

Electricity Consumption

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This paper investigates consumer electronics and the electrical consumption it has had and is having on our society. Looking at how technology has advanced to make both electrical generation and appliances more efficient. The growth of renewable energy sources and their impact on fossil fuels. Using case studies to determine if other/more improvements can be made to reduce the amount of energy we need to power our electronic filled lives.

How electricity is generated

Currently, in the UK, electricity is produced from three main sources;

- Gas
- Nuclear
- Renewable source (wind, solar, hydro etc.)

[hi-energy.org.uk, 2019]. The latest figures show that renewable electricity is the second most resourceful source for generating electricity and was the only source to grow from 2017 to 2018. Only Gas generation provided more power to the UK. [section 5 - electricity, www.gov.uk, 2018]

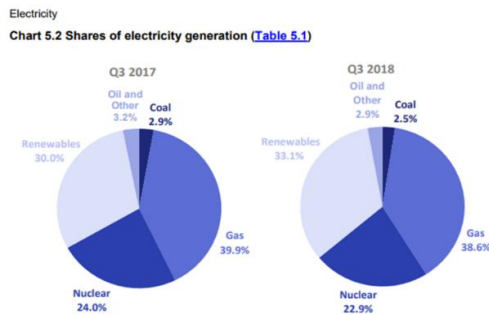


Figure 1: Shares of electricity generation Q3 2017-2018 - Government energy report

The trend is showing to be continued growth from renewable sources as the advances in the technology keep moving forward. The price of solar panels getting more inexpensive [Temple, J, 2016], wind turbines increasing in number, and hydro-electric generation improving in the UK making renewable generation more reliable means of power.

This also has the great benefit of reducing the carbon footprint that the electrical generation industry produces. Being environmentally friendly has pushed the world to create technologies that harness free, sustainable energy from nature. Solar panels have become highly successful in the last decade. *“Last year alone, solar power in the UK almost doubled. New installations in homes, workplaces and solar farms amounted to a total of 709,000 installations... more than one third of households would be utilising solar energy and up to 40% of the total volume of electricity would be generated from the sun”* [Greenmatch.co.uk, 2019]. Having government assistance and funding helps to

increase the amount of clean energy we use.

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Wind turbines both on and off shores have been the biggest renewable source, providing the *“UK’s highest renewable energy percentage. 9.5 terawatt hours (TWh)”* [smarterbusiness.co.uk, 2018].

Electronic appliances

Efficiency for home appliances has become far greater and more important than ever before with design and technological improvements that can provide better performance at lower energy consumption, which means there are less waste energy and money savings.

Fridges and freezers have been one of the most energy draining device, having to be constantly on and drawing from the grid. Ovo energy found that in 2014 *“the average UK home uses around 3700 kWh/year”* [Ovoenergy.com, 2019] and that the cold appliances used the largest amount of electric.

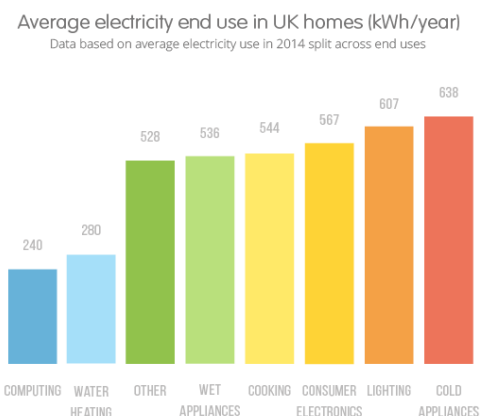


Figure 2: Appliance average electricity use 2014

However, with the improvement in technology, these devices have been able to reduce the amount of electricity needed to operate. This has the added benefit that comes with less electrical consumption, less money being spend on said electric. A 2013 study found that over a typical refrigerator lifespan, a new fridge compared to a 2000 fridge was not only cheaper to purchase but so much more efficient to run. It showed lifetime electricity savings of £264.33 and a total lifetime saving of nearly £400. [Assets.publishing.service.gov.uk, 2014]

Table 1 Purchase prices and running costs for an 'Old' Refrigerator versus 'New' Refrigerator, both run from 2013 to 2025

	'Old' Refrigerator	'New' Refrigerator	Savings in...
Replacement rate ^a	12.5 years	12.5 years	
Year purchased	2000	2013	
Purchase Price (in 2000£)	£236.00 ^b	N/A	N/A
Purchase Price (in 2013£)	£317.23 ^c	£187.00 ^d	£130.23
Electricity consumption ^e	225 kWh/yr	114 kWh/yr	111 kWh/yr
Period of Use	Jan 2013 – June 2025	Jan 2013 – June 2025	
Lifetime Electricity costs (in 2013£)	£534.19	£269.85	£264.33
Lifetime costs (in 2013£)	£851.42	£456.85	£394.59

Figure 3: refrigerator comparison table 2000 v 2013

This innovation

Lighting also drew on a large amount of energy, but lightbulbs have had huge innovation in power consumption. With the major introduction of CFL (compact fluorescent lamps) bulbs and LED bulbs and halogen bulbs being phased out, the lighting industry has become more efficient and continues to show innovation. CFLs are good alternatives although they take a while to get to full brightness. Known as "...a 'warm-up' period..., but after this point they use a lot less energy, simply because nearly all their energy goes into

producing light, rather than heat". [Robinhoodenergy.co.uk, 2018]. LEDs are more effective as they "...only need a small current to produce a lot of light and very little energy is wasted, which makes them much more efficient than halogen bulbs" [Robinhoodenergy.co.uk, 2018].

Comparing these bulbs to typical halogen bulbs it is clear that the efficiency is far superior and the cost to operate over a certain amount of time is nearly five times better. Even though the price per bulb is higher for LEDs "To get 25,000 hours of use from 60-watt incandescent bulbs, you'll have to spend \$12.50 (\$2.50 more) in bulbs, more than the cost of one LED." [Meyer, greatercea.org, 2015]

	Being Phased Out			Available Now		
	60 Watt Incandescent	40 Watt, 4'-0" Fluorescent T-12	50 Watt Halogen Bi-Pin Base	13 Watt CFL Bulb	32 Watt, 4'-0" Fluorescent T-8	9.5 Watt LED Bulb
Bulb Information						
Lumens	850	2,600	1,200	800	2,800	800
Watts	60	40	50	13	32	9.5
Lumens per Watt (LPW)	14	65	24	62	88	84
Life Span (hrs)	1,000	20,000	2,000	8,000	20,000	25,000
Price per Bulb	\$0.50	\$2.00	\$2.50	\$5.00	\$2.50	\$10.00
Analysis						
kWh of electricity used over 25,000 hours	1500	1000	1250	325	800	238
Cost of electricity to operate for 25,000 hours (at 90.11 per kWh)	\$165	\$110	\$138	\$36	\$88	\$26
Bulbs needed for 25,000 hours of use	25.0	1.3	12.5	3.1	1.3	1.0
Cost to buy light bulbs for 25,000 hours of use	\$12.50	\$2.50	\$31.25	\$15.63	\$3.13	\$10.00
Cost to operate for 25,000 hours	\$177.50	\$112.50	\$169.75	\$51.38	\$91.13	\$36.13

Figure 4: Lightbulb efficiency comparison chart

Our consumption

Current statistics show that the domestics consumption of electricity is slowing going down, this has been a trend for the past 10 years [section 5 - electricity, www.gov.uk,

2018].

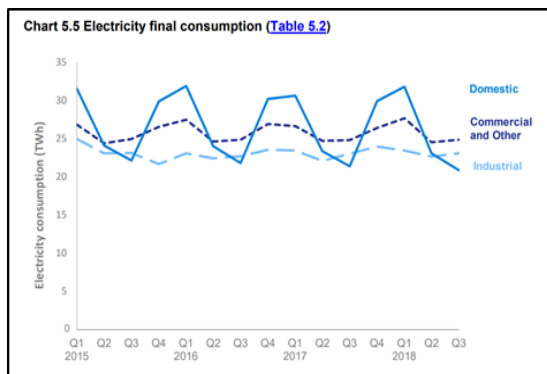


Figure 5: Electricity consumption statistics from 2015 - 2018 Q3

When looking at a wider timeline spanning 1965 – 2014, it is very clear to see that the UK (per capita (per person)) is consuming less electric since 2005. [Data.worldbank.org, 2014].

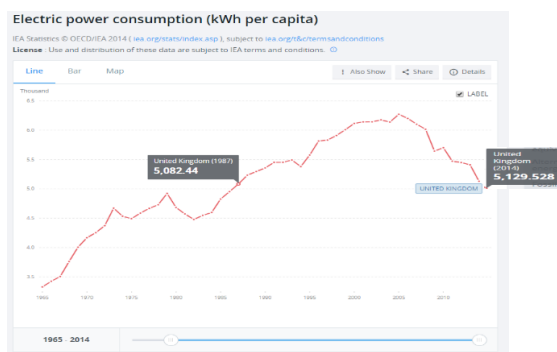


Figure 6: Electric power consumption

Combining these statistics with more current figures of the past 3-4 years, the UK is using roughly the same amount of electric it was 30 years ago. The decrease is largely to the technological advancements that have been implemented in our devices, the efficiency and the generation of electricity. All these improvements reduce the cost that this power has on people and produces, but also has a lesser impact on the environment. The less

waste of electricity there is the more value we can get from the electricity we produce.

Can we sustain ourselves?

With the current figures point towards the UK using less electric than in previous years, and with new technologies allows us to harness clean energy for our homes. Could it be possible for each home to provide its own power?

The Roxbury E+ townhouses by Interface Studio Architects (ISA) and Urbanica Design are four, three storey buildings that have been built to showcase energy efficient housing. Each house has been topped with 38-39 Solar PV panels on the roofs that can produce 10,000 Kilowatts (kW) a year. This is aimed to be more than enough for the occupants and any extra energy can be sold back to the grid. Thermal solar panels that are used to produce heating and hot water, eliminating the need for gas powered heating.



Figure 7: Roxbury E+ townhouses by ISA showing solar panels

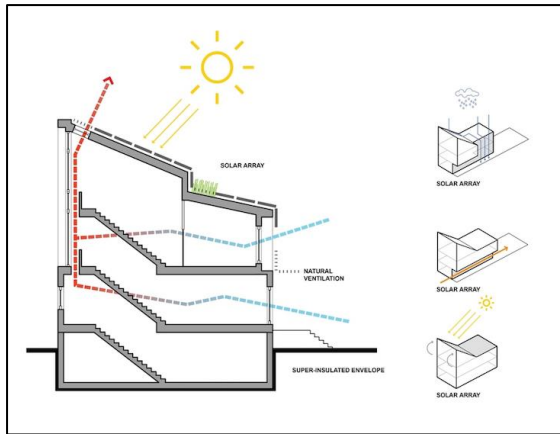


Figure 8: Roxbury E+ diagram

The houses utilise “engineered framing strategies” to allow for generous natural light and cross ventilation. They are airtight and have triple glazed windows, meaning that there is no air escaping and no energy being wasted unnecessarily via heating and cooling. An insulated building envelope as part of the foundation aids to keep heat from escaping through the bottom of the home. [ArchDaily.com, 2015]

By designing the building to be as efficient as possible and attain solar panels as their main energy source, this demonstrates that new houses have the potential to be totally self-sufficient. Providing the electrical needs of the occupier and even giving extra power back to the main grid supply. Older building, however, cannot benefit in the same way.

Older houses are defined by the way they were built at the time. Meaning they cannot accommodate newer energy efficiency methods and devices. On Average most houses only have roof space for enough solar panels to produce around 3,000 kW

[CentreforAlternativeTechnology.com, 2019]. This does not quite meet the needs of current usage per person. Also, investment in solar technology is still expensive, costing “about £6,000 for 25 square meters of panels” [CentreforAlternativeTechnology.com, 2019]. It also depends on if the house has a correct facing roof. Roofs that face any direction other than south cannot harness the maximum potential of the sunrays. “In the UK, South facing panels will generate more than other orientations.” [greenbusinesswatch.co.uk, 2019].

Conclusion

Electricity is a fundamental part of human life. As we continue to progress, our need for electric power becomes more demanding. With innovations in energy efficiency and renewable sources, we have seen a decrease in the amount of electricity we consume.

Renewable energy is a fast growing and has the potential to be the main source of power the UK uses. Being a sustainable provider and well as environmentally friendly, there are many benefits from the type of generation.

Home Appliances have made a huge improvement in efficiency, reducing the amount of electricity they draw on in the last several decades. This shows that there are real, cost-effective benefits to switching to newer versions of consumer appliances.

Having a house that could generate all the electricity that would be needed is an idea that could benefit society massively. New homes are being built with integrated power generation tech (like solar panels) and are made to be as effective as possible with that energy. This shows us that it is defiantly possible for homes to produce its own energy, however, for most people the investment and layout of their current homes which are older and slightly inconvenient for technologies to be implemented and benefit from fully.

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