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Material stocks and their role in reducing resource use in the United States of America

Jan Streeck

Quirin Dammerer, Dominik Wiedenhofer, Fridolin Krausmann
Institute of Social Ecology, Vienna

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European Research Council

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The USA emitted 25% of anthropogenic CO_2 emissions and used 15% of global resource extraction

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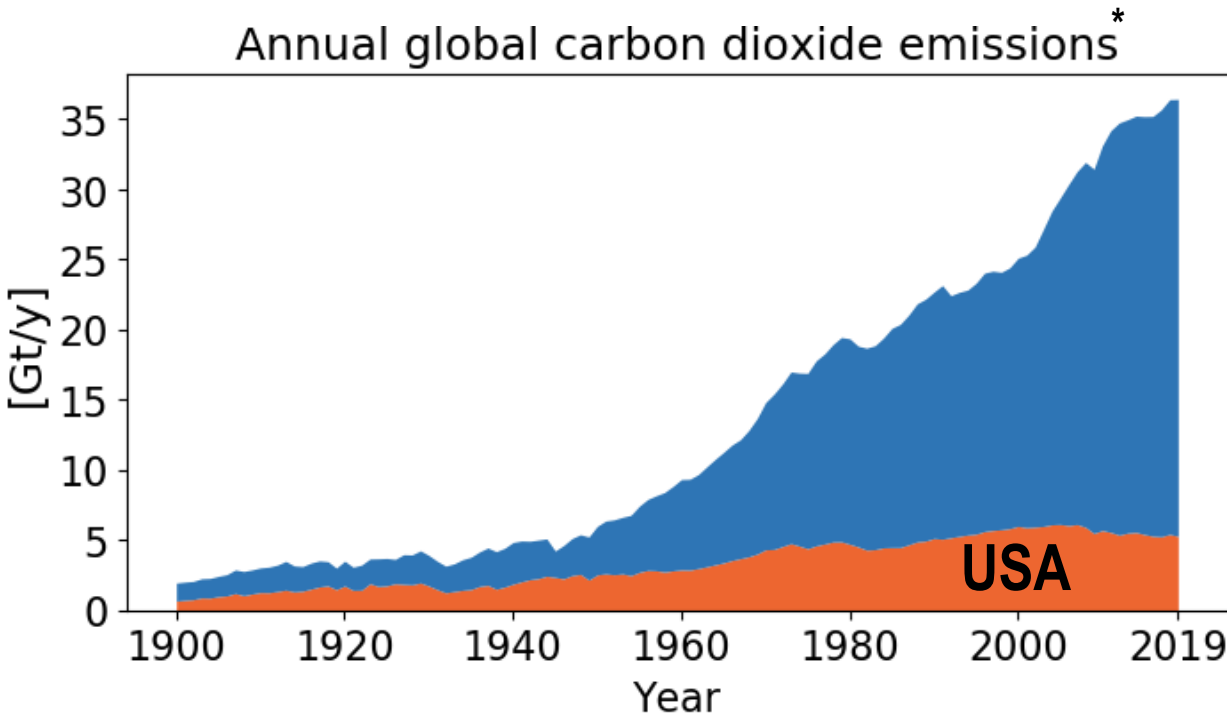

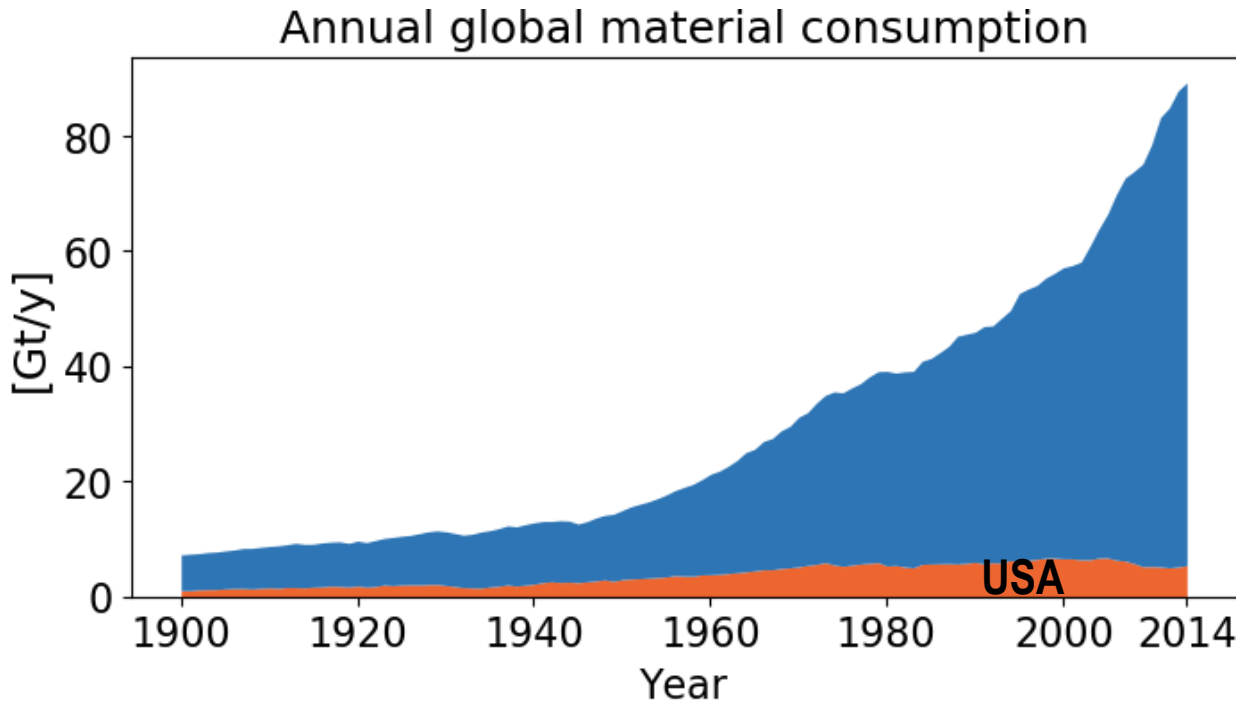

*from fossil fuels and cement production

Sources: ourworldindata.org, Gierlinger & Krausmann 2012, Krausmann et al. 2017, UNEP 2019

Research Aim

1. Investigate the importance of material stocks for historical resource use in the USA…
2. …and explore options for reducing future stock-building resource use.

We use a dynamic extension of Economy-wide Material Flow Accounting

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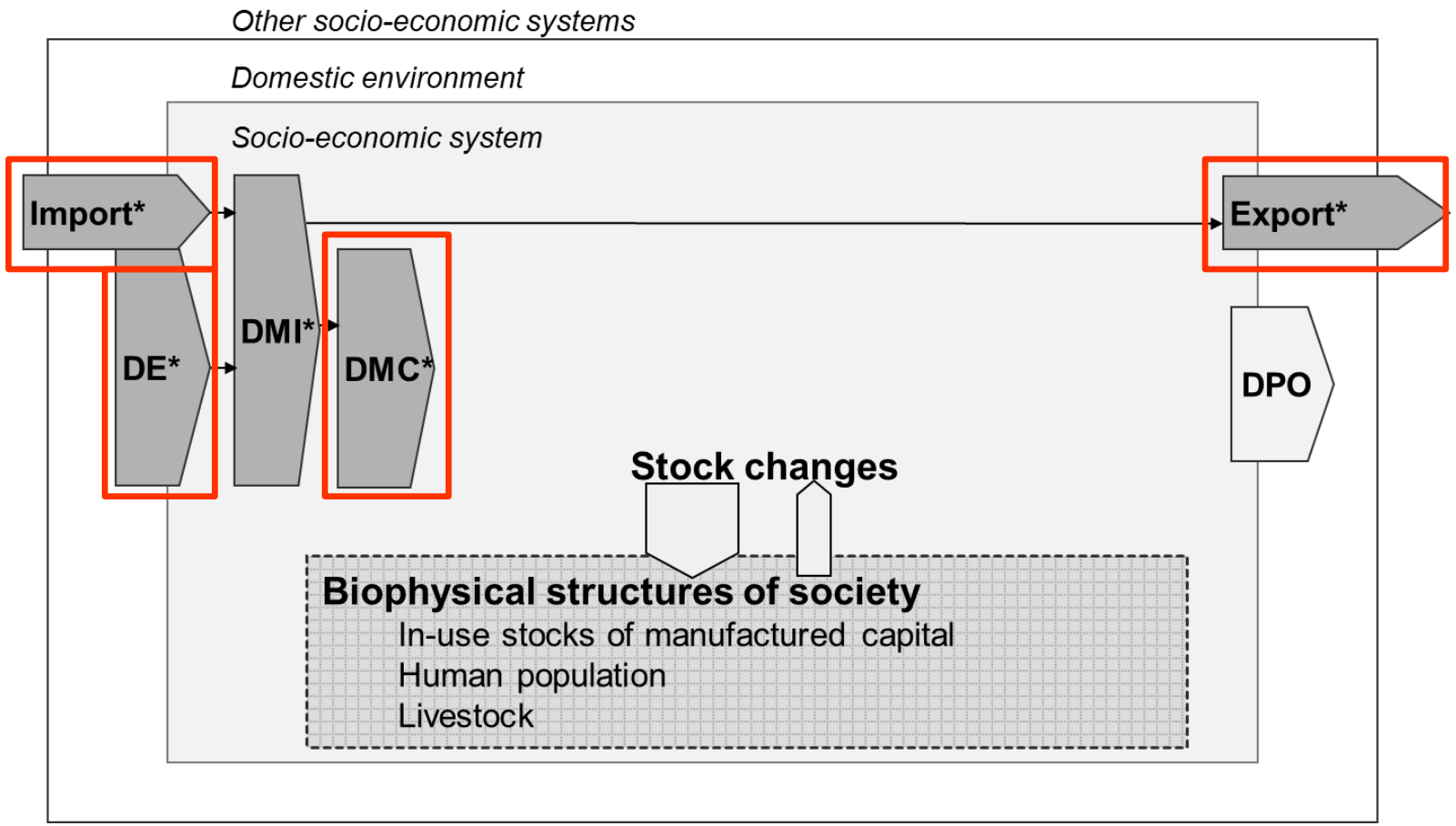

DE = Domestic Extraction
DMC = Domestic Material Consumption

Sources: Wiedenhofer et al. 2019

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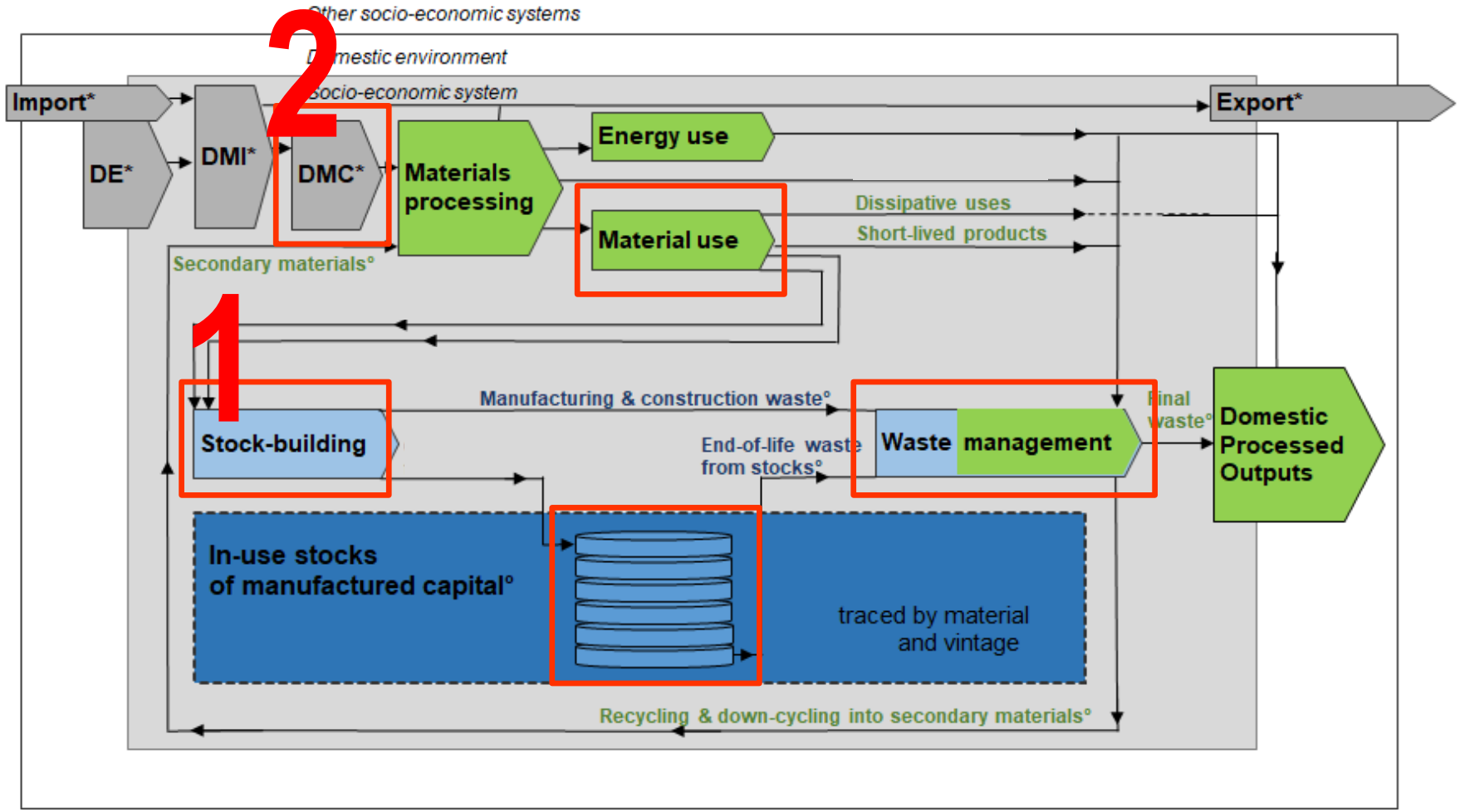

Main data sources:

- U.S. Bureau of Census
- U.S. Geological Survey
- Gierlinger & Krausmann 2012

Sources: Wiedenhofer et al. 2019 (adapted)

Stock-building materials make up a large part of domestic material consumption (DMC)

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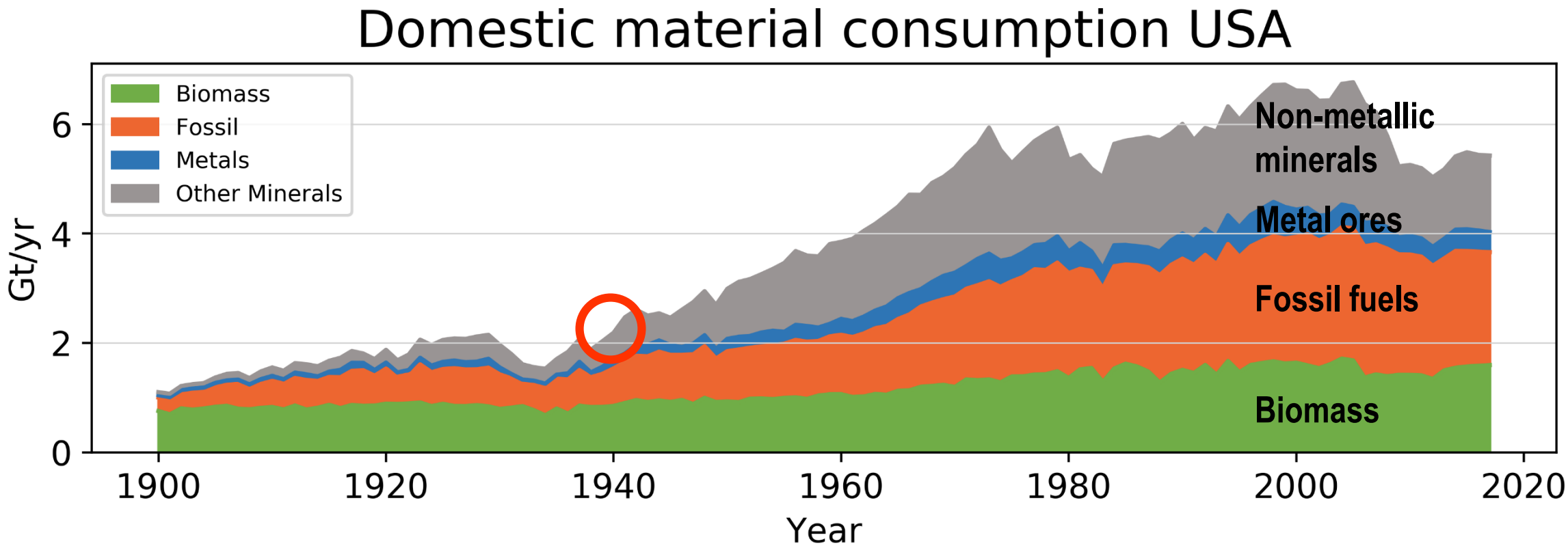
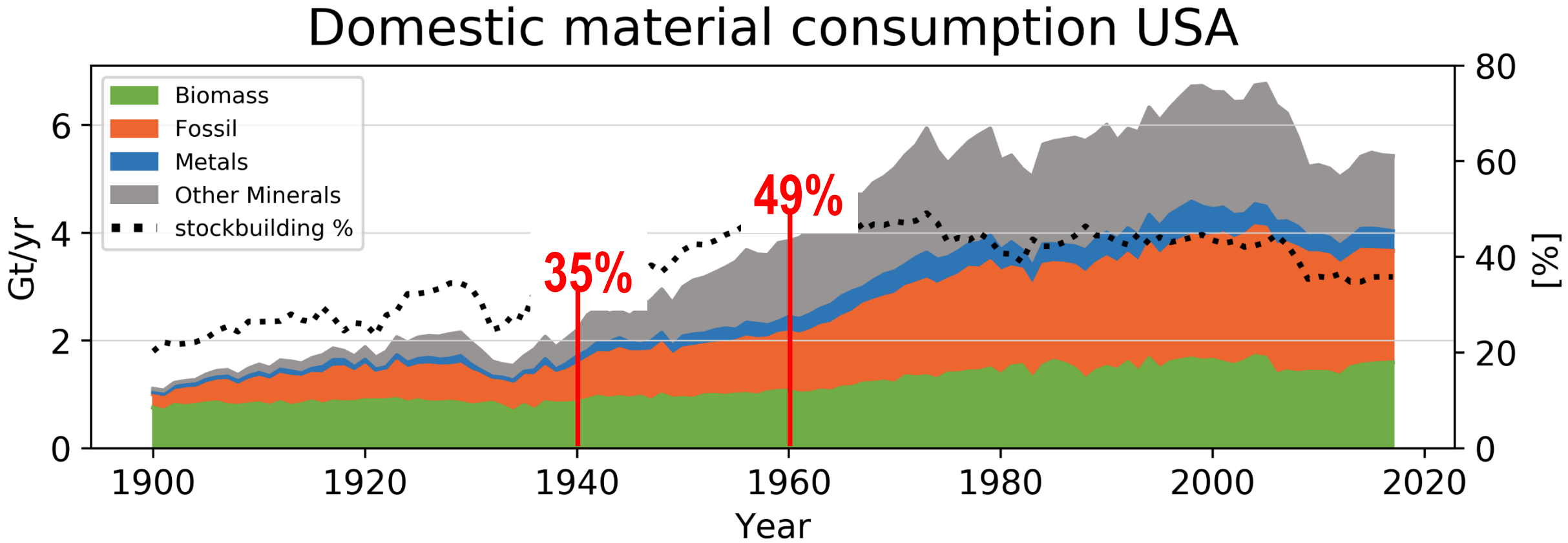


Sources: Gierlinger & Krausmann 2012, UNEP 2019

Stock-building materials make up a large part of domestic material consumption



Sources: Gierlinger & Krausmann 2012, UNEP 2019, own work - Dammerer et al. 2021 - in review (stock-building share)

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60% of stock-building materials consumed since 1870 are accumulated in material stocks

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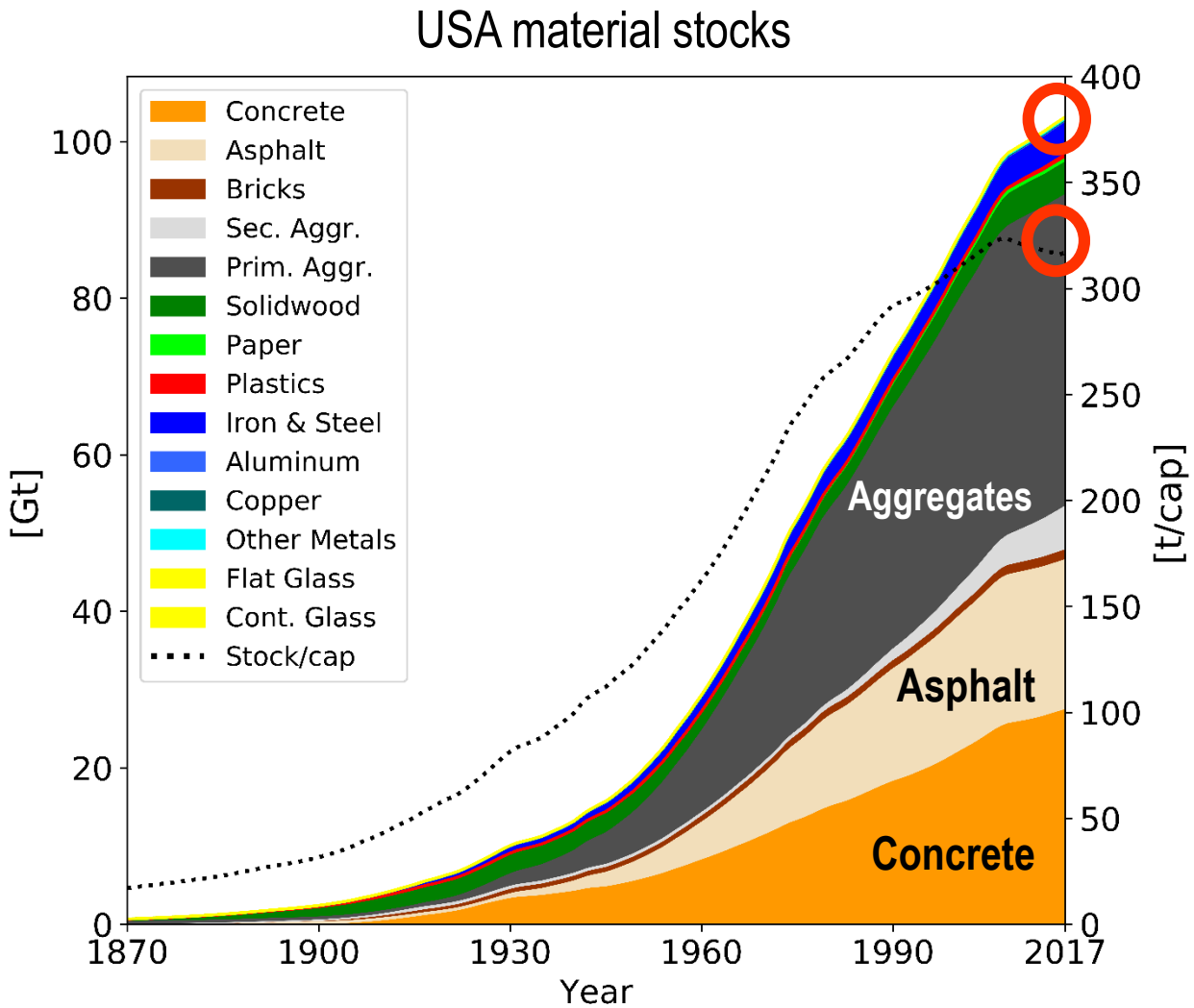

Sources: Own work - Dammerer et al. 2021 (in review)

Interim summary

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- ~40% of historical domestic material consumption (DMC) was used to build and maintain material stocks (~187 Gt raw materials)
- ~60% of these materials are accumulated in material stocks in 2017 (~103 Gt)

→ **Which measures can we take to reduce future resource demand of material stocks?**

We constructed two prospective scenarios to 2100 based on historical stock-building material use

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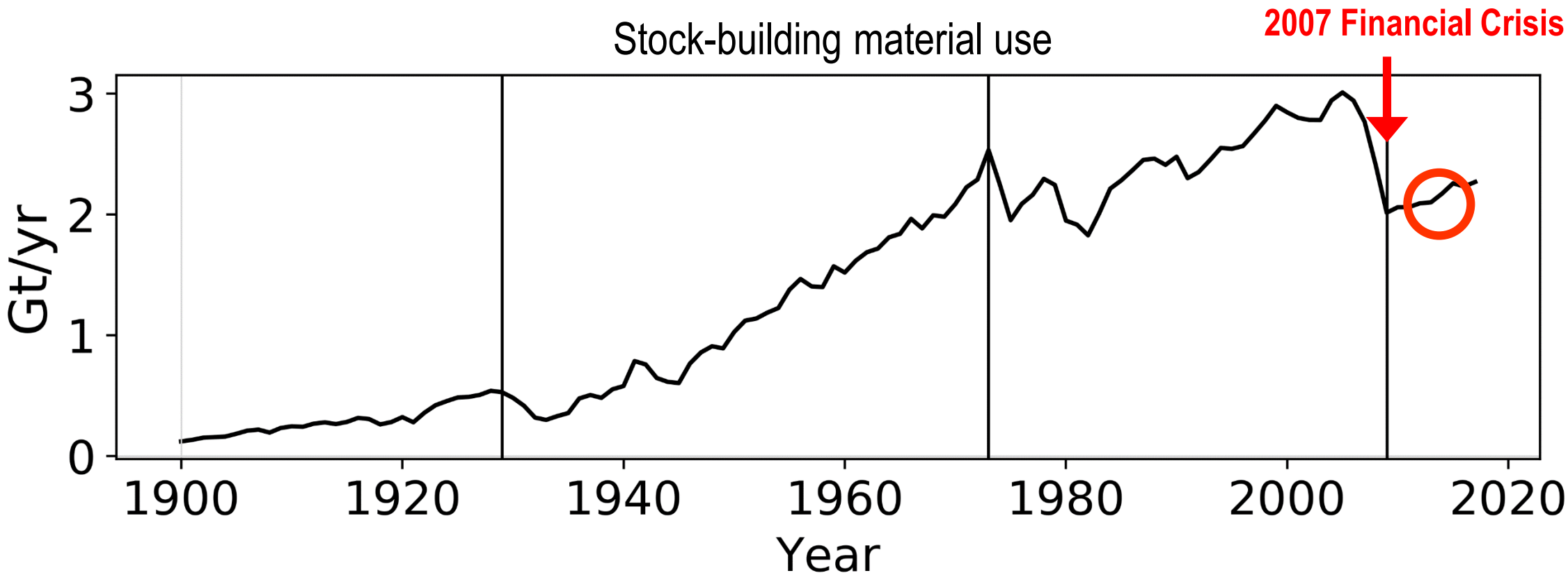

Sources: Own work - Dammerer et al. 2021 (in review)

We constructed two prospective scenarios to 2100 based on historical stock-building material use

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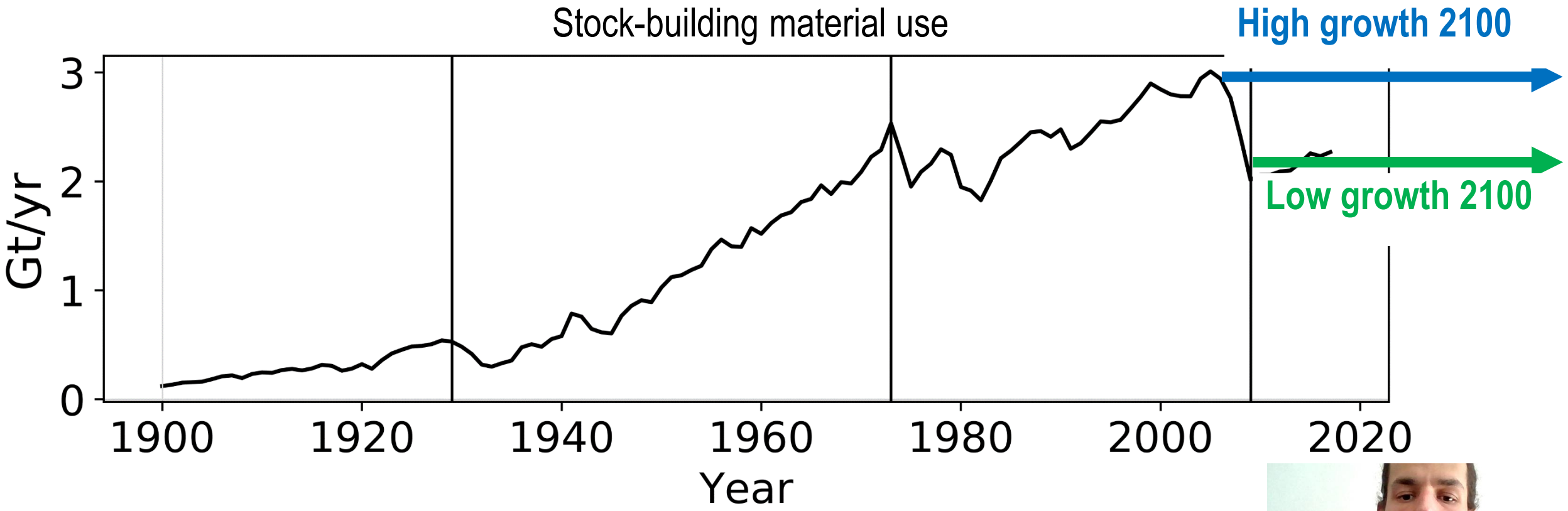

Sources: Own work - Dammerer et al. 2021 (in review)

Material stocks scenarios to 2100

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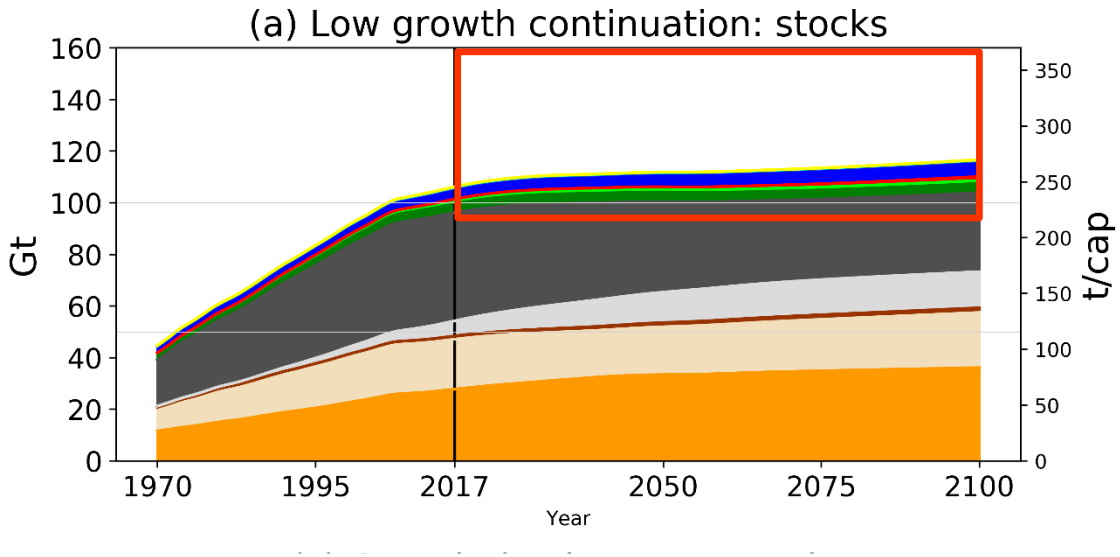

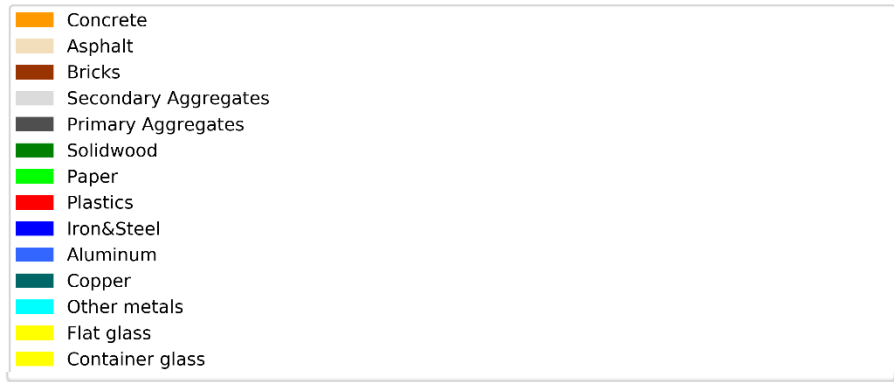

Sources: Own work - Dammerer et al. 2021 (in review)

Material stocks scenarios to 2100

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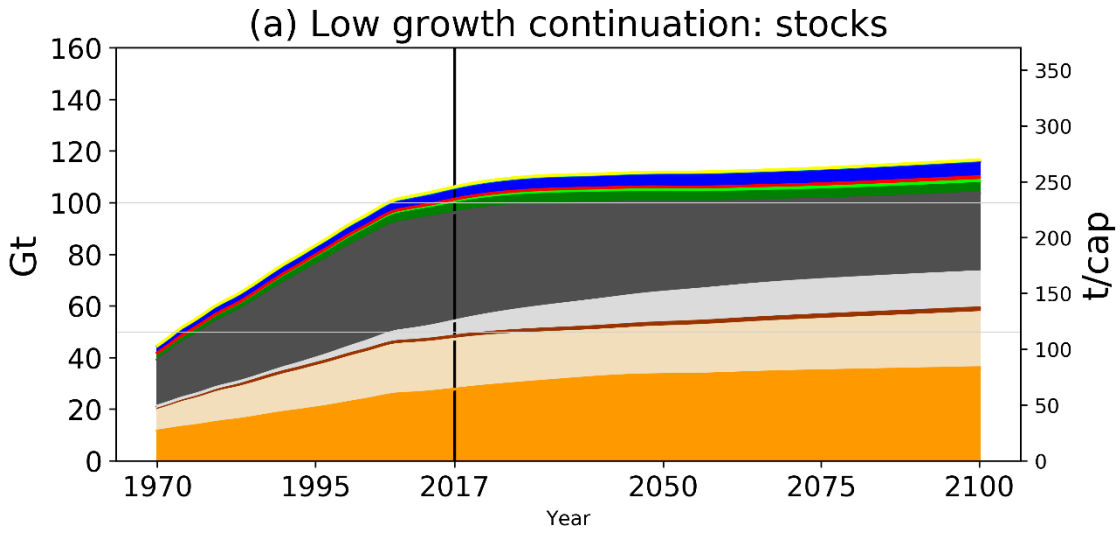

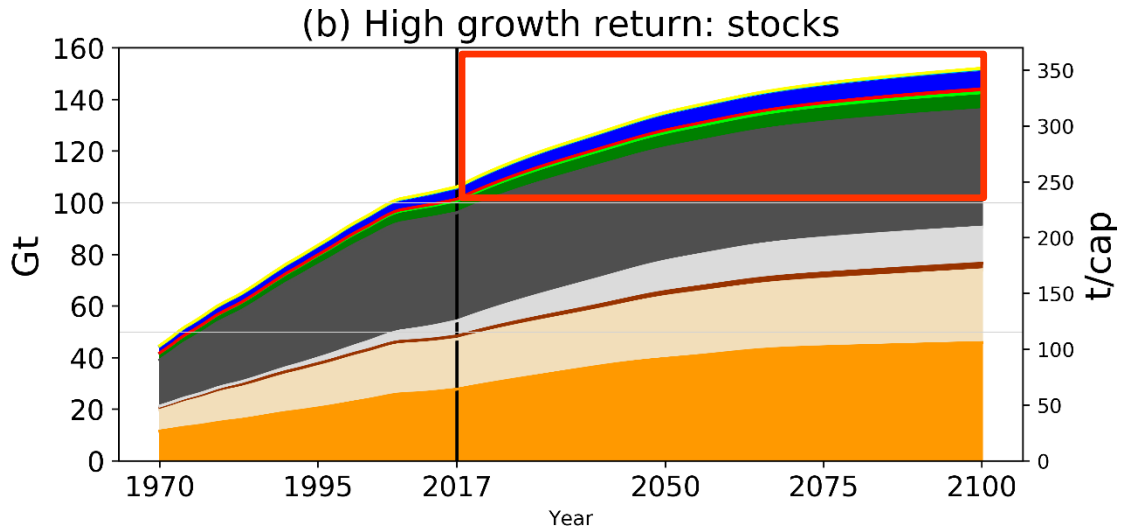

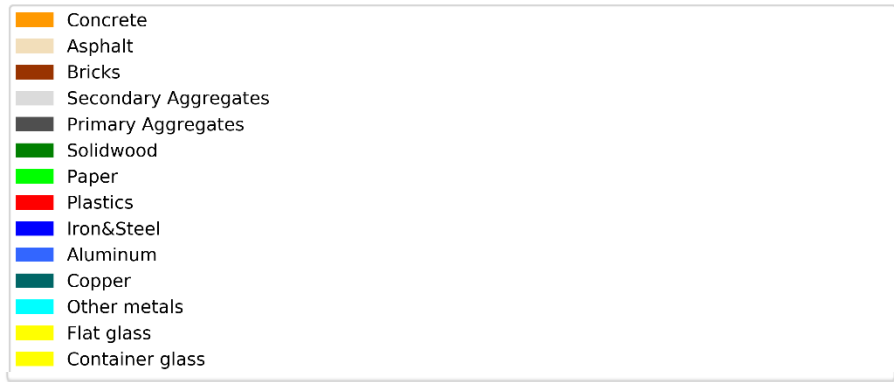

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Material stocks scenarios to 2100

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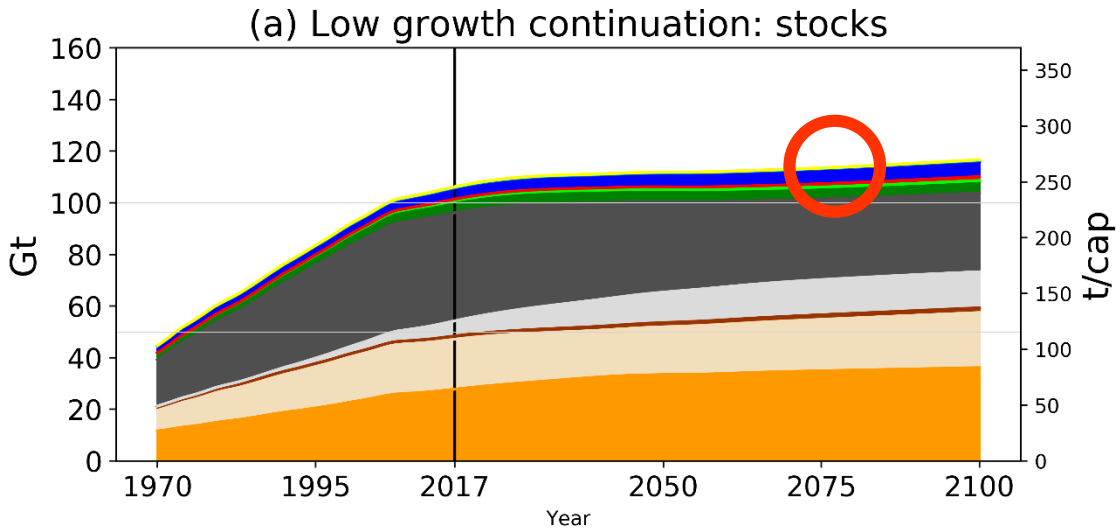

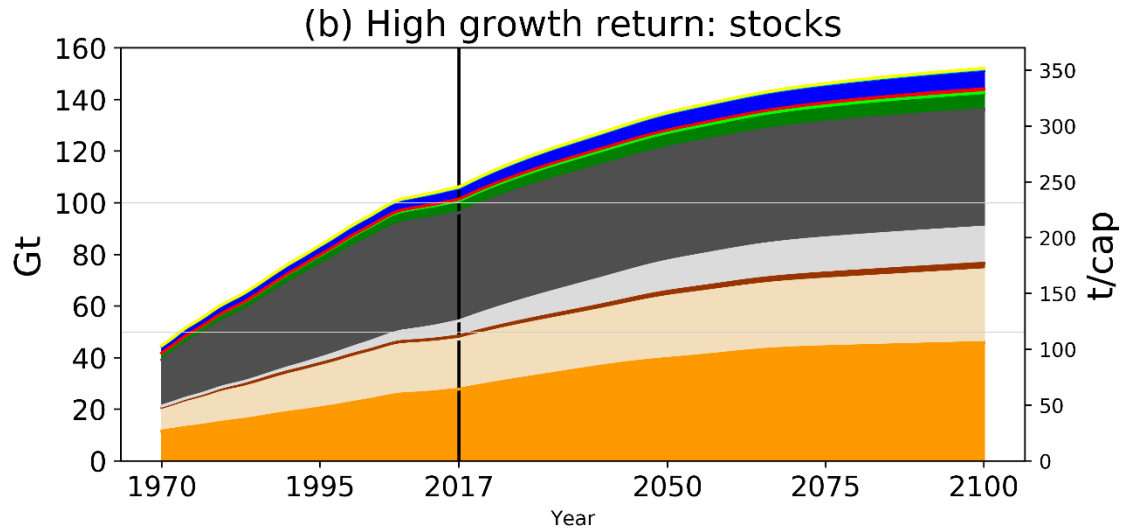

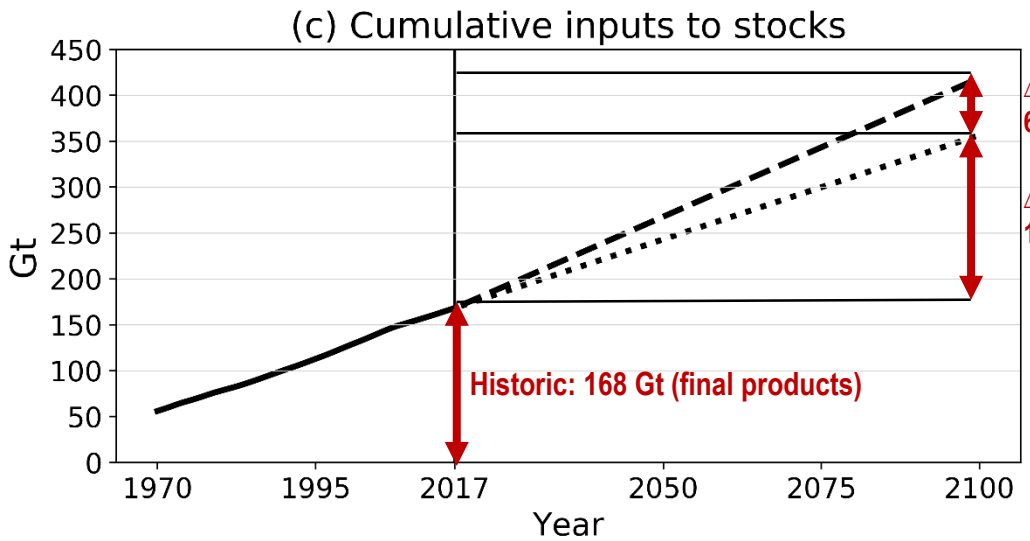

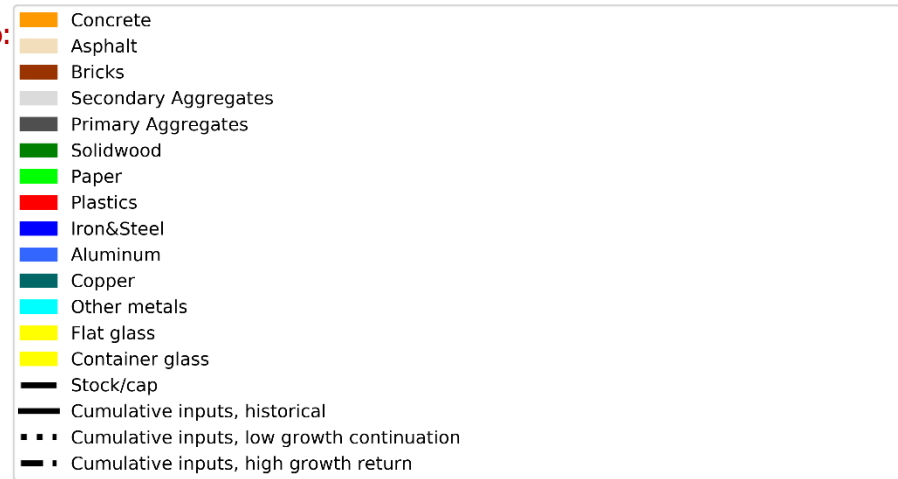

Sources: Own work - Dammerer et al. 2021 (in review)

Which measures can we take to reduce future resource demand of material stocks?

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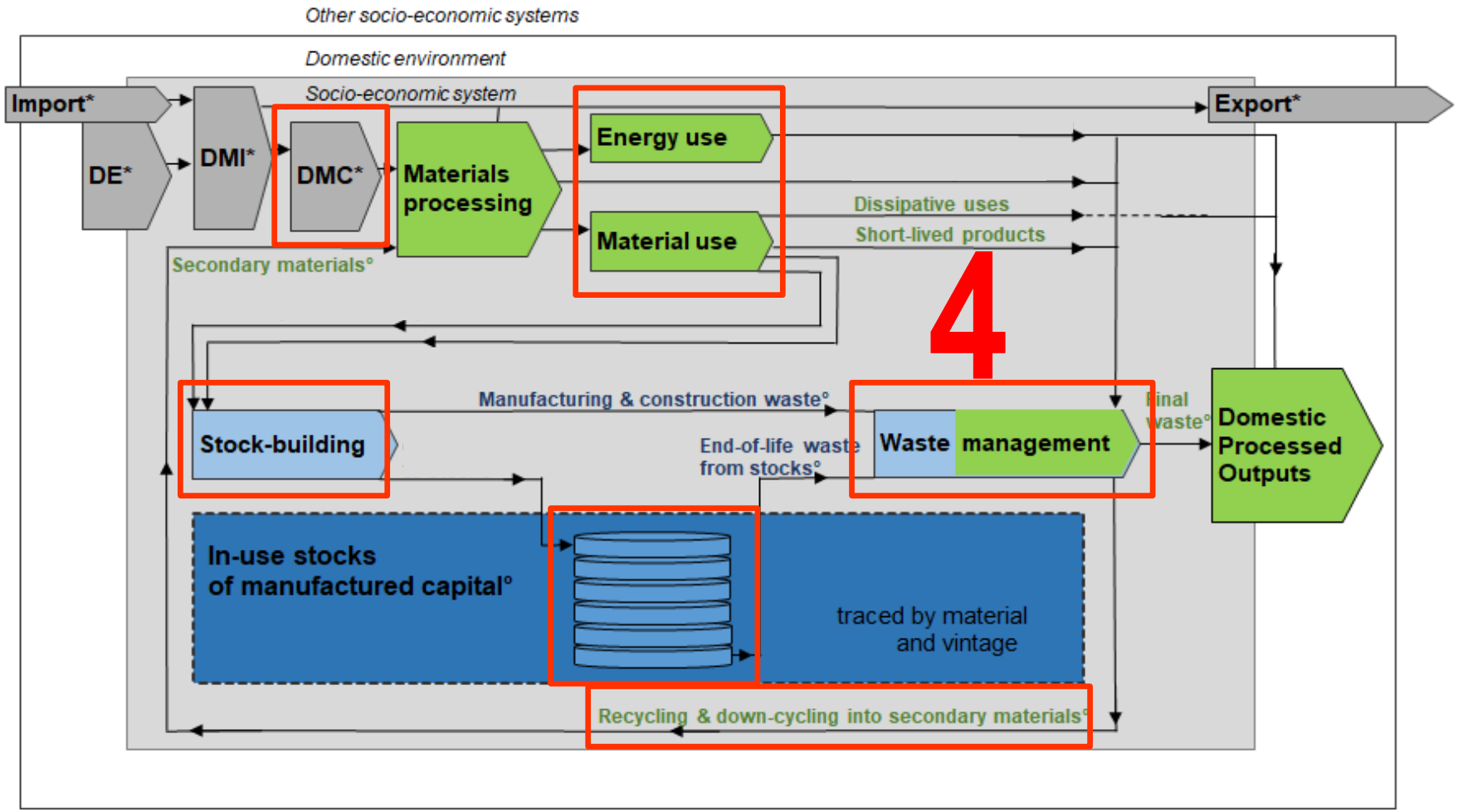
- 1. halt further stock growth

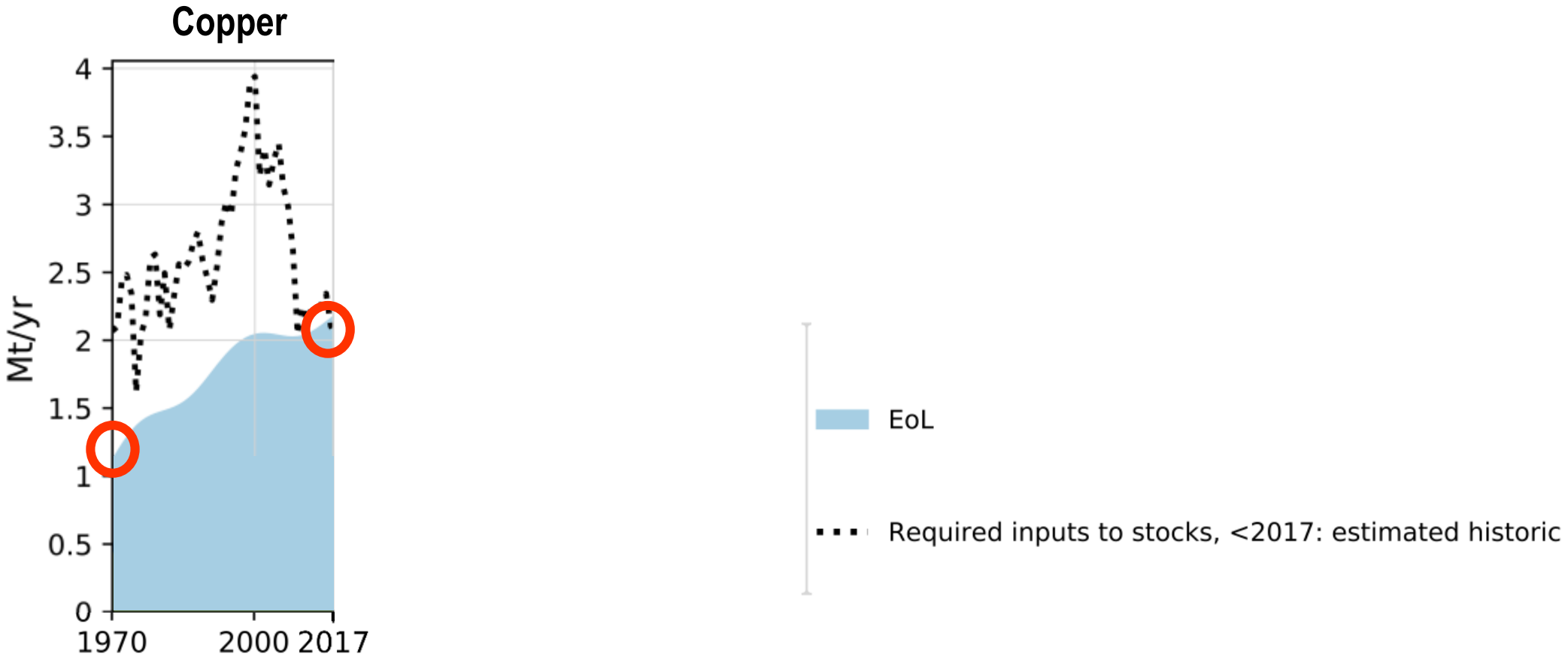
- 2. increase the use of secondary instead of primary material to reduce extraction from nature

Focus 4: End-of-life management



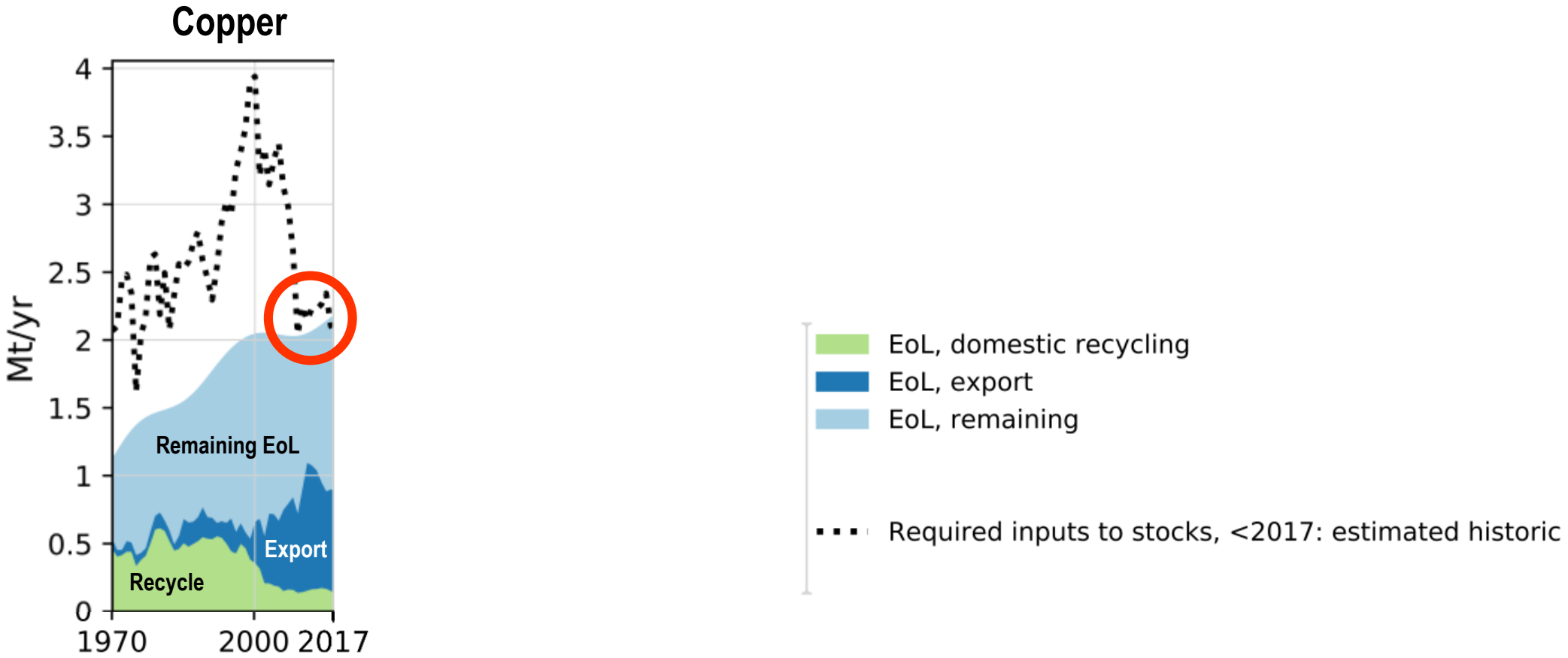
Sources: Wiedenhofer et al. 2019 (adapted)

End-of-life (EoL) outflows from stocks increased steadily in USA



Sources: Own work - Dammerer et al. 2021 (in review)

End-of-life (EoL) outflows from stocks have been increasing steadily in USA



Sources: Own work - Dammerer et al. 2021 (in review)

By sheer mass, future end-of-life outflows might cater for large parts of inputs to stocks

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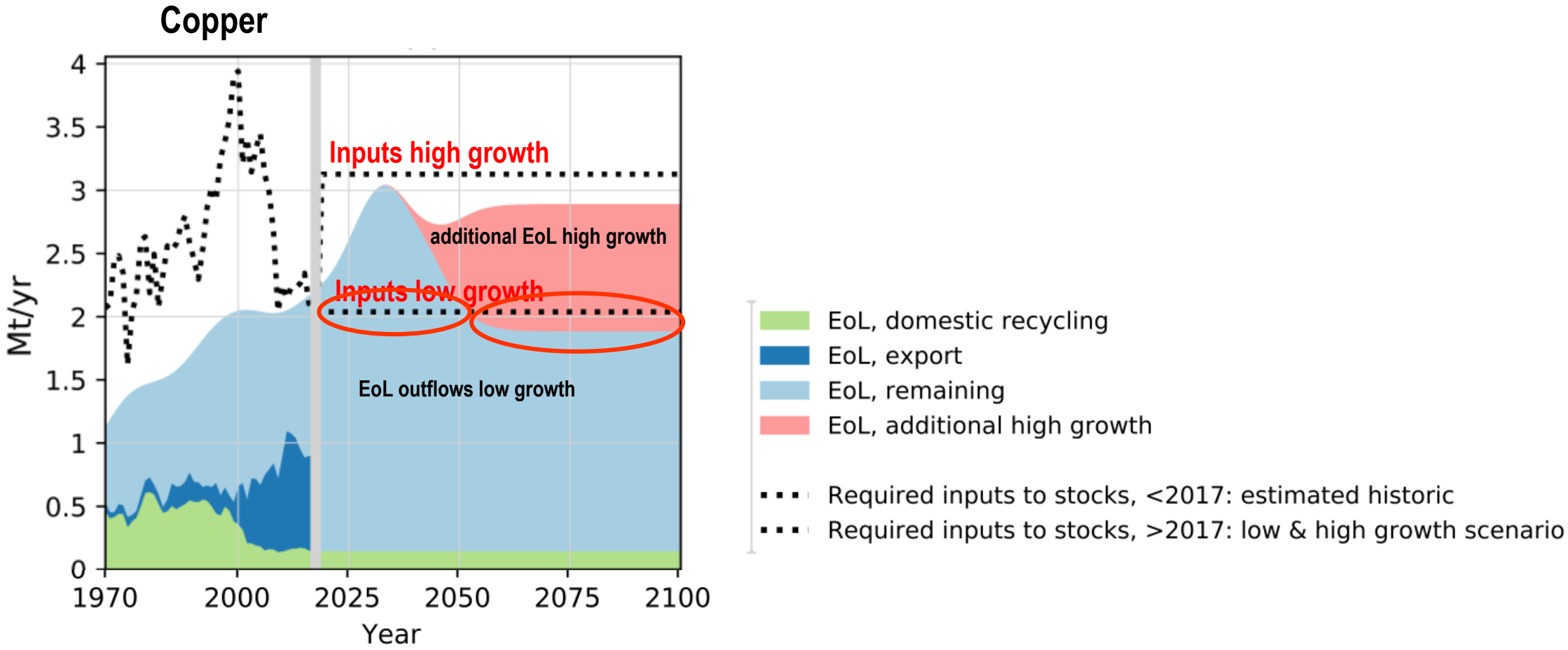
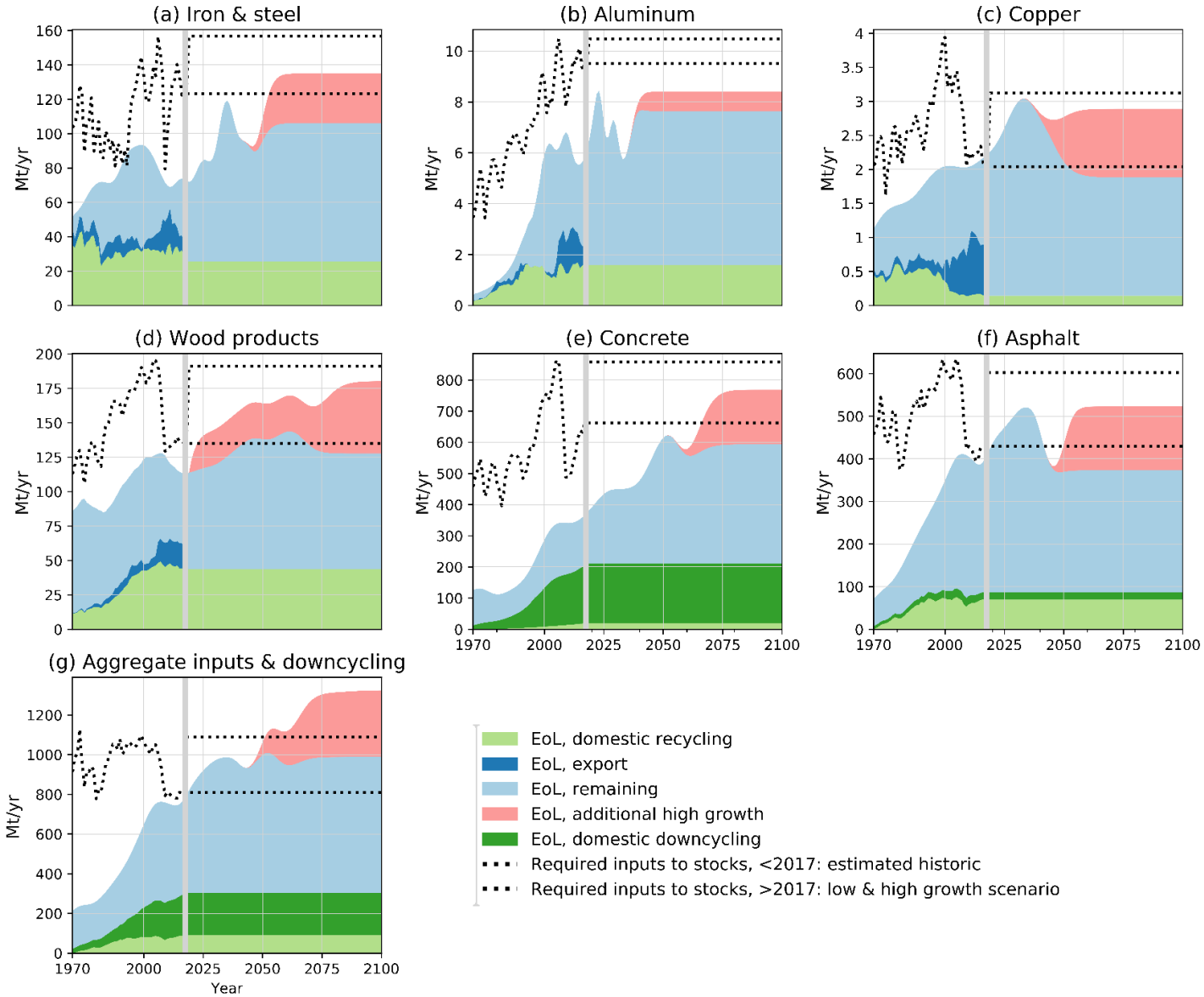


Sources: Own work - Dammerer et al. 2021 (in review)

This also applies to other materials



- Limitation:
  - **Technical feasibility**, e.g. tramp element contamination in metal recycling, needs to be addressed in next steps

Sources: Own work - Dammerer et al. 2021 (in review)

Use of EoL outflows as secondary resource requires recycling to happen domestically or internationally

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- Does the de-industrializing USA have the capacity to recycle rising waste flows domestically?

	End-of-life waste 2017		Domestic production 2017	Unit
Aluminium:	6.3	>	2.4	Mt/yr
Copper:	2.4	>	1.3	Mt/yr

- → for domestic recycling, the recycling/production capacity within the USA would need to increase

Sources: Own work - Dammerer et al. 2021 (in review)

Summary & Conclusion

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- Material stocks…
  - are responsible for 40% of historical domestic material consumption in USA
  - might require even more materials until 2100 than consumed since 1870

- Future (primary) resource use in the USA could be reduced by…
  - stabilizing material stock levels
  - using waste outflows from stocks as secondary resource (recycling, reuse, …)
  - extending material stock lifetimes (not investigated here)

- In order to achieve that…
  - we need to limit further expansion of material stocks (e.g. ever bigger houses)
  - large recycling industries might need to be established within the USA

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Thanks for listening!

Jan Streeck

Institute of Social Ecology

University of Natural Resources and Life Sciences, Vienna

jan.streeck@boku.ac.at

Watch out for our new paper (coming soon):

Dammerer, Quirin; Streeck, Jan; Wiedenhofer, Dominik; Krausmann, Fridolin (in review): The role of socio-economic material stocks for natural resource use in the United States of America from 1870-2100.

Literature I

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