Life-Cycle Assessment and Life-Cycle Cost Analysis on Heavy-Duty Trucks Using Alternative Fuels

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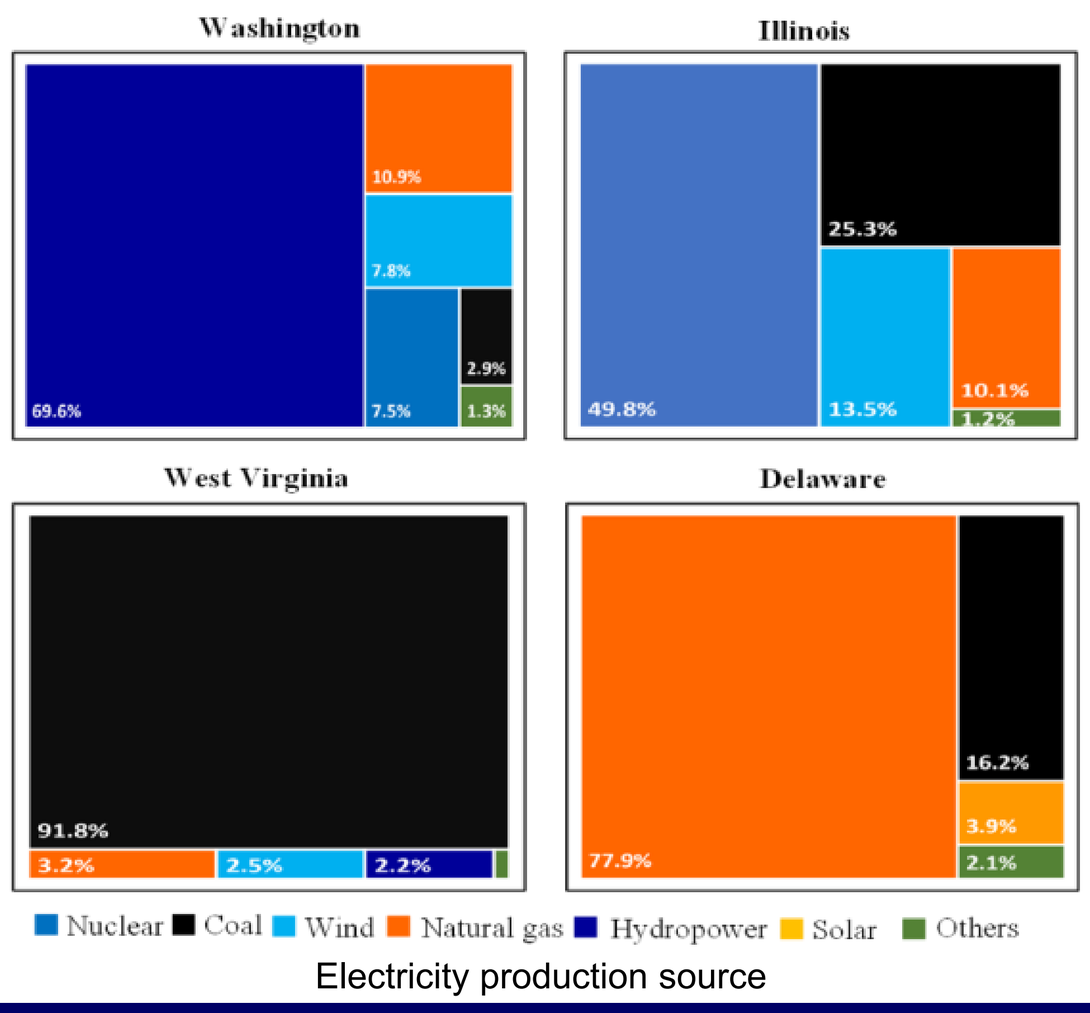
Heavy-Duty Trucks Using Alternative Fuels

Medium- and heavy-duty trucks account for just 5% of total traffic, contributing a staggering 24% of the greenhouse gas (GHG) emissions

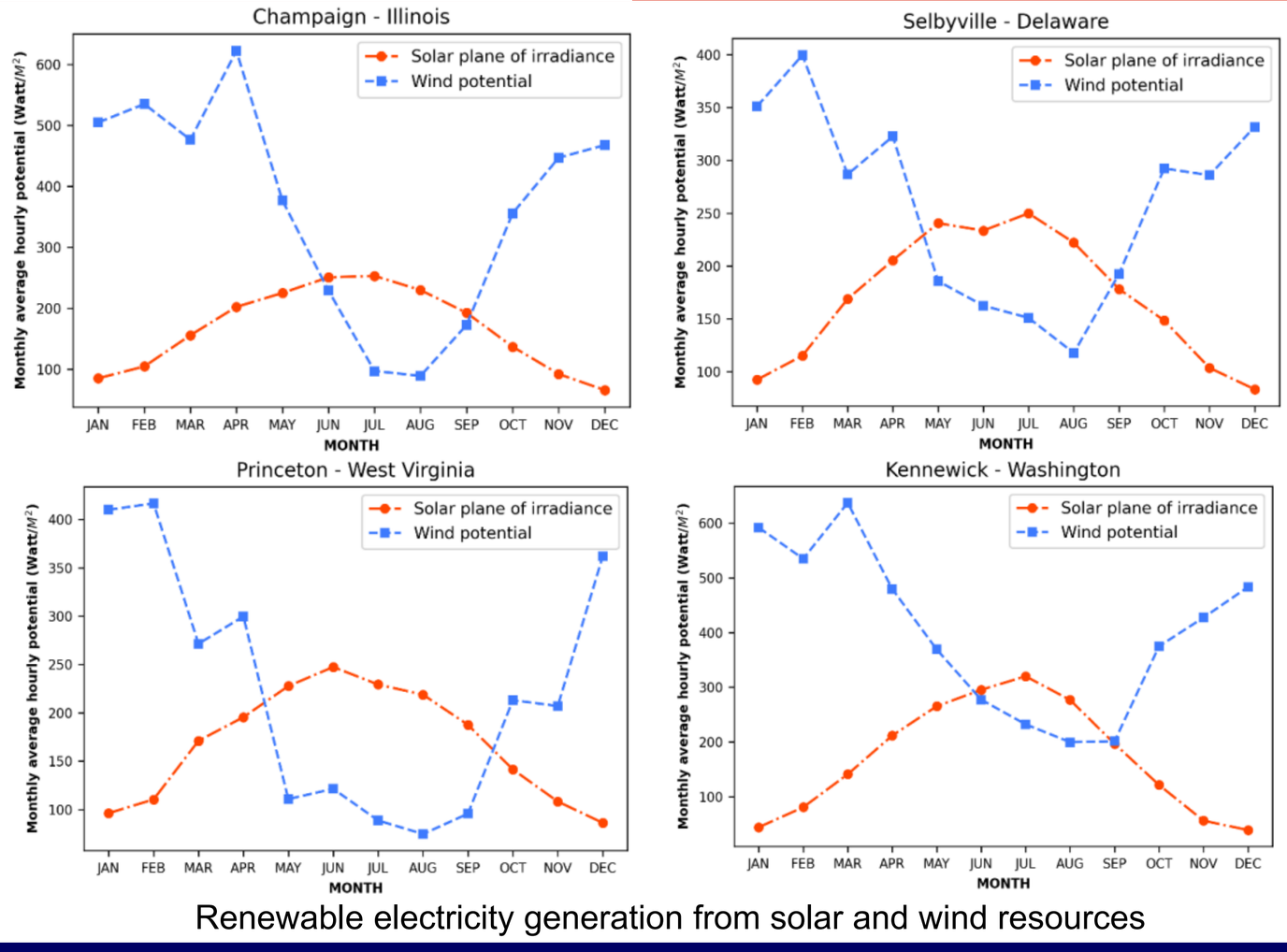
Alternative fuels, such as natural gas and electricity, could reduce operational cost and emissions throughout the entire life-cycle

Energy Input	Truck Manufacturing	Truck Operation	Truck Maintenance	End-of-Life
Diesel production	Diesel combustion engine, diesel tank, exhaust system	Diesel combustion, lubricating oil burning, lubricating oil upstream	Routine maintenance	Dispose/ recycle diesel combustion engine
Natural gas production	Natural gas combustion engine, natural gas tank, exhaust system	Natural gas combustion, lubricating oil burning, lubricating oil upstream	Routine maintenance	Dispose/ recycle natural gas combustion engine
Electricity Generation	Electric traction motor, Li-ion battery, cooling system	Electricity consumption (no emission)	Battery degradation and replacement + routing maintenance	Dispose/ recycle battery + electric traction motor
Energy harvesting: solar and wind	Common components: truck body, doors, tires, automotive battery, etc.	Assuming same pavement profiles		

Energy Harvesting Using Solar and Wind

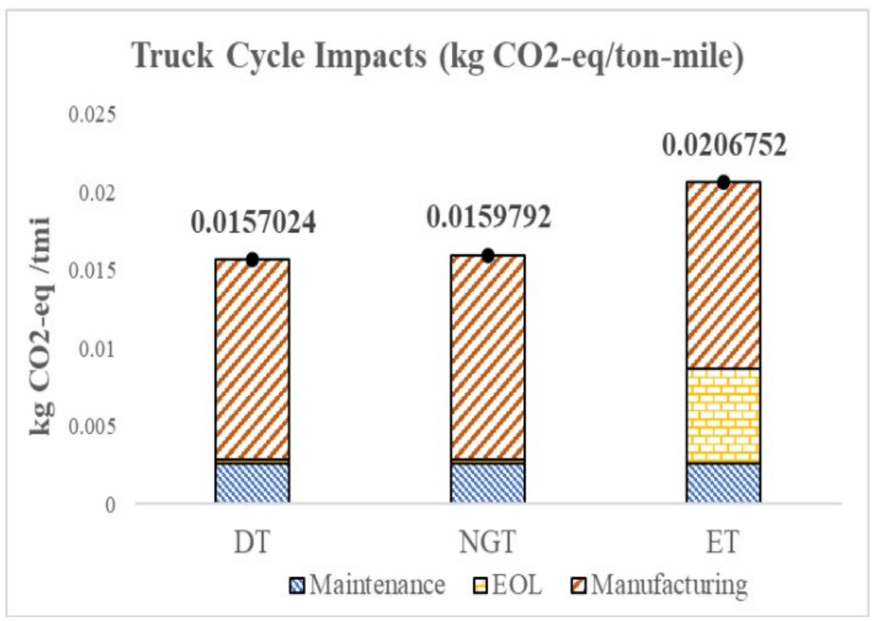


Electricity production source

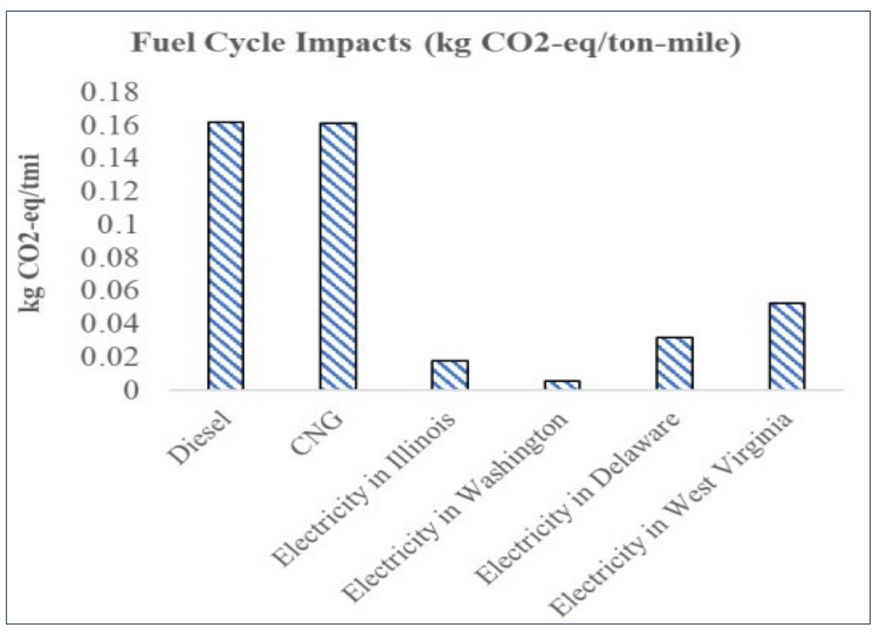


Renewable electricity generation from solar and wind resources

IMPACTS & OUTCOMES



Truck-cycle impacts (including manufacturing, maintenance and EOL of trucks)



Fuel-cycle impacts (including the energy production and operation impacts)

- Diesel truck caused the highest impacts in the total life-cycle
- Electric truck produced higher GWP impact in the truck cycle but generated much less GHG in the fuel cycle
- For states with a cleaner electricity mix, such as Washington, it is recommended to use electric truck, which could reduce the GWP impacts due to heavy-duty trucks by up to **86%**
- Energy harvesting can bring down costs significantly **by $0.17/mile**.

GWP: global warming potential (CO2-eq)

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