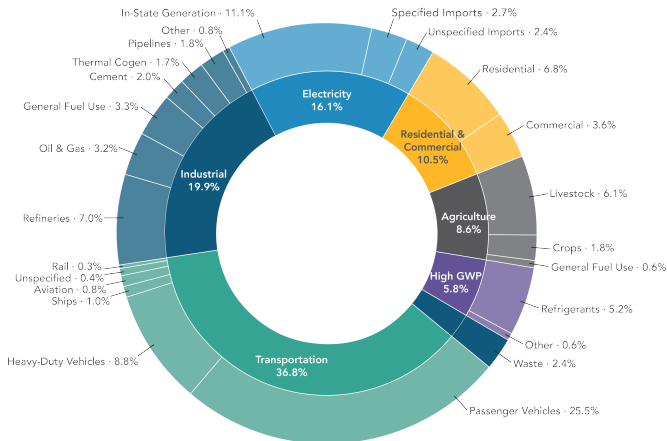


Retiring Old Capital to Foster Decarbonization

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UC Berkeley and the NBER

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Most anthropogenic greenhouse gas emissions involve durable capital



Source: California Air Resources Board

Many environmental policies regulate properties of this capital



U.S. DEPARTMENT OF
ENERGY



- Fuel economy standards regulate vehicle efficiency
- Minimum efficiency standards regulate appliances and equipment
- Building codes set rules for construction
- Air pollution standards control power plant emissions

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- **The thesis of this paper is that we should pay more attention to the policies that target used capital (durables), in particular “pro-retirement” policies**



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- ...but used and new capital interact in critical ways
 - Used capital turnover will affect demand for new innovation
 - Innovation policies will create unintended consequences via leakage into used markets
- **Pro-retirement policies can complement innovation and counteract unintended consequences**

Outline

- **Why:** Why would pro-retirement policies targeting used durables have efficiency benefits?
- **What:** What are the alternative policy options for encouraging retirement?
- **Which:** Which are most appealing based on different criteria?
 - Efficiency
 - Equity
 - Political economy

Efficiency point 1: Most emissions come from used durables

	Average age of fleet in years (source)	Typical life expectancy in years (source)
Vehicles		
National		
Light-duty cars	13.1 (S&P)	20 (NHTSA)
Light-duty trucks	11.6 (S&P)	25 (NHTSA)
California		
Medium-duty trucks	9.66 (ARB)	11.85 (ARB)
Heavy-duty trucks	7.49 (ARB)	9.82 (ARB)

Efficiency point 1: Most emissions come from used durables

	Average age of fleet in years (source)	Typical life expectancy in years (source)
Residential appliances		
National		
Furnaces	10.55 (RECS)	20 (NREL)
Water heaters	8.11 (RECS)	13 (NREL)
Refrigerators	7.43 (RECS)	17.4 (NREL)
California		
Furnaces	15.09 (RASS)	20 (NREL)
Water heaters	9.33 (RASS)	13 (NREL)
Refrigerators	7.81 (RASS)	17.4 (NREL)

Efficiency benefit 1: Most emissions come from used durables

	Average age of fleet in years (source)	Typical life expectancy in years (source)
Power plants		
National		
Coal	40 (S&P)	50 (S&P)
Natural gas steam	50 (S&P)	47 (S&P)
Combined cycle gas	14 (S&P)	27 (S&P)

- Capital that is sold now will create emissions for decades into the future
- ⇒ **If we want to rapidly decarbonize, we will need to accelerate retirement of existing capital stock**

Efficiency benefit 2: Gruenspecht effect



If new cars are too expensive, people won't be willing to scrap and replace

- Regulation can raise the cost of new capital (e.g., by forcing emissions reducing technology adoption)
 - This can cause old durable goods to last longer, pollute more (the Gruenspecht effect)
- ⇒ **Pro-retirement policies can counteract this effect**

Efficiency benefit 3: free market turnover is inefficient



- Even absent a Gruenspecht effect, there is an efficiency gain to pro-retirement policy
- Free market turnover will be inefficiently slow if older products pollute more than newer ones
 - Age degradation
 - Policy
 - Secular trends in innovation

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⇒ **Pro-retirement policies can correct market inefficiencies**

Interactions between innovation and the efficiency gains of pro-retirement policy

- Desire for faster innovation \Rightarrow stricter regulation of new durables \Rightarrow higher cost of new capital \Rightarrow larger Gruenspecht effect \Rightarrow larger efficiency gain from pro-retirement policy

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- Pro-retirement policy \Rightarrow faster innovation (market-size effect) \Rightarrow feedback into more aggressive policy (policy-lag effect)

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- 5 **Mandate retirement** — example: regional vehicle phase outs

Efficiency difference 1: compliance flexibility

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- **Tax emissions >> capital taxes, capital subsidies >> mandate retirement**

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CARS

car allowance rebate system



Passenger Car



Small Truck



Large Truck



Work Truck

	Passenger Car	Small Truck	Large Truck	Work Truck
Minimum Fuel Economy For New Vehicle	22 MPG EPA Combined	18 MPG EPA Combined	15 MPG EPA Combined	Work Truck For Work Truck Only. No mileage reqs.
To Qualify For \$3,500 Voucher	4 MPG Improvement Over Trade-In	2 MPG Improvement Over Trade-In	1 MPG Improvement Over Trade-In Or Trade From Work Truck	Trade-In Must Be From MY 2001 Or Older
To Qualify For \$4,500 Voucher	10 MPG Improvement Over Trade-In	5 MPG Improvement Over Trade-In	2 MPG Improvement Over Trade-In	Not Applicable

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 - For a subsidy, who pays taxes to supply revenue?
 - For a tax, how is revenue used or recycled?
- Focus here on **initial** incidence
 - There is no single answer across all policies, so this is a rough guide

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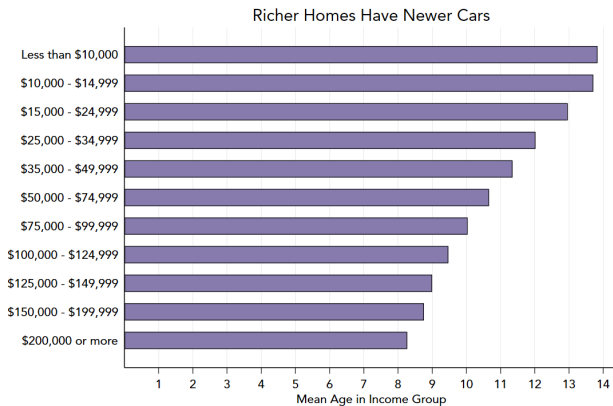
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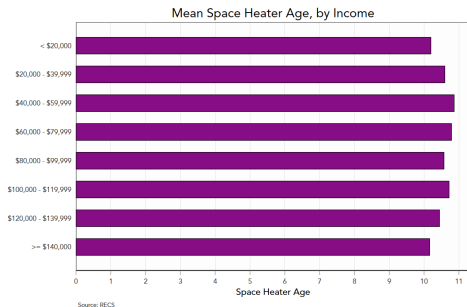
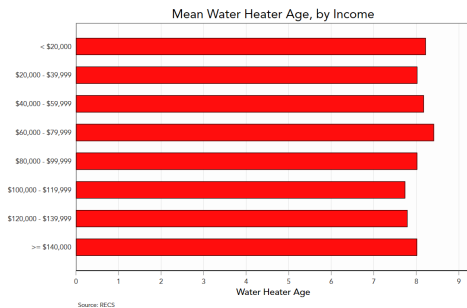
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- 5 **Mandate retirement** — probably **regressive** when lower-income households use older capital

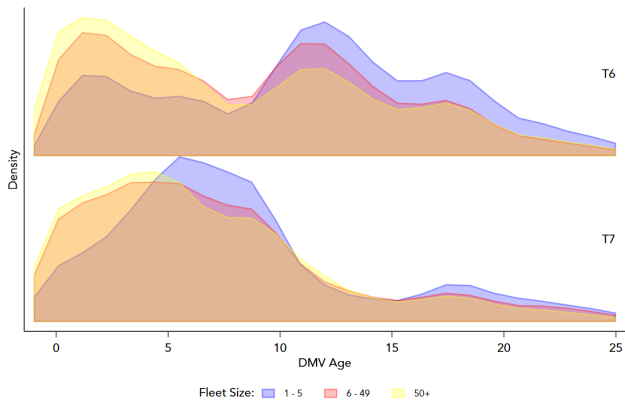
Do lower-income households use older capital?



Do lower-income households use older capital?



Do small businesses use older capital?



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- Subsidies will generally be favored above taxes because they expand the new product market more, and they funnel wealth towards a particular industry
- When comparing subsidies for new capital versus subsidies for scrapping new capital, the main political economy difference is among current owners of old capital

Table: Impact and equity features of policy alternatives

<i>Policy</i>	Targets New	Targets Used	Revenue Impact	Initial Incidence
Tax emissions (fuels)	X	X	+	Regressive
Tax used capital stock		X	+	Regressive
Subsidize new capital	X		-	Regressive
Subsidize scrappage		X	-	Progressive
Mandate scrappage		X	0	Regressive

- Scrappage subsidies stand out for being progressive, but this may vary across cases (appliances) and progressivity can be achieved with revenue recycling
- There are efficiency benefits of taxation over subsidies, but we see many more subsidies in practice suggesting the political economy benefits dominate

Context matters

- According to economic theory, if we priced all pollution externalities (with a tax or cap-and-trade system) and we had subsidies for innovation, there would be no rationale for pro-retirement policies \Rightarrow still prefer taxing pricing pollution directly!
- The case for scrappage subsidies or other pro-retirement policies is strongest when the policy baseline is regulation of new capital
- If instead our policy baseline is all subsidies for new capital (e.g., the IRA), then there is less case for adding subsidies for scrappage on top of that
 - Instead of seeing this paper as an argument to add retirement subsidies on top of the IRA, we can see it as an exploration of the merits of the subsidy-heavy approach of the IRA

Summary

- Decarbonization requires innovation
- Carbon emissions are largely mediated through durable capital
- Policy often (though not always) focuses on new capital
- There is an important role for pro-retirement policy to address old capital
- Pro-retirement policy can have efficiency benefits and accelerate innovation through market-size effects
- Alternative forms of pro-retirement policy offer different trade-offs between efficiency, equity and political economy
- Of particular interest are policies that subsidize scrappage of older capital because they have favorable equity and political economy, though they may not always be as efficient