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Estimation approaches for materials demand, recycling and substitution using the POLES model

WORK IN PROGRESS
findings not final

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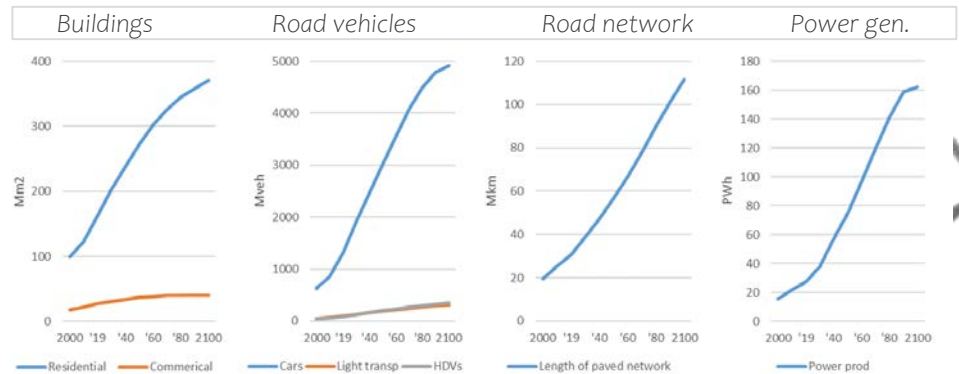
METHODS for materials demand

Method	Pros	Cons
Econometric, Intensity of Use	Based on readily available data on annual demand	Resulting stock differences across countries unexplained; no end-use detail
Intensity of Stock	Annual demand coherent with provision of services	Stock data recreated from annual demand data; no end-use detail
Bottom-up	Annual demand coherent with provision of services	Resulting stock differences across countries unexplained

This study

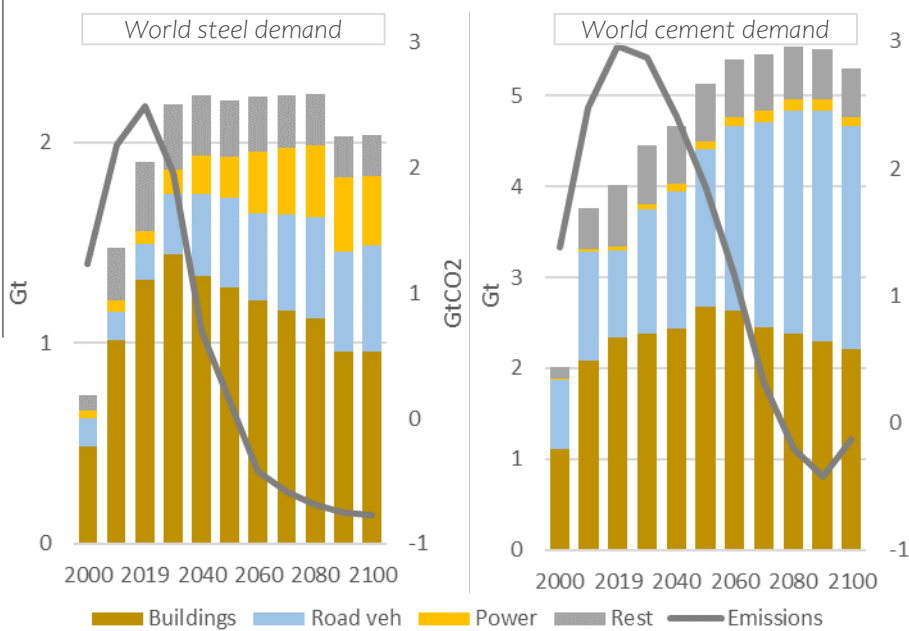
MAIN DRIVERS of materials demand

Method	Explicitly modelled	Implicit/not modelled
Buildings	m ² /cap, cap/dwelling, shift from informal to modern materials, renewal & renovation rates	construction codes, building typology, cities density, real estate cyclical activity, secondary houses, domestic migration
Road transport	car ownership ratio, paved network size	cities density, population distribution
Power gen	technologies mix	sources distance to grid network



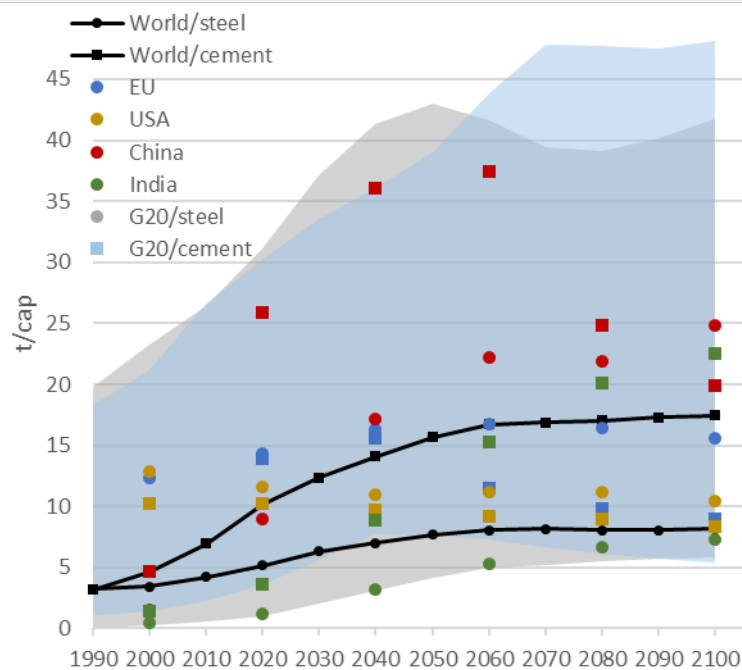
→ All drivers push towards more materials demand

PROJECTIONS of materials demand



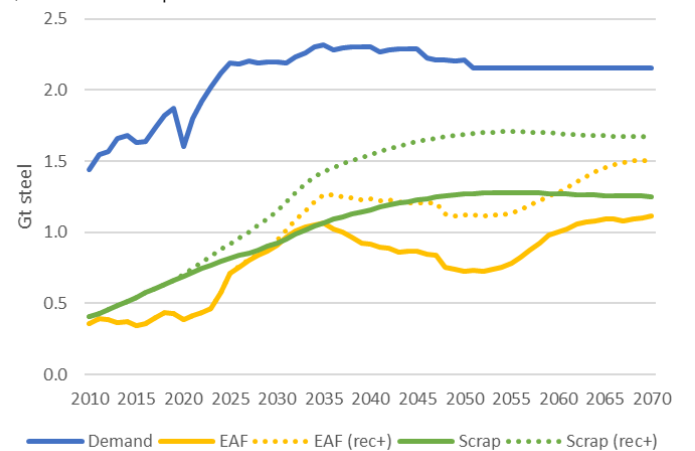
+ main production-side mitigation options: electrification, CCS, biomass, hydrogen

Resulting material stock



> RECYCLE:

- with recycling strategies, steel scrap price ↓, ↑ scrap competitiveness with climate policies: electricity price ↑, ↓ electric arc competitiveness
- rec+ scenario with increased steel scrap recovery factor (75% → 100% of recoverable; 25% considered unrecoverable)
 - scrap available rises to 60-80% of annual demand
 - EAF covers 50-70% of steel production



In addition, not modelled above:

> REDUCE:

- **Building codes:** cement use can be cut by as much as half without losses in structural integrity
- **Material substitution:** timber products can partially substitute concrete (as much as 80% for multi-storey buildings) and even steel; glass can cover a larger share of outer shell

> REUSE:

- **Design with end-of-life in mind:** wall panels can be reused instead of sent to demolition landfill
- **Circularity beyond CO₂ considerations:** concrete can be ground to substitute gravel for new concrete

→ Large potential for material efficiency still untapped

+ TRADE-OFFS on land-use

- PV needs for hydrogen electrolysis for steel direct reduction: x14 land needs compared to a current steel plant
- **Timber** instead of cement in buildings construction (lead to 1/3 less cement demand): plantation surfaces for timber up to x4 vs present

FURTHER RESEARCH

- Quantify material consumption related to urban planning design, land use patterns, buildings types
- Further justify country differences on specific material consumption levels
- Estimate material substitution trade-offs