Operation of Weather & Climate Big Data Platform and Its Application of Energy Section in Korea

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KMI Korea Meteorological Institute

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1. Introduction of Meteorological Organization in Korea

Organizational Structure of Meteorological Work in Korea

There are three affiliated agencies under the Korea Meteorological Administration(KMA). These are cooperative organizations specializing in roles that are difficult to perform directly at the KMA.

기상청
Korea Meteorological Administration

KMI
Korea Meteorological Institute

The Korea Meteorological Industry Technology Institute (KMI) is a public institution established to contribute to the economic development of the national industry by efficiently supporting development of the weather industry and the promotion & distribution of weather information.

APCC
APEC CLIMATE CENTER

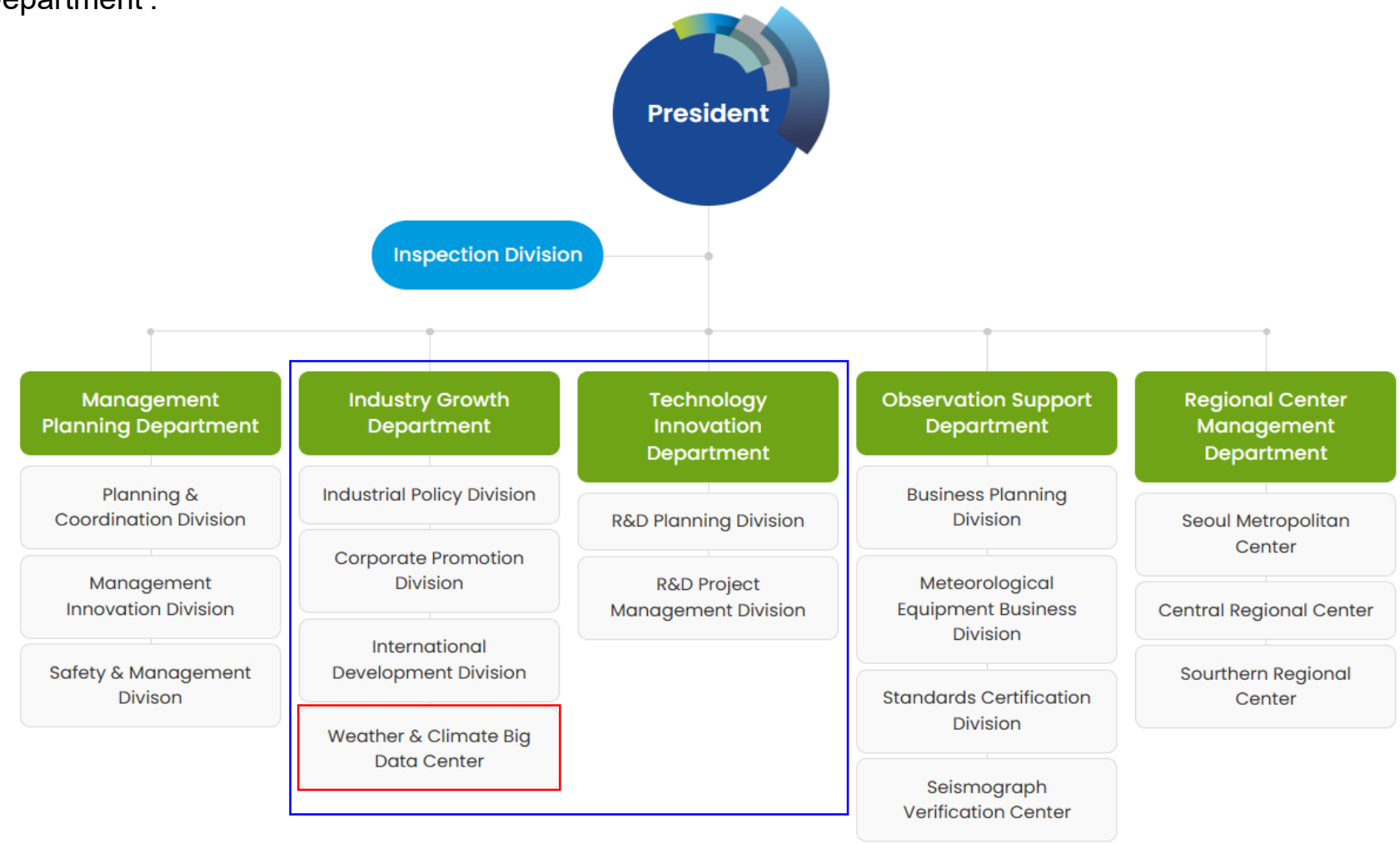
APEC Climate Center is a public institution established to study global climate change analysis and prediction technologies, and to serve as a hub for climate information in the Asia-Pacific region.

KIAPS
KOREA INSTITUTE OF ATMOSPHERIC PREDICTION SYSTEMS

KIAPS is an institution established to continuously develop integrated time and space numerical forecast model technology by developing a numerical forecast model (KIM) independently to suit Korea and improving weather prediction accuracy based on accumulated experience.

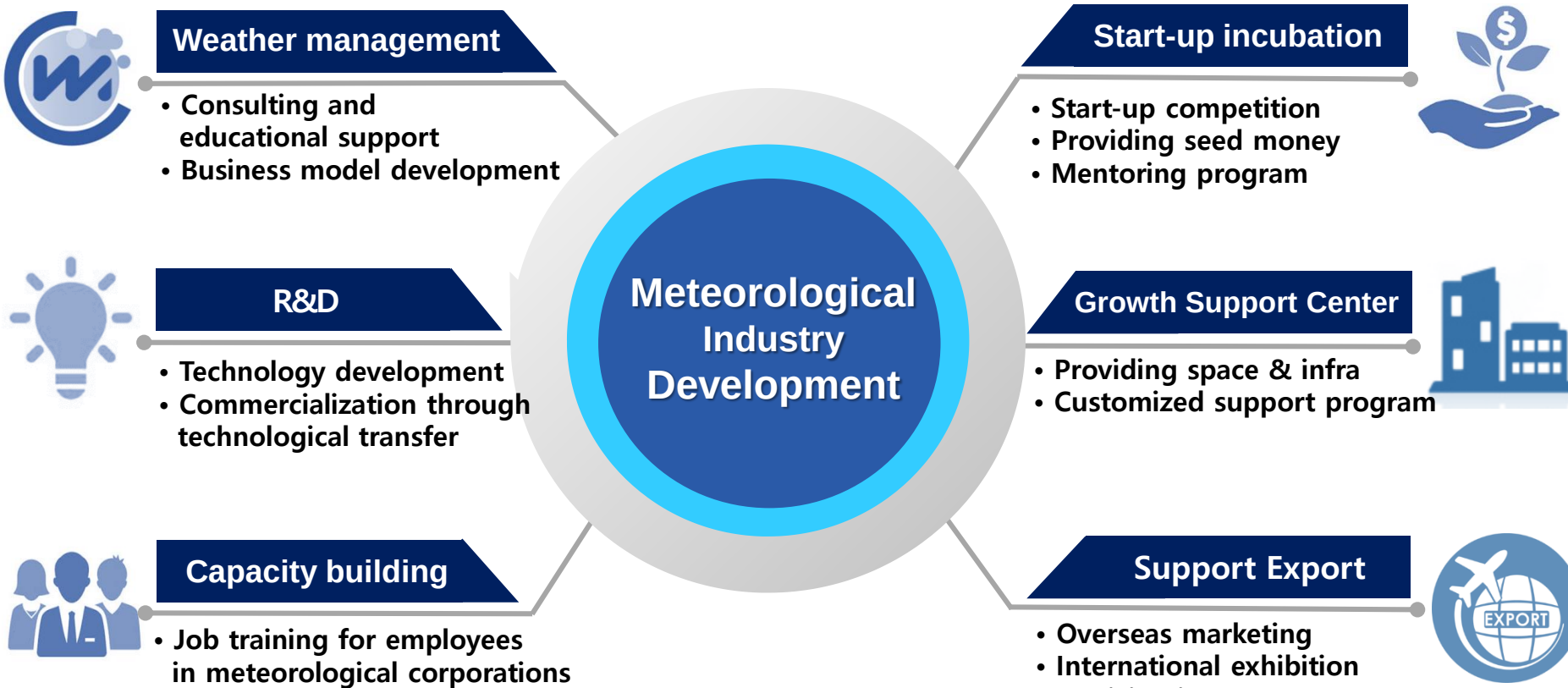
Organizational Structure of KMI

While KMA is responsible for services in the public sector, KMI is responsible for assisting KMA's mission and supporting services in the private sector. To perform this role well, the KMI consists of 5 departments, divided into 11 divisions and 5 centers. Among them, the parts directly involved in the Weather and Climate information service are the ‘Industry Growth Department’ and the ‘Technology Innovation Department’.



Support work for the Development of the Meteorological Industry

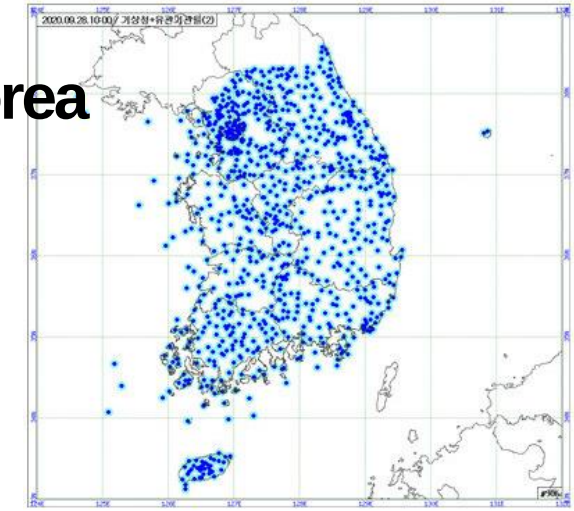
In order to foster the meteorological industry, KMI consults industrial application methods and business models using weather and climate big data, develops data utilization technologies, and supports commercialization through technology transfer.
In addition, KMI is striving to support capacity building of companies with technology, support startups and growth, and support overseas export of technology.

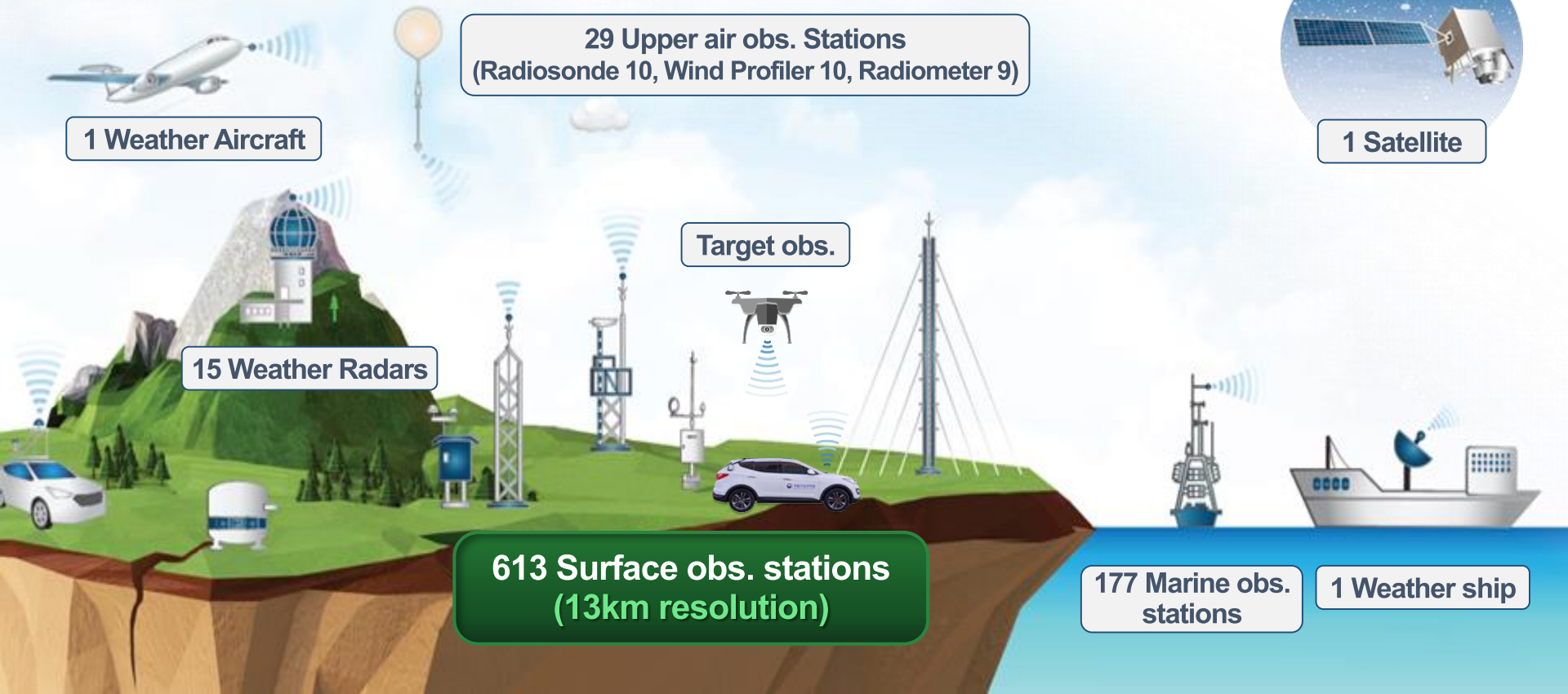


2. Operation Status of Weather & Climate Big Data Platform

Structure of Observation Data Collection in Korea

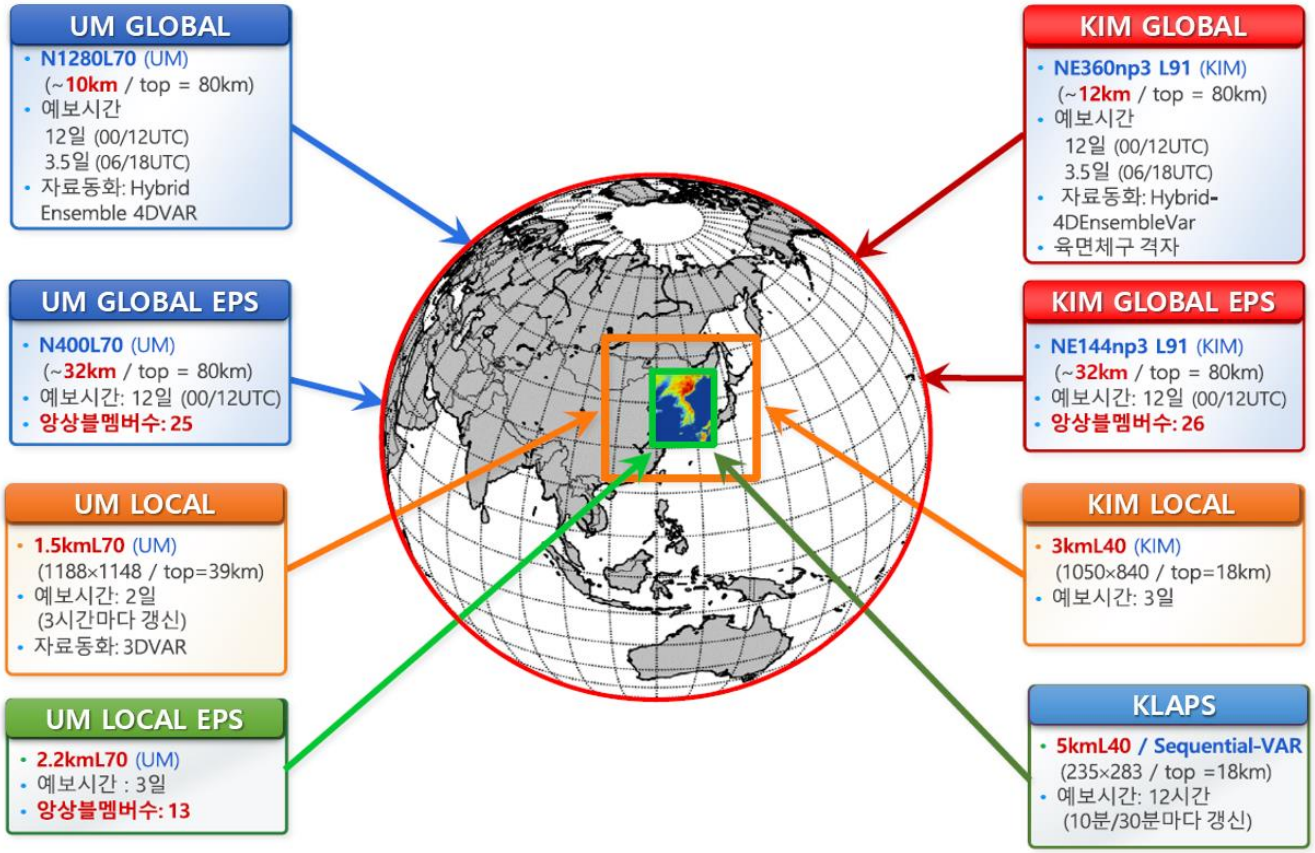
KMA is building a cutting-edge three-dimensional observation network spanning surface, upper air, marine, radar, satellite, aircraft, and ship observations. As of 2022, there are approximately 900 observation points.





The Production Structure of Numerical Prediction Data in Korea

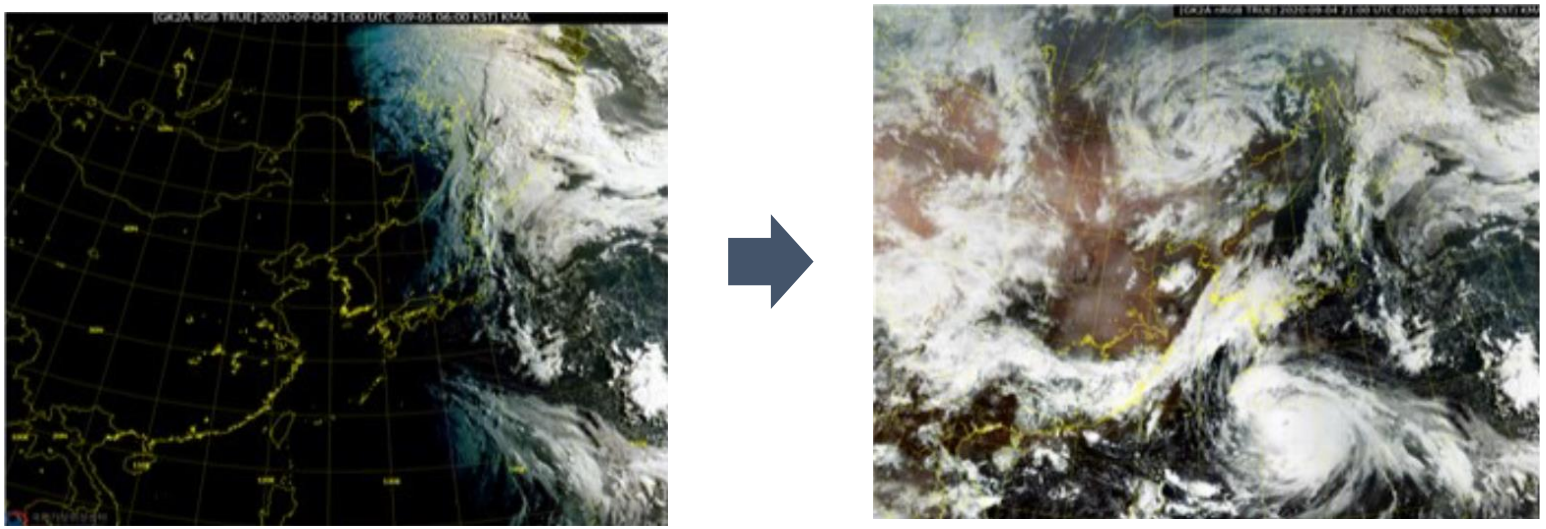
Korea produces and provides global, regional, and local forecast model data produced by the Unified Model (UM), developed by the United Kingdom Met Office, and the Korean Integrated Model (KIM), developed independently in Korea.
Based on this, KMA also produce and provide numerical data through climate models and applied meteorological models.



Data Restoration Using Artificial Intelligence Technology

In addition to basic weather information such as weather observation data and numerical model data mentioned above, data that could not be provided before are also processed and provided with AI technology.

For example, visible channel images observed by solar reflection from Chollian satellite data were difficult to use at night, but dark images were restored to natural colors using an AI technique called CGAN (Conditional Generative Advertising Nets) and are now serviced as data available through the platform.



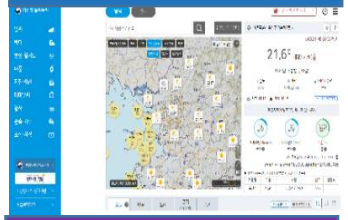
Public Data Open Policy

As such, various weather and climate data are estimated to produce more than tens of terabytes per day in Korea. In particular, in Korea, most of this vast amount of data is not only stored, but also opened to the public in real time through platforms based on public data opening laws.

A weather and climate big data platform is a comprehensive and advanced data infrastructure and analytical system designed to collect, process, manage, and analyze vast quantities of data related to weather and climate conditions. These platforms play a crucial role in the fields of meteorology, climate science, environmental research, and various industries that rely on weather and climate data for decision-making.

However, as each department producing weather and climate data recognized the importance of platforms and built segmented platforms individually, we ended up in a situation where 14 types of platforms were operating within KMA alone.

KMA Home



https://www.weather.go.kr

Open MET Data Portal

https://data.kma.go.kr

Civil Complaint Portal

https://minwon.kma.go.kr

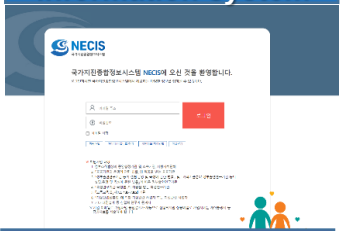
Big Data Analytics Platform

http://bd.kma.go.kr

Disaster Prevention Weather Information System

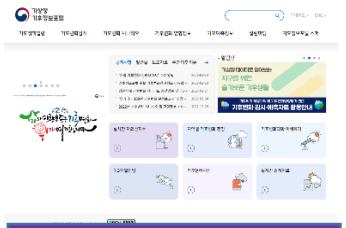
https://afso.kma.go.kr

Earthquake Comprehensive Information System



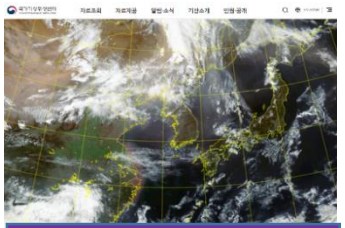
https://necis.kma.go.kr

Climate Information Portal



http://www.climate.go.kr

Meteorological Satellite Center Portal



https://nmsc.kma.go.kr

Weather Ratar Center Portal

http://radar.kma.go.kr

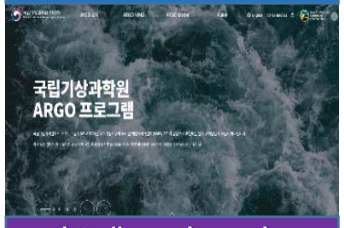
Aviation Weather Service Platform

https://amo.kma.go.kr

Wind & Solar Meteorological Resources Portal

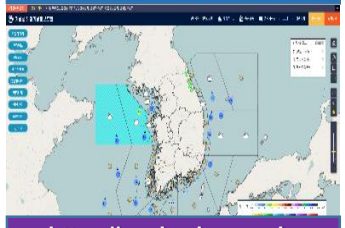
http://www.greenmap.go.kr

ARGO Program



http://argo.nims.go.kr

Marine Weather Information Portal



https://marine.kma.go.kr

CLimate Information toolKit(CLIK) (APCC)

https://apcc21.org

Total

14 Types

Integration of Weather and Climate Data Platforms within KMA

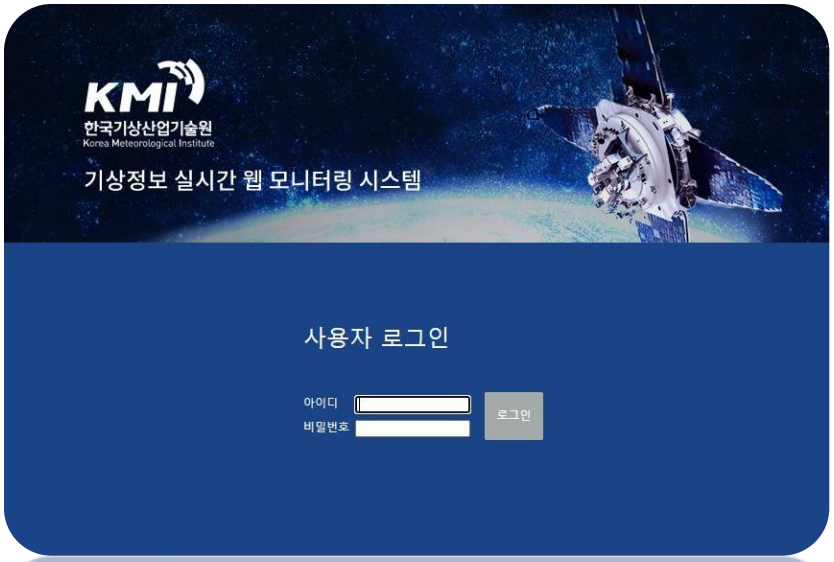
Accordingly, KMA is building an integrated platform to carry out API services so that most of the weather and climate data produced can be easily utilized by anyone. It is still incomplete, but some services have been open since this year.

https://apihub.kma.go.kr

However, as the integrated weather and climate data API platform provides services to a large number of ordinary people, there is a limit to the API reception capacity and the number of calls. Therefore, the service may be insufficient for meteorological companies that receive large amounts of real-time detailed information and provide services after secondary processing.

Services for meteorological enterprises officially registered in KMA

Accordingly, the KMA designates KMI as a weather information support agency in accordance with the Meteorological Industry Promotion Act to provide separate platform services for weather companies. Currently, there are more than 40 companies using the service, and KMI provides stable real-time weather information to companies through FTP as a paid service.



구분	비율(%)	건수	전체 건수	용량(MB)
Code01	19.73	590	2,991	367.83 M
Code02	114.82	29,691	25,858	28.63 M
Code03	66.94	980	1,464	58.62 M
Code04	311.04	7,042	2,264	2.78 M
Code05	28.41	1,337	4,706	76.33 G
Code06	1.04	63	6,048	34.90 M
Code07	129.81	6,667	5,136	22.66 G
Code08	67.36	291	432	46.40 M
Code09	48.61	105	216	8.38 M
Code10	0.00	0	52	-
전체	95.12	46,766	49,167	99.53 G

The data served here is divided into eight types by characteristic, and options can be selected. It's a paid service, but even if you get all the data, it's not that expensive at around $1,000 a month.

Weather and Climate Data Platform operated by Other Agencies

In addition to KMA, there are more than 25 cases of institutions that produce weather and climate data on their own or create application data and share them on the platform.

Water Resources

https://www.bigdata-environment.kr

Agriculture

http://www.ncam.kr

Nuclear Energy

http://www.korad.or.kr

Electric Power

https://www.kpx.or.kr

Traffic Management

https://data.ex.co.kr/

Power Plant

https://www.koenergy.kr

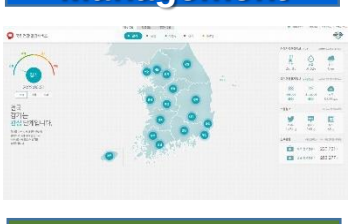
District Heating

https://www.kdhc.co.kr

Forest Weather

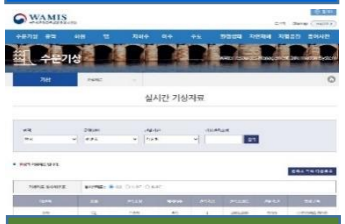
https://www.knps.or.kr

Health Management



http://forecast.nhis.or.kr

Flood Control



http://www.wamis.go.kr

Maritime Weather

https://www.nmpnt.go.kr

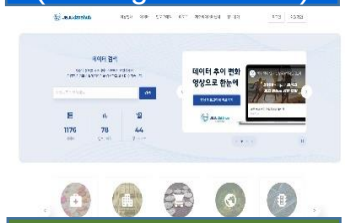
Cultural Heritage

http://drm.cha.go.kr

Seoul (Local government)

https://data.seoul.go.kr

Jeju (Local government)



https://www.jejudatahub.net

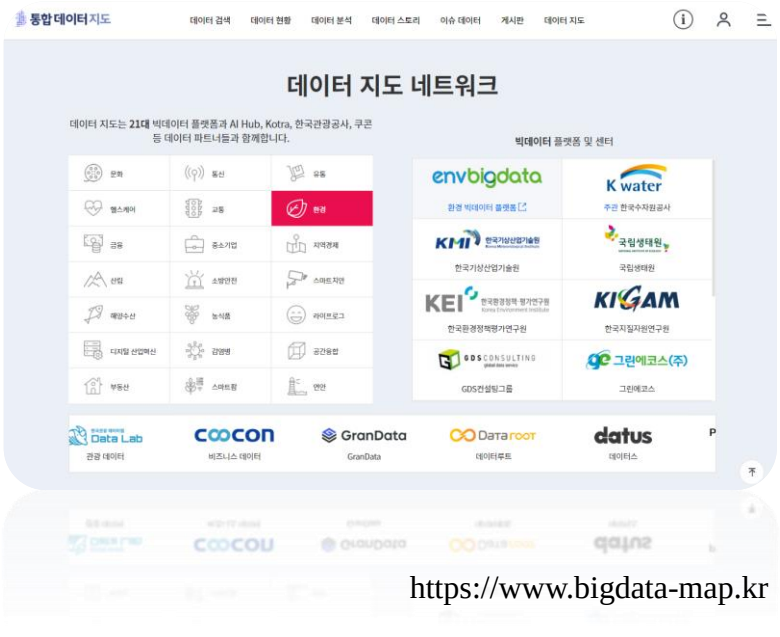
Total

More than 25

Integration of Data Platforms within Government

As many data platforms were built separately for each institution and a lot of data was created, users had difficulty collecting data.
Accordingly, the Korean government is promoting the project to integrate administrative-based public data into the data platform of the ‘Ministry of the Interior and Safety’, and to integrate industrial-based public private data into the platform of the ‘Ministry of Science and ICT’.

https://www.data.go.kr



https://www.bigdata-map.kr

In particular, the data platform of the ‘Ministry of Science and ICT’ has 21 areas of data platforms for each industry, contributing to the development of the national industry. Of course, each platform contains all the weather and climate big data.

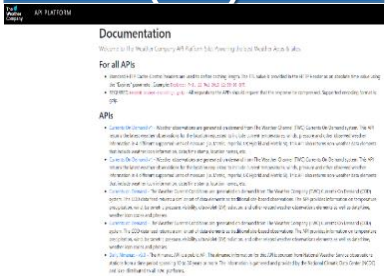
Case of Private Weather and Climate Data Platform in Korea

In Korea, public weather and climate data platforms are so well established that private weather and climate data platforms are relatively inactive. However, some private companies are continuing to make efforts to target niche markets by building their own platforms. Representative examples related to this are as follows.

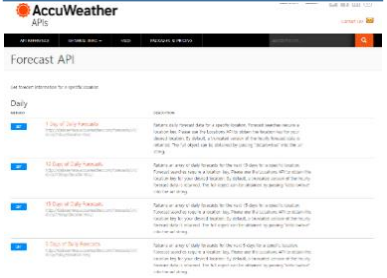
Weather-I

K-weather

Weather Channel (IBM)



AccuWeather



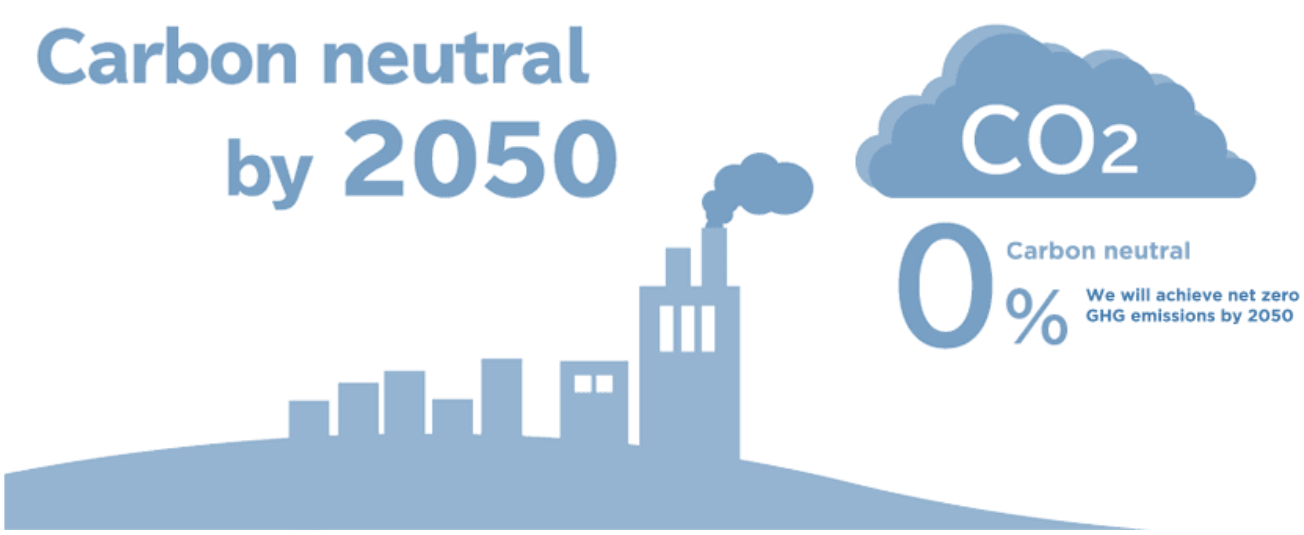
WeatherNews

In particular, WeatherChannel, AccuWeather, and WeatherNews are global companies, and they have opened a Korean branch to occupy the market.

3. Efforts to improve the utilization of Weather & Climate data in the Energy Section

The Importance of Predicting Power Generation

As agreed in the Paris Agreement, the international community must achieve "net zero" global carbon dioxide emissions by 2050 to limit global average temperature rise below 1.5℃ by the end of the century. In general, final energy consumption is largely divided into electricity and thermal energy. In the case of thermal energy produced through oil, coal, gas, etc., reducing the proportion of thermal energy and increasing the proportion of electricity is of paramount importance to carbon neutrality because there are few ways to reduce carbon emissions.



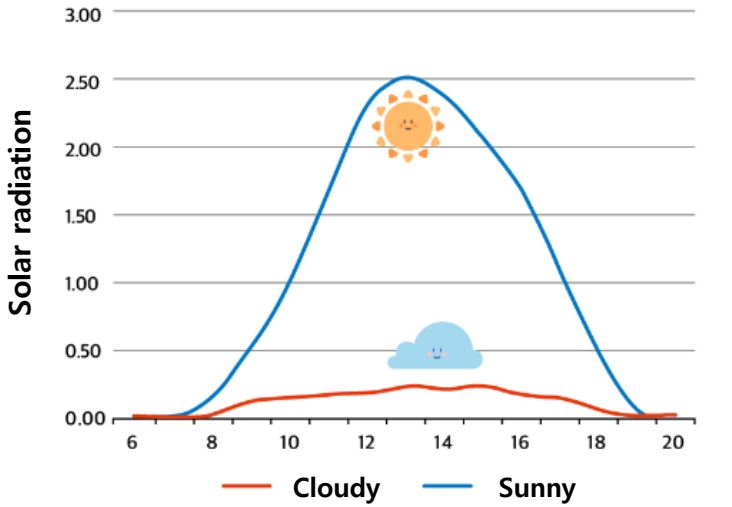
Renewable energy should be made at 70% of global electricity consumption by 2050, according to the report "Electricity Market Report 2023" released by the International Energy Agency (IEA). Therefore, global renewable energy generation is increasing rapidly.

The Importance of Predicting Power Generation

Renewable energy costs little fuel or operating costs because it utilizes the power of weather phenomena, but it is difficult to maintain a certain amount of power and is quite difficult to predict.

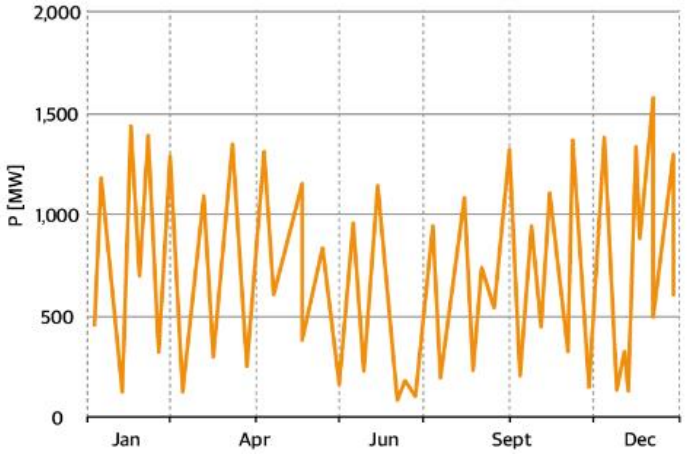
Uncertainty

Differences in solar radiation depending on the weather



Volatility

Annual wind power output change



The power system operates stably only when the supply and demand are maintained, but if production suddenly increases or decreases, such as renewable energy, it can generate a load on the power system and cause a large-scale black out, so curtailment is sometimes enforced to prevent this.

Therefore, power generation forecasting reflecting weather climate information is a key area for expanding renewable energy, and its importance is growing as renewable energy generation increases.

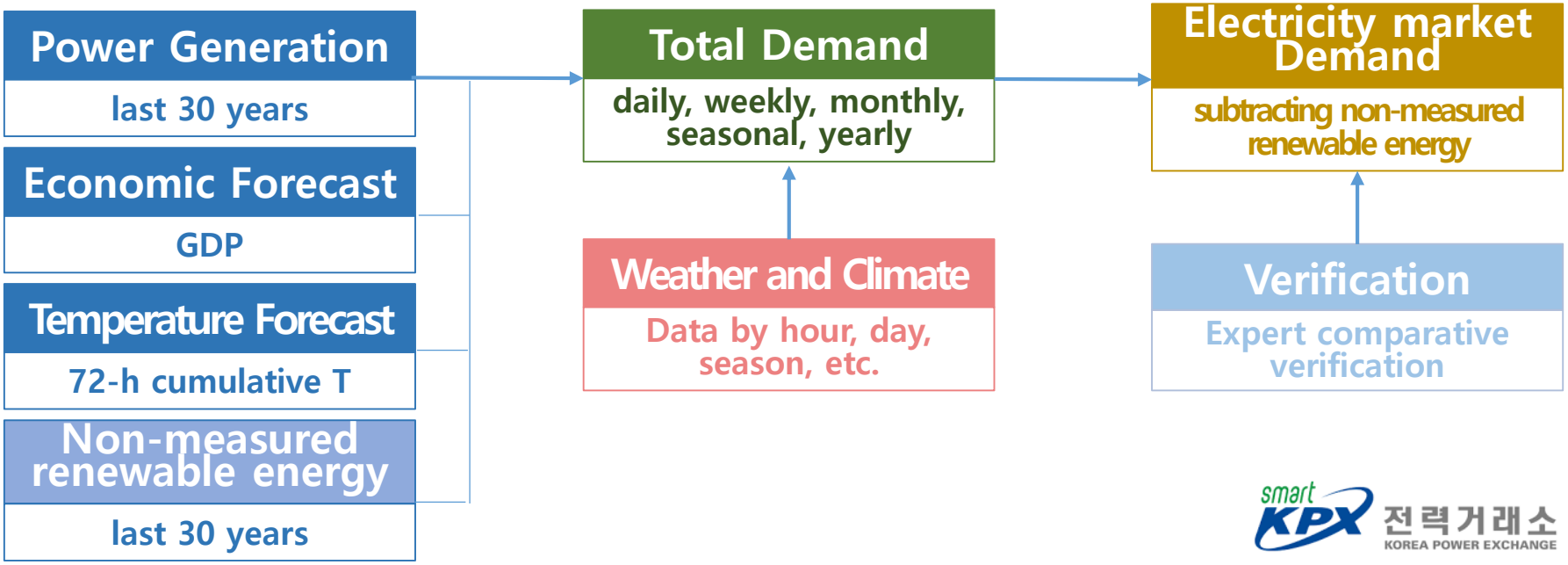
Utilization of Weather & Climate information in KEPCO

Korea Electric Power Corporation establishes a construction plan for generators and transmission networks through Long-Term weather information, and establishes a maintenance plan for power facilities through Mid-Term information.
In addition, an integrated generator operation plan is established with Short-Term information, and Real-Time information is utilized for automatic generation control and economic dispatch management.

Long-Term	Mid-Term	Short-Term	Real Time
Construction Plan for generator & Transmission Network	Power facilities and Maintenance	Electricity generation plan /UC(Unit Commitment) Scheduling	AGC(Automatic Generation Control) & ED(Economic Dispatch)
Climate, Yearly	Monthly	Weekly, Daily	Real-Time

Prediction Method for Maximum Power Demand in Korea

The Korea Power Exchange (KPX) is in charge of forecasting power demand, and the basic process is as follows.
In the demand forecast process, they basically enter power generation data from the last 30 years, economic forecasts, temperature forecasts, and non-measured renewable energy estimates. On top of that, total demand is forecasted by reflecting hourly, daily, and seasonal weather climate data, and electricity market demand is calculated by subtracting non-measured renewable energy generation. The demand is determined after expert comparative verification.



smart KPX 전력거래소 KOREA POWER EXCHANGE

Korean Energy Management System

The Energy Management System (EMS) is a comprehensive national power grid management system. The power generation forecast information derived above is reflected, and the power status of each track is controlled in real time. As renewable energy generation is increasing rapidly, various R&D projects are being promoted to supplement the load pattern estimation function, and efforts are being made to solve it through the development of correction models using weather climate numerical model data.

Efforts in the private sector

Power generation forecasting has been led by the public sector, and KMA and government agencies still provide direct power generation forecasting maps. However, since power generation prediction has different industrial structures and meteorological characteristics by region, it is necessary to develop a power generation prediction algorithm suitable for each power plant. Therefore, many companies in the private sector are working to improve their algorithms and develop technologies that reflect weather climate information, and are forming a new market.

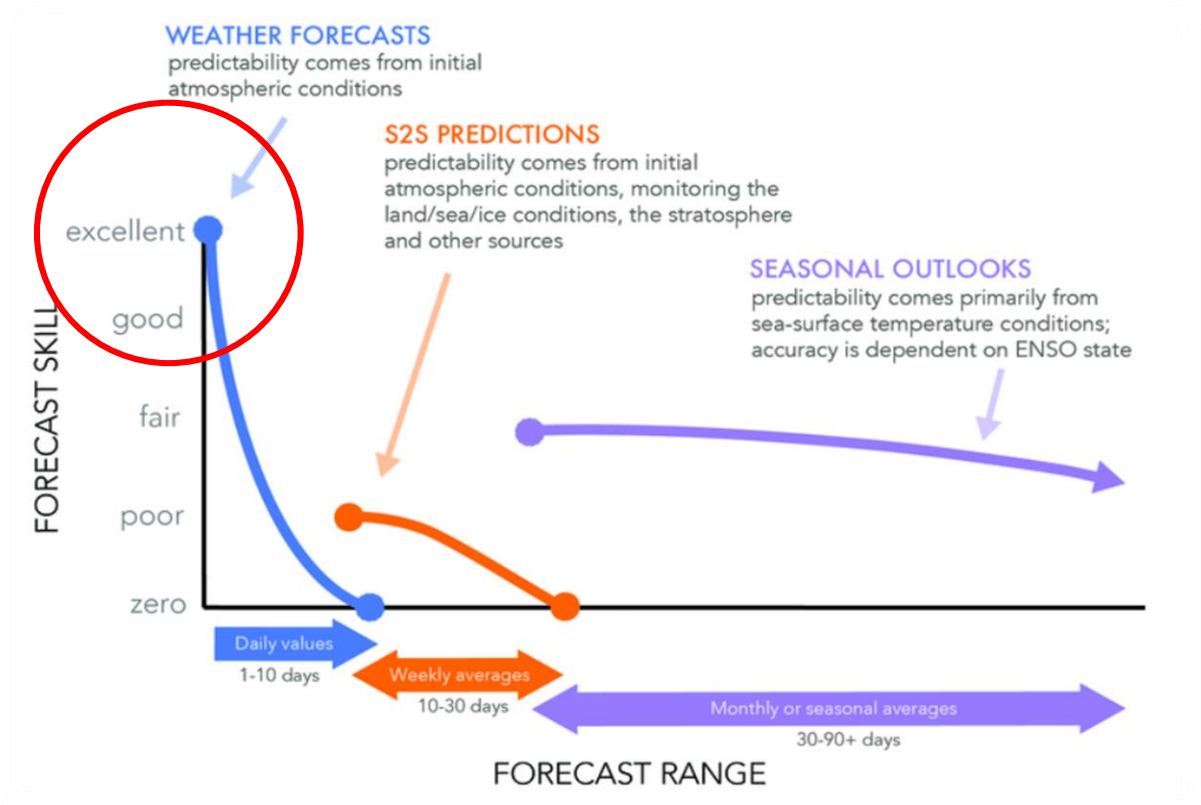
Ecobrain	60Hertz	DI Lab Inc.	Haezoom	ENCORED
E-on solution	Map.60HZ	Di CAST	Haezoom	iDERMS VPP

<An example of a platform for predicting private power generation>

Currently, about 70 companies in the weather service sector are registered as meteorological companies in Korea, and many can operate numerical models, and many have power generation prediction technology.

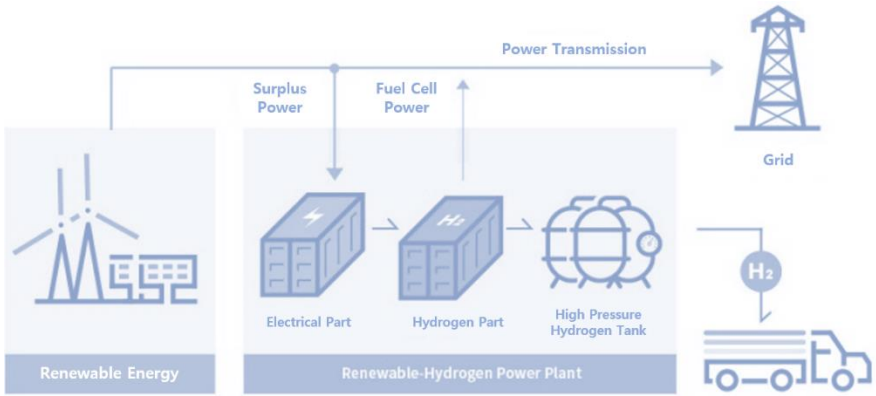
Efforts in the private sector

Predicting energy generation using climate forecasting data is also important, but it is true that climate forecasting data is relatively less accurate than short-term prediction information in terms of time-scale predictability. Therefore, the private sector tends to try to differentiate itself from other competitors by paying more attention to the development of algorithms to improve short-term predictability by receiving real-time information from weather & climate data platforms.

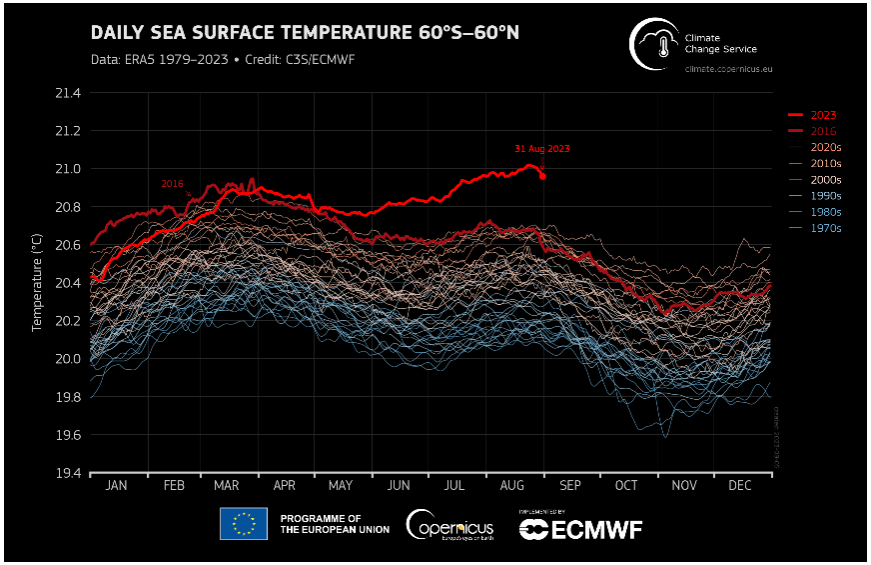


<Predictability by time scale>

A matter to think about…



Even if energy efficiency is increased by utilizing weather and climate information, output control situations are likely to occur due to overproduction of power. In order to solve this problem, it is necessary to apply new technologies such as the introduction of energy storage system (ESS) and hydrogen energy conversion in addition to data utilization technology.



The global average sea level temperature hit an all-time high in August after a prolonged period of abnormally high temperatures since April 2023. As abnormalities caused by climate change worsen, it is difficult to secure the reliability of weather forecast data. Even if algorithms that use weather and climate data in the energy industry are advanced, if the accuracy of the data is lowered, the negative ripple effect is very large, so it is important to come up with improvement measures.

Thank you

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