MITIGATING CLIMATE CHANGE THROUGH ENERGY EFFICIENT FIRST - LAST MILE

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"First mile" and "last mile" are the segments of the order fulfillment process in e-commerce.

**First mile**
- FROM seller/producer facility
- TO e-fulfillment center

**Last mile**
- FROM last hub (delivery station, local freight station)
- TO delivery address

Source: Adapted with changes from *Intermodal Transport Chain, The Geography of Transport Systems*, FIFTH EDITION, Jean-Paul Rodrigue (2020).
### “First Mile” and “Last Mile” in Freight Transport: Features

<table>
<thead>
<tr>
<th><strong>“First Mile”</strong></th>
<th><strong>“Last Mile”</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Consolidation</td>
<td>Urban settings (both contributes to and suffers from congestion)</td>
</tr>
<tr>
<td>Haulage by producer or logistics operator</td>
<td>Small volume shipments</td>
</tr>
<tr>
<td>Variety of modes</td>
<td>Scattered delivery</td>
</tr>
<tr>
<td>In e-commerce might be a trip with multiple stop</td>
<td>Multiple stops per trip</td>
</tr>
<tr>
<td></td>
<td>Road transport</td>
</tr>
<tr>
<td></td>
<td>Smaller vehicles</td>
</tr>
<tr>
<td></td>
<td>Variety of vehicles (light trucks, vans, tri-wheelers, cargo bicycles; electric, diesel, gasoline, pedal-powered)</td>
</tr>
<tr>
<td></td>
<td>Accidents-prone</td>
</tr>
<tr>
<td></td>
<td>Customers’ expectations of fast delivery within a certain delivery window</td>
</tr>
<tr>
<td></td>
<td>Experiments with automated deliveries (drones, robots, vehicles)</td>
</tr>
</tbody>
</table>

#### Costs along the transport chain

<table>
<thead>
<tr>
<th>Unit Transport Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>“First Mile”</strong></td>
</tr>
<tr>
<td><strong>“Last Mile”</strong></td>
</tr>
<tr>
<td>Urban Area</td>
</tr>
</tbody>
</table>

- Up to 50% of logistics costs (fuel, labor at sorting, pick-up transfer, idle time, out-of-route time, failed deliveries)
- At least 25% of GHG emissions of transport

Source: [Transport Costs, The Geography of Transport Systems, FIFTH EDITION, Jean-Paul Rodrigue (2020).](#)
E-COMMERCE AS GROWTH FACTOR OF THE LAST MILE LOGISTICS

Online retail sales share in total retail sales in selected countries (% of retail sales)

<table>
<thead>
<tr>
<th>Economy</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>20.7</td>
<td>24.9</td>
<td>24.5</td>
<td>27.2</td>
</tr>
<tr>
<td>Republic of Korea</td>
<td>20.8</td>
<td>25.9</td>
<td>28.7</td>
<td>27.3</td>
</tr>
<tr>
<td>Singapore</td>
<td>5.9</td>
<td>11.7</td>
<td>n.d.</td>
<td>n.d.</td>
</tr>
<tr>
<td>United States</td>
<td>11.0</td>
<td>14.0</td>
<td>14.7</td>
<td>14.7</td>
</tr>
<tr>
<td>Vietnam</td>
<td>4.9</td>
<td>5.5</td>
<td>7.0</td>
<td>7.2-7.8</td>
</tr>
</tbody>
</table>


E-commerce share of retail sales globally (percent)

E-commerce share of retail sales by region in 2020 (percent)

Source: Statista.com

E-commerce growth year on year, percent

E-commerce growth year on year, inflection points, and major online marketplaces, %


Asia-Pacific region is the leader in e-commerce

Source: Statista.com
E-COMMERCE AS GROWTH FACTOR OF THE LAST MILE LOGISTICS

Top B2C e-commerce companies by gross merchandise volume (GMV), 2020

<table>
<thead>
<tr>
<th>Rank by GMV</th>
<th>Company</th>
<th>HQ</th>
<th>Industry</th>
<th>GMV ($ billions) 2018</th>
<th>GMV ($ billions) 2020</th>
<th>GMV change (%) 2018-19</th>
<th>GMV change (%) 2019-20</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020</td>
<td></td>
<td></td>
<td></td>
<td>2018</td>
<td>2020</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Alibaba</td>
<td>China</td>
<td>E-commerce</td>
<td>$866</td>
<td>$954</td>
<td>1.145</td>
<td>10.2</td>
</tr>
<tr>
<td>2</td>
<td>Amazon</td>
<td>USA</td>
<td>E-commerce</td>
<td>$344</td>
<td>$417</td>
<td>$575</td>
<td>21.0</td>
</tr>
<tr>
<td>3</td>
<td>JD.com</td>
<td>China</td>
<td>E-commerce</td>
<td>$253</td>
<td>$302</td>
<td>$379</td>
<td>19.1</td>
</tr>
<tr>
<td>4</td>
<td>Pinduoduo</td>
<td>China</td>
<td>E-commerce</td>
<td>$71</td>
<td>$146</td>
<td>$242</td>
<td>104.4</td>
</tr>
<tr>
<td>5</td>
<td>Shopify</td>
<td>Canada</td>
<td>Internet Media &amp; Services</td>
<td>$41</td>
<td>$61</td>
<td>$120</td>
<td>48.7</td>
</tr>
<tr>
<td>6</td>
<td>eBay</td>
<td>USA</td>
<td>E-commerce</td>
<td>$90</td>
<td>$86</td>
<td>$100</td>
<td>-4.8</td>
</tr>
<tr>
<td>7</td>
<td>Meituan</td>
<td>China</td>
<td>E-commerce</td>
<td>$43</td>
<td>$57</td>
<td>$71</td>
<td>33.0</td>
</tr>
<tr>
<td>8</td>
<td>Walmart</td>
<td>USA</td>
<td>Consumer goods retail</td>
<td>$25</td>
<td>$37</td>
<td>$64</td>
<td>47.0</td>
</tr>
<tr>
<td>9</td>
<td>Uber</td>
<td>USA</td>
<td>Internet Media &amp; Services</td>
<td>$50</td>
<td>$65</td>
<td>$58</td>
<td>30.5</td>
</tr>
<tr>
<td>10</td>
<td>Rakuten</td>
<td>Japan</td>
<td>E-commerce</td>
<td>$30</td>
<td>$34</td>
<td>$42</td>
<td>13.6</td>
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<tr>
<td>11</td>
<td>Expedia</td>
<td>USA</td>
<td>Internet Media &amp; Services</td>
<td>$100</td>
<td>$108</td>
<td>$37</td>
<td>8.2</td>
</tr>
<tr>
<td>12</td>
<td>Booking Holdings</td>
<td>USA</td>
<td>Internet Media &amp; Services</td>
<td>$93</td>
<td>$96</td>
<td>$35</td>
<td>4.0</td>
</tr>
<tr>
<td>13</td>
<td>Airbnb</td>
<td>USA</td>
<td>Internet Media &amp; Services</td>
<td>$29</td>
<td>$38</td>
<td>$24</td>
<td>29.3</td>
</tr>
</tbody>
</table>

Companies above
$2,035
$2,399
$2,890
17.9
20.5

Note: Alibaba year beginning 1 April, Walmart year beginning 1 February. Figures in italics are estimates. GMV = Gross Merchandise Value (as well as Booking Value).

$ - United States dollar

Web traffic of online shopping platforms in Southeast Asia, 2020
Singapore +35%
Philippines +21%
Vietnam +19%
Malaysia +17%
Thailand +15%
Indonesia +6%
Source: iPrice Group.

Parcel deliveries business-to-consumer, 2020
Globally ~+25%
China +31.2%
State Post Bureau of the People’s Republic of China.
E-COMMERCE DISTRIBUTION AS ENERGY CONSUMER

E-commerce impact on the “Last Mile”

- Increase in the number of deliveries
- Increase in complexity of the delivery network
- More segments
- More reloading points
- More trips
- More handling operations

Types of nodes in a distribution network

1. Inbound Cross Dock
   - Large-sized.
   - Receiving containers and holding inventory.
   - Double side cross-docking configuration.
   - Close to intermodal terminals.

2. E-Fulfillment Center
   - Large-sized.
   - Single side cross docking configuration common.
   - High racks automated storage.
   - Item specialization.
   - Access to a major parcel hub.

3. Sortation Center
   - Large-sized.
   - Cross-docking configuration for loading trucks.
   - Automated and semi-automated sortation.
   - Accessibility to regional distribution.

4. Delivery Station
   - Medium to small-sized.
   - Cross-docking configuration for loading delivery vehicles.
   - Periphery of metropolitan areas.

5. Local Freight Station
   - Small or micro-sized.
   - Store-like facility (pickup location).
   - Locker banks (freight station).
   - High density neighborhood locations.

6. Fast Delivery Hub
   - Small to medium-sized.
   - Near large metropolitan areas.
   - Limited inventory of high demand items.
   - Some co-location with e-fulfillment centers

In top 100 cities by 2030:
- Number of delivery vehicles +36%
- Their emissions +32%
- Caused congestion +21%
- (11 min)

FUEL CONSUMPTION BY FREIGHT ROAD TRANSPORT

Transport energy consumption by mode/vehicle type, IEA

Energy Use by Transportation Mode and Fuel Type in USA, 2019


FUEL CONSUMPTION BY FREIGHT ROAD VEHICLES

Energy intensity for freight transport, 2000-2021, IEA

Average Fuel Economy by Major Vehicle Category (USA)


Average Annual Fuel Use by Vehicle Type (USA)

Environmental benefits of electric vehicles

**GHG over vehicle lifetime/diesel truck’s**

- **BATTERY-ELECTRIC 40-TONNE TRACTOR-TRAILER, 2021**
  - 63%
  - 84% if using only renewable electricity

- **FUEL CELL ELECTRIC TRUCK USING HYDROGEN**
  - 15% if produced from fossil fuel
  - 85% if produced with only renewable electricity

**CO2 per mile driven over vehicle lifecycle**

- **GASOLINE CARS**
  - 350 gram/mile

- **HYBRID AND PLUG-IN HYBRID**
  - 260 gram/mile

- **FULLY BATTERY-ELECTRIC VEHICLE**
  - 200 gram/mile

Sources: [International Council on Clean Transportation, 2023](#)

Energy mix in electricity generation

- Higher share of renewable energy
- Less GHG emissions over EV lifecycle

Sources: [MIT Climate Portal, 2022](#)
Ways to mitigate impact/contingencies

Reduce Energy consumption

Less trips

- Delivery to pick-up points
  - Pick-up counters, lockers in shops, malls, courier retails shop
  - Lockers in residential buildings
- Routes optimization
- Orders consolidation
  - Per customer (incentives for combining several orders in one delivery)
- Capacity optimization
  - Optimization of truck space and vehicles usage
  - Parcels organization within vehicle
  - Incentives for customers to select "green" delivery options

Less fossil fuel

- Clean-vehicle technology (efficient gasoline/diesel vehicles)
- Usage of electric vehicles
- Usage of non-motorized vehicles

Can be influenced by policies, including

- Financial and fiscal incentives
- Fuel efficiency standards
- Low emission zones
- Vehicle emission standards, etc.

Gains depend on energy mix in electricity generation: if fossil fuels share is reduced, the gains are higher.