



# Key Findings from the 2020 LED Manufacturing Supply Chain Report

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# DOE LED Manufacturing and Supply Chain Work

This report is part of broader DOE research efforts to characterize the LED manufacturing processes and supply chains and assess potential opportunities for R&D and increased U.S. involvement. There are two studies that will be published in 2021: 1) the LED Manufacturing Supply Chain report, which focuses on the global supply chain and economic impacts, and 2) the SSL Manufacturing Status & Opportunities report, which focuses on technical manufacturing processes and research opportunities.

## Past Work

- **Manufacturing Roadmap: Solid-State Lighting Research and Development.** Prepared for U.S. DOE. (Aug 2014)
- **Benchmarks of Global Clean Energy Manufacturing.** Clean Energy Manufacturing Analysis Center (Jan 2017).

## Current Work



- **LED Manufacturing Supply Chain.** Prepared for U.S. DOE. (To be Published in 2021)
- **SSL Manufacturing Status & Opportunities.** Prepared for U.S. DOE. (To be Published in 2021)

## Future Work

- Guidehouse is developing a dynamic economic model to assess the potential impact of various macroeconomic events, supply chain disruptions, and demand side shifts on the LED market.

# Report Objectives

This report characterizes the globalized manufacturing supply chain of LEDs and LED lighting products and investigates the economic impacts of this supply chain on the US.

1. How is the **manufacturing process** structured for typical SSL general illumination products?

2. What is the **value added** for each stage of the SSL manufacturing and distribution process?

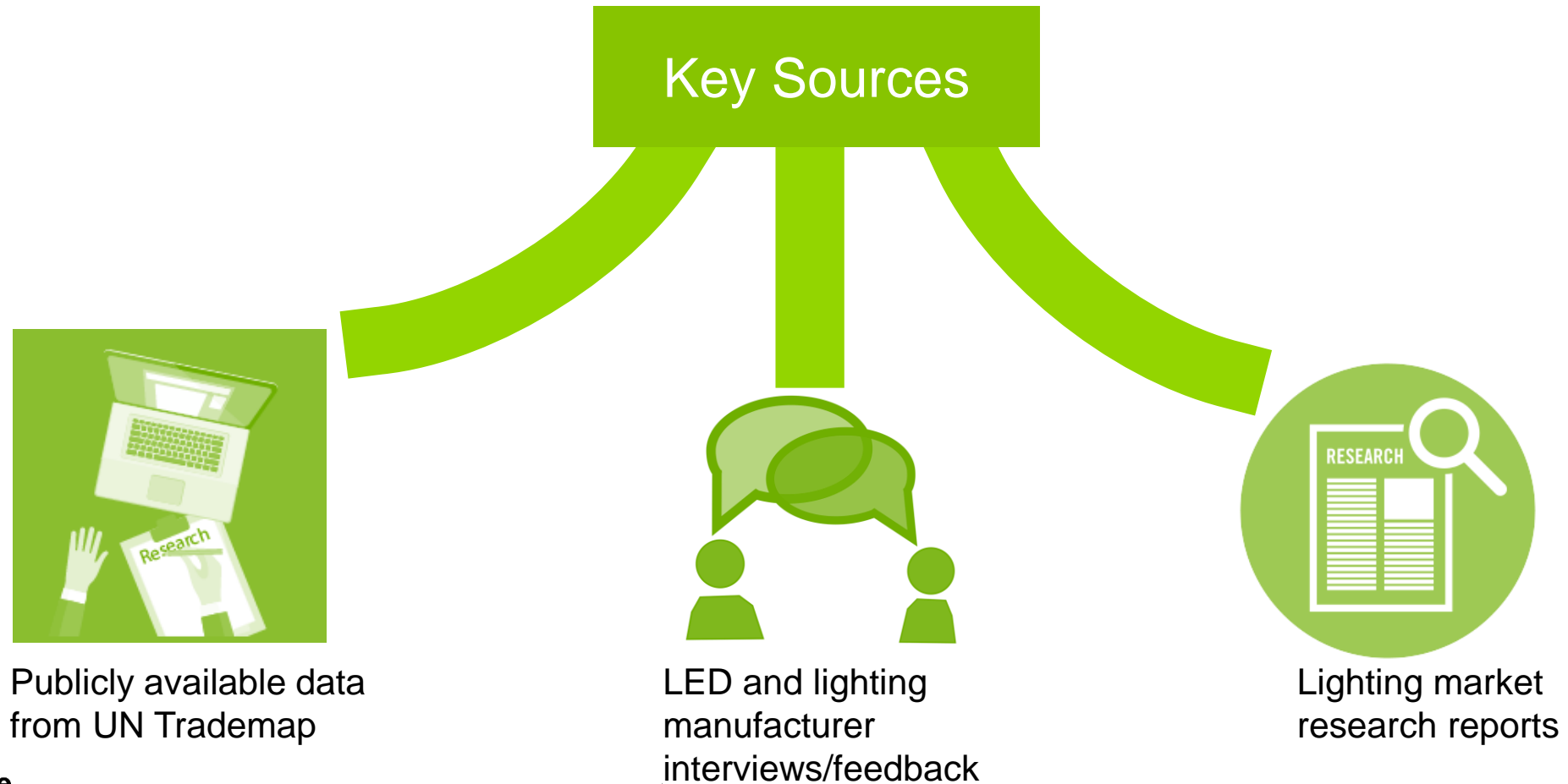
3. What proportion of LED products are **manufactured and assembled in the United States** vs internationally?

4. What is the **impact of an economic event** (e.g., tariffs) on the SSL manufacturing process and to the final consumer?

5. What are the **domestic opportunities for SSL manufacturing** in the global lighting supply chain?

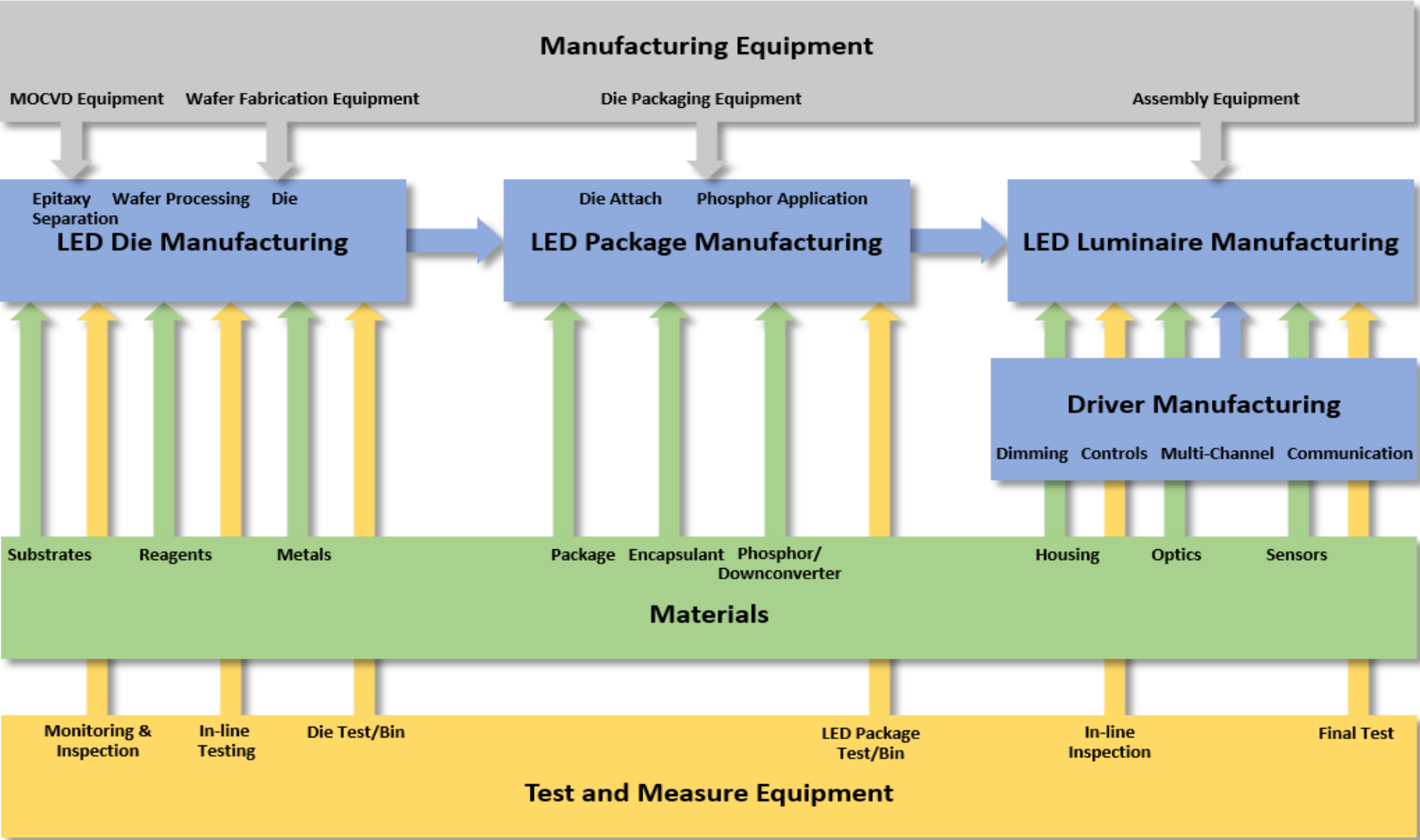
# Methodology and Sources

We utilized a combination of primary and secondary data sources to gain insights on the LED global supply chain, including publicly available data, LED and lighting manufacturer interviews, and LED market research reports.



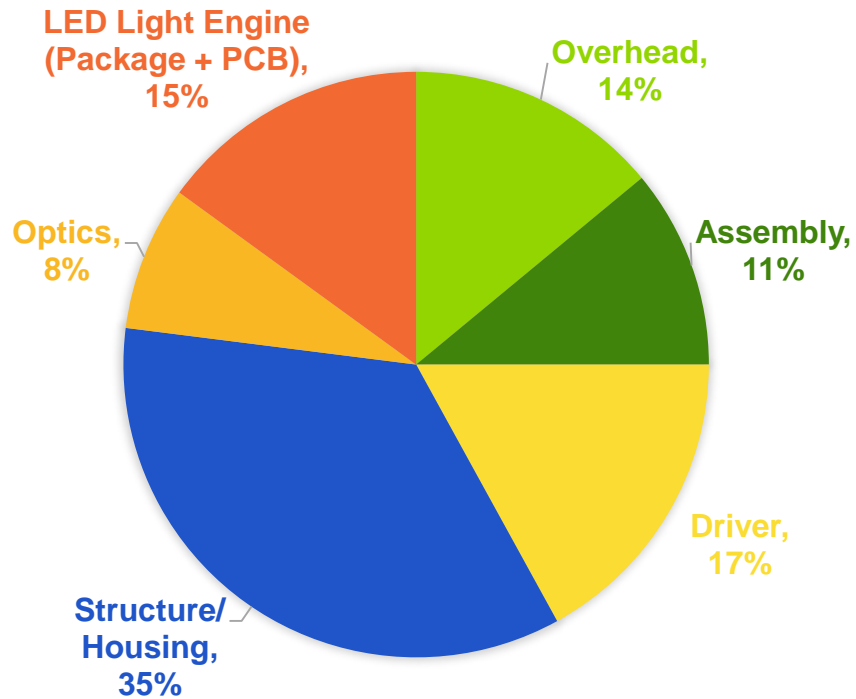
# LED Lighting Supply Chain

The LED manufacturing process links steps that contain three discrete products, each representing a tradeable good: LED die, LED packages, and LED luminaires.



# Value-Added Analysis

This value-added analysis focused on a typical 2' x 4' LED troffer. Of the value added for a domestically manufactured LED troffer, **66% can be attributable to the US.**



	Cost Breakdown	Estimated Gross Margin	Domestically Sourced?	Domestic Value Added (% of Total Value Added)	Foreign Value Added (% of Total Value Added)
Overhead	14%	20%	Yes	13%	-
Assembly	11%	20%	Yes	10%	-
Driver	17%	21%	No	-	17%
Structure/Housing	35%	20%	Yes	33%	-
Optics	8%	26%	Yes	10%	-
LED Package + PCB	15%	24%	No	-	17%
<b>Distribution of Value-added</b>				<b>66%</b>	<b>34%</b>

# LED Lighting Trade Analysis

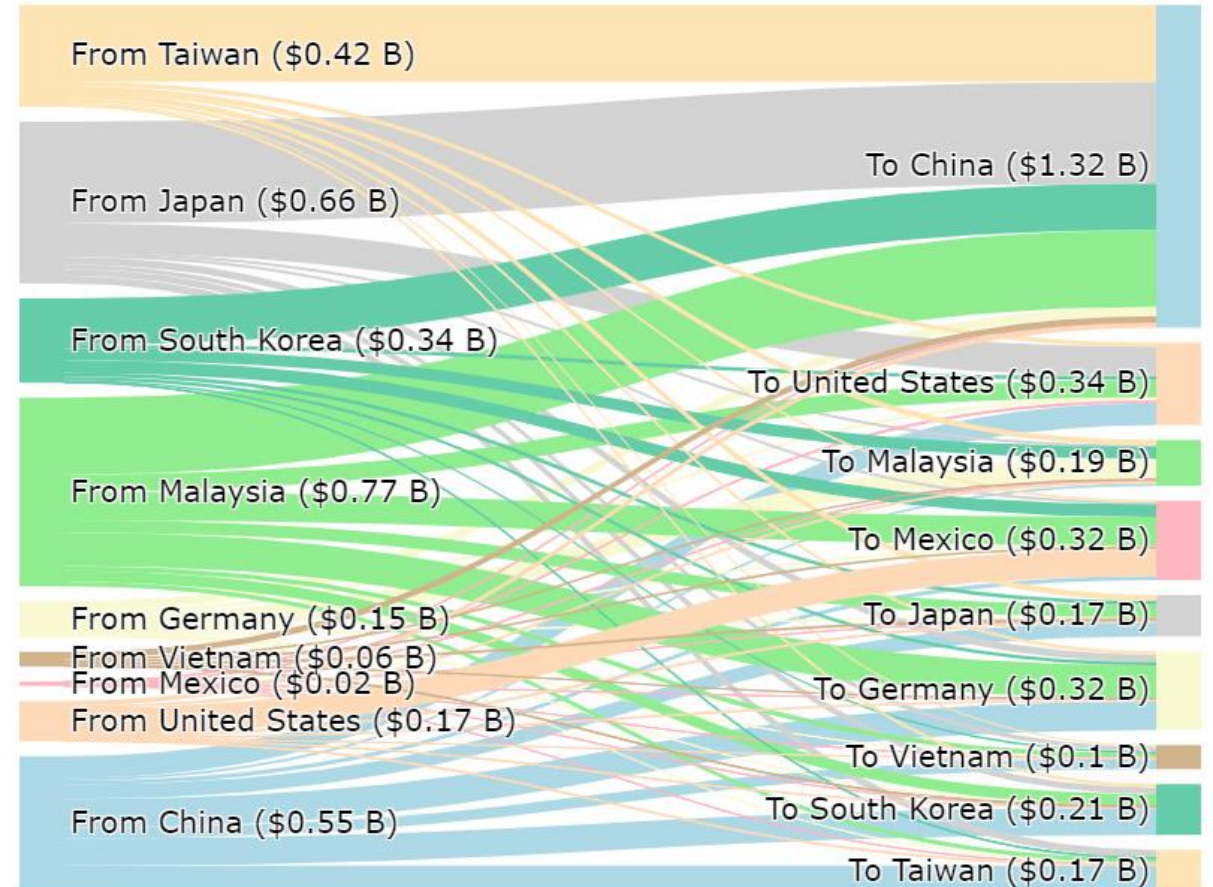
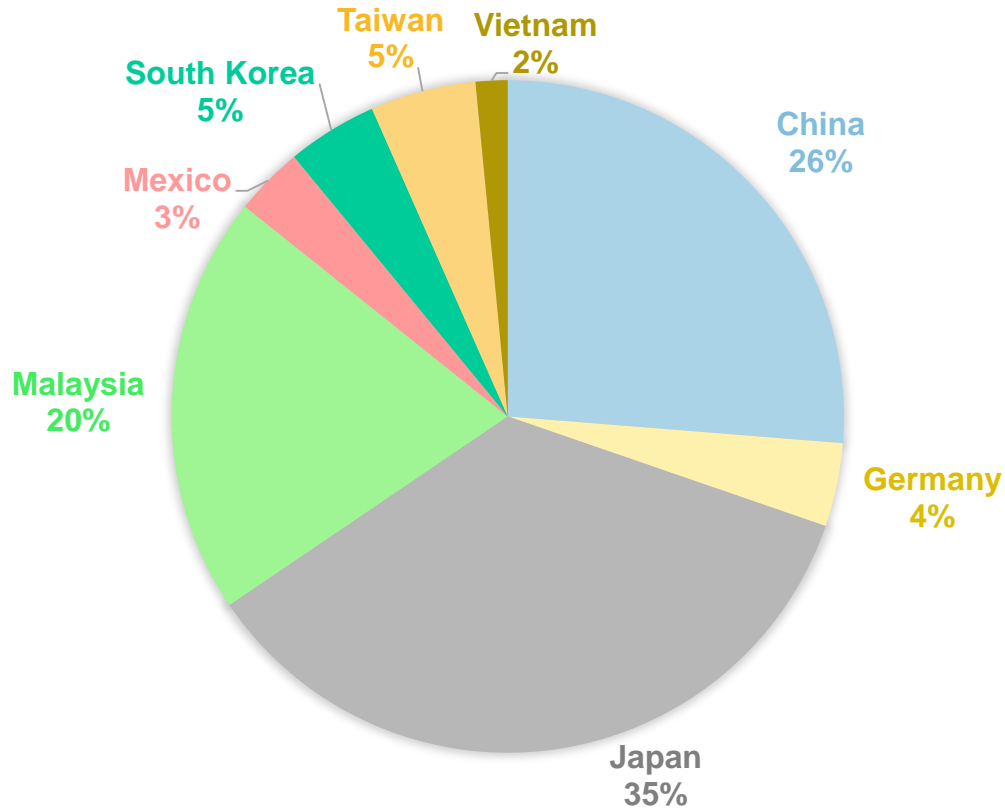
- Our analysis identified **4 Harmonized Tariff Schedule (HTS) codes** of goods with descriptions specific to LEDs or lighting that were determined to impact the manufacture and sale of LEDs and LED lighting products in the US.
- The data used to conduct the LED trade flow analysis was gathered from the **United Nations International Trade Centre Trade Map website**.
- For LED Packages (8539.50), LEDs used for general lighting applications was approximated using % of total LED market share- **36% in 2019**.
- For lighting fixtures (9405.10 and 9405.40), LED luminaires were approximated from the data using the % of total global luminaire market share- **66% in 2019**.

HTS Code	Description	RVC Threshold
8539.50	LED lamps	No product-specific rule of origin
8541.40.10	LED Packages	No RVC threshold values
9405.10	Chandeliers and other electric ceiling or wall lighting fittings, excluding those of a kind used for lighting public open spaces or thoroughfares	No RVC threshold values (unless changed from subheading 9405.91 through 9405.99)
9405.40	Other electric lamps and lighting fittings	

# Trade Flow of LED Packages in 2019

China has a large manufacturing footprint for LED packaging, but **many other Asian countries have significant LED package manufacturing as well.**

US IMPORTS OF LED PACKAGES



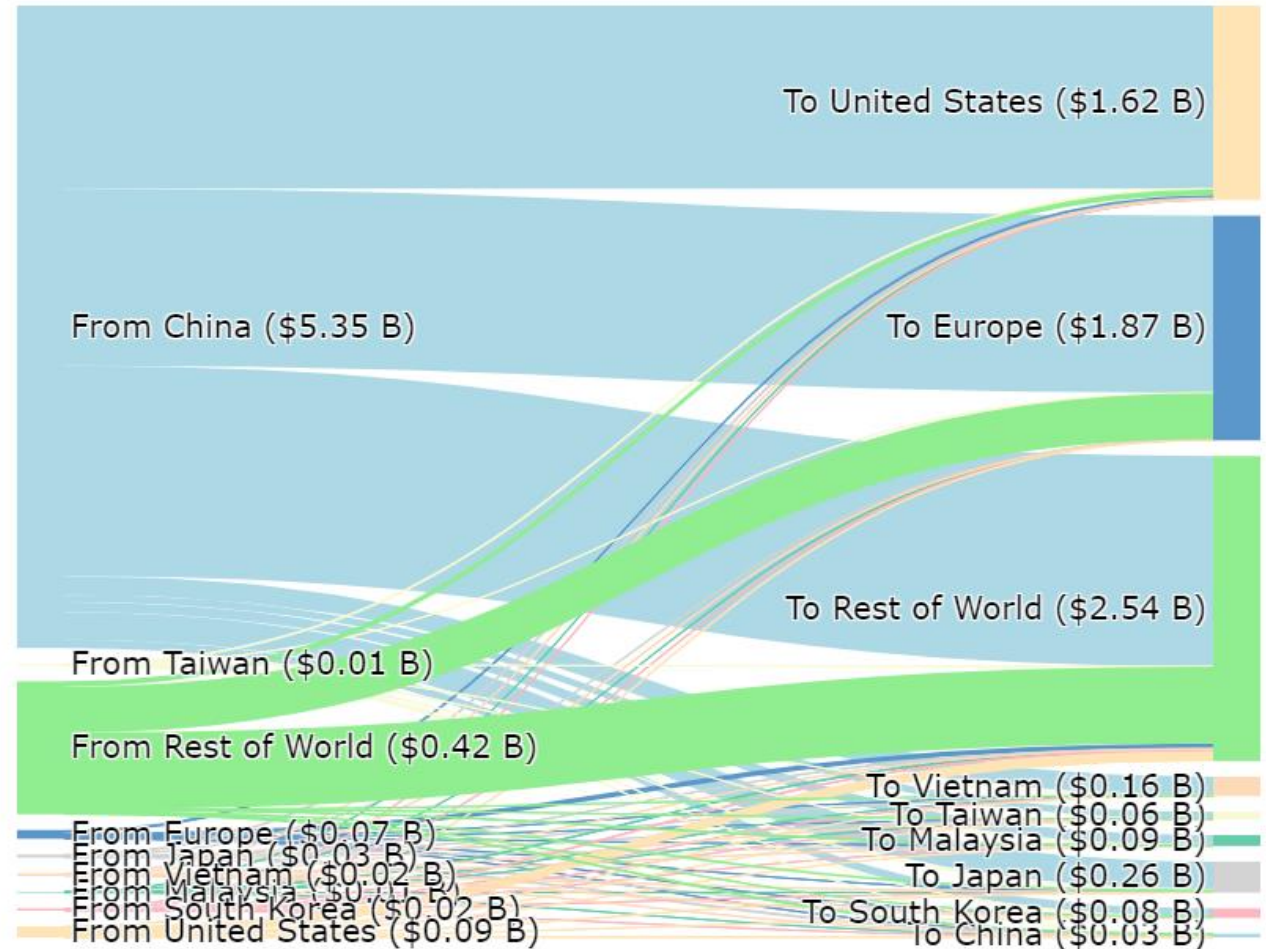
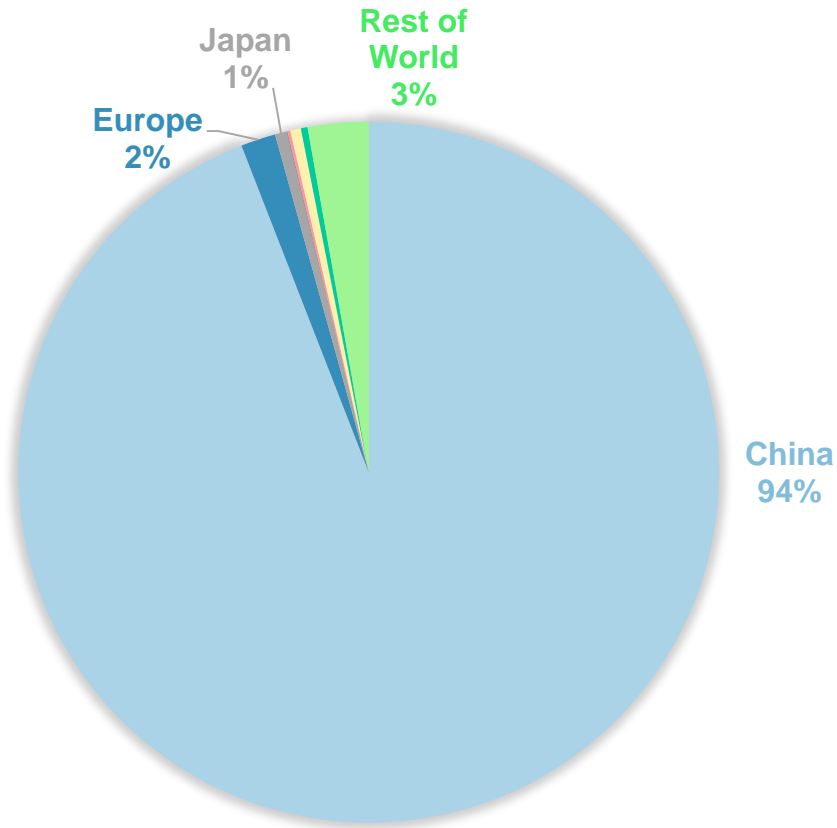
Note: This data only includes exports to other countries and does not include LED packages manufactured for domestic consumption. The total global market for LED packages for general lighting in 2019 was \$5.6 billion. LED packages for general lighting applications were approximated from total LED package trade data based on global market share in 2019.



# Trade Flow of LED Lamps in 2019

Most of the world's LED lamp production occurs in China. **94%** of all LED lamp imports to the US were from China.

US IMPORTS OF LED LAMPS

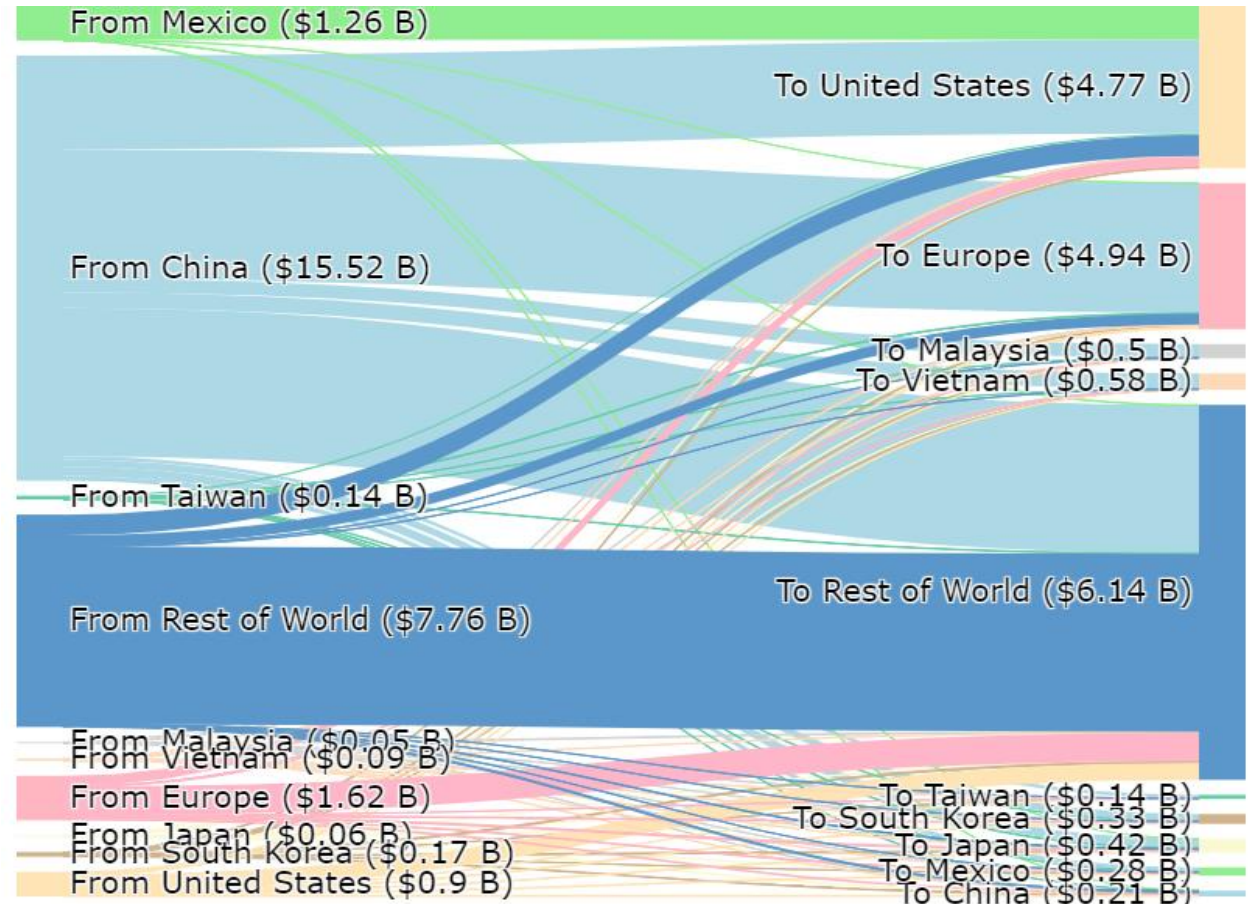
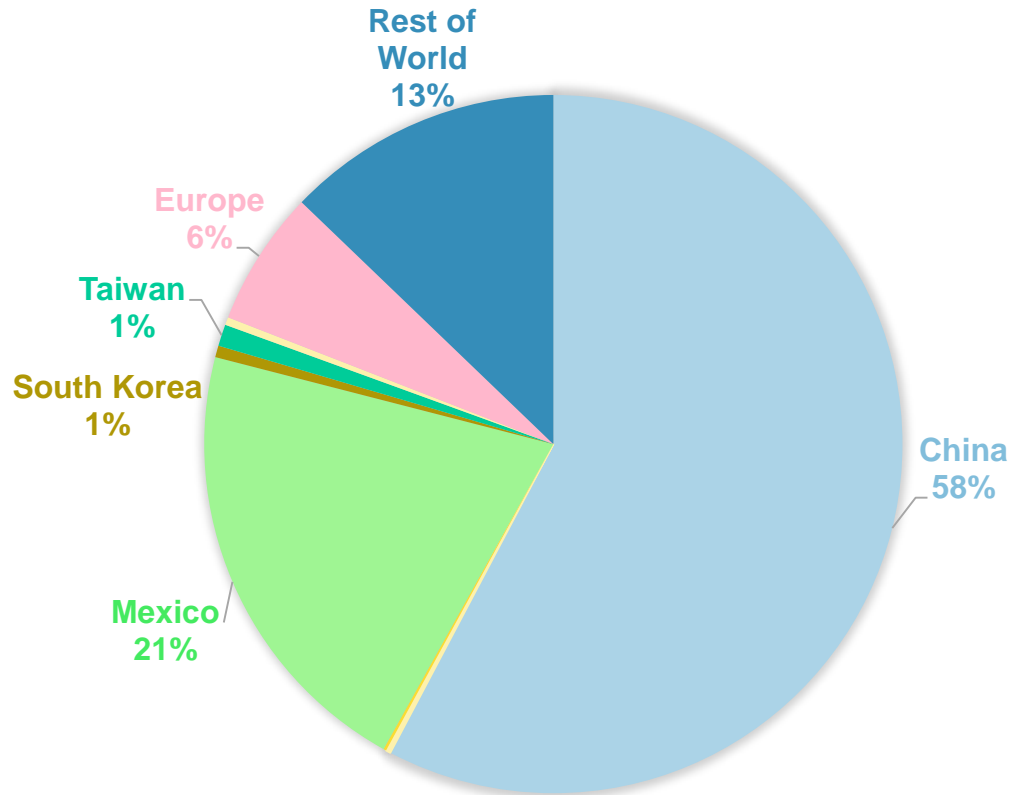


Note: This data only includes exports to other countries and does not include LED lamps manufactured for domestic consumption. The total global market for LED lamps for general lighting in 2019 was \$10.6 billion and the total global exports were approximately \$6.7 billion.

# Trade Flow of LED Luminaires in 2019

LED luminaire manufacturing differs significantly from LED lamp production. By value in 2019, **58%** and **21%** of LED luminaire imports to the US were manufactured in China and Mexico.

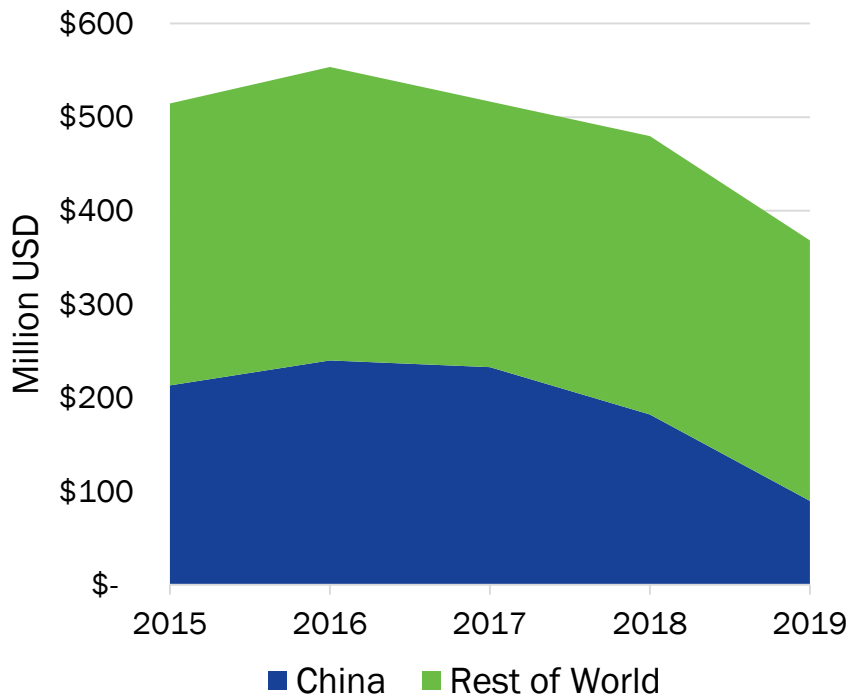
US IMPORTS OF LED LUMINAIRES



Note: This data only includes exports to other countries and does not include LED luminaires manufactured for domestic consumption. The total global market for LED luminaires for general lighting in 2019 was \$50.6 billion and the total global exports were approximately \$27.6 billion. LED luminaires were approximated from total lighting fixture trade data based on global LED market share in 2019.

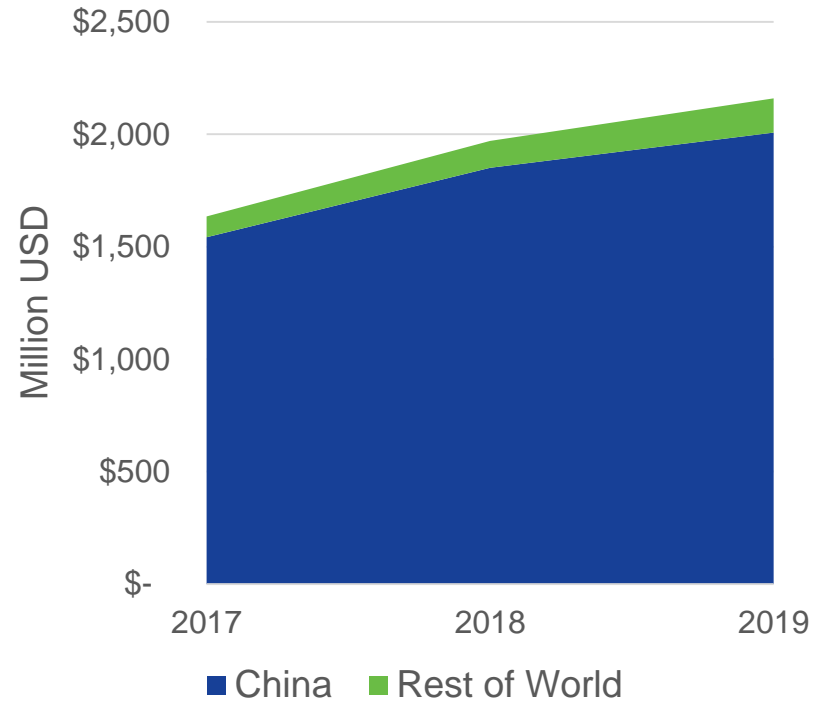
# US Imports Over Time

LED Packages



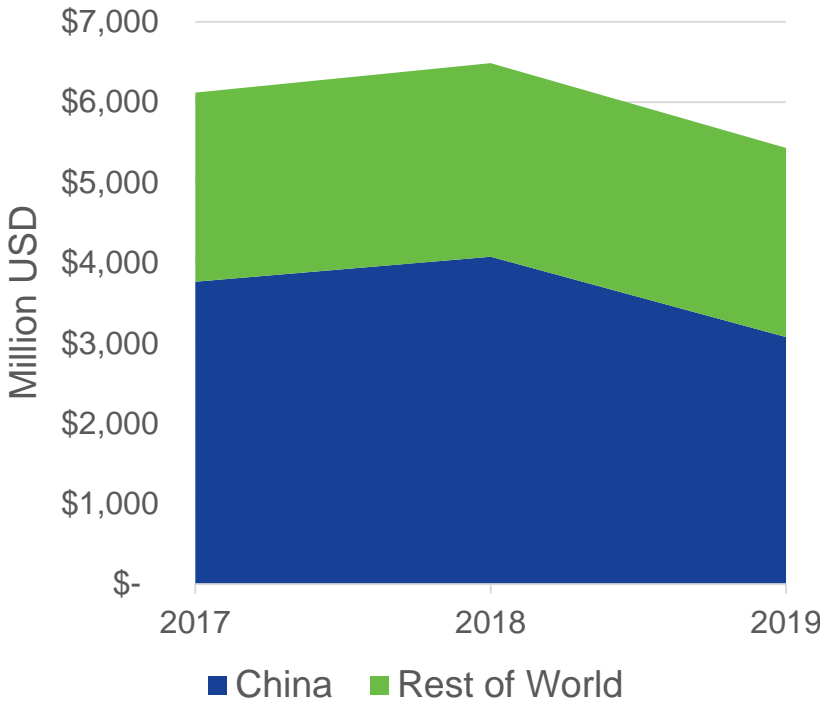
Over the past 5 years, US imports of LED packages have decreased from a high of \$1.5 billion in 2016 to a low of just over \$1 billion in 2019.

LED Lamps



While imports of LED packages decreased, imports of LED lamps increased. In 2017, the US imported \$1.6 billion of LED lamps, which grew to \$2.1 billion in 2019.

LED Luminaires



Fluctuations in yearly imports of LED luminaires to the US since 2017 have tracked closely to imports from China.

# Supply Chain Impacts of the Section 301-China Tariffs

The extent of the impact resulting from the tariffs varied depending on the geographical manufacturing presence of each company.

- LED package manufacturers indicated **some or all of the tariff's cost was passed on** to their customers in most cases- between 5% to 25%.
- LED manufacturers indicated there was a **significant shift in their production from China to Vietnam and Malaysia** (up to 40%).
- The tariffs on intermediate components (e.g., LED packages) often resulted in **shifting their manufacturing and production out of the US** and into Mexico.
  - ***There was no sizeable shift to manufacture LED luminaires in the US because of the tariffs.***

Tariff Level	Effect Date	LED Product
25%	July 2018	LED Packages
10%	July 2018	LED Luminaires
25%	May 2019	LED Luminaires
25%	Did not go into effect (scheduled 2019)	LED Lamps

# Supply Chain Impacts of the COVID-19 Pandemic

Manufacturers described two effects of the pandemic: an initial surge in demand and shortages (feast) followed by a slowing of demand (famine).

## Phase 1: Feast

- Early in the pandemic, many manufacturing plants shut down or were forced to reduce staff and operation significantly, causing shortages in LED packages, driver components, and materials.
- The impending arrival of COVID-19 also caused an initial spike in lighting product demand.
- As a result, manufacturers struggled to keep up and **saw product mfg. delays from 4–8 weeks or more.**
- The supply chain impacts from COVID-19 also showed the resiliency that comes from having a diversified supply chain.
- **Single-source manufacturers were hit the hardest** and struggled to stay operational.

## Phase 2: Famine

- As the pandemic went on, challenges shifted from supply chain issues and shortages to decreased demand and surpluses. Many manufacturers cited a **decreased demand of lighting products as the greatest challenge** they are currently facing due to the pandemic.
- Most manufacturers saw around **30% decreases, with ranges from 10% to 50% earnings losses** varying by region and market sector.

# Domestic Opportunities

## Barriers

- Mfg. has been **dominated by China** because of low labor costs and substantial gov. subsidies.
- The US has little opportunity to compete with China/other Asian countries on commoditized high-volume and low-margin lighting products and LED packages, which are labor-intensive.

## Domestic Lighting

- U.S. manufacturing can still play a role in **high-end luminaire and emerging lighting** technology markets.
  - Ex. GUV LED, human-centric lighting, connected lighting systems, colored LED lighting products

## Advance Mfg.

- Many manufacturers indicated that **additive manufacturing and increased automation** could make mfg. in the US a more viable option in the future, though many challenges remain.
  - 3D printing capabilities are not adequate for manufacturing needs today.
  - ***Significant advances in speed and cost reduction (10 times current levels in both speed and cost reduction) will be necessary*** to make additive manufacturing competitive.

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