

Jeffy and Unity introduce
some amazing things about the
Furukawa Electric Group!

Jeffy

(Elder brother with
uniform number 2)

Unity

(Younger brother with
uniform number 9)



Jeffy and Unity are the team characters of
Jef United Ichihara Chiba.



JEF UNITED
ICHIHARA CHIBA
Furukawa Electric supports
Jef United Ichihara Chiba.

Furukawa Here and There

Actually...

Furukawa Electric Group
products are used in many
situations in our daily lives.

You may not see Furukawa Electric Group products
in your day-to-day life, but rest assured—they are
being put to use wherever you are.

“Furukawa Here and There” is a series of amazing
stories covering lifestyle situations and topics about
Furukawa Electric products.

Read on for more about the Furukawa Electric
Group—here and there.

“Automobiles” Issue

Automobiles are crucial means of transportation
for transporting people and supporting logistics.
Although it is important to improve safety and comfort,
resolving environmental and natural energy problems
is an important global issue. Automobiles continue to
evolve thanks to many technological innovations such
as improved drive-trains (engine/motor) and lighter
vehicles—with the goal of improving fuel efficiency,
reducing CO₂ emissions, and reducing our reliance on
fossil fuels such as gasoline. This evolution is being
accelerated by the push toward self driving technology,
which will create a completely new style of automobile
society.

The Furukawa Electric Group uses a range of
technologies—mainly focusing on copper, aluminum,
plastic, and optical elements—to help evolve
automobiles from various angles.

One day, at a JEF away game...

JEF won!
What a
match!

It really
was!

Yay!

Alright!
Let's head
back!



Let's see if we can figure out how Furukawa Electric Group helps daily life on our way back.

For Safe and smooth starting

Here we go!

Wire harnesses and connectors

Bundles of **thin copper wires**^{*1)}, **wire harnesses (W/H)**^{*2)} deliver electricity and signal to every part of the vehicles. Similar to how nerves or blood vessels function in a human body, W/Hs are crucial components which create electrical connections between electrical parts.

W/Hs are completed by attaching connectors^{*2)} to each end of wires, to connect them with electrical components. **Tin-plated copper alloy strips**^{*3)} are used on the surface of the connector terminals, which serves as an important contact point through electricity and signals flow.

*1) Electric Conductor Division, Furukawa Electric

*2) Furukawa Automotive Systems Inc.

*3) Copper & High Performance Material Products Division, Furukawa Electric



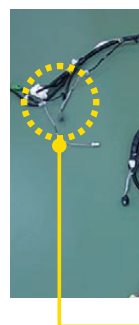
Aluminum wire harness anti-corrosion terminals (α Terminal Series)

The amount of W/Hs inserted in each vehicle increases as computerization and functionality of the vehicle develops, in order to improve safety and comfort. In such situation, **aluminum W/Hs**^{*2)} which are made out of **aluminum alloy wires**^{*1)} are contributing to lighten the weight of vehicle, as aluminum is lighter than copper.

Anti-corrosion terminals (α Terminal Series)^{*3)} for aluminum W/Hs are specially processed using fiber lasers to prevent water from entering and corroding wires—making aluminum wires easier to use and helping to spread their usage.

*1) P.T. Tembaga Mulia Semanan (TMS)

*2), 3) Furukawa Automotive Systems Inc.



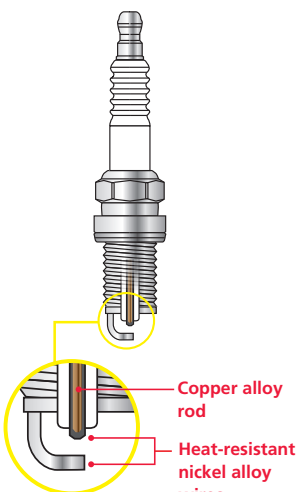
Furukawa Electric Group plays a big role in engines parts as well.

Spark plug electrode material

Gasoline vehicles generate motive power through pistons caused by combusting a mixture of gasoline and air. Spark plugs are responsible for generating sparks and igniting this air-fuel mixture at a voltage from 20,000 to 30,000 V. A **copper alloy rod**^{*2)} is used in the copper core of the central electrode, while **heat-resistant nickel alloy wires**^{*1)} are located at opposite ends. They offer superior heat-resistance and durability, and boast a long life service even in harsh environments. They are crucial components for driving.

*1) Furukawa Techno Material Co., Ltd.

*2) Copper & High Performance Material Products Division, Furukawa Electric



Rectangular enameled wires for alternators

Alternators are power generators that convert engine torque into electricity for battery storage. **Rectangular enameled wires for alternator coils** help to make alternators more efficient, small, and powerful.

► Furukawa Magnet Wire Co., Ltd.

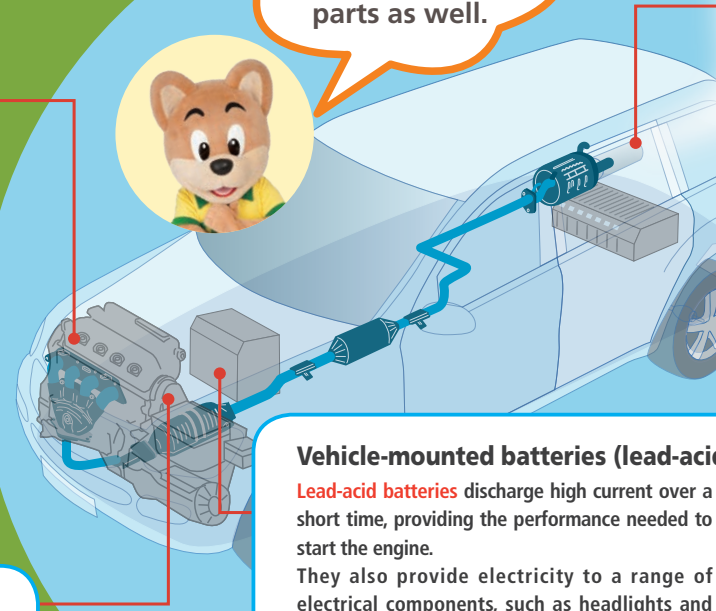


Vehicle-mounted batteries (lead-acid)

Lead-acid batteries discharge high current over a short time, providing the performance needed to start the engine.

They also provide electricity to a range of electrical components, such as headlights and other lights, navigation systems, wipers, and A/C systems. When the vehicle is driven normally, the power generated by the alternator is stored in the battery to recover the amount that was discharged. These batteries offer a long life service by repeating the cycle of charge/discharge.

► The Furukawa Battery Co., Ltd.



Wow!
They really
are like blood
vessels!

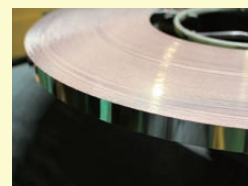
Furukawa
Electric products
take full
advantage of
the materials

Materials technologies also help to make driving comfortable

The materials technologies which Furukawa Electric Group has developed are found in the alloy materials used for terminals in wire harnesses (W/H) and connectors, so as to send secure and rapid electrical signals to vehicles and support intelligent driving.

For example, tin-plated copper alloy strips. Plating prevents oxidation of the copper used in terminals, helping to keep copper stable for a long time. The tin itself is modified to assemble easily.

Anti-corrosion terminals for aluminum W/Hs (α Terminal Series) use an alloy mixed with nickel (Ni) and silicone (Si) inside copper. These can be bent into small shapes, while keeping world highest level of strength with Furukawa Electric's unique blend and technology. This strength and bendability help to save space and create lighter vehicles.



Copper alloy strips



α Terminal

Copper
alloy strips

Aluminum wires

Automotive exhaust gas pipes (thin-walled welded metal pipes)

Automotive braided packing (stainless steel wires)

Thin-walled stainless steel pipes (flexible tubes)^{*1)} inserted in the rear of the vehicle to exhaust gas generated from the engine. Extremely thin with high uniformity, water-tightness, and air-tightness, they even withstand a severe process of shaping into a bellows which absorb vibration from the engine. **Stainless steel wires**^{*2)} are used as packing to connect pipes. This packing material has a finely braided mesh (knitted mesh weave) to connect pipe connections firmly, ensuring that high temperature exhaust gas (at several hundreds of degrees Celsius) go through without leakage.

*1) KANZACC Co., Ltd.

*2) Furukawa Magnet Wire Co., Ltd.



Flexible tubes



Stainless steel wires

Alright!
Let's drive
home safely!



batteries)



For eco-friendly and comfortable driving



I see!
Amazing!

Relay boxes/joint boxes

Relay boxes and **joint boxes**^{*1)} distribute electricity and signals to electrical components inside vehicles, providing drivers with access to a range of functions with the flip of a switch. These devices play an important role in providing high reliability.



Commands are sent through **copper alloy strips**^{*2)}, and extremely thin **enameled wires**^{*3)} coils turn switches on/off. They provide a safety feature that cuts off electricity to prevent fires even if a short circuit occurs.

*1) Furukawa Automotive Systems Inc.

*2) Copper & High Performance Material Products Division, Furukawa Electric

*3) Furukawa Magnet Wire Co., Ltd.

Really important!



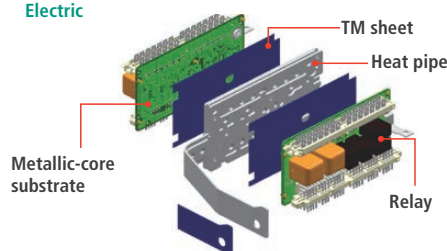
Heat-dissipation/cooling (thermal) products

The heat must be controlled, as many components of vehicle generate heat. For example, relay boxes and joint boxes heat up due to passing through several electronic circuits. However, **metallic-core substrates**^{*1)}, which install copper plate in the center of the circuit board, disperse heat throughout the entire circuit and make temperature distribution uniform. Highly conductive and flexible adhesive **TM sheets**^{*2)} attached to parts that generate heat, pass heat through a **heat pipe**^{*3)} to efficiently disperse heat efficiently, helping to make smaller and lighter products.

*1) Furukawa Automotive Systems Inc.

*2) Furukawa Electric Power Systems Co., Ltd.

*3) Thermal Management Solution & Products Division, Furukawa Electric



Not only engine parts, but also plays a big role in function of the inside.



Foamed air ducts for A/C systems

Foamed air ducts that offer superior heat resistance and are lighter than conventional resin products, are used for A/C pipes to prevent condensation and mold, and to makes A/C systems run quieter.

► AT & Functional Plastics Division, Furukawa Electric



Seat heaters

Seat heaters directly heat seats and offer rapid heating performance, so they use less power and heat quicker than A/C (heating) systems, which heat the entire vehicle. Furukawa Electric continues to seek the optimal materials and manufacturing methods to support a wide range of models and seat shapes, and uses highly bendable and safe heater wires. Furukawa Electric products have continued to ensure safety and security for more than 10 years.

► Totoku Electric Co., Ltd.

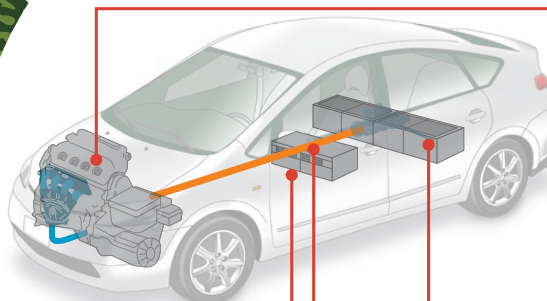


Heater wires sewn into a seat

Electric vehicles [EV] or hybrid vehicles [HV] can be referred to "electric vehicle".

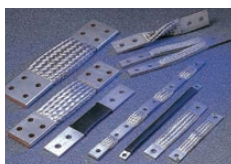


This illustration shows an HV.



Flexible terminals

These are used to provide high power in electric vehicles, connections for inverter circuits and around batteries, etc. Created from flat-braided copper wires, these products can be bent or twisted into complicated shapes, and can withstand expansion and shrinking caused by vibration or heat.



► Furukawa Electric Power Systems Co., Ltd.

Extruded rectangular enameled wires for electric vehicles

These magnet wires are used in drive motor stators found in electric vehicles (EV) and hybrid vehicles (HV). High voltage motors are required for electric vehicles and hybrid vehicles, which require high motive power. **Extruded rectangular enameled wires for electric vehicles** feature a layer of extruded resin around highly heat-resistant enameled wire. In addition to securing an insulation layer formed of highly heat-resistant engineering plastic and providing a high level of voltage resistance, they feature an improved lamination factor thanks to their rectangular shape that allows them to be wrapped without any gaps. It helps to create smaller and lighter motors as it eliminates the need for insulation paper and reduces the amount of copper used.

Furukawa Electric holds the top market share in magnet wires for HV motors due to its advanced technological strengths!

► Furukawa Magnet Wire Co., Ltd.



Wire harnesses for electric vehicles

Drive motor electricity for electric vehicles is transmitted through **high voltage/large-current wire harnesses**. These offer noise shielding (to block electromagnetic waves generated by parts such as the motor circuit) and high insulation performance, preventing malfunctions or image corruption of navigation system caused by noise signals. A range of techniques are also used to develop lighter products.

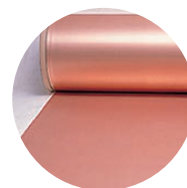
► Furukawa Automotive Systems Inc.



Electrodeposited copper foil for lithium ion batteries

NC-WS electrodeposited copper foil is used for the negative electrodes in lithium ion batteries for electric vehicles. Its surface is flexible (to withstand repeated shrinking and expansion as electricity is charged and discharged) and smooth (so that the active material transferring electrons is attached evenly), for highly stable quality. As an "industry pioneer" product it leads the market due to its superior thermal stability and workability, which plays a role in improving productivity and increasing battery capacity for battery manufacturers.

► Copper Foil Division, Furukawa Electric



Automotive interior lighting

MCPET is a curious plastic with an optical reflectivity greater than that of a mirror. It can be formed and shaped for use as a case for lights, eliminating the need for separate optical reflective plates and light cases, and making it possible to develop bright interior lights that are lighter and use less energy.

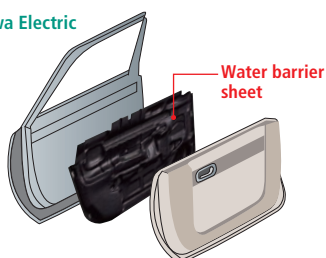


► AT & Functional Plastics Division, Furukawa Electric

Door water barrier sheets

Installed between the steel panels on the inside and outside of doors, **water barrier sheets** prevent water from entering the vehicle. They are made from a foamed resin material for excellent thermal barrier and sound barrier performance.

► AT & Functional Plastics Division, Furukawa Electric



For safe and secure driving

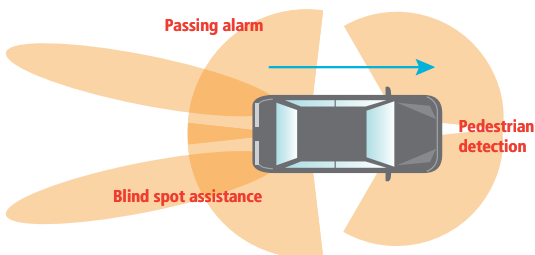
Watch out!



Perimeter monitoring radars

These advanced driving support systems help to prevent accidents from happening. **Perimeter monitoring radars** detect pedestrians and obstructions to the rear of vehicles and in blind spots. Furukawa Electric's internally developed sensing technology combines signal transmission and high frequency technologies, for accurate recognition from close range (several dozen meters) to ultra-close range, helping to ensure safety. It uses electromagnetic waves for accurate operation even at night or during poor weather.

► Furukawa Automotive Systems Inc.



It gives us peace of mind in any situation!

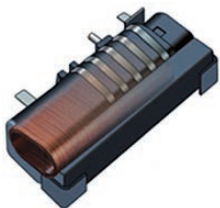


Ribbon wires for HID headlights

Ribbon wires are used in the booster transformer coils found in high-intensity discharge (HID) headlights, in which light is generated by applying high voltage between electrodes and using the discharge phenomenon.

These headlights require only a low voltage to stay bright once turned on, helping to reduce power consumption.

► Furukawa Magnet Wire Co., Ltd.



Woah!

Screech



Helps to save the environment!

Batteries specialized for vehicles with idling stop systems

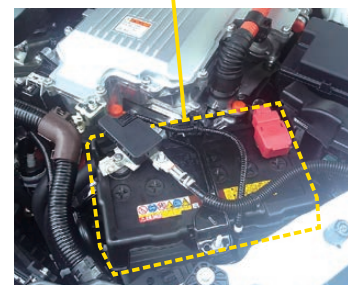
The idling stop function stops an engine when the vehicle stops such as when waiting for a light or in heavy traffic. Although this is great for the environment, it can be rough on the battery. This increases the number of times the engine starts more than tenfold, and the battery tends to be insufficient charging since the battery stops charging while the engine stops. In some cases, idling stop may even stop working. **ECHNO IS Ultrabattery** is a battery specialized for vehicles with idling stop systems. It combines a lead-acid battery with an ultracapacitor to enable quick and highly efficient charging, which 30% improved charging acceptability, as well as improved durability for double the service life. It helps to improve fuel efficiency and reduce CO₂.

► The Furukawa Battery Co., Ltd.

Lead battery status detection sensors

The keys to improve fuel efficiency and extend service life are avoiding battery overcharge/over-discharge and preventing the battery from being fully charged at all times. **Lead battery status detection sensors** monitor the battery's charge/discharge current, voltage, and temperature, and measure its internal resistance to accurately estimate the battery status such as the charge rate, discharge performance, and battery fluid temperature. In addition to extending the life of the battery and preventing it from being used up, this also helps to improve fuel efficiency and reduce CO₂ by stopping the alternator and reducing the load on the engine when the battery is sufficiently charged.

► Furukawa Automotive Systems Inc



Wow!
I had no idea!

Steering roll connectors (SRC)

Steering roll connectors^{*1)} transmit electrical signals to the switches around the steering wheel, and send the command to deploy the driver's side airbag if an impact is detected during an accident. **Flat cables^{*1)}**, in which a rectangular conductor is sandwiched between pieces of film, move flexibly as the steering wheel rotates. **Tin-plated copper alloy strips^{*2)}** are used to reliably connect signals for terminal contacts directly mounted using Furukawa Electric's unique connection technology. Furukawa Electric boasts the top market share in the world (40%) due to their development power, low costs, and high reliability!

*1) Furukawa Automotive Systems Inc.

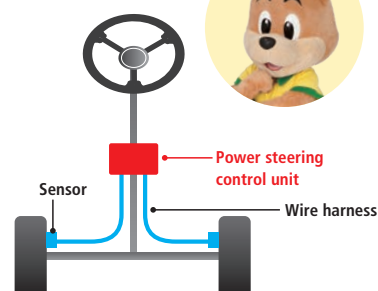
*2) KANZACC Co., Ltd.



Power steering electronic control units (ECU)

Power steering electronic control units provide just the right amount of assistance to allow the steering wheel to be turned with a minimum of force at low speeds. Sensors detect a range of detailed information (such as steering wheel [tire] rotation and the vehicle speed) to provide just the right amount of computer-controlled assistance.

► Furukawa Automotive Systems Inc.



So that's
why steering
is so easy!



Watch out!

Screech!



For the Smart Vehicle Society

Ah!
It says there's
some traffic up
ahead!

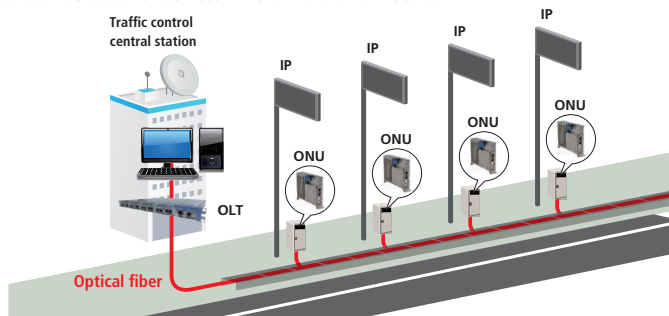
Traffic ahead

Wow!
How useful!

IP telecommunications systems using GE-PON

IP communication systems using GE-PON are used for the systems that monitor traffic conditions and provide information in real-time. These systems use optical couplers to distribute information to multiple sites or to concentrate information from multiple sites, making high-speed IP communications over single mode optical fiber possible between an OLT (optical line terminal) at a central station and ONUs (optical network unit) in multiple locations.

► Broadband Solutions Business Division Furukawa Electric



Power gate electronic control units (ECU)

"Boxes" called **power gate electronic control units** that send commands (signals) make it possible to automatically open and close backdoors with a single flip of a switch. They are equipped with automatic reversal functionality to ensure safety even if the door closes on something (or someone).

► Furukawa Automotive Systems Inc.



Geez!
More shopping?
Isn't this a bit
too much?

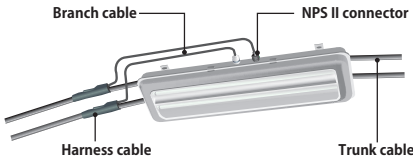
Heh.
Don't worry
about it!
It'll fit!



Branch cables for tunnel lighting
Tunnel harness cables

Tunnel harness cables are used to efficiently transmit power to lights. They connect easily to lights for easier work and maintenance—just plug it in. They help to drastically reduce on-site work costs.

► **Furukawa Electric Industrial Cable Co., Ltd.**



Harness cable branch section



Three-core type (NPS II-3 connector)

Aqualex

Tunnel fire extinguishing pipes

Aqualex pipes are used to supply water to fire extinguishers in tunnels. They can withstand bending, are difficult to crack, and offer excellent earthquake resistance. Light and extendable, they work best for short-term construction in long tunnels.

► **AT & Functional Plastics Division, Furukawa Electric**



What a relief!

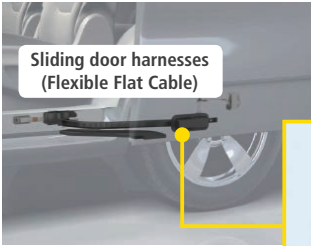


JEF UNITED

Sliding door harnesses

Sliding door harnesses are used to transmit electricity and signals between the vehicle body and doors, so that power windows can be opened and closed with a single flick of a switch—even if the sliding door is open. They can be bent repeatedly and stored in narrow spaces, helping to create smaller and lighter products.

► **Furukawa Automotive Systems Inc.**



For the future towns

Smart cities

Smart cities are environmentally-conscious cities, which use IT (information telecommunications technology) to use energy more efficiently. Countries all over the world are enthusiastically conducting verification testing using major smart grid technologies. Among these are automobiles, which are considered “terminals” in a smart city. The Furukawa Electric Group uses a wide range of smart grid-related technologies, such as automobiles, energy transmission and distribution, superconductors, information telecommunications, and power storage, in order to meet a wide variety of needs when building these towns and to contribute to a low carbon society.

Container type power storage systems

These systems make effective use of power of photovoltaic generation with battery in plants or large hospitals—for example, including backup power during outages, peak cutting during normal situations, storage of excess power/nighttime power, and linking with solar power generation. Major devices such as power storage and control devices are contained in a single container, helping to reduce on-site installation work.



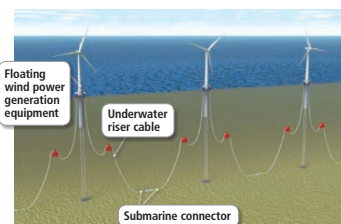
50 kW, 288 kWh (10 HR) (example) lead-acid battery system

Assembled battery unit (assembled from 24 batteries)

► Broadband Solutions Business Division, Furukawa Electric

Riser cables for offshore wind power generation

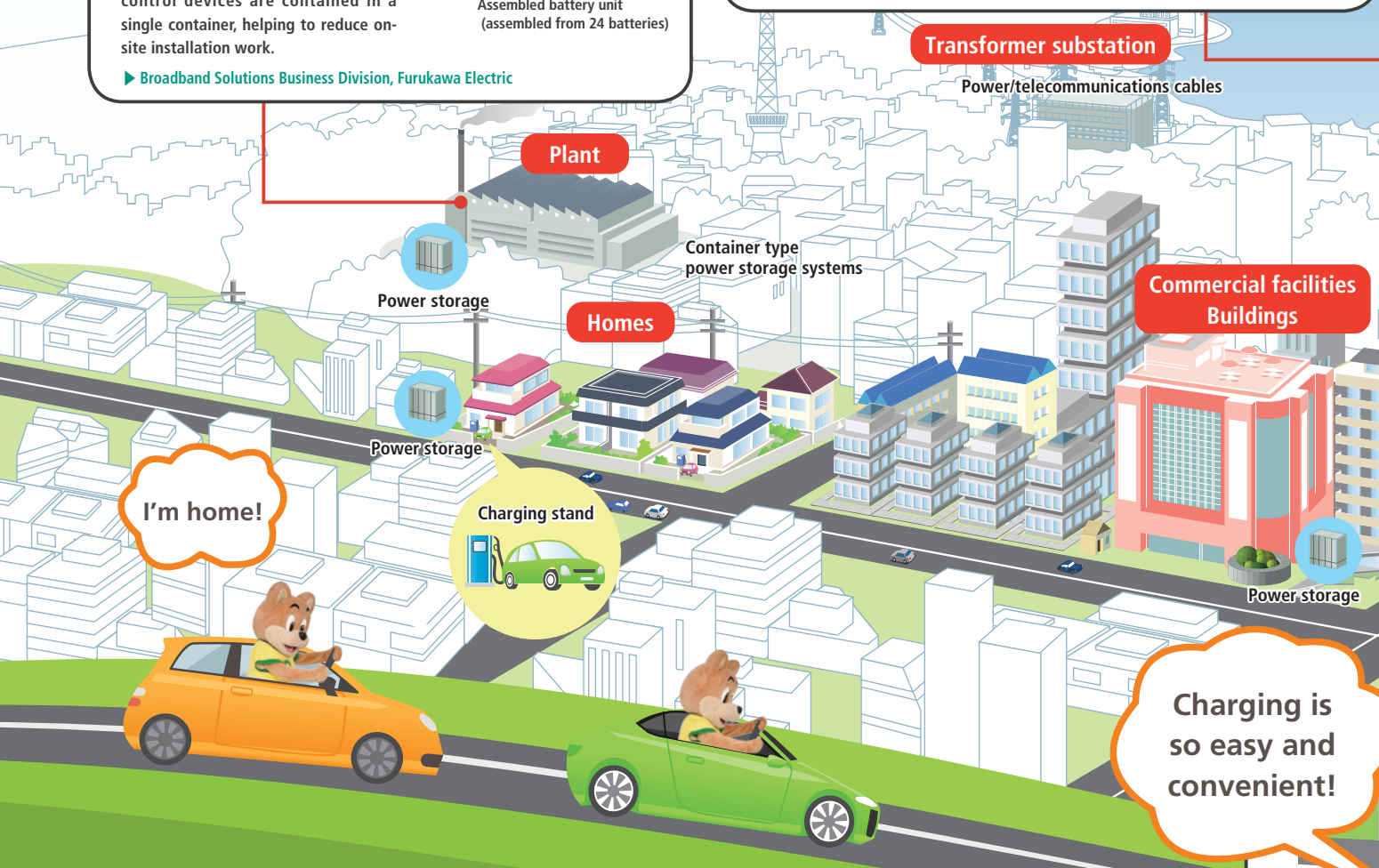
These cables are connected to floating wind turbine and left floating underwater, for use when transmitting generated power and control signals back to land in offshore floating wind turbine systems. They are able to move dynamically in harsh environments such as locations directly exposed to waves, tides, and disturbance of floating bodies, ensuring that electricity and signals are reliably transmitted and received.



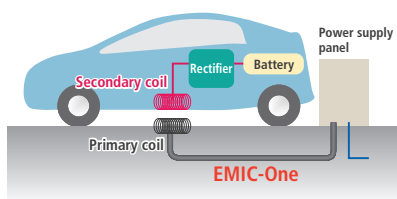
► Oceanic Wind Power Project Team, Power Cable Division, Furukawa Electric

Transformer substation

Power/telecommunications cables



Alumi-Litz wires for non-contact charging systems Non-contact power supply cables



EMIC-One



ALC-fine Litz77

Wireless power supply makes it possible to charge electric vehicles by just stopping at a charging spot. Magnetic flux is generated perpendicular to the ground by sending current to the primary coil of an “aboveground power transmission unit” installed on the surface of the road. When the secondary coil of the “vehicle-mounted power reception unit” installed in the vehicle is brought over the primary coil, it generates voltage and electrical energy is supplied from the primary coil to the secondary coil. **EMIC-One** (an underground multicore conductor cable used to supply high frequency current) supplies the high frequency large current from the power supply panel to the primary coil on the surface of the road. Multicore insulated wire is used for the conductor, and the entire cable is covered with a corrugated metal pipe so it can be buried underground without any protective pipe—for easy and economical installation. **ALC-fine Litz77** high functionality Alumi-Litz wire, which is lighter than copper wire, is used for the secondary coil installed in the vehicle.

► KANZACC Co., Ltd.

Wind power generation tower internal cables and plugin connectors

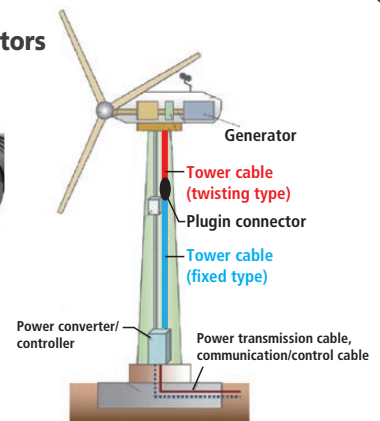
Wind power generation tower internal cables^{*1)} play a role in transmitting power generated by generators on towers. There are two types: twisting wires that twist as the generator portion (nacelle) turns, and fixed wires that are not affected by twisting. Twisted wires are formed from several copper wires and covered in rubber, allowing them to withstand repeated bending and twisting over a long period of time. **Plugin connectors^{*2)}**, which allow different types of cables to be connected without fuss, help to reduce time spent connecting cables in towers.

*1) Furukawa Electric Industrial Cable Co., Ltd.

*2) Furukawa Electric Power Systems Co., Ltd.



Plugin connector



Offshore floating wind power generation

Windmill tower cable

Riser cable
Submarine cable

Solar power generation

Cables for large-scale solar photovoltaic systems

Charging stand

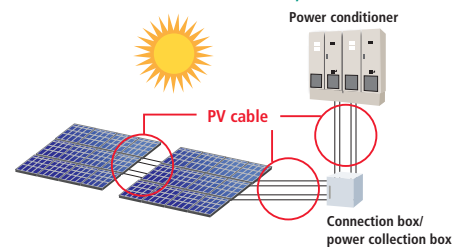
Parking lot

Cables for large-scale solar photovoltaic systems

DC1500V PV-CQ

These cables for 1,500 VDC solar photovoltaic systems are used for large-scale solar power generation (such as mega-solar power). With superior resistance against weather, light, heat, cold, external damage, and fire, these halogen-free eco-cables are also kind to the environment.

► Furukawa Electric Industrial Cable Co., Ltd.



V2B+ lithium ion power storage systems

These systems allow power to be efficiently used in commercial facilities and condominium buildings. They can also charge and discharge electric vehicles—for example, a system could discharge power from electric vehicles during a power outage to operate the water pump on the roof of a building to provide water inside the building.

► Broadband Solutions Business Division Furukawa Electric



Quick charge connectors and cables Low abrasion silver-plated covering

Quick charge connectors^{*1)} are used to connect to electric vehicles when charging. They are easy to use and can be used intuitively with very little strength. **A low abrasion silver-plated covering (anga-U plus)^{*2)}** that is hard and offers superior durability is used on the connector pins, allowing it to withstand repeated connection and disconnection. **Quick charge cables^{*3)}** connect plugs with chargers. Their excellent flexibility allows for stress-free use.

*1), *3) Furukawa Electric Industrial Cable Co., Ltd.

*2) KANZACC Co., Ltd.



Power supply wires inside quick chargers

EM-LMFC is used as the wiring material inside electric vehicle quick chargers. Thin and flexible, this material helps to keep chargers compact.

► Furukawa Electric Industrial Cable Co., Ltd.



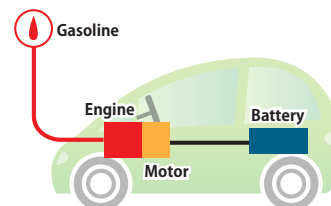
Types of Next-generation Automobiles

Hybrid vehicles (HV)

These vehicles combine an engine with an electric motor, and make efficient use of both types of motive power. In addition to generating power from the engine, regenerative braking* is used to store power so that they can run without external charging. At least 20% of all new vehicles in Japan are HVs.

*Regenerative braking

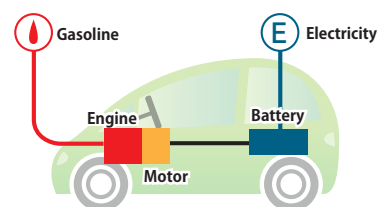
A system that uses the motor as a generator during deceleration when the accelerator is released, recovers energy, and charges the battery.



I drive a PHV

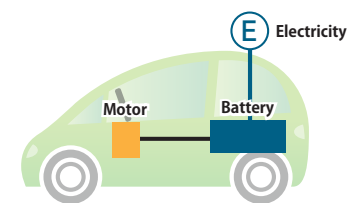
Plug-in hybrid vehicles (PHV)

These vehicles feature larger batteries than HVs (such as lithium ion batteries), allowing them to travel further on just motor power alone (EV driving) and to be charged from an outlet or the like. Because they have a further EV driving distance, they emit even less CO₂ and can also run on the engine using gasoline. They can even be used as power sources when camping or during an emergency.



Electric vehicles (EV)

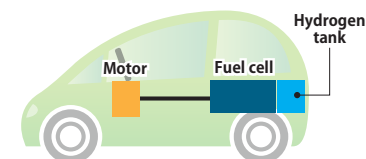
These vehicles have no engines, and run solely on electricity stored in batteries from an external source, such as a home outlet. These eco-friendly vehicles emit no CO₂ whatsoever when driving. The distance they can travel on a single charge continues to increase, and they are expected to continue to gain popularity as advances are made to charging infrastructures.



I'm ahead of the curve in my FCV!

Fuel cell vehicles (FCV)

These vehicles contain fuel cells that generate electricity through chemical reactions between hydrogen and oxygen in air, which operate the motor. They emit only water when driving, so they could be said to be the ultimate eco-friendly vehicles. Once more hydrogen stations, which supply hydrogen as fuel are installed, it will be possible to drive these vehicles long distances without worry, making them just as convenient as conventional vehicles.

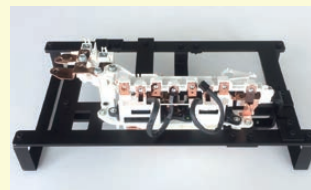


High performance products are being used as vehicles evolve!

High voltage terminal blocks

All of these vehicles, from HVs to FCVs, are called "electric vehicles." High voltage which is several score times more than gasoline vehicle flows though, so it is crucial to make sure that batteries and devices are connected safely. High voltage terminal blocks are made from insulated resin material capable of withstanding high voltages, as well as special design and treatment technologies to ensure safety.

► Furukawa Automotive Systems Inc



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