BRITISH SUGAR

Wissington Sugar Factory

A guide to the history of sugar
and the story of a Fenland factory that grew
to be world class

Wissington Sugar Factory . . . the story so far

Contents

1. Introduction

This guide tells the story of how Wissington grew to be 30 times bigger than the original factory, which was designed in 1925 to process just 600 tonnes of sugar beet per day into raw sugar. Today the factory produces white sugar from more than 18,000tpd (tonnes per day) of beet and imported sugar syrups. In fact, it processes more beet sugar each year than any other factory in the world.

Sugar occurs naturally in sugar beet and so the secret of the factory's success is not to make sugar, but rather not to lose it. Endless attention to detail, combined with clever integration and recycling, has enabled the factory to achieve ever-increasing speed and efficiency. Everything is used and turned into a range of useful products, with the minimum of waste.

This innovative approach has taken Wissington beyond just sugar. The factory is now a major exporter of electricity and can extract other plant materials from the sugar beet. It operates the UK's first fuel bio-ethanol plant and has the largest single salad tomato business* alongside the main factory. The site has developed a strategy of continuous operation, using efficient and innovative processes which integrate to create a unique facility.

The guide provides a brief overview of the processes at Wissington and also gives a brief history of sugar and the politics which have shaped the industry around the world. To be successful, the British industry and Wissington have had to constantly adapt to changing rules. British Sugar has invested heavily in the factory, and this investment together with the skill and dedication of the people who have given so much, has made Wissington the premier UK sugar factory, as well as being a leading force in the industry.

2. The history of Wissington Sugar Factory to 1971

Wissington is built on the edge of the fens, an area originally swept by the sea but which was drained between 1640 and 1750 by Cornelius Vermuyden and others, using Scottish and Dutch prisoners of war.

- **1904 – Arthur Keeble builds his fertiliser factory at Wissington**

The original facility was built as a fertiliser factory in 1904 by Arthur Keeble, a successful farmer, merchant and partner in the Fletton brick company at Peterborough, who was born in 1856. He moved to Wereham in 1904 to concentrate on his 7,000 acre farm south of the river Wissey and immediately started construction of a rail spur to cross the river and connect with the Downham to Stoke Ferry line near West Dereham. This allowed him to collect crops (mainly hay) to ship to London by rail. He named the river crossing Wissington, which at that time was only a collection of a few farm cottages

Keeble had great plans, and once the rail spur was completed he started work on the fertiliser factory. This created a production facility that heated the local peat to produce ammonia, which was reacted with sulphuric acid to make ammonium sulphate. But by 1906 the venture had gone into receivership, and although it continued to operate up to 1914, it was closed down shortly after Keeble's death and sold as scrap to Dodmans in Kings Lynn. Much of Keeble's land was bought by Abel Towler, a local farmer and a partner in the Fen Light Railway Company.

- **1925 – Abel Towler builds the original Wissington Sugar Factory**

The Cantley beet factory opened in 1912 just East of Norwich and Abel Towler grew beet on the back fen which he transported to the Cantley factory by rail. But he had a vision of his own beet factory which he planned for the Wissington site, where Keeble's fertiliser factory had originally stood.

This was made possible by the 1925 Sugar Beet Subsidy Act, and so working with others he formed British Sugar Manufacturers Ltd. The Wissington factory was subsequently built by McAlpine at a cost of £520,000, with production starting on the 1st of December 1925. Skoda engineering in Czechoslovakia designed and supplied the process plant and most of the technical staff were Czech. In fact, at one time the Factory Manager of Wissington was the Czech grandfather of comedian and actor Stephen Fry!

Beet was delivered by rail and also by a fleet of 24 steel barges carrying 20 tonnes each. The factory then produced raw sugar which was shipped by rail to the refineries in London to make white sugar. It was originally designed to process 600tpd, but this was expanded to 1,000tpd by 1930 and then again to 1600tpd by 1936.

- **1936 – Wissington becomes part of the British Sugar Corporation (BSC)**

The factory was expensive to run and struggled to compete against neighbouring facilities at Ely and Kings Lynn. As a result Abel Towler retired in 1932 a poorer man, and Wissington was eventually merged into the British Sugar Corporation four years later. In the 11 year life of British Sugar Manufacturers Ltd. the company never paid a dividend and the shareholders received just 40% of their original investment after the merge.

- **1939 – Wissington in the war**

BSC and Wissington supplied the nation with sugar during World War II and many key staff were brought home from the fighting to run the factory for the campaign. Air raids were always a threat, but 1943 saw the biggest emergency of the war for staff, when they had to quickly rescue the crew of an RAF Feltwell bomber which had crashed into the soil ponds. This may have been the inspiration for an emergency drill some 50 years later, when Wissington's emergency team simulated an aircraft crash at the factory in association with all of Norfolk's emergency services!

- **1945 – After the war**

The war years took their toll on the factory. Investment was badly needed to bring Wissington back to peak efficiency and it wasn't until 1950 that throughput returned to a reasonable level, averaging 1,686tpd. The 1950s then saw steady investment and throughput moved up to 2000tpd, followed by a new reconstruction in 1957 which expanded the factory to a design of 2,500tpd. Modern control equipment was installed in the factory and a Panel Shop was created to assemble instrumentation equipment for BSC.

- **1967 – The new Wissington**

In 1967 the BSC Chairman Sir Edmund Bacon announced that Wissington was to be reconstructed again, with a £10m investment. The work lasted three years, but the factory continued to function throughout, and the result was a facility which could process 7,200tpd, producing white sugar for storage in six new bulk silos. The addition of three juice storage tanks also allowed off-season refining for the first time.

A boiler house which burned the new North Sea gas was built, although heavy oil (and later light oil) was still available as a standby fuel. A new electrical generator was installed which was capable of 10MW with a 6 MVA export/import facility, although the installation was difficult as the new 440V generator needed to be put in place alongside the 525V system which had been there since 1925. The factory was also equipped with the latest control equipment, including the company's first process control computers.

The new Wissington Sugar Factory was officially opened in 1971 by James Prior, the Minister of Agriculture. It quickly became the showpiece of BSC, with 300 permanent staff and 200 seasonal staff processing 1 million tonnes (mt) of beet at the largest and most modern factory in the UK.

3. The modern era at Wissington – 1971 onwards

The opening of the new factory in 1971 was a major milestone and the early 1970s were a proud period for Wissington staff. The factory was further improved, bottlenecks were removed to increase capacity and many visitors came to see the new technology installed.

In 1975 the British government and the European Commission were actively encouraging the expansion of beet sugar production. A quota of 1.3mt was proposed, and under the leadership of John Beckett money was made available to expand capacity at Wissington, resulting in an increase towards 10,000tpd.

- **1980s – A decade of change**

In 1980 the EC changed direction and cut quotas, which resulted in the closure of four factories. Wissington survived and shared beet from Ely with the Peterborough factory, but the investment focus moved away from capacity and onto efficiency, which became Wissington's new target through the decade.

The late 1980s saw the introduction of significant changes which would shape the future of the factory. Multi-skilled training and a 'change culture' were introduced and at the same time, plans were prepared to expand Wissington by 50%, to restore its number one position as the largest factory in the UK, with a processing capacity of 15,000tpd.

- **1990s – A decade of development**

Between 1991 and 1994 the expansion project cost £50m and focused on slice and thick juice production, with little change to crystallisation. The plan was to extend operations with almost year-round crystal production.

At the end of 1994 the expected closure of the adjacent factory at King's Lynn was confirmed, and at the same time it was also announced that Wissington would operate in a different way, with less people. The new team worked together to prepare for the future, working without traditional supervision in a factory split into mill and refinery. At the same time a six crew proposal for the refinery was implemented.

1997 and 1998 saw the arrival of a new combined heat and power (CHP) plant which incorporated a gas turbine. This marked the beginning of a diversification plan around the core sugar process as all year round steam and power presented new opportunities.

- **2000s – A decade of diversification**

A five hectare horticulture business was set up in 2000 and then doubled in size in 2006. This facility used boiler flue-gas and heat from the factory to grow high quality yet low cost British tomatoes, to meet an increasing UK demand.

The next diversification took place in 2001 with the setup of a resin separation plant which extracted Betaine, another part of the sugar beet, as a product. Betaine is a natural moisturiser which is used as an animal feed supplement. The resin separation plant also improved production efficiency by producing a new sugar extract syrup.

This year also saw the worst performance that could be remembered when filtration problems reduced throughput by more than 20%. This was caused by a combination of poor beet quality from a difficult growing season and the factory changes which had been made to produce 'soft' juice for the resin separation plant. Investment was needed to redesign the purification plant to solve the problem.

Wissington bounced back in subsequent years and saw throughput records tumble every year up to 2007. A new focus on reliability and performance then transformed the factory from a 15,000tpd facility to just under 18,000tpd. 2007 also saw creation of the UK's first fuel bioethanol plant and a major new sugar screening, bagging and distribution centre at Wissington, on top of substantial investment to reduce the factory energy demand by 20%.

4. How Wissington operates

This block diagram shows how the separate processes at Wissington are integrated together. The output of each process becomes the input of the next, until raw materials are turned into products and potential wastes are captured as new products. This recycling approach is best illustrated by the horticulture business. Here, the low grade heat and the combustion gases from the power station are diverted away from being just emissions into the air and are instead used to enrich the environment inside the glasshouses, to encourage the tomatoes to grow twice as fast as they normally would.

The basic sugar production process is the core, but there are additional steps which demonstrate how Wissington produces much more than just sugar. Each process has a separate page giving an overview description with illustrations.

The secret of Wissington is the complex interaction and integration between all the processes. To quote a famous song, “It’s not what you do, it’s the way that you do it”.

a. Beet supplies

- Three million tonnes of beet are produced within a 50 mile radius of the factory by some 1,500 growers. Up to 1,000 deliveries arrive at the factory six days a week, from mid September to March.
- Four 50 tonne platform weighbridges account for these beet deliveries.
- Four probes randomly sample approximately 50% of the deliveries.
- The beet samples are analysed in a central tarehouse at Wissington which also serves all UK factories. 6,000 samples can be processed weekly through two auto lines which are fed by rotary washers and single blade saws.
- Beet unloading is carried out direct to factory via four wash-off bays, or directly tipped onto a 35,000 tonne flat pad storage area.
- The beet is conveyed in recirculating water through a beet pump, which is capable of moving 1,000 tonnes of beet per hour in 4,000tph of water.
- Six three-metre rotary stone catchers remove 15kt of stone each year, which is then washed in a rotary washer and sold as an aggregate. Six belt and tine trash catchers remove floating material which is composted.
- The clean beet is separated from the water and soil over four primary and two secondary vibratory screens. There is no separate beet washer.
- The water and soil pass to settlement separation. The water generates biogas in an anaerobic digester before being reused to wash beet and the soil is separated, dried, screened and blended before being sold as high quality topsoil to landscapers and for construction projects.

b. Extraction

- The clean beet is sliced into thin strips called cossettes at up to 800tph using six vertical drum slicers.
- The cossettes are conveyed to three counter-current drum pre-scalders where the cossettes are heated to 70℃ and the sugar juice is cooled to 20° C
- The cossettes are pumped to three separate 6.75m diameter rotary horizontal diffusers, where more than 98% of the sugar is extracted, together with other vegetable components of the beet. This raw juice is used to heat the cossettes and then goes to heat recovery systems and on to purification.

- The remaining fibre leaves the diffuser and is mechanically pressed in seven presses before going to three rotary driers, where gas flames dry the fibre. The familiar plume of steam rising from the drier chimney is from this fibre drying process.

- Various recycled factory syrups can be added to the fibre at this stage, or it can be produced as a plain product.

- The dry fibre is compressed into pellets which are sold in bulk as animal feed direct to farmers or through merchants. Smaller quantities of the pressed or dried fibre are also sold separately. In total around 140,000t of dried animal feed is sold each year.

c. Purification

- The raw juice which comes from the extraction process at 20℃ needs to be progressively heated to 85℃ through heat recovery systems, and it is then passed to first purification.

- Wissington uses a twin parallel stream carbonation system at a combined flow up to 1000m^3 per hour. Milk of lime and CO^2 are then added to precipitate calcium carbonate or chalk.

- This chalk attracts the majority of the vegetable extract out of the sugar juice and produces a finely divided solid, which is settled in clarifiers.

- The settled chalk is filtered, washed and pressed in five vertical presses, producing 800 tonnes of Limex per day. Over 120,000 tonnes of Limex is sold annually as a fertiliser and soil conditioner, and for other non agricultural uses.

- The sugar juice from first carbonation has more CO^2 added to precipitate the lime salts, and is then filtered in five automatic cloth filters with a combined area of 350m^2. Remaining lime salts are removed using a resin de-calcification system.

- This soft, pure juice is passed forward to evaporators which boil the water away and produce a thick syrup. The evaporators are falling film tubular units which are configured as a single-stream seven effect system with a combined area of over 50,000m^2.

- This is the complex heart of the factory's energy efficiency. The water that has been removed by evaporation is then condensed, used for further heating and then stored to be used in other processes on site.

d. Crystallisation

- Up to 50% of the thick juice which is produced can be stored in 10 large steel tanks with a combined capacity of 370kt. This juice is returned to the factory after beet processing to allow refining crystallisation to continue throughout the year. Other syrups and thick juice from other factories are also processed to sugar.

- The 14 batch crystallisation pans are the original ones from before the 1994 expansion, but have been configured to be more flexible in use and have also had a cooling crystalliser seeding system added. Normally six pans produce first product which passes through two continuous vacuum crystallisers. The other pans recover sugar which is recycled back to thick juice.

- A three-stage centrifuge station uses four batch machines for first product, with continuous machines separating the recovery sugars. Maximum production of white sugar is 80tph.

- Production sugar is passed to storage through rotary driers and coolers. The sugar is then sieved through gyratory screens followed by rare earth magnetic separation units.

- There are seven concrete storage silos, six of 12,000 tonnes each and one of 26,000 tonnes, giving a total bulk capacity of 98,000 tonnes.

- The sugar is conditioned in storage by passing cooled, de-humidified air through it.

e. Resin separation

- After crystallisation, the residual syrup together with syrup from other factories is passed through a resin separation process, which separates its components by their molecular size. Three products are formed, a sugar stream called extract, an amino-nitrogen stream which is mainly betaine and a stream of small molecular size which is mainly the mineral salts and is called raffinate.

- This process requires the feed syrup to be diluted and finely filtered in three pre-coated cloth filters.

- The filtered syrup is passed through a resin chromatography system containing resin beads.

- The dilute products are concentrated using falling plate evaporators and boiling plate evaporators. The falling plate units are powered by mechanical vapour recompression and the boiling plate units are powered by CHP steam. Any surplus heat is used in the adjacent glasshouse horticulture business.

- The betaine liquid is passed through a second chromatography separator to increase its purity, prior to being sold as an animal feed supplement. This supplement increases the feed absorption efficiency in the animals' digestiive system, and can also be used as a moisturiser in healthcare and cosmetic products. Wissington is the largest producer of natural betaine in the world.

- The raffinate is used along with beet fibre in animal feed production.

- The sugar extract can be used to crystallise sugar, but is normally passed to the biofuels plant where it acts as the raw material fermentation substrate.

f. Biofuels

- The extract from resin separation, together with other sugar streams, is used in a fermentation/distillation plant to produce 55kt of bioethanol per year. This is used as a renewable fuel to blend with petrol.

- The extract is mixed with yeast and fermented in three 1000m^3 continuous fermenters which are maintained at 35℃.

- The yeast is removed by settlement and recycled back to the fermenter. The resultant 8% alcohol mash is then passed forward to distillation.

- The alcohol is boiled off from the water in a two-stage distillation process that produces a concentrated ethanol, which is 95% ethanol with 5% water. The water is removed using molecular sieve de-hydration technology, producing a 100% pure ethanol product.

- The ethanol is then passed to storage where it is de-natured and loaded out to be shipped to blenders, where it is incorporated into petrol supplies.

- Complex heat recovery systems involving condensing heat exchangers and falling film tubular evaporators have been installed, to minimise the energy demand of the plant. This ensures the plant achieves the low carbon footprint which is necessary to produce sustainable, renewable biofuels.

- The plant is the first UK bioethanol plant and received the award for Best New Project in 2007 from the Renewable Energy Association.

g. Power generation

- The Wissington CHP plant was installed in 1998 and is the heart of the site operation. It produces steam and electricity using gas turbine technology, exhausting into a supplementary fired steam boiler.
- Over 50MW can be exported into the local electrical grid, which is enough for a population of 120,000 people.
- The gas turbine is a GE LM 6000 PD unit which uses leading edge spray intercooling technology and produces the lowest emission levels possible. The installation achieves the best CHP rating under the government CHP environmental quality assurance scheme.
- The flue gas which traditionally goes to the chimney, representing a 15% energy loss, is diverted to the adjacent glasshouse. This provides some heating but also provides CO^2 which is essential to promote plant growth.

h. Horticulture

- Wissington is the UK's largest grower of classic round and speciality salad tomatoes. The glasshouse, known as Cornerways Nursery, covers an area of 11 hectares and produces 70 million tomatoes per year between March and December.
- The plants are trimmed and trained by hand on a weekly basis and the fruit is picked by hand to ensure it is handled gently at the optimum time for harvest.
- All the tomatoes are packed on site in a modern pack-house, with a sophisticated grading system that can sort fruit by colour and size.
- Product is despatched daily and can be on the supermarket shelf within 12 hours of being picked, ensuring freshness and taste as well as maintaining quality. The taste of tomatoes can be destroyed by refrigeration, so Cornerways 365 is a name to look for - the Best of British!
- Over 2,000 bumble bees are at work on the site, pollinating the tomato flowers. Other natural predators are also used to control pests, in preference to more aggressive agro chemicals
- Over 200km of heating pipes bring recovered heat from the adjacent factory to maintain optimum temperatures, without the need to burn additional fossil fuels
- The CHP plant also provides flue gas which is a rich source of carbon dioxide. CO^2 is essential for the photosynthesis process which the plants need in order to grow. It is absorbed by the leaves and combined with water from the roots and using the energy from the sun it produces energy that is stored in the plant. Without the CO^2 the plants would grow much more slowly.
- The glasshouse even recycles rainwater from the roof, along with water from elsewhere, to irrigate the crop.

i. Sugar products

- 400kt of sugar from Wissington is supplied to other food manufacturers in the UK and across Europe.
- 200kt of dry granulated sugar is despatched in bulk each year and can be loaded in batches onto bulk vehicles on two outloading weighbridges every 30 minutes.
- The site also screens and bags sugar, producing caster and granulated in 25kg bags which are fed onto robotic palletisers. 1,000kg bags are also produced.
- 150,000t of bagged sugar is produced annually and a new sugar distribution centre has increased bagging flexibility and speed, with additional screens and bagging lines.

- 40,000 tonnes of sugar is dissolved in high quality water and despatched as liquid sugar to customers who prefer the ease of handling of liquid products.

- Some liquid sugar is inverted or mixed with invert sugars to make a blended product which can then have a range of flavours and ingredients added, to meet specific customer requirements. About 10,000 tonnes of blends are despatched annually.

j. Company services

- As the largest factory site, it's a natural decision to locate common service operations at Wissington. These support both Wissington and the rest of the UK sites.

- The central tarehouse analyses all beet samples from the factories and provides the data to allow payment for the UK beet crop.

- The central knife sharpening facility is a highly automated operation which sharpens all of the company's beet knives. These are sharpened to high quality standards and returned daily

- Operations Services Science is a group of about 10 specialists who are based at Wissington, providing technical advice and analytical support to British Sugar sites and to many customers.

- Operations Services Research is a group of about five scientists who are based at Wissington, working on new business development opportunities. This is applied research and the group is integral to the developments in chromatography and biofuels at Wissington.

- British Sugar logistics and distribution is based at Wissington and controls the sugar delivery fleet for the company. The office is equipped with vehicle satellite tracking, along with telemetry links to customer sites. These allow customer sugar stocks and usage to be monitored in real time, so that deliveries can be planned to maintain supplies without the need for customer input. This information allows the company to achieve the highest standard of delivery service.

5. What makes Wissington work?

Specialist areas
Wissington is a complex site with a range of distinct operational activities, so to achieve the level of focus which is required, the company's people and systems are separated into individual specialist areas. This brings expertise and pride, and in turn delivers the results which make Wissington a World Class operation. To hold everything together, a common set of standards and systems are used.

Safety
Something which is always paramount. The site is registered to OSHAS 18000 and is proud to hold a RoSPA Presidents Award. Both of these accreditations recognise the continuous and ongoing improvement in safety which Wissington has made over many years. The key focus is to never compromise standards and to always train people to know and to care about what they do.

Environmental excellence
This must be a given. The site is IPPC authorised and ISO 14000 registered, and there is an aggressive improvement plan that is being delivered. Environmental performance can be linked to business performance and Wissington aims to deliver both, by cutting waste and improving efficiency.

Food quality
Quality must be delivered to attract and retain customers, as without them there is no business. Wissington is ISO9000 registered and BRC registered for its sugar and tomatoes. It also has a FEMAS accreditation which covers animal feed. The company works hard to improve its operations and recognises it can only do this reliably with the knowledge and commitment of its people.

Engineering standards
These are at the heart of site operations as Wissington has thousands of machines which must be reliable. The business uses a computerised maintenance management system (CMMS) and practices many tools and techniques to increase reliability through an integrated 'maintenance reliability programme' (MRP). The management team at Wissington know that excellence is achieved through people, so staff are trained to high standards and there is an established apprenticeship programme in place.

Wissington in the future
Wissington is an exciting place to be. There are plenty of challenges to be met every day and there will always be a focus on getting the best from the installed plant. But equally, Wissington has never been a place to stand still and must continue to progress, to ensure that it stays ahead of the competition and retains its place as the UK's premier sugar factory.

British Sugar has a vision which includes being the leading supplier whilst also being sustainable, innovative and lowest cost. Wissington will lead that journey and demonstrate the values that will take the business there. This will be achieved by:

- getting more from what is already in place
- finding cost effective ways to expand
- find new opportunities in resin separation
- finding new uses for CO^2 and energy streams
- adapting products to meet the changing needs of customers

In summary, Wissington will always be proud of what it does and will continue to invest in the people who will ultimately build its future.

6. The history of sugar

a. The world story

Humans have always enjoyed sweetness, but before the discovery of sugar this was limited to restricted sources such as honey from bees. However, somewhere between 5,000BC and 2,000BC Polynesian peoples discovered a grassy cane containing a sweet tasting juice which, over many thousands of years, eventually became what we know today as sugar:

- By 1,500BC - migration had brought sugar cane to India with the Sanskrit name 'sakara', which became 'sugar'. At this time it was only known as a liquid and was prized as an expensive and rare medicine.

- By 100BC - trade had spread sugar cane to China and the Middle East.

- By 600AD - the Persians discovered how to boil sugar juice to crystallise it into sugar.

- By 1200 - the Crusaders had brought sugar back from the Middle East and the trading empires of the Venetians and others had spread sugar through the Mediterranean and southern Europe.

- By 1500 - the expansion of the Ottoman empire had brought sugar to Spain and France and it was known throughout the Courts of Europe as a luxury food.

- By 1600 - Columbus introduced sugar cane to the West Indies and the Plantation system was established, with the arrival of slave labour from Africa.

- By 1750 - sugar production was booming and the Golden Age had arrived. European ships would take manufactured goods to sell in Africa and then take slaves to the West Indies, before returning with sugar for Europe. European wealth was built on this Triangular Trade and sugar was known as white gold.

- In 1800 - the French Revolution encouraged a slave revolt on the French island of St. Domingo which stopped French sugar production. Napoleon imposed his Continental System on Europe and looked for home grown sugars. The Napoleonic Wars between Britain and France included a trade war, with the British fighting for free trade and sugar imports from the West Indies, whilst Napoleon was developing the beet sugar industry in France.

- In 1815 - the Battle of Waterloo gave victory to the British and free trade was restored.

- By 1830 - most European countries had seen the benefit of promoting a home grown beet sugar industry and had imposed import tariffs and excise duties to protect their national industries.

b. The beet sugar story

- 1747 - laboratory work by Prussian chemist Andreas Marggraf extracted crystals of sugar from fodder beet which was grown as cattle feed.

- 1772 - Franz Karl Achard, a pupil of Marggraf, developed this technology for the commercial extraction of beet sugar, but finance was withdrawn.

- 1799 - finance was finally made available by the Prussian leader Frederick William III.

- 1801 - the first beet sugar factory opened at Kunern in Silesia, which at that time was part of Prussia but is now in Poland. The factory made six tonnes in its first year.

- 1802 - two factories were built in France, copying the work of Achard with the intention of overcoming the British blockade, which had stopped imports of sugar from the West Indies.

- 1811 - Napoleon ordered 200,000 acres of beet to be planted and 500 factories to be built. 213 of these were operational by 1816 with a total production of 4,000 tonnes of beet sugar. There were still only two factories in Germany.

- 1840 - the French had 436 factories making 40,000 tonnes and Germany had 145 factories making 14,000 tonnes. European governments had seen that beet sugar was a considerable boost to their agricultural economies, improving subsequent crops and providing food to keep livestock through the winter. Import tariffs and excise duties were introduced to protect and encourage this new industry.

- 1900 - German production had exceeded two million tonnes and Britain was importing European beet raw sugar as a cheaper source than cane sugar from the West Indies.

c. The British beet sugar industry

- By 1830 Europe was encouraging beet sugar production, but the British did not follow as there were many vested interests in the slave plantations in the West Indies. A few British beet factories were started by people who were opposed to slavery, but these all failed.

- The abolition of slavery made little difference to the British interest in cane sugar and fortunes continued to be made with the wealth funding investment in industry and society. The Tate Gallery was built by the Tate sugar dynasty, who were the forebears of the modern Tate and Lyle sugar business.

- By 1900 cheap beet sugar from Europe had displaced much of the traditional cane sugar supply and this continued until the start of World War I. The war saw severe sugar shortages in Britain and the government needed to do something about it. European sugar production had been damaged by the fighting and the British Empire expected recognition for the manpower support it provided during the war.

- Britain gave a commitment to import cane sugar from the Empire and later the Commonwealth. It also decided to encourage the establishment of a home grown beet sugar industry. Various incentives were put in place to promote the construction of British beet factories and the Beet Sugar Subsidy Act of 1925 guaranteed the returns needed to establish the industry.

- In 1936 the 18 operating beet factories were amalgamated by government order to form the British Sugar Corporation, 36% of which was owned by the state and so effectively controlled by the Government. This became a national asset that supplied the nation with sugar during World War II.

- The post war years saw steady investment in the 18 factories, to repair the neglect of the war years and to expand production. In 1973 Britain joined the European Community and the Corporation received guaranteed prices and a production quota. £100m was invested to increase capacity to meet the quota by 1980.

- The European Commission introduced changes to the rules in 1980 and cut the quota by 14% to 1.144mt. The result was the closure of four factories in 1981, the same year that the government sold its stake in the company and British Sugar was acquired by S&W Berisfords.

- January 1991 saw the sale of British Sugar to Associated British Foods. This was forced on Berisfords by the financial collapse of its other businesses, but ABF has proved to be a supportive parent. The 1990s were a decade of improvement, with factories getting larger and more efficient and some smaller factories closing. Attempts were made to change the European sugar regime which supported the industry and prices were frozen for many years.

- The 21st century saw a political determination to remove the protection of European agriculture and to allow access to European markets for the poor nations of the world. As a result, sugar prices are likely to fall by 40% and European production by a quarter. Once again, the business environment is changing significantly and British Sugar must continue to maximise efficiencies to be successful in an increasingly competitive marketplace.

d. British beet sugar factories

Operational in 2007

Location	**Tonnes per day**
Bury St Edmunds	12,900
Cantley	8,950
Newark	8,250
Wissington	17,500

Founding factories of British Sugar Corporation in 1936

1912/15 (re-opened1920)	Cantley	Norfolk
1921	Newark	Nottinghamshire
1924 / 1981	Colwick	N Nottinghamshire
1925	Bury St Edmunds	Suffolk
1925	Wissington	Norfolk
1926/1981	Ely	Cambridgeshire
1926/2001	Ipswich	Suffolk
1926/2002	Kidderminster	Worcestershire
1926/1988	Spalding	Lincolnshire
1926/1972	Cupar	Fife
1926/1981	Felsted	Essex
1926/1991	Peterborough	Cambridgeshire
1926/2007	York	Yorkshire

1927/2007	Allscott	Shropshire
1927/2001	Bardney	Lincolnshire
1927/1994	Kings Lynn	Norfolk
1927 1981	Selby	Yorkshire
1928 1991	Brigg	Lincs

Earlier factories which closed before the amalgamation

1832	Maldon	Essex
1850	Mount Mellick	Ireland
1868/886	Lavenham	Suffolk
1925/1926	Eynsham	Oxford
1925/1927	Greenock	Scotland

In addition to the enterprises above, other factories were planned between 1907 and 1912 but due to financial problems were never built. Sleaford in Lincolnshire, Maldon in Essex, Kidderminster in Worcestershire, Hayle in Cornwall, Ticehurst in Sussex and Winsford in Cheshire.

List of pictorial illustrations