

World Display device Industry Cooperation Committee **Environmental Report**

The World Display device Industry Cooperation Committee (WDICC) is organized by 4 members: Taiwan TFT-LCD Association (TTLA), Japan Display Device Industry Committee (JDDIC), Korea Display Industry Association (KDIA), and China Optoelectronics & Display Association (CODA). WDICC is aiming at display industry's global cooperation on climate change and various environmental issues.

With the climate change emerging as a serious global issue, WDICC issues this report in an attempt to announce its reduction target of Fluorinated greenhouse gas (F-gas) emission and to publicize efforts toward the target to suppress the impact that display has on the climate change. This report will be updated every 2 years.

This report includes F-gas emission trend, emission reduction technologies, trends of each association about greenhouse gas in general, F-gas emission reduction target for 2020, and other environmental efforts.

1. Recent F-gas Emission Trends

1.1 F-gas* Purchase NER Trends

As shown in Figure 1, F-gas purchase amount of the three associations** increased over the last 7 years (2008-2014), mainly due to the increase in the production of display products. The average annual growth rate of production during last 7 years was 11.2% while that of the amount of F-gas purchased rose 15.1%. F-gas purchase NER*** grew 3.5% on the average during the same period.

* In this report, scope of F-gas data is CF_4 , C_2H_6 , C_4F_8 , CHF_3 , SF_6 , NF_3 .

** Throughout this report, the three associations mean KDIA, JDDIC, and TTLA. As CODA joined WDICC in 2013, its data are not included in various trend data.

***F-gas Purchase NER (kg / m^2) : The amount of F-gas purchased per input glass area

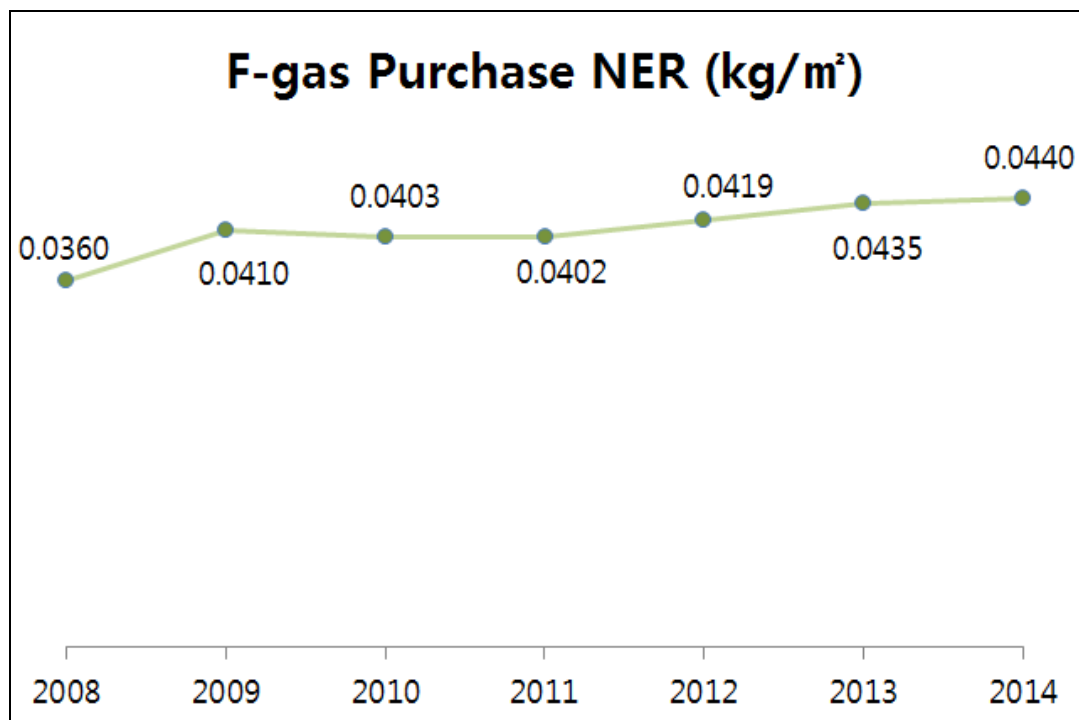


Figure 1- F-gas Purchase NER Trends

1.2 F-gas Emission NER Trends

As shown in Figure 2, F-gas emission NER of the three associations reached the peak in 2009 at 52.08 kg-CO₂/ m² and then decreased in 2012 to 44.46 kg-CO₂/ m² although the display production grew during the same period. This demonstrates the efforts that device makers had done in order to reduce the F-gas emission. F-gas emission NER increased again in 2013 and 2014, because OLED production was increased in some associations.

* F-gas Emission NER (kg-CO₂/ m²): The amount of F-gas emitted per input glass area.

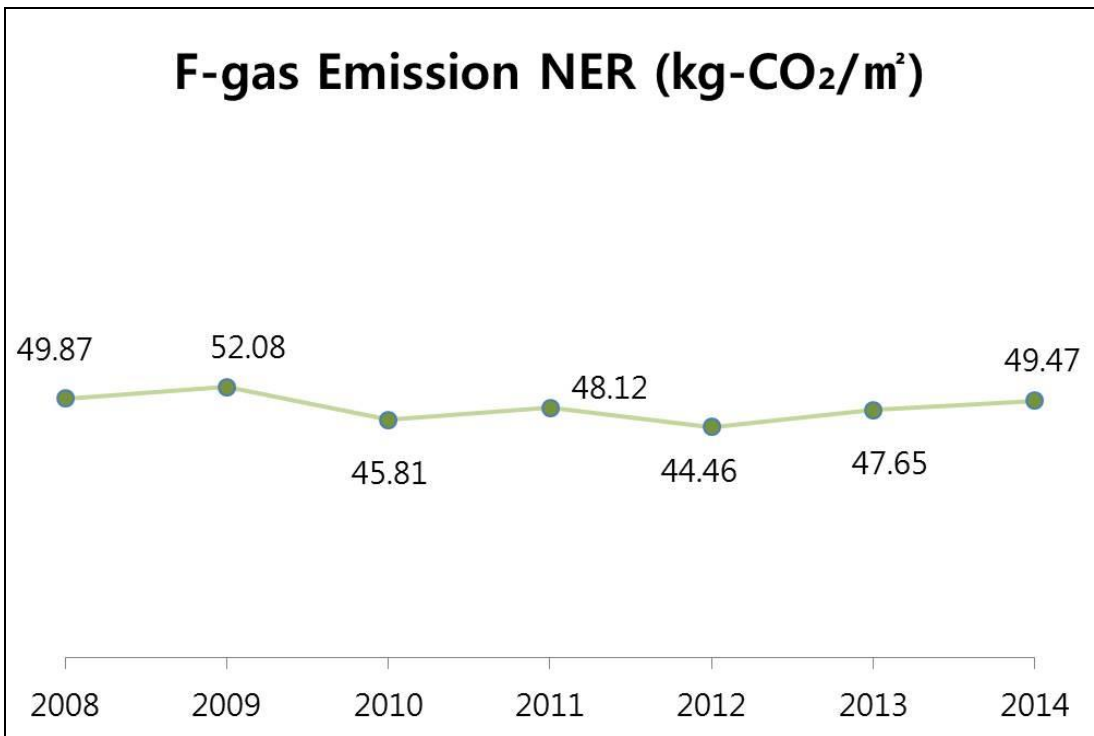


Figure 2- F-gas Emission NER Trends

2. F-gas Emission Reduction Technologies

F-gas emission reduction technologies available in the display industry are described below. There is no particular technology that has a strong comparative advantage over the others. Each device maker can select and use any of the reduction technologies by taking all the factors into consideration such as cost, efficiency, and others.

2.1 Process recipe optimization

Optimizing processes so that less F-gas is consumed is a fundamental practice to be done for F-gas emission reduction.

2.2 Abatement

An abatement system destroying F-gas can be used to reduce its emissions. Destruction methods can be divided into 1) combustion treatment, 2) catalyst treatment, and 3) plasma treatment. Abatement system configuration can be divided into a) Point of Use (POU) system, which is installed at each equipment, and b) Central Abatement System (CAS), which is an integrated processing facility. POU abatement system can handle F-gas and hazardous gas simultaneously.

2.3 F-gas Replacement

Replacing high global warming potential (GWP) gas with lower GWP or GWP-free gas is the most effective solution to further reduce F-gas emission. When adopting alternative gas, it is essential to also consider their potential safety and health impact to fab operations and employee protection,

3. Trends of Each Associations about greenhouse gas in general

3.1 KDIA

On January 1, 2015, the Korea government launched ETS (Emission Trading System). ETS takes effect by two steps. First step is from 2015 to 2017. For the first step, amount of right to discharge in display industry is 26,968,211 t-CO₂ as shown in Table 1. So Korean panel makers need to reduce 23% of their emission quantity.

Table 1- Korean Emission Trade System (Display industry Allocation)

As is (A)	To be (B)	Gap (A-B)
34,859,033	26,968,211	7,890,822

3.2 JDDIC

Japan's INDC (Intended Nationally Determined Contribution), which determined overall GHG emissions reduction target by 2030, was submitted to United Nations in July, 2015. In the INDC, the reduction target for F-gas was set as 25.1% compared to 2013. Measures to accomplish this target are mainly composed of 1) Act on Rational Use and Proper Management of Fluorocarbons and 2) emission control through industries' voluntary action plans with follow-up by the government.

Activities of LCD production companies correspond to the latter voluntary action plans. Owing to the aggressive activities so far, F-gas abatement system installation ratio has been maintained to be 99% in recent years. As there is few room for more NER reduction, maintaining this high ratio is an important task for the future.

3.3 TTLA

In recent years the Taiwan government has followed a proactive advocacy for policies regarding energy saving and carbon reduction. In fact on June 15, 2015, Taiwan's Legislative Yuan passed the Greenhouse Gas Emission Reduction and Management Act, providing a legal basis for an array of measures responding to climate change in Taiwan, and in addition, for decision making from the central authority and coordination among ministries. Apart from stipulating an emissions reduction target to be met by 2050 and other related

measures, the Act calls for periodic five-year reduction targets, offers economic incentives in order to gradually establish a cap and trade system, and also promotes both mitigation and adaptation measures.

3.4 CODA

The Chinese government launched a pilot of carbon emissions trading in 2013. The pilot areas include Beijing, Shanghai, Tianjin, Chongqing, Shenzhen, Guangdong, Hubei provinces and cities and the pilot will be continued for three years. At present the pilot enterprises have completed the two annual carbon emissions verifications and transaction performance. At the next stage, China will accelerate the construction of the national carbon trading market, the establishment of a sound initial distribution system of carbon emissions, and strive to start the nationwide carbon emissions trading market in 2017.

4. F-gas emission reduction target for 2020

As shown in Table 2, WDICC members agreed to 30% F-gas Total Emission NER* reduction compared to 2010 as the WDICC's emission reduction target for 2020.

* F-gas Total Emission NER: Total amount of F-gas emitted per total area of input glass. The total means the sum for 4 associations (note that for base year 2010, CODA is not included).

Table 2-WDICC's target of F-gas Total Emission NER reduction (kg-CO₂/ m²)

2010	2020	Reduction
45.81	32.07	30%

5. Other Environmental Efforts

In addition to the F-gas emission reduction activities responding to climate changes, WDICC members are engaged in a variety of activities to protect environment.

5.1 Energy Saving

Most of energy used in the display industry is electricity. To save electricity, WDICC members are in the process of fixing parts that cause power loss in production equipment, replacing existing equipment with high-efficient one, and promoting energy-saving activities in everyday life.

As shown in Figure 3, Electricity Use NER* of the three associations has been generally decreasing for past 7 years, though it increased slightly in 2011 and 2013.

* Electricity Use NER (MWh / m²) : The amount of electricity used per input glass area

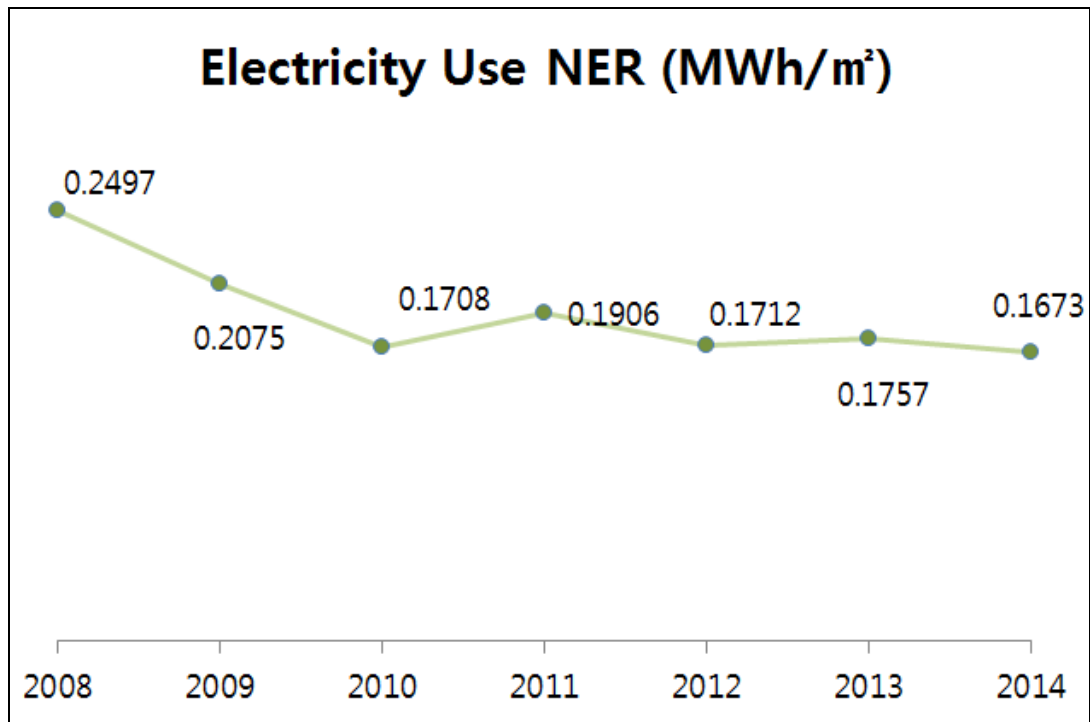


Figure 3- Electricity Use NER Trends

5.2 Reduction of water use

WDICC members are reducing water used by enhancing equipment and process. Such efforts lead to not only reduction of water use but also less need to make further investment or cost for water use and wastewater treatment facilities.

As shown in Figure 4, Water Use NER* of the three associations has been generally decreasing for past 7 years, as a result of their combined efforts.

* Water Use NER (t / m²) : The amount of water used per input glass area

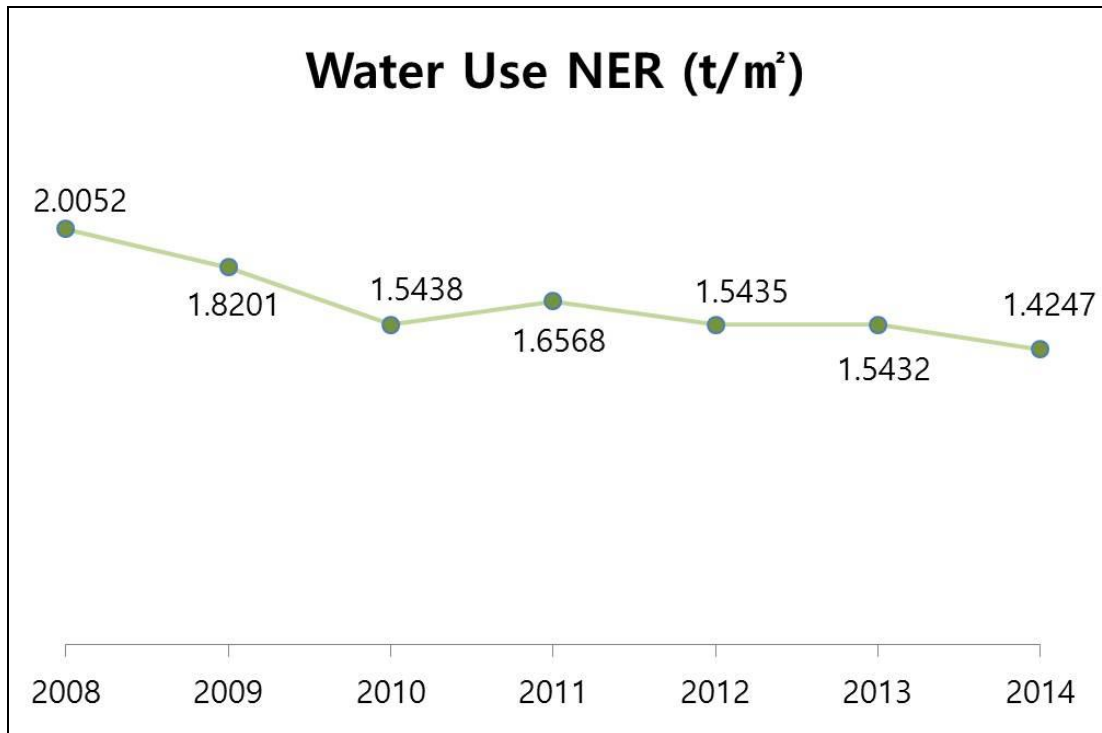


Figure 4- Water Use NER Trends

5.3 Waste Recycling

WDICC members are making multi-faceted efforts to reduce production waste to be incinerated or landfilled. They are also making efforts to recycle waste organic solvent, waste glass, waste papers, and other waste materials.

5.4 Biodiversity Conservation

With the destruction of the ecosystem becoming more severe by the day due to industrialization, WDICC members are taking part in activities to conserve biodiversity. To preserve the habitat of endangered species which are on the verge of extinction, WDICC members has been planning to expand the scope and extent of its environmental conservation activities, and actively contributing to the protection of our environment.

5.5 Conservation of the Local Environment

WDICC members are maintaining close relationship with the local communities collaborating with them in order to protect the environment of the local areas. They are making various efforts to ensure that display production causes the least possible damage to the local environment.

Published on 10 November, 2016.