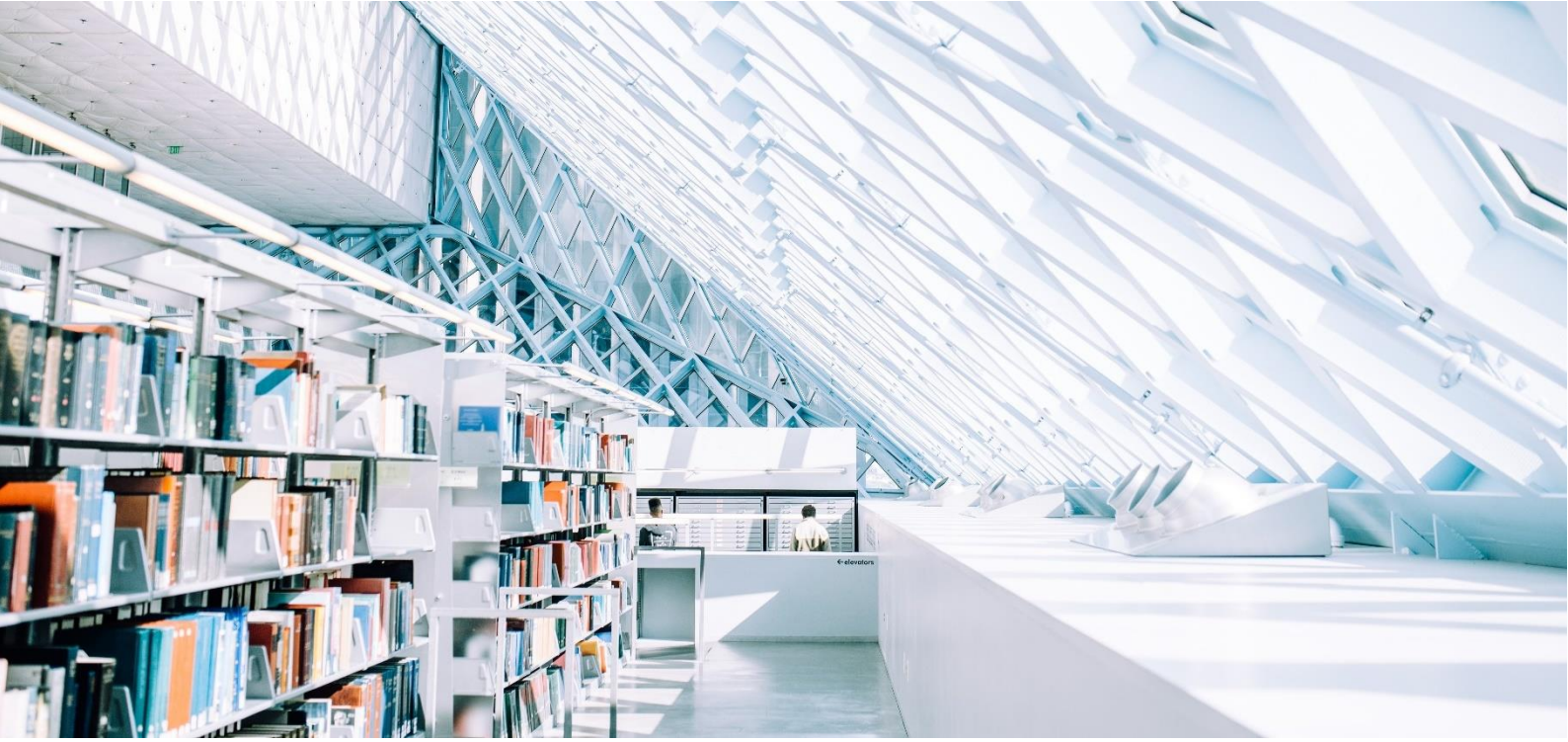
SCI/Verkehr

DIESEL AND ALTERNATIVE DRIVE LOCOMOTIVES

Global Market Trends

2023



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Global Market Trends 2023

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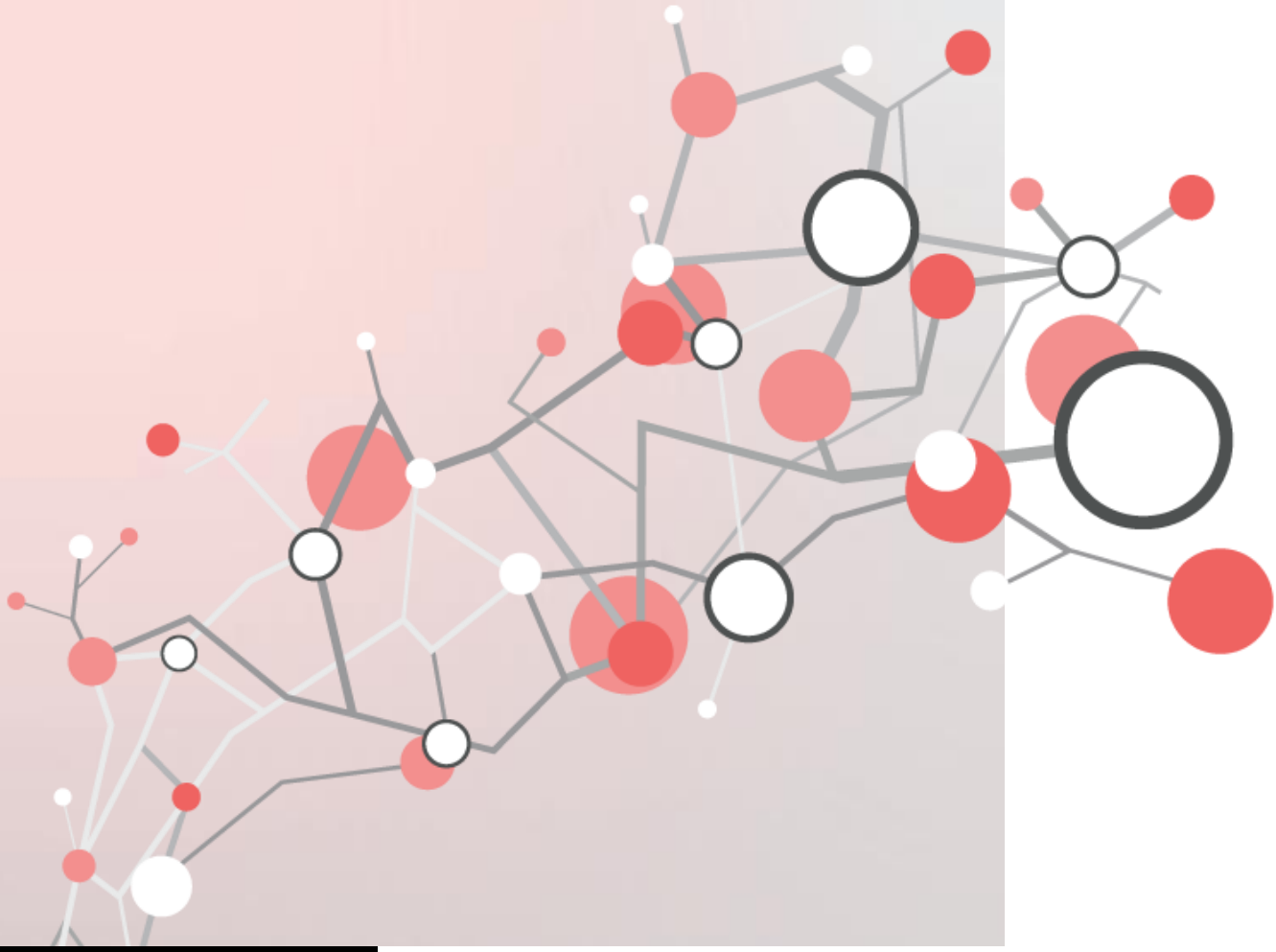


1 Executive Summary

Executive summary

Social and political awareness of environmental protection has increased worldwide, and decision-makers have identified the **transport sector as a key sector to contribute to achieving climate goals**.

(…)

(…)

While the locomotive product variety has decreased in the diesel segment in recent years, several **leading manufacturers** like Wabtec, Progress Rail, Stadler and Siemens **have developed new alternative drive locomotives** of different traction types like dual-mode and pure battery that have emerged from the concept and testing phase and are now entering their first markets.

(…)

Alternative drive locomotives are expected to account for **xx% of the aggregated OEM volume from 2024 to 2028**

Trends and drivers impacting the diesel and alternative drive locomotives market

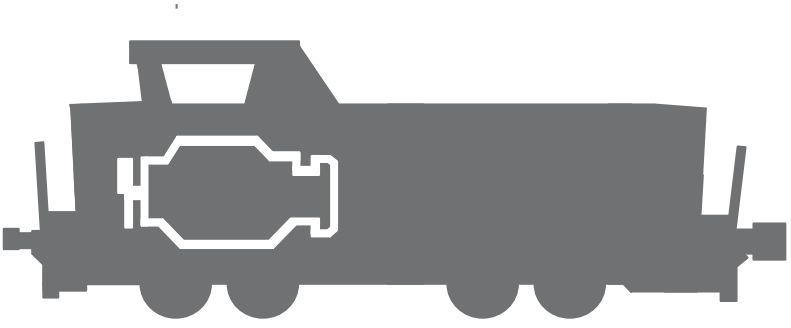
1 SCI Verkehr observes declining diesel locomotive fleets (…)

SCI Verkehr observes declining diesel locomotive fleets (…)

(…), the **fleet of diesel locomotives** is on a **decreasing** trend **due to larger withdrawal activities**. SCI Verkehr identified the following main reasons behind this trend.

- **Higher (…) of new assets**: in general, new locomotives entering the markets provide significantly higher (…) and productivity, as these assets are (…).
- **Track electrification is proceeding**: in some regions like (…), track electrification is proceeding at a high speed, making it possible to withdraw mainline diesel locomotives in particular from service.
- **The (…) segment is losing importance:** in key railway markets, SCI Verkehr observes that the demand for (…) has been declining, for example due to an increasing number of block trains. Moreover, (…).
- (…)
- (…)

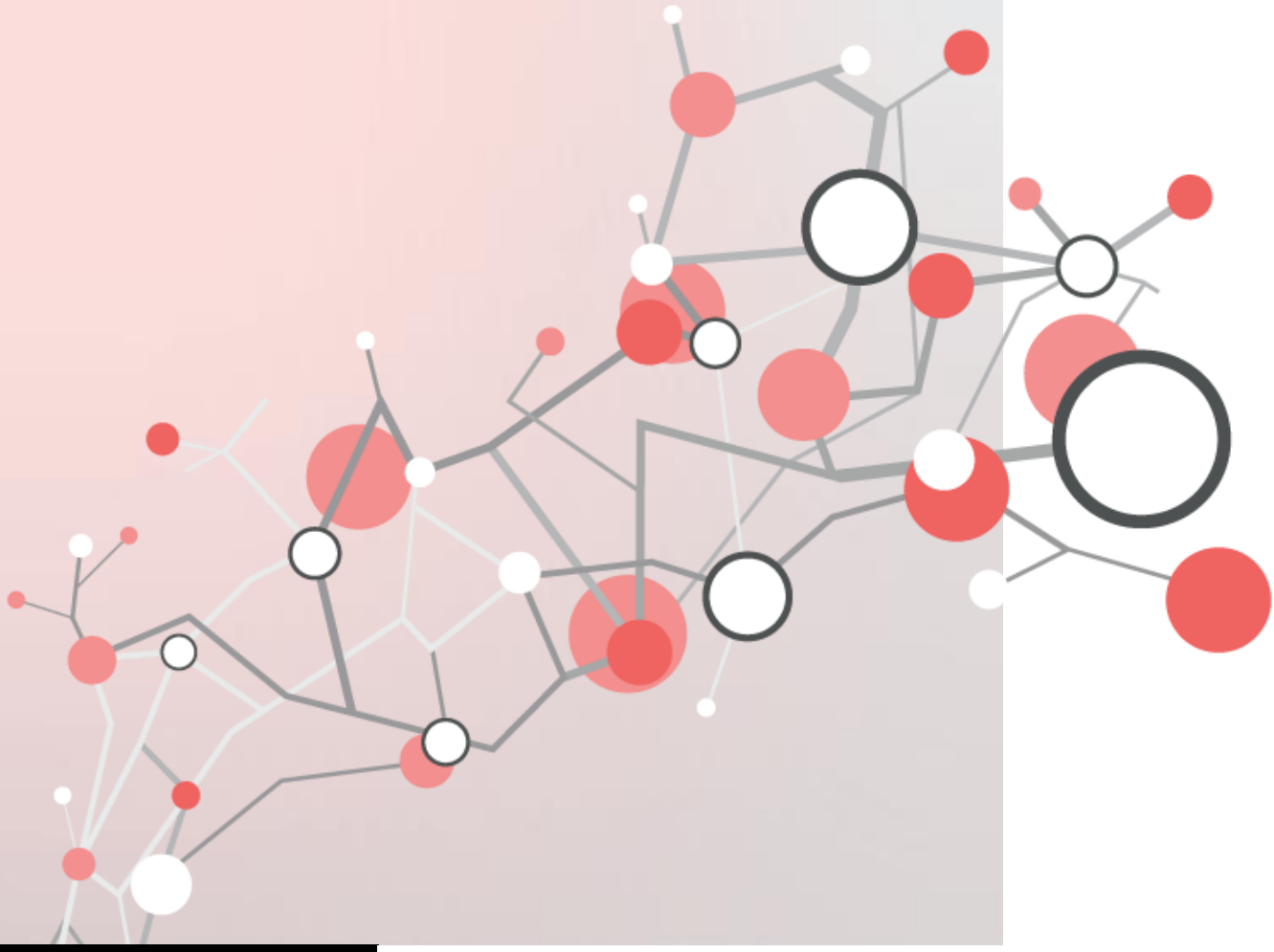
Overall, **SCI Verkehr expects the trend of decreasing diesel locomotive fleets to continue**. The mainline locomotive fleet is forecast to decrease at a CAGR of -xx.xx%, and the shunting locomotive fleet at a CAGR -xx.xx%, within the period from 2023 to 2028.



-xx%

Decreasing fleet

Global fleet reduction since the predecessor study in 2019



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The market for diesel and alternative drive locomotives in Australia/Pacific

The market for diesel and alternative drive locomotives in Australia/Pacific

1 Overview region

1.1 Executive summary

Australia/Pacific – diesel and alternative drive locomotives		Mainline	Shunting	Total	Trend
Installed base	Units 2023	xxx	xxx	xxx	
	Average development 2023-2028 (p.a.)	xxx	xxx	-0.6%	↘
	Average age 2023 (in years)	24	xxx	xxx	
OEM market	Average volume 2023 (EUR m p.a.)	110	xxx	xxx	
	Average development 2023-2028 (p.a.)	xxx	xxx	+6.5%	↑
	Average volume 2028 (EUR m p.a.)	xxx	xxx	180	
AS market	Average volume 2023 (EUR m p.a.)	xxx	xxx	xxx	
	Average development 2023-2028 (p.a.)	xxx	xxx	xxx	↘
	Average volume 2028 (EUR m p.a.)	xxx	xxx	320	

strongly increasing ↑ | increasing ↗ | constant → | decreasing ↘ | strongly decreasing ↓

Australia/Pacific hosts the smallest diesel and alternative drive locomotive fleet that is operating in 2023 (xx%) among the world regions. Alternative drive locomotives are practically non-existent in the fleet, but the first battery locomotives are currently entering the market. More than xx% of the fleet is operated in Australia.

Main drivers	Key takeaways
Political framework	– Australian freight railways are privately owned and divided according to regions. In New Zealand, incumbent KiwiRail is the exclusive operator of locomotives. **There is a strong awareness in the region that a well-functioning railway business reduces the region's carbon footprint** and road congestion while improving overall safety. – (…)
Infrastructure	– (...) – The **construction of the 1,700 km Inland Rail line** from Brisbane to Melbourne has already started. Inland Rail will traverse Australia's richest farming regions and offer more options for transport for agricultural producers in the **long term**. – Only **xx% of the mainline railway network is electrified**. (…)
Operational aspects/ asset trends	– Given (…), the need for modern locomotives will increase. **xx%** of the mainline fleet is operating **in freight mainline services** – **long, heavy trains** in the region require a high energy density. – Given the (…) electrification rate, **(…).** – Moreover, **operators are investing in making diesel locomotives more efficient**, e.g. via (…). – **Battery locomotives** are also going to be (…). – New battery locomotives, e.g. from North American manufacturers, are expected to be **(…) priced** than diesel locomotives. **Launch clients in Australia are** Rio Tinto, Roy Hill, (…) **achieving ESG goals**. – **"Traditional" freight operators** like Aurizon and Pacific National **are (…) operational challenges** still need to be addressed (e.g. charging stations along routes). – (…)

Short- to medium-term implications for the mainline OEM and after-sales market (2024-2028)

- **Fleet evolution**: the overall fleet will decrease due to the increasing withdrawal of outdated diesel locomotives. (…)
- **OEM**: in recent years, the OEM market has been on a lower level. Given the replacement demand in the region and already-firm orders, the OEM volume is expected to grow. In general, the market volume for new locomotives, (…)
- **After-sales**: in light of the declining fleet, the after-sales volume is expected to (…). However, fuel efficiency-increasing retrofit investments in locomotives (like starter batteries) or (…) will ensure a (…) after-sales market.

Short- to medium-term implications for the universal/shunting OEM and after-sales market (2024-2028)

- **Fleet evolution**: (…)
- **OEM**: the OEM market for shunting locomotives has almost been (…) in recent years. Demand for pure shunting locomotives occurs occasionally within the region. (…)
- **After-sales**: the after-sales volume is expected to (…) in line with (…) – large parts of the outdated installed base will not experience any further investments.

OEM of diesel and alternative drive locomotives in Australia/Pacific 2024-2028 by traction type
(EUR xxx million)

Figure 1: OEM of diesel and alternative drive locomotives in Australia/Pacific 2024-2028 by traction type

Long-term outlook for the OEM market for diesel and alternative drive locomotives (after 2040):

- **Mainline**: demand is expected to remain (…) locomotives coupled with (…) tenders, supplying the locomotives with sufficient energy density along long routes. In the long run, this is also realistic for (…) robust infrastructure for hydrogen (production, storage, distribution).
- **Shunting**: given the lower energy density requirements, (…).

1.2 General market overview

Fleet overview – diesel traction is dominant, but the first alternative drive locomotives have entered operation.

The Australia/Pacific region has an installed base of around xxx diesel locomotives. The majority of this fleet (more than xx%) is operated in Australia. The remaining fleet is operated in New Zealand and to a minor extent in Fiji.

– The fleet consists of mainline locomotives (around xx% of the fleet) with an average age of xx years, and of shunting locomotives (xx% of the fleet) with a very high average age of almost 50 years.
– Around xx% of the mainline fleet is operating in freight mainline services.
– (…)

Installed base 2023 (units)	Freight	Passenger	Shunting	Total
Mainline	xxx	xxx	-	xxx
Shunting	-	-	xxx	xxx
Alternative drive	<1%	-	<1%	**<1%**
Ø-age	xxx	xxx	**>45**	**xxx**
Total	**xxx**	**110**	**xxx**	**xxx**
				© SCI Verkehr GmbH

Political framework – the region is characterized by (…).

Generally, governments in the Australia/Pacific region are starting to give more importance to sustainability in the transportation sector. Nevertheless, public investments and subsidies are limited. There is a strong awareness that a well-functioning railway business reduces the region's carbon footprint and road congestion while improving overall safety.

(…)

Considering the size of the region, the population is very small and largely concentrated in the major cities. The region displays the highest degree of urbanisation of all world market regions and this will continue to increase slightly in the years to come.

(…)

Infrastructure – long overland lines with only xx% of the mainline railway network electrified

Railway systems and infrastructure are discontinuous and therefore jeopardize connections between regions. The network consists of three gauge-sizes: narrow (1,067 mm), standard (1,435 mm) und broad gauge (1,600 mm). (…)

In New Zealand, the government introduced a more sustainable model for funding ongoing network maintenance and renewals with the introduction of (…). This represents a historic change in the way the rail network is planned and funded in New Zealand, acknowledging that rail plays an important role in avoiding transport emissions and road congestion.

Rail freight market – rail freight services mainly connect mines with ports; there is a high modal share.

Rail transport in this world market region is almost entirely concentrated in Australia, which has a share of almost xx% of the total rail freight transport performance. (…) The rail freight services mainly run from mines (…).

Freight transport services by rail have strongly increased in recent years. Especially between 2011 and 2014, rail freight transport performance experienced strong growth (…).

Australia was less affected by the COVID-19 crisis than other world regions. However, (…).

(…)

Development of rail freight performance in Australia/Pacific (Index 2008=100)

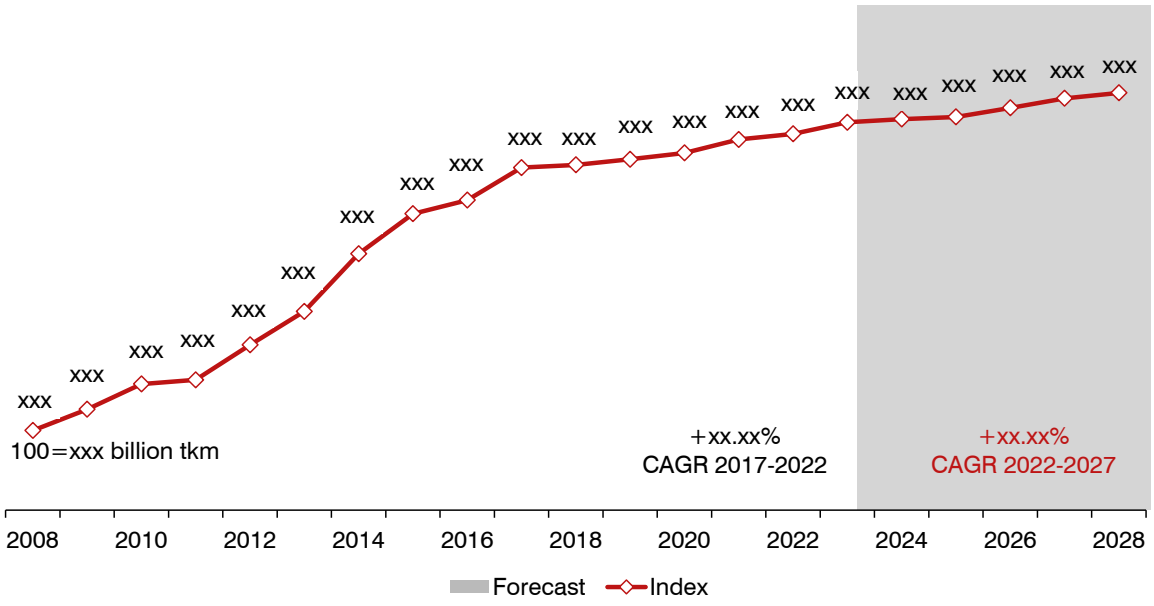

Figure 2: Development of rail freight performance in Australia/Pacific

Together, iron ore and coal have a share of more than (…).

KiwiRail freight is the cargo division of KiwiRail Holdings Limited, the state-owned enterprise for rail operations in New Zealand. The company operates (…)

Rail passenger market – (…).

Australia is by far the largest passenger rail transport market in the Australia/Pacific region (xx% of the global rail passenger market), accounting for xx% of the region's total transport performance. Similarly to North America, (…).

1.3 Mainline locomotives

In the Australia/Pacific region, the diesel mainline locomotive fleet comprises a total of around **xxx locomotives** with an average age of xx years and can be characterised as follows:

- **Fleet development:** (…).
- **Age profile:** around 35% of the installed base has exceeded a service life of 30 years. While the fleet in Australia is around xx years old on average, the fleet in New Zealand is xx years old on average.
- **Ownership/operators:** in Australia, private companies like Pacific National Pty Ltd and Aurizon Network Pty Ltd are operating the locomotive fleet. (…). Leasing company (…) is very active in leasing locomotives in Australia. (…)
- **High-level trend:** emissions standards are (…) in Australia, (…) for operators to procure environmentally friendly locomotives comparable to that in Europe (Stage V) or North America (Tier-4). Considering (…) diesel locomotives are necessary for railway operations in this region and will continue to be necessary in the long term.

Installed base of diesel and alternative drive mainline locomotives in Australia/Pacific

In the Australia/Pacific region, diesel mainline locomotives are equipped with diesel-electric traction. (…) is the only supplier of alternative drive mainline locomotives present in the region's fleet as of 2023.

Traction type of installed base 2023	Diesel-electric	Battery	Total
Total (%)	xx%	xx%	100%
Total (units)			xxx
			© SCI Verkehr GmbH

Almost xx% of the diesel mainline locomotives are operated in Australia, while the rest are operated in New Zealand. No mainline locomotive is operated in Fiji.

Installed base of diesel and alternative drive mainline locomotives in Australia/Pacific 2023 (xxx units)

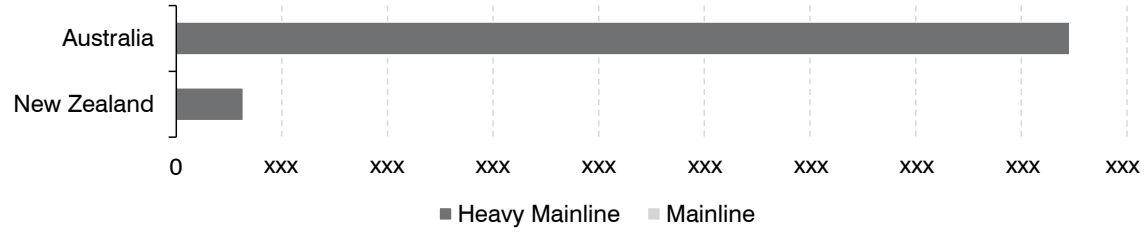

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Figure 3: Installed base of diesel and alternative drive mainline locomotives in Australia/Pacific in 2023

Procurements of diesel mainline locomotives in the Australia/Pacific region have been volatile and have been undertaken in cycles. Following a period with comparably lower procurement volumes at the beginning of (…). Almost xx% of the total installed base was delivered from 2009 to 2013. In the most recent ten-year period (2014-2023), deliveries of new mainline locomotives have dropped again significantly.

Age structure of diesel and alternative drive mainline locomotives in Australia/Pacific 2023 (xxx units)

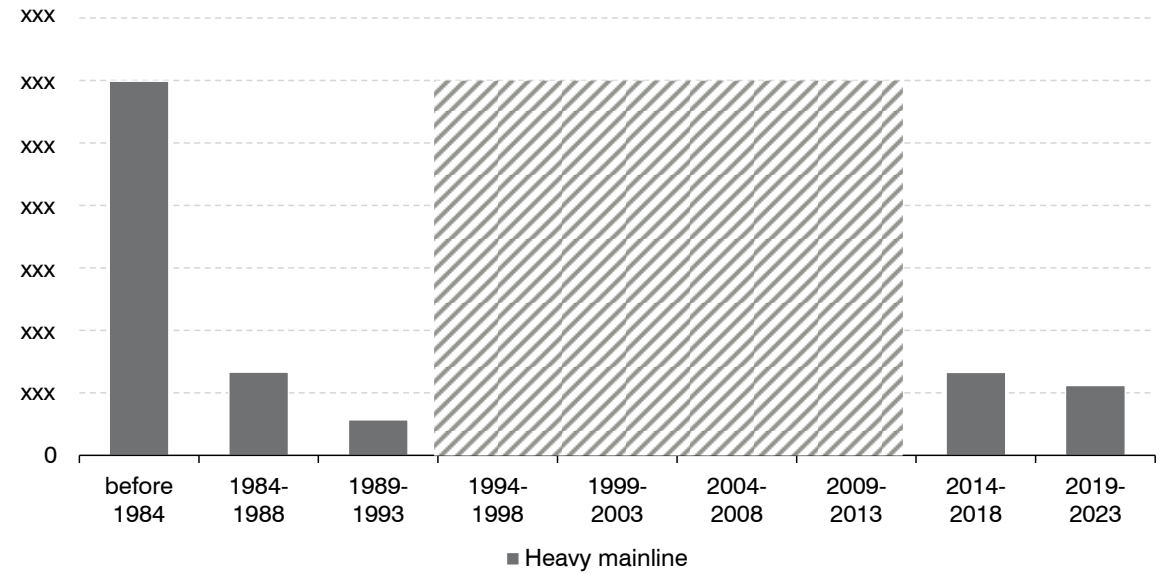

Figure 4: Age structure of diesel and alternative drive mainline locomotives in Australia/Pacific in 2023

Ownership/operatorship and leasing

(…) private railway companies own by far the largest share of the fleet, unlike in other world regions. The leading leasing company, (…), accounts for a share of around xx% of the fleet.

Owner type of installed base 2023	Incumbent	Competitor	Lessor	Total
Total (%)	12%	xx%	xx%	**100%**
Total (units)				**xxx**
				© SCI Verkehr GmbH

The largest fleet of diesel mainline locomotives is owned by (…), which operates in all mainland states and territories. Its services mainly include bulk freight transport (coal, grain, steel, ore) and intermodal containers. The second-largest operator is (…). The company was established in (…). The rail service in New Zealand is wholly owned by the Crown and operates as a state-owned enterprise named KiwiRail.

Owners of diesel and alternative drive mainline locomotives in Australia/Pacific in 2023 (xxx units)

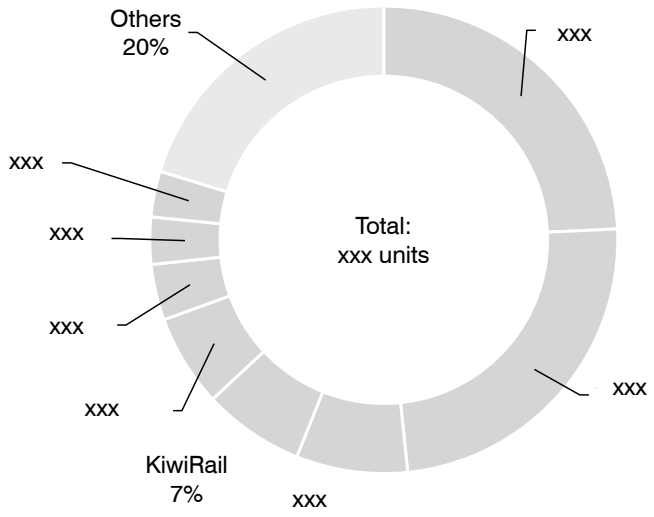

Figure 5: Owners of diesel and alternative drive mainline locomotives in Australia/Pacific in 2023

Manufacturers/products/market shares

The Australian/Pacific region has local production capacities for the manufacture of diesel locomotives. In general, construction has taken place under license from the (…). In the last decade, (…) have dominated Australia's locomotive manufacturing. (…). In the last five years (from 2019 to 2023), about xxx diesel mainline locomotives have been delivered.

The most important diesel locomotives in the market region Australia/Pacific are the following six-axle diesel-electric locomotive series:

- **C44ACi**: widespread locomotive type designed by (…) in Australia (…). It is equipped with a GE 7FDL-16 engine with a power of 3,370 kW.
- **(…)**
- **SDA1**: upgraded 3,150 kW AC transmission diesel locomotives, fully developed by CRRC Ziyang. The diesel engine meets high EU Stage (…) emission standards.
- **CKD9B**: (…)
- **(…)**
- **xxx**: a Wabtec AC-locomotive to be transferred to Australia in the years to come.
- **xxx**: a locomotive type of Stadler reaching 100 km/h that was ordered by (…). The asset meets the most demanding emission standards such as Tier 4 or EU Stage V and can be used with alternative fuels such as HVO.

In the alternative drive mainline segment, only the (…) locomotive is active. The locomotive is a battery-only locomotive that can recharge during the trip through regenerative braking. (…) offers its "heavy-haul" locomotive for the Australian market with a maximum battery capacity of (…).

Delivery of diesel and alternative drive mainline locomotives in Australia/Pacific by manufacturer 2019-2023 (xxx units)

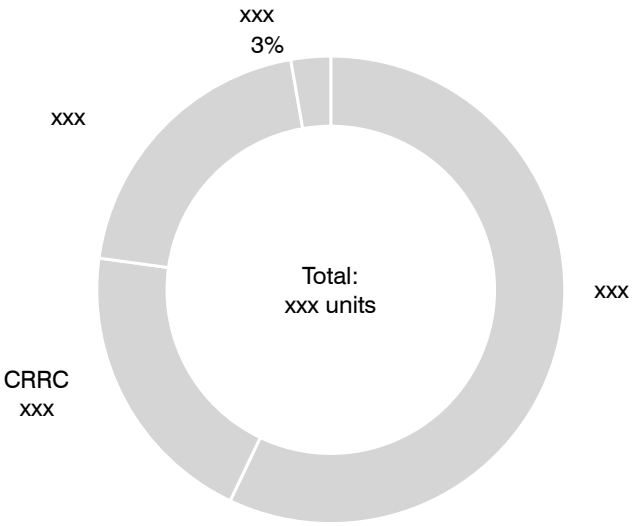

Figure 6: Delivery of diesel and alternative drive mainline locomotives in Australia/Pacific by manufacturer 2019-2023

– With xxx% of the deliveries, (…) has accounted for a majority of the deliveries in recent years.
– The world's largest rolling stock manufacturer CRRC continues to be active in the region and has made deliveries to (…).
– (…).

Market volume and market development

The current market volume for new diesel and alternative drive locomotives in the Australia/Pacific region is around EUR xxx million p.a.; for after-sales services, it is around EUR xxx million p.a.

This market development is influenced by the following drivers:

Drivers of procurement	Brief description	Relevance	Trend	
			Diesel	Alternat.
Price level	– (…) – New alternative drive locomotives, e.g. from North American manufacturers, are expected to be significantly (…) priced. Therefore, (…) is converting a diesel locomotive to a battery-based platform to investigate if the company will be able to (…).	XXX	→	XXX
Technology trends	– In recent decades, the diesel locomotive fleet has strongly decreased its emissions via new, more modern assets and retrofits. The main drivers for the upgrading of existing locomotives are (…). – For example, large operator Pacific National installed (…). The new (…) locomotives will feature a modern Tier 4 engine (…). – (…)	◑	XXX	↗
Political environment	– In the absence of national standards for non-road diesel emissions in Australia, the NSW Environment Protection Authority (EPA) has initiated (…).	◑	XXX	XXX

Drivers of procurement	Brief description	Relevance	Trend	
			Diesel	Alternat.
	– Nevertheless, new locomotives in general feature at least some emission standards, being ordered (…). – In New Zealand, rail funding was changed from a year-on-year basis (short-term decision-making resulting in (…)).			
Fleet structure	– The existing fleet is relatively old and therefore requires replacement and refurbishment investments. Because of (…), SCI Verkehr expects that increasing sales figures will be reached in (…).	XXX	XXX	↗
Asset availability/ product maturity	– Several manufacturers are currently present in the market – these are (…). – Operators like (…) are willing to integrate battery locomotives, but first have to (…) – (…) announced plans to develop, build, and trial prototypes of (…) locomotive tenders.	◑	XXX	↗
Transport demand	– Transport demand is largely dependent on commodity markets (…). – Australia was less affected by the COVID-19 crisis than other world regions. However, the country is noticing the effects of (…). All in all, SCI Verkehr expects the rail freight performance to rise by xx.xx% p.a. in the region between 2022 and 2027.	XXX	XXX	→
Infrastructure	– The line network in this market region comprises more than xxx km, with an electrification rate of around xx%. – In Australia, the existing infrastructure is rarely connected. The largest infrastructure project, Inland Rail (which is to connect Melbourne and Brisbane via the states Victoria, New South Wales and Queensland), is a long-term project, but it offers (…). – According to local experts, (…). – (…)	◑	XXX	XXX

Relevance for procurement: ● = very high, ◕ = high, ◑ = medium, ◔ = low, ○ = none

5-year trend: strongly increasing ↑, increasing ↗, constant →, decreasing ↘, strongly decreasing ↓

SCI Verkehr expects an increase in the OEM market for new diesel and alternative drive locomotives, with deliveries of up to xx locomotives p.a. on average between 2024 and 2028 in line with investments in (…). Overall, operators are looking to increase capacity through locomotives with (…).

Diesel will remain (…) in the forecast period through 2028. Newly built alternative drive locomotives are (…). In light of a high price level for newly built locomotives, (…) will increase in importance.

Important current and planned procurement projects

Traction type	Country	Vehicle type	Units	Power (kW)	Delivery	Remarks
Diesel	Australia	xxx	50	xxx	2024-2027	As a part of a fleet rejuvenation strategy, (xxx) has awarded UGL a framework contract to supply up to (…) diesel locomotives, with a firm order for xx units.
xxx	New Zealand	xxx	xxx	3,000	xxx	(…).
Diesel	Australia	xxx	17	xxx	xxx	The CBH Group has entered into an agreement with Wabtec to acquire (…) narrow-gauge locomotives.

Traction type	Country	Vehicle type	Units	Power (kW)	Delivery	Remarks
Battery	Australia	xxx	1	xxx	2023	At the end of 2023, (…) celebrated the debut of the (…) locomotive for mainline services.
(…)						
Diesel	xxx	xxx	xxx	2,700	xxx	CRRC delivered an additional order of (…).
(…)						
(…)						
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Important current and planned modernisation projects

Traction type	Country	Vehicle type	Units	Operation	Delivery	Remarks
Diesel	Australia	C44-9CW	xx	Modernisation into (…)	2023-	Wabtec will modernise locomotives for (…). The locomotives will be modernised with (…) an upgraded control system to remove obsolescence, AC traction with individual axle control, etc.
(…)						
						© SCI Verkehr GmbH

1.4 Shunting locomotives

In the Australia/Pacific region, the diesel and alternative drive shunting locomotive fleet comprises a total of **xxx locomotives** with a very high average age and can be characterised as follows:

- **Fleet development:** (…).
- **Age profile:** more than xx% of the installed base has exceeded a service life of 40 years.
- **Application:** around 60% of the fleet is operated in the (…) segment. (…).
- **Ownership/operators:** private companies own the largest share of the overall shunting fleet. Lessor (…).
- **High-level trend:** as shunting services can also be conducted by mainline locomotives, demand for new pure shunting locomotives is (…).

Installed base of diesel and alternative drive shunting locomotives in Australia/Pacific

In the Australia/Pacific region, diesel-electric is the most widespread traction type (xx%). Diesel-hydraulic traction follows with a share of around 37%.

Traction type of installed base 2023	Diesel-electric	Diesel-hydraulic	Diesel-mechanic	Battery	Total
Total (%)	xx%	37%	xx%	xx%	**100%**
Total (units)					**xxx**
					© SCI Verkehr GmbH

(…)

Installed base of diesel and alternative drive shunting locomotives in Australia/Pacific 2023 (xxx units)

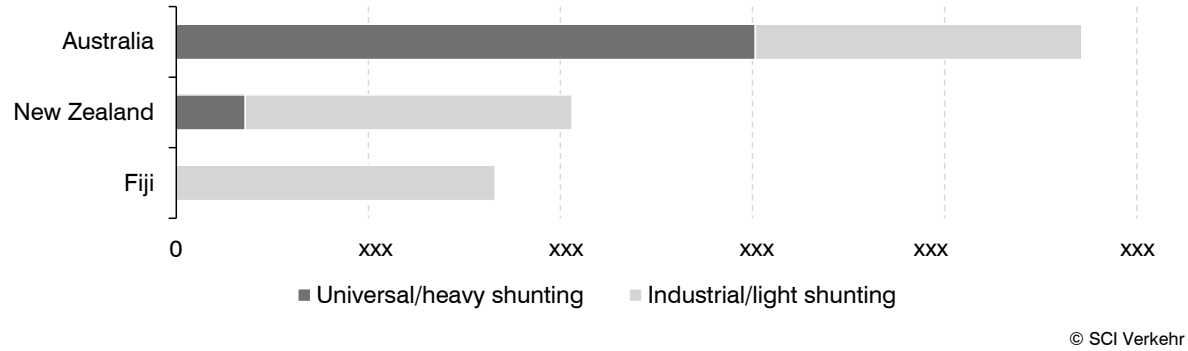

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Figure 7: Installed base of diesel and alternative drive shunting locomotives in Australia/Pacific in 2023

The shunting fleet in the region is (…).

(…)

Age structure of diesel and alternative drive shunting locomotives in Australia/Pacific 2023 (xxx units)

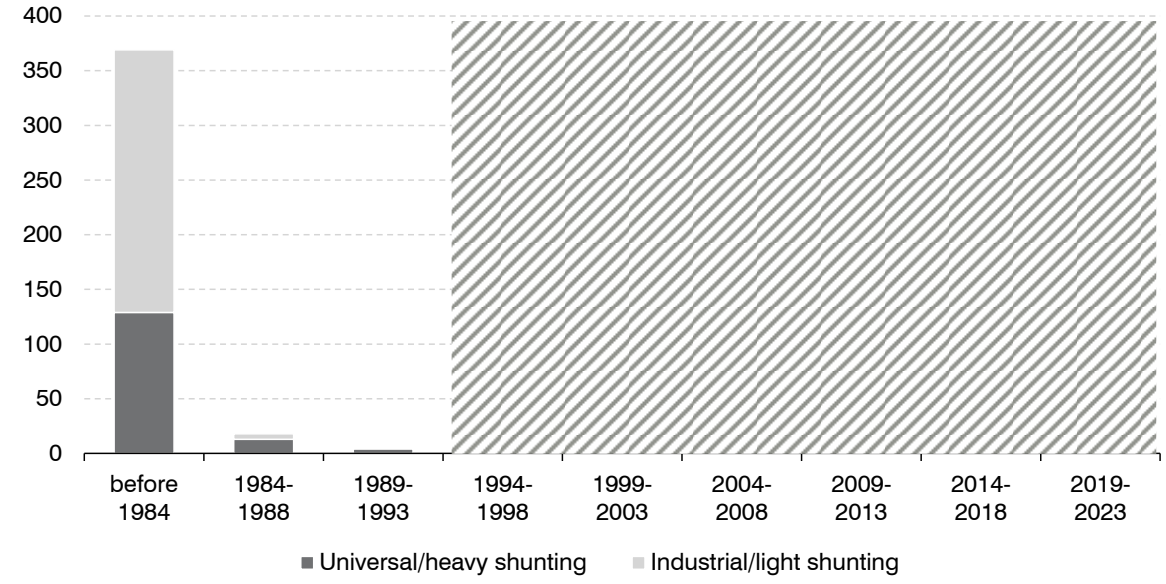

Figure 8: Age structure of diesel and alternative drive shunting locomotives in Australia/Pacific in 2023

Ownership/operatorship and leasing

With almost xx%, private railway companies own the largest share of the fleet by far.

Owner type of installed base 2023	Incumbent	Competitor	Lessor	Total
Total (%)	25%	xx%	xx%	**100%**
Total (units)				**xxx**
				© SCI Verkehr GmbH

A number of industrial shunting locomotives are also used by various operators in light mainline services. The largest fleet is owned by (…).

Owners of diesel and alternative drive shunting locomotives in Australia/Pacific in 2023 (xxx units)

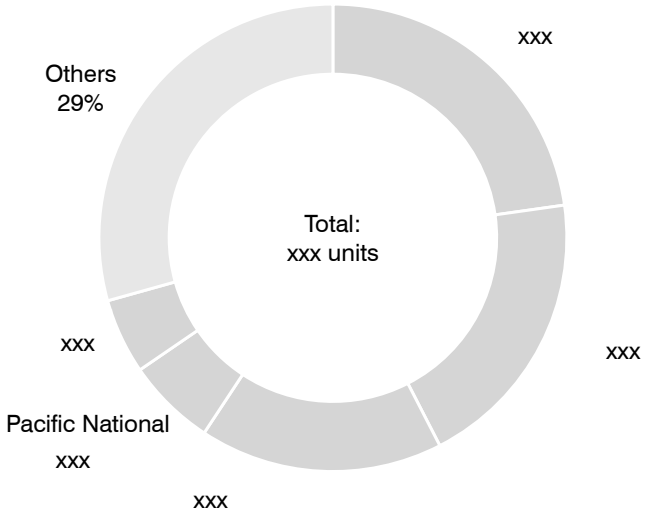

Figure 9: Owners of diesel and alternative drive shunting locomotives in Australia/Pacific in 2023

Manufacturers/products/market shares

Between 2019 and 2023, about xxx shunting locomotives were delivered to the Australia/Pacific market, to (…). The manufacturers of these locomotives were the US-suppliers (…).

Delivery of diesel and alternative drive shunting locomotives in Australia/Pacific by manufacturer 2019-2023 (xx units)

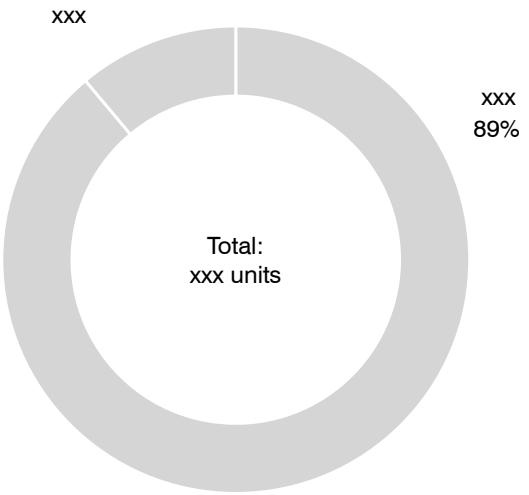

Figure 10: Delivery of diesel and alternative drive shunting locomotives in Australia/Pacific by manufacturer 2019-2023

Market volume and market development

The current market volume for new shunting locomotives in the Australia/Pacific region is about EUR xx million p.a.; for after-sales services, it is around EUR xx million p.a.

This market development is influenced by the following drivers:

Drivers of procurement	Brief description	Relevance	Trend	
			Diesel	Alternat.
Fleet structure	– The existing fleet is very old and therefore (…).	◕	XXX	↗
Asset availability/ product maturity	– With the (…), the first alternative drive locomotive (battery) entered the market in Australia. – (…)	xxx	→	XXX
Transport demand	– In general, the demand for shunting services is (…).	◑	XXX	XXX
Infrastructure	– Except on public railway networks, the shunting locomotives in this region are operated within closed (…).	xxx	XXX	→
Price level, political environment	– (…)	◑	XXX	↗

Relevance for procurement: ● = very high, ◕ = high, ◑ = medium, ◔ = low, ○ = none

5-year trend: strongly increasing ↑, increasing ↗, constant →, decreasing ↘, strongly decreasing ↓

Overall, SCI Verkehr expects a significant (…) in the OEM market, (…) mainly with diesel traction and driven by a firm order from Kiwi Rail. SCI Verkehr expects operators to invest in (…).

(…)

Important current and planned procurement projects

Traction type	Country	Vehicle type	Units	Power (kW)	Delivery	Remarks
(…)						
Battery	Australia	(…)	xx	xxx	2024	Fortescue is due to receive locomotives for operation on lines in the Pilbara region (Western Australia).
Battery	Australia	xxx	2	xxx	2023-2024	BHP purchased (…).
(…)						