Are we turning a brighter shade of green? The relationship between household characteristics and GHG emissions from consumption

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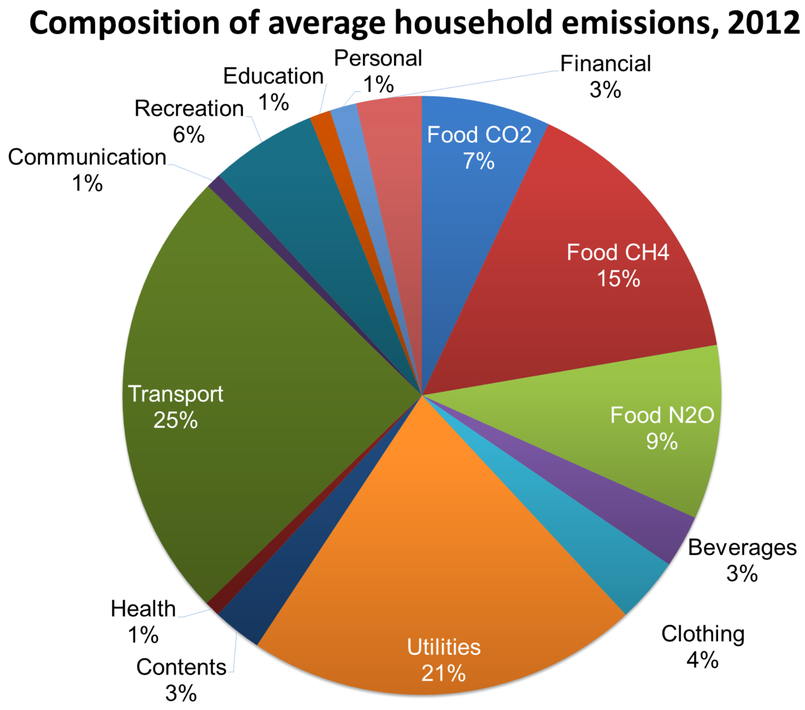
Motivation: GHG emissions are embodied in all goods and services that we buy. The emissions content of different goods depends on where and how they are produced, factors which individual consumers have very little control over. Individuals can choose what they earn and spend, the size of their household, and the type and quantity of goods they consume. This project explores the evolving relationship between consumption behaviour and emissions.

Research questions

What household characteristics explain the variation in consumption emissions? Is there evidence of a shift in household behaviour towards a less emissions-intensive consumption bundle?

Composition of average household emissions, 2012



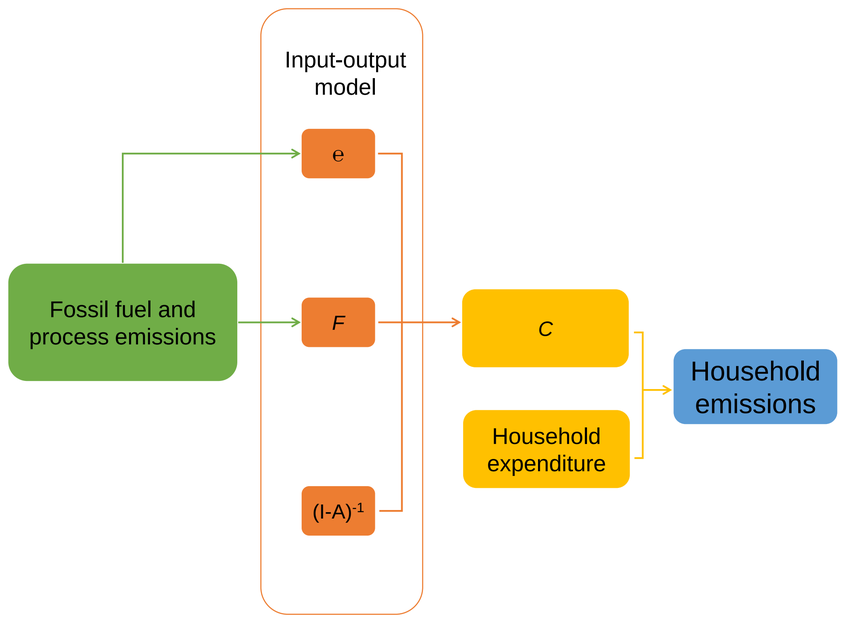
Sources of household emissions

Food, household utilities, and transport are the major sources of household emissions, accounting for 77% of emissions for the average household.

Meat, dairy, electricity, petrol, and air travel are the most emissions-intensive consumption goods. A dollar less expenditure in these categories will have a relatively large effect on a households emissions. Households wanting to reduce their emissions should look at their decisions in these areas.

Nearly 80% of food emissions are process emissions from enteric fermentation and nitrogen fertilisers.

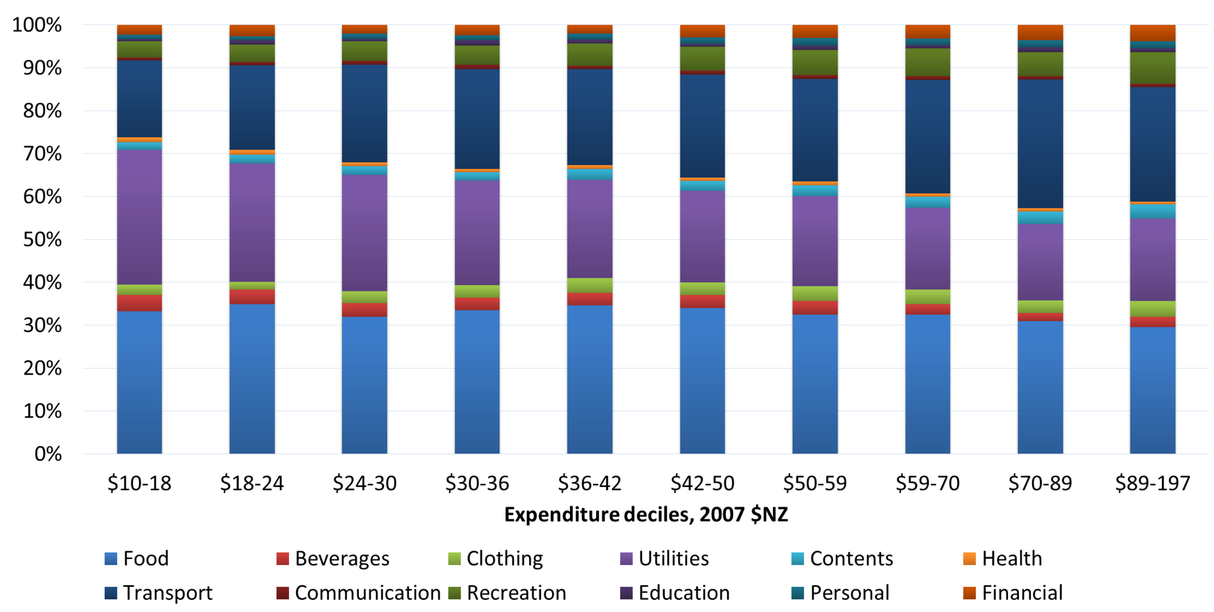
The relative importance of each category changes across total expenditure (proxy for permanent income) deciles. The share of emissions from transport increases with expenditure, while the proportion of emissions from utilities declines with expenditure.



Calculating household emissions

We use an input-output model to trace products through the supply chain. We combine information on inter-industry transactions, industry fuel requirements, fuel emissions factors, and process emissions to derive a vector of industry carbon intensities, measured in t-CO_2eq/$ of output. We map this vector to consumption categories to derive a vector measuring emissions per dollar of expenditure. Combining this with detailed household expenditure data, we calculate the emissions embodied in a household's consumption bundle.

Composition of household emissions by expenditure decile, 2012



Household characteristics and household emissions – regression results

	OLS			Tobit		
	$\log\left(\frac{Total}{emissions}\right)$	$\log(Meat)$	$\log\left(\frac{HH}{energy}\right)$	$\log\left(\frac{Transport}{fuels}\right)$	$\log\left(\frac{Dom.}{air}\right)$	$\log\left(\frac{Int.}{air}\right)$
$\log(Expenditure)$	0.707***	1.094***	0.282***	1.434***	5.288***	6.633***
	(0.0105)	(0.130)	(0.0602)	(0.137)	(0.505)	(0.444)
$\#\ adults$	0.124***	0.455***	0.169***	0.660***	0.375	0.192
	(0.008)	(0.089)	(0.049)	(0.092)	(0.377)	(0.338)
$\#\ children$	0.056***	0.233***	0.178***	0.147*	-1.82***	-1.64***
	(0.007)	(0.083)	(0.037)	(0.075)	(0.338)	(0.303)
$Age\ dummies$	+		+	-	Inverted U	
$Region\ dummies$	North/south		North/south	Auckland effect		Auckland effect
$Home\ ownership$	+					+
$Education$					+	+
$Ethnicity$		Asian, -				Asian, +
N	5120	5120	5120	5120	5120	5120
R^2	0.781	-	-	-	-	-
$Pseudo\ R^2$	-	0.018	0.016	0.028	0.053	0.065

Total household expenditure and composition explain the majority of the variation in household emissions.

Total emissions rise less-than-proportionately with expenditure – consistent with results from other developed countries. There is significant variation in expenditure elasticities across consumption categories. Household energy is relatively unresponsive to changes in expenditure, while transport is very responsive.

Emissions increase with household size, but at a decreasing rate. No evidence of economies of scale in household size, however. A doubling of household size while maintaining per-capita household expenditure leads to a doubling in emissions.

An extra child adds about half as much to total emissions as an extra adult. They have about the same effect on emissions from household energy, but households with more children have lower emissions from air travel.

We find a small but significant decrease in total emissions between the two survey waves. All else equal, emissions were 4.5% lower in 2012/13, a reduction of about 1 tonne for a two person household with expenditure of $60,000.

This fall is largely driven by a nearly 10% reduction in emissions from household energy. It is consistent with a price response, given a large increase in electricity prices between surveys, and general improvements in energy efficiency.

Between 2006 and 2012, emissions have become more responsive to increases in total expenditure, driven primarly by increased sensitivity of emissions from international air travel. This seems to be driven by an increased preference for international air travel among the wealthiest households.

Testing for differences in slopes between 2006/07 and 2012/13

	$\log\left(\frac{Total}{emissions}\right)$	$\log\left(\frac{Int.}{air}\right)$
$\log(Expenditure)$	0.681***	5.726***
	(0.0148)	(0.545)
$\log(Expenditure) * 2012\backslash13\ Survey$	0.056***	1.62**
	(0.021)	(0.782)

Testing for level differences in household emissions between 2006/07 and 2012/13

Dependent variable	Survey dummy
$\log(Total\ emissions)$	-0.0461***
	(0.00905)
$\log(Meat)$	-0.0903
	(0.103)
$\log(HH\ energy)$	-0.0946**
	(0.0459)
$\log(Transport\ fuels)$	0.0249
	(0.112)
$\log(Domestic\ air)$	-0.378
	(0.470)
$\log(Int.\ air)$	-0.441
	(0.407)

Data

Calculating emissions intensities:
- System of National Accounts 2007 input-output tables (Statistics NZ)
- Energy GHG Emissions web tables 2007 (MBIE)
- Energy Data File 2007 (MBIE)
- New Zealand's Greenhouse Gas Inventory 2008 (MfE)

Household expenditure and characteristics:
- Household Economic Survey 2006/07 and 2012/13 unit record data (Statistics NZ)