

# Household Electricity Prices and Energy Mix

Subjects: **Economics**

Contributor: Grzegorz Przekota

Household electricity prices can vary considerably depending on a number of economic, political and natural factors. However, households generally have limited influence on the price of electricity due to a tightly regulated market in many countries. The energy mix, the combination of energy sources used to produce electricity, can have a significant impact on energy prices. The composition of the energy mix varies from region to region and can affect the cost, reliability and sustainability of electricity.

electricity prices

households

energy consumption

## 1. Introduction

Energy markets, including electricity, are among the most important and growing markets in modern economies [1]. In general, the GDP of most countries is dominated by manufacturing, industrial processing, trade and services [2], although economies based on intangible information services are increasingly recognised as modern [3]. However, the profitability of all businesses is highly dependent on energy prices. This was vividly demonstrated in 2022, when global energy prices rose sharply and energy companies began to make unprecedented profits, while global economic growth clearly lost momentum. The implication is that the importance of energy companies, and of energy itself, is much greater than the share of energy production in the GDP would suggest. This is because the economy's dependence on energy is now greater than at any time in history [4][5].

The links between economic growth and the energy market are obvious, there is a bi-directional causality between economic growth and carbon emissions, between energy consumption and economic growth, between economic growth and population growth, between energy consumption and urbanisation and between economic growth and urbanisation, and there is a causality from urbanisation to carbon emissions [6]. The carbonisation of the economy is unprecedented in history, which is why the focus is on developing renewable energy [7]. Furthermore, economies are becoming dependent on them. This relationship grows as the share of renewables in the energy mix increases, but this relationship is seen as positive because it enables the decarbonisation of the economy [8], and, moreover, the development of renewables promotes economic growth [9].

Macroeconomic policies, especially in highly developed countries, try to protect households from high energy price increases. On the one hand, decarbonisation is beneficial for the natural environment and thus for the population, but on the other hand, it requires large financial outlays. It is therefore necessary to find a source to cover these costs. In practice, they are not sought after in households, so they should not be particularly vulnerable to energy price increases.

It should be noted that the energy mix may change over time due to technological advances, changes in public policy and market forces. Consumers and policymakers should take these factors into account when making decisions on energy pro

## 2. Household Electricity Prices and Energy Mix

The links between the electricity market and the wider economy are complex and varied. Much attention is currently being paid to the importance of renewable energy [10][11]. The considerations include technological, social, macroeconomic and microeconomic aspects. Studies look at energy prices [12], production volumes [13] or the direction of the relationship between the energy market and the economy, with some studies suggesting that the economy is dependent on energy [14][15] and others showing that there is no relationship [16][17]. The advantage lies in research suggesting that technologically advanced countries use renewable energy more effectively to stimulate economic growth [18] but are also more sensitive to recession [19].

Environmental issues are an important aspect of research and energy policymaking [20]. Although the costs of implementing renewable energy solutions are high, the low variable costs can compensate for the initial investment expenditure [21][22][23]. However, renewable energy seems to be an unstable energy source [24] and cause serious disruption to the operation of transmission networks [25]. It is therefore difficult to become completely independent of conventional energy from coal or oil, which is becoming a fact. The pressure to use renewable energy sources is not only coming from governments and NGOs but also from business, which are deliberately choosing locations with access to cheap renewable energy. This is often determined by economic considerations related to the penalty for using conventional energy and predictions about the future [26].

One of the arguments for the superiority of renewable energy is related to criticisms of conventional energy. It is commonly argued that disturbances in conventional energy markets affect the course of the economic cycle, including changes in gross domestic product and inflation, through the volatility of prices for conventional commodities such as coal and oil [27][28], but countries are becoming rich from renewable energy production [29]. Meanwhile, the variable costs and prices of renewable energy appear to be more stable, although renewable energy production itself is less stable [30]. In general, the situation varies from country to country, and it is difficult to generalise, as each country has different access to raw materials, is at a different stage of development and has different natural conditions. The factors shaping the energy market and the linkages with the economy can be on the demand or supply side [31]. Therefore, the impact of changes in commodity prices on the economy may vary [32][33][34][35].

Another way of looking at the link between the energy market and the economy is the impact of the economy's needs on the energy market. There is no doubt that as society's standard of living improves, the demand for energy increases [36], and this has been the case for decades [37]. However, recent studies suggest that households may be reducing their demand for electricity [38] by up to 50% without a significant loss of quality of life [39], but at the same time, they need to improve their energy resistance [40]. Similarly, industry is using more and more energy [41]. However, it should be noted that the situation may differ between developing and developed

countries. Typically, developing countries require more energy as industry grows, while developed countries can grow industry with little or no increase in energy demand if they invest more in energy-efficient solutions [42][43][44][45]. However, notwithstanding the recognition of the importance of changes in economic activity for electricity demand, economic activity is one of the most important determinants of electricity consumption projections. On the other hand, there are differences regarding the horizon of analyses [46]. In the short term, it is difficult to transform the economy to cleaner energy sources and more energy efficient technologies, but in the long term, many countries are already making efforts and commitments to reduce energy consumption, and the most energy intensive sectors are in the process of implementing energy-saving solutions [47][48].

When looking at household behaviour in relation to the electricity market and electricity prices, it is important to bear in mind the importance of electricity to modern society. Recent decades have seen fundamental changes in the way people live, work and interact [49]; unfortunately, there are still significant disparities in access to energy around the world [50]. Households in the modern world, especially in developed countries, value comfort and convenience; appliances powered by electricity (refrigerators, heaters, lighting and others) improve the quality of life and have become an integral part of everyday life [51]. Electricity is used to power computers, smart phones and the internet; much of the working life of societies is linked to internet communication [52]. Electricity powers entertainment devices such as televisions, games consoles and audio systems, providing relaxation and leisure for individuals and families [53]. Many medical devices such as life-support systems, nebulisers and other machines use electricity, allowing some medical treatment to be provided at home [54]. There are many more examples of household uses of electrical energy. In summary, electricity is the backbone of the modern household and affects almost every aspect of daily life. Its importance lies in the comfort, convenience and opportunities it provides to households in today's world. Sometimes, an overly rigid approach to energy transformation, without taking into account regional specificities, can lead to energy poverty [55].

Household electricity prices can vary considerably depending on a number of economic, political and natural factors. However, households generally have limited influence on the price of electricity due to a tightly regulated market in many countries [56]. Prices can vary from country to country due to the availability of specific energy sources, market structures, supply and demand, transmission costs, government policies and regulations and other factors beyond the control of households [57], although energy market liberalisation is leading to greater price integration in some countries. This is particularly visible on day-ahead electricity exchanges, where prices between countries are interdependent [58]. However, in addition to the prices themselves, it is the behaviour of households with regard to electricity consumption that is important. Electricity is an important part of a household's total expenditure, so behaviours that encourage energy savings are encouraged [59][60]. Household energy consumption habits and the use of energy-efficient appliances and technologies can have an impact on electricity bills. More-energy-efficient households tend to have lower electricity bills [61][62]. However, there can sometimes be significant barriers to implementing energy-efficient solutions [63].

The energy mix, the combination of energy sources used to produce electricity, can have a significant impact on energy prices. The composition of the energy mix varies from region to region and can affect the cost, reliability and sustainability of electricity. This is because different energy sources have different costs associated with their

extraction, processing and transport. Coal, natural gas and oil are often subject to fluctuations influenced by global markets [64][65]. Renewable energy sources such as wind and solar have lower ongoing fuel costs but may require significant up-front investment in infrastructure [66][67]. Nuclear fuel costs are relatively stable but can be expensive to manage and safely dispose of [68].

duction, consumption and pricing [69]. A diverse and balanced energy mix can contribute to more stable and affordable energy prices in the long term while reducing environmental impacts.

## References

1. Akal, M. Modeling world energy use efficiency, price, and GDP. *Energy Sources Part B Econ. Plan. Policy* 2016, 11, 911–919.
2. Maresova, P.; Soukal, I.; Svobodova, L.; Hedvicakova, M.; Javanmardi, E.; Selamat, A.; Krejcar, O. Consequences of industry 4.0 in business and economics. *Economies* 2018, 6, 46.
3. Corrado, C.; Haskel, J.; Jona-Lasinio, C.; Iommi, M. Intangible Capital and Modern Economies. *J. Econ. Perspect.* 2022, 36, 3–28.
4. Safa, H. The impact of energy on global economy. *Int. J. Energy Econ. Policy* 2017, 7, 287–295.
5. Wu, X.F.; Chen, G.Q. Global primary energy use associated with production, consumption and international trade. *Energy Policy* 2017, 111, 85–94.
6. Bâra, A.; Oprea, S.V.; Oprea, N. How Fast to Avoid Carbon Emissions: A Holistic View on the RES, Storage and Non-RES Replacement in Romania. *Int. J. Environ. Res. Public Health* 2023, 20, 5115.
7. Chen, H.; Tackie, E.A.; Ahakwa, I.; Musah, M.; Salakpi, A.; Alfred, M.; Atingabili, S. Does energy consumption, economic growth, urbanization, and population growth influence carbon emissions in the BRICS? Evidence from panel models robust to cross-sectional dependence and slope heterogeneity. *Environ. Sci. Pollut. Res.* 2022, 29, 37598–37616.
8. Wang, S.; Sun, L.; Iqbal, S. Green financing role on renewable energy dependence and energy transition in E7 economies. *Renew. Energy* 2022, 200, 1561–1572.
9. Wang, Q.; Wang, L.; Li, R. Renewable energy and economic growth revisit-ed: The dual roles of resource dependence and anticorruption regulation. *J. Clean. Prod.* 2022, 337, 130514.
10. Mohtasham, J. Renewable energies. *Energy Procedia* 2015, 74, 1289–1297.
11. Gielen, D.; Boshell, F.; Saygin, D.; Bazilian, M.D.; Wagner, N.; Gorini, R. The role of renewable energy in the global energy transformation. *Energy Strategy Rev.* 2019, 24, 38–50.

12. Li, R.; Leung, G. The relationship between energy prices, economic growth and renewable energy consumption: Evidence from Europe. *Energy Rep.* **2021**, *7*, 1712–1719.
13. Brodny, J.; Tutak, M. Analyzing similarities between the European Union countries in terms of the structure and volume of energy production from renewable energy sources. *Energies* **2020**, *13*, 913.
14. Cleveland, C.J.; Kaufmann, R.K.; Stern, D.I. Aggregation and the role of energy in the economy. *Ecol. Econ.* **2000**, *32*, 301.
15. Ayres, R.U.; Warr, B. Accounting for growth: The role of physical work. *Struct. Chang. Econ. Dyn.* **2005**, *16*, 181–209.
16. Cass, D. Optimum growth in an aggregative model of capital accumulation. *Rev. Econ. Stud.* **1965**, *32*, 233–240.
17. Koopmans, T.C. Objectives, constraints, and outcomes in optimal growth models. *Econometrica* **1967**, *35*, 110–132.
18. Chen, J.; Su, F.; Jain, V.; Salman, A.; Tabash, M.I.; Haddad, A.M.; Shabbir, M.S. Does renewable energy matter to achieve sustainable development goals? The im-pact of renewable energy strategies on sustainable economic growth. *Front. Energy Res.* **2022**, *10*, 829252.
19. Ślusarczyk, B.; Żegleń, P.; Kluczek, A.; Nizioł, A.; Górką, M. The impact of renewable energy sources on the economic growth of Poland and Sweden considering COVID-19 times. *Energies* **2022**, *15*, 332.
20. Panwar, N.L.; Kaushik, S.C.; Kothari, S. Role of renewable energy sources in environmental protection: A review. *Renew. Sustain. Energy Rev.* **2011**, *15*, 1513–1524.
21. Zharan, K.; Bongaerts, J.C. Decision-making on the integration of renewable energy in the mining industry: A case studies analysis, a cost analysis and a SWOT analysis. *J. Sustain. Min.* **2017**, *16*, 162–170.
22. Steffen, B.; Beuse, M.; Tautorat, P.; Schmidt, T.S. Experience curves for operations and maintenance costs of renewable energy technologies. *Joule* **2020**, *4*, 359–375.
23. Hrnčić, B.; Pfeifer, A.; Jurić, F.; Duić, N.; Ivanović, V.; Vušanović, I. Different investment dynamics in energy transition towards a 100% renewable energy system. *Energy* **2021**, *237*, 121526.
24. Han, S.; Shin, H. Policy trends of renewable energy in Korea. In Proceedings of the 2014 International Conference on Renewable Energy Research and Application (ICRERA), Milwaukee, WI, USA, 19–22 October 2014; IEEE: New York, NY, USA, 2014; pp. 218–221.
25. Guerra, K.; Haro, P.; Gutiérrez, R.E.; Gómez-Barea, A. Facing the high share of variable renewable energy in the power system: Flexibility and stability requirements. *Appl. Energy* **2022**, *310*, 118561.

26. Adebayo, T.S. Renewable energy consumption and environmental sustainability in Canada: Does political stability make a difference? *Environ. Sci. Pollut. Res.* 2022, 29, 61307–61322.

27. Lee, K.; Ni, S.; Ratti, R. Oil shocks and the macroeconomy: The role of price variability. *Energy J.* 1995, 16, 39–56.

28. Van de Ven, D.J.; Fouquet, R. Historical energy prices and their changing effect on the economy. *Energy Econ.* 2017, 62, 204–216.

29. Wang, G.; Sadiq, M.; Bashir, T.; Jain, V.; Ali, S.A.; Shabbir, M.S. The dynamic association between different strategies of renewable energy sources and sustainable economic growth under SDGs. *Energy Strategy Rev.* 2022, 42, 100886.

30. Shahzad, U. The need for renewable energy sources. *Energy* 2012, 2, 16–18.

31. Kilian, L. The economic effects of energy price shocks. *J. Econ. Lit.* 2008, 46, 871–909.

32. Ewing, B.T.; Sari, R.; Soytas, U. Disaggregate energy consumption and industrial output in the United States. *Energy Policy* 2007, 35, 1274–1281.

33. Mork, K.A.; Olsen, O.; Mysen, H.T. Macroeconomic responses to oil price increases and decreases in seven OECD countries. *Energy J.* 1994, 15, 19–35.

34. Burbidge, J.; Harrison, A. Testing for the effects of oil-price using vector autoregressions. *Int. Econ. Rev.* 1984, 25, 459–484.

35. Bildirici, M.; Alp, E.A.; Bakirtas, T. The great recession and the effects of oil price shocks and the U.S. recession: A Markovswitching and TAR-VEC analysis. *J. Energy Dev.* 2011, 35, 215–277.

36. Joyeux, R.; Ripple, R.D. Household energy consumption versus income and relative standard of living: A panel approach. *Energy Policy* 2007, 35, 50–60.

37. Hexter, M.B. Implications of a Standard of Living. *Am. J. Sociol.* 1916, 22, 212–225.

38. Gram-Hanssen, K. Efficient technologies or user behaviour, which is the more important when reducing households' energy consumption? *Energy Effic.* 2013, 6, 447–457.

39. Barrett, J.; Pye, S.; Betts-Davies, S. Energy demand reduction options for meeting national zero-emission targets in the United Kingdom. *Nat. Energy* 2022, 7, 726–735.

40. Hasselqvist, H.; Renström, S.; Strömberg, H.; Håkansson, M. Household energy resilience: Shifting perspectives to reveal opportunities for renewable energy futures in affluent contexts. *Energy Res. Soc. Sci.* 2022, 88, 102498.

41. Thoma, M. Electrical energy usage over the business cycle. *Energy Econ.* 2004, 26, 463–485.

42. Stern, D.I. A multivariate cointegration analysis of the role of energy in the US macroeconomy. *Energy Econ.* 2000, 22, 267–283.

43. Erol, U.; Yu, E.S. On the causal relationship between energy and income for industrialized countries. *J. Energy Dev.* 1987, 13, 113–122.

44. Narayan, P.K.; Smyth, R. Electricity consumption, employment and real income in Australia—evidence from multivariate Granger causality tests. *Energy Policy* 2005, 33, 1109–1116.

45. Lee, C.C. The causality relationship between energy consumption and GDP in G-11 countries revisited. *Energy Policy* 2006, 34, 1086–1093.

46. Mir, A.A.; Alghassab, M.; Ullah, K.; Khan, Z.A.; Lu, Y.; Imran, M. A review of electricity demand forecasting in low and middle income countries: The demand determinants and horizons. *Sustainability* 2020, 12, 5931.

47. He, K.; Wang, L.; Li, X. Review of the energy consumption and production structure of China's steel industry: Current situation and future development. *Metals* 2020, 10, 302.

48. Lou, S.; He, J.; Li, H.; Wang, Q.; Lu, C.; Liu, W.; Liu, P.; Zhang, Z.; Li, H. Current knowledge and future directions for improving subsoiling quality and reducing energy consumption in conservation fields. *Agriculture* 2021, 11, 575.

49. Netting, R.; Arnould, E.; Wilk, R. *Households: Comparative and Historical Studies of the Domestic Group*; University of California Press: Berkeley, CA, USA, 2022.

50. Millward-Hopkins, J. Inequality can double the energy required to secure universal decent living. *Nat. Commun.* 2022, 13, 5028.

51. Piao, X.; Managi, S. Household energy-saving behavior, its consumption, and life satisfaction in 37 countries. *Sci. Rep.* 2023, 13, 1382.

52. Dilworth, J.E.; Kingsbury, N. Home-to-job spillover for generation X, boomers, and matures: A comparison. *J. Fam. Econ. Issues* 2005, 26, 267–281.

53. Coleman, M.; Brown, N.; Wright, A.; Firth, S.K. Information, communication and entertainment appliance use—Insights from a UK household study. *Energy Build.* 2012, 54, 61–72.

54. Koch, S. Home telehealth—Current state and future trends. *Int. J. Med. Inform.* 2006, 75, 565–576.

55. Xie, L.; Hu, X.; Zhang, X.; Zhang, X.B. Who suffers from energy poverty in household energy transition? Evidence from clean heating program in rural China. *Energy Econ.* 2022, 106, 105795.

56. Havris, C. Competition and regulation in the EU energy market. *Rom. J. Eur. Aff.* 2009, 9, 18.

57. Moreno, B.; Lopez, A.J.; Garcia-Alvarez, M.T. The electricity prices in the European Union. The role of renewable energies and regulatory electric market reforms. *Energy* 2012, 48, 307–313.

58. Bâra, A.; Oprea, S.V.; Tudorică, B.G. From the East-European Regional Day-Ahead Markets to a Global Electricity Market. *Comput. Econ.* 2023, 1–33.

59. Trotta, G. Factors affecting energy-saving behaviours and energy efficiency investments in British households. *Energy Policy* 2018, 114, 529–539.

60. Romero-Jordan, D.; Del Rio, P.; Penasco, C. An analysis of the welfare and distributive implications of factors influencing household electricity consumption. *Energy Policy* 2016, 88, 361–370.

61. Aune, M. Energy comes home. *Energy Policy* 2007, 35, 5457–5465.

62. Machorro-Cano, I.; Alor-Hernández, G.; Paredes-Valverde, M.A.; Rodríguez-Mazahua, L.; Sánchez-Cervantes, J.L.; Olmedo-Aguirre, J.O. HEMS-IoT: A big data and machine learning-based smart home system for energy saving. *Energies* 2020, 13, 1097.

63. Shevyakova, A.; Petrenko, Y.; Koshebayeva, G.; Ulybyshev, D. Peculiarities of Housing and Communal Services and the Difficulties of Implementing Energy-Saving Technologies: The Case of Kazakhstan. *Energies* 2022, 15, 7576.

64. Regnier, E. Oil and energy price volatility. *Energy Econ.* 2007, 29, 405–427.

65. Chang, C.; Mcalleer, M.; Zuo, G. Volatility spillovers and causality of carbon emissions, oil and coal spot and futures for the EU and USA. *Sustainability* 2017, 9, 1789.

66. Goswami, D.Y.; Kreith, F. *Energy Efficiency and Renewable Energy Handbook*; CRC Press: Boca Raton, FL, USA, 2015.

67. Boie, I.; Fernandes, C.; Frías, P.; Klobasa, M. Efficient strategies for the integration of renewable energy into future energy infrastructures in Europe—An analysis based on transnational modeling and case studies for nine European regions. *Energy Policy* 2014, 67, 170–185.

68. Dittmar, M. Nuclear energy: Status and future limitations. *Energy* 2012, 37, 35–40.

69. Karan, M.B.; Kazdagli, H. The development of energy markets in Europe. In *Financial Aspects in Energy: A European Perspective*; Springer: Berlin/Heidelberg, Germany, 2011; pp. 11–32.

Retrieved from <https://encyclopedia.pub/entry/history/show/122019>