Assessment of Potential Reductions in Greenhouse Gas (GHG) Emissions in Freight Transportation

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Prepared for:

16th Annual International Emission Inventory Conference
U.S. Environmental Protection Agency

May 15-17, 2007

Objectives

- Identify and characterize potential best practices for reduction of greenhouse gas (GHG) emissions from the freight transportation sector
- Quantify and compare the potential reductions in GHG emissions
- Analyze cost effectiveness of each best practice if quantitative cost information is available
- Develop a guidebook regarding these best practices

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Outline

- Definition of Key Concepts
- Study Methodology
- List of Best Practices
- Total Modal GHG Emissions Reductions
- Comparisons of Best Practices Whose Costs Are Assessed Quantitatively
- Inter-modal Substitutions
- Overview of the Guidebook
- Conclusions and Recommendations

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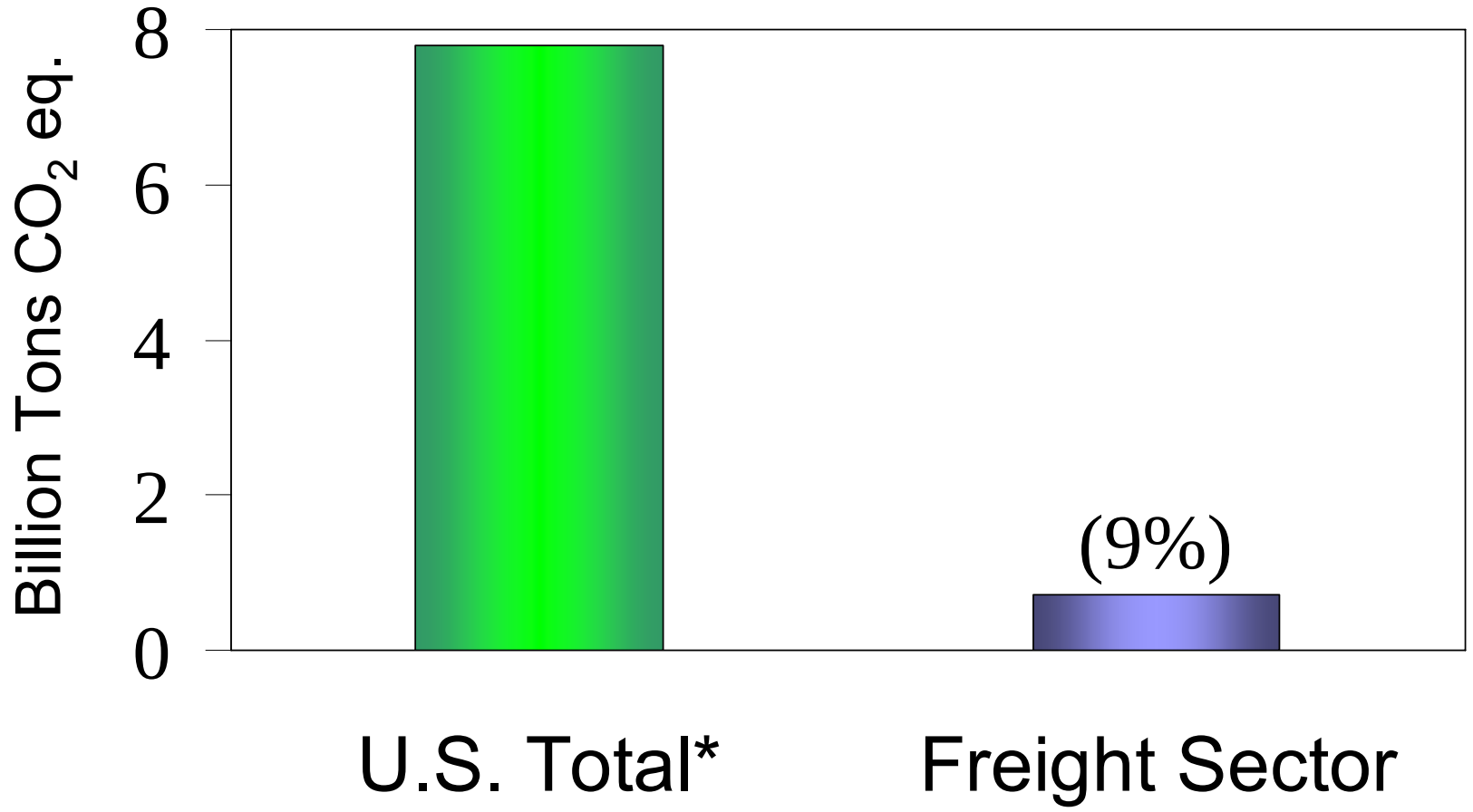
GHG Emissions in U.S. Freight Transportation, 2003



*U.S. Total includes bunker fuel for international aviation and marine

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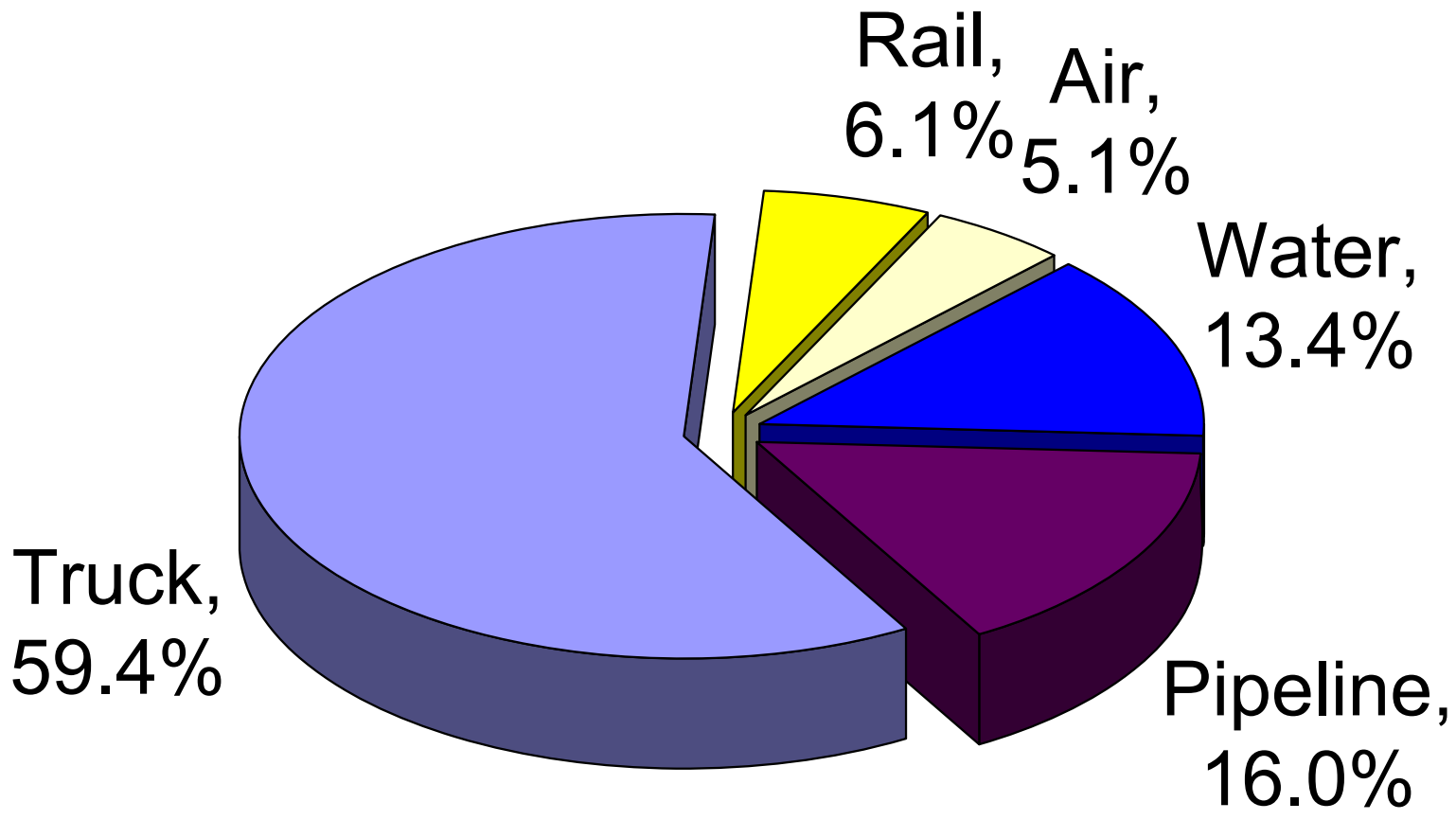
Distribution of GHG Emissions by Mode within the U.S. Freight Sector, 2003



Total GHG Emissions: 7.20×10^8 Tons CO_2 Equivalent

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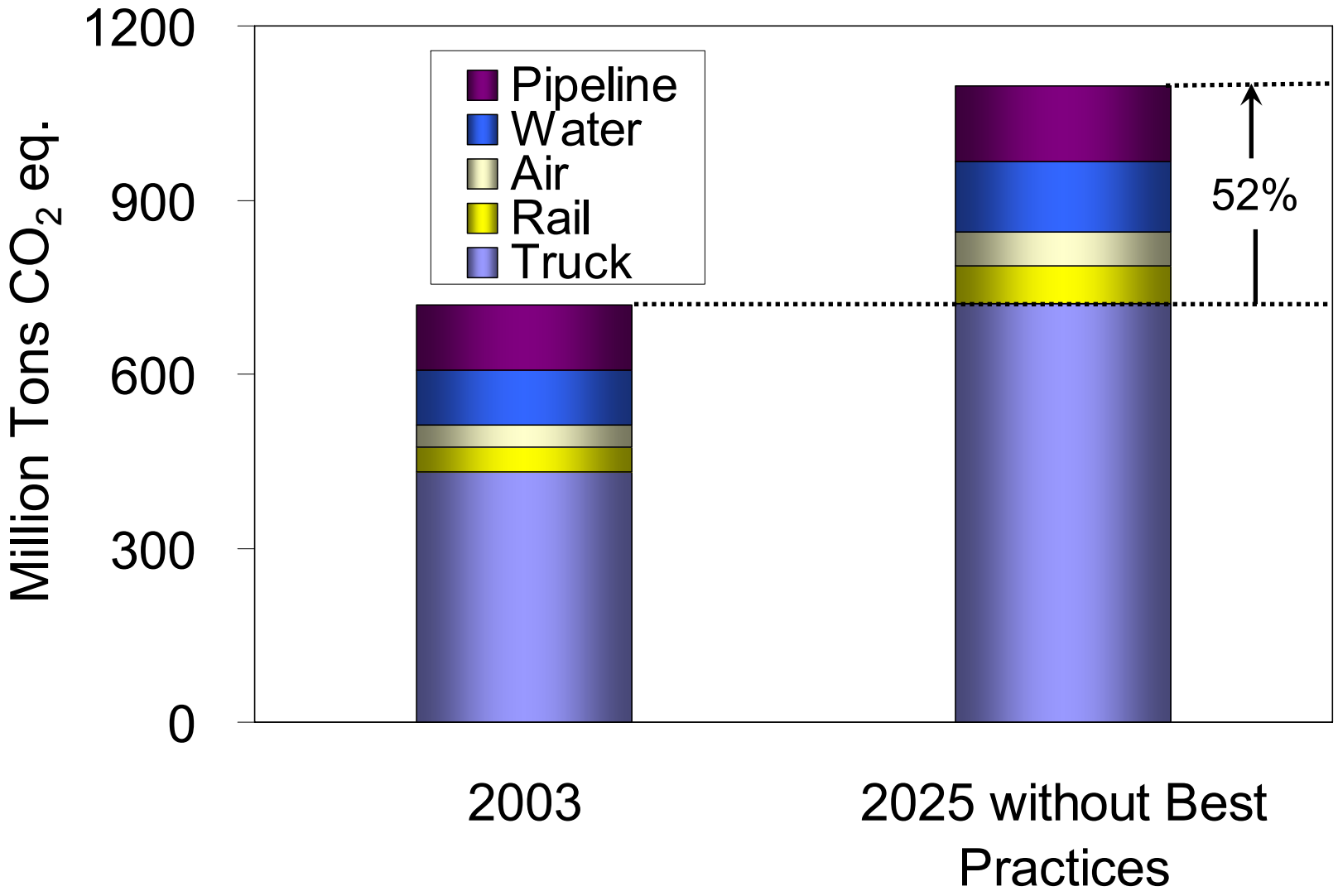
Estimated Baseline GHG Emissions from Freight Transportation from 2003 to 2025



Definitions and Concepts

Best Practices:

- Technological or operational strategies
- Existing or developing
- Reduce GHG emissions
- Reduce energy use or increase use of alternative fuels
- Reduce refrigerant leakage or increase use of low Global Warming Potential (GWP) refrigerants

Definitions and Concepts

Subgroup:

- A collection of best practices in a mode that have either similar objectives or methods

Greenhouse Gas Emissions:

- Focus on CO_2, CH_4, and hydrofluorocarbons (HFCs)
- Global Warming Potential (GWP):
  - GWP = 1 for CO_2
  - GWP = 21 for CH_4
  - GWP = 1,300 for HFC-134a

Developmental Status: New concepts, pilot tests, and commercially available systems

Study Methodology

(1) Identify best practices based on literature review

(2) Assess maximum reductions in 2025 GHG emissions and energy or refrigerant use

(3) Assess cost savings (where data are available)

(4) Summarize and report assessment results

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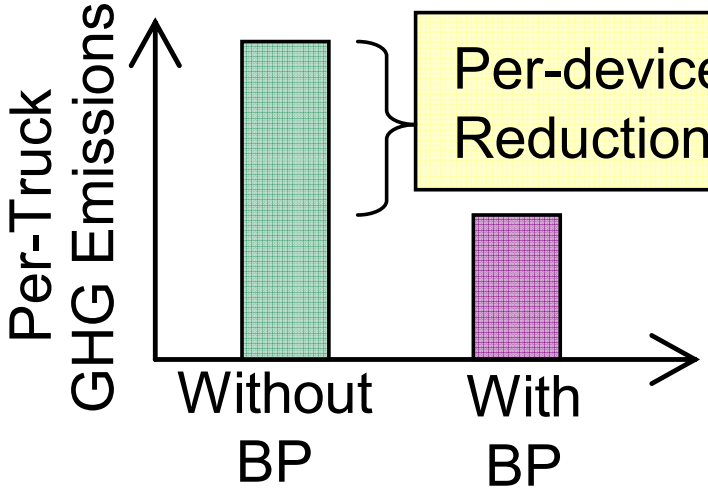
Assessment of Potential GHG Emissions Reductions for Individual Best Practices



Per-device Reductions (%)

Fraction of modal activity to which a BP is applicable

Best estimate of maximum market penetration rate by 2025

Modal Reductions by 2025 (%)

**Life cycle inventories were assessed for alternative fuels*

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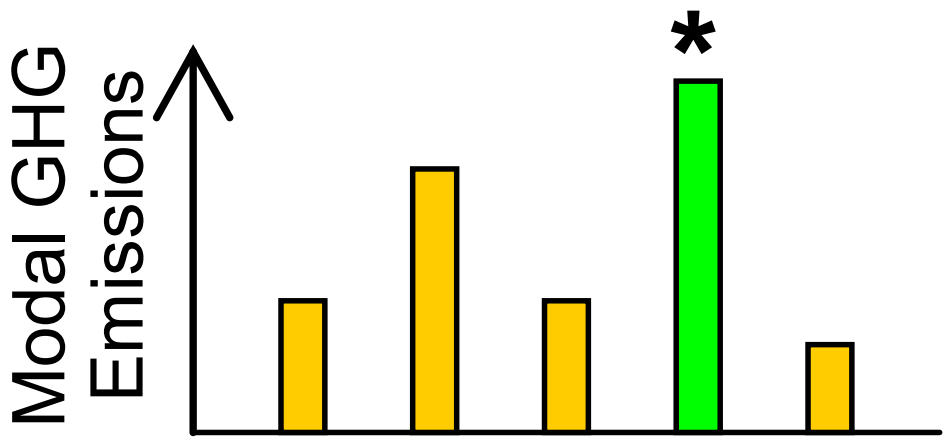
Assessment of Potential GHG Emissions Reductions for Multiple Best Practices

Aggregate reductions for a subgroup:

- Linear combination of individual best practices
- Mutual exclusion
  - Some BPs cannot be used simultaneously
  - Based on BP with the highest reduction potential
  - The estimates do not double count mutually exclusive BPs



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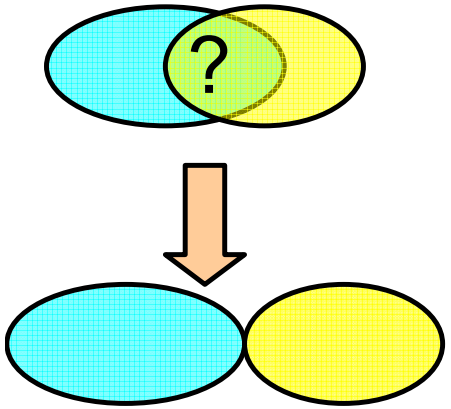
Assessment of Potential GHG Emissions Reductions for Multiple Best Practices

Aggregate reductions for a subgroup:

- Interaction:
  - Some BPs can be used together but interact
  - Quantification of interaction is unknown or not reported
  - Used a linear combination as an estimate
  - May overestimate the maximum possible reduction for the subgroup



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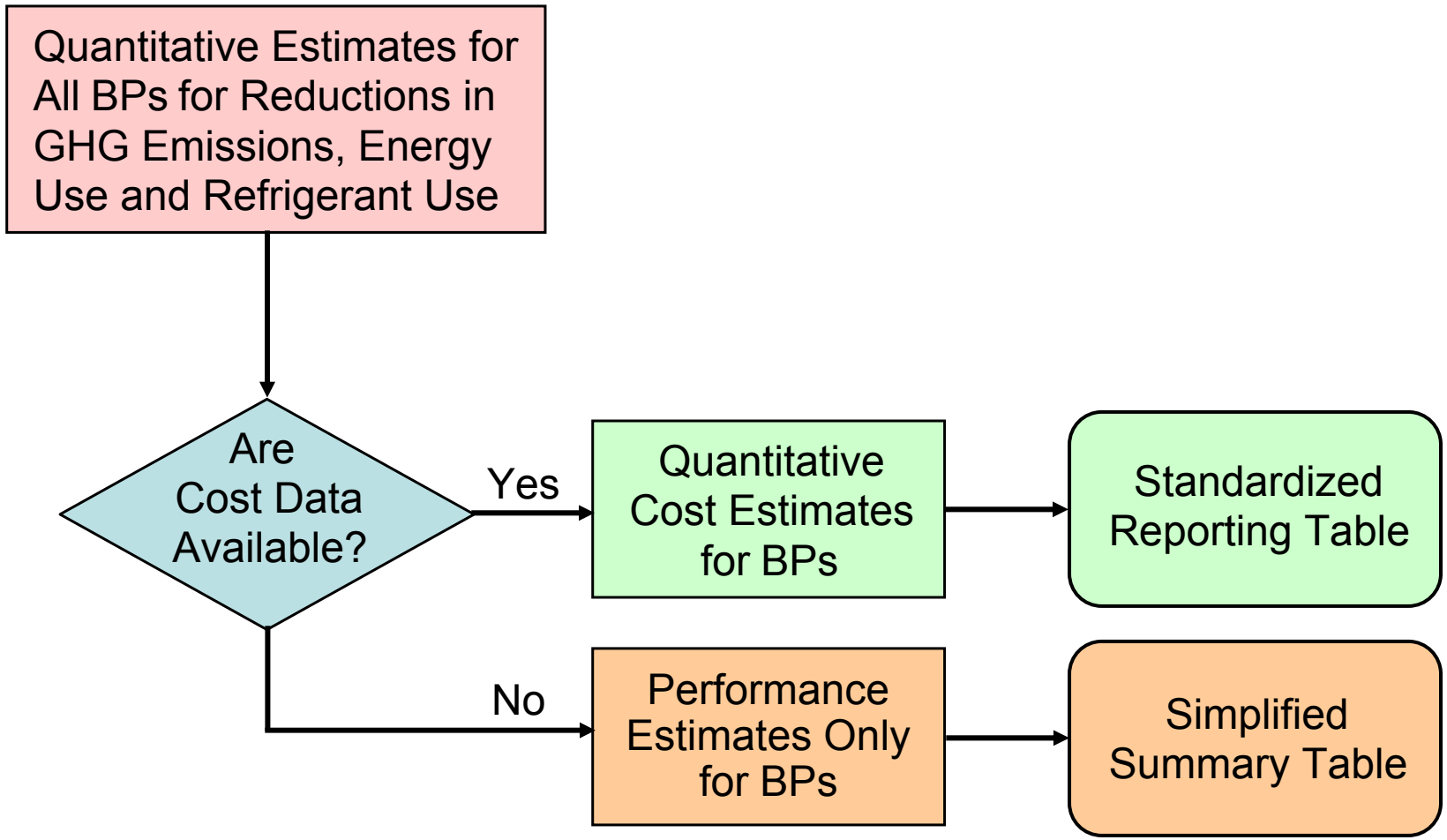
Assessment of Best Practices With or Without Cost Data



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Summary of Best Practices for Freight Transportation

A total of 59 potential best practices have been identified

Mode	Number of Best Practices	Names of Subgroup
Truck	33	Anti-idling; Air Conditioning System Improvement; Aerodynamic Drag Reduction; Tire Rolling Resistance Improvement; Hybrid Propulsion; Weight Reduction; Transmission Improvement; Diesel Engine Improvement; Accessory Load Reduction; Driver Operation Improvement; Alternative Fuel
Rail	6	Anti-idling; Weight Reduction; Rolling Resistance Improvement; Alternative Fuel
Air	10	Aerodynamic Drag Reduction; Air Traffic Management Improvement; Weight reduction; Ground Support Equipment Improvement; Engine Improvement
Water	5	Propeller System Improvement; Anti-idling; Alternative Fuel
Pipeline	5	Process Control Device Improvement; Connecting Method; Maintenance

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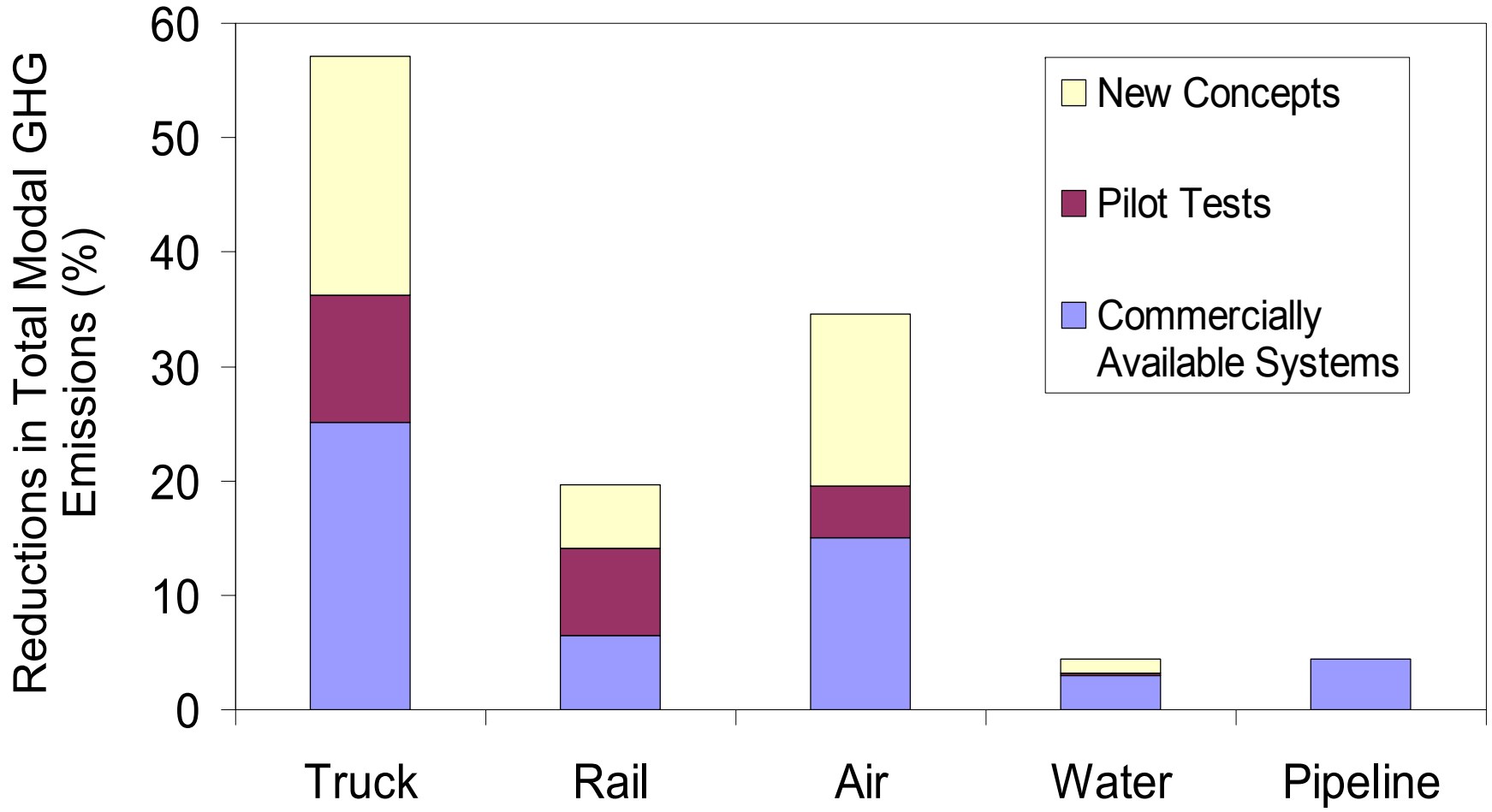
Total 2025 Modal GHG Emissions Reductions Compared to 2025 Without Best Practices



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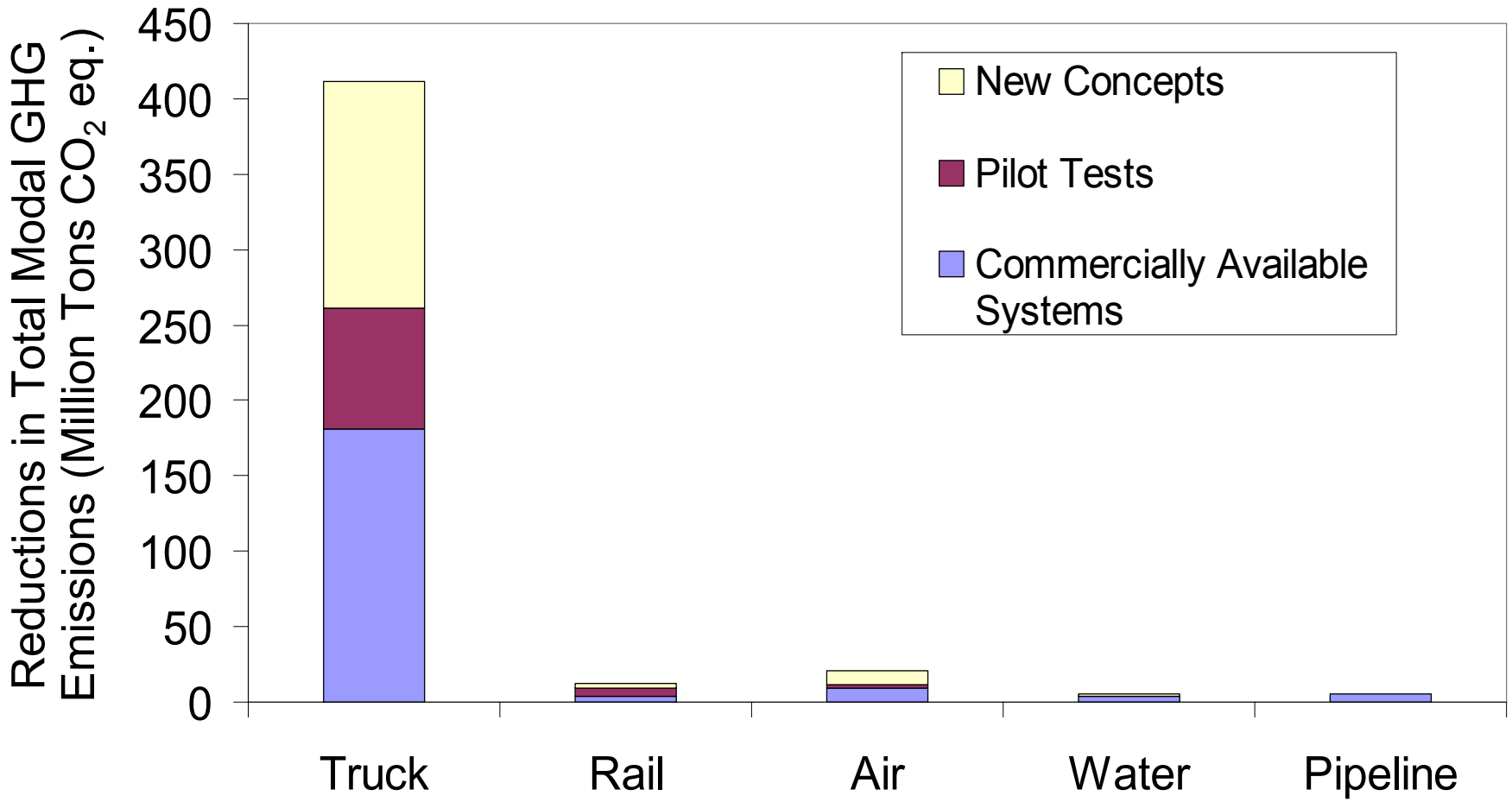
Total 2025 Modal GHG Emissions Reductions Compared to 2025 Without Best Practices



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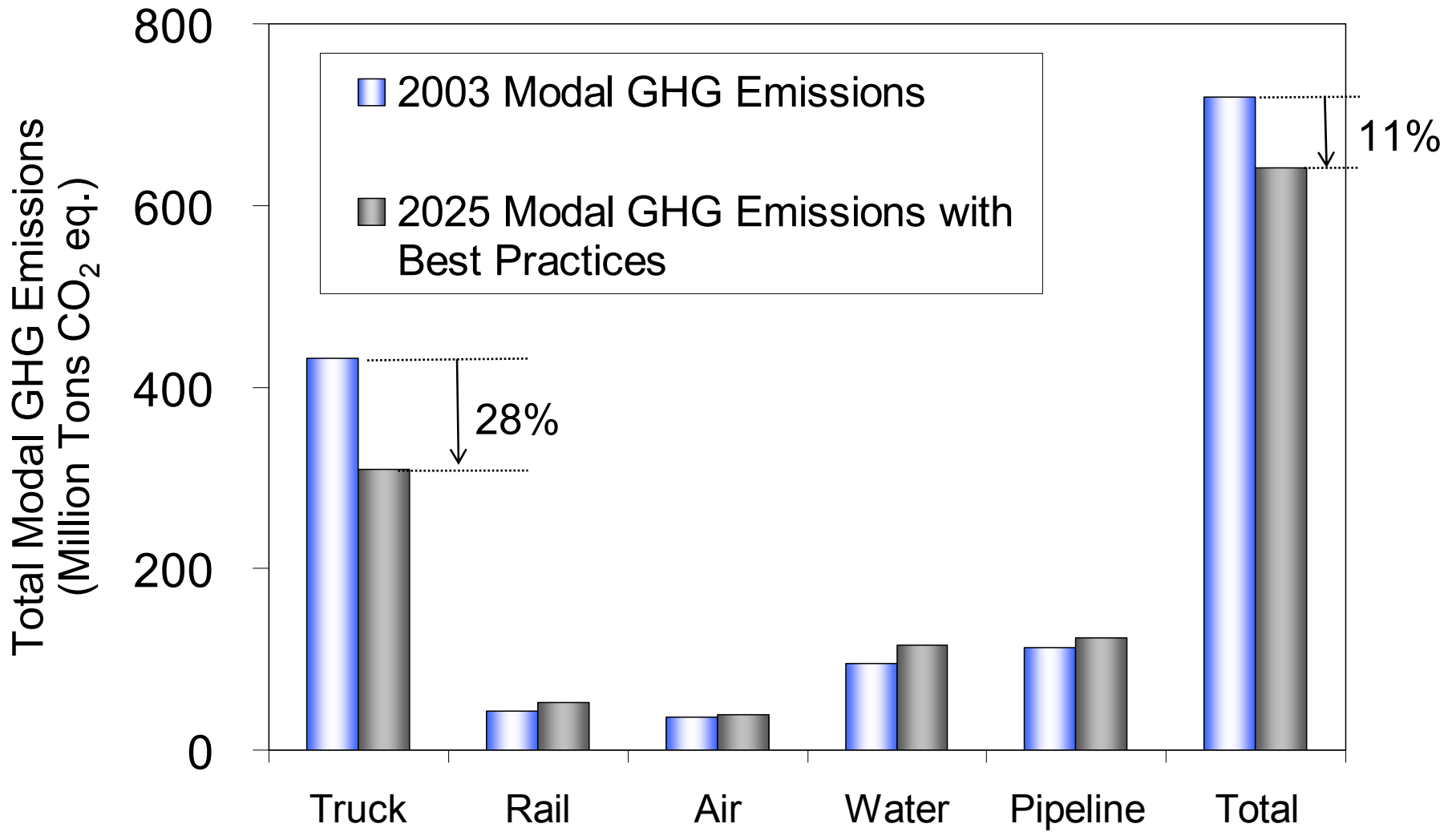
Changes in GHG Emissions from 2003 to 2025 with Best Practices

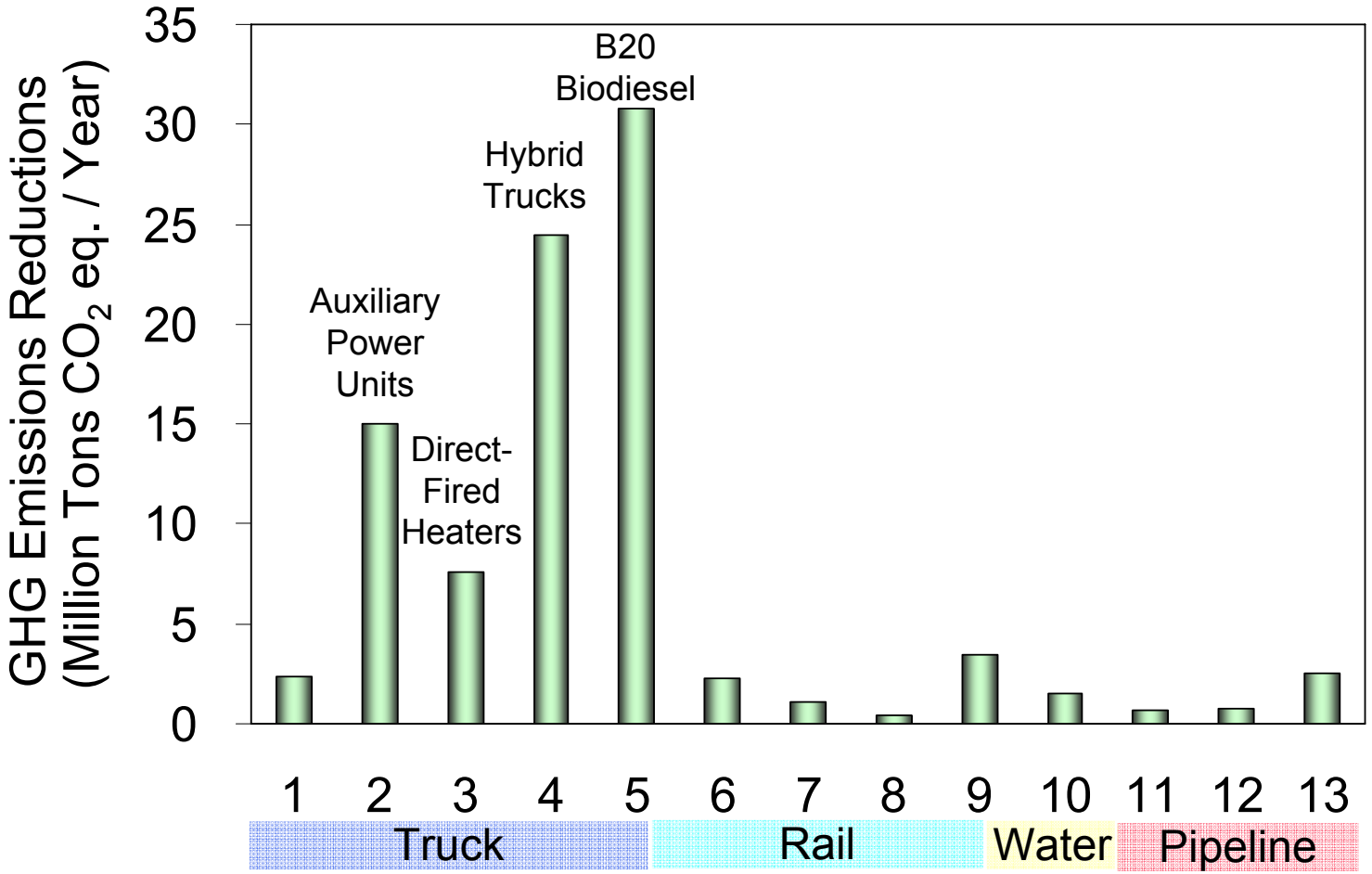


Comparisons of Best Practices Whose Costs Are Assessed Quantitatively

- To date, sufficient cost information has been obtained to assess the costs of 13 practices quantitatively.

Mode	Name of Best Practices
Truck	1. Off-board truck stop electrification; 2. Auxiliary power units; 3. Direct-fired heaters; 4. Hybrid trucks; 5. B20 biodiesel
Rail	6. Combined diesel powered heating and start/stop system; 7. Battery-diesel hybrid switching locomotive; 8. 8. Plug-in units; 9. B20 biodiesel
Water	10. B20 biodiesel
Pipeline	11. Natural gas-powered pipeline process control device replaced by compressed air-powered devices; 12. Natural gas-powered pipeline process control device replaced by low-bleed pneumatic devices; 13. “Hot Tap” method

Comparison of Best Practices Whose Costs Are Assessed Quantitatively (Continued)



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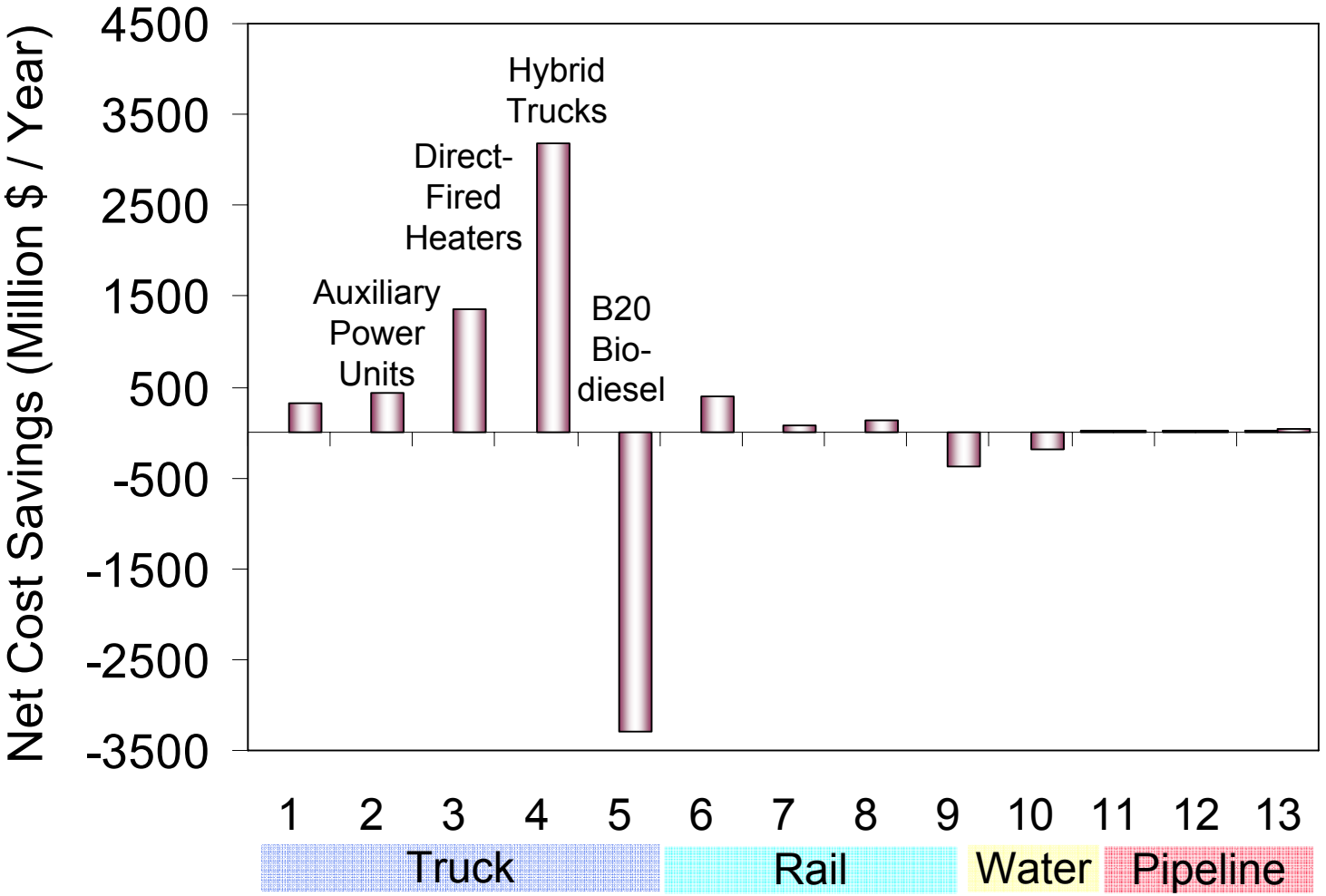
Comparisons of Best Practices Whose Costs Are Assessed Quantitatively (Continued)



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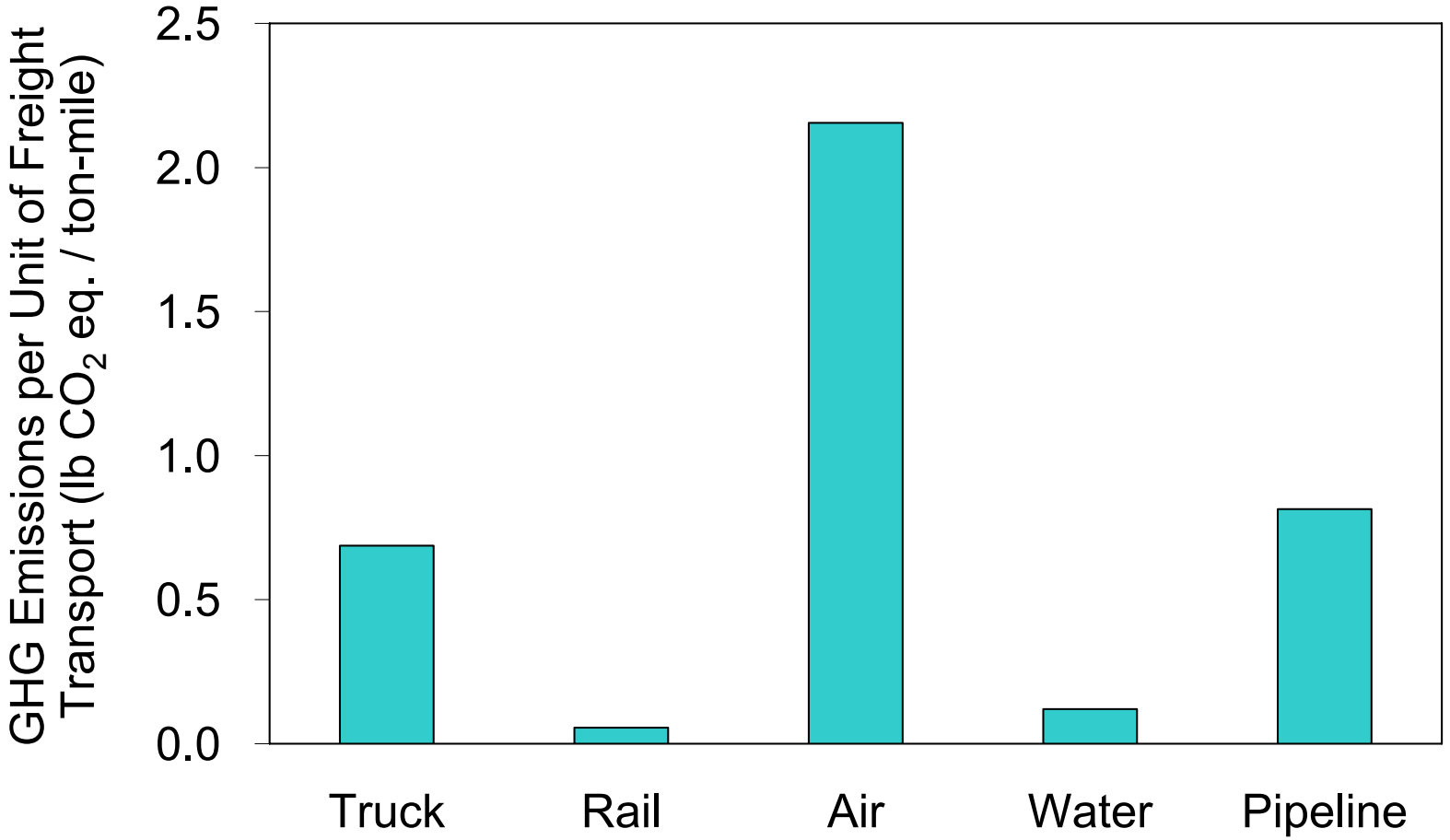
Inter-Modal Comparison of Average Modal GHG Emission Rates



For example, GHG emissions reductions of 85% are possible if long-haul truck transport is replaced with a combination of rail and truck transport

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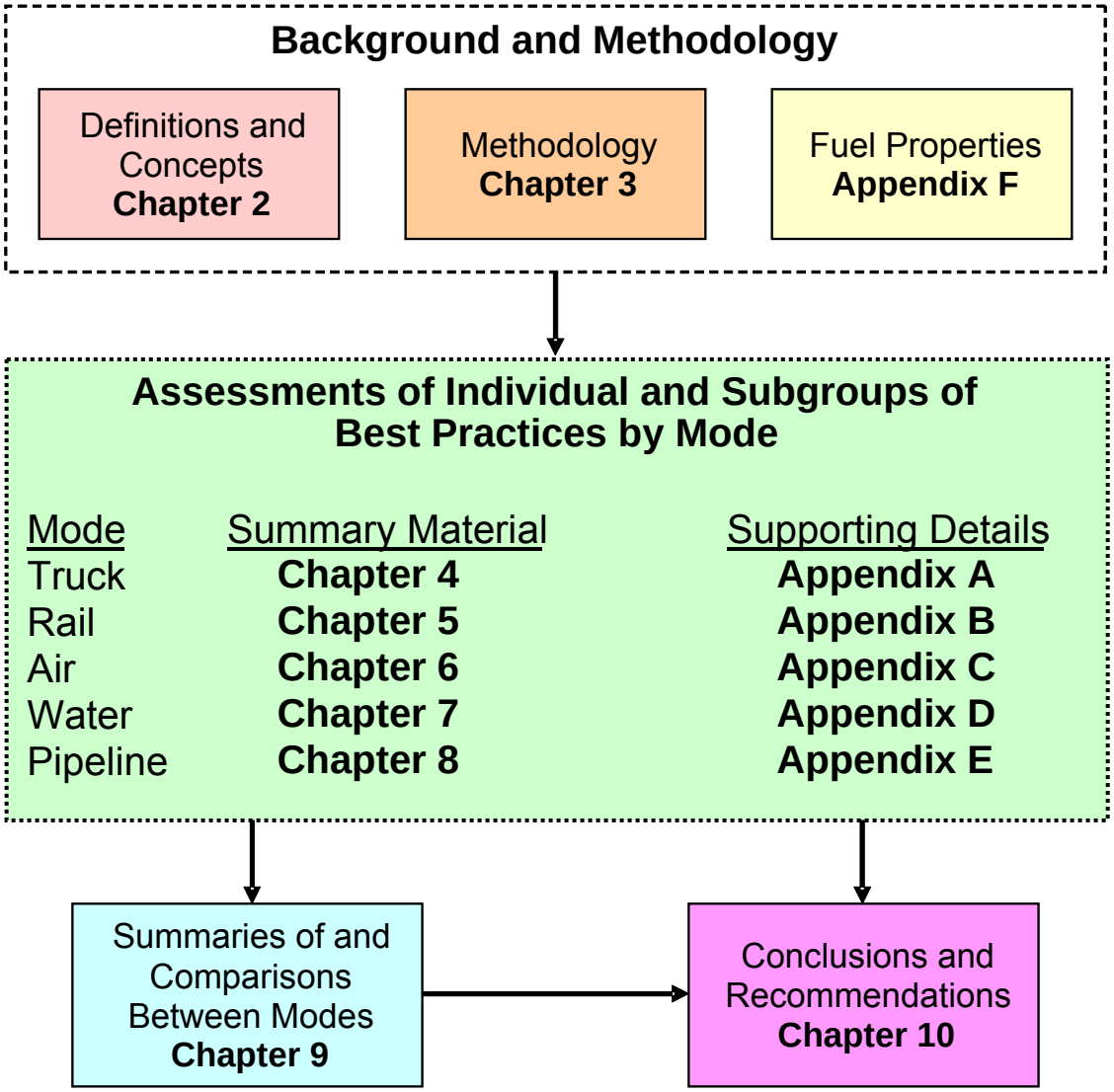
Overview of the Organization and Content of (Draft) Guidebook



Conclusions

- Aggressive implementation of best practices may lead to a *net decrease* in total GHG emissions in freight transportation
- Even larger percentage reductions are possible if inter-modal shifts (e.g., substitute rail for truck) are encourage

Conclusions (Continued)

- There is limited quantitative cost data upon which to base assessments of the costs of best practices
- For 13 best practices for which adequate cost data are available:
  - The normalized cost savings per unit of GHG emissions reduction was highly variable
  - The variability mostly depends on the magnitudes of their energy cost savings

Conclusions (Continued)

- Some best practices (e.g., biodiesel for trucks) offer potential for large magnitudes in GHG emissions reductions, but may not be as cost-effective
  - From a national policy perspective, governments should promote research, development, and demonstration (RD&D) to foster best practices that lead to large absolute reductions in GHG emissions
- Some best practices may lead to “no regrets”
  - e.g., net cost savings to an operator
  - Additional benefits of GHG emissions or energy use reduction

Recommendations

- Update information as new information becomes available
- Revise or develop cost estimates as new data become available
- Evaluate key assumptions (e.g., market penetration rates) that influence the selection of best practices via sensitivity analysis
- Develop tools (e.g., a decision tree, a decision support framework) to support decision making regarding best practices

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Acknowledgement/Disclaimer

- This work is supported by the U.S. Department of Transportation via Center for Transportation and the Environment.

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