Outline and Strategies of Toray Group Plastics and Films Businesses

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Senior Managing Director of the Board,
General Manager, Plastics and Films Division

September 21, 2005
I. Outline of Toray Group
   Plastics & Films Businesses
II. Outline and Strategies of Plastics Businesses
III. Outline and Strategies of Films Businesses
IV. Summary
I. Outline of Toray Group

Plastics & Films Businesses
Aspects of Toray Plastics & Films Businesses

1. Pioneer of “High Performance” plastics and films businesses
2. Expanding business globally
3. Integrating vertically from raw material to processed products
   - Plastics: raw materials – base resins – compounding – precision processed products
   - Films: raw materials – polymer films – processed film products
4. Numbers of global NO.1, Only 1, and First 1 products
5. Supporting the expansion of high technology industries
   (IT, Flat Panel Display, automobile, etc.) through continuous development of advanced materials
6. Penetrating in various part of industrial applications
7. Key business that supports Toray’s foundation businesses and strategically expanding businesses (IT-related and environment businesses)
Current Situation of Toray Plastics and Films Businesses (1)

Plastics and Films Division

<table>
<thead>
<tr>
<th>Division</th>
<th>Japan</th>
<th>Overseas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plastics</td>
<td>TPS</td>
<td>TPM</td>
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<tr>
<td>Division</td>
<td>TPI</td>
<td>TTS (plastics)</td>
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<td>RKH/Z</td>
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<td>*TPRC</td>
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<td>*TBPR</td>
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<td>Films</td>
<td>TAF</td>
<td>TPA</td>
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<td>Division</td>
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<td>*YTP</td>
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<td>TTS (films)</td>
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<td></td>
<td>TFZ</td>
</tr>
</tbody>
</table>

The figures are consolidated basis that of FY Mar/2005

* are not consolidated

“Plastics & Chemicals Segment”
69% of total ¥300.4 bill.

¥208.0 bill.

“IT-related Products Segment”
42% of total ¥219.1 bill.

¥92.0 bill.
Current Situation of Toray Plastics and Films Businesses (2)

- consolidated net sales of FY Mar/2005

Plastics & Chemicals
- Films Businesses: 300.4 (23.1%)
- Plastics Businesses: 148.7 (11.5%)
- Chemicals Businesses: 44.7 (3.4%)
- Plastics- and films-related trading companies: about 300.0

IT-related Products
- Films Businesses: 219.1 (16.9%)
- Plastics Businesses: 148.7 (11.5%)
- Electronics & Information Related Products: 44.7 (3.4%)

Toray Group
- 1,298.6

Unit: ¥ Billion
Plastics Production Bases

TPRC
PET resins for bottles 100,000t/y

TPM
ABS resins 220,000t/y

TPS

STPS

KTP
POM resins 25,000t/y

TREC

SMPC

TN

KTP
POM resins 25,000t/y

TPSZ

RKZ

PNR
PET resins for bottles 75,000t/y

TBPR
PBT resins 60,000t/y (2006~)

Nagoya
Nylon resins 54,000t/y

Ehime
PBT resins 23,000t/y

PPS resins 8,000t/y

Tokai

Chiba
ABS resins 72,000t/y

Chiba

Toyo Plastic Seiko Co.
Films Production Bases

- **TPEU**: PET films, 50,000t/y
- **YTP**: PET films, 21,000t/y
- **TSI**: PET films, 105,000t/y
- **Toray**: PET/OPP films, 106,900t/y
- **PFR**: PET films, 30,000t/y
- **TFR**: PET films, 14,200t/y
- **Gifu**: PET films, 45,600t/y
- **Toray Advanced**: PET films, 36,100t/y
- **WPC**: PET/OPP films, 18,000t/y
- **Mishima**: PET films, 36,100t/y
- **Tsuchiura**: OPP films, 18,000t/y
- **TPA**: PET/OPP films, 67,000t/y

Legend:
- Orange circles: Base film
- Green circles: Film processing

Fact Data:
- **Shiga**: PET films, 14,200t/y
- **Gifu**: PET films, 45,600t/y

Map:
- **Toray Advanced Film Co. (Fukushima)**
- **Toray Advanced Film Co. (Takatsuki)**
- **Toray Advanced Film Co. (Mishima)**
- **Tsuchiura OPP films, 18,000t/y**
- **Shiga PET films, 14,200t/y**
- **Gifu PET films, 45,600t/y**
- **Toray PET/OPP films, 106,900t/y**
1. Create added values through Business Structure Reform
   - Supply advanced materials into growth areas based on polymer chemistry, organic synthetic chemistry, biochemistry, and nanotechnology
   - Expand proactively to the downstream processing businesses
   - Commit to the improvement of global environment

2. Lead the World’s Performance Plastics & Films Industries through Global Expansion
   - Strengthen group-alignment, global operations, and global re-engineering
3. Deepen “Customer Creed” Further
   - Work in close partnership and collaboration with customers
   - Provide 4S to customers
     (Solution, Surprise, Satisfaction, Success)

4. Promote Global Alliance
II. Outline and Strategies of Plastics Businesses
Product Map of Toray Plastics

- Toray products (*brand names in brackets)

Heat Resistance

Price

Super Engineering Plastics

Engineering Plastics

Semi-Engineering Plastics

Crystalline:
- PI (TI polymer)
- PAI (TI polymer)
- LCP (SIVERAS*)
- PPS (TORELINA*)
- Nylon (AMILAN*)
- PBT (TORAYCON*)
- PEEK

Amorphous:
- PC
- mPPE
- ABS (TOYOLAC*)

<Crystalline> and <Amorphous>
Sales trends in s Businesses

Unit: Billion Yen

Including Internal Sales

Toray Japanese Overseas

Fiscal Year

'90 '91 '92 '93 '94 '95 '96 '97 '98 '99 '00 '01 '02 '03 '04 '05

(Total) including non-consolidated subsidiaries and affiliates

PSP TREC TPM PNR, LCH, RKH KTP TTS-R TPRC TPHK

13 (Forecast)
Major Tasks and Expansion Strategy of Plastics Businesses

1. Ensure top share in the fast-growing engineering plastics market in Asia
   Toray’s market share (engineering plastics) in Asia: Mar/05 15% → Mar/11 20%
   Enhancement of a global supply bases

   - Polymerization Capacity Expansion Plan -
     ★ PBT resin: planned to start in Mar/06 (Malaysia)
     ★ ABS, Nylon, PPS, LCP resins are under consideration
   - Compounding Capacity Expansion Plan -
     ★ South China, TTS (Thailand): capacity expansion underway
     ★ East/North China, Malaysia: under consideration

2. Transform to solution-proposal business models → high-value added, highly-profitable businesses

   Polymer design technology + molding technology + product design technology
   → promotion of positive proposal of new applications and advanced materials

3. Respond to environmental issues and develop environment-friendly materials
**PPS Resin, Torelina* - Total Business Development of Resins - Films - Fibers**

Base Resins → Compounding → Only 1 Business: Oriented Film → Fiber

**Automobiles**
- Alternator Ignition, Headlight Reflector

**Electric /Electronic Appliances**
- Optical pickup for DVD, Fixing Unit for Copy Machines

**Home Appliances**
- Boiler, Valve Joint, Pump, Impeller housing

**High-performance films for FPD**
- Capacitors for cellular phones
- In-vehicle motor insulators
- Filters for thermal power plants
- Binding fibers for motors
- Dry canvas for paper manufacturing

Toray Group sales of PPS-related products:

- **World No. 1**
  - ¥ 12.5 billion (FY Mar/06)
  - ¥ 25.0 billion (FY Mar/11)
Expansion Plan of PPS Resin, Torelina*

Polymerization capacity

• Autumn ’04  Increased by 2,000t (for compounding)
• End of ’05  Increase by 1,000t (for fibers, films)
• ’07        Increase by 5,000t planned at Tokai Plant

Compounding capacity

• Autumn ’03  Started in-house PPS compounding in China (at TPSZ, Shenzhen) first as PPS resin manufacturer
• End of ’04  Increased one line to the current production capacity of 3,000t/yr

Aim to become World No.1 PPS resin compound manufacturer
Global Operation of PBT Resin, Toraycon*

TBPR
- World No.1 in quality and cost competitiveness
- Toray’s world’s advanced polyester consecutive polymerization technology
- Stable procurement at low price of major raw material BDO from state-of-the-art facility of BASF subsidiary

Ehime Plant
- Development of high-value added products based on co-polymerization technology and high-performance alloy technology

TBPR
Malaysia (start in 2006) 30,000 t/yr

Toray Ehime Plant 24,000 t/yr

10% of world market share in 2007
Strength of Toray PBT Resins

The only Japanese manufacturer that owns overseas production base
Outstanding development capability supported by co-polymerization technology and high-performance alloy technology

**Co-polymerization Technology (Polymer design)**

- Strain reduction of inside of molding by crystalline control
- Enhanced flexibility by tenderization

- Valves
- Metal-insert parts such as sensors
- Control cable liners, etc.

**High-performance Alloy Technology**

- Polyester nano-alloy (Impact resistance, Chemical resistance)
- PBT / ABS alloy (Impact resistance, Dimensional stability, Heat-cycle resistance)
- PBT / PET alloy (Low warpage, Good appearance)

- Automobile exterior parts such as door handles
- Electric / electronic component chassis such as automobile door-lock housing and motor fans
- Gas range handle
Global Operation of ABS Resin, Toyolac*

Strength of ABS resin, Toyolac*
- The only Japanese manufacturer that owns overseas production base
  - manufacture same grade at TPM for overseas and at Chiba Plant for domestic
- Transparent ABS- World No.1 share
- Sustainable antistatic grade - world First one product

[Specialty Product]
- Transparency
- Antistatic
- Alloy

Commodity
- Flame retardant
- Heat resistant

Capacity Trend at TPM and Chiba Plant (thousand t/yr)

- Chiba Plant
- TPM

Plan

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World Trends related to Plastic Businesses

### Demands for High Speed and Large Capacity in Information-Communication

- **High-speed of Semiconductors**
  - Fine Semiconductors (Half pitch DRAM)
    - 65nm (2007)
    - 45nm (2010)
- **Large Capacity of Storage**
  - 100–200GB (4-8 layer / multi value storage)
- **Flat Panel displays**
  - Scan lines: 1080 over 2000 over 4000

### Technological Issues, Demands

- **Catalyst technology, clean engine car**
- **Hybrid car, materials for fuel-cell vehicles**
- **Sound insulation, sound absorption materials**
- **Gas barrier**
- **CFC’s substitute, treatment of recycled CFC**
- **Weight reduction of automobiles**
- **Renewable resources**
- **Alternatives for thermosetting resin**
- **Recycling**
- **Materials for Pb-free soldering**
- **Non-halogen flame-retardant materials**
- **High thermal conductive materials**
- **Materials for Fine pitch connectors**
- **Optical disks**
- **Plastics for precision molding**
- **LCD / Organic EL / PDP**
- **High-performance optical films**

### Reduction of Environmental Burdens

- **Air Pollution (NOx, CO, HC)**
  - 1978 Clean Air Act
- **Acid Rain**
  - Popularization of Fuel-cell Vehicles (after 2010)
- **Noise**
  - Second-stage regulations of engine / road noise
- **Ozone Depletion (specified CFC)**
  - Montreal Protocol
  - Regulation of mileage CAFE
- **Greenhouse Warming (CO2, CFC)**
  - 10% CO2 reduction by 2015 (that of 1990)
- **Waste Treatment**
  - Recycling Law
  - Home Appliance Recycling Law
  - Revision of Waste Disposal Law
  - Recycling rate of 95% by 2015
- **Hazardous Substances (asbestos, solvent, Pb)**
  - Reduction of Pb usage to 1/5 (that of 1996)
  - Reduction of PRTR Law Substances
  - Restriction of Hazardous Substances Directive
Reduction of Environmental Burden
- Weight reduction of automobiles
- Renewable materials (PLA, 3GT)
- Non-halogen flame-retardant
- Materials for Pb-free soldering
- Alternatives for thermosetting resin
- Gas barrier materials
- Recycling

Demands for High Speed and Large Capacity in Information-Communication
- High thermal conductive materials
- High performance optical films
- Plastics for precision molding
- Fine pitch connectors

Access to customer information
- pursuance of individual development themes
- setting of targets to develop / new business development (SWAT) through integration of research, technology, and sales departments
- provision of total solution

Toray’s Strategy in Technological Development

Polymer Design
- Molecular-structure control
- Molecular-reaction control

Molding
- New molding technology
- Welding technology

Compounding, Alloy
- Nanotechnology
- Dispersion-control technology
- Compatibilizing technology

Analysis evaluation
- CAE

New Value
Toray’s Nano-alloy Technologies

Polymer A + Polymer B

Macromolecular Design
Design Technology of
Compatibilizing Agent
Nano-dispersion Technology

Conventional alloy

Phase-inversion alloy

Nano-dispersion alloy

Nano co-continuous alloy

Cross-section (TEM)

High impact PA
High impact PBT
High impact PPS
Low water absorption PA
High heat resistant PLA
High heat resistant PET
Flexible PLA
Polyester nano-alloy
Toray – A Market Leader of Engineering Plastics for Automobiles

Toray’s advantage for automobile applications

• Can offer wide array of product lineup as a comprehensive manufacturer of engineering plastics
• Strong product development capability due to tie-up with automobile manufacturers
• Preferential allocation of workforce to automobile applications
• Has workforce (production, sales, technology and research) in Nagoya, which is related especially with Toyota Motor Corp.

Rate of usage of Plastic Materials in Automobile Parts

~ Trends of Usage of Plastic Materials ~
Weight reduction / Processability / Modularization / Designing
Modularization of Automobile Parts

Modularization
- Innovative cost reduction → breakthrough in cost reduction limits of each components
- Weight reduction through reducing numbers of components → improvement of fuel efficiency, CO₂ reduction

Example of Aspiration Module

Intake Manifold (Nylon6 GF30)

Cylinder Head Cover (Nylon6 GF45)

Cockpit Module
- Instrument panel, Meter, Steering, etc.

Aspiration Module
- Intake manifold,
- Cylinder head cover,
- Throttle body,
- etc.

Front End Module
- Frame, Radiator, Head light, Bumper, etc.

Door Module
- Wind regulator, Door lock,
- Support frame, Door trim,
- etc.

Major Target Items for Modularization
CAE: Virtual production trial, virtual testing through computer simulation
- investigation of strength, reducing numbers of new-product prototypes by investigation in advance of molding conditions.
Toray’s Molding Technologies

Provide total solutions by developing plastic materials best-suited for customer’s molding technologies

Laser Welding
Welding technology utilizing laser heat (without vibration nor flash)

Vibration Welding
Welding technology utilizing frictional heat generated under pressure / vibration (applicable to wide range of molding shapes)

DSI (Die Slide Injection)
In-mold welding technology consisting of two-stage injection molding (applicable to three-dimensional welding surface)
Plastic Components Expected in Next Generation Power Train

- Power Module
  - Heat cycle, Electrical strength

- Capacitor Case
  - Electrical strength

- Fuel Cell Cooling System
  - Chemical resistance

- Motor Insulator
  - Flowability, Electrical strength

- Hydrogen Tank
  - H₂ barrier

- HV Rechargeable Battery Cell
  - Battery Case
  - Chemical resistance, Dimensional stability, Welding ability

Hybrid / Fuel-cell vehicles
Fuel-cell vehicles only
Partly used
Under development

Each component is expected to be used in either hybrid/fuel-cell vehicles or fuel-cell vehicles only.
## Expansion of Plastic Technologies into IT-related Areas

<table>
<thead>
<tr>
<th>Basic Technologies</th>
<th>Pursuit of Ultimate Performance</th>
<th>IT-related Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Polymer Technologies</strong></td>
<td><strong>Nylon Resin Amilan</strong></td>
<td><strong>PPS Resin Torelina</strong></td>
</tr>
<tr>
<td>New Polymers</td>
<td>Cellular phone components</td>
<td>Optical pickup slide-base</td>
</tr>
<tr>
<td>Polymer Design</td>
<td><strong>High Heat Resistance</strong></td>
<td>30% market share</td>
</tr>
<tr>
<td>Compounding Technologies</td>
<td><strong>High Chemical Resistance</strong></td>
<td>20% market share</td>
</tr>
<tr>
<td>Nano-alloy</td>
<td>Flame Retardancy</td>
<td><strong>LCP Resin Siveras</strong></td>
</tr>
<tr>
<td>Reinforced by fibers / fillers</td>
<td><strong>Moldability</strong></td>
<td>Fine-pitch FPC connector</td>
</tr>
<tr>
<td>Molding Technologies</td>
<td><strong>High Thermal Conductivity</strong></td>
<td>Hard disk drive</td>
</tr>
<tr>
<td>Flow Analysis</td>
<td></td>
<td>30% market share below 0.4mm pitch</td>
</tr>
<tr>
<td>Welding Technology</td>
<td></td>
<td>40% market share below 2.5inch</td>
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<tr>
<td><strong>PLA Resin Ecodear</strong></td>
<td>Note PCs Housing</td>
<td>Fixing component of copying machines</td>
</tr>
<tr>
<td>(* are Toray’s trademarks) Market shares are estimated by Toray</td>
<td></td>
<td><strong>First 1</strong></td>
</tr>
<tr>
<td><strong>High thermal conductive PPS Resin</strong> (planning to commercialize in 2006)</td>
<td>Evaluated in use for optical component</td>
<td></td>
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</tbody>
</table>
Advantage of LCP Resin, Siveras*

LCP resin is superior in flowability to other engineering plastics due to its liquid crystalline properties in molding.

Advantage of LCP resin, Siveras*
Superior in thin-wall flowability (reduced warpage and torsion of molded parts)

Adoption in small-size molding / fine-pitch connectors

New grade, Siveras* LX series, based on unique polymer design
Maintain heat-resistance for Pb-free SMT application
Improved weld strength by controlled solidification

Product examples

Fine pitch connectors
HDD actuator
Optical pickup lens holder

Weld : contacting part of melting polymer flows during molding of products
Development of High Thermal Conductive Thermoplastics

Succeeded in developing a thermoplastic with the world’s highest thermal conductivity, more than 100 times higher compared to conventional plastics, by improving intermolecular interaction between the plastic and the high thermal conductive filler.

<Advantages (compared with aluminum and ceramics)>
- Lightweight
- Quietness
- Low Cost
- High efficient production of complex parts

<Correlation of thermal conductivity and material density>

<table>
<thead>
<tr>
<th>Material Density (g/cm³)</th>
<th>Thermal Conductivity (W/mK)</th>
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</thead>
<tbody>
<tr>
<td>100</td>
<td>10</td>
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<td>10</td>
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<td>0.1</td>
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<tr>
<td>0.1</td>
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</tr>
</tbody>
</table>

- Alumina ceramics
- Graphite, CF compound plastics
- Normal resins
- Newly-developed material

<Thermal conductivity in an actual part>
Newly-developed material has the equivalent heat release properties as those of aluminum die-cast.

Expansion in areas where high heat-release / energy-saving properties are required such as home appliances / office automation equipment / automobiles, and others.
Development of Non-halogen Flame-retardant Materials

World trends in flame-retardant materials
1. RoHS Directive  Usage of specific bromine flame-retardant agents is prohibited in principle for electrical/electronic applications.
2. WEEE Directive  De-installation of plastics containing specific bromine flame-retardant agents from the disposing electrical / electronic appliances is required.

Toray’s Non-halogen Flame-retardant Technology
Selective formation of carbonized layer on the surface of molded part

Non-halogen flame-retardant agent
Polymers
Carbonized layer formation agent
flame
extinction
Carbonized layer

Toray’s Advantage
Non-halogen
Antimony-free
Ready for full-color

Toray’s Non-halogen Flame-retardant Materials:
PBT, PET, Nylon, ABS, PLA

Product examples

- Printer fixing unit cover
- Electrical / electronic connector

PBT Resin
Nylon Resin
Recycling Activities in Toray’s Plastics Businesses

Toray established the “Plastics Ecology & Recycling Department” in August 2004 in order to promote plastics & films recycling. Focusing on material recycling which is considered to be advantageous in “Life Cycle Assessment (LCA)”, Toray is promoting development and establishment of recycling business models. Toray started closed-material recycling of home appliance components with Mitsubishi Electric in February 2005.

1. Effective utilization of production process derivatives

Utilize film derivatives to resins and fiber products

2. Establishment of recycling system with Mitsubishi Electric Corp.

3. Expansion of eco-plastics businesses

Expand activities as part of the “ecodream”, Toray’s total recycling, energy-saving, and environmental preservation system.
Developed high-performance material based on renewable polylactic acid, utilizing Toray’s “nano-alloy technology” and “flame-retardant technology”
Enhancing performances of polylactic acid (PLA) resins for electronic applications by utilizing polymer alloy technologies
Contributing to global environment, through reduction of CO₂ emissions and consumption of fossil resources

Polylactic Acid Resin

Non-halogen, flame-retardant
Improved heat-resistance properties and realized high-level of flame-retardancy by utilizing alloy technology and non-halogen flame retardant technology

Transparent, high heat-resistant
Improved heat-resistance and advanced optical characteristics by utilizing nano-alloy technology

World’s first! Plant-based PC housing

Co-developed with Fujitsu Ltd. → released in Jan., 2005

Under co-development with Victor Co. of Japan

DVD disks from corn

Enhancing performances of polylactic acid (PLA) resins for electronic applications by utilizing polymer alloy technologies
Contributing to global environment, through reduction of CO₂ emissions and consumption of fossil resources

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Co-developed with Fujitsu Ltd. → released in Jan., 2005

Under co-development with Victor Co. of Japan

DVD disks from corn
Business Expansion Plan (Sales)

Sum total including non-consolidated subsidiaries and affiliates

<table>
<thead>
<tr>
<th>Year</th>
<th>¥ billion/year</th>
</tr>
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<tbody>
<tr>
<td>'04</td>
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<tr>
<td>'05</td>
<td>100</td>
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<tr>
<td>'06</td>
<td>200</td>
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<tr>
<td>'09</td>
<td>500</td>
</tr>
<tr>
<td>'10</td>
<td>600</td>
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</table>

- ABS
- Engineering
- Plastics
- Others
III. Outlines and Strategies for Films Businesses
<table>
<thead>
<tr>
<th>Product</th>
<th>Features</th>
<th>Major Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LUMIRROR</strong></td>
<td>High-strength, Transparency, Chemical resistance</td>
<td>Industrial, Packaging, Magnetic, Capacitors</td>
</tr>
<tr>
<td>(baxially-oriented PET film)</td>
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<tr>
<td><strong>TORAYFAN</strong></td>
<td>Lightness, High tensile strength, Electrical properties, Mechanical properties, Chemical resistance, Moisture barrier</td>
<td>Industrial, Print lamination, Packaging, Capacitors</td>
</tr>
<tr>
<td>(baxially-oriented PP film)</td>
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<tr>
<td><strong>TORELINA</strong></td>
<td>High / low temperature resistance, Low flammability, Chemical resistance, Dimension stability to humidity, Creep characteristics</td>
<td>Capacitors, Electric insulation, Electronic components, OA equipment</td>
</tr>
<tr>
<td>(PPS film)</td>
<td></td>
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</tr>
<tr>
<td><strong>MICTRON</strong></td>
<td>High rigidity, Heat resistance, Excellent moisture-proof property, Gas barrier property, Surface smoothness</td>
<td>Computer data storage</td>
</tr>
<tr>
<td>(para-based aramid film)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TRETEC</strong></td>
<td>Excellent uncontamination property, Excellent workability, Heat resistance</td>
<td>Surface protection of optical functional films</td>
</tr>
<tr>
<td>(polyolefin complex film)</td>
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**Toray’s No.1 Business Lumirror*’s Strength**

1. No. 1 in world market share: 20% share on volume base
   Production capacity of 6 global production sites:
   310 thousand tons / year

2. Global operation capability to respond quickly with change of business circumstances
   Maximize profitability through best selection for both market and production
   Strength of local production
   • Buy Korean policy
   • Speedy technical service
   • Provide solutions to customers
   • Respond to unique food culture (Packaging)
   Strength of proper location production
   • Commodity supply from PFR, YTP, TSI
   • Supply of value-added products from Japan, US, Europe, Korea
   • Efficiency of operation

3. Response capability in industrial structure changes and technology innovation
   Spread in wide field of the industry
   Newly created applications

   ![Diagram of newly created applications: Digital photo, LCD, PDP, Hybrid car, Environment, Energy, Solar battery, Mobile, DVC, Silver salt film, Digital recording media, IT handset.]

Japan is the technology development base with advanced technological capabilities

Production base in expanding Asian market (Japan, Korea, Malaysia, China)
Strategies for Expansion of Films Businesses

Business Environment

1. Overall steady growth (+4% points/yr) while significant structural change by region and application
   1. Expansion in China and Asia market
   2. Demand growth in IT-related applications
   3. Creation of new demand derived from concern in environmental and safety issues

2. The imbalance of supply and demand
   - Large capacity increase of thin-type in China

3. High price of raw material will continue

Basic Policy

1. Expansion of No.1 business, Lumirror* through aggressive investment
   1. “Offensive” global engineering
   2. Deepening and expansion of global operations with quick response capabilities with change of business circumstances
   3. Expansion of strategic applications

2. Expansion of Only 1 businesses (Torelina*, Mictron*)

3. Business structure reform through expansion of film processing businesses

Business expansion and strengthening of profitability in growing markets
Sales Trends of Films Businesses

Unit: ¥ Billion Including internal sales

Sum total including non-consolidated subsidiaries and affiliates

Forecast

Toray | Japanese | Overseas
--- | --- | ---
1990 | | |
1991 | | |
1992 | | |
1993 | | |
1994 | | |
1995 | | |
1996 | | |
1997 | | |
1998 | | |
1999 | | |
2000 | | |
2001 | | |
2002 | | |
2003 | | |
2004 | | |
2005 | | |

Forecast 40
1. **Expansion of No. 1 Business, Lumirror* through aggressive Investment**

Maximize profitability by Role and Task Clarification of each Production Site

(1) “Offensive” global engineering

1. Increase capacity of thick-type (optical and industrial applications)
2. Re-engineering of TSI (de-HV, response to Korean optical market)
3. Response to China market
4. Expansion of value-added products at TPA, TPEu

(2) Deepening and expansion of global operation

Maximize profitability through best selection for both market and production

1. Expansion of PFR, TSI
2. Leverage YTP

(3) Creation of new demand and expansion of strategic applications following the industrial structure change and technology innovation

1. Information and telecommunication
2. Environment, safety, and Energy
3. Life sciences
Expansion of High-value Added, Strategic Applications

- Information & Telecommunications (expansion of IT-related area)
  - Components for Flat Panel Display (FPD)
  - Materials for Digital Photos
  - Materials for Data Storage Usage

- Environment, Safety, and Energy
  - Solar Battery Components
  - Building Materials
  - Components for Hybrid Car
  - Non-petrochemical (plant-derived) materials

- Life Sciences
  - High Barrier Food Packaging Materials
Optical Films for FPDs

Toray PET film Lumirror® is used in many components of expanding LCDs and PDPs. Toray boosts synergy with film processing business and further expands / strengthens film businesses for LCDs.

### LCD Panel Composition
- Glass
- Retardation Film
- Diffusion Film
- Prism Sheet
- Light Guide Plate
- Polarizer
- Reflector
- Fluorescent Tube

### PDP Panel Composition
- Glass
- Anti-reflection (AR) Film
- Near-infrared Ray (NIR) Protection Film
- Electromagnetic Wave (EMI) Shielding Film
- Front Filter
- Plasma Panel

### Graph
- Total Area (million m²)
- Year (2003-2009)
- Types of Displays:
  - Large flat-screen TV
  - PDP
  - LCD-TV
  - LCD - PC
  - LCD - Medium / small
Optical PET film demand for FPD use is expected to increase by annually 25% due to drastic growth of personal computers and LCDs/PDPs for large-size TV applications. Toray strives for business expansion by share-up in the market including film processing products.
Films for Digital Photos (1)

Developing both applications for TTR and receiver film

◆ Dye sublimation printer

◆ Dye sublimation printing method

Dye sublimation ink (Y, M, C)

Thermal head

Ink ribbon

Receiver film

Lumirror*

Lumirror*
Films for Digital Photos (2)

Requirements of ribbon application for dye sublimation printer and Toray’s strength

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Toray’s strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-quality images</td>
<td>Surface formation / winding technology</td>
</tr>
<tr>
<td>High-sensitivity</td>
<td>Surface treatment technology</td>
</tr>
<tr>
<td>High speed</td>
<td>Ultra-thin layer formation technology</td>
</tr>
</tbody>
</table>

Expansion of ribbons for dye sublimation printer

Global operation system of Japan, US, Europe, Korea

2005 ⇒ 2009

- Sales volume: 5 x
- World market share: over 90%

Market share is Toray’s estimation
Films for Solar Battery

Toray has 100% domestic market share in films for solar battery application through capability in response to varying composition of back sheets. Able to provide a wide range of line-up including materials with low-hydrolyzable, UV resistant properties.

Market share is Toray's estimation

- Solar battery

- Solar battery composition

<table>
<thead>
<tr>
<th>Glass</th>
<th>EVA</th>
<th>Lumirror*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar battery cell</td>
<td>EVA</td>
<td></td>
</tr>
<tr>
<td>Back sheet</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Expansion of European market

Developed upgraded low-hydrolyzable, UV resistant types

Anticipated installation of solar energy

((unit: MW)
Films of Capacitors for Hybrid Cars

- Loaded onto hybrid cars
- Balance mileage and driving performance ⇒ high-voltage drive capable of high-performance motors

Realized high-capacity film capacitors (actual efficiency: + 78% to conventional type)

Features of capacitors using Torayfan* V-type

<table>
<thead>
<tr>
<th>Feature</th>
<th>V-type</th>
<th>Electrolytic Capacitor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage proof</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Stability</td>
<td>○</td>
<td>△</td>
</tr>
<tr>
<td>Credibility</td>
<td>○</td>
<td>△</td>
</tr>
<tr>
<td>Capacitor life</td>
<td>○</td>
<td>△</td>
</tr>
</tbody>
</table>

Role of capacitors

- Absorb the voltage variation at acceleration / deceleration
- Improve driving performance

Well-designed for reliability (quality variation) in high-voltage usage
- 90% market share

Market share is Toray's estimation

Forecast numbers of hybrid cars (unit: 10 thousand cars)

- '02: 20, '03: 50, '04: 70, '05: 90, '06: 110, '07: 130, '08: 150, '09: 170, '10: 190
Enhancement of Core Technologies

- High-performance polymers technology
  - nano-alloy

- Fine multi-layer control technology
  - thin-layer laminate
  - multi-layer laminate

- Nano-thickness control technology
  - high-function die
  - advanced control (PPC)

- High-functional coating technology
  - high-functional coating materials

- Zero defect, longitudinal extension technology

- High-functional coating technology
  - high-functional coating materials

- Dimensional stabilization technology
  - simultaneous biaxial drawing

- Advanced winding technology
  - electrostatic control

Develops new products through enhancement of No. 1 core technologies which are highly-evaluated in the market.
Multi-nanolayer Films

1000nm (=1μm) 100nm 10nm 1nm

Conventional Technology New Technology

Avg. Layer Thickness (nm)

PET Diverse Polymer

Thermal Shrinkage in Vertical Direction (%)

Tear Resistance (N / mm)

Nano-effect

Development of applications

- Glass protective films (for safety & security)
- Electronic Materials
- Optical Functional Tapes

Falling ball penetration test (height:3m, weight:2.2kg)

[Newly developed film] Succeeded

[PET film] Failed

Penetration
Succeeded first in the world in developing next generation process film with world-class level of surface resistivity and moisture-independent “extreme antistatic” properties based on Toray’s unique nano-coating technology.

★ Toray develops wide-range of applications including IT-, optical-related base materials for film processing using solution, various coating films, packages of electronic components, and dust-proof films.
Succeeded first in the world in developing “fully biodegradable flexible films” made of environment-friendly plant-based Poly Lactic Acid (PLA).

Comparison of film properties

**Elasticity (Gpa)**

- 50
- 100
- 150
- 200

**Melting Point (°C)**

- 0
- 50
- 100
- 150
- 200

**Comparison of film properties**

- PVDC: Polyvinylidene chloride
- LDPE: Low-density polyethylene
- PBAT: Polybutylene adipate terephthalate
- PBSA: Polybutylene succinate adipate
- PCL: Polycaprolactone

Flexible PLA film

Plastic PLA film

100% PLA film

Better

Flexible PLA film

**Legend:**

PLA: Polylactic Acid (PLA) Film

PVDC: Polyvinylidene chloride
LDPE: Low-density polyethylene
PBAT: Polybutylene adipate terephthalate
PBSA: Polybutylene succinate adipate
PCL: Polycaprolactone

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## 2. Expansion and Development of New Applications of Only 1, First 1 Businesses

### (1) Expansion of PPS films

1. Expansion of existing applications
2. Development of new applications
3. Further expansion of production capacity

### (2) Expansion of Mictron*

1. Expansion of computer data storage applications
2. Development of advanced electronic circuit materials
**Application development of Torelina* Films**

Torelina* films are adopted in small-size IT-related components such as cellular phones and chip capacitors while application for electric insulation is expanding by utilizing the heat resistances and nonhydrolyzable properties.

**Application development of Torelina* films**

**Properties of Torelina* films**

Excel in chemical resistance, electronic properties, and heat resistance

<table>
<thead>
<tr>
<th>Properties</th>
<th>Torelina*</th>
<th>PEN</th>
<th>PET</th>
<th>PI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat resistance</td>
<td>🌟</td>
<td>🏷️</td>
<td>🏷️</td>
<td>🌟</td>
</tr>
<tr>
<td>Chemical resistance</td>
<td>🌟</td>
<td>✘</td>
<td>✘</td>
<td>✘</td>
</tr>
<tr>
<td>Release characteristics</td>
<td>🌟</td>
<td>✘</td>
<td>🌟</td>
<td>✘</td>
</tr>
<tr>
<td>Electronic properties</td>
<td>🌟</td>
<td>✘</td>
<td>🌟</td>
<td>✘</td>
</tr>
<tr>
<td>(low dielectric loss)</td>
<td>🌟</td>
<td>✘</td>
<td>🌟</td>
<td>✘</td>
</tr>
</tbody>
</table>

**World first, surface-mounted small size film capacitor**

Reduction of environmental burden ⇒ demand expansion of heat resistant electric insulation film

**Conventional discrete**

- Circuit board
- Lead wire

**Surface mounting**

- Circuit board
- Solder

**Graph**

- Elongation Retention rate (%)
- PPS film
- 155°C 100% RH
- PEN film
- PET film
- PI film

**Aging Days**

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Expansion of Torelina*Films

Scale up of Torelina* films by 2010.

Increase demands for capacitors
Increase demands for LCD release
Increase overseas demand
Increase in-vehicle motor

Triple expansion as of 2004

Technological innovation / Development of new products

- Introduction of multi-layer technology
- Improvement of electric insulation of capacitors
- Nano-alloy
- Mass production of submicron films
- Establishment of manufacturing technology of extra thick films
**Development of Applications of Micron* Films**

Micron* is the only film capable for further high capacitance of data storage tapes.

- **Usages of tape drives**
  - DLT (Lumirror*)
  - DDS (Micron*)

- **Structure of entry server class**
  - HDD

- **Demand characteristics of high capacitance and Toray’s strength**
  - High capacitance
  - Surface smoothness, thin-layer
  - Optimization of nano-scale asperity

- **Credibility**
  - Dimensional stability / Tensile strength

- **High-performance technology**
  - Only Micron* reachable
  - Current generation
Applications expansion of Mictron* Films (Industrial application)

**Strength of Mictron* business**
- Material with excellent properties
- Wide-range of application developed through experience in Lumirror*
- Technological / Development capabilities acquired from experience in Lumirror*

**Advantages in new industrial applications**
- Properties most suitable for high density circuit materials, films for high-sensitive sensors

**Application development of Mictron***

**Film properties**
- High rigidity
- High heat resistance
- Hydrolysis resistance
- Surface smoothness
- Chemical resistance
- Gas barrier property
- Electric insulation property

**Applications**
- Magnetic recording media
- Circuit boards
- Shielding materials
- Insulation / covering materials
- Organic transistors
- Packaging materials

**Utilizing surface formation technology acquired from experience in films for data storage**
- Forms nano-scale protrusions smaller than particles of tobacco smoke or influenza virus

**Temperature limit (°C)**

<table>
<thead>
<tr>
<th>Material</th>
<th>Elasticity modulus (Gpa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PET</td>
<td>4</td>
</tr>
<tr>
<td>PEN</td>
<td>8</td>
</tr>
<tr>
<td>Mictron* (thickness 2~25μm)</td>
<td>12</td>
</tr>
<tr>
<td>PI (thickness 9μm ≤)</td>
<td>200~400</td>
</tr>
</tbody>
</table>

**Utilizing surface formation technology acquired from experience in films for data storage**
- Particles of tobacco smoke: Diameter: 200~500nm
- Influenza virus: Diameter: 100nm
- AFM image: Mictron* (10nm)

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3. Business Structure Reform through Expansion of Films Businesses

(1) Expansion of film processing businesses

1. Expansion of new base / process integrated film products (TAF, TSI, TTS, Toray)
   a. PDP
   b. LCD
   c. Solar battery sheet
   d. High-barrier packaging material
   e. Circuit materials, etc.

2. Reorganization and expansion of metallizing facilities for capacitors

3. Early commercialization and expansion of new businesses through M&A and alliances

(2) Expansion of new material, new process film products

1. New advanced optical films
2. PLA
3. Non-oriented films
4. Multi-layer films
5. Nano-alloy films

(3) Strengthening development workforce

1. Reinforcing development system of film processing products
2. Enhancing and utilizing global development structure
Optical Films for FPDs (anti-reflection (AR) films for PDPs)

Plasma Display Panel (PDP)

PDP panel composition

Advanced AR film, Lumiclear*

PDP panel composition

Advanced AR film, Lumiclear*

Development of next generation AR film

First with PET film to achieve excellent appearance without light interference stripes
Pioneer to develop adhesiveless copper plated polyimide multi-layer film which is indispensable in COF bonding of FPD drive circuits.

“Composition and application of Metaloyal*”

Properties of Metaloyal*

<General Properties>
- Flexible copper properties
- availability for thin films under 8μ
- Transparency under copper etching
- ease of both side processing (2 metals)

<Advantages in customers>
- Excellent flex properties
- availability for Fine Pitch patterning
- availability for TAB bonder
- availability for 2 metal type COF
Surface protection film TRETEC* is complex film produced by co-extrusion method. TRETEC* can avoid contaminations and paste remaining and is used mainly for surface protection of optical functional films.

Characteristics of TRETEC*

- Excellent Anti-contamination (no paste remaining)
- Heat resistance type film can be released easily after high temperature treatment
- There are also excellent type films for fisheye, anti-contamination
- available in wide film (3,000mm)

Used for LCD related functional films:
- AR film
- Polarizer
- Liquid Crystal cell
- Retardation Film
- Prism Sheet
- Diffusion Film
- Light Guide Plate
- Reflector

Surface protection film TRETEC* is complex film produced by co-extrusion method. TRETEC* can avoid contaminations and paste remaining and is used mainly for surface protection of optical functional films.
Transparency metallized film BARRIALOX*, which came out of Toray group’s technology integration, reaches the highest level as a film for packaging.

**Application of BARRIALOX***

- [Dried Food]
- [Liquid]
- [Ham]

**Characteristics of BARRIALOX***

- Excellent oxygen and moisture barrier
- Dioxin free
- Available for metal detectors
- Easy eye confirmation of ingredients

**Components of BARRIALOX***

1. **Coating** specific gas barrier high molecular resin with printability and retort suitability over Alumina layer
2. **Forming** nano-level alumina membrane by specific reactive vacuum metallizing over PET film
3. **Exclusive use** base film to bring out best gas barrier properties after metallizing
Base films (Lumirror*, TORAYFAN*, etc.)

Film processing products

Sum total including non-consolidated subsidiaries and affiliates

Business expansion plan (Sales)
IV. Summary
Plastics and Films businesses expansion plan (Sales)

Sum total including non-consolidated subsidiaries and affiliates

Billion Yen / Year

- Overseas
- Japanese
- Toray

Plan: Fiscal Year Forecast 66

'04 '05 '10

Forecast Plan

Billion Yen / Year

0 100 200 300 400 500 600

'04 '05 '10
Plastics and Films businesses mid-term plan image (Operating Income)

Sum total including non-consolidated subsidiaries and affiliates

Billion Yen / Year

- Toray
- Japanese
- Overseas

Fiscal Year

- '02
- '03
- '04
- '05 Forecast
- '08 Plan
- '10 Plan
### Main subsidiaries and affiliates of Plastics businesses

<table>
<thead>
<tr>
<th>Companies</th>
<th>Products</th>
<th>Location</th>
<th>Established Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toyo Plastic Seiko Co., Ltd.</td>
<td>Plastics moldings</td>
<td>Japan</td>
<td>1961</td>
</tr>
<tr>
<td>Toray PEF Products Inc.</td>
<td>Polyolefin foam products</td>
<td>Japan</td>
<td>1980</td>
</tr>
<tr>
<td>TREC (Toray Resin Co.)</td>
<td>Engineering plastics compoundings</td>
<td>U.S.A</td>
<td>1989</td>
</tr>
<tr>
<td>TPM (Toray Plastics (Malaysia) Sdn. Berhad)</td>
<td>ABS resins</td>
<td>Malaysia</td>
<td>1990</td>
</tr>
<tr>
<td>PNR (P.T. Petnesia Resindo)</td>
<td>PET resins for bottles</td>
<td>Indonesia</td>
<td>1994</td>
</tr>
<tr>
<td>TPHK/SZ (Toray Plastics (Hong Kong) Ltd.)</td>
<td>Plastics compoundings</td>
<td>Hong Kong-China</td>
<td>1995</td>
</tr>
<tr>
<td>RKH/Z (Toray Sanko Precision (H.K.) Ltd.)</td>
<td>Plastics moldings</td>
<td>Hong Kong-China</td>
<td>1995</td>
</tr>
<tr>
<td>KTP (KTP Industries Inc.)</td>
<td>POM resins</td>
<td>Korea</td>
<td>1996</td>
</tr>
<tr>
<td>TTS (Thai Toray Synthetics Co., Ltd.)</td>
<td>Engineering plastics compoundings</td>
<td>Thailand</td>
<td>1998</td>
</tr>
<tr>
<td>TPRC (Thai PET Resin Co., Ltd.)</td>
<td>PET resins for bottles</td>
<td>Thailand</td>
<td>2002</td>
</tr>
<tr>
<td>TBPR (Toray BASF PBT Resin Sdn. Berhad)</td>
<td>PBT resins</td>
<td>Malaysia</td>
<td>2004</td>
</tr>
<tr>
<td>SMPC (Shanghai Mitsui Plastic Compounds Ltd.)</td>
<td>Plastics compoundings</td>
<td>China</td>
<td>1994</td>
</tr>
</tbody>
</table>
# Main subsidiaries and affiliates of Films businesses

<table>
<thead>
<tr>
<th>Companies</th>
<th>Products</th>
<th>Location</th>
<th>Established Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toray Advanced Film Co., Ltd.</td>
<td>Film processing products</td>
<td>Japan</td>
<td>2004</td>
</tr>
<tr>
<td>TPA (Toray Plastics America, Inc.)</td>
<td>OPP films, PET films</td>
<td>U.S.A</td>
<td>1985</td>
</tr>
<tr>
<td>TTS (Thai Toray Synthetics Co., Ltd.)</td>
<td>Metallized films for packaging</td>
<td>Thailand</td>
<td>1988</td>
</tr>
<tr>
<td>TPEu (Toray Plastics Europe S. A.)</td>
<td>PET films</td>
<td>France</td>
<td>1996</td>
</tr>
<tr>
<td>PFR (Penfibre Sdn. Berhad)</td>
<td>PET films</td>
<td>Malaysia</td>
<td>1997</td>
</tr>
<tr>
<td>TSI (Toray Saehan Inc.)</td>
<td>PET film, Film processing products</td>
<td>Korea</td>
<td>1999</td>
</tr>
<tr>
<td>YTP (Yihua Toray Polyester Film Co., Ltd.)</td>
<td>PET films</td>
<td>China</td>
<td>2001</td>
</tr>
<tr>
<td>TFZ (Toray Film Products Zhongshan Ltd.)</td>
<td>Metallized films for capacitors</td>
<td>China</td>
<td>2002</td>
</tr>
</tbody>
</table>
Description of predicted business results, Projections, and business plans contained, in this material are based on predictive forecasts of the future business environment made at the present time.

The material in this presentation is not a guarantee of the Company’s future business Performance.