households	(% rural banking households in 2001 - % rural banking households in 2011)
% television ownership	(Rural households with television/Rural households)
Increase in % rural households owning a television set	(% rural households with television set in 2001 - % rural households with television set in 2011)
% vehicle ownership	(Rural households with vehicle/Rural households)
Increase in % rural households owning a vehicle	(% rural households with vehicle in 2001 - % rural households with vehicle in 2011)e

Understanding quartiles

There are 70 rural districts in Uttar Pradesh (each of the 70 districts is divided into rural and urban). For the analysis of extent of un-electrification, banking services, increase in asset ownership, we have divided the 70 un-electrified rural districts into four subsets or four quartiles.

Table 20: Arranging datasets in quartiles

Quartile	Upper limit of the quartile
First (25% of districts fall within the range of lowest value of dataset and upper limit of this quartile)	Average of lowest value of data set and median value of data set
Second (25% of districts fall within the range of upper limit of first quartile and median value of data set. 50% of the dataset fall in first and second quartiles. combined)	Median value of data set
Third (25% of districts fall within the range of median value of data set and upper limit of this quartile. 75% of the dataset fall in first, second and third quartiles combined.)	Average of median and highest value of data set
Fourth (25% of districts fall within the range of upper limit of third quartile and highest value of data set. 100% of the data set falls in the four quartiles combined.)	Highest value of data set

Each data-set has 25% of the data-points (data-points refer to the 70 districts).

For un-electrification dataset, 25% of the rural districts with maximum un-electrification will lie in the quartile 4. Quartile 1 will contain 25% of the 70 rural districts that have the lowest rates of un-electrification.

For banking services dataset, the quartile 4 will contain 25% of the 70 rural districts that have the highest % of households availing banking services. Quartile 1 will contain 25% of the 70 rural districts that have the lowest % of households availing banking services.

For asset ownership dataset, quartile 4 will contain 25% of the 70 rural districts where highest % of households own assets. Quartile 1 will contain 25% of the 70 rural districts where lowest % of households own assets.

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Sanjoy has over 20 years of experience in finance and entrepreneurship, with a particular focus on the education and green infrastructure. He is concurrently the Director of New Ventures India, Under his leadership, New Ventures has developed a strong network of institutional investors and also been able to help early stage green entrepreneurs raise US$ 10 million in funding. Previously, Sanjoy was part of the management team at SumTotal Systems, a global leader in Talent Management software, where he managed services delivery out of India. As an entrepreneur, he has co-founded and run Aesthetic Technologies, which had major Indian and international firms as its clients and received venture capital funding from Indian investors. In addition, Sanjoy has worked at ITC Classic Finance Ltd. and ICICI Ltd. where he evaluated credit risk and managed debt and equity syndication for project financing. He also provides mentoring to early stage entrepreneurs in his capacity as a Charter Member of TiE. Sanjoy has a Post Graduate Diploma in Management from the Indian Institute of Management, Calcutta and a Bachelor of Technology degree from the Indian Institute of Technology, Kharagpur.

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Pamli brings more than eight years of experience in the Energy Industry across multiple functions. With New Ventures India, she has worked on energy efficiency and renewable energy projects to assess the potential of energy efficiency and renewable energy products for the commercial, residential and industrial sectors. She has co-authored the report on "Integrating Renewable Energy and Energy Efficiency in the Transmission and Distribution Grids of Tamil Nadu and Karnataka". Pamli has presented on energy efficiency topics at the 8th Asia Clean Energy Forum 2013, held at ADB Headquarters.

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