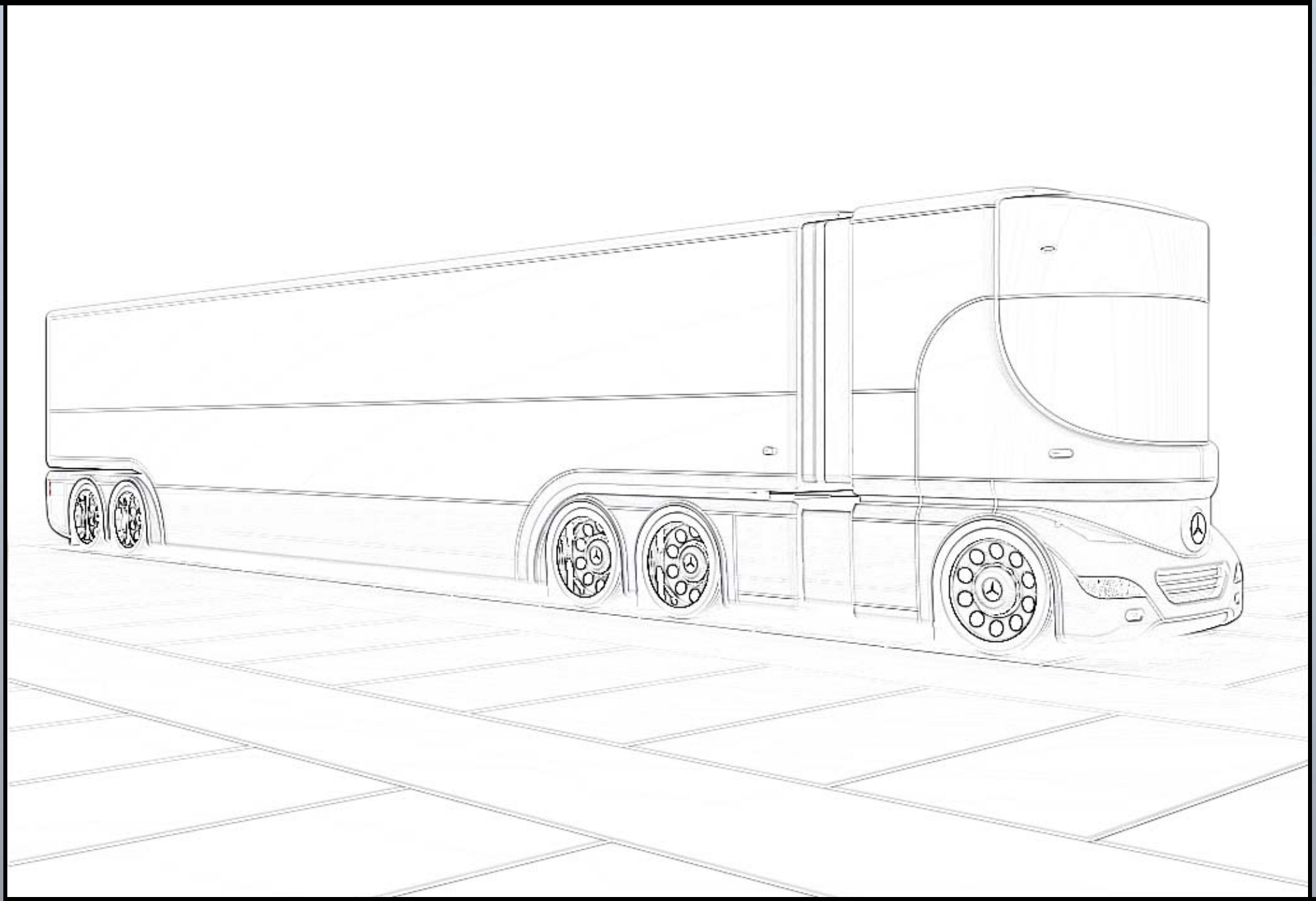
TRANSPORTATION DESIGN

THE HST



A.K. MUTHUI – 2007

The HST is an innovative truck (tractor/semi-trailer) designed for the future (2030) long-distance haulage segment in developed markets. Its aim is to present haulage firms with a maximum productivity solution - and with ever-increasing competitive pressures, maximum productivity is certainly an attractive proposition.

Driver Productivity

Since both the driving environment and experience affect the overall productivity of the driver, they are critical elements in the quest for maximum productivity. Therefore, the HST aims to present the ultimate driving environment and experience. *(See "Cabin", "Controller", and "The Drive" segments for more)*

Vehicle Productivity

In essence, vehicle productivity is achieved by reducing costs while increasing revenue.

Costs

Undeniably, the foremost cost facing any haulage firm is fuel. Fuel consumption can be reduced with a low coefficient of drag. Therefore, for minimal air resistance, the HST aims to incorporate a sleek aerodynamic profile via a conical front, slippery body panels, flush body (i.e. no protrusions like mirrors, wipers, etc), low ride height, and panelling of the entire vehicle.

Furthermore, the undercarriage would be covered and there would be no gap between the tractor and the semi-trailer. These measures would allow the airstreams (from the front) to flow smoothly along the sides, roof, and underbody.

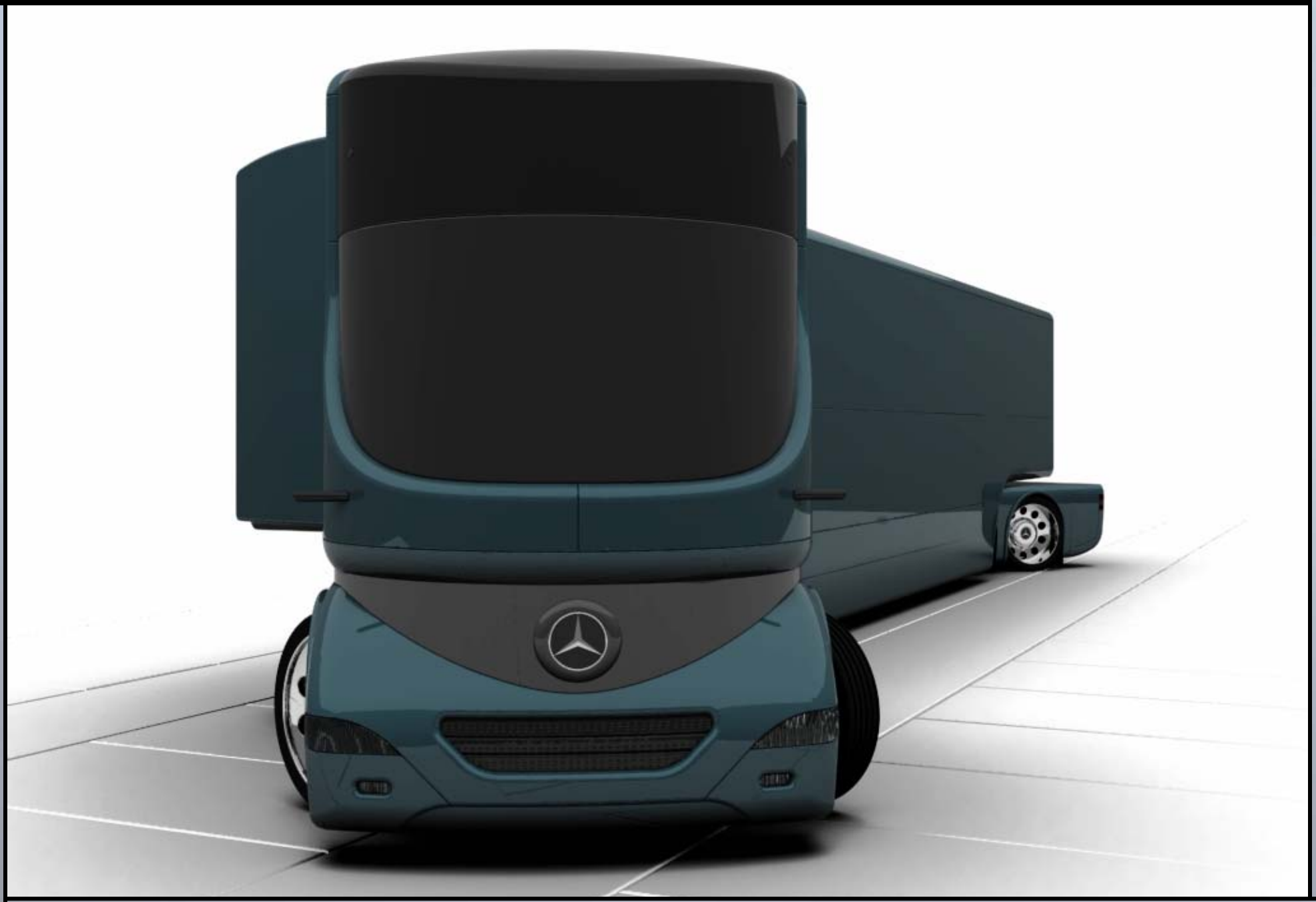
For an even further reduction in fuel consumption, the HST aims to incorporate a fuel-efficient driveline. *(See "Driveline" segment for more)*

Revenue

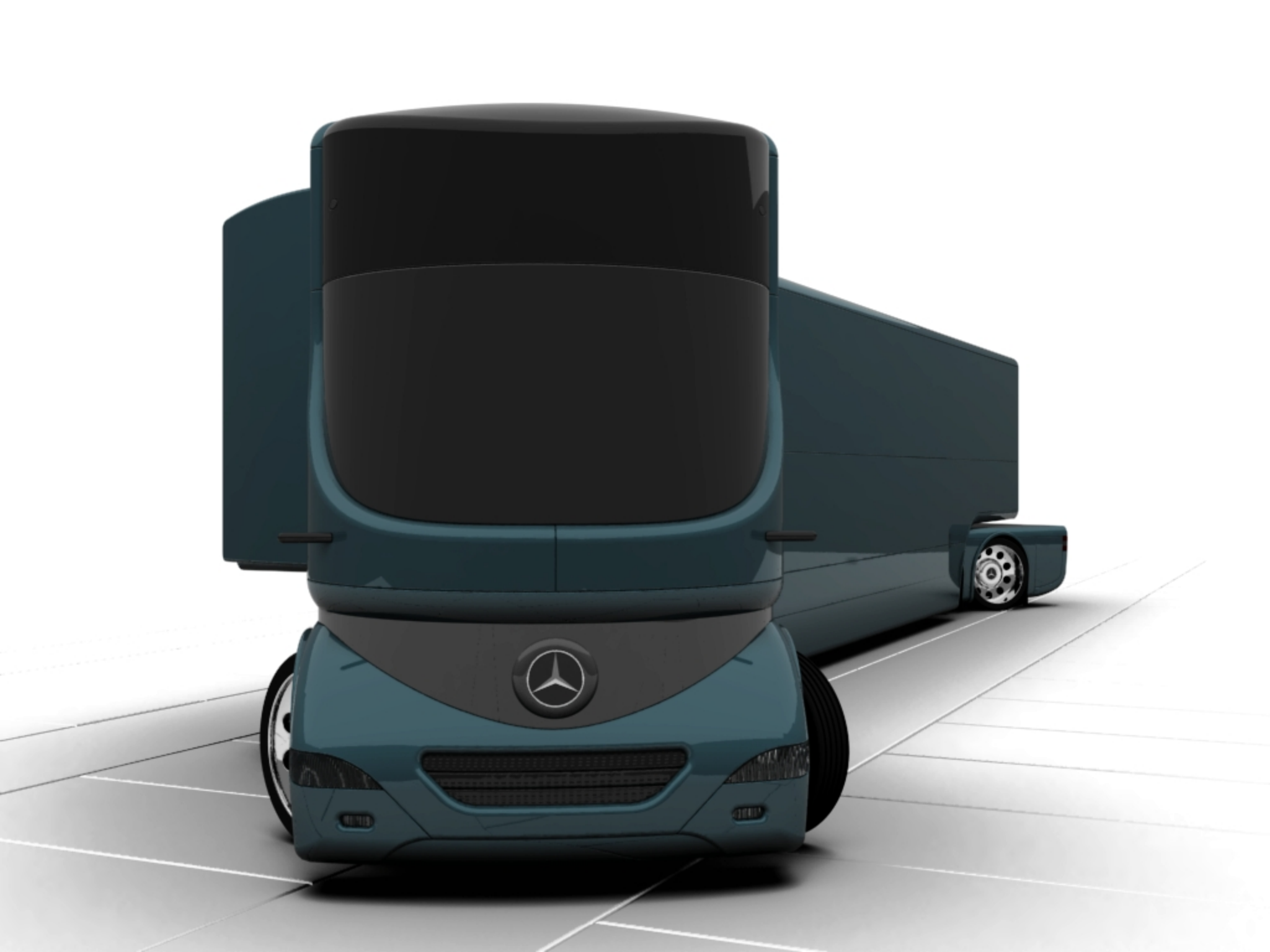
An increase in payload would definitely result in an increase in revenue. One way to increase payload is via longer semi-trailers. However, legislation restricts the length of trucks. Reason being, longer trucks would be difficult to manoeuvre, thus risking the safety of other road users while requiring the rebuilding of infrastructure to accommodate larger turning radii. The HST aims to be longer than current trucks, but more manoeuvrable. *(See "Steering" segment for more)*

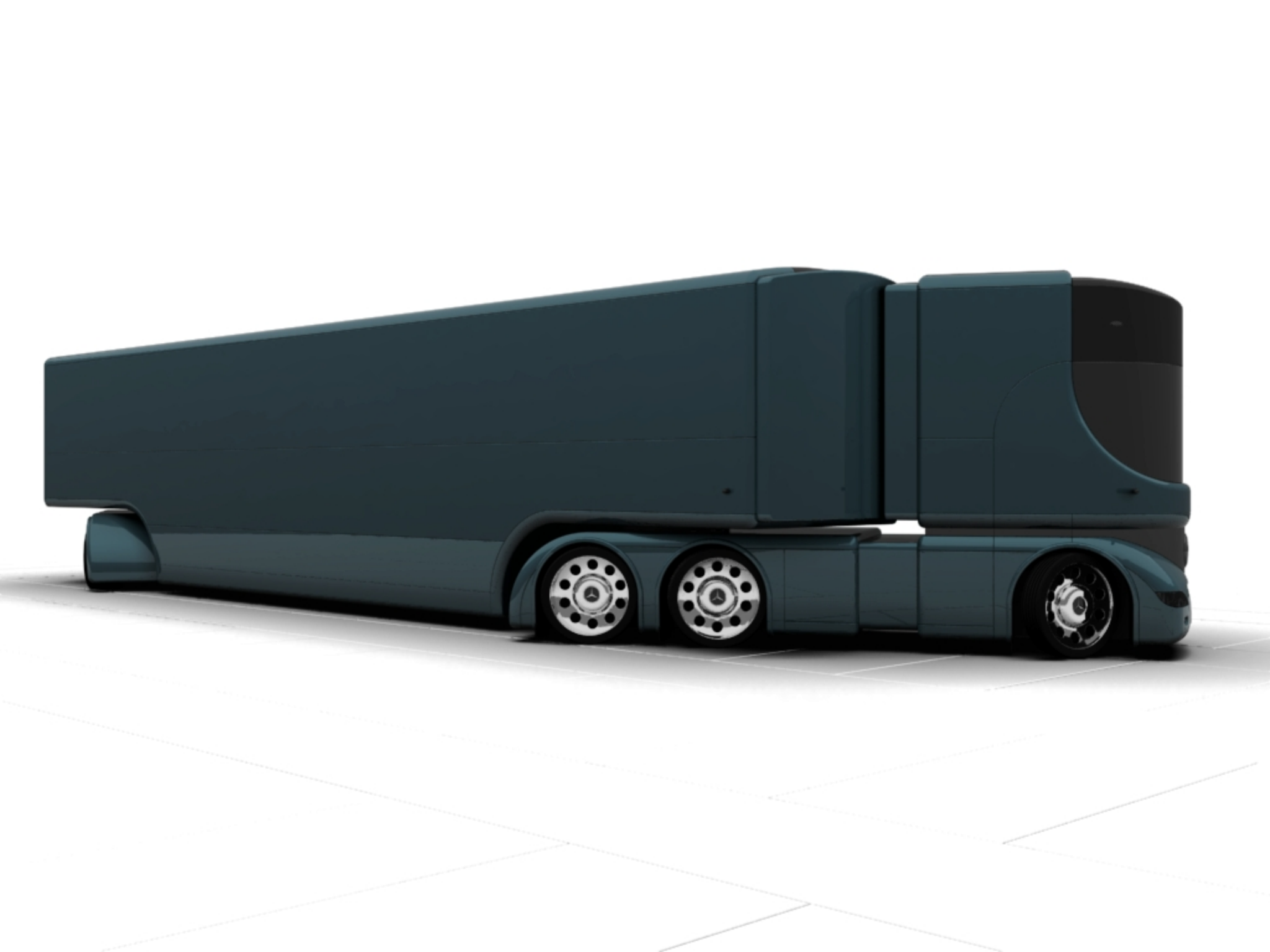
Superior manoeuvrability could pave the way for the legalization of longer trucks. For instance, European legislation could allow the overall length of trucks (articulated) to be increased from 16.50m to perhaps 19.50m, whereas North American legislation could allow the length of semi-trailers to be increased from 53' to perhaps 60'.

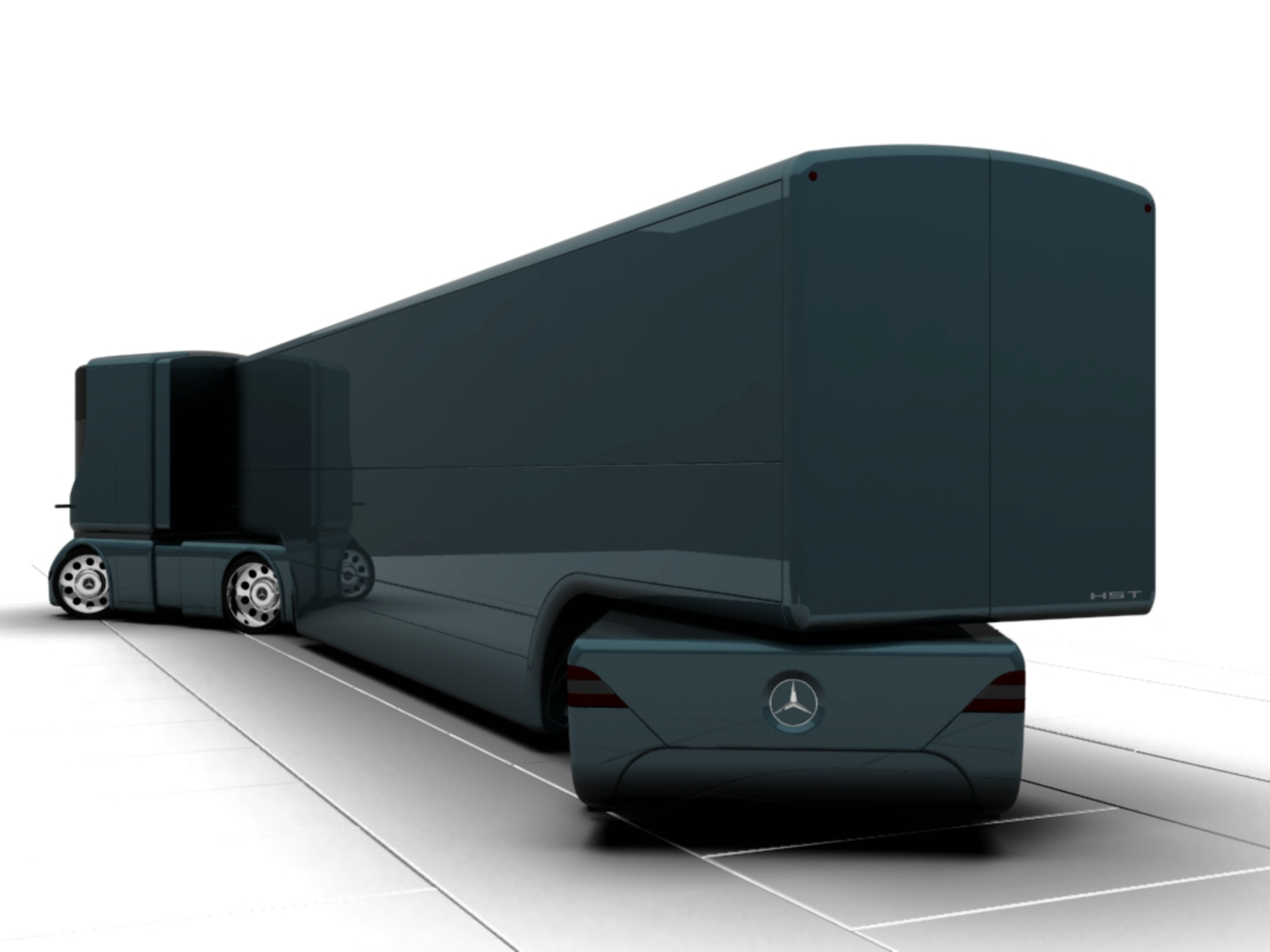
The **HST**, a **H**ighly **S**ophisticated **T**ransporter…



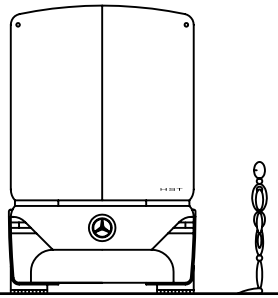

HST






HST

REAR



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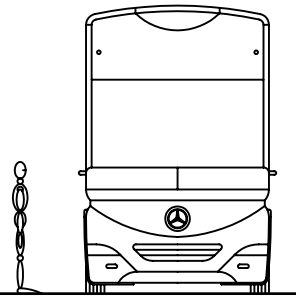

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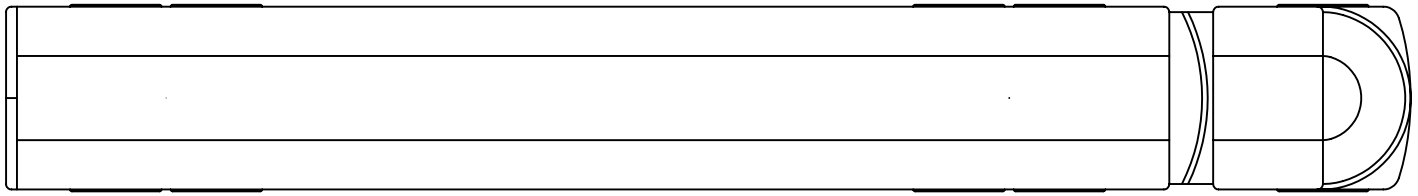

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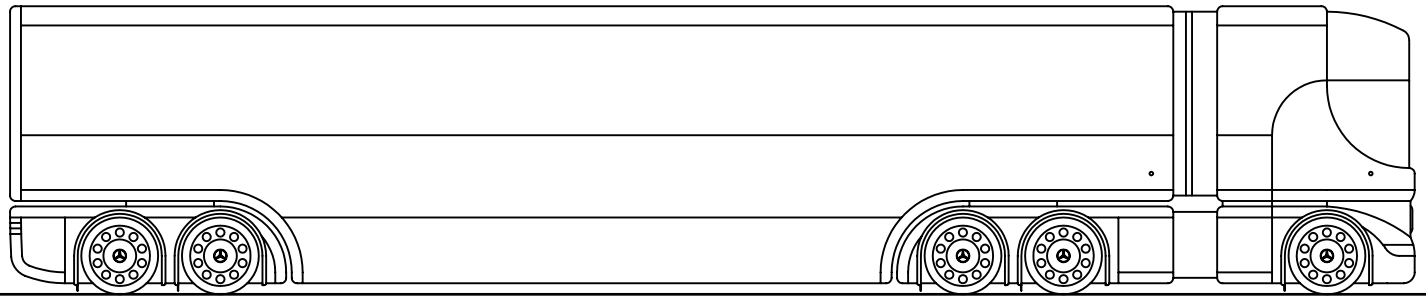
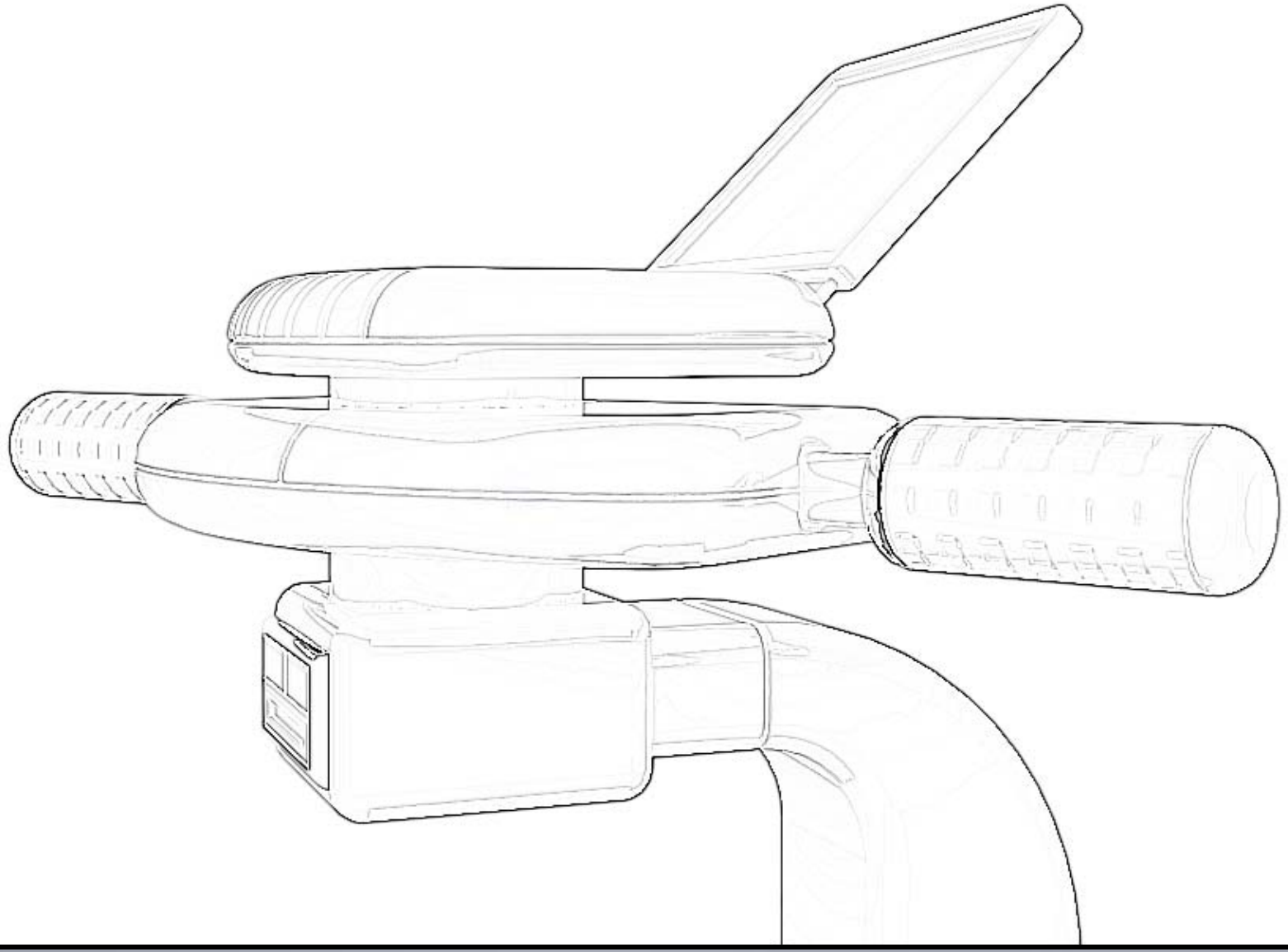




The HST's cabin is divided into two areas: the driving area and the sleeper (living/rest/work) area. The cabin is designed primarily for single-manning, but it can also accommodate a co-driver.

Driving Area

The View

The driver is centrally positioned in the conical cab (a 180-degree arc) and this provides for a uniform and panoramic view. The low-cut windscreen would be made from a material that would be strong enough to contribute to the structural strength of the cabin, eliminating the need for obtrusive A-pillars.

During wet conditions, the water-resistant windscreen and a series of air jets keep the windscreen clear, eliminating the need for distracting wipers. Conventional mirrors would be replaced with small cameras that do not obstruct the view.

The Seat

The driver's seat would feature a wide array of adjustment capabilities so drivers of any shape or size can find a perfect setting. The sitting surfaces of the seat back and bottom would be designed to be somewhat deep so that the driver could slightly sink into the seat, for a comfortable and snug feel.

The seat would feature massage, ventilation (warm and cool air), and air-suspension. It would also feature an adjustable headrest, armrests and thigh extenders (that extend from the front edge of the seat bottom).

The Cockpit

The HST aims to integrate all the elements of a typical driving interface into an all-encompassing unit. *(See "Controller" segment for more)*

Other Features

Above the windscreen would be a wraparound console. It would feature a large LCD TV (viewable from the sleeper) at the center and storage compartments on either side.

Underneath the console would be a display unit that is divided into five sections. The middle section would display images from the curbside or rear-end mounted cameras. The two sections to the left and the right would display images from the primary rearview (on the tractor) and the secondary rearview (at the front of the semi-trailer) cameras.

There would be a large skylight that follows the conical shape of the front and extends to the end of the sleeper. The driving area would be sunken (i.e. a 3" step-down from the sleeper).

Sleeper Area

The Layout

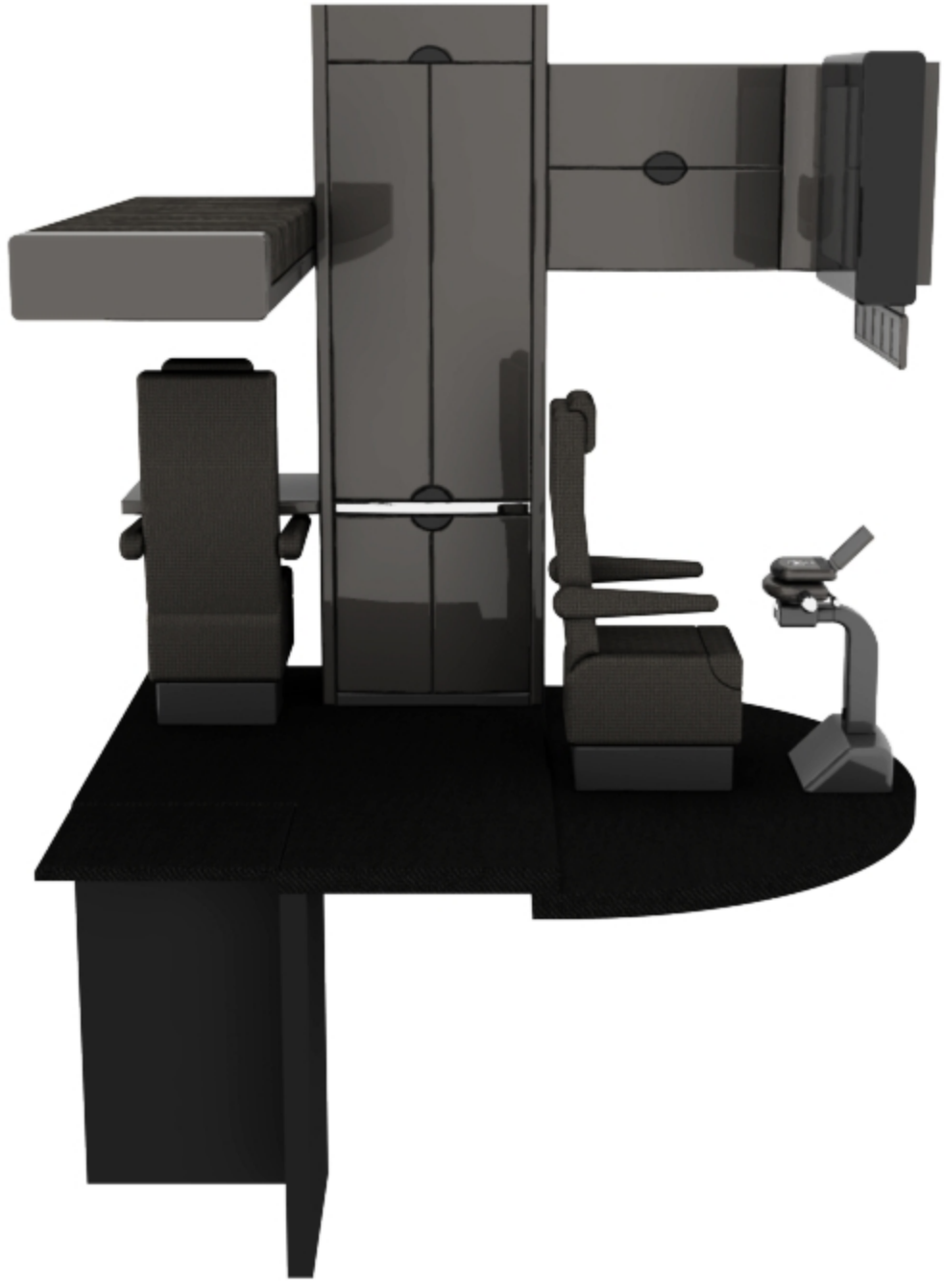
At the rear right (LHD) corner would be an elevator that facilitates access to the cabin floor. An elevator would be used because it would provide easier and safer cabin entry vis-à-vis typical vertical steps. The entry would be located curbside, so drivers can enter/exit from the pavement rather than from traffic.

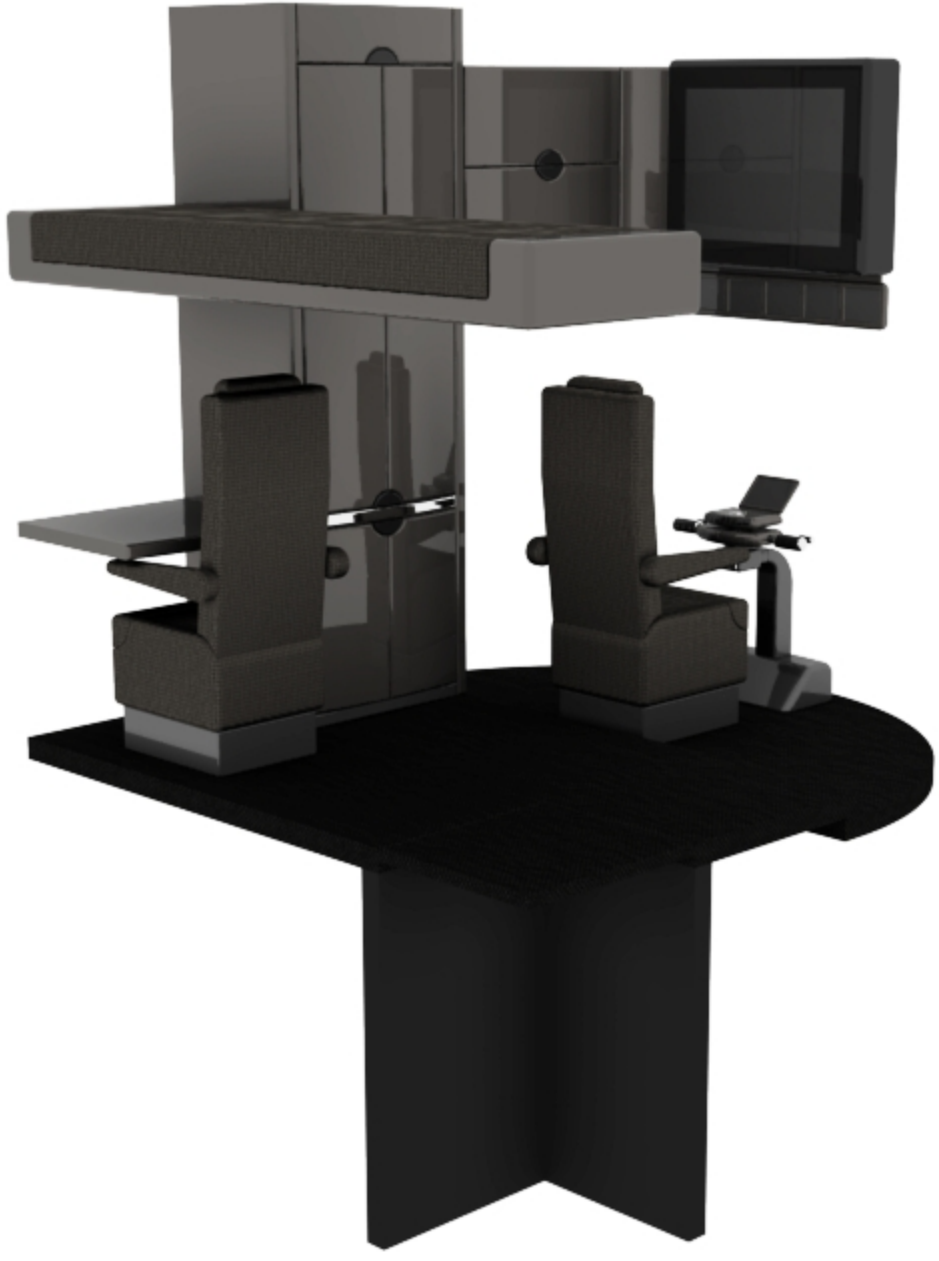
At the rear left corner would be a workstation that features a desk, USB ports (for networking a PC and for connecting devices like a Playstation or an iPod), and an activity seat. The activity seat would be similar to the driver's seat, except it would recline and feature a Maybach-style leg rest. For leisure, the seat would revolve 90-degrees (the seatback is parallel to the rear face of the cabin). With the seat in this position, the driver could recline to relax or view the TV.

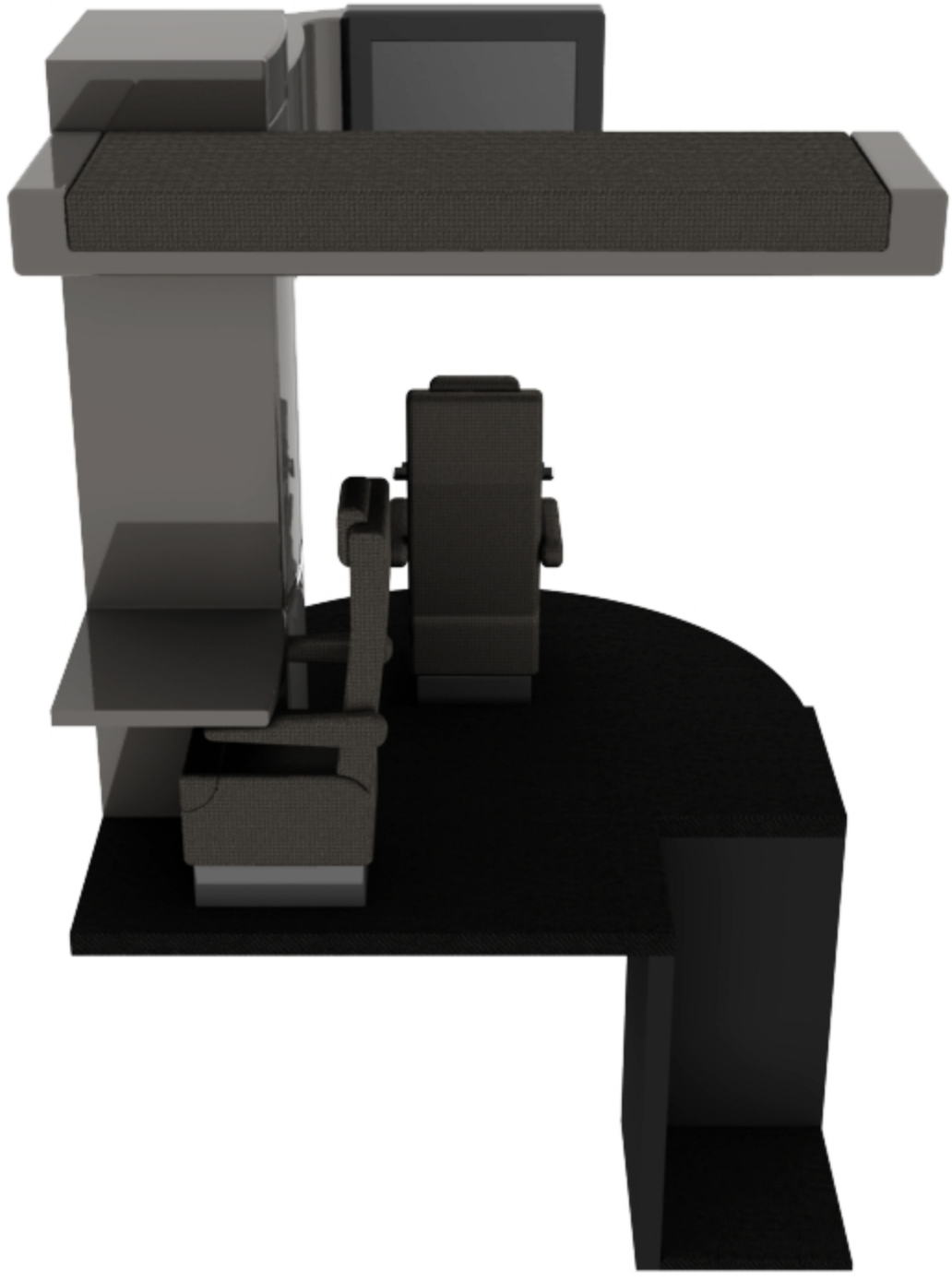
Above the elevator and workstation would be a bunk that ascends to increase headroom. Next to the elevator and the workstation would be standup consoles (one on either side of the cabin). The console next to the elevator would act as a storage facility and would include a shoe rack, drawers, closet for hanging clothes, and shelves for storing various items. The console next to the workstation would store items required for living and would include a fridge, sink, microwave, coffeemaker, and a pantry.

Cabin Features

All glass panels (the windscreen and the skylight) would feature electrochromic glazing so that the driver can adjust tint characteristics – from transparent to opaque and infinite levels in-between. The skylight would feature integrated solar cells that would assist in powering the central climate control system.







The controller is a device that would integrate the elements of a typical driving interface into an all-inclusive unit, which would simplify the driving experience. The controller is comprised of three modules: the base, the steering interface, and the CCi (command and communication interface).

The Base

This is a vertical pillar that sits between the driver's legs. At the bottom of the pillar is a block on which the driver rests their left leg and where the electronic brake/accelerator pads are placed. At the top of the pillar is a small block that houses the interface for turning on 'standby' (power is drawn from an Auxiliary Power Unit), switching on the engine, and inserting a memory card (for personalized settings).

The Steering Interface

This module sits atop the base module (on the small block). It is rectangular and is mounted horizontally. It features handgrips on either side. Behind the left handgrip is a lighting/wiper control stalk while behind the right handgrip is a three-way (RND) drive selector.

The steering interface would be fully adjustable. It would also move (vertically) in unison with the driver's seat so that the handgrips remain at the same level as the armrests. This would provide for a relaxed long-distance cruising experience.

The CCi

This module sits atop the steering interface. However, it is independent of the steering interface so it does not rotate as the driver steers.

Behind the CCi is a projector that facilitates the HUD (head-up display). The HUD would display a virtual image of an instrument cluster on the windscreen. This image would contain important information about the vehicle's status (e.g. speed, engine rpm, fuel level, engine temperature, etc).

At the rear of the CCi is a large touch-screen display unit that is the interface for interacting with the HST's supercomputer, through a 12-icon menu. All components and systems of the HST would be electronic and directly linked to the supercomputer. Thus, through this display unit, the user has access (both monitoring and control) to all functions and elements of the entire vehicle. In front of the display unit is a panel with 'shortcut' keys. The shortcut keys, which are programmable, enable the user to call up particular functions without having to navigate through the expansive (but shallow) menu of the supercomputer.

At the front of the CCi is a panel with 'function' keys. The function keys are used to control the function that is currently active (what appears on the display unit) without the driver using the display unit. For example, if satellite radio is active, pressing the "+" key adds volume whereas pressing ">" moves up a station.

The HST would be propelled by a series hybrid driveline. This configuration would allow for an electrical transmission of power (i.e. no gearbox, driveshaft, or differential) and enable high fuel efficiency.

Power Transmission

A diesel fuelled internal combustion engine (ICE) would power an electric generator – maximum power would be 440kw. This power would be channeled to two 220kw electric motors – one at each drive axle.

Efficiency

Since the ICE does not directly drive the vehicle, it would run continuously at the most efficient speed (RPM) and at the most efficient power output.

Given that power requirements vary throughout a journey (e.g. cruising on a flat stretch requires far less power than cruising on a gradient), it would be inefficient to run at a high power output when a lower power output would suffice. Therefore, the ICE would feature a variable power output system that would disable any number of cylinders to match lower power requirements. The cylinders would be disabled from the crankshaft (rather than just deprived of fuel) to avoid frictional losses.

The ICE would vary power from 110kw up to 440kw (in increments of 55kw).

Because the ICE would run continuously, when the vehicle is coasting or decelerating the unused power would be stored in batteries. Furthermore, the HST's electric motors would act as regenerative brakes (by transforming kinetic energy into electrical power) and the energy would be stored in the batteries. Even further, the semi-trailer would feature solar cells throughout its roof, and the energy captured would be stored in the batteries as well.

When power requirements are at their highest (e.g. acceleration), extra power would be drawn from the battery pack, rather than increasing the ICE's power output. This would enable the ICE to continue running at a low power output, while still allowing for powerful starts.

Layout

Electrical transmission of power would result in an innovative layout. The 16-liter, 8-cylinder ICE would be shaped like a USB flash drive (it would feature inline, horizontally opposed cylinders). Furthermore, the ICE would be placed on a pallet that would slide out from the front of the tractor. This would eliminate the need for tilting the cab.

Due to the absence of a driveshaft, the fuel tank would be a single unit that would extend laterally from the middle of the frame. This would allow for a high volume tank, in a less precarious location.

The HST would feature 'Steer-By-Wire', steering on all five axles, and a steered semi-trailer bogie.

The Interface

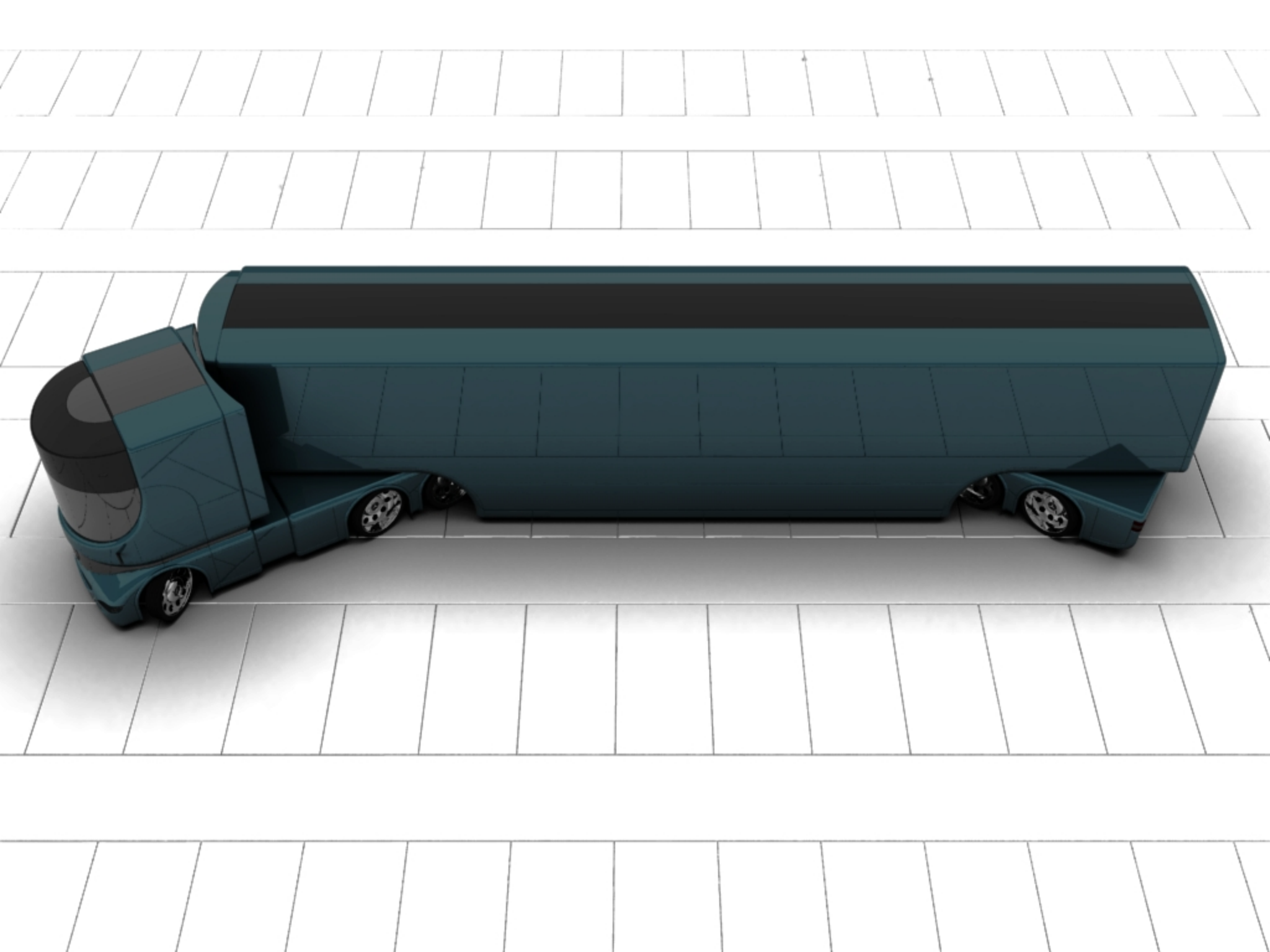
The steering interface would steer to a direct ratio (1:1) with the front axle. This would eliminate the arm-twisting typically experienced with current vehicles while providing a more direct feel. The firmness of the steering interface would be speed sensitive – i.e. it would progressively tighten as speed increases. This feature would allow for effortless maneuvering at slow speeds and firm control at high speeds.

The Axles

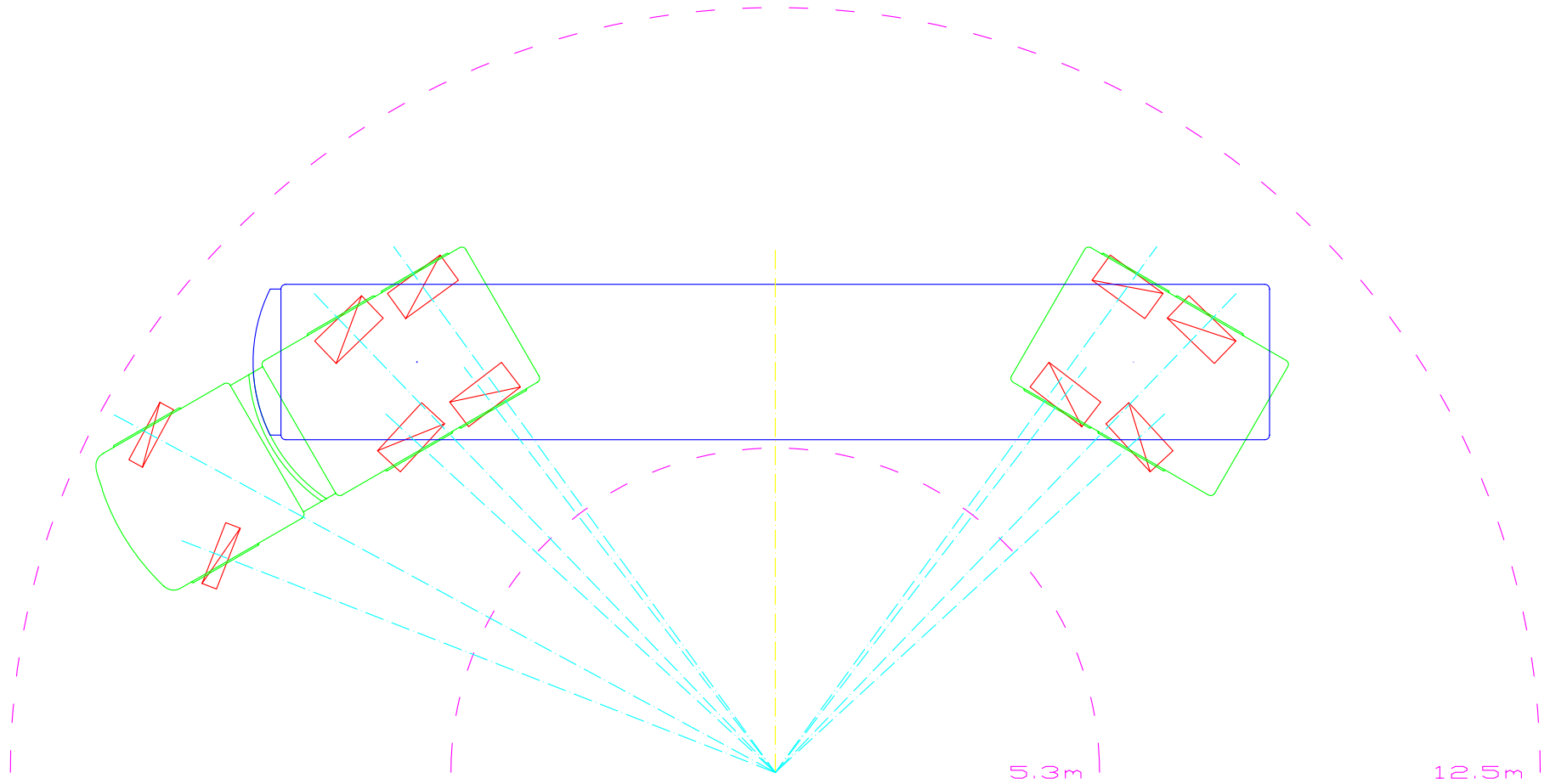
The front axle would steer to 45-degrees while the drive and semi-trailer axles (both sets would feature narrow super-single tires) steer up to 15-degrees – in directions opposite (when cornering) or parallel (when lane changing) with the front axle. This configuration would greatly enhance maneuverability while virtually eliminating tire scrub.

The Bogie

The semi-trailer axles would be fixed to an independent chassis assembly that would be connected to the framework by a turntable. The setback of the turntable would be similar to the kingpin setback. This setup would allow for a small turning radius, and as a result, superior maneuverability.



TURNING



The HST's driving experience would be sophisticated yet simple.

Entering

As the driver approaches the HST's cabin, he needs only the smart card (vehicle specific) in his pocket for complete access. When he gets to the door, he pushes a button on the door's surface and it electronically glides back. He then takes a short step onto the elevator. He pushes the 'UP' button and the door closes as he is smoothly lifted to the cabin floor. The driver proceeds to the cockpit.

Starting

When the driver is seated, he inserts his personal memory card into its slot. This card features information about his custom settings and preferences. After inserting the card, he pushes the *Engine* button and the HST comes to life. The engine roars as the CCi display unit turns on and the seat configures itself into the custom position set by the driver.

The system greets the driver (by voice) and requests him to key in his password. The Mercedes-Benz logo on the CCi display begins to revolve as the system briefly configures itself. When the system is ready, the CCi display shows the main menu. From the main menu, the driver configures his environment (e.g. audio, climate control, etc) and the journey's parameters (e.g. navigation, cargo info, etc).

Driving Off

When the driver is set to go, he shifts the ‘gear’ selector into the *Drive* position and pushes the *Parking Brake* button to disengage it (however it is still active, as it only disengages when the driver actually presses on the accelerator pad).

To move off, the driver presses on the accelerator pad and the HST takes off. The vehicle accelerates smoothly and powerfully.

Cruising

When the driver has reached his desired speed, he activates *Cruise Control* and *Brake Control*, and the vehicle nearly drives itself. *Cruise Control* maintains the set speed while *Brake Control* slows the vehicle to maintain the set distance (based on the current speed) between itself and the vehicle ahead. *Brake Control* could bring the vehicle to a complete stop if necessary, and as the vehicle ahead moves off, *Cruise Control* would automatically accelerate the vehicle up to the previous speed.

The driver can override both systems. Pressing the accelerator pad deactivates *Cruise Control*, but the system would enquire whether the driver wishes to set the new speed. Pressing the brake pad deactivates *Brake Control*, although *Brake Assist* (similar to Mercedes-Benz passenger cars) remains active.

Central Nervous System

A supercomputer would be the nucleus of the HST. Apart from linking the components, functions, and systems of the entire vehicle into a common interface, the supercomputer would simplify the driving experience by assisting or controlling its elements, thereby leaving the driver with a simplified role.

Assistance & Control

The supercomputer would be developed to operate in an advanced state of intelligence that would replace or complement conventional human command. It would have the capacity to sense the driving situation and environment. Thus, the supercomputer would know the best course of action to take in any situation (e.g. accident avoidance, driveline performance management, headlight activation, etc) and would act accordingly.

Driver's Role

The driver would now assume an administrative/supervisory role, as the vehicle handles the details. This would not only provide for an effortless driving experience, but it would also simplify driver training while encouraging driver recruitment – truck driving could be transformed into a "white-collar" type profession (like aircraft piloting).

DIMENSIONS

(European Spec)

Overall Length (Combination):	64 ft	-	19.50m
Overall Length (Semi-trailer):	53 ft	-	16.15m
Overall Width:	100.5”	-	2.55m
Overall Height:	157.5”	-	4.00m
Front Overhang:	48”	-	1.20m
Wheelbase (Tractor):	144”	-	3.65m
Wheelbase (Semi-trailer):	406”	-	10.3m
Front Track:	90”	-	2.30m
Drive/Semi-trailer Track:	80”	-	2.05m
Kingpin/Turntable Setback:	87”	-	2.20m
Tandem Axle Spacing:	55”	-	1.40m
Bumper to Back of Cabin:	108”	-	2.75m
Back of Seat to Back of Cabin:	60”	-	1.50m
Floor Height (Sleeper):	60”	-	1.50m
Interior Height (Sleeper):	94”	-	2.40m
Cargo Capacity (1.2m x 1m Pallets):	32		

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