Eos

Using IoT to reduce daily energy consumption within the home.

Eos.
All your energy saving habits, automated.

Speaker
Dishwasher
Did you leave the Hallway Lights on?
Electric Heater
Television

No? Well done. But you still had to think about it.

National and global scale energy saving campains have ensured that everyone knows that reducing energy consumption in our daily lives is vital to the sustainability of our planet, and we all want to make a real change.

And we all do - at least for a week or so, whilst that particularly bright poster we saw on the tube is seared into our retinas. But habits built from actionable posters (such as turning off lights when you leave a room) fade as the day-to-day utility of these devices overpowers our brief energy conscience, and we become energy hungry once more.

Eos empowers you to retain those energy saving habits whilst maintaining full device utility - using IoT around the home, Eos uses your location within your house combined with your daily habits to learn how your total energy expenditure throughout the day can be reduced. Eos will automatically turn off devices that it is sure are not being used, so wherever you are in your home and whatever you are doing, you'll know that only the devices that you are using are on. So when you next have that heart-dropping moment and you suddenly wonder if you left your bedroom lights on, just glance at Eos and you'll be sure that you're being the most energy conscious version of yourself.

Never turn off your lights again. Save energy.

The Eos wearable serves the dual purpose of streamlining your daily management of Smart Home IoT devices and also ensuring that your energy usage is reduced significantly, by automating your usage of devices within the home. Eos will know when any specific device needs turning on based on your location within the home and your daily habits, so all devices will be off by default until required.

Leaving the living room to go to bed after an evening of watching TV? Walk straight out confidently - Eos will confirm that you are going to bed through daily habit analysis and will turn your TV and lights off automatically. Useful. Energy saving.

How much are you reducing your energy expenditure?

The simple Eos UI lets you know at a glance how your new automated habits have impacted your energy expenditure - the dynamic orb displayed on Eos will let you know through its colour and form. A red, mishapen orb indicates that you are using more energy than the average person in your area. If you consistently use less than the average amount of energy, the orb will slowly shift to a circular green and blue globe - a reflection and reminder of the world that we're working to preserve.

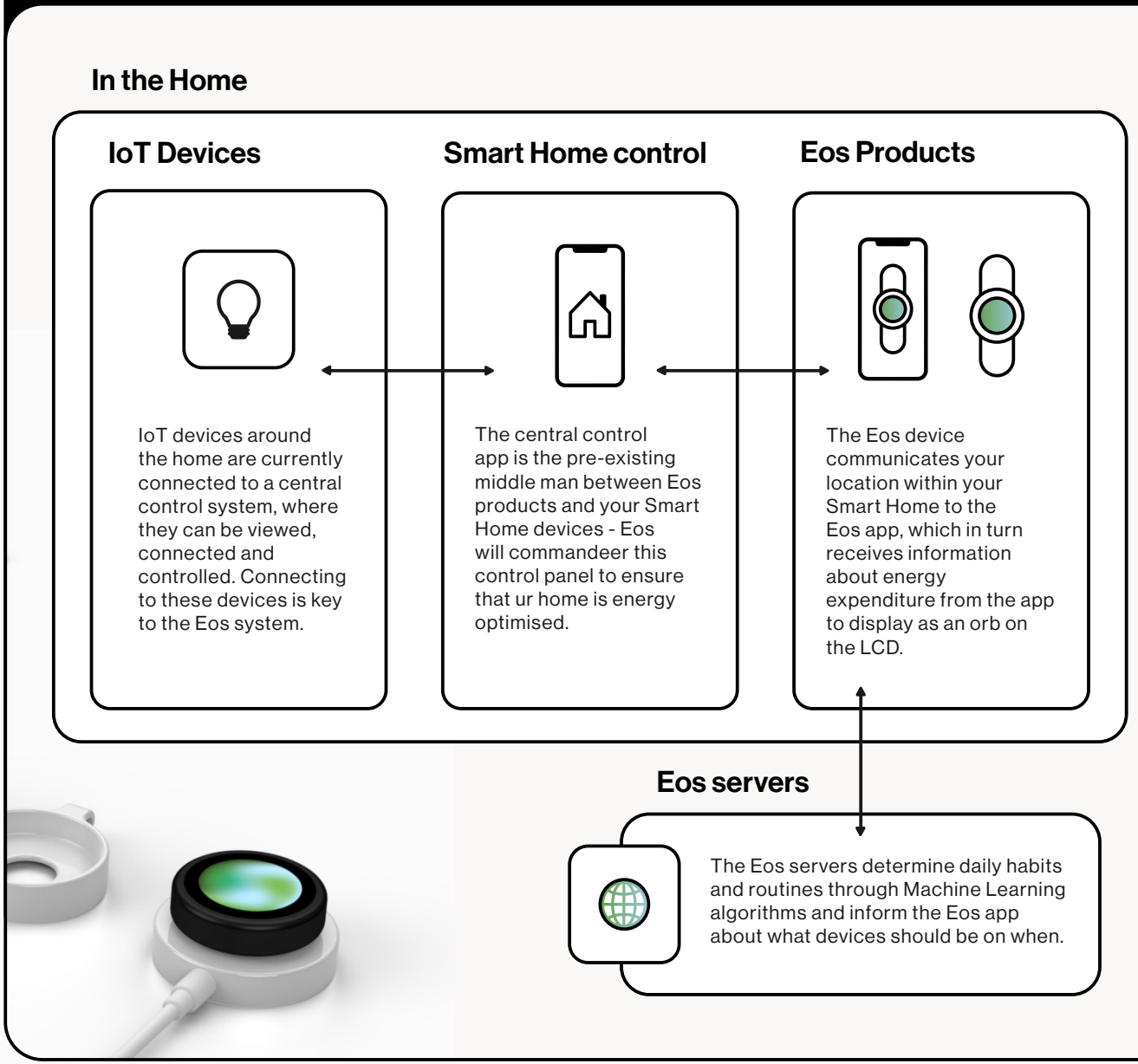
System Design

Make your Smart Home more efficient for you and the planet.

Eos products communicate seamlessly with your Smart Home control system in order to manage every IoT device in your home, maximising energy efficiency. The Eos application works as a middle man between the Smart Home control system and the Eos servers, providing information about repeated device habits to the Eos server for analysis.

This essentially places the Eos device and app as a pseudo Smart Home controller that prioritises the minimisation of your energy expenditure by flicking the switch on devices when necessary - so you can live in the knowledge that you are doing the most you possibly can to help reduce energy consumption nationally, and many of your Smart Home interactions are helpfully automated.

System Diagram



Modular Design

Save energy in style.
Your style.

The success of Eos in reducing the user's daily energy expenditure is reliant on the user developing the habit of wearing the device on their person. Users should view the action of putting on Eos as time saving: putting the Eos on every morning means your Smart Home is in tune with your daily routine, and you are in tune with your energy. For this to work on a large scale, Eos has to be adaptable to the user's preferences so users not only feel the need to put on Eos for their device management, but also want to wear Eos because its a personalised wearable that suits them. In the same way that everyone has their own way of tailoring their energy saving habits, the user can tailor the Eos wearable experience to suit them. This is achieved through the implementation of modular design; Eos is customisable with a variety of forms and colours of wearable accessories.

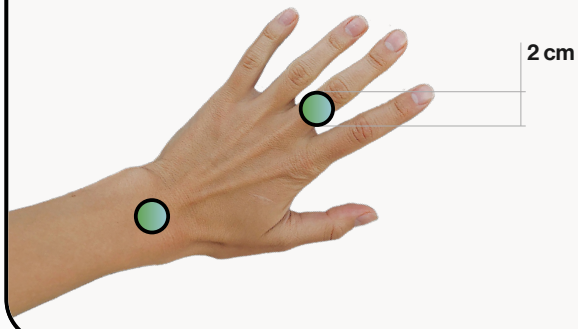
3rd Party Design.

The simplicity of the 'button' connector between the Eos device and the accessories mean that 3rd Party developers will be able to create accessories that fit seamlessly with the device. This is crucial for allowing users to develop their own sense of style and take ownership of their Eos device, and therefore their energy saving habits.

Biometrics

One size fits all.

The Eos band, ring and necklace case were chosen as Eos produced accessories to cover a range of jewellery that already connote habit forming - for example, the habit of putting on your favourite bracelet when you wake up. With three specific constraints, the form factor of the device needs to suit these styles simultaneously, so extensive biometric studies were carried out to develop the form of the Eos. It was determined that a circle with a 2cm diameter fit the constraints of all the accessories the best.



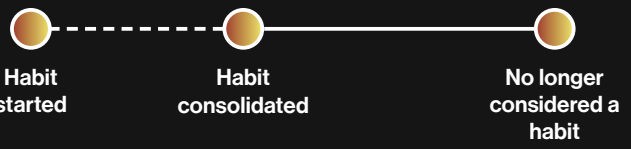
Take TV off standby
Turn down thermostat
Turn off Bedroom light ▶ **Wear Eos.**
Unplug power outlets
Turn off dishwasher

Detailed Design CMF

Works with your outfit so you wear it today.
Works with your routine so you wear it tomorrow.

Every aspect of the Eos device works to ensure desirability for intitial habit creation, and then durability and utility for continued use. Once the habit of putting the device on is set in, Eos is built to last through the bumps and scratches of everyday life: a constant energy saving companion.

Habit-forming timeline



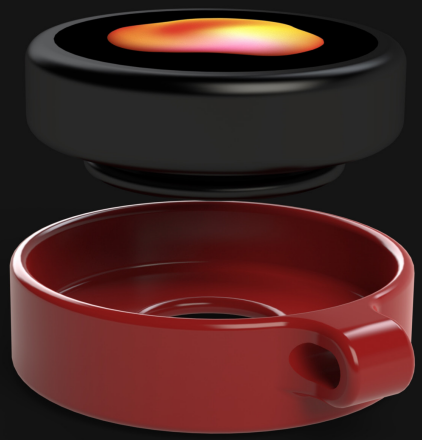
Key

— Time in which Eos is worn and used
● Habit forming checkpoint

- - - Eos is worn intermitently, as the desirability of the product prompts the user to wear it. In this stage, desirability is the most important aspect of the device, so the user wants to keep wearing Eos.

—— Once the habit of putting Eos on has been formed by the desirability of the product, long lasting habits will rely on the use and durability of Eos.

The colours, materials and finishes are all specifically chosen to speak of the values that Eos aims to promote and encourage in its customers: sustainability, consistency and awareness.



Brushed Aluminium Body

Dark grey was chosen for the aluminium body for two reasons. Firstly, the dark colour highlights the bright Eos UI, reflecting the underlying energy saving message. Secondly, the neutral dark colour ensures a good visual fit with any accessory - the user can project their personality on to Eos, rather than the other way round. Aluminium was selected for its high strength to weight ratio - the device feels durable but is not a heavy presence, wherever it is worn. These characteristics help the device speak of permanence and consistency, but not obtrusion. The brushed aluminium finish on the body further accentuates this lack of obtrusion: the metal finish most closely replicates the low-reflective properties of skin, helping the device maintain its subtle presence in the user's life.

Silicon Accessories

A wave texture was implemented on the surface of the band that comes into constant contact with the user. This features serves a dual purpose: most importantly it is user centred - the wave pattern removes 50% of the silicon-skin contact, minimising any discomfort associated with rubbing. The textured surface also helps to reinforce the Eos value of awareness by gently and passively reminding the user that the Eos is there and working to reduce energy expenditure.

Research and Specification

UK Energy Usage

Due to unpredictable factors such as home insulation levels and local weather, it is difficult to determine an average electricity usage figure, but UKPower defines the upper bounds of 'low', 'medium' and 'high' electricity usage as 2400kWh, 4200kWh and 7100kWh respectively. A reduction in these figures (determined by daily habits) would provide the dual benefit of decreaseing energy consumption and therefore increasing the length of time before fossil fuels are depleted, whilst also smoothening the transition to more sustainable but less efficient energy sources such as solar.

The future of Home IoT

According to a paper written by the future trends researcher Ray Hammond, the prevalence of IoT devices in the home will have increased to the extent that all devices will be smart and interconnected, and many manual tasks requiring energy will be automated. Recognising this is key to this project, as the long term solution to energy reduction requires system level intervention, which can be increasingly optimised as all devices that consume energy can communicate with themselves and central control point.

Key Insights from Energy Use Survey

In order to change behaviours surrounding energy usage, it is key to understand the user's awareness levels of their own habits - a survey among 10 participants of various ages was conducted to determine whether people understood the energy costs of their daily habits. Here are some key quotes that led the design process.

'I tend to use devices based on when I need them rather than focussing on energy'

'If I see a light on in an empty room, I'll switch it off'

'How might we?' Questions

How might we reduce the energy consumption of our everyday lives?

How might we make energy a tangible asset?

Solution Specification

The solution needs to...

Communicate and remind the user of the issue that they are helping to tackle.

The solution needs to remind the user of the good that is being done by using it, as a positive reinformement method for continued change.

Cultivate a positive relationship between users and their energy

A display of energy needs to be subtle but informative, without the alarming notifications often found on energy hubs.

Take responsibility for long term change away from the user.

Research showed that users struggle to maintain beneficial habits over a long period of time. The solution should help them with this.

Remove the link between saving energy and habits that worsen our daily lives.

The root of the negative experiences associated with energy saving needs to be removed in order to maintain the positive energy relationship.

Bring energy representation off screens and into the real world.

Energy can be represented in a user interface, but more importantly also in the convenience that a solution could bring.

Adapt to user habits to ensure full utility is still maintained.

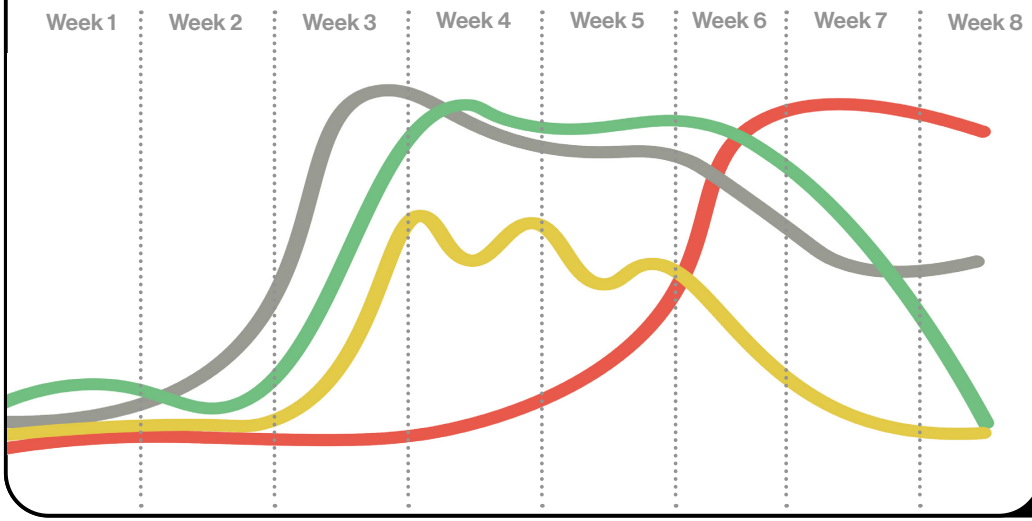
The solution needs to learn the users habits so that any energy saving decisions are implemented without detrimenting the users daily routine.

Scenario Exploration and Narrative

Scenarios with and without Eos

Energy saved per day
Irritation from switching devices on and off
Engagement with energy saving habits
Concern about energy consumption

‘Without Eos’ Scenario Timeline



Persona: Sarah

This scenario portrays an 8 week timeframe of an archetypal citizen, Sarah, tracking her energy saving and their subsequent attitude. Sarah wants to make a difference in their energy spending habits, but finds it difficult to find the time or motivation to make a sustained life-style change. She makes changes when they remember, which isn’t often.

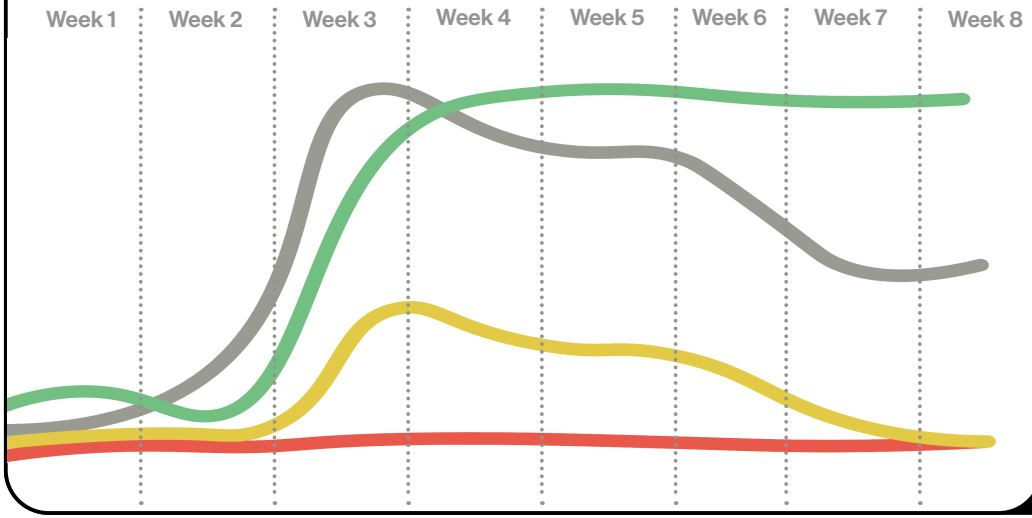
Key Time Points

Week 2 Whilst travelling on the tube, Sarah sees an advert advising people to turn off their lights when they leave a room. This prompts reflection about her energy spending habits and a desire to change.

Week 4 With that advert fresh in her mind, Sarah has developed energy saving habits such as turning her TV off at the wall, but is noticing that she needs to employ a conscious effort every time she wants to watch TV.

Week 7 The memory of the ‘shock factor’ tube advert fades and Sarah becomes frustrated at her constant device management - she decides energy is someone elses problem and her energy saved per day plummets.

‘With Eos’ Scenario Timeline



Persona: Sarah

This scenario portrays another 8 week timeframe of Sarah’s life, but in this scenario, Sarah decides to invest in an Eos at crucial point. See how her energy sustained per day is sustained throughout the 8 week period and into the future. Furthermore, irritation from device management never spiked, as Eos handled it for her.

Key Time Points

Week 2 Sarah looks at her energy bill and notices that it has been steadily climbing for a few weeks - she has been working from home more and likes to change rooms throughout the day, leaving devices all around the house on constantly.

Week 4 Sarah invests in an Eos wearable - she wants to reduce her energy bills, but she also saw her friend wearing one and liked he had personalised it, so she buys one in order to make a sustained impact on her energy saving.

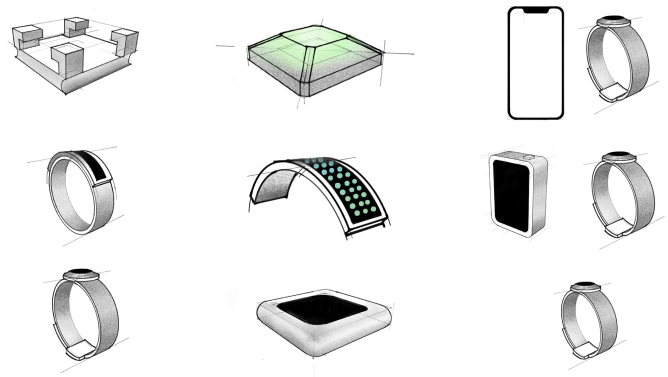
Week 7 Whilst Sarah’s personal concern about energy consumption has naturally faded, wearing Eos means that she can stop thinking about saving energy, whilst maintaining a high level of energy saved every day.

Ideation and Prototyping

Morphological Analysis into form

The initial stages of ideation consisted of a morphological analysis into how the form of the product and system might best address the HMW questions, ideating around the type of wearable, as well as the user experience and system integration.

Wearable Ideation | **Display Ideation** | **System Integration Ideation**



The first row of combinations was selected from the morphological analysis, as this provided simplicity and the most scope for personalising the device to suit the user; both large factors for the uptake of the device and the system.

Iterative Ideation of Device-Accessory connection

Ideation was conducted around the connection mechanism between the device and accessories - ideation centred around the specific connection with the band, with the following design requirements:

1. Needs to be a study mechanism at small sizes to accomodate for the ring accessory
2. Easy to remove when desired, but not accidently removable - it cannot fall off.
3. Needs to be light, compact and unobtrusive
4. Needs to be attachable and suitable for a necklace case accessory
5. Device needs to be stationary on the accessory - cannot swivle around the band.

Band Loops
Violates Design Requirements: 1,5

Band Clips
Violates Design Requirements: 1,2,3

Slots in device
Violates Design Requirements: 1

Button
Final mechanism choice

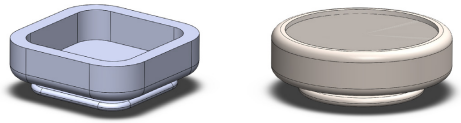
Device **Band** **Connection mechanism**

Prototyping

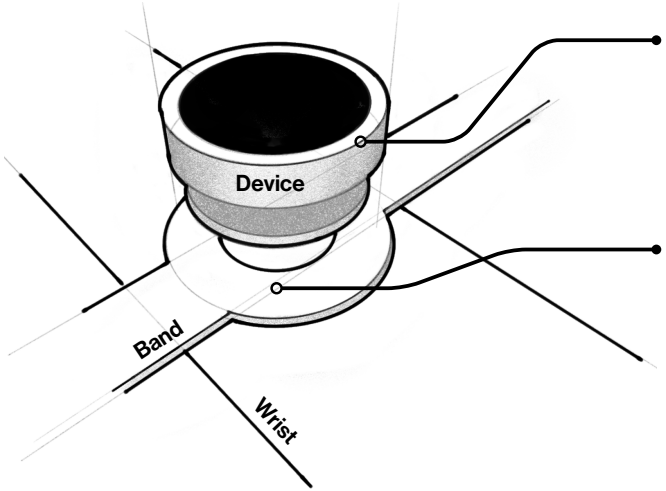
In the first stages of development, the size of the device was the most important aspect to determine - a wearable that works as a ring, bracelet and necklace provides a large variety of design constraints. However, these constraints allowed the prototyping to be very focussed, and once the biometrics were analysed the final size became apparent. Once the size had been determined, a number of shapes were digitally prototyped in SOLIDWORKS - the final decision was led by circular shape of the button mechanism (shown below) designed to attach the device to the accessories.

Stage 1

Stage 2



Final Concept Sketch



The circular shape of the device was influenced by the button mechanism to attach the device to the accessories. This shape is also reminiscent of jewellery rather than typical wearables.

Due to the button mechanism, the accessories such as the band are easy to remove when desired, but when worn, the back of the device receives a small amount of pressure from the wearers body (e.g. wrist), keeping the device securely locked into the mechanism.

Semiotics and Design Inspiration

Eos

Eos is the Ancient Greek personification of dawn, symbolising a new age in energy sustainability.

A mood board was created for the design of the energy expenditure indicator displayed on the Eos Device. This aspect of the device is crucial as it is the single user interaction that the Eos Device provides: it is kept to a minimal form of information display as a result of some key insights from the research - users will save energy if its simple to do so. The orb user interface is a distillation of the user's energy habits, and forms a way of creating a relationship between the user and their energy, following on from the HMW question; How might we make energy a tangible asset? How can we display energy in such a way that it prompts a change in user habits?

How might we make energy a tangible asset?

Connoting possible change

The orb needs to be dynamic in both shape and colour to connote possible change - the smooth transitions from mishapen orb to sphere along with the colour change from red to green denotes improvement, and implies that every small interaction can lead to a change. This becomes obvious when compared to a metric or discrete colour change - a number would only show change when you have saved enough energy to move from one discrete level to the next.

A separate mood board was created for the physical embodiment of the Eos touchpoint, as the form of the device should be designed to speak of very different values from the User Interface. The touchpoint should connote sustainability (in terms of life time of the product), durability and consistency - this is acheived through high quality materials such as aluminium, a subtle, unobtrusive form and colour palette that merges seamlessly with the UI, and solid build quality for guaranteed long life.

Sustainability
Durability
Consistency

Design Process Journey

As the design process unfolded, I logged the stages and steps that were taken to arrive at the final product. This design process journey is displayed here.