Ulsan Clean Energy Transition Strategy and Implementation Plan

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에너지기술지원단

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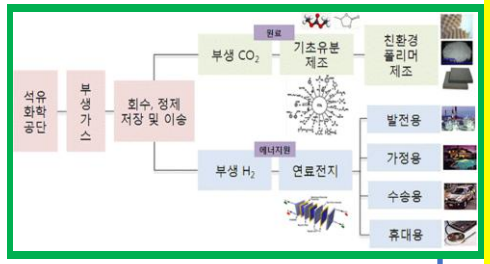
I. Institutional Overview

Ulsan Drives the Global Hydrogen Revolution

▪ A Fast Shift from By-product H_2 Utilization to Clean H_2 Production and Distribution

Start of By-product Hydrogen Commercialization Project (2010–2013)



Ulsan H_2 Town Pilot Project (2012~2018)

Hydrogen Fuel Cell Demonstration Center (2014–Present)

Construction and Operation of Hydrogen Fuel Cell Power Plant (2018–Present)

Hydrogen Electric Vehicle Monitoring and Demonstration Research (2006~2013)

Hydrogen Mobility Regulation-Free Zone (2019–2023)
Hydrogen Pilot City (2019–Present)

- P2G Green Hydrogen Production Demonstration (~2022)
- Hydrogen Co-combustion Gas Turbine Demonstration (2023~)
- R&D Linked to Urban Convergence Special Zones (2023~)
- Hydrogen Electric Tram Demonstration (~2024)
- Planning for 'Clean Hydrogen Cluster' (NOW)

Field Highlights and Key Achievements

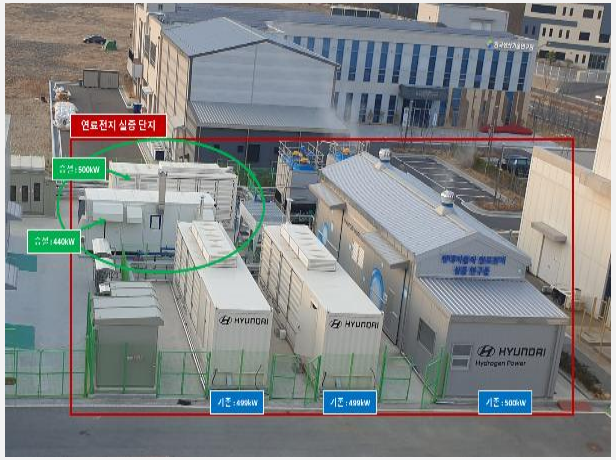
- **Integrated Demonstration Platform with Pipeline Hydrogen and Solar Power**
  - Fuel Cell Power Generation / Stack and System Evaluation / Electrolyzer System Testing

< Demonstration Center Overview>

<Hydrogen pipeline>

<Hydrogen Quality Analysis Lab>

<1MW Green Hydrogen Production Demonstration (Alkaline, PEM) >



< Fuel Cell Power Plant (2.44MW)>

<Fuel Cell Stack and System Evaluation Facility>

Available Equipment

- Hydrogen impurity analysis (C, N, S compounds, H_2O, O_2, etc.)
- PEM fuel cell performance & lifetime evaluation (10kW~100kW)

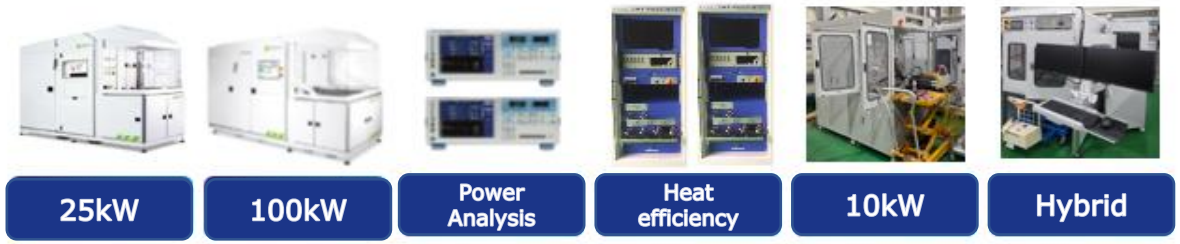
Hydrogen Quality Analysis Equipment

Establishment of a Hydrogen Quality Analysis System, Compliant with ISO 14687 Standards

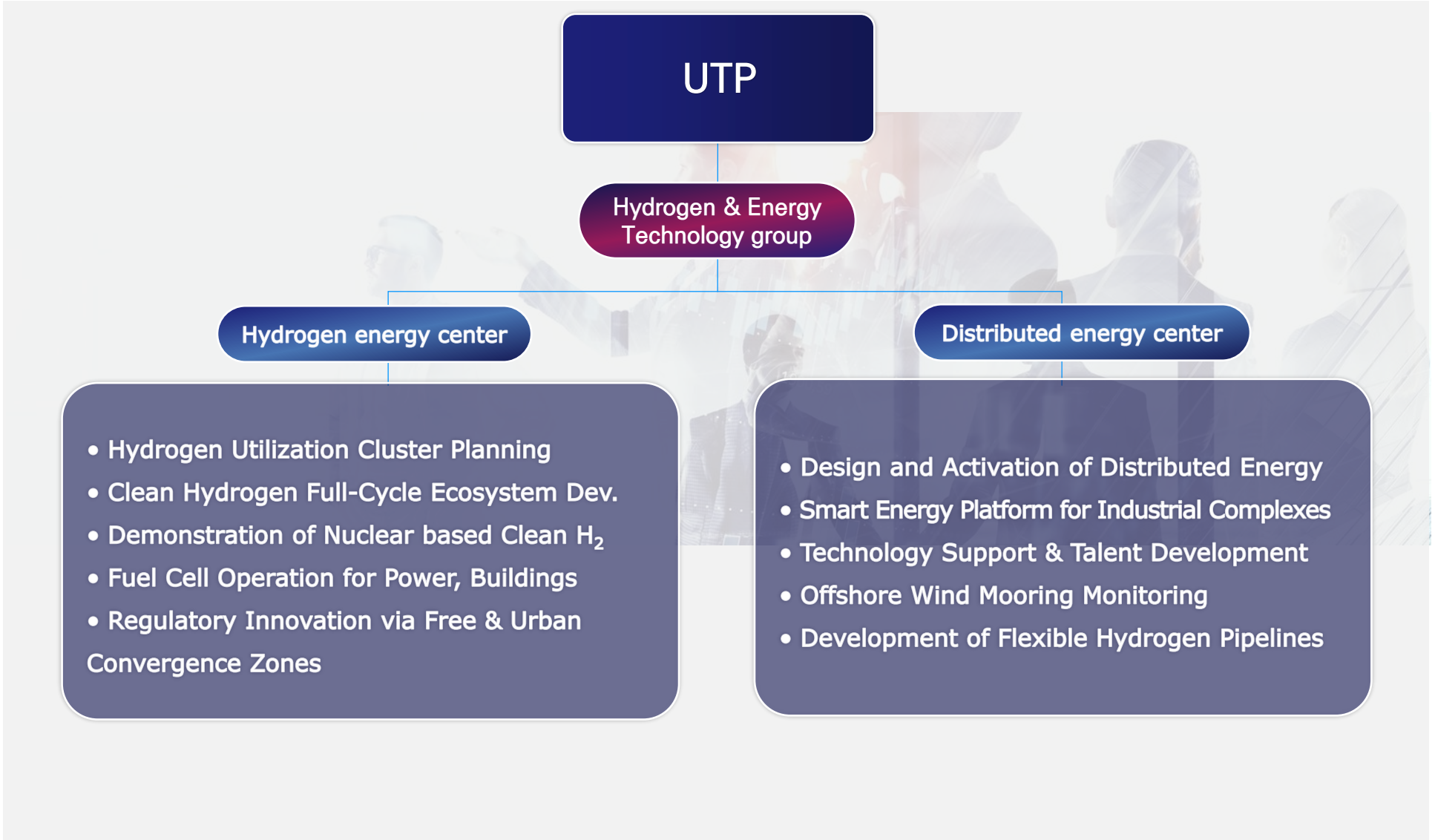
Fuel Cell Evaluation Equipment

Fuel Cell Evaluation for Localization and Technology Support

(Component performance & system durability testing)



Organization Status



II. Key Achievements

Establishing a Clean H_2 & Fuel Cell Ecosystem

- **Hydrogen Tram Demonstration**
  2,500km driving demo, fuel cell performance, H_2 refueling facility test
- **Green Mobility Regulatory-Free Zone**
  Fuel cell standard for replacing small vessel engines
- **Safety Technology for H_2 Stations**
  Commercialization of Predictive Maintenance & Safety Tech
- **Hybrid Powertrain Demonstration**
  Hydrogen & secondary battery system for buses
- **1MW AEM Electrolyzer demo. using renewable energy**
- **Secured 10MW Clean H_2 Demo Project**
  Nuclear-linked; 4 tons/day production capacity
- **Planning Hydrogen Mobility Cluster Project**
  Laying the foundation for clean hydrogen production and application

Strengthening next-gen energy industry foundation

- **Master Plan for Distributed Energy Specialized Zones**
- **Building Energy Self-Sufficiency Infrastructure**
  V2G-compatible bidirectional EV charging stations in National Industrial Complexes
- **Energy Integration & Efficiency Upgrade**
  Supporting modernization of energy systems and performance improvement
- **Nuclear Energy Ecosystem Recovery**
- **Thermal Runaway Prevention & Reuse of Batteries for ESS**
  Developing safety technologies and second-life battery applications
- **Dev. of Flexible Non-metallic Pipes for High-P H_2 Transport**
  Including joint/connectors for safe gas delivery

III. Business Environment Analysis

Overseas

- **Net-Zero and Energy Security as Global Agendas**
- **EU CBAM Press on Ulsan's Manufacturing Sector**
- **Tightening Maritime & Aviation Regulations**
  Clean methanol, ammonia, and SAF
- **Clean Hydrogen as a Core Pathway to Net-Zero**
- **Global H_2 Supply Chain Strengthening**
- **Decarbonization Trend to Continue**

Domestic

- **Accelerating Decarbonization in Power, Transport & Building Sectors**
- **Urgent Need for Industrial Decarbonization**
  Semiconductors, displays, electronics, steel, etc
- **Distributed Energy for Regional Industrial Cluster**
- **Preparing for Clean Hydrogen Imports**
- **Designation of Hydrogen-Specialized Zones**
- **SMRs and Next-Gen Reactors for Clean H_2 Production**

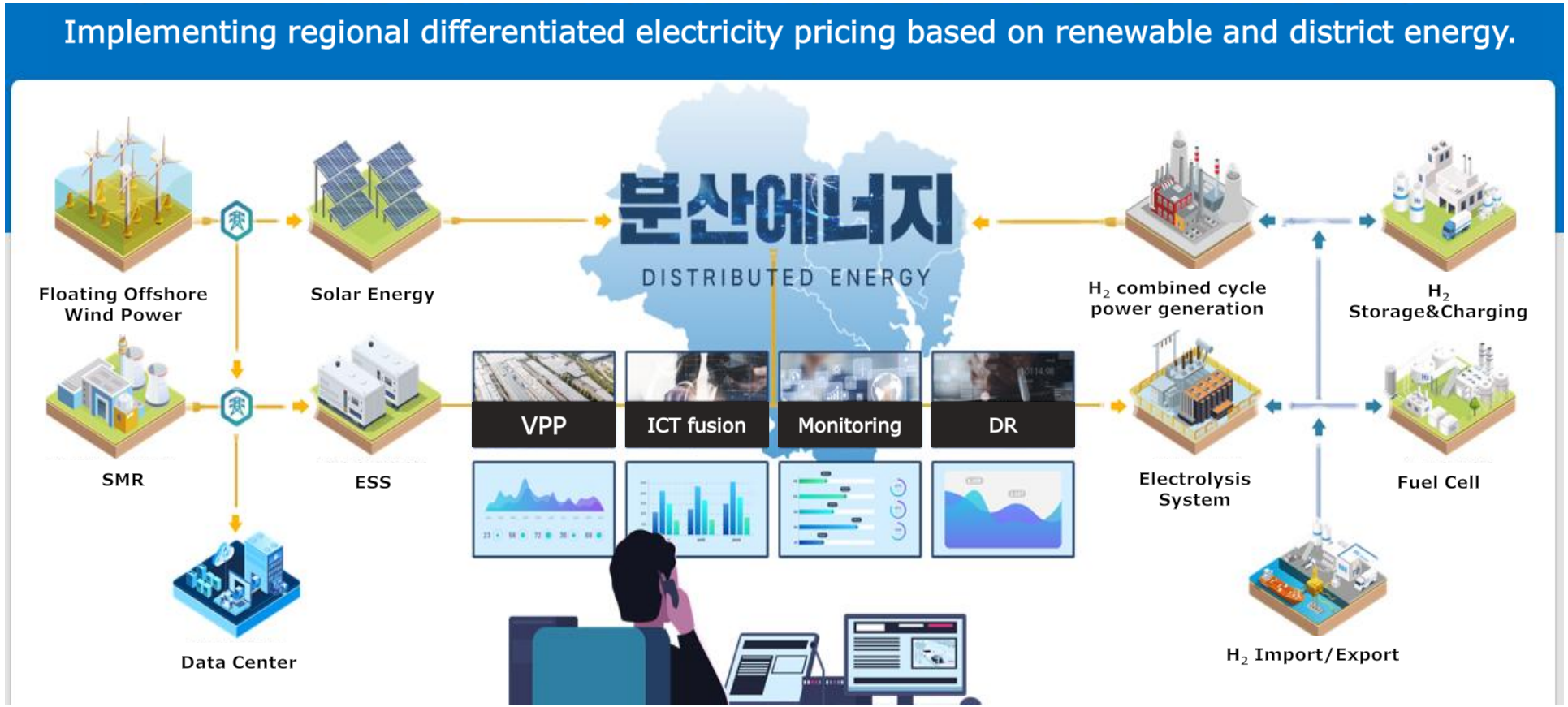
Ulsan City

- **Rising Pressure in Shipbuilding & Automotive Sectors**
- **Strengthening Support for Future Industries**
  2nd batteries and next-gen tech
- **Attracting Large-Scale Power Consumers**
  AI center, Data center, etc
- **Distributed Energy Zones for Energy Paradigm Shift**
- **Launching a Fully Integrated Hydrogen City**
- **Promoting a Clean Hydrogen Industrial Cluster**

Related Organization

- **Korea Energy Agency (KEA)**
  Designated as the lead agency for distributed energy activation
- **Korea East-West Power (EWP)**
  Demonstrating 300MW hydrogen co-firing turbine
- **Korea Institute of Energy Research (KIER)**
  Developing fuel cells to replace diesel generators
- **Korea Testing & Research (KTR)**
  An authorized agency for clean hydrogen certification and testing
- **Hyundai Motor Company**
  Promoting fuel cell power generation, hydrogen city projects
- **LG Chem**
  Demonstrating large-area alkaline water electrolysis systems

III. Business Environment Analysis



IV. Mission, Vision and Strategy

Mission

Driving Ulsan's Energy Paradigm Shift
to Accelerate Industrial Decarbonization and New Industry Growth

Vision

World-Class Expert Group in Regional Energy Strategy Planning & Execution

World-Class Clean Energy City for Distributed Energy and Hydrogen Industries

Strategic Initiative ①
Establishing a Hydrogen Utilization Cluster Ecosystem

- Planning a Hydrogen Utilization Cluster Project
- Demonstration for Electrolyzer Stack & System
- 1MW AEM Electrolyzer Development
- 10MW Nuclear-Linked Clean Hydrogen Demonstration Project
- Hydrogen Import, Synthetic Fuel Production, Storage & Supply

Strategic Initiative ②
Demonstration Centered on the Urban Convergence Zone

- Developing H_2–battery hybrid mobility solutions
- Follow-up R&D projects within the convergence zone
- Promoting interregional cooperation projects linking Ulsan-Busan
- Expanding hydrogen mobility applications (e.g., trams, UAM)

Strategic Initiative ③
Microgrid Readiness through the Distributed Energy Zone

- Reinforcing power infrastructure such as distribution networks and substations
- Expanding clean H_2 pipeline infrastructure
- Implementing a differential electricity pricing system
- Preparing intelligent power systems using AI

Strategic Initiative ④
Promoting Intl. Joint Research and Global Coop.

- Focusing on clean H_2 and energy innovation
- Strengthening technical collaboration via Birmingham Twin City platform
- Advancing practical projects through active corporate participation
- Identifying convergence R&D projects through institutional collaboration

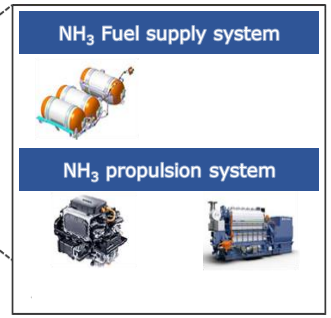
V. Strategic Initiatives & Action Plans

Strategic Initiative ① Establishing a Hydrogen Utilization Cluster Ecosystem

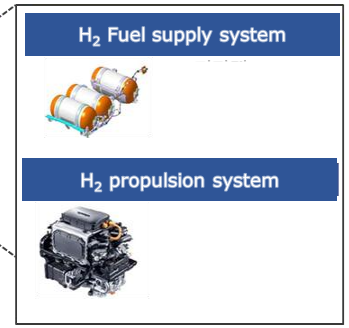
Boosting Hydrogen Applications and Taking Market Leadership

▶ Hydrogen Mobility Expansion: From Vehicles to NH_3-H_2 Ships

Maritime Mobility



Land Mobility



① TESTBED

시험평가 장비

수소/암모니아 배관 연결

성능평가	안전성 평가	내구성 평가
부하 추종능력, 출력 시험설비	주요부품 가스 누출 시험설비	주요부품 crack 분석설비

② Commercialization support

해상

엔진 및 연료전지 부품 사업화지원 센터

암모니아 부식성 의한 부품 내구성 평가
연료전지 해상환경 모사 평가 지원

육상

양산 다목적 활용지원 센터

양산체계 안정성 평가 지원
기타 활용분야 확대를 위한 기술지원

③ Corporate agglomeration

추진 시스템

소재 · 부품 제조기업 ↔ (전후방 연계) 엔진 · 연료전지 제조기업

스택 소재/부품, BOP
엔진 부품

연료공급 시스템

배관, 밸브, 저장탱크 제조기업

V. Strategic Initiatives & Action Plans

Strategic Initiative ② Demonstration Centered on the Urban Convergence Zone

Activating Sustainable Economic Loops in the Urban Convergence Zone

▶ To support the development of optimized systems for eco-friendly and hydrogen mobility solutions

Build a clean transport system in Ulsan urban convergence zones.

Develop and test hydrogen mobility technologies, Link and expand services based on urban convergence plans.

KEY1 Build an optimized eco-friendly transport system.

KEY2 Optimize and validate hydrogen hybrid mobility systems.

KEY3 Integrate and demonstrate urban convergence services.

Goal

To Apply optimized eco-friendly transport technologies

Build a clean transport operational system.

Optimize hydrogen hybrid mobility systems.

Develop integrated urban convergence services.

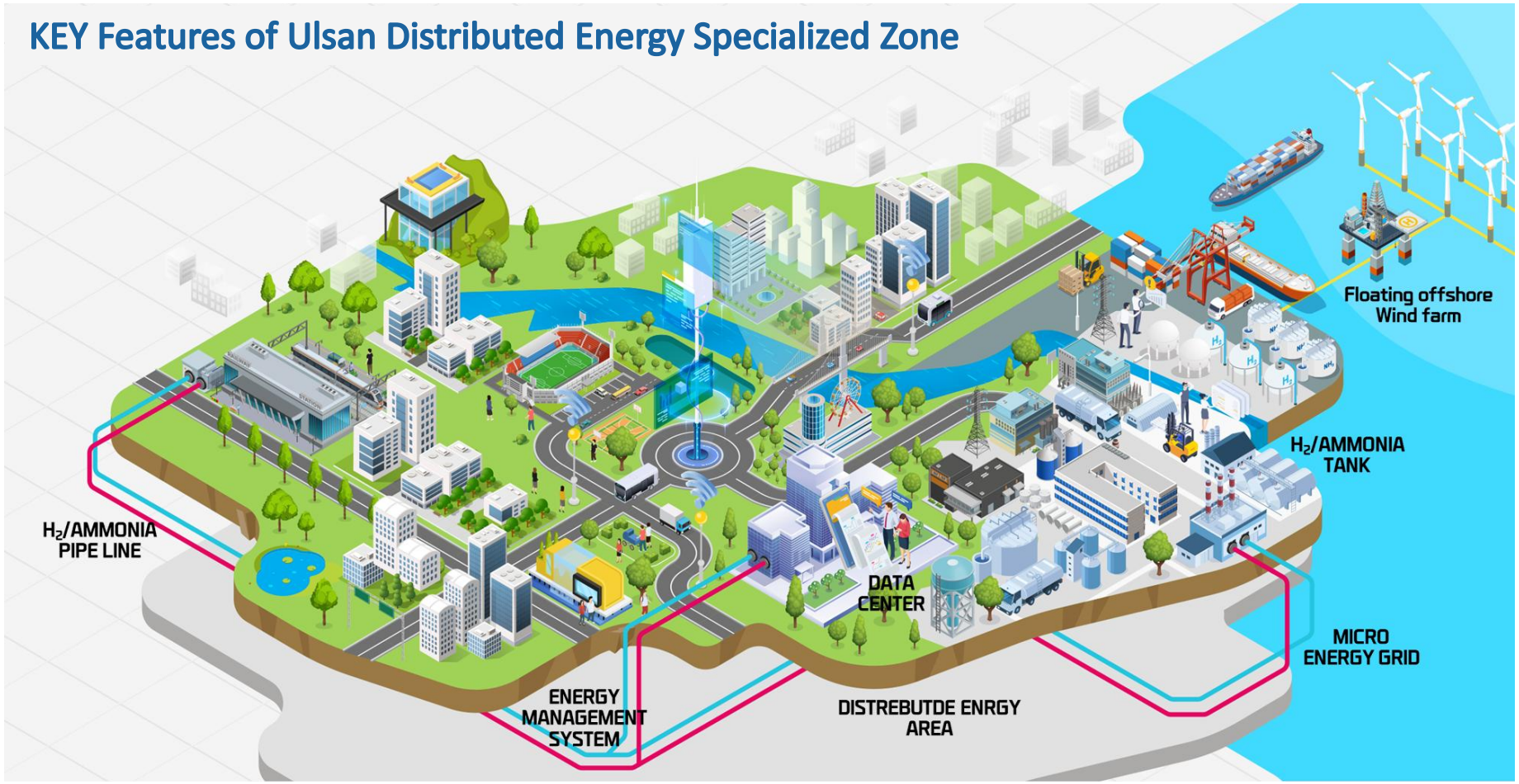
Strategy

Build a clean transport operational system	- Create models for demand forecasting and energy-efficient operation. - Propose methods to reduce carbon emissions.
Optimize hydrogen hybrid mobility systems	- Test capacity using integrated LBTS systems. - Collect real-world driving data from hydrogen buses. - Urban Convergence Services:
Develop integrated urban convergence services	- Develop and evaluate hydrogen-based transport services. - Assess scalability and effectiveness of urban plans. - Create frameworks for service integration.

V. Strategic Initiatives & Action Plans

Strategic Initiative ③ Microgrid Readiness through the Distributed Energy Zone

- Attracting Major Energy Consumers via Direct Power Deals and Reasonable Tariffs



V. Strategic Initiatives & Action Plans

Strategic Initiative ④ Promoting Intl. Joint Research and Global Coop.

› Strengthening Ulsan–Netherlands Cooperation on Clean Energy Materials

- Ulsan was selected for Netherlands R&D partnership (Top 3 of 47 countries, Sep. 2024)

’24.11.21.
Ulsan International Cooperation Forum

⇨

’25.1Q
Korea–Netherlands Mid-to-Long-Term Roadmap Established

⇨

’25.3Q
Promoting clean energy international cooperation R&D

TNO innovates with partners in the H2 supply chain

V. Strategic Initiatives & Action Plans

Strategic Initiative ④ Promoting Intl. Joint Research and Global Coop.

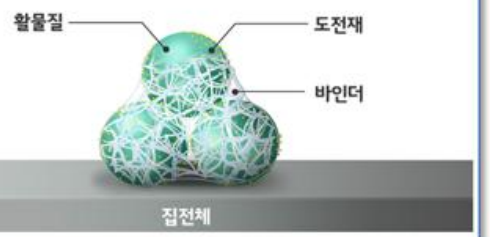
Korea–UK Joint R&D in Energy Storage Systems (ESS)

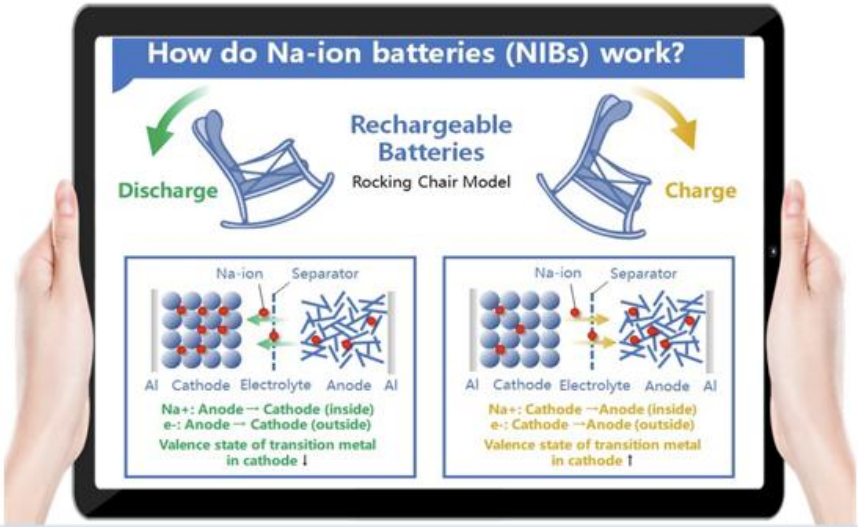
Consortium from Korea–UK selected for joint R&D (Aug. 2024)
(Korea: BTS, Ulsan TP, AMTC / UK: BATRI, Swansea)

NIB Material and Electrode/Cell Manufacturing Technology Collaboration for Customized NIB Prismatic Cell 20kWh BMS and Pack System Technology

20kWh ESS, NIB Prismatic cells with non-fluorinated binders

- Expansion of NIB research with increasing attention to the lithium-ion battery market: material and electrode/cell manufacturing technology, cell-matched BMS and pack systems
- Cycle stability and efficiency challenges of NIBs
- Non-fluorinated binder development under PFAS regulations and associated toxicity and cost issues





개발기술 ▶ Development of non-fluorinated binders and electrode material technology, applied to customized NIB prismatic cells, BMS, and module/pack systems for a 20kWh-class ESS system.

- Binder development in Korea, prismatic cells with UK-sourced materials, domestic manufacturing of BMS, battery systems and ESS, pilot verification and business model establishment.

V. Strategic Initiatives & Action Plans

Strategic Initiative ④ Promoting Intl. Joint Research and Global Coop.

- Swansea Univ. – Sodium Battery R&D / TechWM – AI, Smart Manufacturing & Green Tech

Ulsan Companies Entering UK & EU Markets via TechWM Global Growth Program

Thank you!

Ⅴ. Government strategies

Market Segment	~2030	~2050
Total market Demend	- 1 million tons/year	- 21 million tons/year
transportation	- 500,000 H2 vehicles - 310 H2 refueling stations - Pilot deployment of H2 ships	- 5 million H2 vehicles - 2,000+ H2 refueling network - Large scale adoption
Power generation	100MW mixed fuel	10GW H2 power plants
Industrial Application	- 200,000 tons/year gray H2 - Initial H2 adoption in steelmaking	- 8 million ton/year in steel, cement, etc - Full-scale H2 steelmaking
Residential/Commercial Use	50,000 households using H2	5 million households using H2
Export Market	Initial imports of 200,000 ton/yr of H2 from AU, UAE, etc	South Korea export 3 million tons/yr of H2
Emerging Tech.	R&D investment : $ 2 billion/yr focused on electrolyzer efficiency, fuel cell and etc	$ 10 billion cumulative investment in H2 innovation