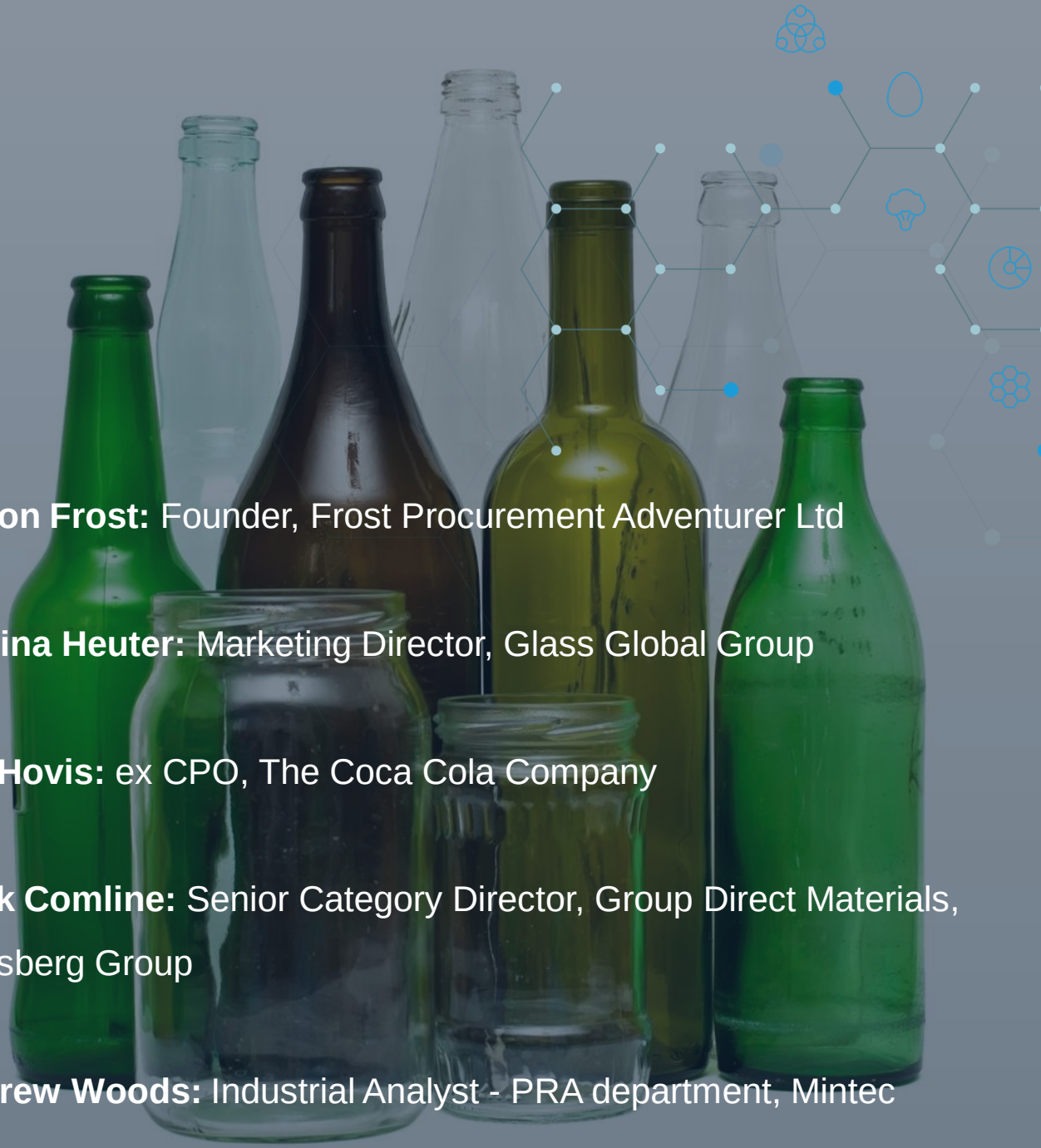
CONTAINER GLASS

Crystal clear market insights

16th Nov 2023



Simon Frost: Founder, Frost Procurement Adventurer Ltd

Bettina Heuter: Marketing Director, Glass Global Group

Bill Hovis: ex CPO, The Coca Cola Company

Mark Comline: Senior Category Director, Group Direct Materials, Carlsberg Group

Andrew Woods: Industrial Analyst - PRA department, Mintec

FROST PROCUREMENT ADVENTURER

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Simon Frost

Food & Drink Procurement Consultancy

Strategic Partnership with Mintec

Mark Comline

Senior Category Director, Group Direct Materials

Bettina Heuter

Marketing Director at Glass Global

Glass Wizz!

Bill Hovis

Ex-CPO at The Coca Cola Company

Mintec Advisory Board Member

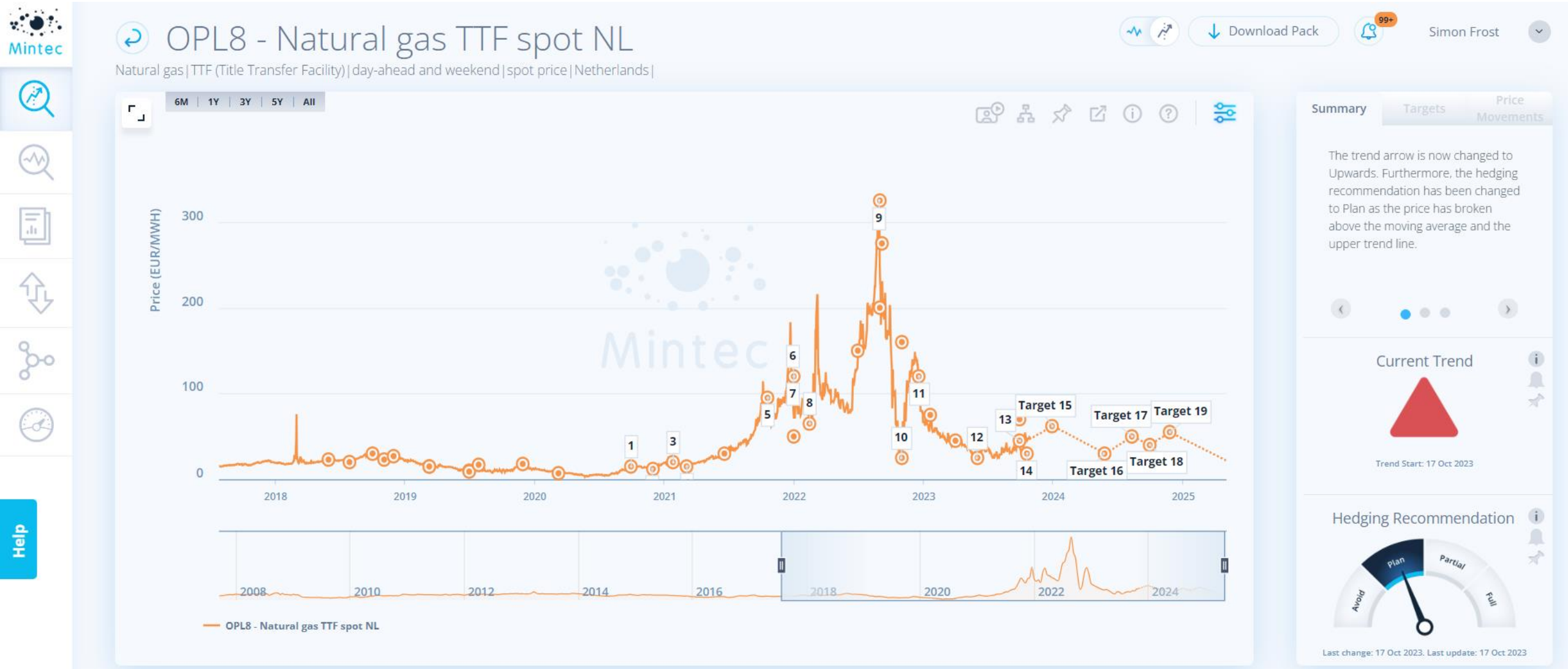
Andrew Woods

Industrial Analyst

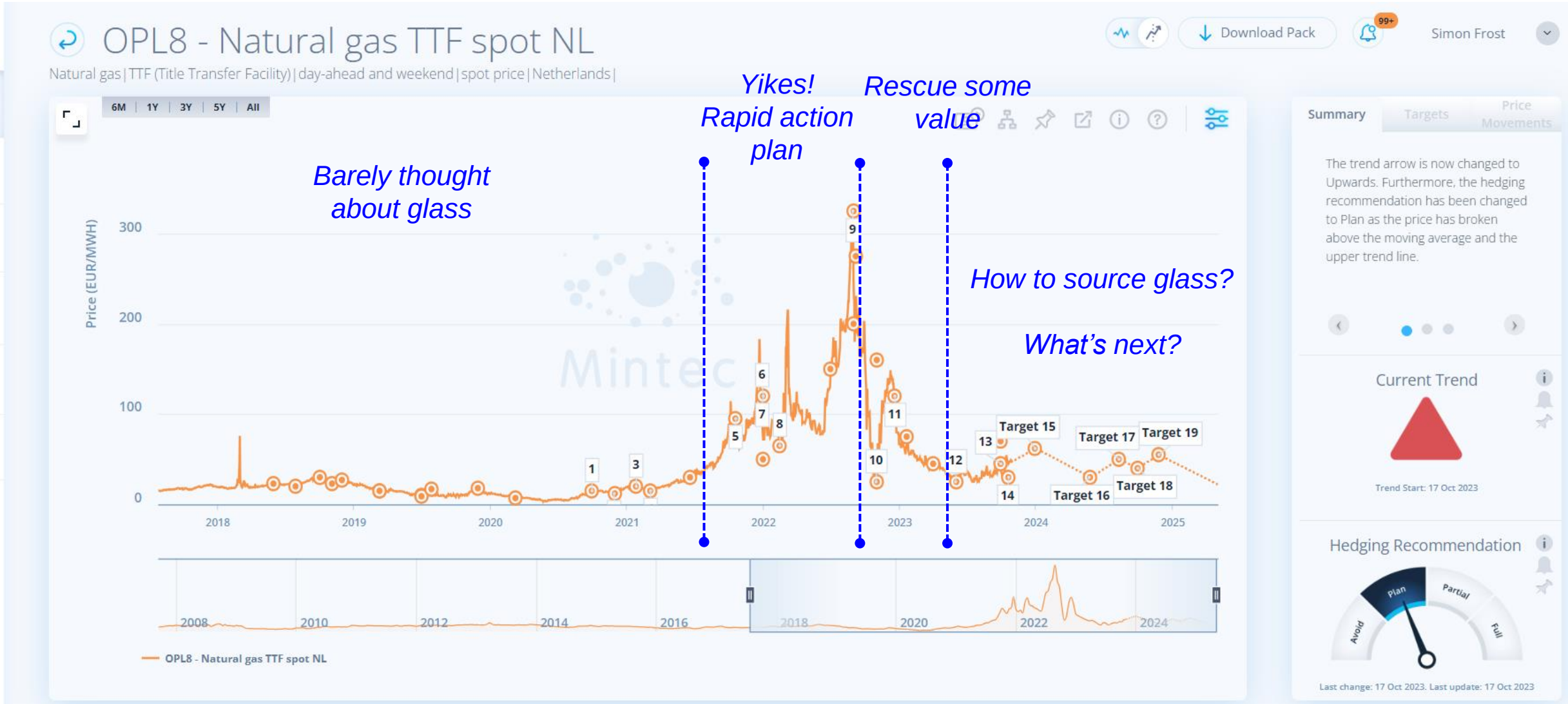
PRA Department

WHY?

The story of why we are having this webinar is in this graph:



This is how I got involved in glass and how I see it…



"My knowledge and expertise on glass is"…

5/5 – very high (I'm a pro)

4/5 – above average

3/5 – average

2/5 – below average

1/5 – very low (I'm a rookie)

We’re catering for a very diverse audience today:

- High number of attendees
- All corners of the globe
- Massive multinationals – mid sized – SME
- Highly experienced to inexperienced
- Along the length of supply chains – producers > brands > retailers
- Simple flint jars/bottles – embossed – all sorts of value add

1.	Cost Dynamics	Simon & Andrew
2.	Market Dynamics – Supply & Demand	Bettina
3.	Market Dynamics – Beer	Mark
4.	Glass Packaging – a CPO's perspective	Bill
5.	Wrap Up & Questions	Simon

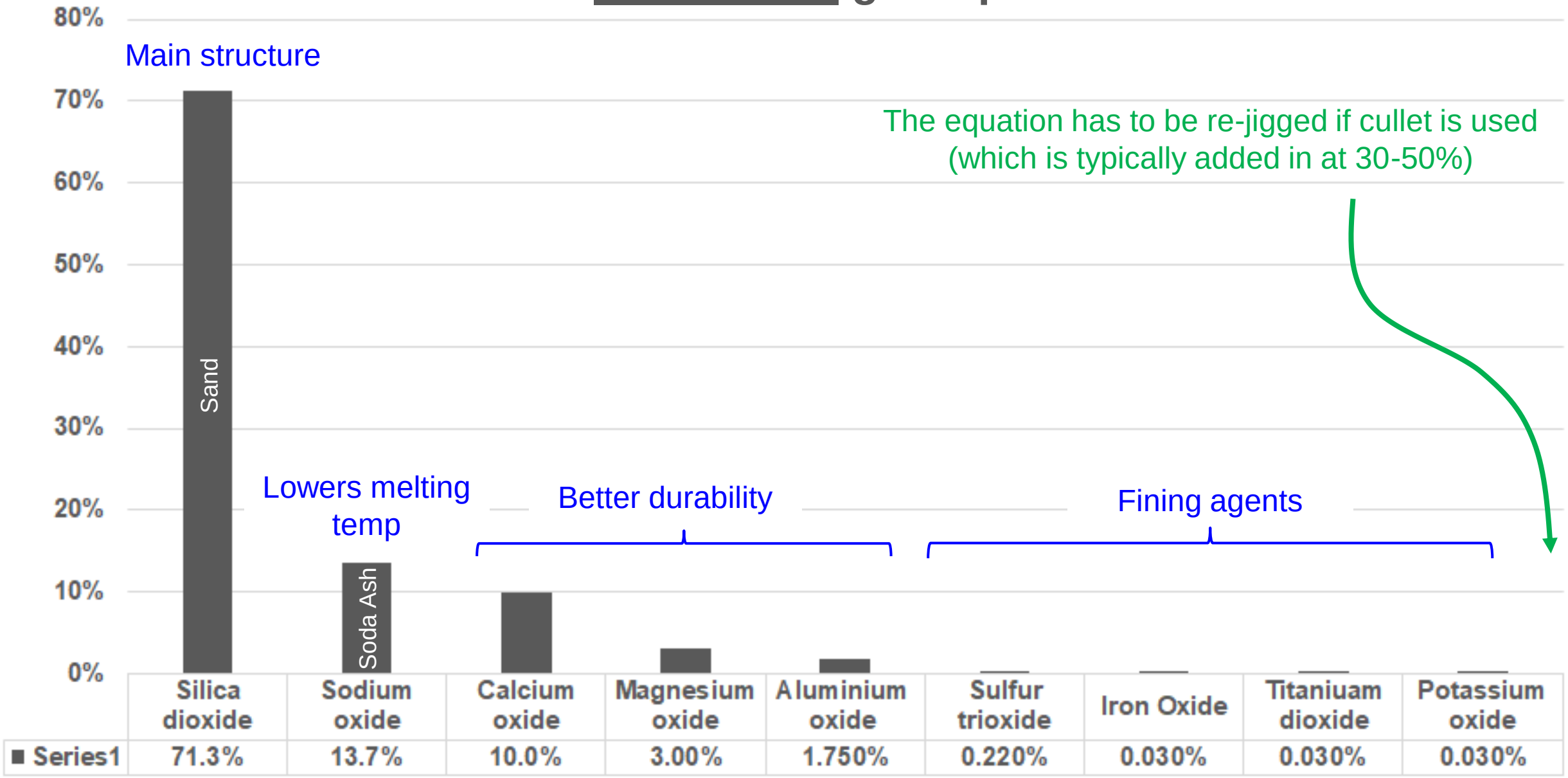
1 – Cost Dynamics

Simon & Andrew

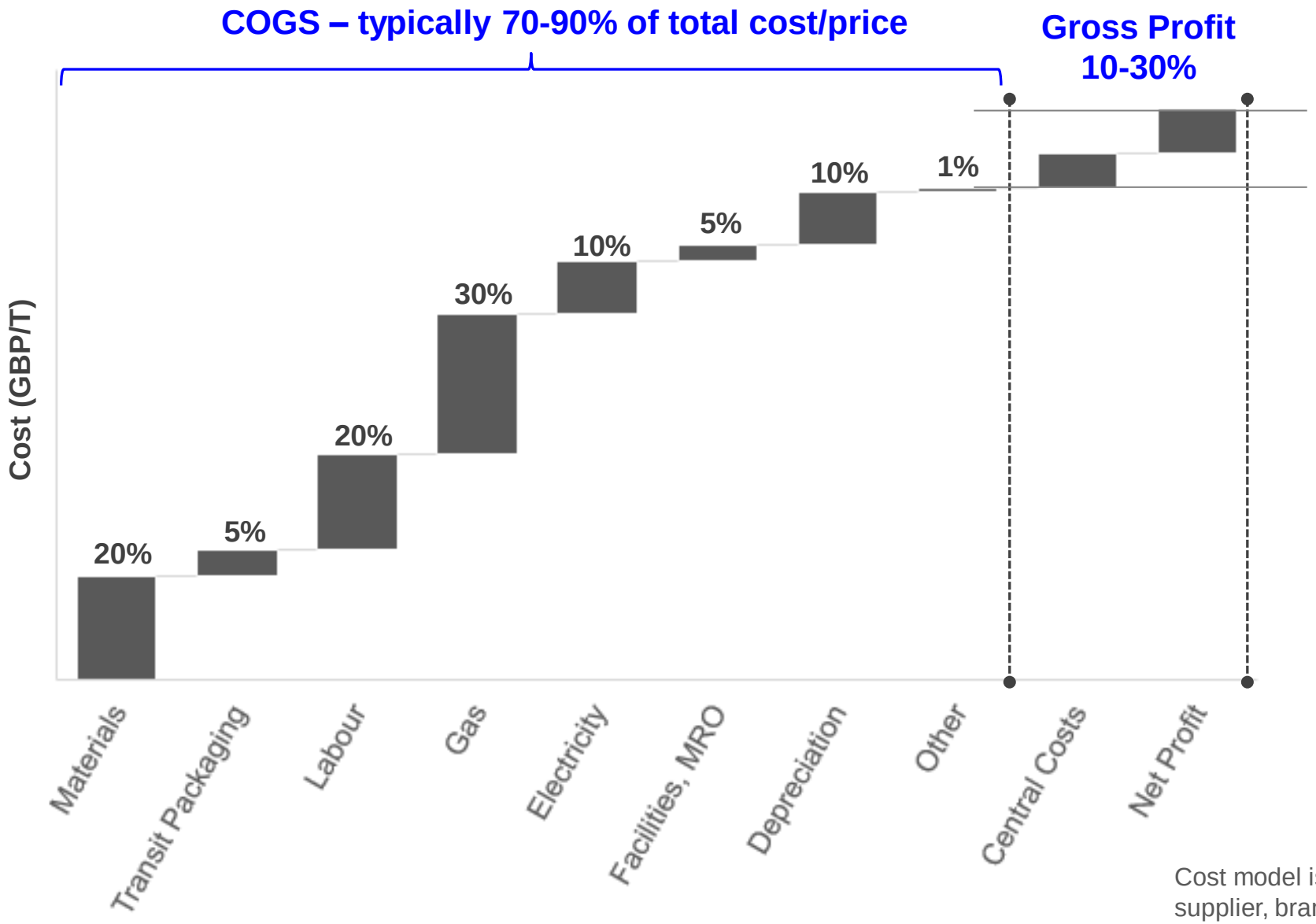
The formats and complexities of glass vary considerably across food and drink:

Area	Economy/Lower Complexity	Value Add	Premium	Super Premium/Complex
Food	 	rare	rare	rare
Drink (Soft)	 	 Shape Embossing Thickness	rare	rare
Drink (Beer & Wine)	 	Labels Thicker  	 Special tops	rare
Drink (Spirits)	 Own label	 Embossed Interesting Shapes Thickenss	 Surface Finishes	 Surface Finishes Thickness Fancy Lids Mixed Materials

The materials used in virgin (flint) glass production are:



The Cost Model shows that the 3 big spend areas are materials, labour & gas:



Considerations

- **Materials** – which materials are statistically significant
- **Labour** – automation really matters (some regions like USA are less advanced)
- **Gas** - ~75-80% of energy. Critical
- **Depreciation** – furnaces cost GBP ~30-70M each so high depreciation pa
- **Gross Profit** – glass is a ‘quantity’ business. Gross Profit very sensitive to fluctuations in COGS

Cost model is directional and will vary from supplier to supplier, brand to brand, year to year, region to region

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Focus on materials

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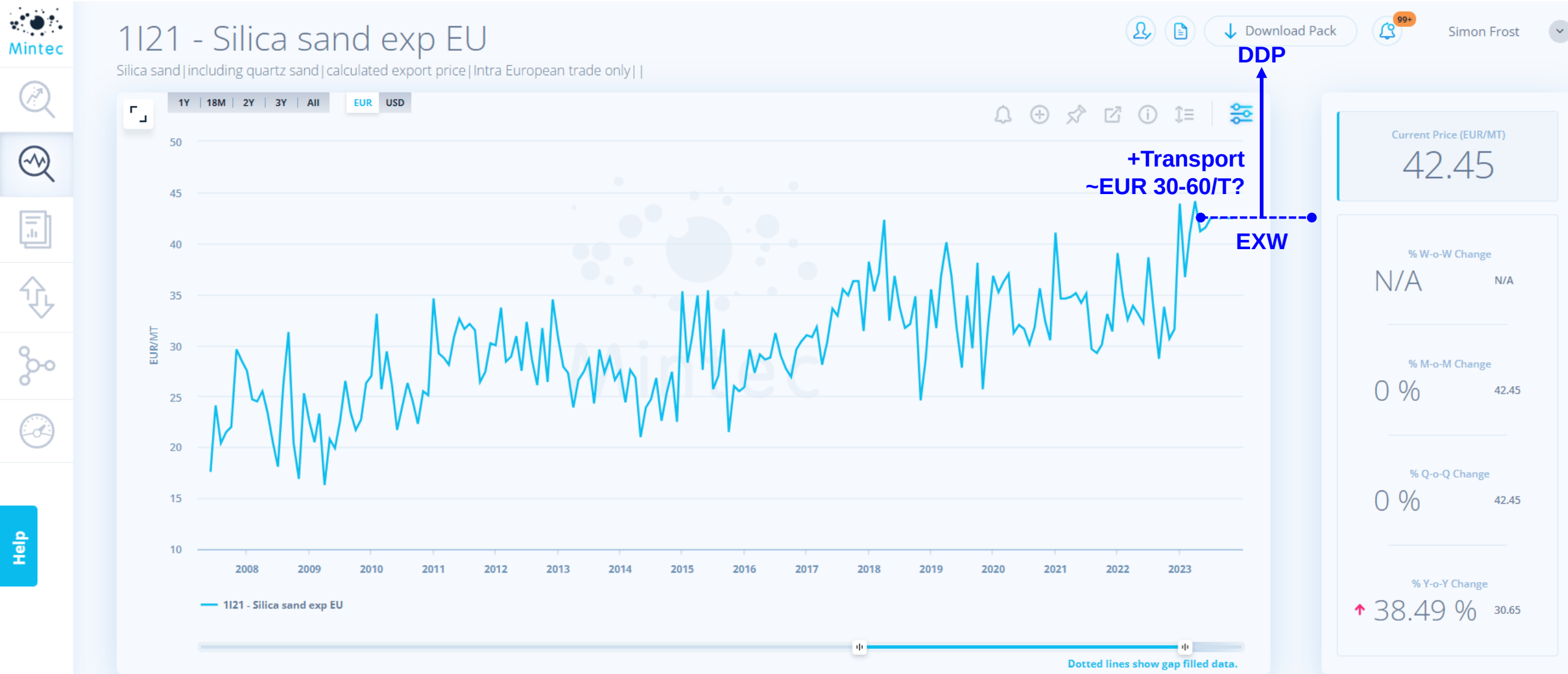
Whilst sand has the highest percentage in the recipe, it's the soda ash that has the biggest impact on the finished cost:

Element	%	Estimated Cost of Material DDP (GBP/T)	Cost in finished material (GBP/T)*	% of total material cost	Relative cost per ton	Volatility	Overall Impact
Silica Dioxide (Sand)	71%	90	65	39%	Cheap	Low (Steady riser)	Medium
Sodium oxide(Soda Ash)	14%	350	50	30%	Medium	Higher	Higher
Calcium Oxide (Calcium Carbonate)	10%	135	15	9%	Cheap	Higher	Low
Magnesium Oxide (Dolomite)	3%	670	20	12%	Medium	Higher	Medium
Aluminium Oxide	2%	550	10	6%	Medium	Higher	Medium-Low
Sulphur Trioxide	0.22%	1,700	5	3%	Expensive	unknown	Low
Iron Oxide	0.03%	1,700	1	1%	Expensive	Higher	Low
Titanium Dioxide	0.03%	3,400	1	1%	Expensive	Higher (Steady Riser)	Low
Potassium Oxide	0.03%	1,700	1	1%	Expensive	unknown	Low
Total materials before losses	**100%**						

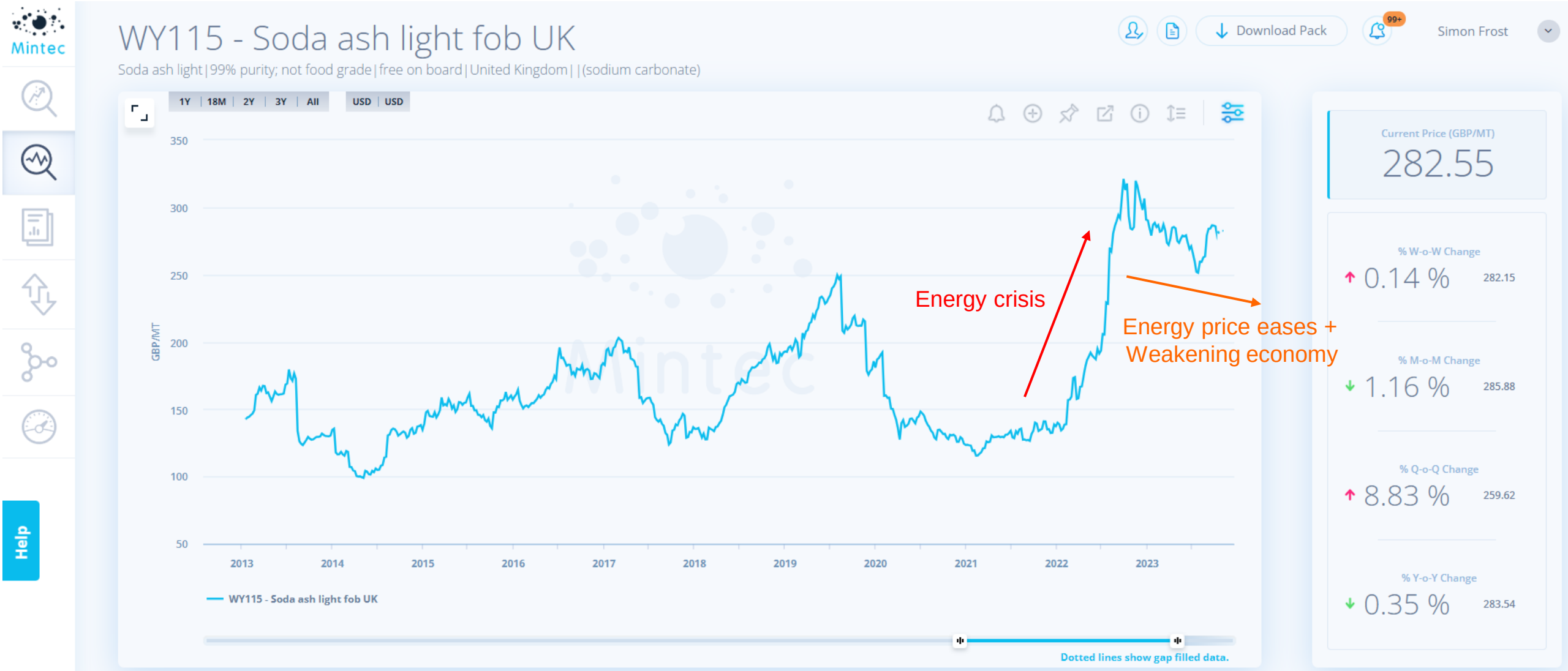
*rounded to the nearest 5 except for trace materials

Trace materials are estimated prices
All material prices subject to variation

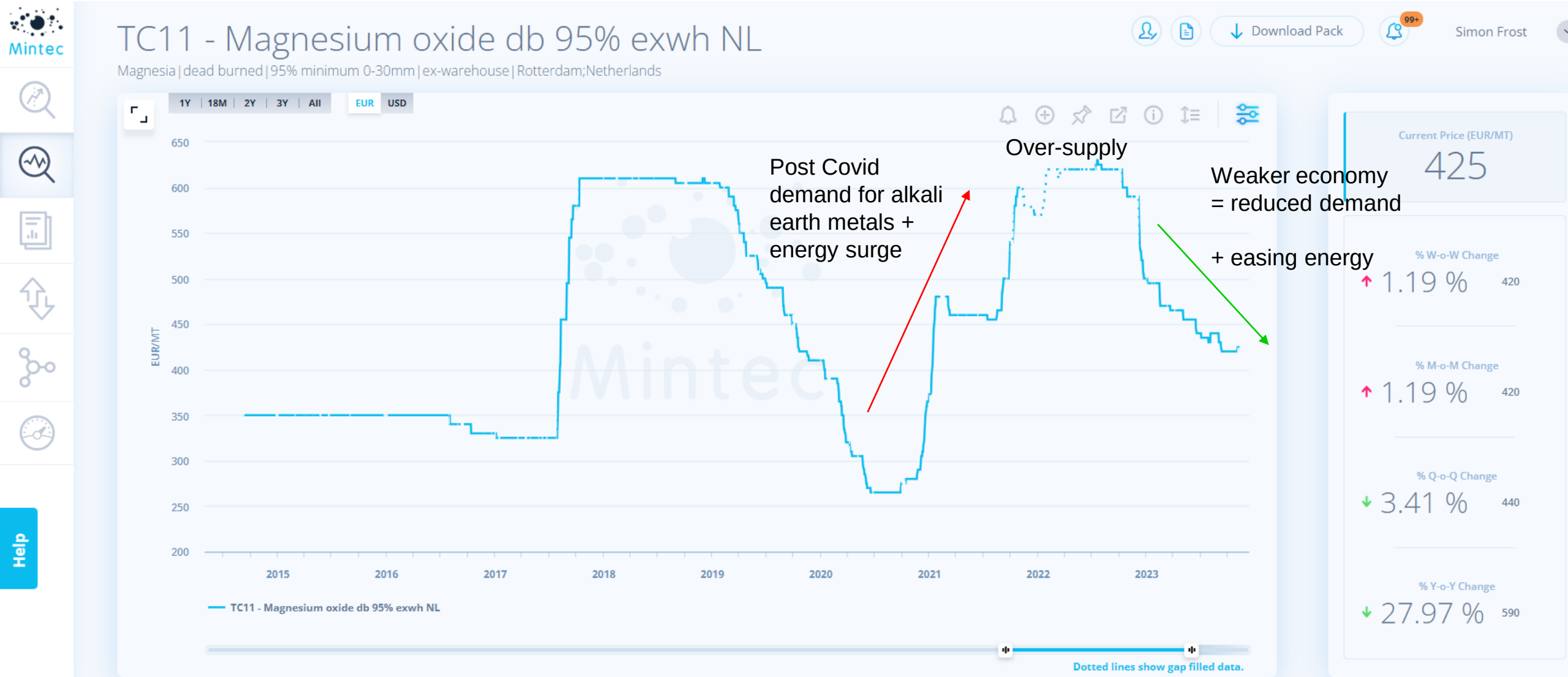
Sand is a ‘steady riser’ driven more by general inflation (eg labour) + fuel to get it out of the ground + transport EXW to DDP (freight train):



Soda Ash saw a big spike up in 2022 driven mainly by the energy price. Key considerations are: 1) energy 2) limited suppliers 3) regional differences 4) economic sentiment – eg glass in cars, buildings etc



As well as its use in glass, dolomite has many uses including as an aggregate, soil conditioner, feed additive source of MgO etc..

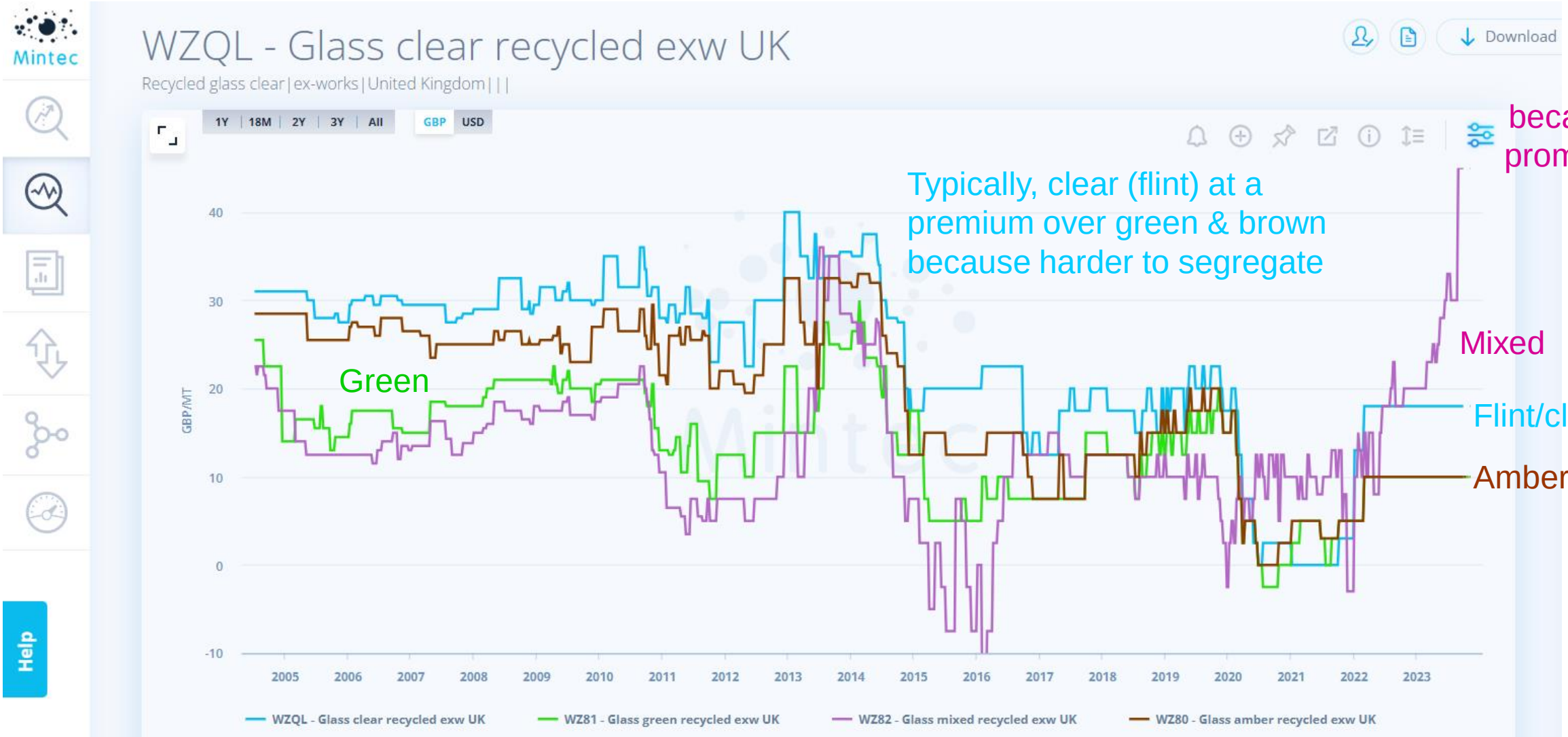


Cullet (smashed recycled glass) is a critical element for glass manufacture:

Considerations:

- Reduces amount of energy needed in furnace (+10% cullet = -3% energy)
- Quality – mixed, green, brown, flint
- Quality variation (country to country, & within country)
- Access by supplier varies
- Competing uses (hardcore for roads)

2014 to 2021 saw a reduction in the UK cullet price driven by UK abundancy and in-country usage. In 2022 exports to Europe shot up 31%:



Shot up because PRNs promoted more exports to Europe (+ 31% to 335kT)

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Focus on Energy

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"I understand the energy equation (usage/cost) for glass production"…

5/5 – very high (I'm a pro)

4/5 – above average

3/5 – average

2/5 – below average

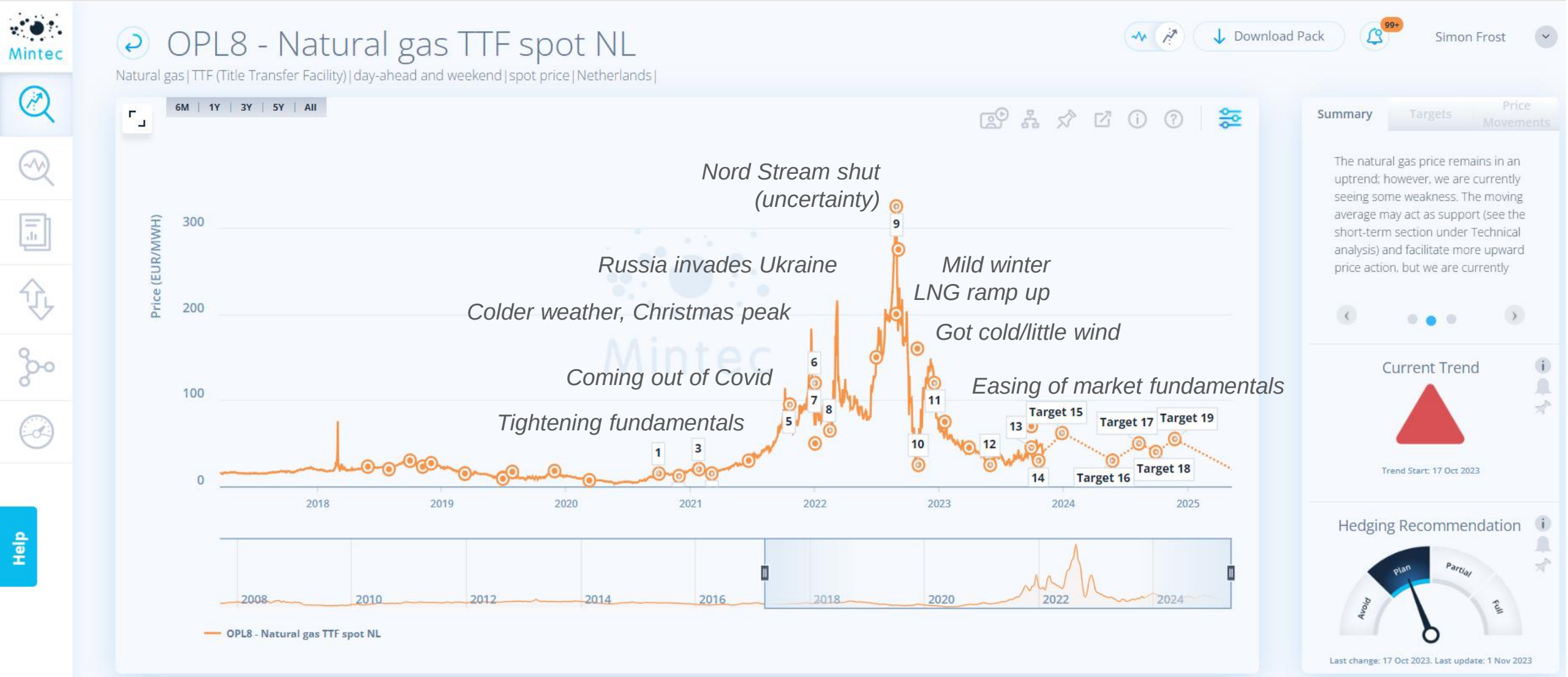
1/5 – very low (I'm a rookie)

Glass production requires a huge amount of energy – typically ~80% gas, ~20% electricity:

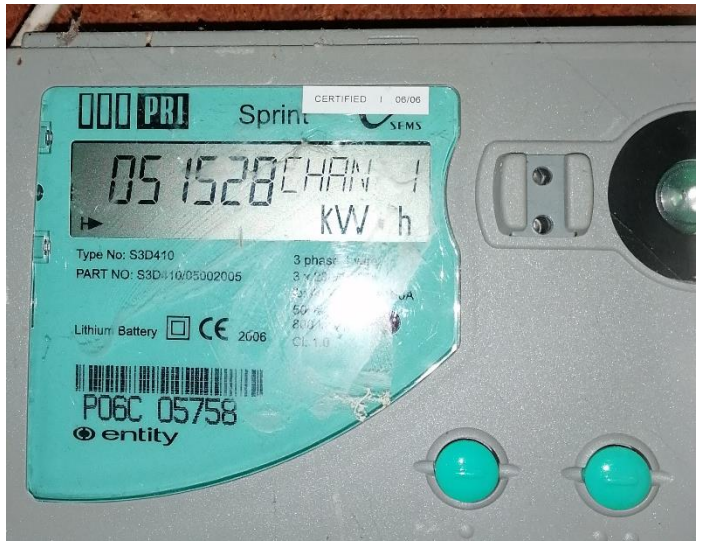
Considerations:

- 24/7 operation
- Temperature of furnace = 1,700 deg.
- Requires considerable energy
- Energy buying is mission critical
- Dependence on gas can favour some regions (eg Middle East)
- Harder to use mechanisms like PPAs

If you're serious about glass, you have to become a (semi) expert in energy, especially gas:



On the one hand the energy markets are complex
…on the other, thinking about it from a home perspective helps:



1 therm = 29.31 kWh

ovo energy

Supply address	THE MILL HOUSE WHERWELL ANDOVER HAMPSHIRE SP117JH
Meter Serial Number	S06R94268
MPAN	2000007096150

S	02	805	104
	20	0000	7096	150

Electricity in detail 21st Mar - 20th Apr 2022

Detailed charges

Night energy use	1132.884 kWh at 12.44p	£140.93
Day energy use	671.201 kWh at 19.33p	£129.74
Standing charge	31 days at 22.99p a day	£7.13
Cost of electricity		**£277.80**

Night meter readings

Opening read on 21st March	Estimated	90864.716
18th April	You gave	91923.000
Closing read as of 20th April	Estimated	91997.600
Total units		**1132.884 kWh**

Day meter readings

Opening read on 21st March	Estimated	22455.840
18th April	You gave	23091.000
Closing read as of 20th April	Estimated	23127.041
Total units		**671.201 kWh**

Your electricity tariff

Plan name	OVO Member Special - Economy 7 22 July 2021
Payment method	Direct Debit
Day unit rate	19.33p per kWh
Night unit rate	12.44p per kWh
Standing charge	22.99p a day
Contract start date	22nd August 2021
Contract end date	21st August 2022
Exit fee	£30.00 if you end your contract

A kilowatt hour (kWh) is a measure of how much energy you're using. Find out more: www.ovoenergy.com/guides/energy-guides/what-is-a-kwh-kw-and-kwh-explained.html

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The cost for energy is relatively simple:

$$\text{GBP/T} = \frac{[\text{kWh gas used}] \times [\text{Price per kWh}] + [\text{kWh electricity used}] \times [\text{Price per kWh}]}{\text{Output pa (tons)}}$$

1 therm of gas = 29.3 kWh

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It helps to have an energy crib sheet…

Price Status	Situation Timing	Electricity (per/kWh)			Gas (per Therm)			Gas (per kWh)		
>> Currency		GBP pence	EUR cents	USD* Cents	GBP pence	EUR cents	USD* Cents	GBP pence	EUR cents	USD* Cents
Super Expensive	Sept 22 NS1 Shut	30 - 87	35 - 100	39 - 113	500 - 790	435 - 685	650 - 1030	17 - 27	20 - 31	22 - 35
Very Expensive	Feb 22 Russian Invasion**	17 - 23	20 - 26	22 - 30	205 - 235	235 – 270	265 - 525	9 - 18	10 - 20	12 - 23
Increasingly Expensive	Sept – Dec 21	14 - 16	16 - 18	18 - 21	115 - 175	130 – 200	150 – 230	4 - 8	4.5 - 9	5 – 10
Cheaper (Datum)	2019-2020 Post Brexit	12	14	16	75 - 115	85 – 130	100 – 150	2.5 - 4	3 – 4.5	3 – 5
Super Cheap	2014-2018 Pre Brexit	9	10	12	45 - 75	50 - 85	60 - 100	1.5 – 2.5	1.7 - 3	2 - 3

*Currency set off GBP for all time period at GBP to USD 1.3, GBP to EUR 1.15. In reality the USD prices (especially recent) are lower given the appreciation of the USD to GBP

1 Therm of gas – 29.3 kWh

**Russian invasion – short peak

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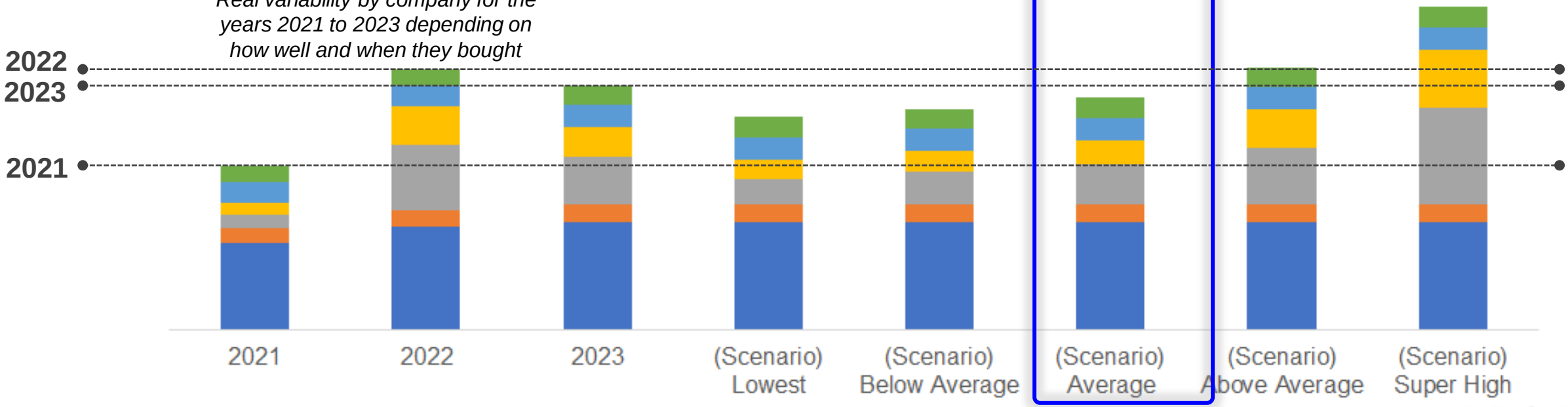
The 2024 outlook is currently better than 2023. The chance of a super-spike is less likely. Equally, the chances of prices returning back to the levels of 2020-early 2021 are also low:

				Lowest	Below Average	Average	Above Average	Super High
	2021	2022	2023			2024		
Gas p/therm >>	40	200	150	80	100	125	175	300
Gas GBP/MWH >>	27	70	70	27	34	43	60	103
Electricity £/MWh >>	60	200	150	100	110	125	200	300
All other costs vs 2023 >>				flat	flat	flat	flat	flat

Real variability by company for the years 2021 to 2023 depending on how well and when they bought



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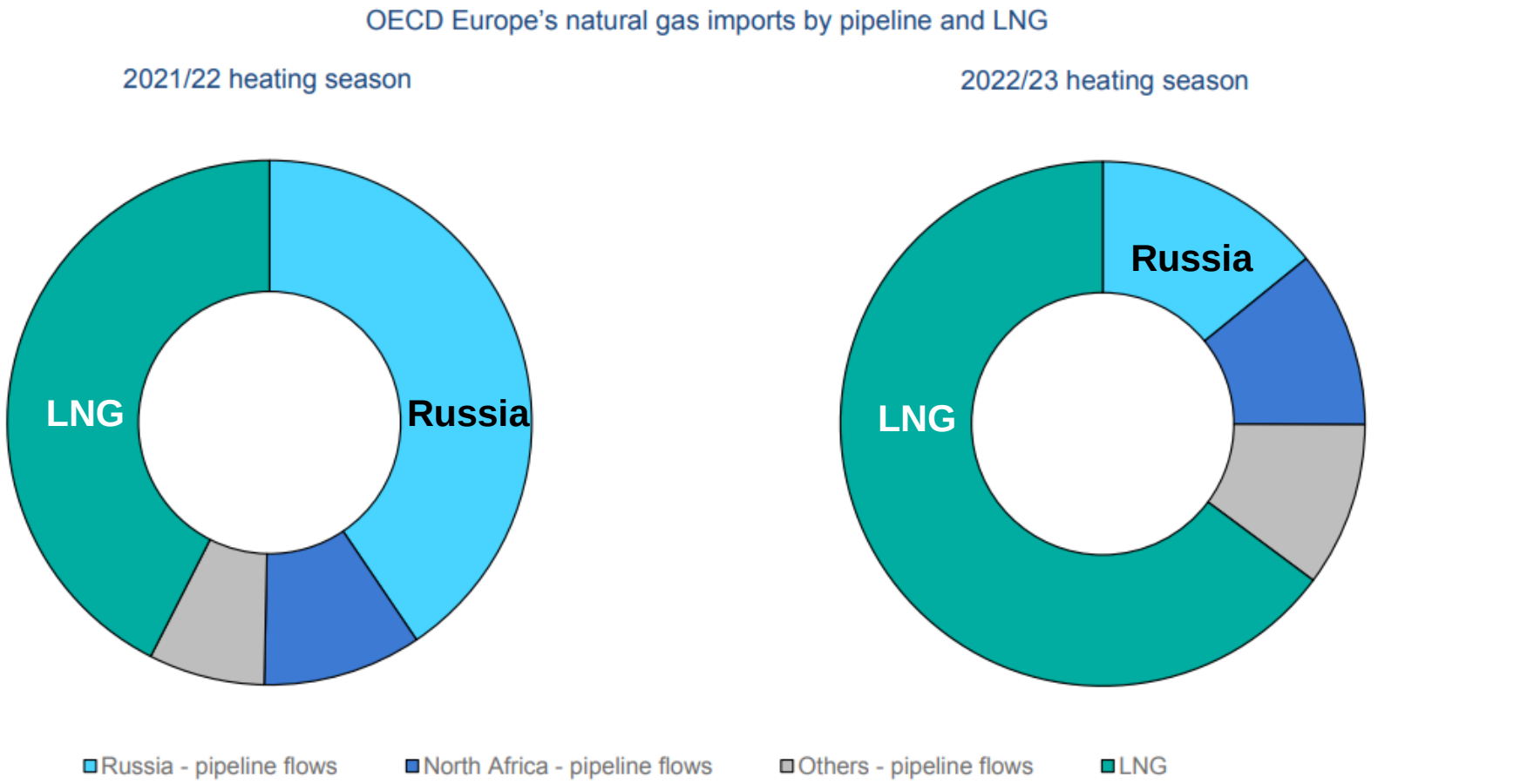
The 2023/24 outlook for gas is much more favourable than it was a year ago: Less dependent on Russia, plus proven LNG + demand reduction:



Sources: IEA analysis based on ENTSOG (2023), Transparency Platform; Eurostat (2023), Energy Statistics; Gas Transmission System Operator of Ukraine (2023), Transparency Platform; ICIS LNG Edge; JODI (2023), Gas World Database.

Data courtesy of IEA

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Focus on Production

(I'll just look at labour as Bettina is a true pro at depreciation, moulds etc)

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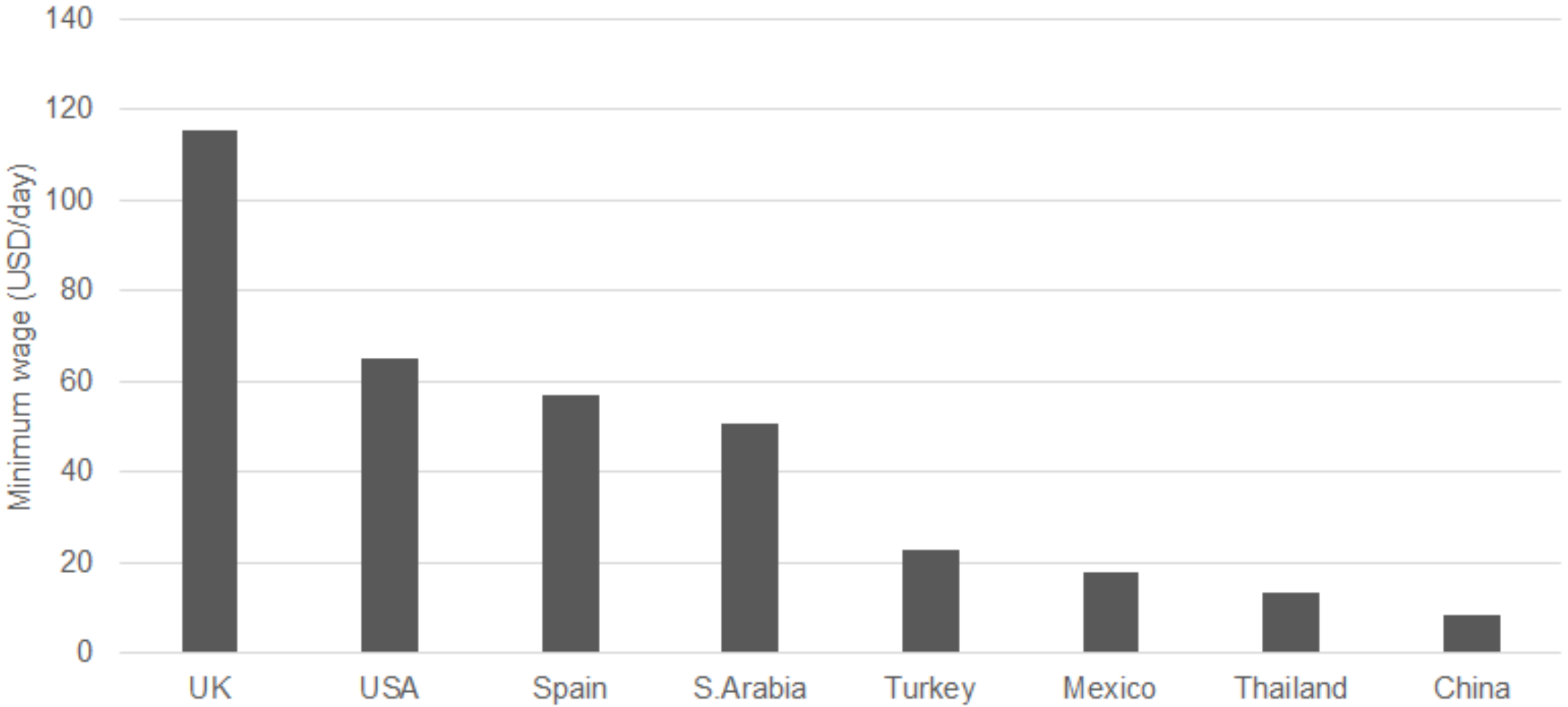
For sure, there are significant labour differences across major glass production countries, but this doesn't always correlate to a lower finished price. Eg the US has a lower labour rate than the UK but US efficiencies are lower and prices are higher:



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Logistics

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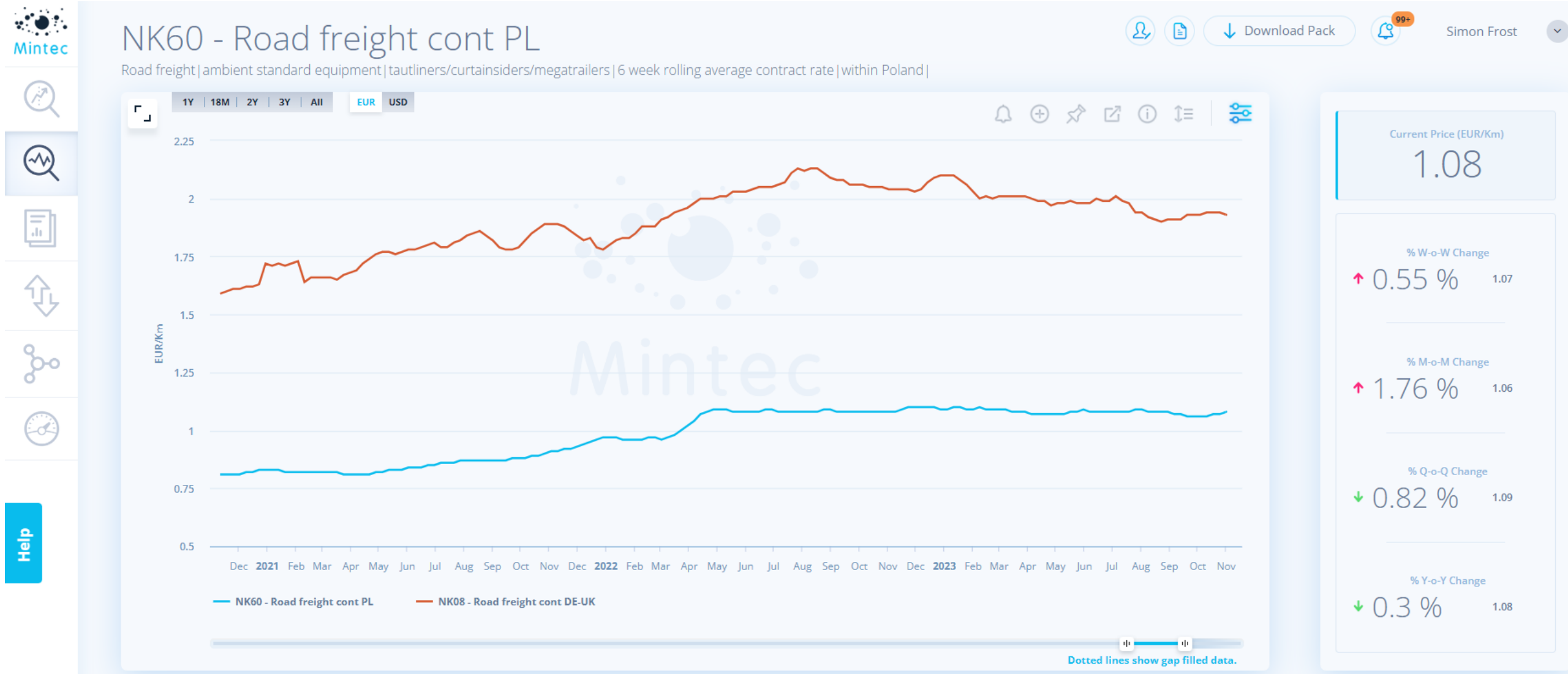
Whether using road freight or sea freight, the logistics costs per ton are pretty simple to calculate (ie load weight/cost of load). Key thing is – don't move glass too far:



2 – Supply & Demand

Bettina

A few words on Glass Global Group:

- Largest network for international glass industry since 2000
- Strong presence worldwide and high reputation in industry
- Glass experts having issued numerous Market and feasibility studies for products and production, Bankable Business Plans
- Unique and exclusive view on glass industry, furnaces, producers
- Consultancy and research about glass worldwide

glassglobal Group

“Have you ever been to a glass manufacturer?”…

Yes

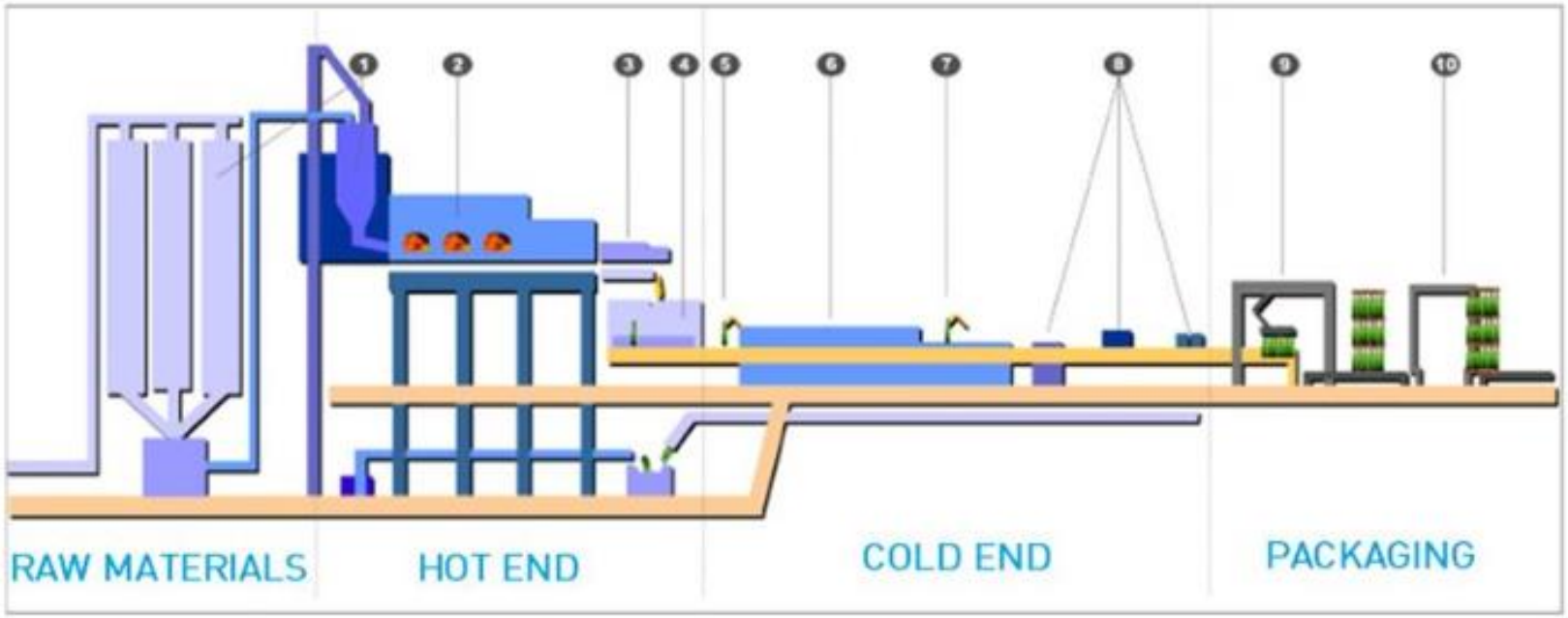
No

The areas I'm going to cover with you today are:

- **Production** – the end-to-end process
- **Production Considerations** - Gobs / Changeover time
- **Market Dynamics** - Europe & the broader global picture
- **Global Demand** – by key markets
- **Key Suppliers** – and their geographic spread
- **Production challenges** – Energies, Cullet
- **Imports & Exports** – key flows
- **Future projects** – market shift
- **General view** - on glass factories, lifetime & depreciation

The glass making process is as follows:

The glass making process



Considerations

Furnaces

- Average 300 tons per day

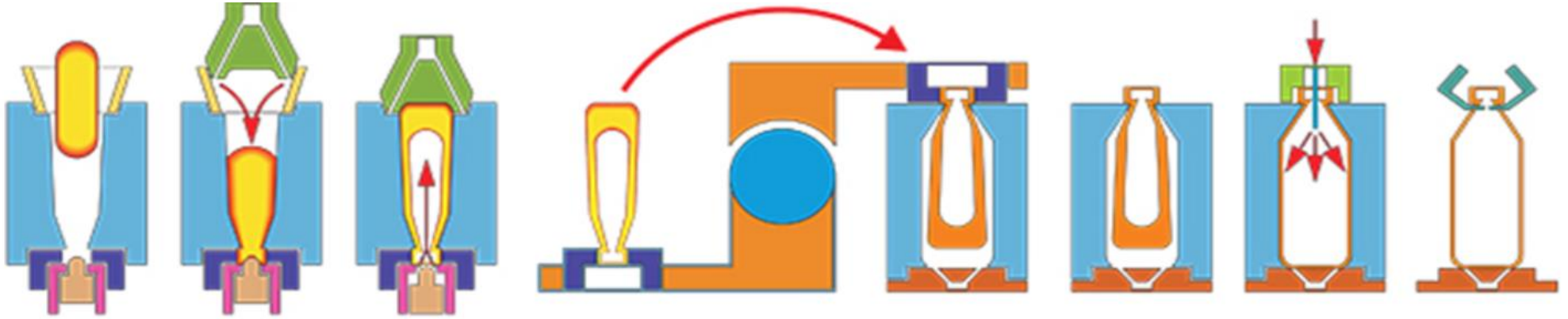
Moulds

- 12 section quadruple gob machine = 48 moulds with 800 containers per minute
- Average 8 section double gob = 16 moulds

Gobs (Forming)

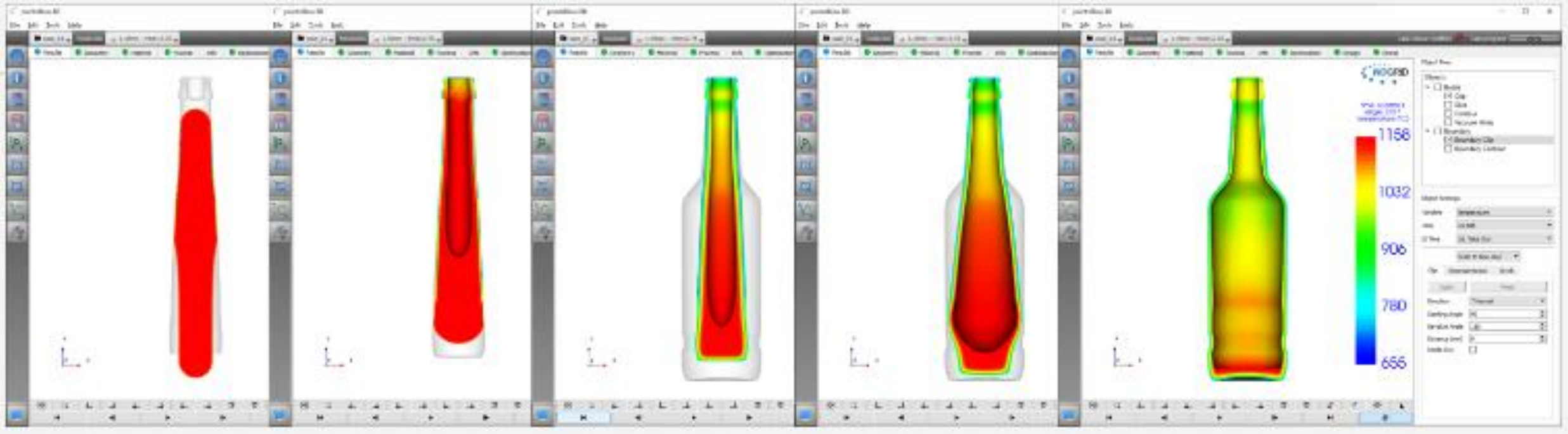
- Melting temperature 1500 °C
- Gob temperature 1150°C
- After forming 500°C
- After annealing 50°C

The product design you choose requires a high degree of technical skill:



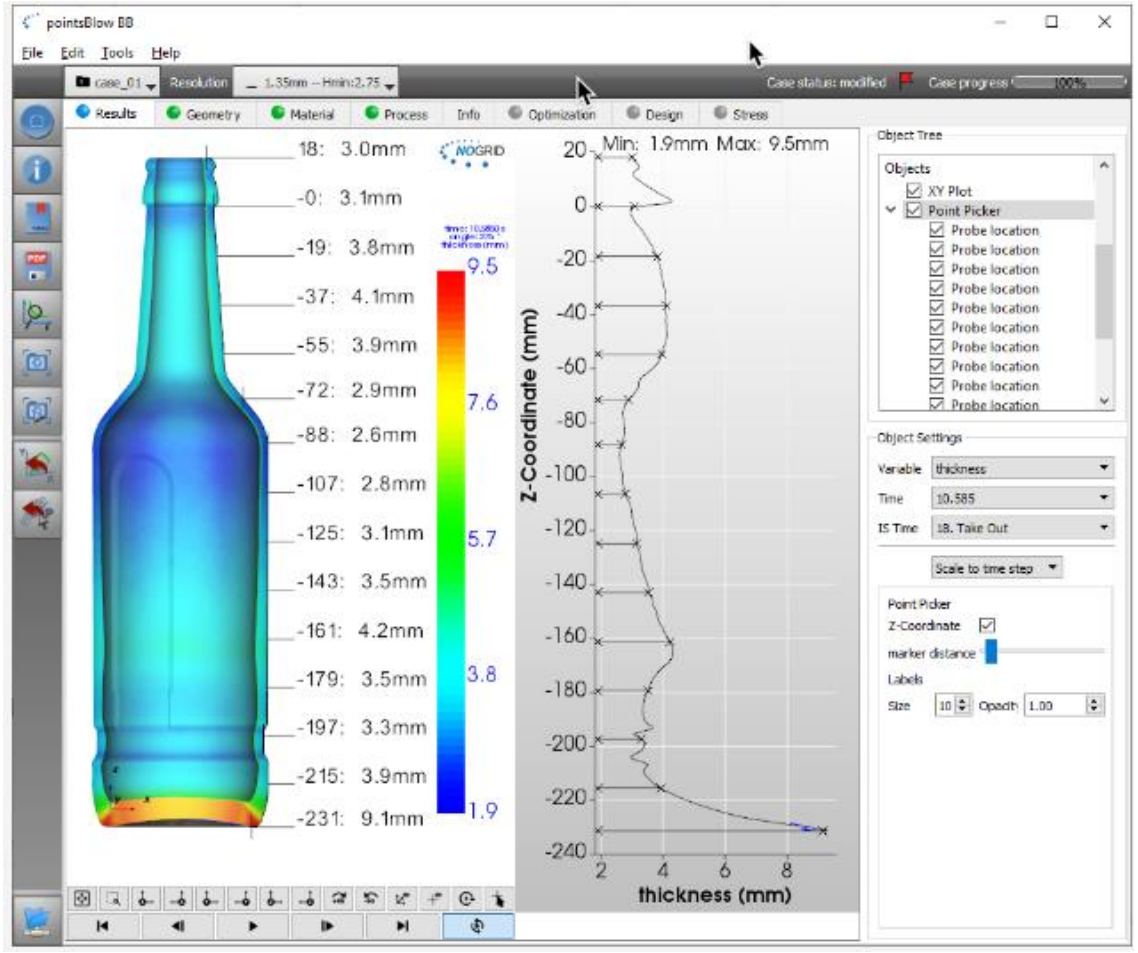
For your product, the glass manufacturer is trying to optimise:

- Weight
- Shape & Pattern
- Wall thickness



Result view of some selected time steps performed with NOGRID points Blow simulation software for container glass computed in full 3D

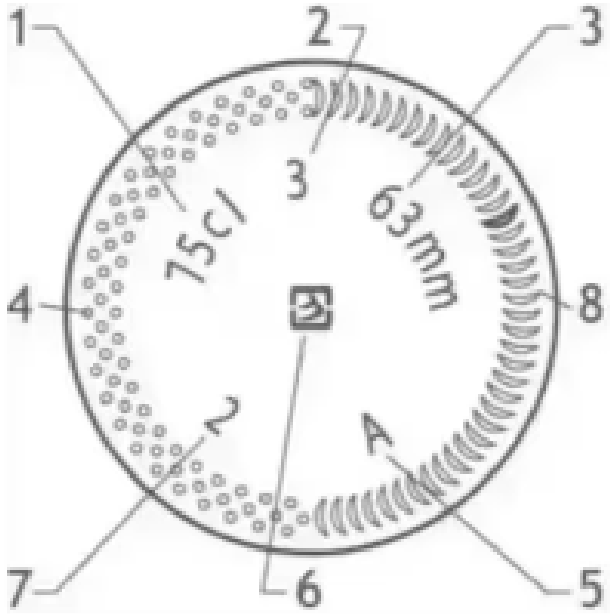
Different bottles need different wall thicknesses. For example, carbonated drinks (eg sodas and champagne) need thicker walls that can withstand pressure of up to > 4 bar which are more expensive)



3D thickness view, xy-plot and point probing in NOGRID pointsBlow

- Identification of the producer with its factory trademark,
- The brim capacity and the filling level,
- The number of mold cavities used to produce the bottle, and the symbol which indicates that the bottle/jar is suitable for food products.
- * The reversed epsilon similar to a number “3” is the symbol established by EC regulations to identify measuring container bottles.

1. Nominal capacity in cl or ml
2. Symbol for measuring container bottle*
3. Filling level
4. bottom with dots
5. Symbol indicating it is suitable for food
6. Manufacturer’s trademark
7. Reference cavity number
8. Bottom with crescents



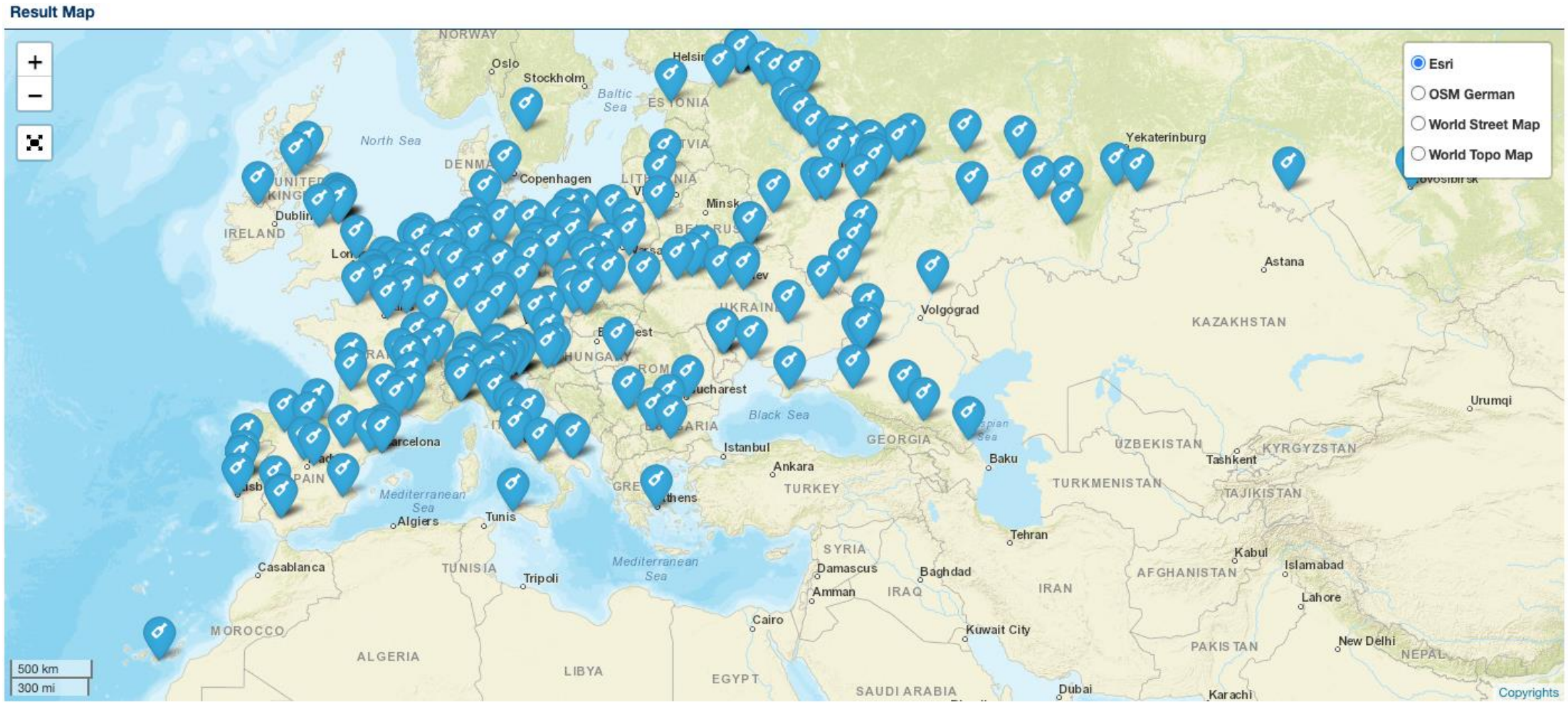
Whilst we're here to review container glass, some key dynamics worth considering are:

- **Materials** – both float glass and container glass draw on the same materials
- **Recycling** – float glass is recycled less – it usually goes to landfill

Float Glass

Container Glass

Glass Global maps all the furnaces around the world (type, capacity, age, supplier etc). This provides a unique picture of the global landscape. As an example, European production = 109,000 tons per day for 750M people:



Data source – Glass Global Master database

….whereas Africa only produces 12,000 tons per day for 1.45BN people

Considerations:

Glass used differently in different regions. Eg in Africa:

Lower in-region production

Not necessarily high imports of unfilled containers

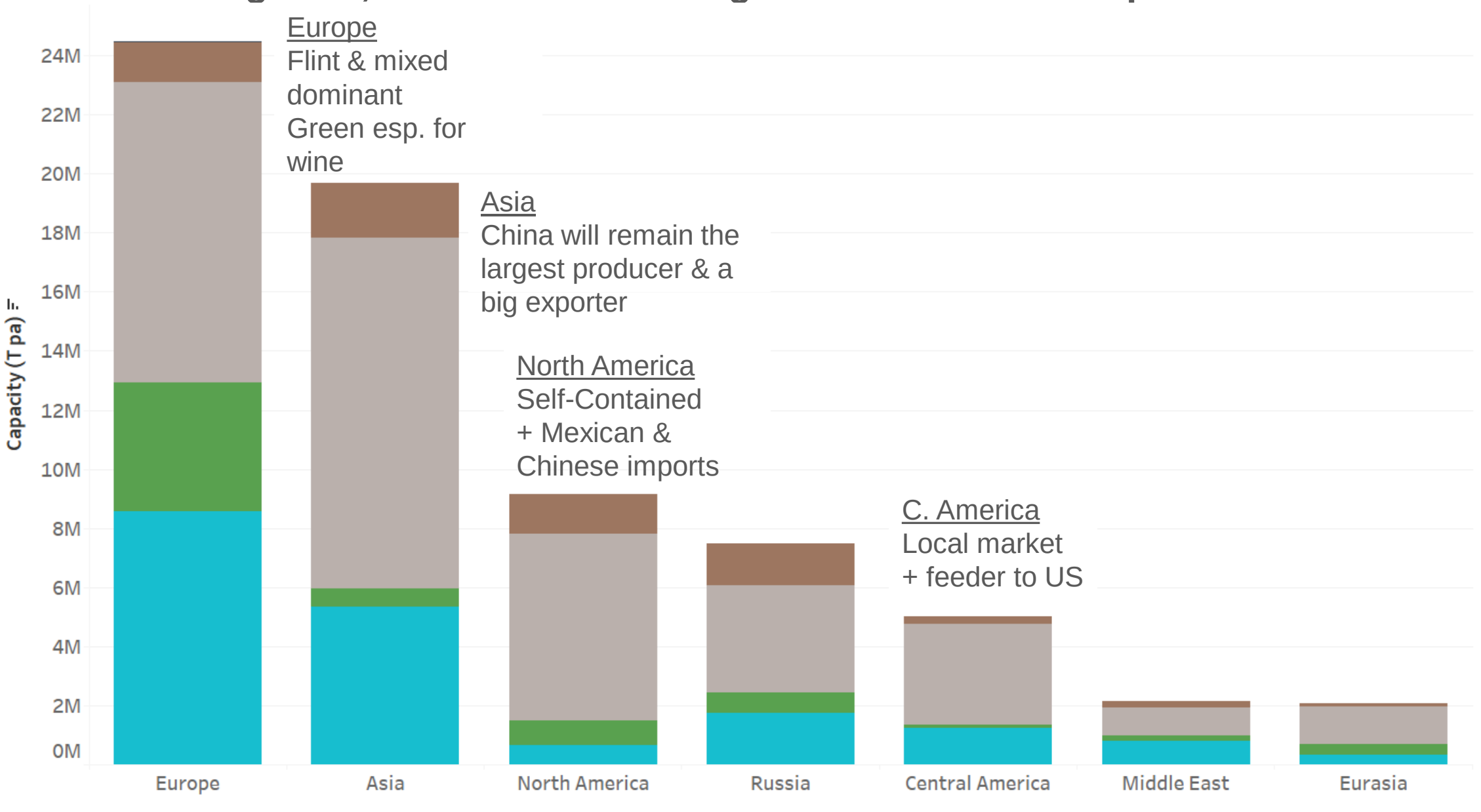
Less glass used in some regions

Glass reused a lot (eg in Africa some bottles are reused ~50-60X!)

Some products imported ready filled

Data source – Glass Global Master database

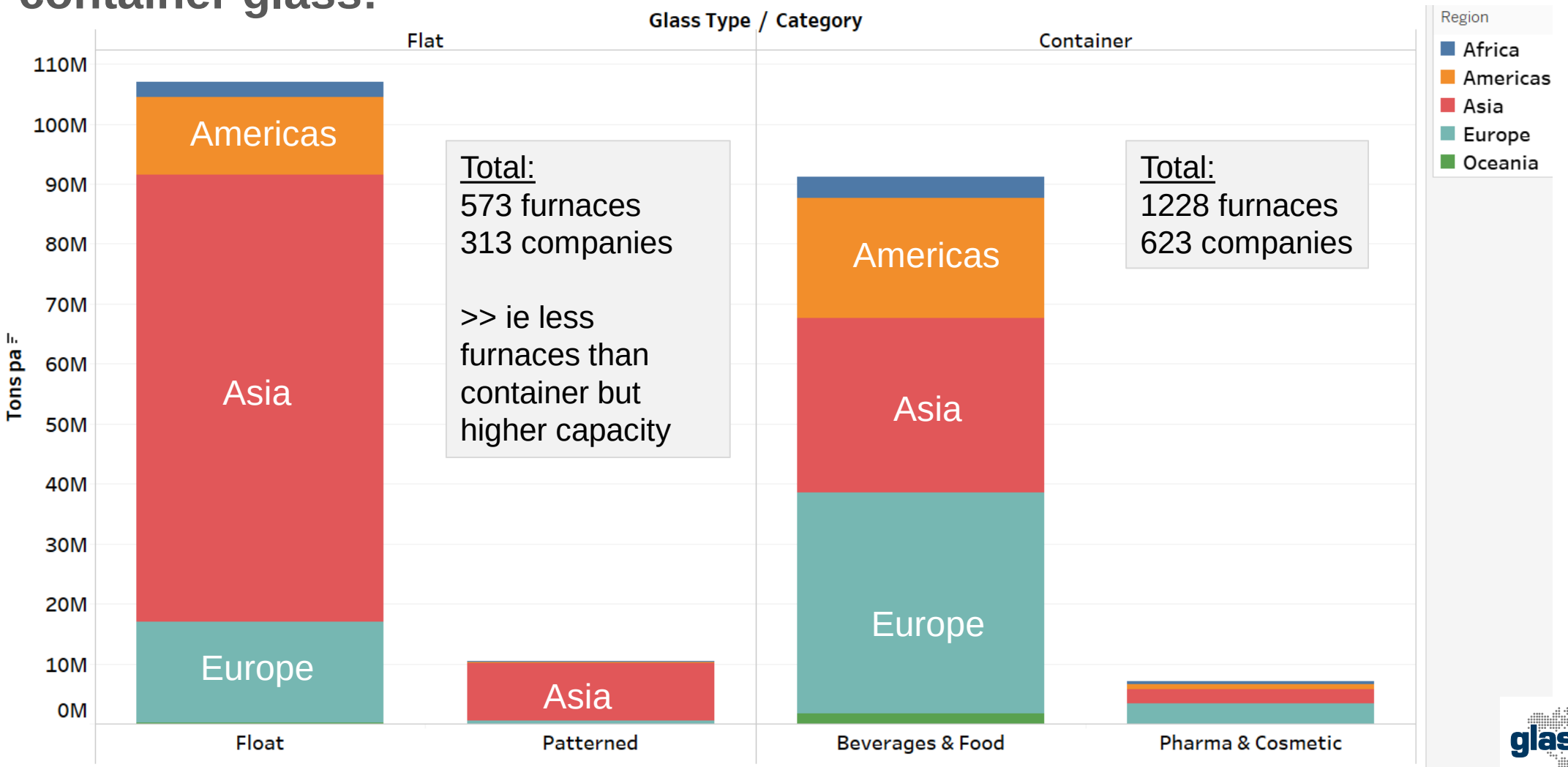
Altogether, the total container glass market is 70MT pa.



Data source – Glass Global Master database

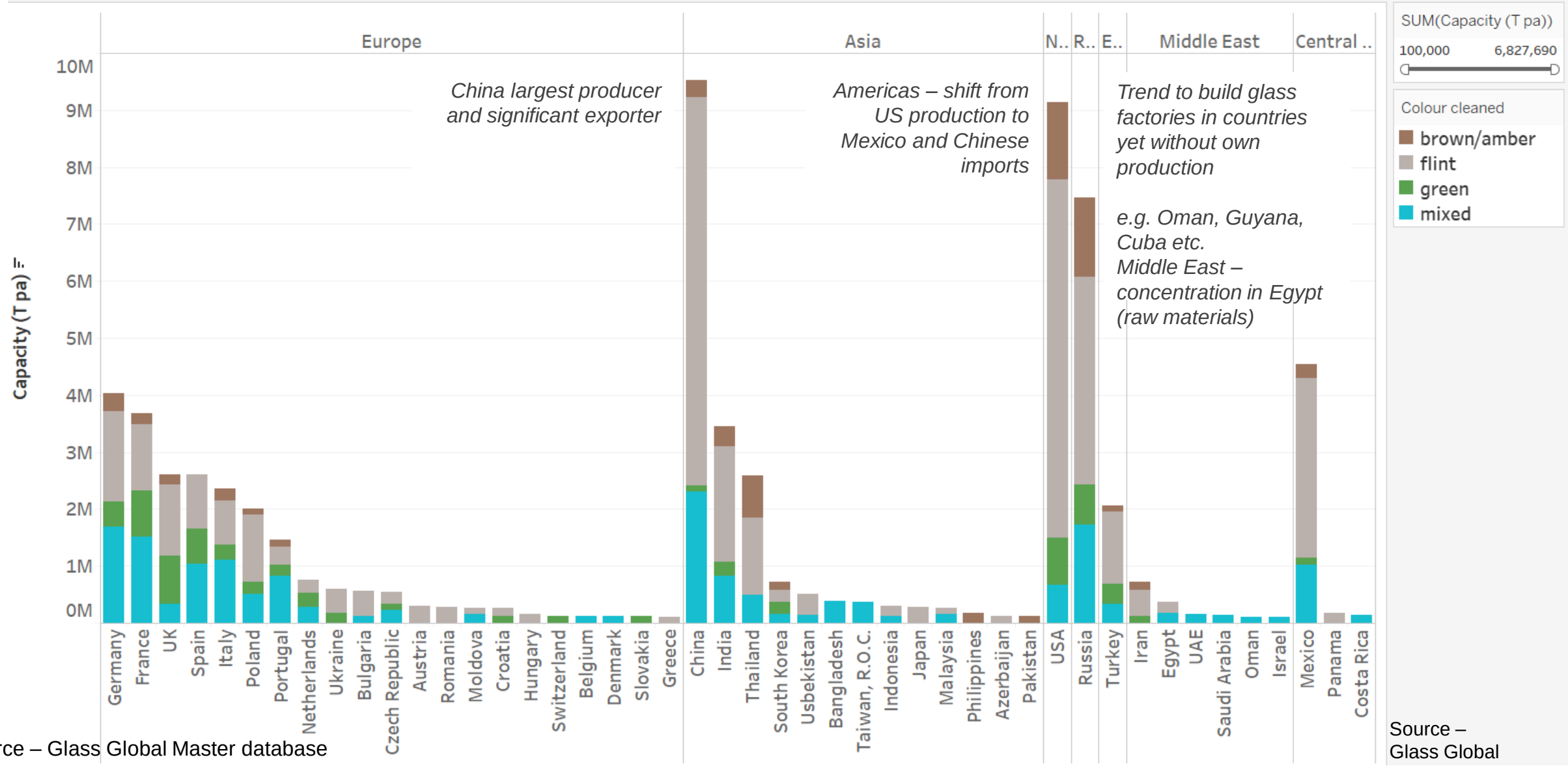
Mixed glass could be any combination of flint, green, brown, amber, blue, black. It's just not split out in Glass Global

The size of the markets of flat glass vs container glass are roughly equal. The key difference is that Asia specialises in flat glass and Europe in container glass:



Data source – Glass Global Master database

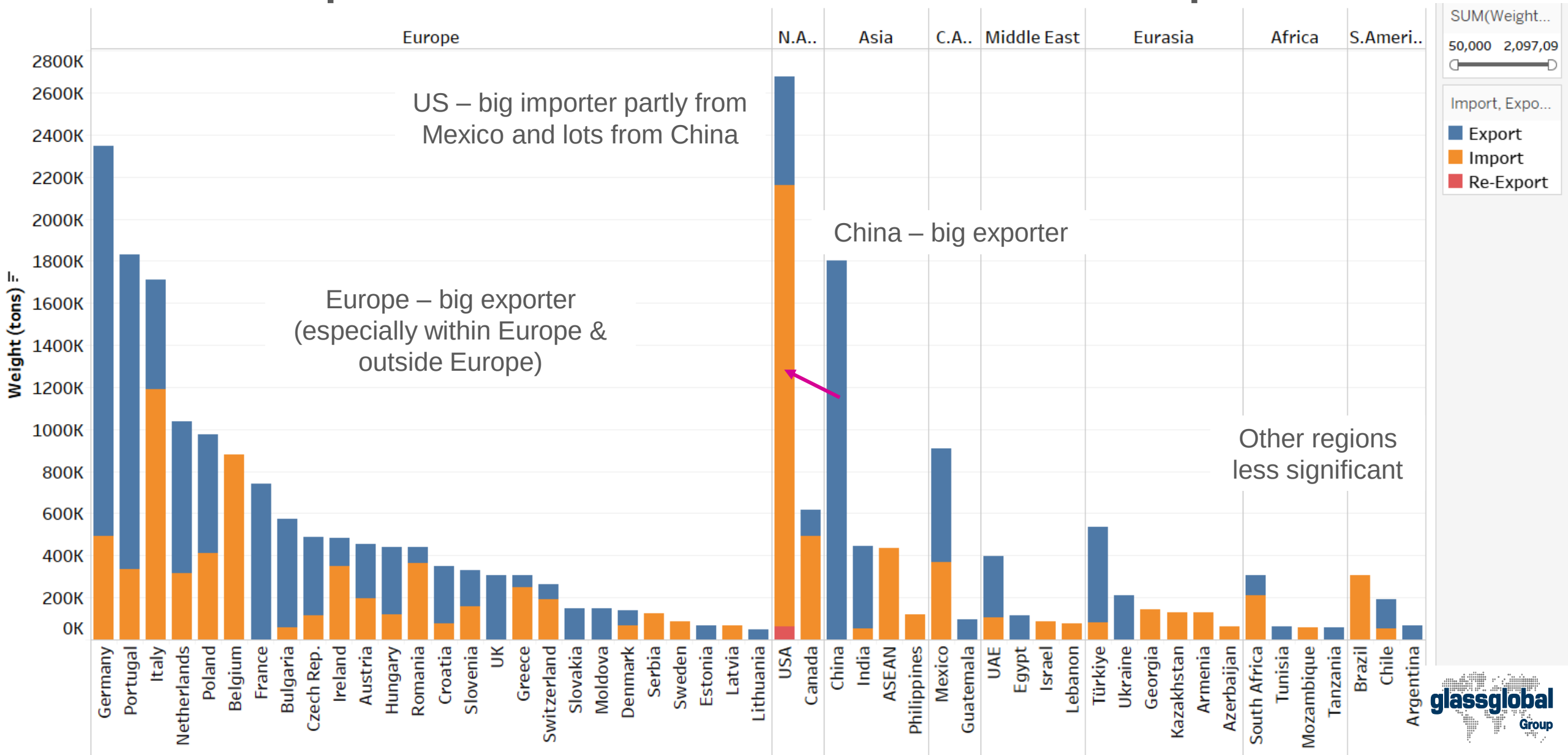
The production by region is, covering both local demand and exports:



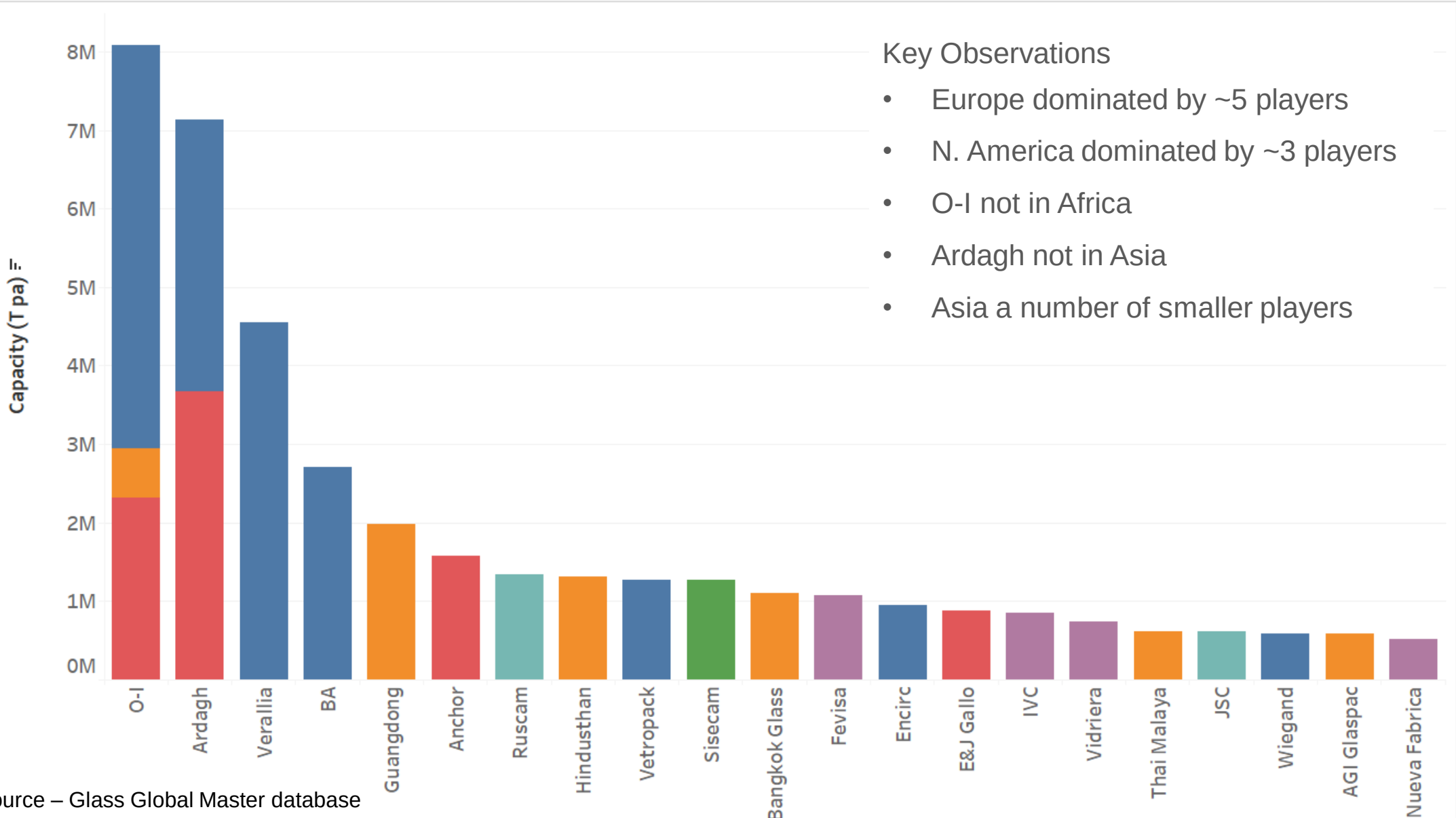
Data source – Glass Global Master database

Source – Glass Global

Glass is produced both for local markets and for export:



The market is semi regional and dominated by ~10 ish suppliers:



Key Observations

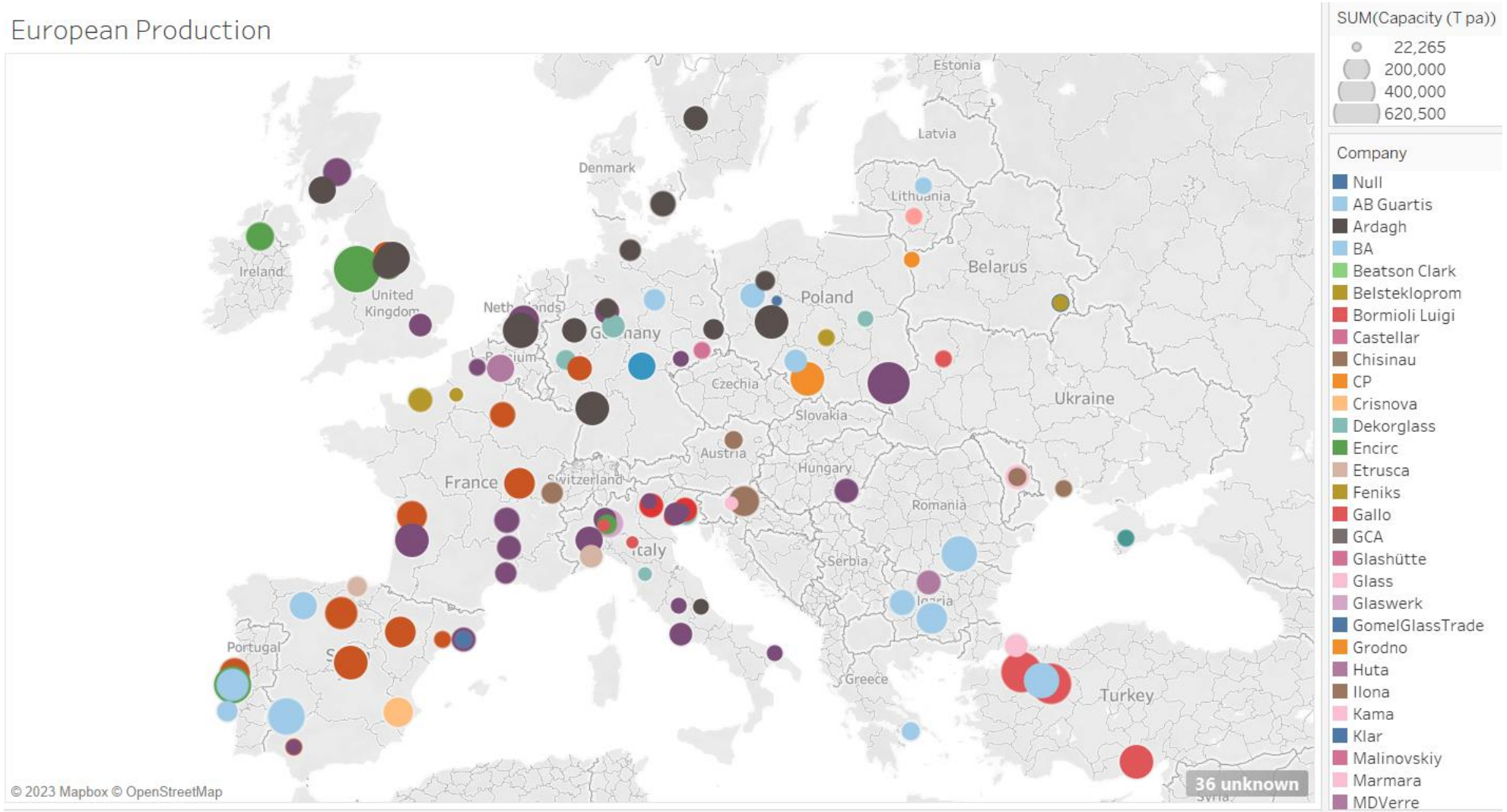
- Europe dominated by ~5 players
- N. America dominated by ~3 players
- O-I not in Africa
- Ardagh not in Asia
- Asia a number of smaller players

SUM(Capacity (T pa))
500,000 6,827,690

Region
- Europe
- Asia
- North America
- Russia
- Eurasia
- Central America

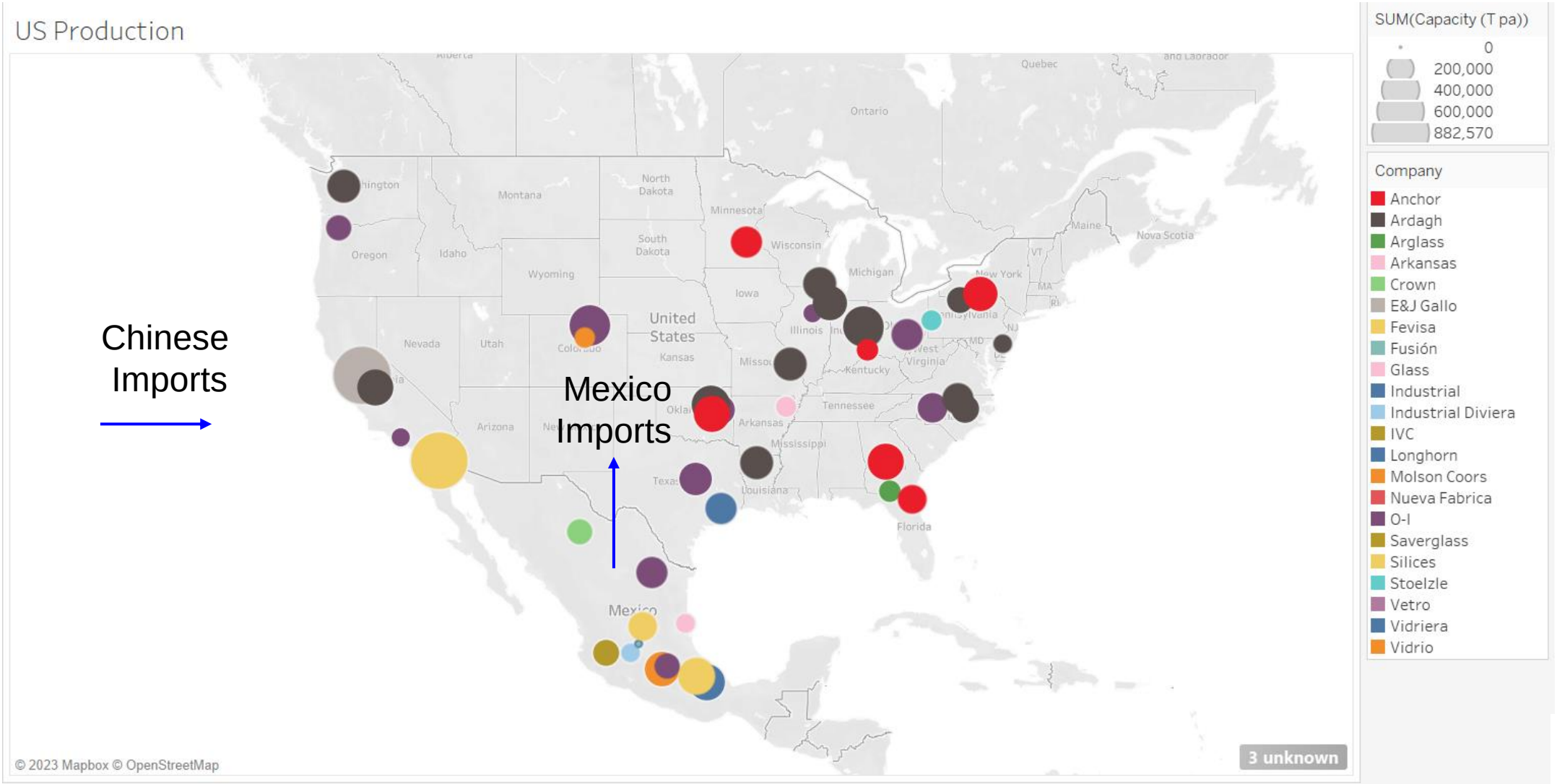
Data source – Glass Global Master database

In Europe, each country has ~2-4 key suppliers. Suppliers tend to focus on a cluster of countries:



Data source – Glass Global Master database

In North America it's very much East Coast/West Coast. Mexico is a big feeder northbound and a lot is imported from China too:



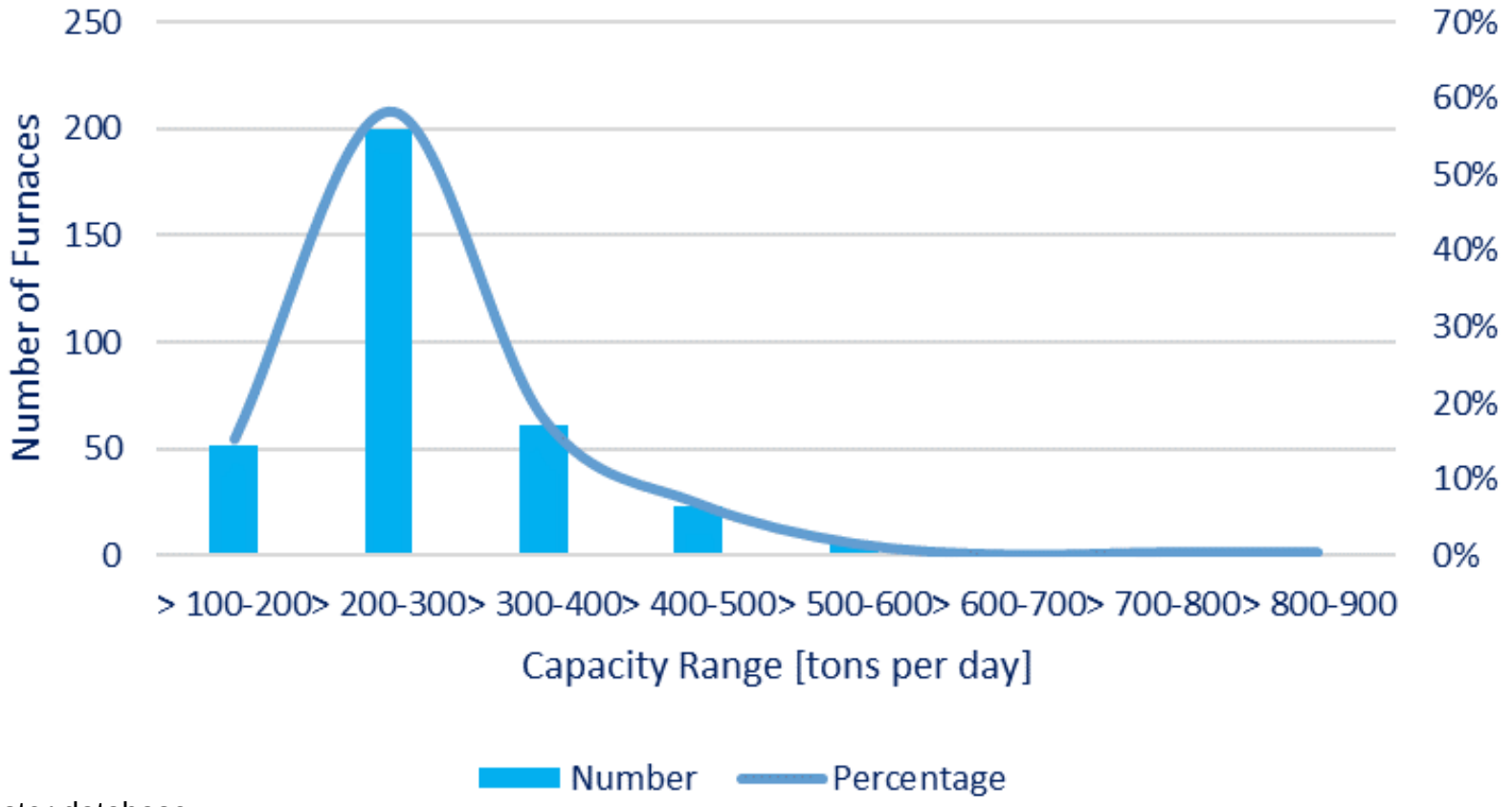
Data source – Glass Global Master database

Glass is growing at CAGR ~5% globally:

Region	2017	2022E	2028F	CAGR (2022-2028)
North America	10,409	12,942	17,309	5%
Europe	14,578	18,361	23,738	4%
Asia Pacific	18,055	23,736	33,697	6%
Middle East and Africa	2,034	2,587	3,943	7%
Latin America	1,706	2,146	3,245	7%
Total	**48,800**	**59,772**	**81,932**	**5%**

Data source – Glass Global Master database

Typically, furnaces are ~200-300T capacity per day, so unless you're a huge player, you'll be sharing a furnace with other customers. The suppliers need to match the furnace output with the finished product production lines to get balanced/smooth material flows:



Data source – Glass Global Master database

Glass production is energy intensive and the nature of the process requires a constant input:

1) Classic fossil furnace (up to 20% electric power):

- End fired furnace
- Cross fired furnace
- Oxy-fuel furnace

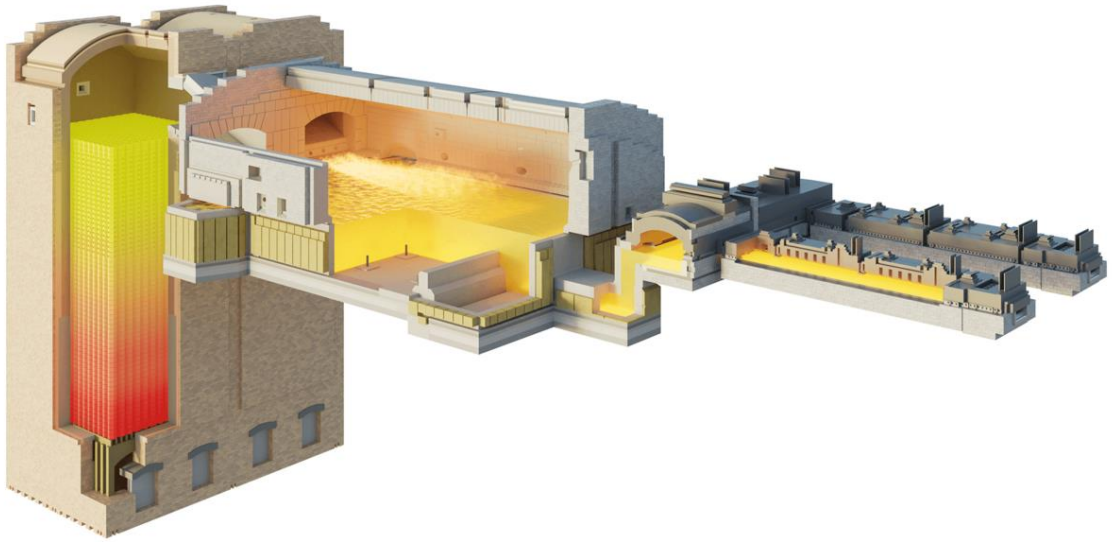
2) Hybrid furnace (20 to 40/50% electric power):

- Hybrid end fired furnace (Hybrid EFF)
- Hybrid oxy-fuel furnace (Hybrid OXY)

3) Super hybrid furnace (20 to 80% electric power):

- Super hybrid oxy-fuel furnace (Super hybrid OXY)

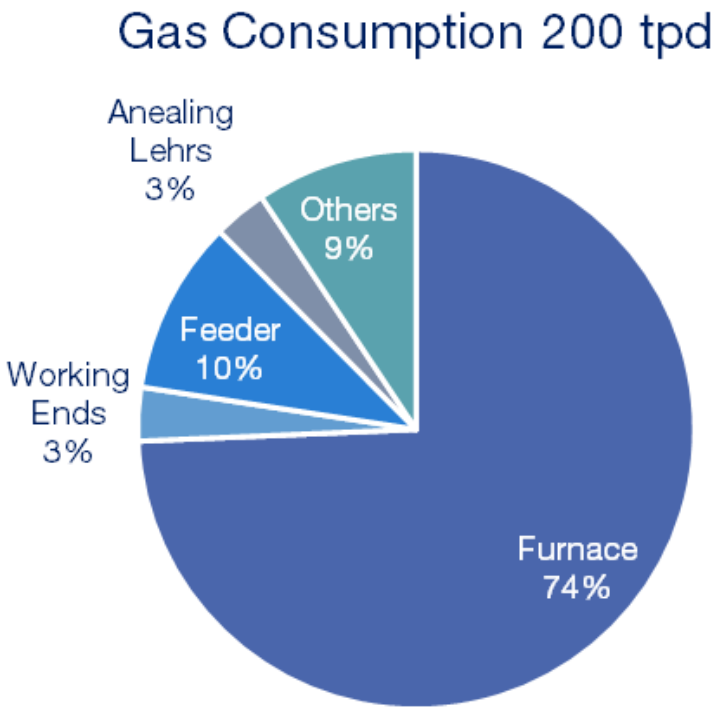
4) All-electric-melter (100% electric power)

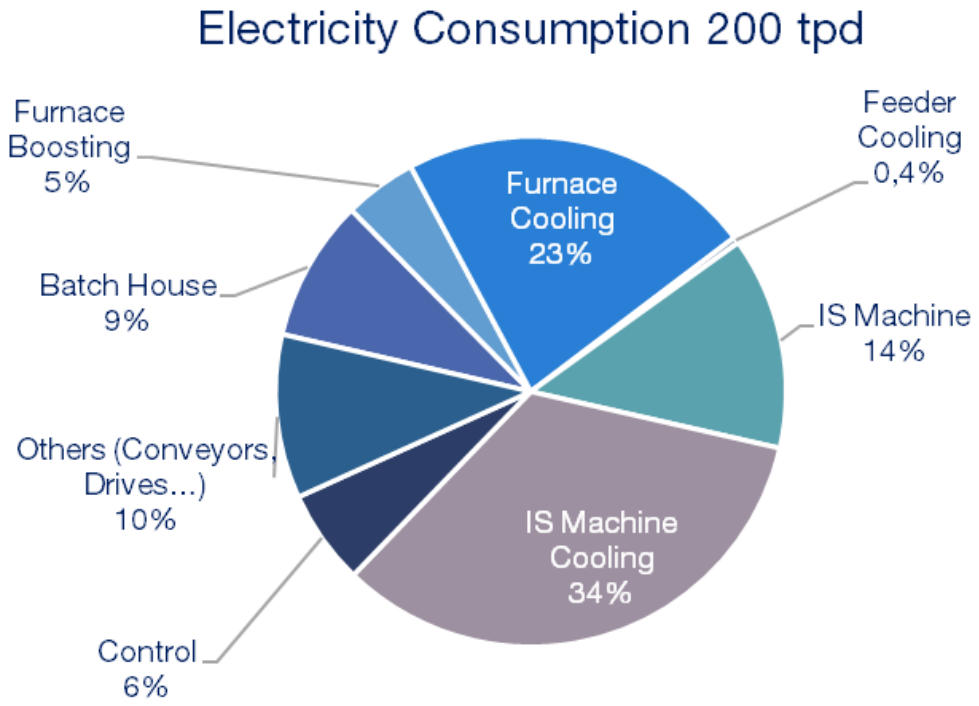


HORN End Fired Furnace

Energy consumption is typically ~80% gas vs ~20% electricity.

It’s the gas that the industry has to work out how to decarbonise

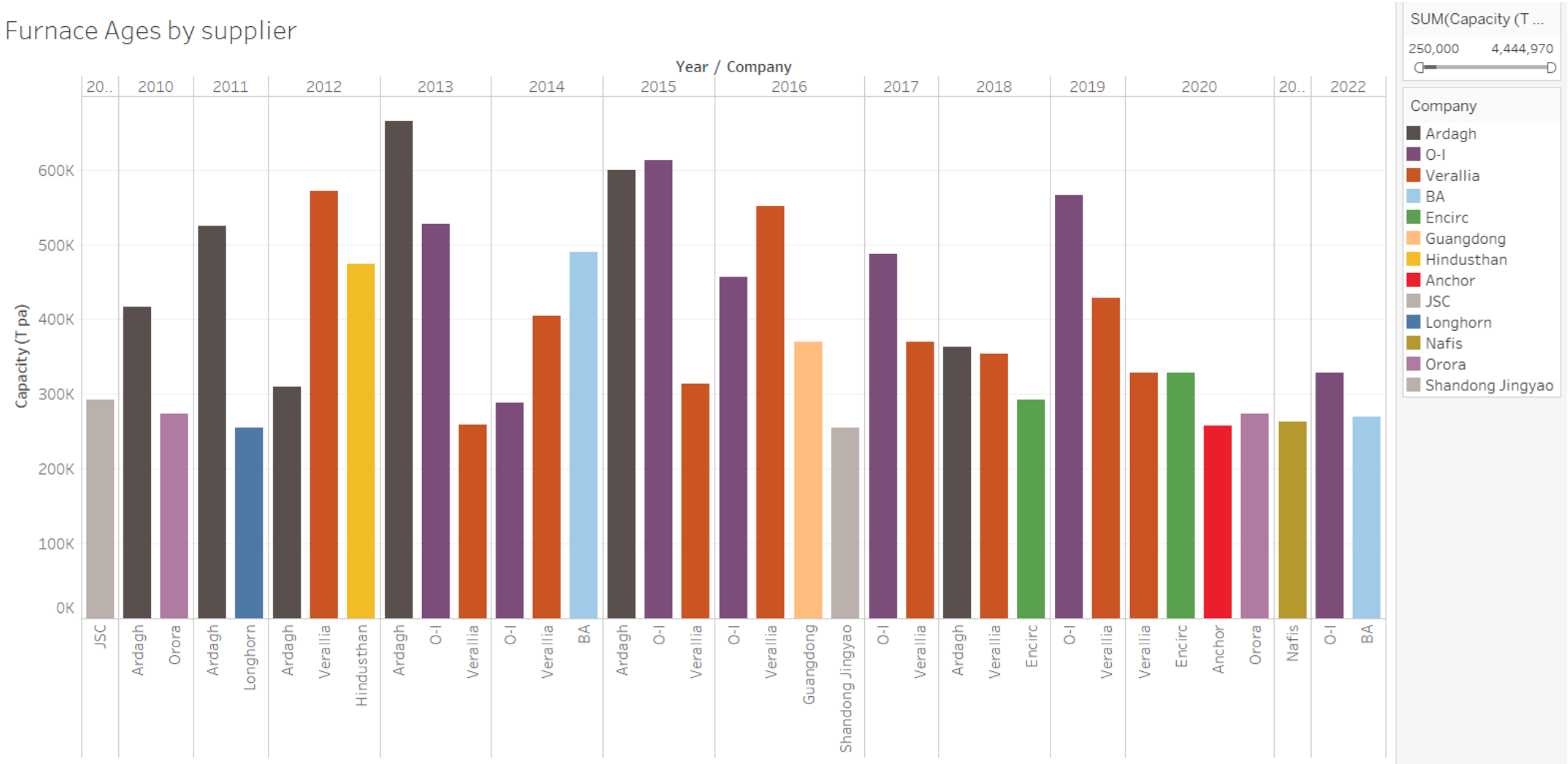




The key production challenges are:

- **Energy shift** - from gas and oil to electricity only possible with new furnace
- **Alternative combustibles** - such as Hydrogen or Ammonia not yet experienced
- **Green Energy** - usage of solar or wind uncertain – only for shop floor or periphery
- **Lower production lots** - requested by customer due to diversity for product and decoration to distinghish the product in the shelves = more job changes
- **Recycled** - Higher % of cullet / recycled glass requested by customer & lack of cullet availability
- **Bottle weight** - reduction of bottle weight potential limited, esp. for carbonated drinks
- **Product shapes** - (thick bottoms etc.) reduce production speed

Understanding the ages of the furnaces gives a feel for the capex & depreciation liabilities for suppliers. Container furnaces typically need replacing/over-hauling every 10-12 years and 15 years for float glass:



Increase of lifetime:
good maintenance

intermediate hot repairs

constant pull rate

Reduction of lifetime:
constant and changing high pull rate

inhomogenous raw materials

change of combustibles

emergency shut-offs

Data source – Glass Global Master database

3 – Beer

Market Dynamics

Mark

Carlsberg Group in numbers

12.5 BILLION*
LITRES BREWED IN 2022

150
MARKETS REACHED BY OUR PRODUCTS

PASSIONATE PEOPLE
40,000

140
BRANDS

Carlsberg Group

We have strong positions in our three regions

Western Europe

- Denmark
- Finland
- France
- Germany
- Norway
- Poland
- Sweden
- Switzerland
- United Kingdom

Central & Eastern Europe

- Azerbaijan
- Belarus
- Bulgaria
- Croatia
- Estonia
- Greece
- Italy
- Kazakhstan
- Latvia
- Lithuania
- Serbia
- Ukraine

Asia

- Cambodia
- China
- Hong Kong SAR
- India
- Laos
- Malaysia
- Myanmar
- Nepal
- Singapore
- Vietnam

Our products are licensed or exported to 100+ countries including: Turkey, Australia, Canada, Ireland, the Middle East, North America, South Korea and Belgium

Carlsberg Group

Our global portfolio consists of 140 brands, each with a unique character

A SELECTION FROM OUR WORLD

Carlsberg Group

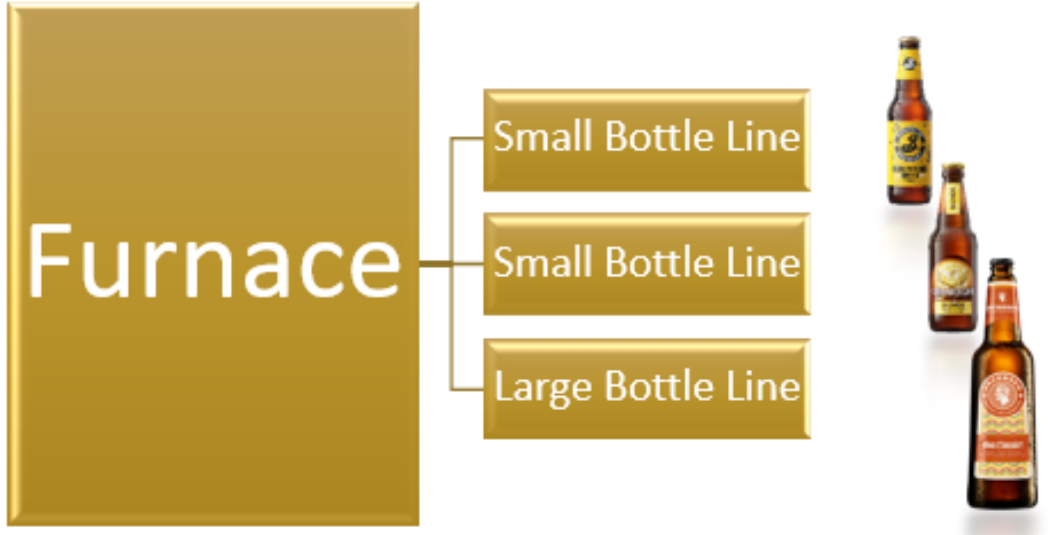
… with 3 main colours used in the beer category

Why Glass containers suite the beer industry

- Glass is Inert and Protects the beer (for oxygen)
- Allows differentiation in shape and can algin to the brand
- Has a unique drinking experience
- Can withstand the pressure of a carbonised liquid
- Can be re-used, and recycled

High speed production of glass bottles, capable of being pressurized

- Beer glass production lines are often purpose built for
  - Light weight products (NNPB capable)
  - High speed production (triple or quad gob, multiple sections)
  - Sometimes with limited adaptability to other glass packaging technologies
  - High levels of automated inspection



How or When do you prefer your favorite beer …?

… and could this be planned years in advance?

Carlsberg Group

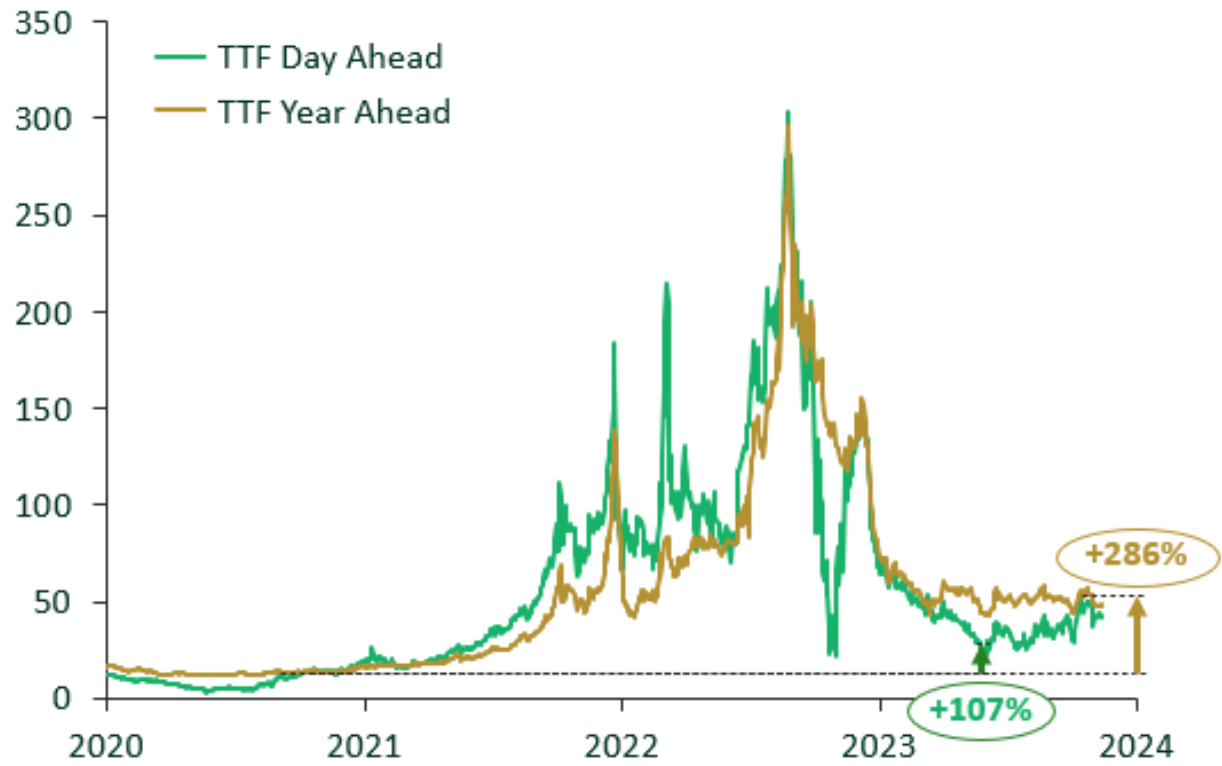
1. Medium term trends shape the glass industry capacity

- Significant volatility in demand over the past 2-3 years (in Europe).
- Investments into new capacity have continued, supporting the medium-term growth trend
- Will this continue with increased cost of capital?

2. Input costs for glass suppliers have been very volatile

- Price competitiveness of glass is strongly impacted via input costs

(often location of production dependent).



3. Packaging is a major contributor to overall carbon emissions of the value chain

OUR VALUE CHAIN CARBON EMISSIONS:
LATEST VALUE CHAIN ANALYSIS BASED ON 2022 DATA

% of total value chain emissions in 2022

23%
Agriculture & processing
Growing and processing of our raw ingredients

10%
Breweries
Production of our beer and beverages

47%
Packaging
Manufacturing and disposal of our packaging

10%
Transportation & distribution
Distribution of our products to customers

10%
Cooling
Refrigeration of our products in bars and retail stores

13.09.23 - https://www.carlsberggroup.com/newsroom/carlsberg-delivers-on-commitments-to-cut-value-chain-emissions/

Carlsberg Group

Traditional Sustainability Approaches

1. **Reduce : light / right weighting programs**
    1. Optimise the distribution of glass within the bottle

2. **Re-Use : Returnable Bottles**
    1. Significant returnable bottle systems are in place at a number of Carlsberg markets.
    2. Deposit Return Schemes are a key enabler
    3. Also “Buy Back” schemes
    4. Requires pasteurisation, and improved by investment in secondary packaging (Crates, boxes etc).
    5. Bottle designs consider thicker glass at impact locations on the bottle (shoulder)

3. **Recycle :**
    1. Maximize Cullet usage
    2. Lower energy is required to melt cullet, therefore also enabler for alternative fuels.
    3. This can also extend the life of the furnace

TOGETHER TOWARDS ZERO & BEYOND

Carlsberg Group

ZERO
Carbon Footprint

ZERO
Farming Footprint

ZERO
Packaging Waste

ZERO
Water Waste

ZERO
Irresponsible Drinking

ZERO
Accidents Culture

Responsible Sourcing | Diversity, Equity & Inclusion | Human Rights | Living By Our Compass | Community Engagement

To reach Net Zero, alternate energy sources for heating of the glass furnace is required

Glass making is an intensive heating process

- Re-use waste heat
- Increase electrical heating %
- Alternate renewable fuels under consideration
  - Various types of fuels under investigation (bio diesel, methane, etc.)
  - Tests for effectiveness, costs and supply remain considerations


THANK
YOU
THE FATHER OF QUALITY LAGER
CARLSBERG BEER
COPENHAGEN

4 – Glass Packaging – a CPO's perspective

Bill

“In terms of consumer preference, does your company see glass packaging:

A - Growing

B - Flat

C - Declining

- Glass: understanding the industry legacy precedes a successful packaging strategy
- Environmental considerations: capitalizing on the opportunities
- Cost Savings: controlling the primary drivers of price volatility
- Supplier Landscape: Finding the right partner

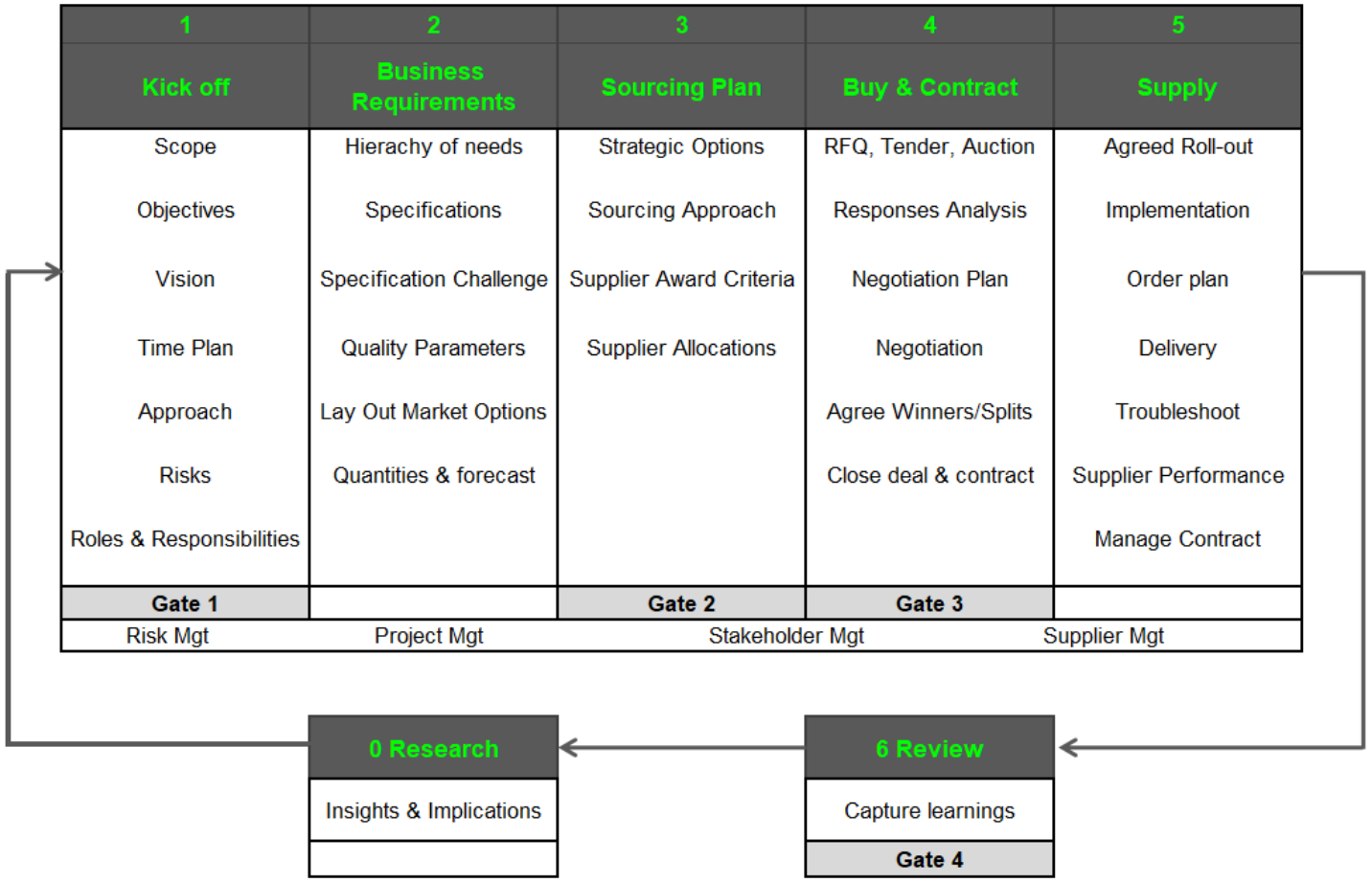
Bill Hovis worked at The Coca Cola Company between 1995 and 2018. His views are a reflection over his career and not the expressed views of The Coca Cola Company

5 – Wrap Up

Simon

Here are a few thoughts of how to procure glass:

Procurement Process



Considerations

- Learn about glass
  (it's surprisingly interesting!)
- Become competent at energy
- Re-check supplier options
- Decide buying mechanism
  (spot, leverage, PAF, partnership)
- Fact based negotiations
- Support de-carbonised energy initiatives

Key Messages

- **Energy** - To understand glass, you need to understand energy
- **Cullet –** preferable to keep cullet for the glass industry, in-country
- **Prices** - 2024 finished prices should be lower than 2023 but are unlikely to be as low as pre 2021 or as high as the spike of 2022
- **De-carbonisation –** the glass industry needs to work out its route to de-carbonisation
- **Sourcing –** you're more likely to source glass in-country or from a neighbouring country

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Thank you

Questions

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