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# GREEN LOGISTICS

## THEORY & PRACTICE

As a federally owned enterprise, GIZ supports the German Government in achieving its objectives in the field of international cooperation for sustainable development.

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# Contents

This report reviews 'Green Logistics' in theory and practice and also explores ongoing efforts, by select multinational companies across different industries in India and abroad, to improve efficiencies and reduce carbon footprint in their logistics activities.

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# Introduction

**The Logistics Division of the Ministry of Commerce and Industry (MoCI), Government of India (GoI) and the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) India, are jointly implementing the Climate Friendly Freight Transport in India (Green Freight) project. As part of the International Climate Initiative and Indo-German Development Cooperation, the Green Freight project has been commissioned by the Federal Ministry for Environment, Nature Conservation and Nuclear Safety (BMU).**

The objective of the Green Freight project is to provide strategies and technical solutions to the decision-making agencies at the national, regional/ local level to develop freight transport in India in a climate friendly and efficient manner to support the India's Nationally Determined Contributions (NDCs). As part of the project, GIZ will support national and state level partners, and private sector in making the Indian freight and logistics sector climate-friendly and efficient. Measures for improved logistics management and the introduction of climate-friendly technologies will be implemented in a selected corridor.

During multi-stakeholder consultations held on 19th February 2020, Logistics Division of MOCI and GIZ decided that under this project scope, pilot measures along the Delhi-Mumbai Dedicated Freight Corridor (DMDFC) would be carried out. DMDFC is a1,504 km long and passes through five Indian states namely, Maharashtra, Gujarat, Rajasthan, Haryana and Uttar Pradesh. The traffic on the corridor includes intermodal containers from Jawaharlal Nehru (JNPT) and Mumbai Port in Maharashtra and Pipavav, Mundra and Kandla ports in Gujarat, destined

for Inland Container Depots (ICDs) located in northern India. The corridor handles more than 70% of India's total container transport with other commodities moving on it as POL, fertilizers, food grains, salt, coal, iron & steel and cement. The development of the DMDFC, one of world's largest infrastructure projects, is expected to boost logistics industry and consequently the demand for skilled workforce in the logistics sector.

An important component of Green Freight project is to improve the capacities for implementing measures for climate friendly and efficient freight traffic on an operational level. In agreement with stakeholders, the project is expected to identify capacity building measures based on the current demand. In partnership with recognised training institutes, the project will build relevant capacity development modules. With support of GIZ, these institutes will implement pilot trainings, assess the impact and adopt these modules in their programs.

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# Scope and Structure of Report

**Capacity Development is a component of the Green Freight Project which aims to improving capacities for implementing measures for climate friendly and efficient freight traffic on an operational level. Towards this, the objective of this interim report is to compile good practices and past practices on improvement of logistical inefficiencies in India and abroad, particularly on greening logistics.**

In order to do so, this report shall,

- Understand role of green logistics in GoI's Draft Logistics Policy;
- Define concept of green logistics, its drivers, strategic frameworks and solutions;
- Collate evidence of companies in different sectors planning and/or adopting good practices in greening their logistics chains and reducing environmental goals;

This report elaborates on the Green Logistics concept by presenting a sound understanding of its theory and practice and ongoing initiatives voluntarily taken up by many Companies across different sectors for relevant stakeholders to learn, frame and implement their own strategies and solutions in greening their logistics. The terms "Green Freight" and "Green Logistics" differ slightly in scope. "Green Freight" focuses on freight transport while the latter also incorporates non-transport aspects of logistics operations, such as manufacturing, warehousing packaging or supply chain management. In practice, both terms are used interchangeably, but for the sake of clarity and consistency this report used the term "Green Logistics".

**This report is structured in the following manner.**

**Section 3** The aim of Draft Logistics Policy released by MOCI and the role of Green Logistics is outlined.

**Section 4** Defines green logistics and identifies the major drivers for green logistics adoption thereby indicating the complex interdependencies and linkages between logistics activities and environmental considerations.

**Section 5** Maps these complex interdependencies in a Green Logistics Systems Model that identifies the key parameters, statistical aggregates and determinants. This model offers stakeholders, particularly policy makers and company executives, a full range of functional decisions necessary to effectively manage available logistical resources in their areas of influence.

**Section 6** Describes three green logistics solution frameworks. These frameworks assist company managers to conceptualise and formulate coherent strategies in their jurisdictions. The Green Logistics Framework, developed by Mc Kinnon and Smart Freight Centre, is elaborated.

**Section 7** Categorizes the whole gamut of green solutions into 5 clusters. This section also describes solutions within each of the 5 clusters in a tabulated format.

**Section 8** Briefly describes business strategies and solutions adopted by top national and international companies. Wherever information is available, the environmental benefits accrued from these initiatives are also mentioned.

**Section 9 concludes with a summary of key findings.**

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# Green Logistics in Draft Logistics Policy

**An efficient and functional logistics sector is central to any country's economic growth and therefore to address the fragmented and unregulated Indian logistics sector, the National Logistics policy draft was released by the Ministry of Commerce and Industry, Government of India in February 2019. This policy aims to create a single point of reference for all logistics and trade facilitation matters, thereby reducing logistics costs from estimated 13-14% of GDP to 10%. The draft policy defines a number of prioritized thrust areas for logistics in India which MoCI and other ministries will focus on and provide guidance to state governments.**

One of the important thrust areas highlighted in the draft logistics policy is promoting green and sustainable logistics. The policy recognises that promoting green and sustainable logistics is crucial for the sustainability of this sector and therefore identifies following areas for intervention:

- To enable modal shift to rail, coastal shipping and inland waterways,
- To improve vehicle utilization
- To raise energy efficiency
- To switch to greener fuels
- To improve vehicle design
- To promote telematics
- To expedite infrastructure investment in alternative modes (e.g. slurry pipelines)

To reduce carbon footprint of logistics sector, the policy advocates framing regulations to mitigate vehicular, noise affluent emissions and wastage and duty rationalisation on alternative fuels. The policy also emphasises the importance of encouraging best practices in the industry and help stakeholders in the logistics sector to advance sustainability in their supply chains by measuring, benchmarking and improving freight transportation efficiency.

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# Concept of Green Logistics

**The Sustainable Development Goals (SDGs) endorsed in 2015 by the United Nations member countries form a universal set of goals and objectives that form the guideposts to formulating policies in the field of ecology and environmental protection for the period 2015-30. Of the 17 goals and 169 identified targets in SDGs, there is no single SDG that focuses on transport and logistics, though there are five targets that involve transport, namely,**

**Target 3.6:** By 2020, halve the number of global deaths and injuries from road traffic accidents.

**Target 7.3:** By 2030, double the global rate of improvement in energy efficiency.

**Target 9.1:** Develop quality, reliable, sustainable, and resilient infrastructure, including regional and trans-border infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all.

**Target 11.2:** By 2030, provide access to safe, affordable, accessible, and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities, and older persons.

**Target 12c:** Rationalize inefficient fossil-fuel subsidies that encourage wasteful consumption by removing market distortions, in accordance

with national circumstances, including by restructuring taxation and phasing out those harmful subsidies, where they exist, to reflect their environmental impacts, taking fully into account the specific needs and conditions of developing countries and minimizing the possible adverse impacts on their development in a manner that protects the poor and the affected communities.

Sustainable freight transport and logistics is an important enabler of economic development where improvements to efficiency, environmental impact or safety produce positive effects across large networks which indirectly support the achievement of almost every SDG. These benefits are all encompassing in which not just freight operators and nations gain, but even multiple public policy goals are achieved transcending boundaries and supply chains. While the potential impact of green logistics is particularly strong on some SDGs (e.g. on responsible consumption and production or climate action), there are strong reasons for investing in green logistics initiatives. Green Logistics provides a foundation for sustainable development by facilitating economic growth, promoting trade, improving access and linking communities and societies to end poverty, protect the planet and ensure prosperity for all.

In response to the Paris Climate Agreement, governments, associations and businesses are seeking ways to reduce their environmental impact. Many have started developing strategies towards low-emissions freight and logistics, with the ultimate vision of zero emissions by 2050. However, only 29% of countries' have formulated Nationally Determined Contributions (NDCs) and many companies that provide freight transport and logistics have yet to develop their own strategies.

Green Logistics can be defined as the alignment and integration of environmental management within supply chain management. It is based on the premise that any Company's environmental impact extends well beyond its external boundaries. Companies applying green principles to their internal operations naturally wish to ensure that their purchases of goods and services come from suppliers that also meet certain minimum environmental standards. At the very least, they want to minimize any environmental liability associated with purchased goods and services (Sarkis, 2000).

Green Logistics encompasses product design, all stages of manufacturing and distribution and all aspects of reverse logistics. Physical distribution is only one component in a much broadly defined system. Companies around the world are keen to promote their green credentials through the management of logistics. While, it is difficult to gauge whether the drivers for this change reflects a true desire to sustain the environment or enhance the public relations, Companies have begun realising the benefits flowing from greening logistics in their business interests.

Improving freight transport efficiency alone (i.e., reducing the costs or fuel consumption per unit freight demand without reducing the demand i.e., in ton-km) can cause a rebound effect where companies start sourcing products from greater distance at higher frequency. This can also cause a trade-off that companies make between transport, warehousing and inventory causing them to trade off more freight movement for lower warehousing and / or inventory costs and could have adverse implications on the efficiency of logistics chains. By integrating one of the strategies described in Section 6, freight can be decoupled from economic growth, ensuring more sustainable growth.

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# Green Logistics Systems Model

**To map the complex interdependencies between logistics activities and its related environmental effects and costs that arise from freight transport operations, warehousing, materials handling and logistics IT activities, the systems model offers a holistic framework for identifying opportunities for greening logistics across its full value chain. The systems model (See Figure 1) aims to provide a common framework for businesses, government and other stakeholders who want to contribute to decarbonising logistics by developing their own roadmaps. The overall roadmap structure is made up of five solution areas which can achieve an 83% reduction in CO2/tonne-km to realise emission targets for freight transport by 2050.The model decomposes the relationship between the material outputs of an economy and the monetary value of the logistics externalities into a series of 9 key parameters and statistical aggregates.**

1. Modal split indicates the proportion of freight carried by different transport modes. Following this split, subsequent parameters need to be calibrated for particular modes.
2. Average handling factor is the ratio of the weight of goods in an economy to freight tonnes-lifted, allowing for the multiple times products are loaded on to vehicles several times across the supply chain. The handling factor is a crude measure of the average number of links in a supply chain.
3. Average length of haul is the average distance covered in each link of the supply chain and essentially converts the tonnes-lifted statistic into tonne-kms.
4. Average payload and the average percent empty running are the two key vehicle utilization parameters. Average payload is normally measured solely in terms of weight, though an increasing proportion of loads is volume constrained. Very little data is available, however, to permit a volumetric analysis of vehicle loading.

5. Energy efficiency is the ratio of distance travelled to energy consumed. It is a function mainly of vehicle characteristics, driving behaviour and traffic conditions.

6. Emissions per unit of energy is the quantity of CO2 and noxious gases emitted per unit of energy consumed. It varies with the type of fuel, nature of the engine (for movement, heating, refrigeration, IT) and exhaust filtration systems. For consistency, full well-to-wheel assessments should be made of the various pollutant emissions, wherever possible.

7. Other externalities per vehicle-km and per unit of throughput. Allowance must also be made for noise irritation, vibration and accidents. This can be expressed either w.r.t vehicle-kms or throughput of warehouses, terminals etc.

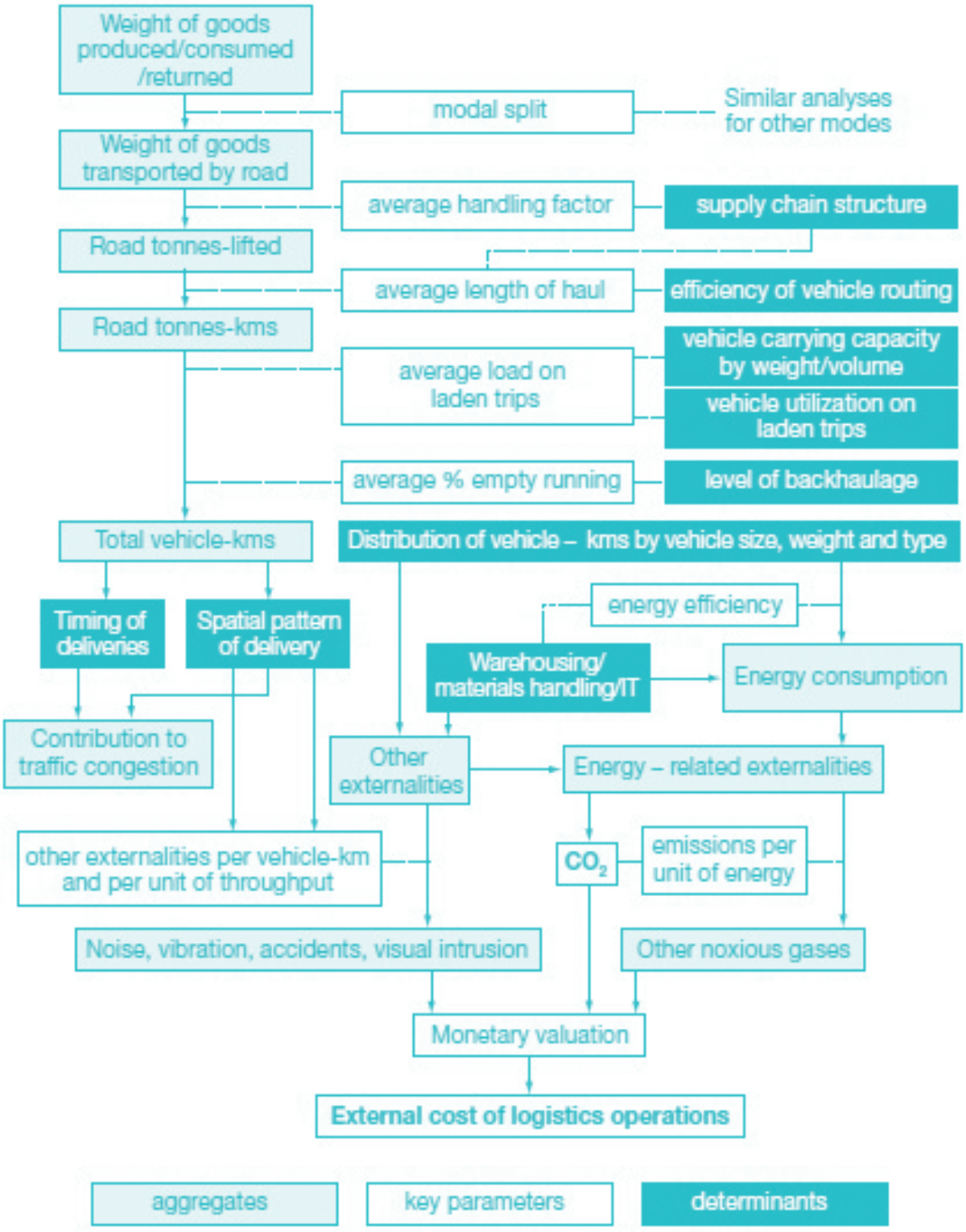
8. Monetary valuation of externalities is to convert above mentioned physical parameters into monetary values. Money then becomes the common metric against which the environmental effects can be compared. This valuation also makes it possible to assess the extent to which environmental costs are recovered by the taxes imposed on logistical activity.

9. External cost of logistics operations

Businesses and Government Ministries developing sustainable logistics policies can exploit the full range of above mentioned parameters. Functional decisions relating to the management of logistical resources.

Logistics companies transcend the influence sphere of countries and companies and therefore individual businesses need broader support from an array of stakeholders. With coordinated efforts at industry level, government partnerships research and development institutes and civil society, individual businesses can take efforts to further optimise efficiency and reduce emissions.

**Figure 1:** Relationship between economic output and GHG emissions from logistics




*Source: (Akyelken 2011)*

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# Frameworks for Green Logistics

**According to available literature, achieving the SDG targets set for global warming is not only dependent on the outcome of achieving carbon neutrality by 2050 but also the way in which these outcomes are accomplished. Moving fast on short term carbon reductions helps to gain time for the implementation of more advanced solutions. Other challenges not directly related to emissions that need to be addressed also need to be acted upon.**

One example is when we focus on deploying resources for vehicle electrification and increasing the share of renewable energy, we are unlikely to have fully electric/decarbonized heavy-goods vehicles for long distances widely available in the next ten years. In this context, relying solely on the electrification of transport will not help achieve our emissions targets. With the forecasted growth in transport sector, it may be difficult to solely fund electrification on the scale required. Therefore, a more holistic approach is necessary for consideration in which different solution pathways and areas are combined towards the emissions-reduction goals while minimising the investments required to reach them. For the freight transport and logistics sector to achieve its targets, gains in efficiency need to work hand-in-hand with emissions reduction. There are very simple and cost-effective ways to maximise a reduction in emissions including NOX and PM as opposed to just CO2. However, in other cases the investments required could make the business case unworkable. Given the magnitude of carbon reductions that logistics will have to deliver, it is inevitable to approach in a way that fully exploits all opportunities. There a multitude of strategies

businesses can do to reduce carbon footprint of their logistics operations. While this offers flexibility and diversity, it becomes difficult to decide on the right mix of strategies and how they can be coordinated. Frameworks exist to help managers and policy makers conceptualise the various options and formulate coherent strategies in their jurisdictions. There are 3 frameworks developed for Green Logistics:

## 6.1 Kaya Identity

One of the earliest frameworks developed to Kaya Identity framework determines the amount of GHGs released by human activity. It was developed by Japanese Energy economist Ypichi Kaya. It suggests that GHG gases are function of population multiplied by three ratios expressed in the form:

$$F = P.\frac{G}{P}.\frac{E}{G}.\frac{F}{E}$$

Where:

- F is global $CO_2$ emissions from human sources.
- P is global population.
- G is world GDP
- E is global energy consumption

And:

- G/P is the GDP per capita
- E/G is the energy intensity of the GDP
- F/E is the carbon footprint of energy.

For freight transport, the above formula is modified to create the 'freight identity' equation:

**GHG emissions = tonne-km x GDP / tonne-km x energy / tonne-km x GHG / energy**

This equation can further be decomposed for each of the modes separately and calibrate their respective intensity values accordingly. Kaya framework offers 5 ways to reduce carbon emissions.

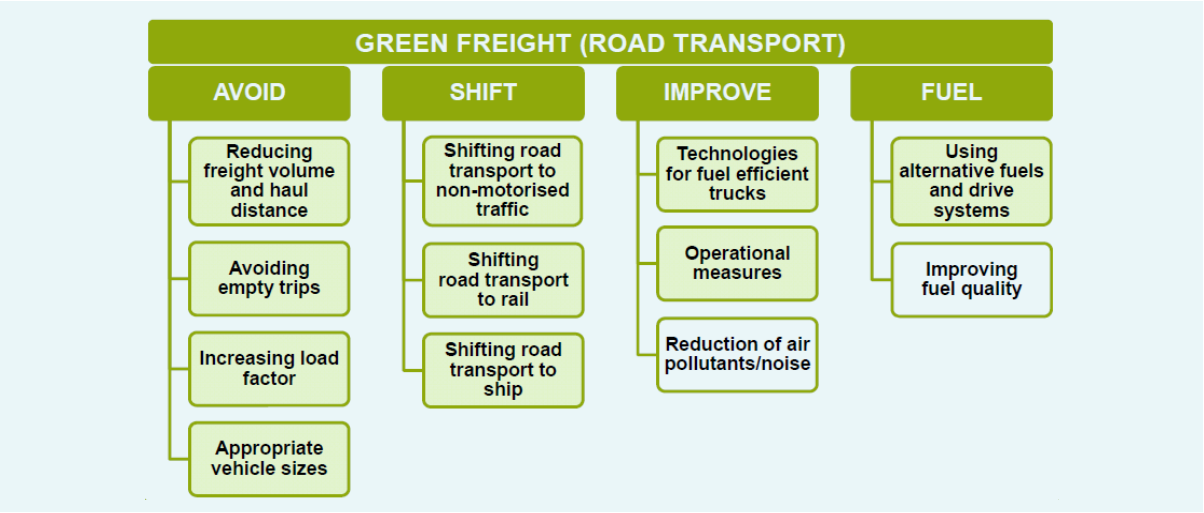
1. Cutting GDP: This is a broader political issue that goes well beyond logistics and beyond the scope of this report.
2. Lowering freight transport intensity: reducing the amount of freight movement generated by each billion dollars of GDP.
3. Shifting transport mode: increasing the proportion of freight moved by modes with a lower carbon intensity.
4. Improving energy efficiency: increasing the amount of freight movement per unit of energy consumed.
5. Switching to lower-carbon energy sources: such as biofuels or electricity generated by 'renewables'.

The Kaya identity has played a key role in the development of future emission scenarios in the IPCC Special Report on Emission Scenarios. However, Kaya identity is not extensively used in categorising the whole gamut of possible solutions to reduce carbon footprint in transport or logistics sector as there are more popular frameworks as described below.

## 6.2 A-S-I-F Framework

The Avoid-Shift-Improve-Fuel (A-S-I-F) is the most widely used analytical framework for analysis and decision making in transportation projects, programs and policies which is adopted by IPCC in its freight modelling schema (See Figure 2). In the sphere of logistics, the 3 elements refer to clean and efficient logistics, modes and equipment. Avoid based strategies aim to optimise logistical strategies to avoid inefficiencies and thereby reduce unnecessary transport. Strategies under this approach focus on increasing vehicle utilization, reduce empty vehicle runs and optimize truck routeing among

**Figure 2: A-S-I-F Framework illustration**



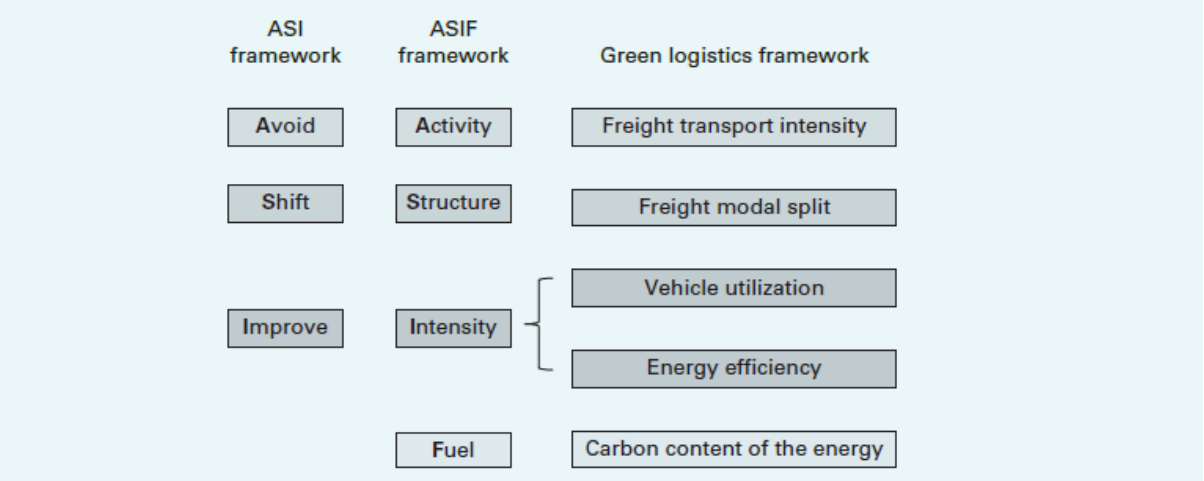

*Source: (Akyelken 2011)*

other enhancements. Shift based strategies promote greener and less polluting transport modes by encouraging shift from road to rail, inland waterways or coastal shipping modes which are lower energy and emissions intensity. Improve strategies aim to reduce the intensity of emissions per unit of energy through technological interventions in fleet and assets. Fuel is to reduce the carbon content of the energy used.

## 6.3 Green Logistics Framework

Solutions that directly lead to emissions reductions, as opposed to policy and research that incentivise their adoption, are framed, mapped and identified in five clusters in this framework. The Green Logistics framework bears a close resemblance to A-S-I-F framework though subdivides some components and also includes storage and handling strategies for a holistic logistical perspective. The framework maps the interrelationship between economic outputs of country, manufacturer and logistics related environmental costs. This interrelationship between A-S-I, A-S-I-F and Green Logistics frameworks shows that A-S-I can be further subdivided into basically five clusters in which logistics can be decarbonised (See Figure 3). This makes up the logistics decarbonization framework.

**Figure 3: Interrelationship between decarbonization frameworks for logistics**



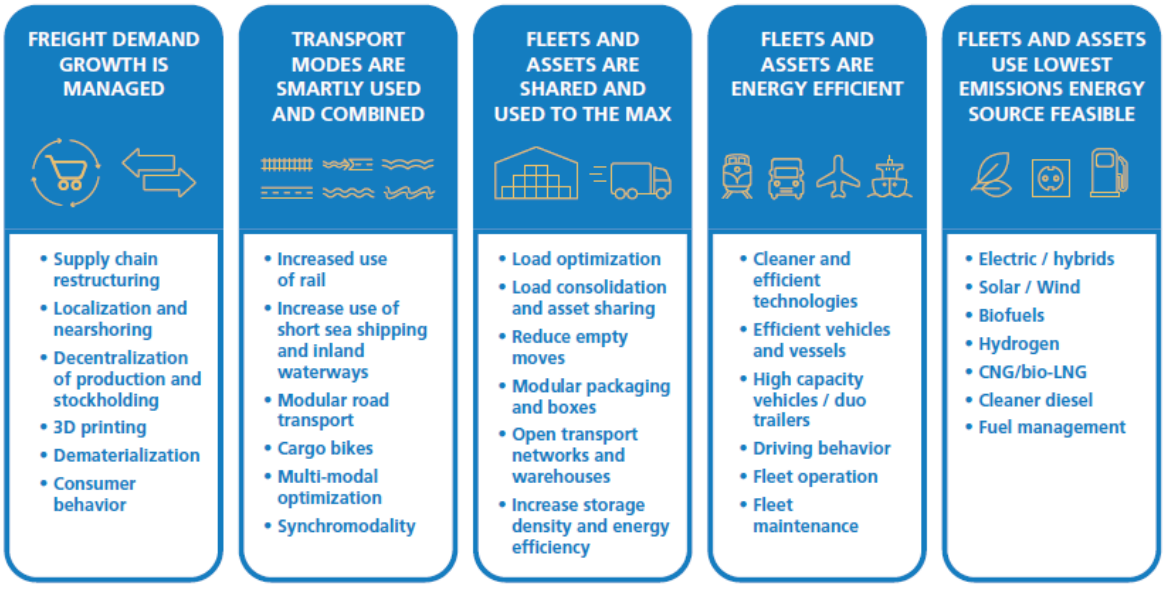

*Source: (Mckinnon 2018)*


SAFETY FIRST
NO SMOKING

# Clusters and Solutions in Green Logistics Framework

Green Logistics solutions that directly lead to emission reductions can be clustered into 5 different strategies under the Green Logistics framework (GLF) as follows:

Each of these solutions under the different clusters and their brief descriptions under each of these clusters are described in the following sub-sections:






*Source: (Punte et al. 2019)*

## 7.1 Freight Transport demand growth is managed

The eight solutions (See Table 1) can provide the same access to goods without exponentially increasing freight transport. Within this cluster of solutions, we may consider supply chain restructuring, 3D printing, dematerialisation, localising production close to consumption and nearshoring of inbound materials, stocks decentralisation, and influencing consumer purchasing behaviours.

**Table 1: Solutions under GLF cluster titled "Freight Transport demand growth in managed"**

| No. | SOLUTIONS | DESCRIPTION |
|---|---|---|
| 1 | **Supply Chain Restructuring** | Redesign of a logistics network's nodal points, distribution hierarchy and inter-related transport flows to minimise distances travelled and optimise load factors. |
| 2 | **Localisation and nearshoring** | Localising production close to consumption where feasible, such as agriculture produce, and nearshoring of inbound materials closer to manufacturing. |
| 3 | **Decentralisation of production and stockholding** | Moving production stockholding and sales closer to consumers. As an example, we can see many retailers that are expanding their inventory management to include stores. |
| 4 | **3-D printing** | 3-D printing of spare parts, selected products or parts of products that can be combined with manufacturing closer to markets, while acknowledging that raw materials still need to be transported. |
| 5 | **Dematerialisation** | Reducing the physical quantity of goods, products and packaging needed to deliver consumer value. Possibilities are product re-design, waste minimisation, recycling, digitisation, miniaturisation, material substitution, and postponement of dispersing products to new markets.<br>In recycling and waste minimisation, to develop new offerings around recycling and waste management and working collaboratively with customers |
| 6 | **Consumer behaviour** | Influencing consumer behaviour through awareness-raising and education on their purchasing habits and encouraging re-use, refurbishment, remanufacturing and recycling. Whether last-mile home delivery reduces carbon emissions depends on how this service is delivered and if it replaces a consumer shopping journey with a motorised vehicle that generates more emissions. It needs to consider lead time and delivery time and move in the opposite direction of the "one hour" and "same day" delivery. |
| 7 | **Packaging practices** | Reducing packed product volume and weight of packaging materials while keeping the same level of protection and manoeuvrability to increase container utilization (i.e. the total stocks units or payloads transported).<br>Increasing container utilization becomes harder as each is more fully optimized, and therefore other strategies besides software optimization include co-loading or delaying shipments to aggregate more cargo. |
| 8 | **Reverse Logistics** | Carbon emissions can be addressed by increase in the recycling and reverse logistics activities. Recycling of metals like aluminium, steel and other metals have the highest environmental benefit and revenue generating potential in comparison to plastics and paper waste. |

### 7.1.1 PACKAGING PRACTICES

Packaging enables minimization of food waste and overall product breakage with advanced convenience features at low costs. However widespread usage of single use packaging my industry in the past decade has resulted in a heavy burden on the environment and management of packaging waste is facing a crisis due to two unresolved challenges – namely the ability to recycle packaging after use and recycling rates for plastic packaging. In Asia packaging demand growth is outpacing global growth rates and waste collection systems are in not in place the required scale. Only 16% of all plastic waste is re-processed to make new plastics.

Government of India has responded to public concerns regarding packaging waste, especially single us packaging waste. India has shelved plans for a complete ban of single use plastics but is pushing for legislation favouring recyclable substrates and formats. India's recent move is to push for increased number of awareness campaigns and enhancing the number of plastic collection points across cities, towns and villages.

Sustainability in packaging primarily revolves under regulatory changes and public perceptions around single use packaging waste to drive major changes in FMCG packaging.

## 7.2 Transport modes are smartly used and combined

Efficiency in freight transport can be made more efficient through optimum use of available modes. In India, road transport operations is the most dominant mode garnering almost 60% of total modal mix with 31% by rail and meagre 9% by water compared to those in United States, China and European countries of approximately 25-30% share of road, 50-55% by railways and 20-25% by waterways. The Draft Logistics Policy has identified the need to optimize India's current modal mix to resemble international benchmarks as one of the key objectives to be achieved in the next five years. This massive shift to alternate modes from road transport will not be feasible unless modal complementarity and a wider range of modal options is developed and made available to shippers. Moreover, other freight transport solutions including bikes and motorbikes could be deployed for first and last mile deliveries, synchromodality (i.e. optimal and flexible use of multiple modes and speed/lead times) are some strategies under this solution. There are four identified solutions under this cluster as described in Table 2 below.

## 7.3 Fleets and assets are shared and exploited

Optimizing asset utilization offers a huge opportunity to accommodate more transport demand with same infrastructure and capital investment. An important benefit is reduced congestion, reduction in empty runs and reduction in the need for storage space. There is a huge opportunity to increase load factors and capacity of individual vehicle combinations while reducing empty runs in road, rail and maritime freight transport. This can be achieved through five unique solutions such as load optimisation and load consolidation, sharing of assets and better management of transport infrastructure such as logistics centres, warehouses as further described in Table 3). Transport predictability and flexibility is an important enabler for such solutions to be successful and accepted by the shippers.

**Table 2: Solutions under GLF cluster titled "Transport modes are smartly used and combined"**

| NO. | SOLUTIONS | DESCRIPTION |
|---|---|---|
| 1 | Increased use of rail, waterborne and low emission modes | Providing a wider free modal choice other than road to achieve lower emissions per tonne-km. To do so, enhance competitiveness of rail, waterborne and low emission modes (such as cargo bikes, etc.) in terms of price, quality, service level, reliability, capacity and flexibility vis-à-vis road transport. |
| 2 | Multi-modal optimisation | Optimising the combination and complementarity of different modes and linkages between them by adding, providing better access to, and optimising transhipment possibilities. For e.g. by optimising ship-port interfaces, use of high capacity road freight transport vehicles for first and last mile deliveries of multimodal transport operations |
| 3 | Synchromodality | Optimal and flexible use of different modes and routes in a network under the direction of a logistics service provider, so that the customer (shipper or forwarder) is offered an integrated solution for its (inland) transport. It also includes the combination of cargo with different time speeds requirements or that could act as ballast for other goods |
| 4 | Transloading (container switch) | Facilities for cargo transfer between transport modes and offering value added services including cargo sorting, consolidation, and deconsolidation constitute transloading. This allows companies to hold cargo as needed to dispatch full truckloads and considerably reduces vehicle-kilometres travelled. |

**Table 3: Solutions under GLF cluster titled "Fleets & assets are shared & exploited"**

| No. | SOLUTIONS | DESCRIPTION |
|---|---|---|
| 1 | **Load optimisation** | • **Adjust truck size to load.** Higher freight efficiency is achieved as the amount of freight hauled per litre of fuel used is reduced. So, the fuller the load compartment the better overall efficiency. Matching the size of the vehicle with the load volume or weight contributes to efficiency.<br>• **Optimising use of vehicle space** Optimise the loading of vehicles taking the vehicle and freight dimensions into account, which can be enhanced using software. Improvements of the load factor of the vehicle through physical techniques such as efficient unit loads, and a combination of mechanical and manual loading may be necessary. |
| 2 | **Load consolidation and asset sharing** | Bundling shipments across product categories with similar shipment characteristics (destination, time constraints). This can be realised through:<br>• **Horizontal collaboration** where companies at the same level of the logistics chain, either shippers or providers, form partnerships to bundle loads or make use of the same vehicles/assets.<br>• **Cargo Consolidation** by hiring third party logistics providers or freight forwarders to combine shipments into a Full Container Load (FCL). While this strategy might increase lead times because of waiting at the CFS, it often reduces the overall transport costs.<br>• **Combined freight and warehouse exchange platforms** for exchanging information between carriers, freight forwarders, logistics service providers (LSPs) and shippers to facilitate new orders and collaboration, including backhauling.<br>• **Pooling and bundling/cross-docking** that are optimised to facilitate load consolidation from different suppliers and shippers.<br>• **Cube optimization** maximizes the volume capacity of trailers, containers, and rail boxcars enhanced by combining diverse cargo and optimizing volume capacity and weight limits. Despite the operational challenges, companies with a wide array of products are better positioned to adopt this type of optimization.<br>• **Floor loading** a container with cargo from the floor up, rather than on pallets. Since pallets take space, eliminating them allows more product to fit. Since loading and unloading is done manually rather than with forklifts it increases loading and unloading time and the risk of cargo damage. For large product quantities, long distances travelled by containers, and the ability to plan and forecast demand to manage inventories and delivery time requirements, floor loading improves container utilization from floor loading.<br>• **Mixed load and weight volume** Non-traditional heterogeneous pallets built from a mixture of products where the degree of pallet density is lower compared to their traditional counterparts.<br>• **Urban consolidation centres** where group shipments from multiple shippers are consolidated onto a single truck/transport vehicle for delivery within a city or urban area.<br>• **Crowd-shipping** by recruiting citizens to serve as couriers using their private vehicles to pick up and drop off parcels along routes they are taking anyway.<br>• **High capacity vehicles** can consolidate bigger load volumes and weights for longer distances.<br>• **Many software management tools** are available to help reduce empty running by finding additional freight to haul given each fleet's capabilities with routes, equipment, time, and other variables.<br>• **Utilisation of public transport modes** such as underground freight trains during non-operating hours or even combining freight and public transport in a way that does not affect current schedules. |

| No. | SOLUTIONS | DESCRIPTION |
|---|---|---|
| 3 | **Modular**<br><br>**Packaging and boxes** | Redesign of product packaging, transport boxes and containers for optimal fit to product and for modularity, to allow efficient handling, consolidation and pooling. This can be combined with re-usable containers (RCs), in anticipation of the implementation of the Physical Internet concept. |
| 4 | **Back-hauling** | Refers to the practice of picking up or delivering cargo on return or round trips as compared to returning with empty vehicles or vessels. |
| 5 | **Open warehouses and transport networks** | This solution looks for a systemic load consolidation and optimisation in which the capacity in logistics sites and transport networks could be made available for the use of the stakeholders in a more optimised way (i.e. following physical internet principles). This includes the possibility of combining flows from different stakeholders.<br><br>Presently multi supplier-multi-retailer software, operations and business models are still not capable to provide collaborative tactical and operational planning, do not support dynamic planning, cannot link to traffic data and unable to support multiparty transport flows and inventory management via shared hubs and warehouses, paperless processes, cost sharing and allocation. |

## 7.4 Fleets and assets are energy efficient

As fossil fuel prices steadily increase globally, they are one of the recurring topics of political discourse especially in India. In Indian truck operations, diesel costs constitute nearly 60%-65% of total operational costs. The management of fleet and deployment of energy efficient technologies can benefit freight transport operators to reduce their operational costs from diesel purchase. Freight transport operators could also consider investing in more efficient vehicles. Cheaper strategies can include better fleet operations, improved and dynamic planning skills, maintenance and monitoring that makes use of Information Communication Technologies (ICT). See Table 5 for further details. Optimal use of truck energy and consequently better environmental performance can be achieved by improvements in driver behaviour, driving techniques and adopting preventative maintenance procedures. This is also termed as Eco-Driving. Driving techniques to reduce fuel consumption include interventions such as:

- maintaining constant speeds,
- eliminating abrupt accelerations
- reducing hard braking and its associated energy waste.

Training drivers to adopt these techniques and maintenance procedures (See Table 4) can provide immediate benefits in terms of energy, emissions, and safety.

**Table 4: Driving techniques and maintenance procedures in eco-driving training programs**

| Driving Techniques | Maintenance procedures |
|---|---|
| • Gear selection (green zone revolutions per minute)<br>• Constant highway speed<br>• Engine braking / torque<br>• Reduce idling<br>• Route planning | • Lubricants / engine oil<br>• Intake / exhaust system<br>• Engine cooling<br>• Air compressors<br>• Wheel alignment<br>• Tyres<br>• Fuel filter systems<br>• Aerodynamic devices (retrofit)<br>• Electrical systems<br>• Air conditioning |

Eco-driving can improve fuel consumption at a relatively low cost, particularly for those techniques where driver behaviour plays a key role. Savings of upto 9% fuel economy improvement can be achieved through eco-driving. To achieve the maximum benefits from eco-driving strategy, it is important to systematize training, continuously monitor driver performance, implement reward schemes, and

leverage technology such as telematics for support and feedback. Today's technology can support or even automate the adoption of some of these techniques. In the case of automatic tyre inflation systems, a drop in tyre pressure can increase rolling resistance thereby increasing fuel consumption. Conducting regular tyre pressure checks will ensure optimal tyre pressure and auto-inflation systems can forego driver monitoring and intervention.

Tata Motors set up commercial driving centers in partnership with public institutes such as Urjanchal Driving School in Madhya Pradesh to promote road safety issues in India. Tata Motors provides training content, advises aspiring agencies on establishing and running driver training schools, monitors the quality of training, and assists in networking with potential employers for trainees.

**Table 5: Solutions under GLF cluster titled "Fleets & assets are energy efficient'**

| No. | SOLUTIONS | DESCRIPTION |
|---|---|---|
| 1 | **Cleaner and Efficient technologies** | **Tyres.** Low rolling-resistance tyres can be designed with various specifications, including dual tyres or wide□base single tyres. It is noted that wear and tear of tyres also generate PM emissions.<br>• **Aluminium wheels**. These wheels replace common steel wheels and are intended to reduce vehicle weight and heat dissipation while improving fuel efficiency.<br>• **Idling-reduction technologies**. These include auxiliary power units and generator sets, battery air conditioning systems, plug-in parking spots at truck stops and thermal storage systems.<br>• **Automatic transmission**. Moving from manual to automatic/automated manual transmission can greatly improve efficiency. Adding gears, reducing transmission friction and using shift optimisation in manual automated or fully automated transmissions can also improve drivetrain efficiency.<br>• **Low-viscosity lubricants**. Oils with less internal resistance to flow that decrease engine mechanical losses, thereby reducing fuel use.<br>• **Oil by-pass filtration system**. Secondary filtration unit with the purpose of super-cleaning engine oil, extending lifetime. It has high contaminant-holding capacity and filters out the smallest particles to include sludge and soot in special cases. |
| 2 | **Efficient Vehicles and vessels** | • **Fleet renewal**. Effectiveness and cost-effectiveness of early replacement of old vehicles to improve air quality, reduce dependence on oil, CO2 emissions and increase road safety.<br>• **Light-weighting**. Broadly, all HDV vehicle types except utility trucks could cost-effectively reduce weight by upwards of 7% within the next ten years. Weight advantage offers a greater degree of freedom in vehicle design and performance.<br>• **High-capacity vehicles**. Refers to an increase in a truck´s size with heavier payloads, leading to a smaller proportionate increase in fuel consumption. Hence, leading to less fuel than smaller trucks per each unit of freight. The European Modular Concept (EMS) and duotrailers are specific types.<br>• **Use mega-vessels and freight trains**. The frequency of shipments can be reduced by increasing the volume transported per shipment. There is a trend towards mega vessels able to hold 20.000+ Twenty-Foot Equivalent Unit (TEUs) combined with freight trains that go beyond the common 600 750 metre lengths.<br>• **Autonomous trucks**. Driverless vehicles which are fully automated and are operated remotely. Managing fleets of autonomous trucks may bring important economic benefits that should and could be translated into low emission energy sources.<br>• **Autonomous rail services**. Driverless trains which are fully automated and are operated remotely. |

| No. | SOLUTIONS | DESCRIPTION |
|---|---|---|
| 3 | **Driving behaviour / Eco-driving** | Practice of eco-driving in such a way as to minimise fuel consumption (i.e. coasting before engine breaking, limit harsh breaking and acceleration), the emission of carbon dioxide and vehicles wear and tear. |
| 4 | **Fleet operation** | • **Platooning** refers to the practice of driving heavy-duty trucks (primarily tractor-trailers or rigid trucks) in a single line with small gaps between them to reduce drag and thereby save fuel during highway operations.<br>• **Routing**. Optimising delivery routes through the deployment of GPS and GIS to assist drivers in finding the shortest route or avoiding traffic congestion.<br>• **Retiming**. Refers to shift to off-hour (or night-time) logistics operations and deliveries.<br>• **Slow steaming**. The practice of operating transoceanic cargo ships, especially container ships, at significantly less than their maximum speed.<br>• **De-speeding**. The practice of operating trucks, especially long-distance trucks, at significantly less than their maximum speed.<br>• **Planning of use**. Reducing the non-productive operations of trucks, trains and ships (e.g. train coupling, truck maintenance, ship cleaning) through better planning.<br>• **Maintenance**. Moving from preventative to predictive maintenance that optimises the use of vehicles and vessels and improves planning of their use. |
| 5 | **Telematics /TMS** | Telematics is technology that combines telecommunications and global positioning system (GPS) information (i.e., time and location) to monitor driver and vehicle performance from the central authority or dispatching unit. Truck fleets can improve operational efficiency, boost driver safety, and reduce high-cost vehicle repairs by implementing these communication systems. Telematics is often combined with boarder Transport Management Systems (TMS). |
| 6 | **Logistics centres and warehouses** | **Energy efficiency measures**. Examples are renewal of equipment for material handling and yard logistics, LED lights, smart-sensors, high frequency battery chargers and lithium batteries, and thermal insulation. Additionally, to increase storage density by improving pallet stacking, automated systems and use of small(er) shuttles and redesign of roll cages. |
| 7 | **Rail Technology** | • **The promotion of cleaner rail technologies** will ensure that climate and energy benefits are not offset by an increase in local pollutant emissions. 2 different strategies are prescribed:<br>• **Setting emission standards for diesel powered locomotives**. By setting world class standards for locomotive design and manufacturing, rail operators can gradually transition to a lesser polluting diesel locomotive fleet over time.<br>• **Electrification of locomotives** is an alternative to decarbonise rail freight but only in the long run. Powering locomotives with electric engines presents significant challenges particularly the high uncertainty that surrounds future trends and how this technology will evolve. India's Dedicated Freight Corridor (DFC) project covering a total distance of 2,843 km on 2 corridors – Eastern DFC (Ludhiana to Dankuni) and Western DFC (Dadri to JNPT) are designed for carrying single-stack containers on the Eastern DFC and double-stack containers on the Western DFC. The containers will be driven by electric locomotives on the Eastern DFC and diesel locomotives on the Western DFC. The maximum speed of the locomotives will be 100km/h. |

## 7.5 Fleets and assets use lowest emissions energy sources.

By using cleaner low carbon fuels and renewable energy air pollution impacts can be mitigated. It is important to combine this with fuel management practices. Solutions like biofuel, hydrogen and electrification that ideally use renewable sources can be explored.

Under this cluster of solutions, the focus is on reducing the carbon content of energy sources, while also considering air pollution impacts. By using cleaner low carbon fuels and renewable energy air pollution impacts can be mitigated. The four types of solutions available (See Table 6) are using cleaner and lower-carbon fuels, such as biofuels, blended fuels, hydrogen, and electrification that ideally use renewable energy. Here, it is critical that these solutions are combined with sound fuel management practices. Low emissions energy sources also apply to logistics sites and equipment used such as tempos, trucks, forklifts, cranes, reach stackers and conveyer technologies. When 'well-to-wheel' emissions are being considered for freight transport, a net zero-emission scenario will likely require off-setting of emissions too.

**Table 6: Solutions under GLF cluster titled "Fleets & assets use low emission energy sources"**

| No. | SOLUTIONS | DESCRIPTION |
|---|---|---|
| 1 | **Optimising Diesel systems** | New cleaner diesel system that includes an efficient engine and optimised combustion system with the most advanced fuel-injection, turbocharging and engine management strategies. Usually coupled with advanced emissions controls and after-treatment technologies, including particulate filters and selective catalytic reduction (SCR) systems, all running on ultra-low sulphur diesel fuel. |
| 2 | **CNG/LNG** | By using positive ignition systems, medium and heavy-duty compression-ignition engines can be designed to run solely on methane, in form of compressed natural gas (CNG) for larger vehicles or liquefied natural gas (LNG) for smaller trucks. |
| | **Biofuels** | A range of biofuel options (biodiesel, HVO and biomethane) has the potential to partially replace petroleum product consumption in heavy-duty road transport, ocean vessels and barges, and airplanes. |
| | **Hydrogen** | Trucks using fuel cells and hydrogen are essentially electric vehicles using hydrogen stored in a pressurised tank and equipped with a fuel cell for on-board power generation |
| | **Electric/ hybrids** | Parallel hydraulic hybridisation may be the most cost□effective near□term technology option for municipal utility vehicles, while electric hybridisation tends to be the best hybridisation option for most other mission profiles. Electric road systems (ERS) consist of infrastructure (e.g. catenary) which supplies electrical energy to trucks while they move. Trucks maintain their operational flexibility as they can operate outside the ETS with a hybrid drive train or by having enough battery. |
| 3 | **De-speeding** | By easing lead times and delivery stipulations by logistics companies reduces pressure on drivers because of which emissions can be reduced through de-speeding. Reducing road vehicle speeds is an effective, relatively easy means to reduce vehicular emissions with a small impact on operations compared to load fill improvement strategies. |

| No. | SOLUTIONS | DESCRIPTION |
|---|---|---|
| 4 | **Green Buildings and Warehouses** | Improving new building specifications and taking incremental improvements to old facilities can reduce energy usage by<br>• Raising awareness of staff in saving electricity inside buildings for lighting, temperature control and ventilation<br>• Implementing more efficient technologies such as for lighting and cooling systems that reduce overall energy consumption<br>• Local energy sourcing and tapping of renewable energy sources such as on-site wind turbine or solar panels. E.g. the roof of the warehouses could be used to produce renewable energy. Equipment used in logistics sites and warehouses can use renewable energy or electricity. |

In designing a decarbonization strategy for any Company, each solution's challenges, opportunities and influence on other selected solutions needs to be thoroughly investigated to arrive at the right mix of solutions for implementation. While it is difficult to know whether all Companies are following the necessary analytical rigor in selecting green solutions, the next section indicates that some Companies like Shell Energy and Tata Group have undergone rigorous policy and planning reviews at the highest levels to determine the mix of green solutions, strategies, business models and investments in the short medium and long term towards decarbonization as well as sustaining their businesses.

8

# Greening Solutions adopted by Companies

This section delves into identifying the strategies, solutions and initiatives taken by the largest and most influential companies in India and abroad towards greening their logistical chains. The selection of Companies was done from a google search of the top 5 companies in FMCG, Manufacturing, Transport and Logistics and Energy sectors. Subsequently, each of the top ten company websites were reviewed to extract information on any green logistics and sustainability initiatives taken up and highlighted by that company on their websites. If available, each such company's published reports namely, the last two years' Annual Reports and Sustainability Reports were thoroughly reviewed to extract details of the implemented and planned greening strategies as well as their impacts which were systematically documented in this section of the report.

## 8.1 Companies in FMCG Sector

Indian and multinational companies active in Fast Moving Consumer Goods (FMCG) sector have mostly focussed on measures such as reducing weight and materials usage which benefit in lowering their packaging costs. These measures have enabled material innovation upstream at substrate producers such as resin producers. These moves have favoured substitution of rigid packaging formats with use of flexible packaging and pouches. In recent years, all the top 100 FMCG companies globally have made bold commitments to drive sustainability focussed on 3 areas of activity:

- Emphasize recycling / recycled content
  - Increase recyclability upto 100%
  - Incorporate high degree of recycled content in the packaging
- Reduce total packaging use
  - Eliminate packaging completely on some items

- Reduce packaging weight by 20-50%
- Eliminate single use bags, wherever possible

- Innovate and promote system level changes
  - Incentivize customers to use recyclable options
  - Partner with suppliers to reduce consumption and increase substitutes
  - Innovate and partner with environment advocacy and engineering groups

There seems a higher degree of focus on reducing packaging use by FMCG Companies accounting for 60% of commitments followed by reduction in plastics usage (26%) and (14%) Companies investing in adoption of innovations around use of packaging. Many FMCG manufacturers and retailers are beginning to self-regulate with complete packaging redesigns and a fundamental rethinking of their delivery chains to reduce plastic waste by experimenting with use of metal and glass in returnable systems. Following are some of the solutions voluntarily taken up by prominent FMCG Companies:

Marico[1] Pvt. Ltd. is one of the largest FMCG companies in India. With GST regulations coming into force in India, Marico restructured its supply chains and reduced the number of warehouses and depots from 32 to 20 for distribution of their products across the markets. In the process they could accrue small savings in logistics costs and have the freedom to restructure further based on total delivered costs. At the same time truck movement and warehouse automation is also being revolutionised.

Under Future Retail Ltd.'s product return policy, customers are encouraged to bring back old clothes and articles in exchange for promotional coupons. The returned items are either recycled or garments with minor defects are refurbished and sold at discounted rates to local communities.

The Colgate Palmolive India Pvt. Ltd. (CPIL) follows Reduce-Reuse-Recycle principle to cut down waste across the value chain. CPIL regularly evaluates the sustainability of its packaging materials and process and works towards using responsibly sourced materials throughout its lifecycle. Using recyclable packaging material, keeping separate bins for dry and wet waste are some of the measures continuously reviewed by the company. Plastic waste generated filling and packaging of products is sent to waste handling / recycling agencies and with the state pollution control board's approval in the most environmentally friendly manner. Expired products are handled by authorised agencies which send the goods to a safe disposal method as per the statutory regulatory guidelines and requirements. (Bains et al. 2018)

Many large Indian Companies have adopted innovative initiatives to reduce packaging materials. To reduce packaging material in soap wrappers, Godrej Consumer Products Ltd. reduced thickness of PET from 10 to 8 microns which resulted in savings of 130 tons of PET per year. Similarly, by reducing Hot Melt Adhesive (HMA) thickness from 15 to 10 gsm, the yield has improved by 6% and reduced 276 tons of HMA per year. In liquid products using PET bottles, 1 gsm reduction has reduced annual PET consumption by 180 tons. The company has also used cutting edge technologies to optimize packaging materials. Wrapper consumption in soaps has been continuously reduced by 20% since last decade. It has reduced flaps from its Active+ detergent cartons that has saved 80 tons of duplex board. Also, by redesigning packaging material 27 tons of duplex board is reduced. The laminate structure of company's product "Expert Hair Powder" of 3g sachet has resulted in a material reduction of 17% over the previous packaging. Other measures include the replacement of corrugated boxes with plastic crates for local material movement (from supplier to manufacturing units). This has allowed to bring down waste boxes generated during material

1 https://www.thehindubusinessline.com/money-and-banking/gst-helped-us-restructure-our-supply-chain-marico-cfo/article24731723.ece

movement. Plastic crates are easier to handle and has lesser damage risk.

Consumers' purchase choices strongly influence the structure and dynamics of product supply chains. Therefore, changing their purchasing habits towards recycling, re-use, refurbishment, remanufacturing and recycling is dependent on supply chain transparency and its communication to the consumer. Just Eat have pre-ticked boxes on its app and website to encourage customers to opt out of plastic cutlery, straws, etc. The company hopes that through such 'nudges' customers will opt out of excess plastics.

Pepsico Foundation has focused on reverse logistics solutions to reduce waste after consumption of their products. It is funding to improve curbside recycling by supporting recycling education and operational programs that will increase collection of recyclables in the US. It is estimated that 7 billion bottles and cans will be recycled in next 5 years that will capture 1.9 million tonnes of recyclable material[2].

ITC Ltd. company is promoting energy efficient practices as well as adopting activities to conserve energy. All luxury hotels and buildings (23 in total) of the company are LEED Platinum certified.

Towards energy conservation, all the GlaxoSmithKline (GSK) sites have increased agri-waste biomass blending with coal for steam generation resulting in approx. 51,000 tons of CO2 emissions. More than 12 energy conservation measures have been deployed that have contributed to energy conservation. Some of them are:

- Installation of 441KW rooftop solar plant for renewable energy
- High speed doors to avoid air conditioning losses
- 1800KVA backup power supply replacement with energy efficient system
- Energy efficient fans in air-conditioning systems
- Sun pipe in finished goods warehouse for daylight use
- Installation of LED lighting in place of conventional lighting at all sites
- Boiler efficiency improvements

Towards supply chain effectiveness the jewellery division of Titan Company Ltd. was able to enhance by implementing a software tool that optimised inventory, capacity utilization and response times to retail demand. Information Technology was also leveraged to enhance its responsiveness to competitive activities by quick turnaround of schemes and dynamic pricing of platinum products.

2 https://www.sustainability.com/thinking/engaging-consumers-to-reduce-and-recycle/

## 8.2 Companies in Transport and Logistics Sector

The Transport and logistics industry is a major and direct contributor to employment and national GDP. The efficient mobility of goods and services is a vital enabler of environmental sustainability, social and economic development. Freight Transport plays a key role in making raw materials accessible to industry, as well as products and services accessible to the population. Sustainable transport and logistics are not represented as a standalone SDG in the 2030 Agenda. It is mainstreamed in a direct manner into many of the proposed SDGs. Transport and Logistics services are essential to achieve most if not all SDGs.

Transport and Logistics companies are also voluntarily taking up initiatives to not just reduce their environmental impacts but also sharing their knowledge and knowhow with customers to de-materialise, redesign and restructure customers' supply chains to mitigate carbon emissions collaboratively. Similarly, some transport service providers like passenger airlines and rail service operator are focusing on reducing waste from catering services offered through measures such as frugal packaging, reuse and recycle measures. Besides, transport companies are testing new vehicle technologies that reduce their carbon footprint. Innovative eco-friendly vehicle technologies and designs are steadily entering vehicular fleets. Renewable cheap energy sources to power their vehicles are being explored and gradually adopted in their operations. While such efforts have only recently commenced (i.e. since a couple of years), the mass adoption will depend on such environmentally friendly vehicle technologies maturing and price points coming in par with existing fossil fuel-powered vehicles in terms of pricing, availability and performance. The following sub-sections illustrate the efforts of Indian businesses to improve and consolidate measures taken voluntarily that contribute to achieving SDGs.

DHL implemented a number of solutions across the different clusters to reduce their carbon footprint. In order to restructure their customers' supply chains, it supports its customers in analysing their entire supply chains and reorganise their supply chain solutions such as designs for multimodal networks alongwith an analysis of cost savings and environmental benefits (DHL 2019).

Towards fostering de-materialisation, DHL has taken many initiatives to support its customers to reduce parcel sizes, number of shipments, packaging and consequently reduce transport costs and wastage to landfills. In one of its initiatives, DHL collaborated with a UK based airline to design innovative in-flight catering to minimize waste to landfill. The team benchmarked waste rates and came up with a plan to install food dryers that reduced the volume of food by 70%. Zero waste to landfill was achieved alongside 70% reduction in food waste transport costs, a significant added value from recovered waste, substantial recycling revenue and eliminated landfill charges. DHL implemented a packaging solution to reduce empty space in each parcel for a US based customer. The solution implemented allowed the site's complex cartonization system to select a right sized box on demand for shipments of cases of product, increasing fill percentage and reducing overall number of shipments. As a result, the cases packed per outbound parcel increased and inbox volumes decreased to less than 10%. The density

of trailers increased 19% reducing outbound trucks needed for fulfilling deliveries.

DHL supported a customer in the retail sector to reduce carbon emissions in its transport operations between suppliers and Distribution Centres in the UK. The teardrop trailer was chosen as the green solution to fulfil requirements in terms of reducing fuel usage and carbon emissions, as well as allowing the customer to carry more stock per trailer, cutting the number of journeys they need to make. The unique aerodynamic shape of these trailers generates fuel savings of approx. 10% and a 10% increase in cubic capacity (Cube Optimization). DHL deployed 399 aerodynamically optimized teardrop trailer trucks that reduce customer's carbon footprint by more than 2,000 tonnes every year.

Towards achieving synchro-modality, DHL is already using 13,532 vehicles with alternative drive systems including 11,610 electric vehicles. The company is also testing plug-in hybrids for short trips and fuel cell vehicles and vehicles powered by biodiesel over longer distances. In Germany electric trucks up to 7.5 tons in Germany and 3 heavy duty trucks (12tons) in Netherlands.

Over 500 DHL operated trucks and trailers are fitted with 2mm thick photovoltaic solar mats that power electronics onboard trucks. This saves upto 4.5 tons of carbon emissions per vehicle per year and reduces fuel consumption by upto 5%. The company frequently upgrade conventional vehicles in accordance with latest emission standards. By optimizing pick-up and delivery routes, to minimize the impact of air quality in urban areas, 80% of their vehicles are compliant with Euro 5 & 6 standards or entirely emission free.

Air France and KLM took efforts to minimize waste from in-flight service. It has implemented rigorous recycling and integrated eco-design approaches for key onboard items. For example, textiles (e.g., used uniforms, carpets, etc.) are recycled into fibres used to manufacture new carpets for cabins and insulation materials for cars. Plastics are mostly reused in the production of new materials such as serving trays and drawers. Non-recycled items such as food waste are recovered to produce energy.

Virgin Train Railway Company introduced local drinks on all trains and introduced sustainable menu options to First Class guests (i.e. locally sourced food, free-range poultry, outdoor reared meat, and sustainable fish stock). The company also requested that food suppliers on all its trains agree on a series of sustainability practices (i.e., locally sourced food, free-range poultry, outdoor reared meat, and sustainable fish stock). The company also requested that food suppliers on all its trains agree on a series of sustainability incentives including reduction of energy consumption, packaging waste reduction, recyclable on-board packaging, and offering of healthy, seasonal products.(Hastings et al. 2016)

## 8.3 Companies in Heavy Industry

Heavy industry is an industry that involves one or more characteristics namely, large and heavy products, equipment and facilities or even complex and numerous processes. It includes heavy equipment, large machine tools, huge buildings and large-scale infrastructure. The biggest opportunities for the heavy industry to create a shared value i.e., coming together of market potential, societal demands and policy action towards achieving sustainable goals.

Amongst the Indian companies in this sector, there have been some voluntary efforts to reduce overall emissions. Most companies have yet to take solutions that make a sizable difference to their emission outputs especially because environmental regulations in India are laxer than in developed countries. However, few companies have taken incremental steps towards de-materialisation in their production and manufacturing processes. Even so, considering their large size of operations, this could lead to sizable environmental impacts.

Bharat Heavy Electricals Ltd. has an institutionalised mechanism to recycle products and wastes generated at source. The general practice adopted in use of steel plates are:

- Computerised nesting plan of each steel plate to adjust maximum number of jobs in a plate.
- Preservation and reuse of off-cuts generated after nesting and using them for cutting out smaller jobs, such as strong lifting lugs and tackles.

By sourcing through e-procurement Ultratech Cement Ltd., one of India's largest cement manufacturing Company, could make sourcing processes more transparent and efficient by making communications with vendors more effective resulting in significant reduction in paperwork as well as travel hours.

Through modal shift of freight flows to greener transport modes like rail and shipping from presently road transport, MOCI's Logistics Policy aims to balance the modal mix across the country. Indian Railway's flagship projects - East and West Dedicated Freight Corridor (DFC) in India are expected to catalyse a paradigm shift from road to rail transport in India's freight transport scenario once commissioned. They will create dedicated rail freight infrastructure and capacity for fast and smooth movement of large freight volumes along the north south corridors of the Indian subcontinent. Besides rail infrastructure capacity augmentation, several changes are envisaged in the rail sector such as modernization, operational changes and organisational reforms to make rail freight once again a preferred transport mode for low and medium value freight transport market segment over 1500 km distances. Amongst the initiatives undertaken by Indian Railways (IR), the Vyapar Mala rails and Kisan rail aim to provide first and last mile connectivity. Under the participative models for rail connectivity, Mundra port rail, Kutch rail, Pipavav Port Rail connectivity projects have been undertaken which has increased the bulk freight volumes transported on rail. Further, to enhance container share, IR allowed public and private players to obtain licences for operation of container trains since 2006. In addition, IR has taken significant number of schemes to attract private investments such as Wagon Leasing, Automobile Freight Operator, General Purpose Wagon Investment schemes. Similarly, IR has been promoting private freight terminals, rail sidings, multimodal logistics parks along the alignment of DFCs which can be a potential area of investment by the private sector[3].

3 http://ficci.in/spdocument/23423/Indian-railway.pdf

By providing targeted and customised interventions IR plans to make rail competitive vis-à-vis road transport. During the nationwide lockdown, Indian Railways played a key role to address the supply chain challenges by transporting essential goods including food grain across the country. Between March – April 2020 more than 788,000 wagons transported essentials such as food grain, salt, sugar, milk, edible oils, onions, fruits, vegetables, petrol products and coal to keep supply chains functional. In this period, IR also upscaled goods transport using roll-on roll-off (Ro-Ro) facility to carry loaded trucks on goods trains.

## 8.4 Companies in Auto Sector

The automotive industry comprises a wide range of companies and organisations involved in the design, development, manufacturing, marketing and selling of motor vehicles. It is one of the world's largest industries by revenue. The automotive industry strongly affects economic development requiring rethinking of business models to reduce their impact on environment. Websites of major automotive companies report sustainability through different solutions and present various practices implementing organisational sustainability through collaborative efforts with their suppliers and customers across their complex value chains. Another area that they are actively focusing are in optimizing manufacturing design and operational processes to reduce material wastage. While these initiatives reap significant financial and material savings to the Companies, de-materialisation and industrial waste reduction measures cumulatively benefit in achieving sustainability goals once scaled and adopted across this industry.

GE Aviation have 3D printed non-critical aviation parts and wants to increase it to 10,000 additive parts by 2020[4]. 3D printing is a process which uses a three-dimensional digital model to create a physical object by adding many layers of material in succession thereby reducing cost by cutting out waste. It has a massive impact on supply chain because it decentralises production, drives product customization, reduces time to market and rationalises inventory and logistics. Airbus is already planning to construct entire airplanes with large scale 3D printers. 3D printing is widely used in professional individualised healthcare to improve patient experience and service quality. NextDent company's Laser scanners create a 3D model of a person's teeth and calculate an adequate model of a dental crown[5]. The printers produce them in resin ensuring accurate aesthetic and functional fit for the patient. Ford has been using 3D printing since 1980s for auto parts manufacturing which result in substantial savings in time and money.

Michelin, in collaboration with UPS, Route Monkey, Total and Nestle, has developed a Road Freight Lab. The Lab explores the untapped and unmapped potential for emissions reduction through optimization and collaboration between road freight transport companies. In the first phase, the Lab aims to design an information and technology platform that enables small and medium-sized enterprises to share data and assets in order to increase asset efficiency and usage. In the second phase, the Lab will bring together companies, government and customers in two locations to demonstrate the developed inter- and intra-city road freight solutions. This collaboration also aims to raise awareness among policy-makers of the potential of these solutions.

BMW helped its supplies to record, monitor and analyse their resource consumption and identify areas of improvement. This is helping to increase transparency of its suppliers' performance against the commitments that have made in agreements with BMW. For example, 78% of BMW's suppliers improved their disclosures compared to previous years.

Hero MotoCorp Ltd. believes in environmental protection as one of its core values. In collaboration with Confederation of Indian Industry (CII) this Company came up with "Green SCM" Initiative which targets suppliers and dealers through Green Partner Development Program (GPDP). In this it has engaged 186 suppliers for last 13 years to de-risk supply chain by knowledge sharing and expanding environmental practices among partners. (Sapti 2020)

Scania provides training to its drivers across multiple markets and the improved driving techniques can raise fuel-efficiency levels by about 10%, save costs, reduce emissions, cut wear and tear on tires and parts, and help the

4 https://www.mainepointe.com/practical-insights/five-ways-3d-printing-will-impact-the-global-supply-chain
5 https://www.dhl.com/content/dam/downloads/g0/about_us/logistics_insights/dhl_trendreport_3dprinting.pdf

powertrain consume less lubricating oil. In the new product and farm divisions, the Company reduced nearly 47% of CO2 emissions and 32% energy consumption by installing solar power plant and developing green building, windmill, biogas and energy efficient projects at their Igatpuri plant.

DOT is a cutting-edge delivery enterprise start-up in Gurugram offering innovative mobility solutions through its fleet of e-cargo vans and e-bikes for the first and last mile delivery solutions to the e-commerce and food tech sectors in the B2B segment in Indian cities. The company was started in 2015 and is catering in over 30 Indian cities. Their clients have a long-term contract based on volume and weight hauled. Clients are offered wet-leased EV fleet for their last mile delivery fulfilment. Their technology platforms are integrated[6] allowing staff and rostering and enabling delivery fulfilment accordingly.

Airbus is supporting the development of sustainable fuels made from biomass feedstock that, through their lifecycle, emit less CO2 than conventional fossil fuels(Hastings et al. 2016). The Group has been working with universities, farmers, airlines, refineries and standard-setting organizations – to act as an agent of change, helping to develop value chains that produce 'drop-in' sustainable fuels that today's aircraft can burn without modification. Airbus aims to be a catalyst, sparking the search for production of affordable sustainable fuels, in sufficient commercial quantities to help the aviation industry reach its goals for minimizing greenhouse gas emissions. Airbus currently has development partnerships in place in Spain, Qatar, Brazil, Australia, Malaysia and China.

In 2014, Jaguar Land Rover opened a new Engine Manufacturing Centre in the UK with a roof-mounted solar array which at the time of construction was the largest privately owned array in Britain (Hastings et al. 2016). The building has 22,622 panels (6.2MWp) which are designed to supply 30% of the site's energy needs (equivalent to the energy required to power 1,600 homes), thereby reducing the plant's CO2 footprint by over 2,400 tonnes per year. Jaguar Land Rover is planning to invest £36 million over the three years to 2017 in improving energy performance through an integrated approach of efficiency, process change and renewable energy.

6 http://bwdisrupt.businessworld.in/article/DOT-This-Green-logistic-Startup-Is-Transforming-Last-mile-Delivery-/27-12-2019-181217/

## 8.5 Companies in Energy Sector

Companies in the Energy sector are in the business of production and supply of energy. It covers companies that explore, produce, refine, market, store and transport oil and gas, coal and other consumable fuels. This sector is subject to risks in changing environmental policies which leads to a trend in investing in renewable resources. In recent years a number of frameworks were created to evaluate energy companies' alignment to the SDGs and to help companies improve performance and decision-making. While such initiatives are a step in the right direction, to date, many of these tools fail to account holistically for the ways that energy sector conduct could impact sustainable development. This failing has allowed companies to "cherry pick" their reporting criteria while ignoring less convenient SDGs. Further the lack of consensus around standards and evaluation metrics for SDG aligned practice has led to broadly different conclusions about the companys' conduct and the evaluation frameworks altogether.

From the cases listed below, it seems that GAIL (India) has taken incremental steps in using renewable energy sources and conserve energy through better designs of their buildings. Similarly, Shell Energy has drawn out a long-term ambitious strategy to become a net-zero emissions company by 2050. From their published reports, it is evident that Shell Energy will be investing in building renewable energy infrastructure and developing business models around these services. Below, the solutions and strategies adopted by these two companies will be discussed in further detail:

GAIL (India) Ltd., a natural gas distribution major in India is following initiatives towards using renewable energy sources:

- At Pata, solar PV rooftop of 5.76 MWp has been installed which will generate 8 million units of captive generation resulting in saving of GHG emissions equivalent to 1,350 passenger vehicles
- Energy requirement of all pipeline stations are met with solar power sources instead of conventional grid power
- A design for energy efficient building has been developed which are in line with GRIHA norms for green buildings. These designs will be used for building control room buildings in pipeline stations.

During the second half of 2020, Shell Energy conducted consultations to investigate how the road freight sector and its business could accelerate decarbonization (Perspectives 2021). In line with Shell's ambitions of becoming a net-zero emissions energy company by 2050, they devised business plans to do so. Following are the key actions Shell is taking to decarbonise road freight in collaboration with its suppliers and customers:

### Increase the production and availability of hydrogen

Shell is investing in the production of green hydrogen to help decarbonise many sectors. This includes building one of the world's largest hydrogen electrolysers of its kind in Germany (10 MW), plans for a second in China (20 MW) and another proposed project the Netherlands (200 MW) that aims to produce enough green hydrogen to fuel approximately 2,300 hydrogen trucks per day by 2023.

Shell will work with truck manufacturers, fleet companies and governments to coordinate hydrogen infrastructure investments along high-traffic freight corridors. They will double their current network of 50 hydrogen refuelling stations for light-duty vehicles and have started to build the infrastructure to meet the specific high-capacity refuelling needs of heavy- and medium-duty vehicles. For their heavy-duty hydrogen truck pilot with Toyota and Kenworth project, Shell is installing three new large-capacity hydrogen refuelling stations between the Port of

Los Angeles and a major warehouse district in California, USA.

In collaboration with Daimler, Iveco, OMV and Volvo, it will focus on the large-scale rollout of hydrogen trucking infrastructure across Europe over the next 10 years.

### Expand electric charging infrastructure and services

Shell offers truck drivers access to more than 200,000 electric vehicle (EV) charging facilities in more than 30 countries. They plan to expand their charging facilities to support the growing fleets of battery electric light- and medium-duty road vehicles. They will invest in Shell Recharge, our retail site EV charging offer, as well as in two Shell Group companies –NewMotion and Greenlots – which provide a range of electric charging solutions to fleets and consumers.

### Provide low carbon fuels to reduce emissions

Shell is the global marketer and trader of low-carbon fuels for road transport, including liquified natural gas (LNG), BioLNG and biofuels. Their investments include:

Developing a European LNG road network with their BioLNG EuroNet partners, and increasing our LNG stations from nearly 30 to 80 by the end of 2022; Constructing the first Dutch BioLNG production facility with consortium partners, Nordsol and Renewi;

Producing their first waste-derived Compressed Natural Gas fuelling site for their haulier partners at our Carson facility in California, USA; Developing IH² advanced biofuels technology in India to produce cost-effective transport fuels from biogenic and waste feedstock.

### Advance a decarbonisation policy framework with industry partners

Shell shall collaborate to advance a sectoral policy framework that includes:

Clear $CO_2$ emission performance standards and time-bound net-zero emission targets; Support of low- and zero-emission fuels through fuel regulations, product and distribution infrastructure investments, and incentives to purchase new vehicles;

Appropriate use of high-quality carbon offsets and trading; and, Taxation of energy products and electricity that is aligned with zero-emission targets.

### Decarbonise Shell's contracted road freight fleet of HGVs

By 2025, Shell aims to deliver an average emissions intensity reduction of 10% across our fleet compared to 2018. By 2030, we aim to deliver an average emissions intensity reduction of 30% compared to 2018. In line with Shell's broader climate ambitions, we aim to achieve net-zero emission operations of our fleet by 2050 or sooner.

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# Conclusions

**Under GIZ's Green Freight Project an important component is to improve the capacities for implementing measures for climate friendly and efficient freight traffic. The scope of this interim report is to compile good practices on improvement of logistical inefficiencies in India and abroad, particularly on greening logistics for sustainability and environmental protection. Green Logistics is defined as the alignment and integration of environmental management within supply chain management. It is based on the premise that any Company's environmental impact extends well beyond its influence boundaries.**

Different parts of Indian logistics value chains are managed, governed and/or regulated by many ministries which are not necessarily in sync with each other. The Draft Logistics policy published in February 2019 by MOCI highlights the importance of creating a seamless, effective and efficient logistics ecosystem to drive the "Make in India" initiative and reduce economic disparities across geographies. Therefore, the policy seeks to create an integrated approach and coordinated oversight to the entire logistics value chain in India. In doing so, one of its key objectives is to encourage adoption of green logistics in the country. The policy recognises that promoting green and sustainable logistics is crucial for the sustainability of this sector and therefore identifies key areas for intervention such as modal shift to rail, improving vehicle utilization, switching to greener fuels, etc.

Green Logistics solutions, unlike Green Freight solutions, encompasses aspects much beyond freight transport and warehousing. It includes product design, all stages of manufacturing and distribution and all aspects of reverse logistics. Physical distribution is only one component in a much broadly defined system. As awareness of environmental degradation

and sustainability issues enhance amongst end consumers and global population in the 21st century, Companies around the world are keen to promote their green credentials through the management of logistics. As stringent laws and regulations do not presently exist in India, only few Companies are voluntarily adopting logistics greening solutions and that too incrementally. In the process, these Companies have begun realising the benefits flowing from greening logistics in their business interests.

From a review of literature, the complex interdependencies between logistics activities and its related environmental effects and costs from logistics activities are mapped in a systems model which offers a holistic framework for identifying opportunities for greening logistics across its full value chain. This model helps develop a common framework for businesses, government and other stakeholders to plan and strategize, individual stakeholders as well as collaboratively, towards decarbonising logistics. The model also indicates the key parameters and determinants useful in zeroing on solutions, their impacts and monitoring progress through selection of key performance indicators in the logistics eco-system.

Besides, solutions that lead to emission reductions in logistics, there are other measures that also need to be taken to help achieve emission targets. With the forecasted growth in transport sector, it may be difficult to solely fund emission reduction strategies like vehicle electrification on the scale required. Therefore, a more holistic approach is necessary exploring different solution pathways and areas are combined towards the emissions-reduction goals while minimising the investments required to reach them. All such solutions have been compiled and categorised in intuitive frameworks to help managers and policy makers conceptualise the various options and formulate coherent strategies in their jurisdictions. There are 3 frameworks developed for Green Logistics - Kaya Initiative, Avoid-Shift-Improve-Fuel (A-S-I-F) and Green Logistics Frameworks. The latter classifies all available solution pathways into five distinct strategies as follows:

1. Freight demand growth is managed
2. Transport modes are smartly used and combined
3. Fleets and assets are shared and exploited
4. Fleets and assets are energy efficient
5. Fleets and assets use lowest energy sources

To understand the sustainability pathways planned and/or adopted by different Companies in India and Abroad, top few companies from each of the five prominent industrial sectors were identified subject to availability of relevant details on greening measures adopted from their published reports and websites. The five sectors selected were FMCG, Transport and Logistics, Automobile, Heavy Industry and Energy industry. From the cases investigated and documented in this report, it seems that all industry champions have recently begun investing in bringing efficiencies in their work processes towards de-materialisation through optimization on material use, recycling and packaging innovations. Besides, some companies are also focusing on energy efficiency solutions and renewable energy transition to reduce their utility bills and over-dependence on fossil fuel and conventional grid power. Also evident is that large companies like DHL are developing collaborative partnerships with their suppliers and customers to jointly examine, monitor, plan and incrementally reduce carbon footprint from their activities through their supply chains. Different companies are in different stages of planning and adopting green logistics solutions. With no regulations mandating green interventions in India, few Companies are taking up de-carbonization strategies on voluntary basis and also documenting the same on their websites and reports. With better awareness programs to educate consumers coupled with appropriate policy incentives and disincentives, companies in the different industry sectors will be coerced into adopting greening of logistics eventually leading to achievement of the carbon emissions target commitments.

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