

High-Efficiency Energy Conversion from Solar to Hydrogen

2019/6/24

FUJITSU ADVANCED TECHNOLOGIES LIMITED

Corporate Profile

**Fujitsu Advanced Technologies (FATEC)
supports Customer's Monozukuri.**

- 1. Development Platform (Engineering Cloud™)**
- 2. Evaluation and Analysis Services**
- 3. Design, Prototyping and Manufacturing Services**



**Development Platform
(Engineering Cloud™)**

**Establishment of Design
Environment and
Supporting Services**



**Evaluation and
Analysis Services**

**Total Support
by Engineering
Experts**



**Design, Prototyping
and Manufacturing
Services**

from B2B to B2C

- Foundation** **1.October, 2007**
- President and
Representative Director** **Akira Ito**
- Locations** **[Head Office] Fujitsu Shinkawasaki Technology Square**
[Nagano Office] Fujitsu Nagano Plant

Our Leading-Edge Technology

HW product



Sever



Network



**Super
Computer**



Ubiquitous



Device



**POS
terminal**

Electric/Optic/Power

L S I design **SI/PI Optical Tech.**
E M I / E S D **Power Electronics**

Software Technology

Embedded(CPU,DSP) **A I Tech.**
Model based design **Security**

Device Evaluation Tech.

Device Data base **Device Library**
Evaluation and Check

Packaging technology

Interconnection, Printed Circuit Board
Cooling **Assembling**

ICT base

CAD

Simulation

AI technology

Cloud

Technology for appropriate cost, quality, advantage form other product

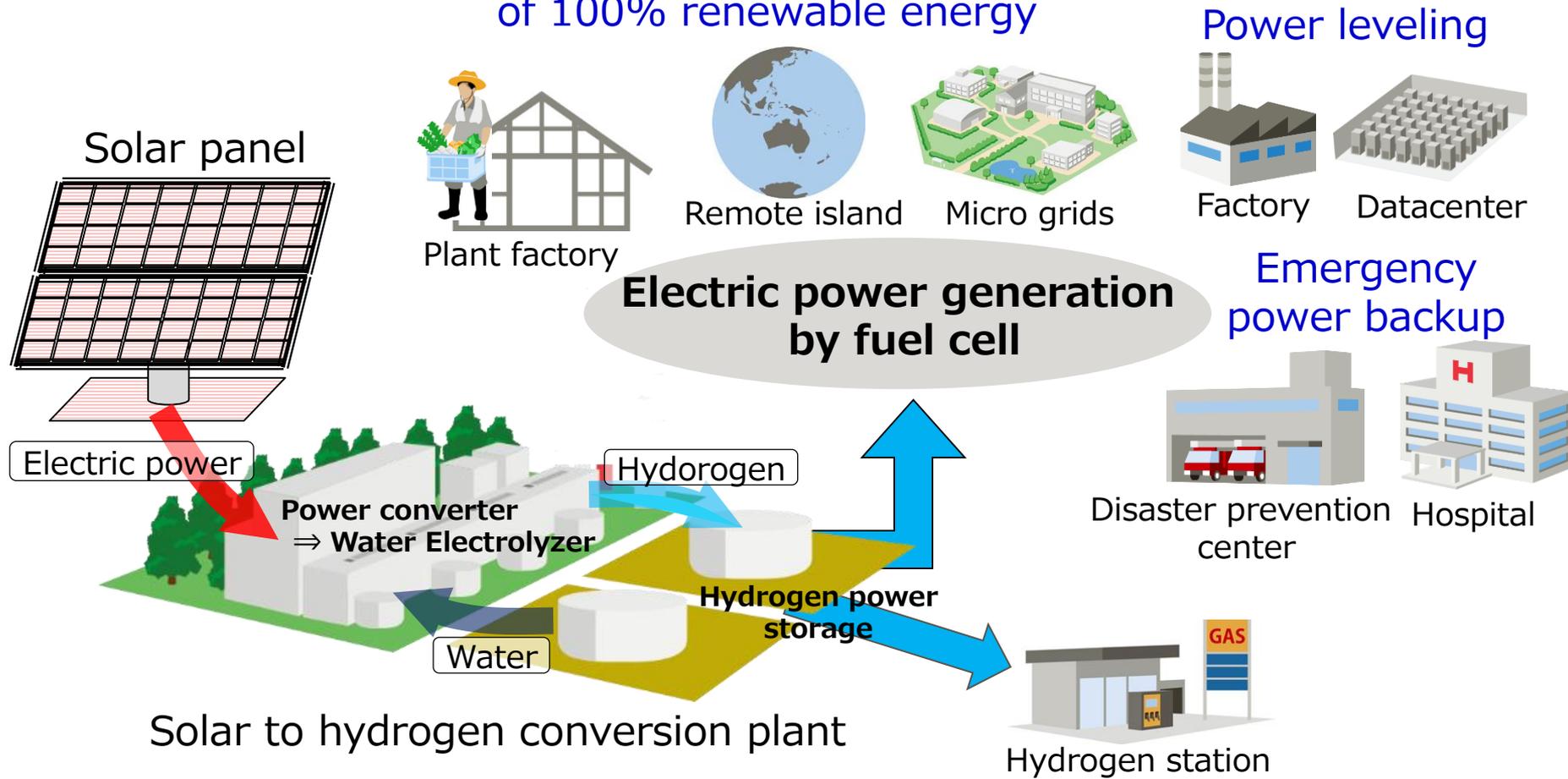
Usage of hydrogen gas storage

Energy Storage Technology with High-Efficiency Conversion from solar to Hydrogen gas



■ Practical use deployment for hydrogen energy storage

Local production for local consumption of 100% renewable energy



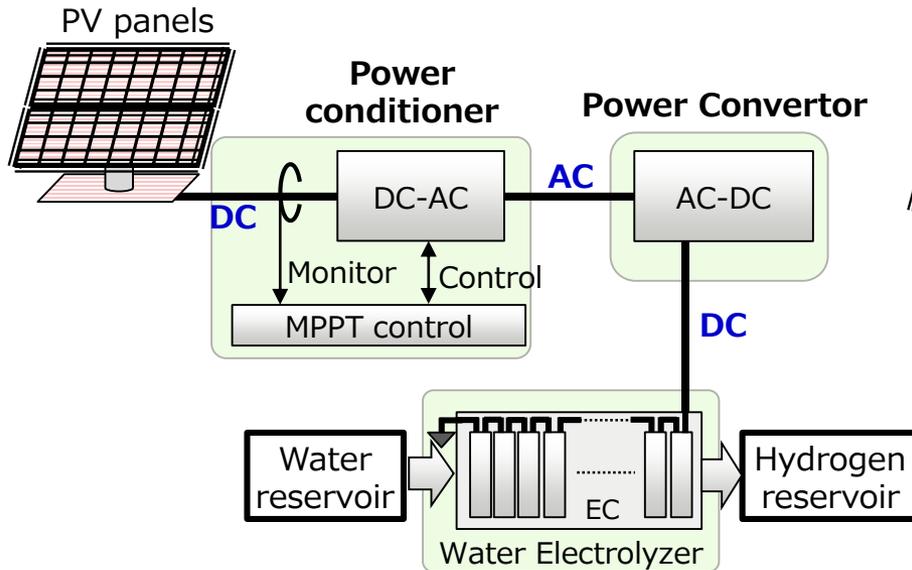
Our system overview

Our proposed system

- Direct conversion from PV to EC with DC connection
- High efficiency energy management system which enables PV maximum power tracking by dynamic control of active numbers of ECs.

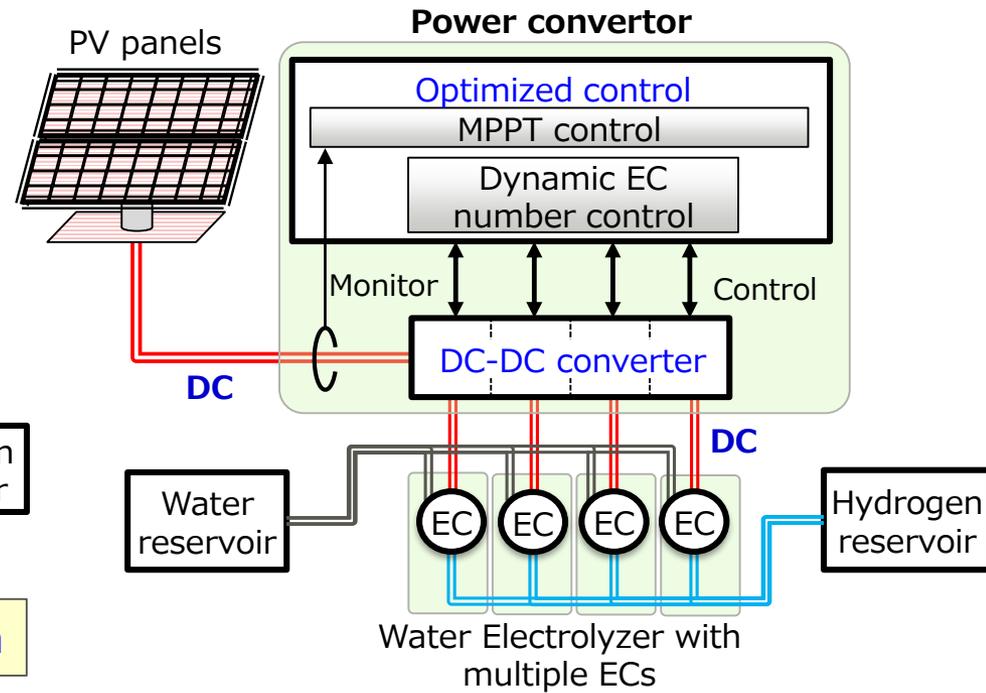
PV: Photovoltaic, EC : Electrolysis cell, DC : Direct Current, AC : Alternating Current

Conventional System

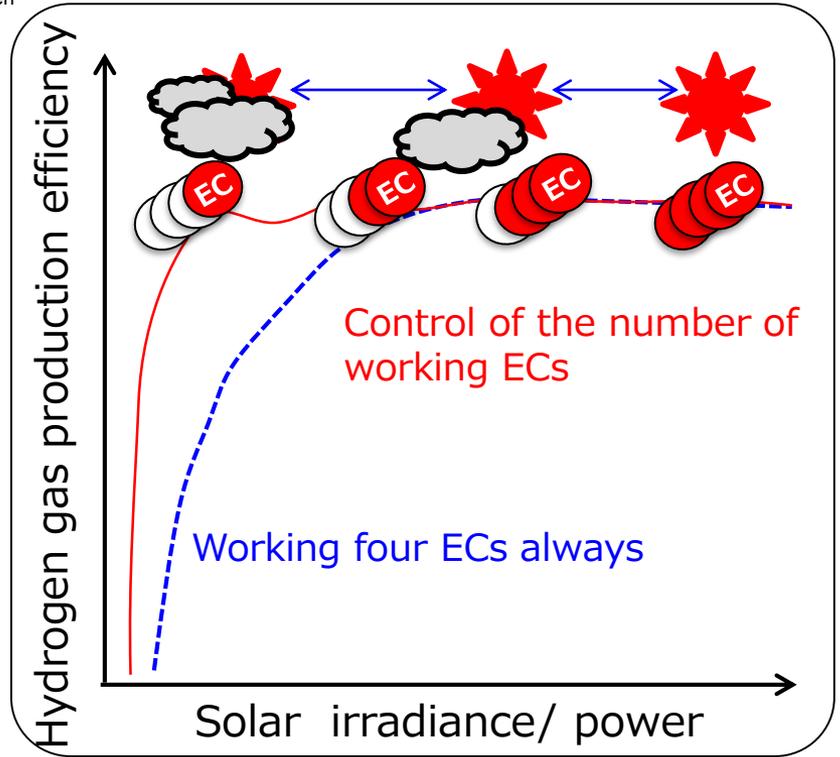
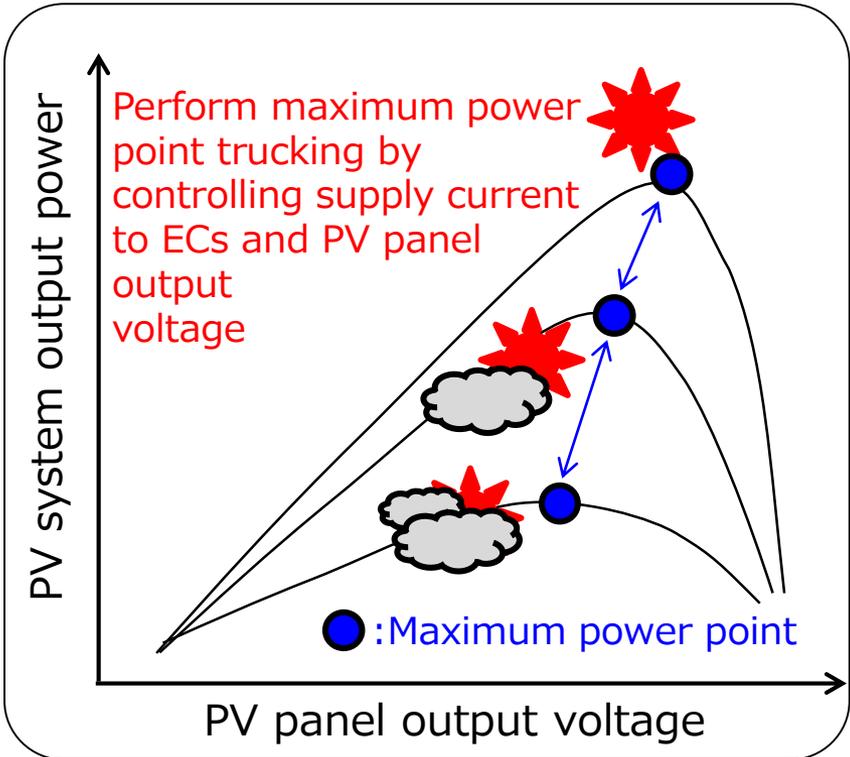
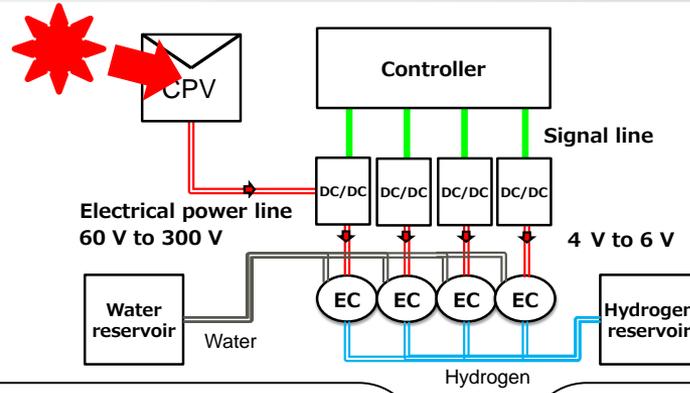


Power loss caused by two step conversion

Proposed System (Patent pending)



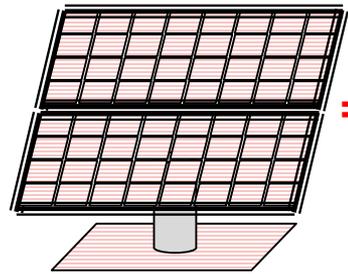
High efficiency with single step conversion



Response to changes in solar irradiance

High efficiency control to changes in solar irradiance

- High efficiency energy management system which enables PV maximum power tracking by dynamic control of active numbers of ECs.



Electrical power line

Power converter unit

Controller

Signal line

DC/DC

Water reservoir

Water

EC

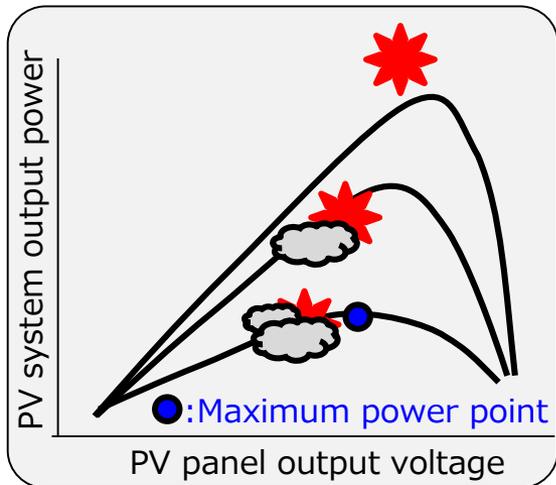
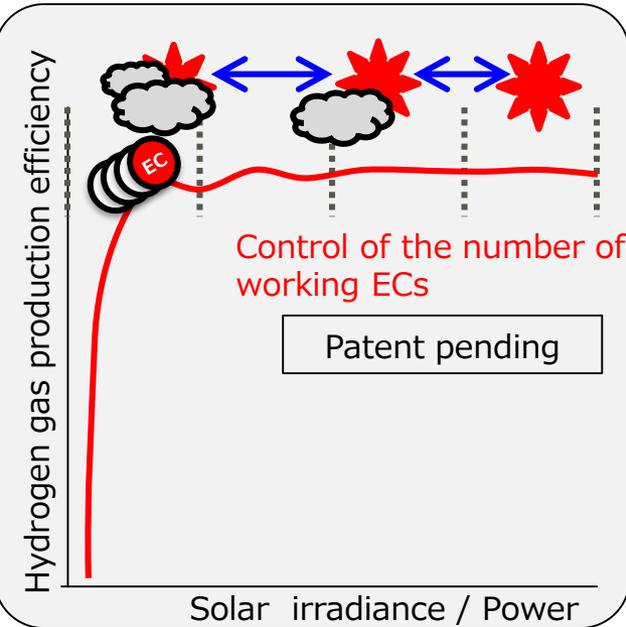
EC

EC

EC

Hydrogen

Hydrogen reservoir

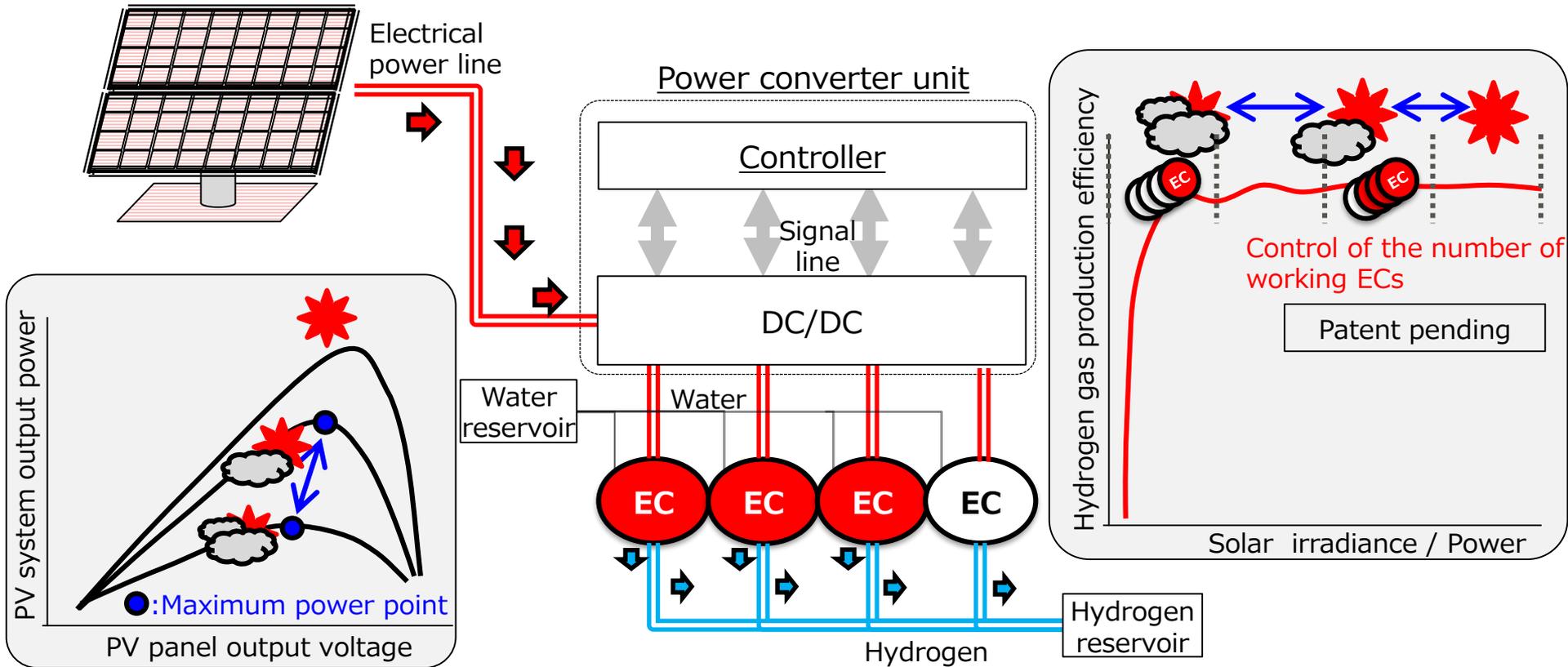


Cloudy

PV: Photovoltaic, EC: Electrolysis cell, DC/DC: DC/DC Converter

High efficiency control to changes in solar irradiance

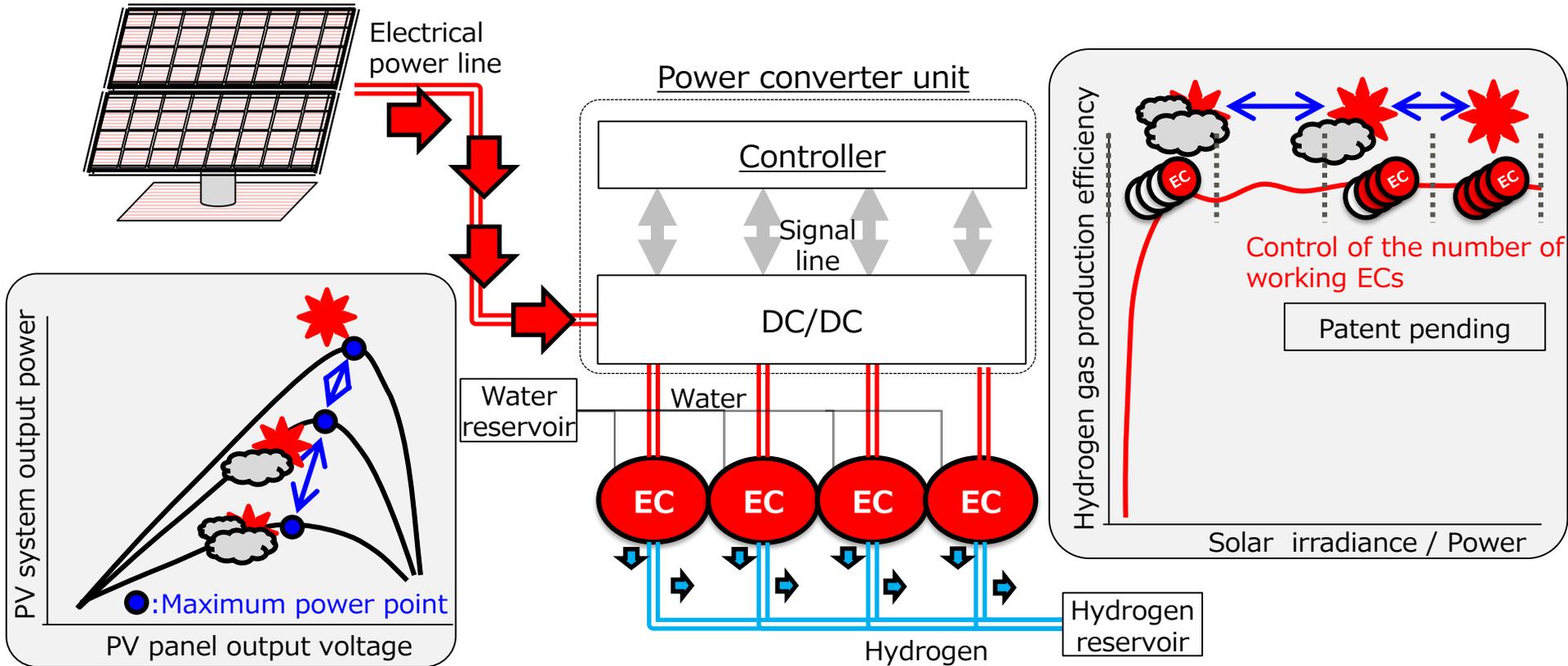
- High efficiency energy management system which enables PV maximum power tracking by dynamic control of active numbers of ECs.



Sunny and Cloudy

PV: Photovoltaic, EC: Electrolysis cell, DC/DC: DC/DC Converter

- High efficiency energy management system which enables PV maximum power tracking by dynamic control of active numbers of ECs.



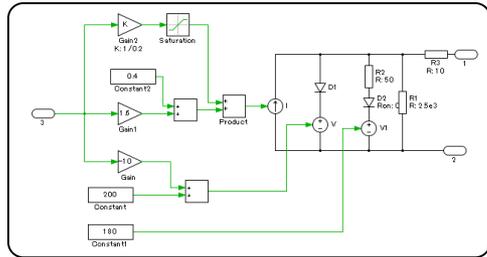
Sunny

PV: Photovoltaic, EC : Electrolysis cell, DC/DC : DC/DC Converter

Component modeling and Simulation

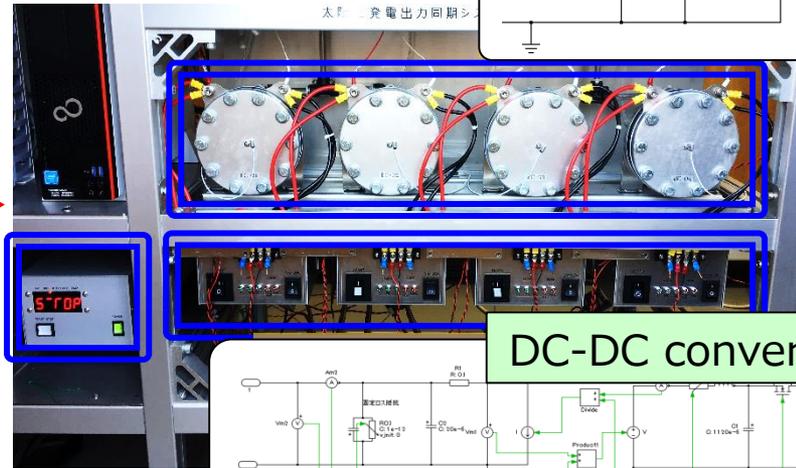
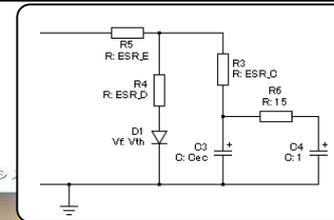
Modeling of components

- Build a high-precision model based on the actual measured characteristic data.
- Execute model based simulation.



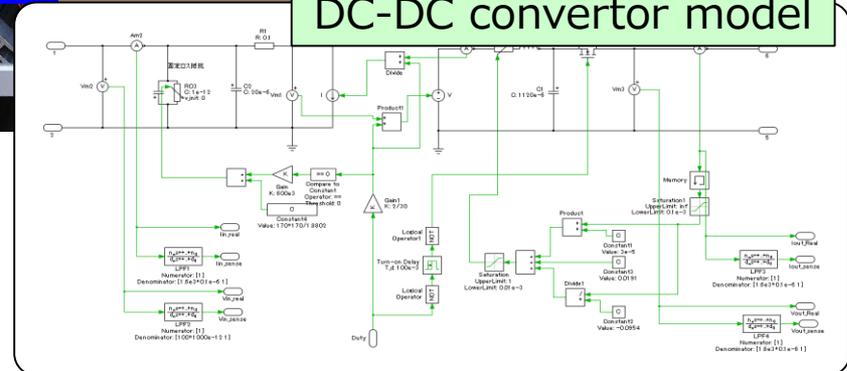
Photovoltaic panel model

Electrolysis cell model

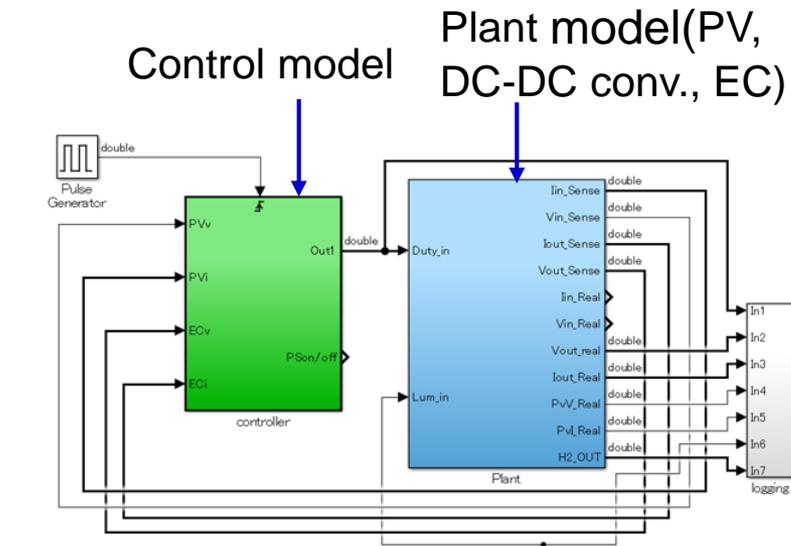


Power

DC-DC converter model

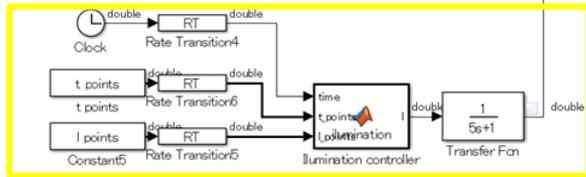


- Achieved optimum system design and high quality system work verification

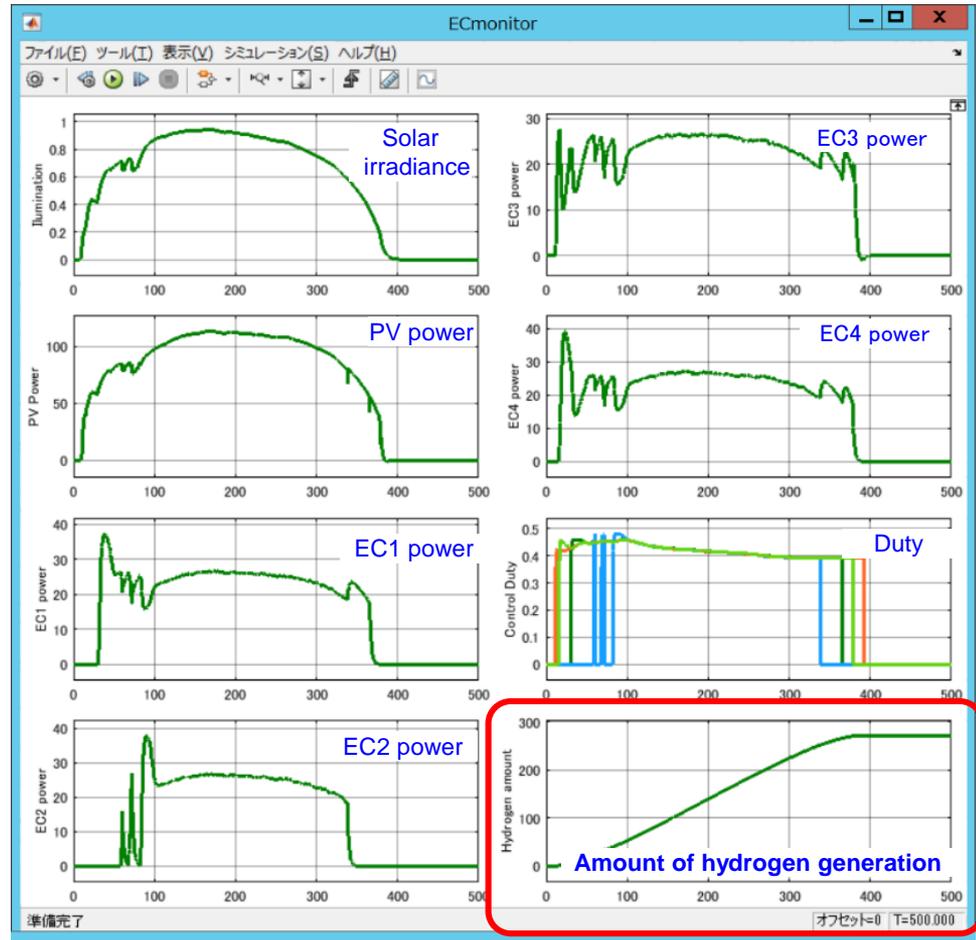


Plant model(PV, DC-DC conv., EC)

Control model



Solar irradiance model

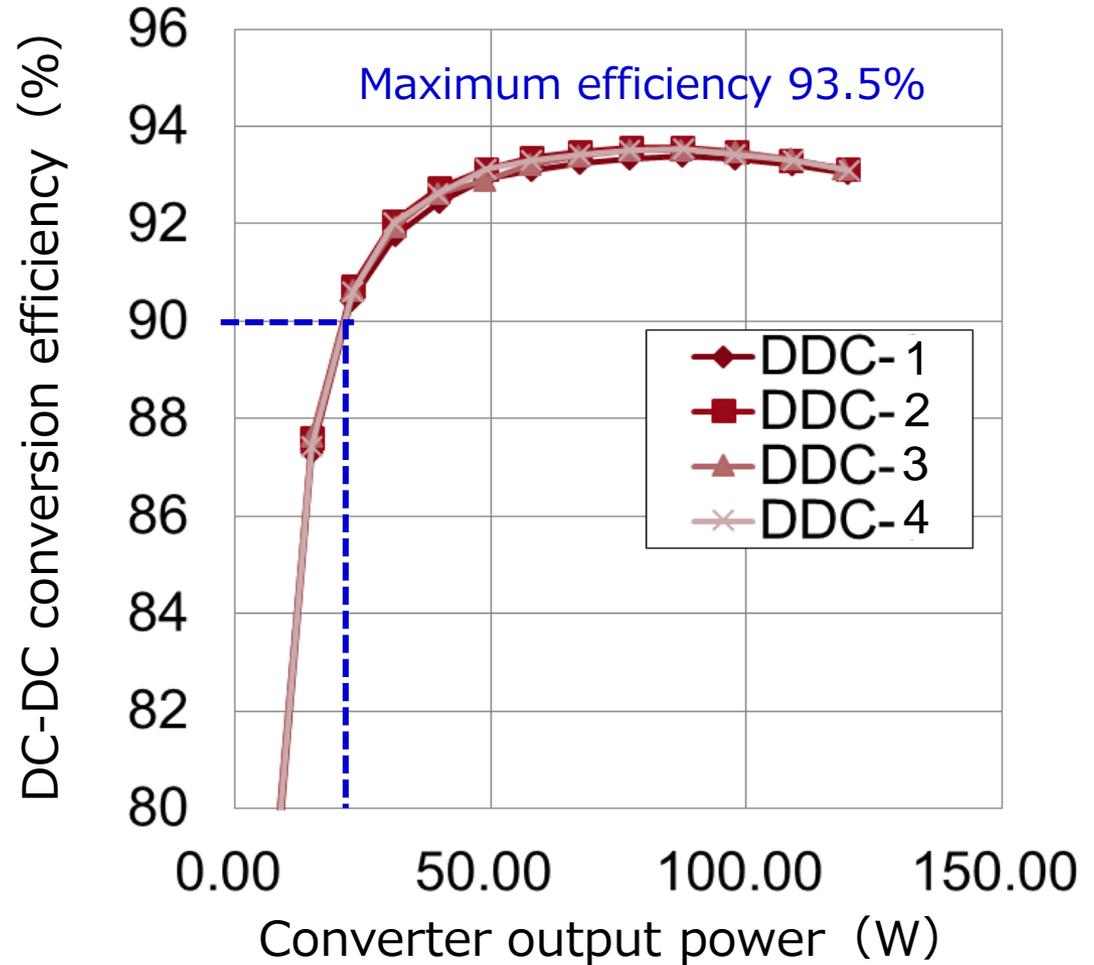


Verification of actual system

Result of converter efficiency evaluation



Four DC-DC converters



We achieved 90% over efficiency from low output power

Evaluation of system

- Solar to Hydrogen(STH) demonstration system with this technology is constructed under the cooperative research with University of Miyazaki.

Concentrating solar cells mounted on tracking type frame^(*)



※PV panel with condenser lens. Movable frame keeps optimized angle with solar irradiance (Built at University of Miyazaki)

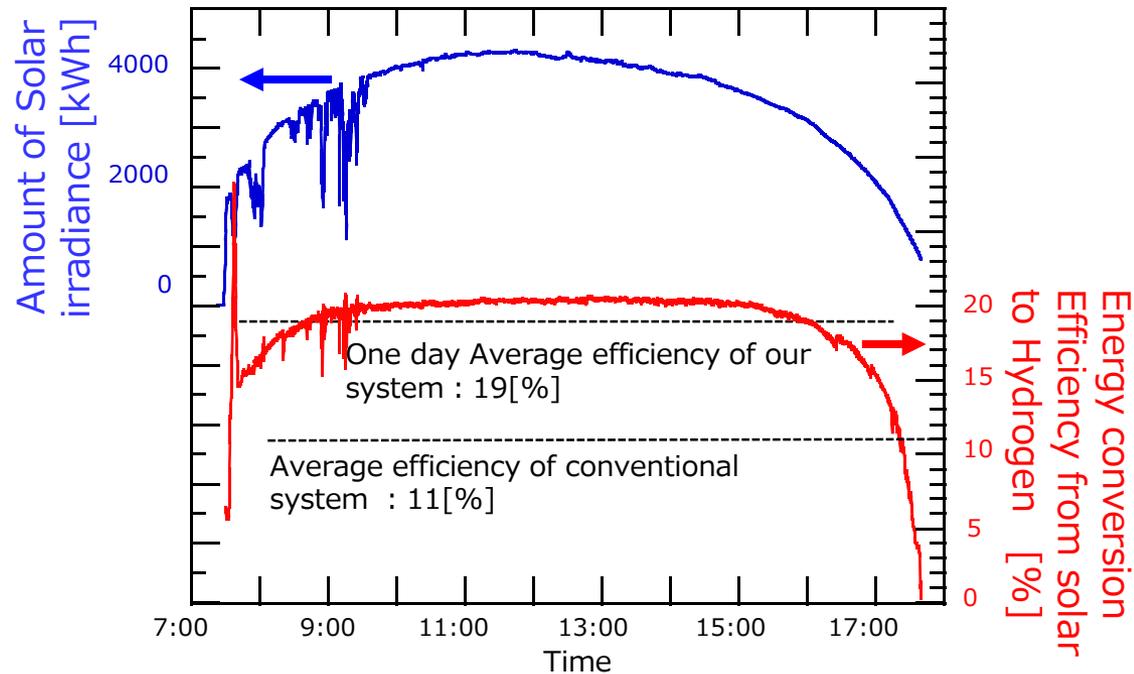


Four ECs



Four DC-DC Converters

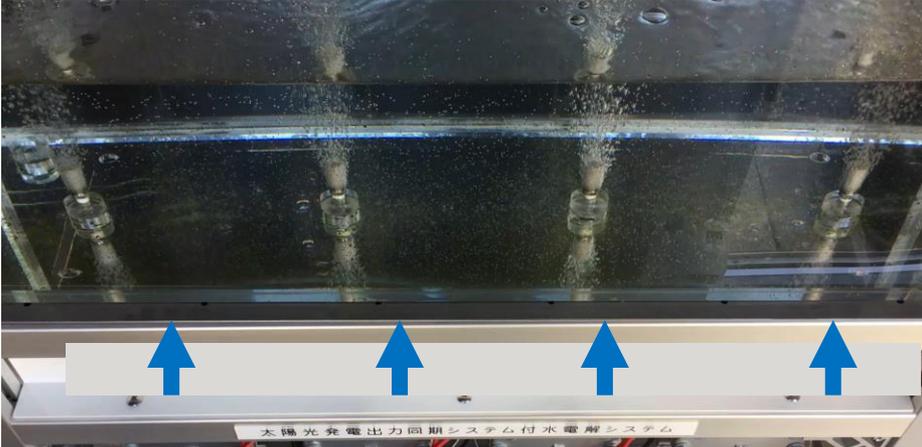
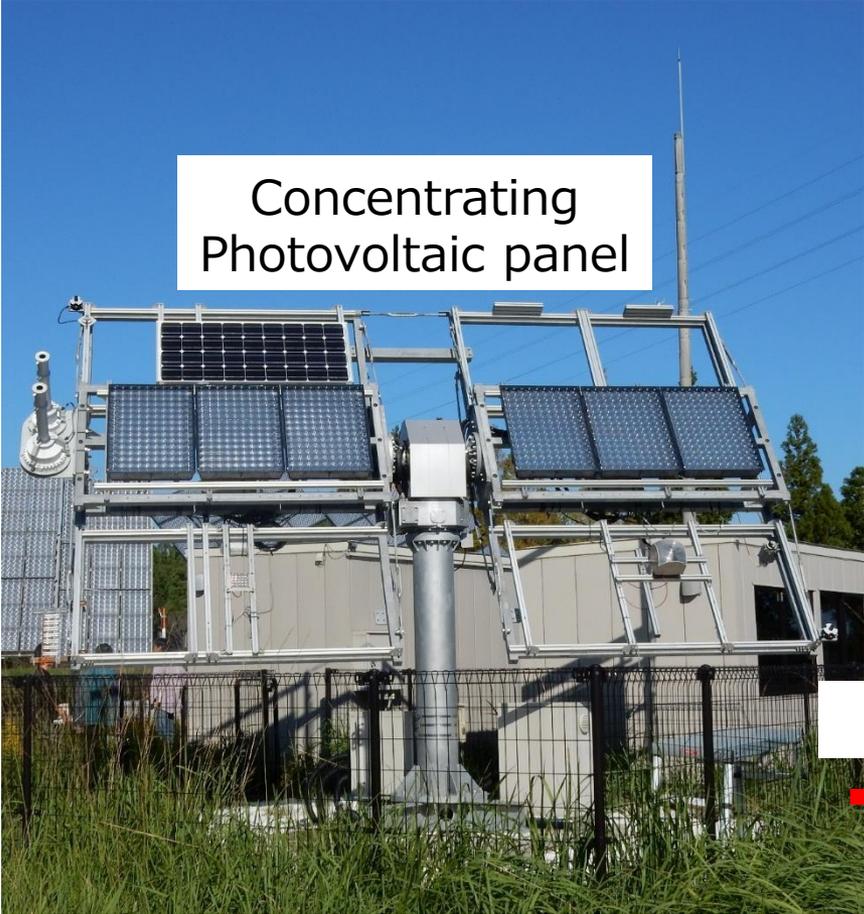
Daily fluctuation of Solar irradiance power and conversion efficiency



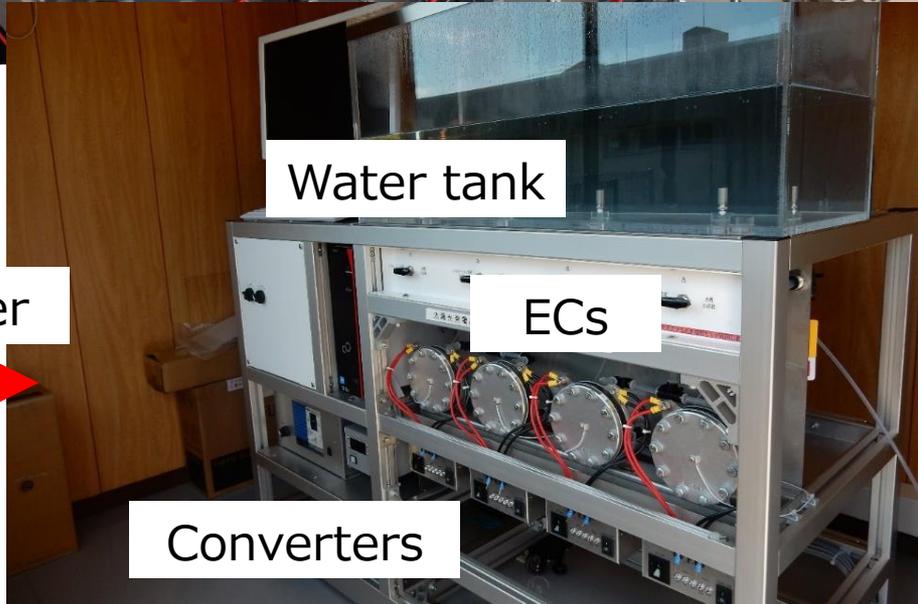
World highest solar to Hydrogen, STH, conversion efficiency of 19% is demonstrated.

Hydrogen generation demonstration

Demonstration of hydrogen generation

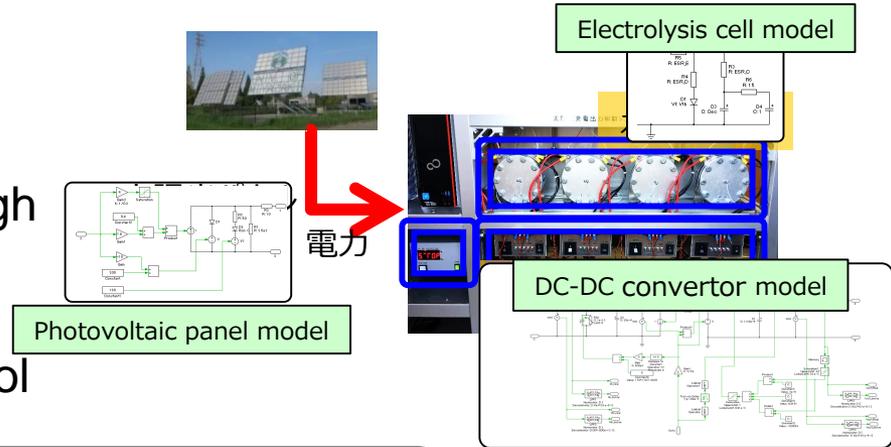


Power



Summary of our strong point

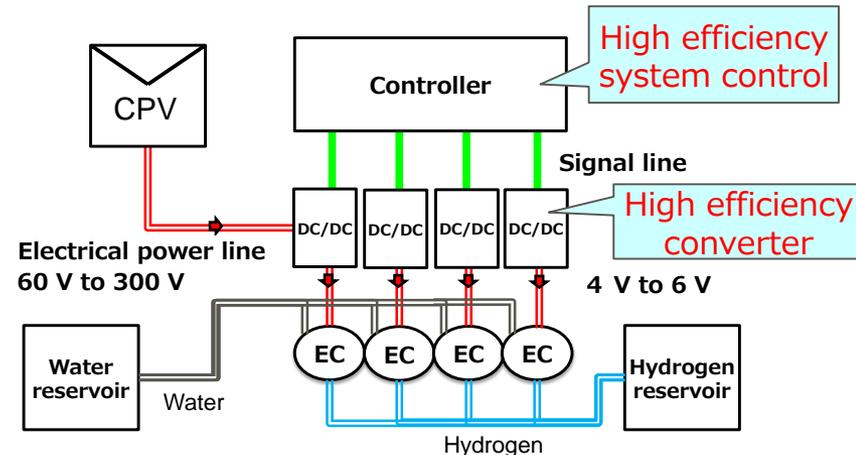
- We can achieve optimized system design by performing model simulation because we have advanced technology making high precision models of power supply, photovoltaic, water electrolyzer and control systems.



We have the know-how to make equivalent circuits from measurement of components characteristics.

- We can achieve high efficiency system operation because we have advanced technology of high efficiency DC-DC converter design and energy management system control.

We achieved the world's highest conversion efficiency 19%(Conventional 10%) from solar energy to Hydrogen gas.





FUJITSU

shaping tomorrow with you