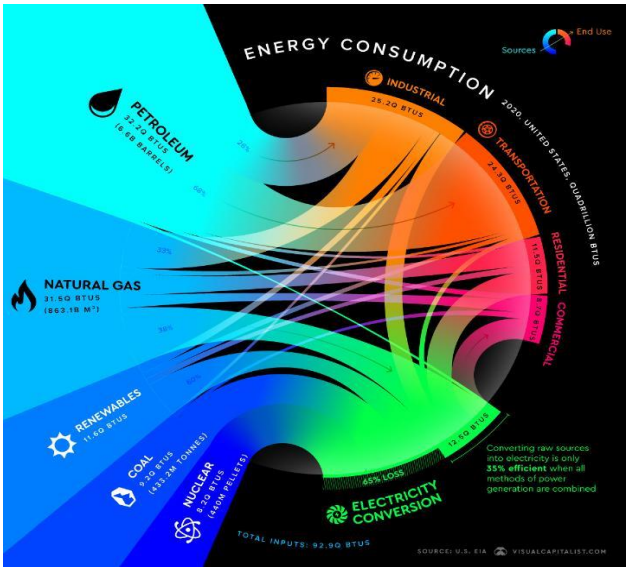
PLUGGING INTO THE FUTURE : AN EXPLOITATION OF ELECTRICITY CONSUMPTION PATTERNS

Introduction:

- Urban areas presently consume around 75% of global primary energy supply, which is expected to significantly increase in the future due to urban growth.
- Having sustainable, universal energy access is a pressing challenge for most parts of the globe.
- Understanding urban energy consumption patterns may help to address the challenges to urban sustainability and energy security.
- However, urban energy analyses are severely limited by the lack of urban energy data. Such datasets are virtually non-existent for the developing countries.
- As per current projections, most of the new urban growth is bound to occur in these data-starved regions.
- Hence, there is an urgent need of research methods for monitoring and quantifying urban energy utilization patterns.

Overall Consumption of Electricity in the United States:

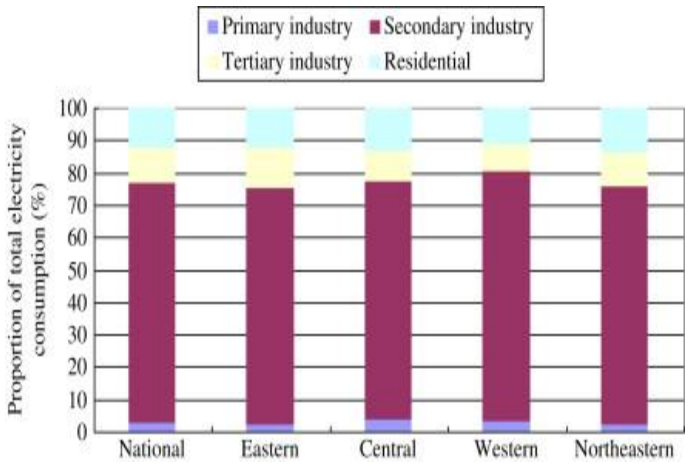
- Electricity consumption in the United States, as a whole, has increased dramatically with the implementation of new and innovative uses for this versatile energy form.
- It is possible to calculate the percentage rate of increase in electrical usage for various blocks of time.
- Alternatively it is instructive to show that the consumption of electricity over time conforms to a sound polynomial equation where x represents the year and y represents annual consumption in billions of kilowatt hours (10^9 kWh)/year.
- One can use elementary calculus to determine the rate of increase at any point in time.
- Manufacturers and commercial establishments in the United States have adopted energy saving processes as well, accentuating this trend.
- They have been supported by the trend in producing energy saving household appliances and devices.
- The increased use of electricity in the United States over the 20th century coincides with a decrease in energy prices.
- Yeh and Rubin [50] document that the price of electricity to the consumer decreased on average, in constant (inflation adjusted) year 2000 dollars, from 420 cents/kWh in 1900 to 7 cents/kWh in the year 2000.



Regional Electricity Consumption Structure:

- Proportions of electricity consumption by primary and secondary industry in the western region are relatively high, but consumption by the three industries and residential show lower proportions than the national average.
- In the western region during 2009, the three industries and residential electricity consumption proportions were 2.95%, 77.49%, 8.15%, and 11.41%, respectively.
- Since 1990, electricity consumption by primary industry has steadily declined in the west.
- The proportion of electricity consumption in the secondary industry first decreased and then increased, with especially significant increases since 2002.
- Within the western region, the electricity consumption by the secondary industry in Qinghai and Ningxia exceeded 90%.
- The proportion of electricity consumption in tertiary industry first rose and then dropped, while the proportion of residential electricity consumption has shown mostly stable increases.
- In the northeast, the proportion of electricity consumption by the tertiary industry is lower than the national average.
- However, residential electricity consumption is at a higher proportion than the national average.
- Furthermore, because of geographical and climate factors, the northeast residential heating period is comparatively long.
- This is partially the reason why residential electricity consumption occupies a comparatively high proportion of the overall consumption in the region.
- In the northeast during 2009, the three industries and residential electricity consumption proportions were 1.97%, 73.60%, 10.55%, 13.88%, respectively.
- Electricity consumption proportions by the primary and secondary industry declined by 0.012% and 8.88%, respectively; when compared with 1990 levels, the consumption by the three industries and residential rose by 3.48 and 5.52 percentage points.

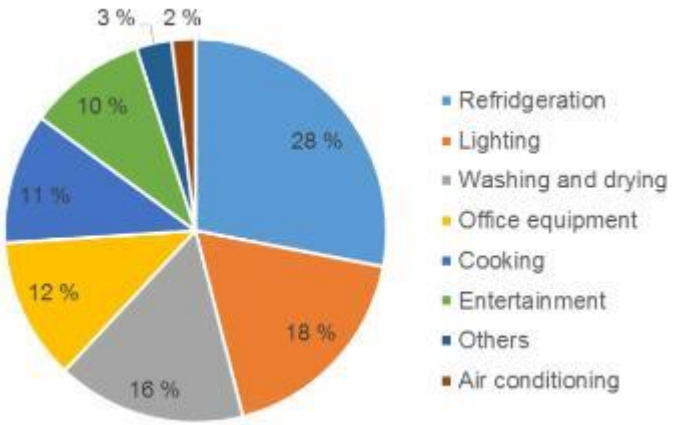
- The 2009 proportions of electricity consumption, both national and regional, are shown in Figure



Purchase and use of household lights and appliances:

- Electricity use for lighting and appliances in households has grown over the long term along with the introduction of new appliances and increases in the number of appliances per household (De Almeida et al. 2011).
- While lighting was the original purpose for supplying electricity to households, in 2010 it amounted to only 18% of domestic electricity use across 12 large European countries, and its share continues to decline with technical improvements in light sources.

Good practice report: Capturing cross-cultural interventions:



- Electricity consumption breakdown in households in 12 countries, excluding space and water heating (De Almeida et al. 2011).
- Household electricity use for appliances and lighting varies greatly by country.
- It ranges from 1,000–1,500 kWh (Estonia, Czech Republic, Romania, Latvia and Portugal) to around 3,000 kWh in the UK and Cyprus and to almost 4,000 kWh in Finland and Sweden (Odyssee 2015).
- According to Lapillone et al. (2015), the average level of electricity use for appliances and lighting in households across Europe is more weakly related to average incomes than other areas of household energy consumption indicating that there are other country-level factors involved.
- Due to technical advances in the efficiency of lighting and energy sources (largely thanks to European regulation), electricity demand in households has recently started to decline in the EU.
- During the 10-year period from 2004 to 2014, the electricity consumption by households fell in the EU-28 by 1.3%.
- Reduction was fast (28.6%) in Belgium, with reductions of more than 10% also being recorded for the UK and Sweden.
- To the contrary, household electricity consumption rose in 18 countries.
- The largest expansions were recorded in Romania (48.1 %), Lithuania (27.1%), Spain (21.8%) and Bulgaria (20.8%).
- These developments are likely to be influenced, in part, by socioeconomic and demographic changes.
- Other influences include the extent of ownership of electrical household appliances as well as the use of energy saving devices (Eurostat 2017b).

Conclusion:

- Our study is an attempt towards using remote sensing data and image processing driven methods to understand local scale electricity consumption patterns and understanding socio-economic dynamics within cities.
- Application of these methods over other cities will validate the assumptions made here and will strengthen the applicability of the method.
- The patterns identified in this study may be used in conjunction with other available data, such as land-use maps, to inform local-level policy making and, ultimately, help inform urban planning decisions in data scarce regions of the world.