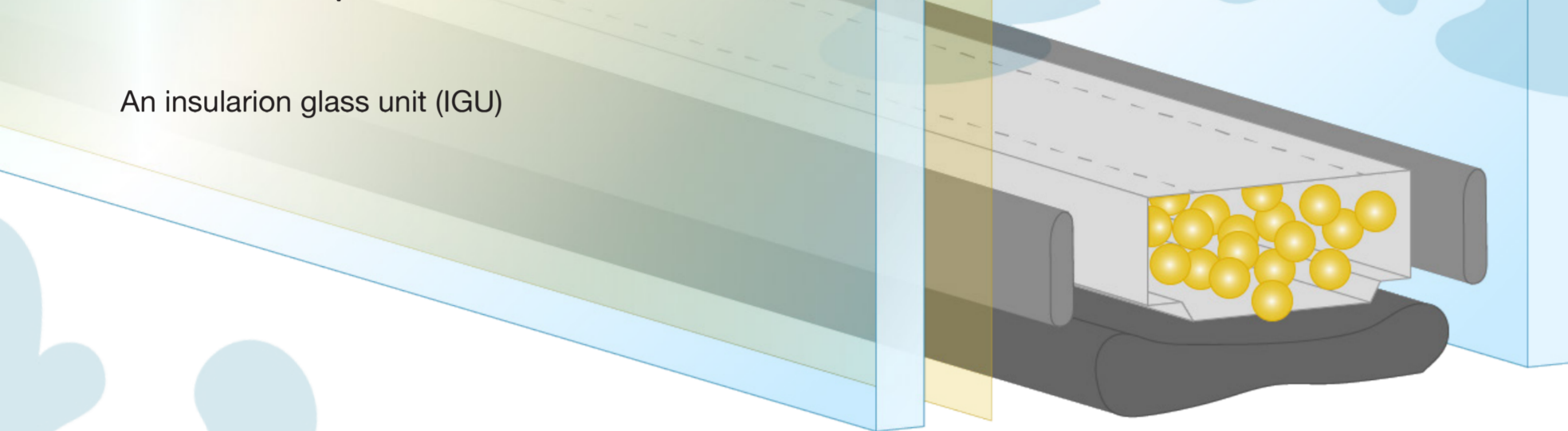


future scenarios for sustainable float glass use

an exploration of material flows, aesthetics, and policy master thesis integrated product design TU Delft

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An insularion glass unit (IGU)



Over half of the materials in Europe are used in construction, and over a third of all waste is generated there.

Float glass, used in windows, is largely unexplored in the context of circularity, but has great potential. It does not age and can be infinitely recycled. Over 100.000 tonnes a year are disposed in the Netherlands, of which less than 10% becomes float glass again. How could the value of glass be maintained? What would the impact of different circular strategies be on the value chain, and the product itself? And how could this be organised on a large scale?

policy recommendations

As a target, saving 19200 tonnes of glass per year through repair, reuse, and remanufacturing each, and 33400 tonnes per year through recycling is recommended. This division saves the maximal amount of glass, at close to the optimal maintained value, while allowing for some flexibility. The development of a decision tree for both demolition and construction is suggested, to find the most valuable material application of in each individual situation. To encourage circular glass use on a large scale, the following policy is recommended:

Green public procurement creating a demand for sustainable glass through government tenders. Points are awarded based on value maintained.

Extended producer responsibility (EPR) with differentiating fees incentivises producers to take steps towards sustainable glass handling: taking back own IGUs, using float glass with a high cullet (glass shards) percentage, using modular design, and offering repair services all lead to financial benefits.

Setting up a *recycling pilot with float glass factories in Belgium or Germany*, to figure out logistics and improve cleaning facilities. Afterwards, sharing the gained knowledge and setting a required minimum percentage of cullet for European production

Dynamic final design in architecture and construction education teaches a new generation the principles needed for reuse in construction, for glass and other materials

Installing demolition committees, or tasking *welstandscommissies* to determine whether a building is allowed to be demolished. This increases the threshold for demolition, maintaining aesthetic heritage and material value

Pigouvian taxes: excises can be levied on virgin glass, and the income will be invested in developing circular infrastructure such as cleaning installations and reuse hubs.

On a larger scale, *Ex-Tax or a similar tax shift* from labour to resources and pollution would benefit a shift to a sustainable construction sector, as most circular practices are relatively labour intensive.

recycling

Float glass contains less than 1% post-consumer glass. Recycling all Dutch float glass could decrease the new glass demand by up to 47%, saving 12,5 - 15% of the production energy. There are no float glass factories in the Netherlands, so international collaboration is needed.

remanufacturing

IGUs, insulation glass units, are usually disposed while the glass is undamaged. The IGU can be dismantled and the glass can be made into new IGUs. When partially standardising glass sizes, no glass will be lost when making windows fit. Remanufacturing could save 9,9 - 29,7% of the glass demand, proportionally decreasing production energy and international transportation. IGU manufacturers could move to glass as a service models, taking back their own IGUs.

reuse

IGUs could also be reused as a whole. With some extra gas and kit, they could be moved to another building. This could decrease the glass demand by around 29,9%. Architects would have to adopt the practice of dynamic final design. A system of physical hubs and digital tracing would facilitate this.

repair

Most value would be maintained by keeping IGUs in their current context. Mobile repair services could locally add gas, kit and foils. This could save 19,8 - 39,6% of the glass demand. By preventing demolition, other, more impactful materials would be saved as well, like concrete, brick, and steel.

reduce

The option of reducing glass use was considered: IGUs could be made smaller, made of new, alternative transparent materials, or replaced by screens. This strategy would improve insulation, but was rejected because currently available alternatives have a larger environmental impact than glass. The development of transparent wood could create interesting possibilities in the future.

