



Estimation approches for materials demand, recycling and substitution using the Poles model

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► To cite this version:

Kimon Keramidas, Silvana Mima, Adrien Bidaud. Estimation approches for materials demand, recycling and substitution using the Poles model. IIASA. Forum on scenarios for climate and social futures, Jun 2022, Laxembourg, Austria. Forum on scenarios for climate and social futures, Laxembourg, Austria Sesion ID n° 43. hal-03711013

HAL Id: hal-03711013

<https://hal.science/hal-03711013>

Submitted on 8 Jul 2022

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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

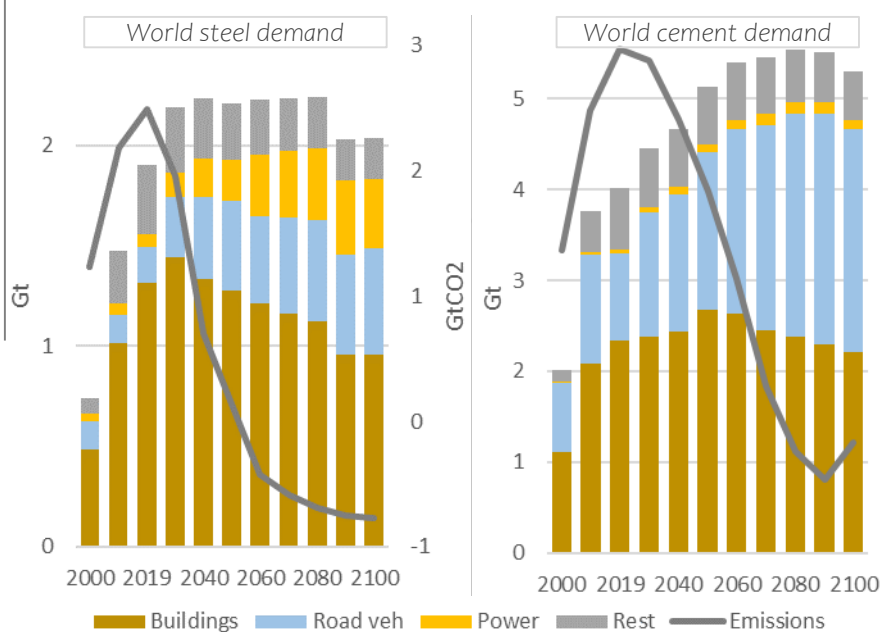
| Method | Pros | Cons |
|--------------------------------|---|---|
| Econo-metric, Intensity of Use | Based on readily available data on annual demand | Resulting stock differences across countries unexplained; no end-use detail |
| Intensity of Stock | Annual demand coherent with provision of services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

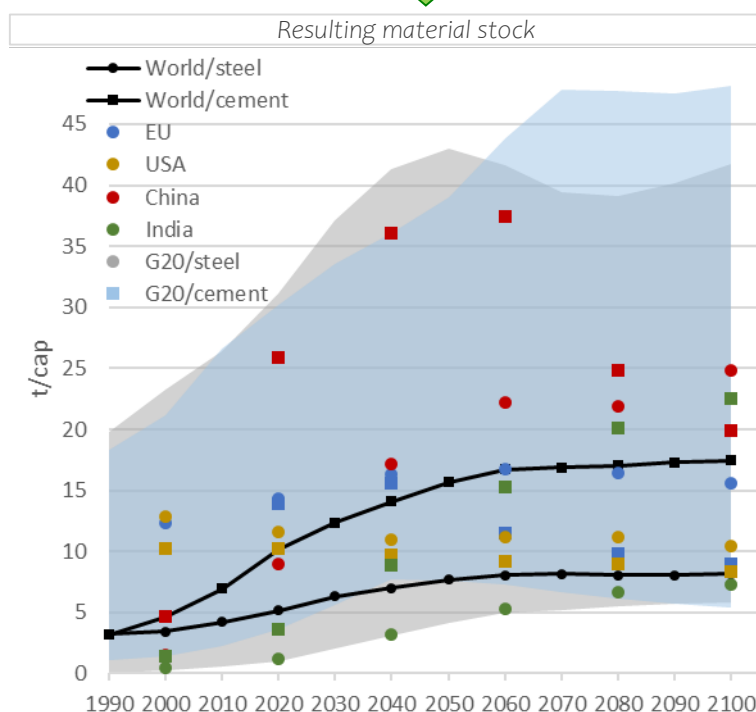
MAIN DRIVERS of materials demand

| 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 |

PROJECTIONS of materials demand

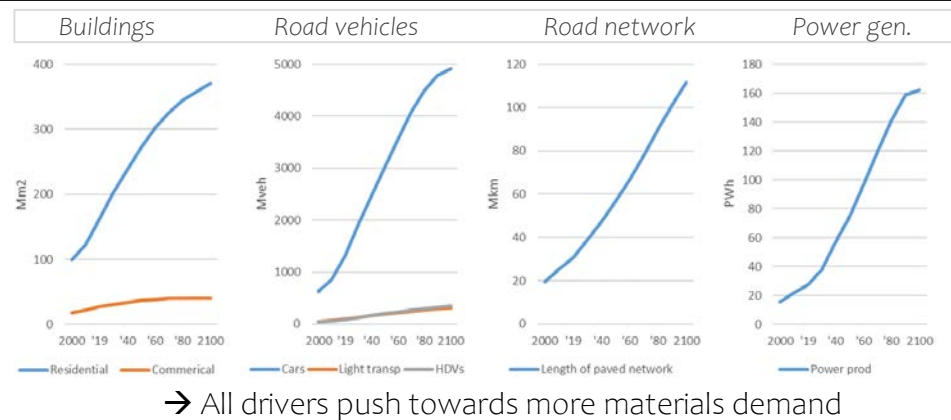


+ main production-side mitigation options:
electrification, CCS, biomass, hydrogen



+ TRADE-OFFS on land-use

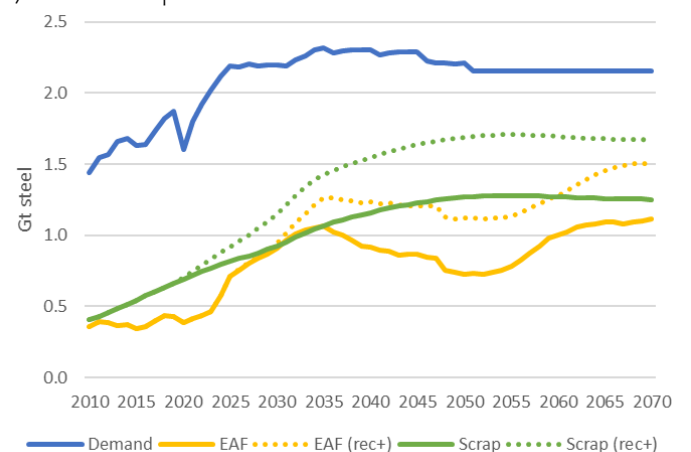
- PV needs for **hydrogen** electrolysis for steel direct reduction: x14 land needs compared to a current steel plant
- **Timber** instead of cement in buildings construction (lead to 1/3 less cement demand): plantation surfaces for timber up to x4 vs present



→ All drivers push towards more materials demand

> 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

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