

# List of LCS Proposals

## Proposal Paper for Policy Making and Governmental Action toward Low Carbon Societies and Survey Reports

### Envisioning the Future

#### [Quantitative Visions of Society and Industrial Structure]

- Industrial Structure in 2030 and 2050 towards Zero Carbon Society (April 2022)
- Changes of Industrial Structure towards Zero Carbon Society: Application of Extended Input-output Table (March 2020)
- Population Analysis for Industrial Structure Study in Future Low Carbon Society (March 2020)
- [Survey Report] Toward Future Low-Carbon Society using Scrap Iron Recycling: Use of recycled steel and CO<sub>2</sub> emissions in venues of the 2020 Tokyo Games (July 2021)
- Toward Future Low-Carbon Society using Scrap Iron Recycling (Vol. 2) (March 2019)
- Toward Future Low-Carbon Society using Scrap Iron Recycling (January 2018)

#### [Communities with Autonomous-Distributed Energy Systems]

- Evaluation on Regional Consumption Structure and Direct and Indirect Carbon Dioxide Emission of Household Sector (June 2021)
- An Empirical Study of Regional Carbon Emission Reduction Potentials by a Smart Integration of Buildings and Mobility Energy Systems (March 2020)
- An Assessment of the Economic and Carbon Emission Reduction Effects of the Distributed Energy Systems Including New Energy Conversion/Storage Technologies and Unutilized Heat Sources (March 2020)
- A Study on the Urban Distributed Energy System Design Including New Energy Conversion and Storage Systems, Unused Heat Sources, and Net Zero Energy Building Technologies (January 2018)

#### [Prospects of Energy Demand and Decarbonization]

- Impact of Progress of Information Society on Energy Consumption (Vol. 4): Feasibility Study of Technologies for Decreasing Energy Consumption of Data Centers (February 2022)
- Impact of Progress of Information Society on Energy Consumption (Vol. 3): Current Status and Future Forecast of Network-Related Energy Consumption and Technical Issues (February 2021)
- Impact of Progress of Information Society on Energy Consumption (Vol. 2): Current Status and Future Forecast of Data Center Energy Consumption and Technical Issues (February 2021)
- Impact of Progress of Information Society on Energy Consumption (Vol. 1): Current Status and Future Prospects for Power Consumption of IT Equipment (March 2019)
- A Study on the Tele-communication Traffic Trends and the Impacts of Teleworking under Covid-19 State of Emergency (March 2021)
- Developments of Dynamic Energy-Economics Model towards Low Carbon Society of Japan (March 2019)
- Proposal for Decarbonization of Residential Sector Based on the Analysis of Thermal Insulation Promotion (April 2022)
- Study on Modeling for Medium-to Long-term CO<sub>2</sub> Emissions Forecasting in the Residential Sector (March 2018)
- Aspects of Decarbonized Society from a Forecast of Energy Demand in Japan (Vol. 2) (March 2017)
- Aspects of Decarbonized Society from a Forecast of Energy Demand in Japan (March 2016)
- Potential and Economic Outcomes of Deploying Currently Available Low Carbon Technologies (March 2015)

### Social Scenarios

#### [Zero Emission Electric Power System]

- Economic and Technological Evaluation for Zero Carbon Electric Power System Considering System Stability (Vol. 3): Evaluation of Government Plan "Outlook for Energy Supply and Demand in 2030" and Issues to Achieve Zero-carbon Power Supply in 2050 (March 2022)
- Economic and Technological Evaluation for Zero Carbon Electric Power System Considering System Stability (Vol. 2): Scenario Analysis for the Development of Zero Carbon Electric Power System in 2050 (September 2021)
- Economic and Technological Evaluation for Zero Carbon Electric Power System Considering System Stability (Vol. 1): Technological Development Issues for Reliable and Affordable Zero Carbon Power Supply (March 2020)
- Economic Evaluation for Low Carbon Electric Power System Considering System Stability (Vol. 3): Technological Development Issues of Low Carbon Electric Power Systems in 2050 (March 2019)
- Economic Evaluation for Low Carbon Electric Power System Considering System Stability (Vol. 2): Technological

Development Issues toward Zero-Emissions Electric Power Systems (March 2018)

- Economic Evaluation for Low Carbon Electric Power System Considering System Stability: Technological Issues of Electric Power System toward 80% CO<sub>2</sub> Reduction by 2050 in Japan (March 2017)

### [Diffusion of Zero Emission Power Supply]

- The Distribution of Principal Renewable Energy Potentials by Prefecture and the Reduction of Power Plant Construction Costs (January 2018)
- Study on Risk Analysis of Photovoltaic Systems and Design of a Novel Institutional Policy for Promotion of Renewable Energy Using Real Options Approach (March 2017)
- Prediction of Popularization of Fuel Cells Considering Limited Rationality of Consumers (March 2017)
- A Review of PV Output Suppression in Japan under Modified Feed-in Tariff Scheme (March 2017)
- Evaluation of the PV Project with Consideration of Output Suppression (March 2016)
- Potential Regional PV System Installation with Consideration of Technology Development (March 2015)

## Quantitative Technology Evaluation

### [Energy Technologies Constitute Zero Emission Power System]

#### ■ Solar Power Systems

- Potential and Distribution of Photovoltaic Power Generation Considering the Efficient Land Use (March 2022)
- Estimation of the Installation Potential of Solar Cells Reflecting Shadow Effect, Geographic Information, and Latest/Future Technology Trends: Analysis in Tokyo Area (December 2021)
- PV Power Systems (Vol. 6): A Future Vision of the PV Power System Industry as a Major Power Source for 2050 (March 2020)
- PV power systems (Vol. 5): Cost Estimates for Crystal Silicon Solar Cells and Perovskite Solar Cells Using Quantitative Technology Scenarios (March 2019)
- PV power systems (Vol. 4): PV Manufacturing Cost Reduction Factor Analysis Using Quantitative Technology Scenarios (March 2017)
- PV power systems (Vol. 3): Cost Estimates for High Efficiency Compound Solar Cells Using Quantitative Technology Scenarios (March 2016)
- PV power systems (Vol. 2): Cost Estimates for High Efficiency Si-based Tandem Solar Cells Using Quantitative Technology Scenarios (March 2015)
- Strategy for Hole-transport-material-free Perovskite Solar Cells Using Carbon-based Electrodes (Vol. 3) (September 2021)
- Strategy for Hole-Transport-Material-Free Perovskite Solar Cells Using Carbon-Based Electrodes (Vol. 2) (March 2020)
- Strategy for Hole-transport-material-free Perovskite Solar Cells Using Carbon-based Electrodes (August 2018)
- PV Power systems: Quantitative Technology Scenarios, and Science and Technology Roadmap based on Elemental Technology Structure (March 2014)

#### ■ Wind Power Generation

- Wind Power Generation Systems (Vol. 2): Economic Evaluation for Future Wind Power Generation Systems Which Are Adapted to Japan Considering Large Scale Installation and Related Technological Development Issues (March 2020)
- Wind Power Generation Systems (Vol. 1): Economic Evaluation for Onshore Wind Power Generation Systems (January 2018)

#### ■ Hydroelectric Power Generation

- Potential Capacity and Cost of Pumped-Storage Power in Japan (Vol. 4): Proposals for Climate Change (March 2022)
- Potential Capacity and Cost of Pumped-Storage Power in Japan (Vol. 3) (February 2021)
- Potential Capacity and Cost of Pumped-Storage Power in Japan (Vol. 2) (February 2020)
- Potential Capacity and Cost of Pumped-Storage Power in Japan (January 2019)
- Small/medium-scale Hydroelectric Generation (Vol. 2): Relationships among Possible Generation Energy, Cost of Power Generation and Energy Availability Factor (March 2015)
- Small/medium-scale Hydroelectric Generations: Quantitative Technology Scenarios, and Science and Technology Roadmap based on Elemental Technology Structure (First Step) (March 2014)

#### ■ Geothermal Power

- Geothermal Power (Vol. 5): Proposal on Reduction of Induced Earthquakes by Hydraulic Fracturing (December 2018)
- Geothermal Power (Vol. 4): Influence of Underground Structure on Induced Earthquakes by Hydraulic Fracturing for Hot Dry Rock System (January 2018)
- Geothermal Power (Vol. 3): Energy of Hydraulic Fracturing for Hot Dry Rock System and Potential Power (March 2018)

2017)

- Geothermal Power (Vol. 2): Electricity Cost Estimation of Hot Dry Rock System (March 2016)
- Geothermal Power (Vol. 1): Design and Estimation to increase Generation Power (March 2015)

### ■ Secondary Battery Systems

- Secondary Battery System (Vol. 9): Cost Evaluation of a Lithium-ion Battery Using Next-Generation Electrode Active Material (March 2021)
- Secondary Battery System (Vol. 8): Cost Evaluation and Technological Challenges of an All-solid-state Lithium-ion Battery (March 2020)
- Secondary Battery System (Vol. 7): Evaluation of the Economics of Power Storage Systems; Efficiency, Costs and Future Challenges (January 2020)
- Secondary Battery System (Vol. 6): Possibility of Energy Density Increase and Technological Challenges of a Lithium-ion Battery (February 2019)
- Secondary Battery System (Vol. 5): Cost Evaluation and Technological Challenges of a Lithium Sulfur Battery (January 2018)
- Secondary Battery System (Vol. 4): Structure Analysis and Cost Evaluation of a Redox Flow Battery System (March 2017)
- Secondary Battery System (Vol. 3): Cost Evaluation and Technological Challenges of a Lithium-air Battery (March 2016)
- Secondary battery system (Vol. 2): Cost Estimation and Future Perspective of High-capacity Active Materials for Lithium-ion Battery (March 2015)
- Report on the Sophistication of Risk Assessment Methods for Large-Scale Energy Storage Systems (April 2022)
- Technical Challenges and Forecasts on Safety Assessment of Large-Scale Energy Storage Systems for Its Social Implementation (March 2021)
- Sulfur/Carbon Composite Electrodes for Lithium-Sulfur Batteries (January 2018)
- [Survey Report] Investigation of Degradation Behavior of Lithium-Ion Battery (March 2020)
- Secondary Battery Systems: Quantitative Technology Scenarios, and Science and Technology Roadmap based on Elemental Technology Structure (March 2014)

### ■ Fuel Cell Systems

- SOFC Systems (Vol. 9): Techno-Economic Assessment of Hydrogen Energy Conversion/Storage Systems (April 2022)
- SOFC Systems (Vol. 8): Evaluations of Energy Conversion and Utilization Technologies for Hydrogen Economy (February 2021)
- SOFC Systems (Vol. 7): Technology and Cost Assessments of High-Temperature Steam Electrolysis (February 2020)
- SOFC Systems (Vol. 6): Comprehensive Evaluation of Cell Designs and New-type Fuel Cells (January 2019)
- New Role of Fuel Cells (SOFC and PEFC) for Hydrogen Production Technology: SOFC Systems (Vol. 5) (January 2018)
- SOFC Systems (Vol. 4): Application of SOFCs to Steam Electrolysis and Technological Challenges (March 2017)
- SOFC Systems (Vol. 3): Role of SOFC Systems in Future Electricity Mix of Japan and Their Technological Challenges (March 2016)
- SOFC Systems (Vol. 2): Cost Analysis of Medium and Large SOFC Systems and Their Technological Challenges (March 2015)
- Carbon-Based Catalysts for Fuel Cells Application (March 2016)
- SOFC Systems: Quantitative Technology Scenarios, and Science and Technology Roadmap based on Elemental Technology Structure (March 2013)

### ■ Stabilities in Decarbonizing Power Systems

- Proposal of Control Method for Compensating Communication Delay in Load Frequency Control Using Electric Vehicles (July 2021)
- An Analysis on Utilizing SOFC to Provide Reserve Capability for Power Systems (March 2020)
- Research on Introduction of Storage Facilities for Improving Operation of Local Power Companies (March 2018)
- A Study on Operation Planning Models of Power Generation System Taking into Consideration the Uncertainty in Renewable Power Generation: A Case Study on a Cost Reduction Measure by Introducing Battery Storage Systems (March 2017)
- Analyses on Transient Stabilities in Decarbonizing Power Systems with Large-scale Integration of Renewable Power Sources: A Case Study in Kyushu Region (March 2017)
- Economical Evaluation of Energy Trading in a Collectively Receiving Apartment Complex in Which a Fuel Cell is Installed (March 2016)
- Provision of Supply and Demand Control System in Power Systems Integrating Large-scale Renewable Energy (March 2016)
- Study on a Novel Economic Load Dispatch Control of Power Systems in Kyushu Region Taking Massive Installation of Solar Power Generation and Transient Stability into Consideration (March 2016)

- Design and Evaluation of Frequency Regulation Market Using Conventional Power Plants and Electric Vehicles (March 2016)

### ■ Power Electronics Devices

- Technological Issues and Future Prospects of GaN and Related Semiconductor Devices (Vol. 4): Manufacturing Cost of GaN Power Device (February 2020)
- Technological Issues and Future Prospects of GaN and Related Semiconductor Devices (Vol. 3): Market Size and Energy Saving Effect (February 2019)
- Technological Issues and Future Prospects of GaN and Related Semiconductor Devices (Vol. 2): Manufacturing Costs of GaN Crystals and Substrates (February 2018)
- Technological Issues and Future Prospects of GaN and Related Semiconductor Devices (March 2017)
- Survey of Technological Issues in Device Fabrications Processes for Gallium Oxide as a Next-Generation Widegap Semiconductor (Vol. 2): Clarification of Energy Band Diagram of Single-Crystalline Gallium Oxides (March 2021)
- Survey of Technological Issues in Device Fabrications Processes for Gallium Oxide as a Next-Generation Widegap Semiconductor (February 2020)
- Issues Regarding the Technological Development of Gallium Oxide as a New Wide Bandgap Semiconductor for Electron Devices Applications (January 2019)

### [Carbon-Free Energy Carrier, CCUS]

- Direct Synthesis of Organic Substances by Hydrothermal Treatment of CO<sub>2</sub>-Rich Absorbent from CO<sub>2</sub> Capture Process (October 2021)
- Economy and CO<sub>2</sub> Emission on Hydrogen Production via Both Coal Gasification and Steam Methane Reforming: Importance of Securing CO<sub>2</sub> Storage Space Domestically (September 2021)
- Turbine System driven by Direct Combustion of Rich Ammonia (Vol. 2) (January 2020)
- Turbine System Driven by Direct Combustion of Rich Ammonia (December 2018)
- Economy of Hydrogen and Ammonia by Coal Gasification and CO<sub>2</sub> Emissions: Study on Production and Logistics of Hydrogen and Ammonia by Coal Gasification with CCS (February 2019)
- Proposal of New NH<sub>3</sub> Process for Small-scale Carbon-free NH<sub>3</sub> Production Technology (February 2019)
- Economy and CO<sub>2</sub> Emission of Carbon Free Hydrogen (Vol. 2) (February 2018)
- Economy and CO<sub>2</sub> Emission of Carbon Free Hydrogen (Vol. 1) (March 2017)
- Storage of Liquid Carbon Dioxide in Deep-sea Sediment Layer: Site Proposal in Japan (March 2022)
- Cost Evaluation of Direct Air Capture (DAC) Process (Vol. 3): Evaluation of adsorption heat and capacity of DAC sorbent (March 2022)
- Cost Evaluation of Direct Air Capture (DAC) Process (Vol. 2): Adsorption Method (February 2021)
- Cost Evaluation of Direct Air Capture (DAC) Process of Carbon Dioxide (February 2020)
- Survey on the Carbon Capture and Storage process (Vol. 2): The CO<sub>2</sub> Capture Cost by the Membrane Separation and the CCS Cost of the Storage and the Injection (March 2017)
- Survey on the Carbon Capture and Storage process: Comparison of the chemical absorption process with the physical absorption process for CO<sub>2</sub> capture (March 2016)

### [Biomass Utilization]

- Trends and Plasticity of Agricultural Production in Japan Resulting from Global Warming (April 2022)
- Methane Production from Biomass Wastes by Anaerobic Fermentation (Vol. 5): Feasibility Study of Biological Hydrogen Methanation Process (February 2021)
- Methane Production from Biomass Wastes by Anaerobic Fermentation (Vol. 4): Rationalization of Multi-Stage Fermentation and High Temperature Fermentation & Examination of Hydrogen Fermentation (March 2020)
- Methane Production from Biomass Wastes by Anaerobic Fermentation (Vol. 3): Process Design Rationalization based on Chemical Reaction Analysis (March 2016)
- Methane Production from Biomass Wastes by Anaerobic Fermentation (Vol. 2): Reaction Engineering Approach towards the Rational Design (March 2015)
- Methane Production from Biomass Wastes by Anaerobic Fermentation (First step) (March 2014)
- Fuel Oil from Algal Biomass: Evaluation on CO<sub>2</sub> Emission and Economy (March 2020)
- Production of Methanol and Liquid Fuels from Gasification of Biomass or Captured CO<sub>2</sub> (January 2018)
- Regional Distribution of Energy Potential of Woody Biomass (Vol. 3): Reduction of Total Production Cost of Woody Biomass (February 2020)
- Regional Distribution of Energy Potential of Wood Biomass (Vol. 2): Cost of Cutting in Artificial Forests Distributed Heterogeneously (February 2019)
- Consideration and Distribution of Energy Potential of Wood Biomass in Japan (January 2018)
- Study on the Effects of Measures to Reduce Timber Production and Distribution Costs Based on a Timber Production and Distribution Flow Model (June 2021)
- Utilization of Containerized Seedlings for the Cost Reduction of Afforestation (January 2019)
- Proposal for Obtaining Sustainable Forest Production (January 2018)
- Cost Reduction of Woody Biomass Fuels (Vol. 2): Total Production Cost and Cost Reduction Scenario of Woody

Biomass in Japan (March 2017)

- Cost Reduction of Woody Biomass Fuels: Cost Reduction Effect by Mechanization of Wood Production (March 2016)
- Establishing Low Carbon Society in Rural Districts with the Activation of Forestry: Manufacturing Cost Structure of Woody Chips and Wood Pellets (March 2015)

## Expanding and Updating Evaluation and Analysis Methods

### [The Platform of Low Carbon Technologies for Process Design and Evaluation and Database]

- An Expansion of Input-Output Model Focusing on the Demand-side Structural Changes (Vol. 1): Changes of Input-Output Coefficients and Capital Formation Coefficients and Model Development (October 2021)
- Proposal of analytical method by Platform of Low Carbon Technologies for Process Design and Evaluation of Manufacturing Cost and CO<sub>2</sub> Emissions: Deployment to Design Type Tools (February 2019)
- Platform of Low Carbon Technologies for Process Design and Evaluation of Manufacturing Cost and CO<sub>2</sub> Emissions (Vol. 4) (January 2018)
- Platform of Low Carbon Technologies for Process Design and Evaluation of Manufacturing Cost and CO<sub>2</sub> Emissions (Vol. 3) (March 2017)
- Platform of Low Carbon Technologies for Process Design and Evaluation of Manufacturing Cost and CO<sub>2</sub> Emissions (Vol. 2) (March 2015)
- Platform of Low Carbon Technologies for Process Design and Evaluation of Manufacturing Cost and CO<sub>2</sub> Emissions (March 2014)
- Development of Data on Energy Consumption and CO<sub>2</sub> Emissions by Sector for Energy and Environmental Analysis (March 2018)
- Guide for Process Design, Cost and CO<sub>2</sub> Emission Estimation with Relevant Database: Structuring Knowledge Base on Equipment, Material and Cost Information (March 2015)

## Others

### [International Strategies]

- Innovative Energy Technology Research & Development and ARPA-E (February 2020)
- Global Water Supply-Demand Assessment (December 2018)
- How Consumers Can Procure Renewable Electricity in Japanese Market: Alignment with GHG Protocol and Proposal for National Tracking System (March 2018)
- Value Chain Assessment of Technology for Climate Change Mitigation and Integrated Contribution Approach (Vol.2): PV Power Systems, CO<sub>2</sub> Emissions and Energy Consumption (February 2018)
- Value Chain Assessment of Technology for Climate Change Mitigation and Integrated Contribution Approach: PV power systems (March 2017)
- Development of an Indicator to Evaluate Social Welfare Moving toward Sustainable Society (March 2016)
- Evaluation of Power Generation and CO<sub>2</sub> Emissions Reduction Potential by PV Application in Developing Countries Considered in the Integrated Contribution Approach for Climate Change Mitigation (March 2015)
- Concept of Technology-based Integrated Contribution Approach and Technology Cooperation Scheme to Other Countries against Climate Change (April 2014)
- Promoting Oversea Transfer of Technology for Climate Change Mitigation (November 2013)

### [Pay-As-You-Save Scheme · Green Power Moderator]

- Proposal for Implementing Pay-As-You-Save Scheme for Energy Efficiency Improvement in Residential and SMEs (March 2017)
- Implementation of Pay-as-you-save (PAYS) type Scheme for Energy Efficiency Improvement in Japanese Residential and Commercial Sector: Current Status of Social Experiments and Similar Scheme Inside & Outside Japan (March 2016)
- Policy Designs for Bringing about Substantial Energy Savings in the Household Sector in Japan: Developing "Green Deal"-Type Payment Schemes and Nega-watt Markets through Activities of the Green Power Moderator (February 2014)

### [Promotion of Energy Saving in Household Sector]

- Policy Recommendation toward Low Carbon Society on Promotion of Energy Saving in Household Sector (Vol. 3) (March 2017)
- Policy Recommendation toward Low Carbon Society on Promotion of Energy Saving in Household Sector (Vol. 2) (March 2016)
- Policy Recommendation toward Low Carbon Society on Promotion of Energy Saving in Household Sector (March 2014)

### **[Living Environments · Consumption Activity]**

- Evaluating CO<sub>2</sub> Emissions Embodied in Consumption Activities in Tokyo (March 2019)
- Possibility of Achieving Both Energy Saving and Good Health by Lifestyle Shift (Vol.2) (January 2018)
- Possibility of Achieving Both Energy Saving and Good Health by Lifestyle Shift (March 2017)
- Assessment of Thermal Sensation by Brain Activity Measurement for Implementation of Energy-saving Air Conditioning (March 2016)

### **[Materials Research with Data-Utilization]**

- Synthetic Materials Design: Fusion of 1D CAE and Data-utilized Materials Research (February 2018)
- Materials Research with Data-Utilization toward Implementation of Low-Carbon Society (Vol. 2) (March 2016)
- Materials Research with Data-Utilization toward Implementation of Low-Carbon Society (March 2015)

### **[Change in Power Consumption after the Great East Japan Earthquake]**

- Change of Power Consumption after the Great East Japan Earthquake (April 2014)

### **[Scenario Planning]**

- Scenarios for 2050 with Low Carbon Attributes Utilizing Scenario Planning Method (March 2017)

### **[Formation of Social Consensus]**

- Realization of Carbon minus Society in the Tokyo 2020 Games by "Platform where various people can participate" (March 2019)

## **Summary Report**

- Challenges and Perspectives toward the Realization of Dynamic and Affluent Low Carbon Society in 2050 (December 2016 issue)
- Towards the Realization of Dynamic and Affluent Low Carbon Society (June 2014 issue)
- Comprehensive Strategies and Scenarios for the Realization of a Low Carbon Society (July 2012 issue)

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※ For more information, please visit our website. You can download PDF.  
<https://www.jst.go.jp/lcs/en/proposals/index.html>

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