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Supplementary data

Appendix A: Future patterns for per capita floor area

In this study, three future patterns for a_t were assumed: a_{sat} at 65.2, 80 and 100 m²/cap. In the $a_{sat} = 80$ and 100 m²/cap scenarios, a_t is assumed to follow a Gompertz curve with per capita GDP (gdp_t) as the variable. This approach was developed based on Dargay et al. (2007) which forecasts the per capita vehicle ownership until 2050.

As with Dargay et al. (2007), long-run equilibrium level of per capita floor area, a_t^* , was estimated at first:

$$a_t^* = a_{sat} \alpha^{\exp(\beta gdp_t)} \quad (A1)$$

The α and β parameters that determine the shape of the curve were set using the least-squares method for a_t^* , gdp_t and a_{sat} ($t = 1960-2010$) so as to pass through the point (gdp_{2010} , a_{2010}) (Table A1). These parameters mean that the value of a_t^* reaches to the 95% of saturation level at $gdp_t = 48$ thousand dollars per capita in the case of $a_{sat} = 80$ m²/cap (i.e. a_t^* reaches to 76 m²/cap) and $gdp_t = 70$ thousand dollars per capita in the case of $a_{sat} = 100$ m²/cap (i.e. a_t^* reaches to 95 m²/cap).

Table A1: Parameters used to estimate floor area

	a_{sat}	
	80 m ² /cap	100 m ² /cap
α	0.0627	0.0874
β	-0.0836	-0.0558
R^2	0.96	0.98

However, there should be a lag that reflect the adjustment of floor area to increased GDP. Using an adjustment coefficient θ , expected at was obtained as equation (A2):

$$a_t = a_{t-1} + \theta (a_t^* - a_{t-1}) \quad (\text{A2})$$

The value of θ was set to be 0.095, which is used in Dargay et al. (2007).

GDP values through 2010 were referred from the Cabinet Office (n.d.) and World Bank (n.d.). From 2011 onwards, the GDP growth rate forecasted by the Energy Information Administration (2011, p. 160) were used. Population figures until 2050 were obtained from United Nations (2011). These data are listed in Table A2.

Table A2: GDP and population of Japan until 2050

Year	GDP (Billion \$ ₂₀₀₅ , PPP constant)	Population, POP_t (1000 persons)	Per capita GDP, gdp_t (1000 \$/cap)
2010	3,947	126,536	31.2
2015	4,235	126,072	33.6
2020	4,405	124,804	35.3
2025	4,483	122,771	36.5
2030	4,558	120,218	37.9
2035	4,624	117,349	39.4
2040	4,680	114,340	40.9
2045	4,742	111,366	42.6
2050	4,806	108,549	44.3

Appendix B: Metal consumption for the construction sector, 1960–2010

Historical data on metal consumption for the construction sector ($C_{m,t}$) were obtained as shown in Figure B1.

Figure B1: Metal consumption for the construction sector, 1960–2010: (a) steel, (b) aluminium, (c) copper, (d) zinc

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