Virtual Power Plants:

innovation in energy management systems

to utilize distributed energy resources

as a source of flexibility

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Journey of DR & VPP introduction in Japan

2011 The great earthquake (Fukushima incident)
⇒energy management became to be a big issue

2012 Electricity system reformation restarted

2014 National Energy Plan including DR enacted

2015 DR guideline established(baseline rule etc.)

2016 Capacity procurement per year started & DR participated
VPP project started (Planned as a 5year project)

2017 DR trading started (in kWh trading and capacity procurement)

Energy management progress in Japan 2011

①Peak Demand reduction by electricity users and Power companies
(energy conservation, peak shift, utilization of distributed generators)

②Introduction of peak cut appliances increased
(Battery and Energy management systems)

③Smart community trial expanded
(Yokohama, Toyota, Keihanna, Kitakyushu・・・)

④Study of DR resource installation on Japan's electricity market started
⇒Implementation started 2017

Implementation of DR resource; capacity procurement

2017 April started, year base contract by TSO among Generators & DR.

Category Ⅰ: primary and secondary, 7% of area peak demand
Category Ⅰ´: for emergency, about 1% of five areas

DR bid in Category Ⅰ´
(Aggregators, Electric power companies, Customer directly)

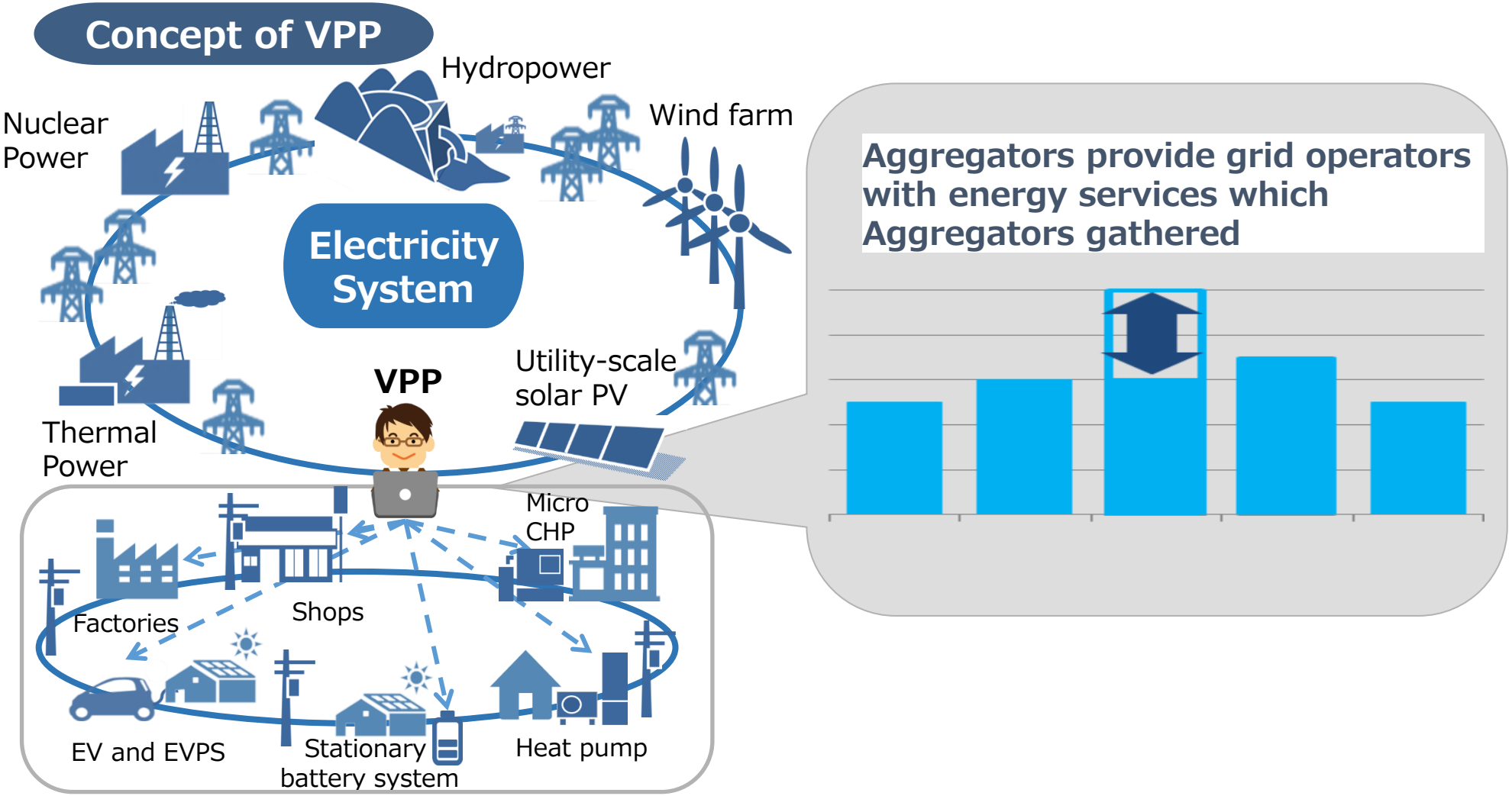
AREA	TOHOKU	TOKYO	CHUBU	KANSAI	KYUSHU	TOTAL
MW	74	599	192	170	290	1,325
(DR)		☆	☆	☆	☆	72% of Total

Activated on 23～27 Jan. 2018 ⇒ Demand side contributed to system operation for the first time in Japan

Virtual Power Plant as advanced DR

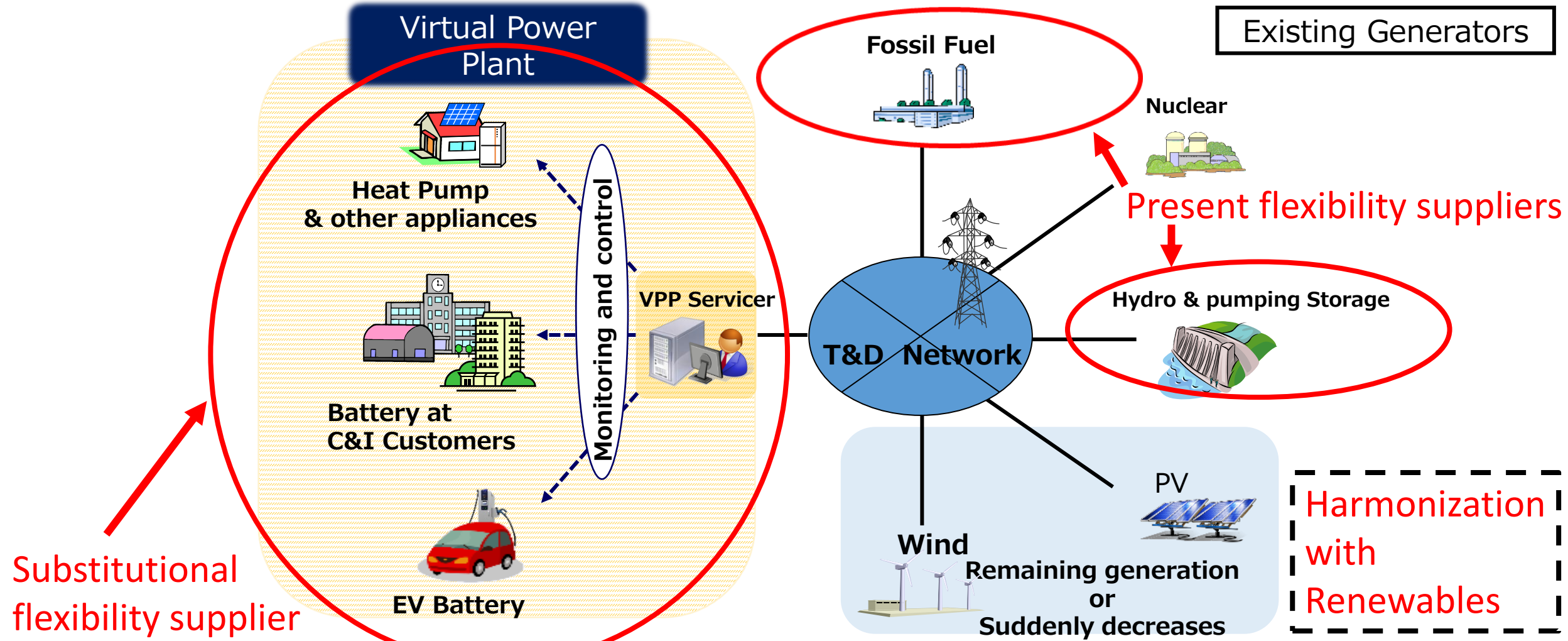
METI Ministry of Economy, Trade and Industry

<u>METI challenged to next step; utilizing various DER by IoT technologies</u>
heat pump, batteries, demand response, EV, ENE-FARM,PV・・・・・

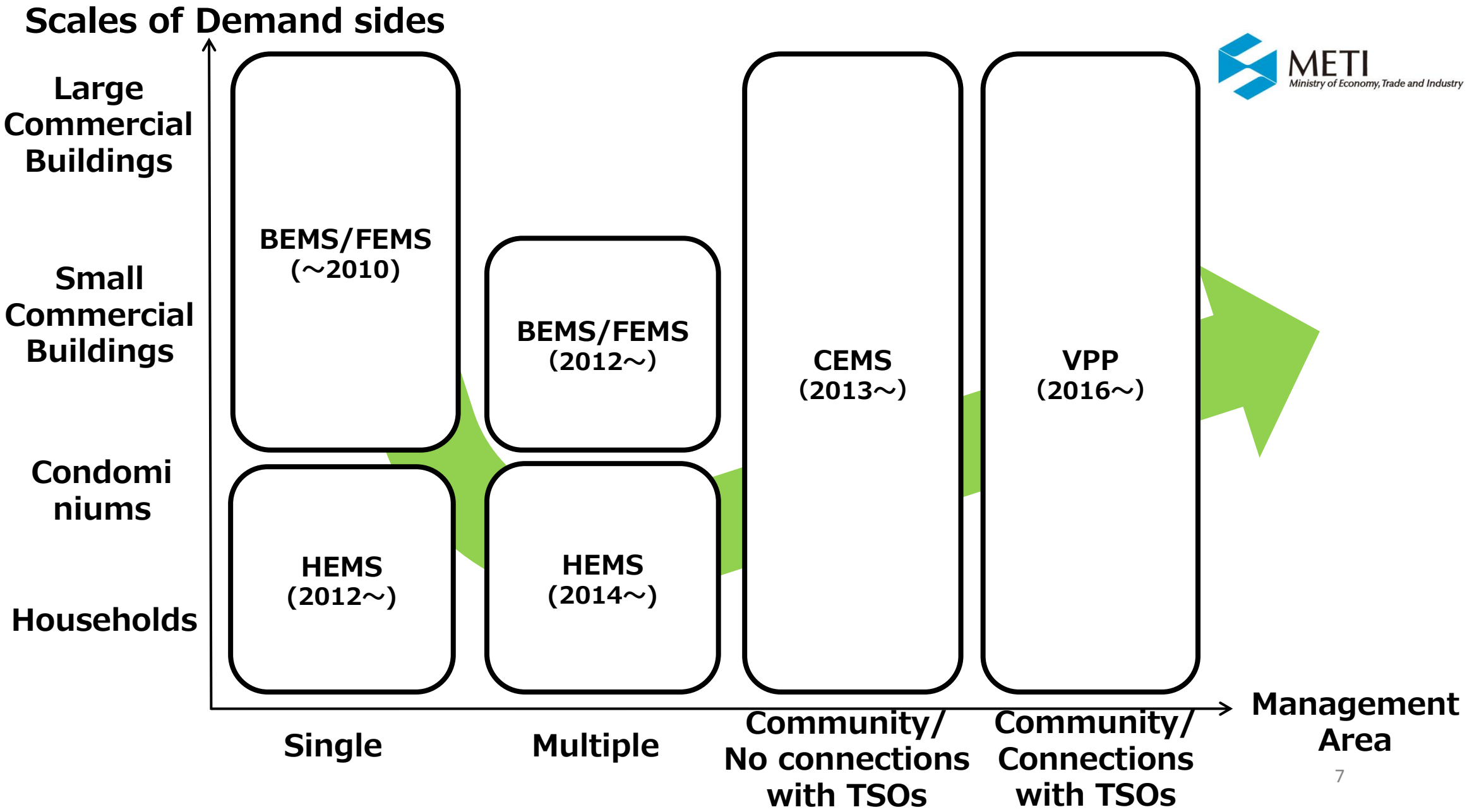


What VPP can implement in energy market??

VPP project started to substitute generator's flexibility utilizing distributed energy resources



Development of Energy Management Systems



What is VPP's significance ??

VPP is a Symbol project integrating Japan's excellent factor grown up after 2011 Earthquake

●utilization of various DERs
●facilitation of technologies
●Involvement of various players

[Factors among Japan's VPP]

Resources
(Enlarged from 2011)
Storages(Large & Small), EMS,
EV, Heat Pumps・・・・

Technologies
(Experience of Japan)
Platform building & operating
Innovation of DERs

Platform Players & Users
Energy companies, TSOs, Retailers,
C&I users,
Residential users・・・

ERAB(Energy Resource Aggregation Business) by METI is a Strategic path of collaboration of Japan's DER factors

Major Aggregators in VPP Trial Projects

Aggregation Coordinators

TEPCO 関西電力 SB Energy ENERES LAWSON azbil

Resource Aggregators

NEC ONE エネルギー株式会社 FNT FAMILYNET JAPAN 東京電力パワーグリッド 株式会社 東光高岳 三井物産株式會社

NTT SMILE ENERGY ELIIY Power SHARP KYOCERA 住友電工 DAIHEN

Panasonic Fukushima 三菱商事 YOKOGAWA GLOBAL ENGINEERING enesys

NTTファシリティーズ OSAKI SEKISUI TEPCO 東京電力エナジーパートナー EFFICIENT 自然エネルギーをあなたのそばに Looop

地域電力 SANIX スマートテック TMEIC We drive industry MEDIOTEC Designing The Future KDDI

VPP Trial project in 2017

- **6 aggregators** joined VPP demonstration project in co-operation with **more than 30 resource aggregators**.

METI
Ministry of Economy, Trade and Industry

Project structure

Multistory Structure

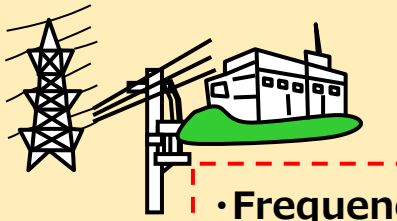
- System operators
- Coordinating Aggregators
- Resource Aggregators

Resources



Solutions provided by VPP Servicer in Future (Business Model)

【System Operator】



・Frequency Control
(Flexibility & Reserve Market)

【Retailers】



【Renewable Generator】



・Customer Service
・Electricity Procurement
・Avoid high imbalance penalty

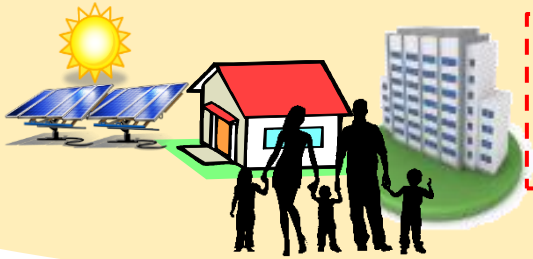
【V P P Servicer】



・Remain generation
(Under FIT) or (Balancing Market)

Aggregate Demand Side Resources

【Customers & Community】



・Energy Management
・CO2 Reduction
・Utilize Renewable Energy

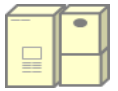
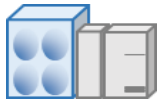
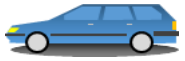
VPP services

VPP incomes

Kansai VPP platform participating resources

Residential HEMS, EV, Battery , Co-generation system, etc

➢VPP resources are operated through IoT, as per the monitoring and controlling systems

	EMS	Air Conditioner	Boiler	EV･PHV	Secondary Battery	Generator	Others
House Hold	HEMS 	Air Conditioner 	Household HP 	PrivateCar 	Small secondary Battery 	Household Co-generation 	
	Enegate	Nature Japan	Kansai Electric Sumitomo Electric Nihon Unisys Enegate	Kansai Electric Sumitomo Electric Enegate	NTT Smile Energy Eliiy Power Mitsubishi Corp Kyocera Panasonic Sharp		
Industry	BEMS FEMS 	Industrial air conditioner 	Industrial HP 	Company car 	Large secondary battery 	Co-generation ,Generator 	Pump  Freezer
	Sumitomo Electric DAIHEN Yokogawa Electric Fukushima-Industries	Sumitomo Electric Fukushima-Industries		Kansai Electric Sumitomo Electric	Kansai Electric Fuji Electric	Sumitomo Electric	Yokogawa Electric Fukushima-Industries

Target resource

Total Resource 15MW

How to accelerate VPP Business Model

① Enlargement of VPP participants (Desirably GW level)

② Cost down of each energy resources(Battery, Appliances…)& IoT

③ Improvement of responding speed and certainty of VPP platform

④ Fair evaluation of VPP at flexibility & Reserve market

VPP Challenges; Speeding up & Earing more income from reserve market

Present plan by METI

		一・二次調整力（GF・LFC）※3 GF・Primary	一・二次調整力（GF・LFC）※3 Secondary	二次調整力② Under5 Min. Reserve	三次調整力① Under 15min. Reserve	三次調整力② Under 60min. Reserve
指令・制御		–	指令・制御	指令・制御	指令・制御	指令
監視の通信方法		オンライン	オンライン	オンライン	オンライン	オンライン
回線※4		–	専用線等	専用線等	専用線等	簡易指令システム等も可
発動までの応動時間		10秒以内	240秒以内	5分以内	15分以内	1時間以内
継続時間※1		240秒以上	15分以上	7~11時間以上	7~11時間以上	3時間程度
Entry Resources	Generator	○	○	○	○	○
	D　R	○	○	○	○	○
	Battery	○	○	○	–	–
	D-Generator	–	–	–	○	○

Potential of VPP resources (Battery, etc..)

Capability of VPP system by speeding up

Present Position of VPP