Toray IR Seminar

Toray Group's Initiatives Toward Realization of a Hydrogen Society

Initiatives at Torayca & Advanced Composites Division

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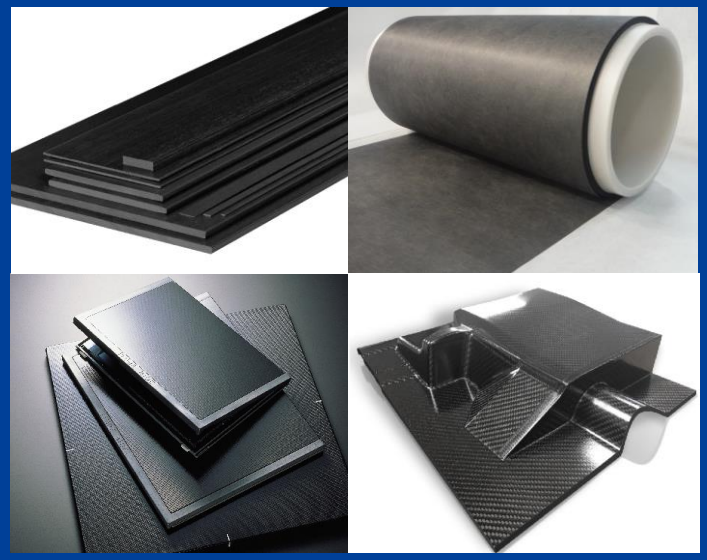

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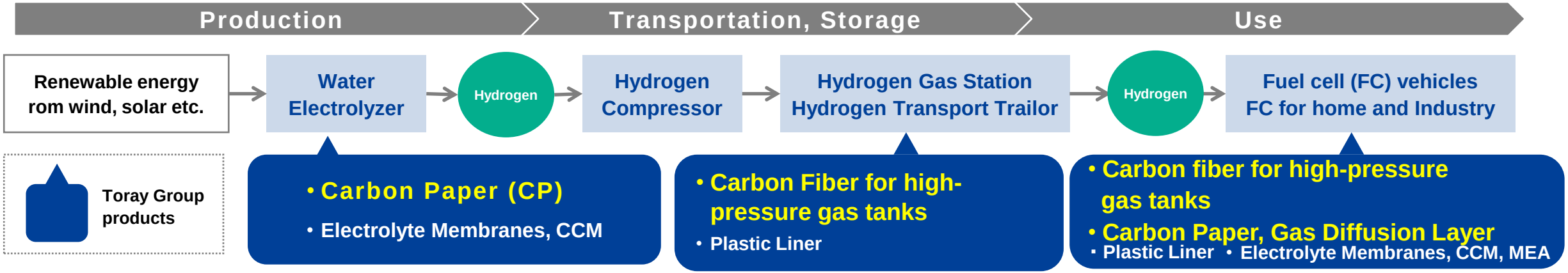
Initiatives to Realize a Hydrogen Society

Initiatives to Realize a Hydrogen Society

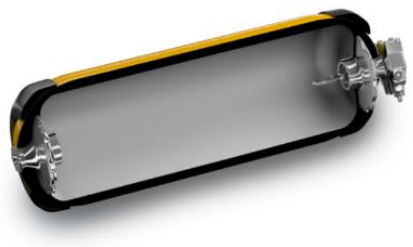
Developing a wide range of core materials for production, transport, storage, and utilization of hydrogen



CCM: Catalyst Coated Membrane MEA: Membrane Electrode Assembly CP: Carbon Paper GDL: Gas Diffusion Layer

Carbon fiber

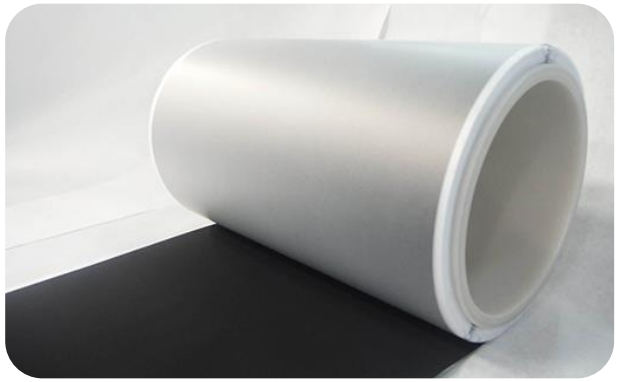
(Example of applications)
High-pressure gas tanks



Courtesy of Toyota Motor Corp.

Carbon paper (CP)

Gas Diffusion Layer (GDL)
＝Carbon paper processed products



II

Carbon Fiber for High-pressure Hydrogen Gas Tanks

Carbon Fiber Demand Outlook for Gas Tanks

- **Global Carbon fiber demand expanding under megatrends towards carbon neutrality**
- **Hydrogen tank demand to significantly expand especially for commercial vehicles (trucks, etc.) beyond 2026-2027**
- **High tensile carbon fibers increasingly required for higher pressure and lighter weight of gas tanks**

Example of hydrogen gas tank application

Passenger vehicle

Courtesy of Toyota Motor Corp.

Truck

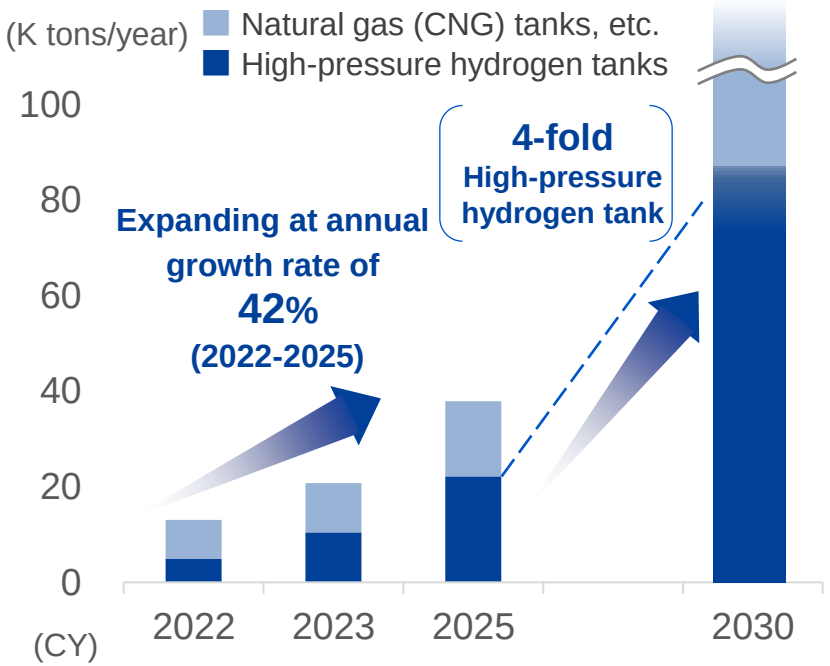
Bus

Train

Ttrailers for transport

Hydrogen station

Carbon Fiber Demand Outlook



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Toray's Strengths and Business Expansion Strategies (Carbon Fiber)

Our Strengths and Value Proposition

- 30 year-experience and database on high-pressure gas tank application
- Stable supply with high performance and quality
- Global production and technical supports base
- Proposal on optimal carbon fibers, resins and tank structure analysis

Business expansion strategies

- Proceed with production capacity increase corresponding to demand increase (U.S.A., South Korea)
- Enhance competitiveness on quality, performance and cost
- Enhance global production base and technical supports
- Strengthen partnership with major global customers

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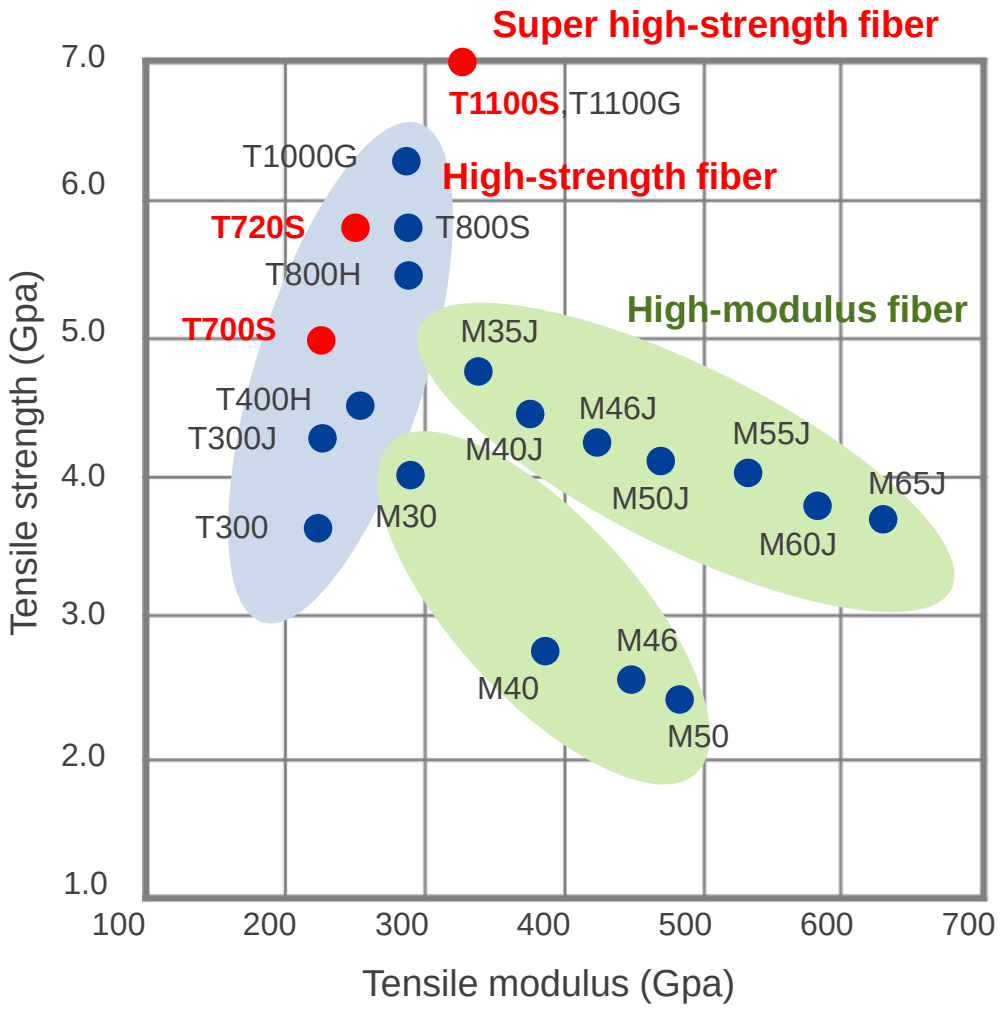
Brief History on Development and Supply of Carbon Fibers for High-pressure Gas Tanks

Strength and modulus of Toray carbon fibers grades



History of Torayca™ carbon fiber development

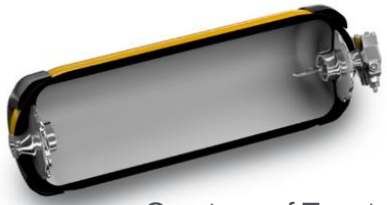
- Development of carbon fiber for tanks started in the 1980s
- Industrial scale adoption for natural gas tanks in the 1990s
  → Baseline data base of T700S for the application (de-facto standard)
- Started sales of high-strength fiber T720S, which is dedicated to hydrogen tanks
- Applied to the high-pressure hydrogen tank application from the 2010s
  → Adopted to Toyota Motor Corporation's "MIRAI"
- Developed T1100S, which is the strongest in our carbon fiber, for space applications
- Established trusts from customers based on the 30+ year history

Global leader through development of new products, proven stable and high-quality production
(40-50% of share)

Characteristics of Toray's Carbon Fiber for High-pressure Gas tank

Torayca™ Carbon Fiber

High-pressure Hydrogen Tank



Courtesy of Toyota Motor Corp.

FCV

Courtesy of Toyota Motor Corp.

- High strength
- Consistent quality and good workability
- Database
- Stable supply

→

- Lightweight and compact
- Improved safety
- Improved productivity, reduced cost
- Stable mass production

→

- Improved fuel efficiency
- Improved cabin comfort
- Improved safety
- Realization of hydrogen society

Torayca™ carbon fiber contributes to improvement of performance and expansion of production of FCV, through realization of mass production for safe and high-performance hydrogen tanks

Further Strengthening of Competitiveness

- **Further high performance and stable supply by utilizing up-to-date DX technologies enable to strengthening competitiveness**

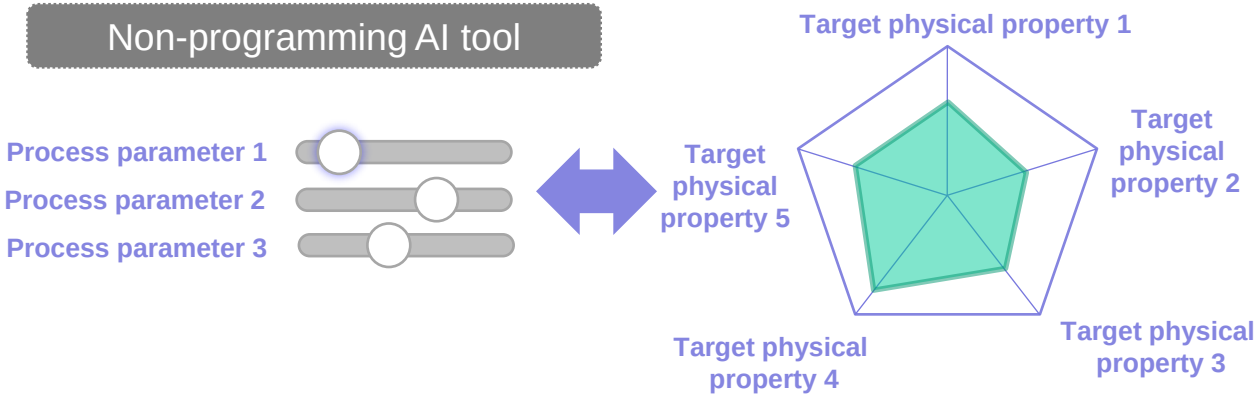
Improved performance

Enhancing product quality competitiveness

Collective strengths of Toray Group's R&D

Example 1: AI technology for carbon fiber development

Non-programming AI tool

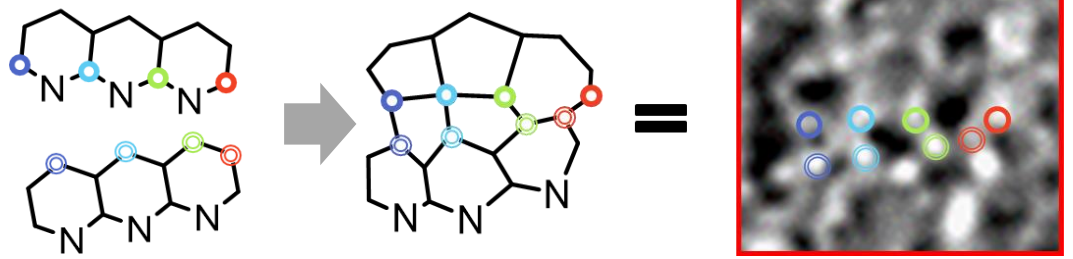


Process conditions determination and prediction of carbon fiber properties → Cut development time by half

Example 2: Atomic level defect control

Introduction of atomic resolution electron microscope

Analysis by Toray Research Center



Observation on individual carbon atoms by electron microscopic (The first success in the world)→
Atomic-scale microstructure control

Global production and technical supports

- **Consistent quality from the four production sites in Japan, the U.S., Europe, and South Korea.**
- **Global technical supports to immediately respond to customers' request**
- **Further enhancement of SCM corresponding to location of customers**

Toray Composite Materials America

Toray Carbon Fibers Europe

Toray (Ehime Plant)

Toray Advanced Materials Korea

● : Production base for T700S, carbon fiber for tanks

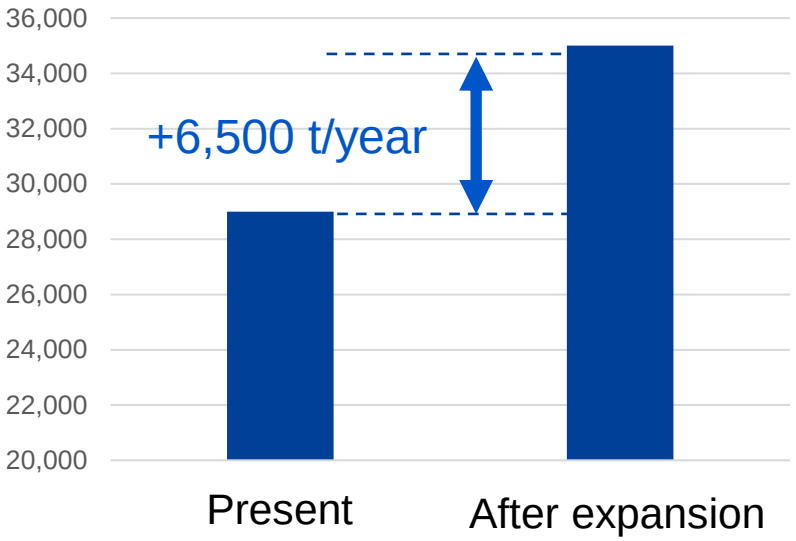
◆ : Technical Supports Base

Expansion to meet rapidly increasing demand

- Expansion of production capacity for regular tow carbon fiber
  Establishment of a stable supply in the U.S.A. and South Korea, where demand for tank applications is growing.
  Increase production capacity 6,500 tons/year. Production scheduled to begin in 2025

  ⇒ Surely meeting customers' requests and continuous supply of products with superior performance will contribute to strengthening the business foundation over the medium- to long- term

Toray group's production capacity



Production sites

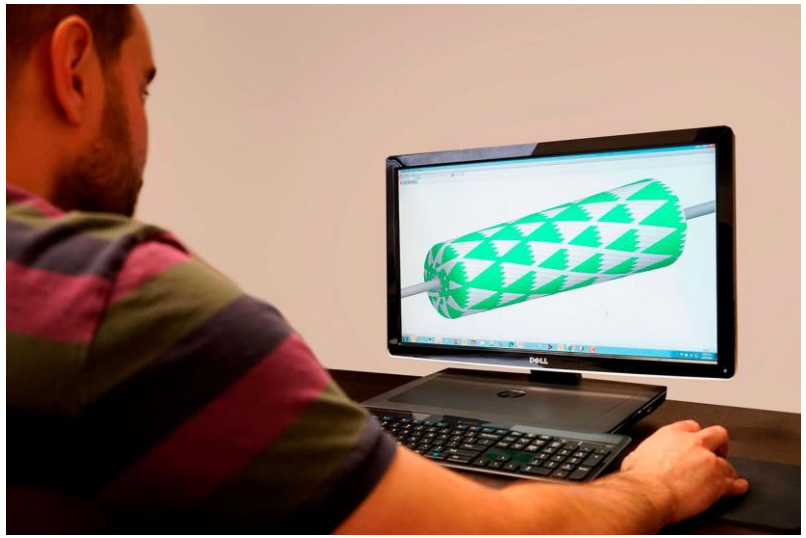
Toray Composite Materials America, Inc.(CMA)
Spartanburg Plant (South Carolina)

Toray Advanced Materials Korea, Inc. (TAK)
Gumi Plant (Gumi-City, Gyeongsangbuk-do)

Strengthening partnership with global major customers

- **Toray Group's development and production technology support for pressure vessels, from materials, design to production technology and facility**

Material selection and designing pressure vessels → Prototyping and evaluation → Production technology and facility



From supplier to a risk sharing partner

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III

Gas Diffusion Layer Base Materials for Fuel Cells

Demand Outlook for CP/GDL Base Materials

- Demand for CP/GDL will increase for water electrolyzer (PEM-based) application and fuel cells that are promising in hydrogen society
- **Full-scale expansion is expected to be in 2026-2030 timeframe. Demand in 2030 is forecasted to grow by 3.5 times compared to 2025**

Application of fuel cell

Passenger vehicle

Courtesy of Toyota Motor Corp.

Truck

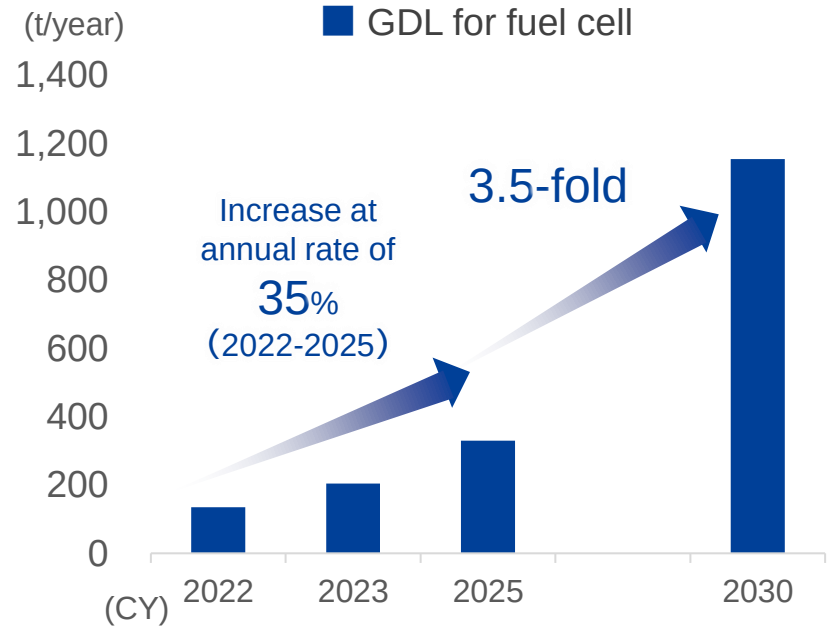
Bus

Train

Aircraft

Electric power source for industrial/domestic use

Demand Outlook for CP/GDL



Toray's Strengths and Business Expansion Strategies (CP, GDL)

Our Strengths and Value Proposition

- World's largest CP/GDL production capacity (Japan and South Korea)
- Over 40 years production experience and a significant database
- Ability to propose material designs meeting customer needs
- Competitiveness from utilization of human resources and know-how deriving of its upper stream (carbon fiber)

Business Expansion Strategies

- **Proactive capital investment** responding to growing demand
  - Development and proposal of materials to meet customer requests
  - Increase production capacity along the global demand
  - Enhancement of global system for technical support
- Strengthen cost competitiveness by **innovative process development**
- Enhance **partnership with global major customers**

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Brief history of Carbon Paper and GDL Development

- **In 1982, Toray started development of carbon paper**
- **Over 40 years production experience, accumulated rich know-how**
- **Capability of design proposal to meet customer needs, and competitiveness by integrated production from carbon fiber**

Global Share No. 1

1980 1990 2000 2005 2010 2015 2020 2025

Development of CP / GDL at Toray

▼ Started R&D for CP (1982)

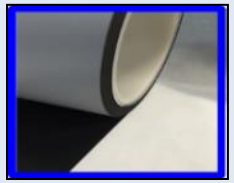
Started R&D for electrode base material of phosphoric acid fuel cell in NEDO's Moonlight Project

Carbon paper sheet

▼Started sales of rolled CP (2003)

Roll

▼ Started sales of GDL (2008)



▼ Mass production system of CP/GDL was introduced at Ehime Plant (2020)

GDL=Gas Diffusion Layer
(Carbon paper processed products)

Examples of application

▼ Started sales of CP TGP-H Series (1990)

Courtesy of Toyota Motor Corp.

▼ Started supply of CP for Toyota's "MIRAI" (2014)

Courtesy of Toyota Motor Corp.

▼ Started supply of CP for Toyota's "MIRAI" (2019)

▼ Adopted TGP-H series for stationary fuel cell (2000 onward)

▼ Started supply of CP for Honda's "CLARITY Fuel Cell" (2016)

▼ Started supply of GDL for automobile manufacturers in Europe, the U.S. and China

Photos are excerpted from websites of Toyota Motor Corp. and Honda Motor Company.

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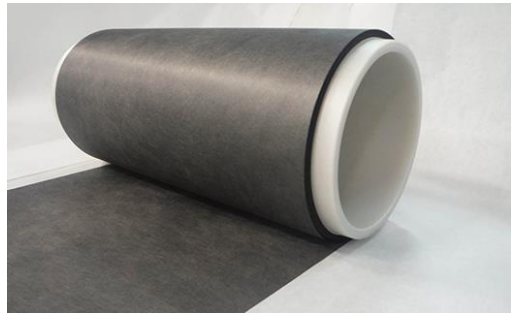
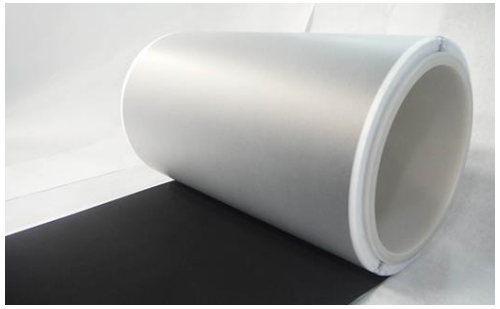
Characteristics of GDL for fuel cells

- **Carbon paper and Gas Diffusion Layer (GDL) contribute to improving performance of FCV by realizing high performance FC**

Carbon paper → GDL → Fuel cell stack → FCV

(Note) The supply chain described above is image, and it does not necessarily represent an actual supply chain.

High gas permeability, high drainage	Excellent current and voltage characteristic	High output, improvement of fuel efficiency
High conductivity	High durability	Long-life, low cost
High strength		
Impurities-less, high surface quality	Simplifying systems	Improvement safety

Further Strengthening of Competitiveness

- **Strengthening competitiveness by leveraging DX (material informatics and AI) to improve quality of products**

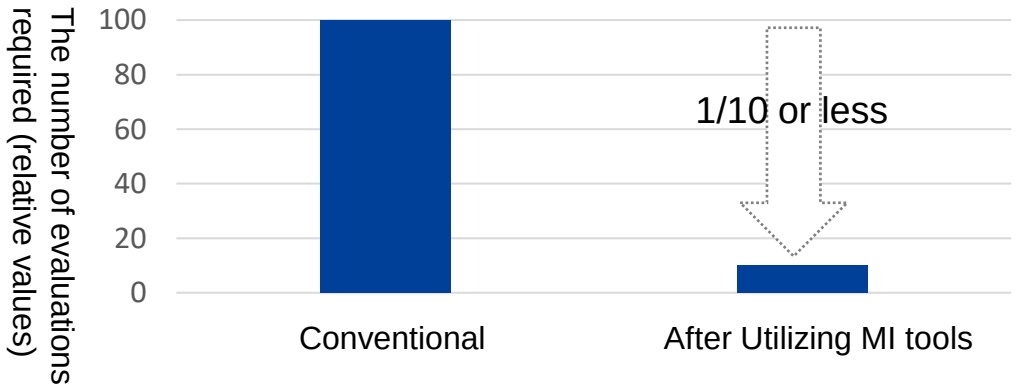
Improving Performance

Improving Quality and reliability

Collective strengths of Toray Group's R&D organizations

Example 1: Utilized proprietary material informatics (MI) tools for complicated parameters

Reduced the number of evaluations required to find an optimal material combination by 1/10 or less

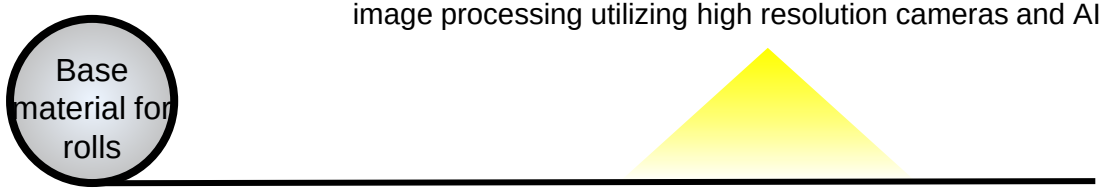


Example 2: Automated appearance inspections from the human eye. AI is used for image processing.

Zero overlooked defects

Appearance inspections

image processing utilizing high resolution cameras and AI



Example 3: Cooperation with Greenerity

Feedback to base materials development for fuel cells from MEA characteristics

TORAY ⟷ Greenerity®

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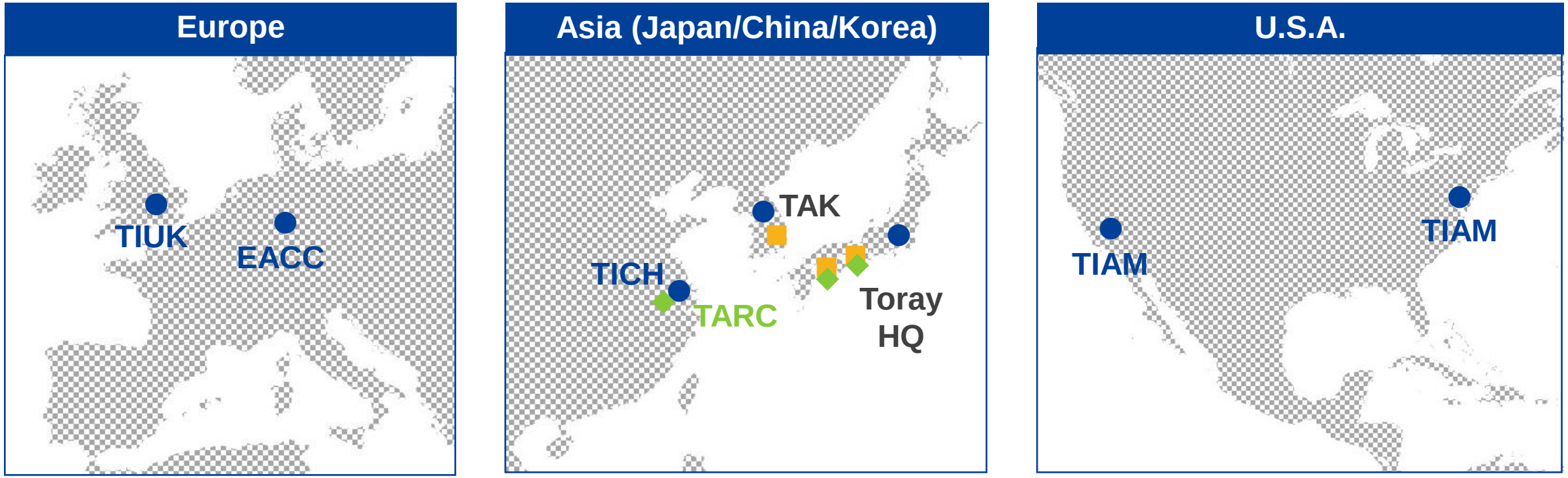
Global Production and Technical Supports

- **Established sales and technical support base in Japan, China, South Korea, Europe and the U.S., corresponding with global demand increase**
- **In addition to two major production bases in Japan and South Korea, considering to expand production sites in the U.S. and Europe**
- **Contributing to increasing value by meticulous service to advanced customer specifications**



- TIUK: Toray International U.K. Ltd.
- EACC: Euro Advanced Carbon Fiber Composites GmbH
- TICH: Toray International (China) Co., Ltd.
- TAK: Toray Advanced Materials Korea Inc.
- TARC: Toray Advanced Materials Research Laboratories (China) Co., Ltd.
- TIAM: Toray International America Inc.

Road to Carbon Neutrality

Policy of Carbon Fiber Composite Materials Business

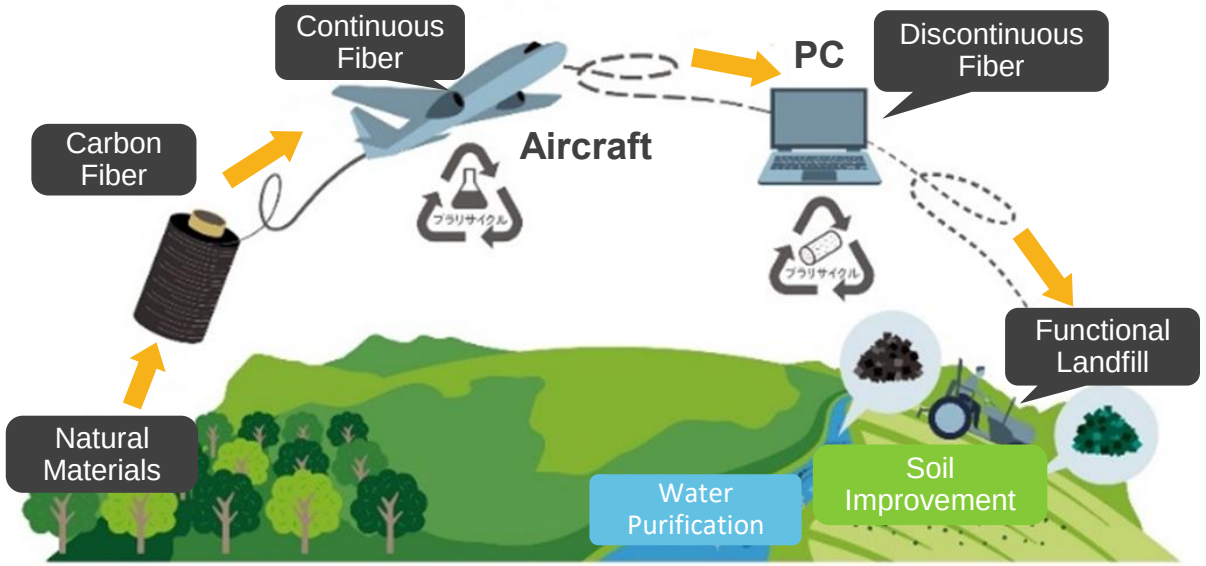
As a leading carbon fiber company, we will promote progressive approach and proactive communication

By 2030	**Over 30% reduction** in CO_2 emissions Start rCF production in Europe and US
By 2040	**Over 50% reduction** in CO_2 emissions Achieve Carbon Neutrality in Europe
By 2050	**Achieve Carbon Neutrality** Introduction of **CCUS**

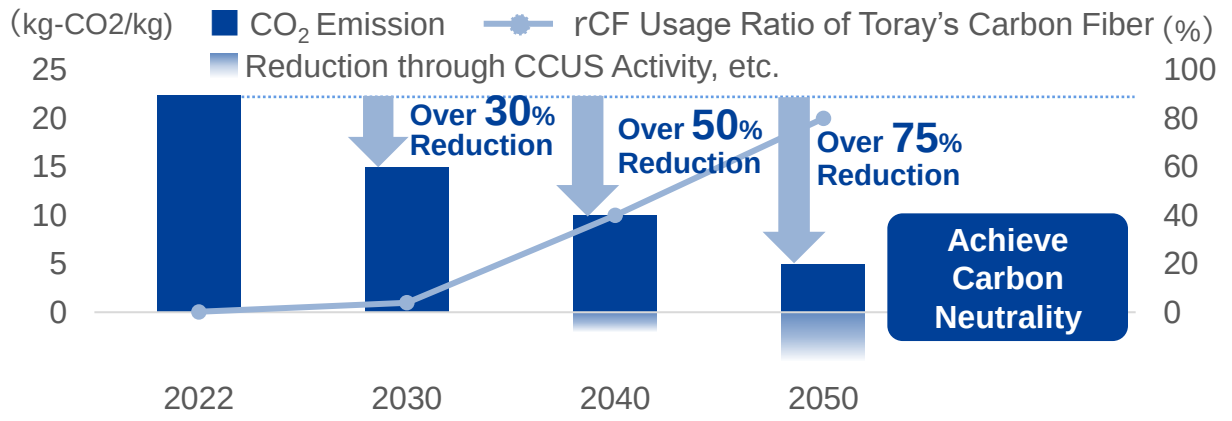
Strategy for Carbon Neutrality (AP-G 2025)

1. Quantify LCA improvement effect at customer's products
2. LCI reduction of our products (carbon fiber, prepreg, etc.)
3. Promote Material Eco-SYSTEM（use of recycled / bio-based raw materials）

Environmental Improvement Model of Carbon Fiber



Carbon Neutrality Milestone for Carbon Fiber



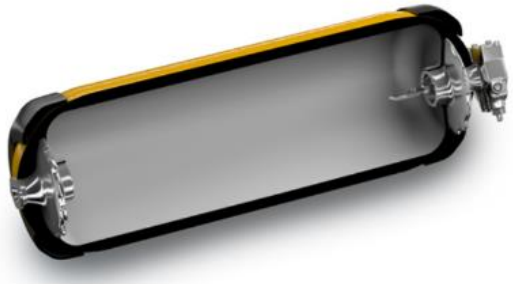
Realizing a Hydrogen Society

In order to capture business opportunities towards the carbon-neutral society, we provide the best products and realize business expansion through social contribution by leveraging our core strengths of carbon fiber composite materials, “high functionality” and “reliability (usability)”

High-pressure hydrogen tank

Carbon fiber demand in 2030, compared with 2025

x4
(90,000t)

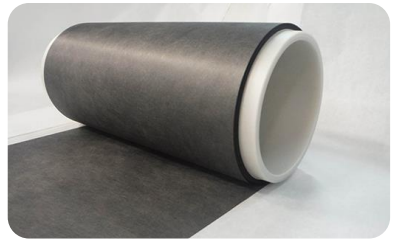


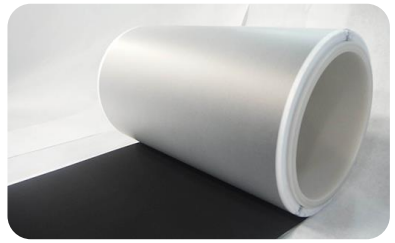
Courtesy of Toyota Motor Corp.

GDL (Gas Diffusion Layer)

Carbon fiber demand in 2030, compared with 2025

x3.5
(1,200t)





(Top) Torayca™ Carbon Paper
(Bottom) GDL

(Note) Carbon fiber demand in 2030 is estimated by Toray

Descriptions of predicted business results, projections and business plans contained in this material are based on assumptions and forecasts regarding the future business environment, made at the time of publication.

Information provided in this material does not constitute any guarantee concerning the Toray Group’s future performance.