A detail report on food packaging materials is as follows:

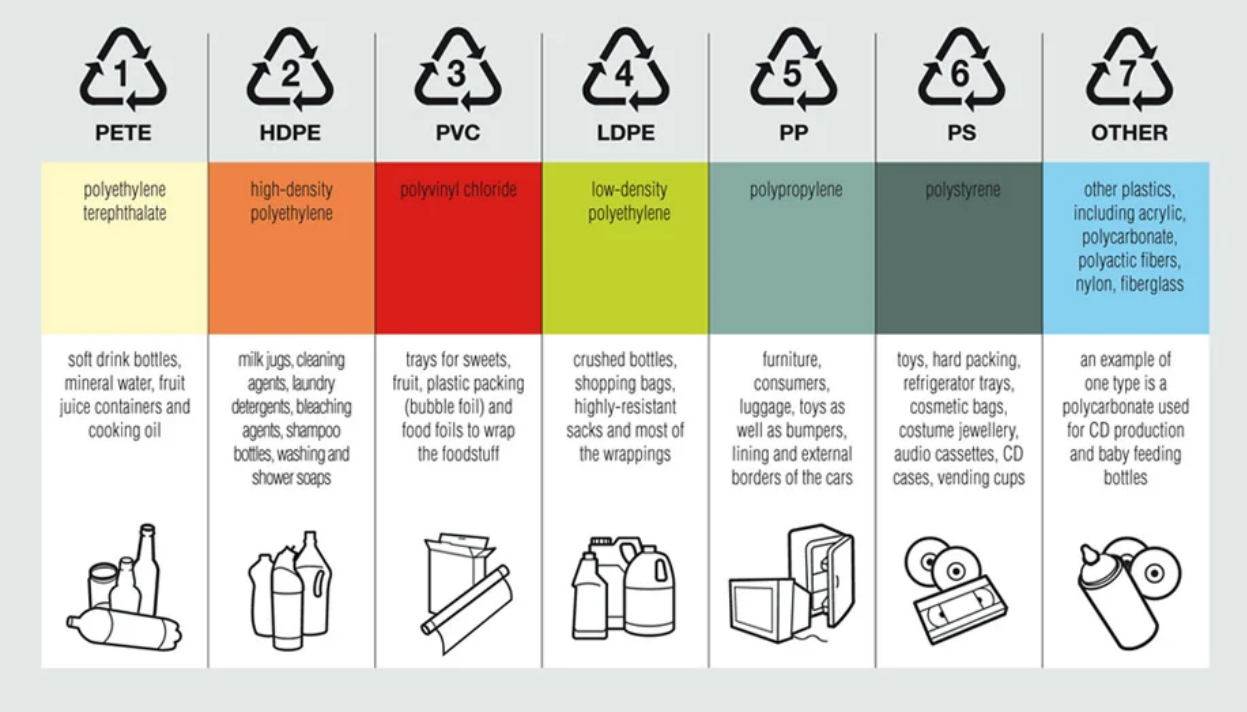
Food packaging is essential for transporting, storing, handling, and preserving food. The most common food packaging materials are different types of plastic polymers, including bio-based and biodegradable plastics, paper and board, metal, glass, and various multilayer materials[1].

Plastic polymers are synthetic or natural materials that consist of long chains of repeating units called monomers. They are widely used in food packaging because they are versatile, lightweight, non-corrosive, energy-efficient, durable and user-friendly. However, they also pose some environmental and health challenges, such as waste generation, resource depletion, greenhouse gas emissions, marine pollution and potential migration of chemicals into foods[2].

There are different types of plastics used in food packaging, each with its own properties and applications. They are usually identified by a number from 1 to 7 inside a triangle symbol on the bottom or side of the package[3]. Some of the most common types are:

- **Polyethylene terephthalate (PET)**: This is a clear, strong and lightweight plastic that is used for bottles, jars, trays, films and clamshells. PET can be recycled into new containers, clothing, carpet and other products[3].
- **High-density polyethylene (HDPE)**: This is a stiff and resistant plastic that is used for milk jugs, juice bottles, cereal box liners, bags and films. HDPE can be recycled into new containers, pipes, crates and other products[3].
- **Polyvinyl chloride (PVC)**: This is a flexible and durable plastic that is used for meat wraps, blister packs, bottles, films and trays. PVC can be recycled into flooring, cables, speed bumps and other products[3].
- **Low-density polyethylene (LDPE)**: This is a soft and flexible plastic that is used for bread bags, produce bags, squeezable bottles, films and coatings. LDPE can be recycled into garbage bags, lumber, furniture and other products[3].
- **Polypropylene (PP)**: This is a tough and heat-resistant plastic that is used for yogurt cups, margarine tubs, microwaveable containers, caps and closures. PP can be recycled into brooms, battery cases, pallets and other products[3].
- **Polystyrene (PS)**: This is a rigid and brittle plastic that is used for egg cartons, meat trays, cups, plates and cutlery. PS can be recycled into coat hangers, picture frames, rulers and other products[3].
- **Other plastics**: This category includes plastics that do not fit into the above categories or are made of a combination of different plastics. Some examples are polycarbonate (PC), which is used for baby bottles, water bottles and food containers; polyethylene naphthalate (PEN), which is used for beer bottles and

microwavable films; and bioplastics, which are made from renewable sources such as corn starch or sugar cane[3].



Bio-based plastics are plastics that are derived from biological sources such as plants or animals. They can have the same or similar properties as conventional plastics but may have lower environmental impacts in terms of fossil fuel consumption and greenhouse gas emissions. However, they may also have some drawbacks such as higher cost, lower availability and competition with food production[2].

Biodegradable plastics are plastics that can be decomposed by microorganisms under certain conditions such as temperature, moisture and oxygen. They can reduce the amount of plastic waste in landfills or oceans but may also have some limitations such as variable degradation rates, incomplete degradation products and potential toxicity to soil or water organisms[2].

Paper and board are natural materials that are made from wood pulp or other plant fibers. They are widely used in food packaging because they are renewable, biodegradable, compostable and recyclable. They can also provide good mechanical strength, printability and barrier properties when coated or laminated with other materials. However, they may also have some disadvantages such as higher weight, moisture sensitivity and potential contamination from additives or inks[2].

Metal is a durable material that is made from elements such as iron, aluminum or tin. It is widely used in food packaging because it can provide excellent barrier properties

against light, air, moisture and microorganisms. It can also withstand high temperatures, pressures and mechanical stresses. However, it may also have some drawbacks such as higher cost, weight and energy consumption. It may also corrode or react with some foods or beverages[2].

Glass is a transparent material that is made from sand, soda ash and limestone. It is widely used in food packaging because it can provide excellent barrier properties against light, air, moisture and microorganisms. It can also preserve the flavor, color and aroma of foods or beverages. However, it may also have some disadvantages such as higher cost, weight and fragility. It may also break or shatter when dropped or exposed to thermal shock[2].

Multilayer materials are composite materials that are made from two or more layers of different materials such as plastic, paper, metal or glass. They are widely used in food packaging because they can combine the advantages of different materials and provide optimal barrier, mechanical and functional properties for specific food products. However, they may also have some disadvantages such as higher complexity, cost and difficulty in recycling or disposing[2].

These are some of the main types of food packaging materials and their characteristics. They have different advantages and disadvantages that need to be considered carefully depending on the type, quality and safety of the food product, as well as the environmental and health impacts of the packaging material.