

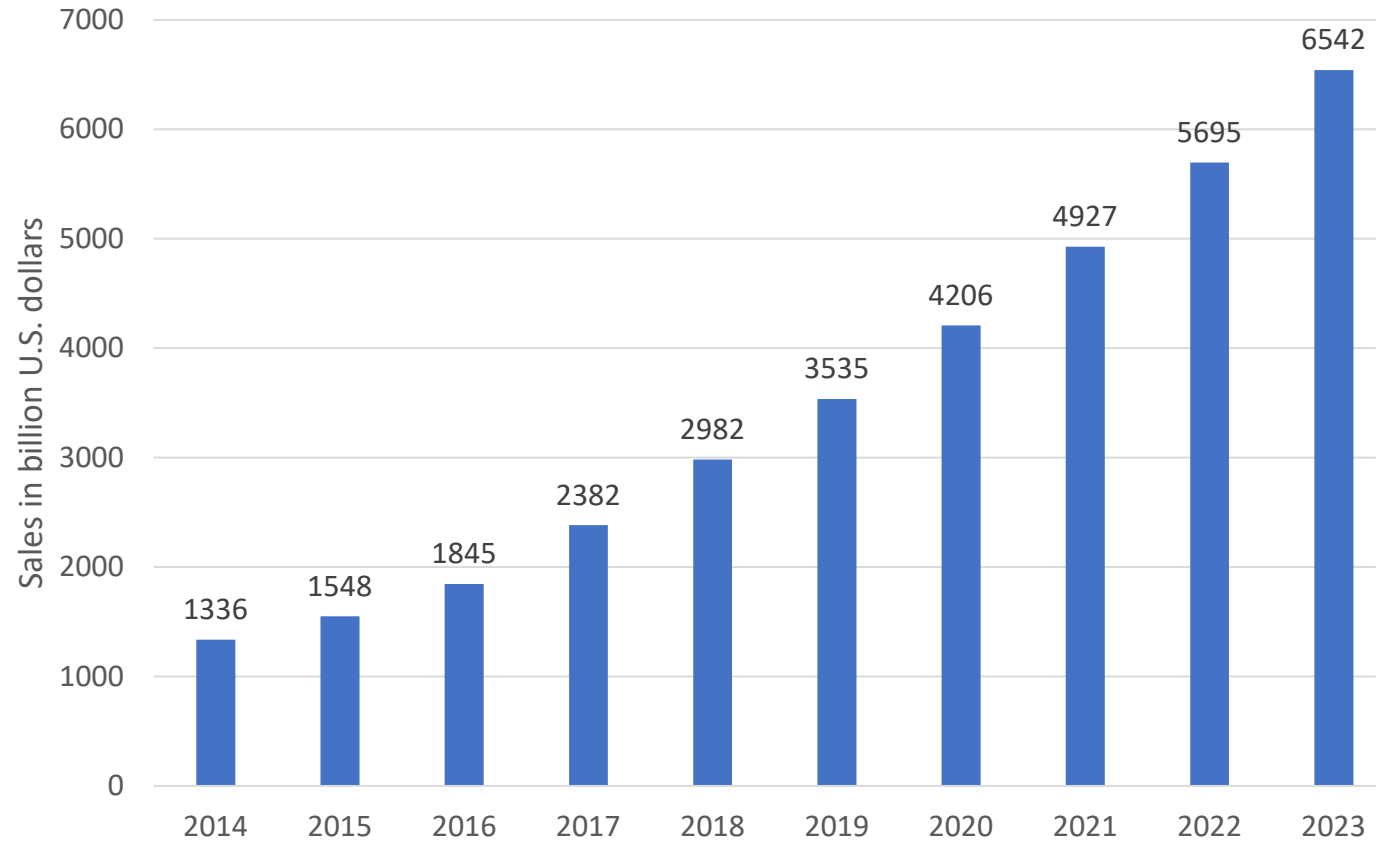
Online Shopping

Positive effects vs. Rebound Effects

Amalia Paulsson

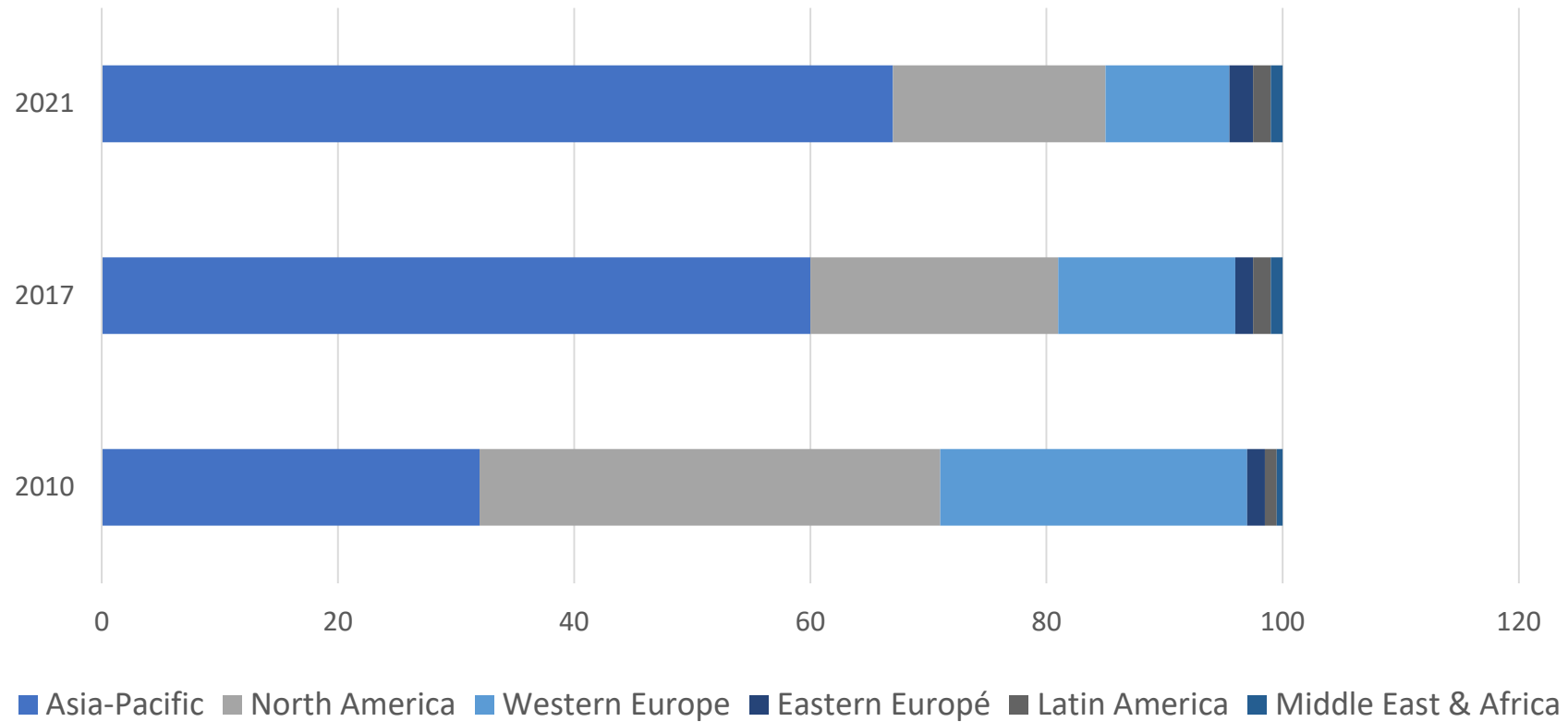
Digitalization and the Rebound Effect - Seminar HS2019
ETH Zurich

Retail e-commerce sales worldwide from 2014 to 2023 (bn \$)



*J, Clement; Statista; 2019; <https://www.statista.com/statistics/379046/worldwide-retail-e-commerce-sales/>

Regional sales share of global e-commerce





amazon
ebay
Walmart ✨
sears 🏠
BEST BUY

mercado libre
LOJAS AMERICANAS
GROUPE Casino
NOURRIR UN MONDE
Alibaba Group
magazineluiza

amazon
ebay
otto group
zalando
bol.com

Alibaba Group
JD.COM 京东
Rakuten
Flipkart 📦
LAZADA GROUP

Woolworths 🌿
amazon
ebay
Alibaba Group
coles

Purpose for this study

- Examine three methodologies for comparing traditional retail and b2c e-commerce
- Find out if there is a rigorous conclusion on which alternative is the most environment friendly
- Identify major emission drivers and motivate further research

Background - Life-cycle Assessment (LCA)



- Model for calculating footprint
- Goes through product phases
 - Raw Materials
 - Manufacturing
 - Distribution
 - Usage
 - Recycling/Landfill

Presentation outline

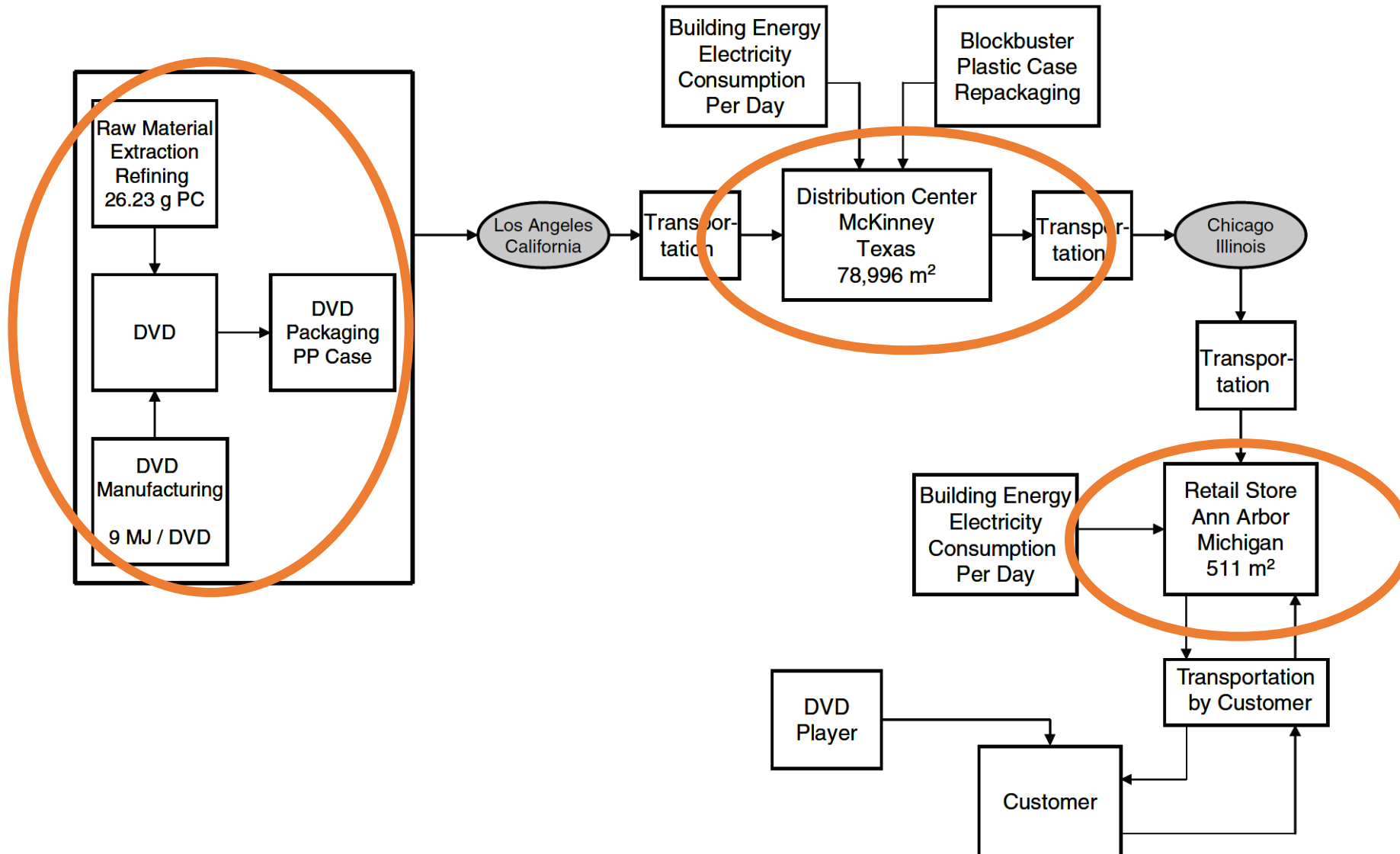
- Case study 1: LCA with block diagrams
- Case study 2: Energy use in distribution network
- Case study 3: Alternative delivery models
- Traditional retail vs. E-commerce - which is most environment friendly?
- Sensitivity analysis & Future possibilities

Life Cycle Assessment

- Sivaraman et al. 2003: case study on DVD rental in Ann Arbor, Michigan.
- Comparing rental networks: DVD-rental through traditional retail versus e-commerce.
- Assumptions
 - Customers always rent three DVDs at one time
 - Same consumer behavior regardless of the situation of purchase
 - Limited routes
- Proposes modelling the LCA with block diagrams

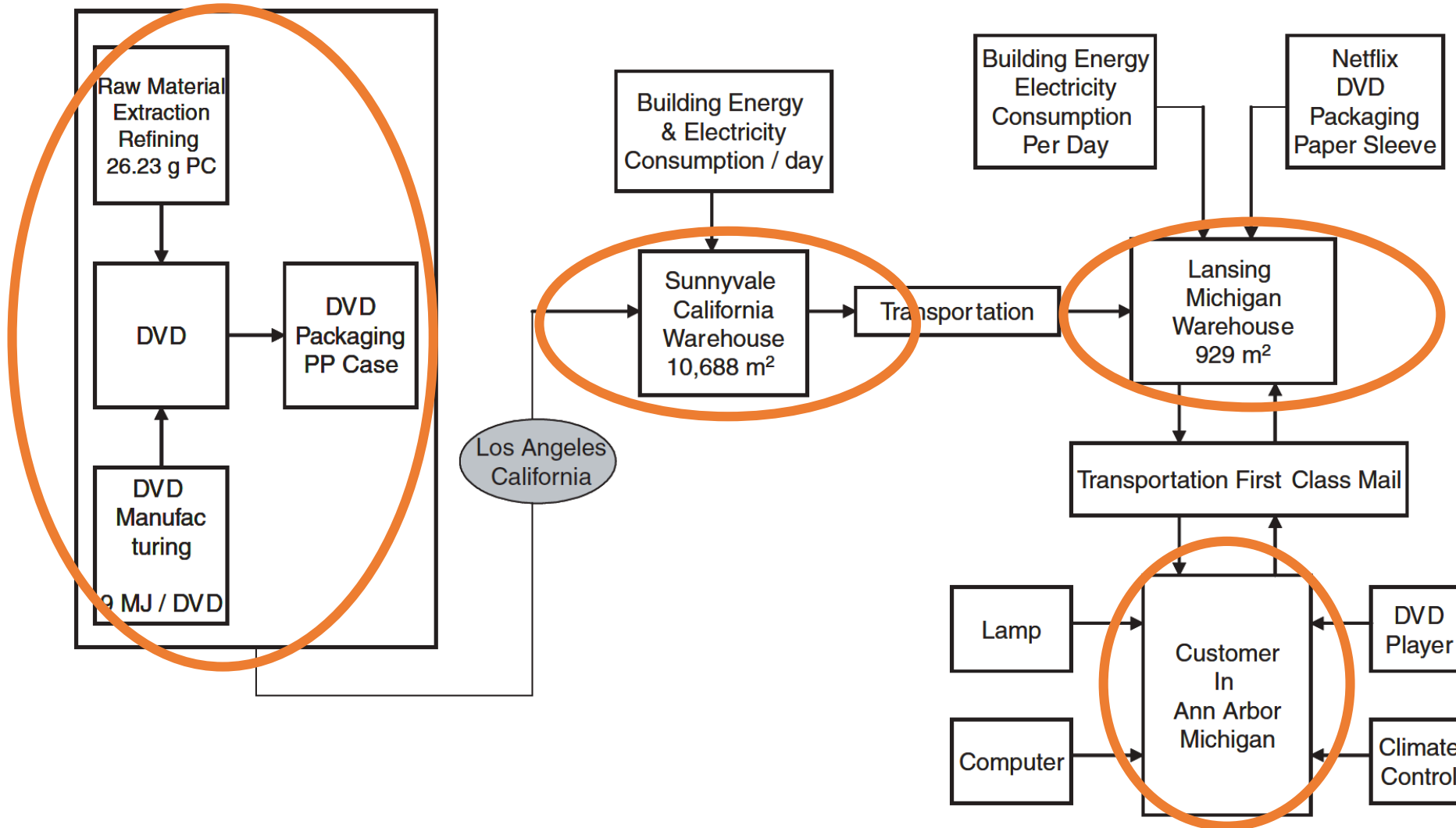
Future possibilities

Traditional network



Future possibilities

E-commerce



Williams and Tagami 2003: Case Study on Book Retail

- Case study on book retail in Japan
- Focuses solely on energy use
- Examines four factors in the distribution network

- Building Energy & Electricity Consumption
- Energy use in Packaging
- Energy use in Personal Transport
- Energy use in Shipping and Courier Service

| Factor | Trad. retail | E-com |
|--------------------|--------------|-------|
| Building energy | x | x |
| Packaging energy | x | x |
| Personal transport | x | |
| Shipping | x | x |

Building Energy & Electricity Consumption

Future possibilities

- Centers, warehouses, local store & home of the customer
- Simplification: one distribution center only
 - Boils down the comparison to the bookstore/ customer's residence
- The store consumed 1.1 MJ per book
- Online purchase consumed 0.95 MJ

Energy use in Production of Packaging

- Life cycle analysis for material types
- Weighting factors for each using step
 - Dimensions (centimeters²)
 - Weight/area (grams/ centimeters²)
 - Production energy for material type (MJ/grams)
- 3.9 MJ/online purchase & 0.8 MJ/purchase in traditional store

Future possibilities

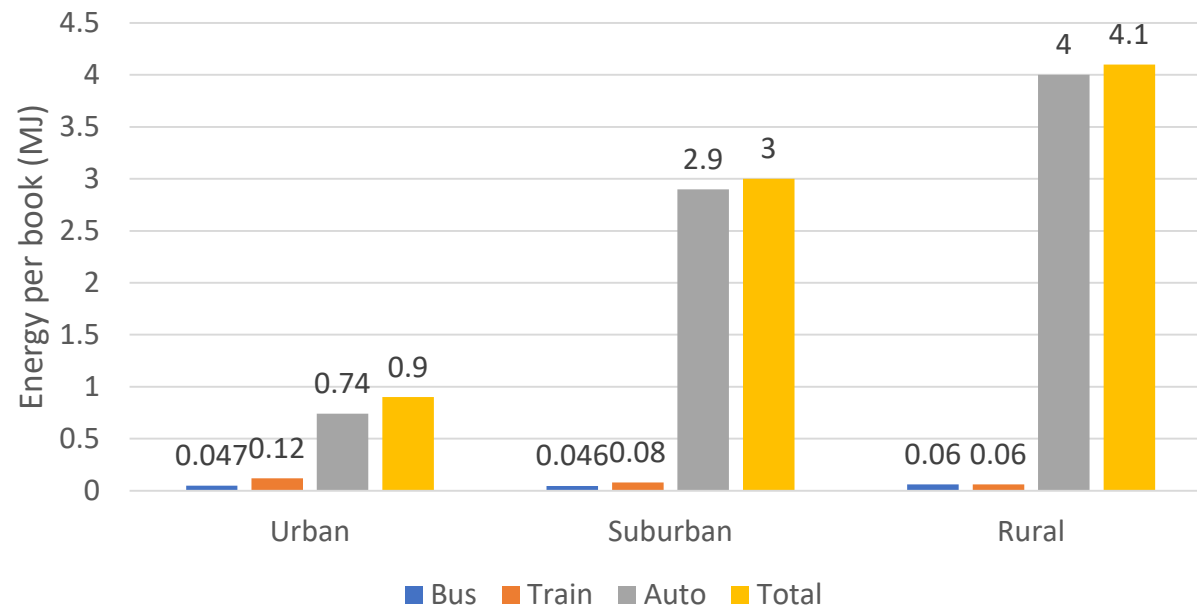
Energy Use in Personal Transport



Future possibilities

Personal Transport Energy per book

Consumer Transport Use $\left[\frac{MJ}{Book} \right] =$



Energy Use in Shipping and Courier Services

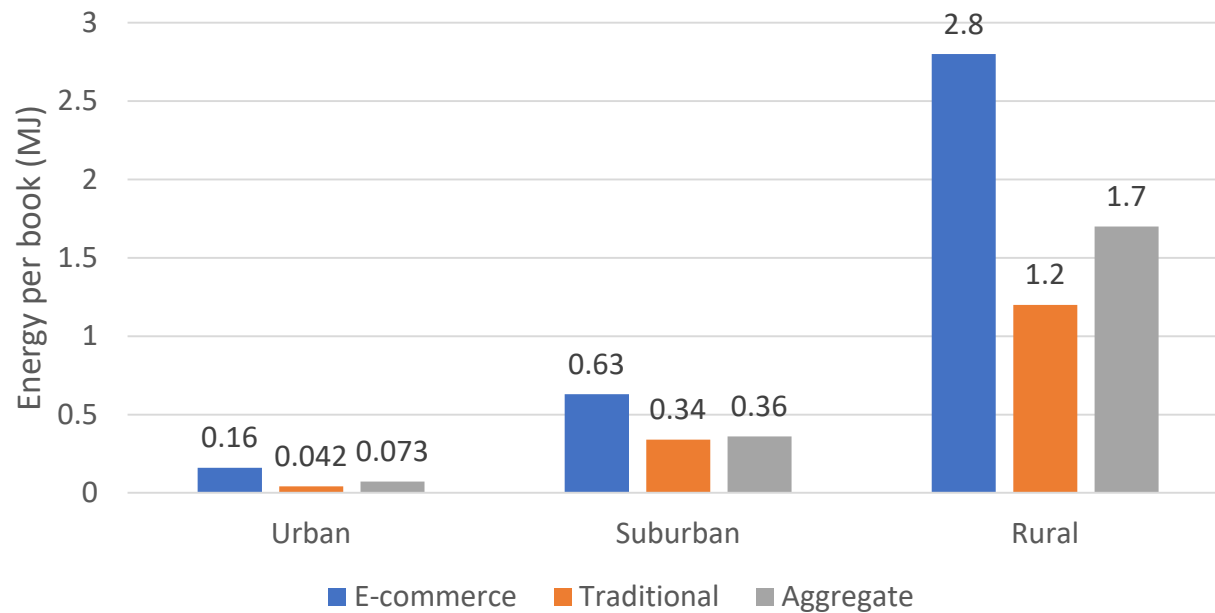
Future possibilities

- Total energy used in transporting books from the publisher to the bookstore/ consumer's home
- Geographical areas taken into account
 - Relative population density → efficiency of distribution
 - Distance from centers
- Traditional retail uses trucking firms, E-commerce companies uses courier services.

Future possibilities

Shipping Energy Use per Book

Vehicle Fuel Energy per book [MJ] =



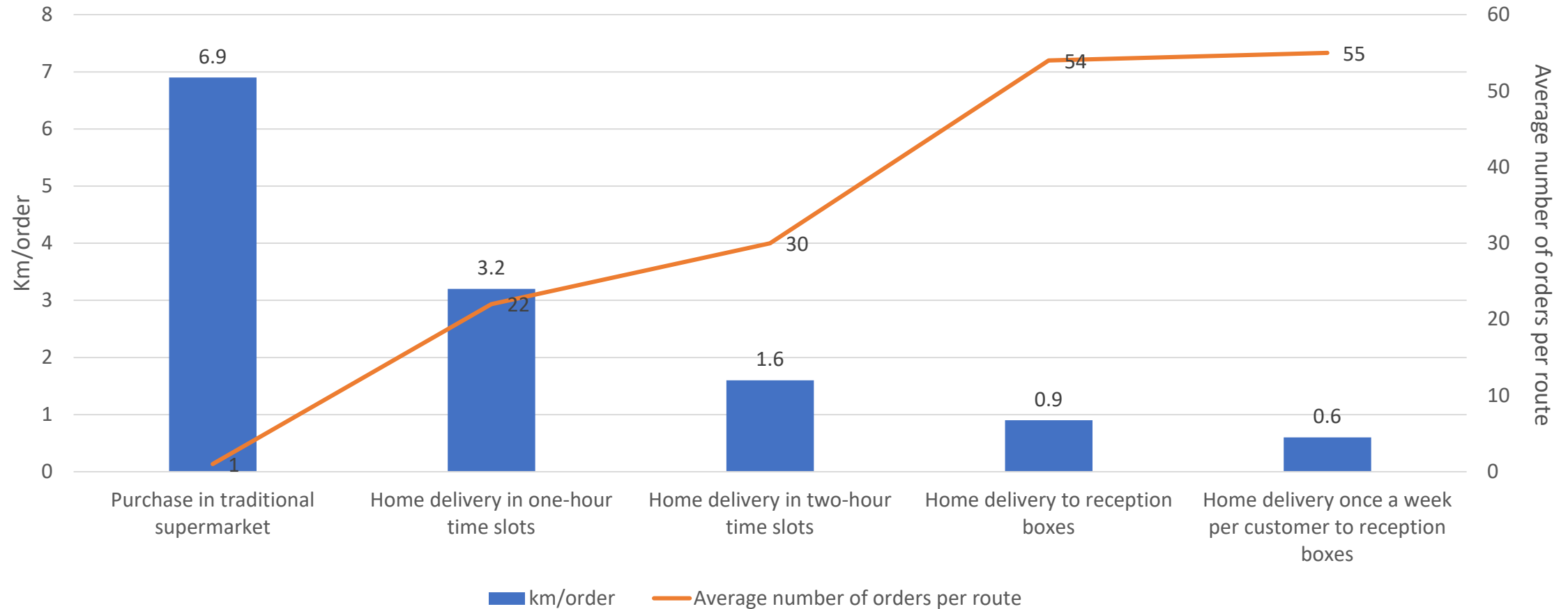
y

Siikavirta et al. 2003: Comparing home delivery models

- Five delivery models simulated grocery deliveries in an area around Helsinki
 - Home delivery in two-hour time slots between 17:00 and 21:00
 - Home delivery in one-hour time slots between 12:00 and 21:00
 - Home delivery to reception boxes between 8:00 and 18:00
 - Home delivery once a week per customer to reception boxes between 8:00 and 18:00
 - Purchase in traditional supermarket

Distance per Order and Numbers of Orders per Route

Future possibilities



Production and market rebound

- In the case of groceries, a pull-production is feasible
 - Lower the risk of overproduction
 - Does not apply on all product types
- Morganti et al. 2013: Online interaction allows vendors to inform the customers of environmental and social impacts
 - Push the market towards more sustainable demand
- Morganti et al. 2013: demand is increasing for dedicated delivery services and broad product scope

Rebound effects of the shift from trad. Retail to E-commerce

- Santarius 2017: Highly accessible internet leads to market transparency → efficient market
- Santarius 2017: Time rebound - saving the extra time and effort from going to store
- Hiselius 2015: Transport behavior for online shoppers in Sweden

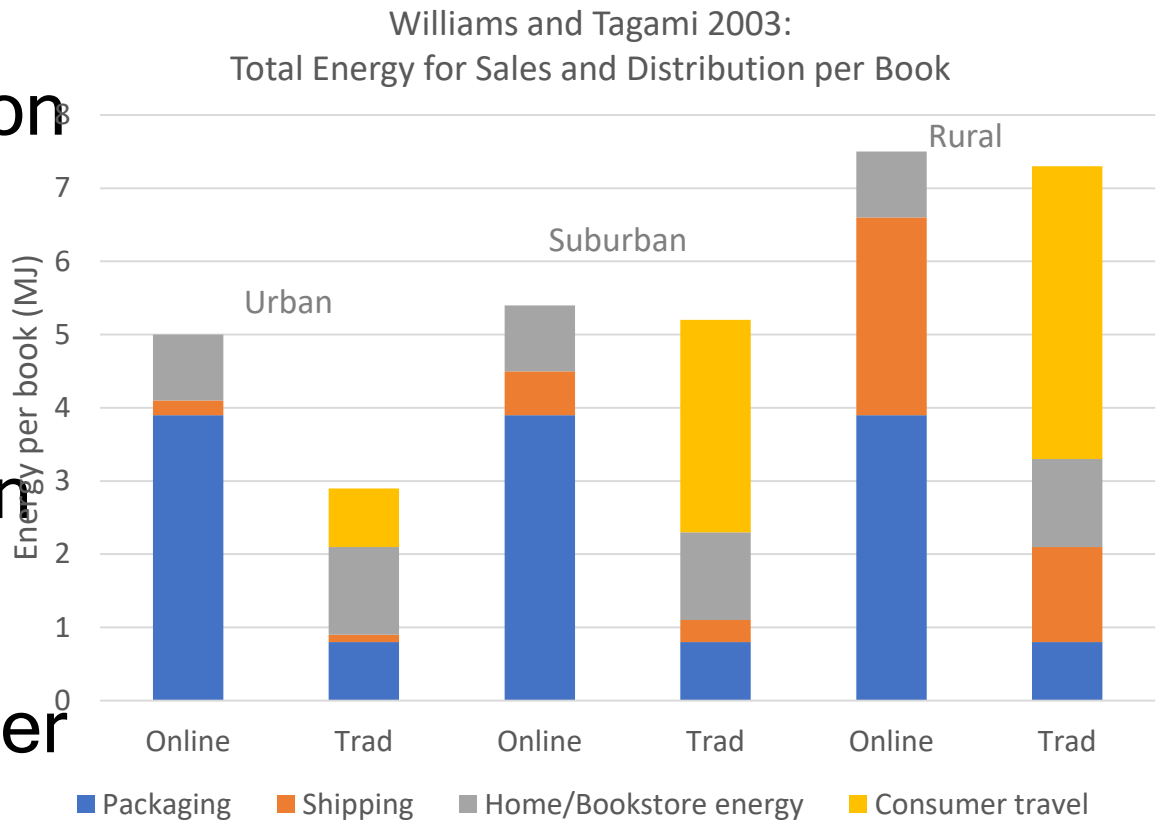
Which alternative is the most environment friendly?

- Sivaraman et al. 2007: E-commerce system had 0.53-0.62 times the impact of traditional retail.
 - Williams and Tagami 2003: Energy consumption is higher in E-commerce regardless of geographical situation
 - Gilbride et al. 2002: E-commerce is
- It's not crystal clear



Emission drivers

- Sivaraman et al. 2007
Mode of personal transportation
- Williams and Tagami 2003
Packaging
- Rotem-Mindali and Weltevreden
2013
Product differentiation in courier
services

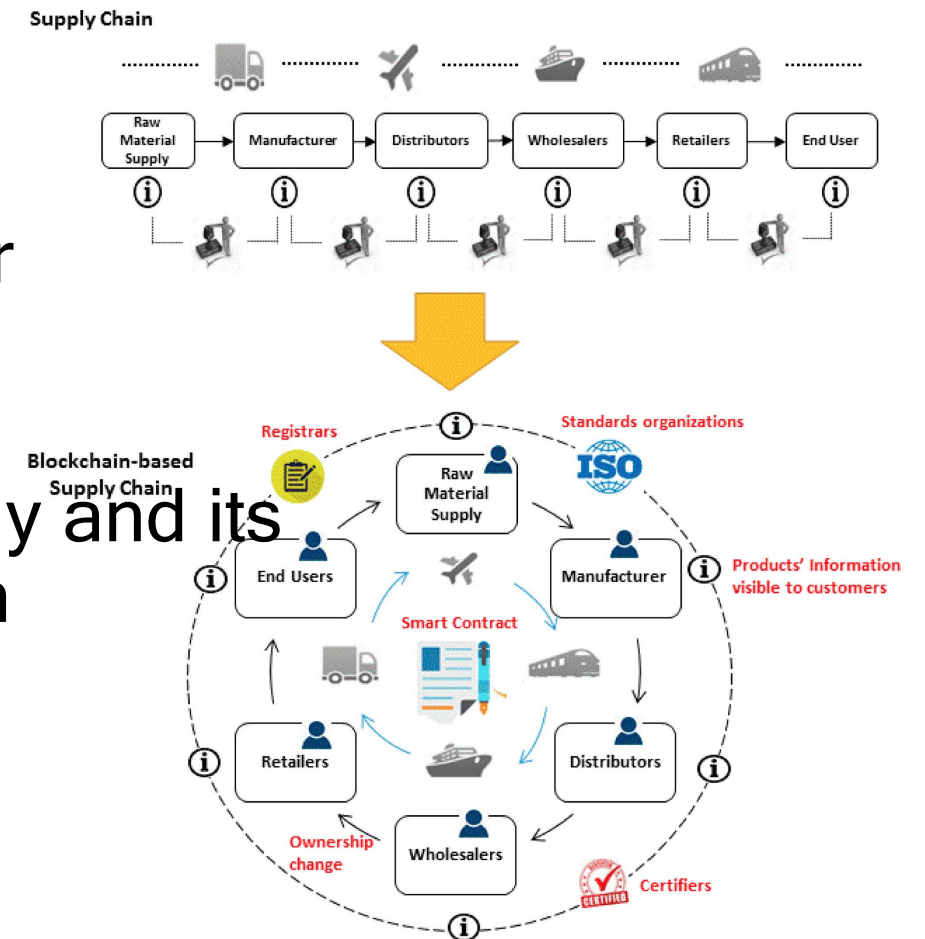


Sensitivity analysis

- Geographic limitation
- Returnings and reshipments unaccounted
 - Williams and Tagami 2003: In Japan and U.S. 30%-50% of all books in stores remain unsold
 - In clothing and other B2C industries
- Demand development
 - Websites designed based on customer behavior to maximize consumption

Future possibilities

- Packaging material innovation
- Sunstein, Cass 2013: Online nudging for sustainable consumption
- Saberi et al. 2019: Blockchain technology and its relationships to sustainable supply chain management



References

- 1) J, Clement; Statista. 2019. <https://www.statista.com/statistics/379046/worldwide-retail-e-commerce-sales/>
- 2) Siikavirta, Hanne; Punakivi, Mikko; Kärkkäinen, Mikko; Linnanen, Lassi. 2003. *Effects of E-Commerce on Greenhouse Gas Emissions - A Case Study of Grocery Home Delivery in Finland*. Journal of Industrial Ecology. Vol 6, nr 2.
- 3) Sivaraman, Deepak. Pacca, Sergio. Mueller, Kimberly. Lin, Jessica. 2007. *Comparative Energy, Environmental, and Economic Analysis of Traditional and E-commerce DVD Rental Networks*. Journal of Industrial Ecology. Vol 11, nr 3.
- 4) Williams, Eric. Tagami, Takashi. 2003. *Energy Use in Sales and Distribution via E-Commerce and Conventional Retail*. Journal of Industrial Ecology. Vol 6, nr 2.
- 5) Morganti, Eleonora. Dablanc, Laetitia. Fortin, François. 2013. *Final deliveries for online shopping: The deployment of pickup point networks in urban and suburban areas*. Research in Transport Business & Management. Vol 11, pp 23-31.
- 6) Rotem-Mindali, Orit. Weltevreden, Jesse. 2013. *Transport effects of e-commerce: what can be learned after years of research?* Transportation. Vol 40, pp 867-885.
- 7) Saberi, Sara. Kouhizadeh, Mahtab. Sarkis, Joseph. Shen, Lejia. 2019. *Blockchain technology and its relationships to sustainable supply chain management*. International Journal of Production Research. Vol 57, Issue 7.
- 8) Tilman Santarius. 2017. *Digitalization, Efficiency and the Rebound Effect*. Degrowth.info. 16 Februari 2017. Available at <https://www.degrowth.info/en/2017/02/digitalization-efficiency-and-the-rebound-effect/> (Downloaded: 28 October 2019)

Thank you for listening!

Feel free to ask questions

