

# NSW Plastics: The way forward

*Submission to NSW Environment Protection Authority*

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## About Doctors for the Environment Australia

Doctors for the Environment Australia (DEA) is an independent, non-government organisation of medical doctors in all Australian states and territories.

DEA's work is based on the premise that humans need a future with clean air and water, healthy soils capable of producing nutritious food, a stable climate, and a complex, diverse and interconnected humanity whose needs are met in a sustainable way. We are therefore interested in environmental protection and restoration to promote human health and social stability.

### Acknowledgement of Country

Doctors for the Environment Australia's members live and work around Australia. We would like to acknowledge Aboriginal and Torres Strait Islander peoples as the Traditional Owners of these lands, in the spirit of reconciliation.

We recognise that First Nations peoples have cared for Country and lived sustainably for millennia, and that sovereignty of this land was never ceded. We pay our respects to First Nations Elders past and present, and to emerging leaders.

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Doctors for the Environment Australia (DEA) welcomes the opportunity to contribute to the Government of New South Wales' consultation on [NSW Plastics: The Way Forward](#).

### Summary

DEA strongly supports decisive and evidence-based strategies to eliminate 'single-use, unnecessary, and problematic plastic items and materials', particularly focussing on 'highly littered plastic items' and those that release harmful chemicals and microplastics.

Australia should aim to achieve national consistency in management of problematic plastics, with alignment with the approaches from other states and territories, but also with the federal government. Notably, the federal Department of Climate Change, Energy, the Environment and Water is presently examining the [reform of packaging regulation](#). However, individual states should not be afraid to show leadership by being more ambitious than the rest of the country, given the scale and impact of plastic waste pollution.

This consultation is an important opportunity to advocate for a ban on a particularly toxic and widespread litter item – cigarette filters. This is in support of and collaboration with advocacy group [No More Butts](#), which has been campaigning tirelessly for a ban on these highly problematic single-use plastics.

Cigarette filters were integrated into cigarette design to alleviate smokers' concerns regarding the safety of tobacco products. However,, there is no evidence that they improve health outcomes for their users. Instead, they generate a false sense of safety by enhancing the taste and sensory experience of smoking. This misconception of reduced harm has been reinforced by tobacco industry marketing.

Cigarette filters have significant deleterious impacts on ecosystems. Annually, 4.5 trillion filters are discarded, with many washing into our waterways and oceans where they leach toxic chemicals, degrade into micro and

nano-plastics, and are ingested by wildlife. This contributes to the loss of biodiversity and contaminates our food chains with heavy metals and other toxic compounds.

There are multiple organisations worldwide calling for a ban on cigarette filters, including the World Health Organization (WHO), the Belgian Superior Health Council and multiple scientific papers.<sup>1-7</sup> DEA supports their statements and call for the NSW Government to adopt these recommendations as part of working towards a national cigarette filter ban.

## Health consequences of smoking cigarettes

Smoking is one of the largest preventable causes of premature death. It is the cause of 1 in 10 deaths globally.<sup>8</sup> Around 1.3 billion people smoke, and half of smokers will die from their smoking habit. This results in the death of approximately 8.7 million annually, with 1.3 million of these deaths attributed to second-hand smoke exposure.<sup>9,10</sup> Regular lifelong smokers will live on average 10 years less than a non-smoker.<sup>11</sup> Tobacco consumption is linked to 41 individual diseases, including 19 different types of cancer, chronic obstructive pulmonary disease (COPD), and cardiovascular disease.<sup>12</sup> Cigarettes smoke contains over 7,000 chemicals, including 69 known carcinogens.<sup>13</sup>

In Australia the current smoking rate in adults is around 11.1%.<sup>14</sup> This tobacco consumption results in 20,500 deaths annually and is responsible for more than 1 in 7 deaths.<sup>12</sup> In 2015, it was the leading risk factor for disease burden and death, attributable to almost 10% of all disease burden in Australia.<sup>12</sup> Of this, tobacco was responsible for 76% of lung cancer, 73% of COPD and 50% of oesophageal cancer.<sup>12</sup> Additionally it contributed to 22% of all cancer burden, 40% of all respiratory diseases and over 10% of cardiovascular disease.<sup>12</sup>

Tobacco also results in intergenerational ill health as it contributes to adverse pregnancy outcomes like perinatal death and intrauterine growth restriction. In 2021, 8.7% of all mothers who gave birth smoked during the pregnancy.<sup>15</sup>

Second-hand exposure to smoke causes significant morbidity. In non-smoking adults it is associated with lung cancer and cardiovascular disease. In children, it can result in several adverse health effects including sudden infant death syndrome.<sup>16</sup> There is no known safe level of exposure to second-hand smoke.

The potential health benefits of further reducing the prevalence of smoking cannot be overstated. As reducing tobacco consumption is one of the most efficient ways to reduce disease and save lives, any measures which may further reduce its use should be strongly considered.

## Cigarette filters and ventilation

Cigarettes are designed and manufactured to make cigarettes as appealing as possible to consumers by alleviating health concerns and formulating a pleasurable smoking experience. Cigarette filters and ventilation are fundamental in achieving both of these aims.

The filters consist of 12,000 fibres of cellulose acetate, a plastic polymer,<sup>17</sup> in addition to plasticisers, glue and titanium dioxide. Titanium dioxide is added to the cigarette's filter to make it appear whiter, which smokers associate with being cleaner. Repeated exposure to titanium dioxide has been associated with lung inflammation and scarring (pulmonary fibrosis).<sup>18,19</sup> Early filters removed more tar and nicotine relative to other gases in the smoke, resulting in a harsher taste.<sup>20</sup> To alleviate this, the industry added flavours like

menthol to mask the unpleasant taste, but they also added microscopic pores to cigarette paper, referred to as filter ventilation.<sup>21</sup> These pores allow surrounding air to be drawn in, diluting the inhaled smoke and tar. On smoking machines, these ventilated cigarettes produced low tar, nicotine and carbon monoxide yields.<sup>17</sup> The tobacco industry marketed these heavily as 'lighter' and 'mild' cigarettes as well as pushing the perception that these filter ventilated cigarettes were healthier.<sup>22</sup> Today almost all cigarettes in Australia contain these filters and ventilations and they can even be added to roll-your-own cigarettes. However, when these cigarettes were tested on machines that replicated behaviours of true smokers, it revealed very different results – much higher levels of nicotine were able to be inhaled.

Further research showed that cigarettes marketed by tobacco companies as 'mild' and 'light', were not in fact safer, and people who used them did not have better health outcomes. This led to them being labelled as fraudulent cigarettes.

Song et al in 2017 examined how the application of filter ventilation into cigarette design resulted in four critical changes that explain why there have not been the health benefits that the tobacco industry initially falsely claimed and marketed.<sup>3</sup>

### **Altered combustion**

The ventilation pores divert air flow through the pores and away from the burning tobacco and this diversion is exacerbated by the increased resistance generated by the filter. Less air flow through the burning tobacco lowers the burning temperature and reduces oxygen exposure, resulting in more incomplete combustion of the tobacco. Furthermore, lowering the burning temperature increases smouldering time, thereby increasing puffs per cigarette and the amount environmental tobacco smoke generated, in turn increasing passive smoke exposure.<sup>23</sup>

### **Increased formation of toxicants**

Greater incomplete combustion alters the toxicant formation, resulting in increased concentrations of tobacco specific nitrosamines (TSNAs).<sup>24</sup> This group of compounds are potent lung carcinogens. The Salmonella Reverse Mutation Assay (Ames test), a highly replicated and extensively used assay for detecting the potential to cause genetic mutations, demonstrated that increasing filter ventilation results in an increase in smoking mutagenicity. Furthermore, an internal tobacco company study showed filter ventilation increased the mutagenicity of tar independent of other designs and tobacco formulations.<sup>25</sup>

### **Altered smoking behaviour**

Filter ventilation results in lower tar and nicotine yields on smoking machines. However, filter ventilation enables smokers to change their smoking practices to increase their nicotine absorption. This nicotine compensation is achieved by blocking the ventilation pores with their fingers or lips and deeper and longer puffs. This was highlighted in a 2006 USA federal court case against Phillip Morris where the court determined that smoking-machine yields of tar and nicotine were completely unreliable as they did not account for smoker compensation. The resulting puff volumes with this compensation likely result in greater delivery of the highly carcinogenic TSNAs to deeper lung tissue.

## False sense of safety

Since filter ventilation produces a less harsh and irritating smoking experience, this has led smokers to believe that the product is less harmful, a message compounded by advertising. This belief remains persistent amongst smokers and the broader public. However, filters and their ventilation have not been demonstrated to be safer, and introduce new harms. The terms 'light' and 'mild' are banned in Australia as the Australian Competition and Consumer Commission believe them to be misleading and deceptive. As Talhouet et al conclude 'Modern-day cigarettes are designed to increase the attractiveness to consumers by reducing negative experiences and creating perceptions of higher taste and decreased risks, leading to more intense smoking behaviour'.<sup>26</sup>

## Health effects of cigarette filters

Prior to filters and ventilation, squamous cell lung carcinomas were the dominant cancer type in smokers. Rates of squamous cell lung cancers fell steadily as smoking prevalence declined. Paradoxically, lung adenocarcinomas rose and are now the dominant lung cancer type in Australia. According to Cancer Council Victoria, adenocarcinomas constitute over 40% of all lung cancer types.<sup>27,28</sup> The National Cancer Institute quantified that the relative risk of lung adenocarcinoma has dramatically increased from 4.6 to 19, and 1.5 to 8.1, in men and women respectively, since the inclusion of filter ventilation in cigarette design.<sup>29</sup> Ito et al compared filter and non-filtered cigarettes across USA and Japan, revealing that filtered cigarettes were strongly associated with lung adenocarcinoma while non-filtered cigarettes were more closely linked to the formation of squamous cell carcinoma of the lung.<sup>30</sup> This study also found that adenocarcinoma occurred around 10 years earlier than squamous cell carcinoma in smokers and the association between adenocarcinoma and filtered cigarettes was stronger than the association between non-filtered cigarettes and squamous cell carcinoma.<sup>30</sup> These findings have been supported in other studies.<sup>31,32</sup> These results led the Surgeon General's report in 2014 to conclude that there was sufficient evidence to link changes in cigarette design to a significantly increased risk of lung adenocarcinoma in smokers.<sup>33</sup>

In addition to the change in lung cancer type, there is also evidence that the inclusion of filtered ventilation in cigarettes has increased the overall risk of lung cancer. The American Cancer Society reported that the cumulative risk of lung cancer in smokers has double since the 1950s.<sup>34</sup> These findings are supported by Burn et al who concluded 'that lung cancer risks from smoking may be increasing in the U.S. due to changes in cigarette design' and as mentioned above Ito et al concluded that the association between filtered cigarettes and lung cancer was greater than non-filtered cigarettes.<sup>30,35</sup>

The Surgeon General's Report in 2014 and Song et al, both conclude that there is biological plausibility that the increased levels of TSNA's formed from altered combustion with filter ventilation could be responsible for the increase in lung adenocarcinoma.<sup>3,33</sup> Compensatory behaviour with deeper inhalations exposes more peripheral lung tissue to these TSNA's.<sup>36</sup> Peripheral lung tissue is richer in cell types (Type II pneumocytes and Clara cells)<sup>37</sup> that animal studies suggest are more sensitive to TSNA's. Consequently, they are more likely to form lung adenocarcinomas than more centralised lung tissue which has a greater propensity for squamous cell carcinomas.<sup>38</sup>

The change in lung cancer type from predominantly lung squamous cell to adenocarcinoma has unfortunately not resulted in significant reductions to mortality. The Australian Institute of Health and Welfare report in 2015 showed the survival outcomes of lung adenocarcinomas is very similar to squamous

cell carcinomas of the lung, with a predicted five-year survival rate of around 17% for each.<sup>27</sup> Lung cancer continues to have one of the poorest survival outcomes of all cancer types.

The tobacco industry in their efforts to design safer cigarettes have made them even more harmful, but have persisted with these harmful design changes because they have alleviated smokers' concerns by creating a false sense of security. This is achieved by removing the largest more irritating molecules from the inhaled tar, resulting in a smoother smoking experience, which gives the perception of lower health risk.<sup>22</sup> In a study by Pulvers et al, they provided filtered and unfiltered cigarettes to participants over a 4-week period, filtered cigarettes were smoked substantially more than unfiltered cigarettes and were perceived to be better tasting, less harsh more enjoyable and far more satisfying.<sup>7</sup> This suggests that banning filtered cigarettes would make smoking appear significantly less appealing and smokers would likely smoke less.

In a 2022 survey in the Netherlands, it found that there was large public support for a ban on filters with only 12% of non-smokers disagreeing with the ban and 45% of smokers. 12% of smokers indicated that they would likely quit smoking with a filter ban and just 16% indicated that they would not comply with the ban.<sup>39</sup>

There is an emerging concern regarding microplastics and their impact on health, with a recent study demonstrating an association between the presence of microplastic in carotid plaques (fatty deposits in neck arteries) and a 4 to 10 fold increased risk in developing further cardiovascular and cerebrovascular events.<sup>40</sup> There has been concern for some time, that smoking through tiny fibres of cellulose acetate may expose smokers to inhaled microplastics. Pauly et al identified cigarette filter fibres in lung tissue from lung cancer patients and in a recent study that compared lung washing (bronchoalveolar lavage) fluid from smokers and non-smokers, it found a substantially more volume and types of microplastics in smokers.<sup>41,42</sup>

Another area of concern for filter ventilated cigarettes is their association with greater passive smoking exposure. The greater smouldering times and increased number of puffs per cigarette due to the lowered combustion temperatures of the burning tobacco, create more environmental tobacco smoke (ETS). Furthermore, the ETS from filtered cigarettes is a higher concentration of very fine particulate matter (PM<sub>2.5</sub>) when compared to ETS from unfiltered cigarettes.<sup>23</sup> Passive exposure to PM<sub>2.5</sub> is an independent risk factor for cardiovascular and lung disease.<sup>43</sup> Therefore, removing filters may also provide health benefits to non-smokers exposed to ETS.

Song et al conclude that there is 'highly suggestive evidence to conclude that filter ventilation has increased the rates of lung adenocarcinoma' and 'evidence does not indicate a public health benefit for the inclusion of filter ventilation'.<sup>3</sup> Moreover the false sense of security created by misleading marketing from tobacco companies and the smoother smoking experience produced by the filter has probably resulted in higher prevalence of smokers today. If filters were removed from cigarette filters, we would expect to see fewer cigarettes smoked each day and more smokers quitting or shifting to nicotine replacement therapy.

## Environmental impacts of cigarettes

The tobacco industry has a colossal global environmental impact, despite their efforts to greenwash and obscure the deleterious effects of their supply chains.<sup>44</sup> As WHO reported during their World No Tobacco Day in 2022, that 'tobacco growing destroys forests, damages soil and depletes water supplies, while manufacturing contributes to the production of toxic waste'.<sup>1</sup> The entire life cycle of cigarette is destructive from cultivation to disposal, 'from the cradle to the grave'.<sup>45</sup>

Six trillion cigarettes are manufactured annually and each individual cigarette contributes 14g of CO<sub>2</sub> and consumes 4 litres of water over its lifecycle,<sup>45</sup> equating to the usage of 22 billion tonnes of water and the emission of 84 million tonnes of CO<sub>2</sub>.<sup>45</sup> The tobacco industry further adds to its contribution to the climate crisis by driving deforestation. It is directly responsible for the elimination of 600 million trees each year and contributes to the deforestation of 200,000 hectares of land.<sup>1</sup> Since 1970, tobacco companies have been responsible for the clearing of 1.5 billion hectares of land.<sup>1</sup>

Growing tobacco uses 5.3 million hectares of farmland, mostly in low- and middle-income countries where farmland for the production of food is critically needed for vulnerable communities.<sup>1</sup> Instead, it is being used to grow tobacco, a lethal crop responsible for 8 million deaths annually. Tobacco directly harms the farm workers growing it, with up to 25% of farms affected by green tobacco sickness, a nicotine poisoning from skin absorption of nicotine through the handling of tobacco leaves.<sup>46,47</sup> Children, who are a significant proportion of the labour force in growing and harvesting tobacco, are especially vulnerable to green tobacco sickness due to their increased relative body surface area compared to adults, but also because they are less tolerant of nicotine.<sup>48</sup>

Additionally, tobacco farming requires extensive agrochemical use, including many highly toxic pesticides. These chemicals directly harm the farmers' health but also degrade the land and leak into waterways contaminating drinking water – they can have substantial impacts on local ecosystems.<sup>49</sup> For *World No Tobacco Day* in 2023, the WHO launched *Grow food, not tobacco* advocating for farmers and policy-makers to support the growth of food in place of tobacco as:

*349 million people are facing acute food insecurity. Meanwhile, tobacco is grown on fertile land that could be used to grow food. These resources are diverted to support the production of a crop that kills over 8 million people every year, erodes the economy and damages the environment.*<sup>50</sup>

Tobacco companies lock communities and farmers into growing tobacco by providing short-term incentives like infrastructure, seeds and fertilisers. As tobacco cropping degrades the land, farmers become increasingly reliant on these incentives to maintain production and eventually become unable to produce other cropping alternatives.<sup>50</sup>

Human health is predicated and sustained by our natural environment, so not only does smoking tobacco directly harm our health but the environmental consequences compound the health effects. Perhaps most egregiously it adversely impacts the most vulnerable countries and communities. Tobacco products are deeply unethical products that destroy our health, trap vulnerable communities in cycles of inequality and degrade our environment while exacerbating climate change.

## Environmental impacts of cigarette filters

Cigarette filters add substantially to the environmental pressure exerted by cigarettes. They are consistently listed as one of the most littered items in the world and within Australia. In the 2023 Litter report by Clean Up Australia, it was calculated that cigarette butts alone made up 16.2% of individual pieces of litter.<sup>51</sup> An estimated 9 billion filters pollute the Australian environment annually with around 40% washing into our waterways.<sup>52,53</sup> The EPA reported in 2019 that around 1.32 billion butts are littered in NSW with 62% of smokers littering their cigarette butts.<sup>54</sup> Worryingly, clean ups efforts are largely ineffective as 60% of cigarette butt litter persists despite extensive rubbish removal efforts. This also suggests that litter reports probably severely under-represent the proportion of cigarette butts.<sup>55</sup>

Globally, the scale of this litter problem is enormous. Dr Ruediger Krech, the Director of Health Promotion at WHO stated that 'Tobacco products are the most littered item on the planet, containing over 7000 toxic chemicals, which leech into our environment when discarded. Roughly 4.5 trillion cigarette filters pollute our oceans, rivers, city sidewalks, parks, soil and beaches every year.<sup>1</sup>

These filters are made of thousands of plastic fibres, which take up to 14 years to break down, fragmenting into micro and nano-plastics as they degrade.<sup>56,57</sup> These microplastics may persist for hundreds of years and emerging evidence demonstrates that human exposure is associated with significant health risks.<sup>40</sup> Furthermore, cigarette butts are soaked with thousands of toxic chemicals, including heavy metals like arsenic and lead, which research suggests leech into the environments they pollute.<sup>58</sup> Bonanomi et al found that the toxic effects of these chemicals on organisms persisted for the entire duration of their 5-year study.<sup>59</sup> Cigarette leachate is particularly lethal to marine life, with just a single smoked cigarette butt capable of killing fish in a 1-litre bucket of water.<sup>60</sup> Crustaceans are even more susceptible, with one cigarette filter lethally contaminating 30 litres of water.<sup>10</sup> Cigarette butts also inhibit both terrestrial and aquatic plant germination and growth.<sup>62,63</sup> Birds that use cigarette butts in the construction of their nests exhibit increased genotoxic effects to the red blood cells of their chicks.<sup>64</sup> The genotoxic effects were directly proportional to the density of cigarette butts in their nests.<sup>64</sup>

Butts in the environment are ingested by wildlife and have been found in the stomachs of various animals including fish, whales, birds and turtles.<sup>65,66</sup> Cigarette filters and their toxic constituents can also enter our food chains as shown by Richardot et al where rainbow trout were found to bioaccumulate several toxic compounds, including nicotine, when exposed to cigarette leachate.<sup>67</sup>

Cigarette butts are an important cause of bushfires. Around 7% of all Australian bushfires are caused by littered cigarette butts.<sup>68</sup> In 2014-15 cigarettes were estimated to be responsible for 4,558 fires in Australia; excluding bushfires, damage was calculated to cost \$80.8 million.<sup>69</sup> A trial in Western Sydney showed that each cigarette discarded into the grass beside roads had a 4% chance of igniting the vegetation, requiring firefighters to extinguish it.<sup>70</sup>

DEA does not support biodegradable or 'green' filters. Since there is no health benefit from the filter, we do not think there is a scientific justification to warrant their inclusion in cigarette design. Moreover, a biodegradable filter may just embolden smokers to litter their cigarette butts, exacerbating the leaching of toxic constituents into our environments and ecosystems. A biodegradable filter will also enable tobacco companies to continue misleading smokers that filters reduce harm.

## Economic impacts of cigarette filters

Cigarettes incur a significant financial and social cost. Increased healthcare expenditure and lost productivity due to tobacco are estimated to cost \$2 trillion worldwide.<sup>71</sup> The tobacco industry's net worth is just \$1 trillion in comparison. The cost of the harms generated by this industry is double the income of the industry itself. Additionally, this \$1 trillion represents money stripped from often vulnerable communities and individuals for corporate profit in a solely harmful product and industry.

The National Drug Institute at Curtin University calculated the net tangible costs of tobacco use in Australia in 2015-16 at \$19.2 billion.<sup>72</sup> Tangible costs included the lost economic productivity from premature mortality, hospitalisation, work absenteeism and expenditure on tobacco. However, when this was expanded to intangible costs, such as the value of life lost and infliction of pain and its associated treatment, then the



reported cost of tobacco ballooned to \$117.7 billion. The report also estimated the cost of managing the litter from cigarette butt to be \$73 million annually. This cost is ultimately covered by taxpayers through state, territory and local governments – ultimately all Australians are covering the enormous costs generated by just 11% of the population.

## Conclusion

As a senior manager at Phillip Morris observed 'There is no perceived social value to our product' and DEA agrees. The interests of the tobacco industry are fundamentally at odds with our public health and as agreed in the [Framework Convention on Tobacco Control](#), it cannot be engaged in decision-making about the regulation of tobacco products. For decades, tobacco companies have undertaken disinformation campaigns to prevent regulation of their harmful products. Given that there are no health, environmental or social benefits from tobacco products, the primary endpoint of policy and decision-making about tobacco should be the cessation of this pernicious industry. Any measure that would help realise a smoke-free future should be prioritised, as limiting tobacco consumption is the most effective way to prevent the illness and loss of life that it causes.

The DEA's assessment of the literature shows that there is a scientific foundation to support a ban on cigarette filters. There is no evidence that cigarette filters have any health benefits – instead, they perpetuate a false sense of safety for smokers. According to the current research, such a ban would likely result in the following:

- reduced smoking prevalence and a decrease in the number of cigarettes smoked by each consumer
- significant cost-saving in clean-up of a problematic litter item and in reduced healthcare expenditure from a decrease in tobacco consumption
- significantly less environmental contamination and degradation from cigarette filter pollution and decreased demand would reduce upstream environmental pressures.

Since 2022 WHO has been encouraging governments and policy-makers to ban 'cigarette filters, to protect our public health and the environment' and DEA strongly supports this. The tobacco industry cannot be permitted to continue to ignore the environmental and health consequences of its products while making billions of dollars. The *NSW Plastics: the Way Forward* consultation, provides an opportunity for NSW to be a leader in removing this highly problematic single-use plastic.

## References

1. World Health Organisation (WHO). Tobacco: poisoning our planet. World Health Organization 2022. Available from: <https://apps.who.int/iris/handle/10665/354579>
2. Superior Health Council. The Impact of Cigarette Filters on Public Health and the Belgian. 2023. Available from: [https://www.health.belgium.be/sites/default/files/uploads/fields/fpshealth\\_theme\\_file/20230511\\_shc\\_9726\\_cigarette\\_filters\\_vweb.pdf](https://www.health.belgium.be/sites/default/files/uploads/fields/fpshealth_theme_file/20230511_shc_9726_cigarette_filters_vweb.pdf)
3. Song MA, Benowitz NL, Berman M, Brasky TM, Cummings KM, Hatsukami DK, et al. Cigarette Filter Ventilation and its Relationship to Increasing Rates of Lung Adenocarcinoma. Journal of the National Cancer Institute. 2017 Apr 10;109(12). Available from: <https://doi.org/10.1093/jnci/djx075>
4. Van Schalkwyk MCI, Novotny TE, McKee M. No more butts. BMJ . 2019 Oct 23;l5890. Available from: <https://doi.org/10.1136/bmj.l5890>
5. Da Silva ALO, Piras SS, Bialous SA, Moreira JC. Health without a filter: the impacts of cigarette filters on health and the environment. Science & Public Health. 2021. 1;26(6):2395–401. Available at: <https://doi.org/10.1590/1413-81232021266.23692019>
6. Evans-Reeves K, Lauber K, Hiscock R. The ‘filter fraud’ persists: the tobacco industry is still using filters to suggest lower health risks while destroying the environment. Tobacco Control. 2021 Apr 26;31(e1):e80–2. Available from: <https://doi.org/10.1136/tobaccocontrol-2020-056245>
7. Pulvers K, Tracy L, Novotny TE, Satybaldiyeva N, Hunn A, Romero DR, et al. Switching people who smoke to unfiltered cigarettes: perceptions, addiction and behavioural effects in a cross-over randomised controlled trial. Tobacco Control. 2021 Nov 19;32(4):520–3. Available from: <https://doi.org/10.1136/tobaccocontrol-2021-056815>
8. Winstanley, MH and Greenhalgh, EM 3.0 Introduction In Scollo, MM, Winstanley, MH and [editors]. Tobacco in Australia: Facts and issues. Melbourne : Cancer Council Victoria; 2019. Available from <https://www.tobaccoinustralia.org.au/chapter-3-health-effects/3-0-background>
9. Global Health Data Exchange. Global burden of disease results. Institute for Health Metrics and Evaluation, University of Washington, 2018. Available from: <http://ghdx.healthdata.org/gbd-results-tool>.
10. Long Term Health Risks & Effects of Smoking | Tobacco Atlas. Tobacco Atlas. 2022. Available from: <https://tobaccoatlas.org/challenges/health-effects/>
11. Jha P, Ramasundarahettige C, Landsman V, Rostron B, Thun M, et al. 21st-century hazards of smoking and benefits of cessation in the United States. 2013; 368(4):341-50. Available from: <https://www.nejm.org/doi/full/10.1056/NEJMsa1211128>

12. [Australian Burden of Disease Study: Impact and causes of illness and death in Australia 2018](#). Australian Institute of Health and Welfare, Australian Government. Published 2021.
13. Winstanley, MH and Greenhalgh, EM 3.0 Introduction In Scollo, MM, Winstanley, MH. Tobacco in Australia: Facts and issues. Melbourne : Cancer Council Victoria; 2019. Available from <https://www.tobaccoinaustralia.org.au/chapter-3-health-effects/3-0-background>
14. Greenhalgh, EM, Bayly, M, Jenkins, S and Scollo, MM 1.3 Prevalence of smoking—adults In Greenhalgh, EM, Scollo, MM and Winstanley, MH. Tobacco in Australia: Facts and issues. Melbourne : Cancer Council Victoria; 2024. Available from <https://www.tobaccoinaustralia.org.au/chapter-1-prevalence/1-3-prevalence-of-smoking-adults>
15. Australian Institute of Health and Welfare (AIHW). 2023b. [Australia's mothers and babies](#). Cat. No. HSE 250. Canberra: AIHW, Australian Government.
16. Campbell MA, Ford C & Winstanley MH (2017) [The health effects of secondhand smoke, 4.0 background- external site opens in new window](#). In Scollo MM & Winstanley MH (eds). Tobacco in Australia: facts and issues. Melbourne: Cancer Council Victoria. Viewed 19 February 2019.
17. Hoffmann D, Djordjevic, MV and Brunnemann, KD. Changes in cigarette design and composition over time and how they influence the yields of smoke constituents., in The FTC cigarette test method for determining tar, nicotine, and carbon monoxide yields of U.S. Cigarettes. Smoking and Tobacco control monograph 7. Bethesda, MD: U.S. Department of Health and Human Services, Public Health Service, National Institutes of Health.; 1996. p 15-37 Available from: <https://cancercontrol.cancer.gov/brp/tcrb/monographs/monograph-07>.
18. National Industrial Chemicals Notification and Assessment Scheme (NICNAS) 2012. Nano Titanium dioxide Health Hazard Review Technical Information Sheet. Available at <http://www.nicnas.gov.au/communications/issues/nanomaterials-nanotechnology/nicnas-technical-activities-in-nanomaterials/nanotitanium-dioxide-human-health-hazard-review>
19. Scientific Committee on Consumer Safety (SCCS) 2013. Opinion on Titanium Oxide (nano-form). Adopted by written procedure on 22 July 2013. Available at [http://ec.europa.eu/health/scientific\\_committees/consumer\\_safety/docs/sccs\\_o\\_136.pdf](http://ec.europa.eu/health/scientific_committees/consumer_safety/docs/sccs_o_136.pdf)
20. Winnall, W and Scollo, MM. Construction of cigarettes and cigarette filters. Tobacco in Australia: Facts and issues. Melbourne: Cancer Council Victoria; 2022. Available from <https://www.tobaccoinaustralia.org.au/chapter-12-tobacco-products/12-8-construction-of-cigarettes-and-cigarette-filters>
21. King B and Borland R. The 'low tar' strategy and the changing construction of Australian cigarettes. Nicotine & Tobacco Research, 2004; 6(1):85–94. Available from: <https://pubmed.ncbi.nlm.nih.gov/14982692>

22. Kozlowski L and O'Connor R. Cigarette filter ventilation is a defective design because of misleading taste, bigger puffs, and blocked vents. *Tobacco Control*, 2002; 11(suppl.1):i40-i50. Available from: [http://tc.bmjournals.com/cgi/content/abstract/11/suppl\\_1/i40](http://tc.bmjournals.com/cgi/content/abstract/11/suppl_1/i40)
23. Schulz M, Gerber A, Groneberg DA. Are Filter-Tipped Cigarettes Still Less harmful than NonFilter Cigarettes? – A Laser Spectrometric Particulate Matter Analysis from the Non-Smokers Point of View. *International Journal of Environmental Research and Public Health*; 2016;13:429. Available from: <https://doi.org/10.3390%2Fijerph13040429>
24. Harris JE. Incomplete compensation does not imply reduced harm: Yields of 40 smoke toxicants per milligram nicotine in regular filter versus low-tar cigarettes in the 1999 Massachusetts Benchmark Study. *Nicotine & Tobacco Research* 2004;6:797–807. Available from: <https://doi.org/10.1080/1462220042000274266>
25. Mutagenicity of mainstream smoke condensate of 30 research cigarettes with differences in 6 parameters. 1993. Philip Morris Records. Available from: <https://industrydocuments.library.ucsf.edu/docs/#id%4thcc0126>
26. Talhout R, Richter PA, Stepanov I, Watson CV, Watson CH. Cigarette Design Features: Effects on Emission Levels, User Perception and Behavior. *Tobacco Regulatory Science* 2019;4:592-604. Available from: <https://doi.org/10.18001%2FTRS.4.1.6>
27. Australian Institute of Health and Welfare & Cancer Australia (AIHW). 2011. Lung cancer in Australia: an overview. Cancer series no. 64. Cat. no. CAN 58. Canberra:
28. Victoria Cancer Council. Lung cancer statistics [Internet]. 2024. Available from: <https://www.cancervic.org.au/cancer-information/statistics/lung-cancer.html>
29. Thun MJ, Lally CA, Calle EE, Heath CW, Flannery JT, Flanders WD. Cigarette smoking and changes in the histopathology of lung cancer. *JNCI Journal of the National Cancer Institute*. 1997 Nov 5;89(21):1580–6. Available from: <https://doi.org/10.1093/jnci/89.21.1580>
30. Ito H, Matsuo K, Tanaka H, et al. Nonfilter and filter cigarette consumption and the incidence of lung cancer by histological type in Japan and the United States: analysis of 30-year data from population-based cancer registries. *Int J Cancer*. 2011;128(8):1918-1928. <https://doi.org/10.1002/ijc.25531>
31. Burns DM, Anderson CM, Gray N. Do changes in cigarette design influence the rise in adenocarcinoma of the lung? *Cancer Causes & Control*. 2010 Oct 21;22(1):13–22. Available from: <https://doi.org/10.1007/s10552-010-9660-0>
32. Doll R, Peto R, Boreham J, Sutherland I. Mortality in relation to smoking: 50 years' observations on male British doctors. *BMJ*. 2004 Jun 22;328(7455):1519. Available from: <https://doi.org/10.1136/bmj.38142.554479.ae>

33. National Center for Chronic Disease Prevention and Health Promotion (US) Office on Smoking and Health. The Health Consequences of Smoking—50 Years of Progress: A Report of the Surgeon General. Atlanta (GA): Centers for Disease Control and Prevention (US); 2014.
34. Thun MJ, Heath CW. Changes in Mortality from Smoking in Two American Cancer Society Prospective Studies since 1959. *Preventive Medicine* [Internet]. 1997 Jul 1;26(4):422–6. Available from: <https://doi.org/10.1006/pmed.1997.0182>
35. Burns DM, Anderson CM, Gray N. Has the lung cancer risk from smoking increased over the last fifty years? *Cancer Causes & Control* [Internet]. 2010b Dec 24;22(3):389–97. Available from: <https://doi.org/10.1007/s10552-010-9708-1>
36. IARC Working Group on the Evaluation of Carcinogenic Risks to Humans. Tobacco Smoke and Involuntary Smoking. Lyon (FR): International Agency for Research on Cancer; 2004. (IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, No. 83.) Available from: <https://www.ncbi.nlm.nih.gov/books/NBK316407/>
37. Devereux TR. Alveolar type II and Clara cells: isolation and xenobiotic metabolism. *Environmental Health Perspectives*. 1984 Jun 1;56:95–101. Available from: <https://doi.org/10.1289/ehp.845695>
38. Hoffmann D, Rivenson A, Amin S, Hecht SS. Dose-response study of the carcinogenicity of tobacco-specific N-nitrosamines in F344 rats. *Journal of Cancer Research and Clinical Oncology*. 1984 Jul 1;108(1):81–6. Available from: <https://doi.org/10.1007/bf00390978>
39. Schep E, de Vries J, Schilling J. Reducing cigarette filters in litter. Study of the size of the problem and analysis of possible policy measures. *CE Delft* 2022; 22.220280.179.
40. Marfella R, Prattichizzo F, Sardu C, Fulgenzi G, Graciotti L, Spadoni T, et al. Microplastics and nanoplastics in atheromas and cardiovascular events. *New England Journal of Medicine* [Internet]. 2024a Mar 6;390(10):900–10. Available from: <https://doi.org/10.1056/nejmoa2309822>
41. Pauly JL, Mepani AB, Lesses JD, Cummings KM, Streck RJ. Cigarettes with defective filters marketed for 40 years: what Philip Morris never told smokers. *Tobacco Control*. 2002 Mar 1;11(Supplement 1):i51–61. Available from: [https://doi.org/10.1136/tc.11.suppl\\_1.i51](https://doi.org/10.1136/tc.11.suppl_1.i51)
42. Lu W, Li X, Wang S, Tu C, Qiu L, Zhang H, et al. New Evidence of Microplastics in the Lower Respiratory Tract: Inhalation through Smoking. *Environmental Science & Technology*. 2023 Jun 2;57(23):8496–505. Available from: <https://doi.org/10.1021/acs.est.3c00716>
43. Hsu SO i, Ito K, Lippmann M. Effects of thoracic and fine PM and their components on heart rate and pulmonary function in COPD patients. *Journal of Exposure Science & Environmental Epidemiology*. 2011 Mar 16;21(5):464–72. Available from: <https://doi.org/10.1038/jes.2011.7>
44. Greenwashing - tobacco tactics [Internet]. Tobacco Tactics. 2022. Available from: <https://www.tobaccotactics.org/article/greenwashing/>

45. Zafeiridou M, Hopkinson NS, Voulvoulis N. Cigarette Smoking: An assessment of tobacco's global environmental footprint across its entire supply chain. *Environmental Science & Technology* [Internet]. 2018 Jul 3;52(15):8087–94. Available from: <https://doi.org/10.1021/acs.est.8b01533>
46. Tobacco farming. In: *Tobacco Tactics* [website]. Bath: University of Bath; 2020. Available from <https://tobaccotactics.org/wiki/tobacco-farming>
47. Zhang Y, He X, Liang H, Zhao J, Zhang Y, Xu C et al. Long-term tobacco plantation induces soil acidification and soil base cation loss. *Environ Sci Pollut Res Int*. 2016;23(6):5442–50. Available from: <https://doi.org/10.1007/s11356-015-5673-2>
48. Mackay J, Eriksen M, Eriksen MP. *The tobacco atlas*. World Health Organization; 2002.
49. Lecours N, Almeida GEG, Abdallah JM, Novotny TE et al. Environmental health impacts of tobacco farming: a review of the literature. *Tob Control*. 2012;21(2). Available from: <https://doi.org/10.1136/tobaccocontrol-2011-050318>
50. *World No Tobacco Day 2023: grow food, not tobacco*. Geneva: World Health Organization; 2023. Licence: CC BY-NC-SA 3.0 IGO.
51. *Clean Up Australia Day Litter Report. Annual National Litter Report*. 2023.
52. Black, S., Harwood, K. *Plastic Revolution to Reality – A roadmap to halve Australia's single-use plastic litter*. 2020. BCG and WWF
53. *Cigarette butts: the main source of sea and ocean pollution* [Internet]. [cited 2024 Jan 6]. Available from: <https://kwit.app/en/blog/posts/cigarette-butts-the-main-source-of-sea-and-ocean-pollution>
54. Taverner Research Group, 2023. *Butt Litter Index 2022: R, research on cigarette disposal behaviour for the NSW Environment Protection Authority*. <https://www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/litter/butt-litter-index-2022.pdf>
55. *Cigarette butts and their negative impact on nature*. Mooimakers.be. Available from: <https://mooimakers.be/kenniswijzer/artikel/peuken-en-hun-negatieve-effect-op-de-natuur>
56. Shen M, Li Y, Song B, Zhou C, Gong J, Zeng G. Smoked cigarette butts: Unignorable source for environmental microplastic fibers. *The Science of the Total Environment*. 2021 Jun 9;791:148384. Available from: <https://doi.org/10.1016/j.scitotenv.2021.148384>
57. Joly FX, Coulis M. Comparison of cellulose vs. plastic cigarette filter decomposition under distinct disposal environments. *Waste Management* [Internet]. 2017 Nov 16;72:349–53. Available from: <https://doi.org/10.1016/j.wasman.2017.11.023>

58. Venugopal PD, Hanna SK, Gagliano GG, Chang HW. No butts on the beach: Aquatic toxicity of cigarette butt leachate chemicals. *Tobacco Regulatory Science* [Internet]. 2021 Jan 1;7(1):17–30. Available from: <https://doi.org/10.18001/trs.7.1.2>
59. Bonanomi G, Maisto G, De Marco A, Cesarano G, Zotti M, Mazzei P, et al. The fate of cigarette butts in different environments: Decay rate, chemical changes and ecotoxicity revealed by a 5-years decomposition experiment. *Environmental Pollution* [Internet]. 2020 Jan 31;261:114108. Available from: <https://doi.org/10.1016/j.envpol.2020.114108>
60. Slaughter E, Gersberg RM, Watanabe K, Rudolph J, Stransky C, Novotny TE. Toxicity of cigarette butts, and their chemical components, to marine and freshwater fish. *Tobacco Control*. 2011 Apr 18;20(Supplement 1):i25–9. Available from: <https://doi.org/10.1136/tc.2010.040170>
61. Van Roy L. 2021. Effects of cigarette butts on the survival and feeding rate of amphipods (*Gammarus pulex*). Master thesis Institute for Environment and Sustainable Development, University of Antwerp.
62. Green DS, Boots B, Da Silva Carvalho J, Starkey T. Cigarette butts have adverse effects on initial growth of perennial ryegrass (gramineae: *Lolium perenne* L.) and white clover (leguminosae: *Trifolium repens* L.). *Ecotoxicology and Environmental Safety*. 2019 Jul 19;182:109418. Available from: <https://doi.org/10.1016/j.ecoenv.2019.109418>
63. Shah G, Bhatt U, Singh H, Kumar D, Sharma J, Strasser RJ, et al. Ecotoxicological assessment of cigarette butts on morphology and photosynthetic potential of *Azolla pinnata*. *BMC Plant Biology*. 2024 Apr 18;24(1). Available from: <https://doi.org/10.1186/s12870-024-04991-z>
64. Suárez-Rodríguez M, Garcia CM. There is no such a thing as a free cigarette; lining nests with discarded butts brings short-term benefits, but causes toxic damage. *Journal of Evolutionary Biology*. 2014 Nov 18;27(12):2719–26. Available from: <https://doi.org/10.1111/jeb.12531>
65. Torkashvand J, Farzadkia M, Sobhi HR, Esrafil A. Littered cigarette butt as a well-known hazardous waste: A comprehensive systematic review. *Journal of Hazardous Materials* [Internet]. 2019 Sep 19;383:121242. Available from: <https://doi.org/10.1016/j.jhazmat.2019.121242>
66. Dobaradaran S, Soleimani F, Akhbarizadeh R, Schmidt TC, Marzban M, BasirianJahromi R. Environmental fate of cigarette butts and their toxicity in aquatic organisms: A comprehensive systematic review. *Environmental Research* [Internet]. 2021 Feb 16;195:110881. Available from: <https://doi.org/10.1016/j.envres.2021.110881>
67. Richardot WH, Yabes L, Wei HH, Dodder NG, Watanabe K, Cibor A, et al. Leached Compounds from Smoked Cigarettes and Their Potential for Bioaccumulation in Rainbow Trout (*Oncorhynchus mykiss*). *Chemical Research in Toxicology* [Internet]. 2023 Oct 12;36(11):1703–10. Available from: <https://doi.org/10.1021/acs.chemrestox.3c00167Toxicol/>.
68. Australian Bureau of Statistics. Year book Australia, 2004: Bushfires. 2006. Available from: <http://www.abs.gov.au/ausstats/abs@.nsf/0/CCB3F2E90BA779D3CA256DEA00053977?opendocument>

69. Identifying the social costs of tobacco use to Australia in 2015/16. National Drug Research Institute Curtin University. 2019. Available from: <https://apo.org.au/node/264631>.
70. Can cigarette butts start bushfires? [Internet]. Fire and Rescue; Bush Fire Research. 2018b. Available from: <https://www.fire.nsw.gov.au/page.php?id=327>
71. Tobacco Industry Sales and Statistics | Tobacco Atlas. Tobacco Atlas. 2022. Available from: <https://tobaccoatlas.org/challenges/product-sales/>
72. Identifying the social costs of tobacco use to Australia in 2015/16. National Drug Research Institute Curtin University. 2019. Available from: <https://apo.org.au/node/264631>.