



ECO SCRIBE

Pen for life



Anastasia Cattaneo

Freddie Nicholson

Reiya Ing

Alex Wilton

PROBLEMS & FUTURE SCENARIOS

ENVIRONMENTAL IMPACT

There is a significant disconnect between the sustainability practices in pen product and usage. Pens, often seen as everyday items, are frequently discarded without much thought. This, while understandable for the users' convenience, can contribute to long-term environmental pollution.

Over **3 billion pens** are manufactured each year [1]

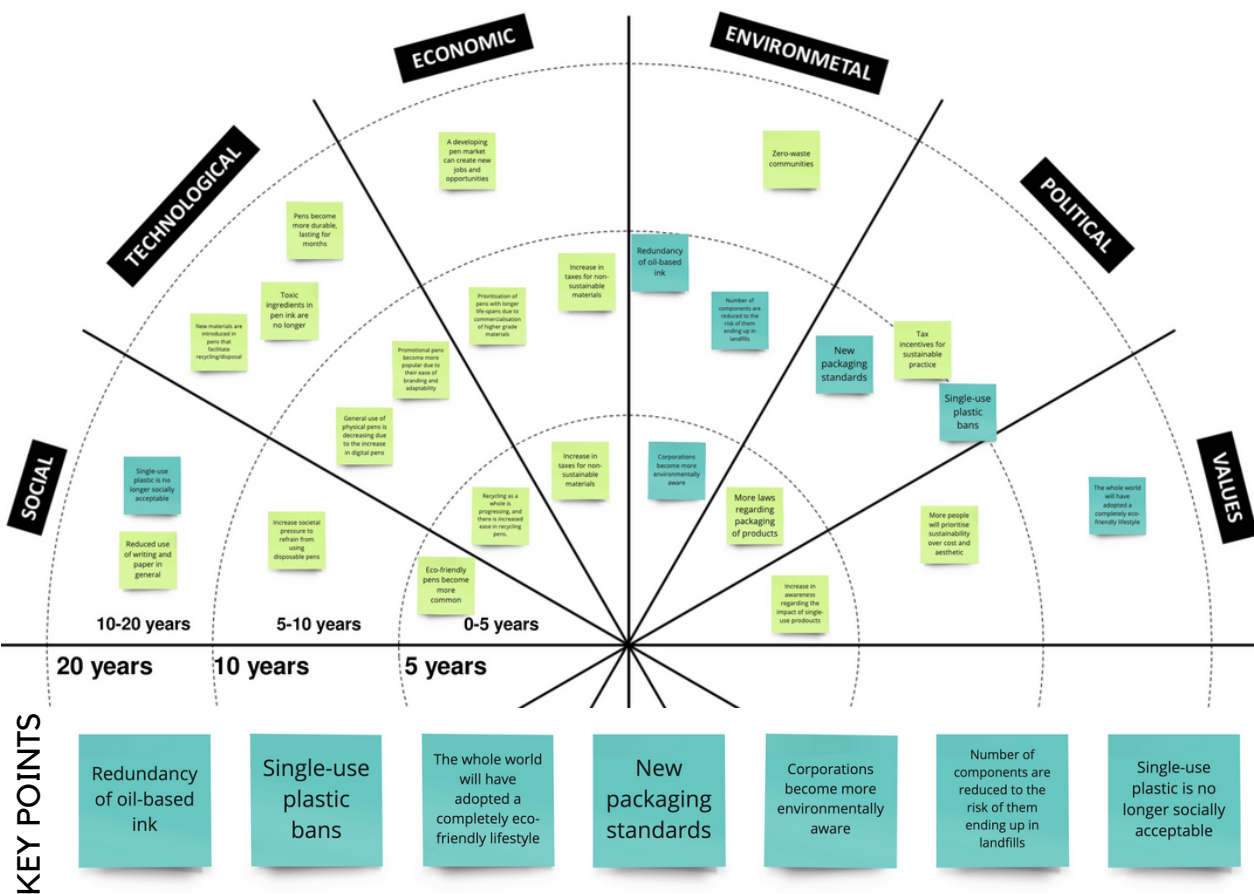
It can take up to **a thousand years** for a pen's casing to fully biodegrade [2]

Around **1.6 billion pens** are discarded each year [3]

Ballpoint and rollerball pens last for **about four years** [4]

More than half of the pens manufactured in a year are discarded within the same time frame [5]

PROPOSED TIME HORIZON



Taking away from the key-points of the scope wheel, the setting and system of EcoScribe will take place 10 years from now (in 2033). The system will be influenced by the idea that corporations and society are all looking to become more sustainable, along with more governments implementing different laws and regulations. Our system will also include newer and more environmentally friendly packaging as well as a more sustainable alternative to current pen inks. With this in mind, there is a hope that the whole world adopts a more eco-friendly lifestyle, starting with EcoScribe.

TRENDS & MARKET ANALYSIS

The global pens market was valued at approximately **\$16.88 billion** in 2022 and is projected to reach \$20.54 billion by 2030 with a **CAGR of 2.5%** [6]

Sustainability: Eco-friendly stationery market was \$9.4 billion in 2022: projected to reach \$13.68 billion by 2030, with a CAGR of 4.8% [7]



Despite a shift towards a paperless economy, demand for eco-friendly, biodegradable, and recyclable stationery offers growth potential in the industry .



Factors impacting **growth**: increase in literacy rates globally, number of youth pursuing higher education, and of working professionals

PROBLEM

- Insufficient specialised recycling programs: dedicated recycling schemes for pens are not widespread or accessible enough
- Recycling unprofitable for companies due to their complex, multi-material composition, making the process too intricate and costly
- Every year **over 10 billion plastic pens worldwide** are thrown out and end up in landfill [8]

INTERVENTION

Eco Scribe innovatively applies a circular economy model in the stationery industry, offering eco-friendly twist-on pens and implementing a system for their distribution, reuse, and recycling. This approach minimises waste and aligns with growing environmental consciousness, marking a significant shift towards sustainable practices in the sector.

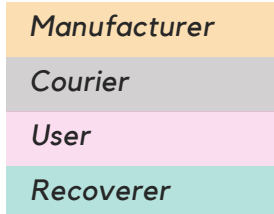
[1] Pen trivia: How many ball point pen are manufactured each year? (2020) Pen Boutique Ltd. Available at: <https://www.penboutique.com/blogs/blog/pen-trivia-how-many-ball-point-pen-are-manufactured-each-year#:~:text=As%20a%20result%2C%20it%20has,point%20size%2C%20materials%20and%20colors>
[2] Rinkesh et al. (2022) Are pens recyclable? (and are they biodegradable?), Conserve Energy Future. Available at: <https://www.conserve-energy-future.com/are-pens-recyclable.php#:~:text=The%20casings%20of%20pens%20are,years%20before%20they%20can%20biodegrade>
[3] How many pens are disposed of each year Green America. Available at: <https://www.greenamerica.org/show-ga-blog?nid=6315#:~:text=While%20many%20school%20supplies%20such,are%20thrown%20away%20every%20year>
[4] How long do pens last? Truphae. Available at: <https://www.truphaeinc.com/blogs/guides/how-long-do-pens-last#:~:text=Generally%2C%20ballpoint%20and%20rollerball%20pens,on%20environmental%20factors%20and%20storage>
[5] Published by Statista Research Department and I, D. (2023) Writing instruments: PEN market value worldwide 2017-2025, Statista. Available at: <https://www.statista.com/statistics/1024005/writing-instruments-pen-market-value-worldwide/#:~:text=Global%20pen%20market%20size%20in%202017%20and%202025&text=This%20statistic%20depicts%20the%20value,billion%20U.S.%20dollars%20by%202025>
[6] The Insight Partners. <https://www.theinsightpartners.com/> (2023) Pens market size report: Growth & forecast 2030, The Insight Partners. Available at: <https://www.theinsightpartners.com/reports/pens-market>
[7] Virtue Market Research. <https://virtuemarketresearch.com/> (no date) Greeneco-friendly stationery market: Size, share, growth: 2023 - 2030, Virtue Market Research. Available at: <https://virtuemarketresearch.com/report/green-eco-friendly-stationery-market#:~:text=The%20Green%2FEco%2Dfriendly%20Stationery,period%20%2023%20%2D%202030>
[8] Eco friendly promotional pens: Eco Promotions (2023) Eco Promotions | Eco Friendly Promotional Products | Eco Promotional Products Supplier. Available at: <https://ecopromotions.com.au/Info---Recycled-Paper-Pens-and-Pencils/#:~:text=Small%20things%20can%20have%20big,and%20end%20up%20in%20landfill>

OUR SOLUTION: SYSTEM DIAGRAM

EcoScribe proposes a solution that reduces the overall waste and energy consumption that comes with manufacturing and disposing of pens. After usage, EcoScribe Pens are collected, cleaned and carefully vetted to be either refilled, or have the PET material recycled to be used again.

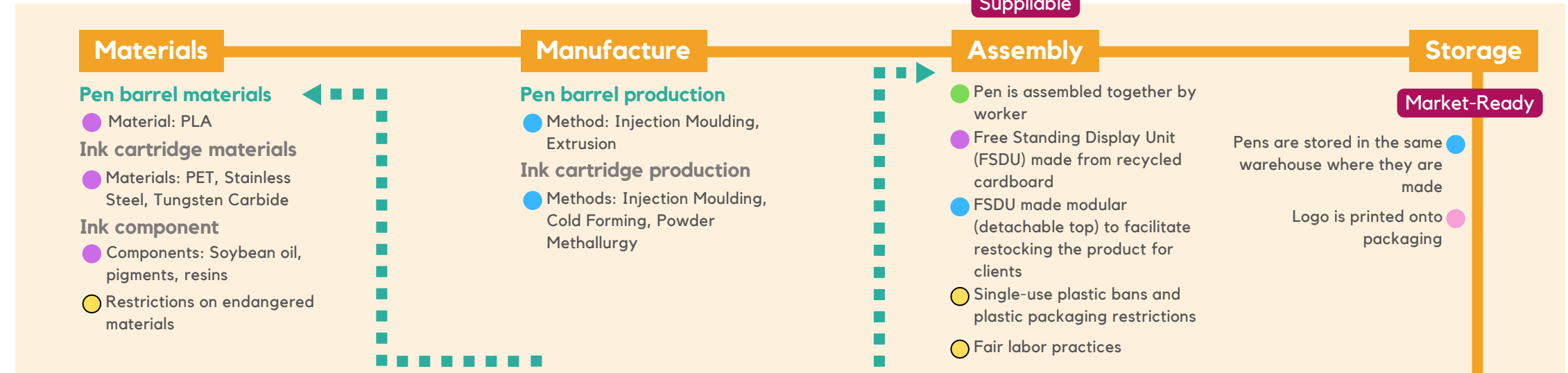


Stakeholders:

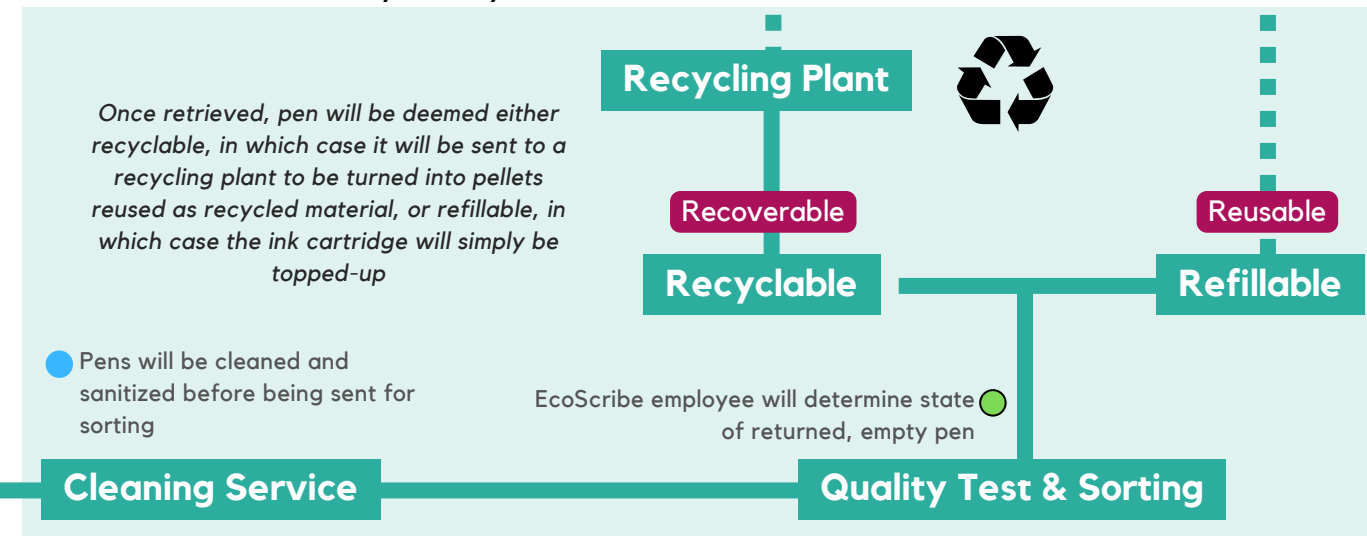


Resource States

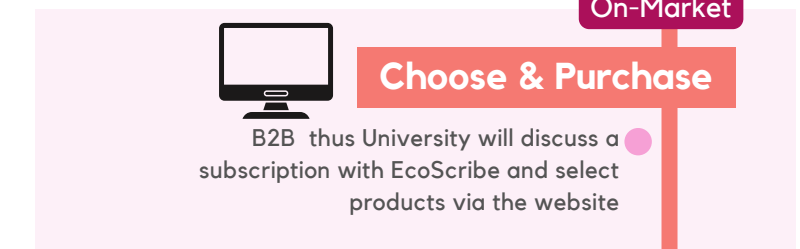
STAKEHOLDER: Manufacturer



STAKEHOLDER: Recovery Facility



STAKEHOLDER: User



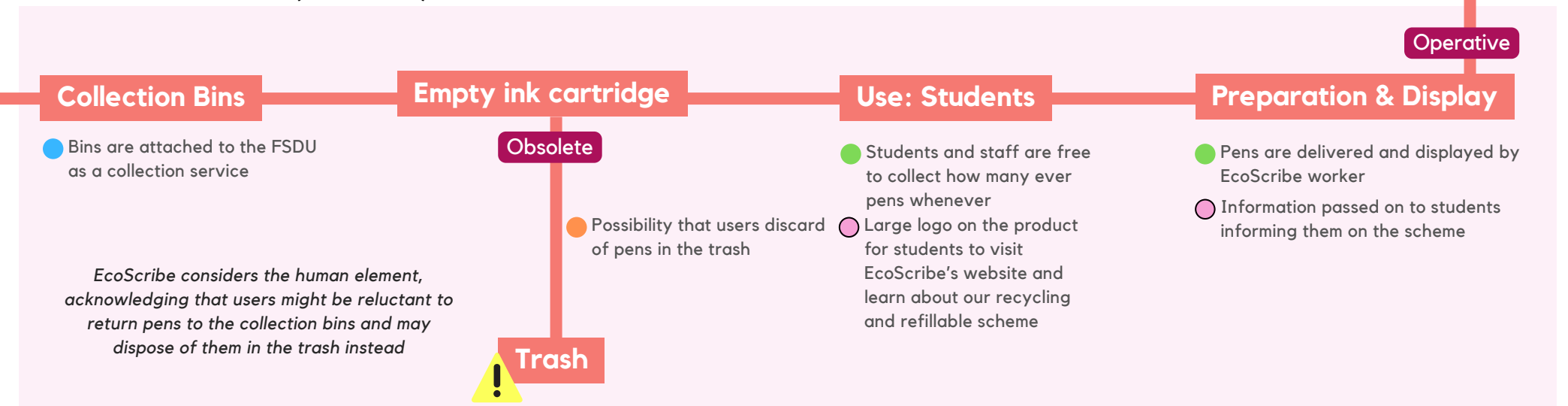
STAKEHOLDER: Driver



STAKEHOLDER: Driver

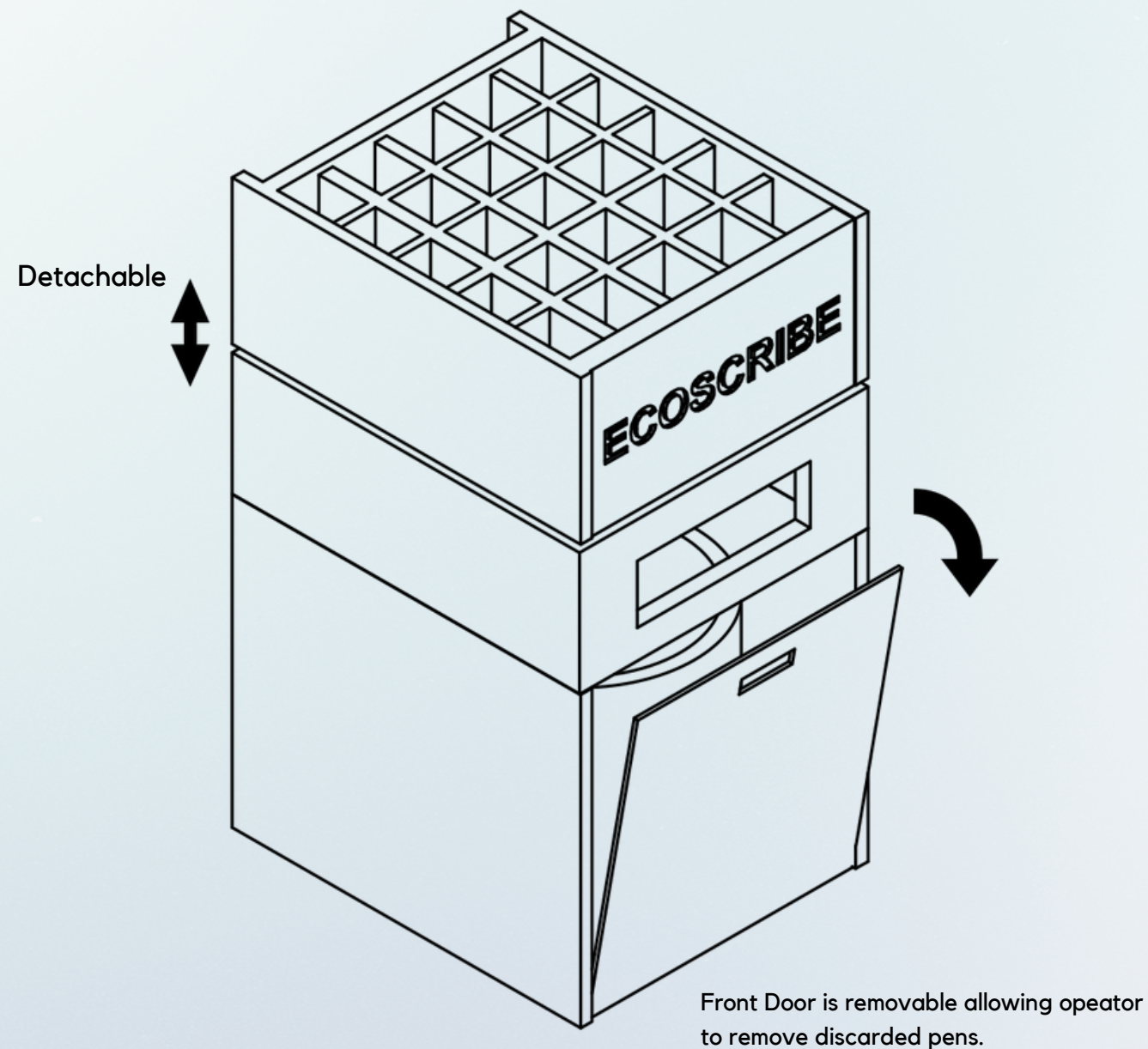


STAKEHOLDER: Business (Universities)



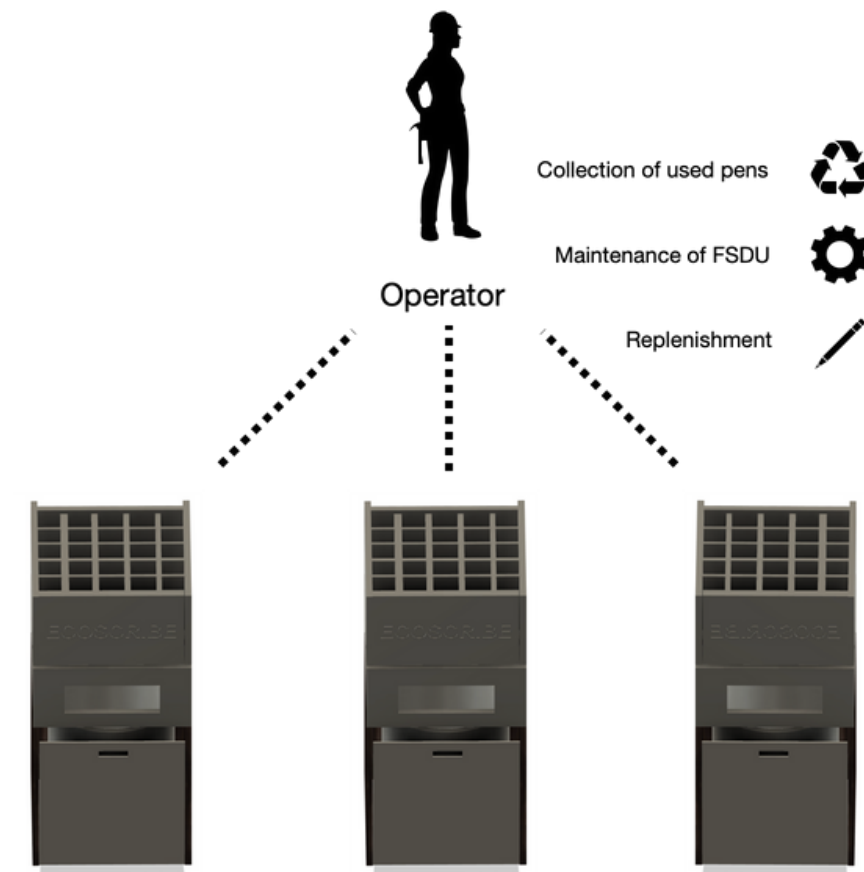
INFRASTRUCTURE

FREE STANDING DISPLAY UNIT (FSDU)



A free standing display unit has been designed to be placed into Universities. The flat pack design allows a consumer to setup the unit with no technical support. As the unit is made out of cardboard it is very easy to unpack and recycle. The top pen bucket unit is removable allowing it to be taken away by an operator.

INFRASTRUCTURE LAYOUT



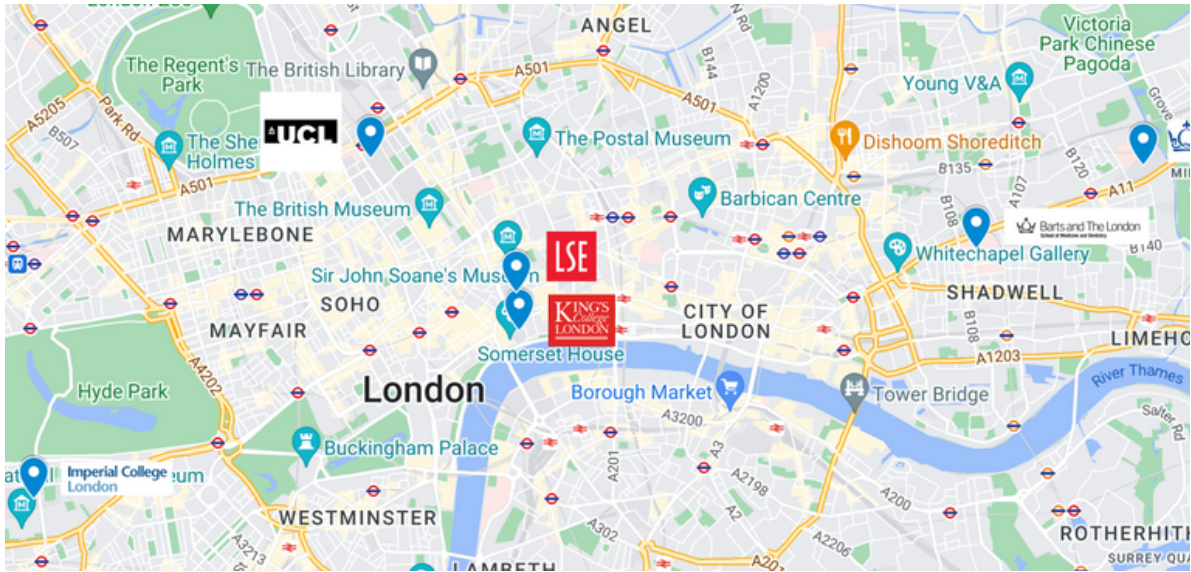
The system is a 1-Many relationship. One regional operator will work with units within their region. The initial setup will be handled by the customer and then all onwards support will be handled by an operator either hired directly by the Company or a vendor could be hired such as a Retail Merchandising Group to handle this workflow.

WEIGHT SENSOR

The integration of a load cell into the disposal system was discussed to notify the operator to come and empty the unit. However, it was decided that this would be an impractical approach as it would be more efficient for the emptying of bins to occur in sequence on a rota.



MAP OF LOCATIONS



The map above shows an example map of locations that might utilise the solution in an initial trial.

In order to ensure cost-effectiveness, it would be best to try and expand beyond Universities as within London there are only select few locations for one work person to operate on at a time.

The clear target for expansion would be towards schools in the area.

APP UX

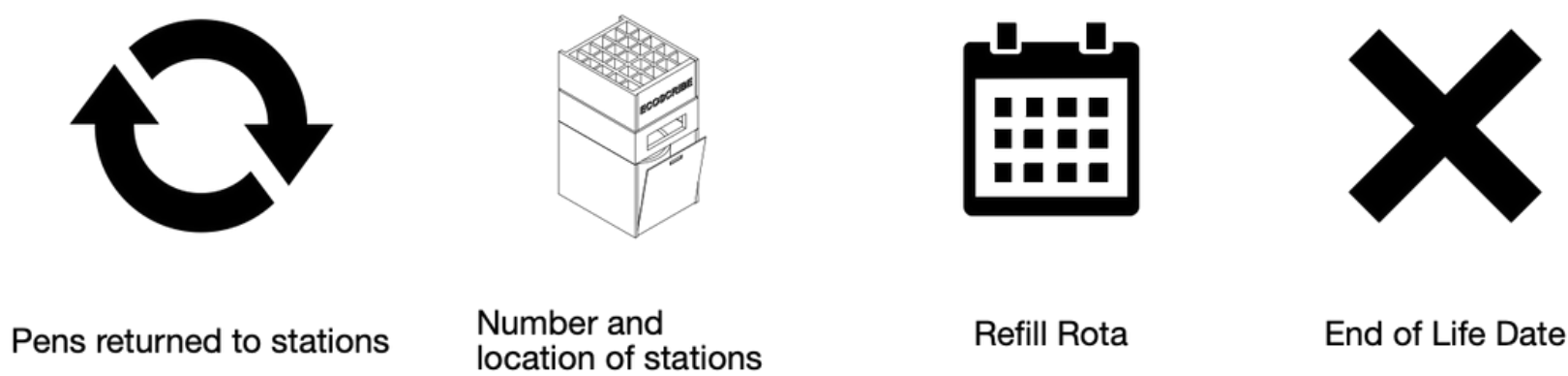
The work person working with the pen recycling solution will have an application that helps them manage their workload and locate bins within a campus.

There will also be additional menus allowing for issues to be flagged.



DATA SYSTEM

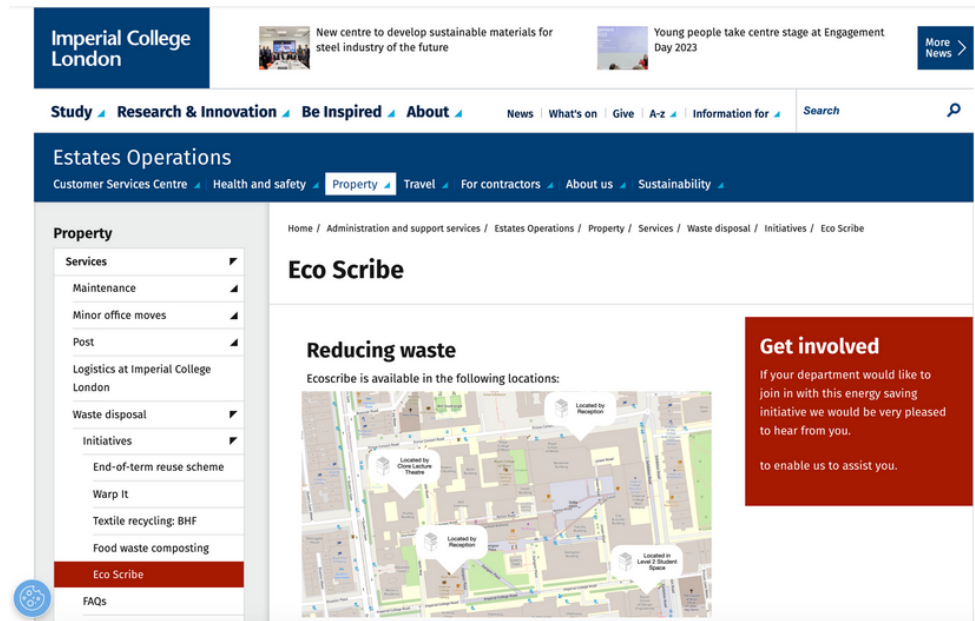
Data would be collected on the following:



To run a successful system data will be used in the following ways:

- The work person would be able to record the number of pens that were placed into the disposal bin and the system would compare this to the original number placed into the unit.
- A schedule will be stored electronically allowing the work person to operate recycling stations in the most cost-effective way.
- A record will be stored of when the unit was first put in place and a refresh in the cardboard design will be required after a set amount of time. When this date is reached the work person will be notified that a unit needs replacing.

MAP FOR UNIVERISITIES API



Universities would have the ability to embed interactive maps directly onto their websites allowing their students, staff and other personnel to be able to locate Eco Scribe stations on campus.

There is the possibility to expand this featureset with additional indicators such as estimated number of pens left based on survey data / external sources.



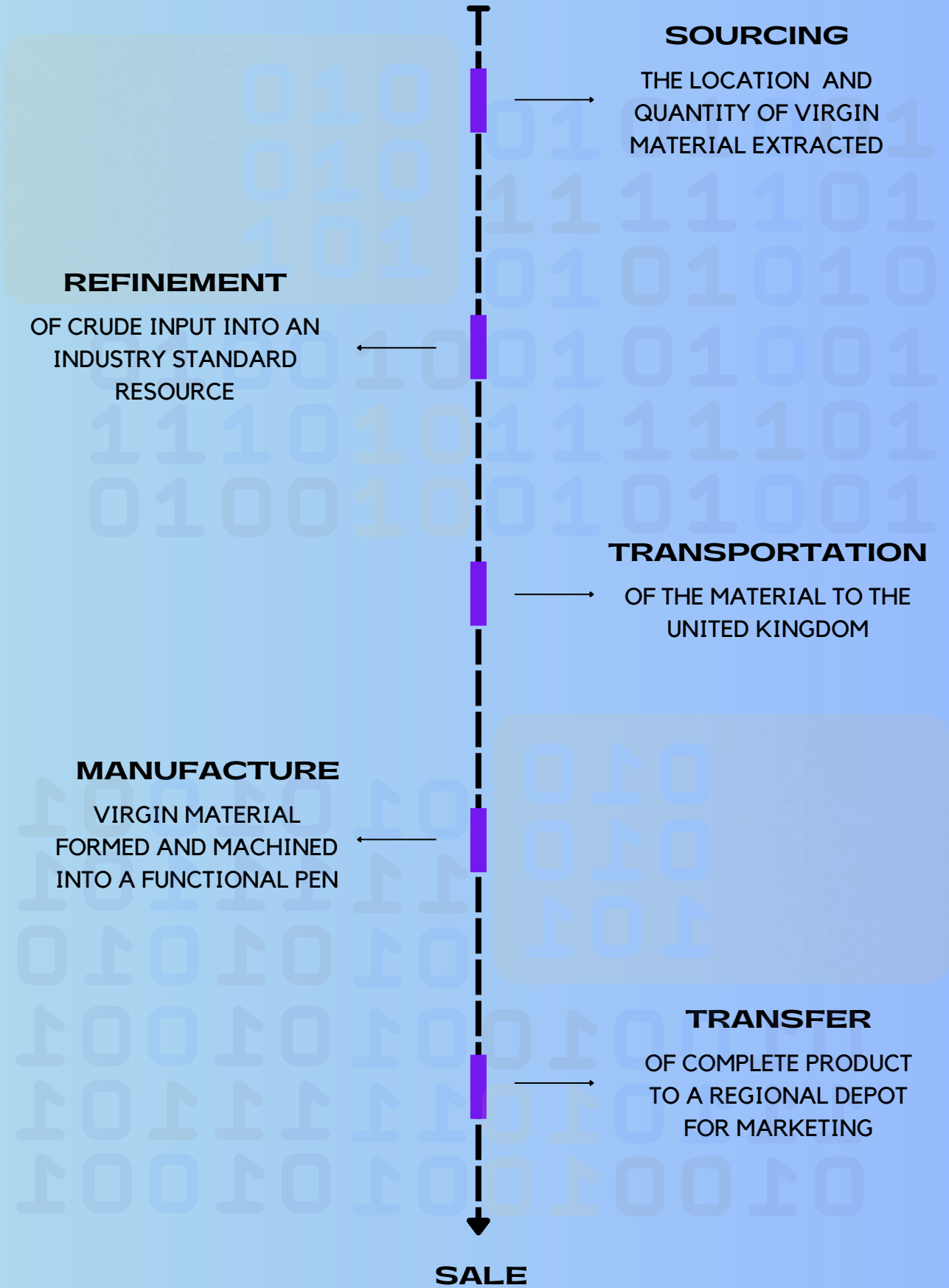
In this age of heightened environmental awareness and increased movement towards sustainable business practices, tracing of raw materials in their journey from source to factory holds a great deal of importance for a progressive, climate-mindful company like Eco-Scribe.

Understanding the origins of raw materials enables Eco-Scribe to introduce decisions that align with our ethical and ecological tenets. Through careful mapping and surveillance of the supply chain, Eco-Scribe can identify areas for improvement, ensuring that materials are sourced responsibly and production processes are without adverse effect. Once publicised, such transparency not only promotes trust in the consumers but also allows the company to proactively address potential environmental impacts both in the short and long term.

Continuing on, tracing the material journey aids in minimising carbon footprints by optimising transportation routes and reducing waste at every possible stage. Realising this approach not only contributes to a more sustainable and resilient planet but also distinguishes the company as a leader in the global shift towards eco-conscious business practices.

Ultimately, the commitment to tracing material sources and journeys must remain a cornerstone for Eco-Scribe as it furthers it's dedication to long-term environmental stewardship and responsibility.

KEY DATA COLLECTION POINTS



ACTORS

Interpersonal communication plays an immense role in the entire process of production from sourcing materials to selling a final product.

In the earliest stages, geologists determine the best locations for safe mining of raw material and then care is taken in selecting the most environmentally safe option.

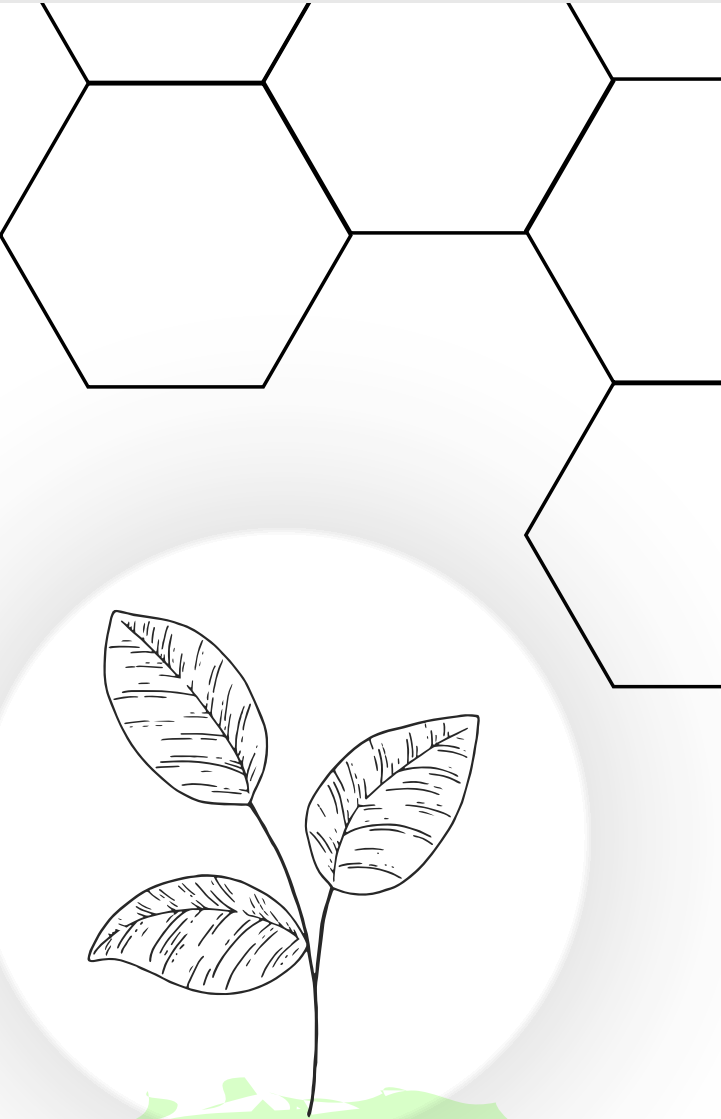
Next, it is down to the transportation experts to optimise the movement of raw material to the site of manufacture. Deviations and delays can markedly boost total emissions and so it is of great importance that the process be meticulously streamlined.

Within the factory, workers must strive to maintain good communication amongst one another in order to maintain the quality of the output product as well as to meet the demand.

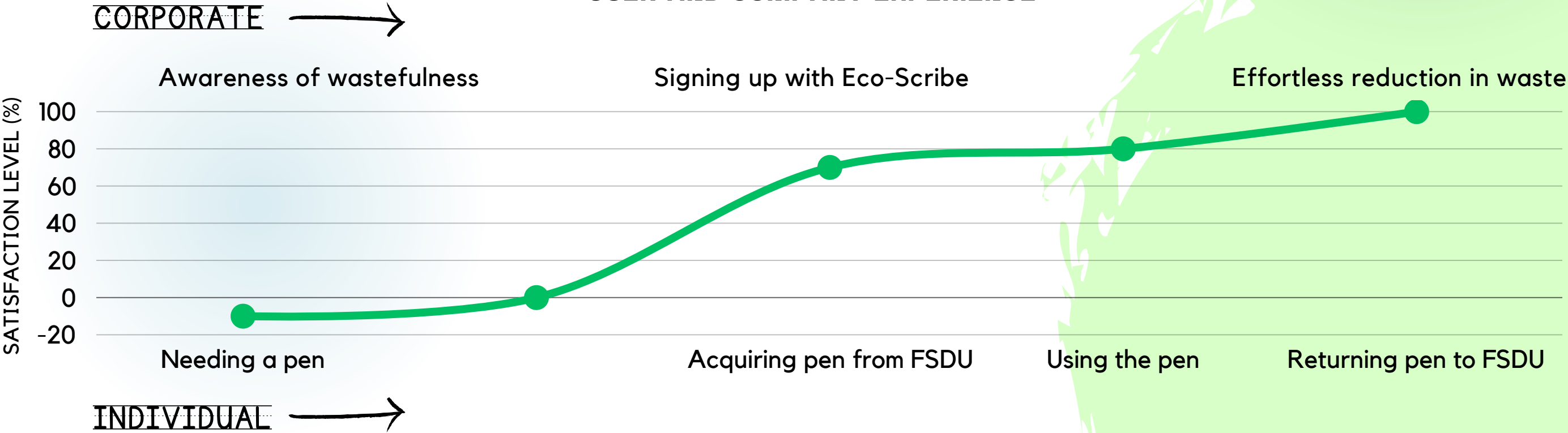
This communication extends beyond, to the logistics expert who determines the amount of pens needed at any given time across the distribution zone and hence adjusts the manufacturing quota so as not to overshoot this and engender wasteful overstocking.

Once stock reaches the regional depots, the stockers and inventory associates prevent unnecessary delays in dispatching orders. Additionally, refilling of pens will be done on sight if deemed fit for immediate reuse (in order to reduce road miles).

From here, sale and delivery would be done via a fulfilment service that would ensure safe delivery of each pen magazine to the customer institution. Periodic collection of expended pen magazines would be the responsibility of a partner as well.

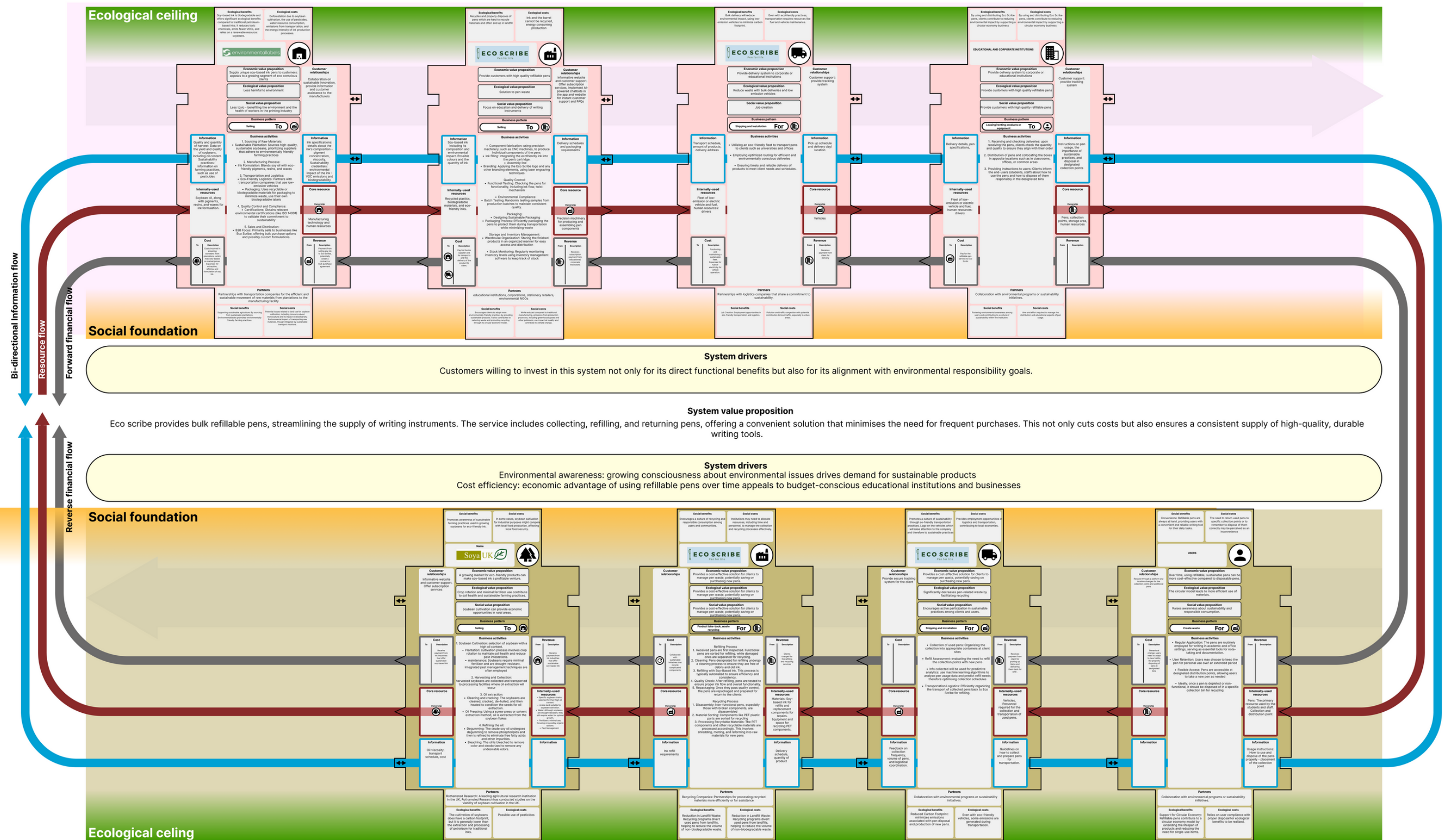


USER AND COMPANY EXPERIENCE



VALUE SYSTEM

ANASTASIA CATTANEO



[1] Environmental labels: Environmental labels (2023) Enviro Labels. Available at: <https://environmentallabels.co.uk/> [2] Soya UK: Soya UK. Available at: <https://www.soya-uk.com/soya/>

VALUE SYSTEM DESIGN

| | Revenue/benefits | Costs | Cost mitigation |
|----------|--|---|---|
| Finances | <p>Soya UK receives payment from Environmentallabels to supply soybean oil</p> <p>Environmentallabel receives payment from Eco Scribe to supply soy-based ink</p> <p>Eco Scribe receives payment from corporate and educational institutions to supply pens and a refill service</p> <p>Eco Scribe recycles irreparable components, bypassing external recycling costs, and reuses the recovered materials to produce new pens</p> <p>By participating in Eco Scribe's refill and recycling program, clients save money over time compared to the cost of continually purchasing new pens</p> | <p>Soya UK handles the costs of producing soy-based oil which includes the extraction and refining processes</p> <p>Environmentallabel purchases a soybean oil supply from Soya UK</p> <p>Eco Scribe purchases the ink from Environmentallabel and it is responsible for the costs associated with manufacturing pens, including the production of components and assembly</p> <p>Eco Scribe incurs costs for pen transportation and collection, including vehicle upkeep and fuel. It also covers expenses for running its recycling facilities, such as energy, labor, and machinery maintenance. Clients pay for the pens/refill services, while Eco Scribe handles waste management, operational costs</p> | <p>Eco Scribe could seek the most competitive prices for soy based ink and make long-term supply agreements</p> <p>Implementing more efficient logistics and transportation strategies, such as route optimisation and using eco-friendly vehicles, could reduce fuel and maintenance costs.</p> <p>Engaging in collaborative consumption, such as shared resources or facilities with other businesses, can spread out costs and reduce individual expenditure.</p> <p>Implementing waste-to-energy systems can turn manufacturing waste into a source of energy</p> <p>Investing in advanced automation and robotics can optimise production processes</p> |
| Ecology | <p>Using soy-based ink reduces environmental impact through lower emissions and VOCs, and it degrades 4 times faster than petroleum-based inks [1]</p> <p>For every pound of recycled PET flake used, there is an 84% reduction in the amount of energy used compared to producing PET from raw materials [2]</p> <p>The use of recycled PET results in a 71% reduction in greenhouse gas emissions, contributing to a lower carbon footprint. [3]</p> | <p>The production of PET resin can generate toxic emissions such as nickel, ethylbenzene, ethylene oxide, and benzene</p> <p>Collection, transportation, and processing of recyclable PET contribute to greenhouse gas emissions</p> <p>Large-scale soybean farming may lead to habitat alteration, potential biodiversity loss, and soil erosion if not managed sustainably</p> | <p>Choose environmentally friendly chemicals for the PET recycling process to minimize chemical pollution.</p> <p>Environmentallabels can implement procedures to ensure that wastewater discharge from ink production does not cause water pollution</p> <p>Partnering with soybean suppliers who use sustainable farming practices</p> <p>Investing in sustainable transportation methods, such as electric or hybrid vehicles</p> |
| Society | <p>Eco Scribe's sustainable manufacturing and recycling initiatives contribute to job creation and economic growth, foster local infrastructure development in recycling and farming, reduce landfill waste, and promote community engagement through educational efforts (involving the public in sustainability efforts)</p> | <p>Encouraging the public to adopt new recycling habits can be complicated, as it requires changing established behaviours. Integrating sustainable practices into supply chains often involves balancing environmental goals with cost-effectiveness, which can be challenging.</p> | <p>Encouraging suppliers to adopt sustainable practices and providing support for doing so can help ensure that the entire supply chain contributes positively to society. Eco Scribe could conduct public education campaigns on social media to raise awareness about the importance of recycling writing tools</p> |

INSIGHTS



Incentive programs: Introducing **reward systems**, such as discounts or loyalty points, can encourage users to participate more actively in recycling.



Offering products like **markers** and **integrating digital features with traditional pens** can cater to a wider market and reduce dependency on a single product line.



Collaborating with established recycling companies like **TerraCycle** can enhance the efficiency of the recycling process.

Having soy ink production in the same location as pen manufacturing can reduce transportation costs and carbon footprint

[1] Contributor, G. (2012) Soy ink: Five ways it's better for the environment, CleanTechnica. Available at: <https://cleantechnica.com/2012/07/09/soy-ink-five-ways-its-better-for-the-environment/> [2] Consultancy, E. (2023) Recycled plastic market is estimated to observe significant growth of SD 56.81 billion by growing rapidly with eco-friendly packaging solutions, Cision PR Newswire UK provides press release distribution, targeting, monitoring, and marketing services. Available at: <https://www.prnewswire.co.uk/news-releases/recycled-plastic-market-is-estimated-to-observe-significant-growth-of-sd-56-81-billion-by-growing-rapidly-with-eco-friendly-packaging-solutions-301775947.html> . [3] Jamie (2021) Recycled plastic: An undervalued carbon reduction strategy, Prevented Ocean Plastic. Available at: <https://www.preventedoceanplastic.com/recycled-plastic-an-undervalued-carbon-reduction-strategy/#:~:text=Similar%20results%20were%20revealed%20by,PP%20%E2%80%93%20alongside%20reducing%20energy%20consumption.>

LEGISLATION

| Policy | Descriptor | Mat. | Cat. |
|--|--|------|---------|
| Product Safety Standards | Regulations ensuring that pens meet a certain safety standard in order to protect consumers from potential hazards. (US: CPSC, EU [1], China: CNCA, Japan: METI, Canada, Australia: ACCC, UK, India: BIS) | E | DR |
| Environmental Labelling Requirements (Transparency) | Mandates for products to display their environmental impact information on packaging. (EU [2], US: EPA, Japan: Eco Mark, Canada: ECP, Australia: NCOS, South Korea: KEITI, Singapore: SGLS, Brasil: Procel) | E | DR / VI |
| Recycling and Waste Management Policies | Regulations outlining responsibilities for pen manufacturers regarding recycling and proper disposal of pen-related waste. | E | DR |
| Single-Use Plastic Bans | There are more and more countries enforcing the ban of single-use plastic in pen packaging or components (EU: Single-Use Plastic Directive [3]) | E | DR |
| Toxic Substances Control | Regulations limiting or controlling the presence of toxic substances in pen inks and materials. (US: TSCA, EU: REACH [4], Canada: CEPA, Australia: AICIS, China, Japan, South Korea, India, Brazil: PNRS, Switzerland) | E | DR |
| Carbon Emission Standards | Policies setting limits on carbon emissions during the production and transportation of pens to address climate change. (US: CAFE, EU: ETS, UK: Net Zero by 2050 & Clean Growth Strategy [5][6]) | E | DR |
| Fair Labor Practices Legislation | Regulations ensuring ethical and fair treatment of workers involved in pen manufacturing (US: FLSA, UK: ERA [7], Australia: FWA, Japan: LSA) | E | DR |
| Import and Export Restrictions on Endangered Materials | Bans or restrictions on the import or export of pens containing materials from endangered species | E | DR |
| Consumer Education Campaigns | Government-led initiatives to educate consumers about sustainable pen choices and responsible consumption | E | EII |
| Tax Incentives for Sustainable Practices | Financial incentives, such as tax breaks, for pen manufacturers adopting environmentally friendly and sustainable practices. (US: ITC & PTC, UK: CCL & ECAs [8][9]) | E | EI |
| Plastic Packaging Restrictions | Legislation limiting or prohibiting the use of plastic packaging for pens to reduce plastic pollution | E | DR |

Maturity (Mat.): E: Established (E*: Established in one or more EU country only); D: Development, I: Idea.
Policy mechanism category (Cat.): DR: Direct regulation, EI: Economic instrument; VI: Voluntary instrument, EII: Education and information initiative.

| | | | |
|---|--|---|---------|
| Energy Efficiency Standards for Manufacturing | Policies to set energy efficient pen manufacturing processes to reduce environmental impact. (UK: Energy Efficiency Directive [10]) | D | DR |
| Water Usage Restrictions | Regulations limiting water usage in pen manufacturing processes to promote water conservation. | D | DR |
| Circular Economy Initiatives | Policies encouraging pen manufacturers to adopt circular economy principles, emphasizing product reuse, recycling, and reduced waste | D | DR / VI |
| Local Procurement Requirements | Policies encouraging pen manufacturers to source materials locally to support local economies | D | DR |
| Eco-Labeling Standardization Framework | A developing framework aiming to standardize eco-labeling criteria for pens, providing clear guidelines for manufacturers | D | DR / VI |
| Global Certification for Ethical Labor Practices | An ongoing effort to establish a global certification system ensuring ethical labor practices across the entire pen manufacturing supply chain | D | VI |
| Microplastics Reduction Strategies | Developing strategies to limit the use of microplastics in pen manufacturing, considering potential environmental impacts | D | DR |
| Social Impact Reporting Requirements | A developing policy that would mandate pen manufacturers to report on their social impact, including contributions to local communities and social welfare. | D | DR / VI |
| Supply Chain Transparency Legislation | Proposed legislation aiming to increase transparency in pen supply chains, disclosing sources of materials and manufacturing processes | D | DR |
| Resource Efficiency Standards | Developing standards to enhance resource efficiency in pen manufacturing, reducing waste and optimizing resource use | D | DR |
| Green Tax Credits for Sustainable Pen Production | Proposed legislation offering tax credits to pen manufacturers adopting sustainable practices and reducing environmental impact | I | EI |
| Carbon Offset Requirements for Pen Imports | An idea suggesting requirements for pen importers to offset carbon emissions associated with transportation through approved offset programs | I | EI / DR |
| Mandatory Extended Producer Responsibility (EPR) for Pens | A proposed regulation making it mandatory for pen manufacturers to participate in Extended Producer Responsibility programs, ensuring responsible end-of-life management | I | DR |

CONDITIONS

There are different conditions surrounding the system of a pen. **Societal trends** are important to mention. Due to **technological developments**, the global digital pen market is expected to grow at a compound annual growth rate of 13.3% from 2022 to 2030 to reach USD 6.29 billion by 2030 [11], thus, the use of physical pens is decreasing. There is also a **large market**, which involves competition as well, with over 3 billion pens manufactured each year [12]. There are lots of different pen companies, several that are trying to become more environmentally friendly, what sets EcoScribe apart is our recycling/refilling scheme.

AGREEMENTS

In order to make pens more sustainable, collaborations need to be made between different actors, which is typically formalised in contracts. EcoScribe **produces and delivers locally**, all within the same large warehouse. EcoScribe will be handling the **retails** as well, working in **business to business** with London Universities. These relationships will need to be maintained, which may involve legal and regulatory compliance.

STANDARDS

There are product quality standards to upkeep. EcoScribe produces pens that will be reused, if not, recycled. If EcoScribe is manufacturing a pen that will be reused, it must maintain a certain quality which is why **PLA** was chosen as it is durable but also easily recyclable. High standards regarding **manufacturing processes and sanitation** must be taken into account as we will be collecting used pens [13]. And packaging uses **cardboard** where the pens are stored in bulk before being delivered.

[1] EU Product Safety Standards European Commission. Available at: https://commission.europa.eu/business-economy-euro/product-safety-and-requirements/product-safety/consumer-product-safety_en

[2] EU Labelling and Packaging. Available at: <https://trade.ec.europa.eu/access-to-markets/en/content/labelling-and-packaging>

[3] EU Single-Use Plastic Directive. Available at: <https://trade.ec.europa.eu/access-to-markets/en/content/labelling-and-packaging>

[4] UK REACH: UK REACH Explained. Available at: <https://www.hse.gov.uk/reach/about.htm>

[5] The UK's plans and progress to reach net zero by 2050. Available at: <https://commonslibrary.parliament.uk/research-briefings/cbp-9888/#:~:text=Download%20full%20report-,The%20UK%20is%20committed%20to%20reaching%20net%20zero%20by%202050,warming%20and%20resultant%20climate%20change>

[6] Department for Energy Security and Net Zero (2018) UK Clean growth strategy, GOV.UK. Available at: <https://www.gov.uk/government/publications/clean-growth-strategy>

[7] Participation, E. (1996) Employment rights act 1996, Legislation.gov.uk. Available at: <https://www.legislation.gov.uk/ukpga/1996/18/section/98>

[8] Customs, H.R.& (2022) UK Climate change levy rates, GOV.UK. Available at: <https://www.gov.uk/guidance/climate-change-levy-rates>

[9] UK Enhanced Capital Allowances GOV.UK. Available at: <https://www.gov.uk/government/publications/ending-enhanced-capital-allowances-for-energy-and-water-efficient-plant-and-machinery/capital-allowances-ending-enhanced-allowances-for-energy-and-water-efficient-plant-and-machinery>

[10] Energy efficiency directive Energy. Available at: https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficiency-targets-directive-and-rules/energy-efficiency-directive_en

[11] Digital Pen Market Size & Share Report, 2022 - 2030. Available at: <https://www.grandviewresearch.com/industry-analysis/digital-pen-market#:~:text=The%20global%20digital%20pen%20market%20is%20expected%20to%20grow%20at,USD%206.29%20billion%20by%202030>

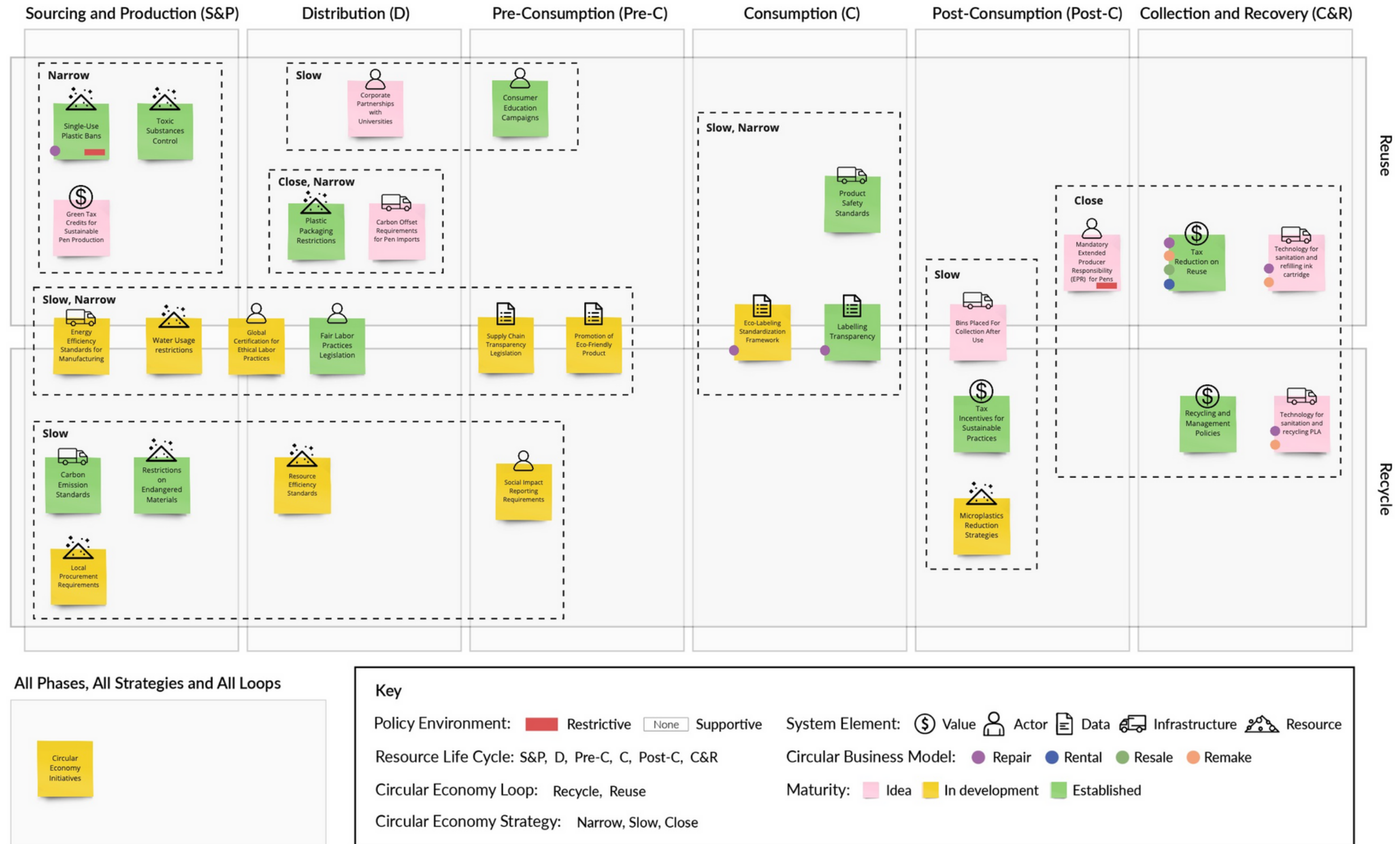
[12] Published by Statista Research Department and I, D. (2023) Writing instruments: PEN market value worldwide 2017-2025, Statista. Available at: <https://www.statista.com/statistics/1024005/writing-instruments-pen-market-value-worldwide/#:~:text=Global%20pen%20market%20size%20in%202017%20and%202025&text=This%20statistic%20depicts%20the%20value,billion%20U.S.%20dollars%20by%202025>

[13] Recycling and garbage collection in the United Kingdom (2023) Expatica United Kingdom. Available at: <https://www.expatica.com/uk/living/household/uk-recycling-467522/#:~:text=Recycling%20is%20organized%20at%20a,council%20tax%20in%20the%20UK>

PRINCIPLES

REIYA ING

CIRCULAR ECONOMY POLICY

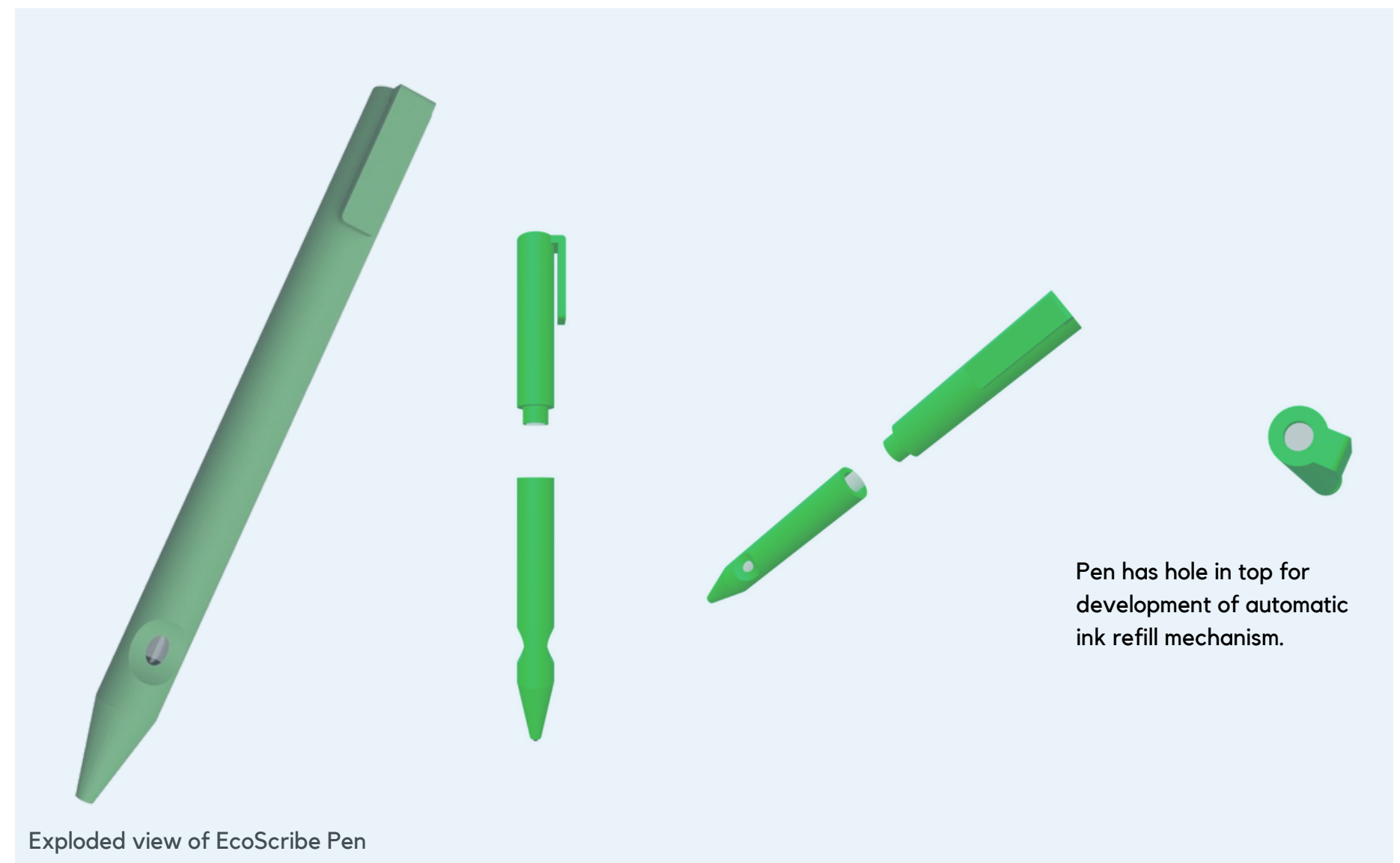
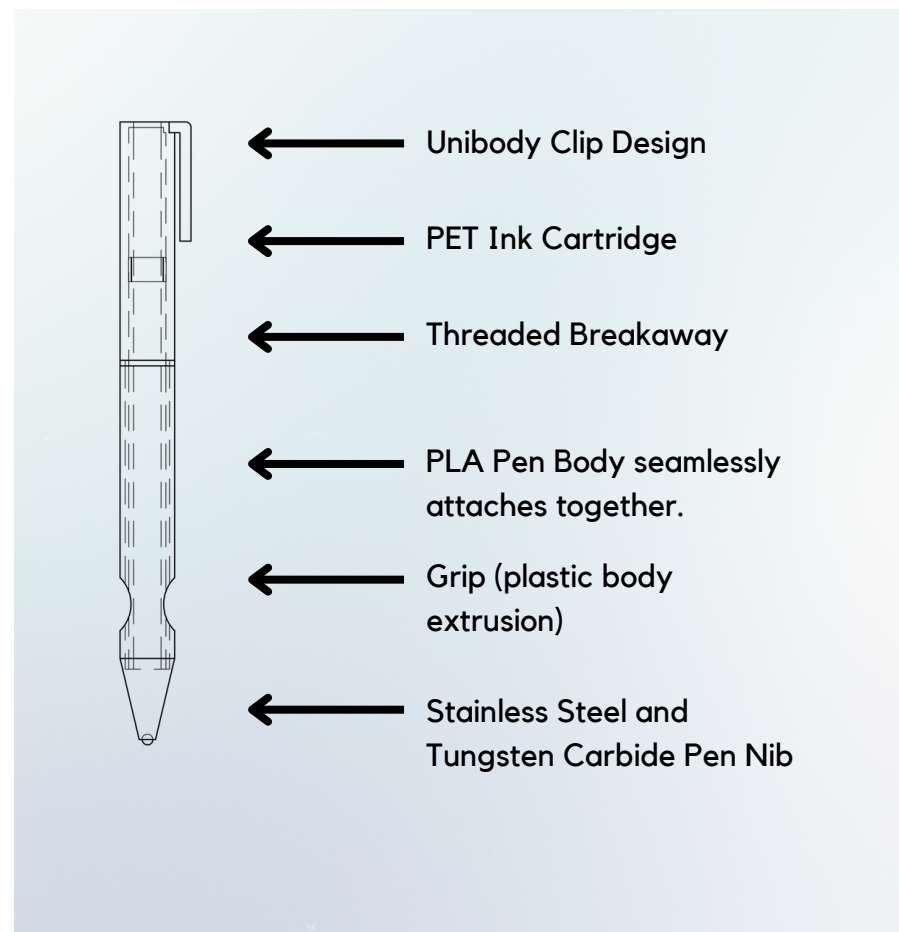


INSIGHTS

The pen industry is influenced by global trends and legislative initiatives. Greater consumer awareness about the environmental impact of single-use items, including pens, leads to a shift toward sustainability. Legislation and quality standards play a vital role, taking into account the materials, manufacturing processes, and environmental considerations. Partnerships such as the ones with London universities for pen distribution and collection, contribute to a circular economy. The emphasis on recycling initiatives, like refilling ink cartridges and recycling PLA plastic pen barrels, aligns with broader global goals for resource efficiency. As the industry evolves, these factors collectively shape a trajectory toward more eco-friendly practices and sustainable solutions in the pen market.

PRODUCT DESIGN

PRODUCT AND PACKAGING DESIGN



LO-FI PROTOTYPING



3D Printing

In order to prototype our designs in a tangible format a 3D printer was used. This allowed us to see how the design could fit together and get a feel for how the pen was in the hand. The model was made out of PLA which was the same material we will use for manufacture.



Testing

Freddie tested how the pen felt in the hand. He then took this to a set of participants to gain their feedback which is detailed to the right. Feedback that was gained from these end users will be taken into account in the final product.

User Feedback

Users realised that the length of the pen was shorter than they naturally expected and it reminded them of a stylus. The grip itself was comfortable and the design looked sleek and modern in their view.

They did feel it was clearly a downgrade compared to their traditional pen but felt that if abundant they would be well used.

INSIGHTS

Bic pens were the most popular pen in market research we performed in part A. Our design is inspired by this simple cheap design to offer a low-cost sustainable alternative.

Users said they did not really have brand loyalty and pickup the pen that is closest to them making our concept a tempting offering

ENVIRONMENTAL IMPACT

The defining tenet and eponym of the eco-scribe company is its commitment to mitigation of environmental damage. this goal stems from the recognition of a major oversight in public market of single-use pens, which more often than not find their way to landfill once they have fulfilled their purpose. Eco scribe offers an alternative. Mindfully constructed pens that are borrowed when and where they are needed, then returned for refilling or recycling when empty. This takes the responsibility off of the user to source the pen and dispose of it. the pen bin could be replaced with a fresh bin of pens once every few months by a janitor, with the 'used' bin being returned to Eco-Scribe for refilling and returning as well as filtering out and recycling of any damaged pens.



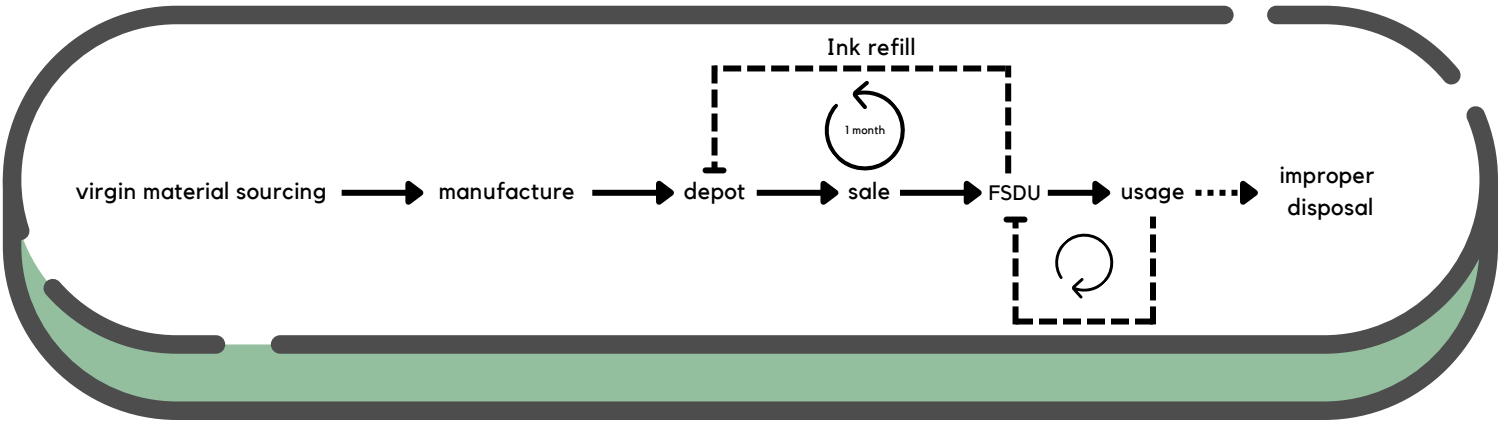
This scheme works best in locations where pens are commonly required and where users are mature enough to keep the pen in suitable condition as well as to return it when needed. Such locations include university campuses and office spaces. These are controlled environments which allows for better monitoring of pen use and ink expenditure as well as accommodating efficient replacement.



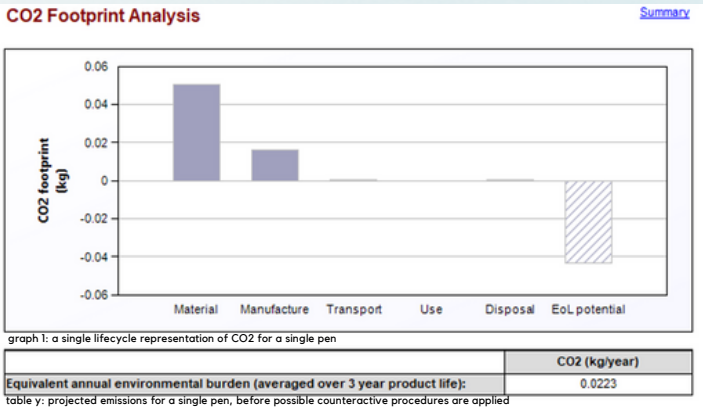
We aim to reach an audience of savvy and progressive professionals or training professionals. These are the sort of people to whom such a product system would appeal since they will have a perception of the larger environmental picture and hence will be more likely to respect and adhere to the recycling system rather than mindlessly disposing of the pen in general refuse due to it being more convenient in the immediate moment.

The pens themselves function through a twist-lock system which has a simpler mechanism than a standard clicker pen and hence less potential failure points. The barrel and constituents are constructed of PLA, a highly recyclable and available polymer that has desirable levels of durability. The reservoir is formed of PET which should be protected from physical damage by the shell and hence ought to be able to be refilled countless times once empty from use.

CIRCULARITY MODEL



ECO-AUDIT



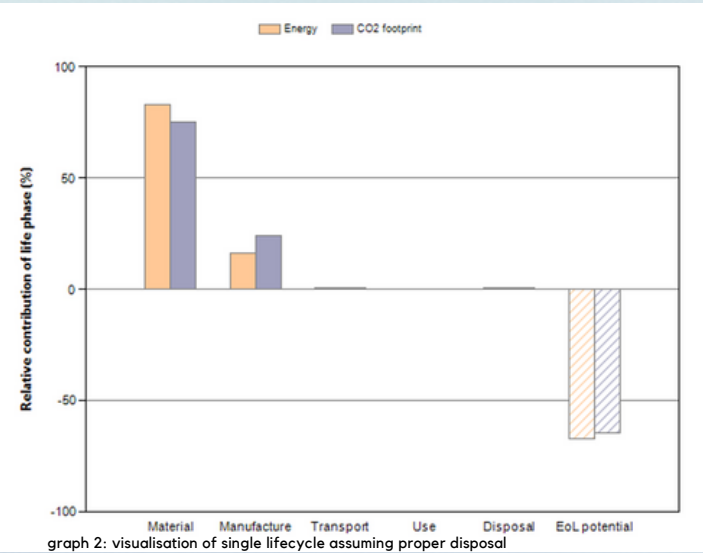
The above graph provides a visualisation for how carbon-efficient the cycle can be when the pen is properly returned for reprocessing.

EoL potential:

| Component | End of life option | Energy (MJ) | % |
|---------------|--------------------|-------------|------|
| main body | Recycle | -0.31 | 37.0 |
| ink cartridge | Reuse | -0.53 | 63.0 |
| Total | | -0.84 | 100 |

table 1: The possible energy recovery in the event of successful recycling of the pen

Thanks to the meticulous checking of used pens, remanufacture is avoided in the majority of cases and the cartridge is refilled with Bio-ink



Finally, a side by side comparison solidifies the fact that such a system expends very little resources once in its cyclical phase and even these can be negated with a tree planting scheme or similar

ASSUMPTIONS

USE
All the above statistics are based upon a model lifecycle as determined by Eco-Scribe. This involves normal use of the pen and returning of the pen to the FSDU once it is no longer needed.

TRANSPORT
Assuming the existence of the manufacturing headquarters to be in London, the average distance from manufacture to regional depot has been set at 300km and by means of a three axle truck (most common for mainland bulk transport). We also assume that the transport to the university will be done by zero-emissions vehicles.

SOLUTION INNOVATIONS & FEASIBILITY

INNOVATIONS

THE TWIST MECHANISM

A time tested mechanism, the twist system is intuitive and satisfying. It was decided that it would be superior to a fixed pen and lid since there would be no additional parts that the user could misplace during use.



INTEGRATED CLIP

Rather than have a separate clip component that needs to be attached during manufacture, we decided to integrate a sturdy clip into the main body of the pen to save resources.



INK INJECTION

Much like a standard lighter, the Eco-Scribe pen has an ink injection port at the top for effortless refilling at the regional depot. This allows for zero-disassembly reuse of the pen.



FEASIBILITY

THE PROS

None of the features that have been incorporated into our final design are anything but repurposed, existing technology. As such, it can be determined that there is very little potential for mechanical failure, and the pens should last many years before the need for remanufacture.

THE CONS

The main issues that Eco-Scribe may encounter are through its outsourcing of delivery and recovery to other companies. This creates a blindspot within which Eco-Scribe is unable to monitor or change procedures. As such, it is important that like-minded and effective partners are chosen so as to form a commendable synergy of productivity and mindfulness.

BENCHMARKING

Popular brands:



Each product in the BIC ReVolution line is made of at least 50% recycled plastic, with the paperboard used in packaging made of 100% recycled and recyclable content.

The line includes pens, pencils, and more, featuring items like a retractable ballpoint pen made from 73% ocean-bound recycled plastic.

Eco Scribe stands out in the stationery market with its innovative refill system, offering a unique and compelling solution to reduce waste. As awareness and demand for sustainable practices continue to rise, especially in institutional and corporate settings, Eco Scribe is well-placed to capitalise on this trend.



Pentel Co., Ltd. has reimagined its product packaging by introducing plastic-free, **all-paper blister** packs for its ball-point pens [1] offers potential internal economic benefits, such as increased throughput and reduced inventory variety [1]

Integrate technology:



Echo 2 from Livescribe: pen that digitizes handwritten notes and automatically uploads them to the cloud. Records everything the user is hearing, saying, and writing, while adding these audio recordings to the notes.

Pens with digital features are gaining prominence, reflecting a shift towards integrating traditional writing instruments with modern technology [1] Eco Scribe, in staying abreast of these trends, should consider exploring the incorporation of digital features into its product line.

SUMMARY

The pen industry is influenced by global trends and legislative initiatives. Greater consumer awareness about the environmental impact of single-use items, including pens, leads to a shift toward sustainability. Legislation and quality standards play a vital role, taking into account the materials, manufacturing processes, and environmental considerations. Partnerships such as the ones with London universities for pen distribution and collection, contribute to a circular economy. The emphasis on recycling initiatives, like refilling ink cartridges and recycling PLA plastic pen barrels, aligns with broader global goals for resource efficiency and environmental stewardship. As the industry evolves, these factors collectively shape a trajectory toward more eco-friendly practices and sustainable solutions in the pen market.

[1] Reynolds, M. (2023) Pentel reimagines blister packs as plastic-free, Packaging World. Available at: <https://www.packworld.com/design/materials-containers/article/22766725/pentel-reimagines-blister-packs-as-plasticfree>

