4.2 Energy and carbon management

The TWSE and its subsidiaries mainly provide financial and IT services, and the majority of its energy consumption is by its offices (including public facilities) and data centers, as well as gasoline consumption by company cars and diesel fuel consumption by backup power generators. In 2022, the TWSE and its subsidiaries first completed its GHG Inventory Report in accordance with ISO 14064-1:2018, establishing the year 2022 as the inventory base year, in order to measure our greenhouse gas emissions and to formulate our carbon reduction plans accordingly.

- Energy usage

Item	2023		2024	
	Energy consumption	GJ	Energy consumption	GJ
Gasoline (liters)	14,485.03	473.04	12,234.02	399.32
Diesel (liters)	10,918.32	383.99	8,662.00	304.47
Purchase of non-renewable energy (kWh)	16,378,523.26	58,962.68	11,779,138.91	42,404.90
Purchase of renewable energy (kWh)	3,041,983.00	10,951.14	9,782,483.00	35,216.94
Self-generated renewable energy (kWh)	5,149.00	18.54	16,330.00	58.79
Total energy consumption (GJ)	-	70,789.39	-	78,384.42
Energy intensity (GJ/person)	-	51.90	-	56.19

Note 1: This report covers data from the TWSE, TWCA, TIP, the TDCC, FundRich, and the TCX in 2024 and 2023, adjusted according to the GHG inventory results with assurance for such year. All calculations are rounded to the nearest two decimal places.

Note 2: The heating value coefficient is based on the Ministry of Environment's Greenhouse Gas Emission Coefficient Management Table 6.0.4 version, with gasoline at 7,800 Kcal/liter and diesel at 8,400 Kcal/liter.

Note 3: 1 gigajoule (GJ) = 10^9 joules (J); 1 kilocalorie (Kcal) = 4,186.8 joules (J); 1 kilowatt hour (kWh) = 3.6 megajoules (MJ)

Note 4: The energy types covered by the energy intensity ratio are fuel and electricity, and this ratio uses the energy consumption within the organization. Energy intensity is calculated based on the number of employees as of December 31 of that year, with 1,395 employees in 2024 and 1,364 employees in 2023.

Note 5: The types of greenhouse gases covered include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6), and nitrogen trifluoride (NF_3).

To enhance the credibility of the inventory report, the TWSE acquired third party verification for Category 1, Category 2, and Category 4 of our GHG Inventory Report in 2024 (see Note). The inventory scope includes Category 1's direct greenhouse gas emissions (refrigerants, gasoline, diesel, etc.), Category 2's indirect greenhouse gas emissions from imported energy (electricity), Category 3's indirect greenhouse gas emissions generated by transportation (business travel emissions), and Category 4's total indirect greenhouse gas emissions caused by organizations' use of products (capital goods, fuel, and energy-related activities).

Note: The TWCA, TIP, and the TCX have acquired third party assurance for Category 1 and Category 2. Please refer to the TDCC 2024 ESG Report for the third-party verification statement of the TDCC and FundRich.

- Greenhouse gas emissions

Item	2023	2024
Category 1 direct GHG emissions (tCO_2e)	512.21	500.63
Category 2 indirect GHG emissions from imported energy (tCO_2e) (by location)	9,598.54	10,651.44
Category 2 indirect GHG emissions from imported energy (tCO_2e) (by market)	8,095.61	5,818.89
Category 3 indirect GHG emissions from transportation (business travel) (tCO_2e)	268.63	196.67
Category 4 indirect GHG emissions from products an organization uses (capital goods, fuel, and energy-related activities) (tCO_2e)	4,986.72	9,228.38
Total (tCO_2e) (by location)	15,366.10	20,577.13
Total (tCO_2e) (by market)	13,863.17	15,744.59

Note 1: This report covers data from the TWSE, TWCA, TIP, the TDCC, FundRich, and the TCX in 2024 and 2023. All calculations are rounded to the nearest two decimal places.

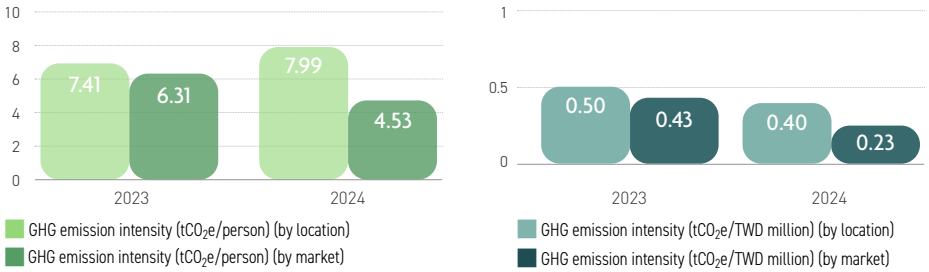
Note 2: The calculation of greenhouse gas emissions is based on the operational control approach. The calculation method is activity data multiplied by the emission coefficient multiplied by GWP values. The emission coefficient is based on the Ministry of Environment's Greenhouse Gas Emission Coefficient Management Table 6.0.4. GWP values are based on the IPCC's Sixth Assessment Report published in 2021. If there are no updates in the Sixth Assessment Report, the calculations should be based on the content of the IPCC's Fifth Assessment Report published in 2013.

Note 3: For Category 2 greenhouse gas emissions, purchased electricity is the main source. In 2024 and 2023, the electricity emission factors are based on the Bureau of Energy, Ministry of Economic Affairs' 2023 and 2022 electricity emission factors of 0.494 and 0.495 $kgCO_2e/kWh$, respectively.

Note 4: The types of greenhouse gases covered include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6), and nitrogen trifluoride (NF_3).

Note 5: In accordance with GHG Protocol Scope 2 Guidance (2015), the TWSE discloses Scope 2 emissions according to both the location-based and market-based methods due to its own and its subsidiaries' purchase of renewable energy. For Category 2 emissions in the above table, location-based emissions are calculated by multiplying total electricity consumption by the average electricity emission factor of the location, while market-based emissions are calculated by multiplying solar power used and the amount bought through the power purchase agreement with Taiwan Power Company with the contract source emissions factor.

Greenhouse Gas Emission Intensity (Category 1 + Category 2)



Note 1: GHG emission intensity is calculated based on the number of employees as of December 31 of that year, with 1,395 employees in 2024 and 1,364 employees in 2023.

Note 2: GHG emission intensity is calculated based on the consolidated revenue for that year with TWD27,806 million in 2024 and TWD20,194 million in 2023.

Use of renewable energy

To mitigate climate change, the TWSE strongly supports the government's promotion of renewable energy use. In 2024, all the TWSE offices in Taipei 101 continued its 100% use of green energy. The First Data Center completed its purchase of green energy, began using green energy in March 2024, and achieved its short-term goal of RE50 in 2024. In addition, the First Data Center completed the installation of solar panels and energy storage equipment, generating 16,330 kWh of electricity in 2024, with a carbon reduction benefit of approximately 8,067 kg of CO2e. In 2024, the proportion of the TWSE's use of renewable energy has grown to 56.56%, significantly higher than the previous year's 19.52%.

- TWSE renewable energy use

Year	Energy used (kWh)	% of total energy used
2023	2,852,617	19.52%
2024	9,231,246	56.56%

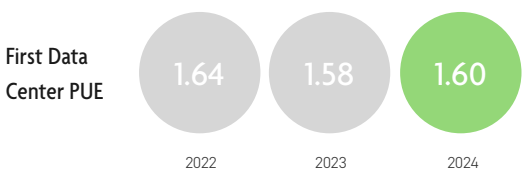
The TWSE exerts great effort in energy conservation to achieve its carbon reduction targets. In addition to using renewable energy, the TWSE has replaced older company cars and leases environmentally friendly and energy-saving models, gradually installed and upgraded energy-saving office equipment, and the central air-conditioning water-cooling system makes ice at night and uses it for cooling during the day. Furthermore, to reduce environmental harm caused by consumption, the TWSE has established an eco-friendly procurement policy for products purchased for operations, including most commonly purchased goods including paper, computer supplies, office supplies, batteries, and light fixtures. The policy gives priority to products that meet the government's Green Mark criteria or are made of recycled materials.

- TWSE energy conservation measures

Item	Content
Chiller	The chiller units are operated alternately on a schedule so as to ensure optimum efficiency.
	The First Data Center building is also equipped with ice storage air conditioning, which creates ice during the night at off-peak hours, and uses the cooling from the ice melt during the day. The process can divert energy consumption from peak hours and is cost-effective and energy saving.
Chilled water pump, cooling water pump, cooling tower	Using frequency conversion technology, the chilled water pumps, cooling water pumps, and cooling towers can be adjusted depending on motor rotational speed to achieve energy conservation.
Computer room	Computer rooms adopt high-efficiency EC fans plus constant temperature and humidity air conditioning units for regulating the temperature and humidity of the environment.
Air distribution system	The First Data Center building adopts frequency conversion technology with its air handling units to cool entire sections through the VAV air distribution system.
Central control system	The central control system manages and monitors the building's systems/operations, ensuring energy conservation, and issuing alerts in the case of abnormal situations.
Air conditioning system energy conservation	The operational parameters for the central air conditioning system of the First Data Center continue to be optimized to achieve energy conservation.
Thermal insulation in the data center	The use of thermal insulation materials in the First Data Center effectively blocks outdoor heat from entering the building, achieving energy savings.
Eco-friendly procurement	The TWSE established an eco-friendly procurement policy, giving priority to products that meet the government's Green Mark criteria or are made of recycled materials.

Data center PUE

The Power Usage Effectiveness (PUE) of the TWSE's First Data Center rose slightly from 2023 to 2024's 1.60, due to system expansion to accommodate new tenants. The TWSE will continue to conserve energy through the HVAC system, enhance the operation environment of the server rooms, and conduct regular maintenance checks to ensure energy consumption is reduced, in order to lower the PUE rating and achieve the goal of lowering carbon emissions.



Note 1: Power Usage Effectiveness (PUE) is calculated by dividing "the total power usage by the data center" by "the total power usage of ICT equipment in the server rooms."

Note 2: Since the solar power generation and consumption in 2023 and 2024 accounts only for a small percentage of total electricity consumption, it is not included in either the numerator or denominator of PUE calculations.

- TWSE carbon reduction targets and performance

2024 Performance

- Completed the 2023 GHG inventory and verification, and became the world's first exchange to be awarded the ISO 14068-1 carbon neutrality verification certificate by BSI.
- The First Data Center achieved 50% renewable energy use, and the installed solar panels generated 16,330 kWh.
- The additional office space on the 36th floor of the 101 Building uses 100% green energy.
- Older company cars were replaced with environmentally friendly and energy-saving models, and employees are encouraged to share rides using the corporate taxi service.
- Replaced all lighting in the TWSE offices, warehouses, and other areas with LED light fixtures; reduced office paper usage by 5% with the paperless office policy; reduced purchase of mineral water by 5% by providing environmentally friendly, reusable cups in conference rooms.
- Promote suppliers' commitment to sustainable development; conducted a series of activities titled "Co-prosperity in all four seasons, sustainability in all directions" to support SDGs.

Short-term targets | 2025 |

- Increase the proportion of renewable energy use and expand solar power generation.
- Promote energy conservation and carbon reduction measures (including upgrading electronics and reducing use of paper and plastic, etc.) in line with sustainable development.
- Continue to respond to international initiatives and conduct activities to support SDGs.
- Conducted the 2024 GHG Inventory and carbon neutrality, both with third-party verification.

Medium-term targets | 2030 |

- Reduce emergency generator diesel fuel consumption and carbon emissions by 4%.
- Continue to increase the use of renewable energy; achieve 60% usage at the First Data Center.
- Replace and upgrade equipment with energy-saving models.
- Reduce office paper usage and mineral water purchases by 10%.

Long-term targets | 2050 |

- Continue to expand the GHG inventory scope, and develop responsive measures based on future developments to achieve net-zero emissions.

4.3 Resource management

Waste management

The TWSE mainly provides financial and IT services, and the majority of our waste is general waste and photocopier paper. There are no concerns about pollution or waste from actual development or manufacturing activities. The office has switched to environmentally friendly toner cartridges, which are 100% recycled after use by the original manufacturer to avoid pollution and waste of resources. The TWSE generated a total of 32.541 metric tons of general waste in 2024, which was handed over to qualified disposal facilities for further processing.

Waste composition	Waste produced	Waste diverted from disposal	Waste directed to disposal
General waste	32.541	4.821	27.72
Hazardous waste	0	0	0

Waste intensity	
Total waste (metric tons)	32.541
Revenue (TWD thousand)	16,621,181
Waste intensity	0.000002 metric ton/TWD1,000

Note: The waste in the above chart is only generated by the TWSE. Waste from the TDCC, TCX, FundRich, TIP, and the TWCA is handled by their respective building management committees and paid for in management fees, and therefore is not included in calculations.

Going paperless

All departments of the TWSE achieved their annual paper reduction goals as of the end of 2024. The TWSE is proactive in digitalizing internal systems, and has set up mechanisms to reduce paper usage and energy consumption in every department. Based on the amount of paper procured by each department in 2023, the target is to reduce usage by 5% by the end of 2024. Departments that achieved the target were rewarded, while those that fail to do so have to explain at a project meeting to ensure that environmental protection and carbon reduction measures are implemented in all departments. In addition, the TWSE continues to improve the operational efficiency of the electronic official document exchange system, and encourages listed companies that have not yet adopted the system to join.

Water resource management

The main source of water for the TWSE comes from the Taiwan Water Corporation, without using groundwater or other water sources. The total water intake in 2024 was 26.583 million liters. In recent years, climate change has indirectly altered the water cycle and precipitation patterns. The TWSE is committed to conserving and managing water resources. In addition to raising awareness of water-saving measures among employees, water saving devices have been installed and the water tower in the building is cleaned regularly. Water quality testing and periodic inspections of water equipment are also conducted. The First Data Center fully adopted water-saving devices, including sensor operated faucets and water-saving taps, dual-flush water-saving toilets certified by the Water Efficiency Label, automatic sensor operated urinals, and water-saving shower fixtures, in order to reduce everyday water consumption. In outdoor areas, a drip irrigation system has been installed, and the water usage is automatically controlled by a schedule to reduce water used for irrigation. In the future, we will replace the old air conditioning cooling towers with more efficient water-saving cooling towers to reduce the loss of cooling water through drift, evaporation, and emissions. The goal is to use less water for air conditioning.