Action 6
Electrifying industrial fleets

Introduction and context
A program of 10 potential actions to deliver significant levels of energy efficiency in industrial and commercial applications has been identified in the Industrial Energy Efficiency Playbook (IEEP). The purpose of this research is to create a set of models and reports that provide estimates of the financial, wider economic and environmental gains that could be achieved by adopting various technologies and approaches to more efficient use of energy in industrial processes.

This paper summarizes the potential benefits associated with the implementation and widespread adoption of Action 6: electrifying industrial fleets.

Rationale for Action 6
Transportation of people, goods and raw materials accounts for around 25% of the world's total energy consumption and around 30% of societal carbon dioxide emissions.[1] Increasing efforts are being made to electrify private car and some light commercial vehicle fleets, but electrification of medium and heavy duty commercial and industrial fleets has so far proceeded slowly.

The electrification of vehicles in industrial and commercial fleets offers considerable potential in contributing to carbon emissions reductions as well as other pollution associated with internal combustion engines. The emergence of electric vehicles also offers an increasingly compelling set of financial benefits to the owners and operators of industrial fleets, with potential for wider productivity and output generation benefits.

The purpose of this paper is to identify and quantify the potential benefits of accelerating progress towards electrification of industrial and commercial fleets, with a particular focus on the scale of benefits that might be available in the short-to-medium term and on to 2030.

Approach and data sources
The approach taken was to review the objectives and analysis provided in Action 6 in the IEEP and then estimate the potential environmental and financial outcomes delivered if significant progress is achieved in implementing the action.

Baseline descriptions and potential future scenarios were obtained from various sources, including:

- Data and insight published by organizations such as Lawrence Berkeley National Laboratory and CALSTART.
- White papers produced by ABB.
- Topic and briefing papers produced by other industry analysts and commentators, such as EY and McKinsey & Company.

Design parameters for the development of new scenarios, such as sector coverage and timeframes, were agreed through discussion with representatives from ABB.

Additional data for the estimation of wider economic impacts were obtained from the International Energy Agency (IEA), the US Government's Bureau of Economic Analysis, Eurostat and the UK's Office for National Statistics.

Decarbonization of truck and van fleets

Baseline position

Worldwide sales of electric light commercial vehicles (LCVs) in 2022 accounted for just 2% of sales in their vehicle segment, compared to 6% for electric passenger vehicles.[2]

However, the share of electric vehicles (EVs) within commercial fleets is increasing, driven by mutually reinforcing factors including improved technology, decreasing total cost of ownership (TCO) compared to internal combustion engine (ICE) vehicles and improvements in charging infrastructure availability. According to an assessment undertaken by EY, the purchase costs of EVs are expected to reduce by around 30% in real terms by 2025 compared to 2020 levels, driven in part by expected falls in battery prices.[3]

Most comparisons of costs between EVs and ICE vehicles are dependent on battery pack costs, which typically account for around 30% of the purchase cost of a medium-duty commercial vehicle depending on the weight and purpose of the vehicle.[4]

Research indicates many fleet operators are preparing to invest in greater electrification of fleets. In industry surveys in the United States, almost 50% of fleet operators purchased an electric vehicle in 2022, and more than 50% plan to operate fully carbon-free fleets by 2027—with 90% planning to fully decarbonize eventually.[5]

Lighter commercial vehicles have reached TCO parity with diesel vehicles in the <6 tons class. However, it is widely recognized that comparative performance is affected by a range of variables. 'Average' performances reported for different vehicle use classes may differ from typical performance achieved by individual users depending on factors such as daily range, average mileages per vehicle and the availability or density of charging infrastructure.

Nevertheless, McKinsey & Company expects battery electric LCVs to be 5% to 10% cheaper to operate than equivalent ICE vehicles by 2025.[6] It also expects the TCO for medium-duty trucks, from six to 16 tons, to achieve parity during 2023, with parity for heavy-duty trucks (over 15 tons) expected by 2025.

However, in some situations cost parity for heavy-duty vehicles appears to have been achieved already. Researchers at Lawrence Berkeley National Laboratory (LBNL) identified that a heavy-duty (US Class 8) truck with a 375-mile range running a 300 mile-per-day route can already achieve a 13% lower TCO than an equivalent diesel vehicle.[7]

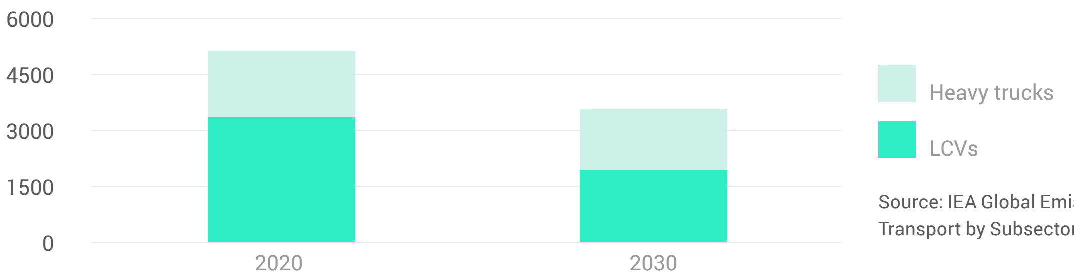
Benefits from reduced carbon and other emissions

Transportation of goods and raw materials accounts for a significant proportion of global energy consumption and carbon emissions. According to the IEA, around 55% of global carbon emissions from the transportation sector is accounted for by light-duty vehicles and heavy trucks, with the combined volume from these sources accounting for slightly over 5 billion metric tons of CO2 equivalent in 2020.[8]

Electrification of a substantial proportion of the world's commercial and industrial vehicle fleet has a crucial part to play in the eventual realization of a successful net-zero transition. Indeed, the trajectory for compliance with the IEA's 'net zero emissions by 2050' scenario requires that carbon emissions from light- and heavy-duty vehicles and trucks would need to reduce to 3.5 billion metric tons of CO2 equivalent by 2030.[9]

The scenario explored here implies a reduction in annual emissions amounting to 30% of 2020 levels by 2030, which is equivalent to an average annual reduction of about 3.5% over the 2020 to 2030 period. The importance of addressing emissions from trucks and buses is underlined by the fact that despite comprising just 4% of the world's fleet of vehicles, buses and trucks contribute 40% of global transport emissions.[10]

Figure 1: Annual carbon emissions from road transport: 2020 levels versus 2030 (net zero trajectory), millions of metric tons of CO2 equivalent (MtCO2e) per year.



Source: IEA Global Emissions from Transport by Subsector, 2020-2030

This scenario aligns with market predictions from sources such as EY and LBNL, whose assessment is that battery-electric LCVs are already competitive with ICE equivalents and that the cost differential on a TCO basis will continue to improve over the decade as the cost of battery packs decreases.

The annual savings in carbon emissions from the transition of light vans and delivery vehicles, as well as modest numbers of heavy trucks, expected under this scenario are summarized in the table below.

Carbon emissions savings from the transition to EVs by industrial fleets

Year	MtCO2e
2024	38.2
2025	44.1
2026	51.0
2027	58.9
2028	68.1
2029	78.7
2030	91.0

This growth rate assumes an increase in the rate of adoption of commercial EVs averaging 16% per annum over the 2022 to 2030 period.

Apart from a reduction in carbon emissions, reduced use of diesel fuels in freight transportation can also deliver local environmental benefits and benefits to human health from reduced levels of pollutants associated with ICEs, such as sulfur dioxide, nitrous oxides and particulates.

Benefits from financial savings to operators

As already noted, using electricity instead of fossil fuels to power vehicles can significantly improve energy efficiency and the overall cost of transport to owners and operators of commercial fleets. For example, when operating in the optimal load range, electric motors can achieve about 95% efficiency, which is more than twice the typical efficiency of diesel engines (45%) and nearly three times the efficiency of petrol engines (33%).[11]

Financial modelling undertaken by McKinsey & Company predicts that on a cost-per-mile basis, battery electric LCVs will be 5% to 10% cheaper to operate than equivalent ICE vehicles by 2025.[12] The cost advantages of LCVs are mainly driven by savings in fuel costs, reduced maintenance costs and higher residual asset values. Moreover, savings in these areas are more than sufficient to offset higher average purchase costs, the cost of investing in charging infrastructure and the costs associated with insuring a higher-value asset.

An additional financial advantage for operators of EVs is their relative resilience to price fluctuations in fuel costs, compared to diesel and petrol vehicles.[13]

However, it is important to point out that the financial incentives for transition to electrified fleets differ by industry segment. In general, savings will be greater and achieved sooner for operators with fleets with a high proportion of LCVs compared to medium- and heavy-duty trucks.

According to McKinsey & Company, a parcel delivery fleet operator with a fleet of 70% LCVs should expect savings of 13% by 2030, whereas a food products distributor with a fleet of 80% medium-duty trucks and 20% LCVs could expect savings amounting to 9% compared to an equivalent 100% ICE powered fleet.

The scope for industry-wide financial savings from a widespread transition to EVs is correlated to the future size and composition of global and national truck fleets. Based on current data, national truck fleets in high-income economies are approximately evenly distributed between light-, medium- and heavy-duty vehicles.

Based on the scale of predicted operating cost savings by vehicle size category for 2030, we estimate a typical blended average of savings across logistics could amount to 1.4% of industry operating costs by 2030. The table below sets out the estimates of savings by commercial vehicle size category.

Table 1: Potential cost savings

Vehicle size band	Assumed proportion of national fleet	Vehicle costs as % of total annual costs	Assumed vehicle cost savings by 2030
Light	33%	34%	15%
Medium	32%	44%	10%
Heavy duty	35%	59%	5%
Totals	**100%**	–	–

Potential cost savings are likely to be larger on a per-vehicle basis for light commercial vehicles, but for these vehicles the proportion of overall costs accounted for by vehicle costs tends to be lower: 34% for light vehicles compared to 44% for medium-sized and 59% for heavy duty vehicles. The remaining portion of costs are accounted for by items such as costs associated with the driver and business overheads.

In monetary terms, annual savings per vehicle could amount to an average of around $2,775 for a light commercial vehicle or around $3,250 for a medium-sized vehicle, at 2021 prices. In specific cases the out-turn results would vary according to range, daily mileage and other factors.

The analysis here has focused on savings for delivery vans and trucks used on the highway network. There are also opportunities to achieve savings for vehicles used in some non-road situations. Examples include light vehicles used on construction sites, in freight terminals and many other situations. However, there is little available benchmark information on these types of non-road vehicles, so they have not been included in the assessment.

Potential wider financial and economic benefits from commercial fleet decarbonization
When rolled out across national and global fleets, potential savings to the truck transportation industry from fleet electrification could become very significant.

The average operating cost savings described in the table above, when extended across national commercial vehicle fleets, could result in reductions in industry-wide operating costs of around 1.4% per annum. Based on current fleet sizes, savings to the truck transportation industry in the United States could amount to at least $11.5 billion per annum, using a weighted average of potential savings across different vehicle size categories.

In the United Kingdom, average annual savings could similarly amount to at least £430 million per annum.

The potential for cost reductions in transport fleet operating costs would also be expected to generate wider economic benefits, including a boost to GDP generated by the truck transportation industry. For example, the $11.5 billion reduction in industry operating costs would be expected to result in an increase in the annual GDP generated by the industry worth around $3.8 billion per annum in 2021 prices.

[1] US Energy Information Administration, International Energy Outlook, 2016

[2] US Department of Energy, Argonne National Laboratory

[3] EY (2020) How commercial fleet electrification is driving opportunities.

[4] CALSTART: Global Roadmap for reaching 100% zero-emission medium- and heavy-duty vehicles by 2040, page 5

[5] McKinsey & Company (December 2022): Getting to carbon-free commercial fleets, page 2

[6] McKinsey & Company (December 2022): Getting to carbon-free commercial fleets, page 3-4.

[7] Phadke et al: Why Regional and Long-Haul Trucks are Primed for Electrification Now, Lawrence Berkeley National Laboratory, March 2021

[8] Global CO2 emissions from transport by subsector, 2000-2030 – Charts – Data & Statistics - IEA

[9] Global CO2 emissions from transport by subsector, 2000-2030 – Charts – Data & Statistics - IEA

[10] ABB E-mobility unveils HVC360, the next evolution in fleet charging solutions

[11] ABB, Sustainable Transport: electrifying the powertrains of industrial vehicles, transportation and marine, June 2022, page 10

[12] McKinsey & Company (December 2022): Getting to carbon-free commercial fleets, page 4

[13] McKinsey & Company (January 2023): Why the economics of electrification make this decarbonization transition different, page 4

About the numbers in this model

The figures in this model refer to global amounts, with financial savings net of investment costs.

The results for emissions reduction, industry savings and gross domestic product (GDP) growth are based on modeling commissioned by the Energy Efficiency Movement from Development Economics, an independent economic impact assessment provider.

From May to October 2023, Development Economics undertook rigorous modeling of the economic and emissions outlook for each action in this model.

This modeling incorporated the best available data and included input from subject matter experts at leading industrial players including ABB, Alfa Laval and Microsoft. Expert advice was also provided by the IEA.

The models include optimistic, mid-range and pessimistic scenarios based on ranges in the underlying data. Each model, and the details of how it was developed, can be accessed via links in the respective actions in this model.

The headline figures cited in the introduction are based on mid-range scenarios.

Nevertheless, all totals have been calculated so as to avoid double counting; for actions where an emissions or economic value was difficult to ascertain, the value has been set to zero rather than using an arbitrary estimate.

The approach taken in our assessment is to quantify the anticipated scale of avoided carbon emissions, in line with the GHG Protocol. An "avoided emission" in this case is the difference between carbon emissions that would occur through the implementation of an action contained within the IEEP, and the emissions that would have occurred in the absence of an implemented IEEP action.

Per the World Business Council for Sustainable Development's "Guidance on Avoided Emissions" (published March 2023), "avoided emissions are emission reductions that occur outside of a [solution's] life cycle or value chain, mainly as a result of the use of that [solution]. Due to their forward-looking nature, avoided emissions are the result of a comparative exercise between emissions associated with an identified reference scenario and emissions associated with the solution (the intervention)."

The analysis presented herein relies on the IEA's Stated Policies Scenario (SPS) as the reference scenario.

Every care has been taken to rely on the most authoritative numbers available for modeling, with a particular emphasis on using IEA data current as of September 2023.

The models have been built assuming reasonable technology adoption curves and validated against third-party sources where possible. In cases where our values or definitions differ from those of the IEA, this has been made clear within the modeling documents.

However, no model can ever be definitive. We intend these models to act as an invitation for your business to carry out its own analysis and, where possible, share data on real outcomes through the Energy Efficiency Movement.

We are grateful to the IEA for acting as an expert contributor to this modeling.

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