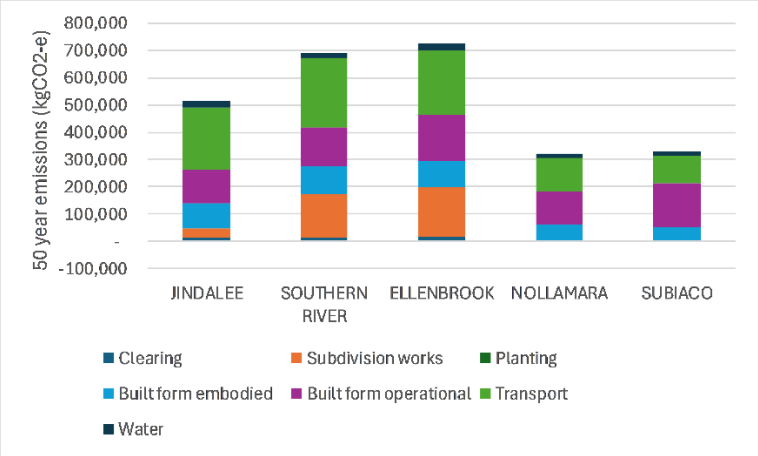
Smaller & slower is the way to go

Typical Perth new suburb – large, densely packed houses

Everyone who is interested in the energy transition understands the need for electrification serviced by renewable energy resources, whether these are on your roof or on the grid (thank you Saul Griffith). However, the elephant in the room is that this transition from fossil fuelled energy to renewable energy involves a switch from one set of non-renewable resources to another. Clean energy technologies require massive increases in the use of a bunch of minerals that are already heavily utilised in our economy, namely: aluminium, steel, copper, nickel; plus lithium, cobalt and rare earths (the critical minerals). According to the Energy Transitions Commission (ETC) demand per year for these materials will grow between 5 and 15 times between now and 2050 (i.e. the life of a modern PV cell). This will obviously hasten the depletion of these finite resources. While there may be debate about the total global stock of these resources, there can be no doubt that depletion will lead to more production energy per tonne of resource. This is already happening and is well documented[1]. Assuming the mining industry also electrifies (as promised) this is a reinforcing feedback loop: more electricity use → more renewable energy capacity → more minerals → further depletion → more production energy required → more electricity use. So reducing the amount of energy we use per household becomes increasingly important.

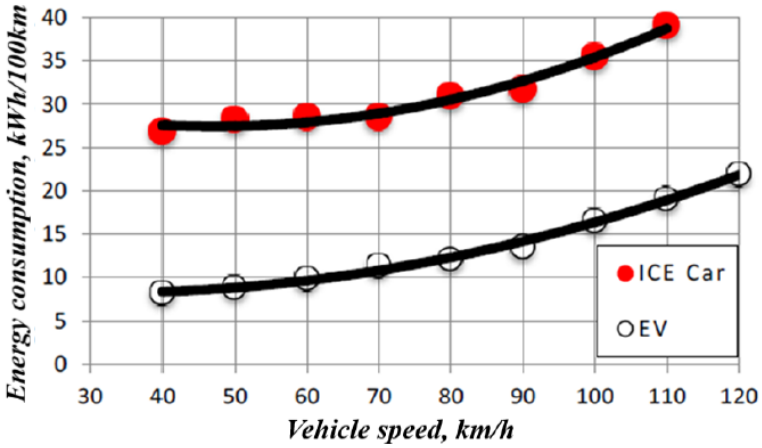
Australia has the largest houses, both on an absolute and per person basis. This has a major impact on the embodied energy and emissions in the physical materials, and the amount of energy required to operate the house. Our recent residential emissions research for the WA government (Accounting for Carbon) illustrates that re-sizing housing to match the actual demographics (2-3 persons per house) could reduce lifecycle emissions by 30-40%, even without renewable sourced electrification or energy efficiency improvements. This would reduce the cost of both owning and operating a house with obvious affordability benefits (aren't we in a cost of living crisis?).

[1] Guiomar Calvo et al., "Decreasing ore grades in global metallic mining; a theoretical issue or a global reality," Resources (Basel) 5, no. 4 (2016), https://doi.org/10.3390/resources5040036.



Lifecycle emissions per dwelling

Electric vehicle batteries will be one source of critical minerals depletion. The larger the EVs the more material they embody, and the faster they go the more electricity they use. If maximum speed limits were reduced, we would simultaneously make the roads safer, incentivise smaller vehicles (and batteries), and save on purchase and operational costs. The slower the EVs go the longer a charge will last, meaning less frequent cycles of charging and discharging and the longer the battery will last.



Energy vs vehicle speed[2]

The other part of "slower" relates to the lifecycle of materials. Higher levels of durability means longer life and therefore a reduced rate of material depletion. The re-purposing of structures and materials to extend their useful life has more energy benefit than recycling, thus slowing materials depletion.

All this is represented in the following causal loop diagram[3] which is a simplified depiction of the dynamics, i.e. behaviour over time.

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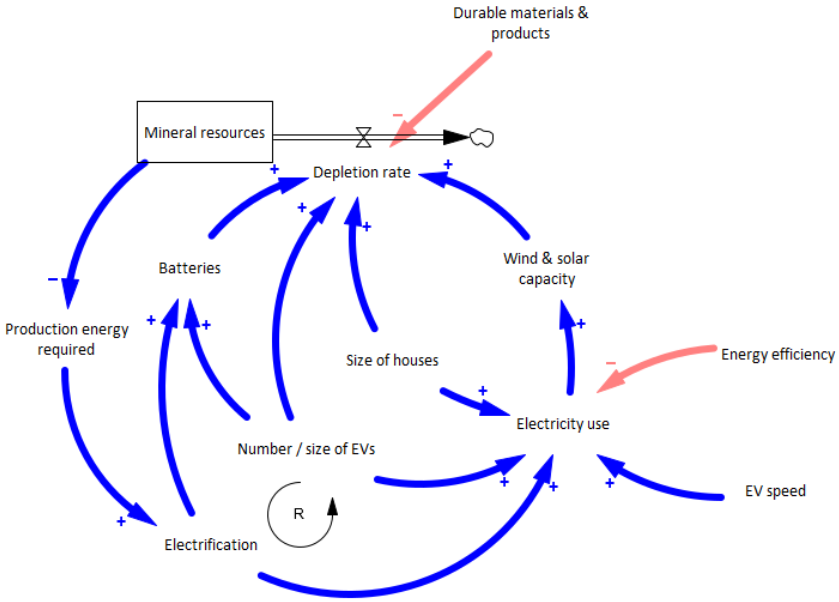
[2] Martins J, Brito FP, Pedrosa D, Monteiro V, Afonso JL. Real-life comparison between diesel and electric car energy consumption. Grid Electrified Vehicles: Performance, De-sign and Environmental Impacts, Nova Science Publishers, New York 2013.

[3] CLDs are read as follows. Over time variable x leads to an increase (+ polarity) or decrease (- polarity). Stocks are shown in boxes with inflows (in this case none as minerals are non-renewable) or outflows as arrows.



The standard of living we have is inextricably linked to energy use. The energy transition means we have to focus on minimising the use of energy not just to reduce emissions but to conserve the precious mineral resources that underpin modern society. Smaller and slower is the way to go.