CSEP Working Paper-30
June 2022

Centre for Social and Economic Progress
CSEP
Independence | Integrity | Impact

A Granular Comparison of International Electricity Prices and Implications for India

KANAK GOKARN, NIKHIL TYAGI and RAHUL TONGIA

Centre for Social and Economic Progress (CSEP)
CSEP Research Foundation
6, Dr Jose P. Rizal Marg, Chanakyapuri,
New Delhi - 110021, India

Recommended citation:
Gokarn, K., Tyagi, N., Tongia, R., (2022). *A Granular Comparison of International Electricity Prices and Implications for India* (CSEP Working Paper 30). New Delhi: Centre for Social and Economic Progress.

The Centre for Social and Economic Progress (CSEP) conducts in-depth, policy-relevant research and provides evidence-based recommendations to the challenges facing India and the world. It draws on the expertise of its researchers, extensive interactions with policymakers as well as convening power to enhance the impact of research. CSEP is based in New Delhi and registered as a company limited by shares and not for profit, under Section 8 of the Companies Act, 1956.

Designed by Mukesh Rawat.

A Granular Comparison of International Electricity Prices and Implications for India*

Kanak Gokarn
Research Assistant (Former)
Centre for Social and Economic Progress
New Delhi, India

Nikhil Tyagi
Research Associate
Centre for Social and Economic Progress
New Delhi, India

Rahul Tongia
Senior Fellow
Centre for Social and Economic Progress
New Delhi, India

This study is supported by a grant from the MacArthur Foundation. Centre for Social and Economic Progress recognises that the value it provides lies in its absolute commitment to quality, independence, and impact. Activities supported by its donors reflect this commitment and the analysis and recommendation found in this report are solely determined by the scholars.

*We thank Dr. Rakesh Mohan and a number of colleagues and experts who have given feedback and shared inputs, including some of the data. We also thank Aditya Srivastava for his help with all-India data compilation and Rishabh Trivedi for other data assistance.

Table of Contents

List of Figures

Abbreviations

ACCC	Australian Competition and Consumer Commission
ADB	Asian Development Bank
AEMC	Australian Electricity Markets Commission
AER	Australian Energy Regulator
ANEEL	National Electric Energy Agency
BNA	German Bundesnetzagentur
C&I	Commercial and Industrial
CEA	Central Electricity Authority
CEER	Council of European Energy Regulators
CRE	Commission for the Regulation of Energy
DisComs	Distribution Companies
EEG	(German) Erneuerbare-Energien-Gesetz (Renewable energy surcharge under the Renewable Energy Sources Act)
EIA	Energy Information Administration
EU	European Union
FERC	Federal Energy Regulatory Commission
FY	Financial Year
GHG	Green House Gas
HT	High Tension
IEA	International Energy Agency
IMF	International Monetary Fund
kWh	Kilo-watt Hour
LT	Low Tension
MoSPI	Ministry of Statistics and Program Implementation
NDRC	National Development Reform Commission
NERSA	National Energy Regulator of South Africa
OECD	Organisation for Economic Co-operation and Development
PFC	Power Finance Corporation
PLN	Perusahaan Listrik Negara
PPP	Purchasing Power Parity
PRR	Permitted Regulatory Revenue
RE	Renewable Energy
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
SERC	State electricity Regulatory Commission
tCO2e	Tonnes of Carbon Dioxide equivalent
UK	United Kingdom
UNCTAD	United Nations Conference on Trade and Development
US	United States
VAT	Value-added Tax

Executive Summary

This study compares electricity prices across countries in an attempt to understand whether electricity is cheap (or expensive) in India. Electricity prices vary across the globe. However, a simple comparison can be misleading, as prices include a number of components, vary across consumer types, and levels of consumption. This paper aims to draw lessons for India and its electricity pricing structure by comparing prices in a granular fashion, across a sample of both developed and developing countries.

While a range of factors—including taxation structures and the degree of market competition—explain why electricity prices vary by market, it is clear that cost-reflective pricing (on a number of quality indicators) is crucial for the proper functioning of the electricity sector. Effective pricing is key to the efficient overall functioning of the electricity sector. However, pricing must also be balanced with affordability concerns, for which options other than cross-subsidies can be considered. Effective pricing is especially urgent, given the financial state of India's electricity distribution companies (DisComs), and the scale of transformation and investment required for India's electricity sector to meet its climate mitigation and renewable energy targets.

While India has low electricity prices on average, the poor quality of supply adds a cost for consumers, especially for those consumers who rely on back-up power. Indian electricity is amongst the most expensive in the world, when measured on the basis of purchasing power parity (PPP). The spread in prices by consumer type—residential, commercial, industrial, and agricultural—is also amongst the highest in the world. Commercial users and industrial users pay high prices (industrial users especially so), because of social welfare redistribution norms and attendant cross-subsidies. Users in these two categories pay high prices not just in relative terms but even in absolute terms (using market exchange rate comparisons).

Electricity prices are a balance between affordability and viability of the supplier. A number of case studies point to the tools available to tackle issues such as affordability and competitiveness. These tools include tax exemptions for certain large consumers (in Germany); a subsidy regime (in Indonesia); and varying ownership structures (in the USA). There are also disparities between the 'developing' countries selected for the present study, and they cannot always be clubbed together. Given that Indian DisComs lose money on average, consumer prices will need to rise even after achieving maximum efficiency gains (improving losses). This analysis shows that such price rise should not be spread across consumer categories but should focus on selected consumer types.

Background and Context

India's electricity demand is projected to grow rapidly, due in part to rising incomes, increased household appliance usage, and greater electrification of end-uses such as cooking and transportation. According to the International Energy Agency's (IEA) *India Energy Outlook* (IEA, 2021), electricity demand is slated to grow faster than overall energy demand.

India's Distribution Companies (DisComs) are responsible for both the distribution network infrastructure, and the procurement and sale of electricity to end consumers. The poor financial state of these DisComs is well-known, and is caused by non-collection of dues and subsidies coupled with high levels of losses (Devaguptapu & Tongia, 2020). The problem is further compounded by the electricity pricing regime, which currently charges industrial and commercial tariffs that are significantly higher than the average cost of supply to industrial and commercial consumers, while a significant consumer base (domestic and agricultural consumers), pay prices below cost. These price distortions are cross-subsidies approved by the independent State Electricity Regulatory Commission (SERC) and reflect social welfare redistribution. This is because provision of affordable electricity to domestic (residential) and agricultural consumers is among India policy priorities.

Effective pricing that reflects the varying cost of supplying electricity to different end-consumers, could be a big step-up in improving the system's overall efficiency and outcomes of India's electricity system. It can provide accurate signals regarding generation, consumption and investment decisions. As the grid is forced to handle growing shares of variable renewable generation, associated changes in load curves, and the changing climate, consumption and investment decisions will become increasingly important. Effective pricing is thus also essential for India's energy transition, its associated climate targets, and for the socio-economic benefits that a reliable supply of electricity can bring.

The purpose of this paper is to look at: (i) how India's prices compare to a sample group of countries; and (ii) whether maintaining these price levels is sustainable over the long-term—are these prices competitive, and what quality of supply are consumers receiving?

In addition, by looking at how other countries have structured their electricity markets—in terms of regulatory frameworks, revenue determination, and competition and affordability—the hope is to spark a discussion on what India can feasibly do to bring about accurate and sustainable prices for electricity. More than a simple comparison between prices (even down to consumer type), we also examine components of pricing structures, taxes, etc. This paper is thus a detailed descriptive analysis, though we do attempt to distil policy implications.

Data Compilation and Methodology

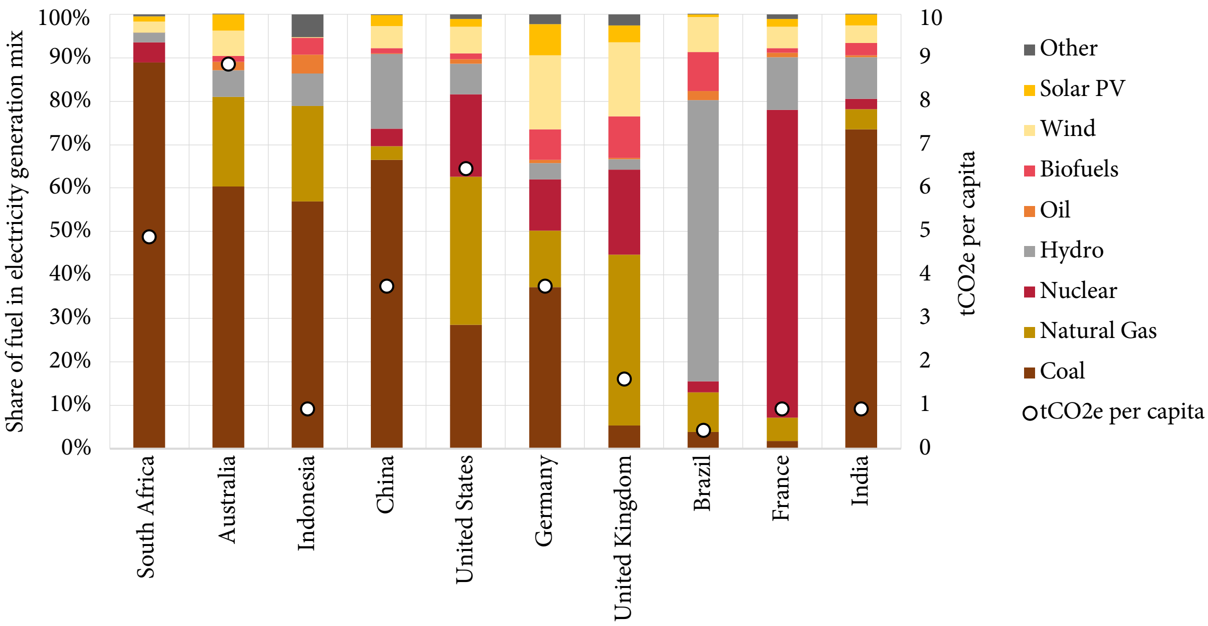
Sample of Countries

The sample of countries was chosen due to the unique characteristics of their electricity systems including their generation mix, the degree of retail competition, and their taxation (or subsidy) regimes. These include middle-income countries such as South Africa, Brazil, Indonesia, Bangladesh and China, and high-income countries such as US, United Kingdom (UK), Germany, France and Australia, as classified by the World Bank. India is presented for reference. Future comparisons can be made with other countries as well, but the scope of this paper is limited to these ten countries.

Figure 1 shows the electricity generation mix for each country for 2018, and their CO2 emissions for the electricity/utility heating sector (including combined heat and power) in tonnes of CO2 equivalent (tCO2e) per capita. Countries in the sample with a higher share of non-fossil fuel-based generation naturally have lower emissions on average. The middle-income countries in the sample, tend to have more fossil-fuel based generation due to a number of contributing factors, including the easier availability of fossil fuels, and their comparatively lower cost of generation. They therefore also face higher emissions on average.

South Africa is 90% reliant on coal-fired generation. Australia also has a relatively fossil-fuel-dependent generation mix at 83%, primarily coal, followed by natural gas. Indonesia relies on fossil-fuels for 83% of its generation. China's share of fossil fuels is 70%, and generation is predominantly coal with limited gas-fired generation. The US' share of fossil fuels is 64%, with natural gas the primary fuel. Nuclear generation also makes up 19% of its generation.

Figure 1: Electricity Generation Mix and Electricity Sector CO2 Emissions 2018



Source: Underlying data for the year 2018 from IEA, and World Resources Institute's (WRI) Climate Watch (World Resources Institute, 2020).

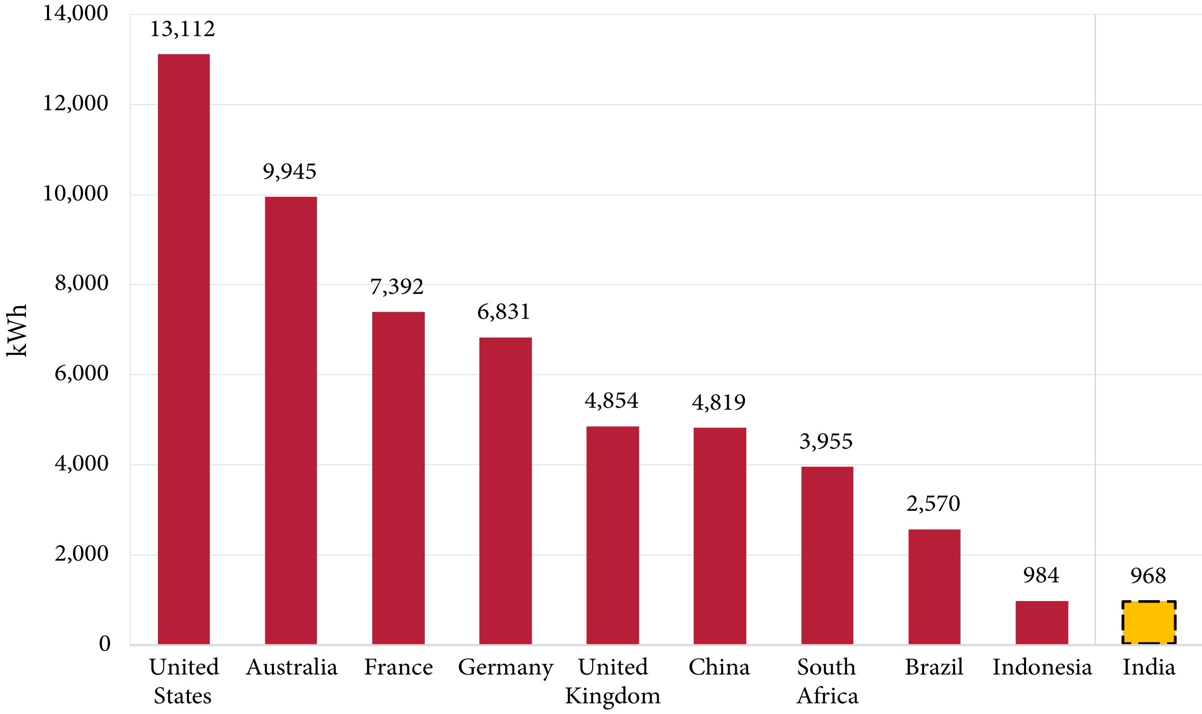
Note:
1. 'Other' includes waste, solar thermal, geothermal and tidal energy.
2. Tonnes CO2 are sectoral, for electricity, combined heat and power, and utility heating only.
3. Brazil and France have supply dominated by hydro and nuclear, respectively, leading to their lower sector-based emissions.
4. India's and Indonesia's low emissions are because of their low consumption.

Germany's electricity mix is quite varied, with coal being dominant but with around 40% of generation coming from renewable sources, primarily wind. The UK's generation mix is not dissimilar to Germany's, however natural gas is the primary fuel. Brazil is notable for its large share of hydropower, accounting for 65% of generation. France also has a relatively low-carbon generation mix, with nuclear power accounting for 71% of its generation, followed by other source of renewable energy (RE), with a minor role for natural gas and coal. In India, fossil fuels make up 79% of generation, predominantly coal.

The CO2 emissions are shown only for the electricity/combined heat sector per capita. Australia has the highest per capita emissions at 8.86 tCO2e, followed by the US at 6.44 tCO2e, and South Africa at 4.88 tCO2e. China and Germany have emissions of 3.74 tCO2e each, despite Germany's larger share of renewable energy. Emissions for the UK stand at 1.92 tCO2e. France and India are at 0.92 tCOe2, and Indonesia is similar at 0.91 tCO2e. While France total electricity use is much higher than India's, its emissions are low due to heavy use of nuclear and hydro power. France also has much higher per capita fossil-fuel consumption (not including electricity) than does India. Brazil emits only 0.42 tCO2e per capita due to its large hydropower potential. However, in absolute terms, China has the highest emissions from the electricity/heat sector, followed by the US and India; these three nations are also the most populous in the world.

Figure 2 shows the per capita levels of electricity consumption in 2018 for each country. As energy systems and economies develop and many uses become electrified, as is the case in high-income countries, it is natural that electricity consumption will be higher per capita. However, this shows that middle-income countries are still on the lower end of electricity consumption, implying that much of their growth in electricity consumption lies ahead. The lessons learnt by high-income countries can therefore be instructive. In India's case, this only serves to highlight the urgency of the problem of effective pricing, linked to affordability. Growing demand must be matched by reliable supply, which is difficult to achieve efficiently without improving the financial viability of DisComs.

Figure 2: Per Capita Electricity Consumption 2018



Source: UNDESA (2019) for population for all countries; IEA (2020b) for electricity consumption for all countries except India; for India, the data is from the (CEA, 2020).

Note: These data include captive power as reported, which is a significant share of consumption in India.

Electricity Pricing Data

The latest data available at time of analysis, i.e., from financial year (FY) 2018–19 is considered for India, and most of the data for other countries has been matched as closely as possible.[1] For Australia, its financial year begins on July 1 and ends on June 30, so data is available for FY 2018–19. South Africa follows a system close to India's, so FY 2018–19 begins on April 1 and ends on March 31. Data for the remaining countries was available for the calendar year 2018. A full list of sources is available in Appendix I.

It is important to note that since the prices used here are averages, they may not reflect what an individual consumer might actually pay. They reflect what the average consumer of a particular type can expect to pay, excluding any exemptions or reductions or subsidies that may apply outside the regulatory pricing structure. Where applicable, this average price includes fixed and variable

[1] Financial Year has FY while other years shown are calendar years. FY 19 is short for FY 2018-19.

(per-unit) charges of electricity, as well as all taxes and surcharges that are applicable.[2] The data here includes components related to electricity generation and supply, including a retail component, network charges, including transmission and distribution, and all taxes and levies.

The prices are in rupees to allow for an effective comparison for the Indian context. Data on nominal exchange rates was obtained from the United Nations Conference on Trade and Development (UNCTAD) database (UNCTAD, n.d.). This enables a fair comparison, but we do revisit the issue of affordability, particularly for household consumers, subsequently, including use of PPP adjustments. Our focus is a price comparison from a regulatory lens, meant to inform policy setting, instead of the specifics of the numbers per se.

All countries in the sample have fairly robust data when it comes to domestic (residential or household) consumers. However, when it comes to non-residential consumers, there are different levels of aggregation.

Europe: Countries combine manufacturers, commercial enterprises and agriculture under 'non-household consumers'. Most of the data was sourced from Eurostat, and the energy regulators in each country. These include the German Bundesnetzagentur (BNA), the Federal Network Agency. For the UK, that includes Ofgem, which is responsible for electricity and gas regulation. For France, that is the Commission for the Regulation of Energy (CRE), as well as the Ministry of Ecological Transition.

All European Union (EU) energy regulators have a common forum, the Council of European Energy Regulators (CEER), which is also the source for some data including on returns and losses. The UK and France, following EU guidelines, report prices by consumption band for non-residential users. Thus the prices reflected here are for the 'standard' consumption band of between 500 and 2,000 megawatt hours (MWh) annually, all taxes included (Eurostat, 2021).

Commercial activities broadly include the service sector, including health and education, arts and entertainment and businesses and offices. Commercial users for the UK, France and Germany follow European Union reporting guidelines. This classification follows the UN's International Standard International Classification (ISIC) guidelines closely (Eurostat, 2019). Some European countries define commercial users in terms of consumption profiles. For Germany, this includes consumers consuming around 50 MWh annually.

Indonesia: Commercial services are considered to be those consuming at medium-voltages (PLN, 2018). Indonesia's data is sourced from Perusahaan Listrik Negara (PLN), the state-owned monopoly utility. They have different classes of consumers, largely classified on the basis of the voltages they consume at, of which smaller consumers tend to receive electricity at subsidised prices.

Australia: Data was sourced from various regulatory bodies, including the Australian Electricity Markets Commission (AEMC), the Australian Energy Regulator (AER) and the Australian Competition and Consumer Commission (ACCC). There is limited data on non-household consumers. However, in this case, data for small business consumers consuming less than 100 MWh annually, larger commercial and industrial consumers (including universities and governments) was reported separately (ACCC, 2019).

US: Commercial activities include non-manufacturing businesses including services such as health and education, public lighting, hospitality, retail and public institutions (EIA, n.d.). The industrial category also includes agricultural consumers. The Energy Information Administration (EIA) is responsible for collecting this data, although the Federal Energy Regulatory Commission (FERC) plays a role as well especially regarding utility financial information where under their jurisdiction.

[2] For India, we estimate the duties as applicable per consumer category based on CEA (2019) using state average consumptions and total duties. A granular compilation, by not just consumer types but also consumption levels (slabs), is not available. Our estimate is cross-referenced via the RBI (2020) estimate of Rs 40,345 crore paid as taxes for electricity.

Brazil and South Africa: Both countries split consumers based on residential use, industrial use, commercial use, and agricultural use, as well as additional categories such as traction/rail services and public lighting. Brazil's data is from its National Electric Energy Agency (ANEEL), whereas South Africa's is from its main utility Eskom, state-owned and vertically-integrated.

China has notified prices for residential and agricultural consumers (regular and those in low-income regions), as well as separate categories for commercial and industrial consumers—large manufacturing industries form one category and smaller industries and commercial consumers form another, each with a separate notified price. Much of the data is from the National Development Reform Commission (NDRC) and its pricing supervision reports, as well as at times from Chinese provinces. China similarly has a separate notified price for large manufacturers, and other 'general' industrial and commercial users whose total transformer capacity is below 315 kVA (Ye Zhang, 2019). It is likely that given the trends, commercial users pay a higher average price than large industrial manufacturing users.

Data and methodology for India

Two sets of the data are used to calculate the average price of electricity for India. The data on DisCom revenues and consumption was compiled from the State Electricity Regulatory Commission (SERC) tariff orders for 2018–19.[3] The average level of consumption for each category and DisCom was calculated by dividing sales volumes and the number of consumers. For this average consumption level, the electricity duty rate is used to estimate the total tax collected. Revenues plus the total electricity duty collected divided by total sales volumes are used to arrive at the average price paid by the average consumer in each category for each DisCom. The weighted average is then taken for each state with more than one DisCom. Other sources of data used include the Power Finance Corporation's (PFC) 2018–19 report,[4] the Central Electricity Authority (CEA), and Ministry of Statistics and Program Implementation (MoSPI). For India we keep track of how much is paid by consumers versus subsidies, but focus on regulator-set prices.

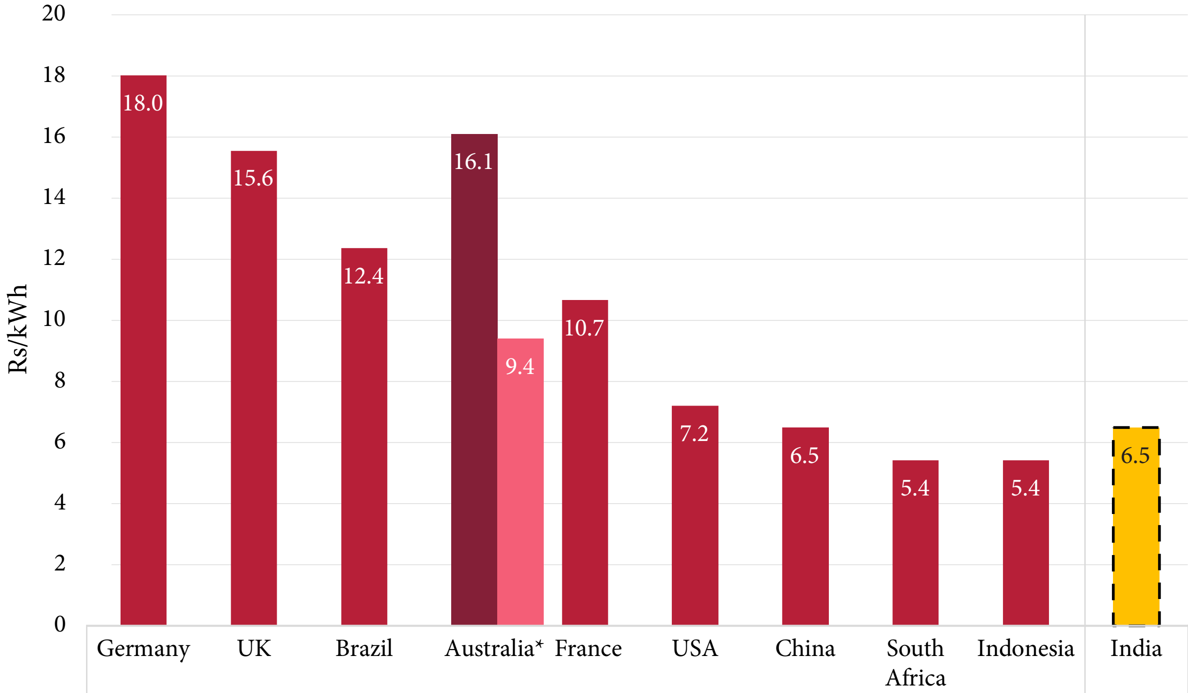
Average Price of Electricity

Figure 3 shows the average effective price paid for electricity by end consumers in each of the sample countries in Rs/kWh. A national average was available for Brazil, US, China and South Africa. For Germany, UK and France, the price was calculated as an average of domestic, i.e., households and non-household prices and electricity consumption. For Australia, in the absence of a clear breakdown of prices for residential and commercial and industrial users, the price shown is the range of average prices for residential users, who pay the highest, and large commercial and industrial users, who pay the lowest per unit rates. The average price is between these two bounds. This is a high-level comparison, and so the data are not the actual prices paid by consumers and are more indicative of the price level in these countries, and include all fixed charges, taxes and surcharges levied.

[3] The tariff orders' cost, revenue and consumption data reflect tariff rates for retail consumer, and these are determined in advance on an a priori basis. The actual average billing rate numbers vary after the tariff order year (post facto), but the all-India difference is small. In contrast, the average costs are much higher. These are meant to be reconciled in the near future, and this would change the cross-subsidy (and even required tariffs), but the spread varies heavily by state. This analysis uses retail prices for a given year, and not actual realizations.

[4] Although PFC also presents data on DisCom revenues and consumption, those figures do not fit our requirements as the share of government subsidies in revenue is given as a consolidated number, with no bifurcation by consumer category, and there is no information on the electricity duty.

Figure 3: Average Consumer Price of Electricity including taxes (FY19)



Source: Detailed in Appendix I.

Note:

*1. *For Australia, in the absence of a national number, the likely range of the average price is given at the upper range being what domestic consumers could pay on average (16.1 Rs/kWh), and the lower end (9.4 Rs/kWh) being the average price for large industrial and commercial consumers. However, given that Australia's domestic electricity consumption accounted for 25% of the total in 2018–19, it is likely Australia's average price falls between the UK and France in the above graph, probably below Brazil, assuming between 25% to 50% of units are priced at the higher level.*

2. Prices have been converted from local currencies to rupees using UNCTAD's nominal exchange rate data; see section 'Data'.

3. For Australia, the reporting year is 1 July 2018 to 30 June 2019. For South Africa and India, it is 1 April 2018 to 31 March 2019. The rest are reported by calendar year. See section 'Data'.

4. For Germany, the price data used was for the second half of 2018 from Eurostat.

Broadly, middle-income countries have lower electricity prices on average while high-income countries tend to have higher electricity prices, probably due to the prioritisation of domestic and agricultural consumers in the former. In this sample of countries, Germany has the highest average price at Rs 18/kWh across all sectors. The UK is next at Rs 15.6/kWh, with France at Rs 10.7/kWh, followed by US at Rs 7.2/kWh. Australia's average price falls in the range of Rs 9.4–16.1/kWh.

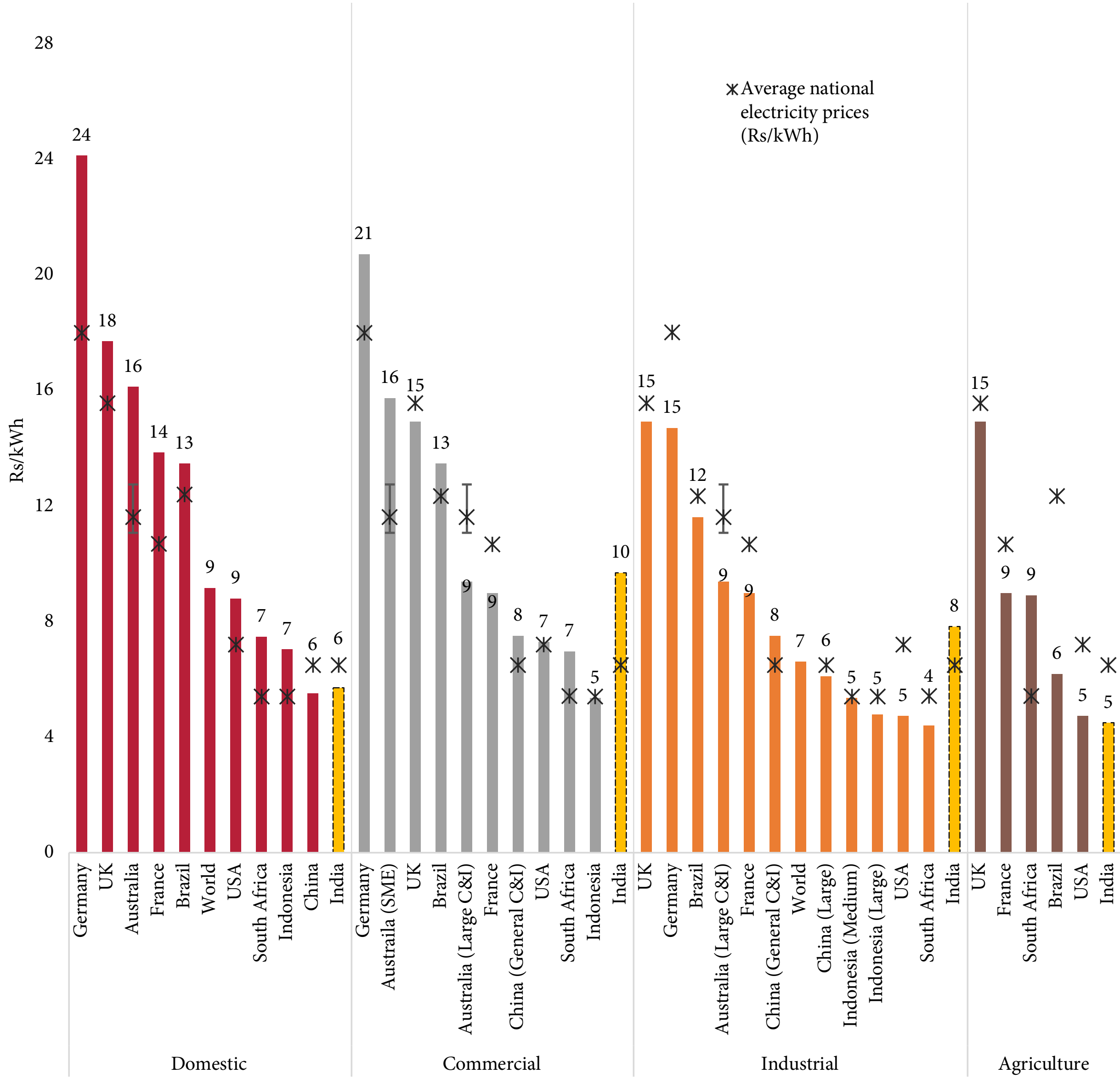
Of the emerging economies, Brazil has the highest price at Rs 12.4/kWh, followed by China at Rs 6.5/kWh, South Africa at Rs 5.4/kWh and Indonesia at Rs 5.4/kWh. India's average price across all sectors was calculated at Rs 6.5/kWh. Two exceptions stand out, notably the US and Brazil. Brazil's average electricity price is more than double that of India's, despite its electricity mix featuring a large percentage of hydropower. It is notably higher than its other BRICS peers (Russia, India, China, and South Africa). The US also is an exception among its peers—the average price in the US being less than half of that in Germany and the UK.

Different users are charged different rates based on the consumption category they fall into, which can be measured by the volume of consumption or, in some cases, by time-of-day use in some countries. Variation in prices and shares of consumption across categories (domestic, commercial, industrial and agricultural) also affects the overall average. Finally, the price paid and the cost-reflectivity of the price, are separate issues. Utilities in some countries, including India, consistently supply electricity at prices lower than the cost of supply, essentially making a loss on every unit sold. We examine some of these issues subsequently in the paper.

Category-wise Average Electricity Prices

Figure 4 shows that the average numbers for countries mask enormous heterogeneity by consumer type. Indian average prices turn out to embed some of the highest relative differences across categories. Agricultural and residential consumers pay nearest the lowest, while in most other countries, industry pays lower than the national average.

Figure 4: Consumption Category-wise Electricity Prices (FY19)



Source: See Appendix I.

Note:
1. The star shows the average price for each country; Australia's has an error bar because data only show the prices for bulk consumers versus small (especially residential) consumers. We assume a mix of anywhere from 25%–50%.
2. South Africa's average prices reflect those who Eskom supplies directly. South Africa's domestic price also includes public lighting. Indonesia's prices are for non-subsidised consumers.
3. These are for FY2018–19 for India, and closest matching for other countries.

These are category-wise averages, and so individual consumers may pay significantly more or less, more so if there are telescopic tiers or slabs of prices. Some large industries may be eligible for further reductions and exemptions that result in an even lower price, as is the case with Germany. These prices also do not capture any subsidies that may be provided outside the regulatory pricing structure, for example by the Indian government directly to DisComs to reimburse agricultural users (where sometimes agricultural users pay close to zero). As average prices are the average revenue collected for each unit sold, they capture the effect of cross-subsidies and discounts that are included in the price the end user pays, including by lifeline users or discounted consumers in the cases of Brazil and South Africa.

Household Consumers

In general, households tend to pay the highest tariffs, probably due to the higher cost of supplying electricity at lower voltages, lower usage rates, and higher system losses. According to IEA data, the world average price of electricity for domestic consumers was USD cents 13.4/kWh in 2018, which was equivalent to Rs 9.2/kWh (IEA, 2020a). The range of prices charged is quite large, ranging from Denmark (world's highest electricity prices at Rs 24.4/kWh), to Turkmenistan (free electricity for domestic consumers).

In the sample of countries in this paper, Germany has the highest average electricity for domestic consumers at Rs 24.1/kWh. This is the average price for household consumers as of 1 April 2018 for consumers falling in the standard consumer profile, consuming between 2,500 kWh and 4,999 kWh annually.[5] The data represents the weighted average of prices across various contracts for a standard consumer (BNA, 2019). This price includes all energy and supply charges, network charges and all taxes (including value-added tax or VAT) applicable to electricity. For the UK, the price given also represents that of the standard consumer whose consumption would fall between 2,500 kWh and 4,999 kWh annually. In 2018, it was Rs 17.7/kWh, including all taxes and levies.

For Australia, it represents the weighted average of the lowest price offered by retailers across the country's sub-divisions by the number of consumers (AEMC, 2019). The average domestic price was Rs 16.1/kWh. This includes all environmental taxes and energy and supply and network charges, as well as Australia's Goods and Services Tax at its standard rate of 10%. The median price is likely higher. For France, the average price here is the weighted average of all household consumer bands, and is Rs 13.8/kWh. These data also include energy and supply, network charges and taxation.

For the US, it represents the total revenues received by US utilities, divided by the total sales in kWh of the utility to arrive at an average price for domestic consumers. The revenue collected includes all retail, state and federal taxes as reported by the utilities to the EIA. The average total electricity price in the US for domestic consumers was Rs 8.8/kWh. For Brazil, data is calculated in a way similar to the US. Here the average price is the total revenues including tax, divided by total sales for the whole of Brazil. Brazil's average electricity price for domestic consumers was Rs 13.5/kWh. For Indonesia, these prices are for consumers that are subject to the tariff adjustment mechanism,[6] at Rs 7 /kWh. Small households that are eligible to be subsidised pay from Rs 2–2.8/kWh.

For South Africa, the average price was taken from the annual reports of Eskom. The average price was also calculated based on revenues and sales numbers for Eskom, with an additional VAT of 15%. It should also be noted that while Eskom generates over 90% of South Africa's electricity,

[5] Consumption bands are standardised across European countries. Band IC corresponds to the average non-household consumer, at an annual consumption of 500–1,999 MWh. Band DC corresponds to the average domestic consumer, consuming on average between 2,500 and 4,999 kWh annually.

[6] The tariff adjustment mechanism in Indonesia is used to adjust electricity prices in response to external factors such as fluctuations in exchange rates or oil prices, meant to keep tariffs affordable. However, tariffs have not been adjusted since 2017 (ADB, 2020b).

it only directly supplies 58% of end consumers. The others are supplied by Eskom through local distributors and municipalities at bulk-power rates, who may add additional charges (Haffajee, 2019). It should also be noted that Eskom's domestic figures also include public lighting. Its average domestic electricity price in 2018–19 was Rs 7.5/kWh.

Similar to India, China practices cross-subsidisation, where industrial and commercial consumers tend to cross-subsidise domestic and agricultural ones. China's domestic price is very close to India's at Rs 5.8/kWh, including the average level of government taxes and surcharges meant to support RE projects. India's support for RE projects isn't explicit as part of consumer bills, but embedded within the generation pricing, e.g., RE projects enjoy free transmission.

Finally for India, the base prices are based on CSEP's own calculations. The method used to derive these prices is described in the data section above. It also includes an additional average rate of electricity duty charged to domestic consumers. These rates vary within states, as some do not charge an electricity duty, whereas Maharashtra charges the highest rate at Rs 1.75/kWh for large domestic consumers (10+ kW connections, 1,000 kWh per month). On average, a domestic consumer would expect to pay around Rs 5.6/kWh.

Non-household Consumers (commercial, industrial, agricultural, etc.)

Challenges in comparing electricity prices globally for non-household consumers include: (1) disaggregation of data is not the same in every country; and (2) the activities included under the commercial or industrial sectors vary. In Figure 4 and subsequent graphs, these categories are matched as closely as possible. Commercial users generally include those that consume on the medium-voltage network according to the classifications of some countries, and non-manufacturing businesses for others. They include a wider range of users based on usage, generally face a higher price than industry but lower than domestic consumers, with India and China being exceptions. This likely reflects the broader range of consumption, as it might be cheaper to supply larger commercial users of electricity. As these are average prices, it is likely that as consumption levels and loads increase, users will pay less. Large industrial users, for example, would pay less than a small corner store, even though they may both come under 'non-household' users.

Commercial users in Germany paid Rs 20.7/kWh in 2018, according to BNA data. Smaller businesses in Australia paid roughly the same effective price as domestic consumers at Rs 15.7/kWh, whereas larger commercial users paid on average Rs 9.4/kWh. It is a similar case with Brazil at Rs 13.5/kWh. Commercial consumers in the US pay Rs 7.3/kWh on average, followed by South African consumers at Rs 7/kWh. Indonesian commercial users pay Rs 5.4/kWh, with subsidised users (small businesses) paying as low as Rs 2.5/kWh. Indian commercial consumers on average pay Rs 9.5/kWh, which includes the average rate of electricity duty charged. They pay the highest average rate among the various categories of consumers in India.

Only the average price for the standard non-household consumer is available for the UK and France, and so is listed here in both the commercial and industrial sectors. In the UK this was Rs 14.9/kWh and France at Rs 9/kWh. Prices for commercial users in China come out to Rs 7.5/kWh, including the average level of government surcharges. This is also the price applicable to smaller industrial users, as they are grouped under one category.

Industrial prices for large manufacturing industries tend to be lower overall within countries, except for China and India who subsidise domestic and agricultural users by charging industrial and commercial consumers more. In general, as electricity is supplied to industrial users at higher voltages, the losses are lower and the infrastructure costs are lower as well, which implies that the cost to serve these users is lower overall, resulting in lower prices in countries with competitive markets. This is reflective of both the cost of service, the possibility of negotiating directly with suppliers to set lower prices, and political decisions such as tax exemptions or refunds for certain industries. These refunds are not reflected in these prices in Figure 4, but will be discussed later in the paper.

The UK's price for non-household users (including industrial) is Rs 14.9/kWh, followed by Germany's at Rs 14.7/kWh. Brazil is at Rs 11.6/kWh. China is at Rs 6.1/kWh for large users, and 7.5 for 'general' industrial users. The US is at Rs 4.7/kWh. South Africa's industrial price is Rs 4.8/kWh. Indonesia's price is at Rs 4.8/kWh, whereas certain smaller industries can pay as little as Rs 2.2/kWh due to subsidies. India's average price was calculated at Rs 7.7/kWh, including the average electricity duty charged to industrial consumers.

Brazil, China, India and South Africa have separate categories for agricultural users. South Africa is the only one where agricultural prices are higher than other sectors. This could be due to the higher cost of servicing rural consumers spread out over a large area (EIA, 2014). The other three countries set artificially low prices for reasons of food and agricultural security and economic competitiveness, and also electoral jockeying. For the UK and France, the prices listed are those applicable to non-household consumers as agricultural users are included in this category. The US includes agricultural user in the industrial category, and so that is the price shown.

The pricing regimes mean agricultural users could pay on average Rs 14.9/kWh in the UK and Rs 9/kWh in France as there is no distinction between them and other non-household consumers. Consumers pay Rs 8.9/kWh in South Africa, Rs 6.2/kWh in Brazil, and Rs 4.8/kWh in the US. Indian agricultural users are charged Rs 4.5/kWh on average, but in reality the end-user may pay much less or even zero as their share is subsidised by the state (distinct from pricing cross-subsidies). While a national average agricultural price for China was not available, the prices in some of its main agricultural regions were. Some of these include the provinces of Henan, Heijongjiang and Hubei. For Heilongjiang, these ranged from Rs 4.8–5.1/kWh. For Hubei, for regular agricultural users, these ranged from Rs 5.4–5.8/kWh and Rs 3.8–4.0/kWh for users in poor counties within the province. For Henan, these ranged from Rs 4.6–4.8/kWh. Agricultural users are exempt from certain surcharges, such as the one for hydropower projects.

Some insights emerge from this data. As a general trend across countries, domestic users pay more than industrial and commercial users, with India and China being notable exceptions. Industrial users pay relatively low prices as they consume more electricity and at higher voltages, requiring less infrastructure and leading to lower network losses when providing supply. There is also a chance of exemption in taxes and other charges to keep these prices as low as possible for economic productivity and competitiveness (and thus employment) reasons.

Although India's prices are quite low for domestic and agricultural consumers, they are not so competitive for industrial and commercial consumers. Commercial users vary significantly in their usage, but they generally consume more than domestic users but less than industrial users. In a competitive electricity market therefore, they would generally see lower prices than would domestic consumers, but still pay more than industrial consumers. However, in India, they are likely to pay no more than domestic users.

In terms of tariff categories, some countries such as Brazil and South Africa have additional categories, such as for public services water treatment, public lighting, rural areas (excluding agriculture) and mining that are charged separate rates.[7] In China and some of the high-income countries, large industrial consumers are treated differently than smaller commercial and industrial users, with a number of tax exemptions, or separate tariff categories that are on average lower than other non-household consumers.

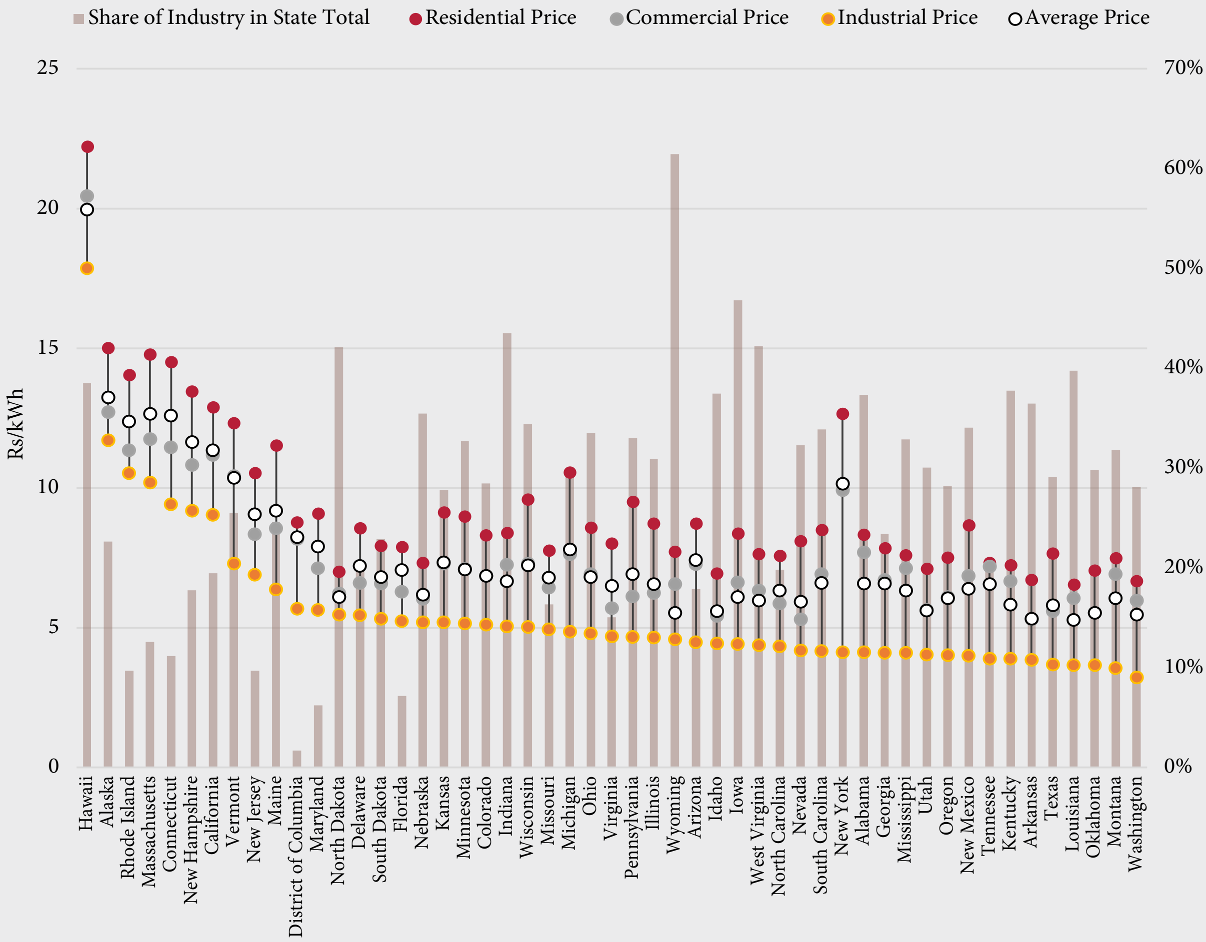
[7] India actually has an enormous number of tariff categories, often due to social welfare redistribution objectives combined with political compulsions.

While we can see discernible trends in the prices across consumer categories, these don't tell the entire picture. In subsequent sections, we examine several important issues including: sub-national variations, comparability of electricity service—including quality of supply, rebates or other support outside the pricing mechanisms and, affordability, or adjustments for purchasing power parity (PPP).

Box 1: US Sub-national Variations in Prices

A source of variation not captured in the national averages in Figure 4 is sub-national price variation, which depends on a number of characteristics including geography, the region's natural-resource endowment, demographic characteristics, regulatory environment and so on. The US provides a good example due to its regional diversity, as shown in Figure 5.

Figure 5: Electricity Prices in States in the US (2018)



Source: EIA data (2018)

Note: The correlation of -0.24 is between the share of industrial consumption in a state and its industrial electricity price.

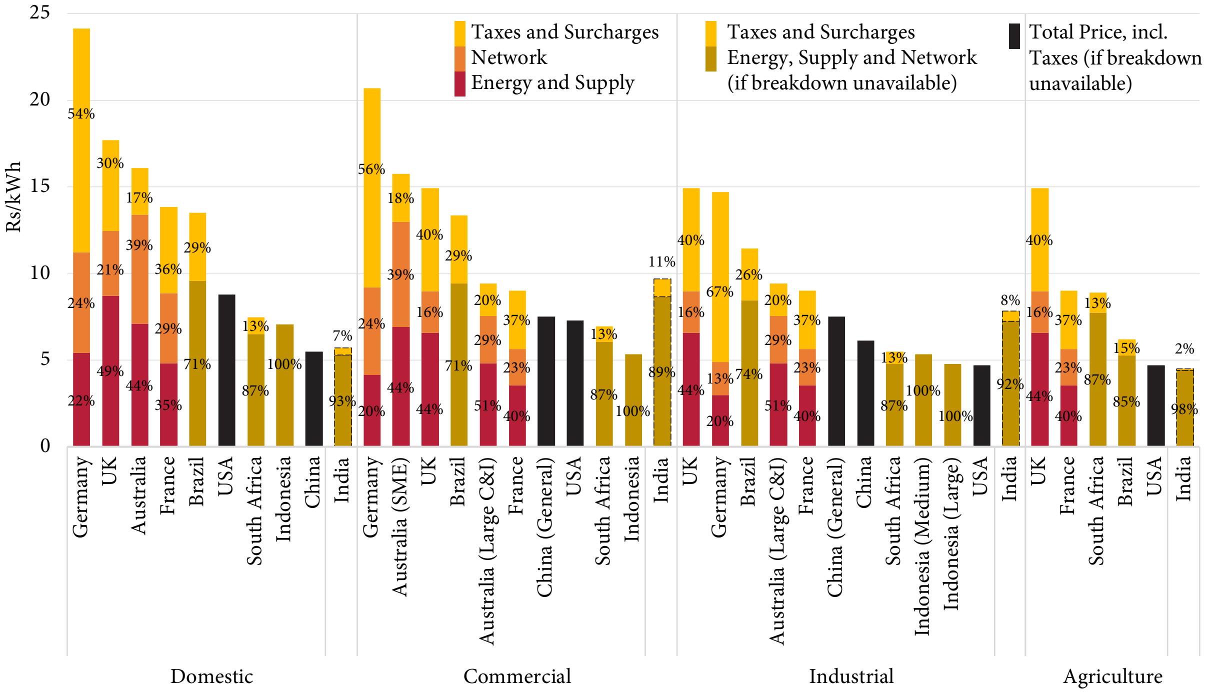
The focus is on industrial prices in this case to showcase industrial competitiveness. In the US, industrial prices generally do not exceed Rs 10.5/kWh, and can go as low as Rs 3.2/kWh in states such as Washington. Hawaii and Alaska are outliers, one being an island and the other being separated from the mainland. The average industrial electricity price in the US is Rs 4.4/kWh. There is a simple negative correlation of -0.24 in terms of where industrial consumption is concentrated and the electricity price, although naturally other factors such as the quality of infrastructure, policy and tax incentives and so on, also come into play.

Price Components

Pricing electricity is a complex calculation, even assuming one is meant to have a costs-plus regulated price. How does one recover the cost—through a simple volumetric charge, or also by splitting up fixed costs such as for last-mile infrastructure? The latter are often calculated through capacity (connection size) charges. By digging further into the price components, we can see how much of the differential is due to cost structure differences, versus choices made by regulators (or policymakers).

Figure 6 shows a breakdown of the electricity price into its components that are broadly: the cost of the electricity from wholesale to retail; the cost of delivering electricity; and any other charges like taxes, surcharges, etc. Generation costs depend on the fuel mix and structure of the market. Retail includes costs incurred by the supplier, such as marketing or service-centre costs. This will be referred to as the 'energy and supply' component where possible.

Figure 6: Breakdown of Electricity Prices (FY19)



Source: See Appendix 1.
Note:
1. Due to changes in data reporting, Germany's domestic price breakdown is for 2019.
2. Prices in the US and China reflect all components, as a national-level breakdown of components was not available.
3. South Africa, Indonesia and India reflects combine energy, Network and Supply.

There is the network component, which would include the cost of transmitting the electricity to the end user. This includes distribution and transmission charges. More often than not, the energy, supply, and network components make up a substantial part of the price of electricity. The network component is more sensitive to technical considerations, such as the distance between generation and consumption centres, and consumption levels. Since the electricity network exhibits the characteristics of a natural monopoly, it is most often regulated by a government body which approves the costs a utility can charge, as well as a reasonable rate of return for their investors, if any. This adds an additional level of variation in the network component, based on the rate of return approved by the regulator, although not by a significant amount as discussed further in the paper.

The final component includes taxes and surcharges that are most often political decisions, for example a surcharge to subsidise the construction of renewable generation, or supply to low-income consumers, or a tax on electricity to encourage efficient usage, or for revenue purposes. However, due to its politically-determined nature, there is more leeway and variation in this component. It is important to note that different categories of consumers can be taxed differently, and that the taxes that are applicable are not always the taxes that end up being owed. This is especially so in the case of non-household consumers, where several exemptions and refunds (rebates) are possible.

Broadly, high-income countries tend to charge higher taxes on the consumption of electricity, whereas developing countries tend to charge low rates or none all. Naturally, the energy, supply, and network components form the largest share of the price (except for Germany, where taxes form the major component). A breakdown of price components was not available for the US at a national-level, so the price listed here includes all components. Indonesia does not have a tax on electricity, and many users are subsidised.

Household Consumers

Germany has the highest share of taxation for its household consumers (54% of its domestic electricity price). This is due to policy decisions made several years ago to support RE growth in the country. France's taxation component is just over a third of its end-user price (36% for domestic consumers). For UK's domestic consumers, the taxation amounts to 30%, but they are not charged the climate-change levy. That burden is borne by non-household consumers.

Australia maintains a relatively lower proportion of taxes, at 17%, with the network cost accounting for 39% of the price. Brazil's taxation component is 29%. South Africa, includes an additional 15% VAT on electricity that is included in the price. However, this is for prices approved for Eskom by the energy regulator. Eskom often sells electricity to municipalities to supply to consumers, who then charge additional fees and levy additional taxes on their customers, for which data was not available.

For China, about 5% of the final price is made up of government surcharges. In India, on average the electricity duty for households' accounts for 6% of the total price paid by consumers as per calculations. Importantly, electricity is not part of the GST regime, and thus there are other embedded taxes in the supply chain, such as the GST on coal (presently 5%).

Non-household Consumers (commercial, industrial, agricultural, etc.)

For **commercial consumers**, South Africa charges VAT at a rate of 15%, while Brazil's taxes account for 29% of the price. Australia's taxation component is moderate, but its network cost accounts for almost 40% of the price. For German commercial consumers consuming around 50 MWh a year, the taxation component amounts to 47%. In India, on average, retail taxes for commercial consumer's amount to just 8% of the price.

For **industrial consumers,** the share of taxation in the overall electricity price varies, with Brazil at 26%, and South Africa at 13% with an additional VAT. For Chinese consumers, there are additional surcharges added to the electricity price. The breakdown here refers to the national average surcharges collected, which make up 5% of the average industrial price. For German industrial consumers consuming around 24 GWh annually, the taxation component is close to 60%. Indian industrial consumers pay a price that has on average a 6% share for taxes.

Australia's energy and supply components account for on average 51% of the price for large industrial and commercial consumers, with network components at 29% and taxes (primarily environmental) at 20%. The UK's energy and supply account for 44% of the cost, with taxes at 40% and network costs at 16%. France's energy and supply cost is at 40%, with taxes at 37% and network costs at 23%. China's government surcharges amount to 4% of the final electricity price for general industrial and commercial consumers.

For **agricultural consumers**, for whom there is limited data, Brazil charges a price that is made up of 15% taxes. Indian agricultural consumers pay an average rate of electricity duty that makes up 1% of the price.

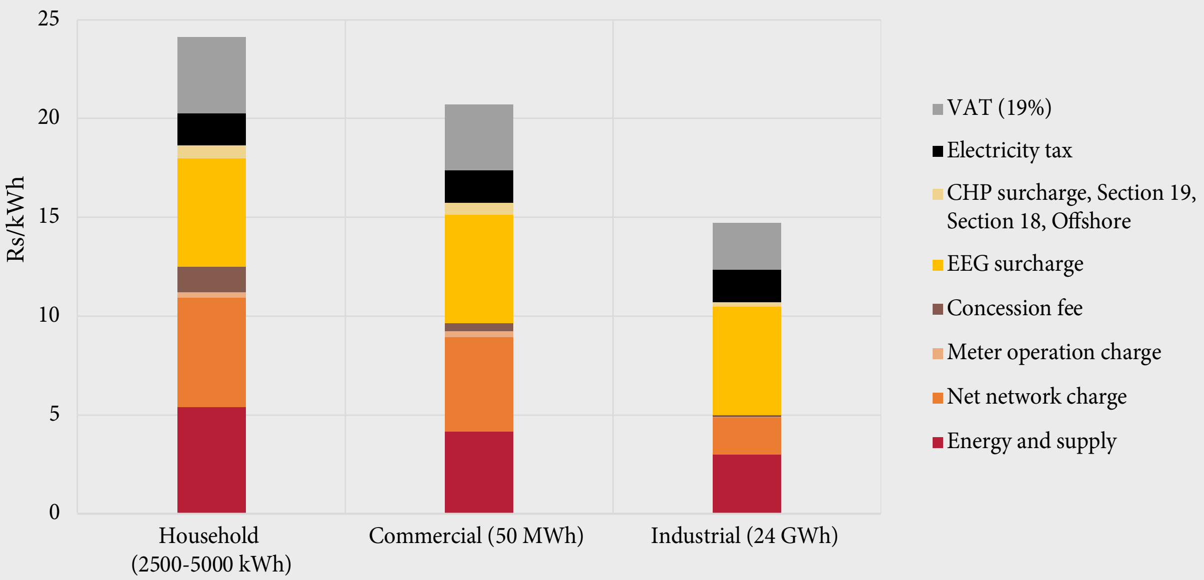
What is notable is that while Germany's prices are the highest in every category, their energy and supply, and network components are not much higher, and are in many cases lower than other countries in the group. The taxation component adds a significant amount to the price paid by end users.

In Australia, the level of taxation is lower than other sample countries, and the energy and supply and network components make up a much larger share of the price, probably due to the spread of its consumption centres that are clustered along its coastline, and according to the ACCC, an overinvestment in network infrastructure that is now passing costs along to consumers. Brazil also has a significant tax component compared to its middle-income peers. India's taxation (which is primarily the electricity duty) is comparatively low, however industrial and commercial users are taxed more than domestic and agricultural users as well, in addition to paying higher base rates.

Box 2: Germany's Taxation of Electricity

Germany is unique in the sample for the fact that its price includes a majority taxation component—54% for domestic consumers, and 60% for industrial consumers.

Figure 7: Breakdown of Electricity Prices for German Consumers (2017)



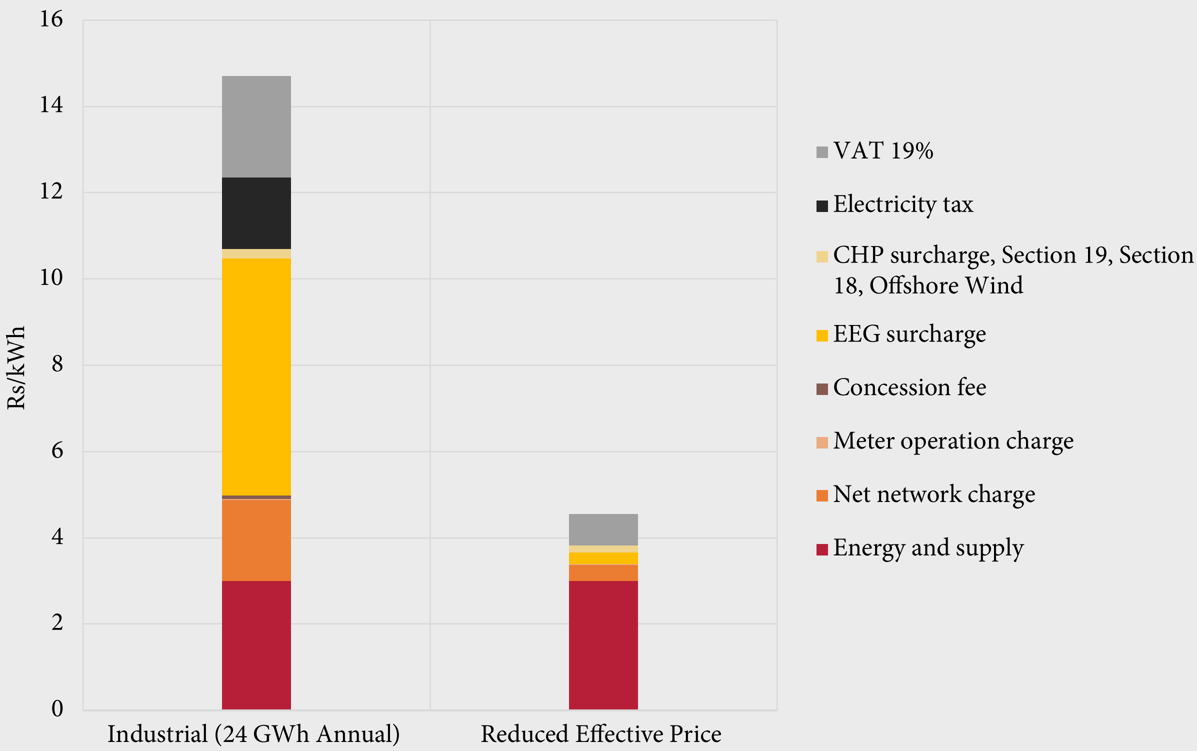
Source: BNA 2018 Monitoring Report

From Figure 7, it is evident that the bulk of the taxation component is the renewable energy surcharge (EEG). The EEG is the surcharge instituted by the Renewable Energy Act in 2003, meant to support the development of renewable sources of generation by charging electricity consumers more. It accounts for 23% of the electricity price, and 42% of the taxation component, for domestic consumers. The benefits of this surcharge were largely confined to the electricity sector itself.

The EEG surcharge was meant to fund the feed-in tariffs for RE-generation initially, which helped promote the growth of solar in Germany (and thus helped the growth of RE globally). It has evolved over the years since. Initially, it was meant to finance the difference between the guaranteed remuneration to renewable power plant operators, and the actual price the electricity would command on the exchange.

Since 2014, larger producers have been selling their electricity on the market, and instead of fixed returns are allowed a premium on the price they sell for on the exchange (Sternkopf, 2019). Since 2017, this premium for large installations has been determined through competitive auctions. This is reflective of the lower costs of newer renewable projects and technologies as they become financially viable without extensive state support. As a result, the amount of the EEG paid has been steadily reducing every year, with older payment agreements coming to an end and new agreements requiring less state support.

Figure 8: Reduced Effective Price for Large Industrial Consumers in Germany (2017)



Source: BNA Monitoring Report 2018.

What is also important to note is that certain large electricity-intensive industrial consumers in Germany may end up paying a much lower price. According to the BNA's *Monitoring Report 2018,* German large industrial consumers are often eligible for various exemptions and tax reductions, in addition to often negotiating their own contracts with suppliers as well as network operators. For some, the EEG can be reduced by 95%.

Overall, for all taxes and levies, there is a possible reduction of 92%. This is done to promote competitiveness, and also to prevent leakage to other jurisdictions with less stringent obligations (BMWi, 2021). It is possible then that such a consumer, while nominally facing higher prices, could end up paying close to or even less than industrial consumers in the US as seen in Figure 4. In Figure 8, industrial consumers who consume around 24,000 MWh annually could end up paying just under Rs 4.5/kWh; excluding VAT this comes down to Rs 3.8/kWh. According to the BNA, data is not available for larger consumers consuming over 150,000 MWh that may trade directly on exchanges.

Taxation and the Energy Transition

A significant source of variation in electricity prices in the sample of countries is the differing level of taxation. Broadly, taxes on electricity can be a source of revenue-generation for specific energy-related purposes—such as supporting renewable energy development, or energy efficiency programmes—or for general purposes. Indirectly, by making electricity more expensive, they also lead to incentives to reduce consumption (OECD, 2019a). As seen in Figure 6, taxes applicable to electricity vary a lot within the sample. More than half of the price paid by a German domestic consumer is made up of taxes. At the other extreme in our sample, Indonesia does not tax electricity.

In cases like Germany, some taxes are earmarked for a specific purpose, usually to promote an environmental goal (the EEG). The UK's climate change levy, adopted in 2001, is the environmental tax applied on some consumers of electricity. By taxing electricity, the hope is that consumers are incentivised to reduce consumption and therefore emissions. Domestic consumers, and some small business consumers are exempt, whereas energy-intensive industries have gained exemptions up to 90% under certain conditions (UK Government, 2016). This includes the steel, chemicals and cement sector, as well as certain intensive agricultural businesses (UNESCAP, 2012).

Australia has separate taxes to support large-scale and small-scale RE development (including distributed solar), and it had a target of generating 20% of its electricity from renewable sources by 2020 (Nielson, 2010). Different regions also impose their own environmental taxes, and these vary from feed-in-tariff charges to energy efficiency schemes to Australia's national RE target for small- and large-scale RE generation, which is meant to end in 2030. Australia has also seen a significant increase in distributed solar domestic customers, around 16% of all domestic consumers. While this has led to cost savings for them, it has led to costs of electricity being passed on to other consumers who effectively end up paying more, and this issue has been raised several times in other contexts as well (Clean Energy Regulator, 2018).

Other taxes may go directly into the state budget. In Germany, another component is an electricity tax that goes to the federal budget, meant to both encourage energy savings and fund some parts of its social security programme. Finally, there is a 19% VAT charged on the total amount including, the energy and supply, network and taxation components. South Africa also charges a 15% VAT on electricity. Australia has a nation-wide GST at a nominal rate of 10%. While certain essential services such as water are exempt, electricity is not (AER, n.d.).

The US has no federal tax on electricity, however each state charges their own taxes on electricity at state and local level. There is no data available on a state-wise comparison of taxes on electricity. However, as an example, Florida charges consumers a 6.95% sales tax, and a 2.5% gross receipts tax (SM Engineering, n.d.). Our limited analysis and estimate suggests that US tax rates are much lower than Europe's.

China's end-user electricity price has several components, most of which are regulated (Moody's, 2019; Fitch, 2020). There are certain government taxes and surcharges, namely the water conservancy project development fund, the rural network loan repayment fund, the post-reservoir resettlement fund and the renewable energy development fund (NDRC, 2018). Certain consumer categories are exempt from some of these charges.

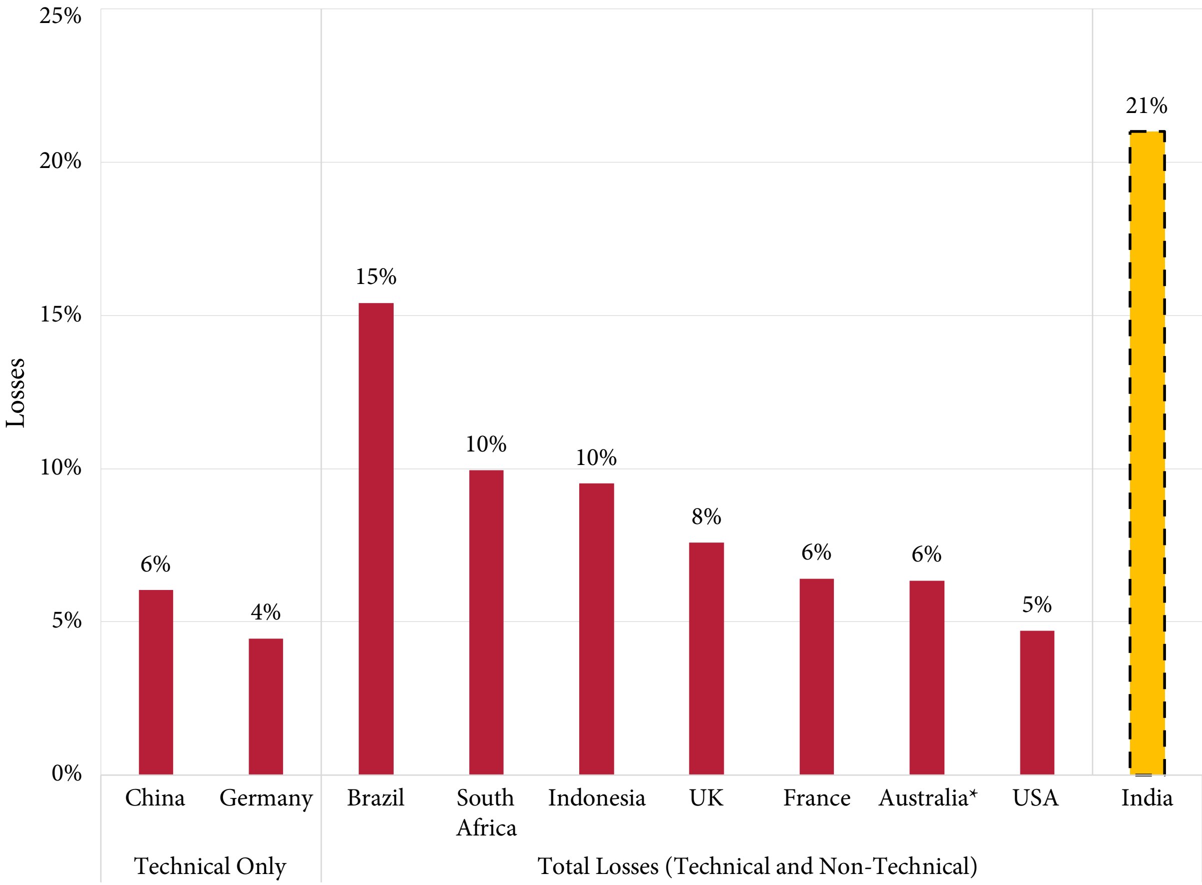
India charges an electricity duty on electricity consumption, which is determined and collected by states. Electricity is not under GST purview, which makes it relatively more expensive for commercial and industrial users. As shown in Figure 6, industrial and commercial consumers also tend to pay higher duties on consumption compared to domestic and agricultural users. While increasing taxation may not be feasible or desirable at the moment, it is an option, especially to promote environmental objectives and energy efficiency improvements. However, this would need a buy-in from all concerned stakeholders.

Quality Issues: Electricity Losses and Reliability

Effective pricing serves to provide accurate signals to producers and consumers, and incentivises efficient consumption and investment decisions. This is more urgent nowadays as countries attempt to transition towards cleaner fuels, with new business models that challenge the prevailing utility-based model, alongside the increasing emphasis on energy efficiency and electrification.

The next part of this analysis seeks to understand the quality of service that consumers receive. This can be seen in terms of reliability and efficiency of supply, as in how many disruptions consumers face on average, and in the volume of losses incurred during transportation of electricity from a generator to a consumer. Since many countries in this sample, notably Germany, have chosen to impose the cost of supporting renewable-electricity generation, and other environmental schemes, on electricity consumers, they face higher prices, but may also perform better on environmental indicators such as GHG emissions. Higher prices also tend to disincentivise wasteful consumption of electricity, and so countries with higher prices may perform better on energy efficiency indicators as well.

Figure 9: Electricity Losses (transmission and distribution)



Sources: See Appendix I.

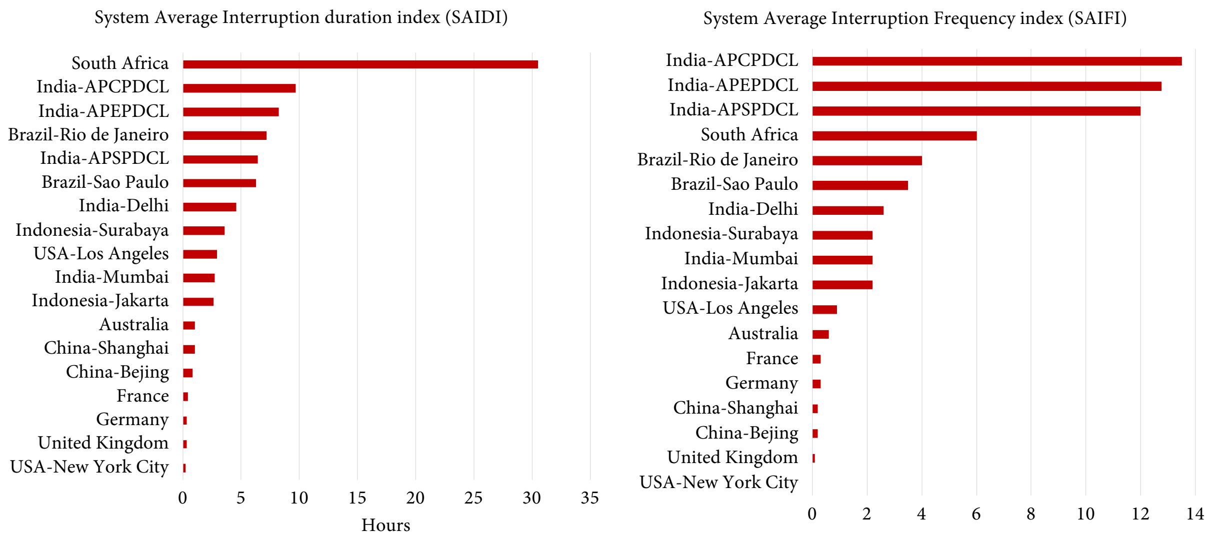
Note:
1. India's losses shown here include transmission losses as well, and so are higher than what are typically called "AT&C losses", which are for distribution networks only. AT&C losses also include non-collection (rupee) losses, and are excluded in our estimate for India.
2. Germany and China's losses do not include non-technical losses.

The above figure shows the losses (technical and non-technical) in electricity through the following: technical reasons in transmission and distribution networks; and commercial losses through theft, non-metered consumption and collection losses. Commercial losses are higher than the typical

AT&C losses, which are only reported for the distribution networks. Overall rates of loss can be affected by a number of factors, including maintenance requirements, quality of infrastructure, distance between generator and consumer, poor monitoring and the occurrence of theft.

Of the middle-income countries, Brazil and South Africa experience 14% and 10% losses respectively. While data on China did not capture non-technical losses, its technical loss rate is quite low (6% on average), indicating a well-operating grid. For the high-income countries, the UK experiences losses higher than its peers at 8%, France is at 6%, while the US and Germany have fairly low losses at 5% and 4% respectively. India's losses—calculated here as the total losses through the transmission and distribution grids, as well as electricity that is stolen or consumed without remuneration—are around 20.6%.

Figure 10: Reliability of Electricity (SAIDI and SAIFI)



Source: World Bank Ease of Doing Business Index (2019), (TNIE, 2021), PLN (2018)

Note:
1. SAIDI is average hours of outage duration per customer per year, SAIFI is average outage events per customer per year.
2. Andhra Pradesh Central Power Distribution Corporation Ltd (APCPDCL), Andhra Pradesh Eastern Power Distribution Company Ltd (APEPDCL), and Southern Power Distribution Company of Andhra Pradesh Ltd (however, known in short as APSPDCL), are distribution utilities considered representative of typical government utilities. The Andhra Pradesh SAIDI and SAIFI numbers are for FY 2020.

Other measures of reliability are the SAIDI and SAIFI indexes that measure the system average interruption duration and frequency per customer, respectively. Figure 10 uses data primarily from the World Bank's Ease of Doing Business Index, and from domestic utilities where available, and represents the average number of hours that consumers face electricity disruptions.

The India subset is either highest or next to highest in the sample, much higher than its BRICS peers. South Africa has highest SAIDI value, while three Andhra Pradesh utilities have the highest SAIFI value. Brazilian cities, such as São Paulo and Rio de Janeiro, are at 6.3 hours and 7.2 hours respectively. Australia, Chinese cities Shanghai and Beijing, France, Germany, the UK and New York City all experienced less than an hour of outages annually in 2018.

India's major cities perform better, with Delhi experiencing 4.6 hours of outages annually, and Mumbai only 2.7 hours, which is better than some American cities such as Los Angeles at 2.9. The spread of the reliability indicator is large across different areas of the country. Delhi, Mumbai and Andhra Pradesh have a range of 2 to over 10 for both the index values. However, these major Indian cities are likely to not be the most representative and it is likely that smaller cities or rural areas experience outages for far longer durations and more frequently.

Load-shedding is excluded in SAIDI and SAIFI, which implies that the consumer may face more disruptions than are captured by these indicators of reliability. Figure 10 also shows the average number of disruptions a customer can expect to face in a year. Six per year on average in South Africa, followed by Brazilian cities at around four a year. Indian cities range from two to 14 a year, with customers in other countries experiencing fewer than one disruption a year on average.

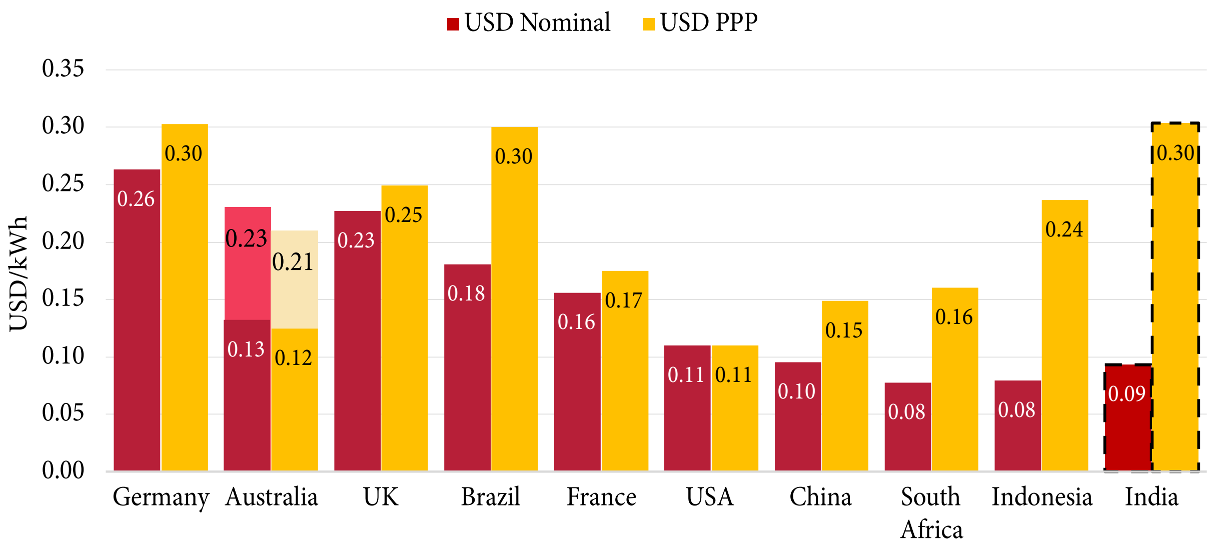
Generally, the lower the price level, the worse the quality and continuity of service. However, Brazil is an outlier among its peers with a high price and poor service. Low prices can therefore be misleading for several reasons, for example the quality of power supply may suffer due to lack of financing, which can impose other costs on end-users such as the necessity for investments in back-up power including batteries or inverters, or diesel generators. This cost is measurable for those willing to invest in such power, often commercial and industrial users who might pay 5–10% more for back-up power, but even the poor pay measurably for kerosene, candles, etc., not to mention opportunity cost losses.

Affordability

One of the main objectives of electricity systems and regulation is to ensure that electricity remains affordable, especially for domestic consumers. Different regulatory frameworks allow for different ways of ensuring this, including by setting price levels directly, taxing certain categories of consumers differently, or providing direct assistance to pay bills (discounts, or lifeline rates). Some countries have tried to ensure this by increasing the level of competition in the electricity sector, with regulated networks but competition at the wholesale and retail levels. This often allows the passing-through of lower wholesale prices to end consumers, which is a likely phenomenon with the rise of renewable generation. As larger consumers are less costly to supply, they benefit from generally lower prices per unit.

Figure 11 shows that when converting electricity prices to a PPP basis (USD), which takes into account cost of living, the electricity prices come out to be very different. Electricity in middle-income countries costs almost the same as that in high-income countries when costs of living are taken into account, hinting that even at low prices (sometimes artificially low), these prices are not always affordable for the average consumer, which is the primary rationale for cross-subsidisation.

Figure 11: Average Electricity Prices on a PPP Basis

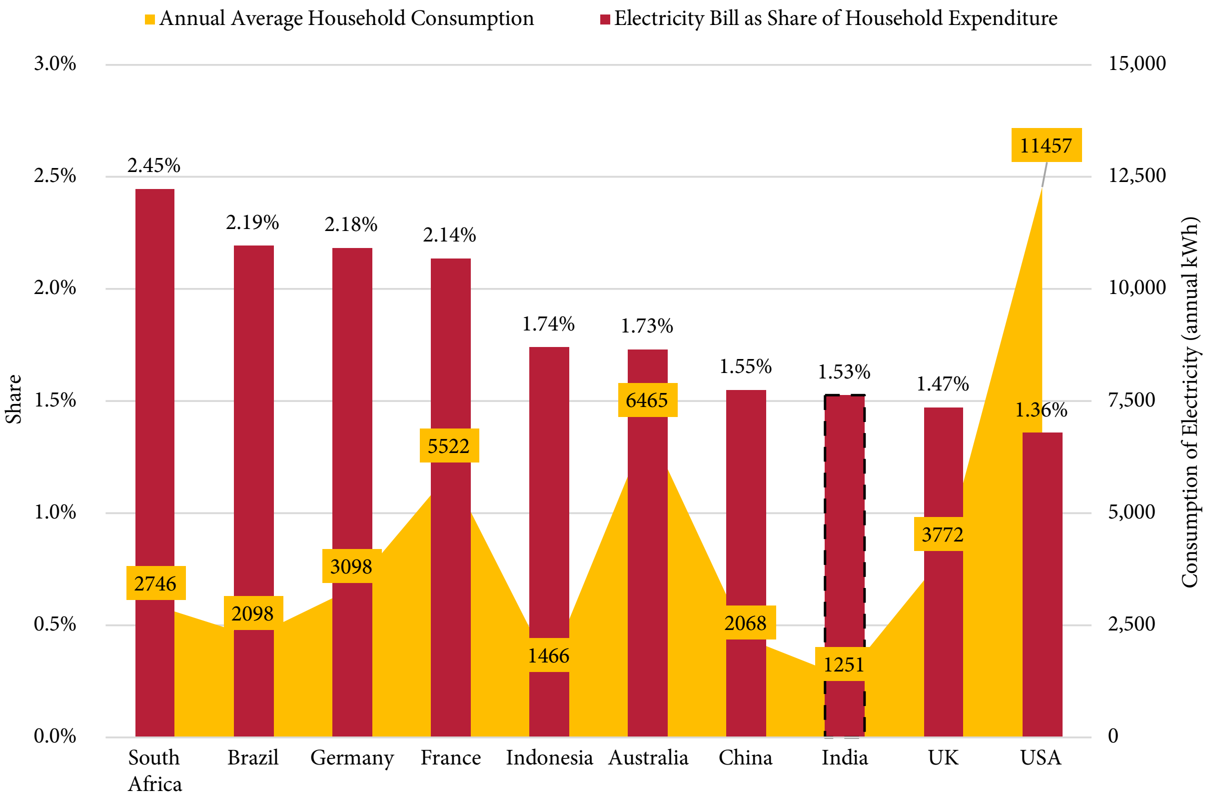


Note: Australia's prices are, again, ranges of the highest-paying consumers (domestic) and lowest-paying (large industrial and commercial users).

To build on this point, Figure 12 shows the expenditure on electricity as a percentage of household income. Earlier, Figure 2 showed the low level of electricity consumption in India. While there could be a number of causes (including the high level of disruptions preventing the use of electricity and therefore continued reliance on traditional fuels, as mentioned earlier), the price level in PPP terms is still quite high. This could also lead to low levels of consumption.

India's household expenditure on electricity is low due to low levels of consumption, but consumption is only expected to grow. However, since this is also an average number, it does not reflect how unequal consumption is, and it is therefore unclear where this growth will come from, likely from higher-income households that can afford to pay more for electricity. If prices continue to stay artificially low, the burden on DisComs will only continue to increase, which highlights the urgency of the issue. Although it would be tempting to lower prices even further to improve affordability, this is unlikely to be sustainable in the long term and it is likely that tariffs (prices) will have to rise, more so for those with lower tariffs. To address this without harming lower-income households, other measures must be explored to shift the burden away from DisComs through other, better-targeted benefits.

Figure 12: Annual Average Household Expenditure on Electricity (FY 19)



Source: Data for 2018: UN for population and household data, OECD (2019b) for household expenditure, and IEA for domestic electricity consumption for all countries; for India, it is based on a CSEP Tariff Order database compilation. The latter is also used for the number of household consumers. The prices used per kWh are the same used earlier in the paper. Prices include taxes, and for India, we have factored in only those subsidies that are part of tariff design by the regulator (that lower the tariff).

Note: This only shows electricity expenditure, and not overall expenditure on energy, including biomass, liquefied petroleum gas (LPG), or natural gas. Importantly, this average excludes any measures of distribution of affordability, especially for the poor (lower deciles of the population).

In South Africa, although users are charged based on the cost to supply them, households are eligible for up to 50 kWh of free electricity, beyond which they are charged regular rates (South African Govt., n.d.). Regular rate hikes are also a feature due to Eskom's financial position. In India and China, commercial and industrial users are charged above the average cost to supply users overall by utilities in order to cross-subsidise lower rates paid by domestic and agricultural users, but the level of cross-subsidy is far higher in India. Within categories, larger consumers also cross-subsidise smaller consumers, and, especially after accounting for subsidies, some smaller slabs do not pay for electricity.

In countries with retail competition, there are several pathways to protect domestic consumers while also incentivising competition. The UK and Australia offer default tariffs that customers are charged, if they do not opt for a competitive supplier. Australia's 'default market offer' set by the regulator also acts as a price cap on electricity. Market offers were found to be generally lower than the default offer owing to competition between suppliers. This rewards consumers who seek out information and opt for a different supplier based on their specific needs, which increases the need to lower information costs by making price comparison easy and transparent, and reducing the time it takes to switch suppliers (ACCC, 2019). Average prices have not seen substantial decreases due to increasing competition, partially due to the relatively large market shares of incumbent retailers and their ability to retain customers who have never switched suppliers and remain on higher-priced standing offers. At times, retail costs have risen (although they make up a small component of the price) as other retailers compete to retain and attract new customers, driving up their marketing costs.

A number of countries also have special programs and rates for low-income consumers. The US offers bill-payment assistance to low-income consumers, as well as automatic enrolment if they qualify for other forms of assistance (US Govt., n.d.). France, for example, has separate allowances for consumers that struggle to pay their electricity bill. Brazil offers a social tariff for certain consumers, which is presented as a tiered discount depending on the level of consumption, starting at 65% for the first 30 kWh consumed (Enel, n.d.). Brazil also has a system of flags intended to communicate to consumers that prices may be higher than usual, and to lower consumption accordingly based on the reservoir level (due to the share of hydropower) (Reuters, 2017).

Box 3: Indonesia's Subsidy Regime

Indonesia is also in a situation where its utility, PLN, supplies electricity below the cost to supply. There are 37 different tariff categories of consumers, based on their characteristics and voltage levels. Those at higher voltages have a lower cost to supply. Of the 37 tariff groups, 25 pay highly subsidised prices (and accounted for 22% of electricity sold in 2017), while others pay a tariff rate that is considerably higher and subject to periodic adjustments, but is still below the cost of supply (G20, 2019). The government pays the difference between these two per tariff category (PLN, 2018).

At present, PLN's financial position is relatively stable as payments from the government are received on time. The gap in earnings is made up with government assistance (ADB, 2020a). As previous CSEP research has shown (Devaguptapu & Tongia, 2020), unpaid dues to India DisComs from governments only compound over time and worsen the situation, and as we will see even these are not sufficient to cover the cost of supplying electricity. This means DisComs are again left to prioritise—should they pay the generators and pay their other dues? Or should they instead pay to invest in adequate maintenance measures, as these will reduce losses and improve the quality of supply?

While the situation in Indonesia may be tenable for the moment, there are concerns about its long-term sustainability and continued reliance on coal-fired generation. This could lead to future struggles to attract investment, as finance shifts towards RE sources of generation. Subsidies also tend to be regressive, and so tend to benefit higher-income households which can afford to consume more electricity. Indonesia has therefore chosen to apply different rates entirely for smaller and larger consumers.

Utility Revenues, Finances and Price Determination

A number of other factors are linked to the prices and price levels of the sample of countries. This could be the way revenues are determined by the regulator, the level of returns authorised for network companies and therefore their cost-recovery, the level of competition in the electricity retail market, as well as utility ownership structures.

Table 1: Overview of Distribution Segments

Country	Revenue determination	Number of distribution network operators	Number of retailers	Retail unbundling (carriage and content)	Source
Australia	Incentive regulation[8]/revenue cap	13 (excl. NT and WA)	~33	Yes	AER, AEMC
Brazil	Incentive regulation/price cap	~108		Yes	ANEEL
China	Cost-plus and cross-subsidies	2		No	NDRC
France	Incentive regulation/revenue cap	~160	44	Yes	CEER
Germany	Incentive regulation/revenue cap	~850	91	Yes	CEER
Indonesia	Cost of service and subsidies	1		No	PLN
India	Cost-plus and cross-subsidies	~63*		No	PFC
UK	Incentive regulation/revenue cap (RIIO)	14	97	Yes	Ofgem, CEER
USA	Predominantly cost-plus	~2000	~3000	Yes, partially	EIA
South Africa	Cost-plus	~188		No	NERSA, Eskom

*Note: *Except for Mumbai, India's DisComs have geographic monopolies. Such regulations are also common in other countries, e.g., in China.*

While most traditionally regulated utilities in this sample use cost-plus regulation, countries such as the UK, Germany, France (CEER, 2019), Australia (AEMC, n.d.) and Brazil have opted for an incentive-based system with revenue and price caps. Leaving aside India, other than Brazil they all have fairly competitive retail markets with several suppliers, with the energy and supply components separated from the transport of electricity. As such, distribution utilities often see their revenues capped for a regulatory period lasting several years, with incentives based on customer satisfaction, lower losses, and innovation that can be rewarded with a bonus.

In Germany, revenues are capped for a five-year period with a rate of return built in. Given the certainty of revenues, Distribution Network Operators (DNOs) are incentivised to reduce costs where possible or increase efficiency. Any additional profit is reserved as a bonus (BNA, n.d.). Brazil follows incentive regulation as well, with a price cap. A limited amount of electricity can be traded on the "free market", mainly for large consumers of electricity. For the other regulated portion, ANEEL oversees public auctions where distribution companies purchase electricity to sell to the "captive market", i.e., all other consumers.

[8] An incentive-based regulation is designed in a way that helps to improve the targeted performance parameter of the regulated entity. In this case the entity is the electricity utility and targeted performance parameters could be network losses, procurement costs etc.

The UK's electricity generation, transmission, distribution and retail segments are all serviced by private companies. The UK has an eight-year regulatory period for its DNOs, and follows the RIIO method (revenues = incentives +innovation + outputs), in an effort to bake performance targets into utility revenues, encourage innovation, and allow them to keep any bonuses (Ofgem, 2018). There is a separate allowance for innovation, administrated by a separate body. The revenue cap is based on total expenditure.

Australia allows for a revenue cap as well as a price cap, and has a robust wholesale market. Australia has one of the largest interconnected electricity networks in the world. According to the 2019 (ACCC,2019) report by the ACCC, Australia has had a history of high network costs owing to over-investment in New South Wales, Queensland and Tasmania.

Other countries such as the US and South Africa follow a predominantly cost-plus model. However, some states in the US also allow for retail competition. The US has over 3,000 utility companies, although the market is dominated by investor-owned, vertically-integrated private companies. There are a sizeable number of publicly-owned utilities, as well as rural cooperatives, which together made up around 55% of all utilities in the US in 2018, as per the EIA (EIA, 2019). The latter two operate on a not-for-profit basis.

South Africa is in the process of unbundling Eskom into generation, transmission and distribution segments, owing to its financial and administrative mismanagement (Deklerk, 2021). For Indonesia, prices are approved by the parliament, and there is an adjustment mechanism for fluctuations in exchange rates or the price of fuel. About 22% of electricity is sold at subsidised prices (G20, 2019).

Box 4: China's Price-Setting Mechanism

China sees heavy state involvement in setting prices, including the price that the generators receive (based on fuel type and the final electricity price for end consumers). China's two grid companies, in charge of buying electricity from generators and selling to consumers, are regulated a bit differently, with the companies charging a transmission and distribution fee separately. Previously, they would charge the difference between the 'on-grid/feed-in' price as well as the final price for consumers (Zhang, 2018). The characteristics of its economy make it a unique case, and access to capital from state-owned banks makes the calculus a bit different.

The permitted regulatory revenue (PRR) of the grid companies is made up of allowed costs, which includes depreciation and operating and maintenance expenses, along with taxes and the allowed revenue, which is the value of allowed transmissions and distribution assets multiplied by the weighted average cost of capital (Moody's, 2019). There are several adjustment mechanisms in case of an over- or under-collection of revenues, or a mismatch in actual asset additions and forecasted additions. The generation segment is also heavily regulated, with centrally-planned output, price and profit levels for generating companies, and it mainly consists of central or provincial government-owned companies.

Prices are notified by the NDRC for domestic, agricultural, commercial and industrial consumers, across various voltage and usage levels and time of use. Generally, similar to India, industrial and commercial consumers cross-subsidise other users. Large industrial consumers tend to pay less than 'general' commercial and industrial users, likely due to reasons of economic competitiveness. However, both pay more than domestic and agricultural users. In the latter category as well, separate and lower prices are notified for users in "poverty-stricken counties". The latter two are also exempted from certain surcharges.

Having a well-functioning wholesale market is linked to lower retail electricity prices to a certain extent, especially with the influx of variable renewable generation with lower marginal costs. Markets are better able to reflect and pass on these lower prices to consumers. In Australia for example, domestic prices have been falling due to the increase in solar generation (AEMC, 2019). However, we see the rise of distributed generation, especially in India, with large consumers resorting to captive generation, and so with the likelihood of fewer remunerative customers using the grid, network costs could be spread across a smaller customer base, which would increase prices paid by them. New business models and associated investments are needed in order to avoid this potential "utility death spiral".[9] Even new revenue determination approaches could be examined such as incentive-based regulation. Current costs-plus regulation, where more investment means more returns, tends to distort incentives to improve performance.

Overall, we find wide heterogeneity in regulatory models, but note that even in geographies with market systems and competition, there remains a strong role for the regulator, who focuses not just on avoiding monopoly power but also setting price caps, support mechanisms (like cross-subsidy) for poorer users, etc. Support for the poor can also come from direct subsidies from the government, but the regulatory framework normally does not take them into cognizance.

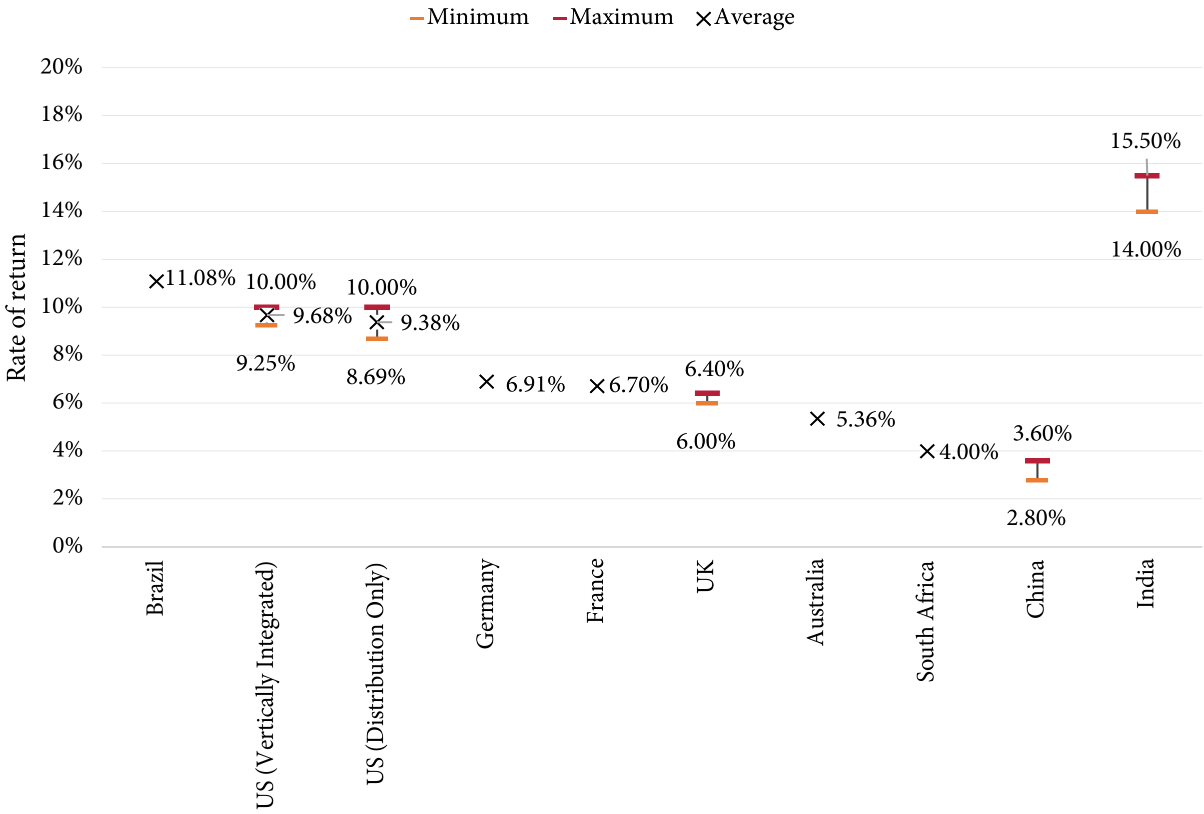
Financial Returns of Distribution Utilities

In setting the rate of return, a utility must strike a balance between allowing a sufficiently high rate to make utilities attractive to investors (and therefore allow for adequate investments for future grid expansion and stability), while keeping prices sufficiently low for end-consumers (for welfare, and reasons of competitiveness). Since distribution companies are widely considered natural monopolies, their rates are often regulated by government regulators. Depending on the market structure, the company, and regulations, many countries have different ways of calculating what rate of return a utility should receive.

Figure 13 shows the expected nominal rates of return utilities can expect to make in the sample of countries. These are the equity rates of return; for a benchmark, we also list the lending rates for each country as per data from the International Monetary Fund (IMF), which could be a proxy for inflation.

[9] 'Utility death spiral' refers to the possible threat to the existing utility business model due to an increase in distributed generation and energy storage technologies. As certain utility consumers generate their own electricity and are in turn compensated for it, the burden of the utility's infrastructure costs are shifted onto a smaller set of consumers. These consumers are then likely to see higher prices due to the smaller rate-paying base, which is then likely to push them to generate their own electricity, and so on. However, the 'spiral' is not uniform or inevitable, and can be managed or even avoided.

Figure 13: Authorised Returns on Equity for Distribution Utilities (2018)



Lending rate (%) sample countries

	Brazil	US	Germany	France	UK	Australia	South Africa	China	India
Lending Rate (%)	29.04	4.9	1.72	1.29	0.5	5.26	10.08	4.35	9.45

Sources: The IMF for lending rates; for ROE, see Appendix 1.

Note:
1. For Brazil, the return on equity rates are for the year 2020.
2. All lending rates are from 2018, except the UK which is for 2014.
3. As per the IMF (n.d.), "Lending Rate is the other depository corporations rate that usually meets the short- and medium-term financing needs of the private sector. This rate is normally differentiated according to creditworthiness of borrowers and objectives of financing."

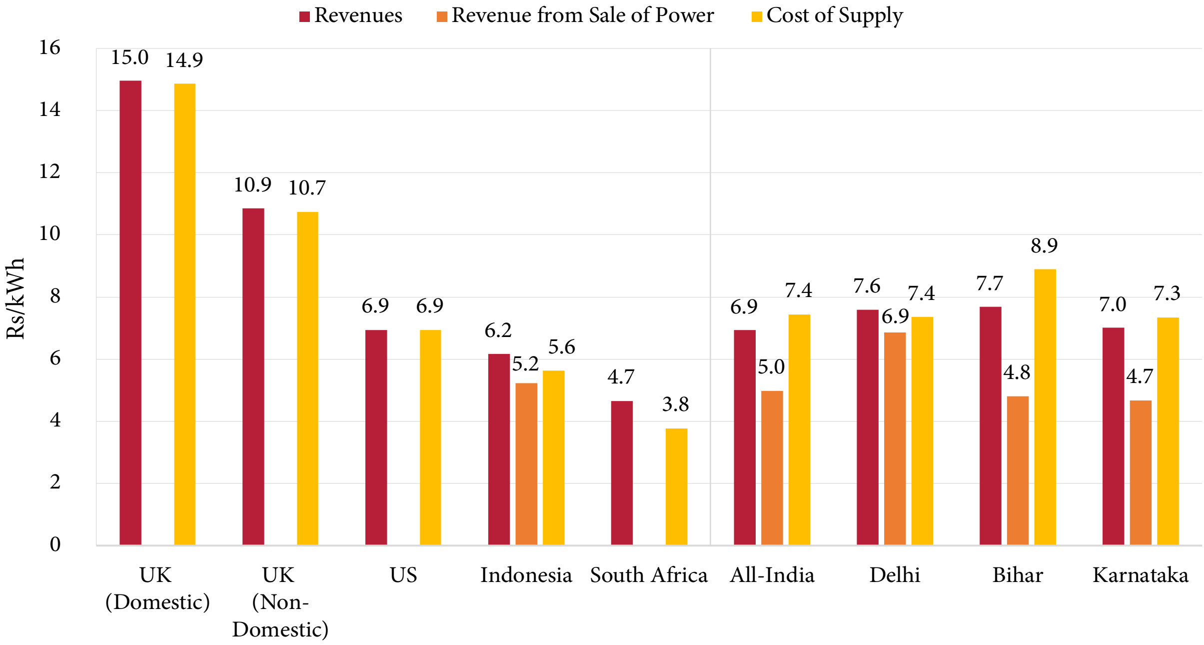
As utilities are relatively 'safe' businesses, the returns required may be lower than for riskier ones. Data for the US represents the maximum, minimum and average authorised returns on equity for both vertically integrated and distribution-only utilities, the former supplying most consumers in the US (EIA, 2017). These utilities are regulated by state-level public utilities commissions. The maximum authorised return on equity on their regulatory asset base (RAB) in 2018 was 10%, with a minimum of 9.25% and an average of 9.68%. For utilities operating only in the distribution segment, their maximum ROE was 10%, with a minimum of 8.69% and an average of 9.38%. For Brazil, the rate was determined at 11.08% by ANEEL pre-tax, however the rate is for 2020 onwards.

For the almost 900 distribution utilities active in Germany the pre-corporate tax rate was 6.91%, and post-tax 5.64% (Groebel, 2018). For the UK, these rates were available for the 'Big 6' suppliers in 2018, with a maximum of 6.4% and a minimum of 6%. For Australia, the rate approved by AER was 5.36%. For Eskom in South Africa, the National Energy Regulator of South Africa (NERSA) approved a rate of 4%. For China's two state-owned utilities, these rates were 3.6% and 2.8%. Most countries incorporate the weighted average cost of capital (WACC, which blends debt and equity) in their calculation of the return, but France is an exception (CEER, 2019).

Although India's regulated rates of return are meant to fall between 14–15.5% (DERC, 2019), putting it on the higher end of returns, this needs clarification. This is the notional return on paper, but in reality the actual returns received by DisComs are much lower, and at times even negative. A number of reasons are behind this, including misvalued asset bases, lack of payments received and so on. This further shifts the burden onto lending institutions and governments as DisComs attempt to make up shortfalls. A parallel study by some of the authors examines actual returns in detail, but is outside the scope of this paper.

The problem of negative returns can be seen in Figure 14. This shows the revenues and costs to utilities, with any difference being the profit (or loss), but we also show a third figure—where available—that reflects the revenues as coming from consumers. The divergence from consumer-borne revenues and total utility revenues are government subsidies and other support outside the tariff regime. In most countries, external subsidies are very low. However, these are very high across most of India and make-up one-seventh of the cost (Devaguptapu & Tongia, 2020) with the remainder of the gap coming from grants and other support.

Figure 14: Average Cost of Supply and Average Revenue for Energy Sold (2018)



Sources: See Appendix I.

Note:
1. UK rates are for the 'Big 6' suppliers.
2. US rates are for private investor-owned utilities taken from the FERC.
3. Revenue from sales of power for India is on billed basis.

Wherever possible, the data above has been calculated from information on the cost of supplying electricity to consumers (i.e., operating costs) and the average revenues per kWh of electricity sold. For the UK, data was taken in 2018 from the 'Big 6' that supply a majority of consumers, and is a weighted average of their average costs and revenues per unit of electricity sold. Suppliers in the UK on average recover Rs 15/kWh for electricity sold to domestic consumers, and Rs 10.8/kWh for electricity sold to non-household consumers.

Data for the US was obtained from the FERC and is only for investor-owned utilities, which are also responsible for the majority of sales. On average, they recover Rs 6.9 /kWh for electricity sold. South

Africa's data reflects that of Eskom and its revenues per unit sold, which includes the environmental levy of Rs 0.18/kWh that Eskom is charged on carbon-intensive sources of generation.[10] It earned Rs 4.4/kWh on electricity that cost it Rs 3.7/kWh to supply. Indonesia's system is similar to that of India, where the national utility deliberately sells electricity below the cost of supply on average, and the difference is made up through subsidies from the government. Certain customer segments pay less than half of the cost to supply.

While Indonesia also offers subsidised rates to electricity consumers, the dues are largely paid on time, and a reduction in subsidies is a performance target for PLN as well. In India, previous research has shown that the lack of payments received from states often compounds the situation for DisComs (Devaguptapu & Tongia, 2020). The average revenues, and costs per unit of revenue sold, do not reflect the deeper financial performance of the company. South Africa is notable in that Eskom seems to earn more per unit of energy sold than the cost of supplying it. Nevertheless, Eskom's finances are actually quite poor due to financial and administrative mismanagement. This is the main challenge and has led to significant injections by the South African government as bailouts; Eskom has been struggling to repay its debt, and therefore also struggles to make necessary investments (Bottomley, 2020).

For India, information was taken from the PFC's report on DisComs, and is the average cost of supply per unit of energy sold for 2018–19. The average revenue per unit sold is also given, with and without subsidies and grants. On average, DisComs earn less than their costs to supply electricity, even with grants and subsidies included. For a cost of Rs 7.4/kWh, they earned Rs 6.9/kWh with subsidies and grants, and Rs 5/kWh without. However, this average figure masks the differences between DisComs, as some are able to earn more than it costs to supply their customers, when subsidies and grants are included.

The actual prices paid by the end consumer can vary, based on the consumer category based on subsidies provided by the state government (outside the tariff mechanism). Based on PFC data, the revenues billed by DisComs for various consumer categories was as follows: Rs 4.38/kWh for domestic consumers, Rs 9.09/kWh for commercial consumers, Rs 0.76/kWh for agricultural consumers, and Rs 7.4/kWh for industrial consumers. The actual payments by agricultural users are far lower than the tariff, and even domestic consumers underpay on average.

Ownership Structures

Countries such as the US have utilities with varying ownership structures. The US is also a federal structure, similar to India, where retail regulation is undertaken at a sub-national level. Many traditional utilities are private companies operating with varying levels of regulatory oversight, others are publicly owned utilities and still others are cooperatives that are owned by members or the local community. Some investor-owned utilities remain vertically integrated, whereas others are active only in the distribution sector. They are mostly active in areas that are more densely populated, are larger and supply most consumers in the US (EIA, 2017). Publicly owned utilities include those owned by federal, state or municipal governments. There are also a significant number of rural electric cooperatives, active in sparsely populated rural areas and collectively owned by members who are usually from the local community.

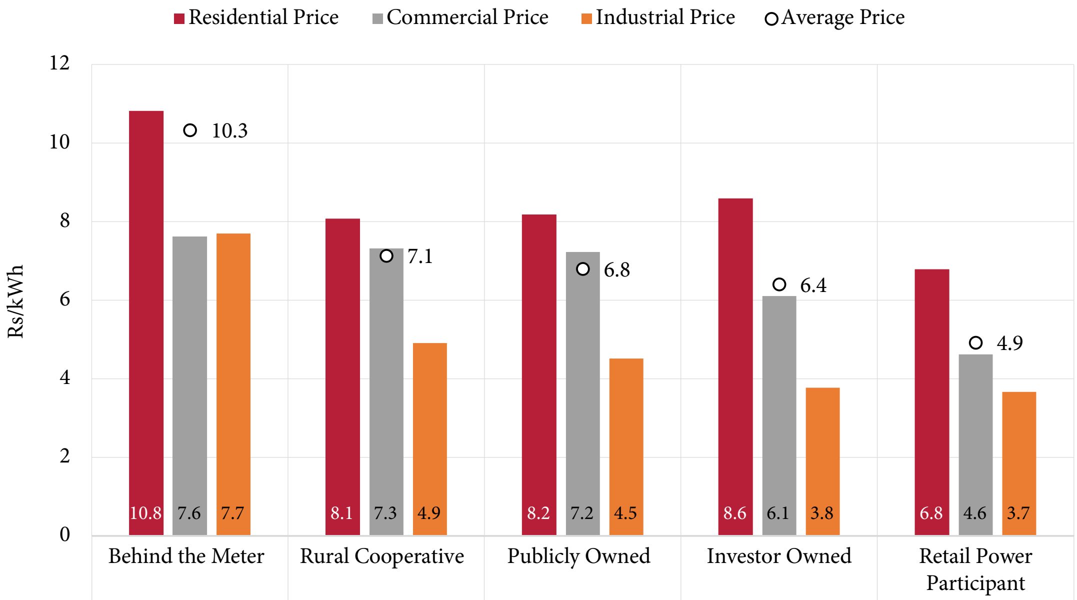
The US is unusual for the sheer number of utilities operating across different sectors in the value chain, and its relatively decentralised regulatory structure. The states have considerable leeway in setting the rates of return for utilities, and most still involve traditional regulation, while some have opened up to full or partial competition. State public utilities commissions have jurisdiction over investor-owned

[10] India's "coal cess" of Rs 400/ton coal began as a clean energy and environment cess, but is not charged to end-consumers. Rather, it is embedded in fuel prices. It translated to approximately Rs 0.25/kWh electricity (Ali and Tongia, 2020).

utilities, whereas other utilities with different ownership structures—such as publicly-owned utilities or rural electric cooperatives—follow different procedures and are not-for-profit.

Figure 15 shows the weighted average price by utility ownership type.[11] All utilities tend to charge domestic consumers more than commercial and industrial consumers. Investor-owned utilities tend to have higher prices for domestic consumers compared to publicly owned and rural cooperatives, whereas their industrial and commercial prices are lower.

Figure 15: US Electricity Prices by Utility Ownership Type (2018)



Share of sales:	0.16%	10%	14%	57%	18%
Share of utilities:	9%	26%	29%	8%	28%

Source: EIA (2019)

Note: 'Behind the Meter' refers to distributed generation (EIA, 2015).

As per data from the EIA, of the 3,277 entities active in the retail electricity market in the US in 2018, investor-owned utilities made up only 8%, however they were responsible for 57% of electricity sales by volume and supplied 63% of the customers. Retail power marketers (including community choice aggregators) in competitive markets were responsible for 18% of the sales and 12% of the customers, although they made up 28% of all utilities active in the retail sector. Similarly, publicly owned utilities (those owned by municipal, state and federal governments), supplied 14% of the electricity but made up 29% of the utilities and supplied about 13% of the customers. Rural cooperatives supplied 10% of the electricity, but made up 26% of all utilities while supplying 12% of the customers. Usually state public service, or public utilities, commissions regulate the rates investor-owned utilities are allowed to charge, based on their assets and costs.

What is interesting to note is that despite operating on a not-for-profit basis, the prices by publicly owned utilities and rural cooperatives do not differ much from investor-owned utilities. However, the comparison isn't straightforward due to the differential nature of the consumer base and their areas of operation. Perhaps in part because of this, domestic consumers under publicly-owned utilities and co-operatives pay less than those supplied by investor-owned utilities, whereas industrial users pay slightly more. Ongoing research by CSEP and others has shown that in some cases discom gets

[11] These include bundled sales for publicly and investor-owned utilities, and energy-only sales for retail power marketers in competitive markets. While the vast majority of both types of utilities provide bundled sales, 76 were distribution-only. 'Behind-the-meter' refers to small-scale solar generating capacity.

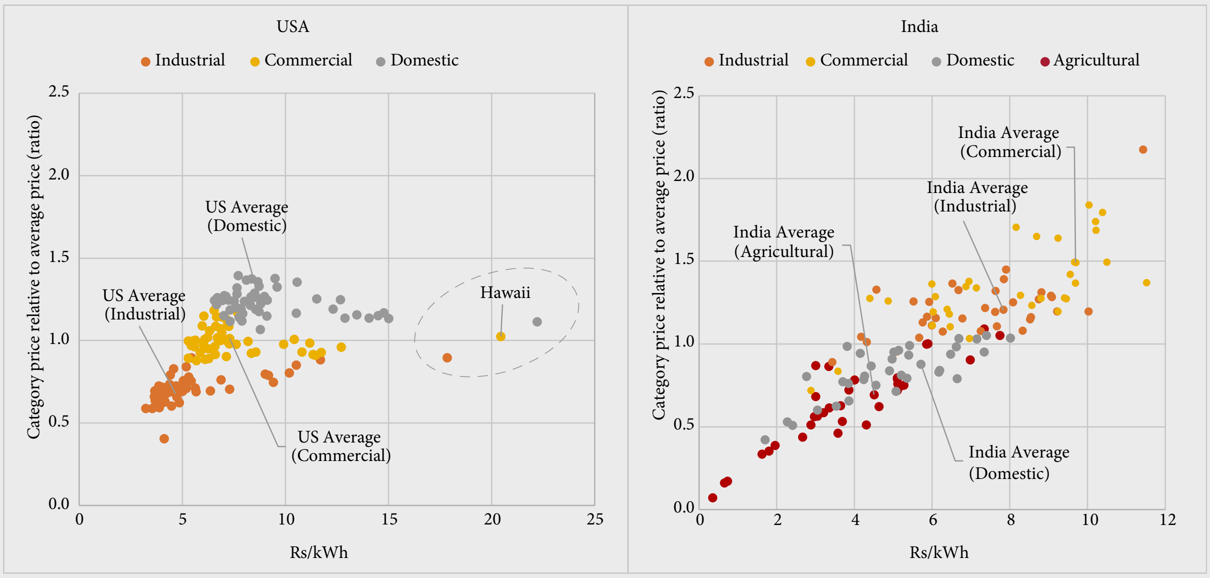
a Regulator-approved zero rate of return, which ostensibly keeps tariffs low for consumers. Figure 15 suggests that such a change may not actually result in significantly lower tariffs when compared to utilities with more traditional rates of return in the US.

While the benefits may not accrue in lower tariffs necessarily, exploring alternate ownership models could be a possible path in rural areas where the consumer mix is largely domestic and agricultural. An important point going forward for India is how a mix of consumers may evolve over time. The present equilibrium of cross-subsidies relies on so-called "paying customers", but over time, due to competition and RE, the larger commercial and industrial consumers are the ones who would exit the grid first.

Box 5: What Could Indian Prices Look Like if Prices followed Costs?

Box 1 discussed sub-national variations in electricity prices, with the US as a special focus. The spread of US electricity prices in the figure below shows that domestic users pay on average 20% more than the average price, balanced by industrial users who pay at 66% of the average, and commercial users who on average pay an amount closer to the average price. Prices in the US are broadly reflective of the cost to supply various categories of consumers. The average spread (category average price to the all-consumers average price) for domestic consumers from the average price is 1.2, 1.0 for commercial users and 0.66 for industrial users.

Figure 16: Spread of Prices by Category for the US and India



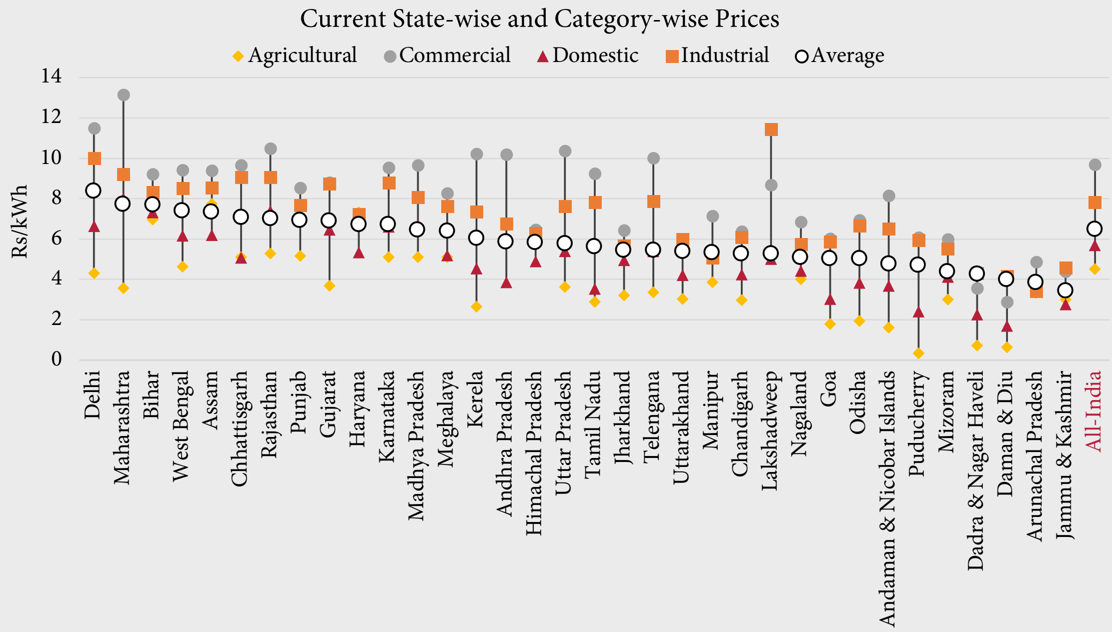
Source: EIA data and CSEP calculations.

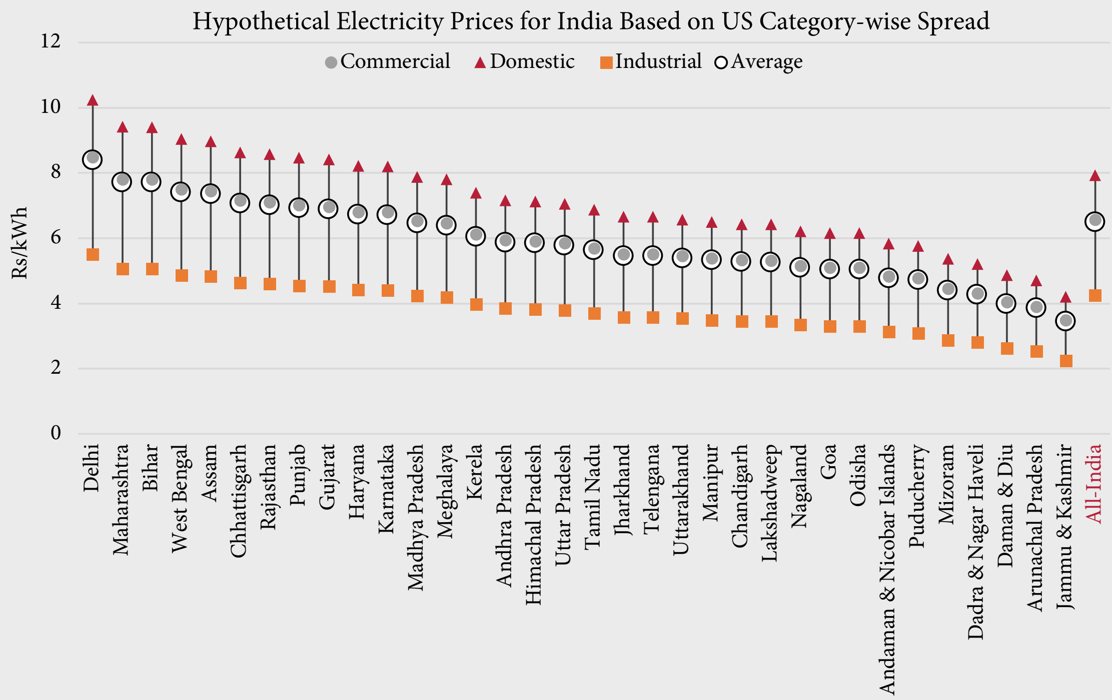
Notes: The US data are for the 50 states, while for data for India are for 34 states and union territories.

For India, the spread is much more distorted, which suggests that impact of political decisions matters more than the actual cost when supplying different categories of consumers. Each state has more leeway when it comes to setting prices, and while agricultural users generally pay the least, there is no clear delineation.

An interesting exercise would be to see what prices could look like if the US spread—which broadly reflects the cost to supply different categories of consumers—was mapped onto Indian states to estimate what Indian prices could look like if they were cost-reflective. Figure 17 presents this hypothetical scenario, with a comparison to what the present pricing structure is like.

Figures 17a and 17b: Current and Hypothetical Pricing Structure for India





Source: SERC data, CSEP calculations

Notes:
1. This keeps the average price the same, but shifts relative prices across categories.
2. These are prices as per regulators, and not the same as the figures given by PFC, which are revenues by category, keeping subsidies separate.

In such a scenario, domestic consumers would be paying the highest rates per unit of electricity, with an average of around Rs 7.9 /kWh as shown in Figure 17b, compared to Rs 5.7/kW has their average presently as of now, Figure 17a. Commercial users would be closer to the average, around Rs 6.5/kWh, with industrial users paying the least at around Rs 4.2/kWh. Commercial users would pay very near the average rate, above high-consumption industrial users and below low-consumption domestic users. Given commercial users have a large range of consumption, for example from small shops to larger shopping malls, individual commercial users may pay higher or lower rates based on their size and any state-level pricing differentials. Such differentials can be based on connection size or voltage level (high tension = HT versus low tension = LT) and, in some cases, geography (rural vs. urban).

Conclusion and Discussion

This paper highlights some of the specificities of other countries and their electricity prices in order to better direct regulatory attention to measures that could be relevant for India, and to gauge where India's position is when it comes to global electricity prices.

India's "low prices" turn out not to be so low when we factor in quality or affordability, and they are only low for some categories of users. The reliance on cross-subsidies through over-payments by commercial and industrial users dramatically hurts economic competitiveness.

What becomes evident after examining these countries is that there is no silver bullet for high-quality and affordable electricity, although a number of commonalities are visible. Some countries, such as China, can have low prices while maintaining affordability and a reliable system, although the peculiarities of China's economy and the level of state-involvement are probably the reasons for this.

High-income countries generally have higher price levels, owing in part to a higher taxation component, but they perform well on reliability, quality and environmental indicators and their prices tend to reflect the cost of service. The low prices in countries such as South Africa, India and Indonesia are a positive indication for affordability for domestic consumers at face value, but the quality indicators are poor, and the low level of prices masks the strain on utilities themselves, which necessitates bailouts and grants and has implications for the overall viability of the system. The US might be a relevant benchmark due to its federal regulatory structure and relatively low taxation system.

Many insights that emerge have also been brought up in previous research and remain avenues for continued investigation. Improving the overall efficiency of the pricing regime can also be achieved by having cost-reflective pricing that allows for the variability in the cost to supply larger/industrial consumers compared to smaller/domestic ones. As seen earlier, Indian electricity prices run counter to those of most other countries, where the categories that cost the most to supply are charged the lowest rates, and vice versa. Even China's higher prices for non-household consumers aren't as skewed as India's, not to mention they have many rebates available to keep manufacturing globally competitive.

The reduction of technical and non-technical losses is also essential, by improving monitoring and maintenance abilities as well as better collection efficiencies, but it is unlikely to be sufficient to keep prices low. Timely payments by states are also necessary to ensure that the per-unit losses faced by DisComs are halted. Other regulatory frameworks, such as incentive regulation, with revenue and price caps, could be investigated to see whether they can improve policy outcomes.

The development of a well-functioning wholesale market, with mechanisms to ensure lower prices due to increased renewable generation, is passed onto consumers is one such option. As Singh and Tongia (2021) note, wholesale competition is more important for India than retail competition. The increasing competitiveness of RE generation sources in India is already leading to strains on the existing system of power purchase agreements. Changes will be required in terms of how large-scale generation is handled. There will also be a need for new business models and a more dynamic regulatory approach, with the advent of newer technologies such as distributed generation and smart grids. Time-of-day pricing will also become more important, which can help with efficiency but raises further complexity for social welfare redistribution objectives. Ultimately, different ownership structures could be looked at further beyond just privatisation, especially for areas that are harder to supply.

The need for tariffs to rise has been acknowledged. A stop-gap measure—the creation of "regulatory asset"[12] in a handful of Indian states—is not sustainable over the long term, as uncollected dues keep compounding (Devaguptapu & Tongia, 2020). Tariffs would need to rise, and in order to improve efficiency and competitiveness overall they would do well to reflect differences in costs of supplying different categories of consumers. However, in the meantime, the lack of timely payments by states to DisComs will continue to worsen the situation. It is accepted that reducing technical and commercial losses is also paramount, as India faces significantly higher losses here, compared to other countries. Another avenue for research could involve looking at the returns for DisComs, what they earn in reality, and how they compare to other industries in India and globally.

The affordability concerns that this would raise can then be addressed through better targeting of subsidies and benefits and identifying lifeline consumers. Many subsidies go far beyond the poor, e.g., Delhi's subsidies which are for consumers who use as much as 400 kWh/month (Tongia, 2017). A rationalisation of categories of consumers and consumption bands could smooth the process. All these would require more data and processing capabilities. Improved communication between DisComs and consumers could also benefit both sides. Similar to Brazil, improved and standardised data communication could be useful to provide simple signals to indicate when the price of electricity is unusually high and encourage users to reduce consumption. Better communication could also help inform consumers about expected rises in tariffs if that is the case.

This paper only showed a snapshot in time; a time series analysis could help discern trends in a range of parameters, including not just pricing but also operating (performance), finance, consumer mix, technology trends, etc., all of which are evolving. *These impact not just prices but the regimes under which prices are established.*

In the long run, price is an instrument that operates under different regimes (regulated returns, competitive, etc.). They are only one tool for signalling to stakeholders. While "fixing" retail price is an unavoidable need, this exercise cannot be undertaken independently of a more holistic examination of utility profitability, quality of supply, and competition. This issue will become all the starker with technology changes. Today, RE without storage is already the cheapest supply for new builds. In the short run, this can create distortions at a time-of-day level, and also for which segments opt for RE. In the long run, as storage prices fall, the entire equilibrium of cross-subsidies by so-termed "paying customers" is at risk.

[12] "Regulatory asset" is the regulator approved cost which is not allowed to be recovered in the respective coming year revenue recovery structure, mostly to avoid tariff shock. Such cost is meant to be recovered in the future using a regulatory surcharge or tariff rise.

References

ACCC (2019). *Inquiry into the National Electricity Market: November 2019 Report*. Canberra: Australian Competition and Consumer Commission. Retrieved from https://www.accc.gov.au/publications/serial-publications/inquiry-into-the-national-electricity-market-2018-2025/inquiry-into-the-national-electricity-market-november-2019-report

ADB (2020a). *Indonesia energy sector assessment, strategy and roadmap*.Manila: Asian Development Bank. Retrieved from https://www.adb.org/sites/default/files/institutional-document/666741/indonesia-energy-asr-update.pdf

ADB (2020b). *Renewable Energy Tariffs and Incentives in Indonesia.* Manila: Asian Development Bank. Retrieved fromhttps://www.adb.org/sites/default/files/publication/635886/renewable-energy-tariffs-incentives-indonesia.pdf

AEMC (2019). *2019Retail Energy Competition Review*. Sydney: Australian Energy Market Commission. Retrieved from https://www.aemc.gov.au/market-reviews-advice/2019-retail-energy-competition-review

AEMC (n.d.) *Network Regulation*. Sydney: Australian Energy Market Commission. Retrieved from https://www.aemc.gov.au/energy-system/electricity/network-regulation

AER (2018). *Rate of return instrument*. Melbourne: Australian Energy Regulator. Retrieved from https://www.aer.gov.au/system/files/Rate%20of%20Return%20Instrument%20-%20Explanatory%20Statement.pdf

AER (n.d.) *Tariffs and fees explained*. Melbourne: Australian Energy Regulator. Retrieved from https://www.aer.gov.au/consumeRs./my-energy-bill/tariff-and-fees-explained

Ali, M., and Tongia, R. (2020). "Pricing Carbon Externality: Context, Theory, Evidence and Lessons for India." In R. Tongia, A. Sehgal, and P. Kamboj (Eds) *Future of Coal in India: Smooth Transition or Bumpy Road Ahead?* New Delhi: Brookings Institution.

ANEEL (2020). *Taxa regulatorio de remuneracao de capital da distribuicao*. Brasilia: Agência Nacional de Energia Elétrica.Retrieved from http://www2.aneel.gov.br/cedoc/aren2020882_2.pdf

ANEEL (n.d.) *Relatorios de consume e receita da distribucao*. Brasilia: Agência Nacional de Energia Elétrica.Retrieved from https://www.aneel.gov.br/relatorios-de-consumo-e-receita

ANEEL (n.d.). *Tarifas Consumidores (Consumer Tariffs).*Brasilia: Agência Nacional de Energia Elétrica.Retrieved from https://www.aneel.gov.br/tarifas-consumidores/-/asset_publisher/zNaRBjCLDgbE/content/classe/654800?inheritRedirect=false

Asian Development Bank (2020a). *Indonesia energy sector assessment, strategy and roadmap*. Retrieved from https://www.adb.org/sites/default/files/institutional-document/666741/indonesia-energy-asr-update.pdf

BNA (n.d.). *The principle of simulated competition*. Retrieved from https://www.bundesnetzagentur.de/EN/Areas/Energy/Companies/GeneralInformationRegulation/IncentiveRegulation/MainPrinciple/start.html

BNA (2019). *Monitoring Report 2018*. Bonn: Bundesnetzagentur. Retrieved from https://www.bundesnetzagentur.de/SharedDocs/Downloads/EN/Areas/ElectricityGas/CollectionCompanySpecificData/Monitoring/MonitoringReport2018.pdf?__blob=publicationFile&v=3

BMWi (2021). *State-imposed components of the electricity price.*Berlin: Federal Ministry for Economic Affairs.Retrieved from https://www.bmwi.de/Redaktion/EN/Artikel/Energy/electircity-price-components-state-imposed.html

Bottomley, E-J. (2020). *Electricity prices are going up by 15% next year—here's how it affects you.* Business Insider South Africa. Retrieved from https://www.businessinsider.co.za/electricity-prices-are-going-up-by-15-next-year-heres-how-it-affects-you-2020-7

CEA (2019). *Electricity Tariff and Duty and Average Rates of Electricity Supply in India.* New Delhi: Central Electricity Authority.

CEA (2020). *Genaral Review.* New Delhi: Central Electricity Authority.

CEER (2019). *Report on Regulatory Frameworks for European Energy Networks.* Brussels: Council of European Energy Regulators. Retrieved from https://www.ceer.eu/documents/104400/-/-/9665e39a-3d8b-25dd-7545-09a247f9c2ff

CEER (2020). *2nd CEER report on power losses*. Brussels: Council of European Energy Regulators Retrieved from https://www.ceer.eu/documents/104400/-/-/fd4178b4-ed00-6d06-5f4b-8b87d630b060

CER (2018). *About the Renewable Energy Target*. Canberra: Clean Energy Regulator. Retrieved from http://www.cleanenergyregulator.gov.au/RET/About-the-Renewable-Energy-Target

CRE (2018*).Délibération de la Commission de régulation de l'énergie du 14 juin 2018 portant projet de décision sur les tarifs d'utilisation des réseaux publics d'électricité dans les domaines de tension HTA et BT*. Paris: Commission de Regulation de l'energie. Retrieved from https://www.cre.fr/Documents/Deliberations/Decision/Tarifs-d-utilisation-des-reseaux-publics-d-electricite-HTA-et-BT

DBEIS (2020). *Digest of UK energy statistics (DUKES): Electricity.* London: UK Department for Business, Energy and Industrial Strategy. Retrieved from https://www.gov.uk/government/statistics/electricity-chapter-5-digest-of-united-kingdom-energy-statistics-dukes

Deklerk, A. (2021). *Eskom unbundling will be completed in June: Pravin Gordhan*. *Sunday Times*. Retrieved from https://www.timeslive.co.za/politics/2021-05-25-eskom-unbundling-will-be-completed-in-june-pravin-gordhan/

DERC (2019). *Statement of Reason DERC (Business Plan) Regulations*. New Delhi: Delhi Electricity Regulatory Commission. Retrieved from http://www.derc.gov.in/sites/default/files/SOR%20-%20BUSINESS%20PLAN%20REGULATIONS%202019.pdf

Deloitte (2017). *An overview of electricity consumption and pricing in South Africa.* Retrieved from https://www.eskom.co.za/Documents/EcoOverviewElectricitySA-2017.pdf

Devaguptapu, R. & Tongia, R. (2020). "Reconciling DisCom 'stimulus' and dues."New Delhi: Centre for Social and Economic Progress. Retrieved from https://csep.org/impact-paper/reconciling-discom-stimulus-and-dues-we-must-look-beyond-the-tip-of-the-iceberg/

EIA (2017). *Investor-owned utilities served 72% of U.S. electricity customers in 2017.* Washington DC: Energy Information Administration. Retrieved from https://www.eia.gov/todayinenergy/detail.php?id=40913

EIA (2019). *Electric Sales, Revenue, and Average Price.* Washington DC: Energy Information Administration. Retrieved from https://www.eia.gov/electricity/sales_revenue_price/

EIA (n.d.). *Form EIA-861 Annual Electricity Power Industry Report Instructions*. Washington DC: Energy Information Administration. Retrieved from https://www.eia.gov/survey/form/eia_861/instructions.pdf

EIA (2015). *EIA electricity data now include estimated small-scale solar PV capacity and generation*. Washington DC: Energy Information Administration. Retrieved from https://www.eia.gov/todayinenergy/detail.php?id=23972

EIA (2014). *Many industrial consumers are farmers*. Washington DC: Energy Information Administration. Retrieved from https://www.eia.gov/todayinenergy/detail.php?id=16231

Enel (n.d.). *Low Income Social Tariff*. Rome: Enel Group. Retrieved from https://www.enel.com.br/en/For_You/Low_Income_Social_Tariff.html

Eskom (2020). *Annual Integrated Report.* Sunninghill: Eskom. Retrieved from https://www.eskom.co.za/IR2020/Pages/default.aspx

EPE (2020). *Brazilian Energy Balance 2020*. Rio de Janeiro: Empresa de Pesquisa Energetica. Retrieved from https://www.epe.gov.br/sites-en/publicacoes-dados-abertos/publicacoes/PublicacoesArquivos/publicacao-217/SUMMARY%20REPORT%202020.pdf

Eurostat (2019). *Electricity and Heat Annual Questionnaire 2017-2021*. Retrieved from https://ec.europa.eu/eurostat/documents/38154/10015688/Ele-Instructions-2018.pdf/9f488d64-032a-46e2-a21a-6ea20afcdf92

Eurostat (2021). *Electricity price statistics*. Retrieved from https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Electricity_price_statistics

Fares, R. L. & King, C. W. (2017). *Trends in transmission, distribution, and administration costs for U.S. investor-owned electric utilities.* Energy Policy 105. 354-362. Retrieved from https://energy.utexas.edu/policy/fce/calculators

FERC (2018). *Form 1 – Electric Utility Annual Report.* Washington DC:Federal Energy Regulatory Commission.Retrieved from https://www.ferc.gov/industries-data/electric/general-information/electric-industry-forms/form-1-electric-utility-annual

Fitch Ratings (2020). *China's T&D tariff cut is credit neutral for grid companies*. Hong Kong/Shanghai: Fitch Ratings. Retrieved from https://www.fitchratings.com/research/corporate-finance/china-t-d-tariff-cut-is-credit-neutral-for-grid-companies-23-10-2020

Fontanella, L. (2020). *Electric ROE authorizations drift lower in H1'20 as virus worries continue.* S&P Global. Retrieved from https://www.spglobal.com/marketintelligence/en/news-insights/research/electric-roe-authorizations-drift-lower-in-h1-20-as-virus-worries-continue

French Ministry of the Ecological Transition (2019). Prix de l'électricité en France et dans l'Union européenne en 2018 [Price of electricity in France and the European Union in 2018].Retrieved from https://www.statistiques.developpement-durable.gouv.fr/prix-de-lelectricite-en-france-et-dans-lunion-europeenne-en-2018

G20 (2019). *Indonesia's effort to phase out and rationalise its fossil-fuel subsidies.* G20 Peer Review. Cancun: G20. Retrieved from https://www.oecd.org/fossil-fuels/publication/G20%20peer%20review%20Indonesia_Final-v2.pdf

Groebel, A. (2018). *BNetzA's role in energy infrastructure regulation and planning/permitting.* Bonn: Bundesnetzagentur. Retrieved from https://chairgovreg.fondation-dauphine.fr/sites/chairgovreg.fondation-dauphine.fr/files/attachments/Groebel%20ok.pdf

Haffajee, F. (2019). *Sunday Read:Electricity costs will rocket beyond 13.8%*. News24. Retrieved from https://www.news24.com/fin24/economy/eskom/sunday-read-electricity-costs-will-rocket-way-beyond-138-heres-why-20190310

Indonesia Cabinet Secretariat (2021). *Ministry: No electricity tariff hike in April-June 2021*. Retrieved from https://setkab.go.id/en/ministry-no-electricity-tariff-hike-in-april-june-2021/

IEA (2020a). *Energy Prices: Overview.*Paris: International Energy Agency. Retrieved from https://www.iea.org/reports/energy-prices-2020

IEA (2020b). *World Energy Balances 2020.*Paris: International Energy Agency. Retrieved from https://www.iea.org/data-and-statistics/data-product/world-energy-balances-highlights

IEA (2021). *India Energy Outlook 2021*. Paris: International Energy Agency. Retrieved from https://www.iea.org/reports/india-energy-outlook-2021

IMF (n.d.) *What is the Lending Rate?* Retrieved from https://datahelp.imf.org/knowledgebase/articles/810906-what-is-the-lending-rate

Moody's (2019). *Credit Opinion: State Grid Corporation of China*. New York, NY: Moody's Investor Service. Retrieved from http://www.sgcc.cn/html/files/2019-07/25/20190725095852185685065.pdf

NDRC (2018). *National Electricity Pricing Supervision Report*. Beijing: National Development and Reform Commission. Retrieved from https://chinaenergyportal.org/en/2018-national-electricity-pricing-supervision-report/#

Nielson, L. (2010). *Renewable energy targets*. Canberra: Parliament of Australia. Retrieved from https://www.aph.gov.au/About_Parliament/Parliamentary_Departments/Parliamentary_Library/pubs/BriefingBook43p/ret

OECD (2019a). *Taxing Energy Use 2019.* Paris: Organization for Economic Cooperation and Development. Retrieved from https://www.oecd-ilibrary.org/sites/499f15c2-en/index.html?itemId=/content/component/499f15c2-en

OECD (2019b). *Household spending.* Paris: Organization for Economic Cooperation and Development. Retrieved from https://data.oecd.org/hha/household-spending.htm

Ofgem (n.d.). *Energy companies' Consolidated Segmental Statements (CSS).* London: The Office of Gas and Electricity Markets. Retrieved from https://www.ofgem.gov.uk/publications/energy-companies-consolidated-segmental-statements-css

Ofgem (2021a). *Return on regulatory equity: Electricity distribution (RIIO-ED1)*. London: The Office of Gas and Electricity Markets. Retrieved from https://www.ofgem.gov.uk/energy-data-and-research/data-portal/all-available-charts?sort=published_date&page=4

Ofgem (2021b). *All electricity licensees*. London: The Office of Gas and Electricity Markets. Retrieved from https://www.ofgem.gov.uk/system/files/docs/2021/04/copy_of_electricity_registered_or_service_addresses_new_1.0_0.pdf

Ofgem (2018). *Network Performance Summary 2018-19*. London: The Office of Gas and Electricity Markets. Retrieved from https://www.ofgem.gov.uk/system/files/docs/2020/02/riio-ed1_network_performance_summary_2018-19.pdf

Ofgem (2018). Consumer engagement in the Energy Market 2018.London: The Office of Gas and Electricity Markets. Retrieved from https://www.ofgem.gov.uk/publications/consumer-engagement-survey-2018

PFC (2020). *Report on performance of state power utilities 2018-19.* New Delhi: Power Finance Corporation. Retrieved from https://www.pfcindia.com/DocumentRepository/ckfinder/files/Operations/Performance_Reports_of_State_Power_Utilities/Report%20on%20Performance%20of%20State%20Power%20Utilities%202018-19.pdf

Pengyuan Rating Agency (2020). *State Grid Corporation of China.* Retrieved from https://www.pyrating.com/pengyuancms/rating-actions/rating/20200702104323536/Issuer%20Credit%20Report_SGCC_Pengyuan%20International.pdf

PLN (2018). *Annual Report.* Jakarta: Perusahaan Listrik Negara. Retrieved from https://web.pln.co.id/statics/uploads/2019/11/PLN-AR-2018_Final-Upload-Website-1.pdf

RBI (2020). *State Finances: A Study of Budgets.*Mumbai: Reserve Bank of India. Retrieved from https://www.rbi.org.in/Scripts/AnnualPublications.aspx?head=State+Finances+%3a+ A+Study+of+Budgets

Reuters (2017). *Brazil power costs likely to increase after below average rains. Retrieved from https://www.reuters.com/article/brazil-power-tariffs-idINL2N1GJ1OZ*

Singh, D., and Tongia, R. (2021). "Reforming Electricity Distribution in India – Understanding delicensing and retail competition". Retrieved from: https://csep.org/wp-content/uploads/2021/11/Reforming-Electricity-Distribution.pdf

SM Engineering (n.d.). *What Are All Those Taxes and Fees on Your Florida Electricity Bill?* Retrieved from https://smeng.com/taxes-fees-florida-electricity-bill/

South African Govt (n.d.). *How do I access free basic municipal services?* Cape Town, Pretoria and Bloemfontein: South African Government. Retrieved from https://www.gov.za/faq/government-services/how-do-i-access-free-basic-municipal-services

Sternkopf, T. (2019). *Premium tariff (Market premium)*. European Commission. Retrieved from http://www.res-legal.eu/search-by-country/germany/single/s/res-e/t/promotion/aid/premium-tariff-i-market-premium/lastp/135/

TNIE (2021). https://www.newindianexpress.com/states. Retrieved from *https://www.newindianexpress.com: https://www.newindianexpress.com/states/andhra-pradesh/2021/may/07/andhra-pradesh-power-distribution-systems-reliability-indices-show-good-improvement-2299556.html*

Tongia, R. (2017). *Delhi's Household Electricity Subsidies: High and Inefficient.* New Delhi: Brookings India. Retrieved from https://www.brookings.edu/research/delhis-household-electricity-subsidies-highly-generous-but-inefficient/

UNCTAD (n.d.). *Currency exchange rates, annual*. Geneva; United Nations Conference on Trade and Development .Retrieved from https://unctadstat.unctad.org/wds/TableViewer/tableView.aspx?ReportId=117

UNESCAP (2012). *Addressing Competitiveness in Introducing ETR—United Kingdom's climate change levy. Bangkok:* United Nations Economic and Social Commission for Asia and the Pacific. Retrieved from https://www.unescap.org/sites/default/files/48.%20CS-United-Kingdom-climate-change-levy.pdf

UNDESA (2019). *Revision of World Population Prospects*. New York, NY; United Nations Department of Economic and Social Affairs. Retrieved from https://population.un.org/wpp/

UK Govt (2016). *Climate Change Levy Rates*. London: UK Government. Retrieved from https://www.gov.uk/guidance/climate-change-levy-rates#main-rates

US Govt (n.d.). *Low Income Home Energy Assistance Program (LIHEAP).* Washington DC: United States Government. Retrieved from https://www.benefits.gov/benefit/623

World Bank (2019). *Ease of Doing Business—Getting Electricity.* Retrieved from https://www.doingbusiness.org/en/data/exploretopics/getting-electricity

World Resources Institute (2020). *Climate Watch*. Retrieved from https://www.climatewatchdata.org/

Ye Zhang, Zoey (2019*). China's Industrial Power Rates: A Guide for Investors*. China Briefing. Washington DC: World Bank. Retrieved from https://www.china-briefing.com/news/china-electricity-prices-industrial-consumeRs./

Zhang, Z.X. (2018). *Energy Price Reform in China*. Working Paper, No. 018.2018. Milan: Fondazione Eni Enrico Mattei. Retrieved from https://www.econstor.eu/bitstream/10419/191360/1/ndl2018-018.pdf

Appendix I: Data Sources

Country	Data	Source
India	1) Prices and components (incl. electricity duty) 2) Losses	CSEP Analysis
	3) Costs	PFC (2020)
Brazil	1) Prices and components	ANEEL (n.d.)
	2) Losses	EPE (2020)
	3) Rate of return	ANEEL (2020)
China	1) Prices and components 2) Losses	NDRC (2018)
	3) Rate of return	Pengyuan Rating Agency (2020)
Indonesia	1) Prices 2) Losses 3) Costs	PLN (2018)
Germany	1) Prices and components	BNA (2019)
	2) Losses	CEER (2020)
	3) Rate of return	CEER (2019); BNA (2019)
France	1) Prices	Eurostat (2021); French Ministry for the Ecological Transition (2019)
	2) Price components	Eurostat (2021)
	3) Losses	CEER (2020)
	4) Rate of return	CRE (2018)
Australia	1) Prices and components	ACCC (2019)
	2) Losses	IEA (2020b)
	3) Rate of return	AER (2018)
USA	1) Prices	EIA (2019)
	2) Losses	EIA (2019)
	3) Rate of return	Fontanella (2020)
	4) Costs	FERC (2019)
South Africa	1) Prices 2) Losses 3) Rate of return	Eskom (2020)
UK	1) Prices and components	Eurostat (2021)
	2) Losses	UK DBEIS (2020)
	3) Rate of return 4) Costs	Ofgem (2021a;2021b; n.d.)

Independence | Integrity | Impact

Centre for Social and Economic Progress

6, Dr Jose P. Rizal Marg, Chanakyapuri, New Delhi - 110021, India

@CSEP_Org @csepresearch www.csep.org