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**Socioeconomics determinants of household carbon footprint in Iskandar Malaysia**

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**Abstract**

Understanding the complex links between socioeconomic variables and carbon emissions can reveal household spending and lifestyle patterns. This study oversees those issues and examines consumption patterns and their related variables such as climate change understanding, attitudes, and knowledge, in order to better comprehend the complicated linkages. This study revealed that eight socioeconomic elements influence a household's carbon footprint: (i) household income ( $\beta = 0.476$ ,  $p < 0.05$ ), (ii) green attitudes ( $\beta = -0.196$ ,  $p < 0.05$ ), (iii) residential space ( $\beta = 0.157$ ,  $p < 0.05$ ), (iv), education levels ( $\beta = 0.131$ ,  $p < 0.05$ ), (v) household's tenure status by ownership ( $\beta = 0.130$ ,  $p < 0.05$ ), (vi) household's age ( $\beta = 0.112$ ,  $p < 0.05$ ), (vii) size of household ( $\beta = 0.101$ ,  $p < 0.05$ ), and, (viii) female-headed household ( $\beta = -0.077$ ,  $p < 0.05$ ). Approximately 83.6% of respondents are mindful of climate change, but only 2.6% correctly define it as a long-term shift in weather patterns. The study found that 82% of households are willing to change their consumption habits and lifestyle to reduce their household's carbon footprint. In order to achieve a low carbon society, our research advocate a multipronged approach and policy action is crucial based on the results. Further, robust climate change educational and awareness programmes is decisive at the multilevel and scale in Malaysia to achieve its carbon emissions reduction target by 2050. © 2022 Elsevier Ltd

**Author Keywords**

Carbon footprint; Climate change; Energy consumption; Environmental awareness; Household lifestyle

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**References**

- Abdullah Chik, N., Rahim, K., Radam, A., Shamsudin, M.N.  
**Impact of Malaysian industrial energy use on carbon dioxide emissions**  
(2013) *Pertanika J. Soc. Sci. Humanit.*, 21, pp. 13-28.
- Abuelgasim, A., Daiban, S.  
**Levels of climate change awareness in the United Arab Emirates**  
(2017) *Horizons Humanit. Soc. Sci.*, 2 (2), pp. 42-53.
- Alfredsson, E.  
**Green Consumption Energy Use and Carbon Dioxide Emission**  
(2002), Umeå University, Faculty of Social Sciences

- Ali, G., Anbren, S., Bashir, M.K.  
**Climate mitigation, low-carbon society, and dynamism of educational institutes in a low-income country**  
(2018) *Environ. Sci. Pollut. Res.*, 25, pp. 3775-3784.
- Alicia, B., Prado, A., Samaniego, J., Perez, R.  
**Sustainable Development 20 Years on from the Earth Summit: Progress, Gaps and Strategic Guidelines for Latin America and the Caribbean**  
(2012), United Nations
- Baiocchi, G., Minx, J.C., Hubacek, K.  
**The Impact of Social Factors and Consumer Behavior on CO2 Emissions in the UK: A Panel Regression Based on Input-Output and Geo-Demographic Consumer Segmentation Data**  
(2010),
- Ballantine, P.W., Creery, S.  
**The consumption and disposition behaviour of voluntary simplifiers**  
(2010) *J. Consum. Behav. An Int. Res. Rev.*, 9 (1), pp. 45-56.
- Baltruszewicz, M., Steinberger, J.K., Ivanova, D., Brand-Correa, L.I., Paavola, J., Owen, A.  
**Household final energy footprints in Nepal, Vietnam and Zambia: composition, inequality and links to well-being**  
(2021) *Environ. Res. Lett.*, 16.
- Begum, R.A., Sohag, K., Abdullah, S.M.S., Jaafar, M.  
**CO2 emissions, energy consumption, economic and population growth in Malaysia**  
(2015) *Renew. Sustain. Energy Rev.*, 41, pp. 594-601.
- Bin, S., Dowlatabadi, H.  
**Consumer lifestyle approach to US energy use and the related carbon emissions**  
(2005) *Energy Pol.*, 33 (2), pp. 197-208.
- Boardman, B.  
**Examining the carbon agenda via the 40% House scenario**  
(2007) *Build. Res. Inf.*, 35, pp. 363-378.
- Büchs, M., Schnepf, S.V.  
**Who emits most? Associations between socio-economic factors and UK households' home energy, transport, indirect and total CO2 emissions**  
(2013) *ecological Econ*, 90, pp. 114-123.
- Christis, M., Breemersch, K., Vercalsteren, A., Dils, E.  
**A detailed household carbon footprint analysis using expenditure accounts – case of Flanders (Belgium)**  
(2019) *J. Clean. Prod.*, 228, pp. 1167-1175.
- Cohen, L., Manion, L., Morrison, K.  
(2007) *Research Methods in Education*, sixth ed. Routledge Falmer New York
- **A Framework for Proenvironmental Behaviours**  
(2008), London

- Degenhardt, L.  
**Why do people act in sustainable ways? Results of an empirical survey of lifestyle pioneers**  
(2002) *Psychol. Sustain. Dev.*, pp. 123-147.
- Degenhardt, L.  
**Why do people act in sustainable ways? Results of an empirical survey of lifestyle pioneers**  
(2002) *Psychol. Sustain. Dev.*, pp. 123-147.
- Druckman, A., Jackson, T.  
**The bare necessities: how much household carbon do we really need?**  
(2010) *Ecol. Econ.*, 69 (9), pp. 1794-1804.
- Druckman, A., Jackson, T.  
**The carbon footprint of UK households 1990–2004: a socio-economically disaggregated, quasi-multi-regional input–output model**  
(2009) *Ecol. Econ.*, 68 (7), pp. 2066-2077.
- Dubois, G., Sovacool, B., Aall, C., Nilsson, M., Barbier, C., Herrmann, A., Bruyère, S., Sauerborn, R.  
**It starts at home? Climate policies targeting household consumption and behavioral decisions are key to low-carbon futures**  
(2019) *Energy Res. Social Sci.*, 52, pp. 144-158.
- Duchin, F.  
**Structural Economics: Measuring Change in Technology, Lifestyles, and the Environment**  
(1998), Island Press
- Duchin, F., Hubacek, K.  
**Linking social expenditures to household lifestyles**  
(2003) *Futures*, 35 (1), pp. 61-74.
- **No Title**  
(2001),
- Farabi, A., Abdullah, A., Setianto, R.H.  
**Energy consumption, carbon emissions and economic growth in Indonesia and Malaysia**  
(2019) *Int. J. Energy Econ. Pol.*, 9 (3), pp. 338-345.
- Feng, Z.H., Zou, L.L., Wei, Y.M.  
**The impact of household consumption on energy use and CO 2 emissions in China**  
(2011) *Energy*, 36 (1), pp. 656-670.
- Ferrer-i-Carbonell, A., Van Den Bergh, J.C.  
**A micro-econometric analysis of determinants of unsustainable consumption in The Netherlands**  
(2004) *Environ. Resour. Econ.*, 27 (4), pp. 367-389.
- Grunewald, N., Harteisen, M., Lay, J., Minx, J., Renner, S.  
**The carbon footprint of Indian households**  
(2012) *General Conference of the International Association for Research in Income and Wealth*,

Boston

- Hamilton, C.  
**Consumerism, self-creation and prospects for a new ecological consciousness**  
(2010) *J. Clean. Prod.*, 18 (6), pp. 571-575.
- Haron, S.A., Paim, L., Yahaya, N.  
**Towards sustainable consumption: an examination of environmental knowledge among Malaysians**  
(2005) *Int. J. Consum. Stud.*, 29 (5), pp. 426-436.
- Harris, R., Johnston, R., Burgess, S.  
**Neighborhoods, ethnicity and school choice: developing a statistical framework for geodemographic analysis**  
(2007) *Popul. Res. Pol. Rev.*, 26 (5-6), pp. 553-579.
- Heinonen, J., Junnila, S.  
**A Carbon Consumption Comparison of Rural and Urban Lifestyles 1234–1249**  
(2011),
- Hertwich, E.G., Peters, G.P.  
**Carbon footprint of nations: a global, trade-linked analysis**  
(2009) *Environ. Sci. Technol.*, 43 (16), pp. 6414-6420.
- Household Expenditure Survey  
**Household Expenditure Survey, DOS**  
(2005), Kuala Lumpur Malaysia
- Edenhofer, O., Pichs-Madruga, R., Sokona, Y., Farahani, E., Kadner, S., Seyboth, K., Adler, A., Minx, J.C.  
(2014) *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*,  
Cambridge University Press Cambridge, United Kingdom and New York, NY, USA
- IRDA  
(2018) *Demographic Information*,  
Iskandar Regional Development Authority Malaysia
- Ivanova, D., Vita, G., Steen-Olsen, K., Stadler, K., Melo, P.C., Wood, R., Hertwich, E.G.  
**Mapping the carbon footprint of EU regions**  
(2017) *Environ. Res. Lett.*, 12.
- Jack, T., Ivanova, D.  
**Small is beautiful? Stories of carbon footprints, socio-demographic trends and small households in Denmark**  
(2021) *Energy Res. Social Sci.*, 78, p. 102130.
- Jackson, A.L.  
**Renewable energy vs. biodiversity: policy conflicts and the future of nature conservation**  
(2011) *Global Environ. Change*, 21 (4), pp. 1195-1208.

- Laroche, M., Bergeron, J., Barbaro-Forleo, G.  
**Targeting consumers who are willing to pay more for environmentally friendly products**  
(2001) *J. Consum. Market.*, 18 (6), pp. 503-520.
- Lee, J., Taherzadeh, O., Kanemoto, K.  
**The scale and drivers of carbon footprints in households, cities and regions across India**  
(2021) *Global Environ. Change*, 66, p. 102205.
- Lenzen, M.  
**Primary energy and greenhouse gases embodied in Australian final consumption: an input–output analysis**  
(1998) *Energy Pol.*, 26, pp. 495-506.
- Lenzen, M., Wier, M., Cohen, C., Hayami, H., Pachauri, S., Schaeffer, R.  
**A comparative multivariate analysis of household energy requirements in Australia, Brazil, Denmark, India and Japan**  
(2006) *Energy*, 31 (2-3), pp. 181-207.
- Lévy, P.Z., Vanhille, J., Goedemé, T., Verbist, G.  
**The association between the carbon footprint and the socio-economic characteristics of Belgian households**  
(2021) *Ecol. Econ.*, 186.
- Liu, Y., Zhang, M., Liu, R.  
**The impact of income inequality on carbon emissions in China: a household-level analysis**  
(2020) *Sustainability*, 12, p. 2715.
- Liu, W., Spaargaren, G., Heerink, N., Mol, A.P., Wang, C.  
**Energy consumption practices of rural households in north China: basic characteristics and potential for low carbon development**  
(2013) *Energy Pol.*, 55, pp. 128-138.
- Lorenzoni, I., Nicholson-Cole, S., Whitmarsh, L.  
**Barriers perceived to engaging with climate change among the UK public and their policy implications**  
(2007) *Global Environ. Change*, 17 (3-4), pp. 445-459.
- (2010) *Malaysia National Climate Change Policy*,
- Minx, J.C.  
**Input–output analysis and carbon footprinting: an overview of applications**  
(2009) *Econ. Syst. Res.*, 21 (3), pp. 187-216.
- Moser, S., Kleinhüchelkotten, S.  
**Good intents, but low impacts: diverging importance of motivational and socioeconomic determinants explaining pro-environmental behavior, energy use, and carbon footprint**  
(2018) *Environ. Behav.*, 50, pp. 626-656.
- Nor, N.H.M., Selamat, S.N., Abd Rashid, M.H., Ahmad, M.F., Jamian, S., Kiong, S.C.  
**Carbon sequestration and carbon capture and storage (CCS) in Southeast Asia**  
(2016) *J. Phys. Conf.*, 725 (No. 1).

012010). IOP Publishing.

- Ottelin, J., Heinonen, J., Nassen, J., Junnila, S.  
**Household carbon footprint patterns by the degree of urbanisation in Europe**  
(2019) *Environ. Res. Lett.*, 14, p. 114016.
- Pachauri, R.K., Mayer, L.  
**Climate Change 2014; Synthesis Report**  
(2015), Intergovernmental Panel on Climate Change Geneva, Switzerland
- Pans, R., Vriend, N.J.  
**Schelling's spatial proximity model of segregation revisited**  
(2007) *J. Publ. Econ.*, 91 (1-2), pp. 1-24.
- Parry, M.L., Canziani, O.F., Palutikof, J.P., Linden, P.J.V.D., Hanson, C.E.  
(2007) *n Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*,
- Poortinga, W., Steg, L., Vlek, C.  
**Values, environmental concern, and environmental behavior: a study into household energy use**  
(2004) *Environ. Behav.*, 36 (1), pp. 70-93.
- Ritchie, R., Roser, M.  
**CO<sub>2</sub> and greenhouse gas emissions**  
(2020),  
Published online at OurWorldInData.org. Retrieved from (Accessed 25 March 2021)
- Safaai, M., Sharliza, N., Zainon, Z., Hashim, H., Ujang, Z., Talib, J.  
**Projection of CO<sub>2</sub> emissions in Malaysia**  
(2011) *Environ. Prog. Sustain. Energy*, 30 (4), pp. 658-665.
- Saidur, R., Masjuki, H., Jamaluddin, M., Ahmed, S.  
**Energy and associated greenhouse gas emissions from household appliances in Malaysia**  
(2007) *Energy Pol.*, 35 (3), pp. 1648-1657.
- Salo, M., Savolainen, H., Karhinen, S., Nissinen, A.  
**Drivers of household consumption expenditure and carbon footprints in Finland**  
(2021) *J. Clean. Prod.*, 289, p. 125607.
- Sarkar, M.S.K., Al-Amin, A.Q., Filho, W.L.  
**Revisiting the social cost of carbon after INDC implementation in Malaysia: 2050**  
(2019) *Environ. Sci. Pollut. Res.*, 26, pp. 6000-6013.
- Sarker, M.N.I., Hossin, M.A., Hua, Y.X., Anusara, J., Warunyu, S., Chanthamith, B.  
**Low carbon city development in China in the context of new type of urbanization**  
(2018) *Low Carbon Econ*, 9 (1), pp. 45-61.
- Schelling, T.C.  
**Models of segregation**  
(1969) *Am. Econ. Rev.*, 59 (2), pp. 488-493.

- Serino, M.N., Klasen, S.  
**Estimation and determinants of the Philippines' household carbon footprint**  
(2015) *Develop. Econ.*, 53 (1), pp. 44-62.
- Sköld, B., Baltruszewicz, M., Aall, C., Andersson, C., Herrmann, A., Amelung, D., Barbier, C., Sauerborn, R.  
**Household preferences to reduce their greenhouse gas footprint: a comparative study from four European cities**  
(2018) *Sustain*, 10.
- Spaargaren, G., Oosterveer, P.  
**Citizen-consumers as agents of change in globalizing modernity: the case of sustainable consumption**  
(2010) *Sustainability*, 2 (7), pp. 1887-1908.
- Stern, P.C.  
**New environmental theories: toward a coherent theory of environmentally significant behavior**  
(2000) *J. Soc. Issues*, 56 (3), pp. 407-424.
- Tahir, N., Zen, I.S.  
**Consumer perception on knowledge, attitude and behaviour towards climate change: case study of Melaka**  
(2016) *Proceeding Int. Conf. Soc. Econ. Dev. Universiti Malaysia Terengganu*, November 3rd – 4th
- Thøgersen, J.  
**How may consumer policy empower consumers for sustainable lifestyles?**  
(2005) *J. Consum. Pol.*, 28, pp. 143-177.
- Tian, X., Chang, M., Lin, C., Tanikawa, H.  
**China's carbon footprint: a regional perspective on the effect of transitions in consumption and production patterns**  
(2014) *Appl. Energy*, 123, pp. 19-28.
- Tukker, A., Jansen, B.  
**Environmental impacts of products: a detailed review of studies**  
(2006) *J. Ind. Ecol.*, 10 (3), pp. 159-182.
- (2015),  
Paris Agreement. United Nations.URL:
- (1992), United Nation General Assembly Agenda 21.
- Vickers, D., Rees, P.  
**Creating the UK National Statistics 2001 output area classification**  
(2007) *J. R. Stat. Soc. Ser. A (Statistics Soc.)*, 170 (2), pp. 379-403.
- Vringer, K., Blok, K.  
**Long-term trends in direct and indirect household energy intensities: a factor in dematerialisation?**  
(2000) *Energy Pol.*, 28 (10), pp. 713-727.

- Wang, Y., Zhao, H., Li, L., Liu, Z., Liang, S.  
**Carbon dioxide emission drivers for a typical metropolis using input-output structural decomposition analysis**  
(2013) *Energy Pol.*, 58, pp. 312-318.
- Weber, C., Perrels, A.  
**Modelling lifestyle effects on energy demand and related emissions**  
(2000) *Energy Pol.*, 28, pp. 549-566.
- Weber, C., Perrels, A.  
**Modelling lifestyle effects on energy demand and related emissions**  
(2000) *Energy Pol.*, 28 (8), pp. 549-566.
- Weber, C.L., Matthews, H.S.  
**Quantifying the global and distributional aspects of American household carbon footprint**  
(2008) *Ecol. Econ.*, 66 (2-3), pp. 379-391.
- Whitmarsh, L.  
**Behavioural responses to climate change: asymmetry of intentions and impacts**  
(2009) *J. Environ. Psychol.*, 29 (1), pp. 13-23.
- Wiedenhofer, D., Guan, D., Liu, Z., Meng, J., Zhang, N., Wei, Y.M.  
**Unequal household carbon footprints in China**  
(2017) *Nat. Clim. Change*, 7, pp. 75-80.
- Zen, I.S., Abul Quasem, A.A., Mohammad, Z.F., Ahmad, M.H., Syed Ariffin, S.A.I., Fizri, F.F.A.  
**Mainstreaming climate adaptation and mitigation policy in Malaysia: case study of Melaka city**  
(2016) *Proc. 2016 Int. Symp. Sustain. Dev. Manag. (ISSDM 2016) – UTM IBS*, Universiti Teknol. Malaysia Malaysia Oct. 8-9
- Zen, I.S., Ahamad, R., Omar, W.  
**No plastic bag campaign day in Malaysia and the policy implication**  
(2013) *Environ. Dev. Sustain.*, 15 (5), pp. 1259-1269.
- Zen, I.S., Noor, Z.Z., Yusuf, R.O.  
**The profiles of household solid waste recyclers and non-recyclers in Kuala Lumpur, Malaysia**  
(2014) *Habitat Int*, 42, pp. 83-89.
- Zen, I.S., Siwar, C.  
**An analysis of household acceptance of curbside recycling scheme in Kuala Lumpur, Malaysia**  
(2015) *Habitat Int*, 47, pp. 248-255.
- Zen, I.S., Al-Amin, A.Q., Doberstein, B.  
**Mainstreaming climate adaptation and mitigation policy: towards multi-level climate governance in Melaka, Malaysia**  
(2019) *Urban Clim*, 30, p. 100501.
- Zen, I.S., Al-Amin, A.Q., Alam, M.M., Doberstein, B.  
**Magnitudes of households' carbon footprint in Iskandar Malaysia: policy implications for sustainable development**



(2021) *J. Clean. Prod.*, 315, p. 128042.

- Zhang, J., Yu, B., Cai, J., Wei, Y.M.  
**Impacts of household income change on CO2 emissions: an empirical analysis of China**  
(2017) *J. Clean. Prod.*, 157, pp. 190-200.
- Zhou, Z.J., Liu, X.W., Zhao, B., Chen, Z.G., Shao, H.Z., Wang, L.L., Xu, M.H., Xu, M.H.  
**Effects of existing energy saving and air pollution control devices on mercury removal in coal-fired power plants**  
(2015) *Fuel Process. Technol.*, 131, pp. 99-108.  
2015

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