



Universiteit
Leiden
The Netherlands

Stock-driven scenarios on global material demand: the story of a lifetime

Deetman, S.P.

Citation

Deetman, S. P. (2021, December 8). *Stock-driven scenarios on global material demand: the story of a lifetime*. Retrieved from <https://hdl.handle.net/1887/3245696>

Version: Publisher's Version

License: [Licence agreement concerning inclusion of doctoral thesis in the Institutional Repository of the University of Leiden](#)

Downloaded from: <https://hdl.handle.net/1887/3245696>

Note: To cite this publication please use the final published version (if applicable).

References

- ABA Foundation. 2016. *Motorcoach Census: A study of the size and activity of the motorcoach industry in the United States and Canada in 2014*. https://buses.org/assets/images/uploads/pdf/Motorcoach_Census_2014.pdf.
- Abbott, B.P., J. Chocola, K. Lin, N. Namenko, and J. Caron. 2005. Characterisation of Bonded Wafer for RF Filters with Reduced TCF. *Proceedings of the 2005 IEEE International Ultrasonics Symposium*: 926–929.
- Abd Rashid, A., J. Idris, and S. Yusoff. 2017. Environmental Impact Analysis on Residential Building in Malaysia Using Life Cycle Assessment. *Sustainability*.
- ADB. 2018. *Sustainable Transport Solutions: Low-Carbon Buses in the People's Republic of China*. Asian Development Bank. <https://www.adb.org/publications/sustainable-transport-solutions-peoples-republic-china>.
- Adra, N., J.-L. Michaux, and M. Andre. 2004. *Analysis of the load factor and the empty running rate for road transport. Artemis - assessment and reliability of transport emission models and inventory systems*. <https://pdfs.semanticscholar.org/6a1a/fdfcd6d808c8aa6c199356ed536d22439876.pdf>.
- Aguilar-Hernandez, G.A., C.P. Sigüenza-Sanchez, F. Donati, S. Merciai, J. Schmidt, J.F.D. Rodrigues, and A. Tukker. 2019. The circularity gap of nations: A multiregional analysis of waste generation, recovery, and stock depletion in 2011. *Resources, Conservation and Recycling* 151: 104452. <https://www.sciencedirect.com/science/article/pii/S0921344919303581>.
- Airbus. 2019. *Global market forecast 2019-2038: Cities, Airports & Aircraft*. <https://www.airbus.com/aircraft/market/global-market-forecast.html>.
- Airbus. 2020. Orders and Deliveries: Commercial Aircraft. <https://www.airbus.com/aircraft/market/orders-deliveries.html#past>.
- Airliners.net. 2020. Aircraft technical data & specifications. April 2. <https://www.airliners.net/aircraft-data>.
- Airports Council International. 2019. *Air Cargo Guide*. <https://airportscouncil.org/wp-content/uploads/2020/03/Air-Cargo-Guide.pdf>.
- Aksoezen, M., U. Hassler, and N. Kohler. 2016. *Reconstitution of the dynamics of an urban building stock. Building Research & Information*. Vol. 45. March. <https://doi.org/10.1080/09613218.2016.1152040>.
- Albers, J.P., W.J. Bawiec, L.F. Rooney, G.H. Goudarzi, and G.L. Shaffer. 1977. *Demand and Supply of Nonfuel Minerals and Materials for the United States Energy Industry, 1975-1990*. https://books.google.nl/books?id=vAM_AAAAIAAJ.
- Albertus, P., S. Babinec, S. Litzelman, and A. Newman. 2018. Status and challenges in enabling the lithium metal electrode for high-energy and low-cost rechargeable batteries. *Nature Energy* 3(1): 16–21. <http://www.nature.com/articles/s41560-017-0047-2>.
- Alcamo, J. and T. Henrichs. 2008. Chapter Two Towards Guidelines for Environmental Scenario Analysis. In , 13–35. <https://linkinghub.elsevier.com/retrieve/pii/S1574101X0800402X>.
- Alibaba.com. 2015. Sales details on “WK-159 BTE hearing aid, hearing aid with ear hook.” http://www.alibaba.com/product-detail/WK-159-BTE-hearing-aid-hearing_1131193832.html.
- Alonso, E., A.M. Sherman, T.J. Wallington, M.P. Everson, F.R. Field, R. Roth, and R.E. Kirchain. 2012. Evaluating Rare Earth Element Availability: A Case with Revolutionary Demand from Clean Technologies. *Environmental Science & Technology* 46(6): 3406–3414.

References

- Amecke, H., J. Deason, A. Hobbs, A. Novikova, Y. Xiu, and Z. Shengyuan. 2013. Buildings energy efficiency in China, Germany, and the United States. *San Francisco, USA: Climate Policy Initiative*.
- Andersson, M., M. Ljunggren Söderman, and B.A. Sandén. 2017. Are scarce metals in cars functionally recycled? *Waste Management* 60: 407–416.
<https://linkinghub.elsevier.com/retrieve/pii/S0956053X16303361>.
- Arai, Y., S. Koga, H. Hoshina, S. Yamaguchi, and H. Kondo. 2011. Recycling of Rare Earth Magnet from Used Home Appliances. *Material Cycles and Waste Management Research* 22(1): 41–49.
https://www.jstage.jst.go.jp/article/mcwmr/22/1/22_41/_article.
- Arderne, C., C. Zorn, C. Nicolas, and E.E. Koks. 2020. Predictive mapping of the global power system using open data. *Nature Scientific Data* 7(1): 19. <http://www.nature.com/articles/s41597-019-0347-4>.
- Asif, M., A. Dehwah, F. Ashraf, H. Khan, M. Shaukat, and M. Hassan. 2017. Life Cycle Assessment of a Three-Bedroom House in Saudi Arabia. *Environments* 4(52): 1–13.
- Asif, M.Ä., T. Muneer, and R. Kelley. 2007. Life cycle assessment : A case study of a dwelling home in Scotland 42: 1391–1394.
- Atmaca, A. and N. Atmaca. 2015. Life cycle energy (LCEA) and carbon dioxide emissions (LCCO2A) assessment of two residential buildings in Gaziantep, Turkey. *Energy and Buildings* 102: 417–431.
- Augiseau, V. and S. Barles. 2017. Studying construction materials flows and stock: A review. *Resources, Conservation and Recycling* 123: 153–164.
<http://www.sciencedirect.com/science/article/pii/S092134491630235X>.
- Auping, W.L., E. Pruyt, and J.H. Kwakkel. 2015. Dealing with Multiple Models in System Dynamics. *International Journal of System Dynamics Applications* 3(4): 17–35.
- Australian Government. 2019. Australian Bureau of Statistics. <http://www.abs.gov.au>.
- Axpo. 2018. *Environmental Product declaration Löntsch high head storage power plant*. Baden.
https://www.axpo.com/content/dam/axpo19/ch/files-ch/private/engagement/nature---environment/1912_Axpo_Umweltdeklaration_Loentsch_2019_EN.pdf.
- Aye, L., T. Ngo, R.H. Crawford, R. Gammampila, and P. Mendis. 2011. Life cycle greenhouse gas emissions and energy analysis of prefabricated reusable building modules. *Energy and Buildings* 47: 159–168.
- Azo Materials. 2020. AISI 4340 Alloy Steel (UNS G43400). <https://www.azom.com/article.aspx?ArticleID=6772>. Accessed May 19, 2020.
- Bačkalov, I., M. Kalajžić, N. Momčilović, and A. Simić. 2014. E-Type self-propelled vessel : a novel concept for the Danube E-Type self-propelled vessel : a novel concept for the Danube. In *European Inland Waterway Navigation Conference*, 1–17.
- Balzer, G. and C. Schorn. 2015. *Asset Management for Infrastructure Systems: Energy and Water*. Springer International Publishing. <https://books.google.nl/books?id=4WJ1CQAAQBAJ>.
- Bansal, D., R. Singh, and R.L. Sawhney. 2014. Effect of construction materials on embodied energy and cost of buildings - A case study of residential houses in India up to 60 m2 of plinth area. *Energy and Buildings* 69: 260–266.
- Batteryuniversity.com. 2019a. Types of Lithium-ion.
https://batteryuniversity.com/learn/article/types_of_lithium_ion. Accessed November 25, 2019.
- Batteryuniversity.com. 2019b. Why does Sodium-sulfur need to be heated.
https://batteryuniversity.com/learn/article/bu_210a_why_does_sodium_sulfur_need_to_be_heated. Accessed November 25, 2019.
- Bauer, C. 2007. Teil IX: Holzenergie. In *Sachbilanzen von Energiesystemen: Grundlagen Fur Den Okologischen*

- Vergleich von Energiesystemen Und Den Einbezug von Energiesystemen in Okobilanzen Fur Die Schweiz. Ecoinvent Report No. 6*, ed. by R et al. Dones, 208. Dubendorf, Switzerland: Ecoinvent. <http://www.ecoinvent.org>.
- Baynes, T.M. and D.B. Müller. 2016. A Socio-economic Metabolism Approach to Sustainable Development and Climate Change Mitigation BT - Taking Stock of Industrial Ecology. In , ed. by Roland Clift and Angela Druckman, 117–135. Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-20571-7_6.
- BBF Associates; Kundig, K.J.A. 2011. Market study: Current and projected wind and solar renewable electric generating capacity and resulting copper demand. New York, U.S.A.: Copper Development Association Inc.
- Beers, D. van and T.E. Graedel. 2004. The magnitude and spatial distribution of in-use zinc stocks in Cape Town, South Africa. *African Journal of Environmental Assessment and Management* 9: 18–36.
- Berg, H. and M. Zackrisson. 2019. Perspectives on environmental and cost assessment of lithium metal negative electrodes in electric vehicle traction batteries. *Journal of Power Sources* 415: 83–90. <https://linkinghub.elsevier.com/retrieve/pii/S0378775319300576>.
- Berrill, P., A. Arvesen, Y. Scholz, H.C. Gils, and E.G. Hertwich. 2016. Environmental impacts of high penetration renewable energy scenarios for Europe. *Environmental Research Letters* 11(1): 014012. <https://iopscience.iop.org/article/10.1088/1748-9326/11/1/014012>.
- Bevington, P.R. and D.K. Robinson. 2003. *Data Reduction and Error Analysis for the Physical Sciences*. McGraw-Hill.
- BGS. 2011. BGS. 2011. Tantalum-Niobium. Mineral profile information sheet by the. <https://www.bgs.ac.uk/downloads/start.cfm?id=2033>.
- Bhaduri, A.K., R. Indira, S.K. Albert, B.P.S. Rao, S.C. Jain, and S. Asokkumar. 2004. Selection of hardfacing material for components of the Indian Prototype Fast Breeder Reactor. *Journal of Nuclear Materials* 334(2–3): 109–114. <http://www.sciencedirect.com/science/article/pii/S002231150400488X>.
- Bhochhibhoya, S., M. Zanetti, F. Pierobon, P. Gatto, R.K. Maskey, and R. Cavalli. 2017. The global warming potential of building materials: an application of life cycle analysis in Nepal. *Mountain Research and Development* 37(1): 47–55.
- BIO by Deloitte. 2015. *Study on Data for a Raw Material System Analysis: Roadmap and Test of the Fully Operational MSA for Raw Materials*. <https://www.certifico.com/component/attachments/download/2886>.
- Bisschop, R., O. Willstrand, F. Amon, and M. Rosengren. 2019. *Fire Safety of Lithium-Ion Batteries in Road Vehicles*.
- Blanchard, S. and P. Reppe. 1998. *Life Cycle Analysis of a Residential Home in Michigan*.
- Bleischwitz, R., M. Dittrich, and C. Pierdicca. 2012. Coltan from Central Africa, international trade and implications for any certification. *Resources Policy* 37(1): 19–29. <https://linkinghub.elsevier.com/retrieve/pii/S0301420711000833>.
- Blonsky, M., A. Nagarajan, S. Ghosh, K. McKenna, S. Veda, and B. Kroposki. 2019. Potential Impacts of Transportation and Building Electrification on the Grid: A Review of Electrification Projections and Their Effects on Grid Infrastructure, Operation, and Planning. *Current Sustainable/Renewable Energy Reports* 6(4): 169–176. <https://doi.org/10.1007/s40518-019-00140-5>.
- Bloodworth, A. 2014. Resources: Track flows to manage technology-metal supply. *Nature* 505(7481): 19–20. <http://www.nature.com/articles/505019a>.
- Boeing. 2018. *World air cargo forecast: 2018-2037*.

References

- https://www.boeing.com/resources/boeingdotcom/commercial/about-our-market/cargo-market-detail-wacf/download-report/assets/pdfs/2018_WACF.pdf.
- Boeing. 2020a. *World Air Cargo Forecast 2020–2039*.
http://www.boeing.com/resources/boeingdotcom/market/assets/downloads/2020_WACF_PDF_Download.pdf.
- Boeing. 2020b. Current products & services. April 2. <https://www.boeing.com/commercial/>.
- Boer, E. den, S. Aarnink, F. Kleiner, and J. Pagenkopf. 2013. *Zero emissions trucks: An overview of state-of-the-art technologies and their potential*. Delft.
https://theicct.org/sites/default/files/publications/CE_Delft_4841_Zero_emissions_trucks_Def.pdf.
- Boer, H.S. de and D.P. van Vuuren. 2017. Representation of variable renewable energy sources in TIMER, an aggregated energy system simulation model. *Energy Economics* 64: 600–611.
<https://linkinghub.elsevier.com/retrieve/pii/S0140988316303528>.
- Bonilla-Alicea, R.J., B.C. Watson, Z. Shen, L. Tamayo, and C. Telenko. 2020. Life cycle assessment to quantify the impact of technology improvements in bike-sharing systems. *Journal of Industrial Ecology* 24(1): 138–148. <https://onlinelibrary.wiley.com/doi/abs/10.1111/jiec.12860>.
- Bonou, A., A. Laurent, and S.I. Olsen. 2016. Life cycle assessment of onshore and offshore wind energy-from theory to application. *Applied Energy* 180: 327–337.
<https://linkinghub.elsevier.com/retrieve/pii/S0306261916309990>.
- Bossche, P. Van den, J. Matheys, and J. Van Mierlo. 2010. Battery Environmental Analysis. In *Electric and Hybrid Vehicles*, 347–374. Elsevier. <https://linkinghub.elsevier.com/retrieve/pii/B9780444535658000142>.
- Bostock, M. 2012. Sankey Diagrams. <http://bost.ocks.org/mike/sankey/>.
- Bressand, F., N. Zhou, and J. Lin. 2007. al Energy use in commercial building in China: Current situation and future scenarios. In *2007 ECEEE Summer Study Proceedings*.
- Brininstool, M. 2014. *Minerals Yearbook; Volume I. Metals and Minerals; Copper [advance release]*. Reston, Virginia, United States, Virginia, United States: U.S. Geological Survey.
<https://minerals.usgs.gov/minerals/pubs/commodity/copper/myb1-2014-coppe.pdf>.
- Buchert, M., A. Manhart, D. Bleher, and D. Pingel. 2012. *Recycling critical raw materials from waste electronic equipment*. Freiburg: Öko-institut. <http://gruener-strom.org/oekodoc/1375/2012-010-en.pdf>.
- Bureau of Transportation Statistics. 2017. The Nation’s Freight. April 4.
https://www.bts.gov/archive/publications/freight_in_america/nations_freight.
- Bureau of Transportation Statistics. 2019. Rail Profile. *United States Department of Transportation*.
<https://www.bts.gov/content/rail-profile>.
- Bureau of Transportation Statistics. 2021. U.S. Automobile and Truck Fleets by Use.
<https://www.bts.gov/content/us-automobile-and-truck-fleets-use-thousands>. Accessed May 10, 2021.
- Busch, J., J.K. Steinberger, D.A. Dawson, P. Purnell, and K. Roelich. 2014. Managing Critical Materials with a Technology-Specific Stocks and Flows Model. *Environmental Science & Technology* 48(2): 1298–1305.
<https://pubs.acs.org/doi/10.1021/es404877u>.
- Butler, J.H. and P.D. Hooper. 2019. Chapter 15 - Glass Waste. In , ed. by Trevor M Letcher and Daniel A B T - Waste (Second Edition) Vallero, 307–322. Academic Press.
<http://www.sciencedirect.com/science/article/pii/B9780128150603000153>.
- Buyle, M., A. Audenaert, J. Braet, and W. Debacker. 2015. Towards a More Sustainable Building Stock: Optimizing a Flemish Dwelling Using a Life Cycle Approach. *Buildings* 5: 424–448.
- Buyle, M., J. Braet, and A. Audenaert. 2013. Life cycle assessment in the construction sector: A review.

- Renewable and Sustainable Energy Reviews* 26: 379–388.
<http://www.sciencedirect.com/science/article/pii/S1364032113002876>.
- Buzby, M. 2018. The State of the U.S. Flag Maritime Industry. <https://www.transportation.gov/testimony/state-us-flag-maritime-industry>.
- BYD. 2019. The BYD K7: 1–2. https://en.byd.com/wp-content/uploads/2019/07/4504-byd-transit-cut-sheets_k7-30-lr.pdf.
- California Air Resources Board. 2015. *Technology assessment: Medium- and heavy-duty battery electric trucks and buses*.
https://ww2.arb.ca.gov/sites/default/files/classic//msprog/tech/techreport/bev_tech_report.pdf.
- Cao, Z., L. Shen, A.N. Løvik, D.B. Müller, and G. Liu. 2017. Elaborating the History of Our Cementing Societies: An in-Use Stock Perspective. *Environmental Science & Technology* 51(19): 11468–11475.
<https://doi.org/10.1021/acs.est.7b03077>.
- Cao, Z., L. Shen, S. Zhong, L. Liu, H. Kong, and Y. Sun. 2018. A Probabilistic Dynamic Material Flow Analysis Model for Chinese Urban Housing Stock. *Journal of Industrial Ecology* 22(2): 377–391.
<http://doi.wiley.com/10.1111/jiec.12579>.
- Capellán-Pérez, I., C. de Castro, and L.J. Miguel González. 2019. Dynamic Energy Return on Energy Investment (EROI) and material requirements in scenarios of global transition to renewable energies. *Energy Strategy Reviews* 26: 100399. <https://linkinghub.elsevier.com/retrieve/pii/S2211467X19300926>.
- Capocritti, S., A. Khare, and U. Mildenerger. 2010. Aviation Industry - Mitigating Climate Change Impacts through Technology and Policy. *Journal of Technology Management & Innovation* 5(2): 66–75.
- Carneiro, J.F., C.R. Matos, and S. van Gessel. 2019. Opportunities for large-scale energy storage in geological formations in mainland Portugal. *Renewable and Sustainable Energy Reviews* 99: 201–211.
<http://www.sciencedirect.com/science/article/pii/S1364032118306786>.
- Carre, A. 2011. *A Comparative Life Cycle Assessment of Alternative Constructions of a Typical Australian House Design*. Vol. 61. <https://www.fwpa.com.au/resources/reports/market-access/204-comparative-life-cycle-assessment-of-alternative-constructions-of-a-typical-australian-house-design.html>.
- Carre, A. and E. Crossin. 2015. *A comparative life cycle assessment of two multi storey residential apartment buildings*. <https://www.fwpa.com.au/resources/market-access/756-life-cycle-assessment-of-a-5-storey-residential-building-in-parkville.html>.
- Carver, E. 2016. Recreation GPS Reviews. <http://gps.toptenreviews.com/recreation>.
- Casanova, A.M., B. van Leeuwen, C. Capelle, S. Finn, and S. Guo. 2017. *An Overview of Commercial Aircraft: 2018-2019*. <https://www.dvbbank.com/~media/Files/D/dvbbank-corp/aviation/dvb-overview-of-commercial-aircraft-2018-2019.pdf>.
- CBS. 2019. Verkeersprestaties bussen; kilometers, leeftijdsklasse, grondgebied. April 8.
<https://opendata.cbs.nl/statline/#/CBS/nl/dataset/80589ned/table?fromstatweb>.
- CCNR. 2020. *Inland Navigation in Europe - Annual Report 2019*. https://www.ccr-zkr.org/files/documents/om/om19_II_en.pdf.
- Chancerel, P., M. Marwede, N.F. Nissen, and K.-D. Lang. 2015. Estimating the quantities of critical metals embedded in ICT and consumer equipment. *Resources, Conservation and Recycling* 98: 9–18.
<http://www.sciencedirect.com/science/article/pii/S0921344915000488>.
- Chaneliere, C., J.L. Autran, R.A.B. Devine, and B. Balland. 1998. Tantalum pentoxide (Ta₂O₅) thin films for advanced dielectric applications. *Materials Science and Engineering R22*: 269–322.
[http://ir.hfcas.ac.cn:8080/bitstream/334002/7792/1/Tantalum pentoxide %28Ta₂O₅%29 thin films for advanced dielectric applications.pdf](http://ir.hfcas.ac.cn:8080/bitstream/334002/7792/1/Tantalum%20pentoxide%20thin%20films%20for%20advanced%20dielectric%20applications.pdf).

References

- Chang, Y.-J., E. Schau, and M. Finkbeiner. 2012. Application of Life Cycle Sustainability Assessment to the Bamboo and Aluminum Bicycle in Surveying Social Risks of Developing Countries. In *2nd World Sustainability Forum*. <https://sciforum.net/manuscripts/953/original.pdf>.
- Chatzinikolaou, S.D. and N.P. Ventikos. 2015. Applications of Life Cycle Assessment in Shipping. In *2nd International Symposium on Naval Architecture and Maritime*, 1–9.
- Chatzivasileiadis, S., D. Ernst, and G. Andersson. 2013. The Global Grid. *Renewable Energy* 57: 372–383. <http://www.sciencedirect.com/science/article/pii/S0960148113000700>.
- Chen, C., R. Agrawal, and C. Wang. 2015. High Performance Li₄Ti₅O₁₂/Si Composite Anodes for Li-Ion Batteries. *Nanomaterials* 5(3): 1469–1480. <http://www.mdpi.com/2079-4991/5/3/1469>.
- Chen, T.Y., J. Burnett, and C.K. Chau. 2001. Analysis of embodied energy use in the residential building of Hong Kong. *Energy* 26: 323–340. [https://doi.org/10.1016/%0AS0360-5442\(01\)00006-8](https://doi.org/10.1016/%0AS0360-5442(01)00006-8).
- Chen, W.-Q. and T.E. Graedel. 2015. In-use product stocks link manufactured capital to natural capital. *Proceedings of the National Academy of Sciences* 112(20): 6265–6270. <http://www.pnas.org/lookup/doi/10.1073/pnas.1406866112>.
- Child, M., C. Kemfert, D. Bogdanov, and C. Breyer. 2019. Flexible electricity generation, grid exchange and storage for the transition to a 100% renewable energy system in Europe. *Renewable Energy* 139: 80–101. <http://www.sciencedirect.com/science/article/pii/S0960148119302319>.
- Christian, B., I. Romanova, and L. Turbini. 2012. Elemental Compositions of Over Two Dozen Cell Phones. In *IPC APEX EXPO 2012*. <http://www.smtnet.com/library/files/upload/cell-phones-composition.pdf>.
- Coffey, B., S. Borgeson, S. Selkowitz, J. Apte, P. Mathew, and P. Haves. 2009. Towards a very low-energy building stock: modelling the US commercial building sector to support policy and innovation planning. *Building Research & Information* 37(5–6): 610–624. <https://doi.org/10.1080/09613210903189467>.
- Collins, B. and BloombergNEF. 2019. Innolith Battery Strikes at ‘Flammable’ Lithium-Ion: Q&A. <https://about.bnef.com/blog/innolith-battery-strikes-flammable-lithium-ion-qa/>.
- Condeixa, K., A. Haddad, and D. Boer. 2017. Material flow analysis of the residential building stock at the city of Rio de Janeiro. *Journal of Cleaner Production* 149: 1249–1267. <http://www.sciencedirect.com/science/article/pii/S0959652617302949>.
- Connor, P. 2011. Railway Passenger Vehicle Capacity: An overview of the way railway vehicle capacity has evolved. *Railway Technical Web Pages*. April 4. <http://www.railway-technical.com/books-papers--articles/infopaper-2-railway-passeng.pdf>.
- Crawford, R.H. 2009. Life cycle energy and greenhouse emissions analysis of wind turbines and the effect of size on energy yield. *Renewable and Sustainable Energy Reviews* 13(9): 2653–2660. <https://linkinghub.elsevier.com/retrieve/pii/S1364032109001403>.
- Creutzig, F. 2016. Evolving Narratives of Low-Carbon Futures in Transportation. *Transport Reviews* 36(3): 341–360. <http://www.tandfonline.com/doi/full/10.1080/01441647.2015.1079277>.
- Crock, W.D. 2016. Mapping stocks and flows of neodymium: An assessment of neodymium production and consumption in the Netherlands in 2010 and 2030. TU Delft, Delft University of Technology.
- Cuéllar-Franca, R.M. and A. Azapagic. 2012. Environmental impacts of the UK residential sector: Life cycle assessment of houses. *Building and Environment* 54: 86–99.
- Cuenot, F., L. Fulton, and J. Staub. 2012. The prospect for modal shifts in passenger transport worldwide and impacts on energy use and CO₂. *Energy Policy* 41: 98–106. <https://linkinghub.elsevier.com/retrieve/pii/S0301421510005471>.
- Cullbrand, K. and O. Magnusson. 2012. The use of potentially critical materials in passenger cars. <http://publications.lib.chalmers.se/records/fulltext/162842.pdf>.

- Cullen, J.M. and J.M. Allwood. 2010. The efficient use of energy: Tracing the global flow of energy from fuel to service. *Energy Policy* 38(1): 75–81. <https://linkinghub.elsevier.com/retrieve/pii/S0301421509006429>.
- Cullen, J.M. and J.M. Allwood. 2013. Mapping the Global Flow of Aluminum: From Liquid Aluminum to End-Use Goods. *Environmental Science & Technology* 47(7): 3057–3064. <https://pubs.acs.org/doi/10.1021/es304256s>.
- Cullen, J.M., J.M. Allwood, and M.D. Bambach. 2012. Mapping the Global Flow of Steel : From Steelmaking to End-Use Goods. *Environmental Science & Technology* 46: 13048–13055.
- Cusenza, M.A., S. Bobba, F. Ardente, M. Cellura, and F. Di Persio. 2019. Energy and environmental assessment of a traction lithium-ion battery pack for plug-in hybrid electric vehicles. *Journal of Cleaner Production* 215: 634–649. <https://linkinghub.elsevier.com/retrieve/pii/S0959652619300678>.
- DAF. 2020. Electric & hybrid trucks. April 10. <https://www.daf.com/en/about-daf/innovation/electric-and-hybrid-trucks>.
- Dagnachew, A.G., P.L. Lucas, A.F. Hof, and D.P. van Vuuren. 2018. Trade-offs and synergies between universal electricity access and climate change mitigation in Sub-Saharan Africa. *Energy Policy* 114: 355–366. <https://linkinghub.elsevier.com/retrieve/pii/S0301421517308467>.
- Daigo, I., Y. Igarashi, Y. Matsuno, and Y. Adachi. 2007. Accounting for Steel Stock in Japan. *ISIJ International* 47(7): 1065–1069.
- Daigo, I., K. Iwata, M. Oguchi, and Y. Goto. 2017. Lifetime Distribution of Buildings Decided by Economic Situation at Demolition: D-based Lifetime Distribution. *Procedia CIRP* 61: 146–151. <http://www.sciencedirect.com/science/article/pii/S2212827116313907>.
- Daimler. 2006. 1896: Gottlieb Daimler builds the world’s first truck. April 10. <https://media.daimler.com/marsMediaSite/en/instance/ko.xhtml?oid=9913722>.
- Daimler. 2008. 1898: The world’s first bus series launched by Daimler – a milestone for passenger transport. April 10. <https://media.daimler.com/marsMediaSite/en/instance/ko.xhtml?oid=9913455>.
- Daiglou, V., B.J. van Ruijven, and D.P. van Vuuren. 2012. Model projections for household energy use in developing countries. *Energy* 37(1): 601–615. <http://linkinghub.elsevier.com/retrieve/pii/S0360544211007110>.
- Dakota Lithium. 2019. Safety Data Sheet Lithium Phosphate (LiFePO₄). <https://dakotalithium.com/wp-content/uploads/2019/01/LiFePO4-Safety-Data-Sheet-Lithium-Iron-Phosphate-Batteries.pdf>.
- Davis, J., R. Geyer, J. Ley, J. He, R. Clift, A. Kwan, M. Sansom, and T. Jackson. 2007. Time-dependent material flow analysis of iron and steel in the UK: Part 2. Scrap generation and recycling. *Resources, Conservation and Recycling* 51(1): 118–140. <http://www.sciencedirect.com/science/article/pii/S0921344906001844>.
- Deetman, S., H.S. de Boer, M. Van Engelenburg, E. van der Voet, and D.P. van Vuuren. 2021. Projected material requirements for the global electricity infrastructure – generation, transmission and storage. *Resources, Conservation and Recycling* 164.
- Deetman, S., S. Marinova, E. van der Voet, D.P.D.P. van Vuuren, O. Edelenbosch, and R. Heijungs. 2020. Modelling global material stocks and flows for residential and service sector buildings towards 2050. *Journal of Cleaner Production* 245: 118658. <https://linkinghub.elsevier.com/retrieve/pii/S0959652619335280>.
- Deetman, S., L. van Oers, E. van der Voet, and A. Tukker. 2018a. Deriving European Tantalum Flows Using Trade and Production Statistics. *Journal of Industrial Ecology* 22(1).
- Deetman, S., S. Pauliuk, D.P. Van Vuuren, E. Van Der Voet, and A. Tukker. 2018b. Scenarios for Demand Growth of Metals in Electricity Generation Technologies, Cars, and Electronic Appliances. *Environmental Science and Technology* 52(8): null. <https://doi.org/10.1021/acs.est.7b05549>.

References

- Dellink, R., J. Chateau, E. Lanzi, and B. Magné. 2017. Long-term economic growth projections in the Shared Socioeconomic Pathways. *Global Environmental Change* 42: 200–214. <http://www.sciencedirect.com/science/article/pii/S0959378015000837>.
- Deng, Y., J. Li, T. Li, X. Gao, and C. Yuan. 2017. Life cycle assessment of lithium sulfur battery for electric vehicles. *Journal of Power Sources* 343: 284–295. <https://linkinghub.elsevier.com/retrieve/pii/S0378775317300368>.
- Deng, Y.Y., K. Blok, and K. van der Leun. 2012. Transition to a fully sustainable global energy system. *Energy Strategy Reviews* 1(2): 109–121. <http://www.sciencedirect.com/science/article/pii/S2211467X12000314>.
- Department for Transport. 2018. *Rail Factsheet*. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/761352/rail-factsheet-2018.pdf.
- Dericks, G., R. Potts, and B. Caldecott. 2018. *Stranded Property Assets in China's Resource-based Cities: implications for financial stability?* Oxford. <https://www.smithschool.ox.ac.uk/research/sustainable-finance/publications/Stranded-Property-Assets-in-Chinas-Resource-based-Cities-Working-Paper.pdf>.
- Deutsche Bahn. 2019. *Deutsche Bahn Facts & Figures 2018*. https://www.deutschebahn.com/resource/blob/4045134/f9331633c8a19470629f9e3aa6d5fe8c/19-03_facts_and_figures-data.pdf.
- Dick, C.T., I. Atanassov, F.B. Kippen III, and D. Mussanov. 2019. Relative train length and the infrastructure required to mitigate delays from operating combinations of normal and over-length freight trains on single-track railway lines in North America. *Proceedings of the Institute of Mechanical Engineers, Part F: Journal of Rail and Rapid Transit* 233(7): 731–742.
- Dinu, O. and A.M. Ilie. 2015. Maritime vessel obsolescence, life cycle cost and design service life. *IOP Conference Series: Material Science and Engineering* 95: 1–7.
- Dobruszkes, F. 2011. High-speed rail and air transport competition in Western Europe: A supply-oriented perspective. *Transport Policy*. <https://linkinghub.elsevier.com/retrieve/pii/S0967070X11000837>.
- Dodd-Frank. 2010. Dodd-Frank Wall Street Reform and Consumer Protection Act. Washington D.C.: 111th Congress of the United States of America. www.sec.gov/about/laws/wallstreetreform-cpa.pdf.
- Doelman, J.C., E. Stehfest, A. Tabeau, H. van Meijl, L. Lassaletta, D.E.H.J. Gernaat, K. Neumann-Hermans, et al. 2018. Exploring SSP land-use dynamics using the IMAGE model: Regional and gridded scenarios of land-use change and land-based climate change mitigation. *Global Environmental Change* 48(December 2016): 119–135.
- Domingo, S.N., R.M. Briones, and D. Gundaya. 2015. *Diagnostic Report on the Bus Transport Sector. PIDS Discussion Paper Series*. <https://pidswebs.pids.gov.ph/webportal/CDN/PUBLICATIONS/pidsdps1502.pdf>.
- Donati, F., G.A. Aguilar-Hernandez, C.P. Sigüenza-Sánchez, A. de Koning, J.F.D. Rodrigues, and A. Tukker. 2020. Modeling the circular economy in environmentally extended input-output tables: Methods, software and case study. *Resources, Conservation and Recycling* 152: 104508. <https://www.sciencedirect.com/science/article/pii/S0921344919304148>.
- Dones, R. 2007. Teil VII: Kernenergie. In *Sachbilanzen von Energiesystemen: Grundlagen Fur Den Okologischen Vergleich von Energiesystemen Und Den Einbezug von Energiesystemen in Okobilanzen Fur Die Schweiz. Ecoinvent Report No. 6*, ed. by R et al. Dones, 208. Dubendorf, Switzerland: Ecoinvent. <http://www.ecoinvent.org>.
- Dones, R., C. Bauer, R. Bolliger, B. Burger, M. Faist Emmenegger, R. Frischknecht, T. Heck, N. Jungblut, A. Roder, and M. Tuchs Schmid. 2007a. *Sachbilanzen von Energiesystemen; Ecoinvent V2.0 report no. 6*. Dubendorf, Switzerland. [ecoinvent.org](http://www.ecoinvent.org).

- Dones, R., C. Bauer, and A. Roder. 2007b. Teil VI: Kohle. In *Sachbilanzen von Energiesystemen: Grundlagen Fur Den Okologischen Vergleich von Energiesystemen Und Den Einbezug von Energiesystemen in Okobilanzen Fur Die Schweiz. Ecoinvent Report No. 6*, ed. by R et al. Dones, 208. Dubendorf, Switzerland: Ecoinvent. <http://www.ecoinvent.org>.
- Doomernik, J.E. 2015. Performance and efficiency of High-speed Rail systems. *Transportation Research Procedia* 8: 136–144. <https://doi.org/10.1016/j.trpro.2015.06.049>.
- Duan, H., J. Wang, and Q. Huang. 2015. Encouraging the environmentally sound management of C&D waste in China: An integrative review and research agenda. *Renewable and Sustainable Energy Reviews* 43: 611–620. <http://www.sciencedirect.com/science/article/pii/S1364032114010089>.
- Dun, C., G. Horton, and S. Kollamthodi. 2015. *Improvements to the definition of lifetime mileage of light duty vehicles*.
- EBRD. 2016. *The EBRD 's projects in the Russian railway sector*. <http://www.oecd.org/derec/ebrd/EBRD-EVD-Russian-rail-sector.pdf>.
- Ebusco. 2020. *ebusco 2.2: made to move people*. <https://www.ebusco.com/wp-content/uploads/Ebusco-brochure-2020.pdf>.
- EC. 2014. *Report on the critical raw materials for the EU. European Commission Report of the Ad hoc Working Group on defining critical raw materials*. Brussels. <http://ec.europa.eu/DocsRoom/documents/10010/attachments/1/translations/en/renditions/native>.
- Ecoinvent. 2007. *Life Cycle inventories of electric and Electronic Equipment: Production, Use and Disposal*. St. Gallen/Dübbendorf.
- Edelenbosch, O.Y., D.L. McCollum, D.P. van Vuuren, C. Bertram, S. Carrara, H. Daly, S. Fujimori, et al. 2017. Decomposing passenger transport futures: Comparing results of global integrated assessment models. *Transportation Research Part D: Transport and Environment* 55: 281–293. <https://linkinghub.elsevier.com/retrieve/pii/S1361920916301304>.
- EERE. 2008. *Furnace fan lifetime determination. Appendix 8-E of the preliminary technical support document on standards for furnace fans of the Department of Energy of the United States*. www.eere.energy.gov/buildings/appliance_standards/pdfs/ff_prelim_app_08_e_lifetime_2012_06_22.pdf.
- Ehtiwesh, I.A.S., M.C. Coelho, and A.C.M. Sousa. 2016. Exergetic and environmental life cycle assessment analysis of concentrated solar power plants. *Renewable and Sustainable Energy Reviews* 56: 145–155. <https://linkinghub.elsevier.com/retrieve/pii/S1364032115013337>.
- Elhacham, E., L. Ben-Uri, J. Grozovski, Y.M. Bar-On, and R. Milo. 2020. Global human-made mass exceeds all living biomass. *Nature* 588(7838): 442–444. <http://www.nature.com/articles/s41586-020-3010-5>.
- Eller, A., I. McClanney, and De. Gauntlett. 2018. *North American Energy Storage Copper Content Analysis*. https://www.copper.org/publications/pub_list/pdf/a6196-na-energy-storage-analysis.pdf.
- Elshkaki, A. and T.E. Graedel. 2013. Dynamic analysis of the global metals flows and stocks in electricity generation technologies. *Journal of Cleaner Production* 59: 260–273. <http://www.sciencedirect.com/science/article/pii/S0959652613004575>.
- Elshkaki, A., T.E. Graedel, L. Ciacci, and B.K. Reck. 2016. Copper demand, supply, and associated energy use to 2050. *Global Environmental Change* 39: 305–315. <http://linkinghub.elsevier.com/retrieve/pii/S0959378016300802>.
- Elshkaki, A., T.E. Graedel, L. Ciacci, and B.K. Reck. 2018. Resource Demand Scenarios for the Major Metals. *Environmental Science & Technology* 52(5): 2491–2497. <https://pubs.acs.org/doi/10.1021/acs.est.7b05154>.

References

- Elshkaki, A. and L. Shen. 2019. Energy-material nexus: The impacts of national and international energy scenarios on critical metals use in China up to 2050 and their global implications. *Energy* 180: 903–917. <https://linkinghub.elsevier.com/retrieve/pii/S0360544219310382>.
- Elwert, T., D. Goldmann, F. Römer, M. Buchert, C. Merz, D. Schueler, and J. Sutter. 2015. Current Developments and Challenges in the Recycling of Key Components of (Hybrid) Electric Vehicles. *Recycling* 1(1): 25–60. <http://www.mdpi.com/2313-4321/1/1/25>.
- Energinet. 2015. *Technical Project Description for Offshore Wind Farms (200 MW)*. Fredericia. https://mst.dk/media/134813/offshore-technical-project-description-generic_vesterhav-syd_april-2015.pdf.
- Energy Information Administration. 2019. Residential Energy Consumption Survey (RECS). <https://www.eia.gov/consumption/residential/index.php>.
- Energy, U.S.D. of. 2018. Average annual vehicle miles traveled by major vehicle categories. April 8. <https://afdc.energy.gov/data/10309>.
- Equasis. *The world merchant fleet in 2005-2018*. April. <http://www.equasis.org/EquasisWeb/public/PublicStatistic?fs=HomePage>.
- Equasis. 2019. *The World Merchant Fleet in 2018: Statistics from Equasis*. [http://www.equasis.org/Fichiers/Statistique/MOA/Documents/available on statistics of Equasis/Equasis Statistics - The world fleet 2018.pdf](http://www.equasis.org/Fichiers/Statistique/MOA/Documents/available%20on%20statistics%20of%20Equasis/Equasis%20Statistics%20-%20The%20world%20fleet%202018.pdf).
- Espinoza, L.A.T. 2012a. Case study: Tantalum in the world economy: History, uses and demand. http://www.polinares.eu/docs/d2-1/polinares_wp2_chapter16.pdf.
- Espinoza, L.A.T. 2012b. The contribution of recycling to the supply of metals and minerals. *POLINARES Working Paper n. 20*. European Commission under grant agreement number 224516 (Polinares). <http://pratclif.com/2015/mines-ressources/polinares/chapter8.pdf>.
- EStat Japan. 2015. 2015 Population Census, Basic Complete Tabulation on Population and Households Japan. https://www.e-stat.go.jp/en/stat-search/files?page=1&layout=datalist&toukei=00200521&tstat=000001080615&cycle=0&tclass1=000001089055&tclass2=000001089056&stat_infid=000031473242.
- EU. 2012. Directive 2012/19/EU of the European Parliament and of the Council on waste electrical and electronic equipment (WEEE). *Official Journal of the European Union, July 24th 2012, Page 3*. <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32012L0019&from=EN>.
- EU. 2014. *Assessment of due diligence compliance cost, benefit and related effects on selected operators in relation to the responsible sourcing of selected minerals*. <https://op.europa.eu/nl/publication-detail/-/publication/dced6d04-92fb-4a20-a499-4dad9974aee7>.
- Eurelectric. 2013. *Power Distribution in Europe - Facts & Figures*. Brussels, Belgium. https://www.eurelectric.org/media/1835/dso_report-web_final-2013-030-0764-01-e.pdf.
- European Commission. 2014. *Report on Critical Raw Materials for the EU; Critical Raw Materials Profiles*. Brussels. <http://ec.europa.eu/docsroom/documents/11911/attachments/1/translations/en/renditions/native>.
- European Commission. 2017. Communication From the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the 2017 list of Critical Raw Materials for the EU. Brussels, Belgium. <http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=COM:2017:0490:FIN>.
- Eurostat. 2010. *Nota Bene For Intrastat Net Mass Since 2006*. [http://epp.eurostat.ec.europa.eu/newxtweb/downloadobject.do?keepsessionkey=true&filenameOut=N OTA BENE FOR INTRASTAT NET MASS SINCE](http://epp.eurostat.ec.europa.eu/newxtweb/downloadobject.do?keepsessionkey=true&filenameOut=N%20OTA%20BENE%20FOR%20INTRASTAT%20NET%20MASS%20SINCE)

- 2006.zip&mimeType=application/zip&objectID=632&objectType=LOB&disposition=attachment.
- Eurostat. 2015. Waste Electrical and Electronic Equipment (WEEE). appliances. <http://tinyurl.com/q53qvax>.
- Eurostat. 2016. Europroms database of trade and production statistics. http://ec.europa.eu/eurostat/c/portal/layout?p_l_id=121328&p_v_l_s_g_id=0.
- Eurostat. 2019. Eurostat database. <https://ec.europa.eu/eurostat/data/database>.
- Eurostat. 2020. Passenger railway vehicles, by type of vehicle. April 3. https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=rail_eq_pa_nty&lang=en.
- Evangelista, P.P.A., A. Kiperstok, E.A. Torres, and J.P. Gonçalves. 2018. Environmental performance analysis of residential buildings in Brazil using life cycle assessment (LCA). *Construction and Building Materials*.
- Exter, P. van, S. Bosch, B. Schipper, B. Sprecher, and R. Kleijn. 2018. *Metal Demand for Renewable Electricity Generation in the Netherlands - Navigating a Complex Supply Chain*. <https://www.copper8.com/wp-content/uploads/2018/12/Metal-Demand-for-renewable-electricity-generation-in-the-Netherlands.pdf>.
- Ezema, I.C., O.I. Fagbenle, and A.O. Olotuah. 2015. Estimating embodied energy in residential buildings in a nigerian context. *International Journal of Applied Engineering Research* 10(24): 44140–44149.
- Faist-Emmenegger, M., T. Heck, N. Jungbluth, and M. Tuchschnid. 2007. Teil V: Erdgas. In *Sachbilanzen von Energiesystemen: Grundlagen Fur Den Okologischen Vergleich von Energiesystemen Und Den Einbezug von Energiesystemen in Okobilanzen Fur Die Schweiz. Ecoinvent Report No. 6*, ed. by R. et al. Dones, 208. Dubendorf, Switzerland: Ecoinvent. www.ecoinvent.org.
- Fan, L., S. Zhang, and J. Yin. 2018. Structural Analysis of Shipping Fleet Capacity. *Journal of Advanced Transportation*: 1–11.
- Fava-Verde, J.-F. 2018. Victorian Telegrams: The Early Development of the Telegraphic Despatch and its Early Interplay With the Letter Post. *Notes and Records* 72(3): 275–292.
- Fay, R., G. Treloar, and U. Iyer-Raniga. 2000. Life-cycle energy analysis of buildings: A case study. *Building Research and Information* 28(1): 31–41.
- Federal Highway Administration. 2010. *Vehicle Travel By Selected Country (Metric)*. <https://www.fhwa.dot.gov/policyinformation/statistics/2008/pdf/in5.pdf>.
- Federal Highway Administration. 2020. *Annual Vehicle Distance Traveled In Miles and Related Date - 2018 By Highway Category and Vehicle Type*. <https://www.fhwa.dot.gov/policyinformation/statistics/2018/pdf/vm1.pdf>.
- Fishedick, M., J. Roy, and A. Others. 2014. Industry. In *Climate Change 2014 Mitigation of Climate Change - Working Group III Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, ed. by Ottmar Edenhofer, Ramón Pichs-Madruga, Youba Sokona, and And Others. New York: Cambridge University Press. https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_chapter10.pdf.
- Fishman, T., N. Heeren, S. Pauliuk, P. Berrill, Q. Tu, P. Wolfram, and E.G. Hertwich. 2021. A comprehensive set of global scenarios of housing, mobility, and material efficiency for material cycles and energy systems modeling. *Journal of Industrial Ecology*: jiec.13122. <https://onlinelibrary.wiley.com/doi/10.1111/jiec.13122>.
- Fishman, T., H. Schandl, and H. Tanikawa. 2016. Stochastic Analysis and Forecasts of the Patterns of Speed, Acceleration, and Levels of Material Stock Accumulation in Society. *Environmental Science & Technology* 50(7): 3729–3737. <https://doi.org/10.1021/acs.est.5b05790>.
- Flury, K. and R. Frischknecht. 2012. Life cycle inventories of hydroelectric power generation. *ESU-Services, Fair Consulting in Sustainability, Commissioned By€ Oko-Institute EV*: 1–51.

References

- Ford. 2019a. New transit minibus Ford: 1–12. https://www.ford.co.uk/content/dam/guxeu/uk/documents/feature-pdfs/FT-new_transit_minibus.pdf.
- Ford. 2019b. New Ford transit and Tourneo custom plug-in hybrids deliver zero emission driving with no range anxiety. April 10. <https://media.ford.com/content/fordmedia/feu/en/news/2019/09/23/New-Ford-Transit-and-Tourneo-Custom-Plug-In-Hybrids-Deliver-Zero-Emission-Driving.html>.
- Furtado, F.M.B.A. 2013. U . S . and European Freight Railways : The Differences That Matter. *Journal of the Transportation Research Forum* 52(2): 65–84. https://trforum.org/wp-content/uploads/2017/04/2013v52n2_04_FreightRailways.pdf.
- Gallagher, K.G., S. Goebel, T. Greszler, M. Mathias, W. Oelerich, D. Eroglu, and V. Srinivasan. 2014. Quantifying the promise of lithium–air batteries for electric vehicles. *Energy & Environmental Science* 7(5): 1555. <http://xlink.rsc.org/?DOI=c3ee43870h>.
- Gallaud, D. and B. Laperche. 2016. *Circular Economy, Industrial Ecology and Short Supply Chain*. Hoboken, NJ, USA: John Wiley & Sons, Inc., May 27. <http://doi.wiley.com/10.1002/9781119307457>.
- Gallo, J.-B., T. Bloch-Rubin, and J. Tomić. 2014. *Peak Demand Charges and Electric Transit Buses*. <https://calstart.org/wp-content/uploads/2018/10/Peak-Demand-Charges-and-Electric-Transit-Buses.pdf>.
- Gallo, J. 2016. Electric Truck & Bus Grid Integration, Opportunities, Challenges & Recommendations. *World Electric Vehicle Journal* 8: 45–56.
- Gao, Z., Z. Lin, T.J. Laclair, C. Liu, J. Li, A.K. Birky, and J. Ward. 2017. Battery capacity and recharging needs for electric buses in city transit service. *Energy* 122: 588–600.
- Gardiner, M.R. 2014. Hydrogen for Energy Storage. *Presentation*. <https://www.h2fc-fair.com/hm14/images/tech-forum-presentations/2014-04-09-1700.pdf>.
- Gerssen-Gondelach, S.J. and A.P.C. Faaij. 2012. Performance of batteries for electric vehicles on short and longer term. *Journal of Power Sources* 212: 111–129. <https://linkinghub.elsevier.com/retrieve/pii/S0378775312007069>.
- Ghisellini, P., C. Cialani, and S. Ulgiati. 2016. A review on circular economy: the expected transition to a balanced interplay of environmental and economic systems. *Journal of Cleaner Production* 114: 11–32. <http://www.sciencedirect.com/science/article/pii/S0959652615012287>.
- Giljum, S., H. Wieland, S. Lutter, M. Bruckner, R. Wood, A. Tukker, and K. Stadler. 2016. Identifying priority areas for European resource policies: a MRIO-based material footprint assessment. *Journal of Economic Structures* 5(1): 17. <http://journalofeconomicstructures.springeropen.com/articles/10.1186/s40008-016-0048-5>.
- Girod, B., D.P. van Vuuren, and S. Deetman. 2012. Global travel within the 2 degree climate target. *Energy Policy* 45(1): 152–166. <https://doi.org/10.1016/j.enpol.2012.02.008>.
- Glöser, S., M. Soulier, and L.A. Tercero Espinoza. 2013. Dynamic Analysis of Global Copper Flows. Global Stocks, Postconsumer Material Flows, Recycling Indicators, and Uncertainty Evaluation. *Environmental Science & Technology* 47(12): 6564–6572. <https://pubs.acs.org/doi/10.1021/es400069b>.
- Gnann, T., M. Haag, P. Plötz, and M. Wietschel. 2013. Market potential for electric vehicles in the German commercial passenger transport sector. *World Electric Vehicle Journal* 6: 976–985.
- Goel, R., S.K. Guttikunda, D. Mohan, and G. Tiwari. 2015. Benchmarking vehicle and passenger travel characteristics in Delhi for on-road emissions analysis. *Travel Behaviour and Society* 2(2): 88–101. <https://linkinghub.elsevier.com/retrieve/pii/S2214367X14000416>.
- Gómez Vilchez, J.J. and P. Jochem. 2020. Powertrain technologies and their impact on greenhouse gas emissions in key car markets. *Transportation Research Part D: Transport and Environment* 80: 102214.

- <https://linkinghub.elsevier.com/retrieve/pii/S1361920919309344>.
- Gontia, P., C. Nägeli, L. Rosado, Y. Kalmykova, and M. Österbring. 2018. Material-intensity database of residential buildings: A case-study of Sweden in the international context. *Resources, Conservation and Recycling* 130(November 2017): 228–239.
- Graedel, T.E. 2019. Material Flow Analysis from Origin to Evolution. *Environmental Science & Technology* 53(21): 12188–12196. <https://pubs.acs.org/doi/10.1021/acs.est.9b03413>.
- Graedel, T.E., J. Allwood, J.-P. Birat, M. Buchert, C. Hagelüken, B.K. Reck, S.F. Sibley, and G. Sonnemann. 2011. What Do We Know About Metal Recycling Rates? *Journal of Industrial Ecology* 15(3): 355–366. <http://doi.wiley.com/10.1111/j.1530-9290.2011.00342.x>.
- Graedel, T.E., R. Barr, C. Chandler, T. Chase, J. Choi, L. Christoffersen, E. Friedlander, C. Henly, C. Jun, and N.T. Nassar. 2012. Methodology of metal criticality determination. *Environmental Science & Technology* 46(2): 1063–1070.
- Graedel, T.E., E.M. Harper, N.T. Nassar, and B.K. Reck. 2015. On the materials basis of modern society. *Proceedings of the National Academy of Sciences* 112(20): 6295–6300. <http://www.pnas.org/lookup/doi/10.1073/pnas.1312752110>.
- Gruhler, K. and C. Deilmannl. 2017. Materialaufwand von Nichtwohngebäuden – Teil II. In . Stuttgart: Fraunhofer IRB Verlag.
- GSM Association. 2006. *Mobile Phone Lifecycles, Use, Take-back, Reuse and Recycle. Report of the GSM Association*. <http://www.gsma.com/publicpolicy/wp-content/uploads/2012/03/environmobilelifecycles.pdf>.
- Guezuraga, B., R. Zauner, and W. Pölz. 2012. Life cycle assessment of two different 2 MW class wind turbines. *Renewable Energy* 37(1): 37–44. <https://linkinghub.elsevier.com/retrieve/pii/S0960148111002254>.
- Gür, T.M. 2018. Review of electrical energy storage technologies, materials and systems: challenges and prospects for large-scale grid storage. *Energy & Environmental Science* 11(10): 2696–2767. <http://xlink.rsc.org/?DOI=C8EE01419A>.
- Gutowski, T.G., S. Sahni, J.M. Allwood, M.F. Ashby, and E. Worrell. 2013. The energy required to produce materials: constraints on energy-intensity improvements, parameters of demand. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences* 371(1986): 20120003.
- Guyonnet, D., M. Planchon, A. Rollat, V. Escalon, J. Tuduri, N. Charles, S. Vaxelaire, D. Dubois, and H. Fargier. 2015. Material flow analysis applied to rare earth elements in Europe. *Journal of Cleaner Production* 107: 215–228. <https://linkinghub.elsevier.com/retrieve/pii/S0959652615004989>.
- Haapala, K.R. and P. Prempreeda. 2014. Comparative life cycle assessment of 2.0 MW wind turbines. *International Journal of Sustainable Manufacturing* 3(2): 170. <http://www.inderscience.com/link.php?id=62496>.
- Haas, W., F. Krausmann, D. Wiedenhofer, and M. Heinz. 2015. How Circular is the Global Economy?: An Assessment of Material Flows, Waste Production, and Recycling in the European Union and the World in 2005. *Journal of Industrial Ecology* 19(5): 765–777. <https://onlinelibrary.wiley.com/doi/10.1111/jiec.12244>.
- Haberl, H., D. Wiedenhofer, K.H. Erb, C. Gorg, and F. Krausmann. 2017. The Material Stock–Flow–Service Nexus: A New Approach for Tackling the Decoupling Conundrum. *Sustainability* 9(7): 1049. <http://www.mdpi.com/2071-1050/9/7/1049>.
- Habib, K. 2015. Critical Ressources in Clean Energy Technologies and Waste Flows. Syddansk Universitet.
- Habib, K., S.T. Hansdóttir, and H. Habib. 2020. Critical metals for electromobility: Global demand scenarios for

References

- passenger vehicles, 2015–2050. *Resources, Conservation and Recycling* 154: 104603. <https://linkinghub.elsevier.com/retrieve/pii/S0921344919305099>.
- Haddad, S.A.P. and W.A. Serdijn. 2009. The Evolution of Pacemakers: An Electronics Perspective. In *Ultra Low-Power Biomedical Signal Processing*. Dordrecht: Springer Netherlands. <http://link.springer.com/10.1007/978-1-4020-9073-8>.
- Hanandeh, A. El. 2015. Environmental assessment of popular single-family house construction alternatives in Jordan. *Building and Environment* 92: 192–199.
- Harmsen, J.H.M., A.L. Roes, and M.K. Patel. 2013. The impact of copper scarcity on the efficiency of 2050 global renewable energy scenarios. *Energy* 50: 62–73. <https://linkinghub.elsevier.com/retrieve/pii/S0360544212009139>.
- Harrison, G.P., E. (Ned) J. Maclean, S. Karamanlis, and L.F. Ochoa. 2010. Life cycle assessment of the transmission network in Great Britain. *Energy Policy* 38(7): 3622–3631. <https://linkinghub.elsevier.com/retrieve/pii/S0301421510001205>.
- Hashimoto, S. and Y. Moriguchi. 2013. Resource management for carbon management: a literature review. *Global Environmental Research* 17: 39–46. www.airies.or.jp/attach.php/6a6f75726e616c5f31372d31656e67/save/0/0/17_1-6.pdf.
- Hashimoto, S., H. Tanikawa, and Y. Moriguchi. 2007. Where will large amounts of materials accumulated within the economy go? - A material flow analysis of construction minerals for Japan. *Waste Management*.
- Hatayama, H., I. Daigo, Y. Matsuno, and Y. Adachi. 2009. Assessment of the Recycling Potential of Aluminum in Japan, the United States, Europe and China. *MATERIALS TRANSACTIONS* 50(3): 650–656.
- Hatayama, H., I. Daigo, Y. Matsuno, and Y. Adachi. 2010. Outlook of the world steel cycle based on the stock and flow dynamics. *Environmental Science & Technology* 44(16): 6457–6463.
- Hausfather, Z. and G.P. Peters. 2020. Emissions – the ‘business as usual’ story is misleading. *Nature* 577(7792): 618–620. <http://www.nature.com/articles/d41586-020-00177-3>.
- Hawkins, T.R., B. Singh, G. Majeau-Bettez, A.H. Strømman, G. Majeau-Bettez, and A.H. Strømman. 2013. Comparative Environmental Life Cycle Assessment of Conventional and Electric Vehicles. *Journal of Industrial Ecology* 17(1): 53–64. <https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1530-9290.2012.00532.x>.
- HCSS. 2013. *Coltan, Congo & Conflict*. www.hcss.nl/sites/default/files/files/reports/HCSS_21_05_13_Coltan_Congo_Conflict_%0Aweb.pdf.
- Heeren, N. and T. Fishman. 2019. A database seed for a community-driven material intensity research platform. *Scientific Data* 6(1): 23. <http://www.nature.com/articles/s41597-019-0021-x>.
- Heeren, N. and S. Hellweg. 2019. Tracking Construction Material over Space and Time: Prospective and Geo-referenced Modeling of Building Stocks and Construction Material Flows. *Journal of Industrial Ecology* 23(1): 253–267. <https://onlinelibrary.wiley.com/doi/abs/10.1111/jiec.12739>.
- Heeren, N., C.L. Mutel, B. Steubing, Y. Ostermeyer, H. Wallbaum, and S. Hellweg. 2015. Environmental Impact of Buildings—What Matters? *Environmental Science & Technology* 49(16): 9832–9841. <https://doi.org/10.1021/acs.est.5b01735>.
- Henckens, M., P.P.J. Driessen, and E. Worrell. 2014. Metal scarcity and sustainability, analyzing the necessity to reduce the extraction of scarce metals. *Resources, Conservation and Recycling* 93: 1–8. <http://linkinghub.elsevier.com/retrieve/pii/S092134491400202X>.
- Henry, A., N. Elambo, T. J.H.M., O. Fabrice, and M. Blanche. 2014. Embodied Energy and CO2 Analyses of Mud-brick and Cement-block Houses. *AIMS Energy* 2(1): 18–40.

- Hertwich, E., R. Lifset, S. Pauliuk, and N. Heeren. 2020. *Resource Efficiency and Climate Change: Material Efficiency Strategies for a Low-Carbon Future*. Nairobi, Kenya. <https://www.resourcepanel.org/reports/resource-efficiency-and-climate-change>.
- Hertwich, E.G. 2021. Increased carbon footprint of materials production driven by rise in investments. *Nature Geoscience* 14(3): 151–155. <http://www.nature.com/articles/s41561-021-00690-8>.
- Hertwich, E.G., S. Ali, L. Ciacci, T. Fishman, N. Heeren, E. Masanet, F.N. Asghari, et al. 2019. Material efficiency strategies to reducing greenhouse gas emissions associated with buildings, vehicles, and electronics—a review. *Environmental Research Letters* 14(4): 043004. <https://iopscience.iop.org/article/10.1088/1748-9326/ab0fe3>.
- Hertwich, E.G., T. Gibon, E.A. Bouman, A. Arvesen, S. Suh, G.A. Heath, J.D. Bergesen, A. Ramirez, M.I. Vega, and L. Shi. 2015. Integrated life-cycle assessment of electricity-supply scenarios confirms global environmental benefit of low-carbon technologies. *Proceedings of the National Academy of Sciences* 112(20): 6277–6282. <http://www.pnas.org/lookup/doi/10.1073/pnas.1312753111>.
- Hill, N., J. Norris, F. Kirsch, C. (Ricardo-A. Dun, N. (Ricardo U. McGregor, E. (TRT) Pastori, and I. (TEPR) Skinner. 2015. *Light weighting as a means of improving Heavy Duty Vehicles' energy efficiency and overall CO2 emissions*. https://ec.europa.eu/clima/sites/clima/files/transport/vehicles/heavy/docs/hdv_lightweighting_en.pdf.
- Hitachi. 2007. Apparatus, system, and method for the selection of perpendicular media segregant materials. <http://www.google.com/patents/US7879470>.
- Hong, L., N. Zhou, W. Feng, N. Khanna, D. Fridley, Y. Zhao, and K. Sandholt. 2016. Building stock dynamics and its impacts on materials and energy demand in China. *Energy Policy* 94: 47–55.
- Howe, S., A.J. Kolios, and F.P. Brennan. 2013. Environmental life cycle assessment of commercial passenger jet airliners. *Transportation Research Part D: Transport and Environment* 19: 34–41.
- Hu, M., S. Pauliuk, T. Wang, G. Huppel, E. van der Voet, and D.B. Müller. 2010. Iron and steel in Chinese residential buildings: A dynamic analysis. *Resources, Conservation and Recycling* 54(9): 591–600. <https://linkinghub.elsevier.com/retrieve/pii/S0921344909002407>.
- Huang, T., F. Shi, H. Tanikawa, J. Fei, and J. Han. 2013. Materials demand and environmental impact of buildings construction and demolition in China based on dynamic material flow analysis. *Resources, Conservation and Recycling* 72: 91–101. <https://linkinghub.elsevier.com/retrieve/pii/S0921344912002273>.
- Huo, H., Q. Zhang, K. He, Z. Yao, and M. Wang. 2012. Vehicle-use intensity in China: Current status and future trend. *Energy Policy* 43: 6–16.
- IATA. 2016. *Airline Disclosure Guide Aircraft acquisition cost and depreciation*. <https://www.iata.org/contentassets/4a4b100c43794398baf73dcea6b5ad42/airline-disclosure-guide-aircraft-acquisition.pdf>.
- IATA. 2018. *Best Industry Practices for Aircraft Decommissioning (BIPAD)*. <https://www.iata.org/contentassets/ffbed17ac843465aad778867cb23c45c/bipad.pdf>.
- IATA. 2019. *World Air Transport Statistics 2019*. <https://www.iata.org/en/publications/store/world-air-transport-statistics>.
- IEA. 2012. Commercial Buildings Energy Consumption Survey (CBECS). <https://www.eia.gov/consumption/commercial/>.
- IEA. 2015. Residential Energy Consumption Survey (RECS). <https://www.eia.gov/consumption/residential/>.
- IEA. 2017a. *Tracking Clean Energy Progress 2017*. Paris. <https://www.iea.org/reports/tracking-clean-energy-progress-2017>.

References

- IEA. 2017b. *The Future of Trucks – Implications for Energy and the Environment*. <https://www.iea.org/reports/the-future-of-trucks>.
- IEA. 2019a. *World Energy Balances 2019*. Paris. <https://www.iea.org/reports/world-energy-balances-2019>.
- IEA. 2019b. *The Future of Rail: Opportunities for energy and the environment*. <https://www.iea.org/reports/the-future-of-rail>.
- IEA. 2020. *Iron and Steel Technology Roadmap*. Paris. <https://www.iea.org/reports/iron-and-steel-technology-roadmap>.
- IHS Maritime & Trade. 2019. *World Fleet Statistics 2018*. London. <https://cdn.ihs.com/www/prot/pdf/0719/WorldFleetStatistics2018Report-LoRes.pdf>.
- International Aluminium Institute. 2017. *Aluminium Global Flow Model 2017*. London, UK: world-aluminium.org. https://www.world-aluminium.org/media/filer_public/2019/03/08/2017.xlsx.
- International Copper Association. 2020. *Global 2020 Semis And End Use Dataset*. Washington D.C. <https://copperalliance.org/trends-and-innovations/data-set/>.
- International Copper Study Group. 2020. *World Refined Copper Production and Usage Trends*. Lisbon, Portugal. <https://www.icsg.org/index.php/component/jdownloads/finish/165/871>.
- Ippoliti, M. and J. Tomić. 2019. *California CLEAN Truck Demonstration Program*. <https://ww2.energy.ca.gov/2019publications/CEC-600-2019-FTD/CEC-600-2019-117.pdf>.
- IRENA. 2017. *Electricity storage and renewables: Costs and markets to 2030. Electricity-Storage-and-Renewables-Costs-and-Markets*. <http://irena.org/publications/2017/Oct/Electricity-storage-and-renewables-costs-and-markets>.
- IRG-rail. 2013. *Independent Regulators ' Group – Rail IRG – Rail Annual Market Monitoring Report*. <https://www.irg-rail.eu/download/5/64/IRG-Rail132-MarketMonitoringReport.pdf>.
- IRP. 2020. *Global Resources Outlook 2019: Natural Resources for the Future We Want*. Ed. by B. Oberle, S. Bringezu, S. Hatfeld-Dodds, S. Hellweg, H. Schandl, J. Clement, L. Cabernard, et al. *Global Resources Outlook 2019*. Nairobi, Kenya: International Resource Panel. United Nations Environment Programme.
- ISUZU. 2020. Citibus. April 8. <https://www.isuzu.com.tr/en/bus/city-interurban/citibus/>.
- ITF. 2019. *ITF Transport Outlook 2019*. Paris.
- IVECO. 2010. Power daily minibus A42.13 Twin Rear wheels: 1–4. https://www.iveco.com/africa-mideast-en/collections/technical_sheets/Documents/Power Daily/MINIBUS/A42.13_EN_rel4.pdf.
- Jacobson, M.Z. and M.A. Delucchi. 2011. Providing all global energy with wind, water, and solar power, Part I: Technologies, energy resources, quantities and areas of infrastructure, and materials. *Energy Policy* 39(3): 1154–1169. <https://linkinghub.elsevier.com/retrieve/pii/S0301421510008645>.
- Jeangrand, J. 2005. Comprehensive strategic analysis of the tantalum supply chain. Simon Fraser University. <http://summit.sfu.ca/item/8196>.
- Jeong, Y.-S., S.-E. Lee, and J.-H. Huh. 2012. Estimation of CO₂ emission of apartment buildings due to major construction materials in the Republic of Korea. *Energy and Buildings* 49: 437–442.
- Jia Wen, T., H. Chin Siong, and Z.Z. Noor. 2015. Assessment of embodied energy and global warming potential of building construction using life cycle analysis approach: Case studies of residential buildings in Iskandar Malaysia. *Energy and Buildings* 93: 295–302.
- Jian, L., H. Zechun, D. Banister, Z. Yongqiang, and W. Zhongying. 2018. The future of energy storage shaped by electric vehicles: A perspective from China. *Energy* 154: 249–257. <https://linkinghub.elsevier.com/retrieve/pii/S0360544218307400>.
- Johnstone, I. 2001. Energy and mass flows of housing: a model and example. *Building and Environment* 36(1):

- Jones, B., R.J.R. Elliott, and V. Nguyen-Tien. 2020. The EV revolution: The road ahead for critical raw materials demand. *Applied Energy* 280: 115072. <https://linkinghub.elsevier.com/retrieve/pii/S0306261920305845>.
- Jorge, R.S., T.R. Hawkins, and E.G. Hertwich. 2012. Life cycle assessment of electricity transmission and distribution—part 2: transformers and substation equipment. *The International Journal of Life Cycle Assessment* 17(2): 184–191. <http://link.springer.com/10.1007/s11367-011-0336-0>.
- JR East. 2017. *Annual report 2017*. https://www.jreast.co.jp/e/investor/ar/2017/pdf/ar_2017-all.pdf.
- Jungbluth, N. 2007. Teil IV: Erdoel. In *Sachbilanzen von Energiesystemen: Grundlagen Fur Den Okologischen Vergleich von Energiesystemen Und Den Einbezug von Energiesystemen in Okobilanzen Fur Die Schweiz. Ecoinvent Report No. 6*, ed. by Roberto Dones. Duebendorf: Swiss Centre for Life Cycle Inventories.
- Kaack, L.H., P. Vaishnav, M.G. Morgan, I.L. Azevedo, and S. Rai. 2018. Decarbonizing intraregional freight systems with a focus on modal shift. *Environmental Research Letters* 13(8): 083001. <https://iopscience.iop.org/article/10.1088/1748-9326/aad56c>.
- Kadaster. 2020. Basisadministratie Adressen en Gebouwen. <https://www.kadaster.nl/zakelijk/registraties/basisregistraties/bag>. Accessed May 11, 2021.
- Kalt, G., D. Wiedenhofer, C. Görg, and H. Haberl. 2019. Conceptualizing energy services: A review of energy and well-being along the Energy Service Cascade. *Energy Research & Social Science* 53: 47–58. <https://linkinghub.elsevier.com/retrieve/pii/S2214629618311757>.
- Kapur, A., G. Keoleian, A. Kendall, and S.E. Kesler. 2008. Dynamic Modeling of In-Use Cement Stocks in the United States. *Journal of Industrial Ecology* 12(4): 539–556. <https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1530-9290.2008.00055.x>.
- Kashkooli, A.M.S., G.A. Vargas, and H. Altan. 2014. A semi-quantitative framework of building lifecycle analysis: Demonstrated through a case study of a typical office building block in Mexico in warm and humid climate. *Sustainable Cities and Society* 12: 16–24. <https://linkinghub.elsevier.com/retrieve/pii/S2210670713000644>.
- Kavgic, M., A. Mavrogianni, D. Mumovic, A. Summerfield, Z. Stevanovic, and M. Djurovic-Petrovic. 2010. A review of bottom-up building stock models for energy consumption in the residential sector. *Building and Environment* 45(7): 1683–1697. <http://www.sciencedirect.com/science/article/pii/S0360132310000338>.
- KC, S., W. Lutz, K. Samir, and L. Wolfgang. 2017. The human core of the shared socioeconomic pathways: Population scenarios by age, sex and level of education for all countries to 2100. *Global Environmental Change* 42: 181–192. <https://linkinghub.elsevier.com/retrieve/pii/S0959378014001095>.
- Keith, D.R., S. Houston, and S. Naumov. 2019. Vehicle fleet turnover and the future of fuel economy. *Environmental Research Letters* 14(2): 021001. <https://iopscience.iop.org/article/10.1088/1748-9326/aaf4d2>.
- Kellenberger, D., H.-J. Althaus, T. Künninger, M. Lehmann, N. Jungbluth, and P. Thalmann. 2007. Life Cycle Inventories of Building Products. *Ecoinvent Report No. 7*.
- Kirchherr, J., D. Reike, and M. Hekkert. 2017. Conceptualizing the circular economy: An analysis of 114 definitions. *Resources, Conservation and Recycling* 127: 221–232. <https://linkinghub.elsevier.com/retrieve/pii/S0921344917302835>.
- Kleemann, F., J. Lederer, H. Rechberger, and J. Fellner. 2016. *GIS-based Analysis of Vienna's Material Stock in Buildings: GIS-based Analysis of Material Stock in Buildings*. *Journal of Industrial Ecology*. June.
- Kleijn, R., E. Van der Voet, G.J. Kramer, L. Van Oers, and C. Van der Giesen. 2011. Metal requirements of low-

References

- carbon power generation. *Energy* 36(9): 5640–5648.
- Klyavin, A. 2010. *Main indicators of inland waterway transport*.
https://www.unece.org/fileadmin/DAM/trans/events/docs/2010/ITC72_RussianFederation_Klyavin.pdf.
- Kodak. 1941. Optical Glass. <http://www.freepatentsonline.com/2241249.pdf>.
- Kofoworola, O.F. and S.H. Gheewala. 2009. Life cycle energy assessment of a typical office building in Thailand. *Energy and Buildings* 41(10): 1076–1083.
<http://linkinghub.elsevier.com/retrieve/pii/S0378778809001121>.
- Koning, A. de, R. Kleijn, G. Huppes, B. Sprecher, G. van Engelen, and A. Tukker. 2018. Metal supply constraints for a low-carbon economy? *Resources, Conservation and Recycling* 129: 202–208.
<https://linkinghub.elsevier.com/retrieve/pii/S0921344917303762>.
- Koskinen, O. and C. Breyer. 2016. Energy Storage in Global and Transcontinental Energy Scenarios: A Critical Review. *Energy Procedia* 99: 53–63.
<http://www.sciencedirect.com/science/article/pii/S187661021631058X>.
- Koutamanis, A., B. van Reijn, and E. van Bueren. 2018. Urban mining and buildings: A review of possibilities and limitations. *Resources, Conservation and Recycling* 138: 32–39.
- Krausmann, F., D. Wiedenhofer, C. Lauk, W. Haas, H. Tanikawa, T. Fishman, A. Miatto, H. Schandl, and H. Haberl. 2017. Global socioeconomic material stocks rise 23-fold over the 20th century and require half of annual resource use. *Proceedings of the National Academy of Sciences* 114(8): 1880–1885.
<https://www.pnas.org/content/114/8/1880>.
- Kriegler, E., N. Petermann, V. Krey, V.J. Schwanitz, G. Luderer, S. Ashina, V. Bosetti, et al. 2015. Diagnostic indicators for integrated assessment models of climate policy. *Technological Forecasting and Social Change* 90: 45–61. <https://linkinghub.elsevier.com/retrieve/pii/S0040162513002576>.
- Kriegler, E., J.P. Weyant, G.J. Blanford, V. Krey, L. Clarke, J. Edmonds, A. Fawcett, et al. 2014. The role of technology for achieving climate policy objectives: overview of the EMF 27 study on global technology and climate policy strategies. *Climatic Change* 123(3–4): 353–367.
<http://link.springer.com/10.1007/s10584-013-0953-7>.
- Kristensen, H.O. 2013. Statistical Analysis and Determination of Regression Formulas for Main Dimensions of Container Ships Based on IHS Fairplay Data. *Technical University of Denmark*.
https://www.danishshipping.dk/en/policy/klimapolitik/beregningsvaerktoejer/download/Basic_Model_Linkarea_Link/162/wp-2-report-3-regression-analysis-for-container-ships.pdf.
- Krook, J. and L. Baas. 2013. Getting serious about mining the technosphere: a review of recent landfill mining and urban mining research. *Journal of Cleaner Production* 55: 1–9.
<http://www.sciencedirect.com/science/article/pii/S0959652613002916>.
- Kuhnimhof, T., M. Bäumer, and U. Kunert. 2017. *Approaches for Establishing In-Use Vehicle Stock and Vehicle Mileages*.
- Kumanayake, R., H. Luo, and N. Paulusz. 2018. Assessment of material related embodied carbon of an office building in Sri Lanka. *Energy and Buildings* 166: 250–257.
<https://linkinghub.elsevier.com/retrieve/pii/S0378778817329857>.
- Kumar, V., K. Hewage, and S. Rehan. 2015. Life Cycle Assessment of Residential Buildings: A Case Study in Canada. <https://zenodo.org/record/1107700>.
- Langkau, S. and L.A. Tercero Espinoza. 2018. Technological change and metal demand over time: What can we learn from the past? *Sustainable Materials and Technologies* 16: 54–59.
<https://linkinghub.elsevier.com/retrieve/pii/S2214993718300368>.
- Lasdon, L.S., R.L. Fox, and M.W. Ratner. 1974. Nonlinear optimization using the generalized reduced gradient

- method. *Recherche Opérationnelle* 8(3): 73–103.
- Laugs, G.A.H., R.M.J. Benders, and H.C. Moll. 2020. Balancing responsibilities: Effects of growth of variable renewable energy, storage, and undue grid interaction. *Energy Policy* 139: 111203. <http://www.sciencedirect.com/science/article/pii/S0301421519307876>.
- Lauinger, D., R.G. Billy, F. Vásquez, and D.B. Müller. 2021. A general framework for stock dynamics of populations and built and natural environments. *Journal of Industrial Ecology*: jiec.13117. <https://onlinelibrary.wiley.com/doi/10.1111/jiec.13117>.
- Lauinger, D., F. Vuille, and D. Kuhn. 2017. A review of the state of research on vehicle-to-grid (V2G): Progress and barriers to deployment. *Proceedings of European Battery, Hybrid and Fuel Cell Electric Vehicle Congress*. https://www.researchgate.net/profile/Dirk_Lauinger/publication/315144641_A_review_of_the_state_of_research_on_vehicle-to-grid_V2G_Progress_and_barriers_to_deployment/links/58cbe97ea6fdccdf531c6e47/A-review-of-the-state-of-research-on-vehicle-to-grid-V2G-P.
- Laver, R., D. Schneck, D. Skorupski, S. Brady, and L. Cham. 2007. *Useful Life of Transit Buses and Vans*. https://www.transitwiki.org/TransitWiki/images/6/64/Useful_Life_of_Buses.pdf.
- Law, K., M.D. Jackson, and M. Chan. 2011. *European Union Greenhouse Gas Reduction Potential for Heavy-Duty Vehicles*. https://ec.europa.eu/clima/sites/clima/files/transport/vehicles/heavy/docs/icct_ghg_reduction_potential_en.pdf.
- Lawrence, M., R. Bullock, and Z. Liu. 2019. *China's High-Speed Rail Development*. Washington. <https://doi.org/10.1596/978-1-4648-1425-9>.
- Lee, N., S. Tae, Y. Gong, and S. Roh. 2017. Integrated building life-cycle assessment model to support South Korea's green building certification system (G-SEED). *Renewable and Sustainable Energy Reviews*.
- Lee, S., S. Tae, S. Roh, and T. Kim. 2015. Green template for life cycle assessment of buildings based on building information modeling: Focus on embodied environmental impact. *Sustainability (Switzerland)* 7: 16498–16512.
- Leuenberger, M. and R. Frischknecht. 2010. *Life Cycle Assessment of Two Wheel Vehicles*. Uster. https://treeze.ch/fileadmin/user_upload/downloads/Publications/Case_Studies/Mobility/leuenberger-2010-TwoWheelVehicles.pdf.
- Li, D. and W. Chen. 2019. TIMES modeling of the large-scale popularization of electric vehicles under the worldwide prohibition of liquid vehicle sales. *Applied Energy* 254: 113627. <https://linkinghub.elsevier.com/retrieve/pii/S0306261919313145>.
- Li, D., P. Cui, and Y. Lu. 2016a. Development of an automated estimator of life-cycle carbon emissions for residential buildings: A case study in Nanjing, China. *Habitat International* 57: 154–163.
- Li, F., Z. Ye, X. Xiao, J. Xu, and G. Liu. 2020a. Material stocks and flows of power infrastructure development in China. *Resources, Conservation and Recycling* 160: 104906. <https://linkinghub.elsevier.com/retrieve/pii/S092134492030224X>.
- Li, G., X. Lu, J.Y. Kim, K.D. Meinhardt, H.J. Chang, N.L. Canfield, and V.L. Sprenkle. 2016b. Advanced intermediate temperature sodium–nickel chloride batteries with ultra-high energy density. *Nature Communications* 7(1): 10683. <http://www.nature.com/articles/ncomms10683>.
- Li, M., J. Lu, Z. Chen, and K. Amine. 2018. 30 Years of Lithium-Ion Batteries. *Advanced Materials* 30(33): 1800561.
- Li, W., S. Lee, and A. Manthiram. 2020b. High-Nickel NMA: A Cobalt-Free Alternative to NMC and NCA Cathodes for Lithium-Ion Batteries. *Advanced Materials* 32(33): 2002718.

References

- <https://onlinelibrary.wiley.com/doi/abs/10.1002/adma.202002718>.
- Ligterink, N.E. 2016. *Composition and payload distribution of the on-road heavy-duty fleet in the Netherlands*. [http://www.emissieregistratie.nl/erpubliek/documenten/Lucht \(Air\)/Verkeer en Vervoer \(Transport\)/Wegverkeer/TNO \(2015\) Composition and payload distribution of the on-road HD-fleet in NL.pdf](http://www.emissieregistratie.nl/erpubliek/documenten/Lucht%20(Air)/Verkeer%20en%20Vervoer%20(Transport)/Wegverkeer/TNO%20(2015)%20Composition%20and%20payload%20distribution%20of%20the%20on-road%20HD-fleet%20in%20NL.pdf).
- Liu, G., C.E. Bangs, and D.B. Müller. 2012. Stock dynamics and emission pathways of the global aluminium cycle. *Nature Climate Change* 3: 338. <https://doi.org/10.1038/nclimate1698>.
- Liu, J., X. Chen, H. Zhou, K. Wang, J. Zou, and Y. Kong. 2019. A practical methodology to evaluate internationally consistent energy data for China's transport sector. *Journal of Cleaner Production* 239: 118030. <https://linkinghub.elsevier.com/retrieve/pii/S0959652619329002>.
- Liu, K. and X.-G. Chen. 2015. Development of Al–Mn–Mg 3004 alloy for applications at elevated temperature via dispersoid strengthening. *Materials & Design* 84: 340–350. <https://linkinghub.elsevier.com/retrieve/pii/S0264127515300319>.
- Liu, M., X. Chen, M. Zhang, X. Lv, H. Wang, Z. Chen, X. Huang, X. Zhang, and S. Zhang. 2020. End-of-life passenger vehicles recycling decision system in China based on dynamic material flow analysis and life cycle assessment. *Waste Management* 117: 81–92. <https://linkinghub.elsevier.com/retrieve/pii/S0956053X20304347>.
- Lombardi, S., L. Tribioli, G. Guandalini, and P. Iora. 2020. Energy performance and well-to-wheel analysis of different powertrain solutions for freight transportation. *International Journal of Hydrogen Energy* 45(22): 12535–12554. <https://linkinghub.elsevier.com/retrieve/pii/S0360319920307989>.
- Long, K.R., B.S. Van Gosen, N.K. Foley, and D. Cordier. 2012. The Principal Rare Earth Elements Deposits of the United States: A Summary of Domestic Deposits and a Global Perspective. In *Non-Renewable Resource Issues*, 131–155. Dordrecht: Springer Netherlands. http://link.springer.com/10.1007/978-90-481-8679-2_7.
- Lopes, J.V.D.O.F. 2010. Life Cycle Assessment of the Airbus A330-200 Aircraft Engenharia Aeroespacial Júri. Universidade Tecnica de Lisboa. https://fenix.tecnico.ulisboa.pt/downloadFile/395142223995/Tese_JoaoVascoLopes.pdf.
- Luderer, G., M. Pehl, A. Arvesen, T. Gibon, B.L. Bodirsky, H.S. de Boer, O. Fricko, et al. 2019. Environmental co-benefits and adverse side-effects of alternative power sector decarbonization strategies. *Nature Communications* 10(1): 5229. <https://doi.org/10.1038/s41467-019-13067-8>.
- Luderer, G., Z. Vrontisi, C. Bertram, O.Y. Edelenbosch, R.C. Pietzcker, J. Rogelj, H.S. De Boer, et al. 2018. Residual fossil CO₂ emissions in 1.5–2 °C pathways. *Nature Climate Change* 8(7): 626–633. <http://www.nature.com/articles/s41558-018-0198-6>.
- Luo, H., Z. Kou, F. Zhao, and H. Cai. 2019. Comparative life cycle assessment of station-based and dock-less bike sharing systems. *Resources, Conservation and Recycling* 146: 180–189. <https://linkinghub.elsevier.com/retrieve/pii/S0921344919301090>.
- Luo, X., J. Wang, M. Dooner, and J. Clarke. 2015. Overview of current development in electrical energy storage technologies and the application potential in power system operation. *Applied Energy* 137: 511–536. <https://linkinghub.elsevier.com/retrieve/pii/S0306261914010290>.
- Machinchick, T. and B. Freas. 2018. *Global Building Stock Database, Commercial and Residential Building Floor Space by Country and Building Type: 2017-2026*. <https://www.navigantresearch.com/reports/global-building-stock-database>.
- Majeau-Bettez, G., T.R. Hawkins, and A.H. Strømman. 2011. Life Cycle Environmental Assessment of Lithium-ion and Nickel Metal Hydride Batteries for Plug-In Hybrid and Battery Electric Vehicles. *Environmental Science & Technology* 45(10): 4548–4554. <https://pubs.acs.org/doi/10.1021/es103607c>.

- Månberger, A. and B. Stenqvist. 2018. Global metal flows in the renewable energy transition: Exploring the effects of substitutes, technological mix and development. *Energy Policy* 119: 226–241. <https://linkinghub.elsevier.com/retrieve/pii/S0301421518302726>.
- Mancheri, N.A.N.A., B. Sprecher, S. Deetman, S.B.S.B. Young, R. Bleischwitz, L. Dong, R. Kleijn, and A. Tukker. 2018. Resilience in the tantalum supply chain. *Resources, Conservation and Recycling* 129: 56–69. <https://linkinghub.elsevier.com/retrieve/pii/S092134491730352X>.
- Maraš, V. 2008. Determining Optimal Transport Routes of Inland Waterway Container Ships. *Transportation Research Record: Journal of the Transportation Research Board* 2062(1): 50–58. <http://journals.sagepub.com/doi/10.3141/2062-07>.
- Marcellus-Zamora, K.A., P.M. Gallagher, S. Spatari, and H. Tanikawa. 2016. Estimating Materials Stocked by Land-Use Type in Historic Urban Buildings Using Spatio-Temporal Analytical Tools. *Journal of Industrial Ecology* 20(5): 1025–1037. <http://doi.wiley.com/10.1111/jiec.12327>.
- Marimuthu, C. and V. Kirubakaran. 2013. Carbon pay back period for solar and wind energy project installed in India: A critical review. *Renewable and Sustainable Energy Reviews* 23: 80–90. <https://linkinghub.elsevier.com/retrieve/pii/S1364032113001470>.
- Marinova, S., S. Deetman, E. van der Voet, and V. Daioglou. 2020. Global construction materials database and stock analysis of residential buildings between 1970–2050. *Journal of Cleaner Production* 247(this issue): 119146. <https://linkinghub.elsevier.com/retrieve/pii/S0959652619340168>.
- Marscheider-Weidemann, F., S. Langkau, T. Hummen, L. Erdmann, and L. Tercero Espinoza. 2016. *Rohstoffe für Zukunftstechnologien 2016. Deutsche Rohstoffagentur (DERA)*. Vol. DERA Rohst. https://www.bgr.bund.de/DERA/DE/Downloads/Studie_Zukunftstechnologien-2016.pdf?__blob=publicationFile&v=5.
- Martínez-Rocamora, A., J. Solís-Guzmán, and M. Marrero. 2016. LCA databases focused on construction materials: A review. *Renewable and Sustainable Energy Reviews* 58: 565–573. <http://www.sciencedirect.com/science/article/pii/S1364032115016263>.
- Mason, J., L. Fulton, and Z. McDonald. 2015. A Global High Shift Cycling Scenario : *Institute for Transportation & Development Policy and the University of California, Davis*. <https://repository.difu.de/jspui/bitstream/difu/232549/1/DS1518.pdf>.
- Mazareanu, E. 2019. Size of aircraft fleets worldwide 2018. *Statista*. April 1. <https://www.statista.com/statistics/262971/aircraft-fleets-by-region-worldwide/>.
- McMillan, C.A., M.R. Moore, G.A. Keoleian, and J.W. Bulkeley. 2010. Quantifying U.S. aluminum in-use stocks and their relationship with economic output. *Ecological Economics* 69(12): 2606–2613. <http://www.sciencedirect.com/science/article/pii/S0921800910003290>.
- Meadows, D.H., D.L. Meadows, J. Randers, and W.W. Behrens III. 1972. *The Limits to Growth*. New York: Universe Books.
- Medtronic. 2015. About Pacemakers. <http://www.medtronic.com/patients/bradycardia/device>.
- Meier, P.J. 2002. Life-Cycle Assessment of Electricity Generation Systems and Applications for Climate Change Policy Analysis. *Fusion Technology Institute*. Madison, Wisconsin: University of Wisconsin - MADison.
- Mendoza Beltran, A., B. Cox, C. Mutel, D.P. van Vuuren, D. Font Vivanco, S. Deetman, O.Y. Edelenbosch, J. Guinée, and A. Tukker. 2020. When the Background Matters: Using Scenarios from Integrated Assessment Models in Prospective Life Cycle Assessment. *Journal of Industrial Ecology* 24(1).
- Mercedes-Benz. 2018. The Citaro city buses: technical information: 1–28. <https://daimlerbuses-printshop.com/media/assets/mb-c-rl-2-en-07-18.pdf>.
- Mercedes-Benz. 2020. Sprinter Technical Data: 1–32. <https://www.mercedes->

References

- benz.com.au/vans/en/sprinter/panel-van/technical-data.
- Messmer, A. and R. Frischknecht. 2016a. *Life Cycle Inventories of Rail Transport Services*. https://treeze.ch/fileadmin/user_upload/downloads/Publications/Case_Studies/Mobility/544-LCI-Rail-Transport-Services-v2.0.pdf.
- Messmer, A. and R. Frischknecht. 2016b. *Life Cycle Inventories of Water Transport Services*. http://www.dflca.ch/inventories/Hintergrund/Messmer_Frischknecht_2016-LCI-Water-Transport-Services_v2.0.pdf.
- Mesta, C., R. Kahhat, S. Santa-Cruz, and S. Santa-Cruz. 2019. Geospatial Characterization of Material Stock in the Residential Sector of a Latin-American City. *Journal of Industrial Ecology* 23(1): 280–291. <https://onlinelibrary.wiley.com/doi/abs/10.1111/jiec.12723>.
- Miatto, A., H. Schandl, L. Forlin, F. Ronzani, P. Borin, A. Giordano, and H. Tanikawa. 2019. A spatial analysis of material stock accumulation and demolition waste potential of buildings: A case study of Padua. *Resources, Conservation and Recycling* 142(July 2018): 245–256.
- Miatto, A., H. Schandl, and H. Tanikawa. 2017. How important are realistic building lifespan assumptions for material stock and demolition waste accounts? *Resources, Conservation and Recycling* 122: 143–154. <http://www.sciencedirect.com/science/article/pii/S0921344917300265>.
- Mittal, S., H. Dai, S. Fujimori, T. Hanaoka, and R. Zhang. 2017. Key factors influencing the global passenger transport dynamics using the AIM/transport model. *Transportation Research Part D: Transport and Environment* 55: 373–388. <https://linkinghub.elsevier.com/retrieve/pii/S1361920916300451>.
- Moran, D., D. McBain, K. Kanemoto, M. Lenzen, and A. Geschke. 2015. Global Supply Chains of Coltan. *Journal of Industrial Ecology* 19(3): 357–365. <http://doi.wiley.com/10.1111/jiec.12206>.
- Morimoto, S., K. Sanematsu, K. Ozaki, A. Ozawa, and Y. Seo. 2019. Methodological study of evaluating the traceability of neodymium based on the global substance flow analysis and Monte Carlo simulation. *Resources Policy* 63: 101448. <https://linkinghub.elsevier.com/retrieve/pii/S0301420719300315>.
- Morris, H. 2017. How many planes are there in the world right now? *The Telegraph*. <https://www.telegraph.co.uk/travel/travel-truths/how-many-planes-are-there-in-the-world/>.
- Moss, R.L., E. Tzimas, H. Kara, P. Willis, and J. Kooroshy. 2011. *Critical Metals in Strategic Energy Technologies, Assessing Rare Metals as Supply-Chain Bottlenecks in Low-Carbon Energy Technologies*. JRC Scientific and Technical Reports. Luxembourg: Publications Office of the European Union. <http://setis.ec.europa.eu/newsroom/library/setis-presentations/jrc-report-on-critical-metals-in-strategic-energy-technologies>.
- Moss, R.L., E. Tzimas, P. Willis, J. Arendorf, P. Thompson, A. Chapman, N. Morley, E. Sims, R. Bryson, and J. Peason. 2013. *Critical metals in the path towards the decarbonisation of the EU energy sector. Assessing Rare Metals as Supply-Chain Bottlenecks in Low-Carbon Energy Technologies*. JRC Report EUR. Vol. 25994.
- Mosteiro-Romero, M., U. Krogmann, H. Wallbaum, Y. Ostermeyer, J.S. Senick, and C.J. Andrews. 2014. Relative importance of electricity sources and construction practices in residential buildings: A Swiss-US comparison of energy related life-cycle impacts. *Energy and Buildings*.
- Mostert, C., B. Ostrander, S. Bringezu, and T. Kneiske. 2018. Comparing Electrical Energy Storage Technologies Regarding Their Material and Carbon Footprint. *Energies* 11(12): 3386. <http://www.mdpi.com/1996-1073/11/12/3386>.
- Müller, D.B. 2006. Stock dynamics for forecasting material flows—Case study for housing in The Netherlands. *Ecological Economics* 59(1): 142–156. <http://www.sciencedirect.com/science/article/pii/S092180090500460X>.
- Müller, D.B., G. Liu, A.N. Løvik, R. Modaresi, S. Pauliuk, F.S. Steinhoff, and H. Brattebø. 2013. Carbon Emissions

- of Infrastructure Development. *Environmental Science & Technology* 47(20): 11739–11746. <https://doi.org/10.1021/es402618m>.
- Müller, D.B., T. Wang, and B. Duval. 2010. Patterns of Iron Use in Societal Evolution §. *Environmental Science & Technology* 45(1): 182–188.
- Müller, E., L.M. Hilty, R. Widmer, M. Schluep, and M. Faulstich. 2014. Modeling Metal Stocks and Flows: A Review of Dynamic Material Flow Analysis Methods. *Environmental Science & Technology* 48(4): 2102–2113. <https://pubs.acs.org/doi/abs/10.1021/es403506a>.
- Murakami, S., M. Oguchi, T. Tasaki, I. Daigo, and S. Hashimoto. 2010. Lifespan of Commodities, Part I. *Journal of Industrial Ecology* 14(4): 598–612. <https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1530-9290.2010.00250.x>.
- Murray, B. 2014. *Russian Railway Reform Programme*. <http://www.ebrd.com/documents/evaluation/special-study-russian-railway-sector-evaluation-working-paper-1.pdf>.
- Nahlik, M.J., A.T. Kaehr, V.M. Chester, A. Horvath, and M.N. Taptich. 2015. Goods Movement Life Cycle Assessment for Greenhouse Gas Reduction Goals. *Journal of Industrial Ecology* 20(2): 317–328.
- Namias, J. 2013. The future of electronic waste recycling in the United States: Obstacles and domestic solutions. Columbia University. http://www.seas.columbia.edu/earth/wternt/sofos/Namias_Thesis_07-08-13.pdf.
- National Bureau of Statistics of China. 2021. Basic conditions of transport. *National Data*. <http://data.stats.gov.cn/english/tablequery.htm?code=ACOL>.
- National Research Council. 1986. *Materials for Large Land-based Gas Turbines: Report of the Committee on Materials for Large Land-Based Gas Turbines, National Materials Advisory Board*. National Academy Press. <https://books.google.nl/books?id=uF8rAAAAYAAJ>.
- National Research Council. 2012. *Review of the 21st Century Truck Partnership, Second Report (2012)*. Washington, DC. <https://www.nap.edu/catalog/13288/review-of-the-21st-century-truck-partnership-second-report>.
- National Transit Database. 2019. *2018 Vehicles*. <https://www.transit.dot.gov/ntd/data-product/2018-vehicles>.
- Nautiyal, H., V. Shree, S. Khurana, N. Kumar, and Varun. 2015. Recycling Potential of Building Materials: A Review. In *Environmental Implications of Recycling and Recycled Products*, ed. by Subramanian Senthilkannan Muthu, 31–50. Singapore: Springer Singapore. https://doi.org/10.1007/978-981-287-643-0_2.
- Nelson, P.A., S. Ahmed, K.G. Gallagher, and D.W. Dees. 2019. *Modeling the Performance and Cost of Lithium-Ion Batteries for Electric-Drive Vehicles*. Argonne. <https://www.anl.gov/cse/batpac-model-software>.
- Nemry, F., G. Leduc, I. Mongelli, and A. Uihlein. 2008a. *Environmental Improvement of Passenger Cars (IMPRO-car)*. Luxembourg. ISSN 978-92-79-07694-7.
- Nemry, F., A. Uihlein, C.M. Colodel, C. Wetzel, A. Braune, B. Wittstock, I. Hasan, et al. 2010. Options to reduce the environmental impacts of residential buildings in the European Union-Potential and costs. *Energy and Buildings* 42(7).
- Nemry, F., A. Uihlein, C. Makishi Colodel, B. Wittstock, A. Braune, C. Wetzel, I. Hasan, et al. 2008b. *Environmental Improvement Potentials of Residential Buildings (IMPRO-Building)*. EUR – Scientific and Technical Research Series. http://publications.jrc.ec.europa.eu/repository/bitstream/11111111/7070/1/reqno_jrc46667_jrc46667%5B1%5D%5B1%5D.pdf.pdf.
- Nest. 2011. *Coltan*. Cambridge: Polity Press.
- Noel, L., G. Zarazua de Rubens, J. Kester, and B.K. Sovacool. 2019. The Technical Challenges to V2G. In *Vehicle-*

References

- to-Grid, ed. by Cham Palgrave Macmillan. Energy, Climate and the Environment. https://link.springer.com/chapter/10.1007/978-3-030-04864-8_3.
- Nomura, K., Y. Suga, and Y. Suga. 2013. Asset Service Lives and Depreciation Rates based on Disposal Data in Japan. In *Economic Measurement Group Workshop Tokyo.*, 29. <http://www.cs.reitaku-u.ac.jp/sm/shimizu/Project/2013Project/Session1/0102Nomura.pdf>.
- Nordelöf, A., M. Romare, and J. Tivander. 2019. Life cycle assessment of city buses powered by electricity, hydrogenated vegetable oil or diesel. *Transportation Research Part D* 75: 211–222.
- Northey, S., S. Mohr, G.M. Mudd, Z. Weng, and D. Giurco. 2014. Modelling future copper ore grade decline based on a detailed assessment of copper resources and mining. *Resources, Conservation and Recycling* 83: 190–201. <http://www.sciencedirect.com/science/article/pii/S0921344913002127>.
- Novikova, A., T. Csoknyai, and Z. Szalay. 2018. Low carbon scenarios for higher thermal comfort in the residential building sector of South Eastern Europe. *Energy Efficiency* 11(4): 845–875. <https://doi.org/10.1007/s12053-017-9604-6>.
- NS. 2018. *NS Jaarverslag 2018*. https://www.nsjaarverslag.nl/FbContent.ashx/pub_1000/downloads/v190228091452/NS-jaarverslag-2018.pdf.
- NS. 2020. Materieel. April 4. <https://www.ns.nl/over-ns/treinen-van-ns>.
- Nunney, T. and C. Baily. 2011. *XPS Analysis of a Hard Disk Platter by Rapid Depth Profiling*. <http://www.revbase.com/tt/sl.ashx?z=73090c66&dataid=277845&ft=1>.
- O'Neill, B.C., E. Kriegler, K.L. Ebi, E. Kemp-benedict, K. Riahi, D.S. Rothman, V.B.J. Ruijven, et al. 2017. The roads ahead : Narratives for shared socioeconomic pathways describing world futures in the 21st century. *Global Environmental Change* 42: 169–180. <http://www.sciencedirect.com/science/article/pii/S0959378015000060>.
- O'Neill, B.C., E. Kriegler, K. Riahi, K.L. Ebi, S. Hallegatte, T.R. Carter, R. Mathur, and D.P. van Vuuren. 2014. A new scenario framework for climate change research: the concept of shared socioeconomic pathways. *Climatic Change* 122(3): 387–400. <http://dx.doi.org/10.1007/s10584-013-0905-2>.
- Oanh, N.T.K. and H.H. Van. 2015. *Comparative assessment of traffic fleets in Asian cities for emission inventory and analysis of co-benefit from faster vehicle technology intrusion*. <https://www.epa.gov/sites/production/files/2015-09/documents/oanh.pdf>.
- OECD. *Material resources, productivity and the Environment: key findings*. <https://www.oecd.org/env/waste/material-resources-productivity-and-the-environment-9789264190504-en.htm>.
- OECD. 2011. *Health at a Glance 2011*. Health at a Glance. Paris: OECD Publishing, November 23. https://www.oecd-ilibrary.org/social-issues-migration-health/health-at-a-glance-2011_health_glance-2011-en.
- OECD. 2019. *Global Material Resources Outlook to 2060*. OECD, February 12. https://www.oecd-ilibrary.org/environment/global-material-resources-outlook-to-2060_9789264307452-en.
- OECD and Eurostat. 2015. *Eurostat-OECD Survey of National Practices in Estimating Net Stocks of Structures*. OECD. <https://ec.europa.eu/eurostat/documents/24987/4253483/Eurostat-OECD-survey-of-national-practices-estimating-net-stocks-structures.pdf>.
- Oguchi, M., S. Murakami, H. Sakanakura, A. Kida, and T. Kameya. 2011. A preliminary categorization of end-of-life electrical and electronic equipment as secondary metal resources. *Waste Management* 31(9–10): 2150–2160. <https://linkinghub.elsevier.com/retrieve/pii/S0956053X11002510>.
- Öhrlund, I. 2012. Future Metal Demand from Photovoltaic Cells and Wind Turbines—Investigating the Potential

- Risk of Disabling a Shift to Renewable Energy Systems. *Science and Technology Options Assessment (STOA)*. Brussel, Belgium: Science and Technology Options Assessment (STOA).
- Oka, T., M. Suzuki, and T. Konnya. 1993. The estimation of energy consumption and amount of pollutants due to the construction of buildings. *Energy and Buildings* 19(4): 303–311.
<http://linkinghub.elsevier.com/retrieve/pii/037877889390016N>.
- Olaya, Y., F. Vázquez, and D.B. Müller. 2017. Dwelling stock dynamics for addressing housing deficit. *Resources, Conservation and Recycling* 123: 187–199.
<http://www.sciencedirect.com/science/article/pii/S0921344916302762>.
- Olofsson, Y. and M. Romare. 2013. Life Cycle Assessment of Lithium-ion Batteries for Plug-in Hybrid Buses. Chalmers University of Technology, Sweden.
<http://publications.lib.chalmers.se/records/fulltext/180166/180166.pdf>.
- Olson, B.D. 2011. *Residential Building Material Reuse in Sustainable Construction*. Washington State University.
https://research.libraries.wsu.edu/xmlui/bitstream/handle/2376/3479/Olson_wsu_0251E_10257.pdf?sequence=1.
- OpenStreetMap contributors. 2016. Planet dump retrieved from <https://planet.osm.org>.
- Ortiz-Rodríguez, O., F. Castells, and G. Sonnemann. 2010. Life cycle assessment of two dwellings: One in Spain, a developed country, and one in Colombia, a country under development. *Science of the Total Environment*.
- Oyarzo, J. and B. Peuportier. 2014. Life cycle assessment model applied to housing in Chile. *Journal of Cleaner Production* 69(March 2012): 109–116.
- Özdemir, E.D., J. Pagenkopf, F. Kleiner, U. Kugler, and S. Schmid. 2015. *Alternative Transport Technologies for Megacities*.
- Pajchrowski, G., A. Noskowiak, A. Lewandowska, and W. Strykowski. 2014. Wood as a building material in the light of environmental assessment of full life cycle of four buildings. *Construction and Building Materials*.
- Pasha, G.R., M.S. Khan, and A.H. Pasha. 2006. Empirical Analysis of the Weibull Distribution for Failure Data. *Journal of Statistics* 13(1).
- Patel, K. 2016. Lithium-Sulfur Battery: Chemistry, Challenges, Cost, and Future. *The Journal of Undergraduate Research at the University of Illinois at Chicago* 9(2).
<http://journals.uic.edu/ojs/index.php/JUR/article/view/7553>.
- Patrício, J., Y. Kalmykova, P.E.O. Berg, L. Rosado, and H. Åberg. 2015. Primary and secondary battery consumption trends in Sweden 1996–2013: method development and detailed accounting by battery type. *Waste Management* 39: 236–245.
<http://www.sciencedirect.com/science/article/pii/S0956053X15000914>.
- Pauliuk, S. 2014. Python Dynamic Stock Model. Trondheim, Norway.
https://github.com/stefanpauliuk/dynamic_stock_model.
- Pauliuk, S., A. Arvesen, K. Stadler, and E.G. Hertwich. 2017. Industrial ecology in integrated assessment models. *Nature Climate Change* 7(1): 13–20. <http://www.nature.com/articles/nclimate3148>.
- Pauliuk, S., N.M.A. Dhaniati, and D.B. Müller. 2012a. Reconciling Sectoral Abatement Strategies with Global Climate Targets: The Case of the Chinese Passenger Vehicle Fleet. *Environmental Science & Technology* 46(1): 140–147. <http://dx.doi.org/10.1021/es201799k>.
- Pauliuk, S. and N. Heeren. 2018. Open Dynamic Material Systems Model. <https://github.com/IndEcol/ODYM>.
- Pauliuk, S. and N. Heeren. 2019. ODYM—An open software framework for studying dynamic material systems: Principles, implementation, and data structures. *Journal of Industrial Ecology*: jiec.12952.
<https://onlinelibrary.wiley.com/doi/abs/10.1111/jiec.12952>.

References

- Pauliuk, S. and E.G. Hertwich. 2015. Socioeconomic metabolism as paradigm for studying the biophysical basis of human societies. *Ecological Economics* 119: 83–93. <http://www.sciencedirect.com/science/article/pii/S0921800915003481>.
- Pauliuk, S., R.L. Milford, D.B. Müller, and J.M. Allwood. 2013a. The steel scrap age. *Environmental Science and Technology* 47(7): 3448–3454.
- Pauliuk, S. and D.B. Müller. 2014. The role of in-use stocks in the social metabolism and in climate change mitigation. *Global Environmental Change* 24: 132–142. <https://linkinghub.elsevier.com/retrieve/pii/S0959378013001982>.
- Pauliuk, S., T. Wang, and D.B. Müller. 2012b. Moving Toward the Circular Economy: The Role of Stocks in the Chinese Steel Cycle. *Environmental Science & Technology* 46(1): 148–154. <http://pubs.acs.org/doi/abs/10.1021/es201904c>.
- Pauliuk, S., T. Wang, and D.B. Müller. 2013b. Steel all over the world: Estimating in-use stocks of iron for 200 countries. *Resources, Conservation and Recycling* 71: 22–30. <http://www.sciencedirect.com/science/article/pii/S0921344912002078>.
- Peck, D., and C.A. Bakker. 2012. Eco-design opportunities for critical material supply risks. In *Proceedings Electronics Goes Green 2012+ Taking Green to the next Level*, ed. by K.D. Lang, N.F. Nissen, A. Middendorf, and P. Chancerel., 1–6. Stuttgart: Fraunhofer Verlag.
- Pelletier, S., O. Jabali, and G. Laporte. 2014. *Battery Electric Vehicles for Goods Distribution: A Survey of Vehicle Technology, Market Penetration, Incentives and Practices*.
- Philips. 2009. *SAA1575HL Global Positioning System (GPS) baseband processor*. <http://pdf.datasheetcatalog.com/datasheet/philips/SAA1575HL.pdf>.
- Pihl, E., D. Kushnir, B. Sandén, and F. Johnsson. 2012. Material constraints for concentrating solar thermal power. *Energy* 44(1): 944–954. <http://www.sciencedirect.com/science/article/pii/S036054421200374X>.
- Pinky Devi, L. and S. Palaniappan. 2014. A case study on life cycle energy use of residential building in Southern India. *Energy and Buildings* 80: 247–259.
- Polák, M. and L. Drápalová. 2012. Estimation of end of life mobile phones generation: The case study of the Czech Republic. *Waste Management* 32(8): 1583–1591. <https://linkinghub.elsevier.com/retrieve/pii/S0956053X12001390>.
- Rail Freight Forward. 2020. *30 by 2030: Rail Freight strategy to boost modal shift*. https://www.railfreightforward.eu/sites/default/files/usercontent/white_paper-30by2030-150dpi6.pdf.
- Railfaneurope.net. 2020. The Railfaneurope.net Stock Lists. April 4. http://www.railfaneurope.net/list_frameset.html.
- Railway Association of Canada. 2018. *Rail trends | 2018*. <https://www.railcan.ca/wp-content/uploads/2018/12/2018-Rail-Trends.pdf>.
- Ramesh, T., R. Prakash, and K.K. Shukla. 2012. Life cycle energy analysis of a residential building with different envelopes and climates in Indian context. *Applied Energy* 89: 193–202.
- Rao, N.D. and J. Min. 2018. Decent Living Standards: Material Prerequisites for Human Wellbeing. *Social Indicators Research* 138(1): 225–244. <http://link.springer.com/10.1007/s11205-017-1650-0>.
- Rauf, A. and R.H. Crawford. 2015. Building service life and its effect on the life cycle embodied energy of buildings. *Energy* 79: 140–148.
- Reid, W. V., H.A. Mooney, A. Cropper, D. Capistrano, S.R. Carpenter, K. Chopra, P. Dasgupta, et al. 2005. *Millennium Ecosystem Assessment - Ecosystems and Human Well-being: Synthesis*. Washington D.C.: Island Press. <https://www.millenniumassessment.org/documents/document.356.aspx.pdf>.

- Reyna, J.L. and M. V. Chester. 2015. The Growth of Urban Building Stock: Unintended Lock-in and Embedded Environmental Effects. *Journal of Industrial Ecology* 19(4): 524–537. <http://doi.wiley.com/10.1111/jiec.12211>.
- Reza, B., R. Sadiq, and K. Hewage. 2014. Emergy-based life cycle assessment (Em-LCA) of multi-unit and single-family residential buildings in Canada. *International Journal of Sustainable Built Environment* 3(2): 207–224.
- Riahi, K., D.P. van Vuuren, E. Kriegler, J. Edmonds, B.C. O’Neill, S. Fujimori, N. Bauer, et al. 2017. The Shared Socioeconomic Pathways and their energy, land use, and greenhouse gas emissions implications: An overview. *Global Environmental Change* 42: 153–168. <http://www.sciencedirect.com/science/article/pii/S0959378016300681>.
- Richa, K., C.W. Babbitt, G. Gaustad, and X. Wang. 2014. A future perspective on lithium-ion battery waste flows from electric vehicles. *Resources, Conservation and Recycling* 83: 63–76. <http://www.sciencedirect.com/science/article/pii/S092134491300253X>.
- Rogner, M. and N. Troja. 2018. *The world’s water battery: Pumped hydropower storage and the clean energy transition*. London. <https://www.hydropower.org/publications/the-world’s-water-battery-pumped-hydropower-storage-and-the-clean-energy-transition>.
- Rosselló-Batle, B., A. Moià, A. Cladera, and V. Martínez. 2010. Energy use, CO2 emissions and waste throughout the life cycle of a sample of hotels in the Balearic Islands. *Energy and Buildings* 42(4): 547–558. <http://www.sciencedirect.com/science/article/pii/S0378778809002734>.
- Ruijven, B.J. van, E. De Cian, and I. Sue Wing. 2019. Amplification of future energy demand growth due to climate change. *Nature Communications* 10(1): 2762. <https://doi.org/10.1038/s41467-019-10399-3>.
- Ruijven, B.J. van, D.P. van Vuuren, W. Boskaljon, M.L. Neelis, D. Saygin, and M.K. Patel. 2016. Long-term model-based projections of energy use and CO2 emissions from the global steel and cement industries. *Resources, Conservation and Recycling* 112: 15–36. <http://www.sciencedirect.com/science/article/pii/S0921344916301008>.
- Ruijven, B.J. van, D.P. van Vuuren, J. van Vliet, A. Mendoza Beltran, S. Deetman, and M.G.J. den Elzen. 2012. Implications of greenhouse gas emission mitigation scenarios for the main Asian regions. *Energy Economics* 34(SUPPL. 3).
- Rydh, C.J. 1999. Environmental assessment of vanadium redox and lead-acid batteries for stationary energy storage. *Journal of Power Sources* 80(1–2): 21–29. <https://linkinghub.elsevier.com/retrieve/pii/S0378775398002493>.
- S&T2 consultants. 2006. *A Review of GHG emissions from Plant Construction and Decommissioning*. Delta, Canada: Natural Resources Canada. <http://www.ghgenius.ca/reports/ConstructionEmissions.pdf>.
- Sandberg, N.H., I. Sartori, and H. Brattebø. 2014. Sensitivity analysis in long-term dynamic building stock modeling—Exploring the importance of uncertainty of input parameters in Norwegian segmented dwelling stock model. *Energy and Buildings* 85: 136–144. <http://www.sciencedirect.com/science/article/pii/S037877881400721X>.
- Sartori, I., B.J. Wachenfeldt, and A.G. Hestnes. 2009. Energy demand in the Norwegian building stock: Scenarios on potential reduction. *Energy Policy* 37(5): 1614–1627. <http://www.sciencedirect.com/science/article/pii/S0301421508007593>.
- Scania. 2020. Scania deploys battery electric trucks in Norway. April 10. <https://www.scania.com/group/en/scania-deploys-battery-electric-trucks-in-norway/>.
- Schandl, H., M. Fischer-Kowalski, J. West, S. Giljum, M. Dittrich, N. Eisenmenger, A. Geschke, et al. 2018. Global Material Flows and Resource Productivity: Forty Years of Evidence. *Journal of Industrial Ecology* 22(4): 827–838. <http://doi.wiley.com/10.1111/jiec.12626>.



References

- Schandl, H., Y. Lu, N. Che, D. Newth, J. West, S. Frank, M. Obersteiner, A. Rendall, and S. Hatfield-Dodds. 2020. Shared socio-economic pathways and their implications for global materials use. *Resources, Conservation and Recycling* 160: 104866. <https://linkinghub.elsevier.com/retrieve/pii/S0921344920301853>.
- Schebek, L., B. Schnitzer, D. Blesinger, A. Köhn, B. Miekley, H.J. Linke, A. Lohmann, C. Motzko, and A. Seemann. 2017. Material stocks of the non-residential building sector: the case of the Rhine-Main area. *Resources, Conservation and Recycling* 123: 24–36. <http://www.sciencedirect.com/science/article/pii/S0921344916301380>.
- Schipper, B.W., H.-C. Lin, M.A. Meloni, K. Wansleeben, R. Heijungs, and E. van der Voet. 2018. Estimating global copper demand until 2100 with regression and stock dynamics. *Resources, Conservation and Recycling* 132: 28–36. <https://linkinghub.elsevier.com/retrieve/pii/S0921344918300041>.
- Schneider Electric. 2011. Product Environmental Profile of the ClimaSys CV. https://download.schneider-electric.com/files?p_Doc_Oid=2331884.
- Schoemaker, J.T. 2007. *Research on the Weight of Buses and Touring Coaches*. <https://www.iru.org/sites/default/files/2016-01/en-nea-bus-2007.pdf>.
- Schulze, R. and M. Buchert. 2016. Estimates of global REE recycling potentials from NdFeB magnet material. *Resources, Conservation and Recycling* 113: 12–27. <http://www.sciencedirect.com/science/article/pii/S0921344916301148>.
- SCI Verkehr. 2017. *2017 Buses - Global Market Trends*. https://www.sci.de/fileadmin/user_upload/Flyer_MC_Bus.pdf.
- Sen, B., T. Ercan, and O. Tatari. 2017. Does a battery-electric truck make a difference? - Life cycle emissions, costs, and externality analysis of alternative fuel-powered Class 8 heavy-duty trucks in the United States. *Journal of Cleaner Production* 141: 110–121.
- Seo, Y. and S. Morimoto. 2014. Comparison of dysprosium security strategies in Japan for 2010–2030. *Resources Policy* 39: 15–20.
- Sharma, A. and B.M. Marwaha. 2015. A methodology for energy performance classification of residential building stock of Hamirpur. *HBRC Journal* 13(3).
- Sharmina, M., O.Y. Edelenbosch, C. Wilson, R. Freeman, D.E.H.J. Gernaat, P. Gilbert, A. Larkin, et al. 2020. Decarbonising the critical sectors of aviation, shipping, road freight and industry to limit warming to 1.5–2°C. *Climate Policy*: 1–20. <https://www.tandfonline.com/doi/full/10.1080/14693062.2020.1831430>.
- Shukla, A., G.N. Tiwari, and M.S. Sodha. 2009. Embodied energy analysis of adobe house. *Renewable Energy* 34: 755–761.
- Sibilski, L. 2016. We, the people, for the global bicycle momentum. *World Bank Blog*. <https://web.worldbank.org/archive/website01603/WEB/BIKE.HTM>. Accessed December 7, 2020.
- Singh, B., E.A. Bouman, A.H. Strømman, and E.G. Hertwich. 2015. Material use for electricity generation with carbon dioxide capture and storage: Extending life cycle analysis indices for material accounting. *Resources, Conservation and Recycling* 100: 49–57.
- Singh, R., C. Sharma, and M. Agrawal. 2017. Emission inventory of trace gases from road transport in India. *Transportation Research Part D: Transport and Environment* 52: 64–72. <https://linkinghub.elsevier.com/retrieve/pii/S1361920915300122>.
- Södersten, C.-J., R. Wood, and E.G. Hertwich. 2018. Environmental Impacts of Capital Formation. *Journal of Industrial Ecology* 22(1): 55–67. <http://doi.wiley.com/10.1111/jiec.12532>.
- Speirs, J., Y. Houari, and R. Gross. 2013. Materials Availability : Comparison of material criticality studies - methodologies and results. *UK Energy Research Centre*. UK ERC (United Kingdom Energy Research

- Centre) and the ICEPT (Imperial College Centre for Energy Policy and Technology). <http://www.ukerc.ac.uk/asset/B0251ACF-8BFD-4BC7-B537D7B2EDED48F8/>.
- Spielmann, M., C. Bauer, R. Dones, and M. Tuchschnid. 2007. Transport Services. Ecoinvent report no. 14. *Swiss Centre for Life Cycle Inventories*.
- Sprecher, B., Y. Xiao, A. Walton, J. Speight, R. Harris, R. Kleijn, G. Visser, and G.J. Kramer. 2014. Life Cycle Inventory of the Production of Rare Earths and the Subsequent Production of NdFeB Rare Earth Permanent Magnets. *Environmental Science & Technology* 48(7): 3951–3958.
- Statistics Norway. 2020. Road traffic volumes. April 8. <https://www.ssb.no/en/klreg>.
- SteelConstruction.info. 2019. Engineering students' guide to multi-storey buildings. https://www.steelconstruction.info/Engineering_students%27_guide_to_multi-storey_buildings.
- Steger, S. and R. Bleischwitz. 2011. Drivers for the use of materials across countries. *Journal of Cleaner Production* 19(8): 816–826.
- Stehfest, E., D. van Vuuren, T. Kram, L. Bouwma, L. Bouwman, R. Alkemade, M. Bakkenes, et al. 2014. *Integrated assessment of global environmental change with IMAGE 3.0: Model description and policy applications*. Ed. by Elke Stehfest, Detlef P. van Vuuren, Tom Kram, and Lex Bouwman. The Hague, the Netherlands: PBL Netherlands Environmental Assessment Agency.
- Steinbuks, J. 2017. Assessing the accuracy of electricity demand forecasts in developing countries. *Working Paper*. <https://documents1.worldbank.org/curated/en/728681487169710866/pdf/WPS7974.pdf>.
- Stephan, A. 2013. Towards a comprehensive energy assessment of residential buildings. The University of Melbourne, Australia. www.msdl.unimelb.edu.au.
- Stephan, A. and A. Athanassiadis. 2017. Quantifying and mapping embodied environmental requirements of urban building stocks. *Building and Environment* 114: 187–202. <http://www.sciencedirect.com/science/article/pii/S0360132316304747>.
- Stephan, A. and A. Athanassiadis. 2018. Towards a more circular construction sector: Estimating and spatialising current and future non-structural material replacement flows to maintain urban building stocks. *Resources, Conservation and Recycling* 129(April 2017): 248–262.
- Stephan, A., R.H. Crawford, and K. De Myttenaere. 2012. Towards a comprehensive life cycle energy analysis framework for residential buildings. *Energy and Buildings*.
- Stephan, A. and L. Stephan. 2014. Reducing the total life cycle energy demand of recent residential buildings in Lebanon. *Energy* 74: 618–637.
- Strijbos, R.C., A. Jansman, J.W. Lobeek, and N. Pulsford. 2007. Design and Characterisation of High-Q Solidly-Mounted Bulk Acoustic Wave Filters. In *IEEE Electronic Components and Technology Conference*, 196–174.
- Stripple, H. and S. Uppenberg. 2010. *Life cycle assessment of railways and rail transports - Application in environmental product declarations (EPDs) for the Bothnia line*.
- Su, X. and X. Zhang. 2016. A detailed analysis of the embodied energy and carbon emissions of steel-construction residential buildings in China. *Energy and Buildings* 119: 323–330 Contents.
- Sullivan, J.L., C.E. Clarck, L. Yuan, J. Han, and M. Wang. 2011. *Life-Cycle Analysis Results for Geothermal Systems in Comparison to Other Power Systems: Part II*. Argonne. <https://publications.anl.gov/anlpubs/2012/01/72073.pdf>.
- Sullivan, J.L. and L. Gaines. 2010. *A Review of Battery Life-Cycle Analysis: State of Knowledge and Critical Needs*. Argonne. https://greet.es.anl.gov/publication-batteries_lca.
- Suzuki, M., T. Oka, and K. Okada. 1995. The estimation of energy consumption and CO2 emission due to

References

- housing construction in Japan. *Energy and Buildings* 22: 165–169.
- Sykes, J.P., J.P. Wright, A. Trench, and P. Miller. 2016. An assessment of the potential for transformational market growth amongst the critical metals. *Applied Earth Science* 125(1): 21–56. <https://doi.org/10.1080/03717453.2015.1104055>.
- Tan, P., H.R. Jiang, X.B. Zhu, L. An, C.Y. Jung, M.C. Wu, L. Shi, W. Shyy, and T.S. Zhao. 2017. Advances and challenges in lithium-air batteries. *Applied Energy* 204: 780–806. <https://linkinghub.elsevier.com/retrieve/pii/S0306261917309091>.
- Tanikawa, H., T. Fishman, K. Okuoka, and K. Sugimoto. 2015. The Weight of Society Over Time and Space: A Comprehensive Account of the Construction Material Stock of Japan, 1945–2010. *Journal of Industrial Ecology* 19(5): 778–791. <https://onlinelibrary.wiley.com/doi/abs/10.1111/jiec.12284>.
- Tanikawa, H. and S. Hashimoto. 2009. Urban stock over time: spatial material stock analysis using 4d-GIS. *Building Research & Information* 37(5–6): 483–502. <https://www.tandfonline.com/doi/full/10.1080/09613210903169394>.
- Teh, S.H., T. Wiedmann, J. Schinabeck, and S. Moore. 2017. Replacement Scenarios for Construction Materials Based on Economy-wide Hybrid LCA. *Procedia Engineering* 180: 179–189. <http://www.sciencedirect.com/science/article/pii/S1877705817316843>.
- Tickner, J., R. Rajarao, B. Lovric, B. Ganly, and V. Sahajwalla. 2016. Measurement of Gold and Other Metals in Electronic and Automotive Waste Using Gamma Activation Analysis. *Journal of Sustainable Metallurgy* 2(4): 1–8. <http://link.springer.com/article/10.1007/s40831-016-0051-y>.
- Trenitalia. 2018. *TRENITALIA S.p.A RELAZIONE FINANZIARIA ANNUALE AL 31 DICEMBRE 2018*. https://www.fsitaliane.it/content/dam/fsitaliane/Documents/il-gruppo/Bilancio_esercizio_Trenitalia_31_12_2018.pdf.
- Truttmann, N. and H. Rechberger. 2006. Contribution to resource conservation by reuse of electrical and electronic household appliances. *Resources, Conservation and Recycling* 48(3): 249–262.
- Tu, J., W. Zou, and H. He. 2014. *New light commercial vehicles in China, 2010: Technology assessment and international comparisons*.
- Tukker, A., R. Wood, and S. Giljum. 2018. Relevance of Global Multi Regional Input Output Databases for Global Environmental Policy: Experiences with EXIOBASE 3. *Journal of Industrial Ecology* 22(3): 482–484. <http://doi.wiley.com/10.1111/jiec.12767>.
- Turconi, R., C.G. Simonsen, I.P. Byriel, and T. Astrup. 2014. Life cycle assessment of the Danish electricity distribution network. *The International Journal of Life Cycle Assessment* 19(1): 100–108. <http://link.springer.com/10.1007/s11367-013-0632-y>.
- U.S. Department of Energy. 2011. Critical Materials Strategy. https://energy.gov/sites/prod/files/DOE_CMS2011_FINAL_Full.pdf.
- U S Department of Transportation. 2019. *Developing a statistically valid and practical method to compute Bus and Truck occupancy data*. https://www.fhwa.dot.gov/policyinformation/tables/occupancyfactors/fhwa_pl_19_048.pdf.
- Ueckerdt, F., R. Pietzcker, Y. Scholz, D. Stetter, A. Giannousakis, and G. Luderer. 2017. Decarbonizing global power supply under region-specific consideration of challenges and options of integrating variable renewables in the REMIND model. *Energy Economics* 64: 665–684. <https://linkinghub.elsevier.com/retrieve/pii/S014098831630130X>.
- UIC. 2018. *UIC activity report 2018*. https://uic.org/IMG/pdf/uic_activity_report_2018.pdf.
- UIC. 2020. *World High Speed Rolling Stock*. https://uic.org/IMG/pdf/20200127_high_speed_rolling_stock.pdf.
- UITP. 2017. Performance analysis of India public bus sector 2015-2016. April 9.

- <https://india.uitp.org/articles/performance-analysis-of-india-public-bus-sector>.
- UITP. 2019. *Global bus survey*. https://cms.uitp.org/wp/wp-content/uploads/2020/07/Statistics-Brief_Global-bus-survey-003.pdf.
- UN-HABITAT. 2013. Global Housing Strategy framework document. *Activities of the United Nations Human Settlements Programme*: 1–15. <http://eprints.lanacs.ac.uk/29226/>.
- UNCTAD. 2005. *Review of maritime transport 2005-2019*. https://unctad.org/system/files/official-document/rmt2005_en.pdf.
- UNCTAD. 2019. *Review of Maritime Transport 2019*. New York. https://unctad.org/system/files/official-document/rmt2019_en.pdf.
- UNData. 2018a. Per capita GDP at current prices. *National Accounts Estimates of Main Aggregates, United Nations Statistics Division*. <http://data.un.org/Data.aspx?q=GDP&d=SNAAMA&f=grID%3A101%3BcurrID%3AUSD%3BpcFlag%3A1#SNAAMA>.
- UNData. 2018b. GVA by kind of economic activity. *National Accounts; United Nations Statistics Division*. <http://data.un.org/>. Accessed November 19, 2018.
- UNECE. 2017. *Trans-European Railway High-Speed: Master Plan Study*. https://www.unece.org/fileadmin/DAM/trans/main/ter/terdocs/TER_High-Speed_Master_Plan_Study.pdf.
- UNFCCC. Conference of the Parties (COP). 2015. *Paris Climate Change Conference-November 2015, COP 21. Adoption of the Paris Agreement. Proposal by the President*. Vol. 21932. <http://unfccc.int/resource/docs/2015/cop21/eng/l09r01.pdf>.
- United Nations. 2019. *The sustainable development goals report 2019. United Nations Publication Issued by the Department of Economic and Social Affairs*. New York. <https://unstats.un.org/sdgs/report/2019/The-Sustainable-Development-Goals-Report-2019.pdf>.
- Urge-Vorsatz, D. and E.L. Ksenia Petrichenko, Miklos Antal, Maja Staniec, Michael Labelle, Eren Ozden. 2012. *Best Practice Policies for Low Energy and Carbon Buildings. A Scenario Analysis*. Central European University Press. http://www.gbpn.org/sites/default/files/08.CEU_Technical_Report_copy_0.pdf.
- US Department of Transportation. 2017. *King County Metro Battery Electric Bus Demonstration — Preliminary Project Results*. https://afdc.energy.gov/files/u/publication/king_county_be_bus_preliminary.pdf.
- USGS. 2011. *2011 Minerals Yearbook: Niobium and Tantalum (advance release)*. <http://minerals.usgs.gov/minerals/pubs/commodity/niobium/myb1-2011-niobi.pdf>.
- USGS. 2012. *2012 Minerals Yearbook: Niobium and Tantalum (advance release)*. <http://minerals.usgs.gov/minerals/pubs/commodity/niobium/myb1-2012-niobi.pdf>.
- USGS. 2017. Mineral commodity summaries 2017. *U.S. Geological Survey*.
- Utama, A. and S.H. Gheewala. 2008. Life cycle energy of single landed houses in Indonesia. *Energy and Buildings* 40: 1911–1916 Contents.
- Utama, A. and S.H. Gheewala. 2009. Indonesian residential high rise buildings: A life cycle energy assessment. *Energy and Buildings* 41: 2263–2268.
- Valero, A., A. Valero, G. Calvo, and A. Ortego. 2018. Material bottlenecks in the future development of green technologies. *Renewable and Sustainable Energy Reviews* 93: 178–200. <https://linkinghub.elsevier.com/retrieve/pii/S1364032118303861>.
- Vásquez, F., A.N. Løvik, N.H. Sandberg, and D.B. Müller. 2016. Dynamic type-cohort-time approach for the analysis of energy reductions strategies in the building stock. *Energy and Buildings* 111: 37–55.

References

- <http://www.sciencedirect.com/science/article/pii/S0378778815303832>.
- Verma, S., G. Dwivedi, and P. Verma. 2021. Life cycle assessment of electric vehicles in comparison to combustion engine vehicles: A review. *Materials Today: Proceedings*. <https://linkinghub.elsevier.com/retrieve/pii/S221478532100763X>.
- Vici Ventus. 2020. Offshore Wind Turbines: Concrete Foundations. Lysaker: Vici Ventus. https://viciventus.no/global/upload/3sPPQ/files/GBF_product_sheet_231111.pdf.
- Voet, E. Van der, L. Van Oers, M. Verboon, and K. Kuipers. 2019. Environmental Implications of Future Demand Scenarios for Metals: Methodology and Application to the Case of Seven Major Metals. *Journal of Industrial Ecology* 23(1): 141–155. <https://onlinelibrary.wiley.com/doi/abs/10.1111/jiec.12722>.
- Volvo. 2020. Volvo 7900 electric hybrid. April 10. <https://www.volvobuses.co.uk/content/dam/volvo/volvo-buses/markets/uk/our-offering/buses/7900electricybrid/documents/7900-Electric-Hybrid-spec.pdf>.
- Vuuren, D. van, J. Edmonds, M. Kainuma, K. Riahi, A. Thomson, K. Hibbard, G. Hurtt, et al. 2011a. The representative concentration pathways: an overview. *Climatic Change* 109(5): 1–27. <http://dx.doi.org/10.1007/s10584-011-0148-z>.
- Vuuren, D. van, M. den Elzen, P. Lucas, B. Eickhout, B. Strengers, B. van Ruijven, S. Wonink, and R. van Houtd. 2007. Stabilizing greenhouse gas concentrations at low levels: an assessment of reduction strategies and costs. *Climatic Change* 81(2): 119–159. <http://dx.doi.org/10.1007/s10584-006-9172-9>.
- Vuuren, D. van, E. Stehfest, M. den Elzen, T. Kram, J. van Vliet, S. Deetman, M. Isaac, et al. 2011b. RCP 2.6: exploring the possibility to keep global mean temperature increase below 2°C. *Climatic Change* 109(1): 95–116. <http://www.springerlink.com/content/701751t54248643j/abstract/>.
- Vuuren, D.P. van. 2007. Energy systems and climate policy: Long-term scenarios for an uncertain future. Utrecht University. <http://dspace.library.uu.nl/handle/1874/21449>.
- Vuuren, D.P. van, O.Y. Edelenbosch, D.L. McCollum, and K. Riahi. 2017a. A special issue on model-based long-term transport scenarios: Model comparison and new methodological developments to improve energy and climate policy analysis. *Transportation Research Part D: Transport and Environment* 55: 277–280. <https://linkinghub.elsevier.com/retrieve/pii/S1361920917303826>.
- Vuuren, D.P. van, E. Kriegler, B.C. O'Neill, K.L. Ebi, K. Riahi, T.R. Carter, J. Edmonds, et al. 2014. A new scenario framework for Climate Change Research: scenario matrix architecture. *Climatic Change* 122(3): 373–386. <http://dx.doi.org/10.1007/s10584-013-0906-1>.
- Vuuren, D.P. van, K. Riahi, K. Calvin, R. Dellink, J. Emmerling, S. Fujimori, S. KC, E. Kriegler, and B. O'Neill. 2017b. The Shared Socio-economic Pathways: Trajectories for human development and global environmental change. *Global Environmental Change* 42: 148–152. <http://www.sciencedirect.com/science/article/pii/S0959378016301790>.
- Vuuren, D.P. van, E. Stehfest, D.E.H.J. Gernaat, J.C. Doelman, M. van den Berg, M. Harmsen, H.S. de Boer, et al. 2017c. Energy, land-use and greenhouse gas emissions trajectories under a green growth paradigm. *Global Environmental Change* 42: 237–250. <http://www.sciencedirect.com/science/article/pii/S095937801630067X>.
- Vuuren, D.P. van, B.J. Strengers, and H.J.M. De Vries. 1999. Long-term perspectives on world metal use - a system-dynamics model. *Resources Policy* 25(4): 239–255.
- Walker, A. 2010. The Emergence and Application of Active Aging in Europe. In *Soziale Lebenslaufpolitik*, 585–601. Wiesbaden: VS Verlag für Sozialwissenschaften. http://link.springer.com/10.1007/978-3-531-92214-0_22.
- Wang, F., J. Huisman, A. Stevels, and C.P. Baldé. 2013. Enhancing e-waste estimates: Improving data quality by multivariate Input–Output Analysis. *Waste Management* 33(11): 2397–2407. <https://linkinghub.elsevier.com/retrieve/pii/S0956053X13003073>.

- Wang, H., N. Li, W. Chen, and J. Shi. 2017. Analysis on building sector's energy consumption and mitigation potential under SSP2. *Energy Procedia* 142: 2435–2440.
- Wang, T., D.B. Müller, and S. Hashimoto. 2015a. The Ferrous Find: Counting Iron and Steel Stocks in China's Economy. *Journal of Industrial Ecology* 19(5): 877–889. <https://doi.org/10.1111/jiec.12319>.
- Wang, T., X. Tian, S. Hashimoto, and H. Tanikawa. 2015b. Concrete transformation of buildings in China and implications for the steel cycle. *Resources, Conservation and Recycling* 103: 205–215. <http://www.sciencedirect.com/science/article/pii/S0921344915300549>.
- Watari, T., B.C. McLellan, D. Giurco, E. Dominish, E. Yamasue, and K. Nansai. 2019. Total material requirement for the global energy transition to 2050: A focus on transport and electricity. *Resources, Conservation and Recycling* 148: 91–103. <https://linkinghub.elsevier.com/retrieve/pii/S0921344919302290>.
- Watari, T., K. Nansai, D. Giurco, K. Nakajima, B. McLellan, and C. Helbig. 2020. Global Metal Use Targets in Line with Climate Goals. *Environmental Science & Technology* 54(19): 12476–12483. <https://pubs.acs.org/doi/10.1021/acs.est.0c02471>.
- Watari, T., K. Nansai, and K. Nakajima. 2021. Major metals demand, supply, and environmental impacts to 2100: A critical review. *Resources, Conservation and Recycling* 164: 105107. <https://linkinghub.elsevier.com/retrieve/pii/S0921344920304249>.
- Watari, T. and R. Yokoi. 2021. International inequality in in-use metal stocks: What it portends for the future. *Resources Policy* 70: 101968. <https://linkinghub.elsevier.com/retrieve/pii/S030142072030996X>.
- Weitzel, P.S., J.M. Tanzosh, B. Boring, N. Okita, T. Takahashi, and N. Ishikawa. 2012. *Advanced Ultra-Supercritical Power Plant (700 to 760C) Design for Indian Coal. Proceedings of Power-Gen Asia, Thailand*.
- Werfel, F.N., U.F.-Delor, T. Riedel, R. Rothfeld, D. Wippich, B. Goebel, G. Reiner, and N. Wehlauf. 2008. 250 kW flywheel with HTS magnetic bearing for industrial use. *Journal of Physics: Conference Series* 97: 012206. <https://iopscience.iop.org/article/10.1088/1742-6596/97/1/012206>.
- Widmer, R., X. Du, O. Haag, E. Restrepo, and P.A. Wäger. 2015. Scarce metals in conventional passenger vehicles and end-of-life vehicle shredder output. *Environmental Science & Technology* 49(7): 4591–4599.
- Wiedenhofer, D., T. Fishman, C. Lauk, W. Haas, and F. Krausmann. 2019. Integrating Material Stock Dynamics Into Economy-Wide Material Flow Accounting: Concepts, Modelling, and Global Application for 1900–2050. *Ecological Economics* 156.
- Wiedenhofer, D., J.K. Steinberger, N. Eisenmenger, and W. Haas. 2015. Maintenance and Expansion: Modeling Material Stocks and Flows for Residential Buildings and Transportation Networks in the EU25. *Journal of Industrial Ecology* 19(4): 538–551. <https://onlinelibrary.wiley.com/doi/abs/10.1111/jiec.12216>.
- Wiedmann, T.O., H. Schandl, M. Lenzen, D. Moran, S. Suh, J. West, and K. Kanemoto. 2015. The material footprint of nations. *Proceedings of the National Academy of Sciences* 112(20): 6271–6276. <http://www.pnas.org/lookup/doi/10.1073/pnas.1220362110>.
- Wikipedia. 2019. Nickel–metal hydride battery. https://en.wikipedia.org/wiki/Nickel–metal_hydride_battery. Accessed November 25, 2019.
- Wilburn, D.R. 2012. Wind energy in the United States and materials required for the land-based wind turbine industry from 2010 through 2030. In *Wind Turbine Manufacturing in the U.S.: Developments and Considerations*.
- Wiseman, J., T. Edwards, and K. Luckins. 2013. Post carbon pathways: A meta-analysis of 18 large-scale post carbon economy transition strategies. *Environmental Innovation and Societal Transitions* 8: 76–93. <https://linkinghub.elsevier.com/retrieve/pii/S2210422413000397>.
- Wong, S. 2019. Number of transport ships in China 2008-2018. *Statista*. April 9.

References

- <https://www.statista.com/statistics/258515/number-of-vessels-in-china/>.
- Woods, R.O. 2009. The Genesis of the Steamboat. *Mechanical Engineering* 131(4): 44–47.
- World Energy Council. 2016. *World Energy Resources report 2016*. London, UK. https://www.worldenergy.org/wp-content/uploads/2016/10/World-Energy-Resources_Report_2016.pdf.
- World Steel Association. 2020. Global crude steel output increases by 3.4% in 2019. <https://www.worldsteel.org/media-centre/press-releases/2020/Global-crude-steel-output-increases-by-3.4--in-2019.html>. Accessed February 2, 2021.
- Xu, G., P. Han, S. Dong, H. Liu, G. Cui, and L. Chen. 2017. Li 4 Ti 5 O 12 -based energy conversion and storage systems: Status and prospects. *Coordination Chemistry Reviews* 343: 139–184. <https://linkinghub.elsevier.com/retrieve/pii/S0010854517301121>.
- Yan, G., M. Xue, and Z. Xu. 2013. Disposal of waste computer hard disk drive: data destruction and resources recycling. *Waste Management & Research: The Journal for a Sustainable Circular Economy* 31(6): 559–567. <http://journals.sagepub.com/doi/10.1177/0734242X13481085>.
- Yan, X. and R.J. Crookes. 2009. Reduction potentials of energy demand and GHG emissions in China’s road transport sector. *Energy Policy* 37(2): 658–668. <https://linkinghub.elsevier.com/retrieve/pii/S0301421508005867>.
- Yang, L., C. Hao, and Y. Chai. 2018a. Life Cycle Assessment of Commercial Delivery Trucks: Diesel, Plug-In Electric, and Battery-Swap Electric. *Sustainability* 10(12): 4547–4568.
- Yang, X., M. Hu, J. Wu, and B. Zhao. 2018b. Building-information-modeling enabled life cycle assessment, a case study on carbon footprint accounting for a residential building in China. *Journal of Cleaner Production*.
- Yang, Y., B. Qiao, X. Yang, L. Fang, C. Pan, W. Song, H. Hou, and X. Ji. 2014. Lithium Titanate Tailored by Cathodically Induced Graphene for an Ultrafast Lithium Ion Battery. *Advanced Functional Materials* 24(27): 4349–4356. <http://doi.wiley.com/10.1002/adfm.201304263>.
- Yano, J., T. Muroi, and S. Sakai. 2016. Rare earth element recovery potentials from end-of-life hybrid electric vehicle components in 2010–2030. *Journal of Material Cycles and Waste Management* 18(4): 655–664. <http://dx.doi.org/10.1007/s10163-015-0360-4>.
- Yeh, S., G.S. Mishra, L. Fulton, P. Kyle, D.L. McCollum, J. Miller, P. Cazzola, and J. Teter. 2017. Detailed assessment of global transport-energy models’ structures and projections. *Transportation Research Part D: Transport and Environment* 55: 294–309. <https://linkinghub.elsevier.com/retrieve/pii/S1361920916301651>.
- Yoshimura, A. and Y. Matsuno. 2018. Dynamic Material Flow Analysis and Forecast of Copper in Global-Scale: Considering the Difference of Recovery Potential between Copper and Copper Alloy. *MATERIALS TRANSACTIONS* 59(6): 989–998. https://www.jstage.jst.go.jp/article/matertrans/59/6/59_M2017399/_article.
- Young, S.B. 2018. Responsible sourcing of metals: certification approaches for conflict minerals and conflict-free metals. *The International Journal of Life Cycle Assessment* 23(7): 1429–1447. <http://link.springer.com/10.1007/s11367-015-0932-5>.
- Yu, S., S. Schmohl, Z. Liu, M. Hoffmeyer, N. Schön, F. Hausen, H. Tempel, H. Kungl, H. Wiemhöfer, and R. Eichel. 2019. Insights into a layered hybrid solid electrolyte and its application in long lifespan high-voltage all-solid-state lithium batteries. *Journal of Materials Chemistry A* 7(8): 3882–3894. <http://xlink.rsc.org/?DOI=C8TA11259B>.
- Yue, Y., T. Wang, S. Liang, J. Yang, P. Hou, S. Qu, J. Zhou, X. Jia, H. Wang, and M. Xu. 2015. Life cycle assessment of High Speed Rail in China. *Transportation Research Part D* 41: 367–376.

- Zackrisson, M., K. Fransson, J. Hildenbrand, G. Lampic, and C. O'Dwyer. 2016. Life cycle assessment of lithium-air battery cells. *Journal of Cleaner Production* 135: 299–311. <https://linkinghub.elsevier.com/retrieve/pii/S0959652616307818>.
- Zardiackas, L.D., M.J. Kraay, and H.L. Freese. 2006. *Titanium, Niobium, Zirconium, and Tantalum for Medical and Surgical Applications*. West Conshohocken: ASTM. http://www.astm.org/DIGITAL_LIBRARY/STP/SOURCE_PAGES/STP1471_foreword.pdf.
- Zhang, L., Z. Yuan, and J. Bi. 2012. Estimation of Copper In-use Stocks in Nanjing, China. *Journal of Industrial Ecology* 16(2): 191–202. <http://onlinelibrary.wiley.com/doi/10.1111/j.1530-9290.2011.00406.x/abstract>.
- Zhang, R. and S. Fujimori. 2020. The role of transport electrification in global climate change mitigation scenarios. *Environmental Research Letters* 15(3): 034019. <https://iopscience.iop.org/article/10.1088/1748-9326/ab6658>.
- Zhang, W., S. Tan, Y. Lei, and S. Wang. 2014. Life cycle assessment of a single-family residential building in Canada: A case study. *Building Simulation*.
- Zhang, X., D. Geltner, and R. de Neufville. 2018. System Dynamics Modeling of Chinese Urban Housing Markets for Pedagogical and Policy Analysis Purposes. *The Journal of Real Estate Finance and Economics* 57(3): 476–501. <https://doi.org/10.1007/s11146-017-9650-z>.
- Zheng, B., H. Huo, Q. Zhang, Z.L. Yao, X.T. Wang, X.F. Yang, H. Liu, and K.B. He. 2014. High-resolution mapping of vehicle emissions in China in 2008. *Atmospheric Chemistry and Physics* 14(18): 9787–9805. <https://acp.copernicus.org/articles/14/9787/2014/>.
- Zhu, Z., A. Kushima, Z. Yin, L. Qi, K. Amine, J. Lu, and J. Li. 2016. Anion-redox nanolithia cathodes for Li-ion batteries. *Nature Energy* 1(8): 16111. <http://www.nature.com/articles/nenergy2016111>.
- Zimmermann, T. and S. Gößling-Reisemann. 2014. Recycling Potentials of Critical Metals-Analyzing Secondary Flows from Selected Applications. *Resources* 3(1): 291–318. <http://www.mdpi.com/2079-9276/3/1/291>.