



# DERMS & VPP

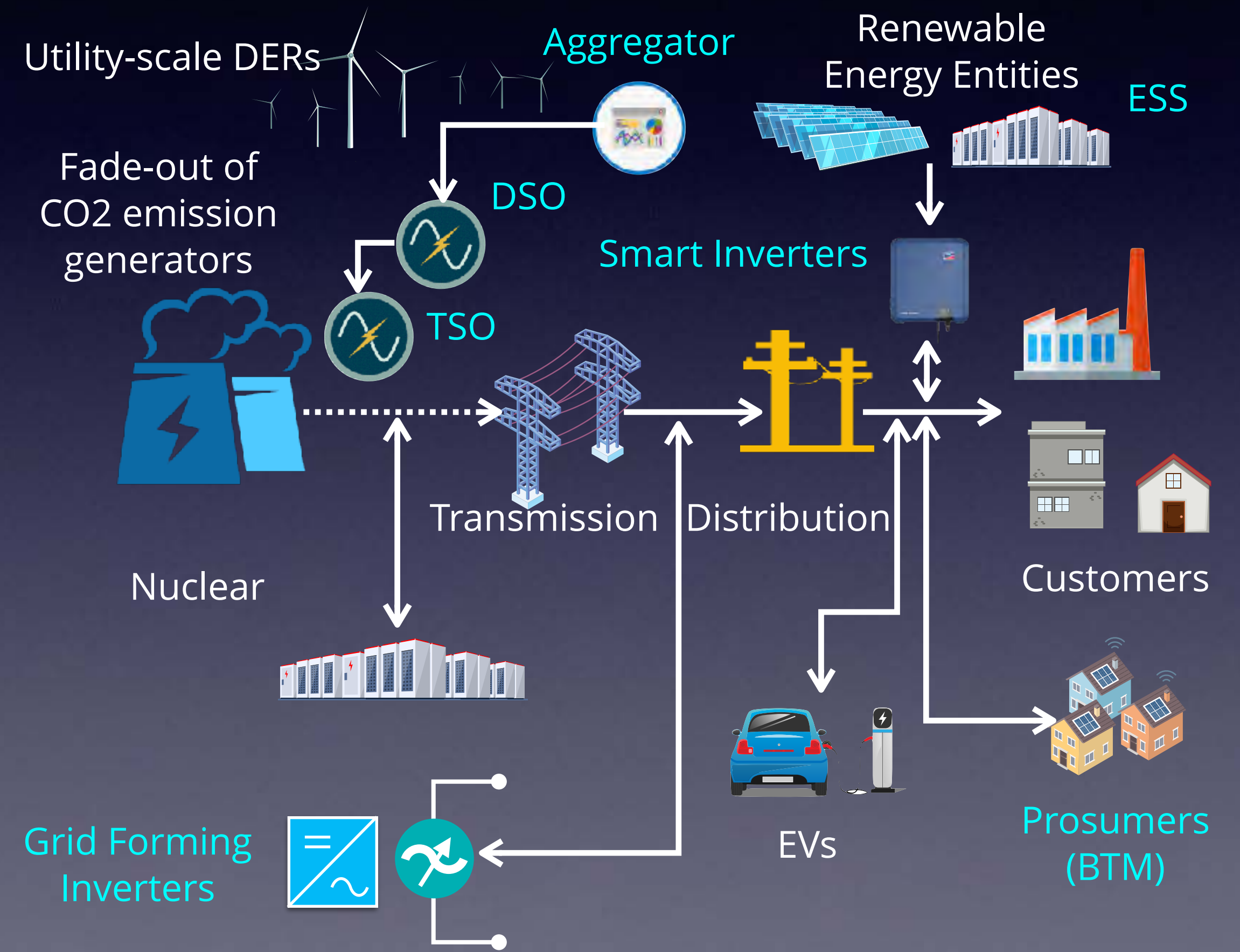
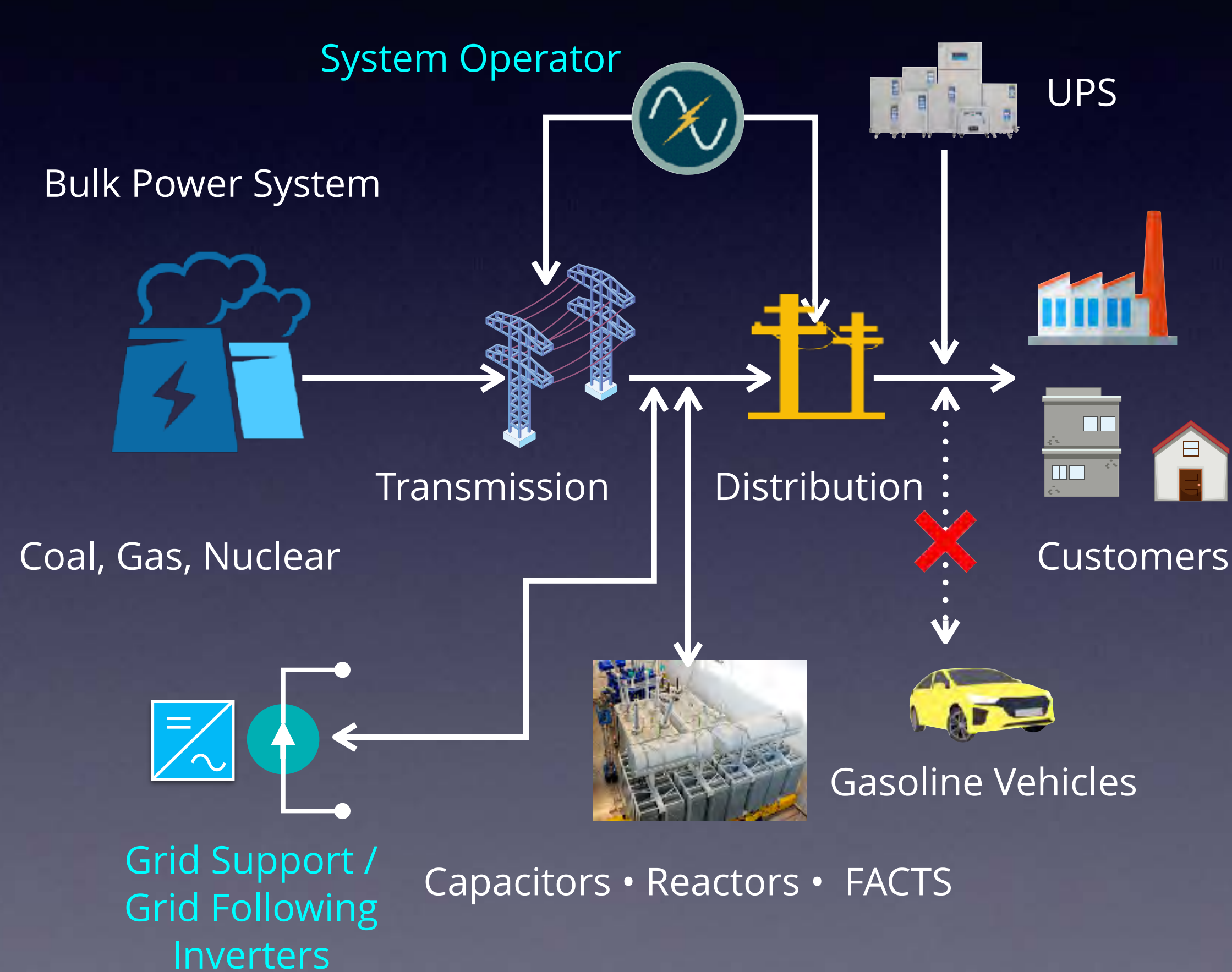
2022.12.05 (World Bank Group)

Dr. Jong-Woong John Choe / CEO of ENCORED

# Repowering & New Players

**Rigid** : Long-term plan, 24/7 running for economics

**Flexible** : Short-term plan, On-Demand dispatch



# Achieving a 100% Renewable Grid

Inverter-Dominated Grids : Controllable by independent parameters ( $V, f, \theta$ )

Energy Cloud (When, Where, How much ?)

Challenges to Power System Stability and Reliability

Power System Protection

Unintentional Islanding, Blackstart and Need Resilience from Contingency



# Solutions for A Renewable-powered future

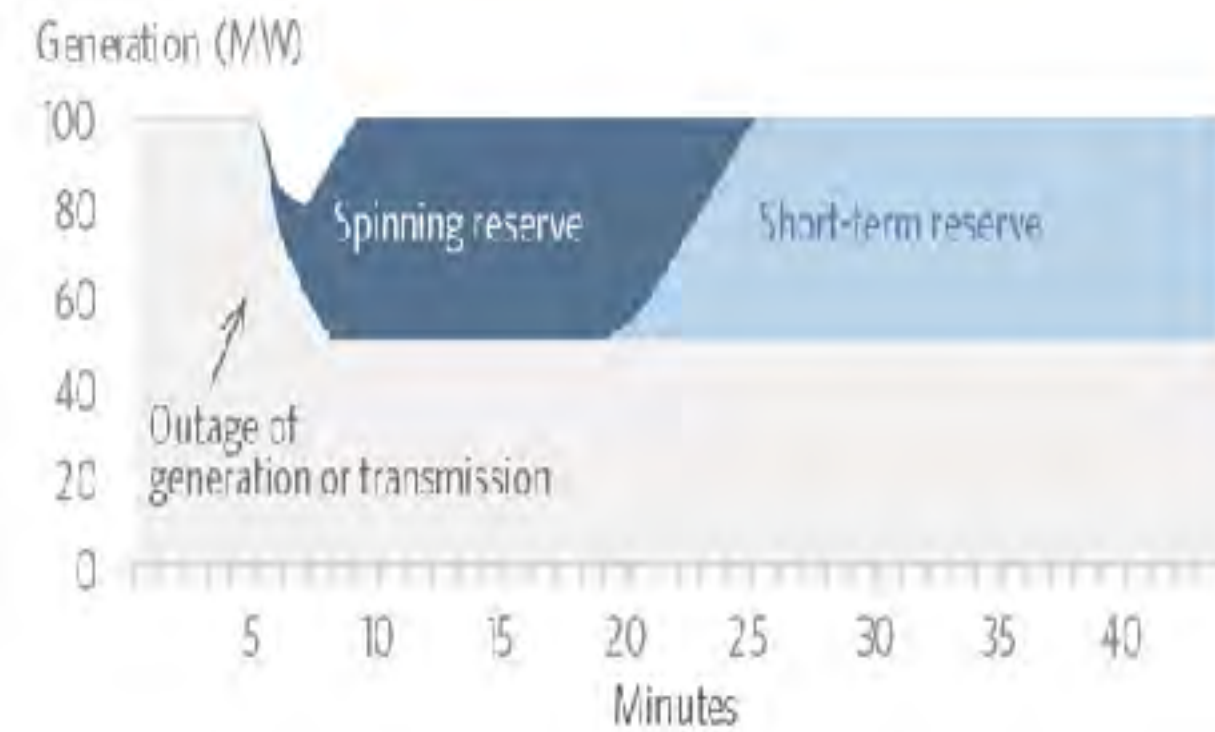
Flexibility solutions result from combining innovations across the power sector :  
Smart, Virtual, Optimize

**FLEXIBILITY SOLUTIONS** : Controllable • Dispatchable + **RESILLIENCY SOLUTION**

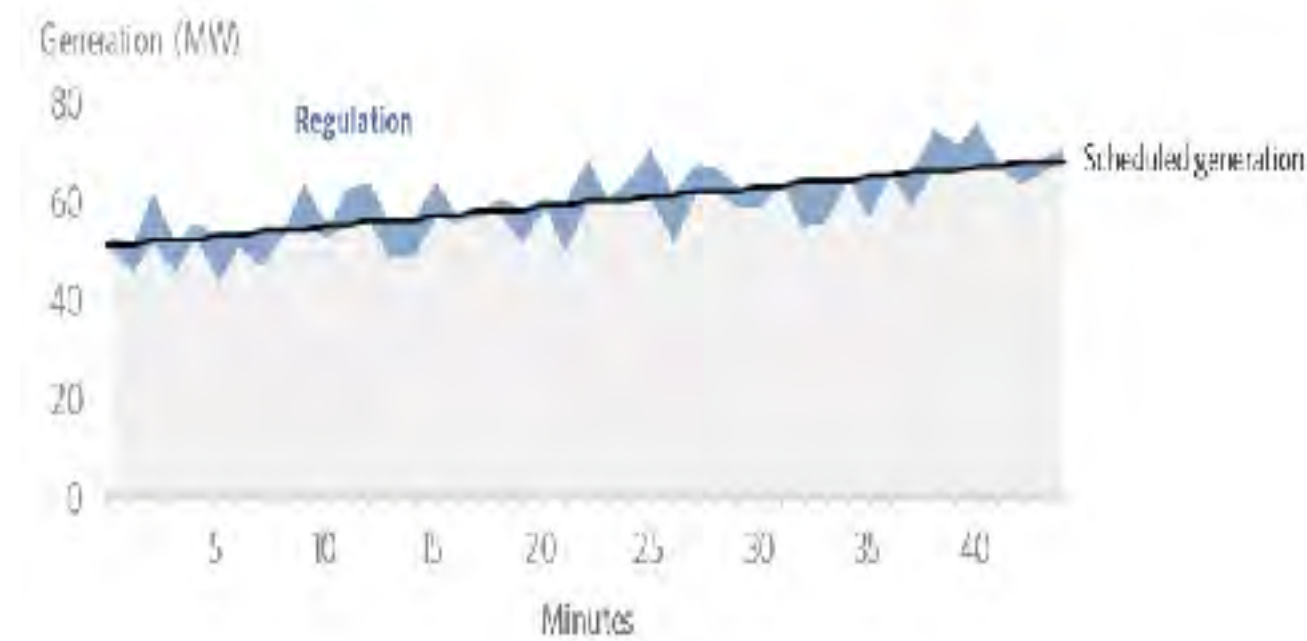


# Flexibility to Address

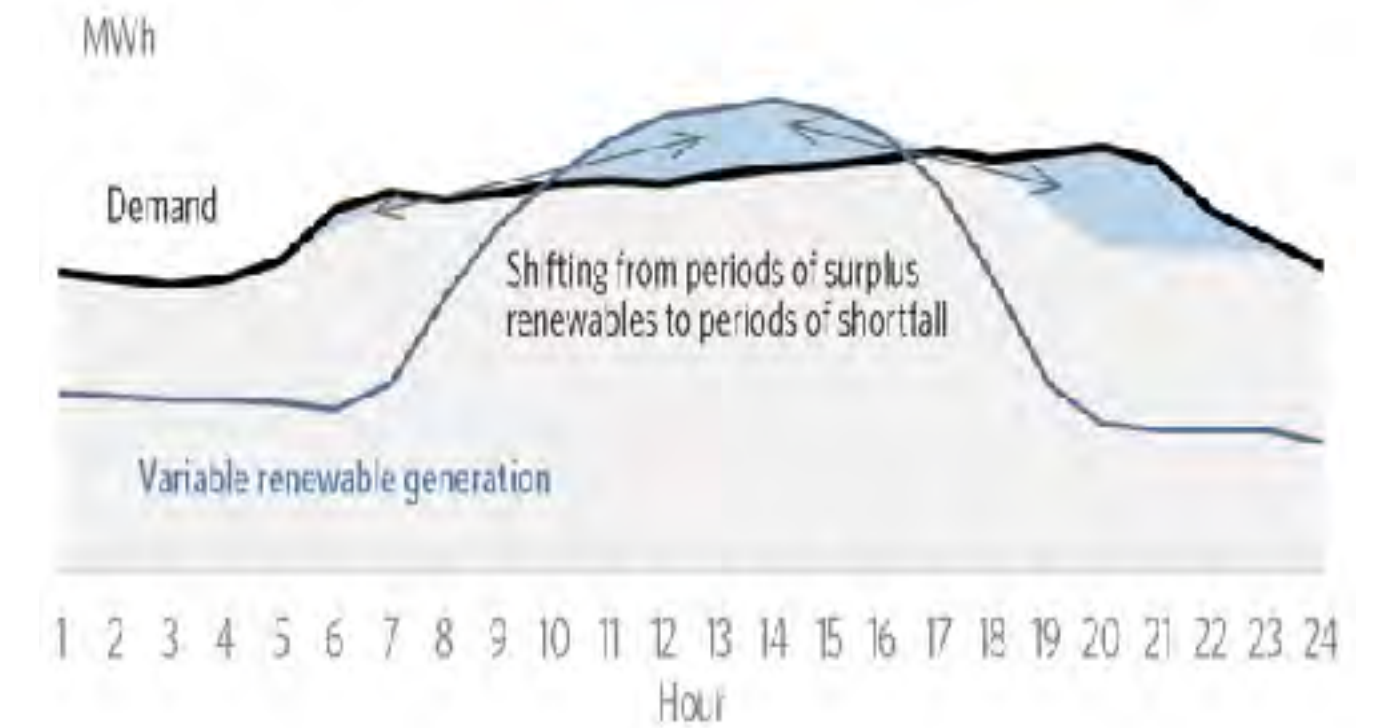
“Contingency-based” spinning and short-term reserves



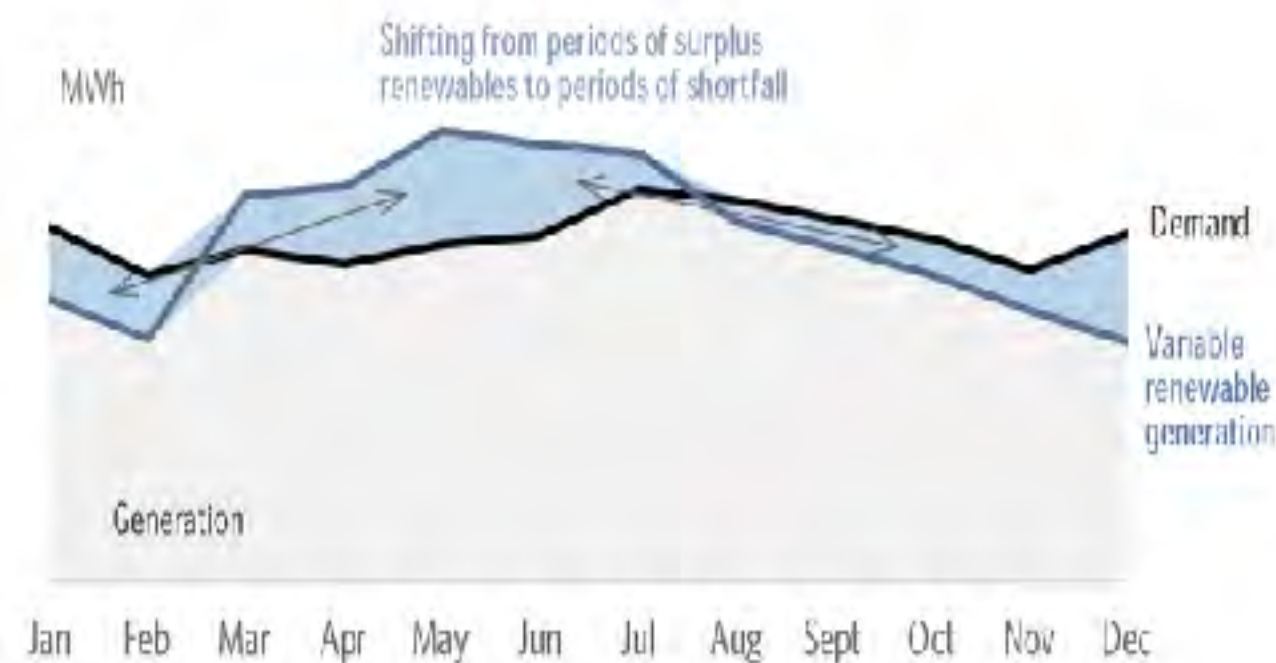
Load-following 'regulation' reserves



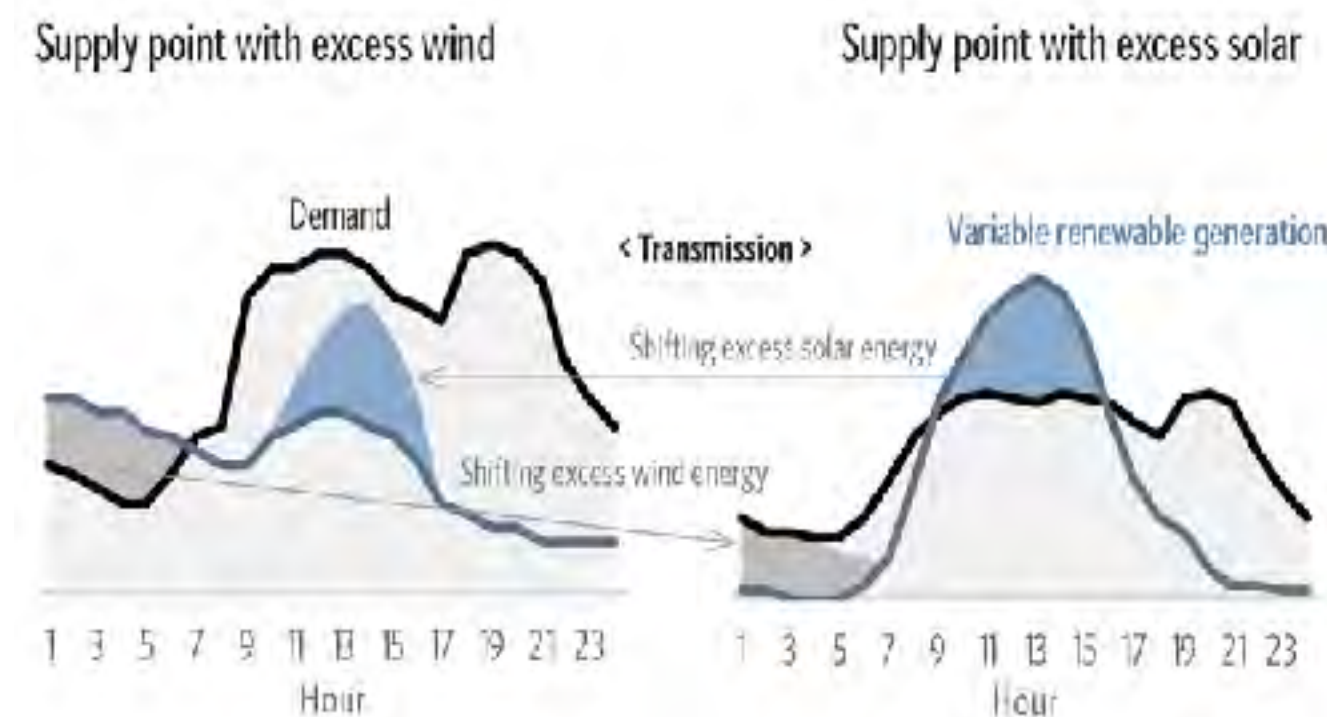
Daily balancing and shifting (Intraday)



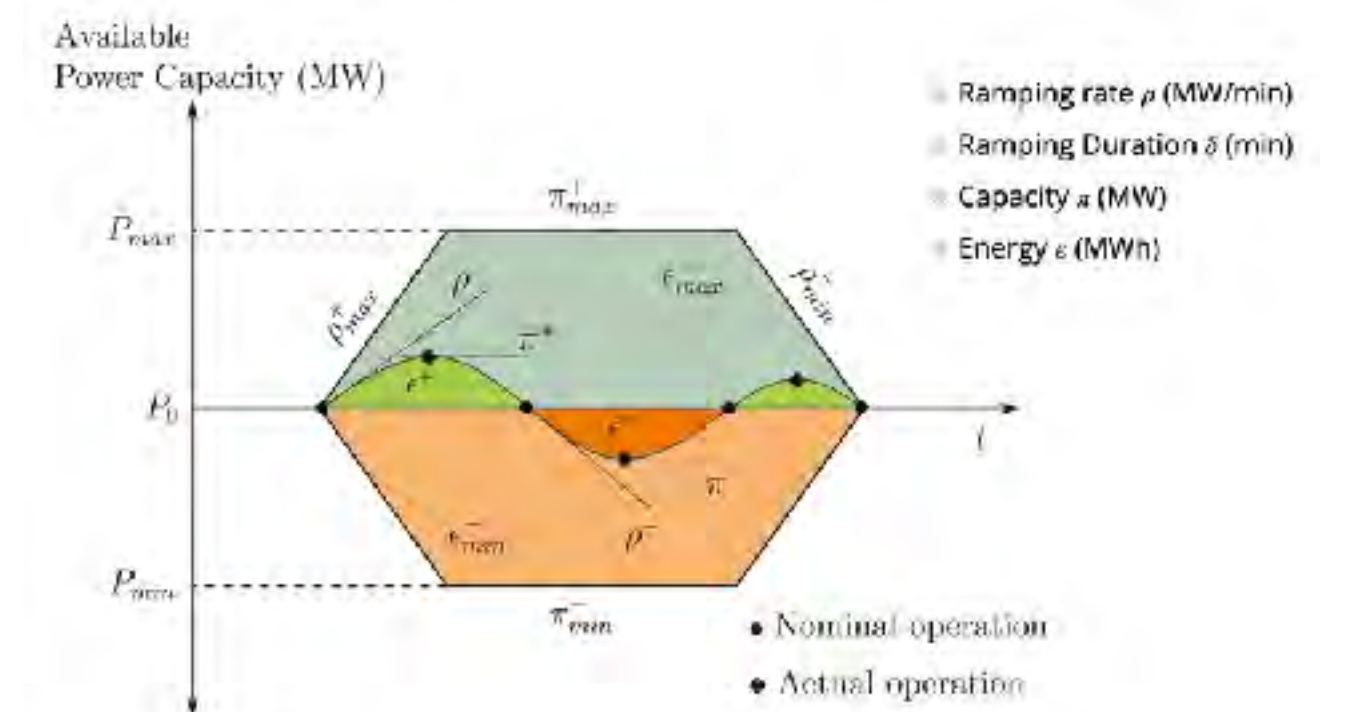
Seasonal balancing (interday)



Shifting excess energy & Curtailment

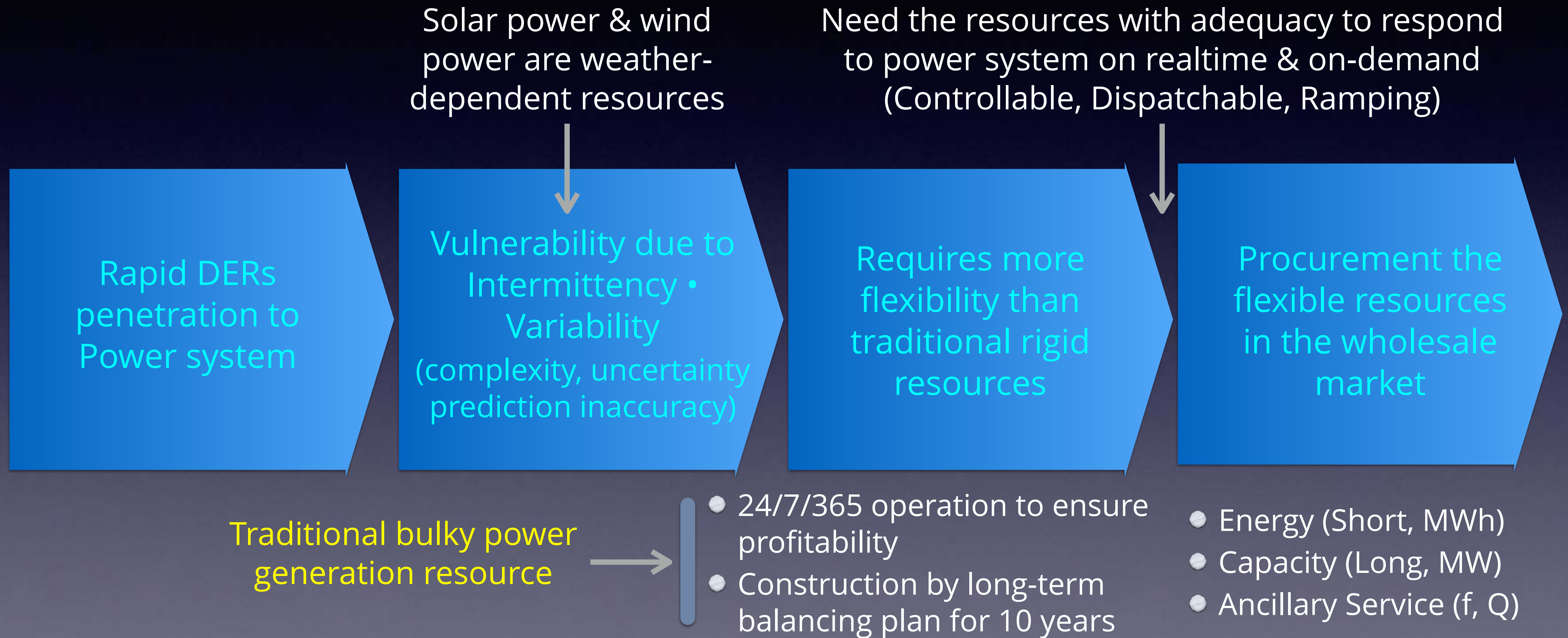


Ramping (Ramp-up)



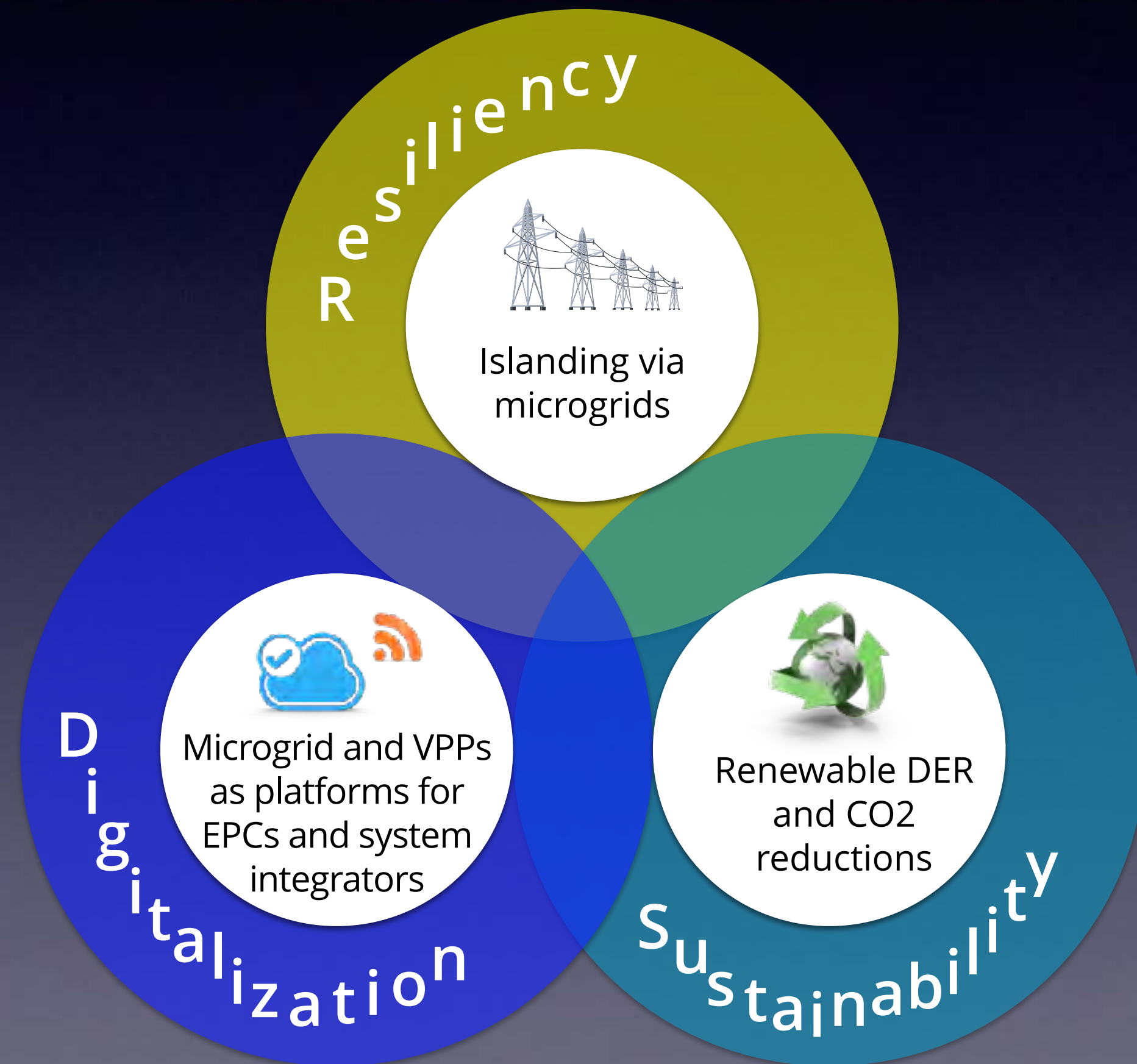


# Flexible Energy Resources through Market



# Vital Digital Platform

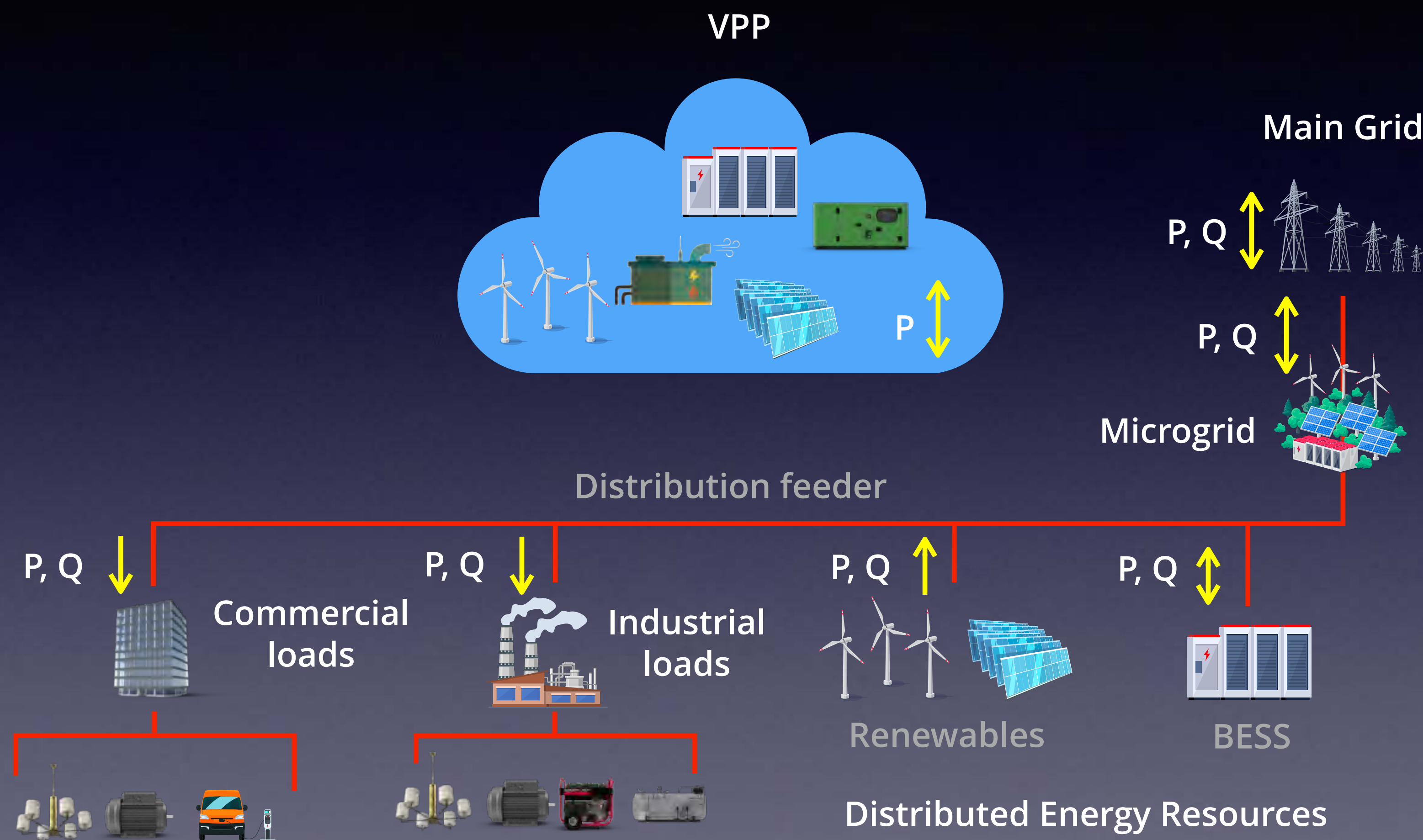
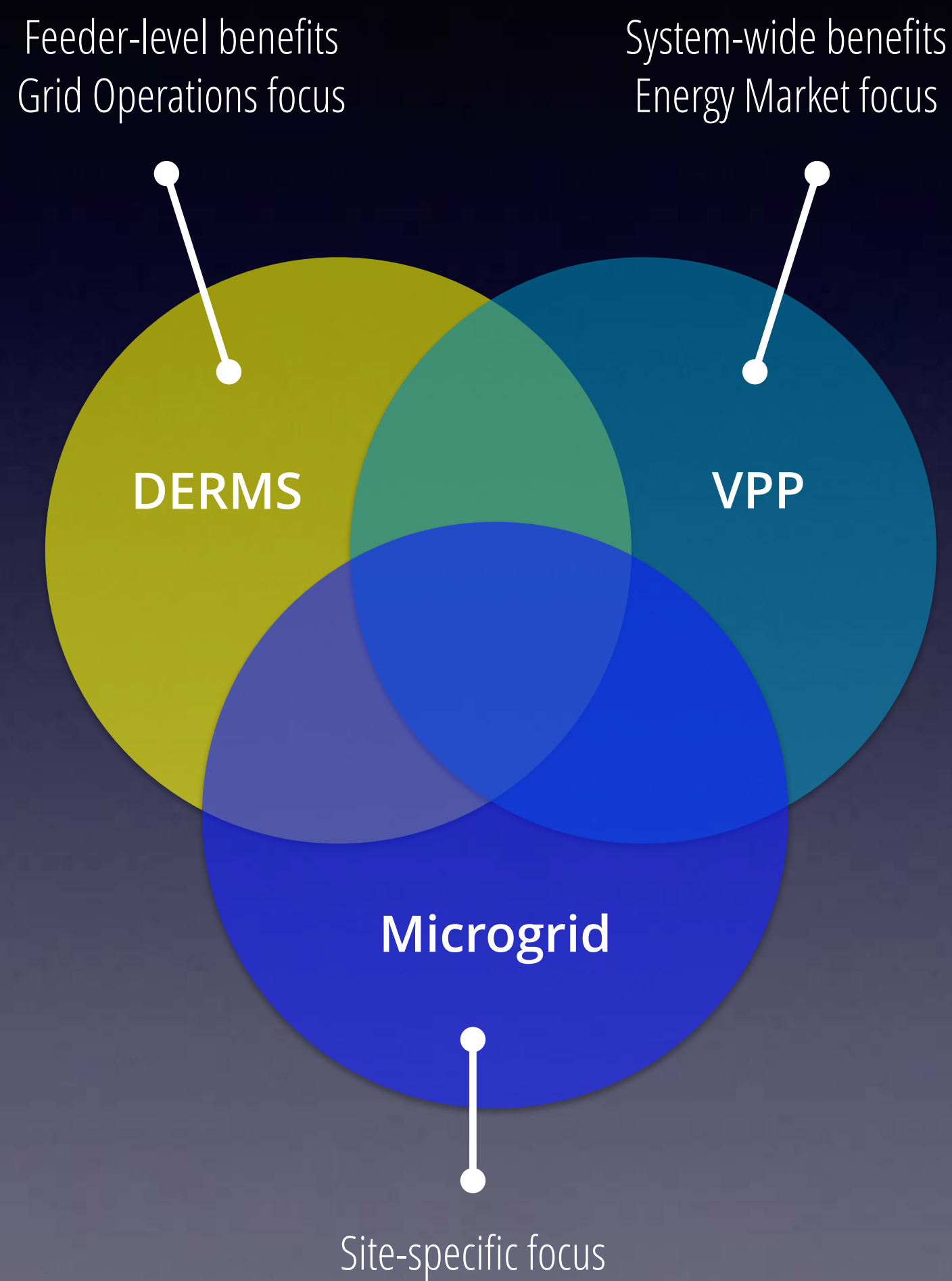
## Microgrids and VPPs Emerging as Vital Digital Platforms



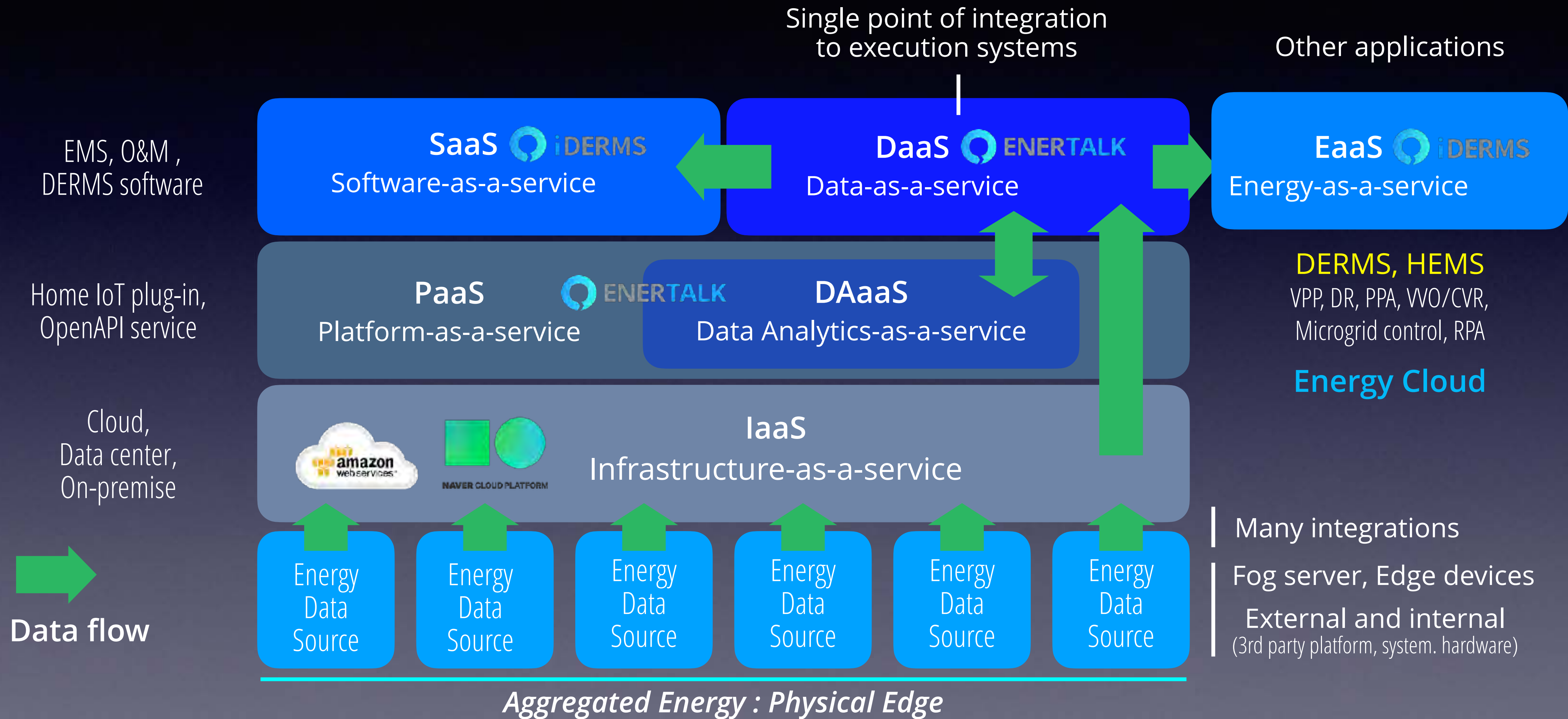
- Three global trends are driving the transformation of industries dependent on reliable energy in the 21st century:
  - Resiliency
  - Sustainability
  - Digitalization
- The last trend – digitalization – is the means by which greater resiliency and sustainability can be achieved.
- Microgrids and virtual power plants (VPPs) are digital platforms driving innovation in energy today.



# Increasing Convergence on Digital Platforms



# ENCORED's X-as-a-service stack

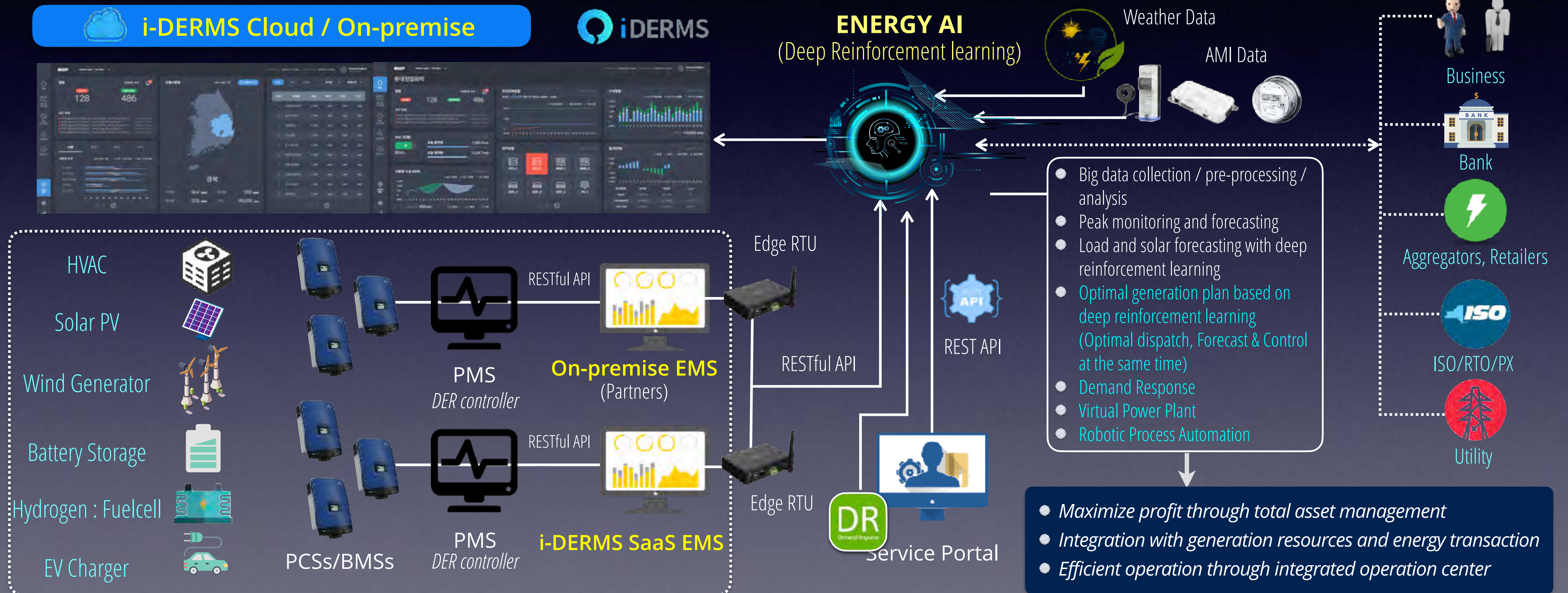




# i-DERMS APM Suite

Asset Performance Management

Harness flexible capacity from storage and other DERs, utilizing advanced A.I analytics for real-time optimization and asset dispatch

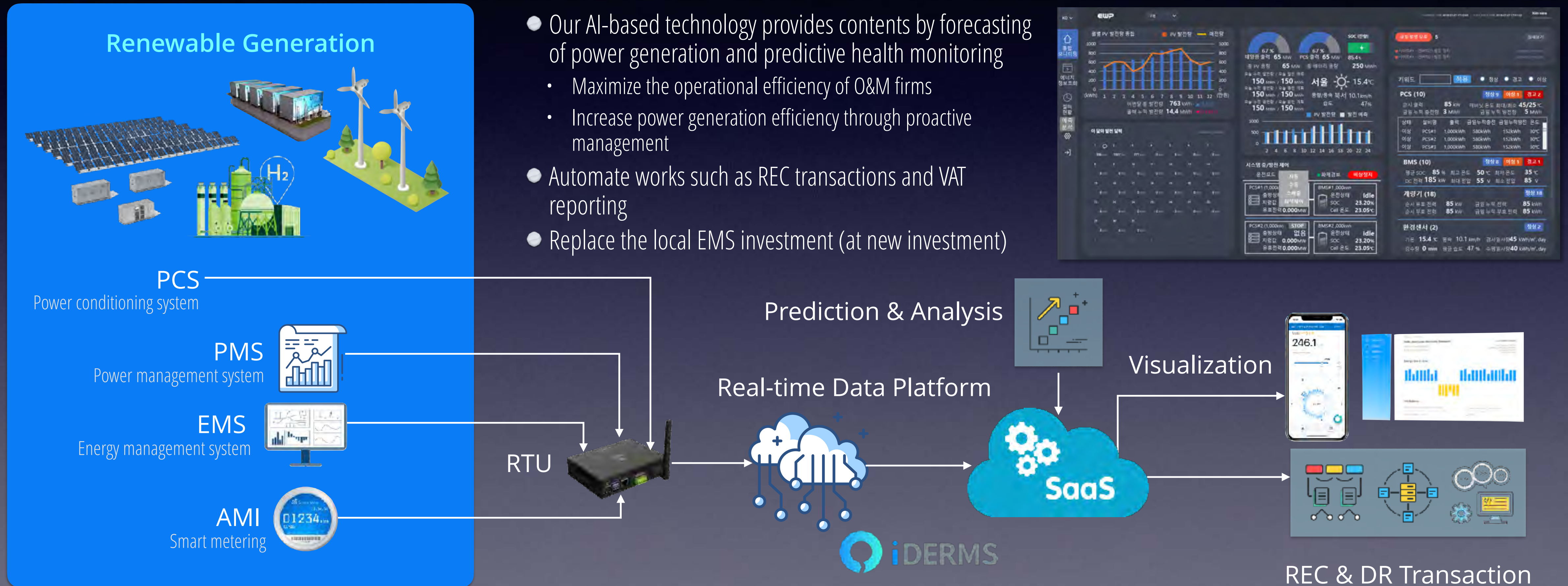




# i-DERMS SaaS EMS

Energy Management System

Still you are using complex and expensive management servers ? Now, change to SaaS





# i-DERMS VPP

Virtual Power Plant

DERMS / TVPP

DERMS

자산관리

DER M&C + Analytics

CVPP

VPP Software

DRMS

- Control system for optimized operation of power grid and DERs
- Service for peak control and voltage regulation of DER system : VVO, CVR and renewable cooperation and controls

- Integrated operation, planning, and forecasting support for DERs
- Operators should understand the impacts on consumption and regions; networks pf DER operation

- Service for energy supply & frequency regulation of the entire power system
- Automatic output control of DERs in connection with the wholesale market remotely
- Energy transaction in wholesale market, considering the price difference on behalf of DERs owners

- Registration, tracking, reporting and settlement of demand resource transactions
- Supply for specific purposes for customers

TVPP : technical VPP, CVPP : Commercial VPP, DRMS : demand resource management system

Data Aggregation (Individual Generation)

Integrated management of multiple plants

Analysis : Forecast / Optimization

Bidding

Facility Controls (Individual Generation)

Settlement



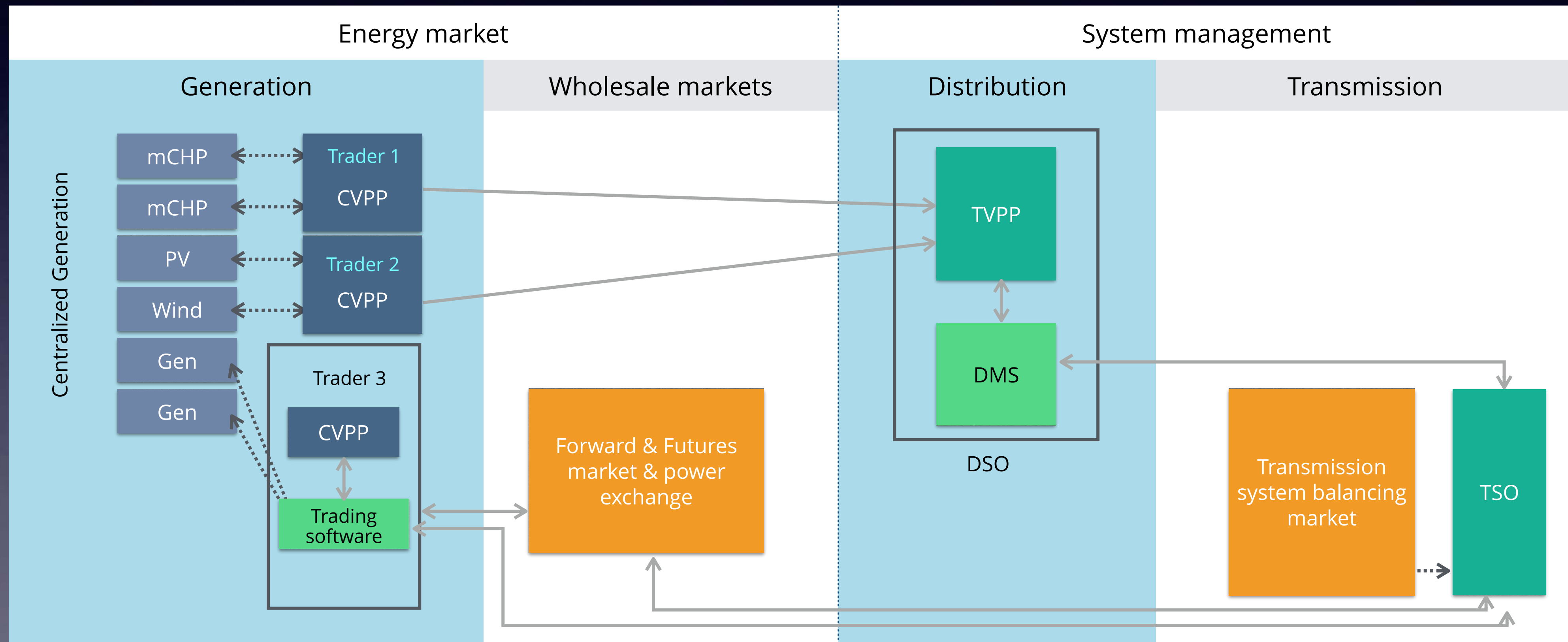
# Two Stages : Virtual Power Plant

## CVPP : Commercial VPP

Optimize energy sales from DERs

## TVPP : Technical VPP

Operated by DSO, optimize grid operation





# i-DERMS FORECAST

## Definition of a Day-ahead Generation Forecasting Service

### Goal

It predicts the generation amount of tomorrow's 15-minute / 1-hour interval.

### Related Regulation

Renewable Energy Generation Prediction System  
(Power Market Operation Rules, KPX, 2020.10)

- Estimated power generation by time period for 24 hours of the trading day must be submitted by 10:00 (1st) and 17:00 (2nd) the day before the transaction.
- Only during the time period where the facility utilization rate is 10% or more, the unit price is differentially applied according to the forecast error rate for each time period.

Application conditions	Settlement unit price
Error rate greater than 6% and less than or equal to 8% at the time	3 Korean Won / kWh
Less than 6% error rate at the time	4 Korean Won / kWh

## Check the generation forecast

### Expression

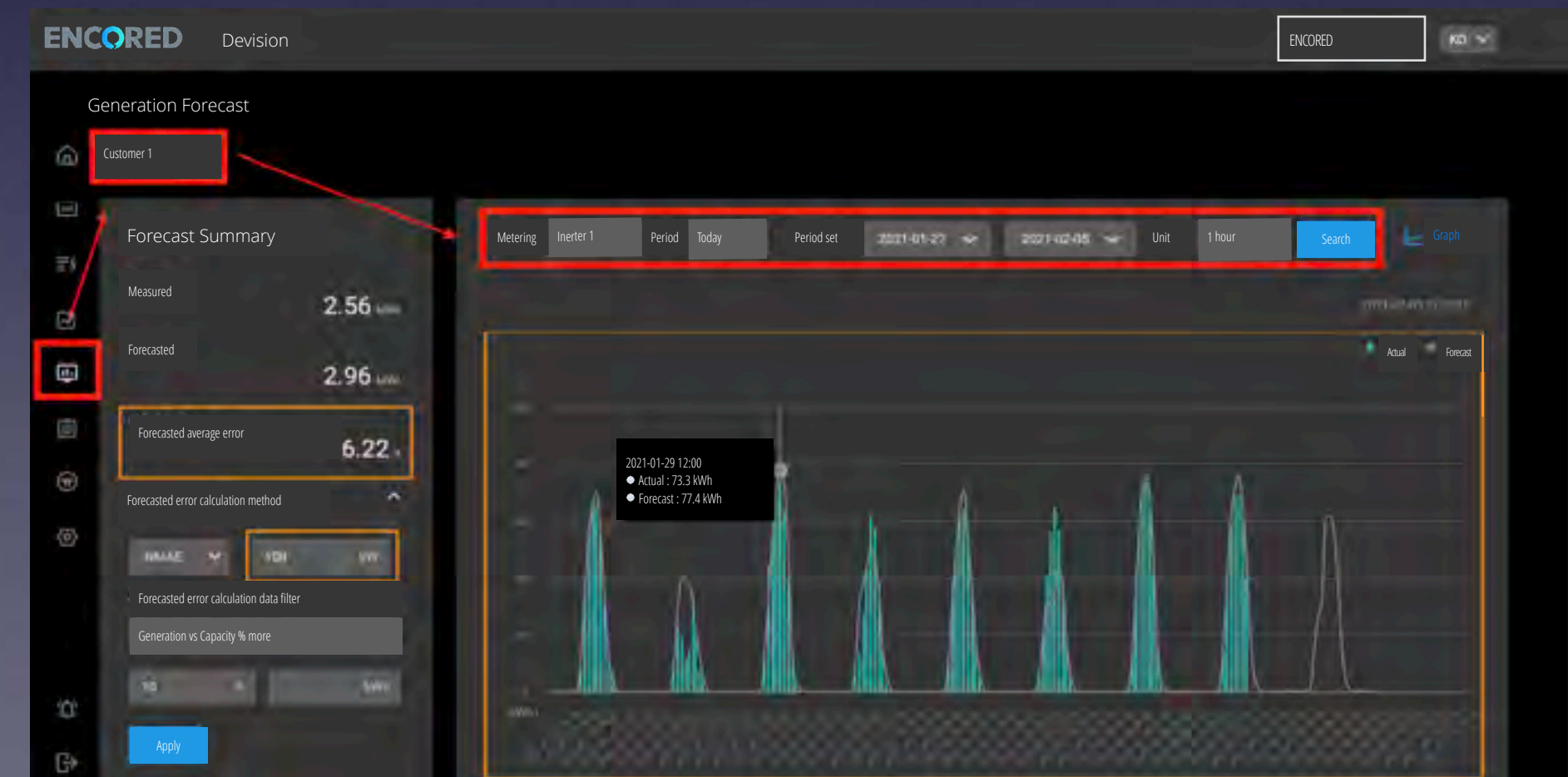
- Generation Actual Value
- Predicted value (most recent)
- Total capacity of the selected plant
- Error rate (default scale NMAE10)

NMAE 10 (Normalized Mean Absolute Error) : The arithmetic average of the FER in the time period when the facility utilization rate is 10% or more

$$NMAE_{10} = \frac{\sum_{t=1}^N FER_t \times 1_{y_t^{true} \geq \frac{Capacity}{10}}}{\sum_{t=1}^N 1_{y_t^{true} \geq \frac{Capacity}{10}}}$$

FER (Forecasting Error Rate) : Percentage of the absolute value of the difference between the predicted power generation and the metered power in the corresponding time period with respect to the facility utilization rate

$$FER_t = \frac{|y_t^{pred} - y_t^{true}|}{Capacity} \times 100 \%$$





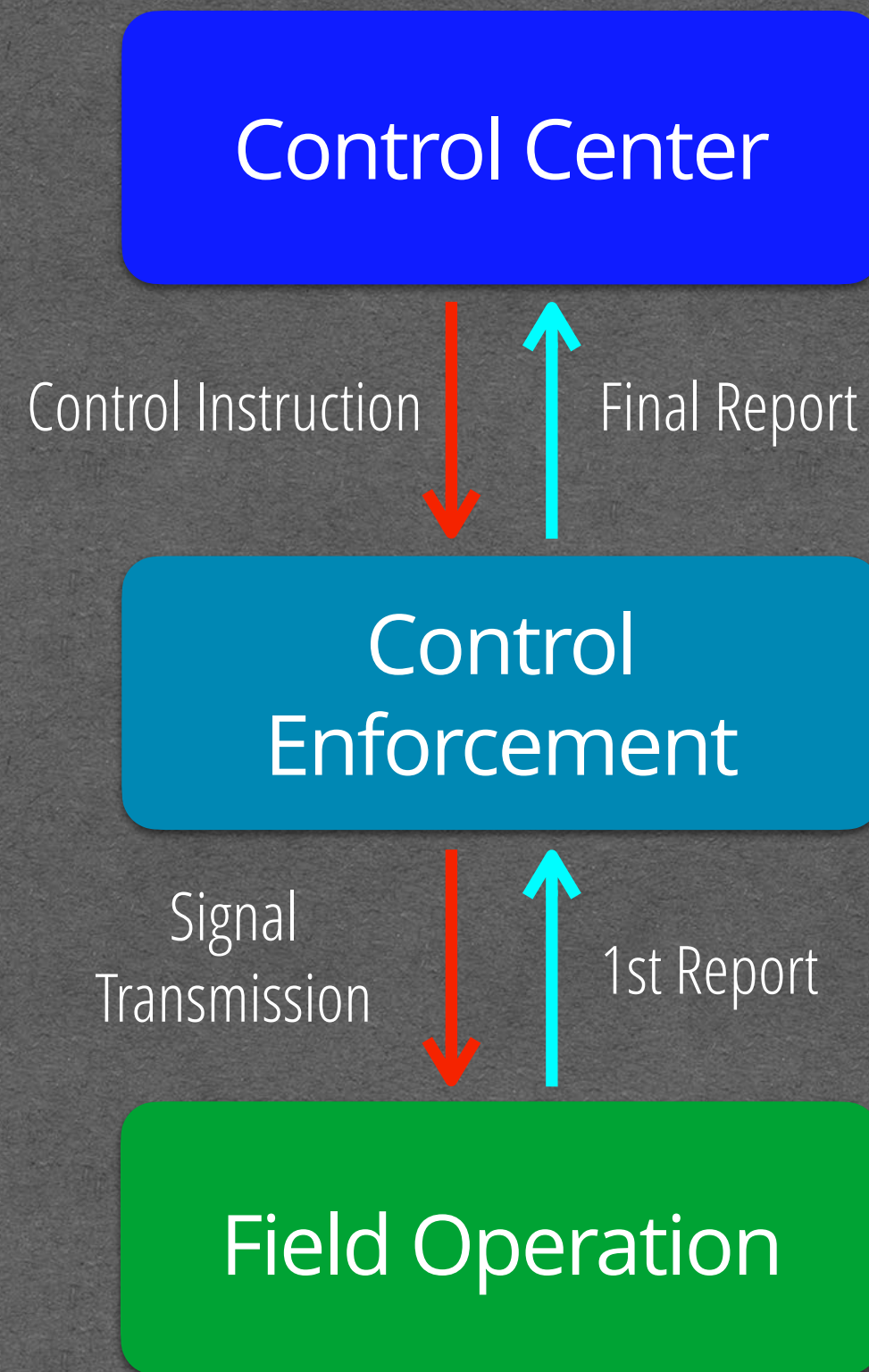
# i-DERMS REDAS (Grid Services)

Provide reactive power, frequency control, inertia response, and self-starting services

- Upper output limit control
- Inverter ON/OFF control
- Reactive Power (VAR) Control
- Active Power (Watt) Control
- Frequency control
- Inertia response & Ramp control
- Black start & Grid Forming



**CONFIDENTIAL**



- directing • supervising
- output control instruction
- Check instruction result
- Command confirmation and control signal transmission
- Power generation output monitoring and reporting
- Check and report generation output matching
- Check control signal reception
- (On-site) Power generation output monitoring and reporting
- Check and report power plant site conditions

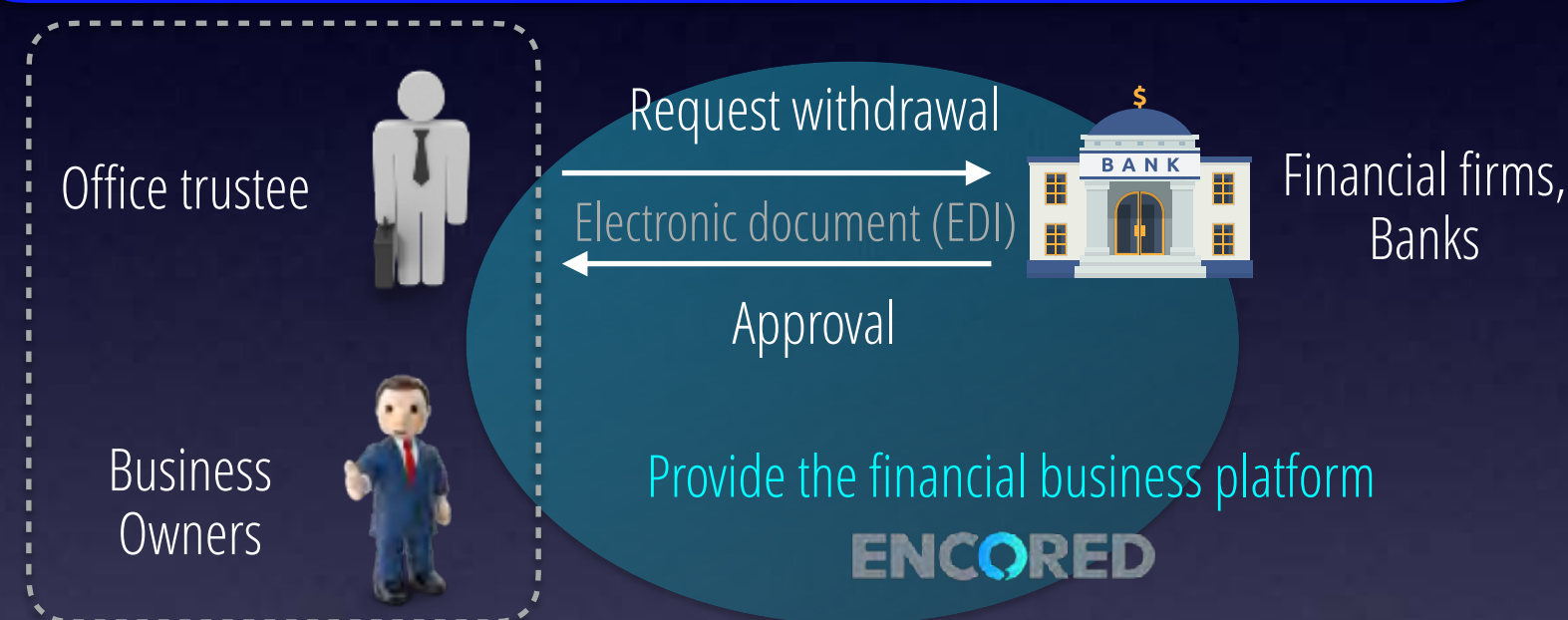


# i-DERMS RPA

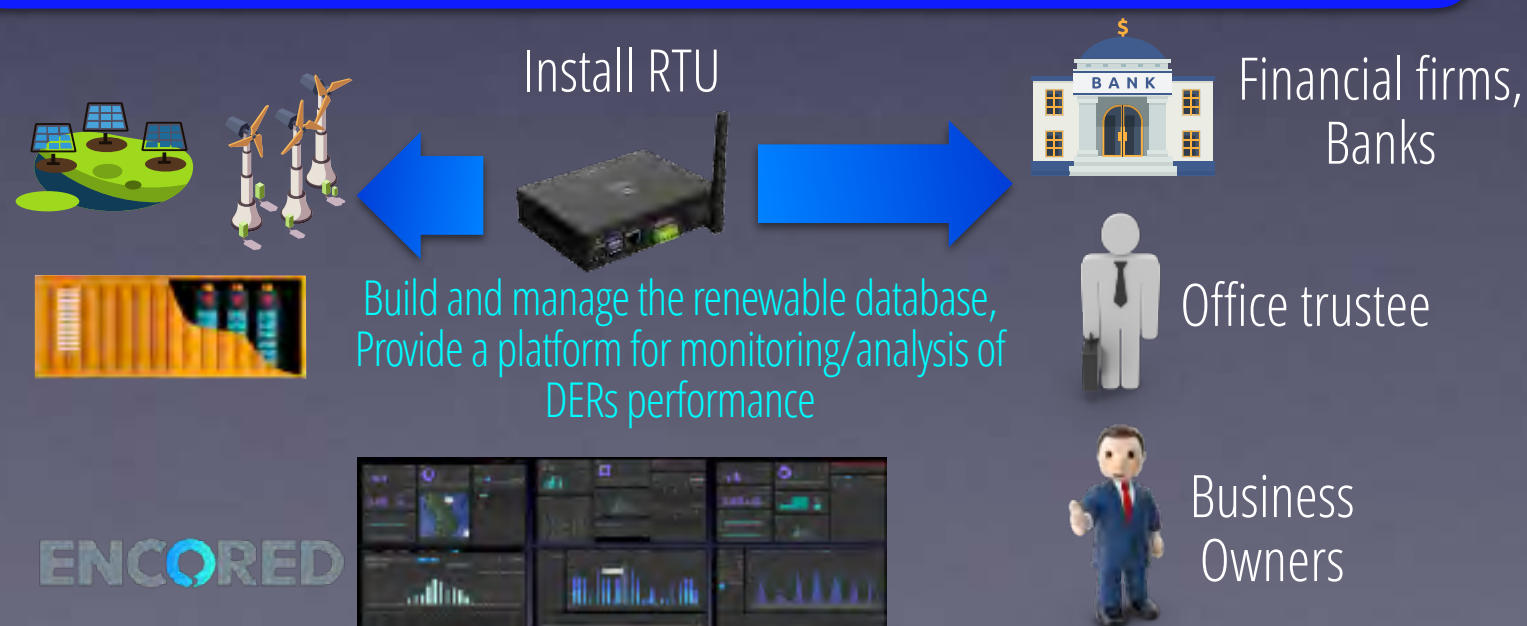
Robotic Process Automation

Support system to manage various processes in the renewable business that proceeds with financial investment

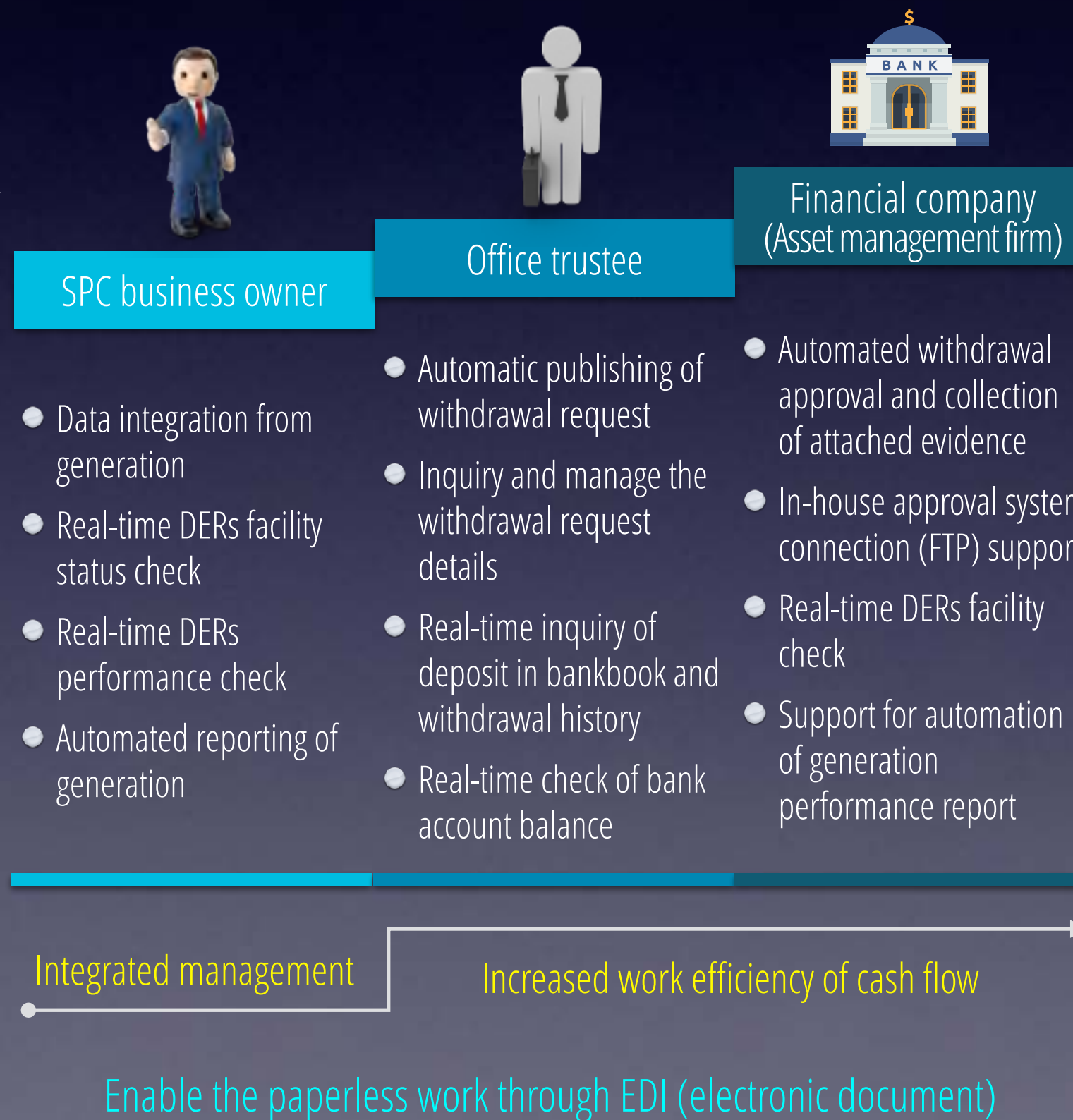
Establish an efficient renewable financial business process through systematic deposit and withdrawal management schedule and office process automation



Integration of management system, and maximization of efficiency through real-time power generation aggregation



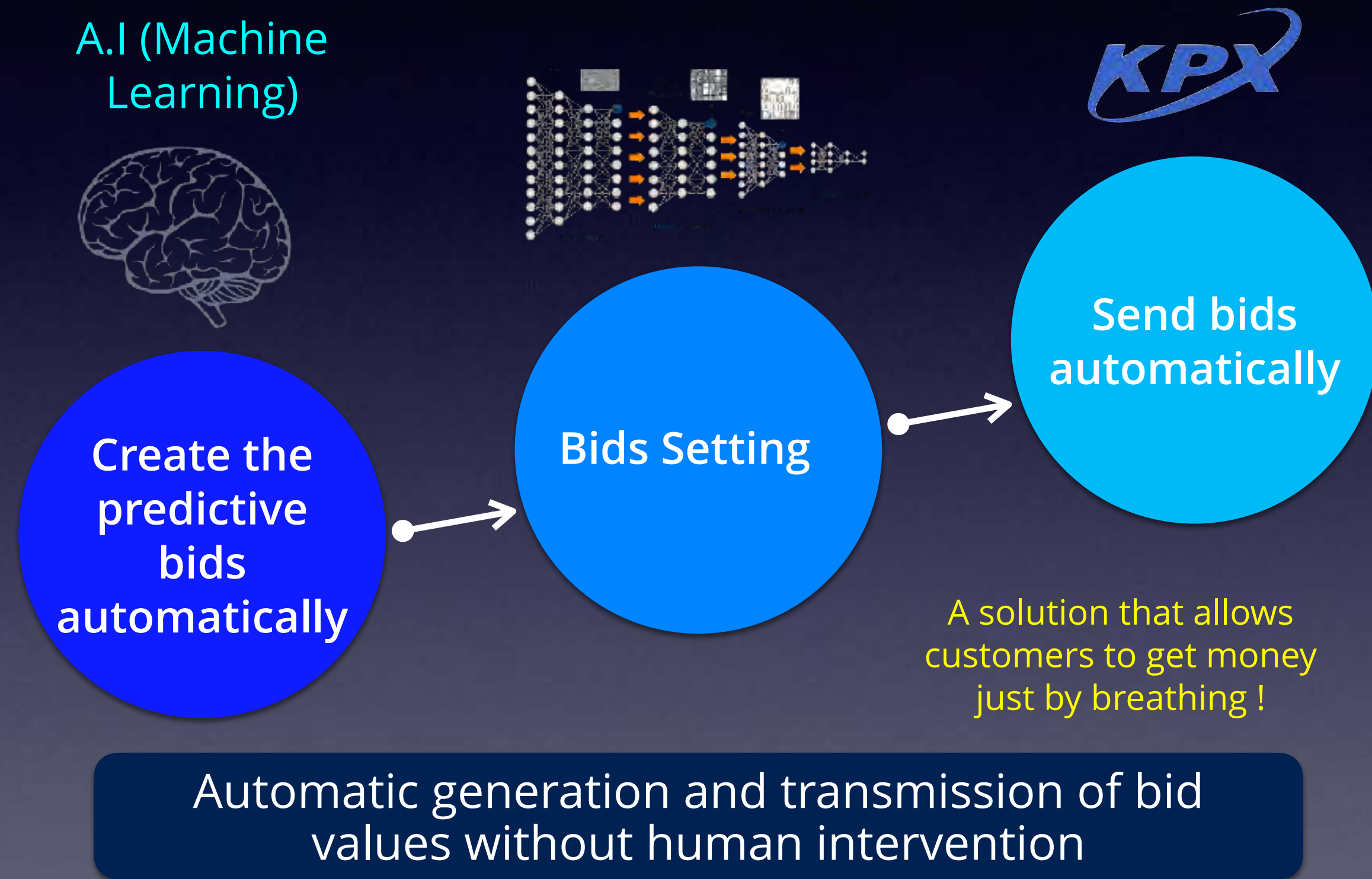
## How to use by customer





# i-DERMS AUCTION

As a developer of API for the RES forecasting system of the KPX, ENCORED provides designs and solutions optimized for bidding based on the predictive energy system.



The forecast value is created according to the automatic bid setting, and the bid value is automatically sent to the Power Exchange. If you need to update your bid volume, you can make the correction with manual bidding and bid immediately with the revised value.

2022.03.23 ED

**1** Select generation plant

**2** Set periods

**3** Validate your forecast

**4** Create bid data

**4** Set automatic bids

**5** Inquiry bid history

Application of the "Renewable Energy Generation Prediction System" form of KPX

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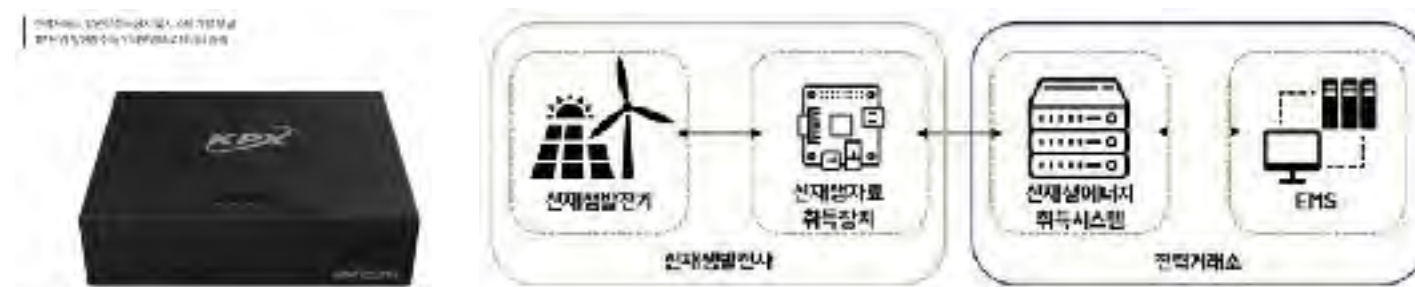
# i-DERMS RTU

Remote Terminal Units (Edge computer)



Korea Power Exchange's mandatory RTU and Data analysis system

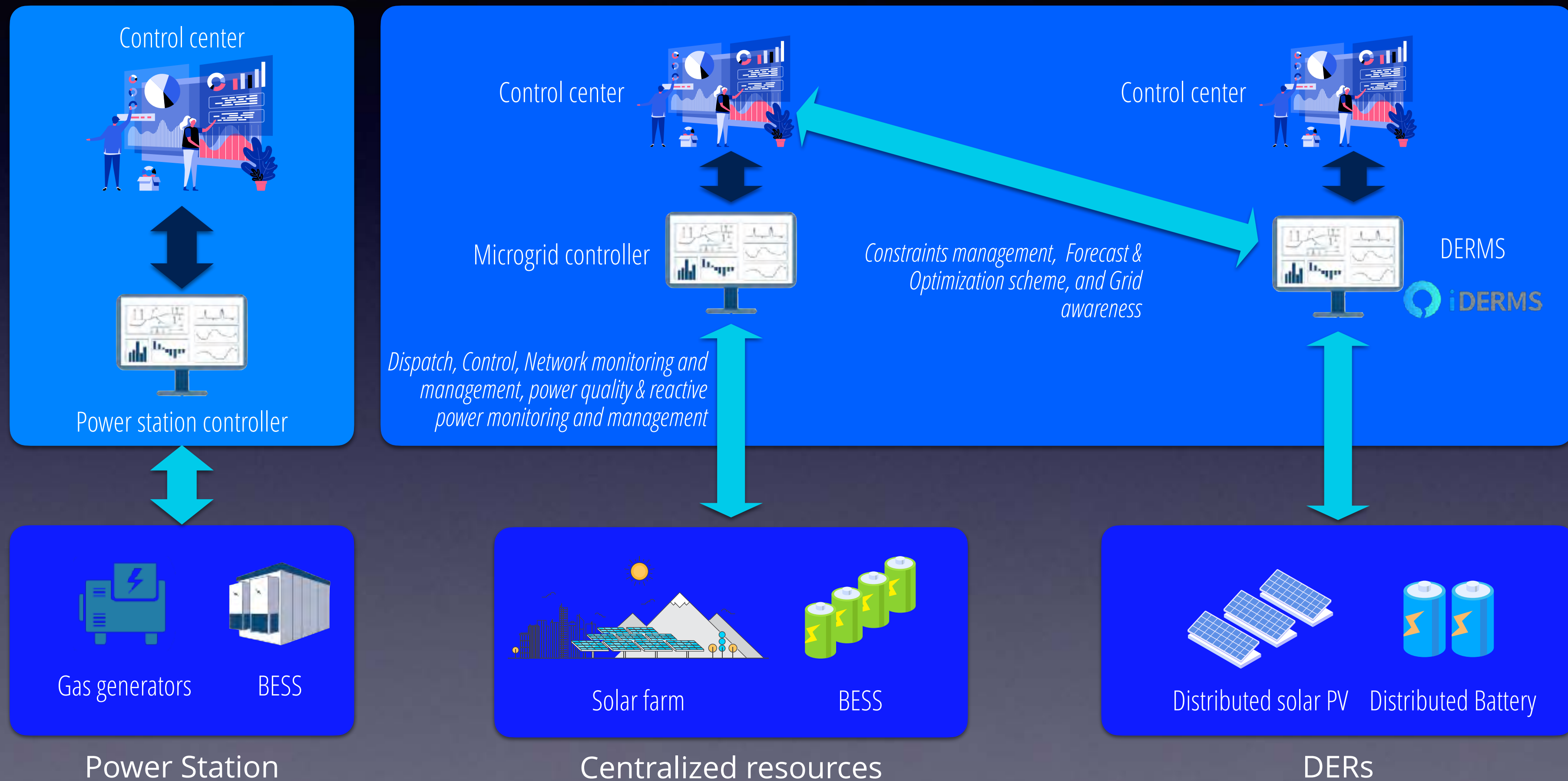
## Korea Power Exchange



General	Classification	Energy Data Gateway (RTU)
	Data Collection	Inverter/Meter/Sensors
	Number of Connection	~15
	Data cycle	1 ~ 15 minutes
	Communication	Wired/Wireless
	Size	150 x 110 x 39 (mm)
Electricity	DC power input	5V
	Operating temperature	0°C ~ 50°C (recommend)
	Power consumption	~15 W

Communication	Connectivity	<ul style="list-style-type: none"> <li>Front-haul : Serial, Ethernet</li> <li>Back-haul               <ul style="list-style-type: none"> <li>Wi-Fi : 2.4GHz/5GHz IEEE 802.11b/g/n/ac</li> <li>Ethernet : RJ45 (~1Gbps)</li> <li>LTE (Optional) : Cat. 1</li> </ul> </li> </ul>
	Port Interface	<ul style="list-style-type: none"> <li>Serial : RS485 x 3</li> <li>Ethernet : RJ45 x 1</li> <li>Wi-Fi / LTE(Optional) : Antenna / Antenna</li> </ul>
	Protocol	Modbus, RTU/TCP, HTTP(S), MQTT, DLMS/COSEM, SNMP, proprietary inverter protocols
	Display	LED
Function	Data backup	1 month
	Firmware upgrade	FOTA / USB
	Data security	Hardware-based data encryption and device sealing label support (SSL / PSK, HSM)
	Warranty	1 year
	KC Certificate	R-R-EdT-SGWBWB

# i-DERMS Microgrid Control





# DERMS/VPP Roadmap by ENCORED

**~2021 (running)**

Distributed Energy Management

Demand Response

Forecast (Generation, Demand)

Microgrid Controller

O&M Support

**2022**

Curtailment (Remote Control)

Grid Services (through TVPP)

Ancillary Service  
(Frequency, Reactive Power)

Transaction  
(Capacity / Ancillary Service)

Customized Modules for Partners

Resilience Support

DERs Control for On-/Off-grid

**2023**

# Track : DERMS



Smart Energy Platform

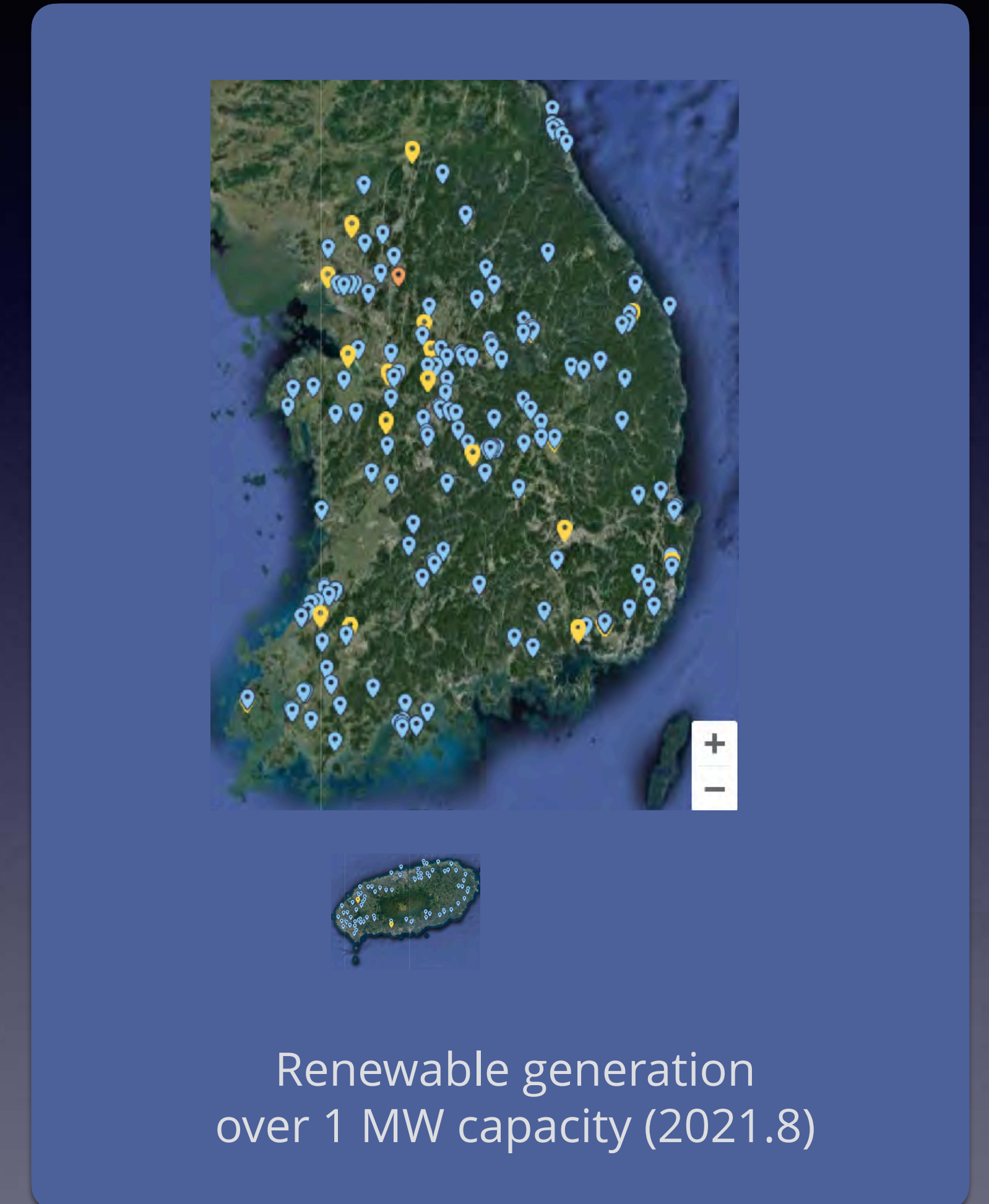


RE100 Energy Platform





# Connectivity of i-DERMS in Korea





# DERMS Control Center



2021.08.16 ED 인코어드소개서



# Track : Microgrids (Hawaii, US)



- Coordination control
- Frequency control
- Black start
- Automatic synchronizing

## PMS



## i-DERMS Cloud



- Optimal generation planning (cost or CO2 emission)
- Monitoring distributed energy resources and analysis field data
- Peak monitoring and estimation
- Cost analysis



## National Weather Service



## SaaS EMS

- Big data collection / pre-processing / analysis
- Load and solar forecasting with deep reinforcement learning
- Optimal generation plan based on deep reinforcement learning

## AI energy meter & Gateway



- Wireless connection
- Low power consumption
- Realtime data transmission

## Solar PV



- 512 kW x 2 ea
- N-Type
- Bifacial module (+5 ~ 30%)

## ESS



- 250 kW PCS
- 500 kWh Battery
- 98.7% efficiency



# COMPANY





## CEO/Ph.D John Choe



- CEO / Founder of ENCORED (US, Japan, Korea)
- Energy Advisory Member of National Academy of Engineering of Korea
- Chair Professor of TECH University of KORES
- Former President of LS Industrial Systems (2012)
- Former Non-executive Director of KETEP (2021 ~ 2022)
- Former A member of the National Energy Commission (2019 ~ 2020)
- Former Korea representative & International Energy Expert of IEC-ACTAD (2005 ~ 2019)
- Former An advisory member of KEPCO Smart Grid (2010~2012)
- Former A member of Regulatory Reform Committee, Prime Minister's Office (2014~2015)
- Former Asia vice-president & Korea representative of International advanced power technology (USA) (2001~2009)
- **R&D Track** : Develop Korean 1st Smart meter, KPX national EMS, KEPCO RTDS (realtime digital power system simulator)



# Meet our great team

Smart may have brains, but stupid has the balls. Be stupid - ENCORED's team



Dr. Jong-Woong "John" Choe

- ENCORED** CEO & Founder
- LSIS** Former President of LSIS
- IEC** IEC-ACTAD International Expert
- NAEK** Member of National academy of engineering of Korea
-  National energy committee member

**Technical Tracks** : Smart meter & AMI, Korean national EMS, KEPCO realtime power system simulator



**76** members

**Different DNA**

We are a group of **Energy experts, Data scientists, Psychologists, Designers, and Computer scientists.**

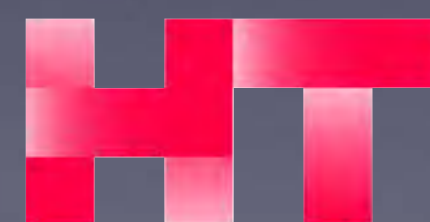
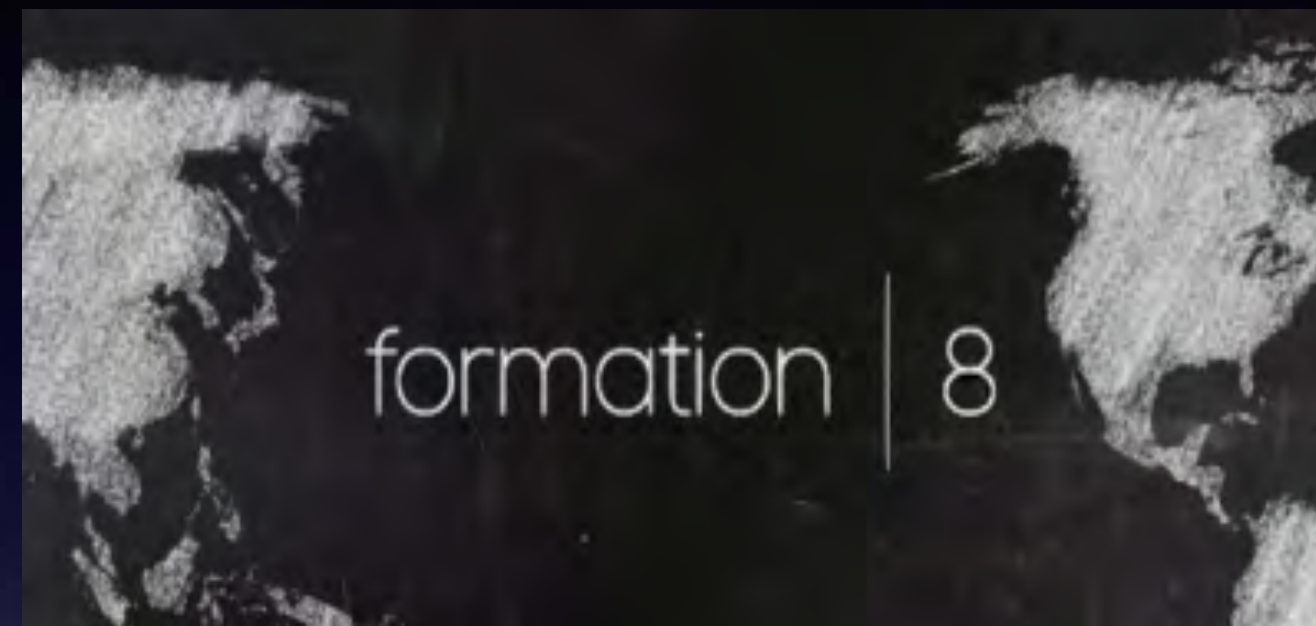
**US : 7** 

**KR : 35** 

**JP-JV : 34** 








# Our benevolent investors





# Achievements (SEP 2022)

-  **No.1 in DERs-connected Capacity**  
(3.9 GW, VPP Service Capacity : 1 GW)
-  **No.1 in Forecasting Accuracy of DER generation**  
(2.85 %)
-  **1st place in the Aggregated DERs for Forecasting Bidding of KPX**  
(1.0 GW)
-  **No.1 in Market Share for Public Utilities**  
(5 GENCOs + KPX)
-  **No.1 in Market Share for medium-to-large power plants over 1 MW of more**



# Top 10 Utilities Solution Provider - 2019





# SoftBank New Business Partners





# 2021 KOREA AI STARTUP 100



# 코리아 시 스타트업 100

\*는 상장사

분야	기업명	분야	기업명
1 교육	위이드	51 인테리어	어반베이스
2	메스프레소	52 패션	오드컨셉
3	모두의연구소	53	마크비전
4	마키메이마이	54 헬스케어	뉴로핏
5	멜라스	55	넷다켓
6	위즈스쿨	56	누비랩
7	클라썸	57	팀바이오
8	플리토*	58	루닛
9 교통/운송	PhantomAI	59	메디픽셀
10	라이드클릭스	60	뉴노*
11	모빌테크	61	스탠다임
12	서울로보틱스	62	쓰리릴리언
13	스마트레이더시스템	63	에어스메디컬
14	스트라드비전	64	에이다이트릭스
15	아우토크립트	65	일포리에도코리아
16	인퍼닉	66	제이웰케어*
17	로르드라이브	67	코어라인소프트
18 금융/보험	업라이즈	68	호모큐브
19	디셈버앤컴퍼니자산운용	69 AI 솔루션/플랫폼	대화이트커뮤니케이션
20	아이지넷	70	아트러서치
21	머메스	71	볼거나이즈코리아
22	메이젠글로벌	72	노라
23	웨이브릿지	73	디메스캡글로벌
24	과لاس프트	74	미안즈랩
25	크래프트테크놀로지스	75	마키나락스
26	파운드	76	슈퍼브에이아이
27 HR 서비스	원리드랩*	77	스누아이템
28 농축산	한국축산데이터	78	아크틸
29 로봇	베어로보틱스	79	에자일소다
30	트위니	80	에이프리카
31 리테일	인레마인즈	81 AI 컨설팅/작업	업스레이지
32 미디어/콘텐츠	네오차파옌스	82 AI 프로세서	리벨라운
33	딥브레인에이아이	83	딤팩스
34	마이셀럽스	84	모빌링크
35	보이저엑스	85	퓨리오사에이아이
36	비프로컴퍼니	86 데이터 가공	가이몬
37	샌드바드	87	디샤일로
38	시아스랩	88	딤팍소스
39	웨인힐스벤처스	89	클라우드웍스
40	LOVO	90	셀렉트스타
41 법률	로앤컴퍼니	91 요소기술	리턴제로
42 세일즈/마케팅	오브젠	92 NLP, 컴퓨터비전 등	비주얼캠프
43	올로코	93	스캘터랩스
44	아드리엘	94	알체라*
45 스마트 시티	수퍼빈	95	엑센파워
46	케이워드	96	이스트소프트
47 스마트 에너지	인코드 테크놀로지스	97	인공지능연구원
48 스마트 팩토리	원프레덕트	98	자이넵스
49 식품료	닥터키킨	99 정보보안	수호다이오
50	더웨이브북	100	지한지교시큐리티



# Connecting People with Energy

## Contact :

# Address

ENCORED, Inc.  
451 University Avenue PaloAlto,  
California 94301, U.S.A.



# Phones

(+1) 650 204 4667  
(+82) (0)10 2468 7302

# E-mail, Home, Blog

john.choe@encoredtech.com

[www.enertalk.com](http://www.enertalk.com)

<https://blog.naver.com/wjohn57>