Asahi Kasei Group Strategy for New Business Creation

*Heightening and deepening internal connections*

April 12, 2017
Asahi Kasei Corporation
Outline

1. “Cs for Tomorrow 2018” and vision for 2025
2. Asahi Kasei’s history of growth and new business creation
3. Framework for new business creation
4. Strategy for new business creation
   • Changing environment surrounding R&D and challenges for new business creation
   • Analysis of accumulated strengths and core technologies
   • Aims and approach for new business creation
5. Solution business using IT
6. Essence of new business creation
1. “Cs for Tomorrow 2018” and vision for 2025
Group’s vision for FY 2025

Building a portfolio of high value-added businesses with high profitability

- Net sales ¥3 trillion
- Operating income ¥280 billion

Strong emphasis is placed on high added value to achieve the vision for FY 2025

“Cs for Tomorrow 2018”: The three years to build the base to achieve FY 2025 targets

Basic strategy

- Pursuit of growth and profitability
- Creation of new businesses
- Acceleration of globalization
Vision for FY 2025 by segment

Net sales\(^1\)

FY 2015

Health Care (Health Care / Acute Critical Care)
Material (Fibers/Chemicals/Electronics)
Homes (Homes/Construction Materials)

FY 2025 (prospect)

Health Care
Material
Homes

Operating income\(^2\)

FY 2015

Health Care
Material
Homes

FY 2025 (prospect)

Health Care
Material
Homes

\(^1\) Percentages calculated by dividing each segment’s net sales by consolidated net sales less net sales in the “Others” category.

\(^2\) Percentages calculated by dividing each segment’s operating income by consolidated operating income less operating income in the “Others” category and corporate expenses and eliminations.
2. Asahi Kasei’s history of growth and new business creation
Features of new business creation from the past cases of Asahi Kasei

Newly developed materials take time to become profitable

- Need to find applications that match the materials’ characteristics
- Dependent on market ramp-up of end products

Highly profitable businesses resulting from start of R&D prior to market formation ahead of other companies

- Ion-exchange membrane
- Li-ion battery separator
- Virus removal filter
- Electronic compass, etc.

Committing strategic resources to new businesses that transform the business portfolio

- Entry into petrochemicals, homes, electronic devices
- Acquisition of ZOLL (acute critical care), acquisition of Polypore (proactive expansion)

Broad lateral extension to develop various businesses centered on same core technology

- Polymer/processing technology
- Performance polymers
- Membrane/separation technology
- Catalyst/process technology
- Compound semiconductors → magnetic and other sensors → UVC LEDs
Past example of new business creation: Hipore flat-film polyolefin membrane

Hipore succeeded in an application different than originally intended

- Initially developed as ion-exchange membrane, but found incompatible
- R&D launched
- Lead-acid battery separator
- Invention of lithium-ion secondary battery
- More than 600 applications were researched and studied
- Lithium primary battery separator
- Lithium-ion secondary battery separator
- Growth image
  - Spread of PCs, mobile phones, etc.
Past example of new business creation: Magnetic sensor

Product-oriented development → change in needs/environment → expansion into various applications

IT/mobile devices/smartphones

Spread of smartphones

Electronic compass

Power window/current sensor

Extension to automotive application

Cellular phones/digital cameras

PC/energy-efficient appliances/in-vehicle electronics

Precise motor control/spread of Video cassette recorder

Motor applications

Developed airbag

Motor applications

Launched development for crash sensor/Hall IC

Adopted for audio equipment motor

Video cassette recorder

Floppy disk drive

PC cooling fan

CD-ROM → DVD

Video cassette recorder

Miyazaki Electronics Co., Ltd. founded

Past example of new business creation:

Magnetic sensor

Development of airbag

Motor applications

Launched development for crash sensor/Hall IC

Adopted for audio equipment motor

Video cassette recorder

Floppy disk drive

PC cooling fan

CD-ROM → DVD

Video cassette recorder

Miyazaki Electronics Co., Ltd. founded
3. Framework for new business creation
R&D Organization

Asahi Kasei Corporation

Corporate Research & Development
- Technology Policy Center
- CVC Office
- Corporate IP
- Analysis & Simulation Center
- R&D Center
- Healthcare R&D Center
- Synergistic Solution Initiative
- Yamashita Laboratory
- Chemistry & Chemical Process Laboratory
- Fibers & Textiles Technology Center
- Performance Polymers Technology Center
- Performance Materials Technology Center

Corporate Production Technology
- Maintenance Technology Center
- Engineering Center
- Production Technology Center

Clean Energy Project
- Technology Policy Center
- CVC Office
- Corporate IP
- Analysis & Simulation Center
- R&D Center
- Healthcare R&D Center
- Synergistic Solution Initiative
- Yamashita Laboratory
- Chemistry & Chemical Process Laboratory
- Fibers & Textiles Technology Center
- Performance Polymers Technology Center
- Performance Materials Technology Center

UVC Project
- Technology Policy Center
- CVC Office
- Corporate IP
- Analysis & Simulation Center
- R&D Center
- Healthcare R&D Center
- Synergistic Solution Initiative
- Yamashita Laboratory
- Chemistry & Chemical Process Laboratory
- Fibers & Textiles Technology Center
- Performance Polymers Technology Center
- Performance Materials Technology Center

Residential Living Project
- Technology Policy Center
- CVC Office
- Corporate IP
- Analysis & Simulation Center
- R&D Center
- Healthcare R&D Center
- Synergistic Solution Initiative
- Yamashita Laboratory
- Chemistry & Chemical Process Laboratory
- Fibers & Textiles Technology Center
- Performance Polymers Technology Center
- Performance Materials Technology Center

Material
- Asahi Kasei (operating function)
  - Fibers & Textiles
  - Petrochemicals
  - Performance Polymers
  - Performance Materials
  - Consumables
  - Separators
- Asahi Kasei Microdevices
  - Research & Development Center

Homes
- Asahi Kasei Homes
  - Technology Div.
  - New Business Development Dept.
  - Housing R&D Center
  - Lifestyle R&D Laboratory
- Asahi Kasei Construction Materials
  - Products & Marketing Development Dept.
  - Materials Technology Dept.

Health Care
- Asahi Kasei Pharma
  - Clinical Development Center
  - Pharmaceutical Research Center
- Asahi Kasei Medical
  - Medical Products Development Div.
- ZOLL Medical
  - R&D departments
Main R&D bases around the world

R&D sites in Japan:
- Core R&D sites.
- Located in Kawasaki, Ohito, Fuji, Moriyama, Mizushima, Nobeoka, etc.

R&D sites overseas:

North America:
- Acquiring new technology (CVC); Healthcare-related R&D; new business creation

Asia, ASEAN:
- Technical Center located in close proximity to market demand

- Dormagen, Germany: Engineering Plastics Technical Center
- Guangzhou, China: Engineering Plastics Technical Center
- Shanghai China: Engineering Plastics Technical Center
- Vietnam: Computer Aided Engineering (CAE)

- Waltham, Massachusetts: Asahi Kasei Pharma America
- Chelmsford, Massachusetts: ZOLL, CVC
- Menlo Park, California: CVC
- Owensboro, Kentucky: Polypore
- Albany, New York: Crystal IS: UVC LED
- Charlotte, North Carolina: Polypore
- Dormagen, Germany: Engineering Plastics Technical Center
- Guangzhou, China: Engineering Plastics Technical Center
- Shanghai China: Engineering Plastics Technical Center
- Vietnam: Computer Aided Engineering (CAE)
Asahi Kasei Group’s R&D expenses

Breakdown of R&D expenses

- Health Care: 39.8%
- Chemicals/Fibers: 23.9%
- Electronics: 21.9%
- Homes/Construction Materials: 4.2%
- Corporate expenses: 10.0%
- Others: 0.1%

Total R&D expenses: ¥81.1 billion (FY 2015)

Annual R&D expenses:

- 2010: ¥62.3 billion
- 2011: ¥66.3 billion
- 2012: ¥71.1 billion
- 2013: ¥71.1 billion
- 2014: ¥75.5 billion
- 2015: ¥81.1 billion

(FY)
4. Strategy for new business creation
Changing environment surrounding R&D

Rapid growth in emerging countries
Intense competition in cutting-edge technology in both developed countries and emerging countries

IT/connected society
Anyone can obtain equivalent information anywhere

R&D and new business creation by companies

Artificial intelligence, big data
Development of new materials by "materials genome"

• Risk that what was thought to be superior will lose its superiority
• Limitations to individual optimization → adapt to changes in business/technology environment
• Need to take inventory of accumulated competitive advantages, technologies, and business platforms; reevaluate competitive advantages
Measures to cope with environmental changes related to new business development

Asahi Kasei Group’s sources of competitiveness
1. Accumulated core technologies, production technologies, know-how
2. Business platforms, diverse market channels, business models

Transformation of business portfolio by business expansion and new business creation

Which business to create? (which mountain to climb?)
“ability to discern”

R&D, business development
Exerting combined strength through internal connections

Outside alliances (by joint R&D etc.)

Acquiring missing parts (by CVC etc.)

Halfway

Halfway
New business creation under the medium-term management initiative “Cs for Tomorrow 2018”

Leveraging Asahi Kasei’s diversity to create value through combinations among various technologies and businesses

Various technologies
- Materials, devices
- Production technology
- Systems
- Analysis, simulation, etc.

Diverse business operations
- Fibers
- Chemicals
- Electronics
- Homes
- Construction Materials
- Health Care
- Critical Care

Strengths of Asahi Kasei

Open innovation
- Joint R&D
- CVC
- M&A

Technology

Connect

Diverse human resources

Business models

Asahi Kasei
Example of competitive analysis of patents
(Membrane for electrolysis)

Vertical axis indicates the comprehensive strength of a company’s patent portfolio

Size of circles is proportional to the number of valid patents

Assignee Score

Large companies

Asahi Kasei

Company A

Company B

Company C

Company D

Company E

Smaller companies

Company F

Horizontal axis indicates the highest scoring patent in a company’s patent portfolio

By Asahi Kasei (Feb. 2017) using Biz Cruncher from Patent Result Co., Ltd.
Core technologies that support Asahi Kasei Products

Core Technologies

- Catalyst/process
  - Cyclohexanol
  - AN/MMA
  - Creolex metallocene polyethylene
  - Sunfine ultrahigh molecular weight polyethylene

- Polymers/processing
  - Performance polymers: Leona, Xyron, Tenac, etc.
  - Synthetic rubber: Tuftec/Tufprene, etc.
  - SB latex/Dura-Photo
  - Saran Wrap cling film
  - Photosensitive resins: Sunfort, Pimel, APR/AFP
  - Novacure latent hardener

- Compound semiconductor/LSI
  - Application-specific IC
  - Electronic compass
  - IR sensor/gas sensor
  - Magnetic sensor
  - Catalysis/inorganic synthesis
  - Compound semiconductors
  - Software algorithms

- Membranes/separation
  - Polymerization/spinning/cellulose
  - Phase separation/electrochemistry
  - Virus removal/blood purification
  - Biological information processing

- Fibers
  - Spunbond nonwovens
  - Bemliese
  - Lamous
  - Microza
  - Ion-exchange membranes

- Health Care
  - Perscription drugs: Teribone, Recomodulin, etc.
  - Acute critical care devices: AEDs, LifeVest, etc.
  - Blood purification: Artificial kidneys (APS), therapeutic apheresis devices

- Homes/construction materials
  - Hebel Haus unit homes
  - Hebel Maison apartment buildings
  - Hebel autoclaved aerated concrete
  - Neoma pheneolic foam insulation

- Software algorithms

AsahiKASEI
Accumulated business platforms

Material
- Fibers
- Chemicals
- Electronics

Products related to living (apparel material, consumables, etc.)
Healthcare-related material
Automotive-related products (structural material, interior material, tire material, LSIs, sensors)
Environment/energy-related material (battery separator)

Various business platforms that contribute to life and living for people around the world
(market channels in each business)

Homes
- Homes
- Construction Materials
- Long-life urban homes
  (ability to develop lifestyle proposals)
- Construction materials
  (products for homes, structural components)

Health Care
- Health Care
- Critical Care
- Business expansion in United States
  - Blood purification devices
  - Bioprocess products
  - Pharmaceuticals (musculoskeletal)
  - Acute critical care devices & systems
New business creation through collaboration among three business sectors

Connecting the strengths of each business sector to create unique new businesses

Working to apply products in the Material sector to housing applications, mainly by the Residential Synergy Initiative

Homes

Material

Health Care

Connect

With homes as a platform, creating new businesses such as at-home healthcare service

Health Care Council

- Healthcare R&D Center
- Asahi Kasei Pharma
- Asahi Kasei Medical
- ZOLL Medical
Aims and approach for new business creation

Our main areas of focus to address social issues

- **Society of clean environmental energy**
- **Society of healthy/comfortable longevity with peace of mind**

- **Fostering and acquiring core technology**
  - Acquiring technology seeds
  - Applying technology laterally

- **Utilizing market channels**
  - Enhancing and fully utilizing business platforms

- **Coordination/combination**
  - CVC

- **Heightening added value**
  - Business models, solutions

**Strengths of Asahi Kasei**

- **Asahi KASEI**
# Approach for new business creation viewed by market axis and technology axis

<table>
<thead>
<tr>
<th>Established mature markets</th>
<th>Established growth markets</th>
<th>New markets</th>
<th>Potential future markets</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Maximizing value of established businesses</strong>&lt;br&gt;• Brand strength/market channels&lt;br&gt;• Cost competitiveness&lt;br&gt;• Services</td>
<td>until FY2018</td>
<td>until FY2025</td>
<td><strong>C</strong>&lt;br&gt;• Marketing&lt;br&gt;• Full utilization of Asahi Kasei Group technologies and business platforms&lt;br&gt;• Acquiring missing parts (CVC)</td>
</tr>
<tr>
<td><strong>Creating added value from new perspectives</strong>&lt;br&gt;• Higher added value from solutions</td>
<td><strong>B</strong>&lt;br&gt;<strong>A</strong>&lt;br&gt;<strong>C</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Newly developed technologies | B-to-C in Health Care and Homes sectors<br>• Better therapy<br>• Comfortable residential living | B-to-B in Material sector<br>• Disregarding mature markets<br>• Pursuing originality and differentiation in growth markets | **E**<br>• Accelerating R&D<br>• Acquiring technology seeds/sprouts by CVC<br>• New business models | **F**<br>Long-term perspective<br>• Develop/acquire leading-edge technology<br>• Collaboration with outside research institutions |

---

Categories A and C: Coordinate with strategic business units and core operating companies
Category B: Utilize information technology, study new business models
Category D: Review programs, examine originality and differentiation
Category E: Focus on strong points and accelerate
Category F: Basic/exploratory research in collaboration with universities and government research organs
Example of new business creation in Category C: Alkaline water electrolysis system

System to convert renewable energy into hydrogen as energy storage medium

Renewable energy

Large-scale adoption but unstable power generation

Energy conversion by electrolysis
Electricity $\rightarrow$ Hydrogen

"Power-to-Gas" energy storage

$CO_2$-free hydrogen

• Fuel-cell vehicles
• Hydrogen power generation
• Clean energy (methane, ethanol)

Clean Energy Project

- Utilizing world-leading core technology: brine electrolysis, catalyst, and membrane tech.
- World’s highest energy efficiency with commercial-scale plant
- Ability to take orders for 10 MW systems by end of FY2017
- Accelerating commercialization with demonstration plant in Europe, the market with the greatest potential

Demonstration plant

Demonstration plant anticipating 10 MW capacity started operation in Nov. 2015 under NEDO* project

* New Energy and Industrial Technology Development Organization

AsahiKASEI
Example of new business creation in Category D: High-performance composite materials

Combinations of fiber, resin, and processing technology

1) Material to replace metal for weight reduction in automotive structural parts

- High degree of design freedom
  - Hybrid (compression and injection) molding with the flexible base material enables complex shapes

- Outstanding strength-to-weight ratio
  - Improved strength and rigidity compared with conventional GF reinforced PA66 resin; outstanding strength of interface between GF and resin

2) Cellulose nanofiber (CNF) nonwoven sheet
   - Uniform dispersion is the key to obtaining maximum performance from CNF
   - Developing CNF nonwoven sheet that already has a network structure enabling impregnation with epoxy, etc.
Targets for high-performance composite materials

- Glass fiber (GF) and cellulose nanofiber (CNF) are presumed to generate less CO₂ during manufacture than carbon fiber (CF) and aluminum.
- Using thermoplastic material → recyclable (eco-friendly)

**CO₂ generated during manufacture** (relative comparison to CF)

*Reinforced thermoplastic*
Example of new business creation in Category E: UVC LED

◆ Compound semiconductor as core technology for business expansion

Hall elements (world-leading share) → IR sensor, CO₂ sensor, etc. → UVC LED using aluminum nitride (AlN)

Mass production of UVC LEDs using the world’s only 2-inch single-crystal AlN substrate

Developing new markets around the world with Klaran UVC LED for disinfection; incorporation in end product designs is advancing
CVC* Function: Bringing in sprouts in Categories C and E

Utilizing venture companies in highly innovative fields to reduce risks and accelerate commercialization.

Technology axis

- New developments
- Existing technology

Market axis

- Established markets
- New markets

Low Commercialization success rate

Utilizing/acquiring external resources

Area of CVC activity

Utilizing internal resources

* CVC: Corporate Venture Capital
CVC Office:
Bringing in sprouts in Categories C and E

- Building information networks through venture capital (VC)
- Identifying venture businesses that are compatible with Asahi Kasei
- Acquiring technology and proposing/advancing new business development through partnership with/acquisition of venture business
5. Solution business using IT
Creating added value from new perspectives (Category B)
ZOLL products in the “Chain of Survival”

Chain of Survival

EARLY INTERVENTION
ACCESS
CPR
DEFIBRILLATION
ACLS
POST RESUS CARE

ZOLL’s products strongly support every phase of the Chain of Survival

ZOLL products

- LifeVest wearable defibrillator
- RescueNet data management suite for fire and emergency medical services
- AutoPulse non-invasive cardiac support pump
- AED Plus automated external defibrillator
- X Series AED Pro defibrillators for hospitals and EMS
- Thermogard temperature management system
LifeVest solution business

Needs (marketing)
- Enabling patients at high risk of sudden cardiac arrest to stay outside the hospital
- If ventricular fibrillation or other life-threatening arrhythmia occurs → life-saving shock without delay

Emergency measures when an event occurs; using ICT to support patients
- Continuous monitoring of patient’s ECG
- Enabling physicians to check patient’s condition through online system linked to the LifeVest*
- 24-hour call center for inquiries; enabling information on state of operation of the device to be shared

* Patient’s data transmitted from the LifeVest is displayed on a computer screen. Medical professionals can check if patients are wearing the device and ECG data before and after an event. Able to send alerts to patients’ cell phones, etc., in the case of important clinical information.
Examples of solutions business being advanced and developed

Plant maintenance services

• Web-based remote automatic vibration diagnostic system
  – Stable operation of plant and equipment (rotating machinery, industrial robots, etc.)

• Electric power system analysis service

Stable supply solution for hydrogen from water electrolysis

• Monitoring and optimization based on sensor data
  – Electrolyzer maintenance
  – Hydrogen production prediction and control system

Disinfection solutions (water, air, surfaces) using UVC LED

• Developing solution business in disinfection applications
  – 1st stage: Selling devices, consulting on design optimization
  – 2nd stage: Extension to disinfection modules and systems
Enhancing business activity utilizing IoT, AI, Big Data

Coordinated utilization of advanced IT

Manufacturing and production technology innovation

1. Optimized plant operation and energy consumption
2. Supply chain innovation, mass customization
3. Risk management, prevention/remote maintenance
4. Standardization/enhancement of operating procedures

High-mix production/decrease of experienced workers/passing on skills/overseas expansion

Application to development/high added value/business analysis
1. Materials informatics
2. Development of solution business/extension to total service
3. Technology/business analysis, competitive analysis
4. Competitive analysis of M&A targets

Manufacturing Technology Center
Corporate IT Management
Corporate Production Technology
Corporate Research & Development, Asahi Kasei Microdevices

Organized by Corporate Production Technology

Asahi KASEI
6. Essence of new business creation
1. Creating and developing new markets ourselves
   • Creating business producing hydrogen by water electrolysis
   • Strengthening CO\textsubscript{2} chemistry business (environmental compatibility)
   • Creating diverse markets for disinfection by UVC LED
   • New sensors (various environmental gas sensors including CO\textsubscript{2} sensor)

2. Leveraging diverse core technologies, business platforms, ability to discern
   New business creation through combinations of diverse technologies and businesses
   • Technology in Material sector (materials/devices/software)
     → Expansion in healthcare applications, pursuit of residential comfort

3. Creating high value added business by combining different cultures
   • Asahi Kasei: Developing components; carefully building technology from the ground up
   • ZOLL: Ability to construct business models; creating business by determining targets based on established technology
The commitment of the Asahi Kasei Group:
To do all that we can in every era to help the people of the world
make the most of life and attain fulfillment in living.
Since our founding, we have always been deeply committed
to contributing to the development of society,
boldly anticipating the emergence of new needs.
This is what we mean by “Creating for Tomorrow.”