De-ICE-ing and the geography of engine sourcing in North America

Automotive Insights Symposium
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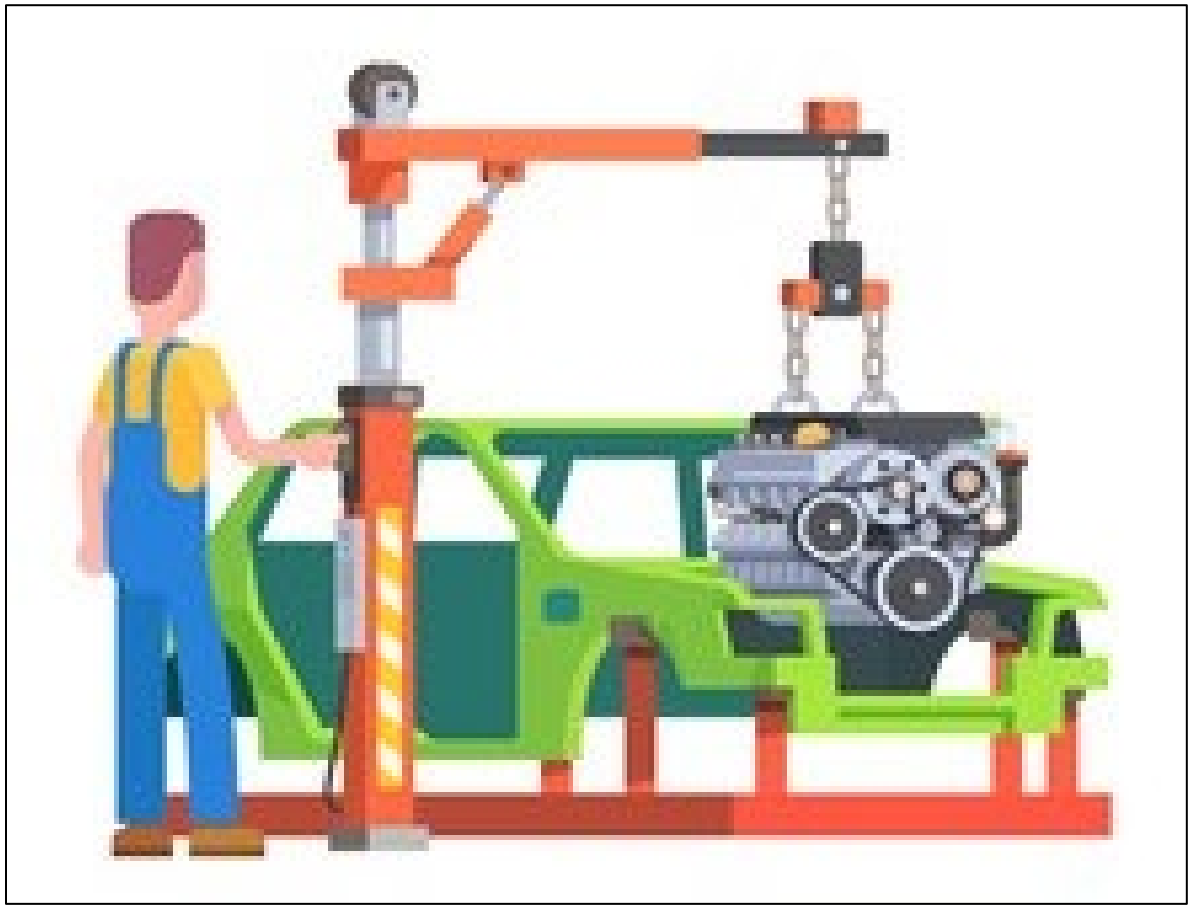

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Motivation:

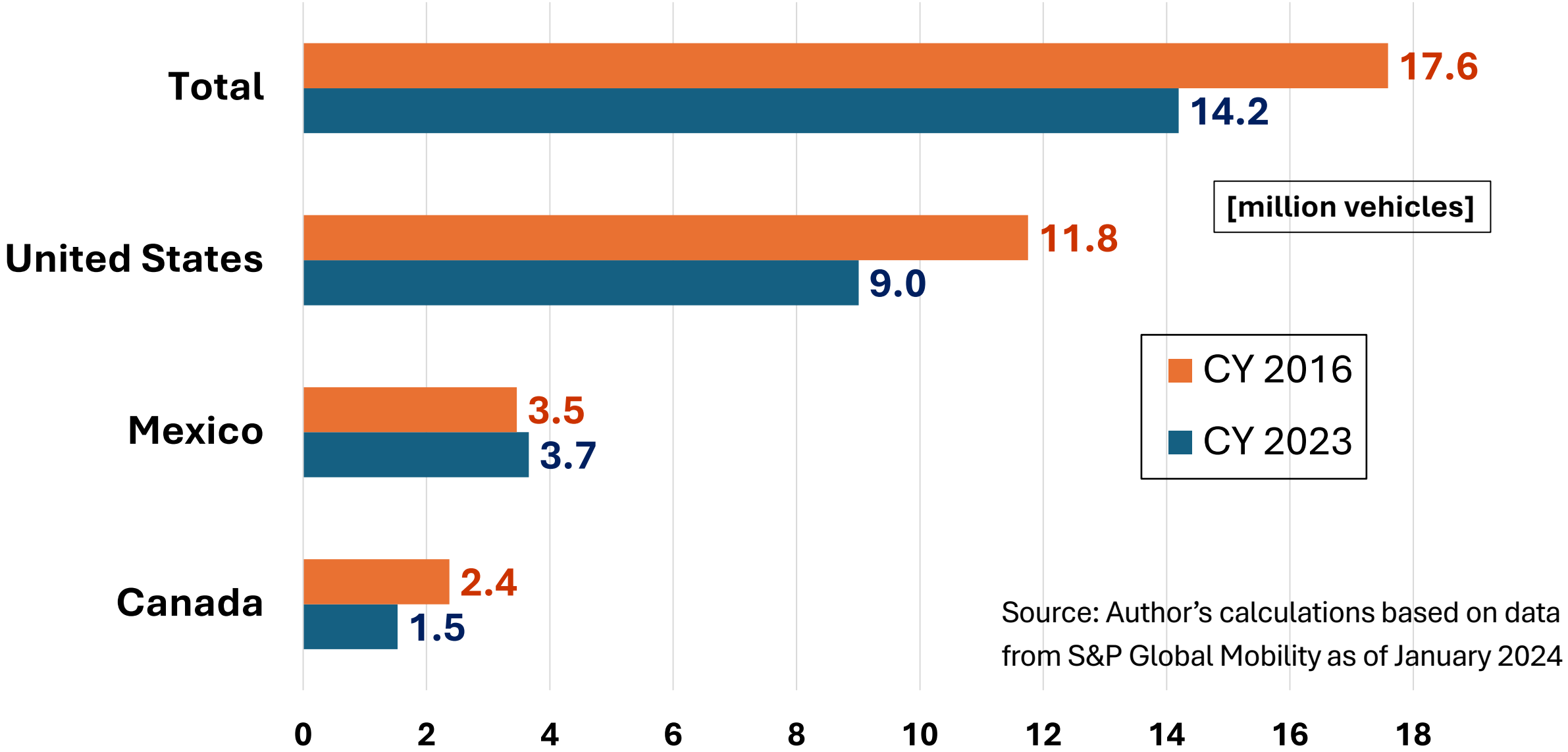
- What is the impact of declining engine volume on the footprint of engine sourcing in North America?

Data

- Compare detailed light vehicle production data (including engine sourcing) for light vehicles produced in North America in 2016 and 2023
- Source S&P Global Mobility

- Note: we drop light vehicle assembly plants that produce fewer than 50k units

19% decline in assembly of vehicles with engines



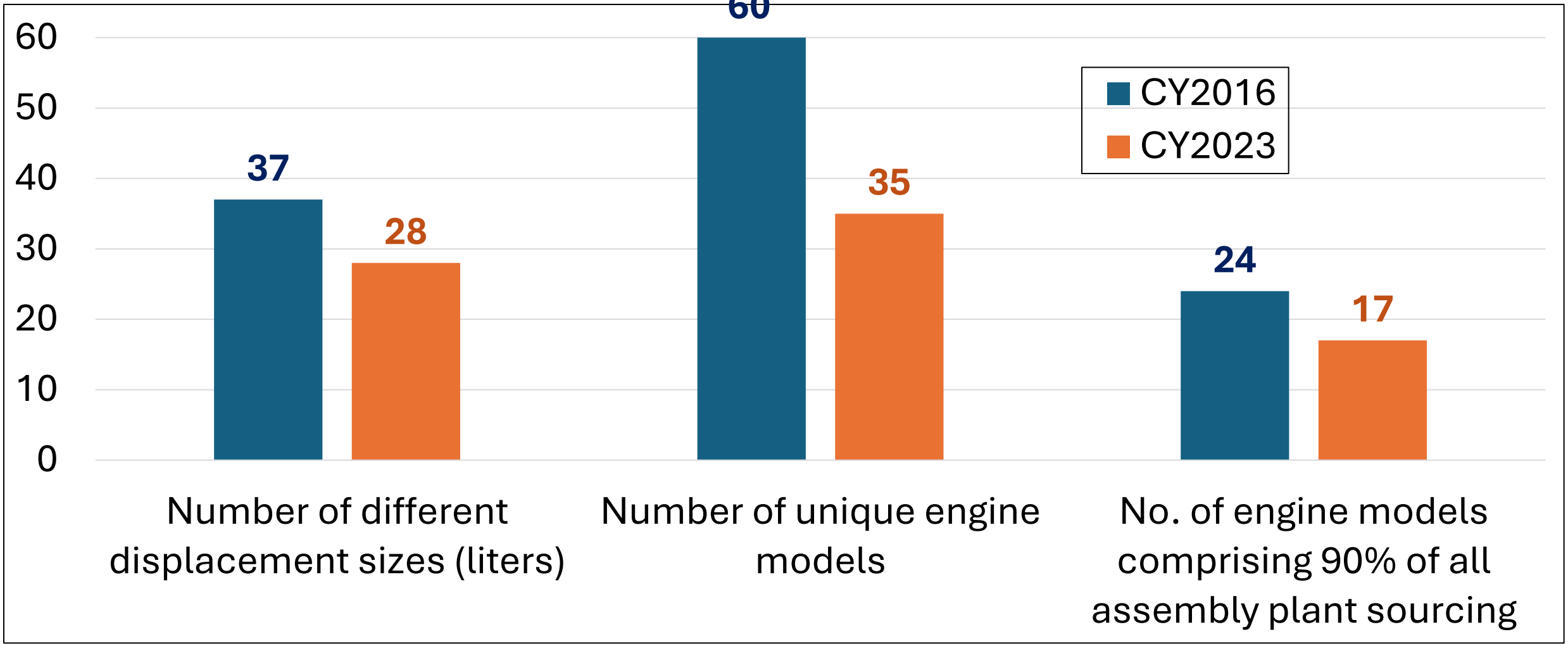
Source: Author's calculations based on data from S&P Global Mobility as of January 2024

5 engine characteristics observed in our data

- Number of cylinders (mostly 4 or 6)
- Displacement (liters)
- Configuration (inline or V-shape)
- Number of valves (mostly 16 or 24)
- Camshaft type (mostly single or dual overhead)

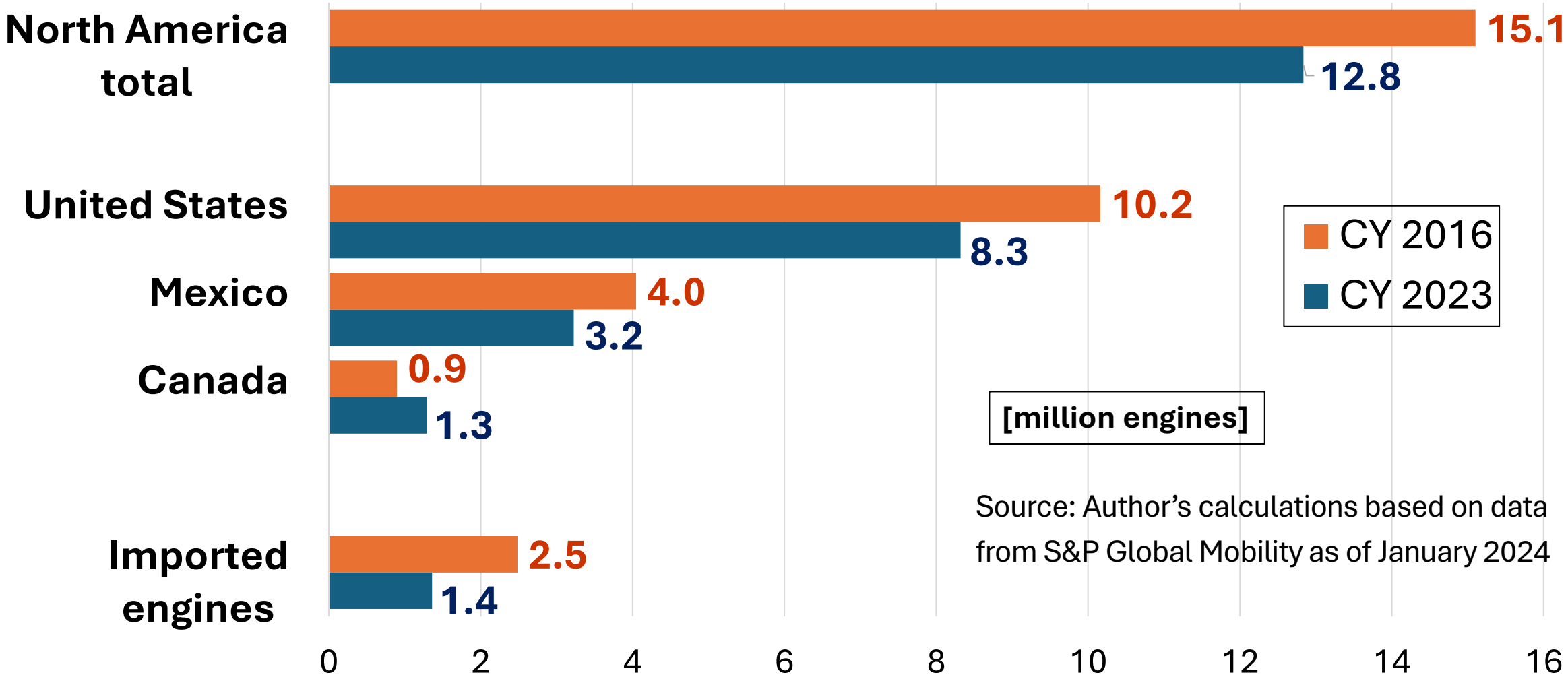
- Note: Highest volume in 2023: 4 cylinder 2.0 liter inline engine with 16 valves and dual overhead camshaft (19.6% of engines sourced)

Decrease in variety of engines sourced by North American assembly plants



Source: Author's calculations based on data from S&P Global Mobility as of January 2024

Only 15% decline in production of engines, though 45% decline in imports of engines



Source: Author's calculations based on data from S&P Global Mobility as of January 2024

But virtually no change in number of plants assembling vehicles with engines

	CY2016	CY2023
Canada	8	7
Mexico	15	17
United States	40	38
Total plants assembling vehicles with engines	63	62

Source: Author's calculations based on data from S&P Global Mobility as of January 2024

And virtually no change in number of plants producing engines for North American assembly

	CY2016	CY2023
Canada	4	4
Mexico	10	10
United States	22	21
Total engine plants	36	35

Source: Author's calculations based on data from S&P Global Mobility as of January 2024

An engine plant now supplies fewer assembly plants

	CY2016	CY2023
1 assembly plant	6	12
2-5 assembly plants	18	19
6-10 assembly plants	12	4
Total	36	35
Mean	4.1	3.1

Source: Author's calculations based on data from S&P Global Mobility as of January 2024

Vehicle assembly plants receive engines from fewer engine plants

	CY2016	CY2023
0 engine plants*	3	2
1 engine plant	15	30
2-3 engine plants	35	25
4-6 engine plants	10	5
Total	63	62
Mean	2.3	1.8

* All engines supplied by importing from outside North America

Source: Author's calculations based on data from S&P Global Mobility as of January 2024

Mean number of engine plants supplying assembly plants

	CY2016	CY2023
Detroit 3	2.9	2.5
International	1.7	1.0
Overall mean	2.3	1.8

Source: Author's calculations based on data from S&P Global Mobility as of January 2024

Mean number of assembly plants supplied by engine plants

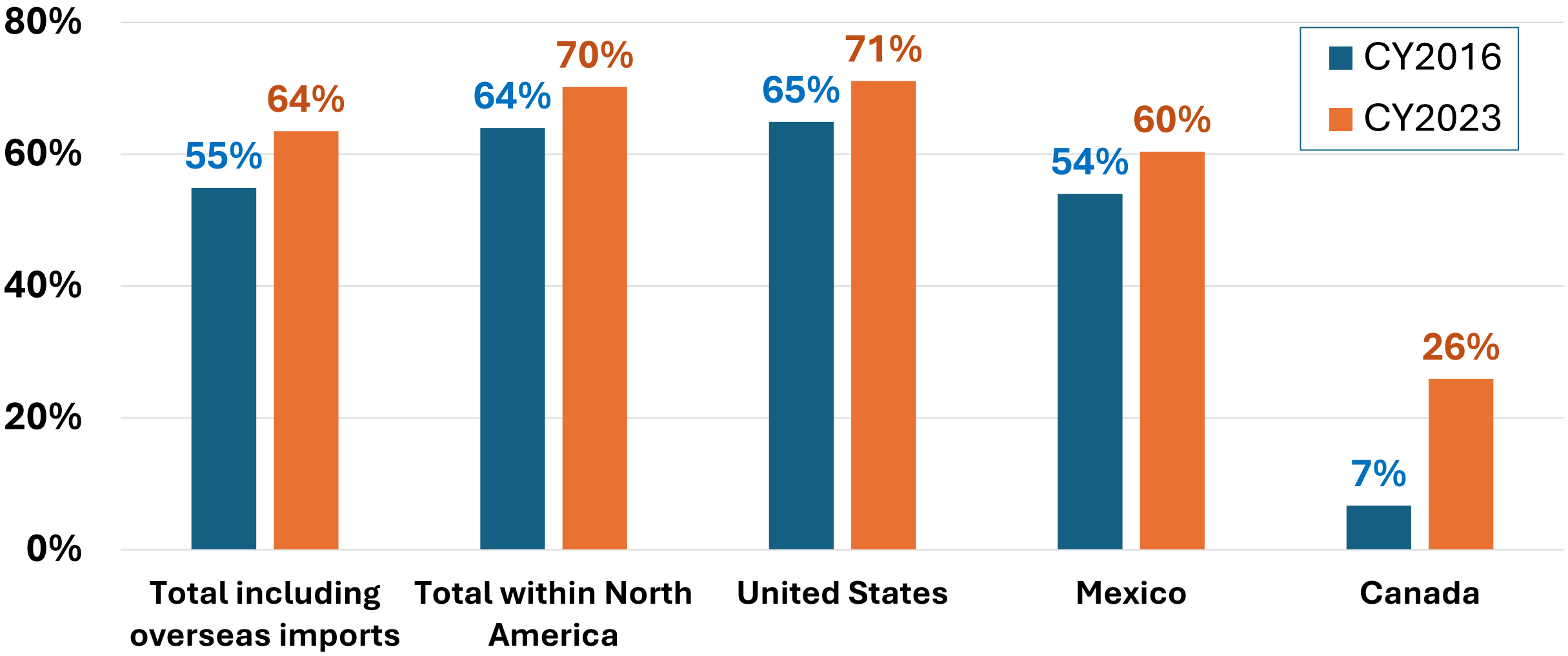
	CY2016	CY2023
Detroit 3	5.0	3.6
International	2.9	2.3
Overall mean	4.2	3.1

Source: Author's calculations based on data from S&P Global Mobility as of January 2024

What is the impact on the geography of engine sourcing?

- More or less complexity?

Share of engines that assembly plants receive from engine plants in the same country



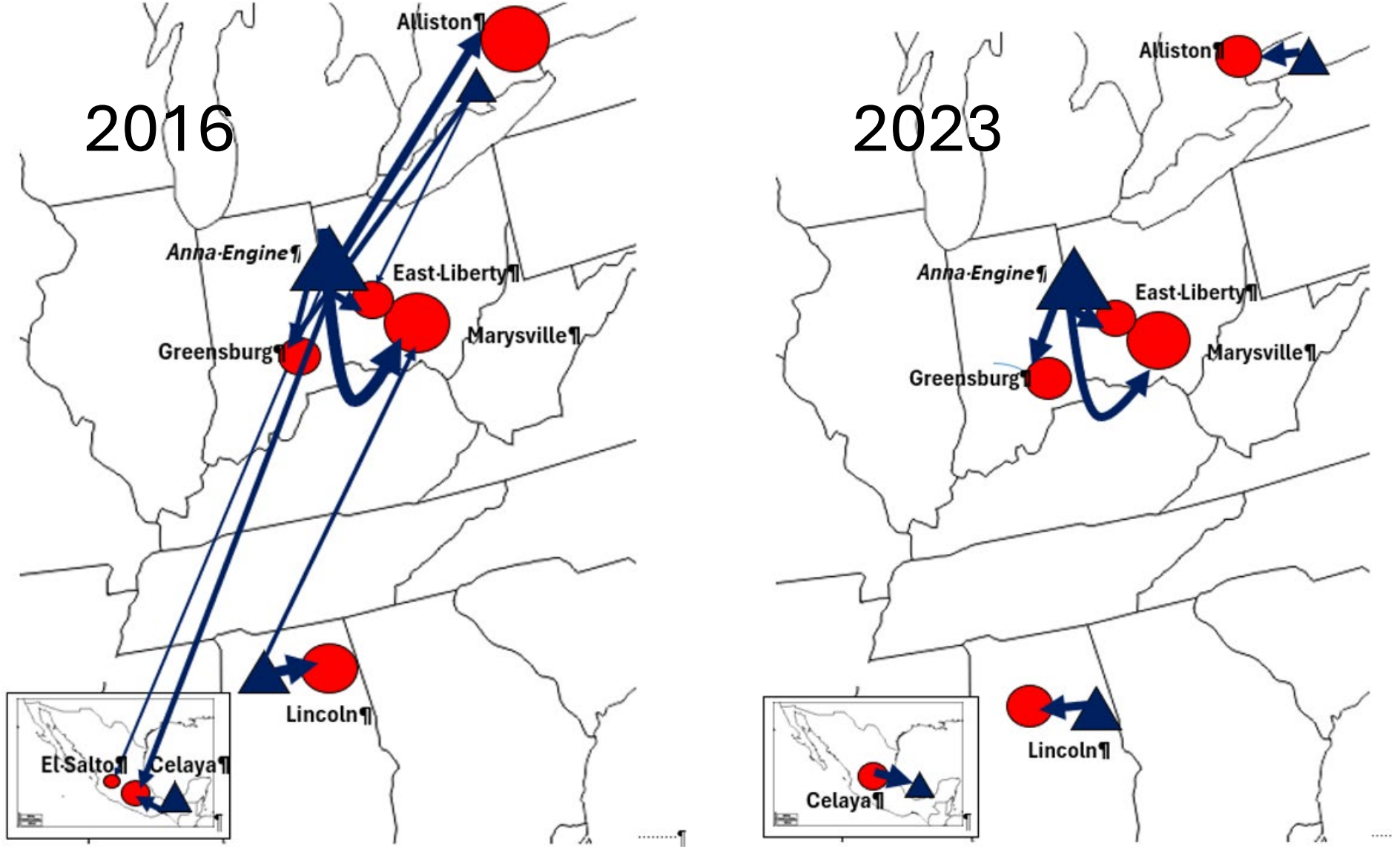
Source: Author's calculations based on data from S&P Global Mobility as of January 2024

Engines are traveling shorter distances

	CY2016	CY2023
Share of engines crossing international borders		
Within North America	31%	27%
From overseas	14%	10%
Median distance from engine plant to assembly plant (miles)	329	256

Source: Author's calculations based on data from S&P Global Mobility as of January 2024

Example: Honda engine sourcing in North America



Source: Author's calculations based on data from S&P Global Mobility as of January 2024

Conclusions

From 2016 to 2023 we observe for North America:

- A 15% decline in the production of engines.
- A much more substantive decline in engine configurations.
- A reconfiguration of engine supply chains:
  - Fewer imports from overseas.
  - Fewer engines cross borders w/in North America.
  - Shorter distances between engine production and vehicle assembly.

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