Paving the Way to A Greener Future: Sustainability from Concept to Market

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Abstract

Background: Novel ways of providing high-quality products in a sustainable way are critically important to the environment, and industry needs to do more in this area. We have created a range of products that combine cutting-edge sustainability initiatives in all steps of the production process, from manufacturing to packaging, to minimize our carbon footprint while maintaining high standards of quality and scientific rigor.

Methods: Our purpose-built manufacturing facility utilizes the greenest, most efficient processes to minimize our carbon footprint. This includes overhauls to, among others, HVAC, filling lines, water retention and recycling, and waste processing. Our new sustainable range of skincare products uses ingredients that are as naturally-derived as possible according to the ISO 16128-1 and 16128-2 Standards. Finally, our packaging uses recycled, locally-sourced plastic milk bottles to offer completely recyclable packaging options.

Results: In 2020 alone, we eliminated the creation of 66 tonnes of carbon dioxide, and are projecting a 40% reduction on 2019 figures for water, natural gas and magnesium hydroxide use by 2025. Our etch&ethos™ products contain 94% naturally-derived ingredients, and the packaging used for these products is recyclable, with caps made from polypropylene, bottles made from 50% recycled resin and 50% virgin resin, and labels made from wood-based polyethylene film.

Conclusion: The etch&ethos™ range and the sustainable infrastructure around it offers truly sustainable skincare products to consumers without compromising on quality or efficacy. This shows that, with the right approach, industry can lead the way on sustainability.

Keywords: sustainability; skincare; cosmetic; naturally-derived; innovation.

1. Introduction

Tackling the environmental impacts of climate change is one of the most pressing issues of our lifetimes.[1] Indeed, the amount of carbon dioxide (CO_2) in the environment only recently passed 400 ppm (parts per million), a threshold that has never been crossed in the history of our species.[2] Despite the overwhelming evidence in the literature [3,4] – not to mention the disastrous environmental impact we see with our own eyes with increasing regularity, from floods and fires to extreme drought – neither world governments nor industry have taken serious action to combat this emergency.[5] In fact, despite high-profile pledges to tackle climate change by reducing carbon emissions relatively slowly over time as set out by the Paris Agreement in 2015,[6] many countries are already reporting that they will miss these targets, an unbelievable dereliction of duty. In North America alone, Canada is projected to miss its 2030 greenhouse gas emissions (GHGE) target by 30%, while the US is projected to miss its 2025 targets by up to 1,800 million metric tons of CO_2 equivalent (MMt-CO_2e).[2]

While the failure of governments to meet their promised goals on carbon emissions is rightly lambasted within the media and academic circles, the contributions of industry to climate change are just as damaging. The effects that the automotive, mining, energy and travel/transport industries have on GHGE are well reported and analysed,[7–9] yet the impact of the healthcare system, and in particular the pharmaceutical sector, often goes overlooked or underreported. Of the few studies done in this area, a 2009 study by Chung and Meltzer found that the US healthcare system contributed roughly 546 MMt-CO_2e of the total 7150 MMt-CO_2e for 2007 alone, which equates to around 8% of all GHGE for the entire country that year.[10] Hospitals and the pharmaceutical sector were the major contributors.[10] Similarly, a 2018 article published in The Lancet found that the Australian healthcare system produced roughly 35,772 kilotons of the total 494,930 kilotons of CO_2e produced by the country in 2014-2015, which equates to about 7% of all GHGE for Australia that year,[11] while a 2021 study found that the health and social care sectors in England contributed approximately 6.3% of total national carbon emissions.[12]

Clearly, industry, and not least the pharmaceutical and healthcare industries, are significant contributors to the carbon emissions that are threatening our communities and our ways of life. It is also clear that the major players in the public and private sectors are not

doing nearly enough to tackle this threat. As such, it is up to smaller businesses and players to innovate and bring positive change to how they conduct business in an environmentally sustainable fashion.

In this paper, we will present ways in which we have sought to tackle the issue of sustainability in the pharmaceutical industry. Our approach is innovative as it looks at the issue of sustainability from an all-inclusive angle, so that each and every part of our various processes – from product inception right through to development, production and packaging – is reworked to reduce carbon emissions by as much as possible. With this approach, we can generate a sustainability 'blueprint' for the pharmaceutical industry to show how we can all help to save our communities and our planet.

2. Materials and Methods

Our sustainability initiatives have been broken up into the five key areas that, together, will provide a blueprint for how to conduct business within the pharmaceutical industry in a sustainable way. These five areas and their associated methodology and initiative are summarised below.

2.1 Energy use and Operations

At our manufacturing site, the majority of our energy consumption comes from water purification, air compression, the operation of production machinery, waste water treatment, and services including heating, ventilation and air conditioning (HVAC), cool storage and lighting. To ensure that these processes are as efficient and sustainable as possible, we have undertaken a major refurbishment of our infrastructure (dubbed 'The Green Core') by installing LED lights and solar panels, and upgrading HVAC.

2.2 Water use

Water use is obviously a huge part of pharmaceutical manufacturing, from use as a product ingredient to the cleaning of vessels. To ensure that our water use is sustainable, we have undertaken steps to reduce our reliance on it, reuse it wherever we can, and retain as much as possible. To this end, we reuse retentate (a by-product of the water purification process, which is done on-site via reverse osmosis) for further use within production, and we have installed 26 rain water tanks throughout the site for use in non-potable applications such as toilets and ground works. Waste water is treated onsite to remove zinc and bulk particulates.

The predominant chemical used to treat waste water is magnesium hydroxide, which itself is removed from our waste water for treatment.

2.3 Equity, Diversity and Inclusion

Sustainability with regards to how we treat and retain staff is also vitally important to ensure that we attract and retain staff who will realise these sustainability goals. To this end, we have implemented a modern slavery policy to outline our moral and legal responsibilities and set out the standards to which we will adhere as a business, and expect our business partners to adhere to also. We have also committed to maintain our annual Workplace Gender Equality Agency (WGEA) report to ensure that we are compliant in reducing the gender pay gap, ensuring pay equity, promoting women in leadership, and allowing flexible parental leave.

2.4 Packaging

Across the business, we will also be replacing, where possible, unrecyclable packaging materials with more sustainable alternatives, as well as updating the information on the websites and on the packaging to help educate consumers on what can and should not be recycled at home. In addition, Ego has joined the federally-backed Australian, New Zealand and Pacific Island Pact on Plastic (ANZPAC PACT)[13] where we have pledged to purchase and reuse a % of recycled plastic in the form of post-consumer resin, which is converted into reusable resin that can be combined with and reduce the dependence on virgin resin, in order to support the developing circular economy.

2.5 Solid and Trade Waste

The amount of waste generated by industry each year for landfill represents a significant environmental impact. To offset this, we have set out a roadmap to 2024 to complete a waste audit review of product waste processes, including filling trials, product campaigns and stability trials. We will also review packaging waste processes such as printed packaging, PVC/PET/HDPE, transport packing material and label backing, and ensure that we have a replacement for single use plastic. We will also conduct reviews of ancillary consumables, Personal Protective Equipment (PPE) recycling opportunities, Point of Sale (POS) recycling opportunities, and raw Material waste processes, including transport damages and replacement of non-recyclable containers.

To tackle trade waste, we have focused primarily on reducing the total amount of discharge, as well as reducing the use of magnesium hydroxide to remove zinc from waste water. In addition, we are planning on redesigning our trade waste system to better handle trade waste and improve sustainability.

2.6 Products: etch&ethos™

The first practical end-user output from the five initiatives above is our new etch&ethos™ range, which has been designed to be as sustainable as possible in all aspects of its formulation, production and packaging. The products use ingredients that are as naturally-derived as possible, according to the ISO 16128-1 and 16128-2 Standards. The packaging used for the etch&ethos™ products has been designed to be recyclable, and are made from recycled plastic containing 50% of post-consumer resin, specifically Australian milk bottles.

3. Results

3.1 Energy use and Operations

In 2020, our 46 kW solar array at our manufacturing site produced 79,300 kWh of electricity, eliminating the creation of 66 tonnes of CO_2. In 2021, we commissioned a further 145 kW of solar capacity. In 2022, this is expected to generate approximately 330,000 kWh of electricity, which would eliminate the creation of approximately 162 tonnes of CO_2. Additionally, we also operate a 62 kW solar array at our commercial site, which is projected to eliminate a further 69 tonnes of CO_2 yearly. In total, our solar energy is expected to eliminate 231 tonnes of CO_2 in 2022 alone, with a total investment of AUD$8.8 million in this sustainability initiative and a 6.9% reduction in total electricity use from 2019 to 2022 (**Figure 1**).

3.2 Water use

At Ego's manufacturing site, collected rain water is stored across 26 tanks which can hold a total of 96,000 L. Rain water is used in non-potable applications such as in toilets and works around the grounds.

From 2019 to 2022, we have invested a total of AUD$1.62 million on water saving initiatives that have translated into a 14% reduction in water use compared with 2019 figures (**Figure 1**).

3.3 Equity, Diversity and Inclusion

Between mid-2019 and 2020, we began mapping our structure and supply chains with a mandatory criterion of reporting, and used this to undertake our first formal audit of suppliers of raw materials and packaging both domestically and internationally. In 2020 we published our first Modern Slavery Act Statement, covering the reporting period from 1st July 2019 to 30th June 2020. This statement was submitted to the Border Force website in September of 2020 and published in October. Our latest WGEA report showed that 56% of management level and 52% of non-management level promotions were awarded to women (**Figure 2**).

3.4 Packaging

The first packaging to be produced from our sustainability initiative is for our etch&ethos™ range. This packaging uses caps made from polypropylene, bottles made from 50% recycled resin and 50% virgin resin, and labels made from wood-based polyethylene film, which is the first time that this particular technology has been used in Australia.

3.5 Solid and Trade Waste

As of 2019, we now optimise processes such as monitoring and reporting, and we have taken additional steps to optimise our magnesium use, our production efficiency, and redirect our retentate water so that it does not need to be treated. Our set goal for 2025 is to reduce the amount of solid waste ending up in landfill by 30%.

3.6 etch&ethos™

Each product in the etch&ethos™ range contains 94% naturally-derived ingredients according to the ISO 16128-1 and 16128-2 Standards, and its packaging is recyclable as detailed in ***Section 3.4***.

4. Discussion

Globally, energy production through the burning of fossil fuels (notably oil, gas and coal) is one of the major contributors to climate change.[14] Despite this, non-renewable sources of energy are still far and away the most widely used, accounting for 93% of Australia's total energy consumption in 2019-20.[15] By investing in solar power and more efficient infrastructure such as LED lighting and HVAC, we were able to eliminate the creation of more than 66 tonnes of CO_2 in 2020 alone, with a further 231 tonnes projected to be

eliminated just in 2022. The efficiencies created by this new initiative have also reduced our total energy expenditure by just under 7% in 3 years, a significant result in a relatively short amount of time. Taken together, these results show that renewable energy is a viable alternative to fossil fuels for a production-heavy industry. Similarly, our investment in more efficient and sustainable water usage and saving initiatives has decreased our total water use by 14% in only 3 years, another significant achievement given the ubiquity of water in our products and processes. Water is itself becoming a scarce commodity,[16] so the ability of industry to meaningfully reduce our use of it will have hugely beneficial impacts on the environment.

While a key focus of sustainability science concerns processes and products, industry also needs to be cognisant of the importance of sustainability in the workplace: without a fair and open working environment that values and supports every employee and ensures moral and ethical practice throughout the business, industry would be unable to attract and retain the staff that would realise sustainability initiatives. By creating and adopting a meaningful modern slavery policy, and by reporting it annually to Australia's Border Force, we will be able to ensure that we and any partners with whom we do business will operate in a morally and ethically appropriate way to eliminate practices such as forced and child labour, modern slavery, corruption, and financial malpractice. In addition, our commitment to workplace gender equality has resulted in more female promotions (in both managerial and non-managerial positions; **Figure 2**) than male, figures that are far above the industry standard.

The first packaging created through our sustainability initiatives uses a significant amount of recycled materials in its construction. This 50:50 mix of recycled and virgin resin in a high-quality pack is a novel achievement, as standard recycled packaging usually contains no more than 30% recycled resin given its fragility, and the technical aspects of adding recycled resin to virgin plastic often has a detrimental impact on packaging quality.[17] The packaging for the entire range is intended to be fully recyclable; indeed the only part of the packaging that is not fully recyclable is the metal spring in the pump mechanism used for the smallest pack size. A metal spring was chosen for its strength, but its unrecyclable nature is offset by our incorporation of larger pack sizes for each of the products in the range; these do not contain a pump mechanism, and are designed to be decanted into the smaller pump-

containing pack. This way, we actively encourage the theoretically indefinite reuse of the smaller pack, further eliminating waste.

The etch&ethos™ range represents the first product range to be created from the five pillars of our sustainability project. In addition to the novel sustainable contributions of the packaging outlined above, each of the products in the etch&ethos™ range uses naturally-derived ingredients where possible to help reduce the carbon footprint of the range. Indeed, 94% of each of the products can be said to be naturally-derived according to the ISO 16128-1 Standard, which is the only internationally-recognised standard for assessing the natural content of a cosmetic product.[18] The ISO 16128-2 Standard provides a method for calculating the natural content of ingredients, where each raw material is assigned a score between 0 and 1—called the Natural Index. A score of 0 means the ingredient is completely synthetic, while 1 means completely natural origin. According to the ISO 16128-2 Standard,[19] each of these indices are then multiplied by the concentration of that ingredient in the formulation, and added together, giving a total score out of 100%. An example of the ISO 16128-2 Standard calculation is included as **Table 1**. Crucially, we were able to create these products without compromising on quality, cosmetic efficacy or safety: the etch&ethos™ products passed all tests that are carried out as standard on such products, including 24-hour hydration, transepidermal water loss (TEWL), repeat insult patch testing (RIPT) and preservative efficacy testing. The almost completely naturally-derived formulation of these products, coupled with their sustainable packaging and uncompromised quality, is an example of high quality sustainable cosmetics that provide for consumers and the environment alike.

Finally, as part of our long-term strategy, we are a signatory to the United Nations Global Compact (UNGC), a voluntary initiative to implement sustainability initiatives in industry with a focus on four key principles: Human Rights, Labour, Environment and Anti-Corruption [20] By operating under these principles, and with significant investment still to come in the five key areas outlined in this paper, we project that we will be on-target to be carbon-neutral by 2030.

5. Conclusion

The negative impact of industry on climate change, which is arguably the most pressing global issue of the 21st century,[21] is significant and needs urgent action to rectify. In the

context of this paper, the pharmaceutical industry is itself a significant contributor to greenhouse gas emissions, and its reliance on non-renewable sources of energy for manufacturing and shipping does not appear to be diminishing in a meaningful way. As such, sustainability in all areas of the industry is a commitment that needs to be adopted urgently. In this paper, we present a sort of 'blueprint' for the pharmaceutical industry that shows what can be achieved in a relatively short amount of time. By recognising the issue of climate change, and by investing time, money and critical thinking into the idea of sustainability in all areas, from manufacturing to market, we can make a positive impact on the environment without compromising on production or product quality, cosmetic efficacy or safety.

Conflict of Interest Statement. Ian P. Harrison, Ingrid Heinicke, Simone Thomassen and Fabrizio Spada are full-time employees of Ego Pharmaceuticals Pty Ltd. Authors declare no conflict of interest.

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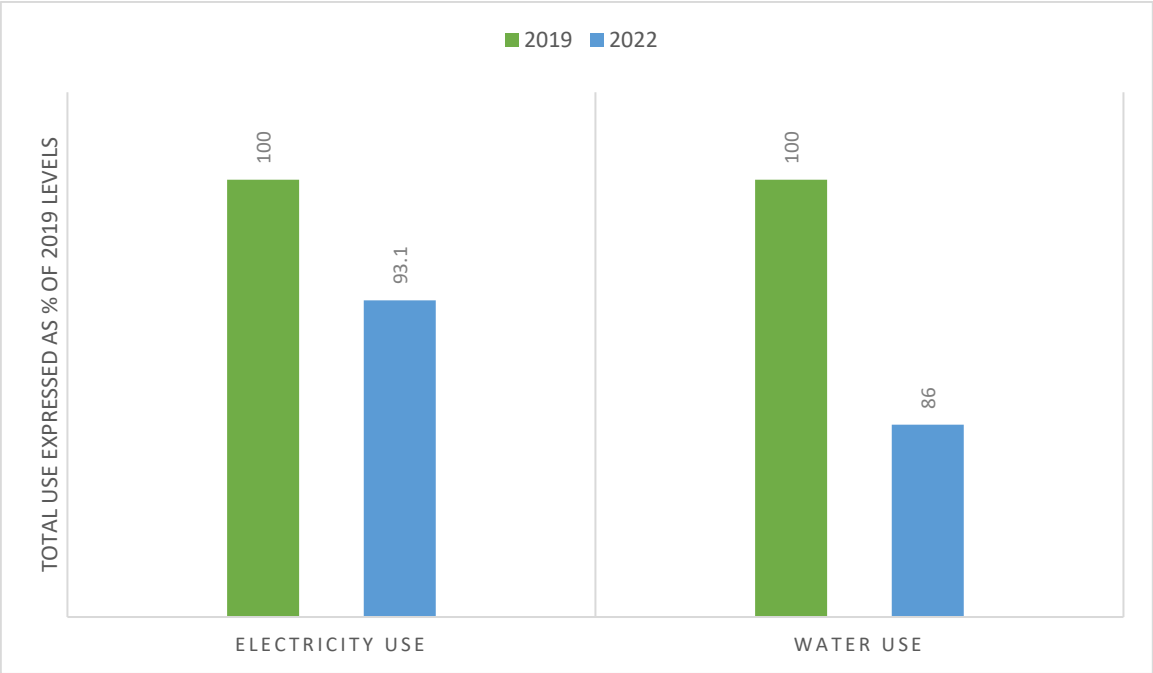

Figure 1: Total electricity and water use in 2022 expressed as % of 2019 levels.

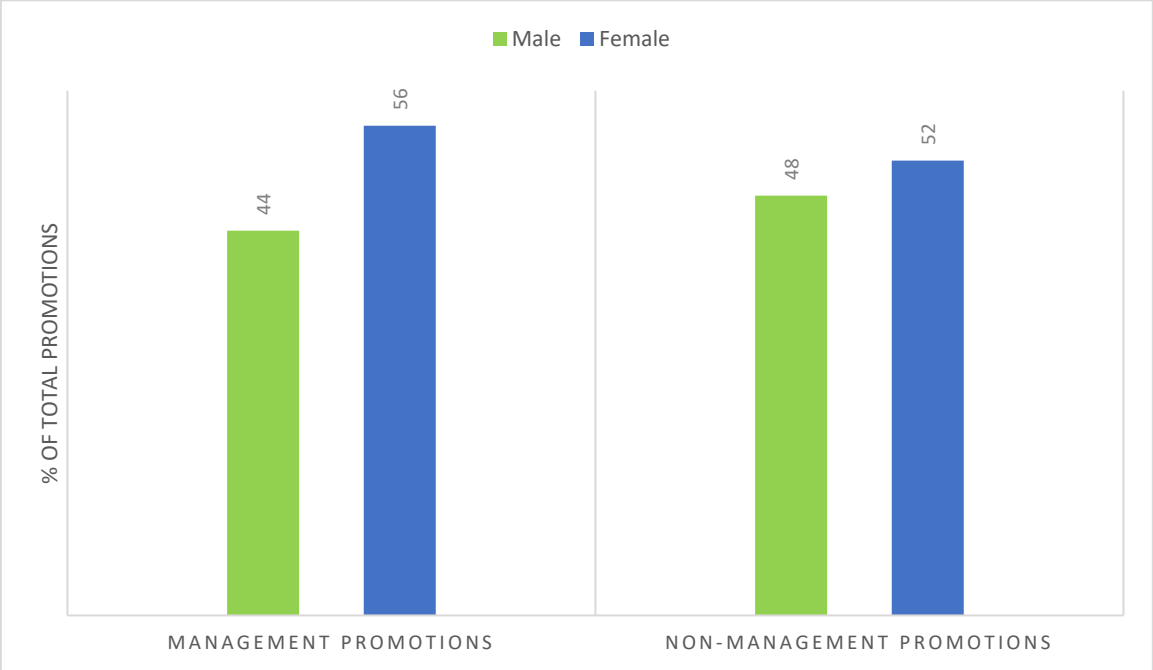

Figure 2: Percentage of male vs female management and non-management promotions according to latest WGEA report

Ingredient	% in formulation		Natural Index		% naturally-derived
Water	60	X	1	=	60
A	20	X	0.7	=	14
B	10	X	1	=	10
C	10	X	0.8	=	8
D	5	X	0.4	=	2
E	5	X	0	=	0
Total % of naturally-derived content in the formulation				**=**	**94.0**

Table 1: Example of the ISO 16128-2 Standard to assess the natural content of a cosmetic. In it, the percentage of each ingredient in the formulation is multiplied by its 'Natural Index' – a number between 0 and 1 assigned according to the ingredients natural or synthetic nature – to give a total percentage of naturally-derived content.