



**ZERO  
WASTE  
SCOTLAND**

**Scoping policy options  
for Scotland focusing on  
understanding and managing  
the environmental impact  
of single-use e-cigarettes**

**Detailed Technical Report**

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# 0 Executive Summary

## 0.1 Introduction

There are growing concerns regarding the increased prevalence of the use of single-use e-cigarettes (SU-ecigs) in Scotland.<sup>1</sup> Of particular concern are the environmental impacts, the level of unsustainable resource use, the potential consequences of failing to ensure safe and responsible management of them once they become waste, and the high usage by young people. These concerns are being increasingly highlighted by campaigners, environmental and health organisations, the media and politicians.

At the request of the Minister for Green Skills, Circular Economy & Biodiversity, Zero Waste Scotland was asked to commission a review of the environmental impact of, and potential policy options for, improving the management of single use e-cigarettes.

The review looked at possible options from a range of perspectives to reduce the disamenity and pollution impact and enhance the safe recycling of disposed products. The review is not intended to be a full impact and policy assessment, it is a high-level review of potential options to inform Ministers and from which Scottish Government will prioritise further work.

The policy options that have been proposed in this report are those considered to be most likely to have the potential to meet the following two objectives:

- Improve management of single use e-cigarettes, and, enhance the safe recycling of discarded products; and
- Reduce the disamenity and pollution impact of single use e-cigarettes.

Please note this report uses estimates based on extrapolations from a range of sources, to be noted by readers in interpreting any data contained in the report. For full details of how the author has estimated data please see relevant sections of this Detailed Technical Report.

## 0.2 Market and Use

In the year 2022:<sup>2</sup>

- 10.8% of the adult population, and 22% of those aged under-18 were users of e-cigarettes;
- Of those e-cigarette users, more than a quarter (27%) are estimated to be users, mainly, of single-use e-cigarettes (SU-ecigs);
- The propensity to adopt SU-ecigs as the main form of e-cigarette use is much higher in the young – in the under 18s, 59% of e-cigarette users are mainly users of SU-ecigs, with the figure being only slightly lower (56%) in the under 18-24 age bracket.

<sup>1</sup> For this report we will use the term of e-cigarette and Single Use e-cigarette (SU-ecig). More details on the terminology adopted for this report can be found in section 1.1.

<sup>2</sup> Author's estimated numbers – See section 4 of the report for details.

In the 52 weeks to early April 2023, the number of SU-ecigs consumed in Scotland was estimated to lie between 21 and 26 million units.<sup>3</sup>

Sales of SU-ecigs have grown extremely quickly over the last two years. Rolling 12-month figures for SU-ecig sales from grocery outlets indicate that sales revenue doubled between October 2022 and March 2023.<sup>4</sup>

In the absence of any intervention, we can expect:<sup>5</sup>

1. Continued growth in uptake of e-cigarettes across the population of Scotland; and
2. A rising share of SU-ecig users (and share of sales revenue) among the growing number who use e-cigarettes.

### 0.3 Review of the Environmental Impacts

A range of environmental issues have been linked to the use of SU-ecigs and the way they are discarded:<sup>6</sup>

- a) Wasteful use of resources;
- b) The impact of consumption in terms of embodied greenhouse gas emissions, and energy use;
- c) Littering of SU-ecigs (and the possible consequences thereof); and

- d) The impact of improperly discarding SU e-cigs so that they are not capable of being recycled;
- e) Potential fire risks posed for waste managers.

There are also concerns over issues related to resource use and pollution for SU-ecig manufacture:

- Water use;
- Pollution of watercourses;
- Pollutants contributing to worsening air quality;
- Effect on habitat of primary materials extraction.

In addition to the 'lost opportunity' associated with not recovering the materials contained in SU-ecigs, the fact that the full suite of chemicals in use might not always be well known is a cause of potential concern.

As data regarding the environmental impact of SU-ecigs are limited at present, we have sought to derive what might be considered 'first estimates' of some of these impacts. Section 5 includes full details of assumptions and sources.

<sup>3</sup> The author's estimated range reflects uncertainty regarding the proportion of sales accounted for by grocery outlets as opposed to specialist e-cigarette stores (both physical and on-line).

<sup>4</sup> Author's estimated numbers – See section 4 of the report for details.

<sup>5</sup> Projection is based on assumptions detailed in the main report under section 4.3.

<sup>6</sup> See section 5 for full details of environmental impacts.

Our estimate of the weight of packaging and materials which are discarded as a result of SU-ecigs consumption in Scotland is between 800 and 1,000 tonnes per year. We estimated this will increase, in the absence of any intervention, to around 1,900 to 2,500 tonnes by 2027 (See section 5.3.5).

A 30g SU-ecig device gives rise to just over 150g CO<sub>2</sub>e and the associated packaging accounts for a further 12g CO<sub>2</sub>e or so. We estimate that, in Scotland, the greenhouse gas emissions 'embodied' in the total discarded packaging and devices associated with SU-ecig consumption are between 4000 tonnes CO<sub>2</sub>e and 5000 tonnes CO<sub>2</sub>e per year.

As regards the device itself, more than half the emissions are associated with the lithium-ion polymer batteries which are used in devices, and which account for about a third of the weight of materials in a discarded SU-ecig.

### **0.3.1 End-of-Life and Littering**

In the absence of explicit data, we have only crude estimates of the contribution of SU-ecigs to Scotland's litter – by weight and by count – see section 5.3.5. Current costs of disamenity to the public are estimated to lie between £0.85 and £6.61 million in 2022, rising to between £2.06 and £16.09 million in 2027.

Most SU-ecigs are manufactured using outer casing that is either wholly, or partially, plastic though some have cases that are primarily metallic. They also contain plastic within their body, as well as lithium-ion polymer batteries, and residual liquids (mainly glycerol and propylene glycol, but also including nicotine). These elements have potential to cause harm, including via ingestion by animals, but evidence as to the nature and extent of impact is very limited at present.

## **0.4 Policies in Other Jurisdictions**

Concerns around SU-ecigs are emerging worldwide. A number of jurisdictions have introduced or are considering bans on sales, whilst some have banned only flavoured e-cigarettes. Several jurisdictions have introduced various forms of tax, but many of them base the tax on the amount of liquid consumed or levied on each rechargeable container/cartridge.

At the EU level, clauses in the proposed Batteries Regulation, soon to be agreed, may lead to SU-ecigs being prevented from being placed on the market in the EU as of the end of 2026.

Australia has recently issued a new strategy which intends to limit the use of e-cigarettes to ones approved only by Australia's Therapeutic Goods Administration, and which will make e-cigarettes only be available in pharmacies.

## 0.5 Policy Options

### 0.5.1 Reserved/Devolved Legislation Interactions

Environmental legislation is a mix of UK and Scottish legislation and though largely devolved, in intersects with certain reserved areas. In some areas a UK wide, or four nation approach has been adopted through agreement.

This report focusses on a range of policy options that could have benefit in Scotland. It is important to note that several options proposed to tackle the issue of SU e-cigs may need to consider the interaction with the Internal Market Act. The nature of these are not considered in this report.

### 0.5.2 Shortlist of potential policy options

This report recommends a shortlist of the following nine high level potential policy options be considered further by Ministers, from which Scottish Government could prioritise further policy work to address the environmental impacts of SU-ecigs. A wider review of potential policy options is considered in section 2 of this technical report.

The environmental impacts identified above could be significantly reduced through implementing design criteria for either e-cigarettes specifically, or more generally, for WEEE (as regards batteries):<sup>7</sup>

#### Policy Option 1

**Setting design criteria for e-cigarettes. and/or**

#### Policy Option 2

**Requiring that batteries can not only be removed, but that they are also capable of being replaced** (the product should always outlive the battery).

We consider this as a standalone policy even though it could also be considered as part of Option 1.

These two policy options would provide wider benefits if they applied to e-cigarettes in general in the case of Option 1, and potentially, to all WEEE items in the case of Option 2. In particular, it might be useful to consider either or both of the following:

1. Addressing the use of rechargeable cigarettes and the related pre-filled containers within the scope of the measure; and
2. Using complementary measures that would have the effect of reducing/eliminating the likelihood of some of the possible negative consequences arising (for example, by positively incentivising a shift to refillable e-cigarettes).

<sup>7</sup> Option 1 and 2 could be implemented through changes to existing regulations which is currently happening with Batteries at the EU level (to note that at the EU level, the new battery regulation which is to be published soon would affect all appliances): [https://ec.europa.eu/commission/presscorner/detail/en/ip\\_22\\_7588](https://ec.europa.eu/commission/presscorner/detail/en/ip_22_7588)

In both the above cases, the Options are considered to have the effect of ruling products off the market where they fail to meet specific criteria. Because the design of SU-ecigs would likely fail a reasonable set of such criteria, they would be excluded from the market.

### **Policy Option 3**

**A ban on SU-ecigs.** A ban on the sale (both store retail and on-line) of SU-cigs in Scotland could be explored. As discussed in section 7, a number of other jurisdictions have introduced or are considering bans on sales. Design and Implementation would need to consider that a possible consequence might be a switch to e-cigarettes that make use of replaceable pre-filled containers of liquids. These are already available at relatively low cost, and the problem of wasted SU-ecigs might be supplanted by a problem of rechargeable e-cigarette containers. Design and implementation would need to consider the potential for cross-border movement, and re-selling, with dissuasive sanctions set at a correspondingly high level to exercise the desired deterrent effect.

### **Policy Option 4**

**Charging a deposit for SU-ecigs to be refunded on return for recycling.**

This option offers potential to deliver significantly against both objectives. One of the advantages of a charged deposit in this context is that if existing WEEE Regulations and associated take-back requirements were complied with, take-back systems would already be in place in a number of locations.<sup>8</sup>

### **Policy Option 5**

**A tax linked to recycling performance.**

This offers the potential to deliver on both objectives, especially if combined with an incentivised scheme to reduce littering.

### **Policy Option 6**

**Changes in the WEEE Regulations.** This could deliver on both objectives, although its impact on littering rates could be less than where a deposit incentivises returns. Potential changes in the WEEE Regulations includes:

- Extending the scope of cost recovery to include litter clean up (amongst other things);
- Introducing a separate WEEE category for e-cigarettes;
- Ensuring that the costs of management of e-cigarettes are borne by the producers of them;
- And setting targets for separate collection and for recycling at high levels on e-cigarettes (of all types).

Note that although this Option could include fee modulation in line with environmental characteristics, such as design for longevity, fee modulation as part of EPR tends to be constrained by the main cost recovery objective. It might be preferable to impart incentives through differential levies which can be set, and varied, without any constraints related to cost recovery.

<sup>8</sup> We note that some industry representatives are supportive of, for example, the initiative of Veolia (see Joshua Doherty (2023) Veolia launches nationwide vape recycling scheme, letsrecycle.com, April 24 2023, <https://www.letsrecycle.com/news/veolia-launches-nationwide-vape-recycling-scheme/>)



### **Policy Option 7**

**A levy or charge on sales payable by the consumer.** This would shift consumption away from SU-ecigs and more towards e-cigarettes where the user is expected to refill the device with liquid themselves. A levy could be structured so that there are differentials across the types of e-cigarette, designed such that the highest levy falls on SU-ecigs with a lower levy applied to refillable and rechargeable e-cigarettes, but with the pre-filled containers used in rechargeable e-cigarettes also subject to a levy to give clear preference to refillable forms.

### **Policy Option 8**

**A ban on flavoured e-cigarettes.** This option has been deployed in many jurisdictions. The evidence such as it exists suggests that such bans can help reduce users over time, and potentially reduce the intensity of use in remaining users.

### **Policy Option 9**

**Tightening of enforcement of existing law in relation to underage sales.** Depending on the approach taken, the effect could be to reduce (over time) the extent to which underage users continue to use e-cigarettes, and to reduce the number (preferably to zero) of new underage users of e-cigarettes. Unfortunately, at this time, there is only anecdotal evidence that underage users are high contributors to the rates of littering of SU-ecigs.

Options for addressing the impact of SU-ecigs tend to work either on sales/demand, or on the way SU-ecigs are managed. Both the resource use and littering are likely to be impacted by demand side changes. Where issues are being addressed through improved management of SU-ecigs the approach needs to consider behaviour, especially in respect of littering, as well as the provision of convenient and properly funded infrastructure.

The performance outcomes which could be targeted – in terms of separate collection and recycling – would benefit from being set at sufficiently ambitious levels as to ensure that littering is addressed, either explicitly, or implicitly, by the measure, or measures being designed.

#### **0.5.3 Combining policy options**

It is worth considering how the above Options might be used as part of a package of complementary measures. All of the above policy options have the potential for significant impact, however a combination of policy options could have increased impact. Combining Option 6, which is strong on infrastructure and managing end-of-life materials, with Option 7 that incentivises shifts away from the main source of littering of SU-ecigs would be an example of this.

Similarly, combining Option 6 with Option 4, or implementing Option 4 as part of Option 6 (in the context of an extended requirement for take-back of e-cigarettes by those selling them).

Option 6 is likely to be key to the proper management of e-cigarettes. For this reason, Option 6 could also easily be combined with any of the others. Consideration could also be given to implementing Option 6 as a standalone policy (extended producer responsibility for e-cigarettes) in Scotland, effectively exempting e-cigarettes from the relevant WEEE Regulations at the same time.

# 1 Introduction

Equanimator Ltd is pleased to present this 'Scoping report on policy options for Scotland on understanding and managing the environmental impact of single-use e-cigarettes'. The report, prepared for Zero Waste Scotland, responds to a request from the Minister for Green Skills, Circular Economy & Biodiversity, and aims to review the environmental impact of and potential policy options for improving the management of single-use e-cigarettes, reducing the disamenity and pollution impact, and enhancing the safe recycling of discarded products.

This report is structured as follows:

- Section 2: Measures for policy development;
- Section 3: Policy options for consideration in the Scottish context;
- Section 4: The current size and nature of the e-cigarettes market;
- Section 5&6: The environmental impact of SU-ecigs in Scotland and other single-use electronic items;
- Section 7: Policy development in the rest of the UK, Irish Republic, rest of the EU, and elsewhere internationally.

Further details on some of the matters investigated are provided in Appendices. These are as follows:

- Appendix 1: Table 17 - a matrix of all the examined options against the criteria noted: implementation cost, deliverability, environmental impacts;
- Appendix 2: Table 18 - a summary matrix of the shortlisted options;
- Appendix 3: Economics of vaping choice;
- Appendix 4: Consultees.



## 1.1 Note on Terminology

The language surrounding the products that are the subject of this work is evolving almost as quickly as the market itself. The word 'vape' is now in general use to apply to both to product (as a noun), and the act of using the product (as a verb). The term 'vaping' does help delineate the activity from 'smoking', which is understood to be 'what people do with conventional cigarettes'.

"E-cigarette" is the term used in Guidance on Waste Electrical and Electronic Equipment (WEEE), since "vaping" relies on a liquid being heated using an electrical current.<sup>9</sup> Within the EU's Tobacco Products Directive (TPD), an electronic cigarette is defined as:<sup>10</sup>

*'electronic cigarette' means a product that can be used for consumption of nicotine-containing vapour via a mouth piece, or any component of that product, including a cartridge, a tank and the device without cartridge or tank. Electronic cigarettes can be disposable or refillable by means of a refill container and a tank, or rechargeable with single use cartridges.*

This report, however, is focusing on the littering of products which are not confined to products containing nicotine.

The Health (Tobacco, Nicotine etc. and Care) (Scotland) Act 2016 uses the term "Nicotine vapour products" (NVPs), and defines them as follows in Section 35A(1):

- (1) In this Part, a "nicotine vapour product" is –
  - (a) a device which is intended to enable the inhalation of nicotine-containing vapour by an individual,
  - (b) a device which is intended to enable the inhalation of other vapour by an individual but is intended to resemble and be operated in a similar way to a device within paragraph (a),
  - (c) an item which is intended to form part of a device within paragraph (a) or (b),
  - (d) a substance which is intended to be vaporised by a device within paragraph (a) or (b) (and any item containing such a substance).
- (2) But the following are not nicotine vapour products –
  - (a) a tobacco product,
  - (b) a smoking related product,
  - (c) a medicinal product (within the meaning of the Human Medicines Regulations 2012 (S.I. 2012/1916)),
  - (d) a medical device (within the meaning of the Medical Devices Regulations 2002 (S.I. Clarif2002/618)).

This definition is somewhat broader than that under the TPD and could provide a basis for the definition here (albeit that using the term "Nicotine vapour products" to cover products containing no nicotine seems counter-intuitive). The term is also used to refer to the sub-components (such as containers used to contain liquids in rechargeable devices used for vaping).

<sup>9</sup> This is somewhat distinct from shisha devices and other heated tobacco products, where a flame may be used to heat the substance being vaporised.

<sup>10</sup> Tobacco Products Directive (2014/40/EU).

In this report, for the relevant noun, we will use the term: e-cigarette. We define an e-cigarette as:

- a) a device which is intended to enable the inhalation of nicotine-containing vapour by an individual,
- b) a device which is intended to enable the inhalation of other vapour by an individual but is intended to resemble and be operated in a similar way to a device within paragraph (a),

*The following are not e-cigarettes:*

- a) *a tobacco product,*
- b) *a smoking related product,*
- c) *a medicinal product (within the meaning of the Human Medicines Regulations 2012 (S.I. 2012/1916)),*
- d) *a medical device (within the meaning of the Medical Devices Regulations 2002 (S.I. 2002/618)).*

*This follows the spirit of the NVPs definition but excludes parts and liquids.*

It is also necessary to delineate the boundary between 'single-use' (or other terminology which might be deployed, such as 'disposable') and 'other' e-cigarettes. All 'single-use' e-cigarettes are designed for more than a single puff.

It is not entirely clear what 'single-use' means: an e-cigarette intended to be used for vaping which is not designed to be recharged or refilled may actually be used many times, subject to there still being liquid in the device, and the battery still holding charge.

What distinguishes the 'single-use' from other e-cigarettes is the extent to which the e-cigarette is designed to be refilled or recharged: it isn't designed for either. Once the liquid contained in the device is expended, it no longer has use. In this sense, the e-cigarette is one where there is only scope for vaping of the liquid contained within the device at the time of purchase. Because this report project has been given the title which it has, we refer to these as SU-ecigs. Nonetheless, it seems likely that the term 'single-use' might, in future, be better defined to reflect the non-refillable/non-rechargeable nature of the e-cigarette (and to avoid, for example, evasion of any law intended to apply to such e-cigarettes by, for example, including more than one container in a device which is neither refillable nor rechargeable). It might also reflect on the nature of the battery used to generate the current that leads to the vaporisation of the liquid to be vaped.

'Other' e-cigarettes are typically discussed as being either rechargeable with a single-use chamber, or rechargeable by (usually) the owner, using liquids purchased specifically for the purpose of refilling the container. We define these in the report, for ease of reference, as rechargeables (Rch-ecigs) and refillables (Rf-ecigs).

The former are defined as e-cigarettes designed to be used so that the vaped liquid is contained in pre-filled containers/cannisters that can be replaced a number of times. The latter are defined as e-cigarettes designed to be used so that the vaped liquid is contained in a container/cannister that the user can fill and refill using bottles/containers of suitable liquid which are poured into the container/cannister.

Note that these definitions are likely to require further refinement should the need arise to reflect such distinctions in legislation. Indeed, as discussed below, it may be relevant to include links to the nature and form of batteries to be used in e-cigarettes, and the longevity of both the devices themselves, and the batteries used to power them.

Rechargeable containers used in rechargeable e-cigarettes are usually 'single-use' in the same sense that SU-ecigs – as defined here – are 'single-use'. These containers are, though, of a different character to SU-ecigs in that they do not, for example, contain batteries. Nonetheless, they are not designed for refill or reuse, and they may include mesh coils as the means by which the liquid is heated (via resistive heating, powered by the battery contained in the device (which should usually be rechargeable)). Where a coil is included, these would qualify as EEE (and as WEEE once it becomes waste), by virtue of being:

*Dependent on electric currents or electromagnetic fields to work properly' means that the equipment needs electric currents or electromagnetic fields (not petrol or gas) to fulfil its basic function. So when the electric current is off, the equipment cannot fulfil its basic function.<sup>11</sup>*

We noted above our classification and terminology for the main products – SU-ecigs, Rch-ecigs and Rf-ecigs – used throughout the document to refer to the three groupings of product of main interest. We also refer to rechargeable containers (Rch-Cs) to describe the containers of liquid used in Rch-ecigs. Those which may be classified as EEE are termed e-Rch-Cs, and those which are not are non-e-Rch-Cs.

## **1.2 Identification of Policies for Appraisal**

The Specification indicates that, at the request of the Minister for Green Skills, Circular Economy & Biodiversity, Zero Waste Scotland is charged with a review of potential policy options for improving the management of single-use e-cigarettes, reducing the disamenity and pollution impact, and enhancing the safe recycling of discarded products.

<sup>11</sup> Environment Agency (2021) Guidance: Electrical and electronic equipment (EEE) covered by the WEEE Regulations, Updated 18 January 2021.

The objectives are considered to be, therefore:

- Improving management of SU-ecigs, and in particular, enhancing the safe recycling of discarded products; and
- Reducing the disamenity and pollution impact of SU-ecigs.

We have interpreted the aims as being informed by Scotland's Litter Strategy<sup>12</sup> (currently in revision), and the broader aspirations set out in the Zero Waste Plan.<sup>13</sup> In our proposal of options, we have disregarded measures which, on their own, are considered unlikely to make a significant contribution to the two objectives mentioned above, or where the likelihood of achieving the outcome is uncertain.

The research project specification for this report listed the following measures to be investigated:

1. Achieving objectives through the review of producer responsibility schemes for WEEE and Batteries (which Scottish Government are carrying out, alongside the other UK administrations, with consultations expected in the course of 2023). In particular, to consider how extended producer responsibility (EPR) can be used to:
  - Significantly increase consumers' access to responsible disposal routes for SU-ecigs;
  - Ensure adequate producer funding for treatment and recycling of SU-ecigs, acknowledging the necessary costs of efficient and effective services (i.e., cost of littered items), and drive more responsible design decisions;
  - Consider the current approach to regulation and enforcement, and options to strengthen or extend enforcement activity.
2. Providing infrastructure support to assist local authorities in extending the availability of safe disposal and recycling locations for SU-ecigs;
3. Establish a Deposit Return mechanism for SU-ecigs, including assessment of a Digital Deposit Return approach;
4. Implement a display ban on all e-cigarettes (including single-use) like that in force for tobacco products;
5. A complete ban on the sale, distribution and/or use of SU-ecigs;
6. Make single use products more difficult to access than reusable alternatives through communications support, incentives, or other measures;

<sup>12</sup> Scottish Government (2014) Zero Waste: Towards a Litter-free Scotland, June 2014.

<sup>13</sup> Scottish Government (2010) Scotland's Zero Waste Plan, June 2010, <https://www.gov.scot/binaries/content/documents/govscot/publications/strategy-plan/2010/06/scotlands-zero-waste-plan/documents/00458945-pdf/00458945-pdf/govscot%3Adocument/00458945.pdf>

7. Associated communications campaigns connected to the proposed options listed above;
8. Fiscal or charging-type options that could be applied in Scotland (e.g., minimum unit pricing, carrier bag charge) and its effectiveness, given the assumed inelastic demand for vaping products;
9. Placing additional resource efficiency requirements on products placed on the market or requiring additional resource efficiency information.

Some of the measures considered as distinct from EPR in the above list could, in principle, be considered as part of an EPR approach, whilst measure number 2 might be considered as a particular form of cost recovery measures under EPR (and, indeed, it is unclear why anyone other than 'producers' should finance the necessary infrastructure).

The list is, otherwise, relatively comprehensive. Other measures that we considered include:

- Linking taxes to recycling rates so as to drive up recycling rates for (single-use) e-cigarettes, as used in Norway for beverage containers (which led to the voluntary implementation of a DRS);
- Stand-alone communications campaign to encourage improved consumer behaviour as regards littering;
- Stand-alone communications campaign to encourage improved consumer behaviour as regards management of end-of-life SU-ecigs; and
- Restricting sales of flavoured e-cigarettes.



## 2 Consideration of Specific Measures

### 2.1 Producer Responsibility Schemes for WEEE and Batteries

According to Material Focus:<sup>14</sup>

*Producers, importers, distributors and retailers of single-use vapes need to do a lot more than they are currently doing to meet their legal and financial responsibilities under UK waste electrical (WEEE) and portable battery regulations.*

If this is the case, then one of the key issues concerning the producer responsibility schemes for WEEE and Batteries is that producers, importers, distributors and retailers of SU-ecigs may not be complying with existing regulations, let alone, any that might be implemented in future. Although the Material Focus extract references SU-ecigs, the issue seems also to affect those in the supply chain for other types of e-cigarettes. An FT article noted:<sup>15</sup>

*In the UK and EU, producers of electronics are legally obliged to fund the recycling of a tonnage equivalent to what they put on the market. But only 16 of 150 vape producers and importers in the UK analysed by Material Focus are registered to do so. BAT subsidiary Nicoventures and PMI are both registered.*

Material Focus has also shared with us the results of its own attempts to match known producers, distributors, and retailers to the list of names on the list of companies registered for EPR schemes for WEEE, batteries and packaging, and there are some surprising omissions. The FT article noted, for example, that the company distributing both Elf Bar and Lost Mary, itself owned by the parent company of both brands, registered as a distributor under the WEEE Regulations only very recently despite (likely) significant sales over recent years (see Section 4).

We noted in Section 4 that the SU-ecig is dominated by a small number of brands, with the majority of production taking place in China. In principle, checking compliance on the producer side should be possible. Another relevant matter, though, is where people are making their purchases from. The Smoking in Scotland survey indicates that specialist e-cigarette shops – both physical stores and online – remain important sources of e-cigarettes for adults (see Figure 1). This does not give us any indication of whether the same pattern is repeated for SU e-cigs. ASH's survey of under-18 vapers indicated a somewhat different pattern of sourcing among younger people (see Figure 2), and these are users whose use of e-cigarettes is predominantly SU e-cigs.

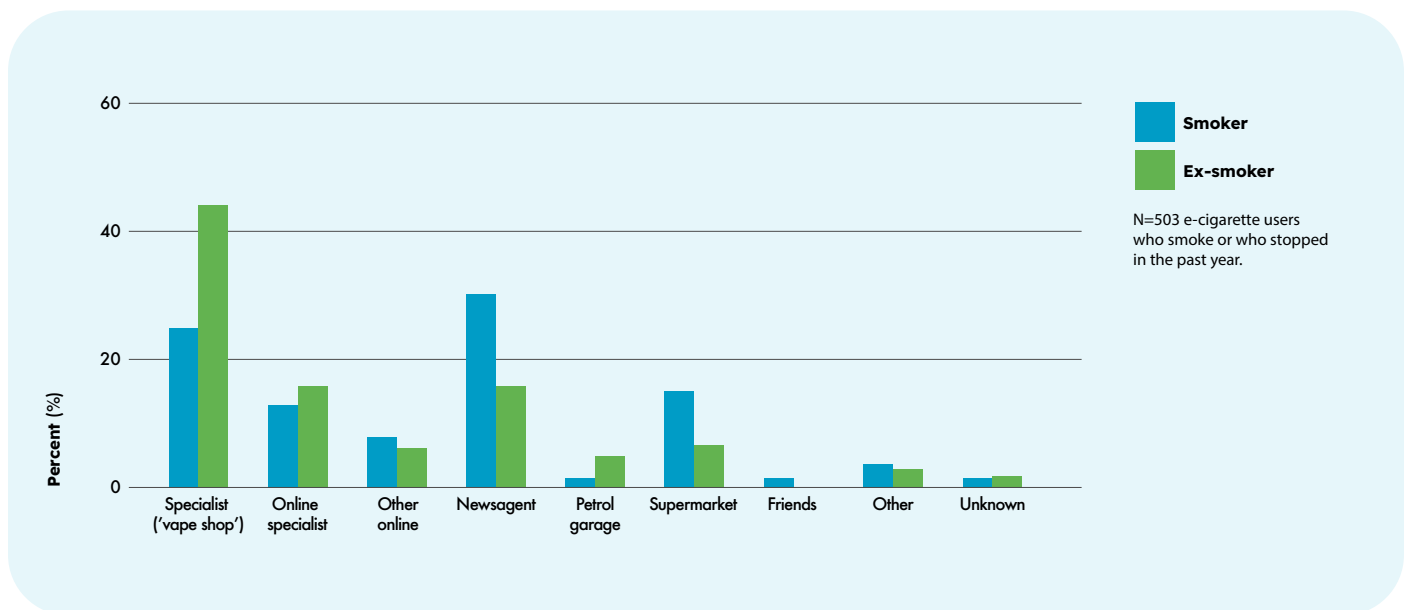
<sup>14</sup> Material Focus (2023) Vapes briefing: Working document last updated 23 January 2023

<sup>15</sup> Oliver Barnes and Alexandra Heal (2023) The environmental cost of single-use vapes: Critical raw metals inside the disposable e-cigarettes enticing Gen Z are more likely to be dumped than recycled, FT, March 7 2023 <https://www.ft.com/content/6d5ed980-8b91-4372-9e7e-14eda5419325>

The ASH data allowed the under-18s to select more than one source, so also may underplay the 'intensity' with which a source is relied upon.

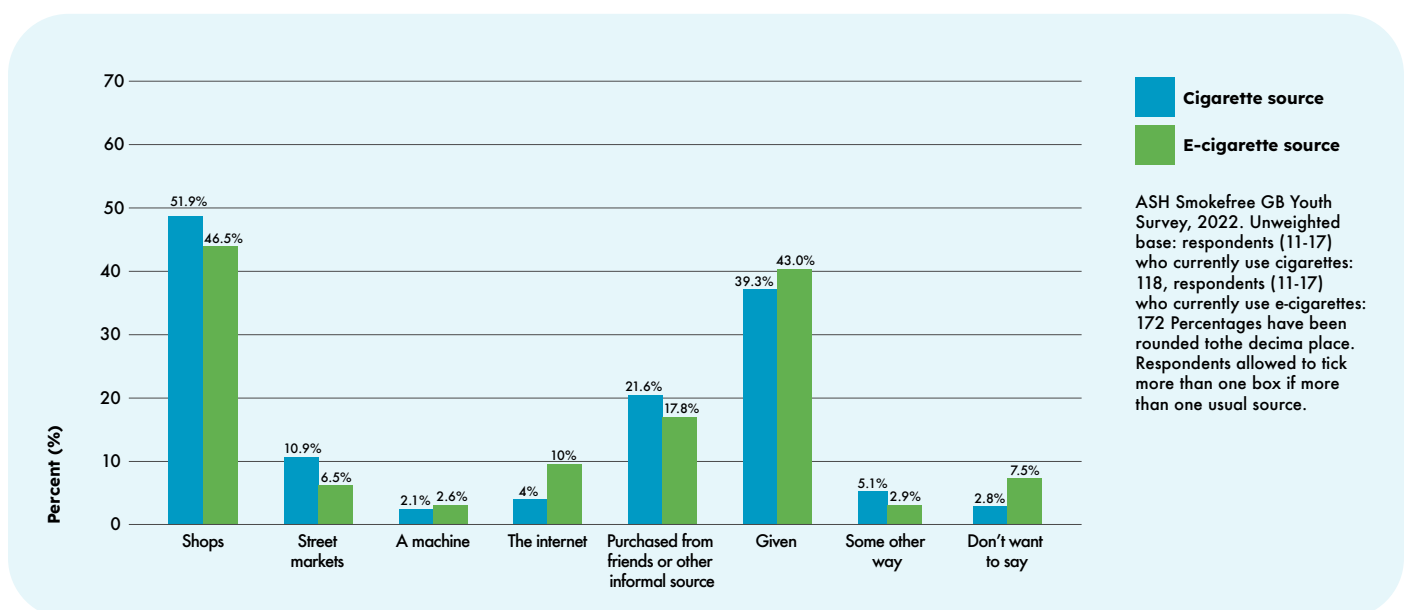
The high share of young users who rely on e-cigarettes being given to them is noteworthy, and suggests that there may be a significant amount of use among younger people where adults are intermediaries who facilitate the activity.

**Figure 1. Ways of sourcing e-cigarettes (Scotland)**



Source: Vera Buss, Loren Kock, Robert West, Emma Beard, Dimitra Kale, Jamie Brown (2023) Trends in electronic cigarette use in Scotland, for Smoking in Scotland, updated 27th April 2023.

**Figure 2. Sources of cigarettes and e-cigarettes among young people 2022 (11-17 years)**



Source: Action on Smoking and Health (ASH) (2022) Use of e-cigarettes (vapes) among adults in Great Britain, August 2022.

Within the UK, under the WEEE Regulations, all producers are required to register. The responsibilities of those falling under the definition of 'producer' varies according to how much they sell. The low level of reported registration, therefore, likely indicates non-compliance.

The matter of 'registration' is the starting point as regards compliance. Depending on sales of EEE (and batteries) falling under the Regulations, producers have responsibilities under the Regulations which are intended to ensure the collection and proper management of WEEE. Thresholds are set to establish the boundary between small producers, and all other producers. Under the WEEE Regulations, a small producer is one who places less than 5 tonnes of EEE into the market in a compliance period. Under the Battery Regulations, a small producer is one placing 1 tonne or less of portable batteries on the market in the United Kingdom during a year.

SEPA guidance, regarding WEEE states:<sup>16</sup>

*If you manufacture, re-brand or import electronic or electrical equipment (EEE), such as household appliances, IT equipment or lighting equipment, you are a producer and must register annually. Registration depends on how much EEE you have put on the UK market in the previous year.*

Details of Offences and Penalties are given under Part 14 of the WEEE Regulations. Some offences are potentially indictable, and are typically dealt with through fines. Similar considerations apply to the Batteries Regulations.<sup>17</sup>

### **2.1.1 Suggested Improvements Based on Minor Amends to the Existing Regulations**

A review, is proposed, of the application of the existing regulations in respect of:

- 1.** Low levels of registration by Producers, as defined under the WEEE and Batteries Regulations;
- 2.** Lower than expected producer funding to support collection (including take-back) and treatment of e-cigarettes (and related cannisters);
- 3.** The definition of small producers, and the thresholds which are linked to some obligations;
- 4.** Provision in respect of take-back and enforcement of obligations therein;
- 5.** Wording of Regulation 7 of the Batteries and Accumulators (Placing on the Market) Regulations 2008 that is designed to ensure that batteries are not wastefully used in SU-ecigs. (A policy suggestion to require that batteries be replaceable, with one route potentially being through the Batteries and Accumulators regs);

<sup>16</sup> <https://www.sepa.org.uk/regulations/waste/waste-electrical-and-electronic-equipment-weee/#three>

<sup>17</sup> <https://www.legislation.gov.uk/ukxi/2013/3113/part/14>

6. Penalties are a sufficient deterrent for those who fail to comply (in various ways). This reflects the combination of a) the likelihood of being sanctioned; and b) the magnitude of the implied sanction.

Note that the research specification asked for consideration of: 'opportunities to place additional resource efficiency requirements on products placed on the market or require additional resource efficiency information.'

These could include (for example, and as a non-exhaustive list):

1. That the battery would have to be removable, rechargeable and replaceable;
2. That all e-cigarettes use the same (specified) port for recharging the battery;
3. That the vessel containing the liquid had to be refillable (or at worst, removable and replaceable – if removable and replaceable, the vessel should be made in such a way that it can be readily recycled – notably, so that any heating element contained within can be easily removed without undermining the potential for recycling the main vessel);

4. That it should be possible to readily remove and replace any other part (such as coil) that may fail within the design life (as per 5 below);

5. That all e-cigarette cases/mouthpieces should be made from readily recyclable (a restricted range) of materials;

6. That specified parts of the e-cigarette should be made from a minimum level of recycled content;<sup>18</sup>

7. That the e-cigarette should be designed so that it could be reused;

8. That the e-cigarette passes relevant tests of durability, requiring it to be capable (subject to replacement of readily removable parts) of being used under normal conditions for a minimum period of time.

Sensible eco-design requirements would most likely exclude the current form of SU-ecigs from the market. It seems possible, given the development of relatively low-cost refillable pod devices, that use of these would increase as use of SU-ecigs declines. It would be sensible, therefore, to develop eco-design criteria of general applicability across the e-cigarette category so as to shift consumption, as far as possible, towards Rf-ecigs which are designed to last.

<sup>18</sup> We have not explored, in this work, the relevance/extent of applicability of regulations in respect of the use of recycled content in different parts of an ecig. Presumably, at least some parts (for example, the mouthpiece) would be covered by such regulations, and possibly also, the container for the e-liquid. The rest of the casing, however, would presumably not be affected. Since designing for reuse probably demands a removable mouthpiece, this would allow for different levels of minimum recycled content to be set for these different parts, should they be affected differently by the ability to use recycled content.

### 2.1.2 Measures Requiring More Substantive Changes to EPR Regulations

Some measures worthy of consideration would imply more significant changes to the existing WEEE (or Batteries) Regulations.

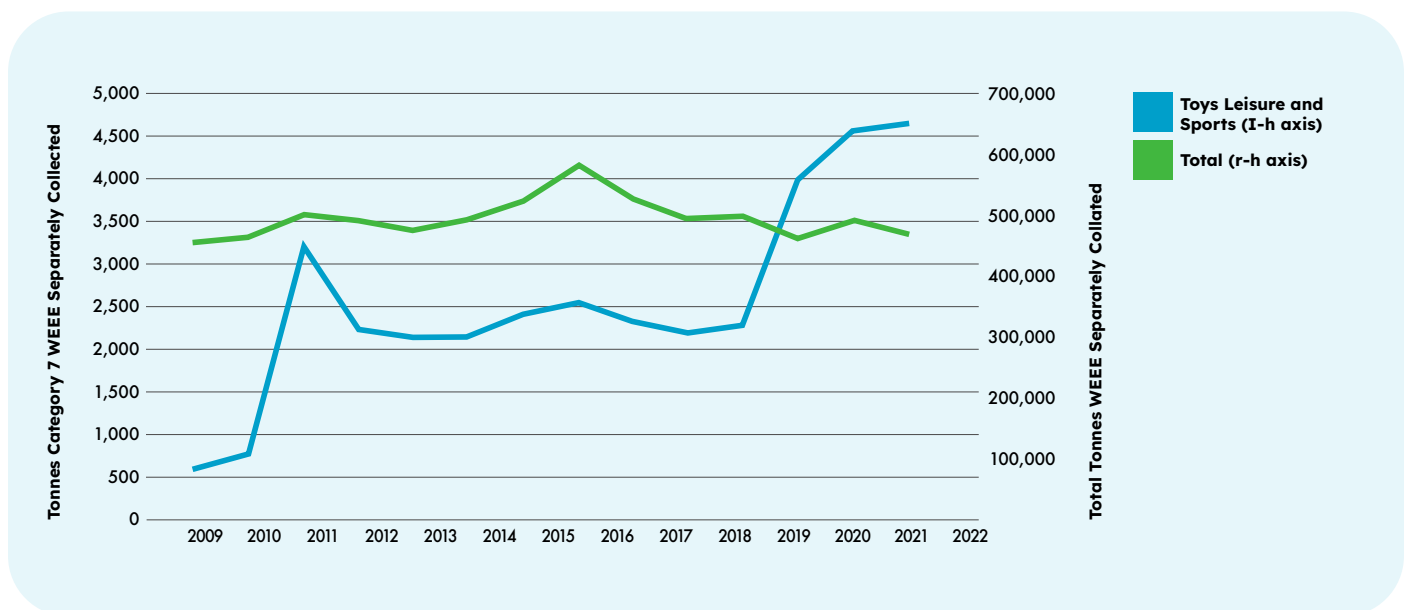
One of the issues raised by those who are charged with responsibility for recycling e-cigarettes is that the costs of proper management, in line with the WEEE Regulations, as well as broader circular economy objectives, is that even where producers are registering (and not all of them are), the costs being derived from producers of WEEE are inadequate to cover the costs of their being properly managed.<sup>19</sup> Currently, e-cigarettes are considered to fall under WEEE Category 7, which is defined as ‘toys, leisure and sports equipment’.

These WEEE items are generally handled and recycled at approved authorised treatment facilities who can do so for fees of the order hundreds of pounds.

WEEE recycling organisations have indicated that the cost of recycling SU-ecigs is of the order 50p per item (some organisations have been quoted £1 per item). Empty SU-ecigs weigh of the order 30g (see Section 5.3), so that a cost of the order 50p per item equates to over £15,000 per tonne. Others have quoted figures of the order £10,000 per tonne for treatment of SU-ecigs.

The evolution of separately collected WEEE in Category 7 has been as shown in Figure 3, which also shows the evolution in the total amount separately collected.

**Figure 3. Evolution in quantity of WEEE collected, Category 7 and total (tonnes)**



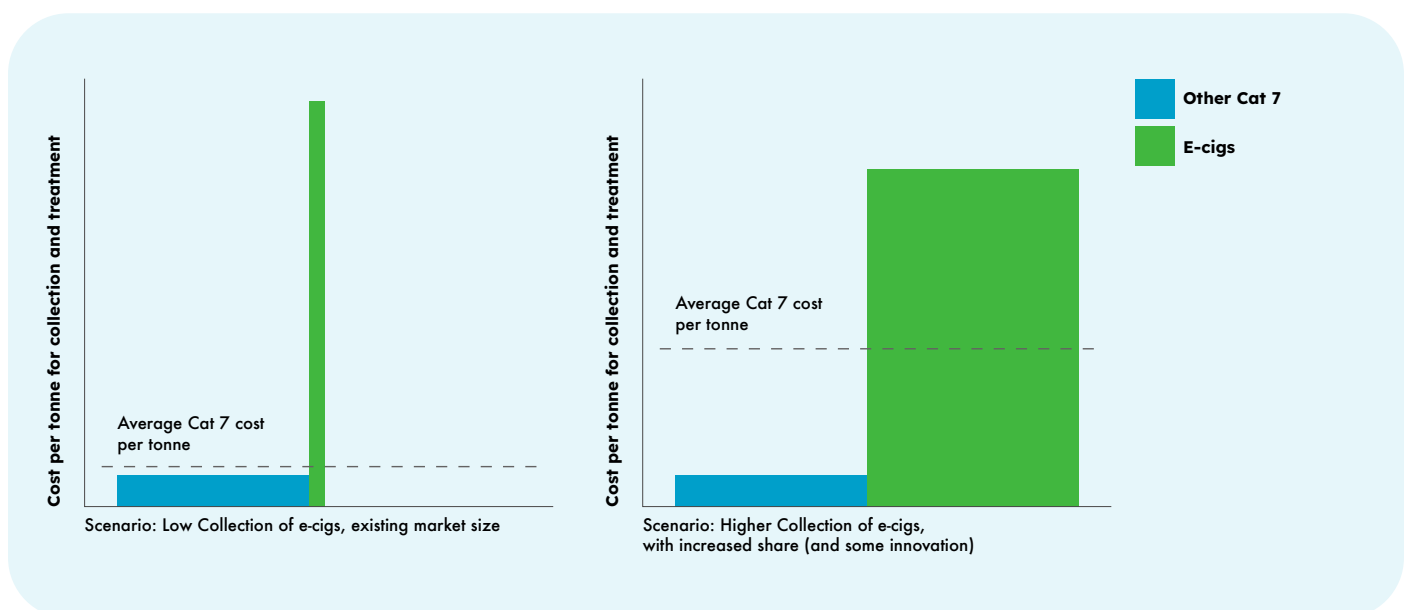
Source: Equanimator Ltd based on data from the Environment Agency

<sup>19</sup> Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE)

Market penetration by e-cigarettes, and especially SU-ecigs, has increased sharply over recent years. The quantity of waste SU-ecigs now accounts for (by our estimate) 7.7 to 9.8 thousand tonnes of WEEE in the UK, which amounts to around 15% of Category 7 tonnage.<sup>20</sup> If the market for e-cigarettes grows as per existing forecasts, then setting relevant targets is likely to pose a growing challenge over time. The weight of SU-ecigs might, in the absence of policy intervention, quickly come to dominate the Category 7 tonnage. The costs for recycling 'other Category 7' WEEE on a per tonne basis being much lower than the cost of recycling e-cigarettes, suggests that some means of treating e-cigarettes as either a separate Category, or as a special case within the existing Category 7, is warranted.

This is necessary to ensure that e-cigarette producers are made fully responsible for the costs of proper management of waste, and so that (over time) 'other Category 7' producers are not required to pay a rapidly rising 'average' cost of managing waste within Category 7 (or in other words, e-cigarette producers do not 'free-ride' on fees generated from 'other Category 7' producers). This is shown in a very simplistic way in Figure 4. It would be unfair for e-cigarette producers to be, effectively, cross-subsidised by producers of 'other Category 7' WEEE items.

**Figure 4. Basic representation of potential effect of e-cigarettes on average costs for producers of 'Category 7' WEEE**



Source: Equanimator Ltd

<sup>20</sup> Environment Agency data for 2020-2022 indicates that EEE placed on the market and purchased by households was between 59 and 75 thousand tonnes (Environment Agency (2023) Electrical and Electronic Equipment (EEE) placed on the UK market, March 2023. <https://www.gov.uk/government/statistical-data-sets/waste-electrical-and-electronic-equipment-weee-in-the-uk>

Measures that could be considered in this respect, and which are likely to be specified under extended producer responsibility (as opposed to in other implementing measures), are:

1. Changing the applicable thresholds that trigger specific obligations for producers as regards financing/take-back;
2. Introducing a broader scope for fee coverage (reflecting the propensity of single-use (and other) e-cigarettes to be littered);
3. Modulating fees/obligation according to sub-categories of WEEE within Category 7 (as part of a wider initiative to introduce 'within category' fee modulation for WEEE);
4. Establishing a specific category of WEEE for 'e-cigarettes' (and modulating fees within the Category);
5. Establishing specific targets for E-cigarettes either as a separate category of WEEE, or within Category 7.

Note that the first three of these could be combined, whilst the fourth could be used as the basis for achieving the same objectives as 1-3. Each of these is discussed below.

### 2.1.3 Definition of Small Producers/ Obligation Thresholds

Small producers are defined under the WEEE Regulations as those generating less than 5 tonnes of WEEE in a given year (see Table 1). Under the Batteries Regulations, the figure is 1 tonne. Where SU-ecigs are concerned, a tonne of WEEE represents around 30,000 units, each of which may (currently) sell for around £4 to £5. 5 tonnes of WEEE would represent sales of £0.6 to £0.75 million or so. The 'sales value per tonne' is relatively high: by way of comparison, 5 tonnes represents around 80 washing machines, which – at a price of around £500 per unit, would have a combined sales value of the order £40,000, less than one tenth that of a tonne of SU-ecigs.

**Table 1. Thresholds for Delineating Small Producers Under the WEEE regulations**

< 5 tonnes = small producer	> 5 tonnes = large producer
<p>Register with your environmental regulator or a PCS</p> <p>Report how much EEE you placed on the market</p> <p>Pay the registration fee</p>	<p>Join a Producer Compliance Scheme (PCS)</p> <p>Report how much EEE you placed on the market</p> <p>Pay PCS fees, which include WEEE collection/ treatment costs</p>

The basis for a threshold value in this respect could be to offer a lower regulatory burden to producers who are less able to afford the associated regulatory burden. Basing this around the tonnage of WEEE which producers are responsible for, it may be argued, is crude and not especially logical. A company selling tens of thousands of SU-ecigs retailing for around £0.5 million might still be defined as a small producer, whilst a business selling 100 washing machines would exceed the small producer threshold, despite their sales being less than 10% those of the SU-ecig producer. The washing machine producer would have to pay PCS fees to cover collection/treatment costs, whereas the SU-ecig producer would only pay a registration fee, despite the costs of managing the WEEE in line with the Regulations being perhaps as much as a hundred times the cost of dealing with the washing machines.

Responsibilities for distributors (including retailers) state you can use the Distributor Takeback Scheme (DTS) instead of providing a takeback service, if either of the following apply:<sup>21</sup>

- Your business sells less than £100,000 of electrical and electronic equipment (EEE) per year;
- You only sell online.

If a business sells £100,000 or more of electricals per year and has physical stores, they need to take back waste in store, or set up an alternative collection point instead.

For very small WEEE, it would seem entirely reasonable to require all stores to accept returns of the same types of product as are sold, not least because the volume of WEEE returned would not be expected to be large. It should be clear to those who fall above and below the thresholds what route they should follow to ensure the safe management of the WEEE they collect, limiting these routes to those which guarantee the appropriate treatment.

The take-back of SU-ecigs is unlikely to impose major costs (in terms of the opportunity costs of retail space) as long as collections are frequent (and there would be a compromise to be met regarding logistical efficiency and the desire to keep fire risks to a minimum through container design and collection frequency).

The Waste Batteries and Accumulators Regs 2009 distinguish between small producers and others, and also between small distributors (less than 32 kg of portable batteries supplied to end-users). Take back obligations relate to distributor size. A distributor is a person that provides batteries on a professional basis to an end-user.

<sup>21</sup> <https://www.gov.uk/electricalwaste-producer-supplier-responsibilities/join-the-distributor-takeback-scheme>



**Table 2. Thresholds for delineating small producers under the Batteries and Accumulators Regulations**

< 1 tonne = small producer	> 1 tonne = large producer
<p>Register with your environmental regulator</p> <p>Submit data on the batteries you placed on the market</p> <p>Pay the annual charge</p>	<p>Join a Battery Compliance Scheme (BCS)</p> <p>Submit data on the batteries you placed on the market</p> <p>Pay BCS fees, which include battery collection/treatment costs</p>

This could include both retailers and those supplying other businesses. The distinction between ‘small producers’ and others are shown in Table 2.

**2.1.4 Scope of Costs to be Recovered from Producers**

The scope of financing by producers of WEEE from private households is set out under Regulation 11 of the WEEE Regulations;

11.– (1) *In each compliance period, the financing of the costs of the collection, treatment, recovery and environmentally sound disposal of WEEE from private households, that –*

- (a) is deposited at a designated collection facility; or*

*(b) is returned under regulation 43, 50 or 52 but is not deposited at a designated collection facility; during that compliance period (“the relevant WEEE”) will be the responsibility of all producers or their authorised representatives, who placed EEE onto the market in the United Kingdom in the previous compliance period, excluding producers or their authorised representatives who have registered as small producers under regulation 16 in that compliance period.*

*(2) Each producer or authorised representative to whom paragraph (1) applies will be responsible for financing the costs of the collection, treatment, recovery and environmentally sound disposal of an amount of the relevant WEEE.*

It is becoming more common now for countries to consider a broader scope of costs to be recovered from producers than those set out above. In particular:

1. Where items are not collected or otherwise separated for recycling, it is becoming more common for countries to consider, under their producer responsibility systems, requiring producers to contribute to those costs associated with the management of those products. This should give some additional incentive to producers and compliance schemes to ensure collection systems are functioning optimally. These costs, insofar as they are incurred by local authorities, are to be covered under the revised Producer Responsibility scheme for packaging in the UK subject to a consultation. This already happens in some EU Member States, such as in Belgium;
2. Where items are littered, there are some producer responsibility schemes that require producers to pay for these costs, whilst for some single-use plastic items, including tobacco products (such as cigarette butts), the Single-use Plastics Directive imposed an obligation on EU member states to ensure that producers of single-use plastic products be obligated for costs.<sup>22</sup>

Costs include, amongst other things, awareness raising measures designed to incentivise responsible consumer behaviour, including the availability of re-usable alternatives and the impact of littering on the environment (details set out at Article 10 of the Directive), as well as (Article 8 (3) (b) and (c):

- (b) *the costs of cleaning up litter resulting from those products and the subsequent transport and treatment of that litter; and*
- (c) *the costs of data gathering and reporting in accordance with point (c) of Article 8a(1) of Directive 2008/98/EC.*

Where 'Tobacco products with filters and filters marketed for use in combination with tobacco products' were concerned, Member States have to ensure that the producers cover also:

*The costs of waste collection for those products that are discarded in public collection systems, including the infrastructure and its operation, and the subsequent transport and treatment of that waste. The costs may include the setting up of specific infrastructure for the waste collection for those products, such as appropriate waste receptacles in common litter hotspots.*

<sup>22</sup> Directive (EU) 2019/904 of the European Parliament and of the Council of 5 June 2019 on the reduction of the impact of certain plastic products on the environment.

Article 8(4) goes on to state that such costs should not exceed those necessary to provide the relevant services in ‘a cost-efficient way’, and that costs of cleaning up litter shall be limited to activities undertaken by public authorities or on their behalf. As regards packaging, it seems Scotland and Wales may oblige producers to cover some or all of these costs.

Given the rapid emergence of SU-ecigs as a problematic item in respect of littering, an obvious measure that could be considered is to extend the scope of cost recovery to include (as well as the full costs of collection for recycling, and the recycling treatment itself):

- The costs of collection and management of SU-ecigs as residual waste;
- The costs of waste collection via public bins, including the costs of establishing that infrastructure; and
- The costs of clean-up of litter which is discarded into the environment (i.e., that which is not placed in any bin).

Including these costs within the scope of costs to be recovered from producers would help reinforce incentives to increase recycling and reduce littering. Including these costs is facilitated by the availability of data of sound quality: it would be sensible to ensure that producers are also made financially responsible for the costs of the acquisition of these data.

### 2.1.5 Fee Modulation

The EU’s Waste Framework Directive, under Article 8a, made it a requirement for collective extended producer responsibility schemes to modulate fees. Article 8a(4)(b) requires that fees:

- (b) in the case of collective fulfilment of extended producer responsibility obligations, are modulated, where possible, for individual products or groups of similar products, notably by taking into account their durability, reparability, re-usability and recyclability and the presence of hazardous substances, thereby taking a life-cycle approach and aligned with the requirements set by relevant Union law, and where available, based on harmonised criteria in order to ensure a smooth functioning of the internal market;*

Many Member States have operated with suitably modulated fees for packaging items for some years now, Italy and France among them, and the UK is planning to introduce modulated fees for packaging in 2025. With regard to WEEE, there are a range of challenges in setting such fees, but for e-cigarettes, or for all items under Category 7, these challenges might be capable of being simplified: a basic requirement of modulation would be that the actual costs to be borne under EPR are accurately targeted at the specific product, or product group, to which they are linked (for reasons depicted in Figure 4).

It might be possible to overlay upon that further modulation within sub-categories of product to incentivise better design of products. So, for example, within Category 7, the specific costs of managing e-cigarettes would be borne by e-cigarettes producers: within the category, modulation of fees might be used to attach a much higher fee to SU-ecigs (relative to Rf-ecigs and Rch-ecigs) to help reduce incentives for their use.

This approach would be somewhat complicated by the fact that Scotland and the UK operate a system in which a number of producer compliance schemes (PCSs) effectively compete to enlist producers as customers. In order to prevent PCSs from varying the extent of modulation (as a basis for competing with each other), it might be necessary to establish, for example, criteria for the scaling of modulation across and within sub-categories of Category 7.

Finally, in moving behind the basic requirement of a more targeted cost recovery mechanism, it might be considered what measure is more appropriate: a further 'layer' of fee modulation, or a system of taxes applied to specific products? One of the reasons why the EU Directive on Waste places such emphasis on modulation can be traced to the limits to the powers of the European Commission (consistent with the fundamental EU Treaties) in respect of its influence over matters of taxation.

For a given jurisdiction, we would suggest that a better approach is to use modulation as a means of more accurately targeting the costs to be recovered to the products with which those costs are associated. If there are additional (environmental or other) arguments for seeking to shift consumer behaviour (and there are in the case we are considering – see also Section 2.3.2 below), then a tax may be a more appropriate means through which to achieve that objective. This also has the merit of raising public revenue: modulation of fees tends to occur within the constraint of cost recovery, which is the primary objective of EPR fees, and so offers less flexibility to policy-makers, and may act to constrain the extent of the incentive imparted through modulation. A tax is not constrained in the same way.

#### **2.1.6 Creating a Specific Category of WEEE for E-cigarettes**

Establishing a specific category – e-cigarettes and cannisters which qualify as EEE – to highlight the specific characteristics of e-cigarettes would be a viable means to achieve all the above. Among these characteristics that would seem to justify this are the following:

1. The quantity of purchases being made is extremely high (it seems likely that no EEE product is purchased so many times in a given year and then discarded shortly after (in the case of the SU-ecigs);<sup>23</sup>

<sup>23</sup> LED light fittings may be purchased in similar numbers, but they are (or should be) relatively long-life products.

2. The design of the products being purchased, giving rise to comparably high costs of collection and proper management;
3. The places where they are consumed (and discarded), with high proportions being used on-the-go, and with growing evidence of discarding behaviours being not entirely dissimilar to that for cigarette butts; and
4. The fact that they do not obviously sit in any other category – UK Guidance places them under Category 7: ‘toys, leisure and sports equipment’.

The merit of establishing a specific category would be to ensure that as a growing (in the absence of other measures) waste stream, and one that creates problems when inappropriately discarded, then targets can be set for this specific stream, and funding channelled into the development of collection and treatment accordingly.

If such a category is not established, and if e-cigarettes and cannisters are considered as part of Category 7, then the possibility for e-cigarettes to free-ride on the collection and treatment of other items remains a distinct possibility.<sup>24</sup> A possible result is that there would be limited pressure (and funding) to develop the infrastructure for what is a growing waste stream (accounting, it would seem, for a growing share of Category 7).

In recent years, having seen collection rates remain flat for many years, Defra increased collection targets for WEEE (and for Category 7), but despite what we believe to have been a significant increase in the weight of (mainly) SU-ecigs discarded in the waste stream, collected quantities barely rose from 2021 to 2022.<sup>25</sup> The collection target for Category 7 remains low relative to the quantity of EEE placed on the market, and the amount collected relative to what is placed on the market is around 6-8%.

The research specification suggested consideration of:

*Providing infrastructure support to assist local authorities (LAs) in extending the availability of safe disposal and recycling locations for single-use e-cigarettes.*

LA collection of WEEE from households is one important option for the reform to WEEE. By extending the availability of locations for discarding SU-ecigs the likelihood of them being littered would be reduced.

Local authorities’ responsibilities for collection do not, of course, extend to retail outlets themselves. They could not reinforce the collection of SU-ecigs from stores, but they could, at least in principle, make use of, or adapt, existing collection locations and services.

<sup>24</sup> Note that the quantity of WEEE in Category 7 is often calculated only by means of Protocols, by which small mixed WEEE, for example, is assigned across a range of WEEE categories. As such, the amount collected is not always accurately known (and especially not if protocols are not regularly updated to account for changing prevalence of products over time).

<sup>25</sup> See section 5.3.5 in this report for more details.

Local authorities already play a role in the collection of WEEE by virtue of their being providers of DCFs (designated collection facilities) as part of the distributor take-back scheme (DTS).

The issue of whether or not consumers would make use of collection systems for the SU-ecigs, given the nature of the product (usable 'on-the-go') and the manner and locations in which some are used, would, however, remain uncertain.

### **2.1.7 Target Setting for E-cigarettes**

The way in which the WEEE Regulations work alongside other measures proposed by the regulations – for example, the Environment Agency has indicated that whole e-cigarettes should not be incinerated – highlights inconsistencies. In Category 7, where the quantity of discarded SU-ecigs we estimate to be (in 2022) 7.7 to 9.8 thousand tonnes, the collection target for all Category 7 in 2022 was 5,067 tonnes. The total Category 7 EEE placed on the market was 63,000 tonnes in the same year. If the intention was to prevent any e-cigarettes from being incinerated, then given that the fate of the majority of residual local authority collected waste in the UK is now incineration, so it would seem that the majority of e-cigarettes would need to be collected separately, and presumably, if they are to be collected separately, they should be collected for recycling.

Notwithstanding the rapid evolution in the market for SU-ecigs (and hence, the fact that the quantity placed on the market is subject to potentially rapid change), SU-ecigs are likely to come into the waste stream shortly after they are purchased. That suggests that the quantity of WEEE which is accounted for by SU-ecigs can be well known based on volumes placed on the market and the weight of the items sold. As long as that information is reported by producers registered under the WEEE regulations, and as long as that requirement to register does not exclude a large share of the market (see Section 2.1.3), then that figure should be well-established on a quarterly basis.

On the basis of those figures, therefore, it would be sensible to establish targets for separate collection that minimise the likelihood of SU-ecigs being incinerated, and maximise the likelihood of their being recycled. For example, as with single-use plastic bottles in the EU Directive on the reduction of the impact of certain plastic products on the environment ((EU) 2019/904), a target for separate collection of SU-ecigs (and other e-cigarettes) of 90% could be set, with targets also for the recycling of the items so collected (for example, 90% by weight, calculated according to a suitable methodology).<sup>26</sup>

<sup>26</sup> Directive (EU) 2019/904 on the reduction of the impact of certain plastic products on the environment: <https://eur-lex.europa.eu/eli/dir/2019/904/oj>

This approach would – especially when used in conjunction with the other EPR measures considered above, and where suitable sanctions were applied to incentivise compliance - enhance the likelihood of SU-ecigs being well-managed at the end of their life.

## 2.2 Communication and Marketing Measures

There are a range of measures that could be considered that are based around imposing restrictions on communications and marketing.

### 2.2.1 Display ban on all e-cigarettes (including single-use)

The interest here is in banning the display of e-cigarettes, similar to the ban which is in force for tobacco products. Such a ban could have some impact on instore purchases and could potentially lead to a reduction in littering. However, it would likely have no effect on on-line consumption if no changes were made to online marketing.

It would not, on its own, improve the management of those e-cigarettes that continued to be consumed.

### 2.2.2 Removing Branding in Marketing of SU-ecigs

The rise in the use of SU-ecigs among young people – we estimated that around 67% of users in Scotland as of 2022 were under 25 – is believed to be a function partly of the nature of marketing of SU-ecigs, these being marketed as colourful, with multiple flavours, and with brands seeking to gain traction through social media channels.

Removing branding could reduce the attractiveness of e-cigarettes to end users. A recent study suggested:<sup>27</sup>

*The findings of this survey study suggest that reducing brand imagery through standardized e-cigarette packaging is associated with decreased appeal of e-cigarette products among youths, specifically never smokers and never vapers, without reducing its appeal among adult smokers. Overall, our findings lend support for reducing brand imagery on e-cigarette products in Great Britain.*

The conclusions are not supportive of a major change in consumption as a result of the removal of branding. Also, they specifically focused on the branding as though this was the only means through which users were drawn to take-up e-cigarette use.

<sup>27</sup> Eve Taylor, Deborah Arnott, Hazel Cheeseman, David Hammond, Jessica L. Reid, Ann McNeill, Pete Driezen and Katherine East (2023) Association of Fully Branded and Standardized e-cigarette Packaging With Interest in Trying Products Among Youths and Adults in Great Britain, JAMA Network Open. 2023 6(3) e231799. doi:10.1001/jamanetworkopen.2023.1799

Demand may fall, and the effect is more pronounced in younger age groups, who constitute the majority of SU-ecig users in number, but the magnitude of the effect is not entirely clear given the opportunities for young people – and adults – to explore opportunities online and given the apparent strength of marketing via social media channels.

Even if it did have some impact on demand, it would not affect littering or the way in which SU-ecigs that continued to be purchased are managed.

### **2.2.3 Standardising Product Colour**

The marketing of e-cigarettes is not merely a matter of branding: it is also one where colour and flavour play a role in promoting products. Just as varied messaging and branding may enhance the appeal of e-cigarettes, restricting colours that can be used for products might also help reduce the appeal of SU-ecigs. For example, all SU-ecigs could be required to be white (making it very visible) or clear (to enhance the recyclability of plastics used as casing for e-cigarettes).

The extent to which this measure would deliver much change is unclear. It might have some impact on uptake by those who are not already users, but there is no clear evidence that it could have a significant impact on either littering, or sustainable management of those e-cigarettes consumed.

Even if it did have some impact on demand, it would not affect littering or the proper management of SU-ecigs that continued to be purchased.

### **2.2.4 Regulating Social Media Promotion**

Social media has ‘helped’ propel the uptake of SU-ecigs, especially among young people. ASH’s survey of young people stated:<sup>28</sup>

*For the first time in 2022 the survey asked 11-17 year olds about their awareness of the promotion of e-cigarette. Over half of all 11-17 year olds reported awareness of some form of e-cigarette promotion (55.8%). Those who have ever used an e-cigarette are more likely to report awareness of e-cigarette promotion (71.5%) than those who have not (52.7%), however, the sources of exposure were common for all groups; in shops (46.5% ever vapers, 34.8% never vapers) and online (35.8% ever vapers, 21.7% never vapers).*

Of those who reported seeing e-cigarettes promoted online the most common place was on TikTok (45.4%).

Instagram, Snapchat, Facebook and Twitter were, in that order (declining percentage of respondents), also mentioned.

<sup>28</sup> Action on Smoking and Health (ASH) (2022) Use of e-cigarettes (vapes) among young people in Great Britain, July 2022.



Advertising and promotion of e-cigarettes is not allowed on various 'conventional' media platforms. They are allowed at point of sale, and marketing occurs online and via social media. Future demand could be affected by reducing the extent of promotion of e-cigarettes via social media channels. This would complement the bans on advertising and promotion via more traditional media channels.

This measure – if it was actually implemented would not, however, affect littering or the proper management of SU-ecigs that continued to be purchased.

### **2.2.5 Communications Campaign to Improve Consumer Behaviour Regarding Management of End-of-life SU-ecigs**

Communications campaigns to improve consumer behaviour are likely to frustrate as much as they enlighten as long as the waste management infrastructure is insufficient to back-up the messaging. In this respect, it is worth considering what that infrastructure might need to look like, given the nature of consumption. It should be convenient and enable users to maximise the extent to which e-cigarettes are discarded into containers which are designed specifically to receive e-cigarettes. That does not include residual waste containers, or containers for conventional household recycling.

The most likely convenient route for return is take-back, so without the enforcement of the existing obligations in the WEEE Regulations, and preferably, expanding the obligation (see Section 2.1.2) on its own, this measure is likely to be of limited success.

### **2.2.6 Communications Campaign to Improve Consumer Behaviour Regarding Littering**

The same comment applies in respect of a campaign to reduce littering. Although it might be considered that 'not littering' is a more unequivocally beneficial outcome, communicating to consumers that they should 'put your e-cigarette anywhere other than the litter bin' might be considered a missed opportunity. A matching positive message – as to 'where to take/leave your old e-cigarette' – would be a more positive campaign, and requires the infrastructure mentioned above to be already in place. The extent to which existing campaigns are effective should also be considered: even items which are widely known to be recyclable, and for which infrastructure already exists to reduce the extent of littering, such as plastic bottles, continue to be littered.

### **2.2.7 Deposit Return Scheme**

Scotland intends to introduce a deposit return scheme (DRS) for single-use drinks containers. The reasons for doing so include the aim of reducing litter, as well as increasing the quantity and quality of recycling of what is collected. These objectives are essentially the same as the objectives set for policies being considered in this report for SU-ecigs. It is logical, therefore, to consider the potential for charging a deposit for SU-ecigs to be refunded on return for recycling, not least given that take-back obligations already apply for some distributors, including retailers (even if they may not be being implemented as they should be).

For many retailers of e-cigarettes, the fact that take-back facilities should already be present suggests that this is a quite different situation to the case of single-use drinks containers.

Key operational considerations would be:

1. How the payment of the deposit would be registered so as to facilitate its return with minimal scope for fraudulent claims. In particular, what form of labelling/ marking might be introduced on e-cigarettes to ensure that at the point of return, pre-payment of the deposit could be recognised?;
2. Where (at what locations) take-back could be undertaken by the consumer and how this could be done:
  - a. So as to maximise convenience/ minimise improper discarding of e-cigarettes); and
  - b. In such a way that the e-cigarettes do not give rise to problems (how should they be contained?).

There has been interest, in the context of a scheme for beverage containers, in a digital DRS. The distinguishing features of a digital DRS are that digital technology, including the use of smart phones, allows the owner of the item of interest to claim their deposit via a) registering their ownership of the item via an e-account, and scanning a unique product label, and b) depositing the item at a designated location where the item's label can be scanned and read as having been taken back.

That scanning could, in principle, be undertaken as the item is discarded into the container.

This might not be so straightforward for SU-cigs due to the nature of containers to be used, and issues that might be associated with them not being adequately supervised. The containers would need to be designed to prevent any fluid escaping, and to minimise the prospect of damage to products, especially batteries. Nonetheless, as long as containers were emptied with sufficient regularity, such an approach might be made viable for e-cigarettes.

One advantage of charging a deposit for SU-ecigs to be refunded on return for recycling is that it does have the potential to address both the objectives articulated at the start of Section 1.2, namely:

- Improving management of single-use e-cigarettes, and in particular, enhancing the safe recycling of disposed products; and
- Reducing the disamenity and pollution impact of single-use e-cigarettes.

As such, there may be much to recommend the approach. The fact that the majority of manufacture of SU-ecigs takes place overseas should not be considered a problem in this regard, but it would be necessary to ensure that all relevant items sold to UK consumers, whatever the origin, were sold with a deposit already paid, and with the item appropriately labelled.

## 2.3 Pricing Instruments

We note in section 7 that there are a number of countries implementing taxes or charges on e-cigarettes. Several possibilities could be considered under this heading.

The specification for this research report mentioned consideration of mechanisms such as minimum unit pricing, or a measure similar to the carrier bag charge. The specification also alluded to 'the assumed inelastic demand for vaping products'. There is likely to be a significant difference between the elasticity of demand for 'vaping' but that might not necessarily translate into an inelastic demand for SU-ecigs per se.

### 2.3.1 Minimum Unit Pricing

The concept of 'minimum unit pricing' (MUP) raises the question as to what 'the unit' would be.

One concept would be to set minimum pricing per unit of liquid, or of nicotine (salts) in liquid. But there are already constraints on what 'disposable' e-cigarettes can contain in terms of liquid and nicotine salts. One can argue that this limit mitigates against resource efficiency (even if it might support health objectives) since a disposable cannot contain a larger quantity of liquid than 20ml, and of nicotine of 2mg. More extensive research would be required to confirm this, but our impression is that most of the consumption of SU-ecigs is of products mainly sold with 20ml of liquid with a 2mg content of nicotine salts. Minimum pricing in relation to either, as regards SU-ecigs alone, would amount to a flat rate of pricing.

A possible perverse effect, as regards SU-ecigs, would be that manufacturers respond by reducing liquid content, thereby potentially worsening the resource efficiency implications of consumption. If the same type of minimum pricing – on liquids or nicotine content – were implemented across all e-cigarettes, then we see little reason why this would radically shift consumption, and waste management and littering behaviour in the short-term: it might affect uptake by people who might not yet be e-cigarette users more than those who are already users.

None of this is to suggest that MUP might not have a role as a measure to address the health impacts of e-cigarette use, or in combination with other measures. Indeed, as Section 7 shows, several other jurisdictions already have 'taxes' in place in relation to volumes of liquid.

Another concept of the 'unit' would be the SU-ecig itself. Minimum pricing in this respect would be more likely to have an effect, and at a sufficient level, it might help shift consumption in favour of Rf- and Rch-ecigs, depending on the levels of minimum price. One possible adverse effect is that there would be a strong shift to Rch-ecigs, pod forms of which appear to be falling in price, so that a problem of littered SU-ecigs could simply be supplanted by one of littered SU-containers (which, if heated using a coil, would still be WEEE).

Another issue with this approach is that whilst minimum pricing of units, expressed in terms of content (as with alcohol), may have legitimacy, an approach which applies minimum pricing to a category of consumer product irrespective of its design or content essentially removes price competition (unless it is set so low as to be ineffectual).

### 2.3.2 Levy or charge on SU-ecigs

Another option would be to design a levy (not a minimum price) applicable to SU-ecigs (and others). If one of the objectives is to reduce littering, then a shift 'up the e-cigarette hierarchy' from SU-ecigs to Rch-ecigs and Rf-ecigs would be desirable, even if it does not directly affect the provision of systems for improved waste management. Indeed, in our discussion of fee modulation (see Section 2.1.5), we suggested that using modulation as a basis for more targeted cost recovery might be complemented by tax incentives designed to shift behaviour in the desired manner.

Such a structure would need to recognise the reduction in resource use (and, most likely, littering) by taxing SU-ecigs higher than others. It would also be desirable to address the single use nature of pre-filled rechargeable containers. A structure might be as follows:

1. Tax on SU-ecigs at £X per device;
2. Tax on Rf-ecigs/Rch-ecigs at a lower level, £Y per device; and
3. A tax on all pre-filled rechargeable containers at £Z per container.

<sup>29</sup> This is rather like the problem of consumers purchasing bags for life where others are no longer available, and using them as though they were single-use carrier bags. It would be counter-productive to have more complex items littered and discarded in similarly large numbers.

This could be given an additional twist, as per other jurisdictions, by also taxing the nicotine content of e-liquids. The structure would then look as follows:

1. Tax on SU-ecigs at £X per device, alongside a separate tax on the nicotine content of the liquid at £A per litre;
2. Tax on Rf-ecigs/Rch-ecigs at a lower level, £Y per device, with;
3. A tax on all pre-filled rechargeable containers at £Z per container as well as their nicotine content at £A per litre; and
4. A tax on the nicotine content of e-liquids purchased for the purpose of refilling refillable containers.

In our view, this form of structure could, with rates set at suitable levels, lead to significant switching away from SU-ecigs. It would be most desirable if the shift away from SU-ecigs did not simply give rise to the use of very similar models of ecig where users purchase devices that allow for use of refillable pre-filled pods, leading to waste (and possibly littering) of those pods, and where they may even opt not to maintain their Rch-ecigs (so that Rch-ecigs resemble SU-ecigs with a slightly longer life).<sup>29</sup> It would be more desirable to incentivise a shift to the refillables.

As indicated elsewhere, the SU-ecigs are not the cheapest way to vape. Refillables will be the less expensive choice for users over a period of a few months, and a well maintained Rf-ecig device could enable users to reduce financial outlay for, potentially, an experience better adapted to their taste.

### **2.3.3 Levy or charge Linked to Collection/ Recycling Rates**

Although the levy proposed above may reduce the extent to which e-cigarette users resort to SU-ecigs, and although that ought to have an impact on littering (the more so, the greater the extent of change), the tax does nothing to affect the system of management of the e-cigarettes at the end of their life.

In principle, this could be addressed using a levy whose magnitude is linked to the achievement in respect of separate collection/recycling of single-use (and other) e-cigarettes. The principle is the one which was set in Norway so as to drive up recycling rates for beverage containers (which led to the voluntary implementation of a DRS).

If we consider this first of all as a standalone principle, then the logic would be that for e-cigarettes, or for each of SU-ecigs and for 'other' e-cigarettes, a levy is set whose scale in any given period is determined by the separate collection/recycling performance achieved in a prior period (preferably, depending on data availability, the one most immediately prior to the current one).

The levy would be akin to an excise duty, paid by all those placing e-cigarettes on the market, and reflecting the performance achieved in the preceding period for which data were available. The levy would be paid to the Scottish Government (or UK Government if the scheme were implemented across the UK). The aim is to convey to those placing products on the market, the desirability of achieving a continuously increasing collection/recycling rate.

Such levies could be set at a very high level for low rates of recycling, falling linearly to a far lower level, or zero, in the event that a 100% recycling rate is met. In the case of SU-ecigs, given that only at very high rates of recycling could it be guaranteed that littering would fall significantly (the effect would depend on the way the producers responded to the levy), so there might be an argument for retaining a non-zero levy even at the 100% recycling rate (the interaction with any other levies used would need to be considered). The same could be done, separately, and with a different profile of levy, falling to zero at 100% recycling, for other e-cigarettes.

This type of measure would likely achieve more in terms of collection/recycling of e-cigarettes, but only if the incentive was sufficient to drive dynamic improvement on a continuous basis would the measure have a major impact on littering. Where significant incentives were in place, something akin to charging a deposit for SU-ecigs might well emerge as the means to deliver high recycling rates (not least because, as mentioned above, take-back infrastructure would already be in place, however partially at the moment).

Hence, the means of achieving the outcome might well be conducive to reducing littering.

Note that there is a potential complementarity with the target setting included under Section 2.1.7. In principle, this type of levy would support the achievement of the targets that might be set under EPR. Indeed, if the incentive imparted through the levy system was sufficiently strong, that might reduce the extent to which enforcement measures are needed in the event of non-compliance with targets.

## **2.4 Bans/Restrictions**

### **2.4.1 Ban on the Sale, Distribution and/or Use of SU-ecigs**

There are issues likely to arise in terms of enforcement of such a ban if it could be achieved: the law alone would struggle to prevent persons crossing the border into England and buying SU-ecigs, either for own use or for re-sale on the black market. How effective enforcement would be may come down to the nature and form of such enforcement, as well as the nature of sanctions that were applied to those who were caught contravening the ban. Contravening the ban in respect of use would require an enforcing authority to distinguish between SU-ecigs and others. This would be less than straightforward without inspecting the e-cigarette itself (it might not – other than by experts – be possible to identify the e-cigarette from, for example, the plume).

A (successful) ban on SU-ecigs would likely lead to increased use of Rch-ecigs. These are already available at relatively low cost, and the problem of wasted SU-ecigs might be quickly supplanted by a problem of Rch-ecig containers, whilst there is also a possibility that because Rch-ecigs are now available at low cost, the Rch-ecigs themselves will be used as though they were SU-ecigs. Manufacturers are likely to already be thinking how best to respond to the proposed EU Batteries Regulation, which because it will require batteries to be replaceable, may be focussing industry's mind on how best to design a Rch-ecig that has the appeal and convenience of an SU-ecig whilst also being aligned with the proposed Regulations.

Note also that rechargeable pods – to the extent that they are EEE (and they are if they contain a heating coil, for example) – are, arguably, a case for banning under Regulation 74 for the simple reason that many rechargeable pre-filled pods are interchangeable with refillable ones: that would seem to make the prefilled pods a rather obvious case of design where reuse has been prevented.

We would expect – obviously – an impact on littering of SU-ecigs, though there might be a corresponding increase in littering of Rch-ecigs and of (associated) pre-filled containers. The extent to which that would occur is unclear. As regards management of those e-cigarettes being discarded, the measure has no impact.

#### 2.4.2 Ban on the Sale, Distribution and/or Use of Flavoured SU-ecigs

Several jurisdictions have implemented bans on the sale and use of flavoured cigs, including China, where most SU-ecigs are manufactured. The bans that have been implemented tend to allow 'only tobacco flavoured' e-cigarettes, or tobacco and menthol flavours.

Review articles indicate that flavour-based bans are likely to affect users, though the effect may be stronger on reducing the rate of future uptake than on existing users. For example:<sup>30</sup>

*Results from local restrictions in Massachusetts suggest limited reductions in the likelihood of initiating tobacco use with flavoured products but reductions in the rate at which current use of any nicotine or tobacco product increases. Restrictions may also play a role in the frequency or intensity of use, as suggested by Hawkins et al.'s findings of reduced days of cigarette smoking. Among these studies, the comparability of individual findings is unclear, given the variation in outcomes.*

ASH's study of GB adults suggests that flavours are an important attractor:<sup>31</sup>

*In 2015, we started asking e-cigarette users what flavour they used most often. (Figure 16). In 2015 tobacco was most popular at 38% followed by fruit flavour at 24.6% and menthol 19%. This has changed over time with fruit flavours now the most popular at 41%, followed by menthol at 19%. Tobacco flavour has fallen to third most popular at 15%. Very few report using products with no flavours.*

Table 3 (overleaf) shows how those who have never smoked are less likely to use tobacco flavoured products and are more likely to use (where they know the flavour) fruit-flavoured e-cigarettes. All user types, though, report that fruit flavours are the most popular ones.

Figure 5 (overleaf) indicates that the flavours of e-cigarettes are, after 'just to give it a try', the most popular reason given for 11-17 year olds who are current or former tobacco smokers, with those who have never smoked tobacco also citing this as a reason, but with joining in with others being a reason chosen more often.

<sup>30</sup> Cadham, C.J., Liber, A.C., Sánchez-Romero, L.M. et al. (2022) The actual and anticipated effects of restrictions on flavoured electronic nicotine delivery systems: a scoping review. BMC Public Health 22, 2128 (2022). <https://doi.org/10.1186/s12889-022-14440-x>; Meernik C, Baker HM, Kowitz SD, et al. (2019) Impact of non-menthol flavours in e-cigarettes on perceptions and use: an updated systematic review. BMJ Open 2019;9:e031598. doi:10.1136/bmjopen-2019-031598.

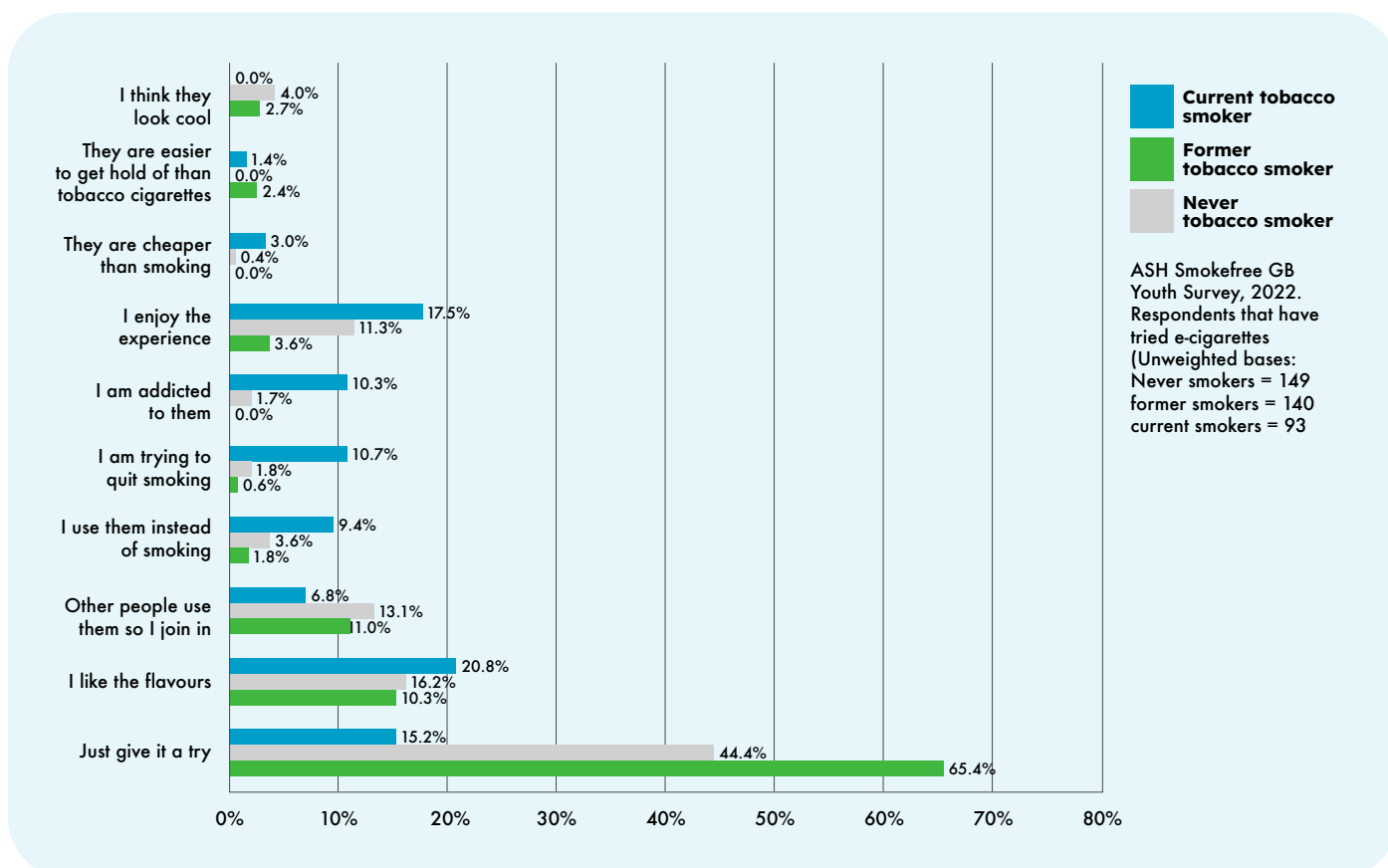
<sup>31</sup> Action on Smoking and Health (ASH) (2022) Use of e-cigarettes (vapes) among adults in Great Britain, August 2022.

**Table 3. Vape liquid flavour most often used (current e-cigarette users)**

Method	Current smokers (dual users)	Ex-smokers	Never smokers
Fruit flavour	44%	39%	41%
Menthol/mint flavour	15%	24%	3.1%
Tobacco flavour	14%	17%	0.0%

Source: Action on Smoking and Health (ASH) (2022) Use of e-cigarettes (vapes) among adults in Great Britain, August 2022.

**Figure 5. Reasons for e-cigarette use, GB youth (11-17), 2022**



Source: Action on Smoking and Health (ASH) (2022) Use of e-cigarettes (vapes) among young people in Great Britain, July 2022.



There would likely be similar issues affecting implementation of this as discussed under Section 2.4.1 as regards potential cross-border shopping. In addition, the study by Cadham et al suggests that such flavour bans have often been flouted by a non-trivial percentage of stores.<sup>32</sup>

We would expect this measure to have a stronger impact on 'future use' than on existing use, whilst the intensity of use by existing users might also fall. These effects would likely translate into an impact on littering of SU-ecigs (and of Rch-ecigs and (associated) pre-filled containers). The extent to which that would occur is unclear. As regards management of those e-cigarettes still being discarded, the measure would have no impact.

### **2.4.3 Tightening Implementation of Age Restriction on E-cigarette Sales/Supply**

Although not strictly addressing environmental matters, the fact that there are so many under-age vapers suggests the existing approach to enforcing the existing age restriction is not working. This applies to persons under the age of 18, and to those who sell e-cigarettes (falling under the definition 'nicotine vapour products', or NVPs – see also Section 1.1) to those under the age of 18. Existing guidance states:<sup>33</sup>

*The sale of tobacco, cigarette papers and nicotine vapour products (NVPs) to anyone under the age of 18 is an offence in accordance with the 2010 Act.*

From 1 April 2017 all tobacco and/or nicotine vapour product retailers (including those operating from moveable premises) must have an age-verification policy in place. It is an offence to run a business selling tobacco products, cigarette papers or NVPs without an age verification policy.

Guidance indicates what is required, but also, what penalties apply to those who have no such policy in place:

*The operator of the business is required to have an age verification policy and must have regard to this Guidance. Failure to have an age verification policy in place, or failure to record the steps required by this Guidance could lead to a warning or fixed penalty from an authorised officer or even a prosecution through the courts that could carry a fine of up to £500.*

Enforcement is by authorised officers in local authority areas, usually trading standards officers, whose numbers more or less halved between 2002 and 2019, and notwithstanding some grant funding from Scottish government to support duties in respect of NVPs (including e-cigarettes), the reducing officer base is a factor.<sup>34</sup>

<sup>32</sup> Cadham, C.J., Liber, A.C., Sánchez-Romero, L.M. et al. (2022) The actual and anticipated effects of restrictions on flavoured electronic nicotine delivery systems: a scoping review. BMC Public Health 22, 2128 (2022). <https://doi.org/10.1186/s12889-022-14440-x>

<sup>33</sup> Scottish Government (2017) Selling Tobacco and/or Nicotine Vapour Products: Age Verification, March 2017.

<sup>34</sup> SCOTSS (Society of Chief Officers of Trading Standards in Scotland) (2019) Trading Standards workforce survey 2019, <https://scotss.org/files/workforce2019.pdf>

With low penalties for breaches of the law, and low levels of enforcement capacity, the rising uptake figures indicated in Section 4.1 indicate a law is not being well enforced (or that it has not been designed with sufficient account taken for the level of enforcement or the financial upside of ignoring the law).

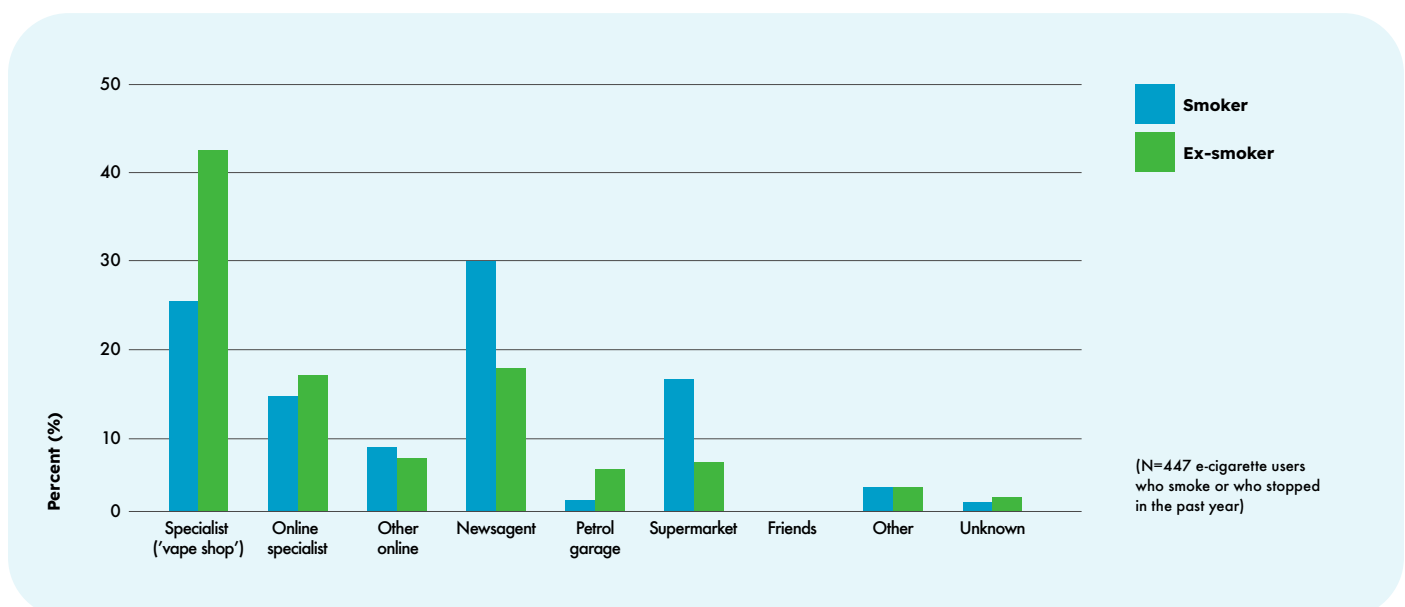
The issue of on-line sales is also relevant. Different sources vary as to the proportion of e-cigarettes they suggest are sourced from different sellers. The figures obtained by Buss et al in work in Scotland indicated that for e-cigarette users who were smokers, 22.9% used online stores for purchases, whereas the figure was 21.7% for ex-smokers (see Figure 6).<sup>35</sup>

Where young people are concerned, the Scottish census data indicated that 10.8% of S4 students (15-year-olds) accessed cigarettes from on-line sellers. This is similar to the 10% figure for young people in GB given in the ASH survey.<sup>36</sup>

Given the above, an option is to give greater effect to existing law by (for example):

1. Making it absolutely clear that anyone (whether the owner of a store, or a parent, or anyone else) who sells, or gives, whether temporarily or permanently, e-cigarettes to under-age persons is committing an offence;

**Figure 6. Sources from which adult e-cigarettes users in Scotland obtained e-cigarettes, by user type**



Source: Vera Buss, Loren Kock, Robert West, Emma Beard, Dimitra Kale, Jamie Brown (2023) Trends in electronic cigarette use in Scotland, for Smoking in Scotland, updated 20th January 2023

<sup>35</sup> <https://www.smokinginScotland.info/resources/link-to-graph-data-scotland-e-cigarettes>

<sup>36</sup> Action on Smoking and Health (ASH) (2022) Use of e-cigarettes (vapes) among young people in Great Britain, July 2022.

2. Increasing the dissuasive power of the sanctions applied to those selling committing such an offence, including increasing the level of fines applicable, and allowing for prosecution with the possibility of a custodial sentence (of, for example, 6 months);
3. Applying banning orders to the persons and premises concerned as regards sale of e-cigarettes where an offence has been committed;
4. Designating specific age verification software for use by online sellers of e-cigarettes;
5. Requiring age verification software to be deployed on the first page a user browses on an online site selling e-cigarettes (as opposed to only at the point of sale) and ensuring blank background screens until the age verification test has been passed; and
6. Increasing the enforcement capacity in Trading Standards to implement frequent inspections/test purchases: In our view, this is a legitimate cost to be recovered through extended producer responsibility (it extends the responsibility of producers to ensuring compliance with legislation).

Future demand among young people could be affected by ensuring that where users sought to make purchases on-line, there was some cross-referencing of personal details to other forms of age verification. These types of change may help reduce consumption, and especially, future increases in uptake by younger people.

The measure would not affect littering or the proper management of those SU-ecigs that continue to be purchased (unless the pattern of discarding is different in under-age and younger users).

#### **2.4.4 Limiting Sale of E-cigarettes to Pharmacies registered for Use in Pharmacies, and Under Prescription**

The approach of the Australian Government is of interest in that it seeks to restrict usage of e-cigarettes to those who are seeking to move away from tobacco products by switching to e-cigarettes. Accordingly, as well as preventing sale of flavoured e-cigarettes:

- Sales of e-cigarettes are to be restricted to pharmacies only;
- All imported e-cigarettes and those sold need to be authorised by the Therapeutic Goods Administration;
- Users would be able to acquire e-cigarettes only where their use had been prescribed.

One of the objectives is to restrict use to those just seeking to cease use of tobacco products and to prevent use by under-age citizens.

These measures could, if effectively implemented, reduce use significantly, but the speed of implementation may need close consideration (in terms of how existing users are dealt with).

For the remaining level of e-cigarette use, there would be no effect on management of e-cigarettes at end-of-life, unless the remaining users' behaviour is very different to the 'average' behaviour.

## 2.5 Synthesis

Our synthesis of all the above measures is presented in Table 17 (Appendix 1, see page 109). As well as assigning a number to each measure, the Table presents the main rationale for each measure, before considering implementation issues, and then considering the measure's impact in three areas:

- Consumption – as a proxy for resource use (and pollution);
- Improved management of SU-ecigs - here, we have considered the provision of infrastructure and the effect on behaviours, and how they combine to affect management of 'what is left' after change in demand; and
- Reducing litter – as a proxy for disamenity (and pollution) here, we consider the combined effect of demand shifts and behavioural change.

On the basis of this synthesis, which reflects the above discursive presentation, we have short-listed measures/combinations deemed to be worthy of further consideration to address the problems of concern for this study. The choice is highlighted in the final column. Note that none of the marketing/communications measures is chosen: that reflects their expected limited effect on demand, the absence of impact (in most cases) on management at end of life, and the limited impact – mainly through demand – on littering.

# 3 Front-running Policy Options

We have examined the range of policy measures as per Section 1.2. Those that were based on either:

1. Restrictions on advertising, or marketing, or promotion (over and above those which already exist); or
2. On communication of information about environmental impacts and behaviour;

were considered to have a possible effect on demand, but an effect on litter that would only be reflected – partially – through change in demand, and no effect on improved management of wastes which would still be generated.

We also considered some issues that appear to be affecting implementation of the WEEE Regulations and the Batteries and Accumulators Regulations as they currently stand. Other than those that relate to possible bans, we do not consider those in detail here.

The remaining policies which we considered worthy of closer consideration are as follows.

## 3.1 Options for Clarifying Eco-design Criteria in Existing Legislation

The environmental impacts identified above could be significantly reduced through either:

### Option 1

Setting design criteria for e-cigarettes; and/or

### Option 2

Requiring that batteries can not only be removed, but that they are also capable of being replaced (and we would add that the product should always outlive the battery). We consider this as a standalone policy even though it could also be considered as part of Option 1.

In considering these options, it might be useful to consider either or both of the following:

1. Addressing the use of Rch-ecigs and the related pre-filled containers within the scope of the measure; and
2. Using complementary measures that would have the effect of reducing/eliminating the likelihood of some of the possible negative consequences arising (for example, by positively incentivising a shift to refillable e-cigarettes). That could be done with a suitably designed levy (see below).

In both the above cases, the Options are considered to have the effect of ruling products off the market where they fail to meet specific criteria. Because the design of SU-ecigs would likely fail a reasonable set of such criteria, so they would be excluded from the market.

## 3.2 Options for a UK-wide or Scotland-specific Ban

### Option 3

A ban on the sale of SU-ecigs. The four nations of the UK could jointly agree to ban the sale (both store retail and on-line) of SU-cigs in Scotland. As discussed in section 7, a number of other jurisdictions have introduced or are considering bans on sales.

Design and Implementation would need to consider that a possible consequence might be a switch to e-cigarettes that make use of replaceable pre-filled containers of liquids (Rch-ecigs). These are already available at relatively low cost, and the problem of wasted SU-ecigs might be supplanted by a problem of Rch-ecig containers. There is also a possibility that because Rch-ecigs are now available at low cost, the Rch-ecigs themselves will be used as though they were SU-ecigs.

Scotland could, alternatively, instigate its own ban on SU-ecigs. Design and implementation would need to consider the potential for cross-border movement, and re-selling, with dissuasive sanctions set at a correspondingly high level to exercise the desired deterrent effect.

## 3.3 Other Policy Options

In considering the other policies, including the ban on flavoured e-cigarettes, we assume that none of the options already discussed is in effect.

It is as well to recall the objectives articulated at the start of Section 1.2, namely:

- Improving management of single-use e-cigarettes, and in particular, enhancing the safe recycling of disposed products; and
- Reducing the disamenity and pollution impact of single-use e-cigarettes.

Most of the measures are more likely to deliver on one or other of the objectives.

### Option 4

Only Option 4, charging a deposit for SU-ecigs to be refunded on return for recycling, offers potential to deliver significantly against both, though it would not address the emissions linked to resource use and consumption (which the measures that shift demand away from SU-ecigs would do).

One of the advantages of charging a deposit for SU-ecigs in this context is that if existing WEEE Regulations and associated take-back requirements were being properly enforced, take-back systems would already be in place in a number of locations.<sup>37</sup> Enforcing the WEEE Regs, and making minor amendments, could ensure a suitably convenient return-to-retail option was in place. It might be that this could be complemented by 'smart-bin' approaches that allow for containers to be placed in other locations to support returns in 'on-the-go' situations.

<sup>37</sup> We note that some industry representatives are supportive of, for example, the initiative of Veolia (see Joshua Doherty (2023) Veolia launches nationwide vape recycling scheme, letsrecycle.com, April 24 2023, <https://www.letsrecycle.com/news/veolia-launches-nationwide-vape-recycling-scheme/>)

### **Option 5**

A tax linked to recycling rates - may offer the potential to deliver on both objectives, but (arguably) only if the route chosen by industry to deliver the higher recycling rate is a DRS, or similarly incentivised scheme to reduce littering. That likelihood increases where the incentive imparted by the tax is sufficiently large that industry opts to adopt an approach that delivers very high rates of performance.

### **Option 6**

The comprehensive change in the WEEE Regulations indicated by Option 6, may deliver both, although its impact on littering rates is likely to be somewhat less than where a deposit incentivises returns, unless the targets that are set effectively makes incentivising returns the most efficient route to compliance. The Option extends the scope of cost recovery to include litter clean up (amongst other things), introduces a separate WEEE category for e-cigarettes, ensures that the costs of management of e-cigarettes are borne by the producers of them, and includes the setting of a challenging collection target and a recycling target for e-cigarettes (of all types). Note that although this Option could include fee modulation in line with environmental characteristics, such as design for longevity, fee modulation as part of EPR tends to be constrained by the main cost recovery objective. It might be preferable to impart incentives through differential levies which can be set, and varied, without any constraints related to cost recovery.

### **Option 7**

A levy or charge on sales payable by the consumer and designed to shift consumption away from SU-ecigs and more towards e-cigarettes where the user is expected to refill the device with liquid themselves (Rf-ecigs). We have suggested levy differentials across the types of e-cigarette, designed such that the highest levy falls on SU-ecigs with a lower levy applied to Rf- and Rch-ecigs, but with the pre-filled containers used in Rch-ecigs also subject to a levy to give clear preference to Refillable forms. This may have merit also in increasing Scotland and UK manufacturing's share in 'vaping spend', given that most SU-ecigs are manufactured in China, but there is domestic production of liquids for use in vaping devices.

### **Option 8**

A ban on flavoured e-cigarettes – is one that has been deployed in many jurisdictions. We do not have exact figures on the proportion of SU-ecig sales which are flavoured (i.e., not tobacco, or not tobacco or menthol). We believe this share to be high, and most likely, growing. The evidence such as it exists suggests that such bans can help reduce users over time, and potentially reduce the intensity of use in (some) remaining users. Equally, there may be issues with purchases from England (and re-sale), whilst some stores might also seek to avoid having to comply. Again, dissuasive sanctions of a suitable magnitude would be useful to support an enforcement effort.

## Option 9

Tightening of enforcement of existing law in relation to under-age sales – is a measure which ought to be considered as a matter of urgency (for the simple reason that the existing approach is failing). Depending on the approach taken, the effect could be to reduce (over time) the extent to which underage users continue to use e-cigarettes, and to reduce the number (preferably to zero) of new underage users of e-cigarettes.

Finally, it is worth considering how the above Options might be used as part of a package of complementary measures. Combining Option 6, which is strong on infrastructure and managing end-of-life materials, with Option 7 that incentivises shifts away from the main source of littering, the SU-ecig, would be complementary. Other combinations are indicated in the final column: Options 6 and 8 could easily be combined. Similarly, combining Option 6 with Option 4, or implementing Option 4 as part of Option 6 (in the context of an extended requirement for take-back of e-cigarettes by those selling them).

Option 6 ought, in our view, to flow naturally from a sensible revision to the WEEE Regulations, so creative combinations of Options along with Option 6 could be of considerable interest. That having been said, the likely pace of delivery of Option 6 is reason enough to keep other options in play.

We have summarised our evaluation in Table 18 (Appendix 2, see page 125). Further, more detailed consideration is merited in advance of making a clear decision.

It should be noted that Option 6 is likely to be key to the proper management of e-cigarettes. For this reason, consideration could be given to implementing Option 6 as a standalone policy (extended producer responsibility for e-cigarettes) in Scotland, effectively exempting e-cigarettes from the relevant WEEE Regulations at the same time.

Further, more detailed, consideration and analysis are merited in advance of making a clear decision. There is an ongoing four-nation review of current WEEE regulations which may be relevant to consideration of policy options, and, given the high degree of public concern regarding SU-ecigs, other nations of the UK will likely also be considering potential options in this area.

It is worth reflecting that Options for addressing the impact of SU-ecigs tend to work either on sales/demand, or on the way SU-ecigs are managed. Both the resource use and littering are likely to be impacted by demand side changes. Where the issues are being addressed through improved management of SU-ecigs (as opposed to measures working on the demand side), the approach needs to consider behaviour, especially in respect of littering, as well as the provision of convenient and properly funded infrastructure. The performance outcomes which could be targeted – in terms of separate collection and recycling – would benefit from being set at sufficiently ambitious levels as to ensure that littering is addressed, either explicitly, or implicitly, by the measure, or measures being designed.



# 4 Size and Nature of the Market for Vaping Products

In order to inform our understanding of the magnitude of the environmental impacts of vaping, and of vaping SU-ecigs in particular, it is essential to understand the current (and anticipated future) level of consumption. The profile of users may also inform understanding of the nature, and likely impact of, measures that could be used to address the impacts identified (see Section 5).

Accordingly, the study was asked to provide an estimate of the size and nature of the single-use e-cigarette market. It asked for an up-to-date assessment of the current size and nature of the e-cigarette market, as well as information regarding trade, and forecasts of future growth for the next five years, and assessment of the likely current and future fate of e-cigarettes.

## 4.1 Current Market Size, SU-ecigs and other e-cigarettes

This Section of the report uses estimates based on extrapolations from a range of sources with the best available data at the time of writing. The data regarding the number of SU-ecigs (and Rch-ecigs and Rf-ecigs) being purchased, and an understanding of their fate, is of variable quality, so that use of a range of sources has been necessary to inform our estimate. The reader should note this when interpreting data, and should also note this is a fast-moving issue and new data sources will quickly supersede the ones used to calculate the following estimates. In due course, such data could become readily available through data reported under relevant producer responsibility regulations, but registration even of producers that should have registered under the existing regulations has been far from complete (see below). This Section seeks to present a picture of the current situation, recognising that this is a rapidly evolving market.

We sought to understand the market from two directions:

- **From data regarding numbers of users of e-cigarettes and SU-ecigs.**

Here, a key issue for which we have relatively little data is the number of e-cigarettes used, on average, by different users, stratified by age. Questions tend to be asked regarding frequency of use, as has been done with tobacco products in the past. Where this study is concerned, we are interested in the number of SU-ecigs (and other e-cigarettes) consumed per annum, and ideally, we would have information on the number used each year by different users in the different age brackets;

- **From data regarding sales/turnover data.**

From these, we could make broad brush estimates as to numbers consumed on the basis of an estimate of average use. However, we have sought to base estimates of the number used on reported figures in relation to sales, and turnover. There are some difficulties in pinning down sales data to devices (and to each type), or liquids, or coils. Reported turnover for the sector is also likely to include the manufacture of liquids by UK-based businesses.

We have based current data on the number of users in Scotland on the following sources:

1. For adults, we considered using the National Statistics Publication for Scotland, The Scottish Health Survey 2021.<sup>38</sup> However, we feel that the data on the number of users of e-cigarettes in Scotland is more carefully considered in the ongoing studies published as Smoking in Scotland.<sup>39</sup> Since these data do not include information on user numbers by age brackets, but the English equivalent does, we have scaled the England figures for take-up by age bracket to a 'Scotland equivalent' by pro rating the user figures in line with the percentage of adults using e-cigarettes in Scotland relative to the percentage of adults using e-cigarettes in England.<sup>40</sup> Our user figures reflect the average of four quarters from April 2022 to January 2023;
2. For young people in the second and fourth years (S2 and S4, or 13- and 15-year-olds) school children, we drew on the Scottish Government's Health and Wellbeing Census Scotland: 2021/22.

Experimental Statistics: Statistics under Development and the accompanying Tables on smoking and the use of e-cigarettes. These data split the reported user numbers between 'regular' and 'occasional' users. We used both figures since the users identified in the Smoking for Scotland study include those who use e-cigarettes less than weekly (i.e. what might be considered occasional users). Since these data related to 2021, we inflated them in line with the change in the overall level of use in the adult population between 2021 and 2022;<sup>41</sup>

3. There were no 'Scotland-specific' data regarding the extent of use of SU-ecigs by each age bracket. To help identify the users of SU-ecigs by age grouping, we drew on two surveys undertaken by Action on Smoking and Health (ASH), one for adults, the other, for young people.<sup>42</sup> Both cover Great Britain, and not only Scotland. For young people, we normalised the figure to account for those who had offered no answer in the ASH survey.

<sup>38</sup> Scottish Government (2022) National Statistics Publication for Scotland, The Scottish Health Survey 2021 edition, Volume 1, Main Report.

<sup>39</sup> Vera Buss, Loren Kock, Robert West, Emma Beard, Dimitra Kale, Jamie Brown (2023) Trends in electronic cigarette use in Scotland, for Smoking in Scotland, updated 20th January 2023.

<sup>40</sup> Vera Buss, Loren Kock, Robert West, Emma Beard, Dimitra Kale, Jamie Brown (2023) Trends in electronic cigarette use in England, for Smoking in England, updated 26th April 2023. (Note that differences might exist between the two nations.)

<sup>41</sup> Scottish Government (2023) Health and Wellbeing Census Scotland: 2021/22. Experimental Statistics: Statistics under Development, 28 February 2023, and Supplementary Tables. (Note the results are not weighted to be nationally representative. Also, just 16 of the 32 Local Authorities took part, with an overall response rate of 58.3%.)

<sup>42</sup> Action on Smoking and Health (ASH) (2022) Use of e-cigarettes (vapes) among adults in Great Britain, August 2022 and Action on Smoking and Health (ASH) (2022) Use of e-cigarettes (vapes) among young people in Great Britain, July 2022.

For adults, we increased the proportion of users in each category so as to align with the figures in the academic paper by Tattan-Birch et al.<sup>43</sup> It is, of course, entirely possible that the proportion of Scotland's population who are users of SU-ecigs is different to the proportion for the whole of GB;

4. In both the ASH studies cited above, the numbers reported appear to capture the 'main device'; being used by the user of e-cigarettes. It is likely, therefore, to understate the overall number of users of SU-ecigs, some of whom may be using a different device for most of the time, but also using SU-ecigs some of the time.

We have used Scotland-specific data wherever this has been available. It is relevant to note that surveys vary in how they define users, and how they distinguish (if they do) between patterns of use. It was somewhat easier in the case of cigarettes to ask 'how many a day?', but the picture with vaping devices is more complex and varied. It is difficult, based on questions asked, to understand how many SU-ecigs are used per annum, by each user, from the data which have been gathered. A temporal frequency of use, for example, tells us rather little about the intensity of use (how many puffs, how many e-cigarettes used) when that takes place.<sup>44</sup>

In respect of current uptake, we estimate, based on the above sources, that in the year ending January 2023, there were 543,000 vapers in Scotland of which we estimate 51 thousand (9%) were under 16, and 78 thousand (14%) were under 18. Users over the age of 16 amount to 10.8% of the total population in that group. This figure for the adult proportion compares with 8.3% reported by ASH for Great Britain as a whole in 2021.<sup>45</sup>

In addition, in any given year, there will be those who 'try' vaping but do not continue vaping (or who vape very infrequently).

Applying the figures for the number of e-cigarette users who list SU-ecigs as their main device to the aforementioned figures, we can estimate that there are 149 thousand users of SU-ecigs in Scotland for whom SU-ecigs are the main device used, with 46 thousand of these being in under 18 age group. That would imply that under 18s account for 31% of all SU-ecig users in Scotland. If one includes the 18-24 age grouping as well as the under 18's, then the proportion of SU-ecig users accounted for by the under 25s is estimated to be 67%.

<sup>43</sup> Tattan-Birch H, Jackson SE, Kock L, Dockrell M, Brown J. (2023) Rapid growth in disposable e-cigarette vaping among young adults in Great Britain from 2021 to 2022: a repeat cross-sectional survey. *Addiction*. 2023;118(2):382–6. <https://doi.org/10.1111/add.16044>

<sup>44</sup> The Smoking in Scotland survey captures frequency of use (by smokers and non-smokers), but that might not necessarily translate into numbers of devices, not least since the use of SU-ecigs might also vary according to how frequently someone vapes.

<sup>45</sup> Action on Smoking and Health (ASH) (2022) Use of e-cigarettes (vapes) among adults in Great Britain, August 2022.

The increasing use of SU-ecigs is a phenomenon that appears to be largely driven by growth in users in the younger age groups, and as Tattan-Birch et al have shown, this has happened over a very short time period.<sup>46</sup> It should also be noted that the basis for generating data for under-16s is based on surveys which effectively ask respondents to admit engaging in an illegal activity: it is quite possible that the prevalence of under 16's in e-cigarette use, and use of SU-ecigs, is understated as a result (see the Vaping - understanding prevalence and trends among adults and children: research for a more in-depth analysis of vaping trends across Scotland).<sup>47</sup>

#### 4.1.1 Sales (and Turnover) Data

It was then necessary to understand the use of the SU-ecigs (and of other vaping products) to understand the likely consumption of SU-ecigs in a given year across Scotland. In estimating this, we considered both the Sales/Turnover Data, and estimates of the nature of expenditure made by users of other devices.

Data from NielsenIQ were quoted in the Grocer:<sup>48</sup>

*Throwaway vapes are a smash hit. They've helped the vaping category more than double its value this year to £793.2m.*

*Elf Bar is now the most valuable e-cigarette brand by a considerable margin, worth £322.1m in grocery, having shifted an extra 55.8 million units.*

*"Since the summer of 2021, the disposable segment has become number one by reaching more than 60% value share in the latest 52 weeks, pushing closed-system products to second place with a bit below 20% value share of e-cigarettes," explains NielsenIQ analyst Laszlo Zsom. Major brands in the closed systems segment were negatively impacted by the fast growth of Elf Bar and similar disposable brands.*

*Indeed, last year's biggest vaping brand, Juul, has slipped to fourth after dropping 14.7% of volumes at a cost of £7.5m. BAT's 10 Motives brand suffered a 4.7% dip in volumes, Imperial's Blu fell 6.7% and JTI's Logic shifted only around half 2021's volume. Only BAT's Vuse (formerly Vype) bucked the trend, growing value by 458%.*

*[...] Vuse's weathering of the disposable storm is part thanks to BAT's own throwaway product, Vuse Go, which launched in the UK in May. It was the result of "our fastest speed to market launch yet" – just six months – and "is expected to drive margin accretion, once at scale", Bowles added.*

<sup>46</sup> Tattan-Birch H, Jackson SE, Kock L, Dockrell M, Brown J. (2023) Rapid growth in disposable e-cigarette vaping among young adults in Great Britain from 2021 to 2022: a repeat cross-sectional survey. *Addiction*. 2023;118(2):382–6. <https://doi.org/10.1111/add.16044>

<sup>47</sup> Scottish Government (2023) Vaping - understanding prevalence and trends among adults and children: research <https://www.gov.scot/publications/understanding-prevalence-trends-vaping-adults-children/pages/2/>

<sup>48</sup> George Nott (2022) Tobacco & vaping 2022: Disposable vapes drive stunning growth, *The Grocer*, December 2022

Sales volumes as reported in the Grocer article cited above are shown in Table 4. These data relate to sales from grocery multiples, co-ops, multiple off-licences,

independents, forecourts, convenience multiples, symbols and online grocery retailers. They exclude specialist vaping shops (both physical and on-line).

**Table 4. Top vaping products by sales in year to September 2022, by sales value via grocery outlets (excludes dedicated e-cigarettes stores, physical and online)**

Top 10 vaping					Total volume change	49.4%	
		Total			£793.2	Change (£m) 434127241.0	Change 120%
2022	2021	Category					
1	18	<b>Elf Bar</b>	Elf Bar UK	322.1	318.4	18526.9%	
2	8	<b>Vuse</b>	BAT	85.1	69.8	458.0%	
3	13	<b>Greek Bar</b>	Greek Bar	44.7	38.3	606.0%	
4	1	<b>Juul</b>	Juul Labs	42.0	-7.5	-15.2%	
5	3	<b>Blu</b>	Imperial Brands	42.0	-2.4	-5.3%	
6	5	<b>10 Motives</b>	BAT	36.8	-0.7	-1.8%	
7	<b>NEW</b>	<b>ELUX</b>	Shenzhen Elux Technology Co	36.8	-36.7	-	
8	7	<b>Edge</b>	Afrapoco	21.1	1.0	5%	
9	4	<b>Logic</b>	JTI	20.8	-17.7	-46.0	
10	6	<b>Cirro</b>	BAT	17.0	-3.6	-17.4	

Source: The Grocer's Top Products 2022 in association with Nielsen IQ: 52 weeks to 10 September 2022

If we consider the grocery sales of £793mn in the year to September 2022, and an average cost of £4.18 per unit, that would equate to around 190 million units sold.<sup>49</sup> This average price of £4.18 is not far from prices typically paid for SU-ecigs today, but as the report indicates, unit values rose, and the average value is likely to have been lower for SU-ecigs. Using a figure of £3.75 per unit and using the figure for the SU-ecigs share of sales value of 60% (see extract above), we can estimate UK sales at grocery outlets (i.e., excluding specialist vaping outlets) to be of the order 127 million units in the year to September 2022.

More up-to-date data from the same source, but covering the 52-week period to 8th April 2023, was provided by the Independent British Vape Trade Association (IBVTA). This indicated that through UK grocery stores, sales revenue from SU-ecigs amounted to £1,039 million, based on sales of 176.2 million units (most up-to-date figure available). On a like for like basis, this would represent an increase of sales revenue, from sales via these outlets, of 118% (i.e. sales revenue more than doubled), whilst the number of units has also increased but potentially by a lower amount (as the revenue per sale may have increased).

**Table 5. E-cigarette Sales from Grocery Outlets**

Product	Sales (units)	Value of Sales (million)
E-cigarette Disposable – single-use products	176.2 million	£1,039
Kits – Both closed pod/battery kits and open tank devices	202 million	£23.6
Refill cartridge – closed pre-filled pods, can't be refilled	24.5 million units	£172
Refill Liquid – 10ml liquids	29.7 million units	£84.3

Source: Data provided by IBVTA based on data from NielsenIQ

<sup>49</sup> The Grocer (2023) Will vaping's youth appeal force a crackdown? 18 February 2023.

As noted previously, these data do not include sales of units made via specialist physical and on-line outlets for e-cigarettes and liquids. In order to gain an understanding of sales of SU-ecigs via all outlets, some understanding of the share of sales made via grocery stores is required.

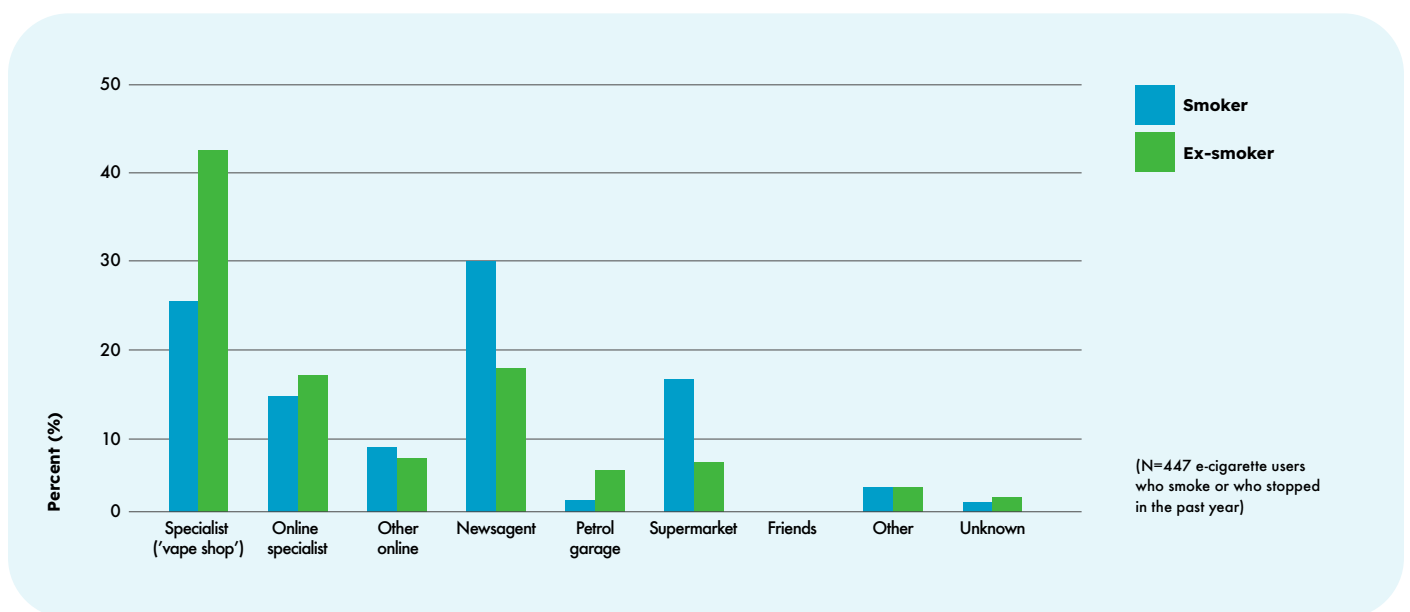
The Smoking in Scotland survey indicates that specialist shops and online stores are still a significant avenue for sales, though far more so (60%) for ex-smokers than for smokers (40%) (see Figure 7).<sup>50</sup> The 'ways of buying' highlighted in Figure 7 reflect sales of all e-cigarettes, and not just those of SU-ecigs. For younger people, ASH's UK study does not differentiate by whether purchases are from grocery, or other stores (though it does suggest a high level of sourcing from others).

Taking into account the preceding evidence, and assuming:

- That the way e-cigarettes are sourced can be considered as an indication of the units purchased from each type of source; and
- That purchasing patterns for SU-ecigs will be similar to purchasing patterns for all e-cigarettes, but with slightly higher shares purchased via grocery outlets (because SU-ecigs are available from a growing number of such outlets, and because the purchases might be assumed to be more of a 'convenience' nature),

we have estimated the proportion of sales of SU-ecigs from grocery stores to be in the range 55-70% of the total.

**Figure 7. Ways of Buying E-cigarettes Used by Current e-cigarette users**



Source: Vera Buss, Loren Kock, Robert West, Emma Beard, Dimitra Kale, Jamie Brown (2023) Trends in electronic cigarette use in Scotland, for Smoking in Scotland, updated 20th January 2023

<sup>50</sup> Vera Buss, Loren Kock, Robert West, Emma Beard, Dimitra Kale, Jamie Brown (2023) Trends in electronic cigarette use in Scotland, for Smoking in Scotland, updated 20th January 2023. Note also that according to the source, the share of smokers and ex-smokers in the number of users is roughly equal.

Total sales in terms of SU-ecigs, as of early 2023, would, based on this range, be between 252 and 320 million units, once the sales from non-grocery outlets are factored in. This is a UK-wide figure.

Ideally, we would repeat the uptake analysis for the whole of the UK, and scale this back to a Scottish share, based on the number of SU-ecig users. We have not done this in the time available. Given the lack of a basis for a regional split, we have apportioned the share to Scotland based on population. According to the Office for National Statistics, Scotland's share was 8.2% as of mid-2021.<sup>51</sup> Using this figure, we estimate sales of SU-ecigs in Scotland to be 20.6 -26.3 million units as of early 2023.

#### **4.1.2 Combining Data on Users and on Consumption**

Bringing together figures regarding the number of users, and the estimated number of units sold, we can estimate the average number of SU-ecigs consumed per user.

Our best estimate of the situation for early 2023 in Scotland is captured in Table 6 (overleaf).

The figures – of 21 to 26 million units consumed in the year to early April 2023 – would equate to purchases of 139 to 177 SU-ecig units per annum per user of e-cigarettes whose main device is a SU-ecig. This is broadly equivalent to smoking (at least in terms of puffs, if not of nicotine) around 20 cigarettes per day.<sup>52</sup>

This analysis is somewhat crude in that it is based on the unlikely assumption that those who declare their main devices, use only those devices. It is reasonable to expect that those who mainly use Rch- and Rf-ecigs will also use SU-ecigs occasionally, and some consumption will be by those who experiment with use, but do not declare themselves to be users of e-cigarettes. If these purchases were accounted for, the average units used per SU-ecig user would fall accordingly. Indeed, since, at the time of writing, surveys indicate the majority of users mainly use Rch- and Rf-ecigs, so the proportion of their vaping activity accounted for by the use of SU-ecigs would not need to be especially high, to lower the estimated average number of units purchased annually by each e-cigarette user whose reports SU-ecigs to be their main device.

<sup>51</sup> Office for National Statistics (2022) Population estimates for the UK, England, Wales, Scotland and Northern Ireland: mid-2021, 21 December 2022, <https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/bulletins/annualmidyearpopulationestimates/mid2021>

<sup>52</sup> Figures vary as regards the equivalence of one SU-ecig to a specific number of cigarettes. Sources suggest a 600 puff device might be equivalent to between 40-50 cigarettes per day. That would give a range of 15-24 cigarettes per day (based on our low and high consumption figures).



**Table 6. Estimated Uptake Rate for SU-ecigs (and others) in Scotland**

Age Bracket	Total Users of E-cigarettes ('000s)	Users as Proportion of Population in Age Group	Users Whose Main Device is SU-ecigs ('000s)	SU-ecig Users as Proportion of e-cigarette Users in Age Group
11 to 17	78.16	22%	45.87	59%
18 to 24	96.49	22%	53.96	56%
25 to 34	137.40	18%	30.41	22%
35 to 44	87.33	13%	11.19	13%
45 to 54	66.66	9%	3.30	5%
55 to 64	52.65	7%	2.61	5%
65 to 74	13.33	2%	0.66	5%
75 and over	11.25	2%	0.56	5%
<b>Total Number</b>	<b>543.27</b>		<b>148.56</b>	
<b>Consumption Levels</b>				
<b>Low (million units)</b>			20.6	
<b>High (million units)</b>			26.3	

Source: Equanimator Ltd estimates

## 4.2 Forecasts

Forecasts of future growth are not straightforward to make in the context of what is evidently a rapidly changing market. If the uptake of vaping is increasing faster than previously, the share of the market which is taken by SU-ecigs is rising much faster. One trade journal article quoted one store founder as follows:<sup>53</sup>

*“The growth of disposable vapes was largely unpredicted and, even for those that had an inkling it was coming, the scale and pace has been unprecedented,” says Harris Tanvir, co-founder of UK e-cigarette Store.*

Another article highlighted the marketing of products to young people:<sup>54</sup>

*There’s no doubt vaping devices are “finding their way into the hands of 12- and 13-year-olds”, says David MacKenzie. (He is chair of the Society of Chief Officers of Trading Standards in Scotland (SCOTTS), the organisation responsible for policing underage sales).*

*They are “very cheap, they have bright colours, and they are attractive to children” he adds. “They’re clearly designed to sell to young people.”*

*[...] Some suppliers are “using pack designs that are likely to appeal to children”, he adds – for example, cartoon images. This “damages the whole industry”, Howell argues.*

The figures from Nielsen IQ for sales from grocery outlets (excluding dedicated physical and online e-cigarettes stores) indicated:<sup>55</sup>

- Vaping sales more than doubled in the year to September, according to NielsenIQ, rising by 120.9% to £793m.
- Price growth was steep – up 47.9% to an average of £4.18 a unit – while volumes shot up 49.4%.
- The growth is largely due to the rise of disposable ‘cigalike’ e-cigarettes, which “dominated the past year” says NielsenIQ analyst Laszlo Zsom.
- Sales of the format rocketed due to “low price per puff, vast flavour variety, high availability and convenience of use”.
- The prime example is ElfBar, which now accounts for two-fifths of vaping’s value with £322m in sales. The brand “built out national presence and offers a wide range of flavours”, says Zsom.

<sup>53</sup> George Nott (2022) Tobacco & vaping 2022: Disposable vapes drive stunning growth, The Grocer, December 2022.

<sup>54</sup> The Grocer (2023) Will vaping’s youth appeal force a crackdown? 18 February 2023.

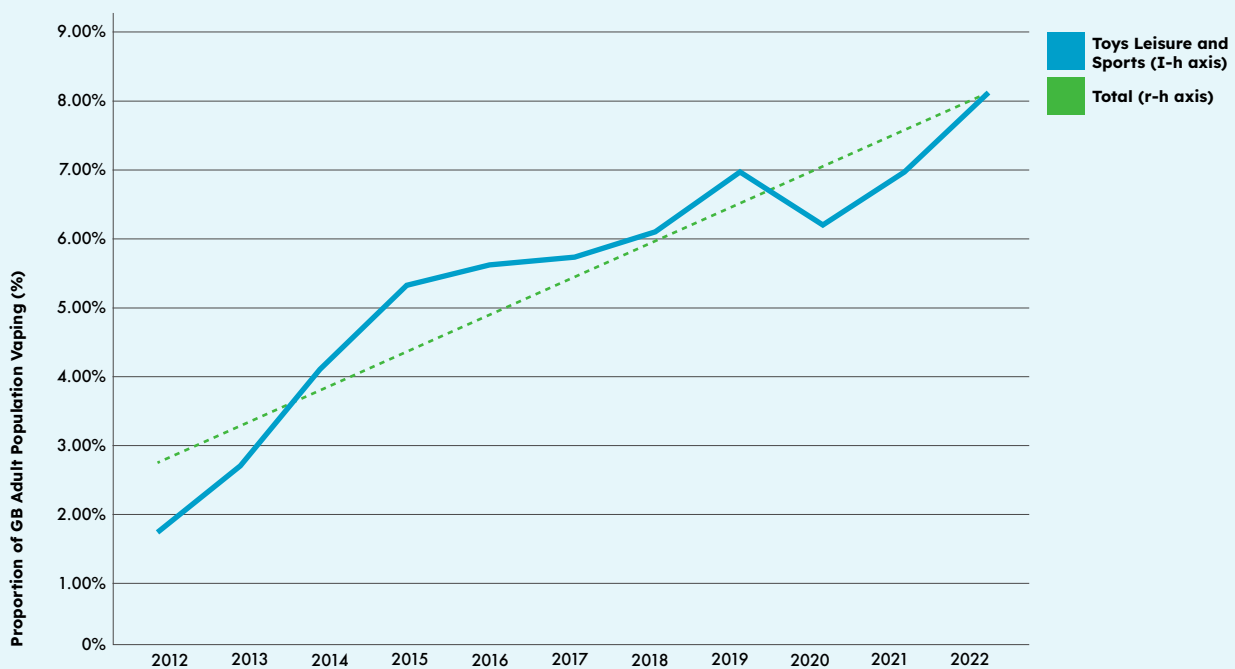
<sup>55</sup> The Grocer (2023) Will vaping’s youth appeal force a crackdown? 18 February 2023.

- Vuse also managed to adapt to the market. Having traditionally been a refillable brand, it launched a cigalike product in May that has generated sales of £85m across its portfolio.
- By contrast, closed system brands suffered. *“Juil, Logic and Blu were negatively impacted by the fast growth of ElfBar and similar disposable brands,”* says Zsom.
- Given the market shift, closed brands like Juul and Logic *“that were seeing significant growth now face losing range availability”*, Zsom warns.

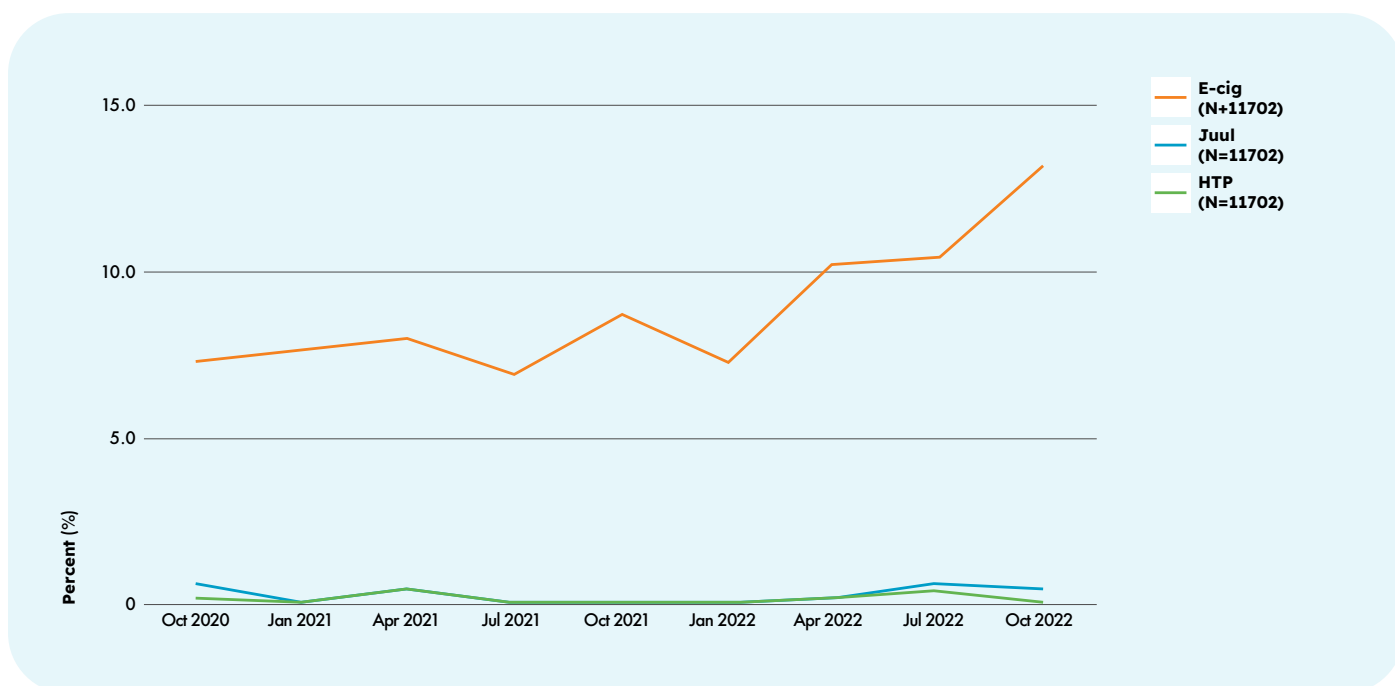
In this forecast, we assume that no further action is taken relative to the current situation: in other words, we consider what may happen if nothing changes. The obvious point is that this is not a ‘legally compliant’ situation: if that were the case, there would be zero sales of SU-ecigs to under-18s in Scotland, and there might also be constraints on product design (see below).

In principle, these trends should be informed by objective data, but the rapidity of change makes this difficult. For the ASH GB survey, the evolution in the share of adults using e-cigarettes appears to be growing at roughly 0.55 percentage points per annum at the GB level (see Figure 8).

**Figure 8. Evolution in Proportion of GB Population Vaping**



**Figure 9. Prevalence of e-cigarette use in Scotland**



Source: Vera Buss, Loren Kock, Robert West, Emma Beard, Dimitra Kale, Jamie Brown (2023) Trends in electronic cigarette use in Scotland, for Smoking in Scotland, updated 20th January 2023

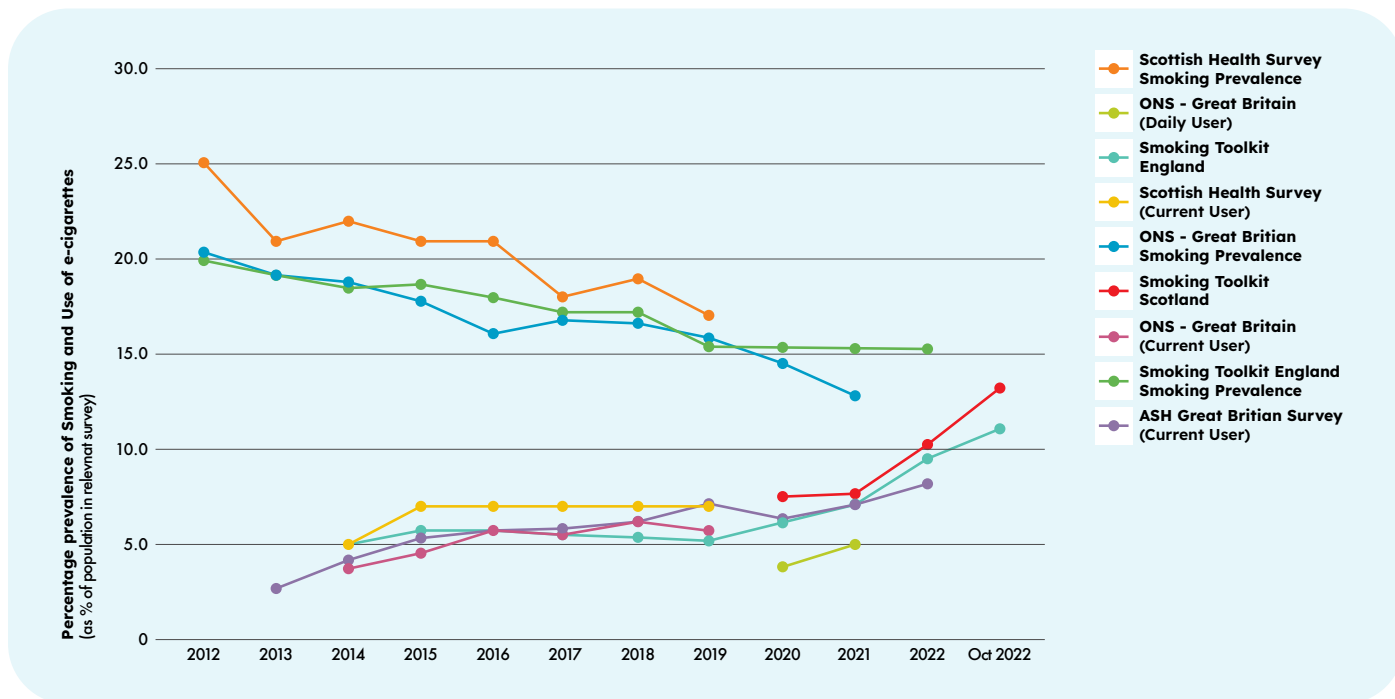
In Scotland, adult use of e-cigarettes climbed from 7.3% of the adult population to 13.2% in the course of not much more than a year (to October 2022) (see Figure 9).

In making our projection, we have assumed that the radical shift reported in sales, and the increased use of SU-ecigs as a main vaping device, indicates a direction of travel, but that the pace of the change that was witnessed in 2021-2022 is not sustained. All 'uptake' surveys suggest that further increases in user numbers are likely in the coming years (see Figure 10, overleaf).

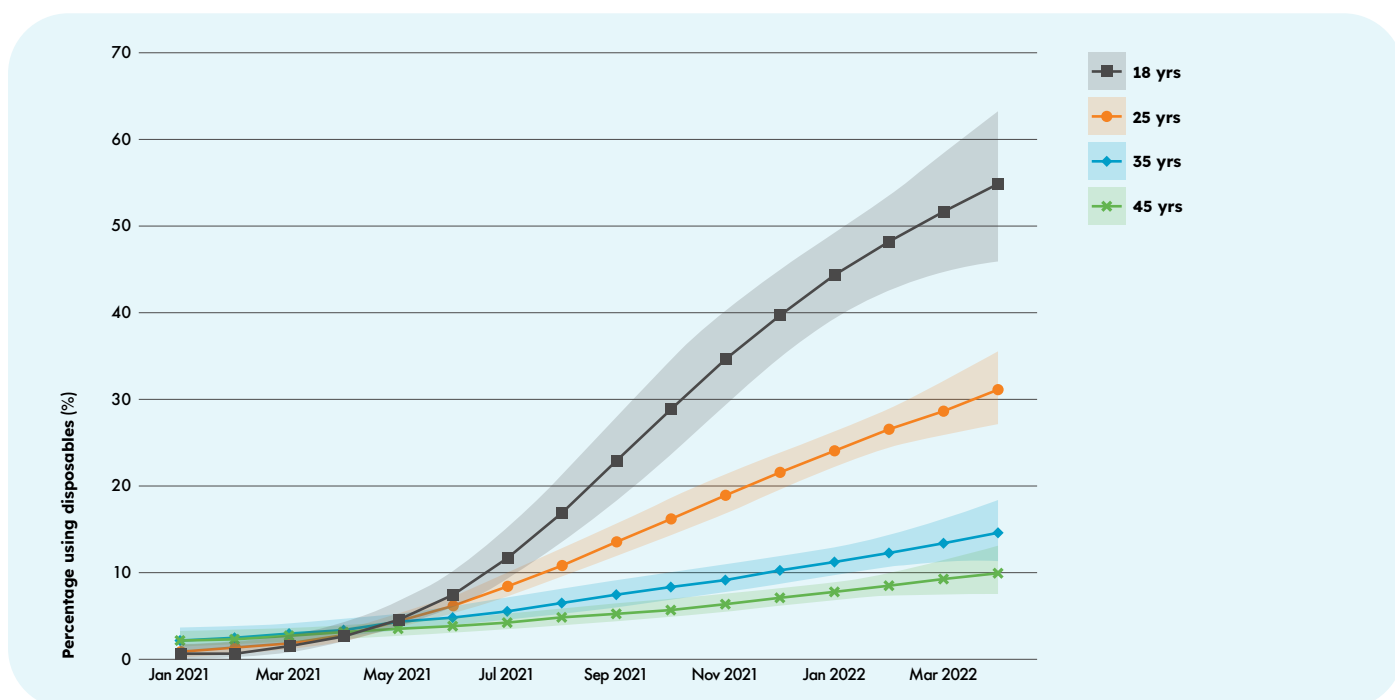
It is difficult to see the growth in the share of overall e-cigarette use accounted for by SU-ecigs being reversed. In Figure 11 (overleaf), we show the evolution of GB users of e-cigarettes in the uptake of SU-ecigs across different age groups. Whilst it is tempting to consider the existence of an upper bound to the overall level of uptake of e-cigarettes, or the share accounted for by SU-ecigs, there is no obvious 'upper bound' that can be considered. Whilst e-cigarettes are different products to cigarettes, SU-ecigs might already be considered – in some age groups – as fashionable, and conventional cigarettes were, in the 1940s, smoked by 65% of adult men, and more than 40% of adult women in Great Britain.<sup>56</sup>

<sup>56</sup> ASH (2023) Trends in Smoking, <https://ash.org.uk/resources/view/smoking-statistics>

**Figure 10. Smoking and e-cigarette use prevalence across time – comparison of different survey – Scotland and other GB**



**Figure 11. Percentage of current vapers using disposable e-cigarettes across ages in Great Britain from 2021 to April 2022**



Note. A total of 36,876 eligible adults were surveyed (approximately 2300 each month). Lines represent point estimates from logistic regression allowing an interaction between age and month, modelled non-linearly using restricted cubic splines (three knots). Shaded areas represent standard errors. Source: Tattan-Birch H, Jackson SE, Kock L, Dockrell M, Brown J. (2023) Rapid growth in disposable e-cigarette vaping among young adults in Great Britain from 2021 to 2022: A repeat cross-sectional survey. *Addiction*. 2023;118(2):382-6. <https://doi.org/10.1111/add.16044>

Nonetheless, it would also be difficult to justify – statistically – a forward projection for five years which is based wholly on extrapolation from one year’s data. We think it reasonable to consider that, in the absence of any intervention, key changes to be expected are:

1. Continued growth in uptake of e-cigarettes across the population of Scotland;
2. Alongside this growth, a rising share of SU-ecig users (and share of sales revenue) among the growing number who use e-cigarettes.

Our projection, therefore, is based on of the following assumptions:

- Uptake of e-cigarettes in the under 16s increasing by 2 percentage points per annum (just below the rate for S2s (regular and occasional), and well below half the rate for S4s (regular and occasional));<sup>57</sup>
- Uptake of e-cigarettes in the population aged 16 and over increasing by 1.5 percentage points per annum, i.e., 1.5% of the population are added to the number of e-cigarette users in each year (half the rate of the year to 2022);<sup>58</sup>

- Increase in the proportion of e-cigarettes users whose main device is SU-ecigs of 4% per annum (of e-cigarette users in the age-bracket) across the under 16s, the 16-24 age bracket, and the 25-34 age bracket;
- Increase in the proportion of e-cigarettes users whose main device is SU-ecigs of 2% per annum (of e-cigarette users in the age-bracket) across those aged 35 and upwards;
- The number of SU-ecig units purchased per annum, expressed per person for whom SU-ecigs are the main device used, remains constant.<sup>59</sup>

The results for user numbers and consumption are shown in Table 7 (overleaf).

### 4.3 Trade

Where SU-ecigs are concerned, it appears that the majority of the production takes place in China. A small amount of manufacturing may occur in the UK, though we are not aware of manufacturers of SU-ecigs based in Scotland (which should not be taken to imply there are none, but if there are any, their market share is currently small).

<sup>57</sup> Scottish Government (2023) Health and Wellbeing Census Scotland: 2021/22. Experimental Statistics: Statistics under Development, 28 February 2023, and Supplementary Tables.

<sup>58</sup> Vera Buss, Loren Kock, Robert West, Emma Beard, Dimitra Kale, Jamie Brown (2023) Trends in electronic cigarette use in Scotland, for Smoking in Scotland, updated 20th January 2023

<sup>59</sup> Both this and the previous rate are conservative if one considers the evidence in Tattan-Birch H, Jackson SE, Kock L, Dockrell M, Brown J. (2023) Rapid growth in disposable e-cigarette vaping among young adults in Great Britain from 2021 to 2022: a repeat cross-sectional survey. *Addiction*. 2023;118(2):382–6. <https://doi.org/10.1111/add.16044>

**Table 7. Forecast number of users of e-cigarettes/SU-ecigs and SU-ecig consumption**

	2022	2023	2024	2025	2026	2027
<b>E-cigarette Users</b>						
<b>Uptake, 11-15 (% population in age bracket)</b>	17%	19%	21%	23%	25%	27%
<b>Uptake, &gt;16, (% population in age bracket)</b>	11%	12%	14%	15%	17%	18%
<b>Uptake, 11-15, '000s</b>	51	57	63	69	74	79
<b>Uptake, &gt;16, '000s</b>	493	563	634	705	777	849
<b>Total, '000s</b>	543	620	697	774	851	929
<b>E-cigarette Users for Whom SU-ecig is Main Device</b>						
<b>11-15 (as % e-cigarette users)</b>	60%	64%	68%	72%	76%	80%
<b>16-24 (as % e-cigarette users)</b>	56%	60%	64%	68%	72%	76%
<b>25-34 (as % e-cigarette users)</b>	22%	26%	30%	34%	38%	42%
<b>35 and higher (as % e-cigarette users)</b>	8%	10%	12%	14%	16%	18%

**Table 7. Forecast number of users of e-cigarettes/SU-ecigs and SU-ecig consumption** cont'd.

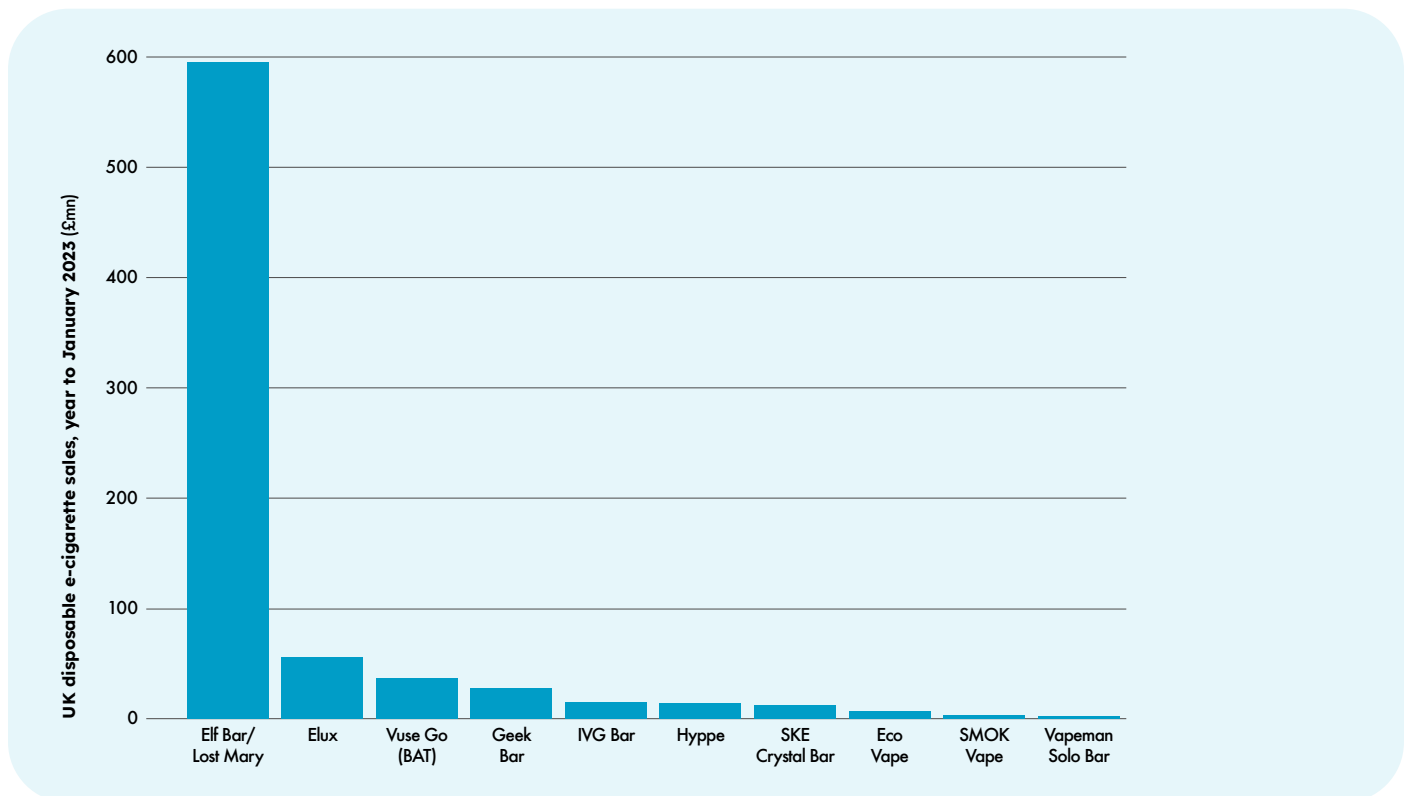
	2022	2023	2024	2025	2026	2027
<b>11-15('000s)</b>	30.46	32.48	34.50	36.53	38.55	40.57
<b>16-24 ('000s)</b>	69.37	84.54	101.38	119.74	140.40	163.64
<b>25-34 ('000s)</b>	30.41	40.03	50.52	61.98	73.43	84.72
<b>35 and higher ('000s)</b>	18.31	26.32	35.74	46.56	58.85	72.53
<b>Total ('000s)</b>	148.56	183.37	222.14	264.81	311.22	361.47
<b>Implied (pro-rated) Consumption of SU-ecigs</b>						
<b>Low (million units)</b>	20.63	25.46	30.85	36.77	43.22	50.19
<b>High (million units)</b>	26.26	32.41	39.26	46.80	55.00	63.88



There are dominant brands, and companies that own those brands. A recent FT article indicated that based on NielsenIQ data, the producer of Elf Bar and Lost Mary (the same parent company) dominates UK disposable e-cigarette sales, accounting for around three quarters of all revenue from SU-ecigs sales (see Figure 12).<sup>60</sup> ASH sought information on popular brands among under-18 users of SU-ecigs in the UK indicated a similar concentration of brand presence, albeit with Geek Bar more prevalent than Lost Mary in the age group according to the survey (see Figure 13, overleaf).<sup>61</sup>

Geek bars are also manufactured in China, and so are Hyppe. Vuse liquids may be made in the US, but the SU-ecigs, Vuse Go, are manufactured in China. IVG (I Vape Great) is headquartered in Preston and as far as we can see, may produce disposables in the UK (though this is not clear as it is a company with presence in several countries). IVG also produces refillable devices and liquids.

**Figure 12. UK disposable e-cigarette sales, year to January 2023 (£mn)**

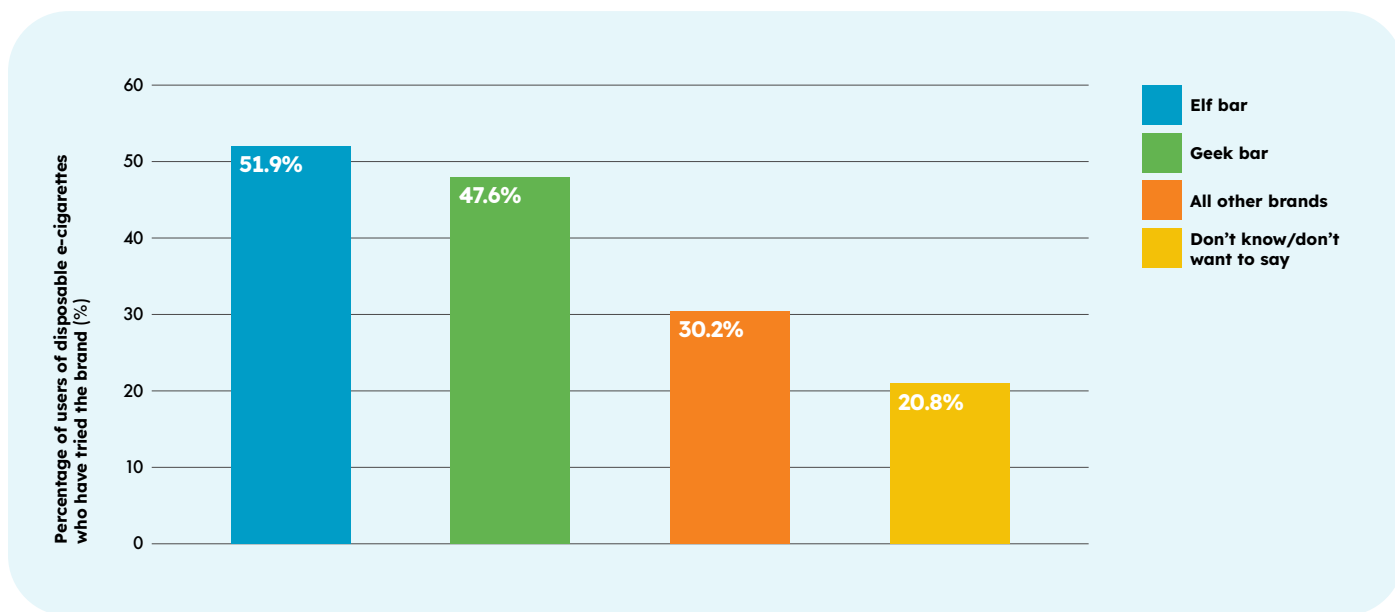


Source: Oliver Barnes and Alexandra Heal (2023) The environmental cost of single-use vapes: Critical raw metals inside the disposable e-cigarettes enticing Gen Z are more likely to be dumped than recycled, FT, March 7 2023 <https://www.ft.com/content/6d5ed980-8b91-4372-9e7e-14eda5419325>

<sup>60</sup> Oliver Barnes and Alexandra Heal (2023) The environmental cost of single-use vapes: Critical raw metals inside the disposable e-cigarettes enticing Gen Z are more likely to be dumped than recycled, FT, March 7 2023 <https://www.ft.com/content/6d5ed980-8b91-4372-9e7e-14eda5419325>

<sup>61</sup> Action on Smoking and Health (ASH) (2022) Use of e-cigarettes (vapes) among young people in Great Britain, July 2022.

**Figure 13. Brand of device tried by 11-17 year olds who vape disposables**



Source: Action on Smoking and Health (ASH) (2022) Use of e-cigarettes (vapes) among young people in Great Britain, July 2022.

The nature of the SU-ecig market is that the vast majority of units sold are imported from Shenzhen in China, the global centre for vaping manufacture, and in particular, the manufacture of SU-ecigs. China is also a centre for low-cost lithium polymer battery manufacture.

Within the UK, a small number of brands appear to dominate the Rch-ecigs market. According to ASH:<sup>62</sup>

Of those who currently vape with a cartridge, the most popular types of rechargeable devices with pre-filled cartridges are JUUL (19%), Logic (17%), Vuse (16%), Vype (16%) and blu (14%).

It is not clear whether these are 'unique' survey results (i.e., the numbers would sum to 100%) or whether they represent the proportion of users trying a given brand. If the former, then 5 brands share 82% of the market for Rch-ecigs used by adults, according to the survey. Note that this might not necessarily translate into sales volumes.

The nature of the supply chain for the Rf-ecigs seems less well-studied. Furthermore, the refillable nature of the product appears to lend itself to a more diverse (and potentially, more local) range of suppliers of vaping liquids. Arguably, if these products are used as intended, they might be less problematic as sources of WEEE. Nonetheless, they are WEEE, but the more diverse market might imply that the dry weight accounted for by some suppliers is relatively low.

<sup>62</sup> Action on Smoking and Health (ASH) (2022) Use of e-cigarettes (vapes) among adults in Great Britain, August 2022.

# 5 Environmental Impacts Associated with E-cigarettes

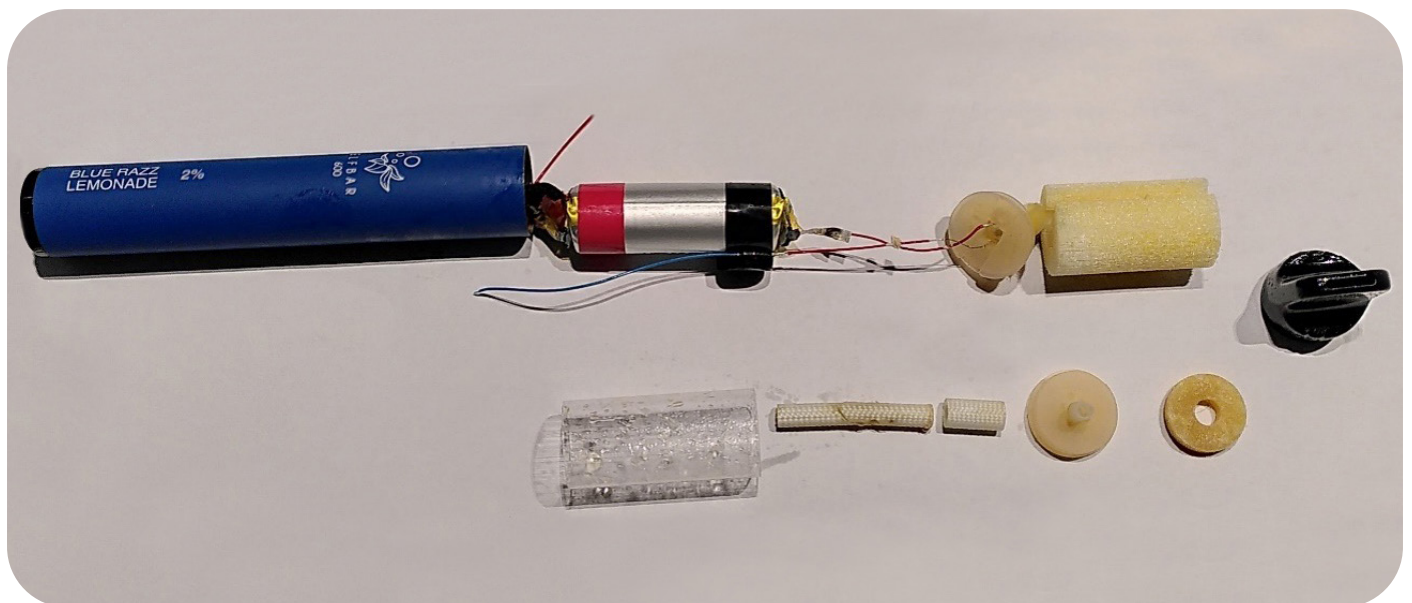
In order to inform an understanding of the environmental consequences of consuming, and end of life management of SU-ecigs, it is important to understand what they are made from and their associated packaging. The materials from which they are made link to the impacts of their manufacture, and their subsequent management.

## 5.1 Content of SU-ecigs

Materials scientist, Mark Miodownik tweeted an image of a tear down of one of the most popular SU-ecigs. This is shown in Figure 14. We also conducted similar teardowns of two other widely consumed SU-ecigs, shown in Figure 15, overleaf.

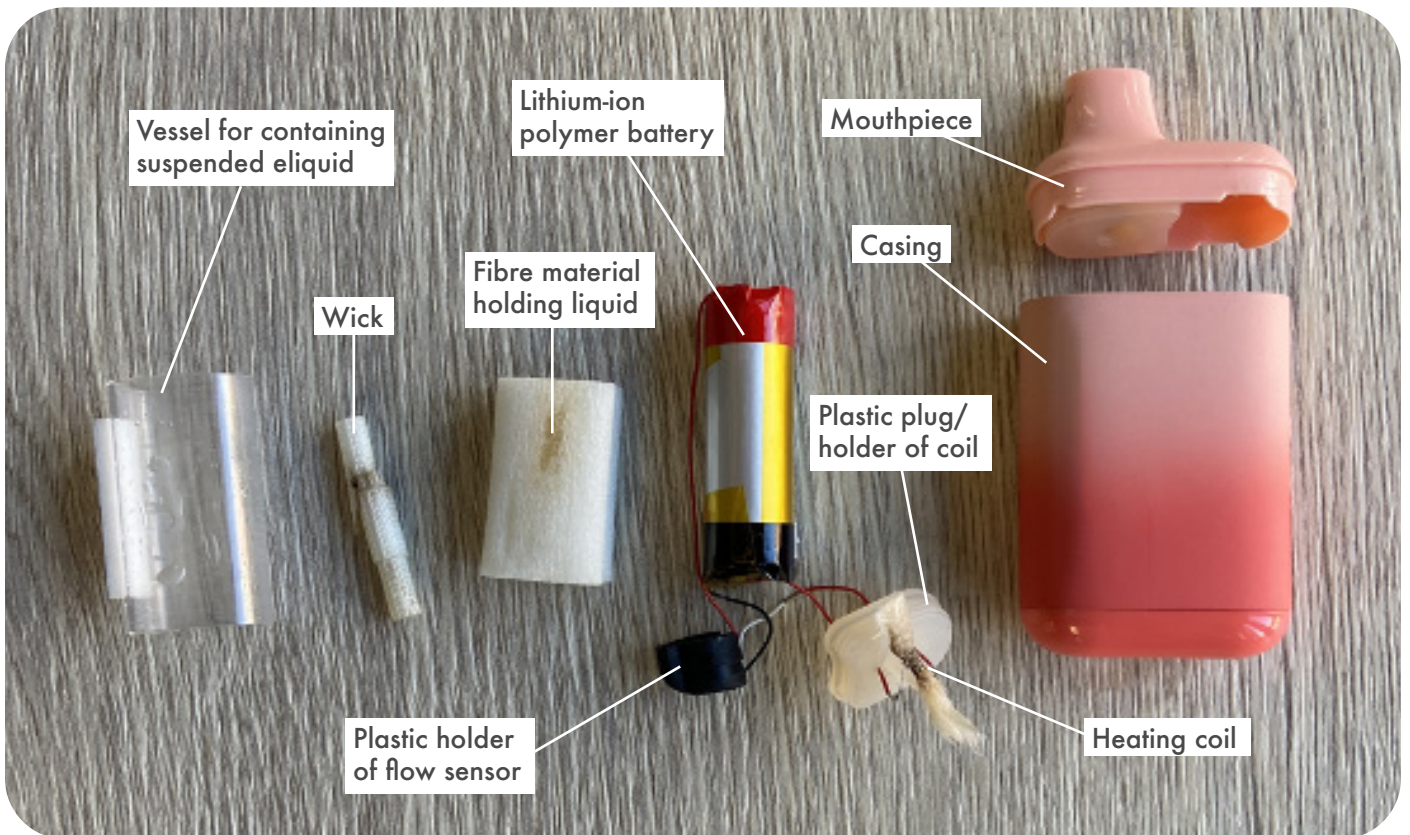
The first is a littered SU-ecig that had been run over by (probably) a car: its fate has the merit of clearly showing the metallic nature of the casing (from the scratching).

Figure 14. Basic teardowns of a popular brand SU-ecig



Source: <https://twitter.com/markmiodownik/status/1574313785569034241>

Figure 15. Basic teardowns of two widely consumed SU-ecigs



Source: Equanimator Ltd

According to the FT, based on data from Nielsen IQ, these two brands may be responsible for around 75% of sales of SU-ecigs in the UK.<sup>63</sup> From the above two Figures, the construction is similar (both products come from the same parent company and the same UK distributor). Essentially, the main differences in the manufacture are:

- The shape of the external casing and the materials used for it;
- The shape of the mouthpiece; and
- The shape of the vessel containing the liquid and the closely fitting (to that shape) material which surrounds the atomizer (which consists of the heating coil and a wicking material).

The battery is the same for both, a rechargeable 13400 lithium polymer battery of 550 milliampere-hour (mAh) capacity, which manufacturers suggest could be recharged 500 times. The coil and wick look to be the same; the coil is usually made from a resistance wire, which sources indicate may be kanthal, a trademarked alloy of iron, chromium and aluminium (FeCrAl). The wick may be made from cotton.<sup>64</sup>

The similarity in design in other respects does not necessarily imply that the same materials are used in all SU-ecigs. For example:

- The nature of the casing may vary, with plastic polymers being widely used, but casings are not exclusively plastics. Plastics that may be used could include polypropylene, polyethylene, polystyrene, polycarbonate, acrylonitrile butadiene styrene (ABS). Other materials used include metals. The Elf Bar, one of the SU-ecigs with greatest market share (see Table 4 and Figure 12), has a metal casing (which appears to be steel – see above);
- Similarly, different polymers could be chosen for the mouthpiece, though plastic is likely to be the material of choice;
- The nature of fillers (designed to suspend the liquid around the atomiser) may show some variation across brands, but they are likely to be non-woven synthetic fibres;

<sup>63</sup> Oliver Barnes and Alexandra Heal (2023) The environmental cost of single-use vapes: Critical raw metals inside the disposable e-cigarettes enticing Gen Z are more likely to be dumped than recycled, FT, March 7 2023 <https://www.ft.com/content/6d5ed980-8b91-4372-9e7e-14eda5419325>

<sup>64</sup> Note that is not strictly necessary to use a coil for heating, which can be achieved through ultrasonic methods.

- The nature of the coil could be kanthal, or nichrome, or another metal alloy. Other materials used in coils include nichrome, which is an alloy of nickel and chromium.

The nature of the coil material is a matter much discussed in vaping circles.<sup>65</sup> The phenomenon of 'sub-ohm' vaping attracts a great deal of attention, the idea being that lower resistance (as measured by the resistance of the coil wire, for which the unit is 'ohms') allows a higher current to flow at a given battery voltage, leading to greater heating, a larger inhalation, and a 'better' plume. It is difficult for disposable e-cigarettes to offer a sub-ohm experience: the coils tend to have a higher resistance (2.4-2.8 ohms, though some have resistance as low as 1.6 ohms). A lower resistance wire would reduce the number of 'puffs' per vape and, other things being equal, run down the battery – which even if 'rechargeable' cannot practically be recharged – faster than with a higher resistance, lower current configuration. For e-cigarettes generally, this highlights a functional relationship between battery voltage and capacity (mAh), the resistance of the coil, and the pace at which liquid is 'used up'. Evidently, whatever the perceived benefits in respect of the plume, the fact that lower resistance coils will produce more vapour per puff also implies that a greater amount of the content is inhaled in each puff;

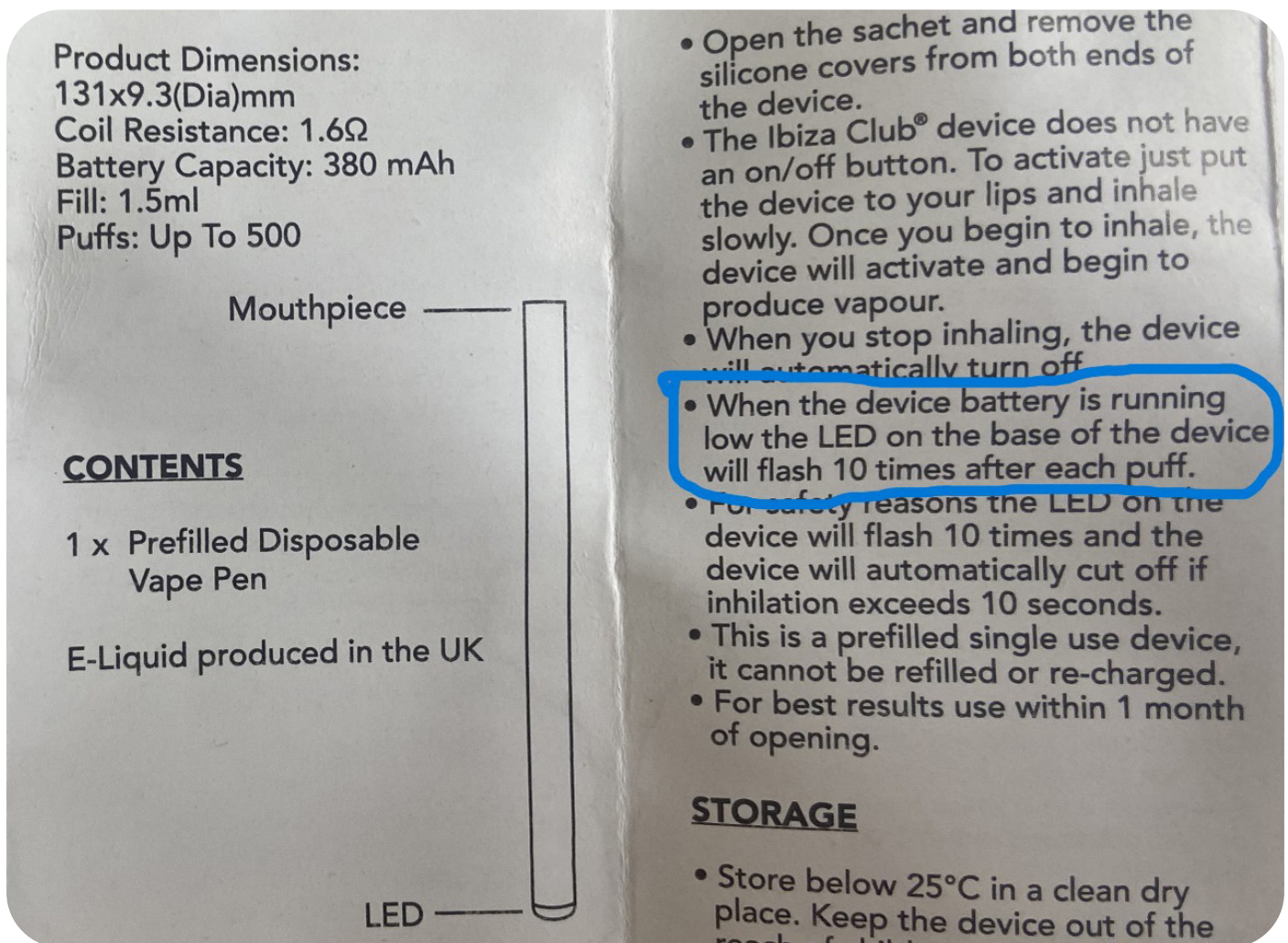
- The choice of the battery might be either a lithium-ion polymer (LiPo) battery that could be recharged (if the rationale for doing so was present) or a primary lithium battery, which is not rechargeable. It seems possible that both are used, but the brands that are thought to have the greatest share of the market (this is evidently subject to change). Primary lithium batteries should have a lower discharge rate (when not used) than rechargeable LiPo batteries which may discharge at the rate of around 5% per month). It is possible, therefore, that lower battery capacities (expressed in terms of mAh) can be used where primary lithium batteries are used as opposed to LiPo ones, where the loss of charge could lead to unexpended vaping liquid remaining in the container after the battery has discharged. Battery size seems to vary across suppliers of SU-ecigs. In a review undertaken by the author for this study, of the most popular brands of SU-ecigs, the capacity varied from 270mAh to 550mAh. Lower capacities tended to be associated with SU-ecigs marketed as having a content equivalent to 500 puffs, as opposed to most which claim 600;

<sup>65</sup> See, for example, Vape Coils Explained - Which Vaping Coil Types Are Right For You? <https://www.theelectroniccigarette.co.uk/vape-coils-explained>

- Some SU-ecigs include LEDs. Ironically, as per the instructions provided with some SU-ecigs, this is often to highlight that the battery is running low (despite there being no way to recharge the battery – see Figure 16);
- Finally, so as to be available for ‘on demand’ vaping, the SU-ecigs typically include a small (hot film flow) sensor that detects airflow and activates the heating element.

Along with the battery, it is effectively the control system that drives the atomisation system. The small flow detection sensor chips in e-cigarettes can monitor the smoke inhaled by users in real time, and adjust heating power to meet users’ intake demand in accordance with airflow inhaled. This function used to be provided by pressing a button (to activate current when inhaling), but the use of airflow-detection systems seems widespread in most SU-ecigs now on the market.<sup>66</sup>

Figure 16. Labelling regarding LED



Source: Equanimator Ltd

<sup>66</sup> See, for example, Bin Zhang et al (2020) Application technology of hot film flow sensor in intelligent electronic cigarette, 2020 Journal of Physics: Conference Series 1653 (2020) 012038

### 5.1.1 Use of Brominated Flame Retardants

In a Technical Note for SWEEEP Kuusakoski, Resource and Waste Solutions cited literature that they suggested would support the notion that plastics used in e-cigarettes include brominated flame retardants (BFRs).<sup>67</sup> They also noted that whilst BFRs are indicated as persistent organic pollutants (POPs), some manufacturers may be using organophosphate flame retardants, which are not classified as POPs. Their conclusions were as follows:

*This suggests that e-cigarette manufacturers are using organophosphate flame retardants (OPFRs), which are not classified as POPs, in preference to BFRs. However, Shan Shan et al from the Baptist University in Kowloon found moderate to elevated levels of poly-brominated diphenyl ethers (PBDEs) in the aerosols from 5 out of the 13 samples of e-cigarettes.*

*We therefore consider that in 2018 at least some e-cigarettes sold containing BFRs which are POPs. We have not found any data that indicates whether the concentration of BFRs is above the threshold for consideration as POPs or whether BFRs are no longer used but given the purpose of the BFRs, we consider it likely that some e-cigarettes will be POPs waste and should be identified accordingly.*

The form of incorporation of BFRs was not made clear, and the conclusions can be considered somewhat speculative given the nature of the evidence. However, it seems clear that the use of BFRs should not be ruled out in the absence of further investigation. The apparent absence of a clear way of knowing which items do, or do not, contain which chemicals is problematic for both consumers, and those entities responsible for handling e-cigarettes (or small mixed WEEE that may contain e-cigarettes).

### 5.1.2 Liquids in (SU) e-cigarettes

All of the above abstracts from the nature of the liquids themselves, some of which may remain in the device, either because it has been discarded before it has been finished, or because the battery no longer provides the necessary current to heat the liquid. Our interest, in this Section, is not the health impact of the liquids as they are intended to be used (for vaping). Our focus is on the potential impact of the chemicals if they are not used as intended, notably, where they are discarded, and considering the impact 'in the environment', and the potential impacts for those who may handle them post-use.

In this context, it should be considered that we have no meaningful data regarding the amount of liquid which are incorporated in discarded SU-ecigs. The author's experience of a relatively small number of tear-downs of littered SU-ecigs suggested there was always some residual liquid in the device as discarded.

<sup>67</sup> Resource and Waste Solutions (2022) Technical note on classifying and consigning used e-cigarettes, October 2022.



In some cases, this was a significant quantity (bearing in mind the maximum allowable quantity of liquid is 2 millilitres). Some of the liquids concerned are volatile (glycerin, ethyl butyrate) and so may be inhaled. Some – such as glycerin, propylene glycol, and ethyl butyrate are also flammable.

Two common components of e-liquids used in SU-ecigs are vegetable glycerin (glycerol) and propylene glycol (PG). The former is quite a thick, sweet-tasting liquid that is used to produce vapour clouds. The latter is a thinner liquid that appears to be used to give a stronger 'throat hit' to vapers. The former is widely used in cosmetics and the latter is used as a food additive. They are not thought to pose great risks in current uses, though there have been concerns around the inhalation of propylene glycol in occupational settings. Propylene glycol (PG) is a chemical to which there is (in relative terms) a fairly high incidence of skin allergy.

Of these two liquids:

- Glycerin has some indications of aqua toxicity, though only at high levels of exposure. The ECHA Registration Dossier indicates that efforts should be made to prevent glycerin from entering into soil, ditches, sewers, waterways and/or groundwater.<sup>68</sup> It is, however, thought to rapidly biodegrade in soil. It has the potential to cause irritation to eyes if contact is made.

Where prolonged or repeated contact may occur, gloves chemically resistant to the material should be used (preferably, a glove with a protection class of 4 or higher (breakthrough time greater than 120 minutes according to EN 374) is recommended). Ingestion should be avoided, but respiratory protection should not be needed;

- The ECHA Registration Dossier indicates that efforts should be made to prevent PG from entering drains or watercourses. It also has the potential to cause irritation to mucus membranes, eyes and skin. It has low toxicity following acute ingestion.<sup>69</sup> PG is readily biodegradable, although there are some indications of aqua toxicity, these are rendered less significant by the biodegradability of the chemical.

There are different issues where nicotine is concerned: the nicotine content of liquids used in SU-ecigs is regulated, and indeed, nicotine is not included in all e-cigarettes, though it is widely used.

The summary of key classifications where nicotine liquid is indicated as harmful, alongside the ECHA recommended labelling, is shown in Table 8, overleaf.

<sup>68</sup> Registration Dossier - ECHA (europa.eu) <https://echa.europa.eu/registration-dossier/-/registered-dossier/14481/9>

<sup>69</sup> Registration Dossier - ECHA (europa.eu) <https://echa.europa.eu/registration-dossier/-/registered-dossier/14481/9>

**Table 8. Summary of key classification and labelling information for nicotine consumption**

<b>Acute toxicity – oral</b>	
<b>Hazard category</b>	Acute Tox. 2
<b>Hazard statement</b>	H300: Fatal if swallowed
<b>Acute toxicity - dermal</b>	
<b>Hazard category</b>	Acute Tox. 2
<b>Hazard statement</b>	H310: Fatal in contact with skin
<b>Acute toxicity - inhalation</b>	
<b>Hazard category</b>	Acute Tox. 2
<b>Hazard statement</b>	H330: Fatal if inhaled.
<b>Environmental hazards</b>	
<b>Hazardous to the aquatic environment (long-term)</b>	
<b>Hazard category</b>	Aquatic Chronic 2
<b>Hazard statement</b>	H411: Toxic to aquatic life with long lasting effects
<b>Labelling</b>	
<b>Signal word</b>	Danger
<b>Hazard pictogram</b>	GHS06: skull and crossbones GHS09: environment
<b>Hazard statements</b>	H330: Fatal if inhaled H300: Fatal if swallowed H310: Fatal in contact with skin H411: Toxic to aquatic life with long lasting effects

Note: the lighter text indicates where nicotine is present below the threshold concentrations when used in e-cigarettes)  
 Source: European Chemicals Agency (ECHA) Registration Dossier for Nicotine Liquid, <https://echa.europa.eu/registration-dossier/-/registered-dossier/15857/2/1>

The following harmonised Acute Toxicity Estimate (ATE) values were included in Annex VI to Regulation (EC) No. 1272/2008:

- Inhalation: ATE= 0.19 mg/L (dusts or mists)
- Dermal: ATE= 70 mg/kg
- Oral: ATE= 5 mg/kg\*

\*converted acute toxicity point estimate according to Table 3.1.2 of Annex I to the regulation.

There are concerns that given its impact on humans, that nicotine might also be harmful if ingested by animals in the terrestrial environment (as well as having impacts on the aquatic environment). This is considered further below.

Accidental Release measures identified in 'Guidance for safe use' are:

*Inform respective authorities in case the substance reaches water or sewage system. Dilute with much water. Do not allow to enter drainage system, surface or groundwater. Keep dirty washing water for appropriate disposal.*

Methods and materials for containment and cleaning up are:

*Absorb with liquid-binding material (sand, diatomite, acid binders, universal binder, sawdust). Ensure adequate ventilation.*

Recommendations are also made for exposure control and personal protection.

Nicotine is biodegradable:

*Biodegradation was tested in water (screening test). Ready degradability is defined in the guidelines as degradation surpassing 60% within 10 days after reaching a level of 10%. Therefore, the test item nicotine can be considered as "readily biodegradable".*

It might be considered that most SU-ecigs market their liquids as containing 'nicotine salts'. ECHA indicates the same labelling as being applicable, as well as the same ATEs.<sup>70</sup>

Note that in a Technical note issued by SWEEEP Kuusakoski late last year, it was reported that a typical e-liquid (strength 18mg/litre of nicotine) analysed in November 2020 was found to contain the following:

- Nicotine
- Benzoic Acid
- Piperonal
- Benzyl alcohol

All these chemicals are listed by the European Chemicals Agency (ECHA) as hazardous above specified concentrations, and all are typically present in e-liquid at or above these concentrations.

<sup>70</sup> <https://echa.europa.eu/substance-information/-/substanceinfo/100.240.835>

Therefore, a report by Resource and Waste Solutions for SWEEEP Kuusakoski concluded that e-liquid itself is hazardous and that, depending on the proportion of e-liquid remaining in the device, several of these liquid components as well as the other parts of an e-cigarette have the potential to make a waste e-cigarette hazardous. They went on to say:<sup>71</sup>

*Based on these limits and the typical weight of e-cigarettes and e-pods, RWSP [Resource and Waste Solutions, who conducted the hazard assessment on behalf of SWEEEP Kuusakoski] concluded in November 2020 that used e-cigarettes would have to contain between 30% and 56% of the e-liquid to be classed as hazardous due to nicotine and/or benzoic acid. An empty e-cigarette contains on average less than 0.25g of e-liquid and therefore it was concluded that on average waste e-cigarettes contain insufficient e-liquid to render them hazardous waste.*

The problem, perhaps, is that 'the average' is exactly that: in the real world, most discarded e-cigarettes do not perfectly resemble 'the average' so there are likely to be e-cigarettes discarded with a quantity of e-liquid that is above and below the average. Perhaps reflecting this, the same report recommended:

*That appropriate safe procedures are adopted, and protective clothing worn to protect the skin from splashes of e-liquid and to prevent or minimise inhalation.*

*Due care needs to be exercised in the handling, transportation and treatment or disposal of e-cigarettes due to the potential hazards arising from e-liquids.*

The Environment Agency recently issued guidance confirming whole e-cigarettes cannot be incinerated due to the dangers of lithium fires & potential mismanagement of persistent organic pollutants (POPs) within the plastic casing.<sup>72</sup>

For compliance schemes, the regulator explained that the WEEE regulations require them to "set up systems that provide for the separate collection and treatment of WEEE using best available collection, treatment, recovery, and recycling techniques, for any WEEE for which they are responsible".

It also requires that Producer Compliance Schemes (PCSs) make sure the WEEE is treated at an ATF (Authorised Treatment Facility). As e-cigarettes are in scope of the WEEE regulations, this regulation applies to e-cigarettes.

Where incineration would be required is for any fractions from the treatment of e-cigarettes that contain POPs, which "need to be managed in a way that ensures the POPs are destroyed or irreversibly transformed".

<sup>71</sup> Resource and Waste Solutions (2022) Technical note on classifying and consigning used e-cigarettes, October 2022.

<sup>72</sup> Joshua Doherty (2023) 'Whole vapes should not be incinerated' EA says, MRW, March 16 2023, <https://www.letsrecycle.com/news/whole-vapes-incinerated-ea-says/>

### 5.1.3 Other Liquids

As well as the above chemicals, others may be included. An example label is shown in Figure 17.

**Figure 17. Example (littered) SU-ecig label indicating content of liquids**



Source: Equanimator Ltd

Taking a cue from the above, the two ingredients, other than those already considered, and other than the 'other flavourings', are considered below:

- Ethyl butyrate, also known as ethyl butanoate, or butyric ether, is an ester which is soluble in (amongst other liquids) propylene glycol. It has a fruity odour, likened by some to pineapple, and is an ingredient used as a flavour enhancer in (amongst other things) processed orange juices. It does also occur naturally in many fruits, albeit at relatively low concentrations;
- Ethyl 2-methylbutyrate is, according to the classification provided by companies to European Chemicals Agency (ECHA) in Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) registrations, a flammable liquid and vapour. It is used in perfumes and fragrances, washing & cleaning products, cosmetics and personal care products, air care products and polishes and waxes.

Evidently, a range of additives are used as flavourings. The composition can vary widely depending on the brand and flavour, and there are many different ingredients that can be used in addition to the components identified above, including sweeteners, preservatives, and colourings. It is beyond the scope of this study to understand the potential implications of all the chemicals that may be in use. However, we note that given that there are already instances of regulatory non-compliance in respect of nicotine content, it seems possible that some chemicals are being used which are not subject to the desired level of regulatory oversight.

Beutel et al, in their review, noted:<sup>73</sup>

*Littering of e-liquid containers from e-cigarettes poses a particularly serious threat of environmental pollution because they can contain high concentrations of residual nicotine [127]. Besides nicotine, e-liquids contain numerous additives for flavouring [122,128], many of which are known to be toxic or have suspected or unknown toxicities [129–133]. These include various aldehydes, TSNA, benzyl alcohol, glycerol-1,2-diacetate, and dioxolane compounds. While the level of toxicants in e-cigarette vapours may be lower than in combustible tobacco smoke as they do not include tobacco combustion products [134], vapours from e-cigarettes are potent sources of environmental air pollution, particularly aldehydes and carbon monoxide [135–138].*

*Discarded e-cigarettes are also sources of metal contamination to the environment, both directly as the result of the breakdown of electronic components and indirectly via contaminated e-liquids. Common metals in the components of e-cigarette products include aluminium, barium, cadmium, chromium, copper, iron, lead, nickel, silver, tin, and zinc [69,72]. In leaching tests of e-cigarette components, lead in the resultant leachate exceeded US regulatory thresholds for hazardous-waste designation by up to ten-fold [127].*

*Toxic metals have also been detected in e-liquids with levels increasing after use, indicating that metals can seep into e-liquids [69]. Metals and metalloids have been detected in e-cigarette atomizers and components that heat and vapourise e-liquids [72]. The potentially cytotoxic metal, copper, was detected in e-cigarette aerosols at concentrations ~6 times higher than combustible cigarette smoke [139]. Additional toxic or potentially toxic compounds have also been detected in e-cigarette filters, mouthpieces, rubber stoppers, and pod plastic [140].*

One of the main concerns raised regarding SU-ecigs is the impact of improper disposal. The impact of residual e-liquids in these devices is not especially well understood at present. However, the fact that there is often limited information available regarding the full list of component chemicals in e-liquids is a reason to be concerned. That concern might well be allayed through greater transparency, but of course, it would be preferable for the SU-ecigs not to be improperly discarded, in which case, the matter becomes one of ensuring safety of operatives and reducing the impact of what would otherwise be considered appropriate end-of-life management.

<sup>73</sup> Beutel, M.W.; Harmon, T.C.; Novotny, T.E.; Mock, J.; Gilmore, M.E.; Hart, S.C.; Traina, S.; Dutttagupta, S.; Brooks, A.; Jerde, C.L.; et al. (2021) A Review of Environmental Pollution from the Use and Disposal of Cigarettes and Electronic Cigarettes: Contaminants, Sources, and Impacts. Sustainability 2021, 13, 12994. <https://doi.org/10.3390/su132312994>

#### 5.1.4 Content of Batteries

Both the SU-ecig tear downs showed the use of lithium ion polymer (LiPo) batteries. LiPo batteries differ from some other lithium-ion batteries in that in LiPo batteries, the electrolyte is not a liquid. Instead, Li-Po technology uses (usually) a gel-like electrolyte. This should make them more durable, and ought to reduce concerns regarding leaking electrolytes. The gel-like material tends to harden over time, reducing the ions' ability to move freely (and reducing the battery life span). Li-Po batteries may also be safer if they are suitably encased, and they usually have a slower rate of discharge than Lithium-ion batteries with liquid electrolytes.

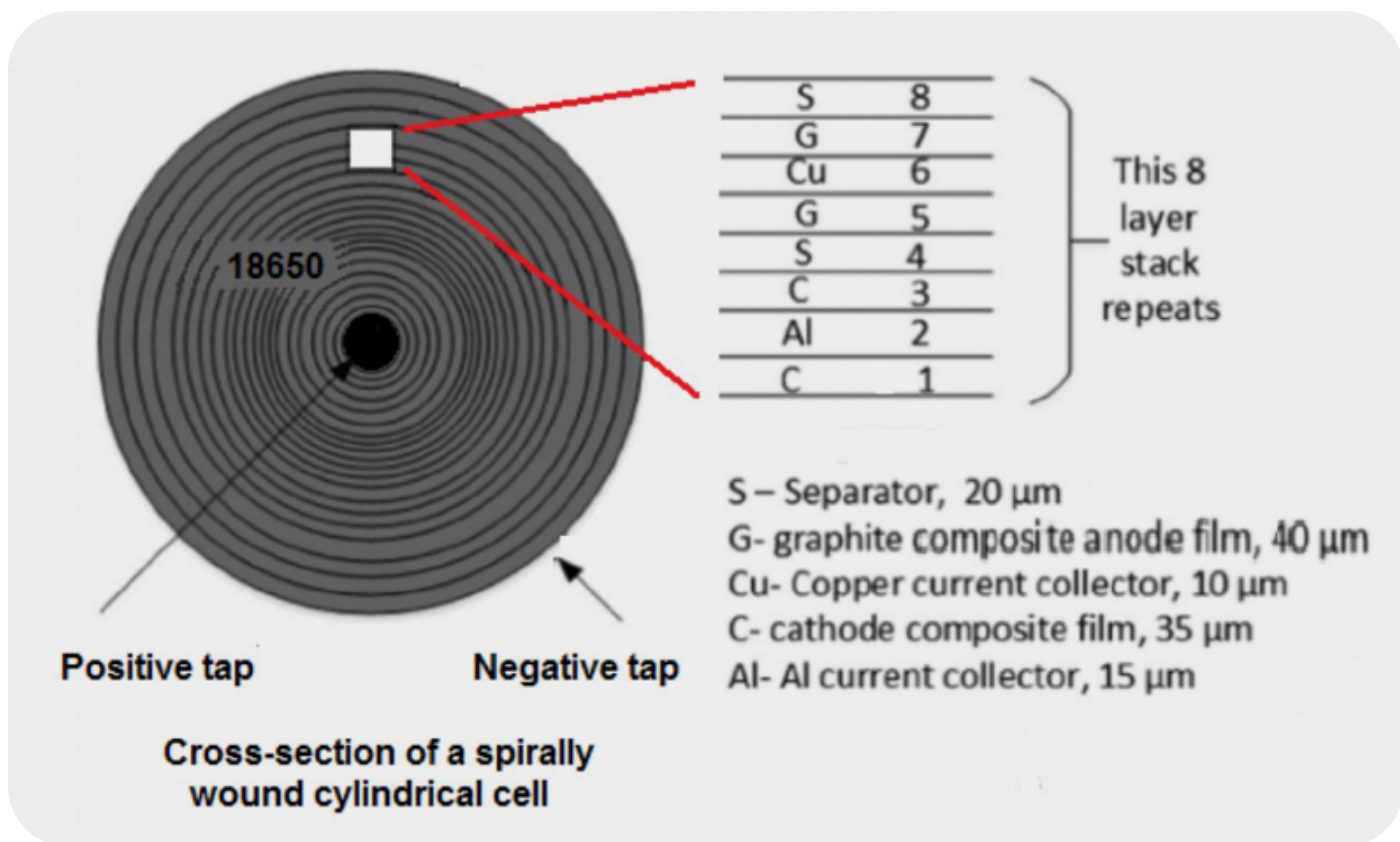
Obtaining specific information on 13400 batteries is not entirely straightforward: the literature is focused more on those batteries used in cars, which (as far as we understand) typically use liquid electrolytes. However, information for similar cylindrical batteries, which are used in Rf-ecigs, is available. The type of LiPo battery concerned typically consists of the following components:<sup>74</sup>

- An outer coating of plastic (maybe polyethylene film);
- An external casing for the battery made of nickel-plated steel;
- Another coating of plastic to contain the 'jelly roll' of rolled up layers of anode, separator and cathode (see Figure 18, overleaf);
- Copper foil, which is effectively used as a collector foil, and next to which, there is a layer of chemicals on the anode side. On each side of the foil (when the battery is 'rolled up) is usually carbon or graphite film;
- Aluminium foil is used as the collector foil on the cathode side, and as the basis for cathode chemicals. On each side of the foil is a cathode composite film, usually a Li-metal oxide. In the case of the 13400 batteries used in these SU-ecigs, the cathode material appears to be NCM (or Lithium Nickel Cobalt Manganese Oxide ( $\text{LiNiCoMnO}_2$ ),<sup>75</sup>
- The Cathode and anode layers are separated by a separator film. This has to allow ions to move back and forth during charge and discharge but must prevent any of the electrolyte from migrating back and forth. This separator can be a composite of polymers, for example, layers of polypropylene (PP), with a layer of polyethylene (PE) between them;
- An internal anode, around which the 'roll' is wrapped, is made from graphite.

<sup>74</sup> The following information was taken from various sources, primarily, Xing-Yan Yao and Michael G. Pecht (2019) Tab Design and Failures in Cylindrical Li-ion Batteries, IEEE Access, Volume 7, 2019, and Electric Bike (2017) What's Inside an 18650 Cell? And Why it's Important, July 26, 2017. The 18650 cell is widely used in vaping machines where the battery is designed to be replaced.

<sup>75</sup> See technical data here: <https://meddore.en.made-in-china.com/product/uECYVUiyygkz/China-Best-3-7V-13400-Rechargeable-Li-Ion-Battery-550mAh-3A-Cylindrical-Lipo-Battery-with-IEC62133-Un38-3-MSDS.html>

**Figure 18. Cross section of cylindrical Li-ion battery**



Source: Electric Bike (2017) What’s Inside an 18650 Cell? And Why it’s Important, July 26, 2017

## 5.2 Packaging

As well as the actual devices and liquids therein, the consumption of SU-ecigs leads to the consumption of packaging. All SU-ecigs that we have examined are packaged first, in metallised film, and then, in a cardboard box (which in some cases appears to have a film cover of plastic or other material). Inside the metallised film, some (we do not know the proportion) SU-ecigs have silicon covers for the top and bottom of the device.

The example in Figure 19, overleaf, shows an example of a collected littered package for one SU-ecig bar.

In this case, the littered box contained the metallised film (so that even if it had been discarded in a recycling container, the material would have been segregated as card, but that card would effectively have been contaminated by the interior flexible film package). The paper instructions were also in the package, as was one of the silicon covers (shown below the instructions).

Taking the packaging alone and based on a cardboard box which is made from 280-400GSM card, we would estimate that on average, a cardboard box for a SU-ecig would weigh around 4.5 grams.



**Figure 19. Example packaging and labelling of SU-ecigs**



Source: Equanimator Ltd

We have assumed (and this might not be correct) that the pouch is metalized biaxially oriented PET (BoPET) and weighs 2g. We have assumed that there is also 2g of paper (containing relevant information). We have not made provision for, for example, silicon covers.

## 5.3 Environmental Issues Associated with SU-ecigs

Discussions have raised a range of environmental issues associated with SU-ecigs. These can largely be defined as:<sup>76</sup>

- Wasteful use of resources;
- Linked to the above, the impact of consumption in terms of embodied greenhouse gas emissions, and energy use;
- Littering of SU-ecigs (and the possible consequences thereof); and
- Not least since many are being sold as 'disposable' devices, the impact of improperly discarding SU e-cigs so that they are not capable of being recycled.

We might add to this list, given the above discussion, the other forms of resource use and pollution that would accompany SU-ecig manufacture. These include the following:

- Water use;
- Pollution of watercourses;
- Pollutants contributing to worsening air quality;

<sup>76</sup> Materials Focus (2023) Vapes Briefing, last updated 23 January 2023; House of Commons Library (2022) The environmental impact of disposable vapes, 28 November 2022; Scottish Parliamentary Briefing by the Marine Conservation Society, ASH Scotland, Keep Scotland Beautiful, Laura Young and Elliott Welch (2023) Tackling the environmental and health impacts of e-cigarettes, January 2023; Wildlife and Countryside Link (2023) The Environmental case for Banning Disposable Vapes - Wildlife and Countryside Link briefing - March 2023; Beutel, M.W.; Harmon, T.C.; Novotny, T.E.; Mock, J.; Gilmore, M.E.; Hart, S.C.; Traina, S.; Duttagupta, S.; Brooks, A.; Jerde, C.L.; et al. (2021) A Review of Environmental Pollution from the Use and Disposal of Cigarettes and Electronic Cigarettes: Contaminants, Sources, and Impacts. Sustainability 2021, 13, 12994. <https://doi.org/10.3390/su132312994>

- Effect on habitat of primary materials extraction.

As well as these impacts, the fact that SU e-cigs are not always discarded/managed in a responsible manner at end-of-life gives rise to additional concerns. Quite apart from the 'lost opportunity' associated with not recovering the materials contained in SU-e-cigs, the fact that the full suite of chemicals in use might not always be well known is a cause of potential concern. SU-e-cigs may contain brominated flame retardants (and other non-POP) flame retardant chemicals, as well as chemicals used in manufacturing the plastic casings and components that may be of concern, and substances used in e-liquids that could be problematic. Those charged with managing SU-e-cigs at end of life should have full knowledge of the content of the devices they are handling.

We explore some of these issues below, but further research is required to shed light on some matters which we have been unable to cover below, as well as improving on estimates which we have made based on the information we have available to us.

### 5.3.1 Impacts Linked to Materials Used

It is well understood that the use of materials gives rise to a range of environmental impacts. The extraction, processing and use of materials, and their use in manufactured products, gives rise to impacts throughout the life-cycle.

From the impact of extractive processes on habitats and land, through to the use of energy, water and ancillary materials, and the implied pollution of land, air, and water to which this gives rise, there is no use of material that implies no impact.

Materials also have value, and the most valuable of materials are often those which are most difficult or energy intensive to extract, so generally, it makes sense to recover these from end-of-life products (and accordingly, products should be designed so as to facilitate that process). Some of the materials used in SU-e-cigs are deemed to be in critical demand in the sense that they are deemed strategically important in fostering a transition to a more sustainable future. Lithium, cobalt and graphite were each included as critical minerals with 'high' criticality in the British Geological Survey (BGS) assessment of criticality for the UK's critical minerals strategy.<sup>77</sup> A report conducted in Scotland highlighted cobalt, copper and lithium as being on a similar list of critical materials.<sup>78</sup> In addition, as discussed above, SU-e-cigs contain plastics, nickel, aluminium and manganese.

We have considered the composition of a typical SU-e-cig. This has required some estimation, and builds on work undertaken by Materials Focus. Our estimated average composition is shown in Table 9, overleaf.

<sup>77</sup> Lusty et al. BGS (2021), UK criticality assessment of technology critical minerals and metals

<sup>78</sup> SNIFFER (2011) Raw materials critical to the Scottish economy: Non-technical summary, [https://www.sepa.org.uk/media/163166/raw\\_materials\\_non-technical\\_summary.pdf](https://www.sepa.org.uk/media/163166/raw_materials_non-technical_summary.pdf)

**Table 9. Average composition assumed for SU-ecig**

<b>Average weight, full</b>	32g
<b>Average weight, 'empty'</b>	29.9g (based on 2ml of liquid estimated to be 50:50 propylene glycol and glycerin with 20mg of dissolved nicotine salts), but with 0.25g remaining at end of life
<b>Average battery weight</b>	10.8g
<b>of which:</b>	
<b>Steel</b>	2.00g
<b>Nickel</b>	0.75g
<b>Copper</b>	0.75g
<b>Aluminium</b>	0.75g
<b>Plastic</b>	2.00g
<b>Graphite</b>	2.00g
<b>LiNi<sub>1/3</sub>Co<sub>1/3</sub>Mn<sub>1/3</sub>O<sub>2</sub></b>	2.50g (based on 0.165 kg of Li for a 550mAh battery)
<b>Average non battery weight</b>	19.2g
<b>of which:</b>	
<b>Plastic</b>	9.5g
<b>Steel</b>	6.5g
<b>Kanthal</b>	0.3g (as Fe 70%; Cr 25%; Al 5%)
<b>Nickel</b>	0.4g
<b>Copper</b>	0.5g
<b>Cotton wick</b>	1.0g
<b>Cellulosic material</b>	1.0g

Based on the above, and our consumption estimates, the forecast weight of materials in the SU-ecigs consumed in Scotland are estimated to be as shown in Table 10.

**Table 10. Weight of discarded SU-ecigs and related packaging (tonnes)**

	2022	2023	2024	2025	2026	2027
<b>Devices</b>						
<b>Low Consumption</b>	617	762	923	1,101	1,293	1,502
<b>High Consumption</b>	786	970	1,175	1,401	1,646	1,912
<b>Packaging</b>						
<b>Low Consumption</b>	175	216	262	313	367	427
<b>High Consumption</b>	223	275	334	398	468	543

### 5.3.2 Greenhouse Gas (and embodied energy) Impacts

The aforementioned materials all have a carbon footprint and energy use associated with their extraction and processing for use in SU-ecigs. Because the SU-ecigs are used for a relatively short period of time (they are deemed to be equivalent to roughly 40-60 cigarettes), the argument is that since they are discarded thereafter, the materials are wastefully deployed.

The lithium polymer batteries used in some of the most popular e-cigarettes could be recharged 500 times if the product allowed for such charging. In SU-ecigs, this is not possible, so the battery, with the associated materials content, is generally only available for, at best, recycling (in principle, the battery could be reused, though this would likely place potential users at risk of legal action should the battery subsequently prove faulty).

Our assessment used figures from a range of studies to estimate the GHG emissions associated with one SU-ecig.<sup>79</sup> The estimate is based on an assumption that all materials used are primary (and not recycled). This is likely to be a reasonable assumption other than for steel casings. We are not aware of any incentive to ensure, in the country of manufacture or in the country of sale, that the products concerned would incorporate recycled content, other than – potentially – in the small amount of BoPET packaging we have assumed to be used. Some SU-ecigs use, for their casing, polymers which are not widely (or even, easily) recycled (such as Poly Cyclohexylenedimethylene Terephthalate glycol-modified, or PCTG).<sup>80</sup>

The emissions associated with the production of the battery are estimated to be 84g CO<sub>2</sub>e or 8g CO<sub>2</sub>e per gramme of Lithium Polymer battery. The emissions associated with the remaining materials are estimated to be 68g CO<sub>2</sub>e or 4g CO<sub>2</sub>e per gram of material.

The total figure for a single SU-ecig is estimated as 151g CO<sub>2</sub>e, or marginally more than 5gCO<sub>2</sub>e per gram of SU-ecig.

Regarding packaging, based on the figures from the Zero Waste Scotland Carbon Metric for paper and cardboard, and for plastics, we estimate that a further 12gCO<sub>2</sub>e are emitted per SU-ecig.<sup>81</sup>

In the absence of policy change, the emissions associated with production under our low and high scenarios would be as shown in Table 11, overleaf. As we show in Section 5.3.5, very little of the material is recycled, and a considerable amount of littering is believed to take place.

<sup>79</sup> We used figures for aluminium and steel taken from the Zero Waste Scotland Carbon Metric (we used the 2020 factors, downloadable from <https://www.zerowastescotland.org.uk/resources/carbon-metric-publications>). For the lifecycle emissions associated with other materials used in the battery, we took these from a study by Falcone et al, focussing on the extraction and processing stages, and with no allowance for transport Falcone, M.; Quattromini, N.F.; Rossi, C.; Pulvirenti, B. (2022) Life Cycle Assessment of a Lithium-Ion Battery Pack Unit Made of Cylindrical Cells. Batteries 2022, 8, 76. <https://doi.org/10.3390/batteries8080076>; for cotton, we also used the average figure from a Better Cotton Initiative study from 2021 for cotton (<https://bettercotton.org/better-cotton-releases-our-first-study-on-ghg-emissions/>); we used a figure for chromium (a constituent of kanthal) taken as the average from values in Wenjing Wei, Peter B. Samuelsson, 1 Par G. Jonsson, Rutger Gyllenram, and Bjorn Glaser (2023) Energy Consumption and Greenhouse Gas Emissions of High-Carbon Ferrochrome Production, JOM (The Journal of The Minerals, Metals & Materials Society), Vol. 75, No. 4, 2023, <https://www.springer.com/journal/11837>

<sup>80</sup> <https://e-liquids.com/collections/ske-crystal-bar-disposable-vape>

<sup>81</sup> Figures taken from the Zero Waste Scotland Carbon Metric (again, we used the 2020 factors, downloadable from <https://www.zerowastescotland.org.uk/resources/carbon-metric-publications>)

**Table 11. GHG emissions associated with SU-ecig production, baseline projection (tonnes CO<sub>2</sub>e)**

	2022	2023	2024	2025	2026	2027
<b>SU-ecigs</b>						
<b>Low Consumption</b>	3,123	3,855	4,670	5,567	6,543	7,599
<b>High Consumption</b>	3,975	4,907	5,944	7,086	8,328	9,672
<b>Packaging</b>						
<b>Low Consumption</b>	249	308	373	444	552	606
<b>High Consumption</b>	317	391	474	565	664	772

### 5.3.3 Water Consumption

The Scottish Government requested a view on the implications of SU-ecig use for water consumption. This is a complicated matter and would merit more focused research than given to it here. For example, as regards metals manufacture, what does one regard to have been consumed if more than 20 cubic metres are utilised per tonne of steel, but only 3 cubic are genuinely ‘lost’ in the process, with the remainder requiring treatment prior to discharge? Is it the 3 cubic metres lost, or the more than 20 cubic metres used?

Similarly, for any cotton used, what should be assumed to be the use of water, given that there are likely to be rain-fed, as well as irrigated forms of cotton growing, with irrigation affecting water scarcity in different ways in different regions.

Nonetheless, as a basic estimate, we have drawn on a range of sources to derive an initial estimate which, no doubt, can be improved upon in future.<sup>82</sup> Excluding the impact associated with cotton, we estimate the water use in manufacturing an SU-ecig to be just over 900ml per SU-ecig.<sup>83</sup>

<sup>82</sup> For steel, we used Colla, V.; Matino, I.; Branca, T.A.; Fornai, B.; Romaniello, L.; Rosito, F. Efficient Use of Water Resources in the Steel Industry. *Water* 2017, 9, 874. <https://doi.org/10.3390/w9110874>; for plastics we used a study by Water Footprint Network; for nickel the source was International Nickel Study Group; for copper the source was International Copper Association; for Li<sub>2</sub>CO<sub>3</sub> we used Jarod C. Kelly, Michael Wang, Qiang Dai, Olumide Winjobi (2021) Energy, greenhouse gas, and water life cycle analysis of lithium carbonate and lithium hydroxide monohydrate from brine and ore resources and their use in lithium ion battery cathodes and lithium ion batteries, *Resources, Conservation and Recycling*, Vol 174, <https://doi.org/10.1016/j.resconrec.2021.105762>; for aluminium we used industry sources; for chromium, the same.

<sup>83</sup> Values for water use in cotton production vary in the literature, but are often extremely high: even with only 1g assumed to be used, the figure for cotton can dominate the analysis. As a result of the potential for the choice of the figure for ‘average use’ to skew the assessment, we have omitted the figure in this estimate.

**Table 12. Estimated water consumption linked to materials used in SU-ecig devices consumed in Scotland (m3)**

	2022	2023	2024	2025	2026	2027
<b>SU-ecigs</b>						
<b>Low Consumption</b>	18,761	23,157	28,054	33,441	39,303	45,648
<b>High Consumption</b>	23,877	29,473	35,705	42,562	50,022	58,098

Given future projections for consumption, therefore, we estimate that associated use of water associated with SU-ecig use in the coming years to be as in Table 12. These are preliminary estimates and are designed to give an idea of the magnitude of the impact. It should be noted that little if any of the use will be in Scotland itself. It should also be considered that we have not included the manufacture of the e-liquids themselves in our calculations.

### 5.3.4 Management of SU-ecigs (and others)

The concerns regarding the alleged mismanagement of SU-ecigs are linked to the nature of the available infrastructure (and the extent to which the industry is compliant even with its existing obligations under various Regulations). In this respect, there are a number of related concerns.

SU-ecigs are an increasingly prominent item in litter, and are now frequently collected items by street cleaning teams (i.e. from the floor), as well as being deposited in public waste collection (litter bins).

The littering of SU-ecigs has given rise to concerns regarding:

- Their plastic content (see Section 5.1). Many of the best-selling brands are encased in plastics, and have plastic mouthpieces, as well as plastic cannisters inside, and non-woven fabrics used to hold suspended e-liquid around the wick;
- The potential for batteries to catch fire. Lithium polymer batteries can catch fire if punctured, or exposed to high temperatures, or if they experience internal short-circuiting as a result of water ingress. Although these incidents may be infrequent, the consequences of a given event can be catastrophic. When littered, SU-ecigs can be run over by vehicles (see the second teardown in Figure 14). They are potentially exposed to elements that may increase the likelihood of fire incidents.

A further source of fires – incorrect charging – is rendered less likely by the design of the product, though we note, in this respect, that batteries can be removed by users and then ‘experimented with’. A House of Commons Library document on ‘The environmental impact of disposable vapes’ includes a link to a website indicating how to recycle disposable e-cigarettes.<sup>84</sup> It reads:<sup>85</sup>

*The best way to recycle disposable vapes is to separate each part. While opening the e-cigarette kit, make sure to go through the packaging, as it gives you information on which parts of the disposable vape kit can be recycled.*

This could be considered questionable advice, not so much regarding the legitimacy of disassembly itself (manual approaches are essentially all there is right now), but the absence of any warnings regarding the potential effects of doing so, and the precautions that might be taken.

The potential for liquid residues – notably, their nicotine content – to give rise to hazards by virtue of their escaping into the environment is highlighted in Box 1, overleaf.

In these respects, it should be considered that we may be experiencing the early days of the emergence of a major problem. As regards the point above, because demand for SU-ecigs has grown so rapidly in recent years, surveys of beach litter (and of litter more generally) will not yet be representative of the current situation. The weight and shape of SU-ecigs may make them less susceptible (than most single-use plastic items) to being blown over distance, so that they are more likely to remain ‘in situ’ (other than where they can easily roll down a slope). It may be that of what is littered can be collected, albeit at cost.

SU-ecigs may be discarded into household/commercial residual waste bins. Compaction with other materials is likely in the transport of materials. The most likely fate of the material were discarded in municipal-type residual waste is now incineration. Here, the material has the potential to give rise to various problems, especially given the potential use of BFRs (Brominated Flame Retardants).

SU-ecigs may be discarded into household/commercial recycling containers. Once here, their likelihood of being recycled is, arguably, limited unless they are specifically sorted by hand: whichever waste stream they may be sorted into at a mechanical sorting facility, they would effectively be ‘a contaminant’.

<sup>84</sup> House of Commons Library (2022) The environmental impact of disposable vapes, 28 November 2022.

<sup>85</sup> Guide to Recycling Disposable Vapes: Everything to Know, June 15 2022, <https://myliquidsupplies.com/guide-to-recycling-disposable-vapes-everything-to-know/>



### **Box 1: Incidents Related to Concerns for Health of Wildlife**

There have been incidents of poisoning by accidental ingestion by pets which seem more likely to be linked to e-cigarettes liquids used in Rf-ecigs, though links to SU-ecigs are not ruled out. Wildlife and Countryside Link noted:<sup>86</sup>

*With increasing levels of vape consumption there is also a greater possibility of harm to wild animals and pets if vapes are chewed or ingested. There have been reports of a bird dying after ingesting a vape and a puppy having died after eating a vape pod. The Veterinary Poisons Information Service (VPIS) warn that “e-cigarettes and their refills contain high doses of nicotine (up to 36 mg per ml) or even higher in products containing nicotine salts. Severe toxicity is uncommon, but could occur if the dose ingested is large. Many animals remain asymptomatic or develop only mild effects; common signs are vomiting, hypersalivation, diarrhoea and tachycardia.*

*Throat irritation may also occur. In addition to the toxicity of nicotine, the actual e-cigarette casing can result in oral injury when chewed and can cause gastrointestinal upset with the risk of a foreign body obstruction.” VPIS have had around 700 enquiries relating to all kinds of vapes since 2017, see Table i.*

**Table i. Enquiries to the Veterinary Poisons Information Service relating to vape liquid products and electronic cigarette products in pets Consumed in Scotland (m3)**

Year	Number of enquiries
2017	88
2018	112
2019	106
2020	86
2021	147
2022	141

Note: Data provided by VPIS: the majority of calls related to dogs (96%), around 3% were exposures in cats, 4 were in birds, 1 in a pony, and 1 in a ferret. Of these calls VPIS have full follow up on 172 cases and of these cases there were 2 fatalities (a cat and a dog), with the other animals either remaining well or making a full recovery. Source: Wildlife and Countryside Link (2023) The Environmental case for Banning Disposable Vapes - Wildlife and Countryside Link briefing - March 2023.

<sup>86</sup> Wildlife and Countryside Link (2023) The Environmental case for Banning Disposable Vapes - Wildlife and Countryside Link briefing - March 2023. [https://www.wcl.org.uk/docs/assets/uploads/WCL\\_Disposable\\_Vapes\\_Briefing.Mar23.pdf](https://www.wcl.org.uk/docs/assets/uploads/WCL_Disposable_Vapes_Briefing.Mar23.pdf)

As a result, they are likely to cause problems for recyclers. Transport in compacting vehicles and some mechanical machinery may also increase the likelihood of fires occurring.

Where appropriately discarded – to take-back locations in stores, for example – the materials, if sent to a recycler, are difficult to recycle. In transporting the SU-ecigs, it would seem that these should be transferred with a properly completed hazardous waste consignment note. Currently, the main approach to recycling is by disassembly, which is a costly approach. The cost for recycling can be of the order £10,000 to £20,000 per tonne of discarded material.

### 5.3.5 Estimated End-of-life Fate of Materials

There appears to be no reliable data regarding the fate of e-cigarettes once they reach their end-of-life. Material Focus has sought to make estimates of the number that are not recycled, based on market research responses.<sup>87</sup> Our review and interpretation of the underlying data, normalised to 100%, suggests that management routes are as follows:

- Taken back to store 12.8%
- Taken to HWRC for recycling 8.3%
- Discarded into residual bin 43.3%
- Discarded into recycling bin 25.0%

This would leave a further 10.6%, which were reported as being either ‘given away’, or the respondent claimed to have done ‘something else with them’: no option was given to declare the item littered, perhaps because it was assumed that respondents would not self-declare littering behaviour. The quantity ‘collected for recycling’ via HWRCs or take-back would be of the order 21%, translating into 951 tonnes. This assumes that all such materials are sent for recycling, which may not be the case: the author’s own experience of HWRCs in Bristol was of operatives giving different advice as to where to put such devices, the advice being either to place in a mixed waste skip (from the adviser at the earlier stage of the site), or in the receptacle for batteries. Furthermore, there are reasons to believe that not all SU-ecigs returned to stores will be sent for recycling. The IBVTA indicated, in responding to our questionnaire, that:<sup>88</sup>

*“Finding reputable recycling companies has proved difficult for the independent vape industry.”*

*Some recycling businesses have been found not to understand the nature or complexity of the product or to make promises to recycle the components, but, on further investigation, the products were being exported for disposal. In addition, finding recycling businesses who could operate at scale has also proven difficult.”*

<sup>87</sup> Market research conducted by Opinium on behalf of Material Focus, June 2022.

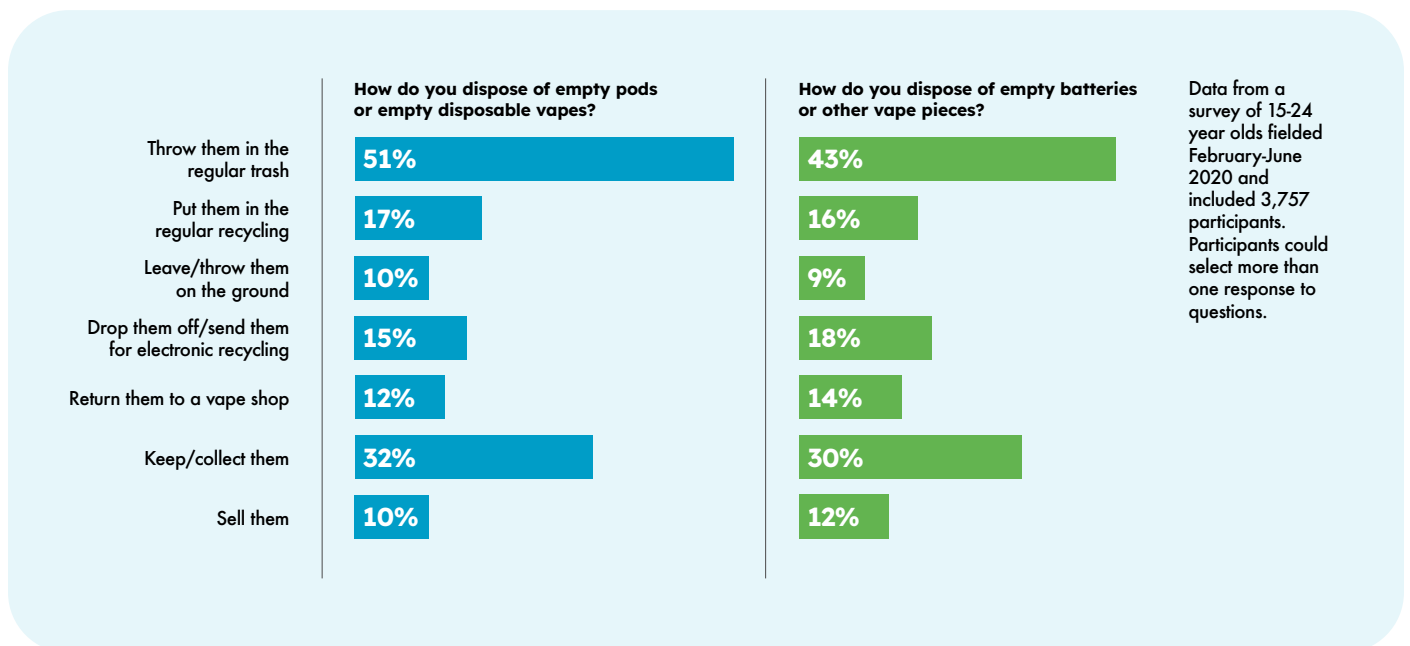
<sup>88</sup> Response received from Gillian Golden, Independent British Vape Trade Association (IBVTA).

It is interesting to compare these figures with data from a survey in the US, the results of which are shown in Figure 20. This asked questions of young people regarding how they dealt with “empty pods or empty disposable vapes”, and how they dealt with “empty batteries or other vape pieces” (presumably, such as coils, where those concerned were not using disposables). If one a) ignores the ‘keep/collect’ and ‘sell’ responses, and b) normalises these responses to 100%, those on the left-hand side suggest:

- Taken back to store 12.8%
- Taken to HWRC for recycling 14.3%
- Discarded into residual bin 48.6%
- Discarded into recycling bin 16.2%

This would leave 9.5% left/thrown on the ground. The relative proportions going to different fates are not dissimilar between this study and the market research conducted on behalf of Material Focus.

**Figure 20. Methods of e-cigarette waste disposal reported through survey**

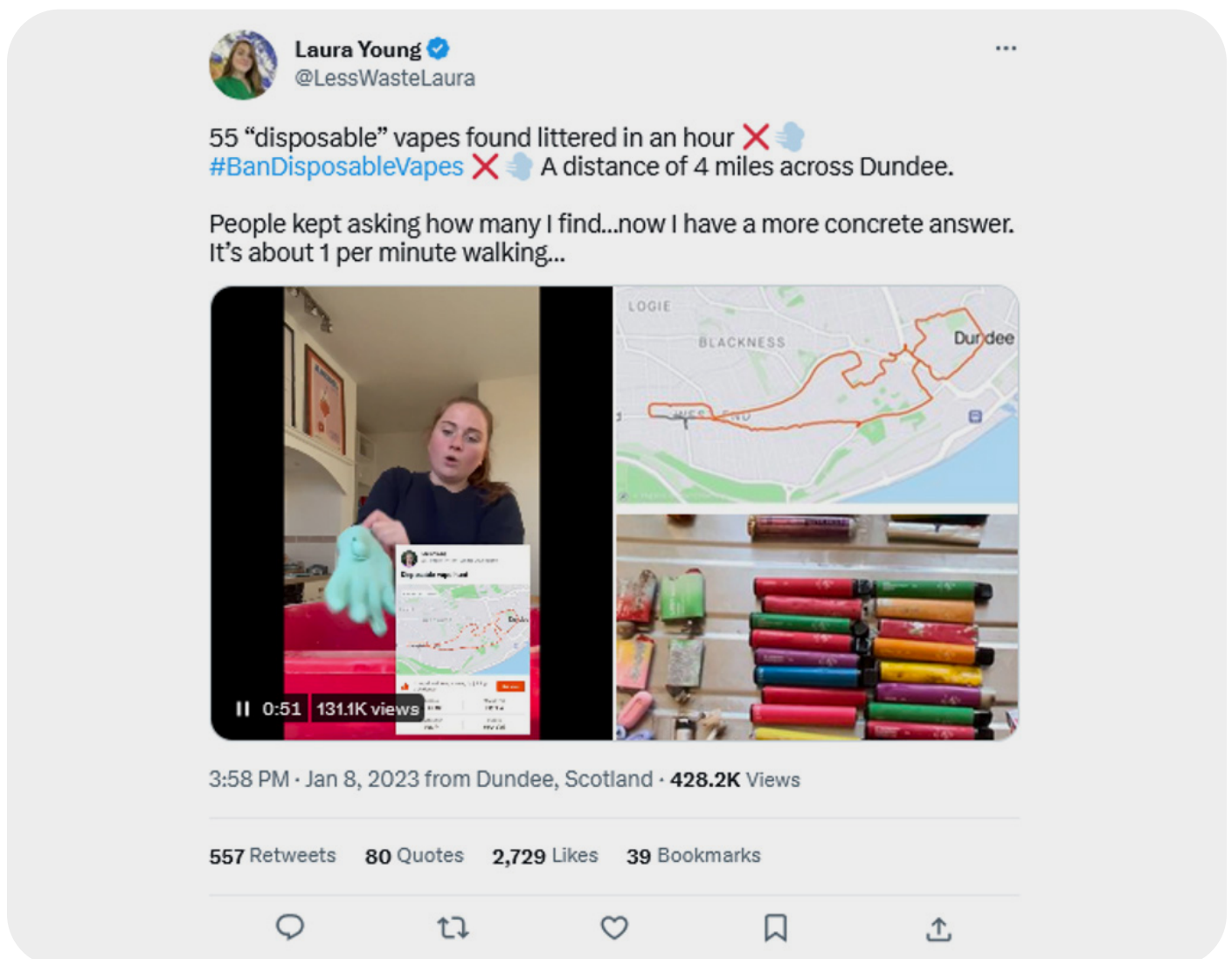


Source: Truth Initiative (2021) A toxic, plastic problem: E-cigarette waste and the environment, February 2021.

A key question is whether the figure of around 10% – assumed to be littered – might be reasonable. The quality of data available to us is limited. NGOs contacted regarding the evidence emerging from litter picks indicated that because of the rapidity of the emergence of SU-ecigs as a category, and because some of those involved in picks were not always familiar with the items, information regarding the prevalence of SU-ecigs in litter is not yet available.

Anecdotally, local authority street cleaning teams who were consulted in the context of this work indicated that they pick up of the order 20 to 30 (sometimes more) per kilometre or so in urban areas. A Tweet from Laura Young indicated around 55 SU-ecigs were picked up on a 4 mile walk across Dundee, on one side of the street only (see Figure 21). If these existed with the same prevalence on each side of the road, the figure would be equivalent to 17.5 per kilometre.

**Figure 21. Tweet Regarding Prevalence of SU-ecigs in Litter**



Even if these reflected relatively infrequent (for urban areas) weekly cleans, that would suggest around 1,040 per kilometre per annum. If littered at that density, then the 10% of littered SU-ecigs would be found on a total stretch of road of the order 14 thousand kilometres, equating to around just over 10% of urban C and U roads (i.e., minor urban roads) in Great Britain.<sup>89</sup>

Working the figures, the other way, if one considers the average density per kilometre of urban C and U road, this would equate to 107 per kilometre per annum, or around 2 per kilometre per week.

Neither of these perfunctory 'sense checks' suggests that a littering rate of the order 10% is out of the realm of possibility. In addition, this is not simply an urban street phenomenon, and whilst the majority of littering might be expected on roadsides (outside pubs, clubs, cafes, universities, offices, factories, schools, and other places where people congregate), public parks are also affected. On the other hand, these cross-checks for 'plausibility' do not offer a compelling basis on which to base littering estimates.

More reliable sources of data and information would be useful to have in future, albeit the author's own experience suggests that estimates of the proportion of a given item or product that is littered are not easy to derive unless data collection and reporting is explicitly oriented towards that objective.

By way of comparison, Eunomia, in evidence to a House of Commons Inquiry, estimated that between 3.3% and 3.6% of single-use plastic beverage containers that were purchased were littered in Scotland.<sup>90</sup> Again, and only anecdotally, street cleaning teams suggested that SU-ecigs were more frequently encountered items than single-use plastic bottles in street litter.

Given the uncertainties involved in these estimates, we have based estimates of current and future quantities littered using a figure for SU-ecigs littered of 3.5% as the lower estimate, and 10% as the higher estimate (noting that these are not upper and lower bounds of possibility). Based on these figures, and combining them with low and high consumption figures, then estimates of the range in quantity of material littered now and in future are as shown in Table 13, overleaf.

<sup>89</sup> Based on Department for Transport (2022) Statistical data set: Road length statistics (RDL), data downloadable from <https://www.gov.uk/government/statistical-data-sets/road-length-statistics-rdl>

<sup>90</sup> Eunomia (2017) Written evidence submitted by Eunomia Research and Consulting Ltd, [https://committees.parliament.uk/writtenevidence/81068/html/#\\_Toc494450395](https://committees.parliament.uk/writtenevidence/81068/html/#_Toc494450395)

**Table 13. Weight of SU-ecigs littered under high and low projections for consumption and high and low scenarios for littering rate (tonnes)**

	2022	2023	2024	2025	2026	2027
<b>Low Consumption, Low Rate</b>	21	26	32	38	45	52
<b>Low Consumption, High Rate</b>	62	76	92	110	129	150
<b>High Consumption, Low Rate</b>	27	33	41	48	57	66
<b>High Consumption, High Rate</b>	79	97	118	140	165	191

These figures can be compared with those in the Zero Waste Scotland document regarding Scotland’s Litter Problem.<sup>91</sup>

- At least 15,000 tonnes (t) of litter is discarded into our urban and rural environment and is subsequently cleared by local authorities every year;
- This equates to approximately 250 million easily visible items every year.

The 2022 figures in Table 13 can be translated into proportions of littered waste by weight (based on the figures in the extract cited above), and by item count. By weight, the amount equates to 0.1% to 0.5% of the tonnage reported as littered in 2013. By count, the amount equates to 0.3% to 1.1% of the count reported in 2013. By 2027, these figures rise to 0.3%-1.2% (weight) and 0.7%-2.6% (count).

SU-ecigs are less voluminous than plastic bottles. On the other hand, the range of colours and shapes in which they are produced makes them highly visible in terms of their colour, and they appear to be littered in a range of locations. It follows that they are likely to contribute – perhaps significantly – to the disamenity associated with littering in Scotland.

A study by Eunomia for Zero Waste Scotland in 2013 estimated the value of disamenity (and other impacts) from littering.<sup>92</sup> Direct costs of litter are the costs to local authorities and other duty bodies of engaging in the clean-up of litter and clearance of flytipping, including additional treatment/disposal of the associated waste; and Indirect costs are those costs visited on other actors in the economy (and on nature and wildlife).

<sup>91</sup> Zero Waste Scotland (2013) Scotland’s Litter Problem: Quantifying the Scale and Cost of Litter and Flytipping, July 2013.

<sup>92</sup> Eunomia (2013) Exploring the Indirect Costs of Litter in Scotland, Report to Zero Waste Scotland.

**Table 14. Aggregate willingness to pay to achieve a ‘One Level’ improvement in respect of neighbourhood litter**

Location	Population	Unit WTP (per person per month)	Total WTP (per month)	Total WTP (per annum)
Urban	3,443,178	£9.75*	£33.57m	£402.85m
Rural	775,213	£11.83*	£9.17m	£110.05m
<b>Total</b>	<b>4,218,391</b>		<b>£42.74m</b>	<b>£512.90m</b>

Source: Eunomia (2013) Exploring the Indirect Costs of Litter in Scotland, Report to Zero Waste Scotland.

**Table 15: Estimated Ranges for Disamenity Associated with SU-ecigs (2022 £)**

		2022	2027
<b>By Weight</b>	Lowest	£0.85 million	£2.06 million
	Highest	£3.12 million	£7.59 million
<b>By Count</b>	Lowest	£1.79 million	£4.36 million
	Highest	£6.61 million	£16.09 million

The values – in 2013 £ sterling terms – are shown in Table 14. Annual willingness to pay (WTP) would be £513 million. On a per person per annum basis, the figures shown in Table 14 equate to £117 in urban areas, and £142 in rural areas. The calculations were focused on neighbourhood environmental quality, and do not value improvements to places that individuals visit, such as beaches or the countryside.

Updating the Total in Table 15 to 2022 Sterling values would give a value of £629.5 million (per annum) for litter-related disamenity in Scotland.

It is not at all straightforward to link the disamenity values to specific item types, especially those which have not been widely present in the past.

However, taking our current estimates of the contribution of SU-ecigs to Scotland’s litter – by weight and by count – then a pro-rating the 2022 value for all litter-related disamenity in 2022 gives figures for disamenity in the ranges shown in Table 15. Current levels would be between £0.85 and £6.61 million in 2022, rising to between £2.06 and £16.09 million in 2027.

It should be noted that the values in Table 15 are crudely estimated, and only provide a potential indication of the cost of the wider disamenity costs of these littered items (they are based on 2013 data and on ‘willingness to pay’ figures, not actual costs, and they take no account of the characteristics of different items and their possible contribution to disamenity).

It should also be noted that there may be a range of issues associated with littering of SU-ecigs which are not captured by the above figures. These could include the impact of plastics in the environment where the SU-ecigs have plastic casings, and where these are left to degrade in the environment, and

especially, where they are discarded directly into water courses or into the sea. Also, as indicated in Sections 5.1.1 and 5.1.2, some of the materials and liquids used in SU-ecigs could prove problematic where they are discarded into the environment: whether or not this leads to problematic releases of chemicals and substances is not yet clear, but as noted in the aforementioned Sections, there is not always clear information regarding the presence or otherwise of some problematic chemicals in SU-ecigs.

### 5.3.6 Waste Management

Based on the Material Focus research discussed above and taking into account the ranges used for the extent of littering of SU-ecigs, patterns of discarding/managing e-cigarettes are considered to be as shown in Table 16. The two columns simply represent a renormalisation (i.e., to ensure totals add to 100%) of our interpretation of the Opinium data to reflect the lower littering rate discussed above.

**Table 16. Patterns of Discarding of SU-ecigs**

Method	% e-cigarettes discarded by route (high % littered)	% e-cigarettes discarded by route (low % littered)
Take-back to Store	12.8	13.8
Recycle them at a local authority recycling centre	8.3	9.0
Recycling bin	25.0	27.0
Residual Bin	43.3	46.7
Littering	10.6	3.5

Source: Based on market research conducted by Opinium on behalf of Material Focus, June 2022.(unpublished)



## 6 Other Single-use Electronic Items Worthy of Attention

The range of other single-use electronic items (SU-e-items), and any available information on their environmental impact in Scotland, has been looked at, with a view to considering the merits of 'targeted or general policy measures to improve the management of single-use electronic items'. Our search focus was initially on those SU-e-items which, like SU-ecigs, are both single-use and widely littered.

In the terminology section of this report (1.1), we discussed the meaning of the term 'single-use' in the context of e-cigarettes, but as applied to (W)EEE more widely, it is not so clear cut. Due to lack of available data we have been unable to define 'widely littered', but would expect to anecdotally see these items on the street or in public places, in similar numbers to other items that are considered widely littered including drinks cans and bottles.

We have been unable to identify any electronic item that is currently both single-use and widely littered.

Some items which might be considered 'single-use', and are electrically driven, are purchased on a one-off basis, perhaps in celebration of a specific event. For example, novelty/gift items may be intended for use at a major celebration, and might include illuminated clothing, or accessories. Another item that could be considered single use would be a greetings card which includes a battery that enables a tune to be played, or for the card to be lit up. These items are however not widely littered.

One item that has endured, despite critical comment over the years, has been the disposable/single-use camera: in many respects, this shares some similarities with the SU-ecigs in that they are typically preloaded with a film, and they are designed to be used only as long as the film has not been used, and there are 'refillable' alternatives available. They tend to be marketed now for use at events such as weddings ('put one on each Table...') or in situations where it is suggested a more expensive camera might be at risk of damage ('why risk your digital camera when on the beach'). A distinction between these and SU-ecigs is that the correct use of such a camera will lead to its being sent for the film to be processed (so that 'not littering' is built into the intended manner of use). Furthermore, the batteries are usually readily removable. Again these items are not widely littered.

Electronic pregnancy test kits have also become popular. Our brief review of these indicates that they typically run using a battery. Manufacturers ask those who use their test kits to remove batteries prior to disposal, with one well known supplier adding 'battery disposal should be in accordance with the appropriate recycling scheme'. That might be considered less than instructive advice.

Despite the growing number of single-use electrical items (SU-e-items) on the market (and therefore required appropriate disposable), we have not been able to identify another item that is widely littered.

### **6.1 Addressing the SU-e-items**

SU-e-items could be addressed through some of the measures considered above. Recovery of the materials, especially the battery, through sensible design and adequate infrastructure for managing items at end of life, is essential. Some toys may well be de facto 'single-use' as a consequence of their design, rather than 'by design'. Ideally, eco-design criteria could be improved to ensure that poorly designed, wasteful, short-life EEE items were not available for sale in Scotland/the UK.

We have very little information regarding the volume of sales of such items, and still less, the extent to which their use and the pattern in which they are discarded is problematic. This would require further research, and in particular, an understanding of the quantity purchased, the materials used in the manufacture of the items, and how the items are managed at end of life.

### **6.2 Littered EEE Items**

Other electrical items which may be found littered include charging leads, ear-bud-style headsets, and, occasionally, bicycle lights. Each of these tends to be left in the environment because they are broken (leads have frayed, or covers have broken), or accidentally lost. Based purely on observation, these would appear to be nowhere near as widespread as SU-ecigs partly because the numbers being purchased in any given period are lower, and secondly, because they are not single use in nature and so have more value. Furthermore, some items, such as wired headsets, are being replaced by wireless items, and this may make them less susceptible to failures that lead to littering.

# 7 Policies in Development in Other Jurisdictions

Concerns regarding the impact of SU-ecigs are not confined to Scotland. This Section highlights policies either in place, or being considered, including in the UK.

## 7.1 United Kingdom Government

Interest in dealing with the issues of SU-ecigs is by no means restricted to Scotland. In April 2023 the UK Government published a 'Youth vaping: call for evidence' to identify opportunities to reduce the number of children accessing and using vapes, exploring issues such as regulatory compliance, the marketing and promotion of vape products and the environmental impact of disposable e-cigarettes.

In the UK Parliament, a Private Members' Bill – the Disposable Electronic Cigarettes (Prohibition of Sale) Bill – has been proposed by Dr Caroline Johnson, a Conservative MP, referencing both health and environmental argument or doing so. The Bill has had its First reading in Parliament and awaits its second, expected on 24th November 2023.

Policies being advanced for consideration in other jurisdictions are discussed below.

## 7.2 EU Actions

The recast WEEE Directive already includes measures, under Article 4, that could have affected e-cigarettes:<sup>94</sup>

*Member States shall, without prejudice to the requirements of Union legislation on the proper functioning of the internal market and on product design, including Directive 2009/125/EC, encourage cooperation between producers and recyclers and measures to promote the design and production of EEE, notably in view of facilitating re-use, dismantling and recovery of WEEE, its components and materials. In this context, Member States shall take appropriate measures so that the ecodesign requirements facilitating re-use and treatment of WEEE established in the framework of Directive 2009/125/EC are applied and producers do not prevent, through specific design features or manufacturing processes, WEEE from being re-used, unless such specific design features or manufacturing processes present overriding advantages, for example, with regard to the protection of the environment and/or safety requirements.*

<sup>93</sup> Politico (2023) UK mulls new tax on vaping, February 24, 2023, <https://www.politico.eu/article/uk-tax-vaping-regulation/>

<sup>94</sup> Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE) (recast).

It would be difficult – given the existence of Rch-ecigs and Rf-ecigs - to argue that SU-ecigs have been designed in such a way that re-use, dismantling and recovery have been facilitated.

Some suppliers of SU-ecigs were already taking the view that proposals for the soon-to-be-approved Batteries Regulation (replacing the existing Directive) could have a major impact on the market for SU-ecigs in the EU. The proposed wording in Article 11 for the proposed EU Regulation was as follows:<sup>95</sup>

*Article 11  
Removability and replaceability of portable batteries*

*1. Portable batteries incorporated in appliances shall be readily removable and replaceable by the end-user or by independent operators during the lifetime of the appliance, if the batteries have a shorter lifetime than the appliance, or at the latest at the end of the lifetime of the appliance.*

*A battery is readily replaceable where, after its removal from an appliance, it can be substituted by a similar battery, without affecting the functioning or the performance of that appliance.*

- 2. The obligations set out in paragraph 1 shall not apply where*
  - (a) continuity of power supply is necessary and a permanent connection between the appliance and the portable battery is required for safety, performance, medical or data integrity reasons; or*
  - (b) the functioning of the battery is only possible when the battery is integrated into the structure of the appliance.*
- 3. The Commission shall adopt guidance to facilitate harmonised application of the derogations set out in paragraph 2.*

The key change here from the Batteries Directive relates to the requirement for replaceability of the battery (not just that the battery can be removed). The likelihood that this will indeed happen was increased in April 2023. A compromise between Parliament and the Council in the trilogue procedure on the Battery Regulation will apparently require that three and a half years after the regulation comes into force, batteries in portable devices, including in disposable e-cigarettes, must be removable and replaceable by the users themselves.<sup>96</sup> It is believed, therefore, that SU-ecigs will be effectively banned in the EU by the end of 2026.

<sup>95</sup> ECigIntelligence (2022) How will the EU's proposed new rules on batteries affect the vaping industry? 17th November 2022

<sup>96</sup> Tobacco Journal (2023) EU bans disposables, 20/04/2023.

The EU was also proposing to amend existing EU rules by removing an exemption on the sale of flavoured tobacco products that currently applies to e-cigarettes and other heated tobacco products. Lawmakers were seeking to ban flavoured heated tobacco products – including flavoured e-cigarettes – in a move intended to protect the health of young. This seems to be related to a previous report which, reflecting on a study by the Scientific Committee on Health and Environmental Risks (SCHEER), stated:<sup>97</sup>

*For users of electronic cigarettes, they found moderate weight of evidence for risks of local irritative damage to the respiratory tract and moderate, but a growing level of evidence from human data suggesting that electronic cigarettes have harmful health effects, especially but not limited to the cardiovascular system. More so, they found weak to moderate weight of evidence for risks of carcinogenicity of the respiratory tract due to long-term, cumulative exposure to nitrosamines and due to exposure to acetaldehyde and formaldehyde and concluded that weight of evidence for risk of poisoning and injuries due to burns and explosion is strong. They also found weak to moderate weight of evidence for several risks related to second-hand exposure.*

*Overall, there is moderate evidence that electronic cigarettes are a gateway to smoking for young people and strong evidence that flavours have a relevant contribution for attractiveness of use of electronic cigarette and initiation. On the other hand, there is weak evidence for the support of electronic cigarettes' effectiveness in helping smokers to quit while the evidence on smoking reduction is assessed as weak to moderate.*

It should be noted that this measure would affect e-cigarettes beyond SU-ecigs, so it might be expected to continue irrespective of the progress of the Batteries Regulation.

The FT also indicated that the EU was exploring the introduction of minimum tax rates on e-cigarettes:<sup>98</sup>

*The EU is to propose a bloc-wide vaping levy as part of a shake-up of taxation on the tobacco industry that would also double excise duties in member states with low cigarette taxes, according to a draft European Commission document.*

*The changes to legislation, part of a push by Brussels to cut smoking rates, will increase the EU's minimum excise duty on cigarettes from €1.80 to €3.60 per pack of 20, which would raise prices in eastern European nations where packs can sell for under €3.*

<sup>97</sup> Report From the Commission to the European Parliament, The Council, The European Economic And Social Committee And The Committee Of The Regions on the application of Directive 2014/40/EU concerning the manufacture, presentation and sale of tobacco and related products (see also SCHEER (2021) Opinion on electronic cigarettes).

<sup>98</sup> FT (2022) Brussels to propose rise in cigarette taxes and first EU-wide vaping levy, November 27, 2022.

*The update to the 2011 EU tobacco taxation directive will also bring the taxation of novel smoking products, such as vapes and heated tobacco, into line with cigarettes, as policymakers worldwide take an increasingly dim view of the new products' popularity among young people.*

*Stronger vaping products would have an excise duty of at least 40 per cent applied to them, while lower-strength vapes will face a 20 per cent duty. Heated tobacco products will also be hit by 55 per cent duty, or a tax rate of €91 per 1,000 items sold.*

Evidently, at the EU level, not only are there measures in train whose effect may be – implicitly – to ban SU-ecigs, but flavoured tobacco products might be banned, and the level of taxation of e-cigarettes containing tobacco may be increased to narrow the price differential between conventional cigarettes, and that of e-cigarettes and heated tobacco products.

### **7.2.1 Finland**

Finland bans the sale of all e-cigarettes with a flavour other than tobacco. The law also restricts e-cigarette advertising and promotion and product display at points of sale. Text-only health warnings in Finnish and Swedish are required to cover 32 percent of the front and back of the package. Plain packaging of e-cigarette products is required.

### **7.2.2 Norway**

Until July 1, 2023, all importation and sale of e-cigarettes and refill containers with nicotine are prohibited. After that date, the retail sales of e-cigarette devices or e-liquids will be allowed only where the product has been approved by the Directorate of Health through an application process.<sup>99</sup>

### **7.2.3 Germany**

In Germany, the Bundesrat is a body which includes representatives of all the Länder. It has no power (to our knowledge) to pass legislation itself, but it can influence what legislation is initiated. In this regard, it has called on the Federal Government to commence the legislative process for an effective ban on the marketing of single-use e-cigarettes at national level, and to make the case for the same at the EU level.

The main rationale for the ban is on ecological, not health, grounds. The Bundesrat noted that disposable e-cigarettes are often not disposed of properly as electrical appliances but with household waste. Due to the improper disposal of the products, there is not only a loss of raw materials but also the danger of fires caused by the lithium-ion batteries that are often contained in the products. It was also argued that disposable e-cigarettes cannot be refilled, and the battery cannot be replaced.

<sup>99</sup> <https://www.tobaccocontrolaws.org/legislation/norway/e-cigarettes?row=1247897>

Following the Bundesrat's vote (of 10th March 2023), the Bundestag has 6 weeks in which to arrive at their decision as to whether or not to move ahead with a legislative process. Hence, we await the decision of the Bundestag in response to the initiative of the Bundesrat.<sup>100</sup>

#### 7.2.4 Ireland

The Republic of Ireland is in the process of publishing the Public Health (Tobacco Products and Nicotine Inhaling Products) Bill which includes wide ranging measures to address smoking and vaping among those under 18 years and all adults.

### 7.3 Other Jurisdictions outside the EU

#### 7.3.1 China

Chinese law bans the domestic sale of flavoured e-cigarettes other than tobacco flavour. The ban on flavoured e-cigarettes does not apply to e-cigarettes manufactured for export.

Otherwise, the sale of e-cigarettes is allowed but subject to several restrictions including a minimum sales age; a ban on sales near certain education facilities; and a ban on sales through vending machines and the internet.

The use of e-cigarettes is prohibited in schools, kindergartens, and other public venues where young people gather.

Text-only health warnings are required to be displayed on 35 percent of the front and back of e-cigarette packaging. The warnings should be rotated annually.

The relevant tobacco advertising laws are applied to e-cigarettes, which prohibit tobacco advertising in mass media, public places, means of public transport, and outdoors. Exhibitions, forums and expos promoting e-cigarettes are also specifically prohibited.

#### 7.3.2 Australia

Australia has recently issued a new National Tobacco Strategy. The Strategy includes the following measures (amongst others) in relation to e-cigarettes:<sup>101</sup>

- Develop and implement additional measures to further restrict the marketing, availability, use, and end-of-life disposal of all e-cigarette components in Australia, regardless of their nicotine content.
- Develop and implement measures to prohibit the sale of flavoured e-cigarettes, regardless of their nicotine content.
- Raise awareness about the marketing and use of e-cigarettes and their immediate and long-term impacts on individual and population health.

<sup>100</sup> See <https://www.iamexpat.de/expat-info/german-expat-news/disposable-e-cigarettes-could-soon-be-banned-germany>; Tobacco Journal International (2023) Bundesrat votes for ban on disposables, 10/03/2023, <https://www.tobaccojournal.com/news/bundesrat-votes-for-ban-on-disposables/>

<sup>101</sup> Department of Health and Aged Care (Australia) (2023) National Tobacco Strategy 2023–2030, May 2023.

- Develop and implement an evidence-based comprehensive regulatory framework for e-cigarettes and all novel and emerging products that pose risks to tobacco control and population health.
- Prohibit advertising, promotion and sponsorship relating to e-cigarettes and other new and emerging products.
- Strengthen research, monitoring and surveillance activities pertaining to the marketing and use of e-cigarettes and novel and emerging products.

Significantly, the speech accompanying the launch of the new strategy made additional commitments, including the following:<sup>102</sup>

*“I also intend to accept the TGA’s [Therapeutic Goods Administration] advice and ban single-use, disposable e-cigarettes that clog landfill and are toxic to the environment.”*

A key element of the strategy is linked to the existing approach which requires consumers to have a valid prescription from an Australian doctor for all purchases of nicotine vaping products. Currently, the prescription can cover a range of flavoured products. The Minister’s speech tightens up the law that was already in place so as to prevent adolescents and young adults from taking up nicotine e-cigarettes, while allowing current smokers to access these products to use for smoking cessation with appropriate medical advice.

The Minister’s speech made this clear:<sup>103</sup>

*“The first thing to do is to stop the import of vapes that aren’t destined for pharmacy shelves - to be sold as a therapeutic product with the approval of a health professional.*

*To obtain an import permit, an importer will have to show the vapes comply with new standards and processes established by the Therapeutic Goods Administration [TGA].*

*They will have to be imported for sale in pharmacies only.*

*The import of vapes for sale in retail settings will end.*

*These are supposed to be pharmaceutical products, so they will have to present that way - no more bubblegum flavours or pink unicorn packaging.*

*Pharmaceutical-style packaging and devices, with plain flavours.”*

It would appear, therefore, that Australia will ban flavoured e-cigarettes, and will restrict consumption to purchases of products approved by the TGA, for sale in pharmacies only, and under the approval of a health professional.

<sup>102</sup> Minister for Health and Aged Care (Australia) (2023) Minister for Health and Aged Care – Speech – National Press Club – 2 May 2023, <https://www.health.gov.au/ministers/the-hon-mark-butler-mp/media/minister-for-health-and-aged-care-speech-national-press-club-2-may-2023?language=en>

<sup>103</sup> Minister for Health and Aged Care (Australia) (2023) Minister for Health and Aged Care – Speech – National Press Club – 2 May 2023, <https://www.health.gov.au/ministers/the-hon-mark-butler-mp/media/minister-for-health-and-aged-care-speech-national-press-club-2-may-2023?language=en>



### 7.3.3 United States

The US Food and Drug Administration (FDA) imposed a ban in 2020 on products using flavoured cartridges and pods. This was in response to health scares linked to Juul products. However, the ban did not include (refillable) tanks, and it also did not ban disposable, flavoured e-cigarette products, which unsurprisingly (with the benefit of hindsight), soared in popularity after the ban was implemented.

The Brookings Urban Institute reported that as of January 2022, 29 states and the District of Columbia tax these products. Indiana began taxing vaping products in July 2022. Additionally, there are local taxes on vaping, but no state tax, in Alaska and Nebraska.

The Urban Institute describes the difference between States' approaches, some using ad valorem taxes, others targeting liquids or cartridges:<sup>104</sup>

*Twenty states and the District of Columbia levy a percentage of price tax on vaping products, ranging from 7 percent in Georgia to 95 percent in Minnesota. Many of these states tax vaping products this way by adding them to their state's existing definition of "other tobacco products." As a result, vaping products are taxed at the same rate as other tobacco products in these states.*

*Fifteen states levy a per unit tax on vaping products. Most of these state taxes are based on the liquid that delivers nicotine to the smoker. These tax rates range from 5 cents per milliliter (in six states) to 40 cents per milliliter in Connecticut.*

*However, Connecticut, Georgia, Kentucky, New Hampshire, New Jersey, and New Mexico levy a per-cartridge tax on certain vaping products. All of these states levy their per-cartridge tax on "closed" vaping products, which are products prefilled with liquid. For example, the company JUUL makes closed vaping products, which anti-vaping advocates argue targets young people. These states all then levy a separate percentage of price tax on "open" vaping products, where the liquid is filled by the user. For example, Kentucky levies a \$1.50 per cartridge tax on "closed" products and a 15 percent of wholesale price tax on "open" products. Similarly, Maryland also levies different percentage of price taxes on "open" and "closed" products, with a higher rate on vaping liquid sold in containers smaller than 5 ml.*

As in California, where an excise tax on e-cigarettes of 12.5% has been implemented (with the revenue to be used for public health and education programmes), a key aim has become discouraging vaping by young people, whilst also bringing taxes on e-cigarettes more in line with levies on other tobacco products.

<sup>104</sup> Urban Institute (2022) Cigarette and Vaping Taxes, <https://www.urban.org/policy-centers/cross-center-initiatives/state-and-local-finance-initiative/state-and-local-backgrounders/cigarette-and-vaping-taxes>

### 7.3.4 New Zealand

The government announced on 6th June 2023 it would be banning most disposable e-cigarettes, not allowing new vape shops near schools and enforcing generic flavour descriptions. The number of teenagers vaping in New Zealand has risen dramatically over the past five years, even as cigarette smoking dropped to its lowest-ever levels, despite Government reforms introduced in 2020 that banned sales to under-18s, prohibited vaping at schools and early childhood centres and prohibited vape advertising and sponsorship reforms introduced in 2020 banned sales to under-18s, prohibited vaping at schools and early childhood centres and prohibited vape advertising and sponsorship.<sup>105</sup>

The new rules will come into place in August, and mean all vaping devices sold in New Zealand will need to have removable or replaceable batteries.

According to the website, [www.TobaccoControlLaws.org](http://www.TobaccoControlLaws.org), the following 27 countries also ban e-cigarettes:

- Argentina
- Brazil (though there is some indication that this could be relaxed)
- Brunei Darussalam
- Cambodia
- Ethiopia
- Gambia
- Hong Kong
- India

- Iran
- Iraq
- Lebanon
- Macau
- Mauritius
- Mexico (though apparently, some retailers are allowed to sell)
- Oman
- Panama
- Qatar
- Singapore
- Sri Lanka
- Suriname
- Syria
- Thailand
- Timor-Leste
- Turkey
- Turkmenistan
- Uganda
- Uruguay

In addition, [www.globaltobaccocontrol.org](http://www.globaltobaccocontrol.org) indicates a range of countries that have imposed taxes on e-cigarettes. We have removed the ad valorem taxes/duties as we believe these may replicate VAT regimes.

Setting these aside, the most common e-cigarette tax is a tax applied to e-cigarette liquid based on its volume. For example, Norway established its tax rate for e-cigarettes with nicotine as 4.50 NOK per millilitre of liquid.

<sup>105</sup> <https://www.theguardian.com/world/2023/jun/06/new-zealand-to-introduce-new-rules-to-crack-down-on-youth-vaping>

Other countries tax the device and accessories as well such as Costa Rica which set a tax rate of 20 percent that is equally applied to e-cigarette liquid and related accessories. In the Republic of Korea, nicotine-containing e-cigarettes can only be featured a maximum of 10 times per magazine per year. The use of e-cigarettes is banned in public places and public transport with the exception of designated smoking areas. E-cigarette products are subject to a number of taxes and charges (national health promotion, tobacco consumption, local education, and individual consumption taxes) proportional to 1,799 won/mL (approx. \$1.53 USD) nicotine liquid; in addition there is a waste charge of 24 won/20 cartridges (approx. \$0.02 USD) and a 10% Value Added Tax (VAT).

The World Bank noted:<sup>106</sup>

*The price of e cigarettes has not increased much despite the tax increases placed upon them. Taxes on e cigarettes were intended to be like for like with cigarettes, but the tax avoiding behavior of e cigarette dealers (which reduce the taxable amount of liquid in the e cigarettes) has resulted in de facto differential tax rates between the two products. As a result, competitive distortions were caused in the market, and sales of e cigarettes rose substantially after the 2015 tobacco tax reform.*

*With the problems of e cigarette taxation unresolved, a new type of e cigarette (using heat not burn tobacco such as IQOS and GLO) appeared on the market in 2017. Tobacco taxes were immediately levied on these products in the same way as for as cigarettes (applying tax rates similar to those for e cigarettes per weight). However, from 2018 (realizing the difficulty of levying taxes per gram), excise taxes for heat not burn tobacco were levied based on 20 sticks. The tobacco tax reforms on e-cigarettes in Korea reflect the strong views that exist in the country on e cigarettes, and which place them in the same category as traditional cigarettes.*

The website identified 18 other countries/ jurisdictions that apply a specific excise tax based on volume:

Denmark; Finland; Georgia; Germany; Indonesia; Israel; Italy; Latvia; Lithuania; Montenegro; Norway; Pakistan; Philippines; Poland; Portugal; Sweden; Ukraine; Uzbekistan.

<sup>106</sup> World Bank group (2018) Reducing Tobacco Use Through Taxation: The Experience Of The Republic Of Korea, June 2018

## 7.4 Summary

Several policy instruments are already in place, or in consideration. The main health related measures have led to taxes/duties and/or restrictions, especially on flavoured e-cigarettes given that they are implicated in increased uptake by young people. It seems clear, however, that as the SU-ecigs have increased their market share, so the environmental concerns are becoming more prominent in the minds of the public. Hence, the Irish and German positions described above.

In terms of the nature of measures, key existing measures (beyond widely applied restrictions on the age of consumer/to whom people can sell) are:

- Taxes/duties, and
- Bans and restrictions on what e-cigarettes can be sold.

The restriction on sales of flavoured products, (as deployed in the Republic of China) – is a common strategy particularly designed to reduce consumption by young people due to health concerns.

# Appendix 1

Table 17. Synthesis of appraisal of all policy options

	Measure	Principal Rationale	Feasibility/ Issues in Implementation	Estimated impact on consumption of SU-ecigs (existing/ future users)	Potential impact on improving management of SU-ecigs/ safe recycling	Potential impact on reducing disamenity and pollution impacts from SU-ecigs	To be given further consideration
<b>Existing Regs on WEEE and Batteries and Accumulators</b>							
<b>1</b>	Pursue increased compliance of Regs in respect of registration of producers	To ensure that all 'producers', as defined under WEEE and B and A Regs are registered, reporting appropriately, contributing financially, engaging in take-back as necessary	None (other than cost, which can be passed to producers under an amended EPR,	None	<b>Low</b> Could increase availability (if not visibility) of take-back. Might not imply distributors 'do the right thing'	<b>Low</b> Enhancing take-back opportunities may reduce littering to a degree	Not considered further Should be given effect as soon as possible
<b>Upgrades to WEEE Regs and batteries and Accumulators (PoM) regs</b>							
<b>2a</b>	Require that batteries are replaceable	A change to ensure that batteries have to be not only removable but also replaceable would improve EEE design. For e-cigarettes (and other categories), replaceable should imply 'by the consumer' (not requiring a technician). Also require product life to exceed useful battery life.	Requires UK-wide agreement (which may take time).	<b>High</b> Would, most likely, regulate e-cigs so that SU-ecigs could no longer be placed on the market.	<b>High</b> Management problem would disappear for SU-ecigs. Issue of managing other (substitute) ecigs and containers would remain.	<b>High</b> Littering/ resource use problem disappears for SU-ecigs. Issue of managing other (substitute) e-cigarettes and containers remains, but these may be less likely to be littered.	<b>Yes</b> Could be discussed in context of revision to Batteries and Accumulators (Placed on the Market) Regulations.

**Table 17. Synthesis of appraisal of all policy options** cont'd.

	Measure	Principal Rationale	Feasibility/ Issues in Implementation	Estimated impact on consumption of SU-ecigs (existing/ future users)	Potential impact on improving management of SU-ecigs/ safe recycling	Potential impact on reducing disamenity and pollution impacts from SU-ecigs	To be given further consideration
<b>Upgrades to WEEE Regs and batteries and Accumulators (PoM) regs</b>							
<b>2c</b>	Increase sanctions for non-compliance	Sanctions are low at present. (Other countries make provision for company representatives to serve custodial sentences.)	Requires UK-wide agreement.	<b>Marginal</b> Arguably, compliance would lead to a change in pricing at the margin, with a small impact on demand. Demand, though, is likely to be inelastic for vaping, even if cross-price effects (switching between devices) may be more elastic.	<b>Low/ medium</b> This would, at least, support the revenue requirement for proper management of e-cigs, but current targets for Category 7 WEEE are set too low.	<b>Low/ medium</b> This would, at least, support the revenue requirement for proper management of e-cigs, partly though take-back. No effect on design.	Not considered further Could be discussed in context of revision to WEEE Regulations.
<b>2d</b>	Upgrade take-back requirements (and implementation)	Take-back infrastructure is insufficiently visible (both for e-cigarettes and for batteries). The existence of, and positioning of, take-back opportunities need to be made obvious to consumers through active marketing thereof (including at point of sale).		<b>Marginal</b> (similar to 2c above)	<b>Low/ medium</b> More likely to be medium if a) all those required to engage in take-back do so and b) if 3b and 3c are implemented.	<b>Low/ medium</b> More likely to be medium if a) all those required to engage in take-back do so and b) if 3a is implemented.	Not considered further Could be discussed in context of revision to WEEE Regulations (and is implicit in some).

**Table 17. Synthesis of appraisal of all policy options** cont'd.

	Measure	Principal Rationale	Feasibility/ Issues in Implementation	Estimated impact on consumption of SU-ecigs (existing/ future users)	Potential impact on improving management of SU-ecigs/ safe recycling	Potential impact on reducing disamenity and pollution impacts from SU-ecigs	To be given further consideration
<b>More Substantive Revisions to WEEE Regs</b>							
<b>3a</b>	Changing thresholds for small producers/ increasing scope of producers with take-back obligation	Ensuring more e-cigarette producers are contributing effectively in financial terms, and regarding take-back infrastructure. Existing thresholds are not well-suited to ecig producers, and the take-back requirements affect many producers who are small. These producers may well be 'taking back', but simply disposing of those taken back (why pay >£10,000 per tonne when you can pay next to nothing for discarding to a bin?)		None	<b>Low/ medium</b> More likely to be medium if a) all those required to engage in take-back do so and b) if 2d, 3b and 3c are implemented.	<b>Low/ medium</b> More likely to be medium if a) all those required to engage in take-back do so and b) if 2d is implemented.	<b>Yes</b> As a package 3a) to d)

**Table 17. Synthesis of appraisal of all policy options** cont'd.

	Measure	Principal Rationale	Feasibility/ Issues in Implementation	Estimated impact on consumption of SU-ecigs (existing/ future users)	Potential impact on improving management of SU-ecigs/ safe recycling	Potential impact on reducing disamenity and pollution impacts from SU-ecigs	To be given further consideration
<b>More Substantive Revisions to WEEE Regs</b>							
<b>3b</b>	Broadening the scope of activities for which costs are recovered from producers.	Currently, producers would be (if registered, and if not small producers) required to pay for their share of the costs of collecting and treating Category 7 WEEE. This measure would require producers to fund costs of a) residual waste collection/ management; b) public waste collection (litter bins) c) clean up of littered e-cigarette and associated materials, and d) information campaigns regarding where to discard e-cigarette to ensure they are recycled and the impacts of improper discarding/ not recycling of e-cigarette. representatives to serve custodial sentences.)	It would seem that this would be unlikely to be agreed by Category 7 producers of products other than e-cigarette without 3c (they would pay well over the odds for their products, allowing free-riding by e-cigarette producers).	<b>Very Low</b> The additional costs are likely to be passed through to consumers. This would likely have some small impact on demand. It is possible that if 3c (or 4) is also implemented, costs of dealing properly with take-back might disincline some retailers to sell e-cigarette. That could also marginally affect use.	<b>Medium</b> In the absence of modulation, funding for e-cigarette management might not proceed smoothly.	<b>Medium</b> The activity of littering might not be readily affected without the effect of modulation – effectively, all Cat 7 producers would be covering littering costs incurred by one subcategory of product (e-cigarette), allowing it to free-ride with limited incentive to change.	<b>Yes</b> As a package 3a) to d)



**Table 17. Synthesis of appraisal of all policy options** cont'd.

	Measure	Principal Rationale	Feasibility/ Issues in Implementation	Estimated impact on consumption of SU-ecigs (existing/ future users)	Potential impact on improving management of SU-ecigs/ safe recycling	Potential impact on reducing disamenity and pollution impacts from SU-ecigs	To be given further consideration
<b>More Substantive Revisions to WEEE Regs</b>							
<b>3c</b>	Modulating fees/ obligations within Cat 7 to ensure targeted cost recovery from e-cigarette producers.	Currently, producers would be (if registered, and if not small producers) required to pay for their share of the costs of collecting and treating Category 7 WEEE. If these costs are properly allocated to producers in line with the costs that managing their products incur, so the costs for e-cigarette management would increase in line with the costs of recycling (and the more so, the more the items were recycled).	Likely to be a complement to 3b.	<b>Low</b> The additional costs are likely to be passed through to consumers. This would likely have some small impact on demand. It is possible that if 3c (or 4) is also implemented, costs of dealing properly with take-back might disincline some retailers to sell ecigs. That could also marginally affect use.	<b>Mediu to High</b> Modulation would allow a clear stream of funding to be dedicated to better management of WEEE. Especially alongside 3a (and 2d), recycling could improve.	<b>Medium</b> The fact that e-cigarette producers would need to pay for clean-up of littered e-cigarette and their management would likely spur efforts to a) communicate with users to affect littering behaviour, and b) ensure that the infrastructure for collection was in place.	<b>Yes</b> As a package 3a) to d)

**Table 17. Synthesis of appraisal of all policy options** cont'd.

	Measure	Principal Rationale	Feasibility/ Issues in Implementation	Estimated impact on consumption of SU-ecigs (existing/ future users)	Potential impact on improving management of SU-ecigs/ safe recycling	Potential impact on reducing disamenity and pollution impacts from SU-ecigs	To be given further consideration
<b>More Substantive Revisions to WEEE Regs</b>							
<b>3d</b>	New targets for separate collection/ recycling of SU (and other) e-cigarettes.	The current collection target for WEEE Category 7 amounts to around 6-8% of Category 7 EEE placed on the market. It would be met by collecting around 50% of SU-ecigs. The Environment Agency indicates that whole e-cigarettes should not be incinerated. In 2021, SEPA data indicates roughly half of residual household waste was incinerated. A high rate of separate collection would be required to prevent whole e-cigarettes being incinerated.	Likely to be a complement to 3b.	<b>Low</b> The measure aims to affect collection services. To the extent that these are paid for by producers, prices may increase at the margin, with knock-on effects on demand.	<b>Medium to High (depending on target levels)</b> The measure sets out to increase collection or/ and recycling rates. If targets are set high enough, then management should show commensurate improvement as long as sanctions are sufficiently dissuasive for non-compliance.	<b>Medium to High (depending on target levels)</b> The closer the targets move to 100%, so the closer a compliant system would come to eliminating the problem of litter. Indeed, left to their own devices, producers may, if faced with high targets, design a system with incentivised return to achieve targets that are set (likely reducing litter).	<b>Yes</b> As a package 3a) to d)

**Table 17. Synthesis of appraisal of all policy options** cont'd.

	Measure	Principal Rationale	Feasibility/ Issues in Implementation	Estimated impact on consumption of SU-ecigs (existing/ future users)	Potential impact on improving management of SU-ecigs/ safe recycling	Potential impact on reducing disamenity and pollution impacts from SU-ecigs	To be given further consideration
<b>More Substantive Revisions to WEEE Regs</b>							
<b>4</b>	Introducing a separate Category for e-cigarettes (as a means to achieve 3a-3d).	The fact that e-cigarettes are included within Category 7 makes it somewhat more difficult to achieve 3a-3d above. There are good reasons (see main text) for including a separate WEEE category for ecigs. The specific category would make it easier to specify targets for e-cigarette management (collection and recycling) and make the allocation of costs to e-cigarettes more straightforward. Data collection, and product segregation requirements might also be more easily enforced. representatives to serve custodial sentences.)		<b>Low</b>	<b>High</b> Dedicated (e-cigarette-specific) performance targets would help incentivise producers to configure a scheme which delivers the outcomes in the most efficient manner. This might also help ensure that the intent of 2d was also achieved.	<b>Medium to High</b> The fact that e-cigarette producers would need to pay for clean-up of littered e-cigarettes and their management would likely spur efforts to a) communicate with users to affect littering behaviour, and b) ensure that the infrastructure for collection was in place.	<b>Yes</b> as a (preferred) variant of the package 3a) to d).

**Table 17. Synthesis of appraisal of all policy options** cont'd.

	Measure	Principal Rationale	Feasibility/ Issues in Implementation	Estimated impact on consumption of SU-ecigs (existing/future users)	Potential impact on improving management of SU-ecigs/safe recycling	Potential impact on reducing disamenity and pollution impacts from SU-ecigs	To be given further consideration
<b>Communication and Marketing Measures</b>							
<b>5a</b>	Display ban on all e-cigarettes (including single-use).	The aim would be to extend existing bans on promotion (in conventional media) to point of sale (currently not prohibited). The objective would be to reduce use (and impact) as a result.		<b>Very low for existing users in short-term</b> Likely higher for those considered 'future users' in the baseline Note that the effect is also limited by the fact that physical stores are not the only source through which e-cigarettes are sold.	<b>None</b> (for e-cigarettes still being discarded).	<b>Very low in short-term</b> Higher in longer-term (limited to a proportion of the change in demand relative to the counterfactual).	Not considered further
<b>5b</b>	Regulating social media promotion	The aim would be to cut down on the extent to which e-cigarettes are marketed using social media platforms such as Tik Tok and Instagram. These are channels through which younger users may be encouraged to become users: younger users (under 25s) are the majority of Scotland's e-cigarette users.	Would either need to be UK wide, or would require change in law to specify the requirement specifically for Scotland. Likely to be difficult to give strong effect to the measure.	<b>Low for existing users in short-term</b> Likely medium for those considered 'future users' in the baseline Likely to be mainly effective in reducing use among younger users.	<b>None</b> (for those e-cigarettes still consumed).	<b>Very low in short-term</b> Higher in longer-term (limited to a proportion of the change in demand relative to the counterfactual).	Not considered further

**Table 17. Synthesis of appraisal of all policy options** cont'd.

	Measure	Principal Rationale	Feasibility/ Issues in Implementation	Estimated impact on consumption of SU-ecigs (existing/future users)	Potential impact on improving management of SU-ecigs/safe recycling	Potential impact on reducing disamenity and pollution impacts from SU-ecigs	To be given further consideration
<b>Communication and Marketing Measures</b>							
<b>5c</b>	Removing branding in marketing of SU-ecigs	The colourful marketing of e-cigarettes makes them attractive to potential users. By removing any branding on SU-ecig packages, this could help reduce their appeal. (representatives to serve custodial sentences.)		<b>Low for existing users in short-term</b> Likely medium for those considered 'future users' in the baseline Note that the effect is thought to be stronger with younger people than older age groups.	<b>None</b> (for those e-cigarettes still consumed).	<b>Low in short-term</b> Higher in longer-term (limited to a proportion of the change in demand relative to the counterfactual).	Not considered further
<b>5d</b>	Standardising product colour (i.e., eliminating the variety in colours)	The aim would be to require all SU-ecigs to be of one colour (potentially a bright one to make the activity conspicuous, or clear to make material easier to recycle).	Would either need to be UK wide, or would require change in law to specify the requirement specifically for Scotland.	<b>Very low for existing users in short-term</b> Likely higher for those considered 'future users' in the baseline Note that the effect may be greater among younger people than older age groups.	<b>Low</b> If this implies, or was designed to imply, greater product standardisation, management at end of life could be somewhat simplified.	<b>Low in short-term</b> Higher in longer-term (limited to a proportion of the change in demand relative to the counterfactual).	Not considered further

**Table 17. Synthesis of appraisal of all policy options** cont'd.

	Measure	Principal Rationale	Feasibility/ Issues in Implementation	Estimated impact on consumption of SU-ecigs (existing/ future users)	Potential impact on improving management of SU-ecigs/ safe recycling	Potential impact on reducing disamenity and pollution impacts from SU-ecigs	To be given further consideration
<b>Communication and Marketing Measures</b>							
<b>5e</b>	Communications campaign to improve consumer behaviour regarding management of end-of-life SU-ecigs	The communications to consumers regarding end-of-life management can (for e-cigarettes specifically) be improved and could help make sure that when users discard e-cigarettes they do so in the correct location.	Would logically be implemented using producer funding under 3b (and 3c)/4 could be implemented as stand-alone requirement for industry.	<b>Very low</b> Not specifically designed to have this effect, but could have a very marginal impact.	<b>Low</b> On its own, likely to be limited. Best used in support of measures which call forward improved infrastructure. In the absence of this, it may simply frustrate.	<b>Low</b> On its own, and without other measures, may have limited effect.	<b>Yes</b> As part of EPR changes
<b>5f</b>	Communications campaign to improve consumer behaviour regarding littering	The communications to consumers regarding end-of-life management can (for e-cigarettes specifically) be improved and could help make sure that users do not litter products at end of life.	Would logically be implemented using producer funding under 3b (and 3c)/4 Could be implemented as stand-alone requirement for industry.	Not specifically designed to have this effect, but could have a very marginal impact.	<b>Low</b> On its own, likely to have limited effect Best used in support of measures which call forward improved infrastructure. In the absence of this, it may simply frustrate.	<b>Low</b> On its own, and without other measures, may have limited effect, although it may encourage a switch from littering to alternatives.	<b>Yes</b> As part of EPR changes

**Table 17. Synthesis of appraisal of all policy options** cont'd.

	Measure	Principal Rationale	Feasibility/ Issues in Implementation	Estimated impact on consumption of SU-ecigs (existing/ future users)	Potential impact on improving management of SU-ecigs/ safe recycling	Potential impact on reducing disamenity and pollution impacts from SU-ecigs	To be given further consideration
<b>Market/Incentive-based measures</b>							
<b>6</b>	Charging a deposit for SU-ecigs to be refunded on return for recycling	A deposit at purchase applied to SU (and other)-ecigs would give users an incentive to return products to appropriate locations, and would (if well designed) support the establishment of the required infrastructure. Scottish Government could set targets for return rates and recycling rates, and automatically adjust deposit levels if rates are not met.	Might be made more difficult by recent discussions re DRS on beverage containers but the basis for take-back is already enshrined in Regulations (so retailer opposition should be lower than for beverages) Issues associated with labelling/ cross border issues would need to be addressed.	<b>Very low</b> Does not necessarily drive change in consumption patterns (may simply ensure that what is consumed is returned for proper management).	<b>High</b>	<b>High</b> With sufficient deposit, could generate reduced littering (and increased activity in litter pick up).	<b>Yes</b>
<b>7a</b>	Minimum unit pricing (e-liquid/ nicotine content)	The measure would be designed to reduce consumption of (nicotine in) e-liquids in e-cigarettes.	Because there are already restrictions on what SU-ecigs can contain, the minimum pricing would have the effect of being akin to a tax (for which there may be better designs – see below).	Not considered	Not considered	Not considered	<b>No</b>

**Table 17. Synthesis of appraisal of all policy options** cont'd.

	Measure	Principal Rationale	Feasibility/ Issues in Implementation	Estimated impact on consumption of SU-ecigs (existing/ future users)	Potential impact on improving management of SU-ecigs/ safe recycling	Potential impact on reducing disamenity and pollution impacts from SU-ecigs	To be given further consideration
<b>Market/Incentive-based measures</b>							
<b>7b</b>	Minimum unit pricing (each SU-ecig)	The measure would be designed to reduce consumption of SU-ecigs by establishing a minimum price for them.	Minimum unit pricing for e-cigarettes would effectively be establishing the price for all e-cigarettes in the market if it was to be effective. If that measure can be implemented, there would be limited rationale for innovation, and there may be perverse effects in terms of resource use ('pimped up' e-cigarettes to gain marketing advantage whilst staying below the minimum price).	Not considered	Not considered	Not considered	<b>No</b>



**Table 17. Synthesis of appraisal of all policy options** cont'd.

	Measure	Principal Rationale	Feasibility/ Issues in Implementation	Estimated impact on consumption of SU-ecigs (existing/ future users)	Potential impact on improving management of SU-ecigs/ safe recycling	Potential impact on reducing disamenity and pollution impacts from SU-ecigs	To be given further consideration
<b>Market/Incentive-based measures</b>							
8	Levy or charge on e-cigarettes designed to shift consumption up 'the e-cigarette management hierarchy'	The rationale is to use a suitably structured tax on e-cigarette to reduce SU-ecig use (and shift consumption more towards Rf-ecigs).		<b>Low to High</b> (dependent on levels) At suitable levels, could considerably reduce SU-ecigs. Structure can also seek to address Rch-ecig containers (and strengthen shift towards Rf-ecigs).	<b>None</b> No impact in terms of enhanced management of e-cigarette which are consumed. Improvement via shift in consumption, but no impact in infrastructure per se.	<b>Low to High</b> (dependent on levels) At higher levels, could reduce SU-ecigs considerably and hence address key source of litter problem. Effect will be enhanced if the structure of the levy discourages the straight-forward replacement of SU-ecigs by Rch-ecigs.	<b>Yes</b>
9	Levy or charge linked to recycling rates	This measure seeks to use tax to incentivise producers (and the supply chain) to increase recycling. The higher the recycling rate, the lower is the tax (and vice versa).	Could be set separately for SU-ecigs and 'other'-e-cigarettes. If so (if data allowed) would enable a different levy profile, and so may also drive consumption away from SU-ecigs.	<b>Low</b> Consumption is unlikely to be strongly affected, though non-zero levies will affect prices at the margin.	<b>Medium to High (depending on marginal incentive)</b> Could enhance recycling as long as the dynamic incentive imparted is strong enough.	<b>Medium to High (depending on marginal incentive)</b> May reduce littering if the incentive pushes recycling rates to very high levels, and leads to very high capture of (SU) e-cigarettes (for example, using a mechanism such as a deposit).	<b>Yes</b>

**Table 17. Synthesis of appraisal of all policy options** cont'd.

	Measure	Principal Rationale	Feasibility/ Issues in Implementation	Estimated impact on consumption of SU-ecigs (existing/ future users)	Potential impact on improving management of SU-ecigs/ safe recycling	Potential impact on reducing disamenity and pollution impacts from SU-ecigs	To be given further consideration
<b>Bans on sale/distribution/use</b>							
<b>10</b>	Ban on sale/distribution/use of SU-ecigs via own initiative	Should Scottish Government feel the environmental issues associated with existing (and projected) SU-ecig use need to be eliminated as far as possible, and if there is no sign of change at the UK-wide level (see above), then a ban specific to Scotland would be an option to consider.	Cross border purchases, and the emergence of a black market for SU-ecigs could result.	<b>High</b> (potentially) A possible means to implement a ban on SU-ecigs.	<b>None</b> Though the management problem largely disappears for SU-ecigs, the issue of managing other (substitute) e-cigarettes and containers remains.	<b>High</b> Littering/ resource use problem largely disappears for SU-ecigs Issue of managing other (substitute) e-cigarettes and containers remains.	<b>Yes</b>
<b>11</b>	Ban on sale/distribution/use of flavoured e-cigarettes	An alternative to an outright ban is a ban on flavoured e-cigarettes, which we believe are likely to account for (now) a large proportion of SU-ecig sales. Other countries have implemented such bans.	Cross border purchases, and the emergence of a black market for S-ecigs could result, and some retailers may choose not to comply.	<b>Medium to High</b> (share of flavoured production market for SU-ecigs is not clear).	<b>None</b> Though the management problem may be significantly reduced for SU-ecigs, the issue of managing other (substitute) e-cigarettes and containers remains.	<b>High</b> Littering/ resource use problem is significantly diminished for SU-ecigs Issue of managing other (substitute) e-cigarettes and containers remains.	<b>Yes</b>

**Table 17. Synthesis of appraisal of all policy options** cont'd.

	Measure	Principal Rationale	Feasibility/ Issues in Implementation	Estimated impact on consumption of SU-ecigs (existing/future users)	Potential impact on improving management of SU-ecigs/safe recycling	Potential impact on reducing disamenity and pollution impacts from SU-ecigs	To be given further consideration
<b>Bans on sale/distribution/use</b>							
<b>12</b>	Tightening Implementation of Age Restriction on E-cigarette Sales/Supply	The high level of underage use of SU-ecigs suggests that the existing policy and/or its implementation has failed. Sanctions for those not complying with the law are weak relative to the benefits of non-compliance. The capacity of Trading Standards to enforce the law is limited, with Trading Standards officers having halved in number over the last decade.		<b>Medium</b> Limited to existing purchasers who are below 18, though underage users may continue to vape in the longer term. Hence, this may affect both existing underage users, as well as users who may have taken up vaping in future. We do not have good data on intensity of use by under age users (number of SU-ecigs per day) relative to users of SU-ecigs in other age groups.	<b>None</b> (for e-cigarettes still being discarded).	<b>Medium</b> Main impact is via demand reduction.	<b>Yes</b> Considered essential given current state of affairs.

**Table 17. Synthesis of appraisal of all policy options** cont'd.

	Measure	Principal Rationale	Feasibility/ Issues in Implementation	Estimated impact on consumption of SU-ecigs (existing/ future users)	Potential impact on improving management of SU-ecigs/ safe recycling	Potential impact on reducing disamenity and pollution impacts from SU-ecigs	To be given further consideration
<b>Bans on sale/distribution/use</b>							
<b>13</b>	Limiting Sale of E-cigarettes to Pharmacies registered for Use in Pharmacies, and Under Prescription	As an alternative to Option 12, this follows the approach which has been proposed in Australia.		<b>Medium to High</b>	<b>None</b> (for e-cigarettes still being discarded) The problem itself could be much reduced in magnitude, however, and could be managed via take-back to pharmacies.	<b>Medium to High</b>	<b>No</b> We have not taken this measure forward as it is primarily motivate by health rather than environmental concerns.

# Appendix 2

**Table 18: Summary of front-running policy options**

Policy Option	Measure	Environmental Impact		Costs	Complementary Measures
		Management of Discarded Items	Litter		
1  2  3	Setting minimum eco-design criteria for e-cigarettes	Likely to reduce quantities. No effect on remaining e-cigarettes used.	Likely to reduce quantities. No effect on remaining e-cigarettes used, though these may be littered less frequently. Possible issue with increase in use of Rch-ecigs (and the pre-filled containers) if they are not banned also.	Not costly to introduce. Enforcement will require resourcing (especially for Scotland-specific ban owing to potential for cross-border imports/black market sales). Main costs will be to manufacturing the vast majority of which is in China. From shift to Rch/Rf-ecigs, maybe upside to local liquid manufacturers.	Make use of other instruments, such as levies, to reduce extent to which the default alternative is low cost Rch-ecigs.
	Imposing a requirement for batteries to be replaceable				
	Ban via new legislation, in Scotland or UK-wide				
4	Charging a deposit for SU-ecigs to be refunded on return for recycling	Could allow for increased rate of return of SU (and other) e-cigarettes to suitable return locations.	With sufficient deposit, could generate reduced littering (and increased activity in litter pick up). Does not necessarily drive change in consumption patterns (may simply ensure that what is consumed is returned for proper management).	Costs depend on baseline availability of take-back. If there is full compliance with take-back obligation, then there may already be a basis for building the necessary infrastructure.	Govt could set minimum return and recycling rates for system. Could be implemented alongside/as part of Option 6
5	Levy linked to recycling rates	Could enhance recycling as long as the incentive effect is strong enough.	May reduce litter if the main mechanism used to increase recycling rates is similar to DRS.	Would generate revenue as recycling rates build up. Industry would be expected to organise response.	Could be set separately for SU-ecigs and 'other'-e-cigarettes. If so (if data allowed) would enable a different levy profile, and so may also drive consumption away from SU-ecigs. Might be linked to Option 6 below.

**Table 18: Summary of front-running policy options** cont'd.

Policy Option	Measure	Environmental Impact		Costs	Complementary Measures
		Management of Discarded Items	Litter		
6	<p>WEEE Regulations reformed such that there is:</p> <ol style="list-style-type: none"> <li>1. a separate Category of WEEE for e-cigarettes, along with;</li> <li>2. full cost recovery from producers (residual, public bins, litter clean up) and comms regarding effects of littering/ alternatives to SU-ecigs;</li> <li>3. category specific collection target; and</li> <li>4. category specific recycling target.</li> </ol>	<p>Management of what is collected could improve considerably. Does not necessarily drive change in consumption patterns (may simply ensure that what is consumed is returned for proper management).</p>	<p>Littering behaviour could decline, but likely not to levels as low as with a charged deposit (consumers have no incentive to return).</p>	<p>Costs to e-cigarettes producers will increase significantly to accurately reflect costs of managing their products at end of life. PCSs will have a basis for investment. Some incentive for better design.</p>	<p>Could be coupled to an incentive mechanism such as Option 7 or Option 4.</p>
7	<p>Levy on e-cigarettes designed to shift consumption 'up the ecig hierarchy':</p> <ol style="list-style-type: none"> <li>1. a levy on SU-ecigs at £X per device;</li> <li>2. a levy on Rf-ecigs/Rch-ecigs at a lower level, £Y per device; and;</li> <li>3. a levy on all pre-filled rechargeable containers at £Z per container</li> </ol> <p>(or as above but with additional levy for nicotine in liquids).</p>	<p>No guarantee of significantly enhanced management of e-cigarettes which are consumed.</p>	<p>At suitable levels, could reduce SU-ecigs considerably and hence address main source of litter problem. Structure also seeks to address Rch-ecig containers.</p>	<p>Could generate revenue. If well designed, manufacturers of SU-ecigs will see market reduced. May lead to increased share of spend moving to refillable liquids (some of which maybe Scotland/ UK based).</p>	<p>Could be coupled to a mechanism designed to enhance management such as Option 6.</p>

**Table 18: Summary of front-running policy options** cont'd.

Policy Option	Measure	Environmental Impact		Costs	Complementary Measures
		Management of Discarded Items	Litter		
8	Ban on flavoured e-cigarettes	No effect on remaining e-cigarettes used, though these may be littered less frequently. Possible issue with an increase in use of Rch-ecigs (and the pre-filled containers) if they are not included in the scope of the ban.	Likely to reduce quantities. If the flavoured SU-ecigs account for a majority of the market, then a ban on flavoured e-cigarettes could reduce demand through affecting user numbers, and intensity of use. It could also reduce (the rate of increase in) uptake.	Not costly to introduce. Enforcement will require resourcing (especially for Scotland-specific ban owing to potential for cross-border imports/re-selling). Main costs will be to manufacturing, the vast majority of which is in China. Shift to Rch/Rf-ecigs, maybe to local liquid manufacturers.	Could be used in conjunction with Option 5 or 7. Implementing Option 6 would also help ensure proper management of remaining e-cigarettes.
9	Enhanced enforcement of age restriction on sales of e-cigarettes	Has no impact on those e-cigarettes still being consumed.	Would impact demand for e-cigarettes, and may impact on future projections of users. Could have some impact through demand effect.	Additional enforcement costs. Costs could be 'offset' somewhat by higher penalties for breaking the law. Enforcement costs could be recovered from producers (including under enhanced WEEE Regulations).	Given that this measure seeks to address failures in enforcing existing law, it could be part of the overall package of measures considered.

# Appendix 3

## Economics of Vaping Choice

Given that vaping can be undertaken using a choice of SU-ecigs, Rch-ecigs and Rf-ecigs, it is interesting to understand the relative costs of that choice. We also compare with conventional cigarettes.

All the prices quoted here are not from a specific source: they are based on looking at a large number of internet sites with UK domain names (which does not necessarily imply they are based in the UK) but which we took to imply that they were oriented to selling e-cigarettes to UK consumers (further confirmed by the currency used for pricing). We have not, therefore, usually cited specific sites for pricing information, but we do cite sites if we are quoting them.

### A.3.1 Conventional cigarettes

A basic search for prices from Tesco indicates a price for a pack of 20 cigarettes varying, approximately, between £10 and £15. In order to convert to a 'vaping equivalent', we considered the quoted figures for how many puffs were equivalent to how many cigarettes. The figures vary, but lie typically in the range 10 to 15. This would imply that 20 cigarettes are equivalent to around 200-300 puffs. The 'cost per puff' would be in the range 5p to 7.5p

### A.3.2 SU-ecigs

For SU-ecigs, a typical 600 puff e-cigarette costs around £5, or £4 when purchased in packs of five or so (there may be further discounts for greater volume). On a basic 'cost per puff', the cost works out at around 0.66p to 0.83p per puff.

From this, it is very clear that, based on 'puff equivalence' (which might not necessarily be the right comparator – another one might be, for example, cost per unit of nicotine delivered, though some e-cigarettes do not contain nicotine), the SU-ecigs are far cheaper than conventional cigarettes.

As an article in the Grocer put it:<sup>107</sup>

*While a 20-deck can cost between £10 and £15 for 200 puffs, a disposable vape can offer triple the amount for as little as £5.*

Also citing ASH's survey, that of full-time vapers in 2022, 13% said saving money was the main reason for ditching tobacco.<sup>108</sup>

### A.3.3 Rch-ecigs/Rf-ecigs

The difference between a Rch-ecig and a Rf-ecig is becoming blurred. Rch-ecigs, those for which a pre-filled liquid container can be removed and replaced by another, are increasingly now designed also to enable refill of pods using liquids purchased by the user. In this respect, they are both Rch-ecigs and Rf-ecigs.

<sup>107</sup> The Grocer (2023) How big tobacco is cashing in on vaping, 18 February 2023.

<sup>108</sup> Action on Smoking and Health (ASH) (2022) Use of e-cigarettes (vapes) among young people in Great Britain, July 2022



The price of these devices appears to be moving relatively close to the price of some of the more popular SU-ecigs, with many priced in the region of £10. Elf Bar has a kit which, for example, enables the user to choose from using pre-filled pods, or a refillable (with own-purchased liquid) pod, and this retails for around £8. The pre-filled pods, on the other hand, are roughly as expensive as the SU-ecigs for the same 500 puffs, suggesting there is likely to be some strategic pricing involved. On the other hand, if users are persuaded to use other suppliers' liquids for refilling a pod, then they would derive significant savings (see below).

The prevalence of dual rechargeable/refillable (pod) devices is important to observe, as is their declining cost. It seems highly unlikely that the long-term cost (in competitive situations) of vaping to the vaper is likely to increase if SU-ecigs were to disappear from the market. What is lost is convenience, and SU-ecigs are marketed heavily for their convenience, whilst both SU-ecigs and Rch-ecigs are marketed as having the benefit that users need not be involved in the handling of liquids.

With improved design for longevity, not only is the 'upfront' cost of alternatives to SU-ecigs falling, but with greater emphasis on design for longevity/reusability/refillability, the relative cost of vaping refillables vis a vis SU-ecigs will likely be determined, increasingly (and in the absence of policy intervention), by the relative cost of replacing a SU-ecig device versus replacing the liquid in a refillable.

Currently, an SU-ecig device costs of the order £4.00 and contains 2ml of liquid. This is roughly the same price as a 10ml refill container. In principle, choosing to refill would have the effect of reducing the cost of the 'next' 2ml by around 80%, whilst reducing the amount of resource use from:

- That associated with an SU-ecig; to
- That associated with one fifth of an e-liquid bottle (and a 10ml e-liquid bottle made from PET or LDPE will, including nozzle and closure, weigh around 5g (note that other polymers used for e-liquids include PETG, PP, glass, and occasionally, steel).<sup>109</sup>

In short, the elasticity of demand for vaping as an activity is – to the extent that it is driven partly by addiction to nicotine (and for younger people, it may be driven by a no less compelling desire to respond peer pressure) – unlikely to exhibit a high elasticity of demand. That certainly seems likely to apply to existing users, though the effect on future uptake might be more pronounced (i.e., growth in uptake might be more responsive to price than demand from existing users).

That does not mean that cross-price effects might not be relatively elastic, or at least, less inelastic, given the changes in design and price of e-cigarettes. A shift from SU-ecigs to Rch-/Rf-ecigs will not necessarily imply additional cost other than in the short-term (at the point of purchase).

<sup>109</sup> Nexxem (u.d.) E-liquid Bottles – Which Type Will Work Best For You?  
<https://nexxem.com/e-liquid-bottles-which-type-will-work-best-for-you/>

Some Rch-/Rf-ecigs will become cheaper than SU-ecigs over around 2500-5000 puffs. Set in context, at an estimated average number of SU-ecigs per user per year of 138-166, the Rf-ecig is cheaper within a period of around 3-4 weeks for the average user. That period is longer for a below average user, and shorter for an above average user, and the period will be longer for both types where the device purchased is more expensive (the period could extend, for the average user, by a factor of 3 or 4).

Discussions on websites regarding the longevity of refillable/rechargeable e-cigarettes suggest that if coils are replaced as required, then a 6-7 month life might be expected, with this being extended where batteries and coils are used and replaced as they are designed to be.<sup>110</sup> In principle, devices can last many years, and the parts needing replacement can be readily replaced, with liquids being readily refilled. That makes the use, and increasing shift towards the use of SU-ecigs, all the more difficult to understand in the light of the resource use they imply.

<sup>110</sup> See, for example, 'How Long Will Your Vape Last', <https://www.simplyeliquid.co.uk/blogs/vaping/how-long-do-vapes-last-answers-to-your-biggest-questions>; and How Long Do Vuse Pods Last? December 2022, <https://www.healthandcare.co.uk/blog/how-long-do-vuse-pods-last.html>

# Appendix 4

## Consultees

Though this report was principally compiled through a desk-based activity, pulling together existing data and evidence, the following people/organisations were engaged with during the preparation of this report where specific additional input was required.

All consultees were required to declare any Declarations of Interest in line with the Conference of the Parties (COP) adopted guidelines for implementation of Article 5.3 of the Framework Convention on Tobacco Control on the protection of public health policies with respect to tobacco control from commercial and other vested interests of the tobacco industry.

These guidelines are provided to ensure that efforts to protect tobacco control from commercial and other vested interests of the tobacco industry are comprehensive and effective.

### A.4.1 Campaigners

- Laura Young of 'Waste Less Laura' provided local knowledge in Dundee and images;
- Gregg Wannell and Catherine Gemmell of Marine Conservation Society provided additional background information;
- Sheila Duffy and Robert Tempelaar of ASH Scotland provided UK wide expert knowledge.

### A.4.2 Research/academic

- Scott Butler of Material Focus provided unpublished data and expert knowledge.

### A.4.3 Industry

- Nigel Harvey of Recolight, and also ICER, shared his experiences and thoughts regarding WEEE Compliance and recycling;
- John Redmayne of European Recycling Platform (ERP) provided on-the-ground anecdotal evidence;
- Nigel Tomlinson of GAP Group, attended a Teams call with ZWS and Dominic Hogg to share GAP's developing plans for collecting and recycling SU-ecigs in England;
- IBVTA provided a written response with statistical data relating to sales across different kinds of e-cigarettes;
- UKVIA provided a written response with a wide range of views on issues and concerns relating to managing the environmental impacts of SU-ecigs.

#### **A.4.4 Public sector**

- SEPA – Zero Waste Scotland shared the initial draft of the report shared with SEPA in May 2023;
- Local Authorities – enquiries were made to selected Local Authority contacts through Zero Waste Scotland, regarding local anecdotal volumes of littering of SU-ecigs.

