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# Overview of IDPP Platform and Benefits

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### First-ever Paradigm Transition Due to Carbon Neutral Policy

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



<Duck Curve – Australia, 2021>

#### 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)



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



#### The number of Tag (a Plant)



**\*** AMI is the biggest in no. of tags

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

#### • 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)

	• no. of sensor/power plant: 20k, Sensor in T&D: 5,200k, Whole World Generation Volume
	from <u>www.globalenergymonitor.org(Jan</u> . 2024)
Estimation	Transmission Daily Readings/GW: 17 billions/110GW
Conditions	• 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

# **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 Al





# 03 IDPP Overview

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





#### IDPP Platform in Global Report

Metaalking Power Systems: Itou Digital have Wit Resolution the Events Sector

#### \*Enablers-

#### Adopt Data-Cantric Thinking-

For more years and for the most part to this des. companies have purchased software solutions to fit their reach and those unlations have deepsted on unsuccetary data crosse. This traditional another his called at an applicationcontric approach: one which puty the actualization on the features and functions of each application and the representation of the data is secondary.

As interspeciality has become more important software developers have counted interfaces to allow their solutions to exchange data with other solutions, in some cases with partner solution and in other cases with competing solutions. While a step in the correct election, this approach is not optimel, it enclurages point-to-point solutions with each application needing a unique interface to each other application for each dataset

A better alternative is to adopt a statecantric approach trainead of the traditional application pentric one. By establishing an enterprise-saide data model that each company manages, software solutions can operate on that central representation of the data. Of course, the more each company can adopt a standard model other their own model, the easier it is to find solutions that sail function on that data without translation.

#### Improve Sensor Measurements-

Within the power grid are a west number of sensors. There are sensors in power plants, sensors in substantions, sensors along transmission and distribution lines, and the sensors ambeddell in subbrier-owned electric devices. There are sensors to measure voltage current, temperature, and phase angle, just to name a few mamples.

Each typical intermal power plant has roughly 20,000 sensor points which stream data, generating on the order of two places 2.000.000.000 measurement values each day. Extrapolating to the entire grid, the number of serioor points is staggering. According to a study by KEPRI , the number is siver 3 quadrillon allocated to the emeration. transmission (including substation equipment). distribution, and customer (including electric meter's domains as illustrated shown in Figure



These three issues are illustrated in Finance 3. and all need attention as sensor data is one of the key inputs to power system Digital Twins.

Standard Data Formats, Even within a single power generation facility, sensors are sourced from different vendors and the data formats are inconsistent between products, very often using proprietary protocols. In addition to this chalance of different ways to describe similar data sets, many sensors compress reading, for example by only reporting values outside of a "doubland", senser reading appropriation systems must else know the logic being employed to manage the readings at the servers.



the Open Platform Communications (CPC) Unified Architecture (UA). Wider adaption of this protocol shauld help to reduce Inconcistent data formatted. OPC-UA may also provide an effective methanism to sublish other power system Digital Twin datasets as well, such as equipment details and market intervention.

Real-firms Access. Accelor shallenge is timelinets. Sensor data which is collected today is often deteved and available only later through access to a data historian. And while useful for analysis of events in the part, it is often not available to operational systems. which might be able to act on the information In near real-time

Emphasis should be places on collecting. accumulating, and exchanging sensor data closer to real-time. There are open sources tools readily available in the space which may supplient vendor solutions that do not support new residence data processing.

Anatolis-Ready Datasets, Finalis, In January to leveraging sensor data effectively currently sophisticated, effort intensive activities are required. Once complete, stata can be fed into evelysts platforms, including emerging Air processing engines. While not the only issue in this space, time alignment and data interpolation to create complete "inapphoto" of the system are a prominent issue .

prevalent issue with sensor data, one can look to IEC 62459. This series of standards focuses on industrial communication networks and importantly annexes the IEEE 1558: Precision Time Protocol Digital Tunks can assist in providing a reference model for all of the sensor objects, allowing measurement to be tied to a established identifiers in the Digital Twin to that translitions to local naming schemes are avoided.

#### Case Shide

misRent Dettal Prover Flart Uptatu kEPRI, leveraging sensor illata from operating **KEPCO** generation fluctilities, this implomented a pilot system which incorporates many of the features identified here to improve senser measurements. The project has demonstrated several innovative functions including:

- · Data Platform: 41-friendly Registreet
- Semar Date Management Platform TirenX: Early Warning System.
- W-Based Status Diagnosis.

 IsT-Based Diagnosis. Asset Performance Management

Gather Data from The Grid Edge-

While the percentage sensors at the custome portain is ministrate as a relative percentage in Figure 1, this is likely the area of most growth. There is an explosion of potential sensor data

### Included in 2024 IEC White Paper as Data-Centric Case

#### Core Techs Comparison with Market Solutions

Core Techs for Data Platform	IDPP Platform	Existing market solutions
Real-time	0	Х
Use by AI	0	Х
Structured data	0	$\bigtriangleup$
Easy data extraction	0	Х

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

# **Core Techs for Ultra-large Data Platform**



14 Core S/W Modules for Perfection & High Availability



### **Apps & Data Interoperability Across Power Plants**



# **Much Faster Than Commercial Solution in Power Plant**



Web-based HMI UX for Situation Awareness



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

# IDPP Platform Deployment ('22.6 ~)



### **Deployed in 19 Power Plants (5 Generation Companies)**

#### IDPP DC Dashboard Screenshot



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

#### 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	0	х	Tomcat
2	Boiler Management	C#	mssql	Х	0	х
3	Water Absorption Diagnosis	spring, java	mariadb	0	х	Tomcat
4	Wedge Evaluation	nodejs , vue	mariadb	0	х	Express
5	Turbine Tool	с	Х	Х	0	х
6	Early Warning System(SirenX)	C#	mariadb	Х	0	х
7	AI based Status Diagnosis	springboot, vue, phython	mongodb	0	х	embedded tomcat
8	GT Combustor Monitoring	С	Х	Х	0	х
9	Expert Knowledge DB	spring, java	mariadb	0	х	Tomcat
10	IoT based aux. diagnosis	nodejs, vue	mariadb	0	х	Express
11	Asset Performance Mgt.	springboot, java	mariadb	0	х	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



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#### **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)
- $\bigcirc$  Can monitor all the power plant facilities under the flexible operation
  - Can catch the degradation of equipment on the time perspective
- $\bigcirc$  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
- $\bigcirc$  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 4<sup>th</sup> Industrial-Revolution level with IDPP Platform
  - and can make a lot of value with IDPP Platform

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  $4^{\text{th}}$  Industrial Revolution.



# Thank you for listening