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# Industry pathways to net zero

## Decarbonisation in transport

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**We would like to thank the Carbon Trust as a trusted advisor in the analysis and modelling for this research.**

**Carbon Trust**
Established in 2001, the Carbon Trust works with businesses, governments and institutions around the world, helping them contribute to, and benefit from, a more sustainable future through carbon reduction, resource efficiency strategies, and commercialising low carbon businesses, systems and technologies.

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# 1. Sector context and overall sustainability strategy

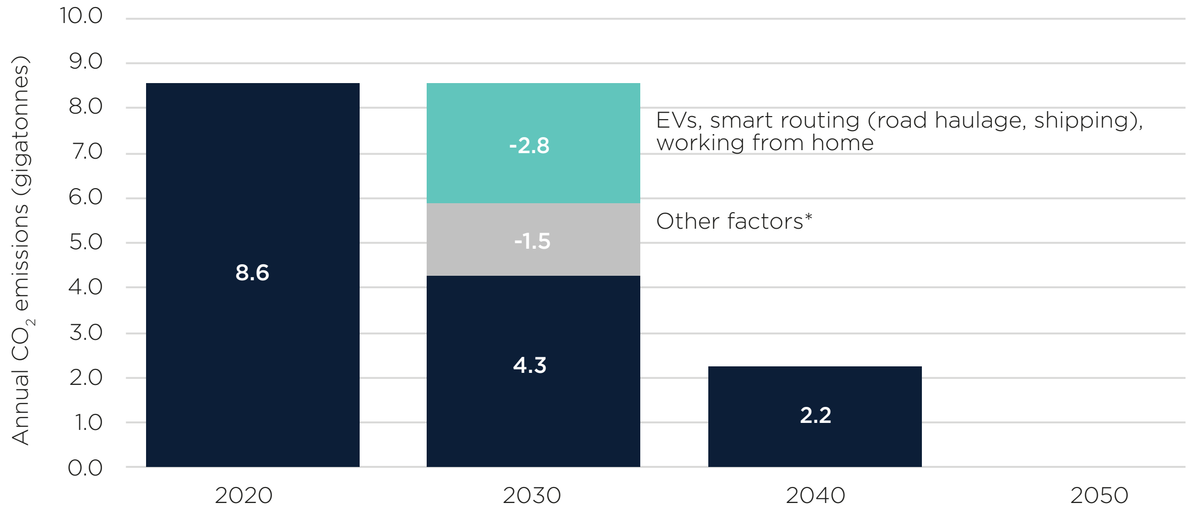
Transport comprises sub-sectors such as private passenger cars, commercial logistics, shipping, aviation, rail networks and public transport. In all, it accounts for around 16% of global $CO_2$ emissions, equivalent to 8.6 gigatonnes (Gt) in 2020. As with manufacturing, transport activity is directly correlated with economic growth and population movement. This has driven the emissions trend steadily upwards over the last 10–15 years in high-growth economies, notably the BRICs (Brazil, Russia, India and China), as well as other countries in Asia (Vietnam, Pakistan and Indonesia) and parts of Africa. This will continue to be the case without changes in terms of technology use, behaviours, cleaner fuels and regulation to encourage decarbonisation.

Achieving 50% reductions in emissions in each of the next three decades to reach net zero by 2050 means removing 4.3 Gt of $CO_2$ from total annual transport-related emissions over the next 10 years. We estimate that 2.8 Gt, or 65% of the total reductions for the sector, can come from mobile and digital technology. The remaining 1.5 Gt will rely on other changes, such as people travelling less (see Figure 1).

As for all the other sectors in our analysis, the 2020s are the most challenging but also the most important in terms of building momentum. Commercial activity in favour of decarbonisation is growing, particularly in the automotive space where the rise of electric vehicles (EVs) represents a significant change in the carbon footprint of one of the highest contributors to greenhouse gases in the industrial age. However, this transition varies by region, with Europe the furthest ahead (aided by regulation).

Figure 1

## The transport sector's path to net zero




*Outlined below in *Decarbonisation drivers – non-digital*
Source: Exponential Roadmap, GSMA Intelligence

## A high-level quantification of $CO_2$ savings from the transport sector

Of the 4.3 Gt of $CO_2$ reductions needed in the transport sector over the period to 2030, we estimate that 2.8 Gt (65%) can be enabled by mobile and digital technology.

**The equivalent of...**

**49 million** cars in use per year

**47 million** roundtrip flights from New York to Beijing

**330 million** The annual energy use of 330 million homes

### *Decarbonisation drivers: digital*

Digital drivers include EV technology and optimised fuel and routing systems through telematics (including logistics and shipping), complemented by the shift from petrol and diesel to renewable fuels. The pandemic-induced shift in working patterns also has implications in terms of reduced commuting volumes and associated $CO_2$, particularly for passenger car journeys. For further details of the modelling assumptions, see Industry Pathways to Net Zero.

- **Electric vehicles: 24% contribution to sector $CO_2$ reductions** – Vehicles that run on battery charging from a network of charging points. This leads to a reduction in $CO_2$ emissions through the substitution of petrol- or diesel-based mileage. There is a minimal offset level from charging if electricity is drawn from non-renewable sources.

- **Optimised routing from telematics**
  - **Heavy goods vehicles (HGVs): 11% contribution** – The use of onboard connected telemetry sensors to optimise the route and speed of HGVs. $CO_2$ is saved by driving fewer miles and optimising consignment collections and deliveries.
  - **Commercial shipping: 21% contribution** – The use of onboard connected telemetry sensors to optimise the route and speed of commercial shipping vessels. Better planning and coordination with port authorities on arrival times to align with onward HGV shipments and reduce idling time are also part of this area.

- **Working from home: 9% contribution** – The overall effect on $CO_2$ emissions from a larger share of the labour force working at home as a result of Covid-era behavioural change. We include it as part of the technology drivers of decarbonisation because it depends on high-speed broadband connectivity at home – whether mobile, fixed or fixed wireless. An underlying assumption is that the temporary shift in working patterns during the pandemic becomes permanent for a portion of working hours. This is informed by survey evidence from McKinsey and is based on eligible workers having the capability to work from home, with access to devices and the internet (via LTE, 5G, fixed wireless or fixed broadband).[1] The reduction is driven by fewer journeys to offices or other workplaces, with a minimal offset from increased energy usage at home.

Aviation and rail transport were not part of the modelling for this analysis, so are not quantified here. While both verticals have potential for emissions reductions from technology, the majority depends on behavioural change (in particular, people flying fewer long-haul journeys), electrification and an increase in the share of cleaner fuels.

In aviation, this includes the use of sustainable aviation fuel (SAF) – an alternative to traditional jet fuel made from feedstocks such as non-palm oils and recyclable materials. Airbus and BP, among others, have prioritised this, as well as the potential use of hydrogen.[2] However, most SAF production is nascent and microscale. A radical improvement in the economics is needed to scale the supply to an extent that it can be used by the majority of aircraft manufacturers and carriers.

In rail transport, electrification and the shift away from diesel are the main goals from a carbon perspective. Beyond higher speed internet connectivity on-board, IoT and other telematics solutions are options here, though on a smaller scale given the point-to-point style of locomotion on tracks.

## *Decarbonisation drivers: non-digital*

Non-digital drivers influencing the $CO_2$ path in the transport sector will revolve around changes in how people live their lives and regulatory mandates.

- **Behavioural change** – This includes working from home (noted above), reduced reliance on cars (accruing fewer miles), the pace of transition to EVs, and people flying less, particularly on long-haul routes (this may be supported by new air duties to disincentivise high-frequency flying). In Europe, for example, 30% of car journeys are for distances of less than 3 kilometres,[3] so can often be substituted with walking, public transport, carpooling or bikes/scooters.
- **Phasing out of petrol and diesel** – Regulation is needed to phase out sales of petrol and diesel cars. Some countries are advanced in this (e.g. the UK has a mandate to eliminate the sale of new petrol and diesel cars by 2030), but many have yet to make meaningful moves.
- **Carbon pricing** – Regulatory models may also be required to craft a system of carbon pricing as a transition mechanism to disincentivise the use of fossil fuels in road, maritime or aviation transport.

As with fuel sourcing among rail and aviation companies, these regulatory considerations are part of the solution but are beyond the remit of this analysis.

1 What's next for remote work: An analysis of 2,000 tasks, 800 jobs, and nine countries, McKinsey Global Institute, 2020
2 "What is sustainable aviation fuel (SAF) and why is it important?", BP, July 2021
3 https://www.euro.who.int/en/health-topics/environment-and-health/Transport-and-health/data-and-statistics/physical-activity2

# 2. Digital technology impact

Table 1 provides illustrations of how different technologies can lead to reductions in energy usage and $CO_2$ emissions. As with the analysis published on **manufacturing** and **energy**, the use cases are mapped to the broad technology groups of IoT, cellular connectivity, and cloud and analytics.

Table 1

## How technology deployment flows through to energy savings

| Tech family | Product/service | Mechanism for $CO_2$ reductions |
|---|---|---|
| IoT | Sensors on EVs and EV charging points | Beyond the $CO_2$ savings from substituting fossil fuels for electricity, embedded sensors in EVs monitor fuel consumption and routing. Linked to a smartphone, they also allow car owners to manage and sell excess power back to the grid (vehicle-to-grid or V2G).<br>Charging point sensors provide location beacons for passing EVs, avoiding wasted emissions from searching for a charging point. Charging point sensors also feed into the mains electricity grid so excess power can be redistributed for onward use. |
| | IoT telematics | Telematics can be embedded in engine and/or navigation systems to optimise speed, fuel use and vehicle performance. Embedded telematics accounts for around 50% of GSMA Intelligence connected car IoT connection forecasts. Adoption is also growing in HGVs, commercial ships and rail. The $CO_2$ reduction comes from shorter distances travelled, and the smoothing of acceleration/deceleration patterns.<br>There is also a benefit in reducing idling times and the associated fuel wastage for ships and trucks at ports, to move to a just-in-time delivery model. The same is true for rail. |
| Cellular connectivity (LTE and 5G) | Private networks (or slices) | The most tangible application is in ports. Private networks – typically LTE networks that can be upgraded to 5G – are set to cover a local area. Low latencies enable sensor data to be sent to the cloud and analysed. Port KPIs are monitored on a central dashboard, including the geopositioning of ships and trucks, overall capacity levels and video surveillance (sometimes via drones). This reduces fuel emissions from idling and truck rolls for equipment repairs, and offers overall productivity gains. |
| | Autonomous mapping and navigation systems, including cross-border roaming (EVs, trucks and shipping) | This software works in tandem with IoT-based telematics. Emissions reductions come from shorter distances travelled per journey. Commercial freight vehicles can also platoon in convoys to reduce drag. |
| | Container logistics, including container port management and tracking | This is covered as part of the private networks use case above. |
| | Home connectivity (fibre, LTE, 5G and Wi-Fi) | A larger share of the labour force working at home is likely to lead to an overall reduction in $CO_2$ emissions through eliminating commuting journeys, particularly those that are car-based. Average commuting distances (one way) tend to be in the range of 10–20 km (UK/US = 18 km, Brazil = 12 km, China = 16 km). Home working is enabled by high-speed mobile (LTE or 5G) and fixed broadband access to support video calling and conferencing. |
| Cloud and analytics | Monitoring of driver behaviour (e.g. speed, braking) and providing recommendations | Telematics and mapping software can be processed in the cloud or at the edge (including in the vehicle) to provide routing recommendations to drivers as well as speed patterns. The emissions reductions depend on driver behavioural change to accept more direct routes and optimise speed patterns (such as eliminating needless over-acceleration). This can work alongside smart car insurance policies offering premiums that depend on the track record from the previous year. |
| | AI-driven predictive maintenance (rather than at set mileage milestones) | AI can be used to pre-empt car maintenance needs well in advance of them being required, reducing the incidence of roadside call-outs. This functionality can be built into SIM-connected navigation and infotainment systems (e.g. BMW Connected Drive, Audi Connect, GM OnStar) |

Note: use cases are non-exhaustive to illustrate how technology investments work in parallel with renewable energy to lower energy consumption and emissions. In some cases, there will be overlap in use cases between different technology families, such as in mapping and telematics.

**Source: GSMA Intelligence**

To help convey the practical benefits, below we expand on some of the use cases and provide examples of real-world deployments.

## *IoT*

IoT devices and modules are becoming ever-present in transport verticals. This analysis primarily focuses on EVs (including the ability to link cars and charging points with mains grids) and telematics.

**EVs and charging (V2G)**
EVs will represent the largest reduction in transport-related $CO_2$ emissions (1 Gt globally or approximately 24% of the reductions needed in the sector over the 10 years to 2030). This depends on the availability of charging points linked with EVs and the electricity grid through sensors and connectivity, either LTE or 5G.

- **Tesla**, the world's largest EV maker, has a network of 25,000 charging stations connected to the grid and accessible via a smartphone app. These have always been available to owners of Tesla vehicles. However, interoperability will be provided to owners of EVs from other car manufacturers including **Mercedes** and **Ford**, where Combined Charging System (CCS) ports are used.
- **Verizon** has entered into a strategic partnership with **Fermata Energy** in the US to extend its vehicle-to-everything (V2X) platform to EVs. Fermata has developed a bidirectional charging system that connects an EV battery to a household or business premises, or to the electricity grid such that energy can be consumed or sold back (if in excess). Verizon's platform is underpinned by its own 5G network and at the edge via **AWS** Wavelength.
- **BP** has developed a UK charging scheme called Pulse, which facilitates data transfer between EVs and charging stations in close proximity when the vehicle needs to be recharged, while also allowing vehicle owners to sell excess electricity to the grid.

**IoT telematics**
IoT-enabled telematics can be used in passenger vehicles, commercial freight and shipping. We estimate that around 50% of HGVs (30 million worldwide) are now equipped with telematics, which can result in fuel savings of 3–5% per year. The penetration is higher in shipping, with fuel savings in the order of 2–3%. While this may seem an insignificant share of fuel consumption, it has a major impact on overall emissions considering that an average ship emits around 350,000 kg of $CO_2$ per year. This is an average across all categories; as container ships vary in length from 900 to 1,200 feet, emissions can be higher or lower.

- **Maersk** has developed an IoT-based container ship with logistics management capabilities, using sensors installed on containers and other onboard equipment. The software allows the company to monitor fleet performance, including fuel efficiency, and optimise routing and port arrival times to align with open slots and onward truck deliveries.
- **Intel** has launched OpenVINO for use in vehicle telematics for logistics firms, particularly in asset management and fleet maintenance. The benefits flow from predictive maintenance algorithms that take vehicles off the road before requiring roadside assistance and extensive repairs (both of which entail costs and emissions).

## *Cellular network connectivity*

Cellular connectivity overlaps with IoT use cases including V2G and signalling from cars to road signage. The latter is part of the V2X category, which encompasses communications between connected cars and urban infrastructure such as traffic lights and road signage (for example, to alert drivers to an upcoming area of congestion). There is also scope for adoption of cellular network connectivity to support those working from home, using 5G fixed wireless access as an alternative to cable or fibre (this space is well known so we have not provided specific examples). However, the greater opportunity lies with private networks for enterprises, particularly port operators and transport hubs.

**Private networks**
The ability to have gated connectivity at a guaranteed quality of service (QoS) for a specific area or premises can improve productivity and reduce energy consumption. An example is in manufacturing plants that make transport vehicles – an indirect contribution covered in our manufacturing analysis. Ports are also adopting private networks for incoming and outgoing asset tracking.

- **Port of Oulu** is one of the leading port operators utilising private networks. It has run an LTE-based private network since 2018 using 2.6 GHz spectrum leased from a national mobile operator. Port of Oulu then sells capacity to nearby port operators, who also share in the cost of operations for joint use. It collects data from different sources such as cranes, security cameras and logistics assets, and then runs analytics in a centralised system. It can also monitor port operations using a 3D digital twin.
- **Edzcom** (now part of Cellnex) is extensively involved in deploying private networks for port groups in the Nordic region. It has partnered with the Port of Oulu as well as those in Kokkala and HaminaKotka. It leverages low-latency connectivity to raise productivity and reduce the carbon footprint of port operations by reducing idling time and optimising shipment timings.
- In the US, CBRS spectrum has garnered strong interest from transport entities including the **Port of Los Angeles** and **FedEx**. Allocations are yet to be confirmed, so interest remains speculative but this may well materialise in 2022/2023, particularly if Priority Access License (PAL) rights become available.

# 3. Go to market: opportunities and challenges

Transport groups, public authorities and transit hubs are generally among the most forward looking in terms of mobile and digital technology adoption. This is confirmed by our modelling, which estimates that 65% of the $CO_2$ reductions required by this industry over the next 10 years can come from technology. This is the highest of any industries we analysed. The challenges mainly reside in integrating technology through retrofits, with large fleets (whether trucks or ships) that have long lifespans. This can be time consuming, while a lack of clear proof points and return-on-investment prospects may deter would-be investors.

The opportunities are, however, evident and backed by market trends. The impending shift to EVs is fundamental to lowering carbon emissions and a sustainable model for automotive transport, particularly short-range journeys in cities. The charging networks to support EVs are nascent; we assume that only 2% of IoT connections as part of 'smart cities' – something that includes urban furniture, signage, road infrastructure, and bike and scooter docking stations – are EV charge points (equivalent to 7 million connections worldwide). However, a conservative estimate is that this could grow more than 15× by 2030 to 122 million connections. Operators have an opportunity with 5G and LTE V2X and V2G networks to support charging, road communication and sale of excess energy to the grid, effectively turning an average car owner into a prosumer.[4] Consumer automotive opportunities also extend to smart insurance and contracts that leverage SIM-based telematics data on driver performance.

Most of the enterprise contracts are likely to be won as joint bids rather than sole suppliers. This may involve, for example, operators working with a vendor and cloud provider in combination. Maersk's investment model is a good example of spreading digital investments across partners. It invests $1 billion per year in energy-efficient technology, directly and via its supply chain. The company has suggested that electric trucks can carry a maximum load of two containers over 800 kilometres on a single charge – better than diesel but still far below the efficiency of shipping, meaning improvement is required.

Embedded telematics or infotainment systems in connected cars and logistics fleets may also be paired with an onboard SIM that requires roaming agreements to be in place for cross-border travel. This could open the door to a model in which an operator becomes a 'global connectivity' provider for automotive companies, covering SIM-based telematics and mapping, EV chargeback, and roaming all in one deal – essentially a software-as-a-service (SaaS) approach.

The private network space is likely to grow in transit hubs (airports, train stations) and port authorities. This can be serviced by operators, equipment vendors or both. In some cases, a transport group may secure spectrum on its own. But even in this case, it would likely have contracts with an operator and/or vendor partners to build and potentially operate the network.

Investment sentiment for large-scale capital projects should start to recover in 2022 as pandemic economic restrictions ease. With proof points of existing deployments (such as from Port of Oulu and Edzcom) showing productivity and energy-efficiency gains, momentum should grow to large commerce centres outside Europe (notably in the US, China, South Korea, Japan and India), providing operators with opportunities to diversify revenues and monetise 5G in the enterprise segment over the long term.

> "With proof points of existing deployments showing productivity and energy-efficiency gains, momentum should grow."

4 Prosumers are consumers who take on an informal micro-entrepreneurial role as part of their lifestyle – in this case, selling energy from a car someone owns back to the grid operator or local energy provider.

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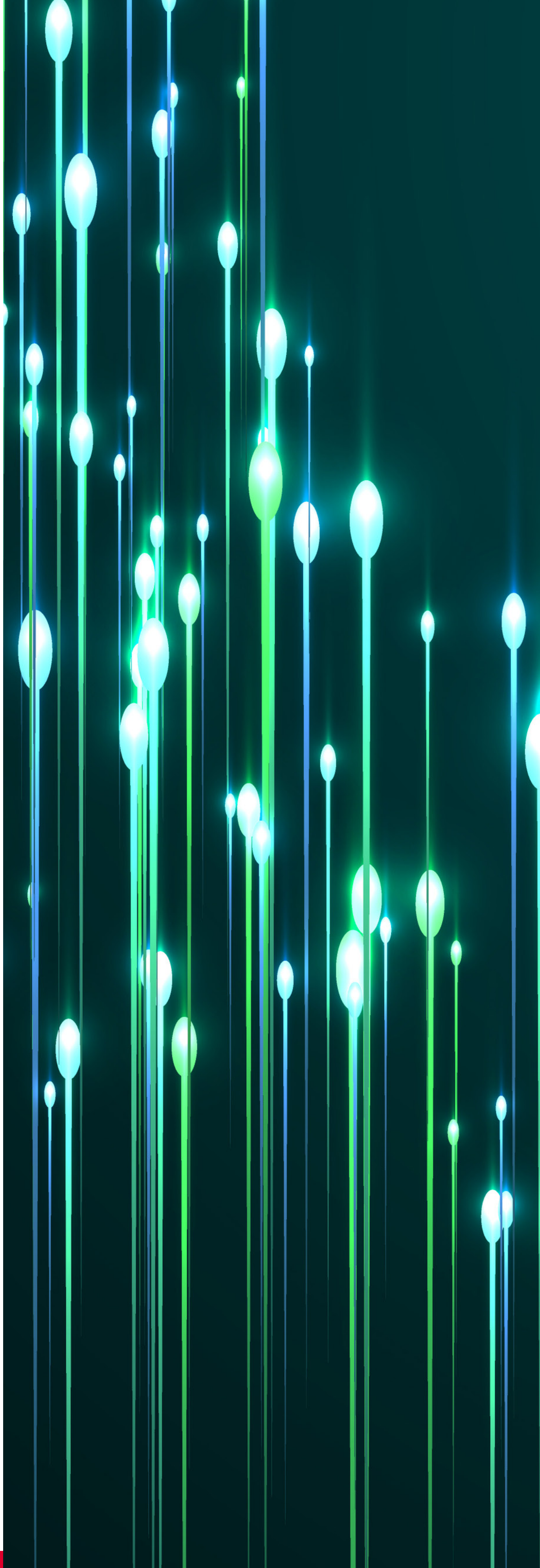

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