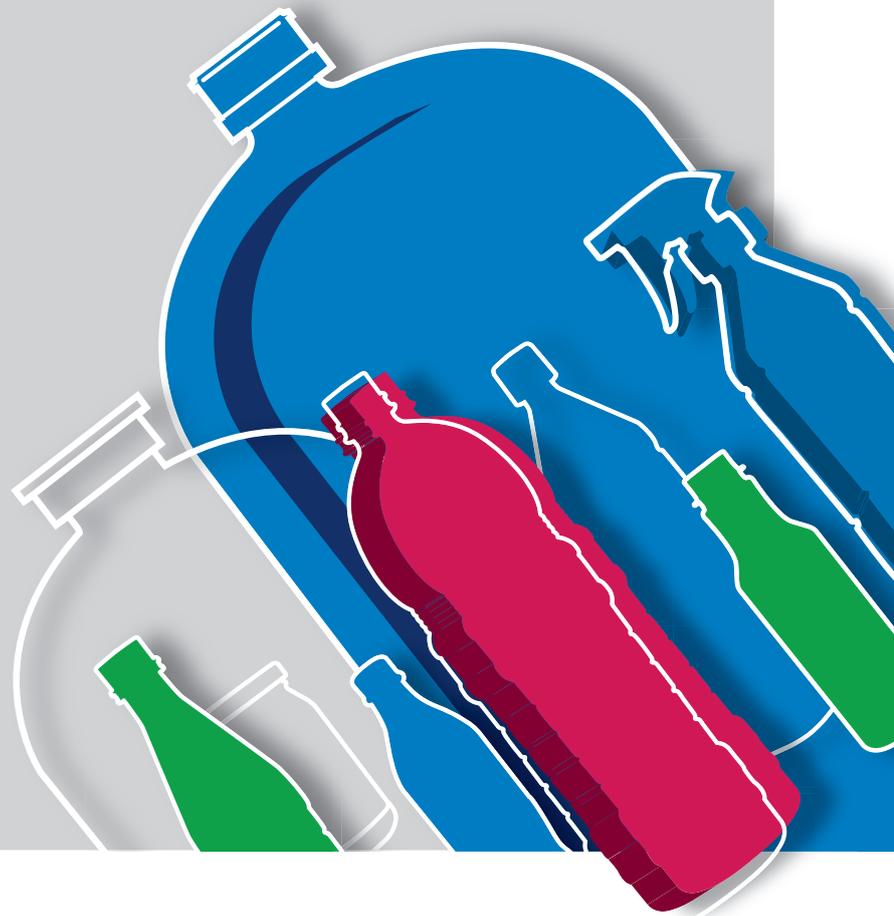# The supply chain benefits of using non-returnable PET kegs

**A white paper prepared for Petainer
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Contents

Executive summary

The international beer market has undergone significant change in recent years. Breweries have been trying to expand their outlets and exploit new markets. Transportation routes and the length of time empty containers remain in transit have both expanded. This has had a huge impact on the draught beer market.

There is clearly a preference for draught beer in smaller containers, with 20 litre or 30 litre containers now replacing the previously popular 50 litre variety. This is because special beers are increasingly produced specifically for export and heavy containers are generally being replaced by lighter ones for cost, environmental and legislative reasons. In Italy, for example, a law prohibits anyone from lifting or carrying an object which is heavier than 25kg.

There are strong environmental and economic reasons for breweries to choose disposable PET kegs rather than conventional heavy stainless steel containers. However the benefits of using these non-returnable kegs are not restricted to the breweries. There are advantages for all those along the supply chain - from brewery right through to the consumer.

The challenge facing breweries

Breweries throughout the world that want to distribute draught beer over long distances or export it to other countries - usually by sea - face the same issues:

- High investment costs for keg pool and filling systems.
- Continually decreasing circulation rates - ie, kegs making fewer 'round trips' each year.
- Smaller container sizes.
- Output peaks at certain times during the year.
- Loss of kegs.
- The considerable cost of return transportation as well as administration and handling costs for managing a keg pool.

Recent increases in the price of metal have seen the costs of stainless steel kegs rise steadily. In Germany they rose to €81 for a 50 litre keg and €72 for a 30 litre keg in 2011[1]. Special types of kegs (eg, polyurethane-coated kegs) have prices of more than €90 per keg.

The value of a steel keg is typically depreciated to zero over eight years in Germany and the average circulation of containers in Germany from breweries that are not exporting is about three times each year. A 30 litre keg therefore depreciates in value by approximately three euros with each circulation - a figure which covers a large part of the purchase cost of a PET keg.

The eight years depreciation time does not correspond to the container's actual lifespan which is highly dependent on the brewery's keg distribution model.

When containers are mostly distributed in areas close to the brewery their lifespan can easily be 20 years or more. However, the impact of intensive export or distribution over expanded routes can reduce this to less than five years. The total of initial investment costs for the keg pool, the cost of the constant distribution of new kegs and the cost of keg repairs (which can average as much as €4 per keg per year) can therefore be high.

A surplus of containers is needed throughout the year to deal with seasonal output fluctuations, including the summer months and other peak demand periods. In practice, this surplus is not available for the reasons already stated. This leads to supply shortages or higher filling costs which could be avoided by using disposable kegs.

The problems will intensify in the future, as current trends indicate an increasing tendency towards smaller containers - 20 and 30 litre sizes - instead of the more traditional 50 litre containers. In this situation, the costs per litre for packing beer in metal kegs increase disproportionately.

Table 1 shows costs for investment, filling and logistics for a brewery with a keg-beer production of 30,000 hectolitre (hl) per year on the basis of a 20 year observation period. This is a generic model calculation which is based on actual costs in Germany. The keg life time of 20 years is an optimal situation.

To illustrate the problems, in this table the parameters "average distance to customers" and "annual circulation rate" are chosen appropriate to a brewery with a mixture of local and export business.

Investments into the pool of reusable kegs and the constant input of new kegs as well as repairs have a considerable impact. Compared with these costs the investment in the filling system (item 2), although considerable, is almost negligible.

For example, a decreased circulation rate with one instead of two circulations per year (calculation 1 compared with calculation 2) leads to additional costs of about €12 per filled hectolitre of beer because of the inevitably higher number of containers needed.

Increasing the average distribution distance from 500km to 800km (calculation 2 compared with calculation 3) means that total costs per hectolitre of beer go up to around €2.60.

The costs shown by items 7.2 and 7.3 are reduced when employing a disposable keg without deposit. Thus a cost advantage of about €5 per hectolitre and more can be achieved. When using disposable kegs there are no costs for water, detergents and thermal energy for cleaning and sterilisation (items 6.3 to 6.5) which gives another advantage when compared with metal kegs.

		Reusable keg, 30 litres Calculation 1	Reusable keg, 30 litres Calculation 2	Reusable keg, 30 litres Calculation 3
	Total costs, discounted to start of project	**13,871,175 €**	**21,827,175 €**	**23,397,413 €**
2	**Investment machines**	350,000 €	350,000 €	350,000 €
4	**Investment package (kegs/petainer/preforms)**	7,956,000 €	15,912,000 €	15,912,000 €
5	**Staff**	1,282,051 €	1,282,051 €	1,282,051 €
6	**Costs of filling**	245,367 €	245,367 €	245,367 €
7	**Transport to distributor**	4,037,756 €	4,037,756 €	5,607,995 €
	Comparable specific costs, discounted to start of project	**23.12 €/hl**	**36.38 €/hl**	**39.00 €/hl**
1	**Basic data**			
1.1	Annual sales	30,000 hl/a	30,000 hl/a	30,000 hl/a
1.2	Observation period (years)	20	20	20
1.3	Interest rate	5.0 %	5.0 %	5.0 %
1.4	Container volume	30 l/Keg	30 l/Keg	30 l/Keg
1.5	Plant capacity	120 Keg/h	120 Keg/h	120 Keg/h
1.6	Plant efficiency	75 %	75 %	75 %
1.7	Total efficiency (incl. cleaning)	65 %	65 %	65 %
1.8	Average distance to customer	500 km	500 km	800 km
2	**Investment costs machines**	**350,000 €**	**350,000 €**	**350,000 €**
2.1	Keg filling line (automatic)	200,000 €	200,000 €	200,000 €
2.2	Pallet un-/loader	150,000 €	150,000 €	150,000 €
3	**Package (kegs, petainer, preforms)**			
3.1	Lifetime keg	20 a	20 a	20 a
3.2	Annual circulation rate keg	2 U/a	1 U/a	1 U/a
3.3	Required number of kegs	50,000 Kegs	100,000 Kegs	100,000 Kegs
	Extra kegs for seasonal sales peaks and losses	20 %	20 %	20 %
		10,000 Kegs	20,000 Kegs	20,000 Kegs
3.4	Costs of keg	78 €/Keg	78 €/Keg	78 €/Keg
3.5	Cost of keg maintenance in relation to investment	70 %	70 %	70 %
		55 €/Keg	55 €/Keg	55 €/Keg
4	**Total costs of containers, discounted to start of project**	**7,956,000 €**	**15,912,000 €**	**15,912,000 €**
4.1	Reusable kegs	4,680,000 €	9,360,000 €	9,360,000 €
	Keg maintenance	3,276,000 €	6,552,000 €	6,552,000 €
5	**Staff costs, discounted to start of project**	**1,282,051 €**	**1,282,051 €**	**1,282,051 €**
5.1	Working hours (filling)	1,282 h/a	1,282 h/a	1,282 h/a
5.2	Required staff	2 MA	2 MA	2 MA
5.3	Spec. labour costs (wage and non-wage)	25 €/(h*MA)	25 €/(h*MA)	25 €/(h*MA)
5.4	Annual labour costs	64,103 €/a	64,103 €/a	64,103 €/a
6	**Filling costs, discounted to start of project**	**245,367 €**	**245,367 €**	**245,367 €**
6.1	Filling hours	1,111 h/a	1,111 h/a	1,111 h/a
6.2	*Electricity*	*889 €/a*	*889 €/a*	*889 €/a*
	Power requirement	10 kW	10 kW	10 kW
	Power consumption	11,111 kWh/a	11,111 kWh/a	11,111 kWh/a
	Spec. costs of electrical power	0.08 €/kWh	0.08 €/kWh	0.08 €/kWh
6.3	*Water*	*5,000 €/a*	*5,000 €/a*	*5,000 €/a*
	Spec. water consumption	20 l/Keg	20 l/Keg	20 l/Keg
	Spec. costs of water consumption	2.50 €/m²	2.50 €/m²	2.50 €/m²
6.4	*Heat energy*	*12,000 €/a*	*12,000 €/a*	*12,000 €/a*
	Spec. heat energy consmption	2.0 kWh/Keg	2.0 kWh/Keg	2.0 kWh/Keg
6.5	*Cleaning and disinfection*	*1,800 €/a*	*1,800 €/a*	*1,800 €/a*
	Spec. detergent costs	0.06 €/hl	0.06 €/hl	0.06 €/hl
7	**Transport to distributor**	**4,037,756 €**	**4,037,756 €**	**5,607,995 €**
7.1	Spec. costs of transport to distributor	4.90 €/hl	4.90 €/hl	7.00 €/hl
7.2	Re-transport of empty kegs	4.90 €/hl	4.90 €/hl	7.00 €/hl
7.3	Deposit handling	1.0 €/hl	1.0 €/hl	1.0 €/hl

Table 1: Comparison of costs per hl

Another problem facing many breweries is the loss of containers, often due to theft. An unfilled 50 litre keg weighs around 13kg. In early 2010 the scrap value of stainless steel in Germany was around €2.10 per kg. Therefore the scrap value of one keg is close to €30, which is the usual inland deposit for a keg in Germany but only a small part of its prime cost.

In times of scarcity of raw materials, kegs exported by breweries to certain countries often disappear despite the deposit. This also happens with domestic sales in some countries. Stainless steel is a valuable raw material and kegs often 'vanish' without any explanation although external use, theft or acquisition by other breweries are the most likely causes. The deposit is not particularly helpful and requires considerable time and effort in book-keeping and handling.

An additional problem is that the kegs used for export are often extensively damaged in circulation. Because of this, breweries often seek to buy used, old or reconditioned kegs for export. However, at times (for example in the summer of 2011) no used kegs are available on the market.

There may also be problems with old kegs as a result of inorganic staining (beer stone) and flavour taints associated with poor washing techniques.

All these issues of concern are removed when non-returnable PET kegs are used - which also saves the cost of transporting containers back to the brewery.

Disposable PET kegs are an attractive alternative for new breweries or those which do not fill kegs, as the acquisition of reusable kegs is a major investment. A keg plant, or at least a keg cleaning plant, would also be needed in order to use metal kegs and this would be an additional investment expense. Disposable kegs are microbiologically harmless and do not need to be cleaned.

Even small batches of different beers can be put into disposable kegs without any significant effort. In this way, breweries can target specific customers to increase their market share.

Another very appealing benefit of disposable PET kegs is the potential to create and use distinct, memorable designs on the packaging. Disposable kegs are usually packed into cardboard boxes or polypropylene casings. These can be designed individually which ensures a much easier distinction of brands and different kinds of beer than is the case with reusable containers. Keg boxes also prevent light from having any impact on the container or its contents.

Export

Worldwide export of beer grew until the economic crisis in 2008. Export of German beer, particularly draught beer, grew until 2007[2]. Afterwards a period of consolidation took place until 2010[3].

Beer is usually exported overseas by ship, the most economic way. Heavy goods vehicles (HGV) and trains are used on intercontinental routes. Trains are relatively expensive and need HGVs to load and unload.

One major disadvantage in exporting, particularly over long distances, is the length of time it can take to reach destinations. Products are often in transit for six or more weeks. During this time, fluctuating and uncontrollable temperatures can have an impact on the quality of the beer.

The beer is often exposed to warm temperatures - temperatures of 40°C and higher are common when transporting from Europe to Asia and America or from North to South America. These temperatures can accelerate the chemical and physical reactions in the beer and make it age quickly.

After reaching the country of destination, containers continue their journey and are stockpiled until they reach their end customer. Re-transporting emptied reusable kegs is therefore slow with circulation periods of a year or sometimes as long as 18 months[4].

The already stated depreciation of a 30 litre keg (€9.0 to €13.9 a year) means that costs can rise steeply. The annual depreciation may be as much as the acquisition cost of one disposable PET keg.

Cost savings can be achieved with PET kegs because they do not have to be transported back to the brewery or washed and there are no handling charges.

Testing[5] shows that PET kegs with integrated oxygen scavenger technology have positive effects on flavour stability. On long journeys, when beer is exposed to relatively high temperatures, this can protect and preserve the original flavour better than stainless steel kegs because of lower oxidation.

As well as preventing oxygen from entering the container, the scavenger also removes some of the oxygen that enters during the filling process[6]. It has also been proven that PET containers with integrated scavenger technology tend to have fewer microbiological issues[7] than those without it.

Additionally, the beer can be ordered in smaller quantities and therefore 'stockpiling' is not required.

From brewery to wholesale drinks business

There are several stages in the traditional method of transporting containers from where they are filled to their final consumers.

After the beer has been loaded onto HGVs at the brewery it is taken to the wholesaler where it is stockpiled. Batches are either transported to another wholesaler or packaged for distribution to the final customers.

Table 2 compares the packing of HGVs with disposable PET kegs and metal kegs. Metal kegs are always put onto pallets in one layer and carried to the warehouse on HGVs. PET kegs with their outer packaging can be put onto pallets in two layers and be stretch-wrapped afterwards. Then they can be loaded onto the vehicles. Metal kegs can be piled one pallet on top of another to a maximum of four layers in the best case.

The table illustrates two main points that prove the advantages of PET kegs. First, PET kegs ensure that, per kilogram, much more beer is loaded each time on a full vehicle compared with beer in conventional metal kegs. This reduces the overall weight which reduces fuel use and transportation costs.

Again, the popular smaller sizes of metal kegs are an issue because they add to the weight of every litre of beer being transported. By employing 20 litre PET kegs instead of 20 litre metal kegs, 50 per cent of packing material can be saved in terms of net volume.

Second, the maximum load permitted for a HGV is 25,000kg in some European countries. If an HGV is loaded with metal kegs this limit would be reached before all available space on the truck is used. An HGV loaded with PET kegs can carry more beer and still remain within the weight limit.

	PET-Keg + Box		Metal keg		
Volume	20l	30l	20l	30l	50l
Dead weight	1.5kg	1.5kg	9.5kg	11kg	13kg
Layer per pallet	2	2	1	1	1
Keg number per pallet	30	24	6	6	6
Keg number per pallet space in the truck	30	16	24	18	12
Net volume per pallet space in the truck [l]	600	480	480	540	600
Number of pallets per pallet space in the truck	1	1	4	3	2
Gross weight per pallet space in the truck [kg]	645	519	768	783	786
Net volume per truck load (34 pallet spaces per load) [kg]	20400	16320	16320	18360	20400
Gross weight per truck load (34 pallet spaces per load) [kg]	21930	17646	26112	26622	26724
Ratio of net volume compared with gross weight	1.1	1.1	1.6	1.5	1.3

Table 2: Comparison of parameters of transportation of PET and metal kegs in common sizes

The weight figures shown in red in Table 2 are not permissible in some countries and the total number of kegs would need to be reduced to remain within the load limit of 25,000kg. Even where the weight is permissible, however, the truck load is limited by the number of available pallet places.

If beer is exported by ship the kegs can be put into sea containers at the brewery and taken to the harbour by HGV. All containers or cardboard boxes are stacked to ensure maximum use of space. Keeping free space to a minimum prevents the load from slipping or moving about and being damaged in transit.

Kegs are usually loaded into containers by hand. Manual handling is much easier with PET kegs than with metal kegs.

Tests have shown that PET kegs are sufficiently robust to be transported in the same way as metal kegs.

From wholesaler to final customer

Retailers of draught beer are usually supplied by drinks wholesalers on a regular basis with ordered batches assembled individually. As customers tend to order single kegs, these need to be unloaded from the vehicle. In some cases they are also packed by hand.

Disposable PET kegs weigh much less than metal kegs which makes them easier and safer to handle.

In Italy there is a law prohibiting workers from carrying objects weighing more than 25kg at work. Therefore, even lighter metal kegs pose a problem so using 20 litre disposable PET kegs is a practical and viable alternative for these markets.

The process is much the same with beer exports. Sea containers are delivered to the importer which can distribute them either directly to the customer or to other wholesalers. The advantages of PET kegs apply equally to export markets.

Reaching the final customer

Final customers of draught beer can be categorised into two groups. Kegs are usually supplied to the retail industry - including pubs, bars and restaurants - and to independent retail outlets selling beer at events. However, the real 'final' customer is the consumer who buys the tapped beer. In this respect, it is irrelevant if the beer is exported or sold in its country of origin.

Either way, the lower weight of disposable PET kegs makes them much easier to handle than metal kegs. Table 2 shows that the difference in weight is about 10kg depending on container size.

Space for stockpiling kegs is especially scarce at retail businesses in major cities. Their sturdy cardboard boxes or polypropylene casings make PET kegs easy to carry and stack in two layers. The slim, taller shape of PET kegs is a real advantage because more storage area is saved.

In addition, an emptied disposable PET keg can be disposed of for recycling of the material after releasing its pressure. This frees up storage space that was previously needed for empty metal kegs until the wholesaler's next shipment. It also reduces the amount of handling.

All these advantages of using disposable PET kegs in pubs and bars also apply to beer sold during events.

On an international scale the range of special beers is expanding. Consumers want a broad choice of draught beer products. One example of this is America's ever growing craft brewer scene which produces a huge variety of special, highly-priced beers. Already, 10 per cent of the entire US beer supply is produced in this way.

Similar developments can be seen in Denmark. More than 10 different draught beers can often be ordered in pubs. This requires much hard work to provide the required stockpiling space. Because of this huge variety, single containers may be in use for a long time before they are emptied. Smaller containers, such as 20 or 30 litre PET kegs, are therefore an ideal alternative because they are emptied quickly.

If beer is served from PET containers with integrated scavenger technology, the ageing process is less pronounced compared with stainless steel containers for reasons already stated. The beer will remain fresh for a longer time.

No more return transportation

Table 3 illustrates costs for different methods of transportation as well as their respective CO_2 emissions. This is average data which is relativised by long transportation routes - prices depend greatly on the actual shipment size. Improved use of the total load also reduces costs and emissions.

Type of Transport	CO_2 (g/tkm)	Costs (€/tkm)	
Truck	50	D	0.24
		EU	0.74
		non-EU	0.40
Plane	540	2.50	
Train	26.5	1.00	
Ship	15	0.05	

Table 3: CO_2 emissions and costs of different means of transportation[8]

Using disposable containers avoids shipment costs, fuel costs and CO_2 emissions because there are no return transport requirements. There are also fuel and CO_2 savings in the original transportation from the brewery to the final customer because PET kegs weigh less than their metal counterparts.

A comparison between a German domestic shipment of 20,400 litres of beer in 20 litre disposable PET kegs with the same shipment using 50 litre metal kegs with a gross weight of 4,794kg (see Table 2 - the difference between 26,724kg load for a truck carrying 50 litre metal kegs and 21,930kg for the truck with 20 litre PET kegs) in a vehicle over 400km hows that €460 (4.794t*400km*0.24€/tkm) can be saved. There is also a reduction in CO_2 emissions of 95kg (4.794t*400km*0.05kg CO_2/tkm) which is shown in Table 3.

When returning a 20 foot sea container holding 350 empty 30 litre metal kegs from Hong Kong to Hamburg, 14,077kg of CO_2 are emitted, according to calculations by the Carbon Footprint Calculator (the weight of the container and empty kegs adds up to 6 tonnes over 26,891 travelled kilometers)[9].

Transporting beer like this would cost 1,032 US$ (calculated at June 2011 figures) which is approximately equal to €730 or just over €2 per keg.

Environment

Disposable PET kegs provide other environmental advantages. The PET kegs and their cardboard boxes or polypropylene casings are 100 per cent recyclable where facilities exist for waste separation and recycling. Alternatively, PET kegs and their boxes can be used as fuel in energy-from-waste plants.

Conclusion

In this paper we have only considered the potential for using disposable PET containers for beer. Most of the advantages that are mentioned here would apply equally to the transportation of beverages such as wine, prosecco, cider and soft drinks.

There is a strong case for using disposable PET kegs instead of conventional metal kegs because there are clear benefits at every stage of the supply chain from the brewery to the final customer.

The brewery can save money by investing less into the keg pool and by not needing to keep kegs to deal with peaks in output resulting from seasonal fluctuations in demand. The standard 20 and 30 litre disposable PET kegs can have a positive impact in relation to the actual demand for smaller containers and special beers, creating a quick route to market for breweries in local, national and international markets.

The use of disposable kegs also simplifies handling at all stages along the supply chain. Retailers stand to benefit significantly as a result of the smaller volume, reduced weight and the opportunity for immediate disposal of the kegs after they are emptied.

By removing the need for a return trip after the containers have been emptied, the use of disposable PET kegs has a significant and positive impact on the environment. The cost savings on transport, fuel and energy as well as the reduced CO_2 emissions create a compelling case for the use of these disposable lightweight kegs.

References

[1] Based on information from Schäfer Werke GmbH.

[2] Brauwelt Nr. 21-22; 2008; S.583.

[3] Brauwelt Nr. 19-20; 2011; S.605.

[4] Tippmann, J. et al; The Institute of Brewing & Distilling Africa Sect. - 12th Scientific and Technical Convention 2009: Disposable Kegs As A New Way For Draught Beer Export.

[5] Flavour stability of beer in Petainer Kegs, 2012, Sauer & Hartwig Technologie GmbH & Co. KG

[6] VLB Berlin, 2010: Report about the testing on plastics big packs for beverages.

[7] Folz, Roland. Dissertation 2010: Geschmacks - und biologische Stabilität von Bier in Kunststoffverpackungen.

[8] Voigt, J. et al: Ohne Rückfahrticket. Brauindustrie 2/2010, S.19.

[9] see: CO_2-Kalkulator on www.hamburgsud-group.de.

www.petainer.com