The *EVAL* Business and Its Future Developments

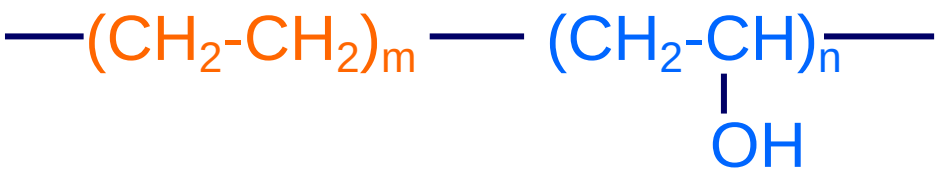
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Kuraray Co., Ltd.

EVAL

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What is *EVAL*

Chemical name : Ethylene Vinyl Alcohol Copolymer (EVOH)

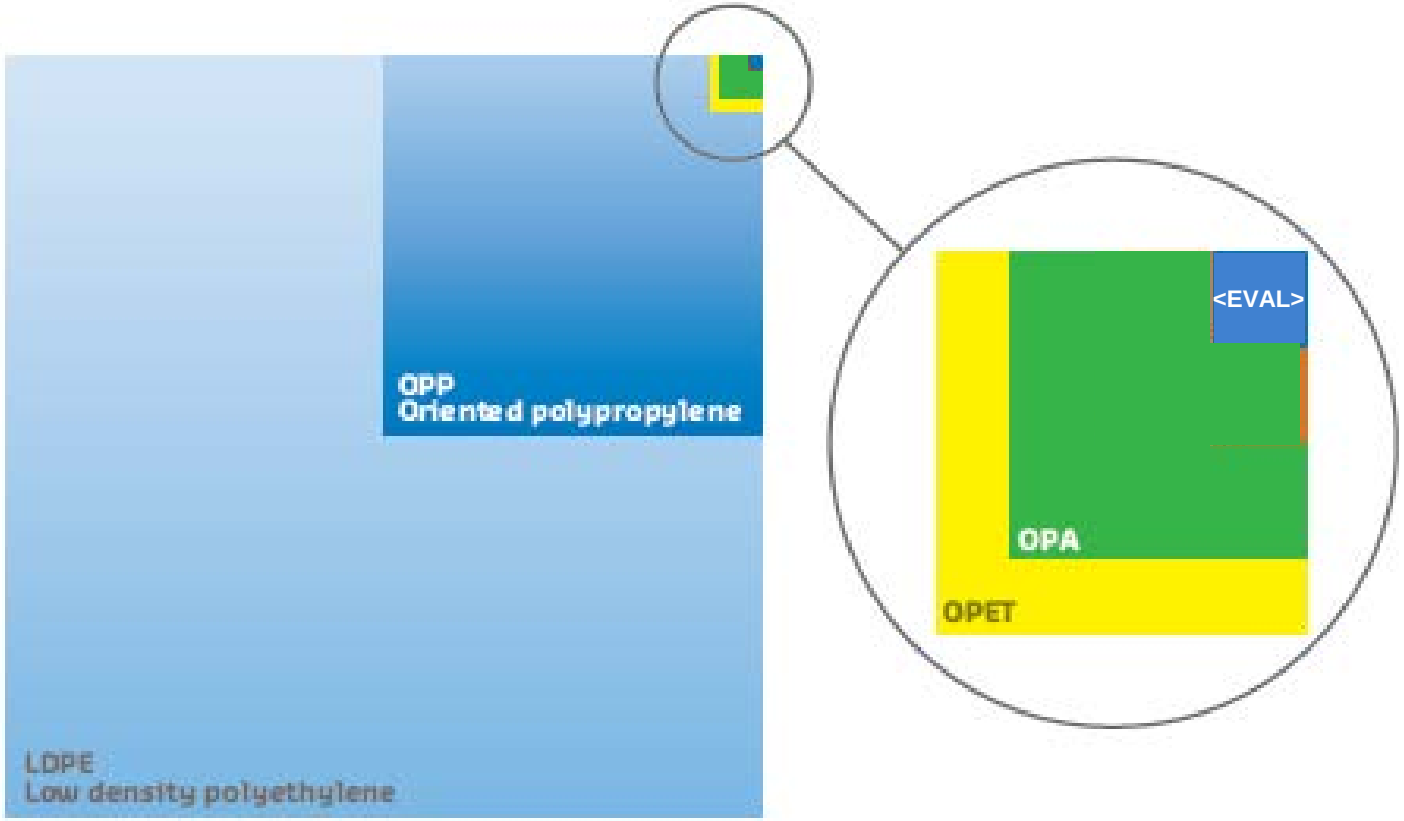


Main raw materials: Vinyl acetate monomer (VAM), Ethylene

Main characteristics: High gas barrier properties, processability

Main applications : Food packaging, industrial application
—multi-layer structure with commodity plastics

EVAL gas barrier properties



Gas barrier property equivalence: 1 mm layer of *EVAL* = 10 m layer of LDPE (1:10,000)

Example of *EVAL* applications (food packaging)

＊Flexible



Nylon/ *EVAL* /Polyethylene

＊Bottle



Polyethylene/ *EVAL* /Polyethylene

＊Cup, Tray



Polypropylene/*EVAL*/Polypropylene

＊Tube



Polyethylene/ *EVAL* /Polyethylene

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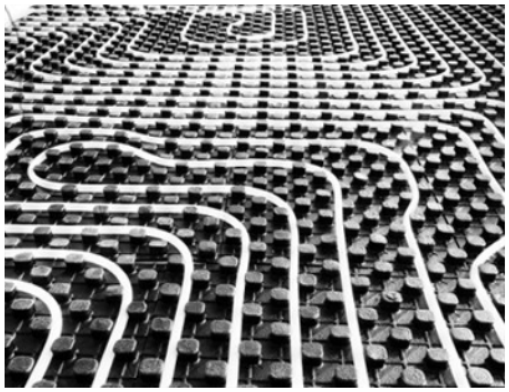
Example of *EVAL* applications (industrial uses)

∗Plastic fuel tanks



Polyethylene/ *EVAL* /Polyethylene

∗Floor heating pipe



Polyethylene/ *EVAL* /Polyethylene

∗Vacuum insulation panels





EVAL resin → *EVAL* film → Vacuum metallizing → Lamination with other films → Bag making

Global framework



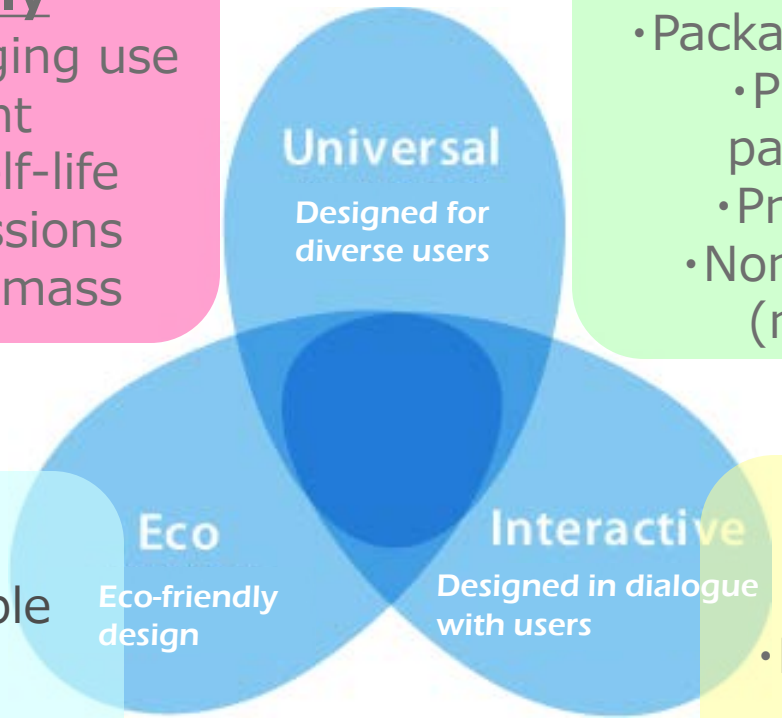
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Business environment and trends in packaging materials

Eco-Friendly
- Reducing packaging use
- Lightweight
- Extending shelf-life
- Low CO2 emissions
- Recycling/Biomass

Safety & Quality
- Package contents visible
- Preservation of package contents
- Preservative-free
- Non-contaminating (non-aluminum)

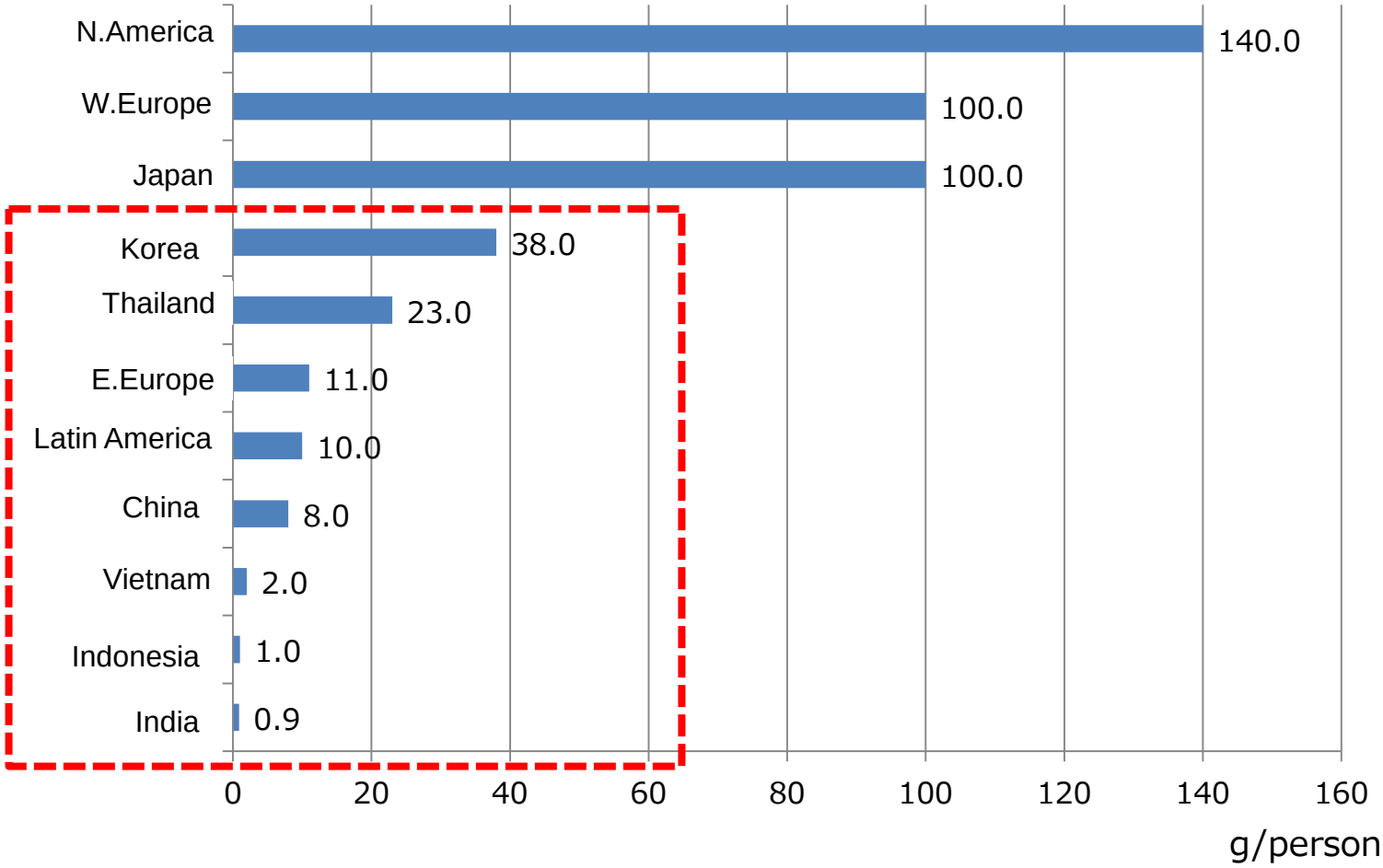


Convenience
- Easy-open/reclosable
- Microwavable (non-aluminum)
- Individual food packaging
- Easy to handle

Design
- Design flexibility
- Novelty and originality
- Easy to see and understand
- Package contents visible

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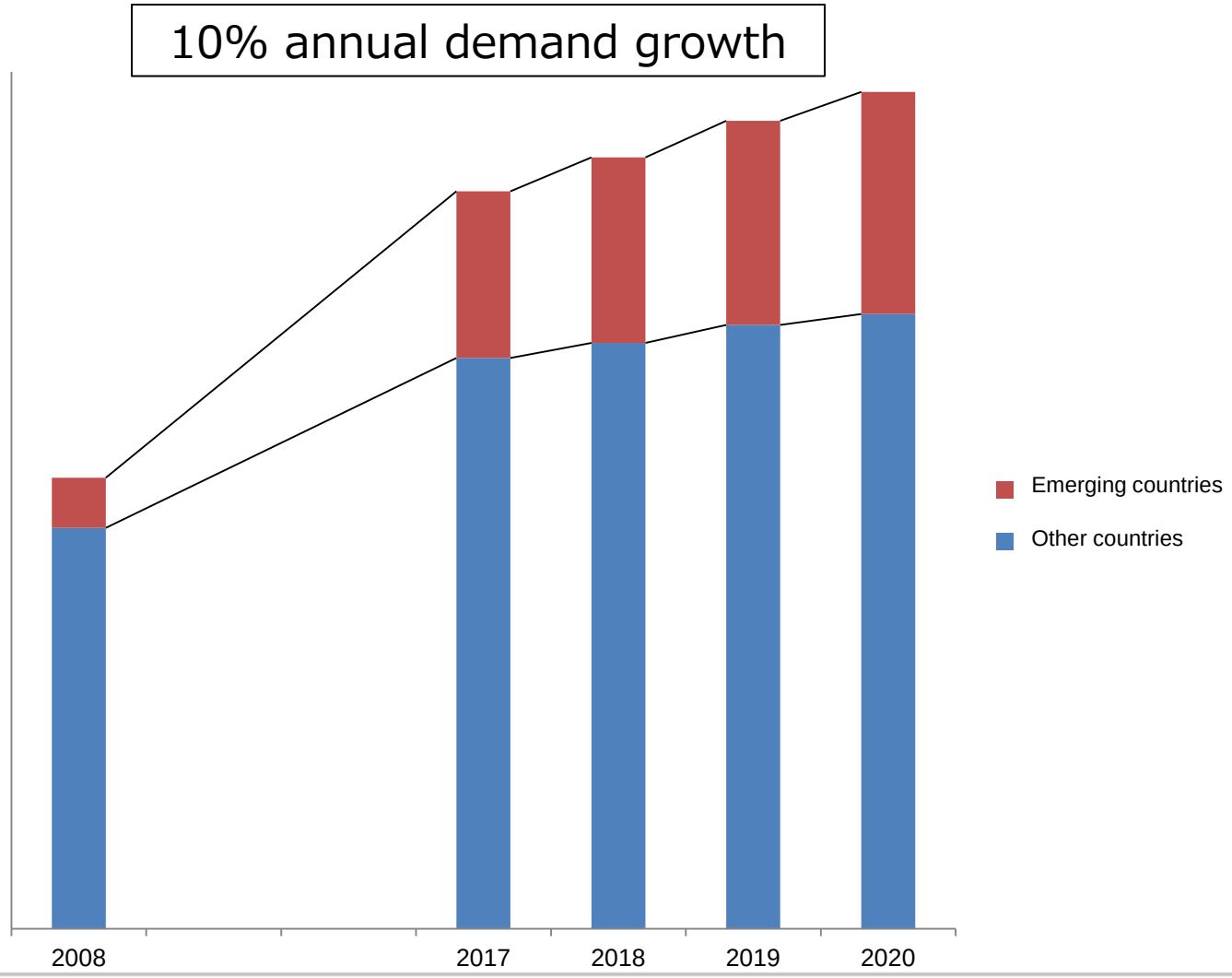
EVOH use per person by country/region



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Demand forecast in emerging countries

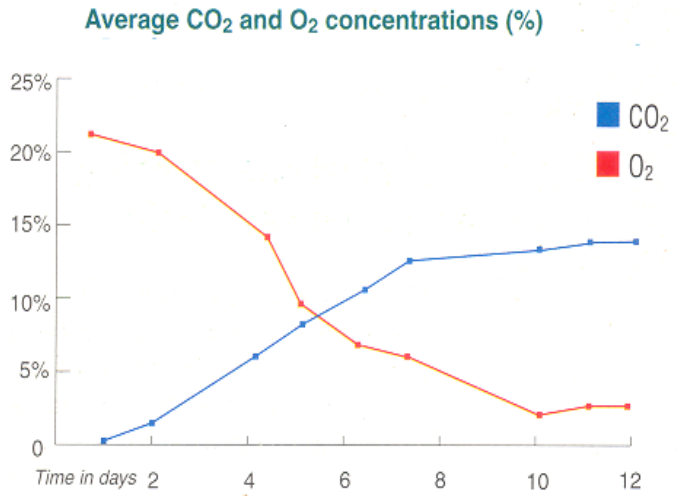


New Applications

1. Grain storage bags(Hermetic Bags)

Protects stored grain from mold, insects and moisture
to reduce food loss in emerging countries

- Post harvest problem: Molds, insects, moisture
- Living organism's respiration makes high CO2 and low O2 atmosphere
- Maintaining a low-oxygen environment using *EVAL* is a low-cost and easy way to suppress the growth of bacteria and insects and maintain grain quality





Convenience

New Applications

2. UHT Milk Pouch

Expanding milk distribution using low-cost, lightweight, simple packaging

- Raw milk will keep up to one week, but only if carefully stored at cold temperature of 2.2-3.3°C.

- UHT milk typically has a shelf-life of at least four months, without cold chain.

- Distribution becomes possible to more remote areas, especially those without reliable cold chain



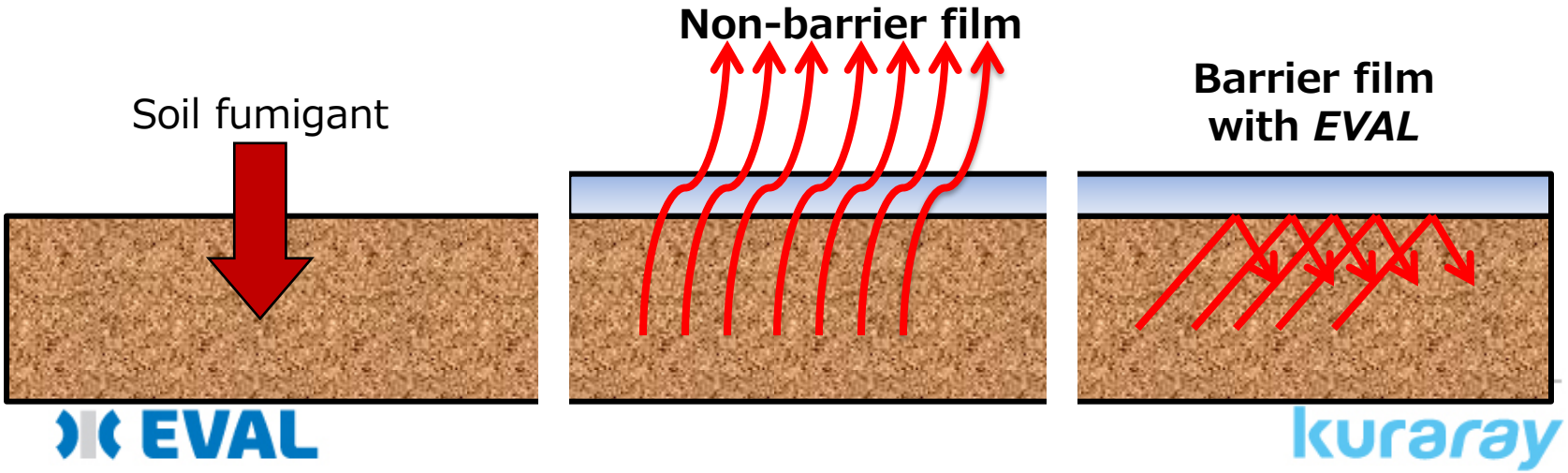
New Applications

3. Fumigation film



Traps fumigants in soil for safe, low-cost soil fumigation

- Reduces emissions of fumigants to the atmosphere
- Effective fumigation increases crop yields
- Reduces the amount of fumigant needed, bringing down costs



New Applications

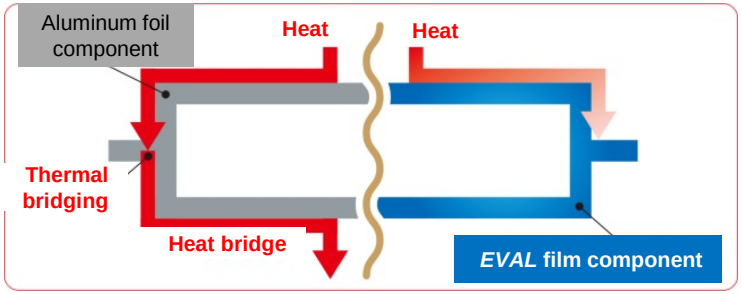
4. Vacuum insulation panels (VIP)

Energy-saving home appliances with excellent insulation reduce environmental burden

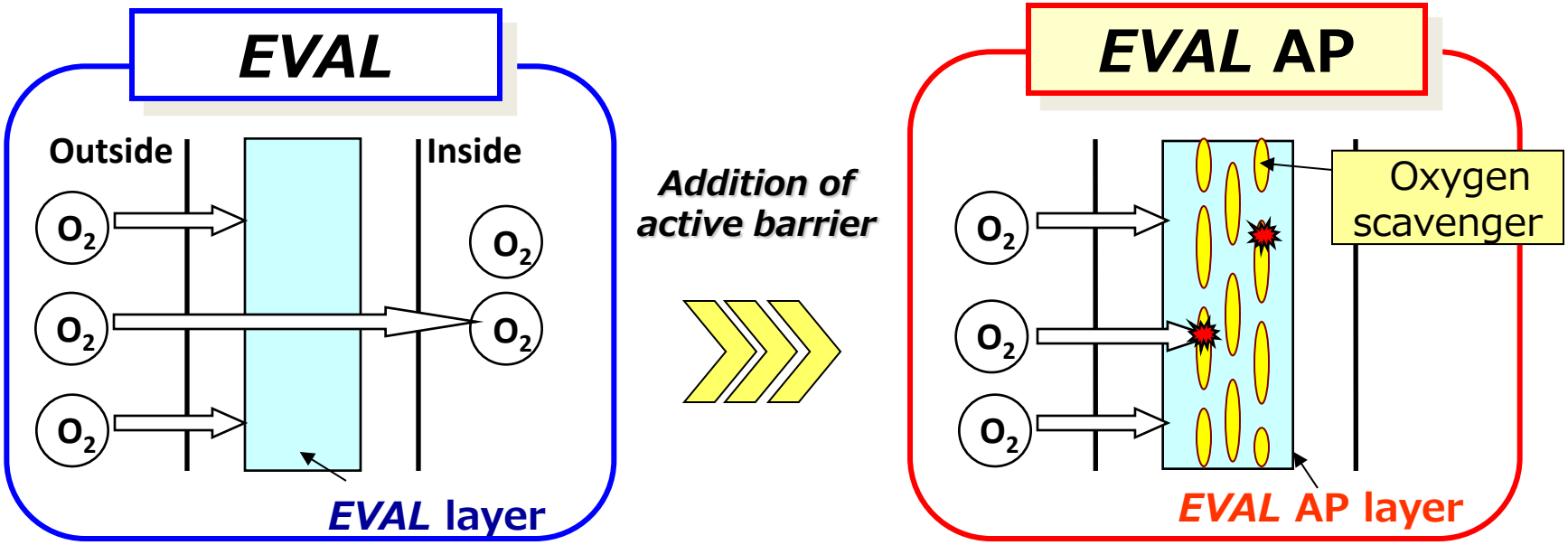
- Acts as an outer barrier on vacuum insulation panels (VIPs) to maintain the vacuum
- *EVAL* offers lower thermal conductivity than aluminum
- Improves VIP insulating performance when used in outer packaging
- Highly isolative VIPs help save energy and increase storage capacity (by making insulating layers thinner)
- Adopted by major Japanese appliance makers for use in large refrigerators; now spreading globally
- Strengthening marketing for insulating applications other than refrigerators







Specialty grade (oxygen absorbing *EVAL*)



Potential applications

Metal cans



Plastic containers/lids





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Driving forces for further growth

1.Global population growth

2.Replacement of glass bottles and metal cans to reduce weight and improve convenience/design

3.Higher barrier requirement

Addressing food crises; reducing food loss; ensuring food safety (preservative-free); addressing growing demand for better flavor/aroma; economic development in emerging countries (logistics system development, Westernization of diets)

4.Barrier needs in industrial applications (environmental, energy saving)

5.Accelerating motorization in emerging regions

Going forward

Proactively increasing production to seize opportunities

◆Increasing capacity
- ・Debottlenecking in Europe: Completed in late 2016
- ・Debottlenecking in the United States: Under construction for 2018
- ・New capacity (under consideration)

◆Increasing cost competitiveness
- ・Ensure competitiveness of raw materials (VAM, ethylene)
- ・Develop highly competitive production technologies

Demand creation

◆Food packaging
- ・Promote awareness through steady marketing to create demand
- ・Develop and release products with enhanced functions

◆Automotive
- ・Introduce products to meet stringent emission regulations

◆Develop and expand new applications
- ・Horizontally expand successful new applications

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