

# Access, Availability and Adequacy in the Rural Areas of 5 districts in North Karnataka served by HESCOM

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## Acknowledgement

This study emerged from a meeting that the SELCO Foundation Policy Group had with former MNRE secretary, Mr. Satish Agnihotri, in which he emphasized the need for understanding four parameters of rural electrification – access, availability, adequacy and quality – to have a clearer picture of regions across the country where decentralized renewable energy could play a major role in providing reliable access to power. We would like to thank him for encouraging us to take this study forward and providing inputs at different stages of the study.

We would also like to thank Dr. Santosh Harish, post-doctoral fellow at the Harvard Kennedy School, who worked closely with us in defining each of these parameters and working out the method for analyzing it. He also obtained the data from various sources and put them together in a form that was easily understandable.

## Objective

The objective of this exercise is to characterize the real electrification level in specific districts. The problem of poor quality electricity supply in rural areas across the country is often neglected, and access is defined in a very limited manner based on village and household electrification rates. Gaps in electricity provision owing to load shedding, unscheduled power cuts, and voltage fluctuations are not clearly identified. By attempting to provide more reliable information on access and availability of electricity in certain districts, this exercise can also identify areas that are under-served. These areas can then become focal points for decentralized energy interventions to complement the grid or substitute it.

## Sources of Data

**Access:** Access signifies the electrification rates of the households in question, i.e. the number of households electrified. This information has been taken from Census 2011 data and is available at the Taluk level.

**Adequacy:** Adequacy signifies the per household and per capita electricity consumption, as well as the ownership percentage of TVs and fans. This information has been taken from NSS data 68th round carried out between July 2011 and June 2012 and is available at the District level.

**Availability:** Supply availability has been analyzed using SCADA (Supervisory Control and Data Acquisition) data taken from KPTCL for representative dates in September and December 2012. These data are available at the 11kV feeder level, but have been aggregated at the Taluk level. The following data are used for analysis

- Single phase power availability for the entire 24 hours,
- Single phase power availability during residential peak hours (6pm- 10pm),
- Three phase supply between 6am- 6pm; usually for micro and small enterprises and pump sets.

All the data represented here pertains only to the rural areas of 5 districts in North Karnataka, served by HESCOM.

## Benchmarks

We have defined benchmarks to all the above stated parameters. These benchmarks serve as the indicators for the minimum values of access, availability and adequacy that each taluk/district should have. They are defined below:

**Access:** According to Census 2011<sup>1</sup>, household electrification in rural Karnataka is 86%. Hence, a round figure of 85% has been chosen as the benchmark. Also, any taluk having more than 10,000 unelectrified homes is highlighted.

**Adequacy:** The Rural electrification policy<sup>2</sup> target of 1 kWh/day and KERC's own tariff orders have set 30 kWh/month<sup>3</sup> as the lifeline level of household consumption. Census 2011 pegs the average family size as 5. We have extended this to the average number of people per household. Hence, the lifeline level of per capita consumption is 6 kWh/month. Areas where the TV and fan ownership is significantly lesser than in urban households in the same district have been highlighted as well.

**Availability:** The national target for availability of single phase power in rural areas is 6-8 hours per day. The availability in Karnataka is better and hence a benchmark of 10 hours per day has been fixed. The benchmark for availability of single phase power between 6 pm and 10 pm in the evening is 3 hours. The benchmark for availability of three phase power is 3 hours per day.

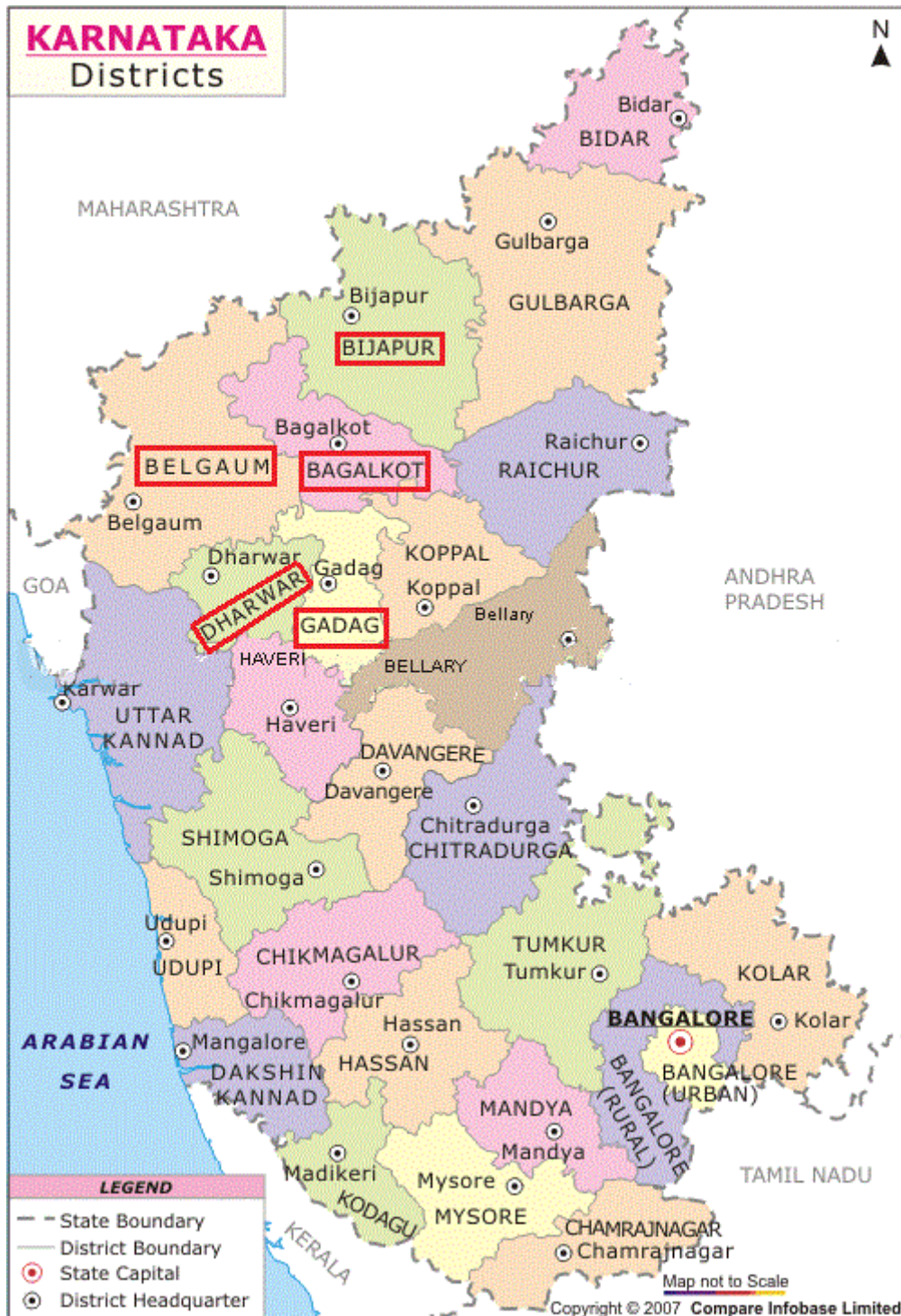
1 - Census of India 2011, Table on Households by Main Source of Lighting (HH-7), House listing and Housing Census Data Tables (District Level) – Karnataka

2 - Ministry of Power 2006, Rural Electrification Policy, No.44/26/05-RE (Vol-II), Government of India (Page 2)

3 - Karnataka Electricity Regulatory Commission, Tariff order 2000, Page 26. This lifeline level slab has been retained in the tariff structures till date.

## District Wise Break Up

5 districts which come under HESCOM’s service have been chosen for the study, namely – Bagalkot, Belgaum, Bijapur, Dharwad and Gadag. These districts have been highlighted in red boxes in the map below.



## Bagalkot

Bagalkot has a total of 6 taluks with a total rural population of 13 lakhs- Jamkhandi, Bilgi, Mudhol, Badami, Bagalkot and Hungund.

### 1. Access:

- The electrification rate in 4 out of 6 taluks is less than 85%.
- Of the total number of 2,38,746 households, 1,95,847 are electrified (82%).
- Jamkhandi taluk has the lowest electrification rate of 75%. Here, a total of 13,637 households out of 54,564 are unelectrified, well below the benchmark.
- The district headquarters Bagalkot has the highest electrification rate of 89%.

District	Taluk	No. of unelectrified households	Percentage of households electrified
Bagalkot	Jamkhandi	13637	75%
Bagalkot	Bilgi	5142	81%
Bagalkot	Mudhol	8143	81%
Bagalkot	Badami	7310	84%
Bagalkot	Bagalkot	3528	89%
Bagalkot	Hungund	5139	86%

### 2. Adequacy:

- Adequacy of power supply is above the benchmark in this district.
- The average electricity consumption per household is 35 kWh per month.
- The per capita electricity consumption is 7.8 kWh per month.
- 69% of the households own fans and 76% own TVs.

District	Taluk	Mean Consumption per household (kWh per month)	Mean per capita consumption (kWh per person)	Percentage TV ownership	Fan ownership %
Bagalkot	Jamkhandi	35	8	76%	69%
Bagalkot	Bilgi				
Bagalkot	Mudhol				
Bagalkot	Badami				
Bagalkot	Bagalkot				
Bagalkot	Hungund				

### 3. Availability:

- On average, single phase power is available for 11.9 hours each day, of which 3 hours of this power is available between 6 pm and 10 pm. Both these parameters surpass the benchmarks defined.
- The lowest availability of single phase power is in Mudhol taluk (9.8 hours per day) and the highest is in Badami taluk (17.4 hours).
- On average, three phase power is available for 3.1 hours between 6 am and 6 pm, which surpasses the benchmark.

District	Taluk	No. of hours of single phase power out of 24 hours	No. of hours of single phase power between 6 pm and 10 pm	No. of hours of three phase power between 6 am and 6 pm
Bagalkot	Jamkhandi	10.8	3.0	3.3
Bagalkot	Bilgi	10.9	3.0	3.4
Bagalkot	Mudhol	9.8	2.9	2.8
Bagalkot	Badami	17.4	3.4	2.0
Bagalkot	Bagalkot	10.7	2.7	3.6
Bagalkot	Hungund	11.6	3.0	3.8

## Belgaum

Belgaum has a total of 9 taluks with a total rural population of 36 lakhs– Chikodi, Athni, Raybag, Gokak, Hukeri, Belgaum, Khanpur, Sampgaon, Parasgad and Ramdurg.

### 1. Access:

- The electrification rate in 5 out of 8 taluks is less than 85%.
- Of the total number of 7,08,069 households, 5,65,135 are electrified (80%).
- Gokak taluk has the lowest electrification rate of 71%. Here, a total of 25,259 households out of 87,552 are unelectrified, well below the benchmark.
- The district headquarters Belgaum has the highest electrification rate of 91%.

District	Taluk	No. of unelectrified households	Percentage of households electrified
Belgaum	Chikodi	13730	87%
Belgaum	Athni	27811	71%
Belgaum	Raybag	18647	72%
Belgaum	Gokak	25259	71%
Belgaum	Hukeri	15642	78%
Belgaum	Belgaum	5971	91%
Belgaum	Khanapur	6812	86%
Belgaum	Sampgaon	8431	88%
Belgaum	Parasgad	12365	79%
Belgaum	Ramdurg	8266	80%

## 2. Adequacy:

- The average electricity consumption per household is 29 kWh per month, close to the benchmark.
- The per capita electricity consumption is 10 kWh per month, surpassing the benchmark.
- 40% of the households own fans and 38% own TVs, well below their urban counterparts.
- Data for Ramdurg taluk is unavailable.

District	Taluk	Mean Consumption per household (KWh per month)	Mean per capita consumption (kWh per person)	Percentage TV ownership	Fan ownership %
Belgaum	Chikodi	29	10	38%	40%
Belgaum	Athni				
Belgaum	Raybag				
Belgaum	Gokak				
Belgaum	Hukeri				
Belgaum	Belgaum				
Belgaum	Khanapur				
Belgaum	Sampgaon				
Belgaum	Parasgad				
Belgaum	Ramdurg				

## 3. Availability:

- On average, single phase power is available for 10.8 hours each day, of which 2.7 hours of this power is available between 6 pm and 10 pm.
- While the per day power availability is above the benchmark, the availability in the evening is insufficient.
- The lowest availability of single phase power is in Raybag taluk (9.5 hours per day) and the highest is in Khanapur taluk (12.7 hours).
- On average, three phase power is available for 3 hours between 6 am and 6 pm, which is on par with the benchmark.
- Data for Ramdurg taluk is unavailable.

District	Taluk	No. of hours of single phase power out of 24 houts	No. of hours of single phase power between 6 pm and 10 pm	No. of hours of three phase power between 6 am and 6 pm
Belgaum	Chikodi	10.4	2.6	3.3
Belgaum	Athni	11.2	3.1	3.4
Belgaum	Raybag	9.5	2.1	3.2
Belgaum	Gokak	10.3	2.6	3.1
Belgaum	Hukeri	10.0	2.4	3.0
Belgaum	Belgaum	11.5	3.0	3.0
Belgaum	Khanapur	12.7	3.2	3.9
Belgaum	Sampgaon	10.0	2.8	3.0
Belgaum	Parasgad	11.8	2.4	4.2
Belgaum	Ramdurg			



## Bijapur

Bijapur has a total of 5 taluks with a total rural population of 18 lakhs—Bijapur, Indi, Sindgi, Basavana Begevadi and Muddebihal.

### 1. Access:

- The electrification rate in 4 out of 5 taluks is less than 85%.
- Of the total number of 3,07,984 households, 2,37,181 are electrified (77%).
- Indi taluk has the lowest electrification rate of 68%. Here, a total of 23,380 households out of 72,125 are unelectrified, well below the benchmark.
- Muddebihal taluk has the highest electrification rate of 88%.

District	Taluk	No. of unelectrified households	Percentage of households electrified
Bijapur	Bijapur	18817	74%
Bijapur	Indi	23380	68%
Bijapur	Sindgi	14219	78%
Bijapur	Basavana Bageva	9439	84%
Bijapur	Muddebihal	4948	88%

### 2. Adequacy:

- The average electricity consumption per household is 26 kWh per month, well below the benchmark.
- The per capita electricity consumption is 8 kWh per month, surpassing the benchmark.
- 48% of the households own fans and 44% own TVs, well below their urban counterparts.

District	Taluk	Mean Consumption per household (kWh per month)	Mean per capita consumption (kWh per person)	Percentage TV ownership	Fan ownership %
Bijapur	Bijapur	26	8	44%	48%
Bijapur	Indi				
Bijapur	Sindgi				
Bijapur	Basavana Bageva				
Bijapur	Muddebihal				

### 3. Availability:

- On average, single phase power is available for 10.8 hours each day, of which 3.2 hours of this power is available between 6 pm and 10 pm. Both these parameters surpass the benchmarks defined.
- The lowest availability of single phase power is in Bijapur taluk (9.4 hours per day) and the highest is in Basavana Begevadi taluk (13 hours).
- On average, three phase power is available for 3.8 hours between 6 am and 6 pm, well above the benchmark.

d) Basavan Begavadi taluk notably has the highest availability of 5.5 hours.

District	Taluk	No. of hours of single phase power out of 24 houts	No. of hours of single phase power between 6 pm and 10 pm	No. of hours of three phase power between 6 am and 6 pm
Bijapur	Bijapur	9.4	2.6	3.1
Bijapur	Indi	10.0	2.8	2.8
Bijapur	Sindgi	9.5	2.8	2.6
Bijapur	Basavana Bageva	13.0	2.8	5.5
Bijapur	Muddebihal	12.2	2.7	4.9

## Dharwad

Dharwad has a total of 5talukswith a total rural population of 8 lakhs–Dharwad, Navalgund, Hubli, Kalghatgi and Kundgol.

### 1. Access:

- The electrification rates in this district are above 85% in all taluks.
- Of the total number of 1,57,960 households, 1,43,454 are electrified (91%).
- Dharwad taluk has the lowest electrification rate of 90%. Here, a total of 4,632 households out of 45,512 are unelectrified.
- Hubli taluk has the highest electrification rate of 92%.

District	Taluk	No. of unelectrified households	Percentage of households electrified
Dharwad	Dharwad	4632	90%
Dharwad	Navalgund	2278	91%
Dharwad	Hubli	2390	92%
Dharwad	Kalghatgi	2568	91%
Dharwad	Kundgol	2638	91%

### 2. Adequacy:

- Adequacy of power supply is above the benchmark in this district.
- The average electricity consumption per household is 41 kWh per month.
- The per capita electricity consumption is 11 kWh per month.
- 20% of the households own fans and 33% own TVs, well below their urban counterparts.

District	Taluk	Mean Consumption per household (KWh per month)	Mean per capita consumption (kWh per person)	Percentage TV ownership	Fan ownership %
Dharwad	Dharwad	41	11	33%	20%
Dharwad	Navalgund				
Dharwad	Hubli				
Dharwad	Kalghatgi				
Dharwad	Kundgol				

### 3. Availability:

- On average, single phase power is available for 12.4 hours each day, of which 2.6 hours of this power is available between 6 pm and 10 pm.
- While the per day power availability is above the benchmark, the availability in the evening is insufficient.
- The lowest availability of single phase power is in Kalghatgi taluk (11.1 hours per day) and the highest is in Hubli taluk (13.8 hours).
- On average, three phase power is available for 4.3 hours between 6 am and 6 pm, well above the benchmark.
- Kalghatgi taluk has notably the lowest availability of 2.7 hours.
- Data for Navalgund taluk is unavailable.

District	Taluk	No. of hours of single phase power out of 24 hours	No. of hours of single phase power between 6 pm and 10 pm	No. of hours of three phase power between 6 am and 6 pm
Dharwad	Dharwad	12.2	2.3	4.7
Dharwad	Navalgund			
Dharwad	Hubli	13.8	2.9	4.7
Dharwad	Kalghatgi	11.1	2.5	2.7
Dharwad	Kundgol	12.4	2.8	5.2

## Gadag

Gadag has a total of 5 taluks with a total rural population of 7 lakhs—Nargund, Ron, Gadag, Shirhatti and Mundargi.

### 1. Access:

- The electrification rates in this district are above 85% in all taluks.
- Of the total number of 1,37,799 households, 1,26,805 are electrified (92%).
- Shirhatti has the lowest electrification rate of 89%. Here, a total of 3,168 households out of 29,675 are unelectrified.
- The district headquarters Gadag has the highest electrification rate of 94%.

District	Taluk	No. of unelectrified households	Percentage of households electrified
Gadag	Nargund	778	94%
Gadag	Ron	3140	92%
Gadag	Gadag	2030	94%
Gadag	Shirhatti	3168	89%
Gadag	Mundargi	1878	91%

## 2. Adequacy:

- The average electricity consumption per household is 22 kWh per month, well below the benchmark.
- The per capita electricity consumption is 10 kWh per month, well above the benchmark.
- 47% of the households own fans and 62% own TVs, well below their urban counterparts.

District	Taluk	Mean Consumption per household (KWh per month)	Mean per capita consumption (kWh per person)	Percentage TV ownership	Fan ownership %
Gadag	Nargund	22	10	62%	47%
Gadag	Ron				
Gadag	Gadag				
Gadag	Shirhatti				
Gadag	Mundargi				

## 3. Availability:

- On average, single phase power is available for 11.6 hours each day, of which 2.8 hours of this power is available between 6 pm and 10 pm.
- While the per day power availability is above the benchmark, the availability in the evening is insufficient.
- The lowest availability of single phase power is in Shirhatti taluk (9.6 hours per day) and the highest is in Nargund taluk (13.5 hours).
- On average, three phase power is available for 3.7 hours between 6 am and 6 pm, above the benchmark.

District	Taluk	No. of hours of single phase power out of 24 hours	No. of hours of single phase power between 6 pm and 10 pm	No. of hours of three phase power between 6 am and 6 pm
Gadag	Nargund	13.5	3.1	4.3
Gadag	Ron	12.4	2.9	4.2
Gadag	Gadag			
Gadag	Shirhatti	9.6	2.5	2.9
Gadag	Mundargi	11.0	2.9	3.3

## Summary of Findings

District	Taluk	Access		Adequacy				Availability		
		No. of unelectrified households	Percentage of households electrified	Mean Consumption per household (KWh per month)	Mean per capita consumption (kWh per person)	Percentage TV ownership	Fan ownership %	No. of hours of single phase power out of 24 houts	No. of hours of single phase power between 6 pm and 10 pm	No. of hours of three phase power between 6 am and 6 pm
Bagalkot	Jamkhandi	13637	75%	35	8	76%	69%	10.8	3.0	3.3
Bagalkot	Bilgi	5142	81%					10.9	3.0	3.4
Bagalkot	Mudhol	8143	81%					9.8	2.9	2.8
Bagalkot	Badami	7310	84%					17.4	3.4	2.0
Bagalkot	Bagalkot	3528	89%					10.7	2.7	3.6
Bagalkot	Hungund	5139	86%					11.6	3.0	3.8
Belgaum	Chikodi	13730	87%	29	10	38%	40%	10.4	2.6	3.3
Belgaum	Athni	27811	71%					11.2	3.1	3.4
Belgaum	Raybag	18647	72%					9.5	2.1	3.2
Belgaum	Gokak	25259	71%					10.3	2.6	3.1
Belgaum	Hukeri	15642	78%					10.0	2.4	3.0
Belgaum	Belgaum	5971	91%					11.5	3.0	3.0
Belgaum	Khanapur	6812	86%					12.7	3.2	3.9
Belgaum	Sampgaon	8431	88%					10.0	2.8	3.0
Belgaum	Parasgad	12365	79%					11.8	2.4	4.2
Belgaum	Ramdurg	8266	80%							
Bijapur	Bijapur	18817	74%					26	8	44%
Bijapur	Indi	23380	68%	10.0	2.8	2.8				
Bijapur	Sindgi	14219	78%	9.5	2.8	2.6				
Bijapur	Basavana Bagevadi	9439	84%	13.0	2.8	5.5				
Bijapur	Muddebihal	4948	88%	12.2	2.7	4.9				
Dharwad	Dharwad	4632	90%	41	11	33%	20%	12.2	2.3	4.7
Dharwad	Navalgund	2278	91%							
Dharwad	Hubli	2390	92%					13.8	2.9	4.7
Dharwad	Kalghatgi	2568	91%					11.1	2.5	2.7
Dharwad	Kundgol	2638	91%	12.4	2.8	5.2				
Gadag	Nargund	778	94%	22	10	62%	47%	13.5	3.1	4.3
Gadag	Ron	3140	92%					12.4	2.9	4.2
Gadag	Gadag	2030	94%							
Gadag	Shirhatti	3168	89%					9.6	2.5	2.9
Gadag	Mundargi	1878	91%					11.0	2.9	3.3

Note:

Red highlights represent the parameters that are below benchmark levels.

Green highlights represent the parameters that are above benchmark levels.

## Conclusions

Poor performance on different indicators ought to be addressed using different strategies.

1. Where the problem is one of access, but supply is known to be reasonably reliable on electrification, grid electrification and perhaps subsidies to help in last mile connectivity should be the optimal approach.
2. Where access is reasonably high, but the reliability is poor, either the Discom must be made more accountable (though better advertisement of scheduled outages, prompt redressal of faults and burnouts, and greater predictability of supply), or augmenting/ backup sources of decentralized generation should be incentivized.
3. In areas where both access and reliability are low or insufficient, decentralized generation should be explored as the mode of electrification.
4. The adequacy metrics help in understanding the sophistication of electricity use among the households. While low appliance ownership could likely be related to the household affordability constraints, they could also point to the quality of supply.

Keeping this in mind, the following taluks are identified as interesting for further exploration.

Metrics	Taluks
Low access, and poor reliability levels	Bagalkot- Mudhol Belgaum- Raybag, Gokak, Hukeri, Parasgad Bijapur- Bijapur, Indi, Sindgi
Low access, but good reliability	Bagalkot- Jamkhandi, Bilgi, Badami Belgaum- Athni
Reasonable access, but poor reliability	Bagalkot- Bagalkot Dharwad- all Taluks Gadag- Ron, Shirhatti, Mundargi Haveri- Shiggaon, Savanur, Hirekarur

This endeavour recognizes the availability analysis was constrained by data limitations. When analyzing reliability, one should go beyond the averages to capture the unpredictability in day-on-day supply. These dimensions can be conveyed using through standard deviations, and the number of days with less than a threshold supply. Thus, an ideal strategy would be to use SCADA data over the course of a month for several representative months. For states or districts which do not have SCADA systems installed, the supply data could be logged directly for a random sample of feeders.



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