Electrifying Transport and the Cost of Mitigation

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Our question

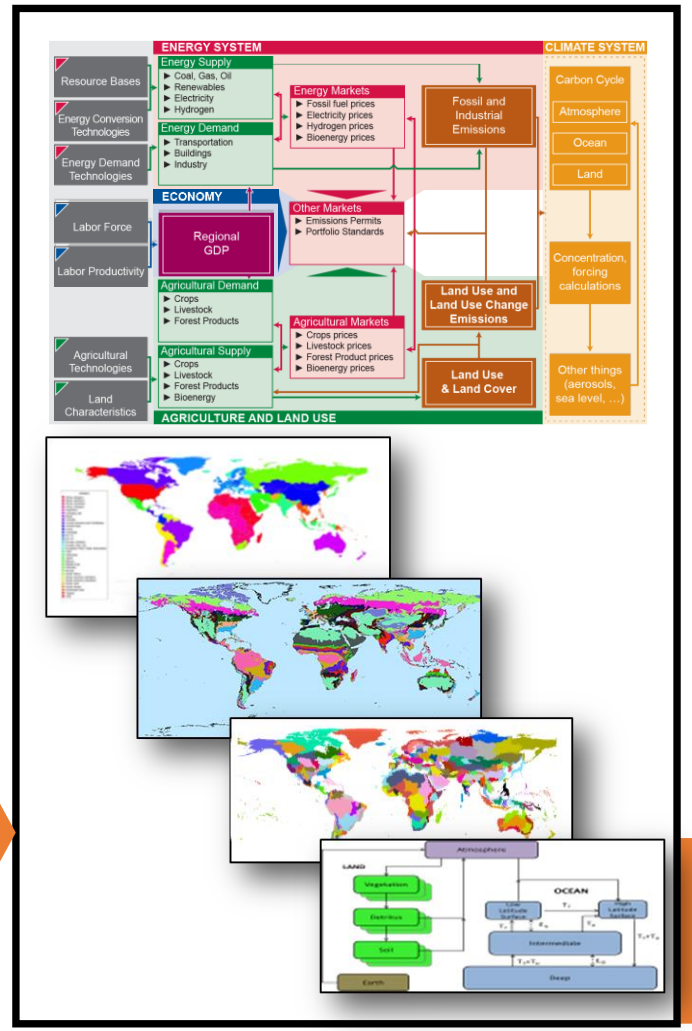
- How would the electrification of transportation affect the global energy system and greenhouse gas emissions mitigation?

Source: https://https://energy.gov/eere/vehicles/plug-electric-vehicles-and-batteries/

Both examples use the JGCRI Global Change Assessment Model (GCAM)

Scenario Assumptions

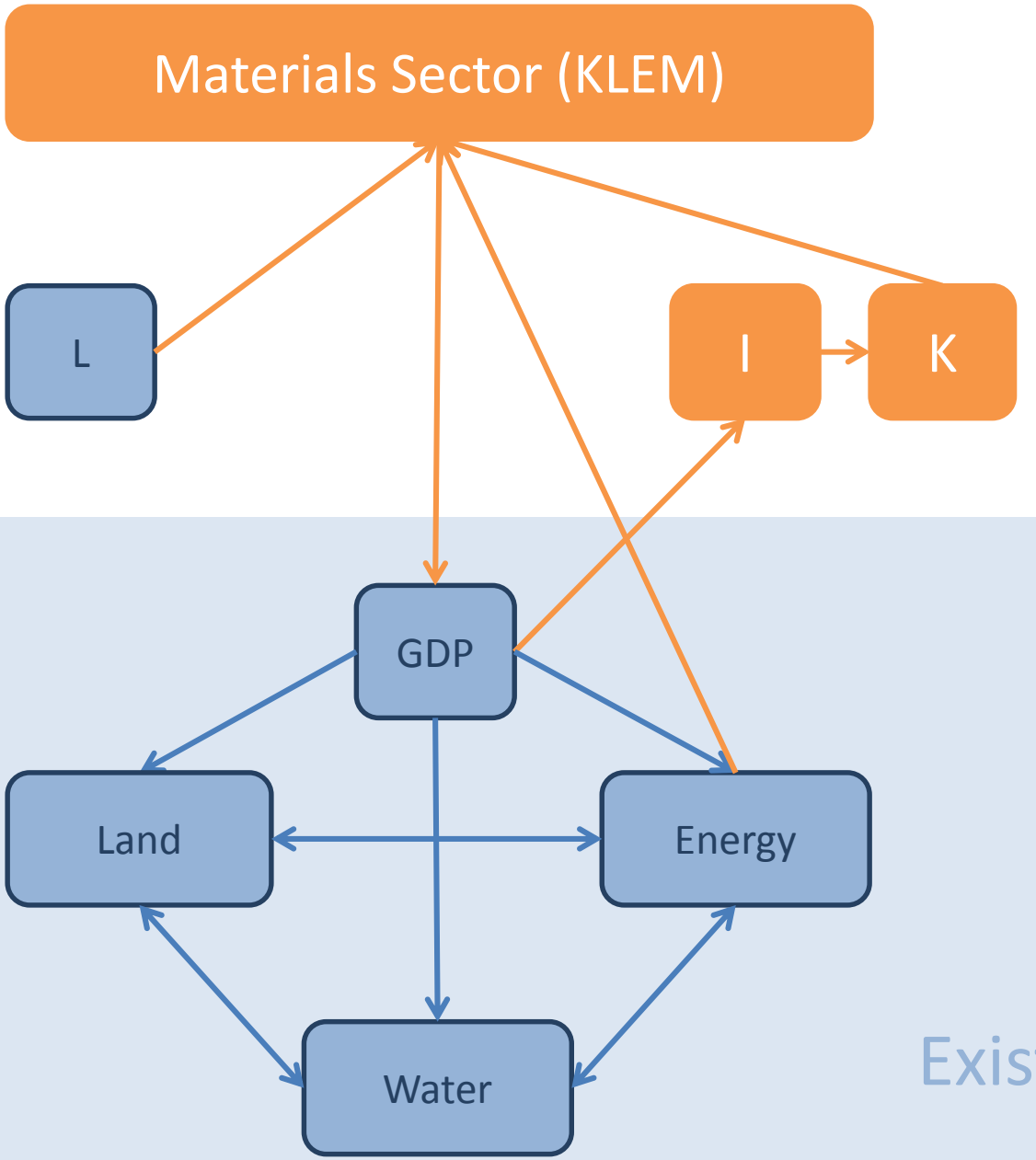
- **Socioeconomic assumptions** (population, GDP)
- Energy, land use, and water **technologies**
- **Policies**
- **Resources**



Scenario Outputs

- **Prices and production quantities**:
  - Energy sectors
  - Transportation
  - Primary energy resources
  - Agricultural products
- **Land use**
  - Crops (by type)
  - Pasture
  - Unmanaged
- **Water demand**
  - Raw demand by sector
  - Response to scarcity
- **Atmosphere-Climate**
- **Economic indicators**
  - Economic losses
  - Income transfer

GCAM-Macro



New GCAM-Macro elements

NOTATION
Lm = labor used for materials production
La = labor used in agricultural production
I = investment
K = capital stock
GDP = gross domestic product

Existing GCAM elements

Experimental design

- All scenarios assume SSP2 (Middle of the Road) underlying socioeconomic drivers

- Policy assumptions
  - Current policies only
  - 2-degrees

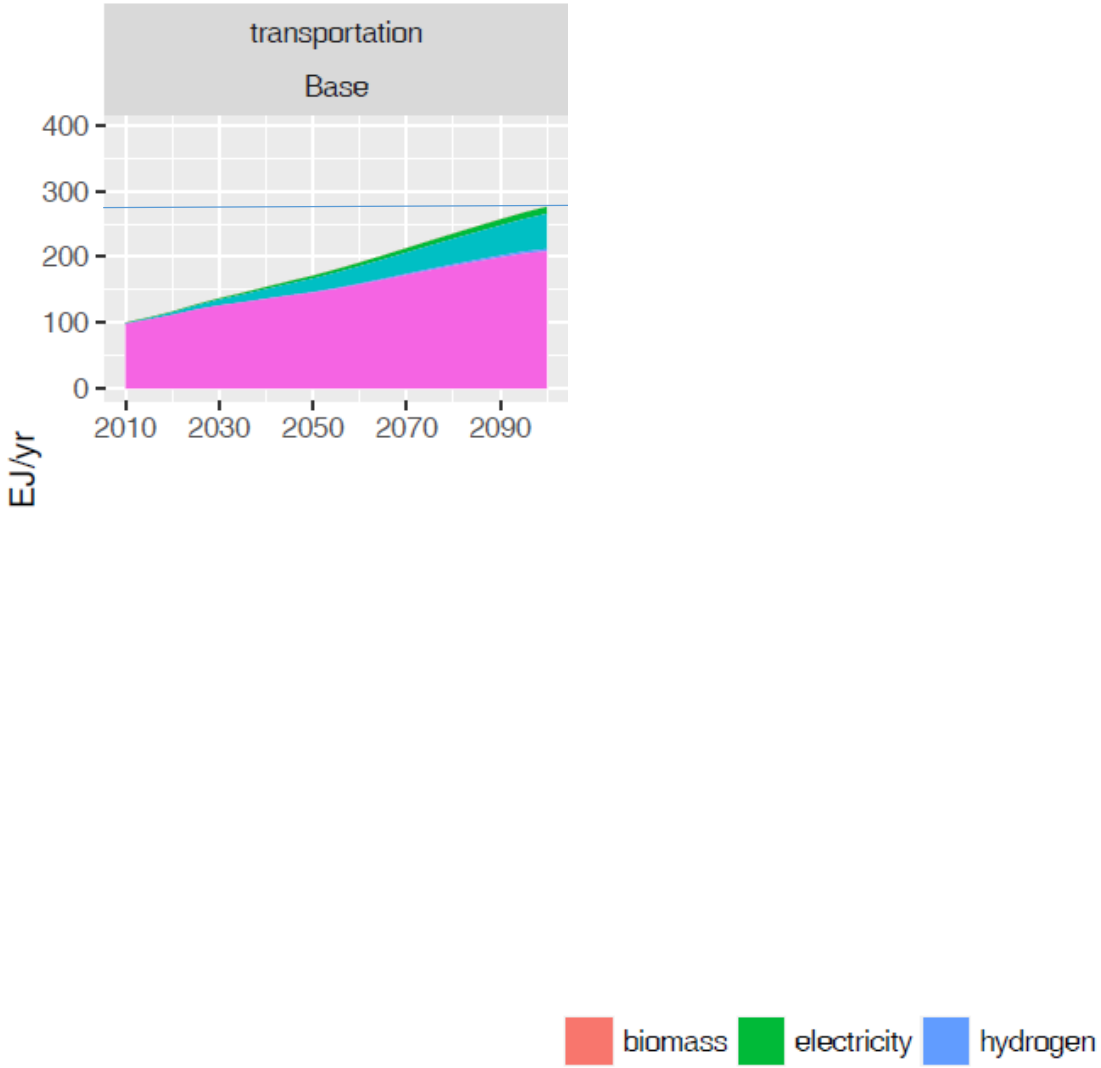
- Transport technology pathways
  - SSP2 transport technology
  - Accelerated electric vehicles
  - Phase out of non-electric vehicles

Source: http://viola.bz/your-life-is-your-road/life-is-a-road-5/

Transport technology pathways

Technology Scenario	Technology Assumptions
SSP2 transport technology	**Passenger Light-Duty** BEV Capital Cost: 10 - 50 % greater than ICE BEV Fuel Efficiency: ~3 x better than ICE
Accelerated electric vehicles	**Passenger Bus and Freight Truck** BEV Capital Cost: Equal to ICE by 2035 BEV Fuel Efficiency: ~3x better than ICE
Phase out of non-electric vehicles	**Phase Out ICE by 2050 for** Passenger Lt-Duty Passenger Bus Freight Truck

Final Energy Consumption



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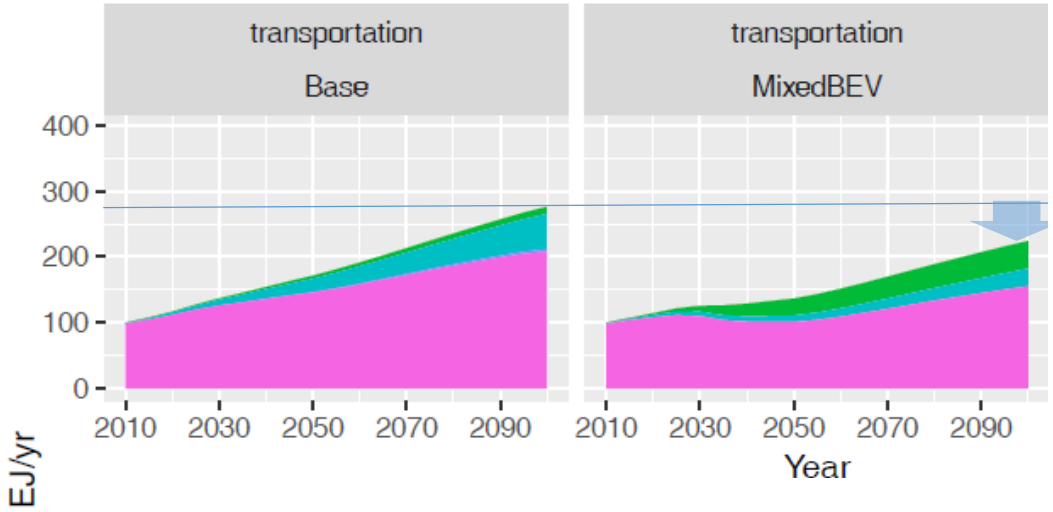

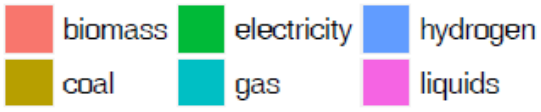

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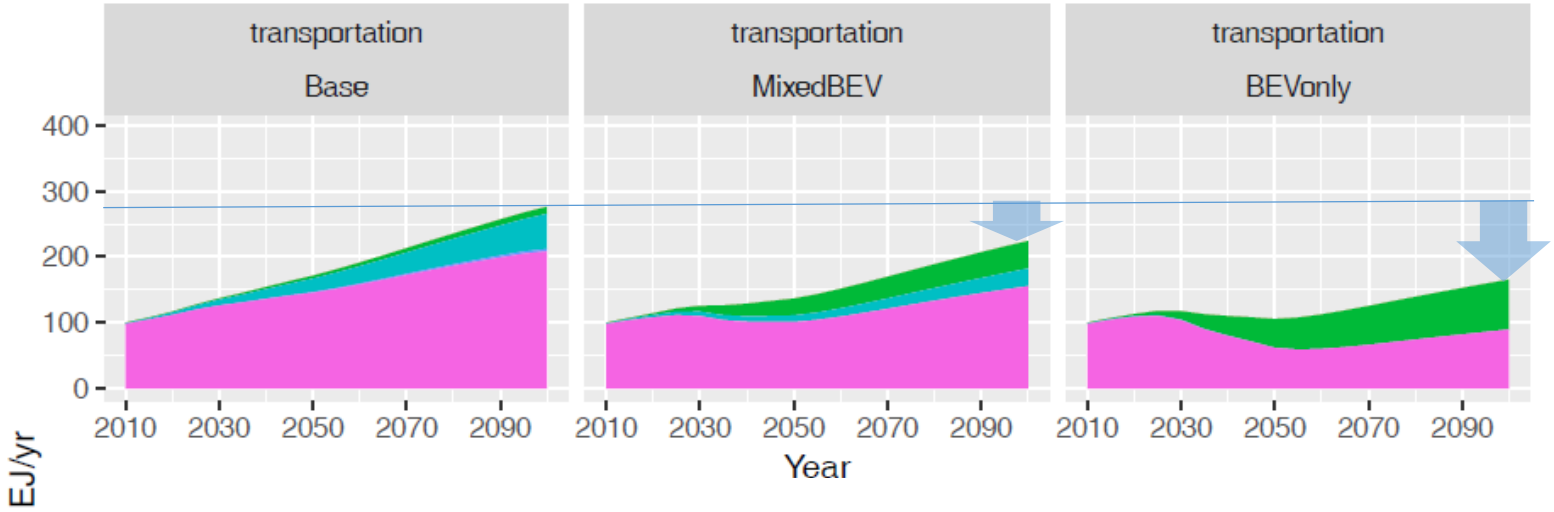

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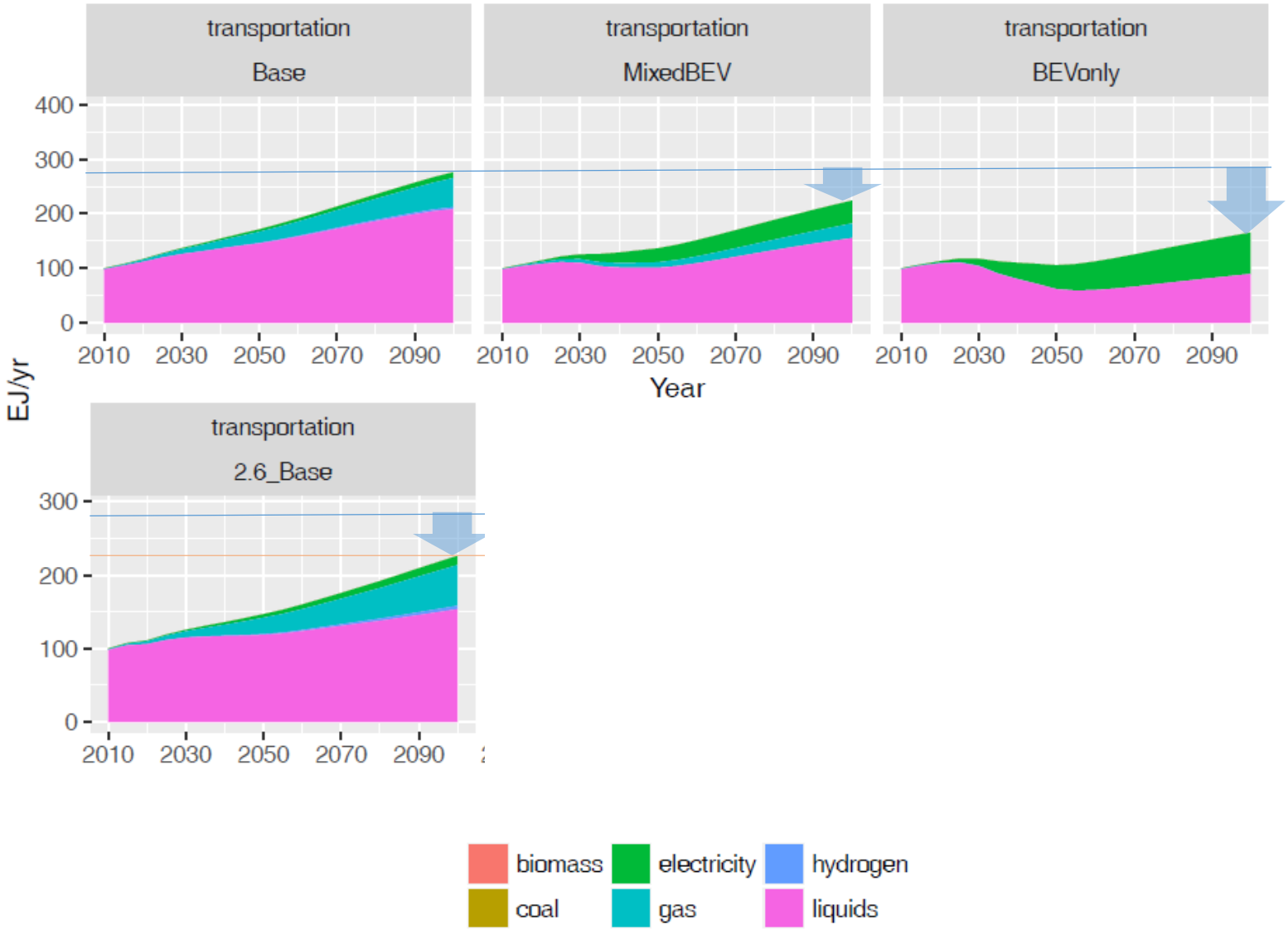

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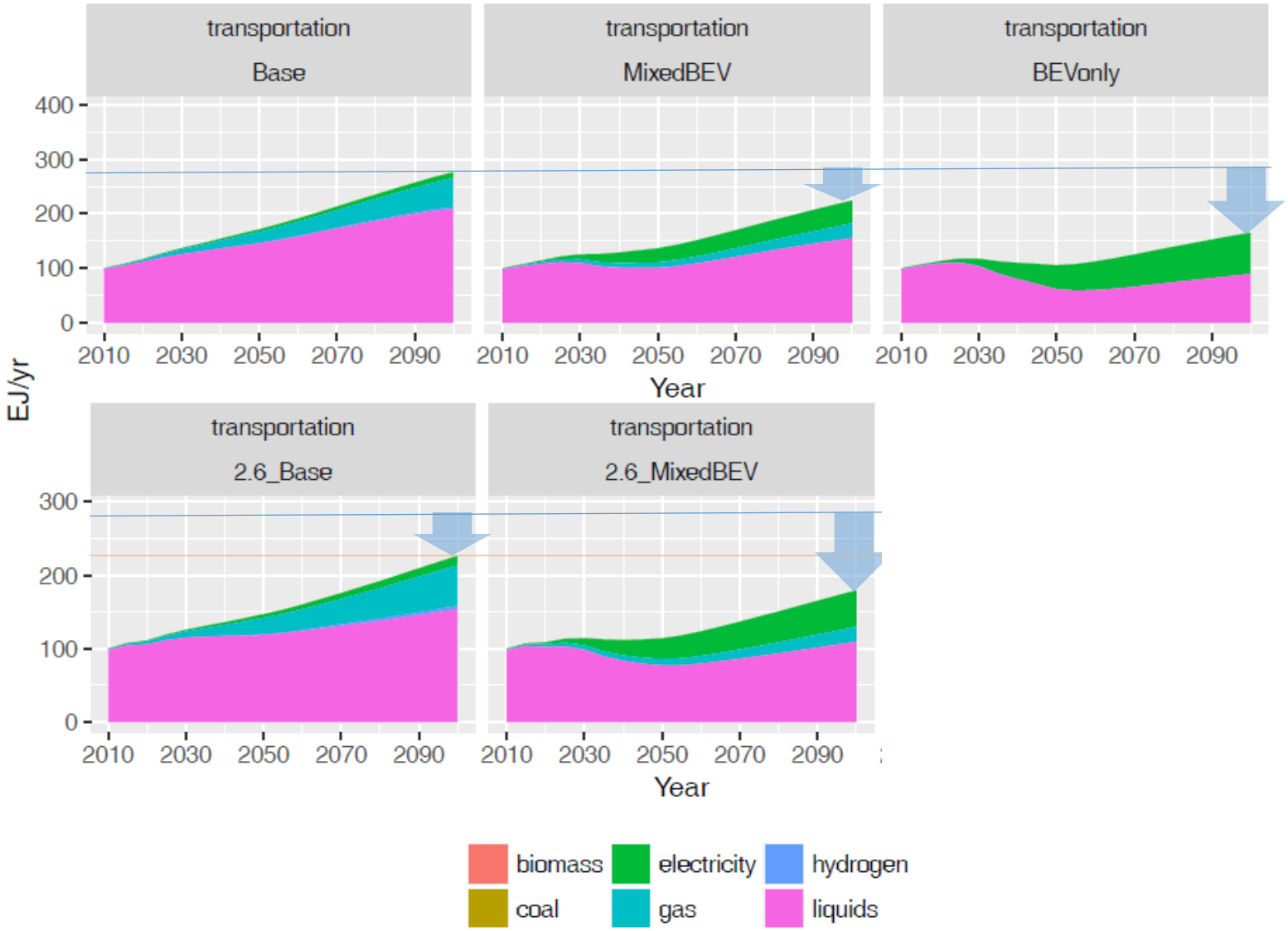

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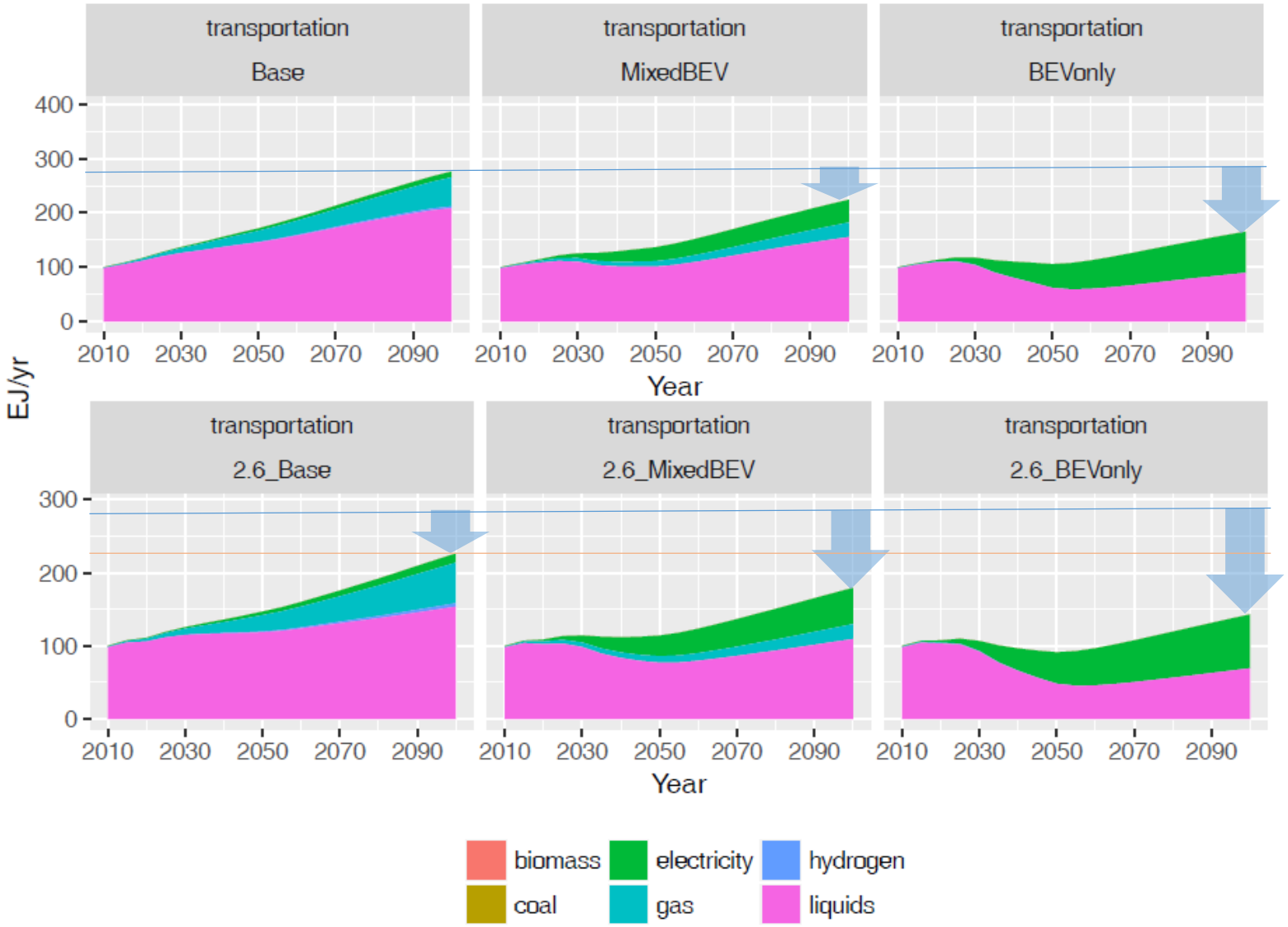
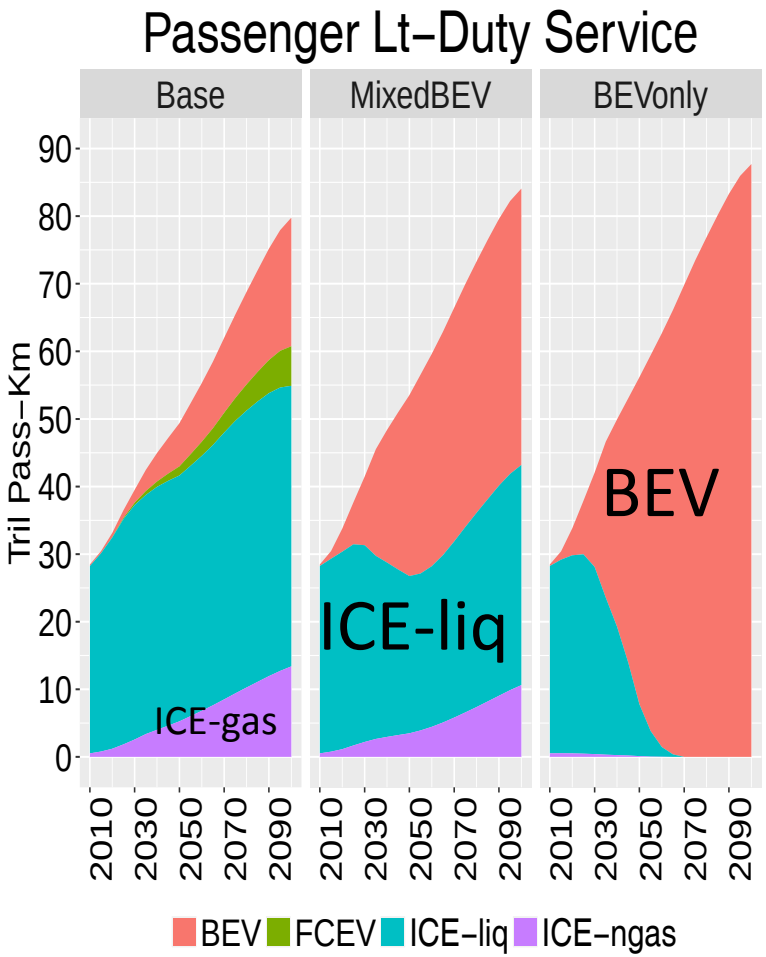
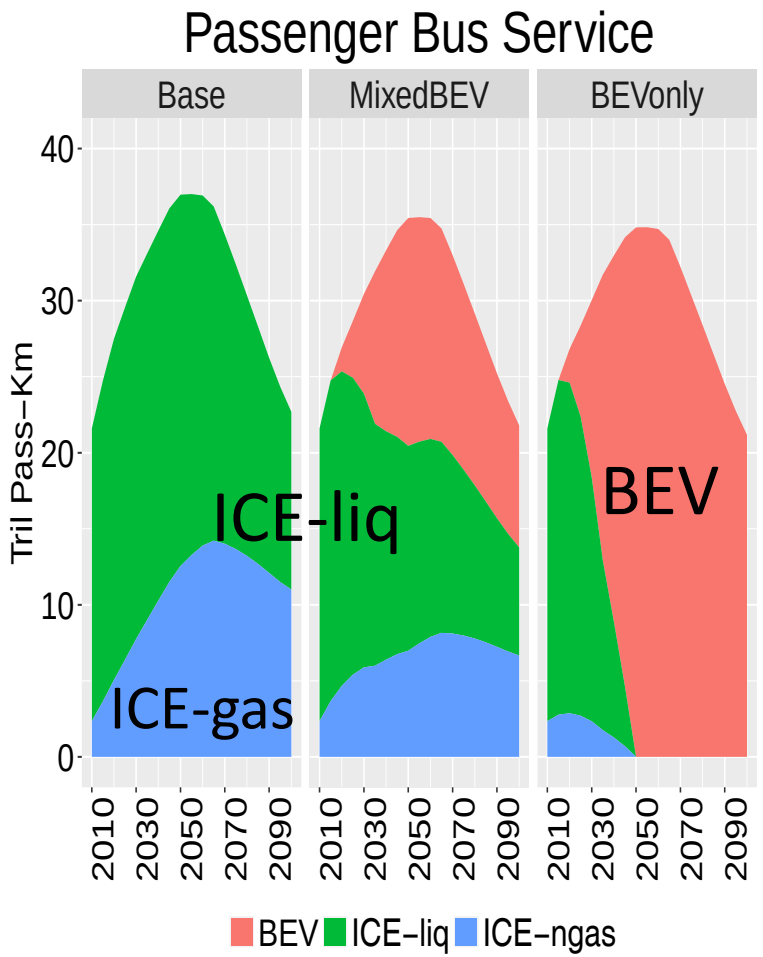
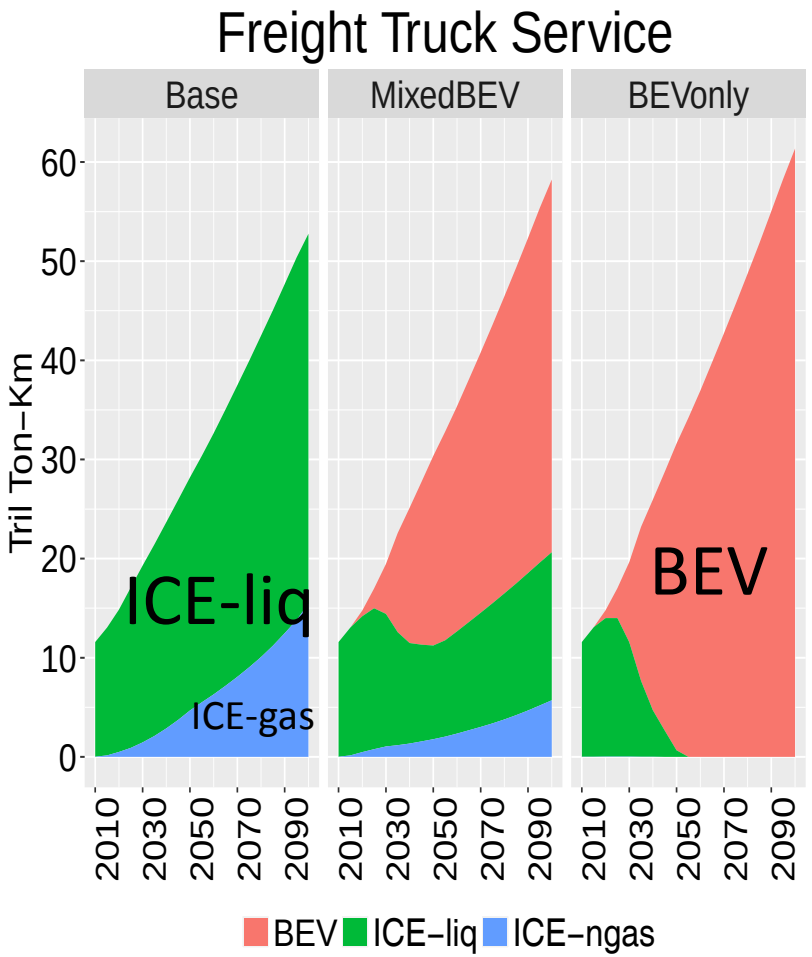


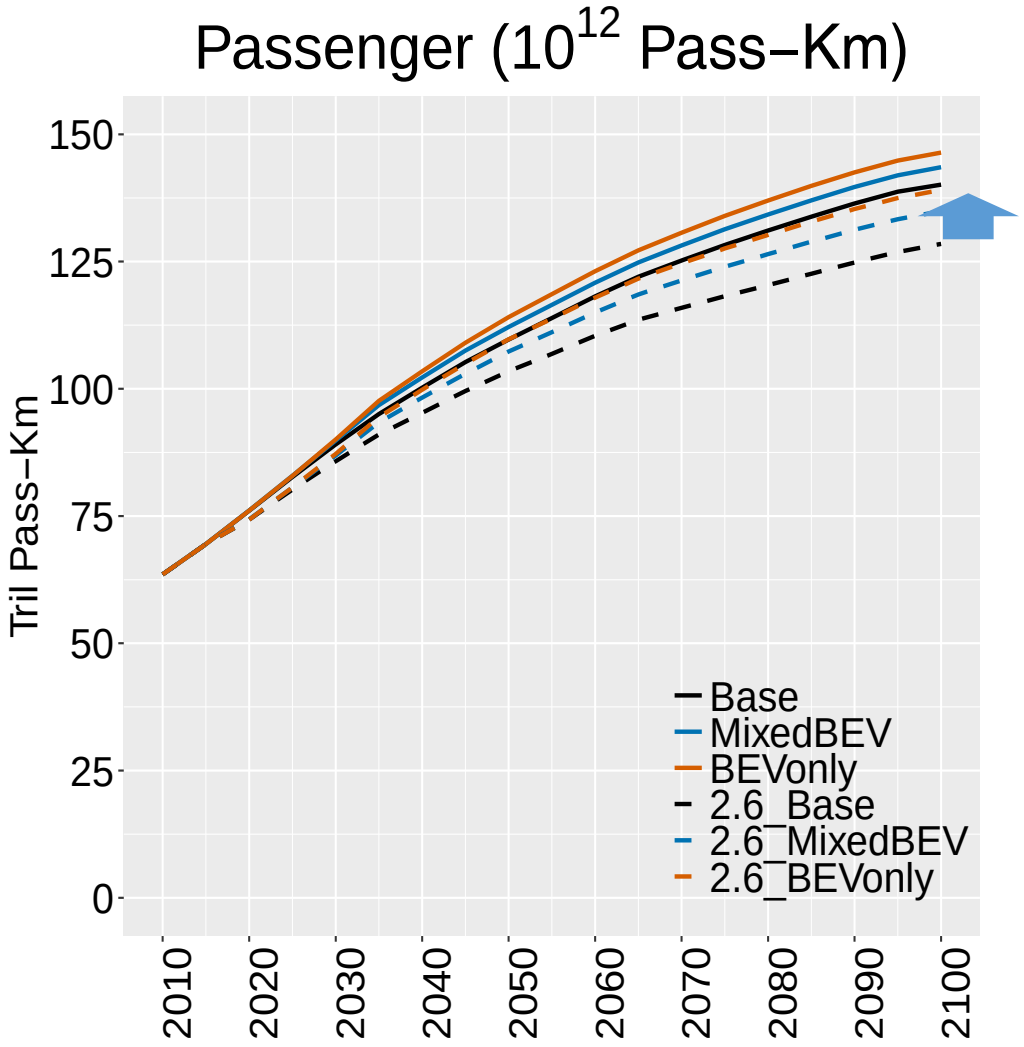
Global Transport Service : No climate policy

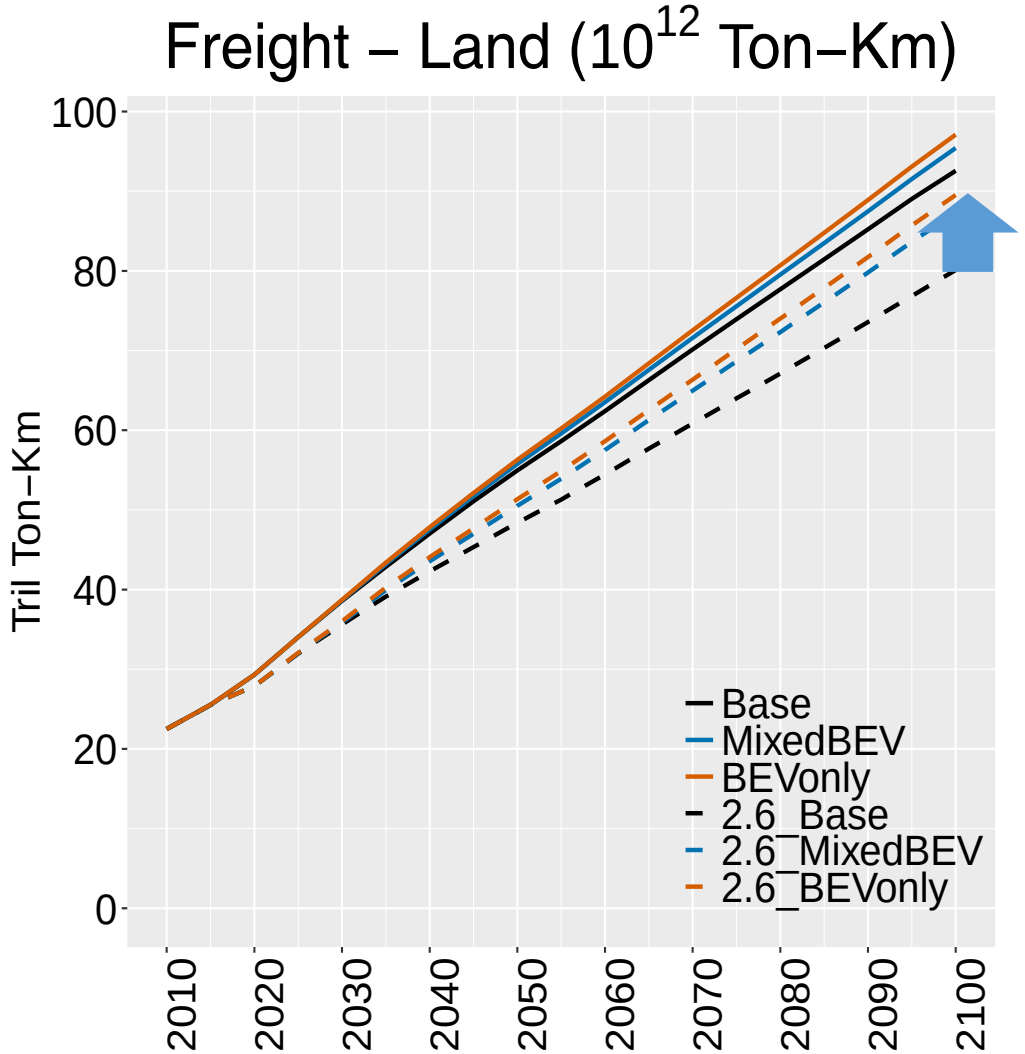




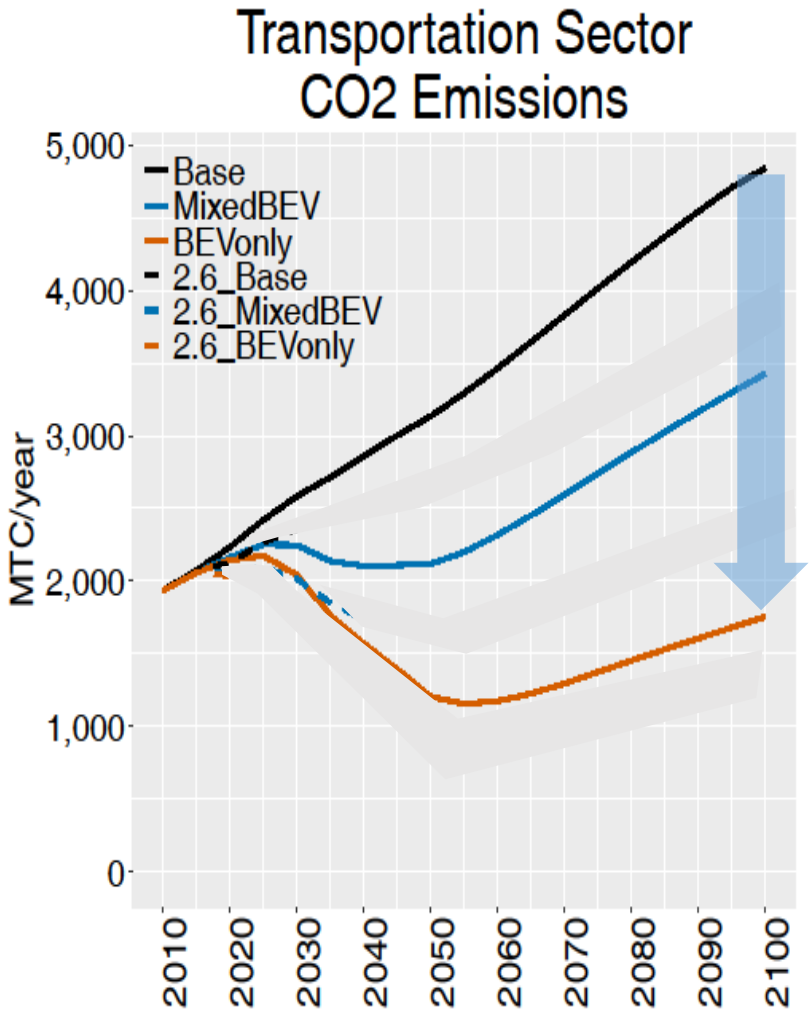


Transportation Services





Global Transport, Power and Total CO_2



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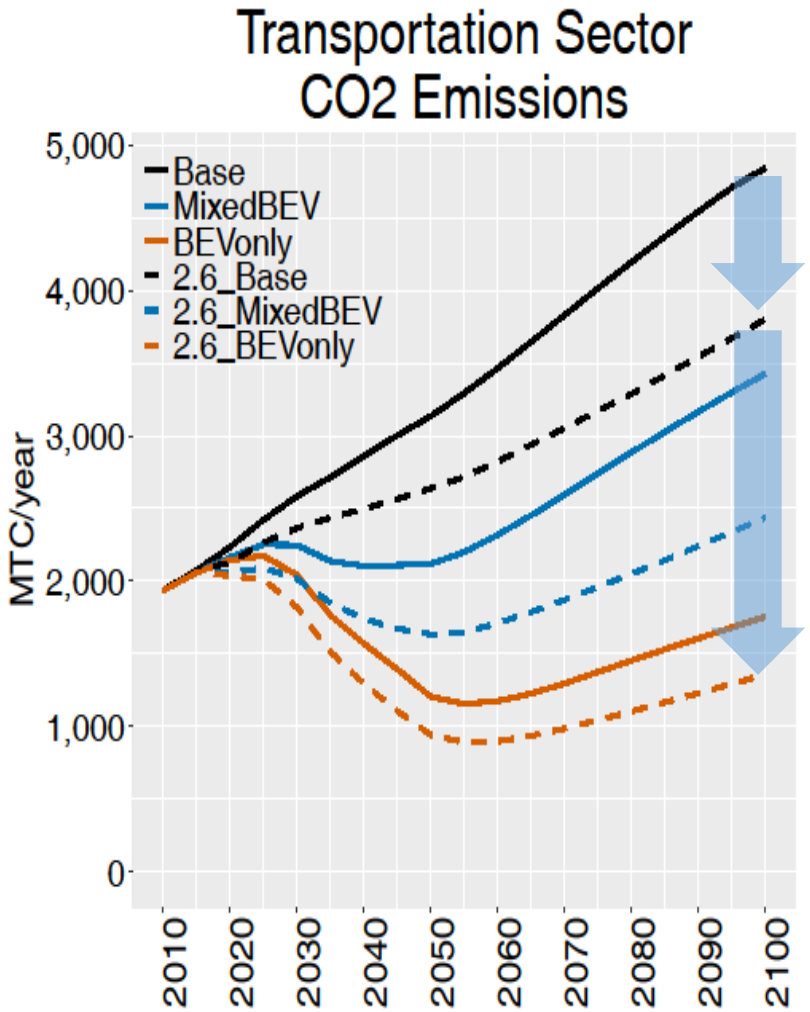

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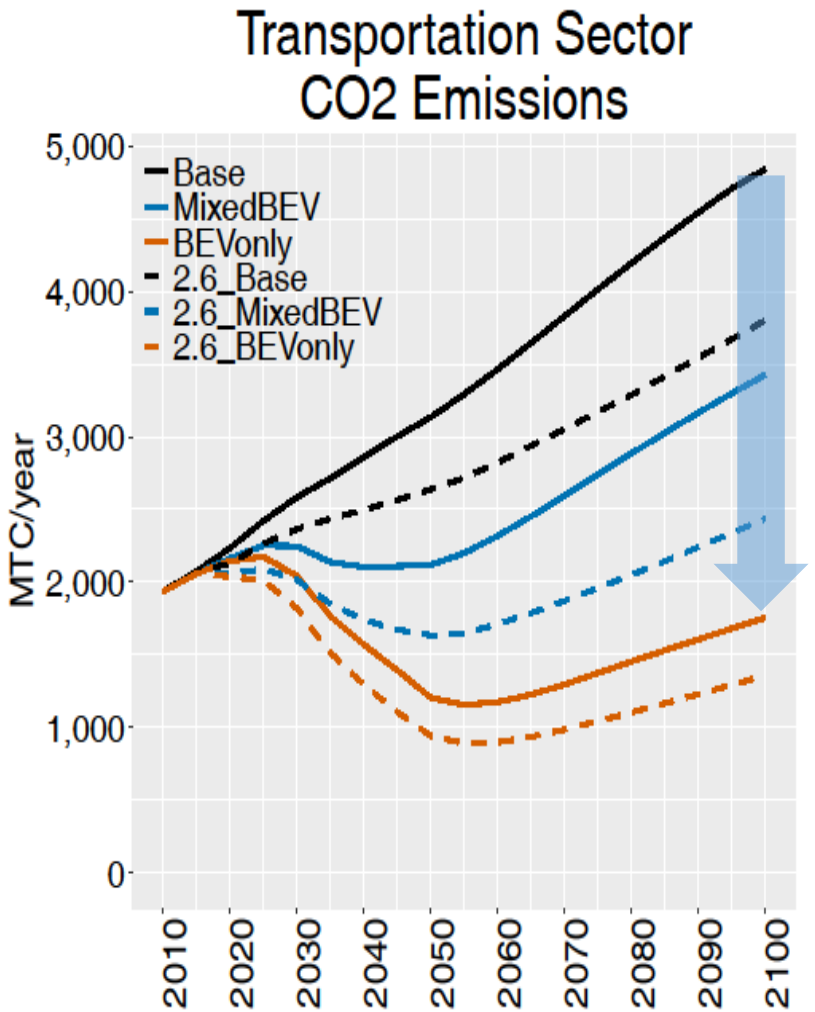

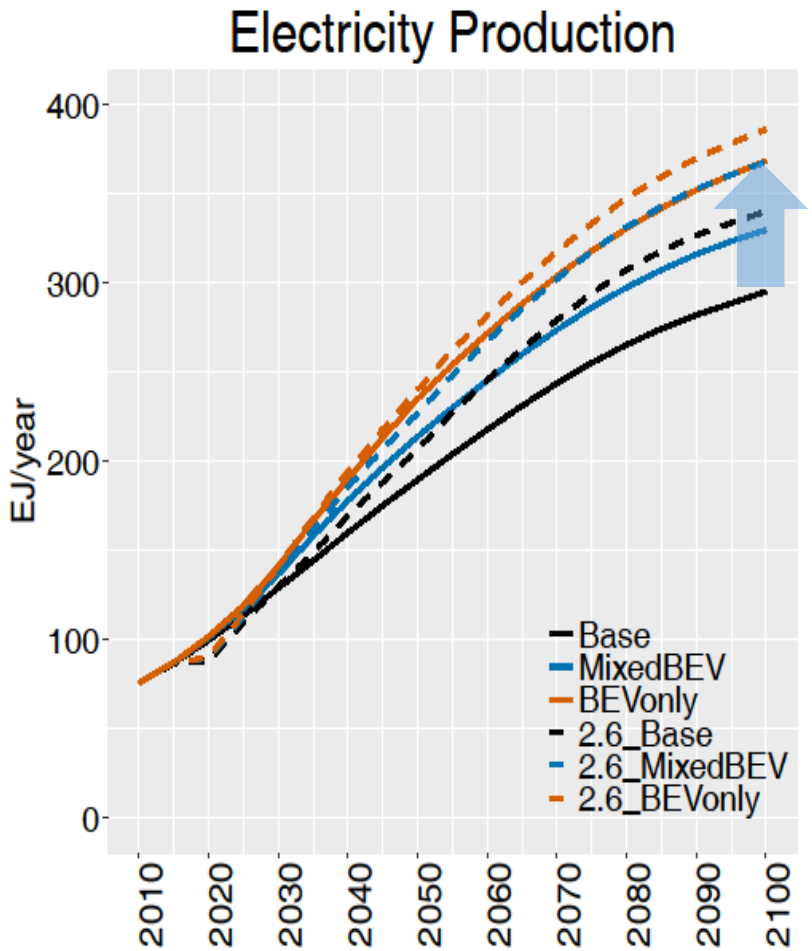

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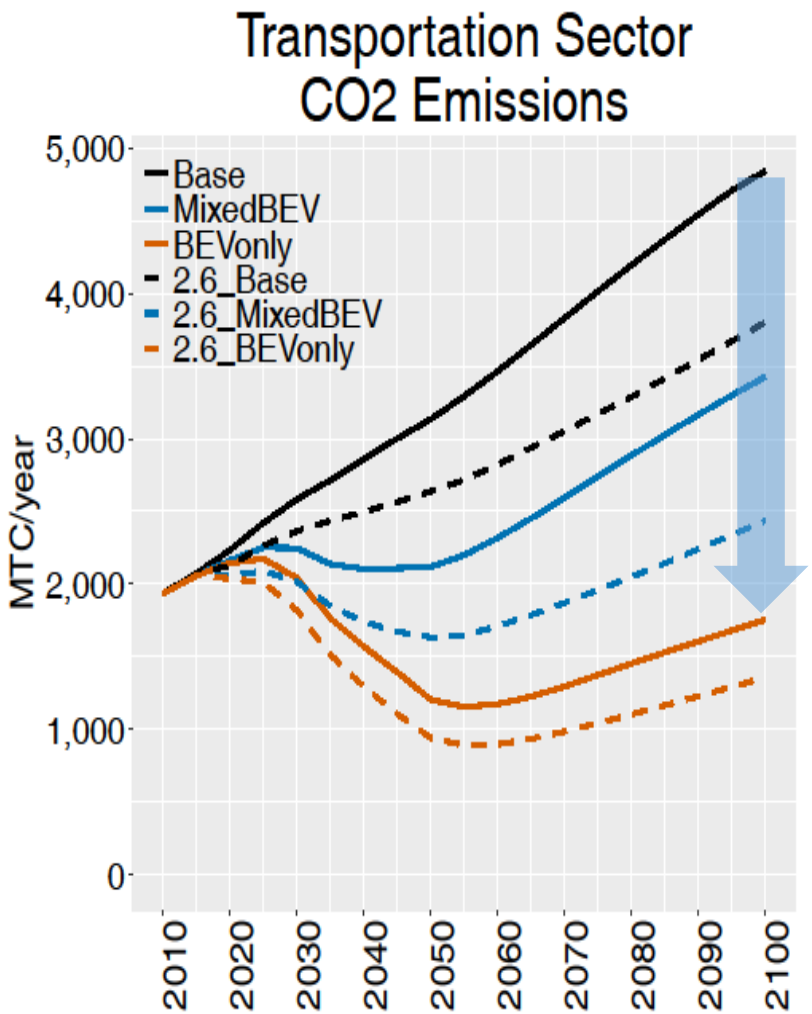
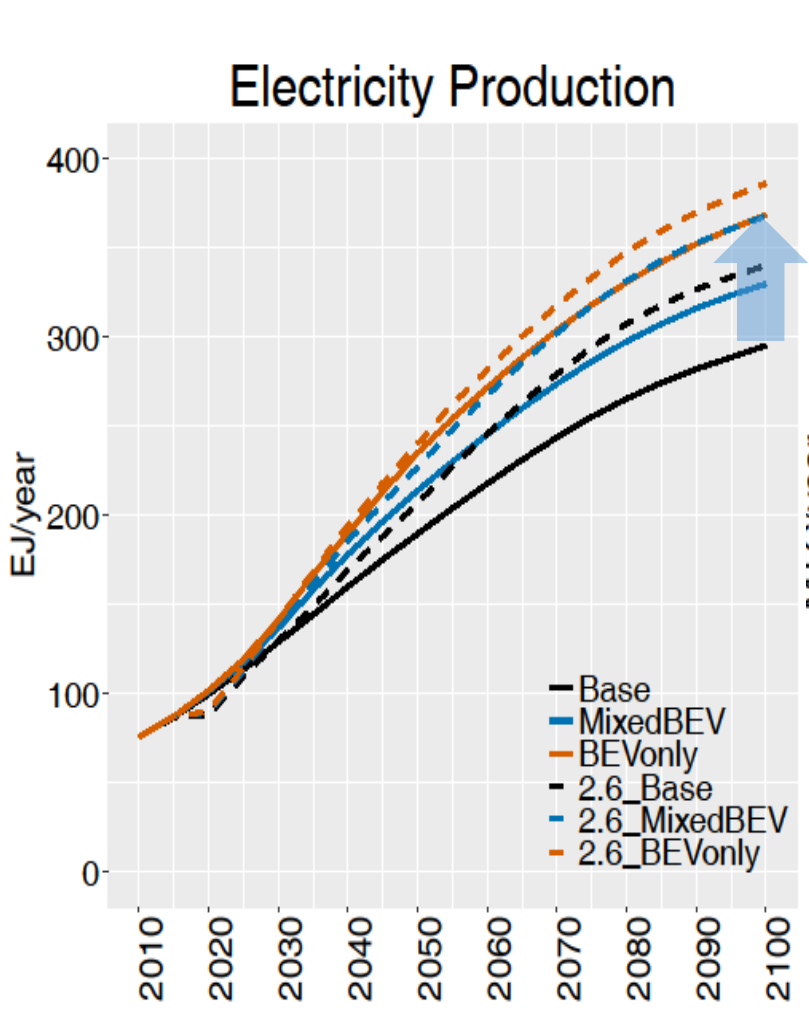
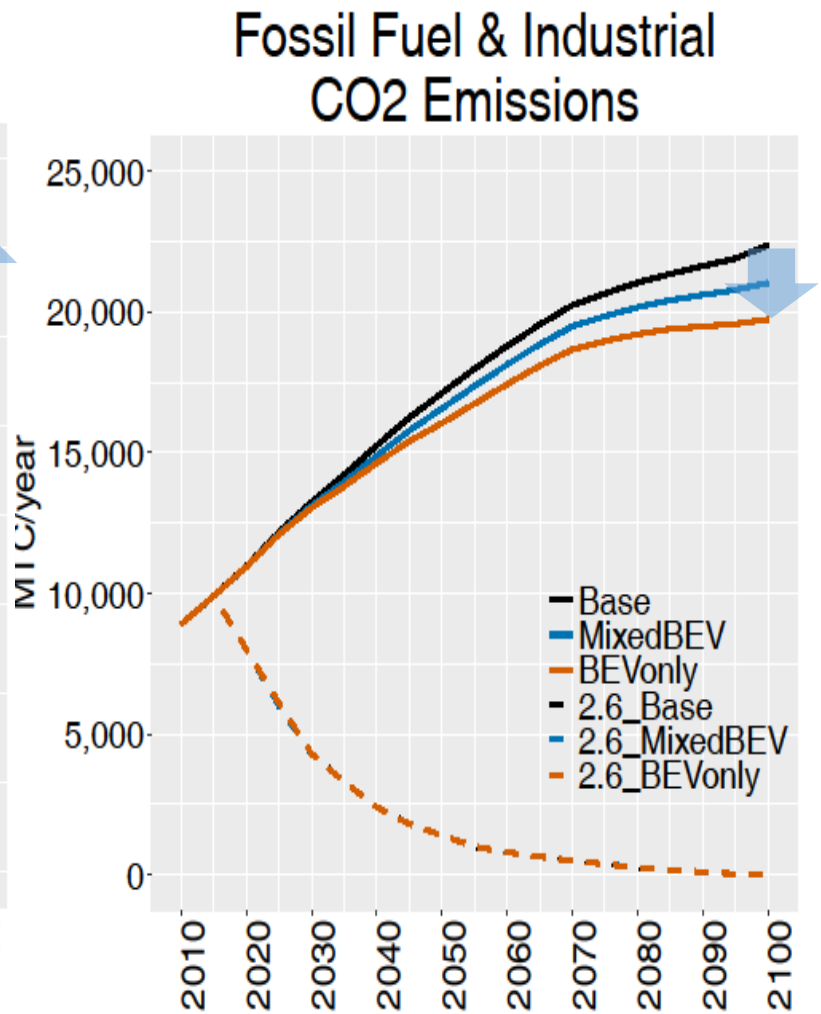
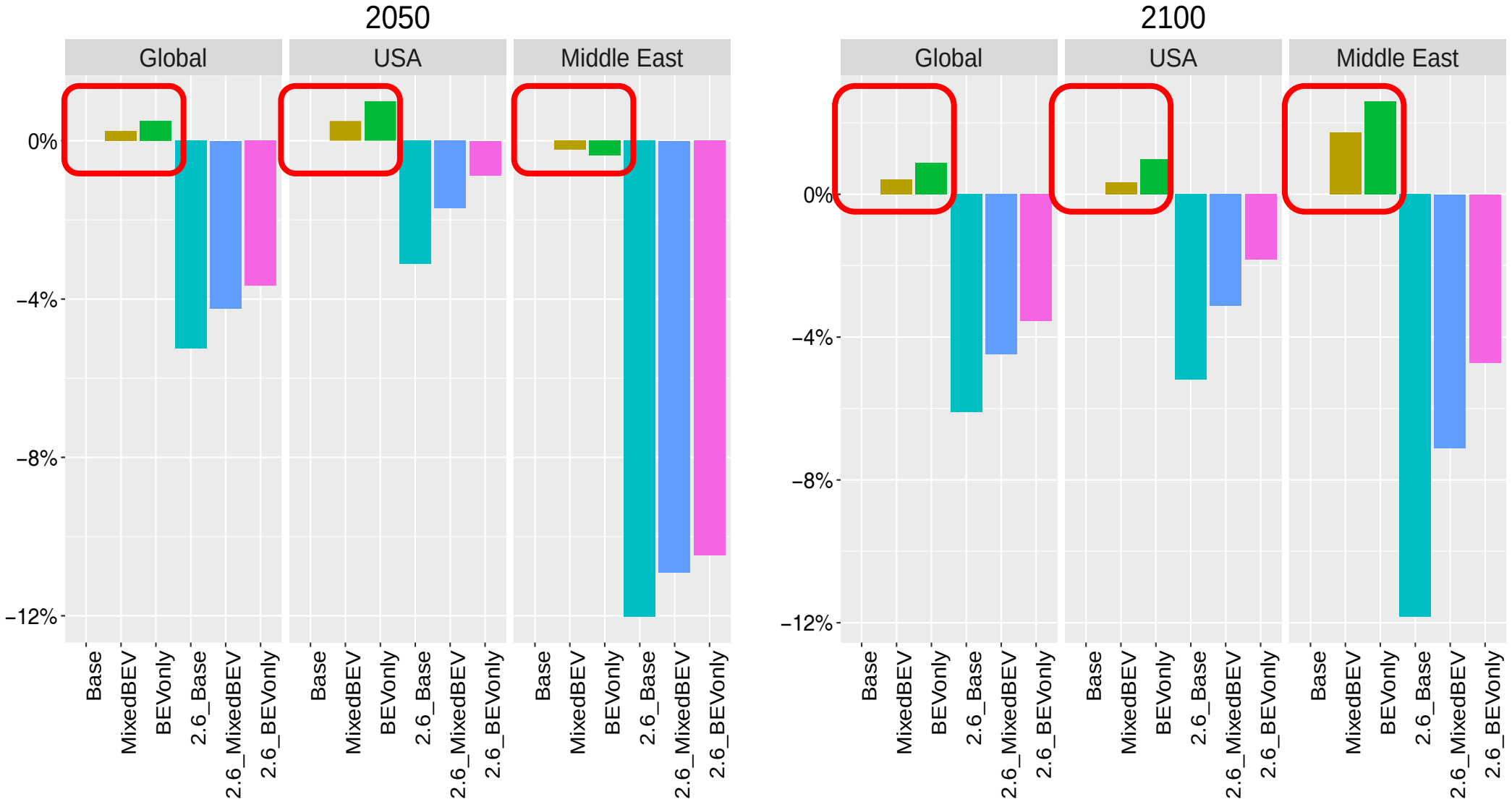


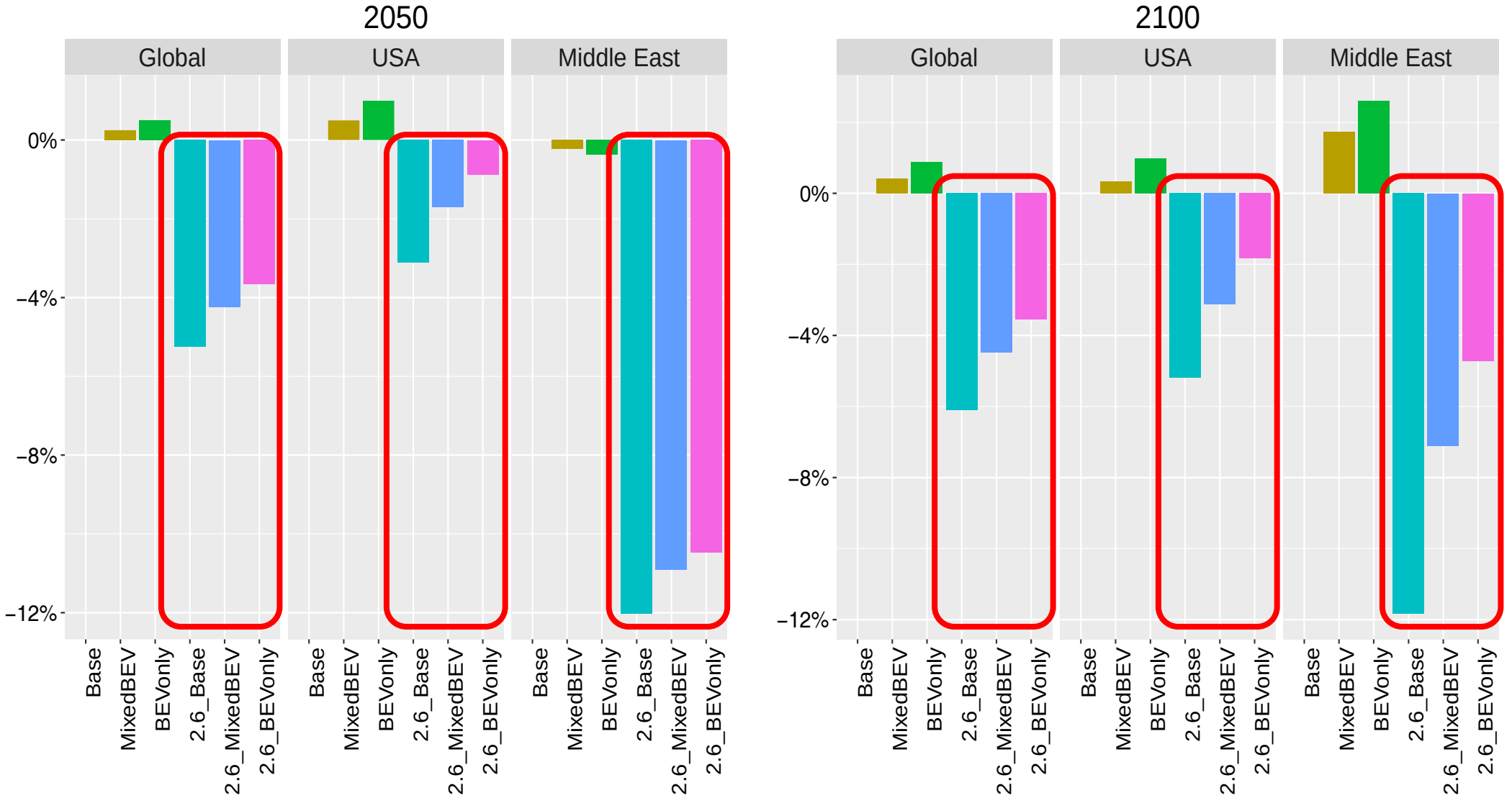




GDP Effects: No Policy

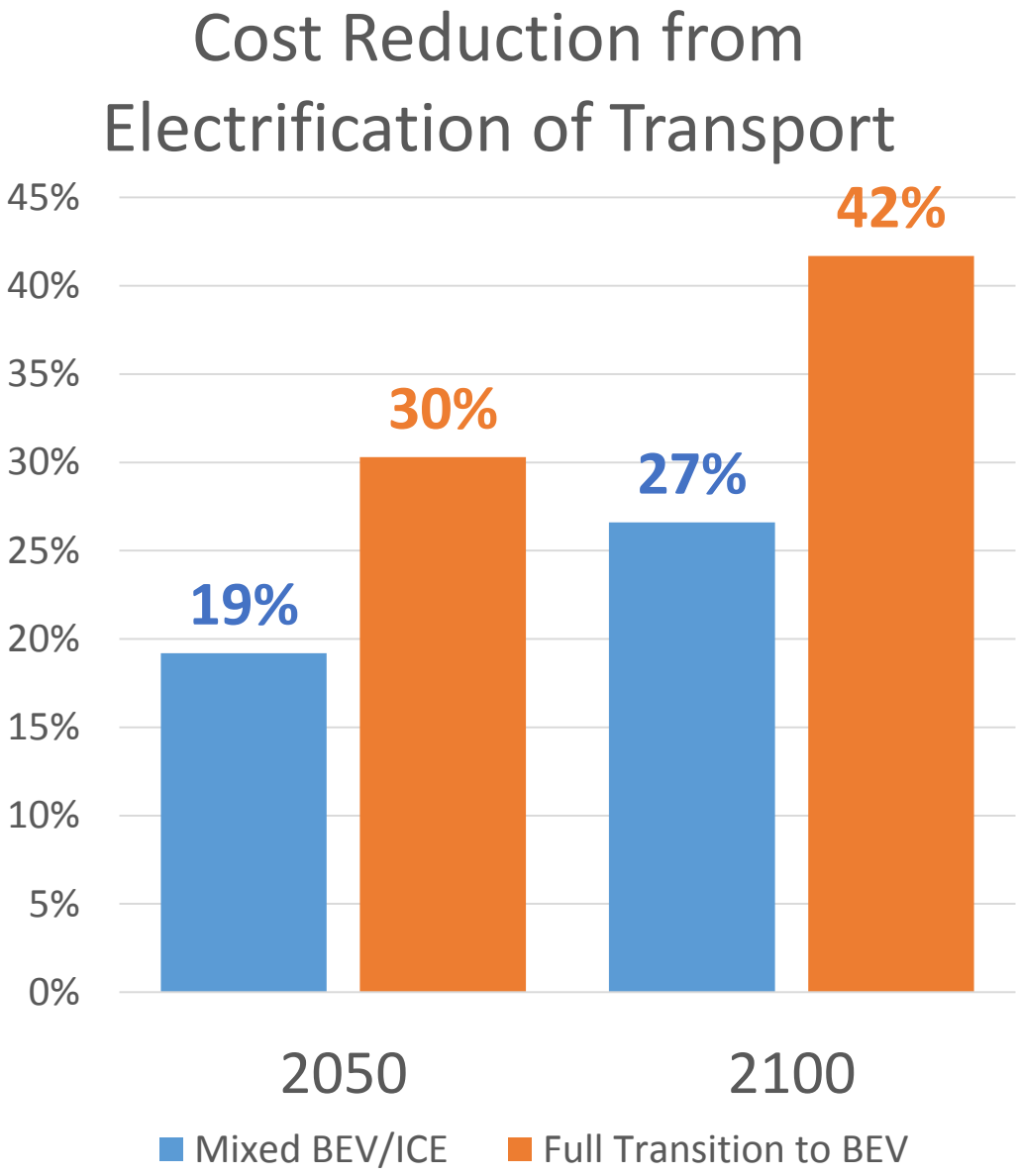


GDP Effects: 2 Degrees



Electrification lowers the cost of reaching a 2-degree goal

- The core approach to mitigation
  - Increase efficiency
  - Decarbonize power
  - Electrify whatever possible
- Electrifying transport turns a problem sector into part of the solution.



Discussion