**ENERGY CONSUMPTION FORECAST USING MACHINE LEARNING**

**A PROJECT REPORT**

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**BONAFIDE CERTIFICATE**

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**ABSTRACT**

To Forecast the Energy usage of households on an hourly basis based on the data fetched through Smart Energy Meters and to study the trends of the area observed. Load forecasting is vitally important for the electric industry in the deregulated economy. It has many applications including energy purchasing and generation, load switching, contract evaluation, and infrastructure development.

Time series have been used for decades in such fields as economics, digital signal processing, as well as electric load forecasting. In particular, ARMA (autoregressive moving average), ARIMA (autoregressive integrated moving average), ARMAX (autoregressive moving average with exogenous variables), ARIMAX (autoregressive integrated moving average with exogenous variables) and SARIMAX (Seasonal autoregressive integrated moving average with exogenous variables) are the most often used classical time series methods. SARIMAX uses the time and load data as the only input parameters for forecasting. The forecast can be developed using Python with statistical libraries for the SARIMAX Time Series Analysis and can be achieved to predict the future consumption data into required formats.

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**INTRODUCTION**

**GENERAL**

As INDIA is progressing towards Digital India, is a flagship programme of the Government of India with a vision to transform India into a digitally empowered society and knowledge economy.

It has become a necessity to move towards a Digital Future, in order to improve the quality of reducing man-work.

One of the ways to inculcate these is to improve The Electrical Energy Sector, where there is lots of scope to produce digitally enabled solutions.

**DISCUSSION AND EXCERPTS**

**EESL SUCCESSFULLY INSTALLS AND OPERATIONALISES 5 LAKH SMART METERS ACROSS INDIA ECONOMIC TIMES**

[MMENT](https://www.thehindubusinessline.com/economy/over-5-lakh-smart-meters-operational-across-india-says-eesl/article29060479.ece#comments_29060479) The programme was aimed at retrofitting conventional meters with smart variants to improve billing efficiency.

Energy Efficiency Services Limited (EESL) has installed over 5 lakh smart meters in Uttar Pradesh, Delhi, Haryana, Bihar and Andhra Pradesh. These meters have been distributed under the Smart Meter National Programme (SMNP). The smart meters operational in these states aim to enhance consumer convenience and rationalise electricity consumption, an EESL statement said.

The Smart Meter National Programme that aims to retrofit 25 crore conventional meters with smart variants will lead to 80-100 per cent improvement in billing efficiency.

These smart meters are installed as per guidelines issued by the Central Electricity Authority. Smart meters are part of the overall Advanced Metering Infrastructure solution (AMI) that measures and records consumers’ electricity usage at different times of the day and sends this information to the energy supplier through GPRS technology, EESL said.

#### **SMART METER NATIONAL PROGRAMME EESL INDIA**

With electricity demand expected to rise by 79 percent in the next 10 years, India is on a path of transforming its energy mix with innovation. Along with enhancing energy production, the nation also needs to cut Aggregate Technical and Commercial (AT&C) losses to below 12% by 2022, and below 10% by 2027.

Enabling India to achieve this imperative is the smart grid, the first step of which, is the creation of Advanced Metering Infrastructure. A new range of ‘smart meters’ can bring efficiency to how India manages its electricity, by checking data-entry errors and billing efficiencies, and cutting the costs of manual meter reading through web-based monitoring system.

With its pioneering role in India’s energy efficiency journey, EESL’s Smart Meter National Programme (SMNP) is working to eventually replace 25 crore conventional meters with smart meters across India.

By bringing standardized solutions based on the GPRS technology, these meters will ease integration in the sector, while cutting capital costs and boosting efficiency in billing and collection. Customers will also benefit from accurate bill readings, and real-time understanding of their electricity usage, catalysing a pan-India movement towards energy efficiency.

Our proven model of bulk procurement, aggregation of demand, and monetisation of savings will be the approach to roll out smart meters. This roll-out is proposed under the Build-Own-Operate-Transfer (BOOT) model, wherein EESL will undertake all the capital and operational expenditure with zero upfront investment from states and utilities. EESL will therefore, receive a nominal Internal Rate of Return that is reflected in a mutually agreed upon, automated payback structure.

In the larger scheme of things, the programme will holistically promote the Indian manufacturing industry while creating more direct and indirect jobs. The programme is expected to better billing efficiency by 75 to 100 percent while increasing the revenues of the utility companies to Rs. 1,38,100 crore.

**UNION BUDGET: RS 22,000 CRORE TO POWER AND RENEWABLE SECTOR ECONOMIC TIMES**

Finance minister Nirmala Sitharaman allocated Rs 22,000 crore for the power and renewable sector and has urged state governments to implement smart meters in three years, which would give the consumers the right to choose suppliers and the rate.  
  
The power distribution companies are under financial stress and the power ministry has been trying to implement smart meters, she said in her Budget speech.  
  
"Ï urge the states to replace conventional energy meters with smart meters in next three years. This would give the conumers the freedom to choose the supplier and the rate as per their requirement," Sitharaman said.  
  
The Union Budget proposes to allocate Rs 22,000 crore to power and renewable sector.

**L&T WINS RS 1,000 CRORE CONTRACT TO MAINTAIN 5 MILLION SMART METERS ECONOMIC TIMES**

Larsen & Toubro (L&T), India’s biggest infrastructure and project execution company, has won a Rs 1,000-crore contract to maintain 5 million smart meters in Uttar Pradesh and Bihar over the next eight years, sources said.  
  
The smart meter tender, floated by state-owned Energy Efficiency Services Limited (EESL) earlier this year, was divided into two parts — meter procurement and systems integration. The latter exercise would involve meter installation, data storage on Cloud and preparing dashboards, among other things.  
  
“L&T has won the bid, and the cost has been arrived at through a competitive bidding process. They will be paid over the course of the next eight years,” Saurabh Kumar, managing director of EESL, confirmed to ET.  
  
L&T, Keonics, and China-based IESLAB had shown interest in the systems integration part of the tender, ET had reported on December 8.  
  
As a systems integrator, L&T will provide the GPRS-based solution that requires the placing of a SIM card in the meter for communication.  
  
Major telecom operators, including Airtel, Vodafone, Idea and BSNL, have been roped in for supplying 5 million SIM cards for the smart meters.

“The number of SIM cards to be supplied by each telco will be decided during the project execution phase,” said another person aware of the matter.  
  
Smart meters are a part of the overall advanced metering infrastructure solutions (AMI) aimed at better demand response designed to reduce energy consumption during peak hours.  
  
The cost has taken different components of systems integration into consideration, including installation of the meters, integrating them with the AMI software, providing GPRS solution, and O&M services. The original cost of the contract is `863 crore, to which 18% GST will be added, bringing the total cost to around Rs 1,020 crore.  
  
L&T had also initially won the contract for supplying 2.5 million smart meters, but later lost out to state-owned Indian Telephone Industries (ITI) Limited, which quoted a price of Rs 2,503 per meter in a reverse auction conducted by EESL. L&T had originally quoted Rs 2,722 for each meter. The smart meters order by EESL is the largest in the world, the government has said.  
  
New Delhi is seeking to bring down aggregate technical and commercial (AT&C) losses of state utilities through smart metering, which will increase billing efficiency.

**‘INDIA IS LOSING RS 100,000 CRORE IN UNBILLED ELECTRICITY. THE SOLUTION IS SMART METERS’ SCROLL.IN**

In conversation with **Saurabh Kumar, Managing Director at the Energy Efficiency Services Ltd** , headed by the power ministry.

In a bid to improve power utilities’ financial health by increasing their revenues through efficient billing, India plans to replace the existing 250 million traditional electricity meters with smart meters that use digital technology to enable a two-way flow of electricity and information. Traditional meters only record energy consumption for billing purposes.

Smart meters are crucial for reducing electricity distribution companies’, or discoms’, losses. In the financial year 2018-’19, these stood at Rs 27,000 crore, four-times the allocation for the renewables ministry in 2020. They do this by not only improving billing and revenue collection but also reducing the difference between the cost of supply and the revenue collected. A smart, automated metering system, without manual intervention, would reduce meter-reading and data-entry errors and costs.

These meters would also estimate consumer demand, letting utilities forecast and contract for power requirements more accurately. This is essential for integrating renewable energy into the grid using the “time of the day” policy, as we further explain.

To smoothen the transition and create an ecosystem for smart meter use, the Central Government, in 2017, created the Energy Efficiency Services Ltd or EESL, a joint venture between several public-sector enterprises helmed by the power ministry. EESL’s best-known success has been speeding up the adoption of fuel-efficient LED lights by bringing prices down by 80%. The company floated its first tender for smart meters in August 2017. On February 24, it announced that it has successfully installed one million smart meters in the country.

States that have installed smart meters include Uttar Pradesh, Haryana, Bihar and Delhi. Some discoms using smart meters have increased their per-meter, per-month revenue by Rs 200, said Saurabh Kumar, managing director at EESL. This increase in discoms’ revenue is mostly due to improved monitoring efficiency of per-unit electricity supplied and improved billing due to smart meters, he added.

Kumar has worked with the government in various capacities. At the Bureau of Energy Efficiency, he led the implementation of the world’s largest Clean Development Mechanism-efficient lighting project to reduce carbon emissions. An electrical engineer from the Indian Institute of Technology, Kanpur, Kumar has a postgraduate degree in public policy from the National Graduate Institute for Policy Studies, Tokyo, Japan.

**Edited excerpts from the interview:**

**How many smart meters has EESL installed so far?**

So far, we have successfully installed 1.10 million smart meters. We have completed a project in the New Delhi Municipal Corporation area about a year ago, with some 55,000 smart meters installed. Our projects are on in Uttar Pradesh, with all five distribution companies in the state; in Haryana, we are working with both the distribution companies. We have just started in Bihar.

**Are these smart meters showing results? How are they improving discom revenues?**

With these 1.10 million meters, the average increase in revenue per month per meter is Rs 200 [when the national average bill is about Rs 450, assuming average consumption of 90 units per month at Rs 5 per unit]. The highest increase was recorded for NDMC, around Rs 500, and the lowest would be in Kanpur and Meerut, about Rs 130. What we are charging to these discoms is Rs 85 for a single-phase meter and about Rs 105 for a three-phase meter.

Numbers are clearly showing that discoms’ revenue is up and there are two main reasons. The first is the elimination of incidences of suppressed demand load. Let’s understand this with a very simple example: Let’s say you took an electricity connection five years ago when you had one air conditioner in your house, and we all know that there is a two-part tariff [i.e. if a discom gives you a 2.5-kilowatt sanctioned load for your house, you will pay some demand charge for it]. Now, over the next five years, you added three more ACs, which means your actual load has gone up from 2.5 kilowatts to about seven kilowatts. But there is no way, in the manual system, to check this. The moment we installed smart meters and put the data online, the discom knew the exact load used in a premise. Therefore, the fixed charges for sanctioned loads go up, increasing the revenue. In fact, [New Delhi Municipal Corporation] and Uttar Pradesh are the biggest benefactors of this.

The second reason is very crucial because a lot of discoms are still saying that they do not need smart meters because their billing efficiency is 99%. [New Delhi Municipal Corporation’s] billing efficiency is 99.8% today and its average bill has gone up by 25%. The reason is, in the manual system you may be billing 99% of consumers, but there is no way of ensuring that the quality of billing is good. There are hundreds of dysfunctional meters and discoms continue to bill at flat rates. Just because you are generating a bill does not mean that you are getting all the revenue that you need to bill for.

The third benefit of a smart meter is transparency. About 99% of consumers in UP who have smart meters are now paying their bills on time–urban and rural. This is because now they know exactly what their consumption is, they do not have to wait for the bill to come after three months. We are now encouraging everyone to download a mobile app through which they can see their daily electricity consumption. Because of this transparency, disputes over bills have also gone down dramatically.

In Bihar, we are taking this one step further. We are going for a prepaid model there. You pay upfront for the energy you would like to consume in the near future [which helps consumers plan and regulate their energy use and bills]. If this happens, imagine how much it will benefit the discoms –they will need no working capital because they get the money upfront before you buy electricity. The need for a huge working capital is exactly the problem they are struggling with today. I would say the exercise has been an enormous success.

**How will these smart meters improve the electricity sector in general? How can renewables benefit from them?**

Let me first start by telling you why smart meters are a critical element in the future health of the sector. The average billing efficiency in India is 83%, which means that 17% of the electricity in the country is not billed for, forget about revenue collection. This 17% means a staggering loss of Rs 100,000 crore [equivalent to India’s education budget for 2020], if I calculate the per-unit cost at Rs 5. There is only one solution to plug this: smart meters. We have seen smart meters solving the problem in UP, where Aggregate Technical and Commercial losses [the difference between the total electricity units supplied by a discom and the total units billed for] have gone down by 36% in certain feeders [transmission lines that take electricity from the spot of generation to distribution points].

Now coming to renewables, what is the problem today? Why are states reluctant to take renewables? Because renewable power generation mostly happens during the time [of the day] when I don’t need it, not even with the per-unit cost of Rs 2.44 [because there is not enough demand given Indian usage patterns]. The solution to this is the “time of the day” policy [under which different rates apply at different times of the day. Usually, under this policy, the rate of the electricity is kept cheaper during off-peak demand hours to compel users to shift most of their non-essential power usage in that time-frame. This helps a user save money along with helping a discom reduce pressure on its grid during peak hours.]

Now, how do you implement “time of the day” policy? You tell a consumer that I will give you electricity at a cheaper price of Rs 3 per unit between 11am and 4pm, so shift your non-essential usage to these hours. But this can only be done with smart meters because it provides you with real-time flexibility. The other benefit of smart meters is incentivising people by demand response, which means that everyone wants to switch on their AC at 6pm...If I tell a consumer to switch on the AC at 9pm and he [or] she will get a rebate of Rs 1 per unit for those three hours, the load on the grid will shift. This can only happen in real-time with smart meters.

**What are the challenges that Energy Efficiency Services Ltd faced with smart meters?**

The first major challenge we faced had several ramifications. It was about the integration of the data that is coming out of smart meters to the head-end system [hardware and software that receives the stream of meter data] to the metre data management system [which helps process the received meter data for insights] and then the legacy software of billing and collection. But I am very proud to say that we overcame that challenge.

Now we have been able to standardise the process up to the meter data management system. So now when we start working with a new discom, the only challenge we face is integrating the entire system to their legacy billing software because all discoms use unique billing software. The other challenge we faced was the supply of smart meters in such huge numbers. The supply, however, has now improved considerably. At the moment there are six- [to] seven-metre manufacturers who have got certification from the Bureau of Indian Standards [the national standards body under the Ministry of Consumer Affairs]. We cannot install any metre that is not certified by the [bureau]. In fact, the minister and secretary of power have been meeting with metre manufacturers on a constant basis and we are seeing the results. The number of people on board is increasing by the day.

**So is EESL trying to figure out a single solution that works with all the legacy billing software of discoms? Or is it using a different integration exercise for every discom?**

It all depends on what softwares the discoms are using. Up to the meter data management system, we have achieved standardisation because it is either us or our partners who are controlling the infrastructure. The only thing that belongs to the discoms is their own billing software. For example, in [Uttar Pradesh], the five discoms have been using three platforms. We are trying to make it common. In the end, UP’s discoms would like to see a consolidated dashboard with all the data about electricity consumption and trends and that is what our endeavour is.

We are bringing all the meter data on a common platform and further, we are planning to have different buckets for different discoms in a virtual framework because all of it is cloud-based. And to achieve this exact model took us a while because no one has ever done such an exercise at such a massive scale in India.

**Why GPRS, why not other advanced technologies like radio frequency mesh that experts believe is better, as IndiaSpend reported?** [Radio frequency mesh technology uses radio waves to communicate among groups of meters that send data to a data concentrator unit with a SIM card which then forwards it through the telecom network to the discom’s main server. This is unlike the GPRS technology where each smart meter needs its own individual SIM card to communicate with the server.]

We are going with GPRS and possibly looking at the [Narrow Band-Internet of Things], which is a specialised band only for machines on a GPRS kind of a network. [Radio frequency] is a good technology but it does not suit our business model because it is capex heavy [requires capital expenditure to build a new network] due to which our cost-per-meter would go up to Rs 6,000 per meter. It is Rs 2,500 in the GPRS system.

Also, with RF, I will have to build institutional capacity to maintain that network. The benefits of GPRS technology is that I am getting data cost at a very reasonable price of Rs 4 per SIM card per month. And the availability of the GPRS network is 98.5% in the country.

I am not saying that moving forward we may not look at other technologies. We may. For example, in multi-storeyed buildings you can have an [radio frequency]-technology network because the data from all the apartment meters will come to a single DCU and from there go to the GPRS network. So we may look at a combination of network technologies going ahead.

**Telecom companies are moving beyond 2G and 3G. Will that not cause a problem?**

Our first tender was for 3G network technology. Let us look at what is in it for a telecom operator. An operator is currently getting only 1.1 million consumers for data, whose bandwidth requirement is so small, probably comparable to a credit card swiping machine, that an operator would never want to discard it. Secondly, for an operator these consumers are for life. EESL may get out of the scene but that SIM card will remain in a consumer’s house forever.

**Is connectivity not a problem for rural areas?**

As I said before, all we need is a telephone line because the data requirement of these meters is very low. And we have worked in rural areas of Haryana and Uttar Pradesh. So far, we did not face any issue with network connectivity. In Bihar, the network coverage is about 99%. In rural Uttar Pradesh, it is almost the same.

**What do the next couple of years look like for smart meters?**

The government has come out with a very ambitious plan of replacing all 250 million meters in the country with smart meters in the next three years. For this, the government has spoken to the entire meter industry to gear up for this drive. The good part is that most meter manufacturers said that they only need three-six months’ time to be ready to deliver 60 million [to] 80 million meters every year.

All the discoms that we are working with understand that they do not have the internal capacity to manage a project like this. They have tried to issue tenders to install smart meters on their own, but failed. But now they are seeing the results. We are also taking steps to build capacity within these discoms so that even after we leave there will still be people working there who understand this technology and how to take it forward.

Also, in our past experience of procuring meters and system integrators, we have identified a very large opportunity in the sector going forward. So last November we tied up with the National Investment and Infrastructure Fund, which manages the sovereign wealth fund of India, to establish a special purpose entity [a subsidiary], the Intellismart Infrastructure Private Limited, only for the purpose of implementing the smart meter project. The vision behind this move is that Intellismart will be the biggest system integrator in the country which will provide high-quality service in the transition period at a very affordable rate.

**How is EESL preparing itself to ramp up meter installation?**

Now, we are at a stage where it is simply a question of how many meters you can install per day. Today, I think we are at a rate of about 8,000 meters per day and the plan is to ramp it up to 15,000 to 20,000 in the next two-three months. By the end of this calendar year, we want to reach 70,000-100,000 meter installations per day. Currently, we have UP installing four million meters with us, as per the existing agreement. With Haryana, the agreement is of one million meters, but there are another one million consumers for which we are already in discussion with the state. In Bihar, we are currently installing about 1.8 million meters.

As for our new projects, we have signed an agreement with Port Blair. In Rajasthan, we have actually won a competitive bid to install 500,000 smart meters. We are also in conversations with Arunachal Pradesh, West Bengal and Telangana for hundreds of thousands of meters.

# **CAN SMART METERS SOLVE INDIA’S ELECTRICITY PROBLEM?**

**HINDUSTAN TIMES**

**Rahul Tongia is fellow, Brookings India, and was technical advisor of the Government of India’s Smart Grid Task Force. He is also the founding advisor of the India Smart Grid Forum.** His personal views are,

Much has changed in the electricity sector in the last few years. Electricity generation capacity is now surplus after years of deficits, and the price of solar power has fallen by 70%. But one thing that has barely changed is the performance of the electricity distribution companies (discoms), which continue to bleed money. They also face operational challenges, despite some improvements in the reduction of losses (and, importantly, 100% electrification). There are now proposals to install 250 million smart meters across all users to try and radically improve the discoms. While a top-down push is important, unless there is bottom-up buy-in, such solutions will likely be under-effective, or worse, crowd out parallel or complementary efforts.

A Smart Grid is a transformation of the electricity grid where digital communications and control enable a more nimble, resilient, flexible, and efficient grid. It’s this last point that is pushing smart meters, which can be a tool for cutting down losses, which span under-billing, under-collection, and outright theft. Given the state of technologies and metering deployments across discoms, it’s inevitable to try and leapfrog to smart meters.

Smart meters could help improve detection of theft (a necessary but not sufficient condition for viable discoms), but they can’t accurately pinpoint all forms of theft alone. The two things really needed are on the ground action (vigilance) as well as analytics. Before discoms take the plunge in paying for smart meters, they have to ensure that vigilance improves through political will and analytics get incorporated in business practices regardless of the level of smart metering. Before asking for smart meters, planners should answer if utilities are harnessing the data they already have.

Prepaid meters are another major thrust. While this could help improve collection, one has to be willing to disconnect non-payers. Automation can make it easier, but it’s political will that’s needed for both automated and manual systems. Note that in a number of regions, the largest defaulter is the government itself. Most honest consumers actually prepay today through a deposit. Instead of the focus on prepaid, such functionality should be viewed as a subset of smart meters. We should also not implement prepaid meters in a standalone manner such as through a keypad for inputting payment codes. Not only is this inconvenient, utilities lose visibility of consumption and they can’t easily offer differential tariffs for users.

There are few arguments against making discoms smarter and the impending need for smart meters. But we should focus on not just “yesterday’s problems” such as billing and loss reduction, but also on tomorrow’s challenges such as renewable energy, electric vehicles, consumer choice and competition. This emphasises that different discoms have different drivers and expected functionalities from their smart systems.

Why did many earlier IT-driven discom projects not reach their potential or even languish? It was because of a lack of preparedness. This same challenge remains for blanket smart meter roll-outs. While volume makes smart metering hardware cheaper, the real challenge remains integration with existing (legacy) systems. Without solving this challenge, no drop-in solution can work well.

Smart meter roll-outs are not quite like LED bulb procurements. Meters are more of an ecosystem, probably closer to smart cities. Volumes and standardisation help, but only up to a point. There is also a new option of third party deployers who invest, and then take a monthly charge. This seems to help liquidity issues more than solvency issues, i.e. business model issues more than business case issues, and it could transfer some risk depending on the contract design. But the utility still pays, today in the order of ~100 per month (including GST). Is the value proposition greater than this? The average Indian household bill is around ~500 per month, and we can’t expect 20% efficiency gains to be revenue-neutral across India purely through smart meters.

There will be pockets and regions where high losses, high renewables, or something else drives more rapid deployment. The best way forward will be what some call “leopard spots” of deployment by geography — intensive deployment in selected areas, growing over time to cover the entire discom. This plan begins with a combination of most prepared discoms and highest urgency areas. This also gives utilities time to do their homework — finish standardising databases and billing platforms and GIS (digital mapping) efforts, not to mention enhance their staffing. Leadership continuity with political backing is another key ingredient for success. With this, even without smart meters, Haryana halved its losses in three years.

Smart meters fail when the technology and price points are off, but they succeed when consumers (and the utilities) ask for them. Instead of just looking at sticks like theft detection, we should also push carrots. These can include guaranteed zero load-shedding (with lifeline supply even during shortfalls), ability to easily integrate electric vehicles and renewables, as well as the potential to save money through time of day pricing.

Much of the focus has been on efficiency, but the real value proposition comes from a transformation, including one with dynamic pricing, and where consumers respond to incentives such as by shifting their loads to off-peak prices. These require awareness, incentives, and regulatory approvals, which will take time. Ultimately, smart meters are a valuable tool for improved discoms, but they are not a panacea for all ills. We should harness, but not rely on technology to solve what are fundamentally governance failures.

**LITERATURE SURVEY**

# Smart Meter Energy Consumption Data in London Households

[UK Power Networks](https://data.london.gov.uk/publisher/uk-power-networks)

Energy consumption readings for a sample of 5,567 London Households that took part in the UK Power Networks led Low Carbon London project between November 2011 and February 2014.  
  
Readings were taken at half hourly intervals. Households have been allocated to a CACI Acorn group (2010). The customers in the trial were recruited as a balanced sample representative of the Greater London population.  
  
The dataset contains energy consumption, in kWh (per half hour), unique household identifier, date and time, and CACI Acorn group. The CSV file is around 10GB when unzipped and contains around 167million rows.  
  
Within the data set are two groups of customers. The first is a sub-group, of approximately 1100 customers, who were subjected to Dynamic Time of Use (dToU) energy prices throughout the 2013 calendar year period. The tariff prices were given a day ahead via the Smart Meter IHD (In Home Display) or text message to mobile phone. Customers were issued High (67.20p/kWh), Low (3.99p/kWh) or normal (11.76p/kWh) price signals and the times of day these applied. The dates/times and the price signal schedule is available as part of this dataset. All non-Time of Use customers were on a flat rate tariff of 14.228pence/kWh.  
  
The signals given were designed to be representative of the types of signal that may be used in the future to manage both high renewable generation (supply following) operation and also test the potential to use high price signals to reduce stress on local distribution grids during periods of stress.  
  
The remaining sample of approximately 4500 customers energy consumption readings were not subject to the dToU tariff.

**CONTEXT**

To better follow the energy consumption, the government wants energy suppliers to install smart meters in every home in England, Wales and Scotland. There are more than 26 million homes for the energy suppliers to get to, with the goal of every home having a smart meter by 2020.

This roll out of the meter is led by the European Union who asked all member governments to look at smart meters as part of measures to upgrade our energy supply and tackle climate change. After an initial study, the British government decided to adopt smart meters as part of their plan to update our ageing energy system.

In this dataset, you will find a[re factorised version of the data](https://data.london.gov.uk/dataset/smartmeter-energy-use-data-in-london-households) from the London data store, which contains the energy consumption readings for a sample of 5,567 London Households that took part in the UK Power Networks led Low Carbon London project between November 2011 and February 2014. The data from the smart meters seems associated only to the electrical consumption.

There is information on the ACORN classification details that you can find in this [report](https://acorn.caci.co.uk/downloads/Acorn-User-guide.pdf) or the website of CACI.

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