Crafting strong, integrated policy mixes for deep CO_2 mitigation in road transport

Jonn Axsen
Associate Professor,
Director,
Sustainable Transportation Action Research Team (START)
Simon Fraser University
Vancouver, Canada

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PERSPECTIVE

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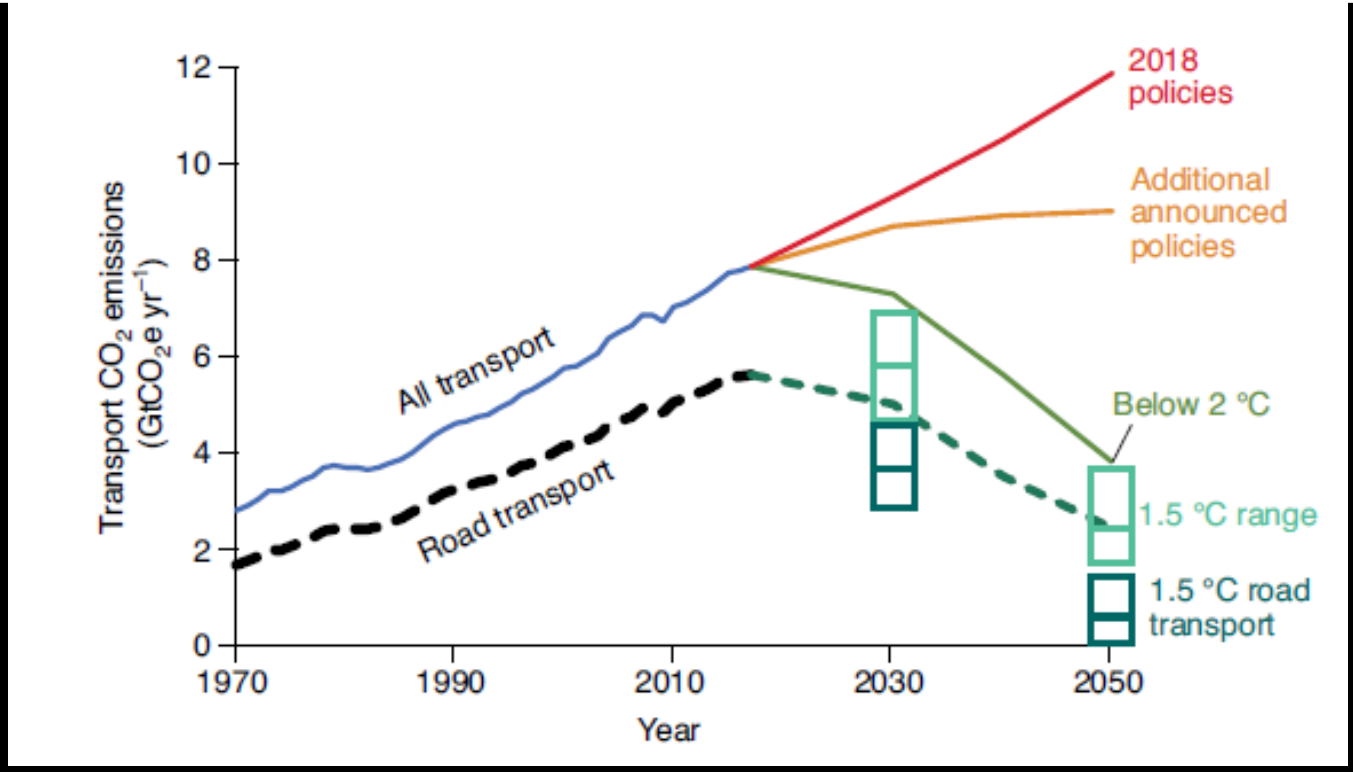
Crafting strong, integrated policy mixes for deep CO_2 mitigation in road transport

Jonn Axsen[1]✉, Patrick Plötz[2] and Michael Wolinetz[3]

Transport CO_2 emissions continue to grow globally despite advances in low-carbon technology and goal setting by numerous governments. In this Perspective, we summarize available evidence for the effectiveness of climate policies and policy mixes for road transport relative to 2030 and 2050 mitigation goals implied by the Paris Agreement. Current policy mixes in most countries are not nearly stringent enough. We argue that most regions need a stronger, more integrated policy mix led by stringent regulations and complemented by pricing mechanisms as well as other efforts to reduce vehicle travel.



Source: Axsen et al. (2020), *Nature Climate Change*, https://www.nature.com/articles/s41558-020-0877-y

Goal versus policy

Goal: what you aim to achieve, e.g.

- Paris Agreement targets, ZEV sales targets

Policy: government laws or actions implemented to achieve social goals (public policy), e.g.

- Tax, incentive, regulation
- *Systemic changes: changing building codes, development zones, new transit line

Why we need policy: 12 failures that prevent transformative change

Market failures (Economics)	1. Information asymmetries
	2. Knowledge spill-over (R&D)
	3. Externalities (GHGs, air pollution)
	4. Over-exploitation of commons
Structural system failures	5. Infrastructural failures
	6. Institutional failures
	7. Interaction/network failures
	8. Capabilities failure
Transformational system failures	9. Directionality failure (lack of shared goals)
	10. Demand articulation failure
	11. Policy coordination failure
	12. Reflexivity failure (lack of adaptiveness)

Source: **Weber and Rohracher (2012), *Research Policy***

Framework for policy mix evaluation: interactions and additive impacts

Policy interaction criterion	Explanation	Quantitative measure
1) Effectiveness at GHG mitigation	Does the policy lead to additional GHG mitigation?	Tonnes CO_2e abated, in a given year, e.g., 2030 or 2050 (ideally well-to-wheel or full Life Cycle Analysis)
2) Cost-effective	Does the policy help the policy mix to achieve the GHG target at the least cost to society?	\$/Tonne CO_2e abated, or welfare
3) Political acceptability	Does the policy improve (or worsen) the political acceptability of the policy mix?	Not as clear. Percentage of citizens or stakeholders that support or oppose the policy? Directly ask the perceptions of the policymaker?
4) Transformational signal	Aside from the above factors, does the policy provide an added "push" in transition towards the low-carbon goal?	Unclear. Could be dollars invested in R&D activity, or number of patents or prototypes per year. Requires qualitative measures to provide a complete picture.

Source: **Bhardwaj et al. (2020), *Transportation Research Part A***

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Three “legs of the stool” for transport GHG mitigation

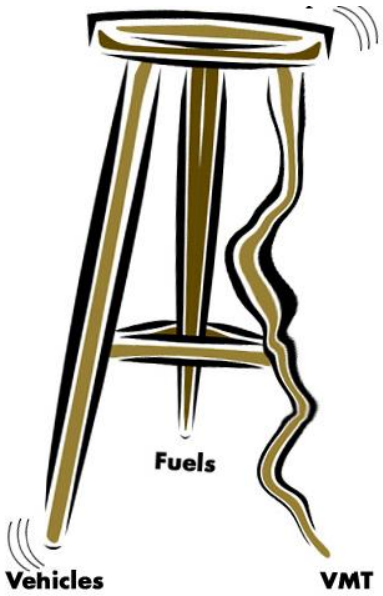
Mitigation pathways

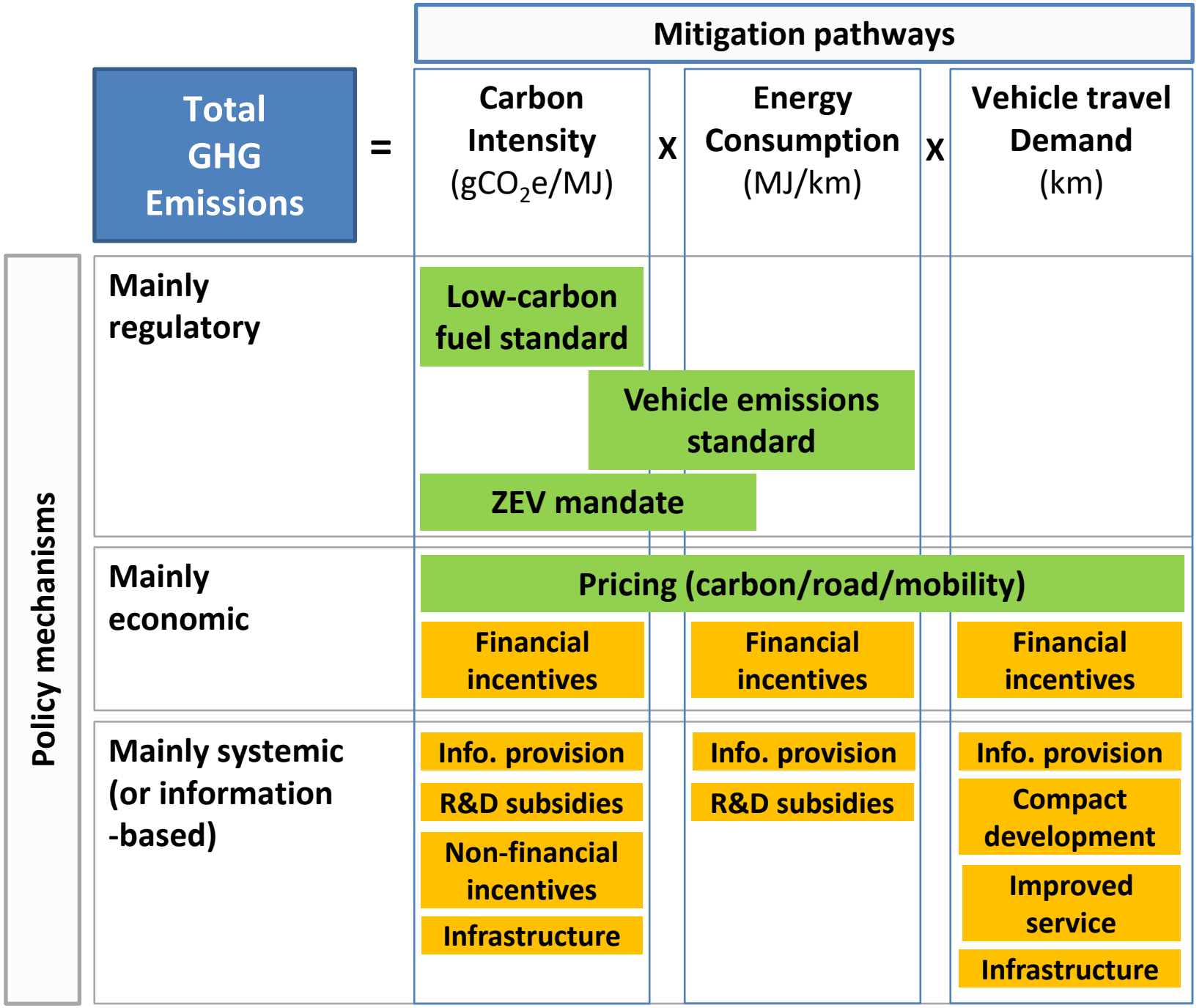
Total GHG Emissions	=	**Carbon Intensity** (gCO_2e/MJ)	x	**Energy Consumption** (MJ/km)	x	**Vehicle travel Demand** (km)

Fuel switching
- To low-carbon:
  - Electricity
  - Hydrogen
  - Biofuels
- Lower carbon fossil fuels

Vehicle efficiency
- Smaller
- Lighter
- More efficient
  - Hybrid

Reduce VKT
- Mode switching:
  - Active travel
  - Public transit
  - “Pooling”
- Built environment
- Other behaviour changes?





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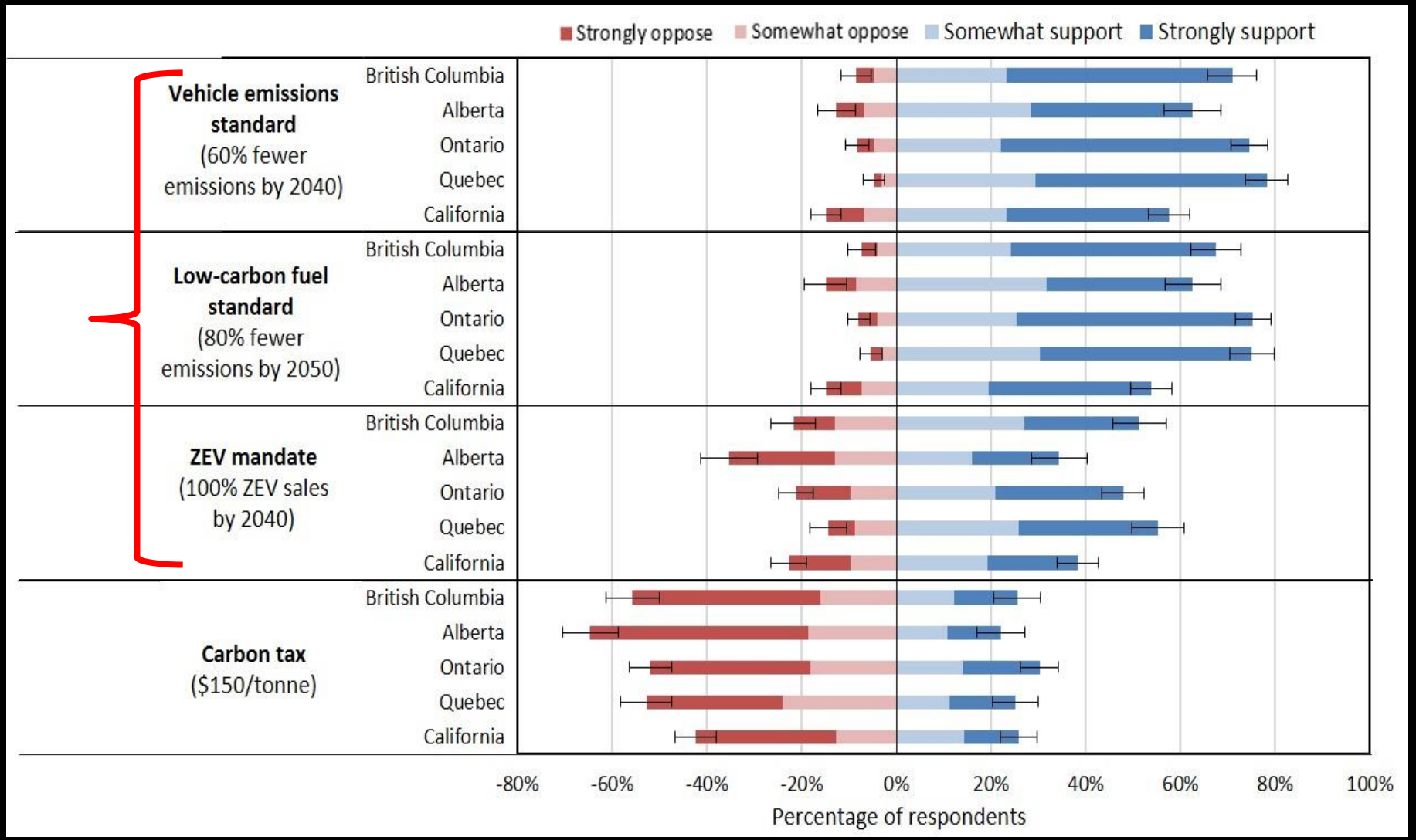
Citizens tend to support market-oriented regulations (and oppose pricing)



Source: Long et al., (2020), *Transportation Research Part A*

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Source: **Bhardwaj et al. (2020),** ***Transportation Research Part A***

ZEV mandate was shown to drive innovation activity for electric vehicles (patents)

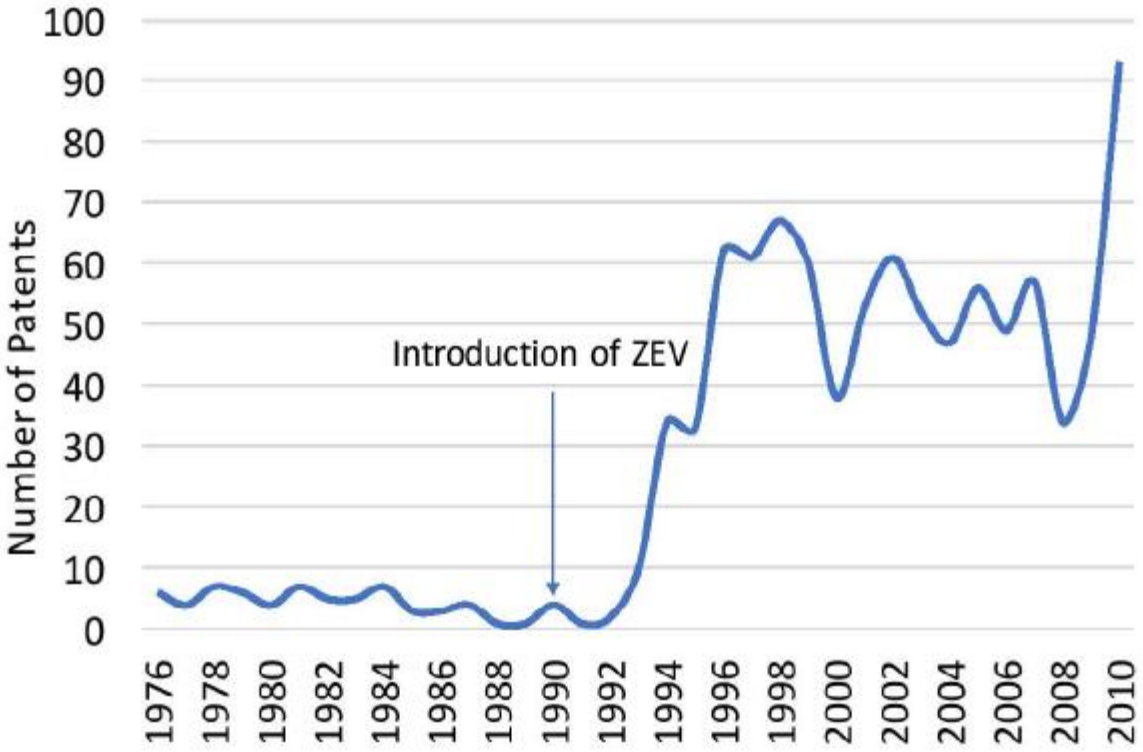
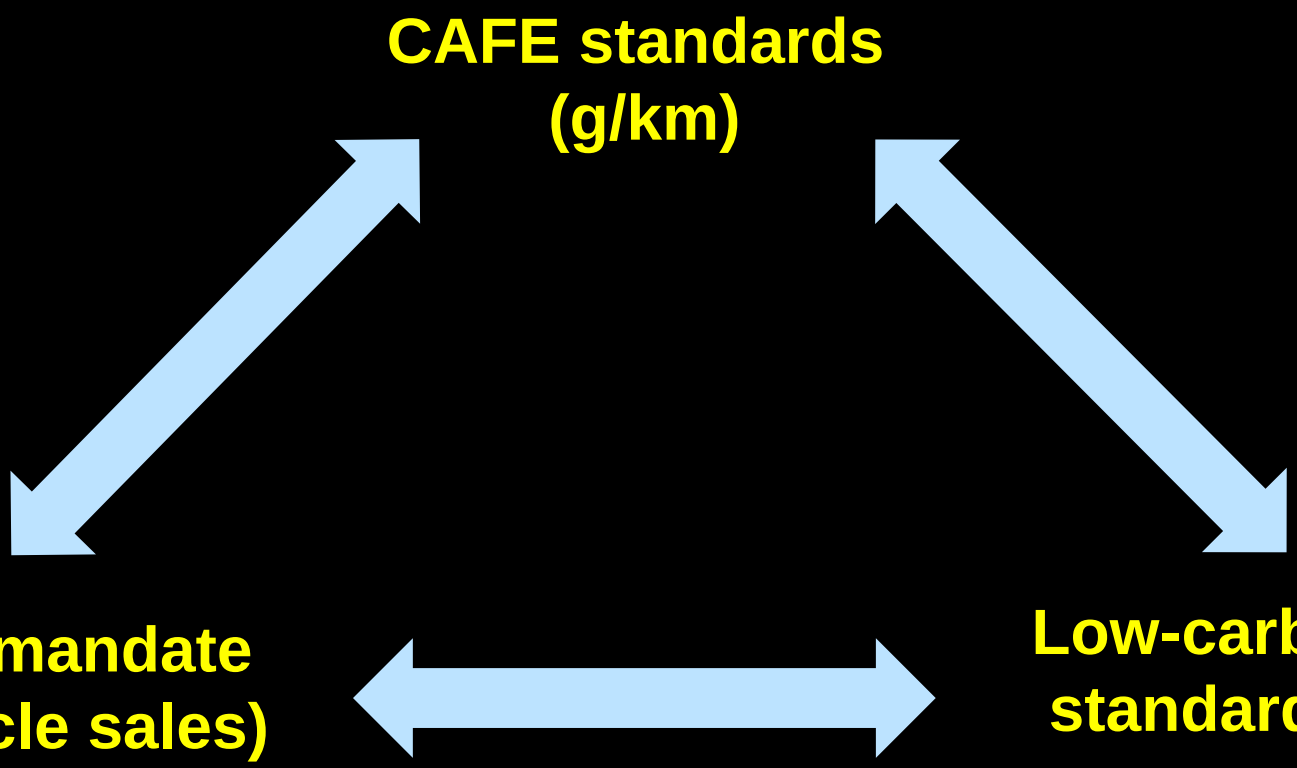


Figure 1: Change in number of patents filed for 'electric vehicles' from 1976 to 2010 [18].

Perspective on "Best policies" low-carbon transport

1. **Carbon pricing is ideal, but won't be strong enough to reach 2050 targets (due to political acceptability).**
   - Other pricing could help (tolls, parking, etc.)
2. **Strong market-oriented regulations will be needed, likely a combination of:**
   - Fuel efficiency standards (CAFE – strengthened for 2050)
   - A low-carbon fuel standard (strengthened for 2050)
   - ZEV mandate (either 100% ZEVs, or ICE ban)
3. **VKT reduction strategies realistically won't make up more than 5-10% of GHG reductions.**
   - Active travel, transit and urban density should be promoted for other benefits (health, social), don't rely on them for climate
   - Shared mobility should emphasize access/equity benefits

Priorities: The supply-focused policy “Triad”



Good “complements”: carbon pricing, purchase incentives, charging infrastructure (home, work, public)