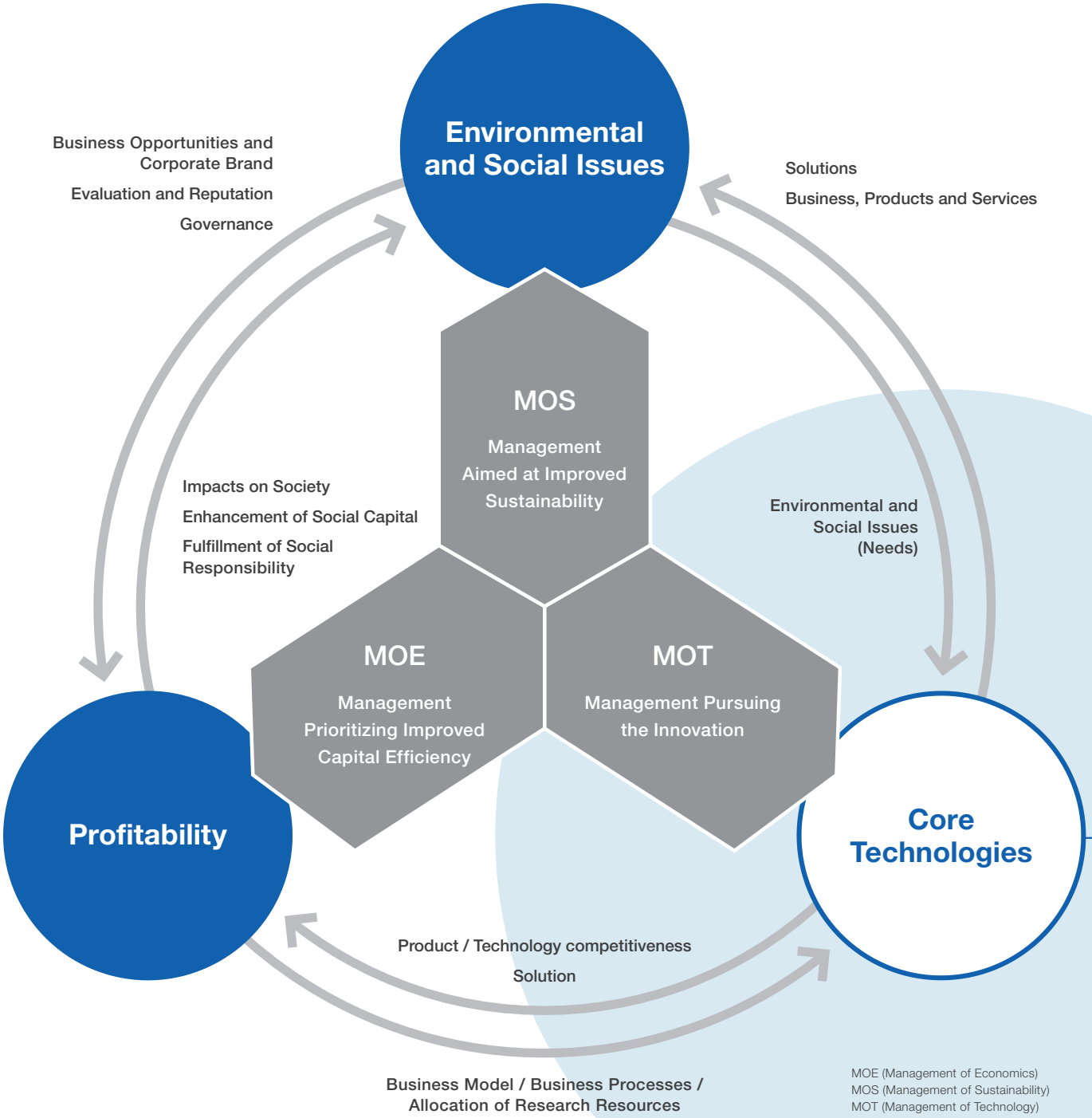
Innovation

Innovation

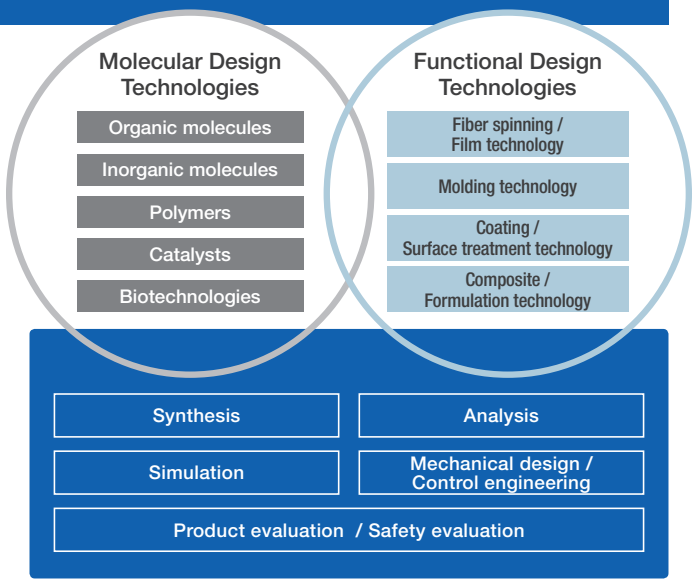
At the MCHC Group, we identify environmental and social issues along with market needs, and leverage our core technologies to create new value chains and innovative lifestyles. Thus, we provide and realize comprehensive solutions.
Our efforts extend beyond component and material research and the development of technologies. We pursue innovation in manufacturing processes and distribution channels, and set our sights on proposing new uses of existing solutions. In so doing, we create things of value for customers, our business partners throughout the value chain, and all of the regions in which the MCHC Group is active.



MOE (Management of Economics)
MOS (Management of Sustainability)
MOT (Management of Technology)

Core Technologies

The MCHC Group maintains a wide range of unique technologies and expertise—its core technologies—which serve as the source of tens of thousands of competitive products and services from materials to consumer goods. Moreover, working on this foundation we are continually striving to strengthen our existing core technologies and create new ones to address rapidly changing market needs and offer solutions to social issues.



Research and Development Management

MCHC embraces various approaches to strengthen core technologies which is the basis of innovation and generate new innovations, including internal R&D, external R&D, venture investments, open shared business (OSB*) and M&A activities.

Moreover, by developing systems to promote information sharing between operating companies and reduce the risk of information leaks, MCHC accelerates the synergy among its core technologies and engages in R&D management that visualizes the progress using the MOT Indices.

The MOT Indices are comprised of twelve indices which were selected from the viewpoint of three indicators: efficiency of research and development (the R&D Index), technological superiority (the Intellectual Property Index), and compatibility with social needs (the Market Index). The indices were introduced on a trial basis in fiscal 2013 and reviewed during formulation of *APTSIS 20*. The new indices began operation from fiscal 2016. (Table on the right shows achievement ratio of the representative indices in fiscal 2016 against the targets)

Examples of MOT Indices and Results

MOT Indices		Success Ratio
R&D Index	**Elevated stage success ratio** (development stage to launch stage)	105%
Intellectual Property Index	**Overseas patent applications ratio** (percentage of overseas applications out of total number of applications)	91%
Market Index	**New product ratio** (percentage of new products and services out of total revenue)	117%

* Open Shared Business (OSB): OSB is the MCHC's original framework where MCHC works with organizations outside the Group to advance collaboration in both R&D and business while developing a distinctive value chain.
"OSB": MCHC registered trade mark No. 5585432

Open Innovation

To provide the products and services demanded by markets and society in a timely fashion, MCHC not only makes full use of its core technologies, but also actively pursues collaboration with partners in possession of sophisticated technologies, efficient production systems, sales channels and so on. Through such collaboration, we fuse our own technologies with those of others in an effort to reach an even higher technological level. In the course of this type of open innovation, across all business domains, we identify the areas to be shut down (closed) and the areas to be put outside (opened) for cooperation with other companies. Thus, we endeavor to quickly develop competitive business models.

Innovation

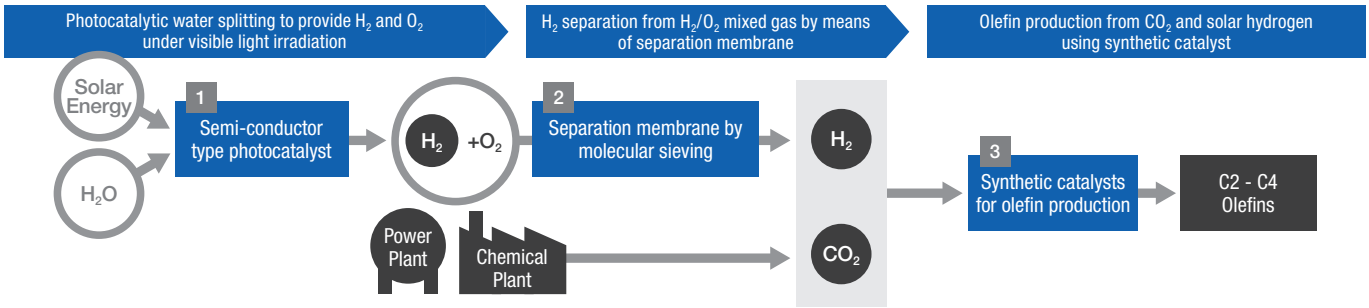
Example of Innovation

Participation in the Artificial Photosynthesis Project

What is artificial photosynthesis?

Artificial photosynthesis is defined as a converting process from energetically little-value materials such as water and carbon dioxide (CO_2) into high energy substances such as hydrogen and organic compounds under the sunlight irradiation. It has attracted a lot of attention as a technology to greatly contribute to the mitigation of CO_2 emissions and fossil resource consumption.

Outline of the Artificial Photosynthesis project

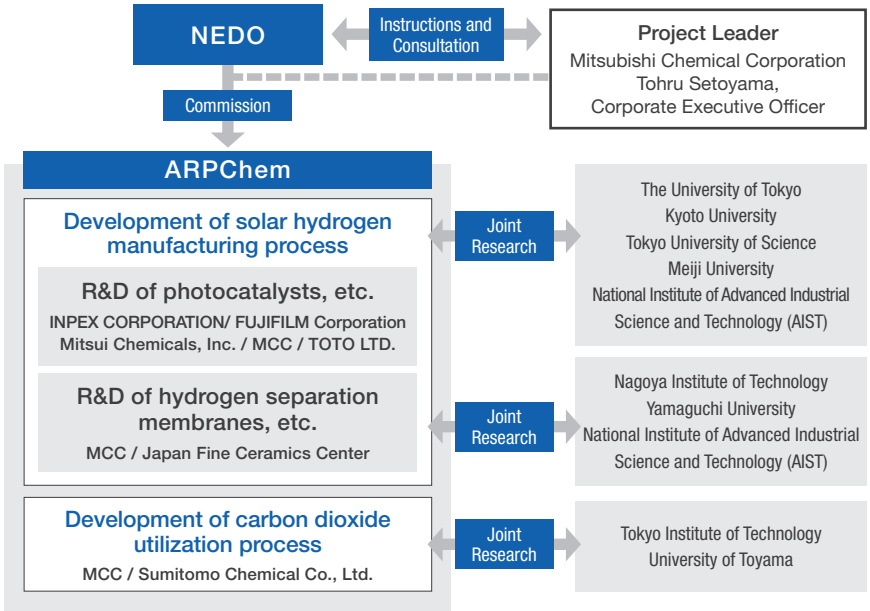


Organization of the Artificial Photosynthesis Project

MCC has been participating in the Artificial Photosynthesis Project commissioned by the New Energy and Industrial Technology Development Organization (NEDO), as a member of the Japan Technological Research Association of Artificial Photosynthetic Chemical Process (ARPChem) established in October 2012.

The Artificial Photosynthesis Project is working on joint research and development with many Japanese companies and research institutions, as shown in the organizational chart on the right, under the direction of the project leader Tohru Setoyama (MCC's Corporate Executive Officer). MCC is working on all subjects of the project.

Organization of the Artificial Photosynthesis Project (FY 2016)



Message from partner

This is truly a dream project involved the conversion of water and CO_2 using solar energy to chemical raw materials necessary for life. I appreciate this process as a technology that should be pursued today for the sake of the future, even though this cannot be practically applied right away.

This project comprises three themes, photocatalyst, separation membrane, and synthetic catalyst, and MCC has participated in every theme through its research and development. In synthetic catalysts for olefin production, MCC has successfully made reliable achievements on schedule from the developments of catalysts and processes to their demonstrations on a small-scale pilot plant. Also, Mr. Setoyama, the project leader, has created worthwhile concepts and scenarios aimed at practical application as well as the directions of the research.

MCC is an integrated chemical company representative Japan, and I have the impression that MCC plays a crucial role as one of suppliers of materials and components that are vital to industry and society. This project enters into its latter half stage, where it is required to establish unprecedented processes, modules and systems, with improving their performances, which would be a keen up-hill research phase in a sense. I hope that MCC contributes to the association with other companies and universities in this project and to the achievements using the wisdom by their integration.

Environment Department, NEDO
Project Manager
Takashi Hattori

Contributions to the Artificial Photosynthesis Project

1 In photocatalyst design, we have developed semi-conductor type photocatalytic materials, co-catalysts and modules that greatly enhance solar energy conversion efficiency. At the beginning of the project, it was only about 0.2%. An intermediate target of 3% in 2016 was realized on schedule. Currently, further research is going on with the aim of achieving energy conversion efficiency of 10%, the final goal of the project in fiscal 2021.

2 For high performance of separation membranes, three types of membrane materials, zeolite, silica and carbon, have been developed, all of which demonstrated the intermediate target for their permeability. In addition, we have started to develop unprecedented methods avoiding the combustion (explosion) of hydrogen and oxygen in module.

3 In the development of high performance synthetic catalysts for olefin production, we have successfully developed a hyper-stable zeolite catalyst for producing light olefins from methanol derived from hydrogen and CO_2 with high yield and high productivity, and confirmed their reliability and the scalability at a small-scale pilot plant. Furthermore, we are developing an innovative catalytic reaction process using separation membranes for methanol synthesis. These technologies are highly expected to contribute to the realization of olefin production process using CO_2 as a resource.

Small-scale pilot plant for the production of light olefins

Utilization of Venture Companies

The MCHC Group actively invests in and coordinates with venture companies with the aim of creating and accelerating innovation.

Examples of Venture Company Utilization in Recent Years

MCC	Acquisition of U.S.-based Gemini Composites LLC (carbon fiber material component designer and manufacturer)
TNSC	Investment in U.S.-based Optomec, Inc. (3D metal printer manufacturer)
	Investment in China-based Jijin OLED Material Tech Co., Ltd. (OLED material manufacturer)
	Investment in U.S.-based Sulfa Trap LLC (desulfurization sorbents manufacturer)
LSII	Acquisition of Japanese firm Clio, Inc. (regenerative medicine) → currently it is taken over

3D Printer Initiatives

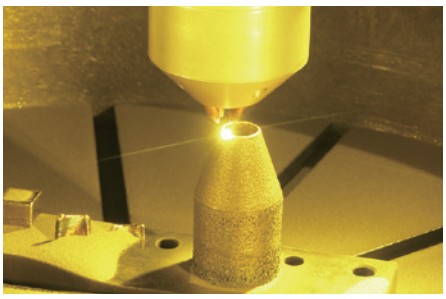
In order to expand its industrial gas business and accelerate the development of new businesses in high growth industrial segment, TNSC is acquiring high-value added products and is providing new services through partnership with venture firms. TNSC has already invested in various segments, such as clean technology, electronics and additive manufacturing (AM) to create synergies with the industrial gas business.

In the projects on desulfurization sorbents with Sulfa Trap and high-purity OLED materials with Jilin OLED, TNSC has been recognized sales record through our global sales network.

In April 2017, TNSC established partnership with 3D metal printer manufacturer Optomec (a U.S.-based venture company) in the AM industry that is growing rapidly in the U.S. and Europe. Since 3D metal printer is also known as micro-welding, TNSC is able to adopt our accumulated welding technologies for the AM businesses and it enables to provide solutions with high quality and higher productivity for customers.

Based on this strategic alliance, TNSC, as an industrial gas company to deliver the innovative solutions for global customers, will be able not only to acquire new customers but also to provide high valued services for existing customers.

Moving forward, TNSC will continue to actively pursue investment and partnership with venture companies having unique technologies and services. TNSC will focus on the fields of gas technology, medical and biotechnology while developing new business models and maximizing operating profit.



Metal processing using a 3D metal printer of Optomec