

Modern World, Recycled glass

11th February 2021,
UWTSD,
Dr Tyra Oseng-Rees



Recycled = ?

- Reuse?
- Reprocess?
- Reclaim?
- Recover?
- Salvage?
- Save?
- Circular economy?

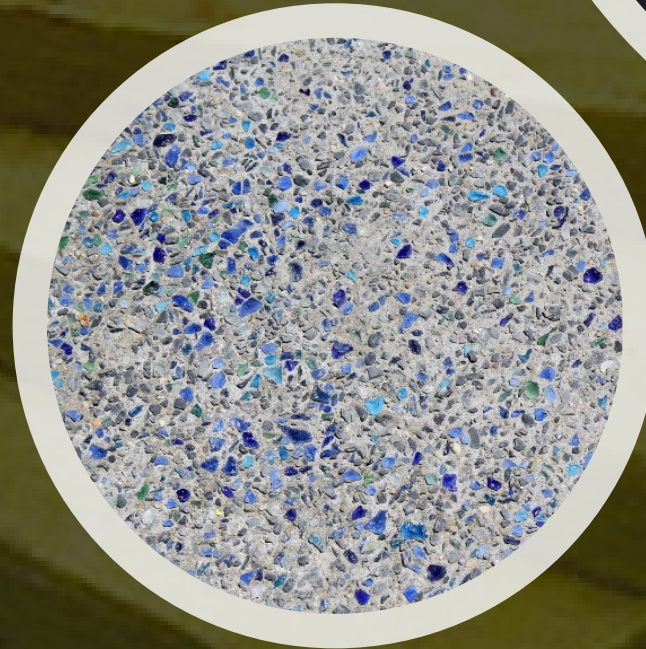


Waste Glass, a problem



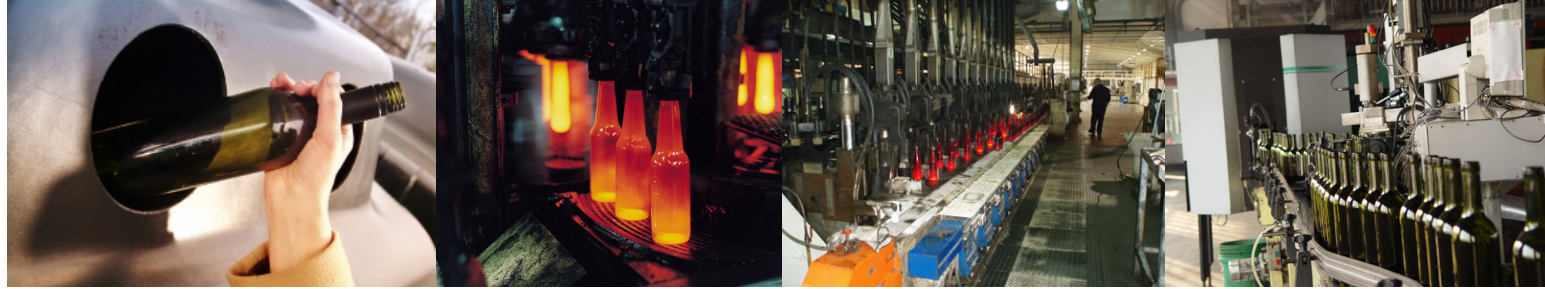
Recycled Glass, a material scientific
response

Some products developed on the
demand to deal with the waste
challenge

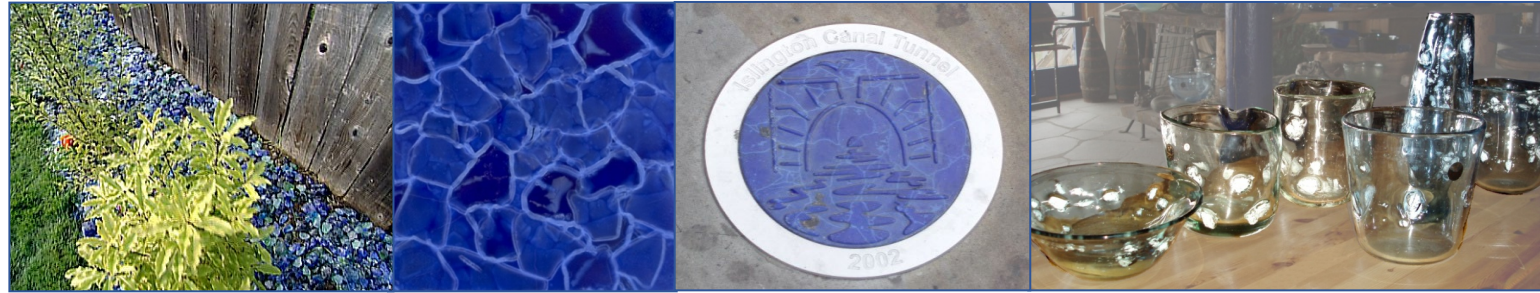


Recycled Glass,

Bottle
manufacturing



Art and design

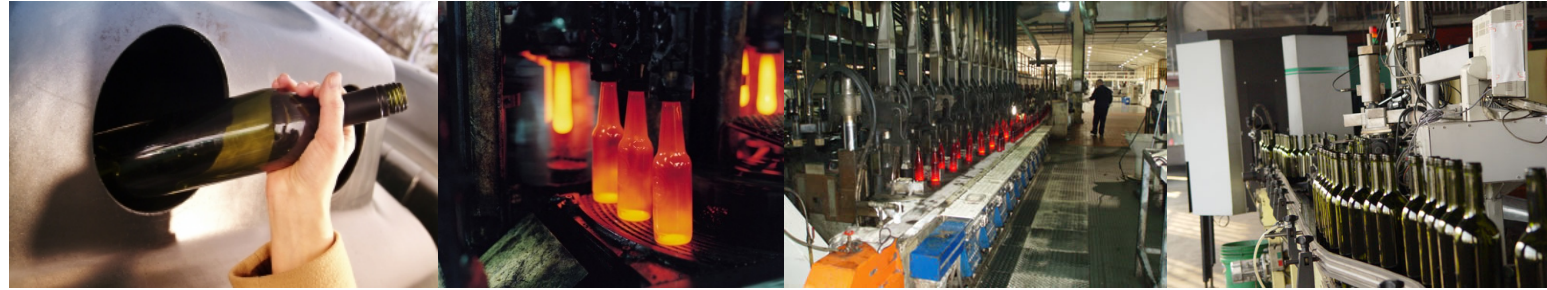


Construction
field

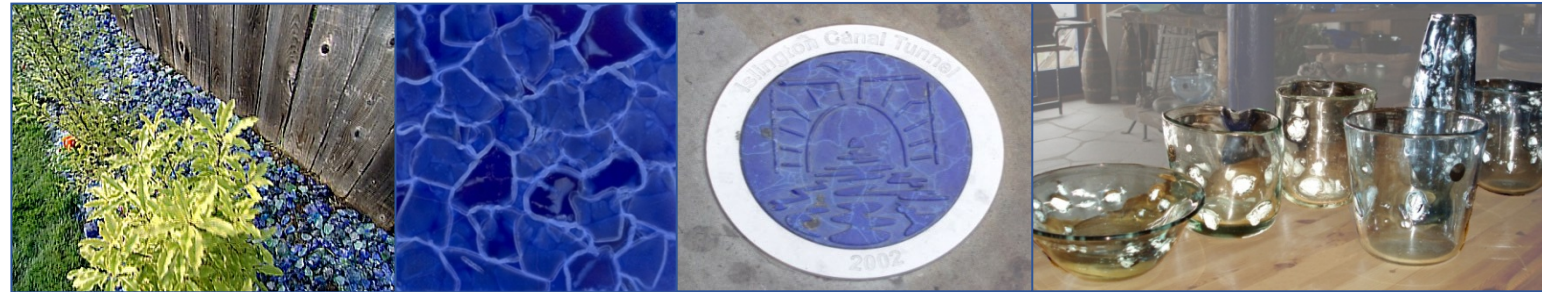


Recycled Glass,

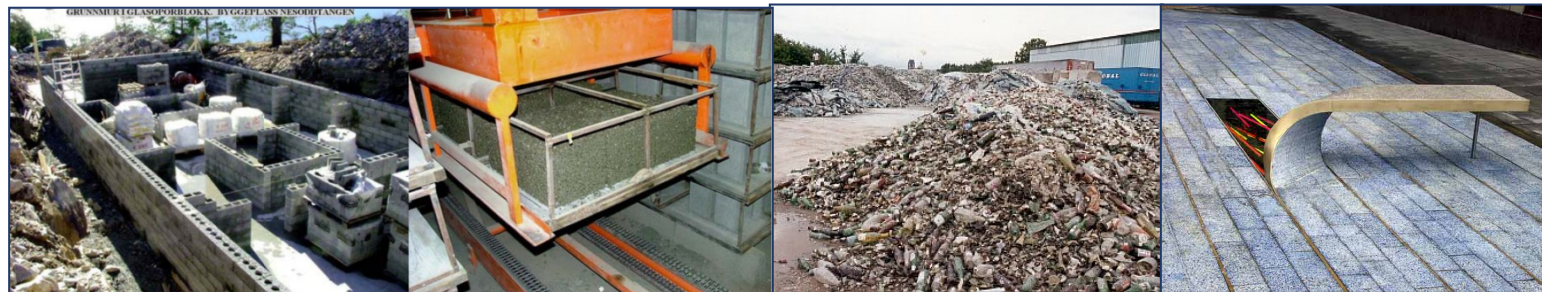
Circular
Economy



Up-cycling



Down-cycling





Sustainability

Sustainable development is development that fulfills existing needs, without bringing future generations' possibilities for fulfilling their needs in jeopardy"

(United Nations [UN], Report of the World Commission on Environment and Development: Our Common Future, 1987).

*** The four pillars of sustainability**



Climate crisis

Oseng-Rees
REFLECTION

MILJØSIDENE

TEKST / ILLUSTRASJON: TYRA

Hva er ordet MILJØ?

Ordet miljø blir mye brukt i dag. Det er klesmiljø, utemiljø, innemiljø og forskjellige slike ting. I markedsføring av varer er det veldig mange miljøprodukter. Så dette tyder på at de fleste er svært opptatt av miljø. Det jeg vil ta opp, er mer om miljø og forurensning.

Lokalt har Saltdal lite betydning for "omværa." Vi har ikke industri som forurensner noe spesielt. Men lokalt er det alltid noe å gjøre bedre. Som f.eks. kloakken under Torrissenbrygga, som slipper ut urensset kloakk, og kloakken ved camping plassen som også er urensset. Vi har en søppelplass som ligger ved elva. Og der kommer det sivende avfall fra innbyggerne, også her kommer det urensset kloakk ut. Men når det gjelder urensset kloakk har jeg og noen andre tatt et interju av Arne Hals.

Og her er de.

-Er det lov å slippe ut urensset kloakk ut i Fjorden?

Både ja og nei.

Ja, det er lov å slippe kloakk ut, men ikke på den måten vi gjør det. Vi har jo en sil som gjør at det blir opptil 20-30% mindre kloakk. Dette er et problem og vi skal prøve å ta det til dyper vann, men det er usikkert om det blir gjort.

-Enn Fjorden?

-Tåler den det?

Ja, det gjør den, den tåler mer enn iver. Den tar hva den kan ta.

Elva

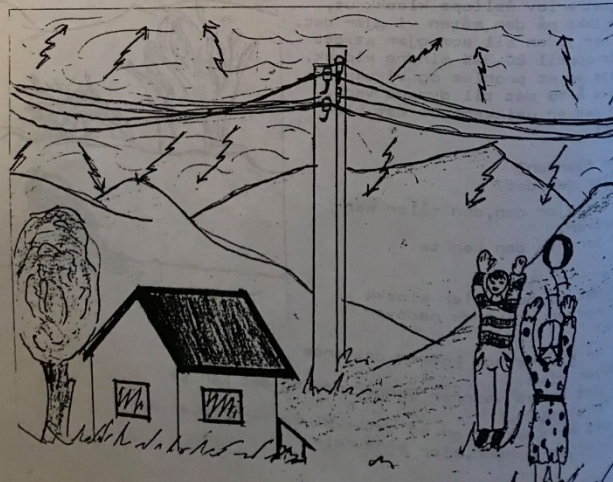
-Er det søppel eller kloakk som kommer drivende nedover elva?

Det er kloakk som kommer drivende nedover elva. Men det er et vannrør lenger ned, og det kan se guffent ut, ja. Og det er snakket om at det skal ta vannprøver, men det koster penger, sier Arne Hals.



Tenk deg, en solvakker sommerdag drar noen ti, elleve og tolvåringer bort i skogkanten for å bygge seg en hytte de kan være i. Og der oppdager de at trærne er såget ned, til og med krokfærre og klatretreet er borte.

Senere fikk de høre at det var noen folk som hadde såget de ned for å få ei høyspentledning opp. Ingen hviste noe om at høyspentledninga skulle opp akkurat der. Ja, nå er det ca. et år siden denne saken ble diskutert og el.verket sa at det ville være greit om de tok å flyttet den lenger sør. Men da de begynte hadde de bare flyttet den ti meter bortover. Høyspentledninger vet vi lite om, men det vi vet er at det er en stor risiko hvis en blir nær den. Og likevel skal de sette ei høyspentledning opp like inntil byggefeltet på Nygård.



Ven i "omværa" har det stor betydning som f.eks. at økonlaget er så hullete som en sveitserost. Og i Afrika og andre steder blir det født blinde dyr p.g.a. at i økonlaget er det et hull hvor solstrålene kommer til jorda. Solstrålene er så farlig at snart kan vi ikke gå ut uten sikkerhet mot sola. Vi kan få hudkreft og forskjellige slike skumle ting.

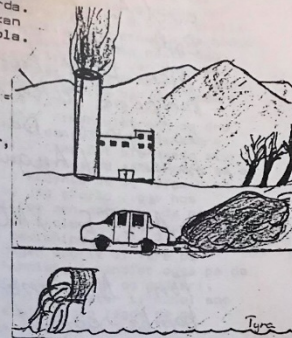
Så hvorfor må de som sitter med pengene bare prate og prate og si: Vi har ikke råd! Nå må dere bruke de små grå dere har, og redd jorda vår, den går jo under om noen år. Ikke vent på at andre skal gjøre det, gjør det selv. Vi som er unge skal jo arve jorda, ikke overlatt alle problemene som dere ikke klarer å ordne opp i selv. Vi vil vel ikke ha de, vi vil heller ikke ha ei grå og ødelakt jord. Vi vil ha ei grønn og frodig jord.

Så dette sier jeg, og ikke bare jeg, men det er både unge og gamle som sier: STOPP!!! Vi vil ikke ha mer av sur nedbør, solbrennhet, hudkreft, vond lukt og tungt med å puste. SLUTT!!!! Slutt med... forurensning, prøv heller å redusere avfall.

Ta åssortert avfallet ditt, legg det i en kompost bak huset ditt, plast i en pose, papir i en annen og det som ikke kan gjenvinnes kan dere kaste på tippen. Røyking er både helseskadelig for røykere og ikke røykere. HUSK! Du har krav på røykfritt spise og arbeidsrom.

Så til deg som har lest dette jeg mener, ikke bare sitt der å glo, gjør noe selv. Vi har da bare en klode å leve på. Og til slutt har jeg noen tips til dere.

* Se folket om å slå av motoren på bilen når den står i ro.
* Se folket om å ta opp søppelet de kaster fra seg.
* Se mor og far om å sykle på jobben/butikken.
* Se dere bruke bilen sitt flere i den, ikke bare en og en.
* Ta hensyn til ikke røykere.



Tyra 12 år, -92



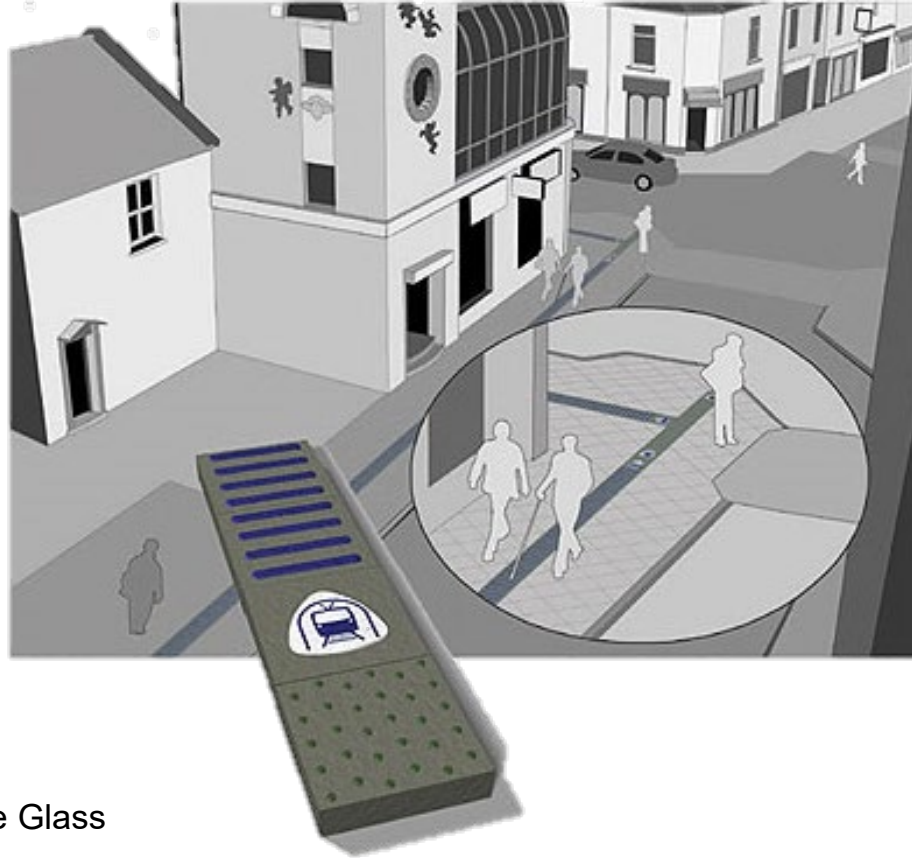


PhD proposal 2004

Recycled glass urban paving

The application?

Tactile paving
Inclusive design
Aesthetic
Materiality
Sustainability



Oseng-Rees
REFLECTION

The process of working with
bottle glass;

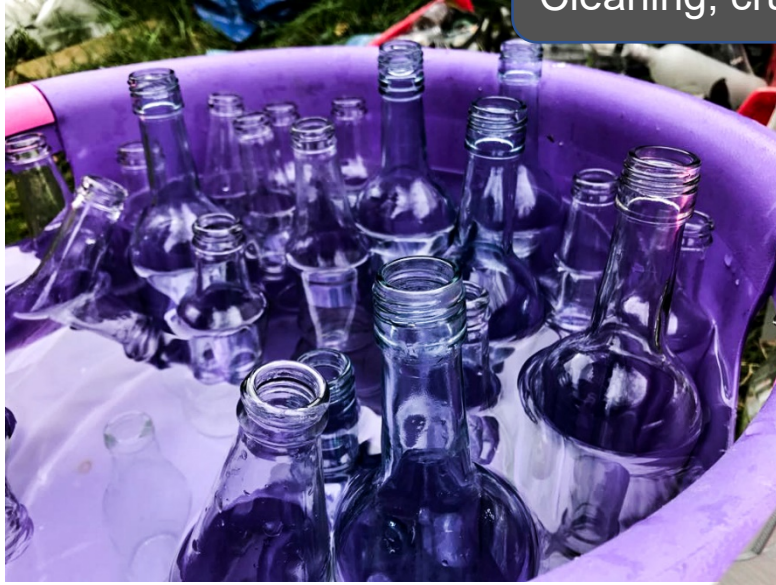
Fusing/Sintering
Vs.
Hot Glass Melt



Research Objectives

- ▶ To *evaluate* the sustainability and *practicality* of using recycled bottle glass for designing architectural products
- ▶ Use of *fusion* as methodology
- ▶ Developing *new directions* in the use of recycled glass as a material
- ▶ *Design and manufacture* of architectural products from recycled glass with an evaluation of sustainability and strength for design application
- ▶ Outcome
 - A range of architectural products
 - An *understanding of the behaviour* of recycled glass as a design material
 - *Design Material Guidebook*

The process of working with bottle glass;
Cleaning, crushing, fusing



Research Theme

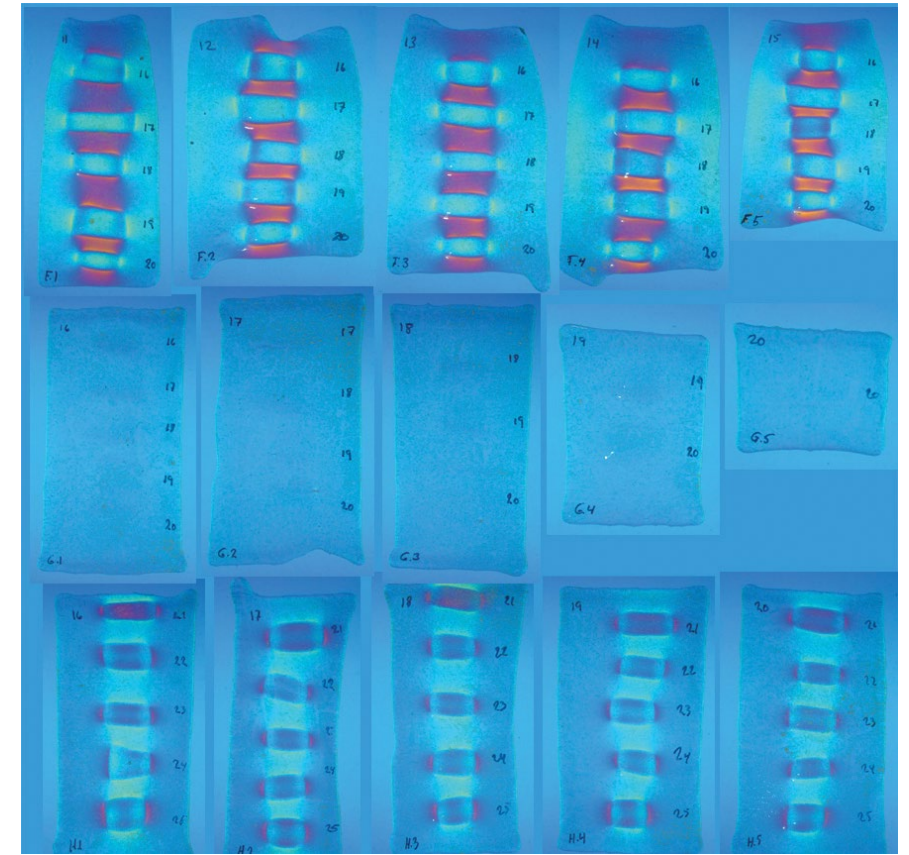
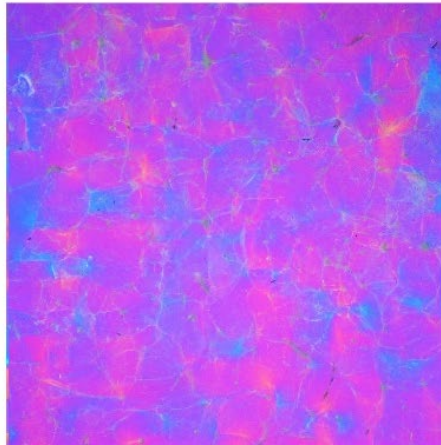
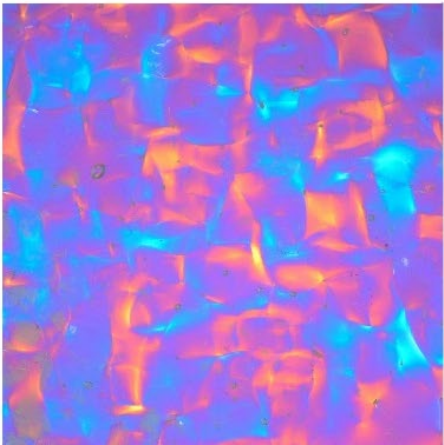
- ▶ Compatibility
- ▶ Devitrification
- ▶ Strength of Fused Bottle Glass
- ▶ Texture
- ▶ Colour Creation
- ▶ Investigation of Fusion Methods
- ▶ The Gwalia Project

Research Theme

- ▶ **Compatibility**
- ▶ Devitrification
- ▶ Strength of Fused Bottle Glass
- ▶ Texture
- ▶ Colour Creation
- ▶ Investigation of Fusion Methods
- ▶ The Gwalia Project

The process of working with bottle glass;

Compatibility of materials



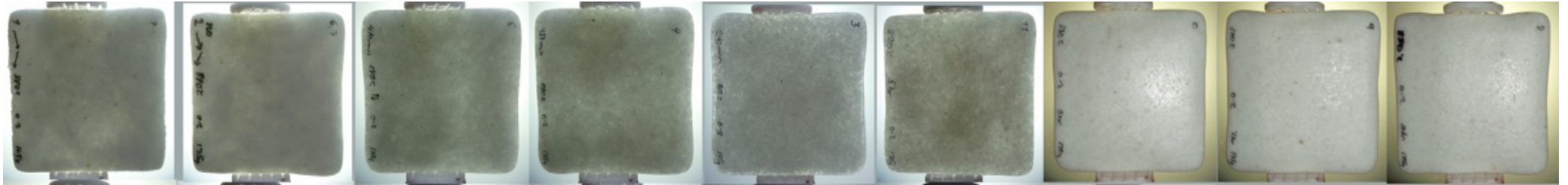
Research Theme

- ▶ Compatibility
- ▶ **Devitrification**
- ▶ Strength of Fused Bottle Glass
- ▶ Texture
- ▶ Colour Creation
- ▶ Investigation of Fusion Methods
- ▶ The Gwalia Project

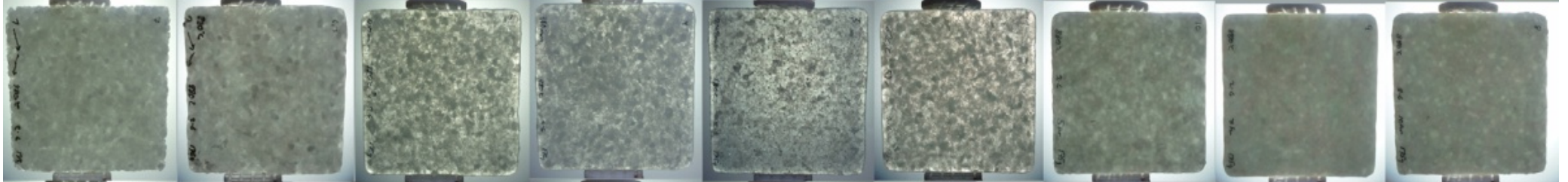
The process of working with bottle glass;

Devitrification/ crystallisation

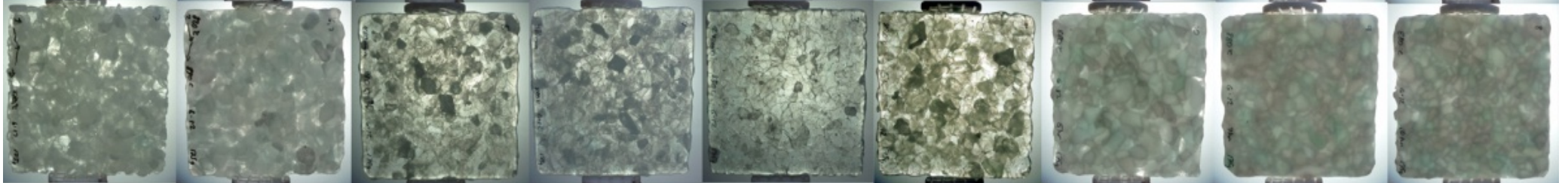
**Fragment
sizes**
0-2mm



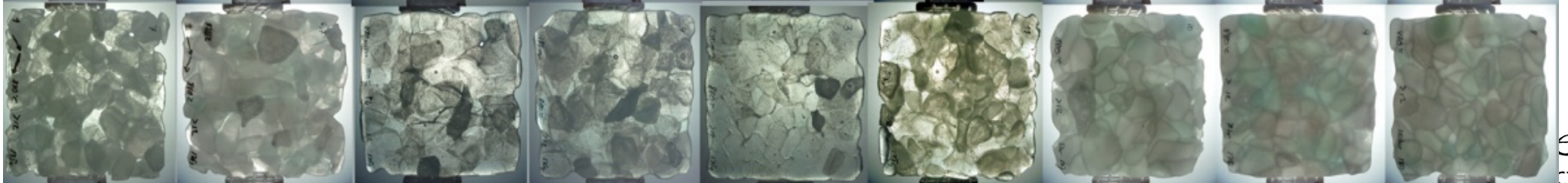
2-6mm



6-12mm



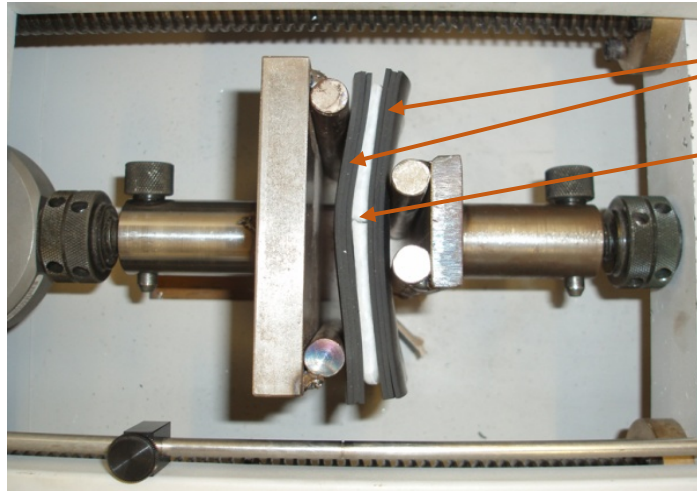
>12 mm



Research Theme

- ▶ Compatibility
- ▶ Devitrification
- ▶ **Strength of Fused Bottle Glass**
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The process of working with bottle glass; Strength



Neoprene cushioning

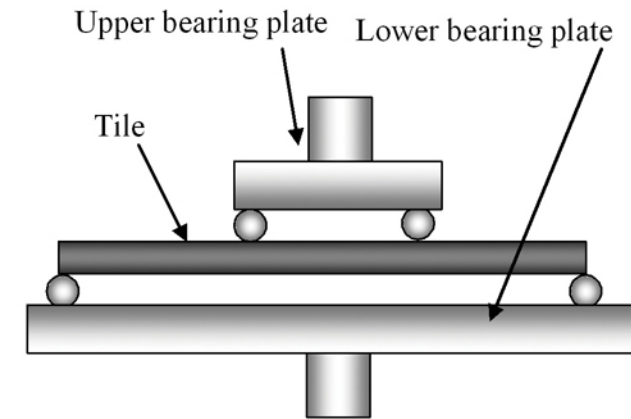
Glass tile

- The specimen is clamped between two bearing plates (upper and lower).
- An increasing load is applied to the centre of the specimen.

- The instrument automatically generates Force versus Displacement data.
- The energy and maximum force required to break the sample can be measured.
- The maximum break force allows the Modulus of Rupture (R) for the sample to be calculated.

$$R = \frac{PL}{bd^2}$$

Where P = maximum breaking force, L = span length between the outer supports of the lower bearing plate, b = sample width and d = sample depth.



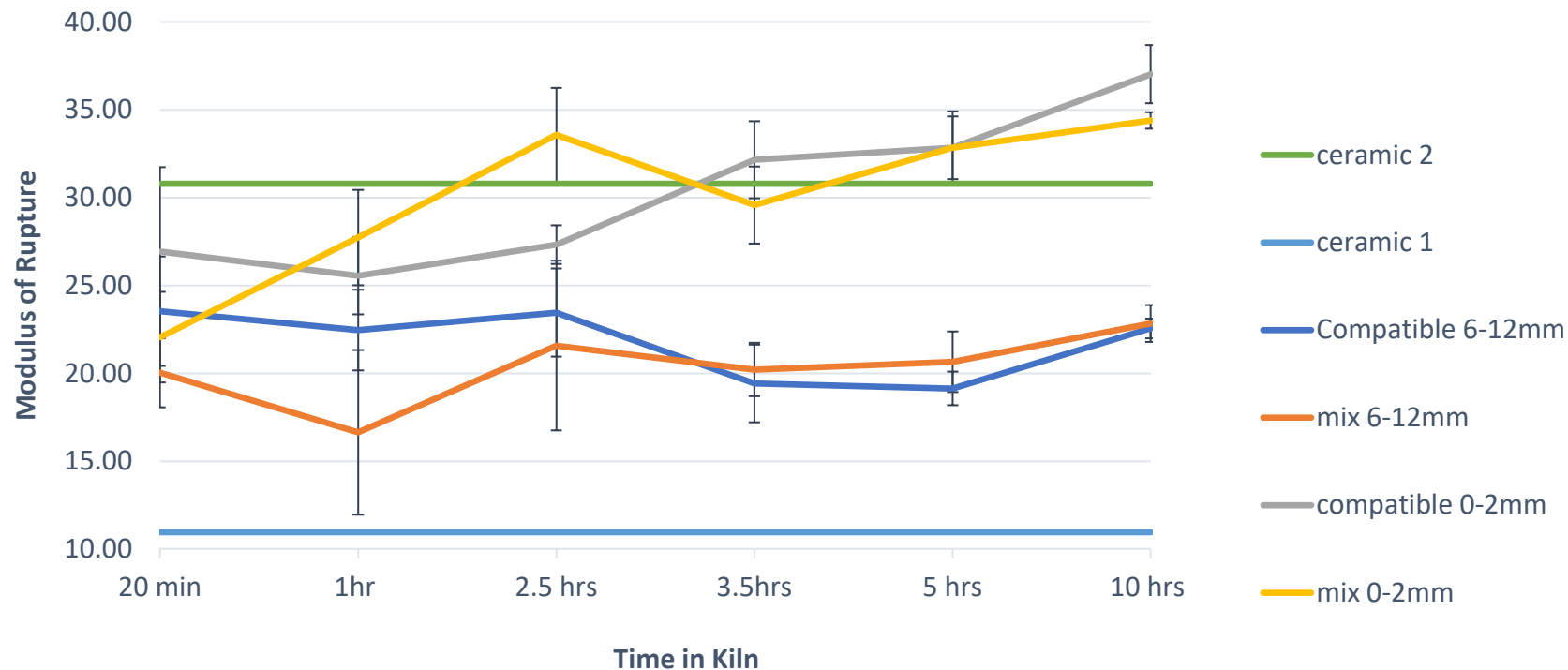
The process of working with bottle glass; Strength

Time in kiln	6-12mm					
	compatible			mix		
	MPa	R	stdv	MPa	R	stdv
20 min	6.23	23.54	3.11	9.64	20.03	1.96
1hr	7.12	22.46	2.30	9.77	16.64	4.69
2.5 hrs	4.69	23.46	2.51	4.58	21.58	4.83
3.5hrs	1.29	19.43	2.21	1.34	20.21	1.52
5 hrs	0.93	19.14	0.95	0.98	20.66	1.73
10 hrs	1.12	22.56	0.56	1.12	22.83	1.05

0-2mm					
compatible			mix		
MPa	R	stdv	MPa	R	stdv
5.01	26.94	4.80	4.14	22.06	2.58
3.84	25.56	2.21	3.49	27.73	2.71
3.07	27.32	1.10	3.55	33.57	2.68
1.73	32.16	2.19	1.61	29.58	2.19
1.47	33.13	1.78	1.16	32.84	2.07
1.50	37.03	1.66	1.26	34.39	0.47

Commercial tiles	R
Ceramic 1	10.95
Ceramic 2	30.79

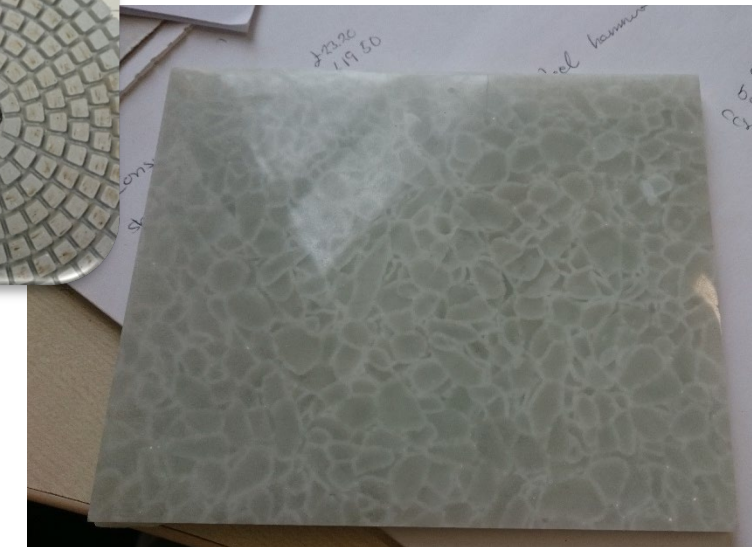
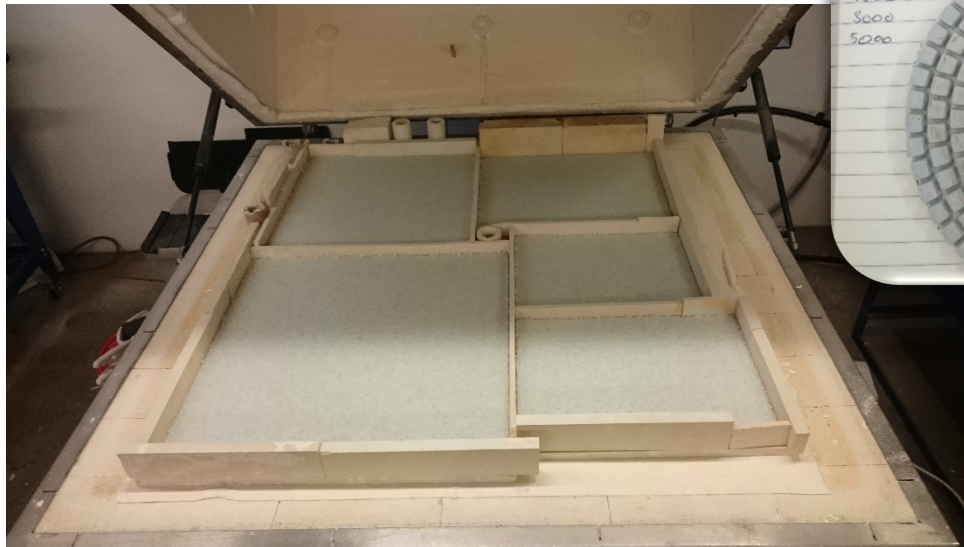
Modulus of Rupture with Increased Time in Kiln



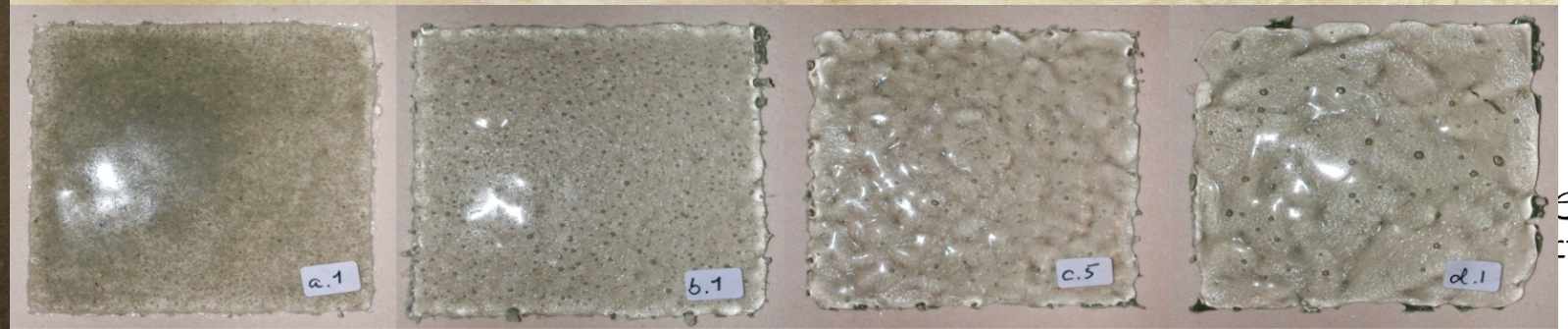
Research Theme

- ▶ Compatibility
- ▶ Devitrification
- ▶ Strength of Fused Bottle Glass
- ▶ **Texture**
- ▶ Colour Creation
- ▶ Investigation of Fusion Methods
- ▶ The Gwalia Project

The process of working with bottle glass;
Fusing and cold working

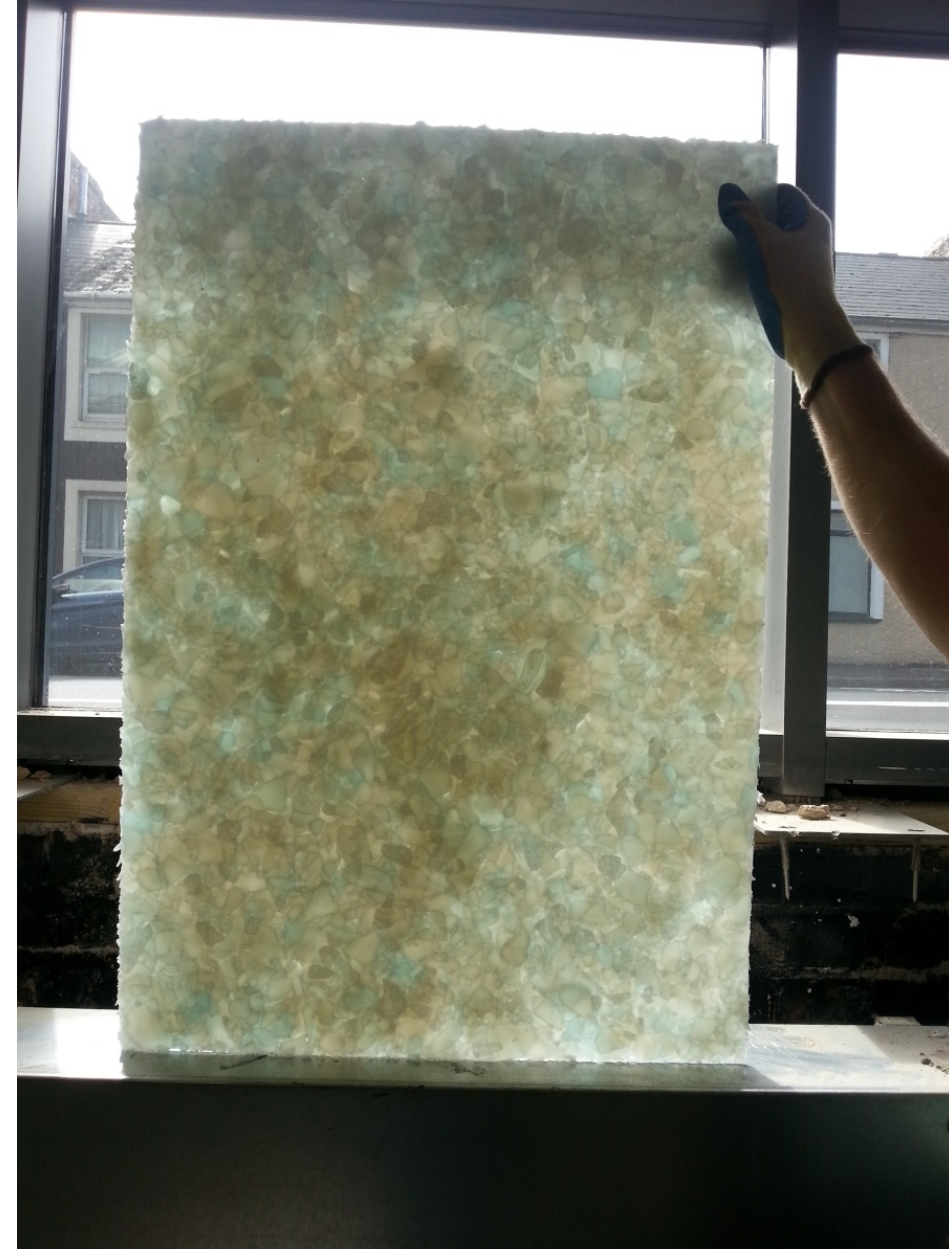
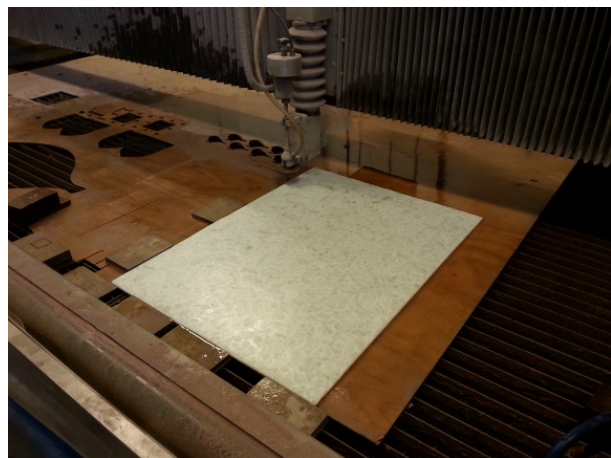
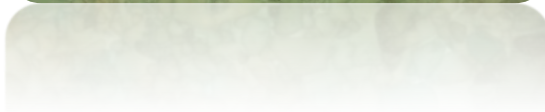


Texture



The process of working
with bottle glass;

Fusing, cold working,
waterjet



Oseng-Rees
REFLECTION

Light shining onto and light passing through the same panel



Research Theme

- ▶ Compatibility
- ▶ Devitrification
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- ▶ Texture
- ▶ **Colour Creation**
- ▶ Investigation of Fusion Methods
- ▶ The Gwalia Project

The process of working
with bottle glass;
Colour creation



Oseng-Rees
REFLECTION

The process of working
with bottle glass;

Colour creation

% frit added Frit added to 35g glass		Blue (B), Yellow (Y), Red (R), White(W)												
		B	B/Y	B/Y	B/Y	B/Y	B/Y	B/Y	Y	Y/R	Y/R	R	R/B	W
		100	50/50	25/75	20/80	15/85	10/90	5/95	100	75/25	50/50	100	50/50	0
Complementary colour added	0.1g													
	0.5g													
	1.0g													
Frit-to-glass ratio	3.0g													
	2.0g													
	1.0g													
	0.5g													
Marble effect	1.0g													
	3.0g													

Research Theme

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- ▶ Texture
- ▶ Colour Creation
- ▶ **Investigation of Fusion Methods**
- ▶ The Gwalia Project

The process of working with bottle glass;
Artistic process, Casting



The process of working with
bottle glass;

Artistic process



The process of working with bottle glass;
Texture and Colour



The process of working with bottle glass;
Texture and Colour



The process of working with bottle glass;
Texture and Colour



Research Theme

- ▶ Compatibility
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- ▶ Investigation of Fusion Methods
- ▶ **The Gwalia Project**

The Gwalia Project



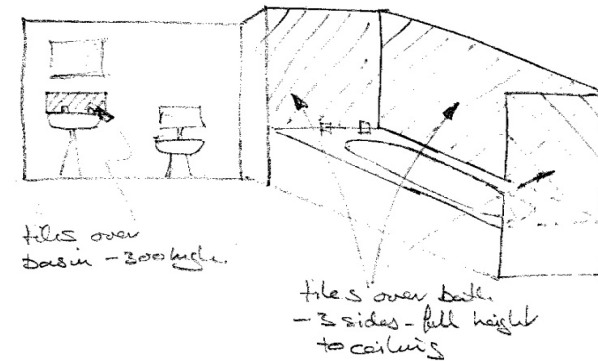
Grŵp Gwalia working with
architects Philip Roberts
and Elfed Roberts



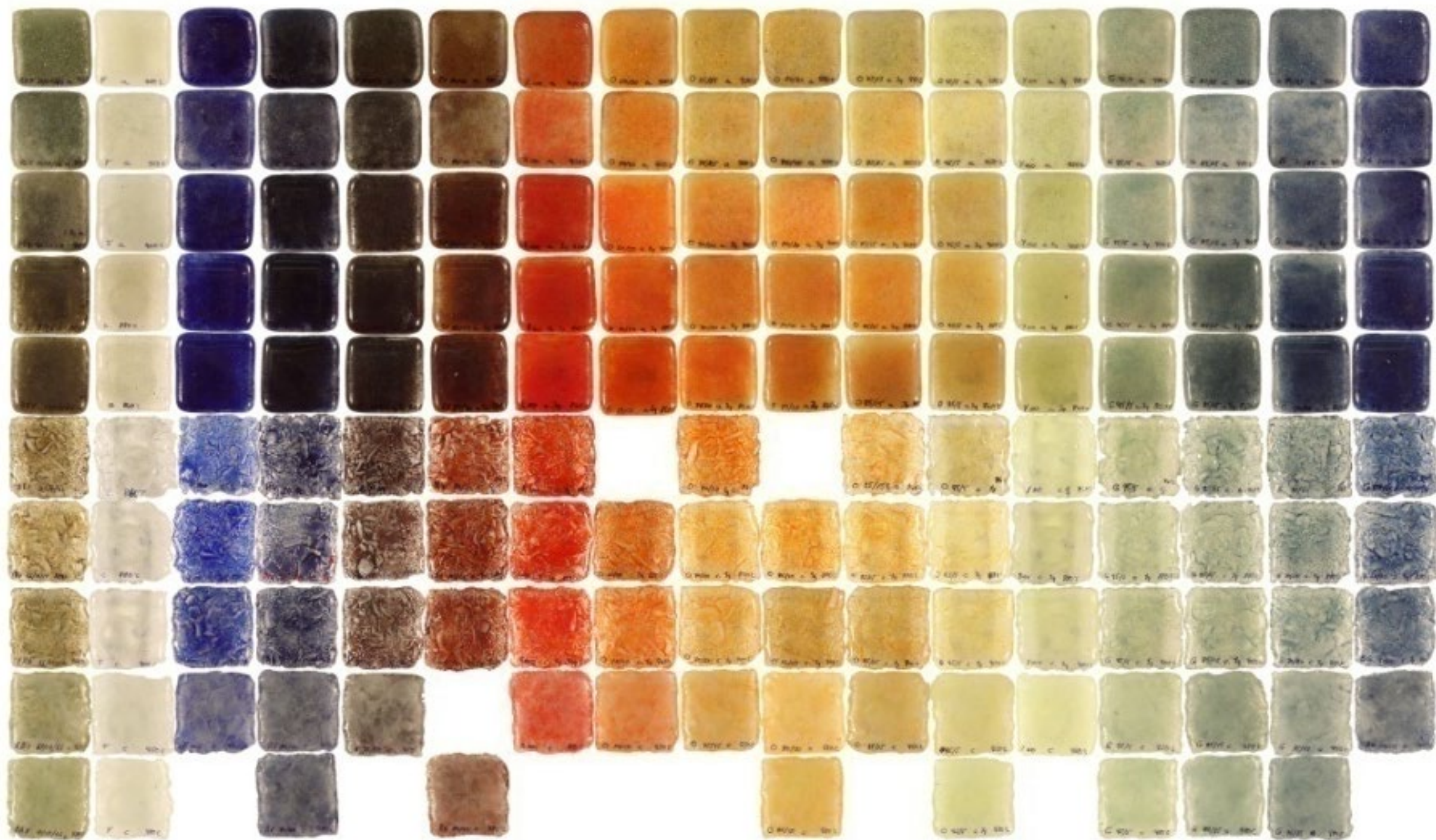
Gŵyr Homes



DIA - BATHROOM LAYOUT - TILING



Oseng-Rees
REFLECTION

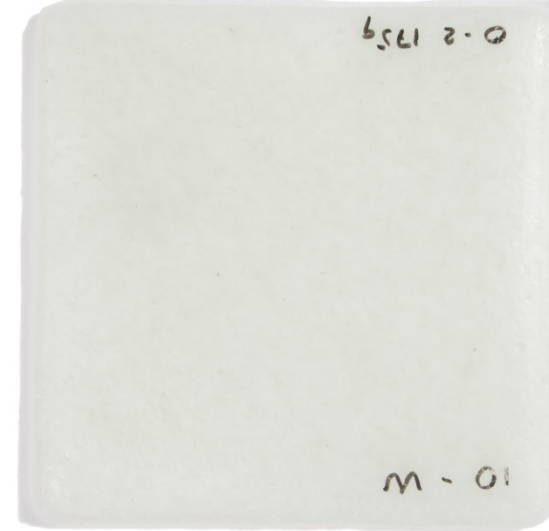




Kitchen Tiles



Bathroom Tiles





Further research:

I believed that fused recycled container glass could be used as an architectural material in a circular economy approach.

Collaborating with a range of other disciplines such as;

- **Scientists**
- **Material engineers**
- **Built environment**
- **Architects**
- **Local industry**
- **Designers**
- **Artists**

To develop a recycled glass material that will fit industry standard and be a true sustainable material in the terms of circular economy

Sustainability - The four pillars of sustainability

“Sustainable development is development that fulfills existing needs, without bringing future generations’ possibilities for fulfilling their needs in jeopardy”

(United Nations [UN], Report of the World Commission on Environment and Development: Our Common Future, 1987).

- Environmental
- Society
- Economic
- Culturally

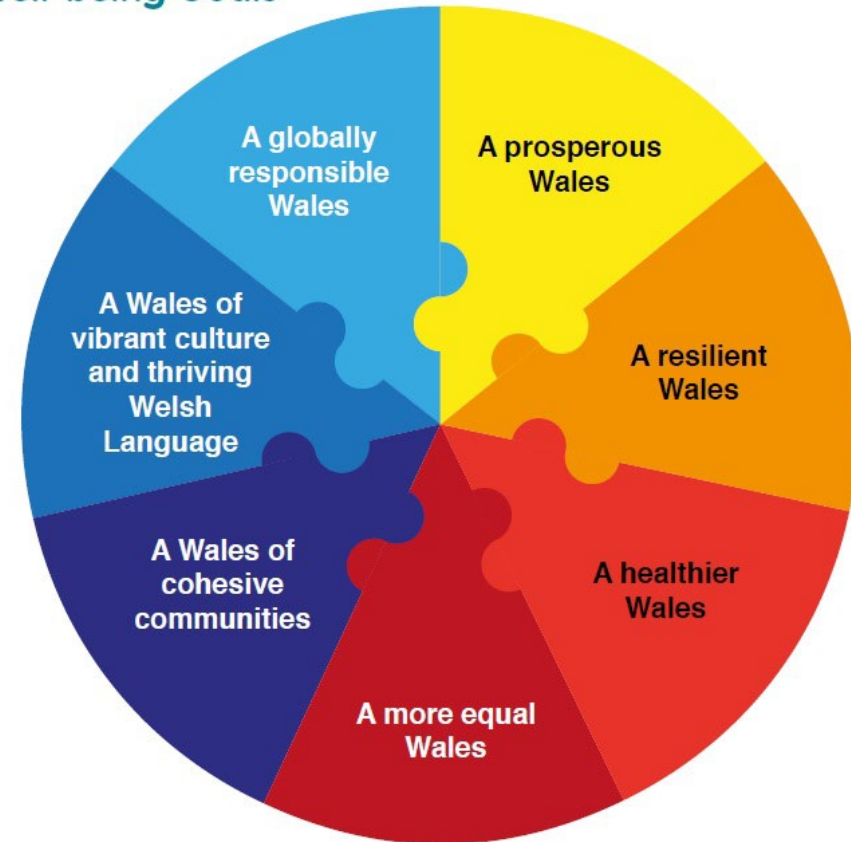


Wellbeing of Future Generations Act (Wales) 2015

- One Act
- Four Sustainability Development Pillars –
 - *Social*
 - *Economical*
 - *Environmental*
 - *Cultural*
- Five Ways of Working
- Seven Goals and their definitions
- 46 Population Indicators

Public bodies need to make sure that when making their decisions they take into account the impact they could have on people living their lives in Wales in the future.

Well-being Goals



Five ways of working

Long term



The importance of balancing short-term needs with the need to safeguard the ability to also meet long-term needs.

Prevention



How acting to prevent problems occurring or getting worse may help public bodies meet their objectives.

Integration



Considering how the public body's well-being objectives may impact upon each of the well-being goals, on their other objectives, or on the objectives of other public bodies.

Collaboration



Acting in collaboration with any other person (or different parts of the body itself) that could help the body to meet its well-being objectives.

Involvement



The importance of involving people with an interest in achieving the well-being goals, and ensuring that those people reflect the diversity of the area which the body serves.

It will expect to:

- Work together better
- Involve people reflecting the diversity of our communities
- Look to the long term as well as focusing on now
- Take action to try and stop problems getting worse - or even stop them happening in the first place.

Circular economy contribution to the well-being goals



Goal	Circular economy contribution
A prosperous Wales	• Potential savings to the Welsh economy of over £2 billion by it adopting a circular economy • Potential for up to 30,000 jobs to be created in Wales through moving towards a circular economy. • Significant carbon savings.
A resilient Wales	• Less wastage of food leading to reduced need for food production, leading to reduced impacts on habitats and biodiversity both in Wales and around the world. • Lower demand for other raw materials sourced from around the globe, leading to reduced mining, destruction of ancient forests and exploitation of other undeveloped habitats, thus protecting species and biodiversity. • Reduced greenhouse gas emissions associated with the production of goods consumed in Wales, and a reduced impact of climate change on biodiversity. • Greater resource resilience / security of supply for manufacturing.
A healthier Wales	• Protecting and improving health through reducing emissions associated with waste and its management • Improving health by reducing poverty through creating jobs in the circular economy, saving money (eg. Love Food, Hate Waste) and through the provision of free / low cost household items (via reuse)

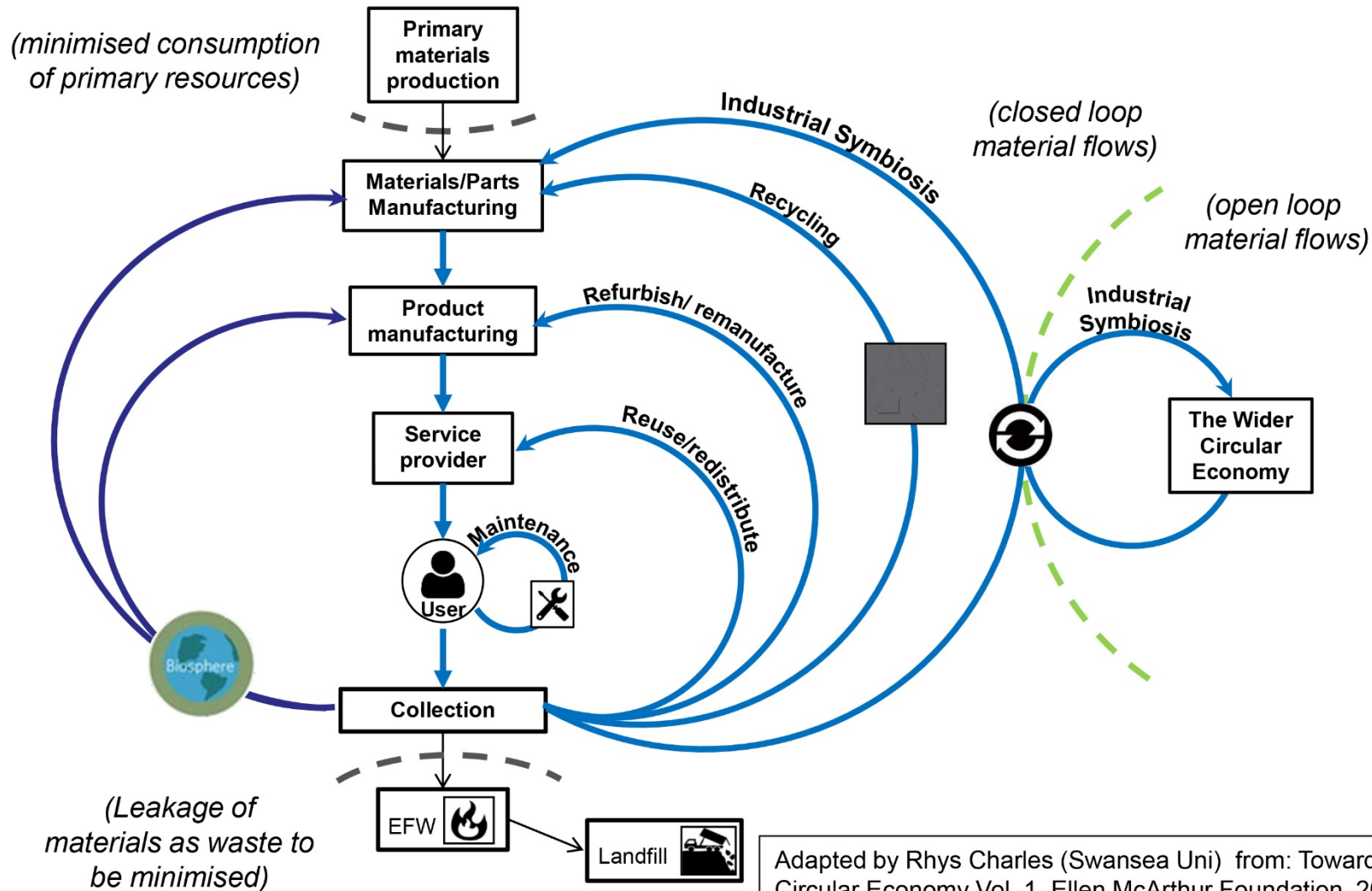
Slide from:
Dr Andy Rees, OBE
Head of Waste Strategy Waste &
Resource Efficiency Division, Welsh
Government

Circular economy contribution to the well-being goals

Goal	Circular economy contribution
A more equal Wales	• Providing jobs, training, skills across a diverse range of the population • Providing surplus food and high quality, affordable second hand domestic goods to those in poverty
A Wales of cohesive communities	• Involving and engaging communities in sustainable waste management, including repair, remanufacturing, recycling, reuse and surplus food redistribution
A Wales of vibrant culture and thriving Welsh language	• Further embedding sustainable development behaviours and cultures within people • Using the arts as appropriate to help with raising awareness and behaviour change • Using the Welsh language creatively in communications • Making high value art / craft out of recycle – ‘upcycling’
A globally responsible Wales	• Making an important contribution to the Welsh Government’s one planet resource use goal; • Helping reduce or reverse global biodiversity loss.

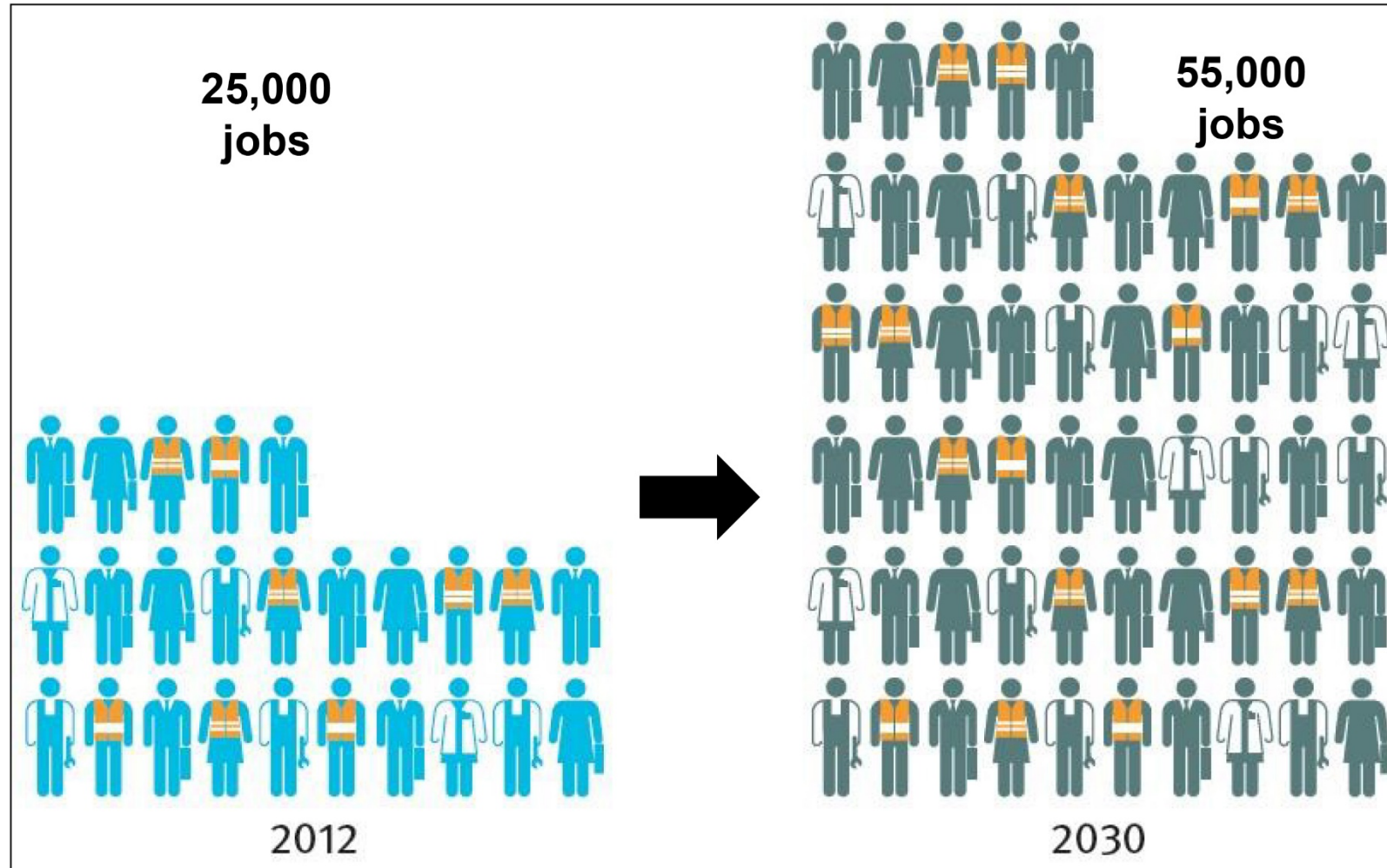
Slide from:
Dr Andy Rees, OBE
Head of Waste Strategy Waste &
Resource Efficiency Division, Welsh
Government

Material flows in a Circular Economy



Slide from:
Dr Andy Rees, OBE
Head of Waste Strategy Waste &
Resource Efficiency Division, Welsh
Government

Potential employment benefits to Wales of operating a 'transformational' circular economy



Source: 'Employment and the circular economy - Job creation in a more resource efficient Britain', January 2015; by WRAP and the Green Alliance)

Slide from:
Dr Andy Rees, OBE
Head of Waste Strategy Waste &
Resource Efficiency Division, Welsh
Government



Glass recovery (British Glass)

- Re-melt saves about 0.3 tons of carbon per tons of glass recycled; aggregate saves none.
- About 93% of waste glass produced by businesses, such as pubs and clubs, is recycled, 2010
- Four fifths of councils provide curbside glass collections to households in 2012.
- 81% of glass recycled in 2005 was re-melted, but in 2010 that had fallen to 64%.
- Today (2021) only about half of household glass packaging get re-melted back to glass.

Student assignment-



Find local materials made in Wales

- What material is available in Wales?
- Who produce the material/product?
- When will the material/product be used?
- Where will the material/product fit within the existing market?
- Why using a local material/product?
- How much will it cost?

*Tip- Millennium Stadium, Cardiff