

2018

**Reefer Shipping &
Logistics**

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I. The history of reefer freight

Today's reefer logistics can't be understood without knowing the origin of reefer shipping.

In 2018, this scene wouldn't be uncommon, but imagine in 1868, when the closest avocado orchard is an ocean's length away, ice is months out of season and the demand for meat in the United Kingdom far exceeds the available supply.

While there had been several previous and successful attempts to ship frozen food products across wide stretches of ocean before the 1880s, both from the United States and Argentina, the introduction of frozen meat in 1880 – and the problems of overzealous copulation in the population of sheep – in Australia and New Zealand generated the ideal environment for innovation and the most well-documented trade as it was initially the most extensive.¹³



Pic.1. (National Maritime Museum from Greenwich, United Kingdom - Unloading frozen meat from the “Clan MacDougall”)



1867

The first patent for refrigerated rail cars was granted in 1867 to J.B Sutherland from Detroit. His design for reefers included a special holding area for ice at each end of the purpose built box car.²⁶

In 1869, ship workers in Indianola, Texas, just north of Corpus Christi, first used what became known as reefers to ship beef to hospitals in New Orleans, a relatively short trip along the Gulf of Mexico. These reefers, a shortened term for refrigerator, were cargo ship with the lower hull filled with ice surrounding the cargo and a fan to maintain constant air circulation. This was not only a costly process, but the technology couldn't even ensure that the ice would remain frozen for the entire voyage, resulting in huge economic losses. The success of the system was entirely dependent on external circumstances, such as the distance of the voyage, the climate and how well insulated the container could be.¹³

A few years after reefers made their debut in the Gulf, mutton producers in Argentina pushed the limits of just how far you could ship meat on ice by successfully transporting it across the Atlantic Ocean to France.¹³

1870's

In 1876 the first attempt to ship refrigerated meat was made from Australia to the UK. Unfortunately the refrigeration machine broke down on the way and the cargo was lost.

But, only 1 year later frozen meat was successfully carried from Argentina to France.

2 years later in 1879 frozen meat was successfully shipped from Sydney to the UK in a ship equipped with compression refrigeration.

1899

The refrigerated fruit ship traffic reached 90,000 tons per year to the US in 1899.

This proves what necessity reefer freight is to the fruit import industry, even in the 1800's.

The early 1900's

The first refrigerated banana ship was sailed from Jamaica to the UK in 1901. The following year the United Fruit Company has refrigerated banana boats built in the UK to add to their fleet.

The 1920's

Refrigerated trailers were alternatives to congested train systems by the 1920's.

The 1930's

Mid-way through the 1930's the first portable air-cooling unit was invented by Fred Jones. These units were placed on the outside of trucks that carried perishable foods. By the late 1930's refrigerated trailers were reaching 38-40 feet in length. For comparison, modern day reefer trailers are usually between 48 and 55 feet in length.



By 1935 the UK was totaling 1,000,000 metric tons of refrigerated imports. This was down to the improvements that have been made in reefer freight.

1940's

The 1940's saw a lot of change in the reefer freight industry. The first van with a wet ice bunker was built by the Steel Products Company. They also built the first factory-finished refrigerated van named the Great Dane Reefer.

Furthermore, refrigerated vehicles were used to transport food, blood and medical supplies to the US and Allied Forces as well as increasing the growth of the frozen food industry.

1980's

In 1980 33% of refrigerated transport capacity in maritime shipping was containerized compared to 90 % in 2010. ²⁶

II. Container reefer shipping

Most people know that refrigerated containers carry frozen foods, meat and fresh produce, but many other products like electronic equipment, flowers, medicine, cosmetics and fine art are also hauled in reefers.

2.1. How does a reefer container work?

Refrigerated containers, commonly called “reefers”, allow freight to be temperature-controlled from pickup to drop-off.

Today all reefer shipments have one thing in common: the container in which the goods are loaded has a built-in refrigeration system to regulate the temperature and keep the freight at its pre-shipment temperature.³¹

How does a reefer work? The main purpose of a reefer isn’t to cool the freight inside but to keep it at its required temperature. Trailer walls are insulated with foam insulation and a heavy-duty seal is used around the door to help seal out external heat and in some cases, the reefer trailer roof uses a reflective material that helps decrease heat absorption from the sun. The reefer also has to remove heat from inside the trailer as well as any that comes in when the door is opened. This is accomplished using a refrigeration system that is affixed to the front of the trailer.

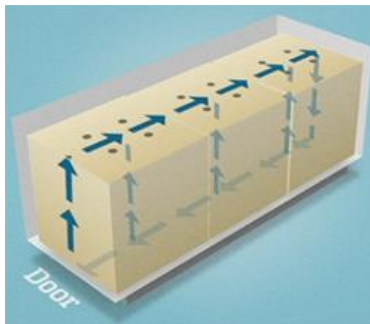
The refrigeration system typically uses a four-cylinder diesel engine to provide power, although emissions standards and rising fuel costs have led to battery, electric, and hybrid refrigeration units being put into service.



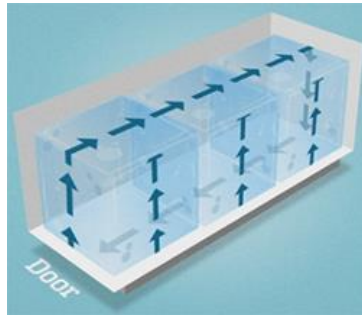
Pic.2. Reefer container

Example:

- in the case of **chilled** cargo, air has to flow **through** the cargo at all times so that heat and gases are removed, therefore the cartons used should have ventilation
- in the case of **frozen** cargo, air has to flow **around** the cargo so there should be no gaps between the cargo and the walls and the cargo itself, so the cargo has to be block stowed. ³¹



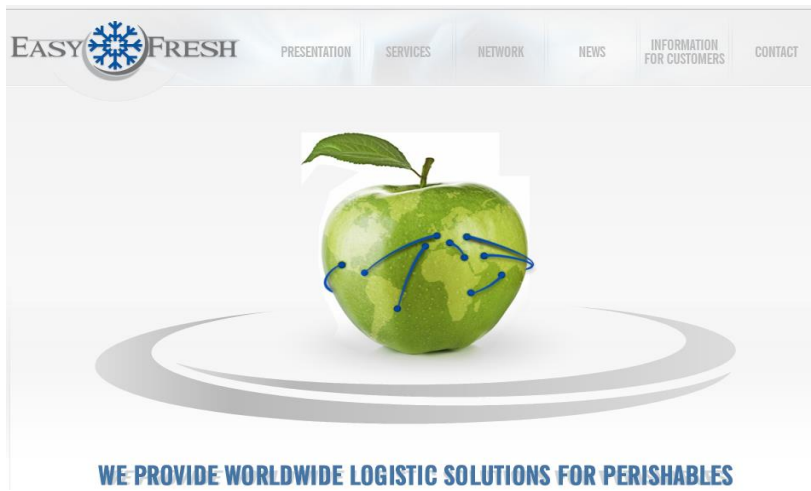
Pic. 3. Airflow pattern for chilled cargo



Pic.4. Airflow pattern for frozen cargo

To know more about types of carriage of perishables in reefer containers you can visit **Easyfresh Logistics S.L.** web-site:

www.easyfresh-logistics.com



Pic.5. Easyfresh Logistics official web-site

2.2. What can you transport by reefer?

List of items typically transported by reefer containers:

1. Transporting fruits and vegetables

This is the most common use of reefer containers. Fruits and vegetables are generally transported by sea and road and in cases of emergency, also by air. In the case of bananas, the largest reefer container ship can accommodate 15,000 boxes of bananas that roughly comes to 746 million bananas, almost the population of Europe.

2. Transporting dairy products

Compared to bananas, dairy products don't have a very big market in terms of reefer container usage because the movement is normally either within the country or within the continent (unless the dairy products are solidified or pasteurized). Most reefer containers are hoisted onto trucks and trains to transport dairy products to different places.

3. Transporting meat and poultry

After fruits and vegetables, meat and poultry are the next largest consignment of items that are shipped by reefer containers across the oceans. In the mid-50s the global consumption of meat was 70 million tones and by 2007 the demand had increased to over 260 million tones. This is primarily because many regions where meat and poultry weren't consumed came on the market.

4. Transporting seafood

The shipping of seafood warrants a separate category because 19% of the food items being shipped using reefer containers are seafood and seafood

products. Seafood spoils easily, as anyone visiting a fish food market will testify. This is why reefer containers carrying seafood need to be of exceptional quality to ensure that it reaches kitchens possibly as fresh as it has just been taken out of water.

5. Transporting medicines

There was a time when long-distance distribution of medicines wasn't possible because refrigeration and ventilation technologies weren't as advanced as they are today. There was no alternative but to send the medicines by air. This didn't just limit the amount of medicines that could be transported (aero planes are not as big as ships) it also increased the cost of these medicines enormously. Reefer containers these days allow transportation of huge amounts of medicinal cargoes. As a result, the cost of many medicines have been brought down and bulk medicines can be transported in one go.

6. Transporting flowers

The next time you give someone a bouquet you may not be aware that you're part of the \$40 billion global fresh-cut flower market. The flowers that you have chosen might have come from South America, Europe, Australia or Asia with all the fragrance and tenderness intact as if they have just been plucked. This intercontinental, unprecedented freshness is ensured by reefer containers.

New reefer containers are being developed with an ozone concentration of 300 times higher than anything is available in the shipping industry that would stop bacteria, fungi and moulds from destroying the flowers. Around

700,000 metric tons of cut flowers are transported worldwide and although more than 90% travel by air, the advancement in reefer container refrigeration and ventilation is making it possible to send more and more varieties of flowers by sea. This tremendously increases the quantity of flowers that can be shipped and significantly reduces the cost of shipment.

7. Transporting and storing wine

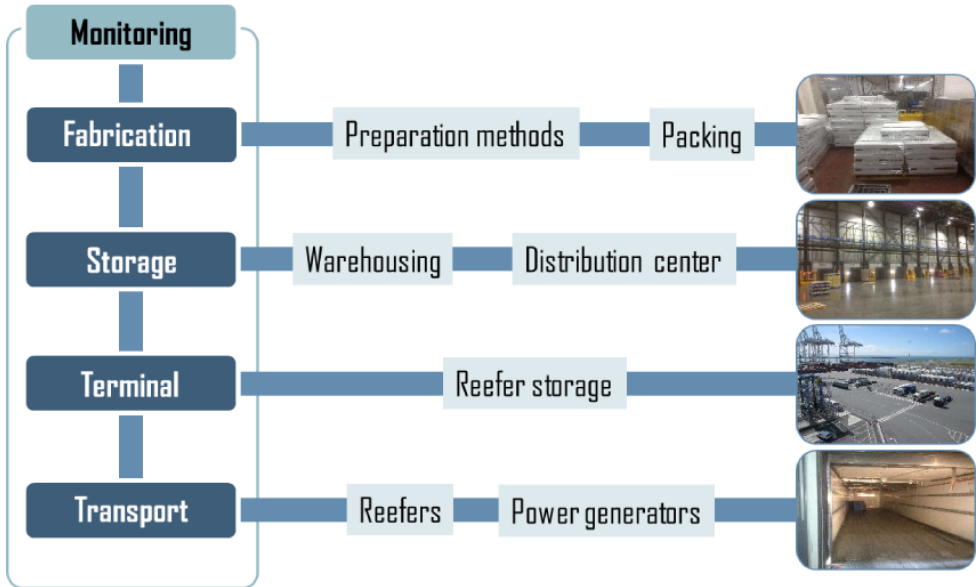
The wine that we drink lives and breathes according to the atmosphere around it. It is not like your average alcoholic beverage. Just like any perishable product, wine can also go bad with sudden temperature changes and this is why when your bottle of wine travels across the oceans, it travels in highly specialized reefer containers. Just like the Phoenicians who sailed their long barges of wine around a couple of thousand years ago, many varieties of wine these days are transported by sea.

8. Being useful during military operations

Reefer containers are used by military forces across the world for the transportation and storage of food, medicine, chemicals and items that can perish in adverse climatic conditions. The reefer containers used by the military can withstand extreme temperatures, electromagnetic interference and vibration. They can be used for road, air as well as sea transportation due to their various sizes and dimensions.

2.3. Cold chain technology

The cold chain involves the transportation of temperature sensitive products along a supply chain through thermal and refrigerated packaging methods and the logistical planning to protect the integrity of these shipments.



Pic.6. The Cold Chain Technology

Several technologies are closely interacting in a sequential manner to support a cold chain:

- **Monitoring.** Usually refers to devices and systems able to monitor the condition of the cold chain, such as temperature and humidity, throughout all the involved stages, namely in the reefer and at the warehouse. These technologies provide an account of the integrity of the chain and help

identify potential weaknesses. For instance, the ISO 10368 standard (1992) was established to provide a series of guidelines in order to monitor the temperature of reefers.

- **Fabrication.** Cold chain products such as food or pharmaceutical products are fabricated in specialized facilities, requiring specific equipment and methods. For instance, blast freezers are able to quickly freeze meat, preventing the formation of damaging ice crystals. Once a product is ready to be shipped, various forms of packing technologies (e.g. crates, perforated boxes) are available to help maintain its temperature integrity as well as protect it from damage. Vacuum packing is often used to efficiently pack meat and extends its shelf life.

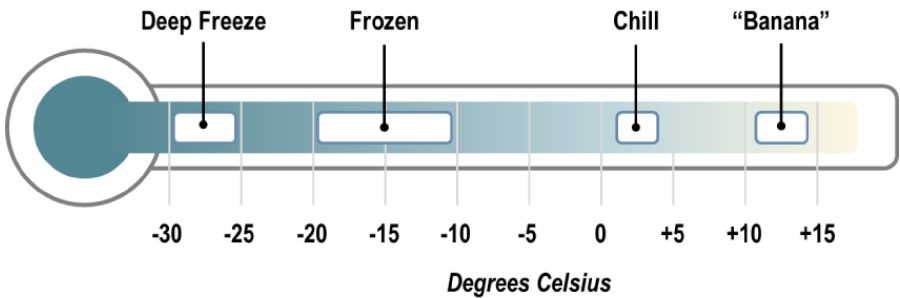
- **Storage.** Like any other good, cold chain products can rarely be made immediately available for final consumption and must thus be stored in cold storage facilities. Large refrigerated warehouses are used to store cold chain products until an order has been filled. Further, specialized distribution centers have been designed to support the efficient and timely storage of grocery goods before being brought to the store.

Among key technological issues for storage is a better energy efficiency of the facility, while being able to maintain a range of temperatures.

- **Terminal.** Since a growing quantity of cold chain goods are shipped internationally, transport terminals such as ports and airports are dedicating areas to cold chain logistics. A container port terminal commonly has dedicated space available to store refrigerated containers.

- **Transport.** A range of transport technologies are available and have been improved to transport cold chain goods. Reefer vehicles (e.g. trucks) and containers (maritime containers and unit load devices) are among the most common technologies being used. They usually rely on attached refrigeration plants, requiring a power generator.

2.4. Temperature control system



Pic.7. Temperature Standards for the Cold Chain

Depending on the type of product being transported through the cold chain, specific temperature standards are enforced. For products such as fruits and vegetables, a breach a integrity can lead to damage such a softening, bruising, unwanted ripening, color changes, texture degradation, and the development of rots and molds, all of which can degrade their value and marketability. Although optimal transport temperature is product specific and

that a wide variety of temperature setting can be selected, five temperature standards are among the most prevalent:

- **Deep freeze** (-25 to -30 Celsius). The coldest temperature range that can be maintained by conventional refrigerated units. This temperature range is used mostly for transporting seafood (particularly shrimp, which is the world's most consumed seafood) and ice cream.

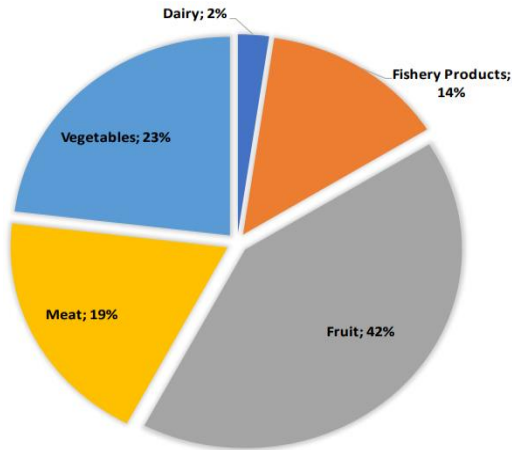
- **Frozen** (-10 to -20 Celsius). Used for transporting frozen meat, including beef, poultry and pork. Frozen bakery (cakes, bread) also falls within this temperature range.

- **Chill** (2 to 4 Celsius). This range comprises the standard temperatures in a refrigerator and is commonly used to transport fruit, vegetables and fresh meat as it confers optimal shelf life without freeze damage.

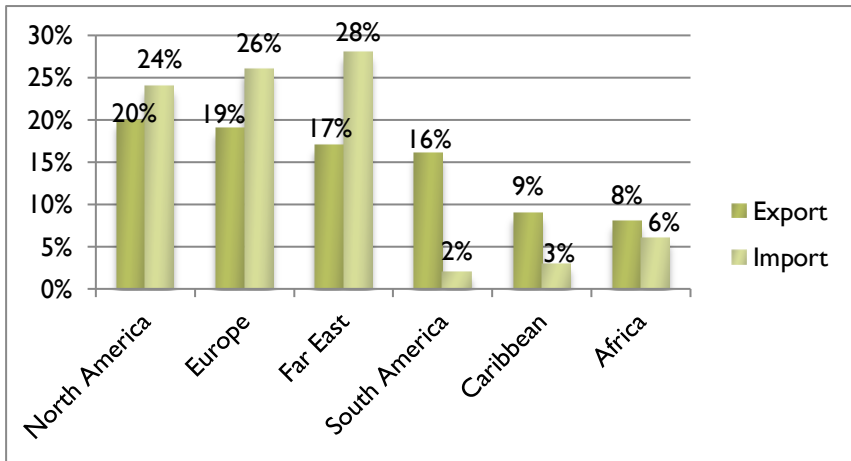
- **Pharmaceutical** (2 to 8 Celsius; not shown). The temperature range at which most pharmaceutical goods, like vaccines, are transported. However, pharmaceuticals are rarely transported in ISO reefers, but in smaller refrigerated packages for van and air transport.

- **Banana** (12 to 14 Celsius). This is temperature range is chosen for one of the world's most produced fruit that usually has its ripening controlled during shipping. It is also used for most tropical fruits (oranges and pineapples) and vegetables (tubers such as potatoes).

Temperature standards are easier to implement and monitor since they apply to a wide range of temperature sensitive goods. Yet, reefers can also be adapted to maintain a specific temperature requirement of any given product.¹⁰



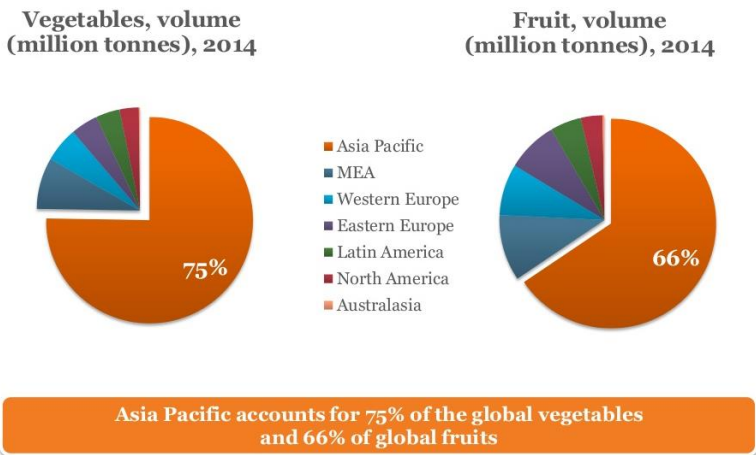
Pic. 8. Refrigerated cargo: conventional ships & containers (tons and %, 2000 - 2015) Total (144.2 million tons).



Pic.9. Main importers and exporters of refrigerated goods ²²

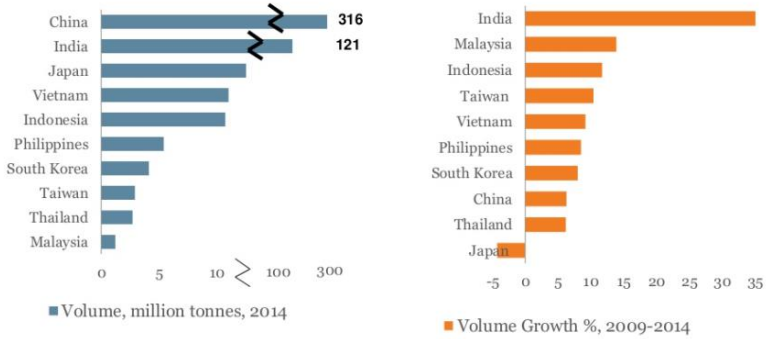
2.5. Distribution global market

Globally, majority of people consistently are consuming less than the daily recommended food and vegetables requirement. Even in developed nations e.g., Australia, Canada, Europe, UK and USA, researchers have concluded that there is a large gap between actual and recommended consumption of both food and vegetables despite decades of concern and publicity while resultant outcomes were short-lived.



Pic.10. Asia Pacific within the global market

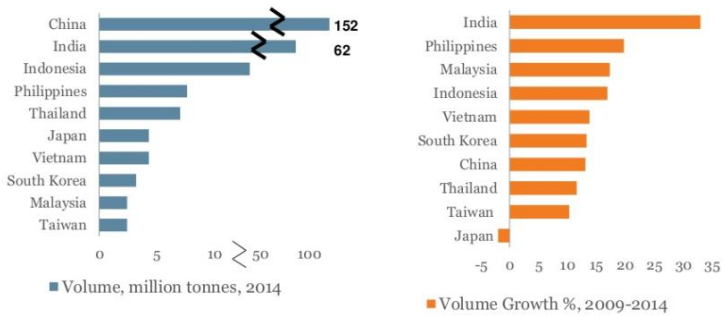
Vegetable : regional volume and growth, a comparison



**China, leading with 59% of regional vegetable consumption
India, second with 22%**

Pic.11. Top ten regional vegetable market

Fruits : regional volume and growth, a comparison



**China, leading with 55% of regional fruit consumption
India, second with 22%**

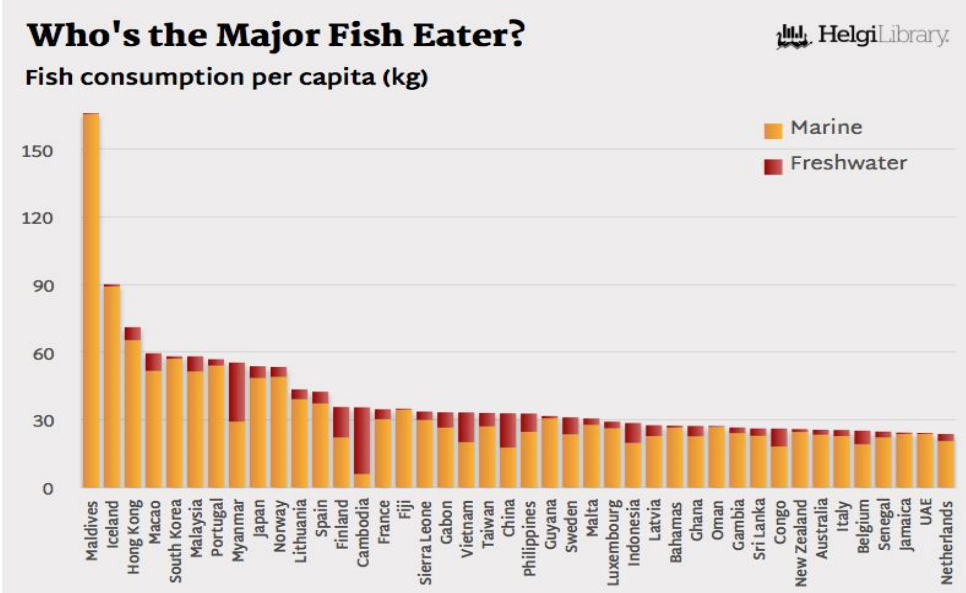
Pic.12. Fruits: regional volume and growth, a comparison

Global rivers, lakes and wetlands contribute significantly to global food supply. The inland freshwater fisheries provide over 33% of the world's small scale fish catch, providing valuable food security, improving rural livelihoods and employing over 60 million people.

Fish is rich in protein, omega 3 and amino acids and often low in fat. Around 100 million people in Africa regularly consume freshwater fish – and the Mekong Basin in Southeast Asia – where 60 million people get their main source of protein from freshwater fisheries.

A World Bank report from 2014 estimates that in 2030, 62% of the seafood we eat will be farm-raised to meet growing demand from regions such as Asia, where roughly 70% of fish will be consumed. China will produce 37% of the world's fish, while consuming 38% of world's food fish.

In 2013, Maldives, Iceland and Hong Kong were the biggest consumers of fish eaten by person, more than 70 kg a year. On average, we eat globally nearly 20 kg of fish per capita, according to FAOSTAT data.³²



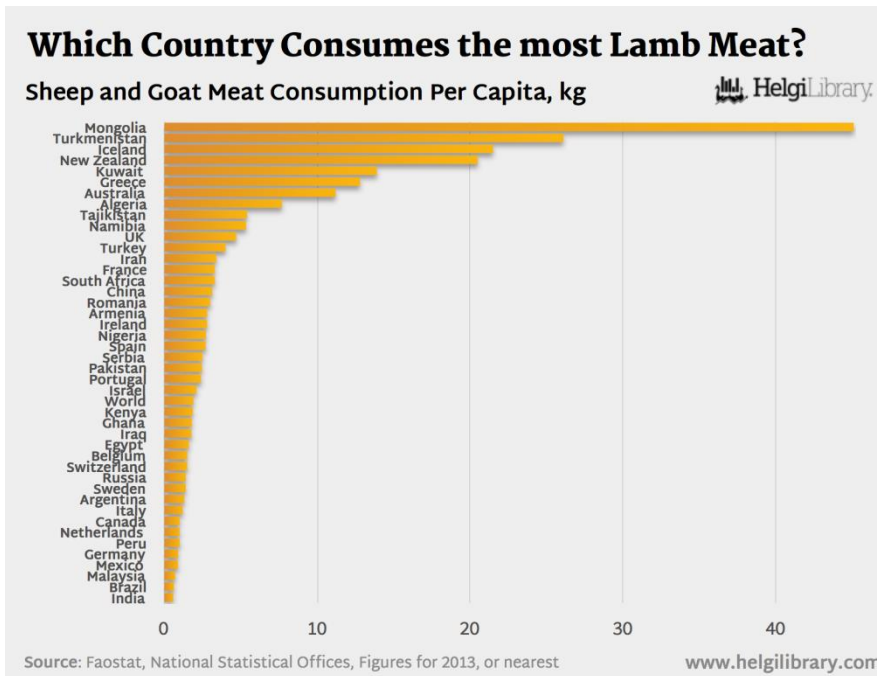
Pic. 13. Fish consumption per capita (kg)

While sheep meat only accounts for 6% of the world's meat consumption now, it is the principal meat in regions of North Africa, the Middle East, India, and parts of Europe.

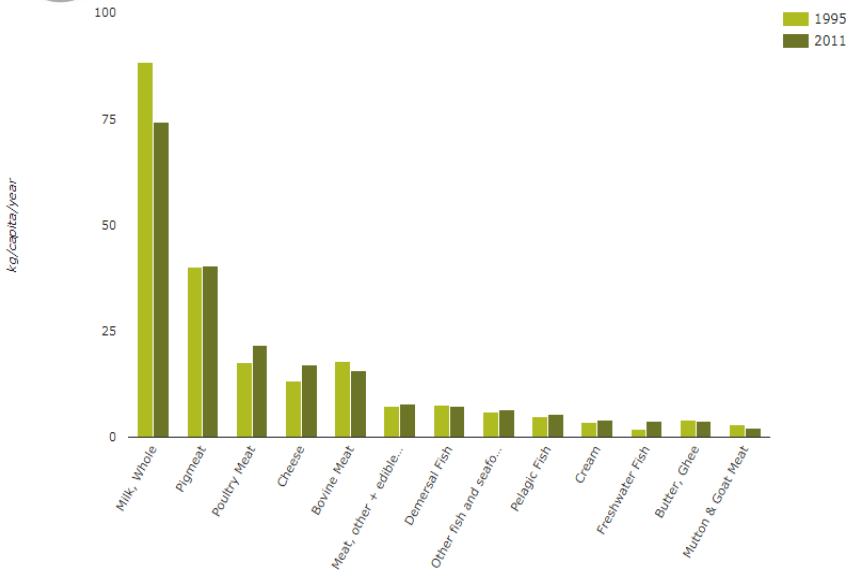
The European Union is the largest lamb consumer and number one importer of lamb; 99% of the lamb imported originates from Australia and New Zealand. In Australia the Leg of Lamb Roast is considered the national dish.

Mongolia, Turkmenistan, New Zealand, Iceland and Greece are the countries where the biggest eaters of sheep and goats live. An average Mongolian eats nearly 50 kg of sheep and goat meat a year, according to FAOSTAT.

Central Europeans are on the other end of the scale hardly eating more than 0.5 kg a year per capita.



Pic. 14. Sheep and goat meat consumption per capita (kg)



Pic.15. Consumption of meat, dairy products and total seafood

We would like to analyze the trends in chicken meat consumption in the Americas.

Global population growth is slowing and, according to USDA economists, is likely to average around one per cent per year between 2013 and 2023, which compares with 1.2 per cent in the previous decade.

Growth rates in most developing countries will remain above the rest of the world hence, by 2023, developing countries will represent 82 per cent of the world’s population compared with 79 per cent in 2000.

Between 2013 and 2023, global economic growth is assessed to average 3.2 per cent per year, being relatively weak in developed countries and stronger in developing nations. Although consumption growth in

developed countries will be slower than in developing countries, average uptake by 2023 at 69 kg per person will remain more than double that in developing countries.

Increases in poultry consumption are primarily linked to four key factors namely population growth, improvements in incomes, chicken prices relative to those for competitive meats and dietary preferences. Global poultry meat uptake is forecast to increase by 1.7kg per person from around 13.2 kg in 2013 to 14.9 kg in 2023. These retail weight figures are equivalent to around 88 per cent of the eviscerated or ready-to-cook weight.

2.6. E-grocery

The index finds the share of grocery shopping conducted online continues to rise, particularly in the world's most advanced e-commerce markets such as South Korea, China and the UK.

In the UK, online sales grew from 6.7% to 7.3% value share in the last year alone, making British shoppers second only to South Koreans in the proportion of groceries they buy online.

In South Korea, the most advanced e-commerce market, almost 70% of the population is shopping online more than once per month. The UK, France, USA, Mainland China and Taiwan online is reaching more than 25% of the population. ²⁹

Market	E-commerce value share 2015	E-commerce value share 2016	Percentage point change
South Korea	14.6%	19.7%	5.1
UK	6.7%	7.3%	0.6
Mainland China	4.0%	5.7%	1.7
Taiwan	4.5%	5.7%	1.2
France	5.1%	5.5%	0.4
Spain	1.3%	1.7%	0.4
Portugal	0.8%	1.0%	0.2
Argentina	1.0%	0.8%	-0.2
Malaysia	0.4%	0.7%	0.3
Thailand	0.3%	0.6%	0.3
Vietnam	0.3%	0.4%	0.1
Brazil	0.1%	0.1%	0

Table 1. E-commerce value share per markets

The top 10 sites for online grocery shopping

Amazon Grocery



Pic.16. Amazon grocery

Amazon is the largest online retailer today, and their grocery offerings span from beverages to meats, seasonal gifts and baskets.

In the past few years, Amazon has greatly expanded their grocery items, giving shoppers the ability to subscribe to items they find themselves ordering on a regular basis (resulting in significant discounts for these subscription items), as well as the ability to order a wide variety of specialty items. If you subscribe to regular delivery (every one, two, three, or four months), you can save a significant amount of money, plus, the ability to subscribe to items that you find yourself ordering quite often is completely free, not to mention convenient.

MySupermarket



Pic. 17. MySupermarket grocery

MySupermarket is a UK-based service that provides online shopping for many different stores including Tesco, Asda, Sainsbury's, and Ocado. You can compare prices instantly across all the stores that MySupermarket currently indexes, plus, MySupermarket offers you the ability to find healthier options for anything you might have in your shopping cart, a nice feature. In addition, if shoppers need to purchase items for a specific occasion coming up (anniversary, birthday, work party, etc.), MySupermarket gives customers the ability to shop directly for items that can assist in planning the best event possible.

FreshDirect



Pic.18. FreshDirect Grocery

FreshDirect delivers fresh, organic, gourmet food to many different areas within the United States. Their food items come directly from local farms and dairies, with specialization for people with kosher, gluten-free, or organic/natural food preferences.

Local Harvest



Pic.19. Local Harvest Grocery

Local Harvest aims to connect people in their local communities with fresh, organic, farm to table produce and goods. Customers can find produce both in their local areas and other cities nationwide; not all of the farms represented in their directory offer delivery outside of their local areas, but many do. Shoppers can also take advantage of CSA deliveries (Community Supported Agriculture), subscribing to seasonal produce.

ShopFoodEx



Pic. 20. ShopFoodEx Grocery

ShopFoodEx has a large inventory (nearly 10,000) of items on hand to order. You can also make lists on the site, take advantage of seasonal specials, and shop a limited array of warehouse (bulk) items. Military families will appreciate that ShopFoodEx delivers to APO/FPO addresses.

WalMart Grocery



Pic.21. WalMart Grocery

Many people have a Walmart in their local communities, and now with the ability to order groceries online with free same day pickup and delivery, this becomes even more convenient. Shoppers can simply order the same items online they would order in a typical visit, and choose delivery or pickup.

GoBio!



Pic. 22. GoBio! Grocery

Organic, high-quality food delivered to the United States and Canada, with free shipping on orders over \$75.

Safeway



Pic.23. Safeway Grocery

Safeway offers the convenience of online shopping to quite a few areas in the U.S. Shipping fees are extremely low, and there are a lot of grocery items from which to choose from.²⁷

2.7. Cold Storages

As products evolve and consumer demands change cold storage warehouse space is a more critical branch of the supply chain than ever. Products being stored in these refrigerated warehouses include frozen and refrigerated food, pharmaceuticals, petro-chemicals and high-tech electronics.

Many of these products are strictly regulated by government agencies such as the FDA. To maintain compliant with these regulations many cold storage operations are focusing on implementing industry best practices. A top priority has continued to be temperature forecasting and monitoring and technology upgrades.

One way cold storage warehouses are making the most of their space is by implementing temporary curtains that allow them to break up facility space in order to create, expand or reduce the square footage of temperature zones. The flexibility of this tool helps refrigerated warehouse operators to reduce energy consumption while also ensuring temperature consistency to avoid spoiling.⁷

Cold storage for fruit and vegetables is a particularly tricky subject as there are many factors, such as age and origin, which can affect how fresh produce should be stored. This guide looks at why you should be using cold storage to stock and distribute your fresh produce and the most important factors to consider when using cold storage for fruit and veg.

The benefits of using commercial refrigeration to store fruits and vegetables

Without cold storage, most fruits and vegetables will not stay fresh for more than a few days. As soon as fresh produce is harvested, it begins to deteriorate and dangerous bacteria will start to develop.

The low temperatures inside cold storage units halt the growth of these pathogenic fungi, ensuring that spoilage of fruits and vegetables is kept to a minimum. Refrigeration and blast freezing are equally popular options for many vegetables and some selected fruits.

This is why cold storage units have a varied temperature range for both freezing and chilling options.

Another ingenious benefit of cold storage units is that they are highly customizable, something that is particularly important when storing fresh fruits and vegetables. Temperature and humidity levels can vary greatly between produce, making customization essential.

Cold storage for fruit and vegetables also comes in a variety of sizes, including mini chillers that are perfect for caterers and mega cold stores made with large distributors in mind.

Whether you're looking to extend your commercial refrigeration or are considering branching out into the fruit and vegetables market, a portable cold storage solution will extend the life of your fruits and vegetables both in storage and in transit.

There is rarely a one temperature fits all solution to storing fruit and vegetables. This is because factors such as crop maturity, the season of harvest and crop origins all play a part in calculating the optimum temperature requirements.

A general “rule of thumb” is that cool season fruit and vegetables, such as kale and sprouts, should be stored at around 0-2°C. Warmer season fruit and vegetables, such a cucumber and tomato, is best stored around 7-10°C. However, there are exceptions to the rule, as some fruit and vegetables are more greatly affected by low temperatures.

All cold store refrigeration units will provide you with a temperature range between -40°C to +10°C, making them perfect for the storage of fruits and vegetables.

What types of cold storage are suitable for fruit and vegetables?

Most cold storage is incredibly versatile, meaning that there are plenty of options when it comes to storing and distributing fruit and veg.

Refrigerated containers

Refrigerated containers come in a variety of sizes from 10ft to 45ft and have a temperature range of -40°C to +10°C. Most cold store units are portable and can be used to safely transport goods. Mega cold stores are also a popular option for larger companies and work by combining multiple linked cold store units for a mega refrigerated solution.



Pic.24. Refrigerated container

Blast freezers and chillers

For businesses looking to stock and distribute frozen fruit and vegetables, rapid freezing blast chillers are a great option. With temperatures as low as -40°C , you can freeze a variety of fruits and vegetables. Mini blast freezers are also available for caterers or smaller businesses short on space.

Cold rooms

Cold rooms are a great solution for any business, looking for custom cold storage for their fruit or vegetables.

Depending on the size and use of the cold room, cold rooms can be broadly classified as walk-in cold rooms and warehouse cold stores. Walk-in cold rooms are smaller in size compared to the large warehouse cold stores and are used primarily by the retail industry to store goods with fast shelf replenishment rate.

Best practices for storing fruit and vegetables

Fruit and vegetables should always be stored separately

Most fruits produce a hormone called ethylene once they begin to ripen and this changes texture, colour and flavour in produce. Unfortunately, fruits producing ethylene also affect all surrounding produce, speeding up the ripening process considerably. If fruits are stored alongside vegetables, you risk speeding up the ageing process of produce, resulting in food wastage.

Adhere to good storage practices

Avoid overstocking your cold storage unit above its capacity, as this raises the internal temperature and speeds up produce deterioration. Tightly packed pallets should also be avoided as crushing can occur, leading to the development of bacterial growth. Pack your fruit and veg so that there is enough room for the internal fan to distribute cool air freely.

Know the history of your produce

Distributors should know the history of fruit and veg to make the best decision regarding cold storage and transportation arrangements. This includes factors such as product maturity, prior goods preparation, previous quality inspections and produce grading.

Whilst cold storage can increase the longevity of your fruits and vegetables, your produce still needs some TLC to keep it at its best. Look after your fruit and veg and you'll extend its lifespan considerably. ⁸

2.8. Track and trace

Refrigerated trucks, or reefer trucks, are an incredibly important asset for companies shipping perishable goods over long distances. The refrigeration units on these trucks are a must for keeping goods from spoiling during the journey from the warehouse to their final destinations.

The supply chain for perishable goods can be fragile compared to non-perishable ones. Delays, power failures, improperly sealed compartments, and mechanical failures in the refrigeration unit can all lead to cargo spoilage. Every measure that companies can take to improve their supply chain is a potential life-saver for their refrigerated truck cargo loads. GPS tracking for reefer trucks are one example of an effective way for transportation companies to improve their supply chains for perishable goods by:

Optimizing Reefer Truck Maintenance Scheduling

Reefer trucks can be more complicated to maintain than regular semis, as the refrigeration systems used in the trailer and the frame of the trailer itself add to the demand for maintenance. As with all vehicle maintenance, fixing a small problem in a refrigerated truck sooner can help prevent a bigger, more expensive problem later.

GPS tracking devices, when integrated with a reefer container's onboard diagnostics systems, can provide fleet managers with detailed diagnostics data for both the container and the refrigeration unit.



By tracking engine performance, it's possible to spot when a semi needs preventative maintenance, helping prevent costly on the road breakdowns. By monitoring data on the conditions in the refrigeration unit, it's easy to track temperatures and power connection status for the refrigerated compartment/trailer.

Setting custom alerts for when the power is disconnected or when the temperature is approaching unsafe levels lets fleet managers immediately detect a problem and alert the driver.

With any long-distance shipment, drivers going off- route can be a problem. For refrigerated trucks, drivers leaving the pre-planned route can be disastrous, depending on the nature of the "detour".

Drivers may leave their assigned routes for a number of reasons, including:

- Planned rest stops
- Heavy traffic
- Emergency repairs
- Road construction/detours
- Personal errands
- Refueling

Some of these detours are unavoidable or beyond a driver's control. Others are unnecessary delays that drag productivity down.

GPS tracking solutions can help provide greater control over vehicle routes so as to minimize the impact of a detour.



For example, if a driver is stuck in traffic, fleet managers can use their GPS tracking data to see where the driver is, and plan a route around the traffic obstruction to minimize the delay.

Additionally, fleet managers can set geofencing boundaries around a route—allowing the manager to know if a driver goes more than a few miles off the planned route. This lets drivers make short detours for rest stops and refueling trips without hassle while still alerting fleet managers of major deviations from the assigned route.

This increased control over vehicle routes help fleet managers reduce delays for their refrigerated trucks, meaning more shipments completed in less time, and with less risk of spoilage.

Verifying Cargo Status

Companies shipping perishable goods for public consumption are required to maintain specific temperature conditions for cold goods. Transportation companies may even be required to maintain and submit documentation of the temperature conditions in a storage unit for later inspection, as per the Food Safety Modernization Act (FSMA).

GPS tracking devices that have remote diagnostics capabilities can improve the supply chain by simplifying the process for recording, storing, and sharing detailed information about the temperature conditions in a reefer truck.

Remote diagnostics reports for a reefer truck's trailer can include temperature information, providing reliable evidence of whether or not the appropriate temperature was maintained inside the refrigeration unit.

This can help fleet managers overcome a key regulatory documentation hurdle without adding labor and delays for a truck driver to repeatedly stop and check the cold trailer every few hours. As an added benefit, this also means fewer rejected shipments since you'll have verifiable evidence recorded by an impartial computer program.

For companies transporting perishable goods long-distance, GPS tracking systems for reefer trucks can be an invaluable tool for strengthening the supply chain.³

2.9. The way forward of a reefer logistics supplier

An extensive know-how in perishable cargo handling is a must to deliver cold chain solutions.

Easyfresh is led by a group of experts in handling of fresh fruits, vegetables, juice, dairy products and fresh and frozen meat and fish products.

Easyfresh offers transport solutions from A to B anywhere in the world under temperature controlled environment, being the world logistic supplier.

Easyfresh is focused exclusively to fresh and frozen cargo logistics. Besides it, we are 100% neutral and independent (not trading and not linked to any carrier or shipping line). We operate, own or subcontract coldstorages and add inland distribution, clearances and other value added services to the seafreight.

III. Trends in reefer cargo shipping

The trends in global reefer shipping depend essentially on these two factors:

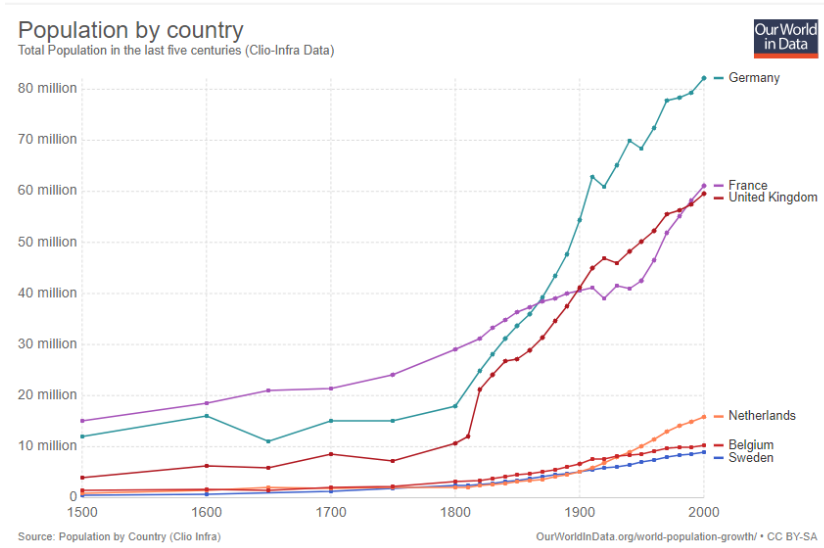
- Production
- Consumption

3.1. Consumption trends

One of the important parts which influence consumption is a population trend, which includes population growth rate and demographic components.

The world is more urbanized. More than half of the world's population consists of urban dwellers, and this is expected to climb to two-thirds by mid-century. International migration is increasing in both volume and impact. Although the increase in the number of migrants has faltered in the aftermath of the global economic recession, more people than ever reside in a country other than where they were born. There are 232 million international migrants, 3 percent of world population.³⁴

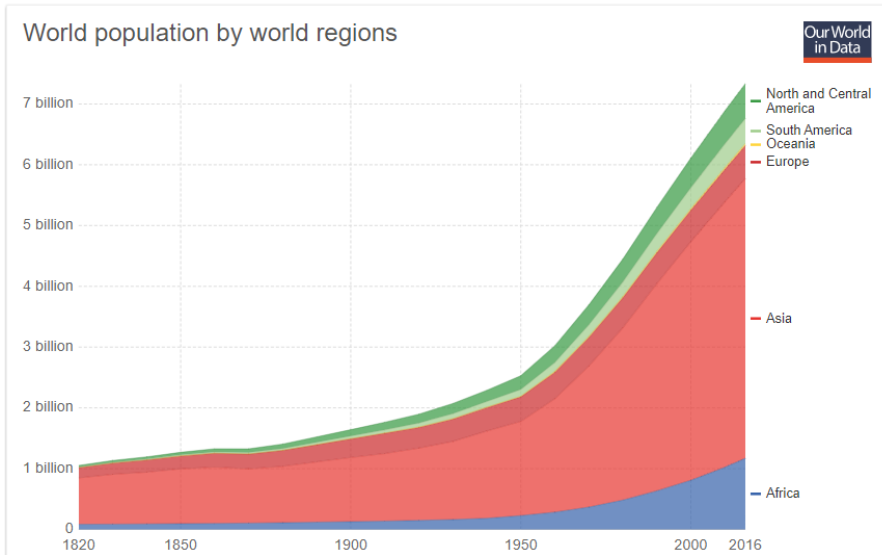
The global pattern masks a great deal of heterogeneity across countries; faster population growth started at different points in time in each country. Data from the Clio Infra project allows a cross-country analysis. The following visualization shows total population by country in the last five centuries.



Pic.25. Population by country

The estimates provided by the History Database of the Global Environment (HYDE) are shown in the following visualization that provides a break down of the world population by world regions.

Asia is – and has been for a long time – the most populous region in the world.



Pic.26. World population by world regions

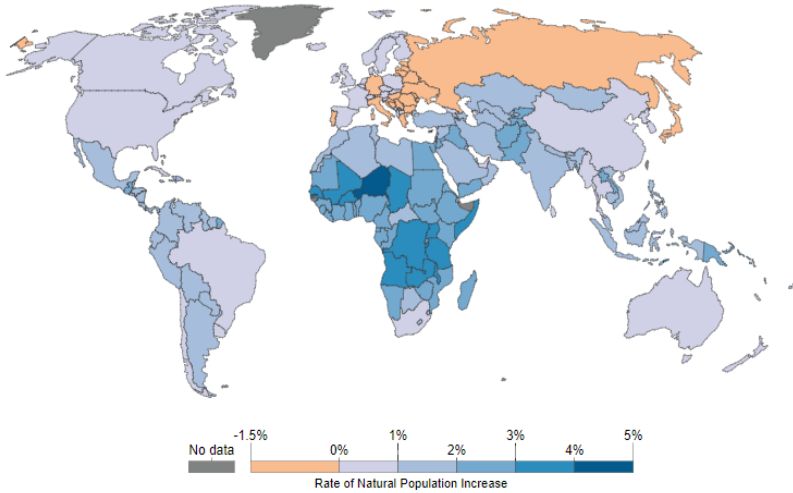
“Natural population growth” measures the rate of population increase as determined solely by births and deaths. Migration flows are not taken into account.

There are some countries today where the natural population growth is slightly negative: the number of deaths exceeds the number of births. Also we can see that this is a new phenomenon. Up until the 1970s, there were no countries with a negative natural population growth.

Worldwide, population growth is slowing—you can see it from the picture below.

Natural population growth, 2015

Natural population growth is the population increase determined by births and deaths. Migration flows are not taken into account.



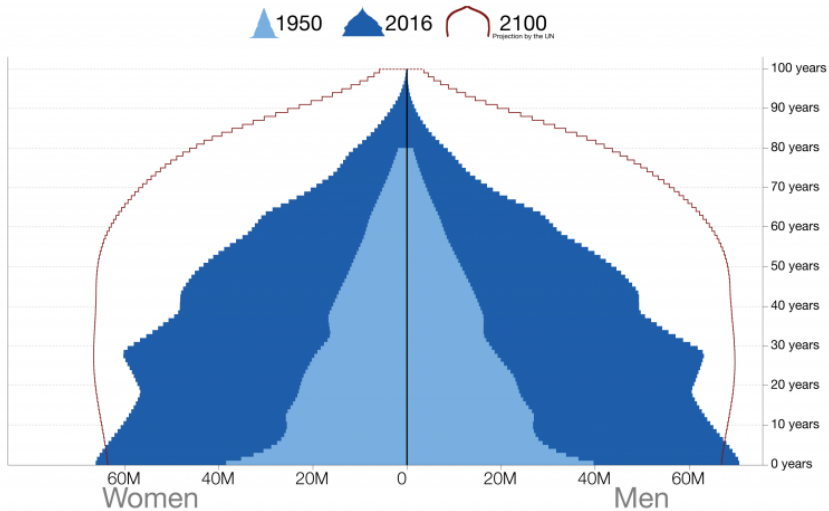
Pic.27. Natural population growth, 2015

At times when the population pyramid actually resembles a pyramid people are facing the risk to die at any point in their life. The uniform narrowing of the pyramid to the top is evidence of the continuous risk of death from birth on and through all ages. The visualization here shows this was still the global reality in 1950 – the narrowing of the pyramid just above base is testimony to the fact that in 1950 every fourth child died before it reached the age of five. The continuing narrowing to the top shows the high mortality throughout all ages.

At a time when the top of the pyramid is much wider and the pyramid increasingly resembles a box shape, the population lives through young ages with very low risk of death and dies at an old age. The box shape is the

demographic structure of a healthy population. The projection in the visualisation shows that the global demography changes from the pyramid to the box shape – the world population through all ages is becoming increasingly healthier.

The World Population Pyramid in 1950, 2016 and 2100 



Data source: United Nations – World Population Prospects 2015. No data for world population older than 100 years in 2016 and 2100 shown; no for world population older than 80 shown in 1950. The interactive data visualization is available at OurWorldinData.org. There you find the raw data and more visualizations on this topic. Licensed under CC-BY-SA by the author Max Roser.

Pic. 28. The World Population Pyramid in 1950, 2016 and 2100

In addition to mortality it is also fertility that shapes the form of the demographic structure. The first aspect that matters for the number of new births in a population is the fertility rate, the number of births per woman in the reproductive age. But if there are only few women in reproductive age the number of births will be low even with a high fertility rate.

Therefore the age structure of women in a population matters too – specifically it is the share of women in the reproductive age that determines the number of births. A bulge of women in this age keeps the number of birth high even when fertility is already low, this is what demographers refer to as “population momentum”.

The pyramid for 2016 shows that the largest cohort of women today are the very young women. The last decades of population growth have left us with a bulge of population in the childbearing ages. For this reason the world population will continue to increase, even as the fertility rate of the world is falling to the replacement level fertility.²⁴

Consumption trends in the world

USDA’s Economic Research Service (ERS) estimates total food expenditures for all food consumed in the United States was \$1.24 trillion in 2010. Food purchased for home consumption accounted for \$646.8 billion or 52 percent of the total.

According to the ERS, spending on food away from home in 2010 was 594\$ billion or 48 percent. Restaurants, both full-service and fast food, account for about three quarters of all food-away-from-home sales. According to the National Restaurant Association, U.S. adults purchase a restaurant snack or meal 5.8 times per week. The United States has 970,000 restaurants and foodservice outlets. The National Restaurant Association projects 2012 sales at \$632 billion, up from \$379 billion in 2000.



U.S. consumers are spending a smaller percentage of their income on food. According to USDA, food expenditures by families and individuals as a share of disposable personal income was 9.4 percent in 2010, versus 11.4 percent in 1990. Food purchased for home consumption accounted for 5.5 percent of total U.S. disposable personal income in 2010. Food purchased away from home accounted for nearly 4 percent of disposable personal income in 2010.

The USDA compiles four food plans for individuals and families for food consumed at home in the United States. Separate food plans are compiled for Alaska and Hawaii. Weekly and monthly costs are calculated for the thrifty, low-cost, moderate-cost and liberal food plans. Based on data from June 2011, food for a single male, age 19-50 cost \$40.60 a week on the thrifty model and \$80.20 a week on the liberal cost plan.

A single female, age 19-50 spent \$36.20 a week on the thrifty model and \$71.80 a week on the liberal food cost plan. The cost of food for a family of four with children ages 6-8 and 9-11 was estimated at \$141.20 per week on the thrifty model and \$71.80 a week on the liberal food cost plan. The cost of food for a family of four with children ages 6-8 and 9-11 was estimated at \$141.20 per week on the thrifty food model and \$278.80 on the liberal cost plan. The food plans only accounted for meals and snacks prepared for home consumption.

There has been an increasing pressure on the livestock sector to meet the growing demand for high-value animal protein. The world's livestock sector is growing at an unprecedented rate and the driving force behind this enormous

surge is a combination of population growth, rising incomes and urbanization. Annual meat production is projected to increase from 218 million tons in 1997-1999 to 376 million tons by 2030.

There is a strong positive relationship between the level of income and the consumption of animal protein, with the consumption of meat, milk and eggs increasing at the expense of staple foods. Because of the recent steep decline in prices, developing countries are embarking on higher meat consumption at much lower levels of gross domestic product than the industrialized countries did some 20-30 years ago.

Urbanization is a major driving force influencing global demand for livestock products. Urbanization stimulates improvements in infrastructure, including cold chains, which permit trade in perishable goods. Compared with the less diversified diets of the rural communities, city dwellers have a varied diet rich in animal proteins and fats, and characterized by higher consumption of meat, poultry, milk and other dairy products. Table 2 shows trends in per capita consumption of livestock products in different regions and country groups.

There has been a remarkable increase in the consumption of animal products in countries such as Brazil and China, although the levels are still well below the levels of consumption in North American and most other industrialized countries.

As diets become richer and more diverse, the high-value protein that the livestock sector offers improves the nutrition of the vast majority of the world.

Livestock products not only provide high-value protein but are also important sources of a wide range of essential micronutrients, in particular minerals such as iron and zinc, and vitamins such as vitamin A. For the large majority of people in the world, particularly in developing countries, livestock products remain a desired food for nutritional value and taste. Excessive consumption of animal products in some countries and social classes can, however, lead to excessive intakes of fat.

Table 2. Per capita consumption of livestock products

Region	Meat(kg per year)			Milk (kg per year)		
	1964-1966	1997-1999	2030	1964-1966	1997-1999	2030
World	24.2	36.4	45.3	73.9	78.1	89.5
Developing countries	10.2	25.5	36.7	28.0	44.6	65.8
Near East and North Africa	11.9	21.2	35.0	68.6	72.3	89.9
Sub-Saharan Africa	9.9	9.4	13.4	28.5	29.1	33.8
Latin America and the Caribbean	31.7	53.8	76.6	80.1	110.2	139.8
East Asia	8.7	37.7	58.5	3.6	10.0	17.8
South Asia	3.9	5.3	11.7	37.0	67.5	106.9
Industrializes countries	61.5	88.2	100.1	185.5	212.2	221.0
Transition countries	42.5	46.2	60.7	156.6	159.1	178.7

The growing demand for livestock products is likely to have an undesirable impact on the environment. For example, there will be more large-scale, industrial production, often located close to urban centres, which brings with it a range of environmental and public health risks. ²

By one calculation, there are now more than 1.7 billion members of “the consumer class”—nearly half of them in the developing world. A lifestyle and culture that became common in Europe, North America, Japan, and a few other pockets of the world in the twentieth century is going global in the twenty-first.

Global per capita fish consumption has risen to above 20 kilograms a year for the first time, thanks to stronger aquaculture supply and firm demand, record hauls for some key species and reduced wastage, according to a new FAO report published today.

The latest edition of the UN agency's *The State of World Fisheries and Aquaculture (SOFIA)* says that almost a third of commercial fish stocks are now fished at biologically unsustainable levels, triple the level of 1974.

There were around 4.6 million fishing vessels in the world in 2014, 90 percent of which are in Asia and Africa, and only 64,000 of which were 24 meters or longer, according to SOFIA.

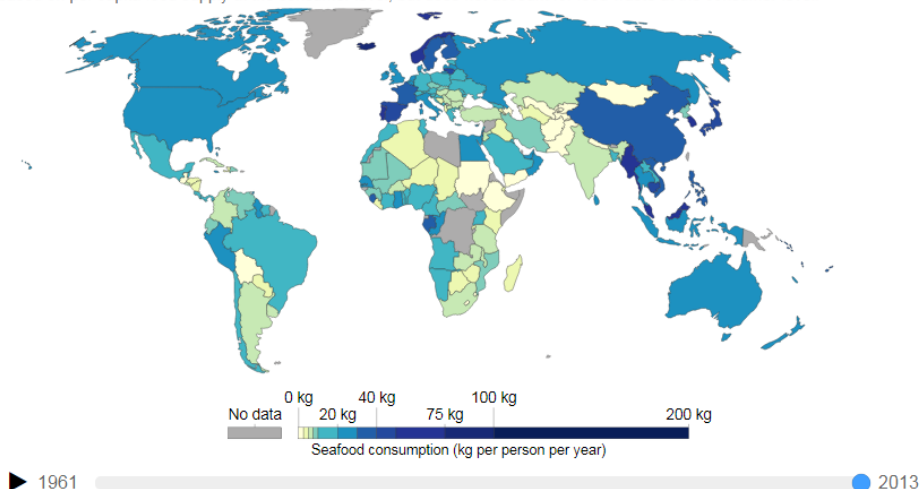
Globally, fish provided 6.7 percent of all protein consumed by humans, as well as offering a rich source of long-chain omega-3 fatty acids, vitamins, calcium, zinc and iron. Some 57 million people were engaged in the primary fish production sectors, a third of them in aquaculture.

Fishery products accounted for one percent of all global merchandise trade in value terms, representing more than nine percent of total agricultural exports. Worldwide exports amounted to \$148 billion in 2014, up from \$8 billion in 1976. Developing countries were the source of \$80 billion of fishery exports, providing higher net trade revenues than meat, tobacco, rice and sugar combined. ²⁸

Fish and seafood consumption per capita, 2013

OurWorld
in Data

Annual consumption of fish and seafood per person per year, measured in kilograms. Data is inclusive of all fish species and major seafood commodities, including crustaceans, cephalopods and other mollusc species. Data is based on per capita food supply at the consumer level, but does not account for food waste at the consumer level.



Pic.29. Fish and seafood consumption per capita, 2013.

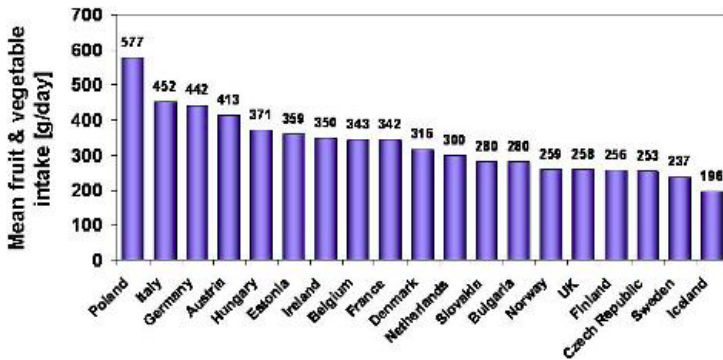
Fruit and vegetables are important elements of a healthy, balanced diet, be it as part of a main meal or as a snack. They bring us vitamins, minerals and fibre, some energy (mainly in the form of sugar), as well as certain minor components

- often referred to as phytochemicals or secondary plant products - which are potentially beneficial for our health.

EFSA has compiled national food consumption data based on dietary surveys in order to assess food intake in Europe. Adjustments of the compiled data allow for a certain level of comparison.¹⁴

These data reveal that the mean vegetable intake (including pulses and nuts) in Europe is 220 g per day. Mean fruit intake is 166 g per day, implying that the average consumption of fruit and vegetables is 386 g per day. The data further show that the vegetable consumption is higher in the South than in the North of Europe and that the regions with the highest intake of fruits are those of Central and Eastern Europe followed by those in the South.

Only in Poland, Germany, Italy and Austria the recommendation of consuming ≥ 400 g of fruit and vegetables per day was met. When fruit and vegetable juices were included, Hungary and Belgium also reached the recommended amount. It is worth noting that the database only contains data from one Southern European country, namely Italy (Pic.30).



Pic.30. Mean fruit & vegetable intake per country (in grams per day), excluding juices

Surprising stats about global food consumption

1. India produces, consumes, and exports the most chili peppers in the world.
2. Italy didn't start eating tomatoes until the 16th century.
3. Forty-nine percent of America eats sandwich every day.
4. Japan is home to some of the most expensive fruits.
5. Serbia is home to the most expensive cheese.
6. Turkey consumes the most tea per person.
7. Netherlands drinks the most coffee.

3.2. Production trends

Growing vegetables is demanding in terms of temperature and relative humidity, as to induce certain phenological stages require specific temperatures and relative humidities. It is therefore interesting the use of greenhouses for production, especially for shortening the growing cycle, earliness of the crop and the possibility of growing when the climate of the area is not suitable.

Traditional greenhouses growing:

This type of culture is used when environmental conditions are not favorable for cultivation in certain periods or seasons, where the climatic requirements are more demanding than the climate of the area provided.

Greenhouses models:

- Parral o flat greenhouses
- Tunnel Greenhouses
- Greenhouses Backbone Structures

Polytunnel greenhouses growing:

The greenhouses used for this production are:

- Chapel Greenhouses
- Gothic Greenhouses
- Asymmetric or Tropical Greenhouses

These greenhouses perform has an exhaustive climate control, and can provide the optimum conditions for each phonological stage of crop.

Which greenhouse is the most suitable for vegetables growing?

From the technical point of view the best recommendation is **Polytunnel Greenhouse** production, which make possible better climate control and better control of pests and diseases.

Production system

Depending on the crop in question will have the following systems:

- **Soil Growing:** plantings on the floor. This type of culture, eventually, leads to problems in the root of diseases due to the continuous production of the same species in a particular area.
- **Growing in bags or containers of substrate:** eliminates the problem of soil depletion, since, depending on the type of substrate used, substrate cleaning tasks can be performed.
- **Pure Hydroponics grown:** in containers or growing tables on nutrient solutions.
- **Trays Crop:** normally used in nurseries.³⁰

Aquaculture, simply defined, is the farming of various types of fish and other aquatic animals. Fish show great promise as a "crop" that respond well to the benefits of being raised in a controlled environment. In a typical aquaculture system, a bio-filter utilizes beneficial bacteria to clean the water for the fish.

The bacteria grows on support media in a tank. The bacteria is aerobic, so it requires oxygen in the form of an air pump. When growing fish in an aquaculture system, it is crucial to not only consider the requirements of the

fish, but also the bacteria. Healthy bio-filters result in healthy, fast growing fish.

Aquaponics is the combination of Aquaculture and Hydroponics. In these semi-closed systems, water flows between an aqua culture fish tank and a plant growing bed. The fish waste in the water is used to supply nutrients to the plants. The plants and micro-organisms clean the water that is returned to the fish tank. This provides a mutually beneficial environment for both the fish and the plants, and results in two crops (the fish and the plants).

The plants grow in a plant bed. These aquaponic hydroponic systems do best growing vegetative crops like lettuce, basil and other herbs. ¹



Pic.31. Aquaponic

IV. The future of reefer logistics

4.1. The Future of Reefer Logistics and its Complexity

The world fruit and vegetables market is expected to exceed \$735 billion by 2015, representing 25% growth over five years. By 2015, the market is predicted to reach over 690 million tons in volume, up 5% compared with 2010. Exports of fruit and vegetables generate around \$45 billion, reports the Food and Agriculture Organization of the UN (FAO).

For the time being, the global fruit and vegetables market is concentrated, with around 50 top companies accounting for a significant portion of revenue. Vegetables represent almost 65% of the overall market. Nevertheless, new producers and farming trends, innovation, new production and consumption areas, food security, food waste policies and the concentration of shipping lines are leading to an utmost complex outlook.

In a similar manner, incomes in developing economies never rose faster or at a greater scale in history, and about a billion people are becoming part of consuming classes in roughly ten years' time.

Likewise, macro-economic changes and shifts in trade patterns have their impact on global supply chains. They provide opportunities as well as challenges. Linked to these, there are a number of uncertainties that only a

global perspective of the logistics of perishables can lead to adequate and stable solutions in the long run.

Below we mention some relevant developments in reefer logistics that are directly or indirectly caused by changes in trade patterns, in GDP growth or in customer behavior :

- **Growth patterns.** Growth in the logistics industry is no longer driven by exports from Asia to North America and from Asia to Europe. It will come from elsewhere, and will be more fragmented, more unpredictable and more volatile.

- **Flexibility.** Meeting consumer's requirements at multiple locations with multiple transport modes at different times requires a flexible supply chain that can adapt easily to unexpected changes and circumstances. Global focus in reefer trades is a must.

- **Globalization.** International, mature and emerging markets have become a part of the overall business growth strategy for many companies.

- **Multi-channel sourcing.** End-consumers increasingly source via multiple channels, ranging from standard shops to e-commerce and retailers. The reefer logistics industry needs to support multi-channel strategies of their customers.

- **Stability and continuity.** To be able to secure speed to market and to reduce risk of delays for perishables, alternative transport modes and routes are required to support the continuing trend of outsourcing of logistics services.

Only specialized reefer logisticians, thinking “out of the box”, specialized / understanding the industry will be able to sort out cited growing bottle-necks.

- **Transparency and integrity.** An ethical way of doing business is required: a code of conduct and respect is necessary.

- **Partnerships and networking.** Producers and receivers continuously search for supply chain innovations and gains through partnerships with logistic service providers. Flexibility and an “open mind” come together with business. Concentration of certain portions of the cold chain goes in the opposite direction. This includes concentration of the seaborne leg driven by shipping lines in “de facto” maritime oligopolies.

In short, cold chains are becoming increasingly complex and dynamic with sourcing locations being changed increasingly quickly and purchase orders becoming smaller and more frequent.

These developments will have their effect on day-to-day reefer logistics, and companies will need to prepare for “the new normal” in supply chain management. ¹⁴

4.2. Food safety and food waste

The EU takes great care to ensure that its food standards do not force traditional foods off the market, stifle innovation, or impair quality.

When new countries join the EU and the single market, they may need transitional measures until they can meet the EU's high food safety

standards. In the meantime, they cannot export foodstuffs that do not meet those standards.

Where foods involving genetically manipulated organisms (GMOs), cloning and nanotechnology (“novel foods”) are concerned, the Commission favours responsible innovation. This both guarantees safety and encourages economic growth.

Animal diseases – containing outbreaks

Animals can be moved freely throughout the EU. But the health and welfare standards that apply on the farm must also be met during transport. When there are outbreaks of animal diseases, the EU has mechanisms and procedures in place to act swiftly and ban products if necessary.

EU “pet passports” enable people to take their pets (cats, dogs and ferrets) with them when they travel. However, to prevent diseases spreading, precautions apply to pets just as they do to other animals.

Keeping plants healthy

All plants and plant material can be moved throughout the EU, as long as they are pest-free. Screening imported plant material and monitoring EU territory helps detect new pests at an early stage.

This means preventive action can be taken, thus avoiding curative measures such as the use of pesticides. “Plant passports” for young trees show they were grown under healthy conditions.

Early warning system

The EU operates a rapid early warning system – RASFF – to protect people from food that does not comply with European food safety rules. This system also spots whether foodstuffs contain banned substances or excessive amounts of high-risk substances, such as residues of veterinary medicines in meat or carcinogenic colorings in food.

Traceability & risk management

Whenever significant outbreaks of animal disease or food poisoning affect European consumers, EU authorities can trace the movement of food products all the way back up the production chain – whether live animals, animal-based products or plants are involved.

These traceability and risk-management functions are carried out by TRACES (Trade Control and Expert System), an electronic system of border controls and certification for traded goods.

Basing decisions on sound science

Science underpins EU food safety policy. The European Food Safety Authority (EFSA) provides the European Commission and EU countries with independent scientific advice when laws are being drafted and when policymakers are dealing with a food safety scare.

The Commission applies the precautionary principle - it acts immediately if scientists say there is even a potential danger.

Enforcement & control

The Commission enforces EU food law by:

- checking that all EU countries incorporate EU legislation into their national law;
- having its Food and Veterinary Office (FVO) conduct on-the-spot inspections both within and outside the EU.

The Food and Veterinary Office inspects individual food production plants.

However, its main task is to check that EU and non-EU governments alike have the mechanisms needed to ensure that their own food producers meet the EU's high food-safety standards. Since 2013, its activities have expanded to include medical devices.

Where specific consumer protection is justified, there may be special rules on:

- use of pesticides, food supplements, colourings, antibiotics or hormones;
- food additives such as preservatives & flavourings;
- substances in contact with foodstuffs, e.g. plastic packaging;
- labelling of ingredients that may cause allergies;
- health claims such as “low-fat” or “high-fibre”.

Up to one third of all food is spoiled or squandered before it is consumed by people.

It is an excess in an age where almost a billion people go hungry, and represents a waste of the labour, water, energy, land and other inputs that went into producing that food.

What is food loss and food waste?

Food loss and food waste refer to the decrease of food in subsequent stages of the food supply chain intended for human consumption. Food is lost or wasted throughout the supply chain, from initial production down to final household consumption.

The decrease may be accidental or intentional, but ultimately leads to less food available for all. Food that gets spilled or spoilt before it reaches its final product or retail stage is called food loss.

This may be due to problems in harvesting, storage, packing, transport, infrastructure or market / price mechanisms, as well as institutional and legal frameworks.

Harvested bananas that fall off a truck, for instance, are considered food loss. Food that is fit for human consumption, but is not consumed because it is or left to spoil or discarded by retailers or consumers is called food waste. This may be because of rigid or misunderstood date marking rules, improper storage, buying or cooking practices. A carton of brown-spotted bananas thrown away by a shop, for instance, is considered food waste.

Food waste is getting a lot of attention lately, and for good reason. No matter how you slice it, the statistics are downright alarming. The world produces 17% more food than it did 30 years ago, yet almost half of it never reaches our bellies.

In a way, it's a testament to the incredible progress we've achieved as a species by producing an overabundance of food to ensure survival. And while

we continue to make progress through technology to increase efficiencies in our food system, we're moving in an unsustainable direction, with more and more food being produced while nearly a billion people still don't have enough to eat. The most effective way to describe food waste problem was presented by Tristram Stuart in his viral Ted Talk back in 2012. He assumes that nine slices of bread represent the world's food supply. Every year, one slice is lost on the farm because of poor handling, lack of sufficient storage, etc. Three slices are fed to animals to produce meat, eggs and cheese. Unfortunately, animals are horribly inefficient when it comes to producing protein, so they replace only one slice of bread, and the other two slices wind up as waste (manure). That leaves only six slices of the original nine. Then, we lose two slices to food that ends up in the garbage for various reasons (spoilage, sell-by-date confusion, imperfect appearance, etc.). So in the end, we're left with four slices to consume. What a colossal mess.

What makes this so maddening is that we're not just wasting food that could end global hunger, but we're burning up the planet's resources in the process. In the United States, food production uses 50% of our land, 30% of all energy resources, and swallows 80% of all fresh water (USDA, 2016). Food waste is the single largest component going into municipal landfills, where it emits methane, helping to make landfills the third largest source of methane in the US. (EPA)

Another overlooked aspect of food waste is the opportunity cost. All the labor, water, and resources used to produce, process, move, package, store, and

discard food waste could have been used in a multitude of ways that are beneficial to society, while eliminating the strain on our environment. Reducing food losses by just 15 percent would save enough food to feed more than 25 million Americans every year at a time when one in six Americans lack a secure supply of food.

So what's the solution?

Technology. The food-tech space has been on fire lately. The smart minds in silicon valley and beyond see the food waste problem as a huge opportunity. Companies like Apeel, Brightfarms, and KDC are providing much needed solutions to cut down on waste and exploit inefficiencies in the system. Amazon just released a new Alexa app “save the food”. Even Anthony Bourdain is getting in on the act with his upcoming documentary on food waste. Fresh food spoilage is a \$1 trillion problem (USDA Irrigation and Water Use 2016), and technology has the potential to be a massive influence on reducing that number. If even a quarter of the food currently lost or wasted globally could be saved, it would be enough to feed 870 million hungry people (FAO).

Food Policy. A depressing amount of food is thrown away because it's not pretty enough. At the retail level, large quantities of food are wasted due to quality standards that over emphasize appearance (up to 1/3 of total food waste). Policies enacted to incentivize companies and consumers to make use of this produce could go a long way towards fixing this. In addition, establishing policies that create uniform standards that reduce confusion around sell-

by/expiration dates would help too. We also process way too much food each year.

The US has twice the calories needed for it's population on store shelves and in restaurants. We simply can't eat that much. And if we take into account the food that's wasted by feeding it to animals instead of humans, it rises to between 300-400%. On average, diners leave 17 percent of meals uneaten and less than half of that gets taken home for leftovers (NRDC). This is largely a serving size problem. Installing portion-control laws and tackling the cronyism that leads to ineffective food policy would help a great deal, though this might be a tough nut to crack.

Consumer Behavior. Of all the available solutions to address food waste, changing our eating habits seems to hold the most promise. Here's why. It turns out that by simply eating certain foods and avoiding others, we can cut down on a significant amount of waste. Did you know that if all of the crop production currently allocated to animal feed were directly consumed by humans, global food production would increase by some two billion tons and food calories would increase by 49 percent.

Animal products require 4 to 40 times the calories to produce than what they provide in nutrition when eaten, mainly due to the crops they consume. Separately, 40 to 60% of fish get discarded at sea after being caught. Most commercial fishing is done (demand of 90 million tons of fish) primarily with enormous fishing nets that sweep up everything in their path. For every pound

of fish caught, there is up to five pounds of untargeted species trapped that die as a result. If this continues, our oceans will reach its breaking point.

Consumer behavior becomes even more important when considering the projections that, barring any shift in diets, worldwide meat consumption could increase 40 percent by 2050. A crucial step in ensuring food security will be to move away from animal products, thus increasing the efficiency of our food system in terms of calories delivered. A shift from standard to vegetarian diets would have roughly the same impact as eliminating all retail and consumer level food losses (Faunalytics). Thankfully, we now have companies like Beyond Meat, Daiya and Hampton Creek that are making it easier to eat sustainably without sacrificing taste. ³³

4.3. New future of reefer logistic – reefer trains

First trial train from Valencia (Spain) to Moerdijk (The Netherlands), hub to the UK, Ireland, Scandinavia, Benelux and Germany.

The first "Easyfresh Iberia" reefer container train travelling between Spain and The Netherlands left 25th of April from Valencia-Silla railhead. The train is operated by Frigobreda, one of the four owning partners of Easyfresh, the only global dedicated reefer logistics operators headquartered in Valencia, Spain. Various freight railway operators handle traction along the 1,800 kilometres route on their behalf.

The train is loaded with 45' feet diesel electric equipment, already part of the fleet operated in the North Sea by Frigobreda. These units match the capacity of the usual

match the capacity of the usual reefer trucks, which normally carry all types of Spanish fresh produce from the Southeast Iberian Peninsula to all Europe.

The Port of Moerdijk is the fourth largest and most inland located sea port in the Netherlands, very close to Frigobreda reputed coldstore facilities.

The open connection to the sea and the maximum freedom of choice for railway, road, inland waterway or sea shipping brings all of the Spanish fresh produce exporters final destinations within reach.

In fact, due to its strategic location, between Rotterdam and Antwerp, the Port of Moerdijk is a pre-eminent logistical hotspot. It connects with 9x sailings per week Moerdijk-Immingham, 3x sailings per week Moerdijk-London , 2x sailings per week Moerdijk-Teesport, 2x sailings per week Moerdijk-Blyth and several others to Norway, Ireland, etc..

Valencia-Silla railhead is owned by ADIF, a Spanish state-owned company under the responsibility of the Ministry of Transport, operating Spain's railway infrastructure that is the track, signaling and stations.

ADIF was formed in 2005 in response to European Union requirements to separate the ownership and infrastructure management from the proper rail services. Valencia-Silla is located south from Valencia and, subsequently, excellently connected by road to all Southeast Spain key production areas within the Provinces of Almeria, Murcia, Valencia and Alicante.



Pic.32. Reefer trail “Easyfresh Iberia”

4.4. The multimodal solutions in reefer shipping

Multimodal Transport is the combination of different means of transport, in order to facilitate the movement of cargo, i.e. making it faster and more efficient.

When it comes to this mode of transportation, there is more than one kind of vehicle necessary to take the goods to their final destination, by the use of trucks, trains, ships, airplanes or some other mean of transport for the delivery.

The advantage of Multimodal Transport lies in the most efficient combination of multiple means of transport, whilst optimizing deadlines, cutting

back on inventory costs, therefore keeping the costs of the merchandise under control. The combination of these also results in high environmental sustainability, since Multimodal Transport reduces the environmental footprint of transportation.

Despite the support of environmentalists and cargo transportation experts, multimodality might induce certain costs through the use of modal interfaces, such as transshipments, handling, etc.

For more complex shipments, or a more thorough exploration of the quality/price ratio of each part of the transportation, multimodal transport is a good, often the only, option to consider, especially to/from countries that do not border on the sea.

Advantages of Multimodal Transport:

- Centralization of responsibility in one transport operator.
- Use of international experience, in transportation as well as in the field of bureaucracy and commerce.
- Economies of scale in transport negotiations.
- Better use of available infrastructure and more efficient means of transport, focused on cost reduction.
- Reduction of indirect costs (e.g. human resources).³³
- Operations' expenses and times decrease.
- Lower risks of loss or theft on the goods since there is only one intermediary. This means that being only one intermediary, there is more control over the merchandise.

- The programming of transport, route, costs, human and logistics resources are easier.

Multimodal transport disadvantages:

- Legal and operational limitations at the time of applying international regulations.
- These operations can be limited by terminal inspections.
- There is a lack of infrastructures to facilitate intermodal transport. There is no investment in expanding the offer of this service. ⁹

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VI. Abbreviation

1. ADIF- Administrator of Railway Infrastructures
2. CAGR - Compound Annual Growth Rate
3. ERS – Economic Research Service
4. EPA – United States Environmental Protection Agency
5. EFSA – European Food Safety Authority
6. FAOSTAT – food and agricultural data. FAOSTAT provides free access to food and agriculture data for over 245 countries and territories and covers all FAO regional groupings from 1961 to the most recent year available.
7. FDA – Food and Drug Administration
8. FMCG - Fast Moving Consumer Goods
9. FSMA – Food Safety Modernization Act
10. FVO – Food and Veterinary Office
11. GDP – Gross Domestic Product
12. ISO (the International Organization for Standardization)
- 10368 Freight thermal containers – Remote condition monitoring
13. HYDE – History Database of the Global Environment
14. NRDC – Natural Resources Defense Council
15. OECD – Organization for Economic Co-operation and Development
16. RASFF – Rapid Alert for Food and Feed

17. SOFIA – The State of World Fisheries and Aquaculture
18. TRACES - Trade Control and Expert System
19. TEU – Twenty Foot Equivalent Unit, it is a standard measure commonly used to describe the capacity of container ships
20. USDA – United States Department of Agriculture





