[KSGA-ADB]

Energy through ICT

Smart Energy Business Unit

kt

Contents
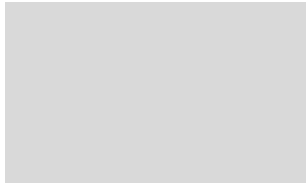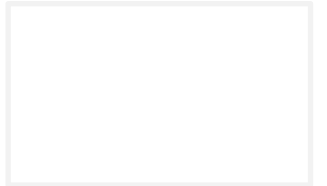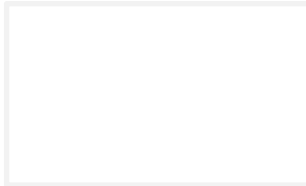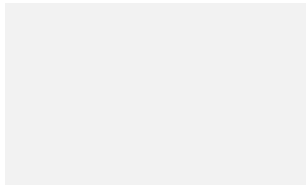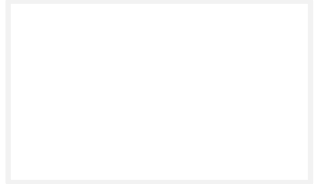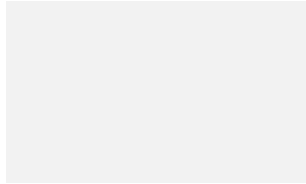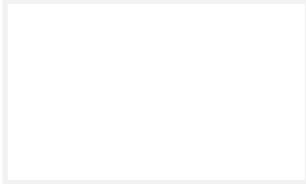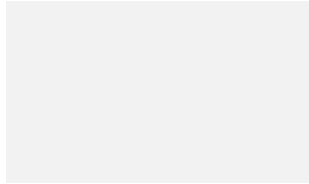
Introduction
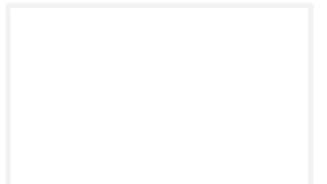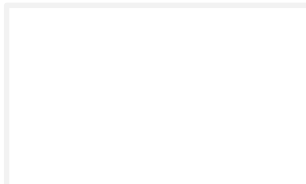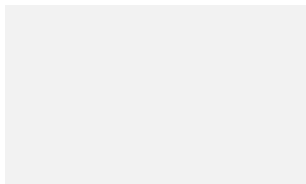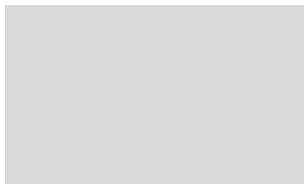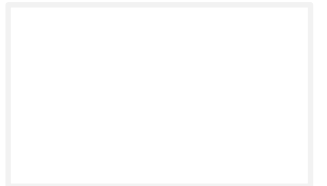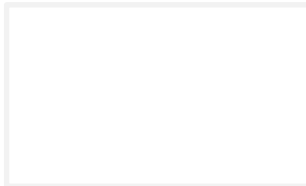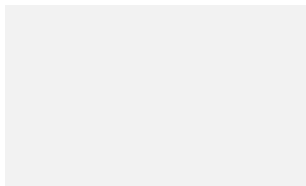
Energy?

01 Introduction

Smart Energy

AMI Renewables EV Charging

DR KT-MEG

ICT Energy
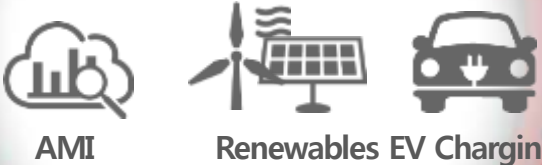
"ICT convergence business models to create the next generation service"

Integrated Safety

- Total security platform & development
- Tailored security-care services

Networked Transportation

- Intelligent Traffic Management Platforms
- Connected Car (media and navigator etc.)

Next Generation Media

- Next generation contents & development
- Globalization of media platforms

Life-Enhancing Care

- Genome Analysis Service
- Biometric Big Data platforms
- Health-care for disease prevention

01 Introduction

① **Optimization Infra + Sensors and Meters for Energy Consumption Metering,**
② **Network for Transmission of Data from Advanced Metering**
③ **Visualizing / Analysis Platform by Big Data**

ICT Sector (②+③)

Big Data Platform

Energy Sector (①)

Power **Gas** **Water** **Heat**

ICT + Energy = Smart Energy

Sensing & Metering

Transmission through NWs

Visualization

Analysis & Prediction

Energy Optimization
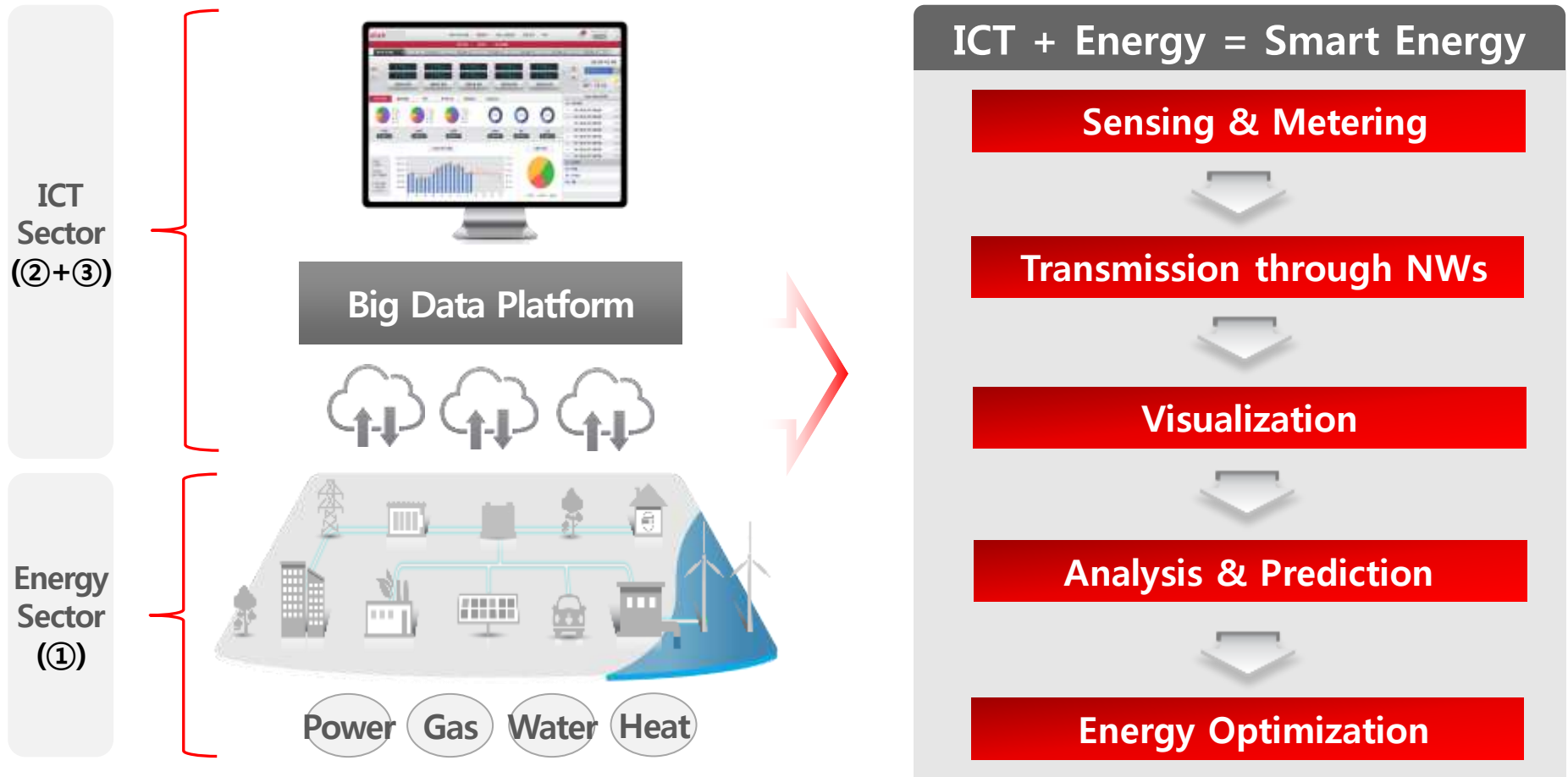
01 Introduction

Creating Generation-Trading-Consumption Convergence Biz. Domain through ICT

Biz. Domain

Generation Aspect

Generation | Convergence

Trading

ICT

Consumption

Utilities

Consumption Aspect

Biz. Portfolio

Energy + Security : Big Data Ecology

Energy Optimization (EMS + IoT + Optimization Infra)

New Biz

IoT

Consumption

Opportunity Sector

Trading

Consulting

Generation

EV Charging, Heat/DR (Demand Response)

Renewable Energy
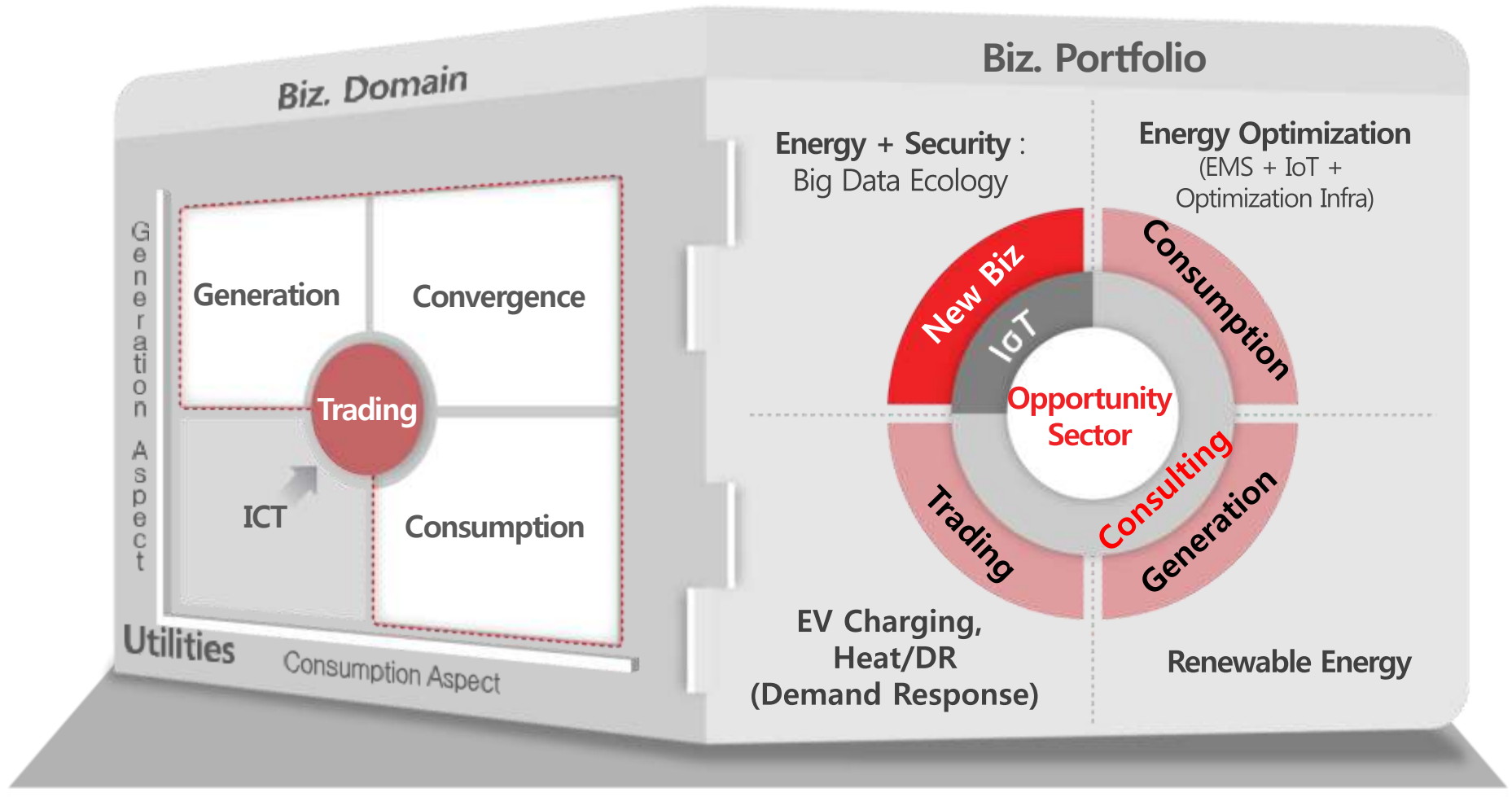
01 Introduction

Realizing Energy Big Data by Utilizing Data, Broadband Network, LBS(Location Based Service), Communication Traffic Data, Customer Behavior

KT Smart Energy Business
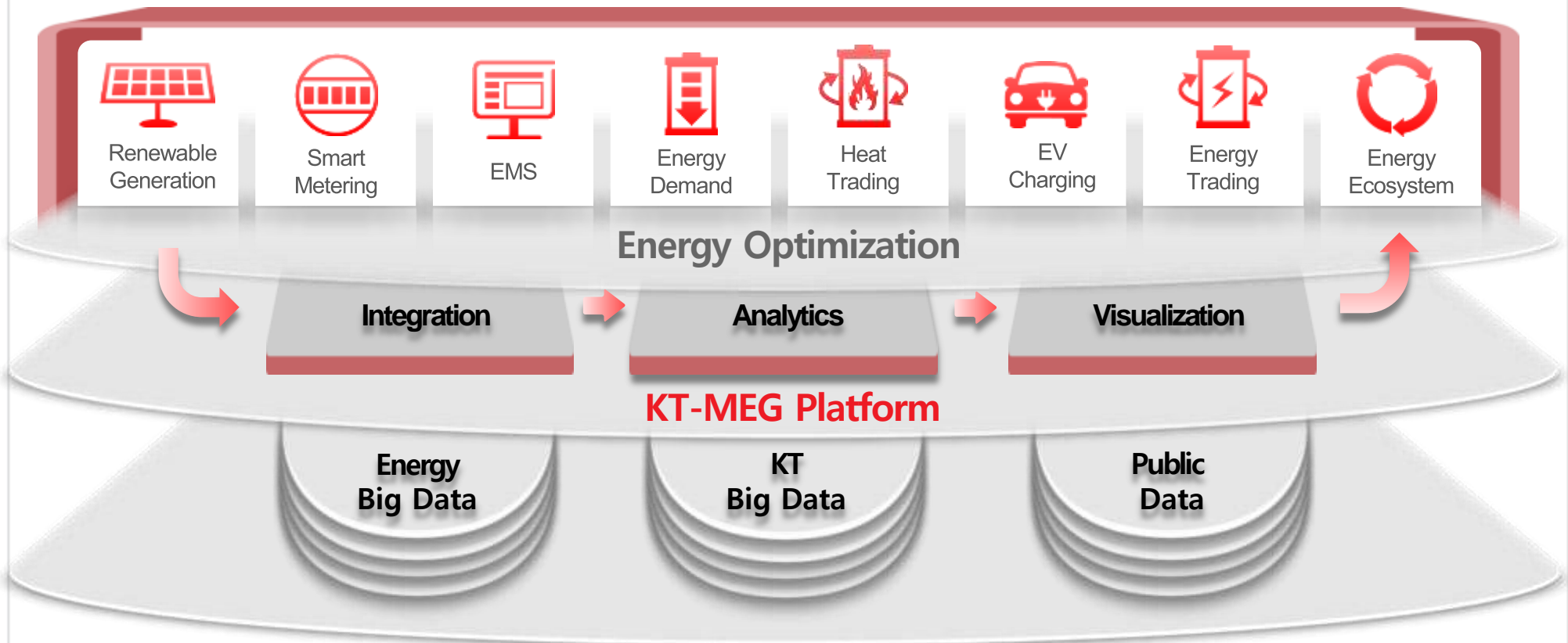
| Renewable Generation | Smart Metering | EMS | Energy Demand | Heat Trading | EV Charging | Energy Trading | Energy Ecosystem |

Energy Optimization

Integration → Analytics → Visualization

KT-MEG Platform

Energy Big Data | KT Big Data | Public Data

02 Energy Optimization

Energy Cost Reduction : Optimizing Energy Efficiency of Facilities

Lighting Optimization

Indoor LED **Outdoor LED**

KT-MEG Center
Operation Center

Operation Server

DataBase

Energy Mgt. Server

Controller & Mgt. Server

Modem Modem Internet
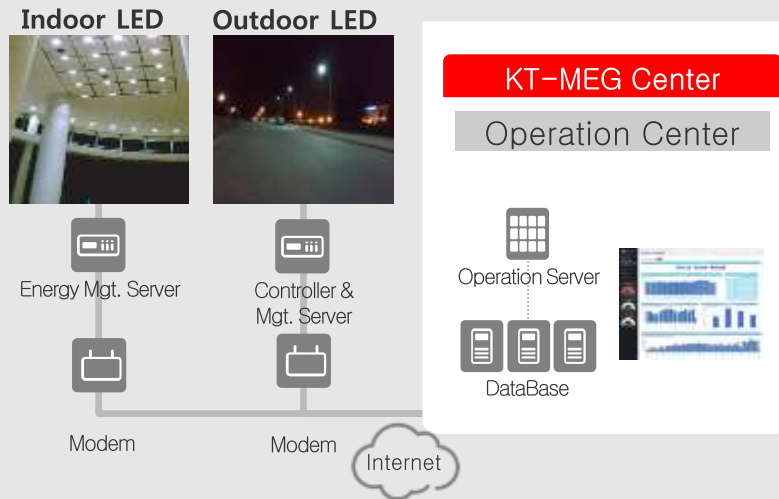
Heating/Cooling Optimization

Heat Pump System

Power Company

Cooling

Heating

Storage Tank

Heat Pump

KT-MEG Center
Operation Center

Operation Server

DataBase

Internet
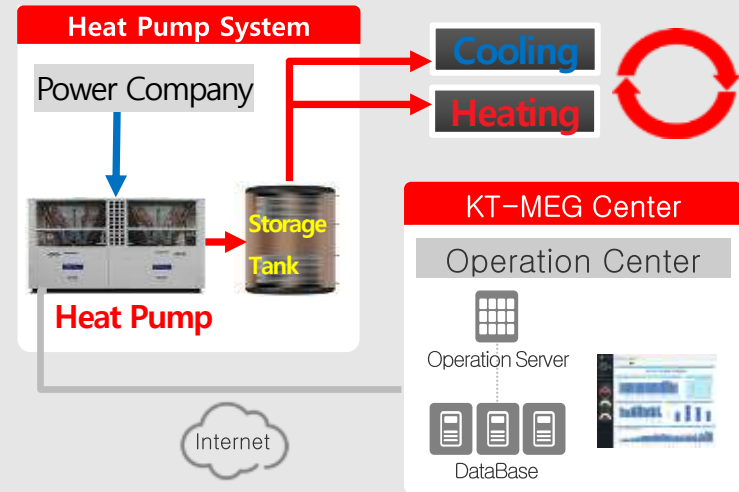
Main Functions

Diagnosis **Efficiency Analysis** **Monitoring** **Remote Control**

- Energy cost is reduced through installation of optimization infrastructure
- Such infra. is interconnected to a centralized operation center(KT-MEG) for optimum operation

02 Energy Optimization

Selling of power conserved by customers through the power market → KT collects demand sources and registers to KPE, which allows the distribution of benefits to customers within KPE's policy

DR(Demand Response) Business

Korea Power Exchange (KPX)

Source demand recruiting & offered

Pay cost of demand source

DR Mgt. Operator (KT)

Offer demand source by ordering reduction

Calculating & Distribution

Customer

Customer A   Customer B   Customer C
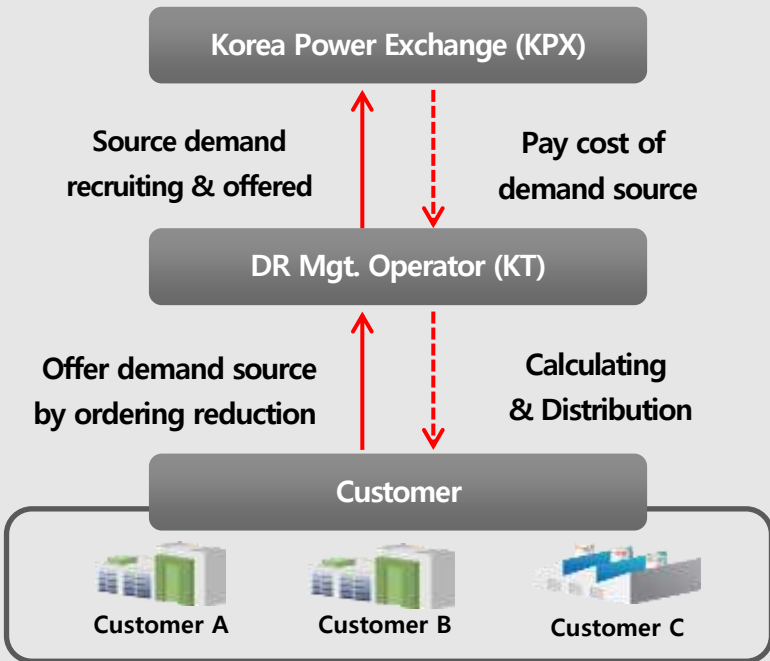
KT's Role

1. Demand source recruiting and market registration
2. Monitor a state of reducing electricity
3. Direct & Spread of demand source reduction
4. DR Management
5. Calculating and distribution of result

Ref.

[Main References : approx. 292 sites]

emart   **E-Mart Corp.**

K water 한국수자원공사   **K-Water Resources Corp.**

200+ Industrial Complexes

02 Energy Optimization

Implementing solar power and other renewable sources + selling of generated power

Renewable Energy Business

- Big-Data
- IoT
- Cloud

Integrated Monitoring (KT-MEG)

| EPC | O&M | Renewable Convergence | → | Micro Energy Grid |

| Engineering | Construction | Operation | Trading |

PV ... Wind ... Geothermal ... ESS ... Waste

※ EPC(Engineering, Procurement, Construction)
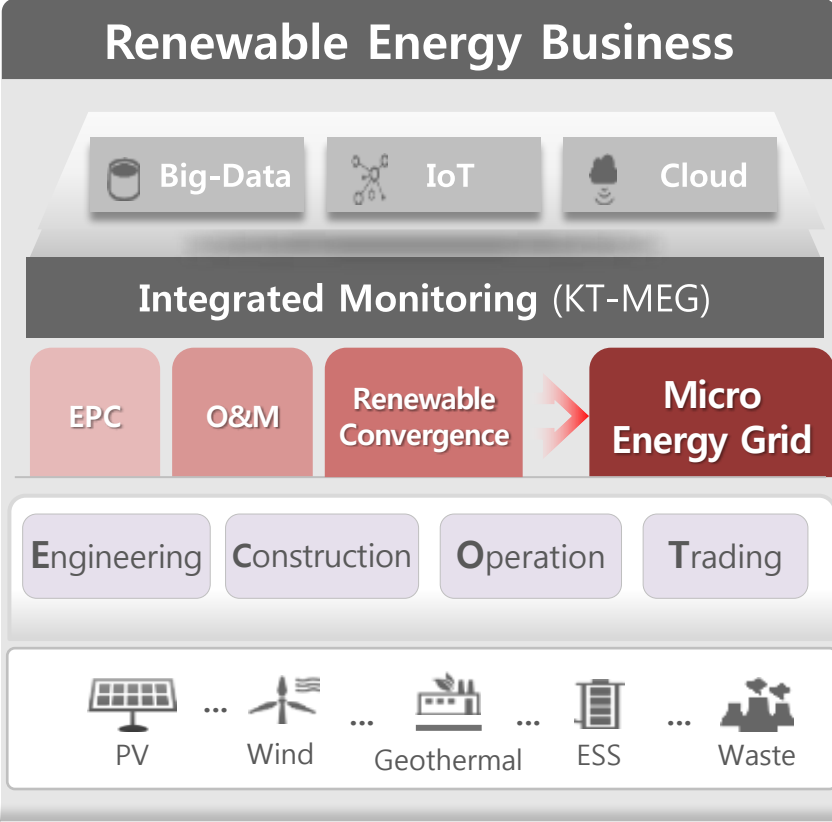
KT's Role

1. Project Design & Consulting
2. Engineering, Procurement, Construction Management
3. Analysis of generation stats. and trend
4. Response to alarm/event

Ref.

1. Daecheok PV Power Plant (7.5Mw)
2. Yeon An PV Power Plant (7Mw)
3. Konam2 PV Power Plant (3.5Mw)
4. Anmyeon PV Power Plant (4Mw)

02 **Energy Optimization**

Example of Optimization by Smart LED Lighting : KangHwa Province

KangHwa Province

Area	• 411.330㎢
Population	• 67,118 (2015.1.1)
Households	• 30,184
No. of Lamp Posts	• Approx. 3,000

02 Energy Optimization

Example of Optimization by Smart LED Lighting : KangHwa Province
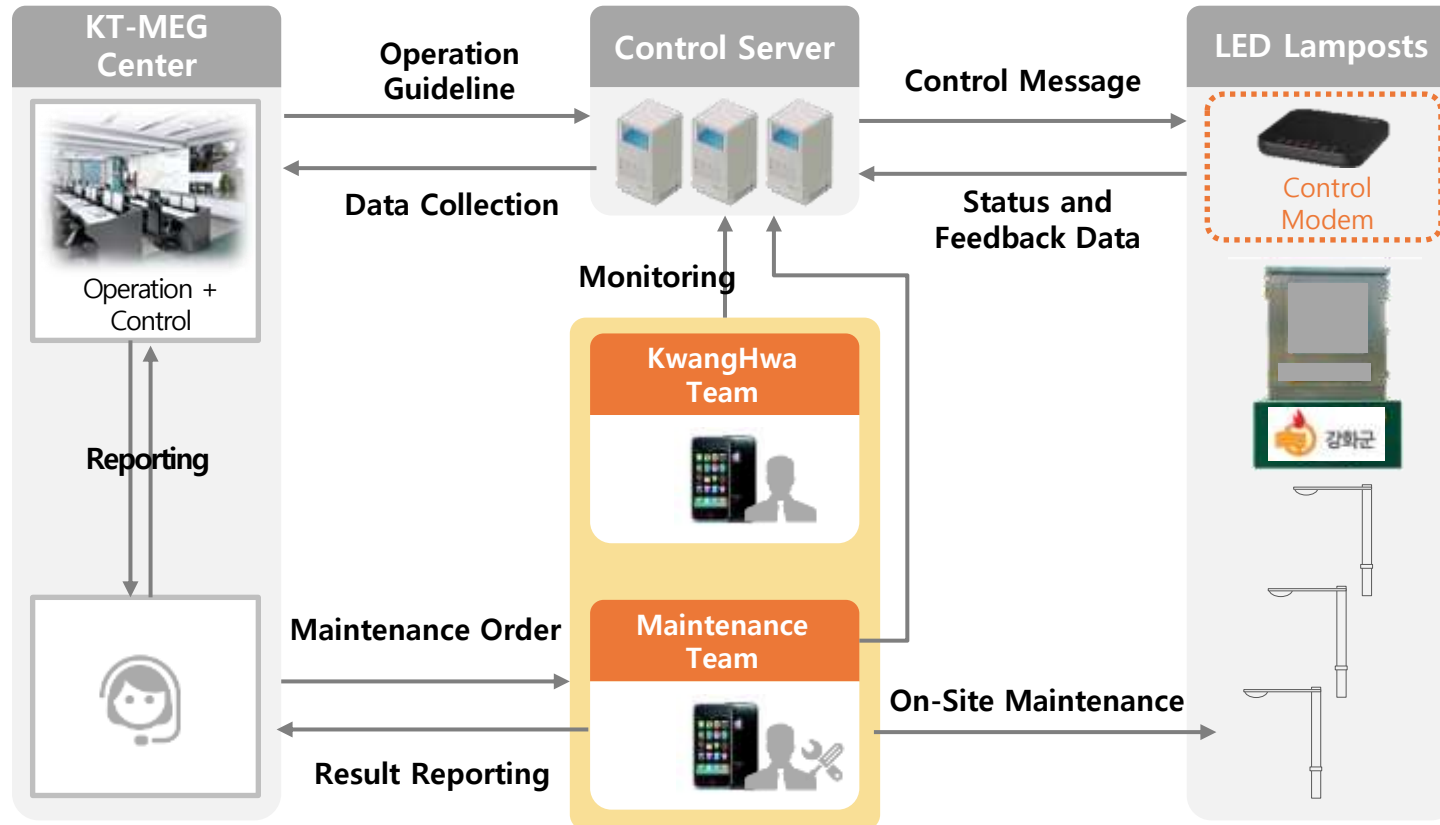
50~60% Reduction of Lighting Energy Expenses after Implementation

02 # Energy Optimization

Example of Optimization by Smart LED Lighting : KangHwa Province

[LED Street Lamp Posts]

[LED Bridge Lamp Posts]

02 Energy Optimization

Example of Optimization by Smart Heating/Cooling : MokPo Central Hospital
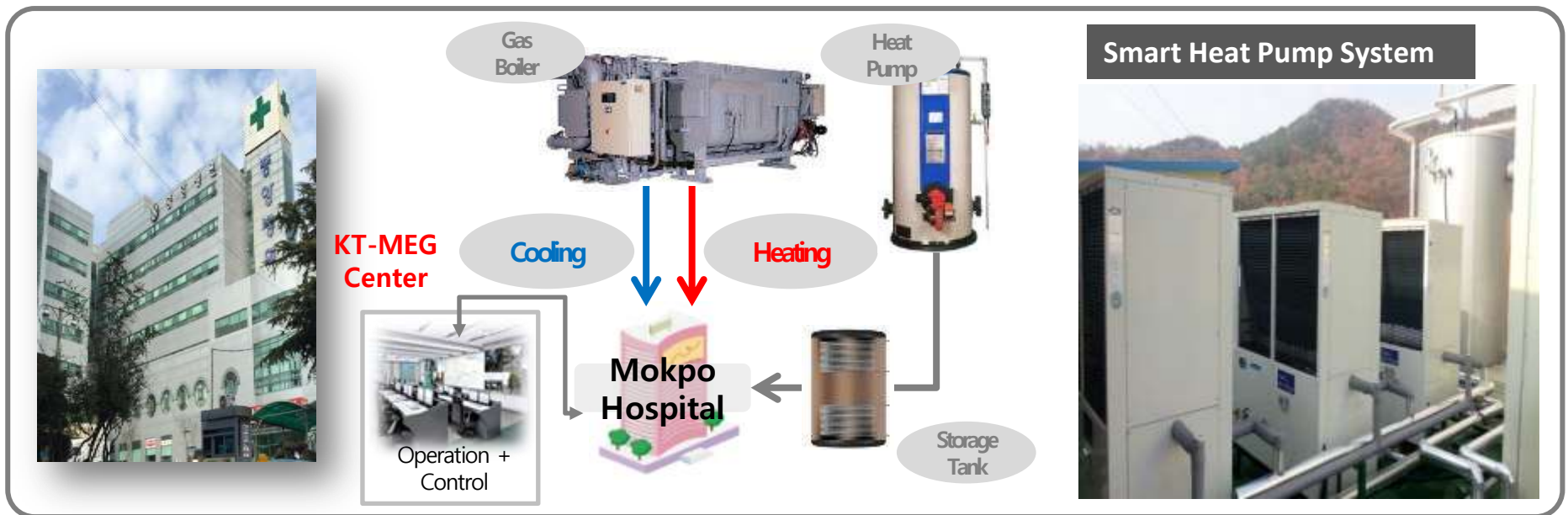
70% Reduction of Heating/Cooling Expenses after Implementation

02 Energy Optimization

Example of Optimization by Smart Heating/Cooling : MokPo Central Hospital

02 Energy Optimization

Example of Optimization by Renewable Energy : Smart Solar

국
내

DaeCheok (7.5MW)	Dong Chun (1.9MW)	Young Mok (1.2MW)	AhnMyun (1.8MW)	YounAhn (3.1MW)	YoungYeoul (5MW)	GoNam (2.5MW)

KT Solar Power Generation
36 Sites, 74MW Capacity

해
외

Acas (3.5MW)	Bobicesti (14.9MW)	Ciocanesti (2.9MW)	Butimanu (7MW)	Doba (5.8MW)	Malu (4.4MW)

※ '15년까지 KT 그룹사 기준

02 # Energy Optimization

Example of Optimization by Renewable Energy : Smart Solar

DaeCheok Solar Power Plant

Generates Power for 2,300 households

Ground

PV 7.5MW

Explanation

- By utilizing a closed salt field in Shin An Province, KT built a solar power plant capable of generating power for over 2,300 households
- Generation Capacity : 7.5MW

02 Energy Optimization

Example of Optimization by Renewable Energy : Smart Solar

HamPyeong Hydro PV Plant

Solar Panel on Reservoir

Hydro
PV 1MW

Explanation

- Utilizing HamPyeong reservoir to build solar generation site
- Generation Capacity : 1MW

02 Energy Optimization

Example of Optimization by Renewable Energy : Smart Solar

IkSan Solar Power Plant

Solar Panel over Farm Roof Top

Roof Top

PV 1MW

Explanation

- Utilizing roof top of IkSan farm to build solar power generation site
- Generation Capacity : 1MW

02 Energy Optimization

Example of Optimization by Renewable Energy : Smart Solar

Explanation

- Micro Renewable Energy Grid based on KT-MEG platform

- 4 Types of Buildings
  - [Culture] Sports Town
  - [Welfare] Health and Welfare Town
  - [Environment] Water Quality Facilities
  - [National Defense] 37 Army Division

Solar Town of JeungPyoung Province

Environmentally Friendly City

Town

30% Reduction

03 Advanced Metering

AMI (Advanced Metering Infrastructure) : Applications based on telecommunication that enable the gathering and transfer of energy usage data in real-time

■ Benefits of AMI

AMI is Smart Grid's Core Infrastructure

Measure	Report
• Active power • Reactive power • Power factor • Voltage • Current status	• Report (H/D/M) • Trend management • Transformer load Management • Automatic warning

Supervise	Control
• Tamper detection (Using the contact of meter cover) • Quality monitoring (V, A, Hz, kVar)	• Power on/off (Real-time) • PLC[1] chip reset • DCU[2] M/D reset

Energy Consumption Visualization

Active energy reduction from clients
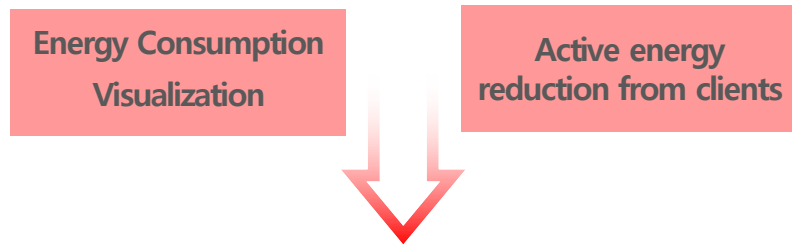
Backbone of ICT based Smart Energy

1) PLC : Programmable Logic Controller, 2) DCU: Data Concentrated Unit

03 Advanced Metering

AMI is the new trend : Governments and utilities are conducting AMI projects globally

(source : Google Map, 2015)

03 **Advanced Metering**

KT's AMI Vision : Global No. 1 AMI Service Provider

Global No.1

Global AMI

Local AMI

KEPCO AMI

LTE, PLC Based Solutions
[KT-KEPCO Partnership]

AMI Partnership with World
Leading Power Company

Local Implementation

Three Provinces
(1 Mil. Households)

**Uzbekistan AMI
(1 million households)**

Region : Uzbek Energo

[KT-Uzbekistan Partnership]

Korea's First Company to implement nation-
wide AMI in a foreign country

Global Implementation

**Energy
GiGAtopia**

**Diverse AMI
Services by KT**

**Global No.1 AMI
Service Provider**

**World's Best AMI
Solution**

03 **Advanced Metering**

KT is currently providing LTE-AMI services to KEPCO : AMI based on LTE communication

Features

❖ Support real time, bi-directional data communication between utility and client based on LTE mobile network.

❖ Deployment of LTE-AMI through minimal construction cost

AMI server

Consolidation server

LTE Base Station

LTE Network

M2M server

❖ Provides the most accurate and fastest AMI connection compared to other communication methods

❖ Reference : KEPCO (approx. 200,000 households)
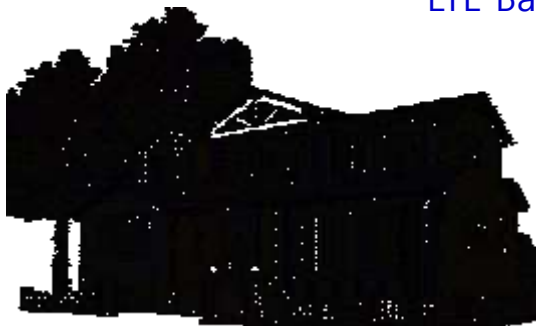
Smart Meter

LTE AMI Terminal Device

Locally, LTE telecommunication is currently used for HV(High Voltage, 22,900V) and LV(Low Voltage, 220V) AMI

03 Advanced Metering

KT is currently supplying DCUs to KEPCO ; PLC-AMI : AMI based on PLC communication

AMI server

Features

❖ Support real time, bi-directional data communication between utility and client using BPLC[1].

❖ Cuts down on communication related costs through Data Concentration Unit (1 DCU = 200 power meters)

1) BPLC : Broadband Power Line Communication

Data Concentration Unit

Wireless LTE

Wired (HFC / Optic Fiber)

PLC (ISO/IEC 12139-1)

Smart Meter
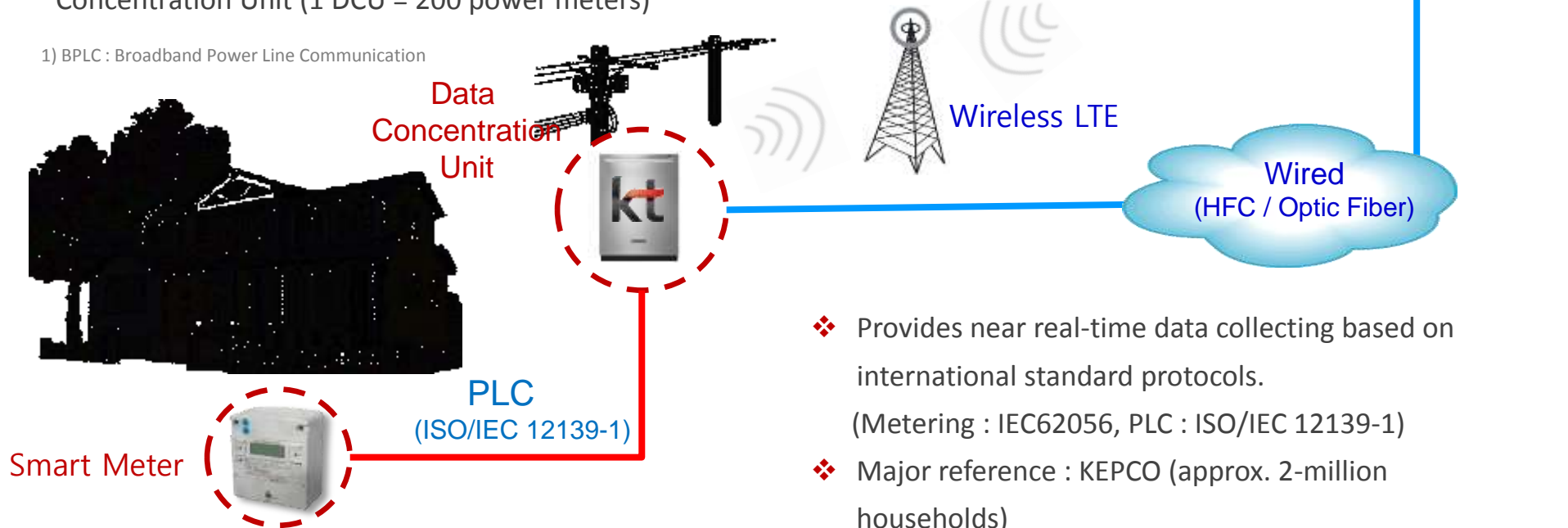
❖ Provides near real-time data collecting based on international standard protocols. (Metering : IEC62056, PLC : ISO/IEC 12139-1)

❖ Major reference : KEPCO (approx. 2-million households)

03 **Advanced Metering**

Advanced Metering Infrastructure is under construction in Uzbekistan by KT

- Overview: Deploying smart meters and mgmt. system for 1 million households

- Buyer: Uzbek Energo

- Investment: USD 110 mil., financed by ADB, 2015~17

- **Effect: Prevent tampering with meters and accordingly generate more revenue**

Terminal	Communication	AMI System
- Single phase Meter	- Power line communication	- MDMS
- Three phase Meter	- Zigbee	- Billing
- DCU & Repeater	- General Packet Radio Service	- CRM
		- Archiving
		- Web Interface

Three Provinces (1 Mil. Households)

THE KOREA TIMES *May 11,2015*

"KT won Advance Electricity Metering project in Uzbekistan"
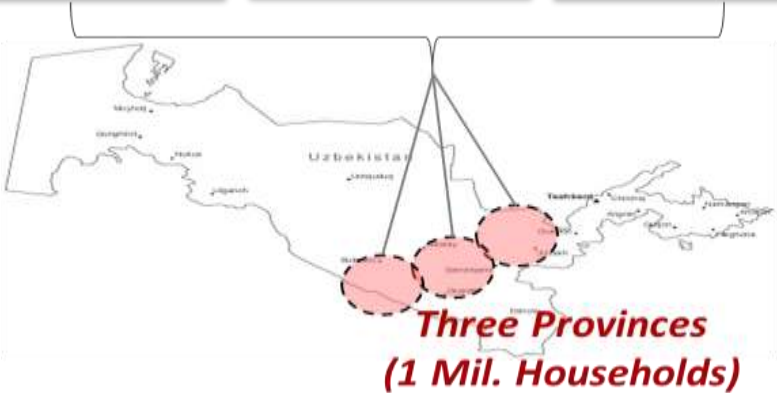
03 **Advanced Metering**

KT's Uzbekistan AMI project is widely considered a **Global Best Practice** made possible by the merging of communication (PLC, Zigbee, GPRS, 3G, LTE, etc.) and Big Data (MDMS, EDM, Billing, etc.) technologies

End-User

Power Meter

Water meter

Gas meter

Calorimeter

PLC[1]
Zigbee

Concentrator

DCU[3]

GPRS[2]
3G
LTE

Central System

- MDMS[4]
- EDM[5]
- Billing
- CRM
- Archiving
- Reporting
- Web Interface
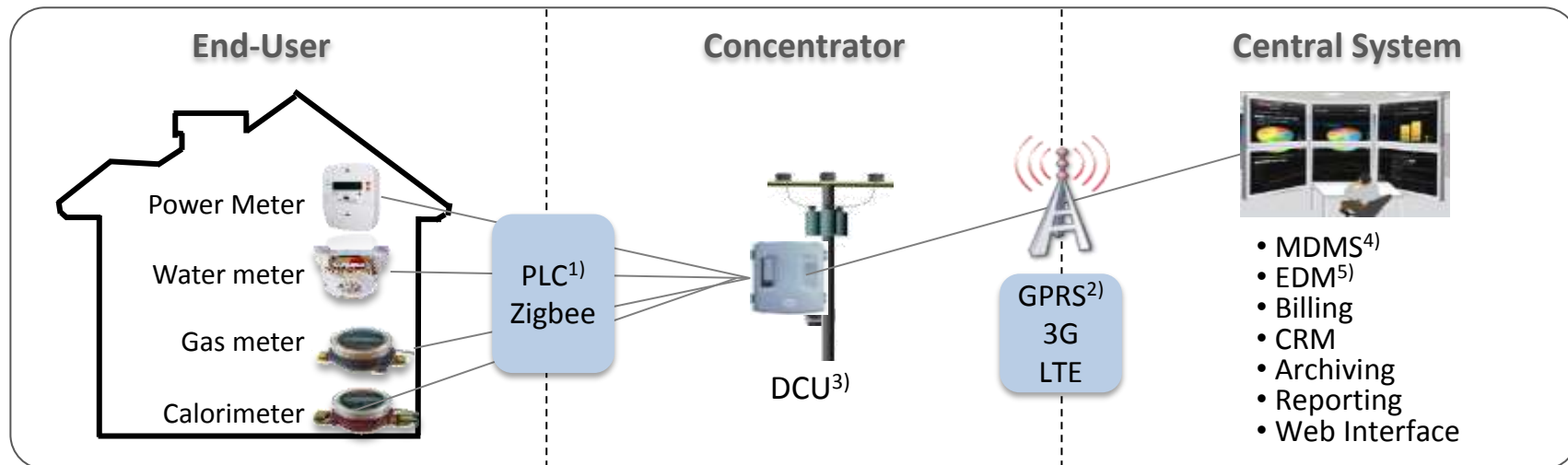
Benefits

> **Prevent Tampering with meters**
  - Block illegal use of electricity

> **More revenue by cutting off tampering**
  - The utility can generate incremental turnover

> **Increased Management Effectiveness**
  - Avoid meter reading errors and enable remote check via IT devices

1)PLC: Power Line Communication, 2)GPRS: General Packet Radio Service, 3)DCU: Data Collection Unit, 4) MDMS: Meter Data Mgmt. System, 5) EDM : Electricity Data Management

04 Platform & Visualization

Definition

Big Data from process of Generation/Transmission/
Distribution/Consumption of Energy

Objective

Optimization of Energy
Generation/Trade/Consumption

by Advanced Analysis of EBD combined with
external data such as Environment-related data

Components

Service
40%

Software
22%

Hardware
38%

< Big Data Revenue
2013 Wikibon >

Control   Report   Consulting   DR   Trade

Cloud   DB   Analysis   Visualization

AMI   Sensor   Weather   Structure

Global Market

2020 Prospective Size $20B Cumulative
(GTM, SoftGrid2013, OCT; HW excluded)

Soft Grid Regional Forecast 2013 - 2020

CAGR 17 %

$1.11 $1.57 $1.95 $2.28 $2.60 $2.98 $3.60 $3.98

China   Europe   North America
Asia-Pacific   Latin America
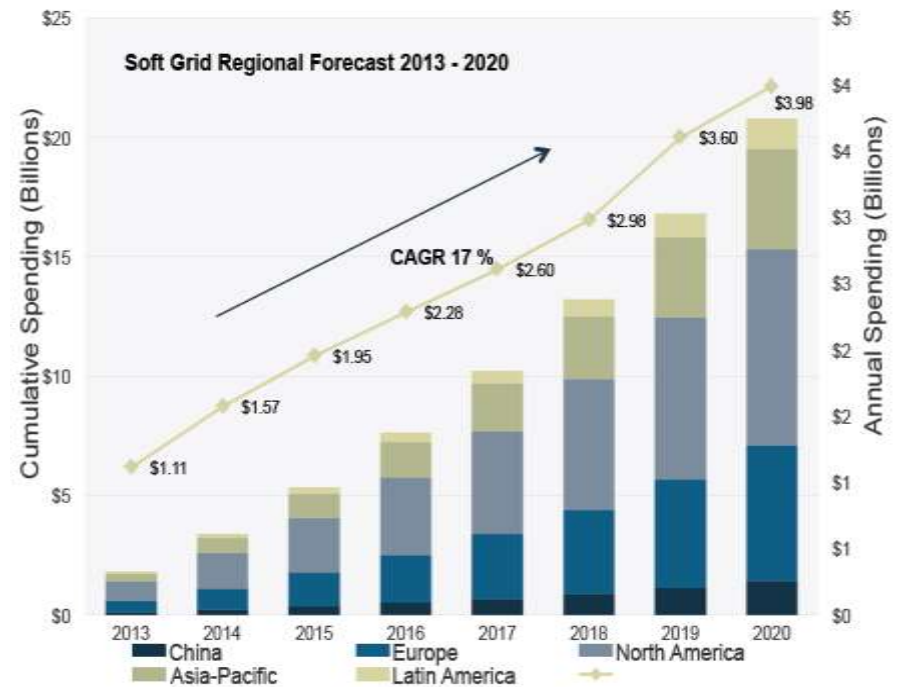
Related New Companies

OPOWER, Energy Pool, nest Labs, ENCORED Tech

04 # Platform & Visualization

Need for energy management systems are on the rise due to regulatory and cost related issues

Segmentation of Building Energy

Energy consumption of an average building in Korea

Air Conditioning 20%

Heat [백분율]

Pumps [백분율]

Annual Consumption 162 KWh/㎡

Other [백분율]

Lighting 24%

Appliance [백분율]
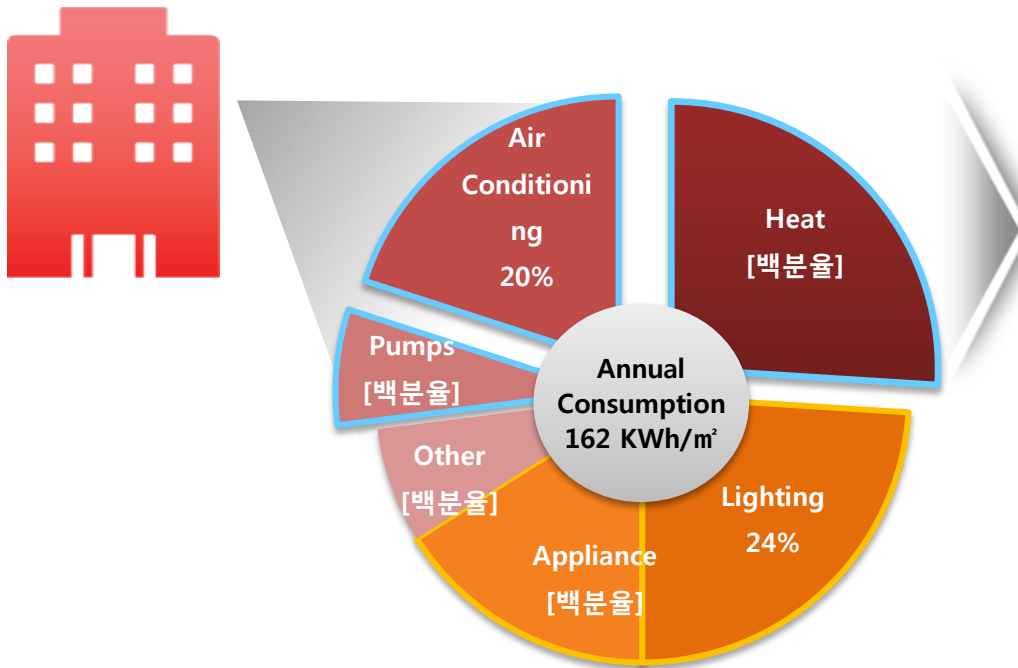
Optimization Methods

1 **Energy Management System**

- **Real-Time monitoring of energy**
- **Human induced optimization methods**

Investment : Minimal

2 **Renewable Energy Implementation**

- **Installing Renewable Energy Generation**
- **Solar, Wind, Geothermal, ESS**

Investment : Medium Scale

3 **Deployment of Optimization Equip.**

- **LED Lighting, Heat Pumps, Inverters, Turbo Chillers, etc.**

Investment : Large Scale

*Source : 에너지기술평가원「그린에너지」연구개발사업 기획보고서

04 Platform & Visualization

KT's Smart Energy Platform : KT-Micro Energy Grid (KT-MEG Center)

Big Data

Customer Lifestyle

Smart Meter

Sensor
(inside bld. & home appliance)

EV charging pattern

Environmental Data

Big Data Analytics Engine

Demand Forecast

Optimization of energy efficiency

Reliable grid (no blackout)
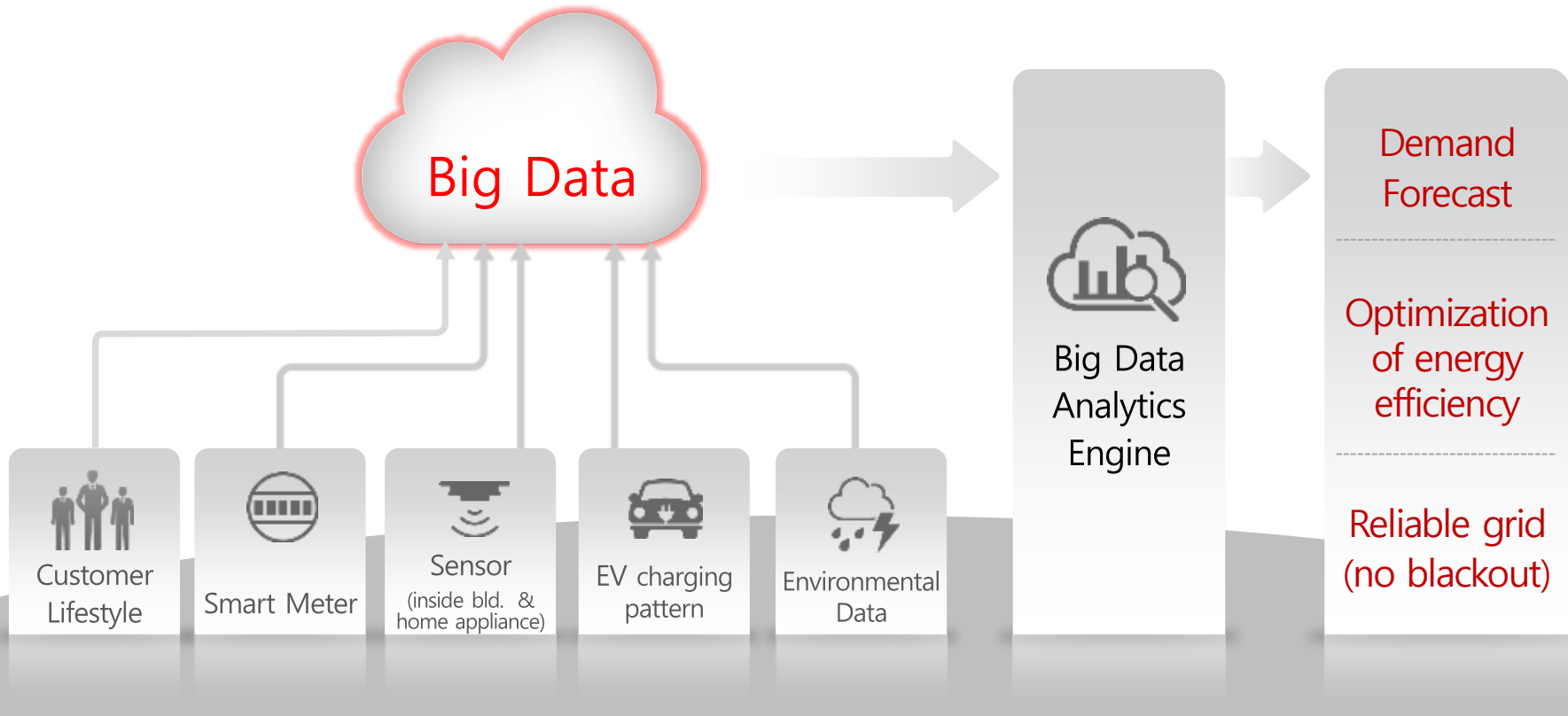
Key enabler for smart reduction based on intelligence by analyzing various data

04 Platform & Visualization

Visualization of KT-MEG : 'ENEReyes'
Intelligent energy portal service based on big data

Before

"Diagnosis, Forecast, Optimize"

After

Building

Factory

Households

Apartments,
Shops, Vendors

Energy IoT

Data Source
- i-Smart
- Environment
- Climate etc.

E-IoT
- Meters
- AMI Infra

KT-MEG Center

Web/App UI

Intelligent Diagnosis
(e-Brain)

Database
/Big Data

**Energy Portal
"ENEReyes 1.0"**

+

Demand
Response

+

Consulting
& Feedback

+

Control &
Optimize

...
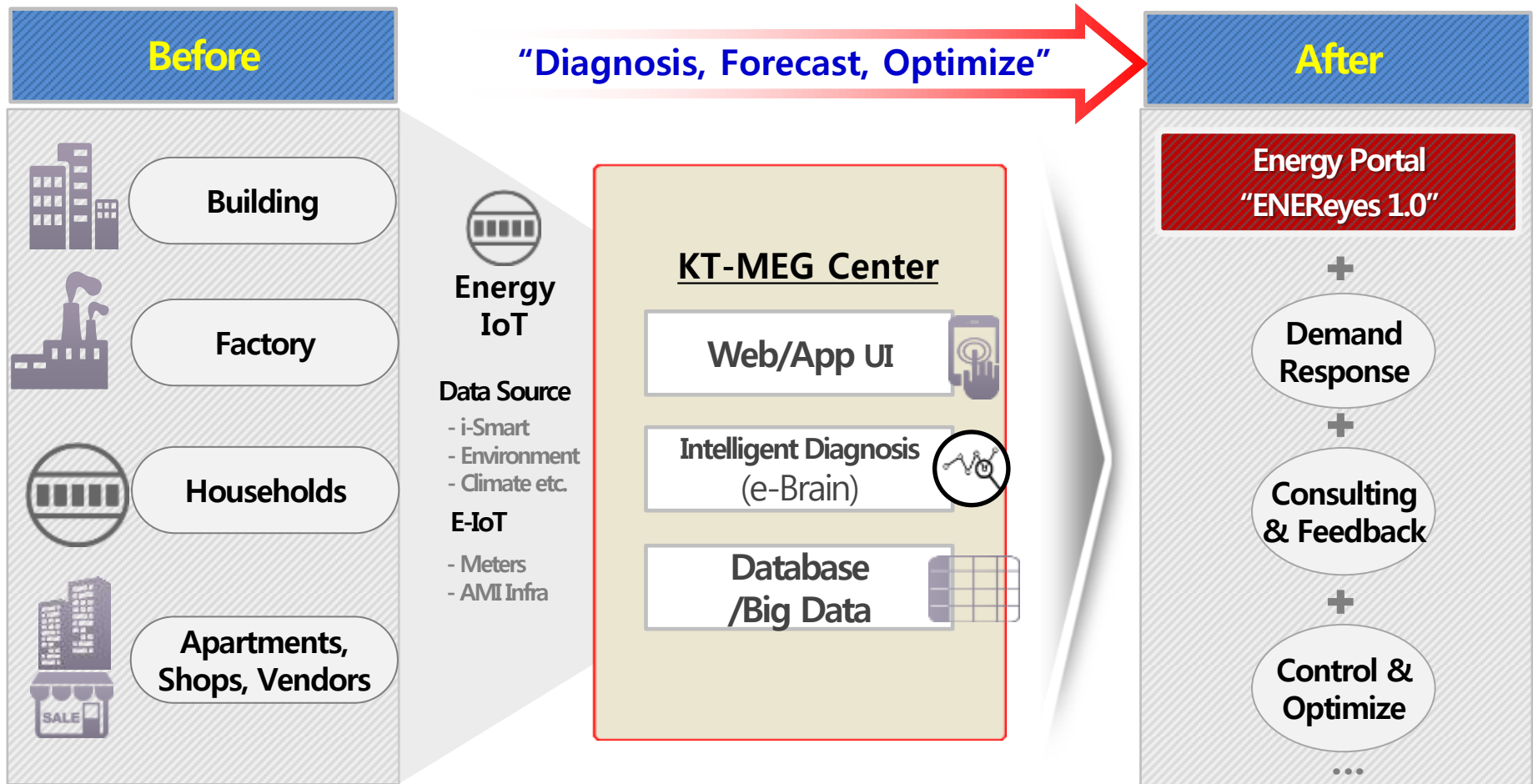
04 Platform & Visualization

Precision of ENEReyes learning system is optimized by large quantities of consumption pattern data, resulting in better forecasting and diagnosis

Optimization Methods

Active Tech.	• **Optimization Equip.** **Heat Pumps** • **Turbo Chillers, Inverter, LED, etc.**
Passive Tech.	• **Human Induced Energy Saving** • **Insulation, B/D energy policy, etc.**
B/D Mgt.	• **Energy Monitoring/Analyze/Control** • **BEMS, BAS, etc.**
Sensing	• **Real-time sensing of comsumption** • **Meters, AMI equipment, etc.**

Core Technologies

1 Segmentation of Energy DNA

Energy Consumption Pattern

Type I Building   Type II Building   SMBs   Hospitals   Factories

2 Analysis Modeling by Consumer Type

<Analysis Algorithm>

- Pattern Segmentation by type
- Peak, Cosumption Forecasting

<분석 서비스>

실시간 모니터링   분석 리포트   피크경보
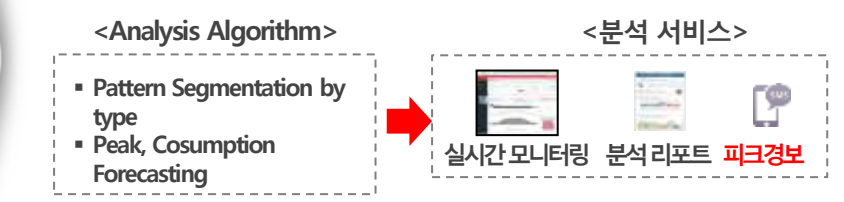
3 Learning Model Validation & Upgrading

Precision
100%
Verification Method 1
Method 2
Precision : 80%
Error

Analysis Model Validation

Main System
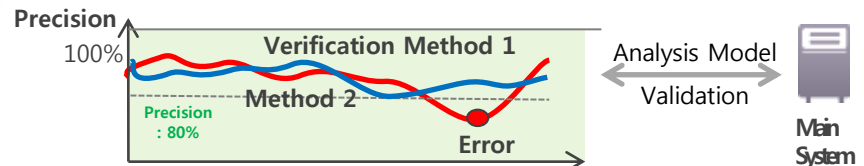
* Compare Forecasting Data and Metering Data

04 Platform & Visualization

**Goal of ENEReyes is for the consumer to
Upgrade from Free → Lite → Premium for optimal efficiency**
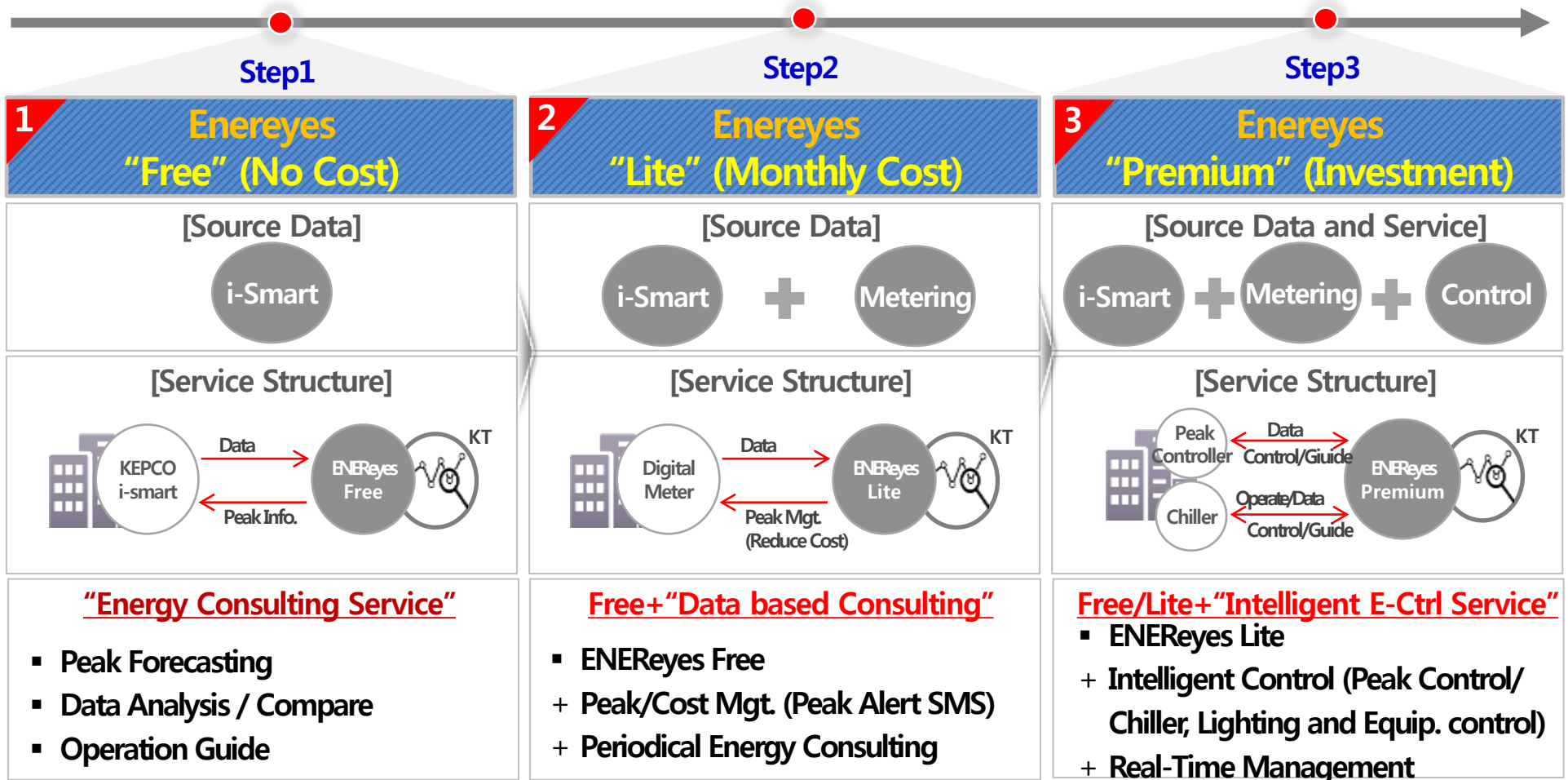
Step1	Step2	Step3
1 Enereyes "Free" (No Cost)	**2 Enereyes "Lite" (Monthly Cost)**	**3 Enereyes "Premium" (Investment)**
[Source Data]	[Source Data]	[Source Data and Service]
i-Smart	i-Smart + Metering	i-Smart + Metering + Control
[Service Structure]	[Service Structure]	[Service Structure]

"Energy Consulting Service"
- Peak Forecasting
- Data Analysis / Compare
- Operation Guide

Free+"Data based Consulting"
- ENEReyes Free
- + Peak/Cost Mgt. (Peak Alert SMS)
- + Periodical Energy Consulting

Free/Lite+"Intelligent E-Ctrl Service"
- ENEReyes Lite
- + Intelligent Control (Peak Control/ Chiller, Lighting and Equip. control)
- + Real-Time Management

05 **Energy GiGAtopia**

Energy GiGA topia

Realization of Energy Optimization

through integrating

Generation-Consumption-Transaction

of various energy sources based on ICT

Smart Generation
Increase generating efficiency

+

Smart Consumption
Intellectual consumption
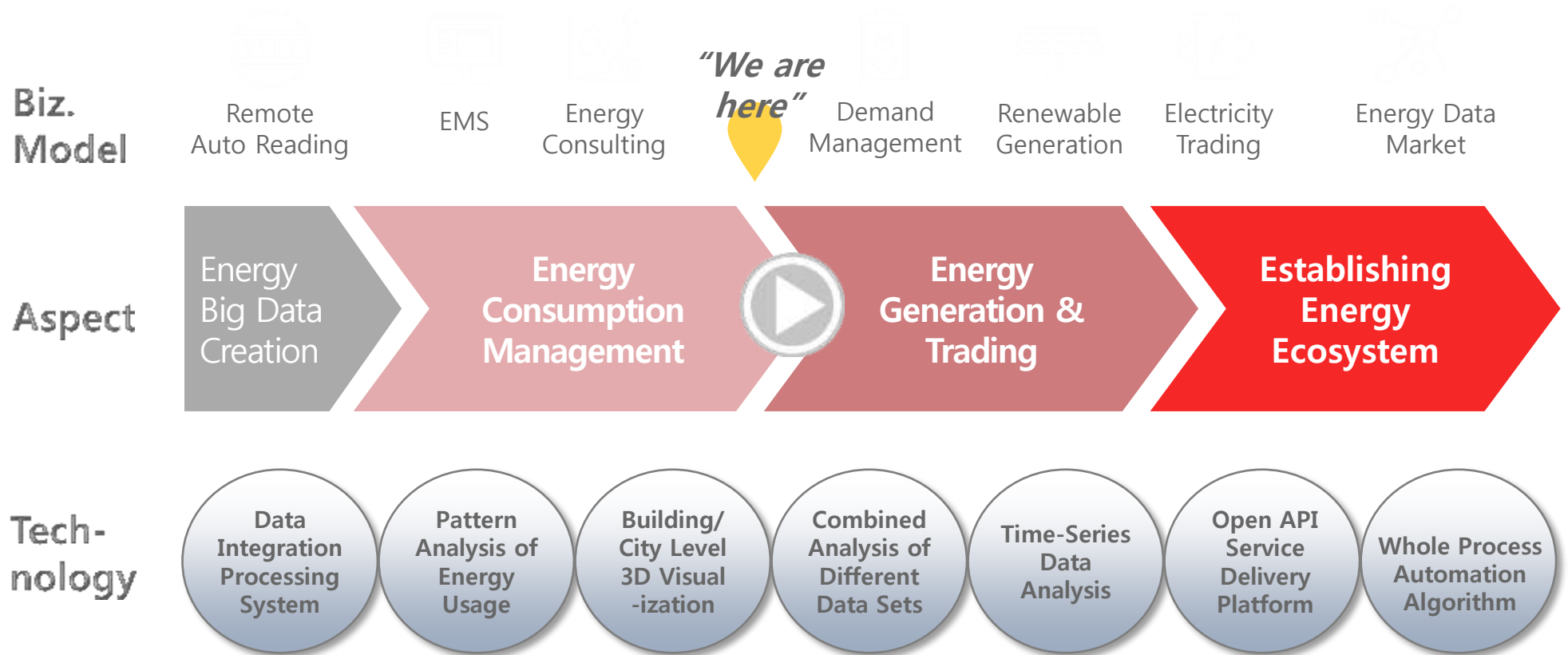
+

Smart Transaction
Energy Prosumer

05 **Energy GiGAtopia**

Enhancing xEMS and Exploring New Data-Driven Market by Demand Forecast & Advanced Analytics through Big Data

Biz. Model	Remote Auto Reading	EMS	Energy Consulting	*"We are here"*	Demand Management	Renewable Generation	Electricity Trading	Energy Data Market

Aspect

Energy Big Data Creation	Energy Consumption Management	Energy Generation & Trading	Establishing Energy Ecosystem

Technology

| Data Integration Processing System	Pattern Analysis of Energy Usage	Building/ City Level 3D Visual -ization	Combined Analysis of Different Data Sets	Time-Series Data Analysis	Open API Service Delivery Platform	Whole Process Automation Algorithm

Pending Issue: Korean Green Button Project

Energy Big Data Standardization is one of the most urgent technical issues
→ Data Openness & Data Privacy Issues are holding back new markets
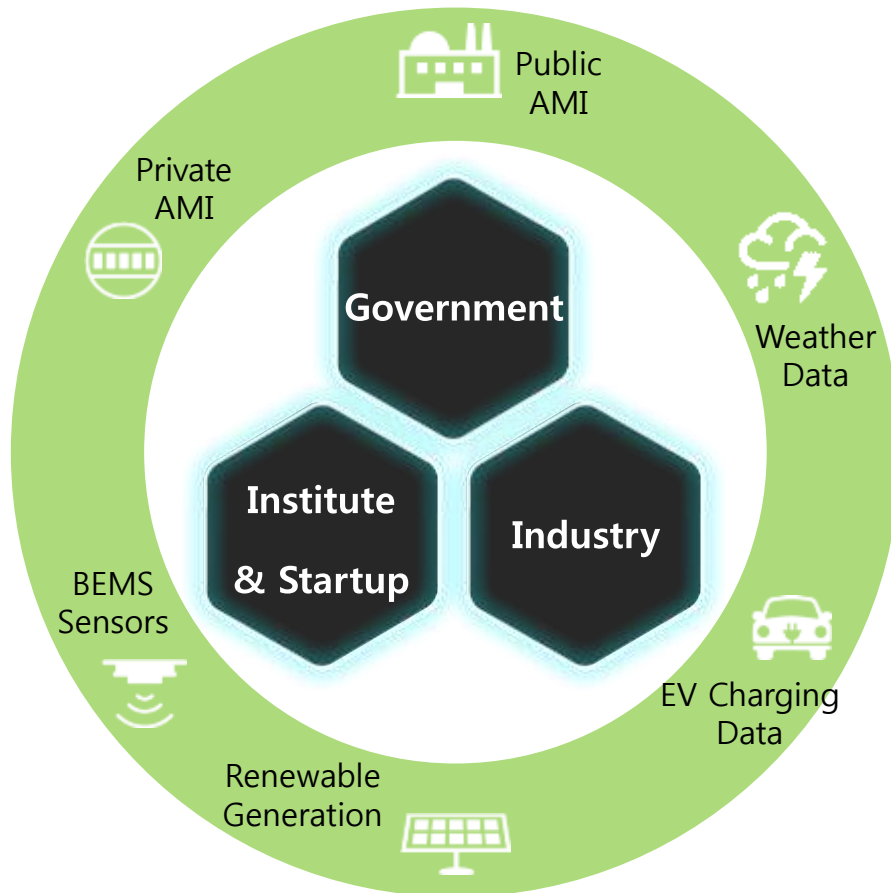
Necessities for Vitalizing Market

Government Initiative is Essential

Openness for Public Data

- Korean Green Button Project
- Support Startup Ecosystem (app contest, etc.)
- Energy Data Standardization (in conjunction with IoT)
- Publicity & Inducing Private Sector Participation

Solving Data Security & Privacy Issues

- Procurement of Big Data Security Infrastructure
- Initial Drive with Customers agreed to disclose personal information (US)

Thank you | **kt**

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