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Overview of IDPP Platform and Benefits

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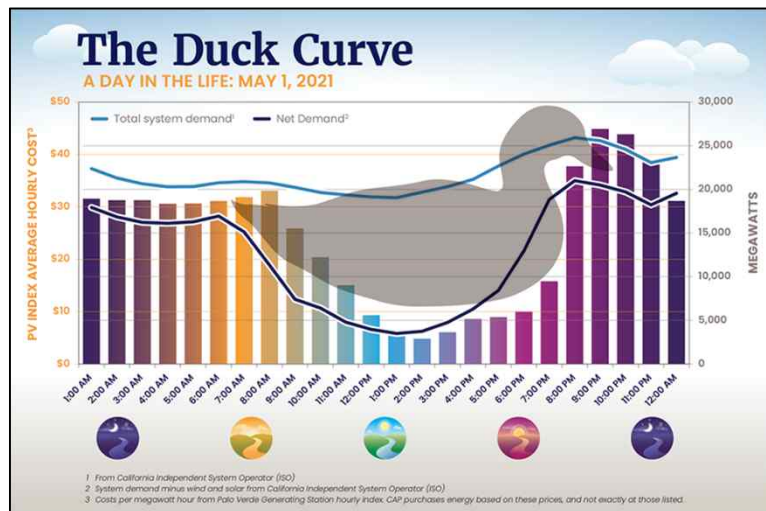
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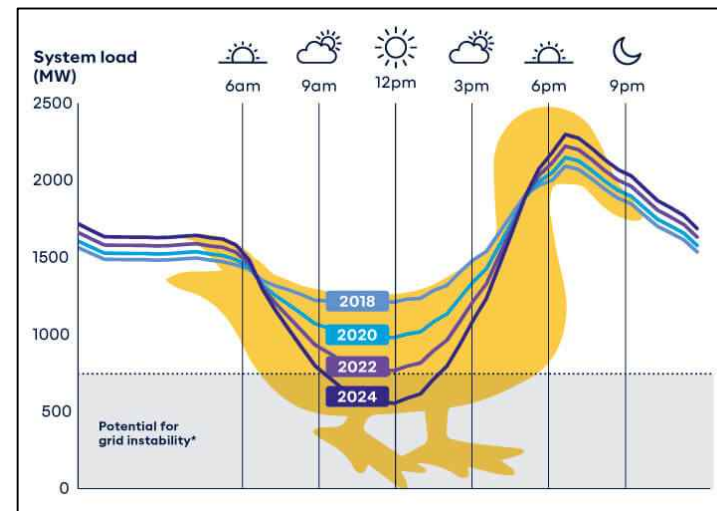
01 Research Background

● First-ever Paradigm Transition Due to Carbon Neutral Policy

- Generation from Renewable has been increasing rapidly
- Big Thermal Power Plant : Generation Volume Control ($\pm 30\sim 40\%$ / a few hours)
 - ☞ Serious Impact to lifespan ($\because$ Designed Fixed or Gradual Output Change)
- ✂ a Power Plant : Consist of 20k~50k Time-Series Sensors



<Duck Curve – California ISO, 2021>

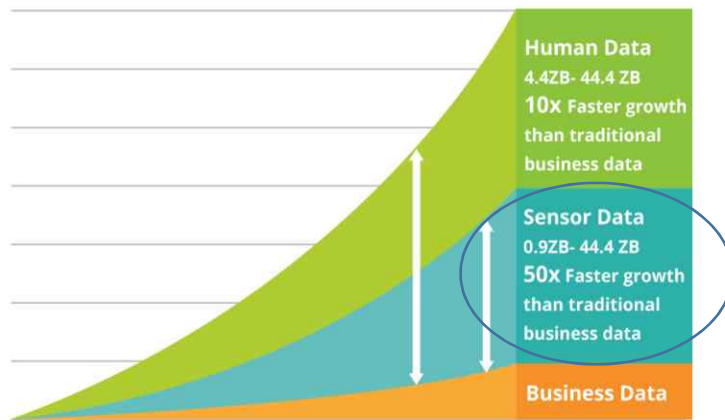


<Duck Curve – Australia, 2021>

01 Research Background

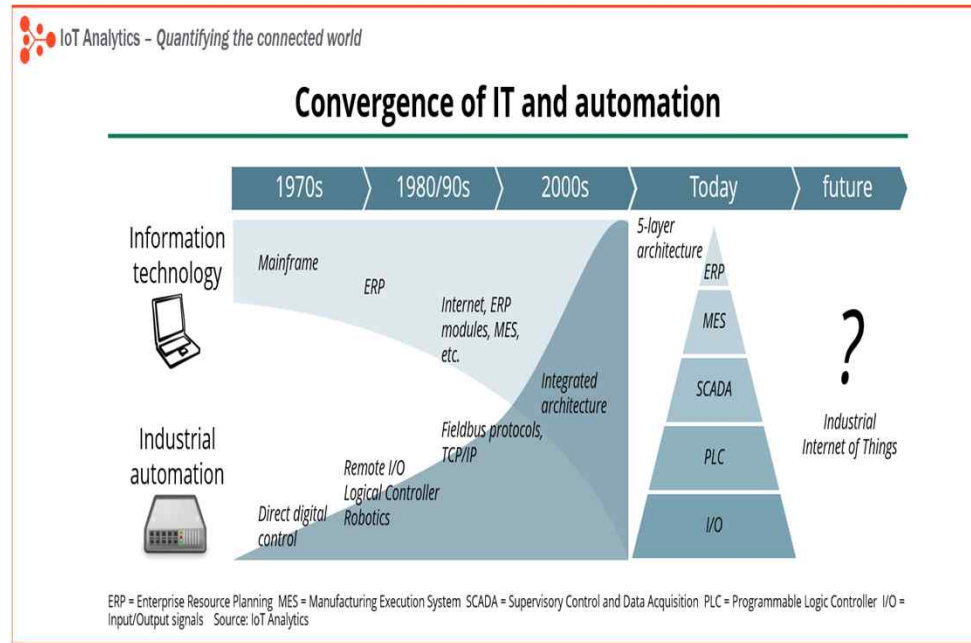
- **IoT(Sensor) data is increasing 50x faster than business data**
 - 90% of the data in the world today has been created in the last two years (a report from IBM Marketing Cloud, 2017)

The growth of human and machine-generated data



Source: Inside big data

<https://www.business2community.com/big-data/iot-big-data-ai-new-superpowers-digital-universe-01926411>

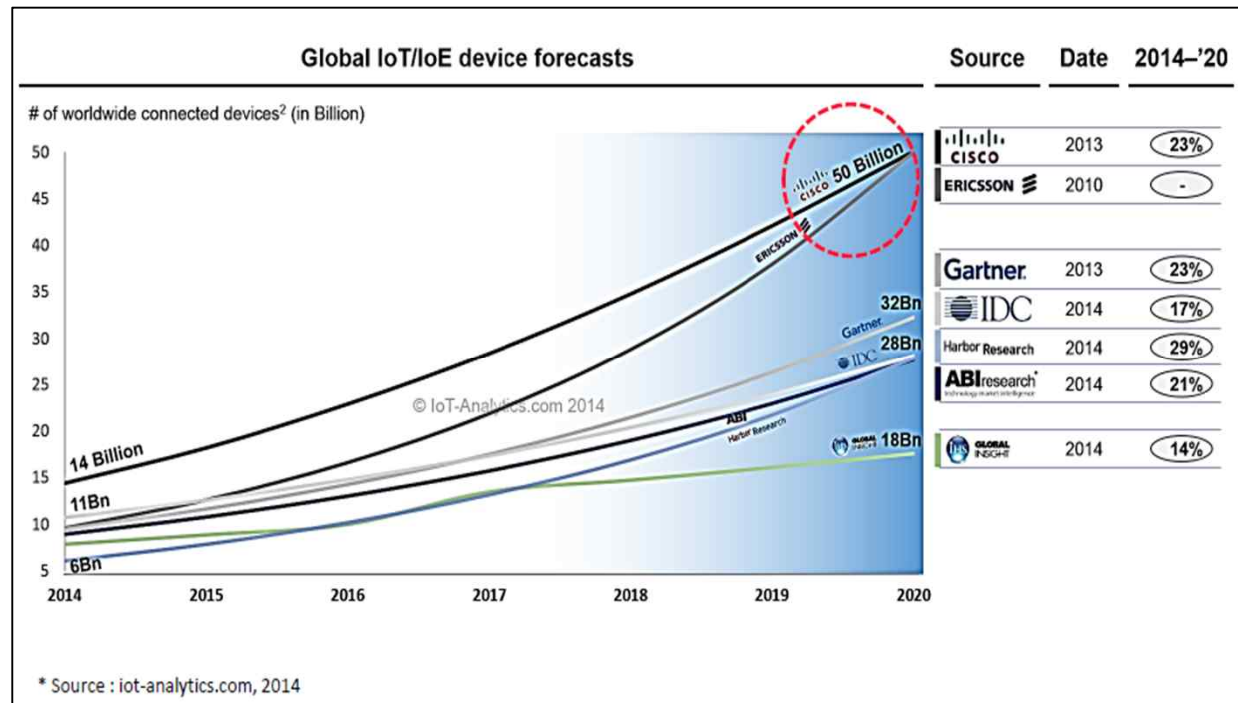
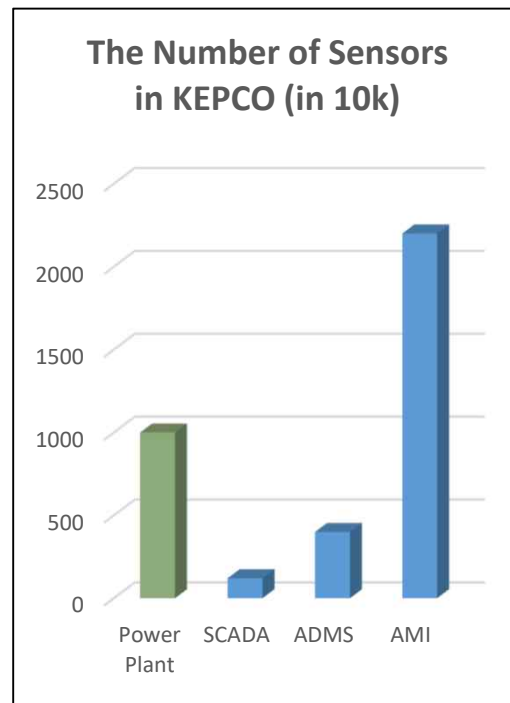


Conquering 'sensor data' is very important for getting insight

02 Field Needs (Challenges)

● Sensors in Power Plant (in case of South Korea)

- 400 Plants +
- Total Tags : approx. 8–10 mil.
- Huge amounts of data : 1.7 bil. / day • a plant
- ※ 1 tag: 80 bytes



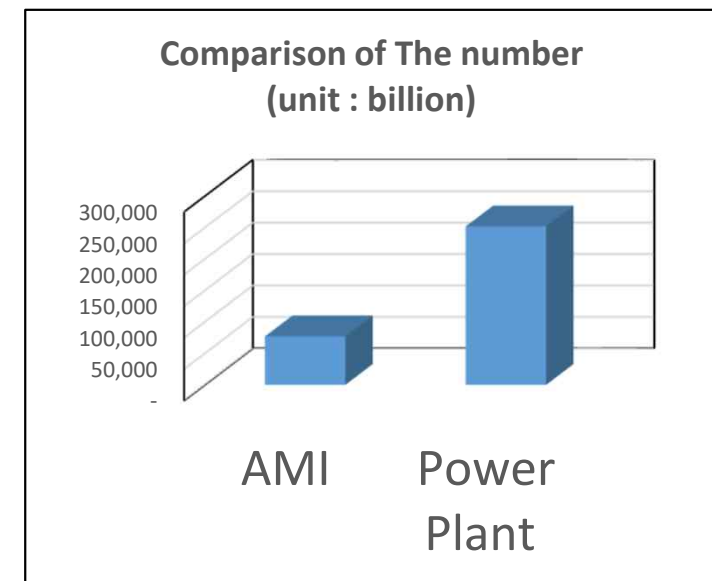
02 Field Needs (Challenges)

● The number of Tag (a Plant)

Sensors	a day (mil.)	a month (mil.)	a year (mil.)
20,000	1,728	51,840	630,720

● Stored Volume (a Plant)

Sensors	Tag Size (Byte)	a day (GB)	a month (TB)	a year (TB)
20,000	80	129	4	46



※ AMI is the biggest in no. of tags

Power plant data is the biggest (3x more than AMI)

02 Field Needs (Challenges)

● The number of Readings in the Power System (83% from Power Plants)

[Unit: in Billions]					
Division	Power Plants	Transmissions	Distributions	Customers	Total
the Number of Readings / Day · GW	3	0.15	0.52	0.02	4.13
the Number of Readings / Day · Whole World (2,130GW)	7,327	329	1,097	41	8,794
the Number of Readings / Year · 50GW-Sized Utility Company	62,780	2,820	9,402	350	75,352
the Number of Readings / Year · 100GW-Sized Utility Company	125,560	5,641	18,803	701	150,704
the Number of Readings / Year · Whole World (2,130GW)	2,674,428	120,151	400,505	14,927	3,210,011

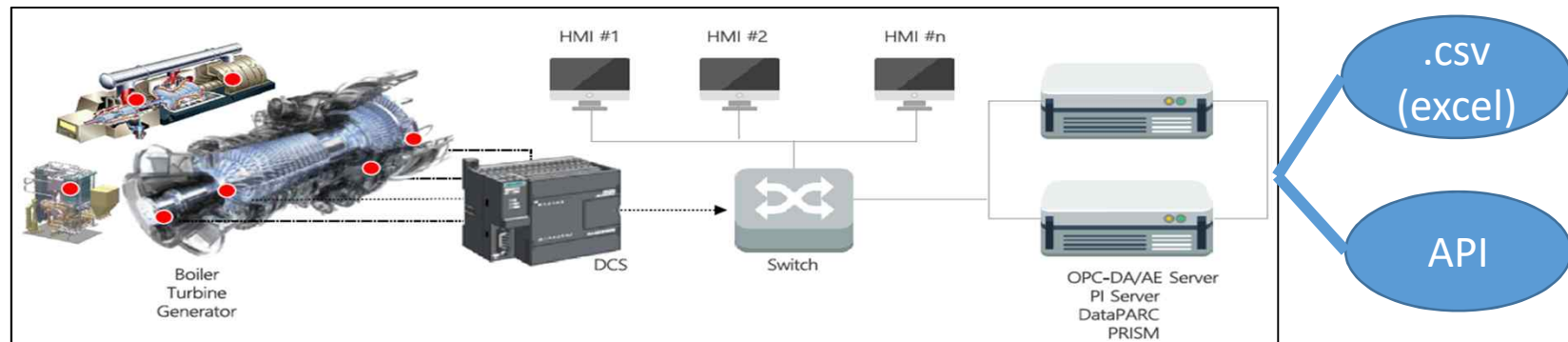
The number of Sensor Readings by Segment (Estimation By IDPP Platform Research)

Estimation Conditions	- no. of sensor/power plant: 20k, Sensor in T&D: 5,200k, Whole World Generation Volume from www.globalenergymonitor.org(Jan. 2024) - Transmission Daily Readings/GW: 17 billions/110GW - Distribution Daily Readings/GW: 17 billions/110GW x 4/1.2(Ratio of Two Sector) - Customers Daily Readings/GW: 22 millions X 4times X 24 / 110GW 110GW is the total capacity of KEPCO
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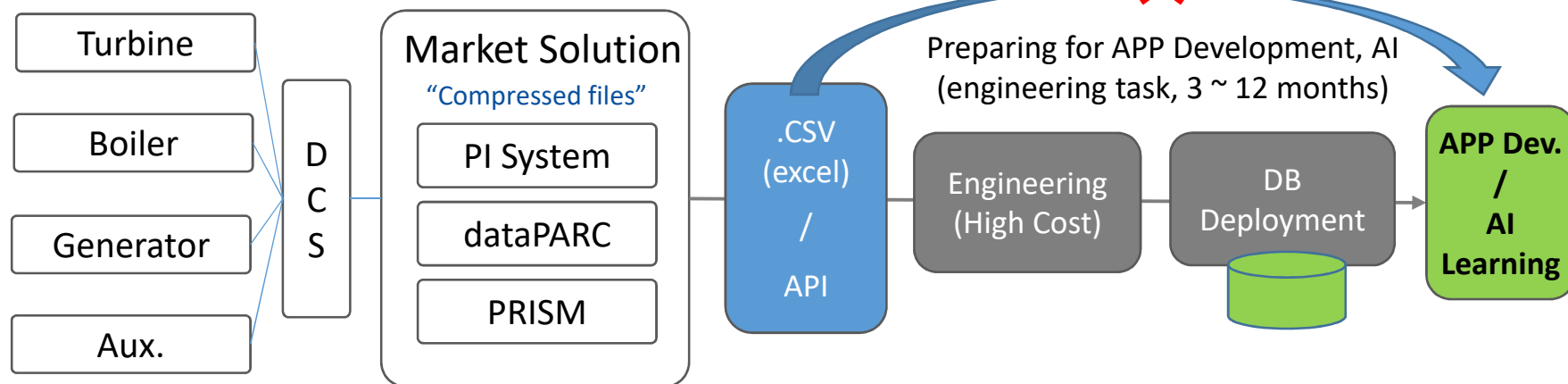
02 Field Needs (Challenges)

● Issues with taking advantage of plant sensors data with market solutions

- **Tag Data Format's Dependency** to DCS vendor
- Just Stored **but hard to Extract and Use it** for App and AI

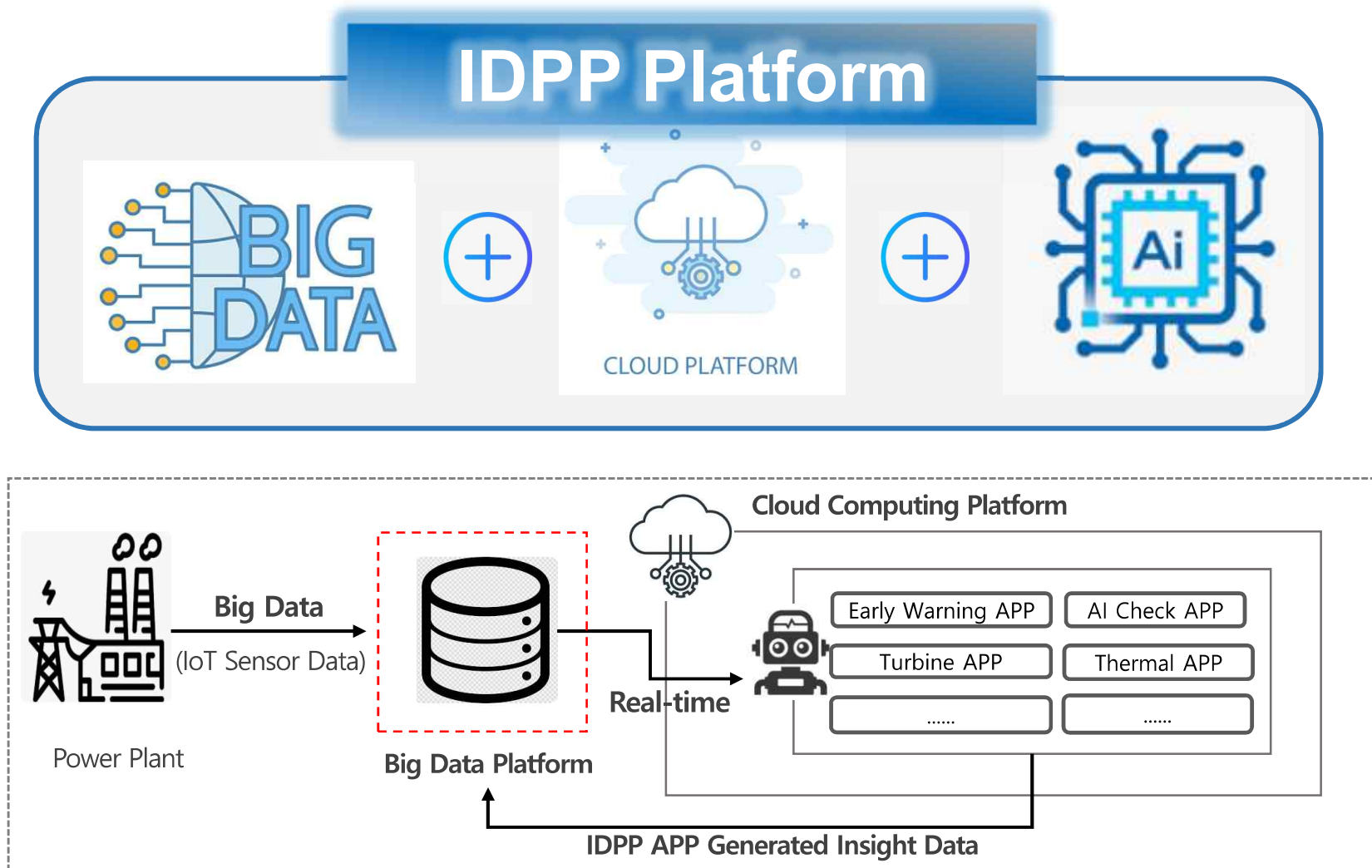


“Data structure is different by DCS vendors”

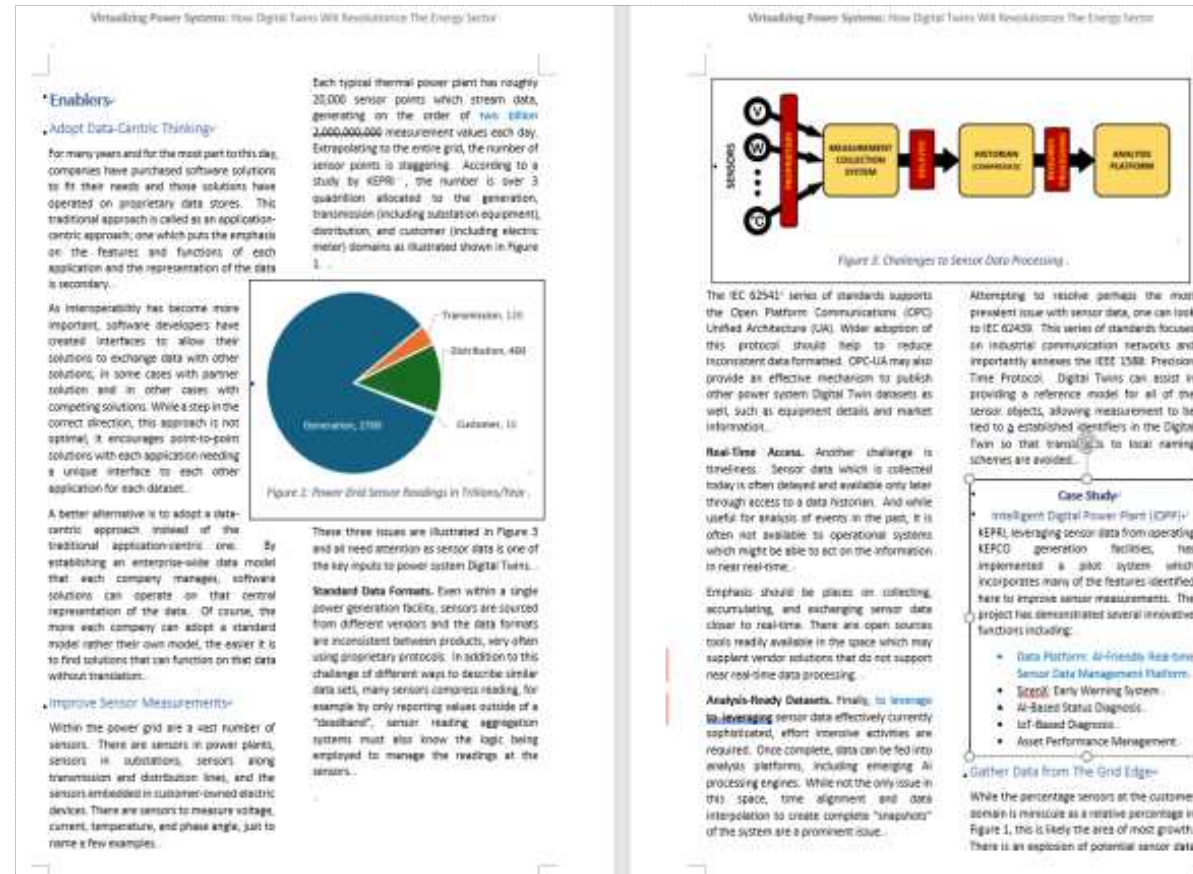


03 IDPP Overview

- IDPP(Intelligent Digital Power Plant) Platform (Since 2019)



● IDPP Platform in Global Report



Included in 2024 IEC White Paper as Data-Centric Case

03 IDPP Overview

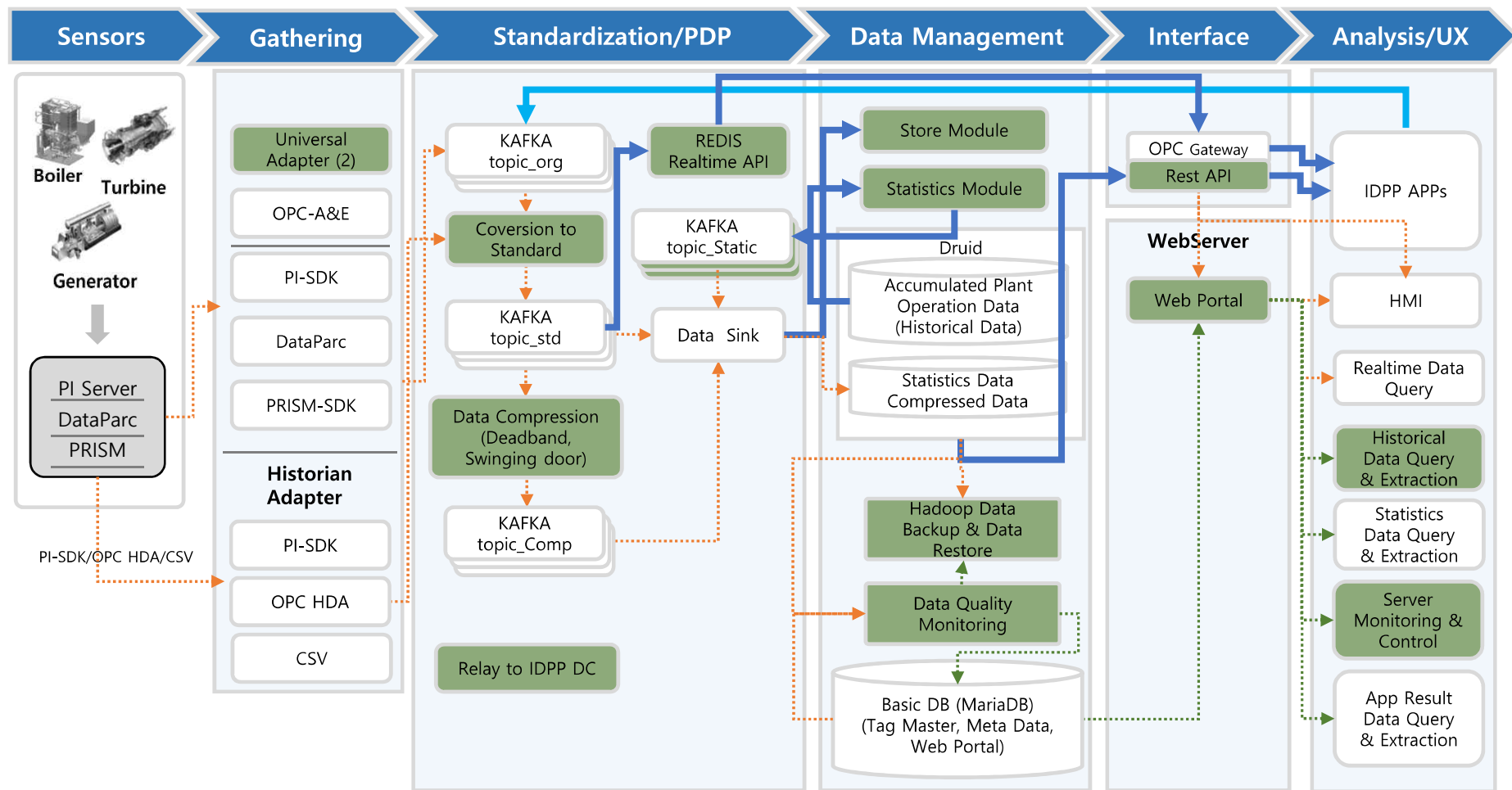
● Core Techs Comparison with Market Solutions

Core Techs for Data Platform	IDPP Platform	Existing market solutions
Real-time	○	X
Use by AI	○	X
Structured data	○	△
Easy data extraction	○	X

- IEC WP comments Standard Data Formats, Real-time Access, Analysis-ready Datasets for Implementation of Digital Twin

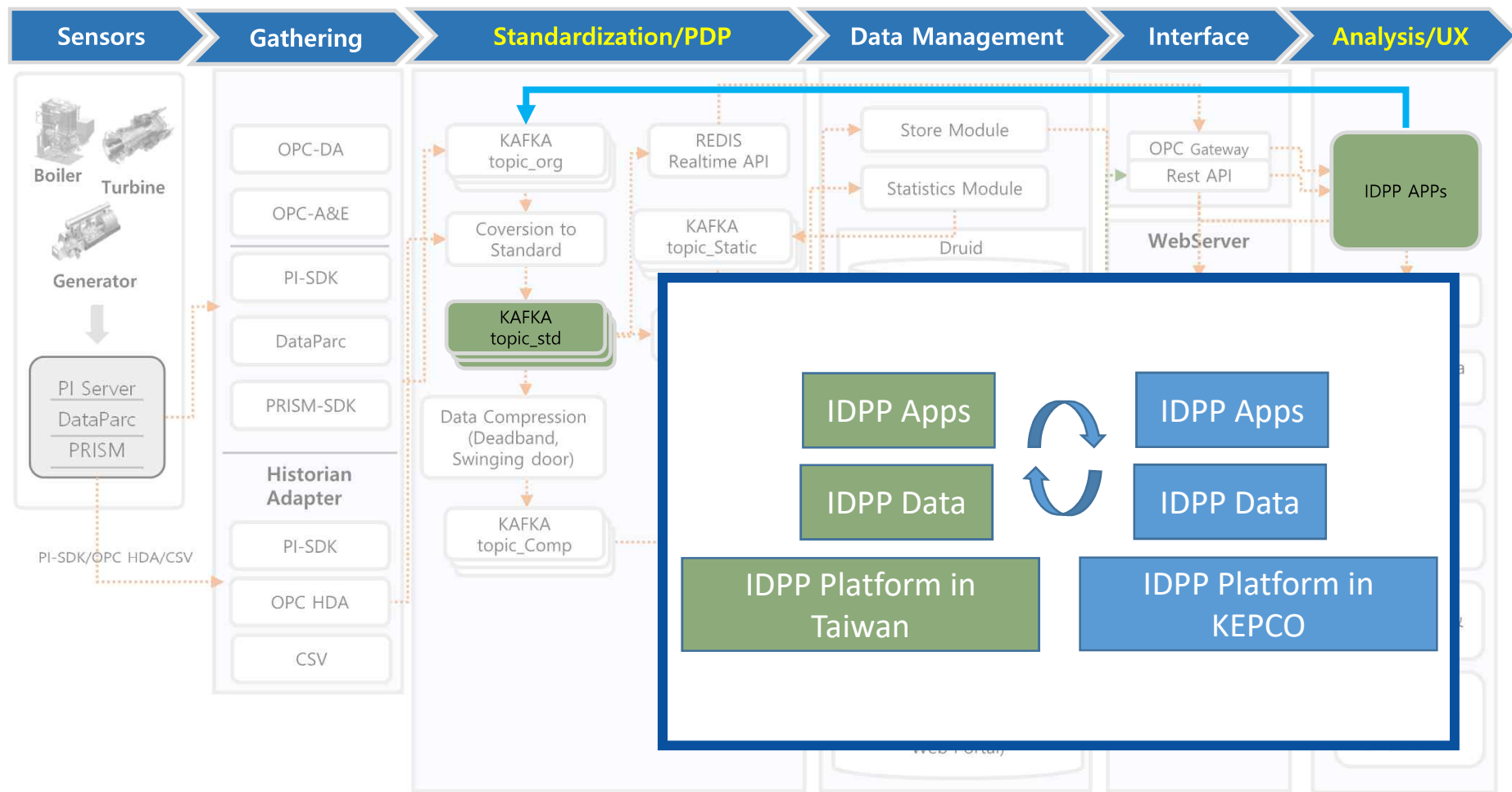
Core Techs for Ultra-large Data Platform

04 Big Data Platform Overview



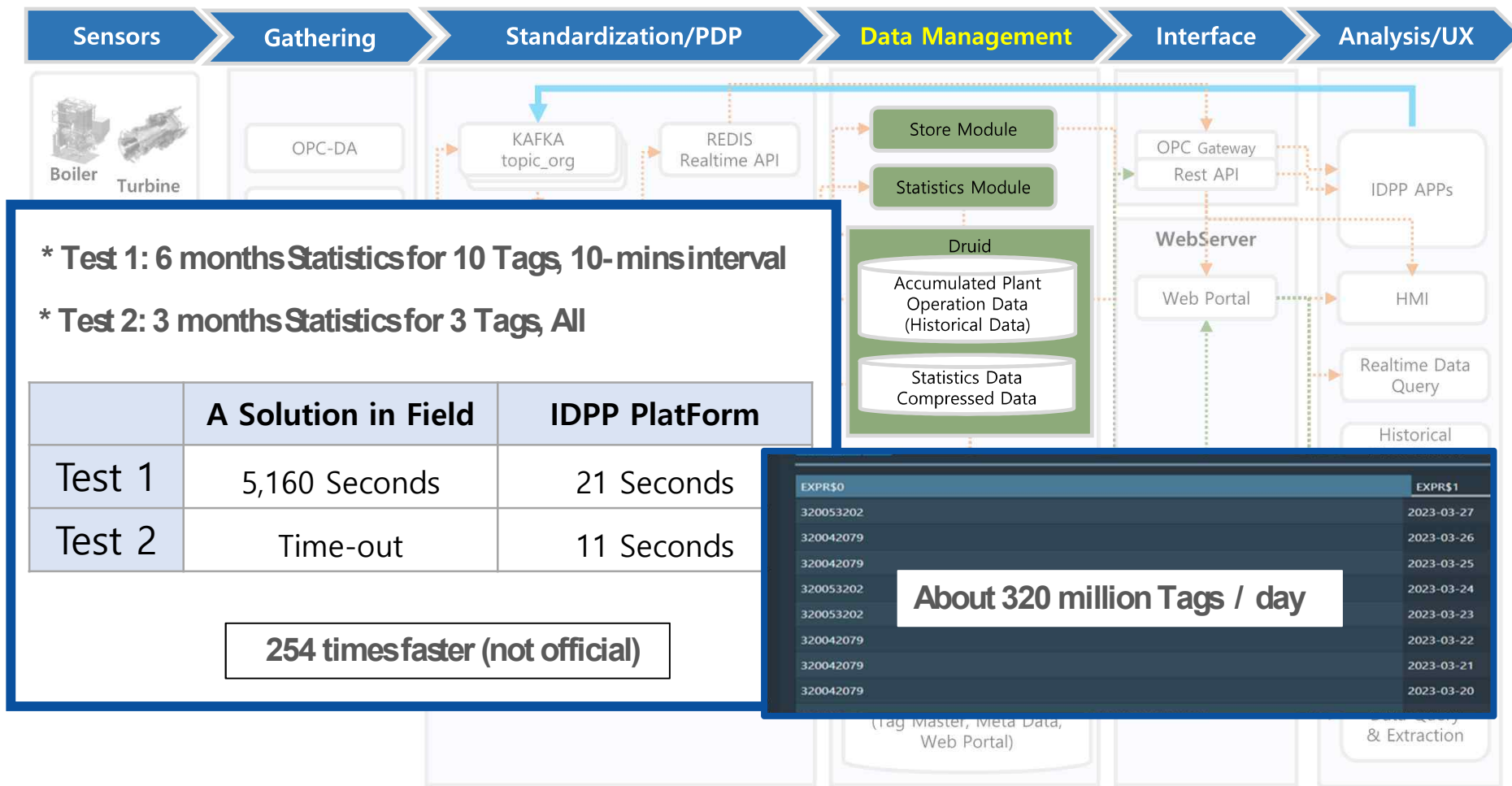
14 Core S/W Modules for Perfection & High Availability

04 Big Data Platform Overview



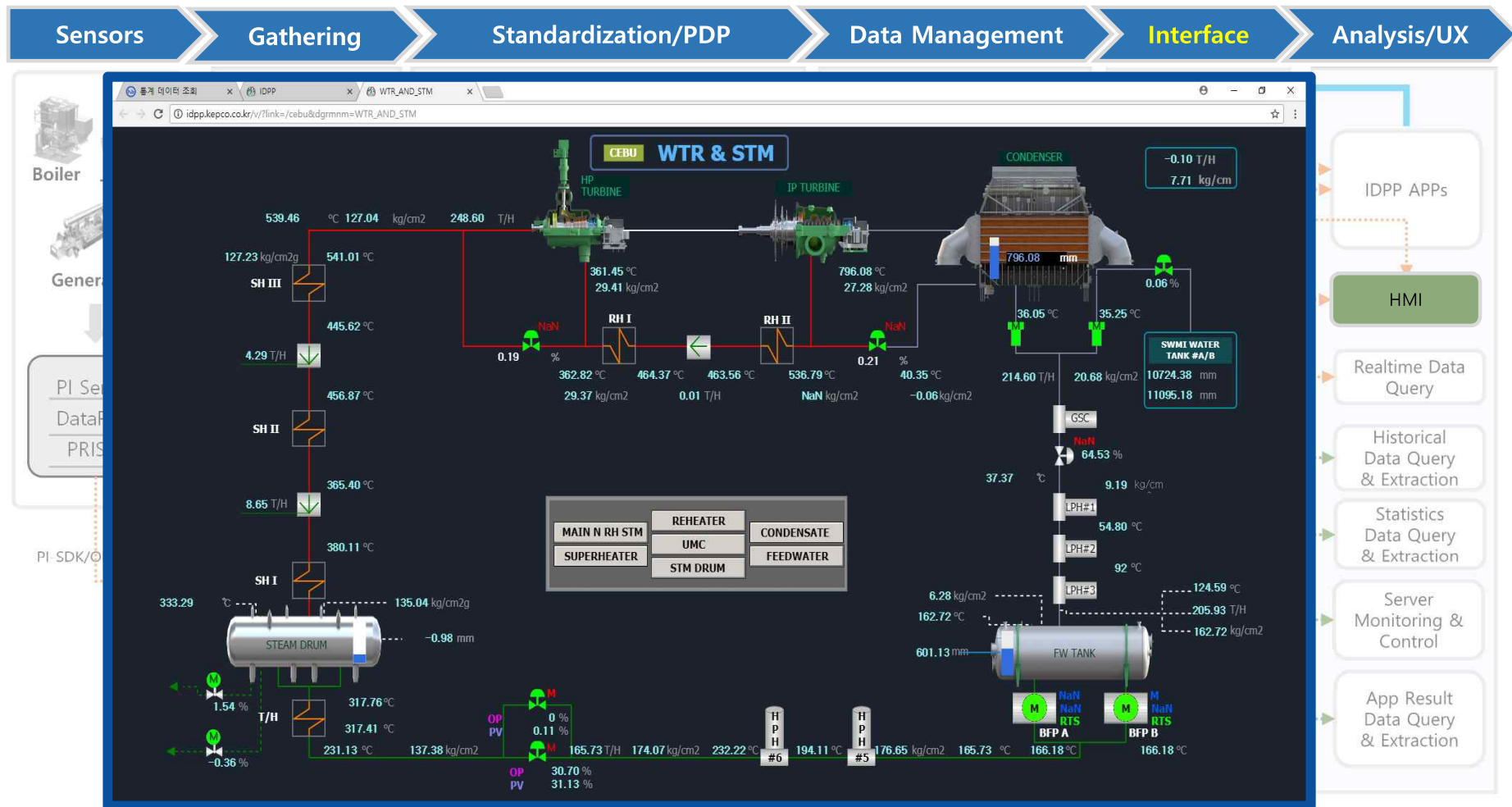
Apps & Data Interoperability Across Power Plants

04 Big Data Platform Overview



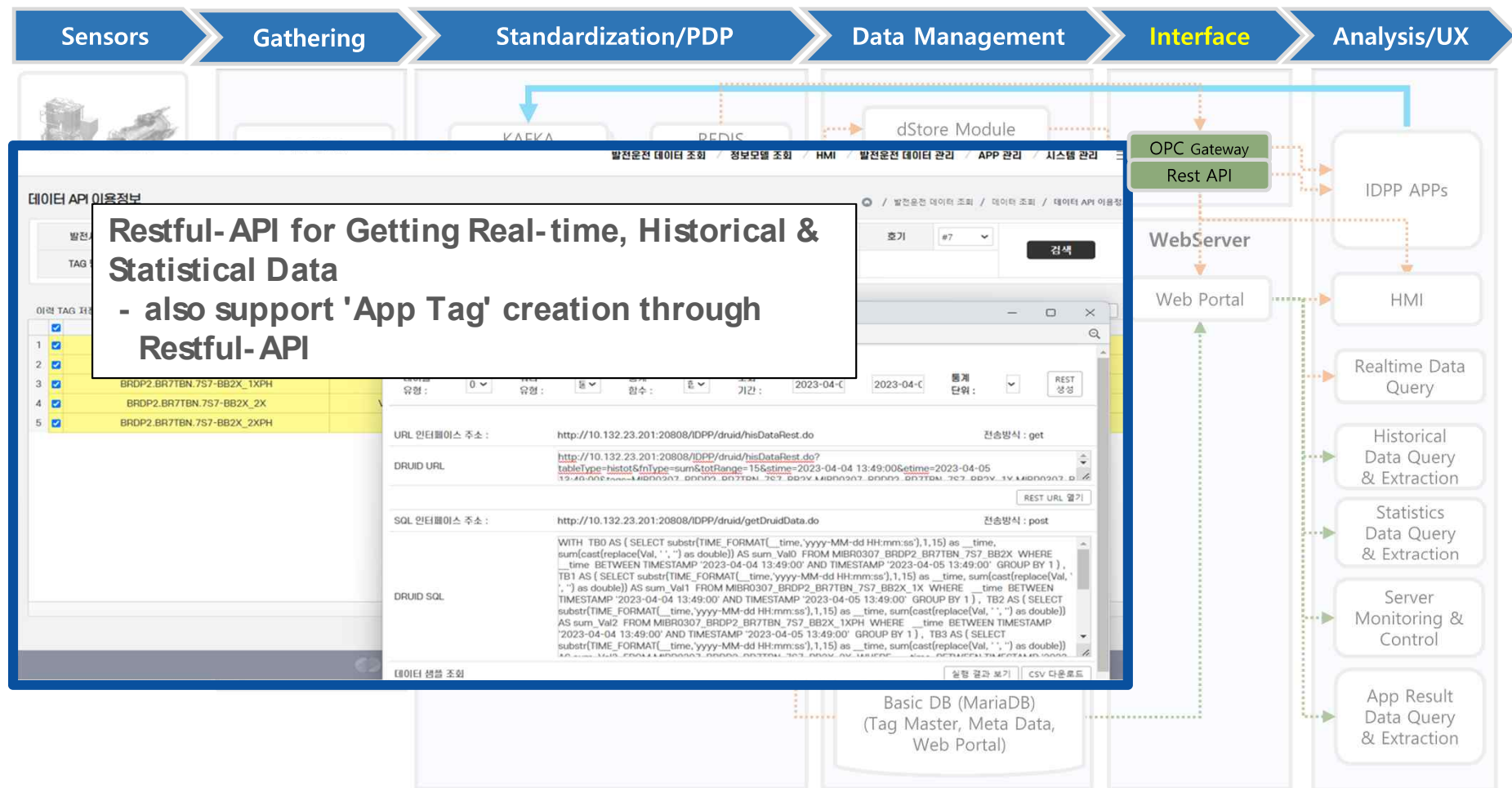
Much Faster Than Commercial Solution in Power Plant

04 Big Data Platform Overview

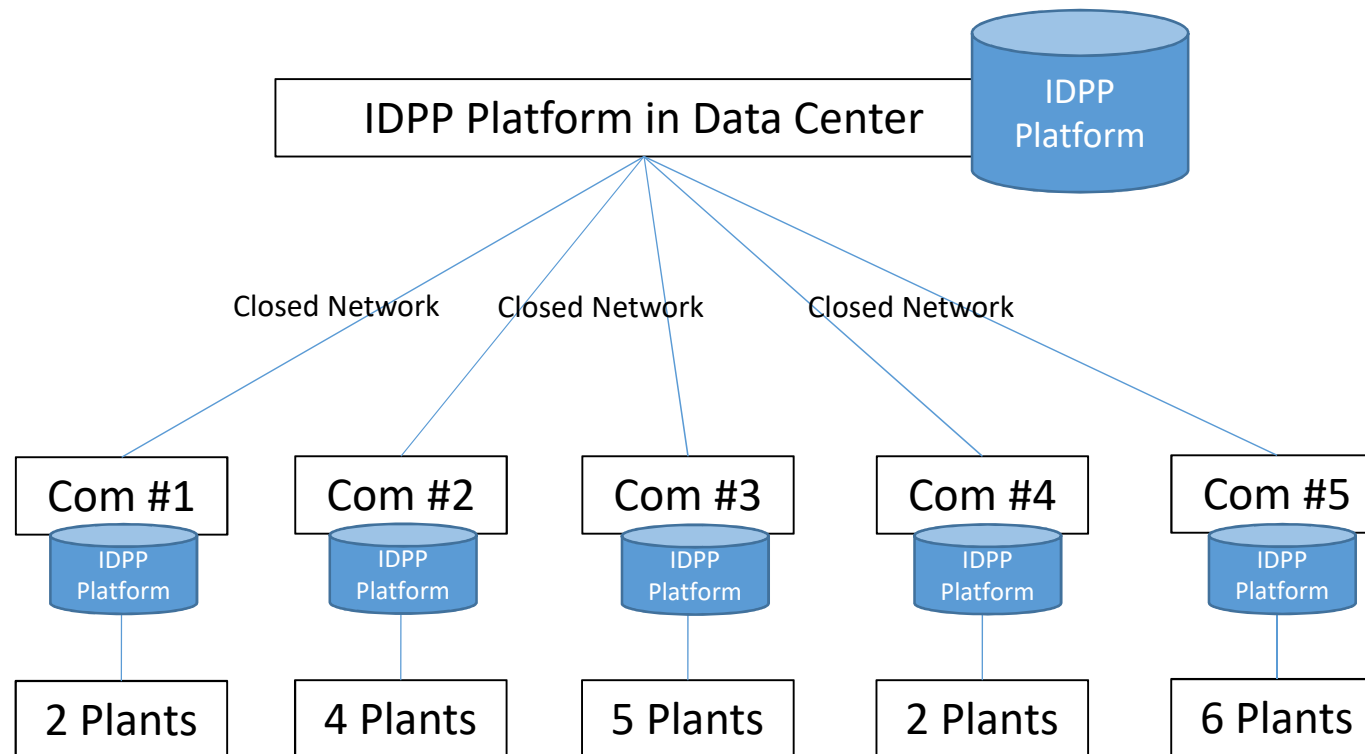


Web-based HMI UX for Situation Awareness

04 Big Data Platform Overview



Easy-to-use APIs for Apps, Engineers, Users



Deployed in 19 Power Plants (5 Generation Companies)

05 IDPP Platform Deployment ('22. 6 ~)

IDPP DC Dashboard Screenshot



Data & ICT fully Monitored w/ High-end Graphics Tech.

06 Applications using IDPP Platform

● Use cases of Realtime and Historical Tag Data (11 apps from research)

No.	App name	Development Language	DB	Web-based	App-based	web,was
1	App Portal	spring, java	mariadb	O	X	Tomcat
2	Boiler Management	C#	mssql	X	O	X
3	Water Absorption Diagnosis	spring, java	mariadb	O	X	Tomcat
4	Wedge Evaluation	nodejs , vue	mariadb	O	X	Express
5	Turbine Tool	c	X	X	O	X
6	Early Warning System(SirenX)	C#	mariadb	X	O	X
7	AI based Status Diagnosis	springboot, vue, phython	mongodb	O	X	embedded tomcat
8	GT Combustor Monitoring	c	X	X	O	X
9	Expert Knowledge DB	spring, java	mariadb	O	X	Tomcat
10	IoT based aux. diagnosis	nodejs, vue	mariadb	O	X	Express
11	Asset Performance Mgt.	springboot, java	mariadb	O	X	embedded tomcat

More and More Apps to be Researched in coming years

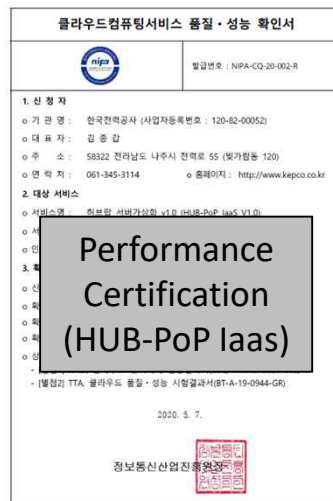
06 Applications using IDPP Platform

- IDPP Platform Users' App (a lot of apps is being developed by users)



<a power generation company developed 8+ apps using IDPP Platform>

User can develop apps using IDPP Platform data



08 Expected Impacts

Demonstrated in Korea

KEPRI and KEPCO's 5 gencos demonstrated Wiseman PP from May 2022 to April 2023

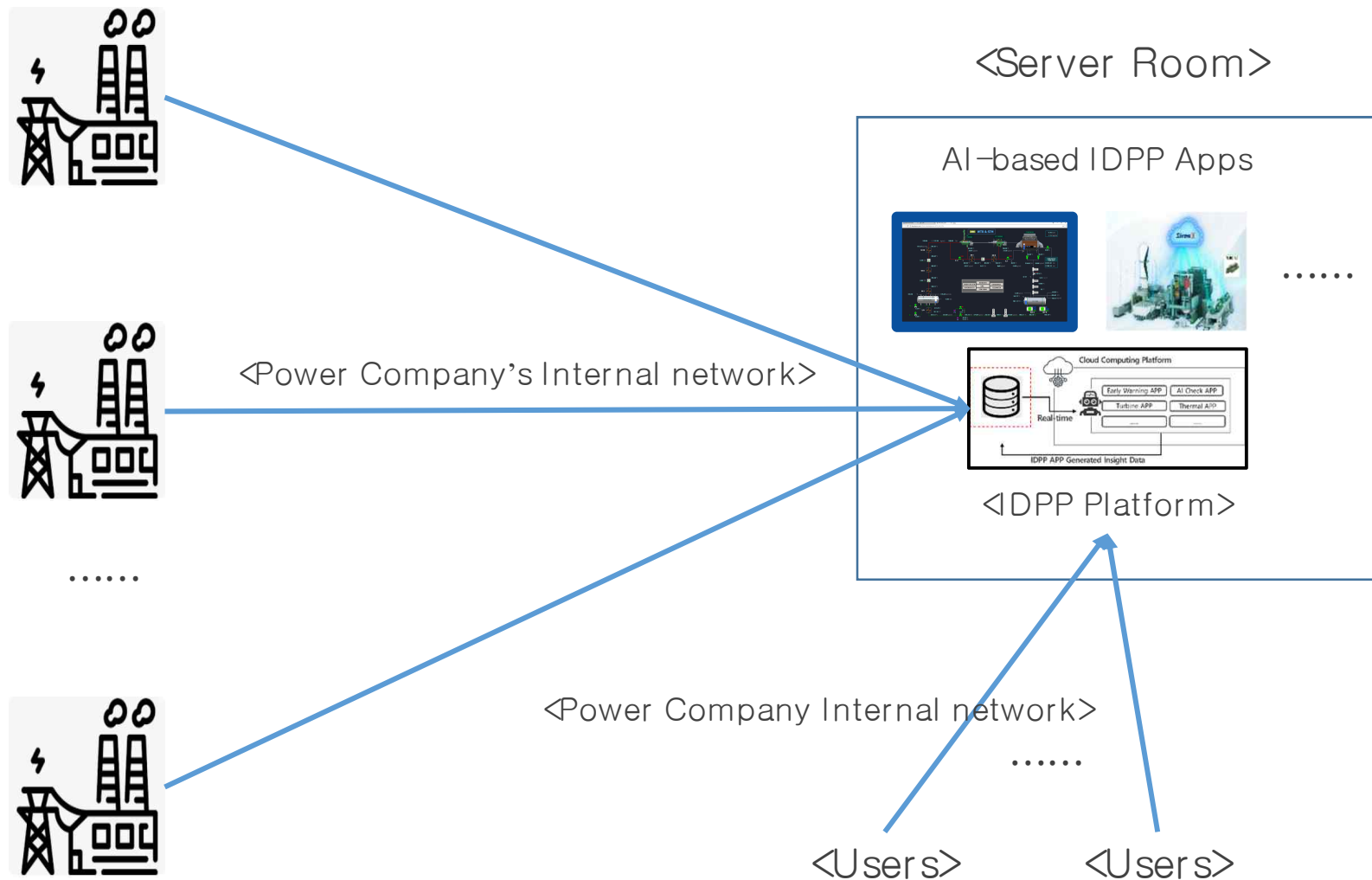
- ✓ Approximately 230,000 sensors had been installed in 19 generation units of 5 gencos.

Benefits Identified During Demonstration

- ✓ Enjoyed a data processing performance 250 times faster than those of competing solutions
- ✓ Avoided failures, which subsequently brought the following benefits:
 - saved USD 47.4 mn/yr, which would have been spent to purchase power from expensive peakers
 - saved USD 6.66 mn/yr, the O&M cost subsequent to the failures * assuming USD 1 per KRW 1349
- ✓ Saved the cost of maintaining the competitor's solutions (license and tech. support fees)

IDPP can reduce the operating cost of power plants by 1-2 mil. USD/ GW-year

09 IDPP Platform Network Diagram



Employees will have a powerful tool for managing power plants

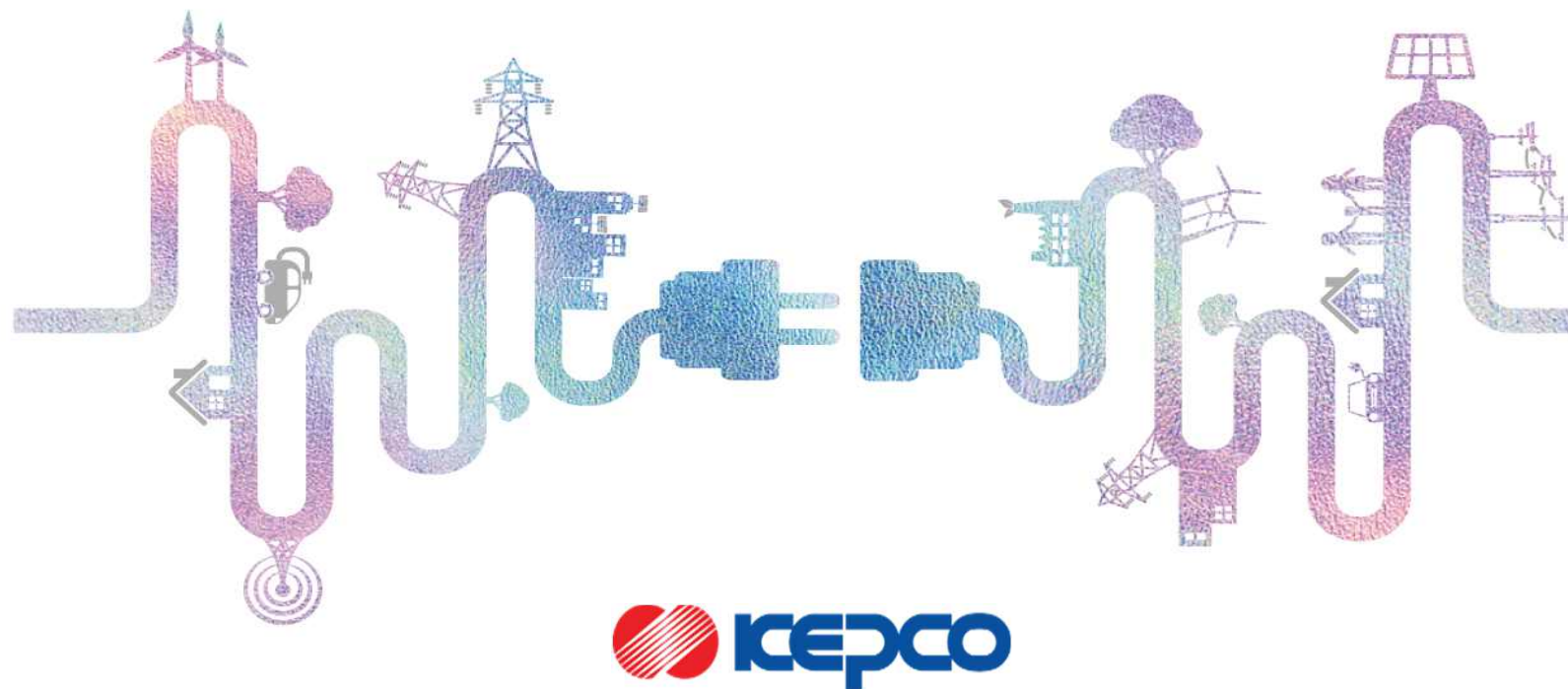
- Can reduce O&M costs by preventing power generation equipment failures
(2 millions USD/GW)
- Can monitor all the power plant facilities under the flexible operation
 - Can catch the degradation of equipment on the time perspective
- Can develop brand-new apps for itself using IDPP platform tag data
 - like a IDPP user company in Korea developed 12 apps for itself in 2023
- Can reduce costs for digital transformation with KEPCO's IDPP Platform
 - It is much cost-effective compared with global solutions such as PI System, dataPARC
 - or if you tried to research a solution like IDPP platform you would spend several dozens of millions of USD and go through trial and error
- Can adopt AI-based facility management technology with IDPP Platform
 - Can jump on the 4th Industrial-Revolution level with IDPP Platform
 - and can make a lot of value with IDPP Platform

10 Summary

KEPCO developed its IDPP Platform to leap beyond the boundaries of services offered by the existing digital power plant management solutions and to be the leader of turning conventional thermal power plants more efficient, flexible and affordable. KEPCO realized that it was essential to make available the time-series, ultra-large-volume Sensor Data generated by a power plant unimpeded use to make that leap, and accordingly, drew the four principles of: real-time; use by AI; structured data; and easy data extraction.

It was the 5 KEPCO's generation companies who noticed the advanced features of KEPCO's IDPP Platform and decided to apply the Platform to their 19 generator units – after they have experienced the Platform, the number of units is growing. In addition, a growing number of utility companies from Vietnam, Indonesia, Taiwan, Kingdom of Saudi Arabia, etc. are inquiring KEPCO about the Platform.

KEPCO has selected IDPP Platform as its representative technology and plans to continuously advance its functions for improving the efficiency of power plants in the era of 4th Industrial Revolution.



Thank you for listening